

ENERFLEX

Compression and
power generation.
Proven solutions.
Anywhere.

Maintenance and Instruction Manual Unit # 060430

CANADIAN LOCATIONS:

Bonnyville	Tel: 780.826.7570
Calgary	Tel: 403.236.1900
Drumheller	Tel: 403.823.9834
Edmonton	Tel: 780.465.5371
Edson	Tel: 780.723.7292
Fort McMurray	Tel: 780.790.9612
Fort Nelson	Tel: 250.774.2895
Fort St. John	Tel: 250.785.1171
Grande Prairie	Tel: 780.539.5974
Kindersley	Tel: 306.463.4838
Lloydminster	Tel: 306.825.9800
London	Tel: 519.455.5600
Medicine Hat	Tel: 403.526.1866
Red Deer	Tel: 403.341.3900
Slave Lake	Tel: 780.849.6555

INTERNATIONAL LOCATIONS:

Moomba, Australia	Tel: 61.8.8867.6000
Perth, Australia	Tel: 61.8.9456.0457
Sydney, Australia	Tel: 61.2.9624.7000
Jakarta, Indonesia	Tel: 62.21.7279.7575
Vianen, Netherlands	Tel: 31.0.347.329.429
Aberdeen, Scotland	Tel: 44.1224.827.000
Odessa, USA	Tel: 915.381.0011
Havre, USA	Tel: 406.265.6664

ENERFLEX

4700 47 Street SE, Calgary, Alberta T2B 3R1
Tel: 1.403.236.6800 Fax: 1.403.279.0367
Toll Free: 1.800.242.3178

Website: www.enerflex.com



ENERFLEX

MAINTENANCE AND INSTRUCTION MANUAL

Table of Contents

Encana Corporation # 060430 – Rev. 01		
SECTION	CONTENTS	VDRL CODE
WARRANTY	<ul style="list-style-type: none"> • Enerflex New Equipment Warranty • Caterpillar Engine Warranty • Ariel Warranty Summary 	
TECHNICAL DATA	<ul style="list-style-type: none"> • Unit Operating Instructions for Screw Compressors 	
PERFORMANCE	<ul style="list-style-type: none"> • Performance Curves • Ariel Report and Data Sheets 	
OPERATING INFORMATION	<ul style="list-style-type: none"> • Unit Operating Instructions for Screw Compressors 	
MAINTENANCE INFORMATION	<ul style="list-style-type: none"> • Maintenance Guidelines for Screw Compressors 	
COMPRESSOR	<ul style="list-style-type: none"> • Operator's Manual <ul style="list-style-type: none"> Ariel Twin Screw Rotary Compressor Manual - Models RG282M and RG357M Ariel RG282M and RG357M Rotary Screw Compressor Ariel Start Up Check List - RC Rotary Compressors Ariel RG Series Rotary Compressor - Bolting Required Tightening Torque Ariel Unit Protection For Extended Storage - Rotary Compressors Ariel Directional Control Valve • Recommended Spares and Parts Manual • Compressor Vendor Literature <ul style="list-style-type: none"> AMOT Controls-Model MPD Commerical Intertech - P75/P76 Service Manual - single and multiple oil hydraulic pumps - 	

ENERFLEX

MAINTENANCE AND INSTRUCTION MANUAL

Table of Contents

Encana Corporation # 060430– Rev. 01		
SECTION	CONTENTS	VDRL CODE
	<p>motors</p> <p>EATON-Vickers Pressure Relief</p> <p>EATON-Vickers Directional Controls</p> <ul style="list-style-type: none">• VIEX Oil Cooler	
DRIVE TRAIN	<ul style="list-style-type: none">• Coupling Information• Torsional Analysis	
DRIVER	<ul style="list-style-type: none">• Caterpillar Operator's Manual• Caterpillar Parts Manual	
COOLER	<ul style="list-style-type: none">• Air-X-Changers - Installation, Maintenance, and Operating Instructions for Engine Drive Units• Cooler Certified Drawing• Cooler Parts Data• Cooler Specification Sheet• Manufacturer's Data Reports for Cooler (U1A's)• Nameplate Facsimiles for Cooler• Cooler Information	
CONTROL PANEL	<ul style="list-style-type: none">• Ariel Booster Compressor (Non Adem III) Control Overview REV. 4 - March 17, 2007• Alarm and Shut Down Key• Control Panel Drawings	
DRAWINGS	<ul style="list-style-type: none">• General Arrangement• Process & Instrumentation Diagram• Service Flows• Ariel RGM Compressor Series Oil Schematic	
VENDOR PARTS INFORMATION	<ul style="list-style-type: none">• Aeroquip - Quick Disconnect Couplings• Alta – Strainers• Altronic - Magnetic Pickup - 691118-2• Amot - Model 4418 - High Pressure	

ENERFLEX

MAINTENANCE AND INSTRUCTION MANUAL

Table of Contents

Encana Corporation # 060430 – Rev. 01		
SECTION	CONTENTS	VDRL CODE
	<ul style="list-style-type: none">Control Valve• Asco - 8320-Valves• Baldwin - BL914 Filters• Browning – Belts• Canimex - Chain Hoist• Catadyne - Heater Regulator• CCS - 6900GZE - Pressure Switch• CFM Air Dryers• Century - CM23-Gauge Valves• Consolidated - Type 1900 - Valve Installation, Operation & Maintenance• Crouse Hind - GHG 43 Series• Daniel - Valves and Gauges• Darcor - Stabilizer Wheels• Donaldson - Rubber Elbow• Dresser – Couplings• Dyalco - M204 - Magnetic Pick-up• Farris - Series 2600 Maintenance Manual• Fisher – Valves• FPE - Fluid Power Energy, Inc. - Model 3010 - Three-Way Thermostatic Valve (T Style)• Goodyear - V-Belt• Henry Technologies - Sight Glass• Holley - Electrodyne Generator• Hydorflex - Series 240• Kenco – Controllers• Kimray - Level Switch• Kito - Hoist Chain• Lube Devices - Level Indicator• MAS - G4-Ball Valves• Metrix Instrument Co.- 2 - Wire Seismic Vibration Transmitter - Model ST5484E-XXX-XXX-XX Installation Instructions• Mid-West - Model 120 Series "Filter	

ENERFLEX

MAINTENANCE AND INSTRUCTION MANUAL

Table of Contents

Encana Corporation # 060430 – Rev. 01		
SECTION	CONTENTS	VDRL CODE
	<ul style="list-style-type: none"> Minder" • Navco - Valves • NetSafety Monitoring Inc. • Nutron - Model T3 and B3 Floating Ball Valves • Parker - Lubricator 07L32BE • Penberthy - Armored Gagecocks Series 100, 200, 300 and 400 • PIC – Generators • Price - Centrifugal Pump - Type CD RC - Installation, Operating and Maintenance Manual • Rite Quick Couplings for Liquid and Gas Transfer Systems • Rosemount - Emerson Process Management - Model 3051 Pressure Transmitter • Sealmaster - Pillow Blocks • Sentry – Seal Closures • Silex - JDDT Series - Silencers • SOR - Type 1530 Pneumatic Level Switch • Sure-Flow - Check Valves • Swagelok – Valves • TDI - Valves & Starters • Thermcat – Heater • Thermo-Kinetics - T-Pak Thermocouples Probes & Assemblies • Trend – Thermometers • Vibracon - SM Series • Viking Pump - Technical Service Manual- TSM 341.1 1 C • Warren Rupp – Diaphragm Pumps • Watson McDaniel Liquid Drainers - WLD1800 & 1800R • Wika - Gauges 	
MATERIAL SAFETY DATA	<ul style="list-style-type: none"> • Paint MSDS 	

ENERFLEX

MAINTENANCE AND INSTRUCTION MANUAL

Table of Contents

Encana Corporation # 060430 – Rev. 01		
SECTION	CONTENTS	VDRL CODE
SHEETS	<ul style="list-style-type: none">• Compressor MSDS• Engine MSDS• Coolant MSDS	
QC DATA	<ul style="list-style-type: none">• Boiler and Pressure Vessel Status Report (AB10)• Manufacturer's Partial Data Report Alternate Form (U-2A)• CRN Letters• Manufacturer's Data Reports for Vessel (U-1A's)• Nameplate Facsimiles for Vessel(s)• Construction Data Reports for Piping (AB83)• PSV Inspection Test Reports	

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WARRANTY

1. **Warranty** - EFX Compression Enerflex, a division of Enerflex Systems Ltd. (hereinafter referred to as "EFX Compression"), warrants new products designed, manufactured and sold by EFX Compression, separately or as part of packaged equipment to be free of defects in material or workmanship. This warranty, including any implied warranties of merchantability and fitness for purpose, is limited in duration for a period of 12 months from the date of initial start-up or 18 months from the date the equipment is ready to ship, whichever comes first. The Customer is responsible for all costs associated with the extension of the major equipment OEM warranty including unit preservation prior to and during storage. Failure to extend OEM warranty will result in loss of coverage for major equipment.
2. **Commissioning** - In order to validate full warranty coverage on the equipment, an initial start-up service must be performed by an authorized agent of EFX Compression.
3. **Repair & Replacement** - EFX Compression's New Equipment Warranty is limited to repair or replacement of defective parts or components at EFX Compression's nearest repair facility. This does not apply if the equipment has been damaged as a result of excessive loading, over or under speeding, heating, fire or abnormal combustion, ingestion of foreign materials, inadequate maintenance, misalignment, accident, improper installations, improper storage, improper use or any other condition or event not within the control of EFX Compression. The warranty on replacement parts or components is limited in duration for a period of 90 days from the replacement date or the duration of the original warranty period, whichever is longer. Customer is responsible to pay for any equipment and transportation costs to and from an EFX Compression repair facility. Customer is also responsible to pay EFX Compression's out-of-pocket costs for transportation, lodging and subsistence, as well as additional and premium labour for any repairs taking place at other than an EFX Compression repair facility and/or being performed outside of normal business hours.
4. **Third Party Performance Guarantees** - EFX Compression's New Equipment Warranty includes all performance guarantees provided from third party product supplier(s) to EFX Compression wherein that supplier's product is distributed or resold separately or as part of an EFX Compression product. Copies of formal written performance guarantees of third party supplier(s) to EFX Compression are available on request.
5. **Limited Warranty** - The warranty provided herein by EFX Compression is the sole and exclusive warranty provided to the Customer and is in lieu of all other warranties, whether expressed or implied, including those found in the Sale of Goods Act (Alberta). EFX Compression is not responsible for any consequential, indirect or special damages whatsoever. In addition, EFX Compression shall not be liable for, including without limitation, lost revenues, downtime, diminished goodwill and damage to, or replacement of other equipment and property, whether such damages are consequential, indirect, special or otherwise, EFX Compression is not responsible for any punitive damages that may arise due to damage or loss.
6. **Modifications and Repair by Others** - EFX Compression shall not be responsible for modifications or repairs made to the equipment by others unless EFX Compression authorizes such actions in writing prior to the time such modifications or repairs are made. Such modifications and repairs made by other than EFX Compression shall, unless authorized by EFX Compression, void EFX Compression's New Equipment Warranty on the equipment.
7. **Analytical Study Exclusion** - EFX Compression's New Equipment Warranty specifically excludes pulsation, acoustical-related vibration and torsional vibration related problems except when a unit specific acoustical / torsional study has been purchased for EFX Compression at the unit design stage. Warranty shall be limited to costs not to exceed the invoice value of the study. EFX Compression will not be responsible for any on-site machinery analysis, post-shipment analytical studies or any repairs resulting from damage due to pulsation, acoustical vibration or torsional vibration.
8. **Transferability** - Subject to EFX Compression's approval, which shall not unreasonably be withheld, EFX Compression's New Equipment Warranty may be transferred to subsequent owners within the original warranty period.
9. **Claims** - All warranty claims must be filed with EFX Compression in writing within thirty (30) days after the claim arises.
10. **Unit Storage** - EFX Compression's New Equipment Warranty specifically excludes damage, deterioration and theft as a result of equipment storage regardless of storage location. The Customer will be responsible to ensure that the unit is properly stored and the equipment properly secured, protected and preserved. Damage due to water ingress, rust, dust, debris or improper security will not be covered by the New Equipment Warranty.

Effective with sales to the first user on or after June 1, 2002

CATERPILLAR LIMITED WARRANTY

Industrial Engine Products and Electric Power Generation Products

Worldwide*

(*excluding the Commonwealth of Independent States)

Caterpillar Inc. or any of its subsidiaries ("Caterpillar") warrants new and Remanufactured engines and electric power generation products sold by it (including any products of other manufacturers packaged and sold by Caterpillar) and operating outside the Commonwealth of Independent States (formerly USSR), to be free from defects in material and workmanship.

A different warranty statement applies to product operating in the Commonwealth of Independent States. Copies of this warranty may be obtained by writing Caterpillar Inc., 100 N.E. Adams St., Peoria, IL USA 61629.

This warranty does not apply to Caterpillar Motoren (CM) product engines sold for use in on-highway vehicle or marine applications, engines in machines manufactured by or for Caterpillar, 3500 and 3600 Family engines used in locomotive applications, 3000 Family engines, or Caterpillar brand batteries. These products are covered by other Caterpillar warranties.

This warranty is subject to the following:

Warranty Period

- For Uninterruptible Power Systems (UPS), the warranty period is 12 months after date of delivery to the first user.
- For new industrial engines and electric power generation products (excluding UPS), the warranty period is 12 months (24 months for Automatic Transfer Switch (ATS) product, mobile agricultural and standby electric power generation applications) after date of delivery to the first user.
- For all Remanufactured engines, the warranty period is 6 months (12 months for mobile agricultural and standby electric power generation applications) after date of delivery to the first user.

Caterpillar Responsibilities

If a defect in material or workmanship is found during the warranty period, Caterpillar will, during normal working hours and through a place of business of a Caterpillar dealer or other source approved by Caterpillar:

- Provide (at Caterpillar's choice) new, Remanufactured or Caterpillar-approved repaired parts or assembled components needed to correct the defect.

Note: Items replaced under this warranty become the property of Caterpillar.

- Replace lubricating oil, filters, coolant and other service items made unusable by the defect.
- Provide reasonable or customary labor needed to correct the defect, including labor to disconnect the product from and reconnect the product to its attached equipment, mounting, and support systems, if required.

For new 3114, 3116 and 3126 engines and electric power generation products (including any new products of the other manufacturers packaged and sold by Caterpillar):

- Provide travel labor, up to four hours round trip if, in the opinion of Caterpillar, the product cannot reasonably be transported to a place of business of a Caterpillar dealer or other source approved by Caterpillar (travel labor in excess of four hours round trip, and any meals, mileage, lodging, etc. is the user's responsibility).

For all other products:

- Provide reasonable travel expenses for authorized mechanics, including meals, mileage, and lodging, when Caterpillar chooses to make the repair on-site.

User Responsibilities

The user is responsible for:

- Providing proof of the delivery date to the first user.
- Labor costs, except as stated under "Caterpillar Responsibilities", including costs beyond those required to disconnect the product from and reconnect the product to its attached equipment, mounting and support systems.
- Travel expenses not covered under "Caterpillar Responsibilities".
- All costs associated with transporting the product to and from the place of business of a Caterpillar dealer or other source approved by Caterpillar.
- Premium or overtime labor costs.
- Parts shipping charges in excess of those which are usual and customary.
- Local taxes, if applicable.
- Costs to investigate complaints, unless the problem is caused by a defect in Caterpillar material or workmanship.
- Giving timely notice of a warrantable failure and promptly making the product available for repair.

- Performance of the required maintenance (including use of proper fuel, oil, lubricants and coolant) and items replaced due to normal wear and tear.
- Allowing Caterpillar access to all electronically stored data.

Limitations

Caterpillar is not responsible for:

- Failures resulting from any use or installation which Caterpillar judges improper.

(Continued on reverse side...)

- Failures resulting from attachments, accessory items and parts not sold or approved by Caterpillar.
- Failures resulting from abuse, neglect and/or improper repair.
- Failures resulting from user's delay in making the product available after being notified of a potential product problem.

- Failures resulting from unauthorized repair or adjustments, and unauthorized fuel setting changes.
- Damage to parts, fixtures, housings, attachments, and accessory items that are not part of the engine or electric power generation product (including any products of other manufacturers packaged and sold by Caterpillar).

- Repair of components sold by Caterpillar that is warranted directly to the user by their respective manufacturer. Depending on type of application, certain exclusions may apply. Consult your Caterpillar dealer for more information.

For products operating outside of Australia, Fiji, Nauru, New Caledonia, New Zealand, Papua New Guinea, the Solomon Islands and Tahiti, the following is applicable:

NEITHER THE FOREGOING EXPRESS WARRANTY NOR ANY OTHER WARRANTY BY CATERPILLAR, EXPRESS OR IMPLIED, IS APPLICABLE TO ANY ITEM CATERPILLAR SELLS WHICH IS WARRANTED DIRECTLY TO THE USER BY ITS MANUFACTURER.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, EXCEPT CATERPILLAR EMISSION-RELATED COMPONENTS WARRANTIES FOR NEW ENGINES, WHERE APPLICABLE. REMEDIES UNDER THIS WARRANTY ARE LIMITED TO THE PROVISION OF MATERIAL AND SERVICES, AS SPECIFIED HEREIN.

CATERPILLAR IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

CATERPILLAR EXCLUDES ALL LIABILITY FOR OR ARISING FROM ANY NEGLIGENCE ON ITS PART OR ON THE PART OF ANY OF ITS EMPLOYEES, AGENTS OR REPRESENTATIVES IN RESPECT OF THE MANUFACTURE OR SUPPLY OF GOODS OR THE PROVISION OF SERVICES RELATING TO THE GOODS.

IF OTHERWISE APPLICABLE, THE VIENNA CONVENTION (CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS) IS EXCLUDED IN ITS ENTIRETY.

For electric power generation products sold for personal or family use, operating in the USA, its territories and possessions, some states do not allow limitations on how long an implied warranty may last or allow the exclusion or limitation of incidental or consequential damages. Therefore, the previously expressed exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights, which vary by jurisdiction. To find the location of the nearest Caterpillar dealer or other authorized repair facility, call (800) 447-4986. If you have questions concerning this warranty or its applications, call or write:

In USA and Canada: Caterpillar Inc., Engine Division, P. O. Box 610, Mossville, IL 61552-0610. Attention: Customer Service Manager, Telephone (800) 447-4986. Outside the USA and Canada: Contact your Caterpillar dealer.

For products operating in Australia, Fiji, Nauru, New Caledonia, New Zealand, Papua New Guinea, the Solomon Islands and Tahiti, the following is applicable:

THIS WARRANTY IS IN ADDITION TO WARRANTIES AND CONDITIONS IMPLIED BY STATUTE AND OTHER STATUTORY RIGHTS AND OBLIGATIONS THAT BY ANY APPLICABLE LAW CANNOT BE EXCLUDED, RESTRICTED OR MODIFIED ("MANDATORY RIGHTS"). ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED (BY STATUTE OR OTHERWISE), ARE EXCLUDED.

NEITHER THIS WARRANTY NOR ANY OTHER CONDITION OR WARRANTY BY CATERPILLAR, EXPRESS OR IMPLIED (SUBJECT ONLY TO THE MANDATORY RIGHTS), IS APPLICABLE TO ANY ITEM CATERPILLAR SELLS WHICH IS WARRANTED DIRECTLY TO THE USER BY ITS MANUFACTURER.

TO THE EXTENT PERMITTED UNDER THE MANDATORY RIGHTS, IF CATERPILLAR IS THE SUPPLIER TO THE USER, CATERPILLAR'S LIABILITY SHALL BE LIMITED AT ITS OPTION TO (a) IN THE CASE OF SERVICES, THE SUPPLY OF THE SERVICES AGAIN OR THE PAYMENT OF THE COST OF HAVING THE SERVICES SUPPLIED AGAIN, AND (b) IN THE CASE OF GOODS, THE REPAIR OR REPLACEMENT OF THE GOODS, THE SUPPLY OF EQUIVALENT GOODS, THE PAYMENT OF THE COST OF SUCH REPAIR OR REPLACEMENT OR THE ACQUISITION OF EQUIVALENT GOODS.

CATERPILLAR EXCLUDES ALL LIABILITY FOR OR ARISING FROM ANY NEGLIGENCE ON ITS PART OR ON THE PART OF ANY OF ITS EMPLOYEES, AGENTS OR REPRESENTATIVES IN RESPECT OF THE MANUFACTURE OR SUPPLY OF GOODS OR THE PROVISION OF SERVICES RELATING TO THE GOODS.

CATERPILLAR IS NOT LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES UNLESS IMPOSED UNDER MANDATORY RIGHTS.

IF OTHERWISE APPLICABLE, THE VIENNA CONVENTION (CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS) IS EXCLUDED IN ITS ENTIRETY.

This warranty covers every major component of the products. Claims under this warranty should be submitted to a place of business of a Caterpillar dealer or other source approved by Caterpillar. For further information concerning either the location to submit claims or Caterpillar as the issuer of this warranty, write Caterpillar Inc., 100 N. E. Adams St., Peoria, IL USA 61629.



ARIEL WARRANTY SUMMARY

Ariel warrants that the Products manufactured by it and delivered hereunder will be free of defects in material and workmanship for a period of twelve (12) months from the date the goods are placed in use or eighteen (18) months from date of shipment, whichever event shall first occur.

In addition, Ariel warrants for a period of thirty-six (36) months after delivery, the following parts to be free from defects in material or workmanship under normal use when properly maintained: (1) Crankshaft, (2) Crankcase Casting, (3) Connecting Rods, (4) Crossheads, (5) Crosshead guide Castings.

EXTENDED WARRANTY:

Effective for all units shipped from Ariel after January 1, 2003, Ariel provides an extended warranty for units that continuously use and maintain 100% Ariel original equipment replacement parts. The extended warranty will be applied as follows:

Ariel warrants for a period of seventy two (72) months after delivery, the following parts to be free from defects in material or workmanship under normal use when properly maintained: (1) Crankshaft, (2) Crankcase Casting, (3) Connecting Rods, (4) Crossheads, (5) Crosshead guide Castings.

In addition, Ariel warrants for a period of twenty four (24) months after delivery, the following parts to be free from defects in material or workmanship under normal use in lubricated compressors when properly maintained: (1) Cylinder bodies, (2) Pistons, (3) Piston Rods.

Ariel warrants that all remaining components manufactured or delivered by Ariel will be free of defects in material and workmanship for a period of twelve (12) months from the date the goods are placed in use by the Distributor or eighteen (18) months from date of shipment, whichever event shall first occur. Labor coverage remains at one year. If at any time parts not manufactured or delivered by Ariel (non-OEM replacement) parts are placed into service on the compressor, the extended warranty will be null and void and the standard warranty will apply.

The effects of corrosion, erosion and normal wear and tear are specifically excluded from this warranty. Performance warranties are limited to those specifically stated within Ariel's written proposal, unless responsibility for meeting such performance warranties are limited to specified shop or field tests.

The above is a summary. Please contact Ariel for additional regarding specific warranty term and warranty administration procedures.

KAB
July 23, 2004

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TECHNICAL DATA
Refer to QC Data

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PERFORMANCE

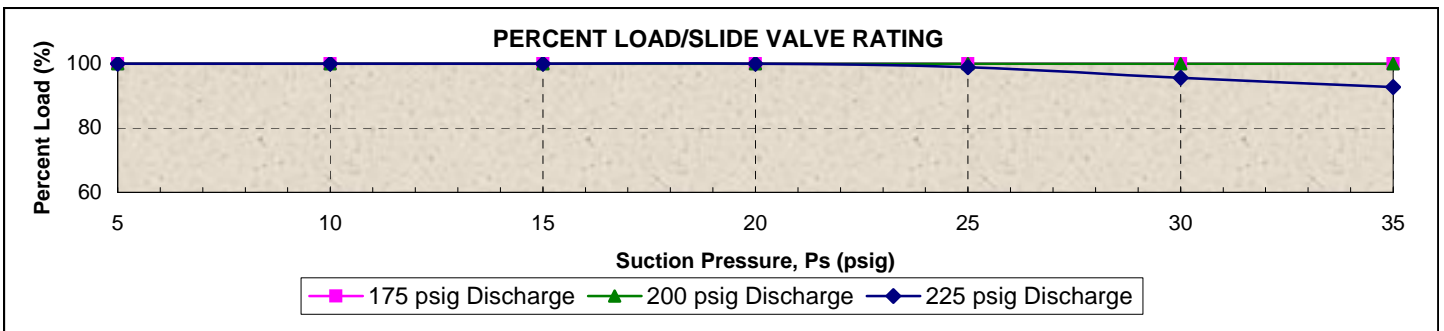
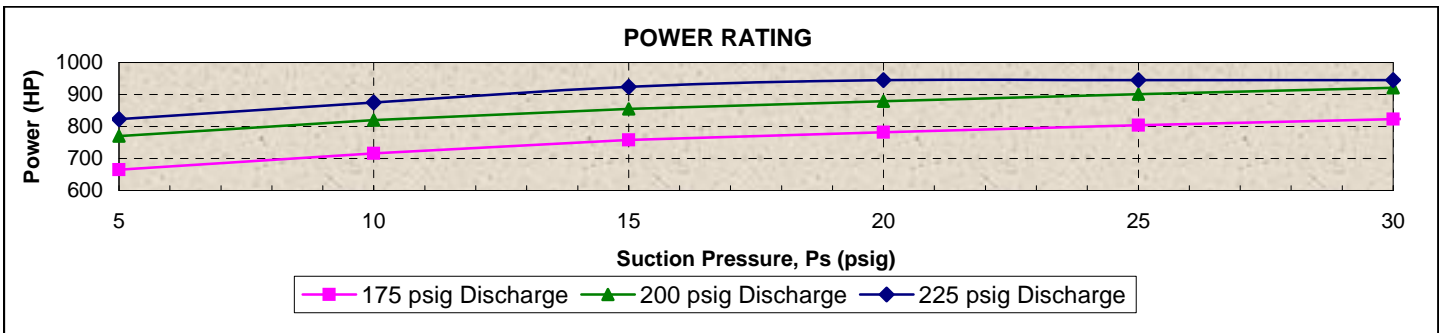
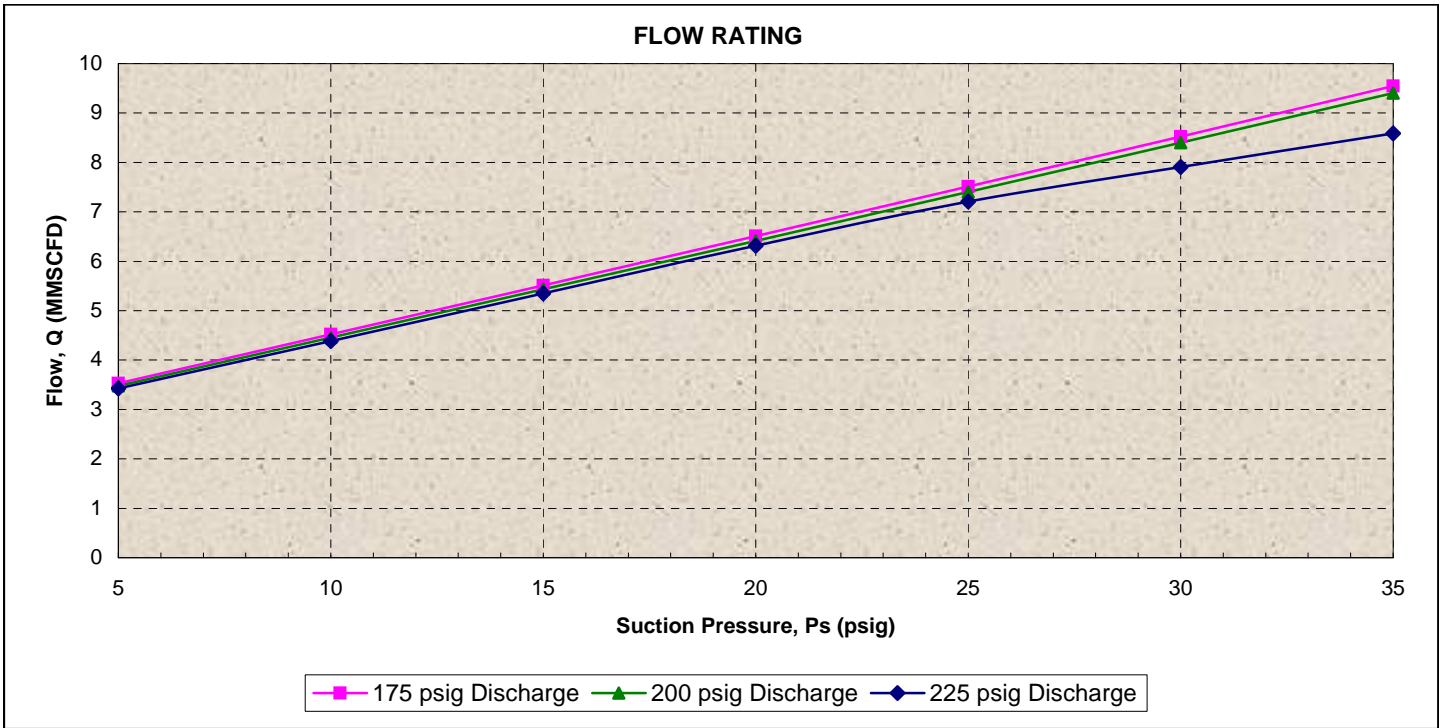
SCREW COMPRESSOR PERFORMANCE MAP

MAJOR EQUIPMENT DETAILS:

Model:	SA1005	Driver Speed:	1400 rpm
Driver:	Cat 3512LE AFRC	Comp. Speed:	1400 rpm
Compressor:	Ariel RG357M	VI Type:	Variable
Gear Ratio:	1	Oil Pump:	Yes

PROCESS DESIGN:

Suction Temperature:	60 °F
Ambient Temperature:	95 °F
Elevation:	2500 ft
Specific Gravity:	0.65



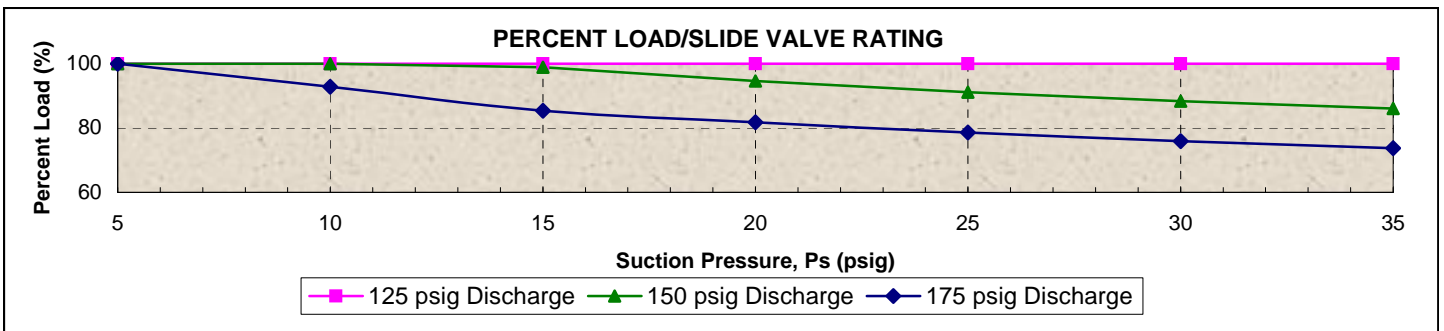
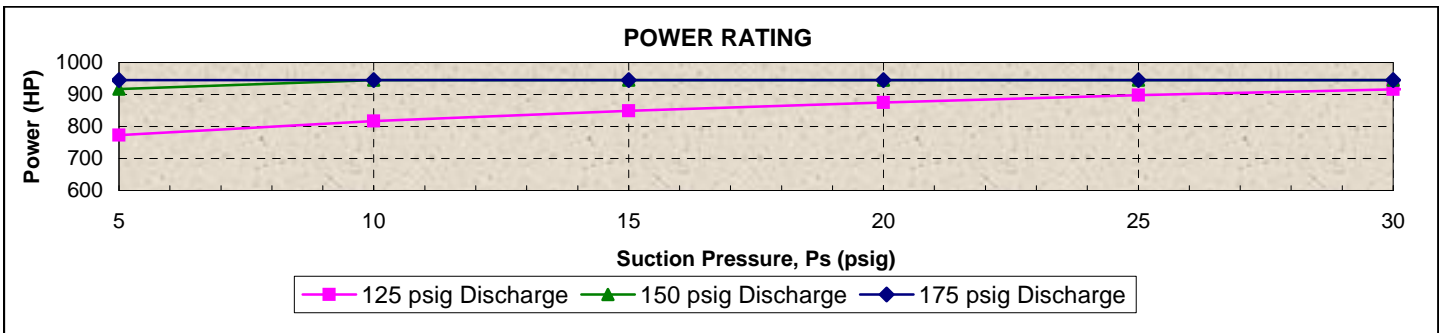
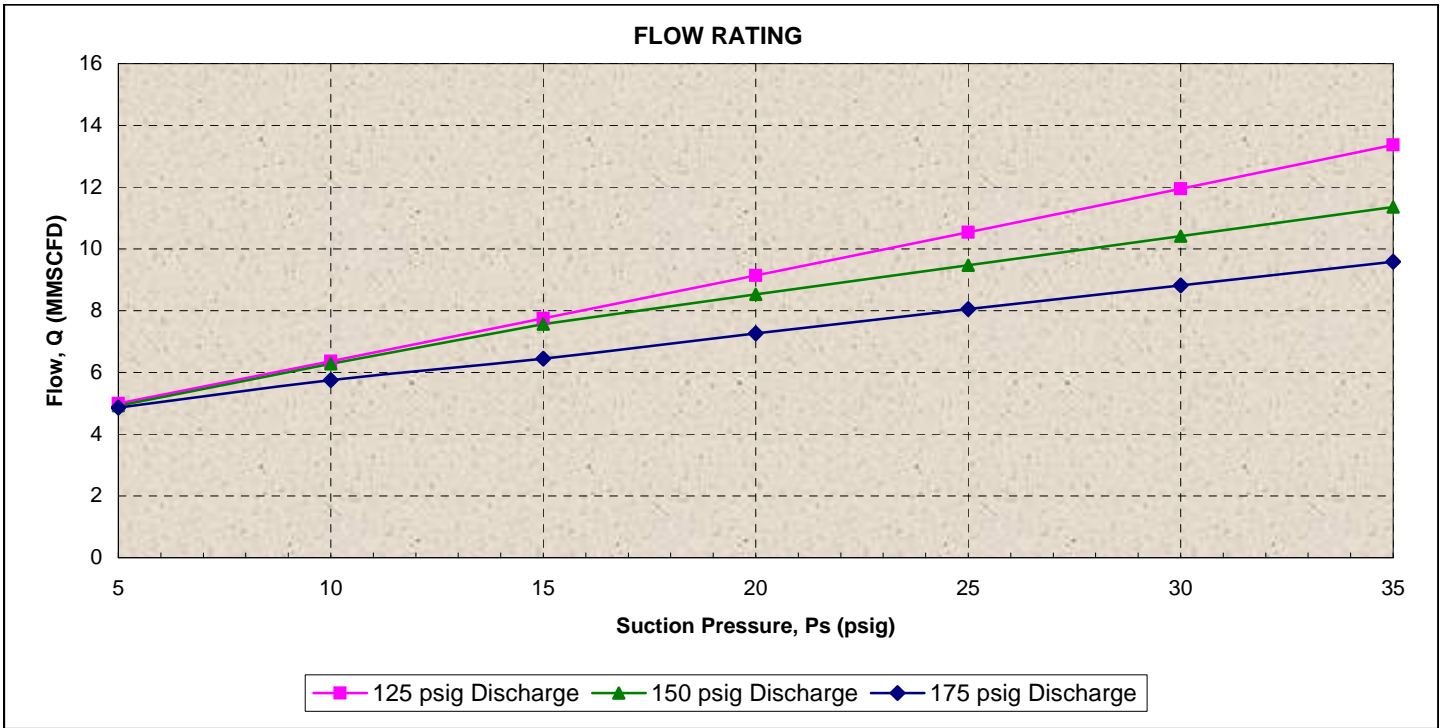
SCREW COMPRESSOR PERFORMANCE MAP

MAJOR EQUIPMENT DETAILS:

Model:	SA1005	Driver Speed:	1400 rpm
Driver:	Cat 3512LE AFRC	Comp. Speed:	1897 rpm
Compressor:	Ariel RG357M	VI Type:	Variable
Gear Ratio:	1.355	Oil Pump:	Yes

PROCESS DESIGN:

Suction Temperature:	60 °F
Ambient Temperature:	95 °F
Elevation:	2500 ft
Specific Gravity:	0.65



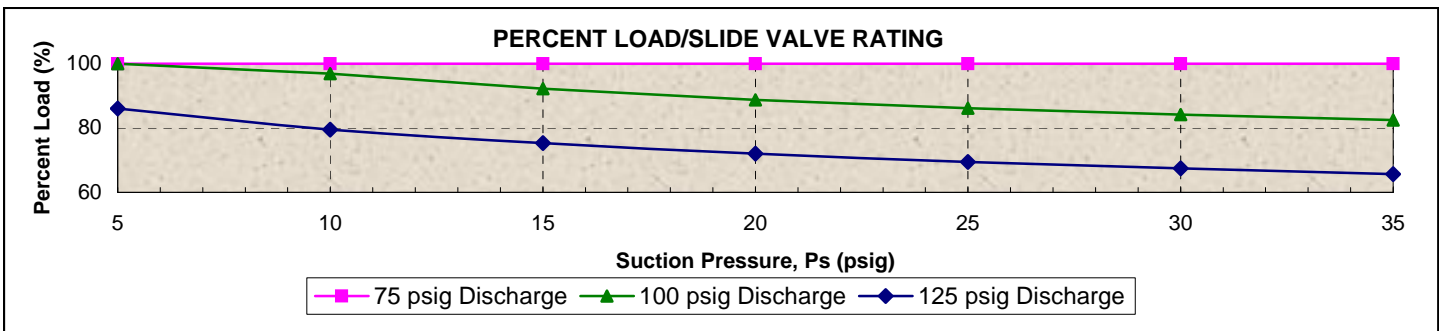
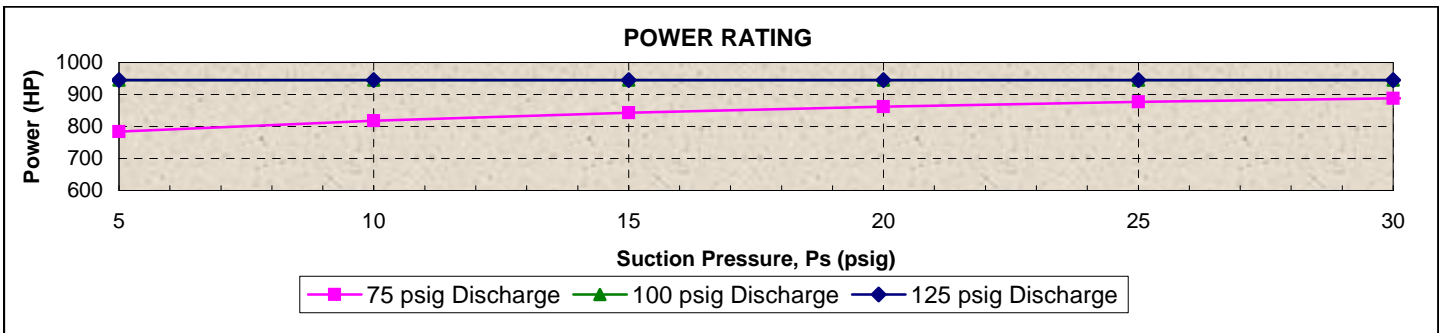
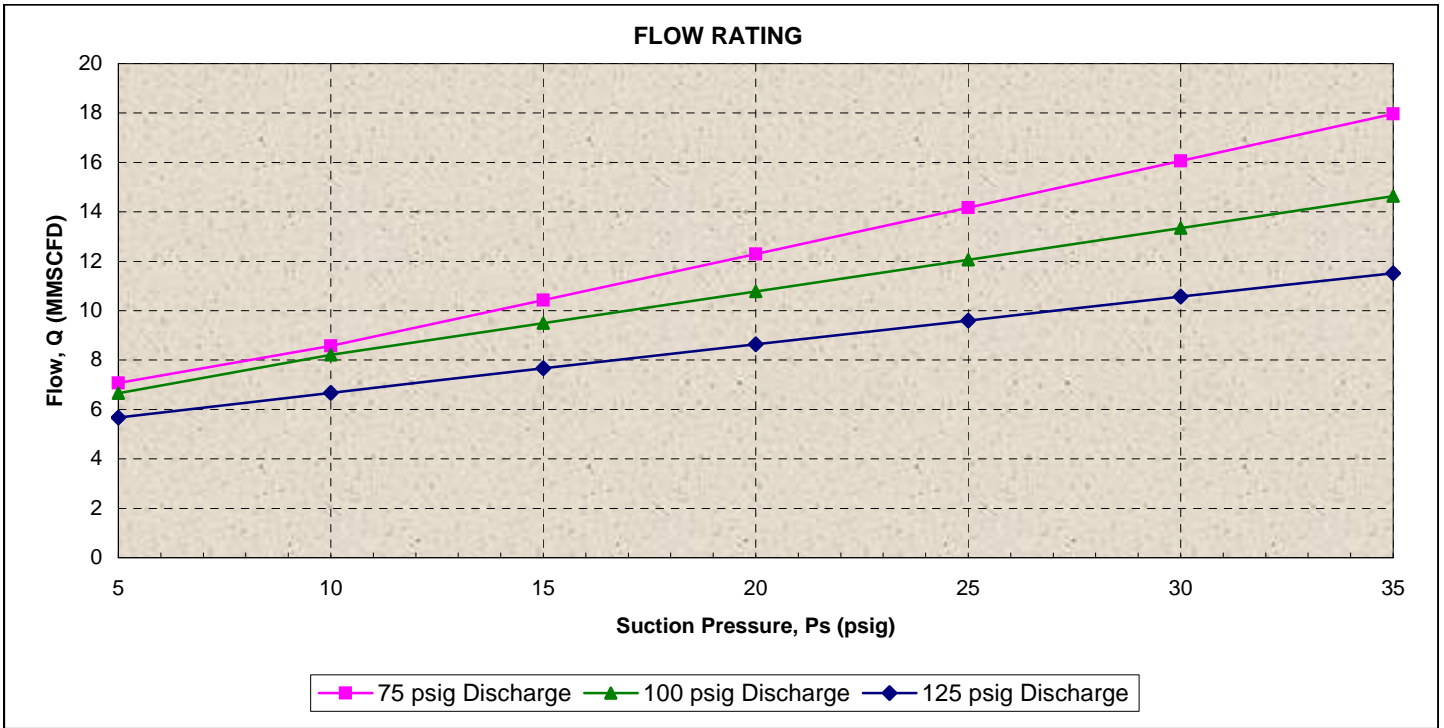
SCREW COMPRESSOR PERFORMANCE MAP

MAJOR EQUIPMENT DETAILS:

Model:	SA1005	Driver Speed:	1400 rpm
Driver:	Cat 3512LE AFRC	Comp. Speed:	2477 rpm
Compressor:	Ariel RG357M	VI Type:	Variable
Gear Ratio:	1.769	Oil Pump:	Yes

PROCESS DESIGN:

Suction Temperature:	60 °F
Ambient Temperature:	95 °F
Elevation:	2500 ft
Specific Gravity:	0.65





Configuration

Company: Ariel Corporation
Quote:

Customer: EnCana Corporation
Inquiry:



7.5.2.2 Case 1: Ps = 10 psig, Pd = 150 psig 1005 hp

Project: Chinook Booster

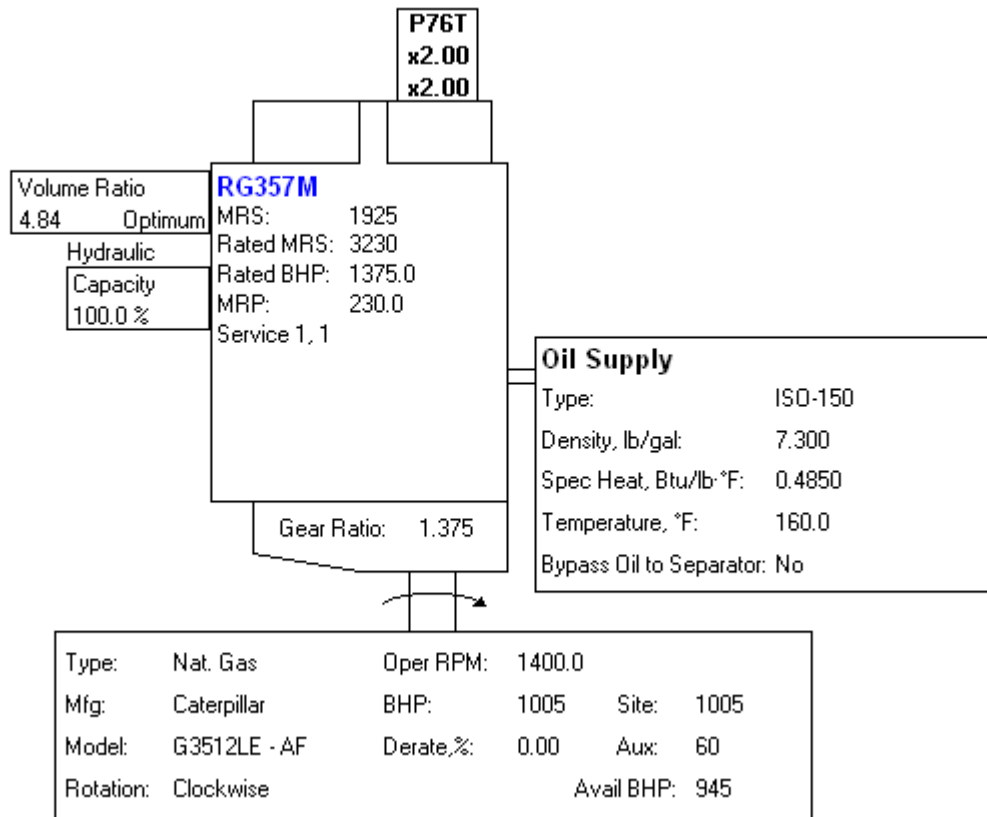
Elevation,ft: 2000.0

Barmtr,psia: 13.651

Ambient,°F: 95.00

Service: Service 1
 Flow,MMSCFD: 5.365
 Ps Line, psig: 10.00
 Ps Loss, psi: 0.00
 Suct Temp, °F: 60.00
 Pd Line, psig: 150.00
 Gas Model: Hall
 Gas Analysis: No
 Specific Gravity: 0.6500
 Remove Water: Yes
 Calc Press Loss: Yes
 Enter Oper Params: No

Stage: 1
 Enabled: Yes
 Press Loss, psi: 4.91
 Cooler Temp, °F: 120.00
 Calc N&Z: Yes
 N: 1.2454
 Zs: 0.9955
 Zd: 0.9938
 Condensate,%: N/A
 Enter Gas: No





Ariel Rotary Compressor Data Sheet



Model: RG357M

Vi: Optimum

Capacity: 1320 - 5150 CFM
 Max Rated Power: 1375.0 BHP
 Male Rotor Speed: 840 - 3230 rpm
 Rated Input Speed: 1800 rpm
 Max. Case Static Press: 300.00 psig

Rotor:

Male Rotor Dia: 357 mm
 L/D Ratio: 2.10

Flanges:

Suction: 16" - 300 FF
 Discharge: 10" - 300 FF

Pressure Ratings*:

Max Suction: 50.0 psig
 MRVS: 300.0 psig
 MRP: 230.0 psig
 HTP: 450.0 psig

* For extended operating pressures see operator's manual.

Available Gear Ratios:

1.000 1.375 1.566 1.778 2.040 2.304 2.667

Available Volume Ratios:

Steplessly adjustable from 2.50 to 5.00

Dimensions:

Maximum Height:	45.00 in	With Bellhousing:		Without Bellhousing:	
Maximum Width:		Maximum Length:	109.00 in	Maximum Length:	97.20 in
Hydraulic Controls:	72.10 in	Maximum Weight:	9850 lbs	Maximum Weight:	9000 lbs
Handwheel Controls:	72.10 in				

Bearings:

Compressor -	Axial:	Angular contact ball bearings
	Radial:	Hydrodynamic - Suction and discharge sides
Gearbox -	Axial/Radial:	Taper roller bearings and cylindrical roller bearing

Material Specifications:

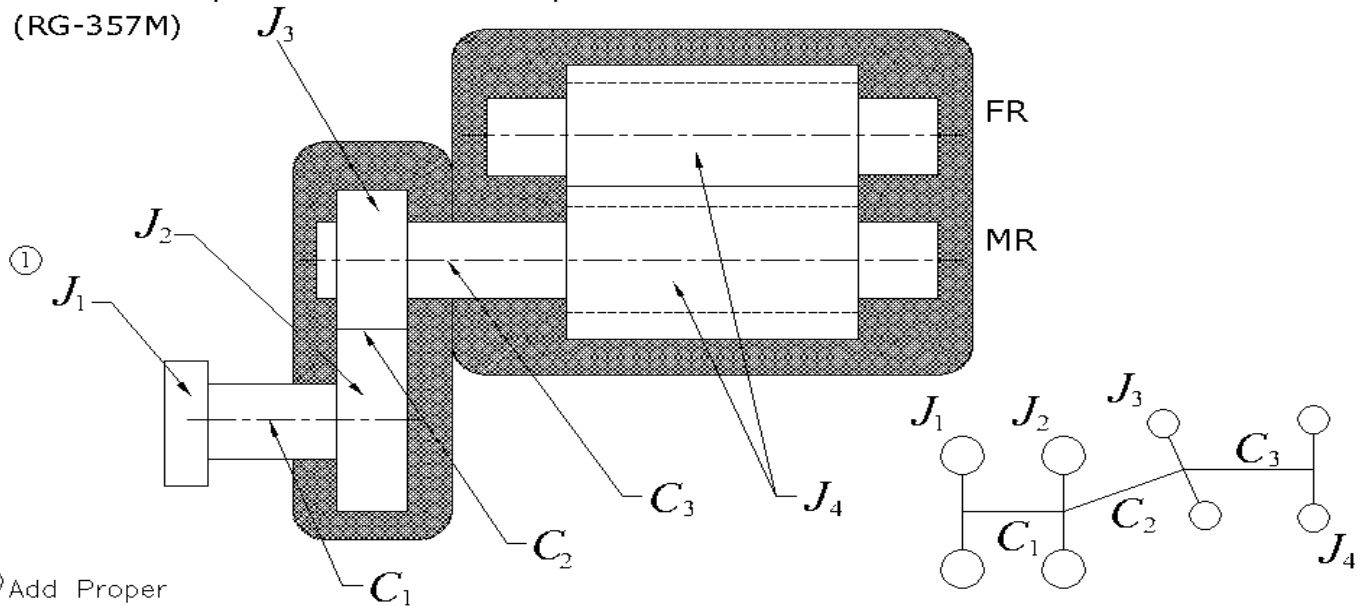
Rotor Housing:	Ductile Iron	14D	(ASTM A395 Grade 60-40-18)
Discharge Housing:	Ductile Iron	14D	(ASTM A395 Grade 60-40-18)
Gearbox Housing:	Ductile Iron	14D	(ASTM A395 Grade 60-40-18)
Discharge Cover:	Ductile Iron	14D	(ASTM A395 Grade 60-40-18)
Rotors:	Forged Carbon Steel	15C	(AISI 1045)
Slide Plate, Vi:	Ductile Iron	16D	(ASTM A536 Grade 65-45-12)
Slide Plate Stem, Vi:	303 Stainless		(303 Stainless Steel)
Slide Plate, Capacity:	Ductile Iron	16D	(ASTM A536 Grade 65-45-12)
Slide Plate Stem, Capacity:	303 Stainless		(303 Stainless Steel)
Stem Seal:	Viton		(V4208A90 Fluorcarbon)
Gears:	Alloy Steel		(AISI 4320H)
Gear Shaft:	Forged Alloy Steel	13N,15N	(AISI 4340)
Radial Bearings:	Steel Backed Babbit		(Steel Backed Babbit)
Mechanical Seal:	Silicon carbide/carbon		(Silicon carbide/carbon)
O-Rings:	Viton	10E	(ASTM D2000)

Outline Drawings:

RG Series Electrical Connection Schematic	002273
RG Series Oil Schematic - Handwheel Control - Sheet 1	001838s1
RG Series Oil Schematic - Handwheel Control - Sheet2	001838s2
RG Series Oil Schematic - Handwheel Control - Sheet3	001838s3
RG Series Oil Schematic - Hydraulic Control - Sheet 1	002234s1
RG Series Oil Schematic - Hydraulic Control - Sheet2	002234s2
RG Series Oil Schematic - Hydraulic Control - Sheet3	002234s3
Outline	002140s1
Outline with SAE 00 Bell Housing	002172s1
Outline - Sheet 2	002140s2
Outline with SAE 00 Bell Housing - Sheet 2	002172s2
Outline - Sheet 3	002140s3
Outline with SAE 00 Bell Housing - Sheet 3	002172s3

GAS COMPRESSORS

Substitute System for Torsion Analysis
(RG-357M)



① Add Proper Coupling Moment of Inertia

ALL DATA REFERENCED TO ITS OWN SPEED, EXCEPT FEMALE ROTOR. GEAR TOOTH STIFFNESS C2 IS REFERENCED TO JACKSHAFT SPEED.

Gear Ratio	① J_1	C_1	J_2	C_2	J_3	C_3	J_4
	Jackshaft Moment of Inertia kg-m ² [lb-in ²]	Jackshaft Stiffness N-m/rad [lb-in/rad]	Jackshaft & Gear Moment of Inertia kg-m ² [lb-in ²]	Gear Tooth Stiffness N-m/rad [lb-in/rad]	Pinion Moment of Inertia kg-m ² [lb-in ²]	Male Rotor Stiffness N-m/rad [lb-in/rad]	Male & Female* Rotors Moment of Inertia kg-m ² [lb-in ²]
1.000	0.012 [40]	2.204*10 ⁶ [1.951*10 ⁷]	0.463 [1,584]	1.705*10 ⁷ [1.509*10 ⁸]	0.270 [922]	7.553*10 ⁶ [6.685*10 ⁷]	*Referenced To Male Rotor Speed 5.869 [20,055]
1.375			0.673 [2,301]	2.352*10 ⁷ [2.082*10 ⁸]	0.134 [458]		
1.567			0.785 [2,682]	2.632*10 ⁷ [2.330*10 ⁸]	0.097 [332]		
1.778			0.907 [3,098]	2.901*10 ⁷ [2.567*10 ⁸]	0.070 [239]		
2.040			1.054 [3,601]	3.176*10 ⁷ [2.811*10 ⁸]	0.048 [163]		
2.304			1.196 [4,086]	3.389*10 ⁷ [3.000*10 ⁸]	0.033 [114]		
2.667			1.378 [4,709]	3.576*10 ⁷ [3.165*10 ⁸]	0.021 [71]		



Ariel Rotary Performance



Company: Ariel Corporation
Quote:

Customer: EnCana Corporation
Inquiry:

7.5.2.2

Case 1: Ps = 10 psig, Pd = 150 psig 1005 hp

Project: Chinook Booster

Compressor Data:

Elevation,ft:	2000.0	Barmtr,psia:	13.651	Ambient,°F:	95.00
Model:	<u>RG357M</u>	Installed Vi:	Optimum	Gear Ratio:	1.375
Oil Pump:	P76Tx2.00x2.00				
Rated RPM:	1800	Rated BHP:	1375.0	Rated MRS:	3230
Oper RPM:	1400.0	Calc BHP:	929	Calc MRS:	1925

Driver Data:

Type:	Nat. Gas
Mfg:	Caterpillar
Model:	G3512LE - AFRC
BHP:	1005
Avail:	945 (60)

Services

Service 1

Stage Data:

#1

Flow Req'd, MMSCFD	5.365
Flow Calc, MMSCFD	6.764
BHP per Stage	926.8
Specific Gravity	0.65
Ratio of Sp Ht (N)	1.2454
Comp Suct (Zs)	0.9955
Comp Disch (Zd)	0.9938
Pres Suct Line, psig	10.00
Pres Suct Flg, psig	10.00
Pres Disch Flg, psig	154.91
Pres Disch Line, psig	150.00
Pres Ratio F/F	7.127
Temp Suct, °F	60.00
Temp Clr Disch, °F	120.00

Compressor Data:

Model	<u>RG357M</u>
Male Rotor Dia, mm	357
MRP, psig	230.0
MRVS, psig	300.0
Capacity, %	100.0
Volume Ratio	4.84
Adiabatic Eff, %	78.0
Volumetric Eff, %	89.4
Temp Disch, °F	205.00
Male Rotor Tip Spd, m/s	35.98
Male Rotor Torque, ft-lbs	2528.7
Clr Gas Heat, BTU/h	609171

Oil Data:

Oil Pump	P76Tx2.00x2.00
Brg & Seal Flow, GPM	60.0
Req'd Pump Flow, GPM	78.0
Pump Flow, GPM	91.1
Rotor Inj Flow, GPM	47.1
Total Oil Flow, GPM	138.2
Oil Temp, °F	160.0
Oil Density, lb/gal	7.300
Oil Sp Ht, Btu/lb·°F	0.4850
Oil Heat, BTU/h	1321179
Bypass Oil to Separator	No



Company: Ariel Corporation
 Quote:

Oil Pump Report

Customer: EnCana Corporation



7.5.2.2

Case 1: Ps = 10 psig, Pd = 150 psig 1005 hp

Inquiry:

Project: Chinook Booster

Compressor Type	<u>RG357M</u>
Gear Ratio	1.375
Suction Pressure, psig	10.00
Discharge Pressure, psig	154.91
Oper Speed, rpm	1400.0
Male Rotor Speed, rpm	1925
Required Oil Flow (Brg,Seal,Shaft), GPM	60.0
Required Pump Flow, GPM	78.0

Pump Model	Pump Flow, GPM
P75Sx2.25	51.3
P75Sx2.50	56.9
P75Sx2.75	62.7
P75Sx3.00	68.3
P76Tx1.75x1.50	74.1
P76Tx1.75x1.75	79.8
P76Tx2.00x1.75	85.4
P76Tx2.00x2.00	91.1
P76Tx2.25x2.00	96.8
P76Tx2.25x2.25	102.6
P76Tx2.50x2.50	113.9
P76Tx2.75x2.50	119.6
P76Tx3.00x3.00	136.7



Ariel Performance Information



Company: Ariel Corporation Customer: EnCana Corporation
Quote: Inquiry:
7.5.2.2 Case 1: Ps = 10 psig, Pd = 150 psig 1005 hp Project: Chinook Booster

Cmpr: RG357M

IN DEVELOPMENT - Preliminary Performance, please Contact Application Engineering for Verification.

Gear Ratio: 1.375

Installed Volume Ratio: 4.84 (Optimum)

Service 1 - Service 1

Service 1 - Stage 1

Oil Pump: P76Tx2.00x2.00

Notes:

BOLD = Out of Limits, Compressor will NOT operate with these errors.

ITALIC = Special Application, Contact Ariel Engineering for Approval.

ENERFLEX

OPERATING INFORMATION

Rotary Gas Compressor Package

This rotary gas compression package was designed and manufactured by Enerflex Systems Ltd., Calgary, Alberta, Canada. All piping, vessels, electrical components and controls are built to the applicable standards and codes. While this unit has been designed and fabricated for safe operation, it is imperative that only trained personnel, who are familiar with the system, be allowed to control and service this package. If in doubt of any operating parameter or function of this unit, immediately contact Enerflex Systems Ltd.

Manual Overview

This manual contains a process overview, operating instructions, and instructions for lubrication and maintenance. Should any questions arise concerning this manual, please contact Enerflex Systems Ltd.

This manual contains a description of the major operating systems. This includes an outline of the design of the package, including performance characteristics. Care must be taken to ensure that the system functions properly.

Please refer to the appropriate section for a description of each section.

Operation

Operating techniques that are discussed in this manual are basic instructions. The field operators will gain the skills and knowledge particular to each package.

For the initial start-up of the package, the system must be tested and verified by trained personnel familiar with the testing procedures for new units. All components that make up this package must be checked and verified to be safe and operating within normal parameters.

Please contact Enerflex Systems Ltd. to schedule this service.

Maintenance

The maintenance schedule that is set out in this manual is a general description and may be subject to variations, depending on the service of the particular unit. Under extreme operating conditions such as high or low operating temperatures, or particularly, wet gas, the routine maintenance schedule may have to be increased.

As outlined in the maintenance schedule of this manual, routine compressor oil sampling and analysis is critical to ensure that the compressor is properly lubricated. Should the oil samples indicate a trend that the oil is being contaminated or is breaking down, the frequency of the oil sampling and analysis schedule must be increased.

Also included in this manual, are the manufacturers' manuals for each of the major mechanical components. Refer to these individual manuals for routine maintenance for each of the devices. This is required to ensure that each piece of equipment, or each device, is properly checked and maintained.

Individual Manuals

This manual contains the individual manuals for each of the components and/or instruments. Reference to these manuals will provide such information as routine maintenance, operating instructions, parts lists, etc. for the individual components.

Manuals specific to the individual instrumentation components can be found in the Vendor Literature section of this manual.

Use of this Manual

The descriptions contained in this manual will include generic information, which is common in most rotary gas compressor packages. Reference to the specific package drawings and the bill of materials, contained within this manual, will be necessary to establish those items which are included with this package. If in doubt, please contact Enerflex Systems Ltd. for clarification.

For general overviews of the system operation and design, refer to the appropriate section of this manual. For information specific to any device or instrument, refer to the appropriate manufacturer's manual, also contained within this manual.

Safety Instructions and Warnings

The unit is designed to operate normally manned, with periodic checks, inspection, and replenishment of engine and compressor fluids and coolant. The unit is designed assuming that all personnel working with the unit have been properly trained for the duties they are to perform.

**** WARNING ****

It is essential that the proper Personal Protective Equipment (PPE) is used when around, operating or maintaining equipment. Examples of the safety equipment required are: safety shoes, gloves, eye and hearing protection, and temperature appropriate clothing.

**** WARNING ****

Any activity performed on the unit during transportation, assembly, operation and maintenance should be done by properly trained personnel.

**** CAUTION ****

The skid is designed to be installed at grade level. Please consult local regulations for elevated work platforms.

NOTE: The user is responsible for levelling and alignment of equipment and required platforms.

**** WARNING ****

When grating is removed for any reason, warning tape is to be placed around openings.

**** WARNING ****

Due to the operating noise level of the equipment, the user must install acoustical and visual evacuation warnings.

**** WARNING ****

User **MUST** refer to the applicable Material Safety Data Sheets (MSDS) prior to handling engine/compressor fluids.

The following are general safety rules and requirements to be adhered to during the different phases of the life of the unit:

Transportation

Do not stand under any suspended lifts.

Lifting

Lifting of skid and major equipment is to be done using the lifting lugs provided. Note: Purchased machinery components are provided with threaded holes and/or shoulder eyebolts for lifting components. Any loose lifting gear required is not supplied by Enerflex. This is the responsibility of the owner.

**** CAUTION ****

Lifting gear and practices are to be in accordance with local regulations and are to be done by properly trained personnel.

Assembly

Do not stand under any suspended lifts.

Insulation for piping is shown on P&ID's and is the responsibility of the customer. Installation of the insulation is to be performed to company specifications and local regulations.

EFX has provided a skid that will act with the customer's foundation as a system to support the static weight of the packages and transmit the dynamic forces into the platform structure. Anchor bolt holes and jacking bolt holes have been provided at specific locations. The customer is to provide support at these locations as a minimum.

Operation

**** WARNING ****

1. This unit requires proper ventilation. Operator is instructed to ensure proper ventilation is used in enclosed areas. Ventilation is to be done in accordance with local regulations.
2. User must conduct a walk around inspection prior to equipment start-up.

Maintenance

Depressurizing the system:

For maintenance purposes the unit must be depressurized using the following procedure:

1. Ensure unit is locked-out prior to performing any maintenance activity (see note below).
2. Close process inlet and discharge isolation ball valves.
3. Open the by-pass valve.
4. Open the unit blowdown valve to reduce the unit pressure to atmospheric. If the unit is being used in sour service a sweet purge of the unit is required.

Note: The owner of the unit must devise and implement a permit/lock-out procedure to be used prior to any work being done on the unit.

Maintenance must be done under well-lit or daytime conditions. Lighting is the responsibility of the owner where permanent lighting is unavailable or insufficient. The owner must provide temporary portable lighting to illuminate the task area. Lighting must be suitable for the hazardous area present.

Fluid fills:

All fluid levels should be filled while the machine is at a standstill.

Pre-Start-up Procedure

Pressure Testing & Purging

After connecting all lines to the compressor package it should be pneumatically leak tested with air or nitrogen. The compressor package has been tested prior to shipment, but leaks can occur during transportation. Air in the compressor shall be displaced from the system by an inert gas prior to startup.

Drive Shaft and Driven Equipment

The compressor shaft drive has been aligned prior to shipment, as well as the associated driven equipment. This alignment may change during transportation and therefore a final alignment must be completed on-site prior to commissioning.

- The coupling shall be hot aligned and all belt drive systems are to be checked within the first 8-hour running period.
- Check all hold down bolting.
- The cooler fan should be checked for correct direction of rotation, pitch, belts (slip), noise and adequate airflow.

Shut down package to tighten belts.

Unit must not be operated without the belt guards installed and secured.

Oil Filtration

The package is equipped with filters for the Horizontal inlet Filter/Separator, Oil Coalescer and screw oil delivery systems.

These shall be installed prior to shipment, but the filter installation should be confirmed prior to start-up. The Horizontal inlet Filter/Separator and Oil Coalescer filters should be changed if the pressure drop exceeds 50 kPag/ 7 psig (at running temperature).

The bearing and mechanical seal filter should be changed if the pressure drop exceeds 240 kPad/ 35 psid (at running temperature). Isolate and bleed/vent the filter housing prior to changing the filter. Failure to properly vent the housing prior to opening may cause injury.

The rotor injection filter should be changed if the pressure drop exceeds 76 kPad/ 11 psid (at running temperature). Isolate and bleed/vent the filter housing prior to changing the filter. Failure to properly vent the housing prior to opening may cause injury.

The package is equipped with a Y-Strainer, the strainer should be cleaned if the pressure drop exceeds 28 kPad/ 4 psid (at running temperature).

Glycol

Glycol must be installed prior to start-up as follows:

- Use a mixture of 50/50 ethylene glycol/water for all cooling systems.
- Open all appropriate valves in the glycol loop. The glycol can then be pumped into the system until a level has been established in the glycol storage tank.
- Because of the high risk of trapping air in the system, a procedure of running the pump until the tank storage level remains constant should be followed.
- Monitor the pump discharge pressure. If no pressure rise occurs there is a possibility that the pump is vapour locked and therefore the air shall be removed to prevent pump damage.
- Monitor the pump for excessive noise, which would likely be due to cavitation. Noise level should moderate once a steady flow is achieved.

Compressor Oil

Verify that an oil flush has been completed prior to start-up. The compressor is sensitive to particulates in the oil. Consult Enerflex Systems Ltd. for the required procedure if it has not been done. Following this flush, charge the system to the normal operating level.

- Care should be taken not to overfill the separator.
- **The compressor oil must be allowed to warm to at least 60°F/16°C prior to starting. The high viscosity of the cold oil may cause a low or no flow condition, which may damage the compressor.**
- Ariel rotary compressors are equipped with hydrodynamic journal bearings which require lubrication prior to starting. A maximum of 2-gallons is all that is required for proper lubrication, excessive lubrication will cause flooding of the gearbox and may damage the journal bearings. The compressor must be prelubed for the initial startup, and again, only if the compressor has been down for 8-hours. Refer to the Ariel Booster Compressor Control Overview for prelube sequence and permissives, located in the Control Panel section of this manual.
- The Ariel screw compressor is equipped with a mechanical shaft seal that uses oil to prevent gas leakage although a small amount of liquid seepage is to be expected. The drip tube from the mechanical seal should be tubed to a small pot and monitored for excessive leakage regularly.
- The compressor uses a manual throttling (globe) valve to adjust flow to the rotors in order to maintain the required minimum gas discharge temperature. Reducing the rotor injection oil flow will raise the discharge gas and oil temperature.
- The package is equipped with a bearing and mechanical seal oil supply pump. Monitor the pump discharge pressure. If no pressure rise occurs there is a possibility that the pump is vapour locked and therefore the air shall be removed to prevent pump damage.
- Monitor the pump for excessive noise, which would likely be due to cavitation. Noise levels should moderate once a steady flow is achieved.

Compressor Control

To maintain high compressor efficiency, the Ariel compressor uses two independent control devices. The inlet volume (capacity) and discharge volume or volume ratio (V_i) control positions are adjusted independently, which allows for V_i optimization during full and reduced capacity conditions.

Although maintained independently, the internal bypassing (capacity control) works together with variable (V_i) to maintain high part load efficiency.

- The Ariel rotary screw compressor uses a hydraulically actuated capacity control system. Compressor bearing oil pressure is used to move the sliding plate (capacity control) from 40% (minimum capacity) to 100% (full load). Oil contained within the hydraulic cylinder is used to hold the plate in a given position. The travel position of the slide plate is determined by a feedback signal from a position transmitter mounted on the hydraulic cylinder. Refer to the Ariel Technical Manual for more information regarding the capacity control.

Note: The linear displacement position indicator originally supplied with the compressor has been replaced with a position transmitter. Information regarding this transmitter is located in the Compressor Vendor Information section of this manual.

- The Ariel rotary screw compressor uses a hydraulically actuated variable (V_i) system. This system can vary the internal volume ratio to save power for operating conditions. Compressor bearing oil pressure is used to move the sliding plate (V_i control) between 2.5 V_i (minimum) and a 5.0 V_i (maximum). Oil contained within the hydraulic cylinder is used to hold the plate in a given position. The travel position of the slide plate is determined by a feedback signal from a position transmitter mounted on the hydraulic cylinder. Refer to the Ariel Technical Manual for more information regarding the volume ratio (V_i) control.

Note: The linear displacement position indicator originally supplied with the compressor has been replaced with a position transmitter. Information regarding this transmitter is located in the Compressor Vendor Information section of this manual.

- Both inlet volume (capacity) and volume ratio (V_i) have visual position indication. The position travel scale nameplates on the hydraulic cylinders provide visual indication of the slide plates travel positions.
- Prior to starting, the capacity slide plate should be set to the minimum capacity position (40%).
- Prior to starting, the volume ratio slide plate should be set to the maximum volume ratio position (5.0 V_i).

After the compressor and driver are warmed up, compressor speed, V_i and capacity control are used to load the available driver horsepower. This will be controlled automatically by the PLC. Refer to the Ariel Booster Compressor Control Overview and Ariel Technical Manual sections of this manual for more information regarding compressor control.

Control System

The control system logic must be checked prior to start-up.

- Ensure all electrical connections are tightened and in good condition prior to commissioning.
- All system trip switches must be pre-set and tested for logic and function prior to start-up.
- Ensure that all functions of the control panel, end device settings and actions have been tested prior to start-up. This should include a complete point-to-point function test of each end device and associated wiring.
- All fire and gas shutdown-monitoring systems should be checked and functioning before starting the package.
- Refer to the panel section of this manual for the sequence of operation.

Initial Starting

This procedure is based upon the assumption that all Pre-Start-Up procedures have been completed, screw oil and glycol have been added, controls were pre-set and the control panel has been logic and function tested.

Start-up Checklist

Ensure the following have been done prior to bumping the driver.

1. Compressor screw oil filled to proper level.
2. Engine lubrication added.
3. Jacket water loop filled to appropriate level with 50/50 ethylene glycol/water.
4. Engine turbo/compressor lube oil water loop filled to appropriate level with 50/50 ethylene glycol/water.
5. All equipment is clear of loose items.
6. All bearings are properly lubricated.
7. Driver and equipment hold down bolts are aligned and tight.
8. All valves and controls are in the proper operating position.
9. Screw compressor oil is warm.

Starting

The compressor is equipped with a PLC based control panel. Refer to the panel section of this manual and initiate the sequence of operation.

Check the control panel to ensure all shutdowns are cleared. Reset as required.

The engine must be allowed to warm at low idle for about 10 minutes. The compressor should be unloaded to minimum capacity and set at maximum V_i .

After warming the engine and ensuring that all machinery is running properly, the compressor can be loaded to 60 percent of the compressor maximum flow rate. The compressor should operate at this capacity until all the following items have been checked:

1. Screw oil supply pressure and temperature.
2. Glycol pressure and temperature.
3. Oil separator oil level.
4. Compressor, engine and pumps for excess noise and vibration.
5. Compressor and engine pressures and temperatures.
6. Shaft seals.
7. Oil filter pressure differential.
8. All operating pressures and temperatures.

At this point the panel can be set to automatic operation. The capacity control system should be checked and adjusted as necessary. The speed of both capacity (load/unload) and volume ratio (max/min V_i) rate may be set by adjusting the hydraulic capacity control valve on the compressor. Refer to the Ariel Technical Manual, Figure 3-2 on Page 3-12 for more information.

The system should be monitored until the unit has been stabilized. Also ensure the inlet filter, oil separator and oil delivery systems are functioning properly.

In the event of a shutdown, the cause must be corrected prior to restart. The restart procedure is the same as the start-up procedure listed above.

The compressor oil must be displaced to fully unload the compressor. A gas-driven pump automatically unloads the compressor at shutdown as well as startup.

Note: The compressor may require up to 20 minutes to fully unload after running.

A good deal of skill and care has gone into the design and manufacture of this equipment. Providing these qualities are applied in its operation and maintenance, a long and successful record of production should be obtained.

Should you require any additional information not covered in this manual, please do not hesitate to call or write:

**ENERFLEX SYSTEMS LTD.
4700 - 47 Street S.E.
Calgary, AB
T2B 3R1**

PH #: (403) 236-6800

Attention: Engineering Department

While any immediate operation problems should be reported to the nearest Pamco Service Branch (see inside front cover), we welcome any suggestions which may assist us in continually refining and improving our products.

ENERFLEX

MAINTENANCE INFORMATION

ENERFLEX

MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES - Screw Compressor (Engine Drive)

In situations where a conflict may arise regarding acceptable service intervals, the manufacturers recommendations will be referred to.

Specific instructions pertaining to procedures may be found in the unit manuals. Maintenance must be performed by qualified personnel. In all circumstances, safe work procedures are to be followed in the maintenance, assembly or disassembly of components. Questions regarding unit operation or maintenance can be referred to the Pamco, Division of Enerflex, Parts & Service outlet nearest your location. Compressor performance data supplied with the unit manual identifies specific sold operating conditions. Requests for additional compressor performance information will be directed to Enerflex Systems Ltd. customer service manager.

GROUPS

- 1) Engine Driver
- 2) Compressor
- 3) Cooling System
- 4) Exhaust System
- 5) Process System



MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES - Screw Compressor (Engine Drive)

ENGINE DRIVER ROUTINE MAINTENANCE

Group 1

1/2

ITEM	SERVICE	AS REQ.	DAILY	WEEKLY	MONTHLY / 720 HRS	3 MONTHS / 2500 HRS	6 MONTHS / 4000 HRS	ANNUALLY 8000 HRS
Air Cleaner Filter Element	Clean or Replace	x						
Pre-Cleaner Element	Clean	x						
Oil Bath Air Cleaner	Oil Change					Seasonal		
Exhaust Backpressure	Check					x		
Intercooler Cores	Visual Check							x
Turbochargers	Inspect						x	
Crankcase Oil Level	Check		x					
Crankcase Pressure	Check					x		
Crankcase Breather	Clean						x	
Oil Pressure Setting	Verify					x		
Crankcase Oil Pick-up Screens	Clean							x
Oil Pan	Clean Sump							x
Governor Oil Level	Check		x					
Eng. Oil (Continuous Duty)	Oil Analysis				x			
Eng. Oil (Continuous Duty)	Oil Change	x			x			
Oil Filter Elements	Change	At Oil Change						
Magnetic Lube Oil Strainer Element	Clean	At Oil Change						
Oil Cooler (Oil Side)	Drain	At Oil Change						
Hydraulic Governor Oil	Change						x	
Main and Rod Bearings	Inspect							x
Air Starter Lubricator	Check Level		x					
Prelube Motor Reservoir Level	Check		x					
Ignition Timing	Check/Verify				x			
Spark Plugs - Dependent upon Type of Service	Clean/Gap/ Replace	x			x	x		
Control Rod Ends & Linkage	Lubricate	x		x				
Governor Rod Ends	Lubricate			x				
Cylinder Compression	Check					x		
Ignition Cables, Primary & Secondary Connections	Inspect					x		
Prechamber Regulator	Adjust					x		

ENERFLEX

MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES - Screw Compressor (Engine Drive)

Group 1

2/2

ITEM	SERVICE	AS REQ.	DAILY	WEEKLY	MONTHLY / 720 HRS	3 MONTHS / 2500 HRS	6 MONTHS / 4000 HRS	ANNUALLY 8000 HRS
Main Chamber Regulator	Check/Adjust					x		
Prechamber Regulator Filter	Clean or Replace						x	
Main Chamber Regulator Filter	Clean or Replace						x	
Valve Cover Gasket	Replace							x
Governor-Synchronizer or Speed Control	Adjust						x	
Admission Valve Assembly	Clean or Replace	x				x		
Admission Valve O-ring	Replace					x		
Carburetor, Air-Gas Valve	Clean/Inspect						x	
Carburetor, Diaphragm	Inspect						x	
Governor Compensating Needle Valve	Adjust As Required						x	
Carburetor, Air-Gas Valve	Replace	x						
Carburetor, Diaphragm	Replace							x
Magneto Drive Disc	Replace						x	
Cooling System Level	Check		x					
Cooling Water Analysis	Check							x
Cooling System Thermostats	Remove & Test							x
Cooling System Tube Bundle	Clean							x
Engine Mounting & Align.	Check						x	

ENERFLEX

MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES - Screw Compressor (Engine Drive)

COMPRESSOR ROUTINE MAINTENANCE

Group 2

1/1

ITEM	SERVICE	AS REQ.	DAILY	MONTHLY	ANNUALLY	20,000 HOURS
Mechanical Seal	Check leak rate		X			
Oil Separator Level	Check Level		X			
Oil filter differential	Check		X			
Oil Sample		X		X		
Oil pressure	Check		X			
Oil Leaks	Repair	X				
Rotor Casing Noise		X	X			
Rotor Casing Vibration				X		
Slide valve position	Note		X			
VI setting	Note		X			
Hold down bolt torque	Check				X	
Coupling Alignment	Check				X	
Oil Cooler	Check Internal Cleanliness / Condition				X	
Thrust Bearing	Change This is based on the oil analysis and the efficiency of the inlet gas filtering conditions.					X
Rotor Bearing	Change This is based on the oil analysis and the efficiency of the inlet gas filtering conditions.					X



**MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES
- Screw Compressor (Engine Drive)**

COOLING SYSTEM ROUTINE MAINTENANCE

Group 3

1/1

ITEM	SERVICE	AS REQ.	DAILY	WEEKLY	MONTHLY / 720 HRS	3 MONTHS / 2500 HRS	6 MONTHS / 4000 HRS	ANNUALLY 8000 HRS
Guard/Screens	Check		x				x	
Finned Cooler Tubes	Ext. Cleaning	x						x
Louvres	Inspect						x	
Actuators/Linkages	Check & Lubricate				x			
Fan Blade Pitce	Seasonal Setting	x						
Fan Hub Blade Retainers	Check						x	
Fan Blades	Inspect						x	
Fan Hub Taper Lock	Check						x	
Fan Shaft Bearings	Grease			x				
Drive Belts	Check				x			
Drive Couplings	Check					x		
Electric Motor Drive	Check Mounts						x	

EXHAUST SYSTEM ROUTINE MAINTENANCE

Group 4

1/1

ITEM	SERVICE	AS REQ.	DAILY	WEEKLY	MONTHLY / 720 HRS	3 MONTHS / 2500 HRS	6 MONTHS / 4000 HRS	ANNUALLY 8000 HRS
System Backpressure	Check				x			
Exhaust Insulation	Inspect							x
System Man Guards	Check				x			
Moisture Traps	Check			x				
Muffler/Mounts	Check				x			
Silencer/Mounts	Check				x			
Uninsulated Expansion Bellows	Visual Check		x					
Flanged Connections	Check Bolt Torque						x	



**MAINTENANCE GUIDELINES FOR COMPRESSION PACKAGES
- Screw Compressor (Engine Drive)**

PROCESS SYSTEM ROUTINE MAINTENANCE

Group 5

1/1

ITEM	SERVICE	AS REQ.	DAILY	WEEKLY	MONTHLY / 720 HRS	3 MONTHS / 2500 HRS	6 MONTHS / 4000 HRS	ANNUALLY 8000 HRS
in-Line Screens	Clean	x						
Inlet Separator Filters	Replace	x						
Scrubber Dumps (Auto)	Activate Manually			x				
Scrubber Drain Valve	Manually Drain				x			
Temperature Indicators	Check Calibration						x	
Suction/Discharge Block Valves	Exercise/Grease						x	
PSV's	Service							x
PSV Flexline Connections	Inspect							x
Vibration/Pulsation	Monitor	x						
Suction/ Discharge Bottle Flange Torque	Check						x	
Flanged/Screwed Connections	Leak Check					x		
Vessel Hold Down Bolt Torque	Check						x	
Piping Flange Torque	Check						x	
Pip Clamps/Brackets	Check						x	
Skid Anchor Bolt Nut - Check After 100 Hours of Initial Operation Following Commissioning.								

ENERFLEX

COMPRESSOR

ARIEL
Heavy Duty
Oil Flooded Twin Screw
Rotary Compressors

Technical Manual
For Models:

RG282M and RG357M



ARIEL CORPORATION
35 BLACKJACK ROAD, MOUNT VERNON, OHIO 43050
TELEPHONE: 740-397-0311 FAX: 740-397-3856
VISIT OUR WEB SITE: www.arielcorp.com

REV: 4/06

CAUTION

GAS COMPRESSOR UNITS ARE COMPLICATED AND DANGEROUS PIECES OF EQUIPMENT, IF YOU ARE NOT FULLY TRAINED AND FAMILIAR WITH THEIR OPERATION.

BEFORE STARTING THIS UNIT:

FAMILIARIZE YOURSELF WITH THE UNIT.

READ AND STUDY START-UP AND SHUT-DOWN INFORMATION FOR BOTH PACKAGE AND COMPRESSOR CAREFULLY!

A GAS/AIR MIXTURE UNDER PRESSURE CAN EXPLODE! YOU CAN BE SEVERELY INJURED OR KILLED. MAKE SURE THE COMPRESSOR IS SUFFICIENTLY PURGED OF ANY EXPLOSIVE MIXTURE BEFORE LOADING.

AFTER COMPLETING THE ABOVE, BEGIN PROPER STARTING PROCEDURE.



CAUTION

DO NOT ATTEMPT TO START-UP UNIT WITHOUT REFERRING TO THIS MANUAL SECTION 3 - "START UP". IT IS ALSO ESSENTIAL TO REFER TO THE PACKAGER'S OPERATING MANUAL.

CAUTION

THIS MANUAL EDITION IS BASED ON THE CURRENT DESIGN AND BUILD PRACTICES. THIS MANUAL MAY NOT BE APPLICABLE TO EQUIPMENT BUILT PRIOR TO THE DATE ON FRONT COVER AND IS SUBJECT TO CHANGE WITHOUT NOTICE. CONTACT ARIEL WITH ANY QUESTIONS. REFER TO LAST PAGE OF THIS MANUAL FOR CONTACT INFORMATION.



WHEN THIS SYMBOL APPEARS ON THE COMPRESSOR OR CONTROL PANEL, THIS TECHNICAL MANUAL IS TO BE CONSULTED FOR SPECIFIC INFORMATION BEFORE PROCEEDING. IF MORE INFORMATION IS NEEDED CONTACT YOUR PACKAGER AND/OR ARIEL CORPORATION.

TABLE OF CONTENTS

Design Specifications & Data	1-1
General	1-1
Compressor Operating Theory	1-4
Compressor Capacity Control Theory	1-5
Specifications	1-7
Product Information and Safety Plates	1-11
Fastener Tightening Torque	1-13
Tightening Torque Procedures	1-13
Ariel Bolting	1-15
Alarm & Shutdown (Also Refer To Section 4)	1-15
Gas Discharge High Temperature Settings	1-15
Storage and Transportation of Compressor	1-15
Zone 1 Environment	1-16
 Installation	 2-1
General	2-1
Electrical Grounding	2-1
Procedure For Setting and Aligning	2-1
Setting	2-1
Setting Compressor with an SAE Mounting-Flange	2-3
Setting Compressor w/o a Bell Housing	2-4
Alignment	2-4
Vents and Drains	2-5
Inlet Gas Debris Strainers	2-5
Inlet Gas Liquids and Solids	2-6
Inlet Gas Scrubbers	2-6
 Start Up	 3-1
General	3-1
Start Up Check List	3-2
Maximum Running Pressure (MRP)	3-8
Maximum Relief Valve Setting (MRVS)	3-8
Filling & Priming a Oil Lube Oil System - Before Starting	3-8
Filling The System	3-8
Compressor Control Devices	3-9
Capacity Control (internal recycle)	3-9
Capacity Control Positioning - Hydraulic	3-10
Capacity Control Theory of Operation - Hydraulic	3-11
Procedure for Adjusting Capacity Loading & Unloading Speed	3-12
Capacity Control Positioning - Hand Wheel	3-12
Capacity Control Theory of Operation - Hand Wheel	3-13
Variable Vi Control	3-14
Variable Vi Positioning - Hydraulic	3-14

Variable Vi Positioning Theory of Operation - Hydraulic	3-14
Variable Vi Positioning - Hand Wheel	3-15
Variable Vi Theory of Operation - Hand Wheel	3-16
Visual Position Indicator - Capacity Control & Vi	3-16
Position Indicator - Hydraulic Visual	3-16
Position Indication - Hand Wheel	3-16
Slide Plates Positioning at Start-up	3-17
Thrust Balance System	3-17
Gas/Oil Separator Coalescing Filter	3-17
Gas/Oil Separator Minimal Differential Pressure Requirement	3-17
Scavenged Gas/Oil Line Flow Adjustment	3-17
Oil System, Lubrication & Venting	4-1
General	4-1
Lubricants	4-2
Warranty	4-3
Petroleum Based Oils - also referred to as mineral oils:	4-6
Synthetic Lubricants	4-6
Associated Equipment	4-7
Gas/Oil Separator and Coalescing Filter	4-7
Oil Cooler	4-7
Thermostatic Temperature Control Valve	4-8
Cold Ambient Temperatures	4-8
Prelube Pumps	4-9
Integral Oil System	4-9
General	4-9
Rotor Injection Oil Flow	4-9
Pumped Oil Flow	4-10
Integral Oil System - Major Components	4-10
Lube Oil Strainers - Reference Figure 4-3 & Figure 4-4	4-10
Rotor Injection Check Valve	4-11
Rotor Injection Temperature Control Valve	4-12
Oil Filters	4-12
Liquids and Solid Contaminants in Gas	4-12
Oil Pressure Regulating Valve	4-13
Compressor Oil Pump	4-14
Compressor Oil System Pressure Calculations	4-14
Compressor Re-Application	4-15
Lube Oil Shutdowns	4-15
Pressure:	4-15
Temperature:	4-16
Hydraulic Control Actuation & Cylinders	4-16
Flushing Requirements	4-17
Maintenance	5-1
General Introduction	5-1
Mechanical Seal	5-2

Replacing the Mechanical Seal	5-3
Capacity Control Devices	5-7
Hand Wheel Control Removal	5-7
Hydraulic Control Removal	5-7
Capacity Control Cavity Cleanout	5-8
Vi Control Sliding Valve Plate Removal	5-9
Hydraulic Actuated Control	5-10
Hand Wheel Actuated Control Position Indication	5-11
Oil Pump and Geared Tooth Coupling	5-11
Oil Pump Replacement	5-11
Oil Pump Coupling Replacement	5-12
Drive Gear Set Replacement	5-13
Gearbox Removal with Bell Housing Flange Mounting	5-13
Gearbox Removal without Bell Housing Flange Mounting	5-14
Gearbox Removal (continued) - with or without Bell Housing	5-14
Gear Set Removal	5-16
Gear Set Installation	5-18
Re-Installing the Gearbox	5-20
Re-Couple Compressor to Driver	5-21
Check Oil Pump Change Requirements	5-22
Old Gear Set and Oil Pump - Handling and Storage	5-22
Oil Filters	5-22
Oil Pressure Regulating Control Valve	5-23
Installation	5-23
Adjusting Oil Pressure Regulating Control Valve	5-23
Ethylene Glycol Contamination	5-23
Mineral Deposit Build-up in Low Pressure Natural Gas Applications	5-24
Technical Assistance	6-1
Recommended Maintenance Intervals	6-1
Daily	6-1
Monthly (in addition to Daily Requirements)	6-2
Every 6 Months or 4,000 Hours (plus Daily/Monthly)	6-2
Yearly or every 8,000 Hours (plus Daily/Monthly/6 Months)	6-2
Trouble Shooting	6-3
Appendices	7-1
Ariel Tools	7-1
Ariel Furnished Tools	7-1
Ariel Tools - Purchased Separately	7-6
Hand Tools Required	7-6
Terms, Abbreviations and Conversion to SI Metric	7-7
Area	7-7
Flow - Gas	7-7
Flow - Liquid	7-8
Force	7-8
Heat	7-8

Length 7-8
Mass 7-8
Moment or Torque 7-8
Power 7-8
Pressure or Stress 7-8
Speed 7-9
Temperature 7-9
Time 7-9
Viscosity 7-9
Volume 7-9
Other Abbreviations 7-9
Gas Analysis Common Abbreviations 7-16
Metric Factors 7-17
Technical and Service Schools on Ariel Compressors 7-17
Ariel Customer Technical Bulletins (Formerly Ariel Newsletters) 7-17
Vender Literature 7-17
Ariel Telephone, Fax, E-Mail and Web Site Numbers 7-18

SECTION 1 - DESIGN SPECIFICATIONS & DATA

General

Ariel compressors are designed for ease of operation and maintenance. Experience has shown that an Ariel compressor will normally provide years of satisfactory performance with minimal proper maintenance.

While Ariel rotary compressors share many similarities, each model has aspects that are unique to the particular model type. The RG series compressors are specifically designed for the natural gas gathering market, where the majority of Ariel compressors are applied.

If you, as an operator, are familiar with Ariel rotary compressors, it is still important to review this manual to determine the differences. If you are new to Ariel rotary compressors, it is critical that you become very familiar with this manual prior to operating the compressor. Rotary compressors are precision rotating equipment, requiring knowledgeable operation and maintenance.

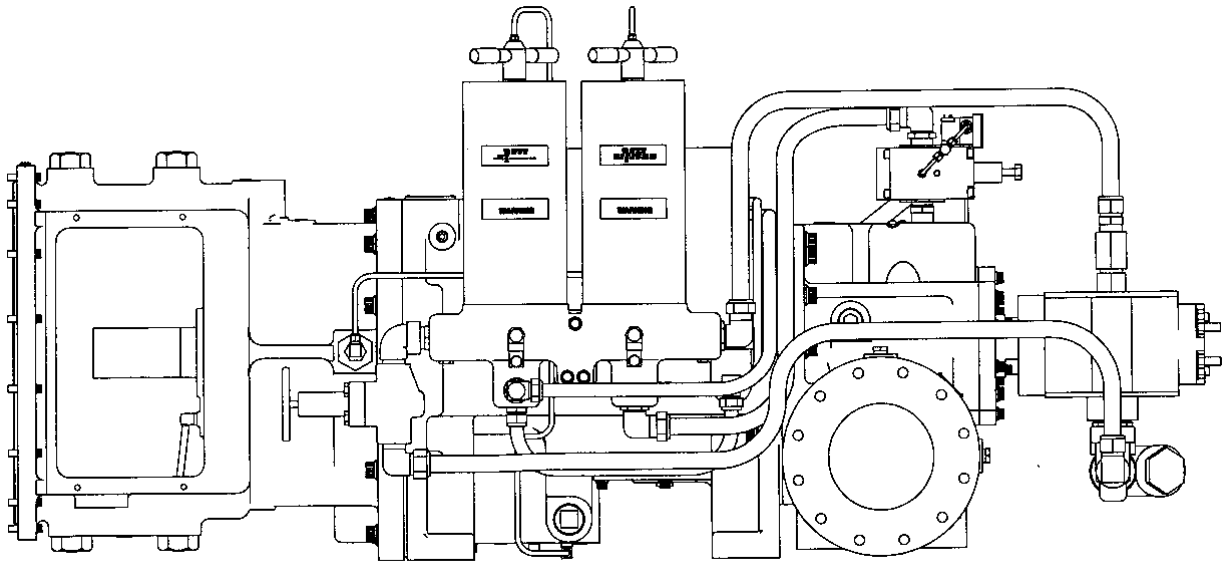


FIGURE 1-1: INTEGRAL OIL SYSTEM AND BELL HOUSING MOUNTING - DISCHARGE SIDE VIEW

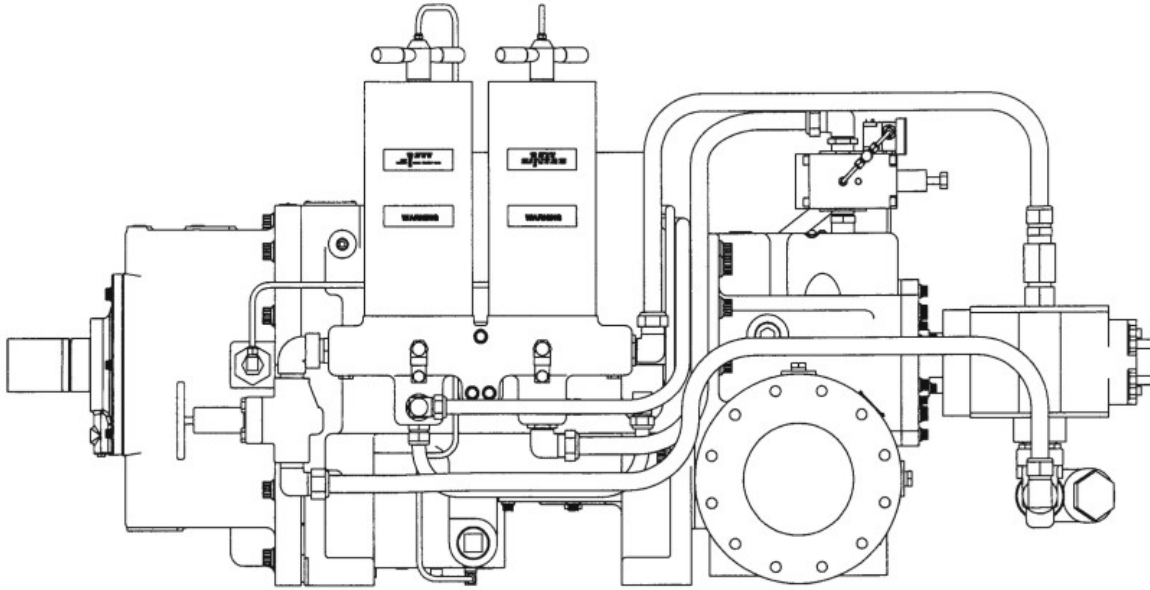


FIGURE 1-2: INTEGRAL OIL SYSTEM AND W/O BELL HOUSING - DISCHARGE SIDE VIEW

Ariel rotary compressors feature positive displacement, single stage, oil-flooded, twin screw rotors, designed primarily for natural gas gathering, but have applications for other gases. Heavy duty babbitted journal bearings, anti-friction rolling element thrust and jack shaft bearings, variable volume ratio (V_i) at full and partial load conditions, variable capacity control and changeable speed increasing gears allow RG rotary compressors to operate in a wide variety of gas applications.

NOTE: VOLUME RATIO (V_i) IS THE VOLUME OF GAS, IN ACTUAL VOLUME, AT THE POINT WHERE COMPRESSION BEGINS, DIVIDED BY THE VOLUME OF GAS, AT THE END OF COMPRESSION. $V_i = V_s/V_d$.

Rotary compressors have few moving parts, can run at high rotating speeds, can accommodate a wide range of compression ratios, and operate with minimum pressure pulsations. They are generally applied in low suction pressure applications, discharging into medium pressure lines. To maintain high compressor efficiency, care should be taken to operate the compressor with the volume ratio (V_i) adjusted as close as possible to the required V_i .

NOTE: REQUIRED $V_i = (P_d/P_s)^{1/K}$, WHERE
PD = DISCHARGE PRESSURE, ABSOLUTE
PS = SUCTION PRESSURE, ABSOLUTE
K = GAS ISENTROPIC EXPONENT

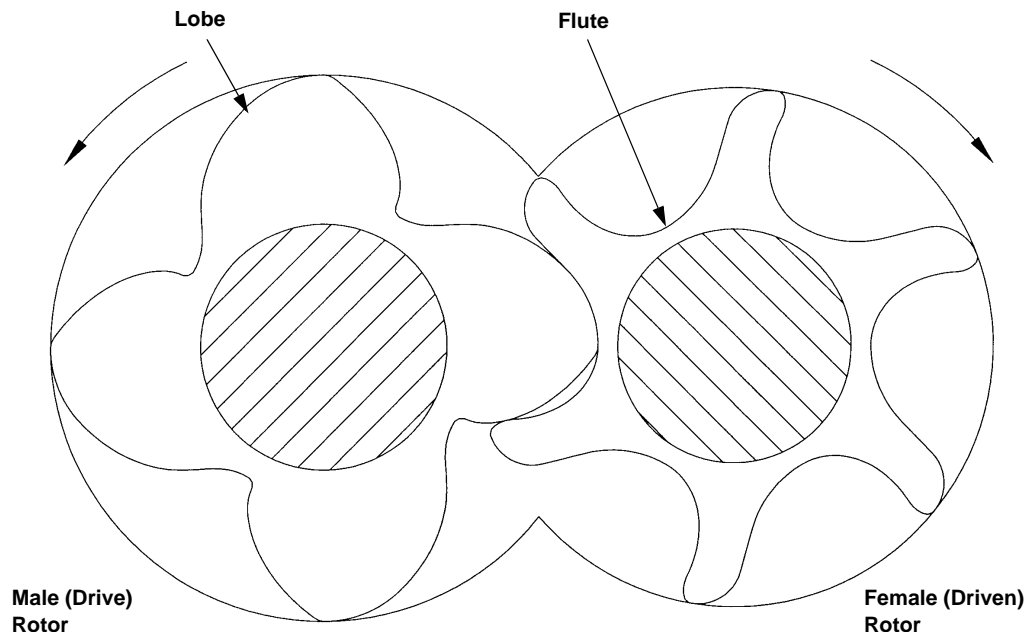


FIGURE 1-3: MALE/FEMALE ROTOR PAIR (4/6 LOBE/FLUTE RATIO) - TYPICAL

RG282M and RG357M compressors are available without bell housing and use all four compressor feet for mounting to the skid, or with bell housing SAE flanges for mounting to the engine and use two feet for mounting to the skid.

Oil is the lifeblood of oil-flooded rotary screw compressors. Catastrophic damage can occur to rotors, bearings, mechanical seal and gears without adequate oil quality, volume and viscosity. Compressor oil selection is based upon process gas composition and contaminants at operating temperatures and pressures. Therefore if gas composition or operating conditions change, the compressor rotating speed, lubrication selection, and gas/oil separator operating temperature must be re-evaluated.

During compressor operation, process gas will always dilute the lubricating oil, reducing viscosity. Liquid and solid contaminants entering with the suction gas stream must be effectively removed to minimize the detrimental affects on the compressor and its oil system. Pressurized oil viscosity should never be allowed to drop below the minimum requirement. Only the oil supplier can predict oil viscosity in its diluted operating condition. Ariel rotary screw compressors are designed for oil flooding of the process gas, with oil separation and recirculation. Packager design and customer oil selection determines the amount of oil carryover (loss) downstream of the gas/oil separator's coalescing filter.

This manual is designed to provide information on installation, start up, operation, maintenance and troubleshooting of an RG compressor. If you have any questions, please contact your Packager. If they are unable to provide resolution, they will refer your concerns to Ariel Corporation. If you prefer, you may always contact Ariel directly, refer to "Ariel Telephone, Fax, E-Mail and Web Site Numbers" on Page 7-18.

This manual provides design specifications for standard current production equipment at the

publication date. Do not exceed information nameplate ratings for a particular compressor.

The data shown on the Information Plates is very important when communicating questions concerning an Ariel compressor.

NOTE: USE SERIAL NUMBERS IN ALL CORRESPONDENCE. REFERENCE FIGURE 1-9 ON PAGE 1-11.

NOTE: INSTALLED SPEED INCREASING GEAR RATIO CAN BE DETERMINED FROM THE GEARBOX HOUSING INFORMATION PLATE.

NOTE: THE ROTARY COMPRESSOR OFFERS TWO OPTIONS FOR CAPACITY AND VOLUME RATIO (VI) CONTROL: HYDRAULIC AND HANDWHEEL.

The various rotary compressor control configurations are shown in Figure 1-5 on Page 1-9, Figure 1-6 on Page 1-9, Figure 1-7 on Page 1-10, and Figure 1-8 on Page 1-10.

Compressor Operating Theory

Ariel developed the 282 mm (11.10 inch) and 357 mm (14.06 inch) male rotor diameter oil-flooded rotary screw compressors specifically for low pressure natural gas service. RG compressors are integrally geared, with interchangeable speed increasing gear sets, to load driver horsepower based upon application requirements.

The rotary compressor's oil-flooded, twin screw design consists of a male rotor which drives the female rotor. The male rotor lobes drive the female rotor flutes, as in a helical gear set. The female rotor speed is linked to the male rotor set through the ratio of male lobes to female flutes (4/6). An optional oil pump is directly coupled to the auxiliary end of the female rotor. Rotor tip speeds are generally between 49 to 197 ft/sec (15 to 60 m/sec).

The male rotor is driven through an integral speed increasing gear set. The compressor and the gearbox share a common oil system. To accommodate a wide application range, gear ratios range from 1:1.029 to 1:2.240 speed increasing for the RG282M compressor and 1:1.000 to 1:2.667 for the RG357M compressor. The compressor's input pinion gear is driven by a bull gear mounted on a jack shaft, that is coupled to the prime mover (engine or motor).

As the compressor's twin rotors un-mesh, at the top, the rotor flutes are exposed to the suction gas stream and filled with gas. As the rotors turn out, the flutes are closed and sealed by the rotor housing, creating spiral segmental compression chambers that move gas axially toward discharge. Oil is injected into the compression chambers, after they close off from the suction pressure, to provide sealing, cooling and lubrication. The rotor meshing, at the bottom, progressively reduces each compression chamber's volume axially, thereby increasing gas/oil mixture pressure. Rotor rotation progressively exposes the compression chambers to the discharge port, moving the compressed gas/oil mixture out of the compressor.

Discharge piping carries the compressed gas/oil mixture to a degassing vessel where the oil is separated from the process gas using gravity separation and a coalescing filter. The oil is

pipled to a cooler and re-circulated to the compressor. See Figure 4-1 on page 4-4 and Figure 4-2 on page 4-5.

Refer to Ariel's "Oil Flooded Rotary Compressor Theory of Operation" and "RG282 Features and Operating Theory" videos, available on CD from Ariel on request, for more details.

Compressor Capacity Control Theory

The compressor's rotor length, diameter, lobe/flute combination and rotating speed determine full load capacity. The selected capacity control position determines inlet volume (V_s), while the selected volume ratio (V_i) determines internal compression ratio. Capacity control positioning provides variable part load capacities. Seven speed increasing gear set choices are available for each compressor model. Depending upon the gear option chosen, the compressor's maximum rotating speed and corresponding full load capacity can be adjusted to load available driver horsepower when operating conditions change. The gear sets are "field" changeable by replacing the bull/pinion gears as a set with a gear ratio appropriate for the conditions. The gear set can be replaced in a properly equipped shop.

The RG series has separate inlet volume (capacity) and discharge volume (volume ratio, V_i) control devices, instead of using a traditional slide-valve. To maintain high compressor efficiency for varying application pressures, RG compressors have independent capacity and volume ratio controls which provide volume ratio control for both full and reduced capacity conditions. The capacity and V_i controls are actuated separately, but move in concert to optimize compressor efficiency with changing conditions. Hydraulically actuated capacity and V_i controls are typically adjusted within the driver's horsepower and speed range using a programmable logic controller (PLC) along with compressor package feedback. Manually actuated capacity and V_i controls are typically adjusted by an operator to meet the driver's optimal horsepower and speed range for the operating conditions encountered.

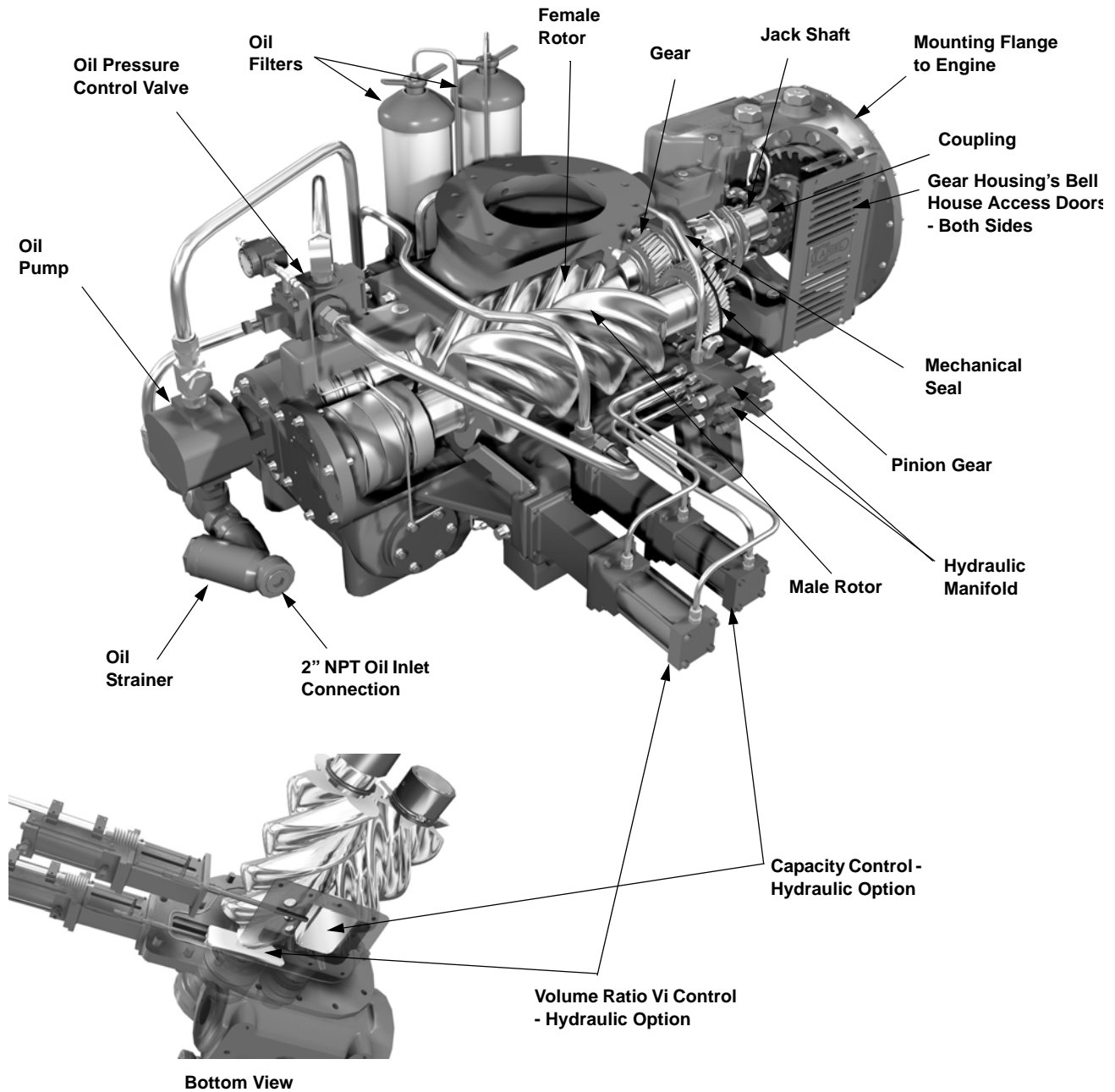


FIGURE 1-4: CROSS-SECTION - HYDRAULIC CONTROLS - TYPICAL

Specifications

TABLE 1-1: BASIC SPECIFICATIONS^A

MODEL	RG282M	RG357M
Male Rotor Diameter, in. (mm)	11.102 (282)	14.055 (357)
Number of Male Rotor Lobes	4	4
Number of Female Rotor Flutes	6	6
L/D Ratio	2.0	2.1
Max. Input Speed, RPM	1800	1800
Gear Ratios, 7 Speed Increasing	1:1.029, 1.250, 1.433, 1.613, 1.793, 2.037, 2.240	1:1.000, 1.375, 1.567, 1.778, 2.040, 2.304, 2.667
Male Rotor Operating Speed, RPM	1040 to 4065	840 to 3210
Full-Load Inlet Volume Capacity, CFM (m ³ /h)	1070 to 2930 (1818 to 4978)	1320 to 5150 (2243 to 8750)
Rated Horsepower BHP (kW)	800 (597)	1375 (1025)
Suction Pressure, psia (bar _a)	Unconditional 3 to 75 (0.21 to 5.17); Conditional ^b , >75 (>5.17)	Unconditional 3 to 65 (0.21 to 4.48); Conditional ^b , >65 (>4.48)
Maximum Running Pressure, psig (bar _g), Discharge	230 (15.86)	230 (15.86)
Maximum Discharge Temperature, °F (°C)	248 (120)	248 (120)
Height - Mounting Feet to Jackshaft, in. (mm)	15.75 (400.1)	18.0 (457.2)
Maximum Height, Mounting Feet to Highest Point ^c , in. (m)	41.8 (1.06)	45.0 (1.14)
Maximum Width ^c , in. (m)	63.2 (1.61)	72.1 (1.83)
Maximum Length ^c , in. (m)	w/o Bell Housing 85.1 (2.16); SAE "0" 91.1 (2.31)	w/o Bell Housing 97.2 (2.47); SAE "00" 109.0 (2.77)
Approximate Weight with Oil Pump & Integral Oil System & Hydraulic Controls, lb. (kg)	w/o Bell Housing 4825 (2200); SAE "0" 5250 (2400)	w/o Bell Housing 9000 (4100); SAE "00" 9850 (4475)
Volume Ratio, (Vi) Adjustable Range ^d	2.5 to 5.0	2.5 to 5.0
Oil Filter - Bearing, Seal & Gears, β ₆ = 200; 99.5% efficiency rating at removing particles 6 μm & larger	6 micron	6 micron
Oil Filter - Rotor Injection, β ₁₆ = 200; 99.5% efficiency rating at removing particles 16 μm & larger	16 micron	16 micron
Recommended Oil Retention in Gas/Oil Separator ^e	2 minutes	2 minutes

a. For more details see the Electronic Databook, available in the Ariel Performance Program.

b. Higher suction pressure may be allowed under limited conditions. Contact Ariel Applications Engineering for Approval.

c. See the Ariel Outline Drawings for more dimensional details.

d. Hydraulic or handwheel actuated controls options available.

e. Per API-619, actual retention time depends on separator design.

TABLE 1-2: HANDWHEEL TURNS VS. CAPACITY CONTROL POSITION

RG282M			RG357M		
CAPACITY HANDWHEEL POSITION	TRAVEL, IN. (mm)	LOAD PERCENTAGE	CAPACITY HANDWHEEL POSITION	TRAVEL, IN. (mm)	LOAD PERCENTAGE
Clockwise to Full Stop	0	100%	Clockwise to Full Stop	0	100%
10 Turns from 100%	0.8 (19)	90%	12 Turns from 100%	0.9 (23)	90%
21 Turns from 100%	1.6 (41)	80%	24 Turns from 100%	1.8 (47)	80%
31 Turns from 100%	2.4 (61)	70%	36 Turns from 100%	2.8 (70)	70%
41 Turns from 100%	3.1 (79)	60%	48 Turns from 100%	3.7 (94)	60%
52 Turns from 100%	4.0 (102)	50%	60 Turns from 100%	4.6 (117)	50%
(62 Turns) Counter-Clockwise to Full Stop	4.7 (119)	40% (Minimum)	(72 Turns) Counter-Clockwise to Full Stop	5.5 (141)	40% (Minimum)

NOTE: TURN HANDWHEEL COUNTER-CLOCKWISE TO REDUCE CAPACITY (UNLOAD) AND CLOCKWISE TO INCREASE CAPACITY (LOAD).

TABLE 1-3: HANDWHEEL TURNS VS. VARIABLE VOLUME RATIO (Vi) POSITION

RG282M			RG357M		
Vi HANDWHEEL POSITION	TRAVEL, IN. (mm)	Vi	Vi HANDWHEEL POSITION	TRAVEL, IN. (mm)	Vi
Clockwise to Full Stop	0	2.5	Clockwise to Full Stop	0	2.5
12 Turns CCW	0.9 (24)	3.0	17 Turns CCW	1.3 (32)	3.0
25 Turns CCW	1.9 (45)	3.5	33 Turns CCW	2.5 (65)	3.5
37 Turns CCW	2.8 (72)	4.0	50 Turns CCW	3.8 (98)	4.0
49 Turns CCW	3.9 (96)	4.5	66 Turns CCW	5.1 (129)	4.5
(62 Turns) Counter-Clockwise to Full Stop	4.7 (119)	5.0	(83 Turns) Counter-Clockwise to Full Stop	6.3 (161)	5.0

NOTE: TURN HANDWHEEL COUNTER-CLOCKWISE TO INCREASE Vi AND CLOCKWISE TO DECREASE Vi.

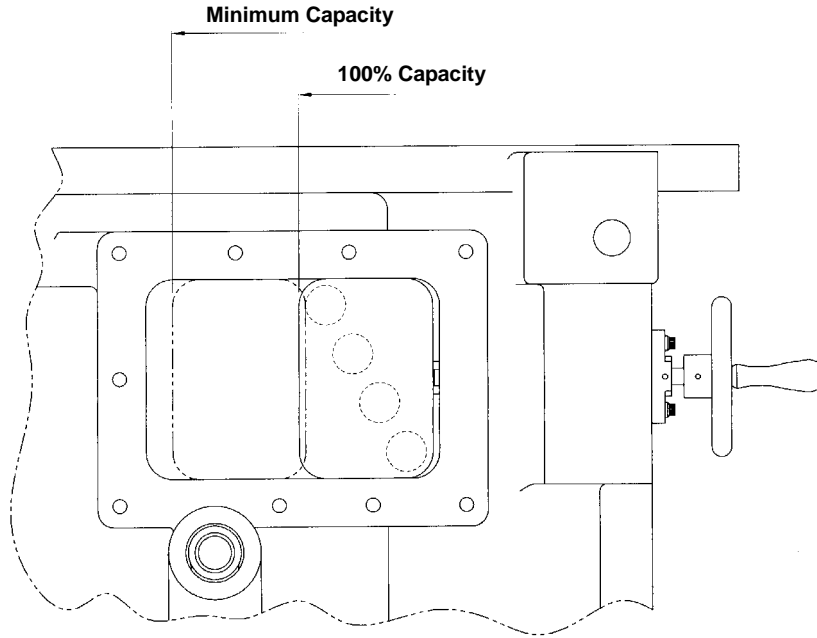


FIGURE 1-5: HANDWHEEL ACTUATED CAPACITY CONTROL - BOTTOM VIEW - TYPICAL

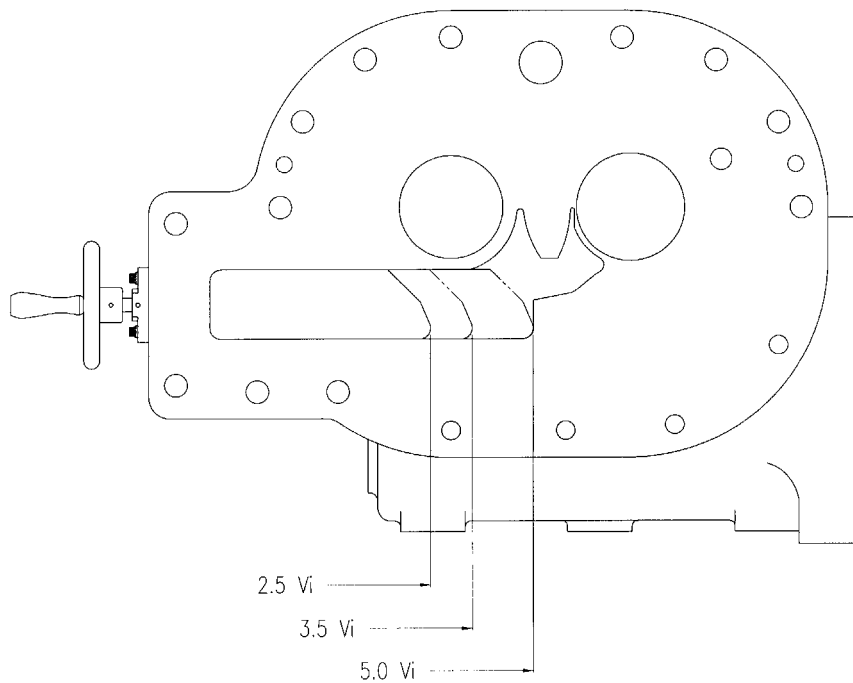


FIGURE 1-6: HANDWHEEL ACTUATED VI CONTROL - DISCHARGE HOUSING - TYPICAL

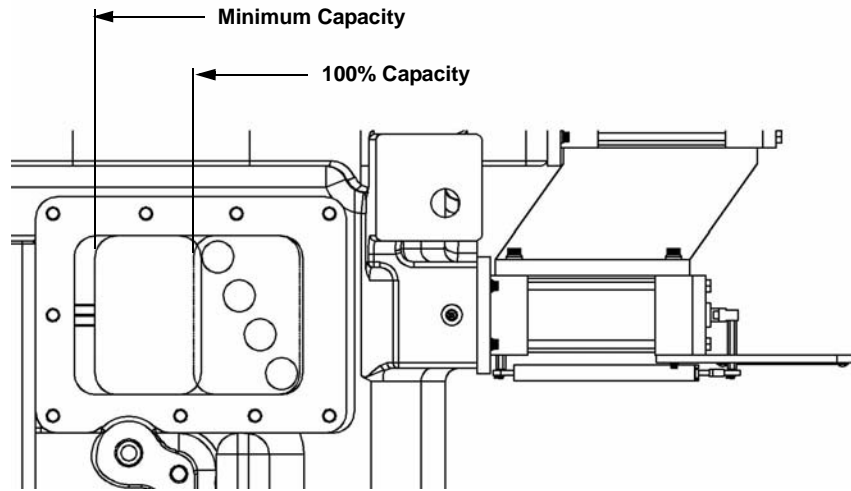


FIGURE 1-7: HYDRAULIC ACTUATED CAPACITY CONTROL - BOTTOM VIEW - TYPICAL

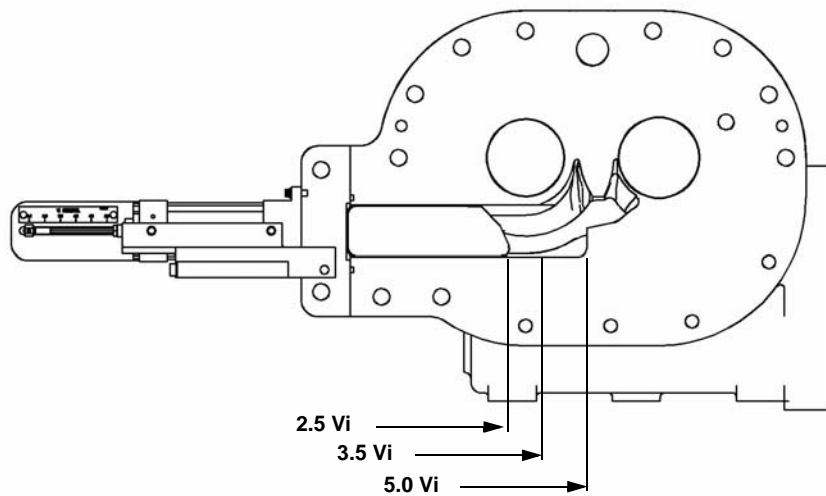


FIGURE 1-8: HYDRAULIC ACTUATED VI CONTROL - DISCHARGE HOUSING - TYPICAL

Product Information and Safety Plates

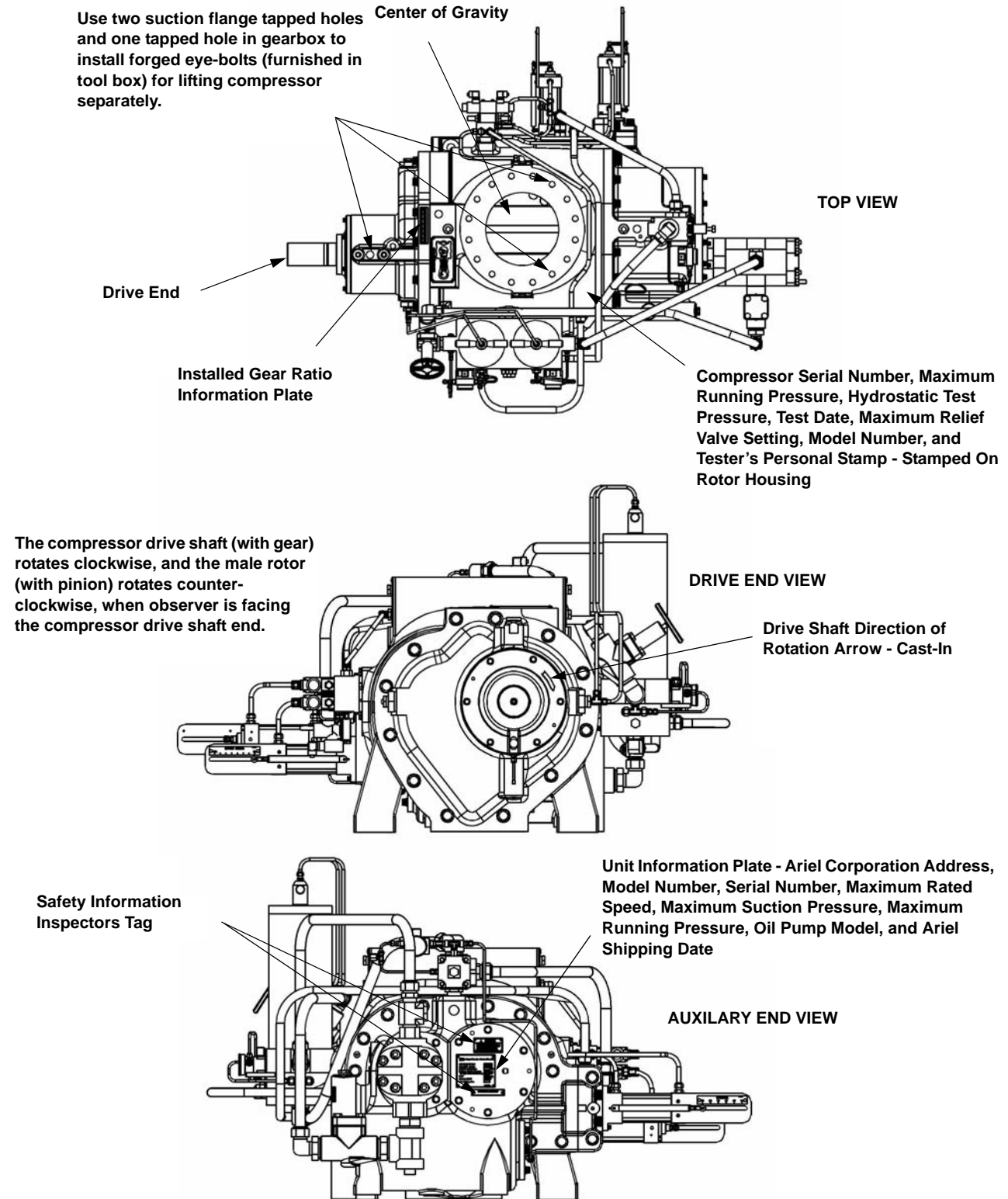


FIGURE 1-9: PRODUCT INFORMATION AND SAFETY - TYPICAL

Important Safety Information

 **CAUTION**

SEVERE PERSONAL INJURY AND PROPERTY DAMAGE CAN RESULT IF PRESSURE SYSTEM IS NOT COMPLETELY VENTED BEFORE LOOSENING THE BOLTS ON FLANGES, HEADS, VALVE CAPS, OR PACKING. CONSULT ARIEL TECHNICAL MANUAL BEFORE PERFORMING ANY MAINTENANCE.

 **CAUTION**

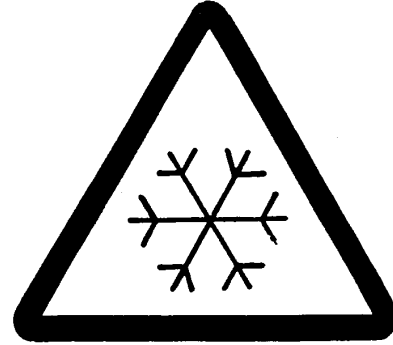
NOISE GENERATED BY COMPRESSION MACHINERY CAN BE A SOURCE FOR HEARING INJURY. SEE PACKAGER'S INFORMATION FOR ANY SPECIFIC RECOMMENDATIONS. WEAR HEARING PROTECTION WHEN UNIT IS RUNNING.

 **CAUTION**

HOT GAS TEMPERATURES ESPECIALLY THE GAS DISCHARGE AREAS, HOT OIL, AND HIGH FRICTION AREAS CAN BE A SOURCE FOR BURNS. WEAR PROPER INSULATION WHEN WORKING AROUND THESE AREAS. SHUT DOWN UNIT AND ALLOW TO COOL BEFORE DOING MAINTENANCE IN THESE AREAS.



CAUTION Hot Surfaces



CAUTION Cold Surfaces

Where these CAUTION symbols appear on the compressor, the surfaces are hot or cold when compressor is operating and can cause injury if touched without proper insulated protective clothing. If servicing the compressor, allow these surfaces to cool or warm to safe temperatures or wear protective clothing before proceeding. When applied to compressor cylinders, the temperature CAUTION applies to all connected piping and equipment.

FIGURE 1-10: HOT & COLD SURFACES - CAUTION SYMBOLS

Fastener Tightening Torque

Listed in Ariel Engineering Reference ER-63.1 are fastener tightening torque values, required for proper assembly of an Ariel RG compressor. ER-63.1 is provided in the toolbox as a laminated chart. ER-63.1 is also available as an electronic document on the Ariel web site.

Threads are to be clean and free of burrs. Check that the threads on the bolts are in good condition to prevent damage to the threaded holes.

Torque values are based on the use of petroleum type lubricants on both the threads and seating surfaces. Use lubricating oil or Lubriplate 630 on threads and seating surfaces, except where Loctite is specified. Molybdenum disulfide lubricants and antiseize compounds are not to be used for fastener lubrication, unless specified, or excessive stresses can result with the listed values.

Tightening Torque Procedures

Listed below are some procedures which make fastener tightening more accurate and will help assure that the proper torque is being applied.

1. Be sure that the torque wrench is properly calibrated and used by qualified personnel to achieve the required fastener tightening torque for all critical parts.
2. Always check to determine over what range the torque wrench is accurate, since most torque wrenches are not accurate over their entire range.
3. Tighten critical multi-bolt assemblies in steps. Tighten each bolt until snug using an alternating (criss-cross) pattern. Next, tighten each bolt to 25 percent of full torque, moving across from bolt to bolt, in a criss-cross pattern. Repeat this step for 50, 75, and 100 percent of full torque.

4. Always apply a slow steady increasing force to a torque wrench handle, do not jerk it. When a torque wrench is jerked the amount of torque applied can be as much as one and a half times the amount set on the wrench. For example, if a wrench is set at 80 lb_f-ft (108 N·m) but is jerked, 120 lb_f-ft (163 N·m) torque can be applied.
5. Always do the final tightening with a torque wrench. Do not tighten the fastener with a ratchet or impact wrench and then “check” the torque with a torque wrench.
6. Do not double tap a torque wrench. Rapidly double tapping a torque wrench will make the torque on the bolt more than what is set by a significant amount.
7. When checking tightened fastener torque, set torque wrench to proper required torque value, slowly apply a steady increasing force to the torque wrench handle until the click is felt.
8. Always reset the torque wrench to its lowest setting when the job is complete. If the torque wrench is left in a high setting the spring in it is stressed and will become inaccurate with time. If the torque wrench is put back to its lowest setting the spring will relax and retain its accuracy.
9. Do not use a torque wrench to break fasteners loose as it may overload the torque wrench and/or cause loss of calibration.
10. For applications requiring the use of a boxed end or crowsfoot type adapter with a torque wrench to reach not readily accessible fasteners, the torque wrench setting will not be the actual torque applied to the fastener.¹
11. The ratio of actual torque at the fastener with that on the wrench scale is a function of the adapter's length and its position in relation to the torque wrench beam and the location on that at which the force is applied, see Figure 1-11 on Page 1-15.

$$T_w = T_a \left(\frac{L}{L + A} \right)$$

T_w = Torque wrench setting, lb x ft or N·m

T_a = Torque required at fastener, lb x ft or N·m

L = Length of wrench, ft or m (from square drive end to center point of force on handle)

A = Length of adapter, ft or m (measured through end of adapter on a line parallel to the center line of the wrench)

These are general guidelines to assist in the proper use of torque wrenches. Consult with your torque wrench dealer for more detailed information.

1. The exception is when the adapter is 90 degrees to the torque wrench. The torque will be the same as on the wrench scale, see Figure 1-12 on Page 1-15.

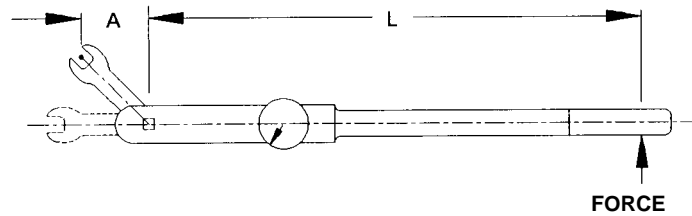


FIGURE 1-11: TORQUE WRENCH WITH ADAPTOR AT ANY ANGLE

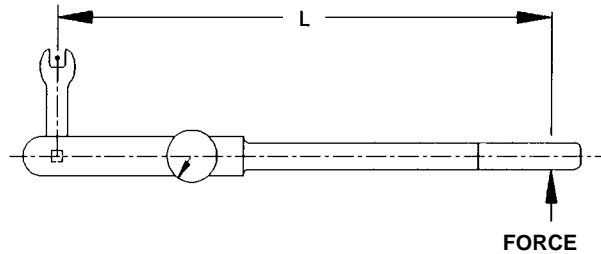


FIGURE 1-12: TORQUE WRENCH WITH ADAPTOR AT RIGHT ANGLE

Ariel Bolting

Bolts have been selected that meet Ariel's strength, elongation, sealing and locking requirements. Proper bolting must be used and tightened to the values listed in ER-63.1.

The fasteners used within an RG compressor are twelve point flanged capscrews.

NOTE: WHEN RE-ASSEMBLING OR REPLACING BOLTING, SEE THE PARTS LIST TO DETERMINE THE PROPER FASTENER GRADE, TYPE, AND PART NUMBER.

Alarm & Shutdown (Also Refer To Section 4)

Gas Discharge High Temperature Settings

A gas discharge high temperature shutdown is required. Set within 10 percent of normal operating temperature, to a maximum of 238°F (114°C) alarm and 248°F (120°C) shutdown. High temperature limits are based on rotating clearance requirements.

NOTE: EXCEEDING THE HIGH TEMPERATURE SHUTDOWN LIMITATION WILL RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

Storage and Transportation of Compressor

Protect compressor to prevent corrosion and seal to prevent exchange of atmosphere, when

inactive, in storage or when transporting. Consult Ariel for instructions to protect and seal compressor to ER-25-1.

Zone 1 Environment

A Zone 1 environment requires the installation of proper intrinsically safe or equivalent protection to fulfill the electrical requirements, where applicable.

SECTION 2 - INSTALLATION

General

Compressor installation with the associated driver and piping, is to be done with care and precision. This section does not attempt to address all of the concerns that can arise during installation, but addresses those areas that the user must be aware.

Electrical Grounding

CAUTION: THE COMPRESSOR SKID MUST BE GROUNDED TO A SUITABLE EARTH GROUND.

Procedure For Setting and Aligning

The following points deserve special attention during the setting and alignment of the compressor:

1. Be sure that driver will rotate compressor rotor drive shaft in proper direction, prior to start-up. See Figure 1-9 on Page 1-11 drive end view for rotation arrow.

NOTE: THE COMPRESSOR JACK SHAFT (WITH GEAR) ROTATES CLOCKWISE, AND THE MALE ROTOR (WITH PINION) ROTATES COUNTER-CLOCKWISE, WHEN OBSERVER IS STANDING AT THE DRIVER LOOKING TOWARD THE COMPRESSOR. REVERSE ROTATION CAN RESULT IN SERIOUS DAMAGE TO THE COMPRESSOR.

2. The skid design should:
 - a. Transmit compressor and driver reaction forces to the foundation.
 - b. Be sure that there is a sufficient mismatch between the shaking forces and the natural frequency of the skid.
 - c. Have sufficient stiffness and strength so that the compressor can be mounted flat with no bending or twisting of the compressor casing, and so that proper compressor coupling alignment can be attained and maintained. This can be accomplished by shims or careful grouting.

Setting

Ariel RG rotary screw compressors, when supplied with an SAE mounting-flange are designed to be mounted directly to the driver. The three point mounting method uses two (2) compressor feet and the SAE mounting-flange to attach the compressor to its pedestal and the driver flange, see Figure 2-1 on Page 2-2 When supplied without a bell housing SAE

mounting flange, the compressor is mounted using all four feet.

Follow the coupling manufacturer’s instructions for installing the coupling. Reference any packager’s instructions, and Ariel’s ER-41.1 on coupling installation.

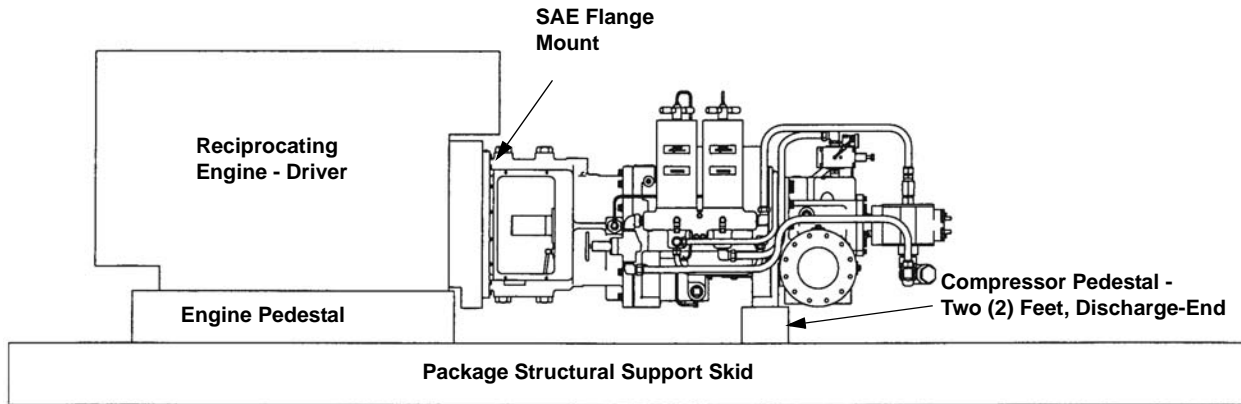


FIGURE 2-1:ENGINE/RGM COMPRESSOR ARRANGEMENT - TYPICAL FLANGE MOUNTED

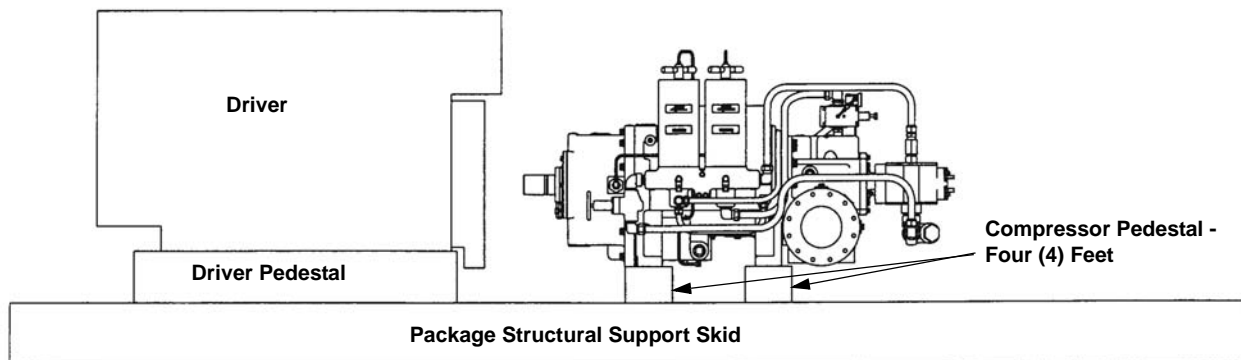


FIGURE 2-2:DRIVER/RGM COMPRESSOR ARRANGEMENT - TYPICAL W/O BELL HOUSING

The RG compressor's integral gears (speed increasing) require a torsionally soft (elastomeric) coupling that incorporates a flywheel adapter. The compressor's SAE flange and input-shaft are designed to accept several manufacturers' existing coupling designs. The straight, keyless input-shaft end location is positioned to use a flywheel adapter type coupling that incorporates a hub with a compression-type shaft attachment method. The hub's reusable compression design provides hub to shaft interference without heat, and allows for multiple reuses.

NOTE: FAILURE TO INSTALL A PROPER COUPLING CAN RESULT IN COUPLING AND/OR COMPRESSOR BEARING DAMAGE. VERIFY THE COUPLING’S FLYWHEEL ADAPTER BOLT CIRCLE WILL FIT WITHIN THE COMPRESSOR’S SAE BELL HOUSING. THE COUPLING MUST BE BALANCED TO ISO 1940 G2.5 AND MATCH MARKED.

A wide variety of preferences and techniques exist on the subject of skid mounting rotary compressors. The objective is to have a smooth running compressor that is not twisted or distorted.

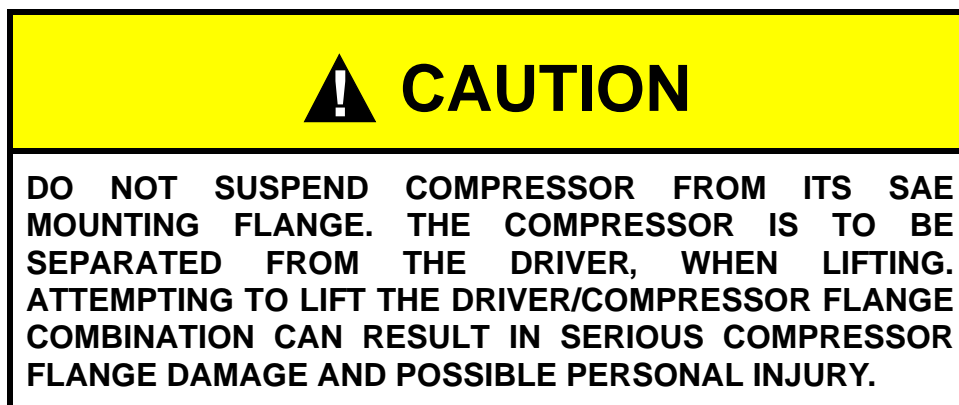
Setting Compressor with an SAE Mounting-Flange

The following general procedure is to be used for setting the compressor onto the package skid;

1. Install driver to skid per packager's recommendations.
2. Lift the compressor with an overhead crane using the forged eyebolts supplied in the Ariel toolbox. Maintaining compressor balance, near to level, will facilitate setting the compressor. Refer to Figure 1-9 on Page 1-11 for the compressor's center of gravity and recommended lifting points.
3. Align the SAE mounting-flange square to the driver housing.
4. Fit the compressor's SAE flange pilot to the mating driver groove.
5. Using four bolts at top and four bolts at bottom, draw the SAE flange pilot diameter into the driver flywheel housing. Turn bolts one turn each at a time in an alternating star (criss-cross) pattern to prevent binding the pilot fit.

NOTE: DO NOT USE THE BOLT HOLES BESIDE THE ACCESS DOORS TO DRAW THE COMPRESSOR FLANGE TO THE ENGINE. EXCESSIVE SIDE FORCES EXERTED ON THE COMPRESSOR'S SAE FLANGE MAY CAUSE FLANGE DAMAGE.

6. Install remaining SAE flange bolting and tighten bolts to ER-63.1 using an alternating star (criss-cross) pattern (25, 50, 75, and 100 percent of final torque).
7. Continue to use the overhead crane to support the compressor's weight.



8. Shim the gap under the compressor's two discharge (non-drive) end feet to positively support the compressor.

9. With the compressor SAE mounting-flange bolting complete and the compressor supported on its pedestal, remove crane support.
10. After finding the approximate position of the compressor, a soft foot check is to be performed. The compressor's two pedestal mounting bolts are to be tightened in place and then loosened. Shims are then adjusted so there is no vertical movement more than 0.002 inch (0.05 mm) between the bottom of the compressor feet and the skid's pedestal.
11. Consult Packager's information for mounting bolt tightening torque values. This work must be performed prior to the addition of piping.

Setting Compressor w/o a Bell Housing

The following general procedure is to be used for setting the compressor onto the package skid;

1. Install driver to skid per packager's recommendations.
2. Lift the compressor with an overhead crane using the forged eyebolts supplied in the Ariel toolbox. Maintaining compressor balance, near to level, will facilitate setting the compressor. Refer to Figure 1-9 on Page 1-11 for the compressor's center of gravity and recommended lifting points.
3. Shim the gap under the compressor's four feet to positively support the compressor.
4. After finding the approximate position of the compressor, a soft foot check is to be performed. The compressor's four pedestal mounting bolts are to be tightened in place and then loosened. Shims are then adjusted so there is no vertical movement more than 0.002 inch (0.05 mm) between the bottom of the compressor feet and the skid's pedestal.

Consult Packager's information for mounting bolt tightening torque values. This work must be performed prior to the addition of piping.

Alignment

Proper alignment is necessary for satisfactory performance. The flexible coupling will not make up for poor alignment. Misalignment can result in:

- High bending moment on the compressor drive shaft
- Large axial forces which reduce thrust bearing life
- Excessive wear to the bearings
- And if severe, probable damage to various components

SAE bell housing mounting was developed for the RG series to minimize misalignment. Actual alignment may be verified by any of a number of acceptable methods such as:

- Face/peripheral
- Reverse indicator

- Across the coupling
- Optical
- Laser
- Mechanical direct to alignment calculating computer

When aligning a unit some procedural concerns are:

- Soft foot (compressor and driver are not laying flat)
- Mounting bolts are bound in skid holes, i.e. "Bolt Bound"
- Repeatable readings
- Which way indicator moves (plus or minus)
- Thermal growth
- Piping stresses
- Indicator sag

When properly aligned the forces on the connected equipment will be at a minimum. This will result in long bearing life and a smooth running unit. Consult Packager's information for alignment procedure.

Vents and Drains¹

It is critical, for the safe operation of the compressor, to ensure that all vents and drains are open, functional and, if necessary, tubed off of the skid or out of the building. Depending upon your climate and insect population it can be necessary to install screens over the vents and drains to ensure that they do not become blocked. This can be essential if the compressor is shutdown for a long period of time.

Some other points are:

1. A vent should be provided to safely relieve pressure from the system.
2. Adequate vents and drains are to be provided for mechanical seal weepage and rotor housing oil drainage. All vents and drains must be installed in such a manner as to prevent the collection of liquids that could cause the build up of either gas or liquid. When a heavier than air gas is involved, vent and drain design must be accommodating.
3. Do not block view of mechanical seal weepage tube, as oil leakage rate is a visual indication of seal condition.

Inlet Gas Debris Strainers

Foreign matter in the gas stream can effect compressor wear and lubrication. Inlet gas debris screens with a maximum 420 micron openings (0.0165 in. aperture, 40 mesh) are required to be installed upstream of the compressor suction flange. These screens should be monitored by differential pressure and cleaned or replaced before differential pressure approaches the

1. Also refer to Section 4.

collapse pressure of the screen.

Inlet Gas Liquids and Solids

Liquid water, gas condensates and solid particulate in the process gas stream have detrimental effects on oil system gas/oil separator operating temperature and oil viscosity. Liquid slugging that can adversely affect the compressors's mechanical operation and oil system must be effectively removed or compressor damage will occur.

NOTE: SOLID AND LIQUID CONTAMINANTS IN THE PROCESS GAS SYSTEM MUST BE EFFECTIVELY REMOVED UPSTREAM OF THE COMPRESSOR.

NOTE: FREE LIQUIDS THAT ARE NOT REMOVED CAN BE PARTICULARLY TROUBLESOME IN LOW PRESSURE NATURAL GAS SERVICE APPLICATIONS. MINERAL DEPOSITS (SALT AND CALCIUM) CAN BUILD UP ON THE SUCTION STRAINER SCREEN AND IN THE COMPRESSOR DUE TO DISSOLVED MINERALS IN WATER SATURATED PROCESS GAS. THESE MINERALS PLATE OUT WHEN WATER FLASHES OFF DUE TO PRESSURE DROP OR HEAT.

Inlet Gas Scrubbers

Each rotary compressor must have a scrubber or some other liquid and particulate removal device immediately ahead of the compressor and a suction strainer ahead of the compressor suction nozzle.

When the process gas stream does not contain continuous particulate carryover, the suction scrubber is to be designed for the removal of both free and entrained liquids, and occasional solids that can loosen from the pipe wall. Solid particulate greater than 75 micron (0.003 in. aperture, 200 mesh screen) should be removed from the gas stream within the scrubber ahead of the compressor, unless a specific contaminant (iron sulfide, pipeline dust, coal fines, etc.), requires a lower limit.

When the process gas stream does contain continuous particulate carryover of known contaminant, the suction scrubber is to use elements that remove both free and entrained liquids and filter the particulate damaging to the compressor. Ariel recommends particulate filtering of the incoming gas to no larger than 5 micron. Otherwise, continuous particulate carryover will lead to excessive wear of rotors and housing and could eventually cause reliability problems.

SECTION 3 - START UP

General

To be sure of a smooth start up, it is important that the items in the Start Up Check List, provided in this section, be positively satisfied. It is also important that the operator understand how to operate the compressor in a safe and efficient manner, prior to start up.

CAUTION

BEFORE STARTING A NEW COMPRESSOR, OR AFTER RELOCATING OR REAPPLYING A COMPRESSOR, OR AFTER MAJOR OVERHAUL, BE SURE TO COMPLETE AND CHECK OF ALL THE ITEMS ON THE START UP CHECK LIST SHOWN IN THIS SECTION. THIS LIST IS DESIGNED TO HELP ENSURE SAFETY IN STARTING AND OPERATING THE COMPRESSOR.

CAUTION

FOR SAFE OPERATION, DO NOT ATTEMPT TO START-UP THE UNIT WITHOUT BEING COMPLETELY KNOWLEDGEABLE OF THE INFORMATION CONTAINED IN THIS SECTION. IT IS ALSO ESSENTIAL TO REFER TO THE PACKAGER'S OPERATING MANUAL.

Start Up Check List

For latest available Start Up Check List, see ER-10.4.2 at www.arielcorp.com.

Compressor Model RG _____ **Serial/No. R-** _____ **Gear Ratio** _____

Control Actuation - Hydraulic _____ Handwheel _____

Driver Manufacturer _____ Model _____ Rated Speed _____ RPM

Packager _____ Packager Unit No. _____

Date Packager Shipped _____ Serviceman _____

Customer _____ Start Up Date _____

Location _____ Field Contact _____

Field Telephone No. _____ Unit Location _____

Gas Service _____

Compressor Oil - Make/Grade _____

YES NO

Check List - Prior To Starting:

1. Are the correct Ariel parts book, technical manual, special tools, and spares available? _____
 2. Have the design limitations for the compressor model such as maximum suction & discharge pressures, maximum and minimum speed, discharge temperature been checked? _____
 3. Have the Packager's design operating conditions been reviewed? _____
- Pressure, psig (bar_g): Suction _____ Discharge _____
- Temperature, °F (°C): Suction _____ Discharge _____
- Maximum RPM _____ Minimum RPM _____
- Type of Gas _____ SG _____
- If start-up conditions are different check with Packager or Ariel.
4. Soft Foot Check [max. allowable 0.002" (0.05 mm)]: Have the compressor feet supports been shimmed so the machine is not twisted or bent? _____
 5. Have compressor anchor and/or bell-housing flange bolts been re-torqued? _____
 6. Have the piping and supports been checked to be sure they do not bend or stress compressor? _____
 7. Have coupling bolt torque values been rechecked? _____

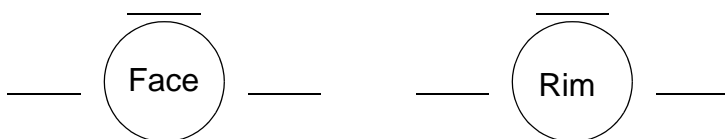
COMPRESSOR MODEL RG _____

SERIAL/NO. R- _____

YES NO

8. Has the compressor to driver alignment been field checked?
See compressor outline drawing for shaft thermal growth value.

9. Record coupling dial indicator field verification readings in inches (mm) at the 3, 6, 9 and 12 o'clock positions on lines provided: (not applicable to bell-house mountings)



Maximum allowable face misalignment 0.005 in. (0.13 mm) TIR
Maximum allowable radial misalignment 0.003 in. (0.08 mm) TIR

10. Does the compressor input shaft turn freely? _____

11. Have coupling elements been installed and has coupling been inspected for proper assembly, including axial engagement? _____

12. Has any preservation oil been drained from rotor housing? _____

13. Have oil & gas systems been pressurized & leak tested? _____

14. Has proper oil been installed that matches operating conditions, with a viscosity adequate for current gas analysis? _____

15. Has oil supplier provided gas dilution versus pure oil viscosity information? _____

16. Has the compressor oil system been filled with oil to the proper level without over filling? _____

17. Is the compressor oil supply isolation valve open? _____

NOTE: NOTE: CLEARLY LABEL UNIT WITH THE COMPRESSOR OIL MAKE/GRADE CURRENTLY IN USE.

18. Does the compressor oil system low level shutdown work? _____

19. Have the properly rated elements been installed in the gas inlet separator, oil filters and strainers, and gas/oil separator? _____

20. Are the oil filter elements and all oil piping primed with oil? _____

21. Is the low oil differential pressure shutdown installed & tubed correctly to the bearing oil supply and scavenged oil gallery? _____

22. Is the low oil differential pressure shutdown set per Ariel's recommendations & does it work on falling pressure? _____

23. Is there an oil cooler? Note: Recommended minimum compressor inlet oil temperature is 150°F (66°C); maximum 170°F (77°C). _____

24. Is the rotor injection's oil temperature control (trim) valve setting appropriate for cold start-up applications? _____

COMPRESSOR MODEL RG _____	SERIAL/NO. R- _____	
	YES	NO
25. Is the oil temperature control valve piped for a "mixing" condition?	_____	_____
26. If so equipped, is there a working vibration shutdown mounted on the compressor or drive train?	_____	_____
27. Is there suction pressure control upstream of the compressor? Refer to Ariel's performance prediction program to verify acceptable P ₁ , P ₂ combination.	_____	_____
28. Are the suction and discharge pressure shutdowns set & working?	_____	_____
29. Are the safety relief valves installed & working to protect compressor gas and oil piping?	_____	_____
30. Is the gas high discharge temperature shutdown installed, set at 10% above anticipated temperature & working? 248°F, max. (120°C)	_____	_____
31. Is the mechanical seal leakage tubing installed, unplugged and visible to determine if leakage occurs?	_____	_____
32. Have the gas suction lines been thoroughly cleaned to be sure that no dirt, slag or other debris enters the compressor?	_____	_____
33. Has strainer screen been installed upstream of compressor suction?	_____	_____
34. Have the oil system components been primed and the compressor prelubed prior to starting?	_____	_____
35. Does the driver rotation match the compressor rotation arrow?	_____	_____
36. For engine driven units, has the machine been rolled to make sure it is free?	_____	_____
37. For other drivers, has the machine been barred over by hand to be sure it is rolling free?	_____	_____
38. For combustible gas applications, has the piping and compressor been purged to remove all air?	_____	_____
39. Have start-up instructions for other package equipment been followed?	_____	_____
40. Has compressor variable Vi been moved to the minimum Vi axial position? (Vi range 2.5 to 5.0)	_____	_____
41. Has compressor capacity control plate been moved to minimum load position, to reduce compressor start-up torque?	_____	_____
42. Have minimum compressor oil pressure alarm and shutdown settings been tested?	_____	_____

COMPRESSOR MODEL RG _____

SERIAL/NO. R- _____

YES

NO

43. Has the Packager's representative reviewed the Packager's Start-Up & Operating Instructions for the unit with the unit operator?

44. Has the separator scavenge line been connected to the gearbox and is the scavenge control valve fully open?

Check List - After Starting:

1. When idle speed is achieved, load compressor to minimum position & increase minimum driver speed if necessary to stabilize load. Did the compressor bearing oil pressure come up immediately after loading the compressor?

2. Was the discharge pressure raised immediately (minimum pressure value) to facilitate oil scavenging and lube flow?

3. Was required differential pressure in the separator, above suction achieved immediately & maintainable until normal operating pressures are reached?

4. Are the oil filters, bearing & oil system, & hydraulic-valve-stack pressure gauges working?

5. Are the oil filter differential pressures less than 35 psid (2.4 bar_d) at operating temperature, unless otherwise specified?

6. Did the compressor develop discharge pressure when capacity control plate moved to loaded position?

7. Has the variable Vi been moved to an appropriate position?

8. Any strange noises or shaking in the compressor or piping?

9. Is the compressor system oil level within acceptable limits?

10. Is bearing oil differential pressure above minimum specified?

11. Is the high discharge temperature shutdown working?

12. Is the high discharge gas temperature shutdown set at approx. 10% above normal discharge temperature? 248°F (120°C) maximum.

13. Is the mechanical seal weep hole leaking?
Drops/minute _____

14. Are there any other oil leaks? If so, where?

15. Are the scrubber dumps and high level shutdowns working?

16. Are the scrubber dumps removing all liquids from the gas without obvious carryover?

17. Do you hear solid contaminants in the suction piping?

18. Is overspeed shutdown set?

COMPRESSOR MODEL RG _____

SERIAL/NO. R- _____

YES

NO

- 19. Is the mechanical seal properly sealing gas and oil at the shaft? _____
- 20. Have all Package safety functions been tested to be sure of unit shutdown upon malfunction? _____
- 21. After the compressor reaches normal operating conditions, has the separator scavenge control been set to show mostly gas flow at the sight glass? _____
- 22. After running compressor for 24 hours, are oil filter and separator differential pressures less than maximum allowable? _____
- 23. Upon shutdown verify that compressor reverse rotation is less than 2 seconds to be sure of check valve operation. _____
- 24. Has initial compressor operating data been recorded? _____
- 25. Complete Ariel's "Compressor Warranty Notification and Installation List Data", copy this completed "Start-up Checklist" and mail both to Ariel Corporation, 35 Blackjack Road, Mount Vernon, OH 43050, USA, Attention: Administrative Assistant - Sales or fax to Ariel at 740-397-3856, Attention: Administrative Assistant - Sales.

DAILY LOG SHEET

COMPANY/LOCATION _____ UNIT _____

COMPRESSOR MODEL RG _____ SERIAL No. R- _____ GEAR RATIO _____

Date/Time							
Operator							
Driver Load, HP (kW)							
Driver Speed, RPM							
Compressor Speed, RPM							
Gas flow Rate MMSCFD (m ³ /s _n)							
Variable Vi Position (Vi or # of turns)							
Capacity Control Position (% or # of turns)							
Suction Pressure, psig (bar _g)							
Suction Temperature, °F (°C)							
Discharge Pressure, psig (bar _g)							
Discharge Temperature, °F (°C)							
Compr. Bearing Oil Supply Temp., °F (°C)							
Bearing Oil Differential Pressure, psid (bar _d)							
Bearing Oil Filter Differential, psid (bar _d)							
Rotor Injection Oil Filter Differential, psid (bar _d)							
Hydraulic Oil Supply Pressure, psig (bar _g)							
Separator Coalescing Filter Differential, psid (bar _d)							
Compressor Oil Supply Pressure, psig (bar _g)							
Coalescing Scavenged Oil Line Valve Adjusted & Flow Observed							
Mechanical Seal Weep Rate, drops/min.							
System Oil Level							
Compressor Oil added, gal (L)							
Remarks:							



Maximum Running Pressure (MRP)

The maximum discharge pressure for these compressors is 230 psig (15.9 bar_g) when running (with rotors turning) and compressing the specified fluid at maximum specified temperature.

All compressors must be equipped with a fail-safe device to shutdown the driver (stop the rotors) if the discharge pressure at the compressor flange exceeds the maximum allowable running pressure.

Maximum Relief Valve Setting (MRVS)

These compressors are designed to withstand a pressure of 300 psig (20.7 bar_g) when the compressor is not running.

It is the responsibility of the packager to provide relief valves to protect the equipment, piping and oil separator. All compressors must have a relief valve in the discharge piping, set not to exceed the maximum relief valve setting for the compressor of 300 psig maximum (20.7 bar_g) or the maximum allowable working pressure of piping components whichever is less.

The pressure within the compressor **MUST** be lowered to the maximum running pressure or less prior to starting.

Filling & Priming a Oil Lube Oil System - Before Starting

Filling The System

1. The normal operating oil level may be higher or lower than the level at shutdown (at rest). The gas/oil separator, piping and oil cooler capacity and elevation affect operating oil levels. Consult the package build book or contact Packager for the approximate design oil fill capacity.
2. Fill the oil filters, piping, cooler and gas/oil separator to an intermediate level on the gas/oil separator's sight glass.

3. Run the prelube pump or circulating pump to ensure system is filled, and bearings and seals are pre-lubricated. Bleed piping and cooler high points vents to remove trapped air pockets.
4. Check sight glass on separator. Oil level at start-up could be high or low on the site glass depending upon component elevations. DO NOT OVERFILL.
5. Proper oil system level is to be checked after compressor is operating when temperatures and pressures have stabilized and should be mid-point of the site glass, during normal operation.

Compressor Control Devices

Ariel developed the RG oil-flooded rotary screw compressors specifically for low pressure natural gas service. Instead of using a traditional slide-valve, the RG series has separate inlet volume (capacity) and discharge volume (volume ratio, V_i) control devices. Compressor V_i and capacity control positions can be adjusted independently, either hydraulically or manually (hand wheel) depending on the purchase option.

To maintain high compressor efficiency, an RG compressor uses the two independent control devices, which allows for V_i optimization during full and reduced capacity conditions. The compressors capacity and V_i controls are actuated separately, but move in concert to optimize compressor efficiency with changing conditions.

NOTE: FAILURE TO MATCH THE COMPRESSOR'S INTERNAL ROTOR COMPRESSION RATIO ($CR_{INT} = V_i^K$) WITH THE COMPRESSOR'S EXTERNAL COMPRESSION RATIO ($CR_{EXT} = PD/PS$, IN PSIA FROM SUCTION FLANGE TO DISCHARGE FLANGE) RESULTS IN EITHER OVER OR UNDER COMPRESSION. OVER COMPRESSION WASTES MORE HORSEPOWER THAN UNDER COMPRESSION, AND SIGNIFICANTLY INCREASES BEARING LOADS. THE COMPRESSOR'S ANTI-FRICTION BEARING LIFE CAN BE MAXIMIZED BY MINIMIZING EXCESSIVE BEARING LOADS DUE TO OVER/UNDER COMPRESSION FROM IMPROPERLY ADJUSTED V_i .

Capacity Control (internal recycle)

Capacity control is achieved with an internal recycle method using an adjustable horizontal slide plate that uncovers progressive, overlapping holes connected to a bypass passage, see Figure 1-5 on Page 1-9 and Figure 1-7 on Page 1-10. The bypass passages are designed to recycle gas at the suction end of the compression chamber before compression begins.

NOTE: THE HORIZONTAL SLIDE PLATE ADJUSTS INLET VOLUME ONLY, WHILE THE V_i SLIDE PLATE ADJUSTS DISCHARGE VOLUME ONLY. THIS CONTROL METHOD IS DIFFERENT THAN A TRADITIONAL SLIDE VALVE THAT AFFECTS BOTH INLET AND DISCHARGE VOLUMES WITH A SINGLE MOVEMENT.

Internal bypassing works together with variable V_i to maintain high part load efficiency with step-less capacity control. Internal bypassing allows the compressor load to be adjusted from

100 percent down to about 40 percent of full load capacity.

Since the compressor's operating conditions often change in gas gathering applications, the capacity control position can be selected with external adjustments. Capacity control adjustments can be made using either hydraulic or hand wheel actuation. With hydraulic actuation, capacity is infinitely adjustable from about 40 to 100 percent of full load capacity, and held in place hydraulically. With hand wheel actuation, capacity is manually adjustable from about 40 to 100 percent of full load capacity, and held in place with a stem locking pin.

Capacity Control Positioning - Hydraulic

On compressors furnished with hydraulically actuated capacity control, the slide plate position is infinitely adjustable from a 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate is pressure balanced to minimize the hydraulic force required to move it in either direction.

Compressor bearing oil pressure provides the hydraulic force used to move the sliding plate, in both load and unload directions, from 100 percent to about 40 percent of full load capacity at full load capacity rotating speed. Oil contained within the hydraulic cylinder is used to hold the horizontal plate in a given position. The horizontal plate's travel position is determined visually and electrically by a feedback signal from a precision electronic linear displacement position indicator, see Figure 5-12 on Page 5-10.

This capacity control actuation design allows for the conversion from hydraulic to handwheel operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

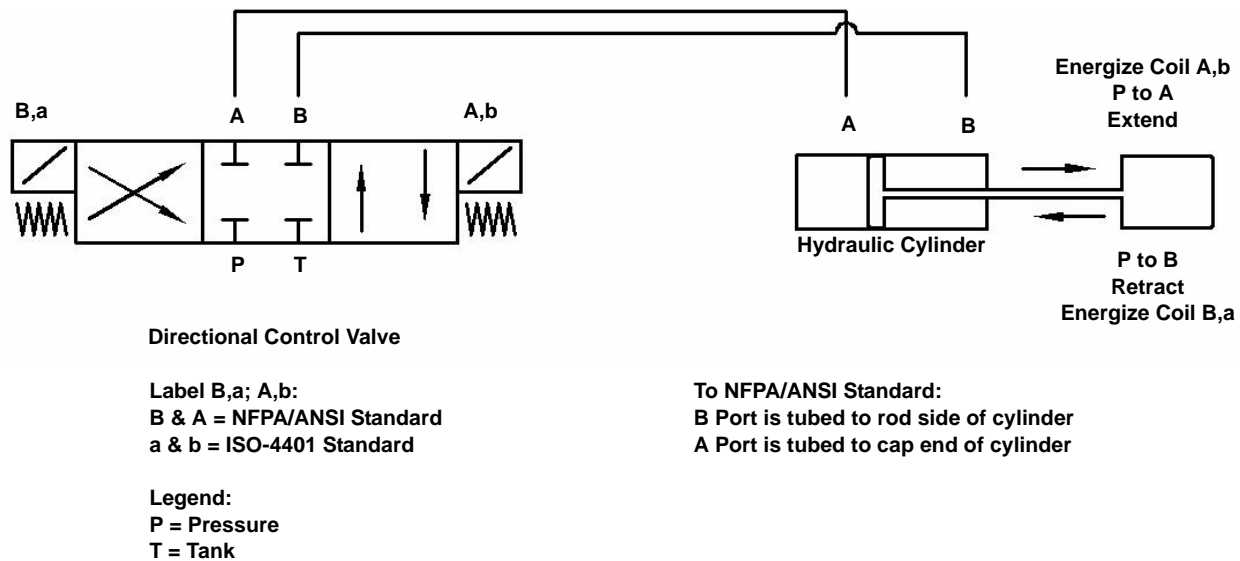


FIGURE 3-1:CAPACITY CONTROL & VARIABLE VI POSITIONING CONTROL SCHEMATIC

Capacity Control Theory of Operation - Hydraulic

The capacity control's hydraulic cylinder is located on the male rotor side, drive end. It is dual acting. A directional control valve is used to simultaneously direct oil to and from each side of the hydraulic cylinder piston.

To Increase Compressor Capacity

Energize coil B (a) to change the directional valve position so that P pressurized oil goes to B port and A port goes to T tank, see Figure 3-1 on Page 3-10. This causes the hydraulic cylinder to retract, as pressurized compressor oil flows into the rod side of the cylinder, the oil on the cap end of the cylinder drains into the compressor inlet nozzle port. The retracting hydraulic cylinder moves the slide plate away from the male rotor, covering bypass holes and increasing capacity, see Figure 1-7 on Page 1-10.

To Hold Capacity Control Position

Allow the directional valve's position to remain neutral. Oil is prevented from entering or leaving the hydraulic cylinder, which maintains the capacity control plate in a given position.

To Decrease Compressor Capacity

Energize coil A (b) to change the directional valve's position so that P pressurized oil goes to A port and B port goes to T tank. Pressurized compressor oil enters the cap end of the hydraulic cylinder causing it to extend and moving the slide plate toward the male rotor, which uncovers bypass holes and decreases capacity.

NOTE: COLD OIL EXITING A HYDRAULICALLY ACTUATED CYLINDER(S) CAN SIGNIFICANTLY INCREASE SLIDE PLATE POSITIONING TIME COMPARED TO HOT OIL. IT MAY BE NECESSARY TO HEAT TRACE AND INSULATE THE HYDRAULIC CYLINDER(S), OIL TUBING LINES AND DIRECTIONAL CONTROL VALVE FOR COLD WEATHER APPLICATIONS.

NOTE: ANY OIL LEAKAGE IN OR OUT OF THE DIRECTIONAL CONTROL VALVE WILL ALLOW THE SLIDE PLATE TO MOVE.

NOTE: FOR SMOOTH EXTENSION AND RETRACTION OF THE HYDRAULIC CYLINDER, A MINIMUM OF 50 PSID (65 BAR_D) DIFFERENTIAL OIL PRESSURE BETWEEN P-PORT TO T-PORT IS RECOMMENDED.

Procedure for Adjusting Capacity Loading & Unloading Speed

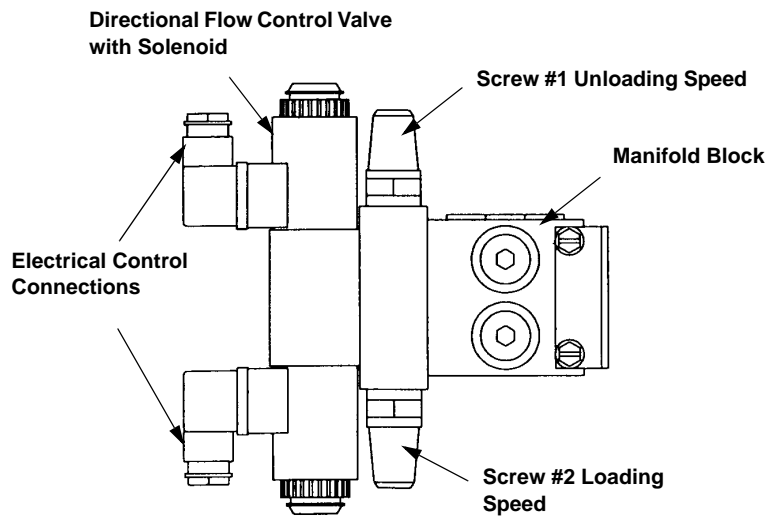


FIGURE 3-2:HYDRAULIC CAPACITY FLOW CONTROL VALVE - TYPICAL

Adjust upper screw (#1), on the directional flow control valve closest to the drive end, to control the compressor unloading speed, see Figure 3-2 on Page 3-12 Remove dust cover, loosen locknut and turn in allen screw clockwise all the way. Then turn out (counter-clockwise) a total of nine (9) full turns. Tighten locknut and replace dust cover. Adjustment can be made with hot or cold oil.

Adjust lower screw (#2) to control loading speed. Remove dust cover, loosen locknut and turn in allen screw clockwise all the way. When adjusting with cold oil, turn allen screw out (counter-clockwise) 3 to 4 full turns, to provide a good starting point. Or with hot oil turn out 2 to 3 full turns. Final adjustment is made with compressor running at desired loading speed. After loading is set to the desired speed, tighten locknut and replace dust cover.

Capacity Control Positioning - Hand Wheel

On compressors furnished with hand wheel actuated capacity control, the slide plate position is infinitely adjustable and may be adjusted, from 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate itself is pressure balanced to minimize the manual force required move it in either direction.

A manual hand wheel is used to move the slide plate in both load and unload directions, from 100 percent to about 40 percent of full load capacity, using a non-rising stem design. A stem locking device is used to hold the radial plate in a given position, see Figure 3-3 on Page 3-13 The slide plate's travel position is determined by counting the number of hand wheel turns, as shown in Table 1-2 on Page 1-8 and Figure 1-5 on Page 1-9.

This capacity control actuation design allows for the conversion from handwheel to hydraulic

operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

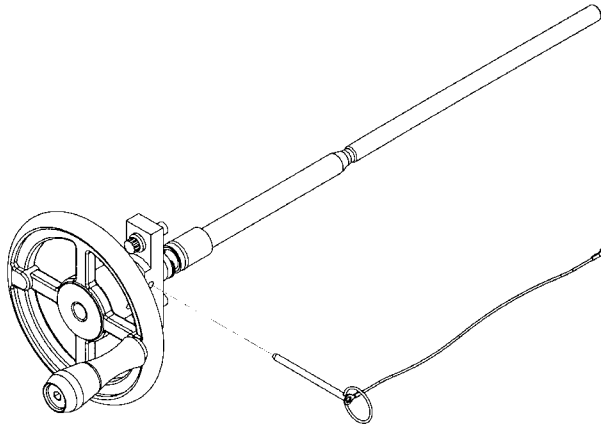


FIGURE 3-3:HANDWHEEL STEM LOCKING PIN - TYPICAL

Capacity Control Theory of Operation - Hand Wheel

The capacity control's hand wheel actuator is located on the male rotor side, drive end. Since manual capacity control is adjusted by means of a hand wheel connected to a threaded rod, no external oil is required.

The slide plate's position can be moved when the compressor is pressurized and operating. To adjust compressor capacity, remove the stem locking device, so the stem is free to turn, see Figure 3-3 on Page 3-13. Turn the stem by using the hand wheel on the male rotor side, drive end.

To Increase Compressor Capacity

To adjust capacity, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to cover internal bypass holes and increase capacity.

To Hold Capacity Control Position

To hold the desired capacity control position, align hole and re-install the stem locking pin.

To Decrease Compressor Capacity

To adjust capacity, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn hand wheel counter-clockwise to uncover internal bypass holes and decrease capacity.

Variable Vi Control

Variable volume ratio (V_i) is achieved using an adjustable slide plate on the discharge end that changes the compressor's axial port (butterfly) size, see Figure 1-6 on Page 1-9 and Figure 1-8 on Page 1-10. The compressor's anti-friction bearing life can be maximized, by minimizing excessive bearing loads due to over/under compression from improperly adjusted V_i . Ariel's method of varying V_i is different than the traditional slide valve, which does not provide independent inlet volume and discharge volume control capability.

Since the compressor's operating conditions often change in gas gathering applications, an appropriate V_i can be selected with external adjustments. V_i adjustments can be made using either hydraulic or hand wheel actuation. With hydraulic actuation, V_i is infinitely adjustable from 2.5 to 5.0, and held in place hydraulically. With hand wheel actuation, V_i is manually adjustable from 2.5 to 5.0, and held in place with a stem locking pin.

Variable Vi Positioning - Hydraulic

On compressors furnished with hydraulically actuated V_i control, the slide plate position is infinitely adjustable from 100 to 0 percent of travel, with the compressor running or stopped. The sliding plate is pressure balanced to minimize the hydraulic force required to move it in either direction.

Pressurized compressor bearing oil provides the hydraulic force used to move the sliding plate in either direction between a 2.5 V_i (minimum) and a 5.0 V_i (maximum). Oil contained within the hydraulic cylinder is used to hold the slide plate in a given position. The slide plate's travel position is determined visually and electrically by a feedback signal from a precision electronic linear displacement position indicator, see Figure 5-12 on Page 5-10.

This V_i control actuation design allows for the conversion from hydraulic to handwheel operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

Variable Vi Positioning Theory of Operation - Hydraulic

The variable V_i 's hydraulic cylinder is located on the male rotor side, non-drive end. It is dual acting. A directional valve is used to simultaneously add and remove oil from the hydraulic cylinder.

To Increase V_i

Energize coil A (b) to change the directional valve position so that P pressurized oil goes to A port and B port goes to T tank, see Figure 3-1 on Page 3-10. This causes the hydraulic cylinder to extend, as pressurized compressor oil flows into the cap end side of the cylinder, the oil on the rod end of the cylinder drains into the compressor inlet nozzle port. The extending hydraulic cylinder moves the slide plate toward from the male rotor, decreasing the

butterfly profile and increasing Vi, see Figure 1-8 on Page 1-10.

To Hold Vi Position

Allow the directional valve's position to remain neutral. Oil is prevented from entering or leaving the hydraulic cylinder, which maintains the Vi plate in a given position.

To Decrease Compressor Vi

Energize coil B (a) to change the directional valve's position so that P pressurized oil goes to B port and A port goes to T tank. Pressurized compressor oil enters the rod side of the hydraulic cylinder causing it to retract and moving the slide plate away from the male rotor, which increases the butterfly profile and decreases Vi.

NOTE: COLD OIL EXITING A HYDRAULICALLY ACTUATED CYLINDER(S) CAN INCREASE SLIDE PLATE POSITIONING TIME COMPARED TO HOT OIL. IT MAY BE NECESSARY TO HEAT TRACE AND INSULATE THE HYDRAULIC CYLINDER(S), OIL TUBING LINES AND PROPORTIONAL VALVE FOR COLD WEATHER APPLICATIONS.

NOTE: CONTACT ARIEL REGARDING VI POSITION DEAD BAND WITH PLC CONTROLLER. EXCESSIVE VI POSITIONING IS DETRIMENTAL TO SOME ELECTRONIC COMPONENTS.

NOTE: ANY OIL LEAKAGE IN OR OUT OF THE DIRECTIONAL CONTROL VALVE WILL ALLOW THE SLIDE PLATE TO MOVE.

NOTE: FOR SMOOTH EXTENSION AND RETRACTION OF THE HYDRAULIC CYLINDER, A MINIMUM OF 50 PSID (65 BAR_D) DIFFERENTIAL OIL PRESSURE BETWEEN P-PORT TO T-PORT IS RECOMMENDED.

Variable Vi Positioning - Hand Wheel

On compressors furnished with hand wheel actuated capacity control, the slide plate position is infinitely adjustable and may be adjusted, from 100% to 0% of travel, with the compressor running or stopped. The sliding plate itself is pressure balanced to minimize the manual force required move it in either direction.

A manual hand wheel is used to move the sliding plate in either direction, between a 2.5 Vi (minimum) and a 5.0 Vi (maximum), using a non-rising stem design. A stem locking device is used to hold the radial plate in a given position, see Figure 3-3 on Page 3-13 The slide plate's travel position is determined by counting the number of hand wheel turns, as shown in Table 1-3 on Page 1-8 and Figure 1-6 on Page 1-9.

This Vi control actuation design allows for the conversion from handwheel to hydraulic operation, with a minimum of conversion components. Contact Ariel for conversion instructions.

Variable Vi Theory of Operation - Hand Wheel

The variable Vi's hand wheel actuator is located on the male rotor side, non-drive end. Since manual Vi is adjusted by means of a hand wheel connected to a threaded rod, no external oil is required.

The slide plate's position can be moved when the compressor is pressurized and operating. Turn the stem by using the hand wheel on the male rotor side, non-drive end.

To Increase Vi

To adjust Vi, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel counter-clockwise to move the plate toward the male rotor, which decreases the butterfly profile and increases Vi.

To Hold Vi Control Position

To hold the desired capacity control position, align hole and re-install the stem locking pin.

To Decrease Vi

To adjust Vi, remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to move the plate away from the male rotor, which increases the butterfly profile and decreases Vi.

Visual Position Indicator - Capacity Control & Vi

Hydraulically actuated capacity control and variable Vi have both visual position indication and electronic position feedback capabilities. Hand wheel actuated capacity control and variable Vi positions are indicated by counting number of hand wheel turns with a non-rising stem.

Position Indicator - Hydraulic Visual

The position travel scale nameplates on the spacer/adaptors provide visual indication of the slide plates travel positions.

Position Indication - Hand Wheel

The hand wheel actuators have no visual indication of the slide plates travel positions. The manual hand wheels are used to move the sliding plates in either direction using a non-rising stem design. The slide plates travel positions are most accurately determined by counting the number of hand wheel turns on a threaded shaft, refer to Table 1-2 on Page 1-8 and Table 1-3 on Page 1-8.

Slide Plates Positioning at Start-up

Prior to starting, position the slide plates, hydraulic or hand wheel actuated, to the minimum Vi and minimum capacity positions.

Minimizing compressor Vi and capacity will reduce driver starting torque.

After starting, and as soon as idle speed is achieved, immediately adjust the Vi to a position that is appropriate for the operating compression ratio. Bearing oil pressure and discharge pressure should increase immediately after loading the compressor. Position other oil system valves, as required, for normal operations.

After compressor and driver are warmed up, compressor speed, Vi and capacity control are used to load the available driver horsepower.

Thrust Balance System

The thrust balance system is integral to the compressor and not adjustable. Discharge gas thrust loads are internally opposed by the gear set thrust load.

Gas/Oil Separator Coalescing Filter

Gas/Oil Separator Minimal Differential Pressure Requirement

A minimal differential pressure of 50 psi (3.4 bar) above the compressor suction pressure must be maintained in the gas/oil separator, from compressor start-up until the system reaches normal operating pressures. This minimal differential pressure is to be sure that an adequate flow of scavenge line gas and oil will prevent the collapse of the coalescing filter elements, that a gearbox differential pressure will allow the gearbox oil to drain at low operating differentials, and that adequate pressure to flow oil, especially when cold, to the inlet of the lube oil pump will prevent cavitation or inadequate oil flow to the journal bearings and mechanical seal.

Scavenged Gas/Oil Line Flow Adjustment

The gas/oil separator coalescing filter removes residual oil from the discharge gas stream. The oil scavenge line is necessary to minimize oil accumulation on the downstream side of the filter. A metering valve, check valve, flow indicator and a 75 micron (0.003 inches, 200 mesh) strainer or filter are to be located in the scavenged oil line to return the downstream coalescing filter oil to the compressor, see Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5. With the compressor at normal operating conditions, adjust the valve to show primarily gas flow movement into the compressor with minimal oil inclusion. Excessive gas flow will reduce compressor performance, due to the recycled gas. Insufficient oil flow will reduce coalescing filter performance resulting in oil carryover with discharge gas

stream.

SECTION 4 - OIL SYSTEM, LUBRICATION & VENTING

General

The oil system is vital for successful operation of oil-flooded rotary screw compressors and deserves special attention in the package design and operation. Ariel oil flooded rotary screw compressors utilize a pressurized, filtered and re-circulated oil system. Oil is supplied to the compressor through rotor injection and various oil connections.

Oil flooding of the gas stream is supplied at scavenged oil and rotor injection ports. Pumped oil supplies lubrication to the bearings, oil to the mechanical seal and speed increasing gear mesh, and provides pressure to position the optional variable V_i and capacity control hydraulic cylinders. The compressor oil system provides the following major functions:

1. Seals the internal running clearances and mechanical seal face.
2. Absorbs the heat of compression.
3. Lubrication of rotors, journal bearings, gear mesh and mechanical seal.
4. Hydraulic power - to move variable V_i and capacity-control hydraulic pistons.

The process gas will always dilute the oil, both mineral and synthetic, resulting in reduced viscosity. The pressurized oil viscosity reduction can be predicted and will remain stable provided that gas composition, pressure and temperature do not change and that any liquids and solid contaminants are effectively removed from the gas prior to compressor suction.

Careful consideration must be given to proper lubrication selection. The degree of compressor oil dilution/saturation by the process gas stream is influenced by the following factors:

1. Process gas composition/Specific Gravity (SG) - usually the higher the SG, the greater the oil dilution.
2. Discharge gas pressure - the higher the pressure, the greater the oil dilution.
3. Discharge gas temperature - the higher the gas/oil separator reservoir temperature, the less the oil dilution.
4. Lubricant selection - some oil types are more dilution prone.

Lubricants commonly used in oil flooded rotary compressors include petroleum based (mineral) oils and synthetic fluids. Lubricant additives are used to improve the viscosity index, inhibit oxidation, depress the lubricant pour point, inhibit rust formation, improve detergency, provide anti-wear protection, provide extreme pressure protection, improve "lubricity", decrease effects of gas dilution, increase "wetability", and resist "washing" of the lubricant due to water, wet or saturated gas, or dilutive properties of the gas stream.

- **Viscosity index** is a measure of the ability of an oil to resist the thinning effect caused by increasing the oil temperature.
- **Lubricity** is the “slipperiness” or ability of a lubricant to decrease friction.
- **Wetability** is a measure of the ability of the lubricant to adhere to metal surfaces. An increase in wetability increases the lubricants’ resistance to “washing” effects.

Pressure gauges are required for monitoring pressure drop across all oil filters.

Compressor oil should be changed at regular maintenance intervals or when oil sample results indicate the need. A more frequent oil change interval may be required if operating in an extremely dirty environment or if the oil supplier recommends it. Oil sampling should be performed on a regular basis to verify suitability of oil for continued service. Degradation to the next lower viscosity grade below the original viscosity or an increase in viscosity to the next higher grade requires a complete oil change.

NOTE: THESE OIL RECOMMENDATIONS ARE GENERAL GUIDELINES. IF THE RECOMMENDED LUBRICANTS OR FLOW RATES DO NOT APPEAR TO WORK PROPERLY, FLOW RATES AND/OR LUBRICANT TYPES MAY NEED TO BE CHANGED. PLEASE CONTACT THE OIL SUPPLIER FOR SPECIFIC LUBRICANT RECOMMENDATIONS.

Lubricants

It is not Ariel's policy to recommend any particular type or brand of oil. There are many companies who specialize in recommending blended or synthetic oil for a given application. These consultants given the gas composition analysis and operating conditions conduct proprietary flash gas and dilution calculations to determine proper lubrication and heat removal, as well as oxidation inhibition, rust and corrosion inhibition, and anti-wear properties. Using an experienced lubricant consulting service is recommended.

Compressor bearings are designed to operate with an optimum kinematic viscosity of 112 SUS (23 cSt) at compressor casing oil inlet port.

- The minimum kinematic viscosity at operating conditions is 80 SUS (15 cSt). Compressor operation with oil viscosity below 80 SUS (15 cSt) will result in inadequate compressor lubrication with bearing and sealing deterioration.
- The maximum kinematic viscosity at operating conditions is 142 SUS (30 cSt).

Once a rotary compressor oil viscosity is selected, operating viscosity is affected by temperature and pressure in the gas/oil separator, plus ingested liquid and solid contaminants in the suction gas stream.

Additives must not be corrosive to lead or copper base bearing materials.

For environmental reasons lead is increasingly being replaced in EP (extreme pressure) additives by alternatives. Care should be taken in the selection of EP additives since it has been proven that rolling element bearing life can be drastically reduced by chemical attack

from unsuitable EP additives.

Automatic transmission fluids (ATF) and used engine oils are not to be used for rotary compressor oils.

Warranty

Warranty of component failures which occur while using lubricants which do not meet these specifications will be subject to review on a case by case basis.

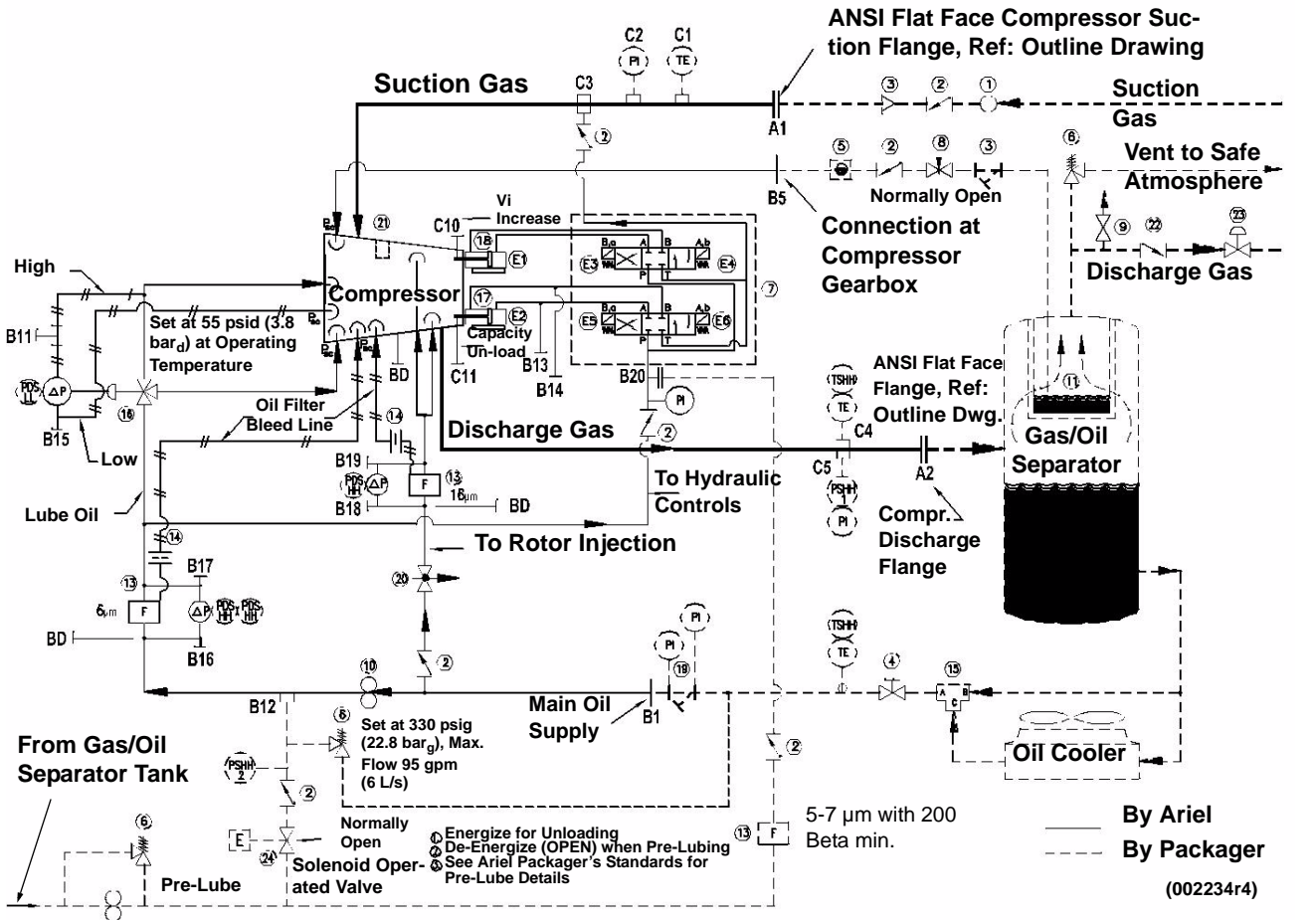
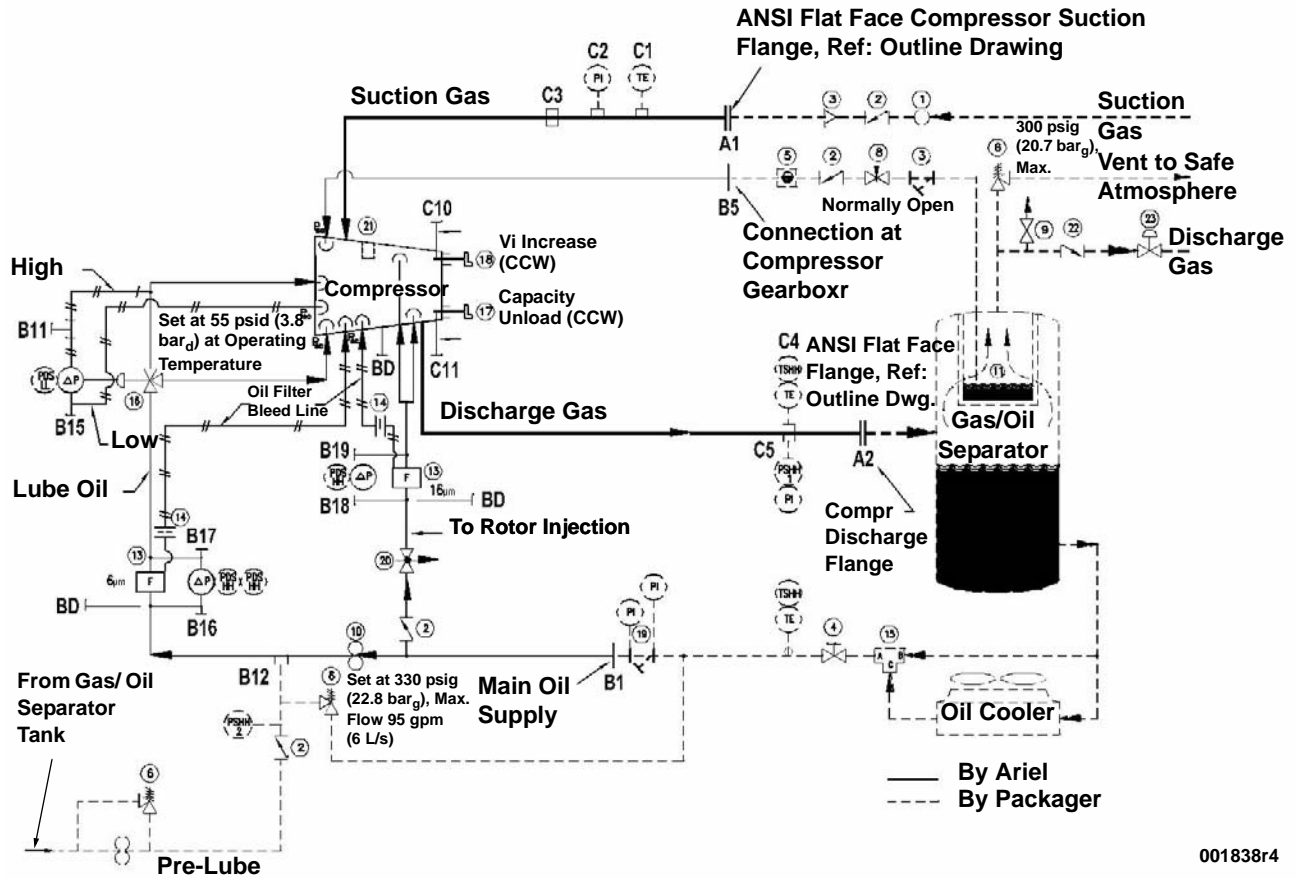


FIGURE 4-1: LUBE OIL SYSTEM SCHEMATIC - HYDRAULIC ACTUATED CAPACITY & VI CONTROLS - TYPICAL (SEE PACKAGER'S OIL SCHEMATIC)

TABLE 4-1: ILLUSTRATIONS LEGENDS FOR FIGURE 4-1 - HYDRAULIC ACTUATED

CONNECTIONS			INSTRUMENTATION	SYSTEM COMPONENTS	
GAS	SYSTEM	ELECTRICAL			
A1 Suction Flange A2 Discharge Flange	C1 TE: 3/4" NPTF C2 PI: 3/4" NPTF C3 Spare Suction Connection: 3/4" NPT C4 TE & TSHH: 3/4" NPTF C5 PI: 3/4" NPTF C8 PI: 1/4" NPT C9 PI: 1/4" NPT C10 Vi Stem Seal Vent: 1/4" NPTF C11 Capacity Stem Seal Vent: 1/4" NPTF	E1 Vi Control Position Indicator E2 Capacity Control Position Indicator E3 Decrease Vi Signal Input E4 Increase Vi Signal Input E5 Increase Capacity Signal Input E6 Decrease Capacity Signal Input	PI = Pressure Indicator PDSLL = Pressure Differential Switch Low-Low Oil Supply PDSHH = Pressure Differential Switch HiHi PSHH = Pressure Switch HiHi S/D, -1 = 230 psig max. (15.9 bar _g) Fail Safe -2 = 300 psig min. (20.7 bar _g) Rising TE = Temperature Element TSHH = Temperature Switch - HiHi, Oil 170°F max. (77°C), Discharge 248°F (120°C) P _{SC} = Pressure - Scavenge ΔP = Differential Pressure Gauge	1. Inlet Scrubber 2. Check Valve 3. Strainer - 420 μm 4. Shutoff Valve 5. Flow Indicator 6. Relief Valve 7. 3-Way 3-Position Directional Control Valve 8. Adjustable Flow Control Valve 9. Compressor Blow-Down Valve 10. Integral Oil Pump - Female Rotor Driven 11. Coalescing Filter 12. Not Used 13. Oil Filter (Filter Bleed must be off the center of top)	14. Orifice 15. Temperature Control Valve - Mixing Mode 16. Differential Pressure Control Valve 17. Capacity Unloading Valve - Hydraulic 18. Vi Control Valve - Hydraulic 19. Oil Strainer - 420 μm 20. Temperature Control Valve - Normally Open 21. Gearbox Scavenge Oil Strainer 22. Check Valve 23. Scavenge Oil Strainer 24. Solenoid Operated Valve
OIL B1 Main Supply B5 Scavenge Oil from Coalescing Filter B11 L.O. Pressure B12 Pre-Lube B13 Hand Pump Unloading B14 Drain for Capacity Unload B15 L.O. Pressure Drain B16-19 Pressure Connections B20 Valve/Cylinder Acuation BD = Drain					



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FIGURE 4-2: LUBE OIL SYSTEM SCHEMATIC - HAND WHEEL ACTUATED CAPACITY & VI CONTROLS - TYPICAL (SEE PACKAGER'S OIL SCHEMATIC)

TABLE 4-2: ILLUSTRATIONS LEGENDS FOR FIGURE 4-2 - HAND WHEEL ACTUATED

CONNECTIONS			INSTRUMENTATION	SYSTEM COMPONENTS	
GAS	ELECTRICAL	SYSTEM			
A1 Suction Flange A2 Discharge Flange	E7 Oil Supply PDSLL E8 Lube Oil Filter PDSHH E9 Rotor Injection Filter PDSHH	C1 Suction TE: 3/4" NPTF C2 Suction PI: 3/4" NPTF C3 Spare Suction Connection: 3/4" NPTF C4 Discharge, TE & TSHH: 3/4" NPTF C5 Discharge, PI & PSHH 1: 3/4" NPTF C10 Vi Stem Seal Vent: 1/4" NPTF C11 Capacity Stem Vent: 1/4" NPTF	PI = Pressure Indicator PDSLL = Pressure Differential Switch LoLo PSHH = Pressure Switch HiHi S/D, -1 = 230 psig max. (15.9 bar _g) Fail Safe -2 = 300 psig min. (20.7 bar _g) Rising TE = Temperature Element TSHH = Temperature Switch - HiHi, Oil 170°F max. (77°C), Discharge 248°F (120°C) P _{SC} = Pressure - Scavenge ΔP = Differential Pressure Gauge	1. Inlet Scrubber 2. Check Valve 3. Strainer 4. Shutoff Valve 5. Flow Indicator 6. Relief Valve 7. Not Used 8. Flow Control Valve - Normally Open 9. Compressor Blow-Down Valve 10. Integral Oil Pump - Female Rotor Driven 11. Coalescing Filter 12. Not Used 13. Oil Filter (Filter Bleed must be off the center of top) 14. Orifice 15. Temperature Control Valve - Mixing Mode 16. Differential Pressure Control Valve 17. Capacity Unloading Handwheel 18. Vi Control Handwheel 19. Inlet Oil Strainer - 420 μm 20. Temperature Control Valve - Normally Open 21. Gearbox Scavenge Oil Strainer 22. Check Valve 23. Back Pressure Control Valve	
OIL					
B1 Main Oil Supply B5 Scavenge Oil from Coalescing Filter B11 Lube Oil Pressure, Supply, High B12 Pre-Lube	B15 L.O. Pressure Drain, low B16 L.O. Filter, High B17 L.O. Filter, Low B18 Rotor Oil Filter, High B19 Rotor Oil Filter, Low BD = Drain				

Petroleum Based Oils - also referred to as mineral oils:

Paraffinic - higher wax content, better resistance to thinning at higher operating temperatures than naphthalenic.

Naphthalenic - (as compared to paraffinic) lower wax content, better ability to flow at low temperatures for cold start-ups, lower resistance to thinning at higher operating temperatures, better solvency, lower life/oxidation stability.

NOTE: ANIMAL FAT AND VEGETABLE OIL ADDITIVES ARE NOT TO BE USED IN ROTARY SCREW COMPRESSORS.

Synthetic Lubricants

Synthetic lubricants are man-made materials with more consistent, controlled chemical structures than petroleum lubricants. This improves predictability of viscosity and thermal stability. Synthetic lubricants can be designed with better dilution resistance, better oxidation resistance, better lubricity, better film strength, natural detergency, lower volatility, and results in decreased operating temperatures. These attributes can help to decrease rotor injection feed rate requirements.

Justification for the use of synthetic lubricants is based on process gas compatibility, energy savings, reduced lubricant usage, increased component life, decreased equipment downtime, and reduced maintenance/labor. Some synthetic lubricants can be used in the compressor lubrication. Consult with the lubricant supplier before using these lubricants in the compressor.

- **Synthesized Hydrocarbons** - polyalphaolefins (PAO) can be used as compressor lubricants and are:
 1. Compatible with mineral oils.
 2. Compatible with Viton and HNBR - Buna N (high end acrylonitrile-butadiene seals).
 3. Generally not water soluble.
 4. Requires additives to improve detergent action and improve seal compatibility.
 5. Can be soluble in some gases. Readily diluted by heavy hydrocarbons. Verify application with lubricant supplier.
- **Organic Esters** - diesters and polyolesters:
 1. Compatible with mineral oils.
 2. Incompatible with some rubbers (O-rings), plastics, and paints.
 3. Compatible with Viton seals.
 4. Primarily used in air compressors.
- **Polyglycols** - polyalkylene glycols (PAG), polyethers, polyglycolethers, and polyalkylene glycol ethers:

1. Not compatible with mineral oils, some plastics and paints. Requires complete system flush when changing to or from polyglycols. Contact oil supplier for flushing details.
2. Can be water soluble at reduced temperature - must verify application with lubricant supplier.
3. Resistant to hydrocarbon gas dilution. Excellent wetability.
4. Poor inherent oxidation stability and corrosion protection - requires additives.
5. Compatible with Viton and HNBR - Buna N (high end acrylonitrile-butadiene).
6. Not recommended for air compressors.

Associated Equipment

Associated equipment is described as the compressor package's auxiliary components, specified and provided by the Packager, that supports successful compressor operation within the specified application.

Gas/Oil Separator and Coalescing Filter

All oil-flooded rotary screw compressors require a gas/oil separator, complete with coalescing filter, to maintain the pressurized, recirculated oil system and to provide minimal oil carry over with the process gas. Typical Lube Oil Systems, Figure 4-1 on page 4-4 and Figure 4-2 on page 4-5, show the gas/oil separator's location schematically, with coalescing filter and the scavenged oil line components identified.

As defined in Ariel's Rotary Screw Packager Standards, Section 4: "It is the Packager's responsibility to determine gas/oil separator vessel sizing for a particular service, or verify adequacy if already determined by the customer's specifications. Gas/oil separators must be designed to have adequate oil coalescing filtration, which minimizes oil carry over with the discharge gas stream. The separator design shall include a coalescing filter oil scavenge system to minimize oil carry over. This scavenge line, with sight flow gauge, check valve and adjustable valve, must be connected to the compressor as shown on the typical lube oil drawing."

Oil Cooler

All compressors must have an oil cooler. Maximum allowable oil temperature into the compressor is determined by the process gas dew point, operating conditions and the type of oil used. Oil temperature into the compressor is recommended to be 150°F (65°C) for maximum discharge gas cooling capability. The packager is responsible for sizing a proper oil cooler. Operating conditions which must be taken into account are; the cooling medium, cooling medium temperature, cooling medium flow rate, lube oil temperature, lube oil flow rate, gas temperatures and gas compression capacities. **Oil heat rejection data for each application is determined from the Ariel Rotary Compressor Performance Program** (contact your Packager or Ariel when you need this information). The cooler should be

mounted as close to the compressor as possible, with piping of adequate size to minimize pressure drop of both the oil and the cooling medium.

Thermostatic Temperature Control Valve

For proper operation of the oil system a temperature control valve is required. A thermostatic valve is available from Ariel. The maximum differential pressure between the hot oil supply line (point B) and the cooled oil return line (point C) is to be 10 psid (0.7 bar_d). Refer to Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5, Item #15. Ariel recommends installation of the temperature control valve in the mixing mode.

The recommended oil injection temperature is 150°F (65°C) at the compressor oil inlet ports for maximum discharge gas cooling capability. An oil temperature of 150°F (65°C) is the minimum temperature required to drive off water vapor in natural gas. Normally select a temperature control valve with a 150°F (65°C) nominal temperature setting, unless other circumstances dictate a higher setting. If operating conditions or design limitations dictate otherwise, contact Ariel Application Engineering, see "Ariel Telephone, Fax, E-Mail and Web Site Numbers" on Page 7-18.

Cold Ambient Temperatures

If an oil-flooded compressor is exposed to cold ambient temperatures, the oil system must be designed so the unit may be safely started with adequate oil flow to the compressor bearings, gears and mechanical seal. Temperature controlled cooler by-pass valves, oil heaters, cooler louvers, insulation/heat tracing and even buildings may be needed to ensure successful operation.

Oil filter differential pressure increases significantly with oil viscosity greater than 2275 SUS (500 cSt). The maximum lube oil viscosity for cold ambient temperature starting, without pump cavitation, is 7275 SUS (1600 cSt) provided that all external piping is heat traced and insulated. Minimum start up temperatures for full or semi-synthetic lubricants can be reduced based on viscosity index. Start up oil viscosity must be sufficiently low to prevent pump, filter, bearing, gear or mechanical seal damage.

When electric oil immersion heaters are used with mineral oils, the watt density of the heater element should not exceed 5 W/in² (0.8 W/cm²) for systems without circulating pumps. Mineral oil coking will occur at the element with higher wattage heaters if a circulating pump is not used. When high wattage heaters are required, the heaters must be interlocked with an oil circulation pump to ensure that coking of the oil will not occur. Coked oil will form deposits which can "insulate" the system and decrease heat removal. The deposits can also break loose and act as abrasives in the lubricating system.

When electric oil heaters are used with synthetic or blended mineral oils, contact your oil supplier to determine maximum heater element watt density limitations. Synthetic or blended mineral oils generally have higher break down temperatures than straight mineral oils.

Prelube Pumps

Ariel rotary compressors are equipped with hydrodynamic journal bearings. Therefore, the compressor must be prelubed before starting. If the compressor was prelubed within the previous 8 hours, it does not require prelube again. During prelube, 1/2 of the lube oil enters the gearbox. If the compressor is prelubed successive or multiple times the gearbox will flood with oil. This can result in damage to the journal bearings when starting. To minimize this, Ariel recommends that a maximum of 2 to 2.2 gallons (7.6 to 8.3 L) of lube oil be supplied to the bearings. The PLC will start prelube pump via gas turbine motor. Once a positive pressure is indicated at the lube oil supply pressure connection or downstream of the prelube check valve, the PLC timer will begin. After the prescribed length of time has expired, the PLC will turn off the prelube pump and indicate permissive to start the compressor. For example, if the prelube pump is a 5 gpm (19 L/min) pump, then running it for 25 to 30 seconds will provide between 2.1 to 2.5 gallons (7.9 to 9.5L) of lube oil.

NOTE: THE MECHANICAL SEAL IS DESIGNED TO OPERATE WITH AN OIL FILM AND MUST BE PRE-LUBRICATED PRIOR TO STARTING. THE SEAL MUST BE CONTINUOUSLY SUPPLIED WITH OIL WHILE COMPRESSOR IS OPERATING. ANY DRY RUNNING OF SEAL, WITHOUT LUBRICATING OIL, WILL RESULT IN SCORING THE SEAL FACES AND REDUCED SEAL LIFE.

Integral Oil System

General

An integrated oil system mounted on a RG compressor is available as an Ariel option, and is designed to provide the required oil flow, pressure and cleanliness for multiple purposes with minimal operating adjustments. Cooled oil is supplied to a system through a single connection, which is then directed to the appropriate compressor connections for lubrication, cooling and hydraulic control pressure. Refer to Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5 for typical oil systems details.

Rotor Injection Oil Flow

Rotor injection oil pressure and flow are a function of operating conditions, specifically suction and discharge pressures and temperatures. Rotor injection oil supply is differential pressure driven through a filter to male and female rotor injection points. See the Ariel Performance Program - generated summary sheet that shows predicted rotor injection oil flow and the associated gas discharge temperature for given operating conditions.

Per Ariel's Rotary Compressor Packager Standards, discharge gas temperature must be maintained at the greater of 150°F (66°C) or 20°F (11°C) above the gas dew point temperature to prevent free liquid condensing in the compressor oil.

Reducing rotor injection oil flow will raise discharge gas and oil/gas temperatures, see "Gas

Discharge High Temperature Settings” on Page 1-15 for compressor operating limitations. Consult Ariel Applications Engineering before reducing oil flow volume.

Pumped Oil Flow

Lubricating oil is pumped through a filter and a three-way, pressure control valve to supply a regulated oil volume for compressor bearings, mechanical seal, gear tooth mesh and input shaft bearings. This lubricating oil also provides hydraulic oil pressure, when so equipped, to position Vi and capacity control sliding plates.

Integral Oil System - Major Components

Oil system major components are shown on the appropriate oil schematic and include; oil pump, strainer, filters, pressure control valve, directional control valves (hydraulic actuated controls only), Vi and capacity control hydraulic cylinders with position indication, and low oil supply pressure differential switch.

Lube Oil Strainers - Reference Figure 4-3 & Figure 4-4

There should be three oil system strainers.

The lube oil supply strainer (provided with lube system option) is located between the oil cooler and the pump suction. Cooled oil supplied to the in-line “Y” strainer passes through the 40 mesh (400 micron) screen, which prevents large particles from entering the pump. The strainer is provided with two plugged 1/4-inch female NPT gauge connections to monitor differential pressure. The strainer basket should be removed and washed in an appropriate solvent every 6 months, or whenever the lubricating oil is changed, or if differential pressure exceeds 4 psid (0.3 bar_d). See Figure 4-3 on Page 4-11.

A “Y” strainer (provided by others) is to be located in the oil return from the gas/oil separator. It should be removed and cleaned with the same frequency as the lube oil supply strainer.

The internal scavenged oil gallery strainer (provided with the compressor) is a cleanable strainer basket, 30 mesh (595 micron), see Figure 4-4 on Page 4-11. It is located in the oil return gallery passage, and should be removed and cleaned with the same frequency as the lube oil supply strainer.

NOTE: FAILURE TO CLEAN THE SCAVENGED OIL GALLERY STRAINER CAN RESULT IN FLOODING THE GEARBOX. IF OIL BECOMES ENTRAINED IN THE GEAR MESH, HYDRAULIC SEPARATION OF THE GEARS WILL SIGNIFICANTLY OVERLOAD THE BEARINGS.

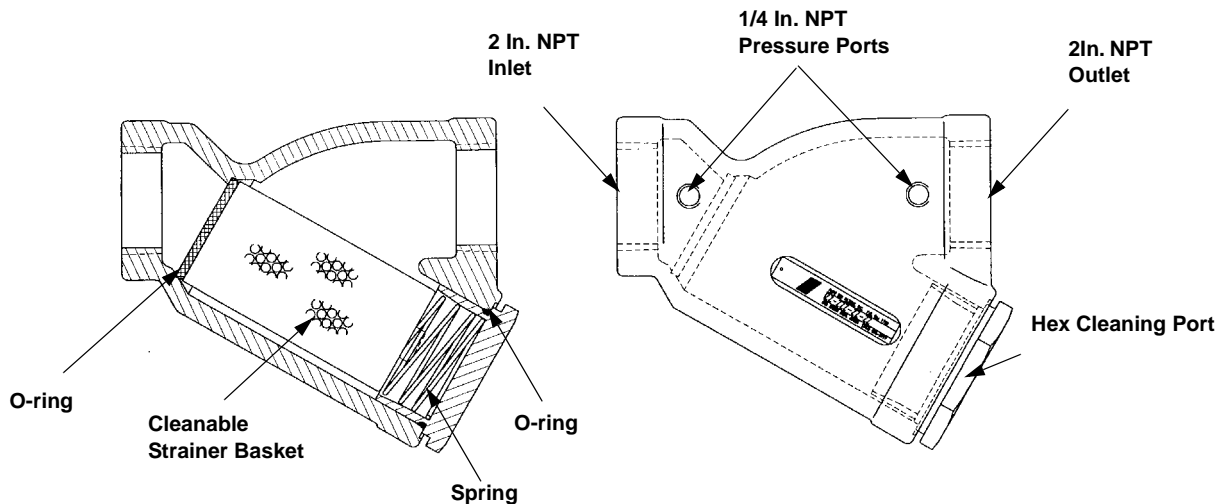


FIGURE 4-3: LUBE OIL STRAINER, CLASS 300 - TYPICAL

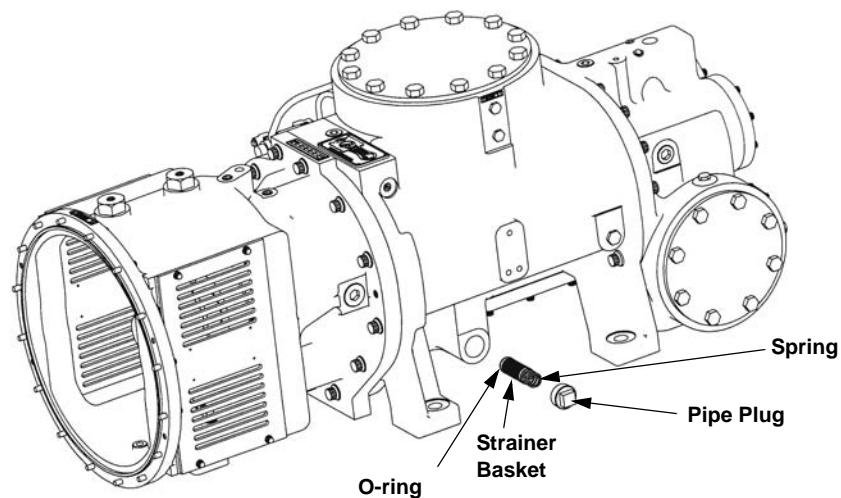


FIGURE 4-4: INTERNAL SCAVENGED OIL GALLERY STRAINER IN SIDE OF COMPRESSOR (STRAINER OUTSIDE TO INSIDE FLOW) - TYPICAL

Rotor Injection Check Valve

A check valve is installed in the rotor injection oil supply line to prevent oil and gas back flow during startup conditions. Under very low compression ratio conditions, rotor injection flow is not required for cooling since compression heat is also very low. The rotor injection's port (internal closed cell) pressure is a function of suction pressure, while rotor injection supply pressure is a function of discharge pressure. The rotor injection check valve must be installed horizontally to function properly. Refer to "Compressor Oil System Pressure Calculations" on Page 4-14 for typical oil system pressure calculations.

Rotor Injection Temperature Control Valve

Rotor injection oil flow is required to cool the compressed gas and also provide gas sealing in the compression chamber. A manual throttling valve is provided in the rotor injection's oil supply line to allow for restricted cooling oil flow. See Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5, Item #20.

Oil Filters

The RG series are oil-flooded rotary compressors that use recirculated, filtered oil for multiple purposes. Oil filter micron ratings and minimum efficiency ratings are designed to protect compressor rotating components from damage.

Full flow oil filtration for bearing, mechanical seal internal gear and hydraulic control actuators' full flow filtration shall equal or exceed a 6 μm rating with a 200 Beta ratio ($\beta_6 = 200$, a 99.5 percent efficiency rating at removing particles 6 μm and larger particle sizes).

Rotor injection full flow oil filtration shall equal or exceed a 16 μm rating with a 200 Beta ratio ($\beta_{16} = 200$, a 99.5 percent efficiency rating at removing particles 16 μm and larger particle sizes).

All Ariel RG compressors with canister type filters are equipped with a continuous flowing vent for removing entrapped process gas from the filter case. A gas/oil mixture is continuously vented into the compressor's gear box to remove all the gas and a limited amount of filtered oil so the filter element is in full contact with the oil flow. An in-line restriction orifice is installed to limit the amount of oil vented.

Ariel recommends replacing filter elements before the differential pressure reaches collapse pressure across the filter, either at normal operating conditions or at six month intervals. Refer to sections 5 and 6 for detailed filter maintenance information. Change rotor injection filter elements if differential pressure exceeds 11 psid (0.75 bar_d).

Liquids and Solid Contaminants in Gas

The use of higher viscosity lubricants or specially compounded lubricants can compensate somewhat for the presence of liquids and solid contaminants in the gas stream.

NOTE: WHEN THERE ARE LIQUIDS AND SOLID CONTAMINANTS PRESENT IN THE PROCESS GAS STREAM, THE MOST EFFECTIVE LUBRICATION OF AN OIL-FLOODED ROTARY COMPRESSOR REQUIRES REMOVAL OF THESE CONTAMINANTS WITH EFFECTIVE SEPARATION BEFORE THE GAS ENTERS THE COMPRESSOR.

To minimize compressor oil dilution, gas/oil separator operating temperatures should be maintained about 20F° (11C°) above process gas dew point temperature at discharge

pressure, but not less than 150°F (66°C). A separator temperature of 150°F (66°C) is minimum temperature required to drive water vapor into process gas stream (natural gas).

Oil Pressure Regulating Valve

The oil pump is generally capable of supplying oil pressure and volume in excess of that required for a specific application. The pressure regulating valve is used to provide an adequate oil flow to bearings, gears, mechanical seal and hydraulically actuated control cylinders, if so equipped, while bypassing the excess oil back into the compressor's scavenged oil gallery. Filtered oil for hydraulic supply is taken upstream of the pressure regulating valve and does not affect valve performance.

The pressure regulating valve is a differential pressure biased, three port valve. This valve is located downstream of the filter, and uses two pressure input signals to maintain an adequate bearing oil flow over a wide range of operating pressures. The valve's biased input has a high pressure leg, which senses oil pressure downstream of the filter, and a low pressure leg, which senses compressor internal scavenged oil gallery pressure. The valve's initial differential pressure setting is performed during Ariel's compressor performance test run at the factory.

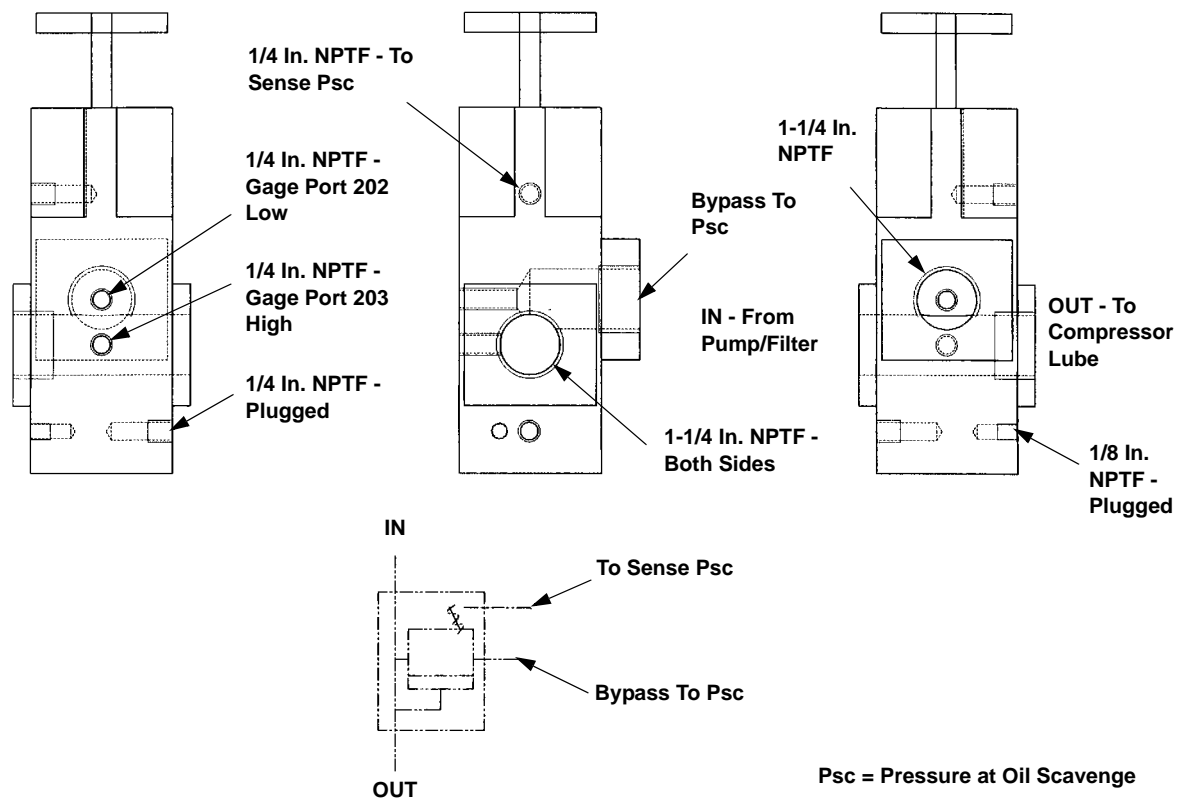


FIGURE 4-5: OIL PRESSURE REGULATING VALVE

Field adjustments of the valve setting allows Ariel rotary compressors to be applied over a wide variety of operating conditions. Refer to "Compressor Oil System Pressure Calculations"

on Page 4-14 to determine proper settings. Refer to Section 5 - "Maintenance" for the field adjustment procedure.

Compressor Oil Pump

For compressor oil pump sizing, refer to the Ariel Performance Program. Changing the gear ratio normally requires changing the oil pump to accommodate minimum and maximum oil flow requirements.

The compressor's integral oil pump is sized for the driver-compressor package speed range and gas application pressures, to provide adequate compressor oil flow and pressure within the driver's normal speed range. Generally, minimum driver speed is based upon a speed versus horsepower or torque lug curve that determines compressor and oil pump minimum speeds. The compressor oil pump is selected to provide adequate oil system flow and pressure at minimum driver speed and maximum compressor differential pressure, based upon the installed speed increasing gear ratio.

The integral compressor oil pump is direct driven by the female rotor. Oil pump flow and pressure are determined by female rotor speed and oil pressure regulating valve position. Male and female rotor speed limitations are given, in Table 4-3 on Page 4-14. Male rotor speed is determined by gear ratio and driver speed, and absolute minimum speed limit for a given application is specified by the Ariel Performance Program.

TABLE 4-3: ROTOR SPEED LIMITATIONS

COMPRESSOR MODEL	ROTOR GEAR RATIO, MALE LOBES/FEMALE FLUTES	MINIMUM ROTOR SPEED, RPM MALE/FEMALE	MAXIMUM ROTOR SPEED, RPM MALE/FEMALE
RG282M	4/6	1040/900	4050/2700
RG357M	4/6	840/560	3210/2140

Minimum bearing oil supply pressure and shutdown setting are based upon the differential pressure connection to the scavenged oil gallery. Refer to "Lube Oil Shutdowns" on Page 4-15 for additional lube oil shutdown information.

Compressor Oil System Pressure Calculations

The pumped oil has a single entry point to the compressor. The oil is distributed internally to the individual components, and is throttled as needed to ensure appropriate oil supply.

Listed below are the minimum compressor oil pressure requirements:

Where: P_s = Suction Pressure, absolute

P_d = Discharge Pressure, absolute

k = Ratio of Specific Heats for Process Gas in Service

p_{sia} = psig + atmospheric pressure at elevation

$$1 \text{ (bar)} = 14.5 \text{ psi}$$

1. Hydraulic Capacity & Vi Control Actuation Pressure, normal = 55 to 60 psig (3.6 to 4.1 bar_g)
2. Bearing Oil Differential Pressure, normal = 55 to 60 psid (3.6 to 4.1 bar_d)
3. Rotor Injection Pressure > Ps x (1.63)^k
4. Scavenged Oil Gallery Internal Pressure = Ps x (1.43)^k

Compressor Re-Application

NOTE: IF ANY OF THE CONDITIONS LISTED BELOW CHANGE, CONSULT YOUR PACKAGER AND/OR ARIEL (“ARIEL TELEPHONE, FAX, E-MAIL AND WEB SITE NUMBERS” ON PAGE 7-18) AS THEY MAY REQUIRE HARDWARE AND/OR DOCUMENTATION CHANGES. PERFORMANCE, GEAR RATIO, OIL PUMP SELECTION AND OIL SYSTEM FLOWS MUST BE RE-CALCULATED.

1. GAS PRESSURES, TEMPERATURES OR FLOW REQUIREMENTS.
2. GAS PROPERTIES.
3. DRIVER TYPE, SPEED OR TORQUE.
4. RE-LOCATION OF COMPRESSOR TO AN ANOTHER SITE.

Lube Oil Shutdowns

NOTE: THE COMPRESSOR MUST HAVE WORKING LOW DIFFERENTIAL OIL PRESSURE AND HIGH INLET OIL TEMPERATURE SHUTDOWN.

Pressure:

Compressor damage can occur with inadequate pumped compressor oil supply flow.

Oil flow across compressor bearings is adequate when the differential oil pressure is greater than the alarm and shutdown setting values. The differential oil pressure shutdown switch (PDSLL - low, low) operates by comparing a high and a low pressure, as shown on the typical oil system schematics seen in Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5. The high leg senses the compressor oil supply pressure, while the low leg senses the compressor's internal scavenged oil gallery pressure (Psc). See the schematics for the location of the differential oil pressure shutdown switch (PDSLL - low, low).

Ariel recommends the oil pressure switch be set to actuate when oil pressure falls below the following pressures:

Normal oil pressure = 55 to 60 psid (3.6 to 4.1 bar_d)

Shutdown = 45 psid (3.1 bar_d), falling

Temperature:

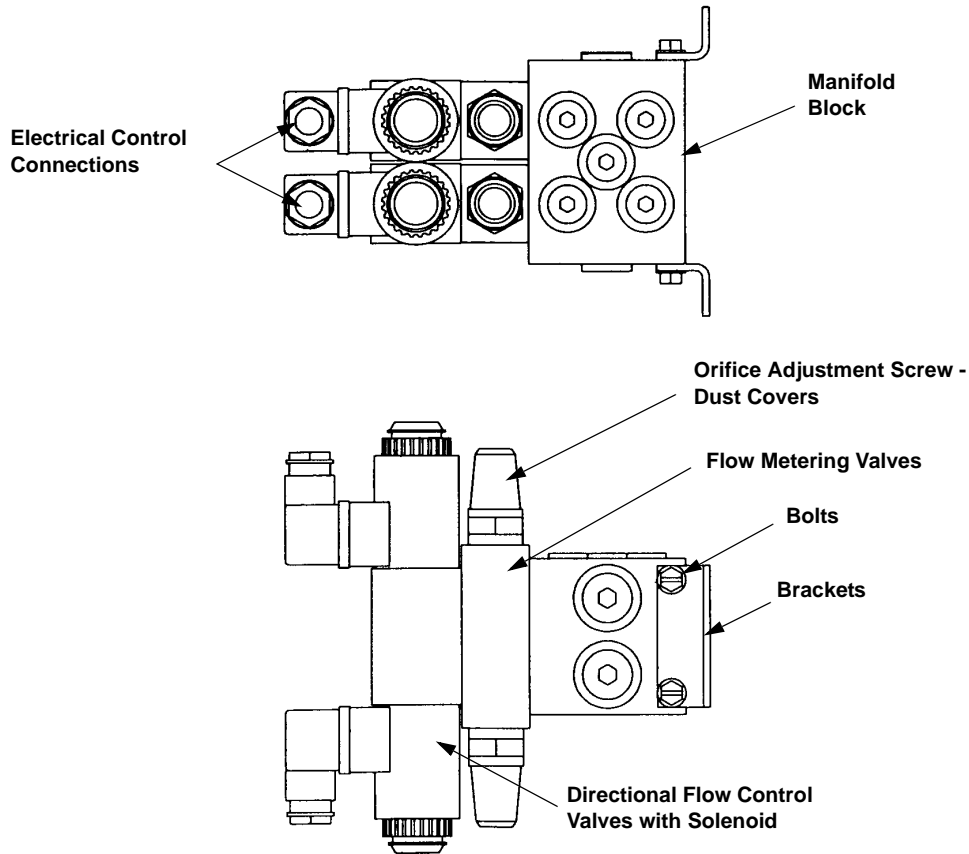
The compressor high oil temperature shutdown is to be located in the Packager's supply oil piping, upstream of the inlet oil strainer connection, refer to Figure 4-1 on page 4-4 and Figure 4-2 on Page 4-5. It is to be set at 170°F (77°C) or lower.

Hydraulic Control Actuation & Cylinders

The RG series compressors has separate inlet volume (capacity) and discharge volume (volume ratio, Vi) control devices. Compressor Vi and capacity control can be adjusted independently by moving pressure balanced sliding plates, either hydraulically or manually (hand wheel option).

The sliding plates, when connected to dual acting hydraulic cylinders, are designed to operate with bearing oil supply pressure, as shown on the typical oil systems seen in Figure 4-1 on page 4-4.

Each control device, capacity and Vi, has separate hydraulic actuation and position feedback. Hydraulic porting is accomplished using a control manifold that consists of a directional control valve, flow metering valve, manifold block and associated inlet/outlet tubing. Two parallel manifold assemblies are shown in Figure 4-6 on Page 4-17.



**FIGURE 4-6:HYDRAULIC CONTROL MANIFOLD - PARALLEL CAPACITY & VI
CONTROL VALVES - TYPICAL**

Flushing Requirements

Some synthetic and mineral based oils are not compatible. Use extreme care and refer to oil suppliers recommendations for draining and flushing the oil system when changing to or from a synthetic oil.

The compressor is tested at the factory using a synthetic - mineral based oil and protected with a vapor phase inhibitor in a mineral oil. These oils may not be compatible with the oil selected for field use. Consult the oil supplier to determine if clean-out flushing is required.

NOTES:

SECTION 5 - MAINTENANCE

General Introduction

The major components of the compressor are the rotor-housing, discharge-housing and gearbox-housing, speed increasing gears, rotors, bearings, mechanical seal, seal housing, oil pump, compressor control devices and oil filters. The mechanical seal, oil pump with coupling, control actuating devices and oil filters may be maintained or replaced in the field.

NOTE: IF OTHER INTERNAL COMPONENTS REQUIRE REPAIR, CONTACT ARIEL FOR ASSISTANCE.

Absolute cleanliness, including the use of lint-free wiping cloths, is a necessity during any maintenance on the compressor. When access covers have been removed, keep the compressor covered to protect the internal surfaces from wind blown debris, except when actually working within it. Any components that have been removed should be protected from falling objects that might mar or chip machined surfaces.

Whenever the compressor is dismantled, O-rings at non-pressure containing positions are to be carefully inspected before reuse, if damaged they should be replaced. O-rings at pressure containing locations should be replaced. O-ring lubricants must be compatible with O-ring materials, lube oil and process gas. Ariel's standard O-ring material is viton.

CAUTION

TO PREVENT PERSONAL INJURY, ENSURE THAT COMPRESSOR ROTOR CANNOT BE TURNED BY THE DRIVER COMPRESSORS, REMOVE THE CENTER COUPLING OR LOCK THE FLYWHEEL. -- ON ELECTRIC MOTOR-DRIVEN COMPRESSORS, IF IT IS INCONVENIENT TO DETACH THE DRIVER FROM THE COMPRESSOR, THE DRIVER SWITCH GEAR MUST BE LOCKED OUT DURING MAINTENANCE.

BEFORE STARTING ANY MAINTENANCE OR REMOVING ANY COMPONENT, RELIEVE ALL PRESSURE FROM THE COMPRESSOR GAS AND OIL SYSTEMS, SEE PACKAGER'S INSTRUCTIONS FOR COMPLETELY VENTING THE SYSTEM.

⚠ CAUTION

AFTER PERFORMING ANY MAINTENANCE, THE ENTIRE SYSTEM MUST BE PURGED WITH GAS PRIOR TO OPERATION TO AVOID A POTENTIALLY EXPLOSIVE AIR/GAS MIXTURE.

Mechanical Seal

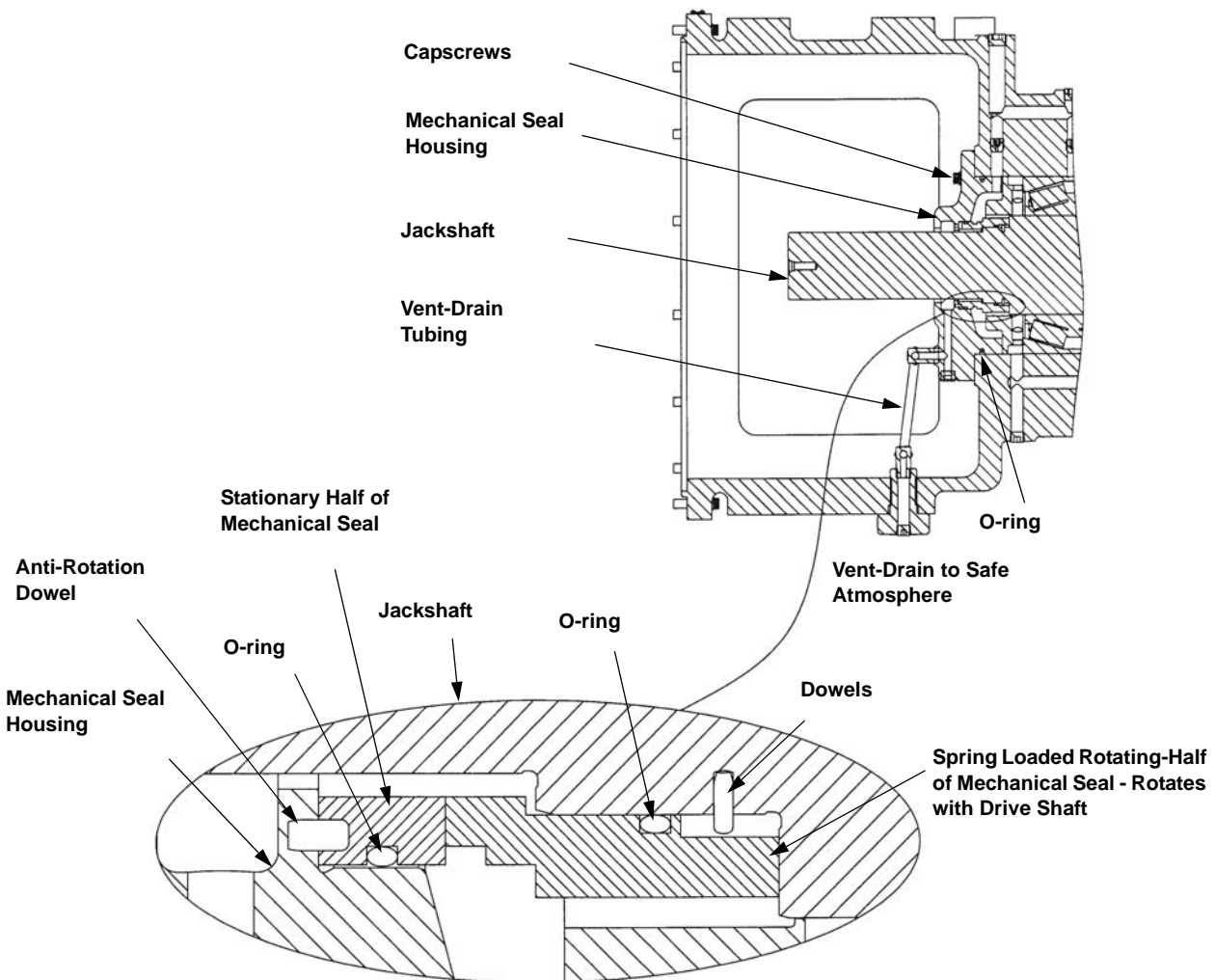


FIGURE 5-1: MECHANICAL SEAL SIDE VIEW - TYPICAL

The mechanical seal prevents loss of internal process gas pressure, at the power input jackshaft, around the shaft to the atmosphere. The seal consists of a spring loaded, pressure balanced carbon seal assembly that turns with the input jackshaft and an outer ring which is

held stationary in the seal housing.

NOTE: MECHANICAL SEAL CRITICAL SURFACES SUCH AS SEAL FACES, O-RING SEATS AND FITS MUST BE HANDLED WITH EXTREME CARE, REPLACEMENT SEAL COMPONENTS MUST BE TRANSPORTED AND STORED IN ORIGINAL UNOPENED PACKAGING. REPLACEMENT SEALS THAT HAVE BEEN SUBJECTED TO SUDDEN IMPACT FORCES, SUCH AS BEING DROPPED, ARE NOT TO BE USED. STORAGE CONDITIONS MUST BE DRY, DUST FREE AND MAINTAINED AT A REASONABLY CONSTANT TEMPERATURE. SEALS STORED IN EXCESS OF THREE (3) YEARS SHOULD BE RE-INSPECTED BEFORE BEING CONSIDERED FOR USE. DO NOT DISASSEMBLE THE SEAL'S SPRING LOADED ASSEMBLY.

TABLE 5-1: APPROXIMATE COMPONENT WEIGHTS - WHEN REPLACING MECHANICAL SEAL

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
Bell Housing Access Cover	10	4.5	20	9
Coupling Components	See Packager Information			
Mechanical Seal Housing	39	17.7	42	19.1
Mechanical Seal	5	2.3	5	2.3

Replacing the Mechanical Seal

Be sure that all pressure is vented from the compressor and piping. Be sure that all the proper tools are available, in good condition and clean. Remove the coupling guard enclosure or the access doors on bell housing mounted models. Disassemble the coupling and remove to allow for mechanical seal replacement. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion.

Install (slip fit) Ariel seal housing removal/installation tool provided in the Ariel tool box as part number 002169. Push tool (over the jackshaft) into place, engaging the spring-loaded grips onto the seal housing. The flange of the tool should be flush with the seal housing. Reference Figure 5-2 on Page 5-4 and Figure 7-3 on Page 7-3.



FIGURE 5-2: INSTALLING SEAL HOUSING REMOVAL/INSTALLATION TOOL

Remove the seal housing vent-drain line tubing.

Remove the 12-point capscrews that secure the mechanical seal housing to the gear housing. Using two of the capscrews as jack bolts in the two tapped holes, loosen the seal housing from the gear housing. See Figure 5-3. Withdraw the seal housing with the installation tool attached, off of the jackshaft to remove. Remove O-ring from seal housing, and stationary ring half of the mechanical seal with its O-ring and discard. Be sure that the anti-rotation dowel pin that holds the stationary ring from turning in the seal housing is retained.



FIGURE 5-3: LOOSENING & REMOVING SEAL HOUSING & TOOL

Remove the spring loaded rotating half of the mechanical seal with its O-ring from the jackshaft and discard. Two large screwdrivers can be used to free the mechanical seal from the jackshaft (engage the large holes on either side of the seal). Be sure that the drive dowels in the jackshaft are retained. Dowels normally stay in place and need not be removed.



FIGURE 5-4: ROTATING HALF OF SEAL REMOVED

Clean parts carefully to remove dirt or residue. Check seal housing for nicks or burrs and remove if necessary. Reassemble using a new mechanical seal with its new O-rings, and a new seal housing O-ring. Inspect new seal to be sure it is clean and the seal faces are free of cracks, scratches, chips and nicks. Lubricate O-rings with a high viscosity silicone fluid such as Parker Super-O-Lube or equal.

Put the new spring-loaded rotating half of seal into place on jackshaft. Be sure that the drive dowels are properly in place and the seal element slots are aligned on the dowels. Fully seat seal into place using the proper assembly tool provided as part number 001788, see Figure 7-2 on Page 7-3. Seal will “snap” into place.



FIGURE 5-5: REAR VIEW ROTATING HALF OF SEAL

Remove the seal housing removal/installation tool (002169) from seal housing before installing the new stationary seal ring. Push the new stationary seal ring into seal housing using the proper assembly tool provided as part number 001742 to seat the seal, see Figure 7-1 on Page 7-2. Before installing stationary half of seal, be sure that the anti-rotation dowel is properly in place in the seal housing and the slot in the ring is aligned with the dowel. Do not push or tap against seal ring face without the proper tool or ring can crack or break. Replace the O-ring on the seal housing.



FIGURE 5-6: INSTALLING STATIONARY HALF OF SEAL

Prior to installing the seal housing, check seal faces again. Faces are to be free from cracks, scratches, dirt, chips and nicks. Use a clean, soft, lint free cloth or paper towel to lightly oil the seal faces with new clean lube oil.

Reinstall seal housing with seal housing removal/installation tool (002169) in place, into gear housing over the jackshaft, being careful to properly position the vent-drain connection vertically downward while aligning bolting holes. Lubricate cap screws, reinstall and tighten to torque values in ER-63.1 using an alternating-star (criss-cross) pattern in 25 percent increments to be sure that seal elements come together squarely. Remove tools, re-install vent-drain line tubing, coupling, and coupling guard or access doors on gear housing, as applicable. Clean tools and return to toolbox.



FIGURE 5-7: INSTALLING SEAL HOUSING & TUBING

NOTE: THE COUPLING BOLT TORQUES ARE BASED UPON COUPLING DESIGN AND THE POWER TO BE TRANSMITTED, CONSULT PACKAGER'S INFORMATION FOR PROPER TORQUE VALUES.

Capacity Control Devices

Capacity control inlet volume (capacity) and discharge volume (volume ratio, V_i) devices can be handwheel or electro-hydraulic actuated. Capacity and V_i devices are identical except for the handwheels or hydraulic actuators. Handwheel actuated devices are positioned by numbers of turns. The hydraulic position actuators have visual indicator plates and electronic position indicators.

Hand Wheel Control Removal

Remove the stem locking pin, so the stem is free to turn. When facing the hand wheel, turn the wheel clockwise to move the sliding valve plate toward the handwheel - this will make it easier to re-engage the valve stem when reinstalling. Orient the hand wheel so a standard socket wrench can access the capscrews. Remove the two capscrews. Turn the hand wheel stem counter-clockwise to disengage it from the valve plate. When the threads have disengaged, pull the stem out. Remove the two Polypac seals and the seal spacer from the valve stem cavity. Discard and replace the Polypac seals. The seal spacer can be reused.

Hydraulic Control Removal

Retract the stem of the hydraulic cylinder to move the sliding plate toward the cylinder - this will make it easier to re-engage the valve stem when reinstalling. Remove tubing from the hydraulic cylinder. Disengage the two "clevis" pins and remove the linear displacement sensor. Protect the sensor from damage. Remove the four capscrews which hold the hydraulic cylinder to the housing. Turn the stem of the hydraulic cylinder counter-clockwise to disengage it from the valve plate. When the threads have disengaged, pull the stem out. Remove the two Polypac seals and seal spacer from the valve stem cavity. Discard and replace the Polypac seals. The seal spacer can be re-used.

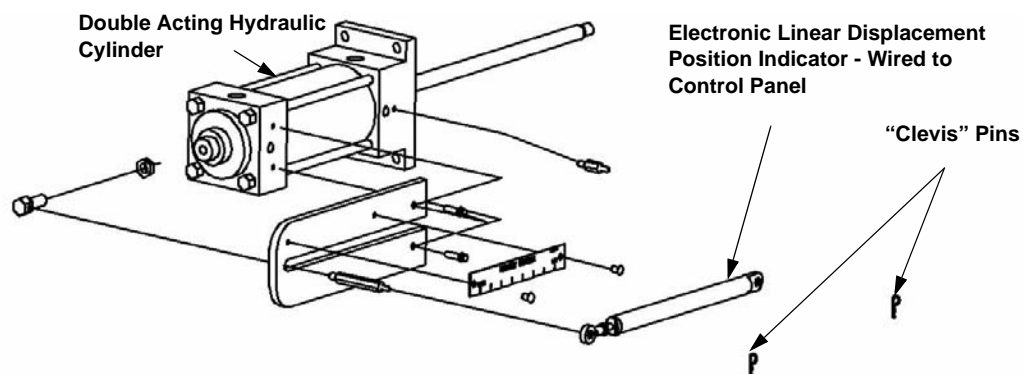


FIGURE 5-8: HYDRAULIC ACTUATED CYLINDER & HARDWARE

TABLE 5-2: CAPACITY CONTROL DEVICES - APPROXIMATE COMPONENT WEIGHTS

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
Hydraulic Cylinder	21	(9.5)	36	(16)
Capacity Valve Cover	55	(25)	97	(44)
Capacity Valve Plate	23	(10)	49	(22)
Vi Valve Cover	24	(11)	44	(20)
Vi Valve Plate	4	(2)	7	(3)

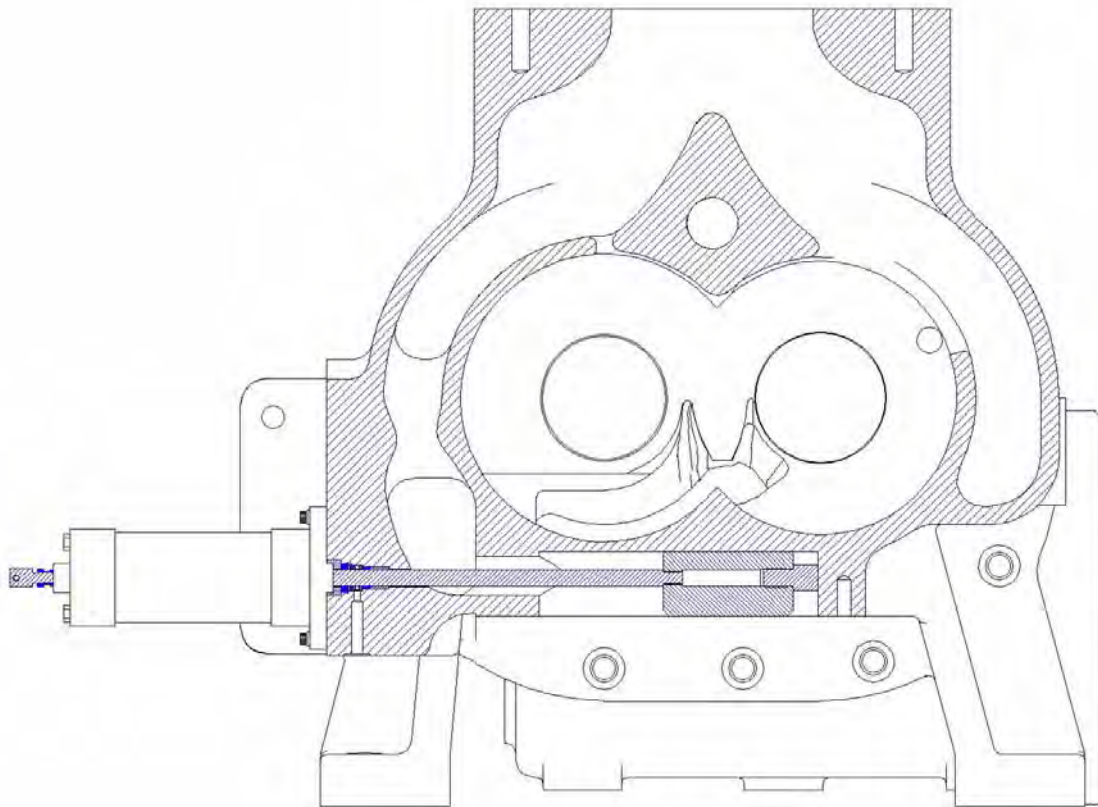


FIGURE 5-9: CAPACITY CONTROL CYLINDER CONNECTED TO ROTOR HOUSING

Capacity Control Cavity Cleanout

First remove the hand wheel or hydraulic control as described in the “Hand Wheel Control Removal” or “Hydraulic Control Removal” sections above, otherwise the valve stem will be bent when removing the capacity control access cover. Remove the drain plug. While

supporting the capacity control valve cover, remove the capscrews which hold the cover to the rotor housing. Carefully lower the access cover and valve plate. Note, the valve plate will be setting loose on the access cover. Remove and replace the O-ring on the access cover. Reference Figure 5-10 on Page 5-9.

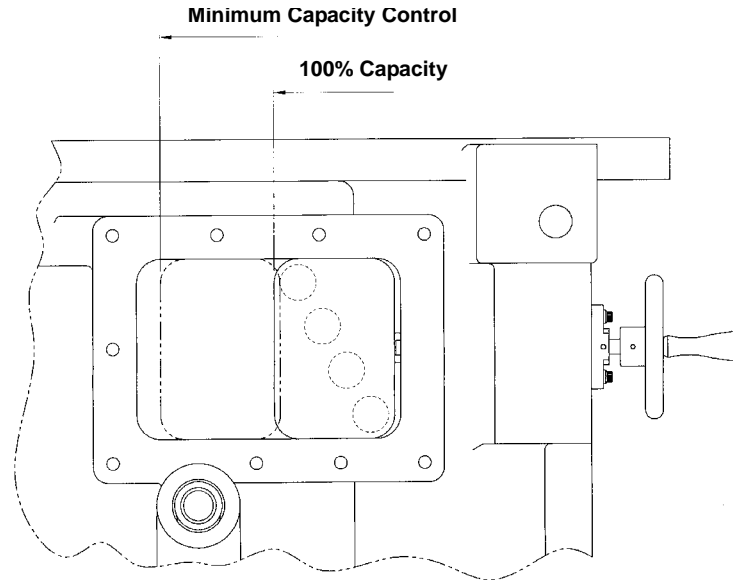


FIGURE 5-10: CAPACITY CONTROL SLIDING VALVE PLATE OVER BYPASS HOLES - TYPICAL BOTTOM VIEW

Vi Control Sliding Valve Plate Removal

First remove the hand wheel or hydraulic control. As described in the “Hand Wheel Control Removal” or “Hydraulic Control Removal” sections above, make certain that the valve plate has been moved toward the Vi valve cover. Remove the four capscrews which hold the Vi valve cover to the rotor housing and discharge housing. Remove the Vi valve cover taking care not to damage the O-ring. Pull the O-ring out of the face of the rotor housing and slide the Vi valve plate under the O-ring.

When reinstalling the Vi valve cover housing, hand tighten the four capscrews in sequence 1-2-3-4 in 1/4 turn increments until cover is firmly seated against the discharge and rotor housings. See Figure 5-11 on Page 5-10. Torque the capscrews 1 & 4 to the full torque value given in ER-63.1 in 25 percent increments, prior to tightening capscrews 2 & 3.

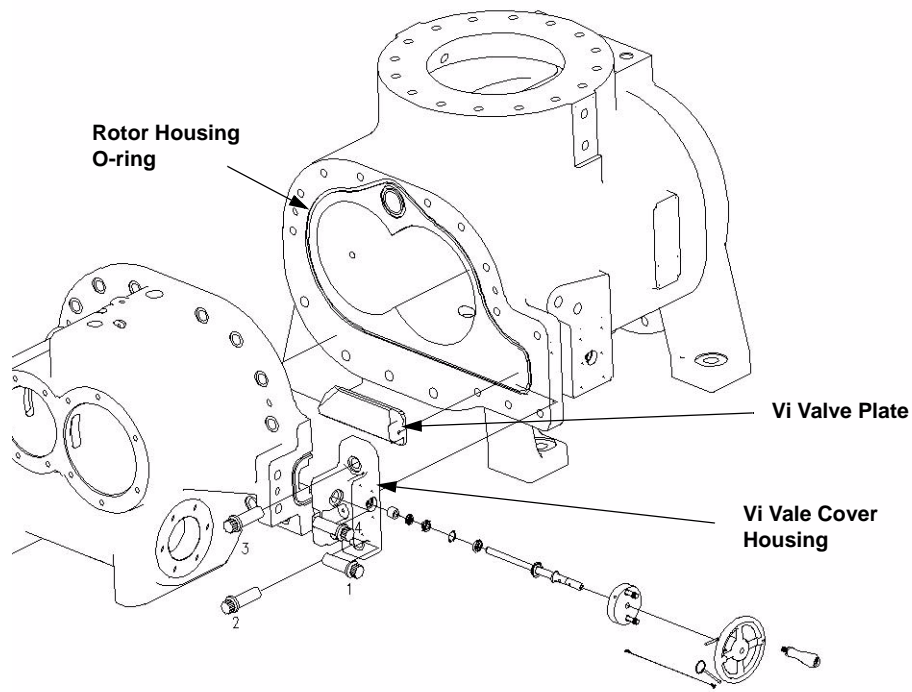


FIGURE 5-11: HANDWHEEL ACTUATED VI CONTROL - TYPICAL

Hydraulic Actuated Control

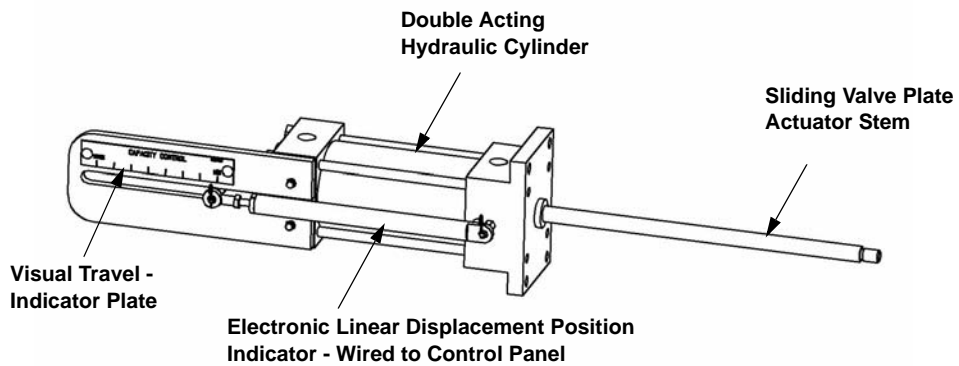


FIGURE 5-12: HYDRAULIC ACTUATED - CYLINDER & ASSOCIATED HARDWARE - TYPICAL

See Ariel Web page at www.arielcorp.com for vendor literature on electronic indicators.

Hand Wheel Actuated Control Position Indication

See Table 1-2 on Page 1-8 and Table 1-3 on Page 1-8 for numbers of turns vs. positions.

Oil Pump and Geared Tooth Coupling

Oil Pump Replacement

Refer to Figure 5-13 on Page 5-12. To replace the oil pump, first mark the pump suction and discharge end connections, then remove oil piping from the pump as required. To remove pump from compressor, remove capscrews (or stud-nuts) and slide pump out, separating the coupling halves at the sleeve. The coupling driven-half will come out attached to the pump shaft, while the coupling sleeve is retained by the drive half of the coupling which is bolted and dowelled to the female rotor. Remove O-ring and discard.

Loosen the key set screw and remove gear coupling-half from the pump shaft with a two or three jaw gear puller. Inspect the coupling's geared teeth, if there is excessive wear, replace the entire coupling with a new assembly.

Replace the pump with a new part, correct for the compressor application. Install the coupling driven-half to the new pump shaft with key installed and firmly seated. There should be a slight clearance of 0.005 in. (0.13 mm) between the top of the key and the mating coupling. Position the coupling-half on the pump shaft end so the axial spacing between the coupling halves is 3/32 in. (2.5 mm), then tighten set screw.

NOTE: THE COUPLING DRIVEN-HALF SHOULD BE APPROXIMATELY FLUSH WITH THE PUMP SHAFT END.

Replace O-ring(s) with new parts. Lubricate coupling sleeve teeth with clean oil. Slide the pump into place, with shaft position rotated to properly engage gear teeth. Be sure pump flow is in the correct direction. Be sure that the flange cover oil passage holes are aligned to scavenged oil port for proper bearing oil flow. Replace fasteners and tighten to the proper torque shown in ER-63.1. Pour a small quantity of oil into pump intake to lubricate new pump, and re-attach oil piping as required.

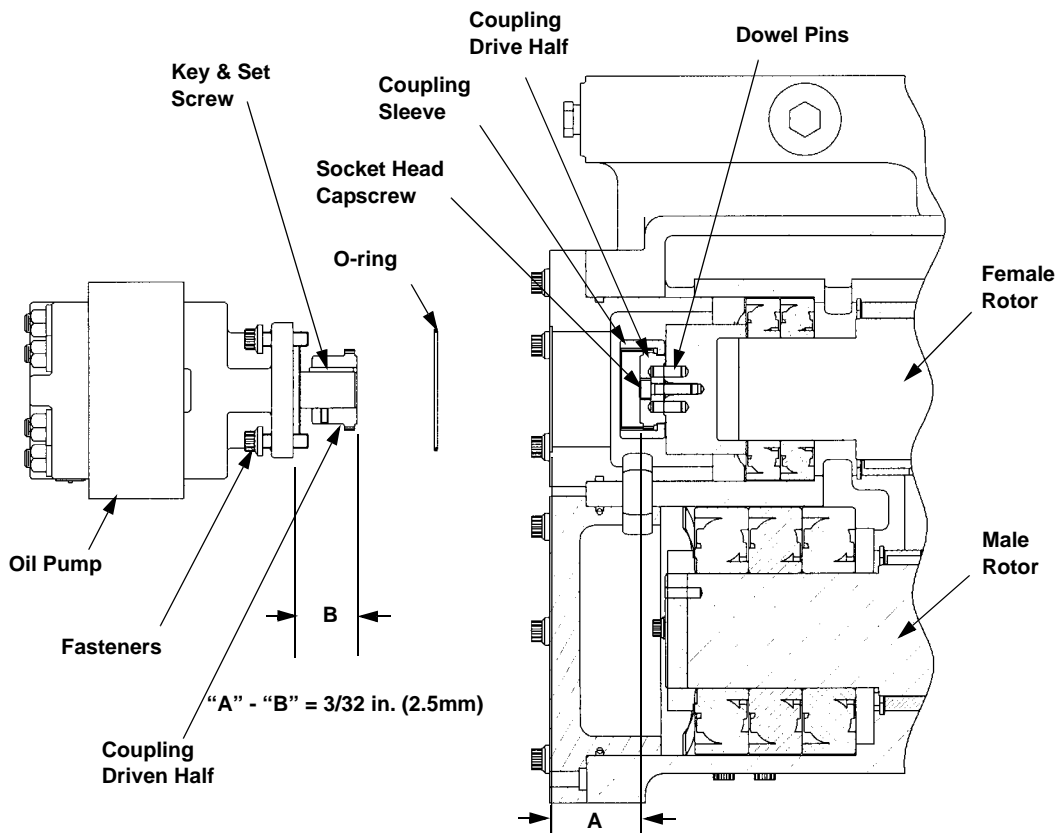


FIGURE 5-13: OIL PUMP AND COUPLING REPLACEMENT - TYPICAL

Oil Pump Coupling Replacement

NOTE: IF THE PUMP COUPLING IS REPLACED, CHECK THE SLEEVE AND HUBS FOR ANY MACHINING CHIPS OR BURRS AND REMOVE BEFORE INSTALLING.

To replace the entire pump coupling, begin as described in first paragraph under Oil Pump Replacement above. Remove the fasteners as required and O-ring. Discard the O-ring. Remove the drive coupling-half socket head cap screw. Remove the drive coupling-half and sleeve assembly, being careful not to cock the coupling half and break the hardened dowel pins.

Replace coupling drive half and sleeve with new parts. Position coupling drive-half, with sleeve installed, over dowel pins and draw up by tightening the cap screw to the proper torque shown in ER-63.1. Verify the sleeve is free to pivot on the drive coupling-half gear teeth. Position new coupling driven-half on the end of the pump shaft and proceed with oil pump re-installation in “Oil Pump Replacement” above.

Drive Gear Set Replacement

TABLE 5-3: APPROXIMATE GEARBOX-ASSEMBLY WEIGHTS

COMPONENT	WEIGHT			
	RG282M		RG357M	
	LB	(kg)	LB	(kg)
w/o Bell Housing	715	(325)	980	(445)
w/Bell Housing	1145	(520)	1805	(820)

Gearbox Removal with Bell Housing Flange Mounting

Be sure all pressure is vented from the compressor and piping. Remove access doors, gas and oil connected piping, vent and drain lines and electrical connections.

Remove coupling. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion.

Supporting the compressor weight from an overhead crane while separating the compressor from driver. Remove the mounting bolts at the two compressor feet. Ariel has identified specific compressor lifting points, and provides lifting eyebolts in the toolbox to support compressor weight while separating and to move the compressor. Refer to Figure 1-9 on Page 1-11 for the compressor's center of gravity and recommended lifting points.

While supporting the compressor weight from the crane, remove the mounting flange bolting. Use four (4) mounting bolts in the four (4) threaded jack bolt holes. Tighten jack bolts in an alternating-star (criss-cross) pattern, one turn at a time, to separate the compressor from the engine. Utilizing a crane, eases the compressor to engine separation and keeps the compressor from exhibiting a sudden downward movement once the SAE pilot diameter disengages the driver housing bore.

Set compressor on its feet on a flat solid surface capable of supporting the weight, to allow for changing the gear set.

Do not suspend compressor from its SAE mounting-flange, when lifting. The compressor is to be separated from the driver when lifting. Attempting to lift the driver/compressor combination can result in serious compressor flange damage and possible personal injury.

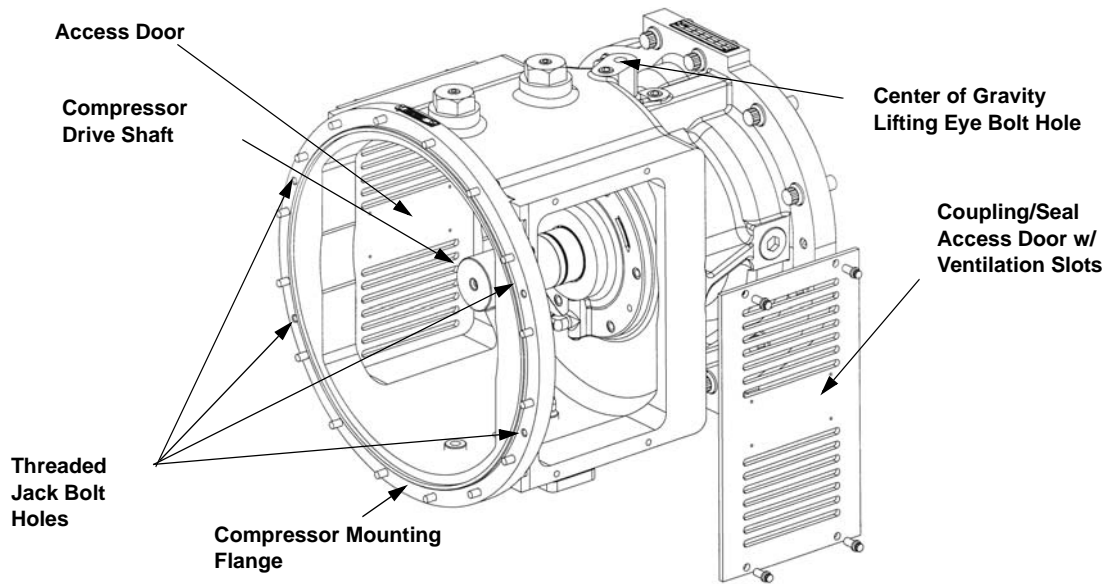


FIGURE 5-14: COMPRESSOR GEARBOX WITH FLANGE MOUNTING - DISCHARGE-SIDE VIEW - TYPICAL

Gearbox Removal without Bell Housing Flange Mounting

It is not necessary to remove the compressor from the package. Be sure all pressure is vented from the compressor and piping. Remove the coupling guard and coupling. Temporarily reassemble the coupling components and store coupling protected from dust and corrosion. Remove vent and drain lines from compressor gearbox.

Gearbox Removal (continued) - with or without Bell Housing

Ariel recommends that the gearbox not be removed from the compressor under outdoor or other conditions which could result in contamination of the gears or bearings.

If changing the gear ratio to accommodate a change of conditions, contact your packager or Ariel for proper application information. See Table 1-1 on Page 1-7 for gear ratios available. A new drive gear and new pinion must be matching ratio, but **new** gears are not matched sets. That is, any new gear can be assembled with any new pinion with matching ratio. If a used gear and the mating pinion are available to the desired gear ratio, the used parts may be installed after cleaning and inspecting to be sure that parts are in good condition, free of corrosion or pitting and do not have an uneven or excessive wear pattern. **Used** drive gear and pinion become matched sets as a result of wear-in and can only be used together.

With the compressor in the horizontal position, place a lifting lug eye bolt in the center-of-gravity position for the gearbox shown in Figure 5-14 on Page 5-14.

Using the dowel puller provided in the Ariel toolbox as part number 002119, pull alignment dowels to completely loosen, leaving the dowels in the gearbox housing.



NOTE: Thermocouple wire at arrow is not present on a typical compressor in the field.

Figure 5-15: Pulling Alignment Dowels

Remove two capscrews, 180° apart just above the horizontal centerline from the gearbox flange and install the two guide pins provided as part number 002151.

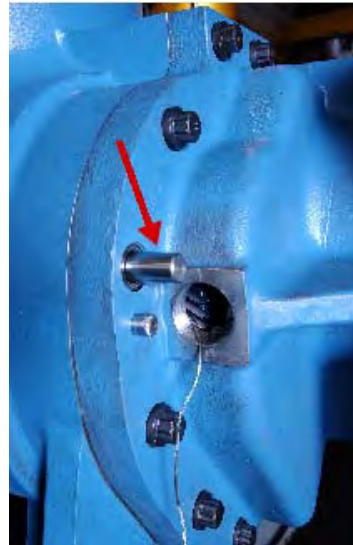


Figure 5-16: Guide Pins Installed

Set a crane in a lifting position, and adjust so that lifting chain or strap is tight, but without lifting the assembly. With a correct crane setting the gear box should remain horizontal when all the capscrews are removed.

Remove remaining capscrews. A special bolting torque adapter provided as part number 002278 is required to remove one of the capscrews. With a correct setting of the crane the

gear box can be moved by hand away from the inlet housing. If the crane is not set correctly the gear and pinion teeth can lock up, resisting removal. This can usually be detected by an uneven gap from top to bottom of the flange face. A small adjustment of the crane up or down should rectify any gear lockup. Remove the housing flange O-ring and discard.



Figure 5-17: Separating Gear Housing from Compressor

Gear Set Removal

With the gear box housing secure on a flat surface, install (slip fit) the plastic protective sleeve tool over the end of the jackshaft. The sleeve is provided as a part the gear stop/retaining tool part number 002119, to protect the inner bearing race shaft-surface from damage.



Figure 5-18: Installing Plastic Protective Sleeve Tool

Route the hydraulic hose provided with the hydraulic gear removal connection hardware part number 002191 through the clearance hole in the gear stop tool. Tighten hose connection

into the jackshaft threaded port. Install the gear stop with the capscrew provided, allowing 1/8 in. (3 mm) clearance between the gear and the gear stop to limit gear travel during removal.



Figure 5-19: Installing Gear Stop/Retainer

CAUTION: BE SURE THE GAP BETWEEN THE GEAR STOP/RETAINER TOOL AND THE GEAR IS NO MORE THAN 1/8 IN (3 mm). FAILURE TO USE THIS TOOL OR ALLOWING A GREATER GAP CAN RESULT IN PERSONAL INJURY AND DAMAGE TO THE HARDWARE.

Apply hydraulic pressure, approximately 15,000 to 22,000 psi (1000 to 1500 bar) using a hand pump such as is available from Ariel, purchased separately, as part number 002191, until the taper fit gear pops to loosen it from the jackshaft. Move out gear stop by loosening center capscrew slightly and re-pressurize until gear is free from the jackshaft.



Figure 5-20: Pressurizing to Remove Gear

Repeat the gear removal procedure for the pinion gear on the male rotor, using the pinion stop/retaining tool furnished as part number 002158, secured with a capscrew to retain the pinion as it comes free.

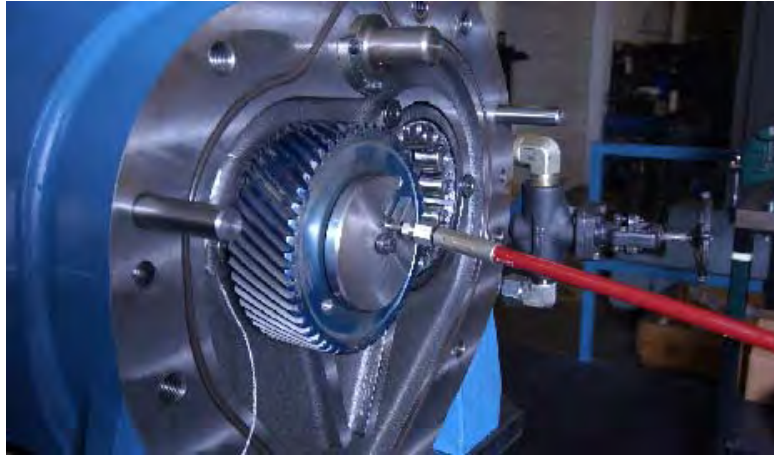


Figure 5-21: Pressurizing To Remove Pinion

CAUTION: FAILURE TO USE THE GEAR STOP/RETAINERS WHEN REMOVING THE GEAR AND PINION CAN RESULT IN SERIOUS PERSONAL INJURY.

Set the removed gear and pinion aside for storage preparation and appropriate marking as a matched set, or scrap depending on the condition.

Relatively new bearings should not need be replaced, but consideration should be given to bearing replacement in each individual case when changing gears.

Gear Set Installation

Be sure that shaft journals and gear bores are free from dirt, oil, rust, dings, burrs and high spots prior to installation. Heat the replacement gear to 325°F maximum (163°C) using an induction heater with a calibrated temperature control. Refer to the manufacturer's instructions for the proper use of the induction heater. Care is to be taken not to over-heat the gears, as too much heat will result in a loss of material hardness causing premature wear. Insufficient heating will result in difficulties at installation due to a lack of assembly clearance. See Figure 5-22: on Page 5-19.

CAUTION: WEAR PROTECTIVE CLOTHING SUCH AS THERMAL GLOVES WHEN HANDLING HEATED PARTS OR SERIOUS BURNS CAN RESULT.



Figure 5-22: Heating New Gear

With the plastic protective sleeve in place on the jackshaft, quickly put the hot gear on the shaft taper and push the gear back until contacting the shaft shoulder. Rotate the gear slowly until it locks onto the jackshaft. Remove protective sleeve. To save time the gear may be cooled with compressed air.



Figure 5-23: Installing New Gear

Repeat the installation process for the pinion onto the male rotor.



Figure 5-24: Installing New Pinion

Re-Installing the Gearbox

Install the two guide pins furnished as part number 002151, 180° apart just above the horizontal centerline in the rotor housing. Install a new O-ring in the compressor to gear box housing flange.

Lift gearbox toward the compressor using a crane. Be sure the housings are aligned to each other. Start gearbox housing over the guide pins. Turn jackshaft as required to align gear teeth and check alignment of jackshaft into the bearing race. When bringing housings together, start alignment dowels into the mating housing's dowel holes.



Figure 5-25: Re-Installing Gearbox on Compressor

Lubricate and install the capscrews by hand except for the two holes occupied by the guide pins. Use hand wrench and the bolting to pull flanges to together, without loading the joint. Finish tapping in alignment dowels using a hammer and a brass punch. Remove the guide pins. Lubricate and install the remaining two capscrews, hand tight. Remove crane.

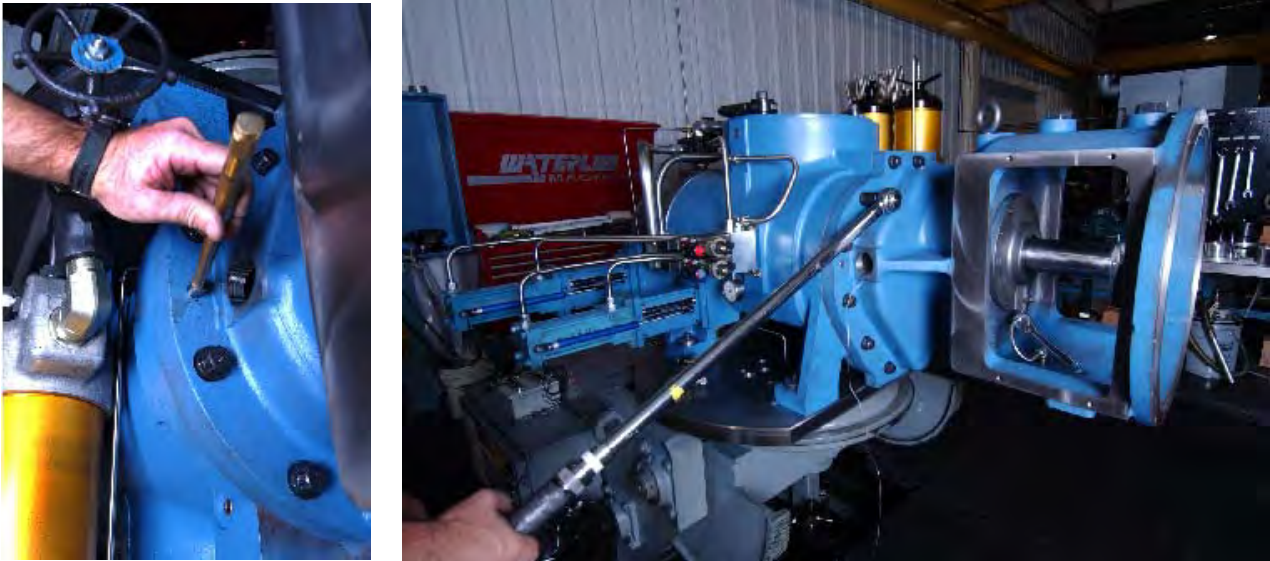


Figure 5-26: Setting Alignment Dowels & Tightening Bolting

Tighten the capscrews to the torque value in ER-63.1 in an alternating-star (criss-cross) pattern in 25% increments. A special bolting torque adapter provided in the toolbox as part number 002278 is required to tighten one of the capscrews. Clean all tools and return to toolbox.

Stamp or vibra-etch the current gear ratio and date on the installed gear ratio/date information plate, refer to Figure 5-27. See Figure 1-9 on Page 1-11, top view for plate location. Mark plate even if gear ratio did not change.

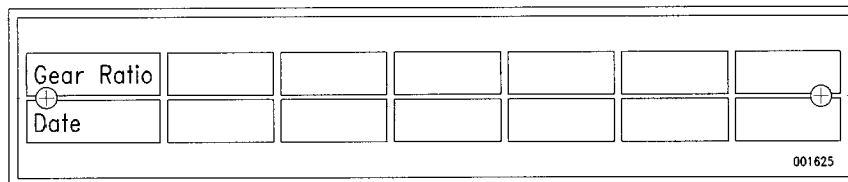


FIGURE 5-27: INSTALLED GEAR RATIO/DATE INFORMATION PLATE

Re-Couple Compressor to Driver

See Section 2 to re-install a flange mounted compressor on the skid. Re-install piping and electrical connections as required.

Reinstall coupling. Reinstall coupling guard or access doors on gear housing, as applicable. Before start-up, refer to Section 3. Repeat check list as part of start-up.

NOTE: THE COUPLING BOLT TORQUES ARE BASED UPON COUPLING DESIGN AND THE POWER TO BE TRANSMITTED, CONSULT PACKAGER'S INFORMATION FOR PROPER TORQUE VALUES.

Check Oil Pump Change Requirements

When changing gear ratio, the oil pump will normally also require changing to match the new operating conditions to the Ariel Rotary Compressor Performance Program (contact your Packager or Ariel when you need this information). See "Oil Pump and Geared Tooth Coupling" on Page 5-11 for pump installation instructions.

Old Gear Set and Oil Pump - Handling and Storage

Clean gear, pinion and oil pump to remove soil and grit. Treat surfaces of parts with a good rust inhibitor, plug openings into oil pump, and package using acid free materials.

Tag/mark gears with parts identification, gear ratio, compressor model, date and the words "Gear set - matched pair". A gear and pinion that have run together become a matched set due to wear-in and may be only reinstalled together as a set, when their gear ratio is required. Mark pump packaging with part number, and description including make and model. If in long term storage, check parts periodically and re-protect as required to prevent rusting.

Oil Filters

Refer to "Oil Filters" on Page 4-12 for the compressor's oil filter specifications. Refer to the Parts List for Ariel part numbers for the proper filter elements.

When changing the canister oil filters, remove the flowing vent line and blow clean with compressed air through the bleed fitting in the T-handle. Drain oil from filter. Failure to drain filter will result in dirty oil being introduced to the compressor internal parts and reduce parts life. Clean the orifice with 1/32 in. (1 mm) diameter wire or standard paper clip (20/21 gage). Close canister drain and fill the canisters with clean filtered oil using the same type and grade as in the compressor. Trapped air will be released through the vent. Reassemble vent line after filter has been changed and canister closed. Check for and fix any leaks.

NOTE: FAILURE TO FILL FILTER VESSELS WITH OIL PRIOR TO STARTING, AND AFTER CHANGING FILTER ELEMENTS CAN CAUSE SEVERE DAMAGE TO THE COMPRESSOR.

See Packager's information for maintaining the coalescing filter in the gas/oil separator.

Oil Pressure Regulating Control Valve

Refer to Figure 4-5 on Page 4-13.

Installation

1. Use Loctite 545 thread sealing compound with Loctite Activator "N" to seal threaded connections.
2. Install valve, as shown on appropriate Ariel assembly drawing, with outlet connection pointing toward compressor oil gallery inlet, valve inlet connection pointing up, and bypass outlet connection pointing toward drive end.
3. Tighten valve until adjusting handle points toward oil pump end of compressor.
4. Turn valve handle from stop to stop (approximately 16 revolutions) to be sure of proper mechanical operation.

Adjusting Oil Pressure Regulating Control Valve

1. This control valve functions as a pressuring sensing logic valve, where it permits secondary oil flow only after a pilot pressure signal is sensed and maintained.
2. The set pressure must be reached and maintained in the primary oil flow leg (compressor oil supply) before excess oil flow is directed to the secondary flow leg (compressor scavenged oil gallery).
3. This valve is preset to 55 psid (3.8 bar_d) at Ariel during performance testing, prior to compressor shipment.
4. If it is necessary to adjust a replacement control valve, first turn valve handle clockwise to compress spring, (16 turns from minimum to maximum spring tension), then loosen about 3 turns.
5. Start compressor, observing compressor's oil supply pressure on the valve's differential pressure gauge.
6. If it is necessary to adjust the control valve's pressure setting, either turn valve handle clockwise to compress spring and increase oil supply pressure, (16 turns from minimum to maximum spring tension), or turn valve handle counter-clockwise to loosen spring and decrease oil supply pressure.
7. Adjust valve's differential pressure to 55 psid (3.8 bar_d) at driver's rated speed (i.e. 1800, 1500, 1400 RPM), then lock handle in position by tightening stem locknut.

Ethylene Glycol Contamination

Ethylene glycol anti-freeze coolant mixture leaking into the oil from a water-cooled oil cooler leak can cause bearing damage and rotor seizure due to lack of adequate lubrication. The oil

should be changed as recommended in the Section 6, while being routinely sampled and analyzed by a qualified laboratory to verify suitability for continued use, including checking for ethylene glycol contamination.

If contamination is found, find and fix coolant leak. Even small quantities of ethylene glycol in the oil can be detrimental. If contamination is less than 5 percent, drain oil, replace filters and flush oil system, including all piping, with a 50-50 mixture of butoxyethanol (Dow Chemical Co. Dowanol EB or equal) and 10W oil using a motor driven pump. Flushing should be done on a warm compressor. Bearings should be continuously flushed for 1/2 hour while barring over compressor. All surfaces that come in contact with the oil are to be flushed which includes spraying all interior surfaces in the compressor and gas/oil separator. Completely drain cleaning mixture, being sure to drain all components of the oil system. Repeat flushing operating using a 60-40 mixture of 10W oil and kerosene or fuel oil. Completely drain oil system, install new filters and fill with proper oil.

If sampling indicates that glycol contamination is greater than 5 percent or compressor has seized due to contamination, the unit is to be returned to Ariel, torn down, cleaned with 100 percent butoxyethanol, flushed with kerosene or fuel oil and repaired as required. All surfaces that come in contact with oil must be cleaned with butoxyethanol, including all passages and piping, and then flushed with kerosene or fuel oil. Oil and filters must be changed. Coolant leak is to be found and repaired.

Butoxyethanol presents health and safety hazards. Use proper eye and skin protection and adequate ventilation. Do not use near open flame or sparks. See manufacturer's Material Safety Data Sheet for complete details.

Ethylene glycol, butoxyethanol, contaminated oils and solvents must be properly disposed. A chemical disposal service should be used.

Mineral Deposit Build-up in Low Pressure Natural Gas Applications

Mineral deposit build-up can occur when liquids have not been completely removed from the gas stream, particularly in low pressure natural gas applications. These minerals (such as salt and calcium dissolved in water saturated process gas) plate out when water flashes off due to pressure drop or heating. The minerals can build up on the suction strainer screen and in the compressor. If mineral build-up is observed during maintenance, additional steps should be taken for liquid removal from the gas stream prior to entering the compressor.

SECTION 6 - TECHNICAL ASSISTANCE

Recommended Maintenance Intervals

Like all equipment, Ariel compressors do require maintenance. The frequency of maintenance is dictated by the environment in which the compressor is placed, the loads the user imposes on the compressor and the cleanliness of the process gas being compressed.

First and foremost on the preventative maintenance list is the completion and compliance with the Ariel Corporation Packagers Standard and Compressor Start Up Check List, see Section 3. All items must be adhered to, both before and after start up.

The following is a guide only and, as stated above, may vary due to operating conditions. The time intervals start with the start up date of the unit. If your oil supplier's recommend oil service changes are more frequent than the Ariel recommendations, the supplier's intervals should be followed. Regular oil analysis is recommended. If problems develop, an oil sample should be taken for analysis by a reputable lab. As part of correcting the problem, it may be necessary to change the oil in the entire system.

A log book should be kept with each unit. Every maintenance item can be entered with exacting detail in order that records will be available for tracking maintenance costs per unit and for trouble-shooting.

Operator logs should be reviewed by qualified personnel to determine trends in compressor performance and/or maintenance.

Daily¹

1. Check oil pressures and temperature. Recommended compressor inlet oil temperature is 150°F (65°C).
2. Check gas/oil separator oil level when compressor is in operation. It should be in mid-sight glass and, if not, determine and correct the cause. Do not overfill.
3. Check mechanical seal vent for blowing gas, or excessive oil leakage. If blowing, or leaking excessively, determine cause and, if necessary, replace mechanical seal parts.
4. Check and correct any gas leaks.
5. Check and correct any oil leaks.
6. Check operating pressure and temperatures. If not normal, determine cause of

1. After running a new compressor (or after re-location or major overhaul) for one week or 150 hours, shutdown and check fastener torque on gas nozzle flanges and scavenge oil connections. Refer to Paragraph 7. on Page 1-14 for information on how to properly check fastener torque and ER-63.1 for torque values.

abnormality. It is recommended that a daily log of operating temperatures and pressure be kept for reference. See Daily Log Sheet in Section 3.

7. Check shutdown set points. High-low pressure and temperature shutdowns set as close as practical to current operating conditions.
8. Check for unusual noises or vibrations.
9. Check gas/oil separator scavenged oil flow indicator for oil and entrained gas flow. Adjust as required.
10. Check oil filters differential pressures.
11. Check slide plate position. Adjust as required.
12. Check gas suction strainer differential pressure. See packager's information for details on mesh size and differential pressure limits.

Monthly (in addition to Daily Requirements)

1. Check and confirm safety shutdown functions.
2. Review oil analysis to determine if good for continued use.
3. Inspect, flange mounting bolts to driver, anchor bolts and shims for looseness. Tighten as required.
4. Check oil viscosity requirements for current gas analysis and operating conditions.

Every 6 Months or 4,000 Hours (plus Daily/Monthly)

1. Change oil filter elements¹ or as specified by the manufacturer or oil consultant.
2. Verify that oil is suitable for continued use. A more frequent oil change interval may be required if operating in an extremely dirty environment or if the oil supplier recommends it or if an oil analysis dictates it. A less frequent oil change interval may be required if the oil is replenished on a regular basis due to usage.
3. Clean the three (3) oil strainers, or whenever lubricating oil is changed or if lube oil supply strainer differential pressure exceeds 4 psid (0.3 bar_d).
4. Re-tighten hold down stud-nuts to proper torque values and perform a soft foot check. More than 0.002 in. (0.05 mm) pull down requires re-shimming.
5. Inspect coupling element for cracking and/or axial distortion. Realign if necessary to hold coupling alignment within 0.002 inch (0.05 mm) TIR.

Yearly or every 8,000 Hours (plus Daily/Monthly/6 Months)

1. Inspect compressor mounting for twist or bending by checking shimming of

1. Change rotor injection filter element more often whenever differential pressure exceeds 11 psid (0.75 bar_d).

- compressor feet.
2. Check and re-calibrate all temperature and pressure gauges.
 3. Change gas/oil separator coalescing filter element, or before differential pressure exceeds collapse pressure, or as specified by the manufacturer or oil consultant.
 4. Clean gas strainer.
 5. Inspect gear tooth mesh wear pattern for abnormal or excessive wear. Reference ANSI/AGMA 1010, "Appearance of Gear Teeth - Terminology of Wear and Failure".
 6. Check gas nozzle and scavenge oil connection fastener torque.

Trouble Shooting

Minor problems can be expected during the routine operation of an Ariel compressor. These troubles are most often traced to liquid, dirt, improper alignment adjustment or to operating personnel being unfamiliar with Ariel compressors. Difficulties of this type can usually be corrected by cleaning, proper alignment adjustment, elimination of an adverse condition, replacement of a relatively minor part or proper training of the operating personnel.

Major problems can usually be traced to long periods of operation with unsuitable lubrication, improper counter-thrust gas balance pressure, careless operation, lack of routine maintenance or the use of the compressor for purposes for which it was not intended.

Recording of the pressures and temperatures is valuable because any variation, when operating at a given load point, indicates trouble.

While it would be impossible to compile a complete list of every possible problem, listed below are some of the more common ones with their possible causes.

PROBLEM	POSSIBLE CAUSES
Low Oil Pressure	Defective pressure gauge. Oil regulating valves improperly adjusted for conditions. Oil regulating valve bypass is stuck in the open position. Oil pressure at pump inlet below 2 psig (0.14 bar _g). Dirty or plugged oil strainer. Dirty oil filter. Improper low oil pressure switch setting. Low oil viscosity (oil supply temperature too high). Excessive leakage at seals or bearings. Leaking oil pump check valve. Oil pump wear. Oil pump coupling disengaged. Improper end clearance in oil pump.
High Oil Pressure	Cold oil. Oil regulating valves improperly adjusted for conditions. High oil viscosity. Oil regulating valve unable to bypass excess oil.

PROBLEM	POSSIBLE CAUSES
Low Oil Temperature	Thermostatic valve element defective. Oil heater or thermostat defective.
High Oil Temperature	Thermostatic valve element defective. Cooler fan not working. Oil cooler dirty. Low oil viscosity.
High Gas Discharge Temperature	Inadequate rotor injection oil rate. Plugged oil strainer. High oil supply temperature High suction temperature. High suction or discharge pressure.
Excessive Vibration and/or Noise in Compressor	Loose compressor hold down bolting. Coupling not properly aligned. Coupling out of balance. Improper lube oil and/or insufficient lube rate. Lubrication failure. Liquids in gas. Excessive rotor end play. Loose or worn bearings. Oil pump damaged.
High Oil Consumption	Oil system over filled. Separator-scavenged oil line plugged or throttling valve closed. Excessive oil dilution from process gas. Collapsed coalescing filter element. Oil/ gas separator coalescing filter gaskets not sealed or defective. Improper coalescing filter element installed. Oil pump damaged.
Excessive Leakage at Mechanical Seal Weep Tube	Mechanical seal is not effective and should be replaced.
Hydraulic Cylinder Motion Erratic	Entrapped air/gas in hydraulic system. Cycle cylinder for full stroke at least twice to remove air/gas. Differential pressure from P-port to T-port is below 35 psid (2.4 bar _d). Oil is cold and very viscous. Flow control valves need to be adjusted.
Capacity or Vi Valve Will Not Move	3-way hydraulic control valve jammed with debris. Insufficient oil pressure or flow control valves closed. Debris has jammed the valve plate. Debris in the actuator cylinder jammed the piston. Solenoid coil on directional control valves burned out.

SECTION 7 - APPENDICES

Ariel Tools

Ariel Furnished Tools

Ariel provides one tool box with each unit with customized tools included in the toolbox as listed below.

TABLE 7-1: ARIEL FURNISHED TOOLS - REFER TO ILLUSTRATIONS ON FOLLOWING PAGES

TOOL DESCRIPTION		RG282M		RG357M	
		QTY	ARIEL P/N	QTY	ARIEL P/N
For Compressors with Handwheel Actuated Controls (R-0480):					
Tool Box		1	A-0798	1	A-0798
Bolting Required Tightening Torque Chart - Laminated ^a		1	ER-63.1	1	ER-63.1
Forged Steel Eye Bolt - Lifting Compressor ^b	1"--8 UNC	1	FE0300KA	1	FE0300KA
	1-1/8"--7 UNC	2	FE0300LA	-	---
	1-1/4"--7 UNC	-	---	2	FE0300MA
Mechanical Seal Installation Seating Tool - Stationary Half		1	001742	1	001742
Mechanical Seal Installation Tool - Spring-Loaded Rotating Half		1	001788	1	001788
Mechanical Seal Housing Installation Tool		1	002169	1	002169
Allen Wrench 1" for Removing Pipe Plugs with a Socket Wrench		1	002249	1	002249
Bolting Torque Adapter for Coupling Hub Capscrews		Furnished by Coupling Manufacturer			
For Compressors with Hydraulic Actuated Controls (R-0483), tools listed above plus:					
Capacity Unloading Hydraulic Tool - Assembly Drawing only ^c		1	002423	1	002423
Pipe Tee - 1/4"		1	A-0958	1	A-0958
Relief Valve 1/4"		1	002325	1	002325
Adapter 1/4" NPT x 3/8"		1	002326	1	002326
Hose, 4 feet x 1/4"		1	002327	1	002327
Gear & Pinion Hydraulic Removal Tools (R-0489):					
Eyebolt 3/4"--10 UNC		3	FE0300IA	3	FE0300IA
Gear Stop/Retaining Tool, w/Protective Bearing Sleeve & Capscrew		1	002095	1	002095
Dowel Pin Puller Tool		1	002119	1	002119
Gearbox Guide Tool (Pin)		2	002151	2	002151
Pinion Gear Stop/Retaining Tool		1	002158	1	002158
Hydraulic Gear Removal Tool - Connection Hardware ^d		1	002191	1	002191
Bolting Torque Adapter, 3/4" square drive x 1", 12-point socket ^e		1	002278	1	002278

TABLE 7-1: ARIEL FURNISHED TOOLS - REFER TO ILLUSTRATIONS ON FOLLOWING PAGES

TOOL DESCRIPTION	RG282M		RG357M	
	QTY	ARIEL P/N	QTY	ARIEL P/N
Overhaul Tool, required in addition to above tools:	(R-0481)		(R-0484)	
Eyebolt 1”--8 UNC / 5/8”--11 UNC	1	FE0300KA	2	FE0300HA
Lifting Tool Discharge Housing†	1	002184	1	002185

- a. The Bolting Required Tightening Torque Chart is also available electronically on the Ariel web site, www.arielcorp.com.
- b. See Table 1-1 on Page 1-7 for compressor weights and Figure 1-9 on Page 1-11 for lifting location connections.
- c. A hydraulic hand pump, with a 3000 psi minimum (205 bar) rating, is required after a hard shutdown for capacity unloading with hydraulic actuated controls, to allow restarting, see Figure 7-4. The high pressure hydraulic hand pump that is used to remove the gear an pinion can also be used for capacity unloading. See “Ariel Tools - Purchased Separately” on page 7-6..
- d. Includes all required hardware for connecting a high pressure hydraulic hand pump to the gear or pinion for gear set removal, including: fittings, tubing, hose and pressure gauge, plus Assembly Drawing 002422 showing the pump assembly and bill of material. A high pressure hand pump is required to remove the gear sets. See “Ariel Tools - Purchased Separately” on page 7-6. for the hydraulic hand pump available from Ariel, and reference Figure 7-12.
- e. This tool is required to remove one (1) of the gearbox to rotor housing capscrews. See Figure 7-9.
- f. This lifting tool is used with the compressor in the vertical position to lift discharge housing with or without rotors. See Figure 7-10 and Figure 7-11.

Ariel provides these tools with every compressor. If you do not have the Ariel furnished tools required for your compressor, please contact your Distributor and obtain them. These tools are specifically designed or selected for use on Ariel RG282M and RG357M compressors.

Clean all tools before use. Be sure that the tool and the part being removed or installed are fully engaged during the process. If a tool is missing, worn, or broken, please call your distributor for a replacement.

CAUTION: DO NOT USE SUBSTITUTES FOR MISSING TOOLS, AND DO NOT USE WORN OR BROKEN TOOLS.

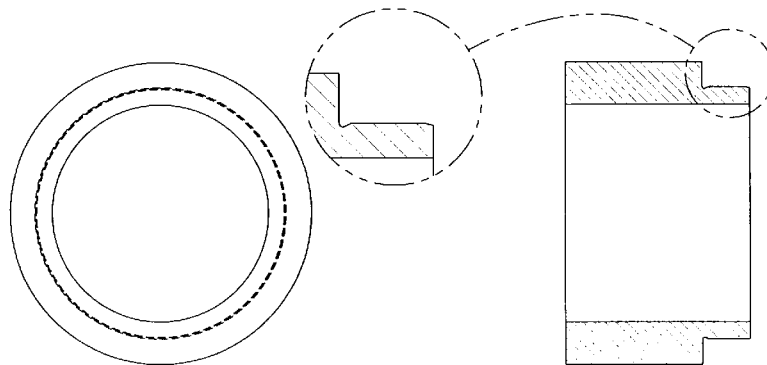


FIGURE 7-1: MECHANICAL SEAL INSTALLATION SEATING TOOL - STATIONARY HALF (001742)

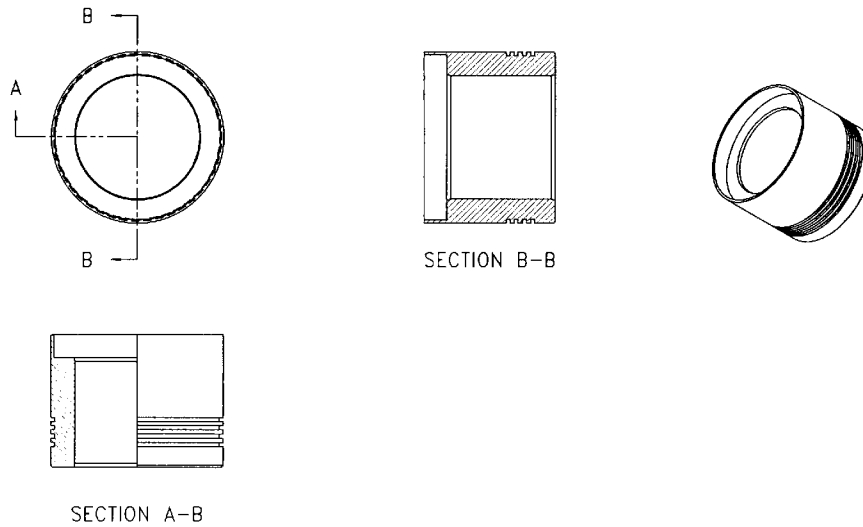


FIGURE 7-2: MECHANICAL SEAL INSTALLATION TOOL - ROTATING HALF (001788)

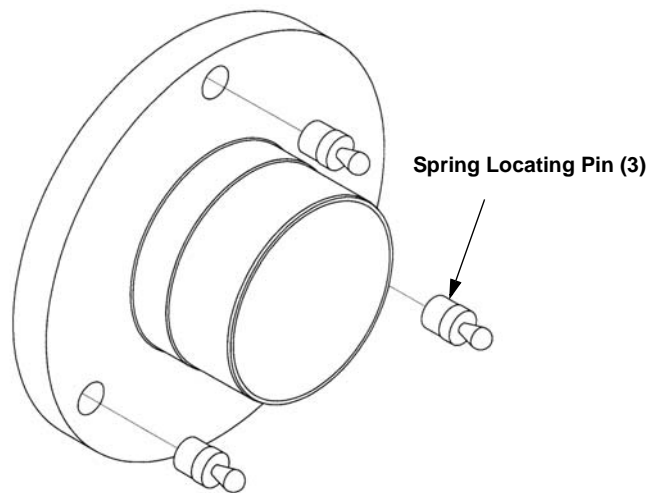
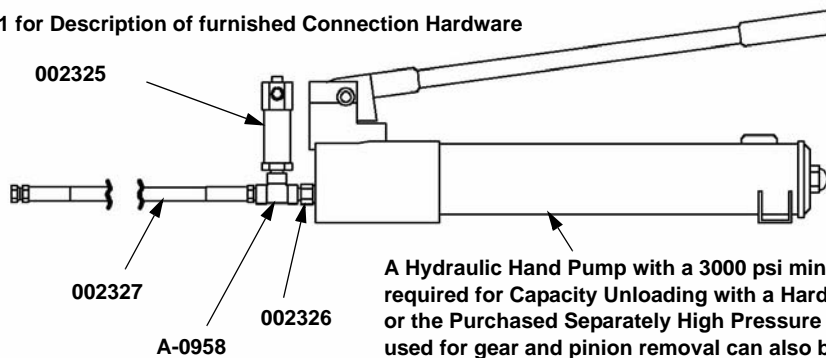


FIGURE 7-3: MECHANICAL SEAL HOUSING INSTALLATION TOOL (002169)

See Table 7-1 for Description of furnished Connection Hardware



A Hydraulic Hand Pump with a 3000 psi minimum (205 bar) Rating is required for Capacity Unloading with a Hard Shutdown - Not Provided; or the Purchased Separately High Pressure Hydraulic Pump (R-0491) used for gear and pinion removal can also be used for Capacity Unloading. See Figure 7-12.

FIGURE 7-4: HYDRAULIC CAPACITY UNLOADING TOOL - CONNECTION HARDWARE

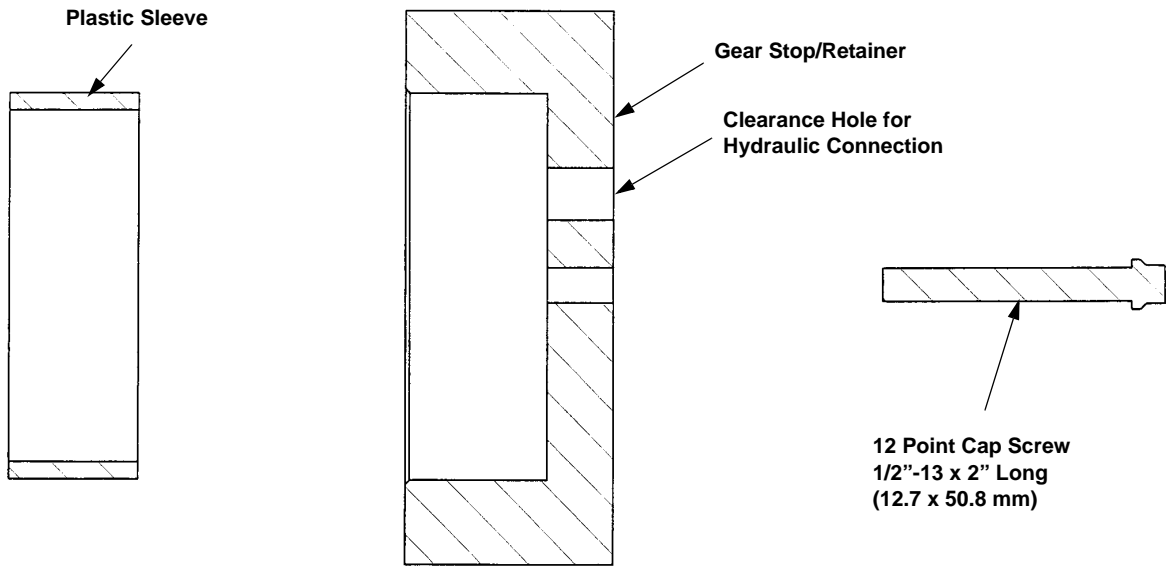


FIGURE 7-5: GEAR STOP/RETAINING TOOL & BEARING RACE PROTECTION SLEEVE ASSEMBLY (002095)

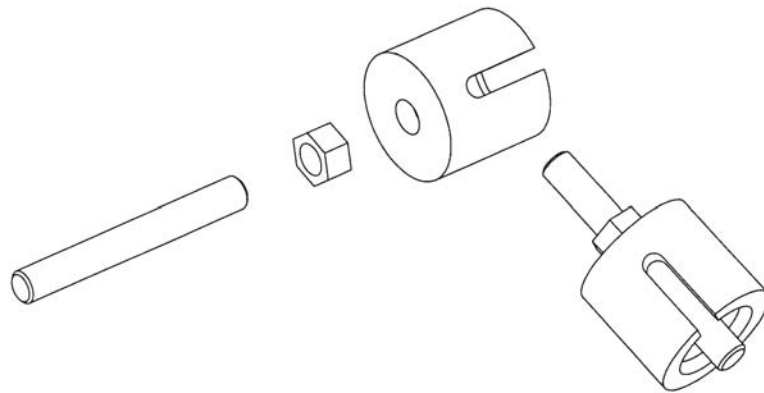


FIGURE 7-6: DOWEL PIN PULLER (002119)

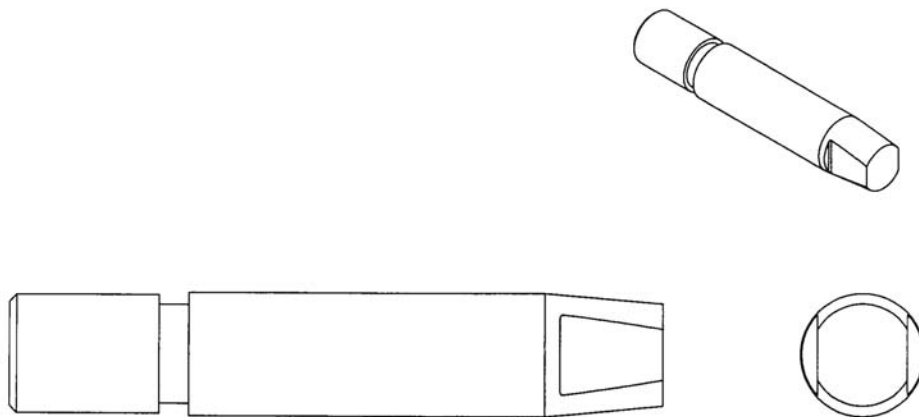


FIGURE 7-7: GEARBOX GUIDE PIN (002151)

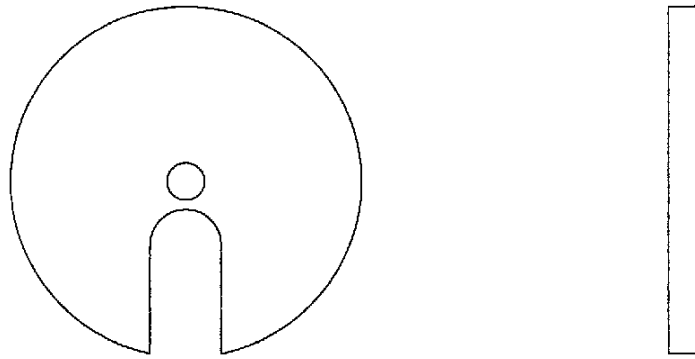


FIGURE 7-8: PINION STOP/RETAINING TOOL (002158)

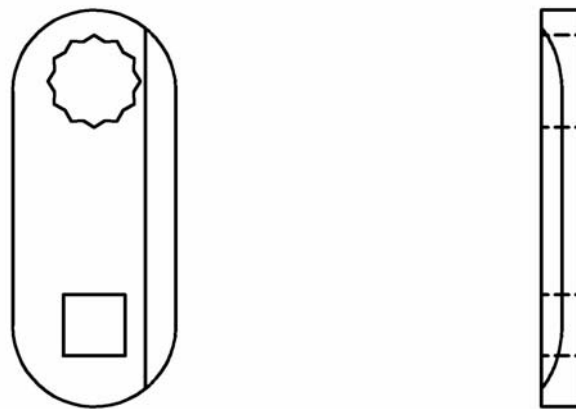


FIGURE 7-9: BOLTING TORQUE ADAPTER FOR GEARBOX CAPSCREW (002278)

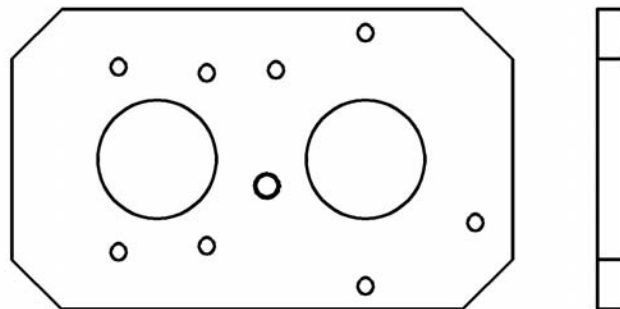


FIGURE 7-10: RG282M LIFTING TOOL DISCHARGE HOUSING W/ROTOR (002184)

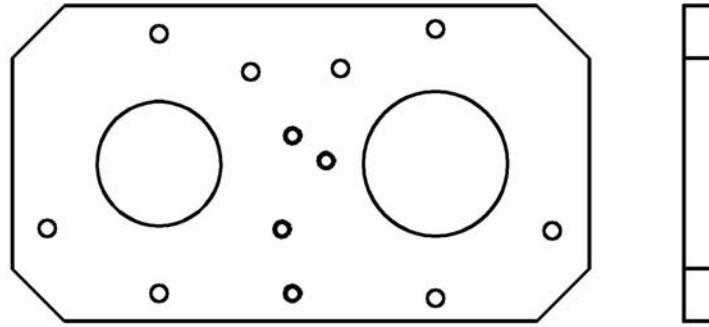


FIGURE 7-11: RG357M LIFTING TOOL DISCHARGE HOUSING W/ROTOR (002185)

Ariel Tools - Purchased Separately

- A High Pressure Hydraulic Hand Pump is required for removal of the gear & pinion. It may be purchased from Ariel as R-0491 (part number 002192). Rating: 40,000 psi (2750 bar). See Figure 7-12.

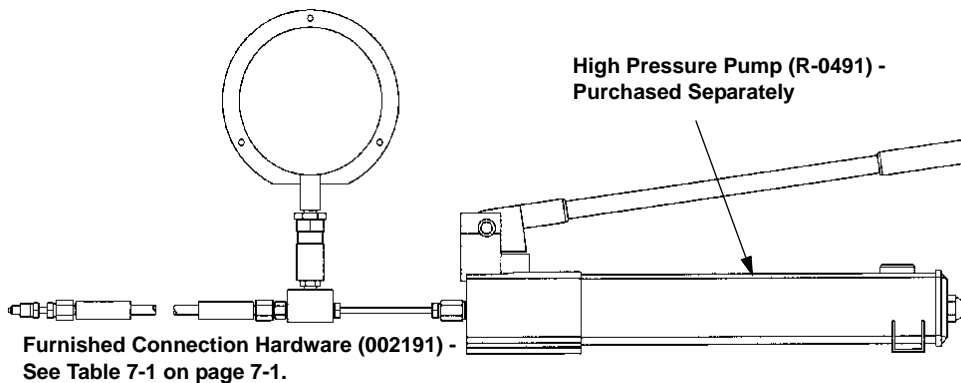


Figure 7-12: HIGH PRESSURE HYDRAULIC HAND PUMP (R-0491) FOR PINION & GEAR REMOVAL, SHOWN WITH FURNISHED CONNECTION HARDWARE

Hand Tools Required

The following hand tools are normally what is required to work on RG Ariel Rotary compressors. These hand tools are readily available from tool suppliers and are needed in addition to the Ariel furnished tools. Please contact Ariel if you have questions about tools on Ariel units.

- 1/2" Square Drive Ratchet Wrench
- 2" and 6" Extensions for above Ratchet
- 1/2" Square Drive Breaker Bar

- 1/2" Drive Speed Wrench
- 1/2" Female x 3/4" Male Adaptors
- 1/2" Square Drive Universal Joint
- 3/8" Square Drive Torque Wrench (10 LB-IN to 250 LB-IN)
- 1/2" Square Drive Torque Wrench (15 LB-FT to 250 LB-FT)
- 3/4" Square Drive Torque Wrench (to 600 LB-FT)
- Torque Multiplier (to 1400 LB-FT)
- 1/2" Hex Key and 1/4" Hex Key (Allen) Sockets for a Square Drive Ratchet Wrench
- 5/16" - 12 Point Box Wrench
- 1/2" x 9/16" Open End Wrench
- 3/8" x 7/16" Open End Wrench
- 7/8" x 15/16" Open End Wrench
- 2 - Medium Size Screw Drivers
- 2 - Large Size Screw Drivers
- Slugging Hammer
- Brass Punch
- Set of Inch - 3/8" Drive, 12 Point Sockets
- Set of Inch - 1/2" Drive, 12 Point Sockets
- Set of Inch - 1/2" Drive Crowsfoot Adaptors
- 3/8" Square Drive Ratchet Wrench
- Set of Inch - 3/4" Drive, 12 Point Sockets
- 3/4" Square Drive Ratchet Wrench
- 3/4" Female to 1" Male Adaptor
- Strap Wrench
- Set of Adjustable Wrenches
- 3/8" Square Speed Wrench
- Induction Heater, capable of heating gears to 325°F (163°C)
- Set of 1/8 in. min. (3 mm) Number Stamps, or Vibrating Etch Tool
- 12 in. (30 mm) Machinist's scale

Terms, Abbreviations¹ and Conversion to SI Metric²

Area

in^2 or square inch x 0.00064516 = meter², or m²

in^2 or square inch x 6.4516 = centimeter², or cm²

Flow - Gas³

MMSCFD or million standard cubic feet per day x 0.310 = normal meter³/second, or m³/s_n

-
1. US units of measure can appear abbreviated in upper or lower case.
 2. Maintain upper and lower case letters in SI Metric as shown.
 3. US standard is based on 14.696 psia & 60°F; Metric normal is based on 1.01325 bar & 0°C.

SCFM or standard cubic feet per minute x 1.607 = normal meter³/hour, or m³/h_n

Flow - Liquid

GPM or US gallons per minute x 0.0630902 = liter/second, or L/s = dm³/s

GPM or US gallons per minute x 0.227125 = meter³/hour, or m³/h

Force

lbf or pound (force) x 4.44822 = Newton, or N

Heat

BTU or British Thermal Units x 1.05506 = kilojoule, or kJ

Length

in. or " or inches x 25.4000 = millimeters, or mm

ft or feet x 0.304800 = meter, or m

Mass

lb or pound (mass) x 0.453592 = kilogram, or kg

Moment or Torque

LB x FT or pound-foot (force) x 1.35583 = Newton-meter, or N·m

LB x IN or pound-inch (force) x 0.112985 = Newton-meter, or N·m

Power¹

HP or Horsepower x 0.745700 = kilowatt, or kW

Pressure² or Stress

PSI or Pounds per Square Inch x 6.89476 = kiloPascal, or kPa

1. Horsepower based on 550 ft-lb/sec

2. G suffix (psig) indicates gauge pressure, a indicates absolute, d indicates differential

PSI or Pounds per Square Inch x 6894.76 = Pascal, or Pa

PSI or Pounds per Square Inch x 0.0689476 = bar

bar x 100 000 = Pascal, or Pa

bar x 100 = kiloPascal, or kPa

bar x 14.50377 = PSI, or Pounds per Square Inch

Speed

FPM or feet per minute x 0.005080 = meter per second, or m/s

RPM or r/min or revolutions per minute ÷ 60 = revolutions per second, or rev/s

Temperature

°F or degrees Fahrenheit. (°F - 32) ÷ 1.8 = degrees Celsius, or °C

Time

sec = second, or s

min or minute x 60 = second, or s

hr or h or hour x 3600 = second, or s

Viscosity

SSU, SUS or Saybolt Universal seconds x 0.22 - (180/SSU) = mm²/s = centistoke, or cSt

(for a range of 33 thru 200,000 SUS)

Volume

gal or gallons (US liquid) x 3.78541 = liter, or L

Other Abbreviations

Ω = Ohm = V/A = Volt ÷ Ampere = Electrical Resistance

A = Ampere = Electrical Current

ADPTR = Adapter

AISI = American Iron and Steel Institute

AL = Aluminum

ANSI = American National Standards Institute

API = American Petroleum Institute

ASME = American Society of Mechanical Engineers

ASSY = Assembly

ASTM = American Society of Testing and Metals

AWS = American Welding Society

BAL = Balance

BHN = Brinell Hardness Number

BRG = Bearing

CB = Carbon Steel

CE = European Conformance Marking to European Union Directives

CERT = Certification

CGA = Compressed Gas Association

CI = Cast Iron

CL = Centerline

CL. = Clearance

COM = Common

COMP or COMPR = Compressor

CNTR = Center

CPLG = Coupling

CR = Neoprene

CSA = Canadian Standards Association

CSTG = Casting

CTRL = Control

CU = Cubic

CVR = Cover

CW = Clockwise

CCW = Counter Clockwise

CWB = Cold Weather Bypass

CYL = Cylinder

DI = Ductile Iron

DIA or D = Diameter

DIN = German Standards Institute

DIS = Discharge

DRCTNL = Directional

ELEC or ELECT = Electric

EX = Explosion Proof

EXT = External

FEM = Female

FLG = Flange

FLTRS = Filters

FPT = Female Pipe Tap

FTG = Fitting(s)

GI = Gray Iron

GPSA = Gas Producers Suppliers Association

HEX = Hexagonal

HHCS = Hexagonal Head Cap Screw

HRC = Hardness Measurement on Rockwell C Scale

HSG = Housing

HTP = Hydrostatic Test Pressure

HWL = Handwheel

HYD = Hydraulic

IEC = International Electric Congress

ID = Inside Diameter

IFI = International Fasteners Institute

ISO = International Standards Organization

IND = Indicator

INJ = Injection

INSTALL = Installation

INT = Internal

IS = Intrinsically Safe

JBOX = Junction Box

k = Ratio of Specific Heats

k = kilo, see Figure 7-3 on Page 7-17

L/D Ratio = Length of male rotor divided by its diameter

LG = Long

LO = Lubricating Oil

LUBE = Lubricating or Lubricated

MAWP = Maximum Allowable Working Pressure

MAX. = Maximum

MECH = Mechanical

MIN. = Minimum

MNFLD = Manifold

MNL = Manual

MPT = Male Pipe Tap

MRP = Maximum Running Pressure

MRVS = Maximum Relief Valve Setting

MSP = Maximum Static Pressure

N/A = Not Applicable

NAC or Nace = (National Association of Corrosion Engineers), now NACE International Corrosion Society

NEC = National Electric Code

NFPA = National Fire Protection Association

NI = Non Incentive

NO. = Number

NOM = Nominal

NPT = National Pipe Thread

NPTF = Dryseal Pipe Threads

OD = Outside Diameter

P_s = Suction Pressure

P_d = Discharge Pressure

% = Percent

PC = Piece or Personal Computer

PIST = Piston

PLC = Programmable Logic Controller

PMP = PUMP

P/N = Part Number

POS = Position

PRS = Pressure

QTY = Quantity

RED = Reducing

RBLD = Rebuild

RD.HD = Round Head

RLR = Roller

ROT = Rotary

RTD = Resistance Temperature Detector

SAE = Society of Automotive Engineers

SBB = Steel Backed Bronze

SD or S/D = Shutdown

SF = Stainless Steel Tubing and Fittings

SG = Specific Gravity

SI = International System, as applied to the modern metric system

S. N. or S/N = Serial Number

S.V. = Slide Valve

SHCS = Socket Head Cap Screw

SNOID = Solenoid

SPCL = Special

SPCR = Spacer

SPEC = Specifications

SS or SST = Stainless Steel

STD = Standard

STL = Steel

STN = Station

STR = Straight

SUC = Suction

SYS = System

T'CPL = Thermocouple

THD or THRD= Thread

TIR = Total Indicator Reading

TPI = Threads per Inch

TRAV = Travel

UL = Underwriters Laboratory

UNC = Unified (Inch) National Coarse Screw Threads

UNF = Unified (Inch) National Fine Screw Threads

UNLD = Unload

UPS = United Parcel Service

V_i or V_i = Volume Ratio = Volume of gas, in actual volume, at point where compression begins, divided by volume of gas, in actual volume, at end of compression:

$$V_i = \frac{V_s}{V_d}$$

V = Volts = Electrical Potential

VIB = Vibration

VLV = Valve

VOL = Volume

VT = Viton

W = Watt = Power

W/ = With

W/O = Without

WT(S) = Weight(s)

ZC = Zinc

2ND = Second (Two)

2SHT = Drawing Has Two Sheets

Gas Analysis Common Abbreviations

TABLE 7-2: GAS ANALYSIS COMMON ABBREVIATIONS

COMMON ABBREVIATION	COMPONENT NAME (SYNONYM)	CHEMICAL FORMULA
C1	Methane	CH ₄
C2	Ethane	C ₂ H ₆
C3	Propane	C ₃ H ₈
IC4	Iso-Butane (2-Methyl Propane)	C ₄ H ₁₀
NC4	N-Butane	C ₄ H ₁₀
IC5	Iso-Pentane (2-Methyl Butane)	C ₅ H ₁₂
NC5	N-Pentane	C ₅ H ₁₂
NEOC5	Neopentane	C ₅ H ₁₂
NC6	Hexane	C ₆ H ₁₄
NC7	Heptane	C ₇ H ₁₆
NC8	Octane	C ₈ H ₁₈
NC9	Nonane	C ₉ H ₂₀
NC10	N-Decane	C ₁₀ H ₂₂
NC11	N-Undecane (Hendecane)	C ₁₁ H ₂₄
NC12	N-Dodecane	C ₁₂ H ₂₆
C2-	Ethylene (Ethene)	C ₂ H ₄
C3-	Propene (Propylene)	C ₃ H ₆
BENZ	Benzene	C ₆ H ₆
TOL	Toluene	C ₇ H ₈
EBNZ	Ethylbenzene	C ₈ H ₁₀
CO	Carbon Monoxide	CO
CO ₂	Carbon Dioxide	CO ₂
H ₂ S	Hydrogen Sulfide	H ₂ S
H ₂	Hydrogen	H ₂
O ₂	Oxygen	O ₂
N ₂	Nitrogen	N ₂
H ₂ O	Water	H ₂ O
He	Helium	He

TABLE 7-2: GAS ANALYSIS COMMON ABBREVIATIONS (CONTINUED)

COMMON ABBREVIATION	COMPONENT NAME (SYNONYM)	CHEMICAL FORMULA
Ar	Argon	Ar
---	Air	---

Metric Factors

TABLE 7-3: USEFUL SI METRIC MULTIPLE AND SUB-MULTIPLE FACTORS

MULTIPLICATION FACTOR	PREFIX	SI SYMBOL ^A
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto ^b	h
10 = 10^1	deka ^b	da
.1 = 10^{-1}	deci ^b	d
.01 = 10^{-2}	centi ^b	c
.001 = 10^{-3}	milli	m
.000 001 = 10^{-6}	micro	:

a. Maintain upper and lower case letters as shown.

b. Not Recommended, but occasionally used.

Technical and Service Schools on Ariel Compressors

Ariel schedules several in plant schools each year, which include classroom and hands on training. Ariel can also arrange to send a representative to provide a customized training school at your location. Contact Ariel for details.

Ariel Customer Technical Bulletins (Formerly Ariel Newsletters)

Ariel Customer Technical Bulletins provide important technical information including changes, corrections and/or additions to the Technical Manual for Packagers and End Users. Be sure to refer to this material before operating or servicing the equipment.

A complete listing of these Bulletins is available at the Ariel Website (www.arielcorp.com), selected Bulletins are available at the Web site, or copies may be obtained from the Packager or from Ariel.

Vender Literature

When available, vendor literature on purchased parts used in Ariel Compressors is provided

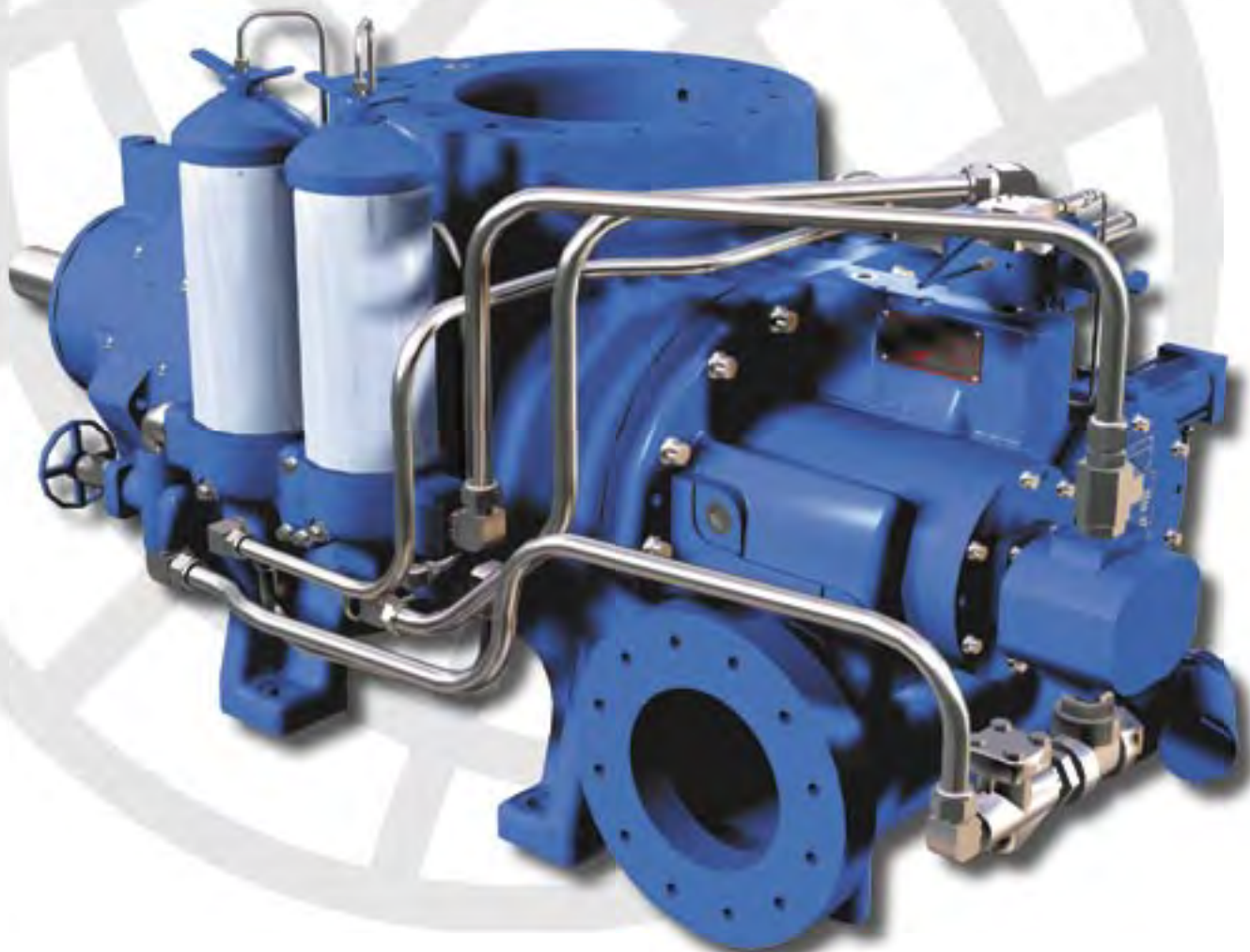
on the Ariel Website (www.arielcorp.com), or copies may be obtained from the Packager or from Ariel.

Ariel Telephone, Fax, E-Mail and Web Site Numbers

TABLE 7-4:ARIEL CONTACT NUMBERS

CONTACT	TELEPHONE	FAX	EMAIL
Ariel Response Center	888-397-7766	740-397-1060	arc@arielcorp.com
Spare Parts	(toll free USA & Canada) or 740-397-3602 (International)	740-393-5054	spareparts@arielcorp.com
Order Entry		740-397-6450	N/A
Ariel World Headquarters	740-397-0311	740-397-3856	info@arielcorp.com
Technical Field Service			fieldservice@arielcorp.com
Web Site: www.arielcorp.com			

- Ariel Response Center Technicians or Switchboard Operators will answer telephones during Ariel business hours, Eastern Time - USA or after hours by voice mail.
- The after Hours Telephone Emergency System works as follows:
 1. Follow automated instructions to Field Service Emergency Technical Assistance or Spare Parts Emergency Service.
 2. Calls are answered by voice mail.
 3. Leave Message: caller’s name, telephone number, serial number of equipment in question (frame, cylinder, unloader) and brief description of emergency.
 4. Your voice message is routed to an on-call representative, who will respond as soon as possible.
- Users are to contact an Authorized Distributor to purchase Ariel Parts.



ARIEL RG282M and RG357M Rotary Screw Compressors

	RG282M	RG357M
Male Rotor Diameter	282mm	357mm
L/D Ratio	2.0	2.1
Capacity, CFM Capacity, m ³ /hr	1,070 to 2,930 1,818 to 4,978	1,940 to 5,200 3,296 to 8,835
Maximum Input Speed	1,800 rpm	1,800 rpm
Gear Ratios	1.06, 1.24, 1.42, 1.61, 1.80, 2.03, 2.25	1.0, 1.35, 1.57, 1.76 2.04, 2.31, 2.65
Rotor Operating Speed	1,484 to 4,050 rpm	1,200 to 3,210 rpm
Rated Power, bhp Rated Power, kW	800 597	1,375 1,026
Maximum Allowable Discharge Pressure, psig Maximum Allowable Discharge Pressure, barg	230 15.9	230 15.9
Suction Pressure Range, psia* Suction Pressure Range, bara*	3 to 75 0.21 to 5.17	3 to 65 0.21 to 4.48

* For extended suction pressures, please contact Ariel.

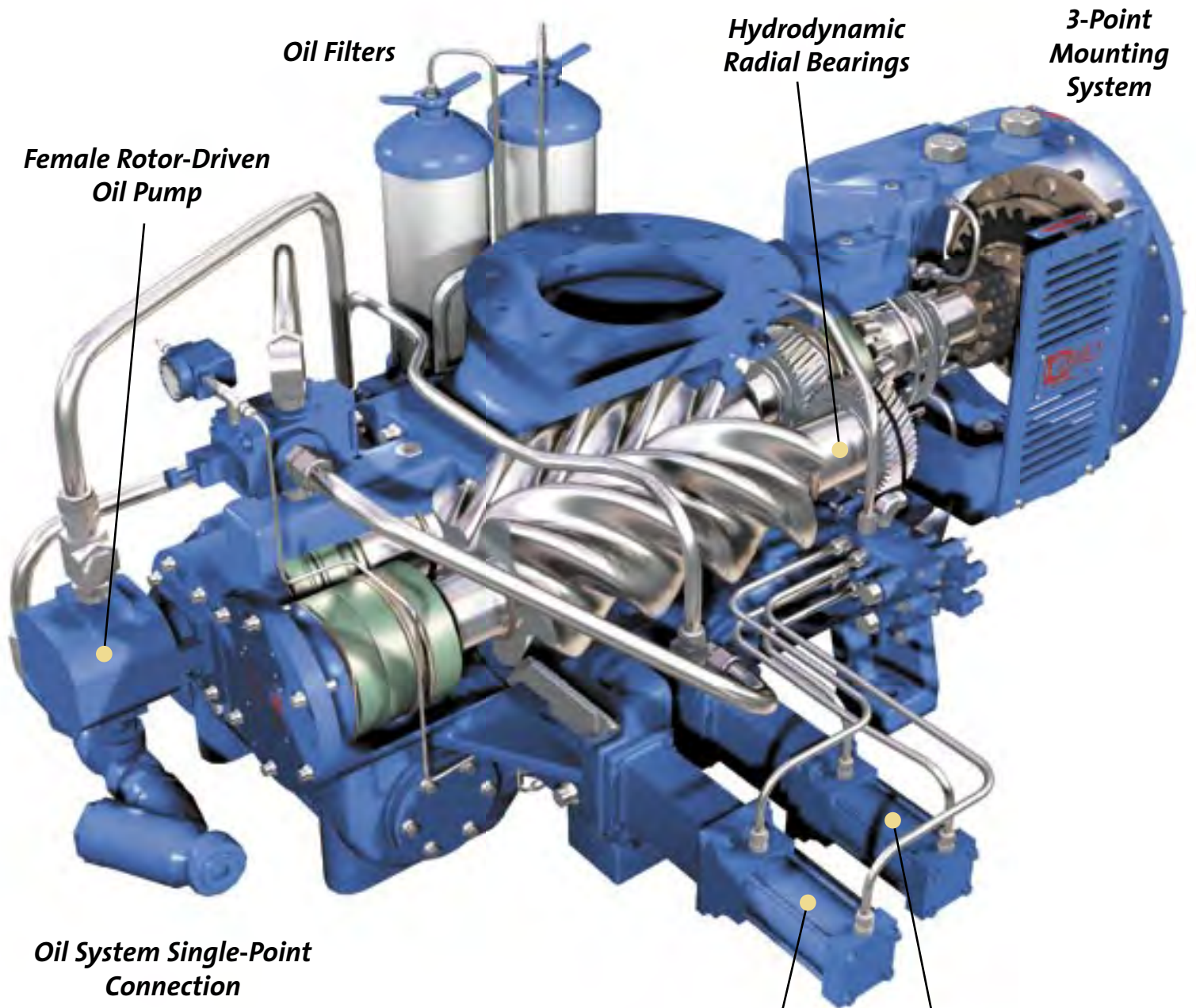
FEATURES

- **Wide Efficiency Range** – A new Ariel 4/6 lobe rotor profile is designed specifically for natural gas service and provides a wide, high-efficiency operating range.
- **Integral Gearbox** – The RG282M and RG357M incorporate an integral gearbox to match current and future needs with a gear ratio change. The seven available gear ratios enable optimum matching of available gas engine drivers with compressor flow and efficiency.
- **Variable Vi** – Since operating conditions always change, the Vi (internal compression ratio) is continuously adjustable from 2.5 to 5.0 while the unit is running. Manual handwheel or hydraulic actuators are available.
- **Capacity Control** – Inlet flow can be continuously adjusted while the unit is running from 100% to 30% of full load capacity. Manual handwheel or hydraulic actuators are available.
- **Flexibility** – Independently controlled Vi and inlet flow allow optimum compressor performance at full- and partial-load operating conditions.
- **Long Bearing Life** – Hydrodynamic radial bearings and thrust-balanced angular contact ball bearings are standard. The thrust from the helical cut drive gears acts opposite the rotor thrust to reduce axial bearing loads.
- **Long Seal Life** – A pressure-balanced, spring-loaded carbon seal is installed on low-speed input shaft.
- **Designed for Packaging** – The optional SAE bell house mounting with integral gear design enables a common skid for a wide range of compressor flows. This feature also minimizes the time required to align the engine and compressor. Top suction and side discharge connections result in low input shaft height and simplified piping arrangement.
- **Ease of Maintenance** – Ample maintenance access is provided to permit changing the seal element without disturbing the compressor or engine connections.
- **Oil Pump** – To ensure adequate oil pressure to the bearings, mechanical seal, Vi and capacity controls, a female rotor-driven oil pump is standard on the RG282M and RG357M.
- **Integrated Oil System** – A complete single attachment point oil system, including filters and control valves, is available as a factory installed option.
- **Dedicated Manufacturing Facility** – Ariel rotary screw compressors are manufactured at a dedicated facility specifically equipped to machine, assemble, and test rotary compressors.
- **Production Unit Performance Testing** – Each rotary screw compressor is performance tested on air to measure the unit's capacity and power consumption.

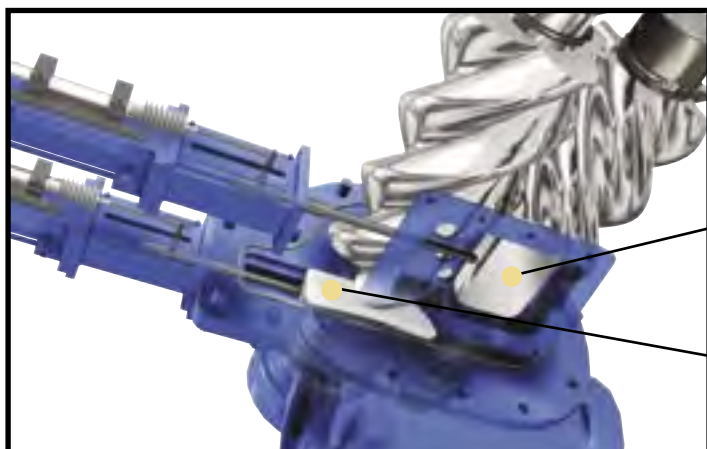


The RG282M and RG357M's unique oil system includes a reliable female rotor-driven oil pump. As an option, the compressors accommodate existing oil systems with a single-point connector.

A WORLD STANDARD GAS COMPRESSOR



VIEW FROM BELOW



Hydraulically Actuated Capacity Control

Hydraulically Actuated Volume Ratio Control

THE ARIEL NETWORK

Ariel's success is based on strong relationships built on mutual respect and trust. Employees, vendors, distributors, and end users are all part of the Ariel Network.

Ariel Compressors are marketed and packaged through a long-established network of elite compression system engineering companies. Ariel's Authorized Distributors integrate the compressor with a structural skid, a prime mover, piping, pulsation control, cooling systems, process valving, and control systems.

- All Ariel distributors adhere to Ariel's strict packaging standards.
- Ariel's large network offers the most complete service and parts coverage available in the world.



The Ariel network of authorized distributors have the engineering expertise and experience to design and assemble complete packaged systems—ready for delivery to the field.

CUSTOMER SERVICE



We are committed to supporting our compressors for life. If there is a problem with an Ariel compressor, we'll help you solve it — now.

- The Ariel Network is composed of more than 1000 Ariel-trained field servicemen and technicians, worldwide.
- Ariel's policy has always been to routinely ship standard parts within 24 hours of receiving an order.
- Ariel gas compressors are backed by more than 100 parts and service outlets close to every major natural gas field.
- Ariel's Service and Technical Schools are held frequently, free of charge, for engineers and field servicemen. These courses are taught by Ariel engineers and technicians directly involved in the subject material.
- The availability of Ariel manufactured parts at competitive prices will ensure your Ariel compressor's maximum reliability and productivity.
- Ariel's goal is to offer the best customer care and service. Our warranty and our treatment of warranty issues clearly show our commitment to this goal.

ARIEL CORPORATION WORLD HEADQUARTERS

35 Blackjack Road
Mount Vernon, Ohio 43050 USA
Telephone: 740-397-0311
Fax: 740-397-3856

24-HOUR SUPPORT

Field Service: 740-393-5052
Spare Parts: 740-397-3602
Parts Fax: 740-393-5054

REGIONAL SALES OFFICES

Denver, Colorado • Fort Worth, Texas
Houston, Texas • Miami, Florida
Buenos Aires, Argentina • Jakarta, Indonesia
Bielsko Biala, Poland • Moscow, Russia



● www.arielcorp.com

START UP CHECK LIST - RG ROTARY COMPRESSORS



Compressor Model RG _____ Serial/No. R- _____ Gear Ratio _____
 Control Actuation - Hydraulic _____ Handwheel _____
 Driver Manufacturer _____ Model _____ Rated Speed _____ RPM
 Packager _____ Packager Unit No. _____
 Date Packager Shipped _____ Serviceman _____
 Customer _____ Start Up Date _____
 Location _____ Field Contact _____
 Field Telephone No. _____ Unit Location _____
 Gas Service _____
 Compressor Oil - Make/Grade _____

YES NO

Check List - Prior To Starting:

1. Are the correct Ariel parts book, technical manual, special tools, and spares available? _____
2. Have the design limitations for the compressor model such as MAWP, maximum suction & discharge pressures, maximum and minimum speed, discharge temperature been checked? _____
3. Have the Packager's design operating conditions been reviewed? _____
 Pressure, psig (bar_g): Suction _____ Discharge _____
 Temperature, °F (°C): Suction _____ Discharge _____
 Maximum RPM _____ Minimum RPM _____
 Type of Gas _____ SG _____
 If start-up conditions are different check with Packager or Ariel.
4. Soft Foot Check [max. allowable 0.002" (0.05 mm)]: Have the compressor feet supports been shimmed so the machine is not twisted or bent? _____
5. Have compressor anchor and/or bell-housing flange bolts been re-torqued? _____
6. Have the piping and supports been checked to be sure they do not bend or stress compressor? _____

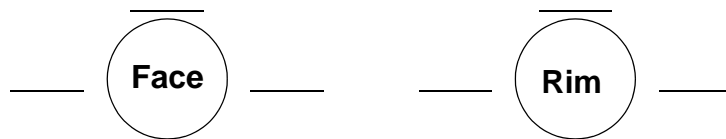
1	Revised/clarified to add RG282M & RG357M. Retyped on FrameMaker.						
		1	013029	3-3-06			
		0	010774	8-14-02			
REV	DESCRIPTION	REV	EC	DATE	REV	EC	DATE

START UP CHECK LIST - RG ROTARY COMPRESSORS



Compressor Model RG _____ Serial/No. R- _____

- | | YES | NO |
|--|-------|-------|
| 7. Have coupling bolt torque values been rechecked? | _____ | _____ |
| 8. Has the compressor to driver alignment been field checked?
See compressor outline drawing for shaft thermal growth value. | _____ | _____ |
| 9. Record coupling dial indicator field verification readings in inches (mm) at the 3, 6, 9 and 12 o'clock positions on lines provided: (not applicable to bell-house mountings) | | |



Maximum allowable face misalignment 0.005 in. (0.13 mm) TIR
Maximum allowable radial misalignment 0.003 in. (0.08 mm) TIR

- | | | |
|--|-------|-------|
| 10. Does the compressor input shaft turn freely? | _____ | _____ |
| 11. Have coupling elements been installed and has coupling been inspected for proper assembly, including axial engagement? | _____ | _____ |
| 12. Has any preservation oil been drained from rotor housing? | _____ | _____ |
| 13. Have oil & gas systems been pressurized & leak tested? | _____ | _____ |
| 14. Has proper oil been installed that matches operating conditions, with a viscosity adequate for current gas analysis? | _____ | _____ |
| 15. Has oil supplier provided gas dilution versus pure oil viscosity information? | _____ | _____ |
| 16. Has the compressor oil system been filled with oil to the proper level without over filling? | _____ | _____ |
| 17. Is the compressor oil supply isolation valve open? | _____ | _____ |

NOTE: CLEARLY LABEL UNIT WITH THE COMPRESSOR OIL MAKE/GRADE CURRENTLY IN USE.

- | | | |
|--|-------|-------|
| 18. Does the compressor oil system low level shutdown work? | _____ | _____ |
| 19. Have the properly rated elements been installed in the gas inlet separator, oil filters and strainers, and gas/oil separator? | _____ | _____ |
| 20. Are the oil filter elements and all oil piping primed with oil? | _____ | _____ |
| 21. Is the low oil differential pressure shutdown installed & tubed correctly to the bearing oil supply and scavenged oil gallery? | _____ | _____ |
| 22. Is the low oil differential pressure shutdown set per Ariel's recommendations & does it work on falling pressure? | _____ | _____ |

START UP CHECK LIST - RG ROTARY COMPRESSORS



Compressor Model RG _____ Serial/No. R- _____

	YES	NO
23. Is there an oil cooler? Note: Recommended minimum compressor inlet oil temperature is 150°F (66°C); maximum 160°F (71°C).	_____	_____
24. Is the rotor injection's oil temperature control (trim) valve setting appropriate for cold start-up applications?	_____	_____
25. Is the oil temperature control valve piped for a "mixing" condition?	_____	_____
26. If so equipped, is there a working vibration shutdown mounted on the compressor or drive train?	_____	_____
27. Is there suction pressure control upstream of the compressor? Refer to Ariel's performance prediction program to verify acceptable P ₁ , P ₂ combination.	_____	_____
28. Are the suction and discharge pressure shutdowns set & working?	_____	_____
29. Are the safety relief valves installed & working to protect compressor gas and oil piping?	_____	_____
30. Is the gas high discharge temperature shutdown installed, set at 10% above anticipated temperature & working? 248°F, max. (120°C)	_____	_____
31. Is the mechanical seal leakage tubing installed, unplugged and visible to determine if leakage occurs?	_____	_____
32. Have the gas suction lines been thoroughly cleaned to be sure that no dirt, slag or other debris enters the compressor?	_____	_____
33. Has strainer screen been installed upstream of compressor suction?	_____	_____
34. Have the oil system components been primed and the compressor prelubed prior to starting?	_____	_____
35. Does the driver rotation match the compressor rotation arrow?	_____	_____
36. For engine driven units, has the machine been rolled to make sure it is free?	_____	_____
37. For other drivers, has the machine been barred over by hand to be sure it is rolling free?	_____	_____
38. For combustible gas applications, has the piping and compressor been purged to remove all air?	_____	_____
39. Have start-up instructions for other package equipment been followed?	_____	_____

START UP CHECK LIST - RG ROTARY COMPRESSORS



Compressor Model RG _____ Serial/No. R- _____

	YES	NO
40. Has compressor variable Vi been moved to the minimum Vi axial position? (Vi range 2.5 to 5.0)	_____	_____
41. Has compressor capacity control plate been moved to minimum load position, to reduce compressor start-up torque?	_____	_____
42. Have minimum compressor oil pressure alarm and shutdown settings been tested?	_____	_____
43. Has the Packager's representative reviewed the Packager's Start-Up & Operating Instructions for the unit with the unit operator?	_____	_____
44. Has the separator scavenge line been connected to the gearbox and is the scavenge control valve fully open?	_____	_____

Check List - After Starting:

1. When idle speed is achieved, load compressor to minimum position & increase minimum driver speed if necessary to stabilize load. Did the compressor bearing oil pressure come up immediately after loading the compressor?	_____	_____
2. Was the discharge pressure raised immediately (minimum pressure valve) to facilitate oil scavenging and lube flow?	_____	_____
3. Are the oil filters, bearing & oil system, & hydraulic-valve-stack pressure gauges working?	_____	_____
4. Are the oil filter differential pressures less than 36 psid (2.5 bar _g) at operating temperature, unless otherwise specified?	_____	_____
5. Did the compressor develop discharge pressure when capacity control plate moved to loaded position?	_____	_____
6. Has the variable Vi been moved to an appropriate position?	_____	_____
7. Any strange noises or shaking in the compressor or piping?	_____	_____
8. Is the compressor system oil level within acceptable limits?	_____	_____
9. Is bearing oil differential pressure above minimum specified?	_____	_____
10. Is the high discharge temperature shutdown working?	_____	_____
11. Is the high discharge gas temperature shutdown set at approx. 10% above normal discharge temperature? 248°F (120°C) maximum.	_____	_____
12. Is the mechanical seal weep hole leaking? Drops/minute _____	_____	_____
13. Are there any other oil leaks? If so, where?	_____	_____

START UP CHECK LIST - RG ROTARY COMPRESSORS



Compressor Model RG _____ Serial/No. R- _____

	YES	NO
14. Are the scrubber dumps and high level shutdowns working?	_____	_____
15. Are the scrubber dumps removing all liquids from the gas without obvious carryover?	_____	_____
16. Do you hear solid contaminants in the suction piping?	_____	_____
17. Is overspeed shutdown set?	_____	_____
18. Is the mechanical seal properly sealing gas and oil at the shaft?	_____	_____
19. Have all Package safety functions been tested to be sure of unit shutdown upon malfunction?	_____	_____
20. After the compressor reaches normal operating conditions, has the separator scavenge control been set to show mostly gas flow at the sight glass?	_____	_____
21. After running compressor for 24 hours, are oil filter and separator differential pressures less than maximum allowable?	_____	_____
22. Upon shutdown verify that compressor reverse rotation is less than 2 seconds to be sure of check valve operation.	_____	_____
23. Has initial compressor operating data been recorded?	_____	_____
24. Complete Ariel's "Compressor Warranty Notification and Installation List Data", copy this completed "Start-up Checklist" and mail both to Ariel Corporation, 35 Blackjack Road, Mount Vernon, OH 43050, USA, Attention: Administrative Assistant - Sales or fax to Ariel at 740-397-3856, Attention: Administrative Assistant - Sales.		

START UP CHECK LIST - RG ROTARY COMPRESSORS



DAILY LOG SHEET

COMPANY/LOCATION _____ UNIT _____

COMPRESSOR MODEL RG _____ SERIAL No. R- _____ GEAR RATIO _____

Date/Time							
Operator							
Driver Load, HP (kW)							
Driver Speed, RPM							
Compressor Speed, RPM							
Gas flow Rate MMSCFD (m ³ /s _n)							
Variable Vi Position (Vi or # of turns)							
Capacity Control Position (% or # of turns)							
Suction Pressure, psig (bar _g)							
Suction Temperature, °F (°C)							
Discharge Pressure, psig (bar _g)							
Discharge Temperature, °F (°C)							
Compr. Bearing Oil Supply Temp., °F (°C)							
Bearing Oil Differential Pressure, psid (bar _d)							
Bearing Oil Filter Differential, psid (bar _d)							
Rotor Injection Oil Filter Differential, psid (bar _d)							
Hydraulic Oil Supply Pressure, psig (bar _g)							
Separator Coalescing Filter Differential, psid (bar _d)							
Compressor Oil Supply Pressure, psig (bar _g)							
Coalescing Scavenged Oil Line Valve Adjusted & Flow Observed							
Mechanical Seal Weep Rate, drops/min.							
System Oil Level							
Compressor Oil added, gal (L)							

Remarks:

BOLTING REQUIRED TIGHTENING TORQUE - RG SERIES ROTARY COMPRESSORS



Visit Ariel Web Site: www.arielcorp.com for Latest Edition

Fastener Tightening Torque

Listed in the following table are fastener tightening torque values, required for proper assembly of an Ariel RG compressor. Refer to the Ariel Technical Manual concerning a subject component for detailed assembly procedures.

Threads are to be clean and free of burrs. Check that the threads on the bolting is in good condition to prevent damage to the threaded holes.

Torque values are based on the use of petroleum type lubricants on both the threads and seating surfaces. Use lubricating oil or Lubriplate 630 on threads and seating surfaces, except stainless steel capscrews use Never-Seez Regular Grade and except where Loctite is specified. Molybdenum disulfide lubricants and anti-seize compounds are not to be used for fastener lubrication, unless specified, or excessive stresses can result with the listed value. These torque values are for current production equipment.

TABLE 1: CAPSCREW (OR STUD-NUT) & PIPE THREADS TIGHTENING TORQUE VALUES

NOMINAL SIZE INCH X TPI (METRIC mm x p)	CAPSCREW OR STUD-NUT - GRADE 8		SEATING DOG POINT STUDS - GRADE 8	
	LB-FT	(N·m)	LB-FT	(N·m)
3/8 - 16	35	(45)	195 LB-IN	(22)
7/16 - 14	55	(75)	25	(35)
1/2 - 13	85	(115)	45	(60)
5/8 - 11	165	(225)	80	(110)
3/4 - 10	295	(400)	150	(200)
7/8 - 9	470	(640)	235	(320)
1 - 8	705 ¹	(1000) ¹	350	(475)
M6 x 1 grade 10.9	105 LB-IN	(12)	---	---
M12 x 1.75 grade 10.9	75	(100)	---	---
NPT Pipe Threads	Hand Wrench Tight - Use Loctite 545 Thread Sealant with Activator 7649(N)			

1. Pending torque wrench capacity, 600 lb-ft (820 N·m) is acceptable.

The bolting has been selected to meet Ariel's strength, elongation, sealing, locking and mechanical clearance requirements. Proper bolting must be used and tightened to the values listed in the table above.

The standard bolting fasteners used in an RG compressor are twelve point, grade 8, flanged capscrews.

NOTE: WHEN RE-ASSEMBLING OR REPLACING BOLTING, SEE THE ARIEL PARTS LIST TO DETERMINE THE PROPER FASTENER GRADE, TYPE AND PART NUMBER.

See Packager's Instructions and reference ER-26.1 in Ariel Packager's Standards for compressor to skid hold down bolt torques.

BOLTING REQUIRED TIGHTENING TORQUE - RG SERIES ROTARY COMPRESSORS



APPENDIX

Notes to print ER-63.1 as an Ariel Part for toolbox charts:

1. Source: Coyne Printing or equal.
2. Print page 1 only with blank back. **Do not print this page 2.**
3. 10 point paper 8-1/2 x 11 inches.
4. 10 mill clear plastic lamination - 2 sides, 1/8 inch sealed.
5. 5/16 inch diameter holes for standard 3 hole notebook.

REV	DESCRIPTION	0	012844	11-7-05			
		REV	EC	DATE	REV	EC	DATE

UNIT PROTECTION FOR EXTENDED STORAGE - ROTARY COMPRESSORS



1.0 PURPOSE

1.1 This procedure covers corrosion protection of rotary screw compressors as shipped from Ariel. It is also to be used when a compressor is put into extended storage. Individual compressors or compressors in a gas/oil system package can be protected using this procedure.

1.2 Following this procedure will protect the compressor internally for at least one year. After one year, the compressor gas passages and visible portions of the rotor pair are to be inspected, and if the protective coating is in good condition, it can be closed up for another six months. If any deterioration is observed, or after 18 months, or if the compressor shaft has been turned, then re-protect according to this procedure.

2.0 MATERIALS AND EQUIPMENT

2.1 Use the following materials and equipment or equivalents:

2.1.1 A liquid vapor corrosion inhibitor CCI 300 (Corroless), grade CCI 300M for mineral oil and CCI 300S for synthetic oil. If the customer oil is not known use CCI 300M,

2.1.2 Two gallons (8 L) of lube oil,

2.1.3 Waterproof cloth tape,

2.1.4 Temporary metallic covers (blind flange, "skillet" or equal) and neoprene gaskets to close the suction and discharge flanges if compressor is taken out of service.

2.1.5 A corrosion-inhibiting pump, oil filter 10 microns or better and necessary pipe fittings, are required to implement this procedure.

3.0 PROCEDURE

3.1 Mix 1 quart (1 L) of corrosion inhibitor with two gallons (8 L) of lube oil.

3.2 Remove the suction and discharge flange covers. Spray the inhibitor mixture into the compressor gas passages covering all internal housing and rotor surfaces that can be reached through the suction and discharge flange openings.

3	Was specific quantities of corrosion inhibitor for each model, now 1 quart plus 2 gallons lube oil mixture regardless of model.						
		3	013234	5-15-06			
		2	010774	8-14-02			
		1	ECN8050	---			
REV	DESCRIPTION	0	ECN7293	6-25-98			
		REV	EC	DATE	REV	EC	DATE

UNIT PROTECTION FOR EXTENDED STORAGE - ROTARY COMPRESSORS



- 3.3 Rotate the male rotor 180 degrees and repeat the spraying process.
- 3.4 Pour one 1 quart (1 L) of inhibitor mixture into the discharge chamber. Pour one quart (1 L) of the mixture into the suction chamber. Reinstall the discharge and suction flange covers and gaskets to retain the inhibitor.
- 3.5 Drain the filter bowls and remove the filter elements, if present. Remove the pipe between the bearing filter and pressure control valve and connect the inhibitor pump to the pressure control valve inlet. Pump the remainder of the inhibitor mixture into the compressor, then replace the pipe. The compressor should not be stored with the filter elements installed as they can be damaged by the corrosion inhibitor.
- 3.6 Reassemble all covers and gaskets, remove pump connections and return all compressor piping connections to their original configuration. Tape the clearance opening between the drive end rotor shaft, or jackshaft as appropriate and the mechanical seal cover to prevent any exchange of air in the compressor frame. Plug or otherwise seal the mechanical seal weepage tube. The external section of drive shaft should be protected as follows: Clean the shaft, then apply a thin film of inhibitor to the shaft, cover with waterproof cloth tape and secure with duct tape as necessary.
- 3.7 Tag the unit with date protected, noting that the compressor shaft should not be turned and whether mineral or synthetic oil was used to preserve the compressor.
- 3.8 Inspect the compressor after one year. If any deterioration is observed, repeat the protection. Also repeat the protection after 18 months, or if the rotor shaft, or jackshaft, has been turned for any reason.

4.0 RECOMMISSIONING COMPRESSOR TO SERVICE

- 4.1 Before going back on-line, drain the inhibitor mixture and install the filter elements. The pre-lube pump should be operated and each lube supply point fitting loosened to be visually assured of a lube oil supply. It may be necessary to flush the compressor and oil system if the inhibitor mixture is incompatible with the compressor operating lube oil. Consult your lube oil supplier to confirm compatibility. Remove the waterproof cloth tape at the drive shaft and uncover the mechanical seal weepage tube.
- 4.2 Check fastener tightening torques on all bolting which may have been loosened as a result of applying this procedure and all critical bolting as a result of re-applying the unit to service. Refer to the Ariel Technical manuals for tightening information and the torque charts (ER-63.1 for RG compressors) for fastener torque values. Documents are available on the Ariel web site at: www.arielcorp.com.
- 4.3 Utilize the appropriate start-up check list (ER-10.4.2 for RG compressors).

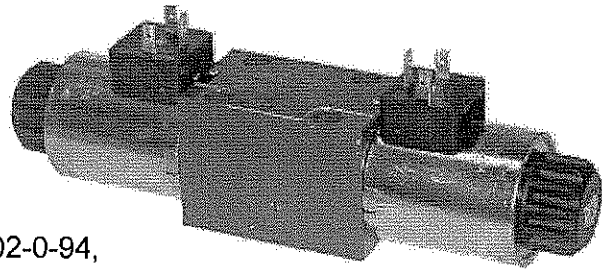


Directional Control Valve Solenoid Operated

001988

Size D03 (06)	...4600PSI (320 bar)	...21 GPM (80 l/min)
---------------	----------------------	----------------------

- 4 Way, 3 Position directional control valve
- Cylindrical DC solenoids with removable coils - Electrical Connectors can be rotated in either direction by 90°
- 24VDC solenoids with integrated transient voltage suppressor
- Four-lan spool - reduced functional dependence on fluid viscosity
- Wet pin core tubes
- Installation dimensions to ISO 4401-03-02-0-94, DIN 24 340-A6, NFPA T3.5.1 M R1, and ANSI B93.7 D03



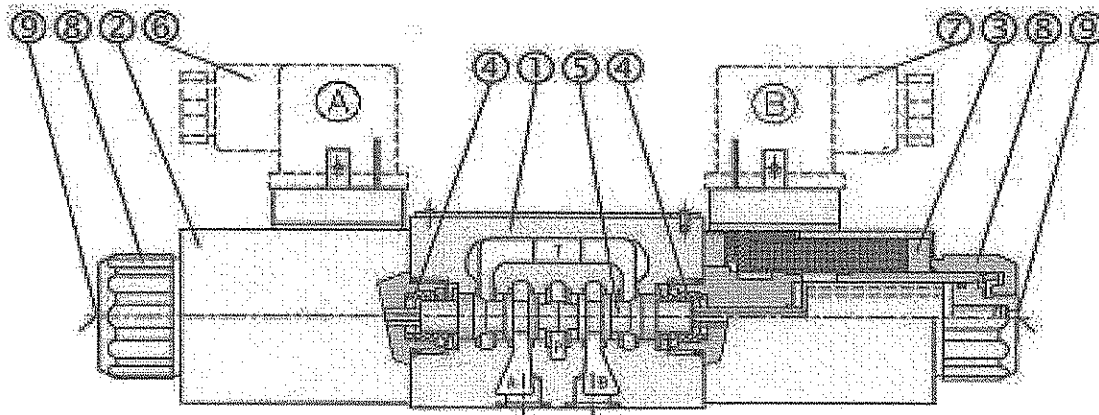
Functional Description

The Ariel directional control valve 001988 consists of a housing (1), a control spool (5) with two centering springs (4), and cylindrical operating solenoids (2,3).

The three-position directional control valve is fitted with two solenoids and two springs.

The operating solenoids are DC solenoids. The connectors (6,7) can be turned 90°. By loosening

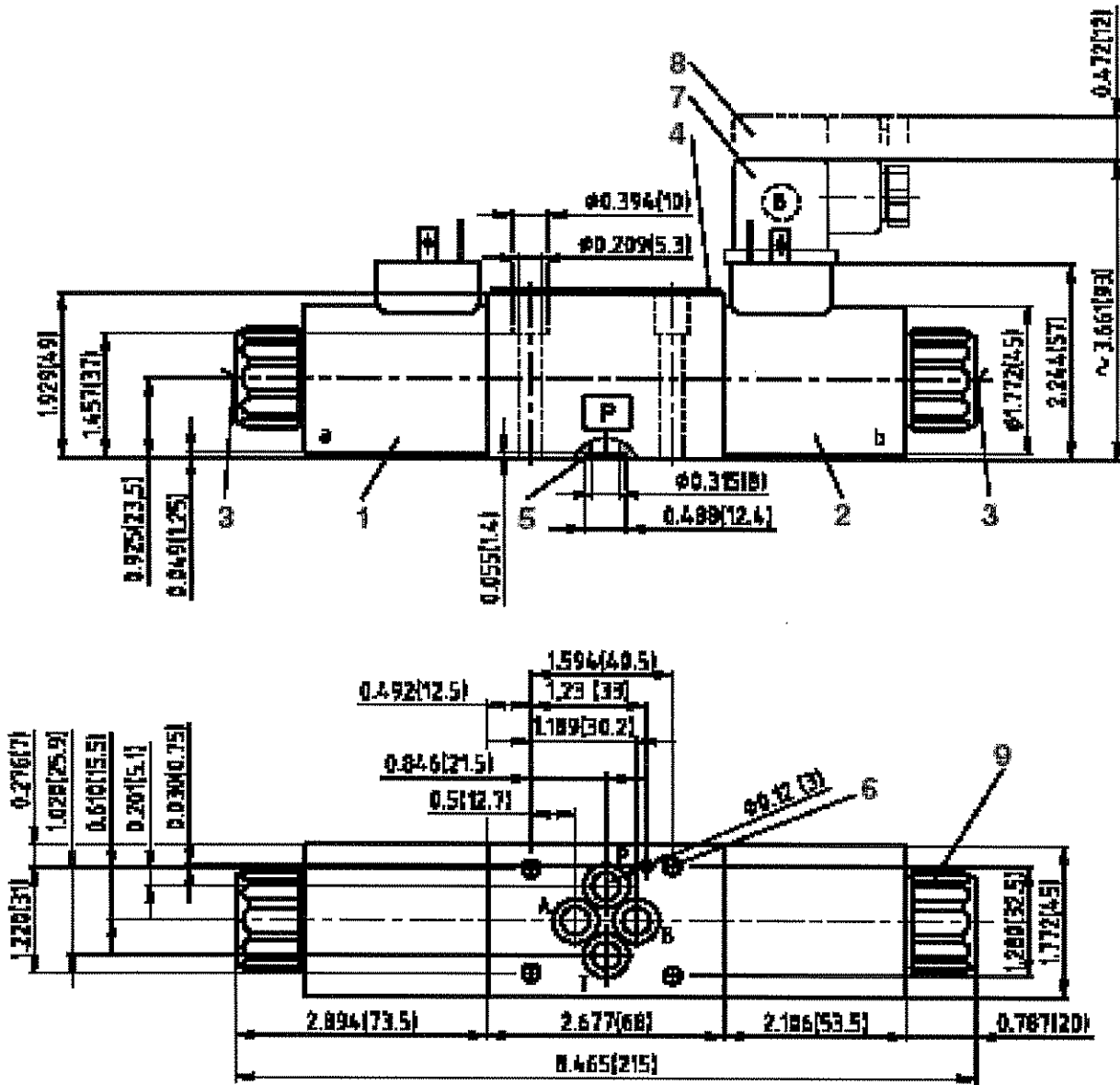
the nut (8), the solenoids can be turned or replaced without interfering with any seals of the valve. In the case of solenoid malfunction or power failure, the spool of the valve can be shifted by manual override (9), provided the pressure in T-port does not exceed 25 bar. The valve housing (1) is phosphate coated and the solenoids (2,3) are zinc coated.



Order Information

Directional Control Valve P/N - - 001988

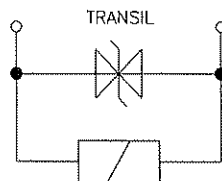
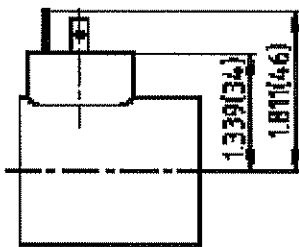
Valve Dimensions Dimensions in inches and millimeters (in brackets)



Technical Data - For Ariel solenoid valve; 24VDC/1.29A Coils w/DIN connector sockets and bipolar transil diodes built into each socket

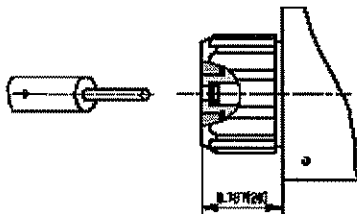
Valve Size	US (mm)	D 03 (06)
Maximum flow	GPM (L/min)	21 (80)
Max operating pressure at port P,A,B	PSI (bar)	4600 (320)
Max. operating pressure at port T	PSI (bar)	3000 (210)
Pressure drop	PSI (bar)	see $\Delta p - Q$ characteristics
Hydraulic Fluid		Petroleum oils (HM, HL, HLP) Phosphate ester fluids (HFD-R)
Fluid temperature range (FPM Seals)	°F (°C)	-22... +176 (-30... +80)
Ambient temperature max.	°F (°C)	-4... +176 (-20... +80)
Viscosity range	SUS (mm ² /s)	up to +122 (+50)
Maximum degree of fluid contamination		Class 21/18/15 to ISO 4406 (1999)
Max. allowable voltage variation	%	DC: ± 10 AC: ± 10
Max. switching frequency	1/hour	15,000
Switching time, on: at v= 156 SUS (32mm ² /s)	ms	DC: 30... 50 AC: 30... 40
Switching time, off: at v= 156 SUS (32mm ² /s)	ms	DC: 10... 50 AC: 30... 70
Duty cycle	%	100
Service life	cycles	10 ⁷
Enclosure type to DIN 40050		IP 65
Weight	lbs (kg)	4.84 (2.2)
Mounting Position		Any

Solenoid Coil



Solenoid coil with bipolar transil diode/transient voltage suppressor and terminal for the electrical connector DIN 43650.

Manual Override



Standard model - captured manual override

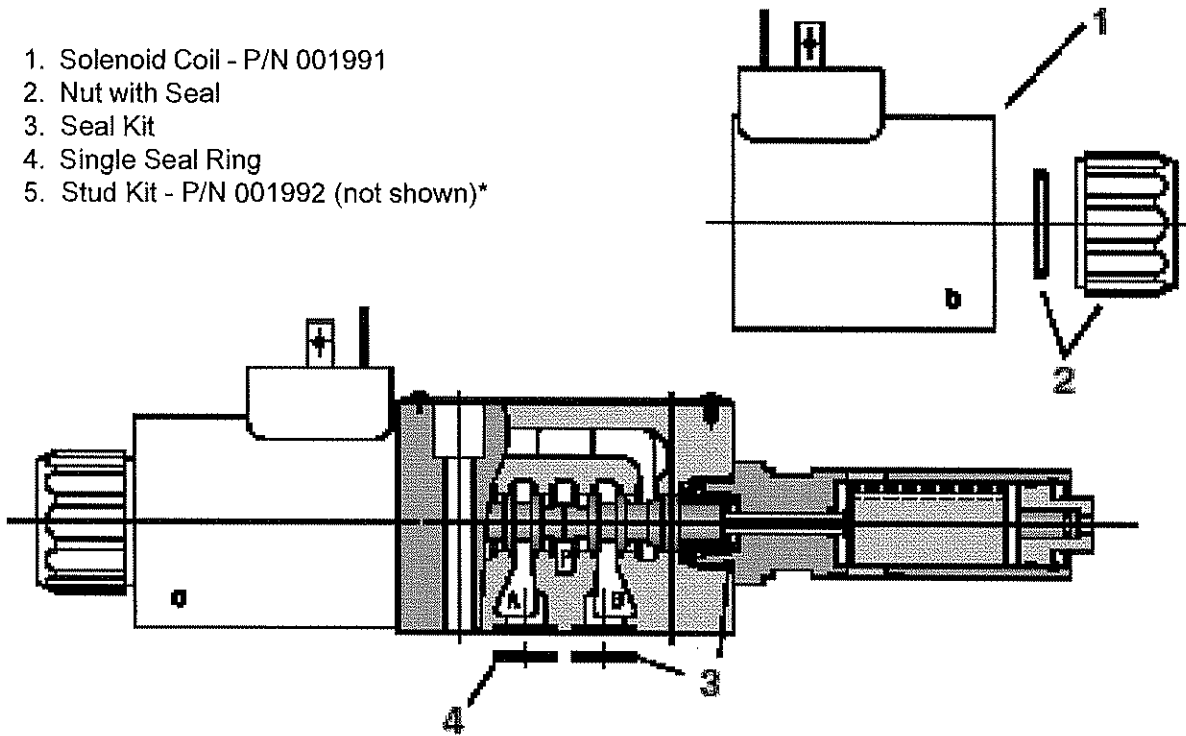
Standard model solenoid retaining nut

Spare Parts

Item	Description	Type, size, quantity	Order Number
1.	Solenoid	24VDC / 1.29 A w/bipolar transil diode	001991
2.	Solenoid Nut and O-ring	Nut Mat'l: Black Polycarbonate; 22 x 2 O-ring	484-9951
3.	Complete Seal Kit	Mat'l: Viton; 9.25 x 1.78 (4 pcs.), 17.17 x 1.78 (2 pcs.)	484-9971
4.	Individual Mounting Seal	Mat'l: Viton: 9.25 x 1.78	HY273220925168

Spare Parts (cont.)

1. Solenoid Coil - P/N 001991
2. Nut with Seal
3. Seal Kit
4. Single Seal Ring
5. Stud Kit - P/N 001992 (not shown)*



*001992 Stud Kit includes (4) 10-24UNC x 3.86" long Studs and (4) stud nuts for valve stack of (1) 001988 and (1) 001989

Notes:



Ariel Corporation

35 Blackjack Road
Mount Vernon, OH 43050 USA

Phone: 740-397-0311 * Fax: 740-397-3856 * E-mail: ARC@ARIELcorp.com * Internet: <http://www.arielcorp.com>

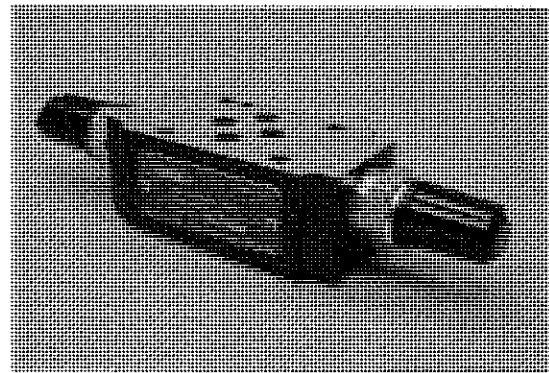
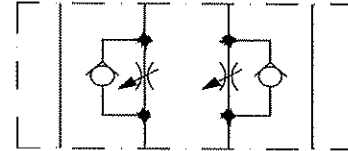


Double Throttle Check Valve Sandwich Plate

001989

Size D03 (06) ...4600PSI (320 bar) ...21.1 GPM (80 l/min)

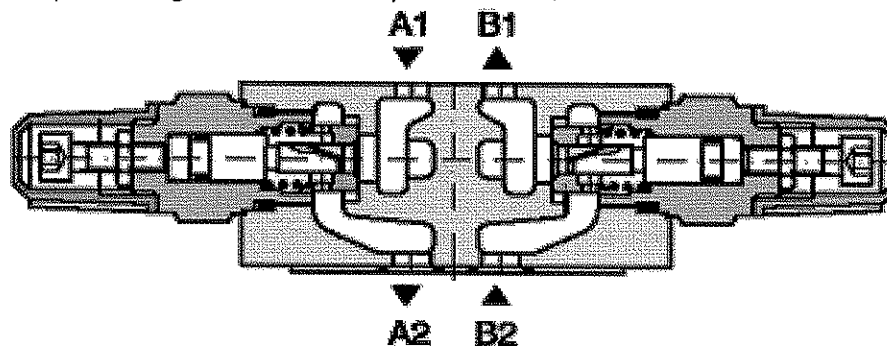
- Sandwich plate design for use in vertical stacking assemblies
- Meter-out control
- Throttle valves in channels A and B
- Flow adjustment - adjustment elements
- Installation dimensions to ISO 4401-03-02-0-94, DIN 24 340-A6, NFPA T3.5.1 M R1, and ANSI B93.7 D03



Functional Description

The Ariel double throttle valve 001989 is used to control flow rates in (2) separate line (A, B) of the hydraulic circuit. A throttle valve is built into each channel, A and B. The valve restricts the fluid flow in one direction while providing reverse free-flow in the opposite direction. The throttling spool is adjusted by means of a set screw and each spool position corresponds with a certain passage area. Traditionally known as a meter-out direct operating flow control sandwich, fluid entering from port A1 shifts the valve seat against the spring, thus creating a passage which allows reverse free-flow to port A2 (function as a check valve). Fluid entering port B2 is throttled to port B1 via a groove and an annulus area. The sandwich design enables simple stacking with the other compo-

nents of the same size, in this case the **directional control valve 001988** is installed against the surface marked **A1 & B1** below and with the valve surface marked **A2 & B2** mating to the surface of the hydraulic manifold. The separate O-ring plate with fitted O-rings provides sealing between the valve 001989 and the hydraulic manifold. The orientation of the throttle check valves in the valve body corresponds with the symbols shown on the valve and the figure below. Dowell pin hole at bottom mating surface (manifold) is immaterial. The set screw can be operated by a hex key wrench (Allen wrench) measuring 5mm across the flats. The valve housing is phosphate coated, the surfaces of the other parts are zinc coated. Seals are viton.

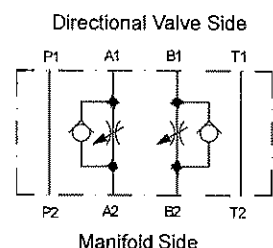


Order Information

Flow Control Valve P/N - - 001989

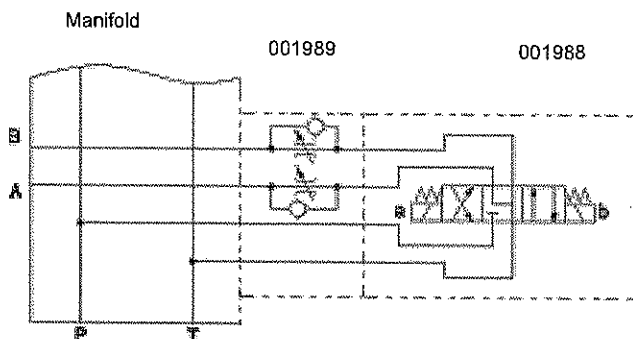
Schematic

Meter-Out Symbol



Valve in channels A & B

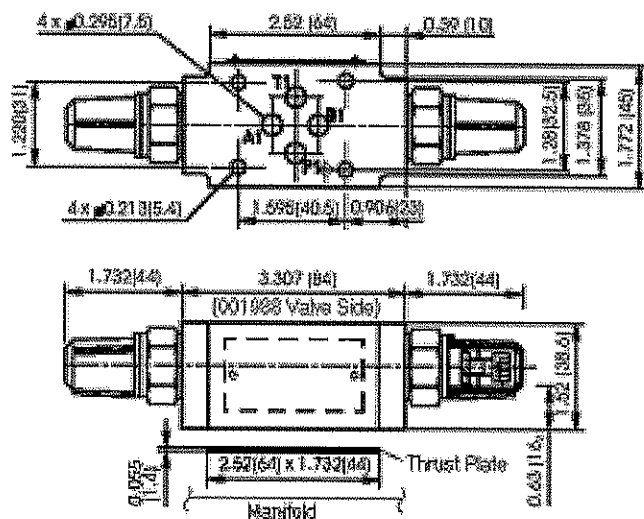
Circuit Diagram



Technical Data

Valve Size	US (mm)	D 03 (06)
Maximum flow	GPM (L/min)	21.1 (80)
Max operating pressure at port P,A,B	PSI (bar)	4600 (320)
Hydraulic Fluid		Petroleum oils (HM, HL, HLP) Phosphate ester fluids (HFD-R)
Fluid temperature range (Viton Seals)	°F (°C)	-4... +176 (-20... +80)
Viscosity range	SUS (mm ² /s)	98 ... 1840 (20 ... 400)
Maximum degree of fluid contamination		Class 21/18/15 to ISO 4406 (1999)
Weight	lbs (kg)	2.65 (1.2)
Mounting Position		Any

Valve Dimensions:



Spare Parts:

Seal Kit

Type	Dimensions / Qty	
Viton	O-ring	17.62 x 2.62 (2 pcs.)
	O-ring	9.25 x 1.78 (2 pcs.)
	O-ring	6.75 x 1.78 (2 pcs.)
	Backup Ring	17.83 x 22.19 x 1.14 (2 pcs.)
	Backup Ring	9.43 x 6.73 x 1.14 (2 pcs.)

525-9940

Notes:

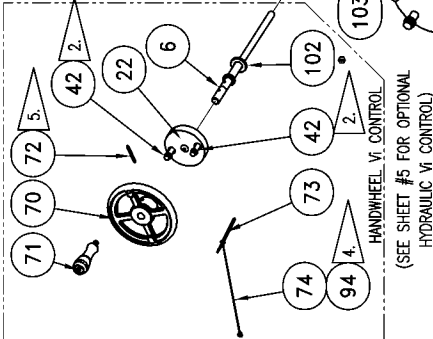
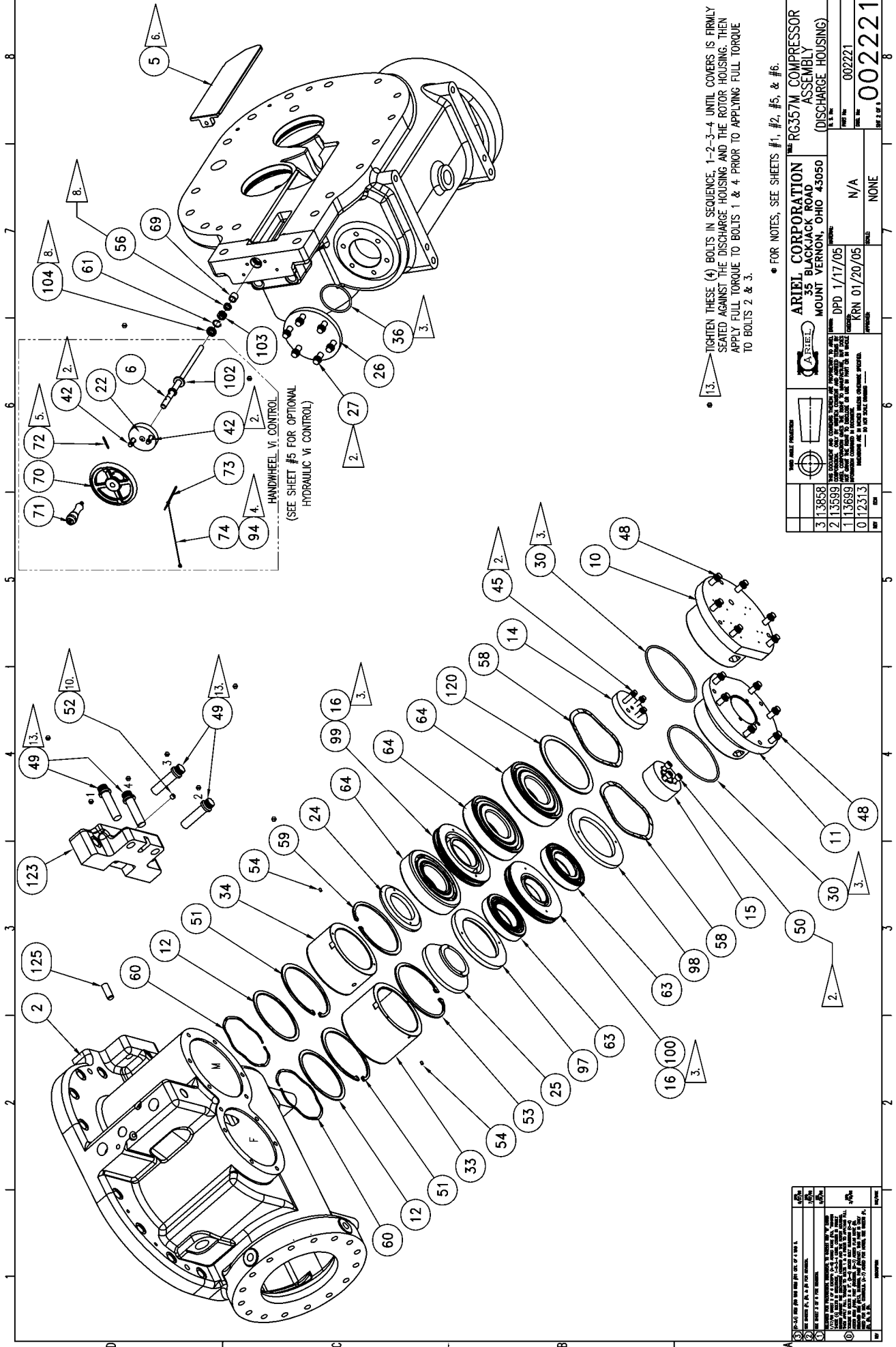
1. Mounting stud kit 001992 for mounting (1) 001988 and (1) 001989 in valve stack
2. The orientation of the throttle check valves corresponds with the name-plate symbol
3. Adjustment hex is 5mm flat to flat. Use appropriate hex key or wrench to adjust flow setting.



Ariel Corporation

35 Blackjack Road
Mount Vernon, OH 43050 USA

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REV	DATE	BY	CHK	DESCRIPTION
3	13858			
2	13599			
1	13689			
0	12313			

DATE	BY	CHK	DESCRIPTION
DPD 1/17/05			
KRN 01/20/05			

DATE	BY	CHK	DESCRIPTION
N/A			
NONE			

DATE	BY	CHK	DESCRIPTION
002221			
002221			

DATE	BY	CHK	DESCRIPTION
01/17/05			
01/20/05			

DATE	BY	CHK	DESCRIPTION
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NONE			

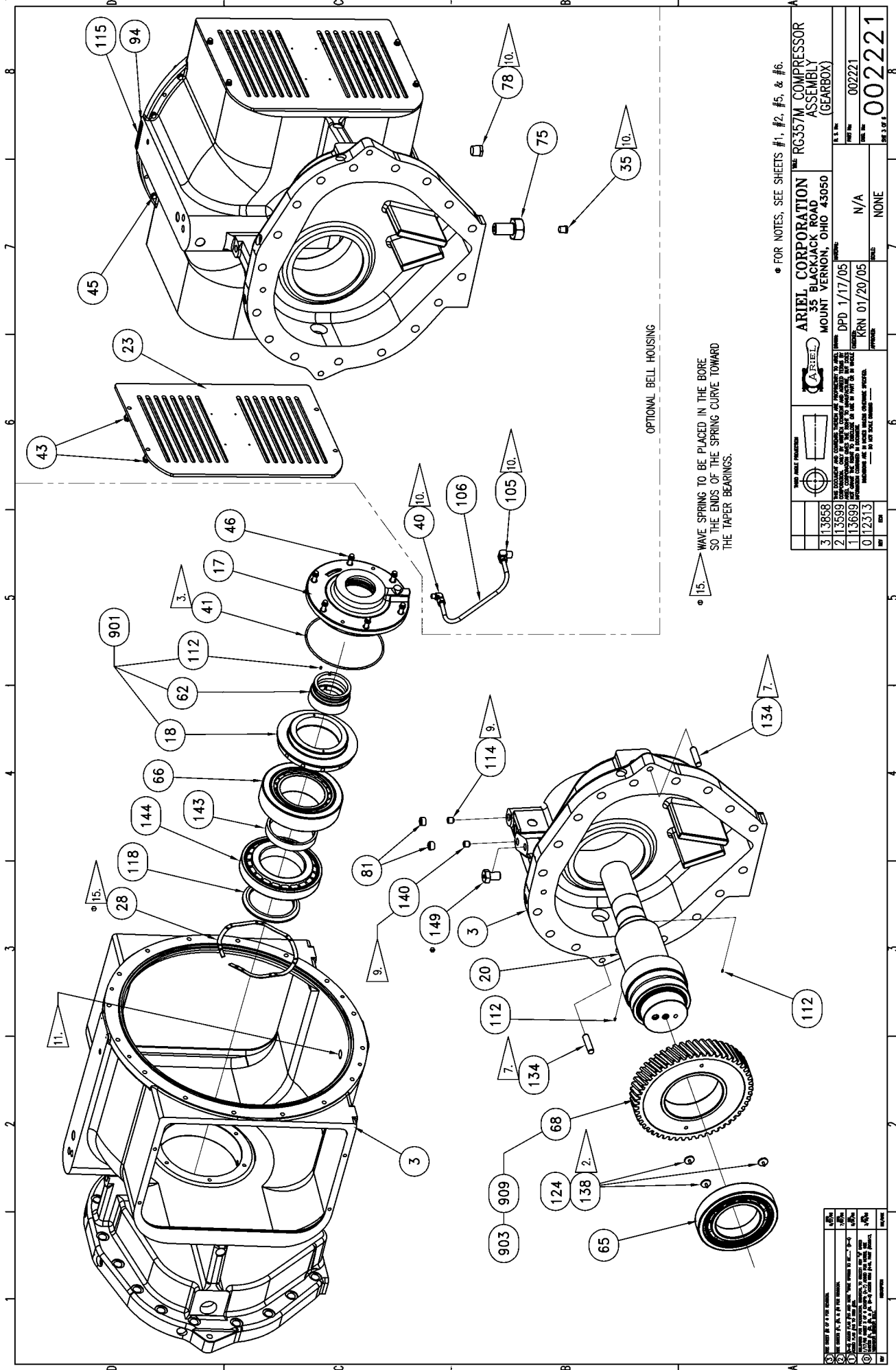
DATE	BY	CHK	DESCRIPTION
002221			
002221			

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OPTIONAL BELL HOUSING

15. WAVE SPRING TO BE PLACED IN THE BORE.
 SO THE ENDS OF THE SPRING CURVE TOWARD
 THE TAPER BEARINGS.

FOR NOTES, SEE SHEETS #1, #2, #5, & #6.

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

DPD 1/17/05
 KRN 01/29/05

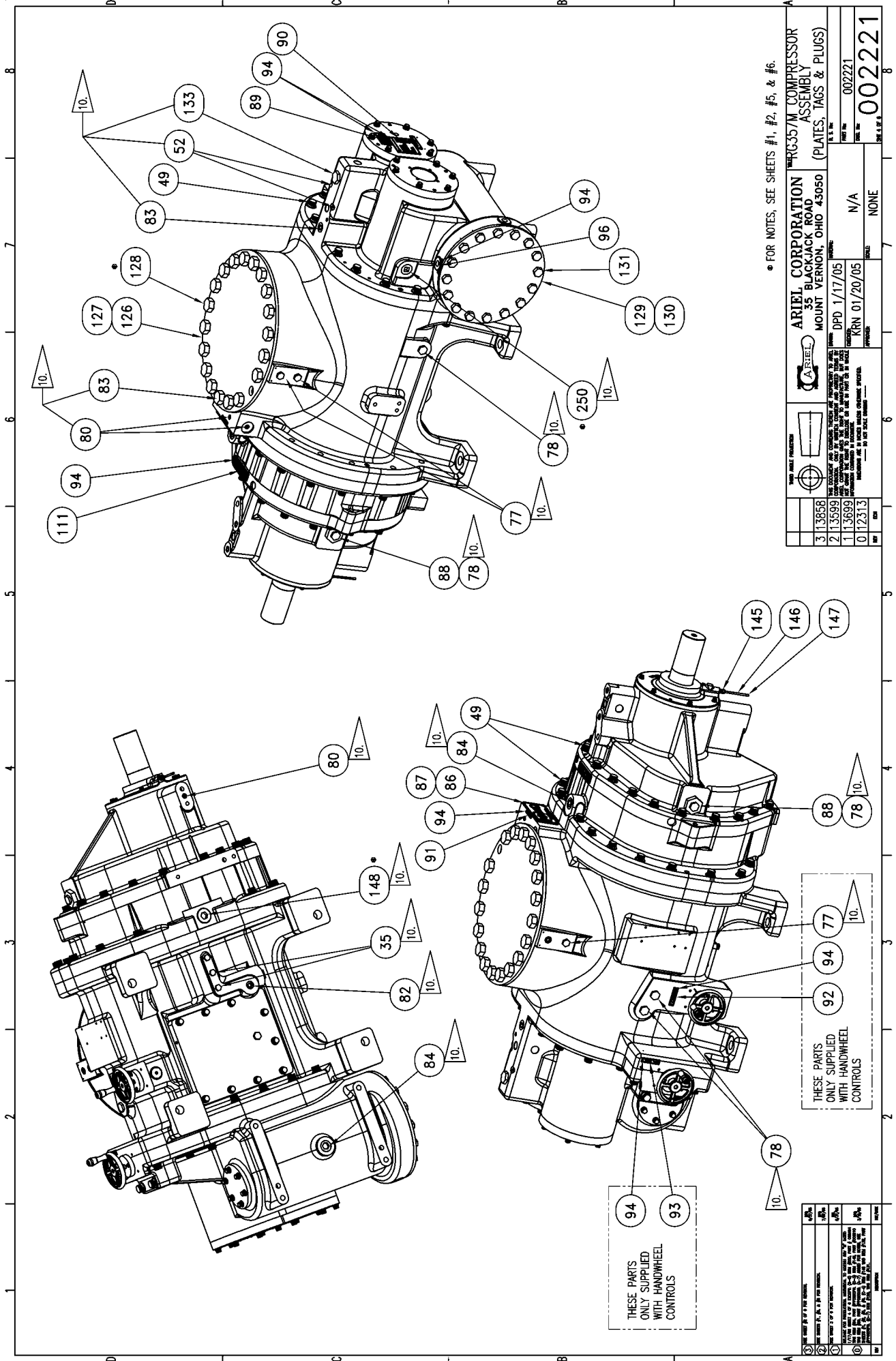
N/A
 NONE

RG357M COMPRESSOR
 ASSEMBLY
 (GEARBOX)

002221

002221

NO.	REVISION	DATE	BY	CHKD.
1	ISSUE FOR THE BORE			
2	ISSUE FOR THE BORE			
3	ISSUE FOR THE BORE			
4	ISSUE FOR THE BORE			
5	ISSUE FOR THE BORE			
6	ISSUE FOR THE BORE			
7	ISSUE FOR THE BORE			
8	ISSUE FOR THE BORE			



• FOR NOTES, SEE SHEETS #1, #2, #5, & #6.

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

DPD 1/17/05
 KRN 01/20/05

002221
 NONE

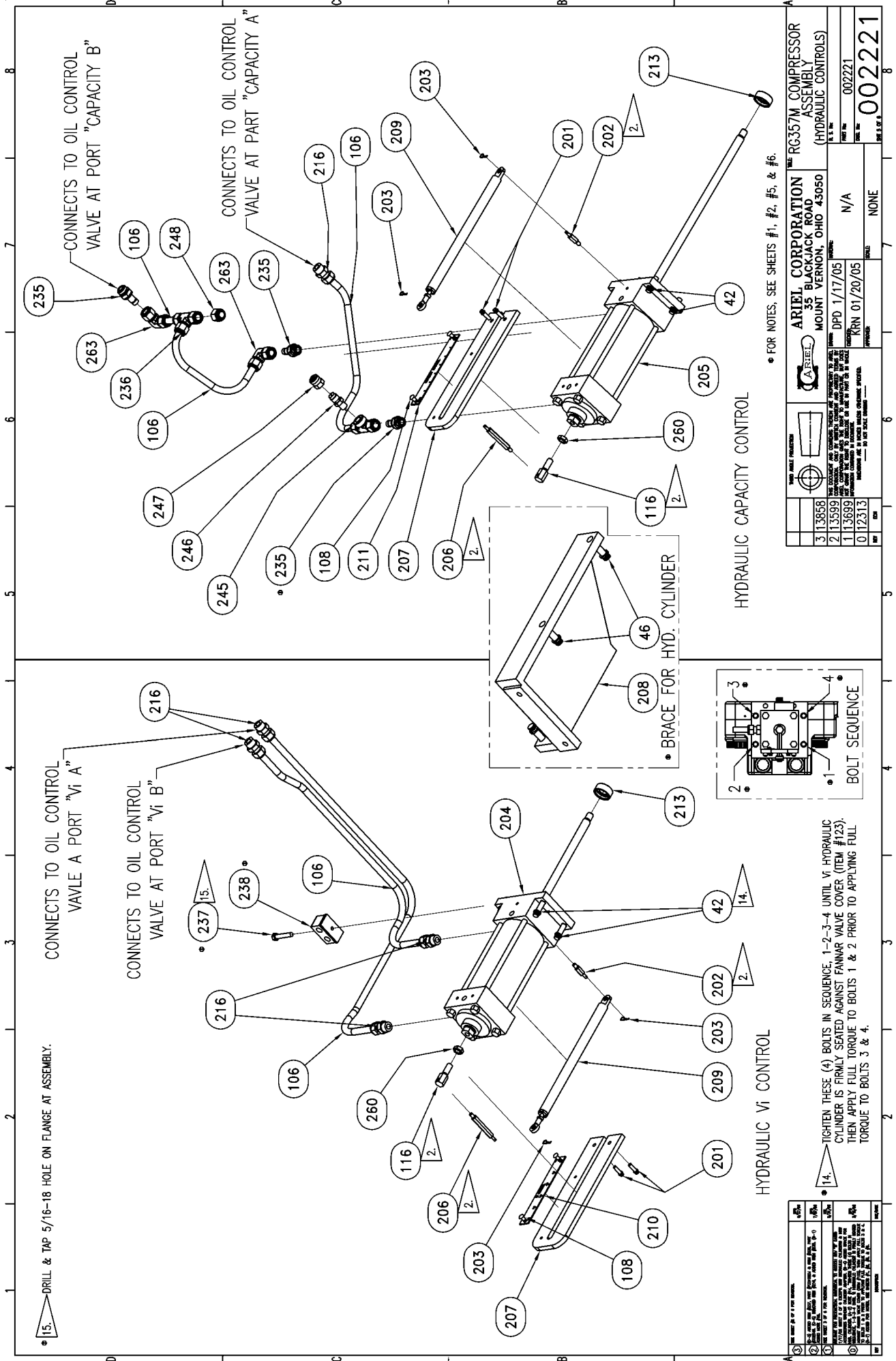
QTY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
3	13858		
2	13599		
1	13699		
0	12313		

THESE PARTS ONLY SUPPLIED WITH HANDWHEEL CONTROLS

THESE PARTS ONLY SUPPLIED WITH HANDWHEEL CONTROLS

QTY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	94		
1	93		

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050
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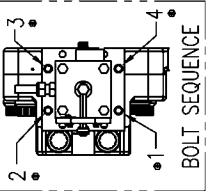


• 15. DRILL & TAP 5/16-18 HOLE ON FLANGE AT ASSEMBLY.

CONNECTS TO OIL CONTROL VALVE AT PORT "Vi A"

CONNECTS TO OIL CONTROL VALVE AT PORT "Vi B"

CONNECTS TO OIL CONTROL VALVE AT PORT "CAPACITY A"



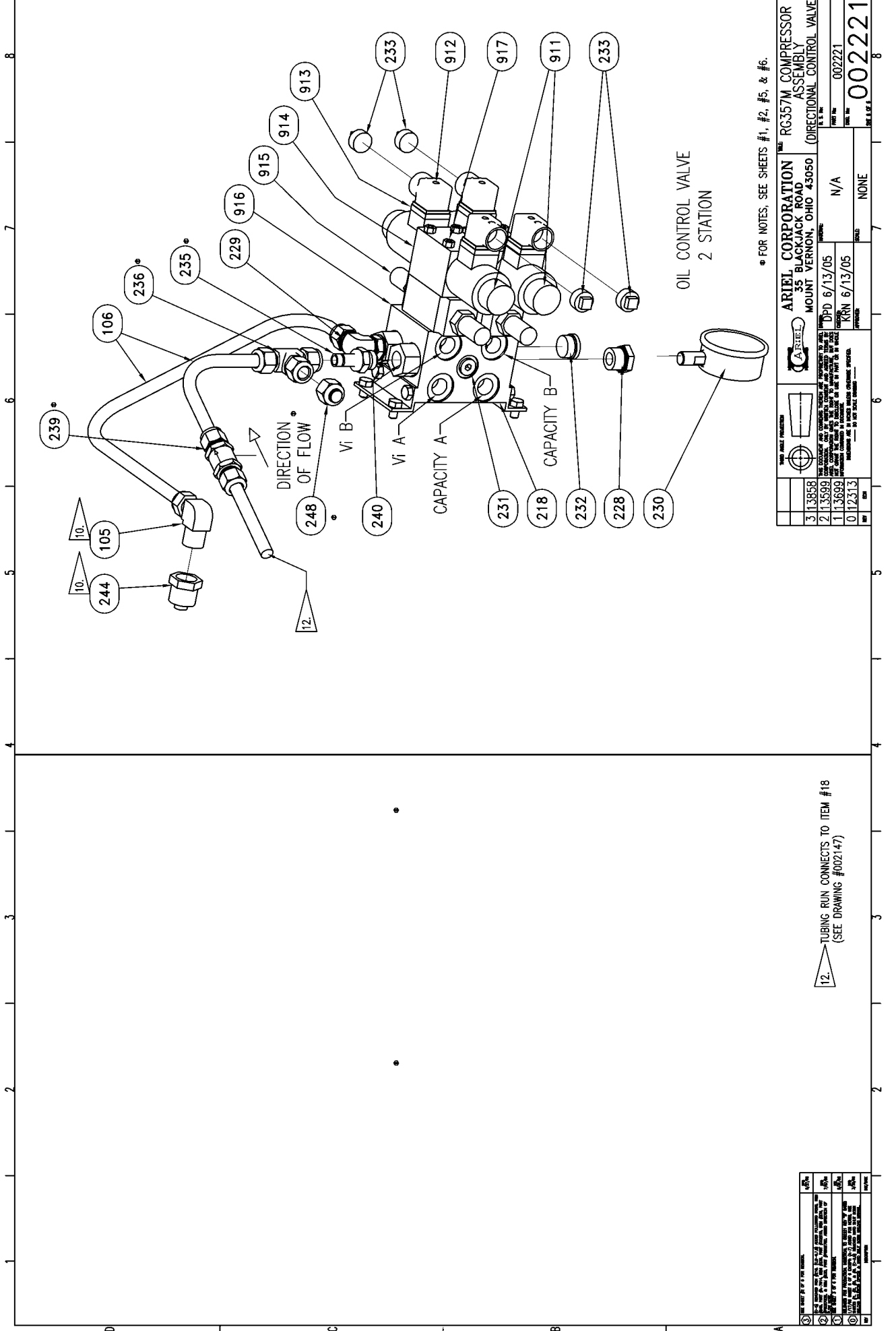
• 14. TIGHTEN THESE (4) BOLTS IN SEQUENCE, 1-2-3-4 UNTIL Vi HYDRAULIC CYLINDER IS FIRMLY SEATED AGAINST FANMAR VALVE COVER (ITEM #123). THEN APPLY FULL TORQUE TO BOLTS 1 & 2 PRIOR TO APPLYING FULL TORQUE TO BOLTS 3 & 4.

HYDRAULIC Vi CONTROL

HYDRAULIC CAPACITY CONTROL

• FOR NOTES, SEE SHEETS #1, #2, #5, & #6.

<p>3 13858 2 13599 1 13699 0 12313</p>		<p>ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050</p>	<p>RG357M COMPRESSOR ASSEMBLY (HYDRAULIC CONTROLS)</p>
<p>DPD 1/17/05 KRN 01/20/05</p>		<p>DATE: 002221</p>	<p>REV. 002221</p>
<p>3 13858 2 13599 1 13699 0 12313</p>		<p>DATE: 002221</p>	<p>REV. 002221</p>



• FOR NOTES, SEE SHEETS #1, #2, #5, & #6.

ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050		R6357M COMPRESSOR ASSEMBLY (DIRECTIONAL CONTROL VALVE) PART NO. 002221	
DATE: 6/13/05 BY: KRN	DATE: 6/13/05 BY: KRN	N/A	NONE
3 13858 2 13899 1 13699 0 12313		THE EXHAUST AND CONDENSER SYSTEMS ARE CONNECTED TO THE COMPRESSOR. ONLY AN APPROVED SERVICE TECHNICIAN SHOULD ATTEMPT TO REPAIR OR REPLACE ANY PART OF THIS SYSTEM. THE USER SHOULD REFER TO THE SERVICE MANUAL FOR THE PROPER REPAIR AND REPLACEMENT PROCEDURES.	

12. TUBING RUN CONNECTS TO ITEM #18 (SEE DRAWING #002147)

1. THE USER SHOULD REFER TO THE SERVICE MANUAL FOR THE PROPER REPAIR AND REPLACEMENT PROCEDURES.	2. THE EXHAUST AND CONDENSER SYSTEMS ARE CONNECTED TO THE COMPRESSOR. ONLY AN APPROVED SERVICE TECHNICIAN SHOULD ATTEMPT TO REPAIR OR REPLACE ANY PART OF THIS SYSTEM.
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11/29/06

Ariel Corporation

SO# 2000350

RG357M MAIN COMPRESSOR ASSEMBLY
 HYDRAULIC CONTROLS
 REF. DRWG. 002221

Seq	Itm#	Comp PN#	Qty	Part desc	
1	1	002295	1	HSG, ROTOR, 300#	RG357M
1	2	002139	1	HSG, DIS, 300# (BUILD#2)	RG357M
1	3	002069	1	GEARBOX W/OUT BELLHSG	RG357M
1	4	002000	1	ROTOR (PAIR)	RG357M
1	5	002506	1	VLV, FANNAR	RG357M
1	7	002018	1	VLV-UNLOADING,	RG357M
1	9	002043	1	COVER, UNLOAD. VLV,	RG357M
1	10	002012	1	COVER, M. ROTOR,	RG357M
1	11	002014	1	COVER, F. ROTOR,	RG357M
1	12	002044	4	SEAL-OIL, FLOAT. M. SUC/F. DIS	RG357M
1	13	002296	1	HSG, INLET,	RG357M
1	14	002045	1	RETAINER, M. THRUST	RG357M
1	15	002046	1	RETAINER, F. THRUST	RG357M
1	16	002106	4	O-RING, VT, 7.987 I.D. X.103	
1	17	002010	1	HOUSING, SEAL	RG357M
1	18	002047	1	SPACER RING-OIL SEAL,	RG357M
1	20	002402	1	JACKSHAFT	RG357M
1	21	FP0500MS	2	DOWEL PIN, 3/4 X 4	.0002
1	24	002120	1	INNER SPCR, M. THRUST BRG	RG357M
1	25	002121	1	INNER SPCR, F. THRUST BRG	RG357M
1	26	001132	1	COVER, DIS. RG282/RG282M/RG357M	
1	27	FC0120HI	6	12 PT CAP, 5/8-11 X 1-1/2	G8
1	28	002039	1	WAVE SPRING, 10.629 BOREX.400	
1	29	001408	2	O-RING, VT, 1.109 I.D. X.139	
1	30	A-3500	2	O-RING, VT, 8.395 O.D. X.210	
1	31	002230	1	O-RING, MOLDED, VT,	RG357M
1	32	002105	1	O-RING, VT, 30.221 I.D. X.275	
1	33	001868	2	SLEEVE BRG, M. SUC/F. DIS	RG357M
1	34	001958	2	SLEEVE BRG, M. DIS/F. SUC	RG357M
1	35	PP0810GB	3	PIPE PLUG, 1/2NPT, HEX HD, STL	
1	36	A-0039	1	O-RING, VT, 4.020 O.D. X.210	
1	38	A-2393	1	O-RING, VT, 14.395 O.D. X.210	
1	39	A-1811	2	O-RING, VT, 3.020 O.D. X.210	
1	41	A-3511	1	O-RING, VT, 10.395 O.D. X.210	
1	42	FC0120EG	8	12 PT CAP, 3/8-16 X 1	G8
1	42	FC0120EG	3	12 PT CAP, 3/8-16 X 1	G8
1	45	FC0120GK	3	12 PT CAP, 1/2-13 X 2	G8
1	46	FC0120GH	4	12 PT CAP, 1/2-13 X 1-1/4	G8
1	46	FC0120GH	6	12 PT CAP, 1/2-13 X 1-1/4	G8
1	47	FC0120IM	9	12 PT CAP, 3/4-10 X 2-1/2	G8
1	48	FC0120HL	12	12 PT CAP, 5/8-11 X 2-1/4	G8
1	49	FC0120KR	54	12 PT CAP, 1-8 X 3-3/4	G8
1	50	FC0110GM	3	SHCS, 1/2-13 X 2-1/2	G8

11/29/06

Ariel Corporation

SO# 2000350

RG357M MAIN COMPRESSOR ASSEMBLY
 HYDRAULIC CONTROLS
 REF. DRWG. 002221

Seq	Itm#	Comp PN#	Qty	Part desc
1	51	FT0230DE	4	SNAP RING - INTERNAL 7.250
1	52	PP0851CB	4	PIPE PLUG,1/4NPTF,STL,FLUSH
1	53	FT0230DG	1	SNAP RING - INTERNAL 7.750
1	54	FP0500FB	2	DOWEL PIN, 1/4 X 3/8 .0002
1	55	FP0504LM	2	DOWEL PIN,PULL,3/4 X 2-1/2
1	56	002274	2	SEAL-POLYPAK TYPE-B 5/8 X 7/8
1	57	002131	1	O-RING,VT,25.940I.D.X.275
1	58	001143	2	WAVE SPRING,8.542 BORE X.400
1	59	FT0230DF	1	SNAP RING - INTERNAL 7.500
1	60	002035	4	WAVE SPRING,7.500 BORE X.400
1	61	FT0235AF	2	SNAP RING - INVERTED 1.000
1	62	001978	1	MECH.SEAL-4.25,LP,VT,282/M,357
1	63	000014	2	THRUST BRG,208/260/282/M/357M
1	64	001149	3	THRUST BEARING, RG282/M/357M
1	65	001995	1	CYL RLR BRG,DRV SHAFT RG357M
1	66	001151	1	TAPER RLR BRG, RG282/357M
1	67	002407	1	PINION - 1.000 RATIO RG357M
1	68	002408	1	GEAR - 1.000 RATIO RG357M
1	69	002186	2	BUSHING BRG, 5/8 X 7/8 X 3/4
1	77	PP0810IB	5	PIPE PLUG,3/4NPT,HEX HD,STL
1	78	PP0810KB	5	PIPE PLUG,1"NPT,HEX HD,STL
1	80	PP0851GB	4	PIPE PLUG,1/2NPTF,FLUSH,STL
1	81	PP0850IB	2	PIPE PLUG,3/4NPTF,HEX SOC,STL
1	82	PP0850KB	1	PIPE PLUG,1"NPTF,HEX SOC,STL
1	83	PP0851MB	2	PIPE PLUG,1-1/4NPTF,FLUSH,STL
1	84	PP0850NB	2	PIPE PLUG,1-1/2NPTF,HEXSOC,STL
1	85	002054	1	OILER-GEARS RG357M
1	86	A-0138	1	NAME PLATE,ARIEL LOGO
1	87	FC0134BC	4	BUT HD CAP,10-24 X 1/2 316SS
1	88	000837	2	HEX RED BUSH,ST, 2M X 1F
1	89	000529	1	CAUTION PLATE VENTING
1	90	002536	1	INFO PLT,ROTARY UNITS
1	91	A-0640-A	1	INFO PLATE,SUCTION
1	92	002539	1	INFO PLATE,INPUT SPEED RG357M
1	94	FR0571CC	16	DRIVE SCREW,U-TYPE #6 X 1/4,SS
1	96	A-0640-B	1	INFO PLATE,DISCHARGE
1	97	002122	1	SPACER - FEMALE (.637")
1	98	002055	1	SPACER - FEMALE (.513") RG357M
1	99	002049	1	SPACER SET,THR.BRG,MALE RG357M
1	100	002123	1	SPACER SET,THR.BRG,FEML RG357M
1	101	FC0120EF	2	12 PT CAP,3/8-16 X 7/8 G8
1	103	002188	2	SPACER,STEM SEAL 282M/357M
1	104	002275	2	SEAL-POLYPAK STD 5/8 X 1-1/8

11/29/06

Ariel Corporation

SO# 2000350

RG357M MAIN COMPRESSOR ASSEMBLY
 HYDRAULIC CONTROLS
 REF. DRWG. 002221

Seq	Itm#	Comp PN#	Qty	Part desc
1	105	A-0901	1	MALE ELBOW,STL, 1/2T X 1/2P
1	106	PT0200FB	294	SS,TUBING,1/2 O.D.X.035 WALL
1	108	FC0134CB	4	BUT HD CAP,1/4-20 X 3/8 316SS
1	110	001905	1	LO MESH ELEMENT1-1/4,282M/357M
1	111	002537	1	INFO PLATE,GEAR RATIO/OIL PUMP
1	112	FP0500EB	3	DOWEL PIN, 3/16 X 3/8 .0002
1	114	002395	1	ORIFICE,.172DIA,3/4-10 X 3/4
1	116	002443	2	ADAPTER,TAIL ROD RG357M
1	117	PP0830PB	1	PIPE PLUG,2"NPTF,SQ HD,STL
1	118	002104	1	SPACER RING,BRG REMOVAL RG357M
1	119	002103	2	BACKING RING,DOC RING RG357M
1	120	002102	1	BACKING RING/M.THRUST RG357M
1	122	FW0505DA	2	WASHER,3/8 X 1"O.D.X 1/8THK SS
1	123	001847	1	COVER,FANNAR VLV RG357M
1	124	002149	3	SOC FLT HD M6-1.0 X 20 CL.10.9
1	125	FP0504LK	1	DOWEL PIN,PULL,3/4 X 2
1	126	002067	1	SHIP.FLG.COVER,16",300#,ANSI
1	127	A-1838	1	LATHE CUT SEAL,17.5 OD X 17 ID
1	128	FC0172NJ	20	HEX HD CAP,1-1/4-7 X 1-3/4 NY
1	129	A-1887	1	SHIP FLG COVER,10.0"- 300#
1	130	A-2455	1	LATHE CUT SEAL,13-3/8 OD X 1/4
1	131	FC0103KI	16	HHCS,1-8 X 1-1/2 G2
1	133	PP0810MB	1	PIPE PLUG,1-1/4NPT,HEX HD,STL
1	134	FP0500MO	2	DOWEL PIN, 3/4 X 3 .0002
1	138	002148	3	WASHER,M6 X 32 X 4, C'SUNK
1	140	002396	1	ORIFICE,.156DIA,5/8-11 X 1/2
1	141	002182	1	PINION RETAINER, RG357M
1	142	FC0101GJ	1	HEX HD CAP,1/2-13 X 1-3/4 G8
1	143	002189	1	SPACER RING,TAPER RLR BRG 357M
1	144	002190	1	TAPER RLR BRG,NARROW 357M
1	145	A-0827	1	MALE CONN,STL, 1/4T X 1/4P
1	146	PT0200CB	4	SS,TUBING,1/4 O.D.X.035 WALL
1	147	A-6099	1	SLEEVE CAP PL,1/4T X 7/16
1	148	002510	1	PIPE PLUG,2"NPTF,HEX SOC, MAG
1	149	002513	1	BOLT,VIBRATION SENSOR,1-1/2LG
1	201	FC0120CE	4	12 PT CAP,1/4-20 X3/4 G8
1	202	002445	2	PIN-POSITION SHORT,.688,RG282M
1	203	002449	4	COTTER PIN,HAIRPIN, 3/16-1/4
1	204	002466	1	HYDRAULIC CYL,VI RG357M
1	205	002467	1	HYDRAULIC CYL,CAPACITY RG357M
1	206	002444	2	PIN-POSITION LONG,2.250,RG282M
1	207	002503	2	BRACKET-POS TAG RG357M
1	208	002531	1	BRACE,HYD.CYLINDER RG357M

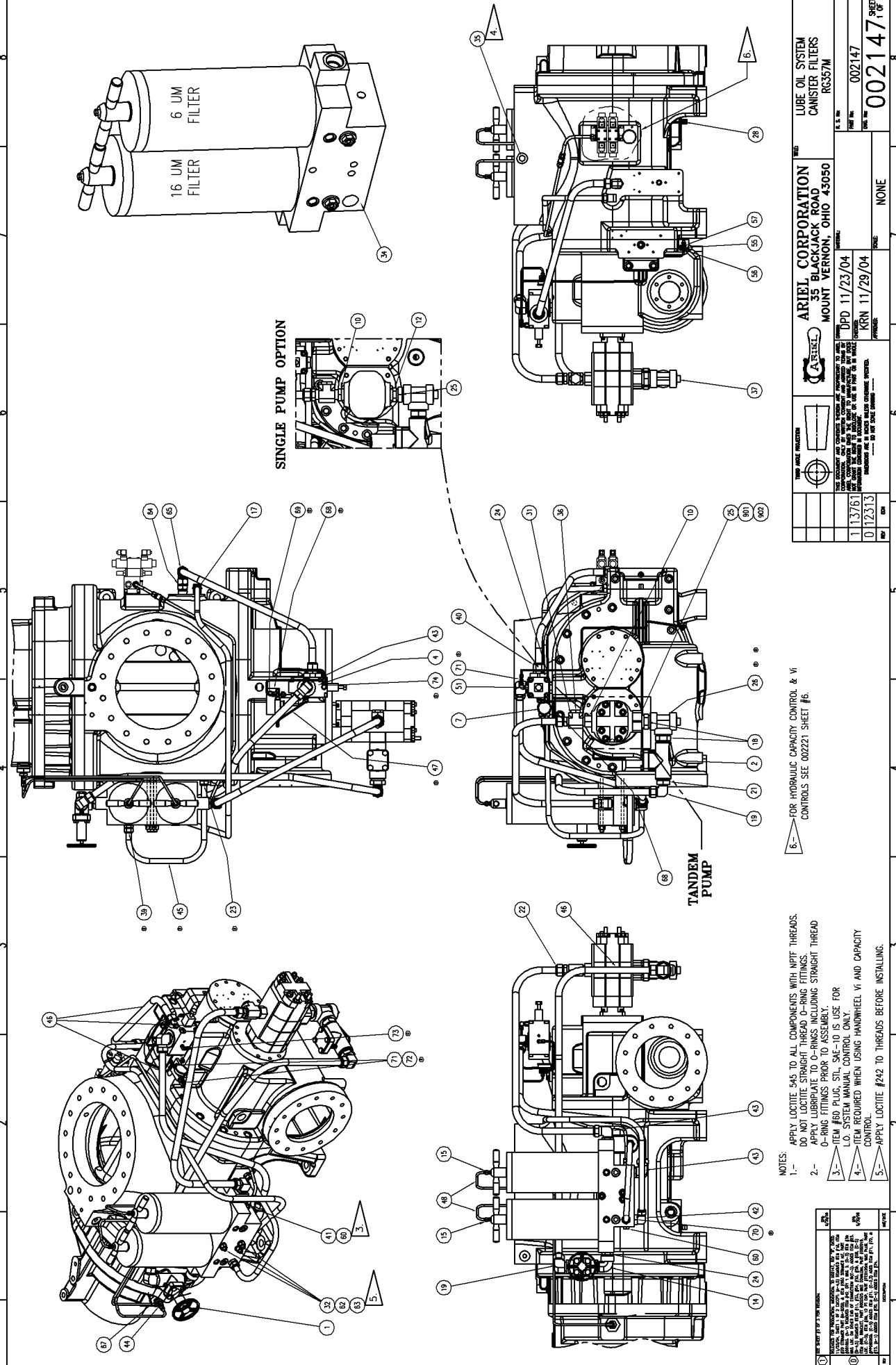
11/29/06

Ariel Corporation

SO# 2000350

RG357M MAIN COMPRESSOR ASSEMBLY
 HYDRAULIC CONTROLS
 REF. DRWG. 002221

Seq	Itm#	Comp PN#	Qty	Part desc
1	209	002040	2	POSITION INDICATOR RG357M
1	210	002218	1	VI CONTRL POSITION TAG RG357M
1	211	002038	1	CAP.CONTRL POSITION TAG RG357M
1	213	002450	2	BUSHING,PILOT ADPTR 282M/357M
1	216	PS0099EE	5	MALE CONN,SS,1/2T X SAE-8
1	218	001994	1	CTRL MNFLD ASSY,2" 282/M/357M
1	228	001667	1	ADAPTER,STL,1/4F X SAE10M
1	229	PS0098DD	1	MALE ELBOW-POS,SS,1/2TXSAE-8
1	230	A-11129	1	L O PRESS GAUGE,ASHCROFT 300#
1	231	PP0861EB	1	SAE PLUG,SOC.HD,#6,9/16-18
1	232	PP0861GB	1	SAE PLUG,SOC.HD,#10,7/8-14
1	233	PP0802GD	4	PIPE PLUG,1/2NPT,SQ HD,PLASTIC
1	235	PS0097DD	4	MALE ADAPTR,SS,1/2T X SAE-8
1	236	PS0070DB	2	UNION TEE,SS, 1/2T
1	237	FC0102DJ	1	HEX HD CAP,5/16-18 X 1-3/4 G5
1	238	002540	1	TUBING CLAMP, TWIN 1/2" TUBE
1	239	002515	1	CHECK VALVE,1/2T
1	240	002285	2	ADAPTER BUSHING,SAE-10 X SAE-8
1	244	002303	1	CHECK VALVE-BUSHING 3/4M X1/2F
1	245	A-11700	1	FEMALE BRANCH TEE,SS,1/2TX1/4P
1	246	002328	1	ADPTR, 1/4"MNPT X 1/4"MJIC,STL
1	247	002329	1	CAP,1/4"JIC,STL
1	248	A-7614	2	PLUG-TUBE FIT,FEMALE,STL,1/2T
1	250	002404	1	PIPE PLUG,1-1/2NPTF,SQ SOC,MAG
1	260	FN0469FA	2	JAM NUT,HEX,7/16-14,SST
1	263	A-9441	2	UNION ELBOW,SS,1/2T
1	901	002229	0	MECH.SEAL REPL.KIT,VT RG357M
1	902	002177	0	STRAINER ORING,40MM O.D. X 4MM
1	903	002242	0	RG357M PINION/GEAR SET 1.000
1	904	002243	0	RG357M PINION/GEAR SET 1.375
1	905	002244	0	RG357M PINION/GEAR SET 1.566
1	906	002245	0	RG357M PINION/GEAR SET 1.778
1	907	002246	0	RG357M PINION/GEAR SET 2.040
1	908	002247	0	RG357M PINION/GEAR SET 2.304
1	909	002248	0	RG357M PINION/GEAR SET 2.667
1	911	001991	0	SOLENOID-DIR CONT VALVE 282/M
1	912	002019	0	CONN.DIN 43650 TYPE/FORM"A"
1	913	001990	0	WAFER,LIGHTED RG282/M,357M
1	914	001988	0	VLV-DIRECTIONAL CTRL, RG282M
1	915	001989	0	VLV-FLOW CONTROL, RG282/M,357M
1	916	001993	0	MANIFOLD BLOCK-2 STATION,2"SPC
1	917	001992	0	KIT,NUT/STUD,10-24UNC X 98MM



6.- FOR HYDRAULIC CAPACITY CONTROL & VI CONTROLS SEE 002221 SHEET #6.

- NOTES:
- 1.- APPLY LOCTITE 545 TO ALL COMPONENTS WITH NPTF THREADS. DO NOT LOCTITE STRAIGHT THREAD O-RING FITTINGS.
 - 2.- APPLY LUBRICANT TO O-RINGS INCLUDING STRAIGHT THREAD O-RING FITTINGS PRIOR TO ASSEMBLY.
 - 3.- ITEM #80 PLUG, STL, SAE-10 IS USE FOR L.O. SYSTEM MANUAL CONTROL ONLY.
 - 4.- ITEM REQUIRED WHEN USING HANDWHEEL VI AND CAPACITY CONTROL.
 - 5.- APPLY LOCTITE #242 TO THREADS BEFORE INSTALLING.

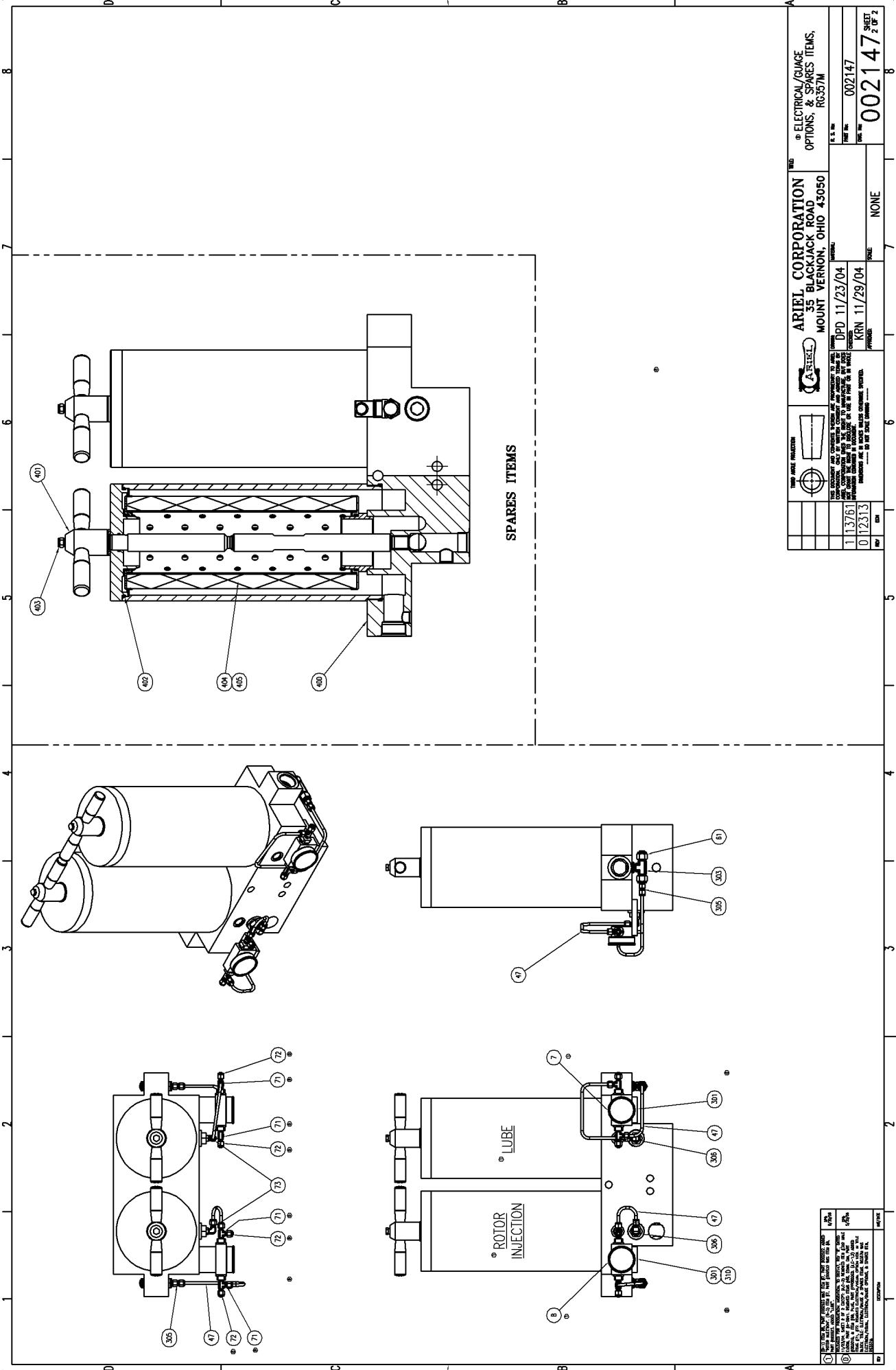
REV	DATE	BY	CHK	DESCRIPTION
1	11/37/04			REVISED TO ADD 16 UM FILTER
0	11/29/04			REVISED TO ADD 6 UM FILTER
0	11/23/04			REVISED TO ADD 16 UM FILTER

DPN 11/23/04
 KRN 11/29/04
 NONE

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

LUBE OIL SYSTEM
 CANISTER FILTERS
 RG357M

002147
 SHEET 1 OF 2



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REV	DATE	DESCRIPTION
1	11/23/04	113761
2	11/29/04	012373

DATED: DPD 11/23/04
 CHECKED: KRN 11/29/04
 APPROVED: NONE

ARIEL CORPORATION
 35 BLACKJACK ROAD
 MOUNT VERNON, OHIO 43050

U.S. PAT. NO. 6,800,000
 U.S. PAT. NO. 6,800,001
 U.S. PAT. NO. 6,800,002
 U.S. PAT. NO. 6,800,003
 U.S. PAT. NO. 6,800,004
 U.S. PAT. NO. 6,800,005
 U.S. PAT. NO. 6,800,006
 U.S. PAT. NO. 6,800,007
 U.S. PAT. NO. 6,800,008
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 U.S. PAT. NO. 6,800,011
 U.S. PAT. NO. 6,800,012
 U.S. PAT. NO. 6,800,013
 U.S. PAT. NO. 6,800,014
 U.S. PAT. NO. 6,800,015
 U.S. PAT. NO. 6,800,016
 U.S. PAT. NO. 6,800,017
 U.S. PAT. NO. 6,800,018
 U.S. PAT. NO. 6,800,019
 U.S. PAT. NO. 6,800,020

© ELECTRICAL/GUAGE
 OPTIONS, & SPARES ITEMS,
 RG357M

SHEET 002147
 2 OF 2

11/29/06

Ariel Corporation

SO# 2000350

RG357M LUBE OIL SYSTEM
REF. DRWG.=002147

Seq	Itm#	Comp PN#	Qty	Part desc
2	1	001663	1	VLV, GLOBE 1-1/4NPT,SCH 80
2	2	002178	1	CHECK VALVE,2"NPT
2	4	001864	1	SEQUENCE VALVE SAE 20 282/M
2	7	002522	2	L.O.PSID GAUGE, RANGE 0-100
2	8	002523	1	L.O.PSID GAUGE, RANGE 0-30
2	10	PB0110KG	1	ADPTR BUSH STL,SAE-24M X1-1/4F
2	14	A-0895	1	STREET ELBOW,STL,1-1/4P 90
2	15	A-0934	2	MALE CONN,STL, 3/8T X 1/4P
2	17	A-0971	1	MALE ELBOW,STL, 1"T X 1"P
2	18	A-2746	1	HEX PIPE NIPPLE,STL, 2 NPT
2	18	A-2746	1	HEX PIPE NIPPLE,STL, 2 NPT
2	19	A-2767	2	MALE ELBOW,STL,1-1/4T X 1-1/4P
2	20	A-8250	1	L O STRAINER, 2"NPT
2	21	A-11051	1	HEX RED BUSH,STL,2M X 1-1/4F
2	22	A-11056	1	MALE CONN,STL, 1-1/4T X 1-1/4P
2	23	A-0967	1	MALE CONN,STL, 1T X 1P
2	24	A-11141	2	MALE PIPE ADPTR 1-1/4NPTXSAE20
2	25	002143	1	FLANGE,4 BOLT,2"NPT
2	26	A-11143	1	STRAIGHT TEE, 2"NPT,SCH 80,SS
2	28	A-11403	1	MALE ELBOW,STL, 1/4T X 1/2P
2	31	A-11052	1	STREET TEE,STL, 1-1/4"P
2	32	002279	3	MOUNTING STUD, FILTER
2	34	002109	1	OIL CANISTER,COMPLETE282M/357M
2	36	PP0810MB	1	PIPE PLUG,1-1/4NPT,HEX HD,STL
2	37	PP0801PA	1	PIPE PLUG,2 NPT,SQ HD,CORED
2	39	PS0091JJ	1	MALE CONN,STL,1 X SAE-16
2	40	PS0091KK	1	MALE CONN,STL,1-1/4 X SAE-20
2	41	PS0099EF	1	MALE CONN,SS,1/2T X SAE-10
2	42	PS0092HH	1	MALE ELBOW-POS,STL,1T X SAE-16
2	43	PS0092JJ	3	M.ELBOW-POS,STL,1-1/4TX SAE-20
2	44	A-12895	1	MALE RUN T,STL, 3/8T X 3/8P
2	45	PT0200JD	120	SS,TUBING, 1" OD X .065 WALL
2	46	PT0200KF	240	SS,TUBING,1-1/4O.D.X.095 WALL
2	47	PT0200CB	276	SS,TUBING,1/4 O.D.X.035 WALL
2	48	PT0200EB	120	SS TUBING,3/8 OD X .035 WALL
2	51	PB0110DB	1	ADAPTER BUSH STL,SAE 6M X 1/4F
2	52	002541	1	TUBING CLAMP, TWIN 3/8" TUBE
2	53	A-0831#1/2	1	TUBING CLAMP, 1/2" TUBE
2	54	A-0831#1	1	TUBING CLAMP, 1" TUBE
2	55	FC0134CC	1	BUT HD CAP,1/4-20 X 1/2 316SS
2	56	A-0886	1	BULK.UNION,STL, 1/4T X 1/4T
2	57	A-0401	1	BRACKET,BULKHEAD UNION
2	60	PP0860GB	1	PLUG,STL,SAE-10
2	61	A-7614	2	PLUG-TUBE FIT,FEMALE,STL,1/2T

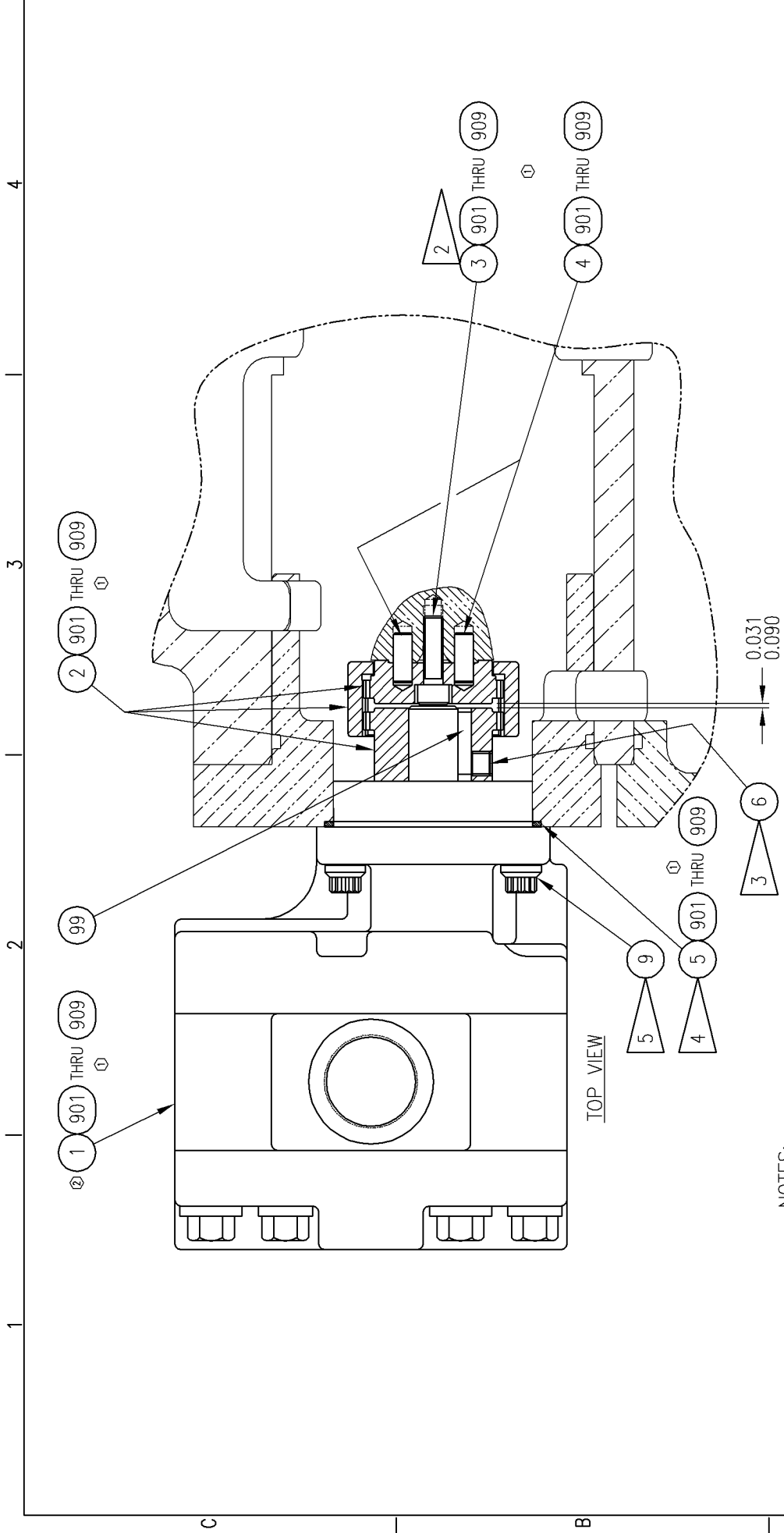
11/29/06

Ariel Corporation

SO# 2000350

RG357M LUBE OIL SYSTEM
REF. DRWG.=002147

Seq	Itm#	Comp PN#	Qty	Part desc
2	62	FW0503IA	3	WASHER,FLAT,HD.5/8 DIA. STEEL
2	63	FN0451HD	3	HEX NUT,H/W,2H,5/8-11
2	64	A-12253	1	MALE ADPTR,SS,1-1/4T X 1P
2	65	A-12257	1	UNION ELBOW,1-1/4T X 1-1/4T
2	67	A-9652	1	HEX RED BUSH,STL, 1"M X 3/8"F
2	68	002525	1	BRACKET,DIF PRESS GAUGE
2	69	FC0120HI	1	12 PT CAP,5/8-11 X 1-1/2 G8
2	70	002405	1	ADAPTER BUSH,VT,SAE20 X SAE16
2	71	A-2186	7	MALE RUN T,SS, 1/4T X 1/4P
2	72	A-0948	6	PLUG-TUBE FIT,FEMALE,SS, 1/4T
2	73	PS0098AA	2	MALE ELBOW-POS,SS,1/4TXSAE-4
2	74	A-2113	1	STREET ELBOW, STL,1/4P
2	301	002174	2	BRACKET,DIFF.PRES.SW,282M/357M
2	303	PS0094CC	2	MALE BRNCH T,STL,POS.1/2TXSAE8
2	305	PS0104FC	2	REDUCER,STL,1/2T MALE X 1/4T
2	310	001982	10	SOC.FLT HD.CAP 1/4-20X3/4 SST
2	400	002211	0	FILTER HOUSING BASE 282M/357M
2	401	002212	0	FILTER HOUSING COVER 282M/357M
2	402	002213	0	O-RING,VT, 180MM X 5MM
2	403	PP0810CE	0	PIPE PLUG,1/4NPT,HEX HD,SS
2	404	002227	0	FLTR ELEM KIT,16UM 282/M,357M
2	405	002226	0	FLTR ELEM KIT,6UM 282/M,357M
2	901	FC0110GK	0	SHCS,1/2-13 X 2 G8
2	902	002150	0	O-RING,VT, 2.234I.D.X.139
2	903	001803	0	STRAINER ELEMENT KIT,2"



NOTES:

1. LOOSEN OR TIGHTEN ALL FASTENERS PER RECOMMENDED PROCEDURES AND TORQUE VALUES IN MANUAL.
2. APPLY LOCTITE #242 TO THREADS BEFORE INSTALLING.
3. APPLY LOCTITE #222 TO THREADS BEFORE INSTALLING.
4. OIL O-RING BEFORE INSTALLING.
5. APPLY LOCTITE #222 AND TORQUE TO 50 FT-LBS.

OIL PUMP ASSEMBLY RG-SERIES
(SINGLE STAGE SHOWN)

② UPDATED DRAWING VIEW TO CORRECT RG-SERIES, WAS SHOWING AR-SERIES, UPDATED ORIENTATION OF OIL PUMP FROM SIDE VIEW, TO TOP VIEW.		DPD 8/07/06	THIS DOCUMENT AND CONTENTS THEREIN ARE PROPRIETARY TO ARIEL CORPORATION. ONLY BY WRITTEN CONSENT AND AGREED TERMS BY ARIEL CORPORATION GIVES THE RIGHT TO MANUFACTURE, BUT DOES NOT GRANT THE RIGHT TO DISCLOSE OR USE IN PART OR IN WHOLE INFORMATION CONTAINED IN DOCUMENT.
① ADDED ITEMS #901 THRU #909.		GRC 8-7-2002	
REV	DESCRIPTION	INIT/DATE	
2	13835	0	
1	8339	7793	
0		02/11/02	
APPROVED:		DRAWN:	
SCALE:	NONE	CHECKED:	
ECN		GRC	6-18-02
ARIEL CORPORATION 35 BLACKJACK ROAD MOUNT VERNON, OHIO 43050			ASSEMBLY DWG. NO. 001705

11/29/06

Ariel Corporation

SO# 2000350

REF.SHEET R-0532
OIL PUMP, P076T X 2.75 X 2.50
REF.DRWG.= 001705

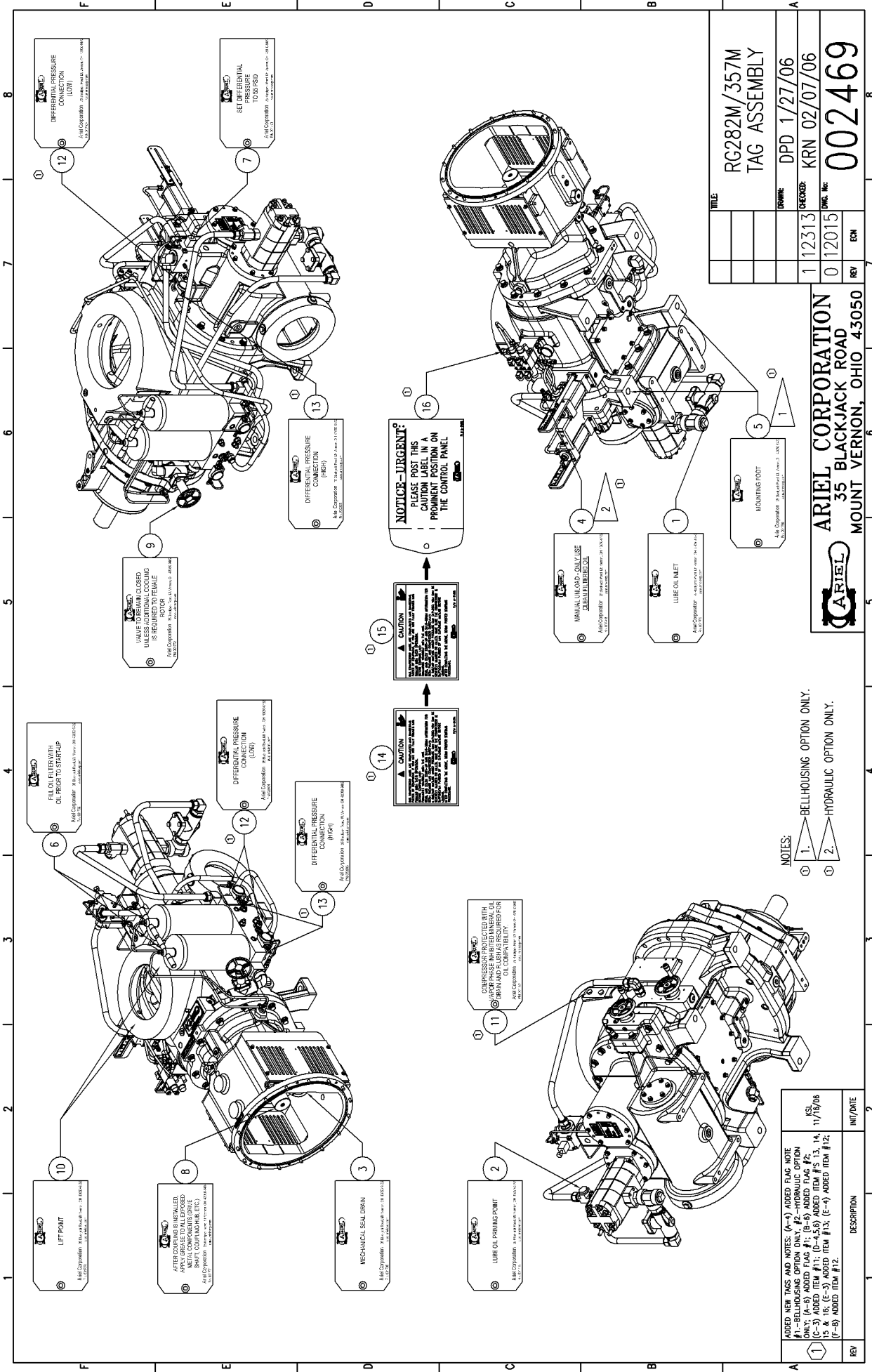
Seq	Itm#	Comp	PN#	Qty	Part desc
8	1		002483	1	OIL PUMP,P076TX2.75X2.5 ASSY
8	2		000933	1	COUPLING,1.250 NOM.DIA.
8	3		FC0110FG	1	SHCS,7/16-14 X 1 G8
8	4		FP0500HG	2	DOWEL PIN, 3/8 X 1 .0002
8	5		000318	1	O-RING,VT, 3.984I.D.X.139
8	6		FS0400EB	1	CUP PT.SET-SCREW, 3/8-16 X 3/8
8	9		FC0120GI	4	12 PT CAP,1/2-13 X 1-1/2 G8
8	99		000696	0	KEY,5/16X15/32X1-3/16
8	907		001817	0	OIL PUMP KIT,P75SX2.25 SWEET
8	908		001818	0	OIL PUMP KIT,P75SX2.50 SWEET
8	909		001819	0	OIL PUMP KIT,P75SX2.75 SWEET
8	910		002166	0	OIL PUMP KIT,P075SX3.00 SWEET
8	911		002163	0	OIL PUMP KIT,P76TX2.00 SWEET
8	912		002164	0	OIL PUMP KIT,P76TX2.25 SWEET
8	913		002165	0	OIL PUMP KIT,P76TX2.50 SWEET
8	914		002485	0	OIL PUMP KIT,P76TX1.75X1.50SWT
8	915		002486	0	OIL PUMP KIT,P76TX1.75X1.75SWT
8	916		002487	0	OIL PUMP KIT,P76TX2.0X2.0SWEET
8	917		002488	0	OIL PUMP KIT,P76TX2.25X2.25SWT
8	918		002489	0	OIL PUMP KIT,P76TX2.75X2.50SWT
8	919		002490	0	OIL PUMP KIT,P76TX3.0X3.0SWEET

11/29/06

Ariel Corporation

SO# 2000350

10	0	002592	1	CAPACITY/FANNAR VALVE TOOL
10	0	002424	0	CAPACITY UNLOAD TOOL
10	0	002423	1	DRAWING, CAPACITY UNLOAD TOOL
10	0	002327	1	HOSE4FT,1/4"MNPTX1/4"FJIC,SWVL
10	0	002326	1	ADPTR,1/4"MNPT X 3/8"HM,SST
10	0	002325	1	RELIEF VLV,1/4MNPTX1/4FNPT,STL
10	0	002249	1	ALLEN WRENCH, 1"
10	0	002169	1	SEAL HSG.INSTALLATION TOOL
10	0	001788	1	MCH.SEAL CARBON INST.TOOL 282
10	0	001742	1	MECH.SEAL SEAT INST.TOOL RG282
10	0	FE0300MA	2	EYEBOLT,1-1/4-7 UNC
10	0	FE0300LA	2	EYEBOLT,1-1/8-7 UNC
10	0	FE0300KA	1	EYEBOLT,1"-8 UNC
10	0	ER-63.1	1	TORQUE CHART, RG SERIES
10	0	A-0958	1	PIPE TEE,1/4 FEMALE,STL
10	0	A-0798	1	TOOL BOX



12 DIFFERENTIAL PRESSURE CONNECTION (LON)
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

7 SET DIFFERENTIAL TO 55 PSI
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

13 DIFFERENTIAL PRESSURE CONNECTION (HIGH)
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

16 NOTICE - URGENT!
PLEASE POST THIS CAUTION LABEL IN A PROMINENT POSITION ON THE CONTROL PANEL.
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

4 MANUAL UNLOAD - OIL/LUBE CLEANOUT BENCH
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

1 LUBE OIL INLET
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

5 MOUNTING FOOT
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

6 FILL OIL FILTER WITH OIL PRIOR TO STARTUP
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

12 DIFFERENTIAL PRESSURE CONNECTION (LON)
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

13 DIFFERENTIAL PRESSURE CONNECTION (HIGH)
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

14 CAUTION
DO NOT OPERATE THE TAG ASSEMBLY WITH THE OIL/LUBE CLEANOUT BENCH ATTACHED UNLESS THE OIL/LUBE CLEANOUT BENCH IS IN THE OPEN POSITION.
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

11 USE THE OIL/LUBE CLEANOUT BENCH WITH THE OIL/LUBE CLEANOUT BENCH ATTACHED UNLESS THE OIL/LUBE CLEANOUT BENCH IS IN THE OPEN POSITION.
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

10 LEFT POINT
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

8 AFTER COVERING IS INSTALLED, APPLY GREASE TO ALL EXPOSED SHIFTS, COUPLERS, ETC.
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

3 MECHANICAL SEAL DRAIN
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

2 LUBE OIL PRIMING POINT
Ariel Corporation 35 Blackjack Road Mount Vernon, Ohio 43050

REV	DESCRIPTION	INT/DATE
1	ADDED NEW TAGS AND NOTES: (A-4) ADDED FLAG NOTE FOR OIL/LUBE CLEANOUT BENCH; (B-3) ADDED FLAG #1; (E-4) ADDED FLAG #2; (C-3) ADDED ITEM #11; (D-4,5,6) ADDED ITEM #S 13, 14, 15 & 16; (E-3) ADDED ITEM #13; (E-4) ADDED ITEM #12; (F-8) ADDED ITEM #12.	US, 11/13/06

NOTES:
1. BELLHOUSING OPTION ONLY.
2. HYDRAULIC OPTION ONLY.

TITLE	DRWING	CHECKED	DATE
RG282M/357M TAG ASSEMBLY	DPD 1/27/06	1 12313	KRN 02/07/06
		0 12015	

ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050



002469

11/29/06

Ariel Corporation

SO# 2000350

RG282M & RG357M PAPER TAGS
REF.DRWG.=002469

Seq	Itm#	Comp	PN#	Qty	Part desc
12	1		001764	1	LUBE OIL INLET TAG
12	2		001765	1	LUBE OIL PRIMING POINT TAG
12	3		001766	1	MECHANICAL SEAL DRAIN TAG
12	4		002468	1	MANUAL UNLOAD TAG
12	6		001769	2	FILL OIL FILTER W/OIL TAG
12	7		001770	1	SET DIFF PRESS TO 55 PSID TAG
12	8		001771	1	GREASE METAL COMPONENTS TAG
12	9		001772	1	VALVE TO REMAIN CLOSED TAG
12	10		001774	2	LIFT POINT TAG
12	11		001550	1	SUCTION FLANGE TAG
12	13		002605	3	DIFF PRESS CONN (HIGH) TAG
12	14		A-6104	1	CAUTIN LABEL ADHESIVE/FR.ENG
12	15		A-6105	1	CAUTION LABEL ADHESIVE/BK.ENG
12	16		A-6108	1	ENVELOPE,CAUTION LABELS

AMOT CONTROLS

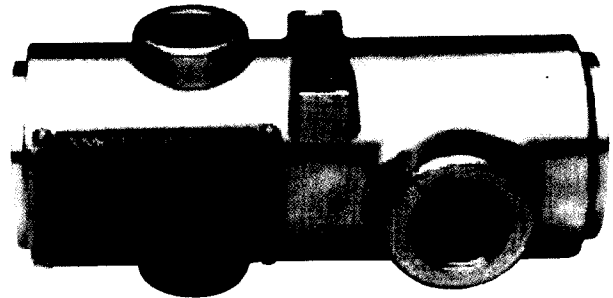
Model MPD

MPD

Metal Particle Detector



NEW!
Patented Design



AMOT's MPD detects metal particles in lubrication fluids.

The MPD Must be used with an intrinsically safe control system in hazardous areas.

APPLICATIONS

AMOT's MPD Switch can detect and alert equipment operators of the presence of metal particles in non-conductive fluid lubrication systems (lube oil, transmission fluid, etc.). The MPD can be used with AMOT's MPD Controller or an alternate, approved controller. Common MPD applications would include the following:

■ RECIPROCATING EQUIPMENT

- ~ Gas Engines
- ~ Diesel Engines
- ~ Compressors

■ ROTATING EQUIPMENT

- ~ Gas Turbines
- ~ Steam Turbines
- ~ Transmissions and Gear Boxes
- ~ Pumps
- ~ Compressors

FEATURES / BENEFITS

- **UNIQUE GRID SENSING TECHNOLOGY**
 - ~ Detects metal particles, metal chips, and metal dust.
 - ~ Detects all conductive metal particles (including non magnetic metal particles).
 - ~ No moving parts.
- **DUAL SEAL WITH WEEP HOLE CONSTRUCTION**
 - ~ Meets API 614
 - ~ Meets National Electric Code
- **SEPARATE CONTROLLER AVAILABLE FOR USE WITH MPD**
 - ~ See AMOT form 1309, Model 8545B for MPD Controller.
 - ~ Complete Metal Particle Detector system available from AMOT.

FORM 1165

ECONOMIC BENEFITS OF INSTALLING AMOT MPD SYSTEM

~ MPD makes maintenance proactive instead of reactive. MPD alerts equipment operators of metal particles in lubricating fluids caused by worn bearings, connecting rods, pistons, rings, camshafts or other metallic parts. Corrective maintenance can then be scheduled to **minimize costly down time.**

~ By alerting equipment operators of metal particles in lubricating fluids, MPD assists in the **prevention of unnecessary repairs and replacement of expensive parts**, i.e., replacement of a bearing instead of a crankshaft.

OPERATION

Operation of AMOT's Metal Particle Detector switch (MPD) is simple and straight forward. Process Fluid, such as lube oil or transmission fluid, enters at the top of the MPD's body. Fluid then travels through a perforated board containing a plated electrical grid on the board's top and bottom sides. Fluid exits through the bottom of the MPD body. (Refer to Figure 1.)

Activation of the MPD switch occurs when metal particles bridge the gaps on the MPD's electrical grid and complete a normally open (N.O.) electrical circuit to drive an alarm or shutdown relay. (Refer to Figure 2.)

INSTALLATION

For in depth installation instructions, refer to AMOT Form No. 1248 and Drawing No. 10956.

Installation of the MPD is accomplished in four (4) steps:

1. Locating where the MPD will be mounted.

The MPD must be located in a side stream of the lube oil / fluid system, after the pump but before the filter. (Refer to Figure 1).

2. Mounting the MPD.

Mount the MPD with the grid in a horizontal position. **It does not matter which process port is the IN port so long as the flow through the MPD is from top to bottom and the grid is on a horizontal plane.** Two 5/16-18 UNC mounting holes are cast into the MPD body. Isolation valves should be used as in Figure 1 to facilitate inspection and service of the MPD switch.

3. Piping the process fluid to the MPD.

When connecting the piping, never use excessive force to stop thread leakage. Apply a quality thread sealant such as Loctite™ Pipe Sealant to the MPD's pipe threads. Do not permit debris to enter the MPD while piping (this will set off the MPD).

CAUTION:

Flow to the MPD should be limited to prevent starving the equipment of oil (use an orifice, needle valve, etc.).

4. Making MPD electrical connections.

All wiring to and from the MPD should be done in accordance with the applicable electrical code. End Cap (22) should be removed (with a 1/2" S.A.E. drive ratchet) to access the MPD's terminal block, flying leads or plug connector (depending on the MPD connection option ordered).

SERVICE & MAINTENANCE

Refer to Figure 3, cross sectional.

Prior to servicing or maintaining the MPD:

Make sure all electricity is disconnected from the MPD.

Ensure all process pressure is relieved from the grid compartment before removing the MPD's end cap (block valve closed, bleed valve open).

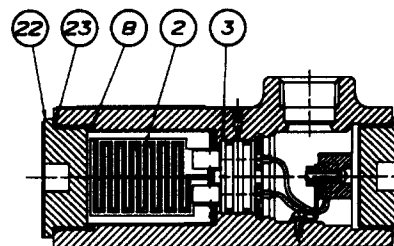
AMOT MPD requires minimal maintenance. Recommended maintenance would include removal and replacement of the MPD's End Cap O-Rings (23), Grid O-Ring Seal (8), and Grid Board (2). Inspection of the aforementioned components should take place during the equipment's scheduled maintenance.

Multi Meter Grid Conductivity Test

Grid (2) should be inspected for signs of lacquering or residue build up which will interfere with the grid's ability to detect metal particles and complete the electrical circuit. AMOT recommends using a multi meter to test the grid's ability to complete an electrical circuit.

Remove End Cap (22) with a 1/2" S.A.E. drive ratchet. Pull the Grid (2) free of the MPD body (26) by hand. Use the multi meter to determine the grid's conductivity. Touch one multi meter probe to each of the MPD's grid pads. Short the grid out by placing a small metal object (such as a penny or screw) across the grid. If the grid will not short out, it must be replaced.

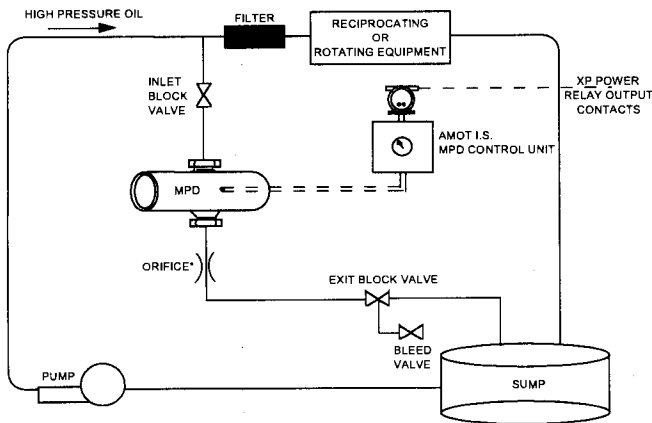
FIGURE 3: CROSS SECTIONAL



Recommended Spares / Service Parts Kit 10829X001

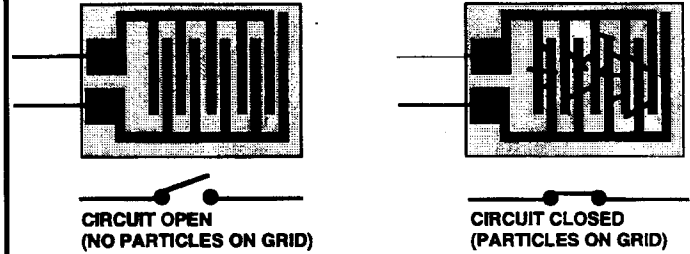
Ref. No.	Qty.	Part No.	Description
2	1	10831.	Grid
23	2	11462L001	End Cap O-Ring, Viton
8	1	1919L001	Grid O-Ring Seal, Viton

**FIGURE 1
MPD INSTALLATION DIAGRAM**



•Flow to the MPD should be limited to prevent starving the equipment of oil (use an orifice or other means of adequate restriction).

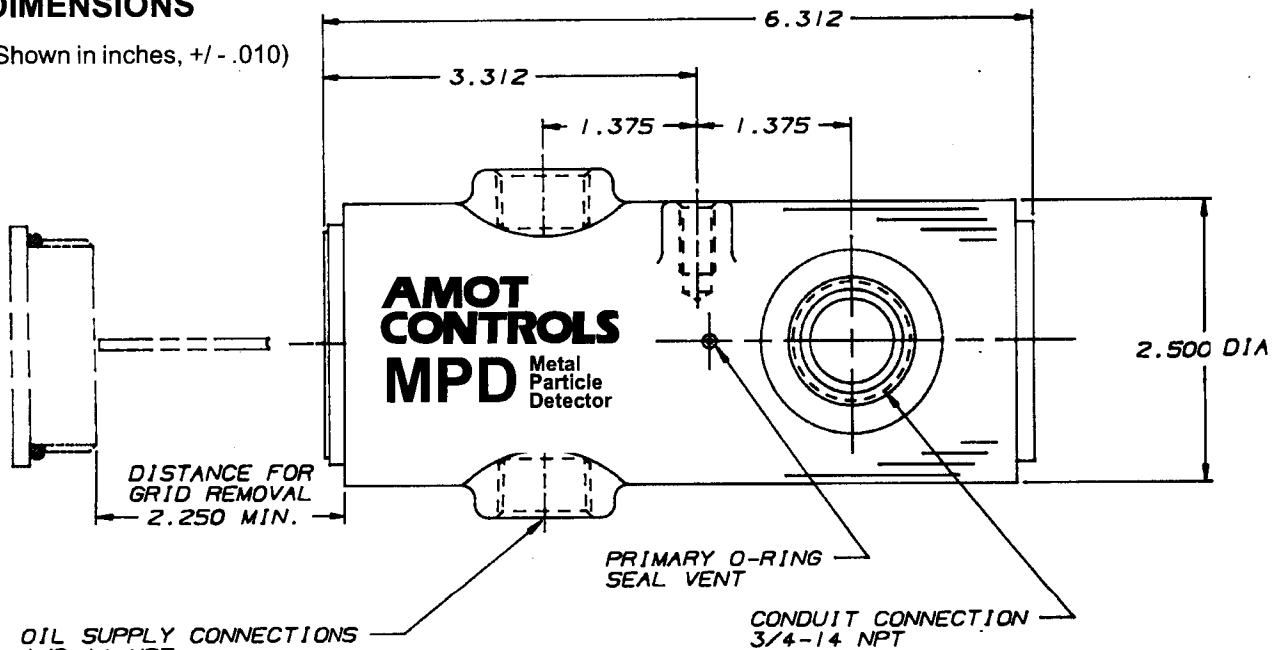
**FIGURE 2
MPD SWITCH DIAGRAM**



Metal particles gather on the MPD's Grid to complete an electrical circuit. Refer to right diagram.

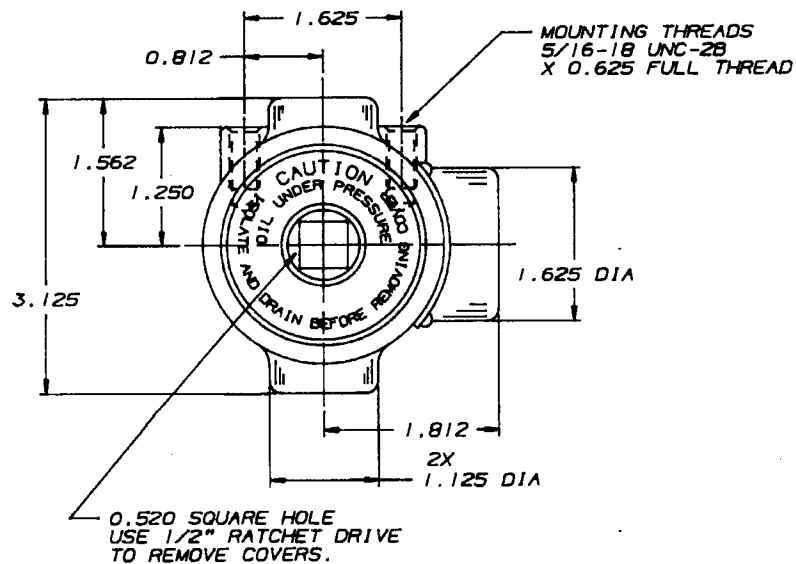
DIMENSIONS

(Shown in inches, +/- .010)



OIL SUPPLY CONNECTIONS
1/2-14 NPT
OR
3/4-16 UNC-2B
SAE O-RING BOSS SEAL

CONDUIT CONNECTION
3/4-14 NPT



0.520 SQUARE HOLE
USE 1/2" RATCHET DRIVE
TO REMOVE COVERS.

SPECIFICATIONS

Body & End Caps	316 Stainless Steel
Seals	Viton (Buna Optional)
Electrical Connections	Plated Tin
Grid Electrical Ratings	Refer to AMOT Drawing 10956
Flow Coefficient (C _v)	4.34
Flow of Oil at 60 psi	27 GPM
(180 SSU, Specific Gravity .90, No Restriction On Outlet)	
Temperature Rating	-10 to 400 deg. F (Viton)
	-55 to 225 deg. F (Buna)
Maximum Working Pressure	Standard: 200 psi
	High Pressure Version: 800 psi
Recommended Wire Gage	16 gage
(Terminal Block Version)	
Lead Wire Gage	16 gage
(Versions With Lead Wires)	
Approvals	UL Class 1, Groups A, B, C, & D
Only if installed per AMOT Drawing 10956 (Intrinsically Safe)	
Shipping Weight	7 lbs.

HOW TO ORDER

To order the MPD, construct the appropriate model number from the Model Code Table or specify the following information:

- 1) AMOT MPD Switch
- 2) Body Material (Stainless Steel); Table A.
- 3) Process Fluid Connection:
1/2" NPT, SAE, or BSP (PI); Table B.
- 4) Electrical Conduit Port Connection (3/4" NPT);
Table C.
- 5) Electrical Connection Type:
Terminal Plug, Terminal Block, or 18" Wire Leads;
Table D.
- 6) Seal Material:
Viton or Buna; Table E.

AMOT can also supply a UL approved control box for use with the MPD. Contact AMOT or your local representative for details.

MODEL CODING TABLE

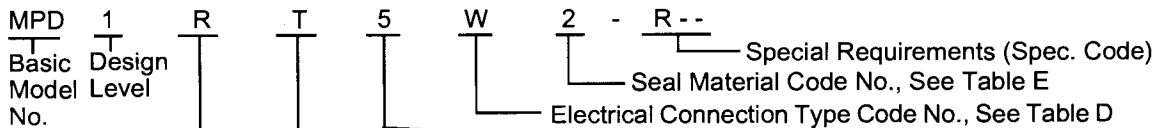


TABLE A Product Type Code No.		TABLE B Oil Port Connection Code No.			TABLE C Electrical Conduit Port Code No.	
Stainless Steel	R	1/2	NPT	T	3/4 NPT	5
Stainless Steel, High Pressure	P	1/2	SAE	W		
		1/2	BSP (P1)	U		

TABLE D Electrical Connection Type Code No.		TABLE E Seal Material Code No.	
Electrical Connection	Code No.	Seal Material	Code No.
Wire Leads, 18"	W	Viton	2
Terminal Plug	P	Buna N	1
Terminal Block	T		

= Non Standard

The AMOT MPD product is a tool to assist in the monitoring / detection of undesirable conditions which may result in reduced engine life or catastrophic failure. Like other monitoring or engine life diagnostic devices / tools, it is not guaranteed to increase engine life and / or eliminate catastrophic failure. The MPD product is primarily a random oil sampling device which may detect the presence of metal particulates in the lubrication oil. AMOT recommends using the MPD in conjunction with good preventative maintenance practices and other bearing temperature sensors, etc. It is the user's responsibility to select the appropriate MPD grid which determines the MPD's sensitivity in detecting metal particulate.

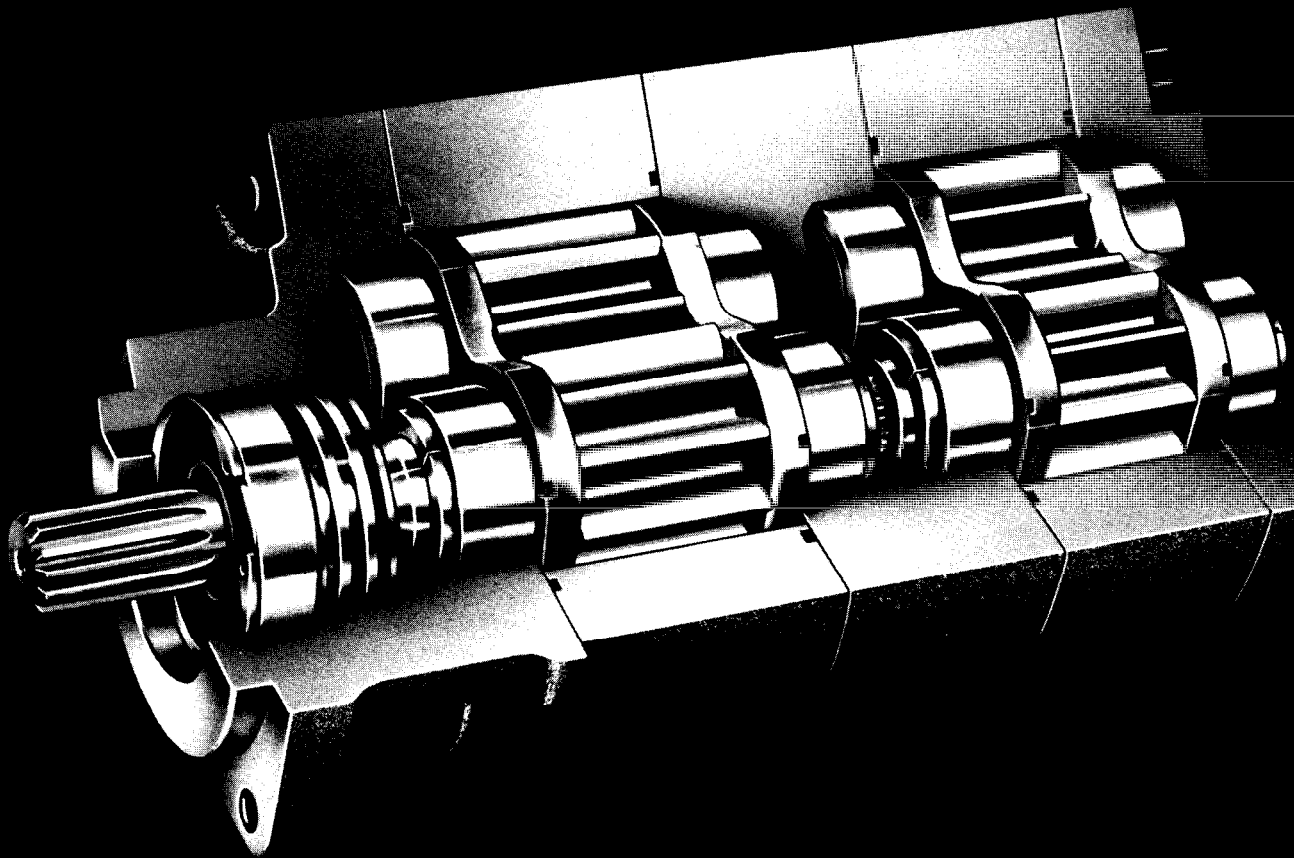
AMOT Controls Corporation
401 First Street
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P75™ / P76™ SERVICE MANUAL

single
and multiple
oil hydraulic
pumps—motors



P75/P76

pump or motor service instructions

GENERAL INSTRUCTIONS

These service instructions will familiarize you with Commercial's single and multiple pumps and motors — their component parts — the relative position of each part — proper methods for assembly or disassembly of the units — care and use of these oil hydraulic power units — so that best performance and longer working life will result for your benefit.

To facilitate the repair of these units — and before any work is done — we suggest that you first read all of the steps used in disassembly and all of the steps used in building up the unit.

Dirt is the enemy of any hydraulic

system. The first requirement of good maintenance of hydraulic equipment is cleanliness. **MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA.**

Our pictures show a Model P76. Notes in the text cover variations between this unit and the P75 model.

It is a good idea to check all replacement parts closely before installing to ensure that no damage occurred during shipment.

USE CAUTION IN GRIPPING ALL PARTS IN THE VISE TO AVOID DAMAGING MACHINED SURFACES.

A pump must be driven in the direction of rotation for which it was built; otherwise, pressure will blow the shaft seal. Check the exploded view below for proper direction of rotation.

COMMERCIAL'S REPLACEMENT PARTS

Commercial's replacement parts are of original equipment standards. For assured quality of material and workmanship, and for compatibility in assembly, **USE ONLY GENUINE PARTS FROM COMMERCIAL.**

It is a good idea to check all replacement parts closely before installing to ensure that no damage occurred during shipment.

EXPLODED VIEW AND PARTS LIST

1. Snap Ring
2. Spacer or Outboard Bearing
3. Seal Retainer
4. "O" Ring
5. Seal
6. Shaft End Cover
7. Check Assemblies or Plug
8. Ring Seals
9. Roller Bearings
10. Pocket Seals
11. Thrust Plates
12. Integral Drive Shaft and Gear Set
13. Gasket Seals
14. Gear Housing
- 14A. Dowel Pins (P76 only)
15. Connecting Shaft
16. Bearing Carrier
17. Matched Gear Set
18. Gear Housing
- 18A. Dowel Pins (P76 only)
19. Plug
20. Port End Cover
21. Name Plate
22. Drive Screws
23. Washers
24. Studs or Cap Screws
25. Nuts

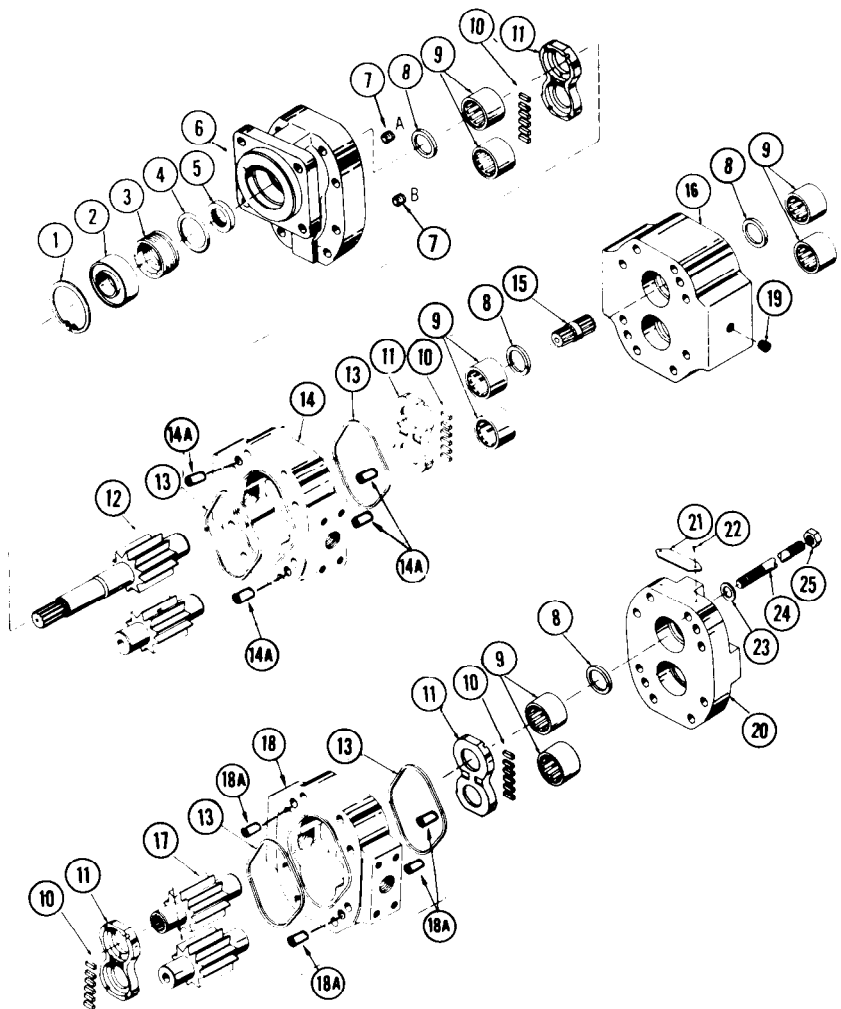
Plug 7 in position B gives clockwise rotation.

Plug 7 in position A gives counterclockwise rotation.

Check valves in both positions give bi-directional rotation.

ITEMS SHADED APPLY TO MULTIPLE ASSEMBLIES ONLY.

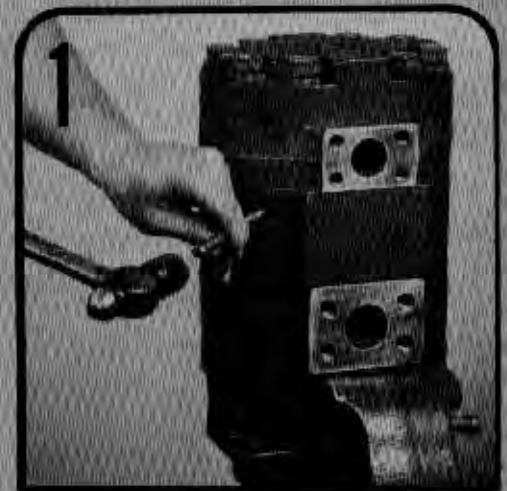
© 1989 Commercial Intertech Corp.



CAUTION:

1. If prying off sections becomes necessary, take extreme care not to mar or damage machined surfaces. Excessive force while prying can result in misalignment and seriously damage parts.
2. Do not force parts during assembly. Never use an iron hammer.
3. Gears are closely matched, therefore they must be kept together as sets when removed from a unit. Handle with care to avoid damage to the journals or teeth.
4. Never hammer roller bearings into bores, push them in place with an arbor press.

start disassembly here



Place the pump in a vise with the drive shaft pointing down. Caution: **DO NOT GRIP ON OR NEAR ANY MACHINED SURFACES DURING ASSEMBLY OR DISASSEMBLY**. Index mark all sections with a punch. Be sure to align these marks when reassembling.



Remove the 8 cap screws or hex nuts and washers with a socket wrench.



Lift off the port end cover. If necessary to pry loose, be careful not to damage the machined surfaces. Dowel pins will remain in either port end cover or gear housing. Do not remove. If the thrust plate remains in the gear housing, it can be tapped out later with a wooden hammer handle. Be careful not to distort the thrust plate.

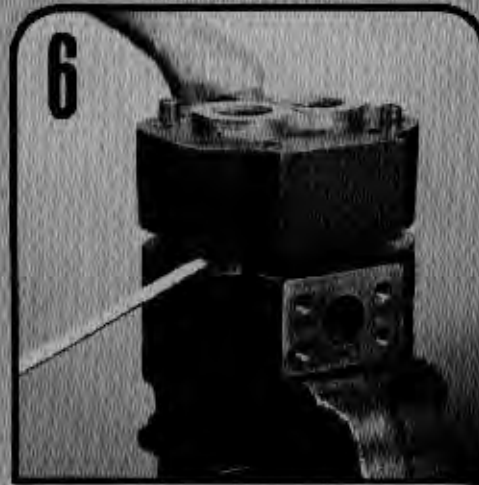


Lift the gear housing from the gears. If necessary to pry loose, take care not to damage machined surfaces.

disassembly, continued



5
Remove the drive and driven gears. Keep the gears together because they are a matched set. Examine and replace if necessary. See below*.



6
Lift or pry off the bearing carrier. Take care not to damage the machined surfaces.



7
Remove the connecting shaft.



11
Examine all roller bearings for wear and discoloration. If replacement is necessary, pull the bearings with a bearing puller. Any sign of wear or discoloration calls for replacement. Remove bearings with a bearing puller.



12
It is generally advisable to replace ring seals when rebuilding unit. To replace, remove the drive gear bearing with a bearing puller and remove ring seal from the bottom of bearing bore. Check all ring seal bores in unit for abnormal wear. If worn, replace those sections.



13
Grip the shaft end cover in the vise with the mounting face up. Remove the snap ring with snap ring pliers.

8

Lift or pry off the first section gear housing. Be careful not to damage machined surfaces. Remove thrust plate as described in step 3.

9

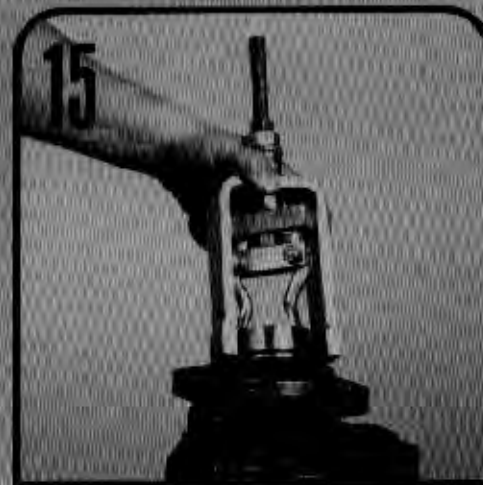
Remove the drive and driven gears. Keep the gears together because they are a matched set. Examine and replace if necessary. See pages 10 and 11.

10

Pry the thrust plate from the shaft end cover, port end cover, or bearing carrier with a screw driver or similar tool. Avoid distorting the thrust plate. Remove and discard all rubber pocket seals and gasket seals.

14

Remove the spacer or outboard bearing (pull the outboard bearing with a bearing puller).

15

Remove the seal retainer and seal with a light duty bearing puller. Remove and discard "O" ring.

16

Tap the seal from the seal retainer and discard. Clean seal bore with solvent to remove old sealant. If bore is scored, smooth with fine grade emery paper. It is generally advisable to replace the seal retainer.

start assembly here



Stone off all cast machined surfaces with a medium grit carborundum stone (to remove any burrs as a result of disassembly). If bearings have been removed, deburr bearing bores. Rinse parts in a solvent. Air blast all parts and wipe with a clean, lintless cloth before starting reassembly.



Grip the shaft end cover in the vise with the mounting face down. Examine the plug or 2 check valves, whichever is used, to be sure they are tightly in place. Replace only if parts are damaged or missing. Check valves can be removed with the special tool (see tool list). Screw in new valve with the tool until tight. Peen with a 1½" steel ball to secure.



Cut 2 pocket seals 1-1/32" long from the pocket seal strip. Grease these pocket seals and insert into the middle slots in the thrust plate.



With the pocket seals down, place the thrust plate over the bearings. Tap thrust plate with a soft hammer to about 1/32" from the machined surface.



Cut 4 pocket seals approximately 7/16" long from the pocket seal strip. Insert one pocket seal into each of the slots in the thrust plate. Push each pocket seal all the way in so that they touch the roller bearings. Tap the thrust plate down firmly against the machined surface with a soft hammer. Use a sharp razor blade to trim exposed end of the pocket seal square and flush with the thrust plate.



3
**ASSEMBLY STEPS 3, 4, 6, 7 AND 8
APPLY TO SHAFT END COVER,
BEARING CARRIERS AND PORT
END COVER.**

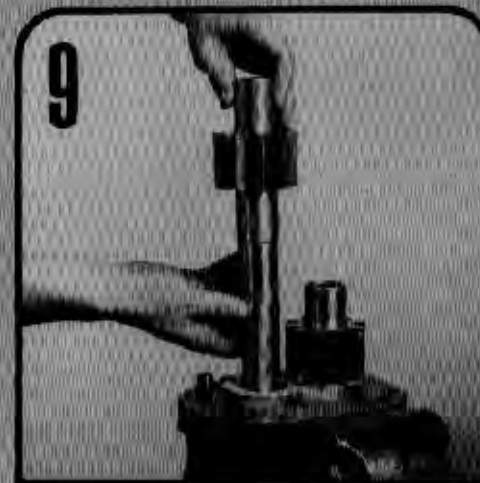
If ring seals are being replaced, insert into bottom of drive gear bearing bore flat side down. The notch in the ring seal **MUST BE VISIBLE**. This is a check to be certain the notched side is next to the bearing.



4
If any bearings have been removed from the shaft end cover, port end cover or bearing carrier, replace the bearings by pressing them into the bearing bore with an arbor press. Take care to avoid pressing on dowel pins.



5
Check all thrust plates for wear. Replace if necessary (see below*). Note that the thrust plates for pumps and motors **can be different**. Pump thrust plates, that have a single relief pocket must be installed with this pocket on the high pressure side. Motor thrust plates are grooved on both sides. The relief groove on all the unidirectional thrust plates must be towards the high pressure (outlet) side of the pump.



9
Insert the integral shaft and gear. Push down until the gear is tight against the thrust plate. Insert the matched driven gear.



10
Grease the new gasket seals and insert them into the grooves in both sides of all gear housings.



11
Slide the first section gear housing over the gears and tap it with a soft hammer until it rests lightly against the shaft end cover. Be careful not to pinch the gasket seal. Squirt oil over the gears to provide initial lubrication when pump is started.

assembly, continued



Position the bearing carrier with thrust plates on the gear housing so that the roller bearings receive the journals of the drive and driven gears. Make sure that the index marks (See Step 1, Disassembly) are properly aligned. Tap the bearing carrier tight with a soft hammer.

FOR MULTIPLE ASSEMBLIES ONLY.



Insert the connecting shaft in the spline of the drive gear.

FOR MULTIPLE ASSEMBLIES ONLY.



Insert the drive and driven gears of the second section in their respective bearings. Push down tightly against the thrust plate.

FOR MULTIPLE ASSEMBLIES ONLY.



Coat the outside of the seal with Permatex Aviation Form-A-Gasket 3D or equivalent. With the metal side of the seal down, press it into the seal retainer with a 2 3/4" diameter bar and an arbor press. Be careful not to damage the lip of the seal.



Grease and install the new "O" ring on the seal retainer. Lightly oil the installation sleeve and twist into the seal. Slide the sleeve over the drive shaft and push the seal retainer into place.



Drop in the spacer or outboard bearing. The outboard bearing may need to be lightly tapped into the bearing bore.



Slide the second section gear housing over the gears and tap it tight against the bearing carrier with a soft hammer. Be careful not to pinch the gasket seal. Squirt oil over the gears to provide initial lubrication when pump is started. Line up the dowels and the holes in the 2 castings. When parts are parallel, squeeze them together or gently tap alternately over the dowels with a plastic hammer until parts move smoothly together. **Do not force.** Insert dowel pins if required (P76 only). **FOR MULTIPLE ASSEMBLIES ONLY.**



Place the port end cover over the gear journals and tap tightly against the gear housing. Be careful not to pinch the gasket seal.

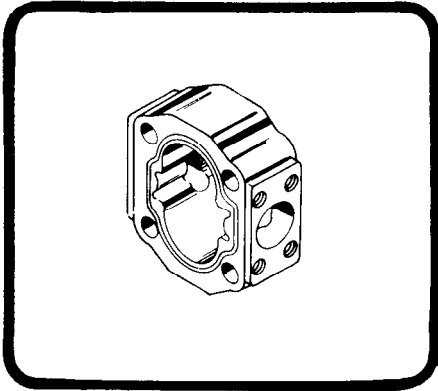


Thread the 8 fasteners (cap screws and washers, or studs and nuts) into the shaft end cover and snug-up alternately or cross-corner. Rotate the drive shaft with a 6" wrench to make sure there is no binding in the pump. After the fasteners are tight and you are sure there is no internal binding, torque the diagonally opposite fasteners to 200 ft. lbs. (2400 in. lb.)



Install the snap ring in the groove.

As a guide in answering the question, "How much wear is allowed before the part should be replaced?", we offer the following suggestions...



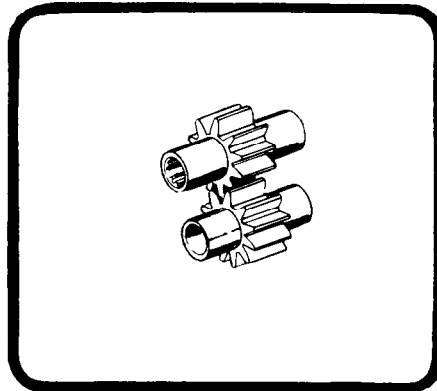
GEAR HOUSINGS:

Wear in excess of .005" cut-out necessitates replacement of the gear housing.

Place a straight-edge across bore. If you can slip a .005" feeler gage under the straight-edge in the cut-out area, replace the gear housing.

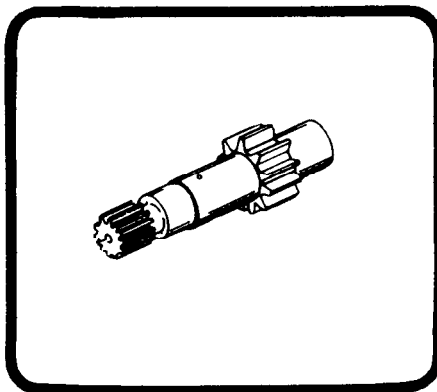
Pressure pushes the gears against the housing on the low pressure side. As the hubs and bearings wear, the cut-out becomes more pronounced. Excessive cut-out in a short period of time indicates excessive pressure or oil contamination. If the relief valve settings are within prescribed limits, check for shock pressures or tampering. Withdraw oil sample and check it and tank for dirt.

Where cut-out is moderate, .005" or less, gear housing is in good condition, and both ports are of the same size, housing may be flopped over and reused.



GEARS:

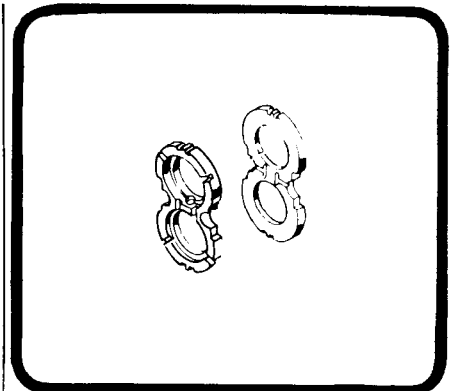
Any wear on gear hubs detectable by touch, or in excess of .002" necessitates replacement. Nicking, grooving, fretting of teeth surfaces or head discoloration also necessitates replacement. Scoring, grooving or burring of outside diameter of teeth generally means replacement is necessary unless damage is light and can be stoned off.



DRIVE SHAFTS:

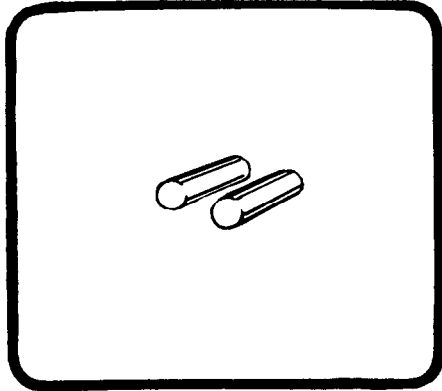
Replace if there is any wear detectable by touch in the seal areas or at the drive coupling. .002" wear is the maximum allowable.

Wear in the shaft seal areas indicate oil contamination and shaft replacement is required. Wear or damage to splines, keys or keyways necessitates replacement.



THRUST PLATES:

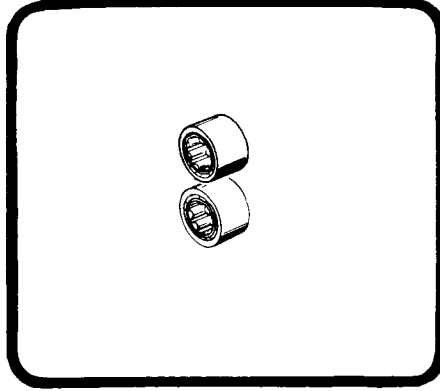
The thrust plates seal the gear section at the sides of the gears. Wear here will allow internal slippage, that is, oil will bypass within the pump. .002" maximum wear is allowable. Replace thrust plates if they are scored, eroded, pitted or discolored. Check center of thrust plates where the gears mesh. Erosion here indicates oil contamination. Pitted thrust plates indicate cavitation or oil aeration. Discolored thrust plates indicate overheating, probably insufficient oil.



DOWEL PINS:

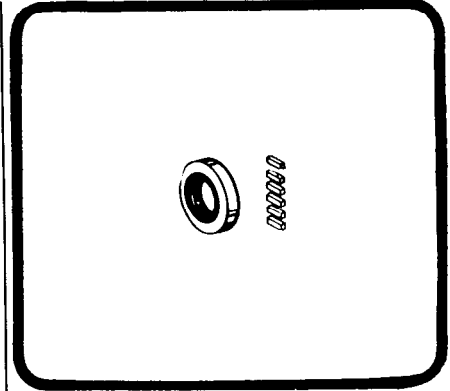
If either the dowel pin or dowel hole is damaged, the pin or machined casting, or both, must be replaced.

If more than reasonable force is required to seat dowels, the cause may be poorly deburred or dirty parts; cocking of dowel in the hole; or improper pin-to-hole fit.



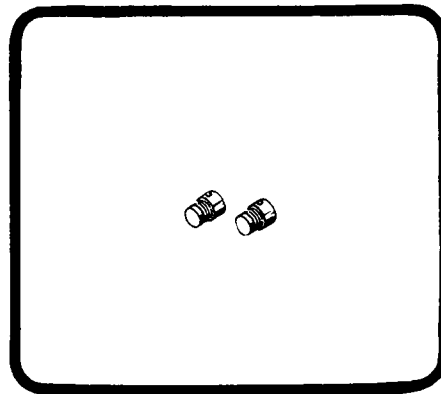
BEARINGS:

If gears are replaced, bearings must be replaced. Bearings should fit into bore with a light press fit. A neat hand fit is allowable. If bearings can fall out, bore may be oversize.



SEALS AND GASKETS:

Replace all rubber and polymer seals whenever disassembling pump. Include all "O" rings, pocket seals behind thrust plates, shaft seal and gasket seals.

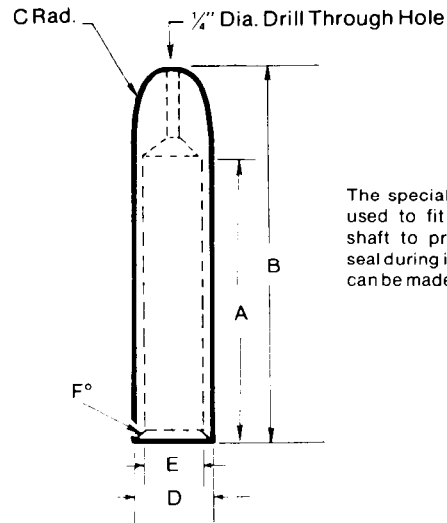
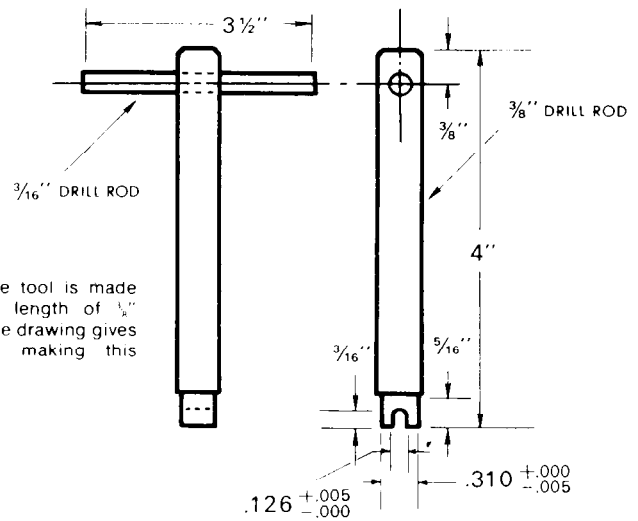


CHECK VALVES:

Examine small check valves in shaft end cover to make sure they are intact and functioning. If there are no check valves here, make sure the high pressure side of the shaft end cover is plugged.

tool list

- Arbor Press
- Awl
- Bearing Puller (Owatonna Tool Co. MD-956 or equivalent)
- Clean Lintless Cloths
- Deburring Tool (an old file with the cutting teeth ground off)
- Machinist's Hammer
- Soft Rubber Hammer
- Permatex Aviation Form-A-Gasket No. 3D Sealant or equivalent
- Medium Grit Carborundum Stone
- Oil and Grease
- Snap Ring Pliers
- Center Punch
- Sharp Razor Blade
- Scale (1/32" or 1/64" graduations)
- 2 Large Screwdrivers/Pry Bars
- Torque Wrench
- Vise with 6" Minimum Open Spread
- Light Duty Bearing Puller for Seal Retainer
- Special Steel Sleeve or Cardboard Sleeve
- Steel Ball



	A	B	C Radius	D Dia.	E Dia.	F° Chamfer
P75/76	4 3/8"	5 1/4"	3/8"	1.379 +.000 -.002	1.259 +.002 -.000	30°

All External surfaces must be free of scratches and burrs.

Lubrication and oil recommendations

All parts, with the exception of the outboard bearing, are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the system clean. Whenever there is a pump or motor failure, and there is reason to feel that metal particles may be in the system, the oil must be drained, the entire system flushed clean, and any filter screens thoroughly cleaned or replaced. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Commercial's pumps and motors should meet the following specifications:

- Viscosity:**
- 50 SSU minimum @ operating temperature
 - 7500 SSU maximum @ starting temperature
 - 150 to 225 SSU @ 100° F. (37.8° C.) (generally)
 - 44 to 48 SSU @ 210° F. (98.9° C.) (generally)

Oil Grade	Approximate SSU at . . .	
	100° F. (37.8° C.)	210° F. (98.9° C.)
SAE 10	150	43
SAE 20	330	51

Viscosity Index: 90 minimum

Aniline Point: +175°F (80°C) minimum.

Recommended Additives: Foam Depressant
Rust and Oxidation Inhibitors

Other Desirable Characteristics:

- Stability of physical and chemical characteristics.
- High demulsibility (low emulsibility) for separation of water, air, and contaminants.
- Resistant to the formation of gums, sludges, acids, tars, and varnishes.
- High lubricity and film strength.

General Recommendations:

A good quality hydraulic oil with the characteristics listed above is essential to satisfactory performance and long life of any hydraulic system.

Oil should be changed on regular schedules in accordance with the manufacturer's recommendations, and the system periodically flushed.

Oil temperature in reservoir must not exceed 200° F., (93.3° C.) with a maximum operating temperature of 180° F. (82.2° C.) recommended. Higher temperatures will result in rapid oil deterioration.

Reservoir capacity should equal in gallons the pump output in gpm or the total gpm of all pumps where there is more than one in the system.

Oil poured into the reservoir should pass through a 100 mesh screen. Pour only clean oil from clean containers into the reservoir. A 100 mesh screen may be used in the suction line leading to the pump. A suction filter should be of sufficient size to handle twice the pump capacity. It must be cleaned and checked regularly to avoid damage due to contamination and cavitation.

Normal Temperatures:

0° F. (—18° C.) to 100° F. (37.8° C.) Ambient
100° F. (37.8° C.) to 180° F. (82.2° C.) System

Be sure your oil is recommended for the temperatures you expect to encounter.

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Vickers®

Pressure Relief



Sequence, Unloading, Back Pressure, Counterbalance, and Reducing Valves

"R", "UR", and "X" 03/06/10/12 Series

Pressures to 210 bar (3000 psi) – Flows to 284 l/min (75 USgpm)



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Introduction

“R” Series Sequence, Unloading, Back Pressure, and Counterbalance Valves

There are several configurations of this basic valve which can be made by changing cover positions. The following outlines each type of function.

Sequence and Unloading

Vickers “Hydrocushion” type pressure control valves are used for the control of unloading and sequence of oil flow in hydraulic systems, induced by a pressure rise, directly or by remote means. They are available in the following types: sequence valve, Type 2—directly operated; sequence valve, Type 3—remotely controlled; unloading valve, Type 4—remotely controlled.

Back Pressure

Back pressure valves are designated as Type 1—internally operated. They are used to provide back pressure on the hydraulic actuator to prevent

overrunning. A remote ‘P’ version is also available for use in braking circuits.

Counterbalance

Vickers “Hydrocushion” type counterbalance valves are used for the control of unloading and sequence of oil flow in hydraulic systems, induced by pressure rise either directly or by remote means. They are available in the following types: counterbalance valve, Type 1—internally operated; counterbalance valve, Type 4—remotely controlled. These valves are usually applied in a system to keep a vertical load from falling. All models provide free reverse flow by means of an integral check valve. (Refer to valves without integral check when reverse free flow is not required.)

“UR” Series Unloading Relief Valves with Integral Check Module

An integral check valve prevents return flow from the accumulator through the unloading valve. In an accumulator

system, the valve cuts out automatically when the accumulator pressure reaches adjusted maximum. At cut-in pressure (approximately 85% of adjusted maximum), the valve directs delivery to the accumulator and the hydraulic system automatically.

In a double pump system, the valve automatically sequences the pumps to deliver a large volume of oil at low pressure and a small volume of oil at high pressure.

Models designated “URT” have threaded ports and require a separate check valve to function as an unloading circuit.

“X” Series Pressure Reducing Valves

These pressure reducing valves maintain a reduced level of outlet pressure regardless of variations in inlet pressure above the pressure setting of the valve. The valves also allow reverse free flow at pressures below the setting of the valve.

Table of Contents

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves	3
Series URT*-06/10 Unloading Relief Valves	14
Series URG*-06/10 Unloading Relief Valves	17
Series XSL/XTL-03 Pressure Reducing Valves	21
Series XGL-03 Pressure Reducing Valves	23
Series X(C)*-03/06/10 Pressure Reducing Valves	26
Application Data	35

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Ratings

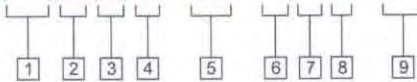
Rated Pressure (Maximum)*	210 bar (3000 psi)
Rated Capacity (Maximum)**	
R*-03	45 l/min (12 USgpm)
R*-06	114 l/min (30 USgpm)
R*-10 and R*-12	284 l/min (75 USgpm)

* 140 bar (2000 psi) permitted on the full piston area at the bottom cover ("P" connection), and at the top cover (spring chamber). See tank drain information on page 4.

**Rated capacities are based on using fluid with a specific gravity of 0.865 and a viscosity of 20 cSt (100 SUS).

Model Code

(F3)R(C)S - 06 - B P 1 - 30



1 Special seals

F3 – For mineral oil and fire resistant fluids. Mounting face seals of RCG model are standard Buna-N unless specified as F3.
Blank – Omit for standard, R(C)S, and R(C)T models.

2 Valve type

R – Pressure control valve

3 Integral check valve

C – Reverse free flow check

4 Connections

G – Manifold or subplate mounting
S – SAE straight thread
T – NPTF thread*

*Not recommended

5 Valve size

03 – 3/8" pipe or 0.7500-16 UNF-2B straight thread (0.500 tubing)
06 – 3/4" pipe or 1.0625-12 UN-2B straight thread (0.750 tubing)
10 – 1 1/4" pipe or 1.6250-12 UN-2B straight thread (1.250 tubing)
12 – 1 1/2" pipe or 1.8750-12 UN-2B straight thread (1.500 tubing) (not available in R(C)G models)

6 Pressure range

X – 0,7 to 2,1 bar (10 to 30 psi)
Y – 2,1 to 4,1 bar (30 to 60 psi)
Z – 4,1 to 8,5 bar (60 to 125 psi)
A – 5,2 to 17,2 bar (80 to 250 psi)
B – 8,5 to 35 bar (125 to 500 psi)
D – 17,2 to 70 bar (250 to 1000 psi)
F – 35 to 140 bar (475 to 2000 psi)

7 Remote control connection

P – Auxiliary remote pressure control connection (not available with X, Y, or Z pressure ranges or in R(C)G-03 models)
Blank – Omit if not required

8 Valve application type

1 – Internal drain directly operated
2 – External drain directly operated
3 – External drain remotely operated
4 – Internal drain remotely operated

9 Design number

Subject to change. Installation dimensions same for designs 30 through 39.

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

General Data

Vickers "hydrocushion" type pressure control valves are used to control the sequencing, unloading, back pressure, and counterbalancing of oil flow in hydraulic systems. Control is initiated by a pressure rise which can be sensed either internally (directly) or remotely. Models are available with or without integral reverse free flow checks.

Pressure Adjustment

Pressure ranges – (see model code page 3) are maximum controllable, and each model selected should be well within the range given to afford fine increments of adjustment. Pressure setting must be at least 17 bar (250 psi) lower than the system relief valve setting.

Pressure can be adjusted by loosening a jam nut and turning an adjustment screw. Turning clockwise increases pressure, and turning counterclockwise decreases pressure.

Installation Data

Mounting

Because all R(C)T and R(C)S models have optional pressure inlets connected by a through passage, the valves may be mounted "in-line". The valves may also be teed to a line by using either one of the pressure inlets and plugging the other.

The remote pressure control connection on type 3 and 4 valves must be connected to an external pilot pressure source sufficient to operate the valve at the desired pressure setting and flow conditions.

Tank Drain

The discharge outlet of valve types 1 and 4 must be piped to tank at atmospheric pressure. The drain connection on types 2 and 3 must be piped directly to tank at atmospheric pressure. Any pressure at the drain port must be added to the pressure setting of the valve.

Auxiliary Remote Pressure Control "P"

All models (except R(C)G -03 and those with an "X", "Y", or "Z" pressure adjustment range in their model code) are available with an auxiliary remote control connection. Required pressure at the auxiliary connection is $\frac{1}{16}$ of the normally required control pressure for the "F" pressure range and $\frac{1}{8}$ of the normally required control pressure for the "A", "B", and "D" pressure ranges. (This applies to -22 design and up.)

Brake Valve

A brake valve is used in the exhaust line of a hydraulic motor to: 1) prevent overspeeding when an overrunning load is applied to the motor shaft; and 2) prevent excessive pressure buildup when decelerating or stopping a load.

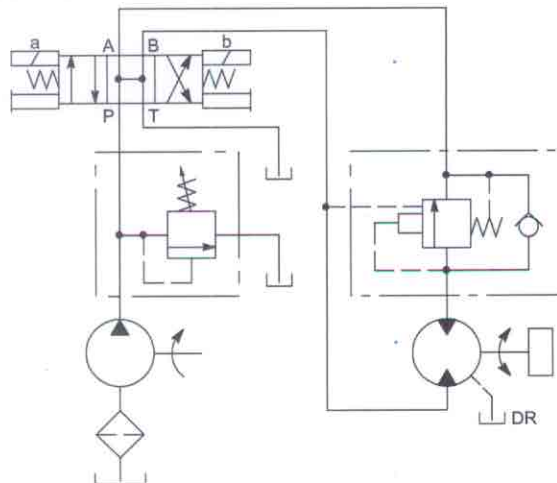
When the "RC" valve is used as a brake valve, it has a solid spool (no drain hole through the center), and there is a remote operating pressure connection in the bottom cover directly under the spool. This connection is teed into the supply line to the motor. The internal control connection is also used under the small piston and senses pressure from the primary port of the "RC" valve, which is connected to the motor exhaust port.

When the load is being accelerated, pressure is maximum at the motor inlet and under the large area of the brake valve spool, holding it in the full open position and permitting free flow from the exhaust port of the motor.

When the motor gets up to speed, load pressure still holds the brake valve open unless the load tries to run away. If this happens, the pressure falls off at the motor inlet and in the remote control pressure passage. The spring force tends to close the valve, thus increasing the back pressure on the motor, tending to brake it.

When the directional valve is shifted to neutral, inertia may cause the motor to continue rotating against the brake valve. Until the motor stops turning, it will operate as a pump, drawing fluid from the motor outlet through the directional valve and circulating it back to the motor inlet. Motor leakage oil will be made up by drawing oil into the loop through the tank port of the valve. At this time, pressure at the motor outlet tending to bring it to a stop will be whatever is required under the small piston to overcome the brake valve setting.

Typical Application: Brake Valve



Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Pressure Drop

The following table lists approximate pressure drops (ΔP) when passing flow of fluid with a specific gravity of 0.865 and a viscosity of 20 cSt (100 SUS).

Valve	Reverse Free Flow Pressure Drop	
	Flow l/min (USgpm)	ΔP bar (psi)
RC*-03	45 (12)	5,5 (80)
RC*-06	114 (30)	3,4 (50)
RC*-10	189 (50)	2,8 (40)
RC*-12	189 (50)	2,4 (35)

For any other flow rate (Q_1), the approximate pressure drop (ΔP_1) can be calculated using the following formula:

$$\Delta P_1 = \Delta P (Q_1 / Q_2)^2.$$

For any other viscosity of fluid, the pressure drop will change according to the following table:

Viscosity cSt (SUS)	Approximate % of ΔP
14 (75)	93
27 (150)	111
38 (200)	119
46 (250)	126
56 (300)	132
64 (350)	137
74 (400)	141

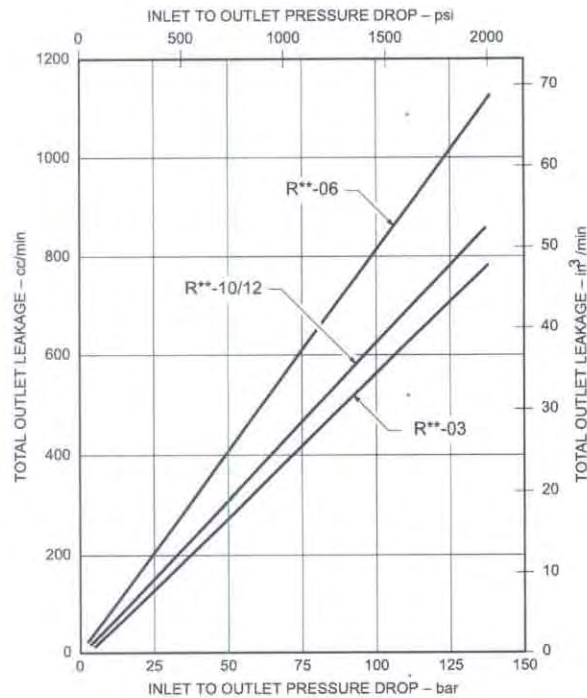
For any other specific gravity (G_1), the approximate pressure drop (ΔP_1) can be calculated using the following formula:

$$\Delta P_1 = \Delta P (G_1 / G).$$

The specific gravity of fluid may be obtained from its producer. The value is higher for fire-resistant fluids than for oil.

Maximum Total Leakage vs. Pressure Drop

The following graph shows the relationship between maximum total leakage and pressure drop for fluid with a specific gravity of 0.865 and a viscosity of 20 cSt (100 SUS). Leakage is approximately proportional to viscosity in centistokes.



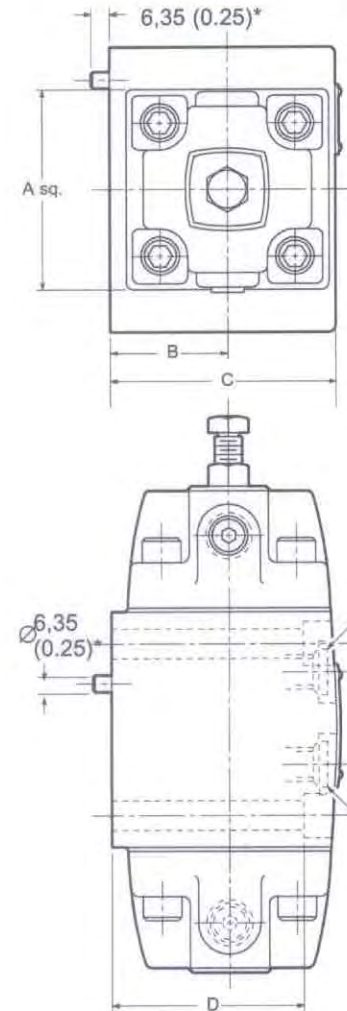
Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Installation Dimensions

Millimeters (inches)

Subplate or Manifold Mounted Models

RG--**-30 Without Check**



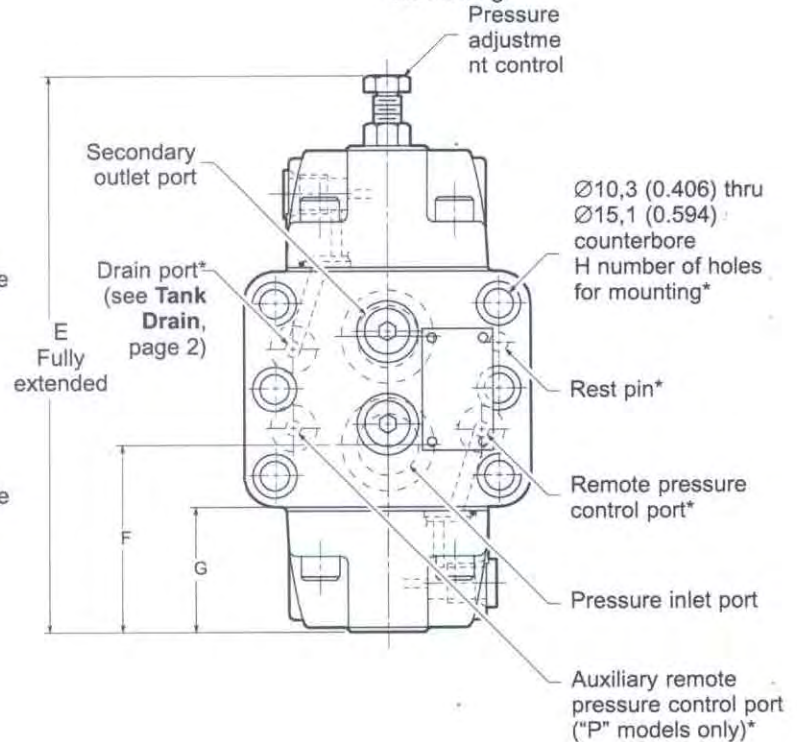
NOTES

Sequence valve shown (remotely controlled, external drain, type 3).

* See mounting subplates for locating dimensions.

** .4375-20 UNF-2B straight thread for 0.250

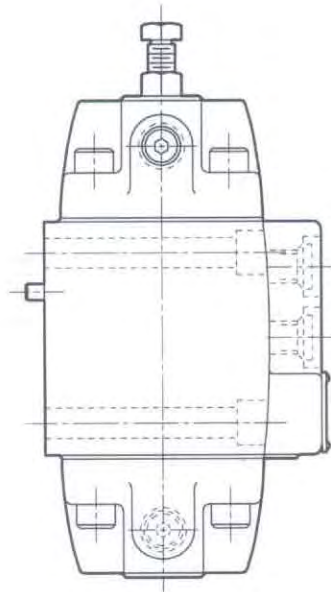
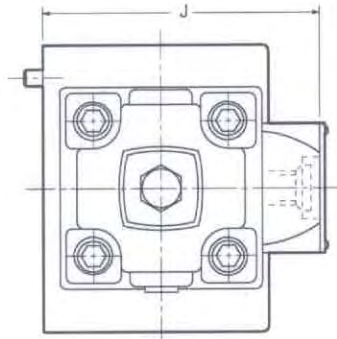
O.D. tubing.



Model	A	B	C	D	E	F	G	H	J	NFPA Interface
R(C)G-03**-30	57,2 (2.25)	36,6 (1.44)	68,1 (2.68)	55,9 (2.20)	178,6 (7.03)	47,5 (1.87)	30,0 (1.18)	4	90,4 (3.56)	P03
R(C)G-06**-30	71,4 (2.81)	41,1 (1.62)	79,2 (3.12)	73,7 (2.90)	201,4 (7.93)	67,6 (2.66)	45,2 (1.78)	4	98,6 (3.88)	P06
R(C)G-10**-30	95,2 (3.75)	50,8 (2.00)	100,1 (3.94)	90,2 (3.55)	282,2 (11.11)	71,6 (2.82)	44,4 (1.75)	6	130,0 (5.12)	P10

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

RCG-**-**-30 With Check



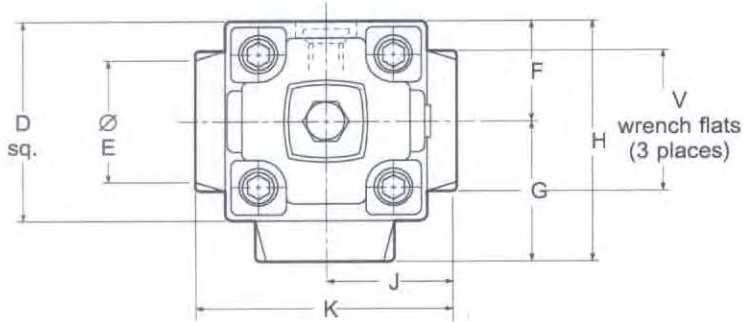
NOTE

Sequence valve shown (remotely controlled, external drain, type 3).

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Threaded Port Models

RS/T-**-**-30 Without Check



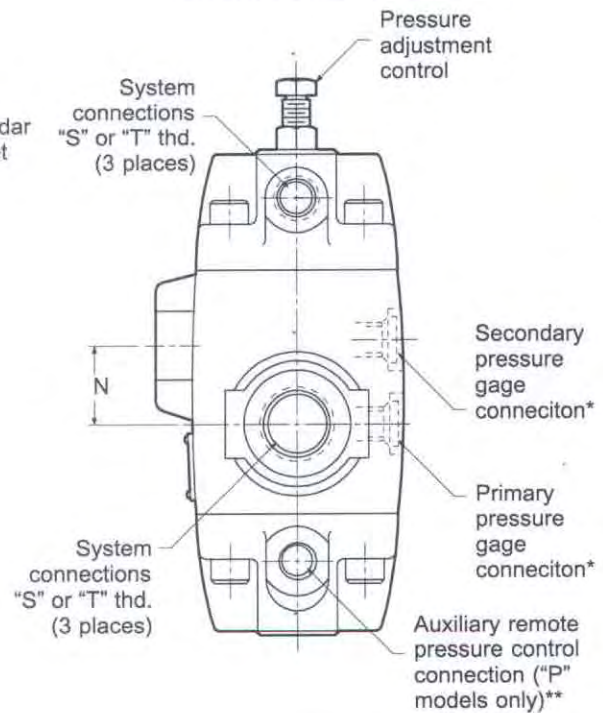
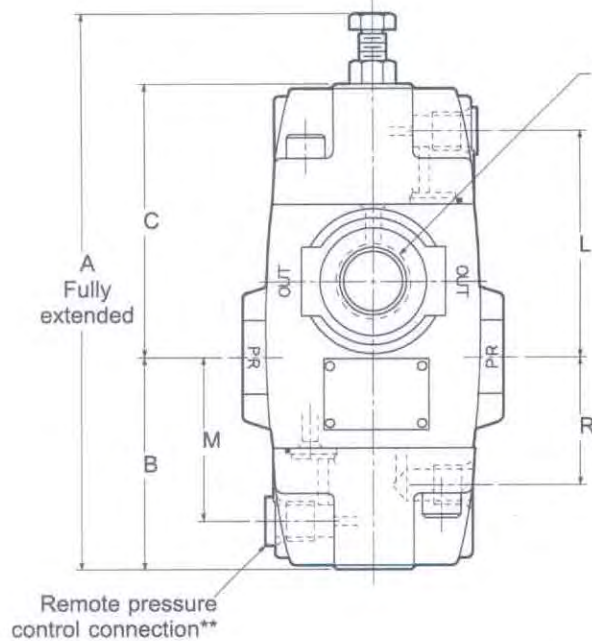
NOTES

Sequence valve shown (directly operated, external drain, type 2).

All external connections are straight thread (except inlet and outlet ports of R(C)T models).

*.4375-20 UNF-2B straight thread for 0.250 O.D. tubing.

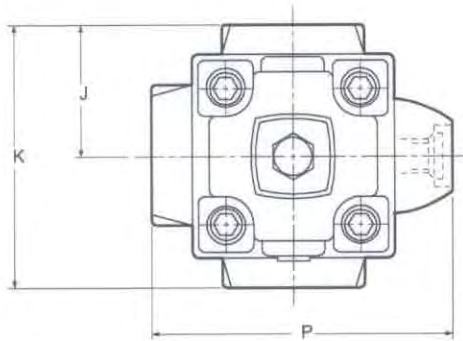
** .5627-18 UNF-2B thread



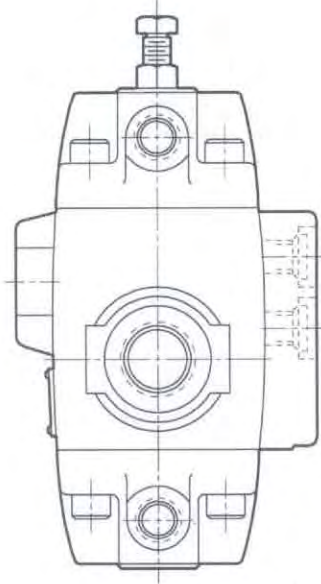
Model	A	B	C	D	E	F	G	H	J	K
R(C)S/T-03**-30	178,6 (7.03)	53,3 (2.12)	96,8 (3.81)	59,4 (2.34)	35,1 (1.38)	29,7 (1.17)	39,6 (1.56)	70,9 (2.79)	35,1 (1.38)	69,8 (2.75)
R(C)S/T-06**-30	201,4 (7.93)	75,4 (2.97)	97,8 (3.85)	74,7 (2.94)	47,8 (1.88)	37,3 (1.47)	50,8 (2.00)	88,1 (3.47)	47,8 (1.88)	95,2 (3.75)
R(C)S/T-10**-30	282,2 (11.11)	84,1 (3.31)	154,2 (6.07)	98,6 (3.88)	82,6 (3.25)	49,3 (1.94)	68,3 (2.69)	117,6 (4.63)	53,8 (2.12)	108,0 (4.25)
R(C)S/T-12**-30	282,2 (11.11)	84,1 (3.31)	154,2 (6.07)	98,6 (3.88)	82,6 (3.25)	49,3 (1.94)	68,3 (2.69)	117,6 (4.63)	53,8 (2.12)	108,0 (4.25)

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

RCS/T-**-**-30 With Check



NOTE
Sequence valve shown (remotely controlled, external drain, type 3).



Model	L	M	N	P	R●	"S" Str. Thd. RS and RCS Models	"T" Str. Thd.■ RT and RCT Models	V
R(C)S/T-03-**-30	58,7 (2.31)	42,9 (1.69)	23,1 (0.91)	93,7 (3.69)	38,9 (1.53)	.7500-16 UNF-2B	3/8	35,1 (1.38)
R(C)S/T-06-**-30	79,5 (3.13)	57,2 (2.25)	27,2 (1.07)	108,0 (4.25)	46,7 (1.84)	1.0625-12 UN-2B	3/4	50,8 (2.00)
R(C)S/T-10-**-30	80,3 (3.16)	70,6 (2.78)	28,7 (1.13)	147,6 (5.81)	57,2 (2.25)	1.6250-12 UN-2B	1 1/4	86,4 (3.40)
R(C)S/T-12-**-30	80,3 (3.16)	70,6 (2.78)	28,7 (1.13)	147,6 (5.81)	57,2 (2.25)	1.8750-12 UN-2B	1 1/2	86,4 (3.40)

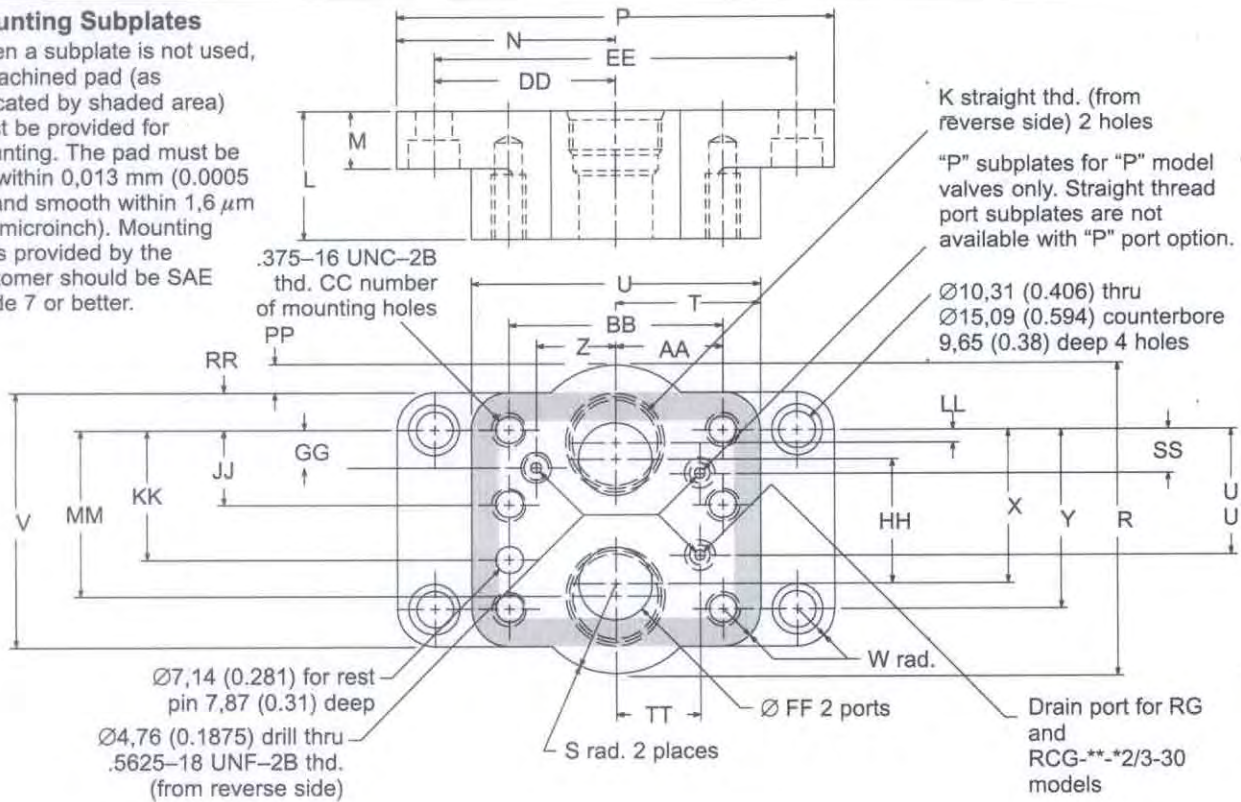
● For "P" models only. See model code.

■ Not recommended.

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Mounting Subplates

When a subplate is not used, a machined pad (as indicated by shaded area) must be provided for mounting. The pad must be flat within 0,013 mm (0.0005 in) and smooth within 1,6 μm (63 microinch). Mounting bolts provided by the customer should be SAE grade 7 or better.



Model	K	Tube O.D.	L	M	N	P	R	S	T	U	V
RXGM-03S-(P)-20	.7500-16 UNF-2B	1/2"	25,4 (1.00)	19,0 (0.75)	63,5 (2.50)	127,0 (5.00)	76,2 (3.00)	23,9 (0.94)	43,7 (1.72)	87,4 (3.44)	63,5 (2.50)
RXGM-06SX-(P)-20	1.3125-1 2 UN-2B	1"	31,8 (1.25)	19,0 (0.75)	73,2 (2.88)	146,0 (5.75)	117,3 (4.62)	39,6 (1.56)	50,8 (2.00)	101,6 (4.00)	82,6 (3.25)
RXGM-10S-(P)-30	1.6250-1 2 UN-2B	1 1/4"	47,8 (1.88)	22,4 (0.88)	79,2 (3.12)	158,8 (6.25)	146,0 (5.75)	47,8 (1.88)	58,7 (2.31)	117,3 (4.62)	104,6 (4.12)

Model	W	X	±0,13 Y (±0.005)	Z	AA	BB	CC	DD	±0,013 EE (±0.005)	FF	GG
RXGM-03S-(P)-20	10,4 (0.41)	35,8 (1.41)	42,87 (1.688)	25,4 (1.00)	33,3 (1.31)	66,5 (2.62)	4	53,1 (2.09)	106,37 (4.188)	14,2 (0.56)	21,3 (0.84)
RXGM-06SX-(P)-20	10,2 (0.44)	49,3 (1.94)	60,32 (2.375)	33,3 (1.31)	39,6 (1.56)	79,2 (3.12)	4	62,0 (2.44)	123,82 (4.875)	23,1 (0.91)	20,6 (0.81)
RXGM-10S-(P)-30	10,4 (0.41)	67,6 (2.66)	84,12 (3.312)	44,4 (1.75)	48,5 (1.91)	96,8 (3.81)	6	69,1 (2.72)	138,12 (5.438)	28,4 (1.12)	24,6 (0.97)

Model	HH	JJ■	KK	LL	MM	PP	RR	SS	TT	UU	NFPA Interface
RXGM-03S-(P)-20	28,4 (1.12)	—	31,8 (1.25)	4,8 (0.19)	38,1 (1.50)	6,4 (0.25)	10,4 (0.41)	—	25,4 (1.00)	21,3 (0.84)	P03
RXGM-06SX-(P)-20	38,1 (1.50)	—	44,4 (1.75)	6,4 (0.25)	53,8 (2.12)	17,5 (0.69)	11,2 (0.44)	16,8 (0.66)	33,3 (1.31)	39,6 (1.56)	P06
RXGM-10S-(P)-30	50,8 (2.00)	42,2 (1.66)	62,7 (2.47)	7,9 (0.31)	76,2 (3.00)	20,6 (0.81)	10,4 (0.41)	24,6 (0.97)	44,4 (1.75)	59,4 (2.34)	P10

■ RXGM-03S/06SX require 4 valve mounting screws. RXGM-10S requires 6 valve mounting screws.

Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

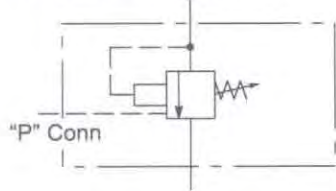
Graphical Symbols

Type P Back Pressure and Counterbalance Valves

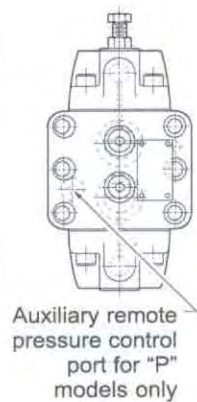
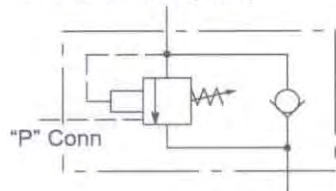
Auxiliary remote control operated with "P" connection – Internal drain (model "*P1" shown)

R(C)G Valves

Back Pressure (RG)

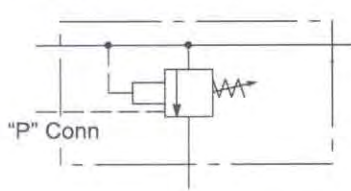


Counterbalance (RCG)

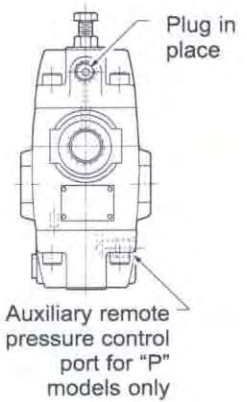
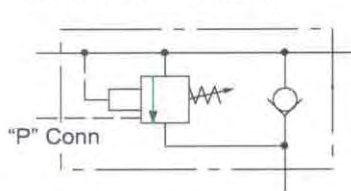


R(C)S/T Valves

Back Pressure (RS/T)



Counterbalance (RCS/T)

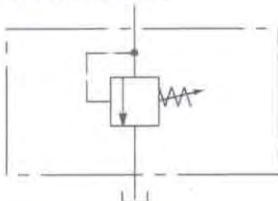


Type 1 Back Pressure and Counterbalance Valves

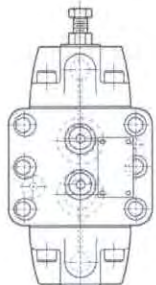
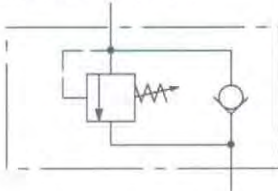
Internally operated – Internal drain

R(C)G Valves

Back Pressure (RG)

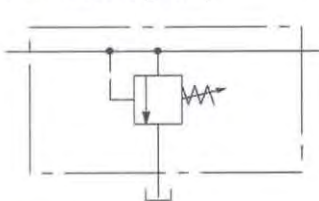


Counterbalance (RCG)

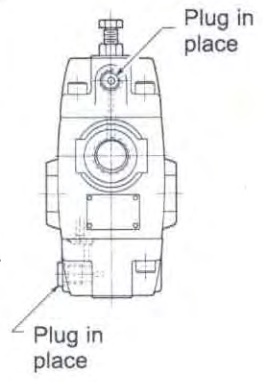
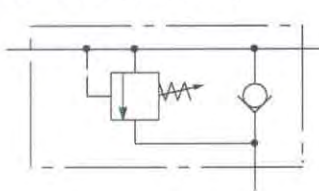


R(C)S/T Valves

Back Pressure (RS/T)



Counterbalance (RCS/T)



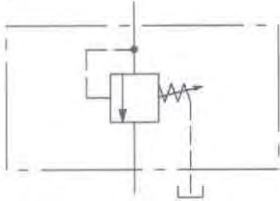
Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Type 2 Sequence Valves

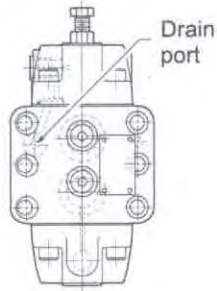
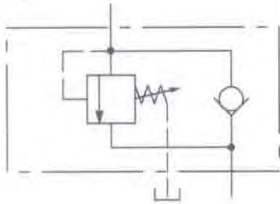
Internally operated – External drain

R(C)G Valves

(RG)

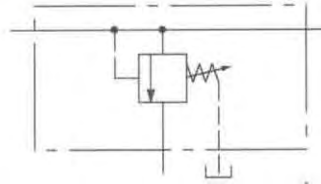


(RCG)

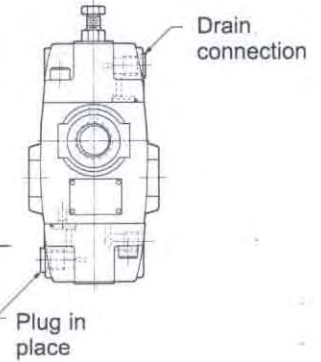
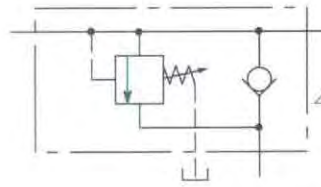


R(C)S/T Valves

(RS/T)



(RCS/T)

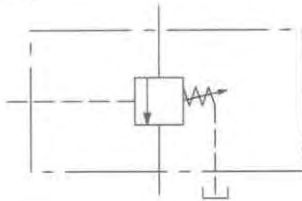


Type 3 Sequence Valves

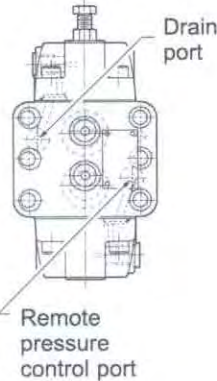
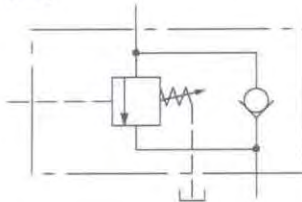
Remote control operated – External drain

R(C)G Valves

(RG)

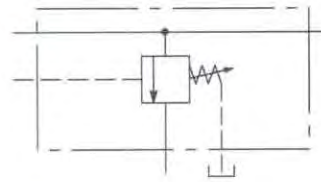


(RCG)

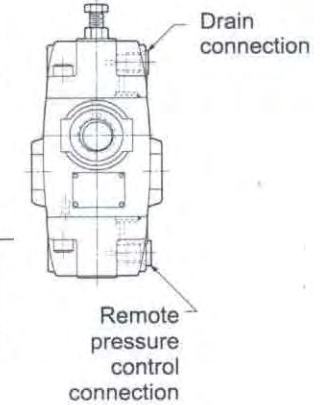
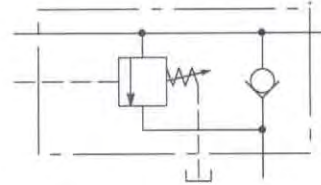


R(C)S/T Valves

(RS/T)



(RCS/T)



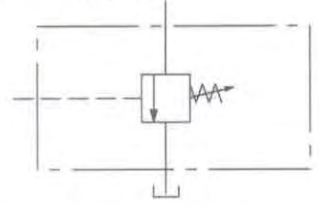
Series R(C)*-03/06/10/12 Sequence, Unloading, Back Pressure, and Counterbalance Valves

Type 4 Unloading and Counterbalance Valves

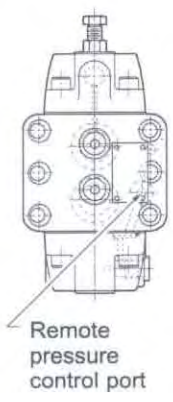
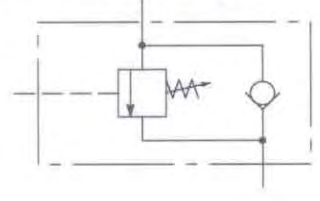
Remote control operated – Internal drain

R(C)G Valves

Unloading (RG)

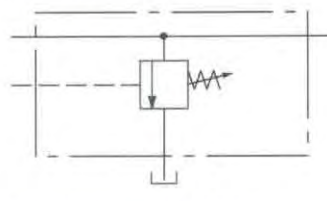


Counterbalance (RCG)

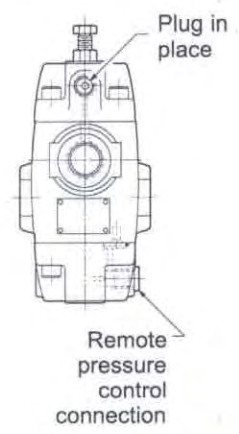
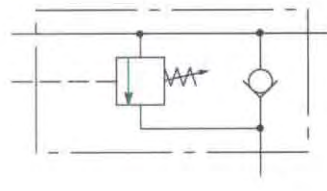


R(C)S/T Valves

Unloading (RS/T)



Counterbalance (RCS/T)

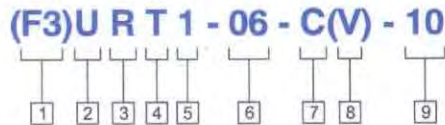


Series URT*-06/10 Unloading Relief Valves

Ratings

Rated Pressure (Maximum)	210 bar (3000 psi)
Rated Capacity (Maximum)	
URT*-06	76 l/min (20 USgpm)
URT*-10	189 l/min (50 USgpm)

Model Code



1 Special seals

F3 – For mineral oil and fire resistant fluids
 Blank – Omit for standard models

2 Valve function

U – Unloading valve

3 Valve type

R – Pressure control valve

4 Connections

T – NPTF thread*
 *Not recommended

5 Drain

1 – Externally drained
 2 – Internally drained

6 Valve size

06 – 3/4" pipe
 10 – 1 1/4" pipe

7 Cutout pressure range

B – 24 to 70 bar (350 to 1000 psi)
 C – 35 to 140 bar (500 to 2000 psi)
 F – 103 to 210 bar (1500 to 3000 psi)

8 High vent spring

V – Optional high vent spring installed
 Blank – Omit if not required

9 Design number

Subject to change. Installation dimensions same for designs 10 through 19.

General Data

These valves are used in oil hydraulic circuits where a pressure regulator is required to automatically unload the pump by diverting the pump delivery to the reservoir, at low pressure, when the accumulator pressure reaches the desired maximum (or "cut out") pressure. When the accumulator pressure drops to the "cut in" pressure (approximately 85% of the desired maximum), the valve directs pump delivery to the accumulator and

hydraulic system. The valve may also be used with a double pump to deliver a large volume of oil to the system at low pressure and a small volume at high pressure, serving the same function as an unloading valve. A separate right angle check valve, C2-815 (3/4") or C2-825 (1 1/4") must be provided to maintain accumulator hydraulic charge or unloading of high volume pump and prevent back flow when pump is unloaded.

Pressure Adjustment

Pressure can be adjusted by loosening a jam nut and turning an adjustment screw. Turning clockwise increases pressure, and turning counterclockwise decreases pressure.

Series URT*-06/10 Unloading Relief Valves

Installation Data

Tank Drain

Back pressure at the tank discharge port of the URT1 series (externally drained) valves will not effect the operation at up to 85% of the inlet pressure. Back pressure at the tank discharge port of the URT2 series (internally drained) valves must not exceed 5% of the inlet pressure.

CAUTION

For series URT1 only, the drain must be connected to tank through a surge free line so there will be no back pressure at this drain. Failure to connect drain can result in infinite system pressures and machine damage. Series URT2 has internal drain and this port is not used.

Connections

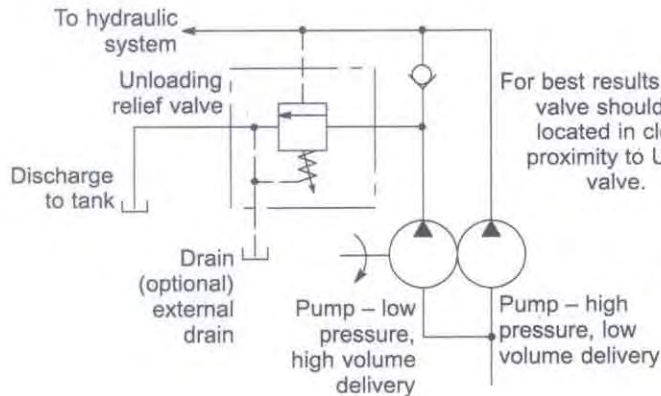
Pressure inlet and outlet connections are connected by a through passage which permits use of either connection as an inlet.

Approximate Minimum Venting Pressures bar (psi) at Various Percentages of Maximum Rated Capacity

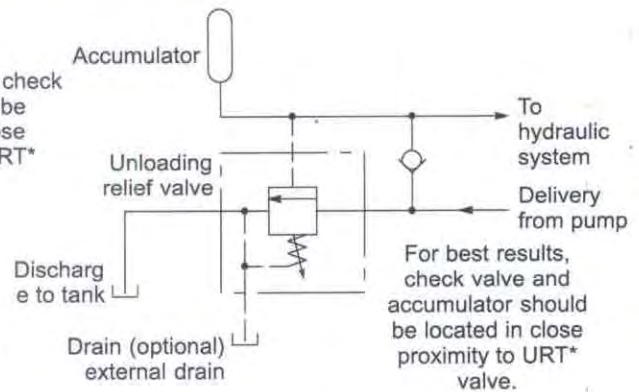
Model	25%	50%	75%	100%
URT*-06-*-10	0,7 (10)	0,8 (11)	1,0 (15)	1,6 (23)
URT*-06-*V-10	3,9 (56)	3,9 (57)	4,1 (59)	4,3 (63)
URT*-10-*-10	0,4 (6)	0,7 (10)	1,6 (23)	2,7 (39)
URT*-10-*V-10	3,6 (52)	3,7 (54)	3,9 (57)	4,1 (59)

Typical Applications

Double Pump Circuit



Accumulator Circuit

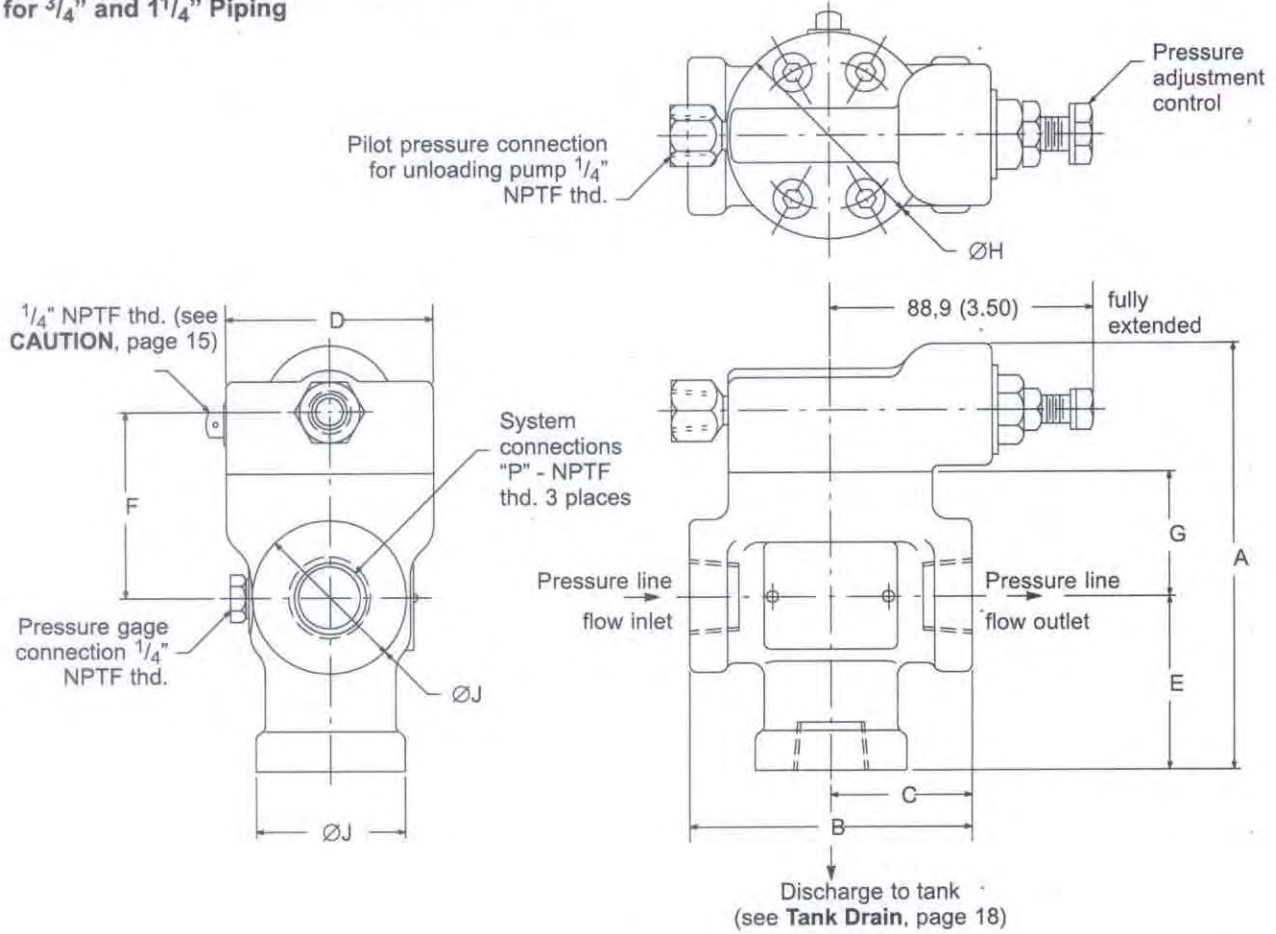


Series URT*-06/10 Unloading Relief Valves

Installation Dimensions

Millimeters (inches)

URT1 and URT2 with Threaded Connections
for 3/4" and 1 1/4" Piping



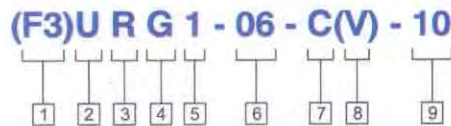
Model	"P" Piping Thd. Size NPTF	Nominal Capacity l/min (USgpm)	A	B	C	D	E	F	G	H	J
URT*-06*-10	3/4"	76 (20)	158,8 (6.25)	108,0 (4.25)	53,8 (2.12)	77,7 (3.06)	65,0 (2.56)	68,3 (2.69)	46,0 (1.81)	76,2 (3.00)	57,2 (2.25)
URT*-10*-10	1 1/4"	189 (50)	189,0 (7.44)	127,0 (5.00)	63,5 (2.50)	95,2 (3.75)	77,7 (3.06)	87,4 (3.44)	60,5 (2.38)	95,2 (3.75)	76,2 (3.00)

Series URG*-06/10 Unloading Relief Valves

Ratings

Rated Pressure (Maximum)	210 bar (3000 psi)
Rated Capacity (Maximum)	
URT*-06	95 l/min (25 USgpm)
URT*-10	246 l/min (65 USgpm)

Model Code



1 Special seals

F3 – For mineral oil and fire resistant fluids
 Blank – Omit for standard models

2 Valve function

U – Unloading valve

3 Valve type

R – Pressure control valve

4 Connections

G – Manifold or subplate mounted

5 Drain

1 – Externally drained
 2 – Internally drained

6 Valve size

06 – 3/4" pipe
 10 – 1 1/4" pipe

7 Cutout pressure range

B – 24 to 70 bar (350 to 1000 psi)
 C – 35 to 140 bar (500 to 2000 psi)
 F – 103 to 210 bar (1500 to 3000 psi)

8 High vent spring

V – Optional high vent spring installed
 Blank – Omit if not required

9 Design number

Subject to change. Installation dimensions same for designs 10 through 19.

General Data

These valves are used in oil hydraulic circuits where a pressure regulator is required to automatically unload the pump by diverting the pump delivery to the reservoir, at low pressure, when the accumulator reaches the desired maximum (or "cut out") pressure. When the accumulator pressure drops to the "cut in" pressure (approximately 85% of the desired maximum), the valve directs pump delivery to the accumulator and hydraulic system. An integral check valve prevents return flow from the accumulator through the unloading valve.

The valve may also be used with a double pump to deliver a large volume of oil to the system at low pressure and a small volume at high pressure, serving the same function as a separate unloading valve and check valve.

Pressure Adjustment

Pressure can be adjusted by loosening a jam nut and turning an adjustment screw. Turning clockwise increases pressure, and turning counterclockwise decreases pressure.

Series URG*-06/10 Unloading Relief Valves

Installation Data

Tank Drain

Back pressure at the tank discharge port of the URG1 series (externally drained) valves will not effect the operation at up to 85% of the inlet pressure. Back pressure at the discharge port of the URG2 series (internally drained) valves must not exceed 5% of the inlet pressure.

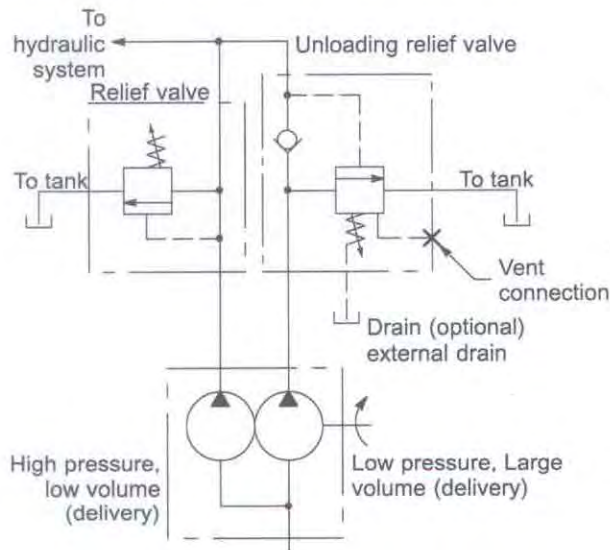
CAUTION

For series URG1 only, the drain must be connected to the tank through a surge free line so there will be no back pressure at this drain. Failure to connect drain can result in infinite system pressures and machine damage. Series URG2 has internal drain and this port is not used.

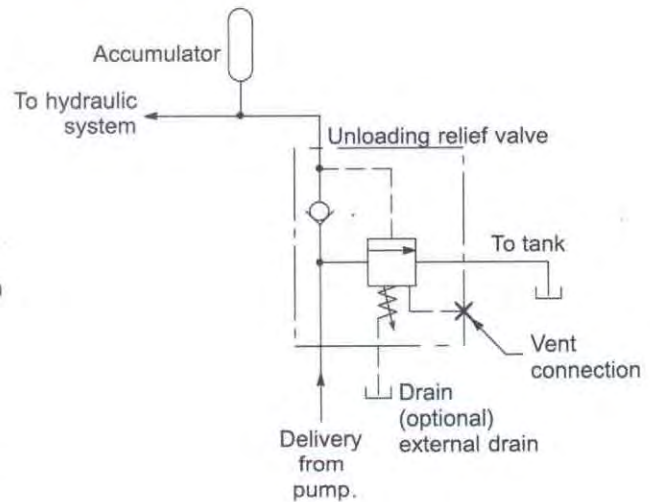
Model	Nominal Capacity l/min (USgpm)	Cut Out Pressure Range bar (psi)	Approximate Pressure Drop bar (psi)	
			Unloading	Via Check To Accumulator
URG*-06-B-10	95 (25)	24 to 70 (350 to 1000)	5,9 (85)	2,4 (35)
URG*-06-C-10		35 to 140 (500 to 2000)		
URG*-06-F-10		103 to 207 (1500 to 3000)		
URG*-10-B-10	246 (65)	24 to 70 (350 to 1000)	2,4 (35)	1,1 (16)
URG*-10-C-10		35 to 140 (500 to 2000)		
URG*-10-F-10		103 to 207 (1500 to 3000)		

Typical Applications

Double Pump Circuit



Accumulator Circuit



Series URG*-06/10 Unloading Relief Valves

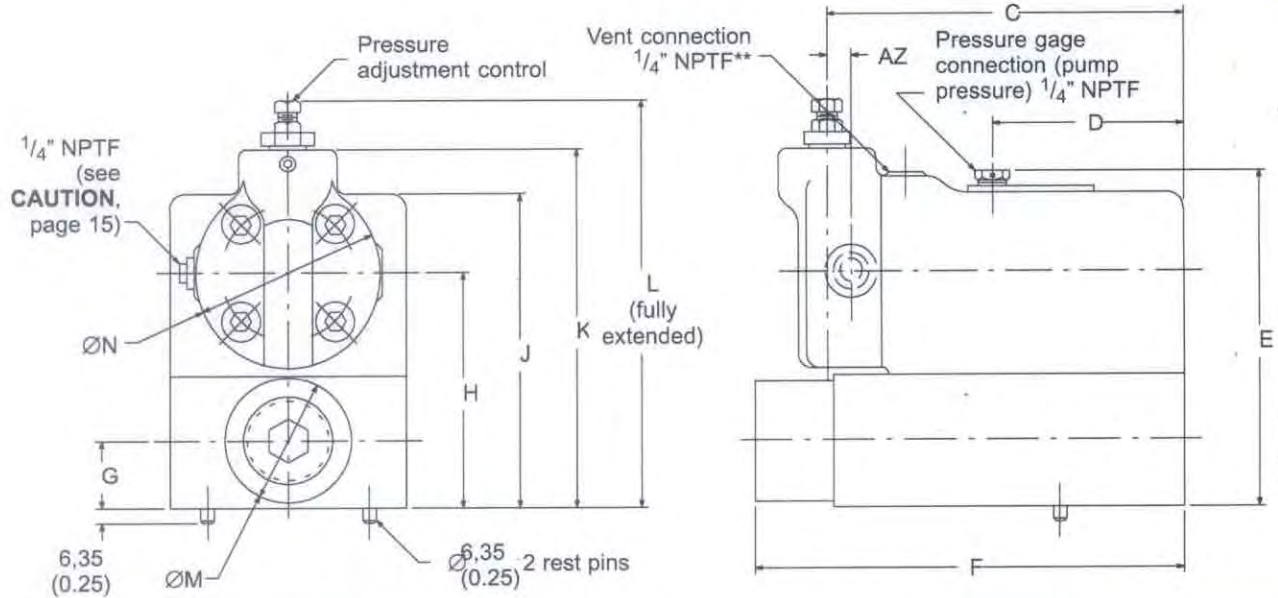
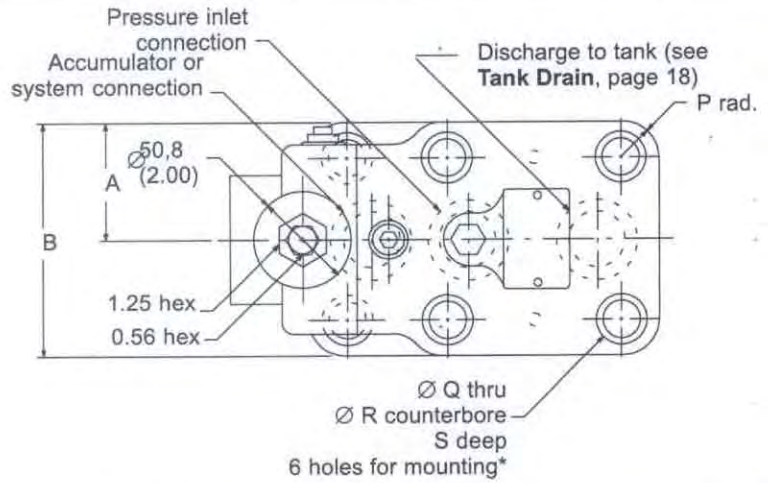
Installation Dimensions

Millimeters (inches)

URG*-06/10 Valve

NOTES

- * See mounting subplates for locating dimensions.
- ** Keep plugged except when circuit indicates connection for venting valve.

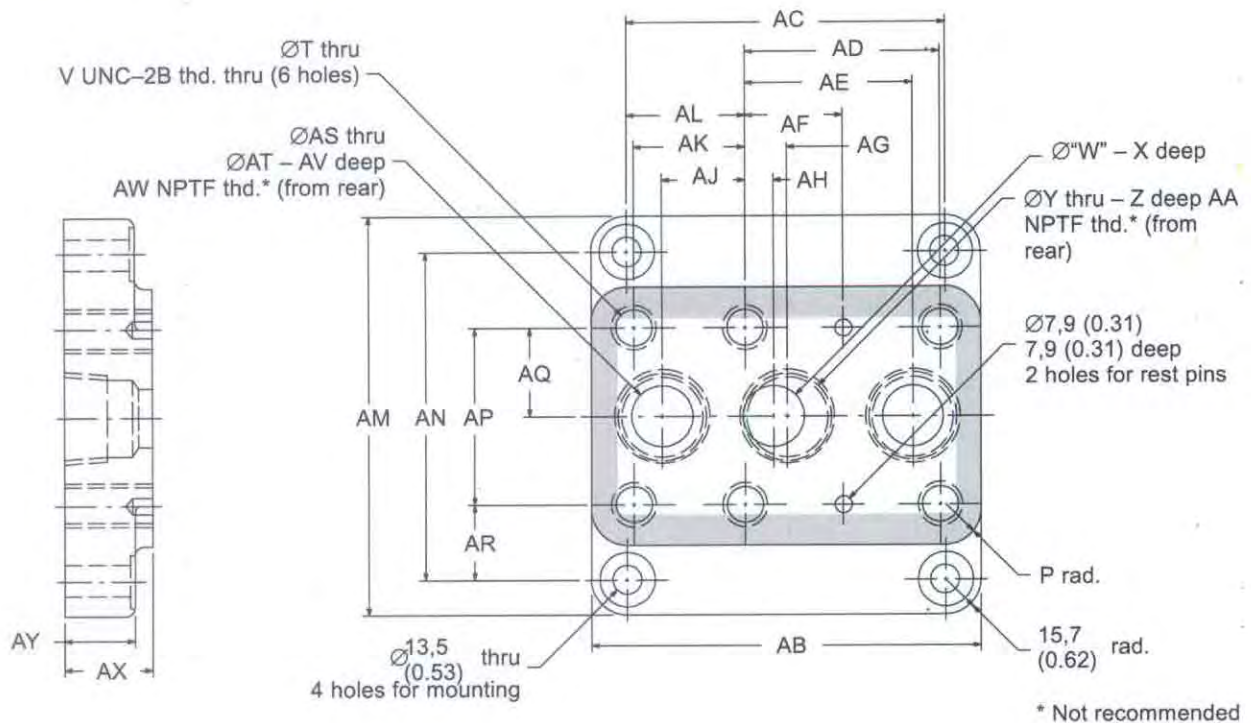


Model	A	B	C	D	E	F	G	H	J
URG*-06*-10	50,8 (2.00)	101,6 (4.00)	139,7 (5.50)	76,2 (3.00)	134,9 (5.31)	160,3 (6.31)	25,4 (1.00)	91,9 (3.62)	124,0 (4.88)
URG*-10*-10	60,5 (2.38)	120,6 (4.75)	179,3 (7.06)	95,2 (3.75)	168,1 (6.62)	217,4 (8.56)	33,3 (1.31)	117,3 (4.62)	157,2 (6.19)

Model	K	L	M	N	P	Q	R	S	AZ
URG*-06*-10	153,9 (6.06)	180,8 (7.12)	44,4 (1.75)	76,2 (3.00)	15,7 (0.62)	16,8 (0.66)	25,4 (1.00)	15,7 (0.62)	3,0 (0.12)
URG*-10*-10	179,3 (7.06)	206,2 (8.12)	63,5 (2.50)	95,2 (3.75)	19,0 (0.75)	17,8 (0.78)	29,5 (1.16)	19,0 (0.75)	1,5 (0.06)

Series URG*-06/10 Unloading Relief Valves

Mounting Subplates



Model	P	T	V	W	X	Y	Z	AA	AB	AC
URG1M-06-10	15,7 (0.62)	14,0 (0.55)	.625-11	23,1 (0.91)	31,8 (1.25)	—	—	3/4"	144,5 (5.69)	112,71 (4.438)
URG1M-10-10	19,0 (0.75)	16,8 (0.66)	.750-10	28,4 (1.12)	11,2 (0.44)	38,1 (1.50)	30,5 (1.12)	1 1/4"	177,8 (7.00)	146,05 (5.750)
Model	AD	AE	AF	AG	AH	AJ	AK	AL	AM	AN
URG1M-06-10	66,5 (2.62)	55,6 (2.19)	33,3 (1.31)	11,2 (0.44)	10,2 (0.44)	33,3 (1.31)	46,0 (1.81)	46,0 (1.81)	162,1 (6.38)	130,18 (5.125)
URG1M-10-10	88,9 (3.50)	76,2 (3.00)	44,4 (1.75)	19,0 (0.75)	12,7 (0.50)	38,1 (1.50)	50,8 (2.00)	53,8 (2.12)	184,1 (7.25)	152,40 (6.000)
Model	AP	AQ	AR	AS	AT	AV	AW	AX	AY	
URG1M-06-10	69,8 (2.75)	35,1 (1.38)	30,2 (1.19)	23,1 (0.91)	—	—	3/4"	31,8 (1.25)	25,4 (1.00)	
URG1M-10-10	82,6 (3.25)	41,1 (1.62)	35,1 (1.38)	28,4 (1.12)	38,1 (1.50)	30,2 (1.19)	1 1/4"	38,1 (1.50)	31,8 (1.25)	

Series XSL/XTL-03 Pressure Reducing Valves

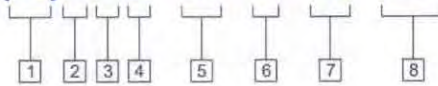
Ratings

Rated Capacity (Maximum)	30 l/min (8 USgpm)
Adjustable Pressure Range	3,4 to 70 bar (50 to 1000 psi)*
Inlet Pressure (Maximum)	140 bar (2000 psi)

* X*L-03-B-10-S21 model has adjustable pressure range of 1,7 to 21 bar (25 to 300 psi) with maximum inlet pressure of 70 bar (1000 psi).

Model Code

(F3)X T L - 03 - B - 10 - S21



1 Special seals

F3 – For mineral oil and fire resistant fluids
Blank – Omit for standard models

2 Valve type

X – Pressure reducing valve

3 Connections

S – SAE straight thread
T – NPTF thread*

* Not recommended

4 Pressure level

L – Low pressure type

5 Valve size

03 – 3/8" pipe

6 Pressure range

B – 3,4 to 70 bar (50 to 1000 psi)

7 Design number

Subject to change. Installation dimensions same for designs 10 through 19.

8 Special feature suffix

S21 – Adjustable pressure range of 1,7 to 21 bar (25 to 300 psi) with maximum inlet pressure of 70 bar (1000 psi)
Blank – Omit if not required

General Data

The operation of these Vickers reducing valves is such that reduced outlet pressure remains constant regardless of variation of inlet pressure above the selected pressure setting. Reverse free flow is allowable, providing the pressure at the reduced pressure port does not exceed the reduced pressure setting of the valve.

Pressure Adjustment

A differential of at least 1,7 bar (25 psi) between inlet and outlet pressure must be maintained for proper functioning.

Adjustment of reduced outlet pressure is accomplished by loosening jam nut and turning pressure adjustment control. Clockwise rotation increases pressure. Counterclockwise rotation decreases pressure. Control adjustment has stops for minimum and maximum pressures.

Drain Connection

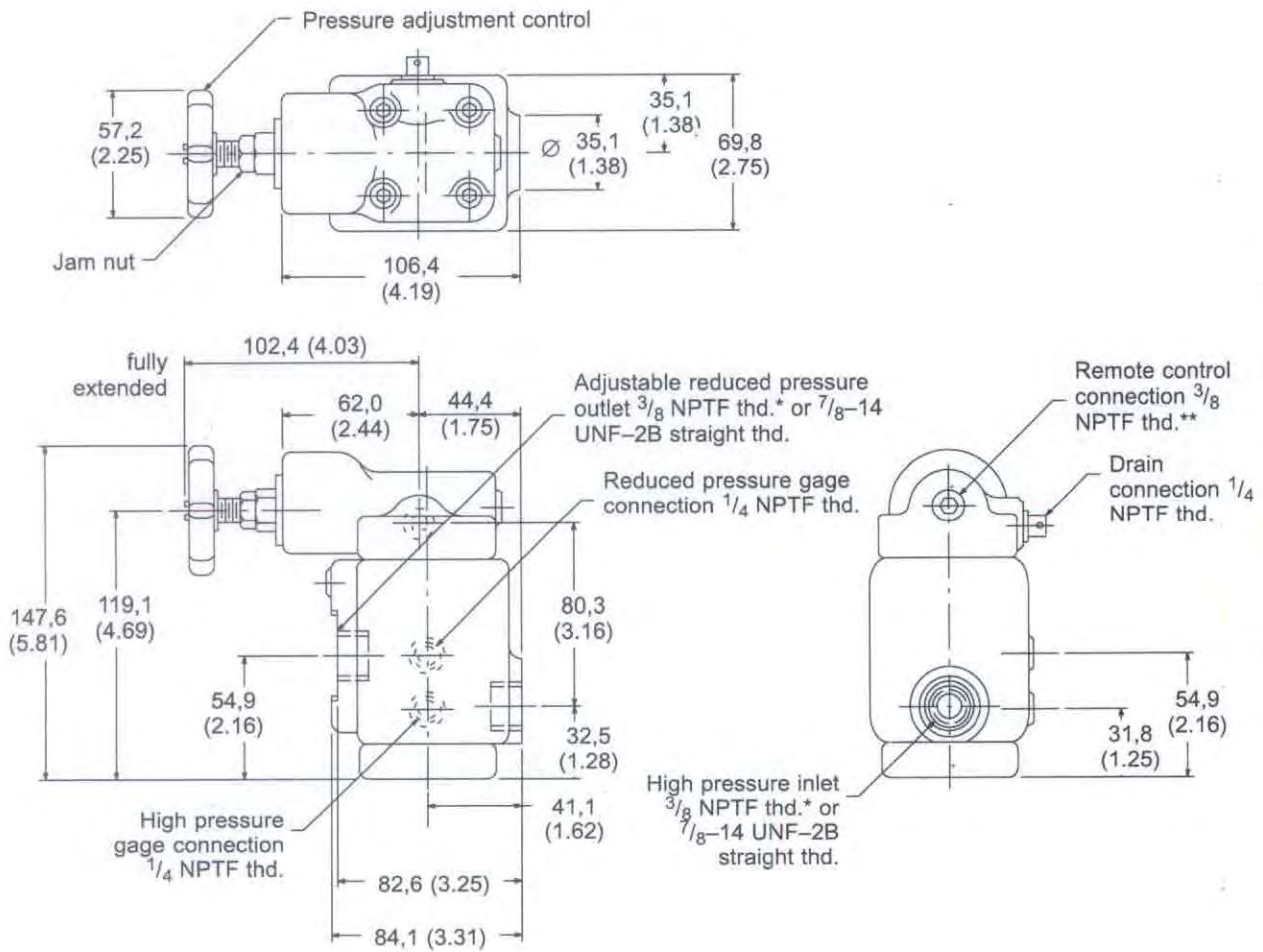
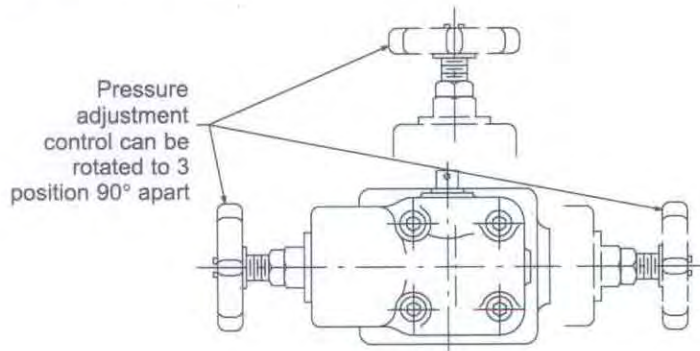
The drain connection must be piped directly to tank. Any pressure at this port must be added to the valve pressure setting.

Series XSL/XTL-03 Pressure Reducing Valves

Installation Dimensions

Millimeters (inches)

XSL/TL-03-B-10 Valve



NOTES

Model XSL-03-B-10 is supplied with $\frac{7}{8}$ -14 straight thread system connections and a $\frac{9}{16}$ -18 straight thread drain connection.

X*L-03-B-10-S21 model has adjustable pressure range of 1,7 to 21 bar (25 to 300 psi) with maximum inlet pressure of 70 bar (1000 psi).

* Not recommended.

** Reduced pressure may be adjusted remotely by connecting this port to pressure inlet port of CGR-02-* -20 valve or C-175-* -10 valve. Pressure setting of main valve must be higher than that of remote control.

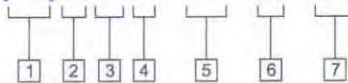
Series XGL-03 Pressure Reducing Valves

Ratings

Rated Capacity (Maximum)	30 l/min (8 USgpm)
Adjustable Pressure Range	1,7 to 70 bar (25 to 1000 psi)
Inlet Pressure (Maximum)	140 bar (2000 psi)

Model Code

(F3)XGL-03-B-10



1 Special seals

F3 – For mineral oil and fire resistant fluids
Blank – Omit for standard models

2 Valve type

X – Pressure reducing valve

3 Connections

G – Manifold or subplate mounting

4 Pressure level

L – Low pressure type

5 Valve size

03 – $\frac{3}{8}$ " nominal size

6 Pressure range

B – 1,7 to 70 bar (25 to 1000 psi)

7 Design number

Subject to change. Installation dimensions same for designs 10 through 19.

General Data

The operation of these reducing valves is such that reduced outlet pressure remains constant regardless of variation of inlet pressure above the selected pressure setting. Reverse free flow is allowable, providing the pressure at the reduced pressure port does not exceed the reduced pressure setting of the valve.

Pressure Adjustment

A differential of at least 1,7 bar (25 psi) between inlet and outlet pressure must be maintained for proper functioning.

Adjustment of reduced outlet pressure is accomplished by loosening jam nut and turning pressure adjustment control. Clockwise rotation increases pressure. Counterclockwise rotation decreases pressure. Control adjustment has stops for minimum and maximum pressures.

Drain Connection

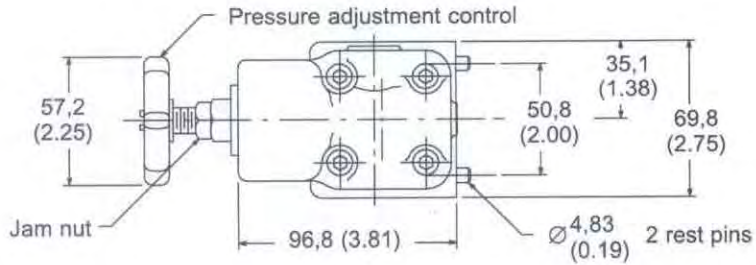
The drain connection must be piped directly to tank. Any pressure at this port must be added to the valve pressure setting.

Series XGL-03 Pressure Reducing Valves

Installation Dimensions

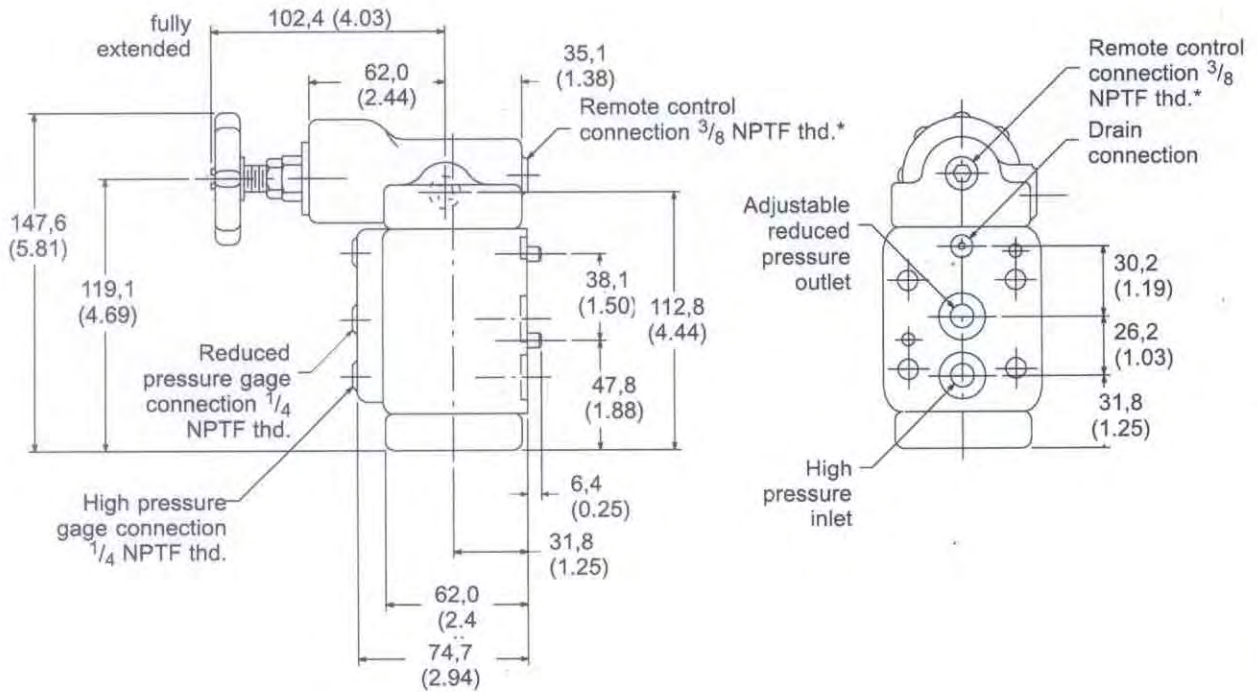
Millimeters (inches)

XGL-03-B-10 Valve



NOTE

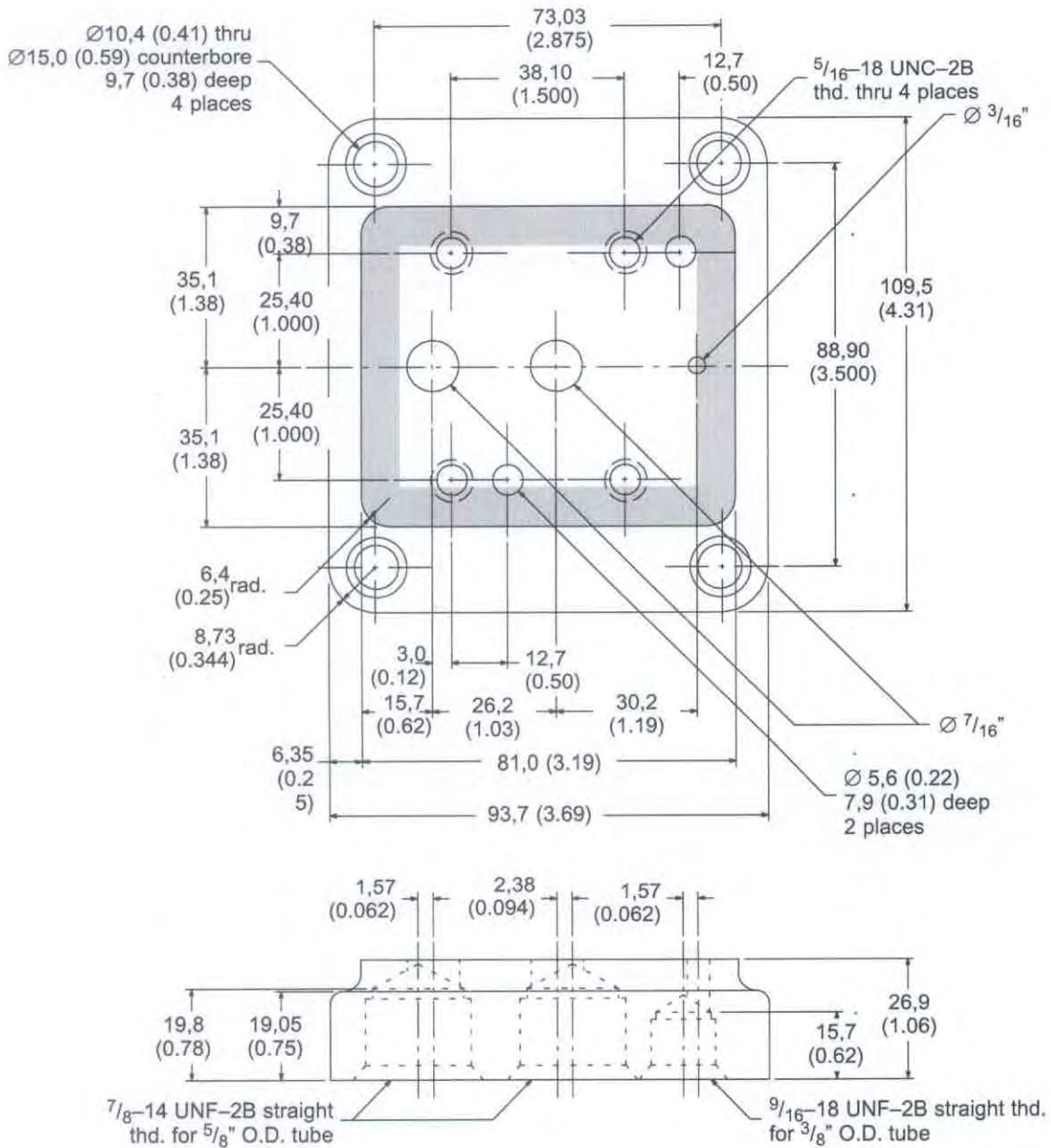
* Reduced pressure may be adjusted remotely by connecting this port to pressure inlet port of CGR-02-*-20 valve or C-175-*-10 valve. Pressure setting of main valve must be higher than that of remote control.



Series XGL-03 Pressure Reducing Valves

Mounting Subplate

Model XGLM-10S-03-10



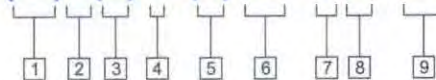
Series X(C)*-03/06/10 Pressure Reducing Valves

Ratings

Rated Capacity (Maximum)	530 l/min (140 USgpm)
Inlet Pressure (Maximum)	210 bar (3000 psi)

Model Code

(F3)X(C) * -(H) 06 - 2 B - 30



1 Special seals

F3 – For mineral oil and fire resistant fluids
Blank – Omit for standard models

2 Valve type

X – Pressure reducing valve

3 Integral check valve

C – Reverse free flow check

4 Connections

G – Manifold or subplate mounting
S – SAE straight thread
T – NPTF thread*

* Not recommended

5 High-flow designation

H – High-flow valve

Size	Flow l/min (USgpm)
03	114 (30)
06	265 (70)
10	530 (140)

Blank – Omit for 'B' and 'F' models

6 Valve size

03 – 3/8" pipe or 0.7500-16 UNF-2B straight thread (0.500 tubing)
06 – 3/4" pipe or 1.0625-12 UN-2B straight thread (0.750 tubing)
10 – 1 1/4" pipe or 1.6250-12 UN-2B straight thread (1.250 tubing)

7 Maximum adjustable pressure

1 – 70 bar (1000 psi)
2 – 140 bar (2000 psi)
3 – 210 bar (3000 psi)*

* 10,3 bar (150 psi) pressure drop across valve minimum recommended. Not available with 'B' flow capacity.

8 Maximum rated flow capacity

B*	Size	Flow l/min (USgpm)
B*	03	26,5 (7)
	06	57 (15)
	10	189 (50)
F	Size	Flow l/min (USgpm)
	03	53 (14)
	06	114 (30)
10	284 (75)	

Blank – Omit for 'H' high-flow models

* Not available with '3' maximum adjustable pressure.

9 Design number

Subject to change. Installation dimensions same for designs 30 through 39.

Series X(C)*-03/06/10 Pressure Reducing Valves

General Data

The operation of these reducing valves is such that reduced outlet pressure remains constant regardless of variation of inlet pressure above the selected pressure setting. Reverse free flow from "reduced pressure outlet" connection to "high pressure inlet" connection is provided by optional integral check valve.

Contact your Vickers representative if maximum inlet pressure is needed with minimum rated reduced pressure.

Adjustment of reduced outlet pressure is accomplished by loosening jam nut and turning pressure adjustment control. Clockwise rotation increases pressure. Counterclockwise rotation decreases

pressure. Control adjustment has stops for minimum and maximum pressures.

Drain Connection

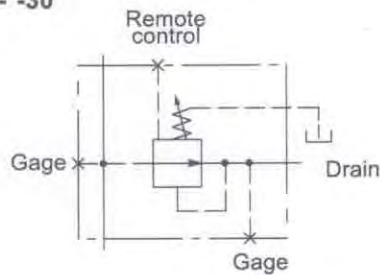
The drain connection must be piped directly to tank through a surge free line. Any continuous drain line pressure must be known and that value added to the valve pressure setting.

Pressure Adjustment

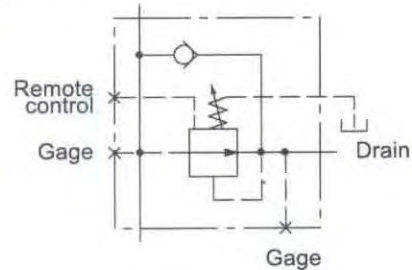
A differential of at least 10,3 bar (150 psi) between inlet and outlet pressure must be maintained for proper functioning.

Graphical Symbols

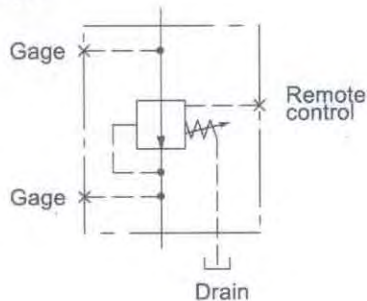
XS-**-*-30



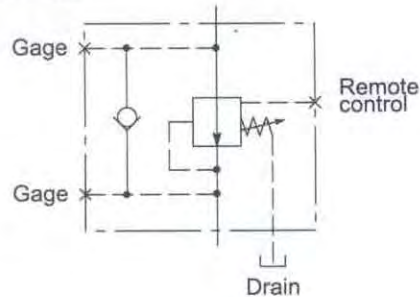
XCS-**-*-30



XG-**-*-30



XCG-**-*-30



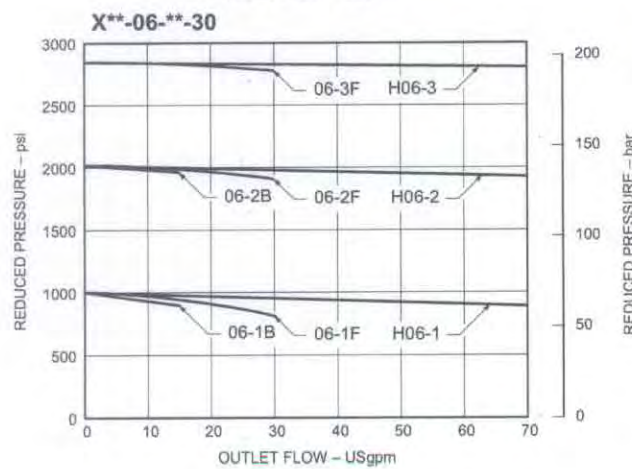
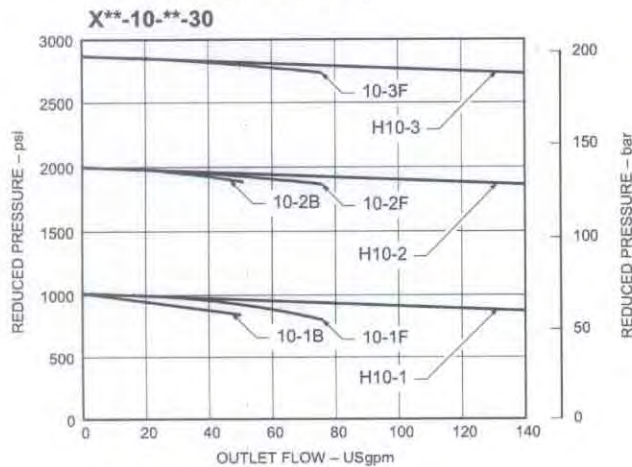
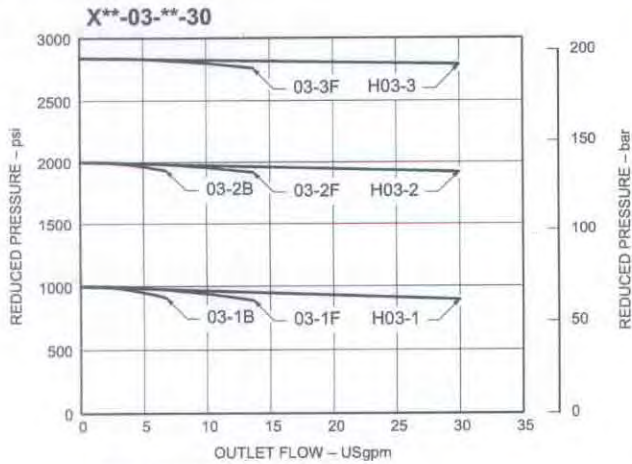
Series X(C)*-03/06/10 Pressure Reducing Valves

Performance Curves

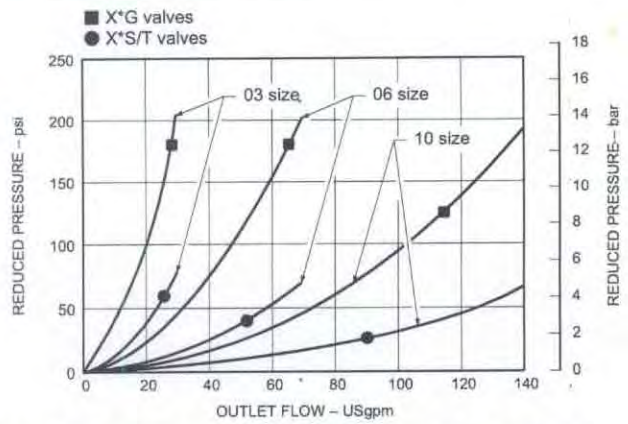
Based on fluid with specific gravity of 0.865 and viscosity of 20 cSt (100 SUS)

Outlet Pressure vs. Flow

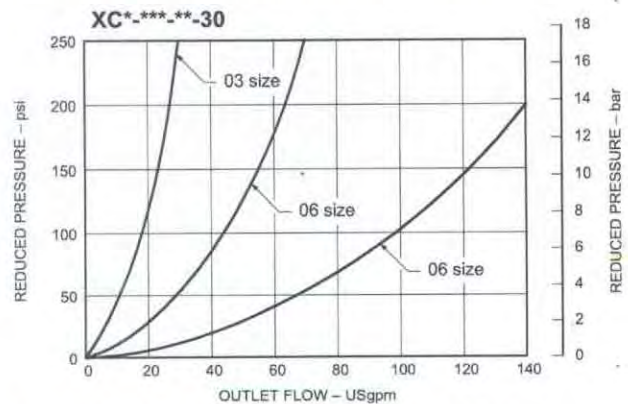
210 bar (3000 psi) inlet



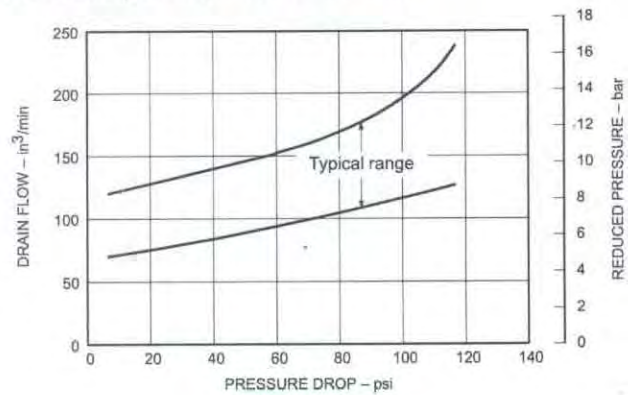
Valve Pressure Drop vs. Flow



Check Valve Pressure Drop vs. Reverse Free Flow



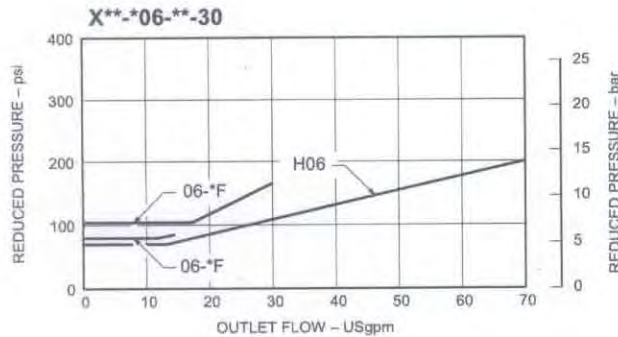
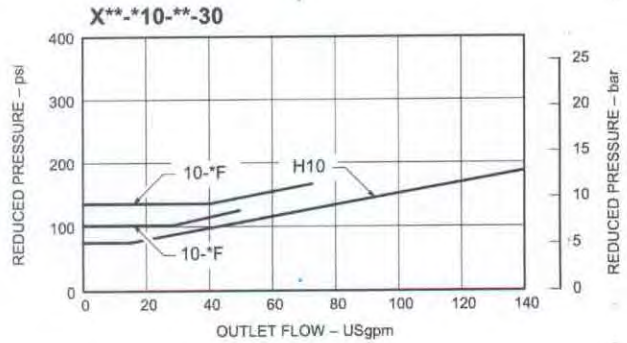
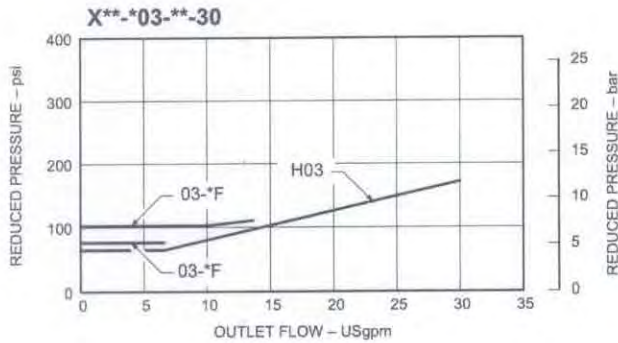
Drain (Control) Flow vs. Valve Pressure Drop (Inlet-Outlet) at Any Flow Condition



Series X(C)*-03/06/10 Pressure Reducing Valves

Minimum Adjustable Pressure vs. Flow

140 bar (2000 psi) inlet



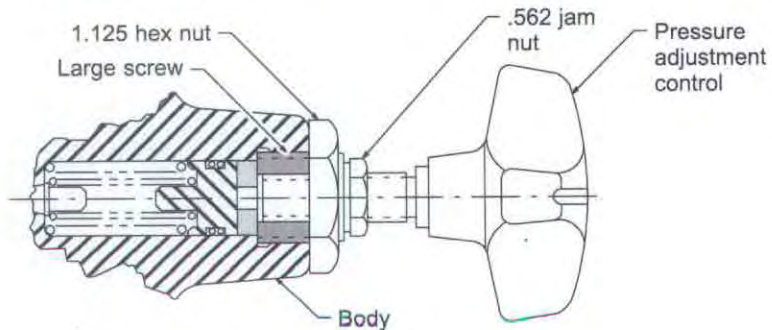
Valve Pressure Adjustment

Maximum pressure for each specific pressure range is pre-set at the factory with the large screw and held in place by the 1.125 hex nut.

Sensitivities for the different pressure ranges are: a) 185 psi/rev for 1000 psi max. pressure (5.4 turns total); b) 295 psi/rev for 2000 psi max. pressure (6.8 turns total); and c) 485 psi/rev for 3000 psi max. pressure (6.2 turns total). To lower the maximum pressure:

1. Start large screw approximately 2 to 3 turns into body, then assemble 1.125 hex nut, pressure adjustment control, and .562 jam nut.

2. Turn pressure adjustment control all the way in so .562 jam nut and pressure adjustment control head are tight against end of large screw.
 3. With 1.125 hex nut backed-off for clearance, continue turning pressure adjustment control (with large screw locked to it) until desired maximum pressure is reached.
 4. Tighten 1.125 hex nut against body to lock maximum pressure setting in place.
1. Back out pressure adjustment control to desired working pressure and lock in place with .562 jam nut.



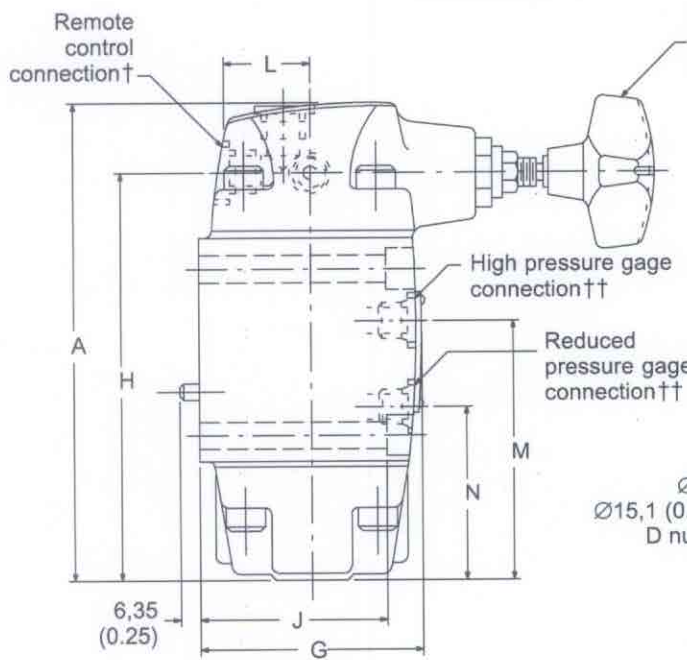
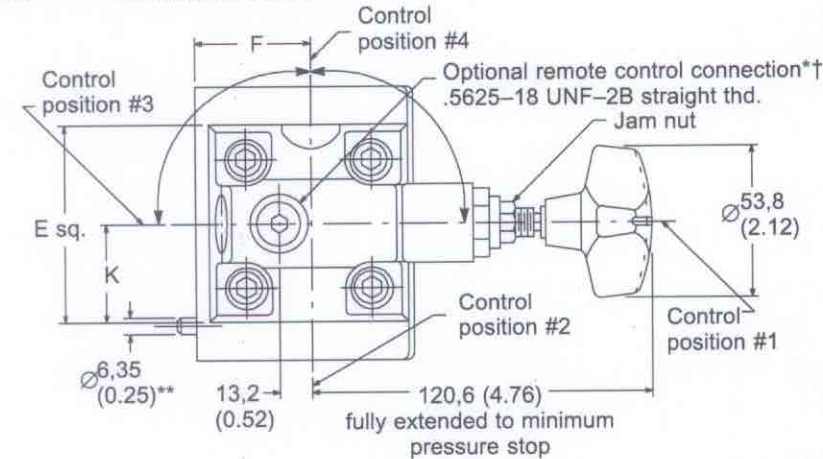
Series X(C)*-03/06/10 Pressure Reducing Valves

Installation Dimensions

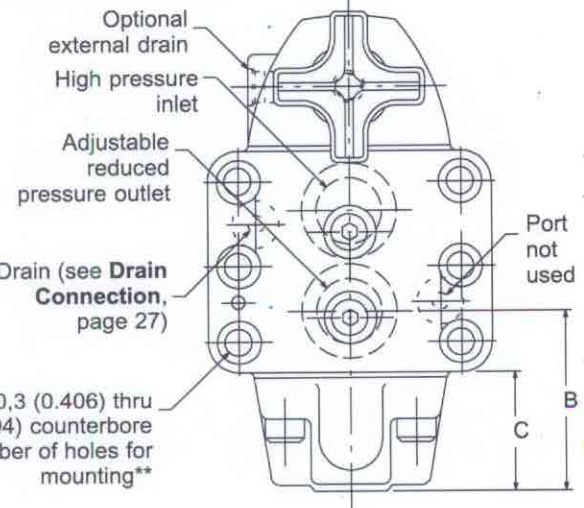
Millimeters (inches)

Subplate or Manifold Mounted Models

XG-**-*-30 Without Check



Pressure adjustment control (knob can be backed out beyond minimum pressure stop)



NOTES

Optional adjustment control positions obtained by rotating cover assembly. Position #1 is standard. Position #2 cannot be used. Position #3 can be used (if it does not interfere with the manifold) providing that the external drain in the cover is connected.

* Available with "(H)06" and "(H)10" models only.

** See mounting subplates for locating dimensions.

† .5625-18 UNF-2B straight thread. Reduced pressure may be adjusted remotely by connecting this port to pressure inlet port of CGR-02*-20 valve or C-175*-10 valve. Pressure setting of main valve must be higher than that of remote control.

†† .4375-20 UNF-2B straight thread.

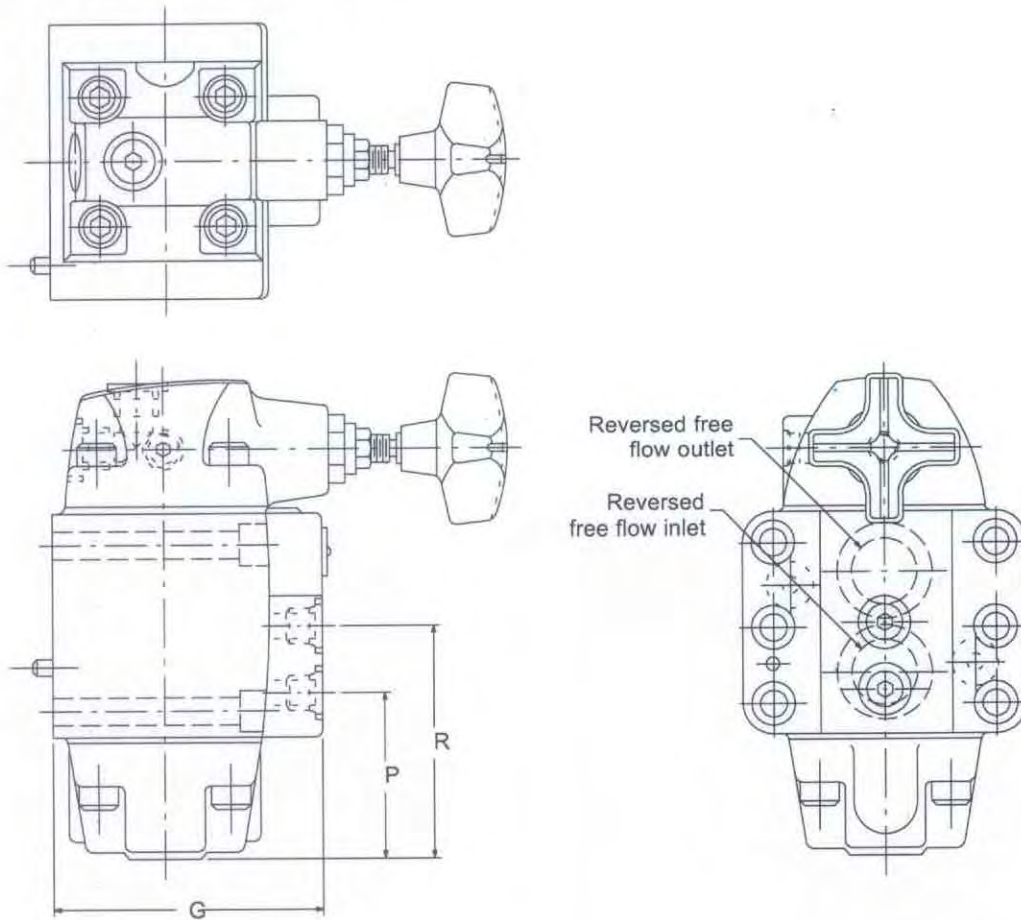
Model	A	B	C	D	E	F	G	H	J	K	L	M	N	NFPA Interface
X(C)G-03*-30	142,2 (5.60)	46,7 (1.84)	29,5 (1.16)	4	57,2 (2.25)	36,6 (1.44)	68,1 (2.68)	116,8 (4.60)	55,9 (2.20)	28,4 (1.12)	24,6 (0.97)	66,0 (2.60)	41,9 (1.65)	P03
X(C)G-06*-30	176,5 (6.95)	66,8 (2.63)	44,7 (1.76)	4	71,4 (2.81)	41,1 (1.62)	79,2 (3.12)	151,1 (5.95)	68,6 (2.70)	35,8 (1.41)	29,5 (1.16)	96,8 (3.81)	65,0 (2.56)	P06
X(C)G-10*-30	211,3 (8.32)	71,4 (2.81)	44,7 (1.76)	6	95,2 (3.75)	50,8 (2.00)	100,1 (3.94)	182,6 (7.19)	90,2 (3.55)	47,8 (1.88)	41,4 (1.63)	101,6 (4.00)	72,4 (2.85)	P10

Series X(C)*-03/06/10 Pressure Reducing Valves

Subplate or Manifold Mounted Models (continued)

XCG--**-30 With Check**

(See previous page for other details and dimensions)

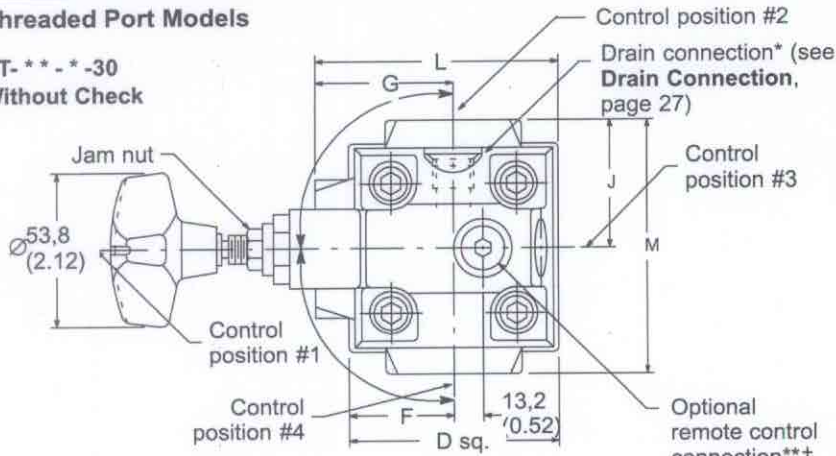


Model	G	P	R
XCG-03-*-30	90,4 (3.56)	41,9 (1.65)	66,0 (2.60)
XCG-06-*-30	98,6 (3.88)	59,7 (2.35)	85,9 (3.38)
XCG-10-*-30	130,3 (5.13)	72,4 (2.85)	101,6 (4.00)

Series X(C)*-03/06/10 Pressure Reducing Valves

Threaded Port Models

XT-**-*-30
Without Check



NOTES

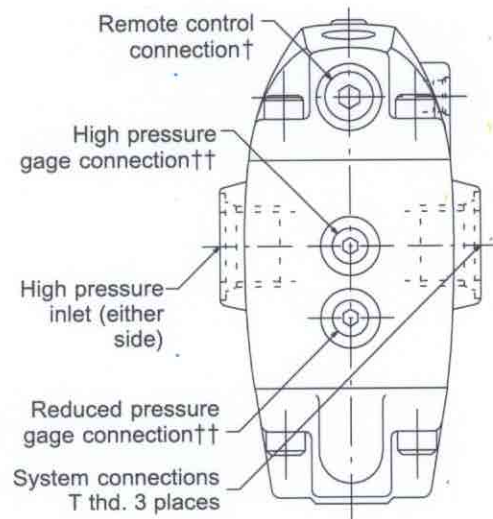
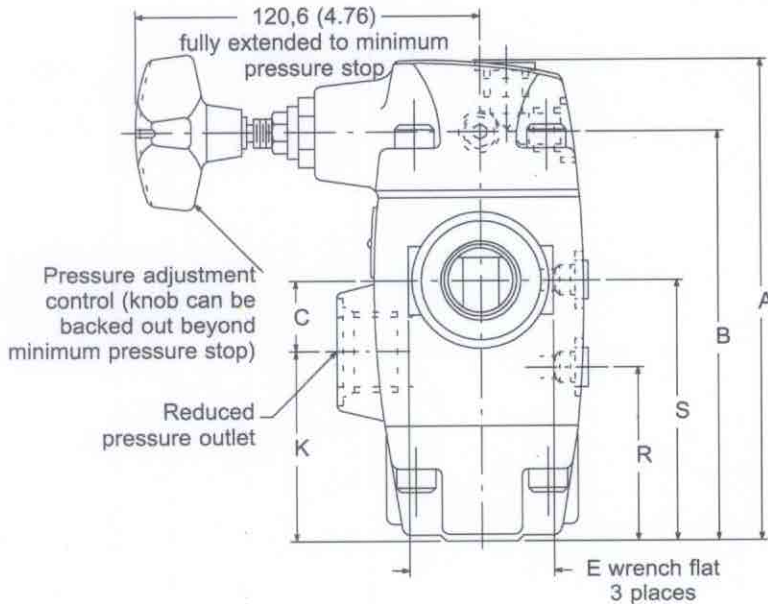
Optional adjustment control positions obtained by rotating cover assembly. Position #1 is standard. Position #2 cannot be used on XS/T-10 models. Position #3 cannot be used.

* .5625-18 UNF-2B straight thread.

** Available with "(H)06" and "(H)10" models only.

† .5625-18 UNF-2B straight thread. Reduced pressure may be adjusted remotely by connecting this port to pressure inlet port of CGR-02-*-20 valve or C-175-*-10 valve. Pressure setting of main valve must be higher than that of remote control.

†† .4375-20 UNF-2B straight thread.



Model	A	B	C	D	E	F	G	H	J
X(C)S/T-03-*-30	142,2 (5.60)	116,8 (4.60)	23,1 (0.91)	59,4 (2.34)	35,1 (1.38)	29,7 (1.17)	39,6 (1.56)	24,6 (0.97)	35,1 (1.38)
X(C)S/T-06-*-30	176,5 (6.95)	151,1 (5.95)	26,9 (1.06)	74,7 (2.94)	50,8 (2.00)	37,3 (1.47)	50,8 (2.00)	29,5 (1.16)	47,8 (1.88)
X(C)S/T-10-*-30	211,3 (8.32)	182,6 (7.19)	28,4 (1.12)	98,6 (3.88)	86,4 (3.40)	49,3 (1.94)	68,3 (2.69)	41,4 (1.63)	53,8 (2.12)

Model	K	L	M	R	S	T – for X(C)S models	T – for X(C)T models
X(C)S/T-03-*-30	46,0 (1.81)	70,9 (2.79)	69,9 (2.75)	41,9 (1.65)	66,0 (2.60)	.7500-16 UNF-2B str thd. (1/2" O.D. tubing)	3/8" NPTF thd. ■
X(C)S/T-06-*-30	69,8 (2.75)	88,1 (3.47)	95,3 (3.75)	65,0 (2.56)	96,8 (3.81)	1.0625-12 UNF-2B str thd. (3/4" O.D. tubing)	3/4" NPTF thd. ■
X(C)S/T-10-*-30	81,0 (3.19)	117,3 (4.62)	108,0 (4.25)	72,4 (2.85)	101,6 (4.00)	1.6250-12 UNF-2B str thd. (1 1/4" O.D. tubing)	1 1/4" NPTF thd. ■

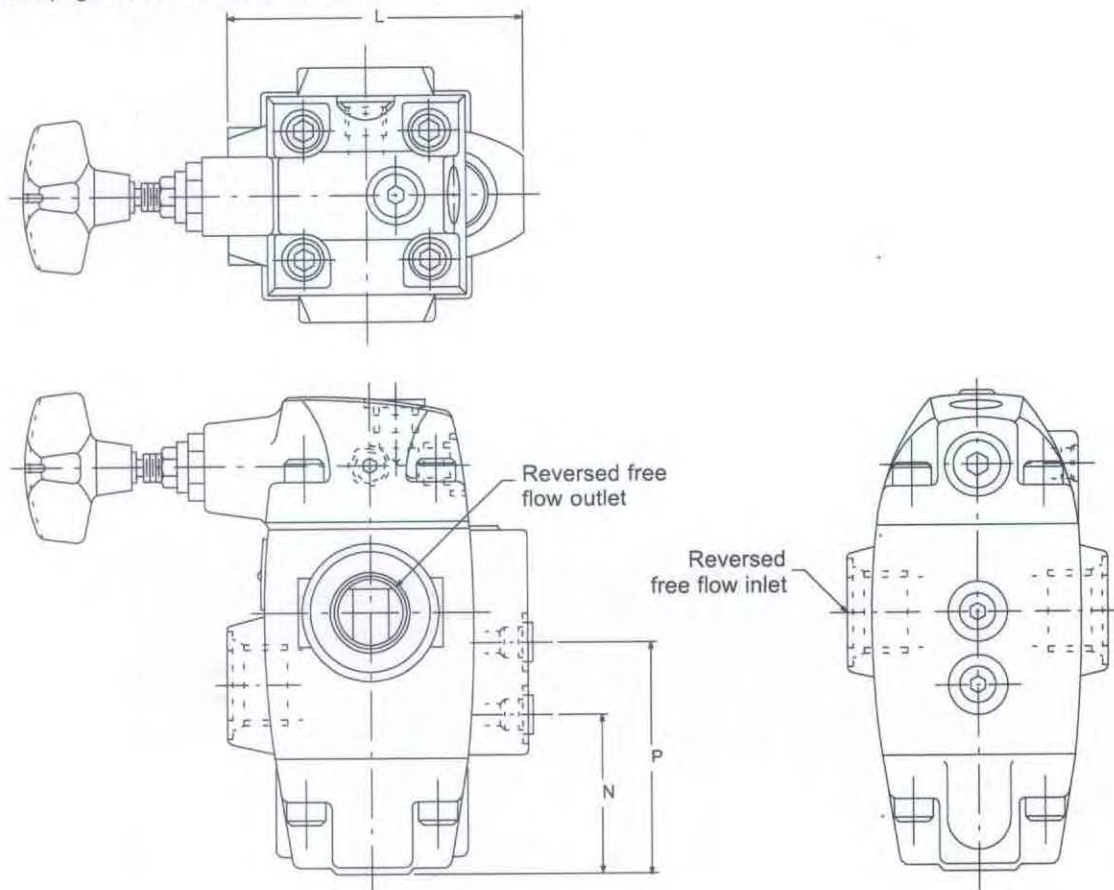
■ Not recommended

Series X(C)*-03/06/10 Pressure Reducing Valves

Threaded Port Models (continued)

XCS/T-**-*-30 With Check

(See previous page for other details and dimensions)

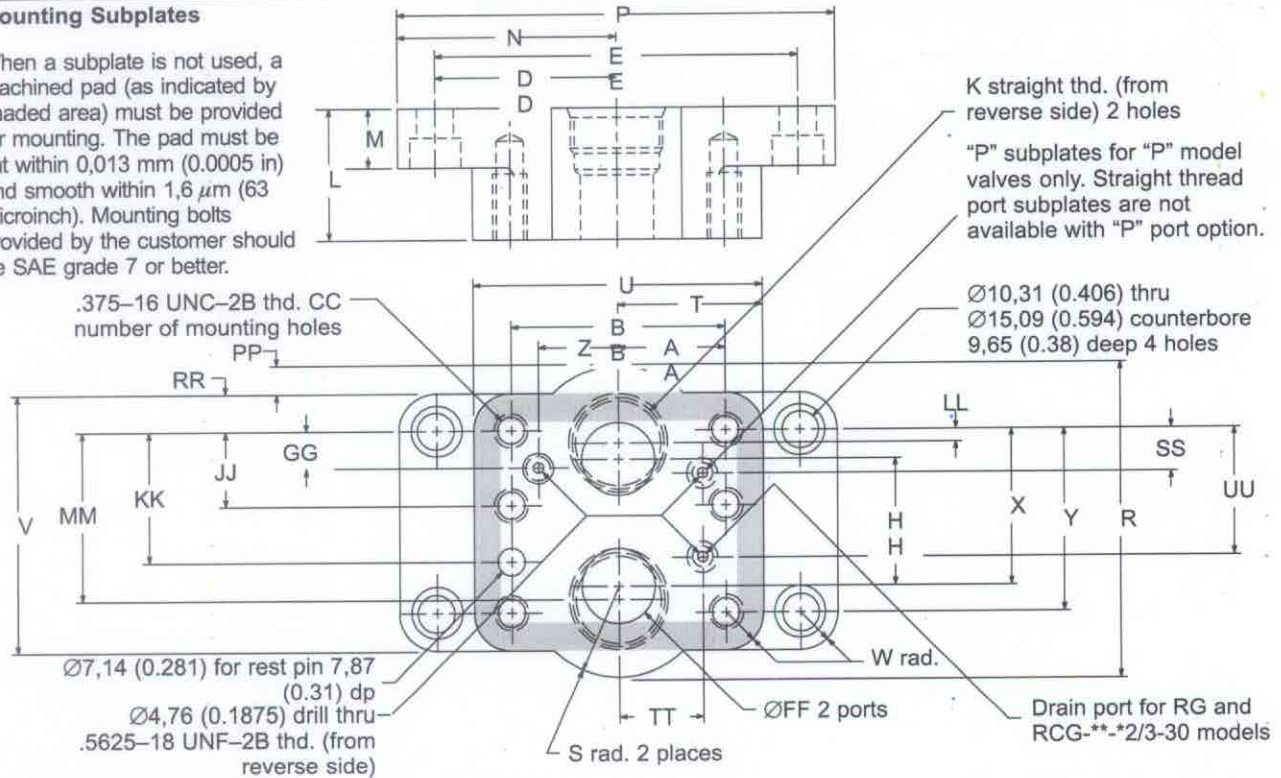


Model	L	N	P
XCS/T-03*-30	93,7 (3.69)	41,9 (1.65)	66,0 (2.60)
XCS/T-06*-30	108,0 (4.25)	59,7 (2.35)	84,6 (3.33)
XCS/T-10*-30	147,6 (5.81)	72,4 (2.85)	101,6 (4.00)

Series X(C)*-03/06/10 Pressure Reducing Valves

Mounting Subplates

When a subplate is not used, a machined pad (as indicated by shaded area) must be provided for mounting. The pad must be flat within 0,013 mm (0.0005 in) and smooth within 1,6 µm (63 microinch). Mounting bolts provided by the customer should be SAE grade 7 or better.



Model	K	Tube O.D.	L	M	N	P	R	S	T	U	V
RXGM-03S-(P)-20	.7500-16 UNF-2B	1/2"	25,4 (1.00)	19,0 (0.75)	63,5 (2.50)	127,0 (5.00)	76,2 (3.00)	23,9 (0.94)	43,7 (1.72)	87,4 (3.44)	63,5 (2.50)
RXGM-06SX-(P)-20	1.3125-1 2 UN-2B	1"	31,8 (1.25)	19,0 (0.75)	73,2 (2.88)	146,0 (5.75)	117,3 (4.62)	39,6 (1.56)	50,8 (2.00)	101,6 (4.00)	82,6 (3.25)
RXGM-10S-(P)-30	1.6250-1 2 UN-2B	1 1/4"	47,8 (1.88)	22,4 (0.88)	79,2 (3.12)	158,8 (6.25)	146,0 (5.75)	47,8 (1.88)	58,7 (2.31)	117,3 (4.62)	104,6 (4.12)

Model	W	X	±0,13 Y (±0.005)	Z	AA	BB	CC	DD	±0,013 EE (±0.005)	FF	GG
RXGM-03S-(P)-20	10,4 (0.41)	35,8 (1.41)	42,87 (1.688)	25,4 (1.00)	33,3 (1.31)	66,5 (2.62)	4	53,1 (2.09)	106,37 (4.188)	14,2 (0.56)	21,3 (0.84)
RXGM-06SX-(P)-20	10,2 (0.44)	49,3 (1.94)	60,32 (2.375)	33,3 (1.31)	39,6 (1.56)	79,2 (3.12)	4	62,0 (2.44)	123,82 (4.875)	23,1 (0.91)	20,6 (0.81)
RXGM-10S-(P)-30	10,4 (0.41)	67,6 (2.66)	84,12 (3.312)	44,4 (1.75)	48,5 (1.91)	96,8 (3.81)	6	69,1 (2.72)	138,12 (5.438)	28,4 (1.12)	24,6 (0.97)

Model	HH	JJ■	KK	LL	MM	PP	RR	SS	TT	UU	NFPA Interface
RXGM-03S-(P)-20	28,4 (1.12)	—	31,8 (1.25)	4,8 (0.19)	38,1 (1.50)	6,4 (0.25)	10,4 (0.41)	—	25,4 (1.00)	21,3 (0.84)	P03
RXGM-06SX-(P)-20	38,1 (1.50)	—	44,4 (1.75)	6,4 (0.25)	53,8 (2.12)	17,5 (0.69)	11,2 (0.44)	16,8 (0.66)	33,3 (1.31)	39,6 (1.56)	P06
RXGM-10S-(P)-30	50,8 (2.00)	42,2 (1.66)	62,7 (2.47)	7,9 (0.31)	76,2 (3.00)	20,6 (0.81)	10,4 (0.41)	24,6 (0.97)	44,4 (1.75)	59,4 (2.34)	P10

■ RXGM-03S/06SX require 4 valve mounting screws. RXGM-10S requires 6 valve mounting screws.

Application Data

Weights

The following table lists the approximate weight of each valve in the catalog:

Valve	Weight kg (lbs)
RS/T-03-*-30	2,7 (6.0)
RS/T-06-*-30	5,7 (12.5)
RS/T-10/12-*-30	12,0 (26.5)
RCS/T-03-*-30	2,9 (6.5)
RCS/T-06-*-30	5,9 (13.0)
RCS/T-10/12-*-30	12,9 (28.5)
RG-03-*-30	3,6 (8.0)
RG-06-*-30	6,4 (14.0)
RG-10/12-*-30	11,8 (26.0)
RCG-03-*-30	3,9 (8.5)
RCG-06-*-30	6,6 (14.5)
RCG-10/12-*-30	12,7 (28.0)
URT*-06-*-10	4,5 (10.0)
URT*-10-*-10	9,1 (20.0)
URG*-06-*-10	11,3 (25.0)
URG*-10-*-10	22,0 (48.5)
XS/TL-03-B-10	4,1 (9.0)
XGL-03-B-10	4,1 (9.0)
XG-03-*-30	3,9 (8.5)
XG-06-*-30	6,1 (13.5)
XG-10-*-30	11,8 (26.0)
XCG-03-*-30	4,1 (9.0)
XCG-06-*-30	6,4 (14.0)
XCG-10-*-30	12,2 (27.0)
XS/T-03-*-30	3,2 (7.0)
XS/T-06-*-30	5,7 (12.5)
XS/T-10-*-30	11,3 (25.0)
XCS/T-03-*-30	3,4 (7.5)
XCS/T-06-*-30	5,9 (13.0)
XCS/T-10-*-30	11,8 (26.0)

The following table lists the approximate weight of each subplate in the catalog:

Subplate	Weight kg (lbs)
RXGM-03S-20	1,5 (3.25)
RXGM-06SX-20	2,9 (6.50)
RXGM-10S-30	5,0 (11.00)
URG1M-06-10	5,7 (12.5)
URG1M-10-10	9,3 (20.5)
XGLM-10S-03-10	1,4 (3.0)

Fluids and Seals

For best results, oil viscosity should range between 32 cSt and 49 cSt (150 SUS and 225 SUS) at 38°C (100°F) with a maximum operating temperature of 68°C (155°F). Water glycol, water-in-oil emulsions, and petroleum oil may be used with non-F3 models, which are furnished with Buna-N seals for the mounting surface and fluorocarbon seals internally. Add F3 prefix when phosphate ester type fluids or blends are to be used. Refer to 694 for hydraulic fluid and temperature recommendations.

The use of synthetic, fire-resistant fluids requires a valve with special seals.

Subplates and Bolt Kits

Valves, subplates, and mounting bolts must be ordered separately.

Example:

- (1) URG*-06-12 valve
- (1) URG1M-06-10 subplate
- (1) BKUR06682 bolt kit (consisting of two bolts, $\frac{5}{8}$ -11 x 2.50", and four bolts, $\frac{5}{8}$ -11 x 5.25")

The following table lists the appropriate subplate for use with each manifold or subplate mounted valve in the catalog:

Valve	Subplate
RG-03-*-30	RXGM-03S-20
RG-06-*-30	RXGM-06SX-20
RG-10/12-*-30	RXGM-10S-30
RCG-03-*-30	RXGM-03S-20
RCG-06-*-30	RXGM-06SX-20
RCG-10/12-*-30	RXGM-10S-30
URG*-06-*-10	URG1M-06-10
URG*-10-*-10	URG1M-10-10
XGL-03-B-10	XGLM-10S-03-10
XG-03-*-30	RXGM-03S-20
XG-06-*-30	RXGM-06SX-20
XG-10-*-30	RXGM-10S-30
XCG-03-*-30	RXGM-03S-20
XCG-06-*-30	RXGM-06SX-20
XCG-10-*-30	RXGM-10S-30

The following table lists the appropriate bolt kit for each subplate mounted valve in the catalog:

Valve	Bolt Kit
R(C)G-03-*-30	BKRX03660
R(C)G-06-*-30	BKRX06661
R(C)G-10-*-30	BKRX10662
URG*-06-*-10	BKUR06682
URG*-10-*-10	BKUR10683
XGL-03-B-10	BKXL03663
X(C)G-03-*-30	BKRX03660
X(C)G-06-*-30	BKRX06661
X(C)G-10-*-30	BKRX10662

When a subplate is not used, a machined pad (as indicated by shaded area on subplate installation dimensions pages) must be provided for mounting. The pad must be flat within 0,013 mm (0.0005 in) and smooth within 1,6 μ m (63 microinch). Mounting bolts provided by the customer should be SAE grade 7 or better.

Application Data

Fluid Cleanliness

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials, and additives for protection against wear of components, elevated viscosity, and inclusion of air.

Essential information on the correct methods for treating hydraulic fluid is included in Vickers publication 561 "Vickers Guide to Systemic Contamination Control" available from your local Vickers distributor or by

contacting Vickers, Incorporated. Recommendations on filtration and the selection of products to control fluid condition are included in 561.

Recommended cleanliness levels, using petroleum oil under common conditions, are based on the highest fluid pressure levels in the system and are coded in the chart below. Fluids other than petroleum, severe service cycles, or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers publication 561 for exact details.

Vickers products, as any components, will operate with apparent satisfaction in fluids with higher cleanliness codes than those described. Other manufacturers will often recommend levels above those specified. Experience has shown, however, that life of any hydraulic component is shortened in fluids with higher cleanliness codes than those listed below. These codes have been proven to provide a long, trouble-free service life for the products shown, regardless of the manufacturer.

Product	System Pressure Level bar (psi)		
	<70 (<1000)	70-207 (1000-3000)	207+ (3000+)
Vane Pumps – Fixed	20/18/15	19/17/14	18/16/13
Vane Pumps – Variable	18/16/14	17/15/13	
Piston Pumps – Fixed	19/17/15	18/16/14	17/15/13
Piston Pumps – Variable	18/16/14	17/15/13	16/14/12
Directional Valves	20/18/15	20/18/15	19/17/14
Pressure/Flow Control Valves	19/17/14	19/17/14	19/17/14
CMX Valves	18/16/14	18/16/14	17/15/13
Servo Valves	16/14/11	16/14/11	15/13/10
Proportional Valves	17/15/12	17/15/12	15/13/11
Cylinders	20/18/15	20/18/15	20/18/15
Vane Motors	20/18/15	19/17/14	18/16/13
Axial Piston Motors	19/17/14	18/16/13	17/15/12
Radial Piston Motors	20/18/14	19/17/13	18/16/13

Vickers®

Directional Controls



Solenoid Operated Directional Valves

DG4V-3 flows to 80 l/min (21 USgpm), 6* design
DG4V-3S flows to 40 l/min (10.5 USgpm), 6* design
ISO 4401, size 03; ANSI/B93.7M-D03



VICKERS

Table of Contents

Introduction	3
Features and Benefits	3
Characteristics	5
Functional Symbols	6
Model Code	7
Operating Data	8
Performance Data	10
Installation Dimensions	13
DG4V-3-*A(L)-(V)M-S6-U-**-60	15
DG4V-3-*A(L)-(Z)-(V)M-S3-FPA5W-*2-60	15
DG4V-3-*A(L)-(Z)-(V)M-S4-FPA5W-*2-60	15
DG4V-3-*A(L)-(Z)-(V)M-S5-E-*2-60	15
Electrical Plugs and Connectors	16
Subplates, Connection Plates and Mounting Surfaces	19
DGMA-3-B-1* Blanking Plate	20
DGMA-3-C2-11 Crossover Plate	20
DGMA-3-T*-1*-* Tapping Plate	20
DGAM-3-01-1*-R (Metric bolt tapping) DGAM-3-01-1* (UNC bolt tapping)	21
Adaptor plate, Size 05 to 03 for pressure up to 210 bar (3000 psi)	21
DGVM-3-1*-*, DGMS-3-1E(Y)-1*-* Single station subplate, rear and side tapped port	21
DGMS-3-3E-1*-* Multi-station subplate	22
Mounting Surface	23
Appendix	24
Mounting Bolts	24
Spare Parts Data	25
Seal Kits	25
Solenoid Coils	25
Mass, approx. kg (lb)	25
Mounting Attitude	25
Temperature Limits	26
Fluid Temperature	26
Fluid Cleanliness	26
Ordering Procedure	26

Introduction

General description

These solenoid operated directional control valves are for directing and stopping flow at any point in a hydraulic system. This 60-design series has been specially designed and developed to cover expanded demands in the industry as well as the many traditional uses of the earlier designs. Some of the more important benefits to users are outlined.

- Efficient control of greater hydraulic powers without increasing solenoid power consumption.
- Installed cost and space savings from higher power/weight-and-size ratios.

- Increases system efficiency; the result of improved manufacture of spools and bores.
- Installation flexibility resulting from choice of numerous combinations of solenoid connectors and locations.
- Multi-fluid capability without need to change seals.
- Higher sustained machine productivity and higher uptime because of proven fatigue life and endurance, tested over 20 million cycles.
- Solenoid coils can be changed quickly and easily without leakage from hydraulic system.
- Compact, cost effective system design when used with Vickers SystemStak™ valves and subplates.

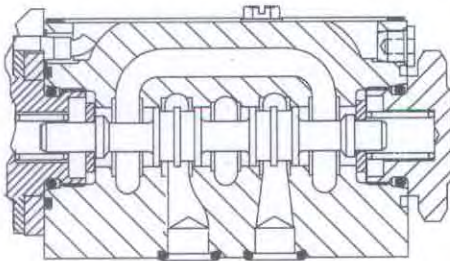
DG4V-3 and DG4V-3S High and standard performance models:

- Up to 80 l/min (21 USgpm) and up to 40 l/min (10.5 USgpm) respectively at 350 bar (5000 psi).
- Builds on Vickers experience as the major supplier of size 03 valves worldwide.
- Offers designers the opportunity to select the optimum valve package for each application.
- International standard interface. The valve mounting face conforms to ISO 4401, size 03 and is compatible with related international standards.

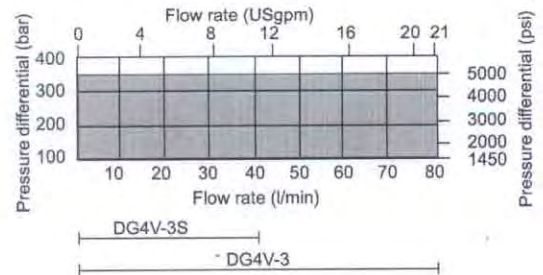
Features and Benefits

- **High pressure and flow capabilities, thanks to special design features**

Highly reliable operation up to 80 l/min (21 USgpm) at 350 bar (5000 psi). Establishes new market standards and opens new possibilities to design engineers on valve size selection.



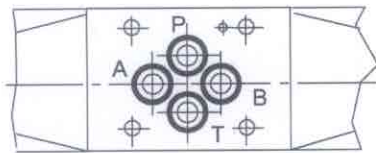
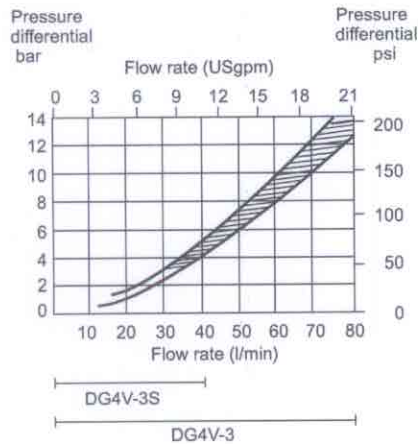
Typical maximum pressure differential (P-A-B-T) flow envelope, blocked center spool.



Features and Benefits

- **Minimal pressure drop, i.e. 2,5 bar (36 psi) at 30 l/min (7.9 USgpm)**

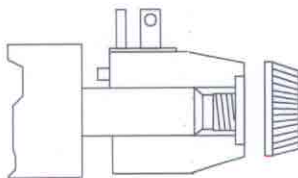
Achieved by optimization of the valve body, spool and spool-stroke design. The results: low energy consumption and improved efficiency.



Mounting surface to ISO 4401 size 03

- **Ease of servicing**

Wet-armature solenoid, screw-in core tube design allows coils to be changed without removing valve from installation and without oil spillage or risk of contaminating system fluid.

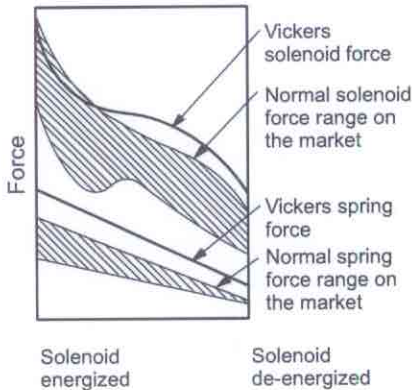


ISO4400 (DIN 43650) coil shown

- **High reliability**

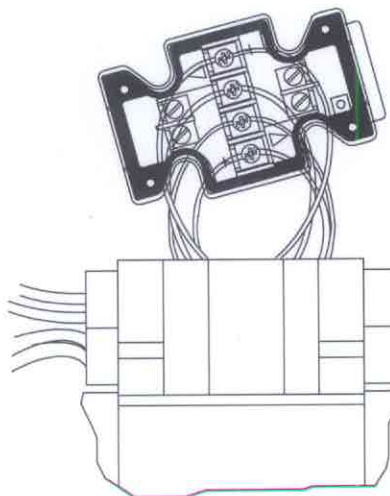
Design of spring forces and profile of DC solenoid force characteristics ensure spool position selection under extreme operating conditions. Result is a valve with high reliability when being energized or de-energized.

Performance leader



- **Electrical connections**

Conduit box design that simplifies electrical wiring connections to solenoids. Orientation tabs prevent incorrect positioning.



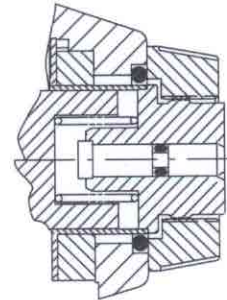
- **Scratch-proof manual override seal**

Internal seals are located such that they are beyond reach of any bore damage caused by small tools used to operate the manual override.

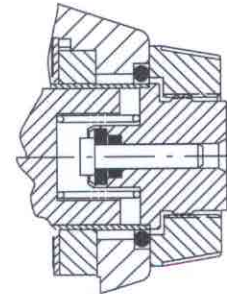
Result is no messy oil drips from the manual overrides.

Small diameter manual overrides prevent inadvertent operation.

DG4V-3 – High Performance



DG4V-3S – Standard Performance



- **Surge suppression for DC valves**

Surge suppression is used to prevent coil damage by reducing contact burnoff – increasing switch life – and protecting electrical controllers from inductive spikes.

Three coil options are available:

- D1 – Encapsulated diode (Industrial application)
- D2 – Encapsulated diode (Mobile application)
- D7 – Transzorb type

Characteristics

High performance DG4V-3, 6* design Standard performance DG4V-3S, 6* design

Mounting interface

ISO 4401 size 03
ANSI/B93.7M size D03
CETOP RP65H, size 3
DIN 24340, NG6

Basic characteristics

Maximum pressure:
DG4V-3 350 bar (5075 psi)
DG4V-3S 350 bar (5075 psi)
Maximum flow:
DG4V-3 up to 80 l/min (21 USgpm)
DG4V-3S up to 40 l/min (10.5 USgpm)

DG4V-3 models are direct solenoid operated four-way directional control valves. Their primary function in a hydraulic circuit is to direct fluid flow. This, in turn, would determine the direction of movement of a fluid cylinder, or the direction of rotation of a fluid motor.

Port connections are made by mounting the valve on a subplate or manifold. The valve has wet armature type solenoids.

Electrical connections to the valve are made in the electrical wiring housing or thru various plug-in connectors such as a DIN 43650 type coil

Good hydraulic design practice suggests that detented models be mounted with longitudinal axis horizontal. Other models may be mounted in any position.

Operating considerations

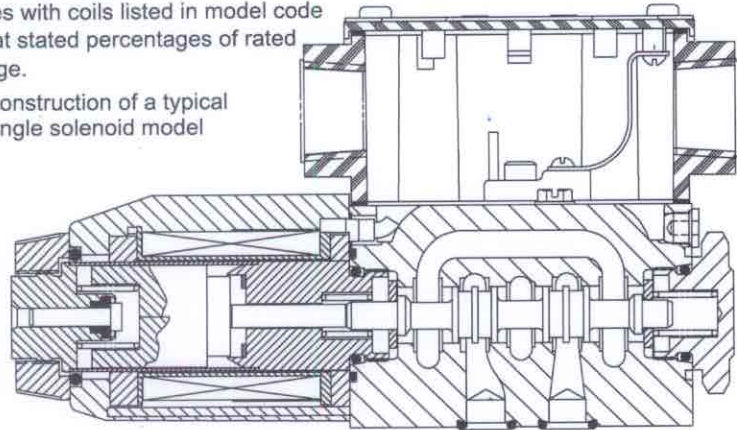
1. Dependent on the application and the system filtration, any sliding spool valve if held shifted under pressure for long periods of time, may stick and not move readily due to fluid residue formation. It may therefore need to be cycled periodically to prevent this from happening.
2. Surges of fluid in a common tank line serving two or more valves can be of sufficient magnitude to cause inadvertent shifting of these valves. This is particularly critical in no-spring detented models, separate drain lines are necessary.

Temperature limits

Minimum ambient -20°C (-4°F)

Maximum ambient
Valves with coils listed in model code and at stated percentages of rated voltage.

Construction of a typical single solenoid model



Fluid temperature

Fluid Temp.	Mineral oil	Water-containing
Min	-20°C (-4°F)	+10°C (+50°F)
Max.*	+70°C (+158°F)	+54°C (+129°F)

* To obtain optimum service life from both fluid and hydraulic system, 65°C (150°F) normally is the maximum temperature except for water-containing fluids.

Coil type and frequency	Percentage voltage	Maximum ambient temperature	
		DG4V-3	DG4V-3S
Dual frequency coils			
@ 50 Hz	107%	40°C (104°F)	65°C (149°F)
@ 50 Hz	110%	30°C (86°F)	65°C (149°F)
@ 60 Hz	107%	50°C (122°F)	65°C (149°F)
@ 60 Hz	110%	40°C (104°F)	65°C (149°F)
Single frequency (50 Hz) coils			
@ 50 Hz	110%	40°C (104°F)	65°C (149°F)
DC coils	110%	70°C (158°F)	70°C (158°F)

For synthetic fluids consult manufacturer or Vickers representative where limits are outside those for mineral oil.

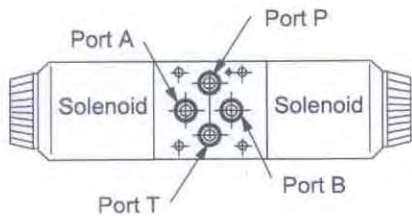
Whatever the actual temperature range, ensure that viscosities stay within the limits specified in the "Hydraulic fluids" section.

Functional Symbols

Spool types shown represent the highest proportion of market requirements. For other spool functions that may be required, consult your Vickers sales representative.

Solenoids identified to U.S. standards

Functional symbols related to solenoid identity "A" and/or "B" according to NFPA/ANSI standards, i.e. energizing solenoid "A" gives flow P to A, solenoid "B" gives flow P to B (as applicable).

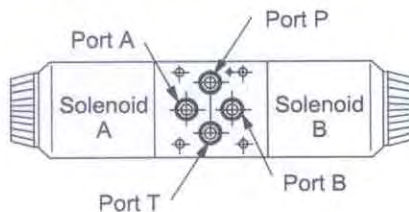


Solenoid	For spool type	Solenoid
B	All except "8"	A
A	"8" only	B

For valves with type "8" spools, solenoid identity to U.S. convention is the same as for European convention.

Solenoids identified to European standards (specify "V" in model code)

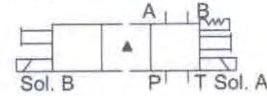
Functional symbols related to solenoid identity "A" and/or "B" according to European convention i.e. solenoid "A" adjacent to "A" port, solenoid "B" adjacent to "B" port of valve.



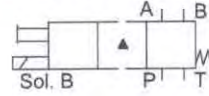
- For differences in valve function, refer to Performance Data page 11.
- F build spools.

U.S. solenoid standard

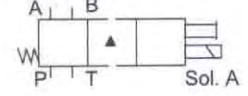
Double solenoid valves, two position, detented



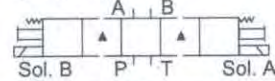
Single solenoid valves, solenoid at port A end



Single solenoid valves, solenoid at port B end



Double solenoid valves, spring centered



▲ Transient condition only

The valve function schematics apply to both U.S. and European valves.

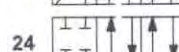
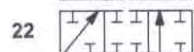
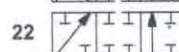
DG4V-3(S)-*N(V)



DG4V-3(S)-*A(V)



DG4V-3(S)-*AL(V)



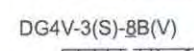
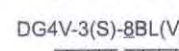
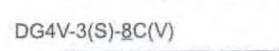
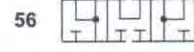
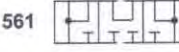
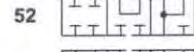
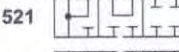
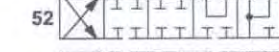
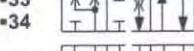
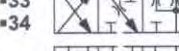
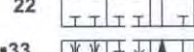
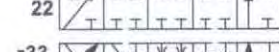
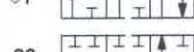
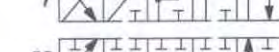
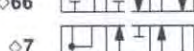
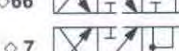
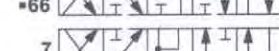
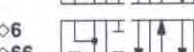
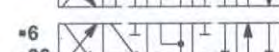
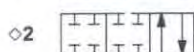
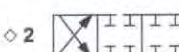
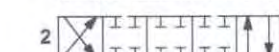
DG4V-3(S)-*C(V)



DG4V-3(S)-*B/F(V)



DG4V-3(S)-*BL/FL(V)



DG4V-3(S)-8C(V)



DG4V-3(S)-8BL(V)

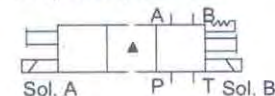


DG4V-3(S)-8B(V)

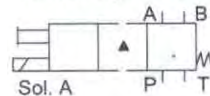


European solenoid standard

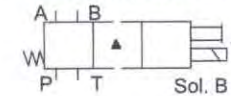
Double solenoid valves, two position, detented



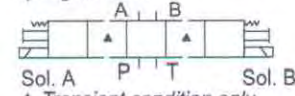
Single solenoid valves, solenoid at port A end



Single solenoid valves, solenoid at port B end



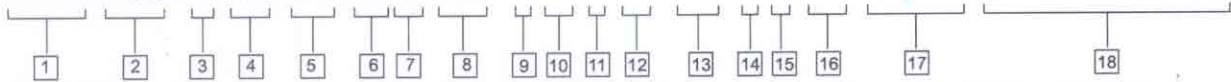
Double solenoid valves, spring centered



▲ Transient condition only

Model Code

DG4V-3(S) - ***(L)-(**)-(V)M-(S*) - * ** * D* (L) - ** -6* -(EN***)-(P** -A** -B** -T**)



1 Model series

D – Directional valve
 G – Subplate/manifold mounted
 4 – Solenoid operated
 V – Pressure rating 350 bar (5075 psi) on P, A & B ports

2 Standard or high performance

3 – High performance specification: up to 80 l/min (21 USgpm) at 350 bar (5075 psi)
 3S – Standard performance specification: up to 40 l/min (10.5 USgpm) at 350 bar (5075 psi)

3 Spool type

See “Functional symbols” section.

4 Spool spring arrangement

A – Spring offset, end-to-end
 AL – Same as “A” but left hand build
 B – Spring offset, end to center
 BL – Same as “B” but left hand build
 C – Spring centered
 F – Spring offset, shift to center
 FL – Same as “F” but left hand build
 N – No-spring detented

5 Manual override option

No symbol – Plain override(s) in solenoid end(s) only▲
 H – Water-resistant override(s) on solenoid end(s)▲
 H2 – Water-resistant override both ends of solenoid.
 P2 – Plain override both ends of single solenoid.
 Y● – Latching manual override on solenoid ends (includes “H” feature seal)▲
 Z – No overrides at either end

▲ No override in non-solenoid end of single solenoid valves
 ● Not available on DG4V-3S, AC models

6 Solenoid energization identity

V – Solenoid “A” is at port “A” end and/or solenoid “B” is at port “B” end, independent of spool type

Omit for U.S. ANSI B93.9 standard requiring solenoid “A” energization to connect P to A and/or solenoid “B” to connect P to B, independent of solenoid location.

NOTE: Type “8” spool valves conform to both U.S. and European solenoid designations. When ordering an “8” spool, designate a “V” in the model code.

7 Flag symbol

M – Electrical options and features

8 Spool indicator switch

Available on high performance models, DG4V-3, only. Omit when not required.

DG4V-3-*A(L)-(V)M models with type U (ISO4400) electrical connector to solenoid; spool type 0, 2 or 22 only:
 S6 – LVDT type DC switch with Pg7 connector plug.

DG4V-3-*A(L)-(Z)-(V)M-S*-FPA5W valves with mechanical type AC (~) switch, wired to 5-pin receptacle:
 S3 – Switch, wired normally open
 S4 – Switch, wired normally closed

DG4V-3-*A(L)-(Z)-(V)M-S5-F(T)W/J valves with mechanical type AC (~) switch:
 S5 – Switch, free leads

9 Coil type

U – ISO 4400 (DIN 43650) mounting◆
 U1 – Connector fitted
 U6 – Connector fitted w/lights
 U11 – Connector fitted w/rectifier & lights**
 U12 – Connector fitted w/rectifier**
 F – 1/2” NPT thread conduit box
 KU – Top exit flying leads*
 SP1 – Single 6,3 mm spade*◆
 SP2 – Dual 6,3 mm spade*◆
 X1 – Flame resistant solenoids TP EEx-d-11B-T4
 X2 – Hazardous location solenoids to meet UL & CSA approval
 X3 – Special protection solenoids to BASEEFA standar SFA009:1972, protection class EX-S-11-T4

◆ Female connector to be supplied by customer
 * DC service only
 ** AC service only

10 Electrical connector

T – Wired terminal block
 PA – Instaplug male receptacle only
 PB – Instaplug male & female receptacle
 PA3 – Three pin connector
 PA5 – Five pin connector

11 Housing (F type coils only)

W – 1/2” NPT thread wiring housing
 J – 20 mm thread wiring housing

12 Surge suppressor/damper

D1 – Encapsulated diode (Industrial applications)
 D2 – Encapsulated diode (Mobile applications)
 D7 – Transzorb type (F,KU,U,SP1,SP2 only)

13 Solenoid indicator lights

Not available on PA, KU, U, SP1 & SP2

14 Coil rating

Full power coils, see “Operating Data”.
 A – 110V AC 50Hz
 B◇ – 110V AC 50Hz/120V AC 60 Hz
 C – 220V AC 50 Hz
 D◇ – 220V AC 50 Hz/240V AC 60 Hz
 G – 12V DC
 H – 24V DC

For DG4V-3 only (not usable with DG4V-3S):
 Low power coils, see “Operating Data”. (Not available with “N” – No-spring detented models)
 BL – 110V 50 Hz/120V 60 Hz
 DL – 220V AC 50 Hz/240V AC 60 Hz
 GL – 12V DC
 HL – 24V DC

◇ For 60 Hz or dual frequency

Contact your Vickers representative for additional coil voltage options

15 Port T code

Refer to “Operating Data” for port T pressure ratings.
 2 – 10 bar (150 psi) for spool position indicator models S3, S4 and S5.
 4 – 70 bar (1000 psi)
 5 – 100 bar (1500 psi) for standard performance models, DG4V-3S, with AC or DC solenoids.
 6 – 207 bar (3000 psi) for AC high performance models, DG4V-3, including spool position indicator type S6.
 7 – 207 bar (3000 psi) for DC high performance models, DG4V-3, including spool position indicator type S6.

16 Design number

60 – Basic design
 61 – Type 8 spool

17 Special features

“EN***” code number assigned as required.
 EN21 – CSA approved models with 1/2” NPT entry conduit box, type FW and solenoid coil letter B,D,G, or H.

18 Port restrictor plugs

For details of plug orifice sizes and how to specify in model code see page 15. May be fitted to valves by agreement with your Vickers representative.

Omit – No restrictor plugs fitted

Operating Data

Performance data is typical with fluid at 36cSt (168 SUS) and 50°C (122°F).

Feature	Standard performance valve DG4V-3S		High performance valve DG4V-3	
Pressure limits: P, A and B ports T port: Spool indicator switch models Types S3, S4, S5 Type S6 All other models	350 bar (5075 psi) ■		350 bar (5075 psi)	
	N/A		10 bar (145 psi)	
	N/A		210 bar (3045 psi)	
	100 bar (1450 psi)		210 bar (3045 psi)	
Flow rating	See performance data		See performance data	
Relative duty factor	Continuous; ED = 100%		Continuous; ED = 100%	
Type of protection: ISO 4400 coils with plug fitted correctly SP1 – Single spade 6,3 mm SP2 – Dual spade 6,3 mm Coil winding Lead wires (coils type F****) Coil encapsulation	IEC 144 class IP65 IEC 760 IEC 760 Class H Class H Class F		IEC 144 class IP65 IEC 760 IEC 760 Class H Class H Class F	
Permissible voltage fluctuation: Maximum Minimum	Refer to temperature limits. 90% rated		Refer to temperature limits. 90% rated	
Typical response times at 100% rated volts measured from application/removal of voltage to full spool displacement of "2C" spool at: Flow rate P-A, B-T Pressure AC (~) energizing AC (~) de-energizing DC (=) energizing DC (=) de-energizing	20 l/min (5.3 USgpm) 175 bar (2537 psi) 18 ms 32 ms 60 ms 40 ms		40 l/min (10.6 USgpm) 175 bar (2537 psi) 15 ms 23 ms 45 ms 28 ms	
Power consumption, AC solenoids (for coils listed in model code).	Initial ▲ VA (RMS)	Holding VA (RMS)	Initial ▲ VA (RMS)	Holding VA (RMS)
Full power coils: Single frequency coils AC 50 Hz Dual frequency coils at 50 Hz Dual frequency coils at 60 HZ	225 265 260	39 49 48	265 280 300	54 61 58
Low power coils, "BL" and "DL": (Not available with "N" – No-spring detented models) Dual frequency coils at 50 Hz Dual frequency coils at 60 Hz	Low power coils not usable with DG4V-3S valves.		170 190	37 37
Power consumption, DC solenoids at rated voltage and 20°C (68°F).				
Full power coils: 12V, model type "G" 24V, model type "H"	30W 30W	– –	30W 30W	– –
Low power coils: 12V, model type "GL" 24V, model type "HL"	Low power coils not usable with DG4V-3S valves.		18W 18W	– –

■ For applications where valves are to remain pressurized (either energized or de-energized) at pressures over 210 bar (3045 psi) without frequent switching, it is recommended to use the high performance model, DG4V-3.

▲ 1st half cycle; armature fully retracted.

Operating Data

Spool Position Indicator Models, high performance valve DG4V-3 ONLY

Spool/spring arrangement types 0A (L), 2A(L), 22A(L)

DC model type "S6" (see page 15 for Installation Dimension)



This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 89/336/EEC, amended by 91/263/EEC, 92/31/EEC and 93/68/EEC, article 5. For instructions on installation requirements to achieve effective protection levels see this leaflet and the Installation Wiring Practices for Vickers Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by Electromagnetic Compatibility (EMC).

Input:

Supply voltage	10 to 35V DC inclusive of a maximum 4V pk-to-pk ripple
Current, switch open	5 mA
Current, switch closed	255 mA

Output:

Voltage	1V below input at maximum load
Maximum continuous current	250 mA
Maximum load impedance	136Ω at maximum input volts
Maximum switching frequency	10 Hz

Plug connections:

Pin 1 (output 1)	Normally open (ie. not connected to pin 3)
Pin 2	Supply +ve
Pin 3	0V
Pin 4 (output 2)	Normally closed (ie. connected to pin 3)
Switching point	Within the spool spring offset condition ●
Connector	Pg7 plug (supplied with valve)
Protection	Overload and short-circuit protected; self re-setting. IEC 144 class IP65 with connector correctly fitted.

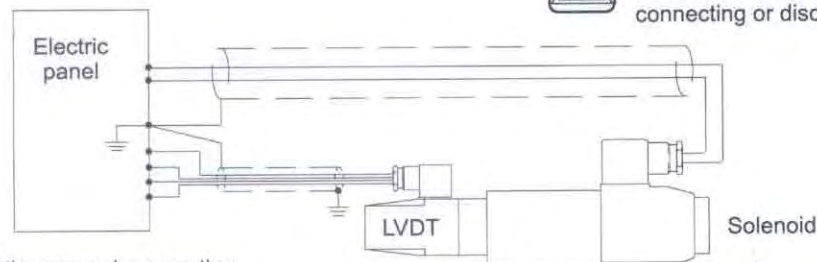
● Factory setting ensures this condition under all combinations of manufacturing tolerance and of temperature drift (see "Temperature Limits").

Wiring Connections



Warning

All power must be switched off before connecting or disconnecting any plugs



Customer's protective ground connection



WARNING: Electromagnetic Compatibility (EMC)

It is necessary to ensure that the unit is wired up in accordance with the connection arrangements shown above. For effective protection the user's electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient ground points.

In all cases both valve and cable should be kept as far away as possible from any sources of electromagnetic radiation such as cables carrying heavy current, relays and certain kinds of portable radio transmitters, etc. Difficult environments could mean that extra screening may be necessary to avoid the interference.

Micro-switch type "S3", "S4" and "S5"

Voltage	250V maximum 50/60 Hz
Maximum current	5A

Performance Data

Typical with mineral oil at 36 cSt (168.6 SUS) and a specific gravity of 0.87.

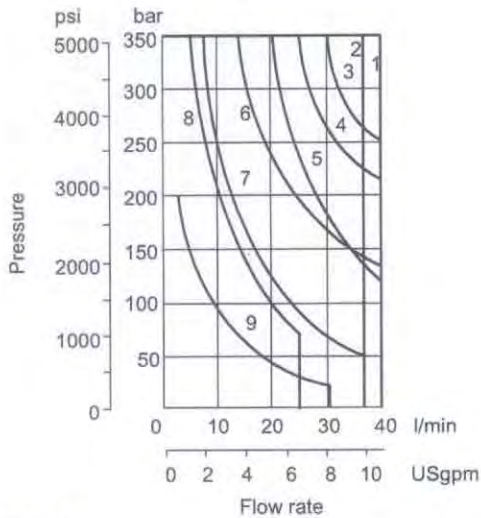
Maximum flow rates

Performance based on full power solenoid coils warm and operating at 90% rated voltage.

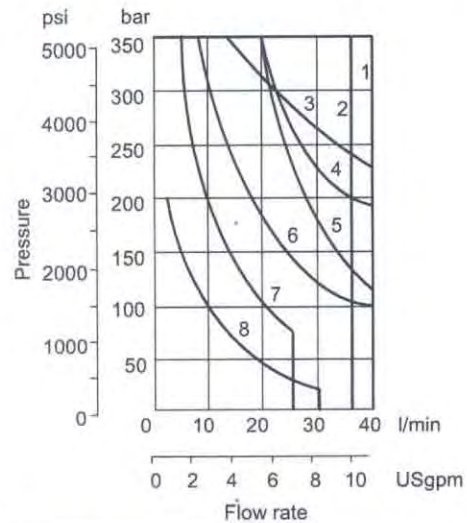
See note at bottom of next page when using low power coils (DG4V-3 models only).

DG4V-3S models (standard performance)

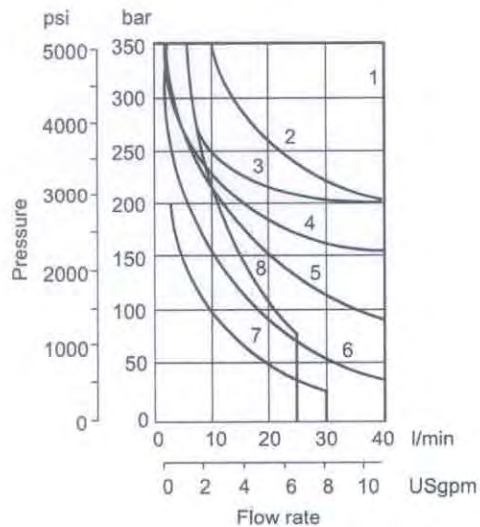
Graph 1
AC solenoid valves with dual frequency coils operating at 50 Hz



Graph 2
AC solenoid valves with
– Dual frequency coils operating at 60 Hz
– Single frequency (50 Hz) coils operating at 50 Hz



Graph 3
DC solenoid valves



Spool/spring code	Graph 1 curve	Graph 2 curve	Graph 3 curve
0A(L)	1	1	3
0B(L) & 0C, 0F	1	1	1
2A(L)	5	5	3
2B(L) & 2C, 2F	2	2	3
2N	1	1	1
6B(L) & 6C, 6F	6	6	5
7B(L) & 7C, 7F	6	6	2
8B(L) & 8C	8▲	7▲	8▲
22A(L)	9	8	7
22B(L) & 22C	7	7	6
24A(L)	6	6	5
33B(L) & 33C	4	4	4
34B(L) & 34C	6	6	5
52BL, 52C, 56BL & 56C	6	6	5
66B(L) & 66C	3	3	5
521B & 561B	6	6	5

▲ Consult Vickers regarding each application that will jointly have flow rates approaching this curve and a pressurized volume exceeding 2000 cm³ (122 cu.in.)

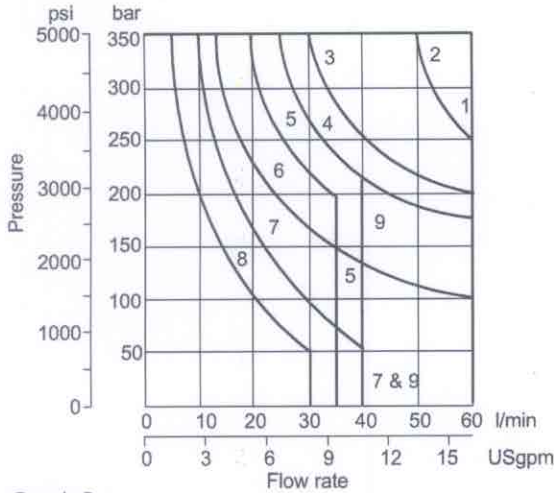
Performance Data

DG4V-3 models (high performance)

Graph 4

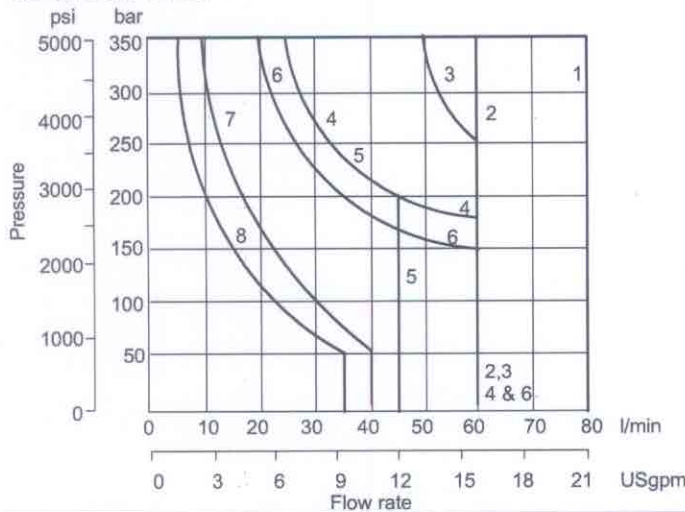
AC solenoid valves with:

- Single-frequency coils
- Dual-frequency coils operating at 50 Hz



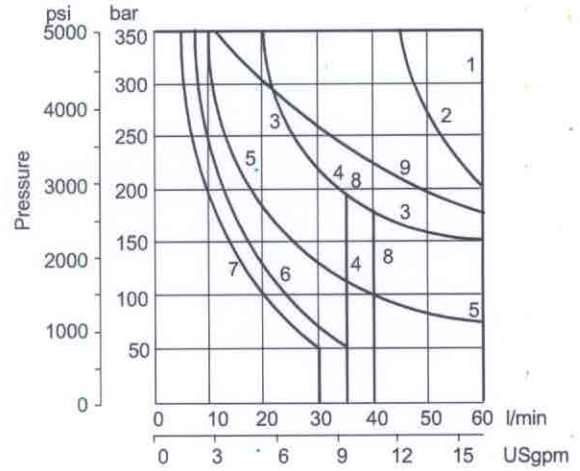
Graph 6

DC solenoid valves



Graph 5

AC solenoid valves with dual-frequency coils operating at 60 Hz



Spool/ spring code	Graph 4 curve	Graph 5 curve	Graph 6 curve
0A(L)	2	2	3
0B(L) & 0C, 0F	1	1	2
2A(L)	2	2	3
2B(L) & 2C, 2F	1	1	1
2N	1	1	2
6B(L) & 6C, 6F	6	5	6
7B(L) & 7C, 7F	1	1	2
8B(L) & 8C	5▲	4▲	5▲
22A(L)	8	7	8
22B(L) & 22C	7	6	7
24A(L)	9	8	5
33B(L) & 33C	4	3	4
34B(L) & 34C	4	3	6
52BL, 52C,	6	5	6
56BL & 56C	6	5	6
66B(L) & 66C	3	9	6
521B & 561B	6	5	6

▲ Consult Vickers regarding each application that will jointly have flow rates approaching this curve and a pressurized volume exceeding 2000 cm³ (122 cu.in.)

Flow limits applicable to the following usages:

1. All valves except types 22 and 52 spools having simultaneous equal flow rates from P to A or B and from B or A to T and S3, S4, S5 (limit switch) models.
2. Valves with type 22 spools having flow from P to A or B, the other being plugged. T is drained at all times.
3. Valves with type 52 spools having one service port (A or B as appropriate) connected to the full bore end of a 2:1 area ratio double-

acting cylinder and the other to the annulus end.

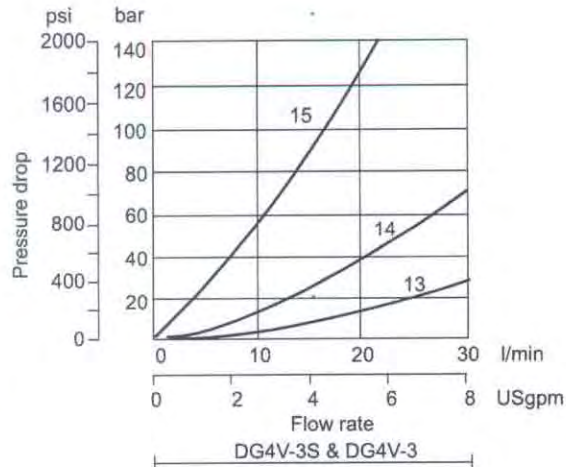
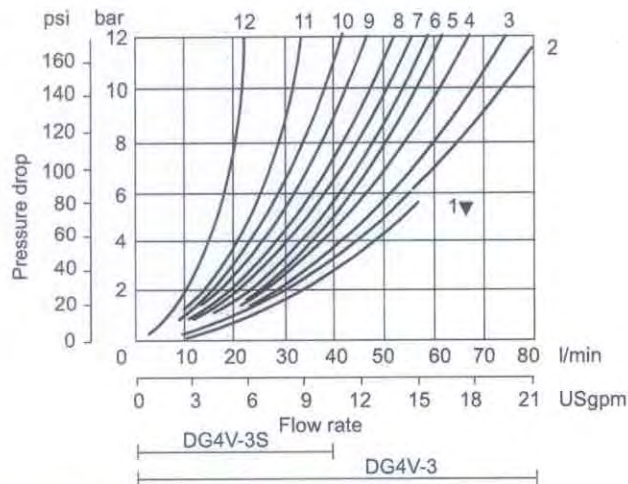
4. Consult Vickers, with application details, if either of the following usages are required:
 - (a) Single flow path, i.e. P to A, P to B, A to T or B to T.
 - (b) Substantially different simultaneous flow rates between P to A or B and B or A to T, e.g. when A and B are connected to a cylinder having a large differential area.

Low Power Coils (DG4V-3 models only)

When using low power coils (coil designations *L in model code) the maximum flow is reduced from values given on this page (graphs 4, 5 and 6) by up to:
 70% - for DC coils
 50% - for AC coils
 depending on spool type. Consult your Vickers representative relative to specific applications for low power coils.

Performance Data

Pressure drops



▼ Curve for spool type 6: not recommended for flows in excess of 60 l/min (15.8 USgpm).

Pressure drops in offset positions except where otherwise indicated

Spool/spring code	Spool positions covered	P to A	P to B	A to T	B to T	P to T	B to A or A to B
0A(L)	Both	5	5	2	2	—	—
0B(L) & 0C, 0F	De-energized	—	—	—	—	4▲▲	—
	Energized	4	4	2	2	—	—
2A(L)	Both	6	6	5	5	—	—
2B(L) & 2C, 2F	Energized	5	5	2	2	—	—
2N	Both	6	6	3	3	—	—
6B(L) & 6C, 6F	De-energized	—	—	3▲	3Δ	—	—
	Energized	6	6	1	1	—	—
7B(L) & 7C, 7F	De-energized	6▲	6Δ	—	—	—	7○
	Energized	4	4	3	3	—	—
8B(L) & 8C	All	9	9	5	5	3	—
22A(L), 22B(L) & 22C	All	6	6	—	—	—	—
24A(L)	De-energized	6	6	2	2	—	—
33B(L) & 33C	De-energized	—	—	15▲	15Δ	—	—
	Energized	5	5	2	2	—	—
34B(L) & 34C	De-energized	—	—	14▲	14Δ	—	—
	Energized	5	5	2	2	—	—
52BL & 52C	Energized	6▲	6Δ	2	—	—	10○
56BL	Both	6▲	6Δ	11▲	10Δ	—	10○
56C	De-energized	—	—	11▲	10Δ	—	10○
	Energized	6▲	6Δ	2	—	—	10○
66B(L) & 66C	De-energized	—	—	12	12	—	13
	Energized	6	6	2	2	—	—
521B	All	6▲	6Δ	—	—	—	10○
561B	De-energized	—	—	10▲	11Δ	—	10○
	Energized	6	6Δ	—	—	—	10○

▲ "B" plugged Δ "A" plugged ○ "P" plugged

For other viscosities, pressure drops approximate to:

Viscosity cSt (SUS)

14	20	43	54	65	76	85
(17.5)	(97.8)	(200)	(251)	(302)	(352)	(399)

% of Δp

81	88	104	111	116	120	124
----	----	-----	-----	-----	-----	-----

A change to another specific gravity will yield an approximately proportional change in pressure drop.

The specific gravity of a fluid may be obtained from its producer. Fire resistant fluids usually have higher specific gravities than oil.

Installation Dimensions

Models for use with ISO 4400 (DIN 43650) connectors

Double solenoid models ▲
 DG4V-3(S)-*C-**-*(V)M-U-**-60
 DG4V-3(S)-*N-**-*(V)M-U-**-60

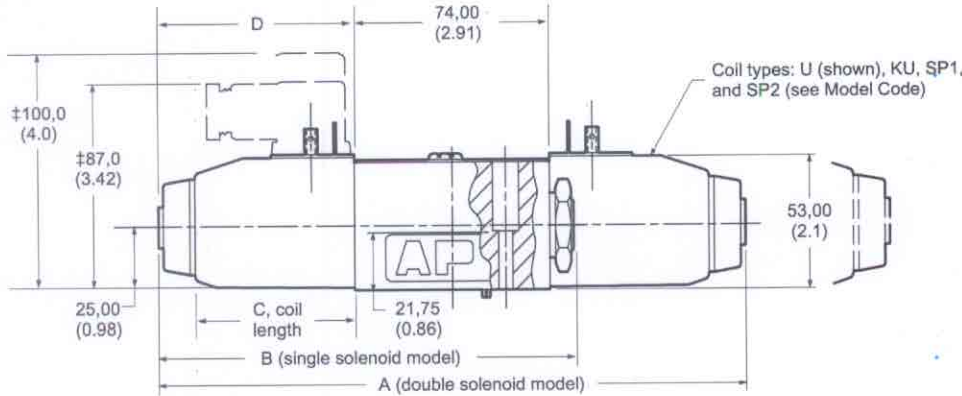
Single solenoid models ▲
 DG4V-3(S)-*A-**-*(V)M-U-**-60
 DG4V-3(S)-*B-**-*(V)M-U-**-60
 DG4V-3(S)-8BL-**-*(V)M-U-**-60
 DG3V-3(S)-*F-**-*(V)M-U-**-60

DG4V-3(S)-*AL-**-*(V)M-U-**-60
 DG4V-3(S)-*BL-**-*(V)M-U-**-60
 DG4V-3(S)-8B-**-*(V)M-U-**-60
 DG4V-3(S)-*FL-**-*(V)M-U-**-60

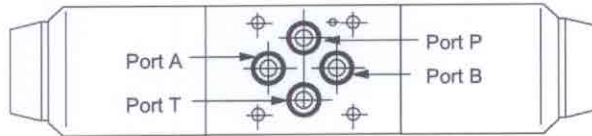
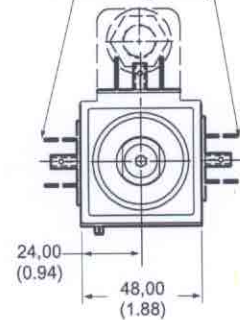
Solenoid and end cap interchanged



Dim mm (in.)



Alternative plug positions by loosening knurled nut, turning coil, and re-tightening.



■ Not applicable to type "8" spool.

▲ See page 25 for solenoid information.

± Can vary dependent on source of plug.

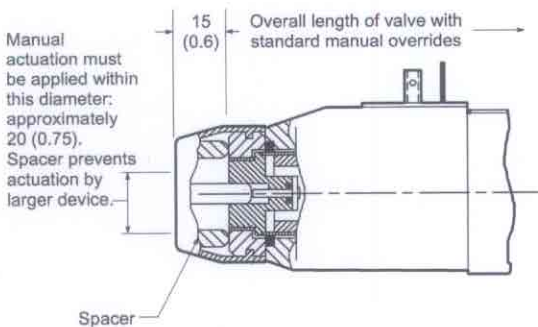
Model type	AC or DC	A Dim.	B Dim.	C Dim.	D Dim.
All	DC =	220 (8.66)	156 (6.14)	61 (2.5)	73 (2.87)
DG4V-3	AC ~	200 (7.87)	146 (5.75)	51 (2.1)	63 (2.48)
DG4V-3S	AC ~	200 (7.87)	146 (5.75)	45 (1.7)	63 (2.48)

Water-resistant manual override on solenoid

DG4V-3(S)-****(L)-H-(V)M-**-**-60

Application

General use where finger operation is required (standard manual overrides cannot be operated without using small tool).



Note:
 "H" feature is not field convertible from other models; specify with order.

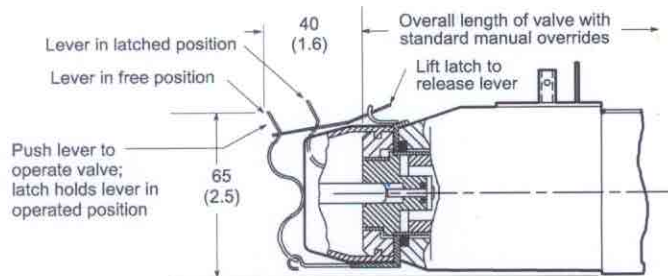
Latching manual override on solenoid

DG4V-3-****(L)-Y-(V)M-**-**-60

DG4V-3S-****(L)-Y-(V)M-**-**-60, DC coil models only

Application

Stainless steel lever/latch mechanism and water-resistant seal make this feature ideal for vehicle-mounted and exposed applications requiring emergency selection of valve for a period of time in the event of electrical failure.



Notes:

1. Opposite solenoid (on "C" and "N" double solenoid models) should not be energized while the valve is latched in selected position; AC solenoid coils will burn out under this improper usage.
2. "Y" feature is field-convertible from "H" type manual override (omitting spacer), but is not field-convertible from other models.

Installation Dimensions

Models with "F" type coils (lead wires) and conduit box.

Double solenoid models ▲
 DG4V-3(S)-*C-**-*(V)M-E-**-60
 DG4V-3(S)-*N-**-*(V)M-E-**-60

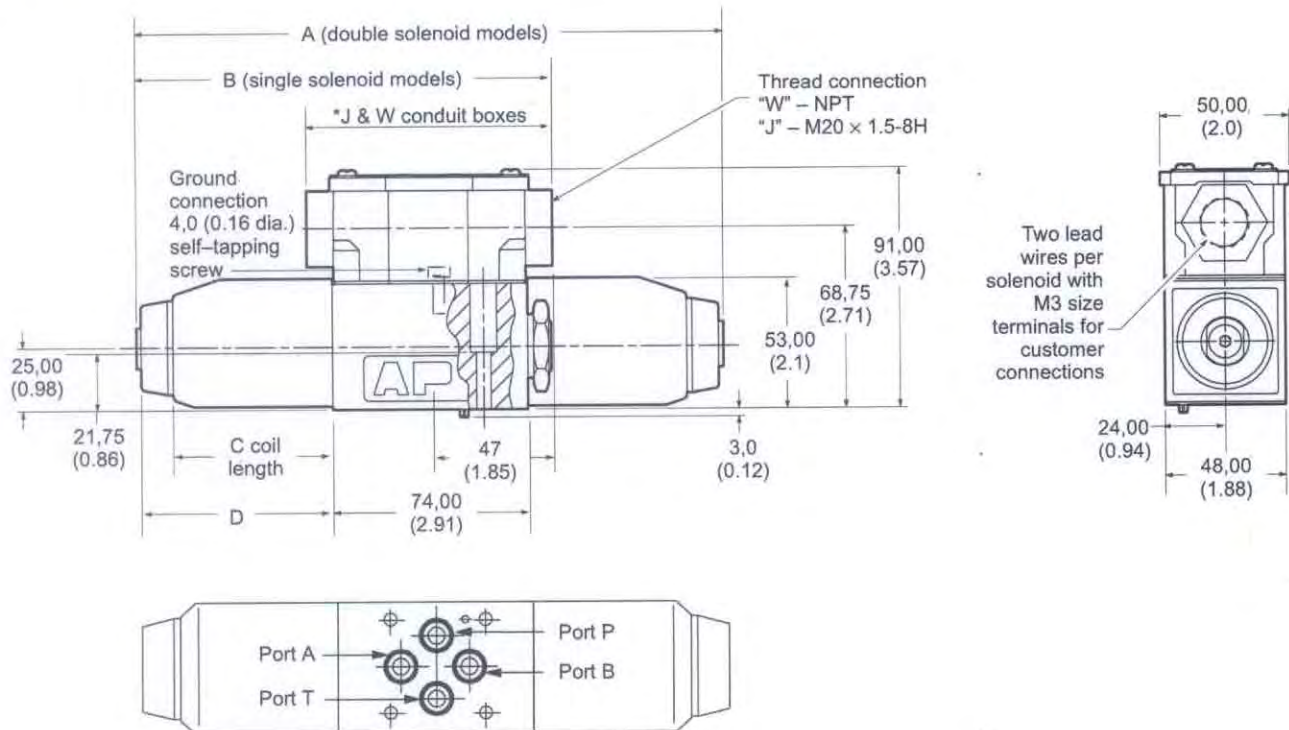
Single solenoid models ▲
 DG4V-3(S)-*A(-**)●
 DG4V-3(S)-*B(-**)●
 DG4V-3(S)-8BL(-**)●
 DG3V-3(S)-*F●

As shown

DG4V-3(S)-*AL(-**)●
 DG4V-3(S)-*BL(-**)●
 DG4V-3(S)-8B(-**)●
 DG4V-3(S)-*FL(-**)●

Solenoid and end cap interchangeable

Dim mm (in.)



* 89 (3.5) for FPB – J & W conduit boxes
 104 (4.0) All plug-in conduit boxes

Model type	AC or DC	A Dim.	B Dim.	C Dim.	D Dim.
All	DC =	220 (8.66)	156,5 (6.14)	61 (2.5)	73 (2.87)
DG4V-3	AC ~	200 (7.87)	146,5 (5.75)	51 (2.1)	63 (2.48)
DG4V-3S	AC ~	200 (7.87)	146,5 (5.75)	45 (1.7)	63 (2.48)

● Not applicable to type "8" spool.

▲ See page 25 for solenoid information.

Codes "FJ" and "FW": 2 lead wires for each solenoid, approximately 150,00 (6.00) long. M3 (#6) terminals provided for customer connection.

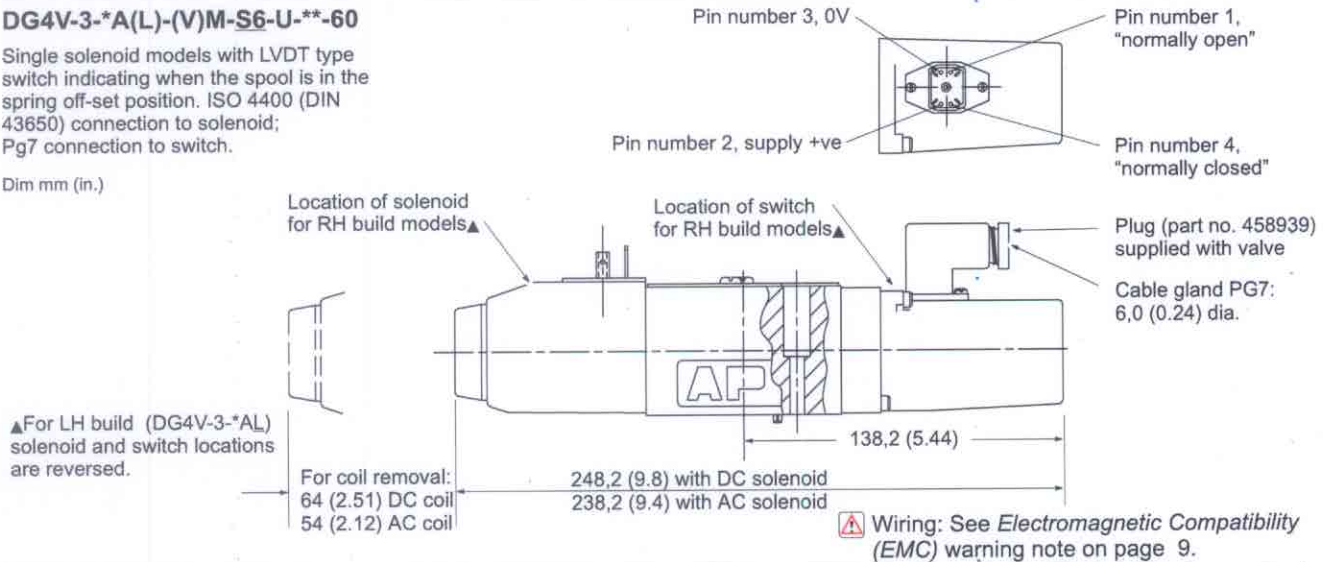
Codes "FTJ" and "FTW": Valve supplied with lead wires connected into terminal strip suitable for M3 (#6) terminals for customer connection.

Installation Dimensions

DG4V-3-*A(L)-(V)M-S6-U-**-60

Single solenoid models with LVDT type switch indicating when the spool is in the spring off-set position. ISO 4400 (DIN 43650) connection to solenoid; Pg7 connection to switch.

Dim mm (in.)



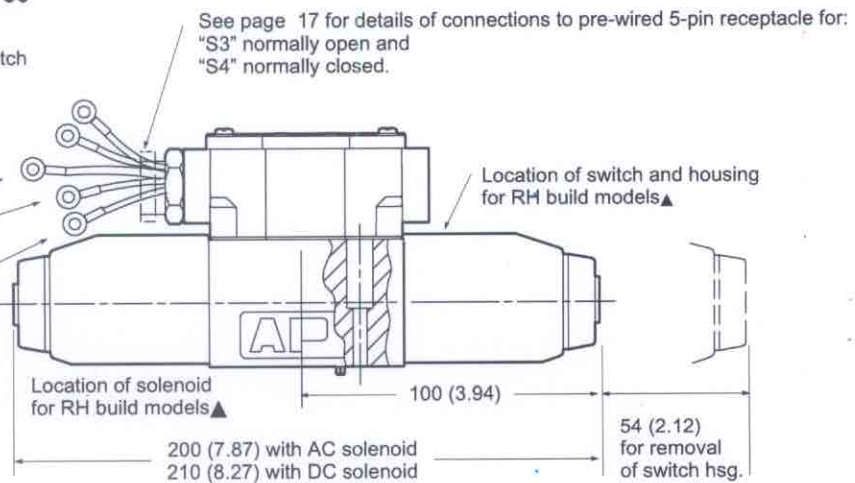
DG4V-3-*A(L)-(Z)-(V)M-S3-FPA5W-*2-60 DG4V-3-*A(L)-(Z)-(V)M-S4-FPA5W-*2-60 DG4V-3-*A(L)-(Z)-(V)M-S5-F-*2-60

Single solenoid models with mechanical type switch monitoring of spool movement.

Conduit box with leads, or pre-wired to NFPA T3.5.29-1980 receptacle.

Normally closed lead (Monitor switch) sleeving identification color white.
Common lead (Monitor switch) sleeving identification color black.
Normally open lead (Monitor switch) no color identification.

▲For LH build (DG4V-3-*AL) solenoid and switch locations are reversed.



Port restrictor plugs

Restrictor plugs are available for use in ports P, T, A or B. These can be used for restricting flow or for circuit dampening. Restrictor plugs are not recommended for use above 210 bar (3000 psi) system pressure.

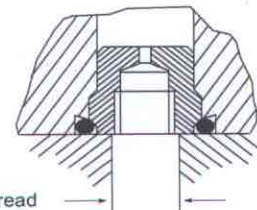
Typical model codes:
DG4V-3(S)-**M-**-**60-P08
(0.8 mm dia orifice in port P)

DG4V-3(S)-**M-**-**60-P10-A10
(1.0 mm dia orifice in ports P and A)

Restrictor plug selection table

Code	Orifice diameter	Part number■
*00	Blank	694353
*03	0,30 (0.012)	694341
*06	0,60 (0.024)	694342
*08	0,80 (0.030)	694343
*10	1,00 (0.040)	694344
*13	1,30 (0.050)	694345
*15	1,50 (0.060)	694346
*20	2,00 (0.080)	694347
*23	2,30 (0.090)	694348

* = P, T, A or B, as required
■ Order in multiples of 25 per part number



M5 x 0.8-6H thread for plug extraction

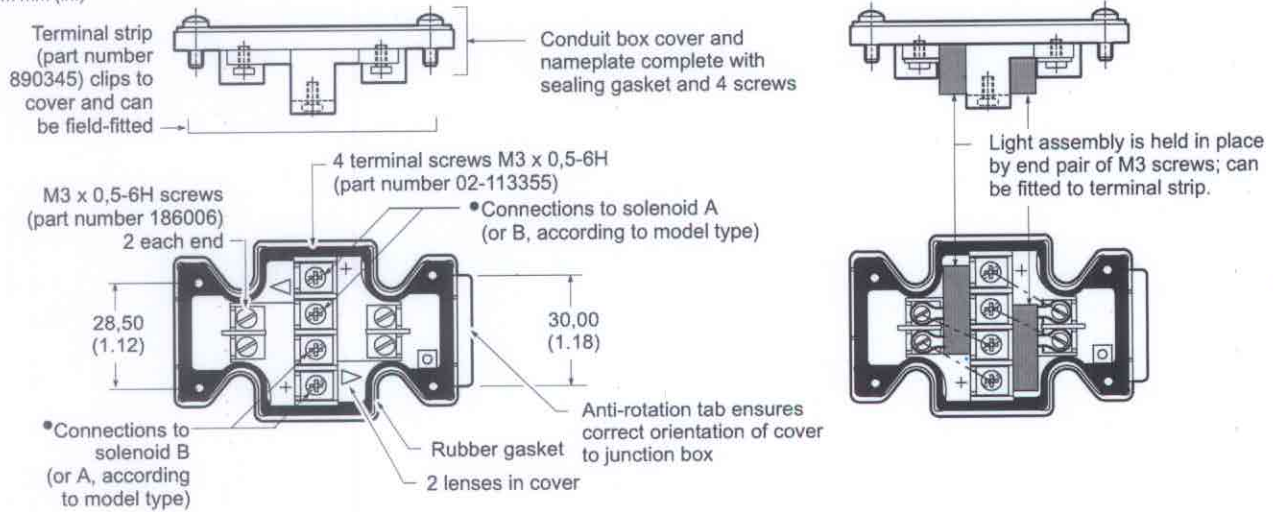
Maximum port dia in subplate/manifold block:
For steel and SG (ductile) iron: 7,0 (0.3)
For gray iron: 6,5 (0.25)

Electrical Plugs and Connectors

Terminal strip and lights

For valves with type "F" coils.

Dim mm (in.)



1. For DC coils the +ve lead(s) must be connected to the terminal(s) marked +. When using 3-wire incoming leads to double solenoid valves (i.e. common neutral) the inner pair of terminals must be interconnected
2. For correct light indication of energized solenoid ensure that solenoid leads are correctly connected: light terminals are common with each outer pair of solenoid terminals according to the side with + mark.

Insta-Plug

DG4V-3(S)—FPA—60
DG4V-3(S)—FPBW—60

Vickers 2-part "Insta-Plug" eliminates breaking electrical inputs for valve disconnect. A male half is pre-wired to the valve body. The mating plug is inside

a wire housing with external terminals for machine wire connections.

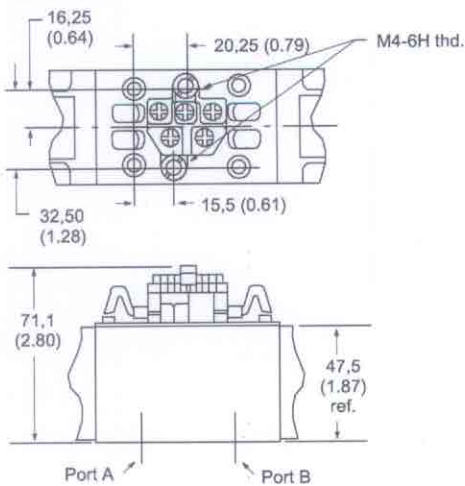
Captive thumb screws, when loosened, permit the wire housing to be pulled clear of the valve for disconnect. A longer ground post provides first make/last break ground connection.

The **PBW** configuration combines both male and female plugs in the wiring housing for a self-contained plug-in unit.

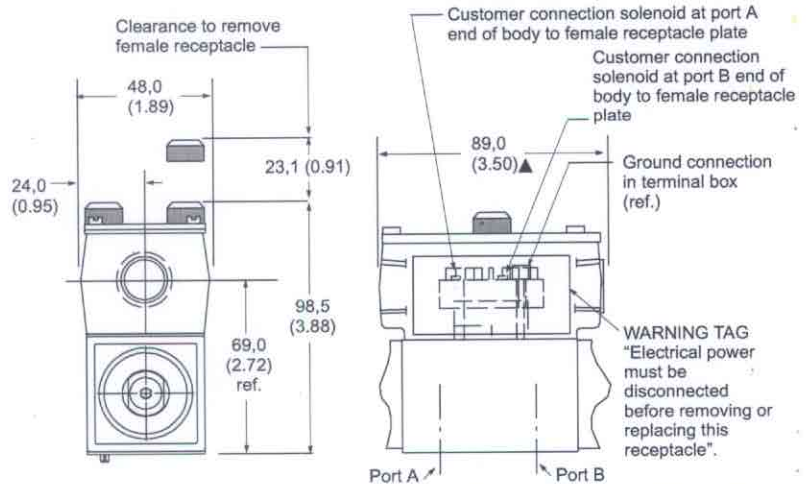
Optional solenoid indicator lights are pre-wired to the female plug. Solenoids "A" and/or "B" are identified on the wiring housing.

PA configuration

Dim mm (in.)



PBW configuration



▲ The conduit box dimensions used for the PA/PBW type connector are different from those on the other "F" type coil models.

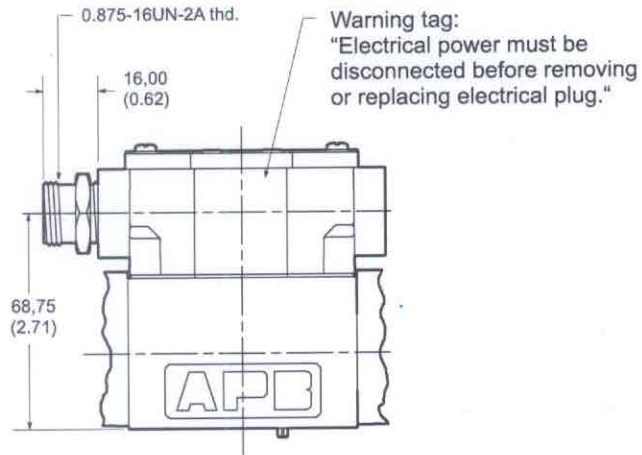
Electrical Plugs and Connectors

NFPA Connector T3.5.29-1980

DG4V-3(S)---FPA3W(L)-**60
 DG4V-3(S)---FPA5W(L)-**60
 DG4V-3---S3-FPA5W(L)-**60
 DG4V-3---S4-FPA5W(L)-**60

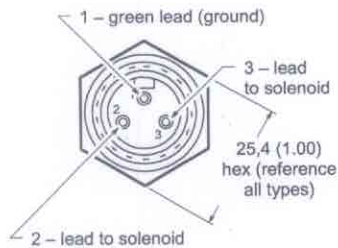
The receptacle is a standard three or five pole connector with shortened leads and terminals added. The five pole plug has four leads 101,6 (4.0) long and one 177,8 (7.0) long. The three pole plug has two leads 101,6 (4.0) long and one 177,8 (7.0). All wires have underwriters recognized non-solder insulated eyelet terminals. The green wire is used for the ground (earth) connection (No. 8 screw furnished). Valves are supplied pre-wired.

Connection details and model type/model code references



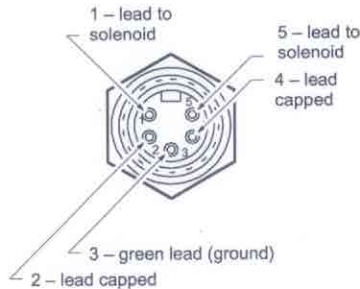
3 pin connector

Use with single solenoid valve
 Key model code designations:
 DG4V-3(S)-*A(L)(-**-)(V)M-FPA3W(L)
 DG4V-3(S)-*B(L)(-**-)(V)M-FPA3W(L)



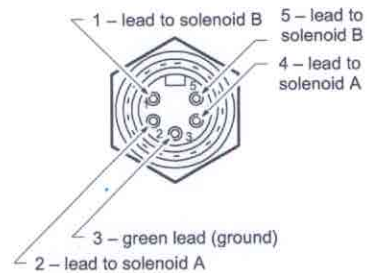
5 pin connector

Use with single solenoid valve
 Key model code designations:
 DG4V-3(S)-*A(L)(-**-)(V)M-FPA5W(L)
 DG4V-3(S)-*B(L)(-**-)(V)M-FPA5W(L)



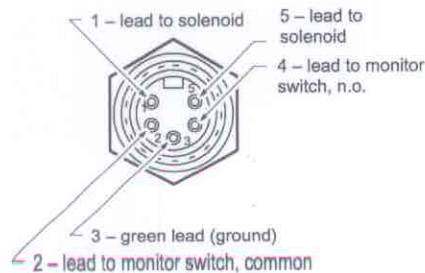
5 pin connector

Use with double solenoid valve
 Key model code designations:
 DG4V-3-*C/N(L)(-**-)(V)M-S4-FPA5W(L)



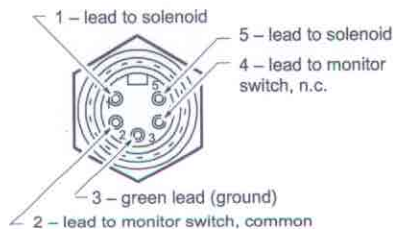
5 pin connector

Use with single solenoid valve with S3 spool position monitor switch
 Key model code designations:
 DG4V-3-*A(L)(-**-)(V)M-S3-FPA5W(L)



5 pin connector

Use with single solenoid valve with S4 spool position monitor switch
 Key model code designations:
 DG4V-3-*A(L)(-**-)(V)M-S4-FPA5W(L)



Female 3 & 5 pin connectors are available from a Daniel Woodhead Co., Brad Harrison Div. Distributor (847-272-7990)

40903 - Female connector with 12' lead for PA3 conn.

41308 - Female connector with 12' lead for PA5 conn.

These are Brad Harrison #'s.

Electrical Plugs and Connectors

DIN 43650 Connector

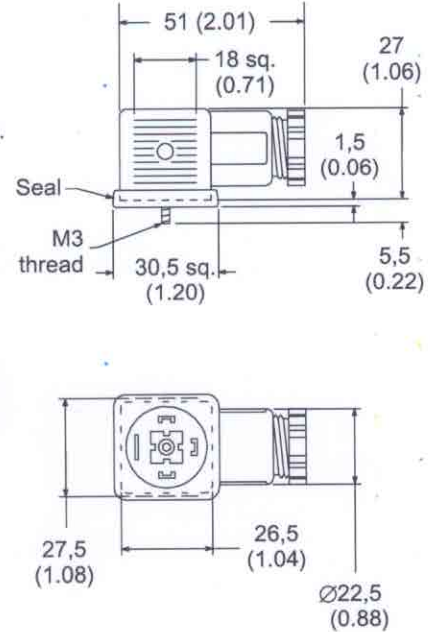
Cable diameter range ... Ø6–10 mm (0.24–0.40)
 Wire section range Ø,5–1,5 mm² (0.0008–0.0023 in²)
 Terminals Screw type
 Type of protection IEC144 class IP65, when plugs are fitted correctly to the valves with interface seals (supplied with plugs) in place.

Connector can be positioned at 90° intervals on valve by re-assembling contact holder into appropriate position inside connector housing.

Use U12 or U11 type connectors with 12 and 24V DC coils if rectification is required.

Connectors with and without indicator lights are available (order separately):

Receptacle	Voltage (AC or DC)	Part Numbers Gray – Black – "A" sol. "B" sol.
U1 Coils without lights	—	710776 710775
U6 Coils with lights	12-24 100-125 200-240	977467 977466 977469 977468 977471 977470
U11 Rectified coils with lights	12 DC 24 DC 98-240 VDC 200-240 VDC	02-141358 02-141359 02-141360 02-141361
U12 Rectified coils without lights		02-141357

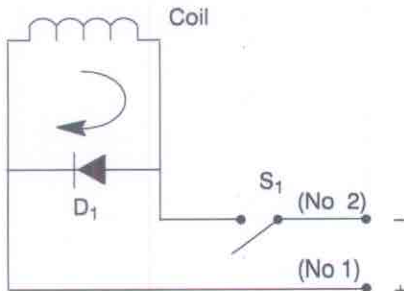


Surge Suppression Devices (For DC Valves)

Standard diode

Diode in parallel with coil. When switch (S₁) is opened, the energy stored in the coil is trapped and dissipated by the diode (D₁).

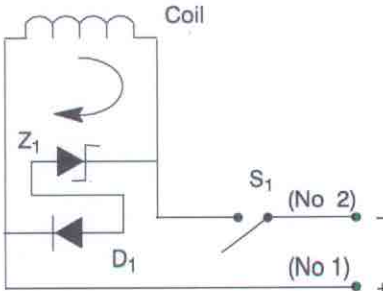
- Works only with DC voltage
- Polarity dependent
- Increases drop out time



Transzorb

Diode and Zener diode in parallel with coil. When switch (S₁) is opened, the energy stored in the coil is trapped and dissipated by the diode (D₁) and Zener diode (Z₁) and the coil resistance.

- The Zener makes exact limitation of inductive spikes.
- Works only with DC voltage
- Polarity dependent



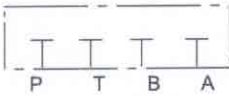
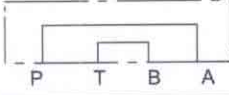
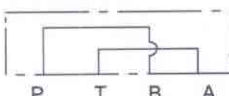
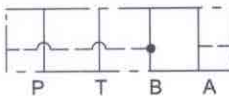
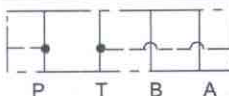
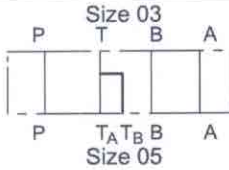
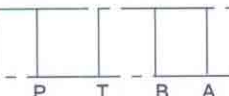
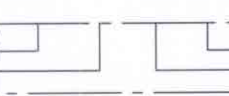
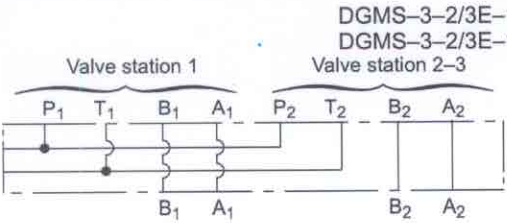
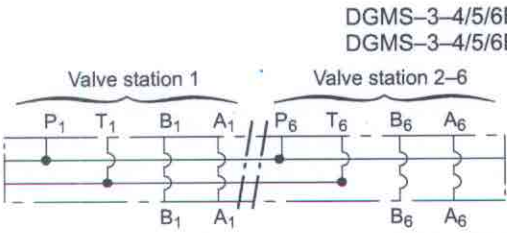
NOTE: These surge suppression devices are "Polarity Dependent." Proper biasing conditions must be met when installing/connecting a coil in a system.

Valve Shift and Dropout Times With and Without Surge Suppression

	Shift	Dropout
CETOP 3		
No Diode	23	60
Diode Alone	23	141
Diode/Zener	23	78
CETOP 5		
No Diode	70	50
Diode Alone	70	158
Diode/Zener	70	100

Times represent cessation/application of voltage to coil versus velocity (start/stop) of a cylinder using a single solenoid, spring offset valve (time in milliseconds).

Subplates, Connection Plates and Mounting Surfaces

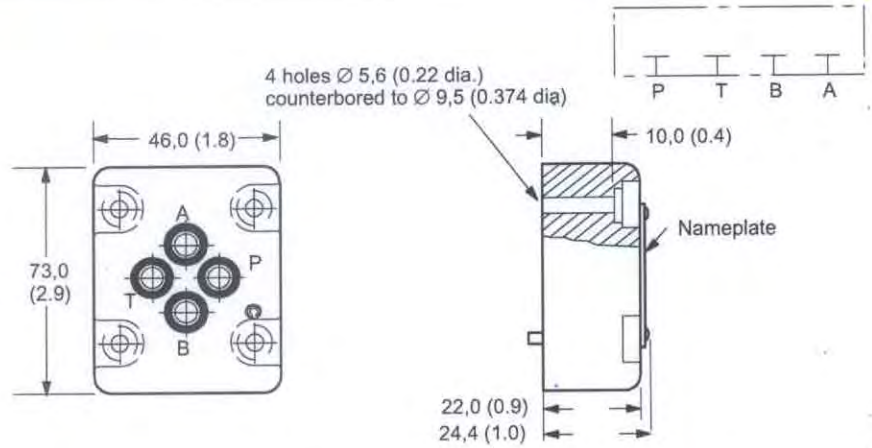
General description	Description and maximum pressure	Functional symbol	Model code
<p>This range of subplates and auxiliary connection plates are for use with size 3 valves. Optional BSPF or SAE/UNF pipe thread connections are available.</p>	<p>Blanking plate 250 bar (3600 psi)</p>		<p>DGMA-3-B-1*</p>
<p>The subplates fall into five groups:</p>	<p>Crossover plate P-A, B-T 250 bar (3600 psi)</p>		<p>DGMA-3-C1-1*</p>
<ul style="list-style-type: none"> Single station subplates with either side or rear entry ports for connecting to the main system. 	<p>Crossover plate P-B, A-T 250 bar (3600 psi)</p>		<p>DGMA-3-C2-1*</p>
<ul style="list-style-type: none"> Multi-station manifolds having from two to six stations. The two service ports per station are arranged along one side but the pressure and tank lines are internally connected in parallel to each station. 	<p>Tapping plate Ports A and B 250 bar (3600 psi)</p>		<p>DGMA-3-T1-1*-B DGMA-3-T1-1*-S</p>
<ul style="list-style-type: none"> Tapping plates for insertion under modules or valves to provide access to service lines, e.g. for pressure gage connection. 	<p>Tapping plate Ports P and T 250 bar (3600 psi)</p>		<p>DGMA-3-T2-1*-B DGMA-3-T2-1*-S</p>
<ul style="list-style-type: none"> Cross-over plates for inter-connecting two sets of service lines at the top of module stacks when directional valves are not fitted. 	<p>Adaptor size 05 to 03 207 bar (3000 psi)</p>		<p>DGAM-3-01-1*-R DGAM-3-01-1* (UNC valve mtg. bolts)</p>
<ul style="list-style-type: none"> Blanking plate for terminating a valve station e.g. when the station is not to be used until later. 	<p>Single station subplate/manifold Rear ports P,T,A,B 250 bar (3600 psi)</p>		<p>DGVM-3-1*-R DGVM-3-1*-S</p>
<p>The 2 to 6 multi-station subplates, when used together with Vickers SystemStak valves, provide very compact control assemblies.</p>	<p>Single station subplate/manifold Side ports P,T,A,B 250 bar (3600 psi)</p>		<p>DGMS-3-1E-1*-R DGMS-3-1E-1*-S</p>
<p>Plates having machined trapezoidal O-ring recesses are supplied complete with Viton O-rings.</p>	<p>Multi-station subplate/ manifold; side ports P,T,A₁,B₁,A₂,B₂, etc. 250 bar (3600 psi) 2 station 3 station</p>		<p>DGMS-3-2/3E-1*-R DGMS-3-2/3E-1*-S</p>
<p>On all models, the size 03 mounting face includes a drilled hole (for a location pin) in conformance with ANSI/B93.7M) and (NFPA) size 03. All Vickers size 3 valves and auxiliary plates contain a matching location pin to ensure correct orientation of the mounting faces.</p>	<p>Multi-station subplate/ manifold; side ports P,T,A₁,B₁,A₂,B₂, etc. 250 bar (3600 psi) 4 station 5 station 6 station</p>		<p>DGMS-3-4/5/6E-1*-R DGMS-3-4/5/6E-1*-S</p>

Design number subject to change. No change of installation dimensions for designs 10 thru 19. "R" (or "B") suffix - ISO 228 (BSPF) ports and/or metric attaching bolt tappings. "S" suffix - SAE/UNC ports and/or UNC attaching bolt tappings.

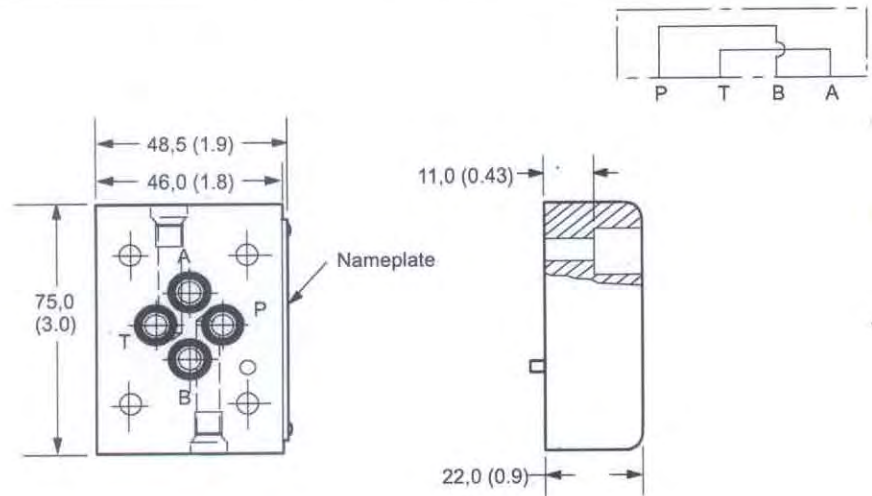
Installation Dimensions

DGMA-3-B-1* Blanking Plate

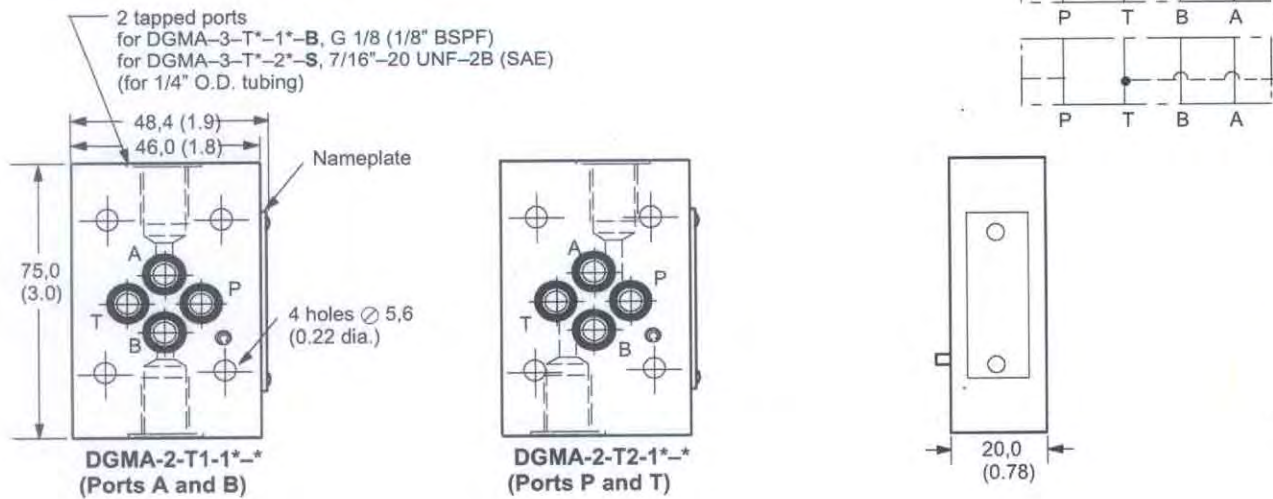
All dimensions shown in mm (inches)



DGMA-3-C2-11 Crossover Plate



DGMA-3-T*-1*-* Tapping Plate



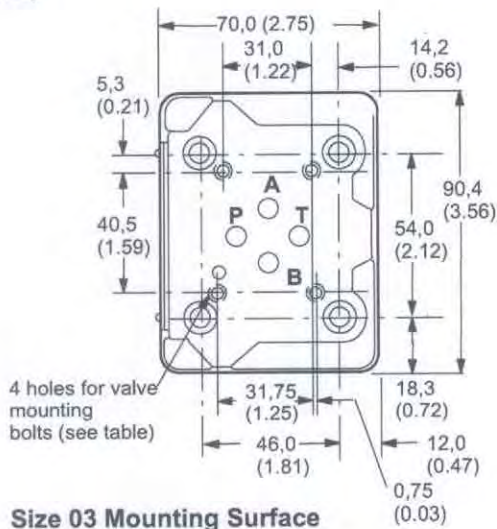
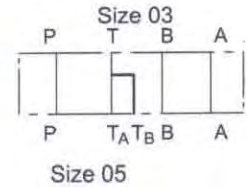
Installation Dimensions

DGAM-3-01-1*-R (Metric bolt tapping) DGAM-3-01-1* (UNC bolt tapping) Adaptor plate, Size 05 to 03 for pressure up to 210 bar (3000 psi)

Dimensions shown
in mm (inches)

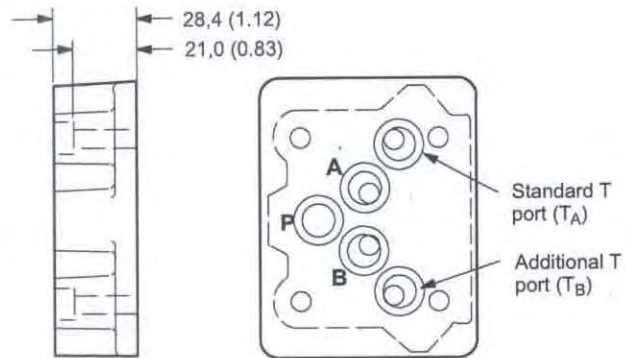
Size 3 valves can frequently be used in place of size 5 valves, typically for pilot control functions, or generally where the system flow rate is within that of size 3 valves.

The DGAM-3 adaptor bolts to an existing size 5 interface and provides a size 3 mounting face for the smaller valves.



Size 03 Mounting Surface

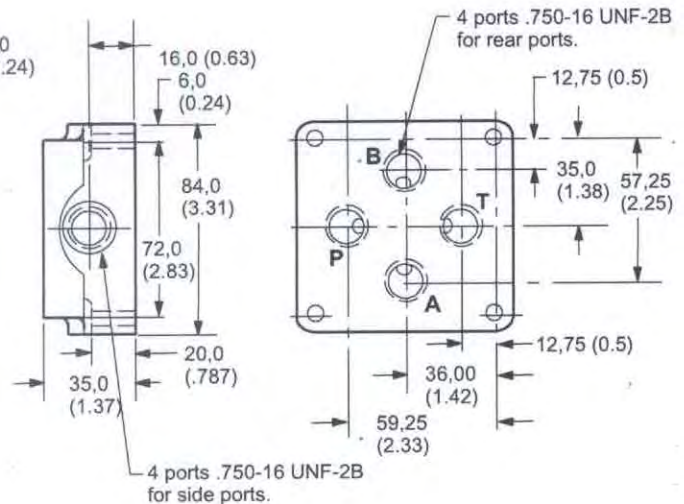
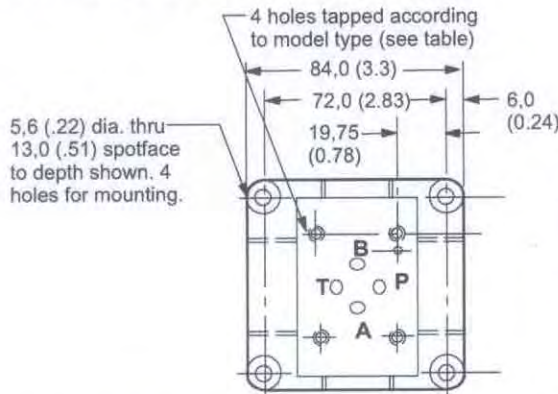
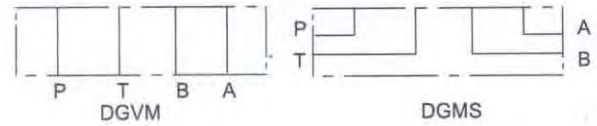
Model	Tappings for valve mounting bolts
DGAM-3-01-1*-R	M5-6H x 12 (0.47) deep
DGAM-3-01-1*	#10-24 UNC-2B x 12,7 (0.5) deep



**Size 05 Mounting Surface
(seals included)**

Adaptor is supplied complete with bolts for mounting to size 5 interface: M6 bolts with type DGAM-3-01-1*-R 1/4"-20 UNC bolts with type DGAM-3-01-1*

DGVM-3-1*-* DGMS-3-1E(Y)-1*-* Single station subplate, rear and side tapped port

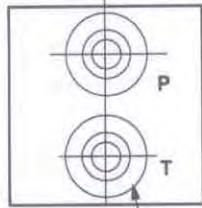
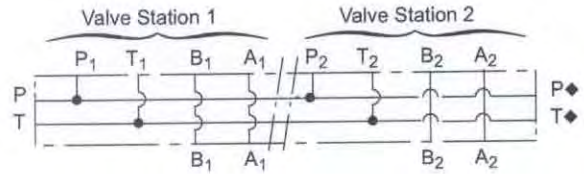


Model	Ports P, A, T, B at rear or side	Thread
DGVM-3-1*-R	Rear	G3/8 (3/8" BSPF) x 12,0 (0.47) deep
DGMS-3-1E-1*-R	Side	3/4" 16 UNF-2B x 14,3 (0.56) deep (SAE)
DGVM-3-1*-S	Rear	5/8" 18 UNF-2B x 12,7 (0.5) deep (SAE)
DGMS-3-1EY-1*-S*	Side	3/4" 16 UNF-2B x 14,3 (0.56) deep (SAE)

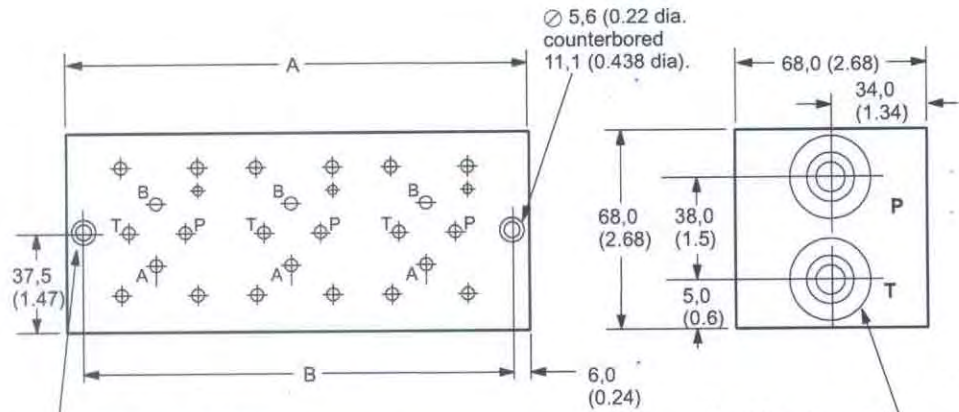
Installation Dimensions

DGMS-3-3E-1*-* Multi-station subplate (3 station shown)

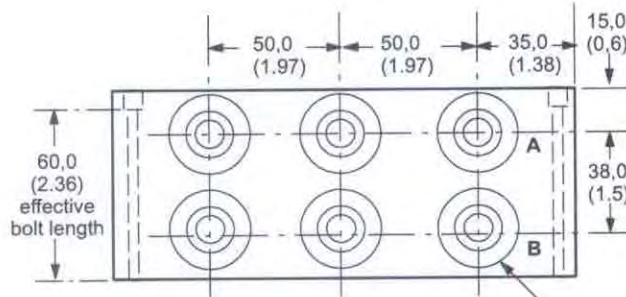
Dimensions shown in mm (inches)



These two ports are present in 4, 5, and 6 station models. Optional in 2 and 3 station models, specify DGMS-3-2EX-1*-* or DGMS-3-3EX-1*-*



P and T ports tapped according to model type:
DGMS-*E(X)-1*-R:
G1/2 (1/2" BSPF)
DGMA-*E(X)-1*-S:
3/4-16 UNF-2B (SAE)



A and B ports tapped according to model type:
DGMS-*E(X)-1*-R:
G3/8 (3/8" BSPF)
DGMA-*E(X)-1*-S:
3/4-16 UNF-2B (SAE)

Model	A Dim.	B Dim.
DGMS-3-2E(X)-1*-*	121 (4.8)	108 (4.25)
DGMS-3-3E(X)-1*-*	171 (6.8)	158 (6.22)
DGMS-3-4E-1*-*	221 (8.7)	208 (8.19)
DGMS-3-5E-1*-*	271 (10.7)	258 (10.15)
DGMS-3-6E-1*-*	321 (12.7)	308 (12.12)

◆ Thru connection P and T ports on types DGMS-3-2EX-1*-* and DGMS-3-3EX-1*-*

Installation Dimensions

Mounting Surface

Dimensions shown in mm (inches ▲)

When a subplate is not used, a machined pad must be provided for mounting. The pad must be flat within 0,01 mm per 100 mm (0.0001" per 1") and smooth within 0,8 μm (32 μin).

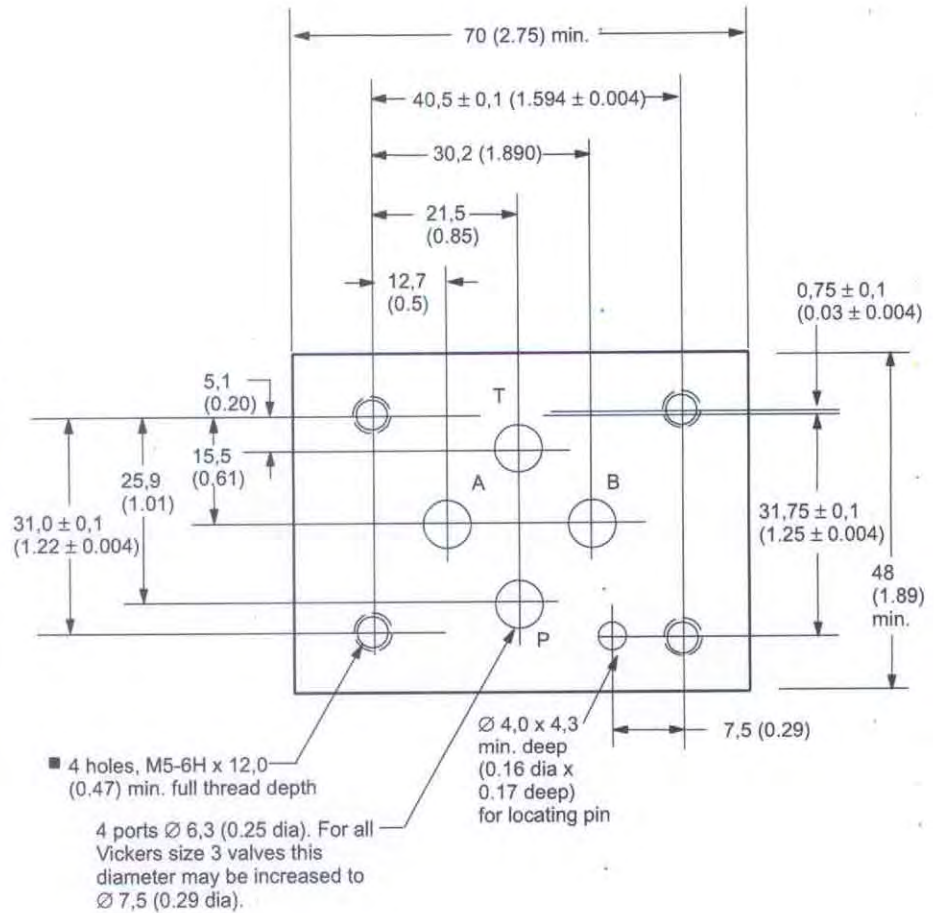
The interface conforms to ISO 4401-AB-03-4A (size 03) plus location pin hole
ANSI/B93.7M (and NFPA) size 03
CETOP R35H4.2-03, plus location pin hole
DIN 24340 Form A6, plus location pin hole

Dimensional tolerance = ±0,2 (±0.008) except where otherwise stated.

Prior to installing a valve, ensure that both valve and mounting surface are clean and free from burrs.

▲ ISO 4401 gives dimensions in mm. Inch conversions are accurate to 0.01" unless stated.

■ #10-24 UNC-2B optional



Appendix

Mounting Bolts

Inch bolt kits, #10–24 UNC–2B

Size x length, in (mm)	
#10-24 x 12,7 (0.50)	BK590715
#10-24 x 19,05 (0.75)	BK466847
#10-24 x 25,4 (1.00)	BK304
#10-24 x 31,8 (1.25)	BK590716
#10-24 x 38,1 (1.50)	BK306
#10-24 x 44,4 (1.75)	BK02-156494
#10-24 x 50,8 (2.00)	BKDG3698
#10-24 x 57,2 (2.25)	BK02-139165
#10-24 x 60,3 (2.38)	BK466849
#10-24 x 69,9 (2.75)	BK870017
#10-24 x 69,9 (2.75)	BKDGfNL694M◆
#10-24 x 76,2 (3.00)	BK02-156496
#10-24 x 79,4 (3.13)	BK466850
#10-24 x 88,9 (3.50)	BK466851
#10-24 x 95,3 (3.75)	BK869704
#10-24 x 100 (3.94)	BK466852
#10-24 x 101,6 (4.00)	BK02-156497
#10-24 x 109,5 (4.31)	BK466853
#10-24 x 120,7 (4.75)	BK466854
#10-24 x 127,0 (5.00)	BK02-156499
#10-24 x 130,2 (5.13)	BK466855
#10-24 x 133,4 (5.25)	BK02-156498
#10-24 x 139,7 (5.50)	BK466856
#10-24 x 150,9 (5.94)	BK466857
#10-24 x 160,3 (6.31)	BK466858
#10-24 x 170,0 (6.69)	BK466859
#10-24 x 177,8 (7.00)	BK890325

Metric bolt kits, M5

Size x length, mm (in)	
M5 x 20 (0.79)	BK466834M
M5 x 25 (0.98)	BK466723M
M5 x 30 (1.18)	BK616452M
M5 x 40 (1.57)	BK02-156493M
M5 x 50 (1.97)	BKDG3699M
M5 x 55 (2.17)	BK986135M
M5 x 60 (2.36)	BK466836M
M5 x 70 (2.76)	BK464125M
M5 x 75 (2.95)	BK869720M
M5 x 80 (3.15)	BK466837M
M5 x 90 (3.54)	BK466838M
M5 x 95 (3.74)	BK869721M
M5 x 100 (3.94)	BK466839M
M5 x 110 (4.33)	BK466840M
M5 x 120 (4.72)	BK466841M
M5 x 130 (5.12)	BK466842M
M5 x 140 (5.51)	BK466843M
M5 x 150 (5.91)	BK466844M
M5 x 160 (6.30)	BK466845M
M5 x 170 (6.69)	BK466846M
M5 x 200 (7.87)	BK464468M

Metric bolt kits, M6

Size x length, mm (in)	
M6 x 16 (0.63)	BK534564M
M6 x 20 (0.79)	BK534565M
M6 x 25 (0.98)	BK534566M
M6 x 30 (1.18)	BK534567M
M6 x 40 (1.57)	BKDG01633M◆
M6 x 45 (1.77)	BK534569M
M6 x 50 (1.97)	BK534570M
M6 x 55 (2.17)	BK534571M
M6 x 65 (2.56)	BK534572M
M6 x 70 (2.76)	BK534573M
M6 x 75 (2.95)	BK534574M
M6 x 80 (3.15)	BK638873M
M6 x 80 (3.15)	BKDGfN01637M◆
M6 x 85 (3.35)	BK978478M
M6 x 90 (3.54)	BK534576M
M6 x 100 (3.94)	BK978479M
M6 x 110 (4.33)	BK978480M
M6 x 115 (4.53)	BK534580M
M6 x 120 (4.72)	BK534581M
M6 x 140 (5.51)	BK638878M

Note: If not using Vickers bolt kits, bolts must be to Grade 12.9 (ISO 898) or better.

The required bolt length should allow 0.40" (10 mm) thread engagement in the subplate/manifold block. Bolts should be torqued to 5–7 N.m (44–62 lbf. in.) with threads lubricated. Prior to installation of DG4V-3 valve, ensure that both the face of the valve and the face on which it is being mounted (i.e subplate, manifold, SystemStak valve or plate) is as clean as possible. Do not over tighten hold-down bolts beyond recommended values.

Appendix

Spare parts data

Refer to service drawing I-3886-S for spare parts and kit information.

Seal kits

For valves with spool indicator switch, model types DG4V-3-*A---M-S*---60 kit no. 859049
 For other models seal kits vary according to type of coil fitted:
 For "U" type coil kit no. 858995
 For "F" type coil kit no. 858996

Note: Each seal kit covers a variety of models and may have redundant seals for a particular model.

Solenoid Coils

AC coils

Code	Voltage/ frequency	Standard performance		High performance	
		"U" type	"F" type	"U" type	"F" type
Full power coils:					
A	110V/50 Hz	02-101725	02-101730	507825	508166
B	110/120V/50/60 Hz	02-101726	02-101731	507833	508169
C	220V/50 Hz	02-101727	02-101732	507826	508167
D	220/240V/50/60 Hz	02-101728	02-101733	507834	508170
Low power coils:					
BL	110/120V/50/60 Hz	N/A	N/A	598562	698563
DL	220/240V/50/60 Hz	N/A	N/A	866455	866457

DC coils (Standard and high performance)

Code	Voltage	"U" type	"F" type	"SP1" type	"SP2" type	"KU" type
Full power coils:						
G	12V	507847	508172	02-111246	02-111166	02-140394
H	24V	507848	508173	02-111248	02-111168	02-140395
Low power coils:						
GL	12V	507855	508175	N/A	N/A	N/A
HL	24V	507852	508174	N/A	N/A	N/A

Mass, approx. kg (lb)

DG4V-3 and DG4V-3S (DC)	"U" coils	"F" coils
Single sol. valve	1,6 (3.5)	1,8 (4.0)
Double sol. valve	2,2 (4.8)	2,3 (5.0)
DG4V-3 and DG4V-3S (AC)	"U" coils	"F" coils
Single sol. valve	1,5 (3.3)	1,6 (3.5)
Double sol. valve	1,8 (4.0)	2,0 (4.4)
Single sol. valve w/ position switch	2,0 (4.4)	2,0 (4.4)

Mounting Attitude

No restrictions except for no-spring, detented models DG4V-3-*N and DG4V-3S-*N which should be mounted with the spool axis horizontal. These model types may be affected by severe vibration or shock, especially if a solenoid is not held energized.



ViEX Inc

1201 Nicholson Road
Newmarket, Ontario, Canada, L3Y 7V1
Tel: 905 954 1325 Fax: 905 954 1391
e-mail: info@viex.com www.viex.com

LETTER OF TRANSMITTAL

Company: Enerflex Compression	Date: June 21, 2006
Address: 4700-47 Street SE	
City: Calgary	Prov/State: AB
Country:	Postal Code/Zip Code: T2B 3R1
For the Attention of: Rajeev Joshi	

By Mail Courier Courier Air Fax E-Mail Other _____

The Status of the enclosures is indicated in the column below.

Item	Document	Rev. #	Quantity	Status	Remark
1	U-1 Manufacturer's Data Report		1	1	WO# 271222
2					
3					
4					
5					

Status:

1 – For your Information	5 – For your Approval – <i>please sign, date and mark corrections/comments/approval and return to us for processing.</i>
2 - For your record – <i>please acknowledge on receipt</i>	6 – As Requested – <i>please acknowledge on receipt</i>
3 – As Built	7 – Fully Approved
4 – Approved subject to comment	8 - Other

Signed For Mohammad Ghahremani

Cc: File

FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by ViEX Inc. 1201 Nicholson Road, Newmarket, Ontario, Canada, L3Y 9C3
(Name and address of Manufacturer)
2. Manufactured for Enerflex Compression 4700-47 Street SE Calgary AB Canada T2B 3R1
(Name and address of purchaser)
3. Location of installation Unknown
(Name and address)
4. Type Vertical VXN36 Plate & Frame Heat Exchanger 271222.11
(Horiz. vert. or sphere) (Tank, separator, jkt. vessel, heat exh., etc..) (Mfg's serial No.)
R5690.213 VXN36-G-400 Rev 0 None 2006
(CRN) (Drawing No.) (Nat'l Bd. No.) (Year built)
5. ASME Code, Section VIII, Division 1 2004 Ed. 05 Add. None No
(Edition and Addenda (date)) (Code Case No.) (Special Service per UG-120(d))

Items 6 - 11 incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multichamber vessels

6. Shell: (a) No. of course(s): -- (b) Overall length (ft & in.): 4' - 0.06"

Course(s)			Material	Thickness		Long. Joint (Cat.A)			Circum. Joint (Cat. A,B,&C)			Heat Treatment	
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type	Nom	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--

7. Heads: (a) SA516 Gr 70 (b) SA516 Gr 70
(Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp) (Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
(a)	Fixed Head	2.75"	--	--	--	--	--	--	19.75X54.00'	--	--	--	--	--
(b)	Mobile Head	2.00"	--	--	--	--	--	--	19.75X53.00'	--	--	--	--	--

- If removable, bolts used (describe other fastenings) 164 Tie Rods SA193 Gr B7 / Hex Nuts SA194 Gr 2H (1 1/4"-8UN)
(Mat'l, Spec No., Grade, Size, No.)

8. Type of jacket n/a Jacket closure n/a
(Describe as ogee & weld, bar, etc.)
If bar, give dimensions n/a If bolted, describe or sketch.

9. MAWP 400 none psi at max. temp. 250 n/a °F Min. design metal temp. -20 °F at 400 psi.
(internal) (external) (internal) (external)

10. Impact test No (Impact Test Exemption Per UCS-66(a)) at test temperature of n/a °F.
(Indicate yes or no and the component(s) impact tested)

11. Hydro., pneu., or comb. test press. 520 psig Proof test n/a

Items 12 and 13 to be completed for tube sections.

12. Tubesheet: -- -- -- -- --
(Stationary (Mat's Spec.No.)) (Dia. in. (subject to press)) (Nom. thk. in.) (Corr.Allow.in.) (Attachment (welded or bolted))
-- -- -- -- --
(Floating (Mat'l Spec.No.)) (Dia., in.) (Nom. thk., in.) (Corr.Allow.in.) (Attachment)

13. Tubes: -- -- -- --
(mat'l Spec. No., Grade or Type) (O.D., in.) (Nom, thk, in. or gauge) (Number) (Type (Straight or U))

Items 14 - 18 incl. to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14. Shell (a) No. of course(s): -- (b) Overall length (ft & in.): --

Course(s)			Material	Thickness		Long. Joint (Cat.A)			Circum. Joint (Cat. A,B,&C)			Heat Treatment	
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type	Nom	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
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15. Heads: (a) -- (b) --
(Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp) (Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
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- If removable, bolts used (describe other fastenings) --
(Mat'l, Spec No., Grade, Size, No.)

FORM U-1 (Back)

16. MAWP 400 none psi at max. temp. 250 none °F. Min. design metal temp. -20 °F at 400 psi.
(internal) (external) (internal) (external)

17. Impact test No (Impact Test Exemption Per UCS-66(a)) at test temperature of n/a °F.
(Indicate: yes or no and the component(s) impact tested)

18. Hydro., pneu., or comb. test press. 520.0 psig Proof test n/a

19. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No	Diameter or Size	Flange Type	Material		Nozzle Thickness		Reinforcement Material	How Attached		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Hot Side Inlet	F4	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Hot Side Outlet	F1	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Cold Side Inlet	F2	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Cold Side Outlet	F3	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--

20. Supports: Skirt No Lugs No Legs No Others Feet Attached Bolted to fixed head/end post
(Yes or No) (No.) (No.) (Describe) (Where and how)

21. Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: (List the name of part, item number, mig's. name and identifying number)

--

--

22. Remarks: (1) Each heat exchanger consists of 105 gasketed heat transfer plates which are clamped between fixed & mobile heads by tie rods.
 (2) Heat transfer plate material -SA240 304 (3) Heating surface is 399.00sq.ft. (4) Inspection openings are not applicable (5) Safety relief devices per UG-125 are the responsibility of the user. (6) Volume per circuit is 15.47US gal.
 (7) Both circuits have same design conditions.

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

U Certificate of Authorization No. 32.742 Expires Aug 17, 2007
 Date 8/06/2006 Name ViEX Inc. Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and / or the State or Province of Ontario and employed by TSSA of Ontario have inspected the pressure vessel described in this Manufacturer's Data Report on 8-JUNE-2006, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 8-JUNE-2006 Signed [Signature] Commissions [Signature]
(Authorized Inspector) (Nat'l Board (incl. endorsements) State, Province and No.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the statements on this report are correct and that the field assembly construction of all parts of this vessel conforms with the requirements of ASME Code, Section VIII, Division 1. U Certificate of Authorization No. _____ Expires _____

Date _____ Name _____ Signed _____
(Assembler) (Representative)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of _____ and employed by _____, have compared the statements in this Manufacturer's Data Report with the described pressure vessel and state that parts referred to as data items _____, not included in the certificate of shop inspection, have been inspected by me and to the best of my knowledge and belief, the Manufacturer has constructed and assembled this pressure vessel in accordance with the ASME Code, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of _____ psi. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date _____ Signed _____ Commissions _____
(Authorized Inspector) (Nat'l Board (incl. endorsements) State, Province and No.)

FORM U-1 MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by ViEX Inc. 1201 Nicholson Road, Newmarket, Ontario, Canada, L3Y 9C3
(Name and address of Manufacturer)
2. Manufactured for Enerflex Compression 4700-47 Street SE Calgary AB Canada T2B 3R1
(Name and address of purchaser)
3. Location of installation Unknown
(Name and address)
4. Type Vertical VXN36 Plate & Frame Heat Exchanger 271222.12
(Horiz, vert, or sphere) (Tank, separator, jkt, vessel, heat exh., etc..) (Mfg's serial No.)
R5690.213 VXN36-G-400 Rev 0 None 2006
(CRN) (Drawing No.) (Nat'l Bd. No.) (Year built)
5. ASME Code, Section VIII, Division 1 2004 Ed. 05 Add. None No
(Edition and Addenda (date)) (Code Case No.) (Special Service per UG-120(d))

Items 6 - 11 incl. to be completed for single wall vessels, jackets of jacketed vessels, shell of heat exchangers, or chamber of multichamber vessels

6. Shell: (a) No. of course(s): -- (b) Overall length (ft & in.): 4' - 0.06"

Course(s)			Material		Thickness		Long. Joint (Cat. A)			Circum. Joint (Cat. A, B, & C)			Heat Treatment	
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type		Nom	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
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7. Heads: (a) SA516 Gr 70 (b) SA516 Gr 70
(Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp) (Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
(a)	Fixed Head	2.75"	--	--	--	--	--	--	19.75X54.00'	--	--	--	--	--
(b)	Mobile Head	2.00"	--	--	--	--	--	--	19.75X54.00'	--	--	--	--	--

- If removable, bolts used (describe other fastenings) 16 Tie Rods SA193 Gr B7 / Hex Nuts SA194 Gr 2H (1 1/4"-8UN)
(Mat'l, Spec No., Grade, Size, No.)

8. Type of jacket n/a Jacket closure n/a
(Describe as ogee & weld, bar, etc.)
If bar, give dimensions n/a If bolted, describe or sketch.

9. MAWP 400 none psi at max. temp. 250 n/a °F Min. design metal temp. -20 °F at 400 psi.
(internal) (external) (internal) (external)

10. Impact test No (Impact Test Exemption Per UCS-66(a)) at test temperature of n/a °F.
(Indicate yes or no and the component(s) impact tested)

11. Hydro., pneu., or comb. test press. 520 psig Proof test n/a

Items 12 and 13 to be completed for tube sections.

12. Tubesheet: -- -- -- --
(Stationary (Mat'l Spec. No.)) (Dia. In. (subject to press)) (Nom. thk. in.) (Corr. Allow. in.) (Attachment (welded or bolted))
-- -- -- --
(Floating (Mat'l Spec. No.)) (Dia. in.) (Nom. thk. in.) (Corr. Allow. in.) (Attachment)

13. Tubes: -- -- -- --
(mat'l Spec. No., Grade or Type) (O.D., in.) (Nom. thk. in. or gauge) (Number) (Type (Straight or U))

Items 14 - 18 incl. to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14. Shell: (a) No. of course(s): -- (b) Overall length (ft & in.): --

Course(s)			Material		Thickness		Long. Joint (Cat. A)			Circum. Joint (Cat. A, B, & C)			Heat Treatment	
No	Diameter, in	Length (ft & in.)	Spec./Grade or Type		Nom	Corr	Type	Full, Spot, None	Eff	Type	Full, Spot, None	Eff	Temp	Time
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15. Heads: (a) -- (b) --
(Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp) (Mat'l Spec. No., Grade or Type) (H.T. - Time & Temp)

	Location (Top, Bottom, Ends)	Thickness		Radius		Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure		Category A		
		Min.	Corr.	Crown	Knuckle					Convex	Concave	Type	Full, Spot, None	Eff
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- If removable, bolts used (describe other fastenings) --
(Mat'l, Spec No., Grade, Size, No.)

FORM U-1 (Back)

16. MAWP 400 none psi at max. temp. 250 none °F. Min. design metal temp. -20 °F at 400 psi.
(internal) (external) (internal) (external)

17. Impact test No (Impact Test Exemption Per UCS-66(a)) at test temperature of n/a °F.
(Indicate yes or no and the component(s) impact tested)

18. Hydro., pneu., or comb. test press. 520.0 psig Proof test n/a

19. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Flange Type	Material		Nozzle Thickness		Reinforcement Material	How Attached		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Hot Side Inlet	F4	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Hot Side Outlet	F1	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Cold Side Inlet	F2	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--
Cold Side Outlet	F3	3"-300#	stud port	--	SA-A105	--	--	--	--	integral	--

20. Supports: Skirt No Lugs No Legs No Others Feet Attached Bolled to fixed head/end post
(Yes or No) (No.) (No.) (Describe) (Where and how)

21. Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: (List the name of part, item number, mfg's. name and identifying number)
 --
 --

22. Remarks: (1) Each heat exchanger consists of 105 gasketed heat transfer plates which are clamped between fixed & mobile heads by tie rods.
 (2) Heat transfer plate material -SA240 304 (3) Heating surface is 399.00sq.ft. (4) Inspection openings are not applicable (5) Safety relief devices per UG-125 are the responsibility of the user. (6) Volume per circuit is 15.47US gal.
 (7) Both circuits have same design conditions.

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

U Certificate of Authorization No. 32.742 Expires Aug 17, 2007

Date 15/06/2006 Name VIEX Inc. Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and / or the State or Province of Ontario and employed by TSSA of Ontario have inspected the pressure vessel described in this Manufacturer's Data Report on 15 JUNE 2006, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 15 JUNE 2006 Signed [Signature] Commissions Ontario
(Authorized Inspector) (Nat'l Board (incl. endorsements) State, Province and No.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the statements on this report are correct and that the field assembly construction of all parts of this vessel conforms with the requirements of ASME Code, Section VIII, Division 1. U Certificate of Authorization No. _____ Expires _____

Date _____ Name _____ Signed _____
(Assembler) (Representative)

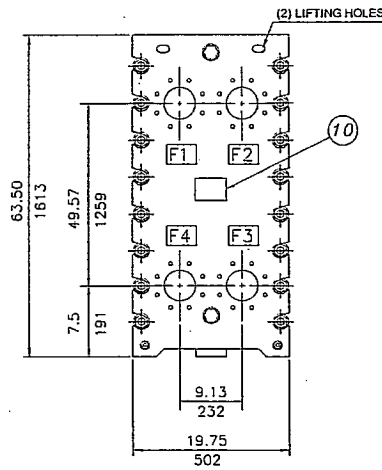
CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of _____ and employed by _____ of _____, have compared the statements in this Manufacturer's Data Report with the described pressure vessel and state that parts referred to as data items _____, not included in the certificate of shop inspection, have been inspected by me and to the best of my knowledge and belief, the Manufacturer has constructed and assembled this pressure vessel in accordance with the ASME Code, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of _____ psi. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

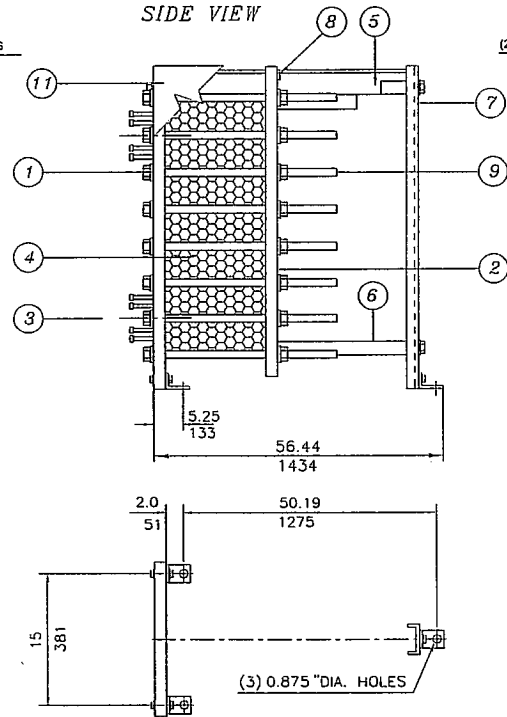
Date _____ Signed _____ Commissions _____
(Authorized Inspector) (Nat'l Board (incl. endorsements) State, Province and No.)

Dwg: Fm/VIEX

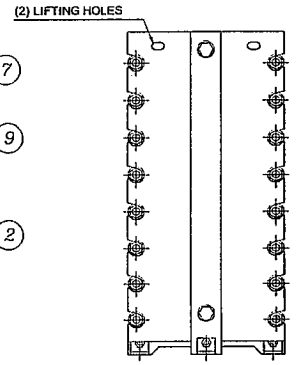
FIXED HEAD VIEW



SIDE VIEW



MOBILE HEAD VIEW



Inches
mm

CERTIFIED BY VIEX Inc.
CHANNEL "A" 400 PSI @ 250.0 F
MDMT -20.0 F @ 400 PSI
CHANNEL "B" 400 PSI @ 250.0 F
MDMT -20.0 F @ 400 PSI
SERIAL NUMBER 271236.11 - 13
YEAR BUILT 2006
CRN R5668.123 ON

ASME VIEX Inc.
ENGINEERING DRAWING RELEASE
 1ST ISSUE APPROVED BY MS
 RE-ISSUE
REVISION NO. 0
W.O. 271236
DATE: June 22, 2006

EXCHANGER DATA		HOT SIDE	COLD SIDE
FLUID TYPE	NGP-150	Ethylene Glycol (35%)	
FLOW RATE	US GPM 175.00	260.00	
TEMPERATURE IN/OUT	F 205.0 - 160.0	129.5 - 144.0	
PRESSURE DROP	PSI 5.44	4.85	
PLATES	SA240-SS304		
GASKETS	Nitrile	Nitrile	
NOZZLES	Carbon Steel	Carbon Steel	
NUMBER OF PASSES	1	1	
DESIGN PRESSURE	PSig 400.0	400.0	
TEST PRESSURE	PSig 520.00	520.00	
MAX. DESIGN TEMP.	F 250.0	250.0	
MIN. DESIGN TEMP.	F -20.0	-20.0	
WEIGHT empty/filled	lb 3073.00 / 3447.00		
FINISH / COLOUR	Epoxy Paint / Blue		
AREA	sqft 599.00	No. of Ass'y	3 UNITS

PARTS LIST

ITM	QTY	DESCRIPTION	DIM.	DRAWING NO.	MATERIAL
1	1	FIXED HEAD	3.5	VXN46-G-400	SA 516 GR.70
2	1	MOBILE HEAD	2.5	VXN46-G-400	SA 516 GR.70
3	4	CONNECTION		(SEE DETAIL)	
4	123	PLATE AND GASKET		(SEE DETAIL)	
5	1	TOP GUIDE BAR	50	VXN46-G-400	A - 36
6	1	BOTTOM GUIDE BAR	50	VXN46-G-400	A - 36
7	1	END POST		VXN46-G-400	A - 36
8	1	ROLLER ASSEMBLY			
9	16	TIE ROD 1 1/4-8UN	36	VXN46-G-400	SA 193 GR. B7
10	1	NAME PLATE SET			STAINLESS
11	1	SHROUD	16 GA		ALUMINUM

UNIT(S) DESIGNED IN ACCORDANCE WITH ASME CODE SECTION VIII, DIV.1 2004 EDITION, 05 ADDENDA REGISTERED WITH PROVINCES OF AB, BC, SK UNDER CRN R5668.123

GLUED GASKETING SYSTEM			
QTY PER UNIT	PLATE Std	GASKET	
1	0.7mm SA240-SS304	Nitrile	
1	FIRST CHP STD	4CR	
121	CHP STD	STD	
1	LAST CHP 4F	STD	

CONNECTIONS			
NO.	SIZE	DESCRIPTION	
F2	3" #300	STUDDED	COLD SIDE IN
F3	3" #300	STUDDED	COLD SIDE OUT
F4	3" #300	STUDDED	HOT SIDE IN
F1	3" #300	STUDDED	HOT SIDE OUT

"U" STAMP

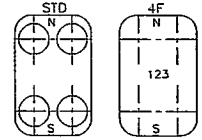
THIS DRAWING IS THE PROPERTY OF VIEX AND IS LOANED SUBJECT TO RETURN ON DEMAND. IT IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO THE INTEREST OF VIEX DIRECTLY OR INDIRECTLY.

NO	BY	CHK	REVISION	DATE

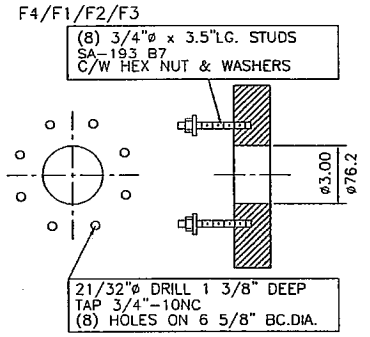
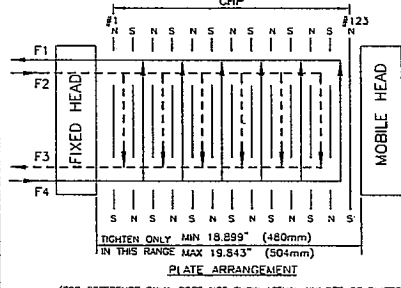
VIEX Inc.
1201 Nicholson Road, Newmarket, Ontario Canada L3Y 9C3
TEL: (905) 954-1325 FAX: (905) 954-1391

TITLE: PHE General Arrangement
MODEL: VXN46-SS-FS-1-150/123
CUSTOMER: ENERFLEX COMPRESSION

NOT TO SCALE	DATE	P.O.	WORK ORDER NO.
BY <u>MS</u>	06/20/06	0661606	271236
CHECKED <u>MS</u>	SERIAL NO.	DRAWING NO.	REV.
	271236.11 - 13	V-271236-1	0



--- COLD SIDE: Ethylene Glycol (35%)
HOT SIDE: NGP-150



M:\V\explate\2712\271236-46-123-1.dwg, Layout1

(FOR REFERENCE ONLY, DOES NOT SHOW ACTUAL NUMBER OF PLATES)

ENERFLEX

DRIVE TRAIN



RINGFEDER
RINGFEDER CORP.
WESTWOOD, NJ 07675
TEL. (201) 666-3320

TITLE **ARCUSAFLEX® – FLYWHEEL COUPLING**
Assembly and Alignment Instructions

DWG NO: 43-91.1050

DRAWN: MN DATE: 11-27-00

PG. 1 of 2

This drawing and the information contained on it are confidential and proprietary, and any reproduction, distribution or disclosure of this drawing or information or any manufacturing of the products or parts depicted on it are expressly prohibited without the written consent of Ringfeder Corporation.
All function values, dimensions and technical data stated in our design proposals are based on proven methods of calculation, backed by our empirical values and therefore, apply to original RINGFEDER® products only.

Correct torque settings for flywheel flange couplings type AC-T, AC-F2 and AC-F2K.

It is important to assure that cast aluminum flange is bolted to the diesel engine flywheel with the correct tightening torque and to check again before start-up that all bolts have been properly tightened. Similarly the taper bushing bolts must also be correctly tightened.

Note: Detailed assembly instructions are available for each coupling upon request.

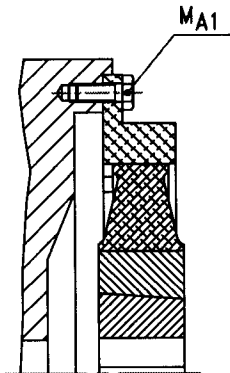


Table 1
Tightening torques for flywheel flange bolts
(bolt grade: 8.8)

SAE Flywheel flange	6 1/2	7 1/2	8	10	11 1/2	14	16	18	21	24
Bolt Size (metric)	M8		M10			M12		M16		M20
Tightening Torque MA1	Nm 25 lb-in 221		Nm 50 lb-in 442			Nm 85 lb-in 752		Nm 210 lb-in 1860		Nm 420 lb-in 3700
Bolt Size (inch)	5/16-18		3/8-16			1/2-13		5/8-11		3/4-10
Tightening Torque MA1	Nm 24 lb-in 212		Nm 42 lb-in 372			Nm 102 lb-in 903		Nm 203 lb-in 1800		Nm 340 lb-in 3010

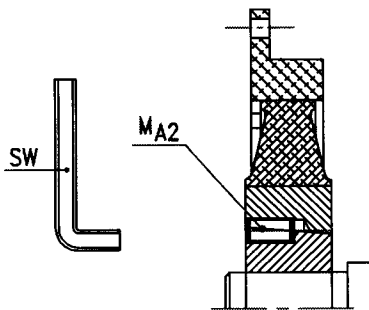


Table 2
Tightening torques for taper bushing screws

Coupling size	AC-T2 AC-T2.3	AC-T2.6 AC-T3	AC-T4	AC-T5	AC-T6	AC-T7
Taper Bushing Size	2012	2517	3030	3535	4040	4545
Bolt size	7/16"	1/2"	5/8"	1/2"	5/8"	3/4"
Bolt qty	2	2	2	3	3	3
MA2 tightening torque	UNC Nm 31 lb-in 274	UNC Nm 49 lb-in 434	UNC Nm 92 lb-in 814	UNC Nm 115 lb-in 1020	UNC Nm 172 lb-in 1520	UNC Nm 195 lb-in 1725
Key Size SW (inch)	7/32"	1/4"	5/16"	1/4"	5/16"	3/8"

Please note that bolts are to be lightly greased or oiled.
Refer to detailed assembly instructions

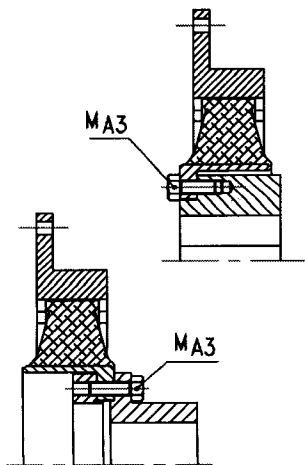


Table 3
Tightening torques for hub bolts (grade: 8.8) of coupling design AC...F2 and AC...F2K

Coupling Size	AC-2 AC-2.3	AC-2.6 AC-3 AC-4	AC-5 AC-6	AC-7 AC-8/8D AC-9/9D	AC10/10D AC11/11D AC 12	AC 12D		
Bolt Size	M8	M12	M16	M16	M20	M24 (10.9)		
Tightening Torque MA3	Nm 25 lb-in 221	Nm 85 lb-in 752	Nm 210 lb-in 1860	Nm 210 lb-in 1860	Nm 420 lb-in 3720	Nm 420 lb-in 3720	Nm 710 lb-in 6280	Nm 1000 lb-in 8850



RINGFEDER
RINGFEDER CORP.
WESTWOOD, NJ 07675
TEL. (201) 666-3320

TITLE **ARCUSAFLEX® – FLYWHEEL COUPLING**
Assembly and Alignment Instructions

DWG NO: 43-91.1050

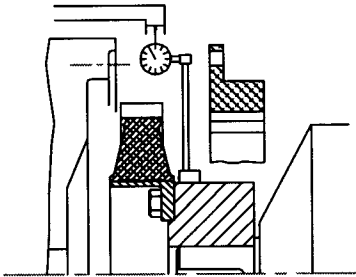
This drawing and the information contained on it are confidential and proprietary, and any reproduction, distributions or disclosure of this drawing or information or any manufacturing of the products or parts depicted on it are expressly prohibited without the written consent of Ringfeder Corporation.
All function values, dimensions and technical data stated in our design proposals are based on proven methods of calculation, backed by our empirical values and therefore, apply to original RINGFEDER® products only.

DRAWN: MN DATE: 11-27-00

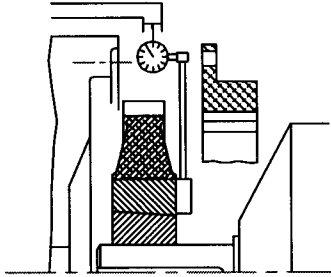
PG. 2 OF 2

It is essential to align the shaft of the driven machine with the diesel engine hub prior to positioning and securing the flywheel flange for the ARCUSAFLEX™ coupling to function correctly and to achieve the maximum rubber element life expectancy.

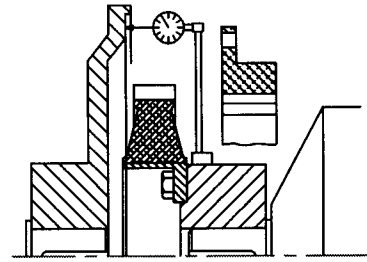
The simplest procedure is to use a dial indicator on the hub of the coupling and check radial and angular misalignment against the machined surfaces of the diesel engine housing with the aluminum flange withdrawn to one side or between the coupling halves for shaft couplings.



ARCUSAFLEX® flywheel coupling
Design AC..F2



ARCUSAFLEX® flywheel coupling
Design AC-T..F2



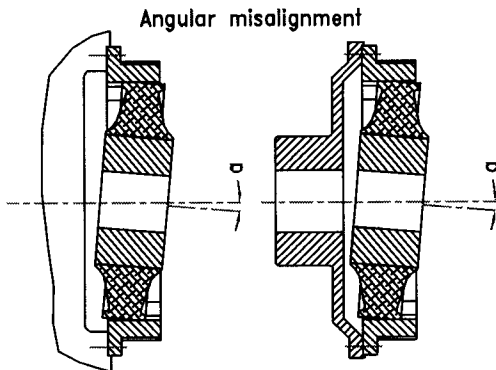
ARCUSAFLEX® shaft coupling
Design AC..T

Permissible Misalignment

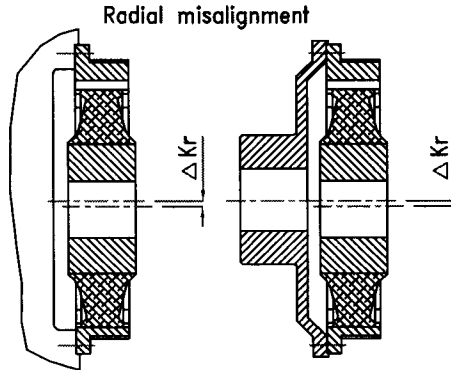
The permissible, continuous running misalignment, is dependent on a number of factors such as coupling size, rubber element Shore hardness, engine speed and applied torque.

As a general rule the maximum permissible radial and angular misalignment of the coupling range at 1500 rpm is given in the following table.

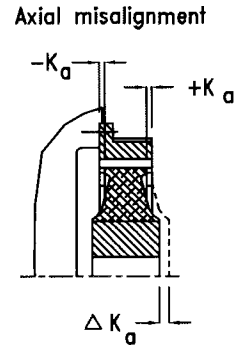
Keep alignment as low as possible – better than below values – to ensure a long coupling life.



Angular misalignment



Radial misalignment



Axial misalignment

ARCUSAFLEX® size	2	2.3	2.6	3	4	5	6	7	8/8D	9/9D	10/10D	11/11D	12/12D
Permissible radial displacement Kr mm	0.75-0.5	1.2-1.0	1.2-1.0	1.2-1.0	1.2-1.0	1.2-1.0	1.3-1.0	1.3-1.0	1.3-1.0	1.5-1.0	1.5-1.0	1.5-1.0	1.5-1.0
inch	0.03-0.02	0.05-0.04				0.05-0.04				0.06-0.04			
Permissible angular displacement degree	0.5°				0.4°				0.3°				
Permissible axial displacement ΔKa mm	±3	±3	±4	±7	±6	±5	±7	±10	±7	±4	±3	±4	±3
inch	±0.118	±0.118	±0.157	±0.275	±0.236	±0.197	±0.275	±0.393	±0.275	±0.157	±0.118	±0.157	±0.118

Safety Precautions

Re-check all screws for proper seating normally after a test run.

It is the customer's and user's responsibility to provide proper guards over rotating machinery and to observe the national and international safety rules and laws.

Technical details

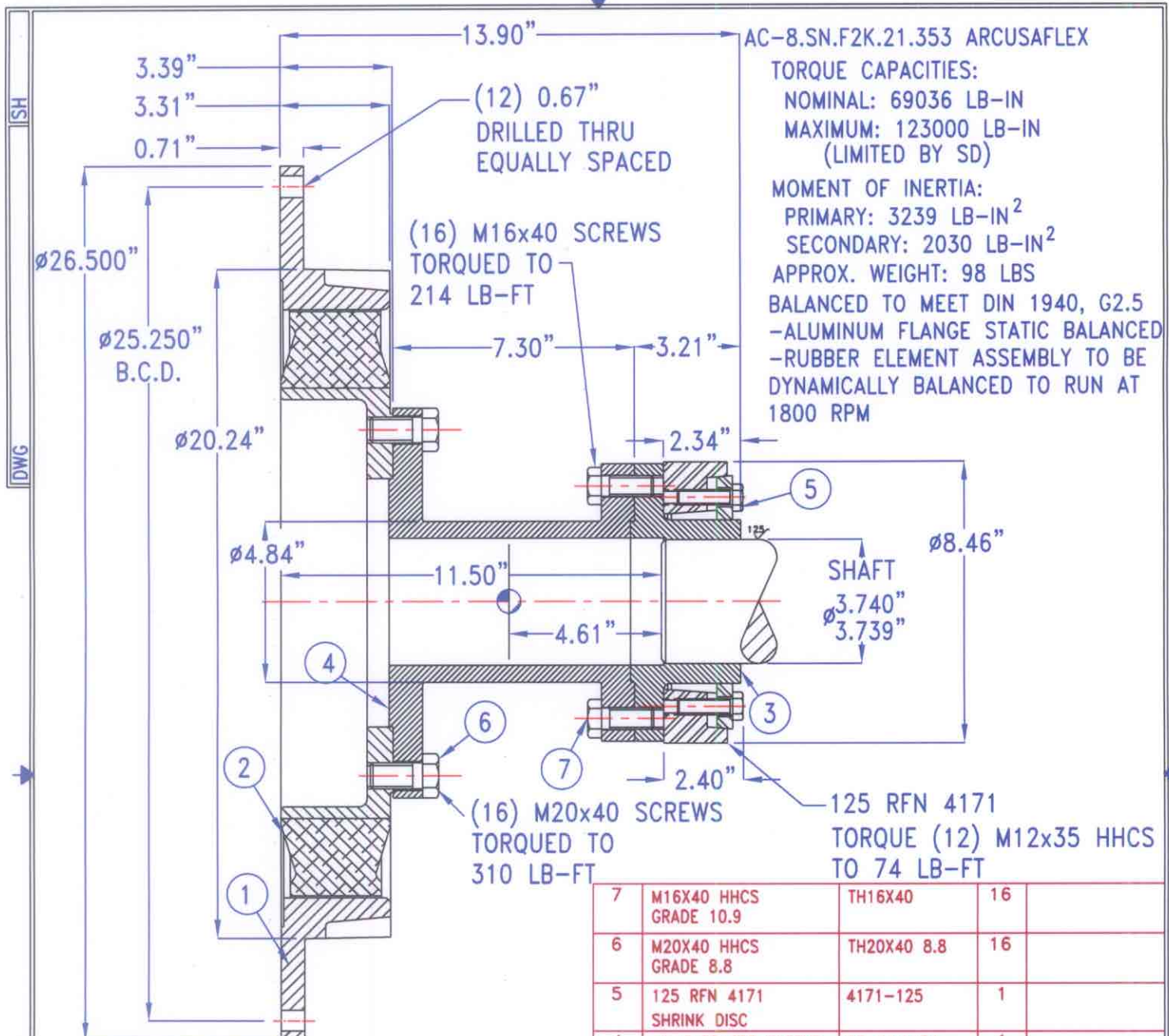
Standard version with 1 element - Natural/synthetic rubber mixture NR/SBR

ARCUSAFLEX® coupling size	Element version	Nominal torque		Maximum torque		Fatigue torque *)		Dynamic torsional stiffness C _{T dyn} (x10 ³)		Flange size to SAE J 620	Max. speed n _{max} rpm
		T _{KN}		T _{Kmax}		T _{KW (10 Hz)}		Nm/rad	lb-in/rad		
		Nm	lb-in	Nm	lb-in	Nm	lb-in				
AC 2.3	WN	330	2921	750	6638	165	1460	1.1	9.7	6.5 - 8 10	4200 3600
	NN	360	3186	900	7966	180	1593	1.7	15.0		
	SN	400	3540	1000	8851	200	1770	2.5	22.1		
	UN	450	3983	1000	8851	225	1991	3.5	31.0		
AC 2.6	WN	500	4425	1250	11063	250	2213	2.1	18.6	8 10 11.5	4200 3600 3500
	NN	600	5310	1800	15931	300	2655	3.1	27.4		
	SN	700	6196	2100	18587	350	3098	4.5	39.8		
	UN	800	7081	2100	18587	400	3540	6.3	55.8		
AC 3	WN	800	7081	2000	17701	400	3540	3.6	31.9	10 11.5	3600 3500
	NN	900	7966	2700	23897	450	3983	5.0	44.3		
	SN	1000	8851	3000	26552	500	4425	7.5	66.4		
	UN	1150	10178	3000	26552	575	5089	10.5	92.9		
AC 4 / 4.1	WN	1200	10621	3000	26552	600	5310	8.0	70.8	10 11.5 14	3600 3500 3000
	NN	1350	11949	3600	31863	650	5753	10.0	88.5		
	SN	1550	13719	4200	37173	750	6638	13.5	119.5		
	UN	1800	15931	4200	37173	900	7966	19.0	168.2		
AC 4.9	WN	1400	12391	3500	30978	700	6196	10.0	88.5	11.5 14	3200 3000
	NN	1800	15931	4500	39828	900	7966	15.0	132.8		
	SN	2300	20357	5500	48679	1150	10178	24.0	212.4		
	UN	2700	23897	5500	48679	1350	11949	34.0	300.9		
AC 5 / 5.1	WN	1800	15931	4500	39828	900	7966	8.5	75.2	11.5 14	3200 3000
	NN	2000	17701	5400	47794	1000	8851	13.0	115.1		
	SN	2500	22127	7500	66381	1250	11063	22.0	194.7		
	UN	2900	25667	7500	66381	1450	12834	31.0	274.4		
AC 6 / 6.1	WN	3100	27437	7700	68151	1500	13276	16.0	141.6	14 18	3000 2300
	NN	3450	30535	10000	88507	1700	15046	30.0	265.5		
	SN	4200	37173	12600	111519	2100	18587	45.0	398.3		
	UN	4800	42484	12600	111519	2400	21242	63.0	557.6		
AC 6.5	WN	4000	35403	10000	88507	2000	17701	25.0	221.3	14	3000
	NN	4500	39828	13500	119485	2250	19914	40.0	354.0		
	SN	5500	48679	16500	146037	2750	24340	72.0	637.3		
	UN	6200	54875	16500	146037	3100	27437	100.0	885.1		
AC 7	WN	4600	40713	10000	88507	2300	20357	35.0	309.8	14 18	2600 2300
	NN	5200	46024	15600	138072	2600	23012	56.0	495.6		
	SN	6300	55760	18900	167279	3100	27437	100.0	885.1		
	UN	7400	65496	18900	167279	3700	32748	140.0	1239.1		
AC 8	WN	6200	54875	14000	123910	3100	27437	38.0	336.3	18 21	2300 2000
	NN	7000	61955	21000	185866	3500	30978	75.0	663.8		
	SN	7800	69036	23400	207107	3900	34518	110.0	973.6		
	UN	9200	81427	23400	207107	4600	40713	160.0	1416.1		
AC 9	WN	8000	70806	18000	159313	4200	37173	55.0	486.8	18 21	2300 2000
	NN	9000	79657	27000	238970	4800	42484	100.0	885.1		
	SN	10000	88507	30000	265522	5500	48679	190.0	1681.6		
	UN	12000	106209	30000	265522	6000	53104	300.0	2655.2		
AC 10	WN	11000	97358	28000	247821	5500	48679	75.0	663.8	18 21	2300 2000
	NN	12500	110634	37000	327478	6250	55317	120.0	1062.1		
	SN	14000	123910	42000	371731	7000	61955	210.0	1858.7		
	UN	16000	141612	42000	371731	8000	70806	320.0	2832.2		
AC 11	WN	16000	141612	40000	354030	8000	70806	150.0	1327.6	21 24	2000 1800
	NN	18000	159313	54000	477940	9000	79657	250.0	2212.7		
	SN	20000	177015	60000	531045	10000	88507	450.0	3982.8		
	UN	23000	203567	60000	531045	11500	101784	650.0	5753.0		
AC 12	WN	25000	221269	75000	663806	12500	110634	250.0	2212.7	similar to DIN 6288	1500
	NN	28000	247821	84000	743463	14000	123910	400.0	3540.3		
	SN	31500	278798	94000	831970	15000	132761	700.0	6195.5		
	UN	36000	318627	94000	831970	18000	159313	1000.0	8850.7		
AC 13	WN	40000	354030	120000	1062089	20000	177015	375.0	3319.0	on request	1500
	NN	45000	398284	135000	1194851	21250	188078	600.0	5310.4		
	SN	50000	442537	150000	1327612	22500	199142	1050.0	9293.3		
	UN	55000	486791	150000	1327612	25000	221269	1400.0	12391.0		

Element versions: WN = 55° Shore A; NN = 65° Shore A; SN = 75° Shore A; UN = 85° Shore A

Due to the physical characteristics of the rubber materials the measurable rubber hardness is subject to a dispersion, which is defined according to DIN 53505 with ± 5° Shore A. Because of in-house manufacturing this dispersion of the shore hardness can be minimized.

*) Continuous fatigue torque under reversing stresses ± T_{KW} at f = 10 Hz; for other frequencies f_x apply T_{KW} · √(10/f_x)



AC-8.SN.F2K.21.353 ARCUSAFLEX
 TORQUE CAPACITIES:
 NOMINAL: 69036 LB-IN
 MAXIMUM: 123000 LB-IN
 (LIMITED BY SD)
 MOMENT OF INERTIA:
 PRIMARY: 3239 LB-IN²
 SECONDARY: 2030 LB-IN²
 APPROX. WEIGHT: 98 LBS
 BALANCED TO MEET DIN 1940, G2.5
 -ALUMINUM FLANGE STATIC BALANCED
 -RUBBER ELEMENT ASSEMBLY TO BE
 DYNAMICALLY BALANCED TO RUN AT
 1800 RPM

CUSTOMER APPROVAL _____
 DATE _____

ITEM	DESCRIPTION	PART NO.	QTY	REMARKS
7	M16X40 HHCS GRADE 10.9	TH16X40	16	
6	M20X40 HHCS GRADE 8.8	TH20X40 8.8	16	
5	125 RFN 4171 SHRINK DISC	4171-125	1	
4	AC-8 SPACER SLEEVE	83-91.1134	1	
3	AC-8.F2K. HUB Ø3.74" FOR 125 RFN 4171	83-91.1135	1	
2	AC-8.SN.K RUBBER ELEMENT	83-91.2848	1	
1	AC-8.21 ALUMINUM FLANGE	83-91.1041	1	

BILL OF MATERIAL

REV.	DESCRIPTION	DATE	APVD
C	RUBBER FROM UN	4/19/06	SEM
REVISIONS			

This drawing and the information contained on it are confidential and proprietary, and any reproduction, distributions or disclosure of this drawing or information or any manufacturing of the products or parts depicted on it are expressly prohibited without the written consent of Ringfeder Corporation.

All function values, dimensions and technical data stated in our design proposals are based on proven methods of calculation, backed by our empirical values and therefore, apply to original RINGFEDER® products only.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. THOSE IN [] ARE mm
 DECIMALS FRACTIONS ANGLES
 .X = ±.015
 .XX = ±.010 ±1/64 ±.5'
 .XXX = ±.005
 SURFACE FINISH Ra = 125 OR BETTER

DRAWN: EMC DATE: 2/17/06
 CHECKED: DATE:
 APPROVED: DATE:

RINGFEDER RINGFEDER CORP.
 WESTWOOD, NJ 07675

TITLE AC-8.SN.F2K.21.353 ARCUSAFLEX COUPLING WITH 3.74" BORE & 125 RFN 4171			
SIZE	CAGE NO.	DRAWING NO.	REV
A	60372	43-91.3327	C
SCALE	NTS	PLOT SCALE	SHEET
		1:4.5	



Report No.16662
July 13, 2006

Torsional Analysis
for
Finning Power Systems

Reported by:
Rajani K. Chundi

A handwritten signature in black ink that reads "Rajani K. Chundi". The signature is written in a cursive, flowing style.

Vibration Analysis Group
130 Enterprise Court
Metamora, Illinois 61548
Phone: (309) 383-3200
Fax: (309) 383-3250

Application:
Engine Model:
S.O. Number:

Rotary Screw Compressor
G3512
CBXPL

Conclusion

The following analysis indicates this system is free of serious torsional vibration for the normal operating conditions described. Engine front crank amplitudes and crankshaft stresses are acceptable. Torque levels in the coupling and the compressor are acceptable.

Caterpillar does not recommend operating any system under engine misfire conditions.

System Data

Engine model G3512 rated at 1005 bHp, 1400 rpm operating speed

Engine Damper: Caterpillar Part No. 8N7182

Engine Flywheel: Caterpillar Part No. 2W8772

Coupling: Ringfeder Arcusaflex AC-8.SN.F2K

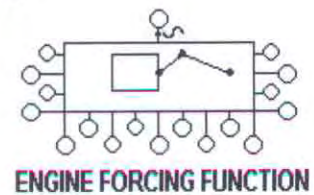
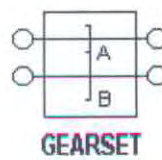
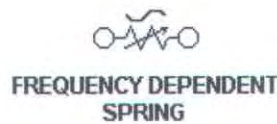
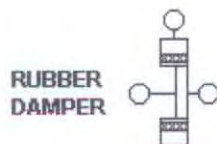
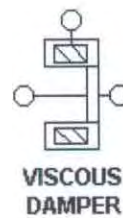
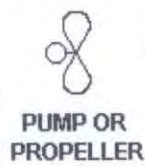
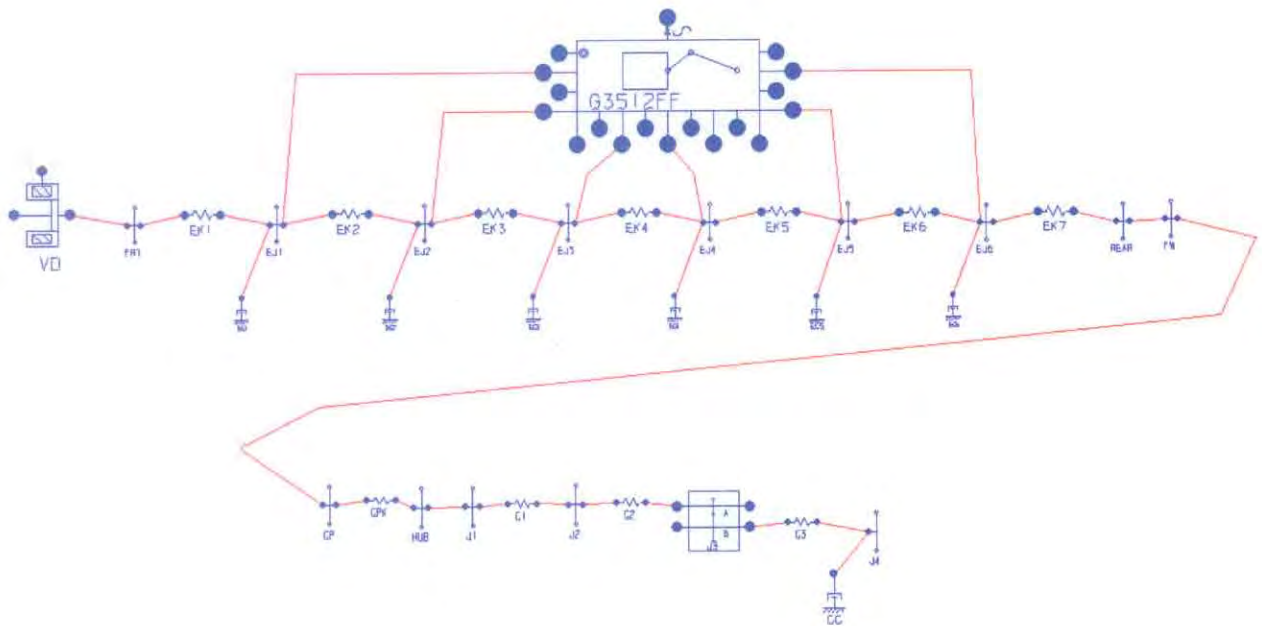
Compressor: Ariel RG357M

System Description

The engine is driving a screw compressor through a flywheel mounted coupling. The system is designed for running at 1400 rpm.

Report Contents

Mass-Elastic Diagram	page 2
Mass-Elastic Data	page 3
Resonant Speed Diagram	page 4
Undamped Frequency Results	pages 5, 6
Forced Response Highlights	page 7
Forced Response Results	pages 8 - 19
Notes	page 20



Damper Parameters

Damper Type	Housing Inertia Nms ²	Ring Inertia Nms ²	Effective Stiffness MNm/rad	Damping Nms/rad
Viscous	1.705	1.639	0.169	564.7

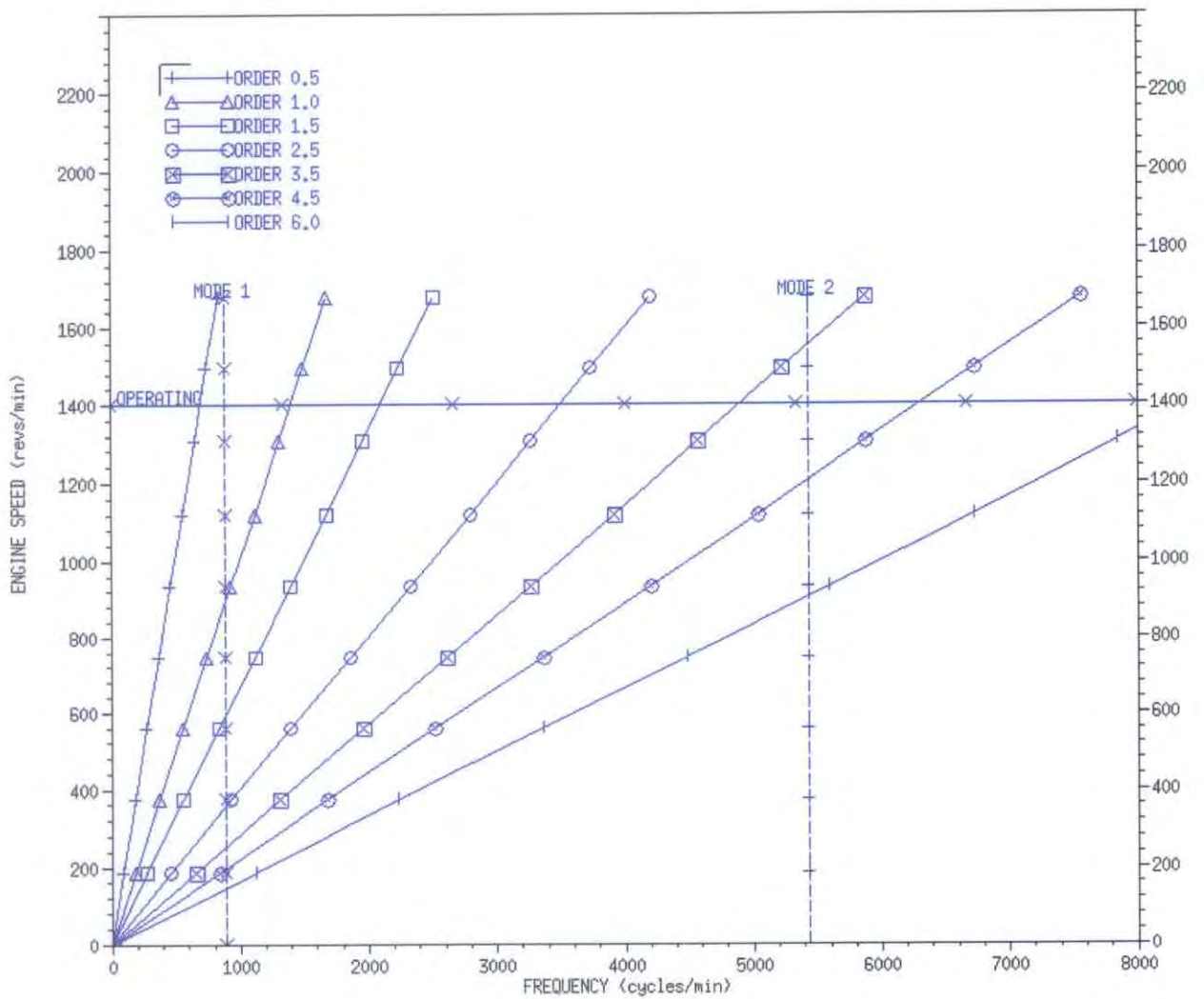
MASS-ELASTIC DATA

MASS ID	MASS NAME	INERTIA (N*m*sec ²)	SPRING ID	STIFFNESS (MN*m/rad)	DIAMETER (mm)
VD		2.524E+00		0.000E+00	0.000E+00
FRT		4.629E-01	EK1	1.274E+01	1.350E+02
EJ1		1.688E+00	EK2	8.626E+00	1.350E+02
EJ2		1.688E+00	EK3	8.626E+00	1.350E+02
EJ3		1.691E+00	EK4	8.626E+00	1.350E+02
EJ4		1.691E+00	EK5	8.626E+00	1.350E+02
EJ5		1.688E+00	EK6	8.626E+00	1.350E+02
EJ6		1.688E+00	EK7	1.274E+01	1.350E+02
REAR		4.629E-01		0.000E+00	0.000E+00
FW		1.461E+01		0.000E+00	0.000E+00
CP		9.480E-01	CPK	1.100E-01	0.000E+00
HUB		5.940E-01		0.000E+00	0.000E+00
J1		1.200E-02	C1	2.204E+00	0.000E+00
J2		9.070E-01	C2	5.630E+01	0.000E+00
GEAR	A	1.000E-04		0.000E+00	0.000E+00
	B	7.000E-02	C3	7.553E+00	0.000E+00
J4		5.869E+00		0.000E+00	0.000E+00

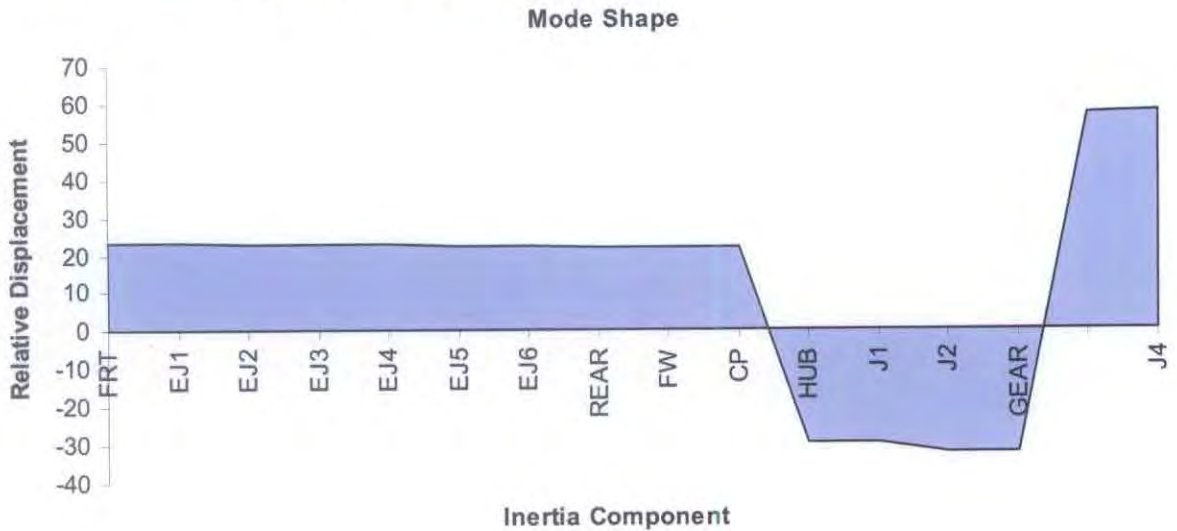
System Damping

Component ID	Damping Nms/rad
EC1 - EC6	48.58 each
CC	10

Resonant Speed Diagram



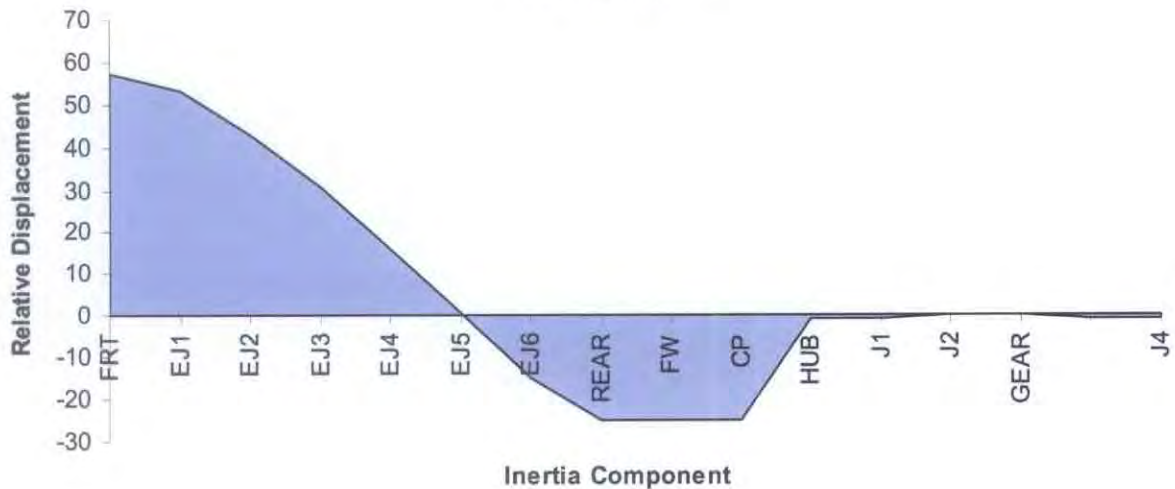
First Natural Frequency Occurs at 889 CPM



MASS ID	MASS NAME	INERTIA (N*m*sec ²)	DISPLACE (degrees)	SPRING ID	STIFFNESS (MN*m/rad)	CUM TORQUE (N*m)	DIAMETER (mm)	STRESS (MPa)
VD		2.524E+00	2.317E+01		0.000E+00	8.858E+03	0.000E+00	0.000E+00
FRT		4.629E-01	2.317E+01	EK1	1.274E+01	1.048E+04	1.350E+02	3.787E-01
EJ1		1.688E+00	2.312E+01	EK2	8.626E+00	1.639E+04	1.350E+02	5.922E-01
EJ2		1.688E+00	2.301E+01	EK3	8.626E+00	2.228E+04	1.350E+02	8.048E-01
EJ3		1.691E+00	2.287E+01	EK4	8.626E+00	2.813E+04	1.350E+02	1.016E+00
EJ4		1.691E+00	2.268E+01	EK5	8.626E+00	3.394E+04	1.350E+02	1.226E+00
EJ5		1.688E+00	2.245E+01	EK6	8.626E+00	3.968E+04	1.350E+02	1.434E+00
EJ6		1.688E+00	2.219E+01	EK7	1.274E+01	4.535E+04	1.350E+02	1.638E+00
REAR		4.629E-01	2.199E+01		0.000E+00	4.689E+04	0.000E+00	0.000E+00
FW		1.461E+01	2.199E+01		0.000E+00	9.554E+04	0.000E+00	0.000E+00
CP		9.480E-01	2.199E+01	CPK	1.100E-01	9.869E+04	0.000E+00	0.000E+00
HUB		5.940E-01	-2.942E+01		0.000E+00	9.605E+04	0.000E+00	0.000E+00
J1		1.200E-02	-2.942E+01	C1	2.204E+00	9.599E+04	0.000E+00	0.000E+00
J2		9.070E-01	-3.191E+01	C2	5.630E+01	9.161E+04	0.000E+00	0.000E+00
GEAR	A	1.000E-04	-3.201E+01		0.000E+00	9.161E+04	0.000E+00	0.000E+00
	B	7.000E-02	5.691E+01	C3	7.553E+00	-5.092E+04	0.000E+00	0.000E+00
J4		5.869E+00	5.730E+01		0.000E+00	3.451E-01	0.000E+00	0.000E+00

Second Natural Frequency Occurs at 5436 CPM

Mode Shape



MASS ID	MASS NAME	INERTIA (N*m*sec ²)	DISPLACE (degrees)	SPRING ID	STIFFNESS (MN*m/rad)	CUM TORQUE (N*m)	DIAMETER (mm)	STRESS (MPa)
VD		2.524E+00	5.730E+01		0.000E+00	8.181E+05	0.000E+00	0.000E+00
FRT		4.629E-01	5.730E+01	EK1	1.274E+01	9.681E+05	1.350E+02	3.497E+01
EJ1		1.688E+00	5.294E+01	EK2	8.626E+00	1.474E+06	1.350E+02	5.324E+01
EJ2		1.688E+00	4.316E+01	EK3	8.626E+00	1.886E+06	1.350E+02	6.812E+01
EJ3		1.691E+00	3.063E+01	EK4	8.626E+00	2.178E+06	1.350E+02	7.870E+01
EJ4		1.691E+00	1.616E+01	EK5	8.626E+00	2.333E+06	1.350E+02	8.429E+01
EJ5		1.688E+00	6.650E-01	EK6	8.626E+00	2.339E+06	1.350E+02	8.452E+01
EJ6		1.688E+00	-1.487E+01	EK7	1.274E+01	2.197E+06	1.350E+02	7.939E+01
REAR		4.629E-01	-2.475E+01		0.000E+00	2.133E+06	0.000E+00	0.000E+00
FW		1.461E+01	-2.475E+01		0.000E+00	8.709E+04	0.000E+00	0.000E+00
CP		9.480E-01	-2.475E+01	CPK	1.100E-01	-4.563E+04	0.000E+00	0.000E+00
HUB		5.940E-01	-9.866E-01		0.000E+00	-4.895E+04	0.000E+00	0.000E+00
J1		1.200E-02	-9.866E-01	C1	2.204E+00	-4.901E+04	0.000E+00	0.000E+00
J2		9.070E-01	2.876E-01	C2	5.630E+01	-4.754E+04	0.000E+00	0.000E+00
GEAR	A	1.000E-04	3.359E-01		0.000E+00	-4.754E+04	0.000E+00	0.000E+00
	B	7.000E-02	-5.973E-01	C3	7.553E+00	2.650E+04	0.000E+00	0.000E+00
J4		5.869E+00	-7.983E-01		0.000E+00	-1.093E-01	0.000E+00	0.000E+00

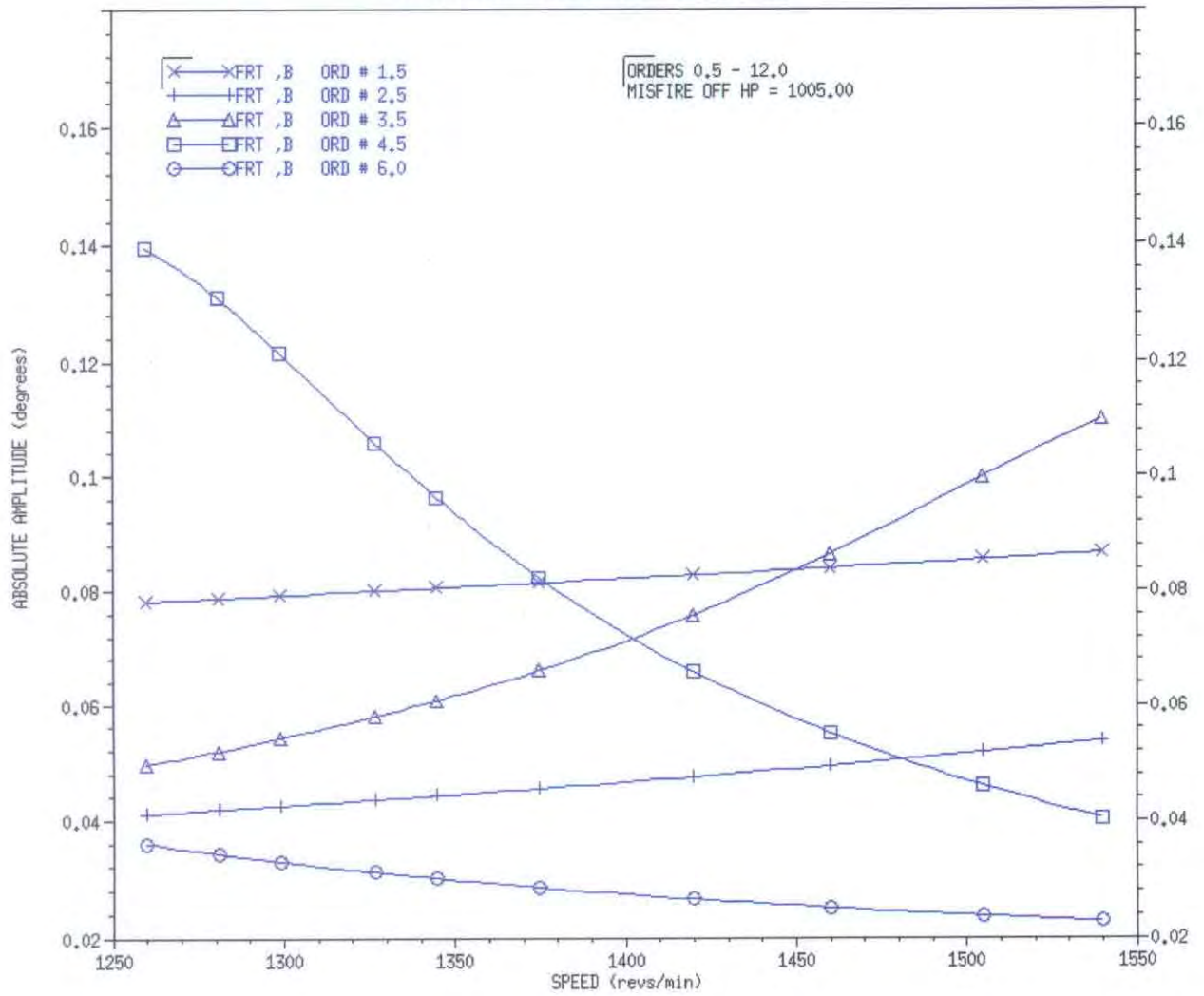
Single Order Results		Order	Predicted	Permissible Limit
FRT	Absolute Amplitude (deg)	1.5	0.087	0.25
	Absolute Amplitude (deg)	2.5	0.054	0.15
	Absolute Amplitude (deg)	3.5	0.109	0.15
	Absolute Amplitude (deg)	4.5	0.139	0.15
	Absolute Amplitude (deg)	6.0	0.036	0.15
EK4	Vibratory Stress (MPa)	1.5	12.22	21.0
	Vibratory Stress (MPa)	2.5	2.17	21.0
	Vibratory Stress (MPa)	3.5	7.99	21.0
	Vibratory Stress (MPa)	4.5	10.78	21.0
	Vibratory Stress (MPa)	6.0	2.29	21.0

Combined Order Results		Predicted	Permissible Limit
CPK	Maximum Torque (Nm)	5325	23000
	Vibratory Torque (Nm)	207	3900
	Nominal Torque (Nm)	5112	7800
	Power Loss (kW)	0.008	0.810
CI	Vibratory Torque (Nm)	215	Ariel to Approve

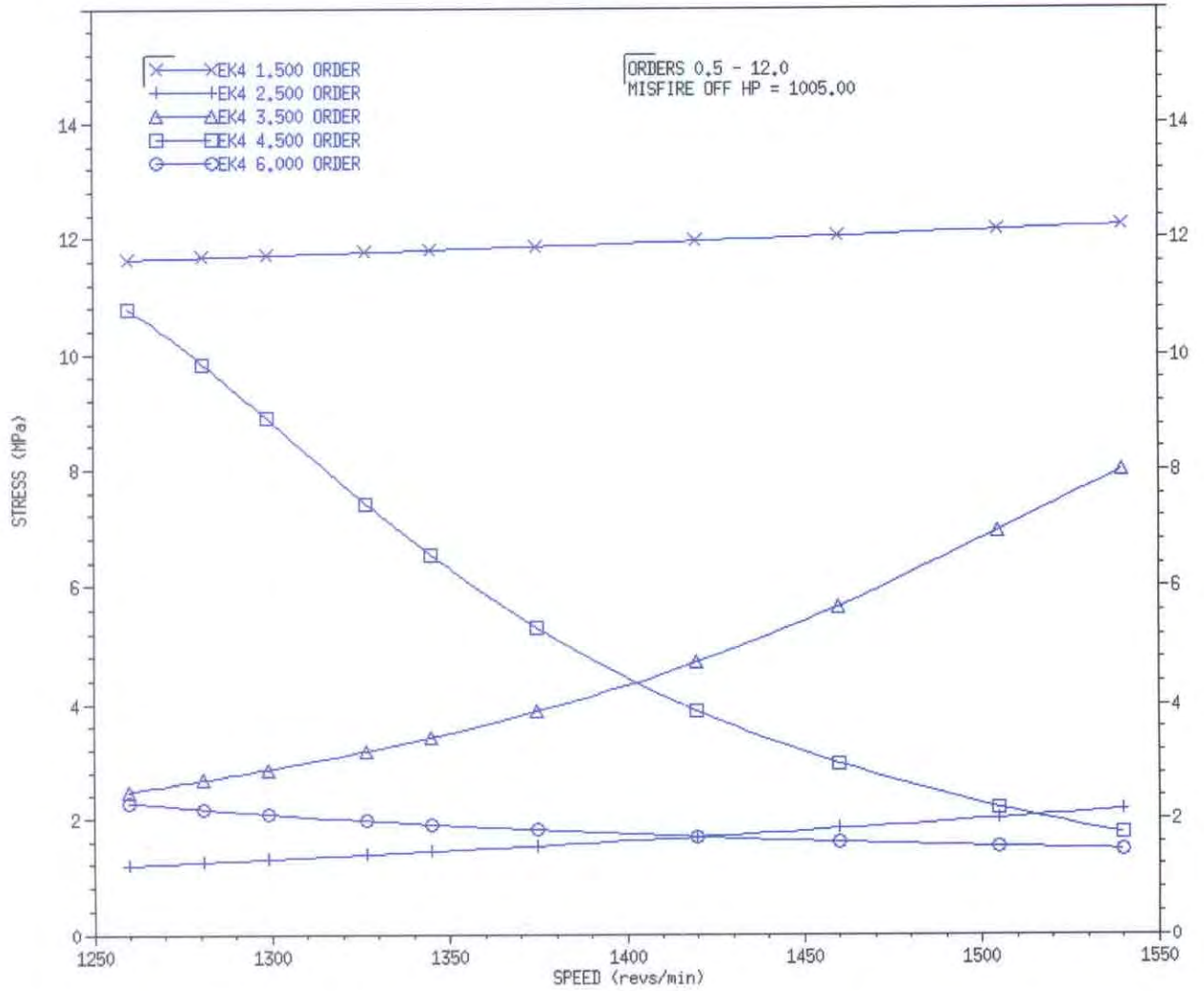
Single Order Misfire Results		Order	Predicted	Permissible Limit
FRT	Absolute Amplitude (deg)	0.5	0.173	0.50
	Absolute Amplitude (deg)	1.0	0.092	0.50

Combined Order Misfire Results		Predicted	Permissible Limit
CPK	Maximum Torque (Nm)	6211	23000
	Vibratory Torque (Nm)	1064	3900
	Nominal Torque (Nm)	5112	7800
	Power Loss (kW)	0.080	0.810
CI	Vibratory Torque (Nm)	1101	Ariel to Approve

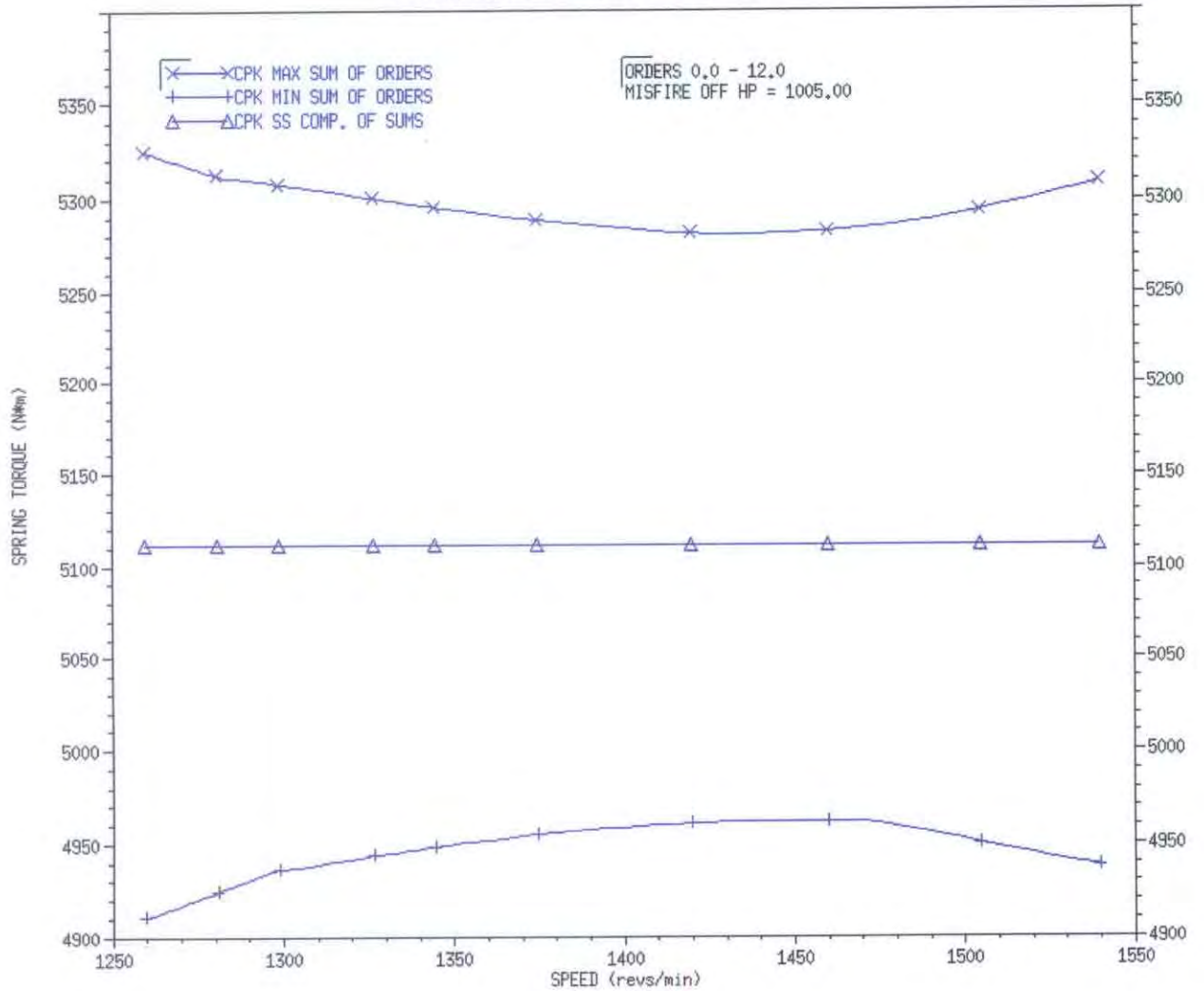
Front Crank Single Order Amplitude



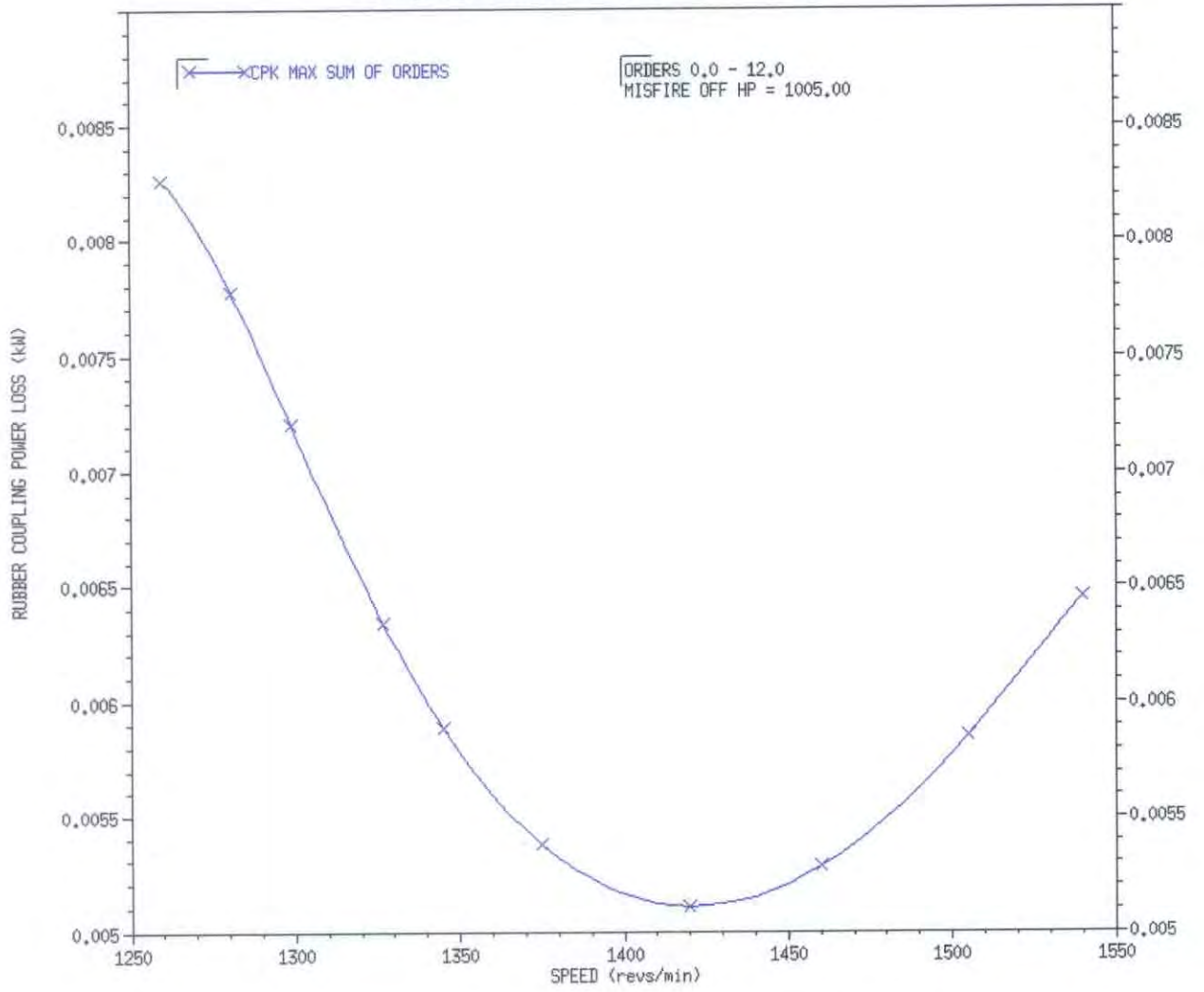
Crankshaft Single Order Stress



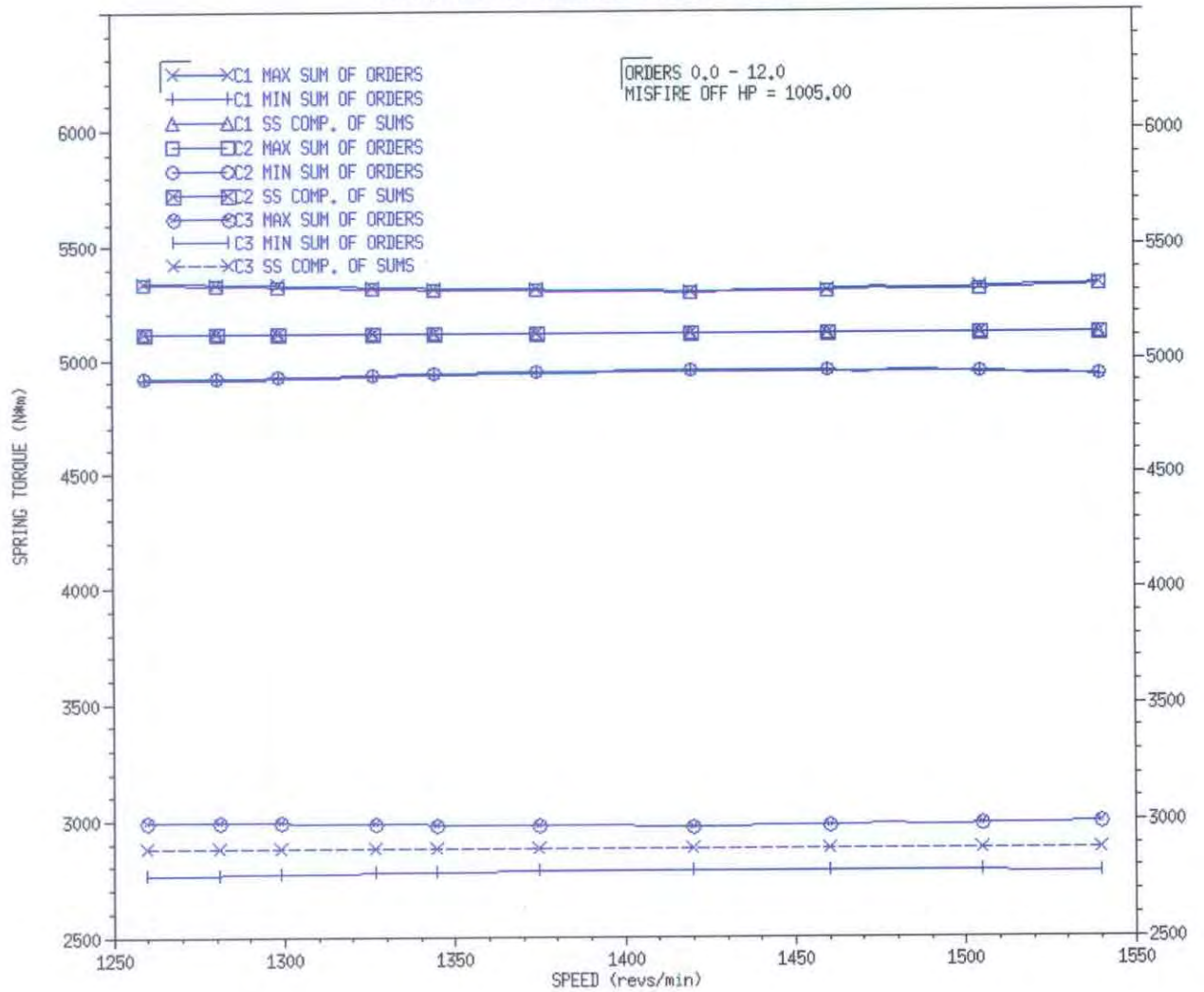
Coupling Combined Order Torque



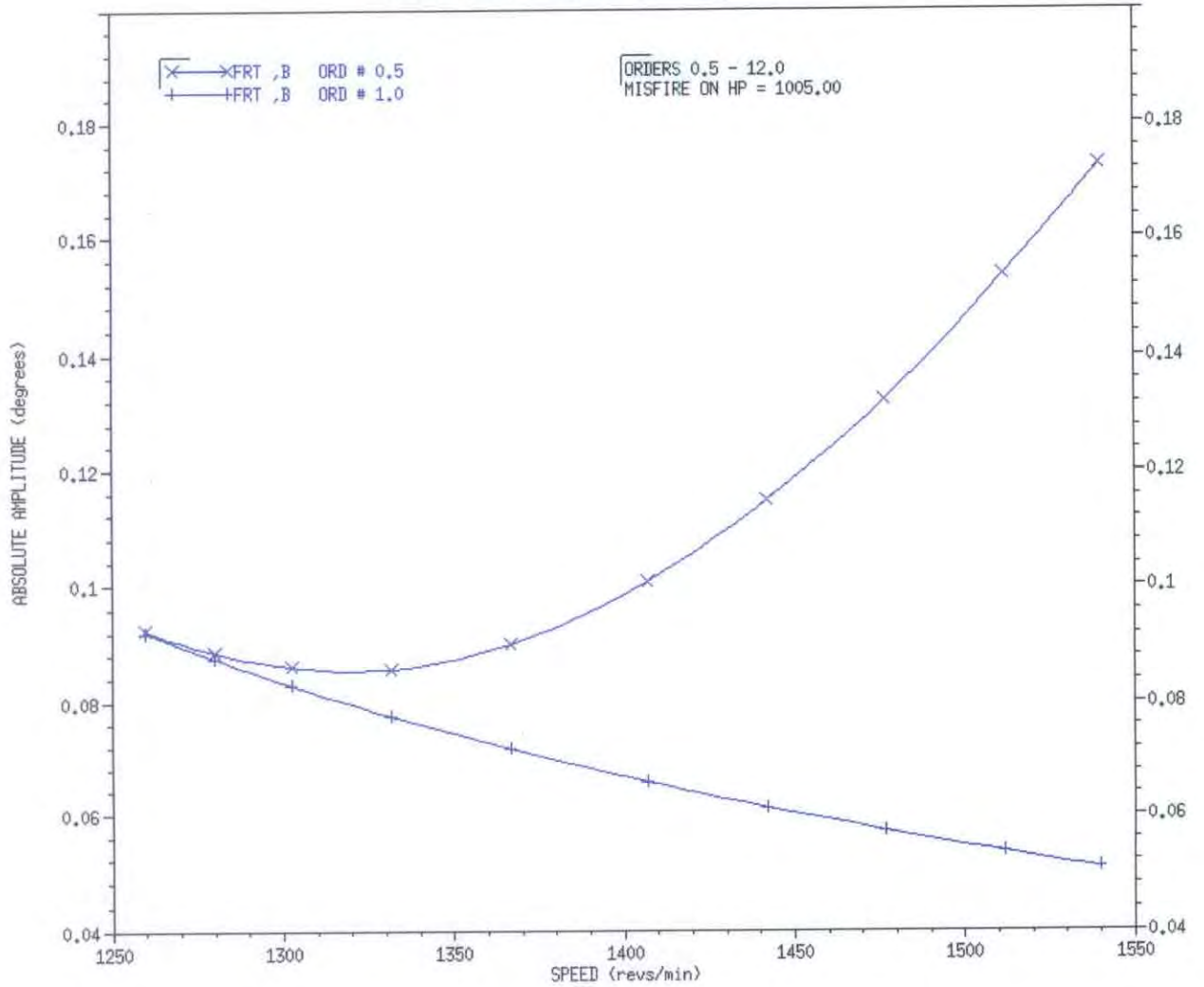
Coupling Combined Order Power Loss



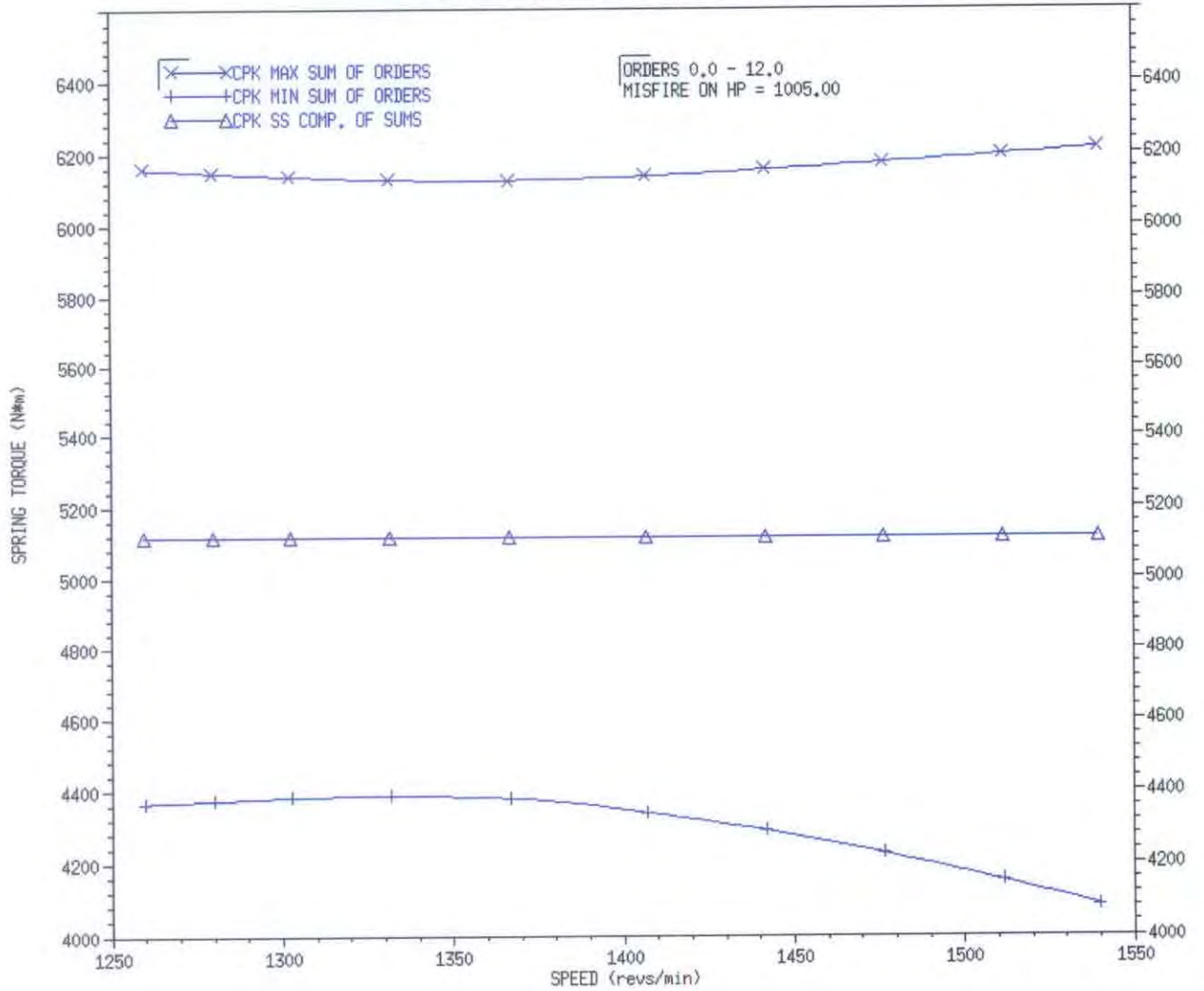
Compressor Combined Order Torque



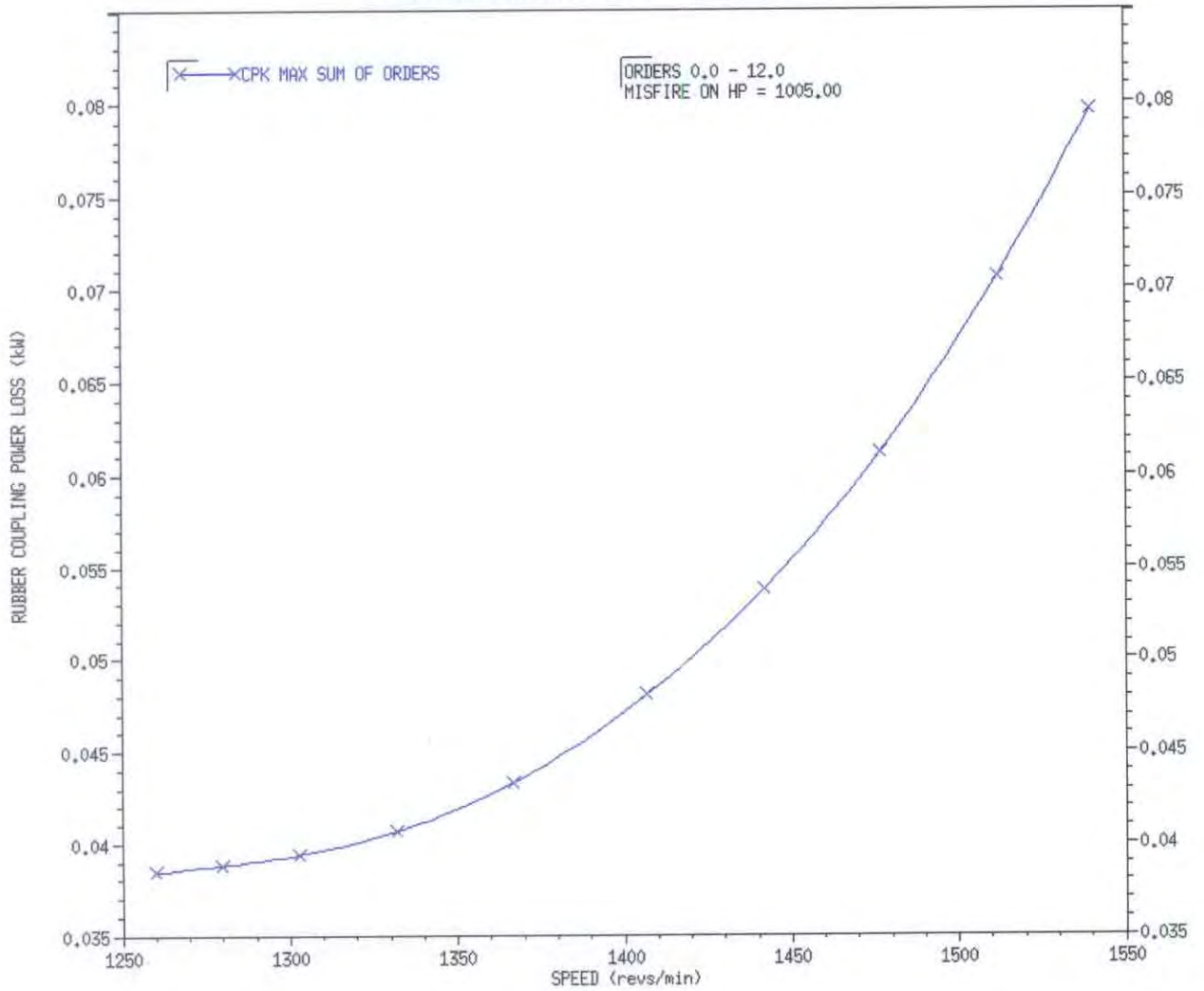
Front Crank Single Order Amplitude



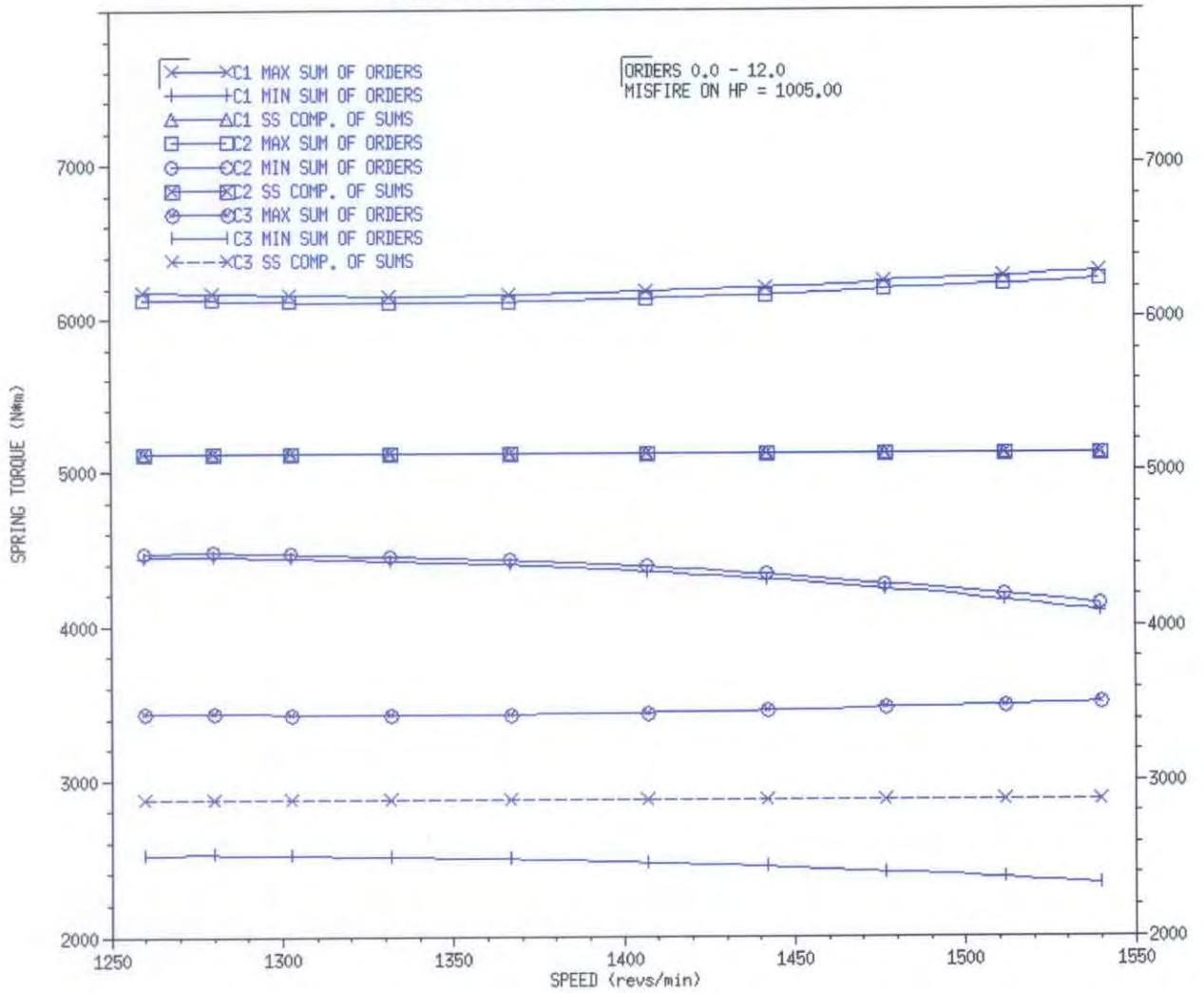
Coupling Combined Order Torque



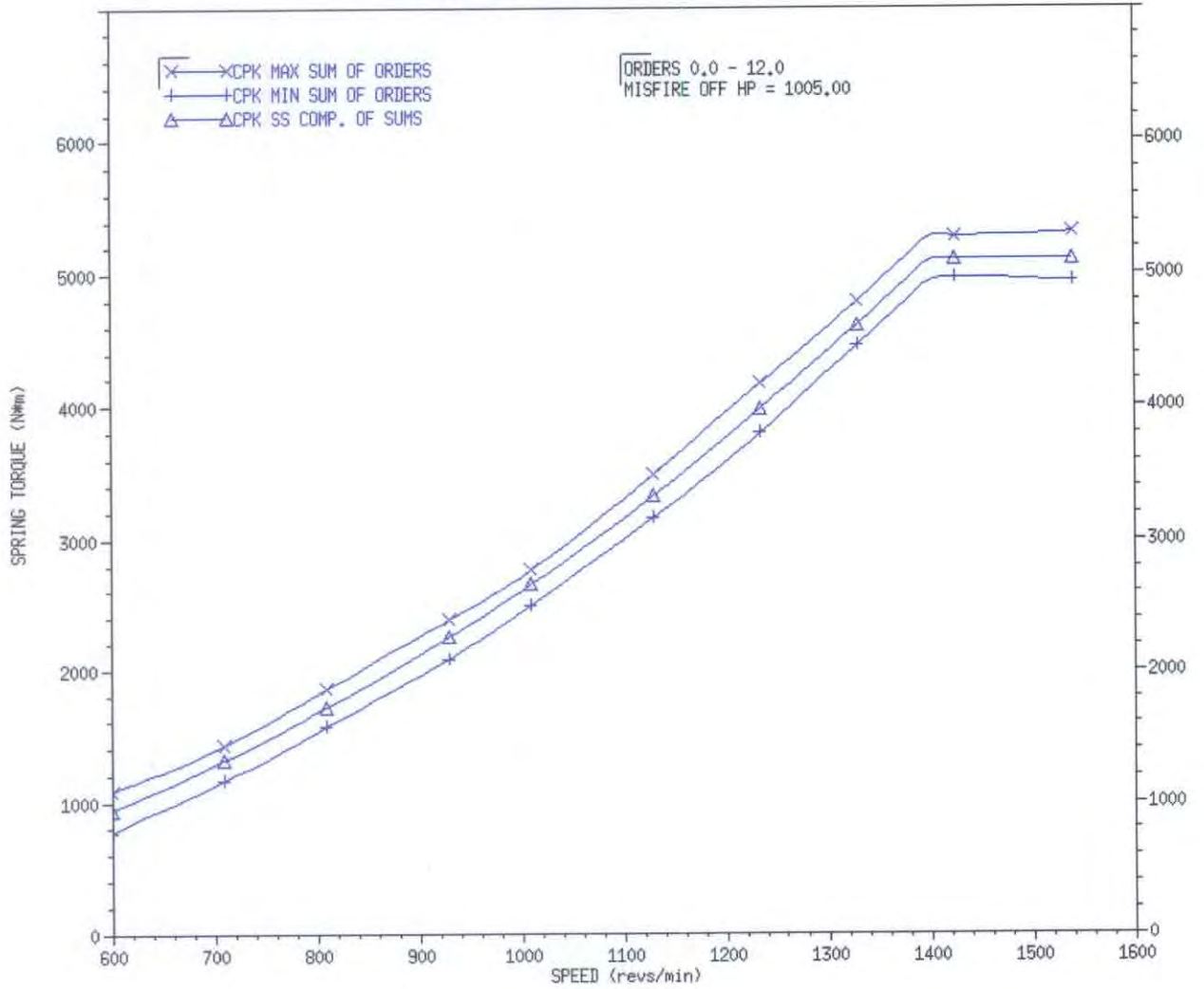
Coupling Combined Order Power Loss



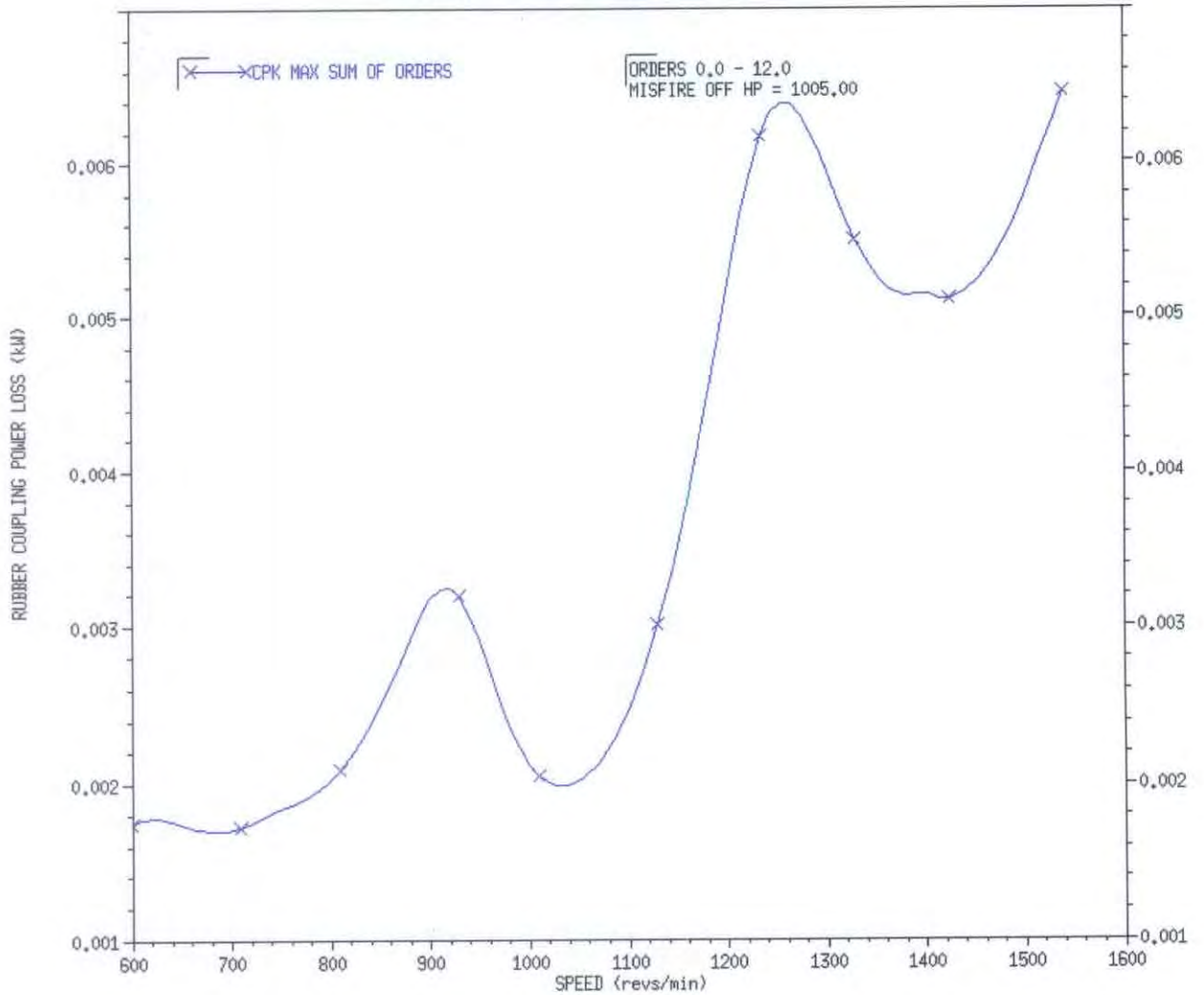
Compressor Combined Order Torque



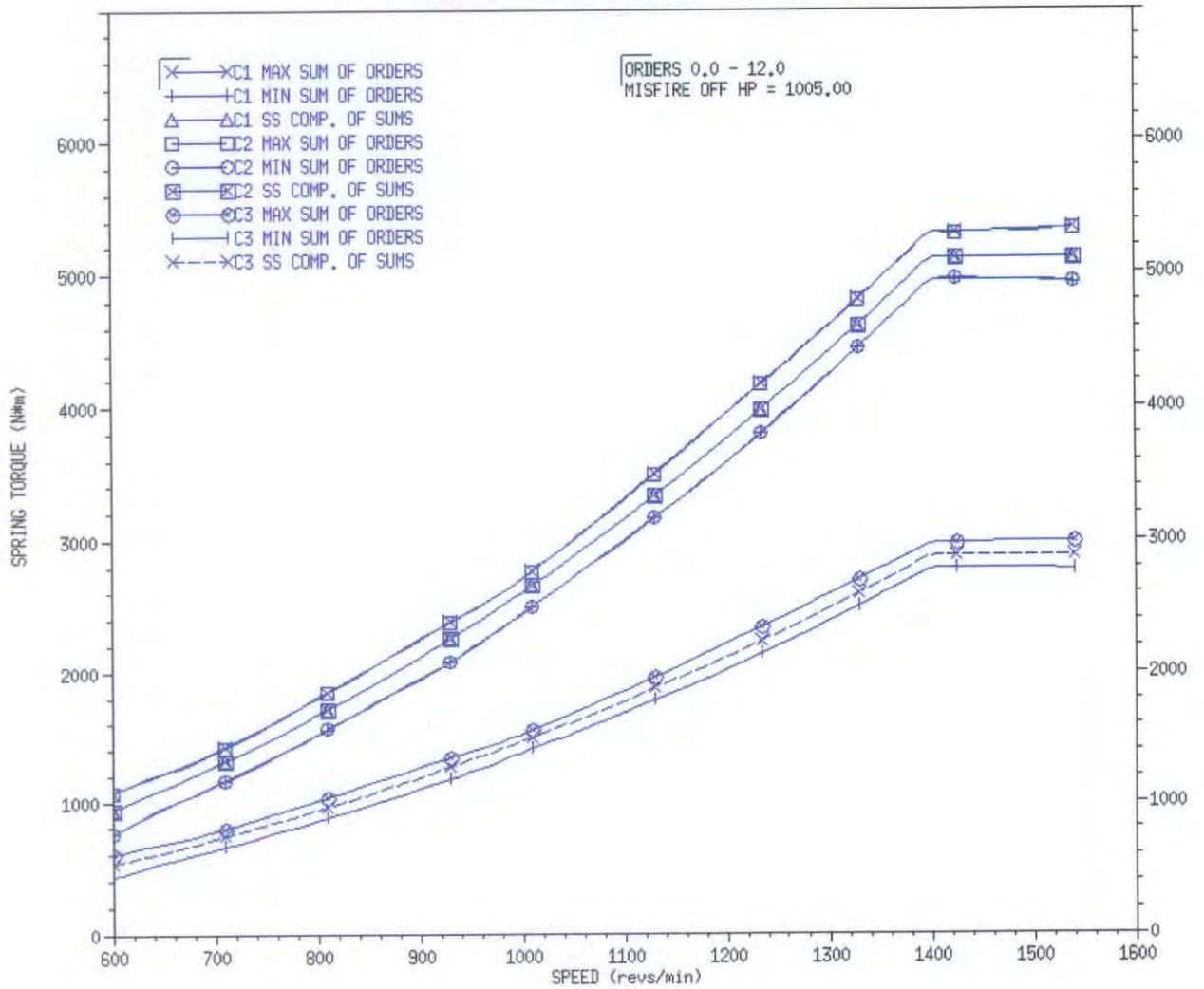
Start Up Speed Sweep
Coupling Combined Order Torque



Start Up Speed Sweep
Coupling Combined Order Power Loss



Start Up Speed Sweep
Compressor Combined Order Torque



1. The analysis is based upon information provided by the customer and other manufacturers. Caterpillar is in no way responsible for the accuracy of that information. Caterpillar warrants this analysis to be free from errors in calculations. Any damages arising out of an alleged error by Caterpillar in this report shall be limited to a refund of monies paid by the customer to Caterpillar for the report. This warranty is expressly in lieu of any other warranties, expressed or implied, including any warranty of merchantability or fitness for a particular purpose. Remedies under this warranty are limited to a refund as specified above. Caterpillar is not responsible for incidental or consequential damages. Nothing herein is intended to supersede or alter in any manner any of the terms and conditions of, or any rights the purchaser may have under, Caterpillar's standard product warranty.
2. Caterpillar excludes all liability for or arising from any negligence on its part or on the part of any of its employees, agents or representatives in respect of the manufacture or supply of goods or the provision of services relating to the goods.
3. Satisfactory system operation also depends on factors other than torsional vibration. This report should not be used as a guarantee of a successful system installation.
4. This installation has been analyzed under full load from 90% to 110% of the rated speed and under no-load from the low idle speed to 110% of the rated speed.
5. Though all relevant orders of vibration have been analyzed, only significant orders of vibration are included in this report. Combined order results include engine orders 0 through 12. Vibratory amplitudes, stresses and torque's are single amplitude, which means they are +/- from zero.
6. System mass-elastic data values are actual values. Mass-elastic values for components driven through a gearbox are not adjusted to engine speed. The viscous damper inertia is an equivalent inertia equal to the damper housing inertia plus one-half of the damper flywheel inertia.
7. This report contains information from two different analysis methods that produce complementary results. The natural frequency tables and the resonant speed diagram contain no damping or excitation. The forced response results shown in the report include system damping and excitation.

ENERFLEX

DRIVER

SEBU8099-01
MAR 2006

Caterpillar Operation and Maintenance Manual

G3500 Engines

For Serial Numbers:
WPR1-Up

SERP 4749
MAR 2006

Caterpillar Parts Manual

G3512 Engines

For Serial Numbers:

WRP1-UP

Refer to CD

ENERFLEX

COOLER



Air-X-Changers

Harsco

Plant Address
5215 Arkansas Rd.
Catoosa, OK 74015

Telephone 918.619.8000
Fax 918.619.5000

TO:	<u>ENERFLEX</u>	DATE:	<u>1/22/2007</u>
	<u>4700 - 47TH STREET SE</u>	AXC #	<u>065070</u>
	<u>CALGARY, ALBERTA T2B 3R1</u>	PO #	<u>0620410</u>
ATTN:	<u>DOCUMENT CONTROL</u>	TAG #	<u>60430-1005HP SCREW</u>

Transmittal Sheet

Attached you will find specific information for the job referenced above.

In order to complete this manual, please reference the Air-X-Changers Library CD to obtain the vendor information and Air-X-Changers Installation, Maintenance & Operating Instructions. If you have any questions, please contact Debbie DeWitt at (918) 619-8004

Engine Drive Operating, Installation & Maintenance Instructions

Maro Shutters, Model EH

Garzo Air Motor, 501-12

Moore Fan, 10K

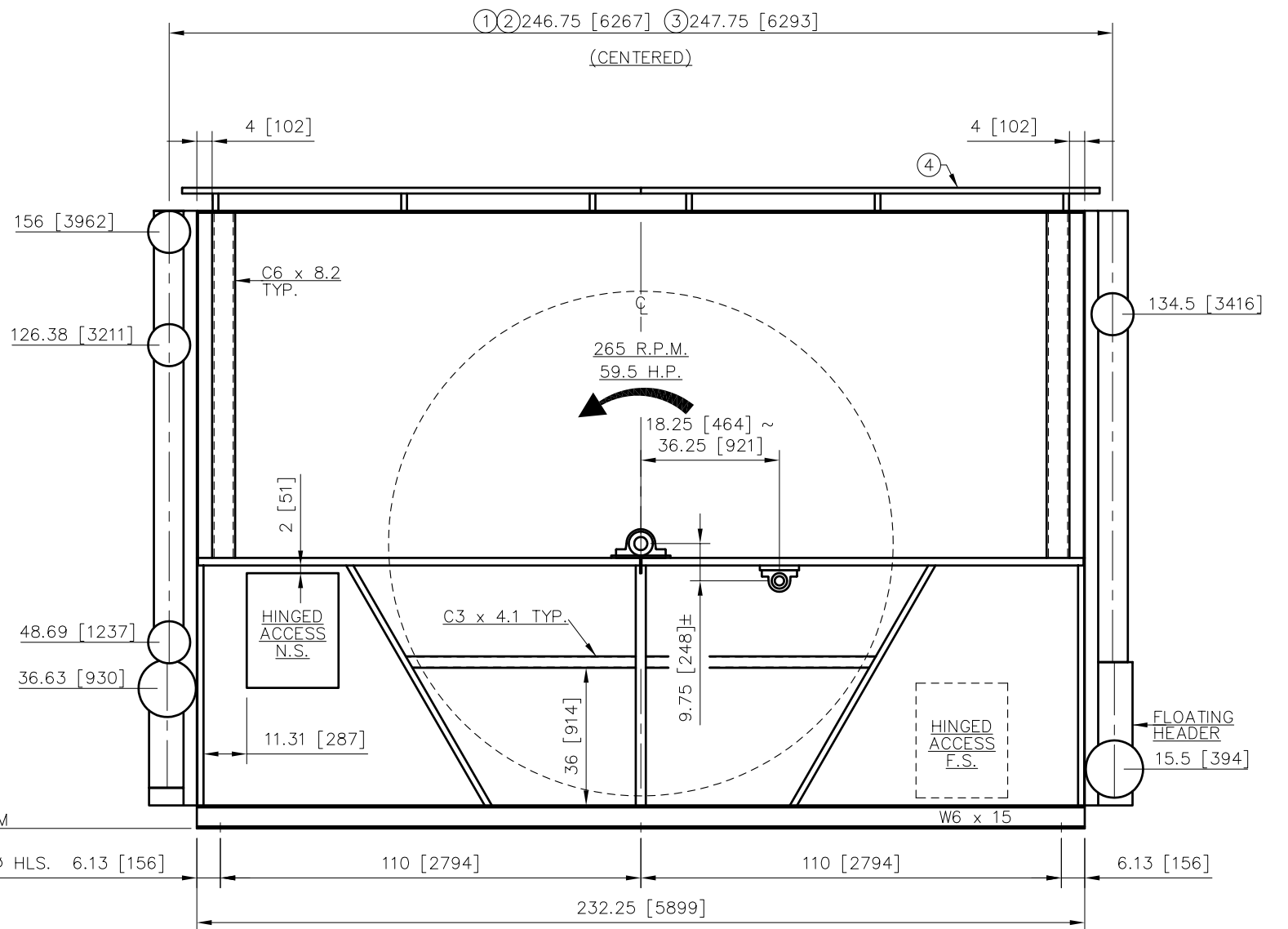
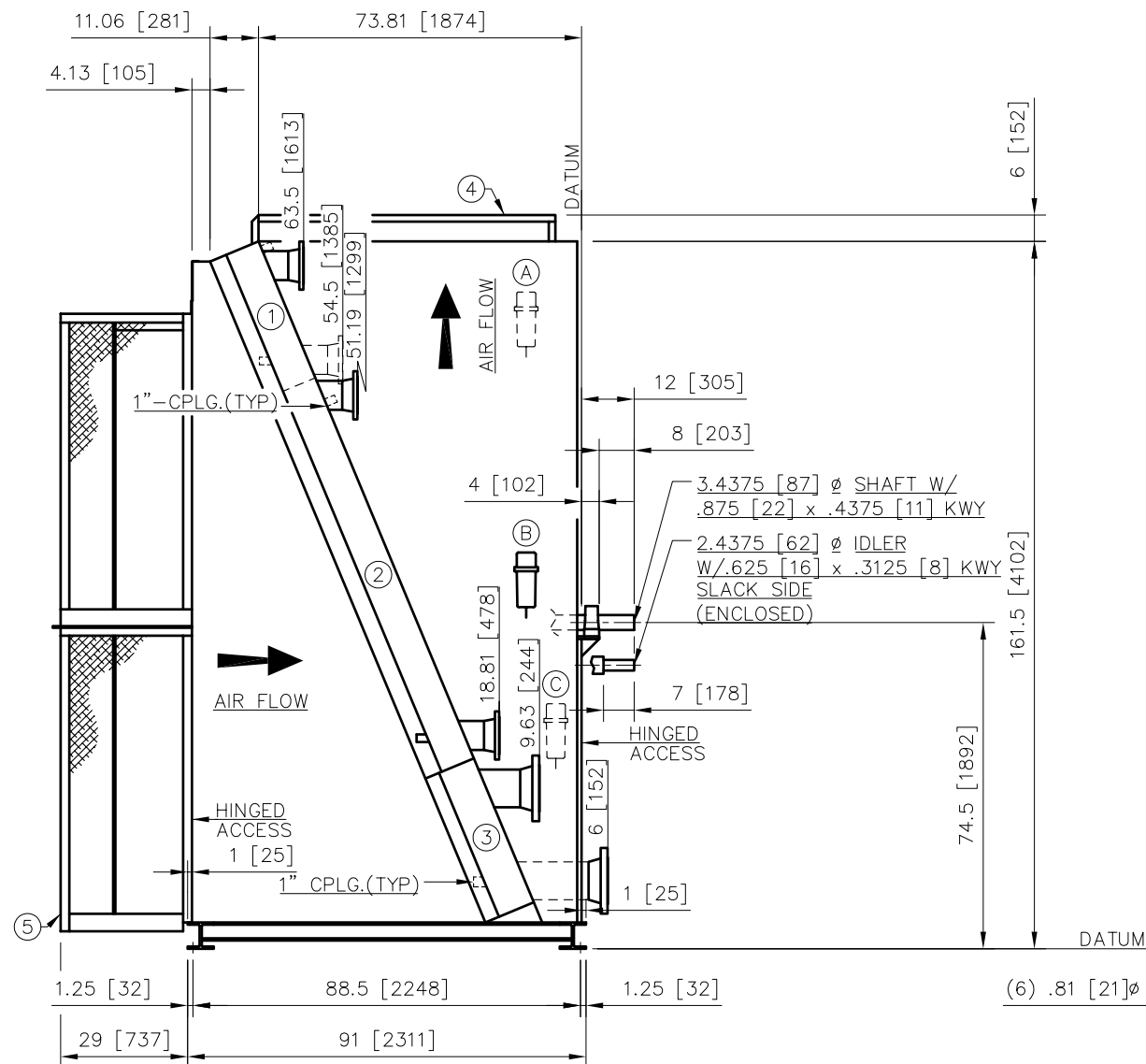
Dodge S2000 Bearings

Debbie DeWitt

cc: EADS - CANADA

For Spare Parts

Call: 1-800-404-3904 or 01-918-619-8028



NOTE:
 1. METRICS SHOWN IN []
 2. ESTIMATED DRY WEIGHT: 18,800#
 3. PAINT: H-I-S 9267 TINT TO MATCH CLOVER DALE PC TUAPE

COMBINED

①	EJW/ELOW (32 GALS) D.P. 14 P.S.I. @ 300/-20 °F. NOZZLES 6"-150 RF
②	TAW/CW (107 GALS) D.P. 14 P.S.I. @ 300/-20 °F. NOZZLES 6"-150 RF

③	AC (ASME STAMP) D.P. 350 P.S.I. @ 300/-20 °F. NOZZLES 8"-300 RF
---	---

④	HAIL GUARD
⑤	BUGSCREEN FRAME / FAN GUARD W/ SOFT BUGSCREENS (FRAME SHIPS LOOSE) (SOFT BUGSCREENS SHIP LOOSE)

- ① AUTO SHUTTER OPERATOR EJW/ELOW
- ② AUTO SHUTTER OPERATOR TAW/CW
- ③ AUTO SHUTTER OPERATOR AC
- AUTO BY (3) GARZO 501-12 AIR MOTORS
(SHUTTERS FAIL CLOSED)

JOB STATUS	AXC JOB NO.	TAG NO.	P.O. NO.
RELEASED	065059	60423-1005HP SCREW	0620399
RELEASED	065060	60449-1005HP SCREW	0620400
RELEASED	065061	60424-1005HP SCREW	0620401
RELEASED	065062	60425-1005HP SCREW	0620402
RELEASED	065063	60450-1005HP SCREW	0620403
RELEASED	065064	60426-1005HP SCREW	0620404
RELEASED	065065	60427-1005HP SCREW	0620405
RELEASED	065066	60451-1005HP SCREW	0620406
RELEASED	065067	60428-1005HP SCREW	0620407
RELEASED	065068	60429-1005HP SCREW	0620408
RELEASED	065069	60452-1005HP SCREW	0620409
RELEASED	065070	60430-1005HP SCREW	0620410
RELEASED	065071	60453-1005HP SCREW	0620411

REV.	DESCRIPTION	BY	DATE	APP'D	DATE
1	TAG WAS "STOCK-1005" ON JOBS 065059 THRU 065071	PLN	05/05/06	DB	05/05/06
2	MOVED LEFT HAND ACCESS DOOR	PLN	05/10/06	DB	05/10/06

JOB STATUS:
 SEE ABOVE

CUSTOMER: ENERFLEX
 TAG: SEE ABOVE
 P.O. NO.: SEE ABOVE

Air-X-Changers
Harsco

MODEL 132EH
 AXC JOB NO.: SEE ABOVE
 DRAWN BY: PN DATE: 04/13/06
 CHECKED BY: DB DATE: 04/13/06
 DRAWING NO.: CRT SCALE: 1:1

NOTICE: THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND IT SHALL NOT BE USED OR REPRODUCED OR CONTENTS DISCLOSED IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT FROM AIR-X-CHANGERS.



REV. 2

PARTS LIST



air-x-changers
 a harsco company

Post Office Box 1804
 Tulsa, OK 74015
 Phone: (918) 266-1850
 Fax (918) 266-1322

JOB NUMBER: 065070
 CUSTOMER: **ENERFLEX**
 ORDER COVERS: (1) Model 132EH-104-20

REV.	BY	DATE	DESCRIPTION OF CHANGE
0	PSWILLIAMS	11/15/06	Initiated Parts List
1			

FINISH: *Encana Standard*

SURFACE PREPARATION: *Chemical Clean*

PRIMER: *H-I-S 9267 Gray Primer; 1.5 TO 2.0 MILS. DFT.*

FINISH COAT: *AXC Std-Customer Tint: H-I-S S687 (tint to match Cloverdale PC Taupe); 1.5 TO 2.0 MILS. DFT.*

Prior to painting, mask off the inside perimeter of each opening of the bugscreen frame (and the air intake on 'F' style coolers) with 1 inch wide 3M Model 481 tape.

P.O.	QTY.	DESCRIPTION OF COMPONENTS
		NOTE: AN ASTERIK (*) IN QUANTITY COLUMN INDICATES A RECOMMENDED SPARE PART
	2	SECTION(S) IN ACCORDANCE WITH SPECIFICATION SHEET.
	1	132EH-104-20 STRUCTURE(S), COMPLETE WITH: <i>Hail Guards - Type: Standard; ; Area(Sq.Ft.): 124.9</i> <i>Enerflex Standard Pipe Supports</i> EXTRA DOOR PER ENCANA UNITS
	1	SET SHUTTERS: TYPE <i>Auto</i> , FOR SERVICE(S) <i>EJW/ELOW, TAW/CW</i> , SQ. FT. = <i>201</i> , #LINKAGE SETS = <i>2</i> , MOUNTING TYPE: <i>Standard</i> , EXTRA FEATURES: <i>None</i>
	1	SET SHUTTERS: TYPE <i>Auto</i> , FOR SERVICE(S) <i>AC</i> , SQ. FT. = <i>59.5</i> , #LINKAGE SETS = <i>1</i> , MOUNTING TYPE: <i>Standard</i> , EXTRA FEATURES: <i>None</i>
	2	AIR MOTOR: FOR SERVICE(S) <i>EJW/ELOW, TAW/CW, Garzo</i> MAKE, <i>501-12 w/Pivot Mount</i> MODEL, <i>6-30</i> SPRING OPTION, <i>Rubber</i> DIAP MTRL., POSITIONER: <i>None</i>
	1	AIR MOTOR: FOR SERVICE(S) <i>AC, Garzo</i> MAKE, <i>501-12 w/Pivot Mount</i> MODEL, <i>6-30</i> SPRING OPTION, <i>Rubber</i> DIAP MTRL., POSITIONER: <i>None</i>
	* 1	FAN(S): <i>132</i> Inch DIAMETER, <i>11</i> BLADES, <i>LH</i> ROTATION, <i>MOORE-CL10K</i> MAKE, <i>15.6°</i> ANGLE @ <i>Clevis</i> , <i>3-7/16</i> Inch BORE WITH <i>7/8</i> Inch X <i>7/16</i> Inch KEYWAY. MODEL/PITCH: <i>60-HDVT/Manual</i> , HUB: <i>TAPER WELD VORTEX TIPS TO FAN BLADES!</i>
	* 1	FAN SHAFT(S): <i>3-7/16</i> Inch DIA. X <i>110</i> Inch LONG WITH <i>7/8</i> Inch SQ. KEYS <i>each</i> END, KEYWAY LENGTH(DRIVE END): <i>7 Inch</i> , KEYWAY LENGTH(FAN END): <i>7 Inch</i> , KEY LENGTH: <i>5 Inch</i>
	* 2	<i>3-7/16</i> Inch FAN SHAFT BEARINGS, MAKE/MODEL: <i>Dodge-S2000/P2B-S2-307R</i> , AXC P/N <i>BR1124</i>
	* 1	IDLER SHAFT(S): <i>2-7/16</i> inch DIA. X <i>20</i> inch LONG WITH <i>5/8</i> inch SQ. KEY <i>6</i> inch LONG-ONE END
	1	SET(S): <i>Adj. Block</i> TYPE IDLER FRAME PARTS
	* 2	<i>2-7/16</i> Inch IDLER BEARING(S), MAKE/MODEL: <i>Dodge-S2000/P2B-S2-207R w/'Boxed' Idler Housing</i> , AXC P/N <i>BR1111</i>
	1	SET(S) BUGSCREEN FRAME/FANGUARD WITH SOFT BUGSCREEN PANELS <i>PER AXC P/N BP0016</i> : ONE SET CONSISTS OF: <i>4</i> PANELS <i>28.5</i> Inches X <i>67</i> Inches <i>6</i> PANELS <i>45.5</i> Inches X <i>69</i> Inches COMPLETE WITH ONE (1) SOFTBUGSCREEN INSTALLATION KIT.



Alr-X-Changers

Harsco

PO BOX 1804
TULSA, OK 74101-1804
PHONE: 918-619-8000
FAX: 918-384-5202

Job No. 065070

Initial Release Date 11/15/2006

Page 1 of 1

1	Purchaser	ENERFLEX	Ultimate User	ENCANA
2	Inquiry	CP051472	Destination	WHEATLAND / PARKLAND
3	No. Units	1	Model:	132EH-104-20
4	Assembly:	PACKAGED	Draft:	FORCED
			Reference	3512AFRC@1400RPM@1005HP W/RG357M
			Overall Size (WxLxH),	-9.29x21.00x13.46
			Est. Wt., lbs.	18,600

PERFORMANCE

Service	EJW/ELOW	TAW/CW	AC
Flow	290GPM	300GPM	14.1MMSCFD
Fluid	50%GLY	50%GLY	.5731SPGR
Temp. In / Out, f	190.0 / 171.9	150.5 / 129.5	190.1 / 123.5
Pressure, psia			112.5
Pressure Drop, psi	4.6	2.6	4.5
Heat Load, btu/hr	2,460,871	2,811,868	1,001,820
True LMTD, f	51.3	25.8	36.5
Overall Rate, U, btu/hr ft ² f	174.1	133.3	68.9
Fouling Factor, ft ² hr f / btu	0.0005	0.0005	0.0020
Surface, Bare / Extended, sq.ft.	278 / 4419	814 / 12134	399 / 5951
Sections, No./Connected	(1) COMBINED w/2	(1) COMBINED w/1	(1) SINGLY
Design Temp. (Max / Min), f	300/-20	300/-20	300/-20
Design / Test Press., psig	*14 / 65	*14 / 65	350 / 455
Pass Arrangement	CROSSFLOW	CROSSFLOW	CROSSFLOW
No. Tube Rows/Tube Passes	4 / 1	4 / 2	5 / 1
Section Weight, lbs	6050		2700
Tubes, OD x BWG	5/8X16(.060MIN)	3/4X16(.060MIN)	3/4X16(.060MIN)
Material	SA214	SA214	SA214
No. Per Section / Length, ft	86 / 20	210 / 20	103 / 20
Retarders			
Accelerators			
Fins, Type	L-TENSION / WHEEL	L-TENSION / WHEEL	L-TENSION / WHEEL
Material	ALUMINUM	ALUMINUM	ALUMINUM
Nozzles, Rating/Type	150 RF	150 RF	300 RF
Material / Bore	SA105 / SCH-40	SA105 / SCH-40	SA105 / SCH-80
(No. Inlets) / Size, in	(1) / 6IN	(1) / 6IN	(1) / 8IN
(No. Outlets) / Size, in	(1) / 6IN	(1) / 6IN	(1) / 8IN
Headers, Type	RECT. TUBE	RECT. TUBE	BOX W/PLUGS
Material	SA500 GR.B	SA500 GR.B	SA516 70
Corrosion Allow., in			0.0625
Grooved Tubesheet			YES
Plugs, Type	SHOULDER	SHOULDER	SHOULDER
Plugs Material	SA105	SA105	SA105
Industry Specifications	AXC-STD	AXC-STD	AXC-STD
ASME Code Stamp / N.B.			YES
Canadian Registration #			YES
PWHT			
NACE			

44 **Inspection/NDT** U

F= 100% R.T of all header seam & nozzle butt welds PLUS 100% U.T. of all attachment welds. S= Spot R.T. of 1 long seam & 1 end closure, per header
 U= 100% UT of all header seam, nozzle and coupling attachment & nozzle butt welds. B= 100% R.T. of all nozzle butt welds.
 SB= S PLUS B as each are described above. UB= U PLUS B as each are described above.

AIR-SIDE PERFORMANCE		FAN DATA		DRIVER DATA		REDUCER DATA	
45 Ambient Air Temp., In, f	100	No. Fans / Make / MOORE-CL10K	Type	ENGINE DRIVE	Type	REDUCER BY OTHERS	
46 Elevation, ft	2500	Blade Material	ALUMINUM				
47 Air Flow, SCFM	171,615	HP @RPM	59.53 @ 265				
48 Air Temp., Out, f	133.2	Dia., in / No. Blades	132 / 11				
49 Min. Ambient, f	-20	Blade Angle, Deg	15.6 @ Clevis				
50		Series/Blade Adj.	60-HDVT/Manual				
51		Fan Hub Bushing	TAPER				

52 * Actually built to standard 50# design. Designated 14# to eliminate necessity of Provincial registration.

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REV	DATE	BY	DESCRIPTION

1. Manufactured and certified by Air-X-Changers, A Harsco Company, 5215 Arkansas Road, Catoosa, Oklahoma, 74015, USA
(Name and address of manufacturer)
2. Manufactured for ENERFLEX, 4700 - 47TH STREET SOUTHEAST, CALGARY, AB, T2B 3R1, CANADA
(Name and address of purchaser)

3. Location of Installation UNKNOWN
(Name and address)

4. Type Heat Exchanger Heat 065070.3 T6624.213 HDR-3, REV0 55549 2007
(Horiz. or Vert. tank) (Mfr's serial No.) (CRN) (Drawing No.) (Nat'l. Bd. No.) (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2004 to A05
Code Case Nos. N/A Special Service per UG-120(d) (year) Addenda (Date)

6. Shell: SA516 70N .75" .0625" 0' 8.7500" OD 2' 11.5000"
Mat'l. (Spec. No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7. Seams: Corner Joint N/A C=.20 N/A N/A N/A N/A N/A N/A
Long. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) H.T. Temp (°F) Time (hr) Girth. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) No. of Courses

8. Heads: (a) Mat'l: SA516 70N (Spec. No., Grade) (b) Mat'l: SA516 70 (Spec. No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	TOP, BTM	.75"	.0625"	N/A	N/A	N/A	N/A	N/A	8" x 35.5"	N/A
(b)	ENDS	.625"	.0625"	N/A	N/A	N/A	N/A	N/A	8" x 7.25"	N/A

If removable, bolts used (describe other fastenings) N/A

9. MAWP 350 (internal) N/A (external) psi at max. temp. 300 (internal) N/A (external) °F (Mat'l., Spec. No., Gr., Size, No.)
Min. design metal temp. -20 °F at 350 psi Hydro, pneu., or comb. test pressure Hydro. 455 psi.

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Mat'l.	Nom. Thk.	Reinforcement Mat'l.	How Attached	Location
IN/OUT	2	8"	300# RFWN	SA105/SA106 GR.B	SCH 80	Weld	Welded	Header
TEMP CONT	1	1"	CPLG	SA105	6000#	Weld	Welded	Header

11. Supports: Skirt NO Lugs N/A Legs N/A Other Structure Attached Bolted
(Yes or no) (No.) (No.) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors, have been furnished for the following items of the report:
N/A
(Name of part, item number, Mfgr's name and identifying stamp)

(A) TUBES: 103 x .75 in. OD, Straight: YES, Length: 240 inches, Gauge: 16BWG, Material: SA214 Rolled Tube Sheet (B) INSP. OPENINGS: 206, Type: 7/8x14UNF-Threaded, Material: SA105 (C) IMPACT REQUIREMENTS: IMPACT EXEMPT PER: UG 20(f) CONSTRUCTED IN CONFORMANCE TO APPENDIX 28.

CERTIFICATE OF SHOP/FIELD COMPLIANCE
We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 4241 expires 12/31/2008
Date 01/19/2007 Co. name Air-X-Changers, A Harsco Company Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION
Vessel constructed by Air-X-Changers, A Harsco Company at 5215 Arkansas Road, Catoosa, Oklahoma, 74015, USA, I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province OK and employed by OneBeacon America Insurance Co. of Boston, MA have inspected the component described in this Manufacturer's Data Report on January 11, 2007 and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.
Date 01/19/2007 Signed [Signature] Commissions 11672A, OK765
(Authorized Inspector) (Nat'l Board (incl. endorsements), State, Prov. and No.)

CERTIFIED BY
Air-X-Changers

TULSA, OKLAHOMA U.S.A.

Harsco

MAX. DESIGN PRESS. 14 PSI @ 300 °F

MAX. DESIGN PRESS. PSI @ °F

MIN. DESIGN METAL TEMP. -20 °F @ 14 PSI

SER. NO. 065070.1.2 CRN

YEAR 2007 HYDRO. 65 PSI ITEM EJW-TA

55549

CERTIFIED BY
Air-X-Changers

TULSA, OKLAHOMA U.S.A.

Harsco

MAX. DESIGN PRESS. 350 PSI @ 300 °F

MAX. DESIGN PRESS. PSI @ °F

MIN. DESIGN METAL TEMP. -20 °F @ 350 PSI

SER. NO. 065070.3 CRN T6624.213

YEAR 2007 HYDRO. 455 PSI ITEM AC

ENERFLEX

Cooler Information



Air-X-Changers

Harsco

CERTIFICATE OF HYDROSTATIC TEST

CERTIFICATE NUMBER: 065070C10611

AXC JOB # 065070 **DATE:** 1/10/2007 **YEAR BUILT:** 2007

ITEM DESCRIPTION: EJW/TAW

AXC SERIAL #: 065070.1.2

DESIGN PRESSURE: 14 @ 300/-20 °F **TEST PRESSURE:** 65

This is to certify that above air cooled heat exchanger section was hydrostatically tested in accordance with ASME section VIII, Division 1, UG-99 and/or the customer requirements, at no less than 1.3 times the working pressure for a time no less than one (1) hour.

HYDROSTATIC TEST CERTIFIED BY: _____

Debbie DeWitt

Witnessed By Client Representative (if applicable) _____



TULSA GAMMA RAY, INC.

1127 SOUTH LEWIS AVENUE
TULSA, OKLAHOMA 74104-3900
918/585-3228 • FAX: 918/584-5598
1-800-625-9288

ULTRASONIC INSPECTION REPORT FORM #1

DATE 1/9/07 DAY Tue

CUSTOMER DATA	
NAME	<u>Axc Port</u>
ADDRESS	
ATTENTION	<u>QC</u>
WORK ORDER	<u>065070</u> PURCHASE ORDER
JOB LOCATION	<u>ASCP</u>
DESCRIPTION	<u>at Insp</u>

INSPECTION DESCRIPTION: WELD LAMINAR REFLECTOR PIPE OTHER dry & copy attach

APPLICABLE CODE ASME Sect. VIII Div 1 PROCEDURE NO. appx 12 REVISION
EQUIPMENT MANUFACTURER: KBF
MODEL NUMBER: USN50 SERIAL NO. 600681

TRANSDUCERS: LONGITUDINAL MHz 1) 225 S/N- 55126 /2) S/N-
SIZE 1) 1" /2)
SINGLE DUAL
ANGLE 1) 70 /2) 45
SHEAR: MHz 1) 225 S/N- 26744 /2) 225 S/N- 53088
SIZE 1) 1/2 /2) 1/2
SURFACE: MHz 1) S/N- /2) S/N-
SIZE 1) /2)

CALIBRATION: LONGITUDINAL - REFERENCE LEVEL 21/32 (db) SCANNING LEVEL 46 (db)
SHEAR - BLOCK TYPE ISW/ASME BUC DISTANCE READING
REFERENCE LEVEL 43/56 (db) SCANNING LEVEL 46 (db)

COUPLANT: CELLULOSE GLYCERIN OIL WATER OTHER
SCANNING: CONTACT IMMERSION MANUAL AUTOMATIC
SPEED 56 in/sec CABLE TYPE Buc/ev LENGTH 6'
100% OF SURFACE GRID OR SPOT (SIZE)
SURFACE - INSIDE OUTSIDE SURFACE CONDITION
VERTICLE HORIZONTAL
DIRECTIONS - PARALLEL PERPENDICULAR OPPOSING
FOR WELD A B C SURFACE(S)

PART IDENTIFICATION - COMMENTS at Insp
Joint 065070
FR/BK 1,3,5-1,2,3,4, EB-1,2, dry & copy attach dry beam weld

RESULTS: accept

TECHNICIAN HOURS ASST. HOURS TRAVEL HOURS MILEAGE 20 PERDIEM
TECHNICIAN: A. Siler LEVEL II
SUPERVISED BY: LEVEL (GRAPHIC DEPICTION)
CUSTOMER REPRESENTATIVE Chris Webb TOTAL TIME 3.0

MATERIAL TRACEABILITY RECORD

Job No. 065070

PIPE PLATE TUBES BY TSE DATE 1-8-07 CUST. EFX

MTL. P.O. NO. SECTION NO.	MATERIAL DESCRIPTION	HEAT OR CERTIFICATION NO.
3 | 103455b (Pi)	1. 8"/80 SA106B	U80255 VAM
1 @ 1034560 (Fl)	2. 8"/80 RFWN 300 SA105	VXK H32649/02 CC GAL
1 @ 1034559 (Fl)		
1 @ 1033485 (CP)	3. 1"-6000 SA105	03K pm
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	

NOTE: ALL MATERIAL OF SAME DESCRIPTION IN A SECTION MUST BE OF SAME HEAT NO.

MATERIAL TRACEABILITY RECORD

Job No. 065070

PIPE

PLATE

TUBES

BY FB

DATE 12.14.06

CUST. ENERFEX

MTL. P.O. NO. SECTION NO.	MATERIAL DESCRIPTION	HEAT OR CERTIFICATION NO.
3	1. SA516-70 N .75 ISG	✓422B07710
	2. SA516-70 N .75 ISG	✓422B07710
	3. SA516-70 .625 IPSCO	✓WG A 846
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	

NOTE: ALL MATERIAL OF SAME DESCRIPTION IN A SECTION MUST BE OF SAME HEAT NO.

MATERIAL TRACEABILITY RECORD

Job No. 065070X

PIPE PLATE TUBES BY LL DATE 1-3-07 CUST. ENERFLEX

MTL. P.O. NO. SECTION NO.	MATERIAL DESCRIPTION	HEAT OR CERTIFICATION NO.
P.O. 1033743	1. BT1470	WB61518
	2.	
2/10/3	3.	
1022582	1. BT-1070	WB-50654
	2.	
.1	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	
	1.	
	2.	
	3.	

NOTE: ALL MATERIAL OF SAME DESCRIPTION IN A SECTION MUST BE OF SAME HEAT NO.

NGC Unit

N/A Not Applicable

air-x-changers

N. Craig

FINAL -- IN PROCESS INSPECTION CHECKLIST

Customer: Enerflex

TAG NUMBER: 065070x

Date: 01/12/07

MODEL: 132 EH

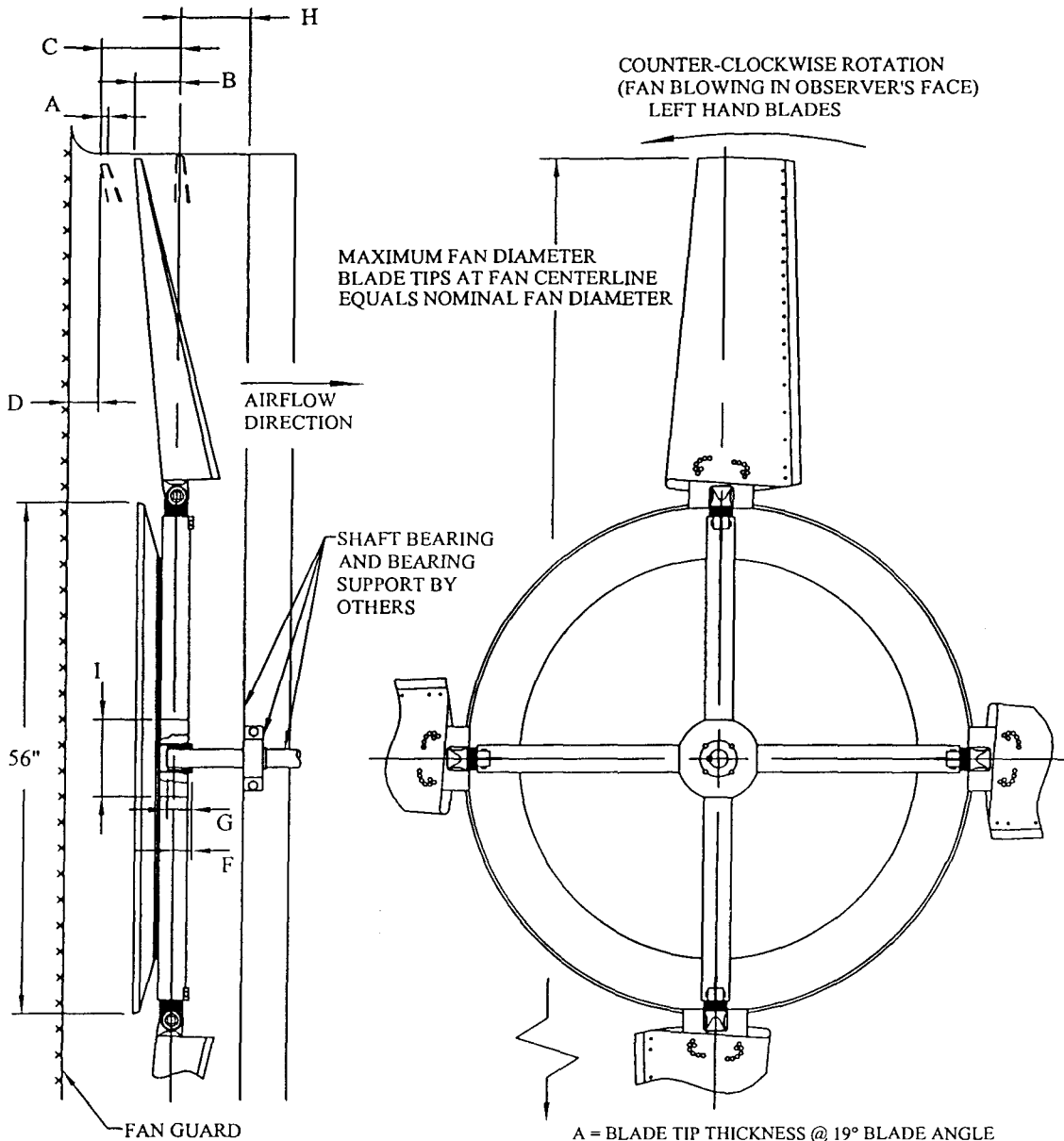
TAG NUMBER:

FINAL ASSEMBLY	Prod. Check	Lead	Hold Points		FINAL ASSEMBLY	Prod. Check	Lead	Hold Points	
			Q. C.	Cust.				Q. C.	Cust.
Dimensional Insp. Of Sub Columns	/	/			Manual and/or 3 - Air Motors	SPW 1-16-07	KB 1-16-07		
Dimensional Insp. Of Base Holes	MC 1-15-07	SPW 1-16-07	SPW 1-17-07	BAW 1/17/06	Final Paint of Unit	LL/LM 1-16-07	KB 1-16-07	SPW 1-17-07	BAW 1/17/07
Fan Blade Clearance	MC 1-15-07	SPW 1-15-07	SPW 1-17-07		All shutter rods pinned With #14 x 3/4" tapping screw	SPW 1-16-07	KB 1-16-07	SPW 1-17-07	
Fan Blade Pitch	MC 1-15-07	SPW 1-15-07	SPW 1-17-07		Clean Galvanizing	/	/	/	
Fan Shaft Clearance	SPW 1-16-07	KB 1-16-07	SPW 1-17-07		All Bearings and/or Universals Greased	MC 1-16-07	SPW 1-16-07	SPW 1-17-07	BAW 1/17/07
Idle Alignment	SPW 1-16-07	KB 1-16-07	SPW 1-17-07		Vibration Switches	/	/	/	
Electric Motor	/	/	/		Unit Name Plate	MC 1-16-07	KB 1-17-07	SPW 1-17-07	BAW 1/17/07
Gear Box	/	/	/		Lifting Lug Attachment	B-J. 1-17-07	KB 1-17-07	SPW 1-17-07	
Bearing set screws Torque	MC 1-15-07	KB 1-17-07	SPW 1-17-07	BAW 1/17/06	All Loose Parts Tagged	T.H. 1-17-07	KB 1-17-07	SPW 1-17-07	
Prevention of Rust	SPW 1-16-07	KB 1-16-07	SPW 1-17-07			/	/	/	
Flange Arrangement and Facing	MC 1-16-07	SPW 1-16-07	SPW 1-17-07		Name Plate Attachment	MC 1-16-07	KB 1-17-07	SPW 1-17-07	BAW 1/17/07
(Hail) Core (Fan Guards) Bug Screens	MC 1-16-07	SPW 1-16-07	SPW 1-17-07		Run Test and Vibration Check	/	/	/	
Shutters Operate Correctly	SPW 1-16-07	KB 1-16-07	SPW 1-17-07		Megger Test on Motors	/	/	/	

Q. C. Review: Jill Cosner

Q. C. Release For Shipment: BA Reig 1/17/07

Comments:



A = BLADE TIP THICKNESS @ 19° BLADE ANGLE
 B = RUNNING POSITION OF BLADES
 C = MAXIMUM BLADE TRAVEL
 D = MINIMUM OBSTACLE CLEARANCE AT INLET
 F = CENTERLINE OF FAN TO BASE OF BUSHING
 G = BUSHING OVERALL HEIGHT
 H = MINIMUM OBSTACLE CLEARANCE AT OUTLET
 I = NOMINAL MECHANICAL HUB DIAMETER
 L = MAX. BUSHING TORQUE FT. LBS.
 # = WITH S.A.E. STANDARD SQUARE KEYWAY
 * = WITH SHALLOW KEYWAY IN BUSHING
 ° = MAX METRIC BORE WITH STANDARD KEYWAY

WITH FAN OPERATING
 AT 12000 FT : MINUTE
 BLADE TIP SPEED
 PERCENT BLADE
 LOADING

DIA	LOADING				D	H	MAX BLADES	BUSHING TYPE	MAX # BORE	MAX * BORE	MAX ° BORE	I	F	G	L
	A	B	C	75%											
10"	2.3"	2.5"	2.1"	3.2"	2.0"	7.0"	6	U	2.750"	2.938"	75	7"	2.0"	2.7"	4000
11"	2.2"	3.4"	2.8"	4.5"	2.0"	7.0"	8	U	2.750"	2.938"	75	9"	2.0"	2.7"	4000
12"	2.1"	4.3"	3.5"	5.8"	2.0"	7.0"	8	W	3.750"	4.000"	100	9"	2.2"	2.8"	7300
13"	1.9"	5.1"	4.1"	7.1"	2.0"	7.0"	8	X	3.750"	4.000"	100	9"	2.2"	4.0"	9800
14"	1.8"	6.0"	4.8"	8.5"	2.0"	7.0"	12	U	2.750"	2.938"	75	12"	2.0"	2.7"	4000
14"	1.8"	6.0"	4.8"	8.5"	2.0"	7.0"	12	W	3.750"	4.000"	100	12"	2.2"	2.8"	7300
15"	1.7"	7.0"	5.6"	10.0"	2.0"	7.0"	12	X	3.750"	4.000"	100	12"	2.2"	4.0"	9800
16"	1.5"	8.1"	6.4"	11.6"	2.0"	7.0"	12	Z	5.000"	5.500"	140	12"	2.2"	4.0"	18000



**SERIES 60 FAN
 LEFT HAND ROTATION**

ENERFLEX

CONTROL PANEL

ENCANA

**ARIEL SCREW COMPRESSOR
[Non ADEM III]
CONTROL OVERVIEW**

REV. 4

March 17, 2007

DPH FOCUS

1 Overview	4
2 Unit Stopped – Step Sequence 0	4
2.1 Shutdown Permissive.....	4
2.2 Ready to Start.....	4
3 Unload / Set Vi 5 / Pre-Lube Sequence – Step Sequence 1.....	5
3.1 Slide Valve Unloading.....	5
3.2 Set Vi 5	6
3.3 Vi Controller Setpoint.....	6
3.4 Compressor Pre-Lube	7
3.5 Engine Pre-Lube	7
4 Cranking – Step Sequence 2	8
4.1 Start Gas Valve	8
4.2 Purge	8
4.3 Ignition.....	8
4.4 Fuel Gas Valve.....	8
4.5 Crank Sequence Failure	8
4.6 Idle Speed	8
5 Warm-up – Step Sequence 3	9
5.1 Compressor Differential Pressure	9
5.2 Compressor Oil Filter Diff Pressures.....	9
5.3 Engine Speed	9
5.4 Compressor Lube Oil Differential Pressure Shutdown Setpoint	10
5.5 Compressor Oil Temperature Warm-up Permissive.....	10
6 Ready to Load – Step Sequence 4.....	11
6.1 Engine Speed	11
6.2 Slide Valve.....	12
6.3 Recycle Valve	12
6.4 Vi Controller	13
6.5 Liquid Dump Control.....	14
7 Cooldown – Step Sequence 5.....	15
7.1 Slide Valve.....	15
7.2 Engine Speed	15
7.3 Compressor Lube Oil Differential Pressure Shutdown Setpoint	15
7.4 Cooldown Requirement	15
8 Post-Lube / Unload / Set Vi 5 – Step Sequence 6	16
8.1 Slide Valve Unloading.....	16
8.2 Set Vi 5	17
8.3 Compressor Pump.....	17
8.4 Engine Post-Lube.....	17
9 Shutdowns.....	18
9.1 Normal Shutdown:	18
9.2 Fast Shutdown.....	18
9.3 ESD Shutdown.....	18
10 Control Valves.....	19
11 Local / Remote Control	20

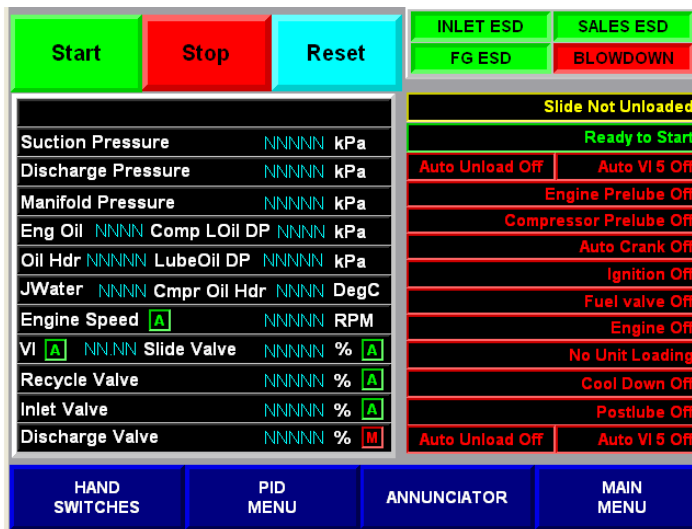
11.1 Local Control	20
11.2 Remote Control	20
12 Remote Start / Auto Restart	21
12.1 Remote Start Active	21
12.2 Remote Start SD Lockout	21
12.3 Remote Start Logging	21
12.4 Auto Restart Active	22
12.5 Auto Restart SD Lockout.....	22
12.6 Auto Restart Logging.....	22
12.7 Restart Attempts	22
12.8 Man on Site	22

1 Overview

The control sequence is broken down into the following sequence steps.

Step Sequence	Sequence Description
0	Unit Stopped
1	Unload / Set Vi 5 / Pre-lube
2	Cranking
3	Warm-up
4	Ready To Load
5	Cooldown
6	Post-lube / Unload / Set Vi 5
0	Unit Stopped

2 Unit Stopped – Step Sequence 0



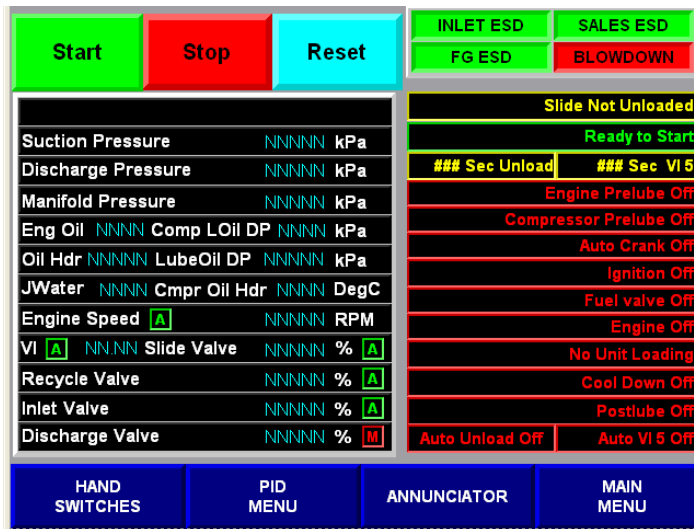
2.1 Shutdown Permissive

- All shutdown conditions must be clear prior to initiating a compressor start.

2.2 Ready to Start

- Once all shutdown conditions are clear, a “Ready to Start” status will indicate that the compressor is ready for a start.
- Pressing the start pushbutton will initiate the start sequence.
- The step sequence will then be automatically advance to **Step Sequence 1 – Unload / Set Vi 5 / Pre-lube.**

3 Unload / Set Vi 5 / Pre-Lube Sequence – Step Sequence 1



3.1 Slide Valve Unloading

- The slide valve must be below the load start set point permissive of 10%, prior to starting the compressor.
- If the slide valve position is greater than 10%, the control system will attempt to unload the compressor prior to the pre-lube sequence;
 - o **UY-223 Solenoid will energize to close the valve Slide/VI Calibrate Unload Valve.**
 - o **UY-201A Unload solenoid will energize to unload the compressor.**
 - o **UY-251 Solenoid will energize to start the compressor pre/post-lube pump.**
- If the slide valve does not unload within 300 seconds, a “Failed to Unload” lockout will cancel the start sequence.
- Once the slide valve is below the load start permissive [10%]
 - o **UY-251 Solenoid will de-energize to stop the compressor pre/post-lube pump.**
 - o **UY-201A Unload solenoid will de-energize.**
 - o **UY-223 Slide/VI Calibrate Unload Valve solenoid will de-energize to open the valve.**

3.2 Set Vi 5

- The Vi position is set to its start set point permissive [Vi 5], prior to starting the compressor.
- If the Vi position is less than Vi 5, the control system will attempt to increase the Vi prior to the pre-lube sequence;
 - o **UY-223 Solenoid will energize to close the valve Slide/VI Calibrate Unload Valve.**
 - o **UY-228B Vi Increase solenoid will energize to increase the compressor Vi.**
 - o **UY-251 Solenoid will energize to start the compressor pre/post-lube pump.**
- If the Vi position does not reach the start set point permissive within 120 seconds, a **“Set Vi 5 Failed”** lockout will cancel the start sequence.
- Once the Vi position is at the start permissive [Vi 5]
 - o **UY-251 Solenoid will de-energize to stop the compressor pre/post-lube pump.**
 - o **UY-228B Vi Increase solenoid will de-energize.**
 - o **UY-223 Slide/VI Calibrate Unload Valve solenoid will de-energize to open the valve.**

3.3 Vi Controller Setpoint

- On initial startup the Vi controller setpoint is set to Vi5.
- After 30 minutes, a calculated Vi value will be used as the Vi controller setpoint. The Vi controller setpoint is only updated if the difference between the calculated Vi value and the present controller setpoint is greater than 0.25 Vi.

Start		Stop		Reset		INLET ESD		SALES ESD			
						FG ESD		BLOWDOWN			
						Slide Not Unloaded					
Suction Pressure						Ready to Start					
Discharge Pressure						Auto Unload Off		Auto VI 5 Off			
Manifold Pressure						### Sec Engine Prelubing					
Eng Oil						### Sec Compressor Prelubing					
Oil Hdr						Auto Crank Off					
JWater						Ignition Off					
Engine Speed						Fuel valve Off					
VI						Engine Off					
Recycle Valve						No Unit Loading					
Inlet Valve						Cool Down Off					
Discharge Valve						Postlube Off					
						Auto Unload Off		Auto VI 5 Off			
HAND SWITCHES			PID MENU			ANNUNCIATOR			MAIN MENU		

3.4 Compressor Pre-Lube

- Once the slide valve has been unloaded and the Vi position set to Vi 5, the pre-lube sequence will start.
- The compressor is only pre-lubed if the compressor has not been running for an 8 hour period.
- If a compressor pre-lube is required, a compressor lube oil differential pressure of 7Kpad must be seen on PDT-207. Once this set point is reached, the compressor pre-lube pump will run for an additional 100 seconds, equating to approx. two gallon maximum to the bearings.
- On a successful start, the compressor pre-lube will not be required on the next start attempt.
- If PDAL-207 lube oil differential pressure permissive has not been achieved within a 120 second period a “Compressor Pre-lube” lockout will cancel the start sequence. Should the sequence cancel, on the next start attempt the pre-lube timer will start from where it had left off.

3.5 Engine Pre-Lube

- The engine pre-lube pump will run until the PT-306 engine oil pressure set point [35kpa] and minimum pre-lube time [20 seconds] have been achieved.
- If the engine pre-lube permissive have not been achieved within a 60 seconds period, an “Engine Pre-Lube” lockout will cancel the start sequence.
- On a successful pre-lube the Step Sequence is advanced to **Step Sequence 2 – Cranking.**

4 Cranking – Step Sequence 2

Start		Stop		Reset		INLET ESD		SALES ESD	
						FG ESD		BLOWDOWN	
Suction Pressure						Slide Not Unloaded			
Discharge Pressure						Ready to Start			
Manifold Pressure						Auto Unload Off		Auto VI 5 Off	
Eng Oil						Engine Prelube Off			
Oil Hdr						Compressor Prelube Off			
JWater						Auto Crank On			
Engine Speed						Ignition On			
VI						Fuel Valve On			
Recycle Valve						Engine Off			
Inlet Valve						No Unit Loading			
Discharge Valve						Cool Down Off			
						Auto Unload Off		Auto VI 5 Off	
HAND SWITCHES		PID MENU		ANNUNCIATOR		MAIN MENU			

4.1 Start Gas Valve

- The start gas valve solenoid **UY-304** will energize during the crank sequence and de-energize once the engine speed has reached 300 RPM [Crank Termination Speed].

4.2 Purge

- The engine is cranked until 60 RPM is established for three seconds in order to purge the system of any residual fuel gas.

4.3 Ignition

- The ignition module is energized once the engine speed has reached the 60 RPM.

4.4 Fuel Gas Valve

- The fuel gas valve solenoid is energized three seconds after energizing the ignition module.

4.5 Crank Sequence Failure

- If the crank termination speed [300 RPM] is not achieved within 20 seconds a “Crank Sequence Fail” will be generated and the crank sequence will start again.
- Three crank attempts are allowed before a “Crank Sequence” lockout becomes active which in turn will cancel the start sequence. .

4.6 Idle Speed

- Once the speed has reached the idle speed setpoint [850 RPM], the **Step Sequence is advanced to Step Sequence 3 – Warm-up.**

5 Warm-up – Step Sequence 3

Start		Stop		Reset		INLET ESD		SALES ESD	
						FG ESD		BLOWDOWN	
Suction Pressure						Slide Not Unloaded			
Discharge Pressure						Ready to Start			
Manifold Pressure						Auto Unload Off		Auto VI 5 Off	
Eng Oil						Engine Prelube Off			
Oil Hdr						Compressor Prelube Off			
JWater						Auto Crank On			
Engine Speed						Ignition On			
VI						Fuel Valve On			
Recycle Valve						Eng Warmup			
Inlet Valve						No Unit Loading			
Discharge Valve						Cool Down Off		Postlube Off	
HAND SWITCHES		PID MENU		ANNUNCIATOR		MAIN MENU			

5.1 Compressor Differential Pressure

- The backpressure differential pressure set point permissive must be made within 30 seconds of starting the compressor. The differential pressure is a calculated value [PT-204 Discharge pressure Minus PT-200 Suction pressure].

5.2 Compressor Oil Filter Diff Pressures

- The compressor oil filter differential pressure set points are elevated during start up due to the colder compressor oil temperature. If the compressor oil supply temperature [TE-209] is below 8 Degrees Celsius the filter differential pressure shutdowns are elevated to 900 KpaD. Once the compressor oil supply temperature [TE-209] is above 8 Degrees Celsius the filter differential shutdowns become active.
- PDIT-328 Compressor Rotor Injection Filter differential shutdown 76 KpaD.
- PDIT-229 Compressor Lube Oil Filter Differential Shutdown 241 KpaD.

5.3 Engine Speed

- With the engine at the idle speed the engine will wait until Engine Jacket Water [TE-310A] warm-up temperature permissive of 50 degrees Celsius has been reached.
- At the warm-up temperature; the engine speed is then ramped up to the Minimum Load Speed set point [1000 RPM or 1400 RPM depending on the engine].

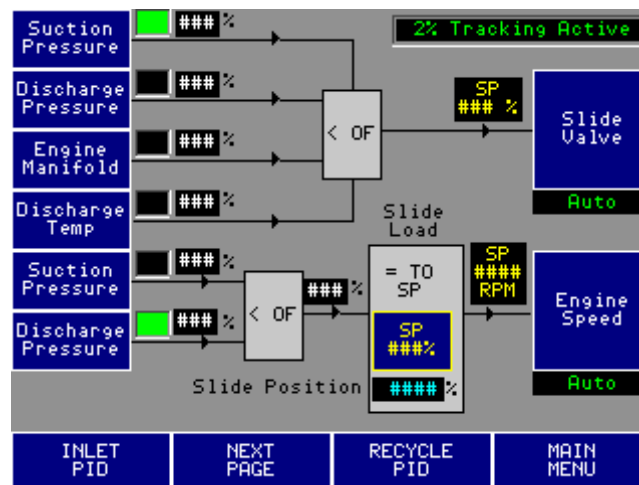
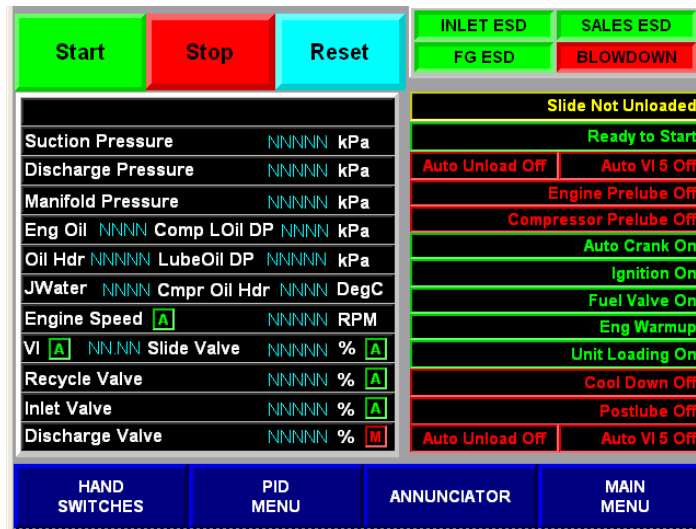
5.4 Compressor Lube Oil Differential Pressure Shutdown Setpoint

- During the warm-up sequence, if the engine speed is less than the minimum load speed setpoint and the slide valve is below the minimum load setpoint [10%] the shutdown setpoint for PDALL-207 Lube Oil Differential Pressure LOLO SD becomes 250 kPad. Otherwise the shutdown setpoint becomes 310 kPad.

5.5 Compressor Oil Temperature Warm-up Permissive

- If the compressor oil temperature [TE-209] is below 45 Deg C the slide valve is loaded to 20% in order to speed up the warm-up process.
- Once the compressor oil temperature is above 45 Deg C the **Step Sequence is advanced to Step Sequence 4 – Ready To Load.**

6 Ready to Load – Step Sequence 4



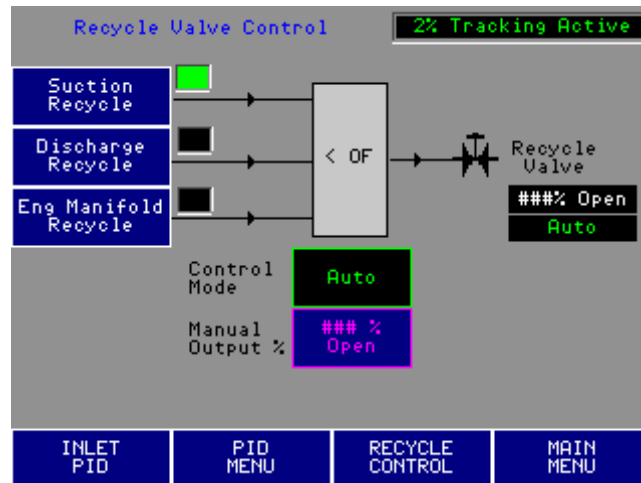
6.1 Engine Speed

- In the ready to load sequence the engine speed is controlled between the minimum load speed and the maximum load speed setpoints.
- The slide valve load % set point must be reached prior to ramping up the engine speed from minimum to maximum load speed.
- The set point for the engine speed controller is the lowest output of two controllers;
 - **Suction pressure controller**
 - **Discharge pressure controller**

6.2 Slide Valve

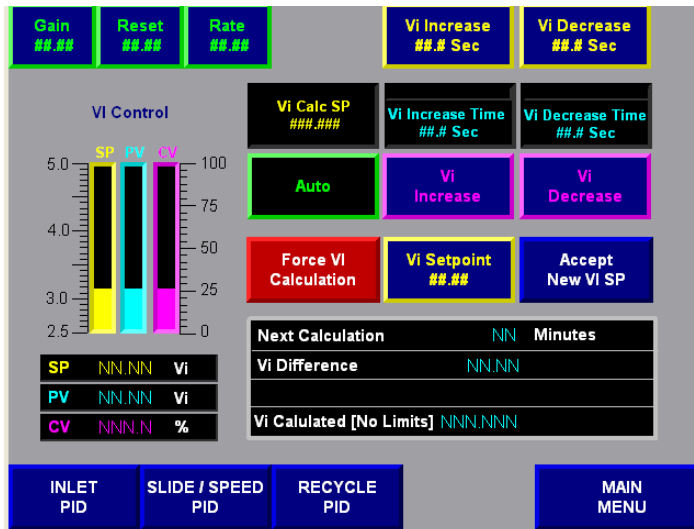
- The set point for the slide valve controller is the lowest output of four controllers;
 - **Suction pressure controller**
 - **Discharge pressure controller**
 - **Engine manifold pressure controller**
 - **Discharge temperature controller**

6.3 Recycle Valve



- The recycle valve is controlled based on the lowest output of the three controllers
 - **Suction pressure controller**
 - **Discharge pressure controller**
 - **Engine manifold pressure controller**

6.4 Vi Controller



- Once the unit has been loaded for 30 minutes the PLC will run the calculation supplied by ARIEL, the result will be the set point for the Vi controller. This calculation will be run every 30 minutes if the unit is running.

6.5 Liquid Dump Control

Compressor Liquid Dump Operational Control				
Selected	Units	Actual	Setpoint	
LT-114 Inlet Sep Level	%	####	Start Lvl SP ### %	
ERROR: START SP MUST BE GREATER THAN STOP SP		DUMP CONTROL OFF	Stop Lvl SP #### %	
Liquid Dump Setpoint	Suction Slide Suction Recycle		Dump Pres SP #### kPa	
		% Loaded	#### %	
		Inlet Valve	#### %	
		Recycle Valve	#### %	

SLIDE CONTROL	SPEED CONTROL	RECYCLE CONTROL	INLET PRESSURE	MAIN MENU
---------------	---------------	-----------------	----------------	-----------

- LIT-114 on the inlet vessel is used to assist the dumping of fluids out of the vessel with low suction pressure. When the level is higher than the operator's set point the PLC moves a new pressure set point into the Slide Suction pressure controller and the Recycle Suction pressure controller. This causes the unit to unload and start to recycle which increases the pressure in the inlet vessel. This increase in pressure helps to push the liquids out and prevents a high level shutdown.

7 Cooldown – Step Sequence 5

Start		Stop		Reset		INLET ESD		SALES ESD	
						FG ESD		BLOWDOWN	
						Slide Not Unloaded			
						Ready to Start			
Suction Pressure		NNNNN		kPa		Auto Unload Off		Auto VI 5 Off	
Discharge Pressure		NNNNN		kPa		Engine Prelube Off			
Manifold Pressure		NNNNN		kPa		Compressor Prelube Off			
Eng Oil		NNNN		Comp LOil DP		NNNN		kPa	
Oil Hdr		NNNNN		LubeOil DP		NNNNN		kPa	
JWater		NNNN		Cmpr Oil Hdr		NNNN		DegC	
Engine Speed		A		NNNNN		RPM		Auto Crank On	
VI		A		NN.NN		Slide Valve		NNNNN	
								Ignition On	
Recycle Valve		NNNNN		%		A		Fuel Valve On	
Inlet Valve		NNNNN		%		A		Eng Warmup	
Discharge Valve		NNNNN		%		M		No Unit Loading	
						### Sec Cooldown			
						Postlube Off			
						Auto Unload Off		Auto VI 5 Off	
HAND SWITCHES			PID MENU			ANNUNCIATOR		MAIN MENU	

7.1 Slide Valve

- In the cooldown sequence, the slide valve is unloaded to 0%.

7.2 Engine Speed

- The engine speed is ramped to the minimum load speed set point, once the slide has been unloaded the speed is then ramped to idle speed set point.

7.3 Compressor Lube Oil Differential Pressure Shutdown Setpoint

- During the cooldown sequence, if the engine speed is less than the minimum load speed setpoint and the slide valve is below the minimum load setpoint [10%] the shutdown setpoint for PDALL-207 Lube Oil Differential Pressure LOLO SD becomes 250 kPad. Otherwise the shutdown setpoint becomes 310 kPad.

7.4 Cooldown Requirement

- At idle speed, a 5 minute cooldown timer is started.
- At the 5 minute mark, the Step Sequence is advanced to **Step Sequence 6 – Post-lube / Unload / Set Vi 5.**
- If idle speed is not achieved within a 10 minute period, the Step Sequence is advanced to Step Sequence 6.

8 Post-Lube / Unload / Set Vi 5 – Step Sequence 6

Start		Stop		Reset		INLET ESD	SALES ESD
						FG ESD	BLOWDOWN
						Slide Not Unloaded	
						Ready to Start	
Suction Pressure NNNNNN kPa						Auto Unload Off	
Discharge Pressure NNNNNN kPa						Auto VI 5 Off	
Manifold Pressure NNNNNN kPa						Engine Prelube Off	
Eng Oil NNNNN Comp LOil DP NNNNN kPa						Compressor Prelube Off	
Oil Hdr NNNNNN LubeOil DP NNNNNN kPa						Auto Crank On	
JWater NNNNN Cmpr Oil Hdr NNNNN DegC						Ignition On	
Engine Speed [A] NNNNNN RPM						Fuel Valve On	
VI [A] NNNNN Slide Valve NNNNNN % [A]						Eng Warmup	
Recycle Valve NNNNNN % [A]						No Unit Loading	
Inlet Valve NNNNNN % [A]						Cool Down Off	
Discharge Valve NNNNNN % [M]						### Sec Postlubing	
						Auto Unload On	
						Auto VI 5 On	
HAND SWITCHES		PID MENU		ANNUNCIATOR		MAIN MENU	

8.1 Slide Valve Unloading

- If the slide valve position is greater than 10%, the control system will attempt to unload the compressor during the post-lube sequence;
 - o UY-223 Solenoid will energize to close the valve Slide/VI Calibrate Unload Valve.
 - o UY-201A Unload solenoid will energize to unload the compressor.
 - o UY-251 Solenoid will energize to start the compressor pre/post-lube pump.
- If the slide valve does not unload within 300 seconds, a “Failed to Unload” lockout will cancel the post-lube sequence.
- Once the slide valve is below the load start permissive [10%]
 - o UY-251 Solenoid will de-energize to stop the compressor pre/post-lube pump.
 - o UY-201A Unload solenoid will de-energize.
 - o UY-223 Slide/VI Calibrate Unload Valve solenoid will de-energize to open the valve.

8.2 Set Vi 5

- If the Vi position is less than Vi 5, the control system will attempt to adjust the Vi position during the post-lube sequence.
 - o **UY-223 Solenoid will energize to close the valve Slide/VI Calibrate Unload Valve.**
 - o **UY-228B Vi Increase solenoid will energize to increase the compressor Vi.**
 - o **UY-251 Solenoid will energize to start the compressor pre/post-lube pump.**
- If the Vi position does not reach Vi 5 within 120 seconds, a “**Set Vi 5 Failed**” lockout will cancel the post-lube sequence.
- At the Vi 5 position
 - o **UY-251 Solenoid will de-energize to stop the compressor pre/post-lube pump.**
 - o **UY-228B Vi Increase solenoid will de-energize.**
 - o **UY-223 Slide/VI Calibrate Unload Valve solenoid will de-energize to open the valve.**

8.3 Compressor Pump

- The compressor does not require a post lube; in this sequence the compressor pre/post-lube pump is only used to assist in the unloading and setting the Vi of the compressor.

8.4 Engine Post-Lube

- In Step Sequence 6 the engine pre/post-lube pump is started for a period of 60 seconds.
- **Once the engine post-lube / unloading / Set Vi 5 is complete, the Step Sequence is advanced to Step Sequence 0 – Unit Stopped.**

9 Shutdowns

- There are three types of compressor shutdowns;
 - ◆ **Normal Shutdown**
 - ◆ **Fast Shutdown**
 - ◆ **Emergency Shutdown**

9.1 Normal Shutdown:

- Unload
- Cool down
- Shutoff Fuel Gas
- Ignition Shutoff
- Post Lube

9.2 Fast Shutdown

- Unload / Cooldown Steps are skipped
- Shutoff Fuel Gas
- Ignition Shutoff
- Post Lube

9.3 ESD Shutdown

- Unload / Cooldown / Post-Lube Steps are skipped
- Shutoff Fuel Gas
- Ignition Shutoff
- Power Removed
- Blowdown Valve

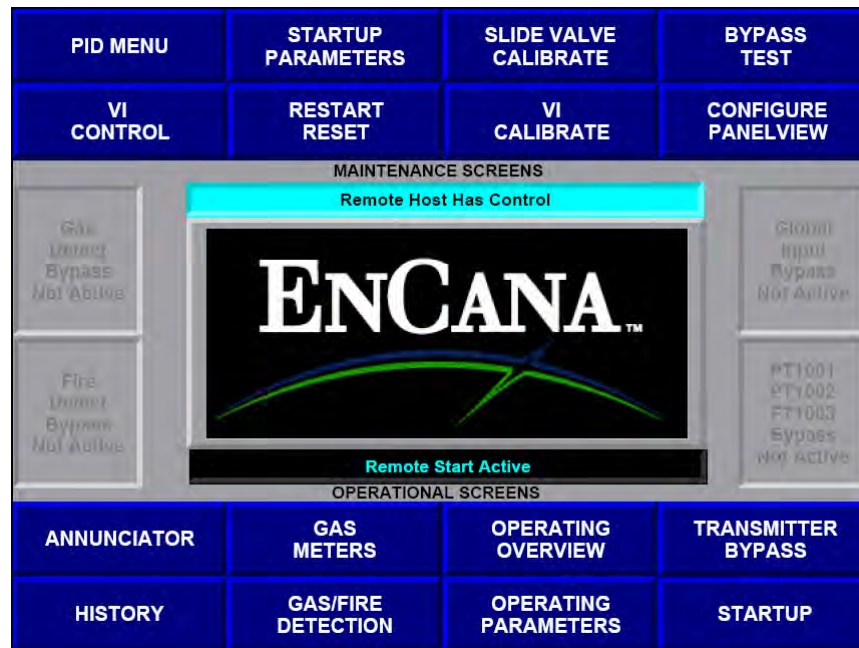
10 Control Valves

Below outlines that status of the control valves during each of the step sequences

	Step Sequence						
	0	1	2	3	4	5	6
Inlet Control Valve	Active	Active	Active	Active	Active	Active	Active
Recycle Control Valve	RO	Open	Open	Open	Active	Active	RO
Back Pressure Control Valve	Open	Open	Open	Active	Active	Active	Open

- **RO** = ramped open
- **Active** = Valve is controller by PID controller

11 Local / Remote Control



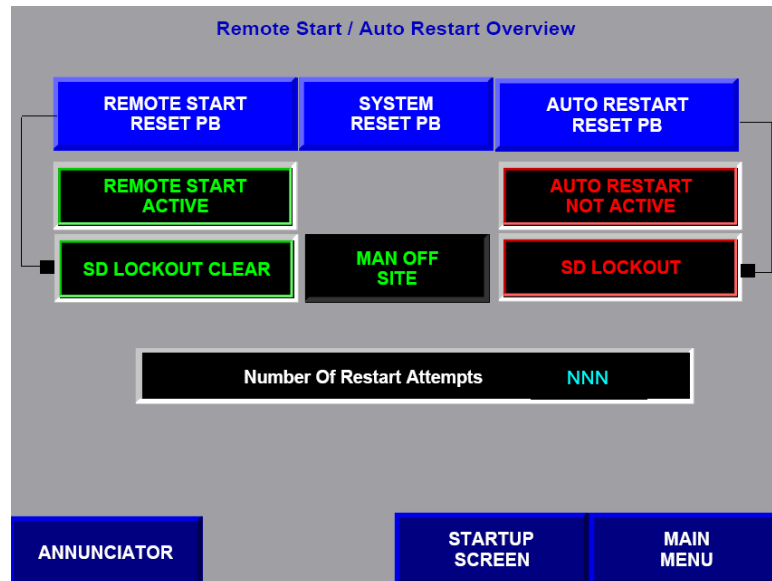
11.1 Local Control

- When the control room activates Man On Site, the control is switched from “Remote Host Has Control” to “Local Station Has Control”. The operator at this time is able to make changes from the local HMI.

11.2 Remote Control

- When the control room activates Man Off Site, the control is switched from “Local Station Has Control” to “Remote Host Has Control”. The operator at this time is not able to make changes from the local HMI. Setpoints are now downloaded from the control room.
- Stop functionality is still given to the operator in this mode; Cooldown Stop, Fire/Gas Bypass Stop, Transmitter Bypass Stop.

12 Remote Start / Auto Restart



12.1 Remote Start Active

- The compressor can be started remotely when remote start is active.

12.2 Remote Start SD Lockout

- A remote start shutdown lockout will cancel the remote start control.
- The remote start shutdown lockout must be cleared locally.
- To clear the remote start shutdown lockout [1] clear all shutdown conditions [2] press the system reset pushbutton [3] press the remote start reset pushbutton.

12.3 Remote Start Logging

- With remote start active, shutdowns are logged each time the compressor is shutdown.
- The control room has the ability to display the remote start shutdown log file.
- Pressing the local **Remote Start Reset Pushbutton** will automatically clear the remote start shutdown log file.
- The remote start reset should only be used if a remote start lockout condition is present.
- If the compressor has been running for 24 hours, the remote start shutdown log file is automatically cleared.

12.4 Auto Restart Active

- The control room is allowed to switch to Auto Restart control once the compressor is running and remote start is active.
- In Auto Restart, the control system will automatically attempt to start the compressor after a shutdown.

12.5 Auto Restart SD Lockout

- An auto restart shutdown lockout will cancel the auto restart control.
- The auto restart shutdown lockout must be cleared locally.
- To clear the auto restart shutdown lockout [1] clear all shutdown conditions [2] press the system reset pushbutton [3] press the auto restart reset pushbutton.
- With an auto restart shutdown lockout, the control system will automatically switch to remote start.

12.6 Auto Restart Logging

- With auto restart active, shutdowns are logged each time the compressor is shutdown.
- The control room has the ability to display the auto restart shutdown log file.
- Pressing the local **Auto Restart Reset Pushbutton** will automatically clear the auto restart shutdown log file.
- The auto restart reset should only be used if an auto restart lockout condition is present.
- If the compressor has been running for 24 hours, the auto restart shutdown log file is automatically cleared.

12.7 Restart Attempts

- Indicates the total number of start attempts while in remote start or auto restart control. The maximum number of start attempts allowed in a 24 hours period is [8] eight.
- If the compressor has been running for 24 hours, the restart attempt total is then reset to zero.

12.8 Man on Site

- The control room activates the Man on Site / Man off Site status.
- Man on Site will cancel both remote start and auto restart control.
- Man off Site will automatically switch the control to remote start control.



**ENERFLEX BULK PURCHASE
SCREW COMPRESSOR PACKAGES
(WITH ADEM III IGNITION SYSTEM)**

YEAR	UNIT NUMBER	HP
2006	060425	1005HP
2006	060426	1005HP
2006	060427	1005HP
2006	060428	1005HP
2007	060429	1005HP
2007	060430	1005HP
2007	060431	1005HP
2007	060432	1005HP
2006	060450	860HP
2007	060451	860HP
2007	060452	860HP
2007	060453	860HP

ENCANA AFE No. COST CENTRE 28597

ISSUED FOR BUILDING FAB. (REV.2)

DPH FOCUS

**PROJECT No. 9066
ELECTRICAL INDEX**

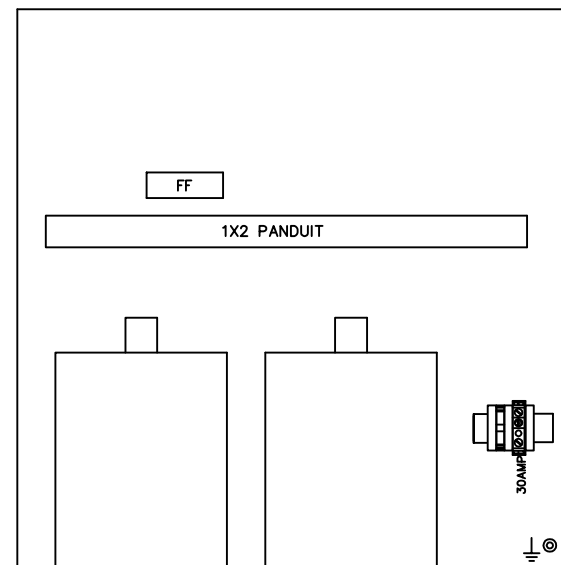
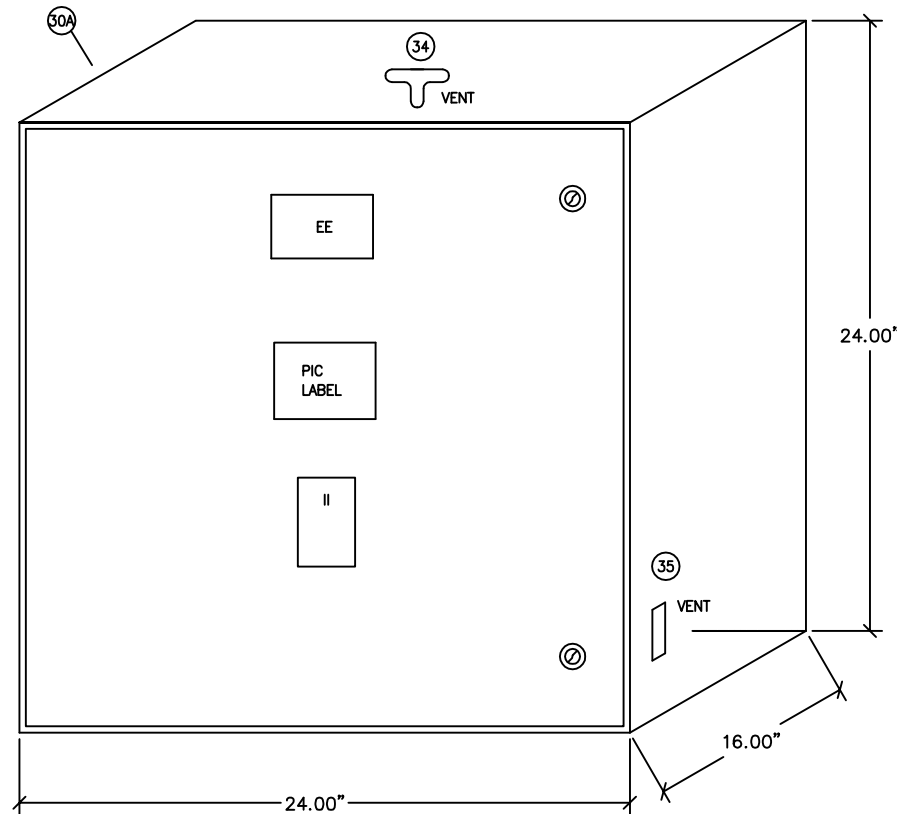
February 05, 2007 3:46:00 p.m.
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DRAWING NO.	DRAWING TITLE	ISSUED FOR APPROVAL	ISSUED FOR BID	ISSUED FOR CONSTRUCTION	AS BUILT	REV.	REMARKS
EL9066A	ELECTRICAL DRAWING INDEX	-	-	07.02.06	-	1BF2	-
9066-SDK1	SHUTDOWN KEY	-	-	-	-	-	-
9066-SDK2	SHUTDOWN KEY	-	-	-	-	-	-
9066-LAYOUT1	ELECTRICAL LAYOUT - COMPRESSOR BUILDING	-	-	07.02.06	-	1BF2	-
9066-JB01	FIELD JUNCTION BOX - COMPRESSOR BUILDING	-	-	07.02.06	-	1BF2	-
9066-JB02	CABLE/CONDUIT AND WIRE SCHEDULE	-	-	07.02.06	-	1BF2	-
9066-PNL01	PANEL - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL02	24VDC DISTRIBUTION - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL03	DIGITAL INPUT - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL04	DIGITAL OUTPUT - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL05	ANALOG INPUT 1 - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL06	ANALOG INPUT 2 - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL07	ANALOG OUTPUT - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF2	-
9066-PNL08	RTD - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF1	-
9066-PNL09	ANALOG INPUT 3 - ARIEL SCREW COMPRESSOR PACKAGE (ADEM 3)	-	-	07.02.06	-	1BF1	-
E-DPH-DET-1	ELECTRICAL INSTALLATION DETAILS	-	-	07.02.06	-	1BF1	-
9066-BTRY01	HOLLEY GENERATOR - CHARGING/POWER CIRCUIT	-	-	07.02.06	-	1	INFO ONLY
9066-BTRY02	HOLLEY GENERATOR - CHARGING/POWER CIRCUIT	-	-	07.02.06	-	1	INFO ONLY
9066-BTRY03	HOLLEY GENERATOR - CHARGING/POWER CIRCUIT	-	-	07.02.06	-	1BF2	-

CADD DWG - DO NOT MANUALLY CHANGE

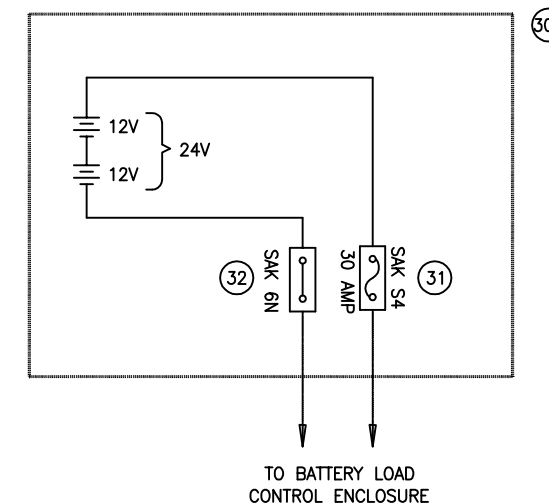
BATTERY ENCLOSURE

BILL OF MATERIALS				
ITEM	QTY.	PART NUMBER	DESCRIPTION	INSTRUCTIONS
30A	1	5412ES242416	EUROBEX ENCLOSURE/24"H x 24"W x 16"D	-
31	1	178220000	WEIDMULLER 1782.2 FUSED TERMINAL BLOCK/SAKS4/TS35	-
	2	KTK 30A	BUSS KTK 30A FUSE (1 SPARE)	-
32	1	2128.6	WEIDMULLER TERMINAL BLOCK/SAK6N EN	-
33	2	DC31	EAST PENN DC31 FLOODED LEAD ACID BATTERY	-
	1	-	1/4" x 1" x 17" FLAT STOCK	-
	3	-	5/16" x 10" READY ROD	-
	1	HS4-30-4	SHRINK TUBE	-
34	1	2224	MURPHY 1" TEE VENT	-
	1	VE0012-GSKT	MURPHY CORK GASKET	-
	1	CN100	NEER 1" CHASE BUSHING	-
35	1	ANMV3	HOFFMAN CABINET VENT	-



SUBPLATE LAYOUT

BATTERY ENCLOSURE (TYPICAL)



FOR INFORMATION ONLY

LAMACOID TAG 'EE'
(LAMACOID SIZE: 2.5x4, COLOUR: RED)

WARNING
DO NOT OBSTRUCT VENT
ENSURE AREA IS SAFE BEFORE SERVICING
DISCONNECT POWER BEFORE SERVICING

AUTHORIZED PERSONNEL ONLY

LAMACOID TAG 'II'
(LAMACOID SIZE: 2.25x3.5, COLOUR: WHITE)

WARNING
ALL EQUIPMENT INSTALLED
IN THIS PANEL MUST
BE SUITABLE FOR USE IN A
CLASS I, DIVISION 2 LOCATION.
USE OF CERAMIC OR SAND FILLED
FUSES IS RECOMMENDED.

ENSURE THERE IS NO GAS
PRESENT AND POWER HAS BEEN
REMOVED BEFORE OPERATING
DISCONNECT TERMINALS, TEST
JUMPERS AND/OR REMOVING FUSES.

LAMACOID TAG 'FF'
(LAMACOID SIZE: 1x3, COLOUR: WHITE)

ENSURE TERMINALS ARE TIGHT AS PART
OF A REGULAR MAINTENANCE PROGRAM

REV.	DESCRIPTION	DATE	ER#	BY	CHK
1	2006-1005HP SCREW COMPRESSOR BULK PURCHASE	06 SEP 11			

DATE:	12 APR 05	POWER IGNITION CONTROLS LTD.
SHEET NO.	1 of 1	
MATERIAL	SCALE: None	FOR HOLLEY GENERATOR CHARGING/POWER CIRCUIT
FINISH	DRWN BY: AW	OUR ORDER NO.
	CHKD BY:	YOUR ORDER NO.
	APPD BY:	DRAWING NO. BB2-BATT-ENCL
		REV 1

ENCANA.

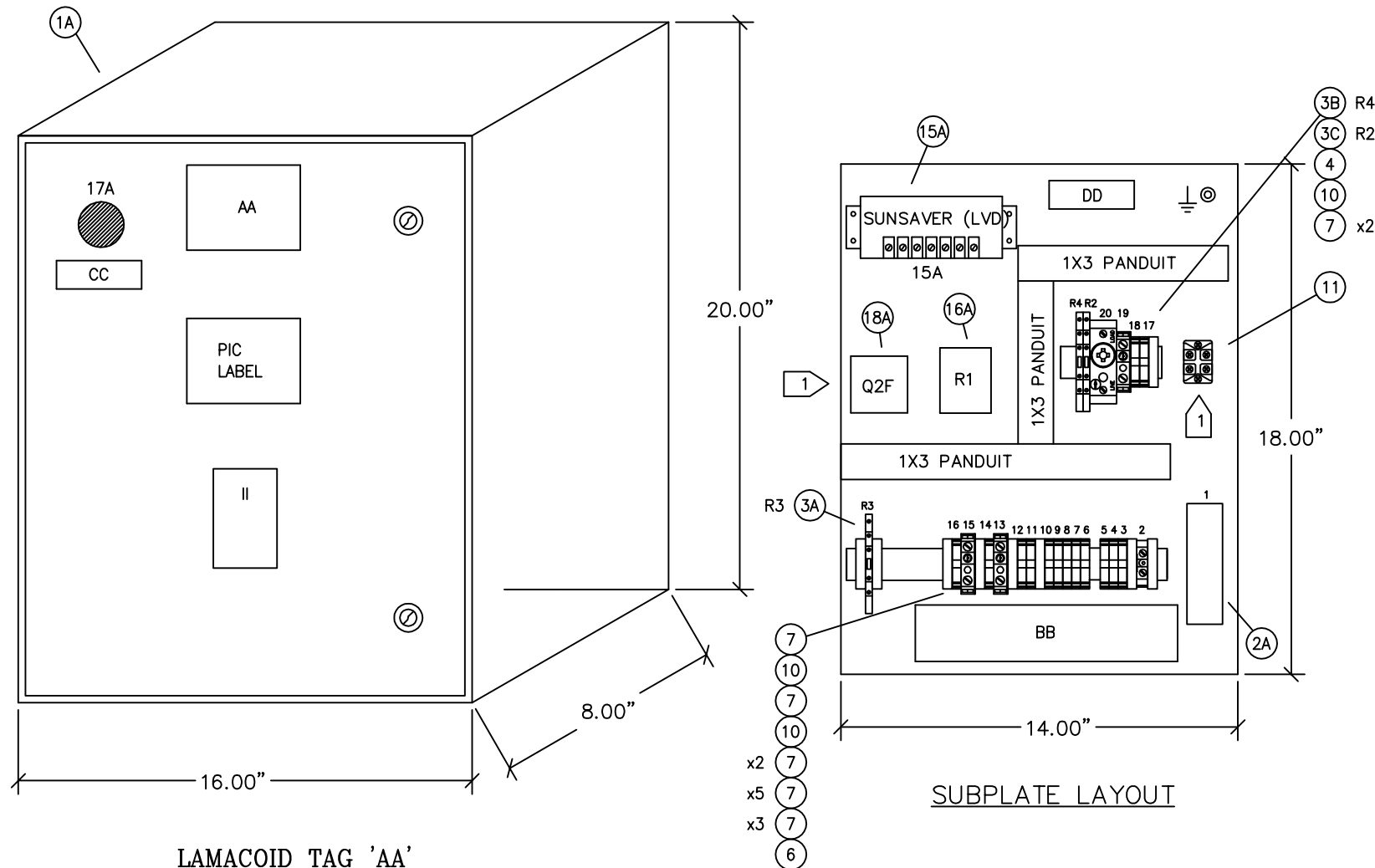
ENC DPH ENGINEERING INC.

TITLE: **HOLLEY GENERATOR CHARGING POWER CIRCUIT**

AREA: **BULK PURCHASE** CLASS: **N** FILE NO.: **9066-BTRY01**

SCALE: NTS ENC 9066

THIS DRAWING REPRESENTS PROPRIETARY INFORMATION AND SHOULD NOT BE DISTRIBUTED OR MODIFIED IN ANY MANNER THAT IS NOT IN THE BEST INTEREST OF ENCANA OR THE ORIGINAL AUTHOR.



LAMACOID TAG 'AA'
(LAMACOID SIZE: 3x4, COLOUR: RED)

WARNING
MORE THAN ONE LIVE CIRCUIT
(see wiring diagram)
ENSURE AREA IS SAFE BEFORE SERVICING
DISCONNECT POWER BEFORE SERVICING
DO NOT EXCEED FUSE RATINGS
SUBSTITUTION OF EQUIPMENT
MAY IMPAIR SUITABILITY
FOR CL 1 DIV 2 HAZARDOUS LOCATIONS

AUTHORIZED PERSONNEL ONLY

LAMACOID TAG 'II'
(LAMACOID SIZE: 2.25x3.5, COLOUR: WHITE)

WARNING
ALL EQUIPMENT INSTALLED
IN THIS PANEL MUST
BE SUITABLE FOR USE IN A
CLASS I, DIVISION 2 LOCATION.
USE OF CERAMIC OR SAND FILLED
FUSES IS RECOMMENDED.

ENSURE THERE IS NO GAS
PRESENT AND POWER HAS BEEN
REMOVED BEFORE OPERATING
DISCONNECT TERMINALS, TEST
JUMPERS AND/OR REMOVING FUSES.

LAMACOID TAG 'BB'
(LAMACOID SIZE: 2X9.5, COLOUR: WHITE)

GENERATOR FAIL/ BLOWN FUSE CONTACT NON-INCENDIVE IF WIRED AS PER CODE	GAS DETECTION SHUTDOWN (REMOVE JUMPERS IF USING)	GAS DETECTION COMMON	GAS DETECTION 3A +24VDC	LOAD 20A +24VDC	LOAD COMMON	BATTERY BOX COMMON	BATTERY BOX +24VDC	GENERATOR COMMON	GENERATOR +24
--	--	-------------------------	-------------------------------	--------------------	-------------	-----------------------	-----------------------	------------------	---------------

SUBPLATE LAYOUT

STANDARD ITEMS

BILL OF MATERIALS				
ITEM	QTY.	PART NUMBER	DESCRIPTION	INSTRUCTIONS
1A	1	5412ES201608	EUROBEX ENCLOSURE/20"H x 16"W x 8"D	-
2A	2	CIS40	FERRAZ SHAWMUT FUSE/40 AMP (1 SPARE)	-
	1	RS63H	FERRAZ SHAWMUT FUSE HOLDER/FRONT MOUNT	-
3A-C	3	80.010.4000.0	WIELAND TERMINAL BLOCK RELAY/24VDC/6AMP	-
4	1	178220000	WEIDMULLER 1782.2 FUSED TERMINAL BLOCK/SAKS4/TS35	-
	2	KTK 20A	BUSS KTK 20A FUSE (1 SPARE)	-
5	-	-	-	-
6	1	4437.6	WEIDMULLER TERMINAL BLOCK/SAK10 EN	-
7	14	2128.6	WEIDMULLER TERMINAL BLOCK/SAK6N EN	-
8	-	-	-	-
9	-	-	-	-
10	3	6675.2	WEIDMULLER FUSED TERMINAL BLOCK/SAKS3/TS35	-
	4	ABC 3A	BUSS 3 AMP CERAMIC FUSE (1 SPARE)	-
11	1	DIGI DSEI 2X61-06C-ND	FAST RECOVERY EPITAXIAL DIODE	-

PARTS IN UNDERVOLTAGE GD OPTION

BILL OF MATERIALS				
ITEM	QTY.	PART NUMBER	DESCRIPTION	INSTRUCTIONS
15A	1	SS-20L-24	MORNINGSTAR LVD SUNSAVER	-
16A	1	D1D40	CRYDOM D1D40 (CC1038-ND) 40AMP RELAY	-
17A	1	9001KR2U	SQUARE D PUSHBUTTON (GREEN)	-
	1	9001KA52	SQUARE D CONTACT BLOCK	-
18A	1	Q2F-18000-327	AMETEK (NATIONAL CONTROLS) TIMER	-
18A*	1	TH3P405HDS	AIROTRONIC TIMER	-

LAMACOID TAG 'CC'
(LAMACOID SIZE: 1x3, COLOUR: WHITE)

IN THE EVENT OF UNDERVOLTAGE
PUSH TO RESET FOR 15 MINUTE TIMER

LAMACOID TAG 'DD'
(LAMACOID SIZE: 1x3, COLOUR: WHITE)

ENSURE TERMINALS ARE TIGHT AS PART
OF A REGULAR MAINTENANCE PROGRAM

NOTE:

➡ HEAT COMPOUND MUST BE USED ON BACKS OF ALL RELAYS AND DIODES.

FOR INFORMATION ONLY

ENCANA

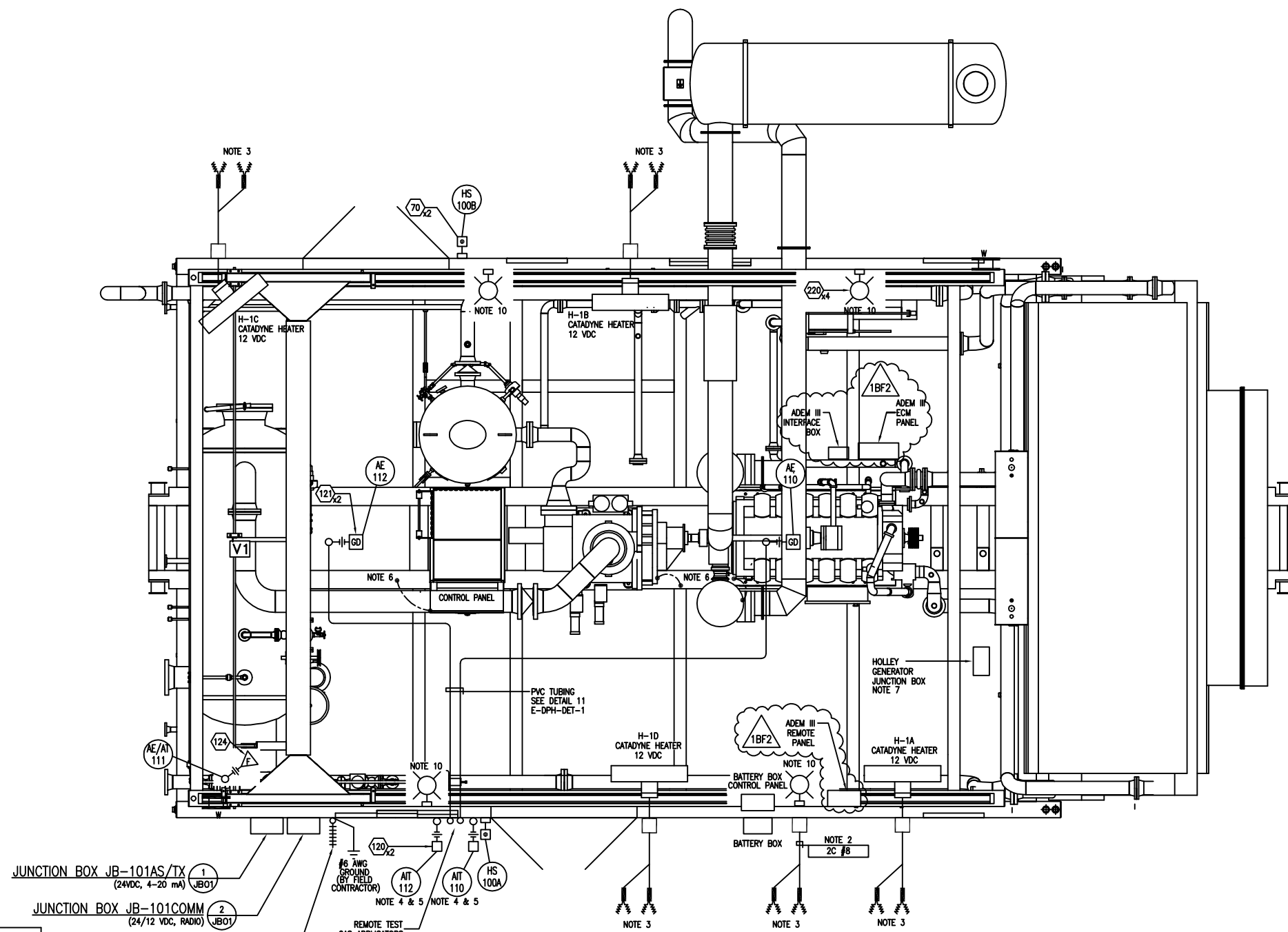
DATE: _____
 DESIGNED BY: _____
 DRAWN BY: _____
 CHECKED BY: _____
 DATE: _____

DPH ENGINEERING INC.
 TITLE: HOLLEY GENERATOR CHARGING POWER CIRCUIT
 AREA: BULK PURCHASE CLASS: N FILE NO.: 9066-BTRY02

THIS DRAWING REPRESENTS PROPRIETARY INFORMATION AND SHOULD NOT BE DISTRIBUTED OR MODIFIED IN ANY MANNER THAT IS NOT IN THE BEST INTEREST OF ENCANA OR THE ORIGINAL AUTHOR.

DIV 2 BATTERY BOX- GAS DETECTION/UNDERVOLTAGE/TIMER

REV.	DESCRIPTION	DATE	ER#	BY	CHK	MATERIAL	FINISH	DATE: 12 APR 05	SHEET NO. 1 of 2	SCALE: None	DRWN BY: AW	CHKD BY:	APPD BY:	POWER IGNITION CONTROLS LTD.	FOR HOLLEY GENERATOR CHARGING/POWER CIRCUIT	OUR ORDER NO.	YOUR ORDER NO.	DRAWING NO. BB2-UVGD-A	REV 1
1	2006-1005HP SCREW COMPRESSOR BULK PURCHASE	06 SEP 11																	

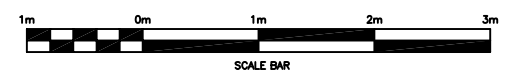


PLAN VIEW

BILL OF MATERIAL					
ITEM	QTY	DESCRIPTION	ZONE	DIV.	MANUFACTURER CATALOG NO.
* 70	2	120 VAC MOMENTARY CONTACT, FACTORY SEALED CONTROL STATION C/W RED MUSHROOM HEAD C/W EMERGENCY LEGEND. PROVIDE 100mm x 100mm RED LAMICOD NAME PLATE ENGRAVED "EMERGENCY SHUTDOWN" & WEATHERPROOF SHROUD ON EXTERIOR UNITS NEMA 4X.	CI Z2	CI D2	ALLEN-BRADLEY #800T-D6A C/W 800T-X8485
* 120	2	COMBUSTIBLE SMART GAS TRANSMITTER	CI Z1	CI D1	NET SAFETY MLP-LP-ARS
* 121	2	COMBUSTIBLE GAS SENSOR HOUSING AND SENSOR C/W REMOTE TEST GAS APPLICATOR	CI Z1	CI D1	NET SAFETY JB2-4 SC1100-SEP
* 124	1	UV DETECTOR C/W SWIVEL MOUNT	CI Z1	CI D1	NET SAFETY UVS-A
* 220	4	CLASS 1, ZONE 2, 200W INCANDESCENT FIXTURE, WALL MOUNTED, C/W GLOBE, GUARD, AND 100W -12VDC BULB.	CI Z2	CI D2	CROUSE-HINDS V4HBF22GP OR EQUAL

* SUPPLIED BY SKID VENDOR

- NOTES:
- THIS COMPRESSOR BUILDING TO BE WIRED CLASS 1, ZONE 2 GROUP IIA, TEMP. CODE T2C. SEALS SHALL BE INSTALLED AS REQUIRED BY THE C.E.C. SEALS TO BE POURED BY FIELD CONTRACTOR. ZONE 2 BUBBLE EXTENDS THREE METERS PAST EXTERIOR WALL.
 - COMPRESSOR VENDOR TO CONNECT FOUR INTERIOR LIGHT FIXTURES IN PARALLEL.
 - BATTERY LEADS USED WITHIN THE DESIGNATED HAZARDOUS LOCATIONS MUST BE TYPE SOW 2C #8 FOR LIGHTS AND 2C #10 FOR HEATERS AND HAVE AN APPROPRIATE CONNECTION FOR THE LOCATION. THE BATTERY TERMINALS MUST EXTEND OUTSIDE OF THE DESIGNATED HAZARDOUS AREA BEFORE THE TERMINALS ARE CONNECTED. THIS DISTANCE IS MINIMUM 25' (7620mm) FROM THE BUILDING.
 - COMPRESSOR VENDOR TO ADD SHROUD OVER LEL GAS DETECTION CONTROLLERS.
 - COMPRESSOR VENDOR TO ENSURE GAS DETECTION IS MOUNTED AS CLOSE TO DOOR FRAME AS POSSIBLE.
 - COMPRESSOR VENDOR TO INSTALL #6 AWG BONDING JUMPER BETWEEN CONTROL PANEL BACK PAN, COMPRESSOR AND ENGINE TO SKID STRUCTURAL STEEL.
 - COMPRESSOR VENDOR TO INSTALL AN ACE 10X8X6 3R JUNCTION BOX COMPLETE WITH TWO WEIDMULLER SAK 10 FOR CONNECTION OF GENERATOR LEADS TO CONDUIT P-100.
 - LIQUID TIGHT FLEXIBLE CONDUIT TO BE USED FOR END DEVICES ONLY AS PER CEC 12-1302.
 - CABLES, INSTRUMENTS AND ENCLOSURES SHALL BE TAGGED AS SHOWN.
 - WALL MOUNT LIGHT FIXTURES TO BE LOCATED BETWEEN 8 & 10 FEET ABOVE THE FLOOR.
 - ANALOG, DISCRETE AND NON-INCENDIVE WIRING TO BE IN SEPARATE CONDUITS.
 - ALL CONDUIT SHALL BE RIGID, THREADED ALUMINUM.
 - ALL CABLE AND CONDUIT ENTRIES INTO JUNCTION BOXES SHALL BE BONDED ACCORDING TO C.E.C
 - GROUND GRID TO BE #2 AWG, STRANDED COPPER TW GREEN INSULATION ALL PILES ARE TO BE BONDED TO THE COMPRESSOR SKID AND THEN TO THE BUILDING SKIN (SEE ELECTRICAL DETAILS). ALL CONNECTIONS TO BE COATED WITH TWO (2) COATS GLYPITAL (BY FIELD CONTRACTOR).



ENERFLEX		
YEAR	UNIT NUMBER	HP
2006	060425	1005HP
2006	060426	1005HP
2006	060427	1005HP
2006	060428	1005HP
2007	060429	1005HP
2007	060430	1005HP
2007	060431	1005HP
2007	060432	1005HP
2006	060450	860HP
2007	060451	860HP
2007	060452	860HP
2007	060453	860HP

REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.	ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGES			DPH FOCUS	9066		1BF2						
										Bldg. Bld						
										Bldg. Fab.	07.01.29	DT				
										Prelim.						
										Bld						
										Constr.						
										As-built						

ENCANA

ENCANA PROJECT NO. 9066

SCALE 1:30 (A1 Size)

PERMIT STAMP AND PROFESSIONAL STAMP AFFIXED ABOVE SHALL APPLY ONLY TO REV(S)

1BF2

ENCANA

DPH FOCUS CORPORATION

ELECTRICAL LAYOUT

COMPRESSOR BUILDING

BULK PURCHASE

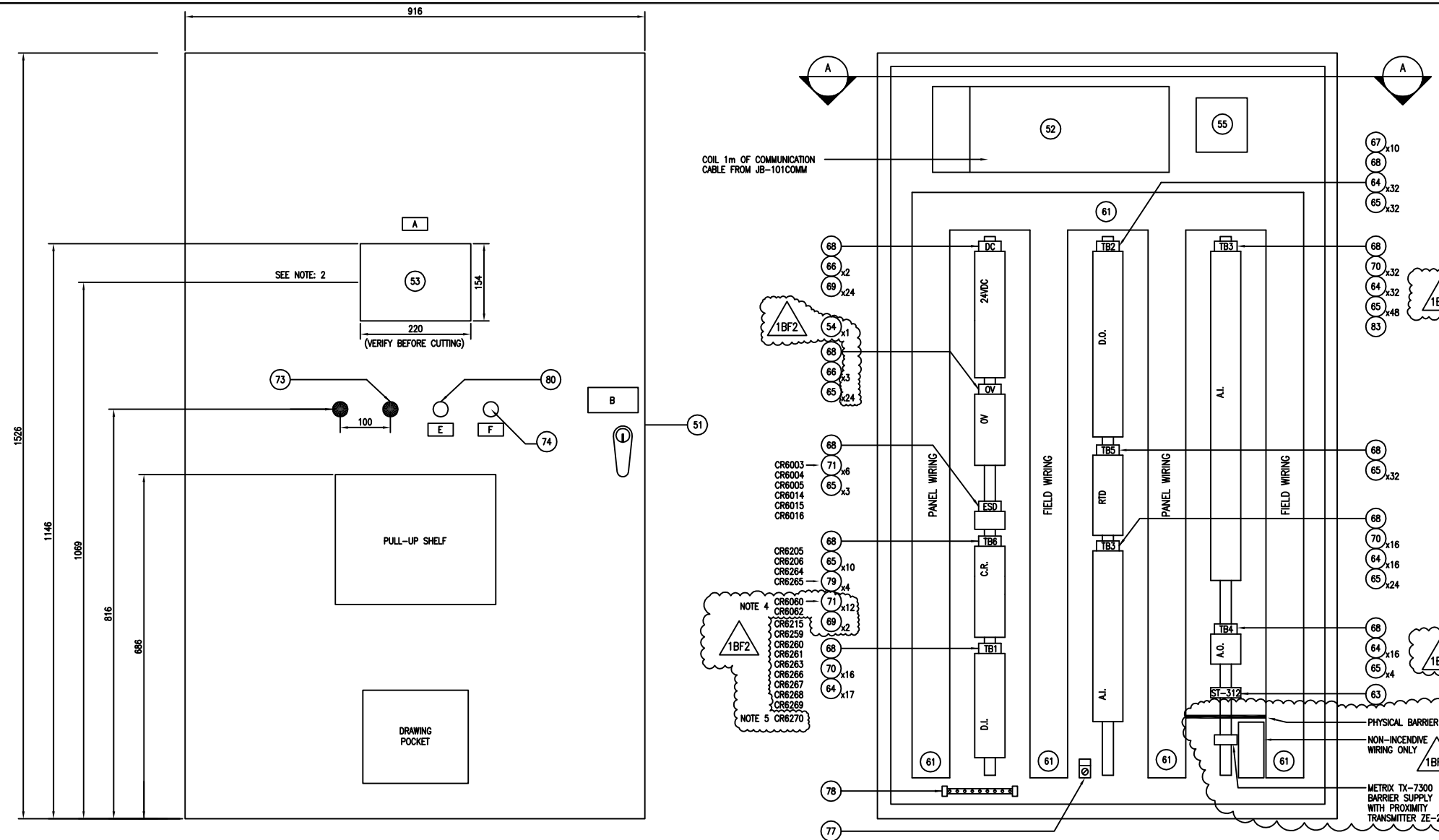
CLASS FILE NO.

N 9066-LAYOUT01

February 08, 2007 9:27:04 a.m.
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 Xrefs: ENC-9066-01.DWG
 -AutoCAD Release: 2007

Drawings Must Comply with Encana Drafting Standards (ECA-A-1)

Date Time



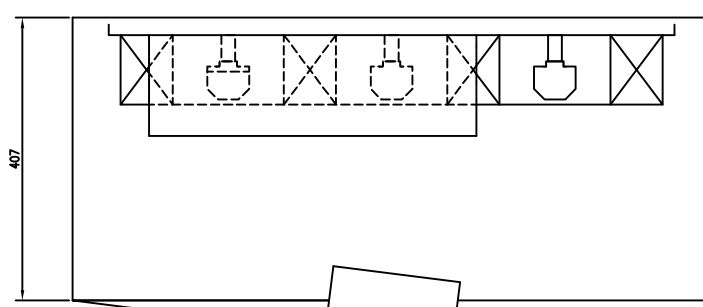
BILL OF MATERIAL			
ITEM	QTY	DESCRIPTION	MANUFACTURER CATALOG NO.
51	1	NEMA-4, 12 ENCLOSURE, 916mm(W) x 1526mm(H) x 407mm(D) C/W BACK PANEL AND LAPTOP PULL-UP SHELF	EUROBEX 5412ES03616 SHELF 880FS1212
52	1	SLC PLC SYSTEM - SLC-5/05 PROCESSOR c/w 10 SLOT I/O CHASSIS - 1746-A10 1 - SLC5/05 1747-L552 PROCESSOR 1 - 1746-P3 POWER SUPPLY 1 - 1746-IB16 DISCRETE INPUT MODULE 2 - 1746-OB16 DISCRETE OUTPUT MODULE 2 - 1746-NI16 ANALOG INPUT MODULES 1 - 1746-NO16 ANALOG OUTPUT MODULE 1 - 1746-NR8 RTD INPUT MODULE 1 - PROSOFIT MV46-AFC (SUPPLIED BY OWNER) 1 - 1746-RT25B SWINGARM ONLY	ALLEN-BRADLEY
53	1	PANEL VIEW 700 HMI INTERFACE COLOR TOUCH SCREEN, ETHERNET	ALLEN-BRADLEY 2771P-17C401
54	1	WEIDMULLER FUSE HOLDER COMPLETE WITH 20A FUSE	WEIDMULLER US1-16 #991073
55	1	ETHERNET SWITCH	NTRON 306TX
56			
57			
58			
59	AS REQ'D	WIRE WAY c/w COVER, 25mm(W) x 25mm(H) NOTE 1	PANDUIT
60	AS REQ'D	WIRE WAY c/w COVER, 50mm(W) x 100mm(H) NOTE 1	PANDUIT
61	AS REQ'D	WIRE WAY c/w COVER, 75mm(W) x 100mm(H) NOTE 1	PANDUIT
62			
63	1	ACROMAG FREQUENCY CONVERTER, LOOP POWERED	250T-FQI-DIN-DT1
64	113	TERMINAL BLOCK, DISCONNECT TYPE	WEIDMULLER WTR2.5 #101120
65	178	TERMINAL BLOCK	WEIDMULLER WDU-2.5 #102000
66	5	TERMINAL BLOCK	WEIDMULLER WDU-6 #102020
67	10	TERMINAL BLOCK, DISCONNECT TYPE, C/W DIODE PLUG	WEIDMULLER WTR 2.5 D #1013500000
68	10	GROUP MARKING CARRIER	WEIDMULLER SCHT-5 #029246
69	24	FUSED TERMINAL BLOCK, DISCONNECT TYPE, C/W LED INDICATING LIGHT FUSE SIZES PER SCHEMATICS (FUSES ARE TO BE CERAMIC TYPE)	WEIDMULLER WSI 6 #101130
70	64	FUSED TERMINAL BLOCK, DISCONNECT TYPE FUSE SIZES PER SCHEMATICS (FUSES ARE TO BE CERAMIC TYPE)	WEIDMULLER WSI 6 #101100
71	18	24 VDC RELAY, SPST, 6A CONTACT c/w MOUNTING RAIL, END PLATES CLASS 1, DIV. 2 RATED	WEIDMULLER MRS #7901690001
72			
73	2	PLUG-OUT HOLE	ALLEN-BRADLEY 800T-N1
74	1	MOMENTARY CONTACT PUSHBUTTON, GREEN, CLASS 1, DIV. 2 1 N.O. CONTACT, 1 N.C. CONTACT	ALLEN-BRADLEY 800T-A1AP
75			
76			
77	1	GROUND LUG FOR #2 AWG	PANEL VENDOR
78	1	GROUND BUS, 10 x 10 x 150, c/w SET SCREWS	PANEL VENDOR
79	4	24 VDC SOLENOID DRIVER, 10A RESISTIVE, 6A INDUCTIVE CONTACT CLASS 1, DIV. 2 RATED	WEIDMULLER MC50 #7901690001
80	1	MAINTAINED CONTACT ESD PUSHBUTTON, RED MUSHROOM HEAD, CLASS 1, DIV. 2 1 N.O. CONTACT, 1 N.C. CONTACT C/W GUARD	ALLEN-BRADLEY 800T-FX602P C/W 800T-N129
81	0	CRYDOM 40A SOLID STATE RELAY	D1D40
82	0	VISHAY/DALE 5.6 KOHM RESISTOR, 2W	CPF25K6000JB14
83	1	VISHAY/DALE 1.5 KOHM RESISTOR, 3W	CPF31K5000KB14

LAMICOID ENGRAVING				
ITEM	FIRST LINE	SECOND LINE	THIRD LINE	COLOUR
A	COMPRESSOR	CONTROL PANEL		WHITE ON BLACK
B	SEE DETAIL 1			WHITE ON RED
C	NON-INCENDIVE	CIRCUITS		WHITE ON BLUE
D				
E	UNIT	SHUTDOWN		WHITE ON RED
F	RESET			WHITE ON BLACK
TB1	TB1	24 VDC INPUTS		WHITE ON BLACK
TB2	TB2	24 VDC OUTPUTS		WHITE ON BLACK
TB3	TB3	ANALOG INPUTS		WHITE ON BLACK
TB4	TB4	ANALOG OUTPUTS		WHITE ON BLACK
TB5	TB5	RTD INPUTS		WHITE ON BLACK
TB6	TB6	24VDC ISOLATED INPUTS		WHITE ON BLACK
DC	DC	POWER DISTRIBUTION		WHITE ON BLACK
ESD	HARDWIRED	ESD STRING		WHITE ON BLACK

WARNING
DE-ENERGIZE ALL POWER SOURCES BEFORE REPLACING FUSES OR PLC EQUIPMENT AS POSSIBLE SPARKS MAY IGNITE EXPLOSIVE VAPOURS

DETAIL 1
N.T.S.

WIRING COLOUR CODE SHALL BE AS FOLLOWS:
 AC POWER WIRING: BLACK - HOT
 WHITE - NEUTRAL
 GREEN - GROUND
 #12 MIN.
 DC POWER WIRING: RED - POSITIVE
 DARK BLUE - NEGATIVE (COMMON)
 #16 MIN.
 I/O WIRING: ORANGE - OUTPUT WIRING
 PURPLE - INPUT WIRING
 #18 MIN.
 RELAYS/CONTACTORS: BROWN - 120VAC CONTACTS FROM RELAYS OR CONTACTORS
 ORANGE - 24VDC CONTACTS FROM



SECTION "A"
COMPRESSOR PLC CONTROL PANEL

1746-P3 POWER SUPPLY	1747-L552 PROCESSOR	1746-IB16 DISCRETE INPUT	1746-OB16 DISCRETE OUTPUT	1746-NI16 ANALOG INPUT	1746-NO16 ANALOG OUTPUT	1746-NR8 RTD INPUT	1746-RT25B SWINGARM
1	1	2	2	1	1	1	1

- NOTES:**
- AC PANDUIT TO BE GREY, DC PANDUIT TO BE WHITE, INTRINSICALLY SAFE WIRING TO BE BLUE.
 - MOUNTING HEIGHT FOR THE CENTER OF THE OPERATOR INTERFACE IS TO BE 1625mm FROM THE TOP OF THE SKID BASE.
 - PANEL IS TO BE CSA APPROVED FOR CLASS 1, DIV. 2 GROUP C&D, TEMP. CODE T3 PANEL IS TO BEAR CSA APPROVAL & CLASSIFICATION RATING.
 - RETAG AND REWIRE RELAYS CR6042/CR6043 TO CR6060/CR6062.
 - CHANGE RELAY CR6270 FROM ITEM 81/82 TO ITEM 71, FOR NEW PANEL CONSTRUCTION ONLY.

February 06, 2007 9:28:27 a.m.
 Drawing: C:\EAD\ENCANA\9066-PNL01.DWG
 Xrefs: ENG-jls-DWG
 T:\encana\Drawings At Site

REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.
		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGES			DPH FOCUS	9066	

REV. NUMBER	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
1BF2						
Bldg. Bld						
Bldg. Fab.	07.01.29	DT				
Prelim.						
Bld						
Constr.						
As-built						

ENCANA

DPH ENGINEERING INC.

TITLE: PANEL 1005HP SCREW COMPRESSOR PACKAGE (WITH ADEM III)

AREA: BULK PURCHASE

CLASS: N

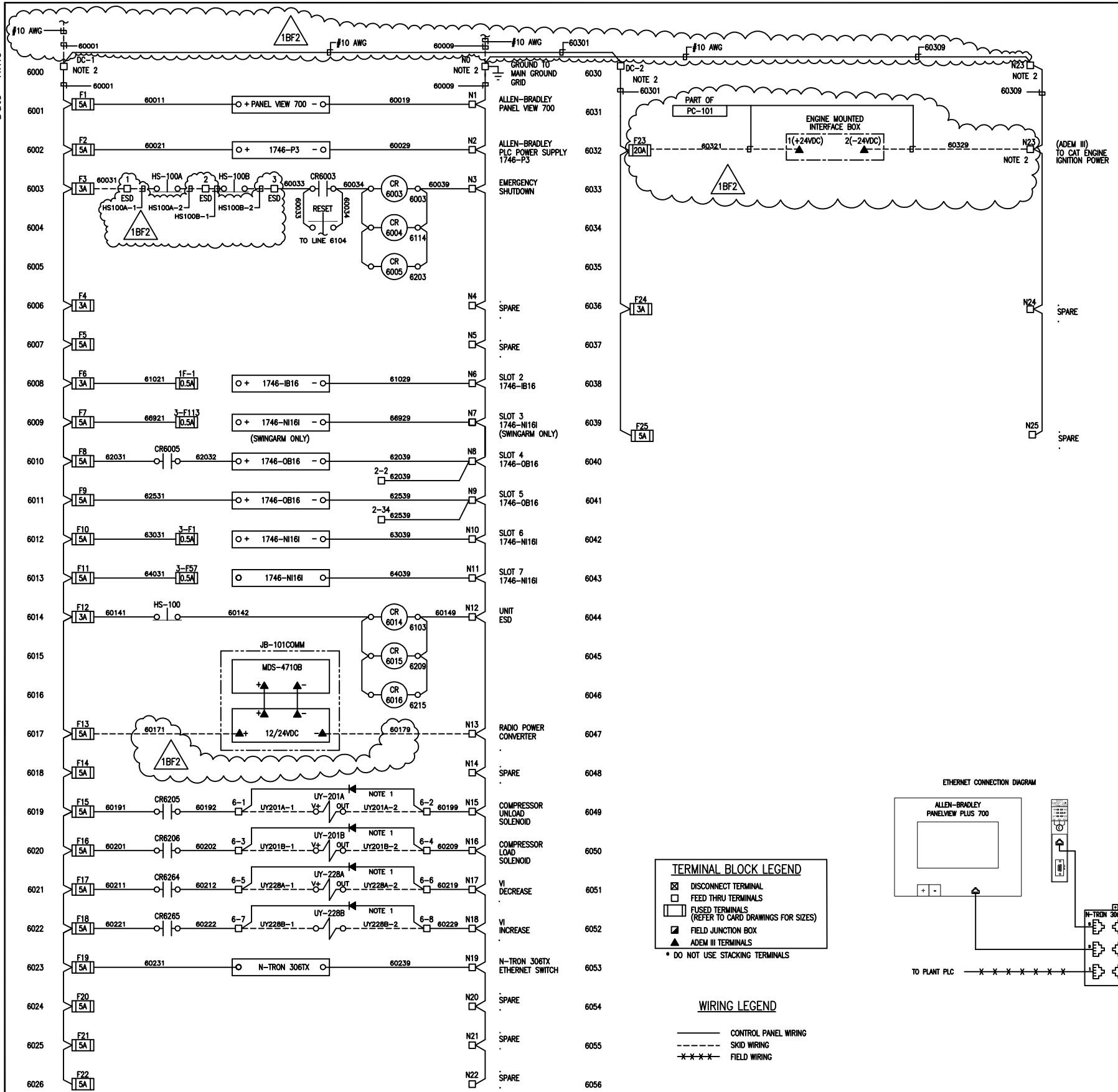
FILE NO.: 9066-PNL01

SCALE: NTS (A1 Size)

SPEC. NO.: 9066

Drawings Must Comply with Encana Drafting Standards (ECA-A-1)

Date Time

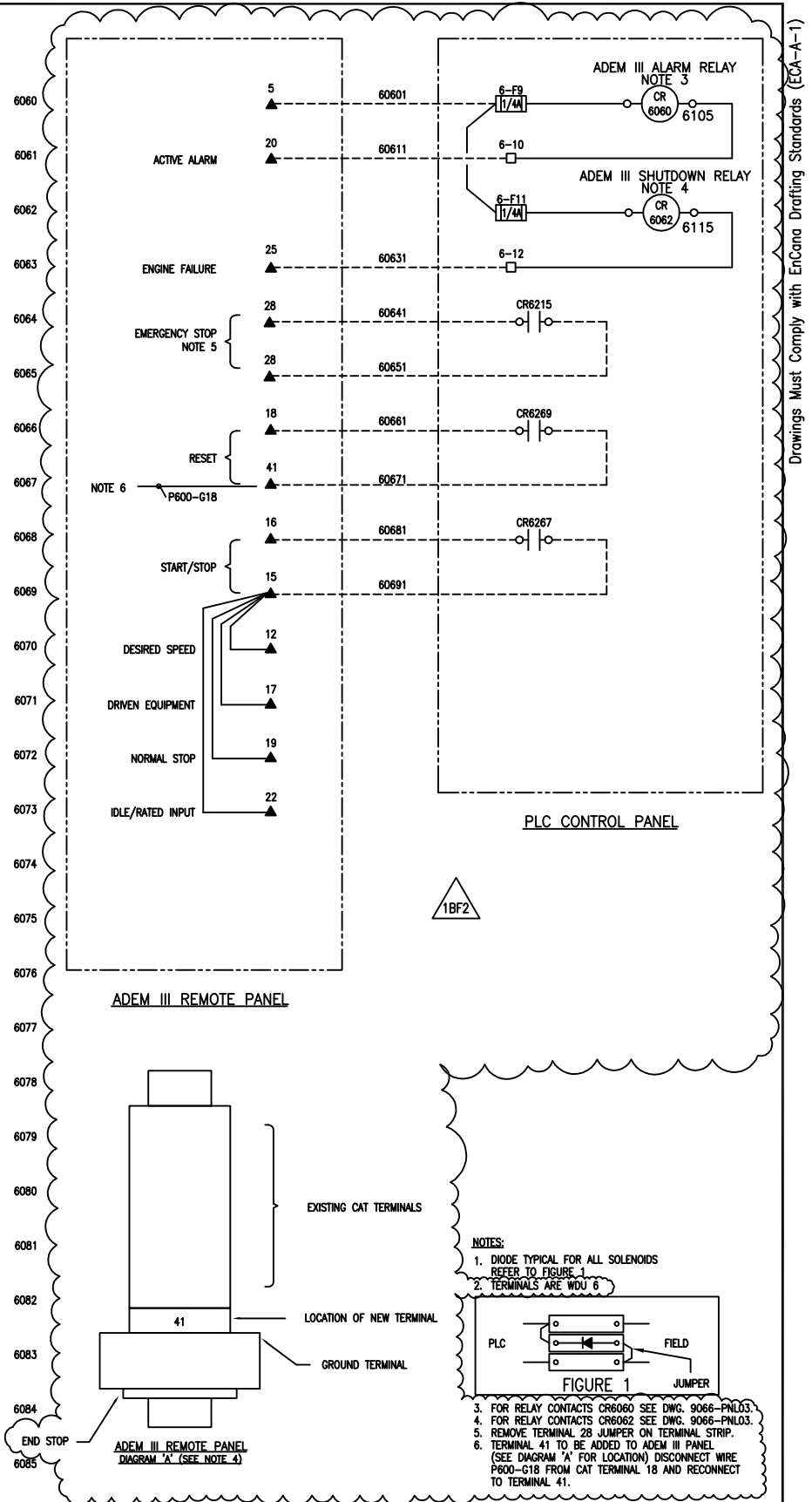


TERMINAL BLOCK LEGEND

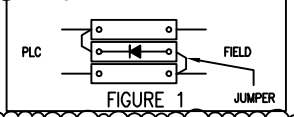
- DISCONNECT TERMINAL
- FEED THRU TERMINALS
- FUSED TERMINALS (REFER TO CARD DRAWINGS FOR SIZES)
- FIELD JUNCTION BOX
- ADEM III TERMINALS
- * DO NOT USE STACKING TERMINALS

WIRING LEGEND

- CONTROL PANEL WIRING
- - - - SKID WIRING
- *-*-*-* FIELD WIRING



- NOTES:**
- DIODE TYPICAL FOR ALL SOLENOIDS REFER TO FIGURE 1
 - TERMINALS ARE WDU 6
 - FOR RELAY CONTACTS CR6060 SEE DWG. 9066-PNL03
 - FOR RELAY CONTACTS CR6062 SEE DWG. 9066-PNL03
 - REMOVE TERMINAL 28 JUMPER ON TERMINAL STRIP
 - TERMINAL 41 TO BE ADDED TO ADEM III PANEL (SEE DIAGRAM 'A' FOR LOCATION) DISCONNECT WIRE P600-G18 FROM CAT TERMINAL 18 AND RECONNECT TO TERMINAL 41.



February 08, 2007 9:28:00 a.m.
 Drawing: C:\EAD\ENCANA\9066-PNL02.DWG
 Xrefs: ENC-9066-PNL02.DWG
 -ENCANA Drawing at Site

REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.	ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGES			DPH FOCUS	9066		REV. NUMBER 1BF2						
										Bldg. Bld						
										Bldg. Fab.	07.01.29	DT				
										Prelim.						
										Bld						
										Constr.						
										As-built						

ENCANA

DPH FOCUS CORPORATION

TITLE: 24VDC DISTRIBUTION 1005HP SCREW COMPRESSOR PACKAGE (WITH ADEM III)

AREA: BULK PURCHASE

CLASS: N

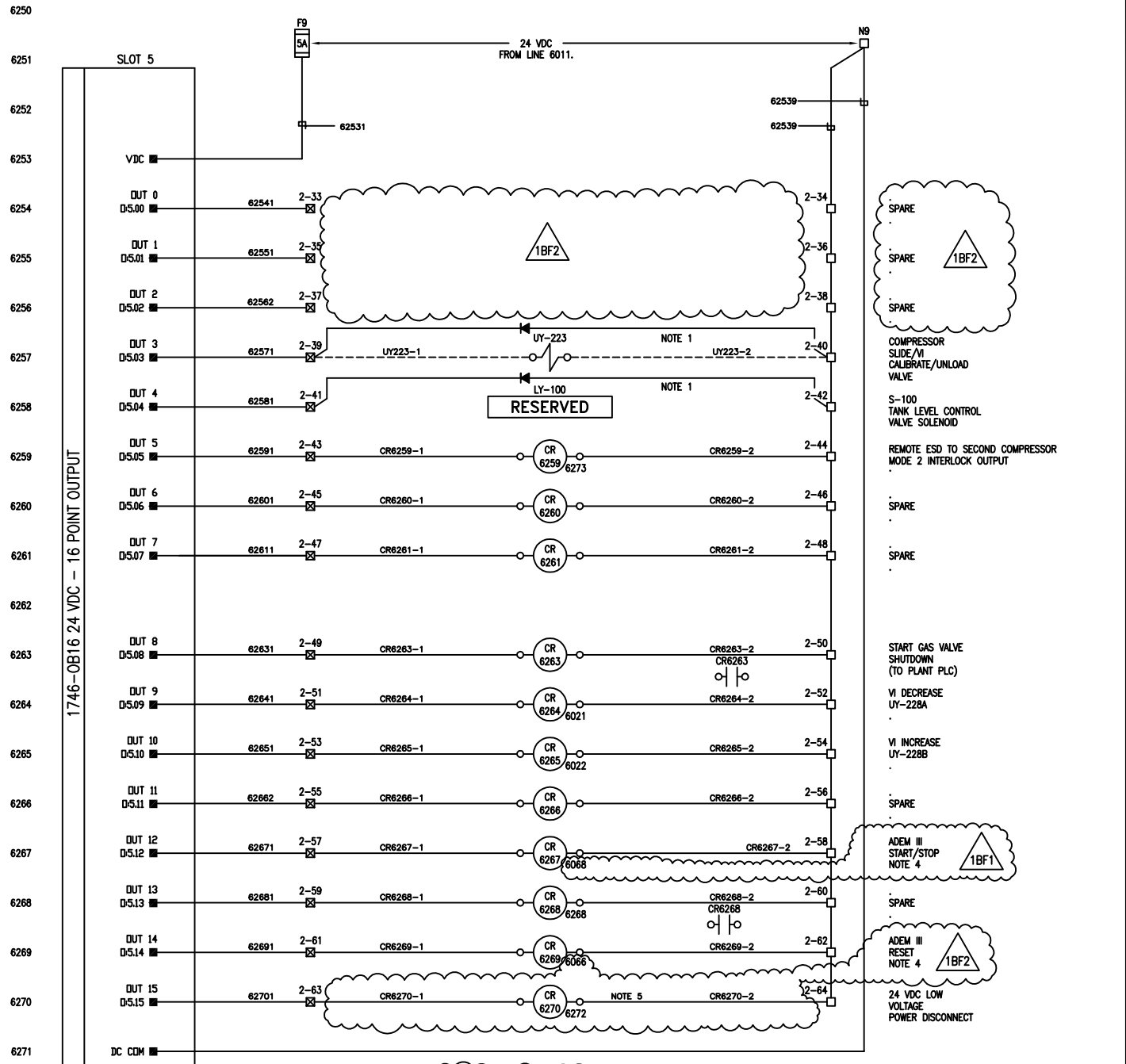
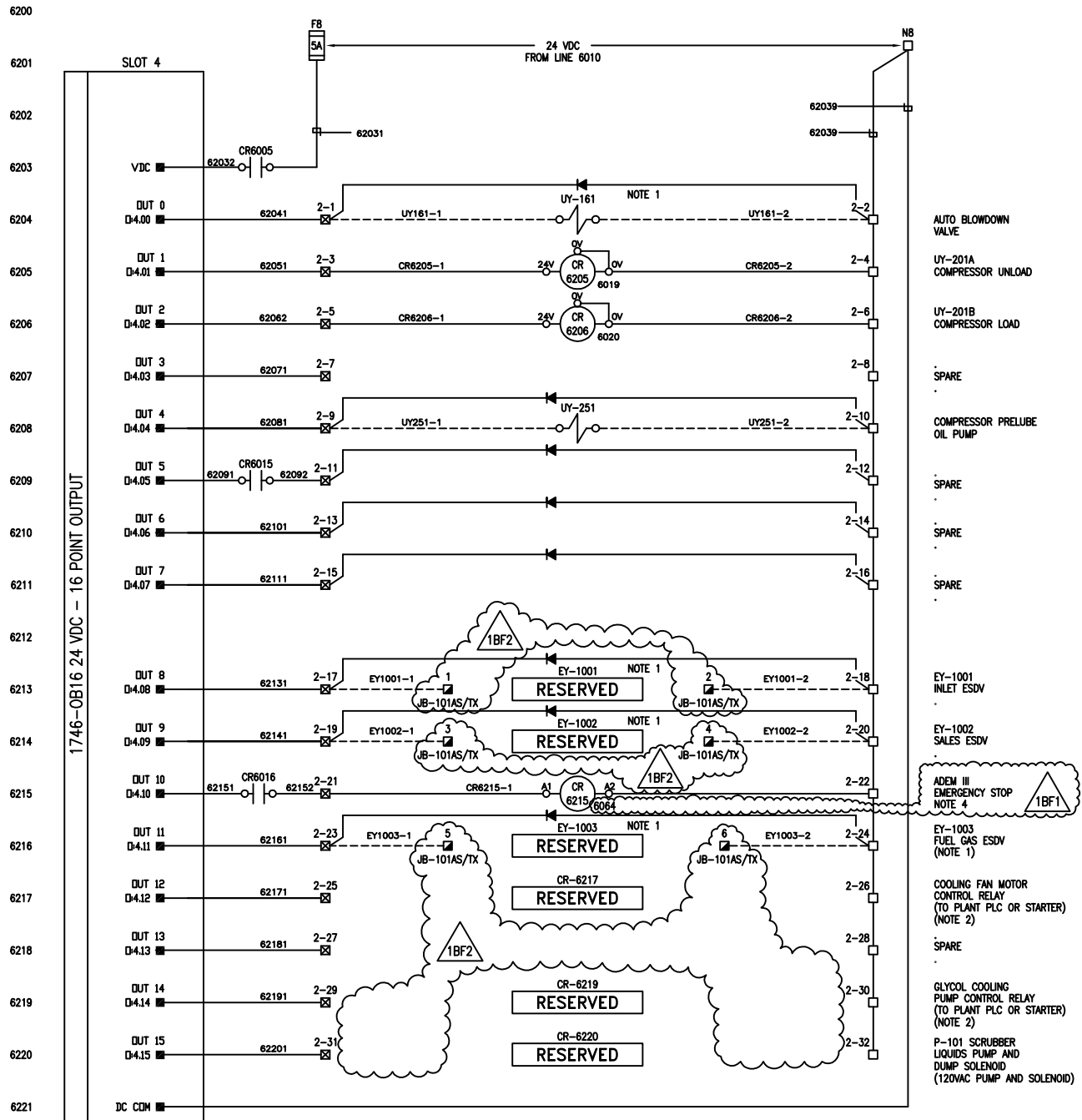
FILE NO.: 9066-PNL02

SCALE: NTS (A1 Size)

REV. NO.: 9066

Drawings Must Comply with Encana Drafting Standards (ECA-A-1)

Date Time



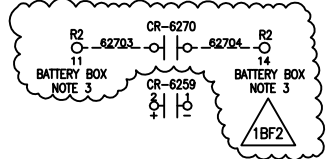
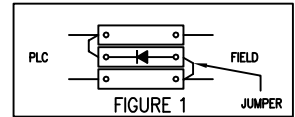
1746-P3
POWER SUPPLY
SLC 5/05
1747-L552
MM46-AFC
(SUPPLIED BY OTHERS)
DIGITAL INPUT
1746-IB16
ANALOG INPUT
1746-NI08 (SWINGARM ONLY)
DIGITAL OUTPUT
1746-OB16
DIGITAL OUTPUT
1746-OB16
ANALOG OUTPUT
1746-NI08
ANALOG OUTPUT
1746-NI08
ANALOG OUTPUT
1746-OB08
RTD
1746-IR08

TERMINAL BLOCK LEGEND

- ☒ DISCONNECT TERMINAL
- ☐ FEED THRU TERMINALS
- ▭ FUSED TERMINALS (REFER TO CARD DRAWINGS FOR SIZES)
- ◻ FIELD JUNCTION BOX
- ▲ ADEM III TERMINALS

* DO NOT USE STACKING TERMINALS

- NOTES:**
1. DIODE TYPICAL FOR ALL SOLENOIDS REFER TO FIGURE 1.
 2. ON SITES WITH POWER AND PLANT PLC.
 3. ON PACKAGES WITH BATTERY BOXES.
 4. REFER TO DWG. 9066-PNL02 FOR DETAILS.
 5. CHANGE RELAY CR6270 FROM ITEM 81/82 TO ITEM 71, FOR NEW PANEL CONSTRUCTION ONLY.



WIRING LEGEND

- CONTROL PANEL WIRING
- - - SKID WIRING
- * - * - FIELD WIRING

February 05, 2007 3:55:10 P.M.
 Drawing: C:\EAD\ENCANA\9066\9066-PNL04.DWG
 Xrefs: ENC-916-DWG TBI.DWG
 T:\encana\Drawings\A1 Size\Ready\4

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		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGES			DPH FOCUS	9066	

REV. NUMBER	ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
1BF2							
	Bldg. Bld						
	Bldg. Fab.	07.01.29	DT				
	Prelim.						
	Bld						
	Constr.						
	As-built						

ENCANA

ENCANA PROJECT NO. 9066

SCALE: NTS (A1 Size) SHEET NO. 9066

ENCANA PROJECT NO. 9066

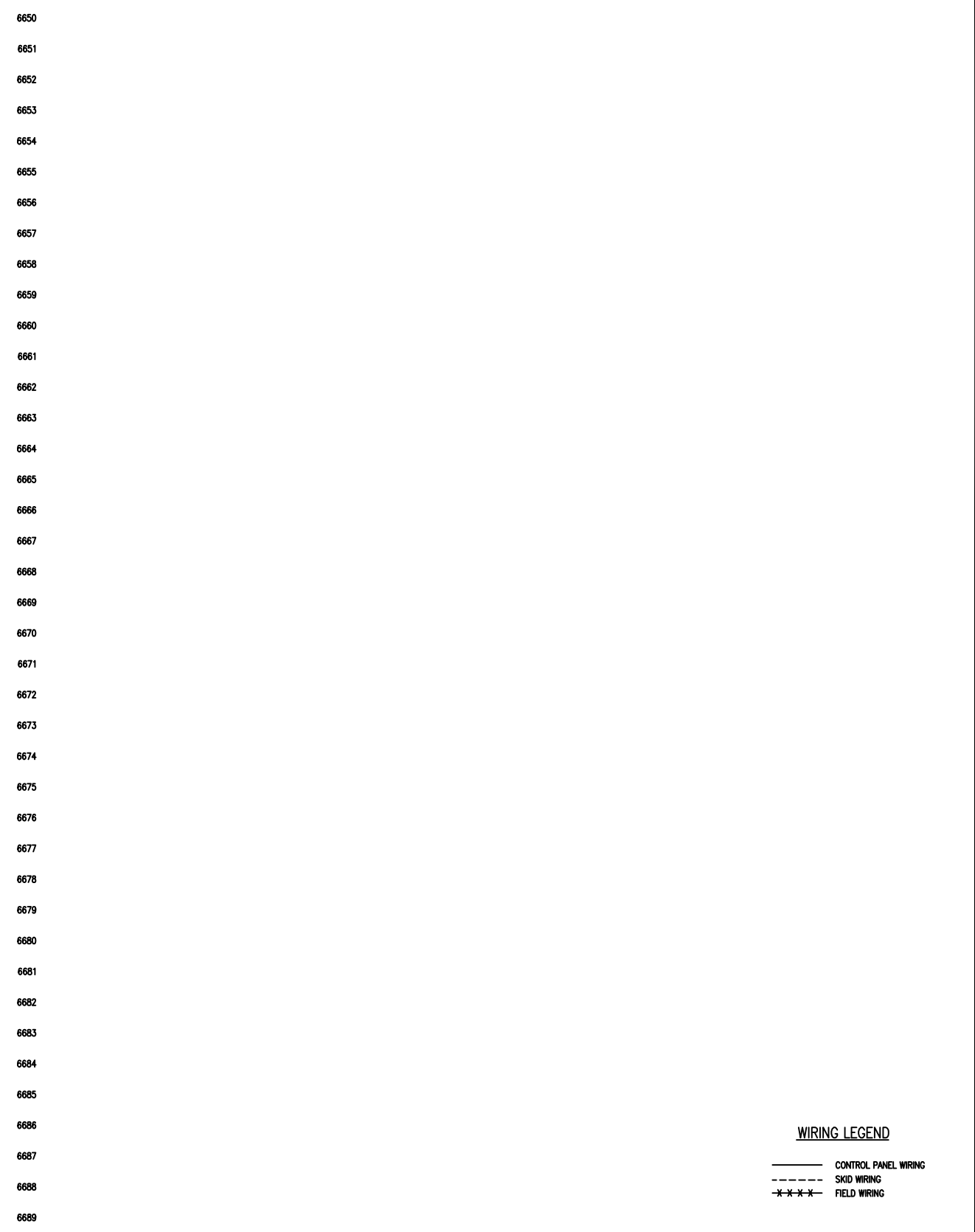
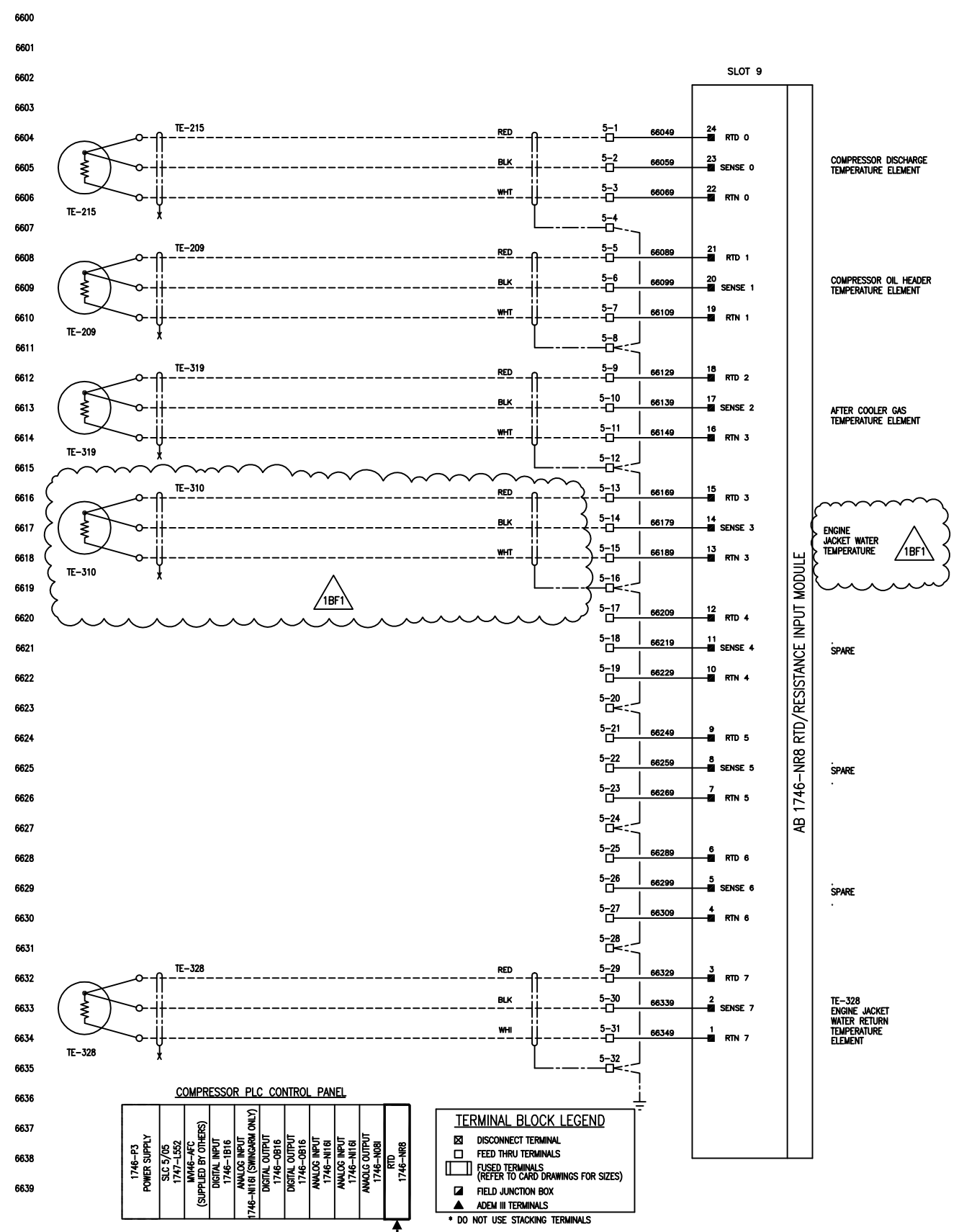
DPH FOCUS CORPORATION

TITLE: DIGITAL OUTPUT 1005HP SCREW COMPRESSOR PACKAGE (WITH ADEM III)

AREA: BULK PURCHASE CLASS: N FILE NO.: 9066-PNL04

Drawings Must Comply with Encana Drafting Standards (ECA-A-1)

Date Time



February 06, 2007 8:00:19 a.m.
Drawing: C:\EAD\ENCANA\9066\9066-PNL08.DWG
Xrefs: ENG-pls.DWG TBI.DWG
- - - - - (Drawing) at Site Rev'd 1.4

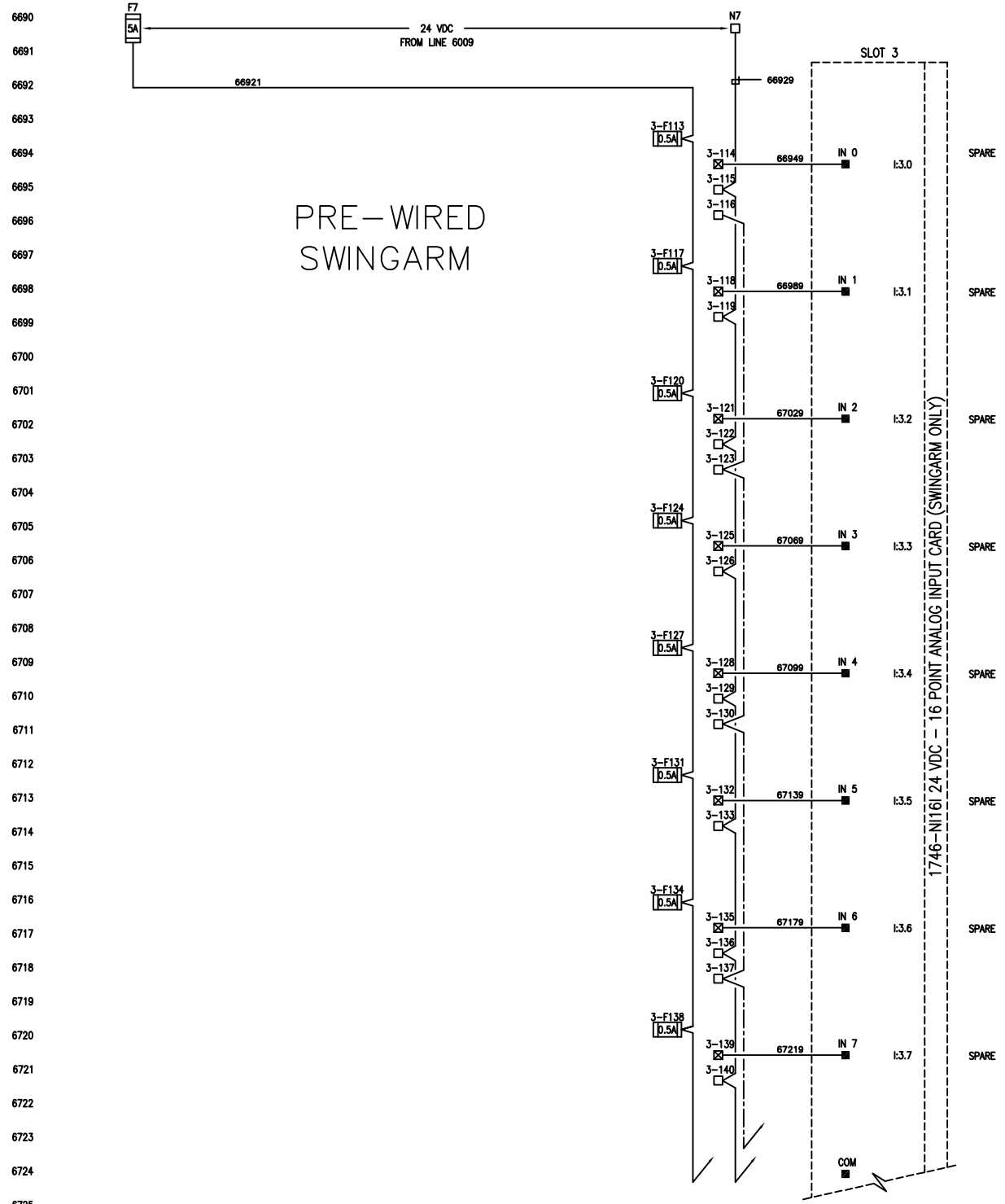
REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.
		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGE			DPH FOCUS	9066	

ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
Bldg. Fab.	07.02.06	IA				
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Constr.						
As-built						

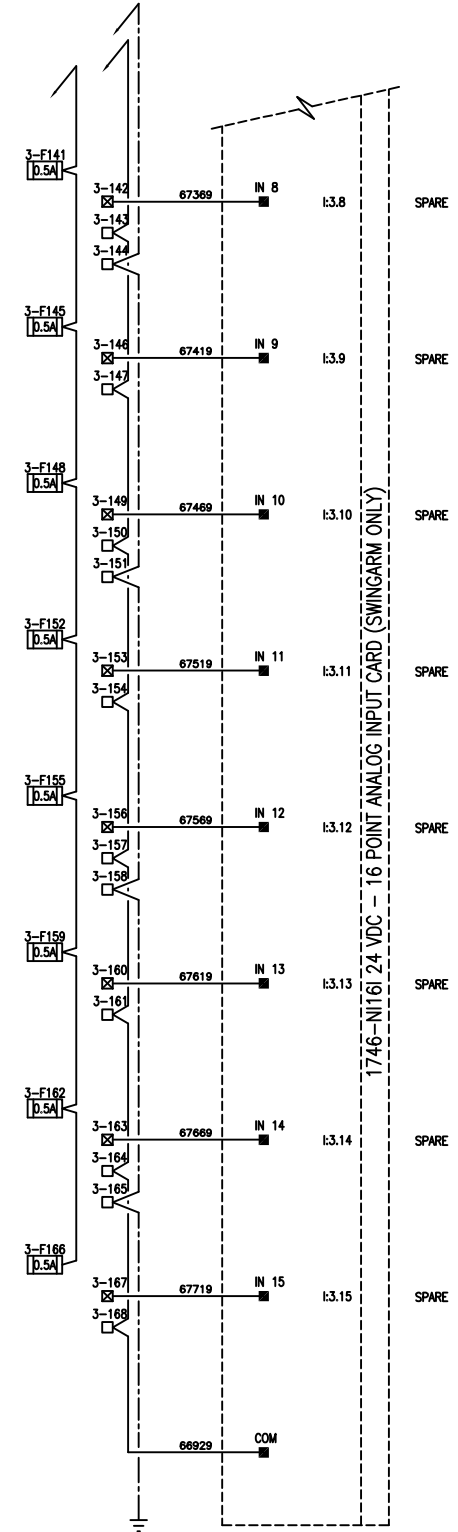
ENCANA

SCALE: NTS (A1 Size)	SPEC. NO.: 9066
EPCM DPH FOCUS CORPORATION	
TITLE: RTD 1005HP SCREW COMPRESSOR PACKAGE (WITH ADEM III)	
AREA: BULK PURCHASE	CLASS FILE NO.: N 9066-PNL08

Date Time



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COMPRESSOR PLC CONTROL PANEL

1746-P3	POWER SUPPLY
SLC 5705	
1747-L552	
MM46-AFC	
(SUPPLIED BY OTHERS)	
DIGITAL INPUT	
1746-1B16	
ANALOG INPUT	
1746-N16I (SWINGARM ONLY)	
DIGITAL OUTPUT	
1746-0B16	
DIGITAL OUTPUT	
1746-0B16	
ANALOG INPUT	
1746-N16I	
ANALOG INPUT	
1746-N16I	
ANALOG OUTPUT	
1746-0A2B	
RTD	
1746-NR8	

TERMINAL BLOCK LEGEND

- DISCONNECT TERMINAL
- FEED THRU TERMINALS
- FUSED TERMINALS (REFER TO CARD DRAWINGS FOR SIZES)
- FIELD JUNCTION BOX
- ADEM III TERMINALS

* DO NOT USE STACKING TERMINALS

WIRING LEGEND

- CONTROL PANEL WIRING
- - - - SKID WIRING
- * * * * * FIELD WIRING

February 08, 2007 8:01:05 a.m.
Drawing: C:\EAD\ENCANA\9066\9066-PNL09.DWG
Xrefs: ENG-plc.dwg TBI.DWG
- - - - - (Drawing) at the end of a line

REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.
		1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGE			DPH FOCUS	9066	

REV. NUMBER	ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
1BF1	Bldg. Fab.	07.02.06	JA				
	Prelim.						
	Bld						
	Constr.						
	As-built						

ENCANA

<p>SCALE: NTS (A1 Size)</p> <p>CLASS: N</p> <p>FILE NO.: 9066</p>	<p>PERMIT STAMP AND PROFESSIONAL STAMP AFFIXED ABOVE SHALL APPLY ONLY TO REV(S)</p> <p>1BF1</p>
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ENCANA

DPH FOCUS CORPORATION

TITLE: ANALOG 1005HP SCREW COMPRESSOR PACKAGE (WITH ADEM III)

AREA: BULK PURCHASE

CLASS: N

FILE NO.: 9066-PNL09

Drawings Must Comply with EnCana Drafting Standards (ECA-A-1)

Date Time

COMPRESSOR PACKAGE

RESERVED

OFF SKID

LEGEND
OP - OPEN
CL - CLOSE
SD - SHUTDOWN (NEEDS RESET)
ST - START (NO RESET REQUIRED)
SP - STOP (NO RESET REQUIRED)
LR - LOCAL ELECTRICAL RESET
AR - AUTO RESET (PLANT ESD RELAY)
TD - TIME DELAYED
LMR - LOCAL MECHANICAL RESET
RER - REMOTE ELECTRICAL RESET
PB - PUSHBUTTON
HW - HARDWARE
P - PERMISSIVE TO START/OPEN
A - ATTEND (FUNCTION OCCURS IN ATTEND MODE)
U - UNATTEND (FUNCTION OCCURS IN UNATTEND MODE)
SR - SHUTDOWN RESTART
DE - DE-ENERGIZE
E - ENERGIZE

CONTROL STATION
S/S - STOP/START
HOA - HAND-OFF-AUTO
O/O - ON/OFF
H/A - HAND/AUTO
O/A - OFF/AUTO
FAR - FORWARD/AUTO/REVERSE
S/O/F - SLOW/OFF/FAST
O/O/S - ON/OFF/START
SHUTDOWN MODES
MODE 2 - SHUTDOWN AND DEPRESSURE
MODE 1 - HARD SHUTDOWN/POST LUBE/PRESSURIZED COOLDOWN - COOLDOWN SHUTDOWN/UNLOAD/POST LUBE PRESSURIZED

Table with columns A through BB, containing various control and shutdown signals like UY-161, UY-251, UY-204, etc.

NOTES:
1. ENGINE COOLDOWN AND STOP (TIME DELAYED CONTROLLED SHUTDOWN) (ENGINE TO MINIMUM RPM, COMPRESSOR TO MINIMUM LOAD).
2. COMPRESSOR START PERMISSIVE.
3. ENGINE WARM UP PERMISSIVE.
4. PLC INTERNAL CONTROL TAG.
5. VIBRATION SHUTDOWN SETPOINTS ARE MULTIPLIED BY 1.5 DURING START-UP (UNTIL ENGINE REACHES IDLE SPEED OR TIME OF 20sec.).
6. CLASS A SHUTDOWN IS IMMEDIATE, CLASS B SHUTDOWN IS BYPASSED FOR 20sec. DURING START-UP. CLASS B SHUTDOWN IS BYPASSED FOR 120sec. DURING START-UP. START-UP IS "DURING THE WARMUP SEQUENCE" (UNIT RUNNING).
7. SLIDE VALVE FAILURE IS AN ALARM. MINIMUM SLIDE VALVE POSITION SETPOINT (10%) IS A START PERMISSIVE.
8. NOT USED
9. ON SITES WITH POWER AND NO PLANT PLC.
10. NOT USED
11. ON SITE WITH POWER AND PLANT PLC.
12. ONLY ACTIVE IF COMPRESSOR HAS BEEN DOWN FOR 8 HOURS.
13. COMPRESSOR OIL FILTER DIFFERENTIAL SETPOINTS ARE ELEVATED DURING START UP TO 900kPa IF COMPRESSOR OIL TEMPERATURE IS LESS THAN 25 deg C.
14. NOT USED
15. IF ALL GAS DETECTION (ON A PER BUILDING BASIS) IS IN MALFUNCTION FOR AT LEAST 30 min., INITIATE COOLDOWN AND STOP. AT 40 min., INITIATE HARD SHUTDOWN (MODE 1).
16. IF TRANSMITTER IS UNDERRANGE BY 1.35% OR OVERRANGE BY 0.85% FOR AT LEAST 1 sec. THEN INITIATE FAULT.
17. RTD OVER/UNDERRANGE FAULT IS DETERMINED WHEN VALUE IS OUTSIDE ITS RATED RANGE OF -200°C TO 850°C FOR AT LEAST 1 sec.
18. NOT USED
19. LAHH-102 & LAHH-140 ARE WIRED IN SERIES TO INPUT 1:2/03.
20. 24VDC LOW VOLTAGE MONITOR WILL PHYSICALLY DISCONNECT POWER TO ALL CONTROL DEVICES INCLUDING THE PLC.
21. ALL VIBRATION SHUTDOWNS HAVE A 3 SECOND DEBOUNCE AS PER MANUFACTURER'S RECOMMENDATION.
22. 15 SECOND DEBOUNCE TO ALLOW CONTROL TO UNLOAD THE SCREW COMPRESSOR.
23. VALVE TO REOPEN AFTER PRESSURE DROPS 35kPa BELOW SETPOINT.
24. SLIDE VALVE IS LOADED TO 20% DURING WARMUP SEQUENCE.
25. ENGINE OVERSPEED SETPOINTS SHALL BE ONE OF THE FOLLOWING:
a) 1550 rpm (3512 UNIT - 1005 hp)
b) 1350 rpm (3512 UNIT - 860 hp)
c) 1550 rpm (3512 UNIT - 1005 hp)
26. NOT USED
27. PSHH-304 START GAS VALUE POSITIVE SHUTOFF HI HI SHUTDOWN IS BYPASSED FOR A 20 SECOND PERIOD DURING THE UNIT STARTUP AND STOP SEQUENCE.
28. FOR SITES WITH NO PLANT PLC.
29. FOR SITES WITH A PLANT PLC.
30. PADL-207 LUBE OIL DIFF. PRESSURE LO LO SET POINT IS SET TO 250kPa DURING THE WARM-UP AND COOLDOWN SEQUENCES AS LONG AS ENGINE SPEED IS BELOW MINIMUM LOAD SETPOINT AND SLIDE VALVE IS UNLOADED (<10%) OTHERWISE A SETPOINT OF 310kPa IS USED.

Drawings Must Comply with Encana Drafting QMP and Guidelines

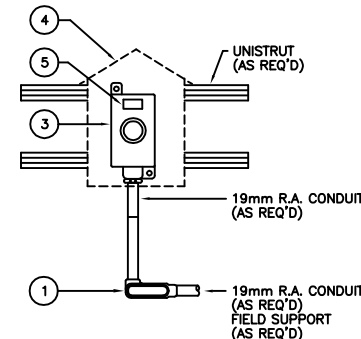
Main table with columns: TAG No., DESCRIPTION, SET POINT, INPUT CONDITION, INPUT/DEVICE TAG NO., OUTPUT INPUT, MODE, SHUTDOWN LEVEL, SHUTDOWN CLASS, NOTE, and columns A through BB.

DRAWING SIGNOFF table with columns: COMPANY, CHECKED BY, INITIAL, DATE.

REFERENCE DRAWINGS, PROJECT DESCRIPTION, ISSUE STAGE, DATE, BY, CHKD, APPD, PERMIT STAMP, ENGINEER'S STAMP.

ENCANA logo, DPH FOCUS CORPORATION, ALARM AND SHUTDOWN KEY, 860HP/1005HP ARIEL SCREW COMP (WITH ADEM III), BULK PURCHASE, 9066-SDK2.

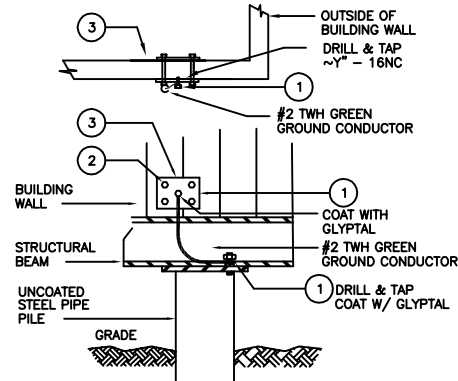
February 07, 2007 10:26:23 a.m.
Drawing: C:\EAD\ENCANA\9066\9066-SDK2.DWG



NOTES:
1. CONTRACTOR TO SUPPLY LAMICOID NAMEPLATE C/W TAG NUMBER.

ITEM	QUAN.	DESCRIPTION	TYPE
1	1	CONDUIT OUTLET BODY	CH #LR OR EQUAL
2	-	-	-
3	1	CONTROL STATION (ESD P.B.)	ALLEN BRADLEY
4	1	WEATHER GUARDHOOD (OUTDOOR ONLY)	-
5	1	LAMICOID NAMEPLATE (ESD# ON PLAN DRAWINGS)	25mmx75mm RED ON WHITE

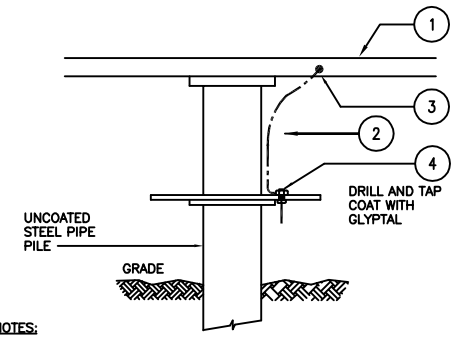
1 SHUTDOWN/CONTROL STATION WALL MOUNTED INSTALLATION TO J.B. CLASS 1, ZONE 2 AREA



NOTES:
1. BOTH GROUND BARS TO BE ALUMINUM AND SECURELY BOLTED TOGETHER THROUGH THE WALL. WIRE BRUSH WALL SURFACE AND BARS TO BARE METAL AND APPLY PENETROX "A" ON PLATE SURFACE TO ENSURE GOOD CONTACT BETWEEN GROUND BARS AND WALL.

ITEM	QUAN.	DESCRIPTION	TYPE
1	2	SERVIT POST	BURNDY KC 23
2	4	ALUMINUM HEX BOLT C/W NUT & WASHERS	9.5mm LENGTH TO SUIT
3	2	75 x 75 x 6mm ALUMINUM PLATE	-

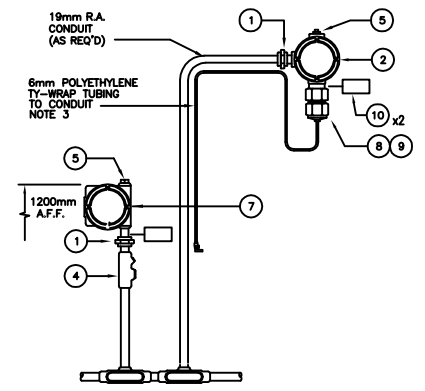
2 FRAMELESS BUILDING GROUNDING CLASSIFIED BUILDING



NOTES:
1. ELECTRICAL CONTRACTOR TO COAT EXPOSED CONNECTORS AND COPPER WITH GLYPTAL.
2. BOND TRAY TO STEEL PILE AS SHOWN EVERY THREE SECTIONS.

ITEM	QUAN.	DESCRIPTION	TYPE
1	AS REQ'D	ALUMINUM LADDER TRAY	-
2	AS REQ'D	#2 AWG GREEN INSULATED COPPER CONDUCTOR	-
3	1	CABLE TRAY GROUND CLAMP	BURNDY GBM26 OR EQUAL
4	1	SERVIT POST	BURNDY KC23 OR EQUAL

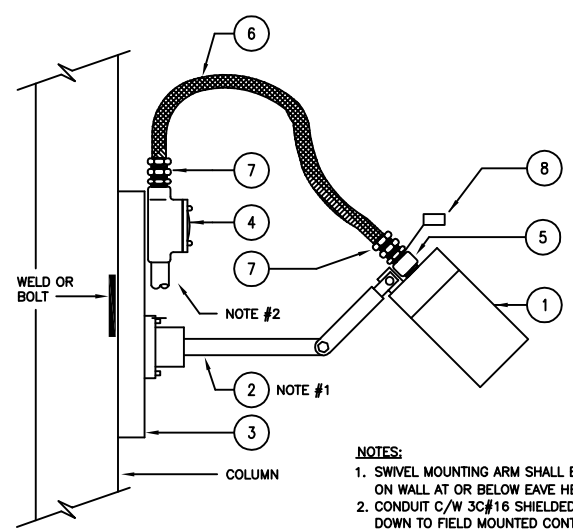
3 CABLE TRAY GROUNDING - TO PIPERACK PILE



NOTES:
1. WIRING FROM TRANSMITTER TO SEPARATION KIT REQUIRED TO BE 1 TRIAD SHIELDED INSTRUMENT WIRE.
2. CONTRACTOR TO SUPPLY LAMICOID NAMEPLATE C/W TAG NUMBER.
3. TUBING TO BE DIFFERENT COLOR FOR EACH SENSOR HEAD.

ITEM	QUAN.	DESCRIPTION	TYPE
1	2	UNION	UNION-2055A OR EQUAL
2	1	SENSOR SEPARATION KIT	NET SAFETY SEE B.O.M.
3	1	CONDUIT OUTLET BODY	CH #LR-26 OR EQUAL
4	AS REQ'D	SEAL	OMNISEAL-310M OR EQUAL
5	2	CONDUIT PLUG	CH #LR-26 OR EQUAL
6	-	-	-
7	1	SMART SENSOR TRANSMITTER	NET SAFETY SEE B.O.M.
8	1	REMOTE TEST APPLICATOR	NET SAFETY
9	1	SENSOR	NET SAFETY
10	2	LAMICOID NAMEPLATE	-

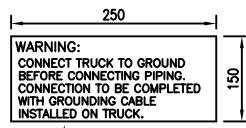
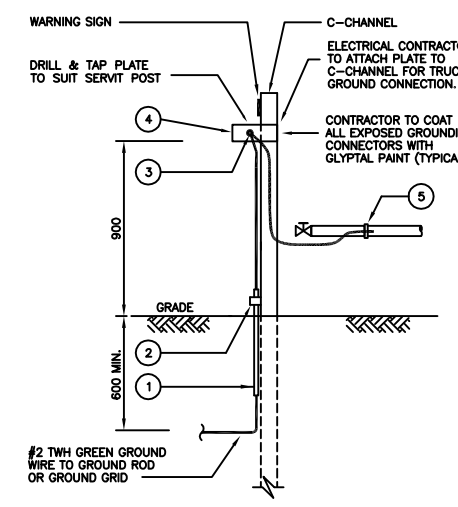
5 NET SAFETY GAS DETECTION TRANSMITTER & REMOTE SENSOR CLASS 1, ZONE 2 & NON-HAZARDOUS AREAS



NOTES:
1. SWIVEL MOUNTING ARM SHALL BE ON WALL AT OR BELOW EAVE HEIGHT.
2. CONDUIT C/W 3C#16 SHIELDED CABLE INSTR. DOWN TO FIELD MOUNTED CONTROLLER.
3. CONTRACTOR TO SUPPLY LAMICOID NAMEPLATE.

ITEM	QUAN.	DESCRIPTION	TYPE
1	1	UV FLAME DETECTOR	NET SAFETY UVS-A
2	1	SWIVEL MOUNT BAR	-
3	AS REQ.	STRUT CHANNEL-PLATED	-
4	1	TERMINATION JUNCTION BOX	NET SAFETY
5	1	3/4" COUPLING	-
6	1	LIQUID TITE FLEX	SFLEX 12 OR EQUAL
7	2	LIQUID TITE FLEX CONNECTOR	T & B 5232 OR EQUAL
8	1	LAMICOID NAMEPLATE	-

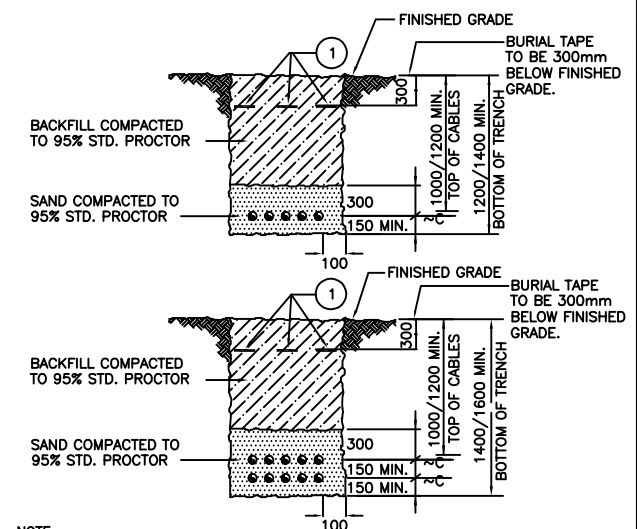
6 U.V. DETECTION HEAD CLASS 1, ZONE 2 AREAS & NON HAZARDOUS AREAS



NOTES:
1. CONTRACTOR TO SUPPLY & INSTALL WARNING SIGN.

ITEM	QUAN.	DESCRIPTION	TYPE
1	1	GROUND STUB-UP PROTECTION	19mm PVC CONDUIT
2	1	ONE HOLE STRAP	-
3	1	SERVIT POST	BURNDY KC 26 OR EQUAL
4	1	6mm THICK BRASS OR ALUMINUM FLAT PLATE (150mm x 50mm)	BY CONTRACTOR
5	1	GROUND CONNECTOR TO FIT PIPE SIZE	BURNDY GAR OR EQUAL

8 TRUCK GROUNDING INSTALLATION (WITHOUT REEL)



NOTE:
THE TOP OF CABLES OPERATING AT 750V OR LESS SHALL BE BURIED A MIN. OF 1000mm BELOW FINISHED GRADE AND CABLES OPERATING AT GREATER THAN 750 VOLTS SHALL BE BURIED A MINIMUM OF 1200mm BELOW FINISHED GRADE. EXCEPT WITHIN THE CONFINES OF FOUNDATIONS. THE MAXIMUM SPACE BETWEEN MARKER TAPE IS 600mm. A MINIMUM OF TWO (2) MARKER TAPES SHALL BE USED IN ALL TRENCHES GREATER THAN 300mm IN WIDTH. WARNING SIGNS SHALL BE POSTED ON BUILDING EXTERIOR WALL(S) TO IDENTIFY THE VICINITY OF UNDERGROUND CONDUITS AND CABLES.

ITEM	QUAN.	DESCRIPTION	TYPE
1	AS REQ'D	MARKER TAPE, 76mm WIDTH	THOMAS & BETTS YT-3

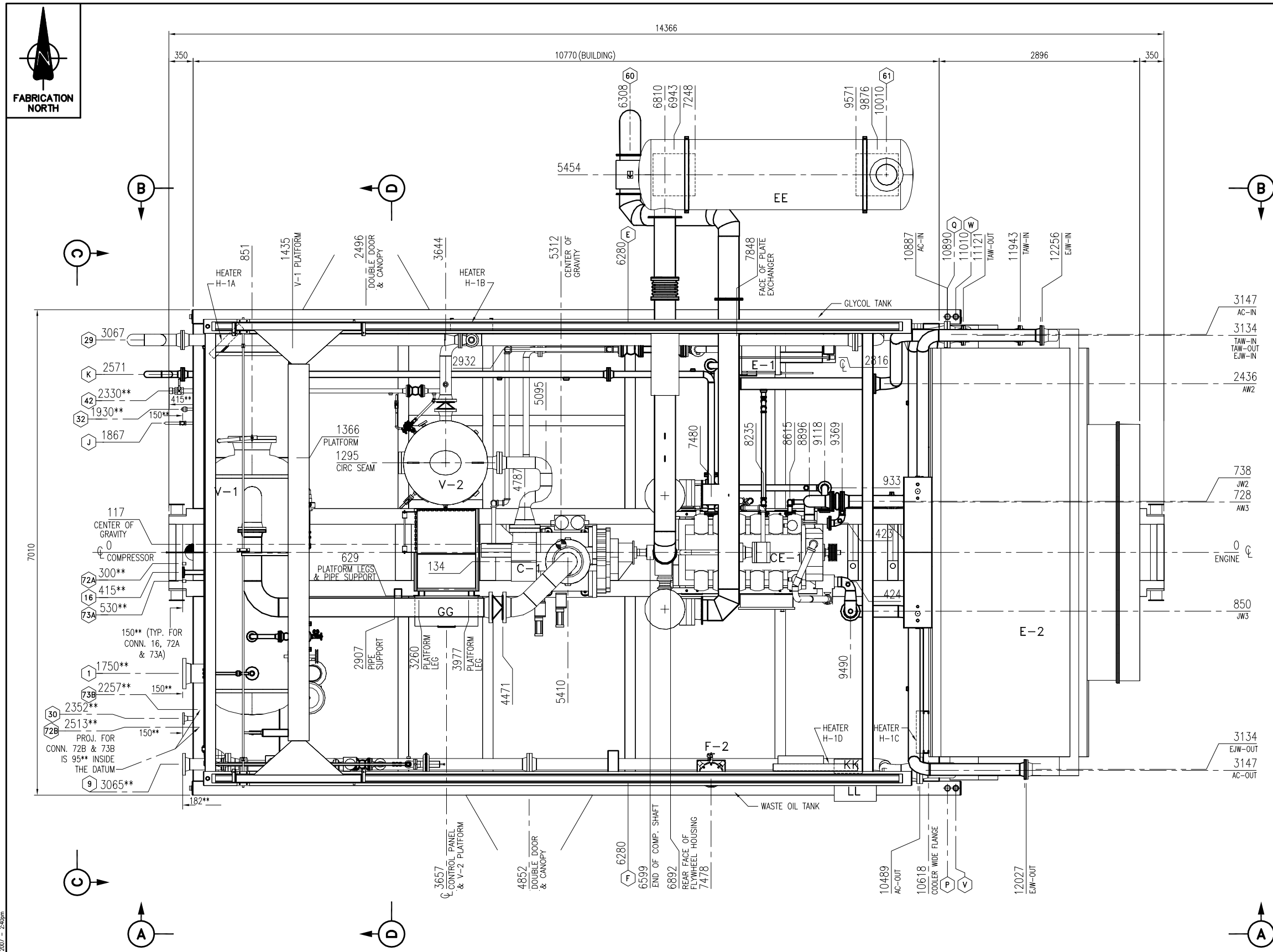
7 UNDERGROUND CABLE DETAIL GREATER THAN 300mm WIDTH

REFERENCE DRAWINGS	DWG. NO.	NO.	DATE	PROJECT DESCRIPTION	PROJ.	AFE	EPCM Co.	EPCM No.	APPD.	ISSUE STAGE	DATE	BY	CHKD.	APPD.	PERMIT STAMP	ENGINEER'S STAMP
-	-	1	07.02.06	BULK PURCHASE SCREW COMPRESSOR PACKAGES	-	-	DPH FOCUS	9066	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	Bldg. Fab.	07.02.06	JA	-	-	-	-
-	-	-	-	-	-	-	-	-	-	Prelim.	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	Bld	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	Constr.	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	As-built	-	-	-	-	-	-

ENCANA		SCALE: NTS (A1 Size)	9066
DPH FOCUS CORPORATION			
ELECTRICAL INSTALLATION DETAILS			
AREA: BULK PURCHASE	CLASS: N	FILE NO.: E-DPH-DET-1	REV. NUMBER: 1BF1

ENERFLEX

DRAWINGS



PLAN VIEW

CUSTOMER CONNECTIONS		
NO.	DESCRIPTION	SIZE
1	INLET	10"-300# RFWN
9	DISCHARGE	6"-300# RFWN
16	INLET SCRUBBER DRAIN	2"-150# RFWN
29	PSV VENT HEADER	6"-150# RFWN
30	FUEL / START GAS SUPPLY	2"-300# RFWN
32	OFF-SKID INSTRUMENT GAS SUPPLY	1" 3000#
42	OIL SEPARATOR DRAIN	2"-CAMLOCK
60	ENGINE AIR INLET	12" TUBING
61	ENGINE EXHAUST	12" TUBING
72A/B	HEAT TRACE SUPPLY	1/2" 3000#
73A/B	HEAT TRACE RETURN	1/2" 3000#

OTHER CUSTOMER LOCAL CONNECTIONS & VENTS		
E	ENGINE OIL TANK FILL	1" NPT
F	ENGINE OIL TANK FILL	1" NPT
J	INSTRUMENT GAS VENT	1" NPT
K	START GAS VENT	3"-150# RFWN
P	WASTE OIL TANK VENT	2" NPT
Q	GLYCOL TANK VENT	2" NPT
V	WASTE OIL TANK PUMP OUT	2" NPT
W	GLYCOL TANK PUMP OUT	2" NPT

SHIPPING WEIGHTS		UNIT DIMENSIONS	
C-1	COMPRESSOR/ARIEL RG357M 4091 kg	MAIN SKID w/ALL EQUIP MOUNTED	
CE-1	ENGINE/ATERPILLAR 3512 TALE AFRC 6705 kg	LENGTH	14366 mm 47'-1 1/2"
E-2	COOLER: AIR-X 132EH 8432 kg	WIDTH	7010 mm 23'-0"
E-1	OIL COOLER: VIEX 1394 kg	HEIGHT	6913 mm 22'-8 1/4"
		WEIGHT	66852 kg

SHIPPING DIMENSIONS	
V-1	INLET SEP. 48" ID, 120" S/S 2480 kg
V-2	OIL SEP. 48" OD, 102" S/S 1840 kg
GG	CONTROL PANEL: ALLEN-BRADLEY 75 kg
KK	BATTERY BOX PANEL
LL	BATTERY BOX

COOLER DIMENSIONS	
SKID	23500 kg
BUILDING	3500 kg
CRANE	3950 kg
MISC.	10185 kg
TOTAL WEIGHT:	APPR. 67327 kg

BUILDING DIMENSIONS	
SHIPPED LOOSE:	LENGTH 10770 mm 35'-4"
EE EXHAUST: EXHDPS	1099 kg
MUFFLER STAND	1200 kg
	WEIGHT 3500 kg

- GENERAL NOTES**
- ALL TAIL DIMENSIONS FROM REFERENCE POINT.
 - ALL DIMENSIONS ARE IN MILLIMETERS.
 - DO NOT SCALE THIS DRAWING.
 - THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS STAMPED "RELEASED FOR MANUFACTURE".
 - FOR DESIGN PARAMETERS AND PAINT SPECIFICATION REFER TO PROJECT SCOPE SUMMARY DRAWING NO. PF-060430-50(SHEET 2 OF 2).
 - ALL PIPING MUST BE SELF SUPPORTING BEYOND UNIT CONNECTIONS.
 - LOCATIONS OF CUSTOMER CONNECTIONS ARE NOT GUARANTEED AS THESE DIMENSIONS MAY BE SUBJECT TO AN AE-2UMULATION OF TOLERANCES ON SEVERAL COMPONENTS. MINOR CHANGES MAY ALSO BE MADE ON SCREWED SERVICE PIPING IN ORDER TO FACILITATE INSTALLATION AND MAINTENANCE. UPON COMPLETION A FINAL DRAWING WILL BE ISSUED WITH FIELD CONNECTIONS CORRECTED TO 5 mm.
 - IT IS EFX'S RECOMMENDATION THAT ANY PRE-SPOOLING TO THIS COMPRESSOR PACKAGE CONTAIN FIELD WELDS AT ALL CUSTOMER CONNECTIONS.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/07/25	MGN	JB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	07/01/19	SN	

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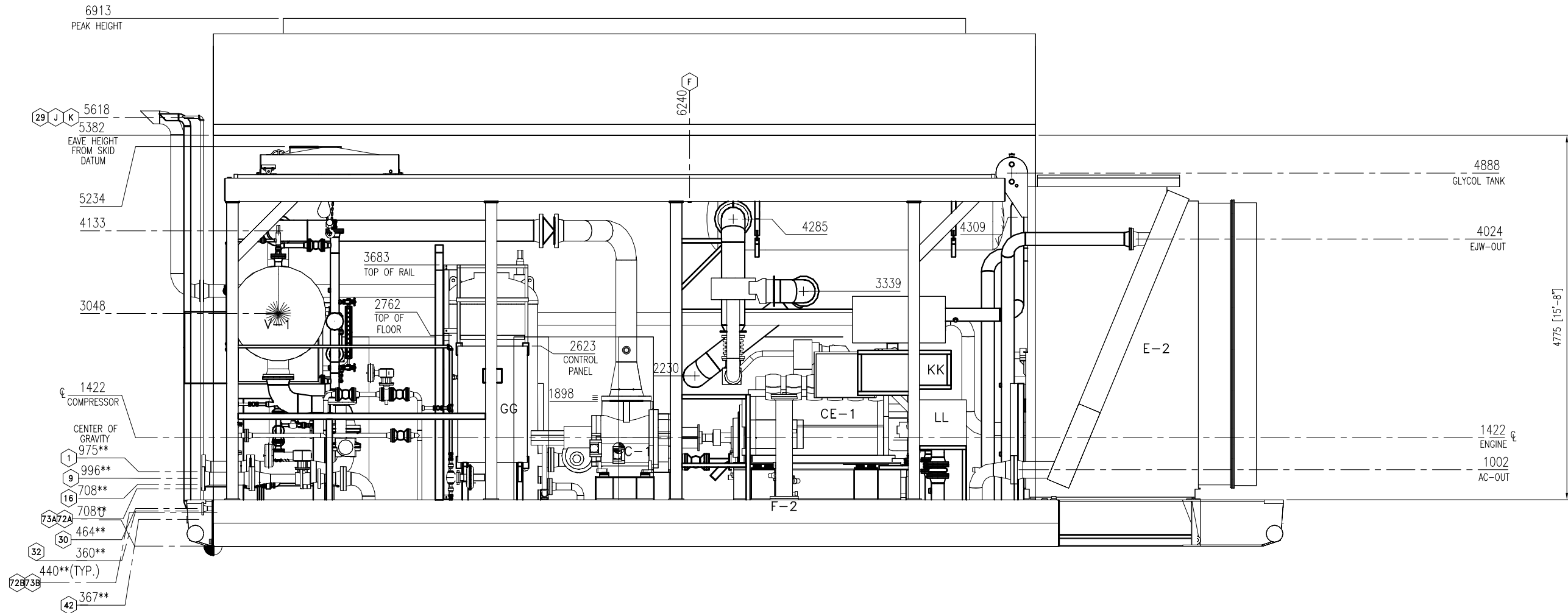
TITLE: **GENERAL ARRANGEMENT**
ARIEL RG357M, CATERPILLAR 3512 ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: **ENCANA OIL & GAS PARTNERSHIP (CHINOOK)**

CONSULTANT: **DPH FOCUS CORPORATION** LSD: INDD00-02
P.O.: 9066-K002 DATE: 06/03/02 JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/02	DWG. No.	OP#
DATE: 06/03/02	CHKD BY:	DATE:	GA-060430	10
SCALE: NTS	APPVD BY:	DATE:		

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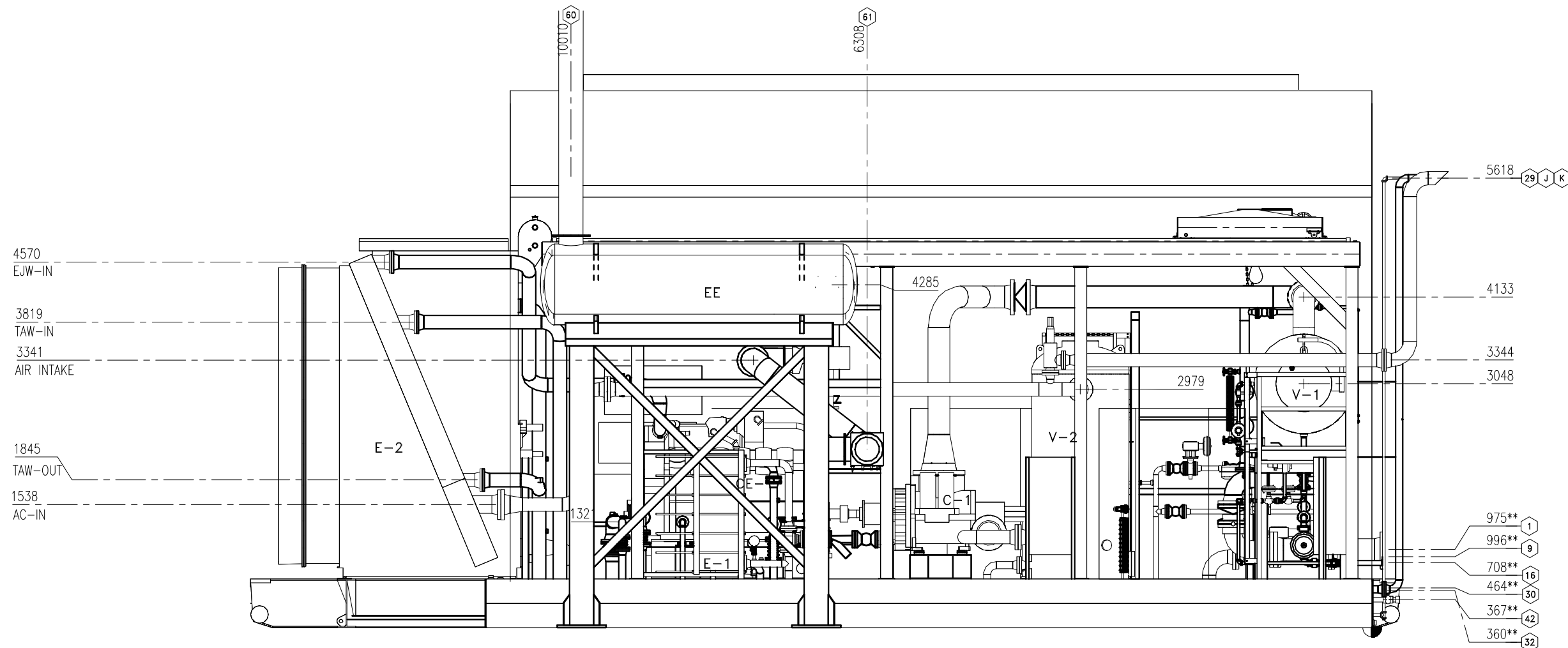
ELEVATION 'A-A'

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/06/28	MGN	JB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	07/01/19	SN	

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TITLE: ELEVATION 'A-A' ARIEL RG357M, CATERPILLAR 3512 ADEM III AFRC, AIR-X 132EH 1005HP SCREW COMPRESSOR PACKAGE				
FOR: ENCANO OIL & GAS PARTNERSHIP (CHINOOK)				
CONSULTANT: DPH FOCUS CORPORATION P.O.: 9066-K002		LSD: INDD00-02 JOB No.: 060430		
DRWN BY: SN DATE: 06/03/02 SCALE: NTS	DESIGN BY: SN CHKD BY: APPVD BY:	DATE: 06/03/02 DATE: DATE:	DWG. No. GA-060430	OP# 10



ELEVATION 'B-B'

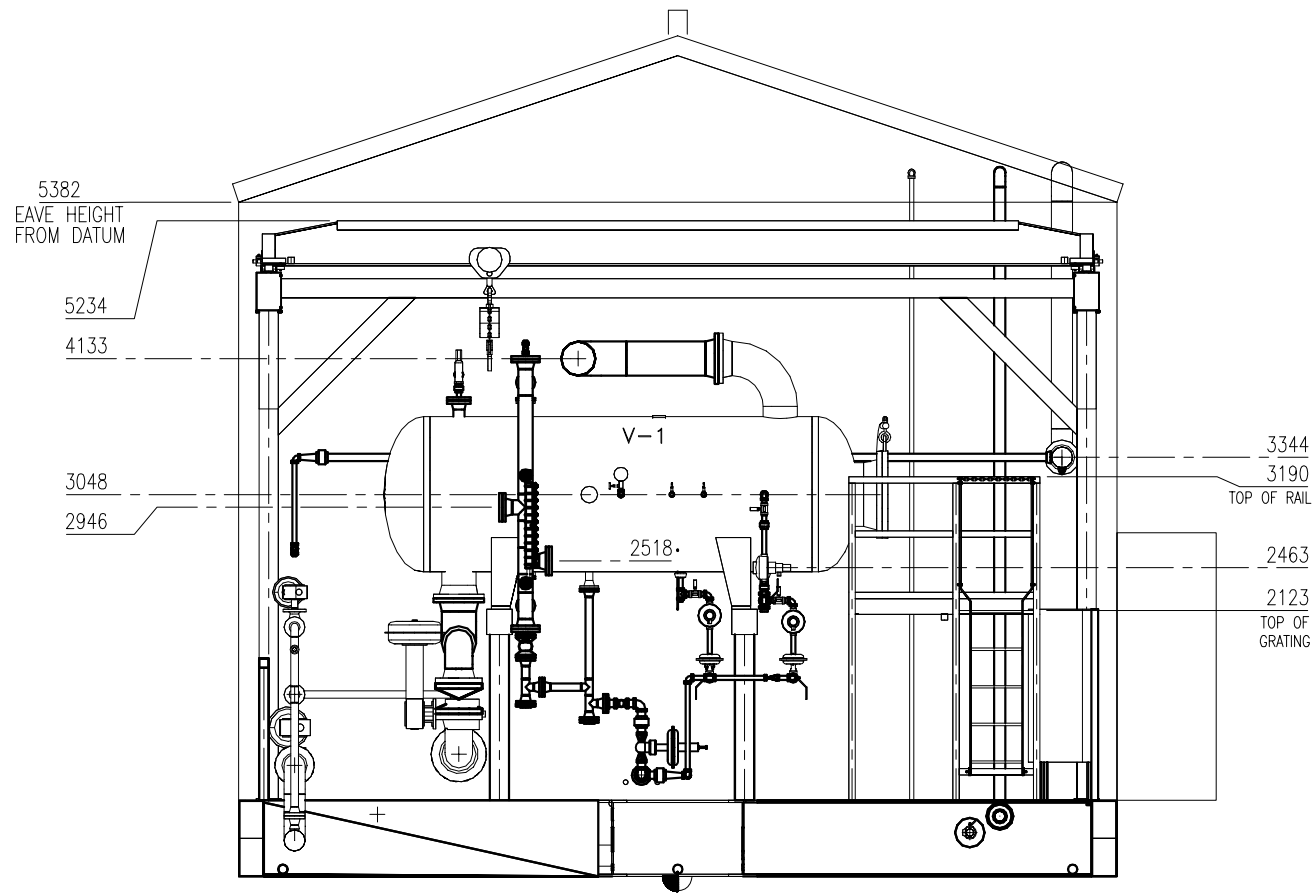
REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/06/28	MGN	JB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/05/10	SN	

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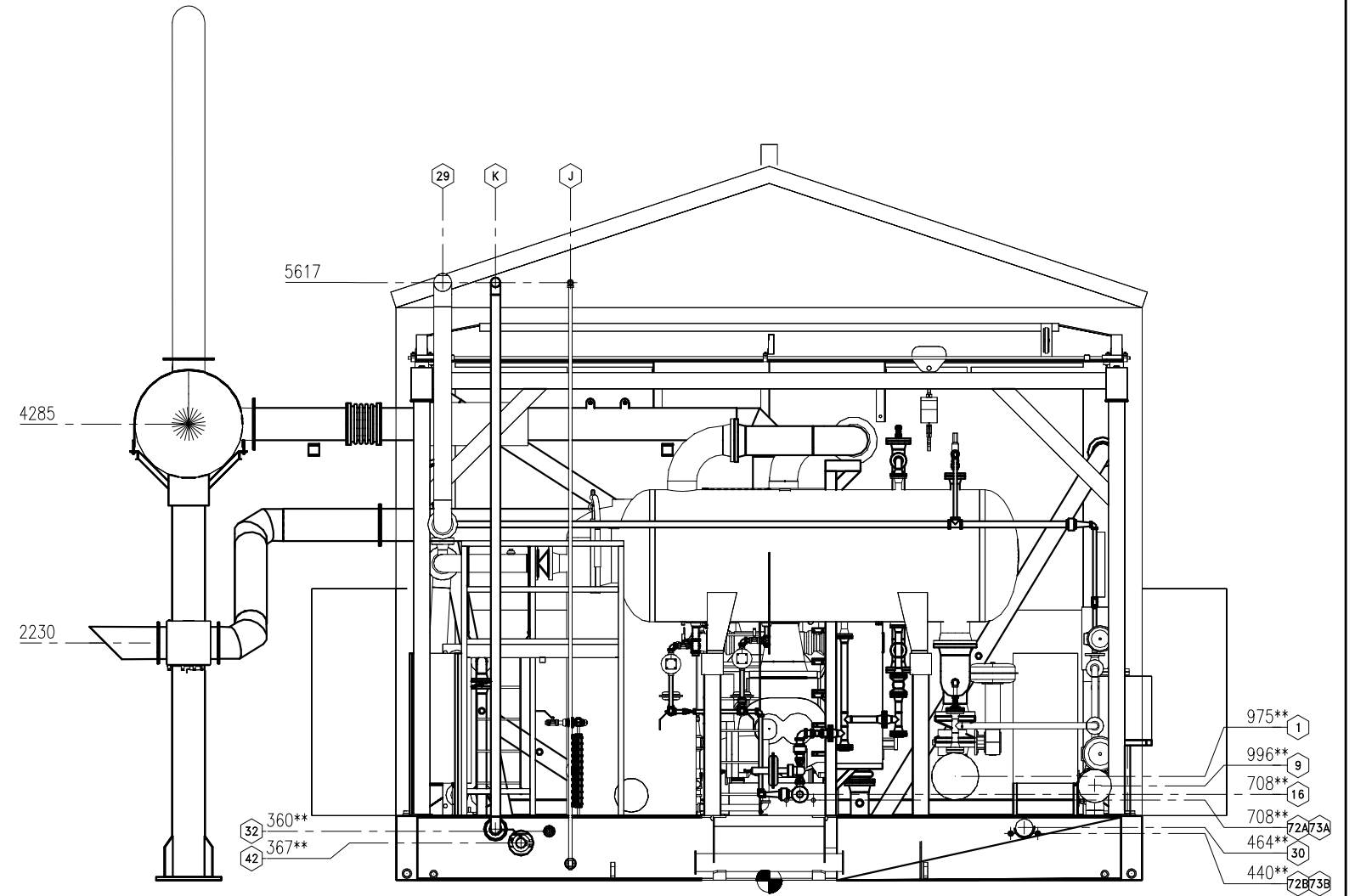
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TITLE: ELEVATION 'B-B' ARIEL RG357M, CATERPILLAR 3512 ADEM III AFRC, AIR-X 132EH 1005HP SCREW COMPRESSOR PACKAGE				
FOR: ENCANA OIL & GAS PARTNERSHIP (CHINOOK)				
CONSULTANT: DPH FOCUS CORPORATION P.O.: 9068-K002		LSD: INDD00-02 JOB No.: 060430		
DRWN BY: SN DATE: 06/03/02 SCALE: NTS	DESIGN BY: SN CHKD BY: APPVD BY:	DATE: 06/03/02 DATE: DATE:	DWG. No. GA-060430	OP# 10

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SECTION D-D



END VIEW C-C

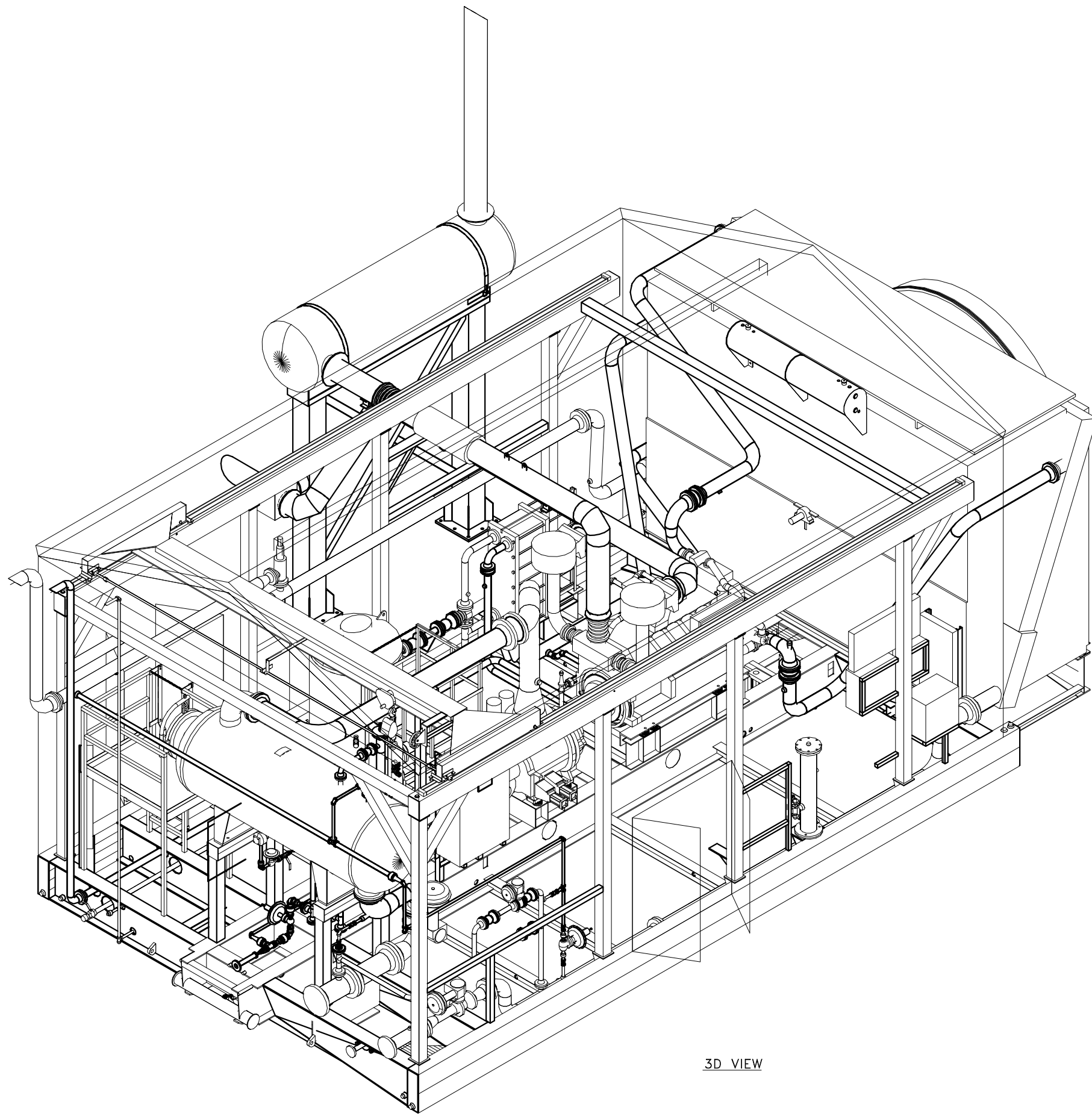
REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/06/28	MGN	JB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	07/01/19	SN	

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TITLE:			
END VIEW ARIEL RG357M, CATERPILLAR 3512 ADEM III AFRC, AIR-X 132EH 1005HP SCREW COMPRESSOR PACKAGE			
FOR:			
ENCANA OIL & GAS PARTNERSHIP (CHINOOK)			
CONSULTANT: DPH FOCUS CORPORATION		LSD: INDD00-02	
P.O.: 9066-K002		JOB No.: 060430	
DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/02	DWG. No.
DATE: 06/03/02	CHKD BY:	DATE:	OP#
SCALE: NTS	APPVD BY:	DATE:	GA-060430 10

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3D VIEW

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/06/28	MGN	JB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/05/10	SN	

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TITLE:		3D VIEW		
		ARIEL RG357M, CATERPILLAR 3512 ADEM III AFRC, AIR-X 132EH		
		1005HP SCREW COMPRESSOR PACKAGE		
FOR:		ENCANA OIL & GAS PARTNERSHIP (CHINOOK)		
CONSULTANT: DPH FOCUS CORPORATION		LSD: INDD00-02		
P.O.: 9068-K002		JOB No.: 060430		
DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/02	DWG. No.	OP#
DATE: 06/03/02	CHKD BY:	DATE:	GA-060430	10
SCALE: NTS	APPVD BY:	DATE:		

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**C-1
SCREW COMPRESSOR**

MAKE: ARIEL
MODEL: RG357M
MAX. RUNNING PRESSURE: 1586 kPag @ 149°C
MAX. CASING PRESSURE: 2068 kPag @ 149°C
S/N: R10332

**E-2
AERIAL COOLER**

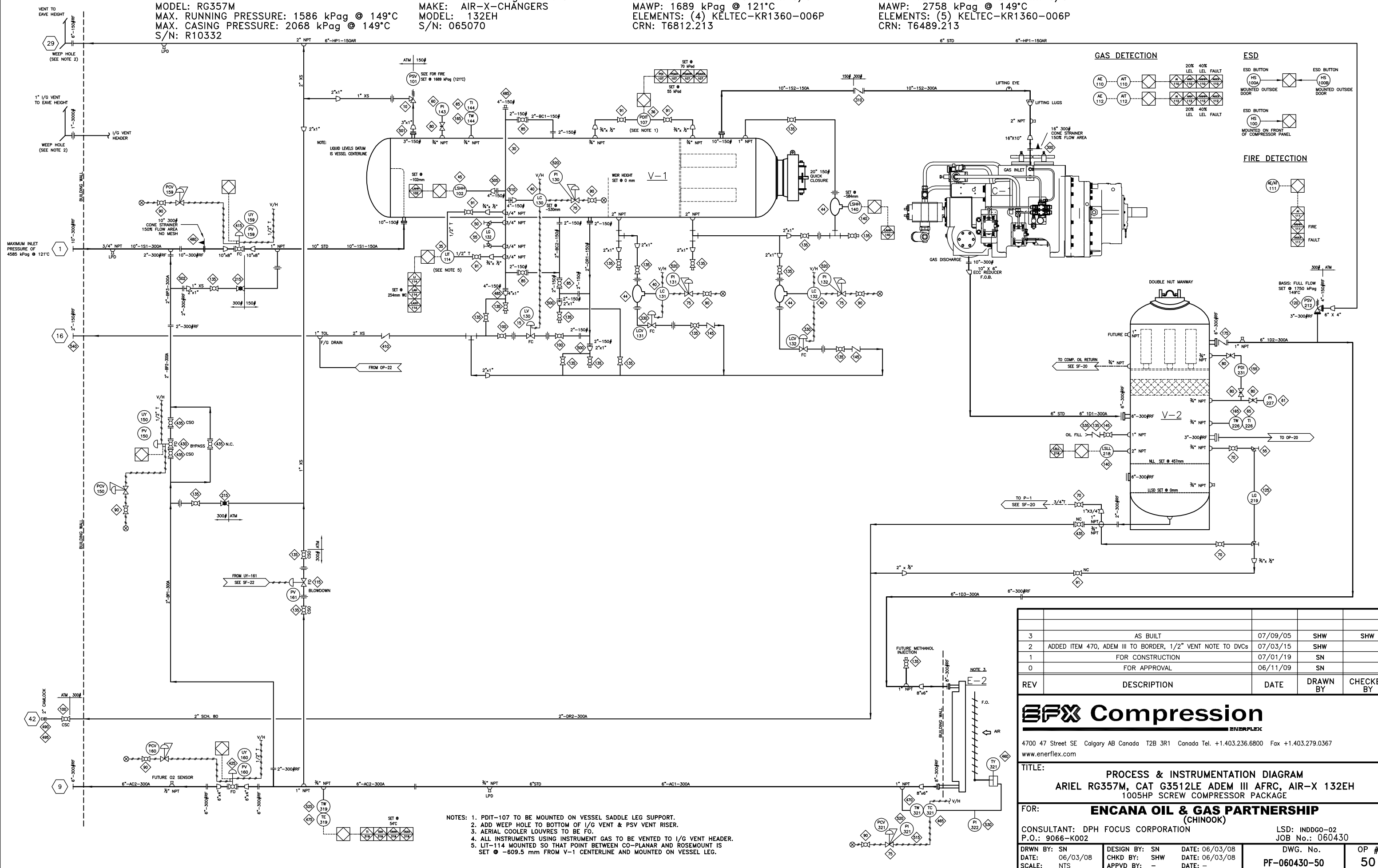
MAWP: 2413 kPag @ 177°C
MAKE: AIR-X-CHANGERS
MODEL: 132EH
S/N: 065070

**V-1
INLET SCRUBBER**

SIZE: 1219mm ID X 3048mm S/S
MAWP: 1689 kPag @ 121°C
ELEMENTS: (4) KELTEC-KR1360-006P
CRN: T6812.213

**V-2
OIL SEPARATOR**

SIZE: 1219mm OD X 2591mm S/S
MAWP: 2758 kPag @ 149°C
ELEMENTS: (5) KELTEC-KR1360-006P
CRN: T6489.213



- NOTES:
1. PDIT-107 TO BE MOUNTED ON VESSEL SADDLE LEG SUPPORT.
 2. ADD WEEP HOLE TO BOTTOM OF I/G VENT & PSV VENT RISER.
 3. AERIAL COOLER LOUVRES TO BE F.O.
 4. ALL INSTRUMENTS USING INSTRUMENT GAS TO BE VENTED TO I/G VENT HEADER.
 5. LIT-114 MOUNTED SO THAT POINT BETWEEN CO-PLANAR AND ROSEMOUNT IS SET @ -609.5 mm FROM V-1 CENTERLINE AND MOUNTED ON VESSEL LEG.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
3	AS BUILT	07/09/05	SHW	SHW
2	ADDED ITEM 470, ADEM III TO BORDER, 1/2" VENT NOTE TO DVCs	07/03/15	SHW	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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TITLE:
PROCESS & INSTRUMENTATION DIAGRAM
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR:
ENCANA OIL & GAS PARTNERSHIP
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002
LSD: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	PF-060430-50	50
SCALE: NTS	APPVD BY: -	DATE: -		

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GENERAL SPECIFICATIONS
PROCESS GAS
 SWEET SOUR _____% H₂S _____% CO₂

CUSTOMER SPECIFICATIONS
 YES NO (IF YES, PLEASE REFERENCE)

SITE CONDITIONS
ELEVATION 762 m
AMBIENT OPERATING CONDITIONS:
MAX 38°C
MIN -29°C

DRIVER
MANUFACTURER: CATERPILLAR MODEL: G3512ALE
SITE RATING: 860/1005 BHP @ 1200/1400 rpm

COMPRESSOR
COMPRESSOR MANUFACTURER: ARIEL MODEL: RG357M
RATING: 1586 kPag MAXIMUM RUNNING PRESSURE 2758 kPag MAXIMUM CASING PRESSURE
PRELUBE YES NO

COOLER
 SKID MOUNTED OFF SKID/ATTACHED TO SKID REMOTE MOUNTED/NOT ATTACHED

WATER TUBES SA-214 SA-179
GAS TUBES SA-214 SA-179

CORROSION ALLOWANCE (GAS SECTIONS) 1/16" 1/8"
STRESS RELIEVE GAS HEADERS YES NO
SPOT RADIOGRAPH GAS HEADER BOX YES NO
100% RADIOGRAPH GAS HEADER BOX YES NO
SPOT RADIOGRAPH NOZZLE BUTT WELDS YES NO
100% RADIOGRAPH NOZZLE BUTT WELDS YES NO
100% U.T. TEST GAS HEADERS/NOZZLES YES NO 100%
DYE-PENETRATE TEST GAS HEADERS/NOZZLES YES NO
SOUR SERVICE MATERIALS YES NO
COLD SERVICE MATERIALS (-40°F) YES NO
PAINT ESL STANDARD OTHER, ENCANA TAUPE
GALVANIZED FINISH YES NO
BUG SCREEN & HAIL GUARD YES NO
AUTO WARM AIR RECIRCULATION YES NO
LOW NOISE FAN: dBA @ 1m 87
TIP SPEED 46.5 m/s 9158 ft/min.

LOUVRES:
WATER SECTIONS: MANUAL YES NO
AUTO YES NO
GAS SECTIONS: MANUAL YES NO
AUTO YES NO

OPN 20: COMPRESSOR OIL

PRESSURE RATINGS 4585 kPag @ 121 °C
HOT OIL FLUSH YES NO

OPN 26: ENGINE AIR, EXHAUST, IGNITION, OIL & MISC.

EXHAUST
SILENCER GRADE REG. CRITICAL SUPER CRITICAL HOSPITAL SUPER HOSPITAL PLUS
EMISSION CONTROL EQUIPMENT YES NO
WARM AIR MAKEUP YES NO
TIP HEIGHT: (1.5 X EAVE HEIGHT) m
EXHAUST INSULATION YES NO

IGNITION
 ALTRONIC III IQ 500 CEC TYPE: CATERPILLAR

OPN 28: DRIVE TRAIN

COOLER DRIVE: JACKSHAFT DIRECT ELECTRIC
GEARBOX INTEGRAL NO

TORSIONAL STUDY

- N/A PREVIOUSLY DONE FLYWHEEL: EXTRA (IF REQ'D)
INCLUDED YES NO INCLUDE
REPORT REQ'D YES NO SPECIAL COUPLING

OPN 30: SKID P.ENG STAMP REQ'D

TYPE
 FULL WIDTH WASTE OIL Drip PAN-EQUIPMENT
 MULTI-PIECE GLYCOL YES NO
 OTHER DRIP PAN OTHER YES NO

CONCRETE FILLED
 YES NO - UNDER ENGINE AND COMPRESSOR ONLY
 BY/AT EFX BY CUSTOMER (REQUIRES CUT-OUTS & REBAR)

OTHER
LIFTING LUGS YES NO
LIFTING ROLLS YES NO
ALUM. CHKR PLATE YES NO
AROUND ENGINE AND COMP. ONLY

OPN 40: PROCESS VESSELS (INLET/OIL SCRUBBER)

RADIOGRAPHY
INLET SCRUBBER ASME(1) FULL RT-1 ASME(2) RT-2
OIL SEPARATOR
OTHER_OIL
U.T. CATEGORY "D" WELDS

REPADS (ON PROCESS PIPE NOZZLES)
INLET SCRUBBER YES, SPECIFY _____ AS REQ'D BY CODE
OIL SEPARATOR YES, SPECIFY _____ AS REQ'D BY CODE

OPN 40: PROCESS VESSELS (INLET/OIL SCRUBBER), CONT'D

FITTINGS
3000# ANSI (1-1/2" AND UP) YES NO
6000# ANSI (1" AND SMALLER) YES NO
THREADOLET YES NO
COUPLING YES NO
FLANGED YES NO
FLANGE FACE FINISH REQUIRED ANSI STD SPECIAL, SPECIFY _____

MIST EXTRACTION
MESH PAD YES NO
MESH PAD DENSITY 9#/ft OTHER, SPECIFY _____
FILTER-COALESCERS YES NO
MESH PAD/VANE REMOVABLE YES NO

MISCELLANEOUS
MINIMUM DESIGN TEMPERATURE PROCESS: -29°C (-20°F)
STRESS RELIEVING YES AS REQ'D BY CODE
CHARPY TESTING YES AS REQ'D BY CODE
PICKLING YES NO
CLEANED & OILED INTERNALLY YES NO
SANDBLAST INTERNALLY EXTERNALLY
CORROSION ALLOWANCE 1/16" 1/8"
HYDROTEST CHART REQ'D YES NO DURATION _____ min
FLUX CORE WELDS YES NO
PROVINCE OF REGISTRATION ALTA, BC, SASK _____
LSD: TBA
FOREIGN COUNTRY REGISTRATION N/A
FUEL GAS FILTER ON SKID OFF SKID SIZE 8" MAKE _____ EFX OTHERS _____

OPN 50: PROCESS FLOW

COMPRESSOR PACKAGE PROTECTION
SUCTION THERMAL FULL FLOW
DISCHARGE THERMAL FULL FLOW

PRESSURE RATINGS
CLASS 150# 1689 kPag @ 121 °C PSV SETTING 1689 kPag @ 121 °C
CLASS 300# 4585 kPag @ 121 °C PSV SETTING 1750 kPag @ 121 °C
UTILITY 758 kPag TEST w/ AIR @ 834 kPag (1.1 x OPERATING PRESSURE)

NOTES: - THIS SECTION INDICATES MINIMUM DESIGN PRESSURE & TEMPERATURE RATINGS. INDIVIDUAL COMPONENTS MAY HAVE HIGHER MAWP'S OR TEMPERATURES. EFX RESERVES THE RIGHT TO USE GENERIC VESSEL DESIGNS.
- PSVs TO BE WITNESSED BY 3rd PARTY INSPECTOR
- PSV CERTIFICATES REQUIRED

OPN 52: PIPING SPOOLS

MATERIAL SPECIFICATIONS
PIPE STANDARD PROCESS/SERVICE COLD TEMP. (-50°F) STAINLESS STEEL
FITTINGS SA-106-B SA-333-GR.6 SA-312-TP316L
FLANGES SA-234-WPB SA-420-WPL6 SA-403-WP316L
FLANGE FACE FINISH REQUIRED SA-105 (N) SA-350-LF2 SA-182-F316L
LOW TEMPERATURE MATERIAL (OUTSIDE ONLY) ANSI STD SPECIAL, SPECIFY _____
PROCESS PIPING FITTINGS 3000# ANSI 6000# ANSI
THREADED, 1/2" & 3/4" SCH. 160 SCH. XXS
THREADED, 1" & OVER SCH. 80 SCH. 160
SOCKET WELD, 3/4" & OVER SCH. 80
BUTTWELD, 2" SCH. 80
BUTTWELD, OVER 2" SCH. STD.
NOTES: 1. FITTINGS NOT PERMITTED - BUSHINGS, STREET ELLS, STREET TEES, ALL-THREAD NIPPLES.
2. NIPPLES ON FIRST PROCESS CONNECTION TO BE SCH. 160, EXCEPT 1/2" & 3/4" (XXS).

PIPING RADIOGRAPHY (PERCENTAGE OF BUTT WELDS FULLY RADIOGRAPHED)
PROCESS 100% 10% 5% NONE OTHER _____

BOLTING
NUTS SA-194-2H or SA-194-2HM
STUDS SA-193-B7 or SA-193-B7M

GASKETS
304 S.S. SPIRAL WOUND GASKETS
316 S.S. SPIRAL WOUND GASKETS

MISCELLANEOUS (PROCESS)
PICKLING YES NO
CLEANED YES NO
SANDBLAST EXTERNALLY YES NO
CORROSION ALLOWANCE 1/16" 1/8"
STRESS RELIEVING YES NO
FLUX CORE WELDS YES NO

SERVICE PIPING FITTINGS
FITTINGS: 2000# ANSI
3000# ANSI
SCREWED
SOCKET WELD
BUTTWELD, 3" & OVER
LOW TEMPERATURE MATERIAL (OUTSIDE ONLY)
NOTE: 1. CONSIDERED PROCESS PIPING UPSTREAM OF FIRST REGULATOR/VALVE.

OPN 60: CONTROL PANEL & UNIT INSTRUMENTATION

SPECIFICATIONS
TUBING SIZE _____
PROCESS 3/8" (19 mm)
CONTROL 3/8" (19 mm)
WATER/OIL/FUEL GAS/START GAS
ELECTRO-GALVANIZED
304SS
316SS

OPN 60: CONTROL PANEL & UNIT INSTRUMENTATION (CONT'D)

SPECIFICATIONS (CONT'D)

FITTINGS
CAD PLATED
316SS

PROCESS
PARKER

CONTROL
SWAGelok

FITTING TYPE
 WATER/OIL/FUEL GAS/START GAS

NOTE: WHEN USING CAD PLATED STEEL FITTINGS ON S/S TUBING, USE S/S FERRULES. SUPPORT REQUIRED WITHIN 18" OF END DEVICE.

INSTRUMENT SUPPLY MEDIUM AIR FUEL GAS
INSTRUMENT VENTED TO OUTSIDE YES NO
CUSTOMER INSTRUMENT MFG. DETAILS APPLY YES NO
INSTRUMENT GAUGE SCALES DUAL METRIC ONLY

CONTROL PANEL

TYPE
 EFX 10.0 EFX 12.5 OTHER ALLEN BRADLEY SLC 5/05
CONTROL SUPPLY AIR GAS(1) AIR OR GAS
POWER SUPPLY 24 VDC 120 VAC N/A OTHER _____
POWER SUPPLY BY CUSTOMER ESL ON SKID SOURCE
REMOTE SHUTDOWN YES NO IF YES, VOLTAGE REQ'D _____
REMOTE STATUS YES NO

NOTE: 1. REQUIRES CLEAN DRY SWEET INSTRUMENT GAS SUPPLY.

OPN 70: BUILDING, ELECTRICAL & PAINT P.ENG STAMP REQ'D

BUILDING
 SHOP INSTALLED FIELD INSTALLED NOT REQUIRED
ACOUSTICAL BUILDING YES NO
AIR CHANGES PER HOUR REQUIRED YES NO
GAS DETECTION REQUIRED YES NO
THERMAL/FIRE DETECTION REQUIRED YES NO

PAINT & FINISH
BUILDING BLACK
EXTERIOR TAN DRIVER ENCANA TAUPE PIPING ENCANA TAUPE
INTERIOR WHITE COOLER ENCANA TAUPE VESSELS ENCANA TAUPE
TRIM BROWN SKID ENCANA TAUPE
GALVANIZING REQUIREMENTS YES NO CONTROL PANEL ENCANA TAUPE

OPN 72: BUILDING HEATERS

SUPPLY VOLTAGE _____
- UNDER 1 HP
- 1 HP & OVER _____
- MAIN DRIVE MOTOR _____
- ENGINE IGNITION SYSTEM 24V DC
- BUILDING LIGHTING BY OTHERS
- IMMERSION HEATER _____

AREA CLASSIFICATION CSA SAA CENELEC OTHER
- INSIDE BUILDING CLASS 1, ZONE 2, GRP. IIA TEMP., CODE T2C
- OUTSIDE BUILDING (3 m BUBBLE) CLASS 1, ZONE 2, GRP. IIA TEMP., CODE T2C

MOTORS - CLASSIFICATION CSA NEMA IEC SAA OTHER
- DRIVE _____ LUBRICATOR _____
- PRELUDE _____ EXHAUST FAN _____
- COOLER _____

- AMBIENT DESIGN TEMPERATURE _____

OPN 74: CRANE

YES NO
 1/2 TON JIB 2 TON 3 TON 5 TON INTEGRAL OIL TANKS IN CRANE RAIL
 PLAIN HOIST GEARED BRIDGE AIR HOIST
 PLAIN TROLLEY GEARED TROLLEY ELECTRIC HOIST

OPN 80: FINANCIAL, SHIPPING & FREIGHT

LOADING: EXTRA FREIGHT ALLOWANCE TO SITE: CUSTER SCOPE OF SUPPLY
 FIRM PRICE EXTRA
 EXTRA STORAGE REQUIRED ESTIMATED
 INCLUDED ONLY IF DONE AT TIME OF SHOP REMOVAL ACTUAL
 OTHER, _____

LONG TERM STORAGE REQUIREMENTS YES NO TIME IN MONTHS: 6 - 12
EFX PRESERVATION PROCEDURE STANDARD DOMESTIC OVERSEAS OTHER

EXPORT CRATING - SUPPLIED BY EFX YES NO
BY FREIGHT FORWARDER YES NO
EFX SUPPLIED RIGGING YES NO
EFX SUPPLIED SPREADER BAR YES NO

SHIPMENT PARAMETERS: PROVINCE - ALBERTA
LSD - _____

OPN 82: RUN TEST & INSPECTION

RUN TEST
ENGINE DRIVE YES NO ELECTRIC DRIVE YES NO
 EFX STANDARD NO LOAD EFX STANDARD FULL LOAD
CUSTOMER PROCEDURE APPLIES YES NO
WITNESSED YES NO
HOLD POINT YES NO
SOUND READINGS REQ'D YES NO READINGS @ _____ m FROM SOURCE
VIBRATION READINGS REQ'D YES NO READINGS @ _____ m FROM SOURCE
CALIBRATION OF INSTRUMENTS REQ'D YES NO
CONTINUITY TEST ALL INSTRUMENTS YES NO
ELECTRIC PRELUDE PUMP TO BE ENERGIZED. YES NO
COOLER MOTOR TO BE ENERGIZED. YES NO
CONTROL PANEL YES NO

INSPECTION -SEE EFX PROJECT INSPECTION & TEST PLAN
PROVIDE COPY TO CUSTOMER YES NO

BILL OF MATERIAL

ITEM	QTY	PART #	DESCRIPTION
10	1	122771	VALVE, PSV, 1" MNPT X 1" FNPT, "D" OR, NACE I [FARRIS, 27DA33-M20]
15	1	100645	VALVE, CONTROL, 2" NPT, LCC, 1-1/4" OR, FC, 0-33 PSI [FISHER, D4-X2A1N]
30	1	127200	VESSEL, BRIDLE, 4" NOM, CS, 150# FLANGED, SWEET, 245 PSIG @ 250 DEG.F
35	1	127333	TRANSMITTER,PRESSURE,-250/250,H2O, 2.5/H2O .CSA [ROSEMOUNT, 3051CD2A82A1BMSB4C6]
36	1	127334	TRANSMITTER, PRESSURE, DIFF, -1000/1000H2O CSA [ROSEMOUNT, 3051CD3A52A1AMS5B4C6]
40	3	101213	SWITCH, LEVEL, 2" NPT, 303SS BODY, PNEUM. C/W FLOAT [SOR, 1530B-G2A-C-JO-PS-CV]
44	3	127518	CAGE, EXTERNAL, 5" NOM STD, C/W 2" NPT FOR LEVEL CONTROLLER/SWITCH, SWEET
45	1	127318	SWITCH, LEVEL, 1-1/2" NPT, 316SS BODY, ELECTRIC, XP [KIMRAY, 1200-SLS-SS6]
50	1	117680	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 1750# [PENBERTHY, 2RL8]
55	2	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
60	1	107924	GAUGE, PRESSURE, BM, 4" LF, 0-60 PSI DUAL, 1/2" NPT [WIKA, 233.54]
61	1	107910	GAUGE, PRESSURE, BM, 4" LF, 0-300 PSI DUAL, 1/2" NPT [WIKA, 233.54]
65	2	128085	GAUGE, TEMP, 5" DIAL LF, 6" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, SF50060]
70	3	113075	VALVE, BALL, 3/4" NPT, 3000# WOG, FP, CS, NACE C/W LOCKING [NUTRON, T3-F07S30S]
75	4	104872	REGULATOR, 1/4" NPT, ALUM., 0-125#, TAPPED (W/O PI) [FISHER, 67CFR-601/SC]
80	4	124564	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, CS, VITON [CENTURY, CM23-MG47-BV]
85	3	102900	VALVE, BALL, 2" 150# RF, FP, CS C/W HANDLE [NUTRON, T3-F20R01B]
90	7	120928	VALVE, BALL, 3/8" NPT, 2000# WOG, FP, 316SS, NACE, 2 PIECE [NAVCO, C1-R03S20A]
91	5	124360	VALVE, BALL, 1/2" NPT, 3000# WOG, FP, CS C/W LOCKING HANDL [NUTRON, T3-F05S30BL]
100	3	114701	VALVE, BALL, 2" NPT, 3000# WOG, FP, CS, NACE C/W LOCKING [NUTRON, T3-F20S30S]
115	1	118070	VALVE, CONTROL, 1" NPT, LCC, FLOW ADJ, FO, NACE, 0-35# [FISHER/FLOPRO, D2-X2]
120	1	114047	VALVE, PSV, 3" 300#RF X 4" 150#RF, 1.838 OR, NACE I, [FARRIS, 26KA12-120/00]
125	1	104430	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 1820# [PENBERTHY, 2RL7]
135	21	112801	VALVE, BALL, 1" NPT, 3000# WOG, RP, CS C/W LOCKING HANDLE [NUTRON, T3-R10S30B]
140	2	127319	SWITCH, LEVEL, 2" NPT, 316SS BODY, ELECTRIC, XP [KIMRAY, 2200-SLS-SS6]
145	3	103085	VALVE, CHECK, SWING, 1" NPT, 800# WOG, CS [NEWCO, 3BT-FS2]
155	1	127611	GAUGE, PRESSURE, DIFF., 2-1/2" DIAL, 0-15 PSID, LF [MIDWEST, 12AA0000015]
165	2	114391	THERMOWELL, 316SS, 1/2" X 3/4" NPTM X 6" LONG, U=4.5", .260" BORE, TAPERED
175	1	114683	VALVE, CHECK, WAFER, 6" 300#RF DUAL WCB, NACE, 316SS DISC [TOPFLOW, A-300-49VXR]
215	2	102876	VALVE, GLOBE, 1" NPT, 800# WOG, CS [NEWCO, 28T-FS2]
300	1	127328	STRAINER, CONE, 16" 300# CS, 40 MESH 316SS, 150% FLOW AREA, 1/8" PERFORATION
310	1	127332	VALVE, CHECK, WAFER, 10" 300#RF DUAL WCB,NACE,SS DISC [SURE-FLOW, 10F300SMRKR]
330	2	104854	VALVE, CONTROL, 1" NPT, LCC, FLOW ADJ, FC, NACE, 0-35# [FISHER/FLOPRO, D2-X1]
410	1	120133	VALVE, CHECK, SWING, 2" NPT, 800# WOG, CS [NEWCO, 3BTFS2]
415	1	127321	VALVE, CONTROL, 8" 300# RF, WCC, FC, NACE, LOW BLEED [FISHER, 1051-V200-DVC602HC]
425	1	127322	VALVE, CONTROL, 4" 300# RF, WCC, FO, NACE, LOW BLEED [FISHER, 1051-V200-DVC602HC]
430	1	127323	VALVE, CONTROL, 2" 300# RF, WCC, FC, NACE, LOW BLEED [FISHER, 1052-V200-DVC602HC]
435	4	102955	VALVE, BALL, 2" 300# RF, RP, CS C/W HANDLE [NUTRON, T3-R20R03B]
460	1	100315	>>ACTUATOR, 6-30 PSIG, SUPPLIED WITH COOLER [GARZO, 501-12]
465	1	127624	CONTROLLER, TEMP, T12DA, 1" NPTM X 12" LG PROBE [KIMRAY, HAP/HCE]
470	1	104069	THERMOWELL, 316SS, 1" NPT X 12" LONG, SS-12-SS FOR HT12/T12DA [KIMRAY, HCE]
475	1	127949	SENSOR, RTD, 100 OHM, 316SS, FLEX ARMOUR 8" [WIKA, OXXAT01XS314J96307.50UTPAG]
480	1	117962	STRAINER, CONE, 10" 300# CS, NO MESH, 150% FLOW AREA
485	2	119218	FLANGE, RF RED HUB, 4" 150# X 1" NPT SA105N
490	1	120227	ADAPTER, QUICK COUPLING, 2" ALUMINIUM FEMALE [RITE, 200D]
495	1	120228	DUST CAP, QUICK COUPLING, 2" [RITE, 200DP]
500	2	106383	FLANGE, RF RED HUB, 2" 150# X 1" NPT SA105N
501	1	106417	FLANGE, RF RED HUB, 3" 150# X 1" NPT SA105N
502	1	106399	FLANGE, RF RED HUB, 2" 300# X 1" NPT SA105N
505	1	114711	FLANGE, RF RED HUB, 4" 150# X 1-1/2" NPT SA105N
510	1	106438	FLANGE, RF RED HUB, 4" 150# X 2" NPT SA105N
515	1	122624	BRACKET, MOUNTING, FISHER 67AFR, LONG
520	4	107925	GAUGE, PRESSURE, CBM, 2" DRY, 0-60 PSI DUAL, 1/4" NPT [WIKA, 111.10]
525	1	114391	THERMOWELL, 316SS, 1/2" X 3/4" NPTM X 6" LONG, U=4.5", .260" BORE, TAPERED
530	1	107878	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-100 PSI DUAL, 1/4" NPT [WIKA, 233.53]
535	1	127422	COUPLER, QUICK DISCONNECT, 1" NPT FEMALE [AEROQUIP, 5601-16-16S]
540	1	106487	FLANGE, RF SCRD, 2" 150# SA105N

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
3	AS BUILT	07/09/05	SHW	SHW
2	ADDED ITEM 470, ADEM III TO BORDER, 1/2" VENT NOTE TO DVCs	07/03/15	SHW	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

EFX Compression
4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367
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TITLE: PROCESS & INSTRUMENTATION DIAGRAM
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: **ENCANA OIL & GAS PARTNERSHIP**
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION LSD: INDDGO-02
P.O.: 9066-K002 JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	PF-060430-50	50
SCALE: NTS	APPVD BY: -	DATE: -		

C-1
SCREW COMPRESSOR

MODEL: RG357M
MAKE: ARIEL
MAX. RUNNING PRESSURE: 1586 kPag @ 149°C
MAX. CASING PRESSURE: 2758 kPag @ 149°C
GEAR RATIO: 1.00
S/N: R10332

E-1
LUBE OIL COOLER

MODEL: VXN-46-SS-FS-1-150MAX
MAKE: VIEX
DESIGN PRESS./TEMP.: 2758 kPag @ 121°C

P-1
PRELUBE PUMP

SIZE: 1/2" NPT
MAKE: VIKING
MODEL: SG40570-GOV

P-2
INTEGRAL OIL PUMP

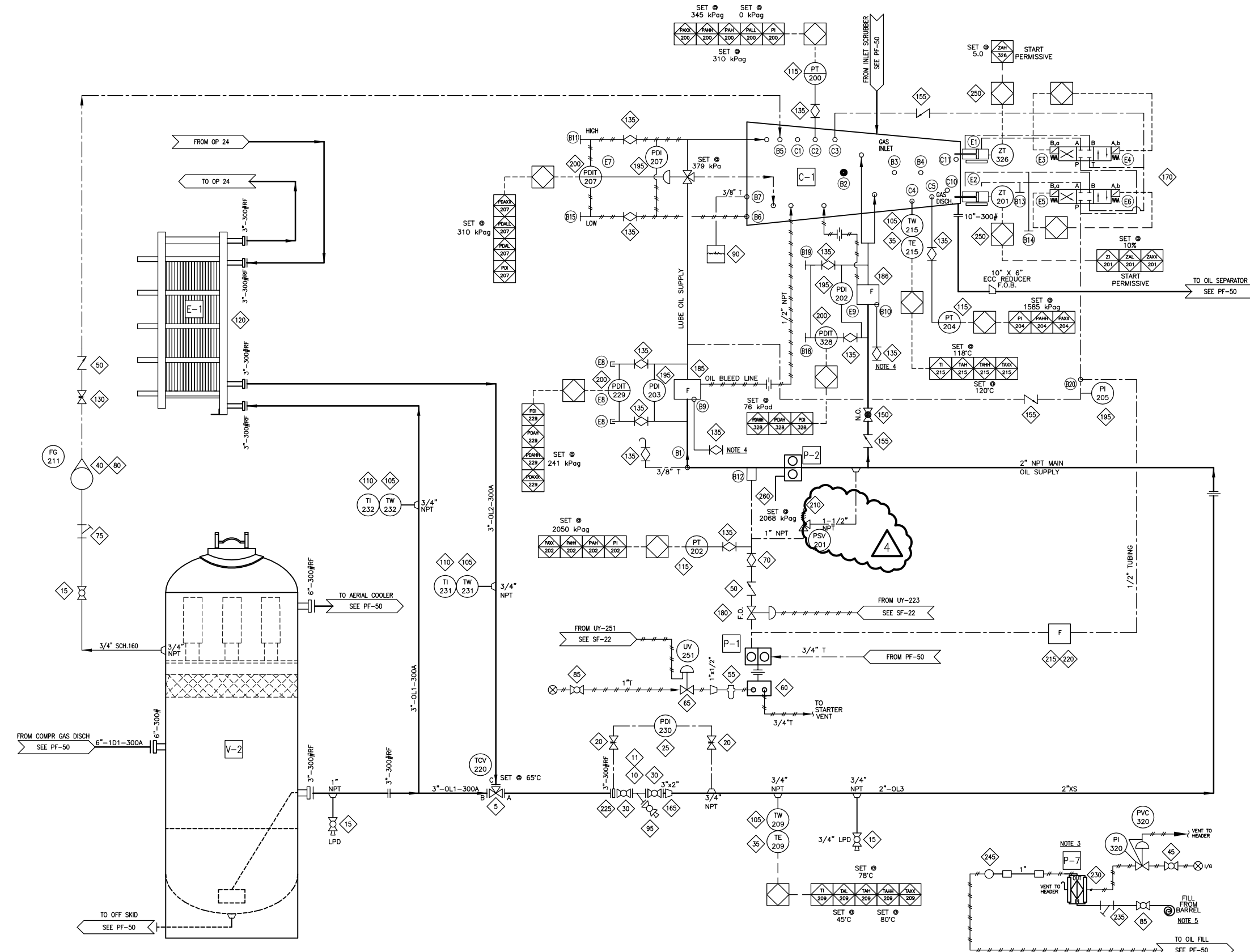
DRIVEN BY FEMALE ROTOR
MODEL: P76Tx2.75x2.50

V-2
OIL SEPARATOR

SIZE: 1219mm OD x 2591mm S/S
MAWP: 2758 kPag @ 149°C
ELEMENTS: (5) KELTEC-KR1360-006P
CRN: T6489.213

P-7
COMPRESSOR LUBE OIL FILL PUMP

MAKE: WARREN RUPP
MODEL: G1FB1ATTXNSX00
MAWP: 689 kPag
CAPACITY: 112 L @ 138 kPag, 1.5 m HEAD



ITEM	CONNECTION	SIZE
B1	MAIN OIL (IN)	2" NPTF
B2	DISCHARGE HOUSING DRAIN	1-1/2" NPTF
B3	CAPACITY VALVE CAVITY DRAIN	3/4" NPTF
B4	ROTOR HOUSING DRAIN & STRAINER PLUG	2" NPTF
B5	SEPARATOR SCAVENGE OIL RETURN	1" NPTF
B6	GEARBOX OIL DRAIN	2" NPTF
B7	MECHANICAL SEAL DRAIN	1/2" NPTF
B9	LUBE OIL FILTER DRAIN	1/2" TUBE
B10	ROTOR INJECTION FILTER DRAIN	1/2" TUBE
B11	LUBE OIL PRESSURE	1/4" TUBE
B12	PRE-LUBE CONNECTION	1-1/4" NPTF
B13	CONNECTION FOR MANUAL OR PUMP UNLOADING	1/4" MJIC
B14	DRAIN (CAPACITY UNLOAD)	1/2" TUBE
B15	LUBE OIL PRESSURE DRAIN, (LOW) PRESSURE CONNECTION	1/4" TUBE
B16	OIL FILTER, LUBE (HIGH) PRESSURE CONNECTION	1/4" TUBE
B17	OIL FILTER, LUBE (LOW) PRESSURE CONNECTION	1/4" TUBE
B18	OIL FILTER, ROTOR (HIGH) PRESSURE CONNECTION	1/4" TUBE
B19	OIL FILTER, ROTOR (LOW) PRESSURE CONNECTION	1/4" TUBE
B20	CONNECTION FOR VALVE/CYLINDER ACTUATION	1/2" TUBE
C1	SUCTION FLANGE TAP - TEMPERATURE	3/4" NPTF
C2	SUCTION FLANGE TAP - PRESSURE	3/4" NPTF
C3	SUCTION FLANGE TAP - SPARE	3/4" NPTF
C4	DISCHARGE FLANGE TAP - TEMPERATURE	3/4" NPTF
C5	DISCHARGE FLANGE TAP - PRESSURE	3/4" NPTF
C10	VI STEM SEAL VENT	1/4" NPTF
C11	CAPACITY STEM SEAL VENT	1/4" NPTF
E1	Vi CONTROL POSITION INDICATOR	ELEC. CONN.
E2	CAPACITY CONTROL POSITION INDICATOR	ELEC. CONN.
E3	Vi POSITION SIGNAL INPUT (DECREASE Vi)	1/2" NPTF
E4	Vi POSITION SIGNAL INPUT (INCREASE Vi)	1/2" NPTF
E5	CAPACITY SIGNAL INPUT (INCREASE LOAD)	1/2" NPTF
E6	CAPACITY SIGNAL INPUT (UNLOAD)	1/2" NPTF
E7	OIL SUPPLY PRESSURE DIFFERENTIAL SWITCH	1/2" NPTF
E8	LUBE OIL FILTER PRESSURE DIFFERENTIAL TRANSMITTER	1/2" NPTF
E9	ROTOR INJECTION FILTER PRESSURE DIF. SWITCH	1/2" NPTF

- GENERAL NOTES:**
- USE LOCTITE 7649 (N) PRIMER & 545 SEALANT FOR ALL THREADED OIL CONNECTIONS.
 - ALL INSTRUMENTS USING GAS TO BE VENTED TO 1/2" VENT HEADER.
 - PUMP MOUNTED UNDER PLATFORM FOR V-1 AND PIPED NEAR V-2 WITH HOSE FOR OIL FILL CONNECTION ON V-2.
 - ROTOR AND BEARING FILTER DRAINS TO BE TUBED TOGETHER AND PIPED TO MECHANICAL SEAL DRAIN POT LOCATION.
 - USE 1" CONDUIT FOR STINGER, NO PAINT

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
4	PSV CHANGED FROM 1" TO 1-1/2" OUTLET	07/10/22	SHW	ATE
3	AS BUILT	07/09/05	SHW	SHW
2	REVISED BOM ADDED ADEM III TO BORDER	07/03/12	SHW	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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TITLE: SERVICE FLOW DIAGRAM
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: ENCAN OIL & GAS PARTNERSHIP (CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002

LSD: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-20	20
SCALE: NTS	APPVD BY: -	DATE: -		

NOTES:

1. THE DISTANCE FROM THE ROTOR HOUSING MOUNTING PADS TO THE SHAFT CENTERLINE WILL GROW 0.25 mm (0.010") WITH A 38°C (100°F) TEMPERATURE INCREASE OF THE ROTOR HOUSING.
2. THE COMPRESSOR MUST BE SUPPORTED BY ALL FOUR (4) FEET.
3. THE AREA BELOW THE COMPRESSOR BETWEEN THE FEET AND AN AREA EXTENDING 457mm (18") BEYOND THE FEET TO THE Vi AND CAPACITY CONTROL SIDE OF THE COMPRESSOR IS REQUIRED TO REMOVE THE CAPACITY VALVE.

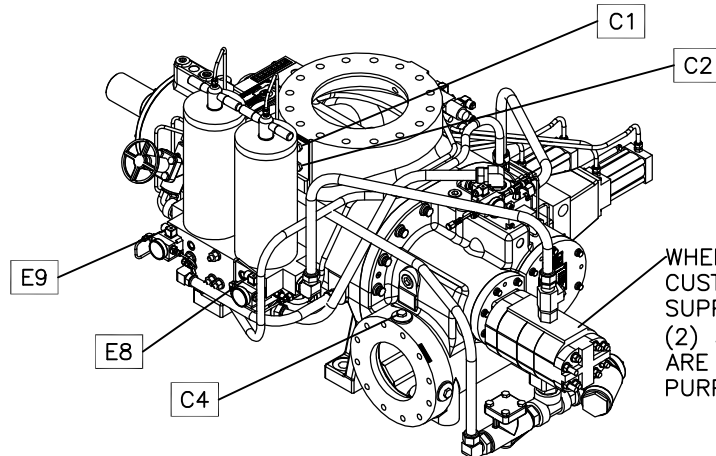
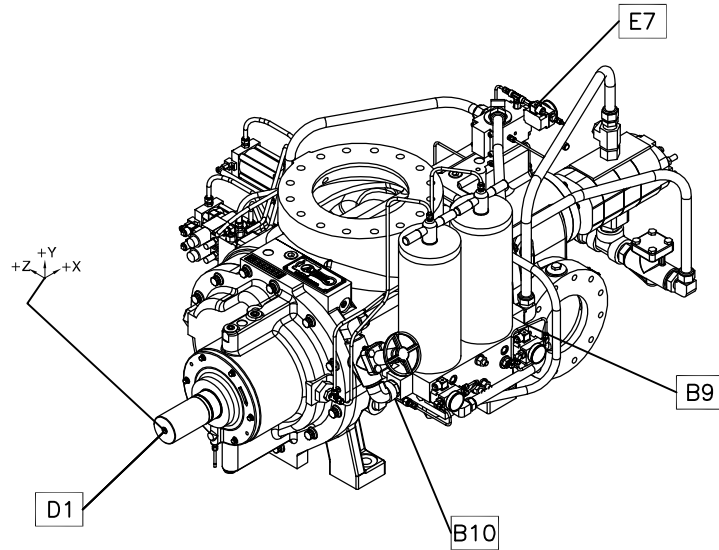
ITEM	CONNECTION	SIZE
B1	MAIN OIL (IN)	2" NPTF
B2	DISCHARGE HOUSING DRAIN	1-1/2" NPTF
B3	CAPACITY VALVE CAVITY DRAIN	3/4" NPTF
B4	ROTOR HOUSING DRAIN & STRAINER PLUG	2" NPTF
B5	SEPARATOR SCAVENGE OIL RETURN	1" NPTF
B6	GEARBOX OIL DRAIN	2" NPTF
B7	MECHANICAL SEAL DRAIN	1/2" NPTF
B9	LUBE OIL FILTER DRAIN	1/2" TUBE
B10	ROTOR INJECTION FILTER DRAIN	1/2" TUBE
B11	LUBE OIL PRESSURE	1/4" TUBE
B12	PRE-LUBE CONNECTION	1-1/4" NPTF
B13	CONNECTION FOR MANUAL OR PUMP UNLOADING	1/4" MJIC

ITEM	CONNECTION	SIZE
C1	SUCTION FLANGE TAP - TEMPERATURE	3/4" NPTF
C2	SUCTION FLANGE TAP - PRESSURE	3/4" NPTF
C3	SUCTION FLANGE TAP - SPARE	3/4" NPTF
C4	DISCHARGE FLANGE TAP - TEMPERATURE	3/4" NPTF
C5	DISCHARGE FLANGE TAP - PRESSURE	3/4" NPTF
C10	Vi STEM SEAL VENT	1/4" NPTF
C11	CAPACITY STEM SEAL VENT	1/4" NPTF

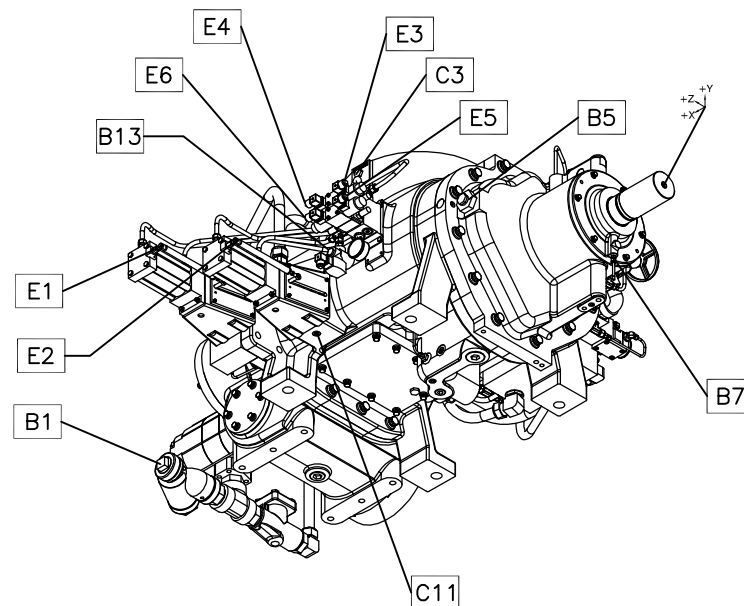
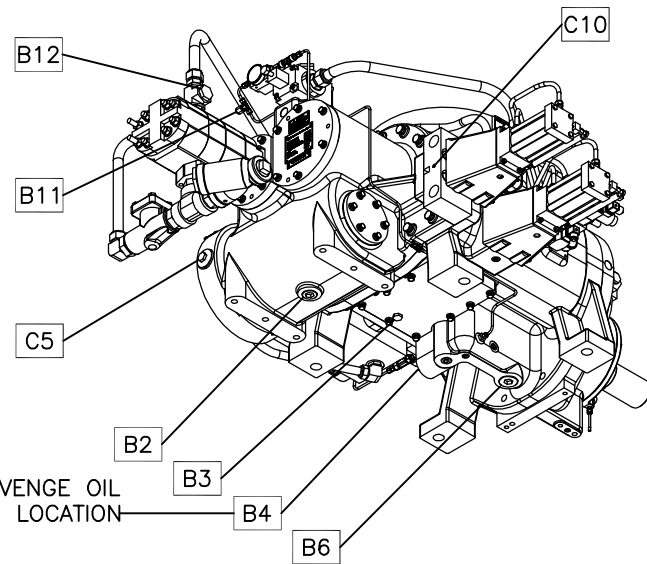
ITEM	CONNECTION	SIZE
E1	Vi CONTROL POSITION INDICATOR	ELEC. CONN.
E2	CAPACITY CONTROL POSITION INDICATOR	ELEC. CONN.
E3	Vi POSITION SIGNAL INPUT (DECREASE Vi)	1/2" NPTF
E4	Vi POSITION SIGNAL INPUT (INCREASE Vi)	1/2" NPTF
E5	CAPACITY SIGNAL INPUT (INCREASE LOAD)	1/2" NPTF
E6	CAPACITY SIGNAL INPUT (UNLOAD)	1/2" NPTF
E7	OIL SUPPLY PRESSURE DIFFERENTIAL SWITCH	1/2" NPTF
E8	LUBE OIL FILTER PRESSURE DIFFERENTIAL	1/2" NPTF
E9	ROTOR INJECTION FILTER PRESSURE DIF. SWITCH	1/2" NPTF

BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
5	1	103933	VALVE, THERMOSTATIC, 3-WAY, 3" 300#RF @ 150 DEG.F, CAST STEEL [FPE, S3010X-140]
10	1	124565	STRAINER, Y, 3" 300# RF, 740 PSIG MAWP, CS, 1/8" SS SCREEN [ALTA, NYF300]
11	1	127701	SCREEN, INSERT, 1/8" PERF, 40 MESH, FOR Y-STRAINER, 3" 300# RF YF300 [ALTA]
15	3	113075	VALVE, BALL, 3/4" NPT, 3000# WOG, FP, CS, NACE C/W LOCKING [NUTRON, T3-F07S30S]
20	2	124564	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, CS, VITON [CENTURY, CM23-M64T-BV]
25	1	127611	GAUGE, PRESSURE, DIFF., 2-1/2" DIAL, 0-15 PSID, LF [MIDWEST, 12AA0000015]
30	2	102964	VALVE, BALL, 3" 300# RF, RP, CS C/W HANDLE [NUTRON, T3-R30R03B]
35	2	127949	SENSOR, RTD, 100 OHM, 316SS, FLEX ARMOUR 8' [WIKI, OXXAT01XS314J96307.50UTPAG]
40	2	123081	INDICATOR, SIGHT GLASS WINDOW, 3/4" NPT, 500 PSIG MAWP, CS [HENRY, SG-1006]
45	1	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
50	2	110386	VALVE, CHECK, 1/2" TUBE, 1/3 PSI, 316SS C/W VITON SEALS [SWAGelok, SS-CHS8-1/3]
55	1	121696	LUBRICATOR [PARKER, 07L32BE]
60	1	124377	PUMP, GEAR, 1/2" NPT C/W RELIEF VALVE, SET @ 55 PSID, [VIKING, SG40570-GOV]
65	1	120270	VALVE, CONTROL, 1" NPT, WCB, 9/16" OR, 5-35 PSI, ON/OFF [FISHER, 119-N12]
70	1	127789	VALVE, PLUG, 1/2" TUBE, 316SS, NUPRO [SWAGelok, SS-8P6T]
75	1	102832	STRAINER, Y, 3/4" NPT, 2000 PSIG MAWP, CS, NACE, 1/32" SS SCREEN [ALTA, YS-800]
80	1	105295	CROSS, SCRD, 3/4" 3000# SA105N
85	2	102937	VALVE, BALL, 1" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R10S20A]
90	1	NPN-REQ	Mechanical Seal Drain Pot
95	1	112801	VALVE, BALL, 1" NPT, 3000# WOG, RP, CS C/W LOCKING HANDLE [NUTRON, T3-R10S30B]
105	4	107977	THERMOWELL, 304SS, 1/2" X 3/4" NPTM X 4" LONG, U=2.5", .260" BORE, STEPPED
110	2	107943	GAUGE, TEMP, 3" DIAL LF, 4" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, SF30040]
115	3	127320	TRANSMITTER, GAUGE PRESSURE, -101.325 TO 2000 KPA [ROSEMOUNT, 3051TG3A2B21AC6]
120	1	127251	PHE, 400 PSIG @ 250 DEG.F [VIEXPATE, VXN-46-SS-FS-1-150]
130	1	108011	VALVE, NEEDLE, 3/4" MNPT X 1/2" FNPT, A105 NACE [CENTURY, CM2-2-M64T-DN-T-SP100]
135	12	102801	VALVE, PLUG, 3/8" TUBE, 316SS, NUPRO [SWAGelok, SS-6P4T]
150	1	NPN-REQ	>> TEMPERATURE CONTROL VALVE, NORMALLY OPEN, BY ARIEL
155	3	NPN-REQ	>> CHECK VALVE, BY ARIEL
165	1	106424	FLANGE, RF RED HUB, 3" 300# X 2" NPT SA105N
170	1	127753	ASSEMBLY, MOUNTING KIT, Vi/CAPACITY CYLINDER FOR ARIEL RG357M, SCREW
180	1	118070	VALVE, CONTROL, 1" NPT, LCC, FLOW ADJ, FO, NACE, 0-35# [FISHER/FLOPRO, D2-X2]
185	1	127868	FILTER, ELEMENT, INJECTION, BEARING, 6-MICRON, VT, FOR RG357M/RG282M [ARIEL, 002110]
186	1	127867	FILTER, ELEMENT, INJECTION, ROTOR, 16-MICRON, VT, FOR RG357M/RG282M [ARIEL, 001661]
195	3	NPN-REQ	PRESSURE INDICATOR BY ARIEL
200	3	127337	TRANSMITTER, PRESSURE, DIFF, -300-300 PSI, CSA, XP [ROSEMOUNT, 3051CD4A22A1AM5B4C6]
210	1	120764	VALVE, PSV, 1" MNPT X 1-1/2" FNPT, .233 OR, NACE I [FARRIS, 27EA34-M20/00]
215	1	127647	ELEMENT, FILTER, LUBE OIL, SPIN-ON TYPE [ARIEL, 001601]
220	1	127648	FILTER ASSEMBLY, 1-1/4" NPT, 350 PSIG MAWP, C/W VISUAL INDICATOR [ARIEL, 001486]
225	1	113133	BLEED RING, 3" 300# RF, 1-1/2" THK, 3/4" NPT SA516-70N
230	1	119927	PUMP, DIAPHRAGM, 1" NPT, ALUM, GAS, CSA, REG/PI [WARREN RUPP, G1FB1ATTXNSX00]
235	1	102828	STRAINER, Y, 1" NPT, 2000 PSIG MAWP, CS, NACE, 1/32" SS SCREEN [ALTA, YS-800]
245	1	127423	COUPLER, QUICK DISCONNECT, 1" NPT MALE [AEROQUIP, 5602-16-165]
250	2	127613	SENSOR, INDUCTIVE PROXIMITY [COMPACT, MADIX-05]
260	1	NPN	ASSEMBLY, SUPPORT, P76T OIL PUMP
505	5	123230	OIL SYNTHETIC, COMPRESSOR LUBE, (208L DRUM) [SUMMIT, NGP 150]



WHEN P76T PUMP IS USED, CUSTOMER TO PROVIDE SUPPORT BRACKET FOR PUMP. (2) 5/8-11 EXTENDED STUDS ARE PROVIDED FOR THIS PURPOSE.



SCAVENGE OIL STRAINER LOCATION

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
4	PSV CHANGED FROM 1" TO 1-1/2" OUTLET	07/10/22	SHW	ATE
3	AS BUILT	07/09/05	SHW	SHW
2	REVISED BOM ADDED ADEM III TO BORDER	07/03/12	SHW	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

EFX Compression
ENERFLEX

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www.enerflex.com

TITLE: SERVICE FLOW DIAGRAM
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: ENCANA OIL & GAS PARTNERSHIP (CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION LSD: INDD60-02
P.O.: 9066-K002 JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-20	20
SCALE: NTS	APPVD BY:	DATE: -		

P:\Projects\custom\060430_Pid\SF-060430-20.dwg Nov 19 2007 11:17am

F-2

FUEL GAS SCRUBBER

SIZE: 219mm OD x 1270mm S/S
MAWP: 1965 kPag @ 38°C
FILTER: POROUS MEDIA, GCR3424K01BM
CRN: K-6363.2135

CE-1

DRIVER

MAKE: CATERPILLAR
MODEL: G3512 TALE
RATING: 1005 HP @ 1400 RPM
S/N: WPRO0161

F-3

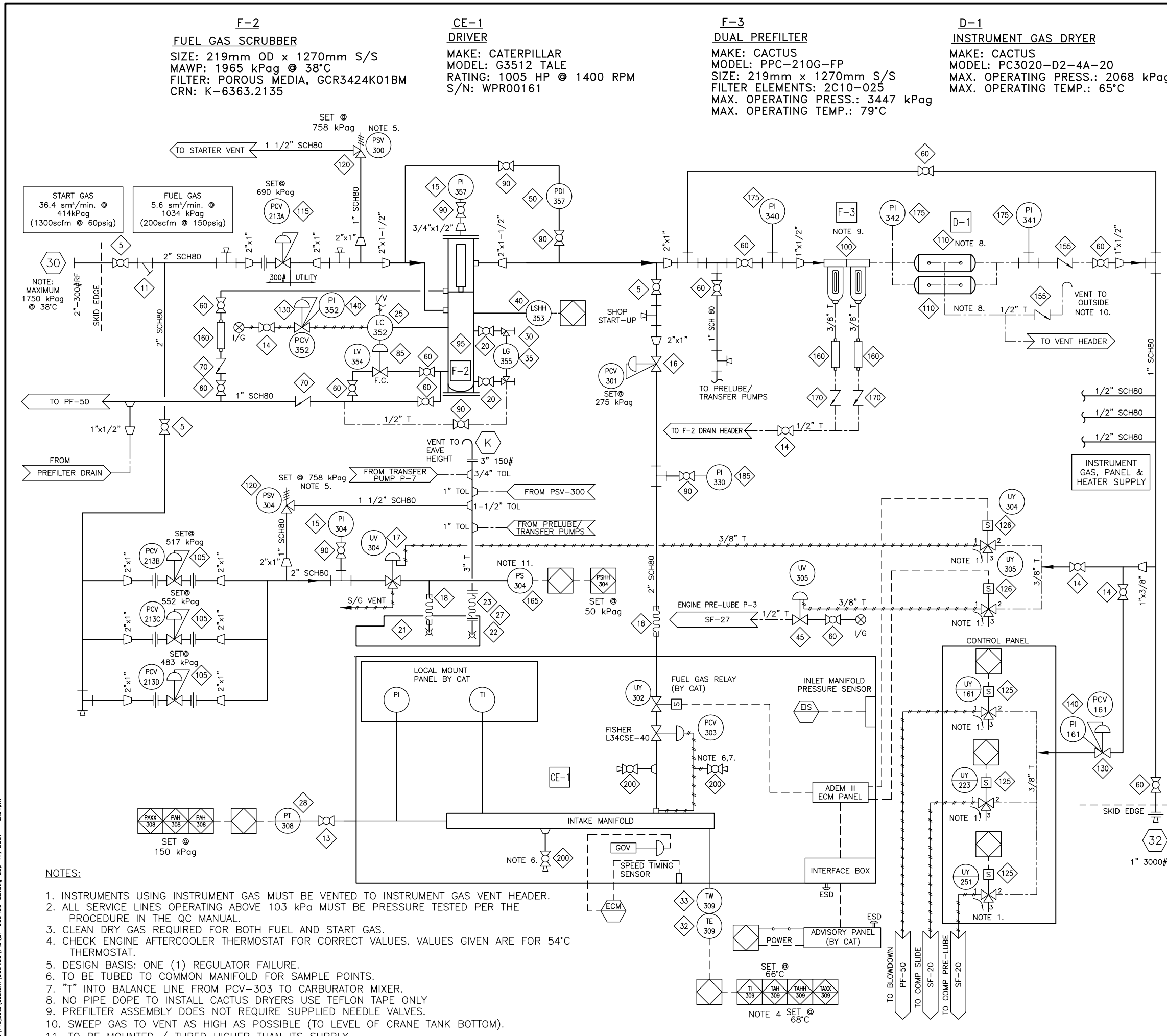
DUAL PREFILTER

MAKE: CACTUS
MODEL: PPC-210G-FP
SIZE: 219mm x 1270mm S/S
FILTER ELEMENTS: 2C10-025
MAX. OPERATING PRESS.: 3447 kPag
MAX. OPERATING TEMP.: 79°C

D-1

INSTRUMENT GAS DRYER

MAKE: CACTUS
MODEL: PC3020-D2-4A-20
MAX. OPERATING PRESS.: 2068 kPag
MAX. OPERATING TEMP.: 65°C



NOTES:

- INSTRUMENTS USING INSTRUMENT GAS MUST BE VENTED TO INSTRUMENT GAS VENT HEADER.
- ALL SERVICE LINES OPERATING ABOVE 103 kPa MUST BE PRESSURE TESTED PER THE PROCEDURE IN THE QC MANUAL.
- CLEAN DRY GAS REQUIRED FOR BOTH FUEL AND START GAS.
- CHECK ENGINE AFTERCOOLER THERMOSTAT FOR CORRECT VALUES. VALUES GIVEN ARE FOR 54°C THERMOSTAT.
- DESIGN BASIS: ONE (1) REGULATOR FAILURE.
- TO BE TUBED TO COMMON MANIFOLD FOR SAMPLE POINTS.
- "T" INTO BALANCE LINE FROM PCV-303 TO CARBURATOR MIXER.
- NO PIPE DOPE TO INSTALL CACTUS DRYERS USE TEFLON TAPE ONLY
- PREFILTER ASSEMBLY DOES NOT REQUIRE SUPPLIED NEEDLE VALVES.
- SWEEP GAS TO VENT AS HIGH AS POSSIBLE (TO LEVEL OF CRANE TANK BOTTOM).
- TO BE MOUNTED / TUBED HIGHER THAN ITS SUPPLY

BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
5	1	102951	VALVE, BALL, 2" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R20S20A]
15	1	107910	GAUGE, PRESSURE, BM, 4" LF, 0-300 PSI DUAL, 1/2" NPT [WIKA, 233.54]
17	1	104091	VALVE, GAS, 3-WAY, 2" NPT, 316SS BODY & TRIM, NACE [AMOT, 4418F6A6X000]
18	1	127994	HOSE, BRAIDED STEEL, SINGLE, 2" MNPT X MNPT UNION X 12" LONG, CGA, CSA & CRN
21	1	103760	STARTER, AIR/GAS, LOW 90-30 PSIG, INERTIA, DUAL [TDI TURBOSTART, T121-60001-B1R]
22	1	103741	ELBOW, STARTER EXHAUST, 90 DEG, SR, 3" NPTM, CS [TDI, T100-27900]
23	1	128014	HOSE, BRAIDED STEEL, SINGLE, 3" 150# RF X 3" 150# RF X 10" LONG, CGA, CSA & CRN
27	1	106497	FLANGE, RF SCRD, 3" 150# SA105N
45	1	120270	VALVE, CONTROL, 1" NPT, WCB, 9/16" OR, 5-35 PSI, ON/OFF [FISHER, 119-N12]
90	1	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
105	3	115599	REGULATOR, 1" NPT, DI, 1/2" OR, 35-80# SPR RNG, [FISHER, 627-498]
120	1	127453	VALVE, PSV, 1" NPT X 1-1/2" NPT, .357 OR. (F), STD TRIM [TAYLOR, 8200]
165	1	105102	SWITCH, PRESSURE, 500 MWP, 3-20R, 1-18F, XP, SS, NACE [CCS, 6900GZE12]
Start Gas (B15)**			
5	2	102951	VALVE, BALL, 2" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R20S20A]
11	1	102831	STRAINER, Y, 2" NPT, 1480 PSIG MAWP, CS, 1/32" SS SCREEN [ALTA, YS-600]
13	1	102950	VALVE, BALL, 1/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R02S20A]
14	4	120928	VALVE, BALL, 3/8" NPT, 2000# WOG, FP, 316SS, NACE, 2 PIECE [NAVCO, C1-R03S20A]
15	1	107910	GAUGE, PRESSURE, BM, 4" LF, 0-300 PSI DUAL, 1/2" NPT [WIKA, 233.54]
16	1	115599	REGULATOR, 1" NPT, DI, 1/2" OR, 35-80# SPR RNG, [FISHER, 627-498]
18	1	127994	HOSE, BRAIDED STEEL, SINGLE, 2" MNPT X MNPT UNION X 12" LONG, CGA, CSA & CRN
20	2	102973	VALVE, BALL, 3/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R07S20A]
25	1	101213	SWITCH, LEVEL, 2" NPT, 303SS BODY, PNEUM. C/W FLOAT [SOR, 1530B-G2A-C-JO-PS-CV]
28	1	127343	TRANSMITTER, GAUGE PRESSURE, -100 TO 200 KPA, CGA, XP [ROSEMOUNT, 3051TG1A2B21AC6]
30	1	112629	VALVE, SET GAUGE, SWEET, 1/2" FNPT X 3/4" MNPT, CS, 3815# [PENBERTHY, 330J 3/4"]
32	1	127949	SENSOR, RTD, 100 OHM, 316SS, FLEX ARMOUR 8" [WIKA, OXXAT01XS314J96307.50UTPAG]
33	1	116110	THERMOWELL, 316SS, 1/2" X 1/2" NPTM X 4" LONG, U=2.5", .260" BORE, STEPPED
35	1	104433	GAUGE, LEVEL, CS WITH REFLEX FLAT GLASS, 2240# [PENBERTHY, 1RL1]
40	1	127319	SWITCH, LEVEL, 2" NPT, 316SS BODY, ELECTRIC, XP [KIMRAY, 2200-SLS-SS6]
50	1	127611	GAUGE, PRESSURE, DIFF., 2-1/2" DIAL, 0-15 PSID, LF [MIDWEST, 12AA0000015]
60	11	102937	VALVE, BALL, 1" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R10S20A]
70	2	103085	VALVE, CHECK, SWING, 1" NPT, 800# WOG, CS [NEWCO, 38T-FS2]
85	1	104854	VALVE, CONTROL, 1" NPT, LCC, FLOW ADJ, FC, NACE, 0-35# [FISHER/FLOPRO, D2-X1]
90	5	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
95	1	127314	VESSEL, FUEL GAS, 8-5/8" OD, 285 PSIG MAWP, 100 DEG.F WAUK VHP C/W P2C-324B ELEMENT
100	1	127609	ASSEMBLY, INLET PRE-FILTER FOR CACTUS PPC-410-G DRYER [CACTUS, PPC-210G-FP]
110	2	127608	DRYER, GAS MEMBRANE [CACTUS, PPC-410-G]
115	1	115800	REGULATOR, 1" NPT, DI, 1/2" OR, 70-150# SPR, SET @ 90 PSIG [FISHER, 627-499]
120	1	127453	VALVE, PSV, 1" NPT X 1-1/2" NPT, .357 OR. (F), STD TRIM [TAYLOR, 8200]
125	3	104789	VALVE, SOLENOID, 3-WAY, 24VDC, CSA, XP, EPNC 115PSI, NC SS [ASCO, EF8320G202-24]
126	2	128125	VALVE, GP-SOLENOID, PRELUBRICATION/STARTER, C/W WIRING & [Caterpillar, 2519396]
130	2	104872	REGULATOR, 1/4" NPT, ALUM., 0-125#, TAPPED (W/O PI) [FISHER, 67CFR-601/SC]
140	2	107925	GAUGE, PRESSURE, CBM, 2" DRY, 0-60 PSI DUAL, 1/4" NPT [WIKA, 111.10]
155	2	110386	VALVE, CHECK, 1/2" TUBE, 1/3 PSI, 316SS C/W VITON SEALS [SWAGelok, SS-CHS8-1/3]
160	3	127336	DRAIN, LIQUID, 3/4" INLET X 1/2" OUTLET [WATSON MCDANIEL, WLD1811]
170	2	102816	VALVE, CHECK, 3/8" TUBE, 1 PSI, 316SS, NUPRO [SWAGelok, SS-6C-1]
175	3	107895	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-200 PSI DUAL, 1/4" NPT [WIKA, 233.53]
185	1	107926	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-60 PSI DUAL, 1/4" NPT [WIKA, 233.53]
200	3	102802	VALVE, PLUG, 1/4" TUBE, 316SS, NUPRO [SWAGelok, SS-4P4T]
Fuel Gas (B35)**			

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
4	AS BUILT	07/09/05	SHW/ATE	SHW
3	REVISED BOM, ADDED ITEM 126, REVISIONS TO CACTUS DRYER	07/03/12	SHW/ATE	
2	ADDED CHECK VALVE, VENT LINE ON ITEM 17 & REVISED SOLENOIDS TO SUIT ADEM III ENG. DELETED ITEM 19	07/01/29	SN	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

ENERFLEX

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www.enerflex.com

TITLE: **FUEL AND START GAS SYSTEM**
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

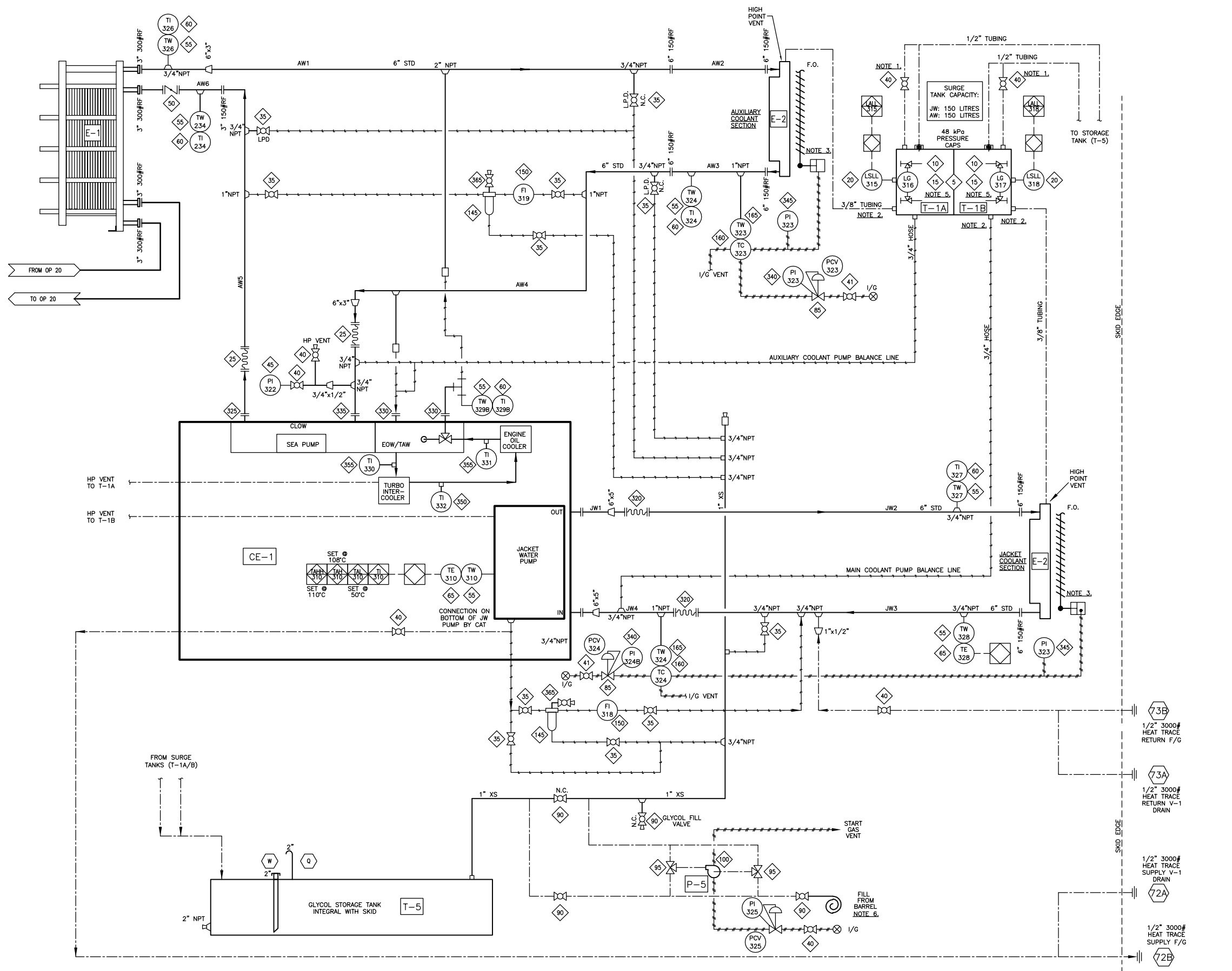
FOR: **ENCANA OIL & GAS PARTNERSHIP**
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002

LSL: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-22	22
SCALE: NTS	APPVD BY: -	DATE: -		

CE-1 DRIVER MAKE: CATERPILLAR MODEL: G3512 TALE RATING: 1005HP @ 1400 RPM GLYCOL CHARGE: 148L S/N: WPRO0161	E-1 LUBE OIL COOLER MAKE: VIEX PLATE & FRAME MODEL: VXN-46-SS-FS-1-150MAX MAWP: 2758 kPag @ 121°C	E-2 AERIAL COOLER MAKE: AIR-X-CHANGERS MODEL: 132EH WEIGHT: 8432 kg S/N: 065070	P-5 GLYCOL TRANSFER PUMP MAKE: WARREN RUPP MODEL: G1FBIABTXNSX00 MAWP: 689 kPag	T-1A/B ENGINE GLYCOL SURGE TANK TOTAL CAPACITY: 300 L	T-5 USED GLYCOL STORAGE TANK CAPACITY: 1236 L
--	--	---	--	--	--



ITEM	QTY	EFX CODE	DESCRIPTION
5	1	126512	TANK, SURGE, 2-COMPARTMENT, 150L/150L
10	2	103698	VALVE, SET GAUGE, SWEET, 5/8"OD TUBULARX1/2"MNPT CS 600# QUEST-TEC [DANIEL, 1TC]
15	2	101257	GAUGE, ACRYLIC SIGHT GLASS, 5/8" OD X 3/8" ID, 1/4" WALL THK
20	2	127318	SWITCH, LEVEL, 1-1/2" NPT, 316SS BODY, ELECTRIC, XP [KIMRAY, 1200-SLS-SS6]
25	2	119977	EXPANSION JOINT, RUBBER, 3" X 150# RF [HYDROFLEX, SERIES 240AV/EE]
35	11	102973	VALVE, BALL, 3/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R07S20A]
40	7	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
41	2	102928	VALVE, BALL, 3/8" NPT, 2000# WOG, FP, 316SS, NACE, 2 PIECE [NAVCO, C1-R03S20A]
45	1	107903	VALVE, PRESSURE, BM, 4" LF, 0-30 PSI DUAL, 1/2" NPT [WIKA, 233.54]
50	1	116798	GAUGE, BUTTERFLY, 3" 150#, WAFER STYLE, CAST IRON BODY, [C&C BUTTERFLY]
55	7	107977	THERMOWELL, 304SS, 1/2" X 3/4" NPTM X 4" LONG, U=2.5", .260" BORE, STEPPED
60	5	107943	GAUGE, TEMP, 3" DIAL LF, 4" STEM, 0-250 DEG.F DUAL, 1/2" NPT [TREND, SF30040]
65	2	127950	SENSOR, RTD, 100 OHM, 316SS, FLEX ARMOUR 8" [WIKA, OXXAT01XS314J963060UTPAG]
85	2	104872	REGULATOR, 1/4" NPT, ALUM., 0-125#, TAPPED (W/O PI) [FISHER, 67CFR-601/SC]
90	4	102937	VALVE, BALL, 1" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R10S20A]
95	2	121379	VALVE, BALL, 3-WAY, 3/4" NPT, FULL SS, 800 PSI C/W LOCKING HANDLE [MAS, G4]
100	1	119927B	PUMP, DIAPHRAGM, 1" NPT, ALUM, GAS, CSA, REG/PI [WARREN RUPP, G1FB1ATTXNSX00]
145	2	127239	FILTER, BAG, 1" NPT, 4" X 14" 150 PSIG MAWP
150	2	127467	INDICATOR, SIGHT GLASS WINDOW, 3/4" NPT, 150# ANSI SF SERIES [WEIR, SFB-3/4]
160	2	127624	CONTROLLER, TEMP, T12DA, 1" NPTM X 12" LG PROBE [KIMRAY, HAP/HCE]
165	2	104069	THERMOWELL, 316SS, 1" NPT X 12" LONG, SS-12-SS FOR HT12/T12DA [KIMRAY, HCE]
320	2	119976	EXPANSION JOINT, RUBBER, 6" X 150# RF [HYDROFLEX, SERIES 240AV/EE]
325	1	127594	FLANGE, SQ, ENGINE AW OULET, 3" NOM, 1" THK PLATE SA36 FOR CATERPILLAR G3512TALE
330	2	106487	FLANGE, RF SCRCD, 2" 150# SA105N
335	1	127593	FLANGE, ENGINE AW INLET, 3" NOM, 1" THK PLATE SA36 FOR CATERPILLAR G3512TALE
340	2	107925	GAUGE, PRESSURE, CBM, 2" DRY, 0-60 PSI DUAL, 1/4" NPT [WIKA, 111.10]
345	2	107878	GAUGE, PRESSURE, BM, 2-1/2" LF, 0-100 PSI DUAL, 1/4" NPT [WIKA, 233.53]
350	1	127924	GAUGE, TEMP, 3" DIAL LF, BM, 6" STEM, 0-250 DEG.F DUAL, 1/2" NPT [WIKA, 31060A006A4SF]
355	2	127923	GAUGE, TEMP, 3" DIAL LF, BM, 4" STEM, 0-250 DEG.F DUAL, 1/2" NPT [WIKA, 31040A006A4SF]
365	2	102950	VALVE, BALL, 1/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R02S20A]

NOTES

- VALVES TO BE MOUNTED AT 1.5 m ABOVE GRATING.
- DO NOT TRAP LINES; SLOPE COOLER HIGHPOINT VENT UP TOWARDS SURGE TANK.
- JW/AUX LOUVRES TO BE FAIL OPEN - TUBE CONTROLLER IN OPPOSITE DIRECTION.
- INSTRUMENTS USING INSTRUMENT GAS TO BE VENTED TO 1/8" VENT HEADER.
- ANGLE IRON TO BE USED FOR LEVEL GAUGE GUARDS.
- USE 1" CONDUIT FOR STINGER, NO PAINT.
- TOTAL ESTIMATED GLYCOL IN COOLING SYSTEM IS APPROX. 1150 L.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
3	AS BUILT	07/09/05	SHW	SHW
2	ADDED ITEM 165, NOT 7 & CHANGED P/N 340	07/03/12	SHW	
	DELTED ITEM 375 & ADDED ITEM 65			
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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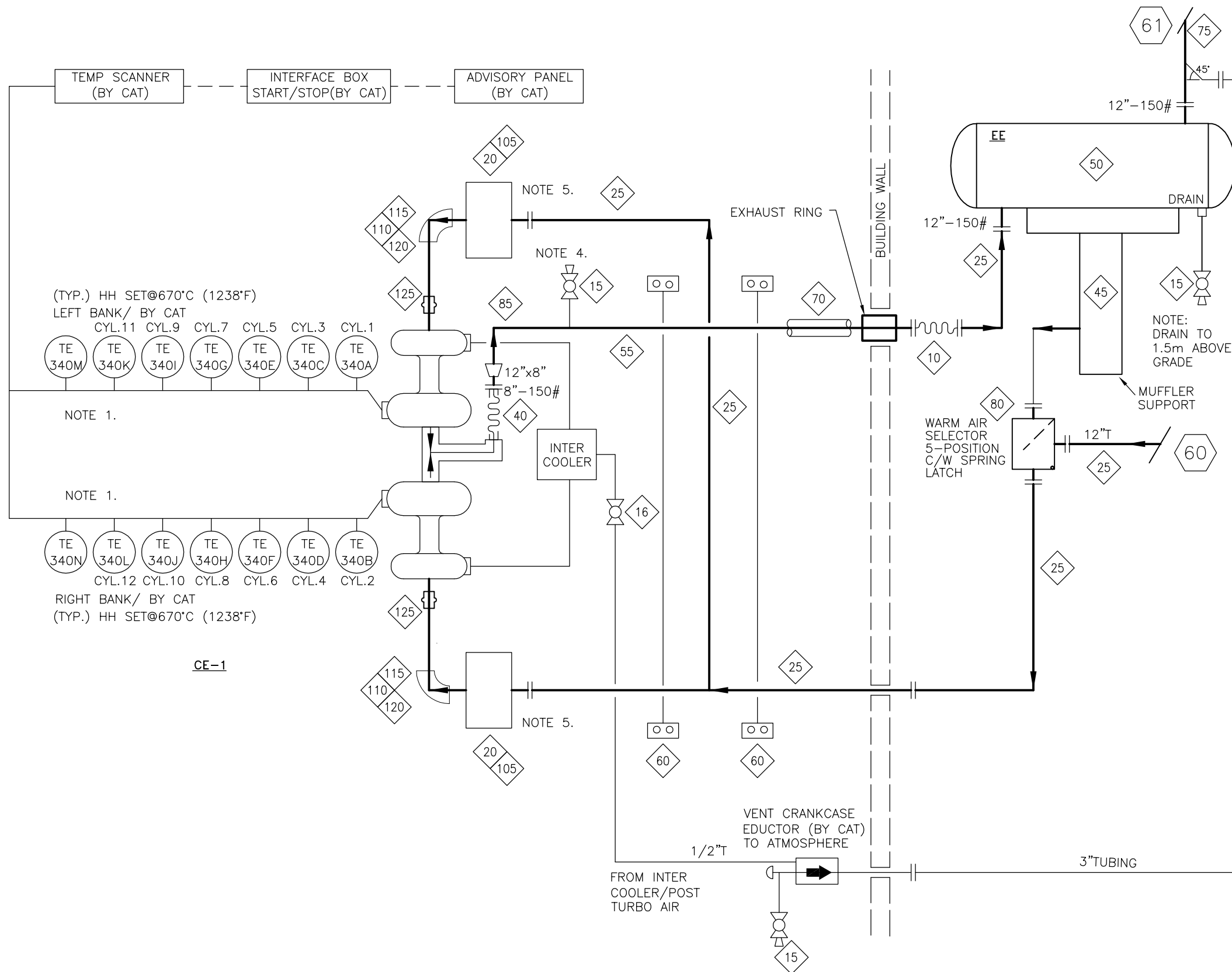
4700 47 Street SE Calgary AB Canada T2B 3R1 Canada Tel. +1.403.236.6800 Fax +1.403.279.0367
www.enerflex.com

TITLE:		ENGINE GLYCOL SYSTEM ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH 1005HP SCREW COMPRESSOR PACKAGE	
FOR:		ENCANA OIL & GAS PARTNERSHIP (CHINOOK)	
CONSULTANT: DPH FOCUS CORPORATION P.O.: 9066-K002		LSD: INDDGO-02 JOB No.: 060430	
DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	DWG. No.
SCALE: NTS	APPVD BY: -	DATE: -	SF-060430-24
			24

CE-1
DRIVER
MAKE: CATERPILLAR
MODEL: G3512 TALE AFRC
RATING: 1005 HP @ 1400 RPM
S/N: WPR00161

EE
SUPER HOSPITAL PLUS MUFFLER
MAKE: EXCEL
MODEL: EXHDPS

HEIGHT IS THE GREATER OF:
1.5 x EAVE HEIGHT OR
1.2 x PEAK HEIGHT



BILL OF MATERIAL			
ITEM	QTY	EFX CODE	DESCRIPTION
10	1	104682	EXPANSION BELLOW, 12" 150# INTERNAL FLANGES C/W 2" COLLAR & SS LINER X 12" LONG
15	3	102802	VALVE, PLUG, 1/4" TUBE, 316SS, NUPRO [SWAGelok, SS-4P4T]
16	1	NPN	VALVE BALL, 1/2" TUBE, SUPPLIED BY CAT
20	2	NPN-REQ	>> AIR FILTER BOX, C/W FILTER, SUPPLIED BY CAT
25	40	104562	EXHAUST TUBING, MECHANICAL, 12" OD X 10 GAUGE (.134" WALL), ERW
40	1	119607	EXPANSION BELLOW, 8" CAT FLG X 8" 150# ANSI EXTERNAL FLANGE X 12" LONG
45	1	127752	MUFFLER STAND
50	1	127221	MUFFLER, SUPER HOSPITAL PLUS, 12", ALUMINUM STEEL, 45-58 DBA, EXHDPS [EXCEL]
55	20	104561	EXHAUST TUBING, MECHANICAL, 12" ID X 11 GAUGE (.125" WALL), 316LSS
60	2	NPN-REQ	SUPPORT FRAME, AIR, JW AND EXHAUST
70	1	122061	***INSULATION, FOR 12" 150# SS EXHAUST LINE, NO AIR SPACE, CUSTOM
75	1	NPN-REQ	Exhaust stack 12" build to suit
80	1	127424	AIR INTAKE TWO-WAY DIVERTER, 12", 5 POSITION, SCREW
85	1	103770	ELBOW, EXHAUST, 90 DEG, SR, 12" ID, 11 GAUGE (.125" WALL), 316LSS
105	1	127615	GROMMET BUMPER, RUBBER, SRB BLACK, 60 DURO, FOR CAT 3500, AIR FILTER HOLE PLUGS
110	1	117770	EXHAUST TUBING, MECHANICAL, 6" ID X 11 GAUGE (.125" WALL), 316LSS
115	8	102324	HOSE CLAMP, 5-1/8" - 7" OD [TRIDON, HS-104]
120	2	127464	ELBOW, RUBBER, 90 DEG, 6" [DONALDSON, P105535]
125	2	104039	HUMPHOSE, STRAIGHT, RUBBER, 6" [DONALDSON, P10-5612]

NOTES:

1. CYLINDER AND EXHAUST TEMPERATURE TO LOCAL MOUNTED PANEL SUPPLIED BY CAT.
2. DO NOT SCALE THIS DRAWING.
3. ALL DIMENSIONS ARE IN MILLIMETRES.
4. ALL TEST PORT CONNECTION TUBES TO COMMON MANIFOLD ON ENGINE.
5. CAT AIR FILTERS TO BE MOUNTED IN HORIZONTAL POSITION FOR ACCESS TO TURBOS.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/09/05	SN	SHW
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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TITLE: **AIR & EXHAUST SYSTEM**
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: **ENCANA OIL & GAS PARTNERSHIP**
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002

LSJ: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-26	26
SCALE: NTS	APPVD BY:	DATE:		

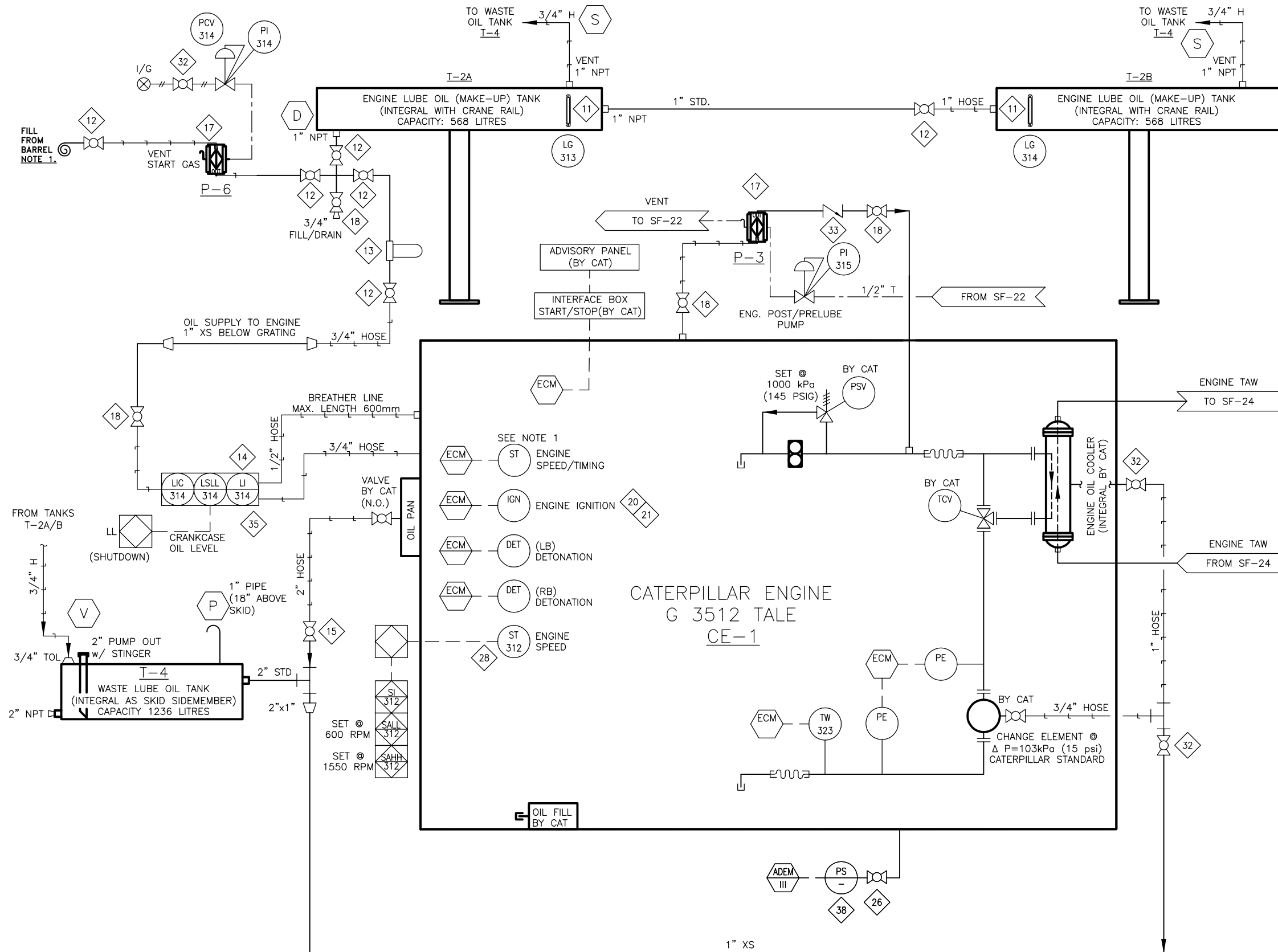
CE-1
DRIVER
 MAKE: CATERPILLAR
 MODEL: G3512 TALE AFRC
 RATING: 1005 HP @ 1400RPM
 OIL CHARGE: 89.5 L
 S/N: WPR00161

P-3
ENGINE POST/PRELUBE PUMP
 MAKE: WARREN RUPP
 MODEL: GIFBIATTXNSX00
 MAWP: 689 kPag
 CAPACITY: 112 L @139 kPag
 1.5m HEAD

P-6
OIL TRANSFER PUMP
 MAKE: WARREN RUPP
 MODEL: GIFBIATTXNSX00
 MAWP: 689 kPag
 CAPACITY: 112 L @139 kPag
 1.5m HEAD

T-2A/B
ENGINE LUBE OIL TANK
 TOTAL CAPACITY: 1136 L

T-4
WASTE LUBE OIL TANK
 CAPACITY: 1236 L



BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
11	2	127616	INDICATOR,LEVEL,SIGHT GLASS WINDOW,8" BOLT CENTER [LUBE DEVICES, G605-08-A-1-RB]
12	7	102937	VALVE, BALL, 1" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R10S20A]
13	1	104295	FILTER, OIL, ASSEMBLY, 1" FNPT C/W BF915 ELEMENT & BASE FB1307 [BALDWIN, BL914]
14	1	107969	CONTROLLER, OIL LEVEL C/W ELECTRIC SWITCH, XP, CSA C/W BRACKET [KENCO, KLCE-9]
15	1	102951	VALVE, BALL, 2" NPT, 2000# WOG, RP, 316SS, NACE C/W LOCKING [NAVCO, C1-R20S20A]
17	2	119927B	PUMP, DIAPHRAGM, 1" NPT, ALUM, GAS, CSA, REG/PI [WARREN RUPP, G1FB1ATTXNSX00]
18	5	102973	VALVE, BALL, 3/4" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R07S20A]
20	1	NPN-REQ	>> IGNITION SYSTEM BY CAT, CSA, CLASS 1, DIV 2
21	1	NPN-REQ	>> HARNESS, IGNITION SYSTEM, CSA, CLASS 1, DIV 2, BY CAT
28	1	104467	MAGNETIC PICK-UP, 5/8"-18 THREAD X 2-1/2" LONG, CSA, IS [DYNALCO, M204]
32	1	102949	VALVE, BALL, 1/2" NPT, 2000# WOG, RP, 316SS, NACE C/W [NAVCO, C1-R05S20A]
33	1	103075	VALVE, CHECK, PISTON, 3/4" NPT, 800# WOG, CS [NEWCO, 48T-FS2]
35	1	104174	BRACKET, MOUNTING, KENCO LCE-9 LEVEL CONTROLLER, FABRICATED
38	1	128126	SWITCH, AS-PRESURE, ACTUATION, C/W WIRING & PIN CONNECTOR [Caterpillar, 1501240]

Lubrication (B30)			

NOTES
 1. USE 1" CONDUIT FOR STINGER, NO PAINT.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
4	AS BUILT	07/09/05	SHW	SHW
3	REVISED BOM, DELETED ITEM #25	07/03/12	SHW	
2	ADDED DBL-BLOCK ON ENG. OIL COOLER; REMOVED TE-323, PT-306, AND PI-306; ADDED PS-___ FOR PRELUBE	07/02/06	ATE	JDB
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	SHW

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TITLE:
 ENGINE OIL SYSTEM
 ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
 1005HP SCREW COMPRESSOR PACKAGE

FOR:
ENCANA OIL & GAS PARTNERSHIP
 (CHINOOK)
 CONSULTANT: DPH FOCUS CORPORATION
 P.O.: 9066-K002
 LSD: INDDGO-02
 JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	
SCALE: NTS	APPVD BY: -	DATE: -	

SF-060430-27 **27**

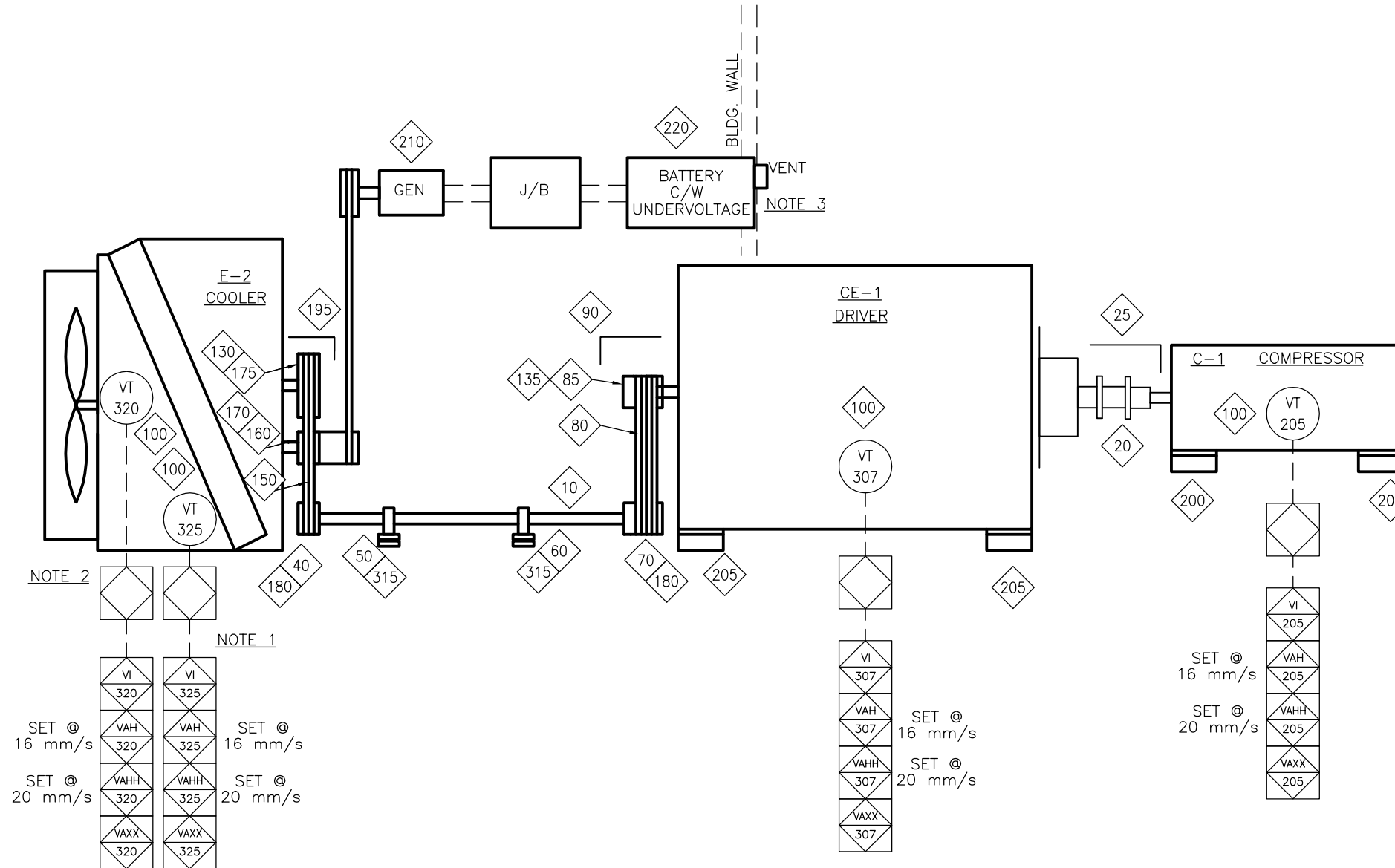
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DESCRIPTION	SHEAVE PITCH ϕ	RPM
ENGINE SHAFT	254 mm	1400
JACK SHAFT:		
ENGINE END	406 mm	875
COOLER END	279 mm	
IDLER		N/A
COOLER END	279 mm	
COOLER SHAFT	914 mm	267
GENERATOR	99 mm	2466

E-2
AERIAL COOLER
MAKE: AIR-X-CHANGERS
MODEL: 132EH
WEIGHT: 8432 kg
S/N: 065070

CE-1
DRIVER
MAKE: CATERPILLAR
MODEL: G3512LE AFRC
RATING: 1005 HP @ 1400 RPM
WEIGHT: 6705 kg
S/N: WPRO0161

C-1
SCREW COMPRESSOR
MAKE: ARIEL
MODEL: RG357M
MAX RUNNING PRESSURE: 1586 kPag
WEIGHT: 4090 kg
S/N: R10332



BILL OF MATERIAL			
ITEM	QTY	EFX CODE	DESCRIPTION
10	1	103585	JACKSHAFT, 2-15/16" DIA C/W 3/4" X 3/8" X 8" KEYWAY @ BOTH ENDS (52")
20	1	127197	COUPLING, ARCUSAFLEX, 4171 SHRINK DISC, 3.74" BORE [RINGFEDER, 43-91.3327]
25	1	NPN-REQ	Coupling guard, steel
40	1	127452	SHEAVE, 5-GROOVE, USED WITH R1 BUSHING [BROWNING, 5C110R]
50	1	107128	PILLOW BLOCK, 2-15/16", EXPANSION [BROWNING, PB970EX 2-15/16]
60	1	107132	PILLOW BLOCK, 2-15/16", NON-EXPANSION [BROWNING, PB970NEX 2-15/16]
70	1	107204	SHEAVE, 5-GROOVE, USED WITH R1 BUSHING [BROWNING, 5C160R]
80	4	107043	V-BELT, C-SECTION [GOODYEAR, C-122]
85	1	107198	SHEAVE, 5-GROOVE, USED WITH R1 BUSHING [BROWNING, 5C100R]
90	1	NPN-REQ	ASSEMBLY GUARD, HINGED
100	4	118229	TRANSMITTER, VIBRATION, 4-20MA, 24VDC CSA, IS [METRIX, ST5484E-123-020-00]
130	1	107209	SHEAVE, 5-GROOVE, USED WITH R2 BUSHING [BROWNING, 5C360R]
135	1	113238	BUSHING, R1 2-1/2" [BROWNING, R1]
150	5	107007	V-BELT, C-SECTION [GOODYEAR, C-255]
160	1	107216	SHEAVE, 6-GROOVE, USED WITH R2 BUSHING [BROWNING, 6C96R]
170	1	107087	BUSHING, R2 2-7/16" [BROWNING, R2]
175	1	107105	BUSHING, R2 3-7/16" [BROWNING, R2]
180	2	107079	BUSHING, R1 2-15/16" [BROWNING, R1]
195	1	NPN-REQ	Assembly guard, steel, hinged
200	4	127649	MOUNT, CARBON STEEL, SM24 [VIBRACON, SM24CS-ID42]
205	8	120462	MOUNT, CARBON STEEL, SM20CS [VIBRACON, SM20]
210	1	NPN	GENERATOR, ELECTRODYNE, 60AMP, CSA CL.1, DIV.II, 3.9" DATUM [HOLLEY, 10-080-678]
220	1	120798	BATTERY BOX, SUITABLE FOR DIV.II C/W UNDERVOLTAGE [PIC, 10-080-678/BB2-DIV2UV]
315	2	123323C	ASSEMBLY, JACKSHAFT ADJUSTING PLATE, A1478

NOTES

- VT-325 TO BE MOUNTED BY FAN INPUT SHAFT SHEAVE INBOARD.
- VT-320 TO BE MOUNTED BY FAN INPUT SHAFT SHEAVE OUTBOARD.
- VT-307 TO BE MOUNTED BY FAN INPUT SHAFT SHEAVE INBOARD.
- BATTERY BOX VENT SIDE OUT SIDE OF BUILDING WALL.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
3	AS BUILT	07/09/05	SN	SHW
2	REVISED SHEAVES & BOM.	07/01/26	SN	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

EFX Compression
ENERFLEX

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TITLE: **DRIVE TRAIN EQUIPMENT**
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: **ENCANA OIL & GAS PARTNERSHIP**
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002

LSID: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	
SCALE: NTS	APPVD BY: -	DATE: -	

DWG. No. **SF-060430-28**

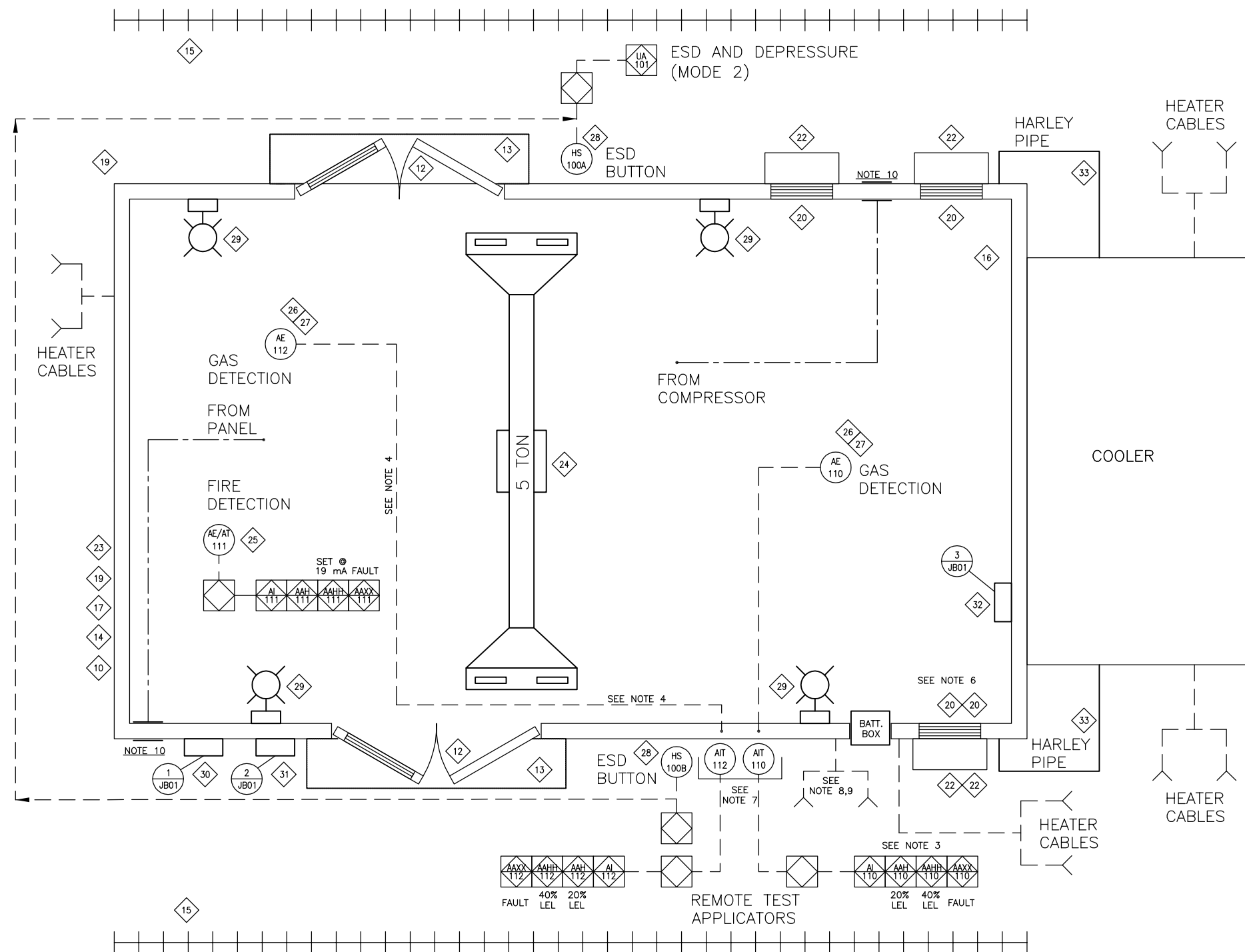
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BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
10	1	NPN	BLDG, 22G PREPAINTED STEEL EXTERIOR
12	2	107545	MAN DOOR, DOUBLE STEEL, 6' X 7'C/W LOCKING PANIC HARDWARE AND SOUND PACKS
13	2	107598	CANOPY, OVER DOOR TO MATCH BLDG EXT.
14	1	NPN	ACTIVE RIDGE VENTILATOR C/W 9" THROAT & ACOUSTICAL CAP
15	2	107535	FULL LENGTH ICE RAKES
16	1	NPN	CUT AND FLASH AROUND COOLER OPENING
17	1	NPN	33% WHITE 20G PERFORATED INTERIOR LINER
19	2	107530	EAVESTROUGHING C/W DOWNSPOUTS & EXTENSIONS
20	4	NPN	18" X 32" MANUALLY ADJUSTABLE WALL LOUVERS
22	4	NPN	ACOUSTICAL STORM HOODS FOR THE 18" X 32" LOUVERS
23	1	NPN	R12 ACOUSTICAL INSULATION IN WALLS AND R20 IN ROOF
24	1	NPN	CRANE, 5 TON
25	1	113989	DETECTOR, UV FIRE DETECTION C/W SWIVEL, ANALOG OUTPUT, [NET SAFETY, UVS-A]
26	2	124495	DETECTOR, COMBUSTIBLE GAS DETECTION, MILLENNIUM [NET SAFETY, MLP-LP-A-SC1100-SEP]
27	2	104309	ACCESSORY, CALIBRATION CUP, SPLASH GUARD & RAINSHIELD [NET SAFETY, CCS-1]
28	2	112586	ESD BUTTON, RED MASH-HEAD, [CROUSE HINDS, GHG4325GT551211/2511EMER-MUS-P]
29	4	NPN	CLASS 1, ZONE 2, 200W INCANDESCENT FIXTURE, WALL MOUNTED C/W CLOSE GUARD AND 100W, 12VDC
30	1	120702	JUNCTION BOX, 24" X 24" X 8" DEEP, FIBREGLASS, TYPE 4X [HOFFMAN, A24H24086QRLP]
31	1	114760	JUNCTION BOX, 16" X 14" X 8", FIBREGLASS [HOFFMAN, A-16148CHQRFQ]
32	1	NPN	JUNCTION BOX, ACE, 10" X 8" X 6"
33	2	NPN	HARLEY PIPE

NOTES:

- THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS STAMPED "RELEASED FOR MANUFACTURE".
- DO NOT SCALE THIS DRAWING.
- GAS DETECTION LEVEL INDICATORS TO BE MOUNTED OUTSIDE BUILDING.
- POLYETHYLENE TUBING LINES TO BE DIFFERENT COLOURS FOR REMOTE GAS TEST APPLICATIONS.
- TRIM INCLUDES DOORS, CANOPIES, WINDOW FRAMES, DOWNSPOUTS, STORM HOODS, ETC.
- LOUVERS ARE STACKED ON TOP OF EACH OTHER AT THIS LOCATION.
- SHROUD TO BE PROVIDED OVER LEL GAS DETECTION CONTROLLERS.
- CONNECT INTERIOR LIGHTS IN PARALLEL.
- USE 2C#8 WIRE.
- GROUND WIRES INSTALLED THROUGH STEEL PLATE ON BOTH SIDES OF BUILDING WALL.



COLOR SCHEDULE

WALL INTERIOR LINER:	WHITE
WALL EXTERIOR:	DOFASCO TAN 5M-QC-315
ROOF INTERIOR LINER:	WHITE
ROOF EXTERIOR:	BROWN 5M-QC-229
TRIM:	BROWN 5M-QC-229 (SEE NOTE 5)
COOLER:	ENCANA TAUPE
EQUIPMENT:	STANDARD
SKID PERIMETER:	STANDARD
GRATING:	BLACK
PIPING & VESSELS:	ENCANA STANDARD
DIMENSIONS	
WIDTH:	23'-0"
LENGTH:	35'-4"
EAVE HEIGHT:	15'-8" SLOPE 4:12

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
2	AS BUILT	07/09/05	SN	SHW
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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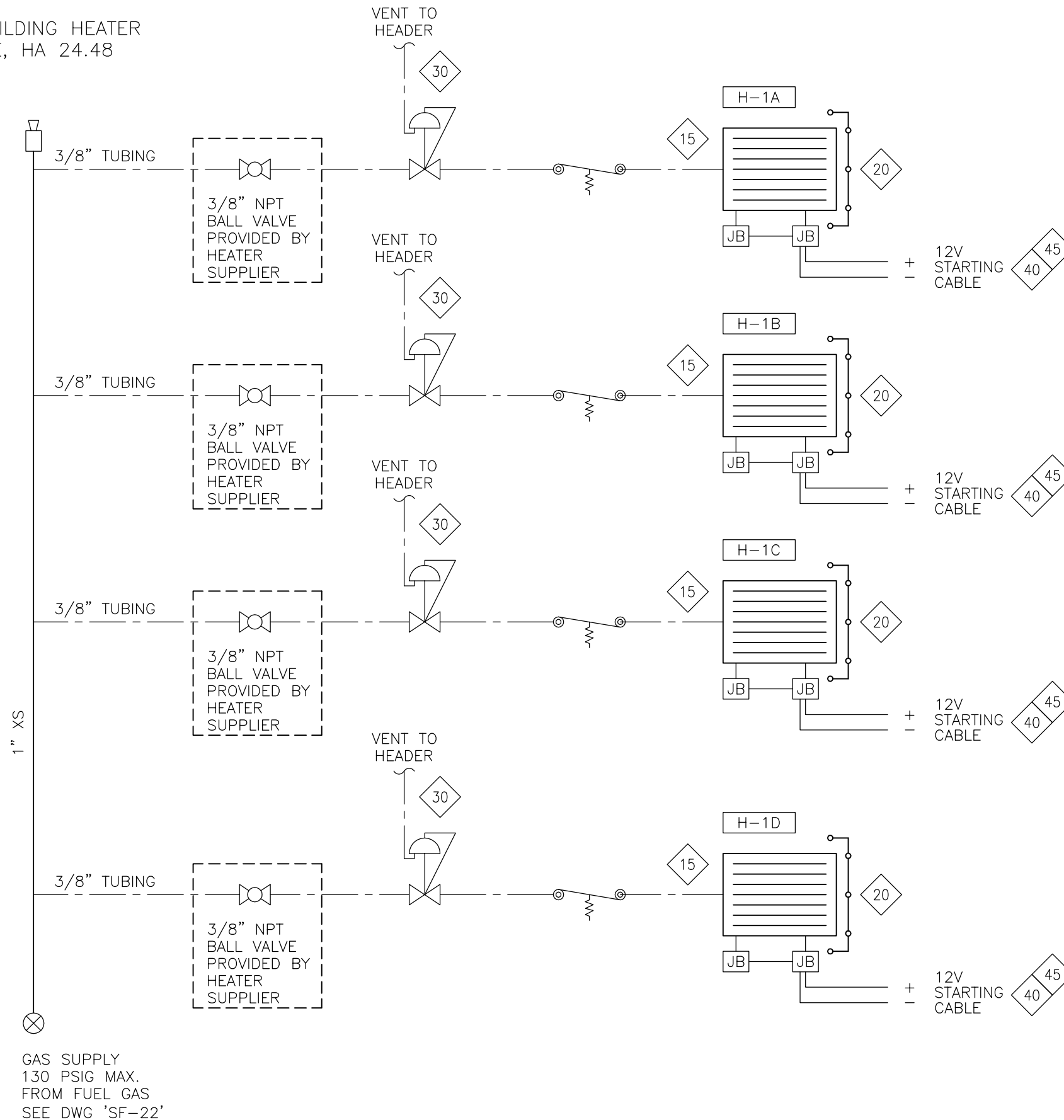
TITLE: BUILDING EQUIPMENT
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
1005HP SCREW COMPRESSOR PACKAGE

FOR: ENCANA OIL & GAS PARTNERSHIP
(CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
P.O.: 9066-K002
LSD: INDDGO-02
JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-70	70
SCALE: NTS	APPVD BY: -	DATE: -		

H-1A/B/C/D
 THERMCAT 2000 BUILDING HEATER
 MODEL: COMBI-SAFE, HA 24.48
 RATING: 32 MBTU
 VOLTAGE: 12 V DC



GAS SUPPLY
 130 PSIG MAX.
 FROM FUEL GAS
 SEE DWG 'SF-22'

BILL OF MATERIAL

ITEM	QTY	EFX CODE	DESCRIPTION
15	4	127445	HEATER, 32 MBTU, 12/120 VOLT, COMBI-SAFE MODEL, CSA C/W [THERMCAT 2000, HA 24.48]
20	4	124349	HEATER, PROTECTION GRILL, 24" X 48" [THERMCAT, 1.17]
30	4	114721	HEATER, REGULATOR, 250 PSIG, 11" WC, 1/4" X 3/8" NPT [THERMCAT, 7.07]
40	4	127444	STARTING CABLE, 12V, 35'
45	4	109152C	SUPPORT, HEATER CABLE

NOTES:

1. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS STAMPED "RELEASED FOR MANUFACTURE".
2. MOUNT SENSING BULB LOW & ON BUILDING WALL
3. DO NOT SCALE THIS DRAWING.

REV	DESCRIPTION	DATE	DRAWN BY	CHECKED BY
3	AS BUILT	07/09/05	ATE	SHW
2	REVISED HEATER SUPPLY LINE TO 1" XS PIPE	07/03/15	ATE	
1	FOR CONSTRUCTION	07/01/19	SN	
0	FOR APPROVAL	06/11/09	SN	

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TITLE: **BUILDING HEATERS**
ARIEL RG357M, CAT G3512LE ADEM III AFRC, AIR-X 132EH
 1005HP SCREW COMPRESSOR PACKAGE

FOR: **ENCANA OIL & GAS PARTNERSHIP**
 (CHINOOK)

CONSULTANT: DPH FOCUS CORPORATION
 P.O.: 9066-K002
 LSD: INDDGO-02
 JOB No.: 060430

DRWN BY: SN	DESIGN BY: SN	DATE: 06/03/08	DWG. No.	OP #
DATE: 06/03/08	CHKD BY: SHW	DATE: 06/03/08	SF-060430-72	72
SCALE: NTS	APPVD BY: -	DATE: -		

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System Components:

- ① Inlet Scrubber
- ② Check Valve
- ③ Strainer
- ④ Shutoff Valve
- ⑤ Flow Indicator
- ⑥ Relief Valve
- ⑦ 3-Way, 3-Position, - Directional Control Valve

Note:

For North American Valves, Valve Schematic Symbols are Per NFPA/ANSI Standards, Providing Flow P to A When Energizing Solenoid A. For European Valves, Valve Schematic Symbols are Opposite, Providing Flow P to A When Energizing Solenoid B.

- ⑧ Needle Valve - Adjustable Flow Control
- ⑨ Compressor Blow-down Valve
- ⑩ Integral Oil Pump - Female Rotor Driven
- ⑪ Coalescing Filter
- ⑫ Open For Use
- ⑬ Oil Filter
- ⑭ Note:
Filter Gas Bleed is in The Center of Top.
- ⑮ Orifice
- ⑯ Temperature Control Valve - Mixing Mode
- ⑰ Differential Pressure Control Valve, Set @ 55 PSID When Lube Oil Reaches Operating Temperature.
- ⑱ Capacity Unloading Valve - Hydraulic (300 PSI Max, Cylinder)

System Components:

- ⑲ Vi Control Valve - Hydraulic (300 PSI Max, Cylinder)
- ⑳* Inlet Oil Strainer: 40 Mesh (420 Micron) 300 Lb. with 1/4" NPT Pressure ports on flanges.
* Clean at 4 PSID Differential Pressure across Inlet Oil Strainer to prevent Pump Cavitation
- ㉑ Temp. Control Valve - Normally Open
- ㉒** Gearbox Scavenge Oil Strainer
**At Regular 6 Month Maintenance Interval Remove and Clean To Maintain Good Gearbox Drainage
- ㉓*** Check Valve - Locate in Gas/Oil Separator Discharge Pipe.
- ㉔*** Back Pressure Control Valve
㉔*** Check Valve To Hold a Minimum Back Pressure of 50 PSI Above Suction Pressure.
- ㉕ Solenoid Operated Valve

Instrumentation:

- PI Pressure Indicator, 0-300 PSI SST Gauge
- ⑳ PDSLL Pressure Differential Switch LoLo - Oil Supply, Shutdown on Falling Pressure Set to 45 PSID Falling
- ㉑ PDSHH Pressure Differential Switch Hi Hi - Oil Filter, Shutdown on Rising Pressure

④	Filter	Clog Δ (Rising)		Maximum Δ	
		Normal Operating	Time Out During Start-Up	Cold Start-Up	Do Not Time Out During Start-Up
	Lube Oil	35 PSID		130 PSID	
	Rotor Injection	11 PSID		130 PSID	

- ㉒ PSHH-1 230 PSIG MAX FAIL SAFE
- ㉓ PSHH-2 Pressure Switch - Hi Hi Set To 300 PSIG Rising (min) (Safety Shutdown - Do Not Disable During Start-Up)
- TE Temperature Element
- ㉔ TSHH Temperature Switch - HiHi (Oil Supply 170°F max/ Discharge 248°F)
- P_{sc} Pressure - Scavenge
- ㉕ Δ P Differential Pressure Gauge, 0-100 PSID (Lube Oil Supply)
0-100 PSID (Lube Oil Filters)
0-30 PSID (Rotor Injection on Filter)

④	#7.- "3-WAY, 3-POSITION, DIRECTIONAL CONTROL VALVE" WAS "6-WAY, PORTED VALVE..." #13.- NOTE: "FILTER GAS BLEED IS IN..." WAS "FILTER BLEED MUST BE IN..." #16.- "DIFFERENTIAL PRESSURE CONTROL VALVE, SET @ 55 PSID WHEN LUBE OIL REACHES OPERATION TEMPERATURE." WAS " DIFFERENTIAL PRESSURE CONTROL VALVE, SET @ 55 PSID". ADDED #23.- "BACK PRESSURE CONTROL VALVE." ADDED #24.- "SOLENOID OPERATED VALVE." AT PDSLL: OIL SUPPLY, SHUTDOWN ON FALLING PRESSURE SET..." WAS "...PRE-SET..." AT PDSHH: "...SHUTDOWN ON RISING PRESSURE" WAS "...FALLING..." ADDED TABLE UNDER "PSHH PRESSURE DIFFERENTIAL." ADDED "PSHH 1, 230 PSIG MAX FAIL SAFE", "PSHH 2" WAS "PSHH". AT DELTA P, ADDED 0-100 PSID (LUBE OIL FILTERS) AND 0-30 PSID (ROTOR INJECTION ON FILTER)".	KSL 04/18/06
	REV	DESCRIPTION	INIT/DATE

4	3599	2	2914
3	3532	1	2695

 **ARIEL CORPORATION**
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

OUTLINE, RG-M SERIES
OIL SCHEMATIC ④
(HYDRAULIC CONTROLS)

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REV	ECN	DRAWN: MLA 02/03/05	CHECKED: KRN 02/04/05	SCALE: NONE
-----	-----	------------------------	--------------------------	----------------

DWG. NO. **002234**
SHEET 2 OF 3

Gas Connections:

- A1 Suction Flange SEE OUTLINE FOR ANSI FF Suction Flange
- A2 Discharge Flange SEE OUTLINE FOR ANSI FF Discharge Flange

Oil Connections:

- B1 Main Oil Supply 2" NPT
- B5 Scavenge Oil from Coalescing Filter 1" NPT
- B11 Lube Oil Pressure, Supply (High) Pressure Connection 1/4" Tube
- B12 Pre-Lube Connection 1-1/4" NPT
- BD See Outline Drawing For A Complete List Oil Drains
- ②B13 Connection for Manual or Pump Unloading (Capacity Unload-300 PSI Max)
When Pressures at A and B are Equal. (Approximately 0.2 Gallons Oil To Fully Extend Cylinder)
- ②B14 Drain (Capacity Unload)
- ③B15 Lube Oil Pressure Drain, (Low) Pressure Connection 1/4" Tube
- ③B16 Oil Filter, Lube (High) Pressure Connection 1/4" Tube
- ③B17 Oil Filter, Lube (Low) Pressure Connection 1/4" Tube
- ③B18 Oil Filter, Rotor, (High) Pressure Connection 1/4" Tube
- ③B19 Oil Filter, Rotor, (Low) Pressure Connection 1/4" Tube
- ④B20 Connection For Valve/Cylinder Actuation 1/2" Tube

System Connections:

- C1 Suction Temperature (TE) 3/4" NPTF
- C2 Suction Pressure (PI) 3/4" NPTF
- C3 Spare Suction Connection 3/4" NPTF
- C4 Discharge Temperature (TE & TSHH) 3/4" NPTF
- C5 Discharge Pressure (PI) 3/4" NPTF
- ⑤
- ⑤
- C10 Vi Stem Seal Vent 1/4" NPTF
- C11 Capacity Stem Seal Vent 1/4" NPTF

Electrical Connections:

- E1 Vi Control Position Indicator 3-wire (See Vendor Literature)
- E2 Capacity Control Position Indicator 3-wire (See Vendor Literature)
- E3 Vi Position Signal Input (Decrease Vi) 1/2" NPT (24 VDC w/Bi-Polar Transient Voltage Suppression)
- E4 Vi Position Signal Input (Increase Vi) 1/2" NPT (24 VDC w/Bi-Polar Transient Voltage Suppression)
- ③ E5 Capacity Signal Input (Increase Capacity) 1/2" NPT (24 VDC w/Bi-Polar Transient Voltage Suppression)
- ③ E6 Capacity Signal Input (Decrease Capacity) 1/2" NPT (24 VDC w/Bi-Polar Transient Voltage Suppression)
- ⑤

4	13599	2	12914
3	13532	1	12695



ARIEL CORPORATION
35 BLACKJACK ROAD
MOUNT VERNON, OHIO 43050

OUTLINE, RG-M SERIES
OIL SCHEMATIC ①
(HYDRAULIC CONTROLS)

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REV	ECN

DRAWN: MLA 02/03/05
CHECKED: KRN 02/04/05

SCALE: NONE

DWG. NO.

002234

4	ADDED OIL CONNECTION "B20, CONNECTION FOR VALVE/CYLINDER ACTUATION.	KSL 03/23/2006
REV	DESCRIPTION	INIT/DATE

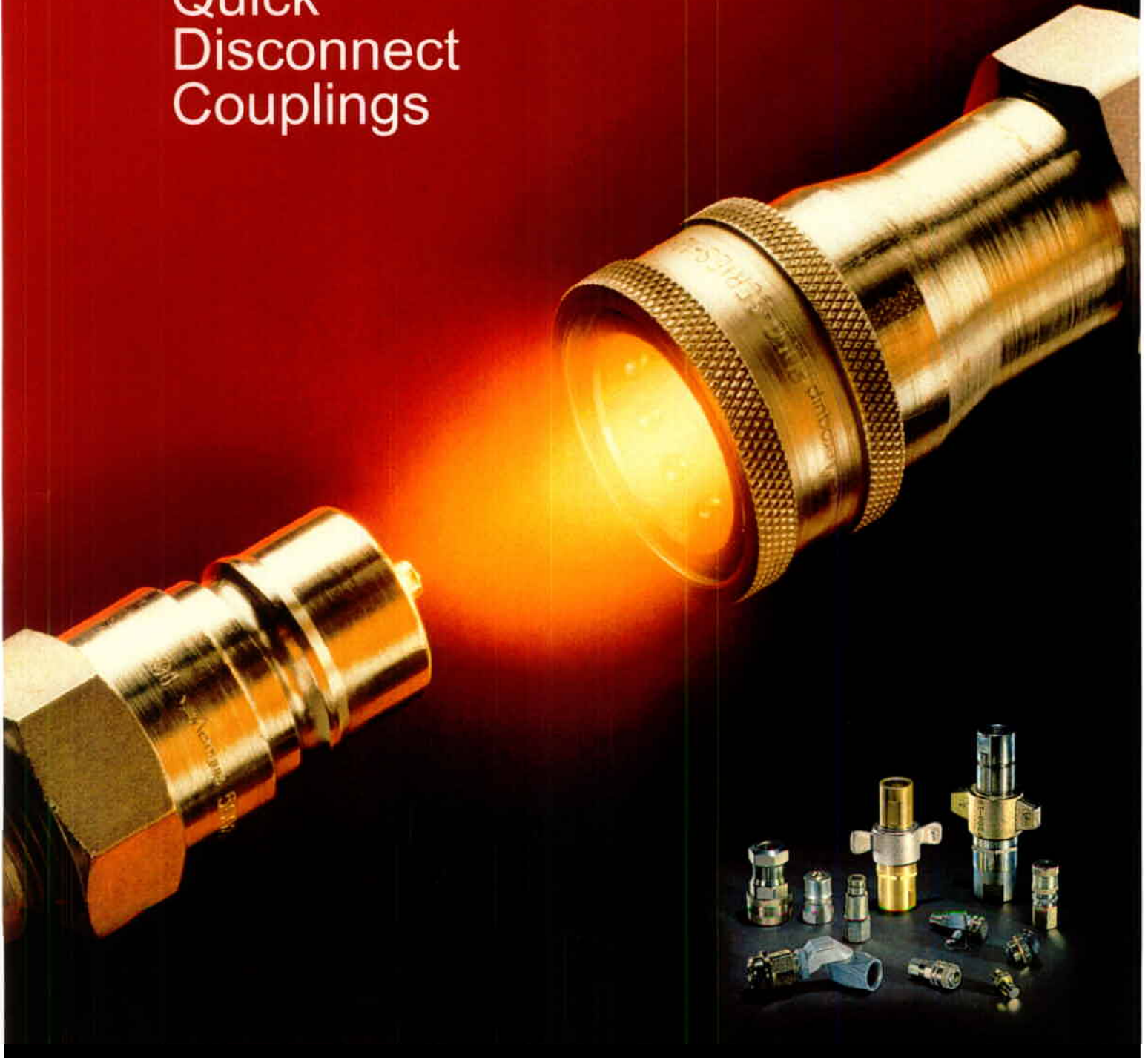
ENERFLEX

VENDOR PARTS INFORMATION
Refer to Electronic Manual

Bulletin JB27B
Supersedes
Bulletin JB27A

Aeroquip®

Quick
Disconnect
Couplings



Serving your industry with quality fluid conveying products



Construction



Forestry



Public Safety



Utility



Marine and Defense



Oil and Gas



Transportation



Steel



Machine Tool



Description	Page
Air Couplings	
FD40 Series - Interchange	17
FD41 Series - Interchange	19
FD43 Series - Interchange	21
Fluid Transfer and Hydraulic	
FD35 Series - Arc Latch, High Pressure	27
FD42 Series - Interchange	30
FD45 Series - DryBreak, Steel	33
FD45 Series - Interchange - Steel	35
FD45 Series - Interchange - Brass	38
FD45 Series - Interchange - Stainless Steel	41
FD48 Series - Interchange	45
FD49 Series - HTMA Interchange	47
5100 Series - Threaded, Low Spill	50
FD56 Series - DryBreak - Steel	33
5600 Series - General Purpose	57
FD86 Series - DryBreak, High Impulse	69

Description	Page
Fluid Transfer and Refrigerant	
5400 Series - Low Air Inclusion, Low Fluid Loss	53
Hydraulic Farm	
FD70 Series - Male Tip - Deere	68
FD71 Series - Push to Connect - ISO	64
FD72 Series - Push to Connect - Connect Under Pressure	66
FD76 Series - Male Tip - ISO	68
Special Application	
FD14 Series - Drain Coupling	23
FD15 Series - Oil Sampling Valve	25
FD69 Series - High Pressure/Water Blast	62
FD90 Series - Diagnostic	72
FF10000-02 - Diagnostic Kit	72
Configuration Index	6
Coupling Construction	9
Coupling Selection Chart	13
Fluid Compatibility Chart	15
How to Order	7
Part Number Index	3
Industry Application Symbols	5
Safety Information	8



Part numbers listed below are base part numbers that exclude size designation, for complete part number refer to page and line referenced.

Part Number	Page	Line	Part Number	Page	Line	Part Number	Page	Line
150-22	52	40-44	565006	59	33-34	FD45-1046	37	9-14
487	55	40-45	565007	59	25-26	FD45-1047	36	33-38
5100	50		565014	61	17-19	FD45-1052	43	1-5
5100	52	1-8	565015	61	9-11	FD45-1053	42	33-37
5100-22	52	45	FD14	23		FD45-1056	43	17-21
5100-S2	51	1-8	FD14-1001	24		FD45-1059	43	9-13
5100-S4	51	9-16	FD14-1002	24		FD45-1061	36	25-30
5100-S5	51	17-24	FD14-1004	24		FD45-1062	42	25-29
5100-S7	52	32-37	FD14-1204	24		FD45-1063	36	17-22
5100-S9	52	32-37	FD14-1206	24		FD45-1064	36	1-6
5101	51	33-40	FD15	25		FD45-1065	36	9-14
5110	52	17-24	FD15-1000	26	1-2	FD45-1070	36	9-14
5110-S5	51	25-32	FD15-1002	26	9	FD45-1071	36	1-6
5111	52	9-16	FD15-1025	26	25	FD45-1072	36	17-22
5400	53		FD15-1026	26	17	FD45-1075	42	17-21
5400-17	56	5	FD35	27		FD45-1076	42	9-13
5400-53	56	8	FD35-1000	28	17	FD45-1078	42	1-5
5400-54	56	7	FD35-1001	28	9	FD45-1086	39	1-7
5400-S2	54	1-4	FD35-1002	28	1	FD45-1090	39	17-23
5400-S5	54	9-12	FD35-1006	29	1	FD45-1091	39	9-15
5400-S6	55	18-21	FD35-1007	28	33	FD45-1092	39	1-7
5400-S8	55	18-21	FD35-1008	28	25	FD45-1100	39	17-23
5400-S16	56	10	FD35-1042	29	30	FD45-1101	39	9-15
5400-S19	56	12	FD35-1043	29	9	FD45-1120	42	17-21
5400-S20	56	4	FD35-1044	29	17	FD45-1121	42	1-5
5401	55	9-15	FD40	17		FD45-1122	42	9-13
5401-S14	55	1-7	FD40-1000	18	2-6	FD45-1142	42	33-37
5401-S17	54	41-47	FD40-1001	18	9-12	FD45-1143	43	1-5
5410	54	33-39	FD40-1013	18	17-21	FD45-1153	39	1-7
5410-S14	54	25-31	FD40-1013	22	22-26	FD45-1156	39	9-15
5410-S17	54	17-23	FD40-1014	18	25-32	FD45-1157	39	17-23
5600	57		FD40-1014	22	29-36	FD45-1172	36	33-38
5600	58	17-23	FD41	19		FD45-1173	37	1-6
5601	58	9-15	FD41-1000	20	1-2	FD45-1174	40	1-7
5602	34		FD41-1013	20	9	FD45-1175	39	25-31
5602	58	1-7	FD41-1014	20	17	FD45-1176	39	33-39
5603	61	42	FD42	30		FD45-1177	40	1-7
5603	65	33	FD42-1000	31	17	FD45-1178	39	33-39
5606	60	17-23	FD42-1001	31	9	FD45-1179	40	1-7
5608	60	9-15	FD42-1002	31	1	FD45-1180	39	33-39
5610	34		FD42-1006	31	41	FD45-1194	43	1-5
5610	60	1-7	FD42-1008	31	33	FD45-1195	42	33-37
5642	58	17-23	FD42-1010	31	25	FD45-1197	43	17-21
5643	58	9-15	FD43	21		FD45-1199	40	18-22
5644	58	1-7	FD43-1001	22	1-7	FD45-1201	40	10-14
5650	59	33-34	FD43-1011	22	8-14	FD45-1203	40	18-22
5651	59	25-26	FD43-1031	22	15-16	FD45-1206	37	1-6
5657	61	32-36	FD45 DryBreak	33		FD45-1207	36	33-38
5657	65	18	FD45 Steel	35		FD45-1209	43	17-21
5657	67	19	FD45 Brass	38		FD45-1211	40	18-22
5659	61	37-41	FD45 Stainless Steel	41		FD45-1228	37	17-22
5659	65	25	FD45-1000	36	17-22	FD45-1229	37	17-22
5659	67	25	FD45-1001	42	17-21	FD45-1267	44	9
5667	61	17-19	FD45-1002	34		FD45-1270	44	1
5668	61	9-11	FD45-1002	36	1-6	FD45-1399	39	31
5690	61	1-7	FD45-1003	36	9-14	FD45-1400	39	31
5691	60	33-39	FD45-1004	42	1-5	FD45-4001	34	
22008	56	6	FD45-1005	42	9-13	FD48	45	
22546	55	27-33	FD45-1040	37	34-39	FD48-1000	46	17
22546	55	35-38	FD45-1040	40	34-39	FD48-1001	46	9
22546	55	40-45	FD45-1040	43	34-38	FD48-1002	46	1
22546	56	3, 11, 13	FD45-1041	37	41-46	FD48-1042	32	9
202208	55	35-38	FD45-1041	40	41-46	FD48-1042	46	26
202208	56	2, 14	FD45-1041	43	39-43	FD49	47	
202220	55	27-33	FD45-1044	37	1-6	FD49-1001	48	25-26
560078	60	1-7	FD45-1045	37	17-22	FD49-1002	48	1-2

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.





Part numbers listed below are base part numbers that exclude size designation, for complete part number refer to page and line referenced.

Part Number	Page	Line	Part Number	Page	Line	Part Number	Page	Line
FD49-1004	48	9-10	FD76-1002	65	1	FF092	61	26-30
FD49-1005	48	33	FD76-1002	67	1	FF093	58	42-46
FD49-1014	49	1-2	FD76-1002	68	9	FF093	59	42-46
FD49-1042	49	20	FD76-1010	68	17	FF093	60	42-46
FD49-1057	48	17-18	FD86	69		FF093	61	26-30
FD49-1088	49	28	FD86-1001	71	9-10	FF095	51	41-46
FD49-1200	49	9-10	FD86-1002	71	1-2	FF095	52	25-30
FD51-1264	51	1-8	FD86-1004	71	17-18	FF097	51	41-46
FD51-1265	51	1-8	FD86-1006	70	17-18	FF097	52	25-30
FD51-1266	51	17-24	FD86-1008	70	1-2	FF098	51	41-46
FD51-1267	51	25-32	FD86-1010	70	9-10	FF098	52	25-30
FD51-1268	51	17-24	FD86-1016	71	2-3	FF1607	32	1
FD51-1269	51	25-32	FD86-1018	71	2-3	FF10000	72	
FD51-1270	51	33-40	FD86-1035	71	10-11	FF10166	63	26
FD51-1271	52	9-16	FD86-1039	71	9-10	FF10173	29	26
FD51-1272	51	33-40	FD86-1040	71	1-2	FF10174	29	27
FD51-1273	52	9-16	FD86-1041	71	17-18	FF10175	29	28
FD56 DryBreak	33		FD86-1042	70	17-18	FF10593	71	30-31
FD56-1009	60	17-23	FD86-1043	70	1-2	FF10594	71	30-31
FD56-1012	60	9-15	FD86-1044	70	9-10	FF10595	71	30-31
FD56-1037	58	25-31	FD86-1049	71	9-10	FF10596	71	27-28
FD56-1062	58	1-7	FD86-1050	71	1-2	FF10597	71	27-28
FD56-1064	58	9-15	FD86-1051	71	17-18	FF10598	71	27-28
FD56-1065	58	17-23	FD86-1052	70	17-18			
FD56-1070	59	25-26	FD86-1053	70	1-2			
FD56-1071	59	33-34	FD86-1054	70	9-10			
FD56-1072	60	1-7	FD90	72				
FD56-1074	60	9-15	FD90-1004	73	9-12			
FD56-1075	60	17-23	FD90-1012	73	17-18			
FD56-1081	61	9-11	FD90-1021	73	32-33			
FD56-1082	61	17-19	FD90-1034	73	1-2			
FD56-1123	59	17-23	FD90-1035	73	1-2			
FD56-1125	59	9-15	FD90-1040	73	32			
FD56-1196	59	17-23	FD90-1041	73	41			
FD56-1201	59	17-23	FD90-1044	73	9-12			
FD56-1204	58	33-39	FD90-1045	73	17-18			
FD56-1205	59	1-7	FD90-1046	73	25			
FD56-1207	58	33-39	FD90-1061	74	9			
FD56-1208	59	1-7	FD90-1090	74	17			
FD56-1209	60	33-39	FD90-1206	74	1			
FD56-1210	61	1-7	FD90-1047	73	25			
FD56-1221	60	25-31	FF013	36	42-47			
FD56-1225	58	33-39	FF013	37	26-31			
FD56-1226	59	1-7	FF014	36	42-47			
FD56-1233	60	33-39	FF014	37	26-31			
FD56-1234	61	1-7	FF015	36	42-47			
FD56-4001	34		FF015	37	26-31			
FD56-4101	34		FF016	39	42-48			
FD69	62		FF016	40	26-32			
FD69-1000	63	18-21	FF017	39	42-48			
FD69-1001	63	10-11	FF017	40	26-32			
FD69-1002	63	2-3	FF018	39	42-48			
FD69-1010	63	23	FF018	40	26-32			
FD69-1011	63	14	FF054	42	42-46			
FD69-1012	63	6	FF054	43	26-30			
FD69-1026	63	10-11	FF055	42	42-46			
FD69-1027	63	18-21	FF055	43	26-30			
FD69-1028	63	10-11	FF056	42	42-46			
FD69-1029	63	18-21	FF056	43	26-30			
FD70	68		FF082	58	42-46			
FD70-1010	68	1	FF082	59	42-46			
FD71	64		FF082	60	42-46			
FD71-1001	65	9	FF082	61	26-30			
FD72	66		FF092	58	42-46			
FD72-1001	67	9	FF092	59	42-46			
FD76	68		FF092	60	42-46			

QUICK DISCONNECT COUPLINGS



Industry Application Symbols

Industry symbols are provided for each coupling indicating where it is typically used. But remember, a coupling can be used in any industry, provided it meets the established application requirements.

Agriculture



FD14, FD42, FD48, 5400, 5600, FD70, FD71, FD72, FD76, FD90

Electronic Cooling



FD45 (stainless), FD45 (brass), 5100, 5400

Marine and Defense



FD14, FD15, FD35, FD45 (stainless), FD45 (brass), 5100, 5400, 5600, FD69, FD86, FD90

Chemical Processing



FD45, FD49, 5100, 5400

Food & Beverage



FD15, FD45 (stainless)

Pharmaceutical/Medical



FD15, FD45 (brass), FD45 (stainless), 5400

Construction



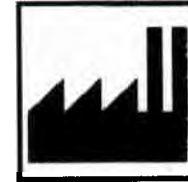
FD14, FD15, FD35, FD40, FD41, FD42, FD43, FD45 (steel), FD48, FD49, 5100, 5400, 5600, FD69, FD86, FD90

Forestry



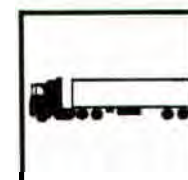
FD14, FD15, 5600, FD86

Industrial Plants



FD14, FD35, FD40, FD41, FD43, FD45 (steel), FD45 (brass), FD45 (stainless), FD48, FD49, 5100, 5600, FD69, FD86, FD90

Transportation



FD14, FD15, FD42, FD45 (steel), FD45 (brass), 5100, 5400, 5600, FD90

Oil and Gas



FD15, FD35, FD45 (stainless), FD45 (brass), 5100, 5600, FD86, FD90

Maintenance & Repair Operations



FD14, FD40, FD41, FD43, FD45 (steel), FD45 (brass), FD49, 5100, 5600, FD69, FD90

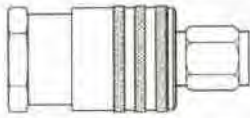
Utility



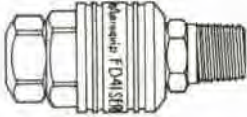
FD14, FD15, FD35, FD45 (steel), FD49, 5100, 5600, FD86, FD90



AIR COUPLINGS



FD40 Series - page 17
MIL-C-4109 Interchange—
Automatic Sleeve



FD41 Series - page 19
ARO-210 Interchange



FD43 Series - page 21
MIL-C-4109 Interchange—
Manual Sleeve

HYDRAULIC—FARM

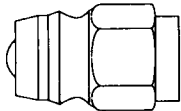


FD71 Series - page 64
Push to Connect
ISO Interchange

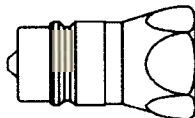


FD72 Series - page 66
Push to Connect
Connect Under Pressure—Male
ISO Interchange

Male Tips

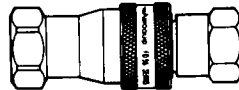


FD70 Series - page 68
Deere Interchange

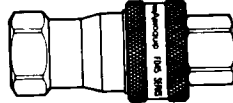


FD76 Series - page 68
ISO Standard

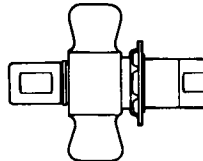
FLUID TRANSFER and HYDRAULIC



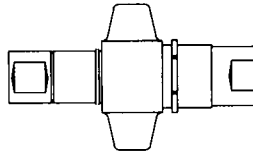
5600 Series - page 57
General Purpose Industrial Interchange
ISO 7241/1 Series A



FD45 Series
Steel...page 35
Brass...page 38
Stainless Steel...page 41
Industrial Interchange
ISO 7241/1 Series B



5100 Series - page 50
Thread Together—Low Spill



FD86 Series - page 69
5000 psi High Impulse—DryBreak



FD49 Series - page 47
Flush Face—No Spill
HTMA Interchange



FD35 Series - page 27
High Pressure—"Arc Latch™"



FD42 Series - page 30
Pioneer 4000-2 Interchange



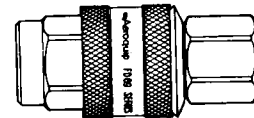
FD48 Series - page 45
Bruning SM-250 Interchange

FLUID TRANSFER and REFRIGERANT



5400 Series - page 53
Low Spill—Low Air Inclusion

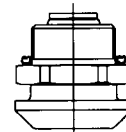
SPECIAL APPLICATION



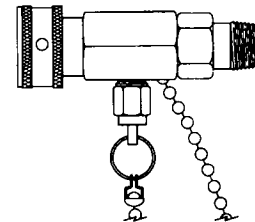
FD69 Series - page 62
Water Blast "Arc Latch™"



FD90 Series - page 72
Diagnostic SAE J1502 Interchange



FD14 Series - page 23
Drain Coupling



FD15 Series - page 25
Oil Sampling Valve

DRYBREAK



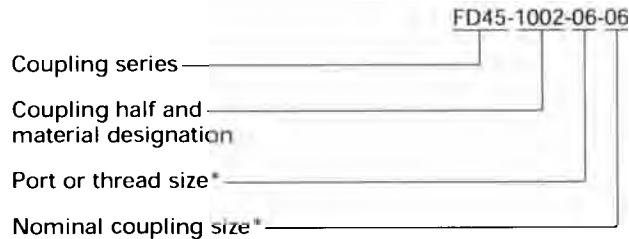
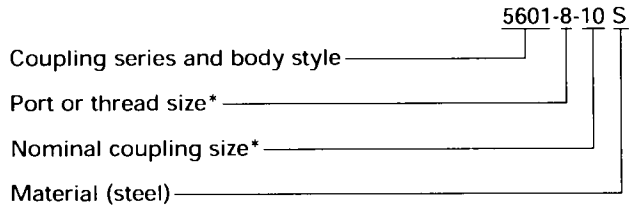
FD56 and FD45 DryBreak - page 33
ISO 7241



How to Order

Aeroquip quick disconnect couplings can generally be ordered as a complete assembly or as separate halves. Couplings ordered by complete assembly part numbers will be supplied by halves. For special packaging, contact Aeroquip. (The FD14, FD40, FD41, FD43, FD86 and FD90 series are ordered by halves only.)

Standard coupling part numbers are described below:



*Size designations are represented in 16ths of an inch, i.e., 06 = 3/8 or 1/2 inch

Dimensions

Dimensions in this catalog are for reference only. Actual dimensions may vary from those shown.

Coupling Identification

Generally, the coupling series or complete part number will be stenciled on the coupling body.

Caution:

The user should observe carefully the precautions listed in this catalog. These include selection of seals and body materials for fluid compatibility and recommendations on the selection of quick disconnect couplings. In addition, care should be taken not to exceed the maximum operating pressures listed for each coupling size and type shown in the physical characteristics table for each coupling. Because of possible variations in machining tolerances, quality control, inspection and quality assurance, Aeroquip coupling halves should not be used with coupling halves supplied by other manufacturers except where such use is approved for a particular coupling as noted in this catalog.

For Technical Assistance Contact:

Eaton Aeroquip, Industrial Division,
3000 Strayer, Maumee, OH 43537
Phone: (419) 867-2600, FAX: (419) 867-2629



Construction



Electronic Cooling



Forestry



Safety Information for Aeroquip Coupling and Swivel Products

1.0 General Instructions

1.1 Scope. The scope of this safety bulletin is to warn against improper selection, use, installation, etc. of Aeroquip coupling/swivel products.

1.2 Distribution. A copy of this safety bulletin should be distributed to all individuals responsible for using and/or selecting Aeroquip coupling/swivel products.

1.3 Fail-Safe. Design all systems and equipment for fail-safe operation such that failure of any component does not result in personal injury and/or property damage.

1.4 User Responsibility. It is the sole responsibility of the user to select and determine that the Aeroquip product is compatible with the end use application. The user is responsible for reading and following this safety bulletin as well as any instructions or literature on the Aeroquip product being used. The user must provide necessary product warnings for Aeroquip couplings/swivel products, used with systems or equipment, to the operators of the systems or equipment.

1.5 Usage with other Manufacturers' Products. When using Aeroquip coupling/swivel products with other manufacturers' adapters, hoses, etc., do not exceed the lowest pressure rating of any of the components being used or rupture may result.

2.0 Selection of Aeroquip Couplings/Swivels.

2.1 Pressure. Ensure that the maximum operating pressure of the system or equipment does not exceed the rated operating pressure of the Aeroquip coupling/swivel product or rupture may result.

2.2 Fluid compatibility. Verify that all components (seals, metals, etc.) are compatible with the fluid being conveyed. Failure to do so may result in high speed fluid discharge and/or leakage of fluids which may be flammable, toxic, at extreme temperatures, or otherwise harmful.

2.3 Temperature. Ensure that the maximum operating temperature of the system or equipment does not exceed the rated operating temperature of the Aeroquip coupling/swivel product (including seals) or rupture may result.

2.4 Coupling/Swivel Size. Use properly sized couplings/swivels such that there is not a large pressure drop across them thus avoiding system damage due to excessive heat generation or failure of internal components.

2.5 Sleeve Lock. Use sleeve locks or threaded couplings where there is the possibility of accidental disconnection. Failure to utilize sleeve locks or threaded couplings in these applications may result in hose whip, expelled components, high speed fluid discharge, system damage, or leakage of fluids which may be flammable, toxic, at extreme temperatures, or otherwise harmful.

2.6 Connect or Disconnect Under Pressure. If connection and/or disconnection of couplings under pressure is a requirement, only use couplings designed for connection/disconnection under pressure. Failure to utilize this type of coupling in that application may result in hose whip, expelled components, high speed fluid discharge, and/or system damage. Be certain not to confuse the rated operating pressure with the rated connect/disconnect under pressure.

2.7 Environment. Ensure that Aeroquip couplings/swivels are compatible with the surrounding environment. The surrounding environment may be heat, salt water, moisture, chemicals, and the like. Failure to protect against an adverse environment may cause system damage, premature failure, and/or leakage of fluids which may be flammable, toxic, at extreme temperatures, or otherwise harmful.

2.8 External Loads. Avoid any external loads such as side loads, tensile loads, vibration, etc. Failure to do so may result in accidental disconnection, premature failure, system damage, and/or leakage of fluids which may be flammable, toxic, at extreme temperatures, or otherwise harmful.

2.9 Welding & Brazing. Extreme heating of plated products above +450°F (+232°C) such as welding, brazing, baking, etc., where the plating is burned off, may result in the release of deadly gases.

3.0 Installation of Aeroquip Coupling & Swivel Products.

3.1 Inspection of Product. Prior to installation, ensure that the Aeroquip product meets all of the requirements of the system and/or equipment it is to be used on. Ensure you have the correct part number, function test the coupling by connecting it with a mating half, and function test the swivel by rotating the sleeve. The function test should result in smooth, non-binding operation or premature failure may result.

3.2 Cleanliness. Use end caps and plugs to reduce the risk of system contamination or damage to critical sealing surfaces. Failure to do so may result in leakage of fluids which may be flammable, toxic, at extreme temperatures, or otherwise harmful. Caps and plugs are not a secondary seal unless explicitly noted.

3.3 Location. Place Aeroquip couplings and swivels in a safe location such as not to expose the user to personal injury (slippage, tripping, falling, etc.) during installation, connection, disconnection and maintenance.

4.0 Product Maintenance. A maintenance schedule should be put in place to ensure that Aeroquip couplings and swivels are functioning properly.

4.1 Inspection. Visually inspect to ensure that there is NO leakage, cracked components, corrosion build-up, contamination build-up, wear, etc. If any abnormality is encountered, the coupling or swivel should be replaced immediately.

Note: To obtain additional copies of this Safety Information Bulletin (60JB), contact Aeroquip at: Phone: 1-800-625-9100 Fax: 1-800-437-5318.



Quick Disconnect Couplings

Quick disconnect couplings are connecting devices which permit easy, immediate connection and separation of fluid lines. When installed in a fluid system, quick disconnect couplings save time by eliminating system bleeding, recharging and purging of air whenever an accessory is being replaced. Dependability is assured because the coupling valves automatically open and close and because the possibility of air, dirt, and moisture being trapped in the system is minimized.

Aeroquip quick disconnect couplings may be used in systems to help align components and the swivel feature helps prevent twisting of hose assemblies. However, they are not intended to be used as swivel joints in applications subjected to constant rotation. Aeroquip swivel joints should be used in these applications. See pages 225-239 of JA316G.

Selection of Quick Disconnect Couplings

See selection chart on pages 13 and 14.

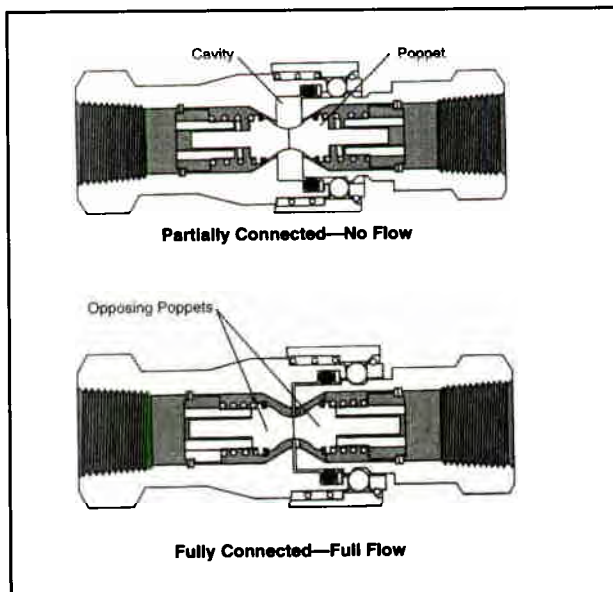
The following questions should be answered before selecting or specifying a quick disconnect coupling.

1. What are the functional requirements of the coupling?
2. To what pressures will the coupling be subjected?
3. What are the flow requirements of the coupling?
4. What is the maximum acceptable pressure drop at specified flow rate?
5. Is the coupling to be connected or disconnected under pressure? How much pressure? Which half?
6. What metals are compatible with the fluid in the system?
7. What seals are compatible with the system's fluid?
8. Are minimum air inclusion or fluid loss upon connection and disconnection critical to the proper operation of the system?
9. What threads and end configurations are necessary?
10. Is bulkhead flange or frame mounting necessary?
11. Should the coupling be interchangeable with other couplings presently in use?

I. Types of Valves

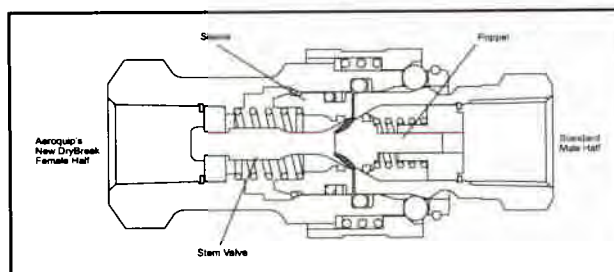
Double Poppet Valves - Most Common

FD14, FD35, FD42, FD45, FD48, 5600, FD71, FD72, FD76



- Spring loaded poppet valves in each half immediately self-seal both halves upon disconnection.
- Cavity between halves allows some air inclusion when connecting and some fluid loss upon disconnection.
- Durable and economical.

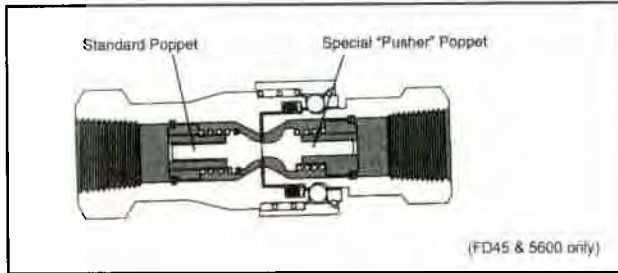
Stem Valve and Sleeve - Poppet FD45 DryBreak and FD56 DryBreak



- Patented valving for low air inclusion and fluid loss.
- Allows mating to any standard ISO 7241 poppet style male half.
- Spring loaded sleeve in the female half seals against stem valve and body.
- Poppet valve in opposing half self seals.
- No cavity between halves to cause spillage or air inclusion.



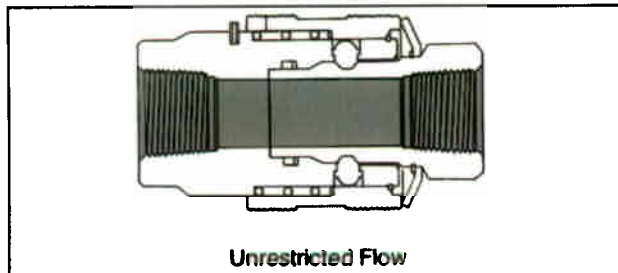
Valved - One Side
FD40, FD41, FD43, FD45, 5600



- Immediate self-sealing in valved half only.
- Either male or female half can be valved.
- Full flow in non-valved half upon disconnection.

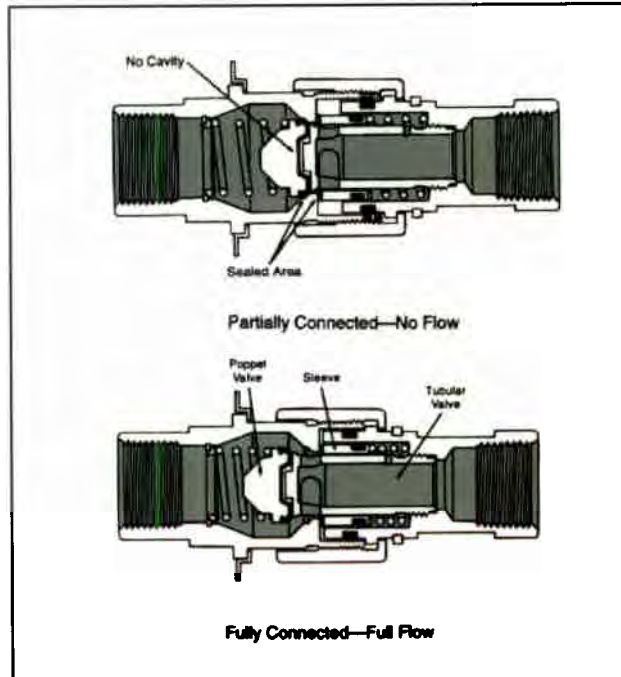
NOTE: A "Pusher" poppet is needed in non-valved half to open poppet in valved half except for FD40, FD41 and FD43.

No Valves
FD45, 5600, FD69



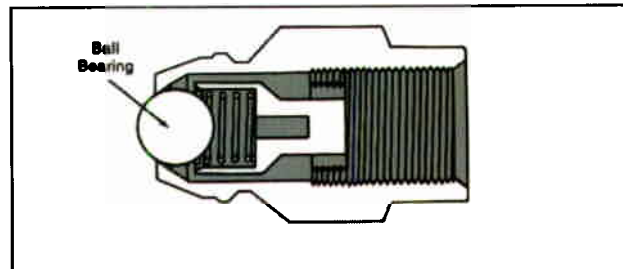
- Full flow when connected and disconnected.
- Minimum pressure drop.
- Maximum flow.

Tubular Valve and Sleeve - Poppet
FD49, 5100, 5400, FD86, FD90



- Precision valving for low air inclusion and fluid loss.
- Spring loaded sleeve provides access to tubular valve ports.
- Poppet valve in opposing half self seals.
- No cavity between halves to cause spillage or air inclusion.

Ball Bearing Valve
FD70

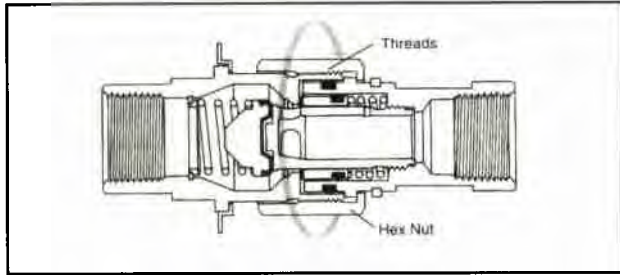


- Spring loaded ball bearing.
- Durable and economical.
- Not recommended for vacuum.
- Metal-to-metal seal.



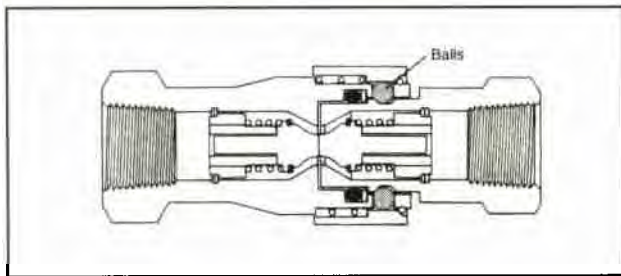
II. Types of Latches

**Threaded Connections
5100, 5400, FD86**



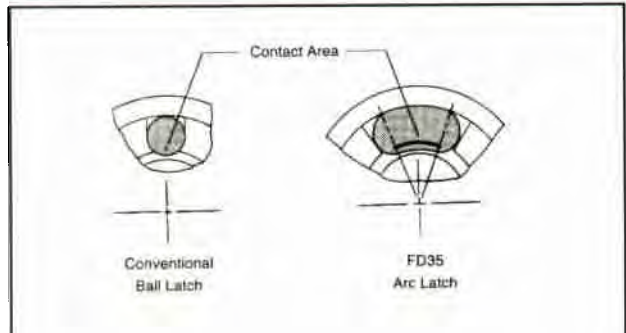
- Uses mechanical advantage of threads to connect or disconnect under pressure.
- Greater holding power under impulsing and vibration.
- Union nuts may be wing or hex type.

**Ball Latch Connections
FD14, FD40, FD42, FD43, FD45, FD48, FD49,
5600 (FD56), FD71, FD72, FD90**



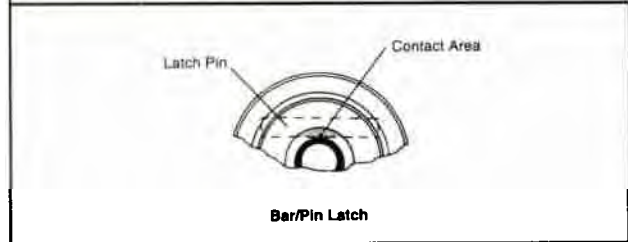
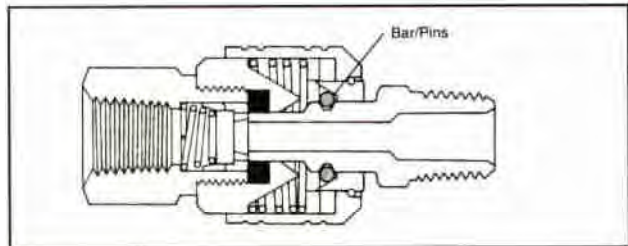
- Series of balls on female half, lock into recess on male half.
- Allows for 360° swiveling (not intended for constant swiveling).
- Quick and easy to connect and disconnect.
- Can be used as an emergency breakaway when female sleeve is frame mounted.
- Most popular and economical latching design.

**"Arc Latch™" Connections
FD35, FD69**



- Exclusive Aeroquip design.
- Series of arcs in female half, lock into recess on male half (same as ball latch).
- Greater surface contact area gives tremendous holding strength.
- For high pressure applications.

**Bar/Pin Latch Connections
FD41**

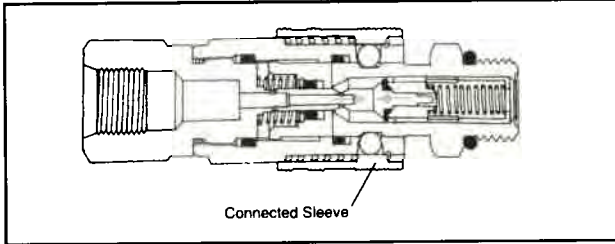


- Two bar/pins in female half lock into recess on male half.
- Allows for 360° swiveling (not intended for constant swiveling).
- Design allows for push to connect operation.
- Typically used for low pressure applications.



**Latching Methods—(How To)
Push-to-Connect**

**FD14, FD40, FD41, FD49, FD90,
(FD71, FD72 when female half is frame mounted)**



To Connect

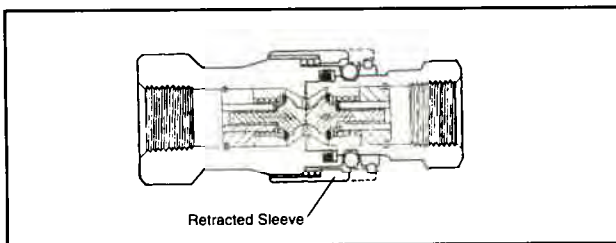
- Relieve system pressure.
- Insert and push male half into female half.
- Release sleeve on female half will connect automatically.
- Only one hand is required.
- FD71, FD72, only—to obtain push-to-connect female half must be frame mounted. (Ref. 5603 breakaway frame.) Female half end port must be connected to a 12" minimum length of flexible hose for full female body motion.

To Disconnect

- Relieve system pressure.
- Manually retract release sleeve on female half and remove male half.
- FD71, FD72 only—female half must be frame mounted and will automatically disconnect when male half is pulled out. This requires a slightly higher force to disconnect.

Retract (Sleeve) To-Connect

FD35, FD42, FD43, FD45, FD48, 5600 (FD56), FD69



To Connect

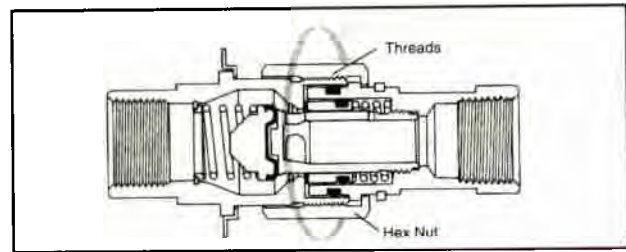
- Relieve system pressure.
- Pull back and hold release sleeve on female half.
- Insert male half.
- Let go of release sleeve on female half.

To Disconnect

- Relieve system pressure.
- Pull back and hold release sleeve on female half.
- Remove male half.
- Let go of release sleeve on female half.

Thread-to-Connect

5100, 5400, FD86



- Prevent male from rotating.
- Insert male into union nut on female body assembly.
- Rotate union nut clockwise.
 - With hand if wing nut type.
 - With wrench if hex nut type.
- Tighten as follows.

5100 Series

- Tighten until halves bottom out and connection indicator groove is no longer visible.

FD86 Series

- Tighten until halves bottom out and connection indicator O-Ring is no longer visible.

5400 Series

- Recommended torque values for S2 half to S5 half are listed below.

Dash Size	Torque - ft. lbs.
-4	10-12
-8	35-37
-12	45-47
-16	65-67

COUPLING SELECTION CHART



QUICK DISCONNECT COUPLINGS

Below is a capability selection chart to aid you in locating the proper coupling to meet your requirements. This chart should be used in conjunction with the fluid compatibility charts on pages 15 and 16 and the appropriate product pages.

This information is intended as a guide only and final selection is further dependent on fluid and ambient temperature, concentration of agent, intermittent or continuous exposure, etc.

For further details on a specific coupling, see the appropriate catalog pages.

Where dash sizes appear in the chart below, the coupling is available only in those sizes.

The check marks (✓) in the chart below indicate product is normally available in either final assembly and/or component form. Contact Aeroquip for availability of products without a check mark.

Function	Nominal Coupling Size (inches)	Dash Size	FD14 Pg. 23	FD15 Pg. 25	FD35 Pg. 27	FD40 Pg. 17	FD41 Pg. 19	FD42 Pg. 30	FD43 Pg. 21	FD45				FD48 Pg. 45
										DryBreak Steel Pg. 33	Steel Pg. 35	Brass Pg. 38	SS Pg. 41	
	1/8	-2									4500	1000		
	1/4	-4		50/300		300	300	3000	300	4000	5000	1000	3000	3000
	3/8	-6	50		10000	300			300	4000	4000	1000	1500	
	1/2	-8				300			300					
	1/2	-8-10								4000	4000	1000	1500	
	3/4	-12								4000	4000	1000	1500	
	1	-16									4000	1000	1250	
	1 1/4	-20										1000		
	1 1/2	-24												
	2	-32												
Vacuum (in./Hg.)			28	28	28	28	28	28		28/15	28	28	28	28
Choice of Seals (other seal compounds available upon request)	Buna-N		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
	Neoprene								✓					
	EPR									✓	✓	✓	✓	
	Viton		✓		✓					✓	✓	✓	✓	
Valve Options	No-spill valving			N/A						✓				
	Double valve		✓	N/A	✓			✓		✓	✓	✓	✓	✓
	Valved male only			N/A							✓	✓	✓	✓
	Valved female only			N/A		✓	✓		✓		✓	✓	✓	✓
	Straight thru - no valves			N/A							✓	✓	✓	✓
Basic Material	Steel		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	Brass											✓		
	Stainless Steel												✓	
	Aluminum													
	Polypropylene													
Latch Style	"Arc latch" TM				✓									
	Ball latch		✓			✓		✓	✓	✓	✓	✓	✓	✓
	Bar Pin latch						✓							
	Threaded													
End Connections	Female pipe		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Male pipe		✓	✓		✓	✓		✓					
	Fem. st. thd. O-ring				✓			✓						
	Male st. thd. O-ring		✓	✓										
	SAE 37° (JIC) male													
	Metric male O-ring		✓											
	Braze													
Mounting Method	Hose barb								✓					
	Bulkhead							✓						
	Flange													
Frame														
Connect Under Pressure						✓	✓		✓					
Caps/Plugs			✓		✓			✓		✓	✓	✓	✓	✓
Full Field Service					✓						✓	✓	✓	
Push to Connect (Automatic Sleeve)			✓			✓	✓							
Interchangeable with Other Brands					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

COUPLING SELECTION CHART



QUICK DISCONNECT COUPLINGS

Function	Nominal Coupling Size (inches)	Dash Size	FD49 Pg. 47	5100 Pg. 50	5400 Pg. 53	5600		FD69 Pg. 62	FD71 Pg. 64	FD72 Pg. 66	FD86 Pg. 69	FD90 Pg. 72
						DryBreak Pg. 33	Standard Pg. 57					
Maximum Operating Pressure (psi connected)	1/8	-2										
	1/4	-4		3000*	3000*		5000					7000
	3/8	-6	3000	3000*		4000	4000					
	1/2	-8		3000*	1750*			10000				
	1/2	-8-10				4000	4000		3000	3000		
	3/4	-12		3000*	700*	4000	4000					
	1	-16		3000*	700*		4000				5000	
	1 1/4	-20		2750*							5000	
	1 1/2	-24		2500*								
	2	-32										
Vacuum (in./Hg.)			28	28	28	28/15	28	28	28	28	28	28
Choice of Seals (other seal compounds available upon request)	Buna-N		✓	✓		✓	✓	✓	✓	✓	✓	✓
	Neoprene			✓								
	EPR			✓		✓	✓	✓			✓	✓
	Viton			✓		✓	✓	✓			✓	✓
Valve Options	No spill valving		✓	✓	✓	✓					✓	✓
	Double valve		✓	✓	✓	✓			✓	✓	✓	✓
	Valved male only						✓					
	Valved female only						✓					
	Straight thru - no valves						✓	✓				
Basic Material	Steel		✓		✓	✓	✓	✓	✓	✓	✓	✓
	Brass			✓								
	Stainless Steel							✓				
	Aluminum											
	Polypropylene											
Latch Style	"Arc latch™"							✓				
	Ball latch		✓			✓	✓		✓	✓		✓
	Bar Pin latch											
	Threaded			✓	✓						✓	
End Connections	Female pipe		✓	✓		✓	✓	✓	✓	✓		✓
	Male pipe											✓
	Fem. st. thd. O-ring		✓			✓	✓				✓	✓
	Male st. thd. O-ring		✓									✓
	SAE 37" (JIC) male				✓							✓
	Metric male O-ring											✓
	Braze				✓							
Hose barb												
Mounting Method	Bulkhead			✓					✓	✓		✓
	Flange			✓							✓	
	Frame					✓	✓		✓	✓		
Connect Under Pressure		500	500	✓		-8 -10			✓	750	500	
Caps/Plugs		✓	✓	✓	✓	✓		✓	✓	✓	✓	
Full Field Service			✓	✓		✓	✓			✓		
Push to Connect (Automatic Sleeve)		✓						✓	✓		✓	
Interchangeable with Other Brands		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

*Not recommended for continuous hydraulic impulse applications at maximum operating pressure.



FLUID COMPATIBILITY

This chart indicates the suitability of various elastomers and metals for use with fluids to be conveyed. It is intended for use with Aeroquip couplings and should not be used to determine compatibility for other products. It is intended as a guide only and is not a guarantee. Final selection of the proper seal or material of metal components is further dependent on many factors including pressure, fluid and ambient temperature, concentration, duration of exposure, etc.

HOW TO USE THE CHART

- Both the elastomer and the metal must be considered when determining suitability of a combination for a coupling.
- Locate the fluid to be conveyed and determine the suitability of the elastomeric and metal components according to the resistance ratings shown for each.
- Dimensional and operation specifications for each coupling can be found on the catalog pages.
- Information on seal options for couplings, and how to specify them, are shown in the respective sections of this catalog.
- Be sure to check the table below for maximum operating temperature range of the elastomer for desired temperature.
- For further details on the products shown in this catalog, and their applications, consult your Aeroquip Sales Representative or Aeroquip Corporation, Americas Industrial Division, Maumee, Ohio.
- Coupling component materials may differ from body material. Refer to specific catalog pages.

RESISTANCE RATING KEY

E = Excellent - Fluid has little or no effect.
 G = Good - Fluid has minor to moderate effect.
 C = Conditional - Service conditions should be described to Aeroquip for determination of suitability for application.
 U = UNSATISFACTORY

The differences between ratings "E" and "G" are relative. Both indicate satisfactory service. Where there is a choice, the materials rated "E" may be expected to give better or longer service than those rated "G".

SEAL ELASTOMER DATA

Seal Elastomer	Application Specification	Max. Operating Temperature Range
Buna-N	none	-40°F to +250°F (-40°C to +121°C)
Neoprene	none	-65°F to +300°F (-54°C to +149°C)
EPR (Ethylene Propylene Rubber)	none	-65°F to +300°F (-54°C to +149°C)
Viton	MIL-R-25897	-15°F to +400°F (-29°C to +204°C)

NOTE: This chart does not apply to bonded seals used in the 5100 and FD86 Series Couplings. Consult Aeroquip for special applications.

FLUID	SEALS							METAL		
	Buna-N	Neoprene	EPR/EPDM	Viton	Steel	Brass	Cres	Aluminum	Monel	
Acetaldehyde	E	E	E	U	E	U	E	E	E	
Acetic Acid, 10%	U	U	U	U	U	U	U	U	U	
Acetic Acid, Glacial	U	U	U	U	U	U	U	U	U	
Acetone	U	U	U	U	U	U	U	U	U	
Acetophenone	U	U	U	U	U	U	U	U	U	
Acetyl Acetone	U	U	U	U	U	U	U	U	U	
Acetyl Chloride	U	U	U	U	U	U	U	U	U	
Acetylene	U	U	U	U	U	U	U	U	U	
Air, Hot (Up to +160°F)	U	U	U	U	U	U	U	U	U	
Air, Hot (161°F - 200°F)	U	U	U	U	U	U	U	U	U	
Air, Hot (201°F - 300°F)	U	U	U	U	U	U	U	U	U	
Air Wet	U	U	U	U	U	U	U	U	U	
Aluminum Chloride	U	U	U	U	U	U	U	U	U	
Aluminum Fluoride	U	U	U	U	U	U	U	U	U	
Aluminum Nitrate	U	U	U	U	U	U	U	U	U	
Aluminum Sulfate	U	U	U	U	U	U	U	U	U	
Alums	U	U	U	U	U	U	U	U	U	
Ammonia, Cold	E	E	E	E	U	C	E	C	C	

FLUID	SEALS							METAL		
	Buna-N	Neoprene	EPR/EPDM	Viton	Steel	Brass	Cres	Aluminum	Monel	
Ammonia, Hot	U	G	G	U	E	U	E	E	E	
Ammonia, Anhydrous	E	E	E	U	E	U	E	E	E	
Ammonia, Aqueous	E	E	E	U	E	U	E	E	E	
Ammonium Carbonate	E	E	E	U	E	U	E	E	E	
Ammonium Chloride	E	E	E	U	E	U	E	E	E	
Ammonium Hydroxide	E	E	E	U	E	U	E	E	E	
Ammonium Nitrate	E	E	E	U	E	U	E	E	E	
Ammonium Phosphate	E	E	E	U	E	U	E	E	E	
Ammonium Sulfate/Sulfide	E	E	E	U	E	U	E	E	E	
Amyl Acetate	U	U	U	U	U	U	U	U	U	
Amyl Alcohol	U	U	U	U	U	U	U	U	U	
Aniline, Aniline Oil	U	U	U	U	U	U	U	U	U	
Aniline Dyes	U	U	U	U	U	U	U	U	U	
Arsenic Acid	U	U	U	U	U	U	U	U	U	
Asphalt	E	E	E	U	E	U	E	E	E	
ASTM #1	E	E	E	U	E	U	E	E	E	
ASTM #2	E	E	E	U	E	U	E	E	E	
ASTM #3	E	E	E	U	E	U	E	E	E	
Automatic Trans. Fluid	E	E	E	U	E	U	E	E	E	
Barium Chloride	E	E	E	U	E	U	E	E	E	
Barium Hydroxide	E	E	E	U	E	U	E	E	E	
Barium Sulfide	E	E	E	U	E	U	E	E	E	
Benzene, Benzol	U	U	U	U	U	U	U	U	U	
Benzin	U	U	U	U	U	U	U	U	U	
Benzoic Acid	U	U	U	U	U	U	U	U	U	
Benzyl Alcohol	U	U	U	U	U	U	U	U	U	
Black Sulfate Liquor	U	U	U	U	U	U	U	U	U	
Blast Furnace Gas	U	U	U	U	U	U	U	U	U	
Borax	U	U	U	U	U	U	U	U	U	
Boric Acid	U	U	U	U	U	U	U	U	U	
Bromine	U	U	U	U	U	U	U	U	U	
Butane	U	U	U	U	U	U	U	U	U	
Butyl Acetate	U	U	U	U	U	U	U	U	U	
Butyl Alcohol	U	U	U	U	U	U	U	U	U	
Butyl Cellulosolve	U	U	U	U	U	U	U	U	U	
Butylene	U	U	U	U	U	U	U	U	U	
Butyl Stearate	U	U	U	U	U	U	U	U	U	
Butyraldehyde	U	U	U	U	U	U	U	U	U	
Calcium Acetate	U	U	U	U	U	U	U	U	U	
Calcium Bisulfate	U	U	U	U	U	U	U	U	U	
Calcium Chloride	U	U	U	U	U	U	U	U	U	
Calcium Hydroxide	U	U	U	U	U	U	U	U	U	
Calcium Hypochlorite	U	U	U	U	U	U	U	U	U	
Calcium Nitrate	U	U	U	U	U	U	U	U	U	
Cane Sugar Liquors	U	U	U	U	U	U	U	U	U	
Carbitol	U	U	U	U	U	U	U	U	U	
Carbolic Acid	U	U	U	U	U	U	U	U	U	
Carbonic Acid	U	U	U	U	U	U	U	U	U	
Carbon Dioxide	U	U	U	U	U	U	U	U	U	
Carbon Disulfide	U	U	U	U	U	U	U	U	U	
Carbon Monoxide	U	U	U	U	U	U	U	U	U	
Carbon Tetrachloride	U	U	U	U	U	U	U	U	U	
Castor Oil	U	U	U	U	U	U	U	U	U	
Cellulosolve Acetate	U	U	U	U	U	U	U	U	U	
China Wood Oil (Tung Oil)	U	U	U	U	U	U	U	U	U	
Chlorine	U	U	U	U	U	U	U	U	U	
Chloracetic Acid	U	U	U	U	U	U	U	U	U	
Chloroacetone	U	U	U	U	U	U	U	U	U	
Chlorobenzene	U	U	U	U	U	U	U	U	U	
Chloroform	U	U	U	U	U	U	U	U	U	
Chlorophenol	U	U	U	U	U	U	U	U	U	
Chlorosulfonic Acid	U	U	U	U	U	U	U	U	U	
Chrome Plating Solution	U	U	U	U	U	U	U	U	U	
Chromic Acid	U	U	U	U	U	U	U	U	U	
Citric Acid	U	U	U	U	U	U	U	U	U	
Coke Oven Gas	U	U	U	U	U	U	U	U	U	
Copper Chloride	U	U	U	U	U	U	U	U	U	
Copper Cyanide	U	U	U	U	U	U	U	U	U	
Copper Sulfate	U	U	U	U	U	U	U	U	U	
Cotton Seed Oil	U	U	U	U	U	U	U	U	U	
Creosote (Coal Tar)	U	U	U	U	U	U	U	U	U	
Crude Oil	U	U	U	U	U	U	U	U	U	
Cyclohexanol	U	U	U	U	U	U	U	U	U	
Cyclohexanone	U	U	U	U	U	U	U	U	U	
Detergent/Water Solution	U	U	U	U	U	U	U	U	U	
Diacetone Alcohol (Acetol)	U	U	U	U	U	U	U	U	U	
Dibenzyl Ether	U	U	U	U	U	U	U	U	U	
Diesel Oil	U	U	U	U	U	U	U	U	U	
Diethylamine	U	U	U	U	U	U	U	U	U	
Dowtherm A&E	U	U	U	U	U	U	U	U	U	
Dowtherm 209	U	U	U	U	U	U	U	U	U	
Ethyl Alcohol (Ethanol)	U	U	U	U	U	U	U	U	U	
Ethyl Acetate	U	U	U	U	U	U	U	U	U	
Ethyl Benzene	U	U	U	U	U	U	U	U	U	
Ethyl Cellulose	U	U	U	U	U	U	U	U	U	
Ethyl Chloride	U	U	U	U	U	U	U	U	U	

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QUICK DISCONNECT COUPLINGS

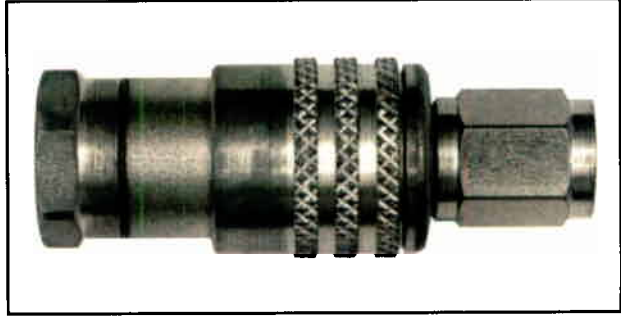
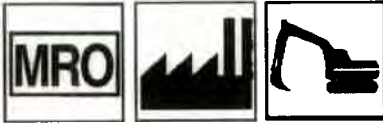
FLUID	SEALS					METAL				
	Buna-N	Neoprene	EPR/EPDM	Viton	Steel	Brass	Cres	Aluminum	Monel	
Ethylene Dichloride	U	U	U	G	G	G	G	G	G	
Ethylene Glycol	U	U	U	G	G	G	G	G	G	
Ferric Chloride	E	E	E	E	U	U	U	U	U	
Ferric Nitrate	E	E	E	E	U	U	U	U	U	
Ferric Sulfate	E	E	E	E	U	U	U	U	U	
Formaldehyde	G	G	G	E	U	U	U	U	U	
Formic Acid	C	C	C	G	U	U	U	U	U	
Fuel Oil	C	C	C	U	U	U	U	U	U	
Furfural	C	C	C	U	U	U	U	U	U	
Gallic Acid	C	C	C	U	U	U	U	U	U	
Gasoline	C	C	C	U	U	U	U	U	U	
Gasohol	C	C	C	U	U	U	U	U	U	
Glycerin/Glycerol	E	E	E	E	E	E	E	E	E	
Green Sulfate Liquor	E	E	E	E	E	E	E	E	E	
Helium	E	E	E	E	E	E	E	E	E	
Heptane	E	E	E	E	E	E	E	E	E	
Hexaldehyde	E	E	E	E	E	E	E	E	E	
Hexane	E	E	E	E	E	E	E	E	E	
Hydraulic Oils	E	E	E	E	E	E	E	E	E	
Straight Petroleum	E	E	E	E	E	E	E	E	E	
Water Petroleum Emulsion	E	E	E	E	C	E	E	E	E	
Water Glycol	E	E	E	E	E	E	E	E	E	
Straight Phosphate Ester	E	E	E	E	E	E	E	E	E	
Phos. Ester/	E	E	E	E	E	E	E	E	E	
Petroleum Blend	E	E	E	E	E	E	E	E	E	
Ester Blend	E	E	E	E	E	E	E	E	E	
Silicone Oils	E	E	E	E	E	E	E	E	E	
Hydrobromic Acid	U	U	U	U	U	U	U	U	U	
Hydrochloric Acid	U	U	U	U	U	U	U	U	U	
Hydrocyanic Acid	U	U	U	U	U	U	U	U	U	
Hydrofluoric Acid	U	U	U	U	U	U	U	U	U	
Hydrofluorosilic Acid	U	U	U	U	U	U	U	U	U	
Hydrogen	U	U	U	U	U	U	U	U	U	
Hydrogen Peroxide	U	U	U	U	U	U	U	U	U	
Hydrogen Sulfide, Dry	U	U	U	U	U	U	U	U	U	
Isooctane	U	U	U	U	U	U	U	U	U	
Isopropyl Acetate	U	U	U	U	U	U	U	U	U	
Isopropyl Alcohol	U	U	U	U	U	U	U	U	U	
Isopropyl Ether	U	U	U	U	U	U	U	U	U	
JP-4, JP-5	U	U	U	U	U	U	U	U	U	
Kerosene	U	U	U	U	U	U	U	U	U	
Lacquer/Lacquer Solvents	U	U	U	U	U	U	U	U	U	
Lime Sulfur	U	U	U	U	U	U	U	U	U	
Linseed Oil	E	E	E	E	E	E	E	E	E	
LPG	E	E	E	E	E	E	E	E	E	
Lubricating Oils	E	E	E	E	E	E	E	E	E	
Magnesium Chloride	E	E	E	E	C	C	G	G	G	
Magnesium Hydroxide	E	E	E	E	C	C	G	G	G	
Magnesium Sulfate	E	E	E	E	E	E	E	E	E	
Maleic Acid	U	U	U	U	U	U	U	U	U	
Maleic Anhydride	U	U	U	U	U	U	U	U	U	
Maleic Acid	U	U	U	U	U	U	U	U	U	
Mercuric Chloride	E	E	E	E	U	U	U	U	U	
Mercury	E	E	E	E	U	U	U	U	U	
Methanol	E	E	E	E	E	E	E	E	E	
Methyl Bromide	U	U	U	U	U	U	U	U	U	
Methyl Chloride	U	U	U	U	U	U	U	U	U	
Methyl Butyl Ketone	U	U	U	U	U	U	U	U	U	
Methyl Ethyl Ketone	U	U	U	U	U	U	U	U	U	
Methylene Chloride	U	U	U	U	U	U	U	U	U	
Methyl Isobutyl Ketone	U	U	U	U	U	U	U	U	U	
Methyl Isopropyl Ketone	U	U	U	U	U	U	U	U	U	
Methyl Salicylate	U	U	U	U	U	U	U	U	U	
MIL-L-2104	E	E	E	E	E	E	E	E	E	
MIL-D-5606	E	E	E	E	E	E	E	E	E	
MIL-H-6083	E	E	E	E	E	E	E	E	E	
MIL-L-7808	E	E	E	E	E	E	E	E	E	
MIL-L-23699	E	E	E	E	E	E	E	E	E	
MIL-H-46170	E	E	E	E	E	E	E	E	E	
MIL-H-83282	E	E	E	E	E	E	E	E	E	
Mineral Oils	E	E	E	E	E	E	E	E	E	
Naphtha	C	C	C	E	-	-	-	-	-	
Naphthalene	C	C	C	E	-	-	-	-	-	
Naphthenic Acid	C	C	C	E	-	-	-	-	-	
Natural Gas	E	E	E	E	G	G	G	G	G	
Nickel Acetate	E	E	E	E	G	G	G	G	G	
Nickel Chloride	E	E	E	E	G	G	G	G	G	
Nickel Sulfate	E	E	E	E	G	G	G	G	G	
Nitric Acid, to 10%	U	U	U	U	U	U	U	U	U	
Nitric Acid, over 10%	U	U	U	U	U	U	U	U	U	
Nitrobenzene	U	U	U	U	U	U	U	U	U	
Nitrogen	E	E	E	E	E	E	E	E	E	
Octyl Alcohol	E	E	E	E	E	E	E	E	E	

FLUID	SEALS					METAL				
	Buna-N	Neoprene	EPR/EPDM	Viton	Steel	Brass	Cres	Aluminum	Monel	
Oleic Acid	U	U	C	G	C	E	G	C	U	
Oleum (Fuming Sulfuric Acid)	U	U	U	U	C	C	C	C	C	
Oleum (Mineral Spirits)	E	G	U	E	E	E	E	E	E	
Ortho-Dichlorobenzene	U	U	U	U	U	U	U	U	U	
Oxalic Acid	G	G	G	E	E	E	E	E	E	
Oxygen	E	E	E	E	E	E	E	E	E	
Palmitic Acid	E	E	E	E	E	E	E	E	E	
Para-Dichlorobenzene	U	U	U	U	U	U	U	U	U	
Pentane	U	U	U	U	U	U	U	U	U	
Perchloroethylene	U	U	U	U	U	U	U	U	U	
Phenol (Carbolic Acid)	U	U	U	U	U	U	U	U	U	
Phosphoric Acid	U	U	U	U	U	U	U	U	U	
Phosphorous Trichloride	U	U	U	U	U	U	U	U	U	
Potassium Acetate	U	U	U	U	U	U	U	U	U	
Potassium Chloride	E	E	E	E	E	E	E	E	E	
Potassium Cyanide	E	E	E	E	E	E	E	E	E	
Potassium Dichromate	E	E	E	E	E	E	E	E	E	
Potassium Hydroxide, to 10%	G	G	E	G	G	G	G	U	E	
Potassium Hydroxide, over 10%	C	C	E	U	G	G	G	U	E	
Potassium Nitrate	E	E	E	E	E	E	E	E	E	
Potassium Sulfate	E	E	E	E	E	E	E	E	E	
Propane	E	E	E	E	E	E	E	E	E	
Propyl Acetate	U	U	U	U	U	U	U	U	U	
Propyl Alcohol	U	U	U	U	U	U	U	U	U	
Propylene	U	U	U	U	U	U	U	U	U	
Refrigerant R-12	U	U	U	U	U	U	U	U	U	
Refrigerant R-13	U	U	U	U	U	U	U	U	U	
Refrigerant R-22	U	U	U	U	U	U	U	U	U	
Refrigerant R-134a	U	U	U	U	U	U	U	U	U	
Sewage	E	E	E	E	E	E	E	E	E	
Soap (Water Solutions)	E	E	E	E	E	E	E	E	E	
Sodium Acetate	E	E	E	E	E	E	E	E	E	
Sodium Bicarbonate	E	E	E	E	E	E	E	E	E	
Sodium Borate	E	E	E	E	E	E	E	E	E	
Sodium Carbonate	E	E	E	E	E	E	E	E	E	
Sodium Chloride	E	E	E	E	E	E	E	E	E	
Sodium Cyanide	E	E	E	E	E	E	E	E	E	
Sodium Hydroxide, to 10%	U	U	G	E	C	C	U	C	C	
Sodium Hydroxide, over 10%	U	U	G	E	C	C	U	C	C	
Sodium Hypochlorite	C	C	E	C	U	U	U	C	C	
Sodium Metaphosphate	C	C	E	C	U	U	U	C	C	
Sodium Nitrate	G	G	E	E	U	U	U	C	C	
Sodium Perborate	G	G	E	E	U	U	U	C	C	
Sodium Peroxide	G	G	E	E	U	U	U	C	C	
Sodium Phosphates	E	E	E	E	U	U	U	C	C	
Sodium Silicate	E	E	E	E	U	U	U	C	C	
Sodium Sulfate	E	E	E	E	U	U	U	C	C	
Sodium Sulfide	E	E	E	E	U	U	U	C	C	
Sodium Thiosulfate	E	E	E	E	U	U	U	C	C	
Soy Bean Oil	E	E	E	E	U	U	U	C	C	
Stannic Chloride	E	E	E	E	U	U	U	C	C	
Steam (up to 300°F)	E	E	E	E	U	U	U	C	C	
Stearic Acid	E	E	E	E	U	U	U	C	C	
Stoddard Solvent	E	E	E	E	U	U	U	C	C	
Styrene	U	U	U	U	U	U	U	U	U	
Sulfur	U	U	U	U	U	U	U	U	U	
Sulfur Chloride	U	U	U	U	U	U	U	U	U	
Sulfur Dioxide	U	U	U	U	U	U	U	U	U	
Sulfur Trioxide	U	U	U	U	U	U	U	U	U	
Sulfuric Acid, over 10%	U	U	U	U	U	U	U	U	U	
Sulfurous Acid	C	C	E	E	U	U	U	C	C	
Tannic Acid	E	E	E	E	E	E	E	E	E	
Tar (Bituminous)	E	E	E	E	E	E	E	E	E	
Tartaric Acid	E	E	E	E	E	E	E	E	E	
Tertiary Butyl Alcohol	E	E	E	E	E	E	E	E	E	
Titanium Tetrachloride	C	C	E	E	U	U	U	C	C	
Toluene (Toluol)	U	U	U	U	U	U	U	U	U	
Trichlorethylene	U	U	U	U	U	U	U	U	U	
Tricresyl Phosphate	U	U	U	U	U	U	U	U	U	
Triethanolamine	U	U	U	U	U	U	U	U	U	
Tung Oil	G	G	U	U	U	U	U	U	U	
Turpentine	G	G	U	U	U	U	U	U	U	
Varnish	G	G	U	U	U	U	U	U	U	
Vinyl Chloride	E	E	E	E	E	E	E	E	E	
Water (to +150°F)	E	E	E	E	E	E	E	E	E	
Water (+151°F to +200°F)	E	E	E	E	E	E	E	E	E	
Water (+201°F to +250°F)	E	E	E	E	E	E	E	E	E	
Xylene	U	U	U	U	U	U	U	U	U	
Zinc Chloride	E	E	E	E	E	E	E	E	E	
Zinc Sulfate	E	E	E	E	E	E	E	E	E	

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FD40 Series/MIL-C-4109 Industrial Interchange - Air

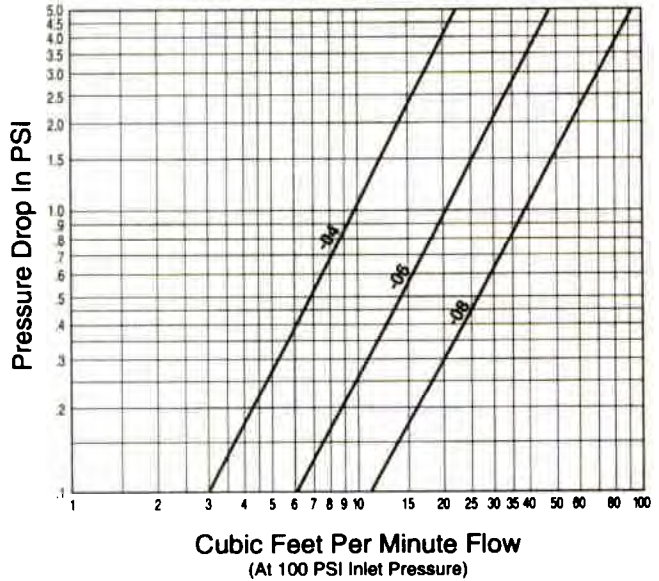


The FD40 Series offers a one-hand push-to-connect latch ideal for compressed air service. The female half features self-sealing poppet valves, preventing air loss while disconnected. Male half uses straight through design.

- Automatic sleeve for one-hand push-to-connect operation.
- Protective collar to prevent accidental snagging and disconnection.
- Meet dimensional requirements of MIL-C-4109 for industrial interchangeability.
- Swivels 360°, eliminating hose kinking.
- Ball latching mechanism.
- Standard seal material – Buna-N.
- Standard body material – Zinc plated steel.

Flow Data

Pressure Drop Versus Flow Graph

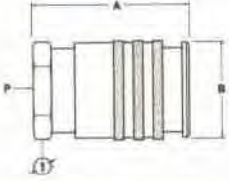
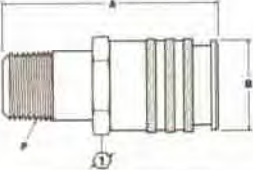
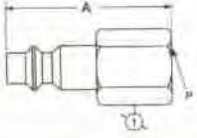
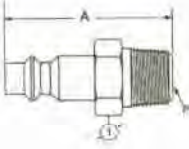


Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)		Vacuum (in./Hg.) Connected Only
		Female Half Only	Connected	
-04	300	3000	8000	28
-06	300	3000	8000	28
-08	300	2000	8000	28

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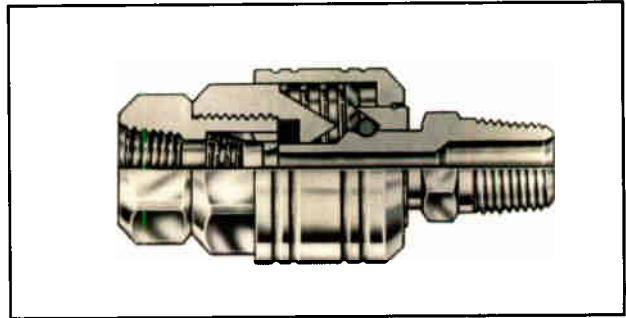
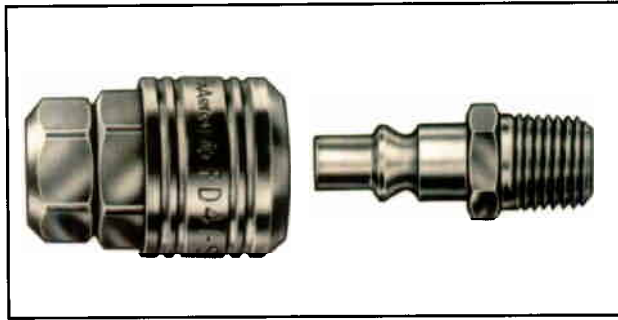


FD40 Series	Coupling Size	Thread Size(P)	Dimensional Data			Part Number Buna-N	Line Ref.
			A	B	ϕ		
Female Half Female Pipe/Valved 	-04	1/4-18	1.88	1.00	.81	FD40-1000-04-04	2
	-04	3/8-18	2.56	1.00	.94	FD40-1000-06-04	3
	-06	1/4-18	2.63	1.16	.94	FD40-1000-04-06	4
	-06	3/8-18	2.13	1.16	.94	FD40-1000-06-06	5
	-08	1/2-14	2.38	1.28	1.06	FD40-1000-08-08	6
							7
						7	
						8	
Female Half Male Pipe/Valved 	-04	1/4-18	2.63	1.00	.81	FD40-1001-04-04	9
	-04	3/8-18	2.63	1.00	.81	FD40-1001-06-04	10
	-06	3/8-18	2.88	1.16	.94	FD40-1001-06-06	11
	-08	1/2-14	3.50	1.28	.88	FD40-1001-08-08	12
							13
							14
						15	
						16	
Male Half Female Pipe/Non-Valved 	-04	1/4-27	1.21		.56	FD40-1013-02-04	17
	-04	1/4-18	1.62		.62	FD40-1013-04-04	18
	-04	3/8-18	1.80		.88	FD40-1013-06-04	19
	-06	3/8-18	1.90		.88	FD40-1013-06-06	20
	-08	1/2-14	2.40		1.12	FD40-1013-08-08	21
							22
						23	
						24	
Male Half Male Pipe/Non-Valved 	-04	1/4-27	1.50		.50	FD40-1014-02-04	25
	-04	1/4-18	1.75		.56	FD40-1014-04-04	26
	-04	3/8-18	1.75		.69	FD40-1014-06-04	27
	-06	1/4-18	1.88		.62	FD40-1014-04-06	28
	-06	3/8-18	1.88		.69	FD40-1014-06-06	29
	-06	1/2-14	2.13		.88	FD40-1014-08-06	30
	-08	3/8-18	2.18		.69	FD40-1014-06-08	31
	-08	1/2-14	2.44		.88	FD40-1014-08-08	32

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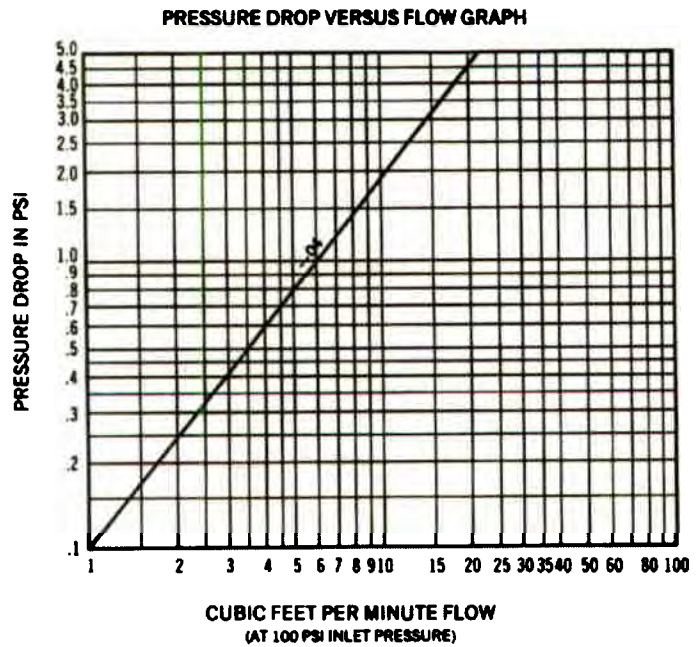
FD41 Series/ARO 210 Interchange - Air



The FD41 interchanges with the ARO 210 Series for compressed air service, with a self-sealing female half and straight through male half.

- Designed to interchange with ARO 210 Series.
- Automatic sleeve for one hand push-to-connect operation.
- Swivels 360°, eliminating hose kinking.
- Designed to assure high flow with low pressure drop for peak tool performance.
- Standard seal material - Buna-N.
- Standard body material - Zinc plated steel.

Flow Data



Physical Characteristics				
Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)		Vacuum (in./Hg.) Connected Only
		Female Half Only	Connected	
04	300	3000	8000	28

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

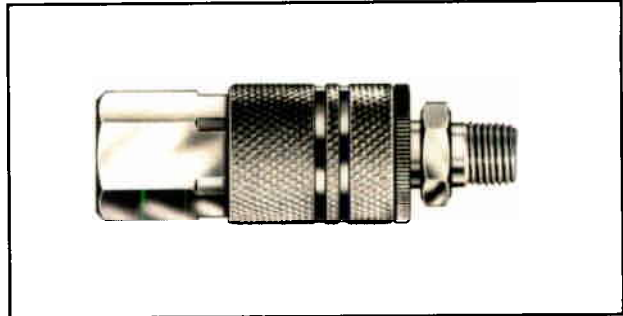
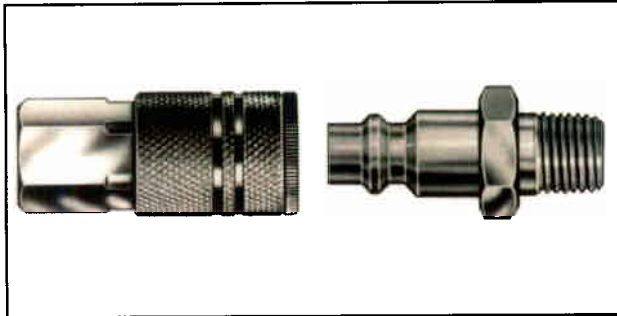


FD41 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number Buna-N	Line Ref.
			A	B			
Female Half Female Pipe/Valved 	-04	1/4-27	2.15	1.12	.62	FD41-1000-02-04	1
	-04	1/4-18	1.62	1.12	.81	FD41-1000-04-04	2
							3
							4
							5
							6
							7
							8
Male Half Female Pipe/Non-Valved 	-04	1/4-18	1.51	-	.62	FD41-1013-04-04	9
							10
							11
							12
							13
							14
							15
							16
Male Half Male Pipe/Non-Valved 	-04	1/4-18	1.61	-	.56	FD41-1014-04-04	17
							18
							19
							20
							21
							22
							23
							24

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



FD43 Series/Industrial Interchange—Air

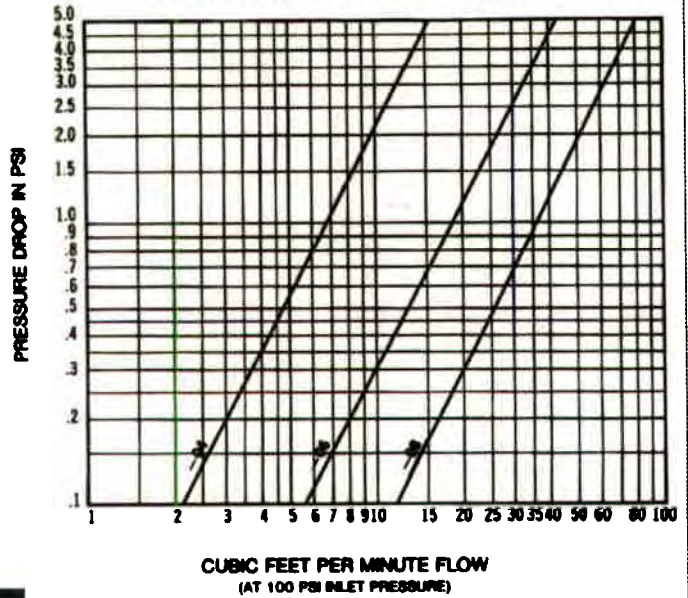


The FD43 Series is a manual retract-type ball latch industrial interchange coupling. Ideal for compressed air service, the FD43 uses FD40 male tips.

- Meets dimensional requirements of MIL-C-4109 specifications for industrial interchangeability.
- Protective collar to prevent accidental snagging and disconnection.
- Manual retract latch design allows quick and easy connection of hose lines.
- Swivels 360°, eliminating hose kinking.
- Standard seal material – Neoprene.
- Standard body material – Zinc plated steel.

Flow Data

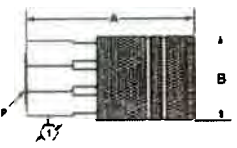
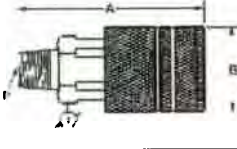
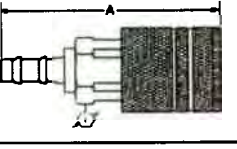
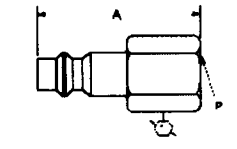
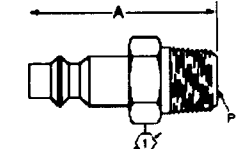
**FD43 SERIES
PRESSURE DROP VERSUS FLOW GRAPH**



Physical Characteristics				
Coupling Dash Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)		Vacuum (in./Hg.) Connected Only
		Female Half Only	Connected	
-04	300	3000	8000	Not Rated
-06	300	3000	8000	Not Rated
-08	300	2000	8000	Not Rated

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

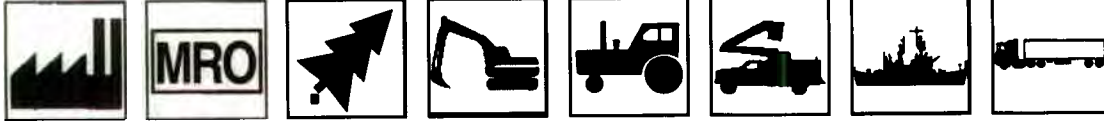


FD43 Series	Coupling Size	Thread Size(P)	Hose I.D.	Dimensional Data			Part Number Neoprene	Line Ref.
				A	B	①		
Female Half Female Pipe/Valved 	-04	1/8-27		1.88	.88	.75	FD43-1001-02-04	1
	-04	1/4-18		2.09	.88	.75	FD43-1001-04-04	2
	-04	3/8-18		2.16	.88	.81	FD43-1001-06-04	3
	-06	1/4-18		2.38	1.06	.88	FD43-1001-04-06	4
	-06	3/8-18		2.38	1.06	.88	FD43-1001-06-06	5
	-06	1/2-14		2.53	1.06	1.00	FD43-1001-08-06	6
	-08	1/2-14		3.06	1.19	1.00	FD43-1001-08-08	7
Female Half Male Pipe/Valved 	-04	1/8-27		2.19	.88	.75	FD43-1011-02-04	8
	-04	1/4-18		2.28	.88	.75	FD43-1011-04-04	9
	-04	3/8-18		2.34	.88	.75	FD43-1011-06-04	10
	-06	1/4-18		2.41	1.06	.88	FD43-1011-04-06	11
	-06	3/8-18		2.44	1.06	.88	FD43-1011-06-06	12
	-06	1/2-14		2.56	1.06	.88	FD43-1011-08-06	13
	-08	1/2-14		3.09	1.19	1.00	FD43-1011-08-08	14
Female Half SOCKETLESS™ Hose Barb/Valved 	-04		1/4	2.78	.88	.75	FD43-1031-04-04	15
	-04		3/8	2.78	.88	.75	FD43-1031-06-04	16
								17
								18
								19
								20
								21
Male Half Female Pipe/Non-Valved 	-04	1/8-27		1.21	.56		FD40-1013-02-04	22
	-04	1/4-18		1.62	.62		FD40-1013-04-04	23
	-04	3/8-18		1.80	.88		FD40-1013-06-04	24
	-06	3/8-18		1.90	.88		FD40-1013-06-06	25
	-08	1/2-14		2.40		1.12	FD40-1013-08-08	26
								27
								28
Male Half Male Pipe/Non-Valved 	-04	1/8-27		1.50	.50		FD40-1014-02-04	29
	-04	1/4-18		1.75	.56		FD40-1014-04-04	30
	-04	3/8-18		1.75	.69		FD40-1014-06-04	31
	-06	1/4-18		1.88	.62		FD40-1014-04-06	32
	-06	3/8-18		1.88	.69		FD40-1014-06-06	33
	-06	1/2-14		2.13	.88		FD40-1014-08-06	34
	-08	3/8-18		2.18	.69		FD40-1014-06-08	35
	-08	1/2-14		2.44	.88		FD40-1014-08-08	36

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



FD14 Series/Drain Coupling



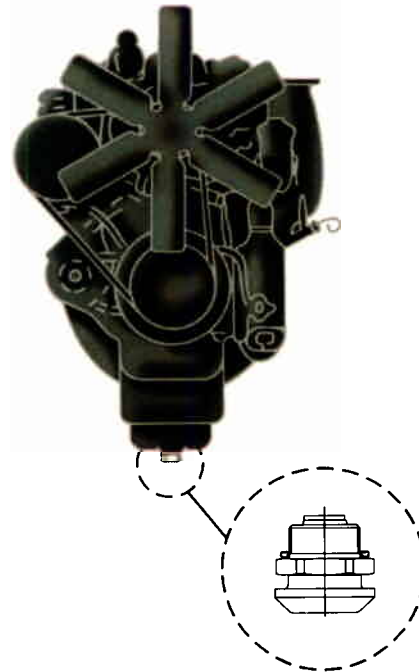
Male Half with Rubber Molded Cap



Female Half

The FD14 Drain coupling is designed to serve as a drain port for use with systems such as the Aeroquip FLOCS (Fast Lube Oil Change System) as well as providing a purging port for use during prefill operations.

- Low-Profile, with multiple sealing mechanisms
 - O-ring – primary seal
 - Metal-to-metal – Secondary Seal
 - Rubber protective cap - Secondary Seal
- Push-To-Connect female half for easy one-hand operation
- Broad range of standard thread styles for Male Half
 - Utilizes a Copper-Crush gasket to seat against the port face.
- Standard male half seal material - Viton
- Standard female half seal material - Buna-N
- Standard body material - Zinc plated steel with zinc die-cast valve
- Rubber molded cap
 - Standard material - Buna-N



Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)
-06	50	200	28	3

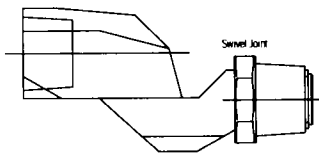
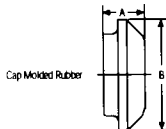
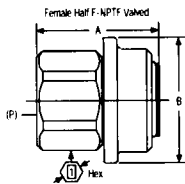
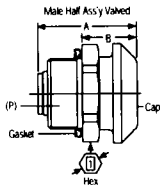


QUICK DISCONNECT COUPLINGS

Aeroquip FD14 Drain Coupling

Providing direct access for fast oil changes.

The FLOCS Direct Access Conversion Kit uses the Aeroquip-developed FD14 Drain Coupling as an alternative to the standard remote hose kit. This coupling design permits easy, one-hand connection and disconnection of the evacuation unit's hose.



Coupling Size	Thread Size (P)	A	B	Ass'y Torque (Ft.-Lbs.)	Assembly (Includes Gasket & Cap)	Gasket (Copper-Crush)	Cap (Buna-N)
-06	1/2 - 20 UNF - 2A	1.33	.56	15/16	20-24*	FD14-1002-01-06	FD14-1206-01
-06	M18 x 1.5 6q	1.33	.56	1 1/4	20-40*	FD14-1002-02-06	FD14-1206-04
-06	M14 x 1.25 6q	1.33	.56	15/16	20-24*	FD14-1002-03-06	FD14-1206-02
-06	1 1/4 - 18 UNEF - 2A	1.37	.56	1 1/2	30-60*	FD14-1002-05-06	FD14-1206-11
-06	1 - 18 UNS - 2A	1.37	.56	1 1/4	30-60*	FD14-1002-06-06	FD14-1206-07
-06	7/8 - 18 UNS - 2A	1.37	.56	1 1/4	30-60*	FD14-1002-07-06	FD14-1206-06
-06	5/8 - 18 UNF - 2A	1.33	.56	15/16	20-40*	FD14-1002-08-06	FD14-1206-03
-06	3/4 - 16 UNF - 2A	1.37	.56	1 1/4	30-50*	FD14-1002-09-06	FD14-1206-04
-06	7/8 - 14 UNF - 2A	1.37	.56	1 1/4	30-60*	FD14-1002-10-06	FD14-1206-05
-06	M24 x 2 6q	1.37	.56	1 1/4	30-60*	FD14-1002-11-06	FD14-1206-07
-06	9/16 - 18 UNF - 2A	1.33	.56	15/16	20-40*	FD14-1002-12-06	FD14-1206-02
-06	1 1/8 - 12 UNF - 2A	1.37	.56	1 1/2	30-60*	FD14-1002-14-06	FD14-1206-09
-06	M20 x 1.5 6q	1.37	.56	1 1/4	30-60*	FD14-1002-16-06	FD14-1206-05
-06	M25 x 1.5 6q	1.37	.56	1 1/4	30-60*	FD14-1002-17-06	FD14-1206-07
-06	M22 x 1.5 6q	1.37	.56	1 1/4	30-60*	FD14-1002-18-06	FD14-1206-06
-06	M24 x 1.5 6q	1.37	.56	1 1/4	30-60*	FD14-1002-19-06	FD14-1206-07
-06	1 1/16 - 12 UN - 2A	1.37	.56	1 1/2	30-60*	FD14-1002-20-06	FD14-1206-08
-06	M30 x 1.5 6q	1.37	.56	1 1/2	30-60*	FD14-1002-21-06	FD14-1206-10
-06	1/2 - 14 UNS - 2A	1.33	.56	15/16	20-24*	FD14-1002-22-06	FD14-1206-01
-06	M12 x 1.5 6q	1.33	.56	15/16	20-24*	FD14-1002-23-06	FD14-1206-01
-06	M14 x 1.5 6q	1.33	.56	15/16	20-24*	FD14-1002-24-06	FD14-1206-02
-06	M12 x 1.75 6q	1.33	.56	15/16	20-24*	FD14-1002-25-06	FD14-1206-01
-06	3/4 - 14 Dryseal NPTF	1.52	.56	1 1/4		FD14-1002-26-06	None Needed

* ⚠ CAUTION: Failure to meet minimum assembly torque could result in fluid leakage.

Coupling Size	Thread Size (P)	A	B	Assembly
-06	3/4 - 14 Dryseal NPTF	1.83	1.81	1 5/16

Coupling Size	A	B	Cap (Buna-N)
-06	0.519	1.400	FD14-1204-06

Coupling Size	Thread Size (P)	Assembly
-06	3/4 - 14 Dryseal NPTF	FD14-1004-12-12

FLOCS System Components & Accessories



- FLOCS Oil Thief Sampling System



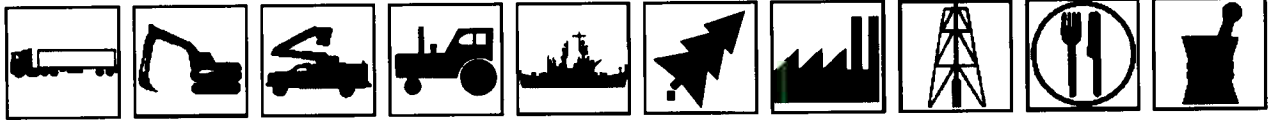
- FLOCS 15 Direct Access Oil Evacuation Unit (Electric)



- FLOCS 30A Air Powered Oil Evacuation Unit



FD15 Series/Oil Sampling Valve



0-50 psi

Part Number	Inlet Ports
FD15-1026-04	1/4" NPTF
FD15-1025-04	7/16-20 Male ORB

As required in MIL-V-81940/2-1 this valve's flow rate is between 100 and 1500 milliliters per minute at pressures from 0-50 psi. (MIL-V-81940/2-1 applies only to pressures from 50-300 psi.)



50-300 psi

Part Number	Inlet Ports
FD15-1000-02	1/8" NPTF
FD15-1000-04*	1/4" NPTF
FD15-1002-04	7/16-20 Male ORB

*The 1/4" NPTF version is qualified to MIL-V-81940/2-1 and its performance is representative of the other inlet port configurations listed above.
QPL-81940-9 6-5-89

FD15 Oil Sampling Valve: In-line sampling of system fluids is made without system shutdown, usually in less than one minute, and without fluid contamination.

Application: Engine oil, lubricating oil, transmission fluid and hydraulic fluids in mobile construction equipment, military vehicles, trucks and stationary equipment.

For best results, Aeroquip FD15 Oil Sampling Valves should be installed in dynamic fluid lines in low pressure and return lines. If only one sampling point can be chosen, it should be in the return line, upstream of any return line filter. This will insure a representative sample of all components in the fluid system for their present condition.

Operation: Remove metal dustcover on discharge port. Discharge approximately 200 ml of oil to flush valve by turning knurled knob 1/4 turn to the right. Dispose of this sample in the appropriate manner. Locate clean oil sample bottle under discharge port.

(Sample bottles are usually supplied by the oil analysis lab.) Turn knurled knob 1/4 turn to the right until bottle is filled to the desired level. The knob can be backed off to throttle the rate of flow. When bottle is filled let go of the knurled knob, the valve will close automatically. Replace metal dustcover wrench tight.

Construction: Corrosion resistant plated steel with brass internal components and Buna-N seal.

Operating Temperature Range: -65°F to +275°F (-53°C to +135°C)

Minimum Burst Pressure: 1200 psi

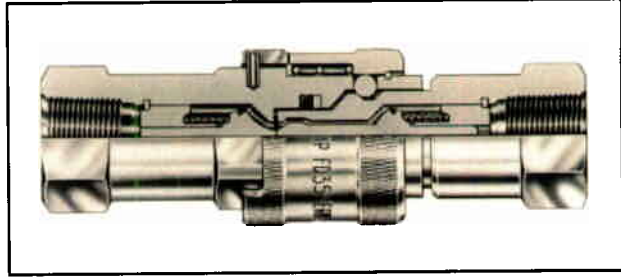
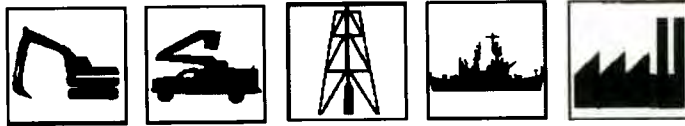
Minimum Particle Restriction: 500 microns

Maximum Torque to Operate: 10 in. lbs.

Note: This valve is not intended for aerospace applications.

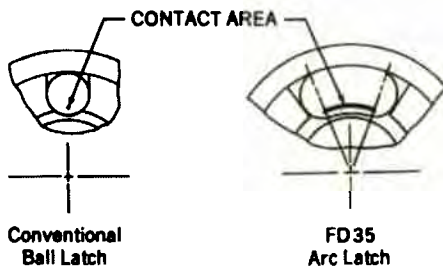


FD35 Series/Arc Latch™ for 10,000 psi High Pressure Applications

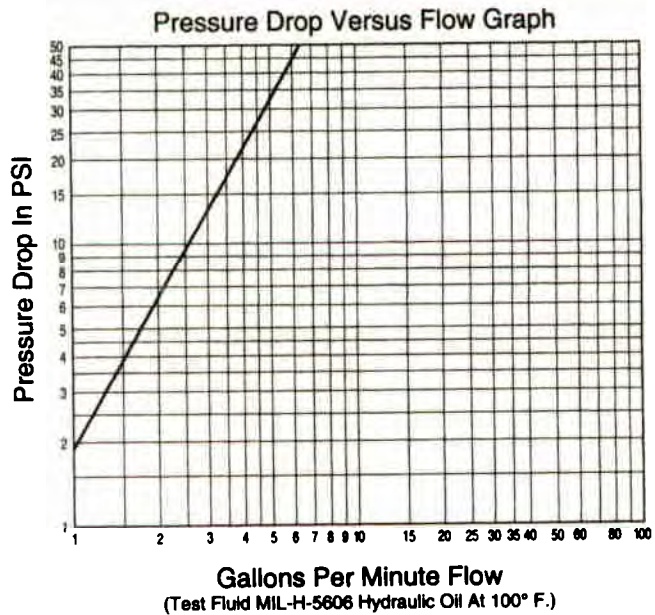


The FD35 Series Arc Latch™ design has a greater surface contact area for long surface life in rugged high pressure applications. The maximum operating pressure is 10,000 psi.

- Safety sleeve lock prevents accidental disconnection.
- Heavy duty back-up ring prevents O-ring extrusion.
- Heat treated and plated steel for greater wear and corrosion resistance.
- Self-sealing poppet valves provide excellent high and low pressure sealing.
- Standard seal material - Viton.
- Standard body material - Zinc plated steel.



Flow Data

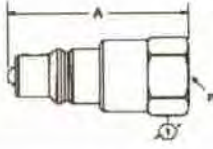
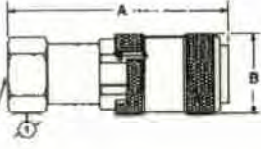
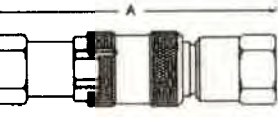
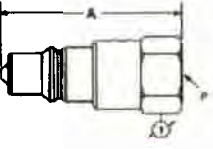
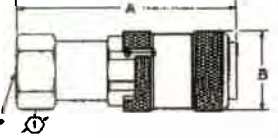


Physical Characteristics						
Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-06	10,000	40,000	28	2	0.50	0.50

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QUICK DISCONNECT COUPLINGS

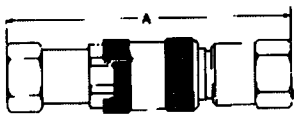
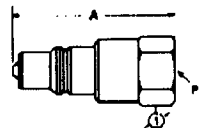
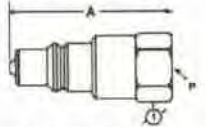



FD35 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number Buna-N	Line Ref.
			A	B	①		
Male Half Female Pipe/Valved 	-06	3/8-18	2.05		0.94	FD35-1002-06-06	1
							2
							3
							4
							5
							6
							7
							8
Female Half Female Pipe/Valved 	-06	3/8-18	2.56	1.27	0.94	FD35-1001-06-06	9
							10
							11
							12
							13
							14
							15
							16
Complete Coupling Female Pipe/Valved 	-06	3/8-18	3.53			FD35-1000-06-06	17
							18
							19
							20
							21
							22
							23
							24
Male Half Female SAE O-Ring/Valved 	-06	3/8-18	2.05		0.94	FD35-1008-06-06	25
							26
							27
							28
							29
							30
							31
							32
Female Half Female SAE O-Ring/Valved 	-06	3/8-18	2.56	1.27	0.94	FD35-1007-06-06	33
							34
							35
							36
							37
							38
							39
							40

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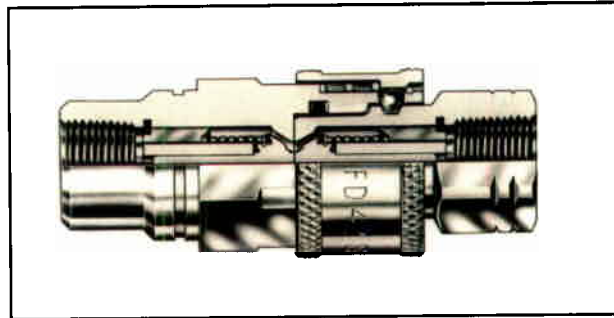
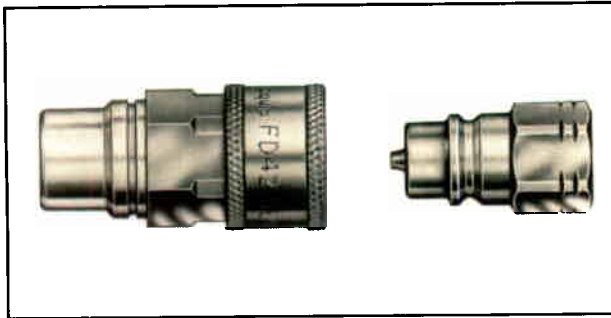
QUICK DISCONNECT COUPLINGS

FD35 Series	Coupling Size	Thread Size(P)	Dimensional Data			Part Number Viton	Line Ref.
			A	B			
Complete Coupling Female SAE O-Ring/Valved 	-06	3/16-18	3.53			FD35-1006-06-06	1
							2
							3
							4
							5
							6
							7
							8
Male Half Female Pipe/45 psi Bleed Valve  Incorporates a special relief valve set at 45 psi, preventing disconnected pressure build-up.	-06	3/16-18	2.05		0.94	FD35-1043-06-06	9
							10
							11
							12
							13
							14
							15
							16
Male Half Female SAE O-Ring/ 45 psi Bleed Valve  Incorporates a special relief valve set at 45 psi, preventing disconnected pressure build-up.	-06	3/16-18	2.12		0.94	FD35-1044-06-06	17
							18
							19
							20
							21
							22
							23
							24
Repair Kits							25
	-06	Male Valving				FF10173-06	26
	-06	Female Valving				FF10174-06	27
	-06	Female Locking Arc Latch				FF10175-06	28
Accessories							29
Dust Cover 	-06	Fits Male and Female Halves				FD35-1042-06	30
							31
							32
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FD42 Series/Pioneer 4000 Interchange

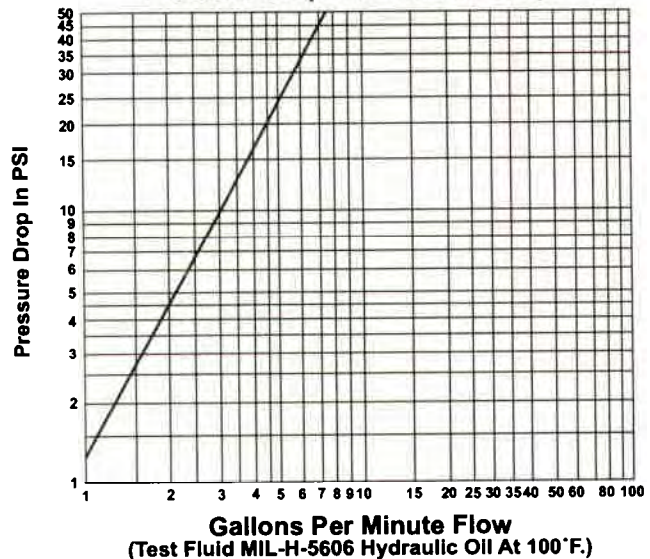


The FD42 Series coupling is designed as a Pioneer 4000 interchange to accommodate high surge flows typically found in snow plow applications. The maximum operating pressure is 3,000 psi.

- Teflon¹ back up ring in female half improves impulse life.
- Self-sealing poppet valve design provides excellent high and low pressure sealing.
- **PUSH-PULL™** ball latch design allows quick and easy connection and disconnection of hose lines.
- Interchanges with Pioneer 4000-2 and Safeway S20-A.
- Retaining groove on female half for bulkhead mounting.
- Male half can be bulkhead mounted with optional adapter.
- Standard seal material – Buna-N.
- Standard body material – Zinc plated steel with zinc poppet guides.

Flow Data

Pressure Drop Versus Flow Graph




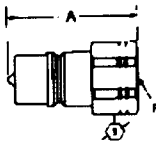
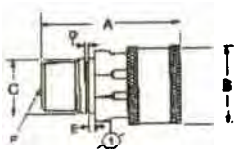
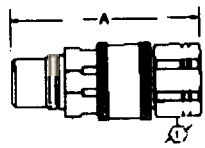
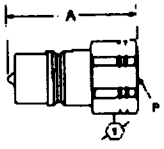
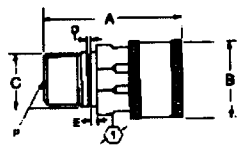
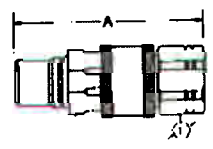
Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-04	3000	12,000	28	3	.62	.60

¹ Teflon is a registered trademark of Dupont.



QUICK DISCONNECT COUPLINGS

FD42 Series	Coupling Size	Thread Size (P)	Dimensional Data						Part Number	Line Ref.
			A	B	C	D	E			
Male Half Female Pipe/Valved 	-04	1/4-18	1.34					.75	FD42-1002-04-04	1
										2
										3
										4
										5
										6
										7
										8
Female Half Female Pipe/Valved 	-04	1/4-18	2.04		.87	.05	.10	.88	FD42-1001-04-04	9
										10
										11
										12
										13
										14
										15
										16
Complete Coupling Female Pipe/Valved 	-04	1/4-18	2.68						FD42-1000-04-04	17
										18
										19
										20
										21
										22
										23
										24
Male Half Female SAE O-Ring/Valved 	-04	9/16-18	1.63					.81	FD42-1010-06-04	25
										26
										27
										28
										29
										30
										31
										32
Female Half Female SAE O-Ring/Valved 	-04	9/16-18	2.13	1.06	.87	.05	.10	.88	FD42-1008-06-04	33
										34
										35
										36
										37
										38
										39
										40
Complete Coupling Female SAE O-Ring/Valved 	-04	9/16-18	2.97						FD42-1006-06-04	41
										42
										43
										44
										45
										46
										47



FD42 Accessories	Coupling Size	Thread Size (P)	Dimensional Data						Part Number Buna-N	Line Ref.
			A	B	C	D	E			
Bulkhead Adapter 	-04	1/4-18	1.39	.87	.08			.88	FF1607-0404S	1
										2
										3
										4
										5
										6
										7
										8
Dust Cap/Plug (Fits Both Halves) 	-04								FD48-1042-04	9
										10
										11
										12
										13
										14
										15
										16

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

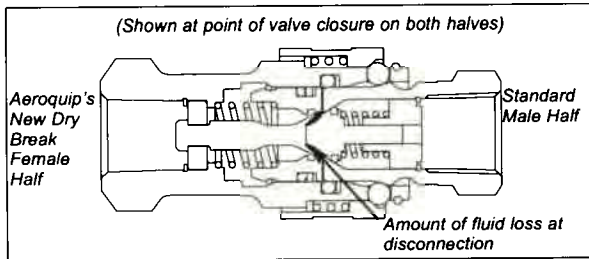


DryBreak

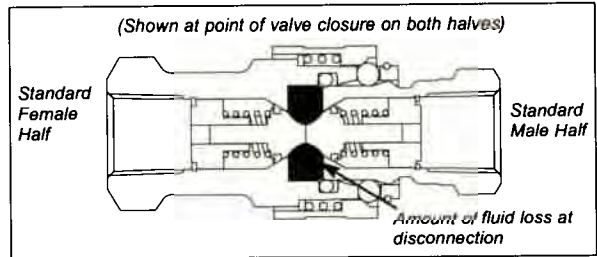
ISO INTERCHANGE

The Aeroquip DryBreak Difference

DryBreak/Industrial Interchange Coupling



Industry Standard Opposed Poppet Style



DryBreak Valves

DryBreak Valve for the 5600 Series

- Mates with all standard poppet valved style ISO 7241/1 Series A male halves.
- Economical Patented concave stem valve in the female coupling half that provides disconnecting fluid loss rates comparable with more expensive flush faced coupling styles.
- Standard Seal Materials – Buna-N, Viton, and EPR available on request.
- Standard body material – Zinc plated steel.

DryBreak Valve for the FD45 Series

- Mates with all standard poppet valved style ISO 7241/1 Series B male halves.
- Economical Patented concave stem valve in the female coupling half that provides disconnecting fluid loss rates comparable with more expensive flush faced coupling styles.
- Standard Seal Materials – Buna-N, Viton, and EPR available on request.
- Standard body material – Zinc plated steel.

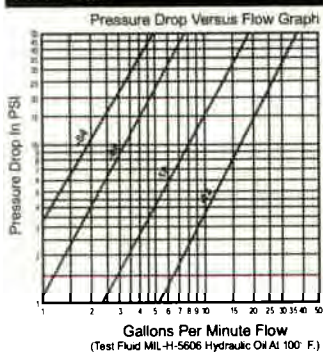
Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max)
-06	4,000	12,000	28	6	.36	.05
-10	4,000	12,000	28	12	1.14	.08
-12	4,000	12,000	15	28	3.39	.23
-16	4,000	12,000				

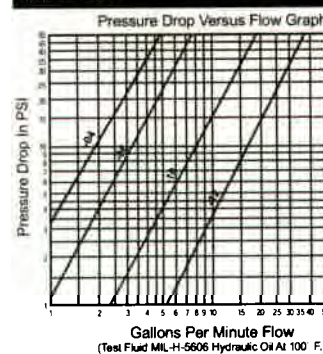
Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max)
-04	4,000	15,000	28	3	.25	.02
-06	4,000	12,000	28	6	.89	.05
-10	4,000	12,000	28	12	1.12	.08
-12	4,000	12,000	15	28	2.53	.23
-16	4,000	12,000				

FLOW DATA

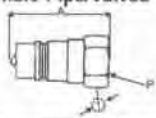
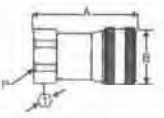
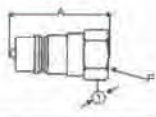
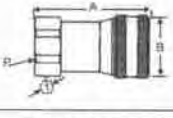
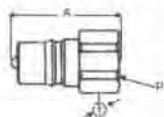
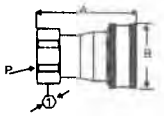


FLOW DATA



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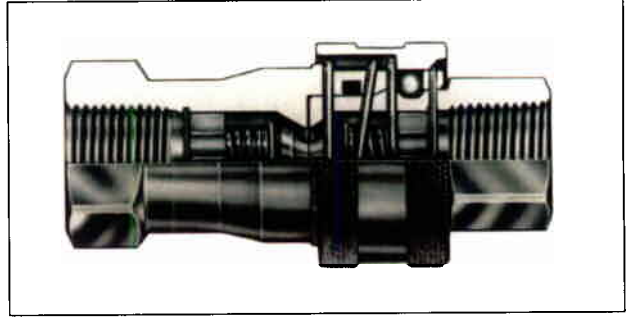


	Coupling Size	Thread Size (P)	Dimensional Data			Buna-N
			A	B	①	
5600 SERIES						
Standard Male Half Female Pipe/Valved 	-06	1/2-18	1.40		.88	5602-6-6S
	-10	1/2-14	1.89		1.06	5602-8-10S
	-12	1/2-14	2.28		1.38	5602-12-12S
Female Half Female Pipe/DryBreak Valving ISO-7241-A 	-06	1/2-18	2.23	1.23	1.00	FD56-4001-06-06
	-10	1/2-14	2.70	1.50	1.19	FD56-4001-08-10
	-12	1/2-14	3.29	1.81	1.50	FD56-4001-12-12
Standard Male Half Female SAE O-Ring/Valved 	-06	1/2-18	1.50		.88	5610-6-6S
	-10	1/2-16	2.03		1.06	5610-8-10S
	-12	1 1/2-12	2.55		1.38	5610-12-12S
Female Half Female SAE O-Ring/DryBreak Valving 	-06	1/2-18	2.23	1.23	1.00	FD56-4101-06-06
	-10	1/2-16	2.70	1.50	1.19	FD56-4101-08-10
	-12	1 1/2-12	3.33	1.81	1.50	FD56-4101-12-12
FD45 SERIES						
Standard Male Half Female Pipe/Valved 	-04	1/2-18	1.53		.75	FD45-1002-04-04
	-06	1/2-18	1.69		.88	FD45-1002-06-06
	-10	1/2-14	1.96		1.06	FD45-1002-08-10
	-12	1/2-14	2.41		1.31	FD45-1002-12-12
Female Half Female Pipe/DryBreak Valving ISO-7241-B 	-04	1/2-18	2.35	1.10	.81	FD45-4001-04-04
	-06	1/2-18	2.65	1.36	1.06	FD45-4001-06-06
	-10	1/2-14	3.02	1.67	1.31	FD45-4001-08-10
	-12	1/2-14	3.44	2.04	1.62	FD45-4001-12-12

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



FD45 Series/Industrial Interchange Series B ... (Steel)

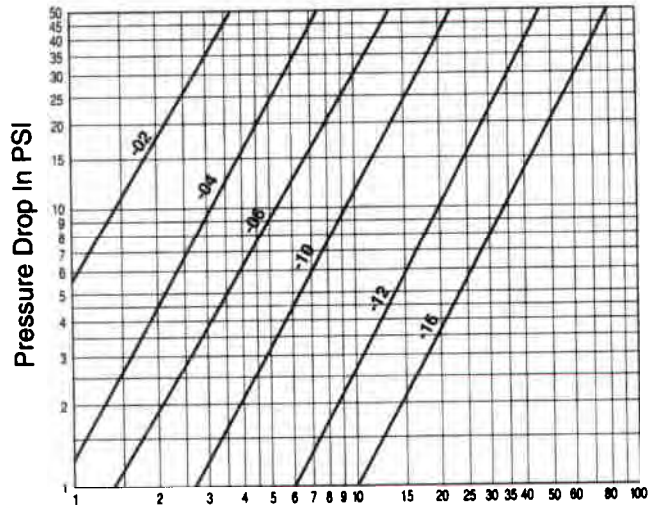


The FD45 Series steel is an industrial interchange popular in North America. Features rugged ball latch mechanism with automatic self-sealing poppet valves.

- Industrial interchange coupling conforming dimensionally to ISO standard 7241/1 Series B.
- **PUSH-PULL™** ball latch design allows quick and easy connection and disconnection of hose lines.
- Self-sealing poppet valve design provides excellent high and low pressure sealing.
- Standard seal material – Buna-N, EPR and Viton.
- Standard body material – Zinc plated steel. (Brass poppet guide in -02 size.)

Flow Data

Pressure Drop Versus Flow Graph



Gallons Per Minute Flow
(Test Fluid MIL-H-5606 Hydraulic Oil At 100° F.)

Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-02	4,500	13,500	28	1	.50	.50
-04	5,000	15,000	28	3	.50	.50
-06	4,000	12,000	28	6	2.5	1.3
-10	4,000	12,000	28	12	4.0	2.8
-12	4,000	12,000	28	28	11.0	8.2
-16	4,000	12,000	28	50	18.0	16.0

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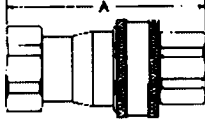
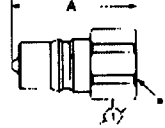





FD45 Steel	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	①	Buna-N	Viton	EPR	
Male Half Female Pipe/Valved 	-02	1/8-27	1.28	.56		FD45-1002-02-02	FD45-1071-02-02	FD45-1064-02-02	1
	-04	1/4-18	1.50	.75		FD45-1002-04-04	FD45-1071-04-04	FD45-1064-04-04	2
	-06	3/8-18	1.66	.88		FD45-1002-06-06	FD45-1071-06-06	FD45-1064-06-06	3
	-10	1/2-14	1.93	1.06		FD45-1002-08-10	FD45-1071-08-10	FD45-1064-08-10	4
	-12	5/8-14	2.26	1.31		FD45-1002-12-12	FD45-1071-12-12	FD45-1064-12-12	5
	-16	1-11 1/2	2.72	1.62		FD45-1002-16-16	FD45-1071-16-16	FD45-1064-16-16	6
									7
									8
Female Half Female Pipe/Valved 	-02	1/8-27	1.81	.96	.75	FD45-1003-02-02	FD45-1070-02-02	FD45-1065-02-02	9
	-04	1/4-18	2.22	1.13	.81	FD45-1003-04-04	FD45-1070-04-04	FD45-1065-04-04	10
	-06	3/8-18	2.45	1.38	1.06	FD45-1003-06-06	FD45-1070-06-06	FD45-1065-06-06	11
	-10	1/2-14	2.86	1.69	1.31	FD45-1003-08-10	FD45-1070-08-10	FD45-1065-08-10	12
	-12	5/8-14	3.40	2.06	1.62	FD45-1003-12-12	FD45-1070-12-12	FD45-1065-12-12	13
	-16	1-11 1/2	4.02	2.44	2.00	FD45-1003-16-16	FD45-1070-16-16	FD45-1065-16-16	14
									15
									16
Complete Coupling Female Pipe/Valved 	-02	1/8-27	2.31			FD45-1000-02-02	FD45-1072-02-02	FD45-1063-02-02	17
	-04	1/4-18	2.74			FD45-1000-04-04	FD45-1072-04-04	FD45-1063-04-04	18
	-06	3/8-18	3.04			FD45-1000-06-06	FD45-1072-06-06	FD45-1063-06-06	19
	-10	1/2-14	3.54			FD45-1000-08-10	FD45-1072-08-10	FD45-1063-08-10	20
	-12	5/8-14	4.02			FD45-1000-12-12	FD45-1072-12-12	FD45-1063-12-12	21
	-16	1-11 1/2	4.88			FD45-1000-16-16	FD45-1072-16-16	FD45-1063-16-16	22
									23
									24
Male Half Female Pipe/Non-Valved <p>Will not operate with valved coupling halves. No valve actuator.</p>	-02	1/8-27	1.20	.56		FD45-1061-02-02	FD45-1061-02-02	FD45-1061-02-02	25
	-04	1/4-18	1.37	.75		FD45-1061-04-04	FD45-1061-04-04	FD45-1061-04-04	26
	-06	3/8-18	1.50	.88		FD45-1061-06-06	FD45-1061-06-06	FD45-1061-06-06	27
	-10	1/2-14	1.76	1.06		FD45-1061-08-10	FD45-1061-08-10	FD45-1061-08-10	28
	-12	5/8-14	2.00	1.31		FD45-1061-12-12	FD45-1061-12-12	FD45-1061-12-12	29
	-16	1-11 1/2	2.43	1.62		FD45-1061-16-16	FD45-1061-16-16	FD45-1061-16-16	30
									31
									32
Female Half Female Pipe/Non-Valved <p>Will not operate with valved coupling halves. No valve actuator.</p>	-02	1/8-27	1.81	.96	.75	FD45-1047-02-02	FD45-1172-02-02	FD45-1207-02-02	33
	-04	1/4-18	2.22	1.13	.81	FD45-1047-04-04	FD45-1172-04-04	FD45-1207-04-04	34
	-06	3/8-18	2.45	1.38	1.06	FD45-1047-06-06	FD45-1172-06-06	FD45-1207-06-06	35
	-10	1/2-14	2.86	1.69	1.31	FD45-1047-08-10	FD45-1172-08-10	FD45-1207-08-10	36
	-12	5/8-14	3.40	2.06	1.62	FD45-1047-12-12	FD45-1172-12-12	FD45-1207-12-12	37
	-16	1-11 1/2	4.02	2.44	2.00	FD45-1047-16-16	FD45-1172-16-16	FD45-1207-16-16	38
									39
									40
Repair Kit									
Each kit will repair one male or female half.									
	-02					FF013-02†	FF014-02†	FF015-02†	41
	-04					FF013-04	FF014-04	FF015-04	42
	-06					FF013-06	FF014-06	FF015-06	43
	-10					FF013-10	FF014-10	FF015-10	44
	-12					FF013-12	FF014-12	FF015-12	45
	-16					FF013-16	FF014-16	FF015-16	46
									47
									48
									49

†The -02 coupling size valving is not repairable. This size repair kit contains an interface seal and back-up ring.

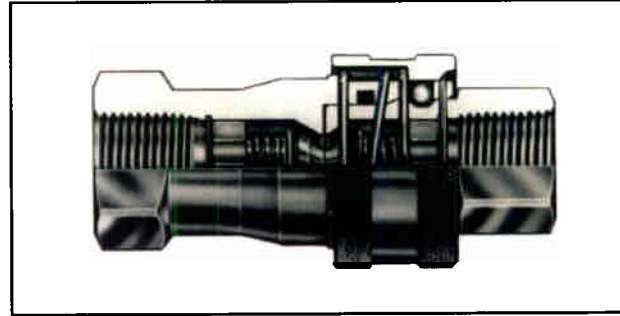
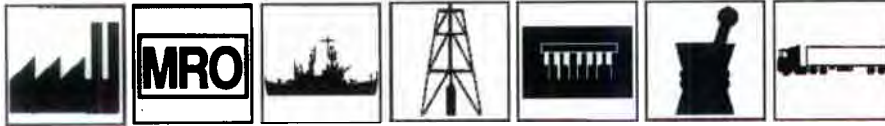


QUICK DISCONNECT COUPLINGS

FD45 Steel	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	(Y)	Buna-N	Viton	EPR	
Complete Coupling Female Pipe/Non-Valved 	-02	1/8-27	2.31			FD45-1044-02-02	FD45-1173-02-02	FD45-1206-02-02	1
	-04	1/4-18	2.74			FD45-1044-04-04	FD45-1173-04-04	FD45-1206-04-04	2
	-06	3/8-18	3.04			FD45-1044-06-06	FD45-1173-06-06	FD45-1206-06-06	3
	-10	1/2-14	3.54			FD45-1044-08-10	FD45-1173-08-10	FD45-1206-08-10	4
	-12	3/4-14	4.02			FD45-1044-12-12	FD45-1173-12-12	FD45-1206-12-12	5
	-16	1-11 1/2	4.88			FD45-1044-16-16	FD45-1173-16-16	FD45-1206-16-16	6
									7
								8	
Male Half Female Pipe/Pusher Style Valving  <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-02	1/8-27	1.28		.56	FD45-1046-02-02	FD45-1046-02-02	FD45-1046-02-02	9
	-04	1/4-18	1.50		.75	FD45-1046-04-04	FD45-1046-04-04	FD45-1046-04-04	10
	-06	3/8-18	1.66		.88	FD45-1046-06-06	FD45-1046-06-06	FD45-1046-06-06	11
	-10	1/2-14	1.93		1.06	FD45-1046-08-10	FD45-1046-08-10	FD45-1046-08-10	12
	-12	3/4-14	2.26		1.31	FD45-1046-12-12	FD45-1046-12-12	FD45-1046-12-12	13
	-16	1-11 1/2	2.72		1.62	FD45-1046-16-16	FD45-1046-16-16	FD45-1046-16-16	14
									15
								16	
Female Half Female Pipe/Pusher Style Valving  <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-02	1/8-27	1.81	.96	.75	FD45-1045-02-02	FD45-1228-02-02	FD45-1229-02-02	17
	-04	1/4-18	2.22	1.13	.81	FD45-1045-04-04	FD45-1228-04-04	FD45-1229-04-04	18
	-06	3/8-18	2.45	1.38	1.06	FD45-1045-06-06	FD45-1228-06-06	FD45-1229-06-06	19
	-10	1/2-14	2.86	1.69	1.31	FD45-1045-08-10	FD45-1228-08-10	FD45-1229-08-10	20
	-12	3/4-14	3.40	2.06	1.62	FD45-1045-12-12	FD45-1228-12-12	FD45-1229-12-12	21
	-16	1-11 1/2	4.02	2.44	2.00	FD45-1045-16-16	FD45-1228-16-16	FD45-1229-16-16	22
									23
								24	
Repair Kit Each kit will repair one male or female half. <p>†The -02 coupling size valving is not repairable. This size repair kit contains an interface seal and back-up ring.</p>	-02					FF013-02†	FF014-02†	FF015-02†	25
	-04					FF013-04	FF014-04	FF015-04	26
	-06					FF013-06	FF014-06	FF015-06	27
	-10					FF013-10	FF014-10	FF015-10	28
	-12					FF013-12	FF014-12	FF015-12	29
	-16					FF013-16	FF014-16	FF015-16	30
									31
								32	
Accessories Dust Cap 	-02						FD45-1040-02		33
	-04						FD45-1040-04		34
	-06						FD45-1040-06		35
	-10						FD45-1040-10		36
	-12						FD45-1040-12		37
	-16						FD45-1040-16		38
									39
								40	
Dust Plug 	-02						FD45-1041-02		41
	-04						FD45-1041-04		42
	-06						FD45-1041-06		43
	-10						FD45-1041-10		44
	-12						FD45-1041-12		45
	-16						FD45-1041-16		46
									47



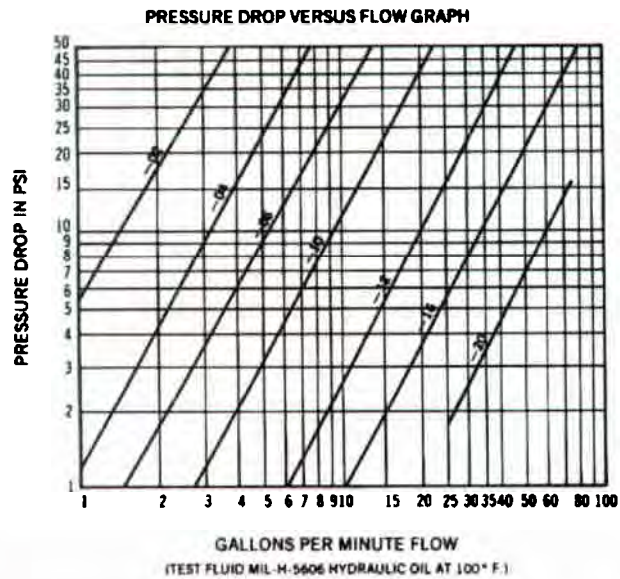
FD45 Series/Industrial Interchange Series B . . . (Brass)



The FD45 Series brass industrial interchange coupling offers corrosion resistance where steel couplings are unacceptable. This general purpose coupling uses a *PUSH-PULL™* latch mechanism.

- Dual interface O-Rings in the female half provide redundant sealing while connected.
- Brass construction with stainless steel springs for greater corrosion resistance and fluid compatibility.
- Industrial interchange coupling conforming dimensionally to ISO standard 7241/1 Series B.
- *PUSH-PULL™* ball latch design allows quick and easy connection and disconnection of hose lines.
- Self-sealing poppet valves provide excellent high and low pressure sealing.
- Standard seal material – Buna-N, EPR and Viton.
- Standard body material – Brass with stainless steel springs and balls.

Flow Data

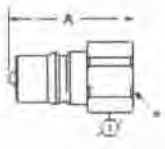
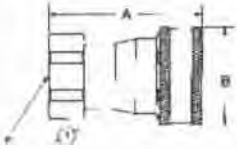
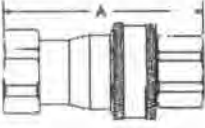
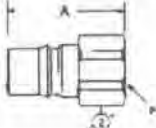
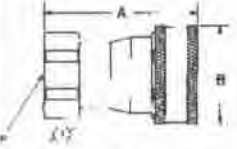


Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure		Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max)
		Connected (psi)	Disconnected (psi)				
-02	1,000	11,000	12,000	28	1	.50	.50
-04	1,000	18,000	14,000	28	3	.50	.50
-06	1,000	12,000	9,000	28	6	2.5	1.3
-10	1,000	12,000	6,500	28	12	4.0	2.8
-12	1,000	10,000	10,000	28	28	11.0	8.2
-16	1,000	8,500	11,000	28	50	18.0	16.0
-20	1,000	6,000	6,000	28	75	30.0	45.0

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



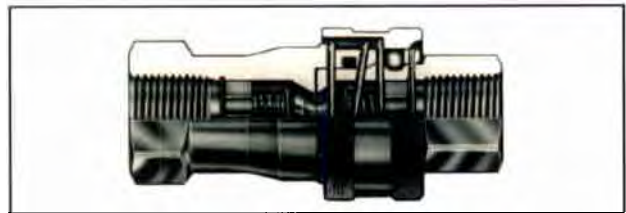
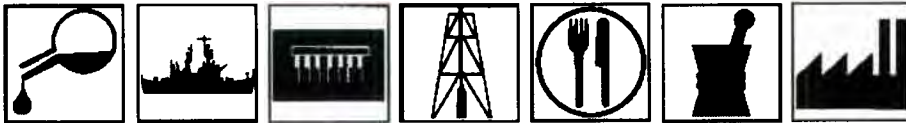
FD45 Brass	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	ϕ	Buna-N	Viton	EPR	
Male Half Female Pipe/Valved 	-02	1/2-27	1.28		.56	FD45-1086-02-02	FD45-1092-02-02	FD45-1153-02-02	1
	-04	1/2-18	1.50		.69	FD45-1086-04-04	FD45-1092-04-04	FD45-1153-04-04	2
	-06	1/2-18	1.66		.88	FD45-1086-06-06	FD45-1092-06-06	FD45-1153-06-06	3
	-10	1/2-14	1.93		1.06	FD45-1086-08-10	FD45-1092-08-10	FD45-1153-08-10	4
	-12	1/2-14	2.26		1.31	FD45-1086-12-12	FD45-1092-12-12	FD45-1153-12-12	5
	-16	1-11 1/2	2.72		1.62	FD45-1086-16-16	FD45-1092-16-16	FD45-1153-16-16	6
	-20	1 1/4-11 1/2	4.25		2.38	FD45-1086-20-20	FD45-1092-20-20	FD45-1153-20-20	7
	Art is not representative of -20 size.									8
Female Half Female Pipe/Valved 	-02	1/2-27	1.81	.96	.75	FD45-1101-02-02	FD45-1091-02-02	FD45-1156-02-02	9
	-04	1/2-18	2.22	1.13	.81	FD45-1101-04-04	FD45-1091-04-04	FD45-1156-04-04	10
	-06	1/2-18	2.45	1.38	1.06	FD45-1101-06-06	FD45-1091-06-06	FD45-1156-06-06	11
	-10	1/2-14	2.86	1.69	1.31	FD45-1101-08-10	FD45-1091-08-10	FD45-1156-08-10	12
	-12	1/2-14	3.40	2.01	1.62	FD45-1101-12-12	FD45-1091-12-12	FD45-1156-12-12	13
	-16	1-11 1/2	4.02	2.38	1.94	FD45-1101-16-16	FD45-1091-16-16	FD45-1156-16-16	14
	-20	1 1/4-11 1/2	4.49	2.62	2.38	FD45-1101-20-20	FD45-1091-20-20	FD45-1156-20-20	15
	Art is not representative of -20 size.									16
Complete Coupling Female Pipe/Valved 	-02	1/2-27	2.31			FD45-1100-02-02	FD45-1090-02-02	FD45-1157-02-02	17
	-04	1/2-18	2.74			FD45-1100-04-04	FD45-1090-04-04	FD45-1157-04-04	18
	-06	1/2-18	3.04			FD45-1100-06-06	FD45-1090-06-06	FD45-1157-06-06	19
	-10	1/2-14	3.54			FD45-1100-08-10	FD45-1090-08-10	FD45-1157-08-10	20
	-12	1/2-14	4.02			FD45-1100-12-12	FD45-1090-12-12	FD45-1157-12-12	21
	-16	1-11 1/2	4.88			FD45-1100-16-16	FD45-1090-16-16	FD45-1157-16-16	22
	-20	1 1/4-11 1/2	6.80			FD45-1100-20-20	FD45-1090-20-20	FD45-1157-20-20	23
	Art is not representative of -20 size.									24
Male Half Female Pipe/Non-Valved  <p>Will not operate with serrated coupling flanges. No valve actuator.</p>	-02	1/2-27	1.20		.56	FD45-1175-02-02	FD45-1175-02-02	FD45-1175-02-02	25
	-04	1/2-18	1.37		.69	FD45-1175-04-04	FD45-1175-04-04	FD45-1175-04-04	26
	-06	1/2-18	1.50		.88	FD45-1175-06-06	FD45-1175-06-06	FD45-1175-06-06	27
	-10	1/2-14	1.76		1.06	FD45-1175-08-10	FD45-1175-08-10	FD45-1175-08-10	28
	-12	1/2-14	2.00		1.31	FD45-1175-12-12	FD45-1175-12-12	FD45-1175-12-12	29
	-16	1-11 1/2	2.43		1.62	FD45-1175-16-16	FD45-1175-16-16	FD45-1175-16-16	30
	-20	1 1/4-11 1/2	4.25		2.38	FD45-1175-20-20	FD45-1399-20-20	FD45-1400-20-20	31
	Art is not representative of -20 size.									32
Female Half Female Pipe/Non-Valved  <p>Will not operate with serrated coupling flanges. No valve actuator.</p>	-02	1/2-27	1.81	.96	.75	FD45-1176-02-02	FD45-1180-02-02	FD45-1178-02-02	33
	-04	1/2-18	2.22	1.13	.81	FD45-1176-04-04	FD45-1180-04-04	FD45-1178-04-04	34
	-06	1/2-18	2.45	1.38	1.06	FD45-1176-06-06	FD45-1180-06-06	FD45-1178-06-06	35
	-10	1/2-14	2.86	1.69	1.31	FD45-1176-08-10	FD45-1180-08-10	FD45-1178-08-10	36
	-12	1/2-14	3.40	2.01	1.62	FD45-1176-12-12	FD45-1180-12-12	FD45-1178-12-12	37
	-16	1-11 1/2	4.02	2.38	1.94	FD45-1176-16-16	FD45-1180-16-16	FD45-1178-16-16	38
	-20	1 1/4-11 1/2	4.49	2.62	2.38	FD45-1176-20-20	FD45-1180-20-20	FD45-1178-20-20	39
	Art is not representative of -20 size.									40
Repair Kit									
Each kit will repair one male or female half.									
	-02					FF016-02†	FF017-02†	FF018-02†	41
	-04					FF016-04	FF017-04	FF018-04	42
	-06					FF016-06	FF017-06	FF018-06	43
	-10					FF016-10	FF017-10	FF018-10	44
	-12					FF016-12	FF017-12	FF018-12	45
	-16					FF016-16	FF017-16	FF018-16	46
	-20					FF016-20	FF017-20	FF018-20	47
†The -02 coupling size valve is not repairable. This size repair kit contains an O-ring seal and back-up ring.									



FD45 Brass	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B		Buna-N	Viton	EPR	
Complete Coupling Female Pipe/Non-Valved 	-02	1/8-27	2.31			FD45-1174-02-02	FD45-1179-02-02	FD45-1177-02-02	1
	-04	1/4-18	2.74			FD45-1174-04-04	FD45-1179-04-04	FD45-1177-04-04	2
	-06	3/8-18	3.04			FD45-1174-06-06	FD45-1179-06-06	FD45-1177-06-06	3
	-10	1/2-14	3.54			FD45-1174-08-10	FD45-1179-08-10	FD45-1177-08-10	4
	-12	3/4-14	4.02			FD45-1174-12-12	FD45-1179-12-12	FD45-1177-12-12	5
	-16	1-11 1/2	4.88			FD45-1174-16-16	FD45-1179-16-16	FD45-1177-16-16	6
	-20	1 1/4-11 1/2	6.80			FD45-1174-20-20	FD45-1179-20-20	FD45-1177-20-20	7
	Art is not representative of -20 size.									8
Male Half Female Pipe/Pusher Style Valving <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-04	1/4-18	1.50		.75	FD45-1201-04-04	FD45-1201-04-04	FD45-1201-04-04	9
	-06	3/8-18	1.66		.88	FD45-1201-06-06	FD45-1201-06-06	FD45-1201-06-06	10
	-10	1/2-14	1.93		1.06	FD45-1201-08-10	FD45-1201-08-10	FD45-1201-08-10	11
	-12	3/4-14	2.26		1.31	FD45-1201-12-12	FD45-1201-12-12	FD45-1201-12-12	12
	-16	1-11 1/2	2.72		1.62	FD45-1201-16-16	FD45-1201-16-16	FD45-1201-16-16	13
									14
									15
									16
Female Half Female Pipe/Pusher Style Valving <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-04	1/4-18	2.22	1.13	.88	FD45-1203-04-04	FD45-1199-04-04	FD45-1211-04-04	17
	-06	3/8-18	2.45	1.38	1.06	FD45-1203-06-06	FD45-1199-06-06	FD45-1211-06-06	18
	-10	1/2-14	2.86	1.69	1.31	FD45-1203-08-10	FD45-1199-08-10	FD45-1211-08-10	19
	-12	3/4-14	3.40	2.01	1.62	FD45-1203-12-12	FD45-1199-12-12	FD45-1211-12-12	20
	-16	1-11 1/2	4.02	2.38	1.94	FD45-1203-16-16	FD45-1199-16-16	FD45-1211-16-16	21
									22
									23
									24
Repair Kit Each kit will repair one male or female half. †The -02 coupling size valving is not repairable. This size repair kit contains an interface seal and back-up ring.	-02					FF016-02†	FF017-02†	FF018-02†	25
	-04					FF016-04	FF017-04	FF018-04	26
	-06					FF016-06	FF017-06	FF018-06	27
	-10					FF016-10	FF017-10	FF018-10	28
	-12					FF016-12	FF017-12	FF018-12	29
	-16					FF016-16	FF017-16	FF018-16	30
	-20					FF016-20	FF017-20	FF018-20	31
									32
Accessories									33
Dust Cap 	-02						FD45-1040-02		34
	-04						FD45-1040-04		35
	-06						FD45-1040-06		36
	-10						FD45-1040-10		37
	-12						FD45-1040-12		38
	-16						FD45-1040-16		39
								40	
Dust Plug 	-02						FD45-1041-02		41
	-04						FD45-1041-04		42
	-06						FD45-1041-06		43
	-10						FD45-1041-10		44
	-12						FD45-1041-12		45
	-16						FD45-1041-16		46
								47	



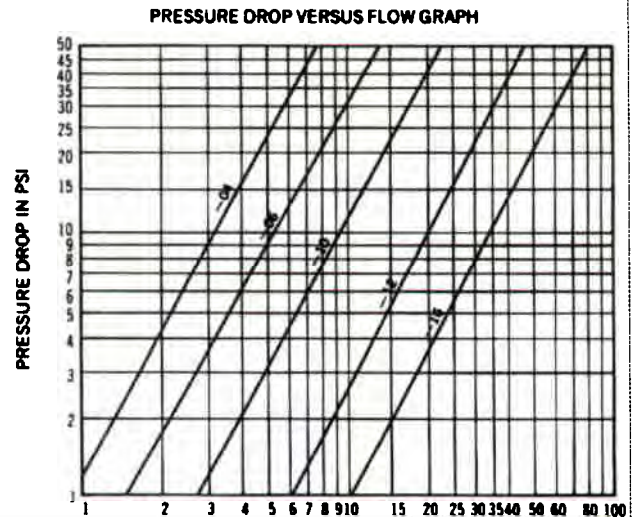
FD45 Series/Industrial Interchange Series B . . . (Stainless Steel)



The FD45 stainless steel is a general purpose industrial interchange coupling available valved or non-valved. Offered in 303/304 grades of stainless steel for excellent corrosion resistance in rugged applications.

- Industrial interchange coupling conforming dimensionally to ISO standard 7241/1 Series B.
- Stainless steel construction for greater corrosion resistance and fluid compatibility.
- *PUSH-PULL™* ball latch design allows quick and easy connection and disconnection of hose lines.
- Self-sealing poppet valves provide excellent high and low pressure sealing.
- Standard seal material – Buna-N, EPR and Viton.
- Standard body material – Stainless Steel.

Flow Data

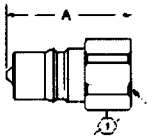
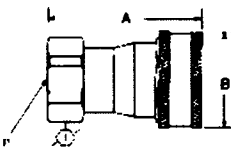
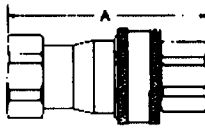
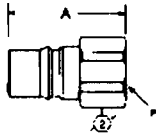
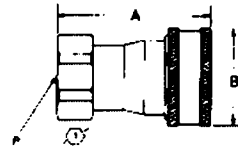


Physical Characteristics

Coupling Size	Maximum Operating Pressure		Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max)
	Hydraulic (psi)	Static (psi)					
-04	3,000	3,000	12,000	28	3	.50	.50
-06	1,500	1,750	12,000	28	6	2.5	1.3
-10	1,500	1,750	12,000	28	12	4.0	2.8
-12	1,500	1,750	12,000	28	28	11.0	8.2
-16	1,250	1,500	12,000	28	50	18.0	16.0

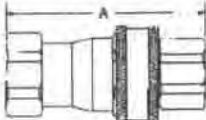
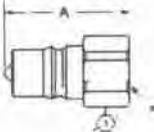
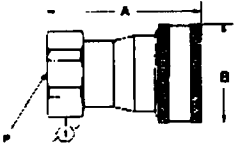


GALLONS PER MINUTE FLOW
(TEST FLUID MIL-H-5606 HYDRAULIC OIL AT 100° F.)



FD45 Stainless Steel	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	Δ	Buna-N	Viton	EPR	
Male Half Female Pipe/Valved 	-04	1/4-18	1.46		.69	FD45-1004-04-04	FD45-1078-04-04	FD45-1121-04-04	1
	-06	3/8-18	1.66		.88	FD45-1004-06-06	FD45-1078-06-06	FD45-1121-06-06	2
	-10	1/2-14	1.89		1.06	FD45-1004-08-10	FD45-1078-08-10	FD45-1121-08-10	3
	-12	3/4-14	2.26		1.31	FD45-1004-12-12	FD45-1078-12-12	FD45-1121-12-12	4
	-16	1-11/2	2.72		1.62	FD45-1004-16-16	FD45-1078-16-16	FD45-1121-16-16	5
									6
									7
									8
Female Half Female Pipe/Valved 	-04	1/4-18	2.22	1.13	.81	FD45-1005-04-04	FD45-1076-04-04	FD45-1122-04-04	9
	-06	3/8-18	2.45	1.38	1.06	FD45-1005-06-06	FD45-1076-06-06	FD45-1122-06-06	10
	-10	1/2-14	2.86	1.69	1.31	FD45-1005-08-10	FD45-1076-08-10	FD45-1122-08-10	11
	-12	3/4-14	3.40	2.01	1.62	FD45-1005-12-12	FD45-1076-12-12	FD45-1122-12-12	12
	-16	1-11/2	4.02	2.38	2.00	FD45-1005-16-16	FD45-1076-16-16	FD45-1122-16-16	13
									14
									15
									16
Complete Coupling Female Pipe/Valved 	-04	1/4-18	2.70			FD45-1001-04-04	FD45-1075-04-04	FD45-1120-04-04	17
	-06	3/8-18	3.04			FD45-1001-06-06	FD45-1075-06-06	FD45-1120-06-06	18
	-10	1/2-14	3.50			FD45-1001-08-10	FD45-1075-08-10	FD45-1120-08-10	19
	-12	3/4-14	4.02			FD45-1001-12-12	FD45-1075-12-12	FD45-1120-12-12	20
	-16	1-11/2	4.88			FD45-1001-16-16	FD45-1075-16-16	FD45-1120-16-16	21
									22
									23
									24
Male Half Female Pipe/Non-Valved  <p>Will not operate with valved coupling halves. No valve actuator.</p>	-04	1/4-18	1.33		.69	FD45-1062-04-04	FD45-1062-04-04	FD45-1062-04-04	25
	-06	3/8-18	1.50		.88	FD45-1062-06-06	FD45-1062-06-06	FD45-1062-06-06	26
	-10	1/2-14	1.72		1.06	FD45-1062-08-10	FD45-1062-08-10	FD45-1062-08-10	27
	-12	3/4-14	2.00		1.31	FD45-1062-12-12	FD45-1062-12-12	FD45-1062-12-12	28
	-16	1-11/2	2.43		1.62	FD45-1062-16-16	FD45-1062-16-16	FD45-1062-16-16	29
									30
									31
									32
Female Half Female Pipe/Non-Valved  <p>Will not operate with valved coupling halves. No valve actuator.</p>	-04	1/4-18	2.22	1.13	.81	FD45-1053-04-04	FD45-1195-04-04	FD45-1142-04-04	33
	-06	3/8-18	2.45	1.38	1.06	FD45-1053-06-06	FD45-1195-06-06	FD45-1142-06-06	34
	-10	1/2-14	2.86	1.69	1.31	FD45-1053-08-10	FD45-1195-08-10	FD45-1142-08-10	35
	-12	3/4-14	3.40	2.01	1.62	FD45-1053-12-12	FD45-1195-12-12	FD45-1142-12-12	36
	-16	1-11/2	4.02	2.38	2.00	FD45-1053-16-16	FD45-1195-16-16	FD45-1142-16-16	37
									38
									39
									40
Repair Kit Each kit will repair one male or female half.	-04					FF054-04	FF055-04	FF056-04	42
	-06					FF054-06	FF055-06	FF056-06	43
	-10					FF054-10	FF055-10	FF056-10	44
	-12					FF054-12	FF055-12	FF056-12	45
	-16					FF054-16	FF055-16	FF056-16	46
									47
								48	

QUICK DISCONNECT COUPLINGS



FD45 Stainless Steel	Coupling Size	Thread Size(P)	Dimensional Data			Part Number			Line Ref.
			A	B	ϕ	Buna-N	Viton	EPR	
Complete Coupling Female Pipe/Non-Valved 	-04	1/4-18	2.70			FD45-1052-04-04	FD45-1194-04-04	FD45-1143-04-04	1
	-06	1/4-18	3.04			FD45-1052-06-06	FD45-1194-06-06	FD45-1143-06-06	2
	-10	1/2-14	3.50			FD45-1052-08-10	FD45-1194-08-10	FD45-1143-08-10	3
	-12	1/2-14	4.02			FD45-1052-12-12	FD45-1194-12-12	FD45-1143-12-12	4
	-16	1-11 1/2	4.88			FD45-1052-16-16	FD45-1194-16-16	FD45-1143-16-16	5
									6
									7
									8
Male Half Female Pipe/Pusher Style Valving  <p><small>Incorporates a pusher device to open mating coupling halves.</small></p>	-04	1/4-18	1.46		.69	FD45-1059-04-04	FD45-1059-04-04	FD45-1059-04-04	9
	-06	1/4-18	1.66		.88	FD45-1059-06-06	FD45-1059-06-06	FD45-1059-06-06	10
	-10	1/2-14	1.89		1.06	FD45-1059-08-10	FD45-1059-08-10	FD45-1059-08-10	11
	-12	1/2-14	2.26		1.31	FD45-1059-12-12	FD45-1059-12-12	FD45-1059-12-12	12
	-16	1-11 1/2	2.72		1.62	FD45-1059-16-16	FD45-1059-16-16	FD45-1059-16-16	13
									14
									15
									16
Female Half Female Pipe/Pusher Style Valving  <p><small>Incorporates a pusher device to open mating coupling halves.</small></p>	-04	1/4-18	2.22	1.13	.81	FD45-1056-04-04	FD45-1197-04-04	FD45-1209-04-04	17
	-06	1/4-18	2.45	1.38	1.06	FD45-1056-06-06	FD45-1197-06-06	FD45-1209-06-06	18
	-10	1/2-14	2.86	1.69	1.31	FD45-1056-08-10	FD45-1197-08-10	FD45-1209-08-10	19
	-12	1/2-14	3.40	2.01	1.62	FD45-1056-12-12	FD45-1197-12-12	FD45-1209-12-12	20
	-16	1-11 1/2	4.02	2.38	2.00	FD45-1056-16-16	FD45-1197-16-16	FD45-1209-16-16	21
									22
									23
									24
Repair Kit Each kit will repair one male or female half	-04					FF054-04	FF055-04	FF056-04	25
	-06					FF054-06	FF055-06	FF056-06	26
	-10					FF054-10	FF055-10	FF056-10	27
	-12					FF054-12	FF055-12	FF056-12	28
	-16					FF054-16	FF055-16	FF056-16	29
									30
									31
									32
Accessories Dust Cap 	-04						FD45-1040-04		33
	-06						FD45-1040-06		34
	-10						FD45-1040-10		35
	-12						FD45-1040-12		36
	-16						FD45-1040-16		37
									38
									39
									40
Dust Plug 	-04						FD45-1041-04		41
	-06						FD45-1041-06		42
	-10						FD45-1041-10		43
	-12						FD45-1041-12		44
	-16						FD45-1041-16		45



FD45 Stainless Steel	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B		Buna-N	Viton	EPR	
*Fryer Coupling/Male Half Female Pipe/Valved 	-10	1/2-14	1.92		1.06		FD45-1270-08-10		1
									2
									3
									4
									5
									6
									7
									8
*Fryer Coupling/Female Half Female Pipe/Valved Silicone Collar on Ball Release Sleeve 	-10	1/2-14	2.86	2.38	1.31		FD45-1267-08-10		9
									10
									11
									12
									13
									14
									15
									16

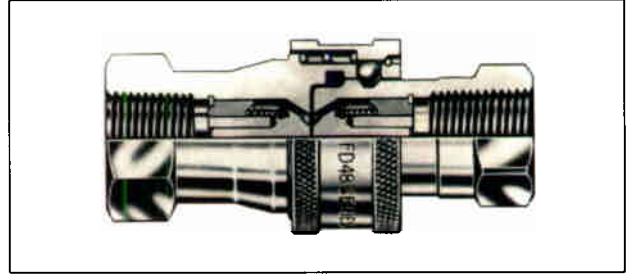
*Special internal Viton seal material approved for use by the National Sanitation Foundation. The fryer coupling uses a silicone collar aiding disconnection with hot fluid applications.

Connecting and disconnecting lines between deep fat fryers and oil recycling units has been made cleaner, safer and quicker with Aeroquip's new FD45 "Fryer" coupling.

Aeroquip's FD45 "Fryer" coupling is made of stainless steel with Viton* seal material. It has a silicone rubber collar on the sleeve of the female half to provide insulation from high oil temperatures and an excellent gripping surface during connection and disconnection. The coupling has been approved for use by the National Sanitation Foundation.



FD48 Series/Parker Bruning—SM Interchange

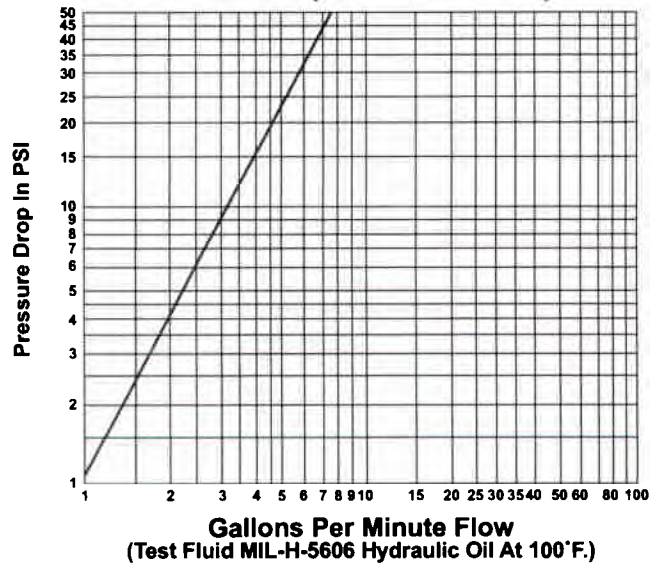


The FD48 Series coupling is designed to interchange with Parker Bruning SM-250 couplings.

- Self-sealing poppet valves provide excellent high and low pressure sealing.
- *PUSH-PULL™* ball latch design allows quick and easy connection and disconnection of fluid lines.
- Heat-treated and plated steel for wear and corrosion resistance.
- 3,000 psi operating pressure.
- Standard seal material – Buna-N.
- Standard seal material – Zinc plated steel with zinc poppet guides.

Flow Data

Pressure Drop Versus Flow Graph

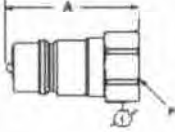
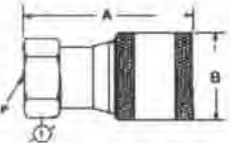
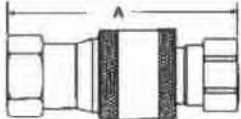



Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-04	3,000	12,000	28	3	0.50	1.10

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

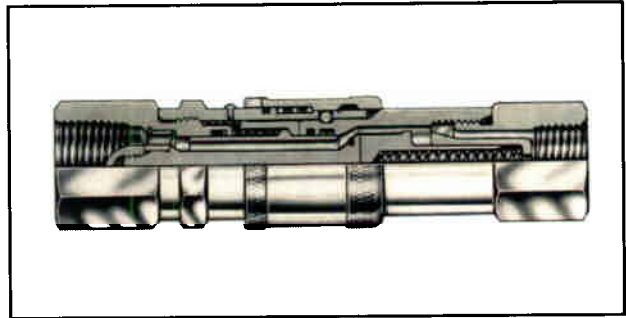


FD48 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number	Line Ref.
			A	B	ϕ		
Male Half Female Pipe/Valved 	-04	1/4-18	1.45		.75	FD48-1002-04-04	1
							2
							3
							4
							5
							6
							7
							8
Female Half Female Pipe/Valved 	-04	1/4-18	2.01	1.06	.81	FD48-1001-04-04	9
							10
							11
							12
							13
							14
							15
							16
Complete Coupling Female Pipe/Valved 	-04	1/4-18	2.69			FD48-1000-04-04	17
							18
							19
							20
							21
							22
							23
							24
Accessories							25
Dust Cap/Plug (Fits both male and female halves) 	-04					FD48-1042-04	26
							27
							28
							29
							30
							31
							32

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FD49 Series/HTMA Flush Face, Hydraulic Tool



The FD49 Series meets NFPA standard T3.20.15, which was developed in conjunction with HTMA (Hydraulic Tool Manufacturer's Association).

- Twin-Guard™ sealing system prevents weepage and allows connection and disconnection against pressure up to 500 psi.
- Dual flush face valving for minimal fluid loss and air inclusion.
- Tubular valve and sleeve construction for high fluid flow with low pressure drop.
- Push-to-connect latching for one hand operation.
- Standard seal material – Teflon channel seal and Buna-N O-Ring backup.
- Standard body material – Zinc plated steel.



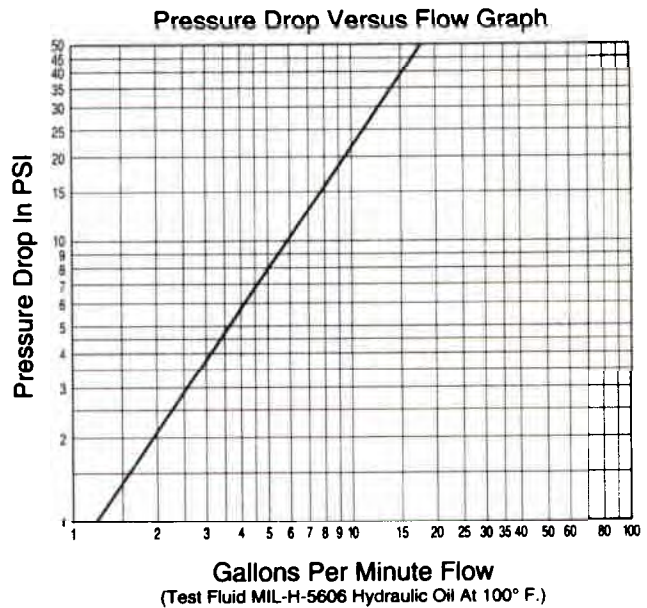
Our patented Twin-Guard™ seal system consists of channel and Buna-N O-Ring seals. The channel seal prevents blowout during connection and disconnection under pressure to 500 psi. The Buna-N O-Ring seal is a secondary seal eliminating fluid weepage.

*Patent Number 5123445

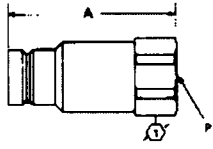
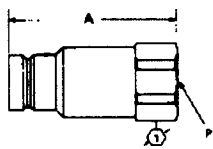
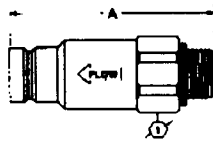
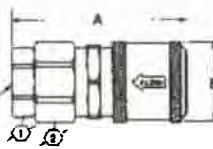
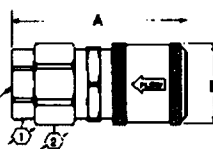
Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-06	3,000	9,000	28	10	.01	.02

Flow Data





FD49 Series	Coupling Size	Thread Size (P)	Dimensional Data				Part Number Buna-N	Line Ref.
			A	B	①	②		
Male Half Female Pipe/Valved 	-06	3/4-18	2.62		1.00		FD49-1002-06-06	1
	-06	1/2-14	2.75		1.06		FD49-1002-08-06	2
								3
								4
								5
								6
								7
								8
Male Half Female SAE O-Ring/Valved 	-06	9/16-18	2.79		1.06		FD49-1004-06-06	9
	-06	3/4-16	2.75		1.00		FD49-1004-08-06	10
								11
								12
								13
								14
								15
								16
Male Half Male SAE O-Ring/Valved 	-06	9/16-18	2.99		1.00		FD49-1057-06-06	17
	-06	3/4-16	2.99		1.00		FD49-1057-08-06	18
								19
								20
								21
								22
								23
								24
Female Half Female Pipe/Valved 	-06	3/8-18	2.74	1.20	1.00	1.06	FD49-1001-06-06	25
	-06	1/2-14	2.85	1.20		1.06	FD49-1001-08-06	26
								27
								28
								29
								30
								31
								32
Female Half Female SAE O-Ring/Valved 	-06	3/4-16	2.82	1.20		1.06	FD49-1005-08-06	33
								34
								35
								36
								37
								38
								39
								40

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

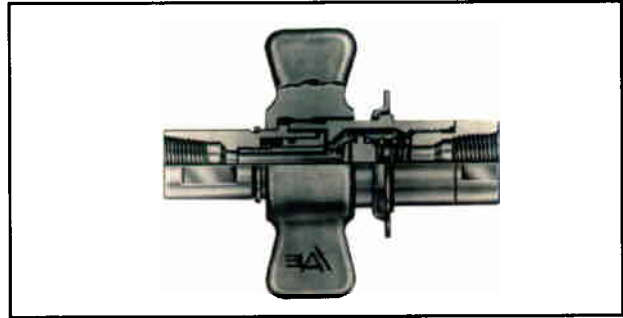


QUICK DISCONNECT COUPLINGS

FD49 Series	Coupling Size	Thread Size (P)	Dimensional Data				Part Number Buna-N	Line Ref.
			A	B				
Female Half Male SAE O-Ring/Valved 	-06	1/16-18	3.22	1.20	1.00	1.06	FD49-1014-06-06	1
	-06	1/8-16	3.28	1.20	1.00	1.06	FD49-1014-08-06	2
								3
								4
								5
								6
								7
								8
Female Half/Heavy Duty Sleeve Female Pipe/Valved 	-06	1/8-18	2.74	1.40	1.00	1.06	FD49-1200-06-06	9
	-06	1/2-14	2.85	1.40		1.06	FD49-1200-08-06	10
								11
								12
								13
								14
								15
								16
Accessories								17
Dust Cover For Standard Coupling 								18
								19
	-06						FD49-1042-06	20
								21
								22
								23
								24
								25
Dust Cover For Heavy Duty Coupling 								26
								27
	-06						FD49-1088-06	28
								29
								30
								31
								32
								33
							34	
							35	



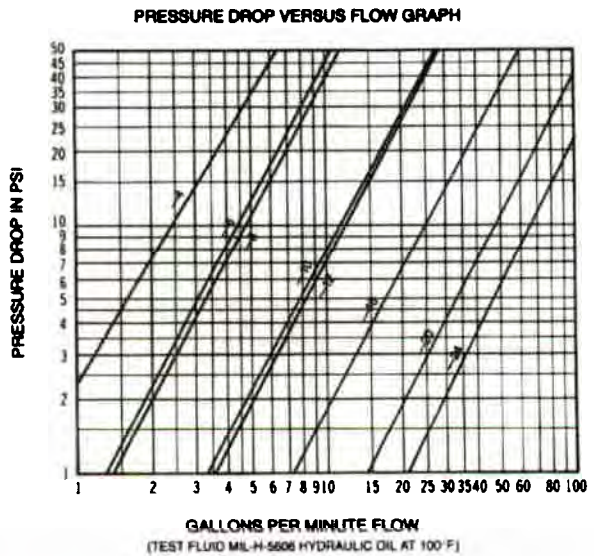
5100 Series/Low Spill—Connect Under Pressure



The 5100 Series brass coupling with steel tubular valve offers minimum air inclusion and fluid loss. Thread together latch provides connect under pressure capability and vibration resistance. It is not rated for continuous hydraulic impulse applications. (See FD86 on page 69.)

- Tubular valve construction for virtually no fluid loss during disconnection, reduces environmental and worker safety hazards.
- Low air inclusion during connection maintains system performance.
- Available with wing or hex nut configurations.
- Connect against pressure capability allows connecting of halves even when pressurized up to 500 psi.
- Steel flange available for accessible bulkhead mounting.
- Standard seal material – Buna-N, Viton and EPR available upon request.
- Standard body material – Brass with steel valving components, hex and wing nuts.

Flow Data



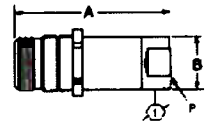
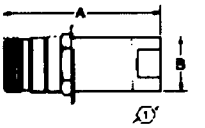
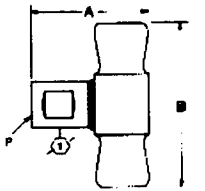
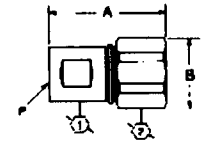
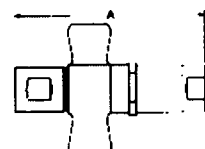
Physical Characteristics

Coupling Dash Size	Coupling Interface Size	Maximum Operating Pressure* (psi connected)	Maximum Operating Pressure (psi disconnected)		Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc max.)	Fluid Loss (cc max.)
			Male Half S2 and S4	Female Half S5				
-4	-4	3000	3000	3000	28	4	.03	.01
-6	-8	3000	3000	3000	28	7	.05	.06
-8	-8	3000	3000	3000	28	7	.05	.10
-10	-12	3000	3000	3000	28	18	.14	.10
-12	-12	3000	3000	3000	28	18	.34	.26
-16	-16	3000	3000	3000	28	40	.50	.35
-20	-20	2750	2500	2750	28	75	.68	.70
-24	-24	2500	2500	2000	28	100	.60	.94

*Minimum burst pressure is equal to three times the maximum operating pressure. Not recommended for continuous hydraulic impulse applications at maximum operating pressures.



For component part number breakdown and service instructions, request bulletin JB41.

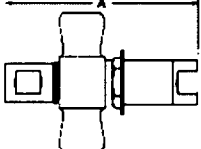
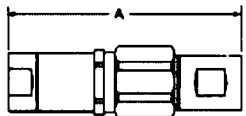
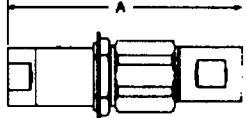



5100 Series	Coupling Size	Thread Size (P)	Dimensional Data				Part Number			Line Ref.
			A	B	①	②	Buna-N	Viton	EPR	
Male Half/Less Flange Female Pipe 	-4	1/8-27	1.88	.90	.69		5100-S2-4B	FD51-1264-04	FD51-1265-04	1
	-6	1/4-18	2.58	1.07	.94		5100-S2-6B	FD51-1264-06	FD51-1265-06	2
	-8	3/8-18	2.58	1.07	.94		5100-S2-8B	FD51-1264-08	FD51-1265-08	3
	-10	1/2-14	3.11	1.38	1.19		5100-S2-10B	FD51-1264-10	FD51-1265-10	4
	-12	3/4-14	3.11	1.38	1.19		5100-S2-12B	FD51-1264-12	FD51-1265-12	5
	-16	1-11 1/2	3.55	1.76	1.56		5100-S2-16B	FD51-1264-16	FD51-1265-16	6
	-20	1 1/4-11 1/2	3.71	2.10	1.88		5100-S2-20B	FD51-1264-20	FD51-1265-20	7
	-24	1 1/2-11 1/2	4.12	2.48	2.19		5100-S2-24B	FD51-1264-24	FD51-1265-24	8
Male Half/With Flange Female Pipe 	-4	1/8-27	1.88	.90	.94		5100-S4-4B			9
	-6	1/4-18	2.58	1.07	1.12		5100-S4-6B			10
	-8	3/8-18	2.58	1.07	1.12		5100-S4-8B			11
	-10	1/2-14	3.11	1.38	1.62		5100-S4-10B			12
	-12	3/4-14	3.11	1.38	1.62		5100-S4-12B			13
	-16	1-11 1/2	3.55	1.76	1.88		5100-S4-16B			14
	-20	1 1/4-11 1/2	3.71	2.10	2.12		5100-S4-20B			15
	-24	1 1/2-11 1/2	4.12	2.48	2.50		5100-S4-24B			16
Female Half/Wing Nut Female Pipe 	-4	1/8-27	1.97	3.03	.56		5100-S5-4B	FD51-1266-04	FD51-1268-04	17
	-6	1/4-18	2.37	3.44	.76		5100-S5-6B	FD51-1266-06	FD51-1268-06	18
	-8	3/8-18	2.37	3.44	.76		5100-S5-8B	FD51-1266-08	FD51-1268-08	19
	-10	1/2-14	3.09	4.06	1.16		5100-S5-10B	FD51-1266-10	FD51-1268-10	20
	-12	3/4-14	3.09	4.06	1.16		5100-S5-12B	FD51-1266-12	FD51-1268-12	21
	-16	1-11 1/2	3.67	4.38	1.44		5100-S5-16B	FD51-1266-16	FD51-1268-16	22
	-20	1 1/4-11 1/2	3.98	5.19	1.78		5100-S5-20B	FD51-1266-20	FD51-1268-20	23
	-24	1 1/2-11 1/2	4.02	5.31	2.00		5100-S5-24B	FD51-1266-24	FD51-1268-24	24
Female Half/Hex Nut Female Pipe 	-4	1/8-27	2.10	1.32	.56	1.19	5110-S5-4B	FD51-1267-04	FD51-1269-04	25
	-6	1/4-18	2.40	1.53	.76	1.38	5110-S5-6B	FD51-1267-06	FD51-1269-06	26
	-8	3/8-18	2.40	1.53	.76	1.38	5110-S5-8B	FD51-1267-08	FD51-1269-08	27
	-10	1/2-14	3.07	1.98	1.16	1.75	5110-S5-10B	FD51-1267-10	FD51-1269-10	28
	-12	3/4-14	3.07	1.98	1.16	1.75	5110-S5-12B	FD51-1267-12	FD51-1269-12	29
	-16	1-11 1/2	3.68	2.41	1.44	2.12	5110-S5-16B	FD51-1267-16	FD51-1269-16	30
	-20	1 1/4-11 1/2	4.00	2.81	1.78	2.50	5110-S5-20B	FD51-1267-20	FD51-1269-20	31
	-24	1 1/2-11 1/2	4.10	3.10	2.00	2.75	5110-S5-24B	FD51-1267-24	FD51-1269-24	32
Complete Coupling Less Flange/With Wing Nut/ Female Pipe 	-4	1/8-27	3.20				5101-4B	FD51-1270-04	FD51-1272-04	33
	-6	1/4-18	4.11				5101-6B	FD51-1270-06	FD51-1272-06	34
	-8	3/8-18	4.11				5101-8B	FD51-1270-08	FD51-1272-08	35
	-10	1/2-14	5.21				5101-10B	FD51-1270-10	FD51-1272-10	36
	-12	3/4-14	5.21				5101-12B	FD51-1270-12	FD51-1272-12	37
	-16	1-11 1/2	5.98				5101-16B	FD51-1270-16	FD51-1272-16	38
	-20	1 1/4-11 1/2	6.31				5101-20B	FD51-1270-20	FD51-1272-20	39
	-24	1 1/2-11 1/2	6.52				5101-24B	FD51-1270-24	FD51-1272-24	40
Repair Kit Each kit will repair male and female halves.	-4						FF098-04	FF095-04	FF097-04	41
	-6, -8						FF098-08	FF095-08	FF097-08	42
	-10, -12						FF098-12	FF095-12	FF097-12	43
	-16						FF098-16	FF095-16	FF097-16	44
	-20						FF098-20	FF095-20	FF097-20	45
	-24						FF098-24	FF095-24	FF097-24	46

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



For component part number breakdown and service instructions, request bulletin JB41.

QUICK DISCONNECT COUPLINGS

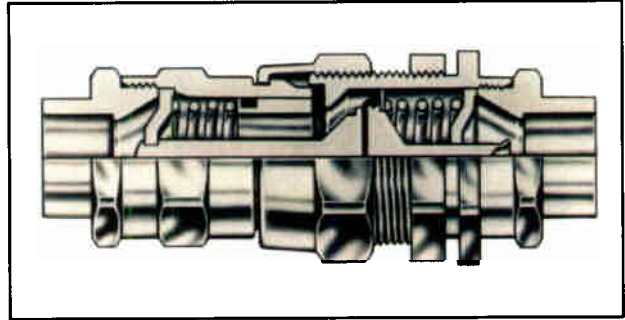
5100 Series	Coupling Size	Thread Size (P)	Dimensional Data				Part Number			Line Ref.		
			A	B	①	②	Buna-N	Viton	EPR			
Complete Coupling With Flange/With Wing Nut/ Female Pipe 	-4	1/8-27	3.24				5100-4B			1		
	-6	1/4-18	4.11				5100-6B			2		
	-8	3/8-18	4.11				5100-8B			3		
	-10	1/2-14	5.21				5100-10B			4		
	-12	3/4-14	5.21				5100-12B			5		
	-16	1-11 1/2	5.99				5100-16B			6		
	-20	1 1/4-11 1/2	6.33				5100-20B			7		
	-24	1 1/2-11 1/2	6.54				5100-24B			8		
Complete Coupling Less Flange/With Hex Nut/ Female Pipe 	-4	1/8-27	3.20				5111-4B	FD51-1271-04	FD51-1273-04	9		
	-6	1/4-18	4.11				5111-6B	FD51-1271-06	FD51-1273-06	10		
	-8	3/8-18	4.11				5111-8B	FD51-1271-08	FD51-1273-08	11		
	-10	1/2-14	5.21				5111-10B	FD51-1271-10	FD51-1273-10	12		
	-12	3/4-14	5.21				5111-12B	FD51-1271-12	FD51-1273-12	13		
	-16	1-11 1/2	5.98				5111-16B	FD51-1271-16	FD51-1273-16	14		
	-20	1 1/4-11 1/2	6.31				5111-20B	FD51-1271-20	FD51-1273-20	15		
	-24	1 1/2-11 1/2	6.52				5111-24B	FD51-1271-24	FD51-1273-24	16		
Complete Coupling With Flange/With Hex Nut/ Female Pipe 	-4	1/8-27	3.20				5110-4B			17		
	-6	1/4-18	4.11				5110-6B			18		
	-8	3/8-18	4.11				5110-8B			19		
	-10	1/2-14	5.21				5110-10B			20		
	-12	3/4-14	5.21				5110-12B			21		
	-16	1-11 1/2	5.98				5110-16B			22		
	-20	1 1/4-11 1/2	6.31				5110-20B			23		
	-24	1 1/2-11 1/2	6.52				5110-24B			24		
Repair Kit Each kit will repair male and female halves.	-4						FF098-04	FF095-04	FF097-04	25		
	-6, -8						FF098-08	FF095-08	FF097-08	26		
	-10, -12						FF098-12	FF095-12	FF097-12	27		
	-16						FF098-16	FF095-16	FF097-16	28		
	-20						FF098-20	FF095-20	FF097-20	29		
	-24						FF098-24	FF095-24	FF097-24	30		
Accessories							Dust Cap with Chain	Dust Plug with Chain	6 Bolt Flange	31		
	Dust Cap with Chain** 	Dust Plug with Chain** 	-4					5100-S7-5	5100-S9-5		32	
			-6, -8						5100-S7-8	5100-S9-8		33
			-10, -12						5100-S7-12	5100-S9-12		34
			-16						5100-S7-16	5100-S9-16		35
			-20						5100-S7-20	5100-S9-20		36
			-24						5100-S7-24	5100-S9-24		37
											38	
											39	
	6 Bolt Flange* 	-4		.201	1.44					150-22-5	40	
-6, -8			.201	1.69					150-22-8	41		
-10, -12			.201	2.12					150-22-12	42		
-16			.201	2.38					150-22-16	43		
-20			.201	2.62					150-22-20	44		
-24			.201	3.25					5100-22-24S	45		

*6 Bolt Flange-holes equally spaced. (See "A" for bolt hole diameter, and "B" for bolt circle diameter).

**To order caps and plugs without chain, order cap by part number 5100-32-(size) and plug by part number 5100-41-(size).



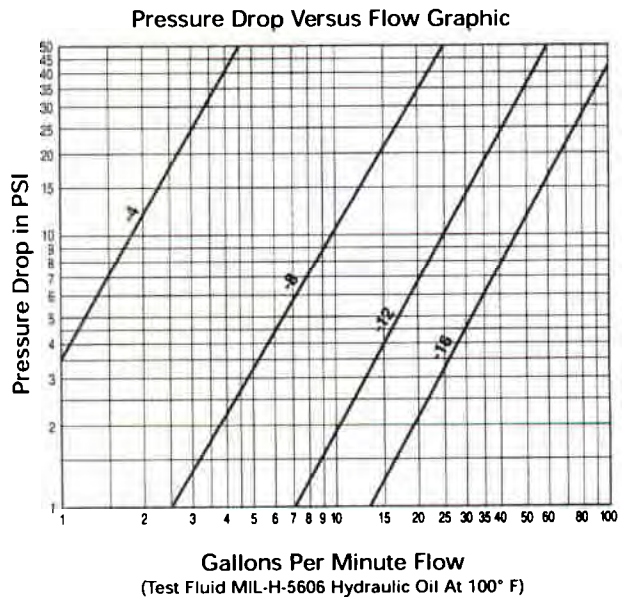
5400 Series/Low Air Inclusion Refrigerant



The 5400 Series is designed for air conditioning, refrigerant, gaseous and fluid transfer applications.

- Brazed or threaded end connections for versatility of installation on tubing or hose.
- Tubular valve construction for low fluid loss and air inclusion.
- Thread together design allows connection and disconnection against pressure.
- Lock washer and jam nut standard for optional bulk-head mounting.
- Standard seal material – Neoprene.
- Standard adapter material – Steel or Brass.
- Standard body material – Zinc plated steel.

Flow Data



Physical Characteristics

Coupling Dash Size	Maximum Operating Pressure (psi connected)	Minimum Burst Pressure (psi connected)	Maximum Operating Pressure (psi disconnected)		Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc max.)	Fluid Loss (cc max.)
			Male Half	Female Half				
-4	3000	9000	2500	500	28	2	.10	.05
-8	1750	5200	1750	400	28	14	.10	.10
-12	700	2100	800	400	28	35	.30	.10
-16	700	2100	700	300	28	75	.50	.20



5400 Series	Coupling Size	Thread Size (P)	Tube O.D. Size	Dimensional Data					Part Number Neoprene	Line Ref.
				A	B	①	②	③		
Male Half No Adapter 	-4			1.08	.83	.75			5400-S2-4	1
	-8			1.37	1.25	1.13			5400-S2-8	2
	-12			1.74	1.83	1.63			5400-S2-12	3
	-16			1.83	2.10	1.88			5400-S2-16	4
										5
										6
										7
										8
Female Half No adapter 	-4			1.13	.83	.63	.75		5400-S5-4	9
	-8			1.63	1.31	1.00	1.19		5400-S5-8	10
	-12			2.15	1.80	1.38	1.63		5400-S5-12	11
	-16			2.37	2.24	1.75	2.00		5400-S5-16	12
										13
										14
										15
										16
Male Half SAE 37° (JIC) 	-4	7/16-20		1.88	.83	.75		.63	5410-S17-4-4	17
	-4	9/16-18		1.89	.83	.75		.63	5410-S17-6-4	18
	-8	9/16-18		2.18	1.25	1.13		1.00	5410-S17-6-8	19
	-8	3/4-16		2.28	1.25	1.13		1.00	5410-S17-8-8	20
	-12	7/8-14		2.75	1.83	1.63		1.38	5410-S17-10-12	21
	-12	1 1/16-12		2.86	1.83	1.63		1.38	5410-S17-12-12	22
	-16	1 3/16-12		2.99	2.10	1.88		1.75	5410-S17-16-16	23
										24
Female Half SAE 37° (JIC) 	-4	7/16-20		1.93	.83	.63	.75	.63	5410-S14-4-4	25
	-4	9/16-18		1.94	.83	.63	.75	.63	5410-S14-6-4	26
	-8	9/16-18		2.43	1.31	1.00	1.19	1.00	5410-S14-6-8	27
	-8	3/4-16		2.53	1.31	1.00	1.19	1.00	5410-S14-8-8	28
	-12	7/8-14		3.16	1.80	1.38	1.63	1.38	5410-S14-10-12	29
	-12	1 1/16-12		3.27	1.80	1.38	1.63	1.38	5410-S14-12-12	30
	-16	1 3/16-12		3.53	2.24	1.75	2.00	1.75	5410-S14-16-16	31
										32
Complete Coupling SAE 37° (JIC) 	-4	7/16-20		3.54					5410-4-4	33
	-4	9/16-18		3.56					5410-6-4	34
	-8	9/16-18		4.23					5410-6-8	35
	-8	3/4-16		4.44					5410-8-8	36
	-12	7/8-14		5.33					5410-10-12	37
	-12	1 1/16-12		5.54					5410-12-12	38
	-16	1 3/16-12		5.89					5410-16-16	39
										40
Male Half Braze Tubing Adapter 	-4		1/4	1.52	.83	.75		.63	5401-S17-4-4	41
	-4		3/8	1.52	.83	.75		.63	5401-S17-6-4	42
	-8		3/8	1.75	1.31	1.13		1.00	5401-S17-6-8	43
	-8		1/2	1.75	1.31	1.13		1.00	5401-S17-8-8	44
	-12		5/8	2.47	1.80	1.63		1.38	5401-S17-10-12	45
	-12		3/4	2.47	1.80	1.63		1.38	5401-S17-12-12	46
	-16		1	2.80	2.24	1.88		1.75	5401-S17-16-16	47
										48

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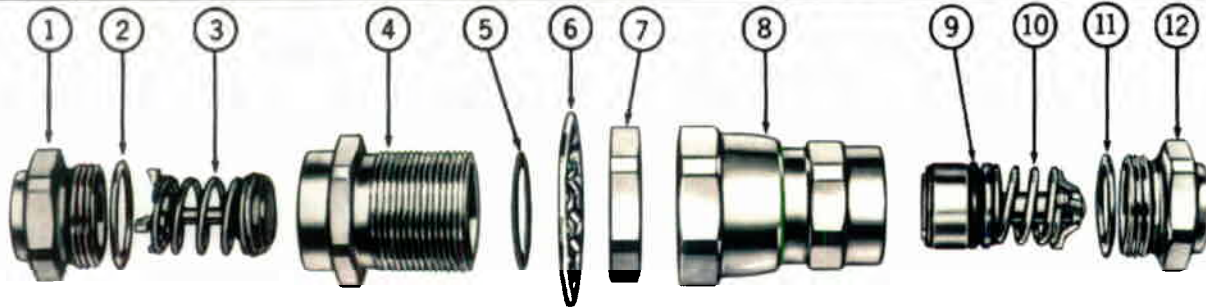
QUICK DISCONNECT COUPLINGS

5400 Series	Coupling Size	Thread Size (P)	Tube O.D. Size	Dimensional Data					Part Number Neoprene	Line Ref.
				A	B	(1)	(2)	(3)		
Female Half Braze Tubing Adapter 	-4		1/4	1.57	.83	.63	.75	.63	5401-S14-4-4	1
	-4		3/8	1.57	.83	.63	.75	.63	5401-S14-6-4	2
	-8		3/8	2.00	1.31	1.00	1.19	1.00	5401-S14-6-8	3
	-8		1/2	2.00	1.31	1.00	1.19	1.00	5401-S14-8-8	4
	-12		5/8	2.88	1.80	1.38	1.63	1.38	5401-S14-10-12	5
	-12		3/4	2.88	1.80	1.38	1.63	1.38	5401-S14-12-12	6
	-16		1	3.34	2.24	1.75	2.00	1.75	5401-S14-16-16	7
									8	
Complete Coupling Braze Tubing Adapter 	-4		1/4	2.82					5401-4-4	9
	-4		3/8	2.82					5401-6-4	10
	-8		3/8	3.37					5401-6-8	11
	-8		1/2	3.37					5401-8-8	12
	-12		5/8	4.76					5401-10-12	13
	-12		3/4	4.76					5401-12-12	14
	-16		1	5.52					5401-16-16	15
									16	
Accessories Dust Cap Dust Plug 				Dust Cap with Gasket				Dust Plug with Gasket		17
	-4					5400-S6-4		5400-S8-4		18
	-8					5400-S6-8		5400-S8-8		19
	-12					5400-S6-12		5400-S8-12		20
	-16					5400-S6-16		5400-S8-16		21
										22
									23	
									24	
									25	
Adapter SAE 37° (JIC) O-Ring Required				O-Ring		Brass		Steel		26
	-4	7/16-20	1/4	22546-12		202220-4-4B		202220-4-4S		27
	-4	9/16-18	3/8	22546-12		202220-6-4B		202220-6-4S		28
	-8	9/16-18	3/8	22546-17		202220-6-8B		202220-6-8S		29
	-8	3/4-16	1/2	22546-17		202220-8-8B		202220-8-8S		30
	-12	7/8-14	5/8	22546-23		202220-10-12B		202220-10-12S		31
	-12	1 1/16-12	3/4	22546-23		202220-12-12B		202220-12-12S		32
-16	1 3/16-12	1	22546-28		202220-16-16B		202220-16-16S		33	
									34	
Adapter-Braze O-Ring Required				Brass						35
	-4	1/2-20	1/4	22546-12		202208-4-4B				36
	-8	7/8-20	1/2	22546-17		202208-8-8B				37
	-12	1 1/4-18	5/8	22546-23		202208-10-12B				38
-16	1 9/32-20	7/8	22546-28		202208-14-16B				39	
Hose Fitting SAE 100R5¹ O-Ring Required			Hose Size	D					40	
	-4	1/2-20	-4	.92	22546-12		487-4-4S		41	
	-4	1/2-20	-6	.96	22546-12		487-4-6S		42	
	-8	7/8-20	-6	.96	22546-17		487-8-6S		43	
	-8	7/8-20	-8	1.06	22546-17		487-8-8S		44	
	-12	1 1/4-18	-10	1.07	22546-23		487-12-10S		45	
-16	1 9/32-20	-16	1.01	22546-28		487-16-16S				

¹Additional dash styles available.



Assembly Instructions/Component Part Numbers



Typical Male Coupling Half (S2)

Typical Female Coupling Half (S5)

Assembly Instructions

Steps:

- After tubing or hose has been connected to adapters ① and ⑫, install O-Rings ② and ⑪ on adapters. Be sure O-Rings are not twisted.
- Oil O-Rings ② and ⑪ liberally with system fluid to prevent them from scuffing and tearing when coupling body is threaded on adapter.
- S2 Half**—Lubricate poppet face with system fluid. Insert poppet valve assembly ③ into body ④. Tighten body ④ on adapter ①. After body and adapter make metal-to-metal contact, tighten by rotating body ④ $\frac{1}{8}$ " with respect to adapter ① or torque per table value.
S5 Half—Oil O-Ring ⑨ liberally with system fluid. Insert valve and sleeve assembly ⑩ into body ⑧. Tighten body ⑧ on adapter ⑫. After body and adapter make metal-to-metal contact, tighten by rotating body ⑧ $\frac{1}{8}$ " with respect to adapter ⑫ or torque per table value.
- Coupling Connection**—Lubricate gasket seal ⑤ on 5400-S2 half with system fluid. Thread union nut ⑥ on 5400-S2 half. Tighten union nut to torque values shown in Table. Be sure S2 and S5 bodies do not rotate during connection.

Bulkhead Mounting—S2 Half

Install lock washer ⑥ on S2 half. Insert S2 half through bulkhead, and tighten jam nut ⑦ so that lock washer teeth are fully compressed.

NOTE: Lock washer ⑥ must be between hex of S2 half and bulkhead.

Maximum Bulkhead Thickness

Coupling Size	Lock Washer Installed	Lock Washer Not Used
-4	.206	.256
-8	.136	.203
-12	.232	.292
-16	.101	.161

Torque Values

Recommended torque values in ft. lbs., are listed below.

Dash Size	Adapter to Body		S2 Half to S5 Half
	Braze Type or Aluminum	Non-braze Type Steel or Brass	
-4	6-8	12-15	10-12
-8	15-20	35-45	35-37
-12	35-40	45-55	45-47
-16	50-60	55-65	65-67

IMPORTANT: Generous lubrication is required for all gaskets and O-Rings. Use refrigeration oil only when used in refrigerant system.

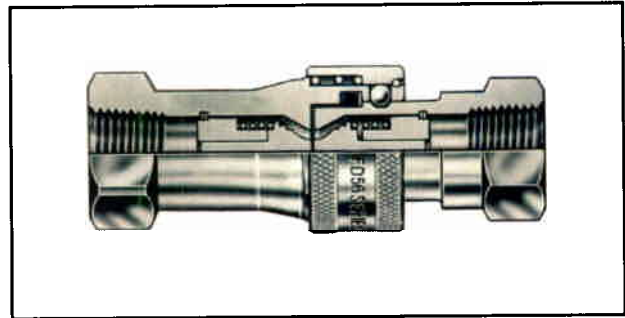
Component Part Numbers

Item No.	Dash Size--	-4	-8	-12	-16	Line Ref.
	O.D. Tube Size--	$\frac{1}{4}$ "- $\frac{3}{8}$ "	$\frac{1}{4}$ "- $\frac{5}{8}$ "	$\frac{5}{8}$ "- $\frac{7}{8}$ "	$\frac{7}{8}$ "- $1\frac{3}{8}$ "	
Typical Male Half						
1	Tubing Adapter	202208-* -4	202208-* -8	202208-* -12	202208-* -16	2
2	O-Ring	22546-12	22546-17	22546-23	22546-28	3
3	Poppet Valve Assembly	5400-S20-4	5400-S20-8	5400-S20-12	5400-S20-16	4
4	Body	5400-17-4	5400-17-8	5400-17-12	5400-17-16	5
5	Gasket Seal	22008-4	22008-8	22008-12	22008-16	6
6	Lock Washer	5400-54-4S	5400-54-8S	5400-54-12S	5400-54-16S	7
7	Jam Nut	5400-53-4S	5400-53-8S	5400-53-12S	5400-53-16S	8
Typical Female Half						
8	Union Nut and Body Assembly	5400-S16-4	5400-S16-8	5400-S16-12	5400-S16-16	10
9	O-Ring	22546-10	22546-112	22546-116	22546-214	11
10	Valve and Sleeve Assembly	5400-S19-4	5400-S19-8	5400-S19-12	5400-S19-16	12
11	O-Ring	22546-12	22546-17	22546-23	22546-28	13
12	Tubing Adapter	202208-* -4	202208-* -8	202208-* -12	202208-* -16	14

*Specify O.D. Tubing size of adapter required in 16th of an inch. Example: -4 coupling with $\frac{3}{8}$ " O.D. tubing is $\frac{1}{4}$ " or -6. Part number is then 202208-6-4.



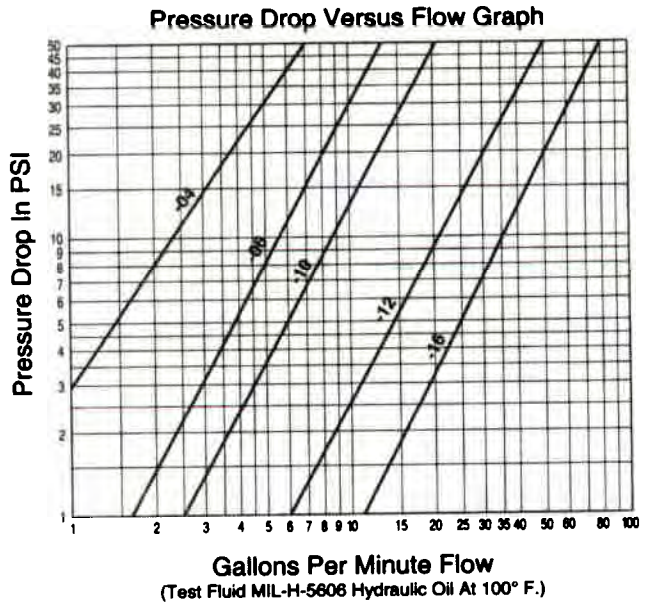
5600 Series/Industrial Interchange (Series A)



The 5600 Series general purpose coupling features a *PUSH-PULL™* latch and poppet valving in a low profile design. It is a favorite in North America and abroad.

- *PUSH-PULL™* ball latch design allows quick and easy connection and disconnection of fluid lines.
- Self-sealing poppet valve provides excellent high and low pressure sealing.
- Conforms dimensionally to ISO standard 7241/1 Series A.
- Streamlined valving provides minimum pressure drop.
- Standard seal materials – Buna-N, EPR and Viton.
- Standard body material – Zinc plated steel with Zinc poppet guides. (Brass poppet guide in -04 size.)

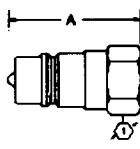
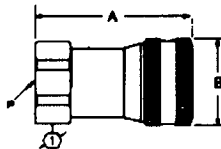
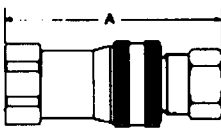
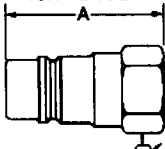
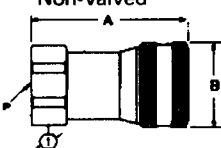
Flow Data



Physical Characteristics						
Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-04	5,000	15,000	28	1	.50	.50
-06	4,000	12,000	28	6	1.5	1.3
-10	4,000	12,000	28	12	2.8	2.8
-12	4,000	12,000	28	28	10.0	8.2
-16	4,000	12,000	28	50	14.2	14.2

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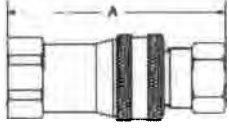
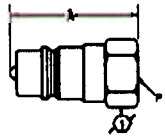
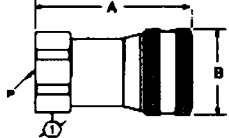
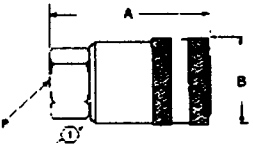
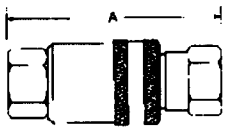


5600 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.	
			A	B	Ø	Buna-N	Viton	EPR		
Male Half Female Pipe/Valved 	-04	1/8-27	1.17		.56	5602-2-4S	FD56-1062-02-04	5644-2-4S	1	
	-04	1/4-18	1.24		.75	5602-4-4S	FD56-1062-04-04	5644-4-4S	2	
	-06	3/8-18	1.40		.88	5602-6-6S	FD56-1062-06-06	5644-6-6S	3	
	-10	1/2-14	1.89		1.06	5602-8-10S	FD56-1062-08-10	5644-8-10S	4	
	-10	3/4-14	2.03		1.38	5602-12-10S	FD56-1062-12-10	5644-12-10S	5	
	-12	3/4-14	2.28		1.38	5602-12-12S	FD56-1062-12-12	5644-12-12S	6	
	-16	1-11 1/2	2.77		1.62	5602-16-16S	FD56-1062-16-16	5644-16-16S	7	
									8	
Female Half Female Pipe/Valved 	-04	1/8-27	1.81	1.08	.88	5601-2-4S	FD56-1064-02-04	5643-2-4S	9	
	-04	1/4-18	1.81	1.08	.88	5601-4-4S	FD56-1064-04-04	5643-4-4S	10	
	-06	3/8-18	2.15	1.23	1.00	5601-6-6S	FD56-1064-06-06	5643-6-6S	11	
	-10	1/2-14	2.61	1.50	1.19	5601-8-10S	FD56-1064-08-10	5643-8-10S	12	
	-10	3/4-14	2.61	1.50	1.31	5601-12-10S	FD56-1064-12-10	5643-12-10S	13	
	-12	3/4-14	3.25	1.81	1.50	5601-12-12S	FD56-1064-12-12	5643-12-12S	14	
	-16	1-11 1/2	3.82	2.10	1.69	5601-16-16S	FD56-1064-16-16	5643-16-16S	15	
									16	
Complete Coupling Female Pipe/Valved 	-04	1/8-27	2.42			5600-2-4S	FD56-1065-02-04	5642-2-4S	17	
	-04	1/4-18	2.49			5600-4-4S	FD56-1065-04-04	5642-4-4S	18	
	-06	3/8-18	2.80			5600-6-6S	FD56-1065-06-06	5642-6-6S	19	
	-10	1/2-14	3.78			5600-8-10S	FD56-1065-08-10	5642-8-10S	20	
	-10	3/4-14	4.06			5600-12-10S	FD56-1065-12-10	5642-12-10S	21	
	-12	3/4-14	4.46			5600-12-12S	FD56-1065-12-12	5642-12-12S	22	
	-16	1-11 1/2	5.54			5600-16-16S	FD56-1065-16-16	5642-16-16S	23	
									24	
Male Half/Female Pipe Non-Valved  <p>Will not operate with valved coupling halves. No valve actuator.</p>	-04	1/8-27	1.17		.56	FD56-1037-02-04	FD56-1037-02-04	FD56-1037-02-04	25	
	-04	1/4-18	1.24		.75	FD56-1037-04-04	FD56-1037-04-04	FD56-1037-04-04	26	
	-06	3/8-18	1.40		.88	FD56-1037-06-06	FD56-1037-06-06	FD56-1037-06-06	27	
	-10	1/2-14	1.89		1.06	FD56-1037-08-10	FD56-1037-08-10	FD56-1037-08-10	28	
	-10	3/4-14	2.03		1.38	FD56-1037-12-10	FD56-1037-12-10	FD56-1037-12-10	29	
	-12	3/4-14	2.28		1.38	FD56-1037-12-12	FD56-1037-12-12	FD56-1037-12-12	30	
	-16	1-11 1/2	2.77		1.62	FD56-1037-16-16	FD56-1037-16-16	FD56-1037-16-16	31	
									32	
Female Half/Female Pipe Non-Valved  <p>Will not operate with valved coupling halves. No valve actuator.</p>	-04	1/8-27	1.81	1.08	.88	FD56-1225-02-04	FD56-1207-02-04	FD56-1204-02-04	33	
	-04	1/4-18	1.81	1.08	.88	FD56-1225-04-04	FD56-1207-04-04	FD56-1204-04-04	34	
	-06	3/8-18	2.15	1.23	1.00	FD56-1225-06-06	FD56-1207-06-06	FD56-1204-06-06	35	
	-10	1/2-14	2.61	1.50	1.19	FD56-1225-08-10	FD56-1207-08-10	FD56-1204-08-10	36	
	-10	3/4-14	2.61	1.50	1.31	FD56-1225-12-10	FD56-1207-12-10	FD56-1204-12-10	37	
	-12	3/4-14	3.25	1.81	1.50	FD56-1225-12-12	FD56-1207-12-12	FD56-1204-12-12	38	
	-16	1-11 1/2	3.82	2.10	1.69	FD56-1225-16-16	FD56-1207-16-16	FD56-1204-16-16	39	
									40	
Repair Kit									41	
Each kit will repair one male or female half.						-04	FF082-04†	FF092-04†	FF093-04†	42
						-06	FF082-06	FF092-06	FF093-06	43
						-10	FF082-10	FF092-10	FF093-10	44
						-12	FF082-12	FF092-12	FF093-12	45
						-16	FF082-16	FF092-16	FF093-16	46

† This size repair kit contains an interface seal and back-up ring.

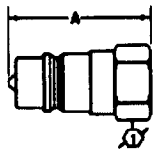
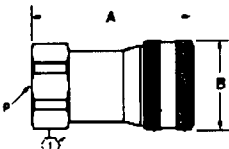
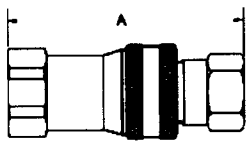
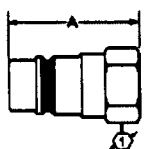
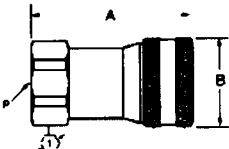


QUICK DISCONNECT COUPLINGS

5600 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	ϕ	Buna-N	Viton	EPR	
Complete Coupling/Non-Valved Female Pipe 	-04	1/8-27	2.42			FD56-1226-02-04	FD56-1208-02-04	FD56-1205-02-04	1
	-04	1/4-18	2.49			FD56-1226-04-04	FD56-1208-04-04	FD56-1205-04-04	2
	-06	3/8-18	2.80			FD56-1226-06-06	FD56-1208-06-06	FD56-1205-06-06	3
	-10	1/2-14	3.78			FD56-1226-08-10	FD56-1208-08-10	FD56-1205-08-10	4
	-10	3/4-14	4.06			FD56-1226-12-10	FD56-1208-12-10	FD56-1205-12-10	5
	-12	3/4-14	4.46			FD56-1226-12-12	FD56-1208-12-12	FD56-1205-12-12	6
	-16	1-11 1/2	5.54			FD56-1226-16-16	FD56-1208-16-16	FD56-1205-16-16	7
									8
Male Half/Female Pipe Pusher Style Valving  <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-04	1/8-27	1.17		.56	FD56-1125-02-04	FD56-1125-02-04	FD56-1125-02-04	9
	-04	1/4-18	1.24		.75	FD56-1125-04-04	FD56-1125-04-04	FD56-1125-04-04	10
	-06	3/8-18	1.40		.88	FD56-1125-06-06	FD56-1125-06-06	FD56-1125-06-06	11
	-10	1/2-14	1.89		1.06	FD56-1125-08-10	FD56-1125-08-10	FD56-1125-08-10	12
	-10	3/4-14	2.03		1.38	FD56-1125-12-10	FD56-1125-12-10	FD56-1125-12-10	13
	-12	3/4-14	2.28		1.38	FD56-1125-12-12	FD56-1125-12-12	FD56-1125-12-12	14
	-16	1-11 1/2	2.77		1.62	FD56-1125-16-16	FD56-1125-16-16	FD56-1125-16-16	15
									16
Female Half/Female Pipe Pusher Style Valving  <p>Incorporates a pusher device to open mating valved coupling halves.</p>	-04	1/8-27	1.81	1.08	.88	FD56-1123-02-04	FD56-1201-02-04	FD56-1196-02-04	17
	-04	1/4-18	1.81	1.08	.88	FD56-1123-04-04	FD56-1201-04-04	FD56-1196-04-04	18
	-06	3/8-18	2.15	1.23	1.00	FD56-1123-06-06	FD56-1201-06-06	FD56-1196-06-06	19
	-10	1/2-14	2.61	1.50	1.19	FD56-1123-08-10	FD56-1201-08-10	FD56-1196-08-10	20
	-10	3/4-14	2.61	1.50	1.31	FD56-1123-12-10	FD56-1201-12-10	FD56-1196-12-10	21
	-12	3/4-14	3.25	1.81	1.50	FD56-1123-12-12	FD56-1201-12-12	FD56-1196-12-12	22
	-16	1-11 1/2	3.82	2.10	1.69	FD56-1123-16-16	FD56-1201-16-16	FD56-1196-16-16	23
									24
Female Half/Female Pipe Connect Under Pressure Style 	-10	1/2-14	2.88	1.52	1.06	5651-8-10S	FD56-1070-08-10	565007-8-10S	25
	-10	3/4-14	3.30	1.22	1.25	5651-12-10S	FD56-1070-12-10	565007-12-10S	26
									27
									28
									29
									30
									31
									32
Complete Coupling/Female Pipe Connect Under Pressure Style 	-10	1/2-14	3.89			5650-8-10S	FD56-1071-08-10	565006-8-10S	33
	-10	3/4-14	4.45			5650-12-10S	FD56-1071-12-10	565006-12-10S	34
									35
									36
									37
									38
									39
									40
Repair Kit									
Each kit will repair one male or female half.									
	-04					FF082-04†	FF092-04†	FF093-04†	42
	-06					FF082-06	FF092-06	FF093-06	43
	-10					FF082-10	FF092-10	FF093-10	44
	-12					FF082-12	FF092-12	FF093-12	45
	-16					FF082-16	FF092-16	FF093-16	46

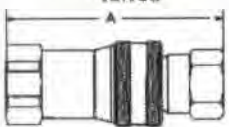
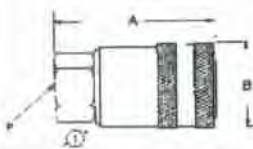
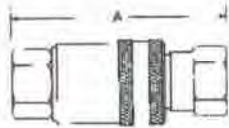



† This size repair kit contains an interface seal and back-up ring.



5600 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	⌀	Buna-N	Viton	EPR	
Male Half Female SAE O-Ring/Valved 	-04	7/16-20	1.28		.62	5610-4-4S	FD56-1072-04-04	560078-4-4S	1
	-06	9/16-18	1.50		.88	5610-6-6S	FD56-1072-06-06	560078-6-6S	2
	-10	3/4-16	2.03		1.06	5610-8-10S	FD56-1072-08-10	560078-8-10S	3
	-10	7/8-14	2.08		1.12	5610-10-10S	FD56-1072-10-10	560078-10-10S	4
	-10	1 1/16-12	2.26		1.38	5610-12-10S	FD56-1072-12-10	560078-12-10S	5
	-12	1 1/16-12	2.55		1.38	5610-12-12S	FD56-1072-12-12	560078-12-12S	6
	-16	1 3/16-12	3.10		1.62	5610-16-16S	FD56-1072-16-16	560078-16-16S	7
									8
Female Half Female SAE O-Ring/Valved 	-04	7/16-20	1.81	1.08	.88	5608-4-4S	FD56-1074-04-04	FD56-1012-04-04	9
	-06	9/16-18	2.11	1.27	1.00	5608-6-6S	FD56-1074-06-06	FD56-1012-06-06	10
	-10	3/4-16	2.76	1.52	1.19	5608-8-10S	FD56-1074-08-10	FD56-1012-08-10	11
	-10	7/8-14	2.81	1.52	1.19	5608-10-10S	FD56-1074-10-10	FD56-1012-10-10	12
	-10	1 1/16-12	3.00	1.52	1.31	5608-12-10S	FD56-1074-12-10	FD56-1012-12-10	13
	-12	1 1/16-12	3.25	1.84	1.50	5608-12-12S	FD56-1074-12-12	FD56-1012-12-12	14
	-16	1 3/16-12	3.83	2.15	1.88	5608-16-16S	FD56-1074-16-16	FD56-1012-16-16	15
									16
Complete Coupling Female SAE O-Ring/Valved 	-04	7/16-20	2.53			5606-4-4S	FD56-1075-04-04	FD56-1009-04-04	17
	-06	9/16-18	2.84			5606-6-6S	FD56-1075-06-06	FD56-1009-06-06	18
	-10	3/4-16	3.78			5606-8-10S	FD56-1075-08-10	FD56-1009-08-10	19
	-10	7/8-14	3.88			5606-10-10S	FD56-1075-10-10	FD56-1009-10-10	20
	-10	1 1/16-12	4.24			5606-12-10S	FD56-1075-12-10	FD56-1009-12-10	21
	-12	1 1/16-12	4.46			5606-12-12S	FD56-1075-12-12	FD56-1009-12-12	22
	-16	1 3/16-12	5.54			5606-16-16S	FD56-1075-16-16	FD56-1009-16-16	23
									24
Male Half Female SAE O-Ring/Non-Valved  Will not operate with valved coupling halves. No valve actuator.	-04	7/16-20	1.21	.72	.62	FD56-1221-04-04	FD56-1221-04-04	FD56-1221-04-04	25
	-06	9/16-18	1.42	.73	.88	FD56-1221-06-06	FD56-1221-06-06	FD56-1221-06-06	26
	-10	3/4-16	1.89	1.02	1.06	FD56-1221-08-10	FD56-1221-08-10	FD56-1221-08-10	27
	-10	7/8-14	1.94	1.07	1.12	FD56-1221-10-10	FD56-1221-10-10	FD56-1221-10-10	28
	-10	1 1/16-12	2.12	1.24	1.38	FD56-1221-12-10	FD56-1221-12-10	FD56-1221-12-10	29
	-12	1 1/16-12	2.28	1.21	1.38	FD56-1221-12-12	FD56-1221-12-12	FD56-1221-12-12	30
	-16	1 3/16-12	2.77	1.45	1.62	FD56-1221-16-16	FD56-1221-16-16	FD56-1221-16-16	31
									32
Female Half Female SAE O-Ring/Non-Valved  Will not operate with valved coupling halves. No valve actuator.	-04	7/16-20	1.81	1.08	.88	5691-4-4S	FD56-1233-04-04	FD56-1209-04-04	33
	-06	9/16-18	2.11	1.27	1.06	5691-6-6S	FD56-1233-06-06	FD56-1209-06-06	34
	-10	3/4-16	2.76	1.52	1.25	5691-8-10S	FD56-1233-08-10	FD56-1209-08-10	35
	-10	7/8-14	2.81	1.52	1.25	5691-10-10S	FD56-1233-10-10	FD56-1209-10-10	36
	-10	1 1/16-12	3.00	1.52	1.38	5691-12-10S	FD56-1233-12-10	FD56-1209-12-10	37
	-12	1 1/16-12	3.25	1.84	1.50	5691-12-12S	FD56-1233-12-12	FD56-1209-12-12	38
	-16	1 3/16-12	4.09	2.15	1.88	5691-16-16S	FD56-1233-16-16	FD56-1209-16-16	39
									40
Repair Kit Each kit will repair one male or female half. † This size repair kit contains an interface seal and back-up ring.	-04					FF082-04†	FF092-04†	FF093-04†	41
	-06					FF082-06	FF092-06	FF093-06	42
	-10					FF082-10	FF092-10	FF093-10	43
	-12					FF082-12	FF092-12	FF093-12	44
	-16					FF082-16	FF092-16	FF093-16	45

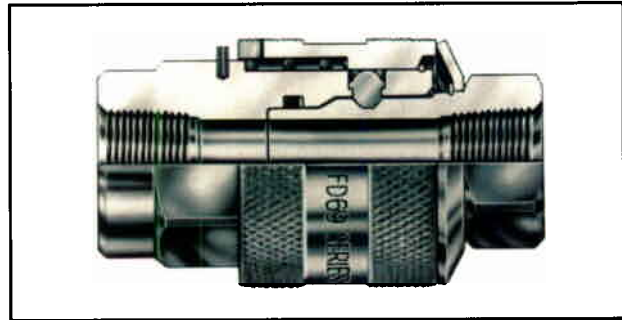


QUICK DISCONNECT COUPLINGS

5600 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	ϕ	Buna-N	Viton	EPR	
Complete Coupling Female SAE O-Ring/Non-Valved 	-04	1/16-20	2.53			5690-4-4S	FD56-1234-04-04	FD56-1210-04-04	1
	-06	1/16-18	2.84			5690-6-6S	FD56-1234-06-06	FD56-1210-06-06	2
	-10	1/16-16	3.78			5690-8-10	FD56-1234-08-10	FD56-1210-08-10	3
	-10	1/8-14	3.88			5690-10-10S	FD56-1234-10-10	FD56-1210-10-10	4
	-10	1 1/16-12	4.24			5690-12-10S	FD56-1234-12-10	FD56-1210-12-10	5
	-12	1 1/16-12	4.46			5690-12-12S	FD56-1234-12-12	FD56-1210-12-12	6
	-16	1 1/16-12	5.54			5690-16-16S	FD56-1234-16-16	FD56-1210-16-16	7
									8
Female Half/Female SAE O-Ring Connect Under Pressure 	-10	1/8-16	2.88	1.52	1.06	5668-8-10S	FD56-1081-8-10	565015-8-10S	9
	-10	1/8-14	3.19	1.52	1.12	5668-10-10S	FD56-1081-10-10	565015-10-10S	10
	-10	1 1/16-12	3.38	1.52	1.38	5668-12-10S	FD56-1081-12-10	565015-12-10S	11
									12
									13
									14
Complete Coupling/Female SAE O-Ring Connect Under Pressure 	-10	3/16-16	3.88			5667-8-10S	FD56-1082-8-10	565014-8-10S	17
	-10	1/8-14	4.25			5667-10-10S	FD56-1082-10-10	565014-10-10S	18
	-10	1 1/16-12	4.62			5667-12-10S	FD56-1082-12-10	565014-12-10S	19
									20
									21
									22
									23
								24	
								25	
Repair Kit Each kit will repair one male or female half. †This size repair kit contains an inter-face seal and back-up ring.	-04					FF082-04†	FF092-04†	FF093-04†	26
	-06					FF082-06	FF092-06	FF093-06	27
	-10					FF082-10	FF092-10	FF093-10	28
	-12					FF082-12	FF092-12	FF093-12	29
	-16					FF082-16	FF092-16	FF093-16	30
Accessories Dust Cap 	-04						5657-4		32
	-06						5657-6		33
	-10						5657-10		34
	-12						5657-12		35
	-16						5657-16		36
Dust Plug 	-4						5659-4		37
	-6						5659-6		38
	-10						5659-10		39
	-12						5659-12		40
	-16						5659-16		41
Break Away Frame 	-10						5603		42
									43
									44
									45
									46

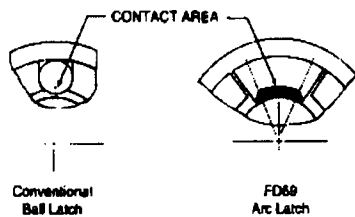


FD69 Series/Arc Latch™—High Pressure Water Blast (10,000 psi)

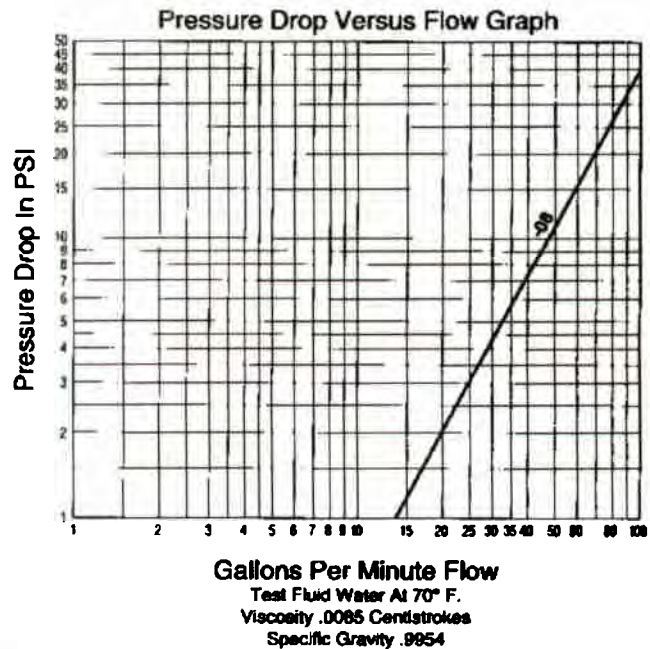


The FD69 Series "Arc Latch™" design has a greater surface contact area for long service life in rugged high-pressure and water blast applications. The maximum operating pressure is 10,000 psi with 40,000 psi minimum burst pressure.

- Safety sleeve lock guards against accidental disconnection.
- Smooth bore "straight through" design for high flow.
- Heavy duty back-up ring to prevent O-Ring extrusion.
- Available in plated steel and stainless steel for added corrosion resistance.
- Standard seal material – Buna-N.
- Standard body material – Zinc plated steel, Stainless steel.



Flow Data

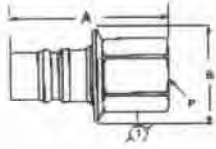
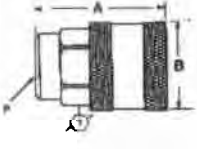
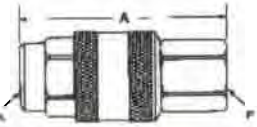


Physical Characteristics

Coupling Dash Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max)
-08	10,000	40,000	28	45	-	-

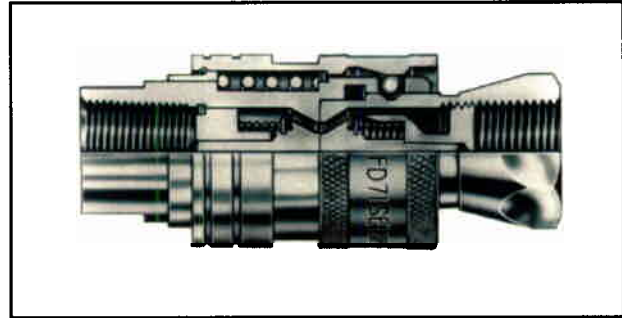
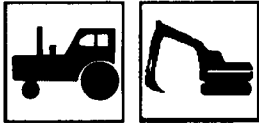


QUICK DISCONNECT COUPLINGS

FD69 Series	Coupling Size	Thread Size (P)	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
				A	B	ϕ	Buna-N	Viton	EPR	
Male Half/Female Pipe 	Steel									1
	-08	1/8-18		1.85	1.64	1.00	FD69-1002-06-08	FD69-1002-06-08	FD69-1002-06-08	2
	-08	1/8-14		2.34	1.64	1.12	FD69-1002-08-08	FD69-1002-08-08	FD69-1002-08-08	3
										4
	Stainless Steel									5
	-08	1/8-14		2.34	1.64	1.12	FD69-1012-08-08	FD69-1012-08-08	FD69-1012-08-08	6
										7
										8
Female Half/Female Pipe 	Steel									9
	-08	1/8-18		2.13	1.62	1.25	FD69-1001-06-08	FD69-1026-06-08	FD69-1028-06-08	10
	-08	1/8-14		2.13	1.62	1.25	FD69-1001-08-08	FD69-1026-08-08	FD69-1028-08-08	11
										12
	Stainless Steel									13
	-08	1/8-14		2.13	1.62	1.25	FD69-1011-08-08			14
										15
										16
Complete Coupling Female Pipe 	Steel									17
	-08	1/2-14	1/2-14	3.43			FD69-1000-080808	FD69-1027-080808	FD69-1029-080808	18
	-08	1/2-14	1/2-18	3.43			FD69-1000-080806	FD69-1027-080806	FD69-1029-080806	19
	-08	1/2-18	1/2-14	2.94			FD69-1000-060808	FD69-1027-060808	FD69-1029-060808	20
	-08	1/2-18	1/2-18	2.94			FD69-1000-060806	FD69-1027-060806	FD69-1029-060806	21
	Stainless Steel									22
	-08	1/2-14	1/2-14	3.43			FD69-1010-080808			23
										24
	Female Interface Seal Kit									25
	-08						FF10166			26



FD71 Series/Push-to-Connect Farm

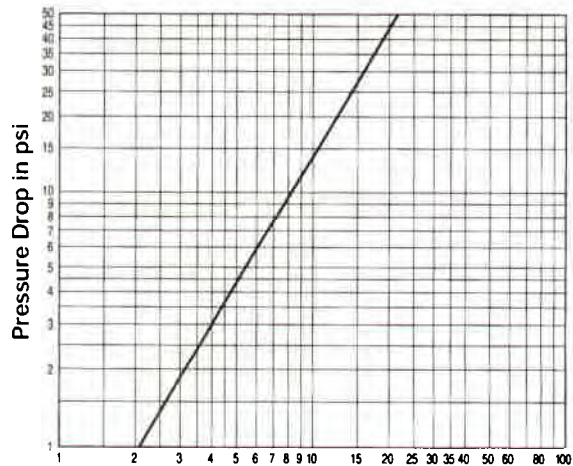


The FD71 Series coupling is designed to interchange with male tips made to ISO 5675 specifications. It features one hand push-to-connect latching. The maximum operating pressure is 3,000 psi.

- Self-sealing poppet valve construction provides reliable leak-free service.
- Push-to-connect for one-hand operation when sleeve is mounted.
- Retaining ring groove on female half for bulkhead and break-away frame mounting.
- Standard seal material – Buna-N.
- Standard body material – Zinc plated steel with Zinc poppet guide.

Flow Data

Pressure Drop versus Flow Graph



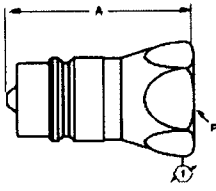
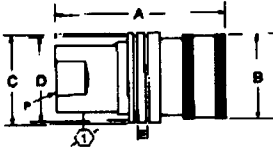



Gallons per Minute Flow
(Test Fluid MIL-H-5606 Hydraulic Oil at 100°F)

Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-10	3,000	12,000	28	16	2.8	2.8



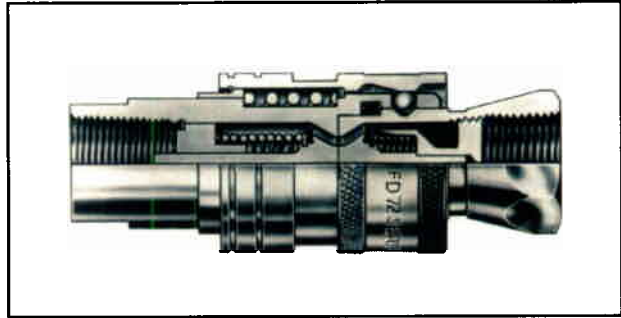
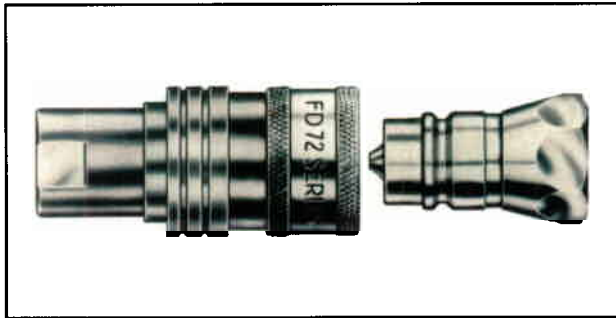
QUICK DISCONNECT COUPLINGS

FD71 Series	Coupling Size	Thread Size (P)	Dimensional Data						Part Number Buna-N	Line Ref.	
			A	B	C	D	E	Ø			
Male Half Female Pipe/Valved 	-10	1/2-14	2.05						1.06	FD76-1002-08-10	1
											2
											3
											4
											5
											6
											7
											8
Female Half Female Pipe/Valved 	-10	1/2-14	2.74	1.52	1.50	1.41	.20	1.00		FD71-1001-08-10	9
											10
											11
											12
											13
											14
											15
											16
Accessories											
Dust Cap 	-10									5657-10	17
											18
											19
											20
											21
											22
											23
											24
Dust Plug 	-10									5659-10	25
											26
											27
											28
											29
											30
											31
											32
Break Away Frame 	-10									5603	33
											34
											35
											36
											37
											38
											39
											40

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



FD72 Series/Connect Under Pressure—Farm



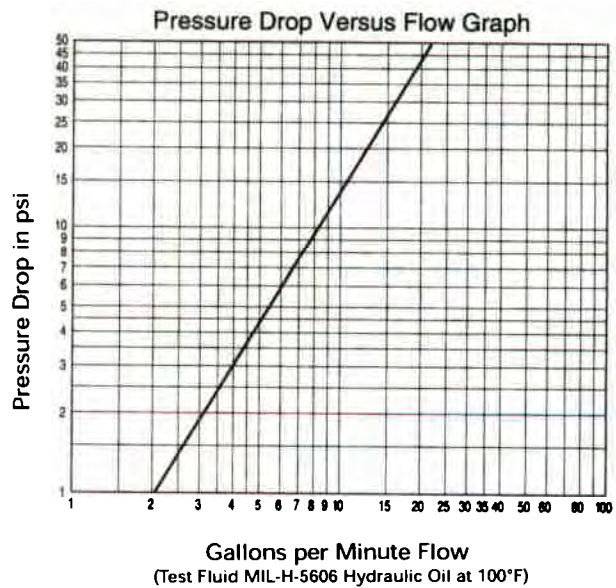
The FD72 Series coupling incorporates special valving allowing connection to a male half under pressure (FD76 Series male). The maximum operating pressure is 3,000 psi.

- Over travel, self-sealing poppet valve construction for connecting to a pressurized male tip. Requires that the tractor control valve be actuated to open the flow path and to equalize the pressure.
- Push-to-connect for one-hand operation when sleeve is mounted.
- Interchanges with ISO 5675 male tips.
- Retaining ring groove on female half for bulkhead and breakaway frame mounting.
- Standard seal material - Buna-N.
- Standard body material - Zinc plated steel with zinc poppet guide.

Physical Characteristics

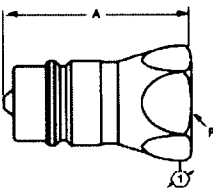
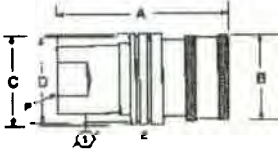



Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in. Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-10	3,000	12,000	28	16	2.8	2.8

Flow Data



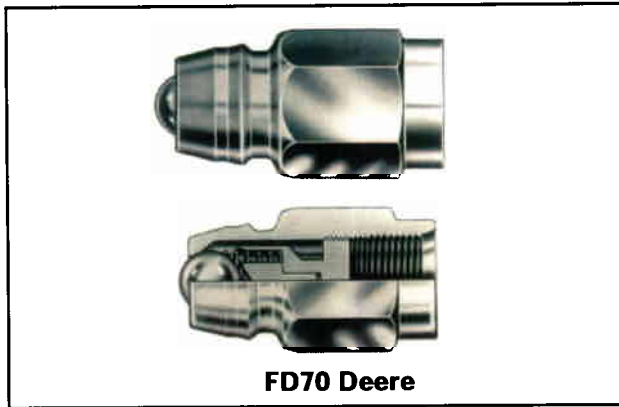


QUICK DISCONNECT COUPLINGS

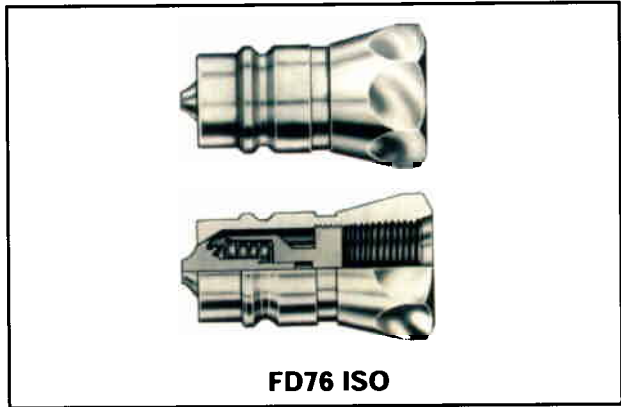
FD72 Series	Coupling Size	Thread Size (P)	Dimensional Data						Part Number	Line Ref.
			A	B	C	D	E	Buna-N		
Male Half Female Pipe/Valved 	-10	1/2-14	2.05					1.06	FD76-1002-08-10	1
										2
										3
										4
										5
										6
										7
										8
Female Half Female Pipe/Valved 	-10	1/2-14	3.17	1.52	1.50	1.41	.20	1.00	FD72-1001-08-10	9
										10
										11
										13
										14
										15
										16
										17
										18
Accessories										
Dust Cap 	-10								5657-10	19
										20
										21
										22
										23
										24
Dust Plug 	-10								5659-10	25
										26
										27
										28
										29
										30
										31
Break Away Frame 	-10								5603	33
										34
										35
										36
										37
										38
										39
									40	



FD70 & FD76 Series/Male Tip—Farm

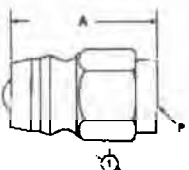
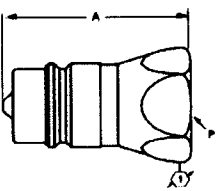
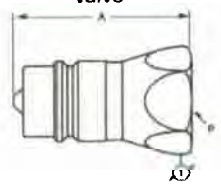


FD70 Deere



FD76 ISO

- Designed to connect with female couplings on most older style John Deere farm equipment.
- Interchanges with ISO 5675 used on most farm tractors found throughout North America and abroad.

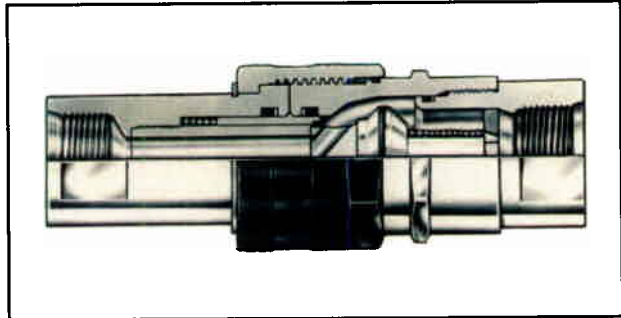
FD70 & FD76 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number Buna-N	Line Ref.
			A	B			
Deere Male Half Female SAE O-Ring/Ball Valve 	-10	1/2-16	1.96		1.00	FD70-1010-08-10	1
							2
							3
							4
							5
							6
							7
							8
ISO Male Half Female Pipe/Poppet Valve 	-10	1/2-14	2.05		1.06	FD76-1002-08-10	9
							10
							11
							12
							13
							14
							15
							16
ISO Male Half Female SAE O-Ring/Poppet Valve 	-10	1/2-16	2.05		1.00	FD76-1010-08-10	17
							18
							19
							20
							21
							22
							23
							24

QUICK DISCONNECT COUPLINGS

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FD86 Series/5,000 PSI DryBreak—High Impulse

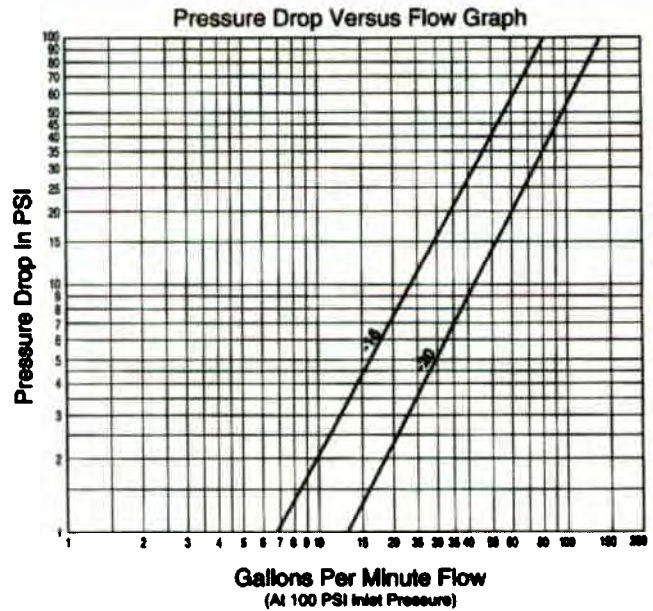


The FD86 Series is a thread together steel coupling offering dry break and high impulse technology and capabilities. The maximum operating pressure is 5,000 psi.

- Tubular valve and sleeve construction for low fluid loss and air inclusion.
- Thread together design using wing or hex nut allows connection and disconnection against pressures up to 750 psi.
- Teflon* back-up rings along with secondary metal-to-metal sealing contact provides high impulse capability up to 5,000 psi operating pressure.
- Acme threads prevent galling and provide ease of connection.
- Metal-to-metal sealing withstands +2,000°F for ten minutes with no fluid loss (requirement in California for oil field blow-out preventers).
- Steel flange available for bulkhead mounting.
- Standard seal material – Buna-N.
- Standard body material – Zinc plated steel.

*Teflon is a registered trademark of Dupont.

Flow Data

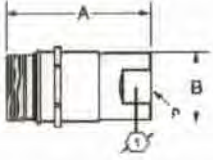
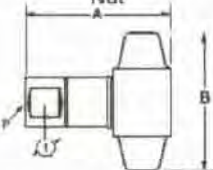
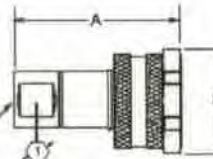


Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-16	5,000	15,000	28	50	2.90	.72
-20	5,000	15,000	28	75	4.61	1.0

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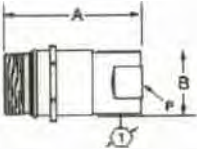
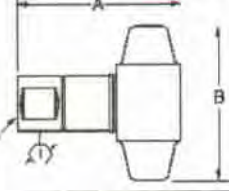
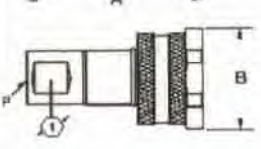


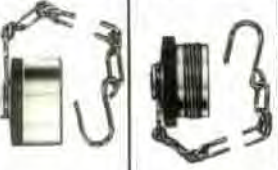

FD86 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number			Line Ref.
			A	B	①	Buna-N	Viton	EPR	
Male Half Female SAE O-Ring 	-16	1 ¹ / ₁₆ -12	4.03	2.11	1.75	FD86-1008-16-16	FD86-1043-16-16	FD86-1053-16-16	1
	-20	1 ¹ / ₈ -12	4.16	2.48	2.25	FD86-1008-20-20	FD86-1043-20-20	FD86-1053-20-20	2
									3
									4
									5
									6
									7
									8
Female Half Female SAE O-Ring/With Wing Nut 	-16	1 ¹ / ₁₆ -12	4.62	4.50	1.62	FD86-1010-16-16	FD86-1044-16-16	FD86-1054-16-16	9
	-20	1 ¹ / ₈ -12	5.22	5.25	2.00	FD86-1010-20-20	FD86-1044-20-20	FD86-1054-20-20	10
									11
									12
									13
									14
									15
									16
Female Half Female SAE O-Ring/With Hex Nut 	-16	1 ¹ / ₁₆ -12	4.62	2.81	1.62	FD86-1006-16-16	FD86-1042-16-16	FD86-1052-16-16	17
	-20	1 ¹ / ₈ -12	5.22	3.40	2.00	FD86-1006-20-20	FD86-1042-20-20	FD86-1052-20-20	18
									19
									20
									21
									22
									23
									24

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



QUICK DISCONNECT COUPLINGS

FD86 Series	Coupling Size	Thread Size(P)	Dimensional Data			Part Number			Line Ref.	
			A	B	ϕ	Buna-N	Viton	EPR		
Male Half Female NPTF 	-16	1-11 $\frac{1}{2}$	4.40	2.11	1.75	FD86-1002-16-16	FD86-1040-16-16	FD86-1050-16-16	1	
	-20	1 $\frac{1}{4}$ -11 $\frac{1}{2}$	4.43	2.48	2.25	FD86-1002-20-20	FD86-1040-20-20	FD86-1050-20-20	2	
									3	
									4	
									5	
									6	
									7	
									8	
Female Half Female NPTF/With Wing Nut 	-16	1-11 $\frac{1}{2}$	4.98	4.50	1.62	FD86-1001-16-16	FD86-1039-16-16	FD86-1049-16-16	9	
	-20	1 $\frac{1}{4}$ -11 $\frac{1}{2}$	5.62	5.25	2.00	FD86-1001-20-20	FD86-1039-20-20	FD86-1049-20-20	10	
									11	
									12	
									13	
									14	
									15	
									16	
Female Half Female NPTF/With Hex Nut 	-16	1-11 $\frac{1}{2}$	4.98	2.81	1.62	FD86-1004-16-16	FD86-1041-16-16	FD86-1051-16-16	17	
	-20	1 $\frac{1}{4}$ -11 $\frac{1}{2}$	5.62	3.40	2.00	FD86-1004-20-20	FD86-1041-20-20	FD86-1051-20-20	18	
									19	
									20	
									21	
									22	
									23	
									24	
Repair Kit Male Half	-16					FF10596-16	FF10597-16	FF10598-16	26	
	-20					FF10596-20	FF10597-20	FF10598-20	27	
	Female Half									
	-16						FF10593-16	FF10594-16	FF10595-16	28
	-20						FF10593-20	FF10594-20	FF10595-20	29
										30

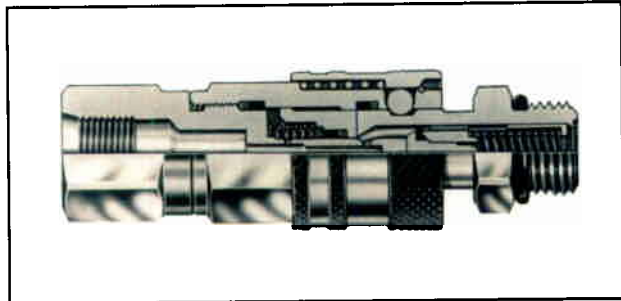
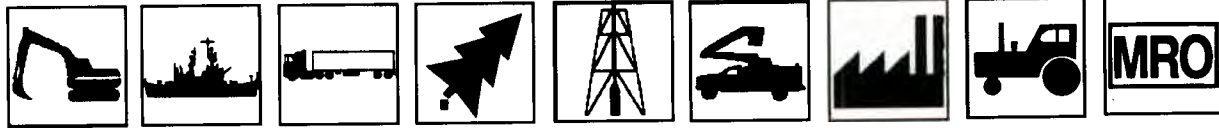
FD86 Series	Coupling Dash Size	Dimensional Size		Part Number			Line Ref.	
		A	B	Dust Cap with Chain	Dust Plug with Chain	6 Bolt Flange Assembly		
Accessories								
Dust Cap With Chain Dust Plug With Chain 	-16			FD86-1018-16	FD86-1016-16		1	
	-20			FD86-1018-20	FD86-1016-20		2	
								3
							4	
							5	
							6	
							7	
							8	
							9	
6 Bolt Flange Assembly* 	-16	.19	2.98			FD86-1035-16	10	
	-20	.19	3.50			FD86-1035-20	11	
								12
								13
								14
								15
							16	

*6 Bolt Flange-holes equally spaced. (See "A" for bolt hole diameter, and "B" for bolt circle diameter.)

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FD90 Series/SAE J1502 Interchange



The FD90 Series diagnostic coupling is designed to connect and disconnect pressure gauges to hydraulic systems, eliminating the need for permanent gauges. The maximum operating pressure is 7,000 psi.

- Automatic sleeve for one hand push-to-connect operation.
- Flush face valving provides minimal fluid loss and low air inclusion.
- Self-sealing valve design allows connection and disconnection at 500 psi.
- Broad range of end configurations for system accessibility.
- Standard seal material – Buna-N.
- Standard seal material – Zinc plated steel.

Diagnostic Kit* – FF10000-02



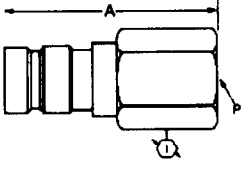
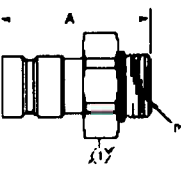
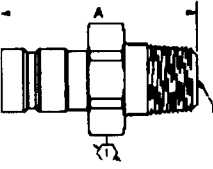
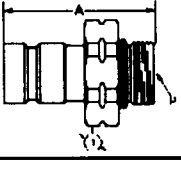
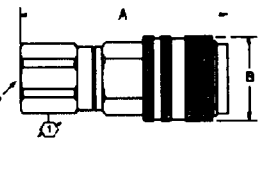

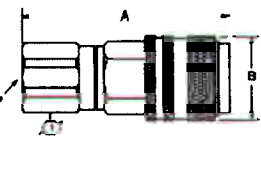
*Contact Aeroquip for additional information.

Physical Characteristics

Coupling Size	Maximum Operating Pressure (psi)	Minimum Burst Pressure (psi)	Vacuum (in./Hg.)	Rated Flow (gpm)	Air Inclusion (cc. max.)	Fluid Loss (cc. max.)
-04	7,000	28,000	28	.50	0.02	0.10

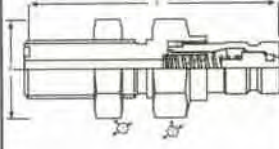

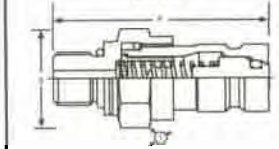


QUICK DISCONNECT COUPLINGS

FD90 Series	Coupling Size	Thread Size (P)	Dimensional Data			Part Number		Line Ref.	
			A	B	Ø	Buna-N	Buna-N with Dust Cap		
Male Half Female Pipe/Valved 	-04	1/8-27	1.70		.62	FD90-1034-02-04	FD90-1035-02-04	1	
	-04	1/4-18	1.90		.75	FD90-1034-04-04	FD90-1035-04-04	2	
									3
									4
									5
									6
									7
									8
Male Half Male SAE O-Ring/Valved 	-04	3/8-24	1.52		.62	FD90-1044-03-04	FD90-1004-03-04	9	
	-04	7/16-20	1.58		.62	FD90-1044-04-04	FD90-1004-04-04	10	
	-04	1/2-20	1.32		.62	FD90-1044-05-04	FD90-1004-05-04	11	
	-04	9/16-18	1.32		.69	FD90-1044-06-04	FD90-1004-06-04	12	
									13
									14
									15
									16
Male Half Male Pipe/Valved 	-04	1/8-27	1.60		.62	FD90-1012-02-04	FD90-1045-02-04	17	
	-04	1/4-18	1.49		.69	FD90-1012-04-04	FD90-1045-04-04	18	
									19
									20
									21
									22
									23
									24
Male Half Metric Male O-Ring/Valved 	-04	M14x1.5	1.38		.75	FD90-1046-06-04	FD90-1047-06-04	25	
									26
									27
									28
									29
									30
									31
									31
Female Half Female Pipe/Valved 	-04	1/8-27	1.95	1.00	.75	FD90-1021-02-04	Dust Cap for Male Halves FD90-1040-04 	32	
	-04	1/4-18	2.25	1.00	.75	FD90-1021-04-04		33	
									34
									35
									36
									37
									38
									39
Female Half Female SAE O-Ring/Valved 	-04	7/16-20	2.20	1.00	.75	FD90-1041-04-04		41	
								42	
								43	
								44	
								45	
								46	
								47	
								48	

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.



FD90 Series	Coupling Size	Thread Size (P)	Dimensional Data				Part Number Buna-N	Part Number with Dust Cap Buna-N	Line Ref.
			A	B	(1)	(2)			
Male Half Male ORS Bulkhead, Valved 	-04	9/16-18	2.46	.94	.81	.81	FD90-1206-04-04		1
			2						
			3						
			4						
			5						
			6						
			7						
			8						
Male Half, Female ORS Swivel Valved 	-04	9/16-18	1.79	.87	.75	.69	FD90-1061-04-04		9
			10						
			11						
			12						
			13						
			14						
			15						
			16						
Male Half Male Metric O-Ring ISO6149-2 Valved 	-04	M10x1	1.58	.72	.62	FD90-1090-10-04		17	
			18						
			19						
			20						
			21						
			22						
			23						
			24						

This page is part of a complete catalog which contains technical and safety data that must be reviewed when selecting a product.

A Brief History of "Dry Break" Couplings



Quick Disconnect Couplings were first introduced with an opposed poppet-type valve. This economical valve type reduces spillage drastically, yet it remains measurable in whole cc's.*



As the number of applications for couplings grew, so did the demand for reduced spillage. Aeroquip responded with the patented tubular valve design which became standard in critical industrial and aerospace applications. Typically, fluid loss is measured in fractions of cc's per disconnection.



State-of-the-art valving was introduced with flush-face style couplings that provide fluid loss rates that are nearly unmeasurable. These couplings also provide one-hand push-to-connect and connect under limited pressure features, but require complete changeover from poppet-style couplings.

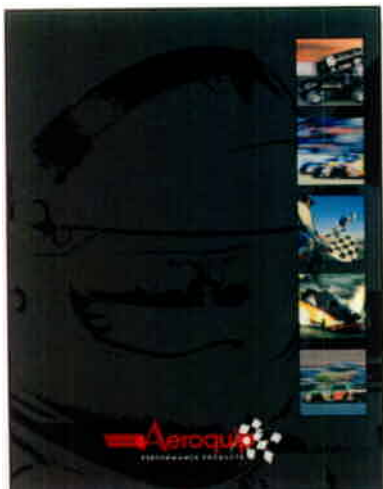


Aeroquip now introduces patented DryBreak female coupling halves that mate with any ISO poppet-style male coupling half. This upgrade ensures virtually no-spill performance without the necessity of changing out any of the male halves.

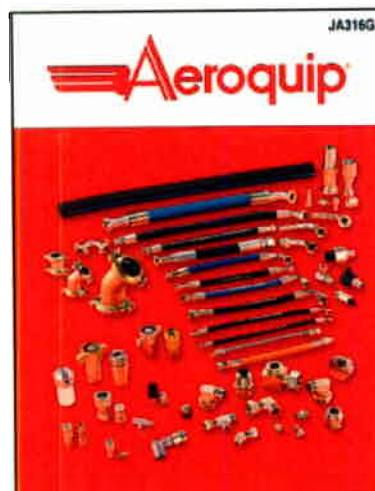


*cc = cubic centimeters (28.4 cc = 1 oz.)

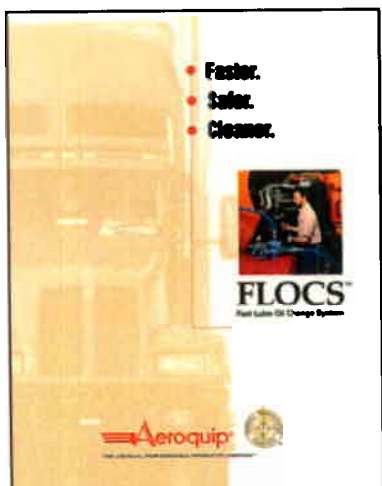
Additional Aeroquip Products Available



JC125



JA316



JB13



JA241



Eaton Aeroquip
Industrial Division
3000 Strayer Road
Maumee, Ohio 43537
419/867-2600, Fax: 419/867-2629
www.aeroquip.com



Specifications subject to change without notice

ALBERTA STRAINERS LTD.
9577 - 60 AVENUE
EDMONTON, ALBERTA
CANADA, T6E 0C2
PHONE: (780) 448-0258 FAX: (780) 435-7146

ALTA STRAINERS

INSTALLATION AND MAINTENANCE INSTRUCTIONS

INSTALLATION:

"Y" STRAINERS SHOULD BE INSTALLED IN A HORIZONTAL LINE OR A VERTICAL LINE WITH THE FLOW GOING DOWN.
BASKET STRAINERS SHOULD BE INSTALLED IN A HORIZONTAL LINE.
IN BOTH STYLES ROOM MUST BE ALLOWED FOR SCREEN REMOVAL.
IDEALLY, PRESSURE GAUGES SHOULD BE INSTALLED UPSTREAM AND DOWNSTREAM OF A STRAINER TO INDICATE PRESSURE DROP CAUSED BY A PARTIALLY PLUGGED SCREEN.

MAINTENANCE:

DETERMINE HOW LONG IT TAKES FOR THE SCREEN TO BECOME APPROXIMATELY 1/3 PLUGGED AND REMOVE AND CLEAN AT THE SAME TIME INTERVAL, OR WHEN THE PRESSURE GAUGES, IF INSTALLED, INDICATE A PRESSURE DROP ACROSS THE STRAINER.
IF A "Y" STRAINER HAS BEEN PROVIDED WITH A BLOW-DOWN VALVE ON THE DRAIN CONNECTION THEN IT MAY BE OPENED TO BLOW DOWN SEDIMENT.

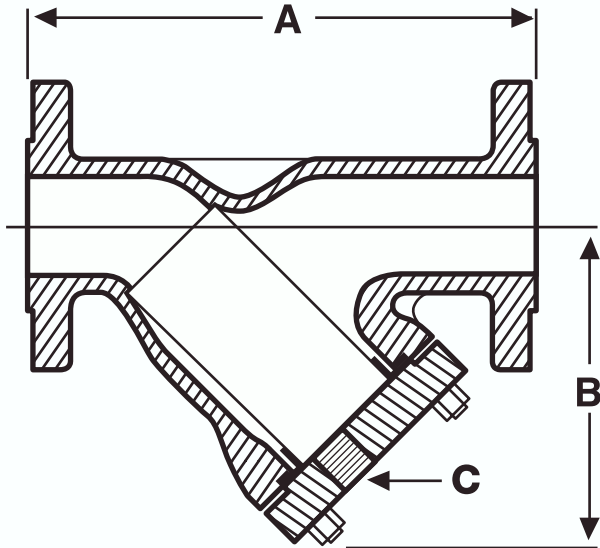
SPARE PARTS:

A SPARE SCREEN AND COVER GASKET ARE THE ONLY PARTS REQUIRED TO REFURBISH A STRAINER.
A SPARE SCREEN WILL DECREASE SHUT-DOWN TIME WHILE THE PLUGGED SCREEN IS BEING CLEANED.

ALTA

**MODEL NYF 300
300# ANSI CARBON STEEL
RAISED FACED FLANGED
"Y" STRAINER**

DRAWING A34



DESCRIPTION	MATERIAL
BODY	ASTM A216 GR. WCB
COVER	ASTM A216 GR. WCB
STUD	ASTM A193 GR. B7
NUT	ASTM A194 GR. 2H
GASKET	NON ASBESTOS
SCREEN	304 SS 1/8 PERF

TEMPERATURE		WORKING PRESSURE	
C	F	kPa	P.S.I.
-29 to 38	-20 to 100	5100	740
95	200	4655	675
150	300	4515	655
200	400	4380	635
260	500	4135	600

FLANGES ARE IN ACCORDANCE WITH ANSI B16.5

ALL STRAINERS ARE INDIVIDUALLY HYDROSTATICALLY TESTED TO ANSI B16.5

SIZE		DIMENSIONS						SCREEN REMOVAL		NET WEIGHT	
		A		B		C					
mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	Kg.	Lbs.
50	2	219	8 5/8	158	6 1/4	20	3/4	177	7	12.7	28
80	3	304	12	209	8 1/4	25	1	254	10	25	56
100	4	368	14 1/2	279	11	40	1 1/2	431	17	44	98
150	6	506	19 15/16	342	13 1/2	50	2	558	22	79	175
200	8	593	23 3/8	400	15 3/4	50	2	863	34	143	315

LARGER SIZES AVAILABLE . PLEASE CONTACT US FOR DIMENSIONS.

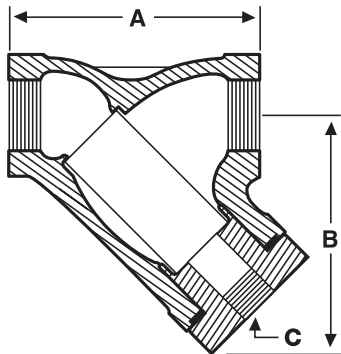
FEATURES

BODY HAS A MACHINED SEAT TO HOLD SCREEN SECURELY.

COVER HAS A MACHINED SCREEN HOLDER TO ALIGN SCREEN DURING INSTALLATION AND TO RETAIN SEDIMENT WHEN COVER IS REMOVED.

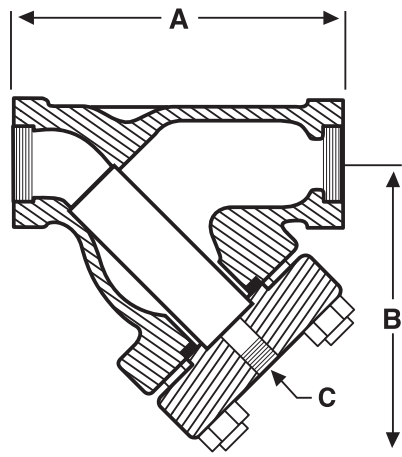
BODY IS MACHINED TO HOLD COVER GASKET IN A BLOW-OUT PROOF DESIGN.

ALTA	MODEL YS 600	DRAWING A 110
	600# ANSI CARBON STEEL SCREWED / SOCKET WELD "Y" STRAINER	



1 1/4" to 2" YS600

DESCRIPTION	MATERIAL
BODY	ASTM A216 GR. WCB
CAP / COVER	ASTM A216 GR. WCB
STUD	ASTM A193 GR. B7
NUT	ASTM A194 GR. 2H
GASKET	SPIRAL WOUND SS
SCREEN 1 1/4" - 2"	304 SS 1/32 PERF
SCREEN 3"	304 SS 1/8 PERF



3" YS600BC

TEMPERATURE		WORKING PRESSURE	
C	F	kPa	P.S.I.
-29 to 38	-20 to 100	10200	1480
95	200	9300	1350
150	300	9060	1315
200	400	8750	1270
260	500	8275	1200

ALL STRAINERS ARE INDIVIDUALLY HYDROSTATICALLY TESTED TO ANSI B16.5

SIZE		DIMENSIONS						NET WEIGHT	
		A		B		C			
mm	in.	mm	in.	mm	in.	mm	in.	Kg.	Lbs
32	1 1/4	133	5 1/4	96	3 7/8	15	1/2	2.7	6
40	1 1/2	159	6 1/4	127	5	20	3/4	4.5	10
50	2	190	7 1/2	165	6 1/2	25	1	7.3	16
75	3	298	11 3/4	279	11	25	1	25.5	56

FEATURES

BODY HAS A MACHINED SEAT TO HOLD SCREEN SECURELY.

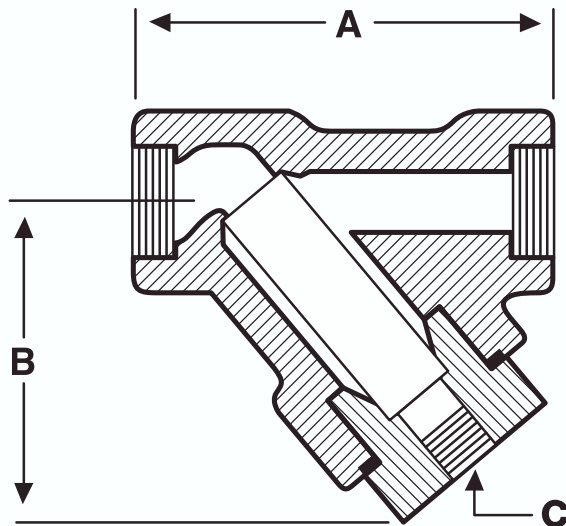
CAP/COVER HAS A MACHINED SCREEN HOLDER TO ALIGN SCREEN DURING INSTALLATION AND TO RETAIN SEDIMENT WHEN CAP/COVER IS REMOVED.

BODY IS MACHINED TO HOLD CAP GASKET IN A BLOW-OUT PROOF DESIGN.

ALTA

**MODEL YS 800
CLASS 800 CARBON STEEL
SCREWED / SOCKET WELD
"Y" STRAINER**

DRAWING A 100



DESCRIPTION	MATERIAL
BODY	ASTM A105 N
CAP	ASTM A105 N
GASKET	SPIRAL WOUND SS
SCREEN	304 SS 1/32 PERF

TEMPERATURE		WORKING PRESSURE	
C	F	kPa	P.S.I.
-29 to 38	-20 to 100	13780	2000
95	200	13366	1940
150	300	13056	1895
200	400	12746	1850
260	500	11954	1735

ALL STRAINERS ARE INDIVIDUALLY HYDROSTATICALLY TESTED TO ANSI B16.5

SIZE		DIMENSIONS						NET WEIGHT	
		A		B		C			
mm	in.	mm	in.	mm	in.	mm	in.	Kg.	Lbs
6	1/4	79	3 1/8	83	3 1/4	10	3/8	.9	2
10	3/8	79	3 1/8	83	3 1/4	10	3/8	.9	2
15	1/2	79	3 1/8	83	3 1/4	10	3/8	.9	2
20	3/4	95	3 3/4	85	3 3/8	10	3/8	1.4	3
25	1	117	4 5/8	89	3 1/2	15	1/2	1.8	4

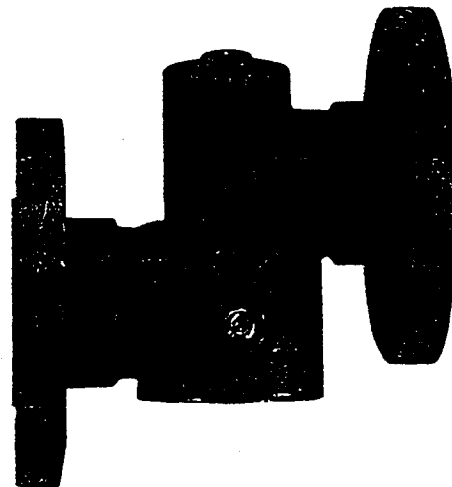
FEATURES

BODY HAS A MACHINED SEAT TO HOLD SCREEN SECURELY.

CAP HAS A MACHINED SCREEN HOLDER TO ALIGN SCREEN DURING INSTALLATION AND TO RETAIN SEDIMENT WHEN CAP IS REMOVED.

BODY IS MACHINED TO HOLD CAP GASKET IN A BLOW-OUT PROOF DESIGN.

High Pressure Control Valve 316 Stainless Steel



FEATURES

- STAINLESS STEEL HOUSING
(Meets NACE MR-0175-92)
- 2-WAY & 2-WAY VENTED
- OPTIONAL STAINLESS STEEL INTERNALS
- 600 PSI RATING
- OPEN/CLOSE POSITION SWITCH INDICATION (OPTIONAL)
- AUXILIARY PORT FOR INDICATION AND/OR PILOT ACTIVATION
- "LEAKLESS DESIGN"

APPLICATIONS

- STARTING AIR/GAS VALVE
- VENTED FUEL GAS VALVE
- CONTROL VALVE

OPERATION

2-Way Version

When pressure is applied to the PILOT port, the main ports (IN and OUT) are opened to allow flow through the valve. When the pilot pressure is released, a spring closes the main ports.

3-Way Version

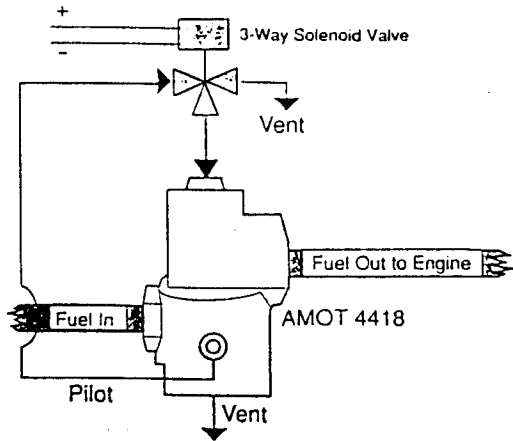
When Pilot Pressure is applied to the PILOT port, IN Port is open to the OUT Port; the VENT Port is closed. When pilot pressure is removed, the IN Port closes while the VENT Port opens to the OUT Port, relieving pressure within the valve and down stream piping. When used on a fuel gas system, the fuel intake manifold is vented causing quick shutdown of the engine.

SPECIFICATIONS

Valve Body	Stainless Steel	
Standard Internals	Anodized Aluminum	
Optional Internals	Stainless Steel	
Standard Seals	Viton	
Operating Temperature	-20° to 400°F (-29° to 204°C)	
Valve Working Pressure Rating	600 psi (38 kg/cm ²)	
Pilot Pressure (standard)	Min. 50 psi (3.5 kg/cm ²)	
	Max. 600 psi (38 kg/cm ²)	
	(optional)	
	Min. 30 psi (2.1 kg/cm ²)	
	Max. 600 psi (38 kg/cm ²)	
Flow Coefficient	IN to OUT	Cv = 45
	OUT to VENT	Cv = 4.5
Net Weight	1" & 1-1/2" threaded	8 lbs. (3.6 kg)
	1" & 1-1/2" flanged	17 lbs. (7.72 kg)
	2" threaded	9 lbs. (4.1 kg)
	2" flanged	23 lbs. (10.4 kg)

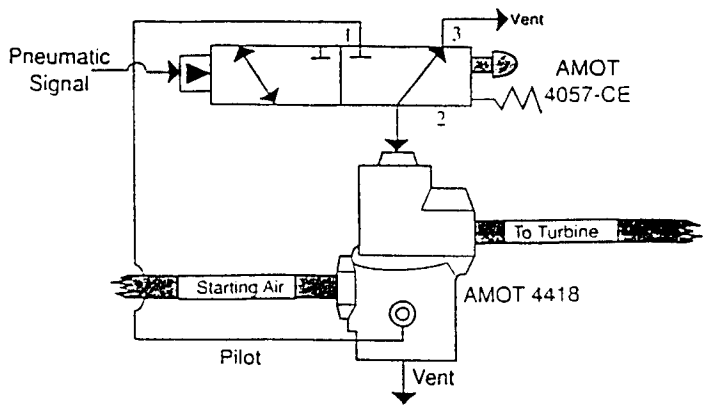
INSTALLATION DIAGRAMS

Fuel Valve For Turbine or Engine

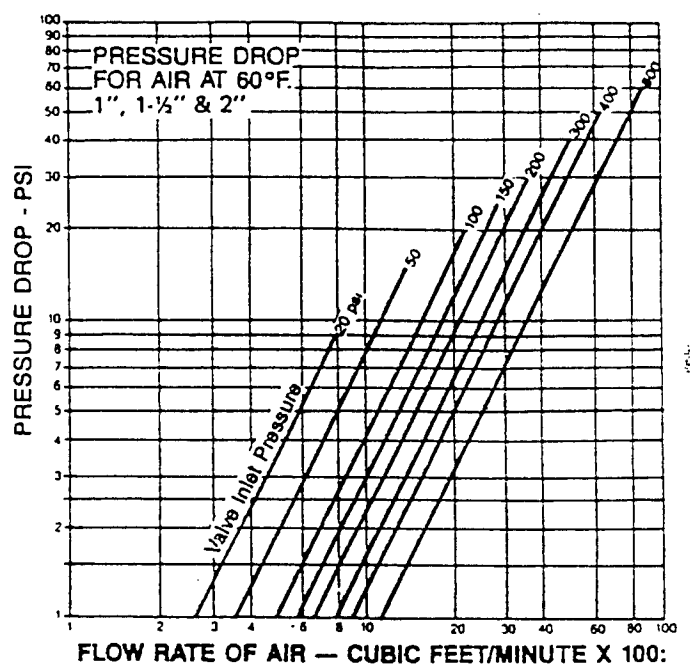
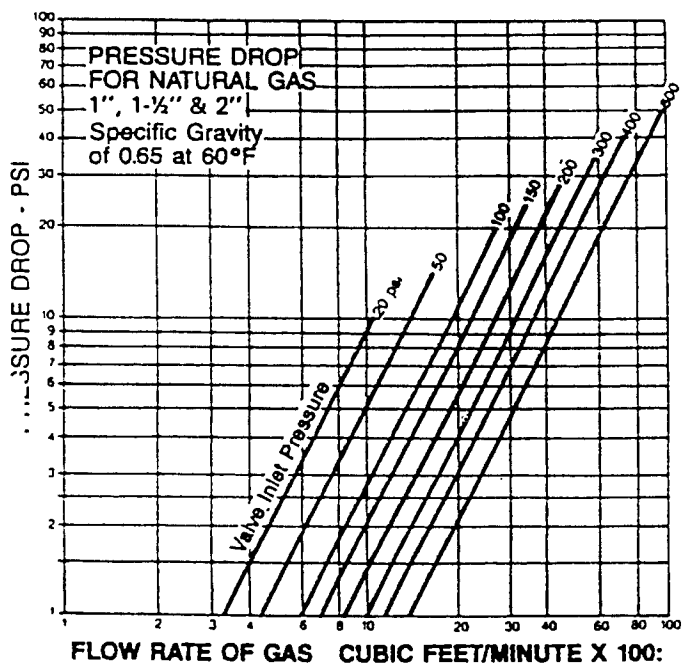


Energize to open fuel valve

Starting Air for Turbine or Engine

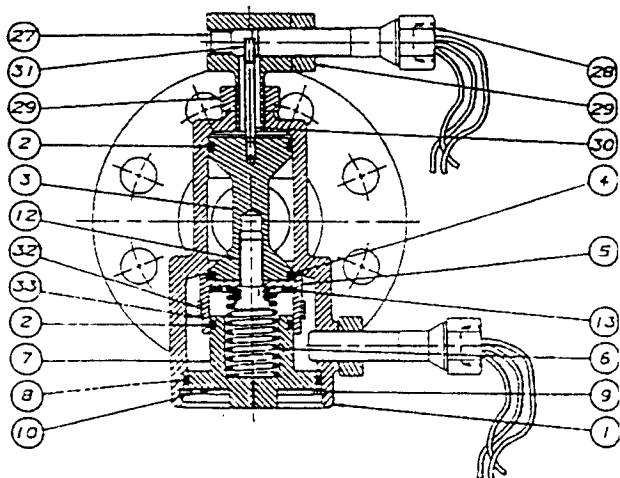


Pneumatic signal or manual pull to start turbine

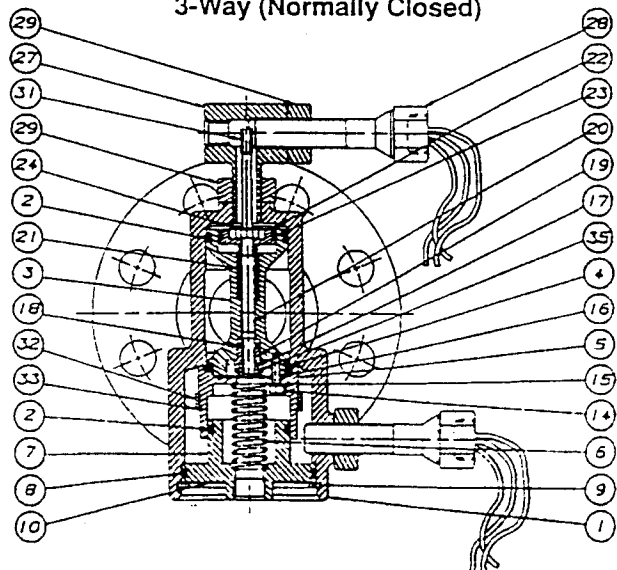


CUT-AWAY DIAGRAMS

2-Way (Normally Closed)

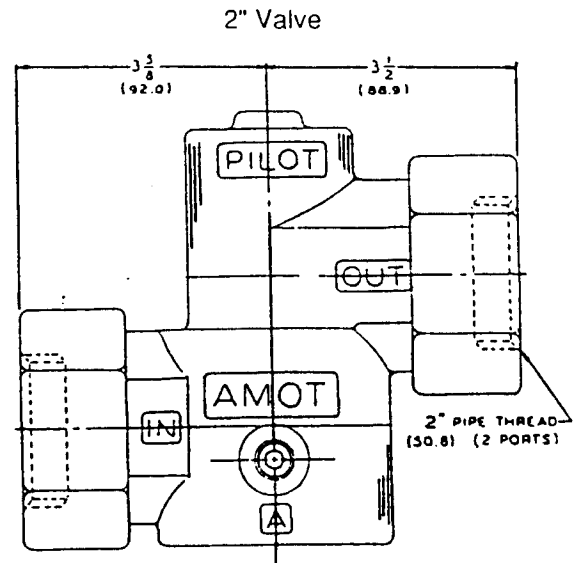
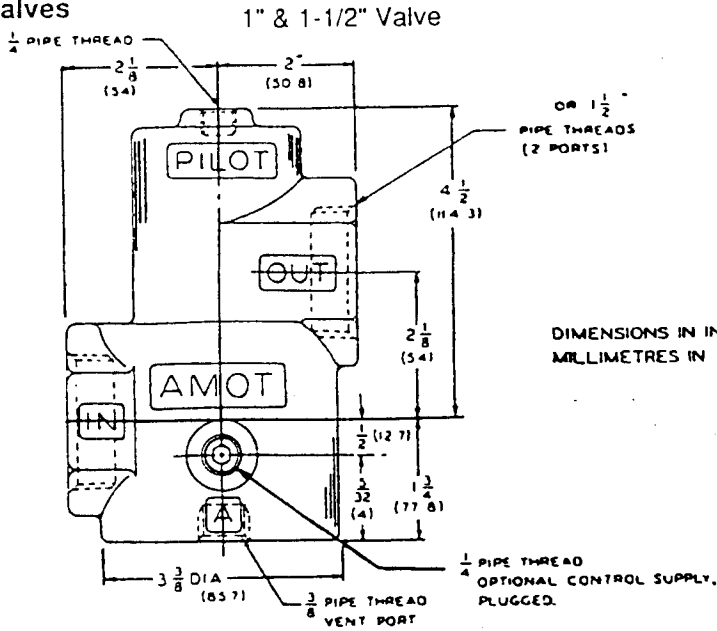


3-Way (Normally Closed)



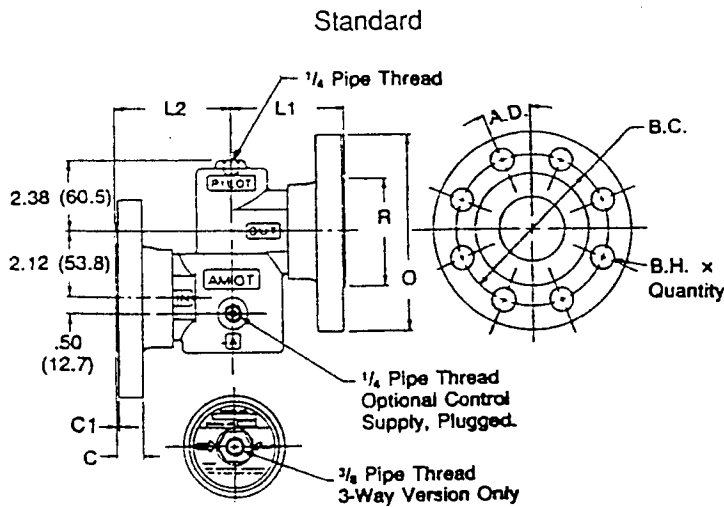
DIMENSIONS

Threaded Valves

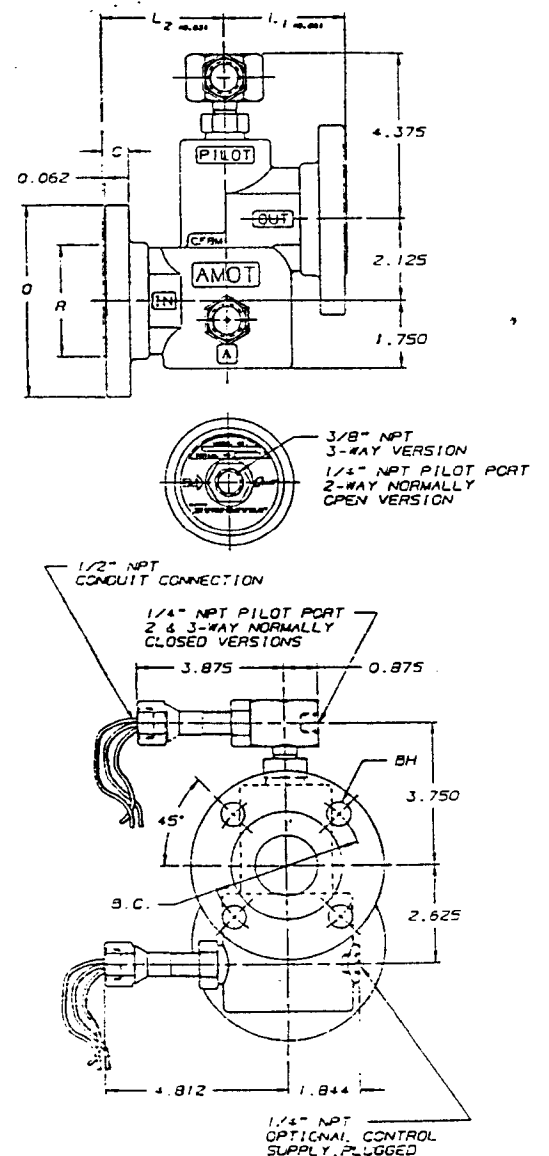


ALL OTHER DIMENSIONS ARE SAME AS 1-1/2" VALVE

Flanged Valves



With Position Indication

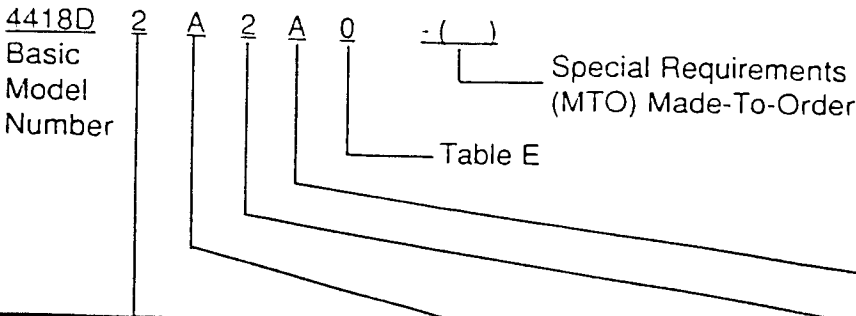


FLANGE CONNECTIONS

	1-1/2" 150 lb.	1-1/2" 300 lb.	2" 150 lb.	2" 300 lb.
L1	3.12 (79.2)	3.25 (82.6)	3.62 (91.9)	3.75 (95.3)
L2	3.25 (82.6)	3.38 (85.9)	3.75 (95.3)	3.88 (98.6)
O	5.00 (127.0)	6.12 (155.4)	6.00 (152.4)	6.50 (165.1)
C	0.75 (19.1)	0.81 (20.6)	0.75 (19.1)	0.88 (22.4)
C1	0.062 (1.6)	0.062 (1.6)	0.062 (1.6)	0.062 (1.6)
B.H.	0.62 (15.7)	0.88 (22.4)	0.75 (19.1)	0.75 (19.1)
	4X	4X	4X	8X
B.C.	3.88 (98.6)	4.50 (114.3)	4.75 (120.7)	5.00 (127.0)
R	2.88 (73.2)	2.88 (73.2)	3.62 (91.9)	3.62 (91.9)
A.D.	45°	45°	45°	22.5°

Dimension in inches, mm ()

MODEL CODE SYSTEM



NOTE: Letters or numbers in the MTO space indicate the unit is built to special requirements and some of the other code numbers may not be valid. Check with the factory for full specification on such models.

TABLE A Type & Size		TABLE B Connections		TABLE C Internal Materials		TABLE D Min. Pilot Pressure			
Code No.	Type & Size	Code No.	In & Out Ports	Pilot "A" & **Vent Ports	Code No.	Seals	Internals	Code No.	Pressure
Normally Closed									
1	1", 2-Way	A	NPT	NPT	2	Viton	Aluminum	A	50 psi
2	1-1/2", 2-Way	B	BSP (PL)	BSP (PL)	4	Viton	Stainless Steel	B	30 psi
3	2", 2-Way	A	NPT	NPT					
		B	BSP (PL)	BSP (PL)					
		E	300 lb. RF Flange	NPT					
		J	150 lb. RF Flange	NPT					
4	1", 3-Way	A	NPT	NPT	6	Viton	Aluminum	C	50 PSI
		B	BSP (PL)	BSP (PL)	8	Viton	Stainless Steel		
5	1-1/2", 3-Way	A	NPT	NPT					
6	2", 3-Way	B	BSP (PL)	BSP (PL)					
		E	300 lb. RF Flange	NPT					
		J	150 lb. RF Flange	NPT					
Normally Open									
7	1", 2-Way	A	NPT	NPT	2	Viton	Aluminum	A	50 psi
		B	BSP (PL)	BSP (PL)	4	Viton	Stainless Steel	B	30 psi
8	1-1/2", 2-Way	A	NPT	NPT					
9	2", 2-Way	B	BSP (PL)	BSP (PL)					
		E	300 lb. RF Flange	NPT					
		J	150 lb. RF Flange	NPT					

NOTE: ** Vent Port on 3-Way version only.

= Non Standard

TABLE E Indicator Options			
CSA Class I, Div. 1 Groups A, B, C, D		UL Class I Groups A, B, C, D	
E	Open	H	Open
F	Closed	J	Closed
G	Open/Closed	K	Open/Closed

Position Indicator Available only for Table B, Codes A, E & J.

This unit may be ordered using the full description as shown or by constructing a Model Number using the Model Code System. Example: The complete Model Number for a standard 2-way valve with 1-1/2" NPT threads, Viton seals and no position indication is 4418D2A2A0.

HOW TO ORDER

When ordering, please specify the following:

- AMOT Model 4418D
- Valve size 1", 1-1/2", or 2"
- Valve function: 2-way IN/OUT
3-way (includes VENT port)
- Features if required:
 - BSP parallel port threads (instead of NPT)
 - Flange connections (instead of threaded)
 - 2" 300 lb. raised face
 - 2" DIN ND40 (U.K. factory only)
 - 30 psi pilot pressure (instead of 50 psi, 2-way valve only)
 - Stainless Steel internal parts (instead of anodized aluminum)
 - Position Indication: None, Open, Closed, Open/Closed

AMOT Controls Corporation
401 First Street
Richmond, CA 94801-2906
Tel: (510) 236-8300
Fax: (510) 234-9950

AMOT Controls Ltd.
Western Way
Bury St. Edmunds IP33 3SZ
Suffolk England
Tel: 0284 762222
Fax: 0284 760256

AMOT Controls Corporation
230 Orchard Road
09-230 Faber House
Singapore 0923
Tel: (65) 235-8187
Fax: (65) 235-8869

INSTALLATION AND MAINTENANCE INSTRUCTIONS

3 way solenoid operated valves normally closed, normally open and universal operation

ASCO

Bulletin

8320

Form no. V32001

DESCRIPTION

Bulletin 8320 valves are 3 way solenoid operated valves with all connections located in the body. Valves are brass or stainless steel with 1/8 or 1/4 inch NPT process connections.

Standard valves have an epoxy encapsulated solenoid coil for Type 1,2,3,3S, and 4 combination general purpose and watertight installations. Valves with "EP" prefixes in the catalogue number have encapsulated solenoids suitable for Type 3,3S,4,6, and 7(A,B,C,&D) explosion proof Class I, Group A,B,C,&D and Type 9(E,F,&G)-Dust-Ignition Proof Class II Groups E,F,&G.

OPERATION

Normally Closed: Applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized. When the solenoid is energized flow is from connection "2" to connection "1". Connection "3" is closed. When solenoid is de-energized flow is from connection "1" to connection "3". Connection "2" is closed.

Normally Open: Applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized. When the solenoid is energized flow is from connection "1" to connection "2". Connection "3" is closed. When solenoid is de-energized flow is from connection "3" to connection "1". Connection "2" is closed.

Universal: For normally closed or normally open operation, selection or diversion of pressure can be applied to connection "1", "2" or "3".

NOTE: To change from normally closed to normally open or universal operation, consult factory.

Positioning

This valve is designed to perform properly when mounted in any position. For optimum performance and life, the solenoid should be mounted vertical and upright.

Mounting

Valves may be pipe mounted, direct mounted with self tapping screws in the case of forged brass bodies, or mounted with optional factory supplied mounting brackets.

Piping

Connect pipe or tubing to valve according to markings on the valve body. Refer to flow diagrams above. Apply pipe compound or teflon tape sparingly to male pipe threads only. When tightening connections do not use the valve body or solenoid as a lever. Locate wrenches as close as possible to the connection point.

IMPORTANT: For protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on service conditions.

Wiring

Wiring must comply with local and national codes. Solenoids are provided with 1/2" conduit hubs or other optional connection methods as illustrated in Fig.2,3. The solenoid may be rotated to facilitate electrical connection.

NOTE: Alternating current and direct current solenoids are built differently. To convert one to the other it is necessary to change the complete solenoid assembly including core tube, bonnet, and core assembly.

MAINTENANCE

NOTE: It is not necessary to remove the valve from the pipeline for repairs.

WARNING: Turn off electrical power supply and de-pressurize valve before making repairs.

Cleaning

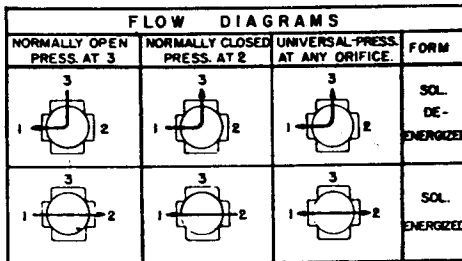
All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the fluid and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required. Clean valve strainer or filter when cleaning the valve.

Preventive Maintenance

1. Keep the fluid flowing through the valve as free from dirt and foreign material as possible.
2. While in service, the valve should be operated at least once a month to insure proper opening and closing.
3. Depending on the fluid and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace worn or damaged parts with an ASCO rebuild Kit.

Causes of Improper Operation

1. **Faulty Control Circuits:** Check the electrical system by energizing the solenoid. A metallic "click" signifies that the solenoid is operating. Absence of the "click" indicates loss of power supply. Check for loose or blown fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open-circuited coil. Replace coils as necessary. Check supply voltage; it must be the same as specified on coil.
3. **Low voltage:** Check voltage across the coil lead. Voltage must be at least 85% of coil rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with an ASCO Rebuild Kit.



TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart below. Check catalogue number prefixes and watt ratings to determine maximum temperatures.

TEMPERATURE LIMITATIONS 8320G, CATA. 32C					
WATT RATING	CATALOGUE PREFIX	MAX. AMBIENT TEMP. F.	MAX. FLUID TEMP F.		
			1/8 NPT	1/4 NPT	
10.1 & 17.1	NONE, FB, KP, KP, SC, SD, SF, SF	125	180	200	
10.1 & 17.1	HB, HT, KB, KH, SS, ST, SU	140	180	200	
11.6 & 22.6	NONE, KB, KP, KP, SC, SD, SF, SF	104	120	150	
11.6 & 22.6	HP, HT, KB, KH, SS, ST, SU, SV	104	120	150	

* MINIMUM AMBIENT TEMPERATURE - 40 F.

INSTALLATION

Check nameplate for correct catalogue number, pressure, fluid and electrical service.

ASCOELECTRIC limited

P.O. Box 160, Brantford, Ontario N3T 5M8

(519)758-2700 fax (519)758-5540

ASCO

Printed in Canada

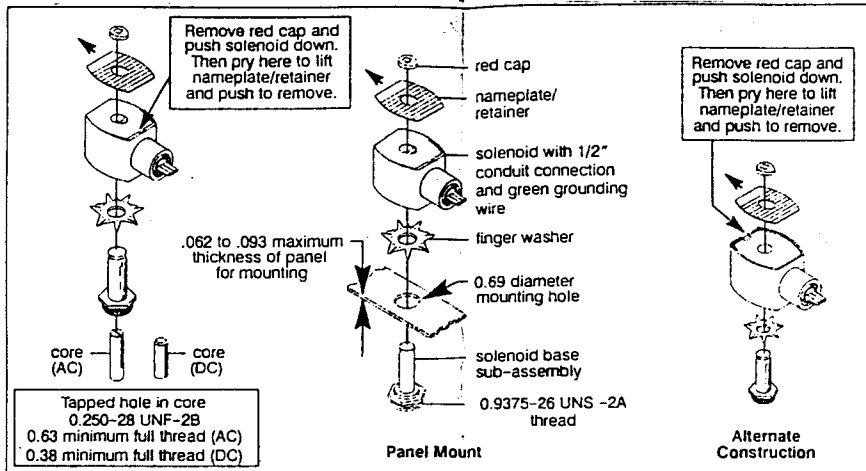


Figure 1. Series 8003G solenoids

Torque Chart

Part Name	Torque Value in Inch-Pounds	Torque Value in Newton-Meters
terminal block screws	10 ± 2	1,1 ± 0,2
socket head screw	15 - 20	1,7 - 2,3
center screw	5 ± 1	0,6 ± 0,1

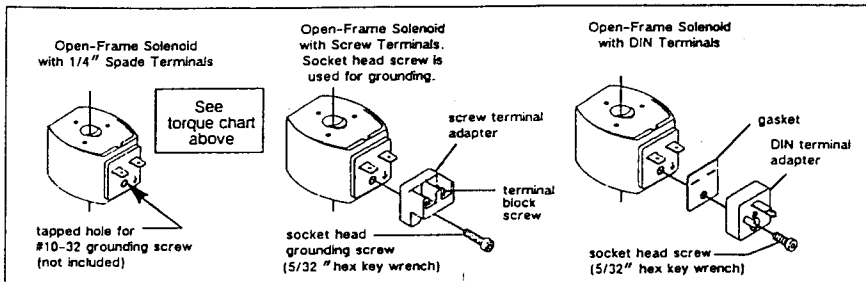


Figure 2. Open-frame solenoids

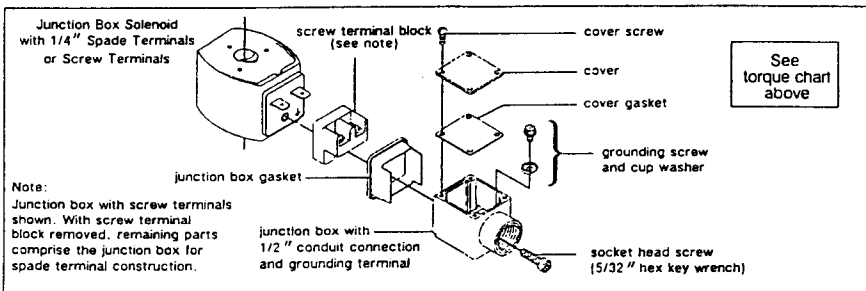


Figure 3. Junction box (optional feature)

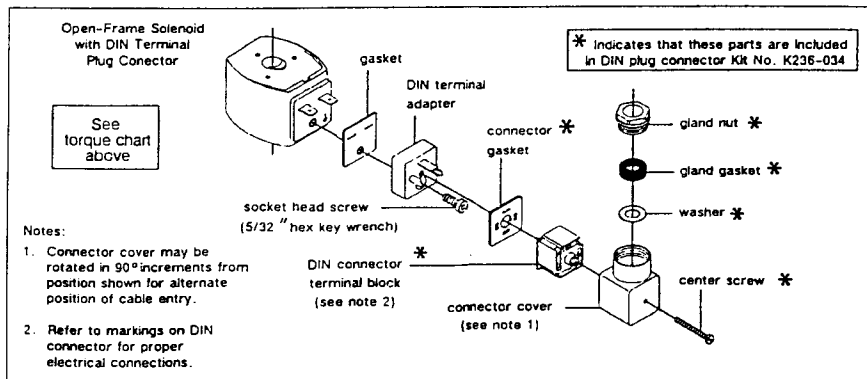


Figure 4. DIN plug connector kit No. K236-034 (optional feature)

COIL REPLACEMENT (REF. FIG. 1)

Turn off electrical power, disconnect coil lead wires and proceed as follows:

1. Remove red cap, and nameplate.
2. Slip coil off solenoid base sub-assembly
3. Reassemble in reverse order of disassembly.

VALVE DISASSEMBLY AND REASSEMBLY (REF. FIG. 1)

Turn off electrical power supply and de-pressure valve.

1. Remove retaining cap and slip entire solenoid off solenoid base sub-assembly.
2. Unscrew bonnet or solenoid base sub-assembly. Remove core assembly, core spring and body gasket.
3. Remove end cap, body gasket, disc spring, disc holder, disc or disc holder assembly.
4. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.
5. Reassemble in reverse order of disassembly paying careful attention to exploded view provided.

ORDERING INFORMATION FOR SPARE PARTS KITS
When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

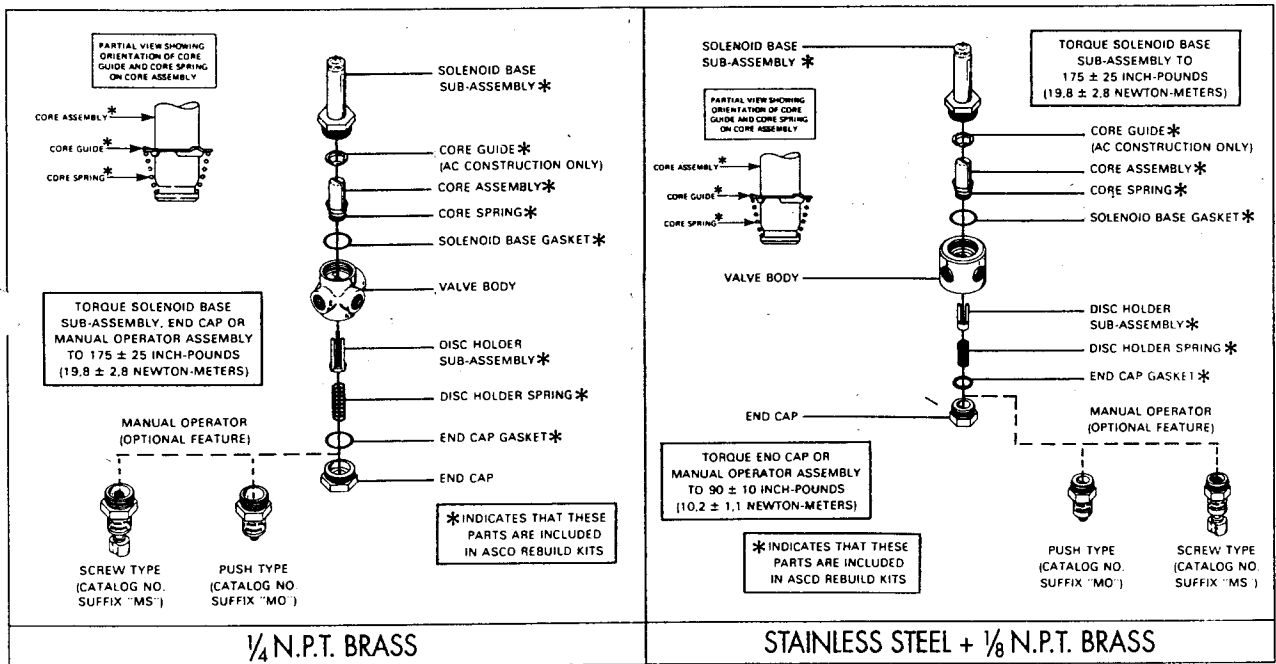


Fig. 5 Series 8320G Valves

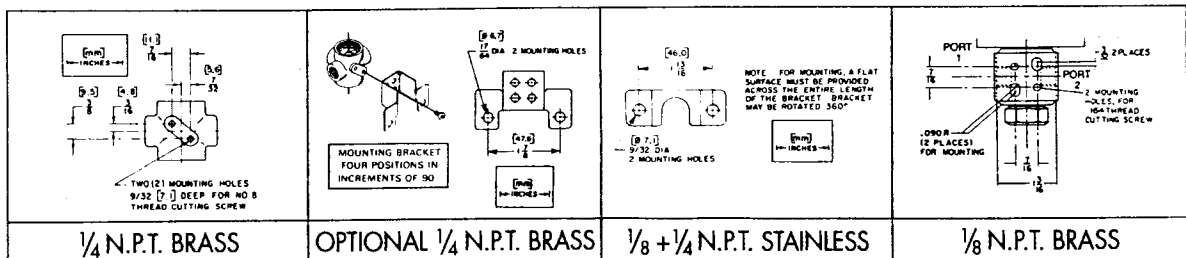


Fig. 6 Mounting

INSTRUCTIONS DE MONTAGE ET D'ENTRETIEN

DESCRIPTION

Les instructions suivantes sont incluses pour vous donner des informations générales pour l'installation de nos pièces de rechange. Ces instructions sont très générales et couvrent plusieurs types de soupapes, telles que soupapes à commande par solénoïde, à commande par pilote externe, etc.. Pour une information plus exacte au sujet d'une soupape particulière, voir les pages d'instructions qui sont incluses avec la soupape en question.

FONCTIONNEMENT

Référez au dessin d'assemblage.

INSTALLATION

Vérifiez la plaque d'identification pour vous assurer que le numéro de catalogue, le voltage, la pression et le service sont tels que requis.

MISE EN PLACE

Référez aux dessins d'assemblage.

TUYOTAGE

Couplez les conduits à la soupape selon les indications données sur le châssis de la soupape. Appliquez la pâte pour conduits généreusement sur les pas de vis du conduit mâle seulement: si on l'applique sur le pas de vis de la soupape même, il y a danger que la pâte pénètre dans la soupape et cause des difficultés de fonctionnement.

- important - Pour meilleure opération, il est recommandé qu'un filtre approprié au service soit installé au plus près de la soupape que possible, et que ce filtre soit nettoyé périodiquement.

- avertissement - Evitez de trop serrer les tuyaux. Appliquez les clés le plus près possible du point de raccordement du tuyau et du corps de la soupape. N'utilisez pas la soupape comme levier.

PRESSION DIFFÉRENTIELLE DE FONCTIONNEMENT (Minimum)

Pour toutes soupapes qui exigent une pression différentielle minimum, il est critique que les lignes de pression et d'échappement ne soient pas réduites. La pression minimum tel qu'indiqué sur la plaque d'identification doit être maintenue.

CABLAGE

Le cablage doit être conforme aux règlements des Codes Electriques soit Nationaux, soit de l'endroit où l'installation est effectuée.

ENTRETIEN

- ATTENTION - Débranchez l'alimentation électrique (ou pression auxiliaire) ainsi que la pression avant d'effectuer aucune réparation.

NETTOYAGE

Un nettoyage périodique de toutes les soupapes et accessoires est recommandé. L'intervalle entre nettoyages variera selon les conditions de service.

ENTRETIEN PREVENTIF

1. Assurez-vous que la matière circulant dans la soupape est aussi propre que possible.
2. Pendant son service, opérez la soupape au moins une fois par mois pour assurer l'opération normale de la soupape.
3. L'inspection périodique (selon les conditions de service) des parties internes de la soupape est recommandée afin d'observer si il y a endommagement ou usure excessive. Nettoyez la soupape au complet et installez les nouvelles pièces de rechange.

FONCTIONNEMENT FAUTIF

1. **Defaut du circuit de contrôle:** Vérifiez le système électrique en mettant le solénoïde sous tension. Un dé clic métallique signifie que le solénoïde fonctionne normalement. L'absence d'un dé clic métallique indique une perte d'alimentation du courant. Vérifiez la présence de fusibles fondus, d'une bobine avec un circuit ouvert ou mise à terre, d'un fil ou d'une éprisure brisée.
2. **Basse tension:** Vérifiez le niveau de tension. La tension doit être au moins à 85% du niveau indiqué sur la plaque d'identification.
3. **Pression inexacte:** Vérifiez que la pression et le service conforme à celle indiquée sur la plaque d'identification de la soupape.
4. **Fuite de pression:** Démontez la soupape et nettoyez toutes les pièces. Installez les pièces de rechange si nécessaire. Vérifiez qu'il n'y a pas d'objets étrangers qui bloquent ou causent la fuite de pression.
- important - Certaines soupapes, à cause de leurs sièges non-élastiques sont allouées une fuite de pression minime. Consultez le bureau de vente Asco.

ENSEMBLES DE PIÈCES DE RECHANGE

Pour commander les ensembles de pièces de rechange et les bobines pour les soupapes ASCO, spécifiez le numéro de catalogue, le voltage, la pression et le service en question.
- a noter - Les pièces indiquées avec (*) sur le dessin d'assemblage sont incluses dans l'ensemble de pièces de rechange.



**BALDWIN
FILTERS**

PRODUCTS

ELECTRONIC CATALOG

SALES

INSIDE BALDWIN

CONTACTS

Air

Protecting today's engines

Coolant

DAHL

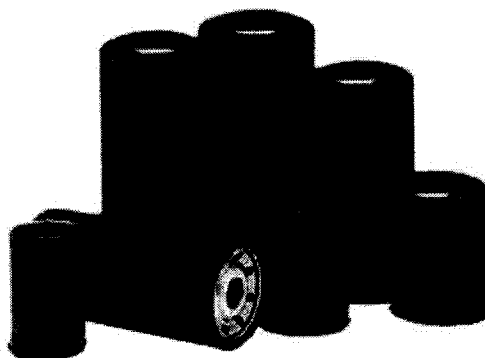
Fuel

Hydraulic

Lube

Transmission

As modern, high-performance engines have continued to evolve over the past 50 years, so has the requirement for more sophisticated oil filters. While filters play a "passive" role in engine protection, they nevertheless must work together with the lubricating oil to keep engines protected and clean.



Modern oils play vital functions in protecting engines, especially in heavy-duty situations such as trucking, construction, mining and agriculture. Lubricating oil acts to reduce friction and wear, cool engine parts, seal combustion chambers, clean engine components and inhibit corrosion. These functions are carried out by special additives

in the oil, which complement the action of the oil itself. The protective action of the lubricating oil and its additives are supported and balanced by the work of the lube filter.

Lube filters, particularly those designed for heavy-duty applications, have the sole purpose of keeping damaging contaminants away from sensitive engine parts. Filters trap oil contaminants in two ways: Some particles "adhere to filter media as the oil flows through the filter. Such particles attach themselves to the media surface without plugging up the media "pores.

Other particles are trapped in the filter media by the pressure of the oil as it flows through the filter. As the oil changes direction in its path through the filter, particles are driven or "impinged into the media. Ideally, most of these particles are trapped in the outer portion of the media, leaving inner media surfaces open to continue catching particles that slip through. Eventually, however, media pores will "fill up and the filter begins to lose its' effectiveness.

A close-up look at filter media

As engine power has increased, so have bearing loads, engine rpms and operating temperatures. With the introduction of combination full-flow/ by-pass filters, equipment operators have gained added efficiency in their vehicles performance. However, as newer engines have been designed with improved oil control, oil drain intervals have been increased to account for lower oil usage levels.

This means that lube filters must be more effective in trapping oil contaminants, and oil drain intervals must be monitored more closely to prevent excessive engine wear. For example, as oil sump capacity decreases, the concentration of fine contaminants in the sump increases. This requires both the oil and the filter to work more effectively to keep particles out of the engine. Filter media today ranges from the long popular and proven cellulose to synthetic media made of fiberglass, polyester, "microglass and various blends of these materials. Each type of media has specific applications for which it is best suited. Cellulose

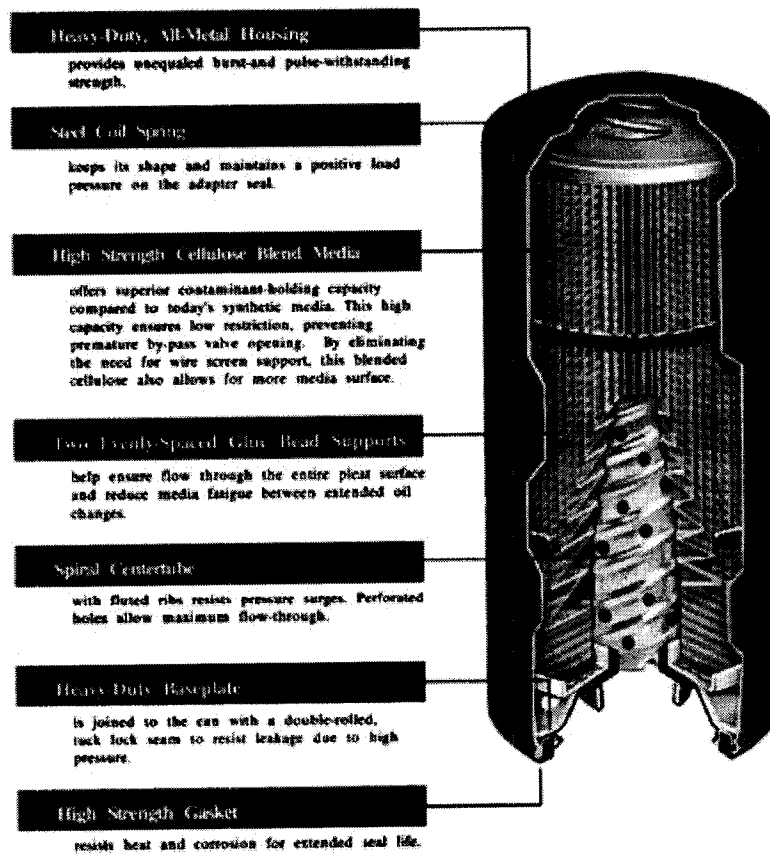
filters are high in efficiency and capacity, yet low in cost. Typically, cellulose filters are rated 98% efficiency at 40 microns. Cellulose media is used in varied oil, air, fuel and some hydraulic applications.

Microglass filters generally have high efficiency, and media pore size can be controlled to catch small particles. This is especially beneficial for hydraulic oil filtration where 3 to 5 micron filtration is desirable, and hydraulic oil is not warmed by engine heat. The drawback to glass media filters is that the media cannot be "bent too sharply in forming the filter pleats or the glass fibers will be broken. This limits the surface area that can be built into a glass media filter. Also, glass media typically requires a wire screen lining to keep the glass fibers together. Newer filters for heavy-duty use are now being made with a combination of cellulose and synthetic media. This blend of fibers provides improved efficiency, along with increased dirt-holding capacity. Although cost for these filters is greater than regular cellulose filters, the cost can be lower than for microglass. These filters are ideally suited for severe service and extended service intervals.

Filter Construction is critical to performance

No matter how efficient the media, lube filters must stand up to tough operating conditions for hundreds of hours or thousands of miles. Over the years, Baldwin has designed and built special machines to perfect filter construction. Innovations include: State-of-the-art high-speed equipment to give filter pleats exceptional uniformity for maximum efficiency in oil flow and contaminant collection.

Centertube forming equipment to form a spiral seam that is actually stronger than the material itself. This lets the centertube better withstand sudden changes between internal and external pressure.



Special can/baseplate seaming techniques with double-rolled lock seams to withstand pressure and vibration. Heavy-duty baseplates which are cold-formed to create a solid platform that doesn't bend or twist under high pressure surges.

Does extended oil change interval pay?

Baldwin engineers have been researching extended oil drain intervals in the field for more than 30 years, as have most engine and equipment manufacturers. These engineers agree that extended drain intervals should be approached with extreme caution. While extended

intervals may save a few dollars in the short run, improperly managed intervals can lead to accelerated engine wear and costly engine rebuilds. When considering extended drain intervals, it's important to develop a consistent oil analysis program.

Another factor to consider is that oil consumption tends to increase toward the end of extended change intervals, because engines burn more used oil than new oil. Increased oil usage reduces the savings from extending the drain interval.

When evaluating the value of extended change intervals, a key factor for selecting lube filters is capacity—the amount of contaminants the filter can hold before it begins to plug. As oil begins to deteriorate, soot and sludge accumulate in the filter and can rapidly plug the filter media. Lube filters with higher capacity protect the engine better when oil change intervals are extended. Whether your equipment can tolerate extended oil drain intervals depends on such variables as operating environment, engine types, oil used, etc. Consider miles traveled vs. hours of operation. Linehaul trucks averaging 80,000 miles per year may handle extended drain intervals better than local service trucks that travel less than 40,000 miles per year, for example. Remember, too, that the accumulation of oil contaminants builds up over time, regardless of miles traveled or hours operated. Extended oil change intervals don't lessen the need for effective preventive maintenance, including regular oil analysis. In fact, it amplifies it!

Baldwin Severe Service Filters Outperform Synthetic Media Filters

Responding to today's demands for effective lube filtration for high performance engines, with the capacity for extending oil change intervals, Baldwin Filters has introduced a new line of "Severe Service filters.

Severe Service filters incorporate the proven effectiveness of cellulose media, blended with synthetic media technology. Under appropriate conditions, these new filters have extra efficiency and capacity to handle extended drain intervals. On the other hand, for equipment operating under extreme conditions, Severe Service lube filters provide added protection against harmful oil contaminants.

Questions or Comments about the internet pages contact
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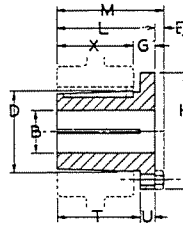
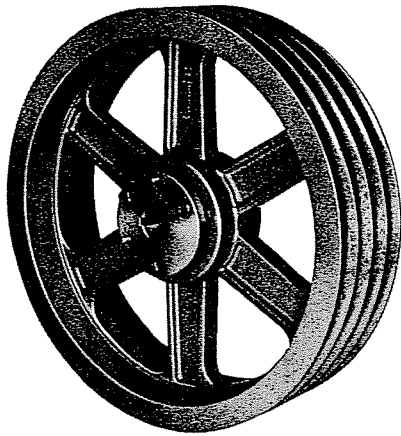


FILTER SPECIFICATIONS: U.S. Thread

Baldwin Part #	Dimensions		Media: Estimated Performance				Structural Specifications								
	Thread Pitch	Gasket Features	O.D. Length	Media Grade	Area	Capacity	Estab. Micron Rating	BX=2 B10=X BX=75	Average Efficiency	Hydrostatic	Hydrodynamic				
BF914 / BF915	1" 12	G381-A D	3 11/16" 7 7/16"	F35-60	683.604 in ²	85.09 grams	16	18 1.19 41	72.04%	200 psi	100 psi	0-50	Pulse	Cycles	25000

Browning Gripbelt Sheaves with Split Taper Bushings TA

For Use with All "A" Section Belts



Standard Keyseats
Table No. 1

Bore Range	Keyseat
1/2" — 9/16"	1/8" x 1/16"
5/8" — 7/8"	3/16" x 3/32"
15/16" — 1 1/4"	1/4" x 1/8"
1 5/16" — 1 3/8"	5/16" x 5/32"
1 7/16" — 1 3/4"	3/8" x 3/16"
1 11/16" — 2 1/4"	1/2" x 1/4"
2 3/16" — 2 1/16"	5/8" x 5/16"

1 3/8" Bore Bushings, also available with 3/8" x 3/16" Keyseat.

Close Grain Cast Iron
Accurately Machined
Statically Balanced
Easy to Mount—Easy to Remove
Clamp Fit on Shaft

Table No. 2 Bushing Dimensions

Part No.	Dimensions									Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H		
P1	2 3/16"	1 15/16"	5/8"	1 5/16"	1/2"	1 17/32"	1 3/32"	1 15/16"	3"	1/2" — 1 3/4"	1 1/4
P2	3 3/16"	2 15/16"	3/4"	2 5/16"	1/2"	2 17/32"	1 3/32"	1 15/16"	3	3/4" — 1 3/4"	1 1/2
Q1	2 25/32"	2 1/2"	3/4"	1 3/4"	9/32"	1 31/32"	1 7/32"	2 7/8"	4 1/8"	3/4" — 2 1/16"	3 1/2

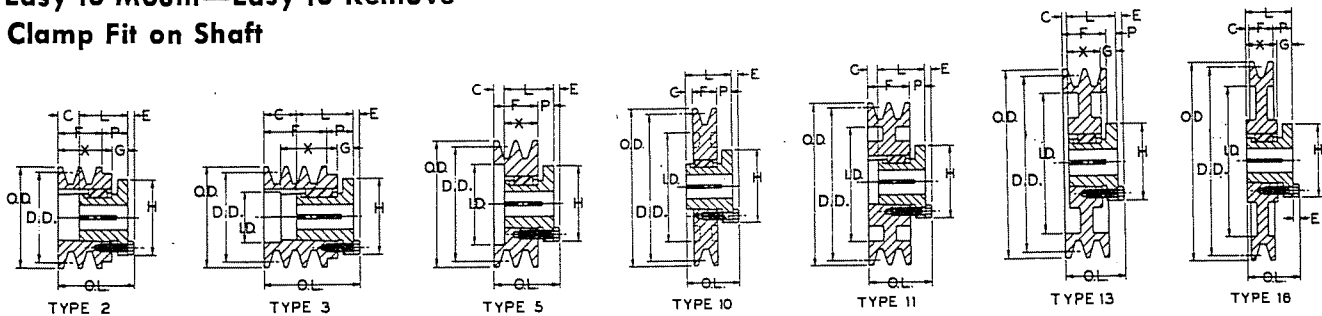


Table No. 3

Specifications—Stock "TA" Sheaves

DIAMETERS			2 GROOVES, F = 1 3/8"											Wt. Less Bush.
Datum "A"	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.25"	—	2TA30	P1	2	2 13/16"	1 15/16"	1 3/16"	5/8"	3"	5/8"	1 15/16"	1 1/4"	2.0
3.2	3.45	—	2TA32	P1	2	2 13/16"	1 15/16"	1 3/16"	5/8"	3	5/8"	1 15/16"	1 1/4"	2.4
3.4	3.65	—	2TA34	P1	2	2 13/16"	1 15/16"	1 3/16"	5/8"	3	5/8"	1 15/16"	1 1/4"	2.8
3.6	3.85	—	2TA36	P1	1	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	2.3
3.8	4.05	—	2TA38	P1	5	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	2.5
4.0	4.25	—	2TA40	P1	5	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	2.9
4.2	4.45	—	2TA42	P1	5	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	3.4
4.4	4.65	—	2TA44	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	3.8
4.6	4.85	—	2TA46	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	4.5
4.8	5.05	—	2TA48	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	5.0
5.0	5.25	—	2TA50	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	5.3
5.2	5.45	—	2TA52	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	5.9
5.4	5.65	—	2TA54	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	6.4
5.6	5.85	—	2TA56	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	6.9
5.8	6.05	—	2TA58	P1	5-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	1 3/8"	1 1/4"	7.6
6.0	6.25	4 3/4"	2TA60	P1	11-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	—	1 1/4"	6.3
6.2	6.45	4 15/16"	2TA62	P1	11-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	—	1 1/4"	6.4
6.4	6.65	5 3/16"	2TA64	P1	11-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	—	1 1/4"	6.9
6.6	6.85	5 1/2"	2TA66	P1	11-Web	2 3/16"	1 15/16"	5/8"	1/16"	3	—	—	1 1/4"	6.9
7.0	7.25	6 1/4"	2TA70	Q1	16-Web	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	8.6
8.2	8.45	6 15/16"	2TA82	Q1	16-Web	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	11.6
8.2	8.45	6 15/16"	2TA80	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	12.5
9.0	9.25	7 1/4"	2TA90	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	12.5
10.6	10.85	9 3/8"	2TA106	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	14.4
12.0	12.25	10 1/4"	2TA120	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	16.3
15.0	15.25	13 1/4"	2TA150	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	21.3
18.0	18.25	16 1/4"	2TA180	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	25.8
19.5	19.75	18 1/2"	2TA195	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	29.8
24.5	24.75	23 3/4"	2TA245	Q1	16-Arm	2 25/32"	2 1/2"	1 5/16"	3/16"	4 1/8"	3/4"	9/32"	1 1/4"	38.1

TA *Browning*® Gripbelt Sheaves with Split Taper Bushings

For Use with All "A" Section Belts

Table No. 1 Specifications—Stock "TA" Sheaves

DIAMETERS			3 GROOVES, F = 2"											Wt. Less Bush.
Datum "A"	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.25"	—	3TA30	P1	3	37/16"	115/16"	13/16"	11/4"	3"	5/8"	29/16"	1/4"	2.6
3.2	3.45	—	3TA32	P1	3	37/16"	115/16"	13/16"	11/4"	3"	5/8"	29/16"	1/4"	3.1
3.4	3.65	—	3TA34	P1	3	37/16"	115/16"	13/16"	11/4"	3"	5/8"	29/16"	1/4"	3.5
3.6	3.85	23/16"	3TA36	P1	5	27/8"	115/16"	7/8"	11/16"	3"	—	13/8"	1/4"	2.9
3.8	4.05	29/16"	3TA38	P1	5	27/8"	115/16"	7/8"	11/16"	3"	—	13/8"	1/4"	3.3
4.0	4.25	23/4"	3TA40	P1	5	27/8"	115/16"	5/8"	11/16"	3"	—	13/8"	1/4"	3.6
4.2	4.45	215/16"	3TA42	P1	13-Sol.	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	4.0
4.4	4.65	33/16"	3TA44	P1	13-Sol.	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	4.5
4.6	4.85	37/8"	3TA46	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	5.3
4.8	5.05	39/16"	3TA48	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	5.8
5.0	5.25	33/4"	3TA50	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	6.3
5.2	5.45	315/16"	3TA52	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	7.0
5.4	5.65	43/16"	3TA54	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	7.8
5.6	5.85	47/8"	3TA56	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	8.1
5.8	6.05	49/16"	3TA58	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	8.8
6.0	6.25	43/4"	3TA60	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	7.3
6.2	6.45	415/16"	3TA62	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	7.8
6.4	6.65	53/16"	3TA64	P1	13-Web	21/4"	115/16"	0	1/16"	3"	5/8"	13/8"	1/4"	8.6
7.0	7.25	513/16"	3TA70	Q1	13-Web	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	10.4
8.2	8.45	615/16"	3TA82	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	13.5
9.0	9.25	713/16"	3TA90	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	14.6
10.6	10.85	93/8"	3TA106	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	17.0
12.0	12.25	1013/16"	3TA120	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	19.0
15.0	15.25	1313/16"	3TA150	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	25.3
18.0	18.25	1613/16"	3TA180	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	31.1
19.5	19.75	181/4"	3TA195	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	36.8
24.5	24.75	231/4"	3TA245	Q1	13-Arm	229/32"	21/2"	5/8"	7/8"	41/8"	3/4"	13/4"	9/32"	46.8

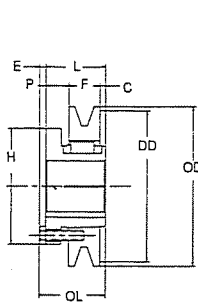
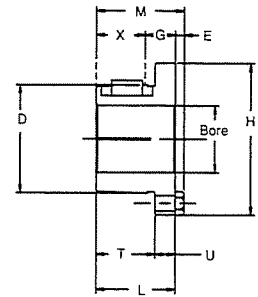
Table No. 2

DIAMETERS			4 GROOVES, F = 23/8"											Wt. Less Bush.
Datum "A"	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		O. L.	L	P	C	H	G	X	E	
3.0"	3.25"	2"	4TA30	P2	3	41/16"	215/16"	13/16"	7/8"	3"	5/8"	25/16"	1/4"	2.9
3.2	3.45	2	4TA32	P2	3	41/16"	215/16"	13/16"	7/8"	3"	5/8"	25/16"	1/4"	3.6
3.4	3.65	23/16"	4TA34	P2	3	41/16"	215/16"	13/16"	7/8"	3"	5/8"	25/16"	1/4"	4.4
3.6	3.85	27/8"	4TA36	P1	5	31/2"	115/16"	5/8"	15/16"	3"	—	15/16"	1/4"	3.6
3.8	4.05	29/16"	4TA38	P1	5	31/2"	115/16"	5/8"	15/16"	3"	—	15/16"	1/4"	4.0
4.0	4.25	23/4"	4TA40	P1	5	31/2"	115/16"	5/8"	15/16"	3"	—	15/16"	1/4"	4.5
4.2	4.45	215/16"	4TA42	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	5.0
4.4	4.65	33/16"	4TA44	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	5.3
4.6	4.85	37/8"	4TA46	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	6.3
4.8	5.05	39/16"	4TA48	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	6.8
5.0	5.25	33/4"	4TA50	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	7.6
5.2	5.45	315/16"	4TA52	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	7.9
5.4	5.65	43/16"	4TA54	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	9.0
5.6	5.85	47/8"	4TA56	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	9.3
5.8	6.05	49/16"	4TA58	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	10.3
6.0	6.25	43/4"	4TA60	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	8.9
6.2	6.45	415/16"	4TA62	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	9.3
6.4	6.65	53/16"	4TA64	P1	13-Web	27/8"	115/16"	0	11/16"	3"	5/8"	15/16"	1/4"	10.3
7.0	7.25	513/16"	4TA70	Q1	13-Web	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	11.9
8.2	8.45	615/16"	4TA82	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	15.9
9.0	9.25	713/16"	4TA90	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	16.1
10.6	10.85	93/8"	4TA106	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	19.8
12.0	12.25	1013/16"	4TA120	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	21.3
15.0	15.25	1313/16"	4TA150	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	29.5
18.0	18.25	1613/16"	4TA180	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	36.0
19.5	19.75	181/4"	4TA195	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	43.3
24.5	24.75	231/4"	4TA245	Q1	13-Arm	37/32"	21/2"	5/16"	7/16"	41/8"	3/4"	13/4"	9/32"	51.8

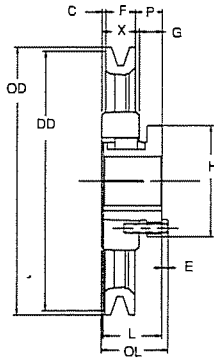
B5V *Browning* Gripbelt Sheaves with Split Taper Bushings

Table No. 1 Bushing Specifications

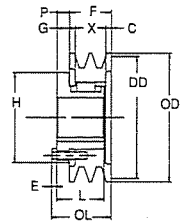
Part No.	Bore Range		Dimensions									Wt. (lbs)
	Type 1	Type 2	M	L	G	E	T	U	D	H		
P1	1/2 - 1 7/16	1 1/2 - 1 3/4	2 3/16	1 15/16	5/8	1/4	1 17/32	1 3/32	1 15/16	3	1.3	
B	1/2 - 1 15/16	2 - 2 7/16	2 3/16	1 15/16	3/4	1/4	1 7/16	1 1/2	2 5/8	3 11/16	1.8	



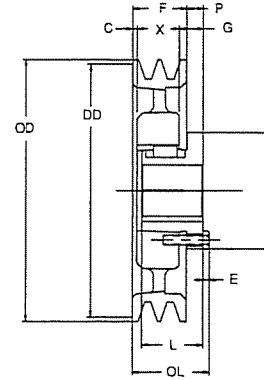
Type 1



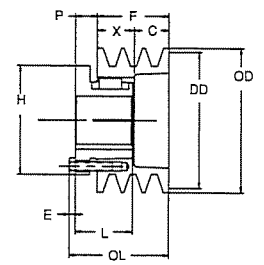
Type 2



Type 3



Type 4



Type 5

Table No. 2 Specifications - Stock "B5V" Sheaves

DIAMETERS				Part Number		Type	Dimensions (Inches)				Wt. (lbs) less Bush.
Datum "A" Belts	Datum "B" Belts	Pitch "5V" Belts	Outside	Sheave	Bushing		OL	P	C	X	
1 GROOVE, F = 1											
3.8	4.2	4.3	4.48	1B5V42	P1	1-Solid	2 3/16	5/8	3/16	1	2.5
4.0	4.4	4.5	4.68	1B5V44	P1	1-Solid	2 3/16	5/8	3/16	1	2.8
4.2	4.6	4.7	4.88	1B5V46	B	1-Solid	2 3/16	3/4	3/16	1	2.5
4.4	4.8	4.9	5.08	1B5V48	B	1-Solid	2 3/16	3/4	3/16	1	2.9
4.6	5.0	5.1	5.28	1B5V50	B	1-Solid	2 3/16	3/4	3/16	1	3.3
4.8	5.2	5.3	5.48	1B5V52	B	1-Solid	2 3/16	3/4	3/16	1	3.7
5.0	5.4	5.5	5.68	1B5V54	B	1-Solid	2 3/16	3/4	3/16	1	4.1
5.2	5.6	5.7	5.88	1B5V56	B	1-Solid	2 3/16	3/4	3/16	1	4.5
5.4	5.8	5.9	6.08	1B5V58	B	1-Solid	2 3/16	3/4	3/16	1	5.0
5.6	6.0	6.1	6.28	1B5V60	B	1-Solid	2 3/16	3/4	3/16	1	5.4
5.8	6.2	6.3	6.48	1B5V62	B	1-Web	2 3/16	3/4	3/16	1	5.3
6.0	6.4	6.5	6.68	1B5V64	B	1-Web	2 3/16	3/4	3/16	1	5.6
6.2	6.6	6.7	6.88	1B5V66	B	1-Web	2 3/16	3/4	3/16	1	6.0
6.4	6.8	6.9	7.08	1B5V68	B	1-Web	2 3/16	3/4	3/16	1	6.4
6.6	7.0	7.1	7.28	1B5V70	B	1-Web	2 3/16	3/4	3/16	1	6.8
7.0	7.4	7.5	7.68	1B5V74	B	1-Web	2 3/16	3/4	3/16	1	7.7
7.6	8.0	8.1	8.28	1B5V80	B	2-Arm	2 3/16	7/8	3/16	1 5/16	7.5
8.2	8.6	8.7	8.88	1B5V86	B	2-Arm	2 3/16	7/8	3/16	1 5/16	7.9
8.6	9.0	9.1	9.28	1B5V90	B	2-Arm	2 3/16	7/8	3/16	1 5/16	8.2
9.0	9.4	9.5	9.68	1B5V94	B	2-Arm	2 3/16	7/8	3/16	1 5/16	8.5
10.6	11.0	11.1	11.28	1B5V110	B	2-Arm	2 3/16	7/8	3/16	1 5/16	10.3
12.0	12.4	12.5	12.68	1B5V124	B	2-Arm	2 3/16	7/8	3/16	1 5/16	11.5
13.2	13.6	13.7	13.88	1B5V136	B	2-Arm	2 3/16	7/8	3/16	1 5/16	13.3
15.0	15.4	15.5	15.68	1B5V154	B	2-Arm	2 3/16	7/8	3/16	1 5/16	15.5
15.6	16.0	16.1	16.28	1B5V160	B	2-Arm	2 3/16	7/8	3/16	1 5/16	16.6
18.0	18.4	18.5	18.68	1B5V184	B	2-Arm	2 3/16	7/8	3/16	1 5/16	20.0
19.5	20.0	20.1	20.28	1B5V200	B	2-Arm	2 3/16	7/8	3/16	1 5/16	21.8
22.9	23.4	23.5	23.68	1B5V234	B	2-Arm	2 3/16	7/8	3/16	1 5/16	28.2
24.5	25.0	25.1	25.28	1B5V250	B	2-Arm	2 3/16	7/8	3/16	1 5/16	31.4
27.3	27.8	27.9	28.08	1B5V278	B	2-Arm	2 3/16	7/8	3/16	1 5/16	36.5
2 GROOVE, F = 1 23/32											
3.8	4.2	4.3	4.48	2B5V42	P1	5	2 13/32	5/8	13/32	1 5/16	3.7
4.0	4.4	4.5	4.68	2B5V44	P1	3	2 3/16	7/32	0	1 5/16	4.1
4.2	4.6	4.7	4.88	2B5V46	B	3	2 31/64	33/64	0	1 31/64	3.3
4.4	4.8	4.9	5.08	2B5V48	B	3	2 21/64	33/64	1 1/64	1 5/16	3.9
4.6	5.0	5.1	5.28	2B5V50	B	3	2 31/64	33/64	1 1/64	1 5/16	4.6
4.8	5.2	5.3	5.48	2B5V52	B	3	2 31/64	33/64	1 1/64	1 5/16	5.3
5.0	5.4	5.5	5.68	2B5V54	B	3	2 31/64	33/64	1 1/64	1 5/16	6.0
5.2	5.6	5.7	5.88	2B5V56	B	3	2 31/64	33/64	1 1/64	1 5/16	6.7
5.4	5.8	5.9	6.08	2B5V58	B	3	2 31/64	33/64	1 1/64	1 5/16	7.4
5.6	6.0	6.1	6.28	2B5V60	B	3	2 31/64	33/64	1 1/64	1 5/16	8.2
5.8	6.2	6.3	6.48	2B5V62	B	3	2 31/64	33/64	1 1/64	1 5/16	9.2
6.0	6.4	6.5	6.68	2B5V64	B	3	2 31/64	33/64	1 1/64	1 5/16	8.4
6.2	6.6	6.7	6.88	2B5V66	B	3	2 31/64	33/64	1 1/64	1 5/16	11.4

Table No. 3

Specifications – Stock "B5V" Sheaves

DIAMETERS				Part Number			Dimensions (Inches)				Wt. (lbs) less Bush.
Datum "A" Belts	Datum "B" Belts	Pitch "5V" Belts	Outside	Sheave	Bushing	Type	OL	P	C	X	
2 GROOVE (Cont.), F = 1²³/₃₂											
6.4	6.8	6.9	7.08	2B5V68	B	4-Web	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	10.2
6.6	7.0	7.1	7.28	2B5V70	B	4-Web	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	12.3
7.0	7.4	7.5	7.68	2B5V74	B	4-Web	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	14.2
7.6	8.0	8.1	8.28	2B5V80	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	11.3
8.2	8.6	8.7	8.88	2B5V86	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	10.6
8.6	9.0	9.1	9.28	2B5V90	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	11.1
9.0	9.4	9.5	9.68	2B5V94	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	11.6
10.6	11.0	11.1	11.28	2B5V110	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	14.4
12.0	12.4	12.5	12.68	2B5V124	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	17.1
13.2	13.6	13.7	13.88	2B5V136	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	19.3
15.0	15.4	15.5	15.68	2B5V154	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	23.2
15.6	16.0	16.1	16.28	2B5V160	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	24.2
18.0	18.4	18.5	18.68	2B5V184	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	33.2
19.5	20.0	20.1	20.28	2B5V200	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	34.8
22.9	23.4	23.5	23.68	2B5V234	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	37.9
24.5	25.0	25.1	25.28	2B5V250	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	47.0
27.3	27.8	27.9	28.08	2B5V278	B	4-Arm	2 ³¹ / ₆₄	3 ³ / ₆₄	1 ¹ / ₆₄	1 ⁵ / ₁₆	55.9
3 GROOVE, F = 2⁷/₁₆											
3.8	4.2	4.3	4.48	3B5V42	P1	5	3 ⁵ / ₁₆	5/8	1 ¹ / ₈	1 ⁵ / ₁₆	4.8
4.0	4.4	4.5	4.68	3B5V44	P1	3	2 ²⁹ / ₃₂	1/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	5.2
4.2	4.6	4.7	4.88	3B5V46	B	5	3 ⁷ / ₁₆	3/4	1 ³ / ₁₆	1 ¹ / ₄	4.9
4.4	4.8	4.9	5.08	3B5V48	B	5	3 ⁷ / ₁₆	3/4	1 ³ / ₁₆	1 ¹ / ₄	5.5
4.6	5.0	5.1	5.28	3B5V50	B	5	3 ⁷ / ₁₆	3/4	1 ³ / ₁₆	1 ¹ / ₄	6.1
4.8	5.2	5.3	5.48	3B5V52	B	5	3 ⁷ / ₁₆	3/4	1 ³ / ₁₆	1 ¹ / ₄	6.7
5.0	5.4	5.5	5.68	3B5V54	B	3	2 ²⁷ / ₃₂	5/32	1 ³ / ₃₂	1 ¹ / ₄	7.4
5.2	5.6	5.7	5.88	3B5V56	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	8.4
5.4	5.8	5.9	6.08	3B5V58	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	9.5
5.6	6.0	6.1	6.28	3B5V60	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	10.6
5.8	6.2	6.3	6.48	3B5V62	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	9.8
6.0	6.4	6.5	6.68	3B5V64	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	10.5
6.2	6.6	6.7	6.88	3B5V66	B	3	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	10.4
6.4	6.8	6.9	7.08	3B5V68	B	4-Web	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	10.9
6.6	7.0	7.1	7.28	3B5V70	B	4-Web	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	11.5
7.0	7.4	7.5	7.68	3B5V74	B	4-Web	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	12.6
7.6	8.0	8.1	8.28	3B5V80	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	14.2
8.2	8.6	8.7	8.88	3B5V86	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	13.7
8.6	9.0	9.1	9.28	3B5V90	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	14.5
9.0	9.4	9.5	9.68	3B5V94	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	17.0
10.6	11.0	11.1	11.28	3B5V110	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	19.8
12.0	12.4	12.5	12.68	3B5V124	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	22.1
13.2	13.6	13.7	13.88	3B5V136	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	24.9
15.0	15.4	15.5	15.68	3B5V154	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	30.4
15.6	16.0	16.1	16.28	3B5V160	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	31.7
18.0	18.4	18.5	18.68	3B5V184	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	40.9
19.5	20.0	20.1	20.28	3B5V200	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	47.6
22.9	23.4	23.5	23.68	3B5V234	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	61.5
24.5	25.0	25.1	25.28	3B5V250	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	66.6
27.3	27.8	27.9	28.08	3B5V278	B	4-Arm	2 ²⁷ / ₃₂	5/32	1 ⁷ / ₃₂	1 ⁵ / ₁₆	79.1
4 GROOVE, F = 3⁵/₃₂											
3.8	4.2	4.3	4.48	4B5V42	P1	5	4 ¹ / ₃₂	5/8	1 ²⁷ / ₃₂	1 ⁵ / ₁₆	5.9
4.0	4.4	4.5	4.68	4B5V44	P1	3	3 ²⁹ / ₆₄	3/64	1 ¹⁷ / ₆₄	1 ⁵ / ₁₆	6.3
4.2	4.6	4.7	4.88	4B5V46	B	5	4 ⁵ / ₃₂	3/4	1 ²⁹ / ₃₂	1 ¹ / ₄	6.1
4.4	4.8	4.9	5.08	4B5V48	B	5	4 ⁵ / ₃₂	3/4	1 ²⁹ / ₃₂	1 ¹ / ₄	6.7
4.6	5.0	5.1	5.28	4B5V50	B	5	4 ⁵ / ₃₂	3/4	1 ²⁹ / ₃₂	1 ¹ / ₄	7.4
4.8	5.2	5.3	5.48	4B5V52	B	5	4 ⁵ / ₃₂	3/4	1 ²⁹ / ₃₂	1 ¹ / ₄	8.0
5.0	5.4	5.5	5.68	4B5V54	B	3	3 ¹³ / ₆₄	—	5 ¹ / ₆₄	1 ¹ / ₄	8.9
5.2	5.6	5.7	5.88	4B5V56	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	9.5
5.4	5.8	5.9	6.08	4B5V58	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	10.3
5.6	6.0	6.1	6.28	4B5V60	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	11.0
5.8	6.2	6.3	6.48	4B5V62	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	11.3
6.0	6.4	6.5	6.68	4B5V64	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	12.1
6.2	6.6	6.7	6.88	4B5V66	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	12.0
6.4	6.8	6.9	7.08	4B5V68	B	3	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	12.6
6.6	7.0	7.1	7.28	4B5V70	B	4-Web	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	13.2
7.0	7.4	7.5	7.68	4B5V74	B	4-Web	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	14.5
7.6	8.0	8.1	8.28	4B5V80	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	15.2
8.2	8.6	8.7	8.88	4B5V86	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	16.6
8.6	9.0	9.1	9.28	4B5V90	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	17.6
9.0	9.4	9.5	9.68	4B5V94	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	20.0
10.6	11.0	11.1	11.28	4B5V110	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	22.8
12.0	12.4	12.5	12.68	4B5V124	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	26.5
13.2	13.6	13.7	13.88	4B5V136	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	30.7
15.0	15.4	15.5	15.68	4B5V154	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	37.9
15.6	16.0	16.1	16.28	4B5V160	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	40.5
18.0	18.4	18.5	18.68	4B5V184	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	50.7
19.5	20.0	20.1	20.28	4B5V200	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	58.5
22.9	23.4	23.5	23.68	4B5V234	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	73.9
24.5	25.0	25.1	25.28	4B5V250	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	83.8
27.3	27.8	27.9	28.08	4B5V278	B	4-Arm	3 ¹³ / ₆₄	—	5 ⁷ / ₆₄	1 ⁵ / ₁₆	94.3

Browning® Gripbelt Sheaves With Split Taper Bushings

B5V

Table No. 1

Bushing Specifications

DIAMETERS				Part Number		Type	Dimensions (Inches)				Wt. (lbs) less Bushing
Datum "A" Belts	Datum "B" Belts	Pitch "5V" Belts	Outside	Sheave	Bushing		OL	P	C	X	
5 GROOVE, F = 3 7/8											
3.8	4.2	4.3	4.48	5B5V42	P2	5	4 3/4	5/8	1 9/16	2 5/16	7.83
4.0	4.4	4.5	4.68	5B5V44	P2	5	4 3/4	5/8	1 9/16	2 5/16	8.73
4.2	4.6	4.7	4.88	5B5V46	P2	5	4 3/4	5/8	1 9/16	2 5/16	9.46
4.4	4.8	4.9	5.08	5B5V48	P2	5	4 3/4	5/8	1 9/16	2 5/16	10.31
4.6	5.0	5.1	5.28	5B5V50	Q2	5	4 29/32	3/4	1 1/8	2 3/4	9.63
4.8	5.2	5.3	5.48	5B5V52	Q2	5	4 29/32	3/4	1 1/8	2 3/4	10.79
5.0	5.4	5.5	5.68	5B5V54	Q2	5	4 29/32	3/4	1 1/8	2 3/4	11.98
5.2	5.6	5.7	5.88	5B5V56	Q1	3	4 9/32	1/8	1 1/2	1 3/4	10.41
5.4	5.8	5.9	6.08	5B5V58	Q1	3	4 9/32	1/8	1 1/2	1 3/4	12.35
5.6	6.0	6.1	6.28	5B5V60	Q1	3	4 9/32	1/8	1 1/2	1 3/4	13.86
5.8	6.2	6.3	6.48	5B5V62	Q1	3	4 9/32	1/8	1 1/2	1 3/4	14.94
6.0	6.4	6.5	6.68	5B5V64	Q1	3	4 9/32	1/8	1 1/2	1 3/4	16.78
6.2	6.6	6.7	6.88	5B5V66	Q1	3	4 9/32	1/8	1 1/2	1 3/4	17.19
6.4	6.8	6.9	7.08	5B5V68	Q1	3	4 9/32	1/8	1 1/2	1 3/4	18.09
6.6	7.0	7.1	7.28	5B5V70	Q2	4-Web	4 1/4	3/32	15/32	2 3/4	21.05
7.0	7.4	7.5	7.68	5B5V74	Q2	4-Web	4 1/4	3/32	15/32	2 3/4	20.95
7.6	8.0	8.1	8.28	5B5V80	R1	4-Web	4 5/32	-	1	2	28.44
8.2	8.6	8.7	8.88	5B5V86	R1	4-Web	4 5/32	-	1	2	26.89
8.6	9.0	9.1	9.28	5B5V90	R1	4-Web	4 5/32	-	1	2	87.84
9.0	9.4	9.5	9.68	5B5V94	R1	4-Web	4 5/32	-	1	2	28.61
10.6	11.0	11.1	11.28	5B5V110	R1	6-Web	4 3/32	1/16	15/16	2	42.31
12.0	12.4	12.5	12.68	5B5V124	R1	6-Web	4 3/32	1/16	15/16	2	52.15
13.2	13.6	13.7	13.88	5B5V136	R1	6-Arm	4 3/32	1/16	15/16	2	45.12
15.0	15.4	15.5	15.68	5B5V154	R1	6-Arm	4 3/32	1/16	15/16	2	55.98
15.6	16.0	16.1	16.28	5B5V160	R1	6-Arm	4 3/32	1/16	15/16	2	60.19
18.0	18.4	18.5	18.68	5B5V184	R1	6-Arm	4 3/32	1/16	15/16	2	77.25
19.5	20.0	20.1	20.28	5B5V200	R1	6-Arm	4 3/32	1/16	15/16	2	91.21
24.5	25.0	25.1	25.28	5B5V250	R1	6-Arm	4 3/32	1/16	15/16	2	130.19
5 GROOVE, F=4 7/16											
3.8	4.2	4.3	4.48	6B5V42	P2	5	5 15/32	5/8	2 9/32	2 5/16	8.97
4.0	4.4	4.5	4.68	6B5V44	P2	5	5 15/32	5/8	2 9/32	2 5/16	9.93
4.2	4.6	4.7	4.88	6B5V46	P2	5	5 15/32	5/8	2 9/32	2 5/16	10.64
4.4	4.8	4.9	5.08	6B5V48	P2	5	5 15/32	5/8	2 9/32	2 5/16	11.53
4.6	5.0	5.1	5.28	6B5V50	Q2	5	5 5/8	3/4	1 27/32	2 3/4	10.91
4.8	5.2	5.3	5.48	6B5V52	Q2	5	5 5/8	3/4	1 27/32	2 3/4	12.13
5.0	5.4	5.5	5.68	6B5V54	Q2	5	5 5/8	3/4	1 27/32	2 3/4	13.39
5.2	5.6	5.7	5.88	6B5V56	Q1	3	5 5/8	1/8	2 7/32	1 3/4	12.86
5.4	5.8	5.9	6.08	6B5V58	Q1	3	5 5/8	-	2 3/32	1 3/4	13.65
5.6	6.0	6.1	6.28	6B5V60	Q1	3	5 5/8	-	2 3/32	1 3/4	14.67
5.8	6.2	6.3	6.48	6B5V62	Q1	3	5 5/8	-	2 3/32	1 3/4	16.51
6.0	6.4	6.5	6.68	6B5V64	Q1	3	5 5/8	-	2 3/32	1 3/4	17.38
6.2	6.6	6.7	6.88	6B5V66	Q1	3	5 5/8	-	2 3/32	1 3/4	18.52
6.4	6.8	6.9	7.08	6B5V68	Q1	3	5 5/8	-	2 3/32	1 3/4	20.14
6.6	7.0	7.1	7.28	6B5V70	Q2	6-Web	4 39/64	17/64	53/64	2 3/4	23.01
7.0	7.4	7.5	7.68	6B5V74	Q2	6-Web	4 39/64	17/64	53/64	2 3/4	22.93
7.6	8.0	8.1	8.28	6B5V80	R1	6-Solid	4 19/32	23/64	1 23/64	2	32.55
8.2	8.6	8.7	8.88	6B5V86	R1	6-Web	4 19/32	23/64	1 23/64	2	29.63
8.6	9.0	9.1	9.28	6B5V90	R1	6-Web	4 19/32	23/64	1 23/64	2	30.67
9.0	9.4	9.5	9.68	6B5V94	R1	6-Web	4 19/32	19/64	1 27/64	2	31.35
10.6	11.0	11.1	11.28	6B5V110	R1	6-Web	4 19/32	27/64	1 19/64	2	45.69
12.0	12.4	12.5	12.68	6B5V124	R1	6-Web	4 19/32	27/64	1 19/64	2	52.23
13.2	13.6	13.7	13.88	6B5V136	R1	6-Arm	4 19/32	27/64	1 19/64	2	48.81
15.0	15.4	15.5	15.68	6B5V154	R1	6-Arm	4 19/32	27/64	1 19/64	2	60.36
15.6	16.0	16.1	16.28	6B5V160	R1	6-Arm	4 19/32	27/64	1 19/64	2	63.72
18.0	18.4	18.5	18.68	6B5V184	R1	6-Arm	4 19/32	27/64	1 19/64	2	82.89
19.5	20.0	20.1	20.28	6B5V200	R1	6-Arm	4 19/32	27/64	1 19/64	2	100.23
24.5	25.0	25.1	25.28	6B5V250	R1	6-Arm	4 19/32	27/64	1 19/64	2	140.18

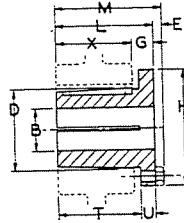
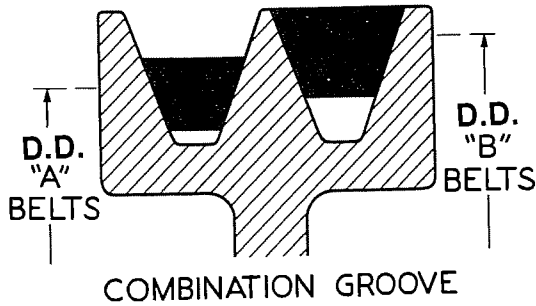
Mix and match with present drive components

Using the new B5V does not make present V-drive components obsolete. In fact, a B5V sheave may be used at any time as the driver or the driven sheave in the same drive with a traditional A/B or 5V sheave, and of course use the same belts. Because B and 5V sheaves utilize different groove spacing, B5V sheaves are not designed for use with banded belts.

Call your Browning Distributor for details.

TB *Browning* Gripbelt Sheaves with Split Taper Bushings

For Use with All "A" and "B" Section Belts



Standard Keyseats
Table No. 1

Bore Range	Keyseat
1/2" — 9/16"	1/8" x 1/16"
5/8" — 7/8"	3/16" x 3/32"
15/16" — 1"	1/4" x 1/8"
1 1/16" — 1 3/8"	5/16" x 5/32"
1 7/16" — 1 3/4"	3/8" x 3/16"
1 13/16" — 2 1/4"	1/2" x 1/4"
2 5/16" — 2 11/16"	5/8" x 5/16"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

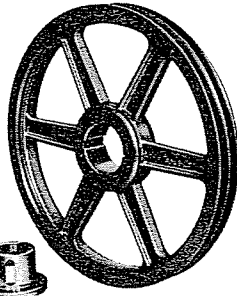
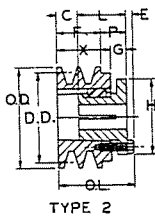


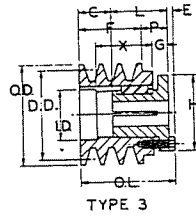
Table No. 2

Bushing Dimensions

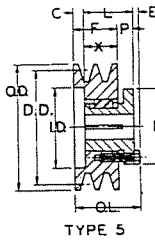
Part No.	Dimensions									Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H		
P1	2 3/16"	1 15/16"	5/8"	1 15/16"	1/4"	1 17/32"	1 13/32"	1 115/16"	3"	1/2" — 1 3/4"	1 1/4
P2	3 3/16"	2 15/16"	5/8"	2 5/16"	1/4"	2 17/32"	1 13/32"	1 115/16"	3	3/4" — 1 3/4"	1 1/2
Q1	2 25/32"	2 1/2"	3/4"	1 3/4"	9/32"	1 131/32"	1 17/32"	2 7/8"	4 1/8"	3/4" — 2 11/16"	3 1/2



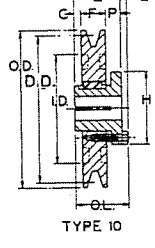
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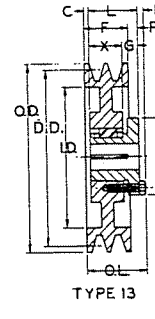
TYPE 3



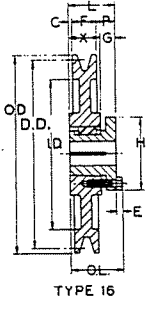
TYPE 5



TYPE 10



TYPE 13



TYPE 16

Table No. 3

Specifications—Stock "TB" Sheaves

DIAMETERS				1 GROOVE, F = 1"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		O. L.	L	P	C	H	G	X	E	
3.0"	3.4"	3.75"	—	1TB34	P1	2	2 5/16"	1 15/16"	1 1/16"	1/8"	3"	5/8"	1 17/16"	1/4"	2.0
3.2	3.6	3.95	—	1TB36	P1	2	2 5/16"	1 15/16"	1 1/16"	1/8"	3	5/8"	1 17/16"	1/4"	2.3
3.4	3.8	4.15	—	1TB38	P1	2	2 5/16"	1 15/16"	1 1/16"	1/8"	3	5/8"	1 17/16"	1/4"	2.6
3.6	4.0	4.35	—	1TB40	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	2.1
3.8	4.2	4.55	—	1TB42	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	2.4
4.0	4.4	4.75	—	1TB44	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	2.8
4.2	4.6	4.95	—	1TB46	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	3.1
4.4	4.8	5.15	—	1TB48	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	3.5
4.6	5.0	5.35	—	1TB50	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	3.9
4.8	5.2	5.55	—	1TB52	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	4.1
5.0	5.4	5.75	—	1TB54	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	4.6
5.2	5.6	5.95	—	1TB56	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	5.1
5.4	5.8	6.15	—	1TB58	P1	10-Sol.	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	5.6
5.6	6.0	6.35	4 1/2"	1TB60	P1	10-Web	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	6.0
5.8	6.2	6.55	4 11/16"	1TB62	P1	10-Web	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	5.5
6.0	6.4	6.75	4 7/8"	1TB64	P1	10-Web	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	5.8
6.2	6.6	6.95	5 1/16"	1TB66	P1	10-Web	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	5.9
6.4	6.8	7.15	5 5/16"	1TB68	P1	10-Web	2 3/16"	1 15/16"	5/8"	5/16"	3	—	—	1/4"	6.1
6.6	7.0	7.35	5 1/2"	1TB70	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	6.4
7.0	7.4	7.75	5 15/16"	1TB74	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	7.3
7.6	8.0	8.35	6 1/2"	1TB80	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	7.8
8.2	8.6	8.95	7 1/16"	1TB86	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	8.6
8.6	9.0	9.35	7 1/2"	1TB90	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	8.9
9.0	9.4	9.75	7 15/16"	1TB94	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	9.1
10.6	11.0	11.35	9 1/16"	1TB110	P1	16-Arm	2 3/16"	1 15/16"	2 5/32"	5/32"	3	3/8"	1 5/16"	1/4"	11.1
12.0	12.4	12.75	10 15/16"	1TB124	Q1	16-Arm	2 25/32"	1 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	17.8
13.2	13.6	13.95	12 1/16"	1TB136	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	18.2
15.0	15.4	15.75	13 15/16"	1TB154	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	20.3
15.6	16.0	16.35	14 1/2"	1TB160	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	22.0
18.0	18.4	18.75	16 15/16"	1TB184	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	27.5
19.5	20.0	20.35	18 1/2"	1TB200	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	27.2
24.5	25.0	25.35	23 1/2"	1TB250	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	42.4
29.5	30.0	30.35	28 1/2"	1TB300	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	56.0
37.5	38.0	38.35	36 1/2"	1TB380	Q1	16-Arm	2 25/32"	2 1/2"	1 1/8"	3/8"	4 1/8"	3/4"	1 3/4"	9/32"	78.0

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-11.

For Use with All "A" and "B" Section Belts

Table No. 1

Specifications—Stock "TB" Sheaves

DIAMETERS				2 GROOVES, F = 1 1/4"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.4"	3.75"	—	2TB34	P1	2	3 1/16"	1 15/16"	1 1/16"	7/8"	3"	5/8"	2 3/16"	1/4"	2.9
3.2	3.6	3.95	—	2TB36	P1	2	3 1/16"	1 15/16"	1 1/16"	7/8"	3"	5/8"	2 3/16"	1/4"	3.8
3.4	3.8	4.15	2 5/16"	2TB38	P1	5	2 5/8"	1 15/16"	5/8"	7/16"	3"	—	1 5/16"	1/4"	3.0
3.6	4.0	4.35	2 1/2"	2TB40	P1	5	2 5/8"	1 15/16"	5/8"	7/16"	3"	—	1 5/16"	1/4"	3.8
3.8	4.2	4.55	2 11/16"	2TB42	P1	5	2 5/8"	1 15/16"	5/8"	7/16"	3"	—	1 5/16"	1/4"	3.9
4.0	4.4	4.75	2 7/8"	2TB44	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	3.9
4.2	4.6	4.95	3 1/16"	2TB46	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	4.5
4.4	4.8	5.15	3 5/16"	2TB48	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	5.3
4.6	5.0	5.35	3 1/2"	2TB50	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	5.6
4.8	5.2	5.55	3 11/16"	2TB52	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	6.1
5.0	5.4	5.75	3 3/8"	2TB54	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	6.5
5.2	5.6	5.95	4 1/16"	2TB56	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	7.4
5.4	5.8	6.15	4 5/16"	2TB58	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	8.0
5.6	6.0	6.35	4 1/2"	2TB60	P1	13-Sol.	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	8.9
5.8	6.2	6.55	4 11/16"	2TB62	P1	13-Web	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	7.6
6.0	6.4	6.75	4 7/8"	2TB64	P1	13-Web	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	7.8
6.2	6.6	6.95	5 1/16"	2TB66	P1	13-Web	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	8.3
6.4	6.8	7.15	5 5/16"	2TB68	P1	13-Web	2 3/16"	1 15/16"	3/16"	0	3	5/8"	1 5/16"	1/4"	8.8
6.6	7.0	7.35	5 1/2"	2TB70	Q1	13-Web	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	11.1
7.0	7.4	7.75	5 5/8"	2TB74	Q1	13-Web	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	11.5
7.6	8.0	8.35	6 1/2"	2TB80	Q1	13-Web	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	12.8
8.2	8.6	8.95	7 1/16"	2TB86	Q1	13-Web	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	16.0
8.6	9.0	9.35	7 1/2"	2TB90	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	15.1
9.0	9.4	9.75	7 5/8"	2TB94	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	15.5
10.6	11.0	11.35	9 1/16"	2TB110	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	18.9
12.0	12.4	12.75	10 15/16"	2TB124	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	21.1
13.2	13.6	13.95	12 1/16"	2TB136	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	23.0
15.0	15.4	15.75	13 5/16"	2TB154	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	24.8
15.6	16.0	16.35	14 1/2"	2TB160	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	27.0
18.0	18.4	18.75	16 15/16"	2TB184	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	32.3
19.5	20.0	20.35	18 1/2"	2TB200	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	42.3
24.5	25.0	25.35	23 1/2"	2TB250	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	50.3
29.5	30.0	30.35	28 1/2"	2TB300	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	68.8
37.5	38.0	38.35	36 1/2"	2TB380	Q1	13-Arm	2 25/32"	2 1/2"	3/4	0	4 1/8"	3/4	1 3/4	9/32	95.5

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-12.

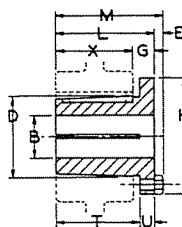
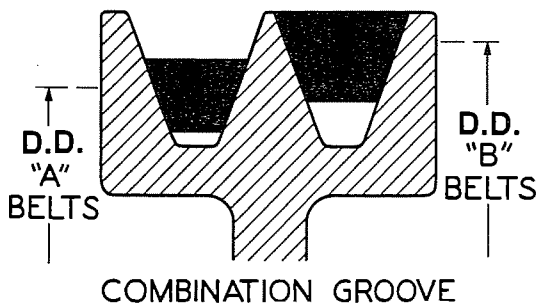
Table No. 2

DIAMETERS				3 GROOVES, F = 2 1/2"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.4"	3.75"	2"	3TB34	P2	3	3 13/16"	2 5/16"	1 1/16"	5/8"	3"	5/8"	2 5/16"	1/4"	3.8
3.2	3.6	3.95	2 1/16"	3TB36	P2	3	3 13/16"	2 5/16"	1 1/16"	5/8"	3"	5/8"	2 5/16"	1/4"	4.4
3.4	3.8	4.15	2 5/16"	3TB38	P1	5	3 3/8"	1 15/16"	7/8"	1 3/16"	3"	—	1 5/16"	1/4"	3.8
3.6	4.0	4.35	2 1/2"	3TB40	P1	5	3 3/8"	1 15/16"	7/8"	1 3/16"	3"	—	1 5/16"	1/4"	4.5
3.8	4.2	4.55	2 11/16"	3TB42	P1	5	3 3/8"	1 15/16"	7/8"	1 3/16"	3"	—	1 5/16"	1/4"	4.9
4.0	4.4	4.75	2 7/8"	3TB44	P1	13-Sol.	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	5.1
4.2	4.6	4.95	3 1/16"	3TB46	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	6.0
4.4	4.8	5.15	3 5/16"	3TB48	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	6.3
4.6	5.0	5.35	3 1/2"	3TB50	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	6.9
4.8	5.2	5.55	3 11/16"	3TB52	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	7.5
5.0	5.4	5.75	3 3/8"	3TB54	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	8.3
5.2	5.6	5.95	4 1/16"	3TB56	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	9.0
5.4	5.8	6.15	4 5/16"	3TB58	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	9.6
5.6	6.0	6.35	4 1/2"	3TB60	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	10.5
5.8	6.2	6.55	4 11/16"	3TB62	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	9.4
6.0	6.4	6.75	4 7/8"	3TB64	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	9.5
6.2	6.6	6.95	5 1/16"	3TB66	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	10.0
6.4	6.8	7.15	5 5/16"	3TB68	P1	13-Web	2 3/4"	1 15/16"	0	9/16"	3	5/8"	1 5/16"	1/4"	10.4
6.6	7.0	7.35	5 1/2"	3TB70	Q1	13-Web	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	13.0	
7.0	7.4	7.75	5 5/8"	3TB74	Q1	13-Web	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	13.3	
7.6	8.0	8.35	6 1/2"	3TB80	Q1	13-Web	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	15.3	
8.2	8.6	8.95	7 1/16"	3TB86	Q1	13-Web	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	18.9	
8.6	9.0	9.35	7 1/2"	3TB90	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	18.1	
9.0	9.4	9.75	7 5/8"	3TB94	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	18.0	
10.6	11.0	11.35	9 1/16"	3TB110	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	21.3	
12.0	12.4	12.75	10 15/16"	3TB124	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	25.4	
13.2	13.6	13.95	12 1/16"	3TB136	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	27.4	
15.0	15.4	15.75	13 5/16"	3TB154	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	29.8	
15.6	16.0	16.35	14 1/2"	3TB160	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	32.0	
18.0	18.4	18.75	16 15/16"	3TB184	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	37.8	
19.5	20.0	20.35	18 1/2"	3TB200	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	49.9	
24.5	25.0	25.35	23 1/2"	3TB250	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	61.0	
29.5	30.0	30.35	28 1/2"	3TB300	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	78.5	
37.5	38.0	38.35	36 1/2"	3TB380	Q1	13-Arm	3 5/32"	2 1/2"	3/8"	4 1/8"	3/4	1 3/4	9/32	110	

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-13.

TB Browning Gripbelt Sheaves with Split Taper Bushings

For Use with All "A" and "B" Section Belts



Standard Keyseats
Table No. 1

Bore Range	Keyseat
1/2" — 9/16"	3/8" x 1/16"
5/8" — 7/8"	3/16" x 3/32"
15/16" — 1 1/4"	1/4" x 1/8"
1 1/16" — 1 1/8"	5/16" x 5/32"
1 1/16" — 1 3/4"	3/8" x 3/16"
1 13/16" — 2 1/4"	1/2" x 1/4"
2 5/16" — 2 11/16"	5/8" x 5/16"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2 Bushing Dimensions

Part No.	Dimensions									Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H		
P1	2 3/16"	1 15/16"	5/8"	1 5/16"	1/4"	1 17/32"	1 3/32"	1 15/16"	3"	1/4" — 1 3/4"	1 1/4
P2	3 3/16"	2 15/16"	5/8"	2 5/16"	1/4"	2 17/32"	1 3/32"	1 15/16"	3	3/4" — 1 3/4"	1 1/2
Q1	2 25/32"	2 1/2"	3/4"	1 3/4"	9/32"	1 31/32"	1 7/32"	2 7/8"	4 1/8"	3/4" — 2 1/16"	3 1/2
Q2	3 25/32"	3 1/2"	3/4"	2 3/4"	9/32"	2 31/32"	1 7/32"	2 7/8"	4 1/8"	1" — 2 5/8"	4 1/2

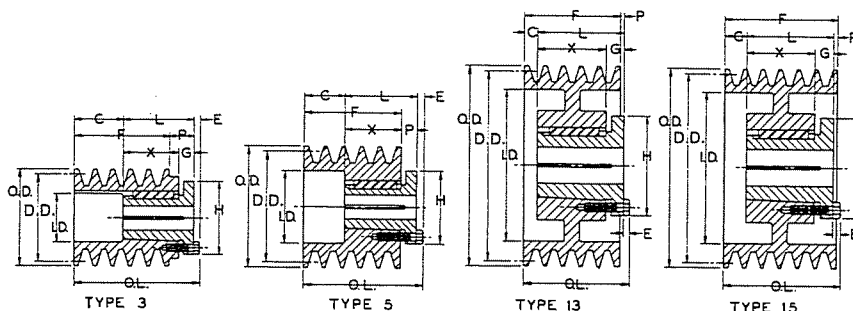
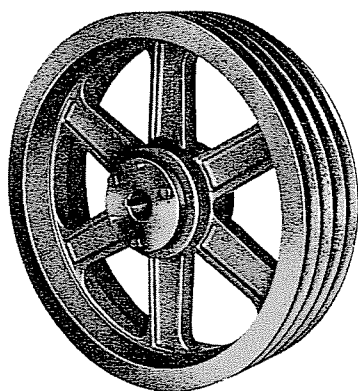


Table No. 3 Specifications—Stock "TB" Sheaves

DIAMETERS				4 GROOVES, F=3/4"												
Datum 'A'	Datum 'B'	Out-side	In-side	Part Number			Dimensions							Wt. Less Bush.		
				Sheave	Bush-ing	Type	O. L.	L	P	C	H	G	X		E	
3.0"	3.4"	3.75"	2"	4TB34	P2	3	4 9/16"	2 15/16"	1 1/16"	1 3/8"	3"	5/8"	2 5/16"	1/4"	4.5	
3.2	3.6	3.95	2 1/16	4TB36	P2	3	4 9/16"	2 15/16"	1 1/16"	1 3/8"	3	5/8"	2 5/16"	1/4	5.3	
3.4	3.8	4.15	2 5/16	4TB38	P1	5	4 7/8"	1 15/16"	5/8"	1 15/16"	3	—	1 5/16"	1/4	4.8	
3.6	4.0	4.35	2 1/2	4TB40	P1	5	4 7/8"	1 15/16"	5/8"	1 15/16"	3	—	1 5/16"	1/4	5.5	
3.8	4.2	4.55	2 11/16	4TB42	P1	5	4 7/8"	1 15/16"	5/8"	1 15/16"	3	—	1 5/16"	1/4	5.9	
4.0	4.4	4.75	2 7/8	4TB44	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	6.5	
4.2	4.6	4.95	3 1/16	4TB46	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	7.1	
4.4	4.8	5.15	3 5/16	4TB48	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	7.5	
4.6	5.0	5.35	3 1/2	4TB50	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	8.3	
4.8	5.2	5.55	3 11/16	4TB52	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	9.1	
5.0	5.4	5.75	3 7/8	4TB54	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	9.6	
5.2	5.6	5.95	4 1/16	4TB56	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	10.6	
5.4	5.8	6.15	4 5/16	4TB58	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	11.6	
5.6	6.0	6.35	4 1/2	4TB60	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	11.9	
5.8	6.2	6.55	4 11/16	4TB62	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	11.1	
6.0	6.4	6.75	4 7/8	4TB64	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	11.8	
6.2	6.6	6.95	5 1/16	4TB66	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	12.0	
6.4	6.8	7.15	5 5/16	4TB68	P1	13-Web	3 1/2"	1 15/16"	0	1 5/16"	3	5/8"	1 5/16"	1/4	12.5	
6.6	7.0	7.35	5 1/2	4TB70	Q1	13-Web	3 17/32"	2 1/16"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	15.3	
7.0	7.4	7.75	5 15/16	4TB74	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	15.3	
7.6	8.0	8.35	6 1/2	4TB80	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	17.0	
8.2	8.6	8.95	7 1/16	4TB86	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	20.8	
8.6	9.0	9.35	7 5/16	4TB90	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	20.6	
9.0	9.4	9.75	7 15/16	4TB94	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	20.1	
10.6	11.0	11.35	9 7/16	4TB110	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	25.8	
12.0	12.4	12.75	10 15/16	4TB124	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	27.5	
13.2	13.6	13.95	12 1/16	4TB136	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	31.5	
15.0	15.4	15.75	13 15/16	4TB154	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	36.0	
15.6	16.0	16.35	14 1/2	4TB160	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	39.0	
18.0	18.4	18.75	16 15/16	4TB184	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	44.8	
19.5	20.0	20.35	18 1/2	4TB200	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	57.0	
24.5	25.0	25.35	23 1/2	4TB250	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	69.5	
29.5	30.0	30.35	28 1/2	4TB300	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	90.8	
37.5	38.0	38.35	36 1/2	4TB380	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 7/8"	3/4"	1 3/4"	9/32"	125	

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-14.

For Use with All "A" and "B" Section Belts

Specifications—Stock "TB" Sheaves

Table No. 1

DIAMETERS				5 GROOVES, F=4"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.4"	3.75"	2"	5TB34	P2	3	5 ⁵ / ₁₆ "	2 ¹⁵ / ₁₆ "	1 ¹ / ₁₆ "	2 ⁷ / ₈ "	3"	5 ⁸ / ₈ "	2 ⁵ / ₁₆ "	1 ¹ / ₄ "	5.3
3.2	3.6	3.95	2 ¹ / ₁₆	5TB36	P2	3	5 ⁹ / ₁₆	2 ¹ / ₁₆	1 ¹ / ₁₆	2 ⁷ / ₈	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	6.1
3.4	3.8	4.15	2 ¹ / ₁₆	5TB38	P2	5	4 ⁷ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	1 ¹¹ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	6.1
3.6	4.0	4.35	2 ¹ / ₂	5TB40	P2	5	4 ⁷ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	1 ¹¹ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	7.0
3.8	4.2	4.55	2 ¹ / ₁₆	5TB42	P2	5	4 ⁷ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	1 ¹¹ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	7.8
4.0	4.4	4.75	2 ⁷ / ₈	5TB44	P2	13-Web	4 ¹ / ₄	2 ¹⁵ / ₁₆	0	1 ¹ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	8.5
4.2	4.6	4.95	3 ¹ / ₁₆	5TB46	P2	13-Web	4 ¹ / ₄	2 ¹⁵ / ₁₆	0	1 ¹ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	9.8
4.4	4.8	5.15	3 ⁵ / ₁₆	5TB48	P2	13-Web	4 ¹ / ₄	2 ¹⁵ / ₁₆	0	1 ¹ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	10.5
4.6	5.0	5.35	3 ¹ / ₂	5TB50	P2	13-Web	4 ¹ / ₄	2 ¹⁵ / ₁₆	0	1 ¹ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	11.6
4.8	5.2	5.55	3 ¹ / ₁₆	5TB52	P2	13-Web	4 ¹ / ₄	2 ¹⁵ / ₁₆	0	1 ¹ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	12.5
5.0	5.4	5.75	3 ⁷ / ₈	5TB54	Q1	13-Web	4 ³ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	10.4
5.2	5.6	5.95	4 ¹ / ₁₆	5TB56	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	11.8
5.4	5.8	6.15	4 ⁵ / ₁₆	5TB58	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	12.8
5.6	6.0	6.35	4 ¹ / ₂	5TB60	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	13.8
5.8	6.2	6.55	4 ¹ / ₁₆	5TB62	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	14.6
6.0	6.4	6.75	4 ⁷ / ₈	5TB64	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	16.4
6.2	6.6	6.95	5 ¹ / ₁₆	5TB66	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	17.1
6.4	6.8	7.15	5 ⁵ / ₁₆	5TB68	Q1	13-Web	4 ⁹ / ₃₂	2 ¹ / ₂	0	1 ¹ / ₂	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	17.9
6.6	7.0	7.35	5 ¹ / ₂	5TB70	Q2	13-Web	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	20.9
7.0	7.4	7.75	5 ¹⁵ / ₁₆	5TB74	Q2	13-Web	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	19.8
7.6	8.0	8.35	6 ¹ / ₂	5TB80	Q2	13-Web	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	22.3
8.2	8.6	8.95	7 ¹ / ₁₆	5TB86	Q2	13-Web	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	29.5
8.6	9.0	9.35	7 ¹ / ₂	5TB90	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	28.6
9.0	9.4	9.75	7 ¹⁵ / ₁₆	5TB94	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	29.5
10.6	11.0	11.35	9 ¹ / ₁₆	5TB110	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	32.8
12.0	12.4	12.75	10 ¹⁵ / ₁₆	5TB124	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	35.4
13.2	13.6	13.95	12 ¹ / ₁₆	5TB136	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	41.0
15.0	15.4	15.75	13 ¹⁵ / ₁₆	5TB154	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	45.3
15.6	16.0	16.35	14 ¹ / ₂	5TB160	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	48.0
18.0	18.4	18.75	16 ⁵ / ₁₆	5TB184	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	57.3
19.5	20.0	20.35	18 ¹ / ₂	5TB200	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	66.0
24.5	25.0	25.35	23 ¹ / ₂	5TB250	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	82.5
29.5	30.0	30.35	28 ¹ / ₂	5TB300	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	117
37.5	38.0	38.35	36 ¹ / ₂	5TB380	Q2	13-Arm	4 ¹³ / ₃₂	3 ¹ / ₂	1 ¹ / ₈	5 ⁸ / ₈	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	159

For sheaves with larger bores, see Page A-46.

Table No. 2

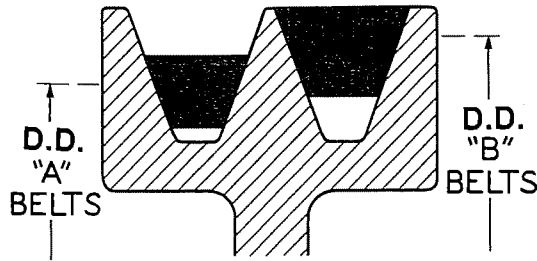
DIAMETERS				6 GROOVES, F=4 ³ / ₄ "											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
3.0"	3.4"	3.75"	2"	6TB34	P2	3	6 ¹ / ₁₆ "	2 ¹⁵ / ₁₆ "	1 ¹ / ₁₆ "	2 ⁷ / ₈ "	3"	5 ⁸ / ₈ "	2 ⁵ / ₁₆ "	1 ¹ / ₄ "	6.1
3.2	3.6	3.95	2 ¹ / ₁₆	6TB36	P2	3	6 ¹ / ₁₆	2 ¹⁵ / ₁₆	1 ¹ / ₁₆	2 ⁷ / ₈	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	7.3
3.4	3.8	4.15	2 ¹ / ₁₆	6TB38	P2	5	5 ⁹ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	2 ⁷ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	7.0
3.6	4.0	4.35	2 ¹ / ₂	6TB40	P2	5	5 ⁹ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	2 ⁷ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	8.1
3.8	4.2	4.55	2 ¹ / ₁₆	6TB42	P2	5	5 ⁹ / ₈	2 ¹⁵ / ₁₆	5 ⁸ / ₈	2 ⁷ / ₁₆	3	—	2 ⁵ / ₁₆	1 ¹ / ₄	9.3
4.0	4.4	4.75	2 ⁷ / ₈	6TB44	P2	13-Web	5	2 ¹⁵ / ₁₆	0	1 ¹³ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	9.9
4.2	4.6	4.95	3 ¹ / ₁₆	6TB46	P2	13-Web	5	2 ¹⁵ / ₁₆	0	1 ¹³ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	11.0
4.4	4.8	5.15	3 ⁵ / ₁₆	6TB48	P2	13-Web	5	2 ¹⁵ / ₁₆	0	1 ¹³ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	11.8
4.6	5.0	5.35	3 ¹ / ₂	6TB50	P2	13-Web	5	2 ¹⁵ / ₁₆	0	1 ¹³ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	12.9
4.8	5.2	5.55	3 ¹ / ₁₆	6TB52	P2	13-Web	5	2 ¹⁵ / ₁₆	0	1 ¹³ / ₁₆	3	5 ⁸ / ₈	2 ⁵ / ₁₆	1 ¹ / ₄	14.8
5.0	5.4	5.75	3 ⁷ / ₈	6TB54	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	11.8
5.2	5.6	5.95	4 ¹ / ₁₆	6TB56	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	17.3
5.4	5.8	6.15	4 ⁵ / ₁₆	6TB58	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	14.5
5.6	6.0	6.35	4 ¹ / ₂	6TB60	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	15.4
5.8	6.2	6.55	4 ¹ / ₁₆	6TB62	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	16.4
6.0	6.4	6.75	4 ⁷ / ₈	6TB64	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	18.6
6.2	6.6	6.95	5 ¹ / ₁₆	6TB66	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	18.5
6.4	6.8	7.15	5 ⁵ / ₁₆	6TB68	Q1	13-Web	5 ¹ / ₃₂	2 ¹ / ₂	0	2 ¹ / ₄	4 ¹ / ₈	3 ⁴ / ₄	1 ³ / ₄	9 ³ / ₃₂	20.8
6.6	7.0	7.35	5 ¹ / ₂	6TB70	Q2	15-Web	4 ²⁵ / ₃₂	3 ¹ / ₂	1 ¹ / ₄	1	4 ¹ / ₈	3 ⁴ / ₄	2 ³ / ₄	9 ³ / ₃₂	22.8
7.0	7.4	7.75													

B

Browning

Gripbelt Sheaves with Split Taper Bushings

For Use with All "A" and "B" Section Belts



COMBINATION GROOVE

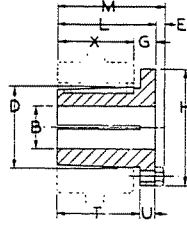


Table No. 2

Bushing Dimensions

Part No.	Dimensions										Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H			
Q1	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	1 ³¹ / ₃₂ "	1 ⁷ / ₃₂ "	2 ⁷ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₈ "	3 ¹ / ₈ " — 2 ¹¹ / ₁₆ "	3 ¹ / ₂
R1	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	7 ¹ / ₈ "	2"	9 ¹ / ₃₂ "	2 ¹ / ₄ "	5 ¹ / ₈ "	4"	5 ¹ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₈ " — 3 ³ / ₄ "	7 ¹ / ₂

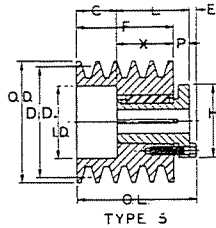
Standard Keyseats

Table No. 1

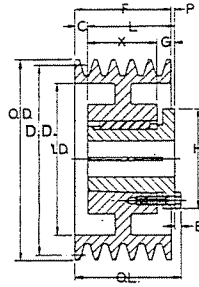
Bore Range	Keyseat
3 ¹ / ₄ " — 7 ¹ / ₈ "	3 ¹ / ₁₆ " x 3 ³ / ₃₂ "
1 ⁵ / ₁₆ " — 1 ¹ / ₄ "	1 ¹ / ₄ " x 7 ¹ / ₈ "
1 ⁵ / ₁₆ " — 1 ³ / ₈ "	5 ¹ / ₁₆ " x 3 ³ / ₃₂ "
1 ⁷ / ₁₆ " — 1 ¹ / ₂ "	3 ¹ / ₈ " x 7 ¹ / ₁₆ "
1 ¹¹ / ₁₆ " — 2 ¹ / ₄ "	1 ¹ / ₂ " x 1 ¹ / ₄ "
2 ⁵ / ₁₆ " — 2 ¹ / ₂ "	3 ¹ / ₈ " x 7 ¹ / ₁₆ "
2 ¹¹ / ₁₆ " — 3 ¹ / ₄ "	1 ¹ / ₂ " x 3 ¹ / ₈ "
3 ¹ / ₈ " — 3 ³ / ₄ "	7 ¹ / ₈ " x 7 ¹ / ₁₆ "

1³/₈" Bore Bushings also available with 3¹/₈" x 3¹/₁₆" Keyseat.

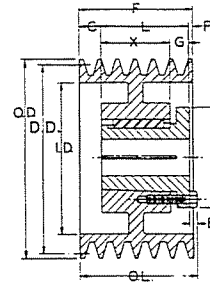
Close Grain Cast Iron
Accurately Machined
Statically Balanced



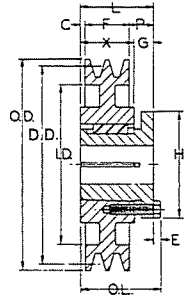
TYPE 5



TYPE 13



TYPE 15



TYPE 16

Table No. 3

Specifications—Stock "B" Sheaves

DIAMETERS				2 GROOVES, F=1 ³ / ₄ "											Wt. Less Bush.
Datum 'A'	Datum 'B'	Outside	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
5.0"	5.4"	5.75"	—	2B54Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0"	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	6.0
5.2	5.6	5.95	—	2B56Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	7.3
5.4	5.8	6.15	—	2B58Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	7.9
5.6	6.0	6.35	—	2B60Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	8.9
5.8	6.2	6.55	—	2B62Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	9.4
6.0	6.4	6.75	—	2B64Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	10.1
6.2	6.6	6.95	—	2B66Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	11.1
6.4	6.8	7.15	—	2B68Q	Q1	5	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	0	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	12.3
15.0	15.4	15.75	13 ⁷ / ₈ "	2B154R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	30.6
15.6	16.0	16.35	14 ¹ / ₂ "	2B160R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	32.0
18.0	18.4	18.75	16 ⁷ / ₈ "	2B184R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	39.1
19.5	20.0	20.35	18 ¹ / ₂ "	2B200R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	43.5
24.5	25.0	25.35	23 ¹ / ₂ "	2B250R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	58.0
29.5	30.0	30.35	28 ¹ / ₂ "	2B300R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	81.0
37.5	38.0	38.35	36 ¹ / ₂ "	2B380R	R1	16-Arm	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	1	1 ¹ / ₈ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	92.0

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-12.

Table No. 4

DIAMETERS				3 GROOVES, F=2 ¹ / ₂ "											Wt. Less Bush.
Datum 'A'	Datum 'B'	Outside	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
5.0"	5.4"	5.75"	3 ⁷ / ₈ "	3B54Q	Q1	5	3 ¹⁷ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	3 ¹ / ₄ "	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	7.9
5.2	5.6	5.95	4 ¹ / ₁₆ "	3B56Q	Q1	5	3 ¹⁷ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₄ "	3 ¹ / ₄ "	4 ¹ / ₈ "	—	1 ³ / ₄ "	9 ¹ / ₃₂ "	9.0
5.4	5.8	6.15	4 ¹ / ₄ "	3B58Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	9.4
5.6	6.0	6.35	4 ⁷ / ₁₆ "	3B60Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	10.4
5.8	6.2	6.55	4 ¹¹ / ₁₆ "	3B62Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	11.3
6.0	6.4	6.75	4 ⁷ / ₈ "	3B64Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	12.1
6.2	6.6	6.95	5 ¹ / ₁₆ "	3B66Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	13.0
6.4	6.8	7.15	5 ¹ / ₄ "	3B68Q	Q1	13-Web	3 ⁵ / ₃₂ "	2 ¹ / ₂ "	3 ¹ / ₈ "	3 ¹ / ₈ "	4 ¹ / ₈ "	3 ¹ / ₄ "	1 ³ / ₄ "	9 ¹ / ₃₂ "	14.3
15.0	15.4	15.75	13 ⁷ / ₈ "	3B154R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	35.5
15.6	16.0	16.35	14 ¹ / ₂ "	3B160R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	38.0
18.0	18.4	18.75	16 ⁷ / ₈ "	3B184R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	44.8
19.5	20.0	20.35	18 ¹ / ₂ "	3B200R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	50.3
24.5	25.0	25.35	23 ¹ / ₂ "	3B250R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	65.0
29.5	30.0	30.35	28 ¹ / ₂ "	3B300R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	89.0
37.5	38.0	38.35	36 ¹ / ₂ "	3B380R	R1	13-Arm	3 ¹³ / ₃₂ "	2 ⁷ / ₈ "	5 ¹ / ₈ "	1 ¹ / ₄ "	5 ³ / ₈ "	7 ¹ / ₈ "	2	9 ¹ / ₃₂ "	106

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-13.

For Use with All "A" and "B" Section Belts

Table No. 1 Specifications—Stock "B" Sheaves

DIAMETERS				4 GROOVES, F = 3 1/4"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
5.0"	5.4"	5.75"	3 3/8"	4B54Q	Q1	5	4 9/32"	2 1/2"	3/4"	1 1/2"	4 1/8"	—	1 3/4"	9/32"	9.3
5.2	5.6	5.95	4 1/16	4B56Q	Q1	5	4 9/32"	2 1/2"	3/4"	1 1/2"	4 1/8"	—	1 3/4"	9/32"	10.5
5.4	5.8	6.15	4 1/4	4B58Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	11.5
5.6	6.0	6.35	4 7/16	4B60Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	12.6
5.8	6.2	6.55	4 11/16	4B62Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	12.6
6.0	6.4	6.75	4 7/8	4B64Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.1
6.2	6.6	6.95	5 1/16	4B66Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.8
6.4	6.8	7.15	5 1/4	4B68Q	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.9
15.0	15.4	15.75	13 3/8	4B154R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	40.1
15.6	16.0	16.35	14 1/2	4B160R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	44.0
18.0	18.4	18.75	16 3/8	4B184R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	50.3
19.5	20.0	20.35	18 1/2	4B200R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	54.0
24.5	25.0	25.35	23 1/2	4B250R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	71.0
29.5	30.0	30.35	28 1/2	4B300R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	99.0
37.5	38.0	38.35	36 1/2	4B380R	R1	13-Arm	3 25/32"	2 7/8	1/4"	5/8"	5 3/8"	7/8"	2	9/32"	126

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-14.

Table No. 2

DIAMETERS				5 GROOVES, F = 4"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
6.6"	7.0"	7.35"	5 1/2"	5B70R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	17.0
7.0	7.4	7.75	5 7/8	5B74R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	20.3
7.6	8.0	8.35	6 1/2	5B80R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	24.8
8.2	8.6	8.95	7 1/16	5B86R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	27.3
8.6	9.0	9.35	7 1/2	5B90R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	29.1
9.0	9.4	9.75	7 7/8	5B94R	R1	15-Web	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	30.0
10.6	11.0	11.35	9 1/2	5B110R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	32.8
12.0	12.4	12.75	10 7/8	5B124R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	36.0
13.2	13.6	13.95	12 1/16	5B136R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	40.3
15.0	15.4	15.75	13 3/8	5B154R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	45.0
15.6	16.0	16.35	14 1/2	5B160R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	48.0
18.0	18.4	18.75	16 3/8	5B184R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	54.0
19.5	20.0	20.35	18 1/2	5B200R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	64.0
24.5	25.0	25.35	23 1/2	5B250R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	79.0
29.5	30.0	30.35	28 1/2	5B300R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	115
37.5	38.0	38.35	36 1/2	5B380R	R1	15-Arm	4 5/32"	2 3/4"	1/2"	1"	5 3/8"	7/8"	2"	9/32"	150

For sheaves with smaller bores, see Page A-44.

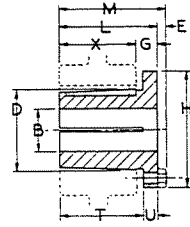
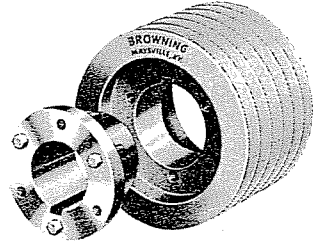
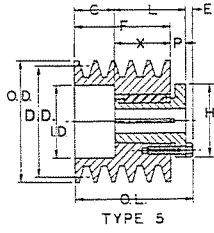
Table No. 3

DIAMETERS				6 GROOVES, F = 4 3/4"											Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Part Number		Type	Dimensions								
				Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
6.6"	7.0"	7.35"	5 1/2"	6B70R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	19.0
7.0	7.4	7.75	5 7/8	6B74R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	21.8
7.6	8.0	8.35	6 1/2	6B80R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	26.8
8.2	8.6	8.95	7 1/16	6B86R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	29.4
8.6	9.0	9.35	7 1/2	6B90R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	31.4
9.0	9.4	9.75	7 7/8	6B94R	R1	15-Web	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	32.8
10.6	11.0	11.35	9 1/2	6B110R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	37.0
12.0	12.4	12.75	10 7/8	6B124R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	39.4
13.2	13.6	13.95	12 1/16	6B136R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	45.3
15.0	15.4	15.75	13 3/8	6B154R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	49.1
15.6	16.0	16.35	14 1/2	6B160R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	52.0
18.0	18.4	18.75	16 3/8	6B184R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	59.0
19.5	20.0	20.35	18 1/2	6B200R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	69.0
24.5	25.0	25.35	23 1/2	6B250R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	83.0
29.5	30.0	30.35	28 1/2	6B300R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	126
37.5	38.0	38.35	36 1/2	6B380R	R1	15-Arm	4 3/4"	2 3/4"	1/2"	1 3/8"	5 3/8"	7/8"	2"	9/32"	170

For sheaves with smaller bores, see Page A-44.

B Browning Gripbelt Sheaves with Split Taper Bushings

For Use with All "A" and "B" Section Belts



Standard Keyseats

Table No. 1

Bore Range	Keyseat
1" - 1 1/4"	1/4" x 1/8"
1 5/16 - 1 3/8	5/16 x 5/32
1 7/16 - 1 3/4	3/8 x 3/16
1 13/16 - 2 1/4	1/2 x 1/4
2 5/16 - 2 3/4	5/8 x 5/16
2 3/16 - 3 1/4	3/4 x 3/8
3 3/8 - 3 5/8	7/8 x 7/16
3 7/8 - 4 1/2	1 x 1/2
4 5/8 - 5 1/2	1 1/4 x 5/8

1 3/8" Bore Bushings (except R2) also available with 3/8" x 3/16" Keyseat.

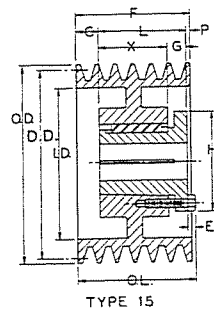
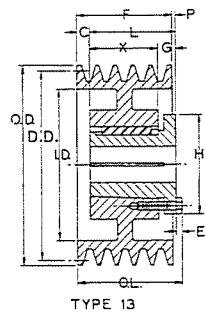


Table No. 2 Bushing Dimensions

Part No.	Dimensions										Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H			
Q2	3 25/32"	3 1/2"	3/4"	2 3/4"	9/32"	2 31/32"	1 7/32"	2 7/8"	4 1/8"	1" - 2 5/8"	4 1/2	
R2	5 5/32"	4 7/8"	7/8"	4"	9/32"	4 1/4"	5/8"	4"	5 3/8"	1 3/8" - 3 5/8"	11	
S1	4 3/4"	4 3/8"	1 1/16"	3 5/16"	3/8"	3 5/8"	3/4"	4 5/8"	6 3/8"	1 11/16" - 4 1/4"	13 1/2	
U0	5 23/32"	5 1/4"	1 1/2"	3 3/4"	15/32"	4 3/16"	1 1/16"	6"	8 3/8"	2 9/8" - 3 3/16"	30	
U0	5 13/32"	4 15/16"	1 1/16"	3 3/4"	15/32"	4 3/16"	3/4"	6"	8 3/8"	3 1/4" - 5 1/2"	27	

Table No. 3 Specifications—Stock "B" Sheaves

DIAMETERS				Part Number		Type	Dimensions								Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Sheave	Bush-ing		O.L.	L	P	C	H	G	X	E	

8 GROOVES, F = 6 1/4"

5.0"	5.4"	5.75"	3 7/8"	8B54Q	Q2	5	7 9/32"	3 1/2"	3/4"	3 1/2"	4 1/8"	—	2 3/4"	9/32"	18.1
5.2	5.6	5.95	4 1/16"	8B56Q	Q2	5	7 9/32"	3 1/2"	3/4"	3 1/2"	4 1/8"	—	2 3/4"	9/32"	20.6
5.4	5.8	6.15	4 1/4"	8B58Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	20.9
5.6	6.0	6.35	4 7/16"	8B60Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	23.0
5.8	6.2	6.55	4 1 1/16"	8B62Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	23.0
6.0	6.4	6.75	4 7/8"	8B64Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	25.0
6.2	6.6	6.95	5 1/16"	8B66Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	27.3
6.4	6.8	7.15	5 1/4"	8B68Q	Q2	15-Web	6 1/4"	3 1/2"	2	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	31.1
6.6	7.0	7.35	5 1/2"	8B70R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	29.5
7.0	7.4	7.75	5 5/8"	8B74R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	34.9
7.6	8.0	8.35	6 1/2"	8B80R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	42.9
8.2	8.6	8.95	7 1/16"	8B86R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	52.0
8.6	9.0	9.35	7 1/2"	8B90R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	48.3
9.0	9.4	9.75	7 7/8"	8B94R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	49.3
10.6	11.0	11.35	9 1/2"	8B110R	R2	15-Web	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	55.0
12.0	12.4	12.75	10 7/8"	8B124R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	60.0
13.2	13.6	13.95	12 1/16"	8B136R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	68.5
15.0	15.4	15.75	13 3/8"	8B154R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	77.3
18.0	18.4	18.75	16 1/8"	8B184R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	90.0
19.5	20.0	20.35	18 1/2"	8B200R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	96.0
24.5	25.0	25.35	23 1/2"	8B250R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	129
29.5	30.0	30.35	28 1/2"	8B300R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	163
29.5	30.0	30.35	28 1/2"	8B300S	S1	15-Arm	6 1/4"	4 3/8"	3/4"	1 1/8"	6 3/8"	1 1/16"	3 5/16"	3/8"	168
37.5	38.0	38.35	36 1/2"	8B380R	R2	15-Arm	6 9/32"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	228
37.5	38.0	38.35	36 1/2"	8B380S	S1	15-Arm	6 1/4"	4 3/8"	3/4"	1 1/8"	6 3/8"	1 1/16"	3 5/16"	3/8"	238

For Use with All "A" and "B" Section Belts

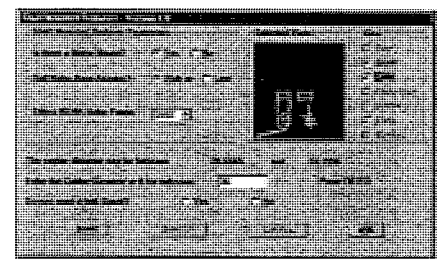
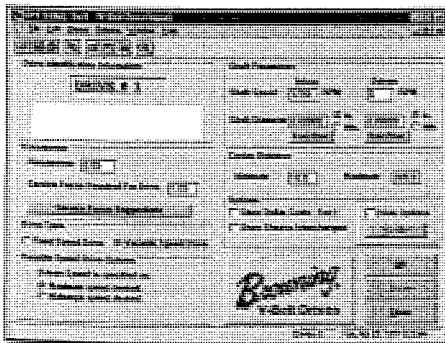
Table No. 1 Specifications—Stock "B" Sheaves

DIAMETERS				Part Number			DIMENSIONS									Wt. Less Bush.
Datum "A"	Datum "B"	Out-side	In-side	Sheave	Bush-ing	Type	O.L.	L	P	C	H	G	X	E		
10 GROOVES F = 7 3/4"																
5.0"	5.4"	5.75"	3 7/8"	10B54Q	Q2	5	8 25/32"	3 1/2"	3/4"	5"	4 1/8"	—	2 3/4"	9/32"	21.5	
5.2	5.6	5.95	4 1/16	10B56Q	Q2	5	8 25/32"	3 1/2	3/4	5	4 1/8	—	2 3/4	9/32	24.9	
5.4	5.8	6.15	4 1/4	10B58Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4"	2 3/4	9/32	23.5	
5.6	6.0	6.35	4 7/16	10B60Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4	2 3/4	9/32	25.6	
5.8	6.2	6.55	4 1 1/16	10B62Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4	2 3/4	9/32	27.5	
6.0	6.4	6.75	4 7/8	10B64Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4	2 3/4	9/32	31.4	
6.2	6.6	6.95	5 1/16	10B66Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4	2 3/4	9/32	32.5	
6.4	6.8	7.15	5 1/4	10B68Q	Q2	15-Web	7 3/4	3 1/2	3 1/2	3/4	4 1/8	3/4	2 3/4	9/32	36.1	
6.6	7.0	7.35	5 1/2	10B70R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	34.0	
7.0	7.4	7.75	5 7/8	10B74R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	39.3	
7.6	8.0	8.35	6 1/2	10B80R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	48.5	
8.2	8.6	8.95	7 1/16	10B86R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	51.5	
8.6	9.0	9.35	7 1/2	10B90R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	52.3	
9.0	9.4	9.75	7 7/8	10B94R	R2	15-Web	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	54.0	
10.6	11.0	11.35	9 1/2	10B110R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	61.0	
12.0	12.4	12.75	10 7/8	10B124R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	77.5	
13.2	13.6	13.95	12 1/16	10B136R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	76.5	
15.0	15.4	15.75	13 7/8	10B154R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	89.0	
18.0	18.4	18.75	16 1/4	10B184R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	104	
19.5	20.0	20.35	18 1/2	10B200R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	112	
24.5	25.0	25.35	23 1/2	10B250R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	153	
29.5	30.0	30.35	28 1/2	10B300R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	188	
37.5	38.0	38.35	36 1/2	10B380R	R2	15-Arm	7 3/4	4 7/8	1	1 1/8	5 3/8	7/8	4	9/32	258	
37.5	38.0	38.35	36 1/2	10B380U	U0	15-Arm	7 3/4	4 1 1/16	1 1/16	1 1/8	8 3/8	1 1/16	3 3/4	1 1/2	270	

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Browning HOP-FLEX® MCGILL® MORSE® ROLLWAY® SEALMASTER® Van Gorp™

B**Browning**

Q-D® Sheaves for "A" and "B" Belts

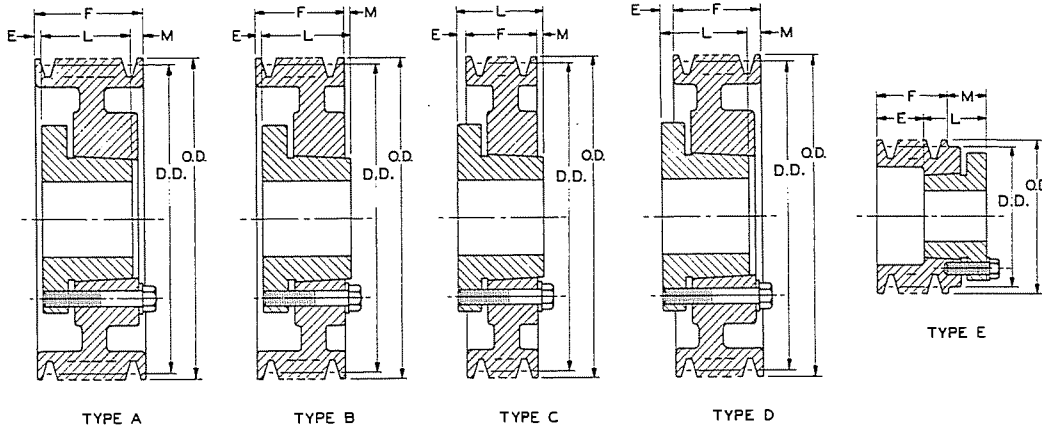
**Standard Keyseats**

Table No. 1

Bore Range	Keyseat
1/2" - 9/16"	1/8" x 1/16"
5/8" - 7/8"	3/16" x 3/32"
15/16" - 1 1/4"	1/4" x 1/8"
1 5/16" - 1 3/8"	5/16" x 3/32"
1 7/16" - 1 3/4"	3/8" x 3/16"
1 13/16" - 2 1/4"	1/2" x 1/4"
2 5/16" - 2 3/4"	5/8" x 5/16"
2 13/16" - 3 1/4"	3/4" x 3/8"
3 3/8" - 3 3/4"	7/8" x 7/16"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Specifications

Table No. 2

Part No.	Bushing	Bore Range	Type*	D. D.		O.D.	E	L	M	Wt. Less Bushing
				"B" Belts	"A" Belts					
1 GROOVE, F = 7/8" (1B34SH-1B70SDS) F = 1" (1B74SDS-1B200SK)										
1B34SH	SH	1/2" - 1 5/8"	E-1	3.4"	3.0"	3.75"	7/32"	1 5/16"	2 1/32"	2.0
1B36SH	SH	1/2" - 1 5/8"	D-1	3.6	3.2	3.95	19/32	1 5/16	5/32	2.2
1B38SH	SH	1/2" - 1 5/8"	D-1	3.8	3.4	4.15	19/32	1 5/16	5/32	2.4
1B40SH	SH	1/2" - 1 5/8"	C-1	4.0	3.6	4.35	1 1/32	1 5/16	3/32	2.7
1B42SH	SH	1/2" - 1 5/8"	C-1	4.2	3.8	4.55	1 1/32	1 5/16	3/32	2.9
1B44SH	SH	1/2" - 1 5/8"	C-1	4.4	4.0	4.75	1 1/32	1 5/16	3/32	3.4
1B46SDS	SDS	1/2" - 2"	C-1	4.6	4.2	4.95	1 1/32	1 5/16	3/32	4.0
1B48SDS	SDS	1/2" - 2"	C-1	4.8	4.4	5.15	1 1/32	1 5/16	3/32	4.3
1B50SDS	SDS	1/2" - 2"	C-1	5.0	4.6	5.35	1 1/32	1 5/16	3/32	4.7
1B52SDS	SDS	1/2" - 2"	C-1	5.2	4.8	5.55	1 1/32	1 5/16	3/32	5.0
1B54SDS	SDS	1/2" - 2"	C-1	5.4	5.0	5.75	1 1/32	1 5/16	3/32	5.3
1B56SDS	SDS	1/2" - 2"	C-1	5.6	5.2	5.95	1 1/32	1 5/16	3/32	5.6
1B58SDS	SDS	1/2" - 2"	C-2	5.8	5.4	6.15	1 1/32	1 5/16	3/32	5.9
1B60SDS	SDS	1/2" - 2"	C-2	6.0	5.6	6.35	1 1/32	1 5/16	3/32	6.2
1B62SDS	SDS	1/2" - 2"	C-2	6.2	5.8	6.55	1 1/32	1 5/16	3/32	6.5
1B64SDS	SDS	1/2" - 2"	C-2	6.4	6.0	6.75	1 1/32	1 5/16	3/32	6.8
1B66SDS	SDS	1/2" - 2"	C-2	6.6	6.2	6.95	1 1/32	1 5/16	3/32	7.2
1B68SDS	SDS	1/2" - 2"	C-3	6.8	6.4	7.15	1 1/32	1 5/16	3/32	7.5
1B70SDS	SDS	1/2" - 2"	C-3	7.0	6.6	7.35	1 1/32	1 5/16	3/32	7.8
1B74SDS	SDS	1/2" - 2"	D-3	7.4	7.0	7.75	1 1/32	1 5/16	7/32	8.8
1B80SDS	SDS	1/2" - 2"	D-3	8.0	7.6	8.35	1 1/32	1 5/16	7/32	9.6
1B86SDS	SDS	1/2" - 2"	D-3	8.6	8.2	8.95	1 1/32	1 5/16	7/32	10.0
1B94SDS	SDS	1/2" - 2"	D-3	9.4	9.0	9.75	1 1/32	1 5/16	7/32	10.5
1B110SDS	SDS	1/2" - 2"	D-3	11.0	10.6	11.35	1 1/32	1 5/16	7/32	11.0
1B124SDS	SDS	1/2" - 2"	D-3	12.4	12.0	12.75	1 1/32	1 5/16	7/32	12.0
1B136SDS	SDS	1/2" - 2"	D-3	13.6	13.2	13.95	1 1/32	1 5/16	7/32	14.0
1B154SK	SK	1/2" - 2 5/8"	C-3	15.4	15.0	15.75	2 1/32	1 15/16	9/32	16.0
1B160SK	SK	1/2" - 2 5/8"	C-3	16.0	15.6	16.35	2 1/32	1 15/16	9/32	16.6
1B184SK	SK	1/2" - 2 5/8"	C-3	18.4	18.0	18.75	2 1/32	1 15/16	9/32	18.0
1B200SK	SK	1/2" - 2 5/8"	C-3	20.0	19.6	20.35	2 1/32	1 15/16	9/32	20.0

2 GROOVES, F = 1 3/4"

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-11.

2B34SH	SH	1/2" - 1 5/8"	E-1	3.4	3.0	3.75	1 3/32	1 5/16	2 1/32	3.2
2B36SH	SH	1/2" - 1 5/8"	D-1	3.6	3.2	3.95	19/32	1 5/16	29/32	3.4
2B38SH	SH	1/2" - 1 5/8"	D-1	3.8	3.4	4.15	19/32	1 5/16	29/32	3.9
2B40SH	SH	1/2" - 1 5/8"	A-1	4.0	3.6	4.35	1 1/32	1 5/16	13/32	4.1
2B42SH	SH	1/2" - 1 5/8"	A-1	4.2	3.8	4.55	1 1/32	1 5/16	13/32	4.4
2B44SH	SH	1/2" - 1 5/8"	A-1	4.4	4.0	4.75	1 1/32	1 5/16	13/32	4.6
2B46SDS	SDS	1/2" - 2"	A-1	4.6	4.2	4.95	1 1/32	1 5/16	13/32	5.0
2B48SDS	SDS	1/2" - 2"	A-1	4.8	4.4	5.15	1 1/32	1 5/16	13/32	5.4
2B50SDS	SDS	1/2" - 2"	A-1	5.0	4.6	5.35	1 1/32	1 5/16	13/32	6.0
2B52SDS	SDS	1/2" - 2"	A-1	5.2	4.8	5.55	1 1/32	1 5/16	13/32	6.3
2B54SDS	SDS	1/2" - 2"	A-1	5.4	5.0	5.75	1 1/32	1 5/16	13/32	6.6
2B56SDS	SDS	1/2" - 2"	A-2	5.6	5.2	5.95	1 1/32	1 5/16	13/32	6.9
2B58SDS	SDS	1/2" - 2"	A-2	5.8	5.4	6.15	1 1/32	1 5/16	13/32	7.2
2B60SDS	SDS	1/2" - 2"	A-2	6.0	5.6	6.35	1 1/32	1 5/16	13/32	7.5
2B62SDS	SDS	1/2" - 2"	A-2	6.2	5.8	6.55	1 1/32	1 5/16	13/32	7.8
2B64SDS	SDS	1/2" - 2"	A-2	6.4	6.0	6.75	1 1/32	1 5/16	13/32	8.2
2B66SDS	SDS	1/2" - 2"	A-2	6.6	6.2	6.95	1 1/32	1 5/16	13/32	8.6
2B68SDS	SDS	1/2" - 2"	A-3	6.8	6.4	7.15	1 1/32	1 5/16	13/32	9.0
2B70SK	SK	1/2" - 2 5/8"	D-1	7.0	6.6	7.35	1 1/32	1 15/16	5/32	9.3
2B74SK	SK	1/2" - 2 5/8"	D-3	7.4	7.0	7.75	1 1/32	1 15/16	5/32	10.6

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-12.

Specifications

Table No. 1

Part No.	Bushing	Bore Range	Type*	D. D.		O.D.	E	L	M	Wt. Less Bushing
				"B" Belts	"A" Belts					
2 GROOVES (Cont.), F = 1 3/4"										
2B80SK	SK	1/2"-2 5/8"	D-3	8.0"	7.6"	8.35"	1 1/32"	1 15/16"	5/32"	11.0
2B86SK	SK	1/2 -2 5/8	D-3	8.6	8.2	8.95	1 1/32	1 15/16	5/32	11.6
2B94SK	SK	1/2 -2 5/8	D-3	9.4	9.0	9.75	1 1/32	1 15/16	5/32	13.0
2B110SK	SK	1/2 -2 5/8	D-3	11.0	10.6	11.35	1 1/32	1 15/16	5/32	14.0
2B124SK	SK	1/2 -2 5/8	D-3	12.4	12.0	12.75	1 1/32	1 15/16	5/32	18.0
2B136SK	SK	1/2 -2 5/8	D-3	13.6	13.2	13.95	1 1/32	1 15/16	5/32	20.0
2B154SK	SK	1/2 -2 5/8	D-3	15.4	15.0	15.75	1 1/32	1 15/16	5/32	23.0
2B160SK	SK	1/2 -2 5/8	D-3	16.0	15.6	16.35	1 1/32	1 15/16	5/32	24.0
2B184SK	SK	1/2 -2 5/8	D-3	18.4	18.0	18.75	1 1/32	1 15/16	5/32	29.0
2B200SF	SF	1/2 -2 15/16	D-3	20.0	19.6	20.35	1 5/32	2 1/16	5/32	33.0
2B250SF	SF	1/2 -2 15/16	D-3	25.0	24.6	25.35	1 5/32	2 1/16	5/32	41.0
2B300SF	SF	1/2 -2 15/16	D-3	30.0	29.6	30.35	1 5/32	2 1/16	5/32	51.0
2B380SF	SF	1/2 -2 15/16	D-3	38.0	37.6	38.35	1 5/32	2 1/16	5/32	64.0

3 GROOVES, F = 2 1/2"

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-12.

3B34SH	SH	1/2 -1 5/8	E-1	3.4	3.0	3.75	1 27/32	1 5/16	2 1/32	4.4
3B36SH	SH	1/2 -1 5/8	D-1	3.6	3.2	3.95	1 5/32	1 5/16	1 21/32	4.7
3B38SH	SH	1/2 -1 5/8	D-1	3.8	3.4	4.15	1 5/32	1 5/16	1 21/32	5.3
3B40SH	SH	1/2 -1 5/8	D-1	4.0	3.6	4.35	1 5/32	1 5/16	1 21/32	5.6
3B42SH	SH	1/2 -1 5/8	D-1	4.2	3.8	4.55	1 5/32	1 5/16	1 21/32	5.9
3B44SH	SH	1/2 -1 5/8	D-1	4.4	4.0	4.75	1 5/32	1 5/16	1 21/32	6.3
3B46SD	SD	1/2 -2	A-1	4.6	4.2	4.95	1 7/32	1 11/16	9/32	6.7
3B48SD	SD	1/2 -2	A-1	4.8	4.4	5.15	1 7/32	1 11/16	9/32	7.1
3B50SD	SD	1/2 -2	A-1	5.0	4.6	5.35	1 7/32	1 11/16	9/32	7.4
3B52SD	SD	1/2 -2	A-1	5.2	4.8	5.55	1 7/32	1 11/16	9/32	7.8
3B54SD	SD	1/2 -2	A-1	5.4	5.0	5.75	1 7/32	1 11/16	9/32	8.2
3B56SD	SD	1/2 -2	A-1	5.6	5.2	5.95	1 7/32	1 11/16	9/32	8.5
3B58SD	SD	1/2 -2	A-1	5.8	5.4	6.15	1 7/32	1 11/16	9/32	8.8
3B60SD	SD	1/2 -2	A-1	6.0	5.6	6.35	1 7/32	1 11/16	9/32	9.1
3B62SD	SD	1/2 -2	A-1	6.2	5.8	6.55	1 7/32	1 11/16	9/32	9.4
3B64SD	SD	1/2 -2	A-1	6.4	6.0	6.75	1 7/32	1 11/16	9/32	9.7
3B66SD	SD	1/2 -2	A-1	6.6	6.2	6.95	1 7/32	1 11/16	9/32	10.0
3B68SD	SD	1/2 -2	B-3	6.8	6.4	7.15	1 7/32	1 11/16	9/32	10.5
3B70SK	SK	1/2 -2 5/8	D-1	7.0	6.6	7.35	7/32	1 11/16	2 1/32	11.0
3B74SK	SK	1/2 -2 5/8	D-3	7.4	7.0	7.75	7/32	1 15/16	2 1/32	12.0
3B80SK	SK	1/2 -2 5/8	D-3	8.0	7.6	8.35	7/32	1 15/16	2 1/32	12.5
3B86SK	SK	1/2 -2 5/8	D-3	8.6	8.2	8.95	7/32	1 15/16	2 1/32	13.0
3B94SK	SK	1/2 -2 5/8	D-3	9.4	9.0	9.75	7/32	1 15/16	2 1/32	16.0
3B110SK	SK	1/2 -2 5/8	D-3	11.0	10.6	11.35	7/32	1 15/16	2 1/32	19.0
3B124SK	SK	1/2 -2 5/8	D-3	12.4	12.0	12.75	7/32	1 15/16	2 1/32	24.0
3B136SK	SK	1/2 -2 5/8	D-3	13.6	13.2	13.95	7/32	1 15/16	2 1/32	27.0
3B154SK	SK	1/2 -2 5/8	D-3	15.4	15.0	15.75	7/32	1 15/16	2 1/32	30.0
3B160SK	SK	1/2 -2 5/8	D-3	16.0	15.6	16.35	7/32	1 15/16	2 1/32	33.0
3B184SK	SK	1/2 -2 5/8	D-3	18.4	18.0	18.75	7/32	1 15/16	2 1/32	38.0
3B200SF	SF	1/2 -2 15/16	D-3	20.0	19.6	20.35	7/32	2 1/16	2 1/32	43.0
3B250SF	SF	1/2 -2 15/16	D-3	25.0	24.6	25.35	7/32	2 1/16	2 1/32	54.0
3B300SF	SF	1/2 -2 15/16	D-3	30.0	29.6	30.35	7/32	2 1/16	2 1/32	67.0
3B380E	E	7/8 -3 1/2	D-3	38.0	37.6	38.35	1 7/32	2 3/4	9/32	90.0

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-13.

4 GROOVES, F = 3 1/4"

4B34SD	SD	1/2 -2	E-1	3.4	3.0	3.75	2 15/32	1 13/16	1 1/32	5.5
4B36SD	SD	1/2 -2	E-1	3.6	3.2	3.95	2 15/32	1 13/16	1 1/32	5.8
4B38SD	SD	1/2 -2	E-1	3.8	3.4	4.15	2 15/32	1 13/16	1 1/32	6.2
4B40SD	SD	1/2 -2	E-1	4.0	3.6	4.35	2 3/32	1 13/16	2 1/32	6.6
4B42SD	SD	1/2 -2	E-1	4.2	3.8	4.55	2 3/32	1 13/16	2 1/32	6.9
4B44SD	SD	1/2 -2	E-1	4.4	4.0	4.75	2 3/32	1 13/16	2 1/32	7.2
4B46SD	SD	1/2 -2	A-1	4.6	4.2	4.95	2 1/32	1 13/16	2 5/32	7.6
4B48SD	SD	1/2 -2	A-1	4.8	4.4	5.15	2 1/32	1 13/16	2 5/32	8.0
4B50SD	SD	1/2 -2	A-1	5.0	4.6	5.35	2 1/32	1 13/16	2 5/32	8.4
4B52SD	SD	1/2 -2	A-1	5.2	4.8	5.55	2 1/32	1 13/16	2 5/32	8.8
4B54SD	SD	1/2 -2	A-1	5.4	5.0	5.75	2 1/32	1 13/16	2 5/32	9.2
4B56SD	SD	1/2 -2	A-1	5.6	5.2	5.95	2 1/32	1 13/16	2 5/32	9.6
4B58SD	SD	1/2 -2	A-1	5.8	5.4	6.15	2 1/32	1 13/16	2 5/32	10.0
4B60SD	SD	1/2 -2	A-1	6.0	5.6	6.35	2 1/32	1 13/16	2 5/32	10.4
4B62SD	SD	1/2 -2	A-1	6.2	5.8	6.55	2 1/32	1 13/16	2 5/32	10.8
4B64SD	SD	1/2 -2	A-1	6.4	6.0	6.75	2 1/32	1 13/16	2 5/32	12.0
4B66SD	SD	1/2 -2	A-1	6.6	6.2	6.95	2 1/32	1 13/16	2 5/32	12.4
4B68SD	SD	1/2 -2	A-3	6.8	6.4	7.15	2 1/32	1 13/16	2 5/32	13.0
4B70SK	SK	1/2 -2 5/8	A-1	7.0	6.6	7.35	7/32	1 15/16	1 3/32	13.5
4B74SK	SK	1/2 -2 5/8	A-3	7.4	7.0	7.75	7/32	1 15/16	1 3/32	14.0
4B80SK	SK	1/2 -2 5/8	A-3	8.0	7.6	8.35	7/32	1 15/16	1 3/32	15.5
4B86SK	SK	1/2 -2 5/8	A-3	8.6	8.2	8.95	7/32	1 15/16	1 3/32	17.0
4B94SK	SK	1/2 -2 5/8	A-3	9.4	9.0	9.75	7/32	1 15/16	1 3/32	19.0
4B110SK	SK	1/2 -2 5/8	A-3	11.0	10.6	11.35	7/32	1 15/16	1 3/32	22.0
4B124SK	SK	1/2 -2 5/8	A-3	12.4	12.0	12.75	7/32	1 15/16	1 3/32	29.0
4B136SK	SK	1/2 -2 5/8	A-3	13.6	13.2	13.95	7/32	1 15/16	1 3/32	34.0
4B154SF	SF	1/2 -2 15/16	A-3	15.4	15.0	15.75	5/32	2 1/16	1 1/32	39.0
4B160SF	SF	1/2 -2 15/16	A-3	16.0	15.6	16.35	5/32	2 1/16	1 1/32	42.0
4B184SF	SF	1/2 -2 15/16	A-3	18.4	18.0	18.75	5/32	2 1/16	1 1/32	47.0
4B200SF	SF	1/2 -2 15/16	A-3	20.0	19.6	20.35	5/32	2 1/16	1 1/32	51.0
4B250E	E	7/8 -3 1/2	D-3	25.0	24.6	25.35	5/32	2 3/4	2 1/32	73.0
4B300E	E	7/8 -3 1/2	D-3	30.0	29.6	30.35	5/32	2 3/4	2 1/32	86.0
4B380E	E	7/8 -3 1/2	D-3	38.0	37.6	38.35	5/32	2 3/4	2 1/32	109

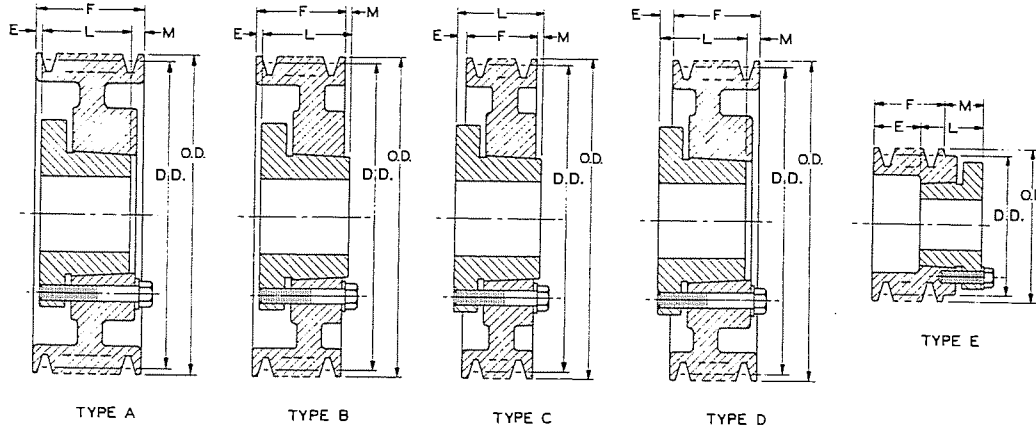
*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

For optimum sheave selection, see B5V Stock Sheave Listing on Page A-14.

B

Browning

Q-D® Sheaves for "A" and "B" Belts



Standard Keyseats

Table No. 1

Bore Range	Keyseat
1/2" - 9/16"	1/8" x 1/16"
5/8" - 7/8"	3/16" x 3/32"
15/16" - 1 1/4"	1/4" x 1/8"
1 9/16" - 1 3/8"	5/16" x 5/32"
1 7/8" - 1 3/4"	3/8" x 3/16"
1 13/16" - 2 1/4"	1/2" x 1/4"
2 3/16" - 2 3/4"	5/8" x 5/16"
2 11/16" - 3 1/4"	3/4" x 3/8"
3 3/8" - 3 3/4"	7/8" x 7/16"
3 7/8" - 4 1/2"	1" x 1/2"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Specifications

Table No. 2

Part No.	Bushing	Bore Range	Type*	D. D.		O. D.	E	L	M	Wt. Less Bushing
				"B" Belts	"A" Belts					
5 GROOVES, F = 4"										
5B34SD	SD	1/2"-2"	E-1	3.4"	3.0"	3.75"	3 7/32"	1 13/16"	1 1/32"	6.1
5B36SD	SD	1/2"-2"	E-1	3.6	3.2	3.95	3 7/32"	1 13/16"	1 1/32"	6.6
5B38SD	SD	1/2"-2"	E-1	3.8	3.4	4.15	3 7/32"	1 13/16"	1 1/32"	7.1
5B40SD	SD	1/2"-2"	E-1	4.0	3.6	4.35	2 27/32"	1 13/16"	2 1/32"	7.4
5B42SD	SD	1/2"-2"	E-1	4.2	3.8	4.55	2 27/32"	1 13/16"	2 1/32"	8.0
5B44SD	SD	1/2"-2"	E-1	4.4	4.0	4.75	2 27/32"	1 13/16"	2 1/32"	8.5
5B46SD	SD	1/2"-2"	A-1	4.6	4.2	4.95	2 1/32"	1 13/16"	1 17/32"	9.0
5B48SD	SD	1/2"-2"	A-1	4.8	4.4	5.15	2 1/32"	1 13/16"	1 17/32"	9.4
5B50SD	SD	1/2"-2"	A-1	5.0	4.6	5.35	2 1/32"	1 13/16"	1 17/32"	10.0
5B52SD	SD	1/2"-2"	A-1	5.2	4.8	5.55	2 1/32"	1 13/16"	1 17/32"	10.4
5B54SK	SK	1/2"-2 5/8"	A-1	5.4	5.0	5.75	1 7/32"	1 15/16"	1 17/32"	10.8
5B56SK	SK	1/2"-2 5/8"	A-1	5.6	5.2	5.95	1 7/32"	1 15/16"	1 17/32"	11.3
5B58SK	SK	1/2"-2 5/8"	A-1	5.8	5.4	6.15	1 7/32"	1 15/16"	1 17/32"	12.0
5B60SK	SK	1/2"-2 5/8"	A-1	6.0	5.6	6.35	1 7/32"	1 15/16"	1 17/32"	14.0
5B62SK	SK	1/2"-2 5/8"	A-1	6.2	5.8	6.55	1 7/32"	1 15/16"	1 17/32"	15.0
5B64SK	SK	1/2"-2 5/8"	A-1	6.4	6.0	6.75	1 7/32"	1 15/16"	1 17/32"	16.0
5B66SK	SK	1/2"-2 5/8"	A-1	6.6	6.2	6.95	1 7/32"	1 15/16"	1 17/32"	17.0
5B68SK	SK	1/2"-2 5/8"	A-1	6.8	6.4	7.15	1 7/32"	1 15/16"	1 17/32"	18.0
5B70SF	SF	1/2"-2 15/16"	A-1	7.0	6.6	7.35	1 5/32"	2 1/16"	1 15/32"	19.0
5B74SF	SF	1/2"-2 15/16"	A-2	7.4	7.0	7.75	1 5/32"	2 1/16"	1 15/32"	20.0
5B80SF	SF	1/2"-2 15/16"	A-2	8.0	7.6	8.35	1 5/32"	2 1/16"	1 15/32"	21.0
5B86SF	SF	1/2"-2 15/16"	A-2	8.6	8.2	8.95	1 5/32"	2 1/16"	1 15/32"	22.0
5B94SF	SF	1/2"-2 15/16"	A-3	9.4	9.0	9.75	1 5/32"	2 1/16"	1 15/32"	24.0
5B110SF	SF	1/2"-2 15/16"	A-3	11.0	10.6	11.35	1 5/32"	2 1/16"	1 15/32"	29.0
5B124SF	SF	1/2"-2 15/16"	A-3	12.4	12.0	12.75	1 5/32"	2 1/16"	1 15/32"	34.0
5B136SF	SF	1/2"-2 15/16"	A-3	13.6	13.2	13.95	1 5/32"	2 1/16"	1 15/32"	38.0
5B154SF	SF	1/2"-2 15/16"	A-3	15.4	15.0	15.75	1 5/32"	2 1/16"	1 15/32"	46.0
5B160SF	SF	1/2"-2 15/16"	A-3	16.0	15.6	16.35	1 5/32"	2 1/16"	1 15/32"	49.0
5B184SF	SF	1/2"-2 15/16"	A-3	18.4	18.0	18.75	1 5/32"	2 1/16"	1 15/32"	55.0
5B200E	E	7/8"-3 1/2"	A-3	20.0	19.6	20.35	3/32"	2 3/4"	1 5/32"	65.0
5B250E	E	7/8"-3 1/2"	A-3	25.0	24.6	25.35	3/32"	2 3/4"	1 5/32"	86.0
5B300E	E	7/8"-3 1/2"	A-3	30.0	29.6	30.35	3/32"	2 3/4"	1 5/32"	102
5B380E	E	7/8"-3 1/2"	A-3	38.0	37.6	38.35	3/32"	2 3/4"	1 5/32"	132

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

Specifications

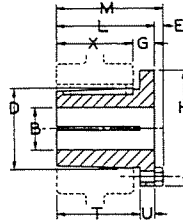
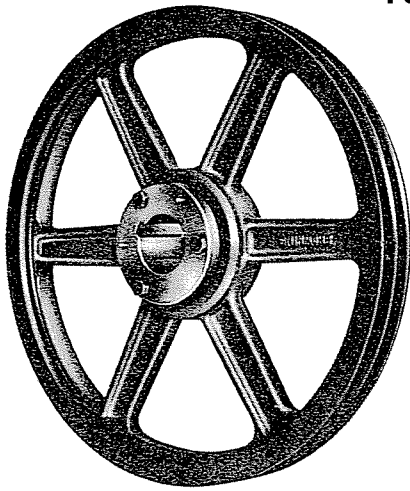
Table No. 1

Part No.	Bushing	Bore Range	Type*	D. D.		O.D.	E	L	M	Wt. Less Bushing
				"B" Belts	"A" Belts					
6 GROOVES, F = 4 3/4"										
6B34SD	SD	1/2"-2"	E-1	3.4"	3.0"	3.75"	3 1/32"	1 1/16"	1 1/32"	6.7
6B36SD	SD	1/2"-2"	E-1	3.6	3.2	3.95	3 1/32	1 1/16	1 1/32	7.4
6B38SD	SD	1/2"-2"	E-1	3.8	3.4	4.15	3 1/32	1 1/16	1 1/32	8.0
6B40SD	SD	1/2"-2"	E-1	4.0	3.6	4.35	3 1/32	1 1/16	2 1/32	8.4
6B42SD	SD	1/2"-2"	E-1	4.2	3.8	4.55	3 1/32	1 1/16	2 1/32	9.0
6B44SD	SD	1/2"-2"	E-1	4.4	4.0	4.75	3 1/32	1 1/16	2 1/32	9.7
6B46SD	SD	1/2"-2"	A-1	4.6	4.2	4.95	2 1/32	1 1/16	2 3/32	10.1
6B48SD	SD	1/2"-2"	A-1	4.8	4.4	5.15	2 1/32	1 1/16	2 3/32	10.6
6B50SD	SD	1/2"-2"	A-1	5.0	4.6	5.35	2 1/32	1 1/16	2 3/32	11.0
6B52SD	SD	1/2"-2"	A-1	5.2	4.8	5.55	2 1/32	1 1/16	2 3/32	12.0
6B54SK	SK	1/2"-2 5/8"	A-1	5.4	5.0	5.75	1 1/32	1 1/16	2 3/32	13.0
6B56SK	SK	1/2"-2 5/8"	A-1	5.6	5.2	5.95	1 1/32	1 1/16	2 3/32	14.0
6B58SK	SK	1/2"-2 5/8"	A-1	5.8	5.4	6.15	1 1/32	1 1/16	2 3/32	14.6
6B60SK	SK	1/2"-2 5/8"	A-1	6.0	5.6	6.35	1 1/32	1 1/16	2 3/32	15.0
6B62SK	SK	1/2"-2 5/8"	A-1	6.2	5.8	6.55	1 1/32	1 1/16	2 3/32	16.0
6B64SK	SK	1/2"-2 5/8"	A-1	6.4	6.0	6.75	1 1/32	1 1/16	2 3/32	17.0
6B66SK	SK	1/2"-2 5/8"	A-1	6.6	6.2	6.95	1 1/32	1 1/16	2 3/32	18.0
6B68SK	SK	1/2"-2 5/8"	A-1	6.8	6.4	7.15	1 1/32	1 1/16	2 3/32	19.0
6B70SF	SF	1/2"-2 15/16"	A-1	7.0	6.6	7.35	2 1/32	2 1/16	1 27/32	20.0
6B74SF	SF	1/2"-2 15/16"	A-1	7.4	7.4	7.75	2 1/32	2 1/16	1 27/32	22.0
6B80SF	SF	1/2"-2 15/16"	A-2	8.0	7.6	8.35	2 1/32	2 1/16	1 27/32	24.0
6B86SF	SF	1/2"-2 15/16"	A-2	8.6	8.2	8.95	2 1/32	2 1/16	1 27/32	26.0
6B94SF	SF	1/2"-2 15/16"	A-3	9.4	9.0	9.75	2 1/32	2 1/16	1 27/32	27.0
6B110SF	SF	1/2"-2 15/16"	A-3	11.0	10.6	11.35	2 1/32	2 1/16	1 27/32	32.0
6B124SF	SF	1/2"-2 15/16"	A-3	12.4	12.0	12.75	2 1/32	2 1/16	1 27/32	39.0
6B136SF	SF	1/2"-2 15/16"	A-3	13.6	13.2	13.95	2 1/32	2 1/16	1 27/32	44.0
6B154SF	SF	1/2"-2 15/16"	A-3	15.4	15.0	15.75	2 1/32	2 1/16	1 27/32	50.0
6B160SF	SF	1/2"-2 15/16"	A-3	16.0	15.6	16.35	2 1/32	2 1/16	1 27/32	54.0
6B184SF	SF	1/2"-2 15/16"	A-3	18.4	18.0	18.75	2 1/32	2 1/16	1 27/32	62.0
6B200E	E	7/8"-3 1/2"	A-3	20.0	19.6	20.35	1 1/32	2 3/4	1 25/32	74.0
6B250E	E	7/8"-3 1/2"	A-3	25.0	24.6	25.35	1 1/32	2 3/4	1 25/32	96.0
6B300E	E	7/8"-3 1/2"	A-3	30.0	29.6	30.35	1 1/32	2 3/4	1 25/32	119
6B380E	E	7/8"-3 1/2"	A-3	38.0	37.6	38.35	1 1/32	2 3/4	1 25/32	134
8 GROOVES, F = 6 1/4"										
8B54SK	SK	1/2"-2 5/8"	A-1	5.4	5.0	5.75	1 1/32	1 1/16	3 3/32	15
8B56SK	SK	1/2"-2 5/8"	A-1	5.6	5.2	5.95	1 1/32	1 1/16	3 3/32	16
8B60SF	SF	1/2"-2 15/16"	A-1	6.0	5.6	6.35	2 1/32	2 1/16	3 1/32	20
8B64SF	SF	1/2"-2 15/16"	A-1	6.4	6.0	6.75	3 1/32	2 1/16	3 1/32	23
8B68SF	SF	1/2"-2 15/16"	A-1	6.8	6.4	7.15	3 1/32	2 1/16	3 1/32	25
8B74SF	SF	1/2"-2 15/16"	A-1	7.4	7.0	7.75	3 1/32	2 1/16	3 1/32	28
8B86E	E	7/8"-3 1/2"	A-1	8.6	8.2	8.95	1 1/32	2 3/4	2 3/32	40
8B94E	E	7/8"-3 1/2"	A-2	9.4	9.0	9.75	1 1/32	2 3/4	2 3/32	43
8B110E	E	7/8"-3 1/2"	A-3	11.0	10.6	11.35	1 1/32	2 3/4	2 3/32	49
8B124E	E	7/8"-3 1/2"	A-3	12.4	12.0	12.75	1 1/32	2 3/4	2 3/32	56
8B154E	E	7/8"-3 1/2"	A-3	15.4	15.0	15.75	1 1/32	2 3/4	2 3/32	69
8B184F	F	1"-4"	D-3	18.4	18.0	18.75	1 1/32	3 3/4	2 17/32	91
8B200F	F	1"-4"	D-3	20.0	19.6	20.35	1 1/32	3 3/4	2 17/32	98
8B250F	F	1"-4"	D-3	25.0	24.6	25.35	1 1/32	3 3/4	2 17/32	121
8B300F	F	1"-4"	D-3	30.0	29.6	30.35	1 1/32	3 3/4	2 17/32	148
8B380F	F	1"-4"	D-3	38.0	37.6	38.35	1 1/32	3 3/4	2 17/32	194
10 GROOVES, F = 7 3/4"										
10B54SK	SK	1/2"-2 5/8"	A-1	5.4	5.0	5.75	1 25/32	1 15/16	4 1/32	18
10B56SK	SK	1/2"-2 5/8"	A-1	5.6	5.2	5.95	1 25/32	1 15/16	4 1/32	20
10B60SF	SF	1/2"-2 15/16"	A-1	6.0	5.6	6.35	1 23/32	2 1/16	3 31/32	24
10B64SF	SF	1/2"-2 15/16"	A-1	6.4	6.0	6.75	1 23/32	2 1/16	3 31/32	26
10B68SF	SF	1/2"-2 15/16"	A-1	6.8	6.4	7.15	1 23/32	2 1/16	3 31/32	28
10B74SF	SF	1/2"-2 15/16"	A-1	7.4	7.0	7.75	1 23/32	2 1/16	3 31/32	32
10B86E	E	7/8"-3 1/2"	A-1	8.6	8.2	8.95	1 31/32	2 3/4	3 1/32	42
10B94E	E	7/8"-3 1/2"	A-2	9.4	9.0	9.75	1 31/32	2 3/4	3 1/32	48
10B110E	E	7/8"-3 1/2"	A-3	11.0	10.6	11.35	1 31/32	2 3/4	3 1/32	56
10B124E	E	7/8"-3 1/2"	A-3	12.4	12.0	12.75	1 31/32	2 3/4	3 1/32	64
10B154F	F	1"-4"	A-3	15.4	15.0	15.75	3/8	3 3/4	3 3/32	88
10B184F	F	1"-4"	A-3	18.4	18.0	18.75	3/8	3 3/4	3 3/32	103
10B200F	F	1"-4"	A-3	20.0	19.6	20.35	5/8	3 3/4	3 3/32	112
10B250F	F	1"-4"	A-3	25.0	24.6	25.35	5/8	3 3/4	3 3/32	142
10B300F	F	1"-4"	A-3	30.0	29.6	30.35	5/8	3 3/4	3 3/32	174
10B380J	J	1 1/2"-4 1/2"	A-3	38.0	37.6	38.35	1 1/8	4 5/8	3	230

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

TC *Browning* Gripbelt Sheaves with Split Taper Bushings

For Use with All "C" Section Belts



Standard Keyseats

Table No. 1

Bore Range	Keyseat
3/4" — 7/8"	3/16" x 3/32"
15/16" — 1 1/4"	1/4" x 1/8"
1 5/16" — 1 3/8"	5/16" x 5/32"
1 7/16" — 1 3/4"	3/8" x 3/16"
1 13/16" — 2 1/4"	1/2" x 1/4"
2 5/16" — 2 11/16"	5/8" x 5/16"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2 Bushing Dimensions

Part No.	Dimensions								Bore Range	Wt. Lbs.	
	M	L	G	X	E	T	U	D			H
Q1	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1 3/4"	9/32"	1 31/32"	1 7/32"	2 7/8"	4 1/8"	3/4" — 2 11/16"	3/2

Close Grain
Cast Iron

Accurately
Machined

Statically
Balanced

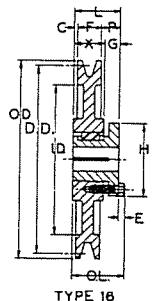
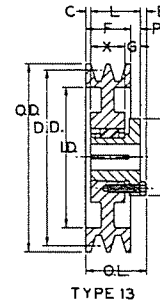
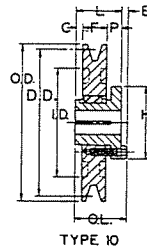


Table No. 3 Specifications—Stock "TC" Sheaves

DIAMETERS			1 GROOVE, F=1 1/4"											
Datum °C	Out-side	In-side	Part Number		Type	Dimensions								Wt. Less Bush.
			Sheave	Bush-ing		O. L.	L	P	C	H	G	X	E	
7.0"	7.40"	—	1TC70	Q1	10-Sol.	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	9.3
7.2	7.60	—	1TC72	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	10.1
7.4	7.80	—	1TC74	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	10.8
7.6	8.00	—	1TC76	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	11.4
7.8	8.20	6"	1TC78	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	9.8
8.0	8.40	6 1/4"	1TC80	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	9.9
8.2	8.60	6 7/16"	1TC82	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	10.1
8.4	8.80	6 9/16"	1TC84	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	11.0
8.6	9.00	6 13/16"	1TC86	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	10.6
8.8	9.20	7"	1TC88	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	11.6
9.0	9.40	7 1/4"	1TC90	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	11.4
9.2	9.60	7 7/16"	1TC92	Q1	10-Web	2 ²⁵ / ₃₂ "	2 1/2"	3/4"	1/2"	4 1/8"	—	—	9/32"	12.6
9.4	9.80	7 9/16"	1TC94	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	14.8
9.6	10.00	7 13/16"	1TC96	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	15.8
9.8	10.20	8"	1TC98	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	15.9
10.0	10.40	8 1/4"	1TC100	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	16.8
10.2	10.60	8 7/16"	1TC102	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	16.1
10.6	11.00	8 13/16"	1TC106	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	17.3
11.0	11.40	9 1/4"	1TC110	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	17.5
11.4	11.80	9 9/8"	1TC114	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	18.6
12.0	12.40	10 1/4"	1TC120	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	19.5
13.0	13.40	11 1/4"	1TC130	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	22.8
16.0	16.40	14 1/4"	1TC160	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	28.5
20.0	20.40	18 1/4"	1TC200	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	37.8
24.0	24.40	22 1/4"	1TC240	Q1	16-Arm	2 ²⁵ / ₃₂ "	2 1/2"	1	1/4"	4 1/8"	3/4"	1 3/8"	9/32"	49.5

For Use with All "C" Section Belts Specifications—Stock "TC" Sheaves

Table No. 1

DIAMETERS			2 GROOVES, F = 2 1/4"											Wt. Less Bush.
Datum °C	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
7.0"	7.40"	5 1/4"	2TC70	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.0
7.2	7.60	5 7/16	2TC72	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	15.4
7.4	7.80	5 9/8	2TC74	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.6
7.6	8.00	5 13/16	2TC76	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	17.6
7.8	8.20	6	2TC78	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.1
8.0	8.40	6 1/4	2TC80	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.3
8.2	8.60	6 7/16	2TC82	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	14.8
8.4	8.80	6 9/8	2TC84	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.4
8.6	9.00	6 13/16	2TC86	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.1
8.8	9.20	7	2TC88	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	17.1
9.0	9.40	7 1/4	2TC90	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.8
9.2	9.60	7 7/16	2TC92	Q1	13-Web	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	18.4
9.4	9.80	7 9/8	2TC94	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	19.1
9.6	10.00	7 13/16	2TC96	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	20.6
9.8	10.20	8	2TC98	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	19.5
10.0	10.40	8 1/4	2TC100	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	22.0
10.2	10.60	8 7/16	2TC102	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	21.3
10.6	11.00	8 13/16	2TC106	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	22.4
11.0	11.40	9 1/4	2TC110	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	22.4
11.4	11.80	9 9/8	2TC114	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	23.5
12.0	12.40	10 1/4	2TC120	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	24.9
13.0	13.40	11 1/4	2TC130	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	28.6
16.0	16.40	14 1/4	2TC160	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	36.0
20.0	20.40	18 1/4	2TC200	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	46.0
24.0	24.40	22 1/4	2TC240	Q1	13-Arm	3 1/32"	2 1/2"	1/2"	1/4"	4 1/8"	3/4"	1 3/4"	9/32"	59.5

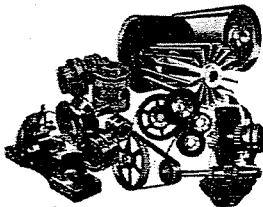
For sheaves with larger bores, see Page A-57.

Table No. 2

DIAMETERS			3 GROOVES, F = 3 1/4"											Wt. Less Bush.
Datum °C	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
7.0"	7.40"	5 1/4"	3TC70	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	16.8
7.2	7.60	5 7/16	3TC72	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	18.0
7.4	7.80	5 9/8	3TC74	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	19.1
7.6	8.00	5 13/16	3TC76	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	21.3
7.8	8.20	6	3TC78	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	17.4
8.0	8.40	6 1/4	3TC80	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	17.8
8.2	8.60	6 7/16	3TC82	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	17.9
8.4	8.80	6 9/8	3TC84	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	20.4
8.6	9.00	6 13/16	3TC86	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	19.5
8.8	9.20	7	3TC88	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	22.5
9.0	9.40	7 1/4	3TC90	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	20.4
9.2	9.60	7 7/16	3TC92	Q1	13-Web	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	22.8
9.4	9.80	7 9/8	3TC94	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	23.0
9.6	10.00	7 13/16	3TC96	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	25.3
9.8	10.20	8	3TC98	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	24.4
10.0	10.40	8 1/4	3TC100	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	27.6
10.2	10.60	8 7/16	3TC102	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	24.9
10.6	11.00	8 13/16	3TC106	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	26.9
11.0	11.40	9 1/4	3TC110	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	27.4
11.4	11.80	9 9/8	3TC114	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	28.3
12.0	12.40	10 1/4	3TC120	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	30.3
13.0	13.40	11 1/4	3TC130	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	34.9
16.0	16.40	14 1/4	3TC160	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	46.0
20.0	20.40	18 1/4	3TC200	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	54.5
24.0	24.40	22 1/4	3TC240	Q1	13-Arm	3 17/32"	2 1/2"	0	3/4"	4 1/8"	3/4"	1 3/4"	9/32"	71.0

For sheaves with larger bores, see Page A-57.

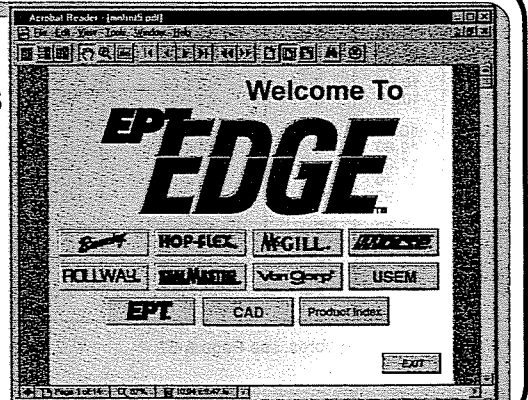
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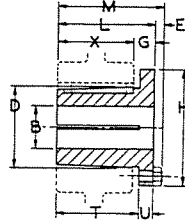
Gripbelt Sheaves with Split Taper Bushings

For Use with All "C" Section Belts

Close Grain
Cast Iron

Statically
Balanced

Accurately
Machined



Standard Keyseats

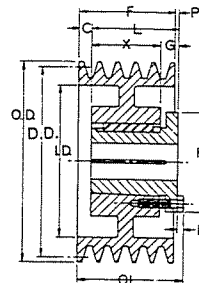
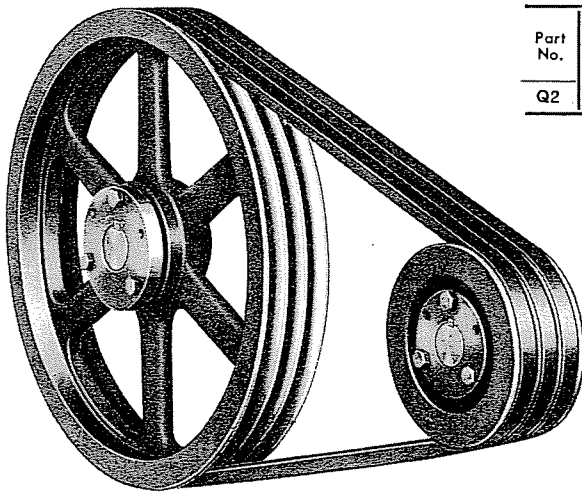
Table No. 1

Bore Range	Keyseat
1" — 1 1/4"	1/4" x 1/8"
1 5/16 — 1 3/8"	5/16" x 3/32"
1 7/16 — 1 7/8"	3/8" x 3/16"
1 9/16 — 2 1/4"	1/2" x 1/4"
2 1/16 — 2 7/8"	5/8" x 5/16"

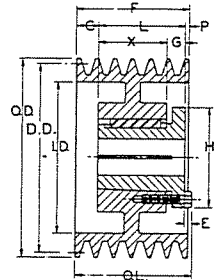
1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2 Bushing Dimensions

Part No.	Dimensions									Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H		
Q2	3 25/32"	3 1/2"	3/4"	2 3/4"	9/32"	2 31/32"	1 7/32"	2 7/8"	4 1/8"	1" — 2 5/8"	4 1/2



TYPE 13



TYPE 15

Table No. 3 Specifications—Stock "TC" Sheaves

DIAMETERS			4 GROOVES, F=4 1/4"											
Datum "C"	Out-side	In-side	Part Number		Type	Dimensions								Wt. Less Bush.
			Sheave	Bush-ing		O. L.	L	P	C	H	G	X	E	
7.0"	7.40"	5 1/4"	4TC70	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	23.8
7.2	7.60	5 7/16	4TC72	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	28.8
7.4	7.80	5 5/8	4TC74	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	27.5
7.6	8.00	5 13/16	4TC76	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	30.3
7.8	8.20	6	4TC78	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	26.4
8.0	8.40	6 1/4"	4TC80	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	29.0
8.2	8.60	6 7/16	4TC82	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	26.8
8.4	8.80	6 5/8	4TC84	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	28.8
8.6	9.00	6 13/16	4TC86	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	27.9
8.8	9.20	7	4TC88	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	31.6
9.0	9.40	7 1/4"	4TC90	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	28.4
9.2	9.60	7 7/16	4TC92	Q2	13-Web	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	32.3
9.4	9.80	7 5/8	4TC94	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	31.8
9.6	10.00	7 13/16	4TC96	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	35.2
9.8	10.20	8	4TC98	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.0
10.0	10.40	8 1/4"	4TC100	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	37.0
10.2	10.60	8 7/16	4TC102	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.5
10.6	11.00	8 13/16	4TC106	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	36.3
11.0	11.40	9 1/4"	4TC110	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	36.3
11.4	11.80	9 5/8	4TC114	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	38.4
12.0	12.40	10 1/4"	4TC120	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	40.5
13.0	13.40	11 1/4"	4TC130	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	43.6
16.0	16.40	14 1/4"	4TC160	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	56.0
20.0	20.40	18 1/4"	4TC200	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	72.0
24.0	24.40	22 1/4"	4TC240	Q2	13-Arm	4 17/32"	3 1/2"	0	3/4"	4 1/8"	3/4"	2 3/4"	9/32"	85.3

For sheaves with larger bores, see Page A-57.

For Use with All "C" Section Belts

Specifications—Stock "TC" Sheaves

Table No. 1

DIAMETERS			5 GROOVES, F=5/16"											Wt. Less Bush.
Datum "C"	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
7.0"	7.40"	5 1/4"	5TC70	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	27.5
7.2	7.60	5 7/16	5TC72	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	29.8
7.4	7.80	5 5/8	5TC74	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	31.0
7.6	8.00	5 13/16	5TC76	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	34.3
7.8	8.20	6	5TC78	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	30.0
8.0	8.40	6 1/4	5TC80	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.4
8.2	8.60	6 7/16	5TC82	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	30.3
8.4	8.80	6 5/8	5TC84	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	32.8
8.6	9.00	6 13/16	5TC86	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	31.0
8.8	9.20	7	5TC88	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	34.9
9.0	9.40	7 1/4	5TC90	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	32.6
9.2	9.60	7 7/16	5TC92	Q2	15-Web	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	36.4
9.4	9.80	7 5/8	5TC94	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	35.6
9.6	10.00	7 13/16	5TC96	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	39.1
9.8	10.20	8	5TC98	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	37.3
10.0	10.40	8 1/4	5TC100	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	42.3
10.2	10.60	8 7/16	5TC102	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	39.4
10.6	11.00	8 13/16	5TC106	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	41.0
11.0	11.40	9 1/4	5TC110	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	42.4
11.4	11.80	9 3/8	5TC114	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	42.8
12.0	12.40	10 1/2	5TC120	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	46.3
13.0	13.40	11 1/4	5TC130	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	49.5
16.0	16.40	14 1/4	5TC160	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	64.5
20.0	20.40	18 1/4	5TC200	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	78.0
24.0	24.40	22 1/4	5TC240	Q2	15-Arm	5 1/4"	3 1/2"	1/2"	1 1/4"	4 1/8"	3/4"	2 3/4"	9/32"	96.0

For sheaves with larger bores, see Page A-58.

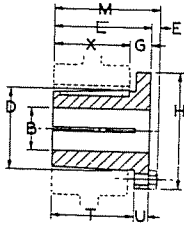
Table No. 2

DIAMETERS			6 GROOVES, F=6/16"											Wt. Less Bush.
Datum "C"	Out-side	In-side	Part Number		Type	Dimensions								
			Sheave	Bush-ing		OL	L	P	C	H	G	X	E	
7.0"	7.40"	5 1/4"	6TC70	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	29.9
7.2	7.60	5 7/16	6TC72	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.6
7.4	7.80	5 5/8	6TC74	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.3
7.6	8.00	5 13/16	6TC76	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	37.9
7.8	8.20	6	6TC78	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	33.5
8.0	8.40	6 1/4	6TC80	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	37.6
8.2	8.60	6 7/16	6TC82	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	34.0
8.4	8.80	6 5/8	6TC84	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	37.0
8.6	9.00	6 13/16	6TC86	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	35.0
8.8	9.20	7	6TC88	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	39.4
9.0	9.40	7 1/4	6TC90	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	36.8
9.2	9.60	7 7/16	6TC92	Q2	15-Web	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	41.0
9.4	9.80	7 5/8	6TC94	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	39.4
9.6	10.00	7 13/16	6TC96	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	43.6
9.8	10.20	8	6TC98	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	42.0
10.0	10.40	8 1/4	6TC100	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	47.3
10.2	10.60	8 7/16	6TC102	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	44.4
10.6	11.00	8 13/16	6TC106	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	45.4
11.0	11.40	9 1/4	6TC110	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	47.0
11.4	11.80	9 3/8	6TC114	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	49.6
12.0	12.40	10 1/2	6TC120	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	51.0
13.0	13.40	11 1/4	6TC130	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	56.0
16.0	16.40	14 1/4	6TC160	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	72.0
20.0	20.40	18 1/4	6TC200	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	88.3
24.0	24.40	22 1/4	6TC240	Q2	15-Arm	6 1/4"	3 1/2"	1"	1 3/4"	4 1/8"	3/4"	2 3/4"	9/32"	108

For sheaves with larger bores, see Page A-58.

C Browning Gripbelt Sheaves* with Split Taper Bushings

Table No. 1 Bushing Dimensions



Part No.	Dimensions										Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H			
P1	2 ³ / ₁₆ "	1 ¹⁵ / ₁₆ "	5/8"	1 ⁵ / ₁₆ "	1/2"	1 ¹⁷ / ₃₂ "	1 ¹³ / ₃₂ "	1 ¹¹ / ₁₆ "	3"	1/2" - 1 ³ / ₄ "	11/4	
P2	3 ³ / ₁₆ "	2 ¹⁵ / ₁₆ "	5/8"	2 ⁵ / ₁₆ "	1/2"	2 ¹⁷ / ₃₂ "	1 ¹³ / ₃₂ "	1 ¹¹ / ₁₆ "	3"	3/4" - 1 ³ / ₄ "	11/2	
Q1	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3/4"	1 ³ / ₄ "	1/2"	2 ¹³ / ₃₂ "	1 ¹⁷ / ₃₂ "	2 ⁷ / ₈ "	4 ¹ / ₈ "	1 - 2 ¹ / ₁₆ "	3 ¹ / ₂	
Q2	3 ²⁵ / ₃₂ "	3 ¹ / ₂ "	3/4"	2 ¹ / ₄ "	1/2"	2 ²³ / ₃₂ "	1 ¹⁷ / ₃₂ "	2 ⁷ / ₈ "	4 ¹ / ₈ "	1 - 2 ⁵ / ₈ "	4 ¹ / ₂	
Q3	5 ⁹ / ₃₂ "	5"	3/4"	4 ¹ / ₄ "	1/2"	4 ¹⁵ / ₃₂ "	1 ¹⁷ / ₃₂ "	2 ⁷ / ₈ "	4 ¹ / ₈ "	1 ³ / ₈ - 2 ¹ / ₂ "	5 ¹ / ₂	
R1	3 ⁵ / ₃₂ "	2 ⁷ / ₈ "	7/8"	2"	1/2"	2 ¹ / ₄ "	1 ⁵ / ₈ "	4"	5 ⁵ / ₈ "	1 ¹ / ₈ - 3 ³ / ₄ "	7 ¹ / ₂	
R2	5 ⁵ / ₃₂ "	4 ⁷ / ₈ "	7/8"	4"	1/2"	4 ¹ / ₄ "	1 ⁵ / ₈ "	4"	5 ⁵ / ₈ "	1 ¹ / ₈ - 3 ³ / ₄ "	11	
S1	4 ³ / ₄ "	4 ³ / ₈ "	1 ¹ / ₁₆ "	3 ⁵ / ₁₆ "	3/8"	3 ³ / ₈ "	3/4"	4 ⁵ / ₈ "	6 ³ / ₈ "	1 ¹ / ₄ - 4 ¹ / ₂ "	13 ¹ / ₂	
S2	7 ¹ / ₈ "	6 ³ / ₄ "	1 ¹ / ₁₆ "	5 ¹¹ / ₁₆ "	3/8"	6"	3/4"	4 ⁵ / ₈ "	6 ³ / ₈ "	1 ⁷ / ₈ - 4 ³ / ₁₆ "	19	
U0	5 ² / ₃₂ "	5 ¹ / ₄ "	1 ¹ / ₂ "	3 ³ / ₄ "	1 ¹ / ₂ "	4 ³ / ₁₆ "	1 ¹ / ₂ "	6"	8 ³ / ₈ "	2 ³ / ₈ - 3 ¹ / ₁₆ "	30	
U0	5 ¹ / ₃₂ "	4 ¹ / ₁₆ "	1 ¹ / ₁₆ "	3 ³ / ₄ "	1 ¹ / ₂ "	4 ³ / ₁₆ "	1 ¹ / ₂ "	6"	8 ³ / ₈ "	3 ³ / ₄ - 5 ¹ / ₂ "	27	

Standard Keyseats

Table No. 2

Bore Range	Keyseat
1/2" - 9/16"	3/8" x 1/16"
5/8" - 1/2"	3/16" x 3/32"
15/16" - 1/2"	1/4" x 1/8"
15/16" - 1/2"	5/16" x 5/32"
17/16" - 1/2"	3/8" x 3/16"
17/16" - 1/2"	1/2" x 1/4"
17/16" - 1/2"	5/8" x 5/16"
2 ¹ / ₁₆ " - 3/4"	3/4" x 3/8"
3/8" - 3/4"	7/8" x 7/16"
3/8" - 3/4"	1" x 1/2"
4/8" - 5/2"	1 1/4" x 5/8"

1 3/8" Bore Bushings (except R2) also available with 7/8" x 3/16" Keyseat.

Table No. 3 Specifications - Stock "C" Sheaves

DIAMETERS			Part Number		Type	Dimensions (Inches)										Wt. (lbs) less Bush.
Datum "C"	Outside	Inside	Sheave	Bushing		OL	L	P	C	H	G	X	E			
1 GROOVE, F = 1 1/4"																
5.6"	6.00"	-	1C56P	P1	10	2 ³ / ₁₆ "	1 ¹⁵ / ₁₆ "	5/8"	1/2"	3"	-	-	1/4"	6.0		
6.0	6.40	-	1C60Q	Q1	10	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	3/4"	1/2"	4 1/8"	-	-	3/32"	6.1		
2 GROOVES, F = 2 1/4"																
5.6	6.00	3 ¹³ / ₁₆ "	2C56P	P1	13-Web	2 ¹ / ₂ "	1 ¹⁵ / ₁₆ "	0	5/16"	3"	5/8"	1 ¹⁵ / ₁₆ "	1/4"	8.4		
6.0	6.40	4 ¹ / ₄ "	2C60Q	Q1	13-Web	2 ²⁵ / ₃₂ "	2 ¹ / ₂ "	1/4"	0	4 ¹ / ₈ "	3/4"	1 ¹ / ₄ "	3/32"	9.5		
14.0	14.40	12 ¹ / ₄ "	2C140R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	33.5		
18.0	18.40	16 ¹ / ₄ "	2C180R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	42.3		
27.0	27.40	25 ¹ / ₄ "	2C270R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	77.0		
30.0	30.40	28 ¹ / ₈ "	2C300R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	93.0		
36.0	36.40	34 ¹ / ₈ "	2C360R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	117.0		
44.0	44.40	42 ¹ / ₈ "	2C440R	R1	13-Arm	3 ³ / ₃₂ "	2 ⁷ / ₈ "	3/4"	1/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	164.0		
3 GROOVES, F = 3 1/4"																
5.0"	5.40"	-	3C50Q	Q1	13-Sol	4 ⁹ / ₃₂ "	2 ¹ / ₂ "	3/4"	1 ¹ / ₂ "	4 ¹ / ₈ "	3/4"	1 ³ / ₄ "	3/32"	8.4		
5.6	6.00	3 ¹³ / ₁₆ "	3C56P	P2	13-Web	3 ¹ / ₂ "	2 ¹⁵ / ₁₆ "	0	5/16"	3"	5/8"	1 ¹ / ₄ "	3/32"	12.9		
6.0	6.40	4 ¹ / ₄ "	3C60Q	Q1	13-Web	3 ¹⁷ / ₃₂ "	2 ¹ / ₂ "	0	3/4"	4 ¹ / ₈ "	3/4"	1 ³ / ₄ "	3/32"	11.8		
9.0	9.40	7 ¹ / ₁₆ "	3C90R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	27.3		
9.2	9.60	7 ¹ / ₈ "	3C92R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	27.5		
9.4	9.80	7 ⁵ / ₈ "	3C94R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	26.9		
9.6	10.00	7 ¹³ / ₁₆ "	3C96R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	28.4		
9.8	10.20	8"	3C98R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	29.3		
10.0	10.40	8 ¹ / ₁₆ "	3C100R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	29.0		
10.2	10.60	8 ³ / ₈ "	3C102R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	31.4		
10.6	11.00	8 ¹³ / ₁₆ "	3C106R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	31.8		
11.0	11.40	9 ¹ / ₄ "	3C110R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	29.3		
12.0	12.40	10 ¹ / ₄ "	3C120R	R1	13-Web	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	36.9		
13.0	13.40	11 ¹ / ₄ "	3C130R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	34.8		
14.0	14.40	12 ¹ / ₄ "	3C140R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	39.4		
15.0	15.40	13 ¹ / ₄ "	3C150R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	43.8		
16.0	16.40	14 ¹ / ₄ "	3C160R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	47.0		
18.0	18.40	16 ¹ / ₄ "	3C180R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	51.5		
20.0	20.40	18 ¹ / ₄ "	3C200R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	58.0		
24.0	24.40	22 ¹ / ₄ "	3C240R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	71.0		
27.0	27.40	25 ¹ / ₄ "	3C270R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	92.0		
30.0	30.40	28 ¹ / ₈ "	3C300R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	110.0		
36.0	36.40	34 ¹ / ₈ "	3C360R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	135.0		
44.0	44.40	42 ¹ / ₈ "	3C440R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	196.0		
50.0	50.40	48 ¹ / ₈ "	3C500R	R1	13-Arm	3 ²⁵ / ₃₂ "	2 ⁷ / ₈ "	1/4"	5/8"	5 ⁵ / ₈ "	7/8"	2	3/32"	213.0		
50.0	50.40	48 ¹ / ₈ "	3C500S	S1	16-Arm	4 ³ / ₄ "	4 ⁹ / ₈ "	1 ¹ / ₃₂ "	1/32"	6 ³ / ₈ "	1 ¹ / ₁₆ "	3 ³ / ₁₆ "	3/8"	224.0		
4 GROOVES, F = 4 1/4"																
5.0	5.40	-	4C50Q	Q2	13-Sol	5 ³ / ₃₂ "	3 ¹ / ₂ "	3/4"	1 ¹ / ₂ "	4 ¹ / ₈ "	3/4"	2 ³ / ₄ "	3/32"	10.9		
5.6	6.00	3 ¹³ / ₁₆ "	4C56P	P2	13-Web	4 ¹ / ₂ "	2 ¹⁵ / ₁₆ "	0	1 ⁵ / ₁₆ "	3"	5/8"	2 ³ / ₄ "	1/4"	15.4		
6.0	6.40	4 ¹ / ₄ "	4C60Q	Q2	13-Web	4 ¹⁷ / ₃₂ "	3 ¹ / ₂ "	0	3/4"	4 ¹ / ₈ "	3/4"	2 ³ / ₄ "	3/32"	17.0		
9.0	9.40	7 ¹ / ₁₆ "	4C90R	R1	15-Web	4 ⁹ / ₃₂ "	2 ⁷ / ₈ "	1/4"	1 ¹ / ₈ "	5 ⁵ / ₈ "	7/8"	2	3/32"	30.0		
9.2	9.60	7 ³ / ₈ "	4C92R	R1	15-Web	4 ⁹ / ₃₂ "	2 ⁷ / ₈ "	1/4"	1 ¹ / ₈ "	5 ⁵ / ₈ "	7/8"	2	3/32"	31.6		
9.4	9.80	7 ⁵ / ₈ "	4C94R	R1	15-Web	4 ⁹ / ₃₂ "	2 ⁷ / ₈ "	1/4"	1 ¹ / ₈ "	5 ⁵ / ₈ "	7/8"	2	3/32"	31.6		
9.6	10.00	7 ¹³ / ₁₆ "	4C96R	R1	15-Web	4 ⁹ / ₃₂ "	2 ⁷ / ₈ "	1/4"	1 ¹ / ₈ "	5 ⁵ / ₈ "	7/8"	2	3/32"	31.1		
9.8	10.20	8"	4C98R	R1	15-Web	4 ⁹ / ₃₂ "	2 ⁷ / ₈ "	1/4"	1 ¹ / ₈ "	5 ⁵ / ₈ "	7/8"	2	3/32"	33.4		
10.0	10.40	8 ¹ / ₁₆ "	4C100R	R1	15-Web											



Gripbelt Sheaves with Split Taper Bushings



For Use with All "C" Section Belts

Table No. 1

Specifications—Stock "C" Sheaves

Diameters			Part Number		Type	Dimensions								Wt. Less Bush.
Datum "C"	Out- side	In- side	Sheave	Bush- ing		O.L.	L	P	C	H	G	X	E	
5 GROOVES, F = 5 1/4"														
9.0"	9.40"	7 1/16"	5C90R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	33.4
9.2	9.60	7 3/8"	5C92R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	36.8
9.4	9.80	7 5/8"	5C94R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	35.8
9.6	10.00	7 7/16"	5C96R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	35.4
9.8	10.20	8"	5C98R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	37.6
10.0	10.40	8 1/16"	5C100R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	38.9
10.2	10.60	8 3/8"	5C102R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	40.6
10.6	11.00	8 13/16"	5C106R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	39.0
11.0	11.40	9 1/4"	5C110R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	38.8
12.0	12.40	10 1/4"	5C120R	R1	15-Web	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	47.5
13.0	13.40	11 1/4"	5C130R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	46.0
14.0	14.40	12 1/4"	5C140R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	52.0
15.0	15.40	13 3/4"	5C150R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	54.0
16.0	16.40	14 3/4"	5C160R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	63.0
18.0	18.40	16 1/4"	5C180R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	69.0
18.0	18.40	16 1/4"	5C180S	S1	13-Arm	5 23/32"	4 3/8"	3/4"	3 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	100
20.0	20.40	18 1/4"	5C200R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	77.0
20.0	20.40	18 1/4"	5C200S	S1	13-Arm	5 23/32"	4 7/8"	3/4"	3 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	99.0
24.0	24.40	22 1/4"	5C240R	R1	15-Arm	5 1/4"	2 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	2"	9/32"	110
24.0	24.40	22 1/4"	5C240S	S1	13-Arm	5 23/32"	4 3/8"	3/4"	3 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	129
27.0	27.40	25 1/4"	5C270R	R2	13-Arm	5 29/32"	4 7/8"	1/4"	5/8"	5 3/8"	7/8"	4"	9/32"	131
30.0	30.40	28 1/8"	5C300R	R2	13-Arm	5 29/32"	4 7/8"	1/4"	5/8"	5 3/8"	7/8"	4"	9/32"	150
30.0	30.40	28 1/8"	5C300S	S1	13-Arm	5 29/32"	4 7/8"	3/4"	3 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	160
36.0	36.40	34 1/8"	5C360R	R2	13-Arm	5 29/32"	4 7/8"	1/4"	5/8"	5 3/8"	7/8"	4"	9/32"	194
44.0	44.40	42 1/8"	5C440R	R2	13-Arm	5 29/32"	4 7/8"	1/4"	5/8"	5 3/8"	7/8"	4"	9/32"	243
50.0	50.40	48 1/8"	5C500R	R2	13-Arm	5 29/32"	4 7/8"	1/4"	5/8"	5 3/8"	7/8"	4"	9/32"	273
6 GROOVES, F = 6 1/4"														
9.0"	9.40"	7 1/16"	6C90R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	53.0
9.2	9.60	7 3/8"	6C92R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	58.0
9.4	9.80	7 5/8"	6C94R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	63.5
9.6	10.00	7 7/16"	6C96R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	55.0
9.8	10.20	8"	6C98R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	65.0
10.0	10.40	8 1/16"	6C100R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	62.0
10.2	10.60	8 3/8"	6C102R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	68.0
10.6	11.00	8 13/16"	6C106R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	55.0
11.0	11.40	9 1/4"	6C110R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	51.5
12.0	12.40	10 1/4"	6C120R	R2	15-Web	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	64.0
13.0	13.40	11 1/4"	6C130R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	61.0
14.0	14.40	12 1/4"	6C140R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	69.0
15.0	15.40	13 3/4"	6C150R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	68.0
16.0	16.40	14 3/4"	6C160R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	77.0
18.0	18.40	16 1/4"	6C180R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	84.0
18.0	18.40	16 1/4"	6C180S	S1	15-Arm	6 1/4"	4 3/8"	1 1/32"	1 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	107
20.0	20.40	18 1/4"	6C200R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	91.5
20.0	20.40	18 1/4"	6C200S	S1	15-Arm	6 1/4"	4 3/8"	1 1/32"	1 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	127
24.0	24.40	22 1/4"	6C240R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	116
24.0	24.40	22 1/4"	6C240S	S1	15-Arm	6 1/4"	4 3/8"	1 1/32"	1 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	125
27.0	27.40	25 1/4"	6C270R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	144
27.0	27.40	25 1/4"	6C270S	S1	15-Arm	6 1/4"	4 3/8"	1 1/32"	1 1/32"	6 3/8"	1 1/16"	3 5/16"	9/32"	151
30.0	30.40	28 1/8"	6C300R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	160
30.0	30.40	28 1/8"	6C300U	U0	15-Arm	6 1/4"	4 13/16"	1/16"	1 1/8"	8 3/8"	1 1/16"	3 3/4"	1 5/32"	191
36.0	36.40	34 1/8"	6C360R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	211
36.0	36.40	34 1/8"	6C360U	U0	15-Arm	6 1/4"	4 13/16"	1/16"	1 1/8"	8 3/8"	1 1/16"	3 3/4"	1 5/32"	233
44.0	44.40	42 1/8"	6C440R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	286
50.0	50.40	48 1/8"	6C500R	R2	15-Arm	6 1/4"	4 7/8"	1/4"	1 1/8"	5 3/8"	7/8"	4"	9/32"	303
7 GROOVES, F = 7 1/4"														
7.0"	7.40"	5 3/8"	7C70Q	Q3	15-Web	7 1/4"	5"	3/4"	1 1/2"	4 1/4"	3/4"	4 1/4"	9/32"	37.5
8.0	8.40	6 3/8"	7C80R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	45.6
8.6	9.00	6 13/16"	7C86R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	52.8
9.0	9.40	7 1/16"	7C90R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	58.0
9.2	9.60	7 3/8"	7C92R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	63.0
9.4	9.80	7 5/8"	7C94R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	68.0
9.8	10.20	8"	7C98R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	73.0
10.0	10.40	8 1/16"	7C100R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	71.0
10.2	10.60	8 3/8"	7C102R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	76.0
10.6	11.00	8 13/16"	7C106R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	71.0
11.0	11.40	9 1/4"	7C110R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	68.0
12.0	12.40	10 1/4"	7C120R	R2	15-Web	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	67.0
13.0	13.40	11 1/4"	7C130R	R2	15-Arm	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	84.0
14.0	14.40	12 1/4"	7C140R	R2	15-Arm	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	83.0
15.0	15.40	13 3/4"	7C150R	R2	15-Arm	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	86.0
16.0	16.40	14 3/4"	7C160R	R2	15-Arm	7 1/4"	4 7/8"	3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	88.0
18.0	18.40	16 1/4"	7C180S	S2	13-Arm	7 29/32"	6 3/4"	9/32"	2 29/32"	6 3/8"	1 1/16"	5 11/16"	9/32"	137
18.0	18.40	16 1/4"	7C180U	U0	15-Arm	7 1/4"	4 13/16"	9/16"	1 3/4"	8 3/8"	1 1/16"	3 3/4"	9/32"	133
20.0	20.40	18 1/4"	7C200S	S2	13-Arm	7 29/32"	6 3/4"	9/32"	2 29/32"	6 3/8"	1 1/16"	5 11/16"	9/32"	152
20.0	20.40	18 1/4"	7C200U	U0	15-Arm	7 1/4"	4 13/16"	9/16"	1 3/4"	8 3/8"	1 1/16"	3 3/4"	9/32"	144
24.0	24.40	22 1/4"</												

C Browning Gripbelt Sheaves with Split Taper Bushings

For Use with All "C" Section Belts

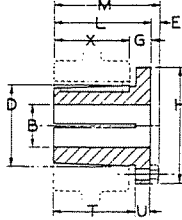


Table No. 1 Bushing Dimensions

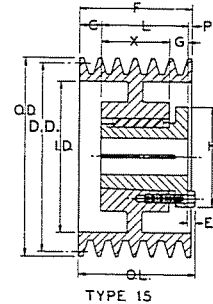
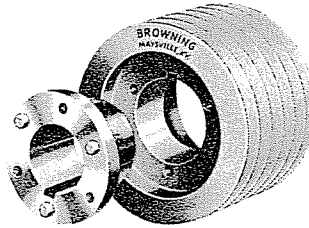
Part No.	Dimensions									Bore Range	Wt. Lbs.
	M	L	G	X	E	T	U	D	H		
Q3	5 ⁹ / ₃₂ "	5"	3/4"	4 1/4"	9/32"	4 1/4"	17/32"	2 7/8"	4 1/8"	1 3/8" — 2 1/2"	5 1/2
R2	5 ⁹ / ₃₂ "	4 7/8"	7/8"	4"	9/32"	4 1/4"	5/8"	4"	5 3/8"	1 3/8" — 3 5/8"	11
S2	7 1/8"	6 3/4"	1 1/16"	5 1 1/16"	3/8"	6"	3/4"	4 5/8"	6 7/8"	1 7/8" — 4 1/16"	19
U0	5 ²³ / ₃₂ "	5 1/4"	1 3/16"	3 3/4"	15/32"	4 3/16"	1 1/16"	6"	8 3/8"	2 3/8" — 3 3/16"	30
U0	5 ¹³ / ₃₂ "	4 15/16"	1 1/2"	3 3/4"	15/32"	4 3/16"	3/4"	6"	8 3/8"	3 1/4" — 5 1/2"	27
U1	7 ¹⁹ / ₃₂ "	7 1/8"	1 1/2"	5 5/8"	15/32"	6 1/16"	1 1/16"	6"	8 3/8"	2 3/4" — 5 1/2"	40

Standard Keyseats

Table No. 2

Bore Range	Keyseat
1 1/8"	5/16" x 5/32"
1 1/16" — 1 3/4"	3/8 x 3/16
1 13/16 — 2 1/4"	1/2 x 1/4
2 5/16 — 2 3/4"	5/8 x 5/16
2 13/16 — 3 1/4"	3/4 x 3/8
3 3/8 — 3 3/4"	7/8 x 7/16
3 7/8 — 4 1/2"	1 x 1/2
4 5/8 — 5 1/2"	1 1/4 x 5/8

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.



TYPE 15

Table No. 3 Specifications—Stock "C" Sheaves

Diameters			Part Number		Type	Dimensions							Wt. Less Bush.	
Datum "C"	Out-side	In-side	Sheave	Bush-ing		O.L.	L	P	C	H	G	X		E
8 GROOVES, F = 8 1/4"														
7.0"	7.40"	5 3/8"	8C70Q	Q3	15-Web	8 1/4"	5"	15 1/8"	15 1/8"	4 1/8"	3/4"	4 1/4"	9/32"	40
8.0	8.40	6 3/8"	8C80R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	49
8.6	9.00	6 15/16"	8C86R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	57
9.0	9.40	7 3/16"	8C90R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	62
9.2	9.60	7 3/8"	8C92R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	68
9.4	9.80	7 5/8"	8C94R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	73
9.6	10.00	7 13/16"	8C96R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	70
9.8	10.20	8"	8C98R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	76
10.0	10.40	8 3/16"	8C100R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	72
10.2	10.60	8 3/8"	8C102R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	79
10.6	11.00	8 13/16"	8C106R	R2	15-Web	8 1/4"	4 7/8"	1 3/4"	1 5/8"	5 3/8"	7/8"	4"	9/32"	76
11.0	11.40	9 1/4"	8C110R	R2	15-Web	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	73
12.0	12.40	10 1/4"	8C120R	R2	15-Web	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	74
13.0	13.40	11 1/4"	8C130R	R2	15-Arm	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	80
14.0	14.40	12 1/4"	8C140R	R2	15-Arm	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	84
15.0	15.40	13 1/4"	8C150R	R2	15-Arm	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	93
16.0	16.40	14 1/4"	8C160R	R2	15-Arm	8 1/4"	4 7/8"	1 1/2"	2 1/8"	5 3/8"	7/8"	4"	9/32"	100
18.0	18.40	16 1/4"	8C180S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	140
18.0	18.40	16 1/4"	8C180U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	141
20.0	20.40	18 1/4"	8C200S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	163
20.0	20.40	18 1/4"	8C200U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	160
24.0	24.40	22 1/4"	8C240S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	194
24.0	24.40	22 1/4"	8C240U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	184
27.0	27.40	25 1/4"	8C270S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	224
30.0	30.40	28 1/8"	8C300S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	212
30.0	30.40	28 1/8"	8C300U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	227
36.0	36.40	34 1/8"	8C360S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	261
36.0	36.40	34 1/8"	8C360U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	288
44.0	44.40	42 1/8"	8C440S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	368
44.0	44.40	42 1/8"	8C440U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	358
50.0	50.40	48 1/8"	8C500S	S2	15-Arm	8 1 3/32"	6 3/4"	7/32"	1 9/32"	6 3/8"	1 1/16"	5 1 1/16"	3/8"	429
50.0	50.40	48 1/8"	8C500U	U0	15-Arm	8 1/4"	4 15/16"	1 1/16"	2 1/4"	8 3/8"	1 3/16"	3 3/4"	15/32"	417

For Use with All "C" Section Belts

Table No. 1

Specifications—Stock "C" Sheaves

Diameters			Part Number		Type	Dimensions								Wt. Less Bush.
Datum "C"	Out-side	In-side	Sheave	Bush-ing		O.L.	L	P	C	H	G	X	E	
10 GROOVES, F = 10 1/4"														
8.0"	8.40"	6 3/8"	10C80R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4"	3/32"	70
8.6	9.00	6 15/16	10C86R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	72
9.0	9.40	7 1/16	10C90R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	72
9.2	9.60	7 3/8	10C92R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	70
9.4	9.80	7 5/8	10C94R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	78
9.6	10.00	7 13/16	10C96R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	73
9.8	10.20	8	10C98R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	88
10.0	10.40	8 3/16	10C100R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	89
10.2	10.60	8 3/8	10C102R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	97
10.6	11.00	8 13/16	10C106R	R2	15-Web	10 1/4"	4 7/8"	3 3/4"	1 5/8"	5 3/8"	7/8"	4	3/32	84
10.6	11.40	9 1/4	10C110R	R2	15-Web	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	84
11.0	11.40	9 1/4	10C110R	R2	15-Web	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	97
12.0	12.40	10 1/4	10C120R	R2	15-Web	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	102
13.0	13.40	11 1/4	10C130R	R2	15-Arm	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	106
14.0	14.40	12 1/4	10C140R	R2	15-Arm	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	110
15.0	15.40	13 3/4	10C150R	R2	15-Arm	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	111
16.0	16.40	14 1/4	10C160R	R2	15-Arm	10 1/4"	4 7/8"	2 1/4"	3 1/8"	5 3/8"	7/8"	4	3/32	164
18.0	18.40	16 1/4	10C180S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	163
18.0	18.40	16 1/4	10C180U	U0	15-Arm	10 1/4"	4 1 1/2"	2 1/16	3 1/4	8 3/8"	1 1/16	3 3/4	1 5/32	170
20.0	20.40	18 1/4	10C200S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	178
20.0	20.40	18 3/4	10C200U	U0	15-Arm	10 1/4"	4 1 1/2"	2 1/16	3 1/4	8 3/8"	1 1/16	3 3/4	1 5/32	210
24.0	24.40	22 1/4	10C240S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	208
24.0	24.40	22 1/4	10C240U	U0	15-Arm	10 1/4"	4 1 1/2"	2 1/16	3 1/4	8 3/8"	1 1/16	3 3/4	1 5/32	246
27.0	27.40	25 1/4	10C270S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	278
30.0	30.40	28 3/8	10C300S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	298
30.0	30.40	28 1/8	10C300U	U1	15-Arm	10 1/4"	7 1/8"	1 3/16	2 1/16	8 3/8"	1 1/2	5 5/8"	1 5/32	324
36.0	36.40	34 1/8	10C360S	S2	15-Arm	10 1/4"	6 3/4"	1 5/32	2 3/32	6 3/8"	1 1/16	5 11/16	3/8	362
36.0	36.40	34 1/8	10C360U	U1	15-Arm	10 1/4"	7 1/8"	1 3/16	2 1/16	8 3/8"	1 1/2	5 5/8"	1 5/32	463
44.0	44.40	42 1/8	10C440U	U1	15-Arm	10 1/4"	7 1/8"	1 3/16	2 1/16	8 3/8"	1 1/2	5 5/8"	1 5/32	480
50.0	50.40	48 3/8	10C500U	U1	15-Arm	10 1/4"	7 1/8"	1 3/16	2 1/16	8 3/8"	1 1/2	5 5/8"	1 5/32	480

12 GROOVES, F = 12 1/4"

9.0"	9.40"	7 3/16"	12C90S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2"	6 3/8"	1 1/16"	5 11/16"	3/8"	88
9.2	9.60	7 3/8	12C92S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	93
9.4	9.80	7 5/8	12C94S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	104
9.6	10.00	7 13/16	12C96S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	102
9.8	10.20	8	12C98S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	111
10.0	10.40	8 3/16	12C100S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	112
10.2	10.60	8 3/8	12C102S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	121
10.6	11.00	8 13/16	12C106S	S2	15-Web	12 1/4"	6 3/4"	3 1/2"	2	6 3/8"	1 1/16"	5 11/16"	3/8	133
11.0	11.40	9 1/4	12C110S	S2	15-Web	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	128
12.0	12.40	10 1/4	12C120S	S2	15-Web	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	140
13.0	13.40	11 1/4	12C130S	S2	15-Web	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	165
14.0	14.40	12 1/4	12C140S	S2	15-Arm	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	148
15.0	15.40	13 3/4	12C150S	S2	15-Arm	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	162
16.0	16.40	14 1/4	12C160S	S2	15-Arm	12 1/4"	6 3/4"	2 7/32	3 3/32	6 3/8"	1 1/16"	5 11/16"	3/8	163
18.0	18.40	16 1/4	12C180U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	204
20.0	20.40	18 3/4	12C200U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	224
24.0	24.40	22 1/4	12C240U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	257
27.0	27.40	25 1/4	12C270U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	300
30.0	30.40	28 1/8	12C300U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	327
36.0	36.40	34 1/8	12C360U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	397
44.0	44.40	42 1/8	12C440U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	519
50.0	50.40	48 3/8	12C500U	U1	15-Arm	12 1/4"	7 1/8"	1 13/16	3 5/16	8 3/8"	1 1/2	5 5/8"	1 5/32	551



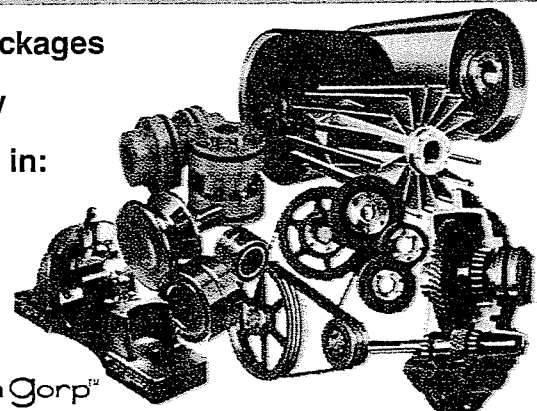
Bulk and Unit Material Handling
Pulp and Paper
HVAC

Complete Product Packages

Designed for Industry

Specific Applications in:

Food and Beverage
Lumber
Packaging

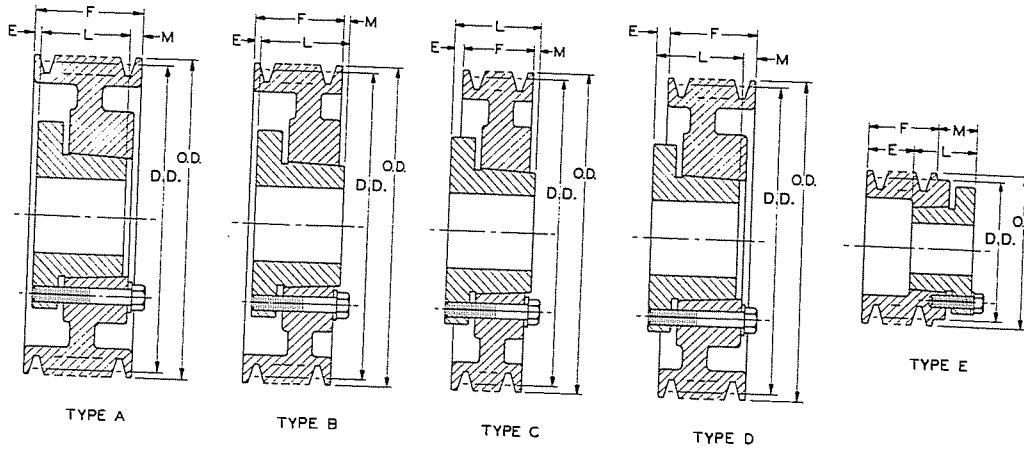


Browning HOP-FLEX Mc GILL MORSE ROLLWAY SEALMASTER Van Gorp™

C

Browning

Q-D® Sheaves for "C" Belts



**Standard Keyseats
Table No. 1**

Bore Range	Keyseat
1/2" - 9/16"	1/8" x 1/16"
5/8" - 7/8"	3/16" x 3/32"
15/16" - 1 1/4"	1/4" x 1/8"
1 1/8" - 1 1/2"	5/16" x 3/32"
1 3/8" - 1 3/4"	3/8" x 1/8"
1 1/2" - 2"	1/2" x 1/4"
2 1/8" - 2 1/4"	5/8" x 5/16"
2 1/4" - 3"	3/4" x 3/8"
3 1/8" - 3 1/2"	7/8" x 7/16"
3 3/8" - 4 1/4"	1" x 1/2"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2

Specifications

Part No.	Bushing	Bore Range	Type*	Datum "C"	O.D.	E	L	M	Wt. Less Bushing
1 GROOVE, F = 1 1/4"									
1C70SF	SF	1/2" - 2 15/16"	D-1	7.0"	7.40"	27/32"	2 1/16"	1/32"	10
1C75SF	SF	1/2" - 2 15/16"	D-2	7.5	7.90	27/32"	2 1/16"	1/32"	12
1C80SF	SF	1/2" - 2 15/16"	D-2	8.0	8.40	27/32"	2 1/16"	1/32"	13
1C85SF	SF	1/2" - 2 15/16"	D-2	8.5	8.90	27/32"	2 1/16"	1/32"	14
1C90SF	SF	1/2" - 2 15/16"	D-3	9.0	9.40	27/32"	2 1/16"	1/32"	15
1C95SF	SF	1/2" - 2 15/16"	D-3	9.5	9.90	27/32"	2 1/16"	1/32"	16
1C100SF	SF	1/2" - 2 15/16"	D-3	10.0	10.40	27/32"	2 1/16"	1/32"	17
1C105SF	SF	1/2" - 2 15/16"	D-3	10.5	10.90	27/32"	2 1/16"	1/32"	18
1C110SF	SF	1/2" - 2 15/16"	D-3	11.0	11.40	27/32"	2 1/16"	1/32"	19
1C120SF	SF	1/2" - 2 15/16"	D-3	12.0	12.40	27/32"	2 1/16"	1/32"	20
1C130SF	SF	1/2" - 2 15/16"	D-3	13.0	13.40	27/32"	2 1/16"	1/32"	22
1C140SF	SF	1/2" - 2 15/16"	D-3	14.0	14.40	27/32"	2 1/16"	1/32"	24
1C160SF	SF	1/2" - 2 15/16"	D-3	16.0	16.40	27/32"	2 1/16"	1/32"	26
1C180SF	SF	1/2" - 2 15/16"	D-3	18.0	18.40	27/32"	2 1/16"	1/32"	30
1C200SF	SF	1/2" - 2 15/16"	D-3	20.0	20.40	27/32"	2 1/16"	1/32"	35
1C240SF	SF	1/2" - 2 15/16"	D-3	24.0	24.40	27/32"	2 1/16"	1/32"	41
2 GROOVES, F = 2 1/4"									
2C70SF	SF	1/2" - 2 15/16"	D-1	7.0	7.40	3/32"	2 1/16"	9/32"	15
2C75SF	SF	1/2" - 2 15/16"	D-1	7.5	7.90	3/32"	2 1/16"	9/32"	17
2C80SF	SF	1/2" - 2 15/16"	D-1	8.0	8.40	3/32"	2 1/16"	9/32"	18
2C85SF	SF	1/2" - 2 15/16"	D-2	8.5	8.90	3/32"	2 1/16"	9/32"	19
2C90SF	SF	1/2" - 2 15/16"	D-2	9.0	9.40	3/32"	2 1/16"	9/32"	20
2C95SF	SF	1/2" - 2 15/16"	D-2	9.5	9.90	3/32"	2 1/16"	9/32"	21
2C100SF	SF	1/2" - 2 15/16"	D-3	10.0	10.40	3/32"	2 1/16"	9/32"	22
2C105SF	SF	1/2" - 2 15/16"	D-3	10.5	10.90	3/32"	2 1/16"	9/32"	23
2C110SF	SF	1/2" - 2 15/16"	D-3	11.0	11.40	3/32"	2 1/16"	9/32"	24
2C120SF	SF	1/2" - 2 15/16"	D-3	12.0	12.40	3/32"	2 1/16"	9/32"	25
2C130SF	SF	1/2" - 2 15/16"	D-3	13.0	13.40	1 1/32"	2 1/16"	17/32"	28
2C140SF	SF	1/2" - 2 15/16"	D-3	14.0	14.40	1 1/32"	2 1/16"	17/32"	31
2C160SF	SF	1/2" - 2 15/16"	D-3	16.0	16.40	1 1/32"	2 1/16"	17/32"	36
2C180SF	SF	1/2" - 2 15/16"	D-3	18.0	18.40	1 1/32"	2 1/16"	17/32"	39
2C200SF	SF	1/2" - 2 15/16"	D-3	20.0	20.40	1 1/32"	2 1/16"	17/32"	48
2C240SF	SF	1/2" - 2 15/16"	D-3	24.0	24.40	1 1/32"	2 1/16"	17/32"	60
2C300F	F	1 - 4	C-3	30.0	30.40	1 7/32"	3 3/4"	9/32"	85

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

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Table No. 1

Specifications

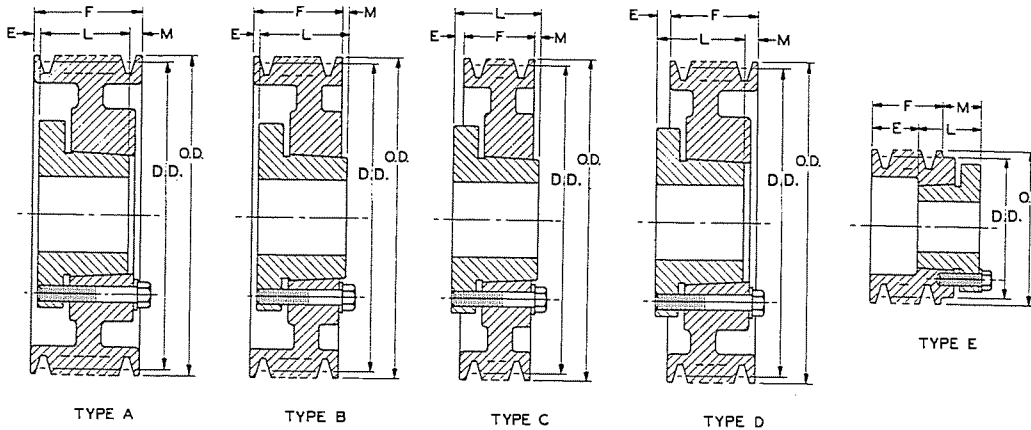
Part No.	Bushing	Bore Range	Type*	Datum "C"	O.D.	E	L	M	Wt. Less Bushing
3 GROOVES, F = 3/4"									
3C50SD	SD	1/2"-2"	A-1	5.0"	5.40"	1 9/32"	1 13/16"	2 7/32"	10
3C55SD	SD	1/2"-2"	A-1	5.5	5.90	1 9/32	1 13/16	2 7/32	12
3C60SF	SF	1/2"-2 15/16	D-1	6.0	6.40	2 3/32	2 1/16	2 29/32	15
3C70SF	SF	1/2"-2 15/16	A-1	7.0	7.40	1 3/32	2 1/16	2 5/32	18
3C75SF	SF	1/2"-2 15/16	A-1	7.5	7.90	1 3/32	2 1/16	2 5/32	20
3C80E	E	7/8"-3 1/2"	B-1	8.0	8.40	1 7/32	2 3/4	1 3/2	26
3C85E	E	7/8"-3 1/2"	B-1	8.5	8.90	1 7/32	2 3/4	1 3/2	29
3C90E	E	7/8"-3 1/2"	A-1	9.0	9.40	1 5/32	2 3/4	1 3/2	32
3C95E	E	7/8"-3 1/2"	A-2	9.5	9.90	1 5/32	2 3/4	1 3/2	34
3C100E	E	7/8"-3 1/2"	A-2	10.0	10.40	1 5/32	2 3/4	1 3/2	36
3C105E	E	7/8"-3 1/2"	A-3	10.5	10.90	1 5/32	2 3/4	1 3/2	38
3C110E	E	7/8"-3 1/2"	A-3	11.0	11.40	1 5/32	2 3/4	1 3/2	40
3C120E	E	7/8"-3 1/2"	A-3	12.0	12.40	1 5/32	2 3/4	1 3/2	43
3C130E	E	7/8"-3 1/2"	A-3	13.0	13.40	1 5/32	2 3/4	1 3/2	45
3C140E	E	7/8"-3 1/2"	A-3	14.0	14.40	1 5/32	2 3/4	1 3/2	51
3C160E	E	7/8"-3 1/2"	A-3	16.0	16.40	1 5/32	2 3/4	1 3/2	59
3C180E	E	7/8"-3 1/2"	A-3	18.0	18.40	1 5/32	2 3/4	1 3/2	65
3C200E	E	7/8"-3 1/2"	D-3	20.0	20.40	7/32	2 3/4	2 3/32	70
3C240E	E	7/8"-3 1/2"	D-3	24.0	24.40	7/32	2 3/4	2 3/32	80
3C270F	F	1 -4	D-3	27.0	27.40	2 1/32	3 3/4	5/32	105
3C300F	F	1 -4	D-3	30.0	30.40	2 1/32	3 3/4	5/32	120
3C360F	F	1 -4	D-3	36.0	36.40	2 1/32	3 3/4	5/32	140
3C440F	F	1 -4	D-3	44.0	44.40	2 1/32	3 3/4	5/32	170
3C500F	F	1 -4	D-3	50.0	50.40	2 1/32	3 3/4	5/32	190
4 GROOVES, F = 4/4"									
4C50SD	SD	1/2"-2"	A-1	5.0	5.40	2 7/32	1 13/16	1 19/32	12
4C55SD	SD	1/2"-2"	A-1	5.5	5.90	2 7/32	1 13/16	1 19/32	14
4C60SF	SF	1/2"-2 15/16	A-1	6.0	6.40	2 1/32	2 1/16	1 17/32	17
4C70SF	SF	1/2"-2 15/16	A-1	7.0	7.40	2 1/32	2 1/16	1 17/32	21
4C75SF	SF	1/2"-2 15/16	A-1	7.5	7.90	2 1/32	2 1/16	1 17/32	25
4C80E	E	7/8"-3 1/2"	A-1	8.0	8.40	2 5/32	2 3/4	2 3/32	30
4C85E	E	7/8"-3 1/2"	A-1	8.5	8.90	2 5/32	2 3/4	2 3/32	33
4C90E	E	7/8"-3 1/2"	A-1	9.0	9.40	2 5/32	2 3/4	2 3/32	35
4C95E	E	7/8"-3 1/2"	A-2	9.5	9.90	2 5/32	2 3/4	2 3/32	38
4C100E	E	7/8"-3 1/2"	A-2	10.0	10.40	2 5/32	2 3/4	2 3/32	40
4C105E	E	7/8"-3 1/2"	A-2	10.5	10.90	2 5/32	2 3/4	2 3/32	43
4C110E	E	7/8"-3 1/2"	A-2	11.0	11.40	2 5/32	2 3/4	2 3/32	46
4C120E	E	7/8"-3 1/2"	A-3	12.0	12.40	2 5/32	2 3/4	2 3/32	50
4C130E	E	7/8"-3 1/2"	A-3	13.0	13.40	2 5/32	2 3/4	2 3/32	54
4C140E	E	7/8"-3 1/2"	A-3	14.0	14.40	2 5/32	2 3/4	2 3/32	59
4C160E	E	7/8"-3 1/2"	A-3	16.0	16.40	2 5/32	2 3/4	2 3/32	65
4C180E	E	7/8"-3 1/2"	A-3	18.0	18.40	2 5/32	2 3/4	2 3/32	73
4C200E	E	7/8"-3 1/2"	A-3	20.0	20.40	3/32	2 3/4	1 7/32	82
4C240F	F	1 -4	D-3	24.0	24.40	3/32	3 3/4	1 9/32	105
4C270F	F	1 -4	D-3	27.0	27.40	3/32	3 3/4	1 9/32	125
4C300F	F	1 -4	D-3	30.0	30.40	3/32	3 3/4	1 9/32	142
4C360F	F	1 -4	D-3	36.0	36.40	3/32	3 3/4	1 9/32	172
4C440J	J	1 1/2"-4 1/2"	C-3	44.0	44.40	0	4 5/8	3/8	225
4C500J	J	1 1/2"-4 1/2"	C-3	50.0	50.40	0	4 5/8	3/8	260
5 GROOVES, F = 5/4"									
5C60SF	SF	1/2"-2 15/16	A-1	6.0	6.40	1 1/32	2 1/16	2 5/32	21
5C70SF	SF	1/2"-2 15/16	A-1	7.0	7.40	1 1/32	2 1/16	2 5/32	26
5C75SF	SF	1/2"-2 15/16	A-1	7.5	7.90	1 1/32	2 1/16	2 5/32	28
5C80E	E	7/8"-3 1/2"	A-1	8.0	8.40	1 1/32	2 3/4	1 11/32	33
5C85E	E	7/8"-3 1/2"	A-1	8.5	8.90	1 5/32	2 3/4	1 11/32	37
5C90E	E	7/8"-3 1/2"	A-1	9.0	9.40	1 5/32	2 3/4	1 11/32	40
5C95E	E	7/8"-3 1/2"	A-2	9.5	9.90	1 5/32	2 3/4	1 11/32	42
5C100E	E	7/8"-3 1/2"	A-2	10.0	10.40	1 5/32	2 3/4	1 11/32	45
5C105E	E	7/8"-3 1/2"	A-2	10.5	10.90	1 5/32	2 3/4	1 11/32	47
5C110E	E	7/8"-3 1/2"	A-2	11.0	11.40	1 5/32	2 3/4	1 11/32	50
5C120E	E	7/8"-3 1/2"	A-2	12.0	12.40	1 5/32	2 3/4	1 11/32	53
5C130E	E	7/8"-3 1/2"	A-3	13.0	13.40	1 5/32	2 3/4	1 11/32	58
5C140E	E	7/8"-3 1/2"	A-3	14.0	14.40	1 5/32	2 3/4	1 11/32	64
5C160E	E	7/8"-3 1/2"	A-3	16.0	16.40	1 5/32	2 3/4	1 11/32	73
5C180E	E	7/8"-3 1/2"	A-3	18.0	18.40	1 5/32	2 3/4	1 11/32	85
5C200F	F	1 -4	D-3	20.0	20.40	3/32	3 3/4	1 19/32	98
5C240F	F	1 -4	D-3	24.0	24.40	3/32	3 3/4	1 19/32	119
5C270F	F	1 -4	D-3	27.0	27.40	3/32	3 3/4	1 19/32	153
5C300F	F	1 -4	D-3	30.0	30.40	3/32	3 3/4	1 19/32	174
5C360J	J	1 1/2"-4 1/2"	A-3	36.0	36.40	1/16	4 5/8	9/16	206
5C440J	J	1 1/2"-4 1/2"	A-3	44.0	44.40	1/16	4 5/8	9/16	254
5C500J	J	1 1/2"-4 1/2"	A-3	50.0	50.40	1/16	4 5/8	9/16	274

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

C

Browning

Q-D® Sheaves for "C" Belts



Standard Keyseats
Table No. 1

Bore Range	Keyseat
1/2" - 9/16"	1/8" x 1/16"
5/8" - 7/8"	3/16" x 3/32"
15/16" - 1 1/4"	1/4" x 1/8"
1 1/4" - 1 3/8"	5/16" x 5/32"
1 3/8" - 1 1/2"	3/8" x 3/16"
1 1/2" - 1 5/8"	1/2" x 1/4"
1 5/8" - 2 1/4"	5/8" x 5/16"
2 1/4" - 3 1/4"	3/4" x 3/8"
3 1/4" - 4 1/2"	7/8" x 7/16"
3 7/8" - 4 1/2"	1" x 1/2"
4 5/8" - 5 1/2"	1 1/4" x 5/8"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2

Specifications

Part No.	Bushing	Bore Range	Type*	Datum 'C'	O.D.	E	L	M	Wt. Less Bushing
6 GROOVES, F = 6 1/4"									
6C60SF	SF	1/2" - 2 15/16"	A-1	6.0"	6.40"	1 1/32"	2 1/16"	3 5/32"	20
6C70SF	SF	1/2" - 2 15/16"	A-1	7.0	7.40	1 1/32	2 1/16	3 5/32	26
6C75SF	SF	1/2" - 2 15/16"	A-1	7.5	7.90	1 1/32	2 1/16	3 5/32	29
6C80E	E	7/8" - 3 1/2"	A-1	8.0	8.40	1 5/32	2 3/4	2 11/32	36
6C85E	E	7/8" - 3 1/2"	A-1	8.5	8.90	1 5/32	2 3/4	2 11/32	39
6C90F	F	1" - 4"	A-1	9.0	9.40	1 1/32	3 3/4	1 15/32	51
6C95F	F	1" - 4"	A-1	9.5	9.90	1 1/32	3 3/4	1 15/32	55
6C100F	F	1" - 4"	A-1	10.0	10.40	1 1/32	3 3/4	1 15/32	59
6C105F	F	1" - 4"	A-2	10.5	10.90	1 1/32	3 3/4	1 15/32	62
6C110F	F	1" - 4"	A-2	11.0	11.40	1 1/32	3 3/4	1 15/32	66
6C120F	F	1" - 4"	A-2	12.0	12.40	1 1/32	3 3/4	1 15/32	70
6C130F	F	1" - 4"	A-3	13.0	13.40	1 1/32	3 3/4	1 15/32	74
6C140F	F	1" - 4"	A-3	14.0	14.40	1 1/32	3 3/4	1 15/32	80
6C160F	F	1" - 4"	A-3	16.0	16.40	1 1/32	3 3/4	1 15/32	89
6C180F	F	1" - 4"	A-3	18.0	18.40	1 1/32	3 3/4	1 15/32	102
6C200F	F	1" - 4"	A-3	20.0	20.40	1 1/32	3 3/4	1 15/32	112
6C240F	F	1" - 4"	A-3	24.0	24.40	1 1/32	3 3/4	1 15/32	131
6C270J	J	1 1/2" - 4 1/2"	A-3	27.0	27.40	1/16	4 5/8	1 15/16	160
6C300J	J	1 1/2" - 4 1/2"	A-3	30.0	30.40	1/16	4 5/8	1 15/16	190
6C360J	J	1 1/2" - 4 1/2"	A-3	36.0	36.40	1/16	4 5/8	1 15/16	232
6C440J	J	1 1/2" - 4 1/2"	A-3	44.0	44.40	1/16	4 5/8	1 15/16	299
6C500M	M	2" - 5 1/2"	B-3	50.0	50.40	7/32	6 3/4	2 3/32	320
8 GROOVES, F = 8 1/4"									
8C80E	E	7/8" - 3 1/2"	A-1	8.0	8.40	2 1/32	2 3/4	3 15/32	43
8C85E	E	7/8" - 3 1/2"	A-1	8.5	8.90	2 1/32	2 3/4	3 15/32	48
8C90F	F	1" - 4"	A-1	9.0	9.40	1 29/32	3 3/4	2 19/32	60
8C95F	F	1" - 4"	A-1	9.5	9.90	1 29/32	3 3/4	2 19/32	65
8C100F	F	1" - 4"	A-1	10.0	10.40	1 29/32	3 3/4	2 19/32	69
8C105F	F	1" - 4"	A-2	10.5	10.90	1 29/32	3 3/4	2 19/32	73
8C110F	F	1" - 4"	A-2	11.0	11.40	1 29/32	3 3/4	2 19/32	78
8C120F	F	1" - 4"	A-3	12.0	12.40	1 29/32	3 3/4	2 19/32	83
8C130F	F	1" - 4"	A-3	13.0	13.40	1 29/32	3 3/4	2 19/32	89
8C140F	F	1" - 4"	A-3	14.0	14.40	1 29/32	3 3/4	2 19/32	97
8C160F	F	1" - 4"	A-3	16.0	16.40	1 29/32	3 3/4	2 19/32	113
8C180F	F	1" - 4"	A-3	18.0	18.40	1 29/32	3 3/4	2 19/32	131
8C200J	J	1 1/2" - 4 1/2"	A-3	20.0	20.40	1/16	4 5/8	3 3/16	152
8C240J	J	1 1/2" - 4 1/2"	A-3	24.0	24.40	1/16	4 5/8	3 3/16	185
8C270J	J	1 1/2" - 4 1/2"	A-3	27.0	27.40	1/16	4 5/8	3 3/16	208
8C300J	J	1 1/2" - 4 1/2"	A-3	30.0	30.40	1/16	4 5/8	3 3/16	230
8C360M	M	2" - 5 1/2"	A-3	36.0	36.40	9/32	6 3/4	1 7/32	306
8C440M	M	2" - 5 1/2"	A-3	44.0	44.40	9/32	6 3/4	1 7/32	400
8C500M	M	2" - 5 1/2"	A-3	50.0	50.40	9/32	6 3/4	1 7/32	475

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

Table No. 1

Specifications

Part No.	Bushing	Bore Range	Type*	Datum "C"	O.D.	E	L	M	Wt. Less Bushing
10 GROOVES, F = 10 1/4"									
10C80E	E	7/8"-3 1/2"	A-1	8.0"	8.40"	2 1/32"	2 3/4"	5 15/32"	65
10C85E	E	7/8"-3 1/2"	A-1	8.5	8.90	2 1/32	2 3/4	5 15/32	69
10C90J	J	1 1/2"-4 1/2"	A-1	9.0	9.40	2 1/16	4 5/8	3 9/16	73
10C95J	J	1 1/2"-4 1/2"	A-1	9.5	9.90	2 1/16	4 5/8	3 9/16	79
10C100J	J	1 1/2"-4 1/2"	A-1	10.0	10.40	2 1/16	4 5/8	3 9/16	84
10C105J	J	1 1/2"-4 1/2"	A-1	10.5	10.90	2 1/16	4 5/8	3 9/16	95
10C110J	J	1 1/2"-4 1/2"	A-1	11.0	11.40	2 1/16	4 5/8	3 9/16	104
10C120J	J	1 1/2"-4 1/2"	A-1	12.0	12.40	2 1/16	4 5/8	3 9/16	113
10C130J	J	1 1/2"-4 1/2"	A-3	13.0	13.40	2 1/16	4 5/8	3 9/16	121
10C140J	J	1 1/2"-4 1/2"	A-3	14.0	14.40	2 1/16	4 5/8	3 9/16	128
10C160J	J	1 1/2"-4 1/2"	A-3	16.0	16.40	2 1/16	4 5/8	3 9/16	146
10C180J	J	1 1/2"-4 1/2"	A-3	18.0	18.40	2 1/16	4 5/8	3 9/16	161
10C200J	J	1 1/2"-4 1/2"	A-3	20.0	20.40	2 1/16	4 5/8	3 9/16	175
10C240M	M	2"-5 1/2"	A-3	24.0	24.40	9/32	6 3/4	3 7/32	265
10C300M	M	2"-5 1/2"	A-3	30.0	30.40	9/32	6 3/4	3 7/32	310
10C360M	M	2"-5 1/2"	A-3	36.0	36.40	9/32	6 3/4	3 7/32	345
10C440M	M	2"-5 1/2"	A-3	44.0	44.40	9/32	6 3/4	3 7/32	450
10C500M	M	2"-5 1/2"	A-3	50.0	50.40	9/32	6 3/4	3 7/32	500

12 GROOVES, F = 12 1/4"

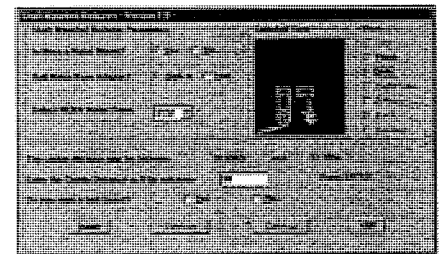
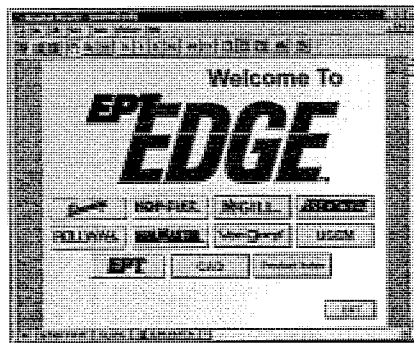
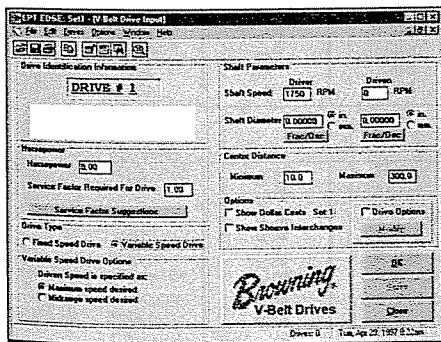
12C90J	J	1 1/2"-4 1/2"	A-1	9.0	9.40	2 9/16	4 5/8	5 1/16	80
12C95J	J	1 1/2"-4 1/2"	A-1	9.5	9.90	2 9/16	4 5/8	5 1/16	88
12C100J	J	1 1/2"-4 1/2"	A-1	10.0	10.40	2 9/16	4 5/8	5 1/16	95
12C105J	J	1 1/2"-4 1/2"	A-1	10.5	10.90	2 9/16	4 5/8	5 1/16	101
12C110J	J	1 1/2"-4 1/2"	A-1	11.0	11.40	2 9/16	4 5/8	5 1/16	111
12C120J	J	1 1/2"-4 1/2"	A-2	12.0	12.40	2 9/16	4 5/8	5 1/16	127
12C130J	J	1 1/2"-4 1/2"	A-3	13.0	13.40	2 9/16	4 5/8	5 1/16	137
12C140J	J	1 1/2"-4 1/2"	A-3	14.0	14.40	2 9/16	4 5/8	5 1/16	150
12C160J	J	1 1/2"-4 1/2"	A-3	16.0	16.40	2 9/16	4 5/8	5 1/16	170
12C180J	J	1 1/2"-4 1/2"	A-3	18.0	18.40	2 9/16	4 5/8	5 1/16	205
12C200M	M	2"-5 1/2"	A-3	20.0	20.40	9/32	6 3/4	5 7/32	245
12C240M	M	2"-5 1/2"	A-3	24.0	24.40	9/32	6 3/4	5 7/32	285
12C300M	M	2"-5 1/2"	A-3	30.0	30.40	9/32	6 3/4	5 7/32	355
12C360M	M	2"-5 1/2"	A-3	36.0	36.40	9/32	6 3/4	5 7/32	420
12C440M	M	2"-5 1/2"	A-3	44.0	44.40	9/32	6 3/4	5 7/32	515
12C500M	M	2"-5 1/2"	A-3	50.0	50.40	9/32	6 3/4	5 7/32	575

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

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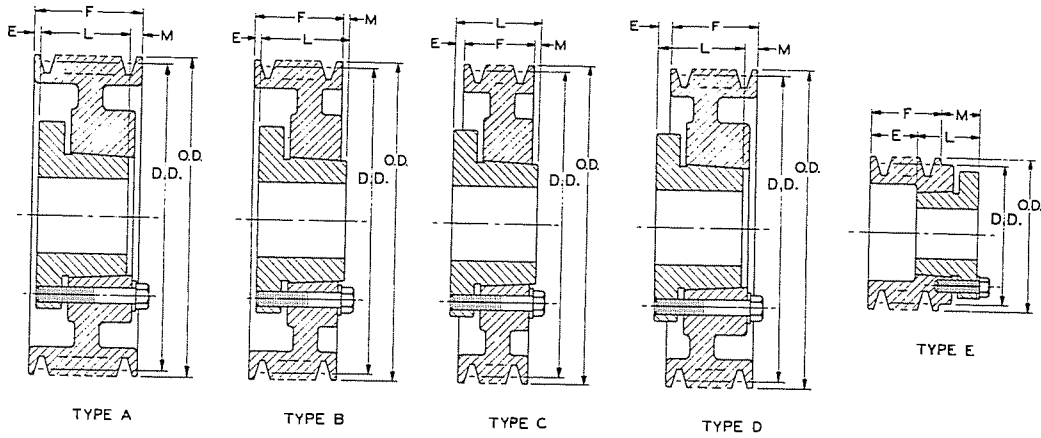
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D

Browning

Q-D® Sheaves for "D" Belts



Standard Keyseats
Table No. 1

Bore Range	Keyseat
15/16" - 1 1/4"	1/4" x 1/8"
1 5/16" - 1 1/2"	5/16" x 5/32"
1 7/16" - 1 3/4"	3/8" x 3/16"
1 13/16" - 2 1/4"	1/2" x 1/4"
2 5/16" - 2 3/4"	5/8" x 3/16"
2 13/16" - 3 1/4"	3/4" x 3/8"
3 3/8" - 3 3/4"	7/8" x 7/16"
3 7/8" - 4 1/2"	1" x 1/2"
4 9/16" - 5 1/2"	1 1/4" x 5/8"
5 3/16" - 6 1/2"	1 1/2" x 3/4"
6 3/16" - 7"	1 3/4" x 3/4"

1 3/8" Bore Bushings also available with 3/8" x 3/16" Keyseat.

Table No. 2

Specifications

Part No.	Bushing	Bore Range	Type*	Datum "D"	O.D.	E	L	M	Wt. Less Bushing
3 GROOVES, F = 4 5/8"									
3D120F	F	1" - 4"	A-2	12.0"	12.64"	5/32"	3 3/4"	2 3/32"	70
3D130F	F	1 - 4	A-2	13.0	13.64	5/32	3 3/4	2 3/32	76
3D135F	F	1 - 4	A-2	13.5	14.14	5/32	3 3/4	2 3/32	79
3D140F	F	1 - 4	A-2	14.0	14.64	5/32	3 3/4	2 3/32	82
3D145F	F	1 - 4	A-3	14.5	15.14	5/32	3 3/4	2 3/32	85
3D150F	F	1 - 4	A-3	15.0	15.64	5/32	3 3/4	2 3/32	89
3D155F	F	1 - 4	A-3	15.5	16.14	5/32	3 3/4	2 3/32	92
3D160F	F	1 - 4	A-3	16.0	16.64	5/32	3 3/4	2 3/32	96
3D180J	J	1 1/2 - 4 1/2	D-3	18.0	18.64	1/4	4 5/8	1 1/4	110
3D200J	J	1 1/2 - 4 1/2	D-3	20.0	20.64	1/4	4 5/8	1 1/4	120
3D220J	J	1 1/2 - 4 1/2	D-3	22.0	22.64	1/4	4 5/8	1 1/4	130
3D270J	J	1 1/2 - 4 1/2	D-3	27.0	27.64	1/4	4 5/8	1 1/4	173
3D330J	J	1 1/2 - 4 1/2	D-3	33.0	33.64	1/4	4 5/8	1 1/4	240
3D400J	J	1 1/2 - 4 1/2	D-3	40.0	40.64	1/4	4 5/8	1 1/4	300
4 GROOVES, F = 6 1/16"									
4D120F	F	1 - 4	A-2	12.0	12.64	31/32	3 3/4	1 11/32	83
4D130F	F	1 - 4	A-2	13.0	13.64	31/32	3 3/4	1 11/32	86
4D135F	F	1 - 4	A-2	13.5	14.14	31/32	3 3/4	1 11/32	89
4D140F	F	1 - 4	A-2	14.0	14.64	31/32	3 3/4	1 11/32	92
4D145F	F	1 - 4	A-3	14.5	15.14	31/32	3 3/4	1 11/32	95
4D150F	F	1 - 4	A-3	15.0	15.64	31/32	3 3/4	1 11/32	99
4D155F	F	1 - 4	A-3	15.5	16.14	31/32	3 3/4	1 11/32	102
4D160F	F	1 - 4	A-3	16.0	16.64	31/32	3 3/4	1 11/32	106
4D180J	J	1 1/2 - 4 1/2	A-3	18.0	18.64	1/8	4 5/8	1 5/16	120
4D200J	J	1 1/2 - 4 1/2	A-3	20.0	20.64	1/8	4 5/8	1 5/16	132
4D220J	J	1 1/2 - 4 1/2	A-3	22.0	22.64	1/8	4 5/8	1 5/16	155
4D270J	J	1 1/2 - 4 1/2	A-3	27.0	27.64	1/8	4 5/8	1 5/16	193
4D330M	M	2 - 5 1/2	B-3	33.0	33.64	1 1/32	6 3/4	1 1/32	280
4D400M	M	2 - 5 1/2	B-3	40.0	40.64	1 1/32	6 3/4	1 1/32	348
4D480M	M	2 - 5 1/2	B-3	48.0	48.64	1 1/32	6 3/4	1 1/32	380
4D580M	M	2 - 5 1/2	B-3	58.0	58.64	1 1/32	6 3/4	1 1/32	420
5 GROOVES, F = 7 1/2"									
5D120F	F	1 - 4	A-2	12.0	12.64	1 27/32	3 3/4	2 1/32	93
5D130F	F	1 - 4	A-2	13.0	13.64	1 27/32	3 3/4	2 1/32	96
5D135F	F	1 - 4	A-2	13.5	14.14	1 27/32	3 3/4	2 1/32	102
5D140F	F	1 - 4	A-2	14.0	14.64	1 27/32	3 3/4	2 1/32	106
5D145F	F	1 - 4	A-3	14.5	15.14	1 27/32	3 3/4	2 1/32	112
5D150F	F	1 - 4	A-3	15.0	15.64	1 27/32	3 3/4	2 1/32	120
5D155F	F	1 - 4	A-3	15.5	16.14	1 27/32	3 3/4	2 1/32	125
5D160F	F	1 - 4	A-3	16.0	16.64	1 27/32	3 3/4	2 1/32	130
5D180J	J	1 1/2 - 4 1/2	A-3	18.0	18.64	1 1/8	4 5/8	1	150
5D200J	J	1 1/2 - 4 1/2	A-3	20.0	20.64	1 1/8	4 5/8	2 3/4	160
5D220J	J	1 1/2 - 4 1/2	A-3	22.0	22.64	1 1/8	4 5/8	2 3/4	190
5D270M	M	2 - 5 1/2	A-3	27.0	27.64	1 1/32	6 3/4	1 3/32	260
5D330M	M	2 - 5 1/2	A-3	33.0	33.64	1 1/32	6 3/4	1 3/32	320
5D400M	M	2 - 5 1/2	A-3	40.0	40.64	1 1/32	6 3/4	1 3/32	390
5D480M	M	2 - 5 1/2	A-3	48.0	48.64	1 1/32	6 3/4	1 3/32	450
5D580M	M	2 - 5 1/2	A-3	58.0	58.64	1 1/32	6 3/4	1 3/32	500

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.

Table No. 1

Specifications

Part No.	Bushing	Bore Range	Type*	Datum "D"	O.D.	E	L	M	Wt. Less Bushing
6 GROOVES, F = 8¹⁵/₁₆"									
6D120J	J	1½"-4½"	A-1	12.0"	12.64"	1⅞"	4⅝"	2⅞"	115
6D130J	J	1½"-4½"	A-2	13.0	13.64	1⅞	4⅝	2⅞	125
6D135J	J	1½"-4½"	A-2	13.5	14.14	1⅞	4⅝	2⅞	135
6D140J	J	1½"-4½"	A-2	14.0	14.64	1⅞	4⅝	2⅞	145
6D145J	J	1½"-4½"	A-2	14.5	15.14	1⅞	4⅝	2⅞	150
6D150J	J	1½"-4½"	A-2	15.0	15.64	1⅞	4⅝	2⅞	160
6D155J	J	1½"-4½"	A-3	15.5	16.14	1⅞	4⅝	2⅞	165
6D160J	J	1½"-4½"	A-3	16.0	16.64	1⅞	4⅝	2⅞	170
6D180J	J	1½"-4½"	A-3	18.0	18.64	1⅞	4⅝	2⅞	180
6D200J	J	1½"-4½"	A-3	20.0	20.64	1⅞	4⅝	2⅞	215
6D220M	M	2"-5½"	A-3	22.0	22.64	1⅞ ³²	6¾	1 ²³ / ₃₂	250
6D270M	M	2"-5½"	A-3	27.0	27.64	1⅞ ³²	6¾	1 ²³ / ₃₂	300
6D330M	M	2"-5½"	A-3	33.0	33.64	1⅞ ³²	6¾	1 ²³ / ₃₂	360
6D400M	M	2"-5½"	A-3	40.0	40.64	1⅞ ³²	6¾	1 ²³ / ₃₂	440
6D480M	M	2"-5½"	A-3	48.0	48.64	1⅞ ³²	6¾	1 ²³ / ₃₂	560
6D580N	N	2⅞"-5⅞"	A-3	58.0	58.64	⅜ ¹⁶	8⅞	⅝	660

8 GROOVES, F = 11¹³/₁₆"									
8D120J	J	1½"-4½"	A-1	12.0	12.64	2⅞	4⅝	5⅞	140
8D130J	J	1½"-4½"	A-2	13.0	13.64	2⅞	4⅝	5⅞	150
8D135J	J	1½"-4½"	A-2	13.5	14.14	2⅞	4⅝	5⅞	160
8D140J	J	1½"-4½"	A-2	14.0	14.64	2⅞	4⅝	5⅞	170
8D145J	J	1½"-4½"	A-2	14.5	15.14	2⅞	4⅝	5⅞	178
8D150J	J	1½"-4½"	A-2	15.0	15.64	2⅞	4⅝	5⅞	182
8D155J	J	1½"-4½"	A-2	15.5	16.14	2⅞	4⅝	5⅞	190
8D160J	J	1½"-4½"	A-2	16.0	16.64	2⅞	4⅝	5⅞	201
8D180M	M	2"-5½"	A-3	18.0	18.64	2⅞ ³²	6¾	2 ²³ / ₃₂	260
8D200M	M	2"-5½"	A-3	20.0	20.64	2⅞ ³²	6¾	2 ²³ / ₃₂	270
8D220M	M	2"-5½"	A-3	22.0	22.64	1⅞ ³²	6¾	4 ²³ / ₃₂	300
8D270M	M	2"-5½"	A-3	27.0	27.64	1⅞ ³²	6¾	4 ²³ / ₃₂	350
8D330M	M	2"-5½"	A-3	33.0	33.64	1⅞ ³²	6¾	4 ²³ / ₃₂	450
8D400N	N	2⅞"-5⅞"	A-3	40.0	40.64	⅜ ¹⁶	8⅞	3⅞	550
8D480N	N	2⅞"-5⅞"	A-3	48.0	48.64	⅜ ¹⁶	8⅞	3⅞	720
8D580N	N	2⅞"-5⅞"	A-3	58.0	58.64	⅜ ¹⁶	8⅞	3⅞	900

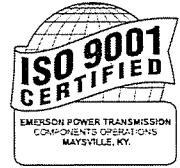
10 GROOVES, F = 14¹¹/₁₆"									
10D120M	M	2"-5½"	A-1	12.0	12.64	2⅞ ³²	6¾	5⅞ ³²	190
10D130M	M	2"-5½"	A-1	13.0	13.64	2⅞ ³²	6¾	5⅞ ³²	220
10D135M	M	2"-5½"	A-1	13.5	14.14	2⅞ ³²	6¾	5⅞ ³²	240
10D140M	M	2"-5½"	A-1	14.0	14.64	2⅞ ³²	6¾	5⅞ ³²	250
10D145M	M	2"-5½"	A-2	14.5	15.14	2⅞ ³²	6¾	5⅞ ³²	260
10D150M	M	2"-5½"	A-2	15.0	15.64	2⅞ ³²	6¾	5⅞ ³²	270
10D155M	M	2"-5½"	A-2	15.5	16.14	2⅞ ³²	6¾	5⅞ ³²	280
10D160M	M	2"-5½"	A-2	16.0	16.64	2⅞ ³²	6¾	5⅞ ³²	290
10D180M	M	2"-5½"	A-2	18.0	18.64	2⅞ ³²	6¾	5⅞ ³²	310
10D200M	M	2"-5½"	A-2	20.0	20.64	2⅞ ³²	6¾	5⅞ ³²	330
10D220M	M	2"-5½"	A-3	22.0	22.64	1⅞ ³²	6¾	6⅞ ³²	350
10D270M	M	2"-5½"	A-3	27.0	27.64	1⅞ ³²	6¾	6⅞ ³²	440
10D330N	N	2⅞"-5⅞"	A-3	33.0	33.64	1⅜ ¹⁶	8⅞	5⅞	500
10D400N	N	2⅞"-5⅞"	A-3	40.0	40.64	1⅜ ¹⁶	8⅞	5⅞	650
10D480P	P	2⅞"-7"	A-3	48.0	48.64	¼	9⅞	5⅞ ¹⁶	920
10D580P	P	2⅞"-7"	A-3	58.0	58.64	¼	9⅞	5⅞ ¹⁶	1100

12 GROOVES, F = 17⁹/₁₆"									
12D120M	M	2"-5½"	A-1	12.0	12.64	3⅞ ³²	6¾	7⅞ ³²	220
12D130M	M	2"-5½"	A-1	13.0	13.64	3⅞ ³²	6¾	7⅞ ³²	250
12D135M	M	2"-5½"	A-1	13.5	14.14	3⅞ ³²	6¾	7⅞ ³²	270
12D140M	M	2"-5½"	A-1	14.0	14.64	3⅞ ³²	6¾	7⅞ ³²	280
12D145M	M	2"-5½"	A-1	14.5	15.14	3⅞ ³²	6¾	7⅞ ³²	300
12D150M	M	2"-5½"	A-2	15.0	15.64	3⅞ ³²	6¾	7⅞ ³²	305
12D155M	M	2"-5½"	A-1	15.5	16.14	3⅞ ³²	6¾	7⅞ ³²	310
12D160M	M	2"-5½"	A-2	16.0	16.64	3⅞ ³²	6¾	7⅞ ³²	320
12D180M	M	2"-5½"	A-2	18.0	18.64	3⅞ ³²	6¾	7⅞ ³²	340
12D200M	M	2"-5½"	A-2	20.0	20.64	3⅞ ³²	6¾	7⅞ ³²	360
12D220M	M	2"-5½"	A-3	22.0	22.64	2⅞ ³²	6¾	8⅞ ³²	400
12D270N	N	2⅞"-5⅞"	A-3	27.0	27.64	2⅞ ³²	8⅞	7⅞	520
12D330N	N	2⅞"-5⅞"	A-3	33.0	33.64	2⅞ ³²	8⅞	7⅞	665
12D400P	P	2⅞"-7"	A-3	40.0	40.64	¼	9⅞	7⅞ ¹⁶	870
12D480P	P	2⅞"-7"	A-3	48.0	48.64	¼	9⅞	7⅞ ¹⁶	1090
12D580P	P	2⅞"-7"	A-3	58.0	58.64	¼	9⅞	7⅞ ¹⁶	1300

*Suffix on Type indicates: 1 = Solid Construction, 2 = Web Construction, 3 = Arm Construction.



V-BELT INSTALLATION INSTRUCTIONS



V-Belt Alignment

Before installing the bushings, refer to EPT Form No. F20-23 for QD® instructions and Form No. 4013 for Split Taper instructions. After installing the bushings in the sheaves and the resulting assemblies onto the shafts, use a straight edge, piano wire or string placed on the outside face of both sheaves to adjust parallel offset and angular alignments. The straight edge, piano wire or string should be close to the shafts and contact each sheave in two places. The objective is to have the shafts parallel and the center lines of the two sheaves in line. See Figure 1 below.

⚠ WARNING

Disconnect power before installation and maintenance. Failure to do so can result in severe injury or death.

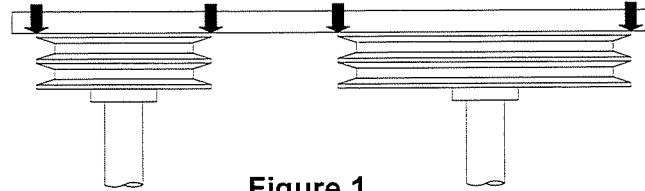


Figure 1

Belt drives should be aligned as perfect as possible to maximize drive life. The practical maximum misalignment is stated as the angle at which the belt enters the sheave. This angle is a result of both angular and parallel offset misalignment, and is 1/2 degree.

V-Belt Sheave Installation

- Step 1:** Loosen moveable base bolts (or motor base bolts) and move sheaves close to facilitate installation of belt. See Table 1 for minimum installation allowance.
 If the design has fixed, non-moveable centers (not a recommended design) do the following:
- A. Mount one sheave onto the shaft loosely and put the belt on it.
 - B. Put the other sheave into the belt loop and slip it onto the other shaft (bushing loosely installed).
 - C. Align the drive and tighten the bushings.
- Step 2:** Move all the slack in multiple belt drives to one side, then remove the slack (increase centers). Then rotate sheaves several revolutions by hand to equalize belt tensions.
- Step 3:** Tension belts as outlined on reverse side of this page.
- Note:** If BROWNING® Tension Checker is used, only 35 lbs maximum force (F) can be obtained. If higher forces are required, use other means such as dead weights or hydraulic pressure to apply a known force.

⚠ CAUTION

Do not pry or otherwise force belts onto sheave. Doing so can result in permanent damage to the belt.

TABLE 1 CENTER DISTANCE ALLOWANCE

Belt No.	Allowance for Installation				Allowance for Initial Tensioning and Subsequent Take-Up
	4L, A	5L, B	C	D	All Sections
26 - 35	.8	1.0	—	—	1.0
38 - 55	.8	1.0	1.5	—	1.5
60 - 85	.8	1.3	1.5	—	2.0
90 - 112	1.0	1.3	1.5	—	2.5
120 - 144	1.0	1.3	1.5	2.0	3.0
158 - 180	—	1.3	2.0	2.0	3.5
195 - 210	—	1.5	2.0	2.0	4.0
240	—	1.5	2.0	2.5	4.5
220 - 300	—	1.5	2.0	2.5	5.0
330 - 390	—	—	2.0	2.5	6.0
420 and over	—	—	2.3	3.0	1 1/2% of Belt Length
	3V	5V	8V		All Sections
250 - 475	.5	—	—		1.0
500 - 710	.8	1.0	—		1.2
750 - 1060	.8	1.0	1.5		1.5
1120 - 1250	.8	1.0	1.5		1.8
1320 - 1700	.8	1.0	1.5		2.2
1800 - 2000	—	1.0	1.8		2.5
2120 - 2240	—	1.2	1.8		2.8
2360	—	1.2	1.8		3.0
2500 - 2650	—	1.2	1.8		3.2
2800 - 3000	—	1.2	1.8		3.5
3150	—	1.2	1.8		4.0
3350 - 3550	—	1.5	2.0		4.0
3750	—	—	2.0		4.5
4000 - 5000	—	—	2.0		5.5
5600	—	—	2.0		6.0

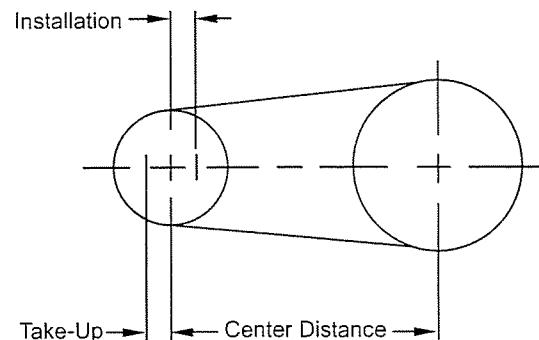


Figure 2

V-BELT SHEAVE INSTALLATION INSTRUCTIONS

Tensioning V-Belts

Calculate or measure the belt span length as shown in Figure 3. Calculate the required deflection by multiplying this number by 1/64. For example, if the belt span is 32 inches, $32 \times 1/64 = 1/2$ inch deflection. Increase the belt tension by increasing the center distance (or adjusting the idler, if present). Apply the force listed in Table 2 evenly across the width of the belt at the center of the belt span. A strip of keystock or similar material may be used to help distribute the force evenly across the belt width. Drives with shock loading or other unusual conditions may require increased tension. Always check to be sure bearings can handle the loads. Excessively high or low tensions will affect belt life. Recheck belt tensions after 24 hours of operation.

TABLE 2
SHEAVE DIAM - INCHES
DEFLECTION FORCE - LBS.

Belt Cross Section	Smallest Sheave Diameter Range	RPM Range	Belt Deflection Force			
			Super Gripbelts and Unnotched Gripbands		Gripnotch Belts and Notched Gripbands	
			Used Belt	New Belt	Used Belt	New Belt
A,AX	3.0 - 3.6	1000-2500	3.7	5.5	4.1	6.1
		2501-4000	2.8	4.2	3.4	5.0
	3.8 - 4.8	1000-2500	4.5	6.8	5.0	7.4
		2501-4000	3.8	5.7	4.3	6.4
	5.0 - 7.0	1000-2500	5.4	8.0	5.7	8.4
		2501-4000	4.7	7.0	5.1	7.6
B,BX	3.4 - 4.2	860-2500	-	-	4.9	7.2
		2501-4000	-	-	4.2	6.2
	4.4 - 5.6	860-2500	5.3	7.9	7.1	10.5
		2501-4000	4.5	6.7	6.1	9.1
	5.8 - 8.6	860-2500	6.3	9.4	8.5	12.6
		2501-4000	6.0	8.9	7.3	10.9
C,CX	7.0 - 9.0	500-1740	11.5	17.0	14.7	21.8
		1741-3000	9.4	13.8	11.9	17.5
	9.5 - 16.0	500-1740	14.1	21.0	15.9	23.5
		1741-3000	12.5	18.5	14.6	21.6
D	12.0 - 16.0	200-850	24.9	37.0	-	-
		851-1500	21.2	31.3	-	-
	18.0 - 20.0	200-850	30.4	45.2	-	-
		851-1500	25.6	38.0	-	-
3V,3VX	2.2 - 2.4	1000-2500	-	-	3.3	4.9
		2501-4000	-	-	2.9	4.3
	2.65 - 3.65	1000-2500	3.6	5.1	4.2	6.2
		2501-4000	3.0	4.4	3.8	5.6
	4.12 - 6.90	1000-2500	4.9	7.3	5.3	7.9
		2501-4000	4.4	6.6	4.9	7.3
5V,5VX	4.4 - 6.7	500-1749	-	-	10.2	15.2
		1750-3000	-	-	8.8	13.2
		3001-4000	-	-	5.6	8.5
	7.1 - 10.9	500-1740	12.7	18.9	14.8	22.1
		1741-3000	11.2	16.7	13.7	20.1
	11.8 - 16.0	500-1740	15.5	23.4	17.1	25.5
		1741-3000	14.6	21.8	16.8	25.0
8V	12.5 - 17.0	200-850	33.0	49.3	-	-
		851-1500	26.8	39.9	-	-
	18.0 - 22.4	200-850	39.6	59.2	-	-
		851-1500	35.3	52.7	-	-

Belt Cross Section	Smallest Sheave Diameter Range	Belt Deflection Force	
		Used Belt	New Belt
3L	1.25 - 1.75	3/8	5/8
	2.00 - 2.25	3/4	1 1/4
	2.50 - 3.00	1	1 1/2
4L	2.10 - 2.80	5/8	1
	3.00 - 3.50	1 5/8	2 1/2
	3.70 - 5.00	2	3
5L	3.00 - 4.20	1 1/2	2 5/8
	4.50 - 5.20	2 1/2	3 1/2

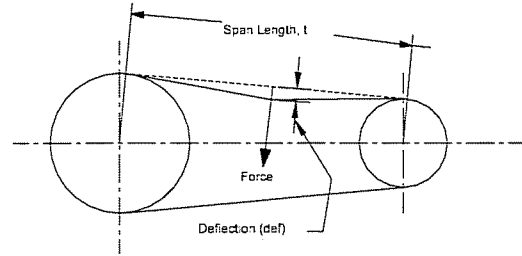


Figure 3

CAUTION

To avoid damage, supporting structure including shafts and bearings must be designed to handle transmitted loads and belt tension(s).

WARNING

Operating drives without guards in place can result in severe injury or death.

Note: For gripbands (multiple or banded belts), the belt deflection force in the above tables must be multiplied by the number of ribs in the gripband. Lay a narrow steel bar such as keystock across the gripband belt and apply the belt deflection force to the bar such that all the individual ribs are deflected evenly.

General Notes

Do not install new belts in worn sheave grooves. Such sheaves should be replaced with new ones to insure a proper fit of the belts in the grooves. Keep belts clean. Do not use belt dressing.

When replacing belts on a drive, be sure to replace the entire set with a new set of matched belts. Failure to do this may result in premature breakage of new (and probably shorter) belts.

Keep extra belts stored in a cool, dark, dry place.

Have questions? Contact Technical Services at 1-800-626-2093.



CAST
STEEL
GATE,
GLOBE &
CHECK
VALVES

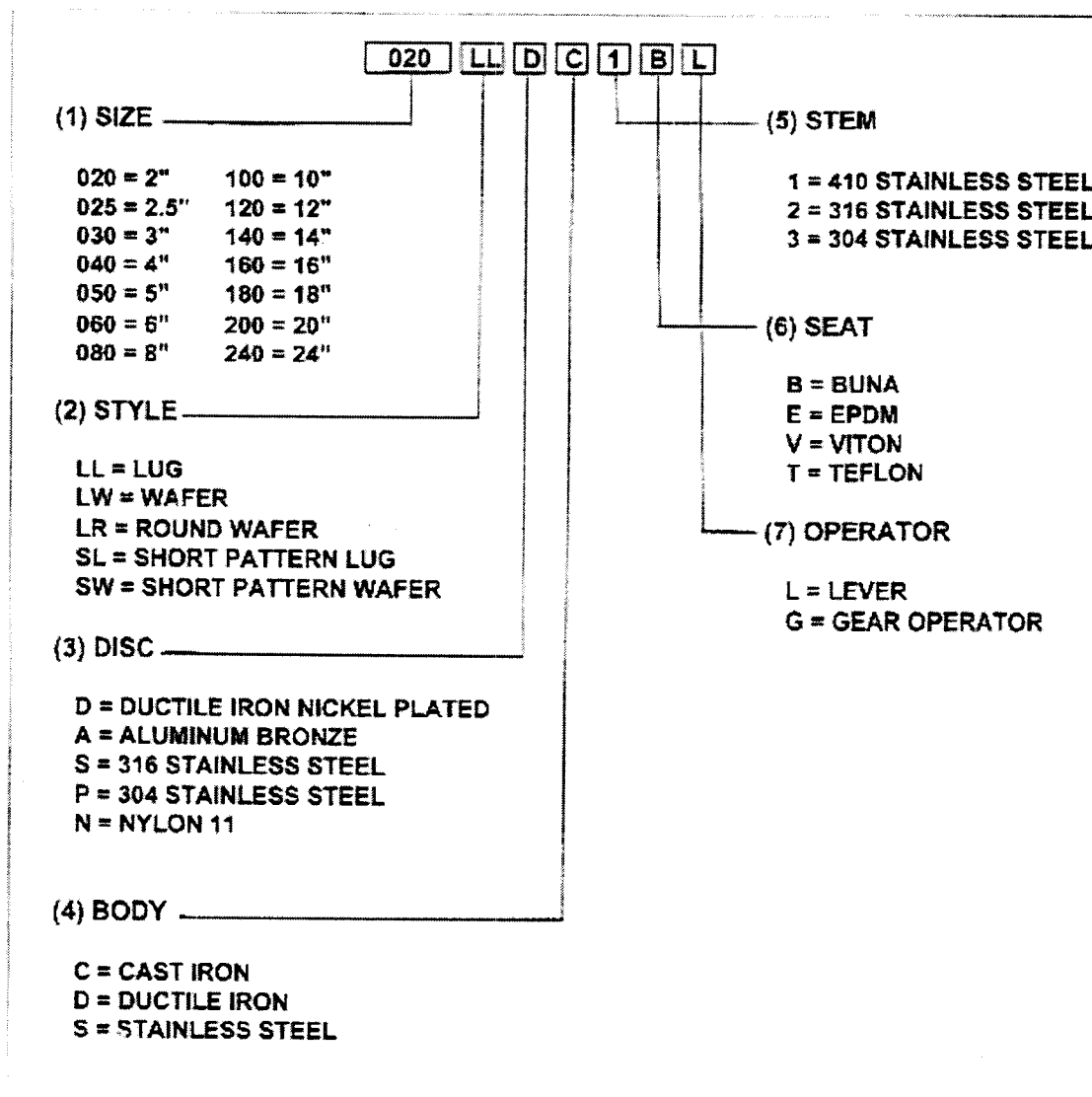
SWING
CHECK
VALVES

300# O-
RING
BRASS
CHECK
VALVES

NEEDLE
VALVES

NEW
PRODUCTS

C & C INDUSTRIES Butterfly Valve Figure Numbering System



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HOME / CONTACT INFO

C200 WAFER STYLE BUTTERFLY VALVE DIMENSIONS

PRODUCT LIST

LUG BUTTERFLY VALVES

A = Body O.D.
B = Centerline of valve to top of mounting flange

WAFER BUTTERFLY VALVES

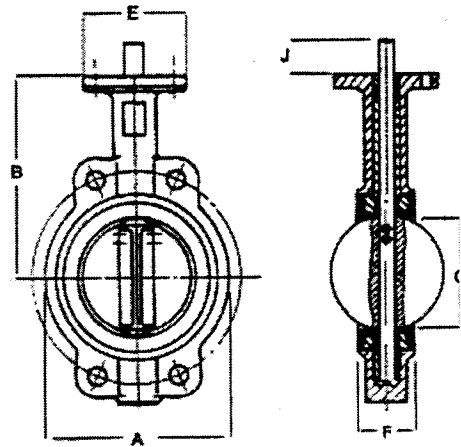
C = Valve Bore
E = O.D. of mounting flange

THREADED BODY STYLE BUTTERFLY VALVES

F = Face to Face
G = Stem Dimension - diameter
H = Stem Dimension - across flats

HAMMER UNIONS

J = Height of stem above mounting flange



MUD TANK UNIONS

VALVE SIZE											MOUNTING FLANGE DRILLING			
	in.	mm	A	B	C	E	F	G	H	J	ISO	BC	HOLES	HOL DIA
FLANGED-END BALL VALVES	2	50	3.94	6.34	2.09	3.03	1.65	0.51	0.35	1.14	F05	1.97	4	0.2
SPECIALTY FLANGED-END BALL VALVES	2.5	65	4.72	6.89	2.52	3.03	1.77	0.51	0.35	1.14	F05	1.97	4	0.2
	3	80	5.00	7.13	3.07	3.03	1.77	0.51	0.35	1.14	F05	1.97	4	0.2
THREADED BALL VALVES	4	100	6.14	7.87	4.09	3.62	2.05	0.63	0.43	1.14	F07	2.76	4	0.3
	5	125	7.48	8.39	4.88	3.62	2.13	0.75	0.51	1.14	F07	2.76	4	0.3
BRASS BALL VALVES	6	150	8.35	8.90	6.14	3.62	2.20	0.75	0.51	1.14	F07	2.76	4	0.3
	8	200	10.67	10.24	7.95	5.91	2.36	0.87	0.63	1.46	F12	4.92	4	0.5
	10	250	12.91	11.50	9.84	5.91	2.56	1.14	0.83	1.57	F12	4.92	4	0.5
	12	300	15.87	13.27	11.85	5.91	2.99	1.26	0.94	1.77	F12	4.92	4	0.5
	14	350	17.17	14.49	13.15	5.91	3.03	1.26	0.94	1.77	F12	4.92	4	0.5
	16	400	19.21	15.75	15.35	7.76	3.43	1.30	1.06	2.05	F14	5.51	4	0.7

CAST STEEL GATE, GLOBE & CHECK VALVES	18	450	21.22	16.61	17.36	7.76	4.17	1.50	1.06	2.05	F14	5.51	4	0.7
	20	500	23.35	18.90	19.37	7.76	5.20	1.61	1.26	2.56	F14	5.51	4	0.7
	24	600	27.27	22.13	23.35	10.87	5.98	2.01	1.42	2.83	F16	6.50	4	0.9

SWING
CHECK
VALVES

300# O-
RING
BRASS
CHECK
VALVES

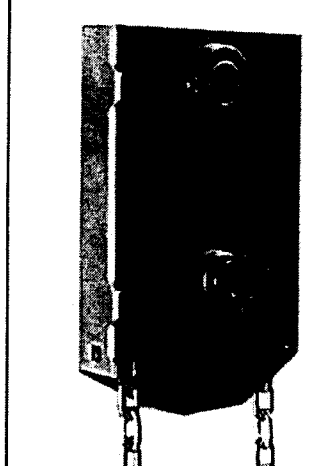
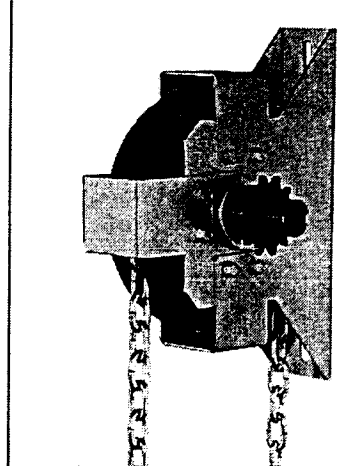
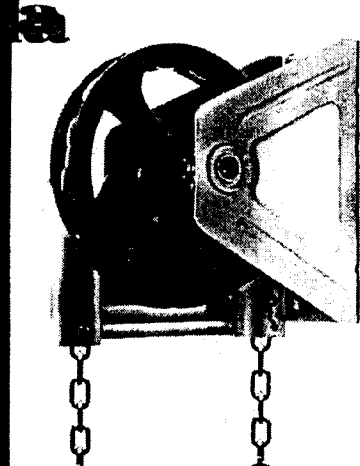
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NEW
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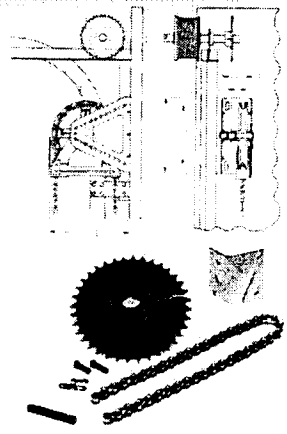
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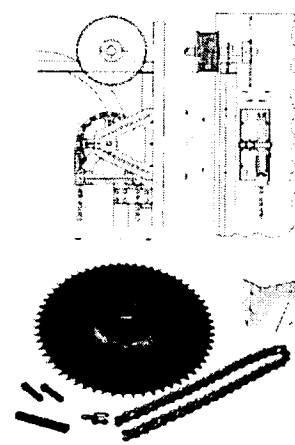
TORQUE FORCE

**2000 R
2000 R HR**

2000 R



2000 R HR



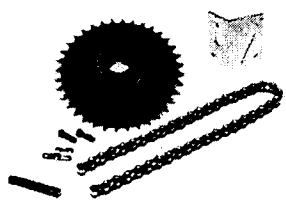
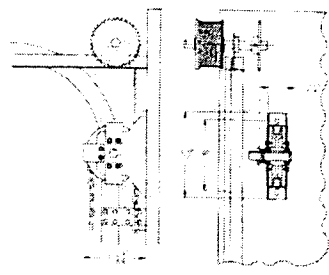
2000 R

- wall mounting
- 4:1 reduction
- including:
 - 1 41B36 sprocket, 1" bore
 - 3' of 41 roller chain
 - 26' of hand chain

2000 R HR

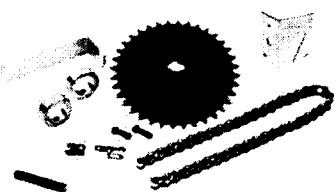
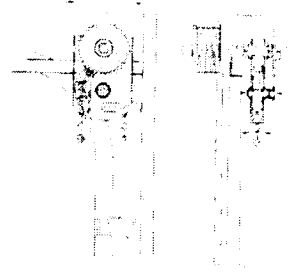
- wall mounting
- 6.6:1 reduction
- including:
 - 1 41B60 sprocket, 1-1/4" bore
 - 4' of 41 roller chain
 - 26' of hand chain

200 R



- wall mounting
- 3:1 reduction
- including:
 - 1 41B36 sprocket, 1" bore
 - 3' of 41 roller chain
 - 26' of hand chain
 - 1 chain keeper
 - 1 key 1/4"

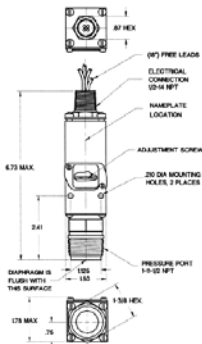
J.R.



- improved design
- now fits 3-3/8 min. offset
- jack shaft mounting for 1" or 1-1/4" shaft
- 4:1 reduction
- including:
 - 1 41B36 sprocket
 - 22" of 41 roller chain
 - 26' of hand chain
 - 1 chain keeper
 - 2 shaft collars
 - 1 wall bracket
 - 1 key 1/4"



INSTALLATION DRAWING

Shipping Wt. Approx.
26 OZ (737 GRAMS)

Press. 1 to 2500 psi

FLUSH MOUNT SERIES:

6900GZE** -7066

6900GZE** -7074

STANDARD FEATURES:

- Flush Mount Diaphragm
- UL/CSA - See Note 1
Explosion Proof: Div. 1, 2
- NEMA: 4, 7, 9, 13

AMBIENT TEMP RANGE

- 30° to 160° F

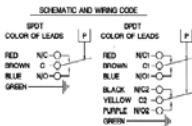
- 34° to 71° C

OPERATING AND ORDERING DATA :

Max. Sys Press. psig	Proof (Test) Press. psig	Adj. Set-Point Range		Approx. Dead Band psig	BASIC MODEL NUMBER		WETTED PARTS ADDER FOR WETTED PARTS
		On Incr. Press. psig	On Decr. Press. psig		MODEL SPDT	MODEL DPDT	
500	750	3 - 15	1 - 13	2	6900GZE12	6900GZEM12	ADD -7066 FOR 316
500	750	12 - 75	6 - 69	6	6900GZE14	6900GZEM14	STAINLESS STEEL PORT AND DIAPHRAGM
1500	2000	18 - 150	6 - 138	12	6900GZE16	6900GZEM16	ADD -7074 FOR HASTELLOY "C" ALLOY PORT AND DIAPHRAGM
1500	2000	45 - 375	15 - 345	30	6900GZE18	6900GZEM18	
2000	3000	300 - 1000	225 - 925	75	6900GZE20	6900GZEM20	
3000	4500	700 - 2500	520 - 2320	180	6900GZE22	6900GZEM22	

ELECTRICAL RATINGS:

VOLTS	AMPERES	
	SPDT Res.	DPDT Res.
125 AC - 50/60 Hz	11	11
250 AC - 50/60 Hz	11	11
30 DC	5	5
125 DC	.5	.5



Note 1:

Div. 1 explosion-proof and hermetically sealed electrical assembly Part No. 46-1058 (46-1061 for DPDT), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and CSA Testing Laboratories (File No. 22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, F, and G.

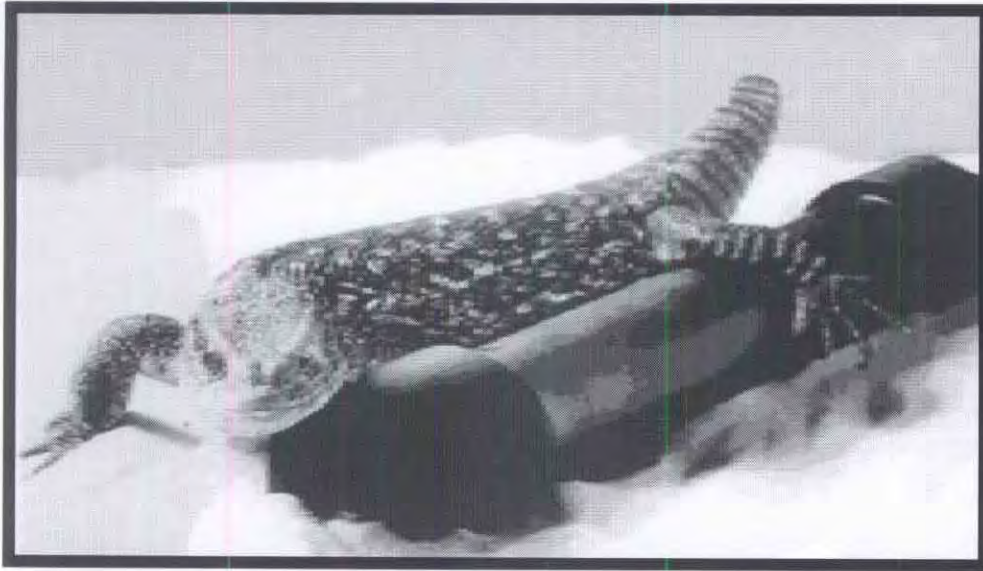
Note 2:

Gold contacts available for milliamp or intrinsically safe circuits.

HOW TO ORDER:

1. Specify model number based on wetted parts: Example: 6900GZE12-7066 for 316 SST Port and Diaphragm or 6900GZE12-7074 for Hastelloy "C" Port and Diaphragm.

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CACTUS®

HOLLOW MEMBRANE TECHNOLOGY

DESIGN AND REFERENCE MANUAL

AIR DRYERS

NATURAL GAS DRYERS

NITROGEN GENERATORS

H₂S / NATURAL GAS SEPARATORS

CFM  [®] *Air
Equipment*

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SAFETY, INSTALLATION AND OPERATING INSTRUCTIONS OF CACTUS MEMBRANES

1. Safety – Obey all safety procedures associated with the use of compressed gases
2. **Be aware that compressed air dried by a membrane gas separator is oxygen deficient and must not be used for breathing air.**

Note: Where oxygen deficient air is exhausted into an enclosed or poorly vented area, the need for special consideration is indicated. See the end of these instructions for a discussion on this matter.

3. **Avoid the use of solvent bearing materials (i.e. Swack) on the ABS SHELL pipe connections. USE ONLY TEPHLON TAPE.**
4. Do not plug, obstruct or restrict vent ports otherwise the shell casing may become over – pressurized (any pressure above 5 PSIG) and become damaged. The result is the sweep (purge) gases, leaking into the ambient atmosphere.
5. Of the purge or sweep gas is to be piped away do not over tighten the fittings threaded into the purge port. (Screw in hand tight and give the fitting an additional one - half turn with a wrench). **Ensure the piping length and diameter will not create back – pressure in excess of 5 PSIG.**

PRE – INSTALLATION INSTRUCTIONS

It is essential the system be protected from over – pressuring.

1. Consult CFM AIR if the dryer is to be installed outside
2. Ensure that the supply air or gas piping is free of liquids and, or, solid contaminants by first implementing an appropriate blow – down procedure.

INSTALLATION

1. Install the valve, a balanced gauge and filters as shown in the diagram.
2. **Note: Filters should be on Air Products/CFM AIR approved list to ensure warranty will not be voided. (See Section 5 of the Design & Reference Manual)**
3. Install a 2nd balance gauge and immediately before the membrane separator (less than one foot separation).

Note: The supply air or gas is to enter the end of the dryer with the open purge ports. If only one port is used position the dryer so that port faces down.

4. Install the 3rd balance gauge on the second valve.
5. Connect the second valve to down – stream equipment.
6. Close both valves.

TESTING AND START UP

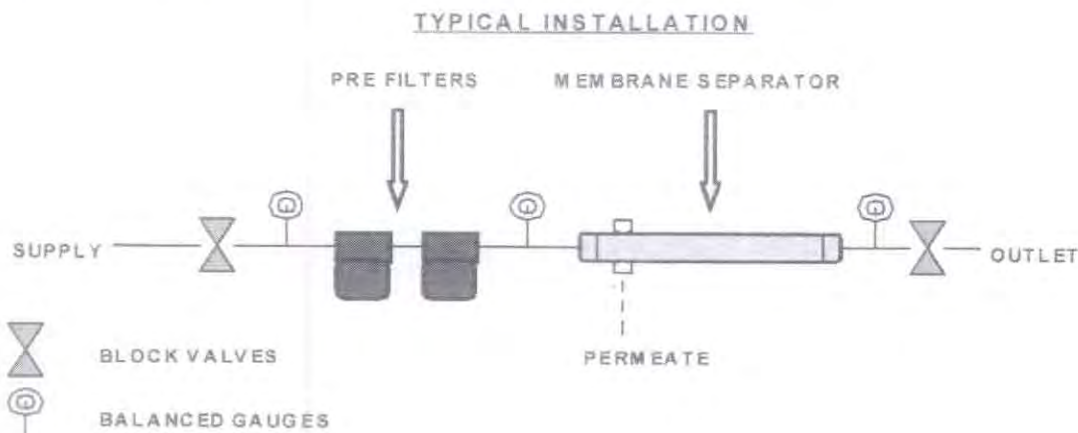
1. Ensure both valves are closed.
2. Pressurize the up – stream air/gas line.
3. Open the inlet valve and slowly pressurize the dryer.
4. Check for leaks. Correct as required.
5. Check to ensure all the gauges show the identical pressure.
6. Slowly open the down stream valve. Do not allow a pressure drop in the excess of 1 PSIG across the dryer. (Ideally, restrict the flow to the maximum design flow parameter). All the system to pressurize fully. Test the down stream equipment for leaks. Correct as required.
7. Test with equipment in operation.

Note: Pressure drop from gauge 1 to 2 and gauge 2 to 3 .Retain this on file for future reference.

Regarding # 2 – Note: Oxygen deficient air introduced to an enclosed or poorly ventilated room presents the problem of an occupant receiving in – sufficient oxygen. However, if the sweep (purge air) is also introduced into the room the hazard is minimized.

Regardless, one should consider introducing a simple ventilating or breathing air system, which would eliminate the risk entirely.

Note: Please note the location of the gauges. They are positioned so the pressure drop across the dryer can be recorded. As the first filter becomes laden with aerosols after start – up the pressure across the filters will increase relatively quick, then it will level off. Record the latter pressure and change the elements when ΔP rises



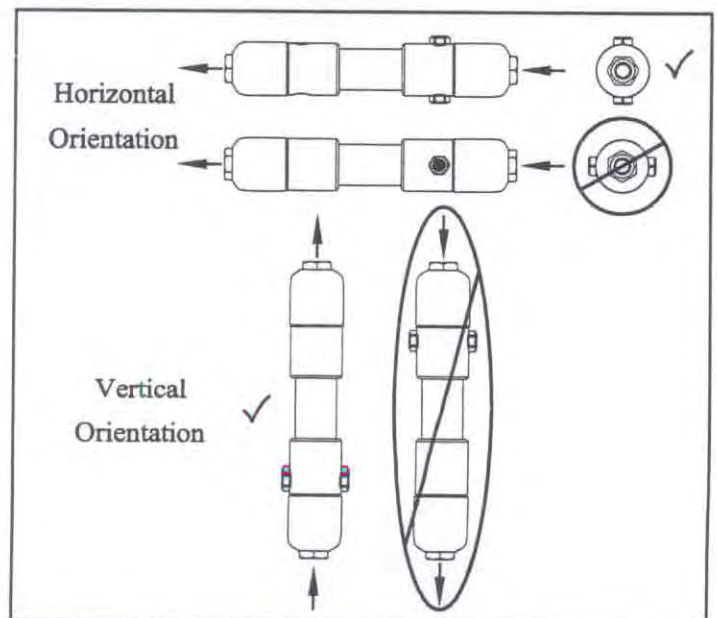
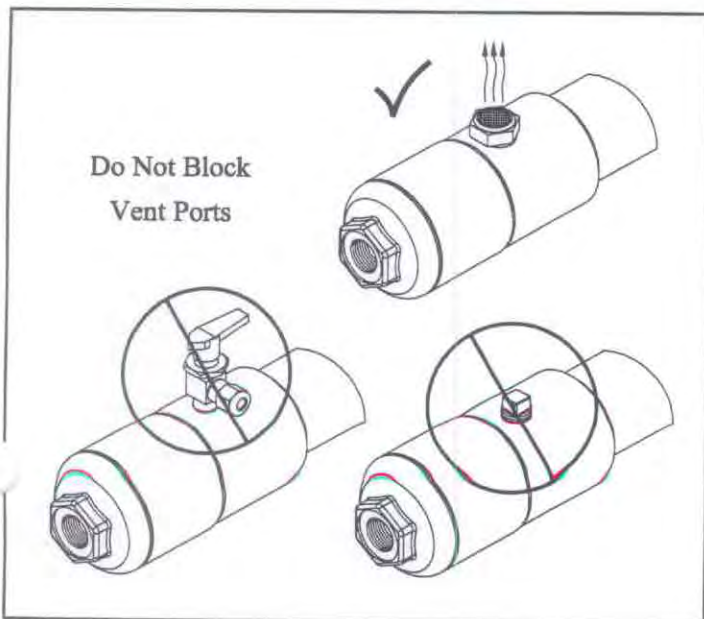
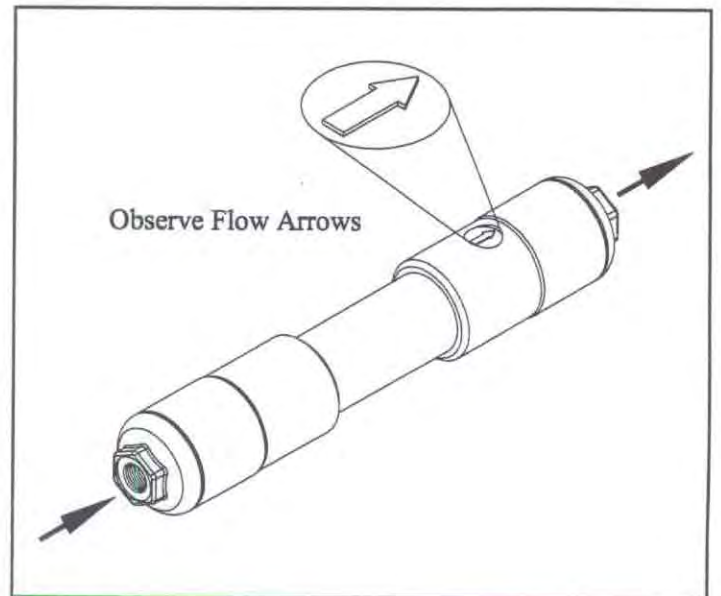
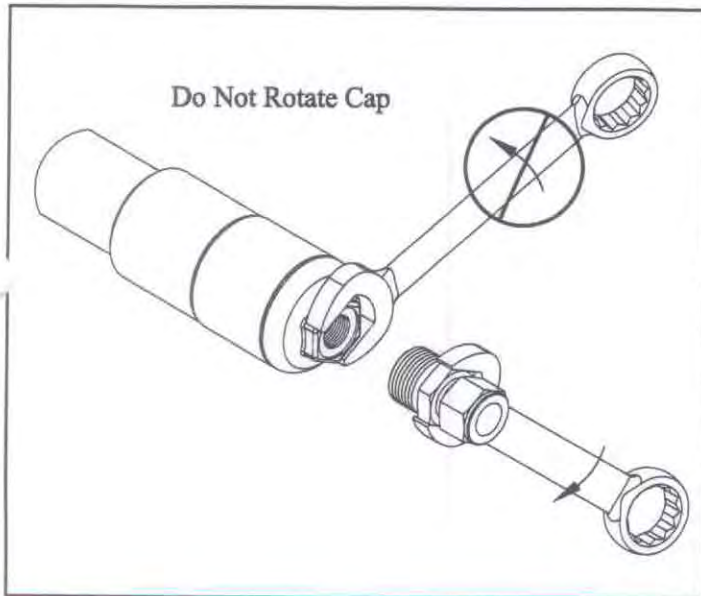
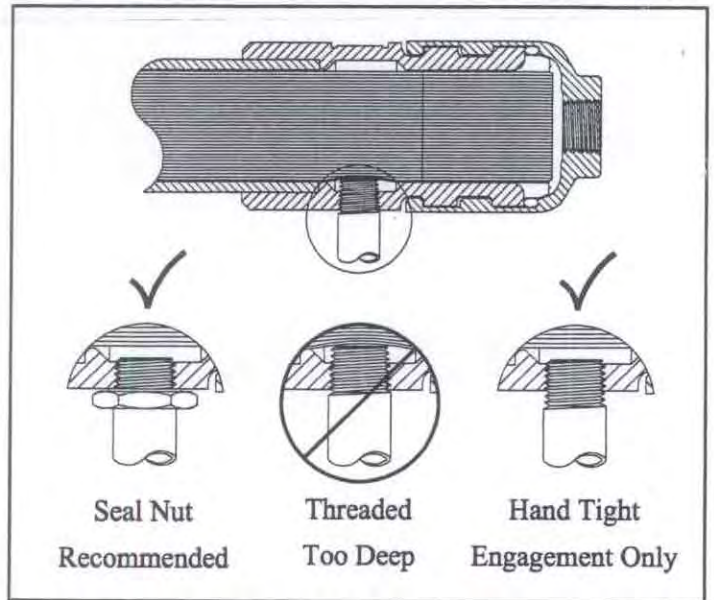


TABLE OF CONTENTS

Section:

- 1.0 Cactus® Membrane Air & Gas Dryers**
- 1.1 How Membranes Work**
- 2.0 Safety**
- 3.0 Comparison with Refrigerated Dryers**
- 3.1 Comparison with Regenerative Desiccant Dryers**
- 3.2 Comparison with Deliquescent Dryers**
- 3.3 Selecting the Appropriate Cactus® Gas Dryer**
- 3.4 Absolute and Relative Humidity**
- 4.0 Design**
- 4.1 Unusual Cases**
- 4.2 The "Supply Air Pressure Dew Point"**
- 5.0 Installation, Start-Up and Operations**
- 5.1 Filtration**
- 5.2 Pre-Installation**
- 5.3 Installation (Continuous Operation)**
- 5.4 Start-Up Operation**
- 5.5 Intermittent or Cyclic Operation**
- 6.0 Multiple Dryers for Higher Capacities**
- 7.0 Sustaining the O₂ Level in the Air**
- 8.0 Maintenance and Troubleshooting**
- 8.1 Filter Elements**
- 8.2 Filter Automatic Drains (non-hazardous gas)**
- 8.3 High Dew Point**
- 9.0 Warranty and Conditions of Sale**
- 9.1 Limitations of Warranty**
- 9.2 Limitations of Liability**
- 10.0 Cactus Specifications**
- 10.1 Design and Reference Addendum #2**
- 10.2 Design and Reference Addendum #3**

1.0

CACTUS[®] MEMBRANE AIR & GAS DRYER (DEHYDRATORS), H₂S SCRUBBERS, N₂ & O₂ GENERATORS

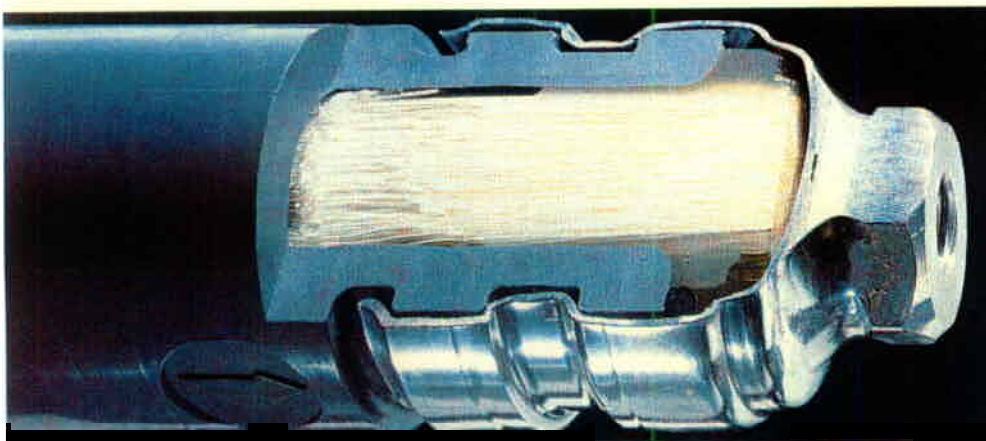
Air Products' CACTUS[®] Membranes employ the principle of selective permeation through a membrane to separate water vapor, H₂S, N₂, O₂ & CO₂ from compressed air and other gases. This passive separation method produces the dry gas you need with no moving parts, no consumables, no noise and no maintenance.

The heart of the dryer is Air Products' patented proprietary semi-permeable, polymeric membranes that are formed into a bundle of tiny hollow fibers. Thousands of these hollow fibers in each dryer provide the maximum separation efficiency. Appropriate selection and modification (fine-tuning) of the hollow fiber membranes achieve desired performance of the system.

1.1

HOW MEMBRANES WORK

Each gas component of a gas mixture has a characteristic permeation rate that is a function of its ability to dissolve in and diffuse through a membrane. This characteristic rate allows fast gases such as water vapor (very fast), oxygen (fast), and hydrogen sulfide (medium fast) to be separated from slow gases, i.e. nitrogen, methane and natural gas respectively. As wet pressurized gas flows into the core of each hollow fiber, the moisture vapor, and sufficient other gas to retain it as vapor, permeate through the fiber walls. This permeate stream is vented at atmospheric pressure. The dry air or gas exits through the end of the fiber at essentially the same pressure as the entering has. The driving force for the separation is the difference between the partial pressure of a gas (which depends on the absolute humidity and total pressure) on the inside of the hollow fiber and that on the outside.



2.0 SAFETY

(A)

As a result of the process described in sections 1.0 & 1.1, dried air from Cactus® Dryers contain less than the normal amount of oxygen and must not be inhaled. Also, some of the H₂S in sour gas permeates along with the water vapor and small quantities of the methane and other gases. This compound flows into the atmosphere creating a hazardous condition which must be **appropriately** dealt with. In the case of Nitrogen Generations, 95% to 98% of the oxygen permeates through the membrane to atmosphere rendering the remaining gas compound 95% to 99.5% pure nitrogen & 0.9% Argon.

(B)

Thus Cactus® products must not be used to supply breathing air or for applications where the product may be accidentally vented, or placed, into an enclosed or poorly ventilated area.

(C)

Avoid the use of "SWAK" and other solvent bearing material on plastic connections. Use only Teflon tape to render connections leak proof thus avoiding the possibility of connection failure, which can occur as the result of liquid sealant.

(D)

Do not plug or restrict vent ports. Doing so would allow the shell to become pressurized thereby possibly damaging it. The maximum safe pressure limit is 5 PSIG.

(E)

Having said that, one must acknowledge that some uses or installations demand that the permeate must be piped to a location remote from the membrane. This will create a back pressure which is acceptable in-so-far as the membrane performance is concerned so long as it does not exceed 5 PSIG and for safety purposes 15 PSIG.

(F)

If there is any possibility of the permeate line plugging or being valved off, it is advisable to install a safe-pressure relief system.

(G)

One possible cause of plugging would be frozen condensate related to the discharge of permeate into sub-zero temperatures or a permeate transmission line so located.

3.0 COMPARISON WITH REFRIGERATED DRYERS

Refrigerated dryers dehydrate a gas or gaseous compound by cooling it down to condense the water vapor. The cooling is provided by freon substitute refrigerant. As ice would block the heat exchanger, the dew point achievable is limited to 35°F by the freezing point of water (32°F). Higher dew points can be obtained by running at higher flows, although this is usually limited to a 50°F dew point by pressure drop at higher flows. Refrigerated dryers do not use any of the compressed gas but do consume electrical power to operate the freon refrigeration compressor. Comparison issues are maintenance, the costs of electrical installation and electricity use; the growing environmental concerns and regulations of freon usage; the 37°F dew point limitation; and, in-line installation without additional support.

3.1 COMPARISON WITH REGENERATIVE DESICCANT DRYERS

These dehydrate gas by absorbing the water on a solid granular desiccant. Because the desiccant must be regenerated, two desiccant towers are used and the gas to be dried is periodically switched between the towers. The tower not being used is regenerated by purging with dry gas. Purge rates for desiccant dryers are nominally 20% for units up to about 200 SCFM feed and 15% for larger units. Desiccant dryers give fixed dew points of -40°F and lower. It is not practical to obtain higher dew points by increasing capacity. Single tower desiccant dryers that use off-line regeneration using an oven are available. They are limited to very low flows by the change out frequency. Very large desiccant dryers (larger than all CACTUS® Dryer models) may use heat (electrical or steam) rather than dry gas to regenerate the desiccant. Comparison issues are the need for -40°F dew point (see section 4), maintenance of the switching valves; desiccant carry over into the dried gas and desiccant life; electrical installation; and in-line mounting without additional support.

3.2 COMPARISON WITH DELIQUESCENT DRYERS

Deliquescent dryers dehydrate air by passing it over a bed of deliquescent material such as calcium chloride. Deliquescent dryers give a dew point depression of 20°F. Desiccant in the dryer absorbs the water to form a corrosive solution that must be drained from the dryer and be discarded in an environmentally acceptable fashion. Desiccant must be replaced on a periodic basis. Comparison issues are the replacement and disposal of the desiccant; installation; and corrosion and fouling of the bed drains by the desiccant solution.

3.3 SELECTING THE APPROPRIATE CACTUS® GAS DRYER

A semi-permeable membrane dryer differs from all other dryers. The inlet gas temperature is of no significance in the selection process. **ONLY THE INLET PRESSURE DEW POINT MATTERS.**

That is not to suggest the two are never the same. In most cases involving compressed air they would be, but that would not be true as far as natural gas, for example, is concerned.

Due to this, the question most often asked is "What if the inlet pressure dew point is not known?" In this case, you should use the inlet temperature. The worst thing that can happen is the dryer may be slightly oversized.

Also, there are two major advantages to using a Cactus® which are often overlooked. Regenerative & Refrigerative dryers are designed to operate continuously and in the case of the former, purge air constantly. A Cactus® can be cycled intermittently.

Secondly, if the inlet air to the dryer has a low dew point to start with, the Cactus® model will be smaller whereas the regenerative model will be determined solely by the flow & pressure and therefore a larger and probably more expensive unit.

3.4 ABSOLUTE AND RELATIVE HUMIDITY

For some applications, i.e. aerating or blanketing of chemicals, the requirement is not prevention of water condensation but absolute or some relative humidity. Cactus® membrane Air/Gas Dryers and N₂ Generators lend themselves to this type of application exceptionally well.

4.0 DESIGN

Refer to the dimensional drawings for the maximum operating pressure of a Cactus® Air or Gas. The PPH250A H₂S/Gas Separator is 300 PSIG max. while the high pressure Air & Gas Dehydrators have a 1100 PSIG design pressure. N₂ Generators are limited to 300 PSIG.

The dryer gas flow (SCFM) from a Cactus® dryer is dependent on the relative humidity and pressure of the supply air and the dry air humidity required by the application. Supply air temperature has no appreciable impact on capacity.

For applications requiring flows higher than that available with the model PC4030-D2-6A-20, multiple dryers is described in section 5.6. DO NOT install dryers in series as the pressure drop will decrease the performance of the second dryer.

Performance tables for pressure dew points are available. They give supply gas and dry gas flows for a series of supply gas dew points and pressures. Linear interpolation can be used to calculate performance for conditions that fall between the values in these tables. To acquire, simply request a set of Cactus® Flow-Charts.

4.1 UNUSUAL CASES

Consult your distributor for sizing dryers for applications that fall outside the bounds of section 8.2, but within the maximum operating temperature and pressure limits of the dryer.

4.2 THE SUPPLY AIR PRESSURE DEW POINT

It is a very significant design application because of the direct effect it has upon the membrane dehydrator's capacity. The lower the inlet pressure dew point, the greater the capacity of the dryer.

When the "inlet pressure dew point" is unknown and difficult to acquire, assume the "inlet pressure dew point" of the gas is the highest temperature at which the gas will enter the dryer. This will avoid difficulties that might otherwise occur.

5.0 INSTALLATION, START-UP AND OPERATION

5.1 Filtration

Cactus® Membrane gas dryers are specifically designed to remove water vapor. Dryer performance and life will be reduced if liquid water or liquid compressor oil enters the dryer. The pre-filter and two coalescing filters (see table specifications) must be installed in front of the dryer to remove both bulk and aerosol liquid water, liquid hydrocarbons, and any other liquids from the gas prior to their entering the dryer. Suitable filters are available from your Cactus® Distributor.

COALESCING FILTER SPECIFICATIONS
<p>EFFICIENCY RATING:</p> <p>Less than 0.01 ppm by weight of oil aerosol after the filter with gas inlet liquid loading up to 100 ppm by weight.</p>
<p>CONSTRUCTION:</p> <p>Must be fitted with a suitable drain. Balanced pressure gauges before and after, or a suitable pressure differential indicator is required. A pressure drop greater than 10 PSIG is excessive. The filter element must be capable of withstanding a minimum of 30 PSI pressure differential between the inlet and outlet.</p>

Filters must be sized for the dryer inlet flow rate and rated for the maximum gas pressure and temperature that could be encountered. DO NOT greatly oversize the filters (dryer supply flow should not be greater than 130% or less than 25% of maximum recommended filter flow). An excessive or insufficient flow can lead to inadequate filtration and failure of the automatic drains.

The three-year warranty on dryers requires use of approved coalescing filters and a written record of filter element changes as well as washing of the bowl every six months.

5.2 Pre-Installation

Cactus® Dryers can be used with oil lubricated, water lubricated or non-lubricated compressors

Cactus® Dryers can be installed:

- Indoors or Outdoors
- Horizontally or at any other angle. If the dryer could be exposed to water it is preferable to mount the dryer horizontally with one of the sweep ports facing down in order to ensure that any water entering the sweep ports will drain. Although the dryer can be mounted at any angle, the coalescing filters and pre-filter must be mounted with the filter bowl vertical as the separated liquids drain by gravity.

Dryers should not be installed at a low point of large compressed gas systems as accumulation of water at low points from a large system can overwhelm the water handling capability of the filter.

Cactus® Dryers and filters are of sufficiently lightweight that they usually require no additional support, however, this should be verified for the particular installation. Weights of the various models of dryers are shown in section 10.0.

Before installing the dryer, verify that:

- 1) The maximum pressure that could be encountered is less than the dryer and filter rated pressures
- 2) The compressed gas supply temperature and ambient temperature at the dryer will not exceed 150°F (65°C) or the filter temperature rating if this is lower.
- 3) The dryer sweep ports will not be obstructed
- 4)
- 5) The line sizes are adequate for the gas flow and allowable pressure drop.

5.3 Installation (Continuous Operation)

A typical Cactus® Dryer installation is shown schematically in Figure 5.1.

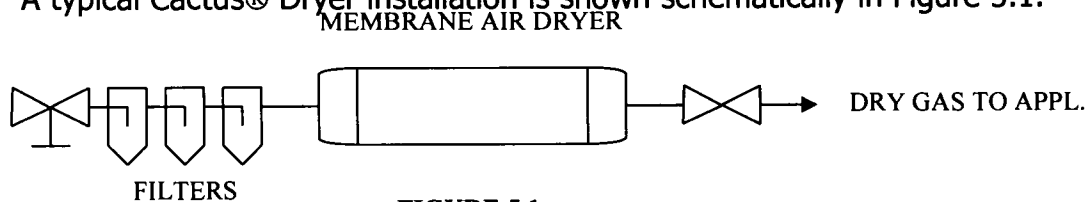


FIGURE 5.1

Open compressed air line at the connection point and allow any accumulated water, oil, or particulates to blow out. Use extreme caution to prevent accidents and injuries during the operation.

If after blowing out the line, the compressed gas is visibly contaminated with water, oil or particulates, then a pre-filter, sized for the supply gas flow and pressure, must be installed. Position it before the coalescing filters to protect the dryer and prolong filter life. Pre-filters are available from your Cactus® Distributor.

Connect the compressed gas supply to the filters and then to the dryer. The coalescing filter should be as close to the dryer as practical (less than one foot separation) to prevent cooling of the air and condensation of water and oil vapor between the coalescing filter and the dryer. A shut-off valve (ball or gate valve) the same size as the supply line should be installed before the filter and dryer so that the dryer and application can be shut-off.

Connect the dry gas outlet to the application and route the filter drain to a suitable location.

5.4 Start-Up Operation

- 1) Close the inlet and outlet valves of the filter/dryer assembly.
- 2) Pressurize the line from the source of the compressed gas to the inlet valve.
- 3) Slowly open the inlet valve so the assembly becomes pressurized gradually.
- 4) Open the outlet valve slowly. DO NOT allow a pressure drop exceeding 1 PSIG to develop across the dryer (ideally, do not exceed the design flow of the dryer).
- 5) When the pressure in the line on the downstream side of the dryer has reached full operating pressure, all valves may be opened completely.
- 6) With the system fully pressurized, check for any possible leaks

The filter differential pressure gauges or indicator should be inspected on a regular schedule, preferable at least once a week. If a high differential pressure is indicated on either the pre-filter or coalescing filters, the offending filter elements must be changed. It is recommended that replacement filter elements be kept on hand as spares. If the filter life is less than six months with a pre-filter installed, compressor maintenance or excessive line corrosion and/or contamination is indicated. If any decrease in the drain rate is observed, the filter should be depressurized and the bowl removed.

Filter elements should be replaced on a regular six month schedule or sooner if the pressure and differential dictates it. When replacing the filter element, the filter bowl and drain should be washed with warm soapy water to remove any accumulated oil.

The three year warranty on dryers requires use of an approved coalescing filter and a written record of filter element changes and washing of the bowl every six months.

To shutdown the dryer, turn off the gas supply and allow the pressure to decrease to atmospheric pressure.

5.5 Intermittent or Cyclic Operation

The configuration shown in figure 5.1 could be used for applications with intermittent or cyclic use of dry gas by installing a valve, controlled by the application, after the dryer. With this configuration the dryer remains pressurized during the no demand segment of the cycle and air will continue to be lost as sweep. The air loss during the no demand segment of the cycle can be reduced or eliminated using the configurations described below.

When a Cactus® dryer is depressurized, moisture from the atmosphere enters the sweep ports and will, after some time, saturate both the gas in the dryer and the hollow fiber membranes. On restarting, this moisture will result in a short period of higher-than-design humidity in the dried air. Also, at start-up, the pressure in the dryer is atmospheric pressure and until the pressure rises to the design pressure, the dryer will give less than design drying efficiency. This effect also contributes to the higher-than-design humidity at start-up.

Figure 5.2 shows an application where use is intermittent but the gas flow (controlled by the application) never exceeds the Cactus® Dryer design flow. The back pressure regulator (BPR) prevents gas flow from the dryer until the pressure is high enough for the dryer to function at near design efficiency. This delay also allows the low pressure wet gas in the dryer and most of the water in the fibers to be removed, as sweep gas before gas flows to the application when the dryer is depressurized. If the piping between the BPR and the application is not depressurized during the no demand segment of the cycle, the BPR can be replaced by a check valve or a check valve with internal bleed back. The check valve with back bleed will give higher air loss than the BPR or normal check valve, but further reduces the higher-than-design humidity spike at start-up by preventing moisture from the atmosphere entering the sweep ports. Check valves with back bleed are not a standard item and must be specially manufactured for the application.

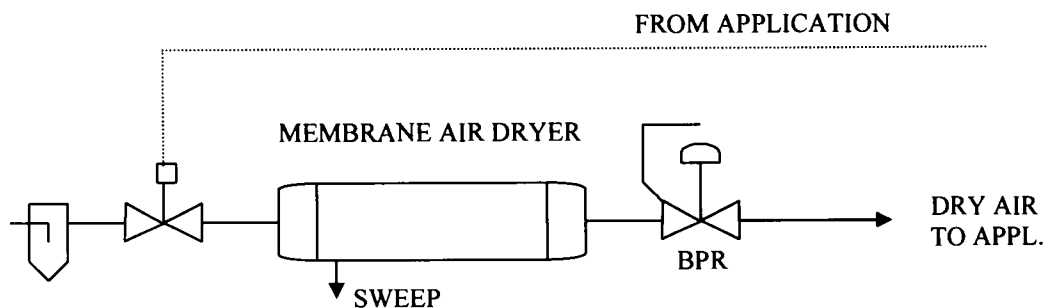


FIGURE 5.2

Figure 5.3 shows an application where the use is intermittent and the instantaneous flow (but not the time average flow) exceeds the dryer design flow. The air storage tank must be sized to handle the high instantaneous flows. The principals of operation are similar to those described above. The needle valve sets the flow from the dryer. It should be sized to give the design flow with a pressure drop that is equal to (gas supply pressure – filter pressure drop – low pressure setting of the tank pressure switch), however, note that the pressure drop across the valve (and flow) will decrease from design valve to zero, as the tank pressure increases to the operating pressure. If the tank pressure is never reduced below 80% of the supply pressure, the back pressure regulator can be replaced by a check valve or a check valve with back bleed.

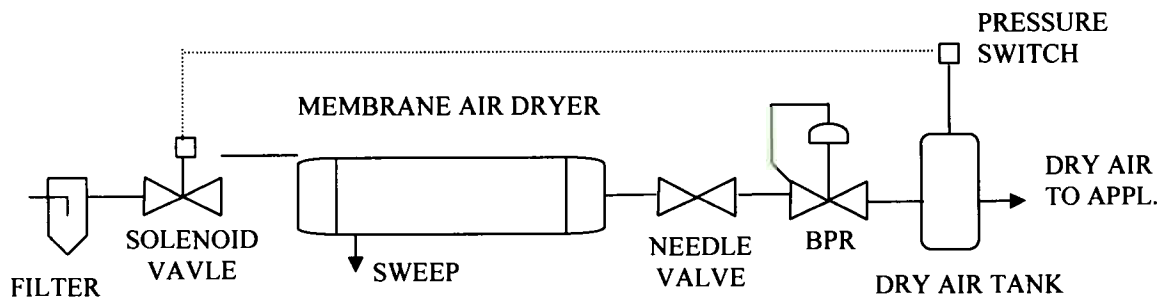
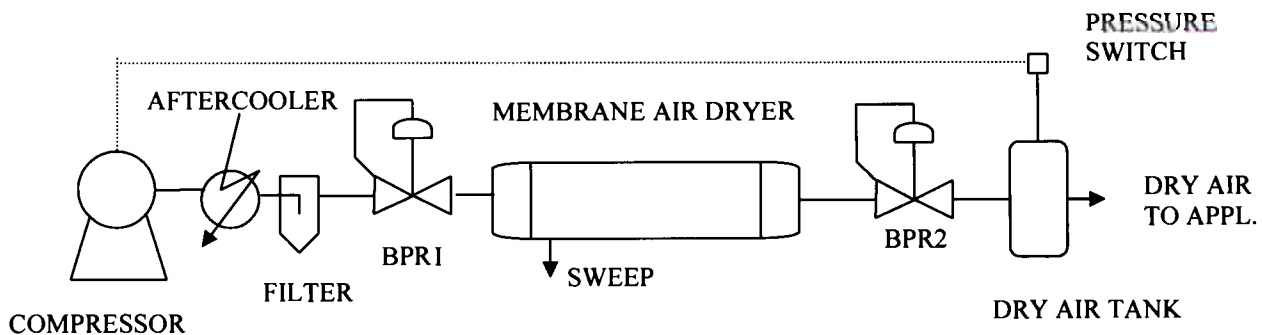


FIGURE 5.3

Figure 5.4 shows an application where a dedicated compressor is used and the average flow is less than the compressor capacity so that the compressor will cycle on and off in response to the pressure in the dry gas storage tank. The Cactus® dryer must be sized for 80% of the maximum tank pressure and the compressor capacity at this pressure. The principals of operation are similar to those described above.

FIGURE 5.4



**BPR1 = BACK PRESSURE REGULATOR
SET AT 50+% OF MAXIMUM TANK PRESSURE**

**BPR2 = BACK PRESSURE REGULATOR
SET AT 50+% OF MAXIMUM TANK PRESSURE**

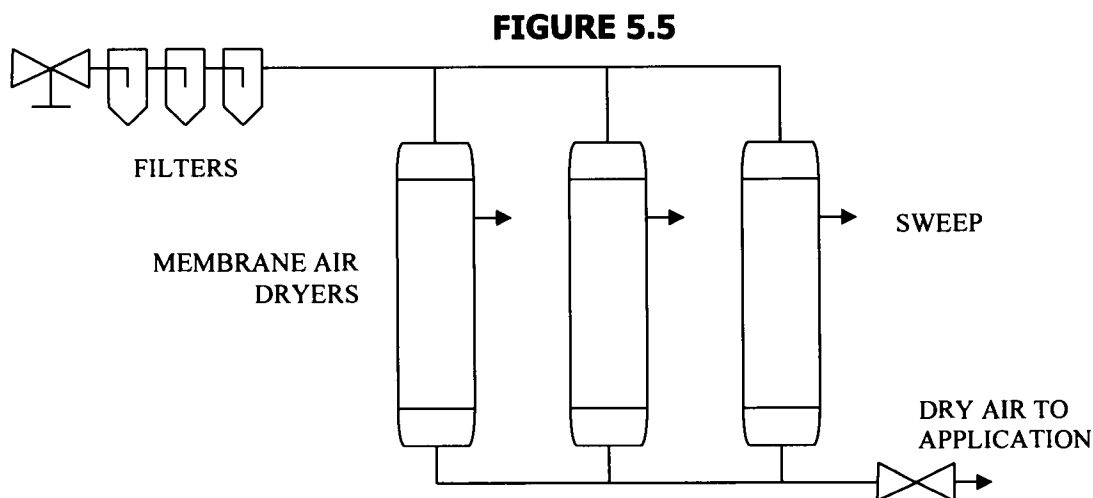
The first back pressure regulator, BPR1, prevents gas from entering the dryer until the pressure reaches 50% of the maximum tank pressure. This prevents very humid and low-pressure gas from entering the dryer, and it allows the coalescing filter to begin operating effectively before gas enters the dryer. The second back pressure regulator, BPR2, provides the function described for figure 5.3. If the tank pressure is never reduced below 80% of maximum pressure, then the second back pressure regulator (BPR2) can be replaced by a check valve or a check valve with a back bleed.

For all the above configurations, the back pressure regulators, solenoid valves and check valves must be selected based on flow and pressure. The pressure drop across the back pressure regulator, solenoid valve and check valve must be allowed for in the dryer design.

Installation, start-up and operation is as described in sections 5(A) through (D) for continuous operation.

6.0 MULTIPLE DRYERS FOR HIGHER CAPACITIES

Multiple dryers in parallel (see Figure 5.5) can be used to increase capacity beyond that available with a single dryer. All the dryers should be the same models. It is not necessary to provide any mechanism to balance flows between the dryers. Only one filter pack is preferred (for pressure-drop balance and cost) and must be sized for the combined flow. Figure 5.5 does not show valves that could be used to isolate one dryer; valves are not recommended, but if used, identical valves and configuration must be used for all dryers.



7.0 SUSTAINING THE O₂ LEVEL IN AIR

By now you are well aware the product from a Cactus® air dryer is oxygen deficient and must not be inhaled. However, there are industrial applications requiring dry air with the normal oxygen content. There is a solution to this conundrum...

If dry air with a normal 20.9% oxygen level is necessary, i.e. ozone generation, this can be achieved with a dedicated compressor as shown in Figure 5.6. With this configuration the air being compressed will contain more than the normal oxygen content and this imposes special consideration in compressor selection. **Consult your distributor before designing and/or operating a system using this configuration.** This configuration is intended for OEM application only. Even with this configuration, Cactus® dryers **MUST NOT** be used to supply breathing air.

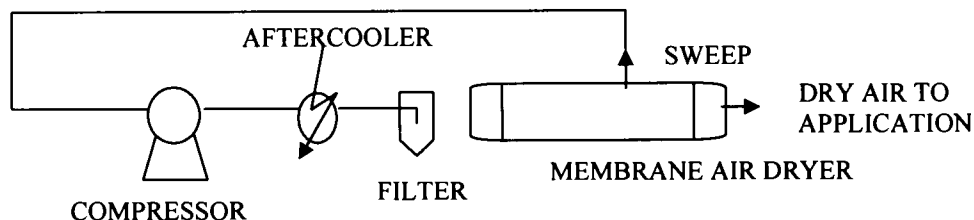


FIGURE 5.6

8.0 MAINTENANCE AND TROUBLESHOOTING

The only routine maintenance required is replacement of the filter element(s) at least every six months. There are no repairable components within the Cactus® dryer and any attempt to disassemble the dryer could lead to damage and will void the warranty.

To ensure performance of the Cactus® dryer and to obtain maximum compressor life, all compressor maintenance schedules recommended by the compressor manufacturer should be followed.

8.1 FILTER ELEMENTS

If the filter differential pressure gauges show a 10 lb. difference on (either of) the filter(s), the element(s) must be changed. Failure to do so will likely result in dryer contamination.

The filter element(s) should be changed at least every six months. See section 2.1.

Detailed instructions for element replacement are supplied with filters and replacement elements.

8.2
FILTER AUTOMATIC DRAINS
(USED WITH NON-HAZARDOUS GAS)

If a high water level is observed in a filter, the automatic drain is not functioning correctly and the dryer should be shut down. Extended operation with malfunctioning automatic drains could result in liquid water and oil entering the dryer resulting in too high dew point and damage to the dryer. See instructions supplied with the filter to replaced the automatic drain.

8.3
HIGH DEWPOINT

Before attempting to troubleshoot the Cactus® Dryer, verify that the dried gas usage is at or below the design level. High gas flow will result in high dew points.

The most likely cause of high dew points is low air-supply pressure, due to either low-pressure to the filters or high-pressure drop across the filters. Filter time-to-change indicator will indicate the latter.

9.0
WARRANTY AND CONDITIONS OF SALE

Warranty and remedy – Seller warrants that the Cactus® Gas Dryer (Module) will be free from defects due to material or workmanship for three (3) years after the first day when a compressed gas stream is put through the module, under proper and normal use and service. If within thirty (30) days after Buyer’s discovery of any such defects Buyer notifies Seller thereof in writing, Seller shall, at its option and as the exclusive remedy for this warranty, promptly repair or replace portion of the module found to be defective F.O.B. Seller’s facility. Failure by Buyer to give Seller such written notice within the applicable time period specified above, shall be deemed a waiver of Buyer’s claim to such defects. This warranty is based on the Module as delivered and is contingent upon the following:

- (A) The module is installed and operated as specified in the installation and operating manual supplied with the Module.
- (B) Operation of the Module is within the Module specification limits.
- (C) Gas filtration prior to the Module is installed and maintained, as specified in the installation and operating manual, and the Buyer utilizes an approved coalescing filter with automatic drain and differential pressure indicator immediately prior to the module. The filter element is to be changed out every six (6) months or sooner if the differential pressure indicator dictates such change.
- (D) The Buyers keeps a written record of all such changes.

Seller shall not be obligated to make repairs or replacement which become necessary because of ordinary wear and tear, corrosion or erosion or as a result of improper handling, maintenance, storage, use or operation. No allowance will be made for repairs or alterations made without the written consent of Seller, in which event all Sellers' warranties shall be void.

9.1 LIMITATIONS OF WARRANTY

Seller makes no representation or warranty of any kind, expressed or implied as to merchantability, fitness for a particular purpose, or any other matter with respect to the Module whether used alone or in combination with other equipment not supplied by the Seller, except for the warranties of good title and right to transfer the Modules free of encumbrance.

9.2 LIMITATIONS OF LIABILITY

Buyer's exclusive remedy for breach of this expressed warranty shall be as stated herein. Seller shall not be liable for injury to person or property arising from the presence or use of the Modules. Buyer's exclusive remedy for all other claims shall be for damages, and Seller's total liability for any and all losses and damages arising out of any cause whatsoever including, without limitation, defect in or defective performance of the Module, (whether such claims be based in contract, negligence, strict liability, other tort or otherwise) shall in no event exceed the purchase price of the Module in respect of which such cause arises or, at Seller's option, the repair or replacement of such. In no event shall Seller be liable for special, incidental, consequential or punitive damages resulting from any such cause. Notice of a claim as to any module delivered or the non delivery thereof shall be made within 30 days of the date of delivery, or the date fixed for delivery, as the case may be, and failure to give notice shall constitute a waiver by Buyer of all claims in respect thereto.

10.0 CACTUS® SPECIFICATIONS

10.1 Design and Reference Addendum #2

CFM Air Equipment has occasionally encountered a client which is unwilling to provide CFM Air Equipment with an analysis of the natural gas to be introduced to a Cactus® natural gas dehydrator, or H₂S scrubber or combination thereof.

It is only mandatory that CFM Air or Air Products be supplied with an analysis for H₂S separation but the reason for wanting one is very valid.

Air Products makes no secret of the fact that the introduction of liquid hydrocarbons to the dehydrator will seriously impair the permeation rate on H₂O

and H₂S. Once this occurs, the damage is irreversible. Providing CFM Air or Air Products with a gas analysis is akin to taking out an insurance policy against physical damage.

If C5, C6, C7 or heavier hydrocarbon vapors are present at a saturated level at the temperature of the gas entering the dehydrator, the membrane is in jeopardy should the gas cool sufficiently to cause condensation to occur.

The problem lies with the fact that as the compressed gases permeate through the membrane, into the area between the membrane and its protective tube, they expand and cool thereby reducing the temperature of the C6 & C7 gases sufficiently to produce some condensate causing residual damage of the membrane.

When CFM receives an analysis report a copy is forwarded to Air Products, with flow, pressure and temperature data. A professional evaluates it and either approves or rejects the installation on the basis of the data received. All data is treated with the utmost confidentiality.

A rejection has never been received and the likelihood of a problem is extremely remote, but the possibility exists and the precaution is a valid one.

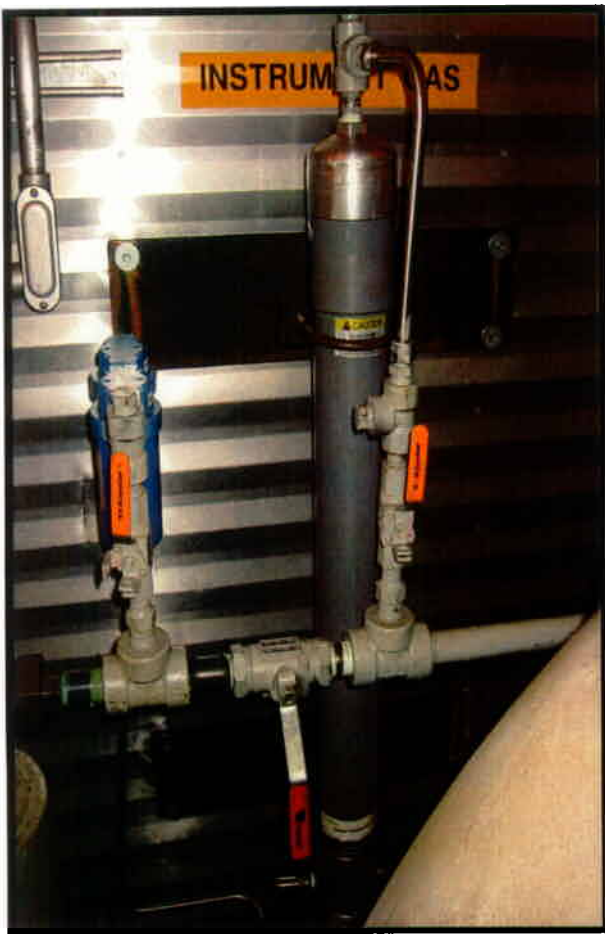
The assessment can easily be made by a competent "professional" employed or retained by the client. No one is going to argue with that, but either way it is a precaution that is well worth the trouble.

10.2 DESIGN AND REFERENCE ADDENDUM #3 SPECIAL NOTES RE H₂S

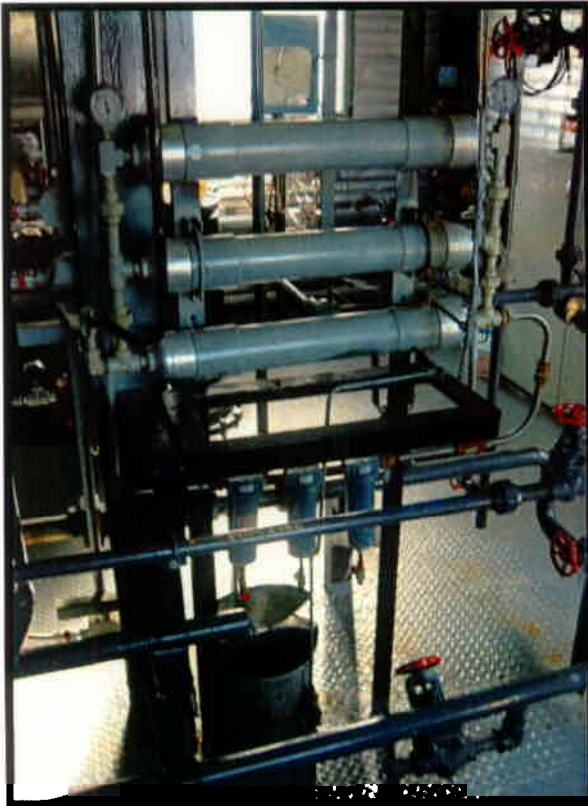
H₂S, being a highly poisonous and dangerous gas, demands that Cactus® Separators & their installation be treated with the same respect as other H₂S associated equipment and their installation.

Sizing of the H₂S Cactus® Separator requires a gas analysis. The concentration of the component gases can vary substantially and may alter the H₂S separation process significantly.

Also, the proposition of the heavier hydrocarbons dictate the temperature at which the gas may be processed thereby avoiding damage of the membrane by hydrocarbon condensate.



Membrane Installations





SAFETY, INSTALLATION AND OPERATING INSTRUCTIONS OF CACTUS MEMBRANES

1. Safety – Obey all safety procedures associated with the use of compressed gases
2. **Be aware that compressed air dried by a membrane gas separator is oxygen deficient and must not be used for breathing air.**

Note: Where oxygen deficient air is exhausted into an enclosed or poorly vented area, the need for special consideration is indicated. See the end of these instructions for a discussion on this matter.

3. **Avoid the use of solvent bearing materials (i.e. Swack) on the ABS SHELL pipe connections. USE ONLY TEPHLON TAPE.**
4. Do not plug, obstruct or restrict vent ports otherwise the shell casing may become over – pressurized (any pressure above 5 PSIG) and become damaged. The result is the sweep (purge) gases, leaking into the ambient atmosphere.
5. Of the purge or sweep gas is to be piped away do not over tighten the fittings threaded into the purge port. (Screw in hand tight and give the fitting an additional one - half turn with a wrench). **Ensure the piping length and diameter will not create back – pressure in excess of 5 PSIG.**

PRE – INSTALLATION INSTRUCTIONS

It is essential the system be protected from over – pressuring.

1. Consult CFM AIR if the dryer is to be installed outside
2. Ensure that the supply air or gas piping is free of liquids and, or, solid contaminants by first implementing an appropriate blow – down procedure.

INSTALLATION

1. Install the valve, a balanced gauge and filters as shown in the diagram.
2. **Note: Filters should be on Air Products/CFM AIR approved list to ensure warranty will not be voided. (See Section 5 of the Design & Reference Manual)**
3. Install a 2nd balance gauge and immediately before the membrane separator (less than one foot separation).
Note: The supply air or gas is to enter the end of the dryer with the open purge ports. If only one port is used position the dryer so that port faces down.

4. Install the 3rd balance gauge on the second valve.
5. Connect the second valve to down – stream equipment.
6. Close both valves.

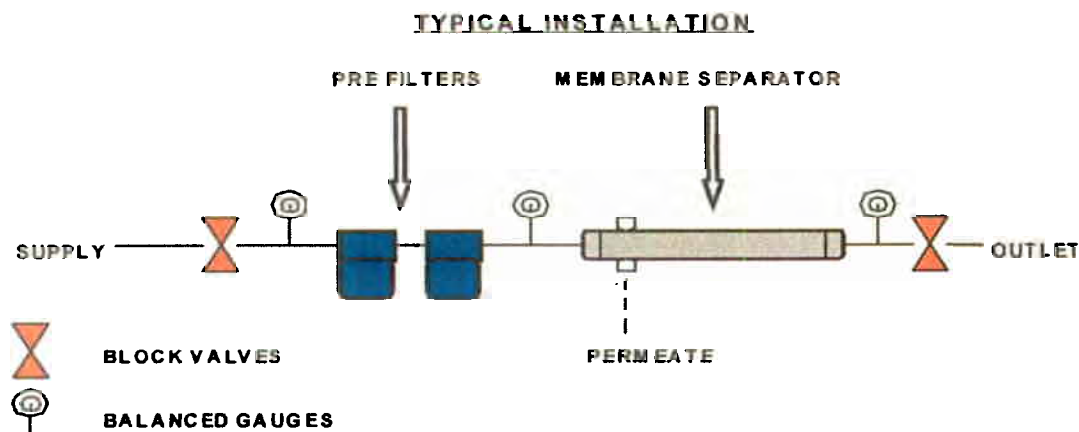
TESTING AND START UP

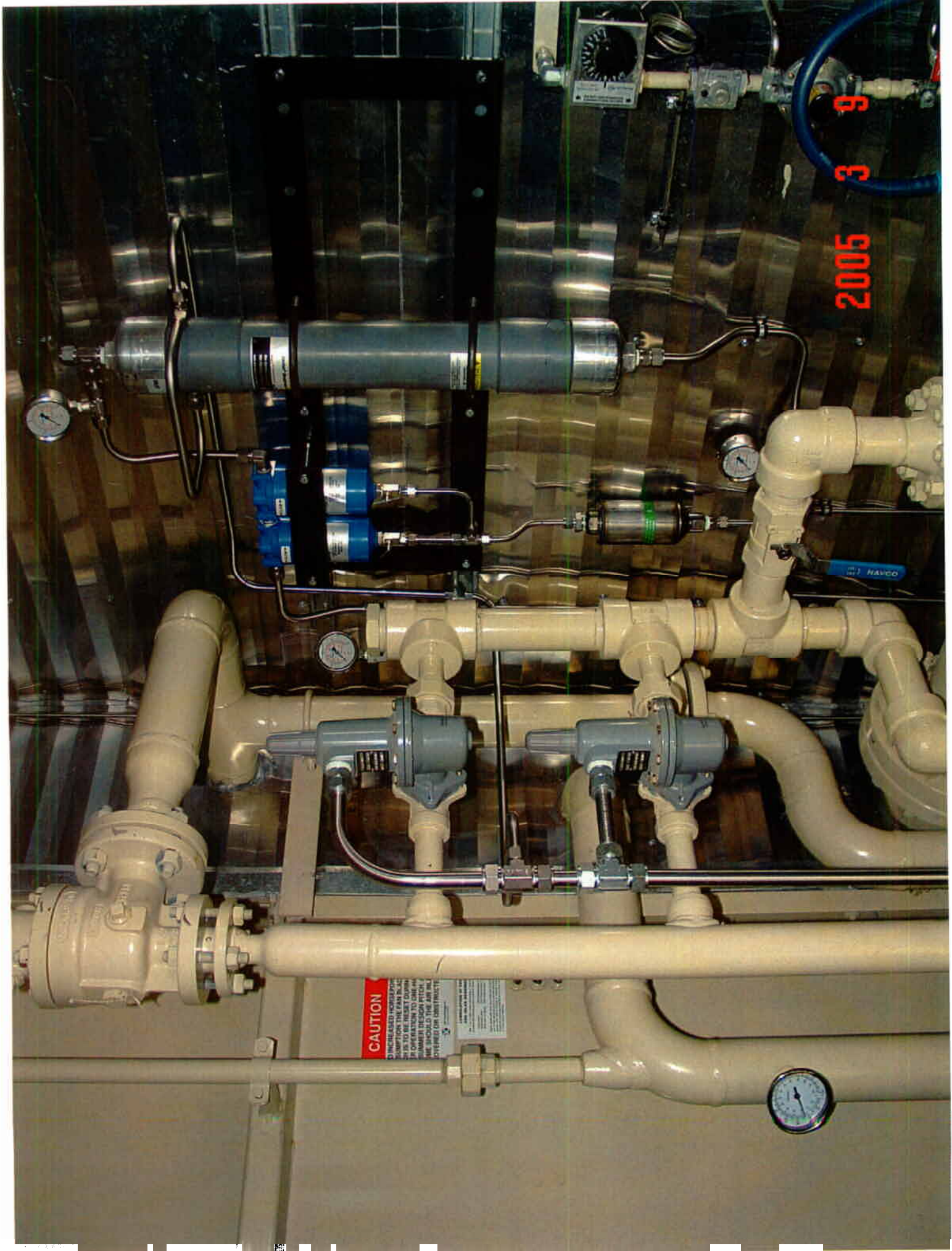
1. Ensure both valves are closed.
2. Pressurize the up – stream air/gas line.
3. Open the inlet valve and slowly pressurize the dryer.
4. Check for leaks. Correct as required.
5. Check to ensure all the gauges show the identical pressure.
6. Slowly open the down stream valve. Do not allow a pressure drop in the excess of 1 PSIG across the dryer. (Ideally, restrict the flow to the maximum design flow parameter). All the system to pressurize fully. Test the down stream equipment for leaks. Correct as required.
7. Test with equipment in operation.

Note: Pressure drop from gauge 1 to 2 and gauge 2 to 3 . Retain this on file for future reference.

Regarding # 2 – Note: Oxygen deficient air introduced to an enclosed or poorly ventilated room presents the problem of an occupant receiving in – sufficient oxygen. However, if the sweep (purge air) is also introduced into the room the hazard is minimized. Regardless, one should consider introducing a simple ventilating or breathing air system, which would eliminate the risk entirely.

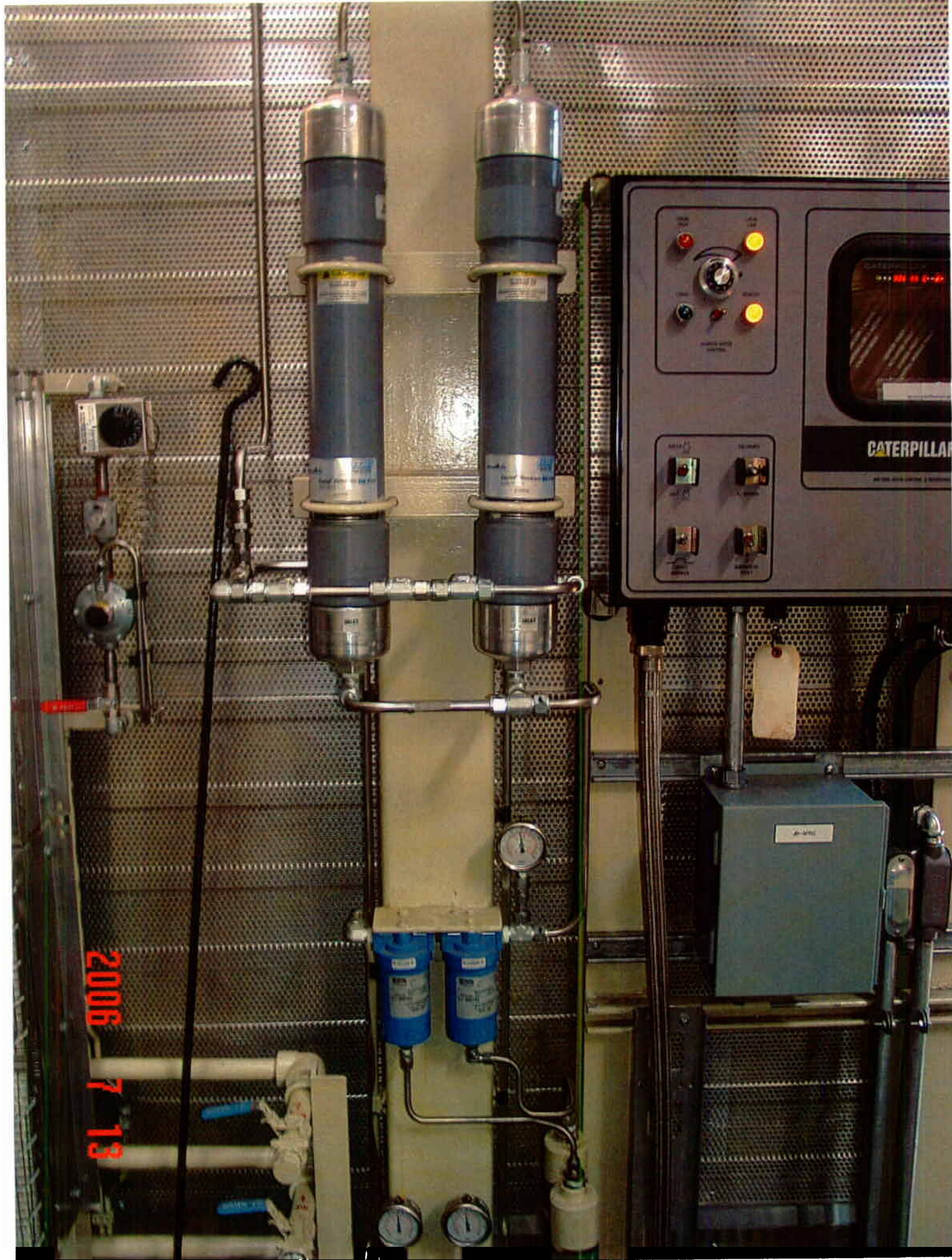
Note: Please note the location of the gauges. They are positioned so the pressure drop across the dryer can be recorded. As the first filter becomes laden with aerosols after start – up the pressure across the filters will increase relatively quick, then it will level off. Record the latter pressure and change the elements when ΔP rises





2005 3 9

CAUTION
INCREASED NOISE LEVELS
DURING THE FAN IN-AC
OPERATION. THE FAN IS
DESIGNED TO OPERATE
AT A DESIGN FLOW RATE.
IF THE FLOW RATE IS
EXCEEDED, THE AIR FLOW
MAY BE UNSTABLE OR
DISCONTINUED.

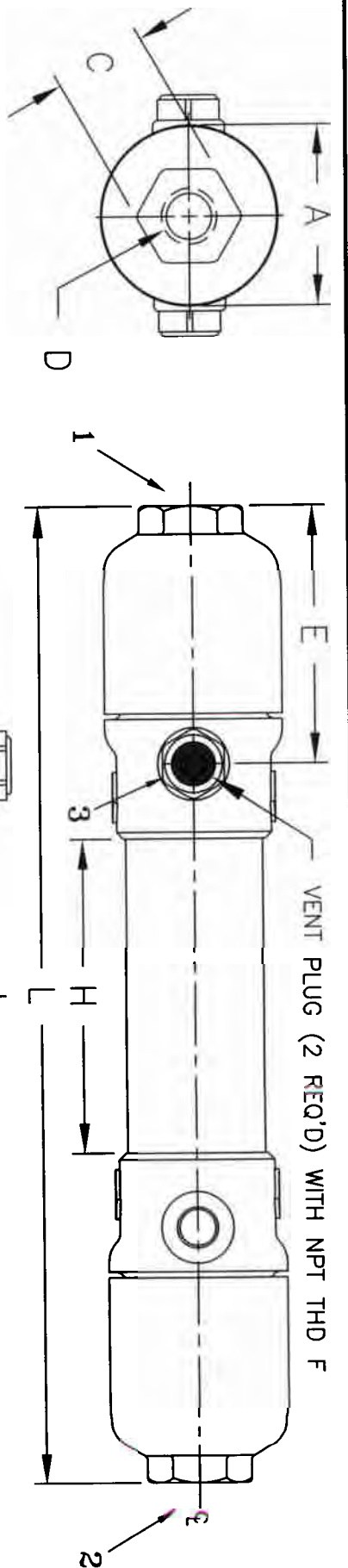


2006 7 13

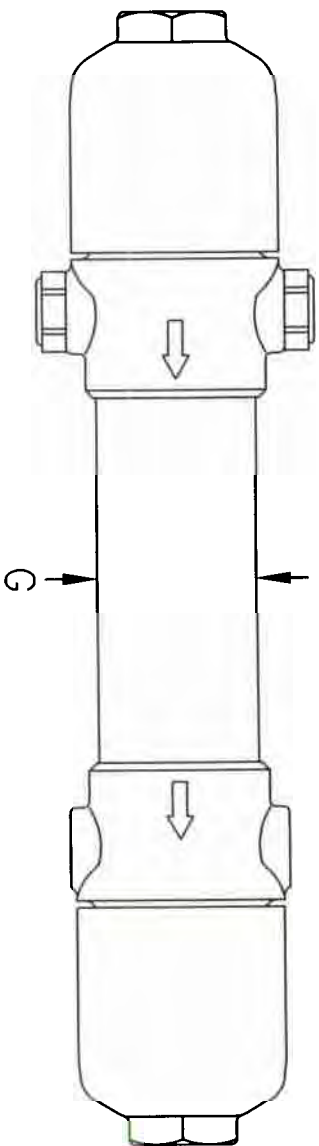
Control panel with a digital display showing '0.00', several indicator lights (red, yellow, green), and physical buttons. The brand name 'CATERPILLAR' is visible on the right side of the panel.

A blue rectangular component, possibly a pump or motor, mounted on a metal frame. It has a label that reads 'A-1000'.

Two circular gauges or pressure sensors located at the bottom of the piping system.



- PORTS
 1 - COMPRESSED AIR INLET
 2 - DRY AIR PRODUCT
 3 - PERMEATE PORT



Cactus® Dryer

MODEL NO.	A (MAX)	C	D	E ± 0.06	F	G	H	L ± 0.12	WEIGHT (LBS)
PC1010-P1-3A-20	2.16	1.13	3/8" NPT	3.13	1/4" NPT	1.66	3.82	11.88	1.3

MAXIMUM OPERATING TEMPERATURE: 150°F
 MAXIMUM OPERATING PRESSURE: 300 PSIG
 MATERIALS: SHELL: HIGH PERFORMANCE ABS
 END CAPS: 6061 ALUMINUM
 OUTLET FLOW: 2 SCFM



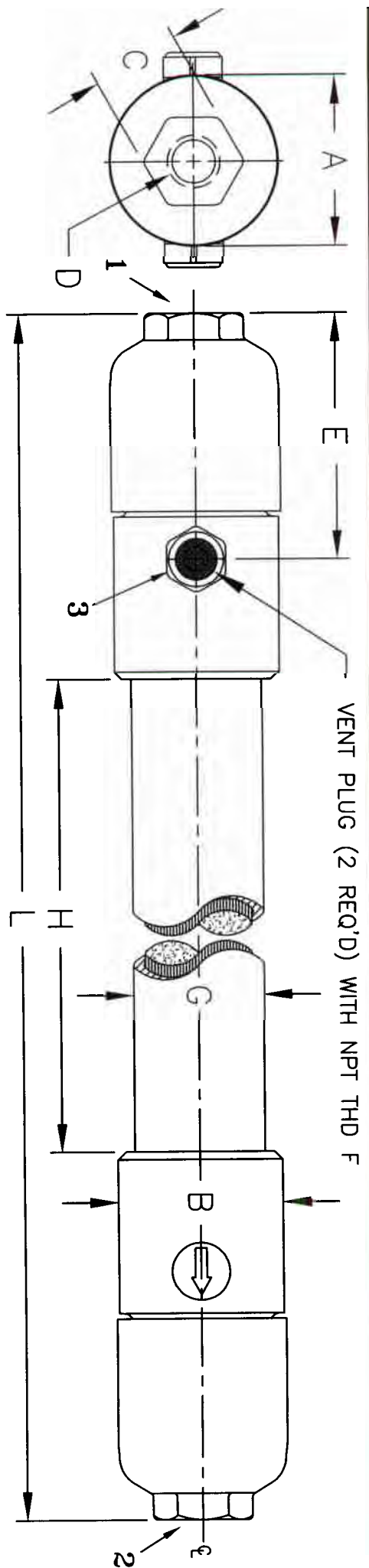
REV	ECR	DESCRIPTION OF CHANGE	BY	DATE	APP
4	01-014	LOGO CHANGE	KMJ	6/20/01	WAB
3	00-014	MODEL NUMBER WAS PPC-21	KMJ	9/25/00	WAU
2	99-004	REV. TO REV 2 SHELL: OMT "PLUGGED PORT"	KMJ	3/1/99	WAU
1	98-045	REV. PRES. RATING: WAS: 200 NOW: 300	KMJ	11/17/98	WAU

DRAWN: KMJ	10/20/97	APPROVE: WAU	8/3/98
THIRD ANGLE PROJECTION			
PRISM® Membranes			

PRODUCTS AIR			
SERIES		PC1010	
TITLE			
EXTERNAL DIMENSIONS			

MATERIAL: NOTED			
NO. REQ'D: 1	SCALE: 1:2	SHEET 1 OF 1	REVISION
DWG SIZE	DRAWING / PART NO.	REV	
A	2942-11-13	4	

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- PORTS**
- 1 - COMPRESSED AIR INLET
 - 2 - DRY AIR PRODUCT
 - 3 - PERMEATE PORT

MODEL NO.	A (MAX)	B	C	D	E ± 0.06	F	G	H	L ± 0.12	WEIGHT (LBS)
PC1020-P1-3A-20	2.16	2.10	1.13	3/8" NPT	3.13	1/4" NPT	1.66	16.71	26.00	1.6

MAXIMUM OPERATING TEMPERATURE: 150°F
 MAXIMUM OPERATING PRESSURE: 300 PSIG
 MATERIALS: SHELL: HIGH PERFORMANCE ABS
 END CAPS: 6061 ALUMINUM

PRISM® Membranes

AIR PRODUCTS **PRISM Membranes**

SERIES PC1020

TITLE EXTERNAL DIMENSIONS

MATERIAL: NOTED

NO. REQ'D: 1 | **SCALE:** 1:2 | **SHEET** 1 OF 1

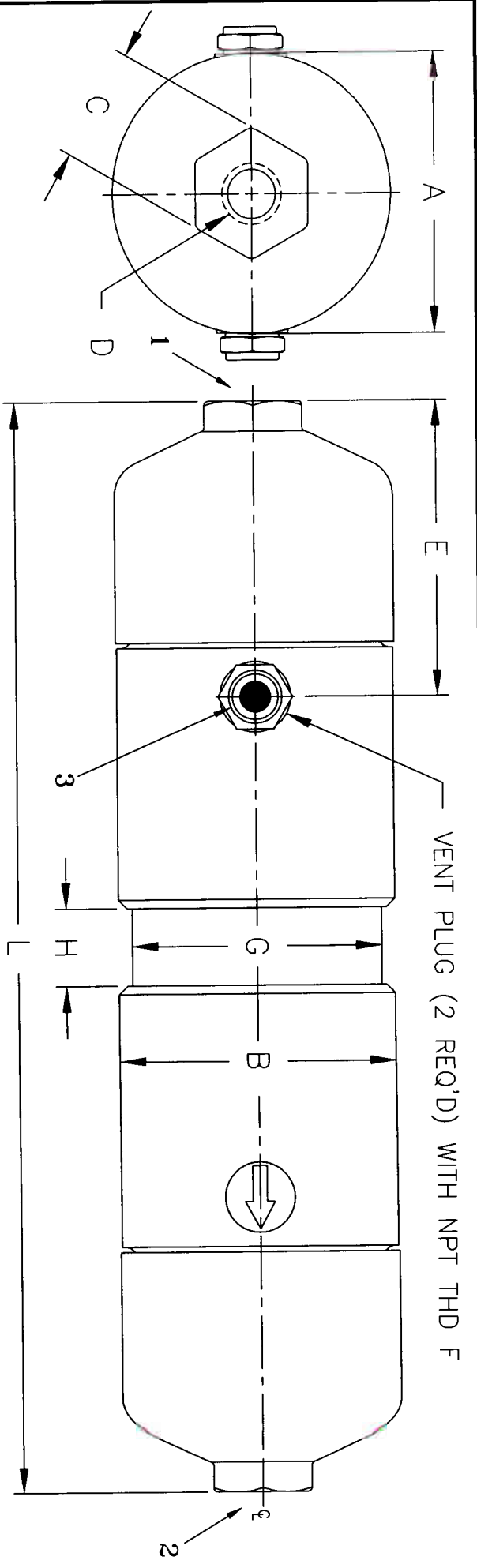
DWG SIZE DRAWING / PART NO. | **REVISION**

A | 2942-10-24 | 3

Rev.	per chg. to	Rev.	per chg. to	Rev.	per chg. to
3	03-082	Rev. per chg. to 2942-10-04 r8.	KMJ	10/27/03	WAU
2	01-014	LOGO CHANGE	KMJ	6/20/01	WAB
1	00-014	MODEL NUMBER WAS PPC-22	KMJ	9/25/00	WAU

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- PORTS
- 1 - COMPRESSED AIR INLET
 - 2 - DRY AIR PRODUCT
 - 3 - PERMEATE PORT

Cactus® Dryer

MODEL NO.	A (MAX)	B	C	D	E ± 0.06	F	G	H	L ± 0.12	WEIGHT (LBS)
PC3010-D2-3A-20				3/8" NPT				1.10	15.25	4.6
PC3020-D2-4A-20	3.91	3.88	1.38	1/2" NPT	4.13	3/8" NPT	3.50	12.73	26.88	6.3
PC3030-D2-4A-20				1/2" NPT				27.10	41.25	8.3

MAXIMUM OPERATING TEMPERATURE: 150°F
 MAXIMUM OPERATING PRESSURE: 300 PSIG
 MATERIALS: SHELL: HIGH PERFORMANCE ABS
 END CAPS: 6061 ALUMINUM



REV	ECR	DESCRIPTION OF CHANGE	BY	DATE	APP
4	03-073	REVISED ARROW LOCATION	WAU	9/29/03	WAU
3	01-014	LOGO CHANGE	KMJ	6/20/01	WAB
2	00-014	MODEL NUMBERS WERE PPC-45, 410, 415	KMJ	9/25/00	WAU
1	99-019	REV. OPER. PRES. WAS: 200 PSIG NOW: 300 PSIG	KMJ	7/8/99	WAU

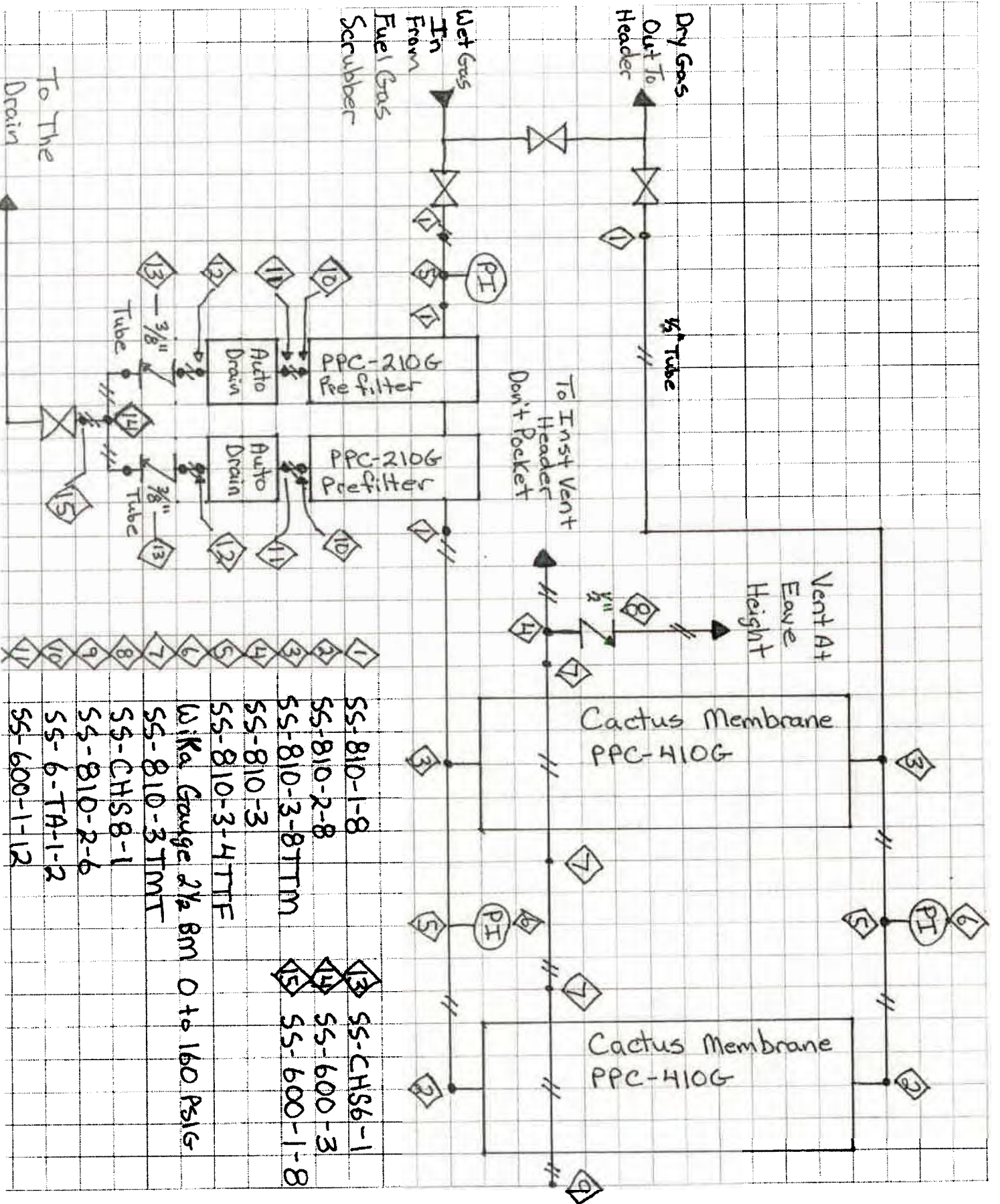
DRAWN: KMJ	11/11/97	APPROVE: KMJ	11/12/97
THIRD ANGLE PROJECTION			

PRISM® Membranes	
SERIES	PC3010, 3020, 3030
TITLE	EXTERNAL DIMENSIONS
MATERIAL: NOTED	

NO. REQ'D:	1	SCALE:	1:2.2	SHEET	1 OF 1
DWG SIZE	A	DRAWING / PART NO.	2941-22-12	REVISION	4

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Product Overview

The CM2 (6000 psig - 414 barg) barstock construction needle valve is designed for multiple applications wherever throttling or bubble-tight shutoff is required. The CM2 is available in a wide variety of inlet & outlet configurations and materials. Specific CM2 models meet the requirements of NACE MR0175-2002. The CM2 is available in both hard and soft seat configurations, and is available with Teflon® or Grafoil® packing or an O-ring seal. To simplify installation requirements the CM2 series can be factory configured with various manufacturers tube fittings.

Features:

- Available with either ball or needle stem ends, providing bubble-tight shutoff and ensuring long valve life. The non-rotating ball tip eliminates seat galling.
- All valves are available with a panel mount system option - consult factory.
- All valves are hydrostatically tested to rated pressure prior to factory shipment.

- Full material traceability is standard on each CM2. All valves are shipped standard with full material documentation for wetted components.
- Either the Teflon® or Grafoil® packing is easily adjustable in field.
- All packing is below the threads which ensures the valve's actuation threads are not contaminated by the process. This feature ensures smooth valve operation and long service life.
- All CM2's feature safety back seating ensuring the prevention of both accidental stem blowout and removal under pressure.
- Standard dust covers ensure long service life by preventing the elements (rain, snow, dirt, etc.) access to the bonnet assembly.

CM2 Ordering Code:

CM2 1 M44T D G SC

Materials:

- 1: SS - 316/316L (meets NACE MR0175-2002)
- 2: CS/SS - A105 CS Body w/ SS Trim (meets NACE MR0175-2002)
- 3: CS - A108 CS

(Other construction materials available - consult factory)

Inlet / Outlet Connections:

Standard threaded connections:

- M22T: 1/4" MNPT x 1/4" FNPT
- F22T: 1/4" FNPT x 1/4" FNPT
- M44T: 1/2" MNPT x 1/2" FNPT
- F44T: 1/2" FNPT x 1/2" FNPT
- M64T: 3/4" MNPT x 1/2" FNPT

Optional socketweld or buttweld connections available - consult factory.

Bonnet Assembly:

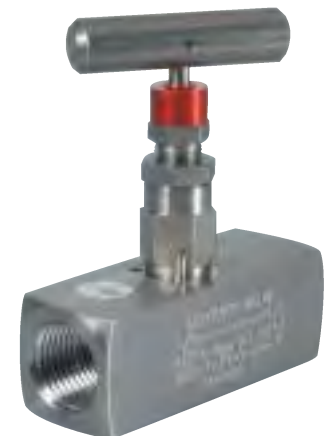
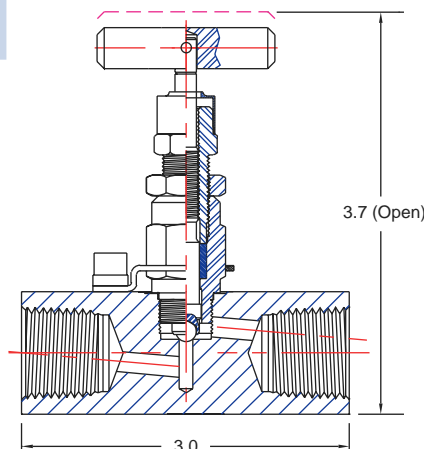
- B: O-ring, Needle tipped stem end
- D: Adjustable packing, Rotating ball tipped stem end
- DN: Adjustable packing, Needle tipped stem end

Packing:

- A: Aflas O-ring
- V: Viton® O-ring
- T: Teflon®, Adjustable packing
- G: Grafoil®, Adjustable packing

Special Construction Options:

- SC-L: Bonnet lock upgrade (in accordance with ANSI B31.1)
- SG: Sour Gas (Valve to meet NACE MR0175-2002)
- SC-O: Gaseous Oxygen Cleaned
- SC: For other special requirements - consult factory



Consolidated®

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Consolidated® Safety Relief Valve Type 1900



Industrial Valves

DRESSER

Industrial Valve Operation

Dresser Valve and Controls Division
Alexandria, Louisiana 71309-1430 (USA)

Design Options
Include:

Bellows
(-30),

O-Ring Seat
(DA),

Liquid Trim
(LA)

and

Thermodisc®
(TD)

CON-2
Revised 7/97

Product Safety Sign and Label System

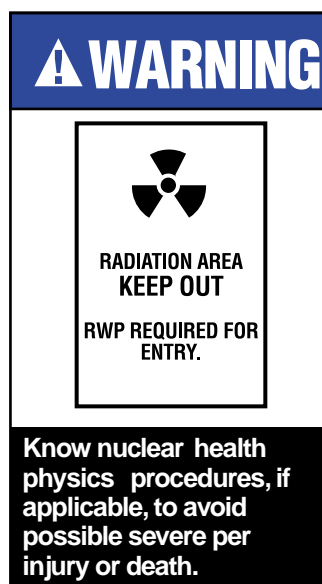
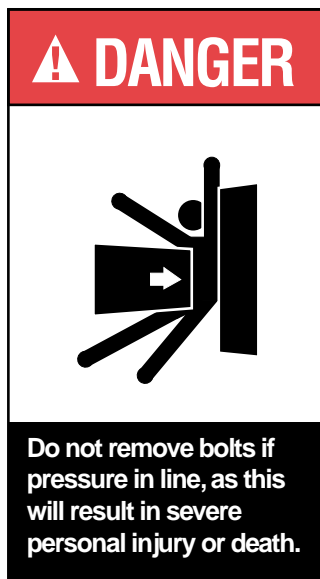
If and when required, appropriate safety labels have been included in the rectangular margin blocks throughout this manual. Safety labels are vertically oriented rectangles as shown in the **representative examples** (below), consisting of three panels encircled by a narrow border. The panels can contain four messages which communicate:

- The level of hazard seriousness.
- The nature of the hazard.
- The consequence of human, or product, interaction with the hazard.
- The instructions, if necessary, on how to avoid the hazard.

The top panel of the format contains a signal word (DANGER, WARNING, or CAUTION) which communicates the level of hazard seriousness.

The center panel contains a pictorial which communicates the nature of the hazard, and the possible consequence of human or product interaction with the hazard. In some instances of human hazards the pictorial may, instead, depict what preventive measures to take, such as wearing protective equipment.

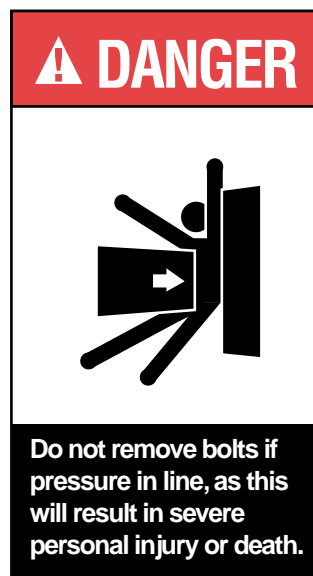
The bottom panel may contain an instruction message on how to avoid the hazard. In the case of human hazard, this message may also contain a more precise definition of the hazard, and the consequences of human interaction with the hazard, than can be communicated solely by the pictorial.



SAFETY ALERTS!

READ – UNDERSTAND – PRACTICE

1. DANGER: High temperature/pressure can cause injury. Be sure all system pressure is absent before repairing or removing valves.
2. DANGER: Don't stand in front of valve outlet when discharging. STAND CLEAR OF VALVE to prevent exposure to trapped, corrosive media.
3. DANGER: When inspecting a pressure relief valve for leakage, BE VERY CAREFUL!



Contents

Section

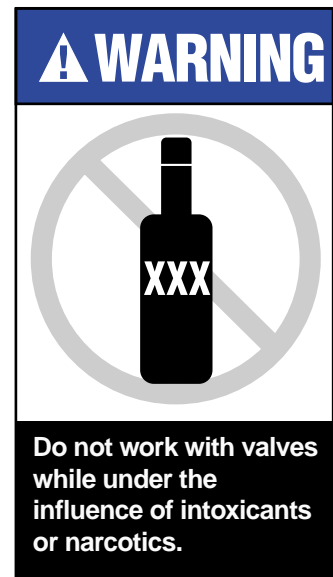
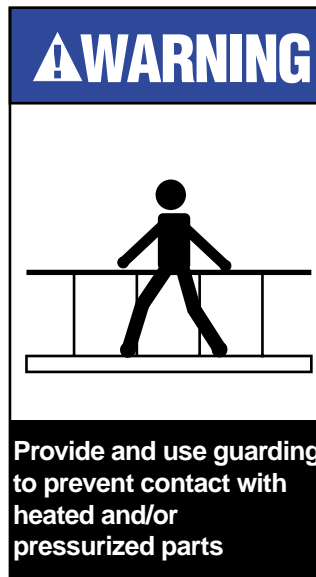
Subject

Page

	Product Safety Sign and Label System	Inside Front Cover
I.	Safety Alerts	2
II.	Terminology for Safety Relief Valves	4
III.	Introduction	5
IV.	Design Features and Nomenclature	5
V.	Handling, Storage and Pre-Installation	8
VI.	Recommended Installation Practices	9
	A. Mounting Position	9
	B. Inlet Piping	9
	C. Outlet Piping	11
VII.	Disassembly Instructions	12
	A. General Information	12
	B. Specific Steps	12
VIII.	Cleaning	14
IX.	Parts Inspection	14
	A. Nozzle	14
	B. Nozzle Seat Width	16
	C. Nozzle Bore	16
	D. 1900, 1900-30 Standard Disc	16
	E. 1900 Series Thermodisc	17
	F. Disc Holder	18
	G. Guide	21
	H. Spindle	21
	I. Spring	21
X.	Maintenance Instructions	22
	A. General Information	22
	B. Lapping Nozzle Seats (Non O-Ring Styles)	22
	C. Nozzle Seat Widths-Lapped	22
	D. Lapping Disc Seats	24
	E. Precautions and Hints for Lapping Seats	24
	F. Lapping O-Ring Seating Surfaces	24
	G. Reconditioning of Laps	25
	H. Remachining Nozzle Seats and Bores	25
	I. Remachining the Disc Seat	26
	J. Checking Spindle Concentricity	27
	K. Set Pressure Change-Disc Holder	28
	L. Checking Lift on Restricted Lift Valves	28
XI.	Reassembly	29
	A. General Information	29
	B. Lubrication	30
	C. Specific Steps	30
XII.	Setting and Testing	35
	A. General Information	35
	B. Test Equipment	35
	C. Test Media	35
	D. Setting the Valve	35
	E. Set Pressure Compensation	35
	F. Seat Tightness Testing	37
XIII.	Hydrostatic Testing and Gagging	38
XIV.	Manual Popping of the Valve	39
XV.	Conversion of Type 1900 Flanged Safety Relief Valves From Conventional to Bellows Type, and Vice Versa	40
	A. General Information	40
	B. Conversion From Conventional to Bellows Type	41
	C. Conversion From Bellows to Conventional Type	41
XVI.	Trouble Shooting Type 1900 Valves	42
XVII.	Maintenance Tools and Supplies	42
XVIII.	Replacement Parts Planning	44
	A. Basic Guidelines	44
	B. Replacement Parts List	44
	C. Identification and Ordering Essentials	44
XIX.	Genuine Dresser Parts	45
XX.	Recommended Spare Parts for the 1900 Safety Relief Valves	46
XXI.	Manufacturer's Warranty, Field Service & Repair Program	48
	A. Warranty Information	48
	B. Field Service	48
	C. Factory Repair Facilities	48
	D. Safety Relief Valve Maintenance Training	48
	Appendix RE: Optional Glide-Alloy® Parts	A.1
	Service Engineers and Sales Office Locations	Back Cover

SAFETY ALERTS!
READ – UNDERSTAND – PRACTICE

1. **WARNING:** Allow the system to cool to room temperature before cleaning, servicing or repairing the system. Hot components or fluids can cause severe personal injury or death.
2. **WARNING:** Always read and comply with safety labels on all containers. Do not remove or deface the container labels. Improper handling or misuse could result in severe personal injury or death.
3. **WARNING:** Never use pressurized fluids/gas/air to clean clothing or body parts. Never use body parts to check for leaks or flow rates or areas. Pressurized fluids/gas/air injected into or near the body can cause severe personal injury or death.
4. **WARNING:** It is the responsibility of the owner to specify and provide guarding to protect persons from pressurized or heated parts. Contact with pressurized or heated parts can result in severe personal injury or death.
5. **WARNING:** Do not allow anyone under the influence of intoxicants or narcotics to work on or around pressurized systems. Workers under the influence of intoxicants or narcotics are a hazard both to themselves and other employees and can cause severe personal injury or death to themselves or others.
6. **WARNING:** Incorrect service and repair could result in product or property damage or severe personal injury or death.

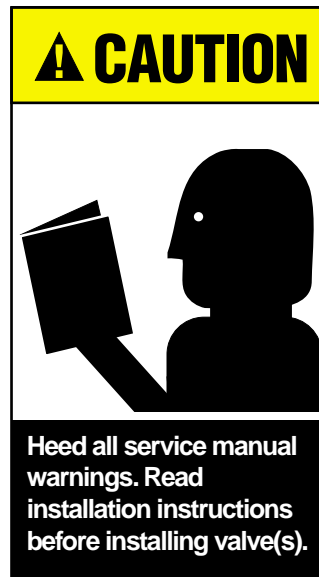


7. **WARNING:** These **WARNINGS** are as complete as possible but not all-inclusive. Dresser cannot know all conceivable service methods nor evaluate all potential hazards.
8. **WARNING:** Use of improper tools or improper use of right tools could result in personal injury or product or property damage.
9. **WARNING:** Some valve products manufactured by DVCD may be used in radioactive environments. Consequently, prior to starting any operation in a radioactive environment, the proper "health physics" procedures should be followed, if applicable.

1. CAUTION: Heed all service manual warnings. Read installation instructions before installing valve(s).
2. CAUTION: Wear hearing protection when testing or operating valves.
3. CAUTION: Wear appropriate eye and clothing protection.
4. CAUTION: Wear protective breathing apparatus to protect against toxic media.

NOTE:

Any service questions not covered in this manual should be referred to Dresser's Service Department, Phone (318) 640-6055.



II. Terminology for Safety Relief Valves

- **Accumulation**
Accumulation is the pressure increase over the maximum allowable working pressure of the vessel during discharge through the pressure relief valve, expressed as a percentage of that pressure, or actual pressure units.
- **Back Pressure**
Back pressure is the pressure on the discharge side of a safety relief valve:
 1. **Superimposed Back Pressure**
Superimposed back pressure is the pressure in the discharge header before the safety relief valve opens.
 - a) Constant - Specify single constant back pressure (e.g., 20 psig/1.38 bar).
 - b) Variable - Specify variable back pressure range using min. and max. limits (e.g., 0 to 20 psig/1.38 bar).
 2. **Built-up Back Pressure**
Built-up back pressure is pressure which develops at the valve outlet as a result of flow, after the safety relief valve has been opened.
- **Blowdown**
Blowdown is the difference between set pressure and reseating pressure of a pressure relief valve, expressed as a percentage of the set pressure, or actual pressure units.
- **Cold Differential Set Pressure**
Cold differential set pressure is the pressure at which the valve is adjusted to open on the test stand. This pressure includes the corrections for back pressure and/or temperature service conditions.
- **Differential Between Operating and Set Pressures**
Valves in process service will generally give best results if the operating pressure does not exceed 90% of the set pressure. However, on pump and compressor discharge lines, the differential required between the operating and set pressures may be greater because of pressure pulsations coming from a reciprocating piston. It is recommended that the valve be set as high above the operating pressure as possible.
- **Lift**
Lift is the actual travel of the disc away from the closed position when a valve is relieving.
- **Maximum Allowable Working Pressure**
Maximum allowable working pressure is the maximum gauge pressure permissible in a vessel at a designated temperature. A vessel may not be operated above this pressure, or its equivalent, at any metal temperature other than that used in its design. Consequently, for that metal temperature, it is the highest pressure at which the primary pressure safety relief valve is set to open.
- **Operating Pressure**
The operating pressure is the gauge pressure to which the vessel is normally subjected in service. A suitable margin is provided between operating pressure and maximum allowable working pressure. For assured safe operation, the operating pressure should be at least 10% under the maximum allowable working pressure or 5 psi (.34 bar), whichever is greater.
- **Overpressure**
Overpressure is a pressure increase over the set pressure of the primary relieving device. Overpressure is similar to accumulation when the relieving device is set at the maximum allowable working pressure of the vessel. Normally, overpressure is expressed as a percentage of set pressure.
- **Rated Capacity**
Rated capacity is the percentage of measured flow at an authorized percent overpressure permitted by the applicable code. Rated capacity is generally expressed in pounds per hour (lb/hr) for vapors; standard cubic feet per minute (SCFM) or m³/min for gases; and in gallons per minute (GPM) for liquids.
- **Relief Valve**
A relief valve is an automatic pressure-relieving device, actuated by static pressure upstream from the valve, a relief valve is used primarily for liquid service.
- **Safety Relief Valve**
A safety relief valve is an automatic pressure-relieving device which may be used as either a safety or relief valve, depending upon application. A safety relief valve is used to protect personnel and equipment by preventing excessive overpressure.

II. (Continued)

- **Safety Valve**
A safety valve is an automatic pressure-relieving device actuated by the static pressure upstream of the valve, and characterized by rapid opening or pop action. It is used for steam, gas or vapor service.
- **Set Pressure**
Set pressure is the gauge pressure at the valve inlet, for which the relief valve has been adjusted to open under service conditions. In liquid service, set pressure is determined by the inlet pressure at which the valve starts to discharge. In gas or vapor service, the set pressure is determined by the inlet pressure at which the valve pops.
- **Simmer**
Simmer is characterized by the audible passage of a gas or vapor across the seating surfaces just prior to "pop". The difference between this "start to open pressure" and the set pressure is simmer, and is generally expressed as a percentage of set pressure.
- **Valve Trim**
Valve trim includes the nozzle and disc.

III. Introduction

A safety relief valve is an automatic pressure actuated relieving device suitable for use either as a safety valve or relief valve, depending on application.

Safety relief valves are used on hundreds of different applications, including liquids and hydrocarbons; therefore, the valve is designed to meet many requirements. The 1900 series valves included in this manual can **only** be used to meet Section VIII requirements. It cannot be used on ASME Code Section I steam boilers or superheaters, but may be used on process steam.

IV. Design Features and Nomenclature

- **Cap and Lever Interchangeability**
Many times it is necessary to change the type of cap or lever in the field after a valve has been installed. All flanged Consolidated® Safety Relief Valves are designed so they can be converted to any type of lever or cap desired. It is not necessary to remove the valve from the installation, nor will the set pressure be affected when making such a change.
- **Design Simplicity**
Consolidated Safety Relief Valves have a minimum number of component parts. This results in a savings by minimizing spare parts inventory and simplifies valve maintenance.
- **Nomenclature Related to Design Features**
Applicable nomenclature of the components of Type 1900 valves, including those with design options for bellows O-Ring seat, and liquid trim and Thermodisc, is identified in Figures 1 thru 6 on pages 6 and 7.
- **Simple Blowdown Adjustment**
The Consolidated single blowdown ring design makes it possible to set and test a valve that has been in service when it cannot be set on line and must be taken to the customer's shop. The ring can be positioned so that the set point can be observed although the volume of the testing media is very low. After the set pressure has been established, proper blowdown can be attained by merely positioning the ring in accordance with the adjusting ring position shown in Tables 12-14 (as appropriate), on page 34 of this manual.
- **Valve Interchangeability**
A Standard Consolidated Safety Relief Valve may be converted to the bellows type, the O-Ring seat seal type, etc. and vice versa. This requires a minimum number of new parts, and results in lower costs should conversion be required.

CONSOLIDATED SAFETY RELIEF VALVE TYPE 1900 - CONVENTIONAL

Part No.	Nomenclature
1	Base
2	Nozzle
3	Adjusting Ring
4	Adjusting Ring Pin
5	Adj. Ring Pin Gasket
6	Disc
7	Disc Retainer
8	Disc Holder
9	Guide
10	Guide Gasket
11	Bonnet
12	Bonnet Gasket
13	Base Stud
14	Stud Nut
15	Spindle
16	Spindle Retainer
17	Spring Washer
18	Spring
19	Adjusting Screw
20	Adjusting Screw Nut
21	Screwed Cap
*22	Bolted Cap
*23	Packed Cap
*24	Plain Cap
*25	Cap Bolt
*26	Cap Set Screw
27	Cap Gasket
*28	Release Nut
*29	Release Locknut
*30	Lever
*31	Lifting Fork
*32	Lever Shaft
*33	Packing
*34	Packing Nut
*35	Top Lever
*36	Drop Lever
40	Eductor Tube
41	Bonnet Vent Plug

* Shown in Figures 38-42 on page 39 of this manual.

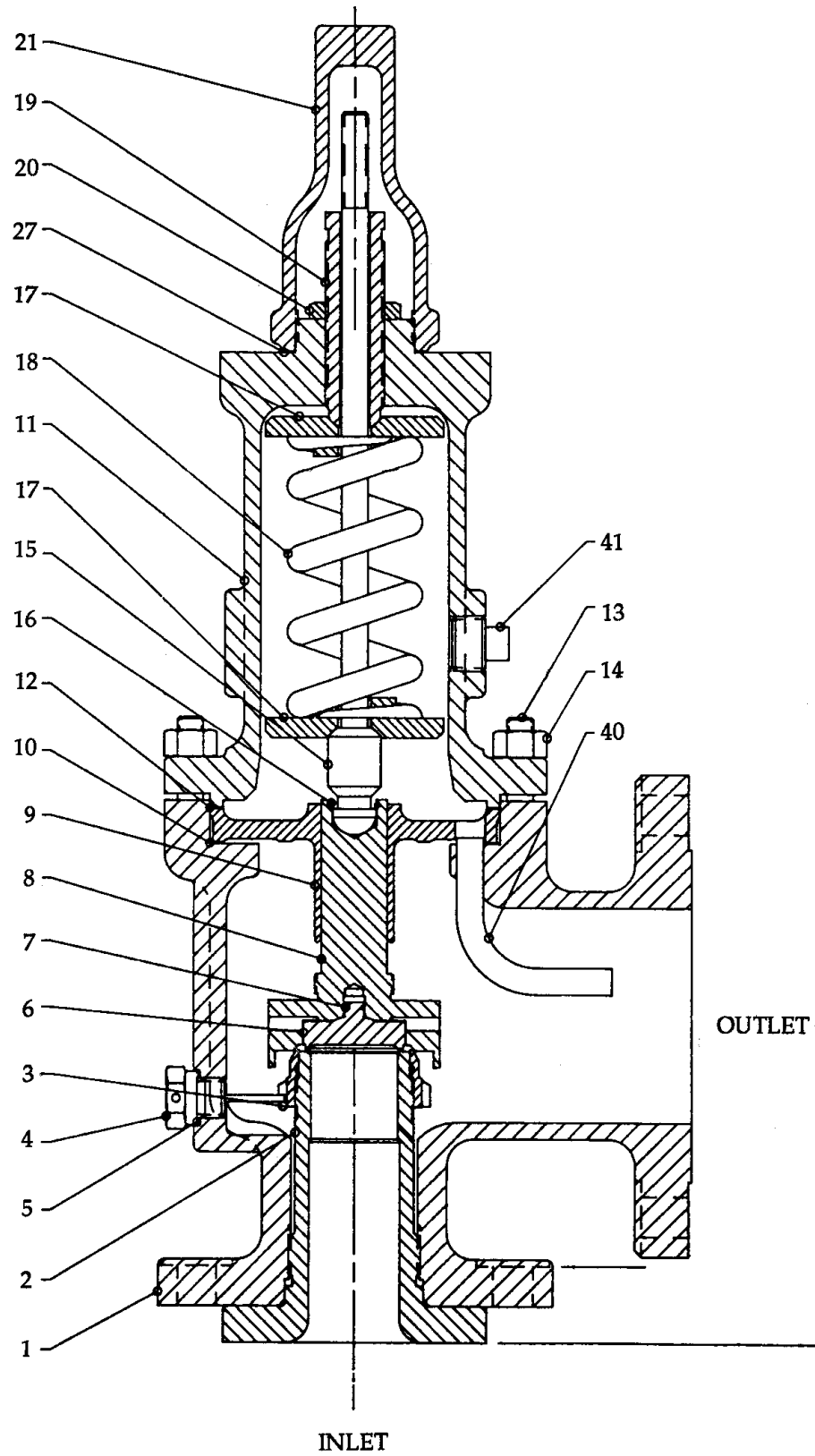
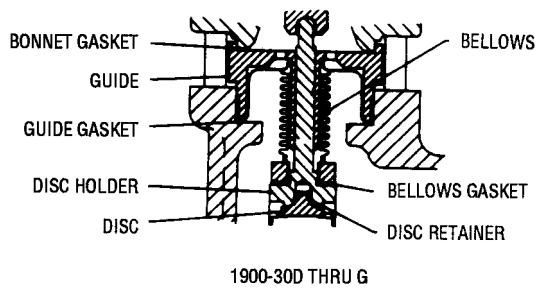
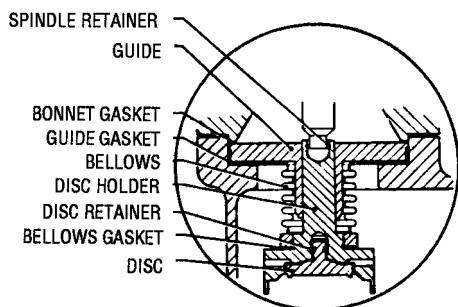


FIGURE 1

DESIGN OPTIONS

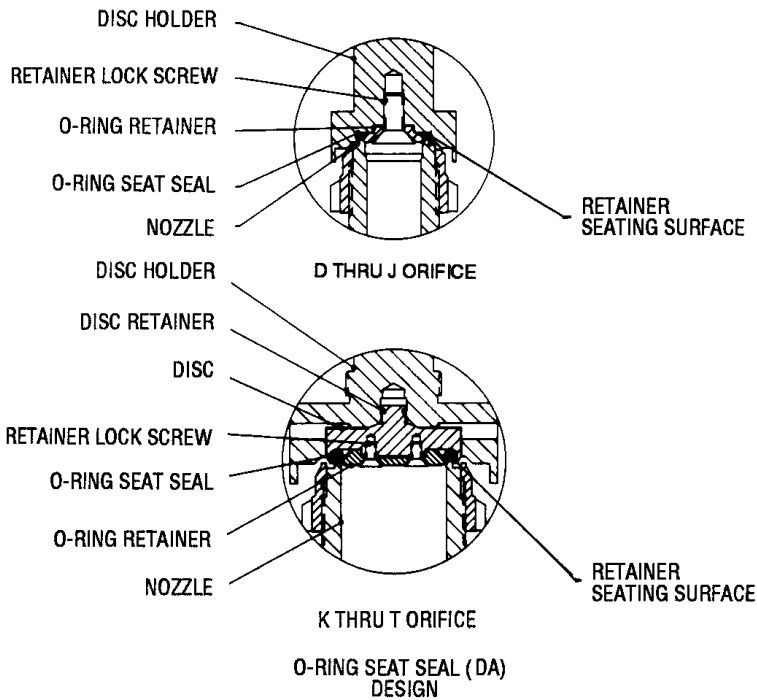


1900-30D THRU G



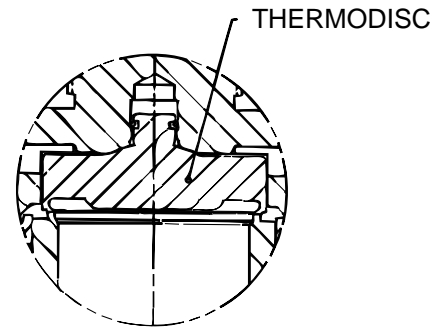
1900-30H THRU T BELLOWS DESIGN

FIGURE 2



O-RING SEAT SEAL (DA) DESIGN

FIGURE 4



THERMODISC (TD) DESIGN

FIGURE 3

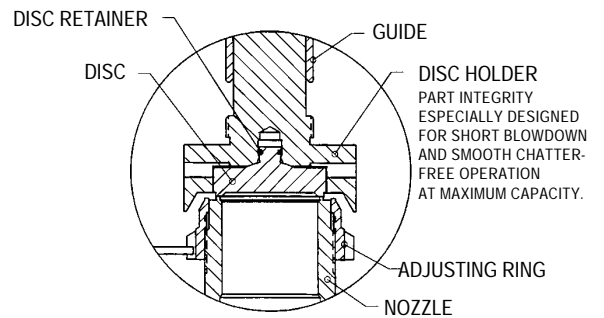


FIGURE 5
LA Liquid Trim Design
(See Fig. 20)

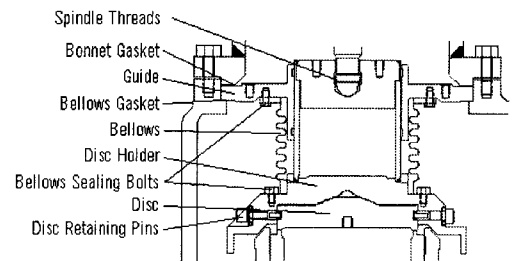


FIGURE 6
V & W Orifice Only

NOTE:

A combination of the O-Ring seat seal and liquid trim design options is designated as DA-LA.

V. Handling, Storage and Pre-Installation

- Handling**

A flanged valve, either crated or uncrated, should always be kept with the inlet flange down (i.e., in order to prevent possible misalignment and damage to internals).

Uncrated valves should be moved or hoisted by wrapping a chain or sling around discharge neck, then around upper bonnet structure in such manner as will ensure the valve is in a vertical position during lift, i.e. not lifted in horizontal position.

NOTE:

Never lift the full weight of the valve by the lifting lever.

Crated valves should always be lifted with the inlet flange down, i.e., same as installation position.

Safety relief valves, either crated or uncrated, should never be subjected to sharp impact. This would be most likely to occur by bumping or dropping during loading or unloading from a truck. While hoisting to the installation, care should be taken to prevent bumping the valve against steel structures and other objects.



- Storage**

Safety relief valves should be stored in a dry environment to protect them from the weather. They should not be removed from the skids or crates until immediately prior to installation.

Flange protectors and seating plugs should not be removed until the valve is ready to be bolted into the installation, i.e., both inlet and outlet.

- Pre-installation**

When safety relief valves are uncrated, and the flange protectors or sealing plugs removed immediately prior to installation, meticulous care should be exercised to prevent dirt and other foreign materials from entering the inlet and outlet ports while bolting in place.



VI. Recommended Installation Practices

A. Mounting Position

Safety relief valves should be mounted in a vertical upright position (per API RP520). Installing a safety relief valve in other than a vertical position (± 1 degree) will adversely affect its operation in varying degrees, as a result of induced misalignment of moving parts.

A stop valve may be placed between the pressure vessel and its relief valve only as permitted by code regulations. If a stop valve is located between the pressure vessel and safety relief valve, the stop valve port area should equal or exceed the nominal internal area associated with the pipe size of the safety relief valve inlet. The pressure drop from the vessel to the safety relief valve shall not exceed 3% of the valve's set pressure, when flowing at full capacity.

The flanges and sealing faces of the valve and all connecting piping must be free from dirt, sediment and scale.



All flange bolts should be drawn evenly to prevent distortion of the valve body and the inlet nozzle.

Safety relief valves should be located for easy access and/or removal so that servicing can be properly performed. Sufficient working space should be provided around, and above, the valve.

B. Inlet Piping

The inlet piping (see Figure 7, below) to the valve should be short and direct from the vessel, or equipment, being protected. The connection to the vessel should be provided with a radius to permit smooth flow to the valve. Sharp corners should be avoided. If this is not practical then the inlet should be bored at least one additional pipe diameter. In any event, the pressure drop from the vessel to the valve should not exceed 3% of valve set pressure when the valve is flowing full capacity. In no event should the inlet piping be smaller in diameter than the inlet connection of the valve. Excessive pressure drop at the inlet of a pressure relief valve in gas, vapor, or flashing-liquid service will cause extremely rapid opening and closing of the valve, which is known as "chattering". Chattering will result in lowered capacity and damage to the seating surfaces. The most desirable installation is that in which the nominal size of the inlet piping is the same as, or greater than, the nominal size of the valve inlet flange, and in which the length does not exceed the face-to-face dimensions of a standard tee of the required pressure class.

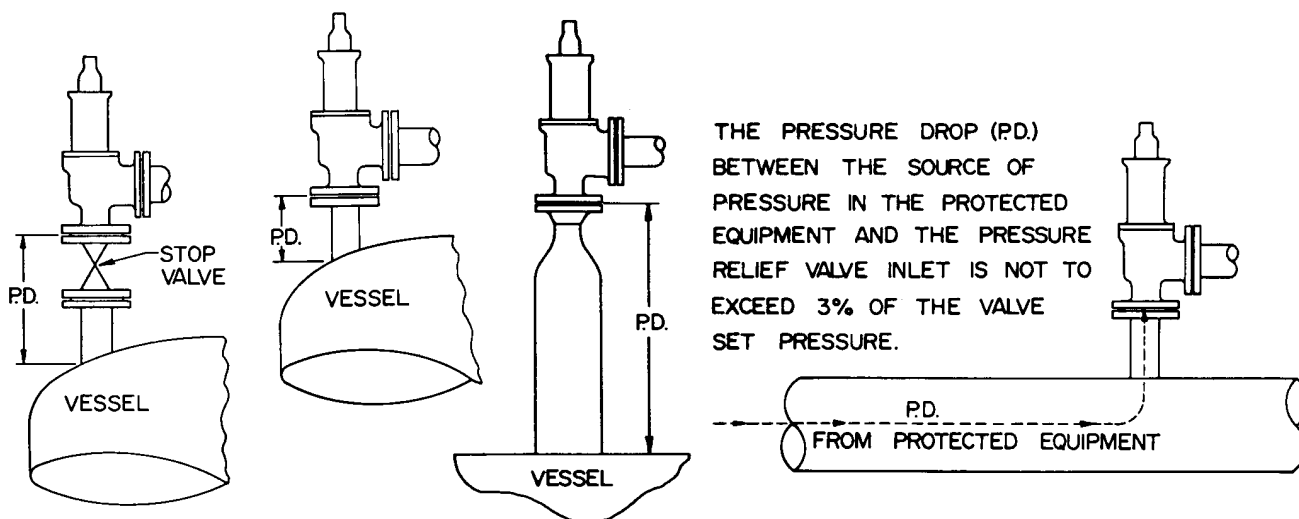


FIGURE 7

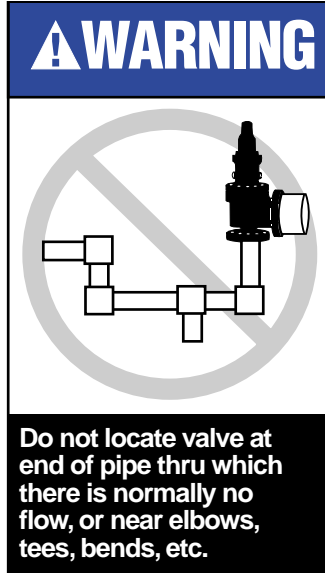
VI.B. (Continued)

Safety relief valve inlets should not be located at the end of a long, horizontal inlet pipe through which there is normally no flow. Foreign matter may accumulate, or liquid may be trapped, and may interfere with the operation of the valve or be the cause of more frequent valve maintenance.

Safety relief valve inlets should not be located where excessive turbulence is present such as near elbows, tees, bends, or throttling valves.

Section VIII of the ASME Boiler and Pressure Vessel Code requires that the design of the inlet connection consider stress conditions induced by reaction forces during valve operation, by external loading, by vibration and by loads due to thermal expansion of discharge piping.

1. The determination of reaction forces during valve discharge is the responsibility of the vessel and/or piping designer. DVCD publishes certain technical information about reaction forces under various fluid flow conditions, but assumes no liability for the calculations and design of the inlet piping.
2. External loading by poorly designed discharge piping and support systems can be the cause of excessive stresses and distortions in the valve as well as the inlet piping. The stresses set up in the valve may cause malfunctioning or leakage of the valve. Forced alignment of the discharge piping will also induce such stresses. Discharge piping should be independently supported and carefully aligned.



3. Vibrations in the inlet piping systems may cause valve seat leakage and/or fatigue failure of the piping. These vibrations may cause the disc seat to slide back and forth across the nozzle seat and result in damage to the seating surfaces. Vibration may also cause separation of the seating surfaces and premature wear to certain valve parts. High-frequency vibrations are more detrimental to pressure relief valve tightness than low-frequency movements. This effect can be minimized by providing a larger difference between the operating pressure of the system and the set pressure of the valve, particularly under high-frequency conditions.
4. Temperature changes in the discharge piping may be caused by fluid flowing from the discharge of the valve, prolonged exposure to the sun, or heat radiated from nearby equipment. Any change in temperature of the discharge piping will cause a change in the length of the piping. The resulting change in length may cause stresses which will be transmitted to the pressure relief valve and its inlet piping. Stresses caused by thermal changes in the discharge piping can be avoided by proper support, anchoring, or provision for flexibility of the discharge piping. **Fixed supports should not be used.**

VI. (Continued)

C. Outlet Piping

Alignment of the internal parts of a safety relief valve is important to ensure proper operation (see Figure 8, below). Although the valve body will withstand a considerable mechanical load, unsupported discharge piping consisting of more than a companion flange, long radius elbow and a short vertical pipe is not recommended. Care should be taken to ensure thermal expansion of piping and support system does not produce strains in a valve. Spring supports are recommended where this may be the case. The discharge piping should be designed to allow for vessel expansion as well as expansion of the discharge pipe itself. This is particularly important on long distance lines.

Consideration should be given to discharge pipe movement resulting from wind loads. A continual oscillation of the discharge piping introduces stress distortion in the valve body and the resultant movement of the internal parts may cause leakage.

Where possible, drains should be piped away to prevent the collection of water or corrosive liquid in the valve body. Attention should be given to the support of the drainage piping.

When two or more valves are piped to discharge into a common header, the built-up back pressure resulting from the opening of one (or more) valve(s) may cause a superimposed back pressure in the remaining valves, unless the bonnet is vented. Under these conditions, use of bellows valves is recommended. Bellows valves may also permit use of a smaller size manifold.

In every case, the nominal discharge pipe size should be as large as, or larger than, the nominal size of the pressure relief valve outlet flange. In the case of long discharge piping, it sometimes must be **much** larger.

NOTE:

Bonnet vent is to be plugged for all non-bellows valves. Bellows valves must have open bonnet vent.

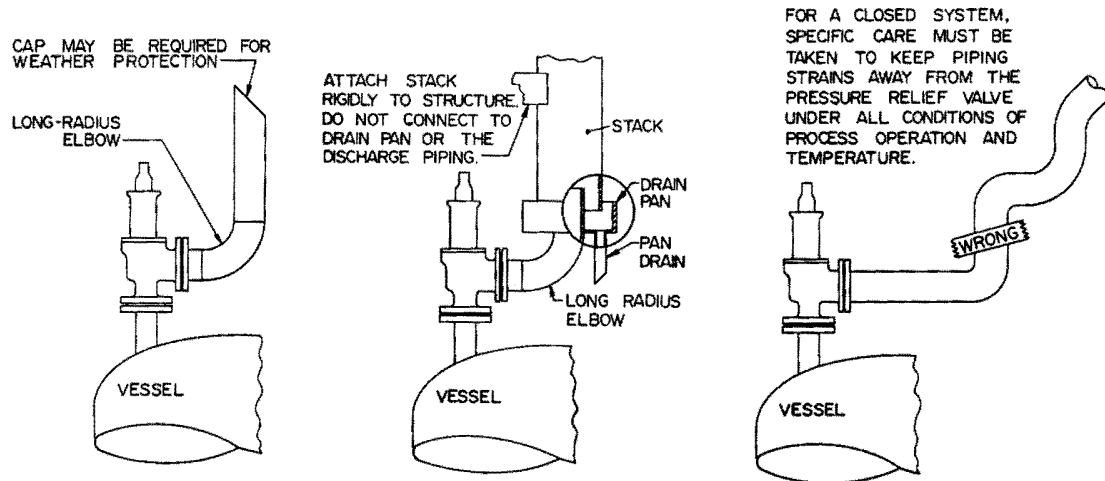


FIGURE 8

VII. Disassembly Instructions

NOTE:

Many pressure vessels that are protected by Consolidated® Safety Relief Valves contain dangerous materials. Decontaminate and clean the valve inlet and outlet and all external surfaces in accordance with the cleaning and decontaminating recommendations in the appropriate Material Safety Data Sheet.



A. General Information

Consolidated® Safety Relief Valves can be easily disassembled for inspection, reconditioning seats, or replacing internal parts. Appropriate set pressure can be established after reassembly. (Again, refer to Figures 1-6, on pages 6 and 7, for parts nomenclature.)

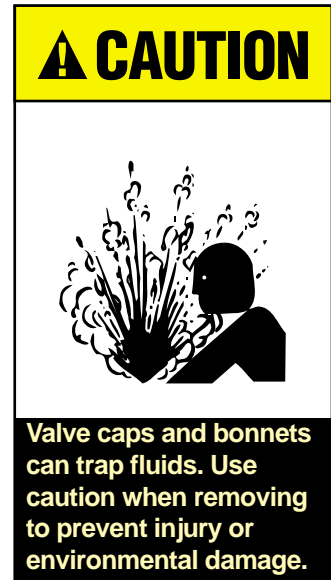


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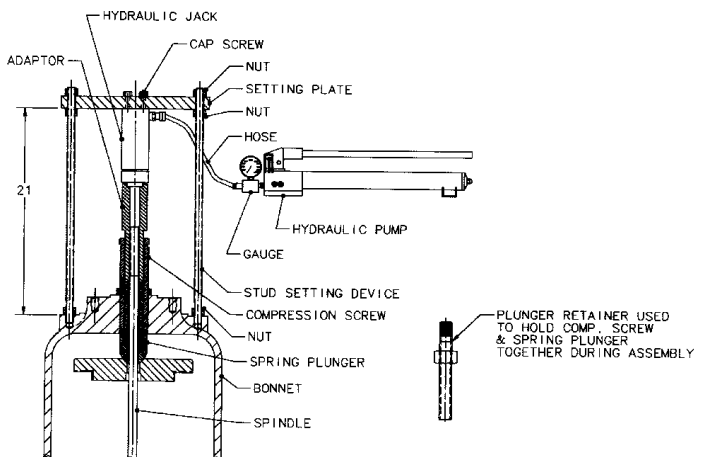
- Before starting to disassemble the valve, be sure that there is no media pressure in the vessel.
- Parts from one valve should not be interchanged with parts from another valve.

B. Specific Steps

1. Remove the cap (including lifting gear); then, remove the cap gasket, if applicable.
2. Remove the adjusting ring pin and gasket. If the existing blowdown is to be restored upon reassembly, the position of the adjusting ring, with respect to the disc holder, should be determined. To do this, turn the adjusting ring counterclockwise (i.e., move notches on the adjusting ring from left to right). Record the number of notches passing the ring pin hole, which are required for the ring to contact the disc holder. This information will be used in setting the ring upon reassembly of the valves.



3. a. For D-T Orifice Valves: Loosen the adjusting screw nut. Using a Depth Micrometer or a Dial Caliper, measure the distance from the top of the spindle to the top of the Adjusting Screw. This allows the adjusting screw to be re-adjusted close to the proper spring compression without excessive testing. Record the measurement for reference when re-assembling the valve. **Note: This procedure does not substitute for actual**



Ram In Use
FIGURE 9

VII.B. (Continued)

pressure testing. Remove the Compression Screw from the Bonnet. Use pliers to prevent the Spindle from turning when removing the Compression Screw.

b. For V and W Orifice Valves: Attach the setting device. Apply enough pressure to the plunger using the ram to free the compression screw. Unscrew the compression screw completely out of the bonnet. The valve should be set using the setting procedure after reassembly.

4. Remove the stud nuts and lift off the bonnet. Next, remove the bonnet gasket.
5. Remove the spring and spring washers. **The spring and spring washers should be kept together, as a unit, at all times.**
6. For D thru M orifice valves, remove the upper internal parts by carefully pulling "straight up" on the spindle. For bellows valves, care should be taken to avoid damaging the bellows or its flange. If parts are fouled, use a suitable solvent for loosening the components. For the P thru T orifice valves, special lifting tools are available for ease of upper, internal-parts removal. First, remove the spindle by using a screwdriver to compress the spindle retainer. Then insert the lifting tool (see Figure 10, below) into the disc holder spindle pocket and tighten the eyebolt. Remove the disc holder and disc by lifting up on the lifting tool. For V and W orifice valves, use the lifting lugs to lift the disc holder top and remove all internals.

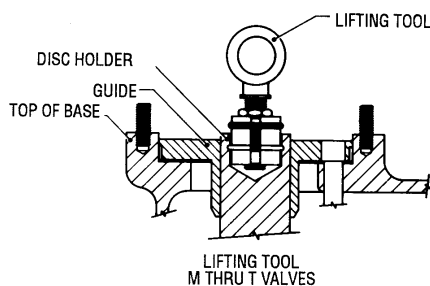


FIGURE 10

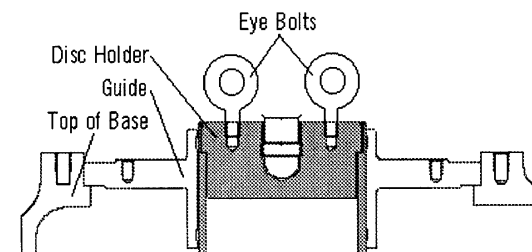


FIGURE 10 b

* Drift Pins, See Section XVII, page 43 for details.

7. To remove the spindle from the disc holder for D thru M orifice valves, clamp the skirt portion of the disc holder snugly between two wooden V-blocks in a suitable vise (see Figure 11, below). Then compress the spindle retainer with a screwdriver or similar tool through the slots provided, and remove the spindle.
8. Remove guide from the disc holder. (For restricted lift valves, refer to Paragraph X.L., on page 28 of this manual.) For V and W orifice, unbolt bellows from guide before guide removal.
9. For D-T orifice bellows valves, the bellows is attached to the disc holder by right-hand threads. Apply a special spanner wrench* to the bellows ring, and remove by turning counterclockwise (again, see Figure 11, below). The bellows convolutions are very thin, and fragile, and care should be taken to protect them from damage at all times. Next, remove the bellows gasket. For V and W orifice bellows valves, the bellows is bolted to the guide and disc holder. These bolts should be removed before removal of the guide.

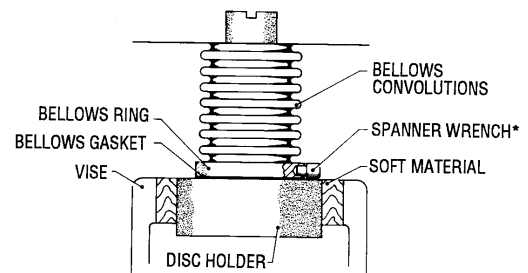


FIGURE 11

10. a. For D-T Orifice Valves: Remove the disc from the disc holder in the following manner. Clamp the stem portion of the disc holder, disc end up, firmly between two wooden V-blocks in a vise. Then start special drift pins* into the holes in the disc holder (see Figure 12) with the tapered portion of the pins working against the top of the disc as indicated. Tap each pin alternately, with a light machinist's hammer, until the disc snaps out of the recess in the disc holder.
- b. For V and W Orifice Valves: Turn the disc holder on its side. Remove the retaining bolts. Attach the lifting lug to the disc and lift out.

VII.B. (Continued)

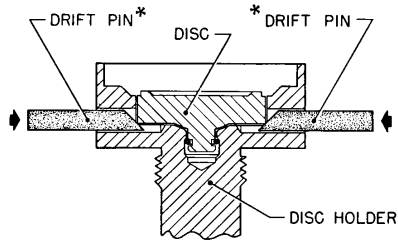


FIGURE 12

11. For O-Ring seat seal valves only, remove the retainer lock screw(s), retainer and O-Ring.
12. Remove the adjusting ring by turning it counterclockwise (left-handed).
13. The nozzle should be removed from the base. (Reference nozzle removal methods in paragraph 14.)
14. The nozzle is normally removed for routine maintenance and service. The nozzle is assembled to the base with threads and may be removed by turning it counterclockwise. To facilitate removal of the nozzle from the base, it may be found beneficial to first soak the threaded joint with a suitable penetrating liquid or solvent. In instances where the nozzle is frozen into the base, its removal may be helped by sufficiently heating the base from the outside with a blowtorch in the area of the nozzle threads, while dry ice or other cooling medium is applied to the inside of the nozzle.

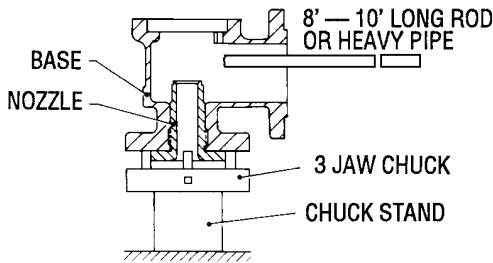


FIGURE 13

NOTE:

Should heat be applied, use care to prevent cracking of cast parts.

15. Utilize a 3 or 4 jaw chuck welded vertically to a stand bolted to a concrete floor. Chuck on nozzle flange and break the body loose from the nozzle with a heavy rod or pipe (see Figure 13).

NOTE:

Exercise care when inserting a rod or pipe in the outlet, in order to ensure that the valve nozzle is not damaged during this operation.

16. Use a large pipe wrench on nozzle flange to remove the nozzle from the base (see Figure 14).

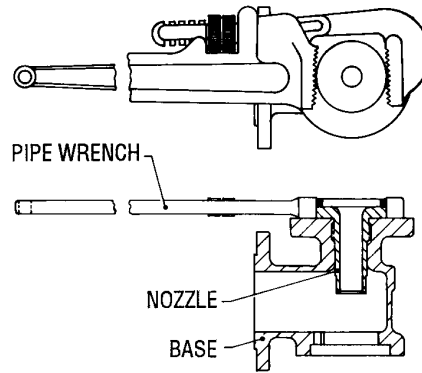


FIGURE 14

VIII. Cleaning

1900 Series Safety Relief Valve internal parts may be cleaned with industrial solvents, cleaning solutions and wire brushes. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.

⚠ DANGER

Follow recommendations for safe handling in the solvent's Material Safety Data Sheet and observe safe practices for any cleaning method.

It is not recommended to "sand blast" internal parts as it can reduce the dimensions of the parts. The base, bonnet and cap castings may be sand blasted with care not to erode internal surfaces, or damage machined surfaces.

IX. Parts Inspection

A. Nozzle Inspection Criteria

Nozzle should be replaced if:

1. Dim. from seat to first thread after remachining and lapping is less than D min. on Table 1.
2. Both thread sections are damaged from pitting and/or corrosion.

VIII. (Continued)

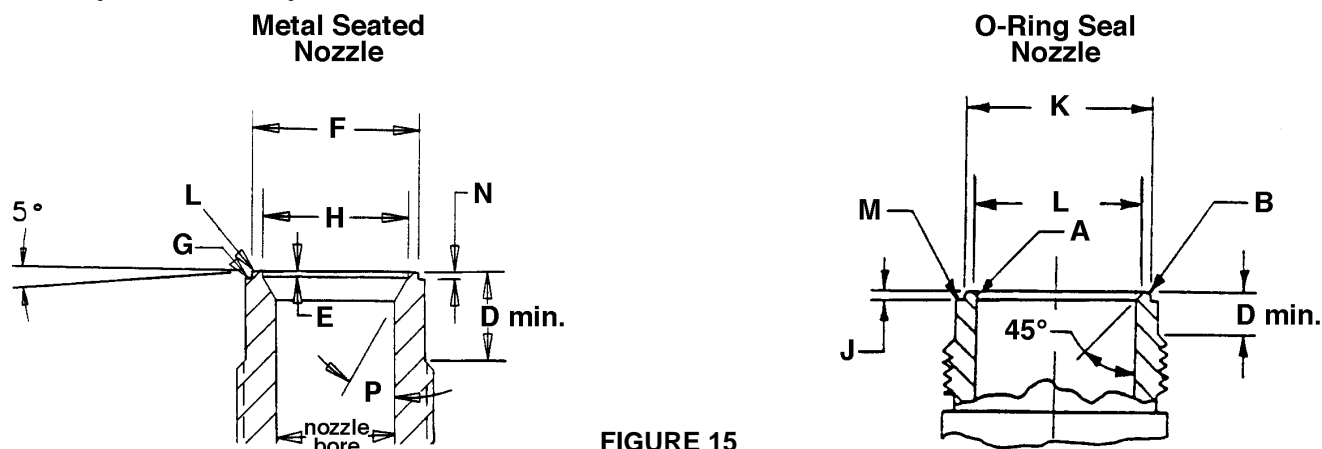


FIGURE 15

TABLE 1

ENGLISH UNITS, INCH											
Nozzle		Metal-To-Metal						O-Ring Seat Seal			
Orifice	D Min.	E \pm .005 .000	F \pm .000 .002	H \pm .002 .000	N \pm .005 .000	P \pm 1/2°	Radius B \pm .002 .000	J \pm .005	K	L Max.	
D-1	13/32	.015	—	.518	—	30°	.015	.062	.573 ^{+0.002} -0.002	.537	
E-1	15/32	.020	.788	.686	.025	30°	.015	.060	.733 ^{+0.002} -0.002	.688	
D-2,E-2,F	5/16	.030	.955	.832	.035	30°	.015	.079	.868 ^{+0.002} -0.003	.814	
G	5/16	.035	1.094	.954	.035	30°	.021	.090	1.060 ^{+0.002} -0.003	.999	
H	1/4	.035	1.225	1.124	.035	45°	.021	.060	1.216 ^{+0.002} -0.003	1.167	
J	3/8	.035	1.546	1.436	.035	45°	.021	.074	1.534 ^{+0.002} -0.003	1.481	
K	7/16	.063	1.836	1.711	.063	45°	.021	.126	1.838 ^{+0.002} -0.004	1.781	
L	7/16	.063	2.257	2.132	.063	45°	.016	.126	2.208 ^{+0.002} -0.004	2.158	
M	7/16	.063	2.525	2.400	.063	45°	.021	.126	2.536 ^{+0.002} -0.004	2.480	
N	1/2	.063	2.777	2.627	.063	45°	.021	.101	2.708 ^{+0.002} -0.004	2.652	
P	5/8	.093	3.332	3.182	.093	45°	.021	.150	3.334 ^{+0.002} -0.004	3.279	
Q	7/8	.093	4.335	4.185	.093	45°	.021	.188	4.338 ^{+0.002} -0.006	4.234	
R	1	.093	5.110	4.960	.093	45°	.021	.215	5.095 ^{+0.002} -0.006	5.036	
T	3/4	—	6.234	6.040	.093	—	.021	.142	6.237 ^{+0.002} -0.007	6.174	
W	1 3/4"	.350	11.058	10.485	.348	30°	—	—	—	—	

TABLE 1A

METRIC UNITS, MM											
Nozzle		Metal-To-Metal						O-Ring Seat Seal			
Orifice	D Min.	E \pm .13 .0	F \pm .0 .05	H \pm .05 .0	N \pm .13 .0	P \pm 1/2°	Radius B \pm .05 .0	J \pm .13	K	L Max.	
D-1	10.3	.38	—	13.16	—	30°	.38	1.57	14.55 ^{+0.00} -0.05	13.64	
E-1	11.9	.51	20.01	17.43	.64	30°	.38	1.52	18.62 ^{+0.00} -0.05	17.47	
D-2,E-2,F	7.9	.76	24.26	21.13	.89	30°	.38	2.01	22.05 ^{+0.00} -0.08	20.68	
G	7.9	.89	27.79	24.24	.89	30°	.53	2.29	26.92 ^{+0.00} -0.08	25.37	
H	6.3	.89	31.12	28.55	.89	45°	.53	1.52	30.89 ^{+0.00} -0.08	29.64	
J	9.5	.89	39.27	36.47	.89	45°	.53	1.88	38.96 ^{+0.00} -0.08	37.62	
K	11.1	1.60	46.63	43.46	1.60	45°	.53	3.20	46.69 ^{+0.00} -0.10	45.24	
L	11.1	1.60	57.33	54.15	1.60	45°	.41	3.20	56.08 ^{+0.00} -0.10	54.81	
M	11.1	1.60	64.14	60.96	1.60	45°	.53	3.20	64.41 ^{+0.00} -0.10	62.99	
N	12.7	1.60	70.54	66.73	1.60	45°	.53	2.57	68.78 ^{+0.00} -0.10	65.07	
P	15.9	2.36	84.63	80.82	2.36	45°	.53	3.81	84.68 ^{+0.00} -0.10	83.28	
Q	22.2	2.36	110.11	106.30	2.36	45°	.53	4.78	110.19 ^{+0.00} -0.15	107.54	
R	25.4	2.36	129.79	125.98	2.36	45°	.53	5.46	129.41 ^{+0.00} -0.15	127.92	
T	19.0	—	158.34	153.42	2.36	—	.53	3.61	158.42 ^{+0.00} -0.18	156.82	
W	44.5	8.89	280.90	266.30	8.84	30°	—	—	—	—	

IX.A. (Continued)

3. Top of flange and intersecting surface are damaged from galling and/or tearing.
4. Seat Width - see Table 7 on page 23 for proper seat width.

B. Nozzle Seat Width

Using a measuring magnifying glass, (See Maintenance Section "C" page 22), determine if the finish lapped seat surface must be machined prior to lapping. If the seat can be lapped flat without exceeding the required seat width, as indicated in table 7, it does not require machining. In order to reduce the seat width, the 5° angle surface must be machined. The Nozzle must be replaced, if the "D" dimension, is reduced below the minimum as indicated in table 1, or 1a.

NOTE: Flange thickness changes the center-to-face dimension. The minimum dimension for orifices D through P is 43/64 and orifices Q through T is 51/64.

C. Nozzle Bore Inspection Criteria

All Type 1900 Valve nozzles, **manufactured after August 1978**, have increased bore diameters. Physically, the nozzles (original versus new) are interchangeable, but their rated capacities are different. The following Table shows how each orifice was affected.

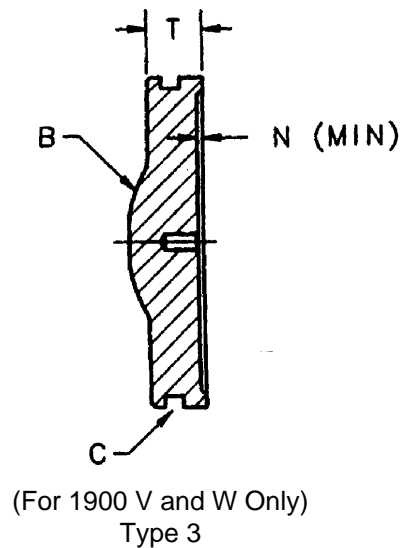
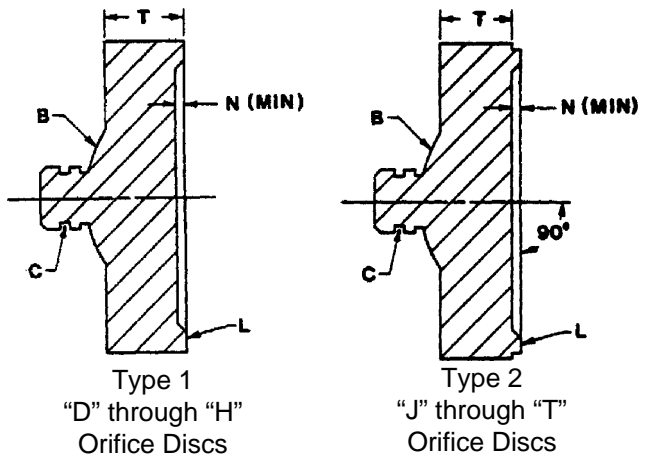
TABLE 2

Orifice	Pre-1978 Bore Diameter in Inches	Current Bore Diameter in Inches	Pre-1978 Bore Diameter in Millimeters	Current Bore Diameter in Millimeters
D-1	.393-.398	.404-.409	9.98-10.11	10.26-10.39
E-1	.524-.529	.539-.544	13.31-13.44	13.69-13.82
D-2	.650-.655	.674-.679	16.51-16.64	17.12-17.25
E-2	.650-.655	.674-.679	16.51-16.64	17.12-17.25
F	.650-.655	.674-.679	16.51-16.64	17.12-17.25
G	.835-.840	.863-.868	21.21-21.34	21.92-22.05
H	1.045-1.050	1.078-1.083	26.54-26.67	27.38-27.51
J	1.335-1.340	1.380-1.385	33.91-34.04	35.05-35.18
K	1.595-1.600	1.650-1.655	40.51-40.64	41.91-42.04
L	1.985-1.990	2.055-2.060	50.42-50.55	52.20-52.32
M	2.234-2.239	2.309-2.314	56.74-56.87	58.65-58.78
N	2.445-2.450	2.535-2.540	62.10-62.23	64.39-64.51
P	2.965-2.970	3.073-3.078	75.31-75.44	78.05-78.18
Q	3.900-3.905	4.045-4.050	99.06-99.19	102.74-102.87
R	4.623-4.628	4.867-4.872	117.42-117.55	123.62-123.75
T	6.000-6.006	6.037-6.043	152.40-152.55	153.34-153.49
W		10.029-10.034		254.74-254.86

D. 1900, 1900-30 Standard Disc

Inspection Areas

The standard 1900 disc as pictured in Figure 16 can be machined until the "N" dimension is reduced to the minimum, as listed in Table 3. The "T" dimension is provided to ensure the disc has not been machined beyond its limits. If the thickness of the disc ("T" min.), is reduced by remachining, the entire disc holder assembly would drop lower with respect to the seating plane of the nozzle. This would create a significant change in the huddle chamber configuration and result in significantly more "simmer" prior to opening.



(For 1900 V and W Only)
Type 3

Disc Inspection Areas
FIGURE 16

IX. (Continued)

TABLE 3

DISC TYPE	ORIFICE SIZE	INCHES		MILLIMETERS	
		"T" Minimum	"N" Minimum	"T" Minimum in millimeters	"N" Minimum in millimeters
TYPE 1	D-1	.155	.005	3.94	.127
	E-1	.158	.005	4.01	.127
	F, D-2, E-2,	.174	.010	4.42	.254
	G	.174	.010	4.42	.254
	H	.335	.010	9.02	.254
TYPE 2	J	.359	.010	9.12	.254
	K	.422	.015	10.72	.381
	L	.457	.015	11.61	.381
	M	.457	.015	11.61	.381
	N	.495	.015	12.57	.381
	P	.610	.015	15.49	.381
	Q	.610	.015	15.49	.381
	R	.610	.015	15.49	.381
TYPE 3	V	—	.015	—	.381
	W	1.692	.015	42.98	.381

Minimum Allowable Dimensions after Machining of the Disc Seat

**E. 1900 Series
Thermodisc®
Replacement Criteria**

If seat defects and damage can not be lapped out without reducing the "A" dimension below that shown on **NOTE 4**, the Thermodisc must be replaced.

NOTE 4: The dimension through the orifices is difficult to measure. If you cannot measure the .006 minimum thickness of the thermal lip, replace the Thermodisc.

TABLE 4

ORIFICE SIZE	"A" MIN. DIMENSION (IN)	"A" MIN. DIMENSION (MM)
D, E, F, G & H	.006	.153
J	.013	.331
K, L, M & N	.014	.356
P	.017	.432
Q & R	.015	.381
T	.025	.635
V & W	—	—

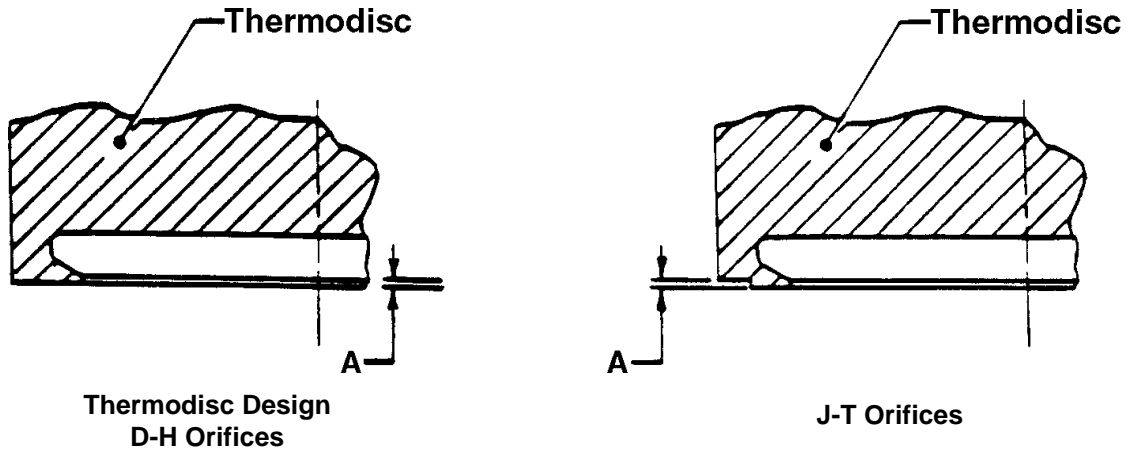


FIGURE 17

IX. (Continued)

F. Disc Holder Inspection Criteria

There are several designs of disc holders. Depending on the service and the type of valve. The particular type may be found in the details of Figure 16. for identification purposes the "G" dimension is provided. Please note that there are low pressure and high pressure disc holders.

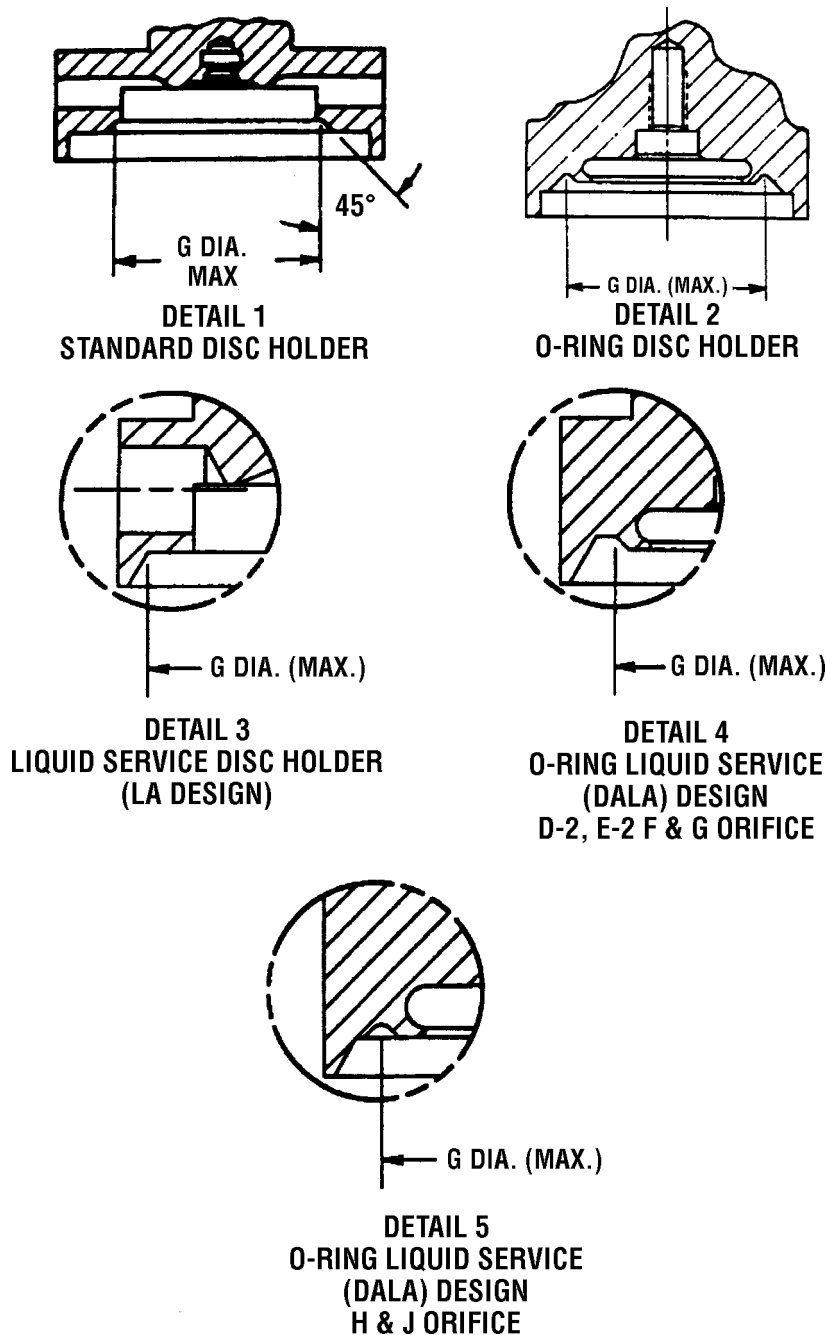


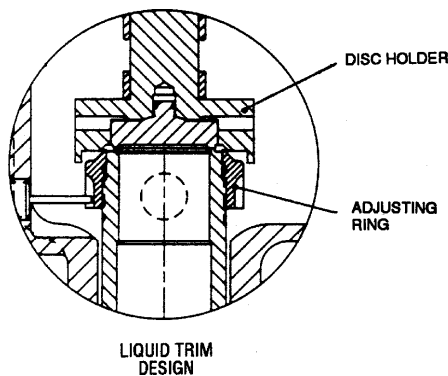
FIGURE 18

IX. (Continued)

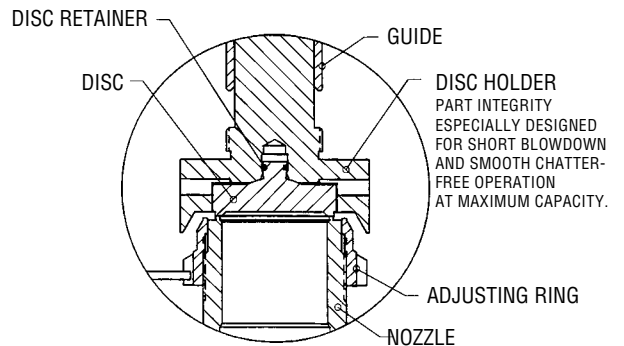
TABLE 5

G Diameter in inches for Disc Holder Identification. See Figure 18, for design details. (Detail 1, is standard unless noted).								
Orifice Size	Standard Disc Holder				O-Ring Disc Holder			
	Low Pressure	High Pressure	Liquid Trim		Liquid Trim		Low Pressure	High Pressure
			LS Design	LA Design	DL Design	DALA Design		
D-1	0.715	0.715	0.811	0.765 Detail 3	0.811	n/a	0.811	0.811
E-1	1.012	0.922	0.971	1.061 Detail 3	0.971	n/a	0.940 Detail 2	0.971
D-2	1.167	1.032	1.167	1.265 Detail 3	1.100 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
E-2	1.167	1.032	1.167	1.265 Detail 3	1.100 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
F	1.167	1.032	1.167	1.265 Detail 3	1.167 Detail 2	1.092 Detail 4	1.100 Detail 2	1.032
G	1.272	1.183	1.272	1.374 Detail 3	1.272	1.262 Detail 4	1.270 Detail 2	1.183
H	1.491	1.394	1.491	1.655 Detail 3	1.491	1.494 Detail 5	1.489 Detail 2	1.394
J	1.929	1.780	1.929	2.155 Detail 3	1.929	1.865 Detail 5	1.851 Detail 2	1.780
K	2.126	2.126	2.264	2.468 Detail 3	2.264	2.468 Detail 3	2.264	2.264
L	2.527	2.527	2.762	3.062 Detail 3	2.762	3.062 Detail 3	2.527	2.527
M	2.126	2.126	3.054	3.358 Detail 3	3.054	3.358 Detail 3	2.264	2.980
N	3.088	3.088	3.480	3.827 Detail 3	3.480	3.827 Detail 3	2.527	2.527
P	3.950	3.950	4.361	4.811 Detail 3	4.361	4.811 Detail 3	2.980	2.980
Q	5.197	5.197	5.546	6.108 Detail 3	5.546	6.108 Detail 3	5.197	5.197
R	6.115	6.115	6.563	7.218 Detail 3	6.563	7.218 Detail 3	6.155	6.155
T	7.494	7.494	7.840	8.624 Detail 3	7.840	8.624 Detail 3	7.494	7.494
W	12-21/32	12-21/32	n/a	n/a	n/a	n/a	n/a	n/a

*For valve manufactured prior to June 1987, use dimension 0.810 for D-1 orifice.



1900 LIQUID SERVICE (LS) INTERNALS
FIGURE 19



1900 LIQUID SERVICE (LA) INTERNALS
FIGURE 20

IX. (Continued)

TABLE 5A

G Diameter in millimeters for Disc Holder Identification. See Figure 18, for design details. (Detail 1, is standard unless noted).								
Orifice Size	Standard Disc Holder				O-Ring Disc Holder			
	Low Pressure	High Pressure	Liquid Trim		Liquid Trim		Low Pressure	High Pressure
			LS Design	LA Design	DL Design	DALA Design		
D-1	18.16	18.16	20.6	19.43 Detail 3	20.6	n/a	20.6	20.6
E-1	25.70	23.42	24.66	26.95 Detail 3	24.66	n/a	23.88 Detail 2	24.66
D-2	29.64	26.21	29.64	32.13 Detail 3	27.94 Detail 2	27.74 Detail 4	27.94 Detail 2	33.53
E-2	29.64	26.21	29.64	32.13 Detail 3	27.94 Detail 2	27.74 Detail 4	27.94 Detail 2	26.21
F	29.64	26.21	29.64	32.13 Detail 3	29.64 Detail 2	27.74 Detail 4	27.94 Detail 2	26.21
G	32.31	1.183	32.31	34.90 Detail 3	32.31	32.05 Detail 4	32.26 Detail 2	30.05
H	37.87	35.41	37.87	42.04 Detail 3	37.87	37.95 Detail 5	37.82 Detail 2	35.41
J	49.0	1.780	49.0	54.74 Detail 3	49.0	47.37 Detail 5	47.01 Detail 2	45.21
K	54.0	54.0	57.50	62.69 Detail 3	57.50	62.69 Detail 3	57.50	57.50
L	64.19	64.19	70.15	77.77 Detail 3	70.15	77.77 Detail 3	64.19	64.19
M	54.0	54.0	77.57	85.29 Detail 3	77.57	85.29 Detail 3	57.50	75.69
N	78.44	78.44	88.39	97.21 Detail 3	88.39	97.21 Detail 3	64.19	65.28
P	100.33	100.33	110.77	122.20 Detail 3	110.77	122.20 Detail 3	75.69	75.69
Q	132.00	132.00	140.87	155.14 Detail 3	140.87	155.14 Detail 3	132.00	132.00
R	155.32	155.32	166.70	183.34 Detail 3	166.70	183.34 Detail 3	156.34	156.34
T	190.35	190.35	199.14	219.05 Detail 3	199.14	219.05 Detail 3	190.35	190.35
W	321.47	321.47	n/a	n/a	n/a	n/a	n/a	n/a

*For valve manufactured prior to June 1987, use dimension 20.57 mm for D-1 orifice.

Set Pressure Change Note: If it is necessary to change the valve set pressure, it may be also be necessary to change the disc holder. See Table 8 to determine if the disc holder must be changed to (from) low pressure from (to) high pressure when changing the set pressure.

Media Change Note: If the protected media is changed in form from a compressable fluid (air, gas or steam), to a non compressable fluid (liquid), change from a standard to a liquid trim disc holder.

Bellows Conversion Note: If a conventional 1900 valve has a D, E, F, G, H, or J orifice disc holder,

the disc holder must be exchanged for a bellows type holder.

O-Ring Conversion Note: If a standard metal seated 1900 valve is to be converted to an O-Ring valve, then the disc holder must be replaced with an O-Ring disc holder. If the valve has a "K" or larger orifice, the standard disc holder may be machined to receive the oversized O-Ring disc. Instructions for this procedure are provided with the kit. O-Ring disc holders may be obtained with the kit.

IX. (Continued)

G. Guide Inspection Criteria

Guide should be discarded if:

1. Visible galling is indicated in the inside guiding surface.
2. The gasket seating areas are pitted and cause the valve to leak between the bonnet and base.

Several different guides could be present in a particular valve depending if it is an O-Ring Valve or Bellows Valve or a Standard valve. On Table 6, find the line that contains the correct orifice size for the valve. Then measure the Barrel portion of the Disc Holder and compare the actual measurement to those indicated in Table 6, to determine the maximum allowable clearance between the disc holder and the guide.

Both the Guide and Disc Holder should be replaced if the clearance between the ID and the Guide and the OD of the Disc Holder is not within the clearance dimensions given in the table below.

H. Spindle Inspection Criteria

Spindle should be replaced if:

1. The bearing point is pitted, galled or distorted.
2. Threads torn so lift nuts won't thread on or off.
3. Concentricity—if spindle cannot be straightened less than .007 total indicator runout (see section X.J and Figure 31).

I. Spring Inspection Criteria

Spring should be discarded if:

1. Pitting and corrosion of the coils reduces coil diameter.
2. Inspect for end parallelism in the free height condition.
3. Check for any obvious unevenness in coil spacing or spring distortion.

4. Spring Washers are custom made for each end of a particular spring. The maximum clearance between the A and A₁ dimension, and B and B₁ dimension (see figure 21), should be 1/32 inch (.79mm) for springs with an inside diameter of less than four inches (100mm). The clearance for valves with a spring inside dimension that is four inches (101. plus) or larger should be 3/64 inch (1.19mm). If you find you must replace a spring, order a Spring Assembly as it will include custom fit Spring Washers not just a spring.

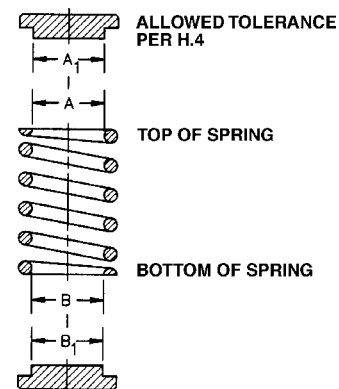


FIGURE 21

5. If constant back pressure is present in a conventional 1900 Series Safety Relief Valve (without balancing bellows), the correct spring should be chosen so that the **COLD DIFFERENTIAL SET PRESSURE** is within the spring range. Normally the spring is selected so that the Set Pressure of the valve is in the spring range. If only the relieving temperature causes the Cold Differential Set Pressure, then the spring is selected using the Set Pressure not the Cold Differential Set Pressure. See Section XII.E for further discussion of set pressure compensation.

TABLE 6
ALLOWABLE CLEARANCE FOR GUIDE AND DISC HOLDER

Orifice Size	Disc Holder Nominal Barrel Size in inches	Disc Holder Diametral Clearance in inches	Disc Holder Nominal Barrel Size in millimeters	Disc Holder Diametral Clearance in millimeters
D, E, F, G	.450, .496, .527 .995	.003-.007 .004-.008	11.43, 12.6, 13.38 25.27	.076-.177 .102-.203
H	.682 1.119	.004-.009 .005-.010	17.32 28.42	.102-.228 .127-.254
J, M	.994, 1.119, 1.744	.005-.010	25.24, 28.42, 44.3	.127-.254
K, L	1.242, 1.367	.007-.012	31.55, 34.72	.178-.305
N	1.870 2.242	.004-.009 .007-.012	47.50 56.95	.102-.228 .178-.305
P	2.304, 2.491	.008-.013	58.52, 63.27	.203-.330
Q,R	3.488, 3.988	.010-.017	88.6, 101.29	.254-.432
T	5.190	.012-.020	131.82	.304-.508
Q-2, R-2, T-3	2.304	.008-.014	58.52	.203-.355
W	8.425	.013-.026	214.0	.330-.660

X. Maintenance Instructions

A. General Information

After the valve has been disassembled, a close inspection should be made of the seating surfaces. In a majority of cases, a simple lapping of seats is all that is necessary to put the valve in first class working order. If an inspection of the parts shows the valve seating surfaces to be badly damaged, machining will be required before lapping. O-Ring seat seal valve nozzles can only be reconditioned by machining, not lapping. (For specific information concerning the machining of nozzle and disc seating surfaces, see Paragraphs X.H. and X.I. which follow.)

NOTE:

In order to determine if the valve contains *Glide-Aloy™ treated components (i.e., the disc holder and/or the guide), which will be identified for a particular valve by the coding found on the valve nameplate, please consult the Appendix to this manual for pertinent supplemental information.

The seating surfaces of the metal seated Consolidated® Safety Relief Valve are flat. The nozzle seat is relieved by a 5° angle on the outside of the flat seat. The disc seat is wider than the nozzle seat; thus, the control of seat width is the nozzle seat (see Figure 22).

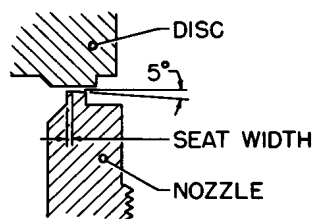


FIGURE 22

Reconditioning of the seating surfaces of the nozzle and disc is accomplished by lapping with a cast iron lap, coated with a lapping compound.

Anytime the V or W orifice valve is disassembled, be sure to inspect the guide rings for wear. If worn, replace before assembly.

NOTE:

In order to establish leak free valve seats, the nozzle seating surface and the disc seating surface must be lapped flat.

B. Lapping Nozzle Seats (Non O-Ring Styles)

NOTE:

Nozzle laps as illustrated below are available from DVCD (instructions and part numbers are located in the tooling section of this manual. It is not recommended to use these laps if the valve nozzle can be removed and machined to the seat dimensions described in Table 7 on page 23.

The 5° angle of the nozzle should be lapped first (see Figure 23, below). Then, invert the nozzle lap and use the flat side as a “starter” lap to insure squareness of the seat (see Figure 24, below). Finish lapping should be done with a ring lap (see Figure 25, below). The ring lap is to be used in an eccentric or figure-eight motion (see Paragraph X.G. for further information). Keep the lap squarely on the flat surface and avoid any tendency to rock the lap which will cause rounding of the seat.

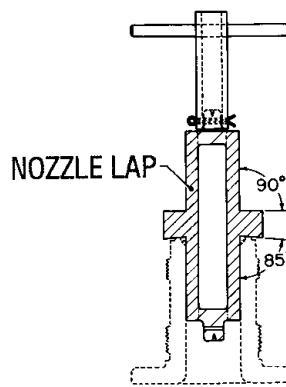


FIGURE 23

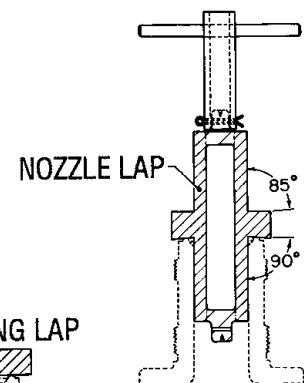


FIGURE 24

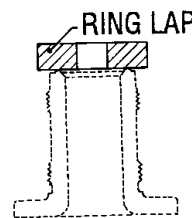


FIGURE 25

C. Nozzle Seat Widths-Lapped

A wide nozzle seat will induce simmer, especially in the smaller orifice lower pressure valves. For this reason, the seat of non-O-Ring valves should be as narrow as practical. Since the seat must be wide enough to carry the bearing load imposed upon it by the spring force, the higher pressure valves must have wider seats than the lower pressure valves. The nozzle seat width should conform with those listed in Table 7, on page 23.

X.C. (Continued)

TABLE 7

Orifice	Set Pressure psig (bar) for Metal Seated Valves except TD		Suggested Lapped Seat Width in Inches (mm)	
D thru J	15-50	(1.03-3.45)	.012-.020	(.30-.51 mm)
	51-100	(3.52-6.90)	.018-.028	(.46-.71 mm)
	101-250	(6.96-17.24)	.025-.035	(.64-.89 mm)
	251-400	(17.31-27.58)	.032-.042	(.81-1.07 mm)
	401-800	(27.65-55.16)	.038-.048	(.96-1.22 mm)
D thru F	801-1500	(55.23-103.42)	.042-.052	(1.07-1.32 mm)
	1501-3000	(103.49-206.84)	.045-.055	(1.14-1.40 mm)
	3001-6000	(206.91-413.69)	.050-.060	(1.27-1.52 mm)
G thru J	801-1000	(55.23-68.95)	.040-.050	(1.02-1.27 mm)
	1001-2800	(69.02-193.05)	.042-.055	(1.07-1.40 mm)
	2801-6000	(193.12-413.79)	.045-.060	(1.14-1.52 mm)
K thru N	15-50	(1.03-3.45)	.025-.040	(.64-1.02 mm)
	51-100	(3.52-6.90)	.030-.045	(.76-1.14 mm)
	101-250	(6.96-17.24)	.035-.050	(.89-1.27 mm)
	251-400	(17.31-27.58)	.040-.055	(1.02-1.40 mm)
	401-800	(27.65-55.16)	.045-.060	(1.14-1.52 mm)
P thru R	15-50	(1.03-3.45)	.030-.045	(.76-1.14 mm)
	51-100	(3.52-6.90)	.035-.050	(.89-1.27 mm)
	101-250	(6.96-17.24)	.045-.060	(1.14-1.52 mm)
	251-400	(17.31-27.58)	.050-.065	(1.27-1.65 mm)
	401-800	(27.65-55.17)	.060-.070	(1.52-1.78 mm)
	801-1000	(55.23-68.95)	.062-.070	(1.57-1.78 mm)
T	15-50	(1.03-3.45)	.040-.060	(1.02-1.52 mm)
	51-100	(3.52-6.90)	.045-.065	(1.14-1.65 mm)
	101-200	(6.96-13.79)	.050-.070	(1.27-1.78 mm)
	201-300	(13.86-20.68)	.060-.080	(1.52-2.03 mm)
W	15-50	(1.03-3.45)	.095-.105	(2.41-2.67 mm)
	51-100	(3.52-6.90)	.115-.125	(2.92-3.17 mm)
	101-250	(6.96-17.24)	.135-.145	(3.43-3.68 mm)
	251-300	(17.31-20.68)	.155-.165	(3.94-4.19 mm)

Orifice	Set Pressure psig (bar) for TD Option only		Suggested Seat Width in Inches (mm) for TD Option only	
D thru F	15-50	(1.03-3.45)	.020-.030	(.50-.76 mm)
	101-300	(6.96-20.68)	.035-.045	(.89-1.14 mm)
	301-800	(20.75-55.17)	.045-.055	(1.14-1.40 mm)
	801 plus	(55.24 plus)	Add .005 (.13 mm) for each additional 100 psig	
	G thru J	15-100	(1.03-6.89)	.025-.035	(.64-.89 mm)
G thru J	101-300	(6.96-20.68)	.035-.040	(.89-1.01 mm)
	301-800	(20.75-55.17)	.045-.055	(1.14-1.4 mm)
	801 plus	(55.24 plus)	Add .005 (.13 mm) for each additional 100 psig	
	K thru N	15-100	(1.03-6.89)	.035-.040	(.89-1.01 mm)
K thru N	101-300	(6.96-20.68)	.045-.055	(1.14-1.4 mm)
	301-800	(20.75-55.17)	.055-.065	(1.4-1.65 mm)
	801 Plus	(55.24 plus)	Add .005 (.13 mm) for each additional 100 psig	
	P thru R	15-100	(1.03-6.89)	.040-.050	(1.01-1.27 mm)
P thru R	101-300	(6.96-20.68)	.055-.065	(1.40-1.65 mm)
	301-800	(20.75-55.17)	.060-.070	(1.52-1.78 mm)
	801-1000	(55.24-68.95)	.065-.075	(1.65-1.90 mm)
	T	15-100	(1.03-6.89)	.050-.065	(1.27-1.65 mm)
T	101-300	(6.96-20.68)	.060-.075	(1.52-1.90 mm)
	W	-	-	-

The seat width can be measured by the use of a "Measuring Magnifier" (see Figure 26 below). DVCD recommends the use of Model S1-34-35-37 (which is manufactured by Bausch and Lomb Optical Co., Rochester, N.Y.). This is a seven power glass, with a three quarter inch scale showing graduations of 0.005 inch. The use of this scale in measuring the nozzle seat width is shown in Figure 26 b (also below).

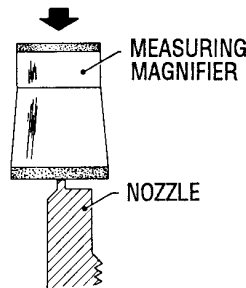


FIGURE 26

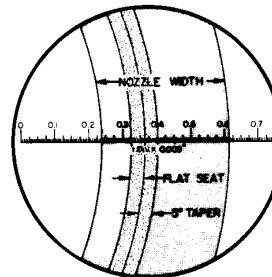


FIGURE 26 b

X.C. (Continued)

If additional lighting is required for measuring the seat, DVCD suggests a goose-neck flashlight similar to the Type A Lamp Assembly Flashlight (which is manufactured by Standard Molding Corporation, Dayton, Ohio).

D. Lapping Disc Seats

The disc seat may be lapped with a ring lap or a lapping plate. Lapping should be done in an eccentric or figure-eight motion in all directions, applying uniform pressure and rotating the disc or lap slowly. (See Paragraph X.G. for further information).

E. Precautions and Hints for Lapping Seats

The following precautions and hints will enable maintenance personnel to do a "professional" job of lapping sets:

1. Keep work materials clean.
2. Always use a fresh lap. If signs of wearing (out of flatness) are evident, recondition the lap.
3. Apply a very thin layer of compound to the lap. This will prevent rounding off the edges of the seat.
4. Keep the lap squarely on the flat surface, and avoid any tendency to rock the lap which causes rounding of the seat.
5. When lapping, keep a firm grip on the part to prevent the possibility of dropping it and damaging the seat.
6. Lap, using eccentric or figure-eight motion in all directions, at the same time applying uniform pressure and rotating the lap slowly. (See Paragraph X.G. for further information.)
7. Replace the compound frequently after wiping off the old compound, and apply more pressure to speed the cutting action of the compound.

8. To check the seating surfaces, remove all compound from both the seat and the lap. Then, shine the seat with the same lap using the lapping motion described above. Low sections on the seating surface will show up as a shadow in contrast to the shiny portion. If shadows are present, further lapping is necessary and only laps known to be flat should now be used. Only a few minutes will be required to remove the shadows.
9. When the lapping is completed, any lines appearing as cross scratches can be removed by rotating the lap (which has been wiped clean of compound) on the seat about its own axis.
10. The seat should now be thoroughly cleaned using a lint-free cloth and a cleansing fluid.

F. Lapping O-Ring Seating Surfaces

The contact surfaces of the nozzle and O-ring retainer are ground, prior to assembly, to provide metal to metal seat tightness in the event of O-ring failure.

Refer to Figure 4 (on page 7 of this manual) and assemble the retainer to the disc holder (D-J orifice), or disc (K-T orifice), using the retainer lock screw(s). Apply 3A compound to the retainer seating surface. Place the retainer on the nozzle seat and grind the retainer to the nozzle. Once uniform contact is established, clean the nozzle and retainer, and repeat the grinding procedure with 1000 grit compound.

Remove the retainer screw(s) and retainer, and thoroughly clean the retainer, retainer screws and disc holder or disc.

X. (Continued)

G. Reconditioning of Laps

1. Ring laps are reconditioned by lapping them on a flat lapping plate. The lapping should be done with a figure-eight motion as indicated in Figure 27, below. To assure the best results when lapping seats, the ring laps should be reconditioned after each usage and checked with an optical flat.

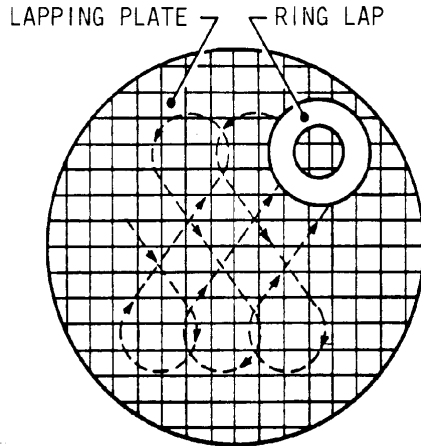


FIGURE 27

2. Nozzle laps must be remachined to recondition the lapping surfaces. Place the nozzle lap in a lathe between centers (see Figure 28, below). The surfaces marked A and B must be running concentric.

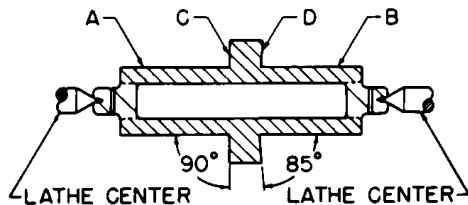


FIGURE 28

One lapping surface is 90° and the other is 85°. The angle of each surface is marked on the lap. Machine surfaces C and D, by taking light cuts at the proper angle, until the lapping surfaces are reconditioned.

H. Remachining Nozzle Seats and Bores

The nozzle should be removed from the valve to be machined (see Figure 29). See Nozzle Removal Instructions in paragraph VII.B.14. If it can not be removed from the base, it should be machined inside the base.

1. Lathe Set Up - Nozzle Removed

- a. Grip the nozzle in a four-jaw independent chuck, using a piece of soft material such as copper or fiber between the jaws and the nozzle as shown at A in Figure 29.
- b. True up the nozzle so that the surfaces marked B, C and D run true within .001" on indicator.

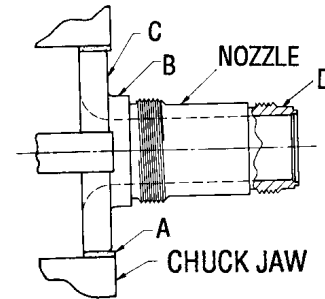


FIGURE 29

X.H. (Continued)

2. Machining Procedure: Metal to Metal Seat

See Figure 15, page 15.

- Take light cuts across the surface L at 5°, until the damaged areas are removed. (See Figure 15) Turn to the smoothest possible finish.
- Cut back the outside surface at G, until dimension N is obtained. The surface at G is common to all nozzles **except the D-1. Omit this step on the D-1 orifice nozzles.**
- Machine bore diameter H, until dimension E is obtained. Re-establish angle P.
- The nozzle is now ready for lapping.
- When the minimum dimension D is reached, the nozzle should be discarded.

3. Machining Procedure: O-Ring Seat Seal

See Figure 15, page 15.

- Take light cuts across surface A (45°), until the damaged areas are removed. Turn to the smoothest possible finish.
- Cut back the outside surface at M, until dimension J is obtained.
- Machine radius B.
- The nozzle is now ready for grinding.
- When the minimum dimension D is reached, the nozzle should be discarded.

I. Remachining the Disc Seat*

The standard disc seating surface (see Figure 30) can easily be machined as follows:

- Grip the disc in a four-jaw independent chuck (or collet, if appropriate), using a piece of soft material such as copper or fiber between the jaws and the disc as shown at A.
- True up the disc so that the surface marked B and C run true within .001" (0.025 mm), TIR.
- Take light cuts across the seating surface L until damaged areas are removed. Turn to smoothest possible finish.
- The disc is now ready for lapping.
- When the minimum dimension N or T (see Table 3) is reached the disc should be discarded. Do not re-establish surface C.

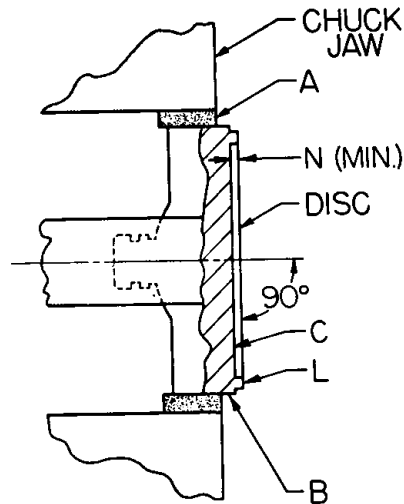


FIGURE 30

*Thermodisc® and O-Ring discs are not to be machined.

X. (Continued)

J. Checking Spindle Concentricity

It is important that the spindle of a safety relief valve be straight, in order to transmit the spring load to the disc without lateral binding. Over-gagging is one of the common causes of bent spindles. To check the essential working surfaces of the spindle, either of the following methods is recommended:

1. V-Block Support Set Up

- a. The ball pointed spindles should be placed in a piece of material, B, that has been recessed to permit free rotation of the spindle. For hollow spindles, a ball pointed support is required. (See Figure 31).
- b. Support the spindle with a V-block A, placed near the upper end of the spindle, but below the threads.

- c. Apply a machinist's indicator at approximately 45° to the outer edge of the spring washer seat at C. Rotate the spindle. The total indicator reading should not exceed .007" (.17 mm). Straighten the spindle, if necessary.

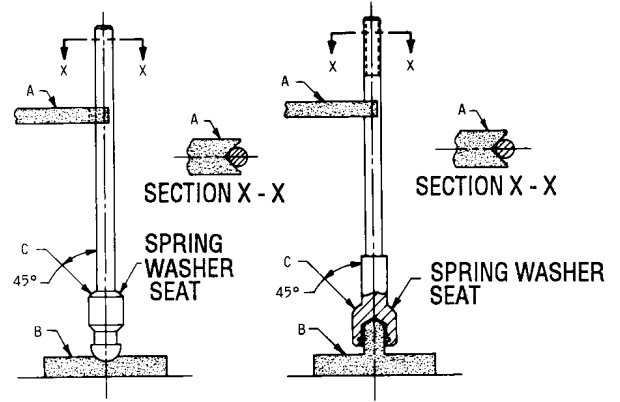


FIGURE 31

TABLE 8

Disc Holder Selection Criteria Pressures in psig, (kg/cm ²) units.								
Orifice Size	Air / Gas Non Liquid Service				Liquid Service			
	Metal Seat		"O" Ring DA		LS Design		LA Design	
	Use low pressure discholder	Use high pressure discholder	Use low pressure "O"ring discholder	Use high pressure "O"ring discholder	Metal Seats	"O" Ring Seat	Metal Seat	"O"Ring Seat
D-1 -30D-1	Not available	Use for all pressures	Use for all pressures same as DL disc holder	Not applicable	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA for all Pressures	LA-DA discholder is not applicable
E-1 -30E-1	5 - 100 (71-1435)	101 and greater (1436) and greater	5 - 35 (71-499)	36 (500) and greater same as DL discholder	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	LA-DA discholder is not applicable
D-2 E-2 -30D-2 -30E-2 F-1 -30F-1	5 - 100 (71-1435)	101 and greater (1436) and greater	5 - 35 (71-499)	36 (500) and greater same as DL discholder	Use LS - Same as low pressure air / gas discholder	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures
G-1 -30G-1 H-1 -30H-1 J-2 30J-2	5 - 50 (71-711)	50 and greater (712) and greater	5 - 120 (71-1706)	121 (1720) and greater	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures
K - T -30K-T	Not applicable	use standard discholder for all pressures	Not applicable	All Pressures	Use LS discholder for all pressures	Use DL or LS-DA discholders for all pressures	Use LA discholder for all pressures	Use DA-LA disc-holders for all Pressures

X. (Continued)

K. Set Pressure Change-Disc Holder*

The disc holder must be replaced if the set pressure must be changed and the change involves crossing the dividing line between high pressure and low pressure. See Table 8 to determine if the disc holder must be changed when changing the set pressure.

dimension of the D-1 or E-1, and the actual seat dimensions and bore diameter are identical to the F orifice nozzle.

Other 1900 series valves may be restricted in the same manner when necessary. These valves may be restricted to a minimum lift of 30% of the full rated capacity, or .080 inches or 2.03 mm. Please refer to National Board Code Case 1945-2.

L. Checking Lift on Lift Restricted Valves

General

Restricted lift valves have a limit washer which prevents the disc and disc holder from lifting beyond the required lift and resulting capacity. The D-1 and E-1 valves do not require limit washers. The D-2 and E-2 valves have a special nozzle with the overall height and flange

It is important to check lift on all restricted lift valves after servicing or replacing parts. This procedure is necessary to insure the reliability of the nameplate capacity.

NOTE:

The required lift for a "restricted lift" valve is indicated on the restricted lift nameplate, (see figure 33).

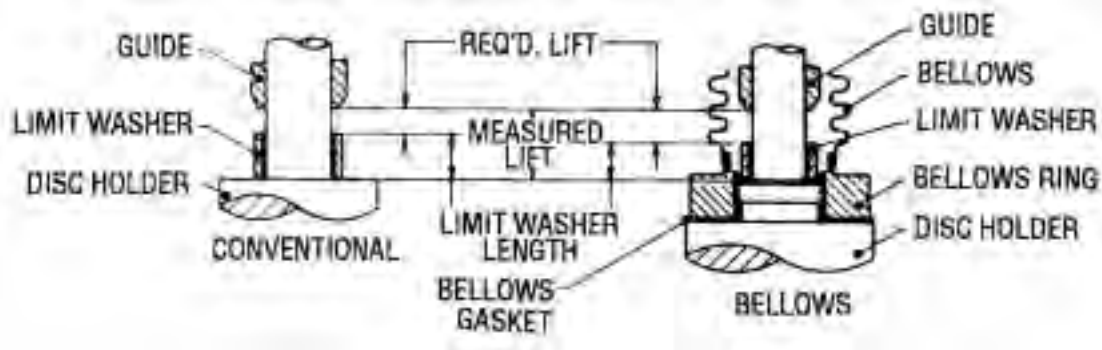


FIGURE 32

Restricted lift valves may be identified by the restricted lift nameplate (see Figure 33).

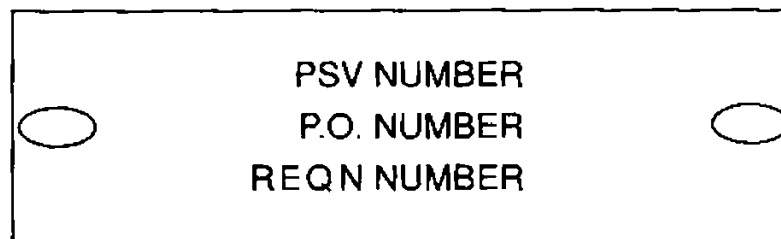
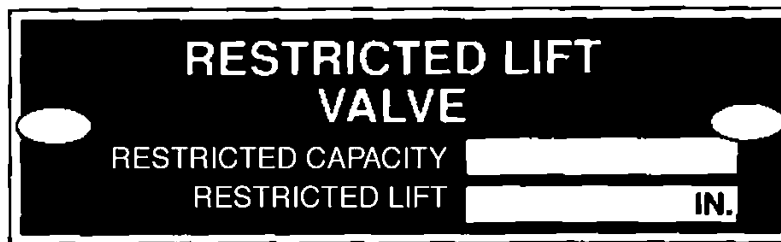


FIGURE 33

X. (Continued)

Specific Steps

Use the following procedure to determine the correct limit washer length.

1. Assemble the disc and holder (installing the bellows gasket and bellows, if applicable). Place the guide over the disc holder barrel; then connect the spindle to the disc holder. (Install the eductor tube in base, if applicable.) Then, install the adjusting ring below the seat.
2. Install the guide gasket and insert the assembly, from Step 1, above, into the base.
3. Install the bonnet gasket and bonnet (leaving out the spring assembly at this time).
4. Tighten the nuts to compress the gasket. **(Do not use an impact wrench on bellow valves.)**
5. Place a dial lift indicator on the bonnet and over the spindle, then zero the indicator.
6. Measure the total lift by pushing the disc upward.
7. Subtract the required lift of the valve from the measured lift, to find the required limit washer length.
8. Machine the limit washer to the required length. Next, machine the inside chamfer, then deburr and polish, as required.
9. Disassemble the valve, install the limit washer (with chamfer down), and prepare to reassemble the valve. Measure the actual lift of the valve, and compare it with the required lift for the valve, per the note above.
10. a. If the actual lift is less than required, machine the lift washer the additional amount necessary to obtain the required lift. (Machine, chamfer and deburr, before installation into the valve.)
 - b. If the actual lift is greater than the required amount, obtain a new limit washer, and begin again with Step 7, above. (Again, machine, chamfer and deburr, before installation into valve.)
11. Remove the bonnet and install the spring assembly; then, reinstall the bonnet and tighten the stud nuts.
12. The valve is now ready for setting and testing.

NOTES:

- **The limit washer must be chamfered to fit over the radius on the disc holder. This**

chamfered end must be located down, next to the backface of disc holder, when assembled.

- **For bellows Type "D" and "E" valves, the limit washer must be chamfered on the lower end, to remove the knife edge of the cut off. For bellow valves, the outside diameter must also be checked, and emery clothed down to .680" or 17.3 mm maximum diameter, in order to avoid any interference with the bellows threads.**
- **Be sure of all dimension requirements for each valve. Do not interchange internal parts, or use a different base, after a set of parts has been custom-fit.**

XI. Reassembly

A. General Information

The Type 1900 Safety Relief Valve can be easily re-assembled after the required maintenance of internal parts has been performed. (Again, refer to Figures 1-6, on pages 6 and 7, for parts nomenclature.) All parts should be clean prior to assembly. Special attention should be given to guiding surfaces, bearing surfaces, flange faces, retainer recesses and grooves. See Section XVII for Recommended Compounds and Tools.

NOTES:

- **Check all gaskets used during re-assembly. Undamaged solid metal gaskets (not pitted or creased) can be reused. All soft gaskets must be replaced. Before placing the (flat) gaskets, apply a light uniform coating of lubricant to the surface to be gasketed; then coat the top of the gasket with lubricant.**
- **If grinding in of bearing parts was necessary, be sure to remove all grinding compound; then, thoroughly clean both surfaces and rinse with alcohol or another suitable cleaner.**
- **With regard to restricted lift valves, be sure to measure the required lift before final assembly. (See Paragraph X.L. for instructions.)**
- **The last step before final assembly is lubrication. Apply lubricants sparingly, but be sure that each bearing surface is lightly (yet uniformly) covered.**

XI.A. (Continued)

- If the involved valve has an O-Ring seat seal, refer to the tag plate mounted on the valve (see Figure 34) to determine O-Ring material and "as built" part number.



FIGURE 34

B. Lubrication

Use a nickel based anti-seize lubricant on all threads, and bearing surfaces. Typical brands are TWIST™, NEVER-SEEZE™, OR FEL-PRO NICKEL EASE™.

C. Specific Steps

1. If the valve nozzle was removed, apply thread lubricant to the nozzle threads before reinstalling in the valve base. Insert it in to the inlet flange of the base, and torque to the correct value listed in Table 9.

TABLE 9

Nozzle Torque Values +10% - 0%		
Orifice	Required Torque ft.lbs.	Required Torque nm
D-1	95	129
D-2	165	224
E-1		
E-2		
F-1	145	197
G		
H	165	224
J	335	455
K	430	584
L	550	746
M	550	746
N	640	868
P	1020	1383
Q	1400	1898
R	1070	1451
T	1920	2604
V	2000	2712
W	2000	2712

2. Reinstall the adjusting ring on the nozzle, below seat level, so that the disc will seat on the nozzle and not on the ring.

3. a. For restricted lift valves, if the nozzle did not require any machining, the same limit washer (tagged during disassembly) may possibly be reused. However, lift should be checked and verified as described in Paragraph X.L.
 b. If a restricted lift valve nozzle was remachined, measure the required lift before final assembly. (Again, see Paragraph X.L. for instructions.)

4. Assemble the disc/disc holder as follows:
 - a. Prior to assembly of the disc into the disc holder, remove the spring clip from the back of the disc. Use 1000 grit grinding compound on the bearing surface to grind the disc into the disc holder to properly establish the bearing surface.
 - b. For all orifices, metal-to-metal discs, place the disc retainer into the groove in the disc. The retainer should “snap” into the disc holder pocket with moderate finger or hand force. **DO NOT USE EXCESSIVE FORCE TO ASSEMBLE THESE PARTS.** Be sure that the disc is free to “wobble” after it is in place.

For V and W orifice discs, place disc into disc holder and secure disc retaining bolts.

- c. For O-Ring disc sizes K thru T, reassemble the disc using a new O-Ring, O-Ring retainer, and new screws. Assemble the disc into the disc holder as described in Paragraph 4.a., above.
- d. For O-Ring disc sizes D thru J, reassemble the disc holder using a new O-Ring, O-Ring retainer, and new screw(s). These disc holders are ready for the next step.

5. For bellows valves through T, (see Figure 11 on page 13), place a new bellows gasket on the disc holder. Thread the bellows, finger-tight, down to the gasket on the disc holder. Use a pin spanner wrench, or special cable type wrench to turn the bellows ring down until a pressure tight joint is obtained.

For bellows valves V and W, place a new bellows gasket on the disc holder. Bolt down using proper torque as found in the assembly instructions.

6. On D and E restricted lift valves, install the limit washer with the chamfered side down.

XI.C. (Continued)

7. Place the guide over the disc holder. **(DO NOT DROP.)** If bellows is present, the weight of the guide will slightly compress the bellows.
8. Set the disc holder (disc side down), on the work surface. Place a small amount of 1000 grit grinding compound onto the ball end of the spindle and place it in the spindle socket of the disc holder. Turn the spindle clockwise, and then counter clockwise, to seat the spindle/disc holder bearing point.
9. Place the spindle retainer over the end of the spindle head or disc holder, as applicable. Apply lubricant sparingly to the ball tip of the spindle. Place the spindle in the disc holder, and align the spindle retainer so that the gap is midway between the two slots. Using a screwdriver, compress the spindle retainer and guide it into the retaining groove. Be sure that the spindle turns freely.
10. With a small amount of 320 grit grinding compound spread on the spring washer bearing surface. Place the spring washer over the spindle/spring washer bearing surface and turn it clockwise and then counter-clockwise to seat in the bearing surface. In the same manner grind the compression screw into the bearing surface of the upper spring washer to establish a smooth bearing surface.

TABLE 10

Bonnet Nut Torque in ft.lbs. +10% - 0%													
	1905 1906	1910	1912	1914	1916	1918	1920	1921	1922	1923	1924	1926	1928
D-1	55	55	55	60	60	120	55	**	55	**	75	60	115
D-2	55	55	60	60	60	120	55	**	55	**	60	60	115
E-1	55	55	55	60	60	120	55	**	55	**	60	60	115
E-2	55	55	60	60	60	120	55	**	55	**	60	60	115
F	55	55	60	70	70	115	55	**	55	**	70	70	115
G	55	55	60	70	70	75	55	**	60	**	70	70	75
H	90	60	75	65	65	**	60	**	60	**	75	85	**
J	60	75	100	100	100	**	75	**	75	**	100	100	**
K	65	60	60	135	145	**	60	**	60	**	60	140	**
L	75	90	90	140	140	**	90	**	90	**	140	140	**
M	95	110	95	95	**	**	90	**	95	**	95	**	**
N	105	130	85	85	**	**	130	**	85	**	85	**	**
P	120	145	125	125	**	**	145	**	**	125	125	**	**
Q	105	125	150	**	**	**	105	**	**	**	**	**	**
R	115	115	135	**	**	**	115	**	150	**	**	**	**
T	95	**	**	**	**	**	**	**	135	**	**	**	**
-2T	**	125	**	**	**	**	**	125	**	**	**	**	**
V	130	130	**	**	**	**	**	**	**	**	**	**	**
W	130	130	**	**	**	**	**	**	**	**	**	**	**

** Valves have not been built in this configuration.

XI.C. (Continued)

- 11. Place a new guide gasket in the base.
- 12. Install spindle/disc guide assembly. On M thru T sizes, use the same lifting tool (see Figure 10 on page 13) as was used during disassembly, then carefully lower it into the valve base. If conventional valve is involved, take care to align the hole(s) in the guide over the extended end of the eductor tube(s), to ensure proper fit. Then, install the spindle as described in Paragraph 8 above.

On V and W sizes, use the same lifting lugs as were used during disassembly.

- 13. Apply a small quantity of lubricant to the spring washer bearing surface of the spindle. Place the spring assembly on the spindle.
- 14. Place a new bonnet gasket in the base prior to installing the bonnet. Uniformly tighten the bonnet stud bolts using the correct pattern as displayed in Figure 35. Use table 10 or 10A, to determine the required torque for the subject valve. Then use Table 11, to determine the torque values for each round of the pattern. The last round insures that all the stud nuts are at the required torque.

TABLE 10A

Bonnet Nut Torque in nm, +10% - 0%													
	1905 1906	1910	1912	1914	1916	1918	1920	1921	1922	1923	1924	1926	1928
D-1	75	75	75	82	82	163	75	**	75	**	102	82	156
D-2	75	75	82	82	82	163	75	**	75	**	82	82	156
E-1	75	75	75	82	82	163	75	**	75	**	82	82	156
E-2	75	75	82	82	82	163	75	**	75	**	82	82	156
F	75	75	82	95	95	156	75	**	75	**	95	95	156
G	75	75	82	95	95	102	75	**	82	**	95	95	102
H	123	82	102	89	89	**	82	**	82	**	102	116	**
J	82	102	136	136	136	**	102	**	102	**	136	136	**
K	89	82	82	184	197	**	82	**	82	**	82	189	**
L	102	123	123	189	189	**	123	**	123	**	189	189	**
M	129	150	129	129	**	**	123	**	129	**	129	**	**
N	143	177	116	116	**	**	177	**	116	**	116	**	**
P	163	197	170	170	**	**	197	**	**	125	170	**	**
Q	143	170	204	**	**	**	143	**	**	**	**	**	**
R	156	156	184	**	**	**	156	**	204	**	**	**	**
T	129	**	**	**	**	**	**	**	184	**	**	**	**
-2T	**	170	**	**	**	**	**	125	**	**	**	**	**
V	177	177	**	**	**	**	**	**	**	**	**	**	**
W	177	177	**	**	**	**	**	**	**	**	**	**	**

** Valves have not been built in this configuration.

XI.C. (Continued)

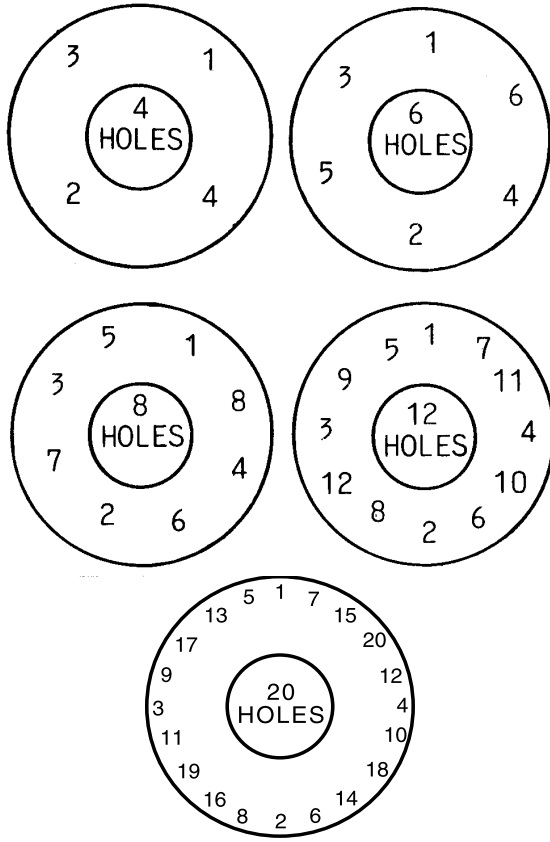


FIGURE 35

TABLE 11

Torque required for each round of pattern	
Round	Percentage of required torque
1	Wrench tight
2	25
3	60
4	100
5	100

15. With the adjusting screw lock nut assembled near the top of the adjusting screw, apply a small quantity of lubricant to the spherical end of the adjusting screw, and also lubricate the threads. Thread the adjusting screw into the bonnet, until it contacts the spring washer.

For V and W orifices, assemble the plunger and compression screw with the setting device. Set as if starting fresh.

16. When compressing the spring, hold the spindle with pliers to prevent the spindle from turning in the disc holder. Turn the adjusting screw clockwise, until the original distance between the end of the spindle and the top of the adjusting screw is obtained. This method of compressing the spring will "approximately" re-establish the original set pressure. **The valve must still be reset for the required pressure.**

17. Restore the adjusting ring to its original position, with reference to the disc holder, as recorded, and replace the adjusting ring pin using a new gasket. If the original position of the ring is not known, verify the number of notches on the adjusting ring, then refer to one of the three tables (i.e., Tables 12, 13 & 14), depending upon the number of notches on the ring, and set the ring position according to the applicable set pressure and orifice size.

18. The valve is now ready for Setting and Testing.

XI.C. (Continued)

TABLE 12

RING SETTINGS FOR VALVES WITH SERIAL NUMBERS BEFORE TK-68738*			
ORIFICE	NO. OF NOTCHES ON ADJ. RING	SET PRESSURE 100 PSIG (6.90 BAR) & BELOW	SET PRESSURE ABOVE 100 PSIG (6.90 BAR)
D-1	16	1 Notch	4 Notches
D-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
E-1	16	1 Notch	4 Notches
E-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
F	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
G	18	1 Notch	4 Notches
	30	2 Notches	6 Notches
H	24	1 Notch	5 Notches
	30	2 Notches	6 Notches
J	24	1 Notch	5 Notches
	30	2 Notches	8 Notches
K	24	6 Notches	14 Notches
	32	8 Notches	19 Notches
L	24	6 Notches	18 Notches
	40	10 Notches	31 Notches
M	24	7 Notches	20 Notches
	40	10 Notches	30 Notches
N	24	7 Notches	20 Notches
	40	10 Notches	30 Notches
P	24	8 Notches	24 Notches
	40	14 Notches	42 Notches
Q	28	10 Notches	28 Notches
	48	17 Notches	47 Notches
R	32	28 Notches	36 Notches
	48	42 Notches	64 Notches
T	24	30 Notches	38 Notches
W	-	-	-

TABLE 13

RING SETTINGS FOR VALVES WITH SERIAL NUMBERS AFTER TK-68738*			
ORIFICE	NO. OF NOTCHES ON ADJ. RING	SET PRESSURE 100 PSIG (6.90 BAR) & BELOW	SET PRESSURE ABOVE 100 PSIG (6.90 BAR)
D-1	16	1 Notch	4 Notches
D-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
E-1	16	1 Notch	4 Notches
E-2	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
F	16	1 Notch	4 Notches
	24	2 Notches	6 Notches
G	18	1 Notch	4 Notches
	30	2 Notches	6 Notches
H	24	1 Notch	5 Notches
	30	2 Notches	6 Notches
J	24	1 Notch	5 Notches
	30	2 Notches	8 Notches
K	24	2 Notches	5 Notches
	32	2 Notches	7 Notches
L	24	2 Notches	6 Notches
	40	4 Notches	11 Notches
M	24	2 Notches	7 Notches
	40	4 Notches	12 Notches
N	24	3 Notches	8 Notches
	40	4 Notches	13 Notches
P	24	3 Notches	9 Notches
	40	5 Notches	16 Notches
Q	28	5 Notches	15 Notches
	48	8 Notches	25 Notches
R	32	7 Notches	20 Notches
	48	10 Notches	30 Notches
T	24	6 Notches	19 Notches
W	24	10 Notches	30 Notches

* Valve Serial Numbers are alphabetically and numerically chronological.

NOTES:

- Be careful to choose the correct table.
- If the Valve has an "O" Ring Seat Seal, tighten and lock the adjusting screw prior to the final setting of the adjusting ring.
- Be sure the ring pin enters the notch in the ring, but does not bind the ring. The ring should move freely from side to side within the notch. If necessary, cut the pin to the needed length, or replace the pin.

TABLE 14

LIQUID TRIM			
OLD - LS		NEW - LA	
ORIFICE	RING POSITION	ORIFICE	RING POSITION
D	10	D	5
E	10	E	5
F	10	F	5
G	14	G	5
H	20	H	5
J	20	J	5
K	24	K	5
L	24	L	5
M	24	M	5
N	24	N	5
P	36	P	5
Q	42	Q	5
R	48	R	5
T	36	T	5

XII. Setting and Testing

A. General Information

Before putting the re-conditioned valve in service, it must be set to open at the required set pressure. Although the valve can be set on the service installation, it is more convenient to set the valve, and check seat tightness, on a test stand. Any spring replacement shall be in accordance with current DVCD guidelines.



B. Test Equipment

Test stands for testing DVCD Safety Relief Valves normally consist of a pressure source, a supply line with a throttle valve, and a receiver having the following features:

1. Outlet for attaching valve to be tested.
2. Pressure gauge with a shut-off valve.
3. Drain line with a shut-off valve.
4. A volume in receiver adequate for the valve to be tested to achieve proper operation.

C. Test Media

For best results, steam valves shall be tested on saturated steam; air or gas valves on air or gas, at ambient temperature; and liquid valves on water, at ambient temperature.

D. Setting the Valve

The valve should be set to open at the set pressure as shown on the nameplate. If a cold differential set pressure is indicated on the nameplate, the valve should be set to open at that pressure. The cold differential set pressure is the set pressure corrected to compensate for back pressure and/or operating temperature.

If changes are to be made to the set pressure or back pressure or the service temperature changes, a new cold differential set pressure may need to be determined.



E. Set Pressure Compensation

1. Cold Differential Set Pressure For Temperature Compensation

During production testing of safety and safety relief valves, the valves are often tested at temperatures that are different from the temperature the valve will be

exposed to in service. Increasing the temperature from ambient causes the set pressure to decrease. This decrease in set pressure is due to thermal expansion of the seating area and spring relaxation.

Therefore, it is important to compensate for the difference between production test temperature and service temperature. The service temperature is the normal operating temperature of the valve. If the operating temperature is unavailable, no correction due to temperature will be made to valve set pressure.

Table 15, below, gives the set pressure multipliers that should be used when computing the cold differential set pressure for valves being set on an air or water test stand at ambient temperatures.

TABLE 15

OPERATING		MULTIPLIER	OPERATING		MULTIPLIER
TEMP. F	TEMP. C		TEMP. F	TEMP. C	
250	120	1.003	900	498	1.044
300	149	1.006	950	510	1.047
350	177	1.009	1000	538	1.050
400	204	1.013	1050	565	1.053
450	248	1.016	1100	593	1.056
500	260	1.019	1150	621	1.059
550	288	1.022	1200	649	1.063
600	316	1.025	1250	676	1.066
650	343	1.028	1300	704	1.069
700	371	1.031	1350	732	1.072
750	415	1.034	1400	760	1.075
800	427	1.038	1450	788	1.078
850	454	1.041	1500	815	1.081

Valves to be used in saturated steam service are tested on saturated steam and, therefore, no CDS is required. However, valves in superheated steam service are tested on saturated steam and, therefore, require a CDS.

Table 16, below, shows the multiplier that should be used based on temperature above the saturated temperature (degrees of superheat).

TABLE 16

Degrees of Superheat, Temp. above Sat.		Multiplier
Fahrenheit	Celsius	
100	38	1.006
200	93	1.013
300	149	1.019
400	187	1.025
500	260	1.031
600	315	1.038
700	371	1.044
800	427	1.050

XII.E. (Continued)

2. Cold Differential Set Pressure For Back Pressure Compensation

NOTE:

For valves with variable superimposed back pressure, install a bellows to allow the set pressure to remain constant.

When a conventional Type 1900 valve is to operate with a constant back pressure, the cold differential set pressure is the set pressure minus the constant back pressure.

When a Type 1900-30 D-1, or 1900-30 E-1, non-balanced bellows valve is used with constant back pressure, the set pressure must be compensated. This valve design cannot be used for variable back pressure. If the valve's set pressure, or back pressure, changes, contact DVCD Field Service at 318-640-6055 for the CDS of the valve.

When Consolidated® Type 1900-30 D-2, 1900-30 E-2 and 1900-30 F thru T balanced bellows valves are used with constant or variable back pressure, no compensation to the valve's set pressure is required due to back pressure.

3. Sample Calculations For Type 1900 Consolidated Safety Relief Valve (Refer to preceding pages, Tables 15 & 16).

Set pressure 2500 psig, temperature 500 F, back pressure atmospheric.

a. Set Pressure	2500	psig
Multiplier from Table X	<u>X1.019</u>	
Cold Differential Set Pressure	2547.5	psig

b. Set pressure 2500 psig, temperature 500 F, constant back pressure 150 psig		
Set Pressure	2500	psig
Minus Constant Back Pressure	<u>-150</u>	psig
Differential Pressure	2350	psig
Multiplier from Table X	<u>X1.019</u>	
Cold Differential Set Pressure	2395	psig

c. Set pressure 2500 psig, temperature 100 F, constant back pressure 150 psig		
Set Pressure	2500	psig
Minus Constant Back Pressure	<u>-150</u>	psig
Cold Differential Set Pressure	2350	psig

d. Set pressure 400 psig on superheated steam, temperature 650 F, back pressure atmospheric		
Operating Temperature	650	F
Minus Temperature of Sat. Steam at 400 psig	<u>-448</u>	F
Degrees of Superheat	202	F
Set Pressure	400	psig
Multiplier from Table Xa	<u>X1.013</u>	
Cold Differential Set Pressure	405	psig

4. Setting Procedure

NOTE:

Valves for steam service should be set using saturated steam. Valves for gaseous service should be set using air or nitrogen. Valves for liquid service should be set using water.

NOTE:

The ASME Boiler and Pressure Vessel Code Section VIII set pressure tolerance is ±2 psi (.14 bar) for set pressures less than 70 psig (4.8 bar) and ± 3% for pressures equal to or greater than 70 psig (4.8 bar).

Before mounting the valve on the test stand, remove all dirt, sediment or scale from the test tank nozzle and the inlet port of the valve. Be sure that the test gauge is accurate and has recently been calibrated on a dead weight gauge tester.

Mount the valve on the test stand. If the adjusting screw of the reconditioned valve has been turned down to its original position, slowly bring the pressure up in the test tank to the cold differential set pressure. If the valve opens before the desired pressure is reached, additional compression is required on the spring. Hold the spindle to prevent rotation and turn the adjusting screw down (clockwise or right-handed). If the valve does not open at the desired pressure, maintain the required pressure in the test tank and slowly release the compression on the spring by turning the adjusting screw counterclockwise, until the valve opens. Continue adjustment until the valve opens at the desired pressure. Be sure to hold the spindle when turning the adjusting screw. The spindle should be centrally located within the adjusting screw. Hard rubbing of the spindle against the side of the adjusting screw can cause poor valve action.

NOTE:

On compressible fluids, set pressure is defined as the pressure where the valve pops open, NOT where it begins to simmer.

NOTE:

On liquid valves, set pressure is indicated by the first continuous flow of water out of the outlet of the valve.

After the required set pressure is obtained, tighten the adjusting screw nut and repeat test. At least two repeat openings at the same pressure should be obtained to be sure that the valve is set accurately.

XII. (Continued)

F. Seat Tightness Testing

1. General Information

A typical test arrangement for determining seat tightness for safety relief valves on air or gas service (in accordance with ANSI B147.1/API RP 527) is shown in Figure 36.

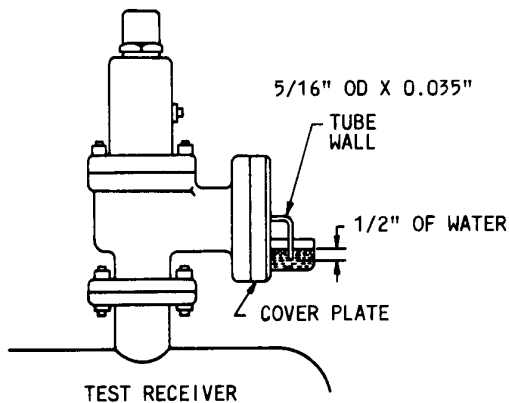


FIGURE 36

Leakage measurement shall be made with the use of a piece of 5/16 in. OD tubing with 0.035 in. wall. The tube end shall be cut square and smooth. It shall also be perpendicular to, and 1/2 in. below, the surface of the water.

2. Seat Tightness Testing: Metal to Metal Seats

With the valve mounted vertically (as shown in Figure 39 above), the leakage rate, in bubbles per minute, shall be determined with pressure at the safety relief valve inlet, which must be held at 90 percent of the set pressure immediately after popping. For valves set at 50 psig or below, the pressure shall be held at 5 psi below set point. The test pressure shall be applied for a minimum of 1 min. for valves on inlet sizes through 2 inches; 2 min. for sizes 2-1/2, 3 and 4 inches; and 5 min. for sizes 6 and 8 inches.

For metal to metal valves, designated for gaseous service, the leakage rate (in bubbles per minute) shall not exceed that shown in Table 17.

TABLE 17

Type of Valve	Manufacturer's Orifice Size	Maximum (Bubbles per Minute)	Approximate Leakage Rate (Standard Cubic Feet per 24 hour) Maximum
Conventional	F and smaller	40	0.60
	G and larger	20	0.30
Balanced Bellows	F and smaller	50	0.60
	G and larger	30	0.45

There shall be **no** visible leakage for valves designated for steam service (and tested on steam) or for liquid service (and tested on water).

3. Seat Tightness Testing for O-Ring Seat Seal Valve

The "Tightness Standard" for O-Ring seat seal valves shall be no leakage at, or below, the test pressures shown in Table 18, below.

TABLE 18

Seat Tightness Testing for "O" Ring Seat Seals®		
Set Pressure		Test Pressure
(psig)	(bar)	(% of Set Pressure)
5 to 30	.35 to 2.07	90
31 to 50	2.14 to 3.45	92
51 to 100	3.52 to 6.9	94
100 and above	6.9 and above	95

4. Recommended Back Pressure Testing for Joint Leakage

After a given valve has been set for the correct opening pressure, and if the valve is to be used in a closed discharge system, it should be back pressure tested. Testing can be conducted by installing the cap, with gasket, and applying air, or nitrogen, to the base drain connection, or to the valve outlet. All other openings must be sealed.

Test pressure should be the greater of 30 psi (2 bar), or the actual valve back pressure. Air, or nitrogen, pressure should be held for 3 minutes, before applying leak detector solution to all connections (joints).

XII.F. (Continued)

On bellows valves, also install a clean pipe plug in the bonnet vent connection, until it is finger tight. The purpose of this is to obtain the smallest possible leak path. **Remove this plug upon completion of test.**

Examine the following valve components for leakage during back pressure testing:

- The nozzle/base joint.
- The adjusting ring pin seal.
- The base/bonnet joint.
- The bonnet/cap joint.
- If conventional valve, the "tight" bonnet vent plug.
- The "loose" bonnet vent plug, if bellows valve.

Leakage is best detected by application of a liquid leak detector.

NOTE:

The use of soap, or household detergent, as a leak detector is not recommended, as it may bridge small leaks.

Repair of leaking valve joints may be attempted by tightening the leaking joint while the valve is still on the stand. If this does not stop the leak, tear down and inspect the leaking joint(s); both the metal surface(s) and gasket(s).

If the valve internals have been disturbed, it is necessary to retest in accordance with the instructions contained in this manual. Otherwise, repeat the back pressure tests, as outlined above.

5. Blowdown Adjustment

Blowdown adjustments are made by means of the adjusting ring on Type 1900 valves.

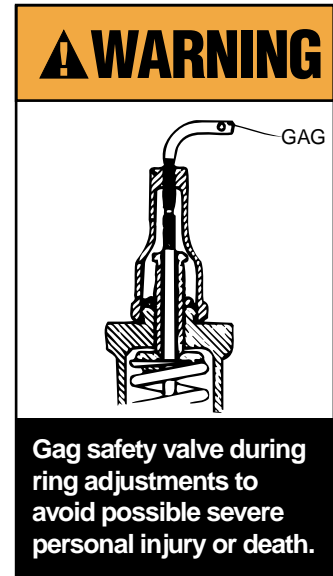
If longer or shorter blowdown is required, it can be obtained as follows:

- To increase the blowdown (lower reseating pressure), the adjusting ring must be raised by moving the notches, from left to right, past the ring pin hole.

- To decrease the blowdown (raise reseating pressure), the adjusting ring must be lowered by moving the notches, from right to left, past the ring pin hole.

NOTES:

- Unless the test stand capacity is equal to, or greater than, that of the valve, do not attempt to set blowdown. Simply return the adjusting ring to the recommended position. (Tables 12-14).
- The valve will not achieve rated relieving capacity if the adjusting ring is positioned too low.



XIII. Hydrostatic Testing and Gagging

When hydrostatic tests are required after installation of a safety relief valve, the safety relief valve should be removed and replaced with a blind flange, if the hydrostatic test pressure will not be greater than the operating pressure of the equipment, a test gag may be used. Very little force (i.e., fingertight pressure) on the test gag is sufficient to hold hydrostatic pressures. **Too much force applied to the gag may bend the spindle and damage the seat.** After a hydrostatic test, the gag must be removed and replaced by the sealing plug furnished for this purpose. (Test gags for Consolidated® Safety Relief Valves can be furnished for all types of caps and lifting gears.)

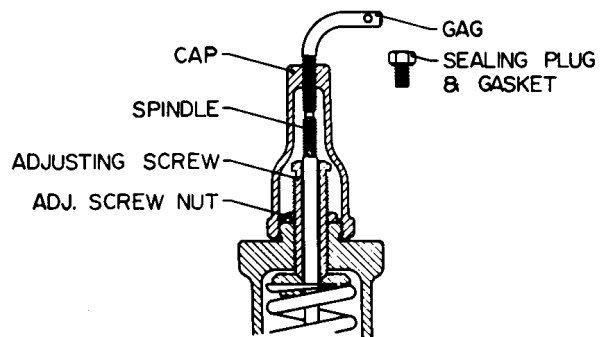


FIGURE 37

XIV. Manual Popping of the Valve

Consolidated Safety Relief Valves are furnished, when so ordered, with packed or plain lifting levers for hand popping, or with an air operated lifting device for remote control. (See Figures 38-42, following.)

When the valve is to be opened by hand, the pressure at the valve inlet should be at least 75% of the valve's set pressure. Under flowing conditions, the valve must be fully lifted from its seat, so that dirt, sediment and scale will not become trapped on the seating surfaces. When allowing the valve to close under flowing conditions, completely release the lever from maximum lift to snap the valve back on its seat.

Since, in some cases, the dead weight of the lever will have a tendency to lift the valve, the lever should be hung, supported, or counter weighted, so the lifting fork does not contact the release nut.

The air operated lifting device is designed to fully open the valve with 75% of set pressure under the valve disc in compliance with ASME Section VIII. For certain applications, the air operator may be designed to fully open the valve with no pressure at the valve inlet. An air operated device can be operated from a remote point and can be used as a "drop out" valve. (A typical design is shown in Figure 42, and can be purchased from DVCD.)

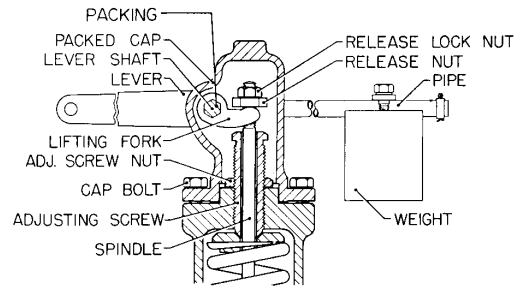


FIGURE 40
"L" TYPE PACKED LEVER

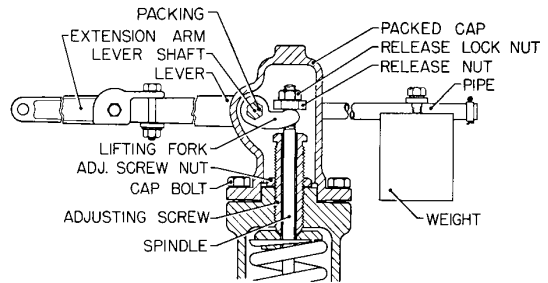


FIGURE 41
"R" TYPE PACKED LEVER

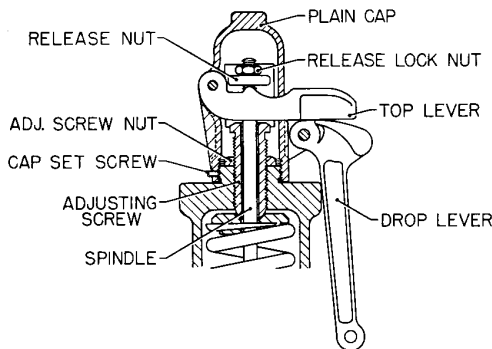


FIGURE 38
PLAIN LEVER

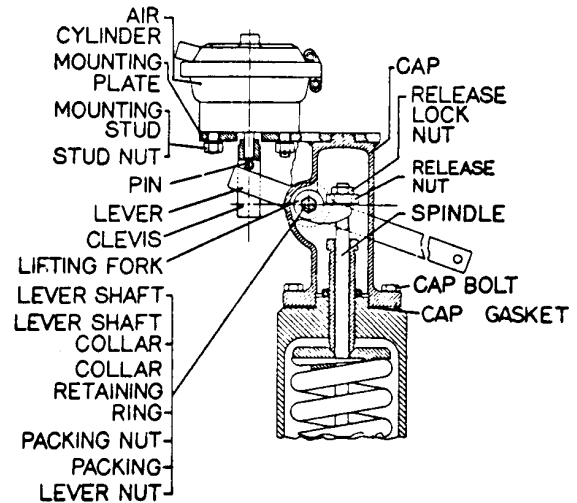


FIGURE 42
AIR OPERATED PACKED LEVER

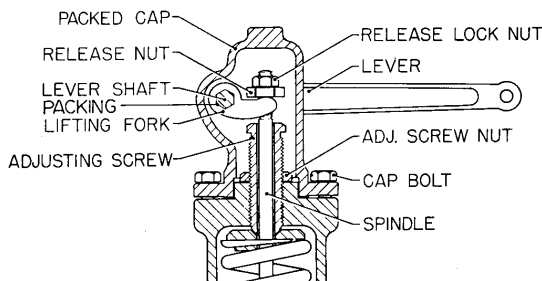


FIGURE 39
PACKED LEVER

XV. Conversion of Type 1900 Flanged Safety Relief Valves From Conventional to Bellows Type, and Vice Versa

A. General Information

Consolidated® Type 1900 Flanged Safety Relief Valves can be readily converted from conventional to bellows style, or vice versa, in the customer's repair shops. However, the Type 1901 and 1902 valves were constructed in the conventional type only. Table 16, below, shows the parts necessary for the typical conversion.

NOTE:

With regard to all bellows valves, the bonnet vent plug must be removed and the bonnet vented to a safe area.

TABLE 19

VALVE ORIFICE SIZE	NEW PARTS TO CONVERT FROM	
	CONVENTIONAL TO BELLOW VALVE	BELLOW TO CONVENTIONAL VALVE
D, E, F, G, H	<ol style="list-style-type: none"> 1. Bellows Assembly - Standard Material, AISI 316L Stainless Steel 2. Set of gaskets for bellows valve. 3. Guide for bellows valve. 4. Disc holder for bellows valve. 5. Spindle for bellows valve (F, G & H only). 6. Spindle retainer for bellows valve. 7. Base studs for bellows valve (D, E, F & G only). 8. Machine existing lower spring washer. (See Paragraph XV.B. and Figure 43 for F, G & H orifices only.) Upper spring washer, no change. 9. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).* 	<ol style="list-style-type: none"> 1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Guide for conventional valve. 4. Disc holder for conventional valve. 5. Spindle for conventional valve (F, G & H only). 6. Spindle retainer for conventional valve. 7. Base studs for conventional valve (D, E, F & G only). 8. New lower spring washer for conventional valve. (See Paragraph XV.C. and Figure 44 for F, G & H orifices only.) Upper spring washer, no change. 9. Bonnet vent plugged (if desired).
K, L, M, Q R, T **Also J, N, P manufactured after 1981	<ol style="list-style-type: none"> 1. Bellows Assembly - Standard Material, AISI 316L Stainless Steel. 2. Set of gaskets for bellows valve. 3. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).* 4. Studs (1905-30 K & L, 1906-30 K & L only). 	<ol style="list-style-type: none"> 1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Bonnet vent plugged (if desired). 4. Studs (1905 K & L, 1906 K & L only).
J, N, P **Manufactured prior to 1982	<ol style="list-style-type: none"> 1. Bellows Assembly - Standard Material AISI 316L Stainless Steel 2. Set of gaskets for bellows valve. 3. Guide for bellows valve. 4. Disc holder for bellows valve. 5. Drill 23/32 dia. on bonnet boss and tap 1/2 N.P.T. (as required).* 6. Studs (1905-30 N & P, 1906-30 N & P only). 	<ol style="list-style-type: none"> 1. Eductor tube for conventional valve. 2. Set of gaskets for conventional valve. 3. Bonnet vent plugged (if desired). 4. Drill 7/16 dia. thru guide flange 1-13/16 from guide bore centerline (J orifice only). 5. Studs (1905 N & P, 1906 N & P only).
W	<ol style="list-style-type: none"> 1. Bellows Assembly 2. Set of gaskets for bellows valve 3. Guide for bellows valve 4. Lift restricting ring 5. Studs 	<ol style="list-style-type: none"> 1. Set of gaskets for conventional valve 2. bonnet vent plug (if desired)

* Valves manufactured after 1980 are furnished with bonnet vent machined.

** J, N, P orifice valves manufactured after 1981 are furnished with threaded disc holder and reduced guide bore for balanced bellows conversion.

XV. (Continued)

B. Conversion From Conventional to

Bellows Type

The eductor tube is not needed in bellows valves, and it should be entirely removed to provide a flat surface for proper bellows flange seating. To remove the eductor tube from the base, first drill into the bore of the tube (where it is attached to the base) with a drill approximately 1/64" smaller in diameter than the outside diameter of the tube. This will reduce the tube wall thickness to the extent that it can easily be collapsed for removal. The hole in the guide surface, which will remain after the eductor tube is removed, will be covered by the bellows flange. Next, machine the existing lower spring washer in accordance with Figure 43 and Table 20, below.

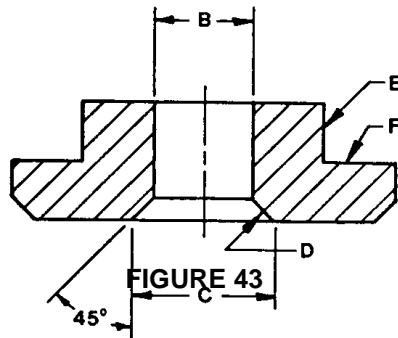


TABLE 20

VALVE TYPE		B	C
1905F	1906F	11/16" 17.5 mm	1" 25.4 mm
1910F	1912F		
1920F	1922F		
1905G	1906G		
1910G	1912G		
1920G	1922G	7/8" 22.2 mm	1-1/4" 31.8 mm
1914F	1916G		
1924F	1926F		
1914G	1916G		
1918G	1924G		
1926G	1928G	1" 25.4 mm	1-7/16" 36.5 mm
1918F	1928F		
1905H	1906H	11/16" 17.5 mm	1-1/8" 28.6 mm
1910H	1911H		
1920H	1922H		
1912H	1924H	7/8" 22.2 mm	1-5/16" 33.3 mm
1914H	1916H	1" 25.4 mm	1-1/2" 38.1 mm
1926			

When indicated at surfaces D and E, run out at surface F is not to exceed .005 full indicator reading.

C. Conversion from Bellows to Conventional Type

In converting from a bellows to a conventional valve, the eductor tube may be secured in the base by expanding, or swaging, into the hole provided. The upper end of the tube should project above the guide surface of the base approximately 1/8-inch, and the lower end should point directly and squarely toward the valve outlet. When the valve is assembled, the hole at the outer edge of the guide flange must fit loosely around the projection of the eductor tube.

The new lower spring washer must be machined as follows for the F, G, & H valves only. (See Figure 44 and Table 21, below.)

NOTE:

For all Type 1900 valves, Dimension A may not be less than specified in Table 18, below.

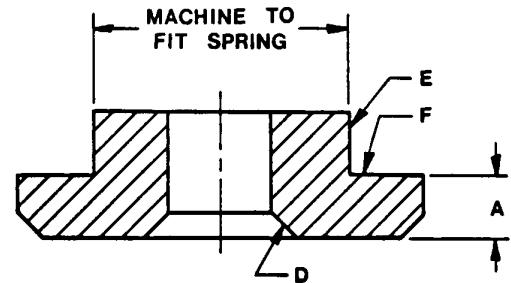


FIGURE 44

TABLE 21

VALVE TYPE			A
1905-30F	1906-30F	1910-30F	1/4" 6.35 mm
1920-30F	1922-30F	1905-30G	
1906-30G	1910-30G	1920-30G	
1905-30H	1906-30H		5/16" 7.94 mm
1912-30F		1922-30G	
1910-30H	1911-30H	1920-30H	
1914-30F	1916-30F	1924-30F	3/8" 9.52 mm
1926-30F	1914-30G	1916-30G	
1918-30G	1924-30G	1926-30G	
1928-30G	1912-30H	1924-30H	
1918-30F	1928-30F		7/16" 11.11 mm
1914-30H	1916-30H	1926-30H	1/2" 12.7 mm

When indicated at surfaces D and E, run out at surface F is not to exceed .005 full indicator reading.

XVI. Trouble Shooting Type 1900 Valves

TABLE 22

MALFUNCTION	CAUSE	SOLUTION
Seat Leakage	Damaged seats	Rework seats or replace part.
	Improper installation	Inspect installation, i.e. piping.
	Operating pressure too close to set pressure Excessive system vibration	Increase differential. Recheck application.
	Misalignment of valve components	Ensure valve is installed vertically. Ensure valve has been properly assembled.
	Trash trapped on seats	Pop valve to clean seats. Rework seats.
Simmer	Damaged seats	Rework seats or replace part.
	Wide nozzle seat	Rework seat.
	Improper adjusting ring setting	Check ring setting.
	Misalignment/binding	Inspect valve and installation.
Chatter	Improper installation or valve sizing	Check for piping restrictions. Check required capacity.
	Built-up back pressure	Check outlet piping.
	Improper ring setting	Check ring setting.

XVII. Maintenance Tools and Supplies

TABLE 23

ORIFICE	*ORIGINAL NOZZLE		*NEW NOZZLE		**NOZZLE LAP HANDLE	***RING LAP
	NOZZLE BORE DIAMETER	NOZZLE LAP PART NO.	NOZZLE BORE DIAMETER	NOZZLE LAP PART NO.		
D	.393-.398	0543001	.404-.409(*4)	4451501	0544603	1672805
E	.524-.529	0543002	.539-.544(*5)	4451502	0544601	1672805
F	.650-.655	0543003	.679-.674(*6)	4451503	0544601	1672805
G	.835-.840	0543004	.863-.868	4451504	0544601	1672805
H	1.045-1.050	0543005	1.078-1.083	4451505	0544601	1672805
J	1.335-1.340	0543006	1.380-1.385	4451506	0544601	1672805
K	1.595-1.600	0543007	1.650-1.655	4451507	0544601	1672807
M	2.234-2.239	0543102	2.309-2.314	4451602	0544601	1672809
N	2.445-2.450	0543103	2.535-2.540	4451603	0544601	1672809
P	2.965-2.970	0543104	3.073-3.078	4451604	0544602	1672810
Q	3.900-3.905	0543105	4.045-4.050	4451605	0544602	1672812
R	4.623-4.628	0543106	4.867-4.872	4451606	0544602	1672812
T	6.000-6.006	0543107	6.037-6.043	4451607	0544602	1672813
W	10.029	None	10.029-10.034	None	None	4875401

* Ring Lap on W orifice is an assembly which includes lap handles, the Ring Lap should be used for all lapping operations.

* After August 1978, all 1900 SRV Nozzles manufactured have increased bore diameter. The above chart shows how each orifice was affected. Nozzles-original vs. new - are interchangeable, but nozzle laps are not. On the O.D. of the new Nozzles, the letter "C" is stamped. If this stamp becomes obliterated, the nozzle bore diameter must be measured to select the correct nozzle lap from above chart.

** Nozzle lap handles are interchangeable between original and new nozzle laps.

*** Ring laps - One set of three (3) ring laps is recommended for each orifice to assure ample flat laps are available at all times.

(*4) Use for all D-1 designs.

(*5) Use for all E-1 designs.

(*6) Also used for all D-2 & E-2 designs.

XVII. (Continued)

LAPPING TOOLS

The following tools are required for proper maintenance of Consolidated® Safety Relief Valve seats, and may be purchased from DVCD upon request.

Nozzle Lap - The nozzle lap is used for lapping the nozzle seat and has one flat side and one side with a 5° angle. This lap guides in the bore of the nozzle; therefore, a different size lap is required for each valve orifice.

Ring Lap - The ring lap is used for lapping the disc seat and finish lapping of the nozzle seat.

Lapping Plate - The lapping plate is used for reconditioning the ring lap. It may also be used for lapping the disc. One 11" diameter plate is required for the entire line of valves (Part No. 0439004).

Lapping Compound - Used as a cutting medium when lapping the valve seats (as specified below).

Brand	Grade	Grit	Lapping Function	Size Container	Part No.
Clover	1A	320	General	4 oz	199-3
Clover	3A	500	Finishing	4 oz	199-4
Kwik-Ak-Shun	----	1000	Polishing	1 lb	199-11
				2 lb	199-12

Drift Pins - Two pins are required for the removal of the disc from the disc holder. (See Figure 45, below.)

Orifice	A (in.)	A (mm)	B (in.)	B (mm)	Part No.
D, E, F G, H, J, K	1-3/4	44.5	7/32	55.5	0430401
L, M, N, P	2-1/2	63.5	3/8	95.3	0430402
Q, R	3	76.2	5/8	158.7	0430403
T	3-1/2	88.9	7/8	222.2	0430404

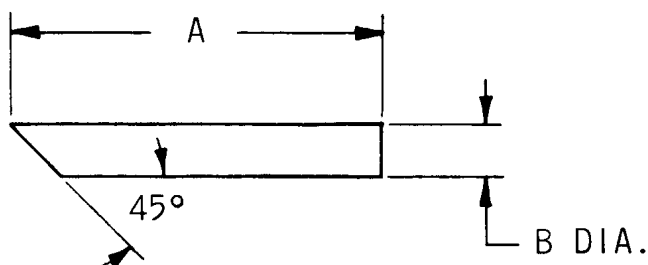


FIGURE 45

Lifting Tools - For removal of upper internal parts of larger valves (as specified below).

Orifice	Part No.
M, N	4464602
P, Q, R, T	4464604

Wrenches - For removal of bellows from disc holder (as specified below).

Valve Orifice	Description of Wrench	Pin Spanner Wrench No.
F	3/4" Radius - 7/32" Pin	4451801
G	3/4" Radius - 7/32" Pin	4451801
H	7/8" Radius - 15/64" Pin	4451802
J	1-1/8" Radius - 17/64" Pin	4451803
K	1-1/4" Radius - 9/32" Pin	4451804
L	1-3/8" Radius - 19/64" Pin	4451805
M	1-5/8" Radius - 21/64" Pin	4451806
N	1-7/8" Radius - 23/64" Pin	4451807
P	1-7/8" Radius - 23/64" Pin	4451807
Q	2-1/2" Radius - 7/16" Pin	4451808
R	3" Radius - 1/2" Pin	4451809
T	3-3/4" Radius - 1/2" Pin	4451810

XVIII. Replacement Parts Planning

A. Basic Guidelines

The following guidelines should be of assistance in developing a meaningful replacement parts plan.

1. The total number of valves in service should be classified by size, type, and temperature class.
2. the parts inventory should be classified by the tendency to require replacement.
 Class I - Most frequently replaced
 Class II - Less frequently replaced but critical in an emergency
3. Parts for the valve types covered by this manual are classified on page 46. "Qty. Parts" is the number of parts or sets which is recommended to achieve a desired need-probability, as it relates to the total number of valves in service by size and type. For example, a "Qty. Parts" of 1 for "Valves in Service" of 5 means that 1 part should be stocked for each 5 valves of the same type and size in service.
4. When ordering replacement parts, please specify in accordance with applicable nomenclature (see Figures 1 through 6). Be sure to state the size, type and serial number of the valve for which parts are required.

* Predicted availability means that percentage of time the user plant will have the right parts to make the proper repair on the product, (i.e. if Class I parts are stocked at the owners facility, the parts needed to repair valve in question will be immediately available in 70% of all instances).

C. Replacement Parts List

Consult the Recommended Spare Parts list (see Section XX of this manual) to define the parts to be included in the inventory plan.

Select the desired parts and determine those required for proper maintenance of the valve population in the plant.

D. Identification and Ordering Essentials

When ordering service parts, please furnish the following information to insure receiving the correct replacement parts:

1. **Identify valve by the following nameplate data:**
 - a. Size
 - b. Type
 - c. Temperature Class
 - d. Serial Number
 Example 1: 1-1/2" 1910Fc*
 S/N TD-94578

2. **Specify parts required by:**
 - a. Part Name (See Figures 1-6 on pages 6 and 7)
 - b. Part Number (if known)
 - c. Quantity

Contact Parts Marketing: 1-318-640-6044
 In addition, the serial number is stamped on the top edge of the outlet flange. Be sure to include the one or two letters preceding the figures in the serial number. Typical valve nameplates are shown in Figures 46-49, below.

CONSOLIDATED SAFETY RELIEF VALVE			
SIZE		TYPE	
SET PRESS.	SERIAL NO.		
UV COLD SET PRESS.	BACK PRESS.	NB	
TEMP.	°F MATL.		
CAP.	LBS./HR. SAT. STEAM	STD. CU. FT. MIN. AIR	
CAP.	G.P.M.		
TAG			
B/M		DATE	

FIGURE 46

RESTRICTED LIFT VALVE	
RESTRICTED CAPACITY	
RESTRICTED LIFT	IN.

PSV NUMBER	
P.O. NUMBER	
REQN NUMBER	

FIGURE 47

THIS VALVE CONTAINS AN O-RING SEAT SEAL	
O-RING MATERIAL	
O-RING PART NO.	

FIGURE 48

XVIII. Replacement Parts Planning (Continued)

* In order to determine if the valve contains Glide-Alloy® components (i.e., the disc holder and/or the guide), which will be identified for a particular valve by the coding found on the valve nameplate, please consult the Appendix to this manual for pertinent supplemental information.

When a pressure relief valve is repaired, a metal repair nameplate (see Figure 49, below), stamped with the DVCD insignia, the National Board "VR" symbol and stamp number, and the date of repair is permanently attached to the valve near the original nameplate. This repair nameplate may also contain information regarding altered set pressures, capacities or blowdown, as applicable.

XIX. Genuine Dresser Parts

The next time replacement parts are needed, keep these points in mind:

- DVCD designed the parts
- DVCD guarantees the parts.
- CONSOLIDATED® valve products have been in service since 1879.
- DVCD has worldwide service.
- DVCD has fast response availability for parts.

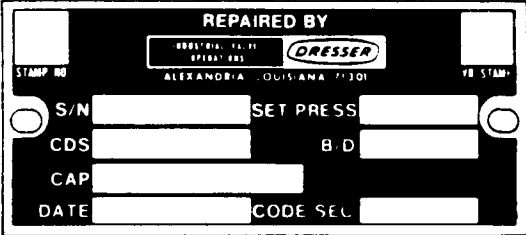


FIGURE 49

XX. Recommended Spare Parts For 1900 Safety Relief Valves

1900 CONVENTIONAL & 1900-30 BELLOWS 1900 CONVENTIONAL & 1900-30 BELLOWS WITH LIQUID TRIM (LS) 1900 CONVENTIONAL & 1900-30 BELLOWS WITH THERMODISC® (TD)

CLASS	PART NAME	C-CONVENTIONAL B-BELLOWS	QTY PARTS/ SAME VALVES IN SERVICE	NEED PROBABILITY COVERAGE
I. Class I Parts should be stocked at the rate described in the column "Qty. Parts". Stocking this class of parts will provide sufficient replacement parts on hand for 70% of all possible maintenance requirements.	Disc (TD) Disc (Standard) Nozzle *Limit Washer Bellows Adj. Ring Pin Disc & Spindle Retainers Gasket (Set) (1) Cap Gasket (1) Bonnet Gasket (1) Guide Gasket (1) Adj. Ring Pin Gasket (1) Bellows Gasket	C & B C & B C & B C & B B C & B C & B C & B C & B C & B C & B C & B C & B B	1/1 1/3 1/10 1/1 1/3 1/3 1 Set/1 1/1 1/1 1/1 1/1 1/1 1/1	70%
II. Class II parts should be stocked at the rate described in the column "Qty. Parts". Stocking Class II parts, in addition to Class I parts, will provide sufficient replacement parts on hand for 85% of all possible maintenance requirements.	Disc Holder Spindle Guide Studs, Base Nuts, Base Stud	C & B C & B C & B C & B C & B	1/6 1/6 1/6 1 Set/6 1 Set/6	85%

*Used only in 1905, 1906/1910 & 1918 D & E Orifices, (-2) Design

YOUR SAFETY IS OUR BUSINESS!!!

DVCD has not authorized any company or any individual to manufacture replacement parts for its valve products.

When ordering replacement valve parts, please specify in your purchase order: "ALL PARTS MUST BE DOCUMENTED AS NEW AND SOURCED FROM DRESSER INDUSTRIAL VALVE & CONTROLS DIVISION"

XXI. Manufacturer's Warranty Field Service, Training & Repair Program

A. Warranty Information

*WARRANTY STATEMENT - Dresser warrants that its products and work will meet all applicable specifications and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship.

Defective and nonconforming items must be held for Dresser's inspection and returned to the original F.O.B. point upon request.

INCORRECT SELECTION OR MISAPPLICATION OF PRODUCTS - DVCD cannot be responsible for customer's incorrect selection or misapplication of our products.

UNAUTHORIZED REPAIR WORK - DVCD has not authorized any non-Dresser affiliated repair companies, contractors or individuals to perform warranty repair service on new products or field repaired products of its manufacture. therefore, customers, contracting such repair services from unauthorized sources must do so at their own risk.

**Refer to Dresser's Standard Terms of Sale for complete details on warranty and limitation of remedy and liability.*

B. Field Service

Utilities and Process Industries expect and demand service on a moment's notice. CONSOLIDATED® Field Service can be depended upon for prompt response, even in extreme off-hour emergency situations.

DVCD maintains the largest and most competent field service staff in the industry. Service Engineers are located at strategic points throughout the United States to respond to customer's requirements for service. Each Service Engineer is factory trained and long experienced in servicing Safety Relief Valves. DVCD Service Engineers restore disc and nozzle critical dimensions which effect valve performance, and are capable of modernizing valves in the field.

It is highly recommended that the professional talents of a DVCD Field Service Engineer be employed to make final field adjustments during the initial setting of all CONSOLIDATED® valves.

All Field Service Engineers' activities are coordinated from the Alexandria, Louisiana, Field Service Office. Upon receipt of a purchase order number authorizing the trip, the engineer is dispatched.

Contact: Field Service Dept., Field Service Supv., (318) 640-6055.

C. Factory Repair Facilities

The factory at Alexandria, Louisiana, maintains a complete CONSOLIDATED repair center. The Repair Department, in conjunction with the manufacturing facilities is equipped to perform specialized repairs and product modifications, e.g. but-weld, bushing replacements, code welding, pilot replacement, etc.

Contact: Customer Service - Valve Repair, (318) 640-6047.

D. Safety Relief Valve Maintenance Training

Rising costs of maintenance and repair in the Utility Process Industries indicate the need for trained maintenance personnel. Dresser Industrial Valve Operation conducts service seminars that can help your maintenance and engineering personnel to reduce these costs.

Seminars, conducted either at your site, or at our Alexandria, Louisiana manufacturing plant, provide participants with an introduction to the basics of preventative maintenance necessary to minimize downtime, reduce unplanned repairs and increase valve safety. While these seminars do not make "instant" experts, they do provide the participants with "hands on" experience with CONSOLIDATED® valves. The seminar also includes valve terminology and nomenclature, component inspection, trouble shooting, setting and testing, with emphasis on the ASME Boiler and Pressure Vessel Code.

For further information, please contact the Product Training Manager by fax at (318) 640-6041, or telephone (318) 640-6054.

The Self Study Edition of the 1900 and 1900-30 Safety Relief Valve Maintenance Training Program is available for valve shop personnel.

The Self Study program consists of a Video Tape that is integrated with a participant work book. A participant begins with an introduction to the product and progresses through the various stages of disassembly, cleaning, maintenance repair, reassembly, setting, testing, installation and conversions. The Program can also be used as an instructor led course. The training package includes:

- five Participant Training Manuals.
- five Consolidated® 1900 and 1900-30 Safety Relief Valve Installation, Operation and Maintenance Manuals.
- an integral 1900 SRV video tape.
- a Coaches' Guide to facilitate learning.

Program Kits, as well as additional Training and Maintenance manuals are available through:

Training Department Manager
Global Aftermarket Group
Dresser Valve and Controls Division
PO Box 1430
Alexandria, LA 71309-1430

Telephone: (318) 640-6054
Telefax: (318) 640-6041

Appendix Re:

Optional Glide-Alloy™ Parts and the Repair Processing of Such Components

Glide-Alloy is a proprietary process of DVCD which is utilized to provide a combination of low coefficient of friction between sliding components and to protect the surfaces of the components to which the process has been applied. A Glide-Alloy™ surface hardened valve component may be readily recognized by its flat, dull gray color and slick surface. The parent metal should not be visible on a new and unused component.

NOTE:

Do not attempt to remove the coating of a Glide-Alloy™ treated component.

The Glide-Alloy™ reaction bonding process is commonly applied to Consolidated® Type 1900 Safety Relief Valve disc holders and/or guides, when specified. Although the entire surface area of the component is treated, **only** the guiding surface is critical. When Consolidated® Type 1900 valves contain Glide-Alloy™ parts, they may be identified by the coding found on the valve nameplate.

Example: 1905Jc-2-G1
where the "G" designation indicates
Glide-Alloy™
"G1" - Glide-Alloy™ Holder
"G2" - Glide-Alloy™ Guide
"G3" - Glide-Alloy™ Holder and Guide

Glide-Alloy™ treated components may be cleaned by low pressure compressed air, microbead blasting, or by brushing. Also, a non-chlorinated hydrocarbon shop solvent may be used. The latter is for personnel safety reasons and **not** because of any incompatibility between chlorides and Glide-Alloy™.

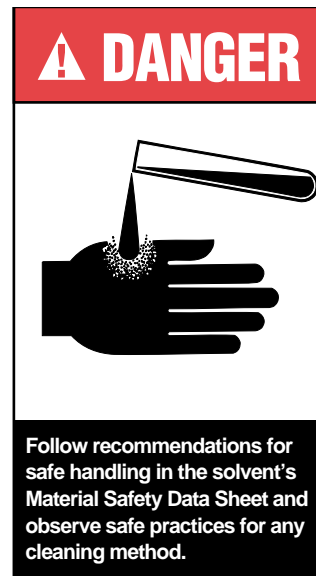
With regard to personnel safety, all personnel should be familiar with the appropriate processes as well as the material safety data sheets supplied by the vendor of any cleaning compounds. Protective gloves, goggles, etc. should be worn so as to avoid contact with materials that may be splashed during the cleaning process.

For a component which has been in service, after the cleaning process has been completed, parts may be visually inspected to ensure that all debris has been removed, and that the components have the required finish. DVCD's experience indicates that if the components have been properly cleaned, adequate coating will remain to ensure proper operation. The coating may appear to be lighter, or even missing, in some areas, but the desired results will be achieved as a result of the coating characteristics which were imparted to the parent metal during the original coating process.

NOTE:

Do not machine guiding surfaces which have been Glide-Alloy™ treated.

Components which are deeply gouged or galled, and which do not meet dimensional requirements, cannot be cleaned and returned to service. Machining will remove the coating and render the parts unacceptable. The surface hardness approximates that for diamonds, and is only approximately 0.002" thick.



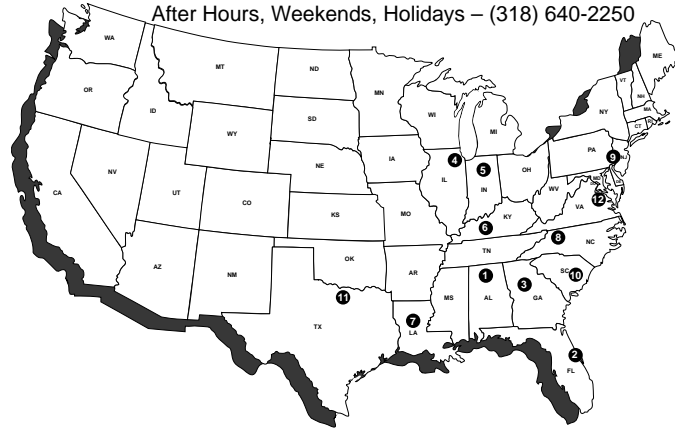
For more detailed instructions, consult the appropriate Dresser manual.

Location of Service Engineers

ALABAMA, Huntsville	1
FLORIDA, Jacksonville	2
GEORGIA, Cartersville	3
ILLINOIS, Chicago	4
INDIANA, Crawfordsville	5
KENTUCKY, Maysville	6
LOUISIANA, Alexandria	7
NORTH CAROLINA, Winston-Salem	8
PENNSYLVANIA, Philadelphia	9
SOUTH CAROLINA, Charleston	10
TEXAS, Dallas	11
VIRGINIA, Richmond	12

THE DRESSER FIELD SERVICE ORGANIZATION IS UNEQUALED

For prompt field service, please call
Dresser Industrial Valve Operations Service Department, Alexandria, Louisiana.
Normal Working Hours – (318) 640-6066
After Hours, Weekends, Holidays – (318) 640-2250



Sales Office Locations

UNITED STATES

Dresser Industries, Inc.
Dresser Valve & Controls Division
Industrial Valve Operation
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P.O. Box 1430, Alexandria, Louisiana 71309-1430
Telephone (*) 1-318-640-2250, Telex 586423
Fax (*) 1-318-640-6222

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85 Bodwell Street
Avon, Massachusetts 02322
Telephone: (*) 1-508-586-4600
Fax: (*) 1-508-941-5480

Eastern Region

85 Bodwell Street, Avon
Massachusetts 02322
Telephone: (*) 1-508-941-5407
Fax: (*) 1-508-427-8959

Northern Region

3201 North Wolf Road
Franklin Park, Illinois 60131
Telephone (*) 1-847-451-3913
Fax (*) 1-847-451-3997

Southern Region

15112 Morales Road (77032)
P.O. Box 60078, Houston, Texas 77205-0078
Telephone (*) 1-713-986-6600
Fax (*) 1-713-986-6608

Western Region

1040 South Vail Avenue
Montebello, California 90640
Telephone (*) 1-213-722-6731
Fax (*) 1-213-721-9113

Latin American Region

10556 N.W. 26th Street, Suite D-201
Miami, Florida 33172
Telephone (*) 1-305-470-2766
Fax (*) 1-305-470-2743

CANADA

Dresser Canada, Inc., Valve & Controls Division
5010 North Service Road
Burlington, Ontario, L7L 5R5 Canada
Telephone (*) 1-905-335-3529
Fax (*) 1-905-336-7628

Dresser Canada, Inc., Valve & Controls Division
3530 78th Avenue
Edmonton, Alberta, Canada, T6B 2X9
Telephone (*) 403-465-7882
Fax (*) 403-468-0934

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Dresser Valve & Controls China
Room 1907, Capital Mansion
Xi Yuan Nan Road, Chao Yang District
Beijing, China 10004
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Fax (*) 86-10-466-7190

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Dresser Japan, Ltd., Industrial Valve Operation
11 F-KY Building, 1-8-11 Kita-Shinagawa
Shinagawa-Ku, Tokyo 140 Japan
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Fax (*) 81-3-5462-8195

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#2107 Kuk Dong Building, 60-1, 3-Ka
Choongmu-ro, Chung-Ku, Seoul, Korea
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Fax (*) 82-2-274-0794

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Masonellan Internacional S.A. de C.V.
Av. Henry Ford No. 114
Apartado Postal 572, 54030 Tlalnepantla, Mexico
Telephone (*) 52-5-310-9863
Fax (*) 52-5-310-5584

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Dresser Al Rushaid Valve & Instrument Co., Ltd.
P.O. Box 10145, Jubail Industrial City 31961
Kingdom of Saudi Arabia
Telephone (*) 966-3-341-0278
Fax (*) 966-3-341-7624

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Dyce, Aberdeen, AB2 OGL, Scotland
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Fax (*) 44-1224-773190

Dresser Valve & Controls
Controls House, Riverside Way
Uxbridge, Middlesex, England UB8 2YF
Telephone (*) 44-1895-258161
Fax (*) 44-1895-234318

VENEZUELA

Riese & CIA S.A.
Apartado 372, Caracas, Venezuela
Telephone (*) 58-2-541-3812
Fax (*) 58-2-545-2702

(*) The appropriate International Access Code will need to precede the telephone/fax number if you are placing a call to a location outside of your country.



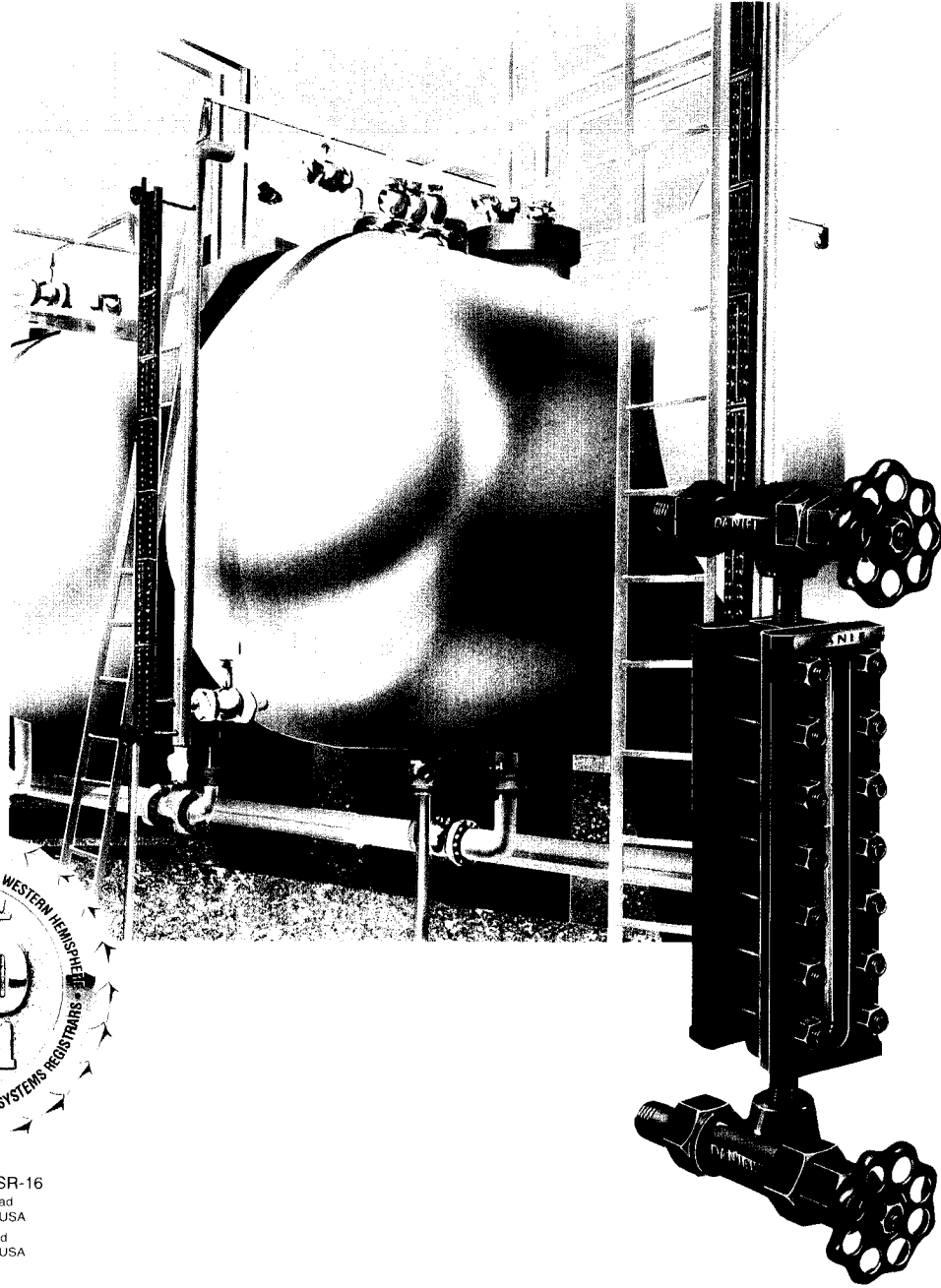
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Industrial Valve Operation
Alexandria, Louisiana 71309-1430 (USA)

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10M - 4/96 CON-2

Liquid Level Gages and Valves

CATALOG 1200



CERTIFICATE QSR-16
9720 Old Katy Road
Houston, TX 77055 USA
19203 Hemsplead
Houston, TX 77065 USA

DANIEL

DANIEL LIQUID LEVEL GAGES and VALVES

ORDERING INFORMATION

Please Specify:

- Gage Size Number
- Type of Service
- Temperature Limits
- Pressure Limits
- Type of Connections
- Special Function
- Vessel Centers if Close Hook-up

GAGE NUMBERING SYSTEM

Example: 71-RL:

7 is #7 Glass (#1 through #9)

1 is One-Section Gage (1, 2, 3, 4, . . .)

R is Reflex (T-Transparent)

L is Low Pressure Series (M = Mid, H = High,
WP = Weld Pad)

(Add appropriate digits or letters to indicate
special purpose gage or accessory)

HC Externally Heating/Cooling Gages

FP Frost Preventive Extensions

LC Large Chamber Gage

EP Explosion Proof Illuminators

CH Close Hook-up Connections

CONTENTS

REFLEX GAGES	
With Straight-Thru Connections	2
With Close Hook-up Connections	2
Pressure Ratings and Dimensions	3-4
TRANSPARENT GAGES	
With Straight-Thru Connections	5
With Close Hook-up Connections	5
Pressure Ratings and Dimensions	6-7
OFFSET VALVES	
Type 1S and 1U	8
Type 2S and 2U	8
Type 3S and 3U (OS&Y)	9
Type 7S and 7U (OS&Y)	10
STRAIGHT-THRU VALVES	
Type 4S and 4U	11
Type 5S and 5U (OS&Y)	12
TUBULAR GAGES AND VALVES	
Gages	13
Tubular Valves (Brass)	14
Tubular Valves (Type 1T and 2T)	15
SPECIALTY GAGES	
Welding Pad Gages	16
Large Chamber for Viscous Liquids	17-18
Heated/Cooled Externally	19-20
Frost-Prevention Extensions	21-22
Illuminators (Explosion-Proof)	23
Quick-Opening Levers	24
DIMENSIONAL DATA	
Flat Gage Glasses	24
Gage Connections	25
Tank Connections	26-27
Installation: Standard Gages	28
Installation: Close Hook-up	29

Carbon steel is the standard material for all Daniel low, mid and high pressure liquid level gages. The percentages of carbon steel pressure ratings for optional gage materials are listed below.

GAGES

Stainless Steel 300 & 400 Series	100%
Monel, Hastelloy B & C	90%
Brass	50%

GASKETS

Special Acid Sheet Gasketing	75%
Blue African®, Teflon®, KEL-F®	50%
Glass Filled Teflon	100%

REFLEX GAGES

Daniel Reflex Gages use prism glass to provide an excellent indication of the liquid level. All liquids appear black in high contrast to the mirror-like surface above. This clean line of separation can be sighted from many yards away. Reflex Gages are made in three pressure series (maximum 4000 psig @ 100°F) and are tapped for 1/2" or 3/4" NPT connections. The standard Daniel level gages are designed for minimum -20°F service.

On Daniel Reflex Close Hook-up Gages with 1/2" NPT connections the center-to-center dimension is the same as the overall length on standard gages. On Close Hook-up Gages with 3/4" NPT connections the center-to-center dimension is the same as the overall length on standard gages plus 3/8". All gage bodies are drilled and tapped for close hook-up.

MATERIALS

BODY (LIQUID CHAMBER): Accurately machined from square tubes to provide perfect gasket seating for gage glasses. Glass is recessed for protection. Body materials include Types 304 and 316 stainless steels and carbon steel.

COVER: Daniel gage covers are made of carbon steel or stainless steel (Type 304) in all their sizes and pressure ratings for higher strength and dependable service. Carbon steel covers are rust-proofed. All covers are machined to provide recessed seating protection for the glass.

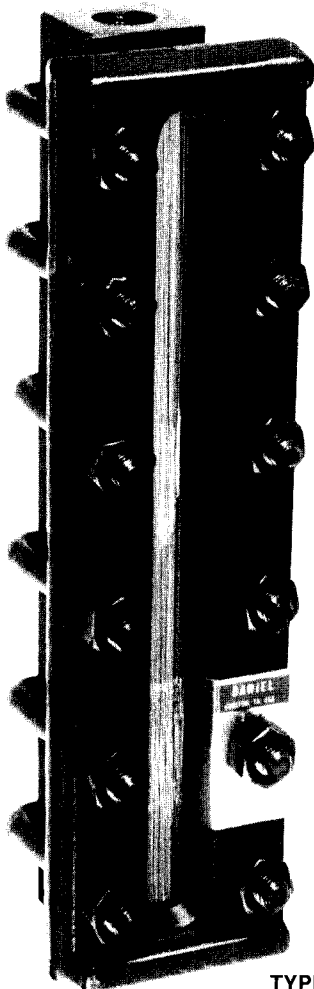
GLASS: All standard Daniel Reflex Gages use tempered borosilicate glass in nine standard lengths. Each glass has expertly molded reflecting prisms.

GASKETS & CUSHIONS: High grade non-asbestos is used in gaskets and cushions for Daniel gages. The machined recess in the gage body and cover protects the gasket and cushion as well as the glass.

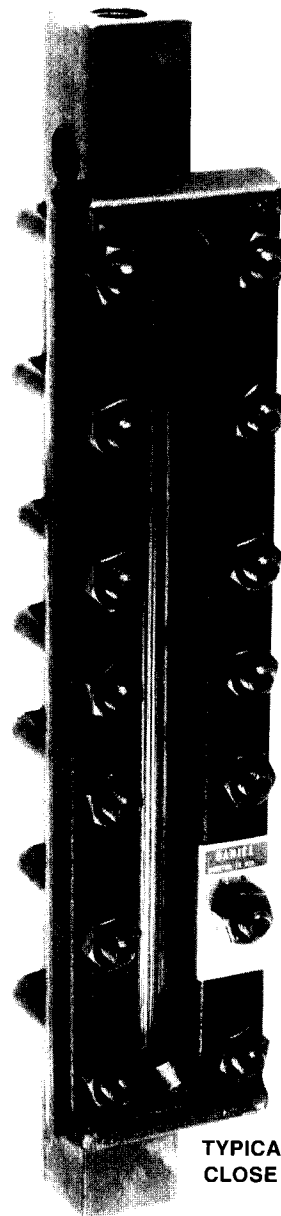
BOLTS: Daniel gage bolts are made of alloy steel, A.S.T.M. A-193 Grade B7, and rust-proofed for long life.

NUTS: Gage nuts are made of steel, A.S.T.M., A-194 Grade 2H, and are rust-proofed.

(Torque instructions for gage bolts are on Back Cover.)



TYPICAL REFLEX
TOP/BOTTOM

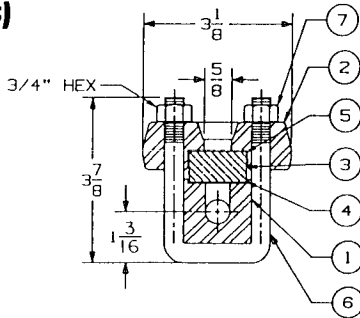


TYPICAL-REFLEX
CLOSE HOOK-UP

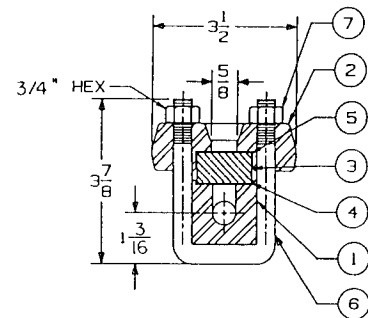
PRESSURE RATINGS & DIMENSIONS:

Reflex Gages

(With Straight-Thru Connections)



SECTION "X-X"
LOW PRESSURE



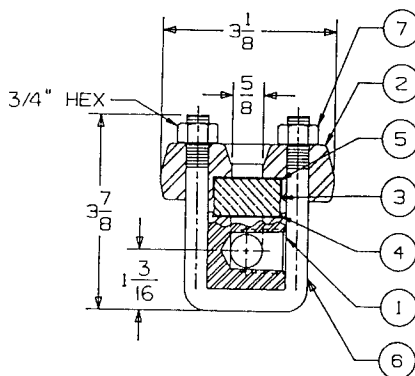
SECTION "X-X"
MID/HIGH PRESSURE

SIZES AND WEIGHTS											
SIZE NUMBERS			OVER-ALL LENGTH (IN.)			VISIBLE GLASS (IN.) B	GLASS SIZE C	CLOSE HOOK-UP CENTER-TO-CENTER (IN.)		APPROX. WT. (LBS.)	
LOW PRESS.	MID-PRESS.	HIGH PRESS.	A (STD)* 1/2 or 3/4 NPT	A(CH) 1/2" NPT	A (CH) 3/4 NPT			D 1/2" NPT	D 3/4" NPT	LOW PRESS.	MID-HIGH PRESS.
SINGLE-SECTION GAGE											
11 RL	11 RM	11 RH	5 1/4	8 7/8	9 1/4	3 3/4	3 3/4	5 1/4	5 5/8	7	8
21 RL	21 RM	21 RH	6 1/4	9 7/8	10 1/4	4 3/4	4 3/4	6 1/4	6 5/8	8	9
31 RL	31 RM	31 RH	7 1/4	10 7/8	11 1/4	5 3/4	5 3/4	7 1/4	7 5/8	9	11
41 RL	41 RM	41 RH	8 1/4	11 7/8	12 1/4	6 3/4	6 3/4	8 1/4	8 5/8	10	12
51 RL	51 RM	51 RH	9 3/8	13	13 3/8	7 7/8	7 7/8	9 3/8	9 3/4	12	14
61 RL	61 RM	61 RH	10 5/8	14 1/4	14 5/8	9 1/8	9 1/8	10 5/8	11	14	16
71 RL	71 RM	71 RH	11 3/4	15 3/8	15 3/4	10 1/4	10 1/4	11 3/4	12 1/8	15	18
81 RL	81 RM	81 RH	13 3/8	17	17 3/8	11 7/8	11 7/8	13 3/8	13 3/4	17	20
91 RL	91 RM	91 RH	14 1/8	17 3/4	18 1/8	12 5/8	12 5/8	14 1/8	14 1/2	18	21
TWO-SECTION GAGE											
32 RL	32 RM	32 RH	14 1/2	18 1/8	18 1/2	13	5 3/4	14 1/2	14 7/8	19	22
42 RL	42 RM	42 RH	16 1/2	20 1/8	20 1/2	15	6 3/4	16 1/2	16 7/8	22	25
52 RL	52 RM	52 RH	18 3/4	22 3/8	22 3/4	17 1/4	7 7/8	18 3/4	19 1/8	24	28
62 RL	62 RM	62 RH	21 1/4	24 7/8	25 1/4	19 3/4	9 1/8	21 1/4	21 5/8	27	32
72 RL	72 RM	72 RH	23 1/2	27 1/4	27 1/2	22	10 1/4	23 1/2	23 7/8	29	35
82 RL	82 RM	82 RH	26 3/4	30 3/8	30 3/4	25 1/4	11 7/8	26 3/4	27 1/8	34	40
92 RL	92 RM	92 RH	28 1/4	31 7/8	32 1/4	26 3/4	12 5/8	28 1/4	28 5/8	37	43
THREE-SECTION GAGE											
63 RL	63 RM	63 RH	31 7/8	35 1/2	35 7/8	30 3/8	9 1/8	31 7/8	32 1/4	41	48
73 RL	73 RM	73 RH	35 1/4	38 7/8	39 1/4	33 3/4	10 1/4	35 1/4	35 5/8	45	53
83 RL	83 RM	83 RH	40 1/8	43 3/4	44 1/8	38 5/8	11 7/8	40 1/8	40 1/2	52	60
93 RL	93 RM	93 RH	42 3/8	46	46 3/8	40 7/8	12 5/8	42 3/8	42 3/4	55	64
FOUR-SECTION GAGE											
74 RL	74 RM	74 RH	47	50 5/8	51	45 1/2	10 1/4	47	47 3/8	60	71
84 RL	84 RM	84 RH	53 1/2	57 1/8	57 1/2	52	11 7/8	53 1/2	53 7/8	69	80
94 RL	94 RM	94 RH	56 1/2	60 1/8	60 1/2	55	12 5/8	56 1/2	56 7/8	72	85
FIVE-SECTION GAGE											
75 RL	75 RM	75 RH	58 3/4	62 3/8	62 3/4	57 1/4	10 1/4	58 3/4	59 1/8	74	88
85 RL	85 RM	85 RH	66 7/8	70 1/2	70 7/8	65 3/8	11 7/8	66 7/8	67 1/4	86	100
95 RL	95 RM	95 RH	70 5/8	74 1/4	74 5/8	69 1/8	12 5/8	70 5/8	71	90	106

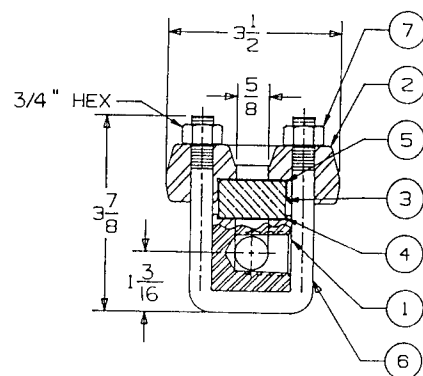
*3/4" NPT Tapped High Pressure Gages Add 1 1/2" to 'A' Dimension.

Reflex Gages (With Close Hook-Up Connections)

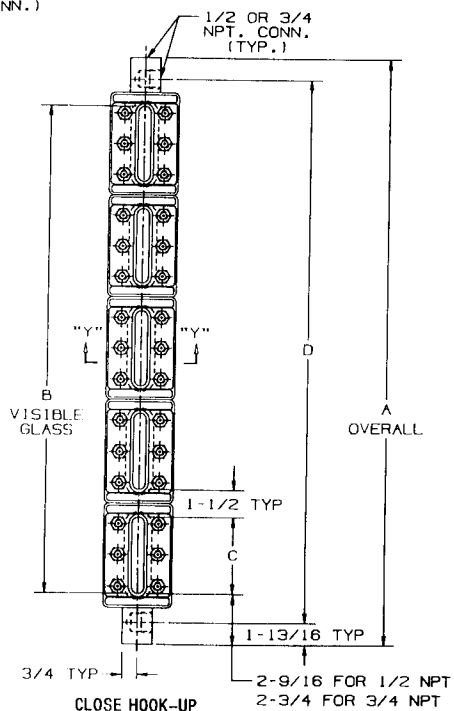
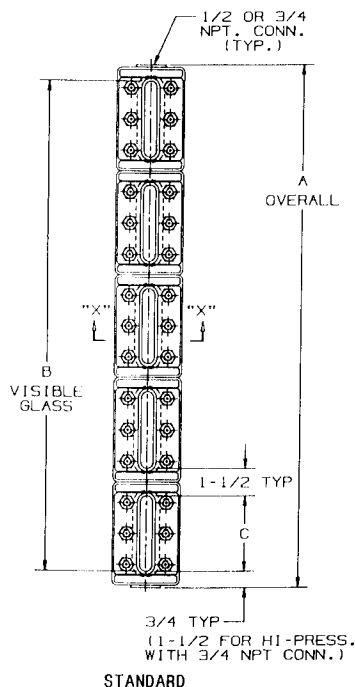
PARTS		
ITEM NO.	NAME	MATERIAL
1	CHAMBER	CARBON STEEL
2	COVER	ASTM A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	BOLT	ASTM A193 B7
7	NUT	ASTM A194 2H



SECTION "Y-Y"
LOW PRESSURE



SECTION "Y-Y"
MID/HIGH PRESSURE



PRESSURE RATINGS AT °F*							
LOW PRESSURE GAGE**							
Glass Size	100°	200°	300°	400°	500°	600°	700°
1	2400	2320	2240	2150	2000	1780	1520
2	2325	2250	2170	2090	1940	1720	1470
3	2250	2180	2100	2020	1880	1670	1420
4	2175	2100	2020	1940	1820	1600	1370
5	2100	2030	1960	1880	1750	1550	1320
6	2025	1950	1890	1810	1680	1500	1280
7	1950	1890	1820	1750	1630	1440	1230
8	1875	1820	1750	1680	1560	1390	1180
9	1800	1740	1680	1620	1510	1340	1140
MID-PRESSURE GAGE**							
Glass Size	100°	200°	300°	400°	500°	600°	700°
1	3000	2900	2800	2690	2500	2220	1890
2	2910	2820	2720	2600	2420	2150	1840
3	2820	2720	2625	2530	2350	2080	1780
4	2725	2640	2560	2460	2270	2040	1740
5	2630	2540	2460	2360	2190	1950	1660
6	2535	2450	2360	2270	2110	1875	1600
7	2440	2360	2280	2190	2030	1805	1540
8	2345	2270	2190	2110	1960	1740	1480
9	2250	2180	2100	2020	1880	1670	1420
HIGH-PRESSURE GAGE**							
Glass Size	100°	200°	300°	400°	500°	600°	700°
1	4000	3860	3735	3580	3330	2960	2530
2	3850	3720	3590	3440	3210	2850	2430
3	3750	3620	3500	3355	3120	2775	2370
4	3600	3465	3360	3220	3000	2660	2270
5	3500	3360	3260	3120	2900	2580	2220
6	3360	3240	3135	3010	2800	2490	2120
7	3240	3120	3020	2900	2700	2400	2050
8	3120	3020	2910	2790	2600	2310	1970
9	3000	2900	2800	2690	2500	2220	1890

* Gages for service up to 800°F are available. Consult the factory for the application and ratings.

** Saturated steam to 350 WSP. Above 350 WSP, use transparent gage with mica shields.

TRANSPARENT GAGES

Daniel Transparent Gages use clear, see-through glass on both sides so that both the color and the interface of liquids can be viewed. Electric lighted gage illuminators are available for use on Transparent Gages and provide easy viewing of liquid levels on dimly lighted areas. Transparent Gages are made in three pressure series (maximum 3000 psig @ 100°F) and are tapped for 1/2" or 3/4" NPT connections. The standard Daniel level gages are designed for -20°F service.

On Daniel Transparent Close Hook-up Gages with 1/2" NPT connections the center-to-center dimension is the same as the overall length on standard gages. On Close Hook-up Gages with 3/4" NPT connections the center-to-center dimension is the same as the overall length on standard gages plus 3/8". All gage bodies are drilled and tapped for close hook-up.

MATERIALS

BODY (LIQUID CHAMBER): Accurately machined from square tubes to provide perfect seating for gasket, and gage glasses. Both glasses are recessed for protection. Body material include Types 304 and 316 stainless steel and carbon steel.

COVERS: Both covers on transparent gages are carefully machined to provide perfect seating for cushions and gage glasses. This machining also provides deep recessed seating in the cover for added glass protection. Covers are available in Type 304 stainless steel and in carbon steel. The latter is rust-proofed.

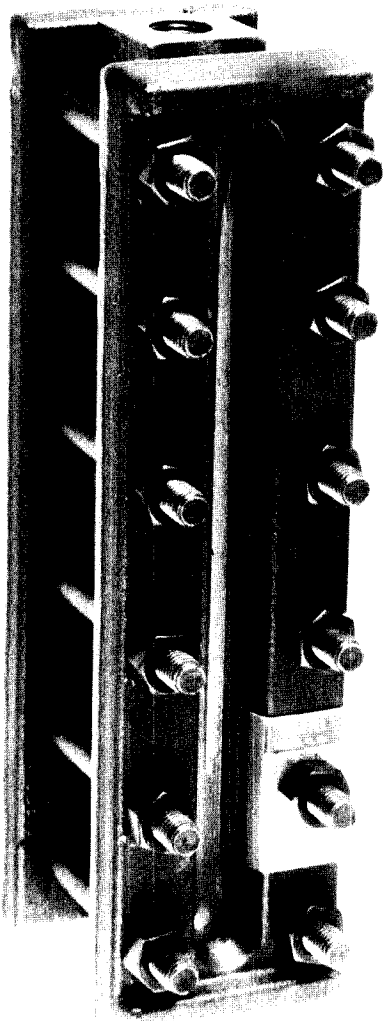
GLASS: All standard Daniel Transparent Gages use tempered borosilicate glass in nine standard lengths. Each transparent glass is crystal clear and has the highest strength possible.

GASKETS & CUSHIONS: High grade non-asbestos is used in gaskets and cushions for Daniel gages. The machined recess in the gage body and cover protects the gasket and cushion as well as the glass.

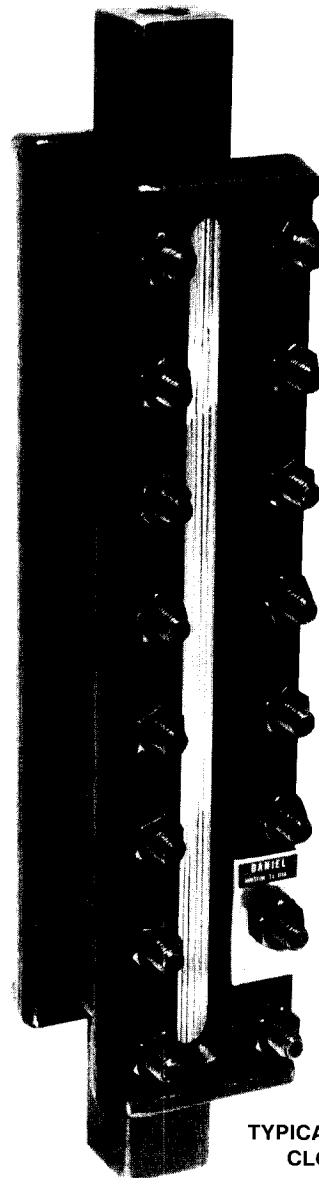
BOLTS: Daniel gage bolts are made of alloy steel, A.S.T.M. A-193 Grade B7, and rust-proofed for long life.

NUTS: Gage nuts are made of steel, A.S.T.M., A-194 Grade 2H, and are rust-proofed.

(Torque instructions for gage bolts are on Back Cover.)



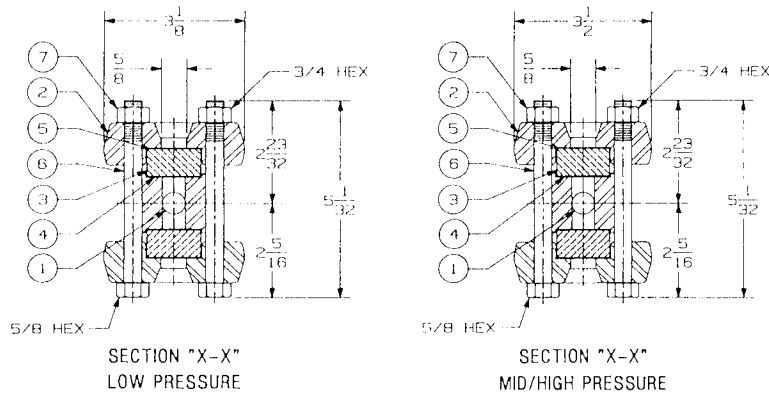
TYPICAL TRANSPARENT
TOP/BOTTOM



TYPICAL-TRANSPARENT
CLOSE HOOK-UP

PRESSURE RATINGS & DIMENSIONS:

Transparent Gages (With Straight-thru Connections)



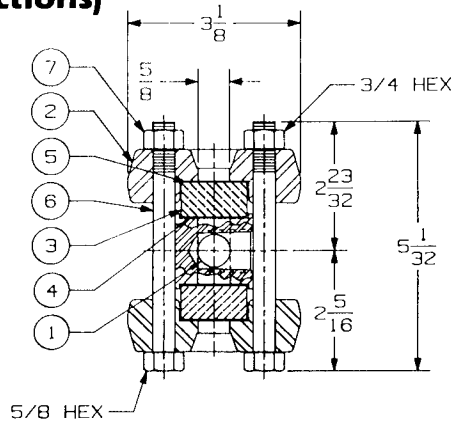
SIZES AND WEIGHTS											
SIZE NUMBERS			OVER-ALL LENGTH (IN.)			VISIBLE GLASS (IN.) B	GLASS SIZE C	CLOSE HOOK-UP CENTER-TO-CENTER (IN.)		APPROX. WT. (LBS.)	
LOW PRESS.	MID-PRESS.	HIGH PRESS.	A(STD) [*] 1/2 or 3/4 NPT	A(CH) 1/2 NPT	A(CH) 3/4 NPT			D 1/2" NPT	D 3/4" NPT	LOW PRESS.	MID-HIGH PRESS.
SINGLE-SECTION GAGE											
11 TL	11 TM	11 TH	5 1/4	8 7/8	9 1/4	3 3/4	3 3/4	5 1/4	5 5/8	10	12
21 TL	21 TM	21 TH	6 1/4	9 7/8	10 1/4	4 3/4	4 3/4	6 1/4	6 5/8	11	14
31 TL	31 TM	31 TH	7 1/4	10 7/8	11 1/4	5 3/4	5 3/4	7 1/4	7 5/8	14	17
41 TL	41 TM	41 TH	8 1/4	11 7/8	12 1/4	6 3/4	6 3/4	8 1/4	8 5/8	16	19
51 TL	51 TM	51 TH	9 3/8	13	13 3/8	7 7/8	7 7/8	9 3/8	9 3/4	17	21
61 TL	61 TM	61 TH	10 5/8	14 1/4	14 5/8	9 1/8	9 1/8	10 5/8	11	19	24
71 TL	71 TM	71 TH	11 3/4	15 3/8	15 3/4	10 1/4	10 1/4	11 3/4	12 1/8	21	27
81 TL	81 TM	81 TH	13 3/8	17	17 3/8	11 7/8	11 7/8	13 3/8	13 3/4	24	30
91 TL	91 TM	91 TH	14 7/8	17 3/4	18 1/8	12 5/8	12 5/8	14 7/8	14 1/2	26	32
TWO-SECTION GAGE											
32 TL	32 TM	32 TH	14 1/2	18 1/8	18 1/2	13	5 3/4	14 1/2	14 7/8	27	33
42 TL	42 TM	42 TH	16 1/2	20 1/8	20 1/2	15	6 3/4	16 1/2	16 7/8	32	38
52 TL	52 TM	52 TH	18 3/4	22 3/8	22 3/4	17 1/4	7 7/8	18 3/4	19 1/8	36	43
62 TL	62 TM	62 TH	21 1/4	24 7/8	25 1/4	19 3/4	9 1/8	21 1/4	21 5/8	40	49
72 TL	72 TM	72 TH	23 1/2	27 1/4	27 1/2	22	10 1/4	23 1/2	23 7/8	43	54
82 TL	82 TM	82 TH	26 3/4	30 3/8	30 3/4	25 1/4	11 7/8	26 3/4	27 1/8	50	61
92 TL	92 TM	92 TH	28 1/4	31 7/8	32 1/4	26 3/4	12 5/8	28 1/4	28 5/8	51	64
THREE-SECTION GAGE											
63 TL	63 TM	63 TH	31 7/8	35 1/2	35 7/8	30 3/8	9 1/8	31 7/8	32 1/4	59	73
73 TL	73 TM	73 TH	35 1/4	38 7/8	39 1/4	33 3/4	10 1/4	35 1/4	35 5/8	63	80
83 TL	83 TM	83 TH	40 1/8	43 3/4	44 1/8	38 5/8	11 7/8	40 1/8	40 1/2	75	92
93 TL	93 TM	93 TH	42 3/8	46	46 3/8	40 7/8	12 5/8	42 3/8	42 3/4	78	97
FOUR-SECTION GAGE											
74 TL	74 TM	74 TH	47	50 3/8	51	45 1/2	10 1/4	47	47 3/8	85	107
84 TL	84 TM	84 TH	53 1/2	57 1/8	57 1/2	52	11 7/8	53 1/2	53 7/8	100	122
94 TL	94 TM	94 TH	56 1/2	60 1/8	60 1/2	55	12 5/8	56 1/2	56 7/8	104	129
FIVE-SECTION GAGE											
75 TL	75 TM	75 TH	58 3/4	62 3/8	62 3/4	57 1/4	10 1/4	58 3/4	59 1/8	106	134
85 TL	85 TM	85 TH	66 7/8	70 1/2	70 7/8	65 3/8	11 7/8	66 7/8	67 1/4	124	152
95 TL	95 TM	95 TH	70 5/8	74 1/4	74 5/8	69 1/8	12 5/8	70 5/8	71	129	161

^{*}3/4" NPT Tapped High Pressure Gages Add 1 1/2" to 'A' Dimension.

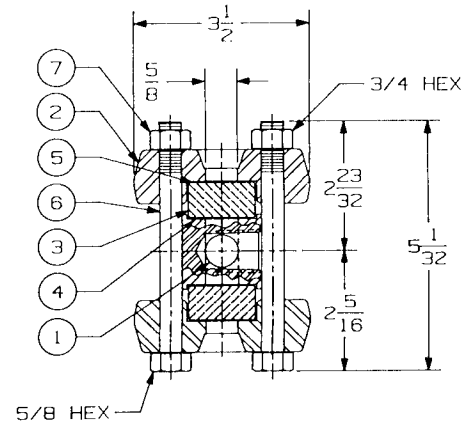
Transparent Gages (With Close Hook-up Connections)

PARTS

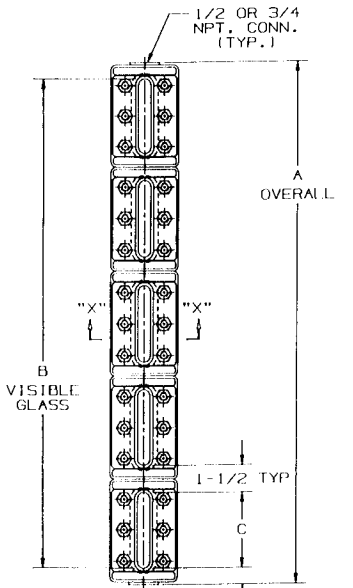
ITEM NO.	NAME	MATERIAL
1	CHAMBER	CARBON STEEL
2	COVER	ASTM A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	BOLT	ASTM A193 B7
7	NUT	ASTM A194 2H



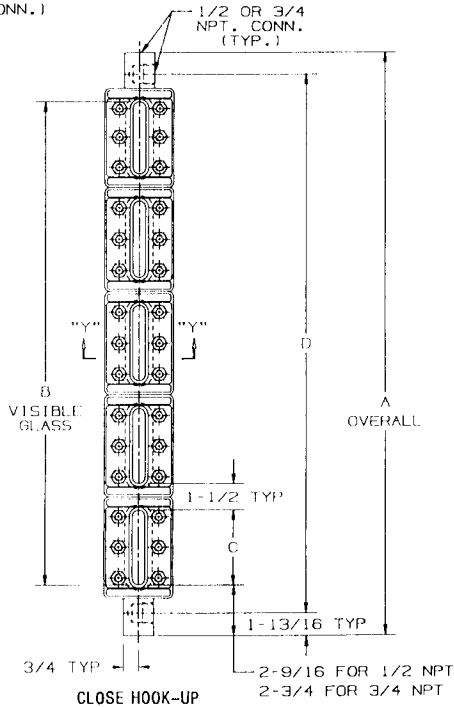
SECTION "Y-Y"
LOW PRESSURE



SECTION "Y-Y"
MID/HIGH PRESSURE



STANDARD
3/4 TYP.
(1-1/2 FOR HI-PRESS.
WITH 3/4 NPT CONN.)



CLOSE HOOK-UP

PRESSURE RATINGS AT °F*

LOW PRESSURE GAGE

Glass Size	100°	200°	300°	400°	500°	600°	700°
1	2000	1935	1870	1790	1660	1480	1260
2	1815	1750	1690	1620	1510	1340	1150
3	1630	1580	1520	1460	1360	1210	1050
4	1440	1390	1340	1290	1200	1060	900
5	1250	1210	1170	1120	1040	920	790
6	1065	1030	995	950	890	790	680
7	875	845	815	785	730	645	550
8	690	665	645	620	575	510	440
9	500	480	465	445	415	370	320

Maximum Saturated Steam 350 WSP

MID-PRESSURE GAGE

Glass Size	100°	200°	300°	400°	500°	600°	700°
1	2500	2420	2340	2240	2080	1850	1580
2	2315	2250	2170	2090	1940	1720	1470
3	2130	2060	1990	1910	1770	1575	1340
4	1940	1875	1810	1740	1620	1435	1230
5	1750	1690	1630	1570	1460	1295	1100
6	1565	1510	1460	1400	1305	1160	990
7	1375	1330	1280	1230	1145	1015	870
8	1190	1150	1110	1065	990	880	750
9	1000	970	935	895	835	740	630

Maximum Saturated Steam 600 WSP with Mica Shields

HIGH-PRESSURE GAGE

Glass Size	100°	200°	300°	400°	500°	600°	700°
1	3000	2900	2805	2690	2500	2220	1890
2	2900	2800	2710	2600	2420	2145	1830
3	2750	2660	2570	2465	2295	2035	1740
4	2600	2515	2430	2330	2170	1925	1640
5	2500	2420	2340	2240	2080	1850	1590
6	2380	2280	2200	2120	1970	1745	1490
7	2250	2165	2090	2010	1865	1660	1410
8	2120	2050	1980	1900	1770	1570	1340
9	2000	1935	1870	1790	1670	1480	1270

Maximum Saturated Steam 750 WSP with Mica Shields

* Gages for service up to 800°F are available. Consult the factory for application and ratings.

OFFSET OS&Y VALVES

TYPE 3S & 3U

HEAVY DUTY OUTSIDE SCREW & YOKE

4000 psig CWP 6000 psig Test
1/2", 3/4" (Std.) or 1" NPT or IPS Solid Shank Tank
Connection or Flanged Tank Connection
1/2" NPT Female Gage Connection
1/2" NPT Female Drain Connection

PRESSURE — TEMPERATURE RATING			
Teflon Packing		Wire-Graphite Packing	
4000 psi	100°F	2950 psi	500°F
3730 psi	200°F	2700 psi	600°F
3470 psi	300°F	2430 psi	700°F
3200 psi	400°F		

The Daniel Type 3 Offset Gage Valve has the Outside Screw & Yoke design which prevents excessively hot and corrosive fluids from contracting stem threads, causing possible malfunction. The stem backs directly off the regrindable valve seat, using the positive, non-rotating stem principle. The valve is offset for ease in gage cleaning and comes in both screwed (S) and union (U) gage connections as standard. On special order, a tubular (T) gage or other type connection can be supplied. Type 3 Valves are used with Reflex and Transparent Gages in working pressures up to 4000 psi.

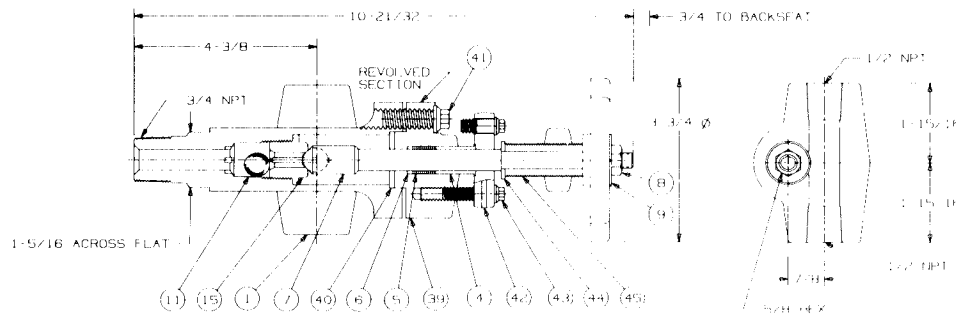
The standard tank connection for Type 3 OS&Y Offset Gage Valves is a 3/4" NPT solid shank, with optional 1/2" and 1" NPT sizes. Ends beveled for welding also are available. Valve materials include forged carbon steel, 304 stainless steel and 316 stainless steel. A molded Teflon packing ring is standard at no extra cost in valves for services up to 450°F. For temperatures to 700°F, valves have wire-graphite packing. The Type 3 Valve has stainless steel safety ball checks to shut off the flow automatically in case of gage glass breakage.

PARTS

ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS		316 S.S. WETTED PARTS	
		MATERIAL	MATERIAL	MATERIAL	MATERIAL	
1	BODY	ASTM A350 LF2	304 S.S.	316 S.S.		
4	PACKING FOLLOWER	316 S.S.	316 S.S.	316 S.S.		
*5	PACKING RING	TEFLON	TEFLON	TEFLON		
6	PACKING WASHER	17-4 PH S.S.	17-4 PH S.S.	17-4 PH S.S.		
7	STEM	304 S.S.	304 S.S.	316 S.S.		
8	STEM NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL		
9	NAME PLATE	304 S.S.	304 S.S.	304 S.S.		
11	BALL	440 S.S.	316 S.S.	316 S.S.		
15	SEAT	416 S.S.	304 S.S.	316 S.S.		
17	FEMALE CONNECTOR	CARBON STEEL	304 S.S.	316 S.S.		

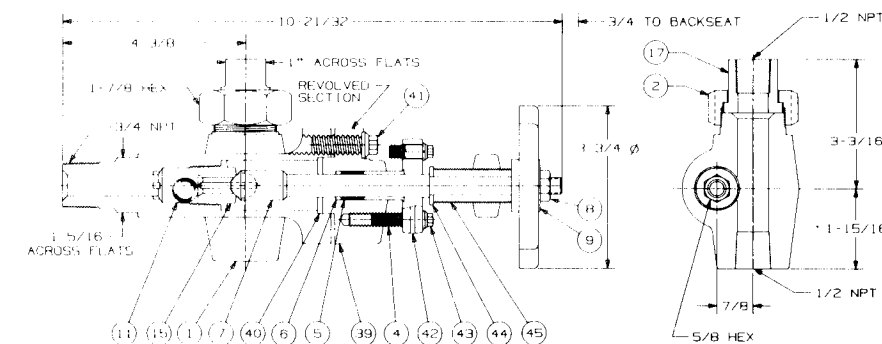
ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS		316 S.S. WETTED PARTS	
		MATERIAL	MATERIAL	MATERIAL	MATERIAL	
39	YOKE	FORGED STEEL	304 S.S.	316 S.S.		
40	YOKE GASKET	ASB-.304 S.S.	ASB-.304 S.S.	ASB-.304 S.S.		
*41	YOKE SCREW	CARBON STEEL	CARBON STEEL	CARBON STEEL		
42	PRESSURE BAR	FORGED STEEL	FORGED STEEL	FORGED STEEL		
**43	PRESS BAR SCREW	ALLOY STEEL	ALLOY STEEL	ALLOY STEEL		
44	INR THRST WASHER	17-4 PH S.S.	17-4 PH S.S.	17-4 PH S.S.		
45	HANDWHEEL ASSY	AL-BZ/ZINC	AL-BZ/ZINC	AL-BZ/ZINC		
46	OUT THRST WASHER	17-4 PH S.S.	17-4 PH S.S.	17-4 PH S.S.		

* 4 REQUIRED
 ** 2 REQUIRED



TYPE 3S

Weight per set approximately 17 lbs. 8 ozs.



TYPE 3U

Weight per set approximately 17 lbs. 8 ozs.

A Tubular Gage Connection is available on request. Optional Tank Connections shown on pages 26 and 27. Optional Gage Connections shown on page 25.

OFFSET OS&Y VALVES

Type 7S & 7U

STANDARD OUTSIDE SCREW & YOKE

1440 psig CWP, 2160 psig Test (600 lbs. Class)

3/4" NPT Male Tank Connection

1/2" NPT Female Union Gage Connection

The Daniel Type 7 Offset Gage Valve features the Outside Screw & Yoke (OS&Y) design which prevents excessively hot and corrosive fluids from contacting stem threads. The stem uses the positive non-rotating stem principle and backs directly off the regrindable seat. This valve is offset for ease in gage cleaning and is available in screwed (S) and union (U) gage connections. The Type 7 Valve also has a backseating stem as a standard feature. Stainless steel ball checks are available upon request.

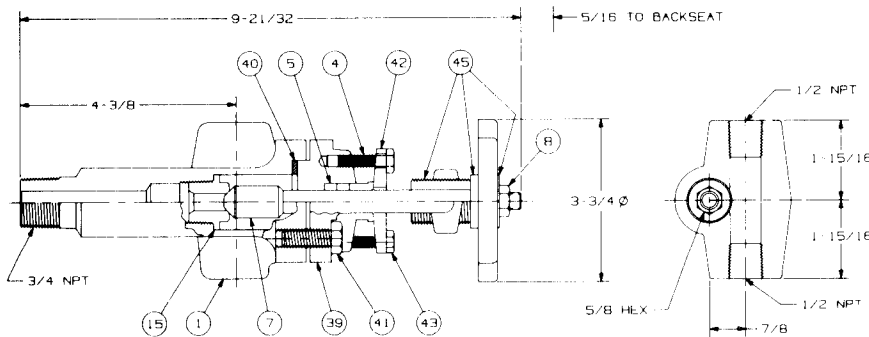
PRESSURE — TEMPERATURE RATING			
Teflon Packing		Wire-Graphite Packing	
1440 psi	100°F	1250 psi	500°F
1400 psi	200°F	1110 psi	600°F
1365 psi	300°F	1065 psi	700°F
1330 psi	400°F		

PARTS

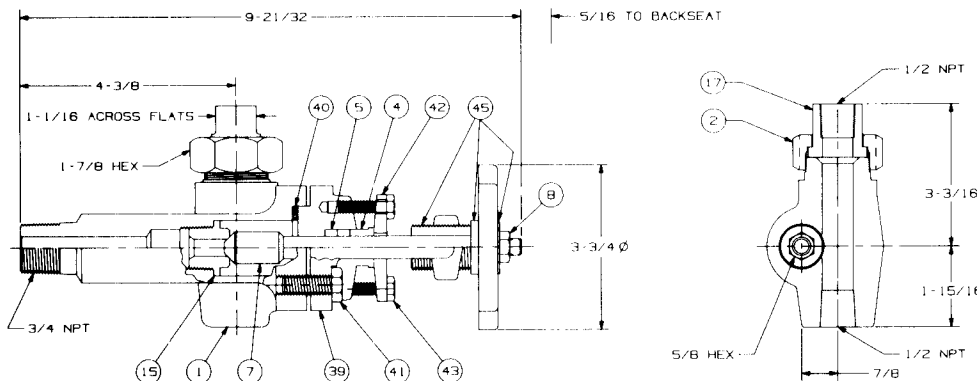
ITEM NO.	NAME	MATERIAL
1	BODY	ASTM A350 LF2
2	UNION NUT	CARBON STEEL
4	PACKING FOLLOWER	STEEL
5	PACKING RING	TEFLON
7	STEM	416 S.S.
8	STEM NUT	CARBON STEEL
15	SEAT	416 S.S.
17	FEMALE CONNECTOR	CARBON STEEL
39	YOKE	FORGED STEEL

ITEM NO.	NAME	MATERIAL
40	YOKE GASKET	SPIRAL ASB-304 S.S.
41	YOKE BOLT	ALLOY STEEL
42	PRESSURE BAR	FORGED STEEL
43	PRESSURE BAR SCREW	ALLOY STEEL
45	STEM-SCREW-HANDLE NAME PLATE ASSEMBLY	304 S.S./ZINC IRON/304 S.S.
46	OUTER THRUST WASHER	STEEL

Note: Valve shown is for bottom left hand (or top right hand) location. Opposite hand is reversed. Valves are furnished in pairs of one bottom left hand and one top left hand.



TYPE 7S
Weight per set approximately 12 lbs.



TYPE 7U
Weight per set approximately 12 lbs.

A Tubular Gage Connection is available on request. Optional Gage Connections shown on page 25. Optional Tank Connections shown on pages 26 and 27. A Ball Check Valve is available on request.

STRAIGHT-THRU VALVES

Type 4S & 4U

RENEWABLE INTERNAL STEM BONNET

4000 psig CWP 6000 psig Test
3/4" NPT Male Union Tank Connection
1/2" NPT Female Gage Connection
1/2" NPT Female Drain Connection

The Daniel Type 4 Straight-Thru Gage Valve is available with screwed (S) and union (U) gage connections and used with Reflex and Transparent Gages in working pressures up to 4000 psi. The "straight-thru" valve body design is popularly used with close hook-up (side connection) gages because the gage side connection centers and vessel centers can be identical. (With offset valves, vessel centers must be inside or outside side connection centers.) Type 4 Valves have a 3/4" NPT Male Tank Connection as standard, with other connections available on order.

Type 4 Straight-Thru Gage Valves are stocked in carbon steel with stainless steel trims. A molded Teflon packing ring is standard at no extra cost in valves for services to 450°F. For temperatures to 700°F, valves have wire-graphite packing. The Type 4 Valve has stainless steel ball checks to shut off the flow automatically in case of gage glass breakage. An optional backseating stem available on request.

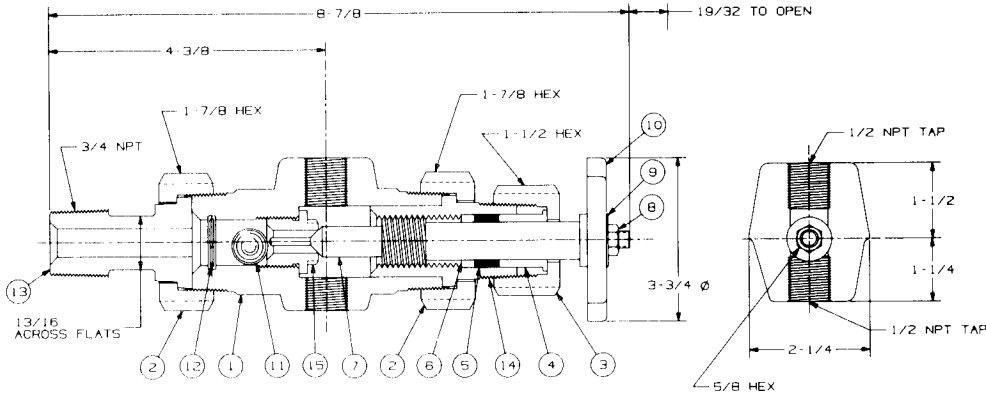
PRESSURE — TEMPERATURE RATING			
Teflon Packing		Wire-Graphite Packing	
4000 psi	100°F	2950 psi	500°F
3730 psi	200°F	2700 psi	600°F
3470 psi	300°F	2430 psi	700°F
3200 psi	400°F		

PARTS

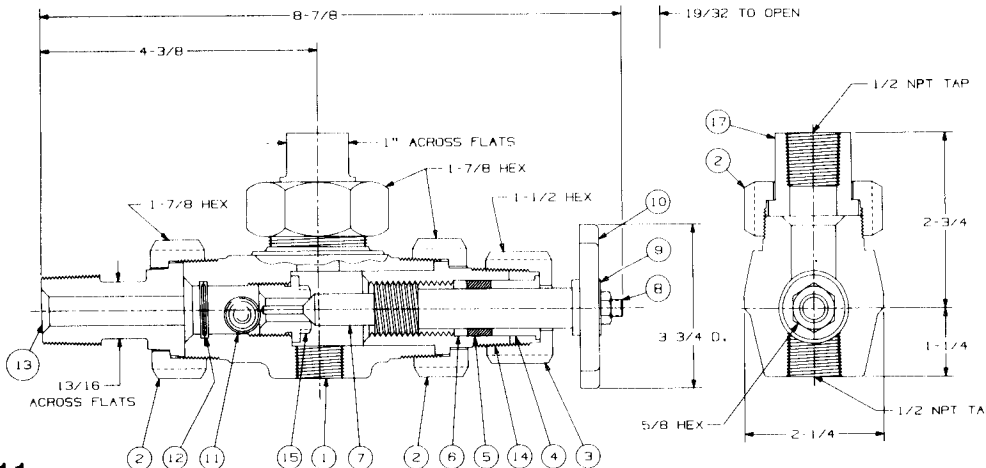
ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL	MATERIAL
1	BODY	ASTM A350 LF2	304 S.S.	316 S.S.
2	UNION NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
3	PACKING NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
4	PACKING FOLLOWER	316 S.S.	316 S.S.	316 S.S.
5	PACKING RING	TEFLON	TEFLON	TEFLON
6	PACKING WASHER	17-4 PH S.S.	17-4 PH S.S.	17-4 PH S.S.
7	STEM	304 S.S.	304 S.S.	316 S.S.
8	STEM NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
9	NAME PLATE	304 S.S.	304 S.S.	304 S.S.
10	HAND WHEEL	ALLOY ZINC	ALLOY ZINC	ALLOY ZINC

ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL	MATERIAL
11	BALL	440 S.S.	316 S.S.	316 S.S.
12	BALL RETAINER	316 S.S.	316 S.S.	316 S.S.
*13	MALE CONNECTOR	CARBON STEEL	304 S.S.	316 S.S.
14	BONNET	416 S.S.	304 S.S.	316 S.S.
15	SEAT	416 S.S.	304 S.S.	316 S.S.
17	FEMALE CONNECTOR	CARBON STEEL	304 S.S.	316 S.S.

* Item No. 13 has hole with 1/16 eccentricity for 1/8 maximum misalignment on the overall center-to-center. Note: Valve shown is for bottom lefthand (or top righthand) location. Opposite hand is reversed. Valves are furnished in pairs of one bottom left hand and one top left hand.



TYPE 4S
 Weight per set approximately 12 lbs.



TYPE 4U
 Weight per set approximately 12 lbs.

A Tubular Gage Connection is available on request. Optional Tank Connections shown on pages 26 and 27. Optional Gage Connections shown on page 25. Quick Opening Valve model shown on page 24.

STRAIGHT-THRU OS&Y VALVES

Type 5S & 5U

STANDARD OUTSIDE SCREW & YOKE

1440 psig CWP, 2160 psig Test (600 lbs. Class)

3/4" NPT Male Tank Connection

1/2" NPT Female Gage Connection

1/2" NPT Female Drain Connection only

PRESSURE — TEMPERATURE RATING			
Teflon Packing		Wire-Graphite Packing	
1440 psi	100°F	1250 psi	500°F
1400 psi	200°F	1100 psi	600°F
1365 psi	300°F	1065 psi	700°F
1330 psi	400°F		

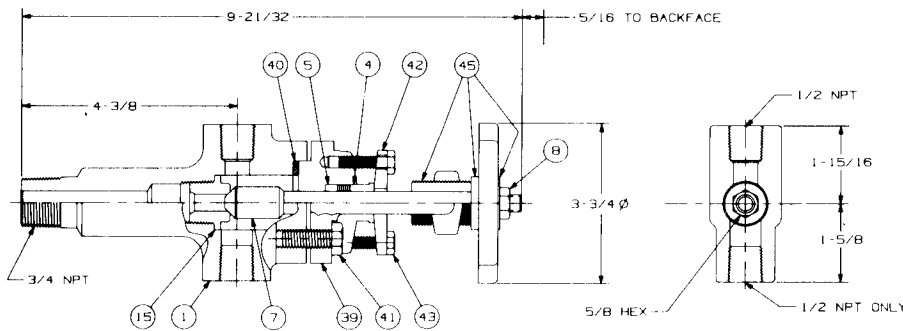
The Daniel Type 5 Gage Valve has the Outside Screw & Yoke design which prevents excessively hot and corrosive fluids from contacting stem threads, causing possible malfunction. The stem backs directly off the regrindable valve seat, using the positive, nonrotating stem principle. The valve has a "straight-thru" body design and, with an optional bleed valve, can be used in a block and bleed application. Standard gage connections are screwed (S) and union (U) but any other type connection can be supplied on special order.

The standard tank connection for Type 5 OS&Y Straight-Thru Gage Valves is a 3/4" NPT solid shank, with optional 1/2" and 1" NPT sizes. Ends beveled for welding also are available. Valve materials include forged carbon steel with stainless steel trims. A molded Teflon packing ring is standard at no extra cost in valves for services up to 450°F. For temperatures to 700°F, valves have wire-graphite packing. The standard Type 5 Valve has a backseating stem that allows the packing to be changed without shutting down the vessel. Stainless steel ball checks are available upon request.

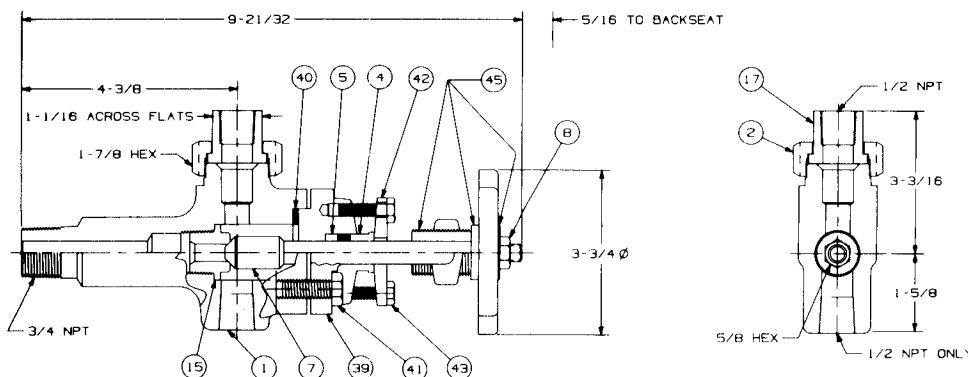
PARTS

ITEM NO.	NAME	MATERIAL
1	BODY	ASTM A350 LF2
2	UNION NUT	CARBON STEEL
4	PACKING FOLLOWER	STEEL
5	PACKING RING	TEFLON
7	STEM	416 S.S.
8	STEM NUT	CARBON STEEL
15	SEAT	416 S.S.
17	FEMALE CONNECTOR	CARBON STEEL

ITEM NO.	NAME	MATERIAL
39	YOKE	FORGED STEEL
40	YOKE GASKET	SPIRAL ASB.-S.S.
41	YOKE BOLT	ALLOY STEEL
42	PRESSURE BAR	FORGED STEEL
43	PRESSURE BAR SCREW	ALLOY STEEL
45	STEM-SCREW-HANDLE NAME PLATE ASSEMBLY	304 S.S./ZINC IRON/304 S.S.
46	OUTER THRUST WASHER	STEEL



TYPE 5S
Weight per set approximately 12 lbs.



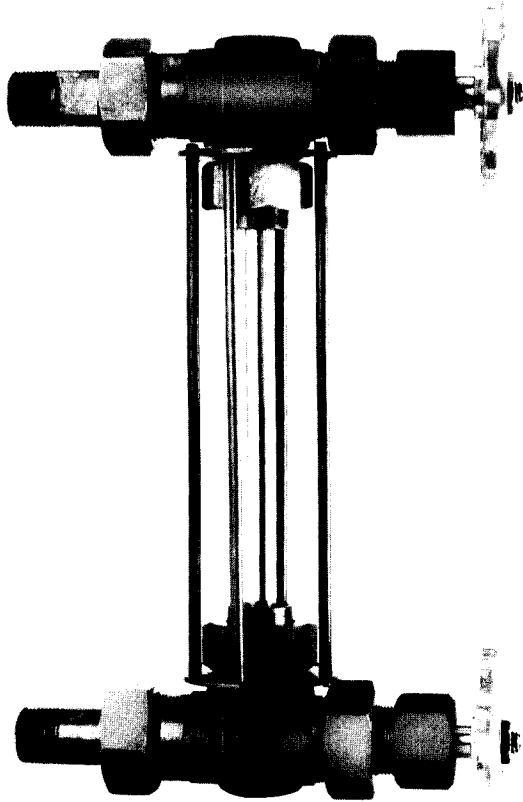
TYPE 5U
Weight per set approximately 12 lbs.

1/2" NPT & 1" NPT OPTIONAL.
1/2" IPS & 1" IPS BEVELED
ENDS OPTIONAL

A Tubular Gage Connection is available on request. Optional Tank Connections shown on pages 26 and 27. Optional Gage Connections shown on page 25. A Ball Check Valve is available on request.

TUBULAR GAGES AND VALVES

5/8" O.D. Glass Standard, 3/4" O.D. Glass Optional



Shown with Type 2T valves

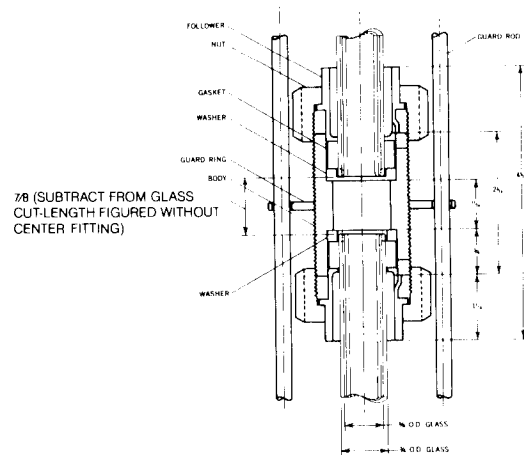
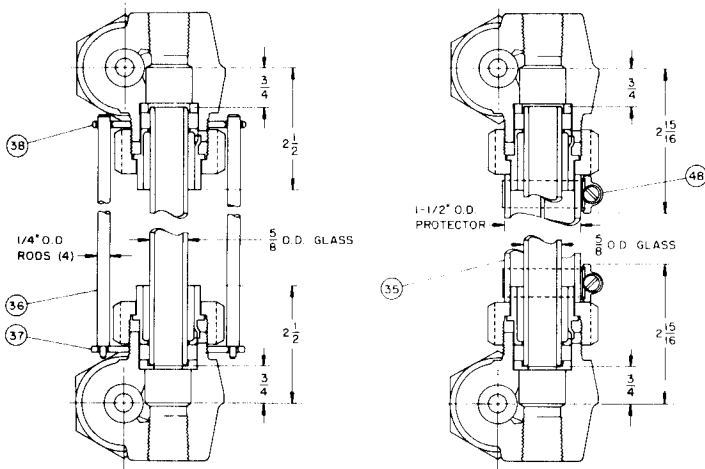
Daniel Tubular Glass Gages are available in any length desired and can be fitted with Type 1T or 2T Gage Valves (see Page 18). These gages provide 360° visibility of the liquid level through strong, clear glass. Tubular glass is used in three types: Red Line, High Pressure and Heavy Wall. Pressure ratings are different for each type and also depend upon glass length (see next page). If glass breakage occurs, a stainless steel ball check shuts off each valve. Glass tubes should be cut 1 1/2" shorter than valve center-to-center. The resulting visible glass length is 5" less than the valve center-to-center.

Red Line glass provides a bright crimson stripe against a narrow white strip throughout the length of the tube. Liquid levels are easy to see against this special optical effect. The glass is heat-resistant and ends are fire polished. Red Line is available in both 5/8" and 3/4" O.D.

High Pressure glass is a versatile, medium-strong type of tube used in many applications. It is crystal clear and ends are fire polished.

Heavy Wall glass has the highest pressure rating of all tubular glass. It is extremely clear, corrosion resistant, will not scratch easily and is extra resistant to heat shock. Ends are ground.

Four carbon steel guard rods and two guard rod rings are used to protect tubular glass gages. The rods are anchored in each ring which is fastened to the valve behind the union nut. Rods should be cut 1 3/4" shorter than valve center-to-center. A transparent plastic sheath also is available to clamp around the glass tube. Sheath length should be 4 3/8" shorter than valve center-to-center. Also available is an expanded metal gage glass protector for additional protection of the glass. Specify gage valve center-to-center for proper sizing of this assembly.



CENTER FITTING
(Recommended when valve centers exceed maximum recommended service length)

NOTE: Type 1T 4000 psi Tubular Valve and Type 2T 4000 psi Tubular Valve shown on page 15.

MAXIMUM RECOMMENDED WORKING PRESSURE, PSIG

GLASS LENGTH	5/8" O.D. Red Line		3/4" O.D. Red Line		5/8" O.D. High Pressure	
	TO 150°F*	TO 425°F**	TO 150°F*	TO 425°F**	TO 150°F*	TO 425°F**
8"	370	285	360	280	435	320
10"	345	280	340	275	420	315
12"	335	280	330	275	410	305
14"	325	275	320	270	390	295
15"	320	275	315	270	380	290
16"	315	270	310	265	375	285
18"	305	265	300	260	360	280
20"	290	265	285	260	350	270
22"	280	260	275	255	335	265
24"	265	255	260	250	320	255
30"	235	†	230	†	280	†
36"	205	†	200	†	245	†
48"	165	†	160	†	195	†
60"	125	†	125	†	150	†
72"	90	†	90	†	100	†

GLASS LENGTH	3/4" O.D. High Pressure		5/8" O.D. Heavy Wall		3/4" O.D. Heavy Wall	
	TO 150°F*	TO 425°F**	TO 150°F*	TO 425°F**	TO 150°F*	TO 425°F**
8"	425	315	600	350	600	350
10"	410	310	600	345	600	345
12"	400	300	600	340	600	340
14"	385	290	600	335	600	335
15"	375	285	600	330	600	330
16"	370	280	600	325	600	325
18"	355	275	600	320	600	320
20"	345	265	600	315	600	315
22"	330	260	590	310	590	310
24"	315	250	580	300	580	300
30"	275	†	550	†	550	†
36"	240	†	500	†	500	†
48"	190	†	340	†	340	†
60"	145	†	†	†	†	†
72"	100	†	†	†	†	†

* To 150°F and/or CORROSIVE SERVICES **For 150-425°F and/or CORROSIVE SERVICES
† Maximum recommended length in this service is 24"
‡ Maximum recommended length in this service is 48"

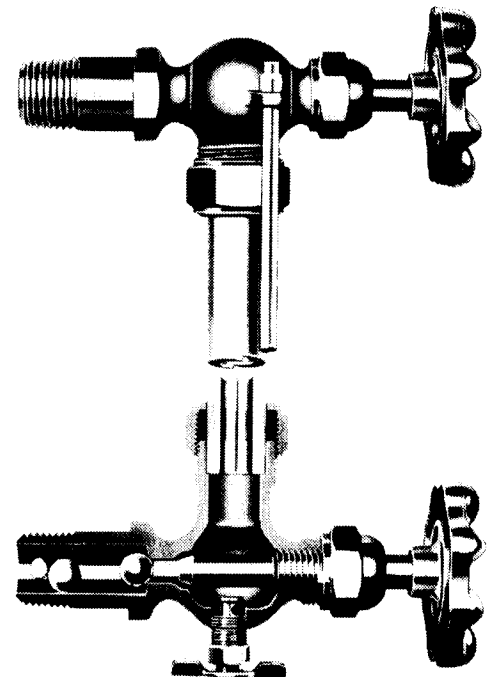
TUBULAR VALVES (Brass)

1/2" NPT Male Tank Connection
5/8" O.D. Tubular Glass Gage Connection

For low pressure water vessels, storage tanks, containers, etc., Daniel provides Type OT Brass Valves for Tubular Gages. The valves are made up with 5/8" O.D. Pyrex Red Line, High Pressure or Heavy Wall Glass from stock. Each valve contains a brass ball check which closes the valve in the event of glass breakage. Two guard rods are used. The lower valve also is fitted with a threaded drain cock. Type OT Brass Valves are suitable for working pressures up to 200 psig at or under 400°F.

Tubular glasses are available in any length and should be cut 1 1/2" shorter than valve center-to-centers. Guard rods should be 3/4" longer than the valve center-to-centers.

Visible length is 3" less than the valve centers.



TUBULAR VALVES

Type 1T & 2T

4000 psig CWP 6000 psig Test

3/4" NPT Male Union Tank Connection

5/8" O.D. Tubular Glass Gage Connection

1/2" NPT Female Drain Connection

Daniel Offset Tubular Gage Valves are identical to Type 1 and 2 S and U Valves except they are fitted with the 5/8" O.D. tubular glass connection. The Type 2T Valve also can be furnished in the coarse thread design and with quick-operating lever for remote operation by chain. Both valves have a molded Teflon packing ring and rubber glass gaskets as standard for services up to 250°F. For temperatures to 425°F, valves have wire-graphite packing and viton glass gaskets. In the event of tubular glass breakage, a stainless steel ball check closes the valve to prevent further loss of fluid.

PRESSURE—TEMPERATURE RATING			
Teflon Packing/ Rubber Gaskets		Teflon Packing/ Viton Gaskets	
4000 psi	100°F	3470 psi	300°F
3730 psi	200°F	3200 psi	400°F
3600 psi	250°F	3150 psi	425°F

NOTES: These ratings are for the valves only and not the tubular glass gages. See glass gage ratings on page 14.

PARTS

ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL ¹	MATERIAL ²
1	BODY	ASTM A350 LF2	304 S.S.	316 S.S.
2	UNION NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
3	PACKING NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
4	PACKING FOLLOWER	316 S.S.	316 S.S.	316 S.S.
5	PACKING RING	TEFLON	TEFLON	TEFLON
6	PACKING WASHER	17-4 PH S.S.	17-4 PH S.S.	17-4 PH S.S.
7	STEM	304 S.S. ¹	304 S.S.	316 S.S.
8	STEM NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
9	NAME PLATE	304 S.S.	304 S.S.	304 S.S.
10	HAND WHEEL	ALLOY ZINC	ALLOY ZINC	ALLOY ZINC
11	BALL	440 S.S.	440 S.S.	440 S.S.
12	BALL RETAINER	316 S.S.	316 S.S.	316 S.S.

ITEM NO.	NAME	STANDARD	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL ¹	MATERIAL ²
*13	MALE CONNECTOR	CARBON STEEL	304 S.S.	316 S.S.
14	BONNET ²	416 S.S.	304 S.S.	316 S.S.
15	SEAT ²	416 S.S.	304 S.S.	316 S.S.
18	GLASS FOLLOWER	CARBON STEEL	CARBON STEEL	CARBON STEEL
19	GLASS GASKET	RUBBER	RUBBER	RUBBER
**20 or 21	LOWER GLASS SUPPORT	CARBON STEEL	304 S.S.	316 S.S.

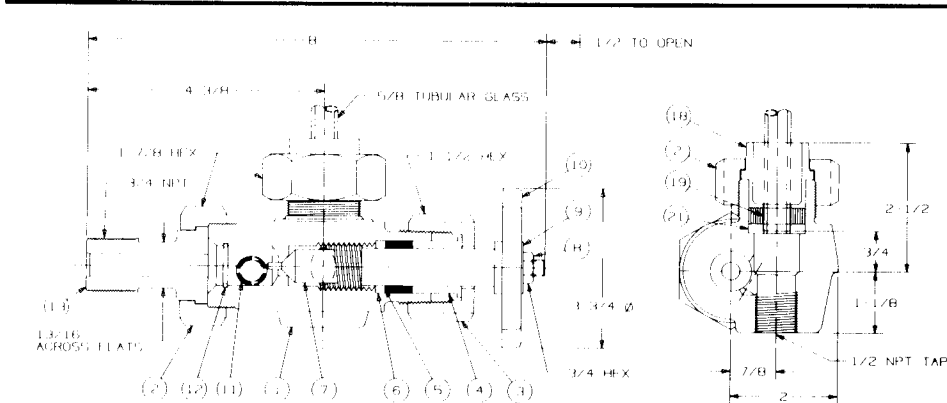
* ITEM NO. 13 HAS HOLE WITH 1/16 ECCENTRICITY FOR 1/8 MAXIMUM MISALIGNMENT ON THE OVERALL CENTER-TO-CENTER

** ITEM NO. 21 IS USED IN LOWER VALVE; ITEM NO. 20 IN UPPER VALVE

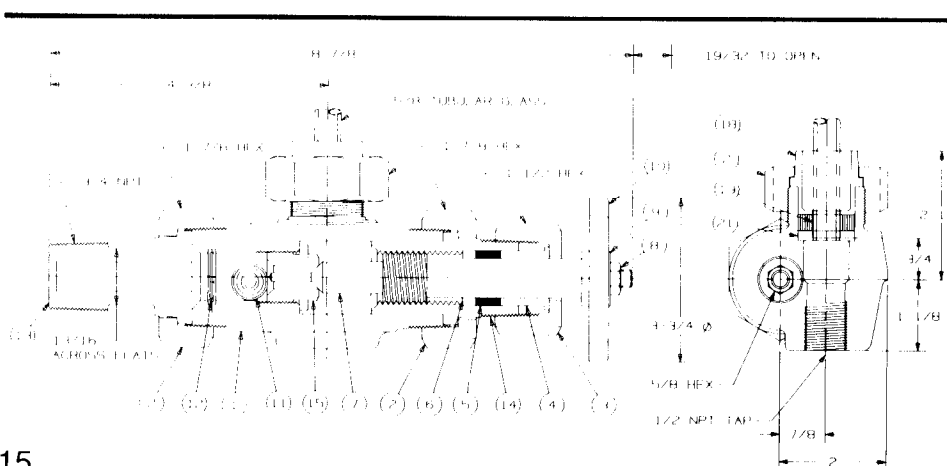
NOTE: Valve shown is for bottom left hand (or top right hand) location. Opposite hand is reversed. Valves are furnished in pairs of one bottom left hand and one top left hand.

¹ For Type 1 -- 416 S.S.

² Available in Type 2 Valve only



TYPE 1T
Weight per set approximately 10 lbs. 12 ozs.

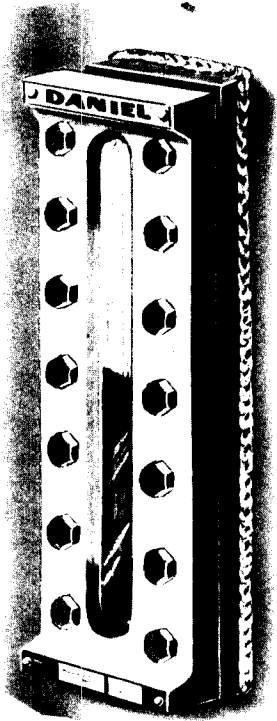


TYPE 2T
Weight per set approximately 11 lbs. 12 ozs.

Optional Tank Connections shown on pages 26 and 27. Optional Gage Connections shown on page 25.

SPECIALTY GAGES:

Welding Pad

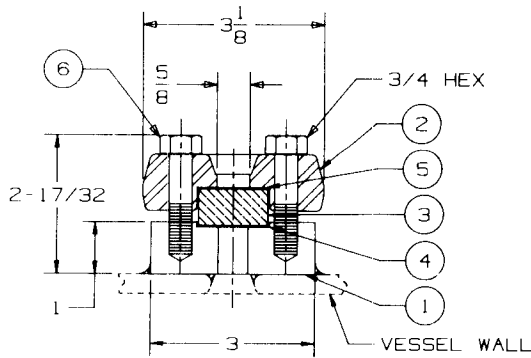
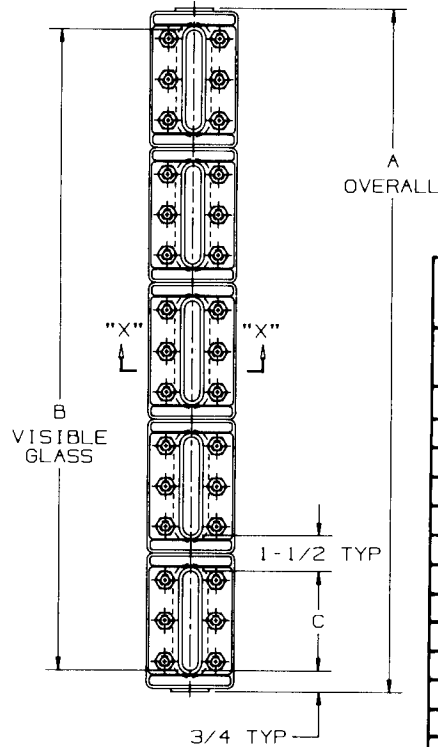


Daniel Welding Pad Gages are used when standard tank connections cannot be used or when the liquid has solids in suspension. The gage becomes an integral part of the vessel because it is welded right onto the outer wall. Reflex glass is used in any of nine standard lengths. Standard covers are 3 1/8" wide. **NOTE:** Welding pad gages to be used on vessels less than 36" in diameter must be special ordered. The welding pad body must be machined to allow proper fit up.

Method of Installation:

1. Assemble complete gage with spacer plate (available on request) in place of gage glass.
2. Place gage in exact location desired on empty vessel and weld around circumference of the pad.
3. Allow gage to cool, then remove cover and spacer. Drill or burn top and bottom holes in vessel wall at the top and bottom of each gage slot. Slot is 5/8" wide.
4. Replace gage glass, gasket, cushion and cover. Torque bolts to prescribed foot/pounds.

NOTE: While the gage itself can be designed to withstand certain pressures, Daniel cannot control the installation of each gage or the load applied to the gage by the vessel. Because of this, Daniel cannot rate Weld Pad Gages. When ordering, add WP to gage size number.



SECTION X-X
REFLEX

PARTS

ITEM NO.	NAME	MATERIAL
1	WELDING PAD	AISI 1020 HR
2	COVER	A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	BOLT	ASTM A193 B7

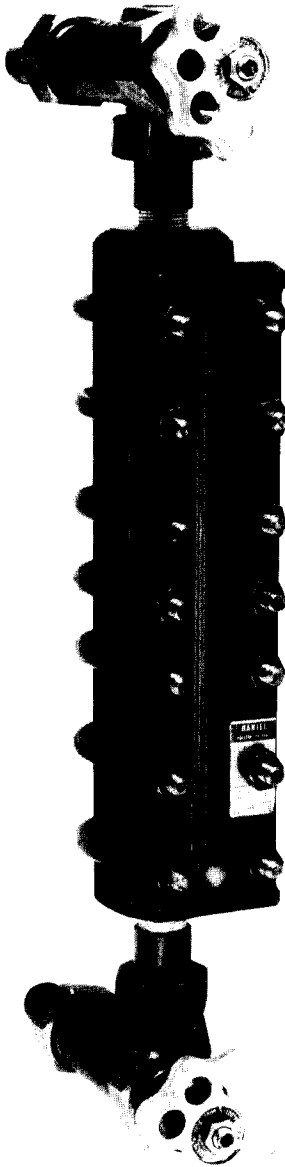
DIMENSIONS

SIZE NO.		DIMENSIONS (IN INCHES)		
Glass Size	NO. SECT.	A	B	C
1	1	5 1/4	3 3/4	3 3/4
2	1	6 1/4	4 3/4	4 3/4
3	1	7 1/4	5 3/4	5 3/4
4	1	8 1/4	6 3/4	6 3/4
5	1	9 3/8	7 7/8	7 7/8
6	1	10 5/8	9 1/8	9 1/8
7	1	11 3/4	10 1/4	10 1/4
8	1	13 3/8	11 7/8	11 7/8
9	1	14 1/8	12 5/8	12 5/8
3	2	14 1/2	13	5 3/4
4	2	16 1/2	15	6 3/4
5	2	18 3/4	17 1/4	7 7/8
6	2	21 1/4	19 3/4	9 1/8
7	2	23 1/2	22	10 1/4
8	2	26 3/4	25 1/4	11 7/8
9	2	28 3/4	26 3/4	12 5/8
6	3	31 7/8	30 3/8	9 1/8
7	3	35 1/4	33 3/4	10 1/4
8	3	40 1/8	38 5/8	11 7/8
9	3	42 3/8	40 7/8	12 5/8
7	4	47	45 1/2	10 1/4
8	4	53 1/2	52	11 7/8
9	4	56 1/2	55	12 5/8
7	5	58 3/4	57 1/4	10 1/4
8	5	66 7/8	65 3/8	11 7/8
9	5	70 5/8	69 1/8	12 5/8

SPECIALTY GAGES:

Large-Chamber for Viscous Liquids

Example: 71 RL-LC (No. 7 glass, 1-section, Reflex, Low Pressure, Large Chamber)



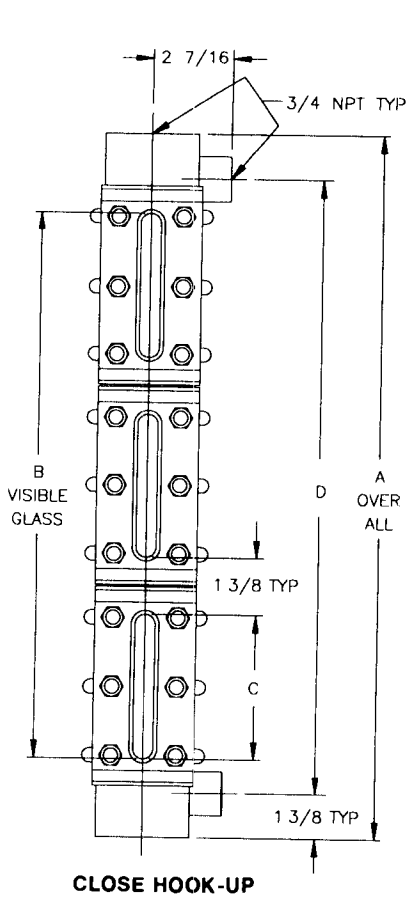
Daniel Large Chamber Gages are made in a special low pressure series of both Reflex and Transparent Gages. The large diameter chamber makes accurate liquid level readings possible under unusual conditions such as boiling, flashing or foaming of the liquid. The chamber is manufactured from heavy duty seamless steel pipe with inside diameter of 2 1/8". Each end of the pipe is closed off with a welded plug which is drilled and tapped for 3/4" NPT connection. For close hook-ups, 3/4" NPT side connections are made and ends may be drilled, tapped and plugged for cleaning as required.

Recessed seats are machined into the liquid chamber and gage covers for protection of glass, gasket and cushion. Special bolts are used. Large Chamber Gages are made in lengths for standard flat glasses and multiple section gages are available.

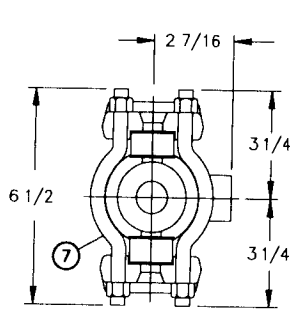
When ordering, add LC for large chamber to gage size number and CH for close hook-up.

DIMENSIONS

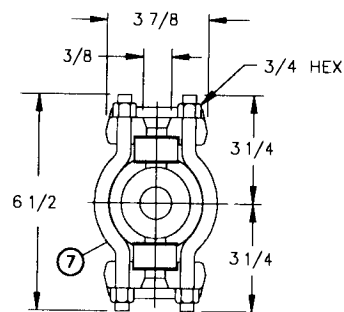
SIZE NO.		DIMENSIONS (IN INCHES)							
GLASS SIZE	NO. SECT.	STANDARD			CLOSE HOOK-UP				
		A	B	C	A	B	C	D	
1	1	6 1/4	3 3/4	3 3/4	8 3/8	3 3/4	3 3/4	5 5/8	
2	1	7 1/4	4 3/4	4 3/4	9 3/8	4 3/4	4 3/4	6 5/8	
3	1	8 1/4	5 3/4	5 3/4	10 3/8	5 3/4	5 3/4	7 5/8	
4	1	9 1/4	6 3/4	6 3/4	11 3/8	6 3/4	6 3/4	8 5/8	
5	1	10 3/8	7 7/8	7 7/8	12 1/2	7 7/8	7 7/8	9 3/4	
6	1	11 5/8	9 1/8	9 1/8	13 3/4	9 1/8	9 1/8	11	
7	1	12 3/4	10 1/4	10 1/4	14 7/8	10 1/4	10 1/4	12 1/8	
8	1	14 3/8	11 7/8	11 7/8	16 1/2	11 7/8	11 7/8	13 3/4	
9	1	15 1/8	12 5/8	12 5/8	17 1/4	12 5/8	12 5/8	14 1/2	
3	2	15 1/2	13	5 3/4	17 5/8	13	5 3/4	14 7/8	
4	2	17 1/2	15	6 3/4	19 5/8	15	6 3/4	16 7/8	
5	2	19 3/4	17 1/4	7 7/8	21 7/8	17 1/4	7 7/8	19 1/8	
6	2	22 1/4	19 3/4	9 1/8	24 3/8	19 3/4	9 1/8	21 5/8	
7	2	24 1/2	22	10 1/4	26 5/8	22	10 1/4	23 7/8	
8	2	27 3/4	25 1/4	11 7/8	29 7/8	25 1/4	11 7/8	27 1/8	
9	2	29 1/4	26 3/4	12 5/8	31 3/8	26 3/4	12 5/8	28 5/8	
6	3	32 7/8	30 3/8	9 1/8	35	30 3/8	9 1/8	32 1/4	
7	3	36 1/4	33 3/4	10 1/4	38 3/8	33 3/4	10 1/4	35 5/8	
8	3	41 1/8	38 5/8	11 7/8	43 1/4	38 5/8	11 7/8	40 1/2	
9	3	43 3/8	40 7/8	12 5/8	45 1/2	40 7/8	12 5/8	42 3/4	
7	4	48	45 1/2	10 1/4	50 1/8	45 1/2	10 1/4	47 3/8	
8	4	54 1/2	52	11 7/8	56 5/8	52	11 7/8	53 7/8	
9	4	57 1/2	55	12 5/8	59 5/8	55	12 5/8	56 7/8	
7	5	59 3/4	57 1/4	10 1/4	61 7/8	57 1/4	10 1/4	59 1/8	
8	5	67 7/8	65 3/8	11 7/8	70	65 3/8	11 7/8	67 1/4	
9	5	71 5/8	69 1/8	12 5/8	73 3/4	69 1/8	12 5/8	71	



CLOSE HOOK-UP

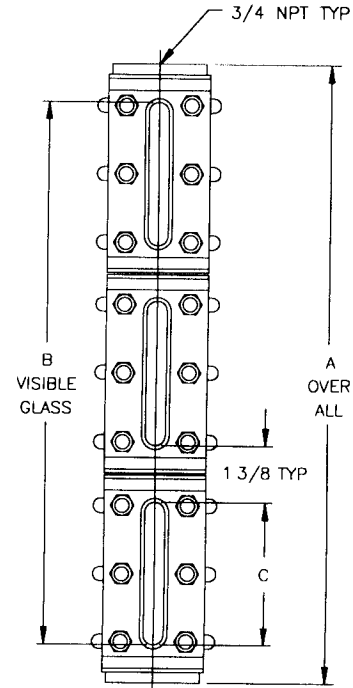


TRANSPARENT (STD.)

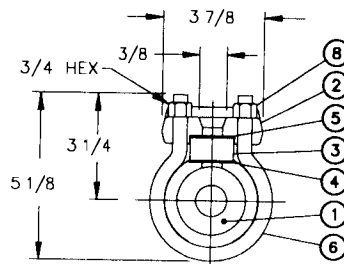


TRANSPARENT (CH)

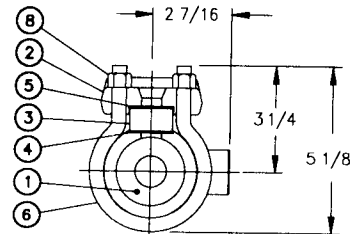
ITEM NO.	NAME	MATERIAL
1	CHAMBER	ASTM A106 GRB
2	COVER	ASTM A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	U-BOLT	ASTM A193 B7
7	BOLT	ASTM A193 B7
8	NUT	ASTM A194 2H



STANDARD



REFLEX (STD.)



REFLEX (CH)

PRESSURES-TEMPERATURE RATINGS (psig)

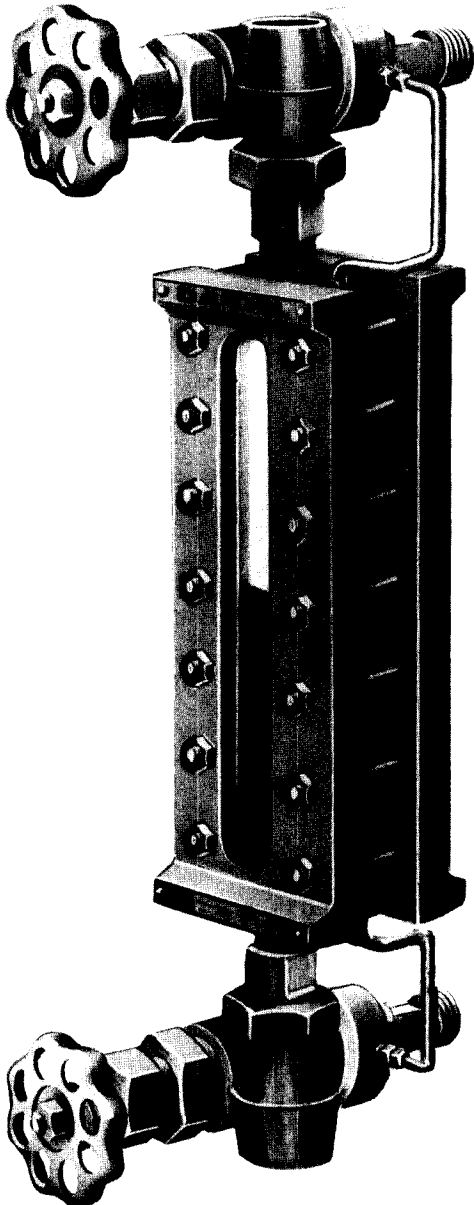
REFLEX — LARGE CHAMBER							
Glass Size	100°F	200°F	300°F	400°F	500°F	600°F	700°F
1	1020	990	950	910	850	755	620
2	980	950	915	875	815	725	600
3	940	910	880	840	780	695	590
4	900	870	840	805	750	665	560
5	860	830	800	770	715	635	540
6	830	805	775	745	690	610	530
7	790	765	735	710	660	585	510
8	750	725	700	670	625	555	500
9	720	695	670	645	600	530	480
TRANSPARENT — LARGE CHAMBER							
Glass Size	100°F	200°F	300°F	400°F	500°F	600°F	700°F
1	790	765	740	705	660	585	390
2	750	725	700	670	625	555	380
3	720	695	670	645	600	530	360
4	680	655	635	610	565	500	340
5	650	630	605	580	540	480	330
6	610	590	570	545	510	450	310
7	580	560	540	520	485	430	300
8	540	520	505	480	450	400	280
9	500	485	465	445	415	370	260

SPECIALTY GAGES:

Heated/Cooled Externally

Example: 71 TL-HC (No. 7 glass, 1-section, Transparent, Low Pressure, Externally Heated/Cooled Gage)

Also available in close hook-up (CH) and internally heated/cooled type.



Daniel Externally Heated/Cooled Gages may be either low Pressure or Mid Pressure, Reflex or Transparent and have $\frac{1}{2}$ " or $\frac{3}{4}$ " NPT Connections. Pressure-temperature ratings and sizes remain the same as standard flat gages.

On externally heated/cooled gages a metal tube is employed to transmit heating or cooling fluid. The tubing starts from an adaptor nut on one valve, passes along a machined groove in the gage body wall and connects to the adaptor nut in the opposite valve. Fluid piped through the tubing serves as the heating or cooling media. Gage bodies (liquid chambers) are made extra long to accommodate the groove and tubing.

Most common heating fluids are steam and hot water. To cool gages, methane, propane, freon and ammonia refrigerants are used.

The adaptor nut on the gage valves can be fitted with either a $\frac{1}{2}$ " NPT Female Tank connection or a $\frac{3}{4}$ " NPT Male Tank connection. Valve Types 1, 2 and 4 may be used.

When ordering Daniel Externally Heated/Cooled Gages, add HC to the gage size number.

Tank Connections (Also see pages 26 and 27)

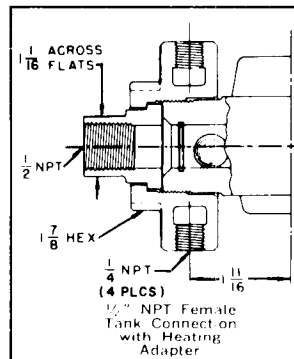


FIG. V

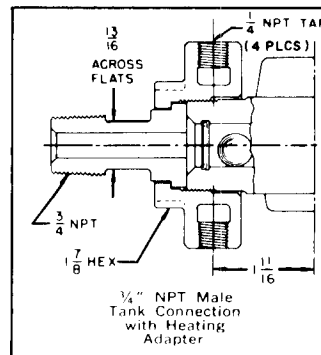
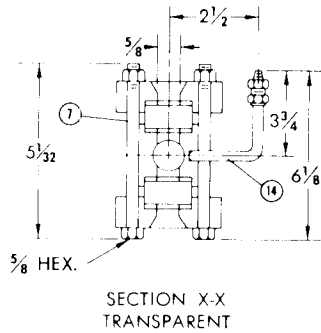
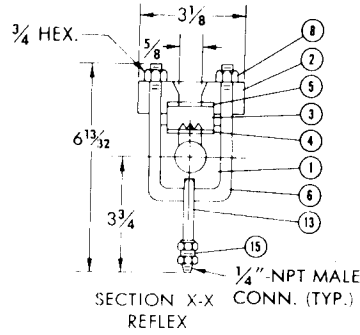
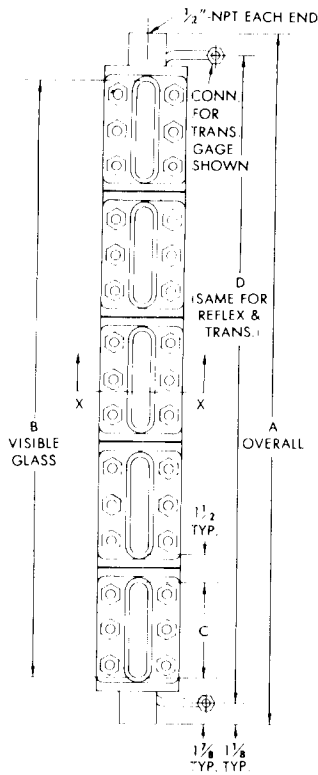


FIG. VI



PARTS

ITEM NO.	NAME	MATERIAL
1	CHAMBER	CARBON STEEL
2	COVER	ASTM A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	U-BOLT	ASTM A193 B7
7	BOLT	ASTM A193 B7
8	NUT	ASTM A194 2H
13	TUBING	COPPER
14	TUBING	COPPER
15	FITTING	STEEL

DIMENSIONS AND PRESSURE RATINGS

SIZE NO.		DIMENSIONS (IN INCHES)				LOW-PRESSURE				MID-PRESSURE			
						REFLEX MAX. PSIG @ TEMP.*		TRANSPARENT MAX. PSIG @ TEMP.*		REFLEX MAX. PSIG @ TEMP.*		TRANSPARENT MAX. PSIG @ TEMP.**	
						100°F	700°F	100°F	700°F	100°F	700°F	100°F	700°F
GLASS SIZE	NO. SECT.	A	B	C	D								
1	1	7 1/2	3 3/4	3 3/4	5 1/4	2400	1520	2000	1260	3000	1890	2500	1580
2	1	8 1/2	4 3/4	4 3/4	6 1/4	2325	1470	1815	1150	2910	1840	2315	1470
3	1	9 1/2	5 3/4	5 3/4	7 1/4	2250	1420	1630	1050	2820	1780	2130	1340
4	1	10 1/2	6 3/4	6 3/4	8 1/4	2175	1370	1440	900	2725	1740	1940	1230
5	1	11 5/8	7 7/8	7 7/8	9 3/8	2100	1320	1250	790	2630	1660	1750	1100
6	1	12 7/8	9 1/8	9 1/8	10 5/8	2025	1280	1065	680	2535	1600	1565	990
7	1	14	10 1/4	10 1/4	11 3/4	1950	1230	875	550	2440	1540	1375	870
8	1	15 5/8	11 7/8	11 7/8	13 3/8	1875	1180	690	440	2345	1480	1190	750
9	1	16 3/4	12 5/8	12 5/8	14 1/8	1800	1140	500	320	2250	1420	1000	630
3	2	16 3/4	13	5 3/4	14 1/2	2250	1420	1630	1050	2820	1780	2130	1340
4	2	18 3/4	15	6 3/4	16 1/2	2175	1370	1440	900	2725	1740	1940	1230
5	2	21	17 1/4	7 7/8	18 3/4	2100	1320	1250	790	2630	1660	1750	1100
6	2	23 1/2	19 3/4	9 1/8	21 1/4	2025	1280	1065	680	2535	1600	1565	990
7	2	25 3/4	22	10 1/4	23 1/2	1950	1230	975	550	2440	1540	1375	870
8	2	29	25 1/4	11 7/8	26 3/4	1875	1180	690	440	2345	1480	1190	750
9	2	30 1/2	26 3/4	12 5/8	28 1/4	1800	1140	500	320	2250	1420	1000	630
6	3	34 1/8	30 3/8	9 1/8	31 7/8	2025	1280	1065	680	2535	1600	1565	990
7	3	37 1/2	33 3/4	10 1/4	35 1/4	1950	1230	875	550	2440	1540	1375	870
8	3	42 3/8	38 3/8	11 7/8	40 1/8	1875	1180	690	440	2345	1480	1190	750
9	3	44 5/8	40 7/8	12 5/8	42 3/8	1800	1140	500	320	2250	1420	1000	630
7	4	49 1/4	45 1/2	10 1/4	47	1950	1230	875	550	2440	1540	1375	870
8	4	55 3/4	52	11 7/8	53 1/2	1875	1180	690	440	2345	1480	1190	750
9	4	58 3/4	55	12 5/8	56 1/2	1800	1140	500	320	2250	1420	1000	630
7	5	61	57 1/4	10 1/4	58 3/4	1950	1230	875	550	2440	1540	1375	870
8	5	69 1/8	65 3/8	11 7/8	66 7/8	1875	1180	690	440	2345	1480	1190	750
9	5	72 7/8	69 1/8	12 5/8	70 7/8	1800	1140	500	320	2250	1420	1000	630

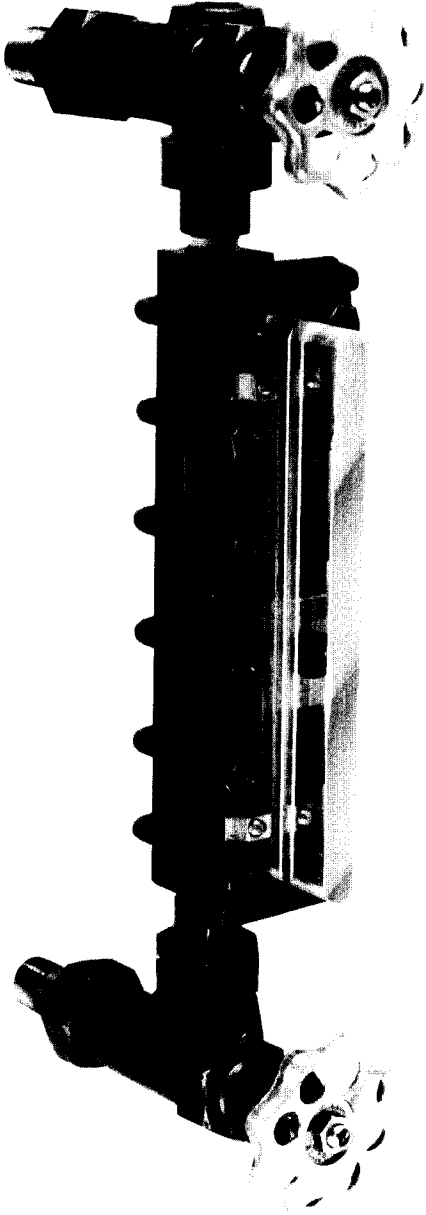
* Saturated steam to 350 WSP

** Maximum saturated steam 600 WSP with mica shields.

SPECIALTY GAGES:

Frost-Prevention Extensions

Example: 81 RL-FP w/ 3 $\frac{5}{8}$ " extensions (No. 8 glass, 1-section, Reflex, Low Pressure, Frost Preventive Gage with 3 $\frac{5}{8}$ " extensions).

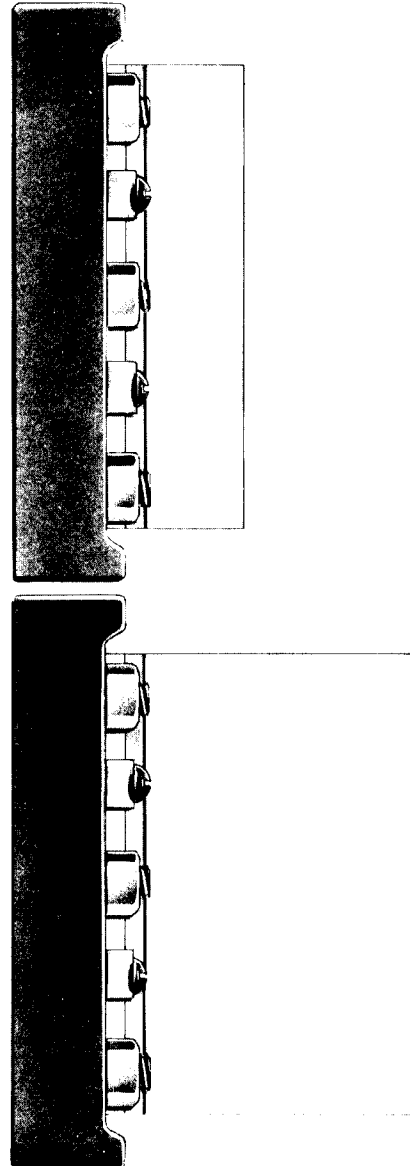


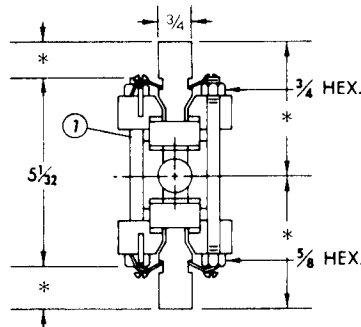
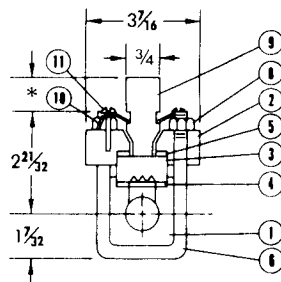
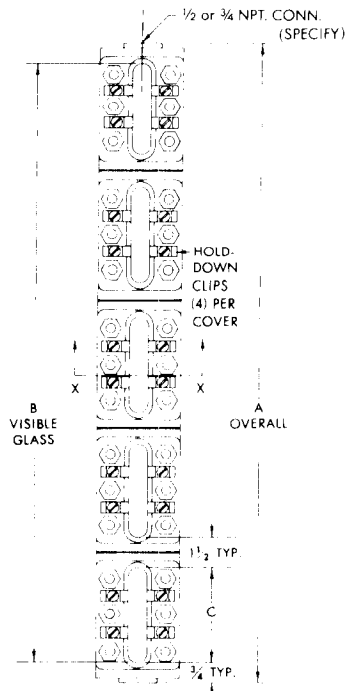
Daniel plastic extensions for flat gage glasses prevent frost from forming in the liquid level view slot in low temperature services. Reflex and Transparent Gages in all pressure ratings can be fitted with plastic extensions.

Projecting from the view slot, the clear plastic extension keeps the liquid level indication clearly visible. Stocked extensions are 1 $\frac{5}{8}$ " and 3 $\frac{5}{8}$ " in length. If the gage is thickly insulated, longer extensions are available. The extension is held in place by stainless steel clamps fastened to the gage cover. For extra low temperature services, Daniel gages can be made of special metals.

Recommended length for Frost Preventive Extensions: 1 $\frac{5}{8}$ " extension is standard from 80°F ambient to 0°F temperature. Add 1" extension length for each 100°F below 0°F.

When ordering, specify length and add FP to gage size number.





*Depends on Extension Length

PARTS

ITEM NO.	NAME	MATERIAL
1	CHAMBER	CARBON STEEL
2	COVER	ASTM A350 LF2
3	GLASS	TEMPERED
4	GASKET	NON-ASBESTOS
5	CUSHION	NON-ASBESTOS
6	U-BOLT	ASTM A193 B7
7	BOLT	ASTM A193 B7
8	NUT	ASTM A194 2H
9	EXTENSION	PLASTIC
10	CLIP	303 S.S.
11	SCREW	303 S.S.

DIMENSIONS AND PRESSURE RATINGS

SIZE NO.		DIMENSIONS (IN INCHES)			LOW-PRESSURE				MID-PRESSURE			
					REFLEX MAX. PSIG @ TEMP.*		TRANSPARENT MAX. PSIG @ TEMP.*		REFLEX MAX. PSIG @ TEMP.*		TRANSPARENT MAX. PSIG @ TEMP.**	
					100°F	700°F	100°F	700°F	100°F	700°F	100°F	700°F
GLASS SIZE	NO. SECT.	A	B	C								
1	1	5 1/4	3 3/4	3 3/4	2400	1520	2000	1260	3000	1890	2500	1580
2	1	6 1/4	4 3/4	4 3/4	2325	1470	1815	1150	2910	1840	2315	1470
3	1	7 1/4	5 3/4	5 3/4	2250	1420	1630	1050	2820	1780	2130	1340
4	1	8 1/4	6 3/4	6 3/4	2175	1370	1440	900	2725	1740	1940	1230
5	1	9 3/8	7 7/8	7 7/8	2100	1320	1250	790	2630	1660	1750	1100
6	1	10 5/8	9 1/8	9 1/8	2025	1280	1065	680	2535	1600	1565	990
7	1	11 3/4	10 1/4	10 1/4	1950	1230	875	550	2440	1540	1375	870
8	1	13 3/8	11 7/8	11 7/8	1875	1180	690	440	2345	1480	1190	750
9	1	14 1/8	12 5/8	12 5/8	1800	1140	500	320	2250	1420	1000	630
3	2	14 1/2	13	5 3/4	2250	1420	1630	1050	2820	1780	2130	1340
4	2	16 1/2	15	6 3/4	2175	1370	1440	900	2725	1740	1940	1230
5	2	18 3/4	17 1/4	7 7/8	2100	1320	1250	790	2630	1660	1750	1100
6	2	21 1/4	19 3/4	9 1/8	2025	1280	1065	680	2535	1600	1565	990
7	2	23 1/2	22	10 1/4	1950	1230	875	550	2440	1540	1375	870
8	2	26 3/4	25 1/4	11 7/8	1875	1180	690	440	2345	1480	1190	750
9	2	28 1/4	26 3/4	12 5/8	1800	1140	500	320	2250	1420	1000	630
6	3	31 7/8	30 3/8	9 1/8	2025	1280	1065	680	2535	1600	1565	990
7	3	35 1/4	33 3/4	10 1/4	1950	1230	875	550	2440	1540	1375	870
8	3	40 1/8	38 5/8	11 7/8	1875	1180	690	440	2345	1480	1190	750
9	3	42 3/8	40 7/8	12 5/8	1800	1140	500	320	2250	1420	1000	630
7	4	47	45 1/2	10 1/4	1950	1230	875	550	2440	1540	1375	870
8	4	53 1/2	52	11 7/8	1875	1180	690	440	2345	1480	1190	750
9	4	56 1/2	55	12 5/8	1800	1140	500	320	2250	1420	1000	630
7	5	58 3/4	57 1/4	10 1/4	1950	1230	875	550	2440	1540	1375	870
8	5	66 7/8	65 3/8	11 7/8	1875	1180	690	440	2345	1480	1190	750
9	5	70 5/8	69 1/8	12 5/8	1800	1140	500	320	2250	1420	1000	630

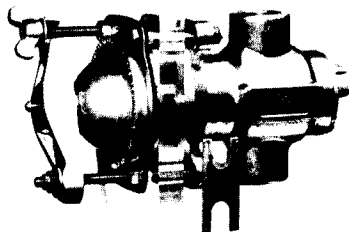
* Saturated steam to 350 WSP

** Maximum saturated steam 600 WSP with mica shields

SPECIALTY GAGES:

Illuminators (Explosion-Proof)

TYPE EP-HW

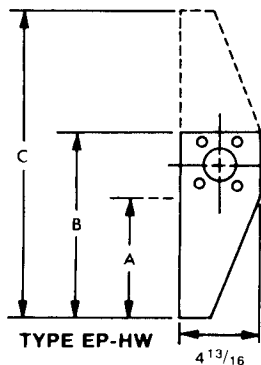


Daniel Explosion-Proof Gage Illuminators give bright, evenly diffused light for easy viewing of liquid levels in Transparent Gages. The illuminator spreads light from a single source throughout the length of its Lucite plastic reflector(s). The reflectors are $\frac{3}{4}$ " thick and come in lengths to fit 9 standard glass sizes. Single section illuminators are made to fit 1-section gages, double sections to fit 2-section gages. On 3-section gages, one single section and one double section illuminator are used.

Daniel Standard illuminators are approved by Underwriter Laboratories under their Standard for Electric Lighting Fixtures for use in hazardous locations, Class 1, Group "C" and "D" Services, Divisions I & II. Group B service is available upon request. Illuminators are 110 voltage.

The explosion-proof fitting is separable from the plastic reflector and consists of an aluminum housing for the wiring and bulb socket and a thick, heat-resistant glass housing for the light bulb. A bracket is furnished for fastening the illuminator to the two top bolts on the left side of the gage cover. On multiple-section illuminators, a 1" NPT pipe nipple can be supplied for wiring conduit between lamps.

EP-HW type
are available in
single or double
sections.



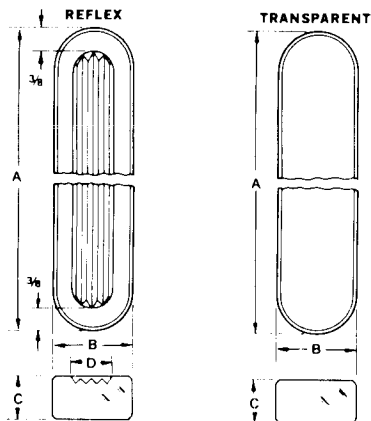
DIMENSIONS (IN INCHES) EP-HW ILLUMINATOR					
SIZE NO.	A	SINGLE		DOUBLE	
	VISIBLE LENGTH	B OVER-ALL	CAT. NO.	C OVER-ALL	CAT. NO.
1	$3\frac{3}{4}$	7	11-HW	9	12-HW
2	$4\frac{3}{4}$	8	21-HW	11	22-HW
3	$5\frac{3}{4}$	9	31-HW	13	32-HW
4	$6\frac{3}{4}$	10	41-HW	15	42-HW
5	$7\frac{7}{8}$	$11\frac{1}{8}$	51-HW	$17\frac{1}{4}$	52-HW
6	$9\frac{1}{8}$	$12\frac{3}{8}$	61-HW	$19\frac{3}{4}$	62-HW
7	$10\frac{1}{4}$	$13\frac{1}{2}$	71-HW	22	72-HW
8	$11\frac{7}{8}$	$15\frac{1}{8}$	81-HW	$25\frac{1}{4}$	82-HW
9	$12\frac{5}{8}$	$15\frac{7}{8}$	91-HW	$26\frac{3}{4}$	92-HW

Catalog No. EP-HW has a 58-watt threaded base lamp bulb.

When ordering, specify Catalog Number, gage length and number of sections.

DIMENSIONAL DATA

Flat Gage Glasses



Glass Size No.	A
1	4½"
2	5½"
3	6½"
4	7½"
5	8½"
6	9½"
7	11"
8	12½"
9	13½"

B	C	D
1⅛"	1⅛"	1⅛"

TOLERANCES FOR DIMENSIONS ABOVE

A	B	C
+0 -½"	+½" -0	+0 -½"

Daniel standard gage glass is made of borosilicate glass. For higher temperature service or requirements, aluminosilicate glass can be supplied.

Mica shields are available for use with Transparent Gages in steam boiler service enabling glass to be used in higher pressures. They are placed between gasket and glass. KEL-F shields are available for use with Transparent Gages in corrosive service.

NOTE: For cyclic temperature applications, or to aid in torque retention, spring washers are available upon request.

LIQUID LEVEL GAGE VOLUMES

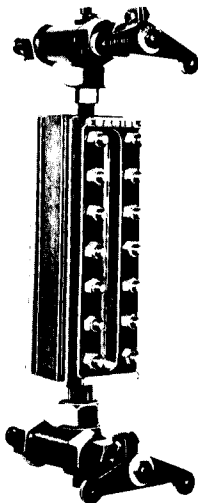
Glass Size No.	Visible Length (inches)	STANDARD GAGE VOLUMES (approximate)				LARGE CHAMBER GAGE VOLUMES (approximate)			
		REFLEX		TRANSPARENT		REFLEX		TRANSPARENT	
		Cu. In.	Cu. Cm.	Cu. In.	Cu. Cm.	Cu. In.	Cu. Cm.	Cu. In.	Cu. Cm.
1	3¾	2.07	34	3.17	52	15.49	254	15.92	261
2	4¾	2.61	43	3.99	65	19.16	314	19.70	323
3	5¾	3.21	53	4.82	79	22.82	374	23.48	385
4	6¾	3.68	60	5.63	92	26.49	434	27.26	447
5	7¾	4.28	70	6.55	107	30.61	501	31.51	516
6	9¾	4.94	81	7.58	124	35.19	577	36.24	594
7	10¾	5.55	91	8.50	139	39.31	644	40.49	664
8	11¾	6.42	105	9.83	161	45.26	742	46.64	764
9	12¾	6.82	112	10.45	171	48.01	787	49.47	811

C = .271 Cu. In. = 4.4 Cu. Cm.

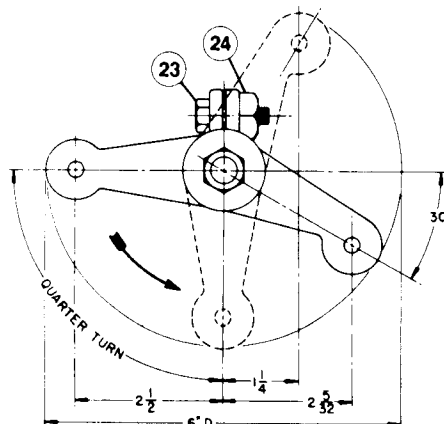
C = 3.54 Cu. In. = 58.1 Cu. Cm.

NOTE: For multiple section level gages, add "C" volume for each additional section. "C" is volume between gage sections.

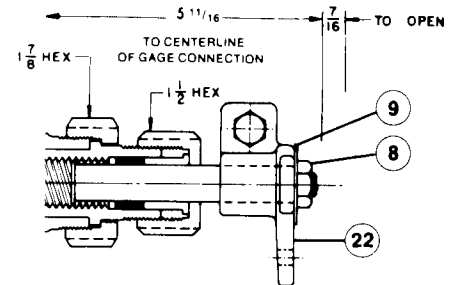
QUICK-OPENING LEVERS



FOR TYPE 2 & TYPE 4 (S, U AND T) VALVES RATED 4000 PSI @ 100°F



Daniel Type 2 & Type 4 (S, U and T) Offset Gage Valves are available with a coarse thread stem design and levers for fast, remote operation by chain. Only ¼ turn of the lever opens or closes the valves, which may be mounted in hard-to-reach areas. A ¼" hole is drilled in the end of each lever for connecting the chain.



PARTS

ITEM NO.	NAME	MATERIAL
8	STEM NUT	CARBON STEEL
9	NAME PLATE	304 S.S.
22	LEVER	DUCTILE IRON
23	BOLT	CARBON STEEL
24	NUT	CARBON STEEL

GAGE CONNECTIONS

All Daniel gage valves, types 1 thru 7, can be fitted with any gage connection shown here.

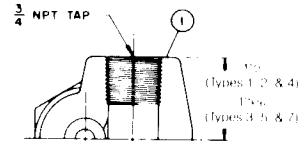


FIG. VII

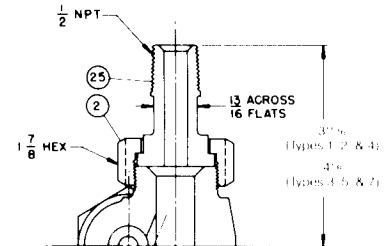


FIG. VIII

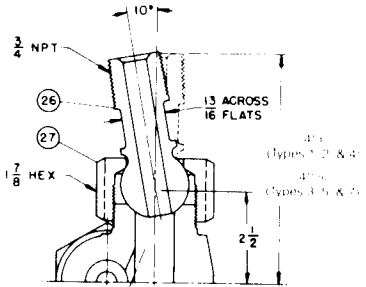


FIG. X

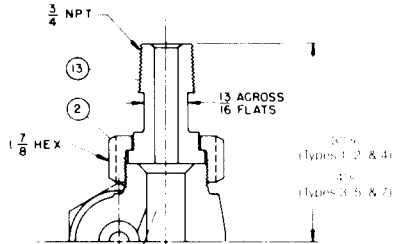


FIG. XI

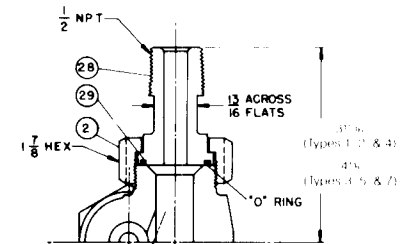


FIG. XIII

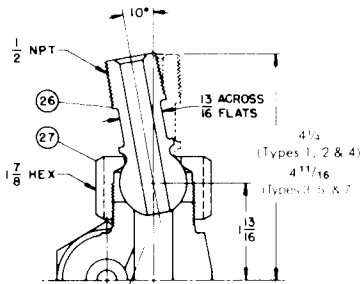


FIG. XIV

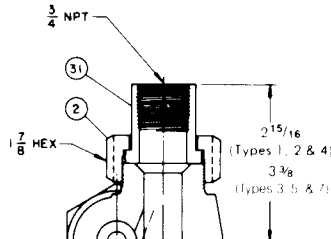


FIG. XV

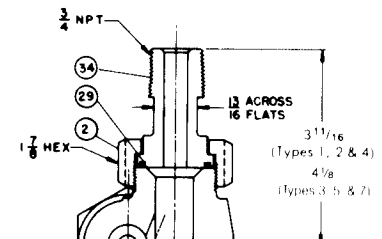


FIG. XVI

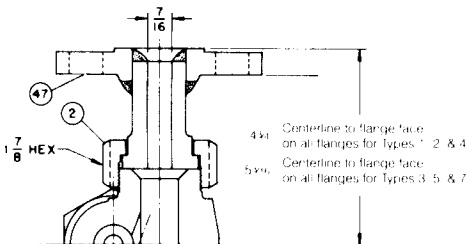


FIG. XVII

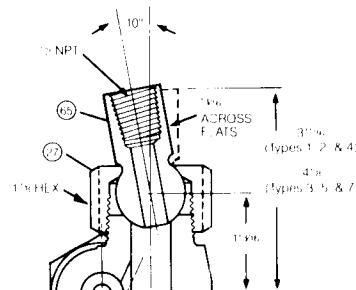


FIG. XXIX

PARTS

ITEM NO.	NAME	STANDARD TRIM	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL	MATERIAL
1	BODY	FORGED STEEL	304 SS	316 SS
2	UNION NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
25	MALE CONNECTOR-1/2"	CARBON STEEL	304 SS	316 SS
26	MALE SPHERICAL CONN.-3/4"	CARBON STEEL	304 SS	316 SS
26	MALE SPHERICAL CONN.-1/2"	CARBON STEEL	304 SS	316 SS
27	SPHERICAL NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
28	MALE "O" RING CONN.-1/2"	CARBON STEEL	304 SS	316 SS
*29	"O" RING	BUNA-N	BUNA-N	BUNA-N
31	FEMALE UNION-3/4"	ALLOY STEEL	—	—
34	MALE "O" RING CONN.-3/4"	CARBON STEEL	304 SS	316 SS
47	ANSI RF SLIP-ON FLG'D ASSY.	CARBON STEEL	304 SS	316 SS
**65	FEMALE SPHER. CONN.-1/2"	CARBON STEEL	304 SS	316 SS

* O-Ring of Teflon® or Viton® on request.

** 3/4" NPT female spherical connections are not available.

NOTE: Valve shown is for bottom left hand (or top right hand) location. Opposite hand is reversed. Valves are furnished in pairs of one bottom left hand and one top left hand.

TANK CONNECTIONS

All Tank Connections for Daniel Gage Valves are shown here, including the standard connections illustrated on the valves. For Types 1, 2 and 4 Valves, Fig. II thru XXVIII are available.

For Types 3, 5, and 7 Valves, Fig. XXV thru XXVIII are available.

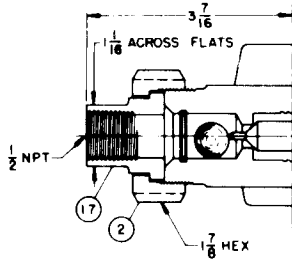


FIG. II

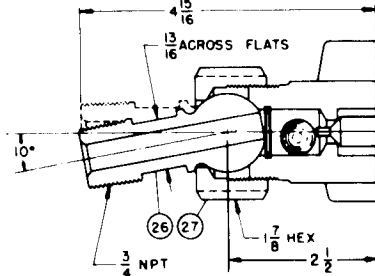


FIG. III

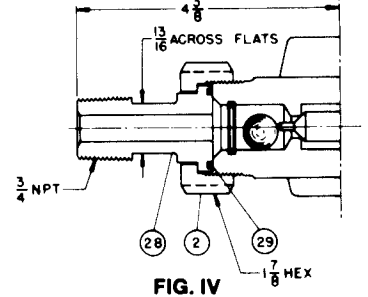


FIG. IV

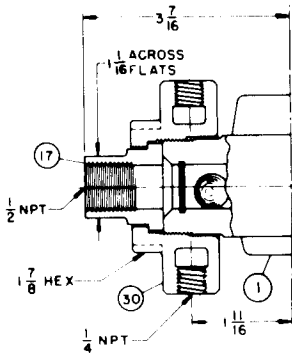


FIG. V

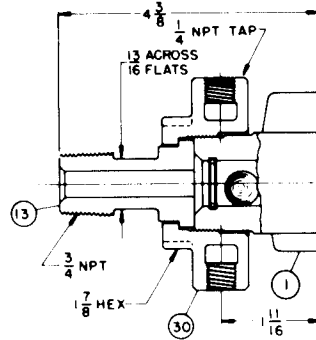


FIG. VI

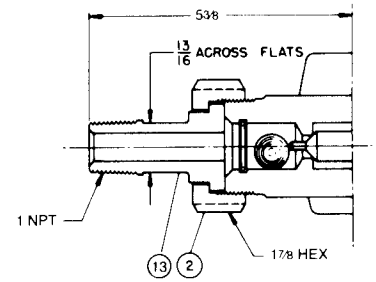


FIG. VII

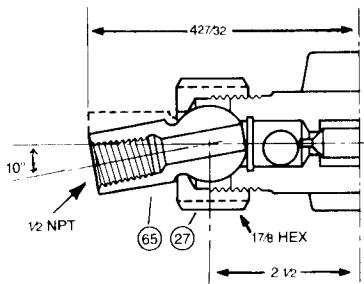


FIG. XVIII

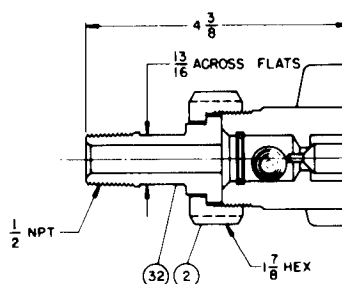


FIG. XIX

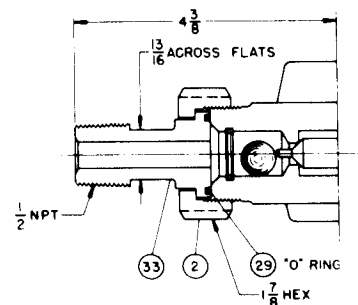


FIG. XX

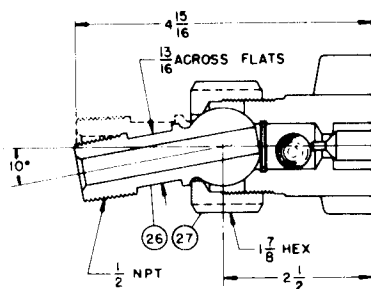


FIG. XXI

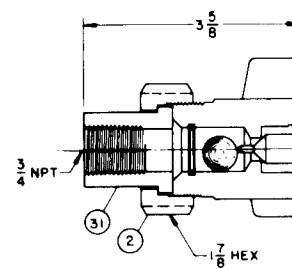


FIG. XXII

TANK CONNECTIONS (CONTINUED)

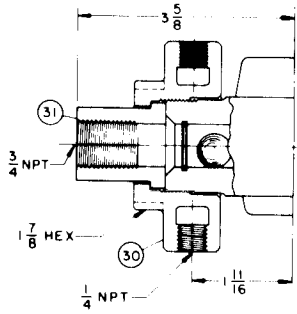


FIG. XXIII

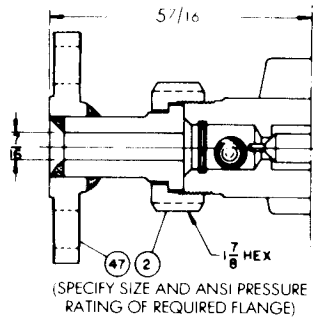


FIG. XXIV

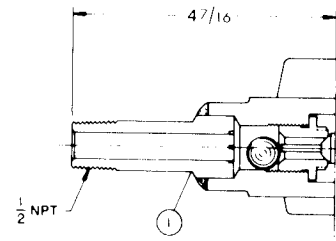


FIG. XXV

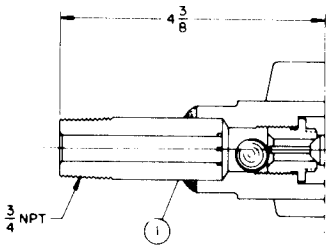


FIG. XXVI

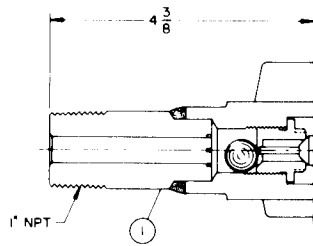


FIG. XXVII

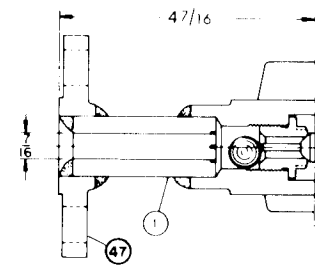


FIG. XXVIII

PARTS

ITEM NO.	NAME	STANDARD TRIM	304 S.S. WETTED PARTS	316 S.S. WETTED PARTS
		MATERIAL	MATERIAL	MATERIAL
1	BODY	FORGED STEEL	304 SS	316 SS
1	BODY-1/2" NPT SHANK	FORGED STEEL	304 SS	316 SS
1	BODY-3/4" NPT SHANK	FORGED STEEL	304 SS	316 SS
1	BODY-1" NPT SHANK	FORGED STEEL	304 SS	316 SS
1	BODY-RF FLG'D SHANK	FORGED STEEL	304 SS	316 SS
2	UNION NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
*13	MALE CONNECTOR	CARBON STEEL	304 SS	316 SS
17	FEMALE CONNECTOR 1/2"	CARBON STEEL	304 SS	316 SS
26	MALE SPHERICAL CONN.	CARBON STEEL	304 SS	316 SS
27	SPHERICAL NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
*28	MALE "O" RING CONN. 3/4"	CARBON STEEL	304 SS	316 SS
**29	"O" RING	BUNA-N	BUNA-N	BUNA-N
30	HEATED/COOLED NUT	CARBON STEEL	CARBON STEEL	CARBON STEEL
31	FEMALE CONNECTION 3/4"	ALLOY STEEL	—	—
*32	MALE CONNECTOR-1/2"	CARBON STEEL	304 SS	316 SS
*33	MALE "O" RING CONN.-1/2"	CARBON STEEL	304 SS	316 SS
47	ANSI RF SLIP-ON FLG'D ASSY.	CARBON STEEL	304 SS	316 SS
***65	FEMALE SPHER. CONN.-1/2"	CARBON STEEL	304 SS	316 SS

* Has hole with 1/16 eccentricity for ± 1/8 maximum misalignment on the overall center-to-center.

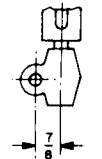
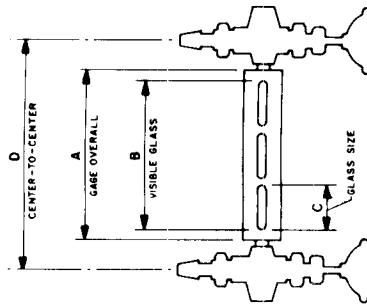
** O-Ring of Teflon® or Viton® on request.

*** 3/4" NPT female connection is not available.

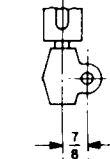
NOTE: Valve shown is for bottom left hand (or top right hand) location. Opposite hand is reversed. Valves are furnished in pairs of one bottom left hand and one top left hand.

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INSTALLATION: STANDARD GAGES



BOTTOM
LEFT HAND
OFFSET
GAGE VALVE



TOP
LEFT HAND
OFFSET
GAGE VALVE

NOTE: A, B, C & D Dimensions are in inches.

SIZE NO.	A GAGE OVERALL	B VISIBLE GLASS	C GLASS SIZE	D* MINIMUM VALVE CENTER-TO-CENTER WITH GAGE CONNECTION								
				FOR GAGES TAPPED 1/2" NPT				FOR GAGES TAPPED 3/4" NPT				
Glass No.	No. Sect.			**1/2"-NPT Female Screwed CAT. 1S, 2S, 4S	**1/2"-NPT Female Union ⁵ CAT. 1U, 2U, 4U	1/2"-NPT Male Union Fig. VIII	1/2"-NPT Male Spherical Fig. XIV	**3/4"-NPT Female Screwed CAT. 1S, 2S, 4S	3/4"-NPT Female Union** CAT. 1U, 2U, 4U	3/4"-NPT Male Union Fig. XI	3/4"-NPT Male Spherical Fig. X	
1	1	5 1/4	3 3/4	3 3/4	8 1/2	11	11 5/8	12 3/4	8 3/4	11 5/8	11 1/2	12 5/8
2	1	6 1/4	4 3/4	4 3/4	9 1/2	12	12 5/8	13 3/4	9 3/4	12 5/8	12 1/2	13 5/8
3	1	7 1/4	5 3/4	5 3/4	10 1/2	13	13 5/8	14 3/4	10 3/4	13 5/8	13 1/2	14 5/8
4	1	8 1/4	6 3/4	6 3/4	11 1/2	14	14 5/8	15 3/4	11 3/4	14 5/8	14 1/2	15 5/8
5	1	9 3/8	7 7/8	7 7/8	12 3/8	15 1/8	15 3/4	16 7/8	12 7/8	15 3/4	15 5/8	16 3/4
6	1	10 5/8	9 1/8	9 1/8	13 7/8	16 3/8	17	18 1/8	14 1/8	17	16 7/8	18
7	1	11 3/4	10 1/4	10 1/4	15	17 1/2	18 1/8	19 1/4	15 1/4	18 1/8	18	19 1/8
8	1	13 3/8	11 7/8	11 7/8	16 5/8	19 1/8	19 3/4	20 7/8	16 7/8	19 3/4	19 5/8	20 3/4
9	1	14 1/8	12 5/8	12 5/8	17 3/8	19 7/8	20 1/2	21 5/8	17 5/8	20 1/2	20 3/8	21 1/2
3	2	14 1/2	13	5 3/4	17 3/4	20 1/4	20 7/8	22	18	20 7/8	20 3/4	21 7/8
4	2	16 1/2	15	6 3/4	19 3/4	22 1/4	22 7/8	24	20	22 7/8	22 3/4	23 7/8
5	2	18 3/4	17 1/4	7 7/8	22	24 1/2	25 1/8	26 1/4	22 1/4	25 1/8	25	26 1/8
6	2	21 1/4	19 3/4	9 1/8	24 1/2	27	27 5/8	28 3/4	24 3/4	27 5/8	27 1/2	28 5/8
7	2	23 1/2	22	10 1/4	26 3/4	29 1/4	29 7/8	31	27	29 7/8	29 3/4	30 7/8
8	2	26 3/4	25 1/4	11 7/8	30	32 1/2	33 1/8	34 1/4	30 1/4	33 1/8	33	34 1/8
9	2	28 1/4	26 3/4	12 5/8	31 1/2	34	34 5/8	35 3/4	31 3/4	34 5/8	34 1/2	35 5/8
6	3	31 7/8	30 3/8	9 1/8	35 1/8	37 5/8	38 1/4	39 3/8	35 3/8	38 1/4	38 1/8	39 1/4
7	3	35 1/4	33 3/4	10 1/4	38 1/2	41	41 5/8	42 3/4	38 3/4	41 5/8	41 1/2	42 5/8
8	3	40 1/8	38 5/8	11 7/8	43 3/8	45 7/8	46 1/2	47 5/8	43 5/8	46 1/2	46 3/8	47 1/2
9	3	42 3/8	40 7/8	12 5/8	45 5/8	48 1/8	48 3/4	49 7/8	45 7/8	48 3/4	48 5/8	49 3/4
7	4	47	45 1/2	10 1/4	50 1/4	52 3/4	53 3/8	54 1/2	50 1/2	53 3/8	53 1/4	54 3/8
8	4	53 1/2	52	11 7/8	56 3/4	59 1/4	59 7/8	61	57	59 7/8	59 3/4	60 7/8
9	4	56 1/2	55	12 5/8	59 3/4	62 1/4	62 7/8	64	60	62 7/8	62 3/4	63 7/8
7	5	58 3/4	57 1/4	10 1/4	62	64 1/2	65 1/8	66 1/4	62 1/4	65 1/8	65	66 1/8
8	5	66 7/8	65 3/8	11 7/8	70 1/8	72 5/8	73 1/4	74 3/8	70 3/8	73 1/4	73 1/8	74 1/4
9	5	70 5/8	69 1/8	12 5/8	73 3/8	76 3/8	77	78 1/8	74 1/8	77	76 7/8	78
8	6	80 1/4	78 3/4	11 7/8	83 1/2	86	86 5/8	87 3/4	83 3/4	86 5/8	86 1/2	87 5/8
9	6	84 3/4	83 1/4	12 5/8	88	90 1/2	91 1/8	92 1/4	88 1/4	91 1/8	91	92 1/8
8	7	93 3/8	92 1/8	11 7/8	96 7/8	99 3/8	100	101 1/8	97 1/8	100	99 7/8	101
9	7	98 7/8	97 3/8	12 5/8	102 1/8	104 5/8	105 1/4	106 3/8	102 3/8	105 1/4	105 1/8	106 1/4
8	8	107	105 1/2	11 7/8	110 1/4	112 3/4	113 3/8	114 1/2	110 1/2	113 3/8	113 1/4	114 3/8
9	8	113	111 1/2	12 5/8	116 1/4	118 3/4	119 3/8	120 1/2	116 1/2	119 3/8	119 1/4	120 3/8
8	9	120 3/8	118 7/8	11 7/8	123 5/8	126 1/4	126 3/4	127 7/8	123 7/8	126 3/4	126 5/8	127 3/4
9	9	127 1/8	125 5/8	12 5/8	130 3/8	132 7/8	133 1/2	134 5/8	130 5/8	133 1/2	133 3/8	134 1/2

*Dimensions in column "D" apply to low-pressure (series "L"), mid-pressure (series "M"), 1/2" NPT high-pressure (series "H"), frost-free (all series), and internally heated/cooled reflex and transparent level gages tapped 1/2" NPT or 3/4" NPT. For installation dimensions on other level gages see footnote.

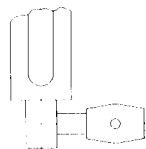
**These dimensions use close pipe nipples. For short 1/2" nipple add 3/4"; for short 3/4" nipple add 1 1/4".

NOTE: Use the following constants for other level gages:

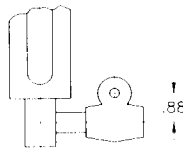
1. Low pressure (series "L") large chamber, add 1" to above "A" and "D" dimensions.
2. Low-pressure (series "L"), mid-pressure (series "M") externally heated/cooled, add 2 1/4" to above "D" dimensions.
3. For valve Types 3, 5, or 7, add 7/8" to Column "D" to obtain minimum centers.
4. For High Pressure (series "H") with 3/4" NPT, add 1 1/2" to dimensions "A" and "D".
5. For a 1/2" NPT Female Spherical Gage connection (Figure XXIX), add 1 7/8".

INSTALLATION: CLOSE HOOK-UP GAGES (GAGE CONNECTIONS)

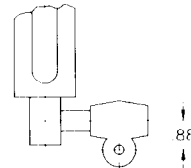
SIZE NO.	MINIMUM CENTER-TO-CENTER TANK CONNECTIONS					
	STRAIGHT-THRU 1/2" VALVE 3/4"		OFFSET VALVE HANDLES 1/2" INSIDE 3/4"		OFFSET VALVE HANDLES 1/2" OUTSIDE 3/4"	
11	5 1/4"	5 5/8"	3 1/2"	3 7/8"	7"	7 3/8"
21	6 1/4"	6 5/8"	4 1/2"	4 7/8"	8"	8 3/8"
31	7 1/4"	7 5/8"	5 1/2"	5 7/8"	9"	9 3/8"
41	8 1/4"	8 5/8"	6 1/2"	6 7/8"	10"	10 3/8"
51	9 3/8"	9 3/4"	7 5/8"	8"	11 1/8"	11 1/2"
61	10 5/8"	11"	8 7/8"	9 1/4"	12 3/8"	12 3/4"
71	11 3/4"	12 1/8"	10"	10 3/8"	13 1/2"	13 7/8"
81	13 3/8"	13 3/4"	11 5/8"	12"	15 1/8"	15 1/2"
91	14 1/8"	14 1/2"	12 3/8"	12 3/4"	15 7/8"	16 1/4"
32	14 1/2"	14 7/8"	12 3/4"	13 1/8"	16 1/4"	16 5/8"
42	16 1/2"	16 7/8"	14 3/4"	15 1/8"	18 1/4"	18 5/8"
52	18 3/4"	19 1/8"	17"	17 3/8"	20 1/2"	20 7/8"
62	21 1/4"	21 5/8"	19 1/2"	19 7/8"	23"	23 3/8"
72	23 1/2"	23 7/8"	21 3/4"	22 1/8"	25 1/4"	25 5/8"
82	26 3/4"	27 1/8"	25"	25 5/8"	28 1/2"	28 7/8"
92	28 1/4"	28 5/8"	26 1/2"	26 7/8"	30"	30 3/8"
63	31 7/8"	32 1/4"	30 1/8"	30 1/2"	33 5/8"	34"
73	35 1/4"	35 5/8"	33 1/2"	33 7/8"	37"	37 3/8"
83	40 1/8"	40 1/2"	38 3/8"	38 3/4"	41 7/8"	42 1/4"
93	42 3/8"	42 3/4"	40 5/8"	41"	44 1/8"	44 1/2"
74	47"	47 3/8"	45 1/4"	45 5/8"	48 3/4"	49 1/8"
84	53 1/2"	53 7/8"	51 3/4"	52 1/8"	55 1/4"	55 5/8"
94	56 1/2"	56 7/8"	54 3/4"	55 1/8"	58 1/4"	58 5/8"
75	58 3/4"	59 1/8"	57"	57 3/8"	60 1/2"	60 7/8"
85	66 7/8"	67 1/4"	65 1/8"	65 1/2"	68 5/8"	69"
95	70 5/8"	71"	68 7/8"	69 1/4"	72 3/8"	72 3/4"
86	80 1/4"	80 5/8"	78 1/2"	78 7/8"	82"	82 3/8"
96	84 3/4"	85 1/8"	83"	83 3/8"	86 1/2"	86 7/8"
87	93 5/8"	94"	91 7/8"	92 1/4"	95 3/8"	95 3/4"
97	98 7/8"	99 1/4"	97 1/8"	97 1/2"	100 5/8"	101"
88	107"	107 3/8"	105 1/4"	105 5/8"	108 3/4"	109 1/8"
98	113"	113 3/8"	111 1/4"	111 5/8"	114 3/4"	115 1/8"
89	120 3/8"	120 3/4"	118 5/8"	119"	122 1/8"	122 1/2"
99	127 1/8"	127 1/2"	125 3/8"	125 3/4"	128 7/8"	129 1/4"



STRAIGHT-THRU VALVE



CLOSE HOOK-UP WITH HANDLE INSIDE



CLOSE HOOK-UP WITH HANDLE OUTSIDE

CAUTION

Gage glasses may fail from improper external mechanical stress or accident rather than from internal pressure, but both factors should be considered. Four basic precautions when heeded will assure the gage glass user of safe, satisfactory performance:

1. Proper glass selection.
2. Correct installation.
3. Periodic inspection and cleaning.
4. Replacement as necessary.

Proper glass selection involves size, pressure rating and quality of glass. Flat and tubular glasses should fit perfectly without stress; glass should be crystal clear and without blemish; length determines pressure rating; if longer glass results in breakage, a multiple-section gage with shorter glasses should be considered.

Installation involves proper seating on gaskets and cushions; glass-to-metal contact should not occur; do not install any glass with scratches or chipped edges; do not

tighten gage bolts when gage is in use; use torque instructions provided with gage; use gage valves with ball checks that shut-off automatically if breakage occurs; make sure vessel center-to-centers are correct and *vertical*.

Proper tightening of bolts with torque wrench is extremely important, so that no unusual stress is introduced into the glass.

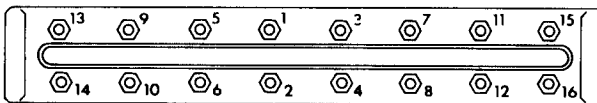
Clean outside of glasses with ordinary glass cleaners, not harsh chemicals; check for scratches, chipped edges on glass; inspect glass for clarity.

Glass should be replaced if any blemish mars surface. If gage is taken apart, glass, gaskets and cushions should be automatically replaced to reduce risk; make sure gage or tubular valve surfaces are clean and dry before installing glasses.

For safety purposes, glasses in high temperature service should be replaced more often than similar glasses used in low temperature service.

DANIEL GAGE ASSEMBLY

(Numbers Indicate Proper Bolt Torquing Sequence.)



Gage Series	Torque (Tighten in 4-5 Ft.-Lb. Steps)
Low Press. Large Cham.	20 Ft.-Lb.
Mid-Press.	32 Ft.-Lb.
High Press.	40 Ft.-Lb.

DANIEL

Daniel Measurement and Control

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OFFICES AND REPRESENTATIVES WORLDWIDE

www.danielind.com



INNOVATORS IN MOTION TECHNOLOGY
CATALOGUE 2000 N.A.

 **Darcor** 

Darcor's ergonomic logo symbolizes...

work-efficient, worker-friendly casters.

Darcor is the standard for ergonomically designed casters.



Darcor Limited

TORONTO - BUFFALO - LOS ANGELES

Tel: 1-800-387-7206 or 1-416-255-8563

Fax: 1-800-465-6544 or 1-416-251-6117

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www.casterdesign.com

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7 Staffordshire Place, Toronto, Ontario M8W 1T1

HISTORY

Darcor: Past, Present, Future

Darcor Casters originated in Toronto, Canada in 1931 as an importer and manufacturer of high quality wheels and casters. The company was purchased by Robert Hilborn in 1975. This was followed by a period of feverish product development which continues to this day. During those evolutionary years, Darcor grew into a multifaceted manufacturing operation with a powerful commitment to quality and innovation using advanced in-house facilities.

Throughout the company's history, Darcor's vision has remained steadfastly in the future anticipating the proliferating demand for specialty casters in today's rapidly evolving manufacturing environment. And responding with uniquely

designed products that blend ergonomic principles and advanced materials to improve bottom-line results and workplace conditions.

That is how Darcor has developed – and continues to increase – its enviable reputation for keeping business in motion across North America and around the globe.



A

A

B

C

D

16

6 4 A

INSTALLATION OPTIONS		
		PAGE
*	TOP PLATE *(SPECIFY PLATE NUMBER)	16
O*	GRIP RING STEM *(SPECIFY SIZE CODE)	14/15
L*	THREADED STEM *(SPECIFY SIZE CODE)	14/15
PB*	PIPE STEM *(SPECIFY SIZE CODE)	14/15
PC*	PIPE CAP *(SPECIFY SIZE CODE)	14/15
S*	SQUARE STEM *(SPECIFY SIZE CODE)	14/15
JA	STEM FOR METAL SOCKETS	14/15
WSA	WOOD LEG STEM	14/15
C*	CLINCHED SWIVEL *(SPECIFY SIZE)	14/15

COMPLETE CASTER

A - B C D - E F

WHEEL ONLY

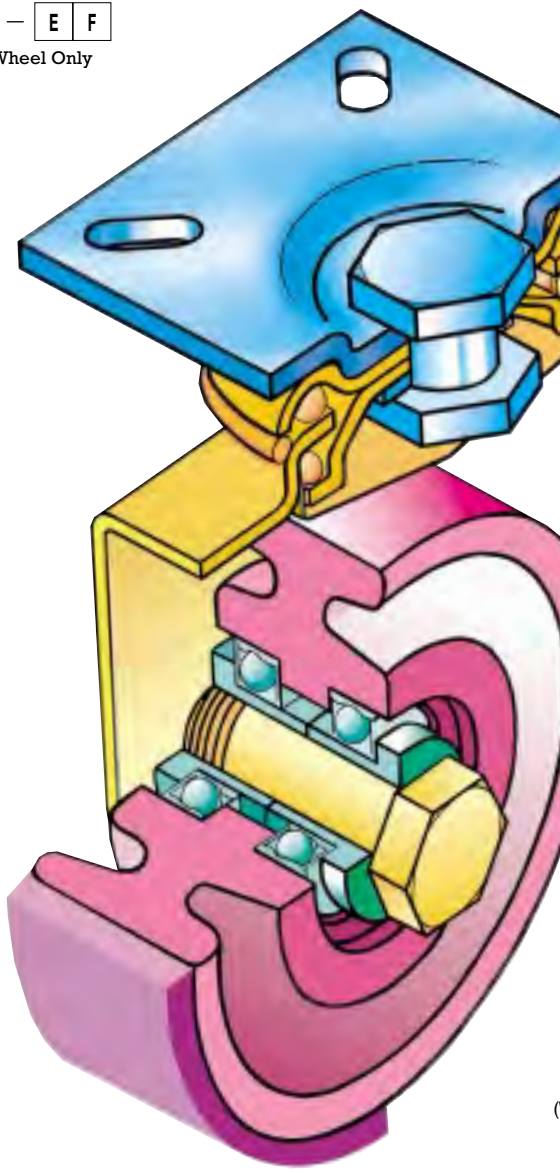
W* - B C - E F

W* Designates Wheel Only

B

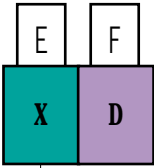
C

LOAD RANGE LBS./CASTER	SERIES DESIGNATION	WHEEL DIAMETER	PAGE	STANDARD TOP PLATE
75	E2 ETERNITY II	2"	18	NA
125	53 CARPETMASTER	3"	19	NA
75-125	20 SERIES EXAMPLES = 22-22.5-23-24-25	2"-2.5"-3"-4"-5"	20	#12
200-400	30 SERIES EXAMPLES = 32-32.5	2"-2.5"-3"-4"	22	#16
175-400	60 SERIES EXAMPLES = 62.5-63-63.5-64-65	2.5"-3"-3.5"-4"-5"	24	#16
300-600	70 SERIES EXAMPLES = 73-74-75-76	3"-4"-5"-6"	26	#31
400-1000	400 SERIES EXAMPLES = 403-404-405-406-408	3"-4"-5"-6"-8"	28	#31
1350-2200	700 SERIES EXAMPLES = 705-706-708-710	5"-6"-8"-10"	31	#6
1300-1800	800 SERIES EXAMPLES = 805-806-808-810	5"-6"-8"-10"	30	#8
1200-3500	900 SERIES EXAMPLES = 906-908-910-912	6"-8"-10"-12"	32	#6
2000-5000	5000 SERIES EXAMPLES = 5006-5008-5010-5012	6"-8"-10"-12"	33	#5000
1400-10000	5200 SERIES EXAMPLES = 5206-5208-5210-5212	6"-8"-10"-12"	34	#5200
300-2700	300/3000 PNEU EXAMPLES = 308-310-3016-3018 EXAMPLES = 3216-3218-3318	8"-10"-16"-18"	35	#6 #5200



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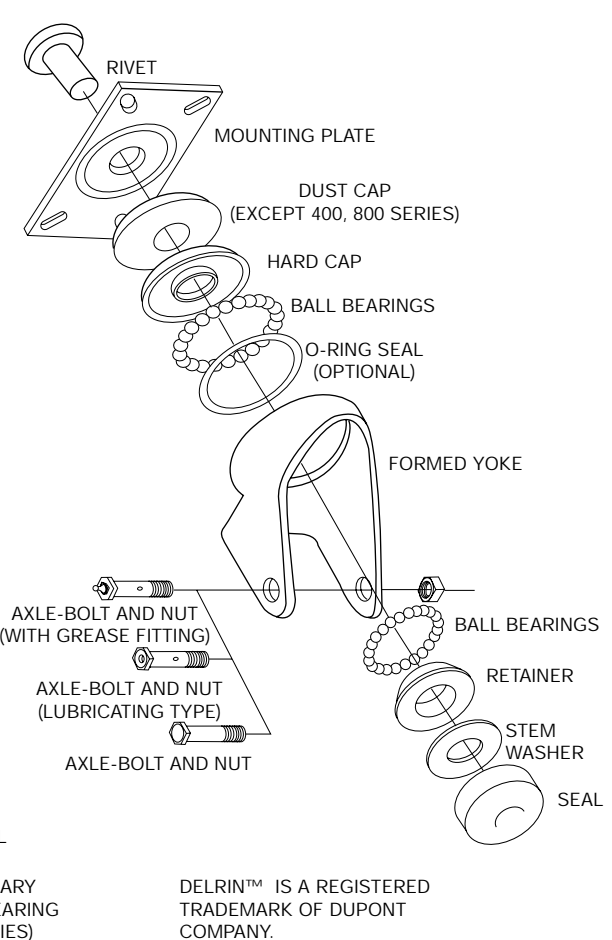
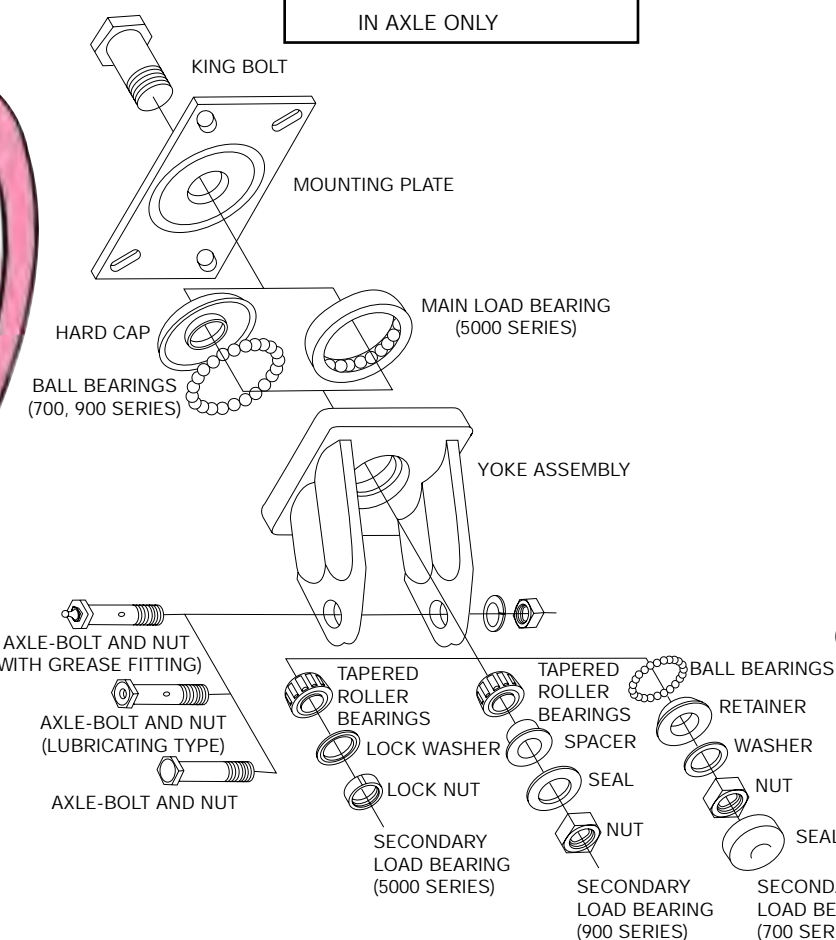
DARCOR CASTER MODEL NUMBER GUIDE



D OPTIONS	
SEE PAGE 9 FOR MORE INFORMATION	
R	RIGID CASTER
B	BRAKE
F2	TWO POSITION SWIVEL LOCK
F4	FOUR POSITION SWIVEL LOCK
A	COMBINATION BRAKE AND 4 POSITION SWIVEL LOCK
S	SEALED SWIVEL WITH GREASE FITTINGS IN SWIVEL AND AXLE.
G	GREASE FITTING IN AXLE ONLY

E BEARING TYPE	
SEE PAGE 10 FOR MORE INFORMATION	
X	BALL
T	ROLLER
P	PRECISION SEALED BALL BEARING
Y	TAPERED ROLLER
M	DELRIN
OMIT	PLAIN SLEEVE

F TREAD MATERIAL	
SEE PAGE 7 FOR MORE INFORMATION	
D	NEOPRENE
SR	SUPER ROLL NEOPRENE
SE	SOLID ELASTOMER
U	POLYURETHANE
CI	SEMI-STEEL
H	HARD RUBBER
K	SEMI-RESILIENT RUBBER
CV	V-GROOVE-SEMI-STEEL
N	INDUSTRIAL RUBBER
PN	PNEUMATIC



DELRIN™ IS A REGISTERED TRADEMARK OF DUPONT COMPANY.

SPECIALTY CASTERS: *SEE PAGES 36-47.



Darcor's ergonomic logo symbolizes work - efficient, worker - friendly casters. Darcor is the standard for ergonomically designed casters.

We are proud of the casters we manufacture. Visit our manufacturing facilities and you will see the evidence of that pride in the care and attention to detail focused on each caster – from the design stage, through production, to shipping and after-sale service.

To some, quality control is a marketing strategy; to us, it is a way of business life. That is why our comprehensive line of casters has won a worldwide reputation for reliability, longevity and, perhaps most importantly, usefulness.

We manufacture a wide variety of casters, ranging from the Carpet Master office chair caster to our heaviest casters rated to a load capacity of 60,000 lbs. In between, you'll find ... well, casters of almost any size or style you can imagine.

The reason for all these choices is not to fill catalogue pages. It is to ensure we can provide you with the bolt-hole pattern, the caster size and height, the wheel material that is perfectly useful for your needs.

And, if we can't deliver what you need from stock, we'll be happy to design and manufacture a specialty caster that delivers maximum usefulness. And we'll do it quickly, efficiently and economically. (We're flexible that way – your way!)

What sets us apart from other caster manufacturers is people. Sure, we have state-of-the-art design and manufacturing systems and processes. Certainly, our quality controls and strict adherence to technical specifications are second to none. But it is the caliber of our dedicated and versatile employees which has allowed Darcor to establish a standard of excellence that is far above the rest.

Personal Customer Service

Our customer service personnel are experienced professionals. They know casters and can match our products to your needs. If you have any questions about specifications, pricing, delivery information or any wheel or caster listed in this catalogue, just give our "problem solvers" a call. They'll be happy to get you moving the best possible way: on a Darcor caster.

Our Guarantee

Every Darcor product is warranted against defects in material and workmanship for a period of one year from the date of original purchase. Any product defective because of material or workmanship returned with the prior written approval of Darcor's Quality Control Department, within the warranty period, will be repaired or replaced, free of charge, non-inclusive of freight and installation, if delivered, transportation and shipping charged prepaid, to Darcor factory located at 7 Staffordshire Place, Toronto, Ontario M8W 1T1 or Darcor Caster C/O ABF Transport, 50 Flyder Ave., Tonawanda N.Y. 14150. This guarantee does not include any product that has been abused, misused, improperly installed, mishandled, not used for the purpose intended, used under severe or adverse conditions.



The laws of some states in the U.S. may limit or prohibit exclusion or limitation of written or implied warranties; therefore, any portion of this Limited Warranty held void shall be deemed severed from the balance.

Designs

Dimensions and designs are subject to change without notice.

Shipping Terms

Shipments F.O.B. Buffalo, New York

Shipments F.O.B. Los Angeles, California

Shipments F.O.B. Toronto, Ontario

Return Goods Policy

Return goods shipment requires prior authorization and a return goods number from Darcor.

A charge will be applied to cover the handling and restocking, providing goods are resaleable and do not require refurbishing. No cancellations after the start of production.

No specially manufactured casters may be returned.



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HOW TO SELECT THE PERFECT CASTER & WHEEL

Darcor offers you a wide variety of caster types and wheel options – and for good reason. Choosing the correct caster for the job and the work environment dramatically increases the life and performance of the caster – as well as enhancing its ergonomic benefits.

Here's how to select the perfect Darcor caster for your needs:

LOAD CAPACITY

This is your most important criterion for caster choice. In general, each caster should have the capacity to support one-third of the total load weight. That is because overloading, uneven floors and/or uneven load distribution may place a heavier burden on one or more casters.

To determine the required caster load capacity add the weight of the load and the weight of the cart, then divide by three.

MAXIMUM MOBILITY

The larger the wheel size (and swivel radius), the greater the mobility. The type of bearing selected will also further improve mobility and reduce rolling resistance.

Darcor's Neoprene, Super Roll Neoprene, Solid Elastomer, and Polyurethane offer maximum mobility in any application they are required for.

Your choice should be dictated by conditions in the work environment.

TREAD MATERIALS AND CASTER TYPES

Floor Conditions – Check for rough or uneven surfaces – joints, grates, potholes – oil, grease or chemicals, and note any carpeted areas.

Darcor Neoprene (D & SR) wheels are recommended for all types of floor conditions up to a load capacity of 270 kg per caster. For moderate to heavy loads, our Solid Elastomer (SE) wheels are an excellent choice. And for the heaviest loads, choose Polyurethane or Steel wheels.

Environmental Conditions - Check for dust, humidity and temperature extremes. Are the floors littered with debris or metal scraps?

Darcor Cart Washable™ Casters are ideal in areas with sprays or wash down requirements. The sealed swivels and rust-inhibiting finish add extra life. Sealed swivels are also a good idea where there is grinding action, lint or dust. They are also quiet – a consideration in hospitals.

APPLICATION CONSIDERATIONS

Check the speed of your operation. Are you using tow-line vehicles or Automatic Guided Vehicles (AGVs)? Most casters are rated for "walking speed". Higher speed applications decrease their load capacity and can increase heat build-up.

Darcor Solid Elastomer (SE) wheels are a perfect "high speed" choice. In continuous use, they don't build up heat, are easy to maneuver with less effort and, because of their exceptionally low rolling resistance, actually extend the "in-use" time for battery powered vehicles.

CONTENTS

HISTORY OF DARCOR.....	2
DARCOR CASTER SYSTEM GUIDE.....	3 - 4
HOW TO SELECT A CASTER.....	5
CONTENTS.....	5
THE INCREDIBLE ERGONOMIC WHEELS AND CASTERS FROM DARCOR	6 - 7
WHEEL MATERIALS AND SELECTION GUIDE.....	8 - 9
ACCESSORIES.....	9
BEARINGS AND AXLES.....	10
APPLICATIONS	11 - 12
DARCOR STATEMENT.....	13
CORPORATE PROFILE.....	14-17
OPTIONAL TOP PLATE	18
GLOSSARY OF TERMS.....	19
OFFICE CHAIR CASTERS.....	20 - 21
20 SERIES.....	22 - 23
30 SERIES	24
40 SERIES	25
60 SERIES.....	26 - 27
70 SERIES.....	28 - 29
400 SERIES.....	30 - 31
800 SERIES.....	32 - 33
H700 SERIES	34
900 SERIES	35
5000 SERIES.....	36
5200 SERIES.....	37
SPRING LOADED CASTERS.....	38 - 39
SPECIAL APPLICATION CASTERS	40
HOSPITAL CASTERS	41 - 43
NEOPRENE WHEELS.....	44 - 45
SOLID ELASTOMER	46
DARCOR URETHANE WHEELS.....	47
SEMI-STEEL WHEELS.....	48
SOLID ELASTOMER GUIDE.....	49-52
SERVICE AND GUARANTEE.....	53



Darcor's ergonomic logo symbolizes work - efficient, worker - friendly casters. Darcor is the standard for ergonomically designed casters.

The Incredible Ergonomic casters from Darcor



**DARCOR CASTERS
ARE ENGINEERED
AND MANUFACTURED
TO STRINGENT
STANDARDS FOR
STRENGTH,
RELIABILITY AND
EXTENDED LIFE.**

TOUGH...

Tough conditions are a way of life for Darcor Datryl™ 'SE' and Neoprene 'D' and 'SR' Super Roll Wheels and Casters. These exceptional casters are designed to survive the harshest environments and operating conditions. They have proved their worth in thousands of miles of use, over years of service in applications worldwide. Darcor wheels stay in shape, protect floors and always swivel and roll freely. They can greatly **reduce back strain.**

SMOOTH...

Our sealed precision ball bearings and highly resilient, durable tread materials provide quiet, silky smooth mobility with very long life. It takes so little force to move an 'SE' wheel that one person can easily manoeuvre a 1200 kg load. The silent and smooth rolling 'D' and 'SR' wheels have an extraordinary ability to **roll over obstacles** and floor litter (**glass, metal cuttings, plastic resin pellets**) without stopping or jarring the cart or embedding in the tread. Darcor Casters are the perfect problem solvers.

Wheel Performance Profile

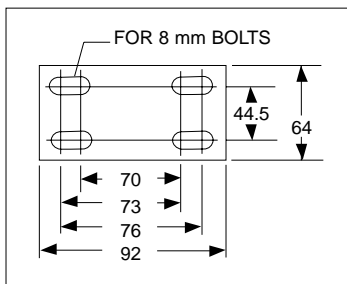
	PSE	PD	XD	XSR
* very easy to push	Y	Y	Y	Y
* minimal wear in extended use	Y	Y	Y	Y
* very quiet	Y	Y	Y	Y
* shock absorbing	Y	Y	Y	Y
* low heat build up	Y	Y	Y	Y
* resists abrasion	Y	Y	Y	Y
* resist harsh chemicals	Y	Y	Y	Y
* high speed operation	Y	Y	Y	Y
* non marking non staining	Y	Y	Y	Y
* oil resistance	Y	Y	Y	Y

DARCOR ERGONOMIC CASTERS

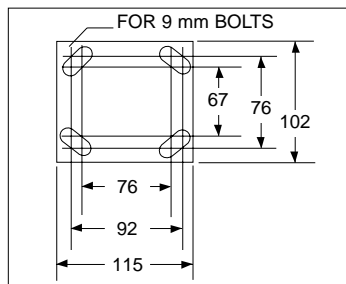
Typical 31- 406 -PSE
 Model ! ! !
 Code ! ! Bearing Type & Wheel Material
 ! Caster Series & Wheel Diameter
 Type of Mounting Plate or Stem Size and Type
 Use "W-" for Wheels only e.g. (W-406-PSE)

Note: Mounting Plates shown are standard.
 Other plates, stems and CARTWASHABLE™ finish are available.

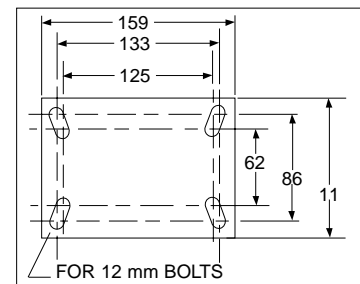
WHEEL DIAMETER mm	TREAD WIDTH mm	CARRYING CAPACITY kg	SWIVEL MODEL NUMBER	FIXED MODEL NUMBER	SWIVEL RADIUS mm	OVERALL HEIGHT mm
XD AND PD-SILENT-SHOCK RESISTANT-EASY ROLLING-ALL TERRAIN						
75	35	90	16-63-XD	16-63R-XD	70	111
100	35	100	16-64-XD	16-64R-XD	83	137
100	51	230	31-404-PD	31-404R-PD	93	143
125	35	110	16-65-XD	16-65R-XD	102	162
125	51	250	31-405-PD	31-405R-PD	108	170
150	41	160	31-76-XD	31-76R-XD	124	192
150	51	270	31-406-PD	31-406R-PD	118	195
200	51	270	31-408-PD	31-408R-PD	147	248
XSR-VERY QUIET-GOOD SHOCK RESISTANCE-EASY ROLLING AND SWIVELLING						
63	35	80	16-62.5-XSR	16-62.5R-XSR	64	97
88	35	100	16-63.5-XSR	16-63.5R-XSR	77	121
100	35	125	16-64-XSR	16-64R-XSR	83	137
125	35	150	16-65-XSR	16-65R-XSR	102	162
150	38	170	31-76-XSR	31-76R-XSR	124	192
PSE AND XSE-LOWEST ROLLING EFFORT-GOOD SHOCK RESISTANCE-QUIET						
63	32	135	16-62.5-XSE	16-62.5R-XSE	64	97
75	35	230	31-73-PSE	31-73R-PSE	77	117
75	51	400	31-403-PSE	31-403R-PSE	83	121
88	32	160	16-63.5-XSE	16-63.5R-XSE	77	121
100	35	270	31-74-PSE	31-74R-PSE	89	141
100	51	400	31-404-PSE	31-404R-PSE	93	143
125	35	270	31-75-PSE	31-75R-PSE	102	168
125	51	450	31-405-PSE	31-405R-PSE	108	170
125	64	610	8-805-PSE	8-805R-PSE	118	181
150	35	270	31-76-PSE	31-76R-PSE	124	192
150	51	450	31-406-PSE	31-406R-PSE	118	195
150	64	680	8-806-PSE	8-806R-PSE	134	206
200	51	450	31-408-PSE	31-408R-PSE	147	248
200	64	750	8-808-PSE	8-808R-PSE	159	260
250	64	820	8-810-PSE	8-810R-PSE	185	311



SWIVEL NO. 16 TOP PLATE



NO. 31 TOP PLATE



NO. 8 TOP PLATE

CARTWASHABLE™ and DATRYL™ are registered trademarks of Darcor Casters

WHEEL MATERIALS



D

W-76-XD

NEOPRENE
TREAD SYMBOL "D"
DUROMETER - SHORE 62 "A"

Superior for all floor surfaces and ergonomically designed for excellent mobility and resistance to wear. These quiet and easy rolling wheels are very shock absorbing, non-marking and will reject floor debris, roll over screws, metal or glass fragments, resin pellets and are non-staining. Darcor "VQ" very quiet ball bearings are standard in the 20 through 70 series. Precision ball bearings "P" are recommended in the 400 series. Sizes available 50 mm - 200 mm.



SE

W-406-PSE

SOLID ELASTOMER
TREAD SYMBOL "SE"
DUROMETER - SHORE 55 "D"

The solid Elastomer Wheel has set a new standard of performance for all applications where exceptional mobility is required. Ergonomically designed for medium loads (135 to 820 kg per wheel) the "SE" wheel is recommended for continuous use and "tow lines". It is also tolerant of a wide range of chemicals and is quiet, durable, shock-absorbing. For the ultimate mobility precision "P" bearings are recommended. The broad temperature range encourages use in freezers where ordinary wheels will seize and become immovable. The "SE" wheel is a real "BACK SAVER".



SR

W-76-XSR

NEOPRENE
TREAD SYMBOL "SR"
DUROMETER - SHORE 62 "A"

These wheels offer the same high quality as "D" wheels but with a low profile tread for easier swivelling and mobility.



U

W-406-TU

DARCOR URETHANE
TREAD SAYMBOL "U"
DUROMETER 95 "A"

Recommended for heavy loads and rough floors. Shock-absorbing. When fitted with tapered bearings, improves life and mobility.

WHEEL SELECTION GUIDE

FLOOR SURFACE

WHEEL MATERIAL	CARPET	LINOLEUM	WOOD	QUARRY TILE	CEMENT	ASPHALT	TERRAZZO	STEEL	ROUGH AND UNEVEN FLOORS
"D" NEOPRENE	X	X	X	X	X	X	X	X	X
"SR" SUPER ROLL NEOPRENE	X	X	X	X	X	X	X	X	X
"SE" SOLID ELASTOMER	X	X	X		X		X	X	
"U" DARCOR URETHANE		X	X	X	X	X	X	X	X
"CT" SEMI - STEEL					X			X	

OPERATING CONDITIONS

WHEEL MATERIAL	TEMPERATURE RANGE	MOBILITY	DURABILITY	FLOOR PROTECTION	CHEMICAL TOLERANCE	GLASS OR METAL CHIPS	WATER	STEAM
"D" NEOPRENE	-29 TO 150°C	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
"SR" SUPER ROLL NEOPRENE	-29 TO 150°C	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
"SE" SOLID ELASTOMER	-50 TO 110° C	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	FAIR	EXCELLENT	POOR
"U" DARCOR URETHANE	-40 TO 95°C	EXCELLENT	EXCELLENT	VERY GOOD	VERY GOOD	GOOD	GOOD	POOR
"CT" SEMI - STEEL	-40 TO 260°C	EXCELLENT	GOOD	POOR	GOOD	GOOD	POOR	POOR

SEE WHEEL SECTION, PAGE 44-56 for complete descriptions and sizes

ACCESSORIES

BRAKES - SWIVEL LOCKS - SWIVEL SEALS - THREAD GUARDS



12-24B-XD

20 SERIES
SIDE BRAKE. Hardened spring. Steel brake pad for optimum braking on light loads.



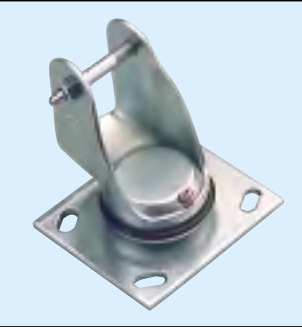
16-65B-XD

60-70 SERIES
PIT BULL BRAKE. Specially designed metal pad riveted to the brake spring for use with neoprene wheels.



6-908B-TU

H700 - 900 SERIES
DISC BRAKE. Automotive brake pad material offers superior grip for heavy loads.



SWIVEL SEALS
OPTIONAL 60-70 SERIES
STANDARD 400-800 SERIES. Protects swivel from dirt, moisture and foreign material.



31-75B-PSE

60-70 SERIES
Wheel brake rubber pad riveted to spring steel engages against face of wheel.



31-406B-TD

400-800 SERIES
Cam action brake and swivel lock. Thick spring steel pad grips both the wheel and swivel.



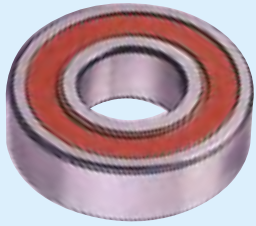
31-76F-XD

SWIVEL LOCKS
Available from 40 series up. Foot operated for easy activation.



THREAD GUARDS
Standard on carpet masters through 400 series wheels. Protects against thread wrap up in axles and bearings.

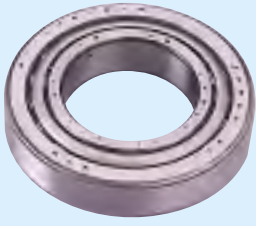
BEARINGS



PRECISION SEALED BALL BEARING
DESIGNATION "P"
 Offers least rolling resistance. Never requires lubrication. For medium loads, side thrust and high speeds.



MACHINED V. Q. (VERY QUIET) BALL BEARING
DESIGNATION "X"
 Balls roll in a machined steel, case hardened raceway for least resistance. Slots allow grease into raceway.



TAPERED ROLLER BEARING
DESIGNATION "Y"
 For heavy loads, side thrust and high speeds.

ROLLER BEARING SPLIT SLEEVE OR DRAWN CUP
DESIGNATION "T"
 Rollers turn on a hardened steel spanner bushing.



DELRIN™ BEARING
DESIGNATION "M"
 A strong bearing material that resists corrosion. Ideal in wet applications. Requires lubrication.

SLEEVE BEARING (BUSHING)
 No designation.
 Case hardened steel.
 An inexpensive bearing for lighter loads.

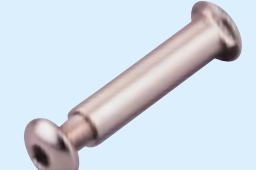


AXLES



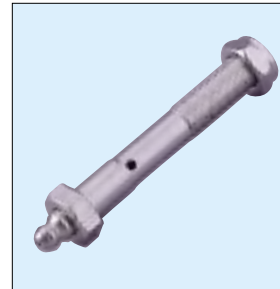
PLAIN AXLE
 Standard in 20 series and all casters with sealed precision bearings. Also heavy duty series casters with grease fittings in wheel.

SELF TAPPING ALLEN HEAD AXLE.
 Used with e2 and Carpet Master. Eliminates unsightly nut. Stops wear on shoes and nylon runs.



CROSS DRILLED AXLE
 Standard on 60 and 70 series casters. Axle is drilled through center. Allows grease to flow into the bearing.

GREASE FITTING IN AXLE
 Standard on 400 series optional 60 and 70 series. Cross drilled axle with zerk fitting in end. Fits standard grease guns.



* DELRIN is a registered trademark of the Dupont Co.

APPLICATIONS



At Darcor, we understand that every workplace is different, yet many share certain common requirements. We have set the pace of innovation by establishing industry application standards on four continents.

shock &
vibration



materials
handling



laundry



office
applications



medical
diagnostic



textile
applications



In all of these application areas, Darcor remains successful by producing casters that feature ergonomic design, value, quality, flexibility, durability and performance.

...designed products that blend ergonomic principles and advanced materials to improve bottom-line results and workplace conditions. As a result, we have had more customers than ever before. • Revolution? They have found it. • The most common casters in the workplace. Among our revolutionary innovations are the Neoprene wheel and the Solid Elastomer wheel. Check the specifications for these remarkable wheels and you will be amazed at their versatility and performance. • When you choose a Darcor caster, you can rest easy, secure in the knowledge you have chosen the best. • We design to achieve a perfect balance between need and caster. We engineer for strength, reliability and extended life. And we manufacture our casters under rigid controls that guarantee maximum long-life performance. • To ensure their integrity, we subject our casters to destruction tests under unbelievably hostile conditions. The trouble is, our casters are so good they sometimes wear out the test machinery before they wear out themselves. • So, while Darcor casters may have a higher initial price than others, they are the lowest cost casters you can buy. • Remember our motto: "We design to last." • In this catalogue, you will find a complete range of the casters and wheels most frequently used by organizations like yours. You will also find something else: Casters and wheels which represent breakthrough advances that will markedly improve the function of your operations over the long term. • Research and development is one of our strengths. It allows us to actually anticipate the need for new types of casters in today's rapidly evolving manufacturing environment. We are able to respond with uniquely

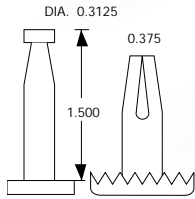
designed products that blend ergonomic principles and advanced materials to improve bottom-line results and workplace conditions. As a result, we have had more customers than ever before. • Revolution? They have found it. • The most common casters in the workplace. Among our revolutionary innovations are the Neoprene wheel and the Solid Elastomer wheel. Check the specifications for these remarkable wheels and you will be amazed at their versatility and performance. • When you choose a Darcor caster, you can rest easy, secure in the knowledge you have chosen the best. • We design to achieve a perfect balance between need and caster. We engineer for strength, reliability and extended life. And we manufacture our casters under rigid controls that guarantee maximum long-life performance. • To ensure their integrity, we subject our casters to destruction tests under unbelievably hostile conditions. The trouble is, our casters are so good they sometimes wear out the test machinery before they wear out themselves. • So, while Darcor casters may have a higher initial price than others, they are the lowest cost casters you can buy. • Remember our motto: "We design to last."



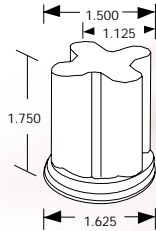
STEMS & OPTIONAL FITTINGS

MODEL #	DIAMETER X LENGTH	AVAILABLE ON CASTER SERIES					
		E2	53	20	30	60	70
CS125	1-1/4 square socket					60	
CS150	1-1/2 square socket					60	
CS150	1-5/8 round socket					60	
PIANO SOCKET	Use with OH Stem 1/2" x 1-1/8"			20	30	60	
JA	7/16" x 1-7/8"	E2	53	20			
LA	5/16" x 1" NC	E2	53	20			
LB	5/16" x 1-1/2" NC	E2	53	20			
LD	3-8" x 3/4" NC		53	20			
LE	3/8" x 1-1/4" NC		53	20			
LG	1/2" x 5/8" NC		53	20	30	60	
LH	1/2" x 1-1/2" NC		53	20	30	60	70
LK	1/2" x 2" NC		53	20	30	60	
LN	5/8 x 2" NC		53	20	30	60	70
LR	3/4" x 2" NC		53	20	30	60	70
OA	3/8" x 1"	E2	53	20			
OB	7/16" x 13/16"	E2	53	20			
OC	7/16" x 1-1/4"	E2	53	20			
OD	7/16" x 1-3/4"	E2	53	20			
OE	7/16" x 2"	E2	53	20			
OJ	7/16" x 1-1/2"				30	60	
OH	1/2" x 1-1/8"		53	20	30	60	
OM	9/16" x 4-1/2"		53	20			
OU	5/8" x 1-5/8"		53	20	30	60	70
OY	3/4" x 1-5/8"		53	20	30	60	70
OCC	13/16" x 2"				30	60	70
OEE	0.862" x 1-1/2"		53	20	30	60	
OGG	7/8" x 1-7/8"		53	20			
OHH	7/8" x 2"				30	60	70
OKK	1" x 1-5/8"		53	20	30	60	70
OKW	3/4" x 1-5/8" w/ .188 key				30	60	70
OXX	1.480 x 2-1/2					60	70
PBE	1/2" Pipe bushing		53	20	30	60	
PBF	3/4" Pipe bushing		53	20	30	60	70
PBG	1" Pipe bushing			20	30	60	70
PBH	1-1/4" Pipe bushing				30	60	
PCE	1/2" Pipe cap		53	20	30	60	
PCF	3/4" Pipe cap		53	20	30	60	70
PCG	1" Pipe cap				30	60	70
PCH	1-1/4" Pipe cap				30	60	
SA	Square 3/4" x 2"		53	20	30	60	
SB	Square 7/8" x 2-1/2"				30	60	70
SC	Square 7/8" x 2-1/2"			20	30	60	70
WSA	5/16" x 1-1/2" #3 Socket	E2					

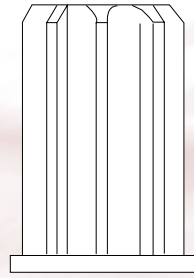
PLASTIC SOCKETS USE WITH STEMS "OC" 7/16" X 1-1/4" "OD" 7/16" X 1-3/4"



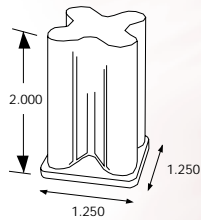
STEM FOR WOOD LEGS ETERNITY 2 ONLY PREFIX NUMBER "WSA" WITH #3 SOCKET



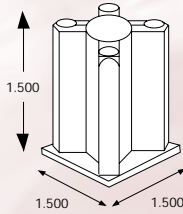
CS 158 SOCKET FITS 1-5/8" 16 GAUGE ROUND TUBING USE WITH "OU" STEM 5/8" x 1-5/8"



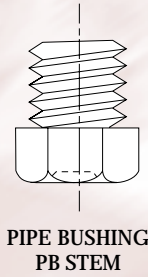
MODEL NUMBER	SIZE	FITS RD.I.D TUBE	FITS SQ.I.D. TUBE
RA	5/8"	5/8"	13/32"
RB	11/16"	11/16"	21/32"
RC	3/4"	3/4"	23/32"
RD	25/32"	25/32"	47/64"
RE	13/16"	13/16"	3/4"
RF	27/32"	27/32"	25/32"
RG	7/8"	7/8"	27/32"
RH	15/16"	15/16"	29/32"
RI	1"	1"	15/16"
RJ	1-1/16"	1-1/16"	1"
RK	1-1/8"	1-1/8"	1-3/64"
RL	1-3/16"	1-3/16"	1-7/64"



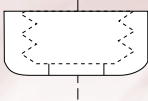
CS 125 SOCKET FITS 1-1/4" 14 GAUGE SQUARE TUBING SIZE WITH "OU" STEM 5/8" x 1-5/8"



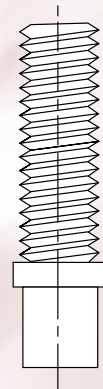
CS 150 SOCKET FITS 1-1/2" 18 GAUGE SQUARE TUBING USE WITH "OU" STEM 5/8" X 1-5/8"



PIPE BUSHING PB STEM



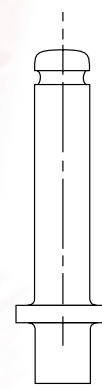
PIPE CAP PC STEM



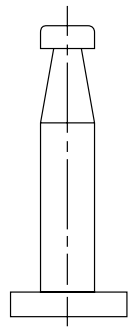
L SERIES



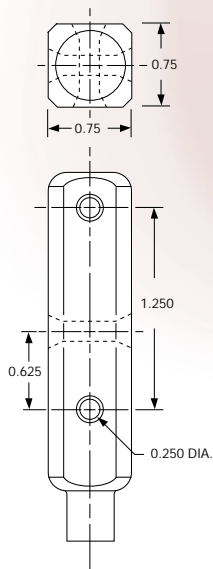
JA STEM



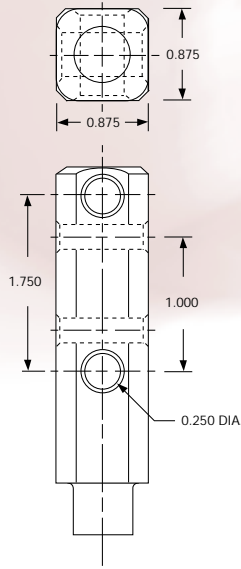
O SERIES



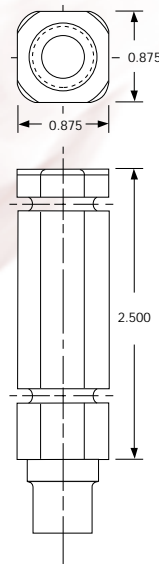
WSA STEM



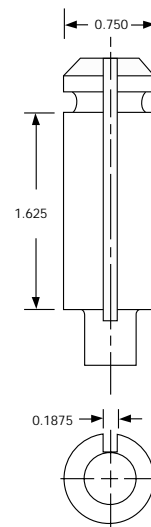
SA STEM



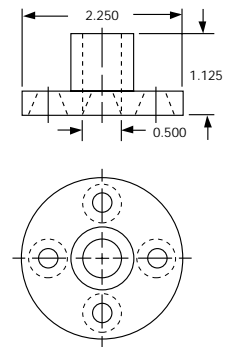
SB STEM



SC STEM



OKW STEM



PIANO SOCKET

TOP PLATES - STANDARD AND OPTIONAL

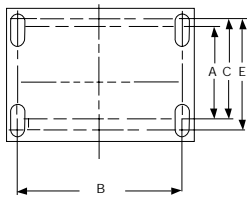
Over the years, Darcor has manufactured many different sizes of top plates to eliminate problems when changing casters. These top plates are shown as options. Darcor can manufacture other top plates as required, provided the bolt hole centers do not interfere with the swivel raceway. Their cost is based on size and quantity.

TOP PLATE NUMBER	OVERALL SIZE		BOLT HOLE CENTERS (SEE DIAGRAMS)			MOUNTING BOLT SIZE	STANDARD ON SERIES	* OPTIONAL ON SERIES
	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH				LENGTH	LENGTH
	W x L		A - B		C - D		E	
3 (Swivel only)	1-3/8 x 1-7/8		13/16 x 1-3/8				3/16	E2
3	4 x 4		3 x 3				3/8 - 9/16	30-60-70-400
4 (Swivel only)	1-1/4 x 2-3/8		13/16 x 1-7/8				3/16	53-20
4	4 x 7		3 x 6				3/8	400
5 (Swivel only)	1-7/8 x 2-5/8		1-1/4 x 2				1/4	53-20
6 (Slotted)	5 x 7		3-3/8 x 5-1/4		4-1/8 x 6-1/8		1/2	700-900 400-800
7 (Swivel only)	2 x 2-1/8		1-1/2 x 1-1/2				1/4	53-20
8 (Slotted)	4-1/2 x 6-1/4		2-7/16 x 4-15/16		3-3/8 x 5-1/4		1/2	800 400
9	3-3/8 x 4-3/8		2-3/8 x 3-3/8				3/8 - 9/16	30-60-70-400
11 Swivel only	1-3/4 x 3		1 x 2-1/4				1/4	53-20
12 (Swivel-elongated holes)	2-1/2 x 3-5/8		1-3/4 x 2-3/4		x 2-7/8		3	5/16 20 53
12 (Rigid-elongated holes)	2-3/4 x 4		1-3/4 x 2-3/4		x 2-7/8		3	5/16 20
14	4 x 5		3 x 4				3/8	70-400
16 (Swivel-elongated holes)	2-1/2 x 3-5/8		1-3/4 x 2-3/4		x 2-7/8		3	5/16 30-60 70 Swivel & Rigid
16 (Rigid-elongated holes)	2-7/8 x 4-1/8		1-3/4 x 2-3/4		x 2-7/8		3	5/16 30-60
19 (Swivel only)	3-3/8 x 4-3/8		2-3/8 x 3-3/8				3/8	70 Swivel
22	3-7/8 x 6-1/4		2-7/16 x 4-7/8				3/8	400
31 (Slotted)	4 x 4-1/2		2-5/8 x 3		3 x 3-5/8		3/8	70-400 30-60
5-5000	6 x 10		4-3/4 x 8-3/4				1/2	5000
5-5200	6 x 12		4-1/2 x 10-1/2				1/2	5200
IS 2 (Slotted)	85mm x 100mm		45mm x 75mm		60mm x 80mm		9mm	30-60-70
IS 3 (Elongated)	110mm x 140mm		73mm x 105mm		80mm x		87mm 11mm	400 30-60-70

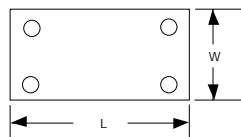
* All top plates available as options on other series are subject to special pricing.

DIMENSIONS

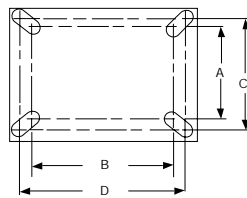
IS ELONGATED



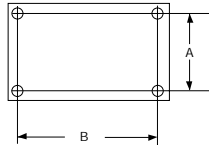
OVERALL



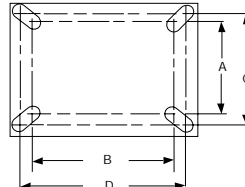
IS SLOTTED



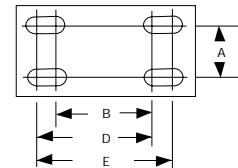
BOLT HOLE CENTERS



SLOTTED



ELONGATED



TUBING AND PIPE SIZES

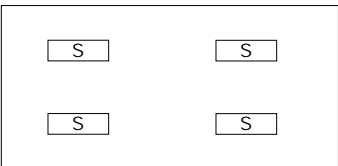
Due to the large quantity of tubing sizes available, we have endeavoured over the years to manufacture stems to fit most standard sizes of tubing. We do not feel that expanding stems are the proper solution to these problems, as they have a tendency to wear and become loose. Our stems are equipped with a grip ring made from hardened spring steel to eliminate wear. Most of these can be installed at no extra charge where they apply to the series of caster. Please check optional fitting pages, for available sizes.

STANDARD IRON PIPE SIZES:

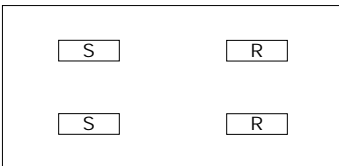
TUBING SIZE	"O" STEM SIZE REQUIRED
1" 16 GA Square Tubing	7/8 x 2
1" 16 GA Round Tubing	.862 x 1-1/2
1" 18 GA Round Tubing	.895 x 1-1/2
1-5/8" 16 GA Round Tubing	1.480 x 2-1/2
1-5/8" 16 GA Round Tubing	CS 158 Socket (5/8 x 1-5/8 Stem)
1-1/4" 14 GA Square Tubing	CS 125 Socket (5/8 x 1-5/8 Stem)
1-1/2" 18 GA Square Tubing	CS 150 Socket (5/8 x 1-5/8 Stem)

PIPE SIZE	INSIDE DIAMETER (DECIMAL) (FRACTION)		OUTSIDE DIAMETER
3/8"	.493	31/64"	.675
1/2"	.622	5/8"	.840
3/4"	.824	53/64"	1.050
1"	1.049	1-3/64"	1.315
1-1/4"	1.380	1-3/8"	1.660
1-1/2"	1.610	1-39/64"	1.900

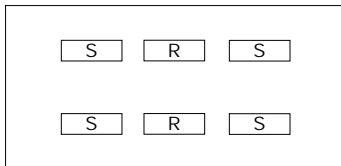
CASTER MOUNTING CONFIGURATIONS



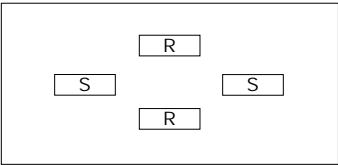
Four Swivel



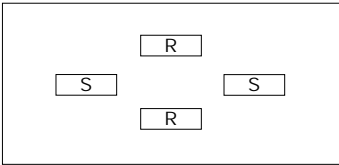
Two Swivel Two Rigid



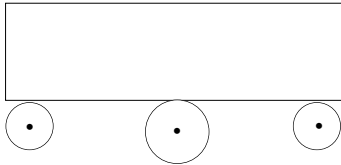
Four Swivel Two Rigid



Diamond Mounting



Tilt Mount



Tilt Mount Side View

OFFICE CHAIR CASTERS

Office Chair Casters by Darcor have earned a distinguished reputation for quality, based on years of consistently high performance and durability.

Their product stature is attributed to Darcor's dedication to meticulous research, design, engineering and testing. Widely used on office chairs, they are equally useful for many institutional applications including IV poles, overbed tables, nightstands and many other uses.

Darcor's innovative designs not only reduce wear and tear on the mechanism of chairs but increase the user's physical efficiency and comfort by reducing the strain of moving the chair during daily chores at workstations. Darcor's designs eliminate the frustrating experience of shoving and ploughing office chairs through carpets and over warped plastic mats.

The Carpet Master™ for carpeted floors, and the Eternity II for tile and linoleum floors - are synonymous with comfort. They have the qualities desired in a superior product, such as reliability, durability and unparalleled ease of movement. Both the Carpet Master™ and Eternity II incorporate the legendary Darcor double ball bearing swivel design, with two ball bearing races of equal diameter.

This ingenious design eliminates any possibility of binding, sticking, or sliding.

THE CARPET MASTER™



OC-53-XD

The Carpet Master rolls and swivels effortlessly, eliminating the need for unsightly and hazardous plastic mats. The silent, donut neoprene wheel with its soft resilient texture, rolls smoothly and quietly on all floor surfaces from carpet to quarry tile. The large swivel off-set and soft wheel reduces the stress on carpet fibers thus greatly extending carpet life. Carpet Master's are available in standard chrome and black matte finish. Also available with bright brass and brushed brass finish.

FEATURES

- 5/16" Axle
- 7/16" Rivet
- Double row ball bearing swivel, both raceways equal diameter. Ball bearings standard in wheel.
- Specially designed removable axle eliminates unsightly nut
- All swivel parts are case hardened
- Thread guards standard

ETERNITY II

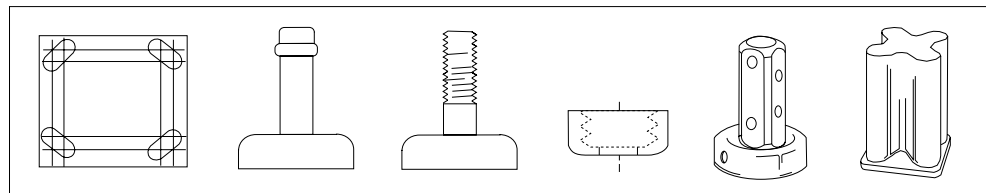


OC-E2-XD

The Eternity II is recommended for all types of hard floors. The neoprene wheel will not mark or stain tile and has a remarkable inter-floor capability. Darcor casters are available with optional fittings, including top plates, stems and sockets. Eternity II has a standard chrome or black matte finish and is also available with a bright brass finish.

FEATURES

- 5/16" Axle
- 11/32" Rivet
- Double row ball bearing swivel, both raceways equal diameter. Ball bearings standard in wheel.
- Specially designed removable axle eliminates unsightly nut
- All swivel parts are case hardened



OPTIONAL TOP PLATES AND STEMS ARE AVAILABLE. SEE PAGES 14, 15, 16.

OFFICE CHAIR CASTERS

THE "CARPET MASTER"

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP. /LBS	BEARING TYPE	FINISH	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - ERGONOMICALLY DESIGNED FOR EASY ROLLING							
3"	1"	100	BALL	CHROME	53-XD	3-1/8"	3-15/16"
3"	1"	100	BALL	BLACK MATTE	BM53-XD	3-1/8"	3-15/16"
3"	1"	100	BALL	BRUSHED BRASS	BR53-XD	3-1/8"	3-15/16"
3"	1"	100	BALL	ANTIQUE BRONZE	AB53-XD	3-1/8"	3-15/16"
HARD RUBBER - FOR DEEP PILE PLUSH OR SHAG CARPET							
3"	1"	125	BALL	CHROME	53-XH	3-1/8"	3-15/16"
3"	1"	125	BALL	BLACK MATTE	BM53-XH	3-1/8"	3-15/16"
3"	1"	125	BALL	BRUSHED BRASS	BR53-XH	3-1/8"	3-15/16"
3"	1"	125	BALL	ANTIQUE BRONZE	AB53-XH	3-1/8"	3-15/16"

THE "ETERNITY II"

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP. /LBS	BEARING TYPE	FINISH	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - ERGONOMICALLY DESIGNED FOR EASY ROLLING							
2"	1"	75	BALL	CHROME	E2-XD	2"	2-3/4"
2"	1"	75	SLEEVE	CHROME	E2-D	2"	2-3/4"
2"	1"	75	BALL	BLACK MATTE	BME2-XD	2"	2-3/4"
2"	1"	75	SLEEVE	BLACK MATTE	BME2-D	2"	2-3/4"
2"	1"	75	BALL	BRIGHT BRASS	BBE2-XD	2"	2-3/4"
2"	1"	75	SLEEVE	BRIGHT BRASS	BBE2-D	2"	2-3/4"
HARD RUBBER							
2"	1"	75	BALL	CHROME	E2-XH	2"	2-3/4"
2"	1"	75	SLEEVE	CHROME	E2-H	2"	2-3/4"
2"	1"	75	BALL	BLACK MATTE	BME2-XH	2"	2-3/4"
2"	1"	75	SLEEVE	BLACK MATTE	BME2-H	2"	2-3/4"
2"	1"	75	BALL	BRIGHT BRASS	BBE2-XH	2"	2-3/4"
2"	1"	75	SLEEVE	BRIGHT BRASS	BBE2-H	2"	2-3/4"



12-24-XD

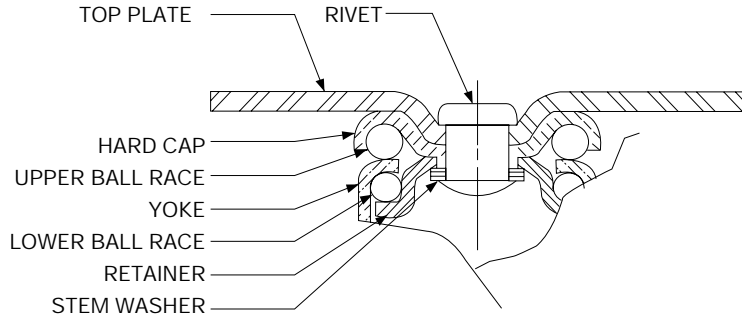


12-24R-XD



12-24B-XD

FEATURES

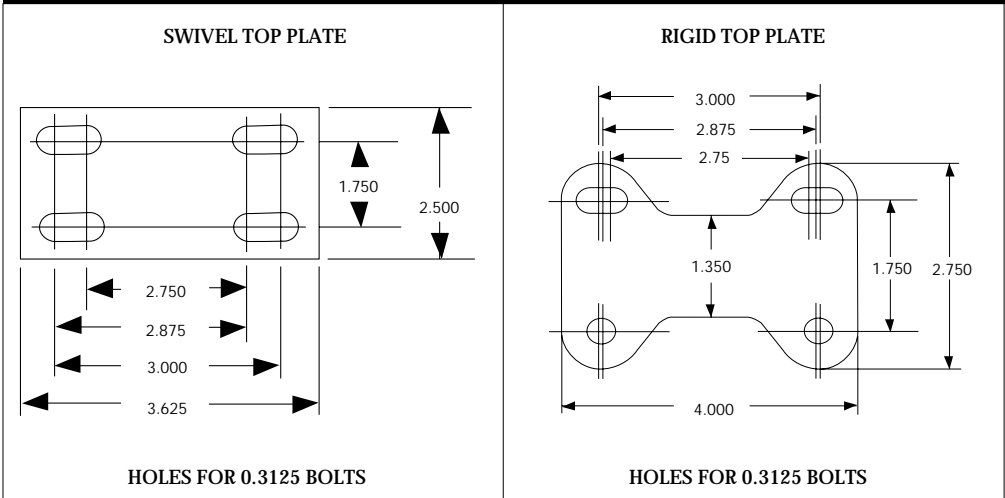


- 5/16" Axle
- 7/16" Rivet
- Double row ball bearing swivel. Both raceways equal diameter.
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C
- Thread guards standard on sizes larger than 2"

OPTIONS

- Brakes available on 3" and 4" models. Add letter "B".

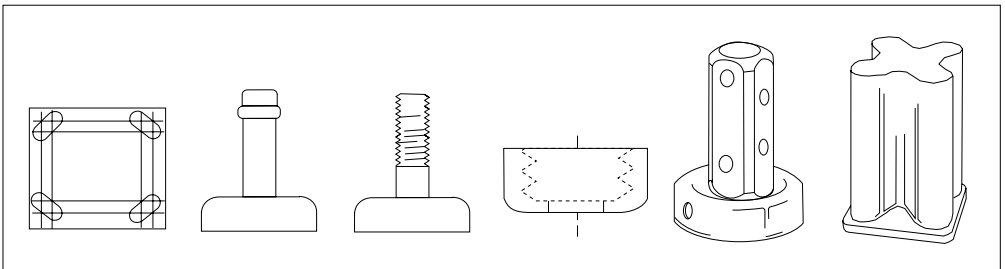
INSTALLATIONS



HOLES FOR 0.3125 BOLTS

HOLES FOR 0.3125 BOLTS

NO. 12 TOP PLATE (STANDARD ON 20 SERIES)



OPTIONAL TOP PLATES AND STEMS, PAGES 14, 15, 16.

20 SERIES

CAPACITY: 75 - 125 LBS PER CASTER

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - SOFT, NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
2"	1"	125	BALL	12-22-XD	12-22R-XD	2"	3-1/8"
2"	1"	75	SLEEVE	12-22-D	12-22R-D	2"	3-1/8"
3"	1"	125	BALL	12-23-XD	12-23R-XD	3"	4-1/4"
3"	1"	75	SLEEVE	12-23-D	12-23R-D	3"	4-1/4"
4"	1"	125	BALL	12-24-XD	12-24R-XD	3-3/8"	5-1/4"
4"	1"	75	SLEEVE	12-24-D	12-24R-D	3-3/16"	5-1/4"
5"	1"	125	BALL	12-25-XD	12-25R-XD	3-7/8"	6-1/4"
5"	1"	75	SLEEVE	12-25-D	12-25R-D	3-7/8"	6-1/4"
NEOPRENE SUPER ROLL - SOFT LOW PROFILE TREAD FOR EXTREMELY EASY ROLLING AND SWIVELING - ERGO*							
2-1/2"	1"	125	BALL	12-22.5-XSR	12-22.5R-XSR	2-1/8"	3-5/8"
2-1/2"	1"	75	SLEEVE	12-22.5-SR	12-22.5R-SR	2-1/8"	3-5/8"
SEMI-STEEL - CROWNED SEMI-STEEL CASTING OF A CLOSE-GRAINED CAST IRON							
2"	1"	100	SLEEVE	12-22-CI	12-22R-CI	2"	3-1/8"
2-1/2"	1"	125	SLEEVE	12-22.5-CI	12-22.5R-CI	2-1/8"	3-5/8"
RUBBER - SEMI-RESILIENT RUBBER MATERIAL							
2"	1"	75	SLEEVE	12-22-K	12-22R-K	2"	3-1/8"
2-1/2"	1"	75	SLEEVE	12-22.5-K	12-22.5R-K	2-1/8"	3-5/8"
3"	1"	75	SLEEVE	12-23-K	12-23R-K	3"	4-1/4"
4"	1"	75	SLEEVE	12-24-K	12-24R-K	3-3/8"	5-1/4"
HARD RUBBER - HARD SYNTHETIC RUBBER MATERIAL NOT AFFECTED BY OIL OR GREASE							
2"	1"	100	BALL	12-22-XH	12-22R-XH	2"	3-1/8"
2"	1"	100	SLEEVE	12-22-H	12-22R-H	2"	3-1/8"
2-1/2"	1"	125	SLEEVE	12-22.5-H	12-22.5R-H	2-1/8"	3-5/8"
3"	1"	125	SLEEVE	12-23-H	12-23R-H	3"	4-1/4"
4"	1"	125	SLEEVE	12-24-H	12-24R-H	3-3/8"	5-1/4"

* Ergonomically designed for easy rolling.

30 SERIES/TWIN WHEEL CASTERS

CAPACITY: 300 — 400 LBS PER CASTER



16-32-XD



16-32R-XD

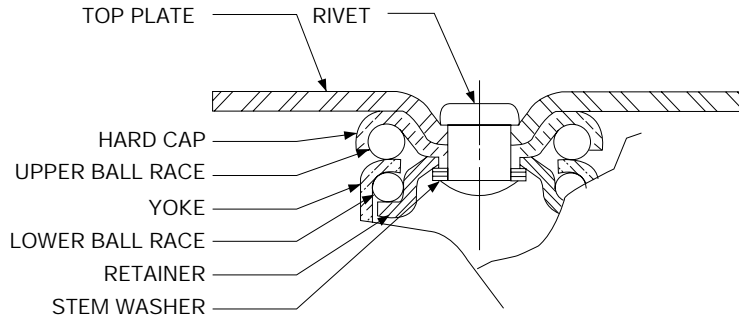


16-32.5-XSR



16-32.5R-XSR

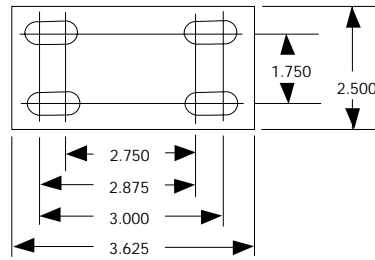
FEATURES



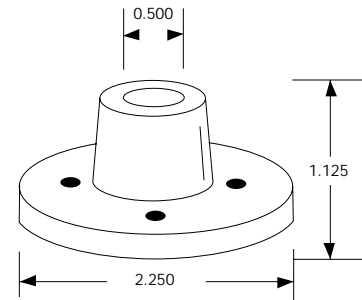
- 5/16" Axle
- 1/2" Rivet
- Double row ball bearing swivel. Both raceways equal diameter
- Bright chrome finish
- All swivel parts case hardened to Rockwell 62C
- Thread guards standard on 2-1/2" wheels

INSTALLATIONS

SWIVEL TOP PLATE

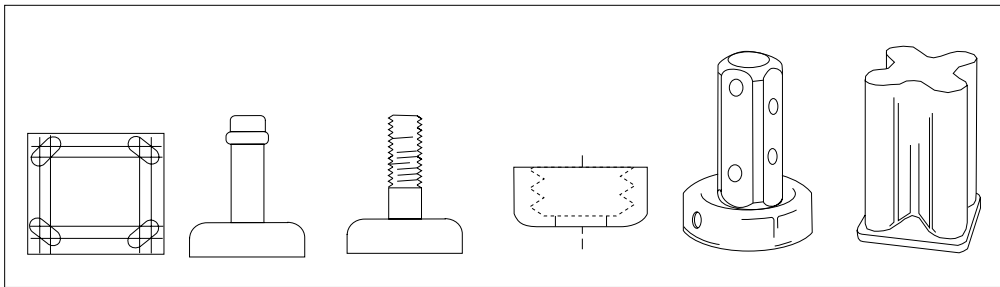


HOLES FOR 0.3125 BOLTS



NO. 16 TOP PLATE

PIANO SOCKET SYMBOL P.S. "0" STEM 1/2" X 1-1/8"



OPTIONAL TOP PLATES AND STEMS, PAGES 14, 15, 16

WHEEL DIA.	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE SUPER ROLL - ERGO*							
2"	1"	300	BALL	16-32-XD	16-32R-XD	2-3/8"	3-3/8"
2-1/2"	1"	300	BALL	16-32.5-XSR	16-32.5R-XSR	2-5/8"	3-7/8"
HARD RUBBER							
2"	1"	400	BALL	16-32-XH	16-32R-XH	2-3/8"	3-3/8"
2-1/2"	1"	400	BALL	16-32.5-XH	16-32.5R-XH	2-5/8"	3-7/8"

* Ergonomically designed for easy rolling.

OTHER SIZES (3", 4" AND 5") AVAILABLE ON SPECIAL ORDER.



Tel • 1-416-255-8563
Fax • 1-416-251-6117



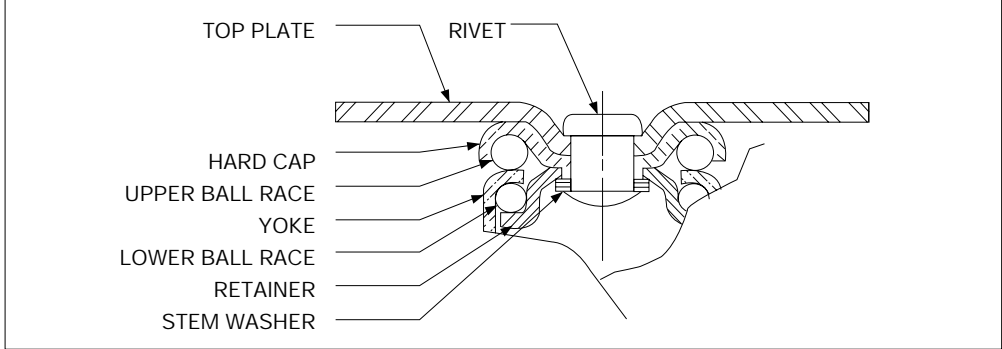
60 SERIES

CAPACITY: 150 – 400 LBS PER CASTER



16-65-XD

FEATURES



16-65R-XD

- 3/8" Axle
- 1/2" Rivet
- Double row ball bearing swivel. Both raceways equal diameter
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C
- Thread guards standard on wheels

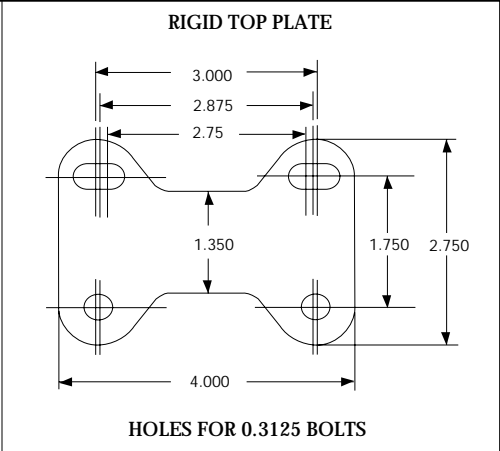
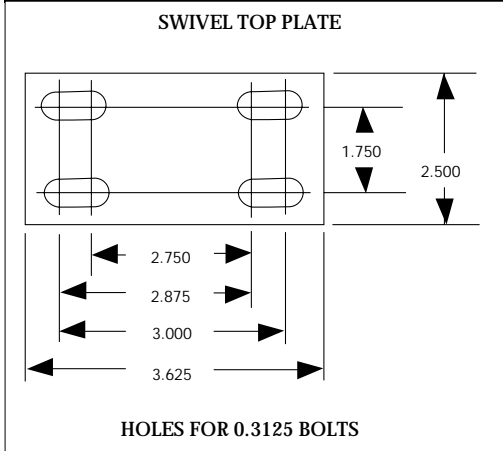
OPTIONS

- Brakes available, 3", 3.5", 4", and 5" models. Add letter "B".
- Four position swivel locks. Add letter "F". Not available on stem casters.
- Brakes and swivel locks cannot be combined on the same caster.
- Swivel seals with zerk in swivel and axle. Add letter "S".
- Zerk in axle only. Add letter "G".

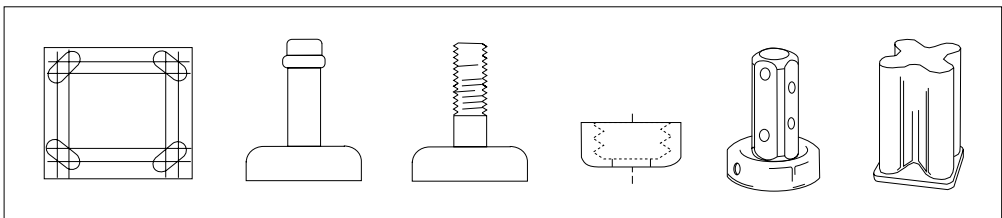


16-65B-XSR

INSTALLATIONS



NO. 16 TOP PLATE (STANDARD ON 60 SERIES)



OPTIONAL TOP PLATES AND STEMS ARE AVAILABLE. SEE PAGES 14, 15, 16.

60 SERIES

CAPACITY: 150 – 400 LBS PER CASTER

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
3"	1-3/8"	200	BALL	16-63-XD	16-63R-XD	2-3/4"	4-5/16"
3-1/2"	1-3/8"	200	BALL	16-63.5-XD	16-63.5R-XD	3"	4-3/4"
4"	1-3/8"	225	BALL	16-64-XD	16-64R-XD	3-1/4"	5-5/16"
5"	1-3/8"	250	BALL	16-65-XD	16-65R-XD	4"	6-5/16"
NEOPRENE - SUPER ROLL SOFT LOW PROFILE TREAD FOR EXTREMELY EASY ROLLING AND SWIVELING - ERGO*							
2-1/2"	1-3/8"	200	BALL	16-62.5-XSR	16-62.5R-XSR	2-1/2"	3-13/16"
3-1/2"	1-3/8"	225	BALL	16-63.5-XSR	16-63.5R-XSR	3"	4-3/4"
4"	1-3/8"	275	BALL	16-64-XSR	16-64R-XSR	3-1/4"	5-5/16"
5"	1-3/8"	325	BALL	16-65-XSR	16-65R-XSR	4"	6-5/16"
SOLID ELASTOMER-VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
2-1/2"	1-1/4"	300	BALL	16-62.5-XSE	16-62.5R-XSE	2-1/2"	3-13/16"
3-1/2"	1-1/4"	350	BALL	16-63.5-XSE	16-63.5R-XSE	3"	4-3/4"
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
2-1/2"	1-1/4"	400	SLEEVE	16-62.5-CI	16-62.5R-CI	2-1/2"	3-13/16"
3"	1-3/8"	400	SLEEVE	16-63-CI	16-63R-CI	2-3/4"	4-5/16"
3-1/2"	1-1/4"	400	SLEEVE	16-63.5-CI	16-63.5R-CI	3"	4-3/4"
4"	1-3/8"	400	SLEEVE	16-64-CI	16-64R-CI	3-1/4"	5-5/16"
5"	1-3/8"	400	SLEEVE	16-65-CI	16-65R-CI	4"	6-5/16"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
3"	1-1/4"	300	SLEEVE	16-63-CV	16-63R-CV	2-3/4"	4-5/16"
RUBBER - SEMI-RESILIENT RUBBER MATERIAL							
3-1/2"	1-3/8"	150	SLEEVE	16-63.5-K	16-63.5R-K	3"	4-3/4"
4"	1-3/8"	175	SLEEVE	16-64-K	16-64R-K	3-1/4"	5-5/16"
5"	1-3/8"	175	SLEEVE	16-65-K	16-65R-K	4"	6-5/16"
HARD RUBBER - HARD SYNTHETIC RUBBER MATERIAL NOT AFFECTED BY OIL OR GREASE							
3"	1-3/8"	350	SLEEVE	16-63-H	16-63R-H	2-3/4"	4-5/16"
3-1/2"	1-3/8"	375	SLEEVE	16-63.5-H	16-63.5R-H	3"	4-3/4"
4"	1-3/8"	400	SLEEVE	16-64-H	16-64R-H	3-1/4"	5-5/16"
5"	1-3/8"	400	SLEEVE	16-65-H	16-65R-H	4"	6-5/16"

* Ergonomically designed for easy rolling.

SLEEVE - M - BEARINGS AVAILABLE FOR WET APPLICATIONS.

70 SERIES

CAPACITY: 225 — 600 LBS PER CASTER



31-76-XSR



31-76R-XD

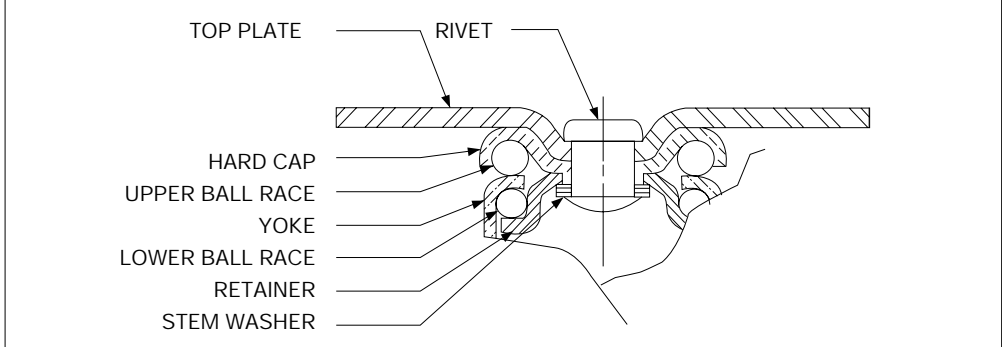


31-76B-XD



31-76-PSE

FEATURES

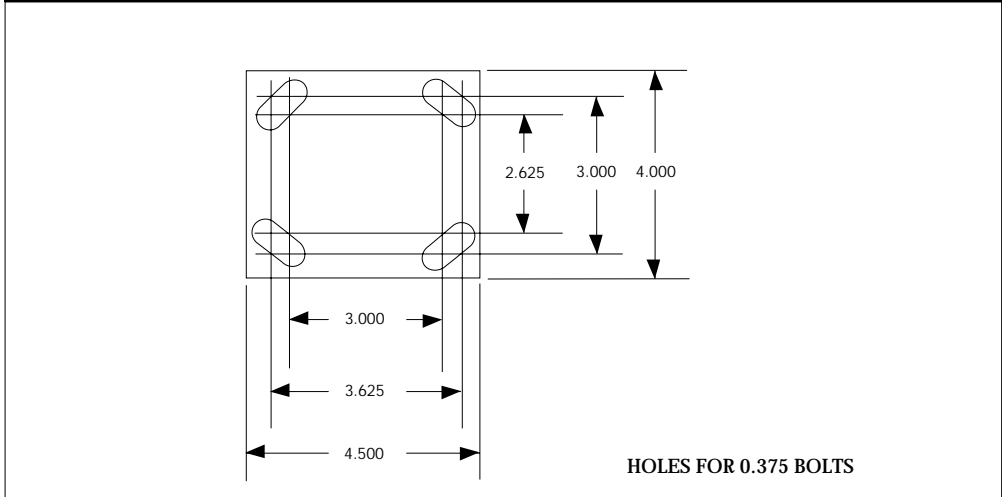


- 3/8" Axle
- 9/16" Rivet.
- Double row ball bearing swivel. Both raceways equal diameter
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C
- Thread guards standard on wheels

OPTIONS

- Brakes available, on 4", 5", and 6" models. Add letter "B"
- Four Position Swivel locks. Add letter "F".
- Swivel seals with zerk in swivel and axle. Add letter "S".
- Zerk in axle only. Add letter "G".

INSTALLATIONS



NO. 31 (STANDARD ON 70 SERIES)
 OPTIONAL TOP PLATES AVAILABLE, SEE PAGE 16.

70 SERIES

CAPACITY: 225 – 600 LBS PER CASTER

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - SOFT NON MARKING AND NON STAINING — USED ON ANY FLOOR SURFACE - ERGO*							
3"	1-3/8"	225	BALL	31-73-XD	31-73R-XD	3"	4-5/8"
4"	1-3/8"	250	BALL	31-74-XD	31-74R-XD	3-1/2"	5-9/16"
5"	1-3/8"	275	BALL	31-75-XD	31-75R-XD	4"	6-5/8"
6"	1-5/8"	300	BALL	31-76-XD	31-76R-XD	4-7/8"	7-9/16"
NEOPRENE SUPER ROLL - SOFT LOW PROFILE TREAD FOR EASY ROLLING AND SWIVELING - ERGO*							
4"	1-3/8"	300	BALL	31-74-XSR	31-74R-XSR	3-1/2"	5-9/16"
5"	1-3/8"	350	BALL	31-75-XSR	31-75R-XSR	4"	6-5/8"
6"	1-1/2"	400	BALL	31-76-XSR	31-76R-XSR	4-7/8"	7-9/16"
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
3"	1-3/8"	500	PRECISION BALL	31-73-PSE	31-73R-PSE	3"	4-5/8"
4"	1-3/8"	600	PRECISION BALL	31-74-PSE	31-74R-PSE	3-1/2"	5-9/16"
5"	1-3/8"	600	PRECISION BALL	31-75-PSE	31-75R-PSE	4"	6-5/8"
6"	1-3/8"	600	PRECISION BALL	31-76-PSE	31-76R-PSE	4-7/8"	7-9/16"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
4"	1-3/8"	600	ROLLER	31-74-TU	31-74R-TU	3-1/2"	5-9/16"
5"	1-3/8"	600	ROLLER	31-75-TU	31-75R-TU	4"	6-5/8"
6"	1-3/8"	600	ROLLER	31-76-TU	31-76R-TU	4-7/8"	7-9/16"
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
3"	1-3/8"	500	SLEEVE	31-73-CI	31-73R-CI	3"	4-5/8"
3"	1-3/8"	500	ROLLER	31-73-TCI	31-73R-TCI	3"	4-5/8"
4"	1-3/8"	600	SLEEVE	31-74-CI	31-74R-CI	3-1/2"	5-9/16"
4"	1-3/8"	600	ROLLER	31-74-TCI	31-74R-TCI	3-1/2"	5-9/16"
5"	1-3/8"	600	SLEEVE	31-75-CI	31-75R-CI	4"	6-5/8"
5"	1-3/8"	600	ROLLER	31-75-TCI	31-75R-TCI	4"	6-5/8"
6"	1-3/8"	600	SLEEVE	31-76-CI	31-76R-CI	4-7/8"	7-9/16"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
4"	1-3/8"	500	ROLLER	31-74-TCV	31-74R-TCV	3-1/2"	5-9/16"
5"	1-1/2"	600	ROLLER	31-75-TCV	31-75R-TCV	4"	6-5/8"
HARD RUBBER - HARD SYNTHETIC RUBBER MATERIAL NOT AFFECTED BY OIL OR GREASE							
3"	1-3/8"	500	SLEEVE	31-73-H	31-73R-H	3"	4-5/8"
4"	1-3/8"	550	SLEEVE	31-74-H	31-74R-H	3-1/2"	5-9/16"
5"	1-3/8"	600	SLEEVE	31-75-H	31-75R-H	4"	6-5/8"
6"	1-3/8"	600	SLEEVE	31-76-H	31-76R-H	4-7/8"	7-9/16"

* Ergonomically designed for easy rolling.

SLEEVE - M - BEARINGS AVAILABLE FOR WET APPLICATIONS.

400 SERIES

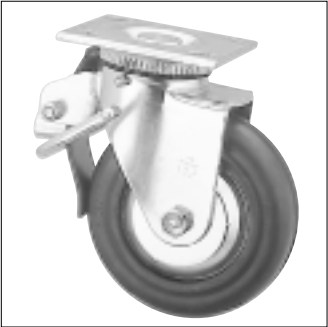
CAPACITY: 400-1000 LBS PER CASTER



31-406-PSE



31-406R-PD



31-406B-PD



31-406F-PSE

FEATURES

KING BOLT

TOP PLATE

HARD CAP

UPPER BALL RACE

UPPER SWIVEL SEAL

YOKE

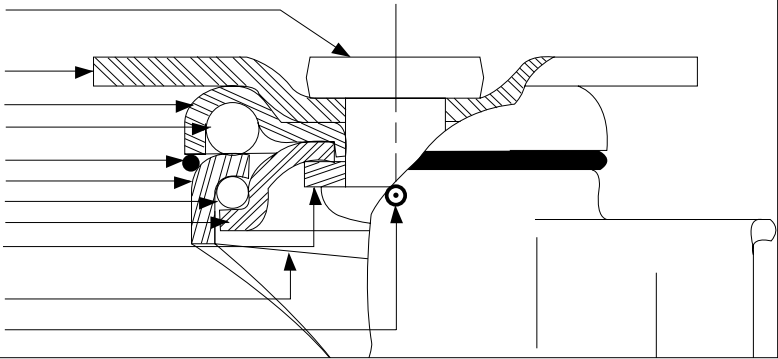
LOWER BALL RACE

RETAINER

STEM WASHER

LOWER SEAL

ZERK FITTING



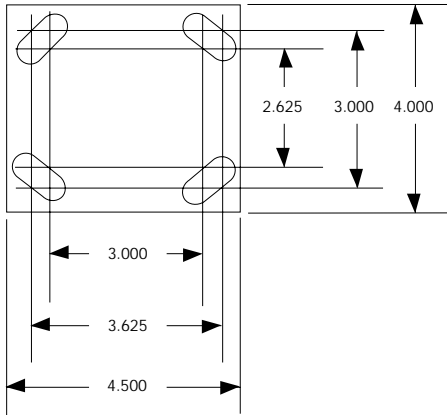
- 1/2" Axle
- 3/4" Rivet
- Double row ball bearing swivel. Both raceways equal diameter
- Standard with swivel seals and grease fittings in swivel and axle
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C
- Thread guards standard on wheels

OPTIONS

- Brakes, locks wheel and swivel. Available on 5", 6" and 8" models. Add letter "B".
- Four position swivel locks. Add letter "F".
- Brakes and swivel locks cannot be combined on the same caster.

INSTALLATIONS

NO. 31 TOP PLATE
(STANDARD ON 400 SERIES)



HOLES FOR 0.375 BOLTS

OPTIONAL TOP PLATES

NO. 4 TOP PLATE

NO. 1S3 TOP PLATE

NO. 6 TOP PLATE

NO. 8 TOP PLATE

NO. 14 TOP PLATE

NO. 22 TOP PLATE

SEE PAGE 16 FOR DIMENSIONS

400 SERIES

CAPACITY: 400 – 1000 LBS PER CASTER

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
4"	2"	400	ROLLER	31-404-TD	31-404R-TD	3-5/8"	5-5/8"
4"	2"	500	PRECISION BALL	31-404-PD	31-404R-PD	3-5/8"	5-5/8"
5"	2"	450	ROLLER	31-405-TD	31-405R-TD	4-1/4"	6-11/16"
5"	2"	550	PRECISION BALL	31-405-PD	31-405R-PD	4-1/4"	6-11/16"
6"	2"	500	ROLLER	31-406-TD	31-406R-TD	4-5/8"	7-11/16"
6"	2"	600	PRECISION BALL	31-406-PD	31-406R-PD	4-5/8"	7-11/16"
8"	2"	500	ROLLER	31-408-TD	31-408R-TD	5-3/4"	9-3/4"
8"	2"	600	PRECISION BALL	31-408-PD	31-408R-PD	5-3/4"	9-3/4"
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
3"	2"	900	PRECISION BALL	31-403-PSE	31-403R-PSE	3-1/4"	4-3/4"
4"	2"	900	PRECISION BALL	31-404-PSE	31-404R-PSE	3-5/8"	5-5/8"
5"	2"	1000	PRECISION BALL	31-405-PSE	31-405R-PSE	4-1/4"	6-11/16"
6"	2"	1000	PRECISION BALL	31-406-PSE	31-406R-PSE	4-5/8"	7-11/16"
8"	2"	1000	PRECISION BALL	31-408-PSE	31-408R-PSE	5-3/4"	9-3/4"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
3-1/2"	2"	800	ROLLER	31-403.5-TU	31-403.5R-TU	3-1/2"	5-1/16"
4"	2"	900	ROLLER	31-404-TU	31-404R-TU	3-5/8"	5-5/8"
5"	2"	1000	ROLLER	31-405-TU	31-405R-TU	4-1/4"	6-11/16"
6"	2"	1000	ROLLER	31-406-TU	31-406R-TU	4-5/8"	7-11/16"
8"	2"	1000	ROLLER	31-408-TU	31-408R-TU	5-3/4"	9-3/4"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
4"	2"	800	ROLLER	31-404-TCV	31-404R-TCV	3-5/8"	5-5/8"
5"	2"	1000	ROLLER	31-405-TCV	31-405R-TCV	4-1/4"	6-11/16"
SEMI - STEEL - CROWNED SEMI - STEEL CASTING							
3"	1-7/8"	900	ROLLER	31-403-TCI	31-403R-TCI	3-1/4"	4-3/4"
4"	1-7/8"	1000	ROLLER	31-404-TCI	31-404R-TCI	3-5/8"	5-5/8"
5"	1-7/8"	1000	ROLLER	31-405-TCI	31-405R-TCI	4-1/4"	6-11/16"
6"	1-7/8"	1000	ROLLER	31-406-TCI	31-406R-TCI	4-5/8"	7-11/16"
8"	1-7/8"	1000	ROLLER	31-408-TCI	31-408R-TCI	5-3/4"	9-3/4"

* Ergonomically designed for easy rolling.

DELRIN™ BEARINGS AVAILABLE IN NEOPRENE (D) AND SOLID ELASTOMER "SE" WHEELS. SUBSTITUTE LETTER "M" FOR LETTER "P"

800 SERIES

CAPACITY: 1350-1800 LBS PER CASTER



8-808-TU

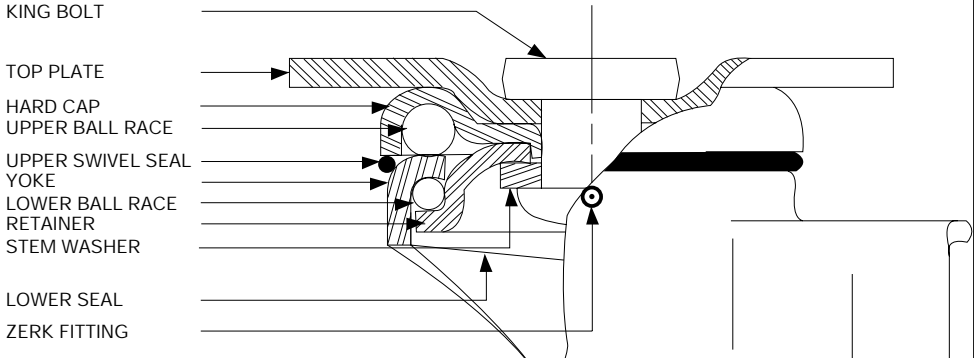


8-808R-TCI



8-810F-PSE

FEATURES

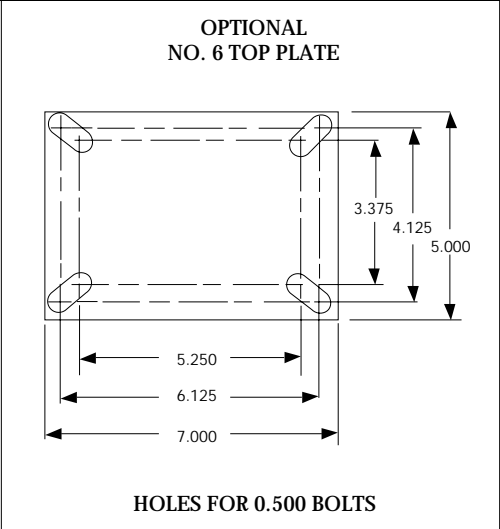
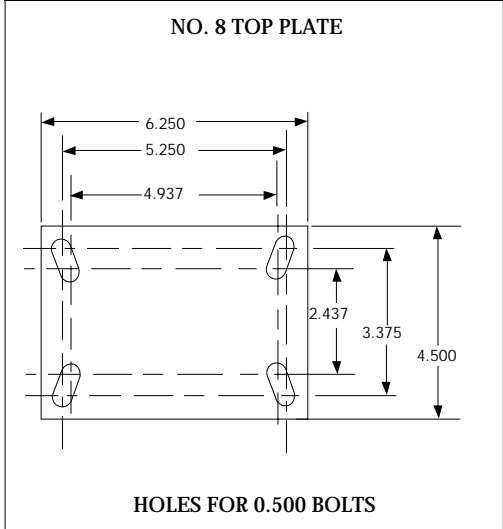


- 3/4" Axle
- 1" King bolt
- Double row ball bearing swivel
- Both raceways equal diameter
- Standard with swivel seals and grease fittings in swivel and axle
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C

OPTIONS

- Brakes, locks wheel and swivel. Available on 6", 8" and 10" models. Add letter "B".
- Four position swivel locks. Add letter "F".
- Brakes and swivel locks cannot be combined on the same caster.

INSTALLATIONS



800 SERIES

CAPACITY: 1350-1800 LBS. PER CASTER

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
5"	2-1/2"	1350	PRECISION BALL	8-805-PSE	8-805R-PSE	4-5/8"	7-1/8"
6"	2-1/2"	1500	PRECISION BALL	8-806-PSE	8-806R-PSE	5-1/8"	8-1/8"
8"	2-1/2"	1650	PRECISION BALL	8-808-PSE	8-808R-PSE	6-1/8"	10-1/4"
10"	2-1/2"	1800	PRECISION BALL	8-810-PSE	8-810R-PSE	7-1/8"	12-1/4"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
6"	2-1/4"	1500	ROLLER	8-806-TU	8-806R-TU	5-1/8"	8-1/8"
8"	2-1/2"	1800	ROLLER	8-808-TU	8-808R-TU	6-1/8"	10-1/4"
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
5"	2-1/4"	1500	ROLLER	8-805-TCI	8-805R-TCI	4-5/8"	7-1/8"
6"	2-1/4"	1700	ROLLER	8-806-TCI	8-806R-TCI	5-1/8"	8-1/8"
8"	2-1/4"	1800	ROLLER	8-808-TCI	8-808R-TCI	6-1/8"	10-1/4"
10"	2-1/4"	1800	ROLLER	8-810-TCI	8-810R-TCI	7-1/8"	12-1/4"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
6"	2-1/2"	1500	ROLLER	8-806-TCV	8-806R-TCV	5-1/8"	8-1/8"
8"	2-1/2"	1800	ROLLER	8-808-TCV	8-808R-TCV	6-1/8"	10-1/4"

* Ergonomically designed for easy rolling.

700 SERIES

CAPACITY: 1350-2200 LBS. PER CASTER

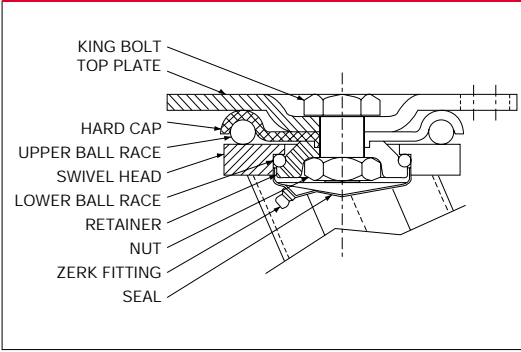


6-708-TU



6-708R-TU

FEATURES

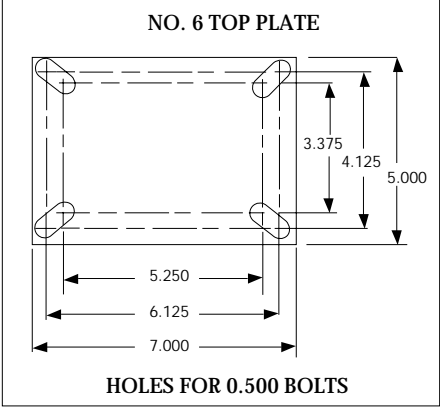


- 3/4" Axle
- 7/8" Grade 8 King bolt
- Double row ball bearing swivel
- Grease fittings in swivel and axle
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C

OPTIONS

- Brakes available. Add letter "B".
- Four Position Swivel locks. Add letter "F"
- Brakes and swivel locks cannot be combined on the same caster.

INSTALLATION



WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
5"	2-1/2"	1350	PRECISION BALL	6-705-PSE	6-705R-PSE	4-5/8"	7-1/8"
6"	2-1/2"	1500	PRECISION BALL	6-706-PSE	6-706R-PSE	5-1/8"	8-1/8"
8"	2-1/2"	1650	PRECISION BALL	6-708-PSE	6-708R-PSE	6-1/8"	10-1/4"
10"	2-1/2"	1800	PRECISION BALL	6-710-PSE	6-710R-PSE	7-1/8"	12-1/4"
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
5"	2-1/4"	1500	ROLLER	6-705-TCI	6-705R-TCI	4-5/8"	7-1/8"
6"	2-1/4"	1700	ROLLER	6-706-TCI	6-706R-TCI	5-1/8"	8-1/8"
8"	2-1/4"	1800	ROLLER	6-708-TCI	6-708R-TCI	6-1/8"	10-1/4"
10"	2-1/4"	2200	ROLLER	6-710-TCI	6-710R-TCI	7-1/8"	12-1/4"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
6"	2-1/2"	1800	ROLLER	6-706-TCV	6-706R-TCV	5-1/8"	8-1/8"
8"	2-1/2"	2000	ROLLER	6-708-TCV	6-708R-TCV	6-1/8"	10-1/4"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
6"	2-1/4"	1500	ROLLER	6-706-TU	6-706R-TU	5-1/8"	8-1/8"
8"	2-1/2"	1800	ROLLER	6-708-TU	6-708R-TU	6-1/8"	10-1/4"

* Ergonomically designed for easy rolling.

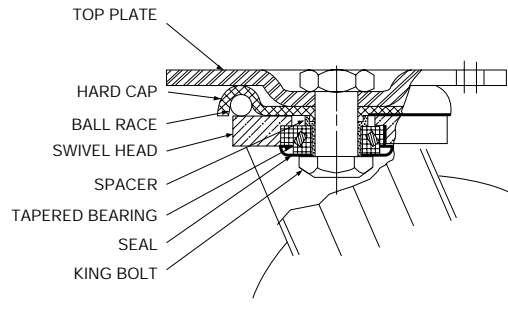


6-908-TN



6-908B-TCI

FEATURES



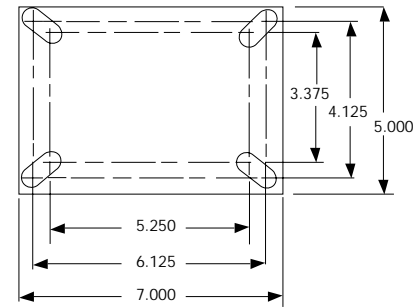
- 3/4" Axle
- 7/8" Grade 8 King bolt
- 4" Diameter upper raceway, 1/2" balls
- 5/8" Thick swivel head, precision machined and equipped with tapered roller bearings
- Ribbed legs for extra strength
- Grease fittings in swivel and wheel
- Bright zinc finish
- All swivel parts case hardened to Rockwell 62C

OPTIONS

- Brakes available. Add letter "B".
- Four Position Swivel locks. Add letter "F"
- Brakes and swivel locks cannot be combined on the same caster.

INSTALLATION

NO. 6 TOP PLATE



HOLES FOR 0.500 BOLTS

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
6"	3"	3500	ROLLER	6-906-TCI	6-906R-TCI	5-1/4"	8-1/4"
6"	3"	3500	TAPERED	6-906-YCI	6-906R-YCI	5-1/4"	8-1/4"
8"	3"	3500	ROLLER	6-908-TCI	6-908R-TCI	6-1/4"	10-1/4"
8"	3"	3500	TAPERED	6-908-YCI	6-908R-YCI	6-1/4"	10-1/4"
10"	3"	3500	ROLLER	6-910-TCI	6-910R-TCI	7-1/4"	12-1/4"
10"	3"	3500	TAPERED	6-910-YCI	6-910R-YCI	7-1/4"	12-1/4"
12"	3"	3500	ROLLER	6-912-TCI	6-912R-TCI	8-1/4"	14-1/4"
12"	3"	3500	TAPERED	6-912-YCI	6-912R-YCI	8-1/4"	14-1/4"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
6"	3"	2500	ROLLER	6-906-TU	6-906R-TU	5-1/4"	8-1/4"
6"	3"	2500	TAPERED	6-906-YU	6-906R-YU	5-1/4"	8-1/4"
8"	3"	3000	ROLLER	6-908-TU	6-908R-TU	6-1/4"	10-1/4"
8"	3"	3000	TAPERED	6-908-YU	6-908R-YU	6-1/4"	10-1/4"
10"	3"	3500	ROLLER	6-910-TU	6-910R-TU	7-1/4"	12-1/4"
10"	3"	3500	TAPERED	6-910-YU	6-910R-YU	7-1/4"	12-1/4"
12"	3"	3500	ROLLER	6-912-TU	6-912R-TU	8-1/4"	14-1/4"
12"	3"	3500	TAPERED	6-912-YU	6-912R-YU	8-1/4"	14-1/4"
INDUSTRIAL WHEELS - HIGH QUALITY NATURAL RUBBER FOR EASE OF MOBILITY							
6"	3"	700	ROLLER	6-906-TN	6-906R-TN	5-1/4"	8-1/4"
8"	3"	900	ROLLER	6-908-TN	6-908R-TN	6-1/4"	10-1/4"
10"	3"	1100	ROLLER	6-910-TN	6-910R-TN	7-1/4"	12-1/4"
12"	3"	1200	ROLLER	6-912-TN	6-912R-TN	8-1/4"	14-1/4"

* Ergonomically designed for easy rolling.

5000 SERIES

CAPACITY : 2000 - 5000 LBS. PER CASTER



5-5008-TU



5-5008R-TU

FEATURES

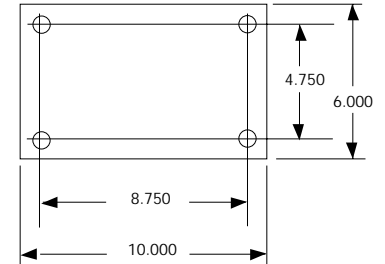
- 1" Axle
- 1" King bolt
- Precision machined swivel head equipped with tapered bearings
- Ribbed legs for strength
- Grease fittings in swivel and wheel

OPTIONS

- Brakes available. Add letter "B".

INSTALLATION

5-5000 TOP PLATE



HOLES FOR 0.500 BOLTS

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
6	3"	5000	ROLLER	5-5006-TCI	5-5006R-TCI	6-1/8"	8-5/8"
6	3"	5000	TAPERED	5-5006-YCI	5-5006R-YCI	6-1/8"	8-5/8"
8	3"	5000	ROLLER	5-5008-TCI	5-5008R-TCI	7-3/8"	10-5/8"
8	3"	5000	TAPERED	5-5008-YCI	5-5008R-YCI	7-3/8"	10-5/8"
10	3"	5000	ROLLER	5-5010-TCI	5-5010R-TCI	8-1/4"	12-5/8"
10	3"	5000	TAPERED	5-5010-YCI	5-5010R-YCI	8-1/4"	12-5/8"
12	3"	5000	ROLLER	5-5012-TCI	5-5012R-TCI	9-3/8"	14-3/4"
12	3"	5000	TAPERED	5-5012-YCI	5-5012R-YCI	9-3/8"	14-3/4"
V-GROOVED - ECONOMICAL HANDLING OF HEAVY LOADS ON ANGLE TRACK							
8	2-5/8"	2000	ROLLER	5-5008-TBCV	5-5008R-TBCV	7-3/8"	10-5/8"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
6	3"	2500	ROLLER	5-5006-TU	5-5006R-TU	6-1/8"	8-5/8"
6	3"	2500	TAPERED	5-5006-YU	5-5006R-YU	6-1/8"	8-5/8"
8	3"	3000	ROLLER	5-5008-TU	5-5008R-TU	7-3/8"	10-5/8"
8	3"	3000	TAPERED	5-5008-YU	5-5008R-YU	7-3/8"	10-5/8"
10	3"	3500	ROLLER	5-5010-TU	5-5010R-TU	8-1/4"	12-5/8"
10	3"	3500	TAPERED	5-5010-YU	5-5010R-YU	8-1/4"	12-5/8"
12	3"	4000	ROLLER	5-5012-TU	5-5012R-TU	9-3/8"	14-3/4"
12	3"	4000	TAPERED	5-5012-YU	5-5012R-YU	9-3/8"	14-3/4"

* Ergonomically designed for easy rolling.

5200 SERIES / TWIN WHEEL

CAPACITY: 1400 - 10000 LBS. PER CASTER



5-5210-TCI



5-5210R-TCI

FEATURES

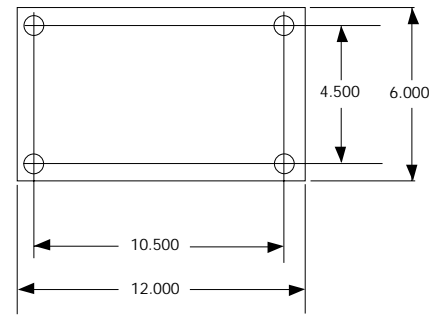
- 1" Axle
- 1 - 1/4" King bolt
- Dual wheel construction for easier swiveling
- Precision machined swivel head equipped with tapered bearings
- Grease fittings in swivel and wheel

OPTIONS

- Brakes available. Add letter "B".
- Swivel locks available. Add letter "F".

INSTALLATION

5-5200 TOP PLATE



HOLES FOR 0.500 BOLTS

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
SEMI-STEEL - CROWNED SEMI-STEEL CASTING							
6"	3"	10000	ROLLER	5-5206-TCI	5-5206R-TCI	5-7/8"	9-7/8"
6"	3"	10000	TAPERED	5-5206-YCI	5-5206R-YCI	5-7/8"	9-7/8"
8"	3"	10000	ROLLER	5-5208-TCI	5-5208R-TCI	6-3/4"	11-3/4"
8"	3"	10000	TAPERED	5-5208-YCI	5-5208R-YCI	6-3/4"	11-3/4"
10"	3"	10000	ROLLER	5-5210-TCI	5-5210R-TCI	7-5/8"	13-3/4"
10"	3"	10000	TAPERED	5-5210-YCI	5-5210R-YCI	7-5/8"	13-3/4"
12"	3"	10000	ROLLER	5-5212-TCI	5-5212R-TCI	8-5/8"	15-3/4"
12"	3"	10000	TAPERED	5-5212-YCI	5-5212R-YCI	8-5/8"	15-3/4"
URETHANE - FOR HEAVY LOADS AND ROUGH FLOOR CONDITIONS - ERGO*							
6"	3"	5000	ROLLER	5-5206-TU	5-5206R-TU	5-7/8"	9-7/8"
6"	3"	5000	TAPERED	5-5206-YU	5-5206R-YU	5-7/8"	9-7/8"
8"	3"	6000	ROLLER	5-5208-TU	5-5208R-TU	6-3/4"	11-3/4"
8"	3"	6000	TAPERED	5-5208-YU	5-5208R-YU	6-3/4"	11-3/4"
10"	3"	7000	ROLLER	5-5210-TU	5-5210R-TU	7-5/8"	13-3/4"
10"	3"	7000	TAPERED	5-5210-YU	5-5210R-YU	7-5/8"	13-3/4"
12"	3"	8000	ROLLER	5-5212-TU	5-5212R-TU	8-5/8"	15-3/4"
12"	3"	8000	TAPERED	5-5212-YU	5-5212R-YU	8-5/8"	15-3/4"
INDUSTRIAL WHEELS - HIGH QUALITY NATURAL RUBBER FOR EASE OF MOBILITY							
6"	3"	1400	ROLLER	5-5206-TN	5-5206R-TN	5-7/8"	9-7/8"
8"	3"	1800	ROLLER	5-5208-TN	5-5208R-TN	6-3/4"	11-3/4"
10"	3"	2200	ROLLER	5-5210-TN	5-5210R-TN	7-5/8"	13-3/4"
12"	3"	2400	ROLLER	5-5212-TN	5-5212R-TN	8-5/8"	15-3/4"

* Ergonomically designed for easy rolling.

PNEUMATIC CASTERS

CAPACITY: 300 - 2700 LBS. PER CASTER



6-310-TPN



6-3218-YPN



52-3318FP-YPN

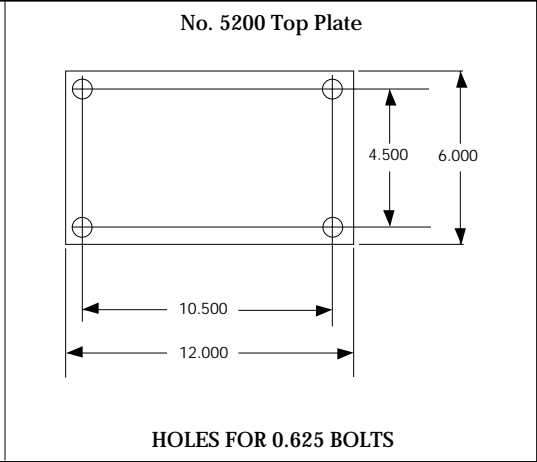
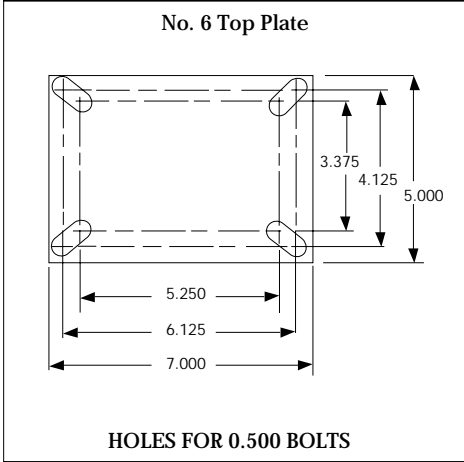
FEATURES

- 300 Series
- Manufactured with the same swivel construction as the 700 series
 - 4 Ply wheels equipped with roller bearings
 - Grease fittings in swivel and wheel for easy lubrication
- 31, 32, 3300 Series
- Heavy duty swivel equipped with tapered roller bearings
 - King pin threaded, and welded to plate for extra strength
 - 4 Ply tires rated for 5 M.P.H.
 - Tapered roller bearings in wheels, supported by protective seals
 - Grease fittings in wheel and swivel

OPTIONS

- Available with swivel locks
- Wheels may be polyurethane filled to eliminate flats

INSTALLATIONS



WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
8"	2-3/8"	300	ROLLER	6-308-TPN	6-308R-TPN	7-3/8"	11-3/4"
10"	3-5/8"	350	ROLLER	6-310-TPN	6-310R-TPN	8-1/4"	12-1/2"
16"	4-1/2"	750	TAPERED	6-3116-YPN	6-3116R-YPN	12-3/4"	20-1/2"
18"	5-3/4"	900	TAPERED	6-3118-YPN	6-3118R-YPN	13-3/4"	21-1/2"
16"	4-1/2"	1500	TAPERED	6-3216-YPN	6-3216R-YPN	14-1/4"	20-1/2"
18"	5-3/4"	1800	TAPERED	6-3218-YPN	6-3218R-YPN	15-1/4"	21-1/2"
18"	5-3/4"	2700	TAPERED	52-3318-YPN	52-3318R-YPN	16"	22"

V-GROOVE CASTERS

CAPACITY: 300 - 2000 LBS. PER CASTER

FEATURES

- High quality semi-steel wheels, machined to close tolerances
- Economical handling of heavy loads
- Floor protection
- Adaptability, (will roll on track or floor)
- Free rolling on sediment covered floors as the angle iron track is self cleaning

OPTIONS AND INSTALLATIONS

See proper series page of model selected for available options, and pages 15, 16 and 17 for available installations.



31-405-TCV



31-75R-TCV

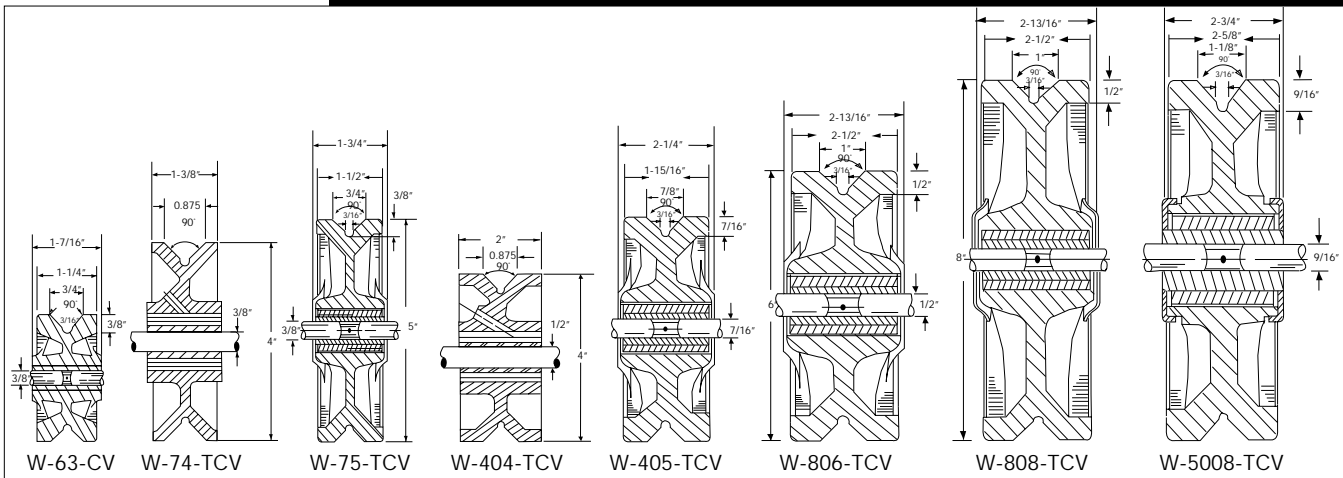
WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
3"	1-1/4"	300	SLEEVE	16-63-CV	16-63R-CV	2-3/4"	4-5/16"
4"	1-3/8"	500	ROLLER	31-74-TCV	31-74R-TCV	3-1/2"	5-9/16"
4"	2"	800	ROLLER	31-404-TCV	31-404R-TCV	3-5/8"	5-5/8"
5"	1-1/2"	600	ROLLER	31-75-TCV	31-75R-TCV	4"	6-5/8"
5"	2"	1000	ROLLER	31-405-TCV	31-405R-TCV	4-1/4"	6-11/16"
6"	2-1/2"	1500	ROLLER	8-806-TCV	8-806R-TCV	5-1/8"	8-1/8"
8"	2-1/2"	1800	ROLLER	8-808-TCV	8-808R-TCV	6-1/8"	10-1/4"
8"	2-5/8"	2000	ROLLER	5008-TBCV	5008R-TBCV	7-3/8"	10-5/8"

V-GROOVE

WHEEL DIMENSIONS

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	WHEEL MODEL	BEARING TYPE	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
3"	1-1/4"	300	W-63-CV	SLEEVE	3/8"	1-1/2"	60
4"	1-3/8"	500	W-74-TCV	ROLLER	3/8"	1-3/4"	70
4"	2"	800	W-404-TCV	ROLLER	1/2"	2-5/16"	400
5"	1-1/2"	600	W-75-TCV	ROLLER	3/8"	1-3/4"	70
5"	2"	1000	W-405-TCV	ROLLER	1/2"	2-5/16"	400
6"	2-1/2"	1500	W-806-TCV	ROLLER	3/4"	2-3/4"	700/800
8"	2-1/2"	1500	W-808-TCV	ROLLER	3/4"	2-3/4"	700/800
8"	2-5/8"	2000	W-5008-TCV	ROLLER	3/4"	3-1/4"	900/5000

WHEEL DRAWINGS



Tel • 1-416-255-8563

Fax • 1-416-251-6117



SPRING LOADED CASTERS

31-SL 400 SERIES



31-SL404-PSE

SPRING LOADED CASTERS

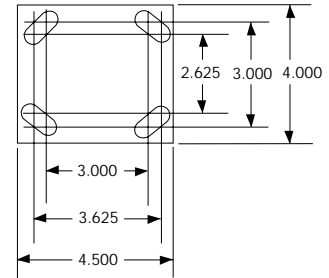
FEATURES

- Oil impregnated permanently lubricated sintered bearings for all moving parts
- Sealed precision ball bearings in the wheel permanently lubricated for long life and low rolling resistance
- Sealed swivel assembly with grease fitting for ease of access
- Load rating 1000 pounds at maximum spring deflection
- Various Mounting plates available

Available in 3", 4", 5", 6" , and 8" models

INSTALLATIONS

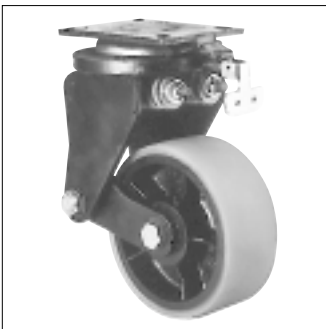
NO. 31 TOP PLATE
(STANDARD ON 400 SERIES)



HOLES FOR 0.375 BOLTS

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*							
3"	2"	900	PRECISION BALL	31-SL403-PSE	3.50"	7.00"	6.00"
4"	2"	900	PRECISION BALL	31-SL404-PSE	4.00"	7.50"	6.50"
5"	2"	1000	PRECISION BALL	31-SL405-PSE	4.85"	9.00"	8.00"
6"	2"	1000	PRECISION BALL	31-SL406-PSE	5.30"	9.50"	8.50"
8"	2"	800	PRECISION BALL	31-SL408-PSE	7.30"	11.50"	10.00"
NEOPRENE - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
4"	2"	450	PRECISION BALL	31-SL404-PD	4.00"	7.50"	6.50"
5"	2"	500	PRECISION BALL	31-SL405-PD	4.85"	9.00"	8.00"
6"	2"	550	PRECISION BALL	31-SL406-PD	5.30"	9.50"	8.50"
8"	2"	550	PRECISION BALL	31-SL408-PD	7.30"	11.50"	10.00"

6-SL 900 SERIES



6-SL908-YU

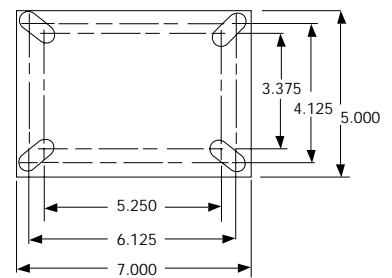
SPRING LOADED CASTERS

FEATURES

- Oil impregnated permanently lubricated sintered bearings for all moving parts
- Tapered bearings in swivel
- Load rating to 2500 lbs
- Available in 5", 8", and 10" models
- Can be manufactured in additional sizes as required

INSTALLATIONS

NO. 6 TOP PLATE



HOLES FOR 0.500 BOLTS

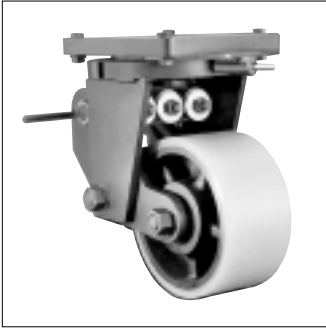
WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD
5"	2-1/2"	1000	PRECISION BALL	6-SL905-PSE	4.50"	10.00"	7.25"
8"	3"	2500	TAPERED	6-SL908-YU	6.45"	13.00"	12.00"
10"	3"	2500	TAPERED	6-SL910-YU	8.60"	15.00"	14.00"

* Ergonomically designed for easy rolling.

SPRING LOADED CASTERS

SL 8510-YU

SPRING LOADED CASTER

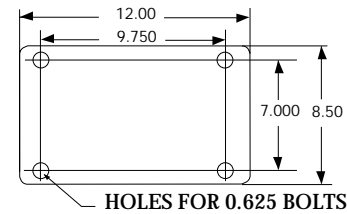


SL-8510-YU

FEATURES

- Oil impregnated bearings in all pivoting points
- Grease fitting in swivel and wheel
- Sealed bearings in wheel
- Tapered bearings in swivel head and wheel
- Four position swivel locks and brakes available

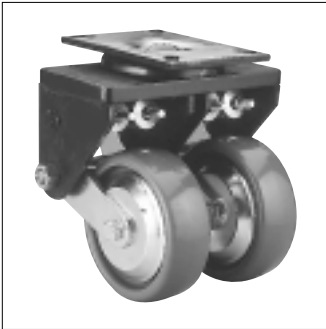
INSTALLATION



WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD
10"	5"	10,000	TAPERED	SL8510-YU	9.40"	15.625"	14.50"

TWIN WHEEL

SPRING LOADED CASTERS



6-TSL2406-PSE

FEATURES

- Twin wheels reduced resistance to swiveling
- Twin wheels spread load over a wider area
- Twin wheels offer higher load carrying capacity
- Available with swivel locks

INSTALLATION

No. 6 and 5200 Top plates
See page 16 for dimensions

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD
6"	2"	2200	PRECISION BALL	6-TSL2406-PSE	6.30"	9.45"	8.45"
8"	3"	6000	TAPERED	Q-TSL5208-YU	9.60"	14.75"	12.25"

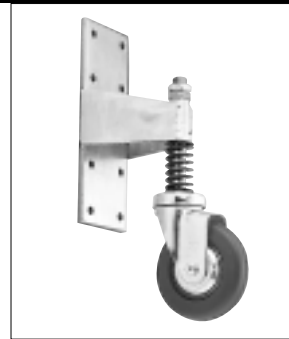
GATE SPRING LOADED CASTERS



QSL-22-XD



QSL-32-XD



QSL-75-XD



QSL-405-TD

WHEEL DIAMETER	CASTER MODEL NO.	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD	SWIVEL OFFSET C/W BRACKET	LOAD CAPACITY
2"	QSL-22-XD	7.375"	6.375"	1.750"	75 lbs.
2"	QSL-32-XD	8.500"	7.625"	3.500"	200 lbs.
5"	QSL-75-XD	13.250"	12.000"	5.375"	300 lbs.
5"	QSL-405-TD	13.250"	12.000"	5.375"	400 lbs.

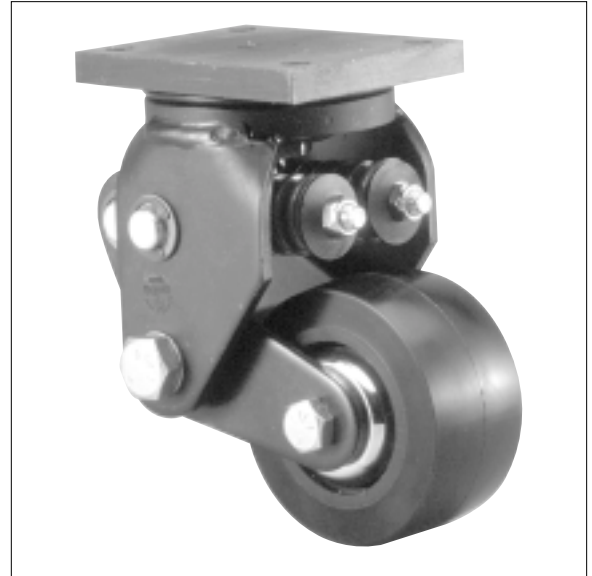
LIFT TRUCK APPLICATIONS

FEATURES

Darcor offers a unique line of Spring Loaded Casters for lift trucks. Ergonomically designed, these easy to maneuver casters offer the utmost in superior performance. Darcor "SE" Solid Elastomer Wheels are chemical resistant and show minimal wear or heat buildup in extended use. Spring Loaded Casters equipped with SE wheels feature precision sealed ball bearings and require little maintenance. Darcor also supplies "high quality" Polyurethane wheels with tapered bearings for heavier loads and varying speed conditions.



LT1



LT2



LT3



LT4

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	MODEL NUMBER	SWIVEL RADIUS	OVERALL HEIGHT NO LOAD	OVERALL HEIGHT MAX. LOAD
4"	2"	800	PRECISION BALL	LT2	4.125	7.375"	6.375"
4"	2-1/2"	1200	PRECISION BALL	LT1	5	8.66"	7.66"
4"	2-1/2"	1000	PRECISION BALL	LT3	4	7.56"	6.56"
6"	2-1/2"	1000	PRECISION BALL	LT4	5	11.4"	10.4"

- Pre-loading and custom spring rates/capacity available as special order.

Internet • www.darcor.com

E-mail • casters@darcor.com

The following are just a few of our special application casters. They have been designed to meet specific requirements of customers by our engineering department. These applications are found in many different areas of industry so we feel it is important to show these casters in their own section of our catalogue. We hope they will offer you a solution to your own unusual or special application problems. We encourage you to call us if you don't find the caster you require in our catalogue.



8216-YU

16,800 lbs. capacity caster with twin 16" x 5" polyurethane wheels. Extra heavy assembly designed to withstand extreme thrust on king pin. Presently being used in the mining industry OH 21-3/4".



9K

20,000 lbs. capacity steel wheel caster with an overall height of just 1/2". This caster was designed to move a large heavy load in a confined area where overall height was restricted. Available in swivel and rigid models, it can be supplied in larger sizes as well.



TURTLE

"Turtle" Caster designed for load ratings from 600 lbs. to 2,500 lbs. Equipped with 3 swivel casters mounted to a swivel head. Good for low heights and heavy loads. Reduced swivel effort gives a smooth gliding action while protecting floor surfaces. Excellent choice for applications such as studio, theatre and stage equipment.



31-224-XD

300 lbs. twin wheel caster available with either 3" or 4" diameter wheels and can be supplied with any fittings applicable to the 70 series. The twin wheels offer easier swiveling and are ideal for equipment going on and off elevators where single wheel casters tend to get caught in the entrance.



31-274-PSE

Twin wheel caster, equipped with solid elastomer sealed precision ball bearing wheels. Twin wheels maintain a low profile while providing easy pivoting action. Good for heavy loads, offering ease of movement over floor gaps and joints. Excellent for continuous use operations such as tow lines, and Automatic Guided Vehicles.



8-2404-PSE

CARTWASHABLE™ CASTERS

CAPACITY: 225-1000 LBS. PER CASTER



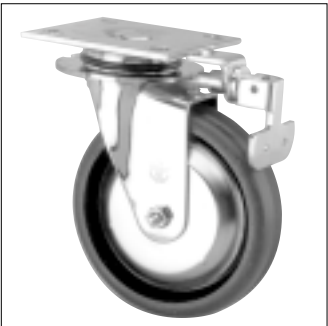
31-CW76-XD



31-CW76B-XD



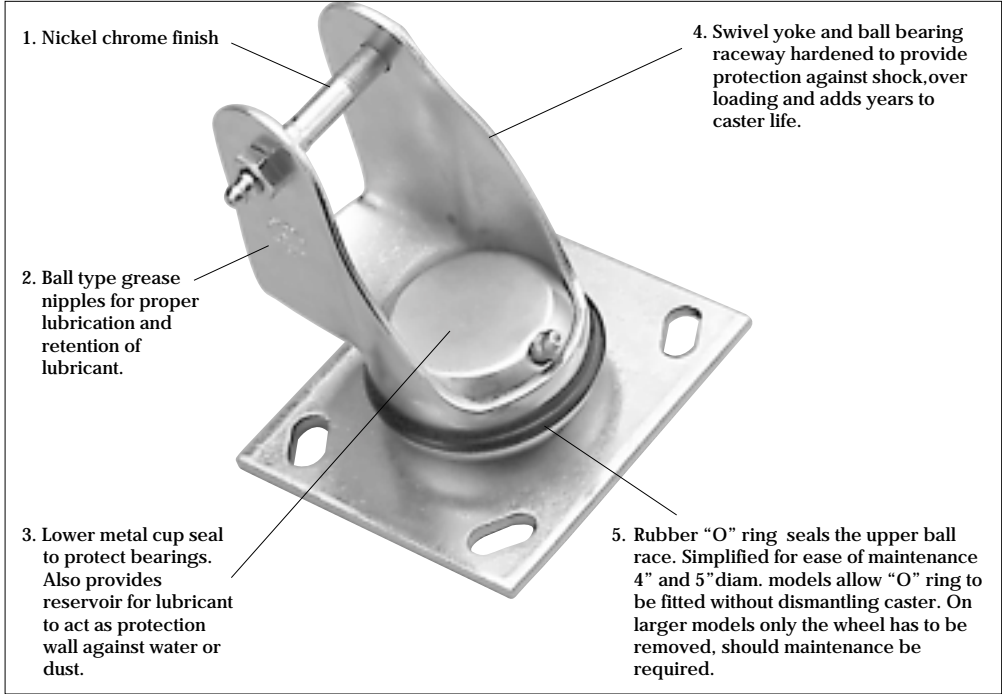
31-CW76R-XD



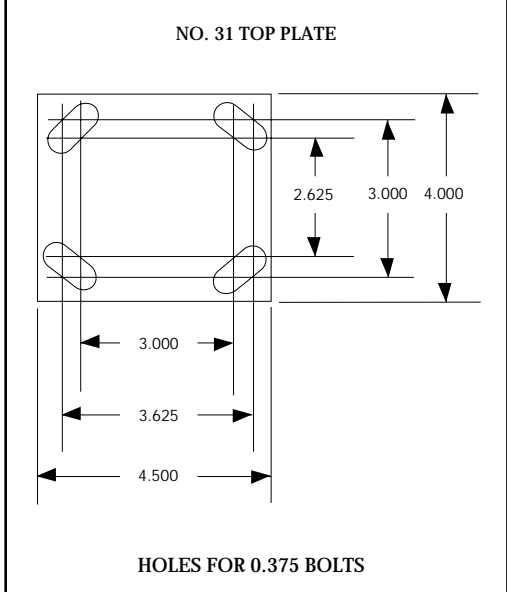
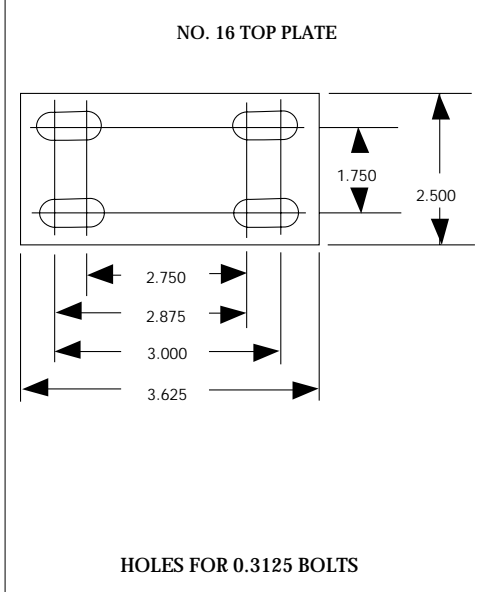
31-CW76F-XSR

FEATURES

After years of actual experiments and hundreds of tests, we have developed a line of casters to reduce rusting under wet conditions. Hospital laundries and dietary departments, plus hotel and motel areas concerned with sanitary operations will find the cartwashable design reduces maintenance and provides extra life both to the casters and equipment. The medium and heavy duty models are ideally suited to the sanitary conditions dictated by experimental and pharmaceutical laboratories as well as firms connected to the meat packing and food industries.



INSTALLATIONS



OPTIONAL STEMS AND PLATES AVAILABLE UPON REQUEST. SEE PAGES 14, 15, 16.

CARTWASHABLE™ IS A REGISTERED TRADEMARK OF DARCOR CASTERS.

CARTWASHABLE™

CASTERS

WHEEL DIA.	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	RIGID MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE - NON MARKING AND NON STAINING - USE ON ANY FLOOR SURFACE							
4"	1-3/8"	225	BALL	16-CW64-XD	16-CW64R-XD	3-1/4"	5-3/8"
4"	1-3/8"	250	BALL	31-CW74-XD	31-CW74R-XD	3-1/2"	5-9/16"
5"	1-3/8"	250	BALL	16-CW65-XD	16-CW65R-XD	4"	6-3/8"
5"	1-3/8"	275	BALL	31-CW75-XD	31-CW75R-XD	4"	6-5/8"
5"	2"	450	ROLLER	31-CW405-TD	31-CW405R-TD	4-1/4"	6-11/16"
5"	2"	550	PRECISION BALL	31-CW405-PD	31-CW405R-PD	4-1/4"	6-11/16"
6"	1-5/8"	300	BALL	31-CW76-XD	31-CW76R-XD	4-7/8"	7-9/16"
6"	2"	500	ROLLER	31-CW406-TD	31-CW406R-TD	4-5/8"	7-11/16"
6"	2"	600	PRECISION BALL	31-CW406-PD	31-CW406R-PD	4-5/8"	7-11/16"
8"	2"	500	ROLLER	31-CW408-TD	31-CW408R-TD	5-3/4"	9-3/4"
8"	2"	600	PRECISION BALL	31-CW408-PD	31-CW408R-PD	5-3/4"	9-3/4"
SUPER ROLL NEOPRENE - SOFT LOW PROFILE TREAD FOR EASY STARTING AND ROLLING							
4"	1-3/8"	250	BALL	16-CW64-XSR	16-CW64R-XSR	3-1/4"	5-3/8"
4"	1-3/8"	300	BALL	31-CW74-XSR	31-CW74R-XSR	3-1/2"	5-9/16"
5"	1-3/8"	275	BALL	16-CW65-XSR	16-CW65R-XSR	4"	6-3/8"
5"	1-3/8"	350	BALL	31-CW75-XSR	31-CW75R-XSR	4"	6-5/8"
6"	1-1/2"	400	BALL	31-CW76-XSR	31-CW76R-XSR	4-7/8"	7-9/16"
SOLID ELASTOMER - VERY LOW STARTING AND ROLLING RESISTANCE							
4"	1-3/8"	600	PRECISION BALL	31-CW74-PSE	31-CW74R-PSE	3-1/2"	5-9/16"
5"	1-3/8"	600	PRECISION BALL	31-CW75-PSE	31-CW75R-PSE	4"	6-5/8"
5"	2"	1000	PRECISION BALL	31-CW405-PSE	31-CW405R-PSE	4-1/4"	6-11/16"
6"	1-3/8"	600	PRECISION BALL	31-CW76-PSE	31-CW76R-PSE	4-7/8"	7-9/16"
6"	2"	1000	PRECISION BALL	31-CW406-PSE	31-CW406R-PSE	4-5/8"	7-11/16"
8"	2"	1000	PRECISION BALL	31-CW408-PSE	31-CW408R-PSE	5-3/4"	9-3/4"

CARTWASHABLE™

WHEELS

WHEEL DIA.	TREAD WIDTH	LOAD CAP./LBS	BALL BEARING	ROLLER BEARING	PRECISION BALL BEARING SEALED	BORE SIZE	HUB LENGTH	SERIES USED IN
NEOPRENE WHEELS - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*								
4"	1-3/8"	225	W-CW64-XD			3/8"	1-1/2"	60
4"	1-3/8"	250	W-CW74-XD			3/8"	1-3/4"	70
5"	1-3/8"	250	W-CW65-XD			3/8"	1-1/2"	60
5"	1-3/8"	275	W-CW75-XD			3/8"	1-3/4"	70
5"	2"	450/550		W-CW405-TD	W-CW405-PD	1/2"	2-3/8"	400
6"	1-1/2"	300	W-CW76XD			3/8"	1-3/4"	70
6"	2"	500/600		W-CW406-TD	W-CW406-PD	1/2"	2-3/8"	400
8"	2"	500/600		W-CW408-TD	W-CW408-PD	1/2"	2-3/8"	400
SUPER ROLL NEOPRENE - SOFT LOW PROFILE TREAD FOR EASY STARTING AND ROLLING								
4"	1-3/8"	250	W-CW64-XSR			3/8"	1-1/2"	60
4"	1-3/8"	300	W-CW74-XSR			3/8"	1-3/4"	70
5"	1-3/8"	275	W-CW65-XSR			3/8"	1-1/2"	60
5"	1-3/8"	350	W-CW75-XSR			3/8"	1-3/4"	70
6"	1-1/2"	400	W-CW76-XSR			3/8"	1-3/4"	70
SOLID ELASTOMER WHEELS - VERY LOW STARTING AND ROLLING RESISTANCE - ERGO*								
4"	1-3/8"	600			W-CW74-PSE	3/8"	1-3/4"	70
5"	1-3/8"	600			W-CW75-PSE	3/8"	1-3/4"	70
5"	2"	1000			W-CW405-PSE	1/2"	2-3/8"	400
6"	1-3/8"	600			W-CW76-PSE	3/8"	1-3/4"	70
6"	2"	1000			W-CW406-PSE	1/2"	2-3/8"	400
8"	2"	1000			W-CW408-PSE	1/2"	2-3/8"	400

MEDICAL APPLICATIONS

Darcor manufactures a complete line of ergonomically designed casters for medical and diagnostic equipment such as portable x-ray machines, MRI's and ultrasound machines. Darcor's twin wheel casters – featuring directional locks, brakes and central locking systems – are available with either LE or Neoprene wheels, which are quiet, non-marking and shock absorbent. Darcor is proud to manufacture a complete line of products that exceed current medical industry standards.



M6 SERIES

The Darcor M6 incorporates an advanced caster design and central locking mechanism that makes it an excellent choice for transporting the most sensitive diagnostic equipment. It can be custom-configured to meet the customer's precise specifications.

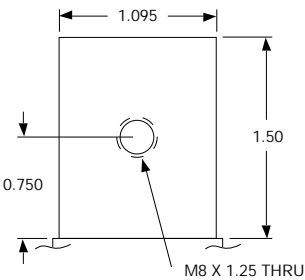


M5 SERIES

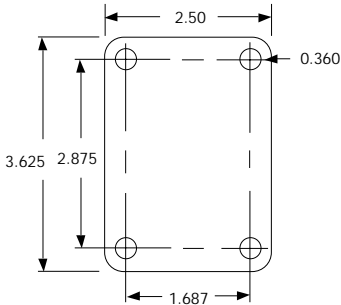
The robust, twin-wheel design of the M5 caster makes it ideal for applications, such as bariatric beds, where strength and maneuverability are critical. Equipped with shock-dampening wheels to cushion its load, the M5 is widely used in health-care facilities around the world.

SERIES	INSTALLATION	WHEEL DIA.	TREAD WIDTH	LOAD CAP./LBS	BRG TYPE SWIVEL/WHEEL	BRAKE MODEL	SWIVEL MODEL	SW. RAD	O. A. H.
M5	TOP PLATE	5"	1"	300	PRECISION/BALL	T-CLM5-XD	T-M5-XD	4-5/8"	6-7/8"
	STEM	5"	1"	300	PRECISION/BALL	S-CLM5-XD	S-M5-XD	4-5/8"	5-7/8"
M6	TOP PLATE	6"	7/10"	250	PRECISION/PRECISION	T-CLM6-PD	T-M6-PD	5-3/8"	8"
	STEM	6"	7/10"	250	PRECISION/PRECISION	S-CLM6-PD	S-M6-PD	5-3/8"	7"

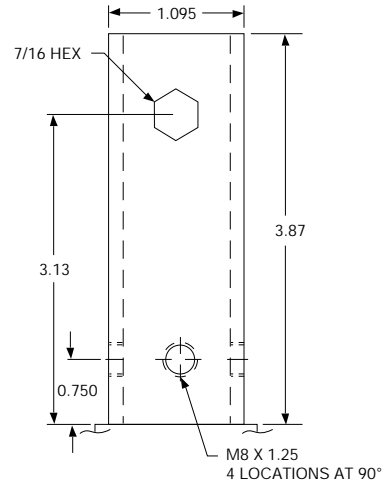
- Mounting Option: Stem Diameter 1.1" (28 mm) Available as CL (Industry STD)
- Wheel Option: Neoprene (LE as special order)
- Finish: Off White on M5 models
Grey on M6 models



SWIVEL STEM



TOP PLATE



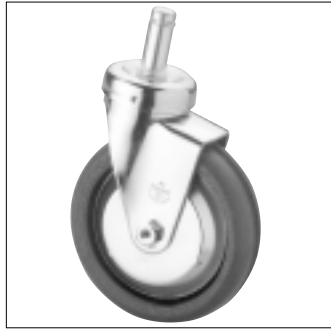
CENTRAL LOCK STEM (BRAKE MODEL)

HOSPITAL BED CASTER

LOCKS SWIVEL AND WHEEL



OU-BC65B-XSR



OU-BC5-XSR

FEATURES

Our brake and swivel locking bed caster is the first North American design of this type. Designed with a cam action locking mechanism, the lever easily engages and disengages with the touch of a toe. As well as offering easy access, the lever design keeps it within the swivel radius of the caster, eliminating any interference. The assembly is available with nickel chrome finish (BC5) or zinc finish (BC45) and equipped with our non-marking Super Roll neoprene wheel complete with ball bearings.



OU125-BC5B2-XSR

KEYWAY SOCKETS AND STEM

Prevents stem from turning inside socket. For use with hospital bed total lock brakes.

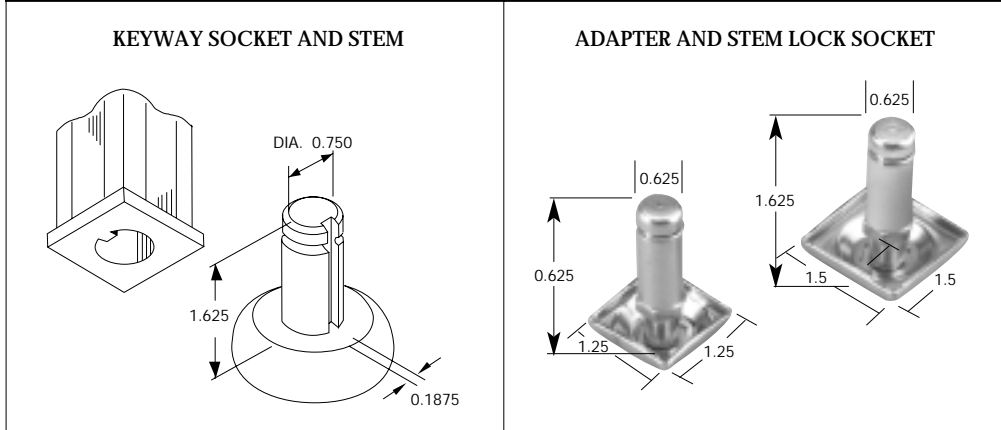
- CSK 125 - Fits inside 1-1/4"
14 Gauge square tubing
- CSK 150 - Fits inside 1-1/2"
18 Gauge square tubing
- CSK 158 - Fits inside 1-5/8"
16 Gauge round tubing

ADAPTER AND STEM LOCK SOCKET

Prevents stem from turning. For use with hospital bed total lock brakes.

- OU 125 - Fits over 1-1/4"
OD square tubing
- OU 150 - Fits over 1-1/2"
OD square tubing

INSTALLATIONS



WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BEARING TYPE	SWIVEL MODEL	BRAKE MODEL	SWIVEL RADIUS	OVERALL HEIGHT
NEOPRENE SUPER ROLL - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
4"	1-3/8"	275	BALL	OU-BC64-XSR	OU-BC64B-XSR*	3-1/4"	5-3/8"
5"	1-3/8"	325	BALL	OU-BC65-XSR	OU-BC65B-XSR*	4"	6-3/8"
NEOPRENE SUPER ROLL - NON MARKING AND NON STAINING - USED ON ANY FLOOR SURFACE - ERGO*							
4"	1-3/8"	275	BALL	OU-BC4-XSR	OU-BC4B-XSR*	3-1/4"	5-3/8"
5"	1-3/8"	325	BALL	OU-BC5-XSR	OU-BC5B-XSR*	4"	6-3/8"

- B2 brake casters available on BC64 and BC65 casters with additional charge.
- All bed casters shown with OU 5/8" x 1-5/8" grip ring stem, optional stems and sockets as shown. Also available with all 60 series stems and top plates see pages 14,15 and 16.

* Stems should be secured on brake casters to prevent turning when swivel lock is engaged.

* Ergonomically designed for easy rolling.



Tel • 1-416-255-8563

Fax • 1-416-251-6117



HOSPITAL CASTERS

Darcor has been supplying casters to hospitals for over 60 years and has become recognized as the leading authority for solving replacement caster problems. We have been involved in both new and existing applications for major hospitals in cities all over North America.

We recommend our specially formulated neoprene wheel for most applications found in hospitals. It is very quiet, extremely easy to roll over all surfaces including carpet and quarry tile, resists chemicals and cleaning compounds common to the hospital environment, and is **GUARANTEED NON MARKING AND NON STAINING**

For heavier loads, the **SOLID ELASTOMER** wheel is an ideal solution. On the following pages (45, 46, 47), we will identify some of the more common applications, and the casters we recommend for them. As well, we elaborated (pages 41, 42, 44) on bed casters, and wash down applications with casters specifically designed for these and other problem areas in hospitals.



OC-E2-XD

- Bedside and Overbed Tables
- O.R. Equipment
- I.V. Stands
- Office Chairs (Tile)



OC-53-XD

- I.V. Stands
- Nursery cribs
- Incubators
- Office Chairs (Carpet)



I.V. STAND FITTED WITH DARCOR NEOPRENE 53-XD

HOSPITAL CASTERS



12-24B-XD

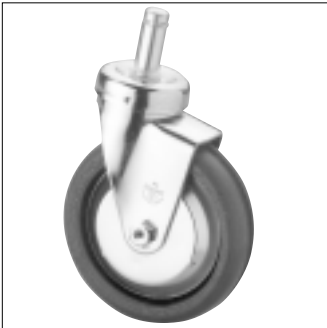


12-24-XD

- Medicine Carts
- Commode Chairs (With Stem Mount)



MEDICINE CART



OU-BC5-XSR



OU125-BC5B2-XSR

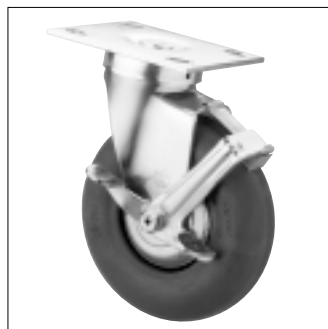
- Hospital Bed Casters available in 4" and 5" models with combination swivel lock and brake. See page 44 for complete description.



HOSPITAL BED



31-76-XD



31-76B-XD

- Portable Ultrasound Machines
- Crash Carts
- Kitchen Equipment



DIAGNOSTIC EQUIPMENT

HOSPITAL CASTERS



FOOD CART

- Supply Carts
- Linen Trucks
- Kitchen Tray Trucks
- Portable X-Ray Equipment



31-76S-XSR



31-408-TD



SUPPLY CART

- Heated Food Trucks
- Laundry Trucks
- Housekeeping Carts
- Maintenance Carts



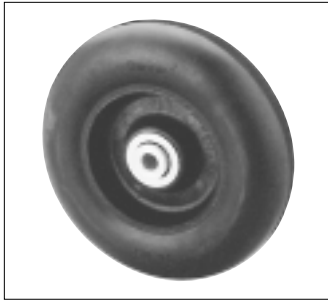
16-65B-XSR



31-76-XD

NEOPRENE WHEELS - SUPER ROLL NEOPRENE WHEELS

TREAD SYMBOL "D"



W-76-XD

NEOPRENE
TREAD SYMBOL "D"
DUROMETER - SHORE 62 "A"

Superior for all floor surfaces and ergonomically designed for excellent mobility and resistance to wear. These quiet and easy rolling wheels are very shock absorbing, non-marking and will reject floor debris, roll over screws, metal or glass fragments, resin pellets and are non-staining. Darcor "VQ" very quiet ball bearings are standard in the 20 through 70 series. Precision ball bearings "P" are recommended in the 400 series. Sizes available 2" to 8".

TREAD SYMBOL "SR"



W-76-XSR

NEOPRENE
TREAD SYMBOL "SR"
DUROMETER - SHORE 62 "A"

The "SR" wheels offer the same high quality as "D" wheels but with a low profile tread for easier swiveling and very low rolling resistance.

- Shore Hardness 59-63 "A" Scale
- Non marking and non staining
- Temperature ranges 300° F for 20 minutes, 175° F for 1 hour
- Highly resistant to wax, oils, greases, cleaning compounds, weather and ozone.
- Can be used on all floor surfaces
- Does not flat spot when sitting for long periods under load

* All Darcor "D" and "SR" wheels are mold-on wheels with a neoprene tread thermally bonded to a glass fibre reinforced nylon core for exceptional strength, impact resistance and outstanding rollability.

NEOPRENE WHEEL CHEMICAL RESISTANCE GUIDE

This table lists a broad range of fluids and chemicals which are considered compatible with our Neoprene wheel. Ratings are at 72°F unless specified otherwise. Concentrations of aqueous solutions are saturated, except where noted. Note especially that this data is based on laboratory tests and may vary in practice. Field testing is suggested to confirm these recommendations. Only those chemicals that have little or no effect on the Neoprene wheel are listed here. Other fluids may have a very minor or major effect. For information on the compatibility of other fluids contact engineering.

Acetic acid, 20%	Castor oil	Hydrochloric acid, 20%	Potassium hydroxide, dilute solutions
Acetic acid, 30%	Chlorine gas, dry	Hydrochloric acid, 37%	Sea water
Acetic anhydride	Chloroacetic acid	Hydrocyanic acid	Silicone grease
Acetone	Citric acid solutions	Hydrofluoric acid, up to 75%	Soap solutions
Acetylene	Copper chloride solutions	Hydrofluoric acid, anhydrous	Sodium chloride solutions
Aluminium chloride solutions	Copper sulfate solutions	Hydrogen	Sodium dichromate, 20%
Aluminium sulfate solutions	Cottonseed oil	Hydrogen peroxide, 90%	Sodium hydroxide, up to 23%
Ammonia, anhydrous	DOWTHERM A	Hydrogen sulfide	Sodium hydroxide, 46½%
Ammonium chloride solutions	Ethyl alcohol	Isooctane	Sodium hypochlorite, up to 20%
Ammonium hydroxide solutions	Ethylene glycol	Isopropyl alcohol	Sodium peroxide solutions
Ammonium sulfate solutions	Ferric chloride solutions	Lactic acid	Soybean oil
Amyl alcohol	Fluosilicic acid	Linseed oil	Stannic chloride
ASTM oil #1	Formaldehyde, 40%	Lubricating oils	Stannous chloride, 15%
ASTM oil #3	Formic acid	Magnesium chloride solutions	Steam
ASTM reference fuel A	FREON* -11	Magnesium hydroxide solutions	Stearic acid
Asphalt	FREON-11	Mercuric chloride solutions	Sulfur, molten
Barium hydroxide solutions	FREON-12	Mercury	Sulfur dioxide, gas
Beer	FREON-22	Methyl alcohol	Sulfur dioxide, liquid
Borax solutions	FREON-22 (130°F)	Mineral oil	Sulfuric acid, up to 60%
Boric acid solutions	FREON-113	Nitric acid, 10%	Tannic acid, 10%
Butane	FREON-113 (130°F)	Oleic acid	Tartaric acid
Butyraldehyde	FREON-114	Palmitic acid	Triethanolamine
Calcium bisulfite solutions	FREON-114 (130°F)	Phosphoric acid, 20%	Trisodium phosphate solutions
Calcium chloride solutions	Furfural	Phosphoric acid, 60%	Tung oil
Calcium hydroxide solutions	Gasoline	Phosphoric acid, 70%	Water
Calcium hypochlorite, up to 20%	Glue	Phosphoric acid, 85%	Zinc chloride solutions
Carbon dioxide	Glycerin	Pitric acid	
Carbon monoxide	n-Hexane	Potassium dichromate solutions	

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	BALL BEARING	ROLLER BEARING	PRECISION SEALED BALL BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
NEOPRENE WHEELS								
2"	1"	75	W-22-XD			5/16"	1-1/8"	20 ETERNITY 2
2"	1"	150	W-32-XD			5/16"	1-1/8"	30
3"	1"	75	W-53-XD			5/16"	1-1/8"	CARPET MASTER
3"	1"	75	W-23-XD			5/16"	1-1/8"	20
3"	1-3/8"	200	W-63-XD			3/8"	1-1/2"	60
3"	1-3/8"	225	W-73-XD			3/8"	1-3/4"	70
3-1/2"	1-3/8"	200	W-63.5-XD			3/8"	1-1/2"	60
4"	1"	75	W-24-XD			5/16"	1-1/8"	20
4"	1-3/8"	225	W-64-XD			3/8"	1-1/2"	60
4"	1-3/8"	250	W-74-XD			3/8"	1-3/4"	70
4"	2"	400/500		W-404-TD	W-404-PD	1/2"	2-5/16"	400
5"	1"	75	W-25-XD			5/16"	1-1/8"	20
5"	1-3/8"	250	W-65-XD			3/8"	1-1/2"	60
5"	1-3/8"	275	W-75-XD			3/8"	1-3/4"	70
5"	2"	450/550		W-405-TD	W-405-PD	1/2"	2-5/16"	400
6"	1-5/8"	300	W-76-XD			3/8"	1-3/4"	70
6"	2"	500/600		W-406-TD	W-406-PD	1/2"	2-5/16"	400
8"	2"	500/600		W-408-TD	W-408-PD	1/2"	2-5/16"	400
SUPER ROLL NEOPRENE WHEELS								
2-1/2"	1"	75	W-22.5-XSR			5/16"	1-1/8"	20
2-1/2"	1"	150	W-32.5-XSR			5/16"	1-1/8"	30
2-1/2"	1-3/8"	175	W-62.5-XSR			3/8"	1-1/2"	60
3-1/2"	1-3/8"	225	W-63.5-XSR			3/8"	1-1/2"	60
4"	1-3/8"	225	W-64-XSR			3/8"	1-1/2"	60
4"	1-3/8"	300	W-74-XSR			3/8"	1-3/4"	70
5"	1-3/8"	275	W-65-XSR			3/8"	1-1/2"	60
5"	1-3/8"	350	W-75-XSR			3/8"	1-3/4"	70
6"	1-1/2"	400	W-76-XSR			3/8"	1-3/4"	70



W-406-PSE

- Shore Hardness 55 + 1 "D" Scale
- Temperature Ranges -40°F to 230°F.
- Resistant to Wide Range of Chemicals.
- A must for tow line applications.
- Extraordinarily easy to push.
- Shows minimal wear in extended use.
- Shock absorbing and extremely quiet.
- Resists abrasion and many hazardous chemicals.
- Displays extremely low heat build-up in continuous use.
- No maintenance required for precision bearings.
- No flat spotting.

ROLLABILITY TESTS DARCOR "SE" VS THE COMPETITION

Tests were conducted using a platform truck equipped with two swivel and two rigid 6 x 2 casters loaded with a total of 2150 pounds (537 per caster). The effort required to start and maintain the truck in motion was measured. The swivelling test was conducted by aligning the two swivel casters at 90° to the direction of travel.

Each test was conducted three times and the results averaged. Variations of twenty percent were common. The greatest variation was experienced when the forces required were greater than eighty pounds due to the physical effort required. All tests were conducted manually with appropriate force gauges, and roller bearings in the wheel.

The ranking of the various wheels gave the greatest weight to starting and rolling. It was felt that swivelling could be affected by the shape of the tread and would not be as valid an indication of performance.

TEST RESULTS

RANK	MANUFACTURER & TYPE OF WHEEL	HARDNESS SHORE D	LOAD LBS	START LBS	ROLL LBS	SWIVEL LBS
#1	DARCOR Solid Wheel - SE	55 ^o	2150	16	11	65
#2	DARCOR TD NEOPRENE	60-65 ^A	2150	26	24	115
#3	DARCOR Cast Iron Core - Cast Urethane	55	2150	34	25	120
#4	Competitor #1 Aluminium Core-Moulded Wheel	58	2150	35	25	130
#5	Competitor #2 Solid Wheel	60	2150	38	26	80
#6	Competitor #3 Thermoplastic Core - Thermoplastic Rubber	67 ^A	2150	43	27	117
#7	DARCOR Solid Wheel - Hard Rubber	78 ^o	2150	44	33	66
#8	Competitor #4 Aluminium Core - Cast Urethane	40-100	2150	44	38	145
#9	Competitor #5 Thermoplastic Core - Thermoplastic Urethane	50-60	2150	58	53	130
#10	Competitor #6 Thermoplastic Core - Thermoplastic Urethane	40-70	2150	63	49	130
#11	Competitor #7 Solid Wheel - Cast Urethane	60	2150	66	52	135
#12	Competitor #8 Aluminium Core - Thermoplastic Urethane	60	2150	120	90	150

DATRYL, as used in the "SE" WHEEL, is a proprietary blend of elastomers and other constituents to produce a wheel which we believe is superior in performance to conventional urethane, hard rubber and Phenolic wheels.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAPACITY	BALL BEARING	PRECISION SEALED BALL BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
2-1/2"	1-1/4"	300	W-62.5-XSE		3/8"	1-1/2"	60
3"	1-3/8"	500		W-73-PSE	3/8"	1-3/4"	70
	2"	900		W-403-PSE	1/2"	2-5/16"	400
3-1/2"	1-1/4"	350	W-63.5-XSE		3/8"	1-1/2"	60
4"	1-3/8"	600		W-74-PSE	3/8"	1-3/4"	70
	2"	1000		W-404-PSE	1/2"	2-5/16"	400
5"	1-3/8"	700		W-75-PSE	3/8"	1-3/4"	70
	2"	1000		W-405-PSE	1/2"	2-5/16"	400
6"	2-1/2"	1350		W-805-PSE	3/4"	2-3/4"	700/800
	1-3/8"	750		W-76-PSE	3/8"	1-3/4"	70
6"	2"	1100		W-406-PSE	1/2"	2-5/16"	400
	2-1/2"	1500		W-806-PSE	3/4"	2-3/4"	700/800
8"	2"	1200		W-408-PSE	1/2"	2-5/16"	400
	2-1/2"	1650		W-808-PSE	3/4"	2-3/4"	700/800
10"	2-1/2"	1800		W-810-PSE	3/4"	2-3/4"	700/800

URETHANE WHEELS

TREAD SYMBOL "U"



W-406-TU

Shore Hardness: 95 "A" Scale
 A Urethane Tread moulded and bonded to a steel core. Recommended for heavy loads and rough floor conditions. Resistant to a wide range of chemicals, oils and solvents.
 Withstands temperature ranges from 25°F below 0 up to 200°F.
 Resists abrasion and flat spotting.



W-8510-YU

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	ROLLER BEARING	TAPERED BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
3-1/2"	2"	800	W-403.5-TU		1/2"	2-5/16"	400
4"	1-3/8"	600	W-74-TU		3/8"	1-3/4"	70
4"	2"	900	W-404-TU		1/2"	2-5/16"	400
5"	1-3/8"	600	W-75-TU		3/8"	1-3/4"	70
5"	2"	1000	W-405-TU		1/2"	2-5/16"	400
6"	1-3/8"	600	W-76-TU		3/8"	1-3/4"	70
6"	2"	1000	W-406-TU		1/2"	2-5/16"	400
6"	2-1/4"	1500	W-806-TU		3/4"	2-3/4"	700/800
6"	3"	2500	W-5006-TU	W-5006-YU	3/4", 1"	3-3/8"	900, 5000, 5200
8"	2"	1000	W-408-TU		1/2"	2-5/16"	400
8"	2-1/2"	1800	W-808-TU		3/4"	2-3/4"	700/800
8"	3"	3000	W-5008-TU	W-5008-YU	3/4", 1"	3-3/8"	900, 5000, 5200
10"	3"	3500	W-5010-TU	W-5010-YU	3/4", 1"	3-3/8"	900, 5000, 5200
10"	4"	8000		W-8010-YU	1-1/2"	4-1/2"	WHEEL ONLY
10"	5"	10,000		W-8510-YU	1"	5-1/2"	SL-8510
12"	3"	4000	W-5012-TU	W-5012-YU	3/4", 1"	3-1/4"	900, 5000, 5200
16"	5"	8400		W-8016-YU	1-1/2"	5-1/2"	8216

Additional Bore Sizes available.

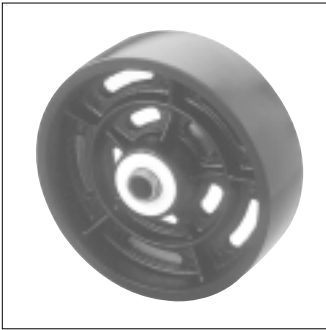
400 Series - 3/4"

700 Series - 1/2", 1"

5000 Series - 1-1/4"

SEMI-STEEL WHEELS

TREAD SYMBOL "CI"



W-406-TCI

A Semi-Steel Casting of a close-grained high tensile iron. All Wheels are crowned to help prevent floor damage, and improve swiveling. Also available in "Grooved" type for inverted angle iron applications. See Page 36.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	SLEEVE BEARING	ROLLER BEARING	TAPERED BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
2"	1"	100	W-22-CI			5/16"	1-1/8"	20
2-1/2"	1"	125	W-22.5-CI			5/16"	1-1/8"	20
2-1/2"	1-1/4"	400	W-62.5-CI			3/8"	1-1/2"	60
3"	1-3/8"	400	W-63-CI			3/8"	1-1/2"	60
3"	1-3/8"	500	W-73-CI	W-73-TCI		3/8"	1-3/4"	70
3"	1-7/8"	900		W-403-TCI		1/2"	2-5/16"	400
3-1/2"	1-3/8"	400	W-63.5-CI			3/8"	1-1/2"	60
4"	1-3/8"	400	W-64-CI			3/8"	1-1/2"	60
4"	1-3/8"	600	W-74-CI	W-74-TCI		3/8"	1-3/4"	70
4"	1-7/8"	1000		W-404-TCI		1/2"	2-5/16"	400
5"	1-3/8"	400	W-65-CI			3/8"	1-1/2"	60
5"	1-3/8"	600	W-75-CI	W-75-TCI		3/8"	1-3/4"	70
5"	1-7/8"	1000		W-405-TCI		1/2"	2-5/16"	400
5"	2-1/4"	1500		W-805-TCI		3/4"	2-3/4"	700/800
6"	1-3/8"	600	W-76-CI			3/8"	1-3/4"	70
6"	1-7/8"	1000		W-406-TCI		1/2"	2-5/16"	400
6"	2-1/4"	1700		W-806-TCI		3/4"	2-3/4"	700/800
6"	3"	5000		W-5006-TCI	W-5006-YCI	3/4", 1"	3-3/8"	900, 5000, 5200
8"	1-7/8"	1000		W-408-TCI		1/2"	2-5/16"	400
8"	2-1/4"	1800		W-808-TCI		3/4"	2-3/4"	700/800
8"	3"	5000		W-5008-TCI	W-5008-YCI	3/4", 1"	3-3/8"	900, 5000, 5200
10"	2-1/4"	2200		W-810-TCI		3/4"	2-3/4"	700/800
10"	3"	5000		W-5010-TCI	W-5010-YCI	3/4", 1"	3-3/8"	900, 5000, 5200
12"	3"	5000		W-5012-TCI	W-5012-YCI	3/4", 1"	3-3/8"	900, 5000, 5200

Additional Bore Sizes available:

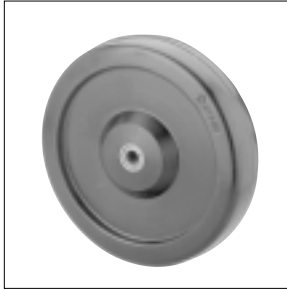
400 Series - 3/4"

700 Series - 1/2", 1"

5000 Series - 1-1/4"

RUBBER WHEELS

TREAD SYMBOL " K "



W- 75-K

Shore Hardness: 85-90 "A" Scale.
Semi resilient rubber. A tough robust wheel.
Recommended for temperature ranges from 0°F to 110°F.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	SLEEVE BEARING	BALL BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
2"	1"	75	W-22-K		5/16"	1-1/8"	20
2-1/2"	1"	75	W-22.5-K		5/16"	1-1/8"	30
2-1/2"	1"	100		W-32.5-XK	5/16"	1-1/8"	30
3"	1"	75	W-23-K		5/16"	1-1/8"	30
3-1/2"	1-3/8"	150	W-63.5-K		3/8"	1-1/2"	60
4"	1"	75	W-24-K		5/16"	1-1/8"	20
4"	1-3/8"	175	W-64-K		3/8"	1-1/2"	60
4"	1-3/8"	300	W-74-K		3/8"	1-3/4"	70
5"	1-3/8"	175	W-65-K		3/8"	1-1/2"	60
5"	1-3/8"	300	W-75-K		3/8"	1-3/4"	70
6"	1-3/8"	300	W-76-K		3/8"	1-3/4"	70

HARD RUBBER WHEELS

TREAD SYMBOL " H "



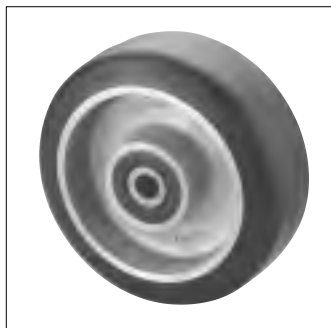
W-75-H

An extremely durable synthetic rubber material formed under very high pressure.
Tremendous wearing characteristics.
Shore Hardness: 78 "D" Scale.
NOT affected by oil, grease, water, gas or cleaning compounds.
Non-Conductive.
Temperature range 110°F max. to -40°F.
Not recommended for use on tile.
Identification: Brown in colour.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	SLEEVE BEARING	BALL BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
2"	1"	100	W-22-H	W-22-XH	5/16"	1-1/8"	20
2"	1"	150		W-32-XH	5/16"	1-1/8"	30
2-1/2"	1"	125	W-22.5-H		5/16"	1-1/8"	20
2-1/2"	1"	150		W-32.5-XH	5/16"	1-1/8"	30
3"	1"	125	W-23-H		5/16"	1-1/8"	20
3"	1-3/8"	350	W-63-H		3/8"	1-1/2"	60
3"	1-3/8"	500	W-73-H		3/8"	1-3/4"	70
3-1/2"	1-3/8"	375	W-63.5-H		3/8"	1-1/2"	60
4"	1"	125	W-24-H		5/16"	1-1/8"	20
4"	1-3/8"	400	W-64-H		3/8"	1-1/2"	60
4"	1-3/8"	550	W-74-H		3/8"	1-3/4"	70
5"	1-3/8"	400	W-65-H		3/8"	1-1/2"	60
5"	1-3/8"	600	W-75-H		3/8"	1-3/4"	70
6"	1-3/8"	600	W-76-H		3/8"	1-3/4"	70

INDUSTRIAL WHEELS

TREAD SYMBOL " N "



W-908-TN

Aluminium core with roller bearing and protective outer seal.
 Black natural rubber tread bonded to core.
 Hardness - 70 Shore 'A'
 Tread resists chipping and abrasion as well as flat spotting.
 High quality natural rubber allows for ease in mobility.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	ROLLER BEARING	TAPERED BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
6"	3"	700	W-906-TN	W-906-YN	3/4"	3-3/8"	900, 5200
8"	3"	900	W-908-TN	W-908-YN	3/4"	3-3/8"	900, 5200
10"	3"	1100	W-910-TN	W-910-YN	3/4"	3-3/8"	900, 5200
12"	3"	1200	W-912-TN	W-912-YN	3/4"	3-3/8"	900, 5200
14"	3"	1350	W-914-TN	W-914-YN	3/4"	3-3/8"	WHEEL ONLY
16"	3"	1550	W-916-TN	W-916-YN	3/4"	3-3/8"	WHEEL ONLY

Optional Bore sizes: 1", 1-1/4"

"1-1/4" Bore is not supplied with a hardened spanner bushing

PNEUMATIC WHEELS

TREAD SYMBOL " PN "



W-3118-YPN

Fully Pneumatic with separate inner tube and wheel discs of heavy gauge metal.
 Polyurethane filling is available.
 Pneumatics do require inflation.
 Lubrication through nipple in hub.

WHEEL DIAMETER	TREAD WIDTH	LOAD CAP./LBS	MAX. AIR PRESSURE	ROLLER BEARING	TAPERED BEARING	BORE SIZE	HUB LENGTH	USED IN CASTER SERIES
8"	2-3/8"	300	100 PSI	W-308-TPN		1/2", 3/4"	3-1/4"	300
10"	3-5/8"	350	80 PSI	W-310-TPN		1/2", 3/4"	3-1/4"	300
16"	4-1/2"	750	70 PSI		W-3116-YPN	5/8"	4-1/4"	3100, 3200
18"	5-3/4"	900	60 PSI		W-3118-YPN	5/8"	4-1/4"	3100, 3200, 3300

NON-MARKING PROTECTIVE BUMPERS

PROTECTS WALLS AND EQUIPMENT



C-1676

C-1676 Corner Bumpers
Made especially for use with C-567 Strip Bumper to give a uniform continuous effect all around the equipment.



C-833

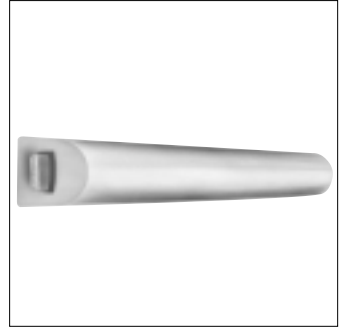
C-833 Corner Bumper
Made to give adequate protection to all surfaces that may be contacted, such as doors, door facings, walls, furniture, and other equipment. Easily attached by using self-tapping sheet metal screws.

C-813 Donut Bumpers
Commonly installed on the ends of tubular handles to give needed protection in manipulation of equipment. Note: steel insert around mounting hole. Attached to wood with wood screws or to metal with rivets, bolts, or metal screws.



C-813

Model C-567 Strip Bumper
A flat based rubber strip bumper designed for installation on either metal or wood surfaces. This model is easily applied and does not require a special channel.



C-567

(MI-500- Flat Bar Metal Inserts 1/8" x 1/2" for C-567, ordered separately, subject to cutting charge).

FLOOR LOCKS

SECURES LOAD IN POSITION



634

HOW TO OPERATE FLOOR LOCKS

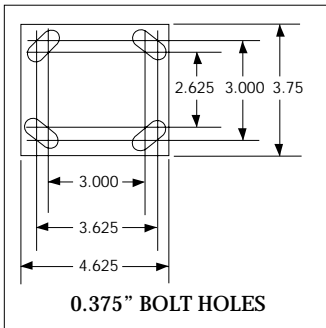
Press down to lock. Press down to release. Double non-slip pedals.

Simply press down on larger pedal to set positive lock. (This moves second pedal into top or up position.)

Press down on release pedal and spring quickly returns lock to non-operating position. Both pedals are out in front for safety and ease of operation.


INSTALLATION RECOMMENDATIONS FOR CASTER & FLOOR LOCK.

It is important to select a Caster with an overall height to permit the floor lock to clear the floor in retracted position. The clearance between floor and floor lock rubber pad should be minimal in order to use as much pressure from spring locking device. This will ensure better holding pressure from lock.



No. 31 Top Plate

MODEL NUMBER	EXTENDED HEIGHT	RETRACTED HEIGHT
558	5-5/8"	5"
614	6-1/4"	5-5/8"
634	6-3/4"	6-1/8"
734	7-3/4"	7"

ABRASION RESISTANCE:	The ability of a wheel to resist wear due to use with various floor materials.
AXLE & NUT:	Retains wheels in the yoke.
BOLT HOLE SPACING:	The distance from the centre of one bolt hole to the centre of the next. Where slotted bolt holes are used, two dimensions will be shown.
BORE SIZE:	The axle diameter required for installing a wheel.
CASTER:	One complete unit consisting of all basic caster components: top plate, yoke, wheel, wheel bearing, thread guards, axle nut and washer.
CHEMICAL RESISTANCE:	The degree to which a wheel or tread material is affected when exposed to chemicals.
COMPLETE WHEEL:	The wheel, wheel bearing and related parts, and thread guards.
COMPRESSION SET:	(Also referred to as set or flat spotting.) The effect on a wheel, under load, after a given period of time.
CONDUCTIVE WHEELS:	Measurement of a wheel material's ability to dissipate static electricity (as in anti-static or spark proof wheels).
CROWN:	The Radius molded or machined on the periphery of the wheel to reduce swivelling effort.
DUROMETER (HARDNESS):	SYSTEM for establishing how hard or soft a wheel is. Measured as shore hardness on either the "A" scale for softer tread materials, or the "D" scale for harder tread materials.
DUSTCAP:	Encloses the hardcap to protect the raceway from foreign materials.
DYNAMIC LOAD:	The maximum load on a caster in motion under normal conditions.
ERGONOMICS:	A way of thinking about the design of tools and equipment, the layout of workplaces, and the overall organization of work. The goal of ergonomics is the realization of production and health/safety benefits by fitting the job to the person rather than making the person fit the job.
	
HARDCAP:	The thrust bearing upper raceway.
HUB LENGTH:	The distance from one edge of the hub (axle opening) to the other.
KING BOLT OR RIVET:	Holds swivel components together. A King Bolt is threaded with a nut tightened over the lower end of the swivel. A rivet is either staked through, or orbitally connected to the swivel.
LOAD CAPACITY:	The recommended maximum weight to be carried by a single caster or wheel.
MOBILITY:	Defines the degree of freedom of movement.
OVERALL HEIGHT:	The vertical distance between the top of the caster mounting plate and the bottom of the wheel. When using a stem, this dimension is reduced by the thickness of the top plate.
RESILIENCY:	The amount of spring or bounce in a wheel and the resulting effect on rolling resistance.
RIGID CASTER:	A basic caster unit which does not swivel.
ROLLING RESISTANCE:	The amount of effort required to move a load usually measured in pounds of force.
SHOCK LOAD:	The maximum load a caster can withstand under shock conditions.
SOLID ELASTOMER:	A breakthrough advance in wheel technology, exclusive to Darcor. Solid elastomer wheels are renowned for low rolling resistance, imperviousness to harsh chemicals, and perfect shape retention even after long-term exposure to temperature and load extremes.
STATIC LOAD:	The maximum load on a caster when movement or shock are not present.
SWIVEL CASTER:	A basic caster unit with the addition of a bearing that allows the caster to swivel about a vertical axis.
SWIVEL RACEWAY:	The part of the swivel that contains the bearings.
SWIVEL RADIUS:	The radius required for a caster to swivel freely. Determined by measuring from the centre of the King Bolt to the outside of the wheel.
TEMPERATURE RANGE:	The maximum temperature range that a wheel can operate within for a period of time and still maintain its characteristics.
THREAD GUARDS:	(Also known as string guards.) Keep foreign materials away from axle and bearings.
TOP PLATE OR STEM:	Elements for attaching a caster to a piece of equipment.
TOP PLATE SIZE:	Determined by measuring from one outside edge to the other outside edge.
TREAD WIDTH:	The distance between the outermost edges of the wheel.
WHEEL BEARINGS:	Various types of bearings available.
WHEEL SIZE:	Determined by the diameter of the wheel.
YOKE:	Supports upper and lower raceways. A rigid yoke is either a top plate with legs welded to it or a formed, single-piece top plate/yoke combination.

INTRINSICALLY SAFE MAGNETIC PICKUPS



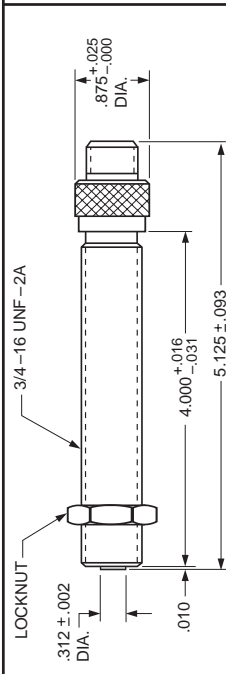
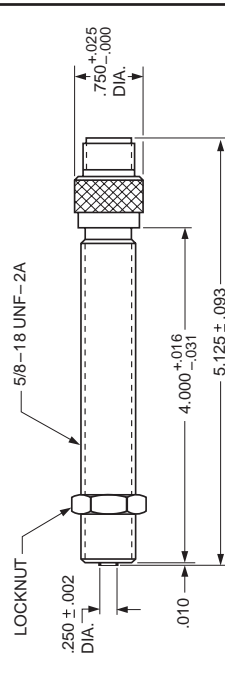
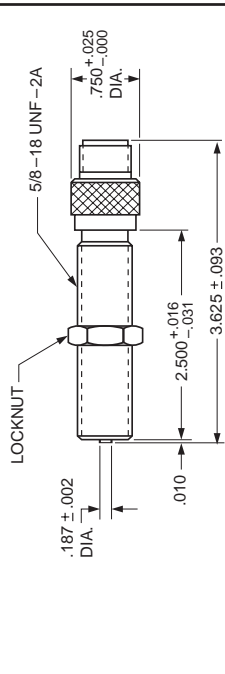
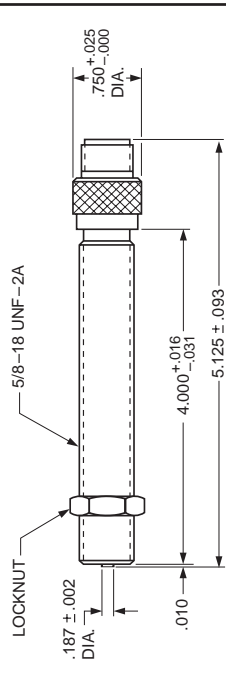
Power Source



A Crane Co. Company

Cross-Section
Output Voltage Peak-to-Peak
Temperature
DC Resistance
Inductance
Output Polarity
Output Connector
Characteristic Curve Group
Figure No. To Use For Computing
Third Party Approved
Model No.

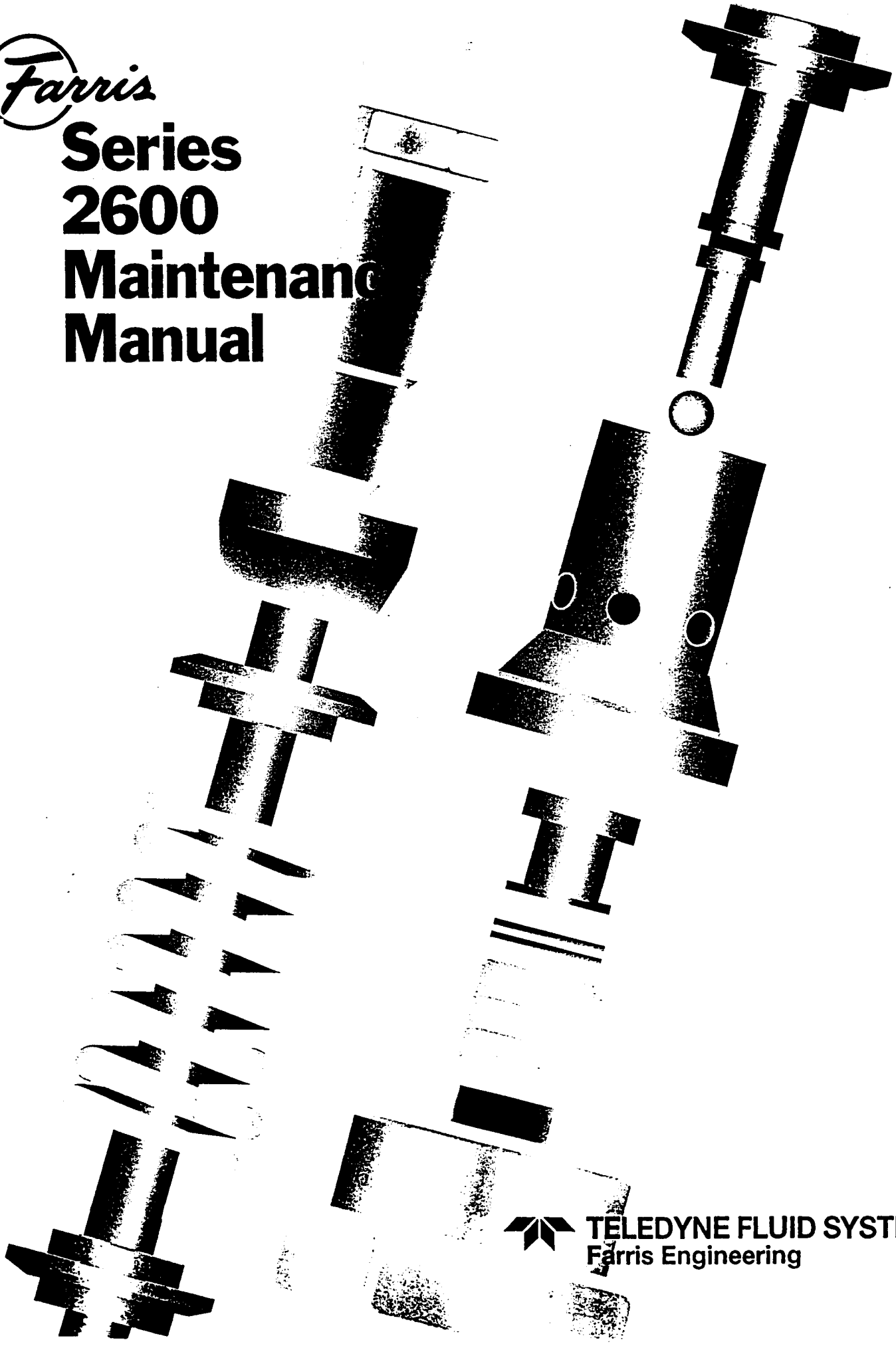
Model No.	Third Party Approved	Figure No. To Use For Computing	Characteristic Curve Group	Output Connector	Output Polarity	Inductance	DC Resistance	Temperature	Output Voltage Peak-to-Peak	DC Resistance	Inductance	Output Polarity	Output Connector	Characteristic Curve Group	Figure No. To Use For Computing	Third Party Approved	Model No.
M203	CSA ⁽⁸⁾	6	Mates With MS3106A-10SL-4S ⁽¹⁾	Pin B Positive	260 mH Nominal	550-650 Ohms	-65°F to +225°F	15-17 Volts ⁽⁴⁾		15-17 Volts ⁽⁴⁾	550-650 Ohms	260 mH Nominal	Pin B Positive	Mates With MS3106A-10SL-4S ⁽¹⁾	15	6	CSA ⁽⁸⁾
M204	CSA ⁽⁸⁾	6	Mates With MS3106A-10SL-4S ⁽¹⁾	Pin B Positive	260 mH Nominal	550-650 Ohms	-65°F to +225°F	15-17 Volts ⁽⁴⁾		15-17 Volts ⁽⁴⁾	550-650 Ohms	260 mH Nominal	Pin B Positive	Mates With MS3106A-10SL-4S ⁽¹⁾	15	6	CSA ⁽⁸⁾
M205	CSA ⁽⁸⁾	6	Mates With MS3106A-10SL-4S ⁽¹⁾	Pin B Positive	37 mH Nominal	115-140 Ohms	-65°F to +225°F	15-17 Volts ⁽⁴⁾		15-17 Volts ⁽⁴⁾	115-140 Ohms	37 mH Nominal	Pin B Positive	Mates With MS3106A-10SL-4S ⁽¹⁾	16	6	CSA ⁽⁸⁾
M207	CSA ⁽⁸⁾	--	Mates With MS3106A-10SL-4S ⁽¹⁾	Pin B Positive	4.5 mH	15-18 Ohms	-65°F to +225°F	15-17 Volts ⁽¹⁰⁾		15-17 Volts ⁽¹⁰⁾	15-18 Ohms	4.5 mH	Pin B Positive	Mates With MS3106A-10SL-4S ⁽¹⁾	--	--	CSA ⁽⁸⁾
M208	CSA ⁽⁸⁾	--	Mates With MS3106A-10SL-4S ⁽¹⁾	Pin B Positive	18 mH	55-65 Ohms	-65°F to +225°F	15-17 Volts ⁽¹⁰⁾		15-17 Volts ⁽¹⁰⁾	55-65 Ohms	18 mH	Pin B Positive	Mates With MS3106A-10SL-4S ⁽¹⁾	--	--	CSA ⁽⁸⁾



(1) A 10' shielded cable assembly with mating connector and clamp is available.
 (2) Tested at 1000 inches/sec. with a 20 pitch, 30 tooth gear. 0.005" clearance and 100,000 ohm load shunted by 250 picofarads.
 (3) Tested at 1000 inches/sec. with an 8 pitch, 12 tooth gear. 0.005" clearance and 100,000 ohm load.
 (4) Tested at 1000 inches/sec. with an 8 pitch, 12 tooth gear. 0.005" clearance and 1250 ohm load shunted by 250 picofarads.
 (5) Tested at 25°C with 12 Vdc, 20 pitch, 30 tooth gear. 0.005" clearance and 100,000 ohm load. Voltage output is independent of speed.
 (6) Tested at 100 inches/sec. with an 8 pitch gear. 0.005" clearance and 100,000 ohm load.
 (7) Tested at 50 inches/sec. with a 16 pitch gear. 0.005" clearance and 100,000 ohm load.
 (8) Only as part of CSA certified system/assembly.
 (9) Usable with any instrumentation.
 (10) Tested at 1000 inches/sec. with a 6 pitch gear. 0.005" clearance and 100,000 ohm load.

Farris

Series 2600 Maintenance Manual



TELEDYNE FLUID SYSTEMS
Farris Engineering

This Maintenance Manual is provided because you have Farris Pressure Relief Valves protecting equipment and personnel in your plant. We trust that you will find this manual useful, as it is intended to clearly present all the essential information you will need in order to keep your Farris Valves in perfect operating condition.

Generally, maintenance becomes necessary as a result of dirt or scale in the lines, exposure to service conditions, incorrect servicing, improper testing procedure, or improper installation. If you follow the instructions in this Manual, the maintenance of your valves should be reduced in effort and expense.

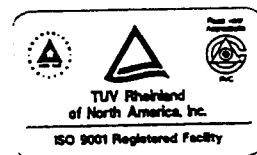
These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be

met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to Farris Engineering.

On the following pages you will find definitions of commonly used pressure relief valve terminology, cross-sectional illustrations of both conventional (A10) and Balanseal bellows (A11) 2600 Series valve designs along with a page explaining the numbering system used on this valve series. In order to get the most out of this maintenance manual you should familiarize yourself with the information on these pages and the design of the Farris 2600 Series valve line.



PRESSURE RELIEF
VALVES
AND TESTING EQUIPMENT



Series 2600
Table of Contents
(Manual Revision 3, May 1998)

Page	Topic
1&2	Type and Serial Numbering Systems
3	2600 Series Terminology
4	Conventional Valve Cross-Section and Typical Nameplates
5	Cross-Section of Valve Internals
6	Standard Bill of Material
7 - 8	Installation, Storage and Handling
7 - 8	Maintenance and Inspection
9 - 15	Disassembly of Valves
16	O-Ring Construction
17	Nozzle and Disc Refacing
17 - 18	Lapping Procedures & Compounds
19 - 22	Assembly Procedures, Lubrication, and Sealants
23 - 27	Setting, Testing, Blowdown, Leak, and Differentials
28	Trouble Shooting
Appendix A (page 29)	Required Tools
Appendix B (page 30)	External Loads
Appendix C (page 31)	Specification and Historical Record
Back Cover	General Reference Sources

TYPE AND SERIAL NUMBERING SYSTEMS

Familiarity with Farris valve type and serial numbering systems will greatly benefit anyone using this manual or any other Teledyne Farris literature. The ability to recognize certain valve type and construction features along with identifying serial numbers will assist correct maintenance procedures and spare part selection/ordering. All Farris valve nameplates contain a specific valve type number and serial number unique to the particular valve that the nameplate is attached upon. See Figure 1.2 for an example of a typical 2600 Series Nameplate.

Serial Numbering System

Each Farris pressure relief valve is assigned a unique serial number. This serial number is assigned by the factory and remains part of the factory records. Providing this serial number to the factory will assist in the identification of the construction and metallurgy of the valve in question. The following outline will give general guidelines on the serial numbering system used on 2600 Series valves.

Serial Number Suffix	Valve Type	Description	Production Dates
-A	Full nozzle valves, conventional and bellows types	This serial number suffix covered all types of constructions, i.e. Conventional, FarrisSeal, BalanSeal, Enclosed and Exposed Spring.	1943- 1955
-A2, A4 & A6	Conventional Design	Includes both 2605 and 2675 Series	1955 - 1967
-A3, A5 & A7	BalanSeal Bellows Design		
-A8	Conventional Design	Full nozzle valves conforming to API RP-526	1959 - 1976
-A9	BalanSeal Bellows Design		
-A10	2600 Conventional Design (air, steam & vapor)	Full nozzle valves conforming to API RP-526 with nozzles revised to incorporate ASME 0.9 capacity reduction factor.	1976 - present
-A11	2600 BalanSeal Design (air, steam & vapor)		
-A14	2600L Conventional Design (liquid service)	Full nozzle valves conforming to API RP-526 ASME Section VIII certified for liquid service.	1985 - present
-A15	2600L BalanSeal Design (liquid service)		
-A10/M	2600 Conventional - "O" Ring (air, steam & vapor)	Modified "D" through "K" orifice "O" ring seat design that replaced the original A10 & A11 "O" ring seat design. Starts at serial #'s above 300000.	July 1993 - July 1996
-A11/M	2600 BalanSeal - "O" Ring (air, steam & vapor)		
-A14/M	2600L Conventional - "O" Ring (liquid service)	Modified "D" through "K" orifice "O" ring seat design that replaced the original A14 & A15 "O" ring seat design. Starts at serial #'s above 300000 & above.	July 1993 - present
-A15/M	2600L BalanSeal - "O" Ring (liquid service)		
-A10/R	2600 Conventional - "O" Ring (air, steam & vapor)	"D" through "K" orifice "O" ring seat design that replaced the modified A10/M & A11 /M "O" ring seat design. Starts at serial #'s above 312123.	August 1996 - present
-A11/R	2600 BalanSeal - "O" Ring (air, steam & vapor)		

TELEDYNE FARRIS ENGINEERING BECKSVILLE, OHIO U.S.A.			
TYPE	26FB10-120		
SIZE AND ORIFICE	1-1/2F2	SET PRESS.	110 PSIG
BACK PRESSURE	10		PSIG
COLD DIFF. TEST PRESS.	110		PSIG
CAPACITY AT 10% OVER PRESSURE	790	STD. SCFM AIR	
		LEASHR SAT. STEAM	
SERIAL	21310-A11	TAG	PSV-13489A

Figure 1.2

Type Numbering System

The diagram below illustrates the Farris 2600 Series valve type numbering system. You will find this type of number on the nameplate of every Farris 2600 Series valve. The number found on each valve nameplate describes the valve with its construction and metallurgy. Valve types with numbers ending in "SP" are special valves. Example; (26DA10-120/S4/SP).

It may be necessary to contact the factory for assistance when replacement parts or maintenance is required on such valves.

Complete standard metallurgy details for individual parts in the 2600 Series valve line can be obtained by consulting a current sales catalog.

Example: Valve Type H26QA10L-120/S4



VALVE TERMINOLOGY

SAFETY VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve, and characterized by rapid full opening or pop action. It is used for steam, gas, or vapor service.

RELIEF VALVE - An automatic pressure relieving device actuated by the static pressure upstream of the valve which opens in proportion to the increase in pressure over the opening pressure. It is used primarily for liquid service.

SAFETY RELIEF VALVE - An automatic pressure actuated relieving device suitable for use as either a safety or relief valve, depending on application.

PRESSURE RELIEF VALVE - A pressure relief valve is a pressure relief device which is designed to reclose and prevent the further flow of fluid after normal conditions have been restored.

SET PRESSURE - Set pressure, in pounds per square inch gage, is the inlet pressure at which the pressure relief valve is adjusted to open under service conditions. In a safety or safety relief valve in gas, vapor, or steam service, the set pressure is the inlet pressure at which the valve starts to discharge under service conditions.

DIFFERENTIAL SET PRESSURE - The pressure differential in pounds per square inch between the set pressure and the constant superimposed back pressure. It is applicable only when a conventional type safety relief valve is being used in service against constant superimposed back pressure.

COLD DIFFERENTIAL TEST PRESSURE - Cold differential test-pressure, in pounds per square inch gage, is the inlet static pressure at which the pressure relief valve is adjusted to open on the test stand. This pressure includes the corrections for service conditions of back pressure or temperature, or both.

OPERATING PRESSURE - The operating pressure of a vessel is the pressure, in pounds per square inch gage, to which the vessel is usually subjected in service. A vessel is usually designed for a maximum allowable working pressure, in pounds per square inch gage, which will provide a suitable margin above the operating pressure in order to prevent any undesirable operation of the relief device. (It is suggested that this margin be as great as possible consistent with economical vessel and other equipment design, system operation and the performance characteristics of the pressure relieving device.)

MAXIMUM ALLOWABLE WORKING PRESSURE - Maximum allowable working pressure is the maximum gage pressure permissible at the top of a completed vessel in its operating position for a designated temperature. This pressure is based on calculations for each element in a vessel using nominal thicknesses, exclusive of allowances for corrosion and thickness required for loadings other than pressure. It is the basis for the pressure setting of the pressure-relieving devices protecting the vessel. The design pressure may be used in place of the maximum allowable working pressure in cases where calculations are not made to determine the value of the latter.

OVERPRESSURE - Overpressure is a pressure increase over the set pressure of a pressure relief valve, usually expressed as a percentage of set pressure.

ACCUMULATION - Accumulation is the pressure increase over the maximum allowable working pressure of the vessel during discharge through the pressure relief valve, expressed as a percent of that pressure or in pounds per square inch.

BLOWDOWN - Blowdown is the difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units.

LIFT - Lift is the actual travel of the disk away from closed position when a valve is relieving.

BACK PRESSURE - Back pressure is the static pressure existing at the outlet of a pressure relief device due to pressure in the discharge system.

CONSTANT BACK PRESSURE - Back pressure which does not change appreciably under any condition of operation whether the pressure relief valve is closed or open.

VARIABLE BACK PRESSURE - The pressure existing at the outlet of a pressure relief device, which does not remain constant when the pressure relief valve is closed.

BUILT-UP PRESSURE - Built-up back pressure is pressure existing at the outlet of a pressure relief device occasioned by the flow through that particular device into a discharging system.

SUPERIMPOSED BACK PRESSURE - Superimposed back pressure is the static pressure existing at the outlet of a pressure relief device at the time the device is required to operate. It is the result of pressure in the discharge system from other sources.

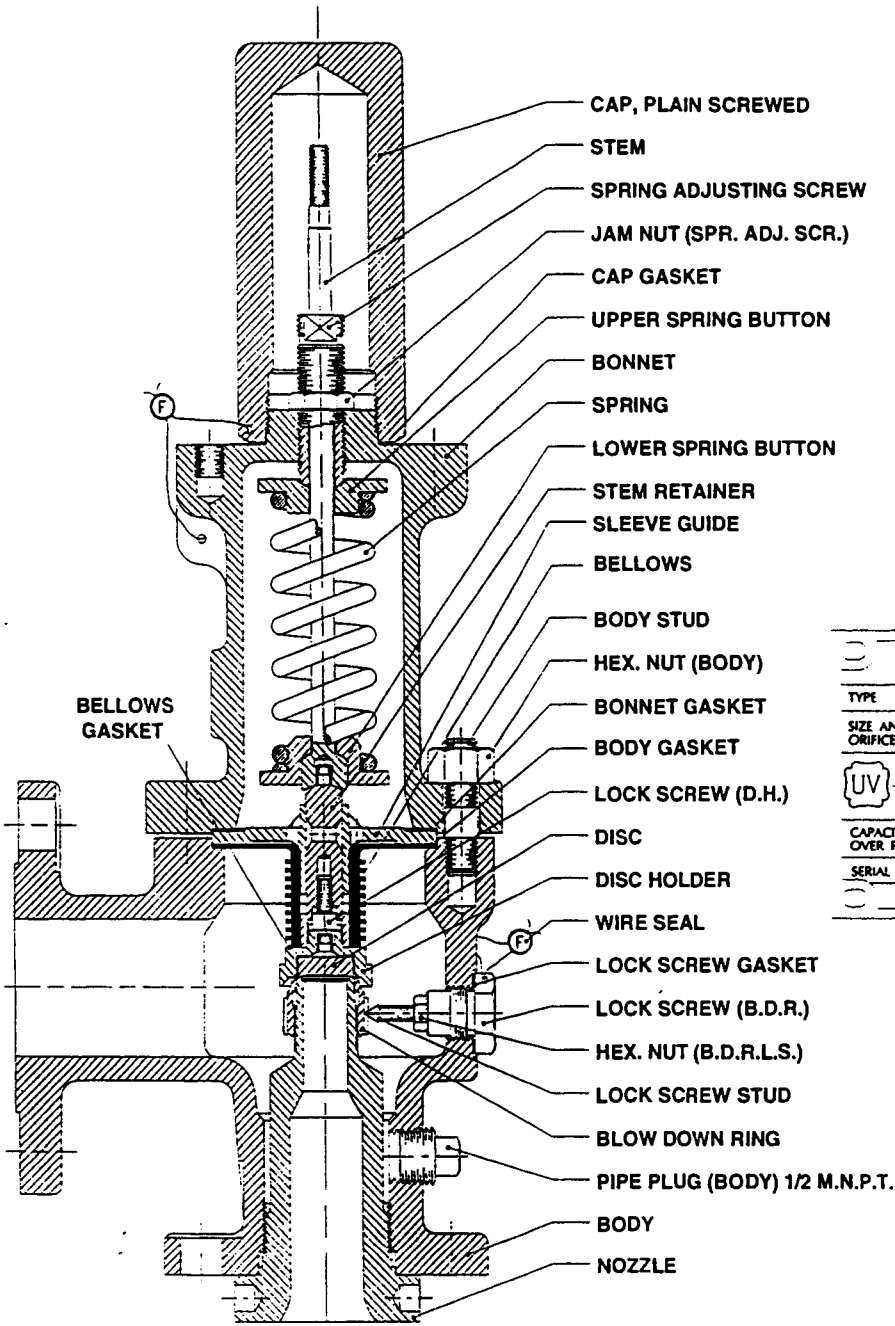


Figure 1.3



Figure 1.1

TELEDYNE FLUID SYSTEMS FARRIS ENGINEERING			
TYPE	26FB10-120		
SIZE AND ORIFICE	1-1/2F2	SET PRESS.	110 PSIG
UV	BACK PRESSURE	10	PSIG
	COLD DIFF. TEST PRESS.	110	PSIG
CAPACITY AT 10% OVER PRESSURE	790	ST'D. SCFM AIR	NB
SERIAL	21310-A11	TAG	PSV-13489A
			LBS/HR SAT. STEAM

Figure 1.2

Notes: Figure 1.1 Only BalanSeal® bellows equipped valves are supplied with this identifying plate. The maximum backpressure figure indicated thereon is a design rating and in actual usage the backpressure should not exceed 80% of the valve set pressure as applicable for the particular model.

Figure 1.2 The nameplate illustrated is typical and may contain more or less information depending on the actual valve model supplied.

Figure 1.3 The BalanSeal® safety valve cross-section illustrated is typical and actual construction details will vary depending on valve size and pressure rating. Consult the other illustrations contained elsewhere in this manual for greater detail or consult the factory for a cross-section drawing for the actual valve size and pressure rating.

INTERNALS FOR A10/A11 & A14/A15 SERIES

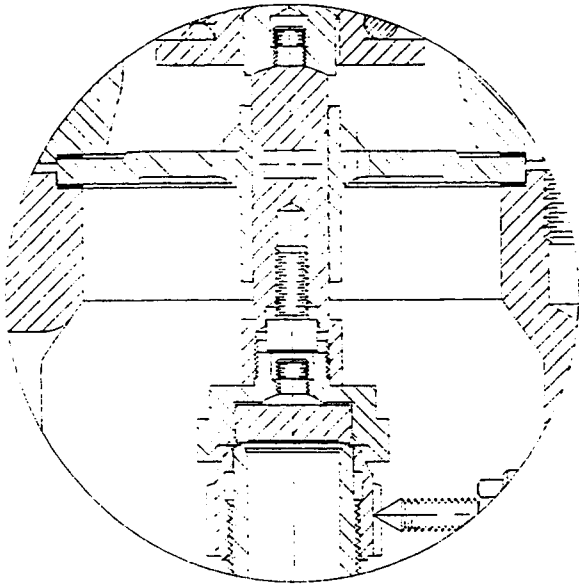


Figure 1.4

Internals for Orifice D-J

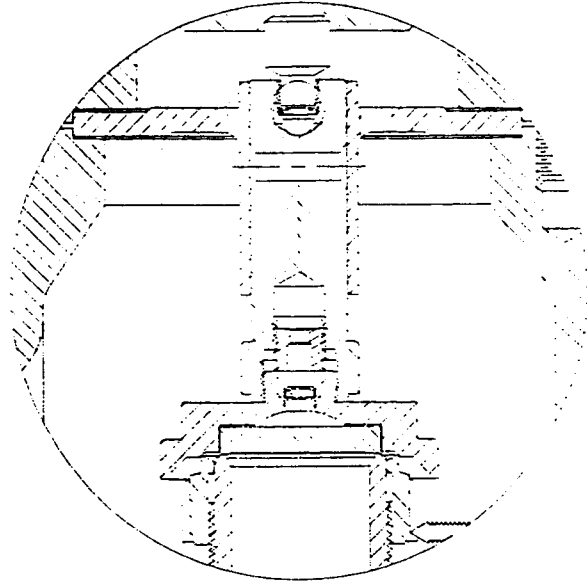


Figure 1.5

Internals for Orifice K-P

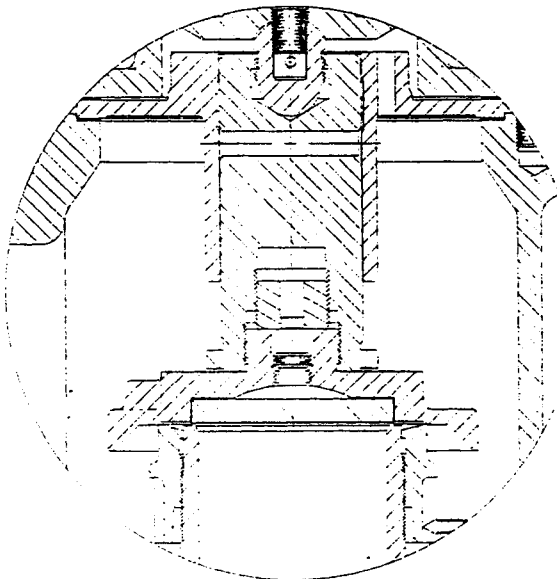


Figure 1.6

Internals for Orifice Q-T

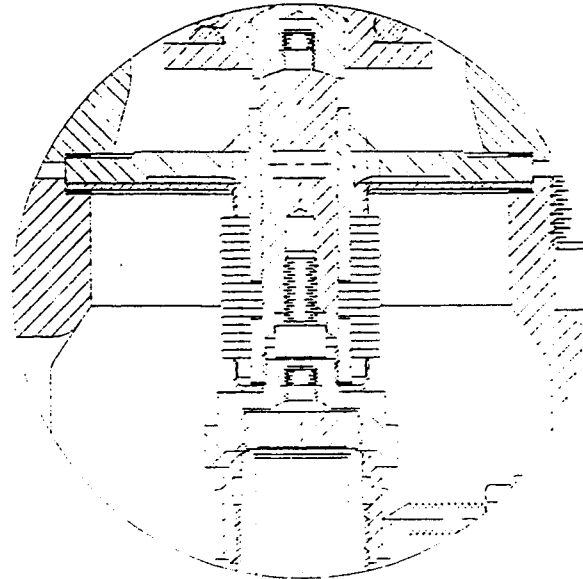


Figure 1.7

BalanSeal® Bellows Safety Valve

GENERAL DISASSEMBLY OF VALVES

After the valve is received and checked it is ready for shop inspection and repair. The valve should be carefully dismantled. If you are unfamiliar with this line of Farris valves carefully study the cross-sectional drawings in Figures 1.3 through 1.7 to familiarize yourself with part terminology and location. Proper facilities should be available for segregating parts as the valve is dismantled. At each stage in the dismantling process all parts of the valve should be visually inspected for evidence of wear and corrosion. If parts are worn, replace them. See Appendix A for necessary tools.

BILL OF MATERIALS

Conventional (A10)		BalanSeal® (A11)		
PART NAME	MATERIAL	VALVE TYPE	MATERIAL	
Body	26()A10 thru 26()A26	SA-216 GR.WCB. Carbon Steel	26()B10 thru 26()B26	SA-216 GR.WCB. Carbon Steel
	26()A32 thru 26()A36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)	26()B32 thru 26()B36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)
Bonnet	26()A10 thru 26()A26	SA-216 GR.WCB. Carbon Steel	26()B10 thru 26()B26	SA-216 GR.WCB. Carbon Steel
	26()A32 thru 26()A36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2 Moly)	26()B32 thru 26()B36	SA-217 GR.WC6, Alloy St. (1-1/4 CR—1/2Moly)
Cap. Plain Screwed	Carbon Steel		Carbon Steel	
Disc	Stainless Steel		Stainless Steel	
Nozzle	316 Stainless Steel		316 Stainless Steel	
Disc Holder	316 Stainless Steel		316 Stainless Steel	
Blow Down Ring	300 Series Stainless Steel		300 Series Stainless Steel	
Sleeve Guide	300 Series Stainless Steel		300 Series Stainless Steel	
Stem	Stainless Steel		Stainless Steel	
Spring Adjusting Screw	Stainless Steel		Stainless Steel	
Jam Nut (Spr. Adj. Scr.)	Stainless Steel		Stainless Steel	
Lock Screw (B.D.R.)	Stainless Steel		Stainless Steel	
Lock Screw Stud	Stainless Steel		Stainless Steel	
Stem Retainer	Stainless Steel		Stainless Steel	
Bellows	N/A		Inconel Composite	
Bellows Gasket	N/A		Flexible Graphite	
Spring Button	Carbon Steel, Rust Proofed		Carbon Steel, Rust Proofed	
Body Stud	ASTM A193 Gr. B7, Alloy Steel		ASTM A193 Gr. B7, Alloy Steel	
Hex Nut (Body)	ASTM A194 Gr. 2H, Alloy Steel		ASTM A194 Gr. 2H, Alloy Steel	
Spring	26()A10 thru 26()A26	Chrome Alloy, Rust Proofed	26()B10 thru 26()B26	Chrome Alloy, Rust Proofed
	26()A32 thru 26()A36	High Temp. Alloy Rust Proofed	26()B32 thru 26()B36	High Temp. Alloy Rust Proofed
Gasket, Cap	316 St. St.		316 St. St.	
Gasket, Body	316 St. St.		316 St. St.	
Gasket, Bonnet	316 St. St.		316 St. St.	
Gasket, Lock Screw	316 St. St.		316 St. St.	
Hex Nut (B.D.R.L.S.)	Stainless Steel		Stainless Steel	
Lock Screw (D.H.)	Stainless Steel		Stainless Steel	
Pipe Plug (Bonnet)	Steel		N/A	
Pipe Plug (Body)	Steel		Steel	

Table 1.1

General Notes:

1. Parenthesis in type number indicates orifice designation, as 26FA10, for conventional and 26FB10 for BalanSeal® bellows design.
2. Materials listed are for general purpose valves. For materials used in specific applications such as high or low temperatures, for open and packed lever valve materials, please refer to a current sales catalog.

2. INSTALLATION, STORAGE, & HANDLING

Installation guidelines are provided in Technical Bulletin 286T available free on request from your Farris Engineering Representative or the factory. A more thorough discussion of installation can be found in this bulletin.

Installation is the keynote of any successful valve operation. Maintain cleanliness in all installation work. Pipelines, connecting flanges and connecting spools should be carefully cleaned. At all cost, avoid foreign material which might lodge between the disc and seat, such as loose pieces of gasketing material, pipe turnings, dirt, rust, etc.. Pipelines should be blown out to clean the lines on both the inlet and outlet sides of the valve. Failure to do so may cause seat leakage. Tighten all bolts evenly. Prevent strain on the valve body and outlet flanges by supporting the discharge piping. Mount the valve in a vertical position with the inlet down and keep inlet and discharge piping as short as possible. Never use inlet or outlet piping of sizes less than the size of the valve connection. Where direct connection of the pressure relief valve to its pressure source or point of discharge is not possible then pipe sizes larger than the nominal connections on the pressure relief valve may be necessary to minimize the inlet pressure drop or the back pressure build-up. A 1/2" NPT drain connection is provided on all 2600 Series A10/A11 valve bodies and is fitted with a pipe plug as shipped from the factory. The pipe plug should be removed and a drain pipe fitted, otherwise discharge piping should be self draining.

Because cleanliness is essential for the satisfactory operation and tightness of a pressure relief valve, all necessary precautions should be taken to keep out all foreign materials. Valves which are not installed soon after

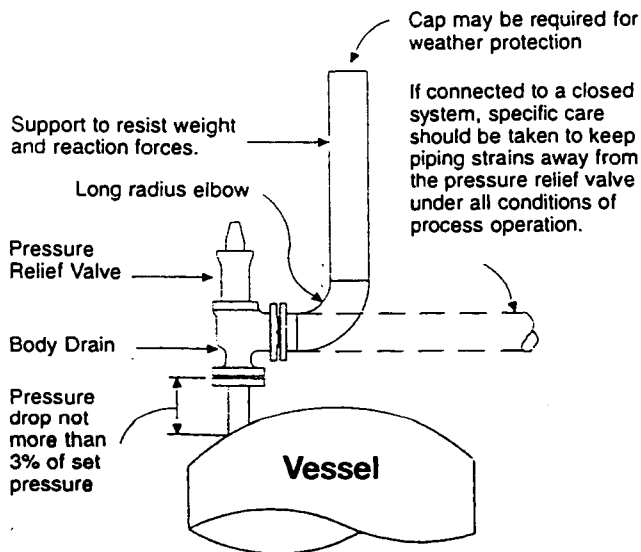


Figure 2.1

receipt should be closed off properly at both inlet and outlet flanges. Particular care should be taken to keep the valve inlet and internals absolutely clean. Preferably, valves should be stored indoors or in location where dirt and other forms of contamination are at a minimum. Valves should be handled carefully and not subjected to heavy shocks. If due consideration is not given to this point, some internal damage or misalignment can result and seat tightness may be adversely affected. Store, transport and install valves with the stem in the vertical position.

After the pressure relief valve is removed from the installation it should be transported to the shop for inspection, testing, maintenance, and resetting. Careful handling in transit is important, as rough handling can change the pressure setting or deform the pressure relief valve parts so they cannot be set or function properly. Flanges on the piping and flange faces on the valve should be protected so that gasket faces are not damaged. Large valves should be handled with suitable rigging equipment to avoid dropping or rough handling. Pressure relief devices should not be stocked in a careless manner and, where practical, they should be segregated and not stored with heavy pipe fittings or other types of valves. Pressure relief valves should be treated as delicate instruments because their accurate functioning is very important to safe plant operation.

MAINTENANCE AND INSPECTION

After a manufacturer or one of their authorized assemblers has delivered a valve that meets all the requirements of ASME Section VIII or other construction code, a continuity of this level of integrity and safety should be maintained. In practice, a repaired pressure relief valve (including one that has been only cleaned or readjusted) is called upon to provide the same degree of protection

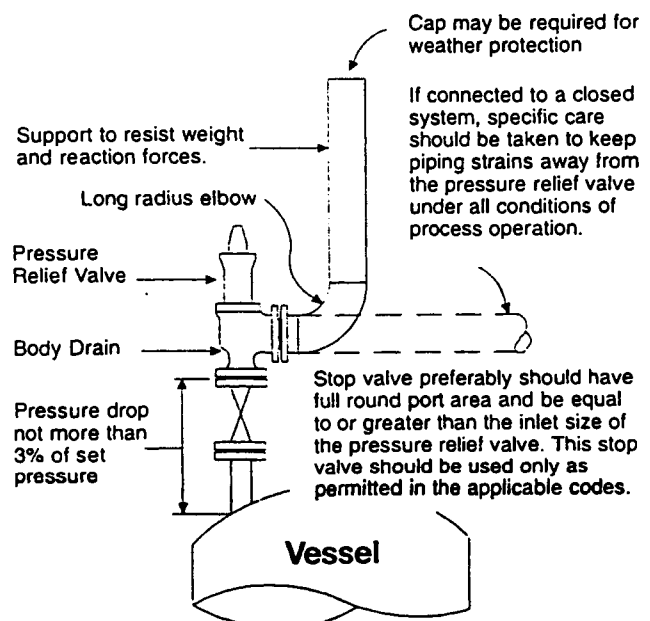


Figure 2.2

as a new valve. It follows that maintenance personnel must be trained to a level of proficiency that enables them to restore a valve to original condition and function. Complete individual hands-on training by Farris Engineering is recommended to maintain warranties and becomes most effective when monitored and coordinated by the owner/user and conducted at the users repair facility or at a Farris factory. The company also supports the prerequisite training activities promoted by jurisdictions, and the National Board of Boiler and Pressure Vessel Inspectors. It is recommended that historical records be established and maintained including brief test reports. This will provide data to determine the frequency of inspection and repair for various services. One excellent publication for reference on pressure relieving devices is the American Petroleum Institute's Guide for Inspection of Refinery Equipment, Chapter XVI. The use of original manufacturer's replacement parts is necessary to maintain new valve performance, capacity flow and warranty. Teledyne Fluid Systems expressly voids its warranty and will not be responsible for faulty valve operation if non-factory replacement parts or methods are utilized in product repair.

FIELD REMOVAL

A visual inspection of pressure relief valves should be made when the valves are first removed from the system. Many types of deposits or corrosive debris may be loose and drop out from the pressure relief valve while it is being transported to the shop. When fouling is a frequent problem, it may be desirable to collect samples for further testing and to make notes regarding deposit location and appearance. Any obstructions in the valve should be noted and corrected.

Inspection of Inlet and Outlet Piping

When a pressure relief valve is removed from service, the upstream and downstream piping is often open and available for inspection. However, where it is the practice to remove pressure relief devices from equipment during operation by closing block valves, it is usually not possible to make a complete inspection of piping. Such inspection should be made when the operation equipment is out of service. Inspection of the piping at the pressure relief valve will often indicate the condition of other process piping which is not readily available for inspection. Piping should be checked for corrosion, indications of thinning and deposits which may interfere with valve operation. The character of the deposits may supply clues regarding leakage from the pressure relief valve in a closed system.

In-Situ Testing

In-situ or in place testing is frequently performed as a substitute for valve removal and in-shop testing. This

should not be considered as equivalent to shop maintenance, however, it may be employed under controlled situations to extend the shop service frequency of particular valves. The most common method of in-situ testing employs an external power source applied to the valve to determine the valve set pressure at some lower system pressure. While this method can accurately determine the valve set pressure, valve reseal pressure cannot be determined using the method. Care must be exercised with this method to avoid possible valve damage that may go undetected during the in-situ test.

In-Shop Inspection

When a valve is first received in the shop it should be given a visual inspection to note its condition when removed from service. The results of this inspection should be noted on appropriate forms. It is generally considered important to determine the set pressure of the valve when removed from service and prior to the valve being disassembled. If the valve opens at the set pressure, the valve need not be tested further to determine the as-received relieving pressure. If the initial pop is higher than the set pressure, it is advisable to test a second time. If the valve then pops at approximately the set pressure, this indicates that the valve was probably stuck because of deposits. If the valve does not pop near the set pressure, this indicates that the valve setting was either in error originally or may have been changed during operation.

Valves which are found acceptable upon shop pre-test cannot be returned to service with a National Board "VR" stamp being applied unless they are completely disassembled and complete repairs are undertaken. Some maintenance programs may however authorize valves found acceptable on shop pretest to be returned to service based on historical records, tear-down cycles and all seals and valve identifications remaining intact.

Preparation For Maintenance

Before valve teardown is performed a review of previous maintenance records will assist in an understanding of past valve performance, settings and maintenance requirements. A complete maintenance records management system will allow proper stocking of common replacement items such as gaskets and seals and adequate stocking of major replacement parts such as nozzles, discs, and springs. Maintenance records, when properly updated, can serve to identify the need for ordering spare parts when valve servicing shows that the useful life of a particular part has been reached. Rematching details and installation of new parts should be recorded to aid future service activities.

3. DISASSEMBLY OF VALVES

GENERAL DISASSEMBLY OF VALVES

After the valve is received and checked it is ready for shop inspection and repair. The valve should be carefully dismantled. If you are unfamiliar with this line of Farris valves carefully study the cross-sectional drawings in Figures 1.3 through 1.7 of Chapter 1, to familiarize yourself with part terminology and location. Proper facilities should be available for segregating parts as the valve is dismantled. At each stage in the dismantling process all parts of the valve should be visually inspected for evidence of wear and corrosion. If parts are worn, replace them. See Appendix A for necessary tools.

CLEANING AND CHECKING OF PARTS

All parts should be properly marked and segregated by individual valve. At this point, the valve parts should be thoroughly cleaned and inspected. Cleaning methods should be carefully selected to avoid part damage. Abrasive blasting of ground surfaces can alter the factory supplied finish. Threads can also be damaged by excessive blasting or shot cleaning. These surfaces should be protected during such cleaning processes.

The following discussion on parts inspection will precede the detailed valve disassembly. However, detailed inspection should be given separate attention to assure that only serviceable parts are used. This inspection should be completed after the proper parts cleaning.

The following general points will provide a brief checklist to follow during assembly. Detailed discussion will follow for specific critical parts.

- Presence of Wire Seal at all points of adjustment.
- Complete and properly identified nameplates and tags.
- Condition of flanges; for evidence of pitting, roughening, deterioration of gasket surface, distortion, etc.
- Springs, for evidence of corrosion or cracking, and correct selection.
- Bellows (if the valve is of bellows type).
- O-Ring condition (if applicable).
- Inlet and outlet openings, for evidence of deposits of foreign material and for corrosion.
- Condition of the external surfaces; for any indication of corrosion or evidence of mechanical damage.

- Body, nozzle, and bonnet wall thickness, thread and stud condition.
- Valve components and material; to check against identification tag and specification card.

NOZZLE AND DISC

The nozzle and disc require the greatest inspection of all the critical parts. Inspect for the following:

1. Nozzle length and disc thickness. It is important to replace the nozzle and/or disc when they are below the minimum length or thickness. Failure to do so may cause part failure or faulty valve operation due to the change in the critical parts respective relationship.
2. Seating surfaces should conform to the manufacturer's dimensions and profile. Normal lapping will alter these dimensions and profiles. Machining or refacing of the seat surfaces should be in accordance with the original manufacturer's specifications. Any refacing should be followed by a confirmation that the minimum nozzle length and disc thickness are within specification.

Since the nozzle and disc contain the primary or inlet pressure of the protected system these parts should be checked for any cracks or other detrimental material conditions. Corrosion and service stresses induce cracking which must be found during valve repair. Applicable NDE procedures should be employed to detect these conditions. When the set pressure is changed substantially, consideration should be given to hydrostatically test these components at the new pressure conditions.

SLEEVE GUIDE AND STEM RETAINER

The sleeve guide and stem retainer make up an important part of the guiding for the valve. Their mating surfaces are machined to close tolerances. The outside of the stem retainer and the inside barrel of the sleeve guide should be closely examined for any sign of galling or scoring. The stem retainer should move freely within the barrel of the sleeve guide. The drainage holes in the sleeve guide flange should be clear and open.

SPRING

Springs are always stressed once the valve is set. Large orifice or high set pressure valves will have higher stressed springs. Surface corrosion or surface defects can quickly cause stress concentration points.

These conditions can lead to corrosion failure or load loss capacity. Springs should be adequately examined for such defects and even minor defects should be cause for considering spring replacement. NDE processes should be employed for spring examination as visual examination alone may not be sufficient to adequately accept springs for further service.

It is common for springs to be blasted clean however the remaining surface will readily allow corrosion to take hold. Spring surfaces should be painted or coated after cleaning and inspection to retard any further deterioration.

Spring identification during repair is important. Small springs may not contain any permanent marking thus making record keeping vital to retain spring integrity.

BELLOWS

Bellows require very thin materials to provide the required flexibility. This results in a delicate assembly which should be carefully handled. Do not attempt to repair a bellows assembly and cleaning should be limited to solvent methods. Any pitting or surface corrosion are sure signs of limited service life even though the bellows may be pressure tight. All bellows assemblies should be pressure tested in accordance with Figure 3.0. Any leakage should be cause for bellows replacement.

BELLOWS ASSEMBLY LEAK TESTING

1. Place bellows/stem retainer/disc holder assembly into bellows leak test fixture with the bellows flange at the base.
2. Seal the flange of the bellows to the base of the bellows test fixture as illustrated in Figure 3.0 below.
3. Compress the bellows approximately 1/8 inch with a securing bar so that the bellows does not elongate when pressure is applied as in Figure 3.0.
4. Fill the disc holder with water. Omit this step for D & E Balanseal® designs as these designs have a one piece disc holder/stem retainer.
5. Apply 30 psig pressure to the bellows.
6. Apply soapy water to bellows exterior to check for bellows integrity.
7. If bubbles appear on bellows exterior there are pin holes or a tear. Replace bellows and repeat the procedure.
8. Check to be sure the bellows/disc holder connection is leak tight. If water in disc holder bubbles or the connection bubbles, tighten the connection or replace gasket.
9. Vent pressure.
10. Release bellows assembly.
11. Air dry bellows assembly to remove soapy water.

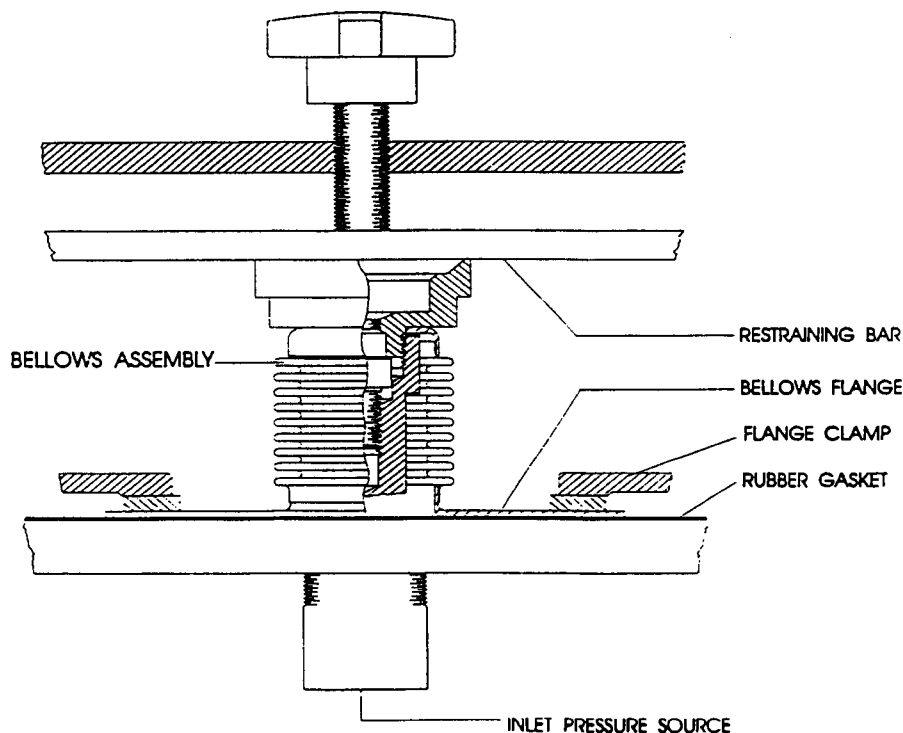


Figure 3.0

STEM

The stem transmits the spring load to the stem retainer. This load must be transmitted axially otherwise a side load will exist which will cause binding. Over-gagging is a common cause for bent stems. The stem is also integral to any lifting gear. Abuse of the lifting gear may result in stem damage. Check the bearing point on the stem tip for a smooth surface. Lap if necessary against the mating part to improve the surface. However excessive lapping will destroy the spherical contact. At this point replace the stem.

To check the critical stem areas for eccentricity use the following procedures; Take Vee Blocks of bench rollers and check the stem at the mid point and also at the lower spring button radius for any eccentricity. By applying a machinist's dial indicator and rotating the stem the total indicator reading should not exceed .007". Straighten if necessary. (Figure 3.1)

The top area of the stem (A) just below the thread serves as the valve internals upper guide surface in conjunction with the spring adjusting screw. This area should be free from any signs of galling or pitting. This area is supplied from the factory with a 63 AARH finish.

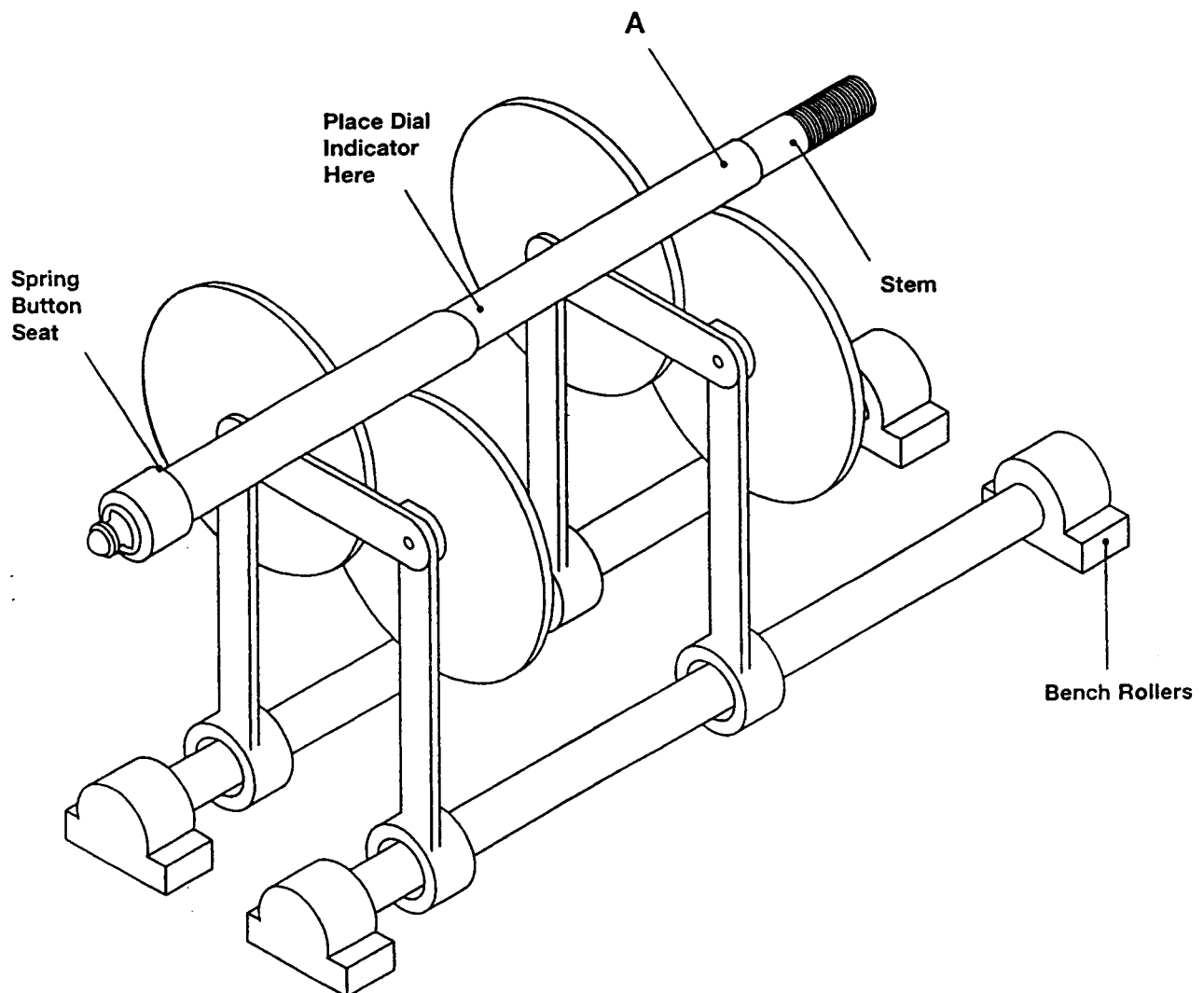


Figure 3.1

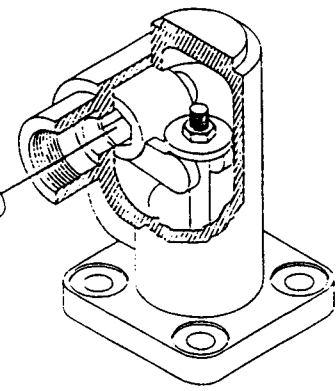
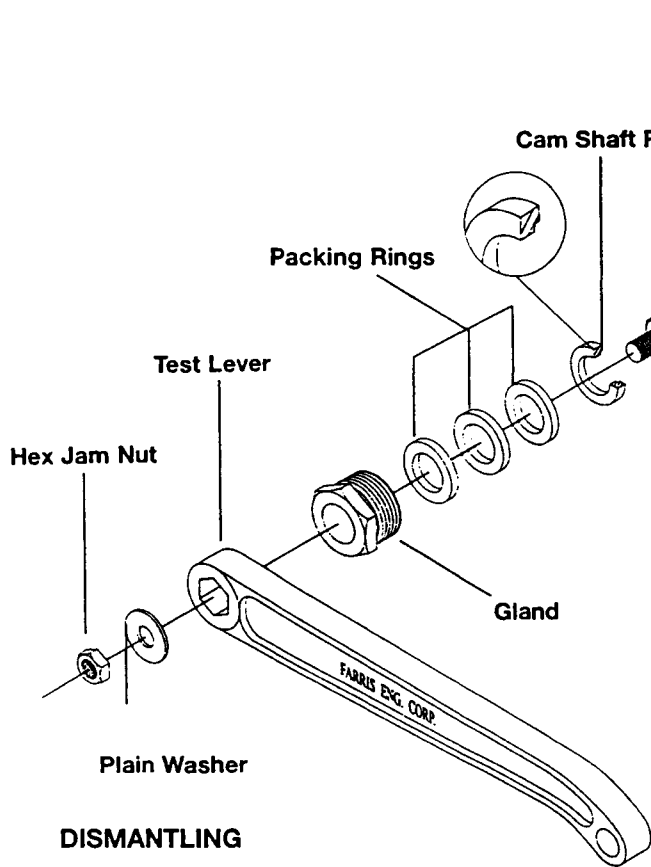


Figure 3.3

Packed Lever Cap

A packed lever cap assembly does not require complete disassembly in order to remove it from the valve. Complete disassembly is required only when the packing rings require replacement or internal inspection of the packed lever parts is required.

To remove the packed cap assembly from the valve, remove the hex nuts from the cap studs. Rotate the lever assembly down and lift up on the cap assembly until free from the stem and stem test washer.

To disassemble the packed cap lever assembly, (Figure 3.3), remove the hex jam nut, plain washer and test lever from the camshaft. Remove the gland nut. Considerable force is required to remove the camshaft and packing rings from the cam as the packing rings will have been compressed into place. Place a short 1/2" drive socket over the end of the camshaft and using a standard hex nut and plain washer tighten the hex nut to exert a pulling force on the camshaft and packing ring assembly. Continue until the camshaft and packing rings have been freed from the cap housing.

DISMANTLING

Place the internal assembly at a suitable work height. The work surface should be clean and strong enough to handle the weight of the parts and the forces required during disassembly and assembly.

When dismantling valves with lifting gear, record the position of the lever relative to the outlet as some installation positions may require a nonstandard lever position

Plain Cap

Unscrew the cap from the valve (see Figure 3.2). Remove the cap gasket.

Figure 3.2

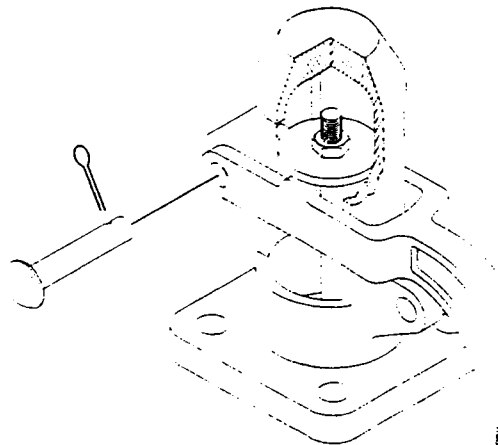
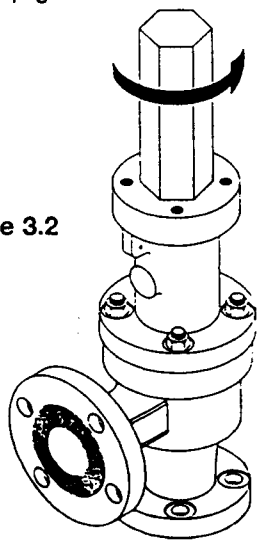


Figure 3.4

FARRIS ENG. CO.

OPEN LEVER CAP ASSEMBLIES

Open lever caps may be classified as single or double acting. Double acting levers use a fork and two fulcrum points for increased lifting advantage. This type of open lever is found on larger orifice valves as well as high pressure models.

Open Lever-Single Acting

Remove the cotter pin from the rivet holding the test lever. Remove the rivet and lever. Remove the cap bolts and lift off the cap. Remove the stem jam nut and stem test nut from the end of the stem (Figure 3.4).

Open Lever-Double Acting

Remove the cotter pins from the test lever and test lever fork. Remove both rivets, test lever and test lever fork. Remove cap studs and lift off the cap. Remove the stem jam nut and stem test nut from the stem (Figure 3.5).

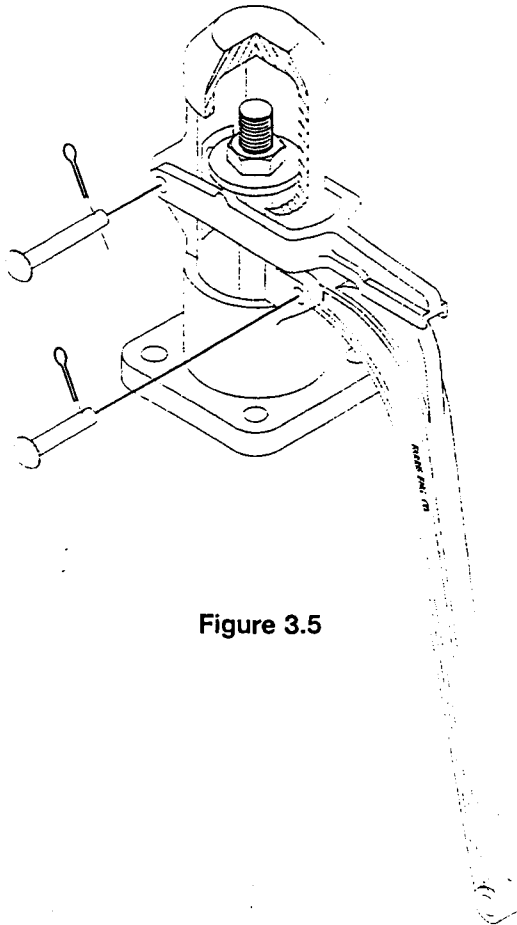


Figure 3.5

VALVE DISASSEMBLY

Remove the lock screw assembly (Figure 3.6). Count the number of notches the blowdown ring is from contacting the disk holder. Measure location of spring adjusting screw by marking spring adjusting screw above jam nut before loosening the jam nut (Figure 3.7), or by counting the number of counter clockwise revolutions of the spring adjusting screw until the spring is no longer compressed. This will allow the approximate set pressure to be re-established when reassembling the valve. Once the data are recorded, remove the jam nut and spring adjusting screw. Recording the spring adjusting screw position and blowdown ring position will save time in the reassembly of the valve.

Remove the body hex nuts (**first ensure that the spring is not compressed**) and remove the bonnet. On larger valves the combination of bonnet weight and the height that it must be lifted to clear the stem requires that a hoist be used to remove the bonnet. During this

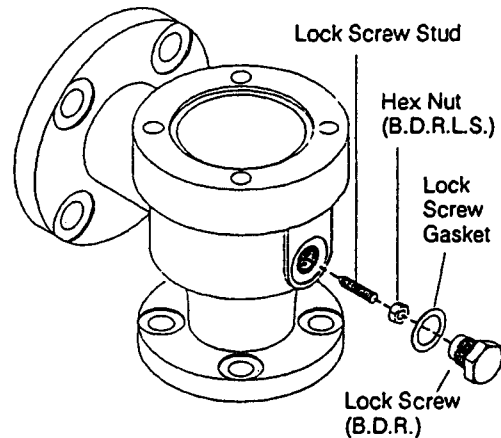


Figure 3.6

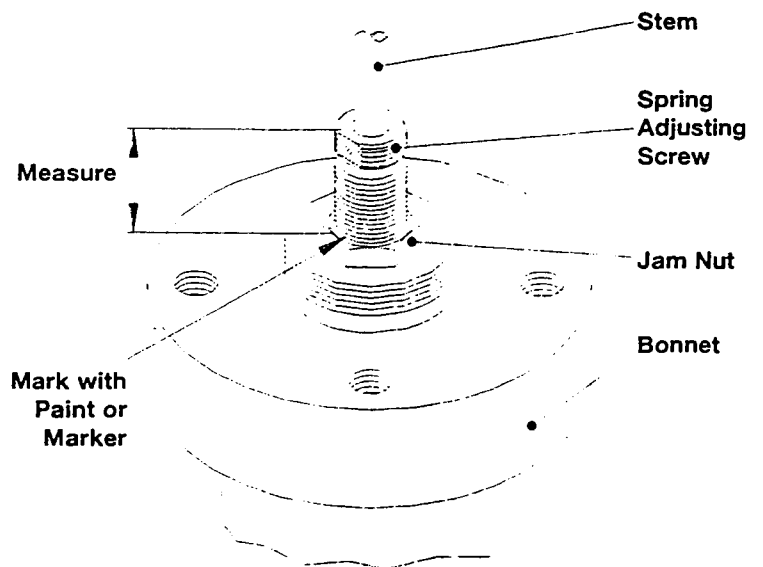


Figure 3.7

operation the valve body should be secure to prevent it from tipping over once the bonnet is removed. The weight of the spring assembly at an angle to the rest of the valve will be sufficient to cause the valve to tip over. Record the position of the bonnet drain relative to the valve outlet. Remove spring assembly from the stem (spring and spring buttons) and bonnet gasket (Figure 3.8)

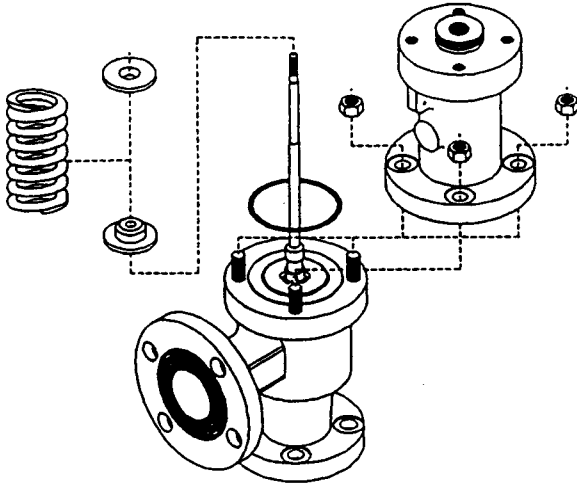


Figure 3.8

To remove the stem from the stem retainer, lift up on the stem and rotate counter-clockwise at the same time. This will engage the thread. Continue rotating until the stem is removed (Figure 3.10).

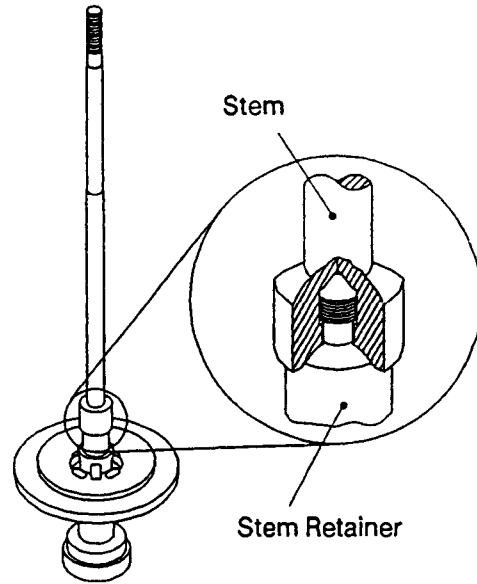


Figure 3.10

Using stem as a handle lift the complete internal assembly from the body. On larger valves a hoist is advisable due to the weight of the internal assembly. An eye bolt may be attached to the stem test washer thread at the end of the stem to assist in lifting. Remove body gasket (Figure 3.9).

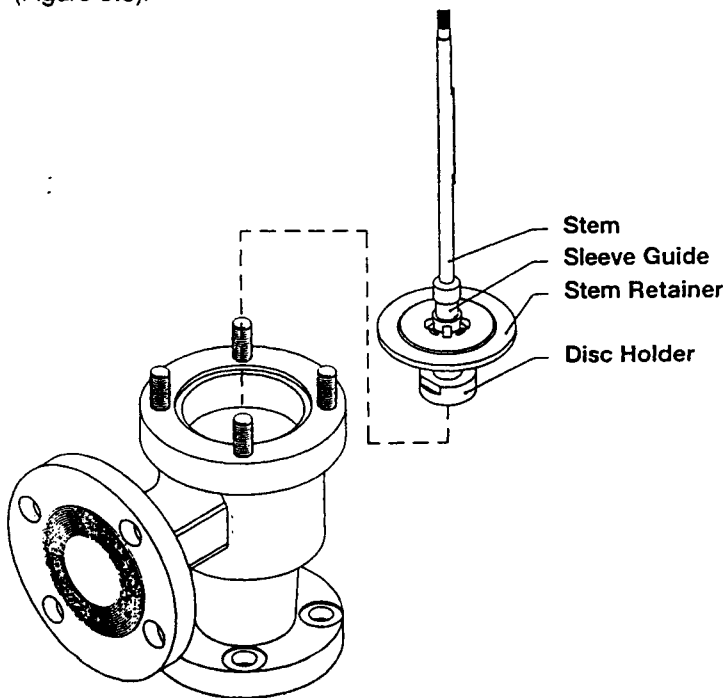


Figure 3.9

Lift off the sleeve guide (Figure 3.11) and place it such that it cannot fall or roll.

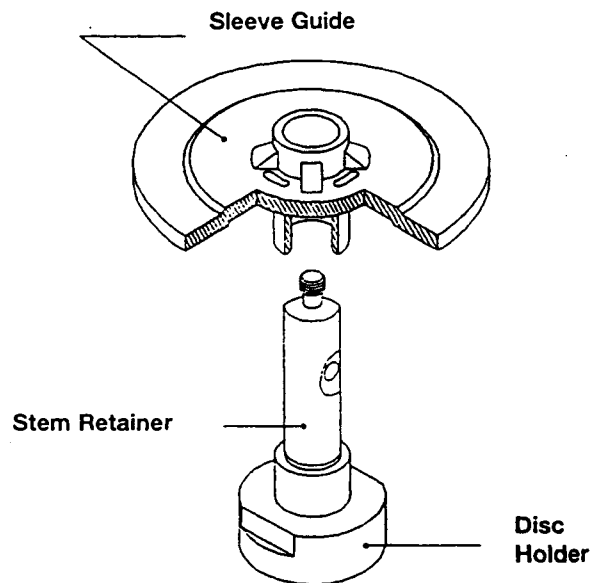


Figure 3.11

Remove the disc from the disc holder (Figure 3.12). Hold assembly and rotate disc with tip of finger. For O-Ring seat type valves, refer to Figure 3.15 and 3.16 (page 16).

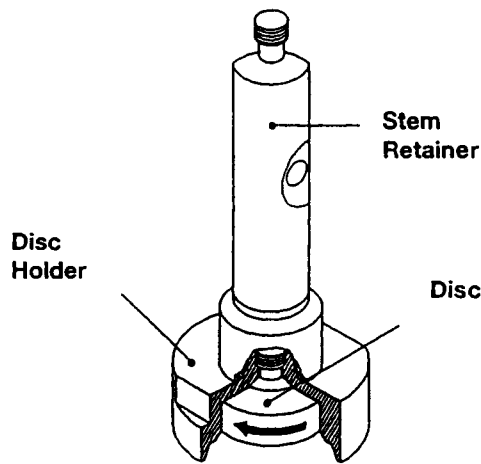


Figure 3.12

Except for the D & E orifice bellows (A11) designs (which have a one piece stem retainer/disc holder) the stem retainer and disc holder are held together with a "disc holder lock screw". The disc holder lock screw has a hex socket requiring use of an allen key (Figure 3.14). Locking tension is relieved by threading the lock screw UP INTO the stem retainer. To separate the two parts first thread the lock screw up into the stem retainer using the fixture shown in Figure 3.13 to hold the assembly. Allen key wrench sizes are shown in Table 3.1. **DO NOT USE A VISE OR ANY METHOD THAT MIGHT MAR THE GUIDING SURFACE OF THE STEM RETAINER.**

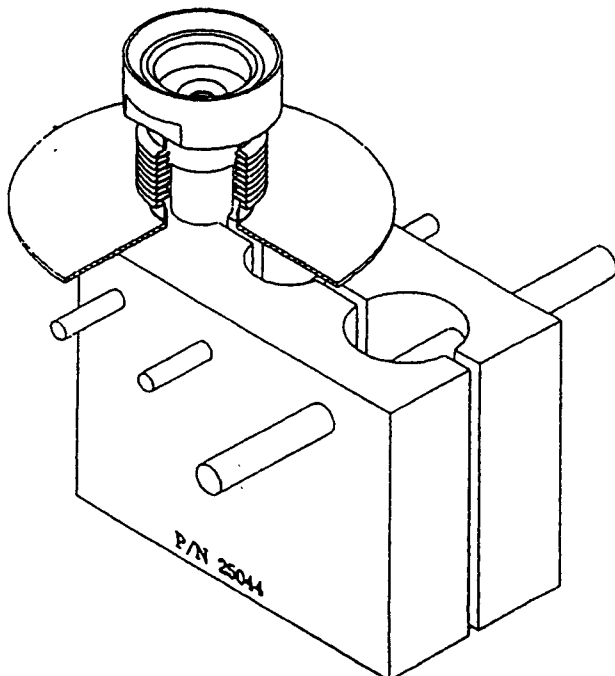


Figure 3.13

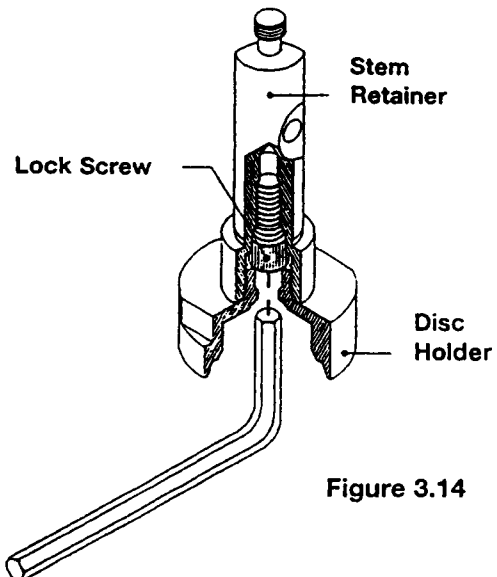


Figure 3.14

ALLEN KEY SIZES	
DISC HOLDER LOCK SCREW	
ORIFICES	ALLEN KEY SIZE
D THRU J	3/16"
K THRU P	7/32"
Q THRU T	3/8"

Table 3.1

For Balanseal bellows equipped valves use the same fixture shown in Figure 3.13. Exercise care in handling the internal assembly when equipped with a bellows as any damage to the bellows in the form of a nick or dent will render the bellows unfit for service. Bellows are not repairable.

To finish the disassembly of the entire valve take the blowdown ring lock screw assembly and remove the hex nut from the lock screw stud. Remove the lock screw stud from the lock screw thus separating all parts in the assembly. (See Figure 3.15).

Next remove the blowdown ring from the nozzle and remove the nozzle by unscrewing it from the body. Be careful not to damage the seat while removing the nozzle.

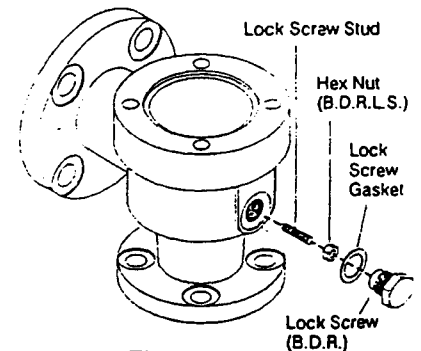


Figure 3.15

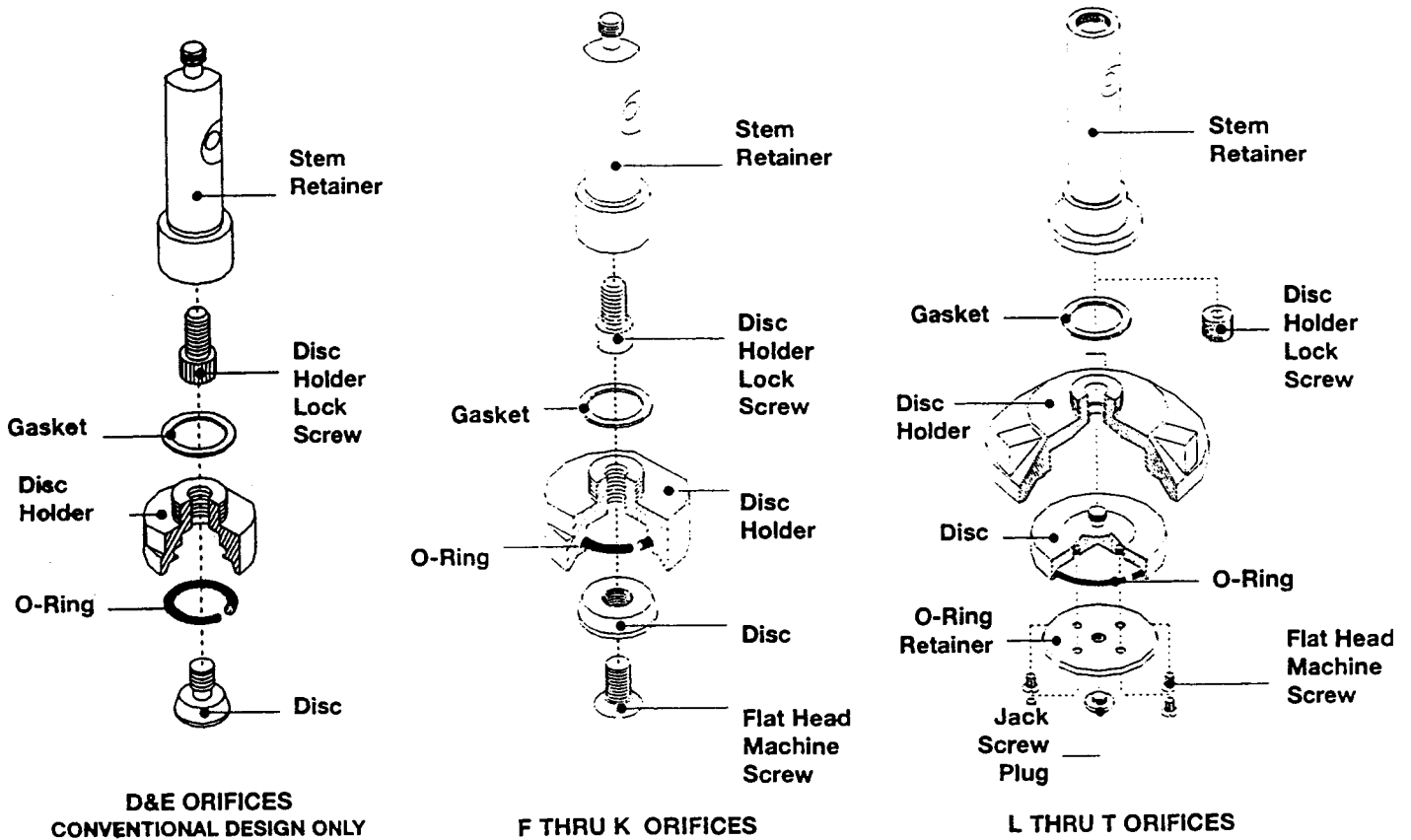
Finally, if the body studs are damaged or corroded and need to be replaced they can be removed by unscrewing them from the valve body. This will complete the disassembly of the valve.

O-RING CONSTRUCTION

Follow the standard disassembly instructions except for the removal of the disc. The following diagrams (Figure 3.16) illustrate 2600 Series Soft Seat design. These illustrations are typical for conventional (A10) construction.

For Balanseal® bellows construction a bellows and gasket(s) are added in all orifices except D and E. For D and E orifice O-ring bellows construction refer to Figure 3.17.

Figure 3.16



D & E ORIFICES
CONVENTIONAL DESIGN ONLY

F THRU K ORIFICES

L THRU T ORIFICES

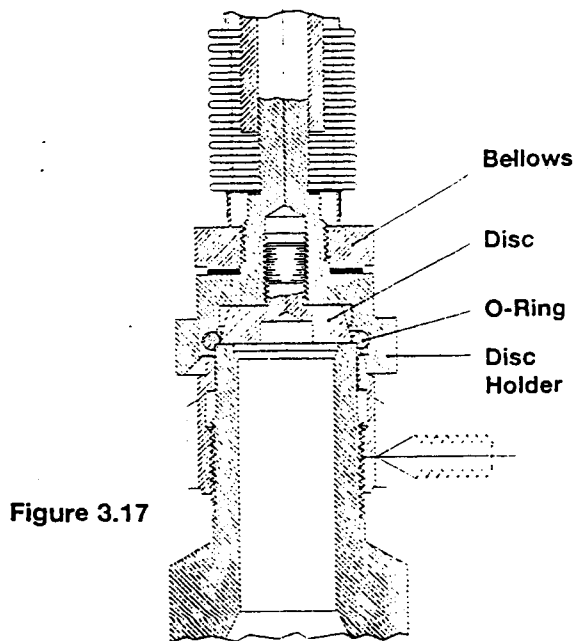


Figure 3.17

D & E O-RING SEAT WITH
BALANSEAL® BELLOWS

Note that disc holder/stem retainer is a one piece design, for the D & E orifice Balanseal® valves.

To Remove the "O"-ring on D thru K orifice valves first remove the discs and use an "O-ring extractor" to reach into the disc holder and pull the "O"-ring out.

On orifice sizes L and above, first remove the "O"-ring retainer from the disc by removing the outer flat head machine screws. Next remove the Jack screw plug and thread a long screw into the retainer in its place such that it bottoms out on the disc and forces the retainers to separate from the disc. The "O"-ring can then be removed with the aid of an "O"-ring extractor if necessary.

Figure 3.16 is a typical example of this one design found on both the soft & metal seat bellows designs for these orifices.

4. NOZZLE AND DISC REFACING

Nozzle Refacing

1. Prior to refacing the nozzle seating area, grip the nozzle flange in a universal three-jaw lathe chuck fitted with soft jaws (preferably with removable top jaws), and bored on each set-up to fit the nozzle flange outside diameter.
2. True up the nozzle by means of an indicator, ensuring that the nozzle bore and flange outside diameter are concentric with each other within 0.002" full indicator reading.
3. Machine a light cut across the seat until the damaged areas are removed. The seat should be machined to the smoothest possible finish. Rigidity of the cutting tool is critical.
4. Relap to the required finish.
5. Discard and replace the nozzle when the length from the seat to the flange becomes less than the minimum specified by the manufacturer. Do not reduce the nozzle flange thickness in an attempt to maintain the "L" dimension. The valve center to face dimension will be altered as a result and nozzle strength may be impaired.

Disc Refacing

1. Prior to refacing the disc seating area, grip the disc outside diameter in a universal three-jaw lathe chuck fitted with soft jaws (preferably with removable jaws), and bored on each set-up to the disc outside diameter. Avoid excessive chucking force.
2. True up the disc by means of an indicator, ensuring that the disc outside diameter and seat face are true with each other within 0.002" full indicator reading.
3. Machine light cuts across the seat at 90 deg. to the axis until the damaged areas are removed, facing to the smoothest possible finish. Rigidity of the cutting tool is critical.
4. Relap flat across the full width of the raised seating surface.

5. Discard and replace the disc when the raised seating surface has been depleted.

LAPPING COMPOUNDS

The three grades of Farris Lapping Compounds are prepared especially for the requirements of pressure relief valves. These are the only compounds recommended for achieving extreme valve tightness. These compounds are available in 2 ounce tubes. Use sparingly.

FARRIS LAPPING COMPOUNDS			
PART NO.	GRADE	FINISH	SIZE
18635 (055)	3F	ROUGHING	2 OZ. TUBE
18636 (075)	38-500	MEDIUM	2 OZ. TUBE
18637 (105)	38-1200	FINAL	2 OZ. TUBE

LAPPING PROCEDURES (Manual)

1. Use a cast iron lapping block or Pyrex lapping glass which is known to have a perfectly flat face.
2. Select the appropriate lapping compound. When lapping the disc, operate with a light figure eight motion over entire block surface. In this way complete contact will be made (Figure 4.1).

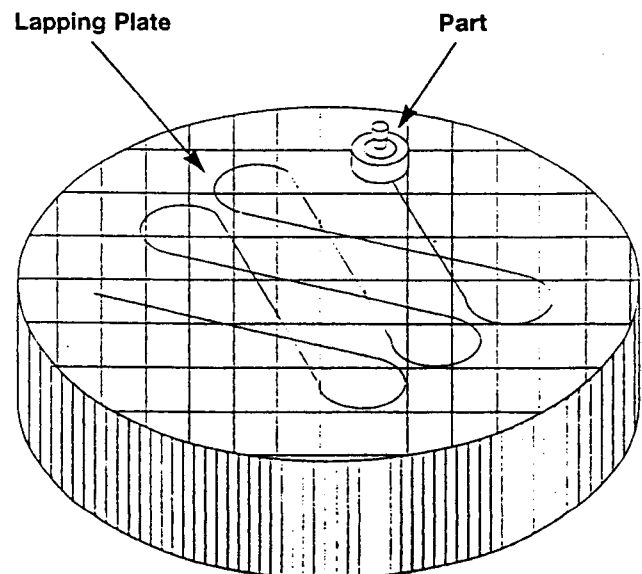


Figure 4.1

3. Lap the disc until all blemishes and score marks have been removed. As the figure eight motion is executed, frequently lift the disc away from the block to get a fresh bite on the compound. Most important, do not contaminate compounds with dirt. Store lapping blocks and lapping glass in a clean, dust-free area.
4. Follow the same procedure for lapping the nozzle. When lapping nozzles the nozzle can be placed on a table and a lapping block placed on the nozzle. Be sure that the lapping block does not tip over the side of the nozzle (which would cause rounding of the edges). Use a light, rapid figure eight stroke, lifting the block from the nozzle occasionally.
5. When finished, be sure that all parts are carefully cleaned of all lapping compound using a suitable solvent. Residual compound may damage the seating surfaces during valve operation. When reassembling the parts in the valve be careful not to scratch or score the seating surfaces.
6. If the nozzle or disc is badly scored or pitted a fine machine cut should be made to reface the surfaces following instructions in the refacing section of this manual.

LAPPING PROCEDURES (Machine)

Machine Lapping Instructions

Lapping machines come in a variety of styles. There are limitations to the parts that can be lapped, which may be due to constraints of the lapping machine or the nature of the part to be lapped.

Limitations:

1. The size of the lapping machine.

Obviously, you will be limited by the size of the lapping plate on the machine. A part that is larger than the lapping plate capacity will have to be hand lapped.

2. The weight of the part to be lapped.

Some parts will be too heavy to lap on the machine, relative to the area to be lapped. These parts will have to be hand lapped.

3. How well the part can be balanced on the lapping machine.

Due to geometry and weight distribution of the part, the part may tend to wobble or fall over in the lapping machine. For these types of parts a holding fixture should be designed or the part should be lapped by hand.

General Operation

This is a general procedure for the use of lapping machines. ALWAYS FOLLOW THE MANUFACTURERS OPERATING INSTRUCTIONS.

Thoroughly clean all contaminants from the seat area of the nozzle or disc to be lapped. Place the nozzle or disc seating area on the lapping plate. Turn on the machine and adjust the flow of lapping fluid which should be enough to keep the lapping plate covered with a thin film. The lapping plate should be neither dry nor overly lubricated.

The duration of time that the nozzle or disc should be lapped is dependent on the weight of the part, the hardness of the material, and the area to be lapped. A combination of a heavy part with a small area to be lapped made from a soft material will take the shortest time to lap. A combination of a light part with a large area to be lapped made from a hard material will take the longest time to lap.

Once the lapping is complete, remove the nozzle or disc from the lapping plate and remove the lapping fluid with soft tissue and suitable solvent. Protect the seating areas with soft tissue covered by a plastic cap.

LAPPING MACHINE MAINTENANCE AND SEAT INSPECTION

Seat flatness is critical to achieving leak tight seats. As the width of most pressure relief valve seats is quite narrow it is difficult to check seat flatness directly with a monochromatic light. Instead, a standard test block should be kept on the lapping machine that can be periodically checked to determine the condition of the lapping plate. If the test block "reads" flat then all parts lapped on the machine will also be flat. Since the lapped surface needs to be reflective in order to "read" the surface flatness using a monochromatic light source and optical flat, a polishing stand is a needed accessory. Remove the test block from the lapping machine and clean off all lapping fluid. Rub the test block on the polishing stand as if you were hand lapping the test block. Only a few strokes will be necessary to make the surface reflective enough to allow reading the lines produced by the monochromatic light. For full details on how to read these lines and the subsequent adjustments of the machine consult the lapping machine manufacturer.

The quality of the lapped surface produced by the lapping machine can only be as good as the level of maintenance of the machine itself.

5. 2600 ASSEMBLY PROCEDURE

Lubrication and Sealant:

All threaded parts should be lubricated to prevent galling, especially parts made of similar materials. In addition, guides and pivot points should contain lubricant which is compatible with the service conditions. Sealant should also be applied to prevent fluid from escaping valve boundaries, especially if back pressure is present. The adjacent table lists the suggested lubricant and sealant for air, steam, and liquid service. Service conditions may dictate that other lubricant or sealant be used.

- Only a light film lubricant should be applied to the guiding surfaces. Too much lubricant will hinder valve performance.
- Always use new gaskets and packing when reassembling valves.

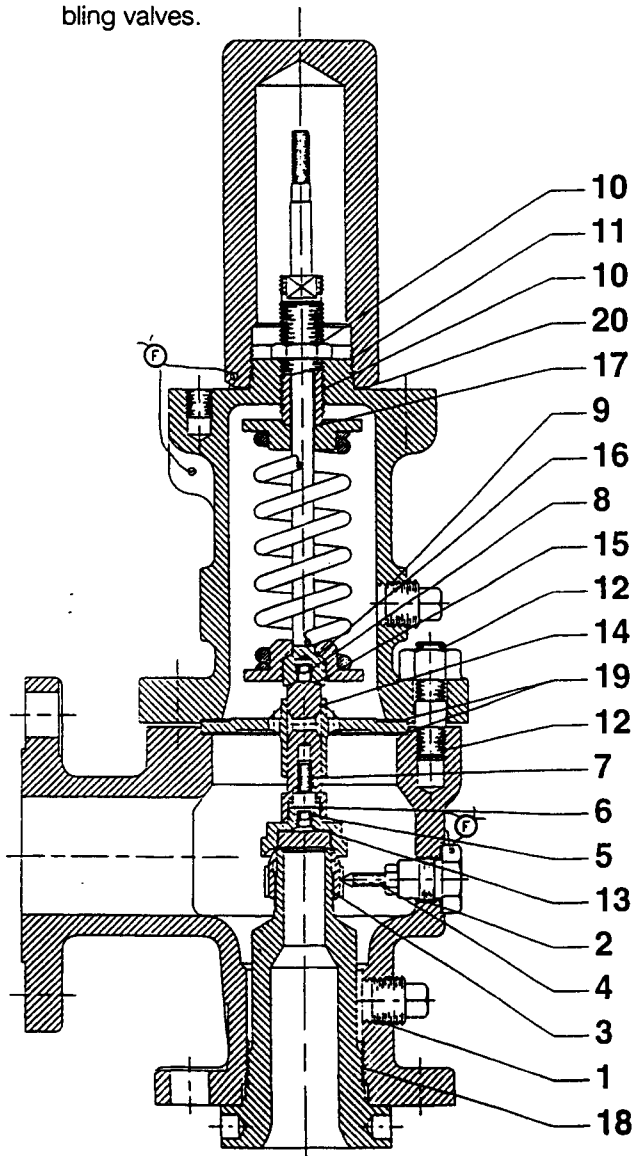


Figure 5.1

ITEM	THREAD LUBRICATION	AIR	STEAM	LIQUID
1	PIPE PLUG/BODY	A	A	A
2	LOCK SCREW (BDR) BODY	A	A	A
3	BLOWDOWN RING/NOZZLE	A	A	A
4	LOCK SCREW STUD /JAM NUT (BDRLS)	A	A	A
5	DISC/DISC HOLDER	A	A	A
6	STEM RETAINER/ DISC HOLDER (IF APPLICABLE)	A	A	A
7	LOCK SCREW (DH)/STEM RETAINER	A	A	A
8	STEM RETAINER/STEM	A	A	A
9	PIPE PLUG/BONNET (IF APPLICABLE)	A	A	A
10	SPRING ADJUSTING SCREW/BONNET/ JAM NUT	A	A	A
11	PLAIN CAP/BONNET (IF APPLICABLE)	A	A	A
12	BODY STUD/BDDY/HEX NUT	A	A	A
GUIDING AND PIVOT LUBRICATION:				
13	DISC/DISC HOLDER	A	A	B
14	SLEEVE GUIDE /STEM RETAINER	D	D	D
15	STEM RETAINER/STEM	A	A	A
16	SPRING BUTTON/STEM	A	A	B
17	SPRING BUTTON/SPRING ADJUSTING SCREW	A	A	B
SEALANT:				
18	BODY/NOZZLE	A	A	A
19	BODY/BONNET/SLEEVE GUIDE/GASKETS	C	A	C
20	BONNET/GASKET/CAP (IF APPLICABLE)	C	A	C

CODE FOR ABOVE RECOMMENDED LUBRICATION AND SEALANT

A = BOSTIC NEVER SEEZ

B = MOLYKOTE 3452

C = PERMATEx FORM-A-GASKET OR RECTOSEAL #5

D = NO LUBRICATION

* SERVICE CONDITIONS MAY REQUIRE AN ALTERNATE LUBRICANT OR SEALANT

I. Conventional Construction

1. Thread Nozzle into Body.
2. Thread Pipe Plug (Body) into Body.
3. Thread Blow Down Ring onto Nozzle.
4. Thread Hex Nut (BDRLS) onto Lock Screw Stud. Thread Lock Screw Stud into Lock Screw (BDR).
5. Thread Lock Screw assembly into Body including Lock Screw Gasket. Adjust position of LOCK Screw Stud so that it prevents rotation of the Blow Down Ring yet does not bind the Blow Down Ring. Tighten hex nut to lock screw stud in correct position.
6. Thread Body Studs into Body.
7. Place Body Gasket in Body counterbore.
8. Thread Disc Holder Lock Screw into Stem Retainer.
9. Thread Disc Holder onto Stem Retainer using special assembly block (see Figure 5.2). Do not attempt to hold Stem Retainer on the guiding surface. Thread Disc Holder Lock Screw counter clockwise until contact is made with Disc Holder. Tighten to lock the assembly together.

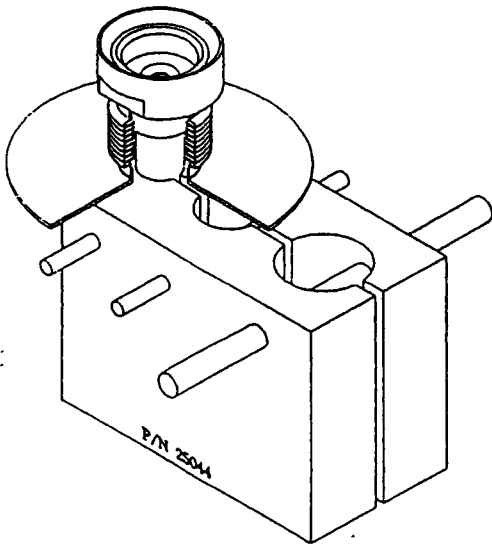


Figure 5.2

10. Thread Disc into Disc Holder. Be sure Disc is free floating.
11. Place Guide over Stem Retainer with long Lift Stop down. Be sure that the guiding motion is smooth with the least resistance possible.
12. Thread Stem and Stem Retainer together. Be sure connection is free floating.

13. Lower Stem, Sleeve Guide, and Disc Holder assembly into Body counterbore.
14. Place Bonnet Gasket on Sleeve Guide, or secure with sealant in Bonnet counterbore.
15. Place Lower Spring Button on Stem (Caution—in some valve sizes the upper and lower buttons are different).
16. Place Spring on Lower Spring Button.
17. Place Upper Spring Button on Spring.
18. Thread Pipe Plug (Bonnet) into Bonnet.
19. Place Bonnet on Body aligning Pipe Plug to the position indicated in disassembly notes. Normal convention is to position Pipe Plug opposite the valve outlet.
20. Thread Hex Nut (Body) onto Body Studs. Be sure that Body and Bonnet Gaskets are properly positioned in the respective counterbores.
21. Thread Jam Nut onto Spring Adjusting Screw.
22. Thread Spring Adjusting Screw into Bonnet to the position indicated in disassembly notes.
23. Valve should now be ready for testing, final assembly and sealing.

II. BalanSeal® Bellows Construction

Follow the same procedure as for Conventional type valves except as follows:

For D and E orifice valves only:

Place Bellows Gasket on Disc Holder. Thread Bellows onto Disc Holder and securely tighten. See Figure 5.3 for bellows leak test.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

For J and K orifice valves only:

Place Gasket on Stem Retainer. Place Bellows on Stem Retainer. Thread Disc Holder to Stem Retainer using special assembly block. Thread Disc Holder Lock Screw counter clockwise until contact is made with the Disc Holder. See Figure 5.3 for bellows leak test.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

For all other orifices:

Place Bellows on Stem Retainer. Place Gasket on Stem Retainer. Thread Disc Holder to Stem Retainer using special assembly block. Thread Lock Screw counter clockwise until contact is made with the Disc Holder.

Do not thread Pipe Plug (Bonnet) into Bonnet (omit step 18). Bonnet must be vented.

See Figure 5.3 for Bellows Leak Test.

III. O-Ring Seat Construction (Figure 5.4)

Follow the same procedure as for Conventional type valves except for as follows:

For D and E orifices only:

Place O-Ring in Disc Holder groove. Thread Disc into Disc Holder.

For orifices F through K only:

Place O-Ring in Disc Holder groove. Place Disc into Disc Holder. Thread Flat Head Machine Screw through Disc into Disc Holder.

For orifices L through T only:

Thread Disc into Disc Holder. Be sure Disc is free floating. Place O-Ring into Disc groove. Place O-Ring Retainer on Disc. Thread Flat Head Machine Screws through Stem O-Ring Retainer into Disc. Thread Jack Screw Plug into O-Ring Retainer.

IV. Plain Cap Construction

23. Place Cap Gasket on Bonnet.

24. Thread Cap onto Bonnet.

V. Open Lever Cap Construction

For single acting lever only: (Figure 3.4, page 12)

23. Thread Stem Test Washer onto Stem.

1. Place bellows/stem retainer/disc holder assembly into bellows leak test fixture with the bellows flange at the base.
2. Seal the flange of the bellows to the base of the bellows test fixture as illustrated in Figure 5.3.
3. Compress the bellows approximately 1/8 inch with a restraining bar so that the bellows does not elongate when pressure is applied as in Figure 5.3.
4. Fill the disc holder with water. Omit this step for D & E Balanseal® designs as these designs have a one piece disc holder/stem retainer.
5. Apply 30 psig pressure to the bellows.
6. Apply soapy water to bellows exterior to check for bellows integrity.
7. If bubbles appear on bellows exterior there are pin holes or a tear. Replace bellows and repeat the procedure.
8. Check to be sure the bellows/disc holder connection is leak tight. If water in disc holder bubbles or the connection bubbles, tighten the connection or replace gasket.
9. Vent pressure.
10. Release bellows assembly.
11. Air dry bellows assembly to remove soapy water.

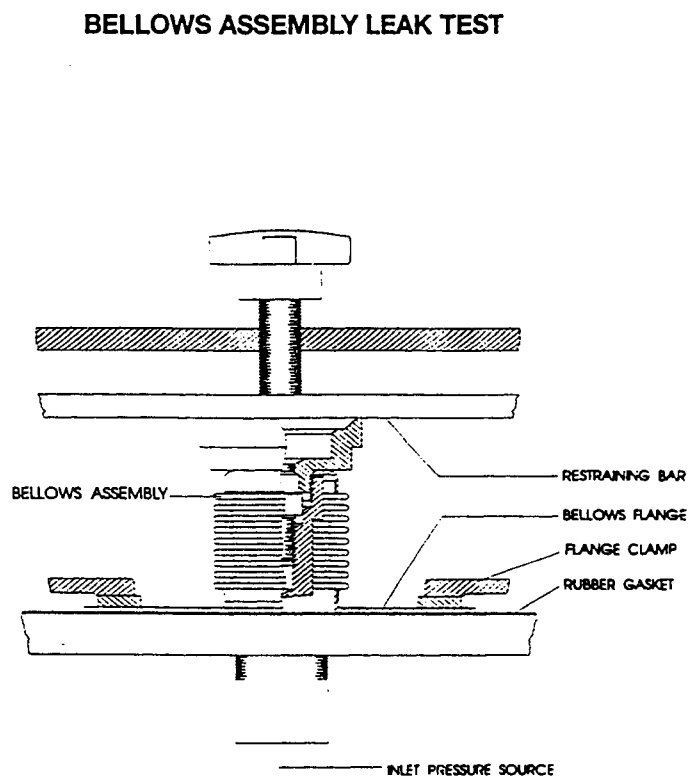


Figure 5.3

24. Thread Jam Nut (Stem) onto Stem.
25. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.
26. Thread Cap Studs through Cap into Bonnet.
27. Place Rivet through Test Lever and Cap hole and secure with Cotter Pin. Adjust Stem Test Washer so there is 1/8" clearance between Test Lever fulcrum and Stem Test Washer.

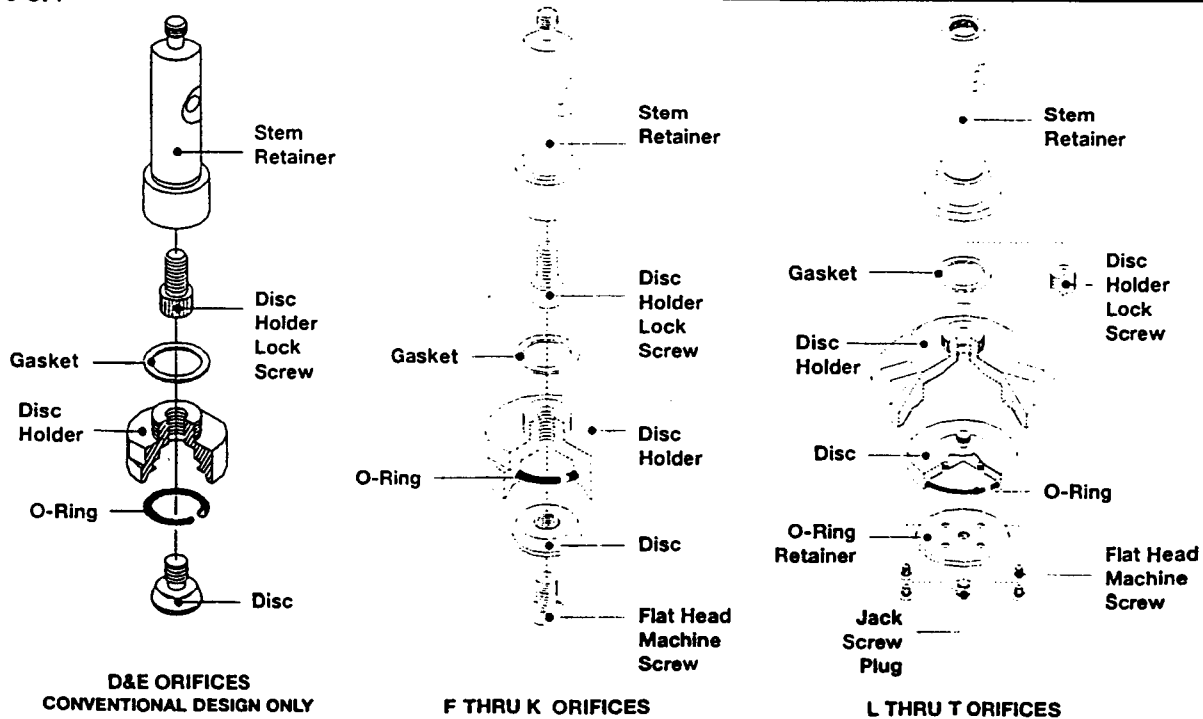
For double acting lever only: (Figure 3.5, page 13)

23. Thread Stem Test Washer onto Stem.
24. Thread Jam Nut (Stem) onto Stem.
25. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.
26. Thread Cap Studs through Cap into Bonnet.
27. Place Rivet through Test Lever Fork and Cap hole. Secure Rivet with Cotter Pin.
28. Place Rivet through Test Lever and Cap hole and secure with Cotter Pin. Adjust Stem Test Washer so there is 1/8" clearance between Test Lever Fork fulcrum and Stem Test Washer.

VI. Packed Lever Construction (Figure 3.3, page 12)

23. Thread Stem Test Washer onto Stem.
24. Thread Jam Nut (stem) onto Stem.
25. Place Cap Gasket on Bonnet.
26. Place Cam Shaft Ring on Cam Shaft.
27. Place counter-bored side of Retaining Ring on cam shaft against cam shaft ring.
28. Place Packing Rings over Cam Shaft and into Retaining Ring cavity.
29. Slide Cam Shaft through hole in cap and through Cam while holding Cam in place inside Cap.
30. Place Cap onto Bonnet so that Test Lever is in the same position as in disassembly notes. The standard position is opposite the valve outlet.
31. Thread Cap Studs through Cap into Bonnet.
32. Adjust Stem Test Washer so there is 1/8" clearance between Stem Test Washer and Cam.
33. Thread Gland into Cap.
34. Place Test Lever on Cam Shaft.
35. Place Plain Washer over Cam Shaft.
36. Thread Hex Jam Nut (Lever) onto Cam Shaft.

Figure 5.4



6. SETTING & TESTING

TRAINING COURSES

Farris Engineering provides programs which coordinate classroom and hands-on training. It is recommended that individuals performing pressure relief valve maintenance receive training specific to those valve series they expect to repair and set. Only this type of training will ensure the proper application of these instructions. The National Board of Boiler and Pressure Vessel Inspectors conducts training programs on valve repair in conjunction with their VR program. This is a broad-based program and is recommended to supplement training received from specific manufacturers.

Equipment

Air testing is the usual method of testing and setting pressure relief valves. A pressure source supplies air to a test drum usually having 1-1/2 cubic feet internal volume. The air pressure to the test drum is controlled by a quick opening valve (approximately 1 inch). The valve being tested is mounted directly on the test drum without restrictions. If considerable numbers of valves are tested, it is advisable to provide an air receiver between the compressor and the quick opening valve. This arrangement allows a small-volume high-pressure compressor to store air during off-hours. Farris Engineering offers a complete line of valve test stands designed to facilitate the proper layout of a test center. They can be augmented by existing or new air receivers to suit the plant or repairer's particular requirements. A worthwhile advantage to these is the accompanying adaptors and clamping arrangements which enable quick test set-ups.

Adjustments & Performance

The use of the correct spring is a matter of critical importance. Attempting to employ a spring below its rated pressure range may result in a loss of lift with resulting loss of capacity and a generally sluggish valve action. Using a spring above or below its rated temperature range may cause a change in spring characteristics and possibly failure of the spring itself. Before changing the set pressure of any valve verify that the new pressure is within the range of the spring and valve construction. When raising the set pressure, check the applicable design code and the design pressure of the protected equipment to ensure compliance with equipment design and local requirements. Before reducing the set pressure, make certain that the capacity at the reduced pressure is sufficient for the protection of your equipment. Valves which are properly installed on steam, gas, or vapor services will relieve with a pronounced pop when opening. After the excess pressure has been relieved, the valve will generally reseal at approximately 5% to 7% below the set pressure. Actual blowdown will vary with each valve and installation.

There is generally no distinct pop with liquid service relief valves as the opening will generally be proportional to the rise in pressure. It is usual for a sudden increase in lift to occur at some overpressure. Where such data are not available, blowdown rings should be set carefully and accurately in accordance with the table values.

Procedure

To properly test a valve, the test drum pressure is brought up to about 90% of the set pressure of the valve. The quick opening valve is now opened sufficiently to cause the test drum pressure to continue to increase 2 psi/sec until the valve pops. A test gage connected to the test drum in a static pressure zone will indicate the pressure the valve pops. Further spring setting adjustments may be necessary to achieve the desired set pressure of the valve. The tightness of a pressure relief valve on gas or vapor service is closely connected with the operation of the valve, i.e. unless a valve opens and closes sharply, it may leak. The action of such a valve depends upon the expansive and reactive forces of the flowing medium (gas or vapor only) which in turn depends upon the location of the blowdown ring. Since the capacity of the test stand is considerably less than the actual valve capacity, it is essential that the blowdown ring be adjusted for good test stand operation. The lowest ring position that can be tolerated for a given size test drum depends upon the valve size and its set pressure relative to the test drum size. Raising the nozzle ring to within two notches from touching the disc holder will obtain the maximum reaction from the smallest amount of the test fluid. However, this position may produce excessive impact and seat damage to small valves set at high pressures. This ring setting is necessary for checking the valve on the test stand and adjusting conditions.

Adjusting Valve to Required Set Pressure

After the valve has been reconditioned and reassembled minus the cap and/or lever assembly, it is ready for a final spring adjustment to the required set pressure. If a new set pressure is required, the limits for adjustment of the spring must be observed. It may be necessary to provide a different spring. After the final adjustment is made, the valve should be popped at least once to prove the accuracy of the setting.

Air Test Stand Settings

For spring Adjustment or checking set point on air test stands with a capacity under 1-1/2 cu. ft., raise ring to a position 2 notches down from contact with disc holder. On air test stands with capacity over 1-1/2 cu. ft., raise ring to a position of approximately 1/2 of tabulated number of notches down from contact with disc holder. Return ring to tabulated field setting or setting established through in-place testing before installation... Be sure to include temperature compensation of set pressure where applicable.

Liquid Service

Liquid relief valves must be set on water at the first continuous flow as the inlet pressure is raised. Intermittent opening and closing indicates leakage. The reduction in inlet pressure required to reseal the valve depends on the rate of flow and operator manipulation.

Set the blow down ring to the position indicated in Table 6.3. Do not attempt to adjust the blow down ring without gagging the valve first (or reducing inlet pressure to zero). Remove the gag. When the valve is first mounted there will be some air under the disc of the valve. This may cause the valve to pop open suddenly. To remove the air lift up on the stem to let the air slowly seep out, if possible. Pressure may need to be added under the valve to assist in lifting the stem. Next, raise the pressure to the desired set point. When the pressure is within 90% of the set pressure, raise the pressure at a rate of 1 psig per 2 seconds. Adjust the spring adjusting screw until the desired set pressure is reached. We define set pressure for a liquid valve as the first continuous flow which is flowing 90 degrees from the outlet. Be patient with liquid valves. They will sometimes exhibit a "false" set point. By holding the pressure at the point which appears to be the set pressure the system operator can prevent the valve from thinking that this is the correct set pressure. If the valve is exhibiting a "false" set point and the operator holds the pressure constant, the flow from the valve will taper off and may even completely stop flowing. The operator should then continue to raise the pressure until the valve is correctly set.

Securing The Blowdown Ring

The adjusted position of the ring is maintained by a Blow Down Ring Lock Screw which threads into the valve body from the outside and engages notches (like gear teeth) on the outside diameter of the blowdown ring. To make an adjustment, loosen and remove the blowdown ring lock screw assembly. Insert a screw driver and rotate the nearest notch toward the left to lower the ring or toward the right to raise it, counting the notches as they are moved. Reinstall the lock screw assembly, ensuring that it intercepts a notch without exerting side-pressure on the ring. **CAUTION!** When making the adjustments under pressure, be sure the valve is lightly gagged to avoid accidental popping. The gag screw must be removed immediately after use. Failure to do so will render the valve inoperable.

SEAT TIGHTNESS TESTING

After the valve is satisfactorily checked for set pressure it is necessary to check the valve for leakage. It is important

to minimize leakage from pressure relief valves. Excessive leakage could lead to fouled and inoperable valves and serious product loss and could also be hazardous to personnel and equipment. The valve can be tested for tightness on the test stand by increasing the pressure on the valve to 90 percent or more of the set pressure and observing the discharge side of the valve for evidence of leakage. Methods of determining leakage are covered by applicable standards and specific user requirements.

API Standard 527 is a widely accepted standard for the procedure and acceptance criteria for assessing the seat tightness of pressure relief valves. The user should be familiar with this standard, in addition to any information presented therein. The following seat tightness methods and requirements are in general compliance with API Standard 527.

Air Testing Blow Down Ring Position

All openings from the secondary pressure zone shall be closed before counting the bubble rate. This includes such items as caps, drain holes, vents and outlets. A soap solution or equivalent test shall be applied to secondary joints to detect escape of air other than that being measured. Seat tightness tests are normally conducted with pressure at the pressure relief valve inlet held at 90 percent of the set pressure immediately after popping. For valves set at 50 PSIG or below, the pressure shall be held a 5 PSIG below the set pressure immediately after popping. Before starting the bubble count, the test pressure shall be applied for a minimum of: 1 minute for valves of inlet sizes 2 inches and smaller; 2 minutes for sizes 2-1/2, 3, and 4 inches; 5 minutes for sizes 6 inches and larger.

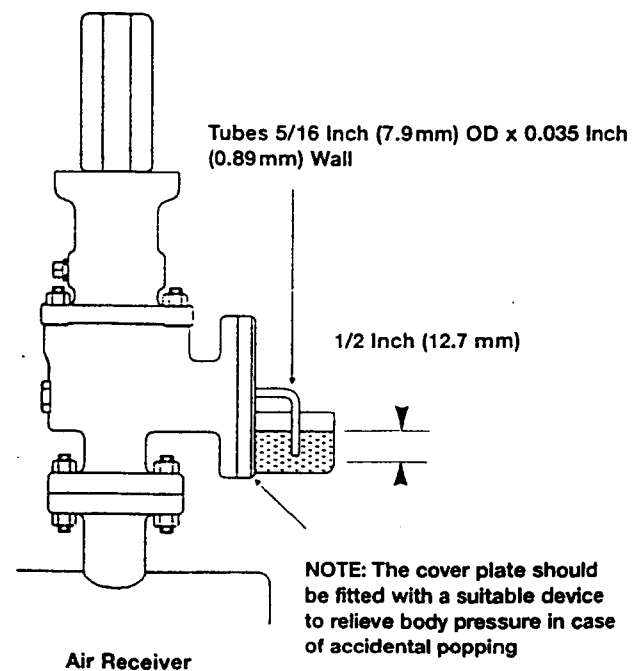


Figure 6.1

Air at ambient temperature shall be used as the pressure medium. The valve shall be observed for leakage for at least 1 minute. The leakage rate in bubbles per minutes shall not exceed the numbers listed in Table 6.1. For an O-Ring seated valve, there shall be no leakage for 1 minute (0 bubbles per minute @ 95% of set pressure). (Figure 6.1)

Maximum Seat Leakage Rates for Metal-Seated Pressure Relief Valves		
SET PRESSURE psig	LEAKAGE RATE (BUBBLES PER MINUTE)	
	F ORIFICE AND SMALLER	G ORIFICE AND LARGER
15-1000	40	20
1500	60	30
2000	80	40
2500	100	50
3000	100	60
4000	100	80
5000	100	100
6000	100	100

Table 6.1

Steam Testing

Steam service pressure relief valves which are set and adjusted on steam shall be leak-tested on steam visually using a black background. There shall be no visible or audible leakage from the valve outlet when the inlet pressure is held at 90% of the set pressure after popping and reseating. For set pressure below 50 psig this test shall be conducted at 5 psig below set pressure. The valve shall be observed for leakage for at least 1 minute. This criteria applies to both metal and O-Ring seated valves.

Liquid Testing

Liquid service pressure relief valves which are set and adjusted on water shall be leak-tested on water at near ambient conditions. Before starting the seat tightness test, the set pressure shall be verified, and the outlet body bowl shall be filled with water, which shall be allowed to stabilize with no visible flow from the valve

BLOW DOWN RING SETTINGS

AIR, GAS, AND VAPOR APPLICATIONS									
ORIFICE	SET PRESSURE RANGE, PSIG								
	15-100	101-200	201-300	301-400	401-500	501-600	601-800	801-1000	1000 & UP
D (note 1)	37 2	37 2	38 3	39 4	39 4	40 5	40 5	41 6	42 7
E (note 1)	37 2	37 2	38 3	39 4	39 4	40 5	40 5	41 6	42 7
F	2	3	4	5	6	7	8	9	10
G	3	4	5	6	7	8	9	10	11
H	3	4	5	6	7	8	9	10	11
J	3	5	5	6	7	8	9	10	11
K	4	5	6	7	8	9	10	11	12
L	4	6	9	9	10	10	10	11	12
M	4	6	12	12	12	12	12	12	12
N	5	10	15	15	15	15	15	15	15
P	6	16	20	20	20	20	20	20	20
Q	6	16	20	20	20	20	20	20	—
R	4	16	20	20	—	—	—	—	—
T	4	16	20	—	—	—	—	—	—
STEAM APPLICATIONS									
ORIFICE	SET PRESSURE RANGE, PSIG								
	15-100	101-200	201-300	301-400	401-500	501-600	601-800	801-1000	1000 & UP
D (note 1)	37 2	38 3	39 4	40 5	41 6	42 7	43 8	44 9	45 10
E (note 1)	37 2	38 3	39 4	40 5	41 6	42 7	43 8	44 9	45 10
F	2	4	5	6	7	8	9	10	12
G	3	5	6	7	8	9	10	11	13
H	3	5	6	7	8	9	10	11	13
J	3	6	6	7	8	9	10	11	13
K	4	6	7	8	9	10	11	12	14
L	4	7	7	8	9	10	11	12	14
M	4	7	7	8	9	10	11	12	14
N	4	7	7	8	9	10	11	12	14
P	4	7	7	8	11	10	11	12	14
Q	4	8	9	10	11	12	13	15	—
R	4	8	9	10	—	—	—	—	—
T	4	8	9	—	—	—	—	—	—

Note 1: Use this row only for "D" & "E" orifice valves purchased before July 1, 1993

Table 6.2

outlet. The inlet pressure shall be increased to the test pressure. The valve shall be observed for 1 minute at the test pressure. For valves set at 50 PSIG or below, the pressure shall be held at 5 PSIG below the set pressure. Above 50 PSIG set pressure hold the pressure at 90% of the set pressure.

For O-Ring seated valves there shall be no visible leakage when held at the test pressure for 1 minute regardless of valve size. For metal seated valves less than 1 inch inlet size the allowable leakage rate shall not exceed 10 cubic centimeters per hour. For metal seated valves one inch inlet size or larger the allowable leakage rate shall not exceed 10 cubic centimeters per hour per inch of inlet size. Example: The maximum allowable leakage rate from a 4 inch inlet metal seated pressure relief valve shall not exceed 40 cubic centimeters per hour. This is a difficult test to conduct and it is easier to aim for zero leakage during this test by proper repair procedures. Should seat leakage be encountered a more quantitative test can be conducted to determine valve acceptability.

BLOWDOWN RING SETTING

Tables 6.2 and 6.3 give blow down ring settings in the number of notches down from disc holder contact. The higher the ring the sharper the pop and longer the blowdown. The lower the ring, the poorer the pop, the shorter the blowdown.

LIQUID SERVICE APPLICATIONS			
ORIFICE			NUMBER OF NOTCHES
D	E		2
F			3
G	H	J	4
K	L		8
M	N	P	12
Q	R	T	20

Table 6.3

FIELD SETTINGS

The above settings are final average field settings for good performance under actual operating conditions on the installation. Use recommended number of notches, or maximum adjustment possible if less than table. Finer adjustments may be desirable or necessary because of individual piping and service differences. On applications where the valve will operate at substantially reduced flow, fewer notches may help eliminate chatter and ensure seat tightness.

COMPENSATION FOR TEMPERATURE

Any increase in temperature causes a reduction in set pressure of a safety-relief valve. The primary factors are the linear expansion of the body and top works, which reduces the spring loading, and the direct effect of temperature on the spring itself.

It is customary to compensate for this effect by increasing the setting when a valve is set at ambient conditions on a test stand and the valve is intended for a higher operating temperature in service. Although the adjustment is approximate and may be outweighed by other differences caused by variations in media and blowdown ring adjustments, compensation for temperature as an independent variable improves the accuracy of the setting. It is not recommended to reduce a spring setting for valves intended for sub-zero service. (Table 6.4)

Normal Operating Temperature	% Increase in Set Pressure At Atmospheric Temp.
minus 400°F to +300°F	none
+300°F to +600°F	1%
+601°F to +900°F	2%
+901°F to +1200°F	3%

Table 6.4

COLD DIFFERENTIAL TEST PRESSURE (CDTP) is the inlet pressure at which the valve is adjusted to open on a test stand at ambient temperature conditions, discharging to atmosphere. Computation includes compensation for constant back pressure (if required) and inlet operation temperature. Cold Differential Test Pressure is the sum of the Spring Selection and the Increase in Setting to compensate for temperature. The abbreviation is Cold Set. (Table 6.4)

COMPENSATION FOR BACKPRESSURE

BACK PRESSURE is the pressure existing at the valve outlet and in the valve outlet and in the downstream portion of the valve body. It may be superimposed, built-up, constant, or variable. The spring setting should be compensated for constant and superimposed back pressure, except for BalanSeal[®] valves. For these type valves variable back pressure is not compensated for, but the maximum pressure limit of the bellows is stamped on the nameplate.

OPERATING DIFFERENTIALS

The variety of service conditions for section VIII applications precludes a rigid set of rules. Operating difficulties can be minimized by providing as much differential as possible for known conditions on a particular application. Table 6.6 lists the suggested minimum differentials.

SET PRESSURE TOLERANCE AND OPERATING DIFFERENTIALS GASES, VAPORS, AND LIQUIDS

	SET PRESSURE psig	SET PRESSURE TOLERANCE (+) OR (-)	MINIMUM DIFFERENTIAL SUGGESTED (Gases & Vapors)	MINIMUM DIFFERENTIAL SUGGESTED (Liquids)
METAL SEAT SOFT SEAT	15 To 70	2 PSI	5PSI	5PSI
METAL SEAT SOFT SEAT	71 To 1000	3%	10%	10%
METAL SEAT SOFT SEAT	1001 To 6000	3%	10%	10%

Table 6.6

FINAL NOTES

Once your valve has been assembled and tested make sure that you have completed all necessary records before placing it back in service. These records are important for the effective future use of the valve. They will provide some guidance as to when to retire valves and replace components as well as providing the historical record of the conditions and services under which the valve operated. A sample history card

appears in Appendix C which can be photocopied and used for this purpose.

The valve should be properly installed in service or prepared for storage. If the valve is to be stored the inlet and outlet of the valve should be covered to protect against any foreign matter entering the valve.

TROUBLE SHOOTING

TYPICAL PROBLEMS WITH PRESSURE RELIEF VALVES

CHATTER

The valve is oversized for installation.

If the inlet capacity is less than 25% of the valve capacity there will be a tendency for the valve to chatter.

The inlet piping is of excessive length or the inlet pipe diameter is less than the inlet size of the valve.

Design inlet piping systems so that the pressure drop to the valve is less than 3%. The inlet pipe diameter should be at least the inlet size of the valve.

The outlet piping is of excessive length or the diameter is less than the valve flange size.

Design outlet piping so that the diameter is at least the outlet size of the valve and that pressure on the outlet does not build up causing the valve to shut.

INCORRECT SET PRESSURE

Misreading the nameplate

Always compensate for backpressure and temperature when bench testing the safety-relief valve by following the Cold Differential Test Pressure.

The blowdown ring position changed

Check that the lock screw stud has engaged between the teeth on the blowdown ring to prevent rotation. This could also cause erratic blowdown characteristics as well as leakage.

Internals are misaligned.

See section on leakage.

Jam nut is loose.

Tighten jam nut.

Rough handling.

A safety-relief valve is a precision instrument and should be handled with care. It is also recommended that the valve be popped once or twice to realign the parts after rough handling.

Pressure surge at inlet.

Sudden impact of a fluid may cause the valve to open prematurely. Pressure build-up should be gradual.

The valve contains a bellows and the bonnet is not vented.

Remove bonnet pipe plug so that the bonnet is exposed to atmospheric pressure.

LEAKAGE

The seats are damaged.

Lap the seats to remove the damage. If the scratches are deep, machining may be required. Remove any foreign particles from the system to prevent scoring the seats.

The system operating pressure is too close to the valve set pressure.

Always have at least 10% (or 5 psig, whichever is greater) differential between operating pressure vs. set pressure for metal seated valves, and 7% (or 5 psig, whichever is greater) for soft seated valves. See table 6.6. page 27

Misaligned lifting gear.

Adjust the stem test washer so that there is 1/8 inch clearance between either the cam or lever and the stem test washer.

Excessive external loads to the outlet piping.

Support outlet piping so that the maximum recommended weight on the outlet is not exceeded. See Appendix E, Table 7.1

Horizontal mounting.

Safety-relief valves must be mounted with the stem in the vertical plane. If mounted horizontally the valve will experience excessive friction on the guides and will not align properly.

Lock screw stud not adjusted properly.

Adjust the length of the lock screw stud so that it does not press into the blowdown ring causing misalignment.

Misaligned internals.

Disassemble valve and check all universal ball joints, flatness of disc and nozzle seat and repair or replace.

Other.

Check for bent stem, springs with uneven ends or out of alignment. A common cause of bent stems is overgagging. Test gags are designed to be finger tightened only.

BLOWDOWN

Blowdown is excessive/the valve is hanging up

Lower the blowdown ring until the desired blowdown is achieved. Also check for dirt or other foreign material in the seating area or on the guiding surfaces.

Blowdown is too short.

Raise the blowdown ring to lengthen the desired blowdown.

REQUIRED TOOLS	ORIFICE													
	D	E	F	G	H	J	K	L	M	N	P	Q	R	T
OPEN END WRENCHES														
7/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
9/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
3/4"	•	•	•	•	•	•	•	•	•	•	•			
13/16"	•	•	•	•	•	•	•	•	•	•	•			
7/8"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
1"	•	•	•	•	•	•	•	•	•	•	•	•	•	•
1-1/16"	•	•	•	•	•	•	•	•	•	•	•	•	•	
1-1/8"								•	•	•	•	•	•	•
1-1/4"			•	•	•	•	•	•	•	•	•	•	•	•
1-3/8"	•	•	•	•	•									
1-1/2"				•										
1-5/8"					•									
1-3/4"						•	•	•	•	•	•			
2"								•	•	•	•	•	•	•
2-1/4"	•	•	•	•	•	•	•	•	•	•	•			
2-3/4"							•							
3-1/4"						•	•	•	•	•	•	•	•	•
3-1/2"								•	•					
3-11/16"				•	•									
3-3/4"										•				
5"							•			•				
5-1/4"						•								
5-3/4"												•		
6"													•	
6-3/16"							•	•	•	•	•	•	•	
ALLEN WRENCHES														
3/16"	•	•	•	•	•	•								
7/32"							•	•	•	•	•			
3/8"												•	•	•
ADJUSTABLE PIN SPANNERS														
1-1/4" TO 3"	•	•	•		•									
2" TO 4-3/4"				•	•	•								
4-1/2" TO 6-1/4"							•	•	•	•	•	•	•	
8-1/2"												•	•	
10 5/8"														•
ADJUSTABLE HOOK SPANNERS														
2" TO 4-3/4"								•	•	•				
4-1/2" TO 6-1/4"											•			
6-1/8" TO 8-3/4"												•	•	
9-1/4"														•
ADJUSTABLE WRENCHES	•	•	•	•	•	•	•	•	•	•	•	•	•	•
FLAT HEAD SCREW DRIVERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
WIRE CUTTERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SUPER JOINT PLIERS	•	•	•	•	•	•	•	•	•	•	•	•	•	•
PIPE WRENCH	•	•												
O-RING PICK	•	•	•	•	•	•	•	•	•	•	•	•	•	•
FLASHLIGHT	•	•	•	•	•	•	•	•	•	•	•	•	•	•

APPENDIX B EXTERNAL LOADS

Mechanical forces may be applied to the valve by discharge piping as a result of thermal expansion, movement away from anchors and weight of any unsupported piping. The resultant bending movements on a closed pressure relief valve may cause valve seat leakage and excessive stress in inlet piping. The design of the installation should consider these factors.

The determination of bending movements, stresses and supports is the responsibility of the designer of the pressure relief system in accordance with the appropriate codes, recommended practices and site conditions. However, since a closed pressure relief valve cannot tolerate as much load applied to the outlet as a fitting or line valve, the manufacturer is often requested to provide guidelines to avoid seat leakage.

For this purpose, we are considering small deflections at moderate stress levels principally in a vertical plane through the horizontal and vertical axes of the valve. Let us examine a maximum allowable dead weight applied vertically at the outlet flange, being a function of the moment of inertia of the inlet neck, the horizontal moment arm, a constant and an empirical factor determined by tests. The result would be a great number of computations compared with a fitting whose bending moment is simply 1500 times the section modulus.

Similarly, the bending moments in X, Y and Z axes could be calculated by dimensional analyses of the great number of valve bodies in the catalog. However, lacking industry standardization in presenting such data in a uniformly acceptable manner, the use of weight units provide a quantitative reference for improving installation designs. It is preferable to the general instruction of supporting all discharge piping independently.

The following approximate method tabulates only the most significant factor, which is the maximum dead weight load F_z in pounds which we recommend as a limit to avoid seat leakage.

MAXIMUM RECOMMENDED WEIGHT ON OUTLET F_z POUNDS					
ORIFICE	TYPE	F_z	ORIFICE	TYPE	F_z
D	26DA10	85	K	26KA10	630
	11	85		11	940
	12	85		12	940
	13	85		13	400
	14	158		14	400
	15	158		15	470
	16	230		—	—
	—	—		—	—
E	26EA10	85	L	26LA10	600
	11	85		11	900
	12	85		12	2000
	13	85		13	1070
	14	158		14	820
	15	158		—	—
	16	230		—	—
	—	—		—	—
F	26FA10	205	M	26MA10	1220
	11	275		11	1900
	12	140		12	1900
	13	140		13	1240
	14	155		14	820
	15	155		—	—
	16	230		—	—
	—	—		—	—
G	26GA10	350	N	26NA10	830
	11	400		11	900
	12	145		12	900
	13	155		13	815
	14	155		14	815
	15	330		—	—
	16	330		—	—
	—	—		—	—
H	26HA10	330	P	26PA10	600
	11	370		11	700
	12	590		12	730
	13	300		13	730
	14	430		14	730
	15	430		—	—
	—	—		—	—
	—	—		—	—
I	26IA10	330	Q	26QA10	1350
	11	370		11	1350
	12	590		12	2700
	13	300		13	2700
	14	430		H26QA13	—
	15	430		26RA10	1500
	—	—		11	2700
	—	—		12	1800
J	26JA10	490	R	13	2200
	11	620		H26RA13	—
	12	770		26TA10	2400
	13	445		11	2400
	14	870		12	2400
	15	870		T	H26TA12	2400

Table 7.1

APPENDIX C

MAINTENANCE & INSPECTION SPECIFICATION RECORD

Valve Type:	S/N:	Relieving Pressure:
Manufacturer:		Remarks:
Body and Bonnet Material:		
Nozzle and Disc Material:		
Trim Material:		
Spring Material	Spring No.	
Carbon Steel:		
Alloy:		
Inlet:		
Orifice:		
Back Pressure:		Maintenance Engineers Phone:
Spring Set Pressure		

No	Unit	Location

HISTORICAL RECORD

Date Tested	Popped	Reseat	Disposition	Condition	Repairs	Remarks

The information in the above form is typical of the data that should be recorded for all valves. This information should be compiled for new valves as well as valves

removed from service for maintenance. This form should be photocopied and used as part of any repair shops' proper record keeping system on maintenance of valves.

GENERAL REFERENCE SOURCES

These reference materials are available and should be helpful in the installation and testing of Pressure Relief Valves. Since it is impossible to include all industry practices that are used in the installation of a Pressure Relief Valve, this manual has been prepared to describe routine field handling and installation procedures to make a safe and acceptable installation.

American National Standards Institute

New York, NY

ANSI B16.5 - Pipe Flanges and Flanged Fittings

ANSI B16.34 - Valves - Flanged, Threaded and Welding End.

ASME PTC 25 - Performance Test Code.

ANSI/ASHRAE 15-78 - Safety Code for Mechanical Refrigeration, [B9.1].

American Petroleum Institute Washington, D.C.

API RP 520, Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries, Part-1 Sizing and Selection.

API RP 520, Part II - Installation

API RP 521, Guide for Pressure-Relieving and Depressuring Systems.

API Standard 526, Flanges Steel Safety Relief Valves.

API Standard 527, Seat Tightness of Pressure Relief Valves.

API Standard 2510, Design and Construction of LP-Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refiner- and Tank Farms.

API RP 576, Inspection of Pressure-Relieving Devices.

API PAPER 62-73, Computerized Safety Valve Maintenance Records by JH Forrester, Jr., May 17, 1973

American Society of Mechanical Engineers New York, NY

ASME Boiler and Pressure Vessel Code Section VIII, Rules for Construction of Pressure Vessels, Division I.

ASME Boiler and Pressure Vessel Code Section I, Rules for Construction of Power Boilers

Compressed Gas Association, Inc. Arlington, VA

Safety Relief Device Standards:

Part 1 - Cylinders for Compressed Gases, Pamphlet S-1.1.

Part 2 - Cargo and Portable Tanks for Compressed Gases, Pamphlet S-1.2.

Part 3 - Compressed Gas Storage Containers, Pamphlet S-1.3.

National Board of Boiler and Pressure Vessel Inspectors Columbus, Ohio

National Board Inspection Code, NB-23.

National Fire Protection Association Quincy, Massachusetts

NFPA No. 30, Flammable and Combustible Liquids Code.

NFPA No. 58, Standard for the Storage and Handling of Liquefied Petroleum Gases.

NFPA No. 59, Standard for the Storage & Handling of Liquefied Petroleum Gases at Utility Gas Plants.

TELEDYNE FLUID SYSTEMS **Farris Engineering**

An Allegheny Teledyne Company

10195 BRECKSVILLE ROAD, BRECKSVILLE, OHIO 44141 USA TELEPHONE: (440) 838-7690 FAX: (440) 838-7699 www.teledynefluid.com

Plant

Farris Engineering, Brecksville, Ohio USA

Plants in Canada

Farris Engineering, Brantford, Ontario; Edmonton, Alberta

While this information is presented in good faith and believed to be accurate, Teledyne Fluid Systems, Farris Engineering does not guarantee satisfactory results from reliance upon such information. Nothing contained herein is to be construed as a warranty or guarantee, expressed or implied, regarding the performance, merchantability, fitness or any other matter with respect to the products, nor as a recommendation to use any product or process in conflict with any patent. Teledyne Fluid Systems, Farris Engineering reserves the right, without notice, to alter or improve the designs or specifications of the products described herein.

PRESSURE RELIEF VALVE INSTALLATION INSTRUCTIONS

1. Introduction

Pressure relief valves are precision instruments. Correct installation is essential for plant, property, personnel and public safety. Failure of a pressure relief valve can lead to catastrophic overpressure of equipment and/or the release of fluid under pressure. The fluids may be hazardous and all precautions should be taken to ensure safe disposal.

2. Storage & Handling

Cleanliness is essential to the satisfactory operation and tightness of a pressure relief valve. Every precaution should be taken to ensure that dirt or other foreign matter does not enter the valve.

- Valves that are not immediately installed in service should be stored indoors.
- Inlet and outlet covers should be left in place until the valve is to be installed.
- Valves should be moved and installed with the stem in the vertical position.
- Care should be taken to keep the inlet and outlet clean.

3. Receiving Inspection

A visual inspection of the valve should be made when it is first received. Any problems should be recorded and reported to the manufacturer or his local representative. Points that should be checked include:

- Looking for any shipping damage.
- Confirming the nameplate data against ordering documents.
- Verifying the factory wire seals are in place.
- Storing properly if the valve will not be installed immediately.

4. Confirmation of Set Pressure

Before the valve is installed, it is important to confirm the set pressure. This step should only be performed by trained personnel using proper test equipment. If trained personnel and/or proper test equipment are not available, this step should be skipped. Use of improper test procedures or equipment can damage the valve and will void any warranties.

5. Confirmation of Seat Tightness

After the set pressure has been verified, the valve's seat tightness should be checked using the procedures outlined in the appropriate maintenance manual. As a general rule, seat tightness testing is performed at 90% of the set pressure. This testing should only be performed by trained personnel using proper test equipment. If trained personnel and/or proper test equipment are not available, this step should be skipped. Use of improper test procedures or equipment can damage the valve and will void any warranties.

6. Inspection of Inlet and Outlet Piping

Before a pressure relief valve is installed in service, the upstream and downstream piping should be inspected for foreign matter such as welding beads, pipe scale, and other material that could damage the valve during relief. Wherever possible, the system should be thoroughly purged before the valve is installed.

7. Pressure Relief Valve Installation

Pressure relief valve performance can be adversely affected by improper installation. To ensure good performance, the following guidelines should be followed.

- Always install pressure relief valves upright with the stem in the vertical position and the inlet at the bottom.
- Avoid mounting valves close to equipment that can cause pressure fluctuations, such as compressor discharge lines.
- Avoid installing valves close to equipment that emits excessive heat.
- Install valves close to the pressure source so that the inlet pressure loss is no more than 3%.
- Mount valves away from equipment that may cause turbulence, such as reducing stations, orifice plates and nozzles, and other valves and fittings.
- Make sure all inlet and outlet piping is properly supported to avoid putting an excessive load on the valve. Provide drainage from the piping or from the valve body.
- Remove the inlet and outlet flange protectors. Any extraneous materials inside the valve body or nozzle should be removed.

- Make sure inlet piping is at least equal to or greater than the inlet size of the valve. Outlet piping should be equal to or greater than the valve's outlet size.
- On bellows valves remove the plastic shipping plug from the bonnet. Discharge vent in a safe direction.
- Tighten all inlet and outlet flange bolts evenly.
- Leave enough room to allow for in-line maintenance and adjustments.

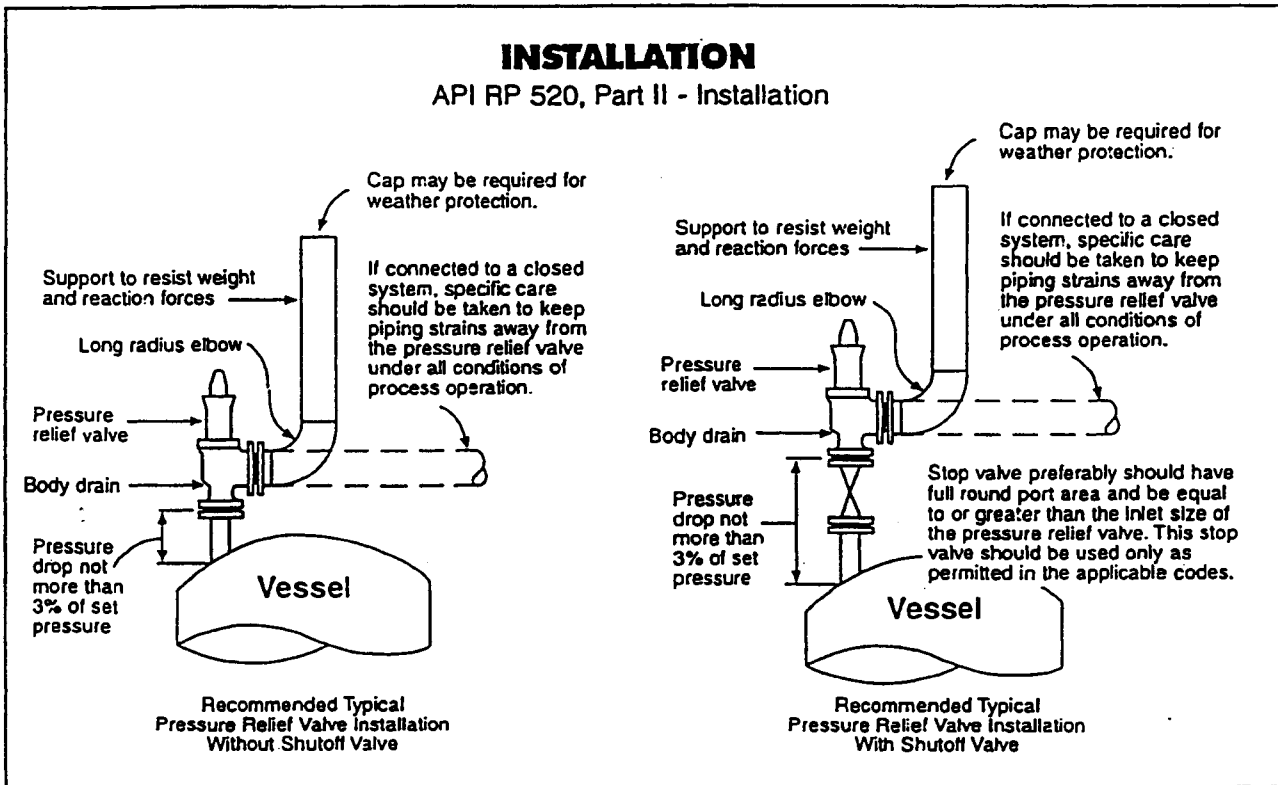
8. Lifting Levers

Lifting levers are provided on some valves to allow the user to manually verify that the valve trim is free to move when the operating pressure exceeds the set pressure.

To prevent stem damage, the valve should have a minimum of 75% of the set pressure under the disc before operating the test lever. In addition, the valve should never be carried by the lever as this can move the disc off the seat, resulting in damage to both parts.

9. System Start Up and Testing

It is recommended that the valve be isolated during pressure testing of the system, either by blanking or closing a stop valve. If gagging is used, extreme caution should be used to avoid damaging the valve stem or seat by overtightening the gag screw. Gag screws should be installed hand tight and should always be removed after system testing has been completed.



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Division of Curtiss-Wright Flow Control Corporation

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www.cwfc.com



RO 10/99 5M

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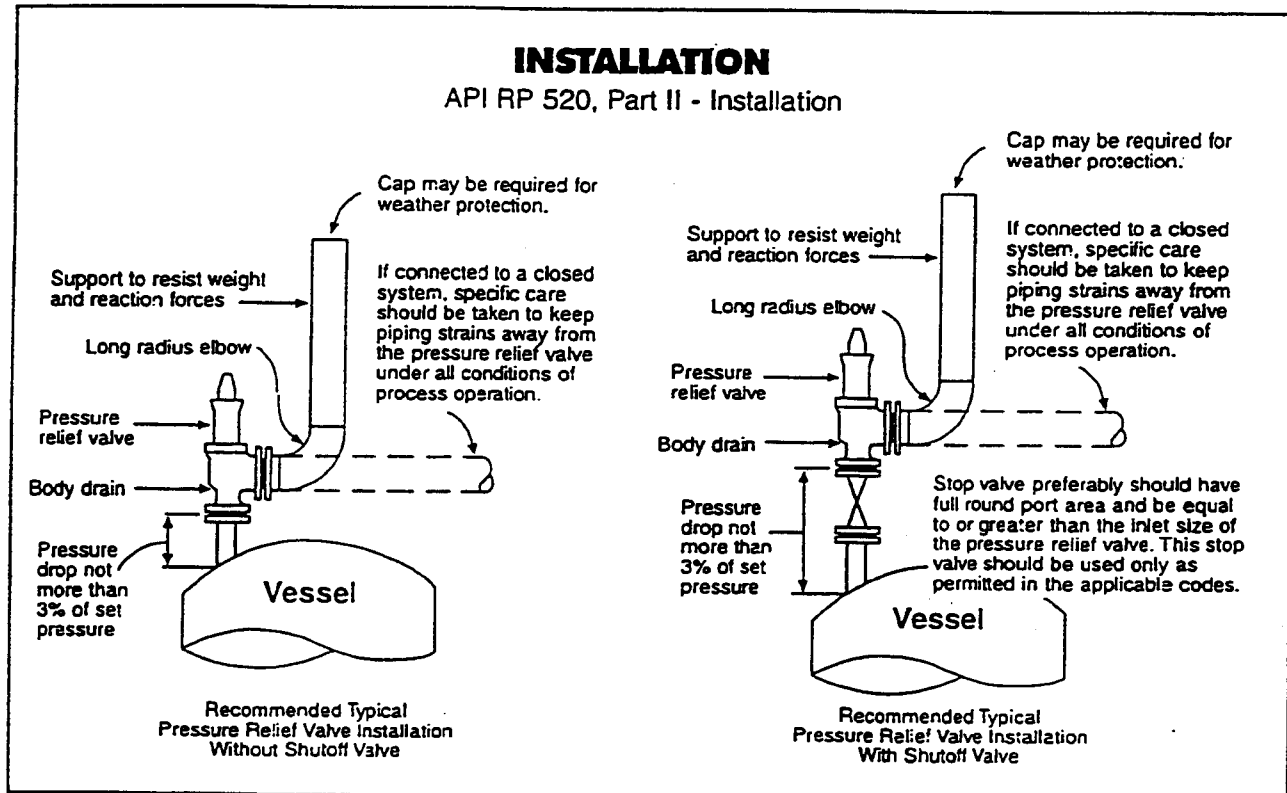
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RO 10/99 5M



Series 2700

Pressure Relief Valves



Flanged



Female NPT Inlet



Sanitary Inlet



Sanitary Inlet and Outlet



Farris Engineering

Division of Curtiss-Wright Flow Control Corporation



Series 2700 Pressure Relief Valves



Designed to provide customers with the widest selection of sizes, orifices and construction materials, Series 2700 meets the exacting demands of the process industry.

Table of Contents

General Description.....	2
Ordering Information & Numbering System.....	3
Bill of Materials-Conventional.....	4
Bill of Materials-Balanced Design.....	5
Selection Table: O-Ring Design.....	6
Selection Tables: Conventional U.S. Customary Units	
Threaded Connections.....	6
Flanged Connections.....	7
Selection Tables-Balanced Design U.S. Customary Units	
Threaded Connections.....	8
Flanged Connections.....	8
Special Materials.....	9
Capacity Tables-U.S. Customary Units	
Air.....	10
Steam.....	10
Water.....	11
Selection Tables-Conventional-Metric	
Threaded Connections.....	12
Flanged Connections.....	13
Selection Tables-Balanced Design-Metric	
Threaded Connections.....	14
Flanged Connections.....	14
Capacity Tables-Metric	
Air.....	15
Water.....	15
Steam.....	16
Cap Constructions.....	16
Dimensions & Weights.....	18
Other Farris Engineering Valves.....	19

Superior Design

- A single design handles air, steam, vapor and liquid services.
- Maximum interchangeability of parts affords easy maintenance and lower costs.
- Fixed blowdown design simplifies testing and repair. Maximum blowdown of 5% to 15% regardless of service.¹
- A built-in lift stop ensures stable performance.
- Balanced design in “C” and “D” orifices nullifies the effects of back pressure on set point.

ASME Code Certification

- Manufactured in conformance to Section VIII of the ASME Boiler and Pressure Vessel Code for air, steam, and liquid service.
- Capacities certified by The National Board of Boiler and Pressure Vessel Inspectors.

Optional O-Ring Seat Design

- O-ring seat design available for maximum seat tightness.
- Teflon[®] available at higher pressures to provide the same zero bubbles per minute leakage as elastomer O-ring seats.

Comprehensive Product Line

- Set pressures from 15 psig to 6500 psig with orifice areas from 0.068 to 0.573 sq. in.
- Standard valves have MNPT inlet X FNPT outlet. Optional female thread, flanged, socket weld, welding nipple, and sanitary connections available.

Maximum Selection of Materials

- Standard construction includes 316 stainless steel body, trim and spring, with carbon steel bonnet.
- Optional materials include Monel[®], Hastelloy C[®], and materials suitable for NACE service.

General Note:

¹Blowdown on liquid service may slightly exceed 15% in certain applications.

Teflon is a registered trademark of the DuPont Company.

Monel is a registered trademark of Inco Alloys International Inc.

Hastelloy and Hastelloy C are registered trademarks of Haynes International Inc.



Numbering System

Selecting and specifying Farris pressure relief valves is simple using the numbering system that follows. Each digit of the part number has a distinct significance. The digits describe the basic valve series, orifice, seat design, inlet temperature range, body, bonnet and spring material, inlet type and pressure rating.

27	D	A	2	3	H -	M	2	0	S4
Series Number	Orifice/Area	Seat Construction	Inlet Size ¹	Outlet Size ¹	Special Variations	Inlet Connections	Cap Construction	Test Gag	Special Materials
27	C 0.068	A Metal Seat	1 1/2"	3 1"	H High pressure variations of standard types B Balanced design ² D Heat transfer fluid standard pressure E Heat transfer fluid high pressure	M MNPT	2 Plain	0 No Gag	S4 Complete 316 St. St. S7 NACE Trim M1 Monel Body & Disc M2 Monel Trim M4 Complete Monel H1 Hastelloy C Body & Disc H2 Hastelloy C Trim H4 Complete Hastelloy C
	D 0.125	C Soft Seat	2 3/4"	4 1 1/2"		F FNPT	4 Packed Lever	1 Test Gag	
	E 0.223	T Teflon Seat	3 1"	5 2"		1 Flanged -150RF	7 Open Lever		
	F 0.350		4 1 1/2"	6 2 1/2"		2 Flanged -300RF			
	G 0.573					3 Flanged -600RF			
					4 Flanged -900RF				
					5 Flanged -1500RF				
					6 Flanged -2500RF				
					O Special				
					S Socket Weld				
					T Sanitary				
					W Welding Nipple				

Ordering Information

Please specify the following so that we may process your order as quickly as possible.

- 1 Quantity.*
- 2 Inlet and outlet sizes.
- 3 Farris type number.*
- 4 Inlet and outlet connections: MNPT, FNPT, flanged, socket weld, sanitary inlet or weld nipple.
- 5 Materials of construction if other than standard.
- 6 O-ring seat pressure seal material, if required.
- 7 Set pressure.*
- 8 Operating and relieving temperatures.*
- 9 Allowable overpressure.*
- 10 Fluid and fluid state.*
- 11 Backpressure, superimposed constant and/or variable, and built-up.*
- 12 Required capacity.*
- 13 Accessories: open or packed lever if required; test gag.
- 14 Code requirements, if any.

**As a customer service, we verify your selection and sizing. In order to do this, we must have this information.*

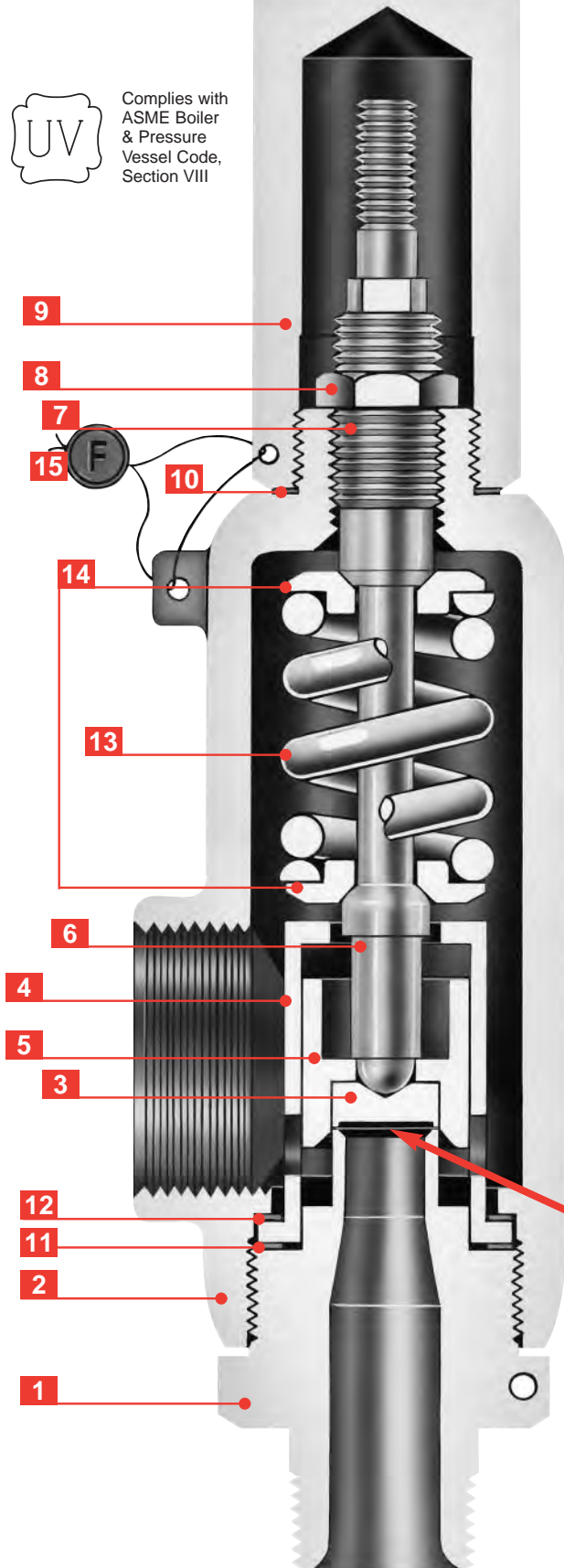
General Notes:

1. Not all combinations of inlet and outlet sizes shown are available. Consult the selection tables of pages 6 and 7.
2. Test gag option is not available with open lever cap.
3. Available in O-ring seat design only. Consult the Farris Factory.

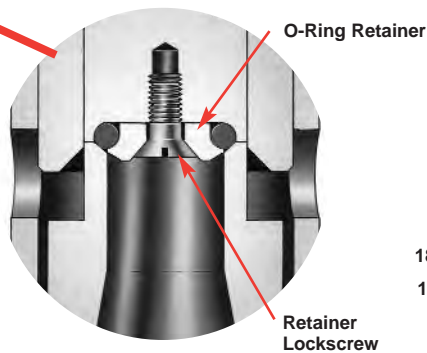
Bill of Materials - Conventional



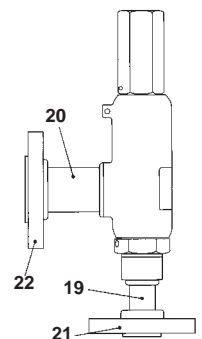
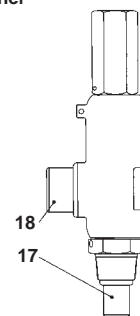
Complies with ASME Boiler & Pressure Vessel Code, Section VIII



Item No.	Part Name	Standard Material
1	Body	SA-351, Gr. CF8M St. St. or SA-479 Type 316 St. St.
2	Bonnet	SA-216, Gr. WCB, Carb. St.
3	Disc	316 St. St.
4	Guide	316 St. St.
5	Disc Holder	316 St. St.
6	Stem	316 St. St.
7	Spring Adj. Screw	316 St. St.
8	Jam Nut	316 St. St.
9	Cap, Plain Screwed	Carbon Steel
10	Cap Gasket	316 St. St.
11	Body Gasket	316 St. St.
12	Guide Gasket	316 St. St.
13	Spring (-20° to +750°F)	Stainless Steel
14	Spring Buttons	316 St. St.
15	Wire Seal	St. St. Wire / Lead Seal
16	Nameplate (Not Shown)	Stainless Steel
17	Welding Nipple (Inlet)	316 St. St.
18	Welding Nipple (Outlet)	Carbon Steel
19	Lap Joint Stub End (Inlet)	316 St. St.
20	Lap Joint Stub End (Outlet)	Carbon Steel
21	Lap Joint Flange (Inlet)	Carbon Steel
22	Lap Joint Flange (Outlet)	Carbon Steel

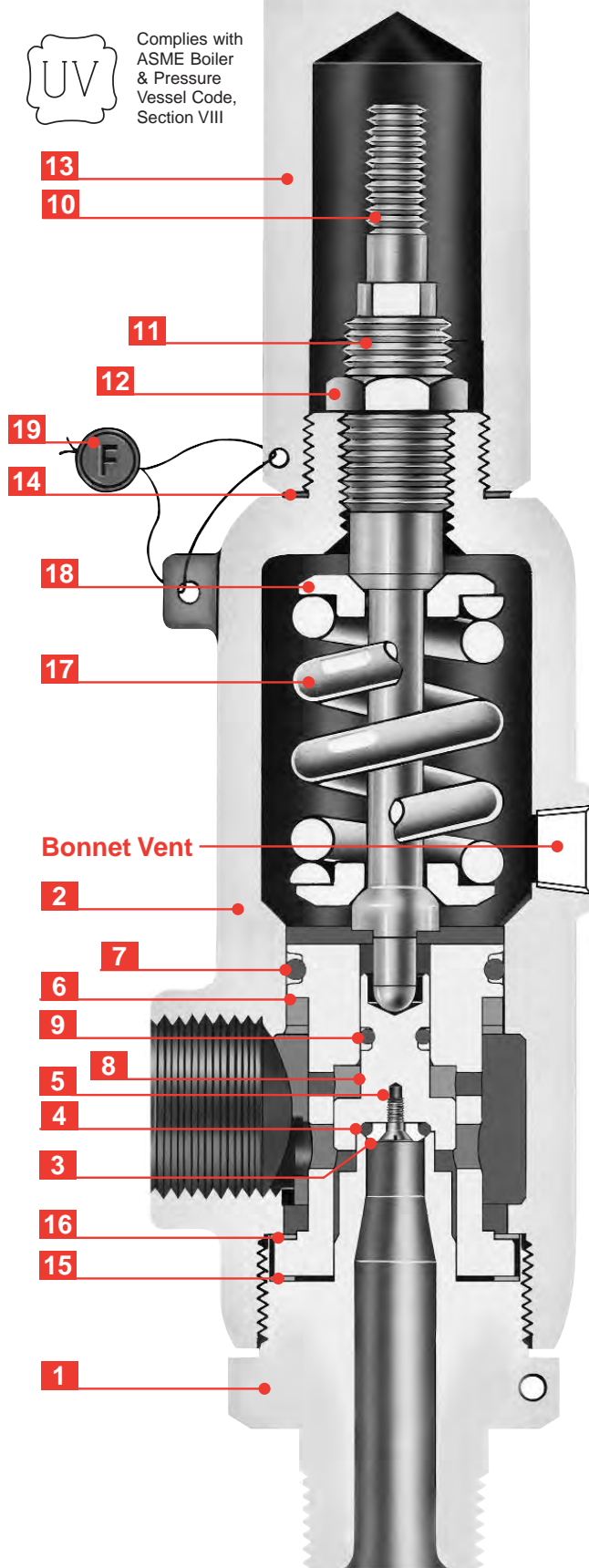


O-Ring Design (Optional)





Complies with ASME Boiler & Pressure Vessel Code, Section VIII



Do you have variable back pressure? Can't use a balanced bellows design? Farris has the solution with the Series 2700 balanced design pressure relief valve. The balanced effect is achieved by isolating the upper valve chamber and eliminating any back pressure build-up in the bonnet effecting valve set pressure.

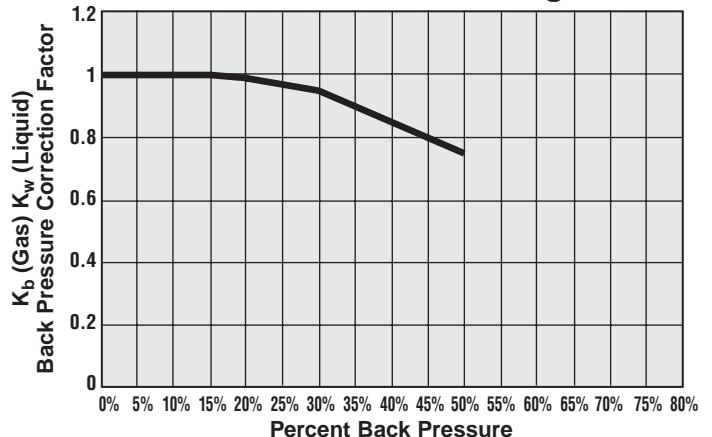
These valves are available in 1/2", 3/4" and 1" inlet sizes with a 1" outlet and two orifice areas. Pressure ranges from 15 to 1480 psig, standard soft seat design. Flanged and welded inlet and outlet connections are available with the same material options as the standard design.

Item No.	Part Name	Standard Material
1	Body	SA-351, Gr. CF8M St. St. or SA-479 Type 316 St. St.
2	Bonnet	SA-216, Gr. WCB, Carb. St.
3	O-ring Retainer	316 St. St.
4	O-ring Seat Seal	Viton®
5	Retainer Lock Screw	304 St. St.
6	Guide	316 St. St.
7	Guide Seal	Viton
8	Disc Holder	316 St. St.
9	Disc Holder Seal	Viton
10	Stem	316 St. St.
11	Spring Adj. Screw	316 St. St.
12	Jam Nut	316 St. St.
13	Cap, Plain Screwed	Carbon Steel
14	Cap Gasket	316 St. St.
15	Body Gasket	316 St. St.
16	Guide Gasket	316 St. St.
17	Spring (-20° to +750°F)	Stainless Steel
18	Spring Buttons	316 St. St.
19	Wire Seal	St. St. Wire/Lead Seal
20	Nameplate (Not Shown)	Stainless Steel

General Notes:

1. Other O-ring materials available. Consult the Factory.
2. Flanged, socket weld, welding nipple and female threaded designs available.

Series 2700 Back Pressure Correction Factors Balanced Design



Viton is a registered trademark of DuPont Dow Elastomers.

PRESSURE & TEMPERATURE LIMITS O-RING SEAT VALVE

The 2700 Series is available with an optional O-ring seat which minimizes fugitive emissions and costly product loss. This optional seat construction provides zero bubbles per minute leakage at 90%

of set pressure per API Standard 527. The Tables below list the set pressure and temperature range for both the elastomer and Teflon seat options.

Orifice	Pressure Range, PSIG ¹		Pressure Range, Bar G ²	
	Elastomer Seat	Teflon Seat	Elastomer Seat	Teflon Seat
C High Pressure	15 to 1480 —	800 to 2500 2501 to 5000	1.00 to 102 —	55.1 to 172 172.1 to 345
D High Pressure	15 to 1480 —	800 to 1600 1601 to 5000	1.00 to 102 —	55.1 to 110 110.1 to 345
E	15 to 1480	600 to 2500	1.0 to 102	41.3 to 172
F	15 to 1480	600 to 1600	1.0 to 102	41.3 to 110
G	15 to 1000	200 to 1000	1.0 to 69	14 to 69

MATERIAL AVAILABILITY		
Material	Temperature Range ¹	
	°F	°C
Viton®	-20° to +450°	-29° to +232°
Buna N	-20° to +250°	-29° to +121°
EPR	0° to +350°	-18° to +177°
Silicone	-150° to +450°	-101° to +232°
Kalrez®	-20° to +550°	-29° to +289°
Teflon	-300° to +500°	-184° to +260°

General Notes:

1. Maximum O-ring set pressure limit cannot exceed the pressure limit for a given type number and size as indicated in the metal seat selection tables.
2. Temperature range may vary depending on service fluid.
3. Ethylene propylene is suitable for steam service up to 350°F, Teflon up to 500°F.
4. Consult the Farris Factory for other materials.

Selection Table

U.S. CUSTOMARY UNITS: THREADED CONNECTIONS-MNPT X FNPT

Orifice Area Sq. In.	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, PSIG	Max. Back Pressure PSIG at 100° F	Materials	
			-20° F to 750° F		Body/Bonnet	Spring
0.068	1/2 x 1	27CA13-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CA23-M20	2500			
	3/4 x 1	27CA23H-M20	5000			
	1 x 1	27CA33-M20	2500			
	1 x 1	27CA33H-M20	6500			
0.125	1/2 x 1	27DA13-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DA23-M20	1600			
	3/4 x 1	27DA23H-M20	5000			
	1 x 1	27DA33-M20	1600			
	1 x 1	27DA33H-M20	5000			
0.223	1 x 1 1/2	27EA34-M20	2500	400	316 St. St. / Carb. St.	Stainless Steel
0.350	1 1/2 x 2	27FA45-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
0.573	1 1/2 x 2 1/2	27GA46-M20	1000	400	316 St. St. / Carb. St.	Stainless Steel

Viton and Kalrez are registered trademarks of DuPont Dow Elastomers.



Selection Tables

U.S. CUSTOMARY UNITS: FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, PSIG			Max. Back Pressure PSIG at 100° F	Materials		
		Inlet RF	Outlet RF		-20° F to 100° F	400° F	750° F		Body / Bonnet	Spring	
0.068	1/2 x 1	150#	150#	27CA13-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA13-220	740	635	505	285			
		600#	150#	27CA13-320	1480	1270	1010	285			
		900#	300#	27CA13-420	2220	1900	1510	400			
		1500#	300#	27CA13H-520	3705	3170	2520	400			
		2500#	300#	27CA13H-620	5000	5000	4200	400			
	3/4 x 1	150#	150#	27CA23-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA23-220	740	635	505	285			
		600#	150#	27CA23-320	1480	1270	1010	285			
		900#	300#	27CA23-420	2220	1900	1510	400			
		1500#	300#	27CA23H-520	3705	3170	2520	400			
		2500#	300#	27CA23H-620	5000	5000	4200	400			
	1 x 1	150#	150#	27CA33-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA33-220	740	635	505	285			
		600#	150#	27CA33-320	1480	1270	1010	285			
		900#	300#	27CA33-420	2220	1900	1510	400			
		1500#	300#	27CA33H-520	3705	3170	2520	400			
		2500#	300#	27CA33H-620	6170	5280	4200	400			
0.125	1/2 x 1	150#	150#	27DA13-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA13-220	740	635	505	285			
		600#	150#	27DA13-320	1480	1270	1010	285			
		900#	300#	27DA13H-420	2220	1900	1510	400			
	3/4 x 1	150#	150#	27DA23-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA23-220	740	635	505	285			
		600#	150#	27DA23-320	1480	1270	1010	285			
		900#	300#	27DA23H-420	2220	1900	1510	400			
		1500#	300#	27DA23H-520	3705	3170	2520	400			
		2500#	300#	27DA23H-620	5000	5000	4200	400			
	1 x 1	150#	150#	27DA33-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA33-220	740	635	505	285			
		600#	150#	27DA33-320	1480	1270	1010	285			
		900#	300#	27DA33H-420	2220	1900	1510	400			
		1500#	300#	27DA33H-520	3705	3170	2520	400			
		2500#	300#	27DA33H-620	6170	5280	4200	400			
	0.223	1 x 1 1/2	150#	150#	27EA34-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
			300#	150#	27EA34-220	740	635	505	285		
600#			150#	27EA34-320	1480	1270	1010	285			
900#			300#	27EA34-420	2220	1900	1510	400			
0.350	1 1/2 x 2	150#	150#	27FA45-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27FA45-220	740	635	505	285			
		600#	150#	27FA45-320	1480	1270	1010	285			
0.573	1 1/2 x 2 1/2	150#	150#	27GA46-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27GA46-220	740	635	505	285			
		600#	150#	27GA46-320	1000	1000	1000	285			

General Notes:

- Available with optional elastomer or Teflon seat design as illustrated. Change the fourth digit of the type number from "A" to "C" for soft seat, "A" to "T" for Teflon. Example: 27DC23-M20 for soft seat, 27DT23-M20 for Teflon. See Selection Table for pressure and temperature limits.
- Above type numbers indicate standard materials of construction. To select corrosive or low temperature materials, add type number suffix as indicated on pages 3 and 9.
- Available in materials suitable for sour gas (H₂S) service to NACE Standard MR0175: add "S7" to the type number. Example: 27DA23-M20/S7.
- For open or packed levers, change the second digit of the type number suffix. Examples: 27FA45-M70 for open lever, 27GA46-M40 for packed lever.
- For socket weld or welding nipple connections, change the first digit of the type number suffix to "S" for socket weld or "W" for welding nipple inlet and outlet. Examples: 27DA33-S20 for socket weld, 27DA33-W20 for welding nipple.
- Female threaded inlet available. Change first digit of type number suffix to "F". Example: 27EA-34-F20.
- For set pressures below 15 psig, consult the Farris Factory.

Selection Tables - Balanced Design



U.S. CUSTOMARY UNITS: THREADED CONNECTIONS-MNPT X FNPT

Orifice Area Sq. In.	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, PSIG		Materials	
			-20° F to 450° F	Max. Back Pressure PSIG at 100° F	Body/Bonnet	Spring
0.068	1/2 x 1	27CC13B-M20	1480	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CC23B-M20				
	1 x 1	27CC33B-M20				
0.125	1/2 x 1	27DC13B-M20	1480	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DC23B-M20				
	1 x 1	27DC33B-M20				

U.S. CUSTOMARY UNITS: FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, PSIG		Max. Back Pressure PSIG at 100° F	Materials	
		Inlet RF	Outlet RF		-20° F to 100° F	400° F		Body / Bonnet	Spring
0.068	1/2 x 1	150#	150#	27CC13B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC13B-220	740	635	285		
		600#	150#	27CC13B-320	1480	1270	285		
		900#	300#	27CC13B-420	1480	1270	400		
	3/4 x 1	150#	150#	27CC23B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC23B-220	740	635	285		
		600#	150#	27CC23B-320	1480	1270	285		
		900#	300#	27CC23B-420	1480	1270	400		
	1 x 1	150#	150#	27CC33B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC33B-220	740	635	285		
		600#	150#	27CC33B-320	1480	1270	285		
		900#	300#	27CC33B-420	1480	1270	400		
0.125	1/2 x 1	150#	150#	27DC13B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC13B-220	740	635	285		
		600#	150#	27DC13B-320	1480	1270	285		
	3/4 x 1	150#	150#	27DC23B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC23B-220	740	635	285		
		600#	150#	27DC23B-320	1480	1270	285		
	1 x 1	150#	150#	27DC33B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC33B-220	740	635	285		
		600#	150#	27DC33B-320	1480	1270	285		



FOR CORROSIVE & LOW TEMPERATURE SERVICE

Part Name	316 St. St.		Monel			Hastelloy C		
	S7 (NACE)	S4	M1	M2	M4	H1	H2	H4
	-20°F to 750°F	-450°F to 750°F	-20°F to 750°F			-20°F to 750°F		
Body	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Bonnet	—	SA-351 Gr. CF8M St. St.	—	—	Monel	—	—	Hastelloy C
Disc	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Guide	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Disc Holder	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Stem	—	—	—	—	Monel	—	—	Hastelloy C
Spring Adj. Screw	—	—	—	—	Monel	—	—	Hastelloy C
Jam Nut	—	—	—	—	Monel	—	—	Hastelloy C
Cap, Plain Screwed	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Cap Gasket	—	—	—	—	Monel	—	—	Hastelloy C
Body Gasket	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Guide Gasket	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Spring	Inconel® X-750	316 St. St.	—	Inconel X-750	Inconel X-750	—	Inconel X-750	Hastelloy C
Spring Buttons	—	—	—	—	Monel	—	—	Hastelloy C
O-Ring Retainer (note 5)	—	316 St. St.	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Retainer Lock Screw (note 5)	—	316 St. St.	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
O-Ring Seat Seal (note 5)	—	—	—	—	—	—	—	—
Guide Seal (note 5)	—	—	—	—	—	—	—	—
Disc Holder Seal (note 5)	—	—	—	—	—	—	—	—
Wire Seal	—	—	—	—	—	—	—	—
Nameplate (Not Shown)	—	—	—	—	—	—	—	—
Welding Nipple (Inlet)	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Welding Nipple (Outlet)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Stub End (Inlet)	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Lap Joint Stub End (Outlet)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Flange (Inlet)(note 4)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Flange (Outlet)(note 4)	—	316 St. St.	—	—	Monel			Hastelloy C

General Notes:

1. Any part denoted with a dash is standard material.
2. For S4 trim, a 17-4 Ph. or 17-7 Ph. spring may be necessary for some pressures and temperatures.
3. For open and packed lever materials, see page 16.
4. Maximum set pressures for S4, M4, and H4 trim are the same as the carbon steel valves or the 316 St. St., Monel and Hastelloy C flange limits respectively, whichever is lower.
5. Temperature for balanced or O-ring seat design is limited by the elastomer selected. For Viton O-rings, the temperature range is -20°F to +450°F. For other materials, consult chart on page 6.
6. Hastelloy and Hastelloy C are registered trademarks of Haynes International. Monel, Inconel and Inconel X-750 are registered trademarks of Inco Alloys International. We reserve the right to substitute comparable material from other manufacturers.

AIR

10% OVERPRESSURE

Capacities in Standard Cubic Feet Per Minute at 60° F

Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	35	65	117	183	301
20	41	75	135	212	347
30	52	95	171	268	439
40	64	117	210	330	540
50	76	140	249	392	642
60	88	162	288	454	743
70	100	184	328	515	844
80	112	206	368	577	946
90	124	228	407	639	1047
100	136	250	447	701	1148
150	196	361	644	1011	1655
200	256	471	841	1320	2161
250	316	582	1038	1630	2668
300	376	692	1235	1939	3175
350	436	803	1432	2248	3681
400	497	913	1630	2558	4188
450	557	1024	1827	2867	4695
500	617	1134	2024	3177	5201
550	677	1245	2221	3486	5708
600	737	1355	2418	3796	6215
650	797	1466	2615	4105	6721
700	857	1576	2813	4415	7228
750	917	1687	3010	4724	7735
800	978	1797	3207	5034	8241
850	1038	1908	3404	5343	8748
900	1098	2018	3601	5653	9255
950	1158	2129	3799	5962	9761
1000	1218	2240	3996	6272	10268
1050	1278	2350	4193	6581	—
1100	1338	2461	4390	6891	—
1150	1398	2571	4587	7200	—
1200	1459	2682	4784	7509	—
1250	1519	2792	4982	7819	—
1300	1579	2903	5179	8128	—
1350	1639	3013	5376	8438	—
1400	1699	3124	5573	8747	—
1450	1759	3234	5770	9057	—
1500	1819	3345	5967	9366	—
1550	1879	3455	6165	9676	—
1600	1940	3566	6362	9985	—
1650	2000	3676	6559	—	—
1700	2060	3787	6756	—	—
1750	2120	3897	6953	—	—
1800	2180	4008	7151	—	—
1850	2240	4118	7348	—	—
1900	2300	4229	7545	—	—
2000	2421	4450	7939	—	—
2100	2541	4671	8334	—	—
2200	2661	4892	8728	—	—
2300	2781	5113	9122	—	—
2400	2902	5334	9577	—	—
2500	3022	5555	9911	—	—
2600	3142	5776	—	—	—
2700	3262	5997	—	—	—
2800	3383	6218	—	—	—
2900	3503	6439	—	—	—
3000	3623	6661	—	—	—
3500	4224	7766	—	—	—
4000	4826	8871	—	—	—
4500	5427	9976	—	—	—
5000	6028	11081	—	—	—
5500	6629	—	—	—	—
6000	7231	—	—	—	—
6500	7832	—	—	—	—

Capacity Tables



**U.S. CUSTOMARY UNITS:
ASME PRESSURE VESSEL CODE, SECTION VIII
(UV) STAMP**

STEAM

10% OVERPRESSURE

Capacities in Pounds Per Hour at Saturation Temperature

Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	100	184	329	516	846
20	115	212	379	595	975
30	146	269	480	754	1234
40	180	331	591	927	1519
50	214	393	702	1101	1803
60	247	455	812	1275	2088
70	281	517	923	1449	2373
80	315	579	1034	1623	2657
90	349	641	1145	1797	2942
100	382	704	1255	1971	3227
150	551	1014	1809	2840	4650
200	720	1325	2363	3710	6073
250	889	1635	2917	4579	7497
300	1058	1946	3471	5448	8920
350	1227	2256	4025	6318	10344
400	1396	2567	4579	7187	11767
450	1565	2877	5133	8057	13190
500	1734	3188	5687	8926	14614
550	1903	3498	6241	9796	16037
600	2072	3809	6795	10665	17461
650	2241	4119	7349	11535	18884
700	2410	4430	7903	12404	20307
750	2578	4740	8457	13273	21731
800	2747	5051	9011	14143	23154
850	2916	5361	9565	15012	24578
900	3085	5672	10119	15882	26001
950	3254	5982	10673	16751	27424
1000	3423	6293	11227	17621	28848
1050	3592	6603	11781	18490	—
1100	3761	6914	12335	19359	—

General Notes:

1. Capacities at 30 PSIG and below are based on 3 PSI overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.

Farris Capacity Tables

**U.S. CUSTOMARY UNITS:
ASME PRESSURE VESSEL CODE,
SECTION VIII (UV) STAMP**

WATER					
10% OVERPRESSURE					
Capacities in U.S. Gallons Per Minute at 70° F³					
Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	7.4	13.6	24.3	38.1	62.4
20	8.3	15.3	27.4	43.1	70.5
30	10.0	18.4	32.9	51.6	84.5
40	11.5	21.2	37.9	59.6	97.6
50	12.9	23.8	42.4	66.6	109
60	14.1	26.0	46.5	73.0	119
70	15.3	28.1	50.2	78.8	129
80	16.3	30.1	53.7	84.3	138
90	17.3	31.9	56.9	89.4	146
100	18.3	33.6	60.0	94.2	154
150	22.4	41.2	73.5	115	189
200	25.9	47.6	84.9	133	218
250	28.9	53.2	94.9	149	244
300	31.7	58.3	104	163	267
350	34.2	63.0	112	176	288
400	36.6	67.3	120	188	308
450	38.8	71.4	127	200	327
500	40.9	75.3	134	210	345
550	42.9	78.9	140	221	362
600	44.8	82.4	147	230	378
650	46.7	85.8	153	240	393
700	48.4	89.0	158	249	408
750	50.1	92.2	164	258	422
800	51.8	95.2	169	266	436
850	53.4	98.1	175	274	450
900	54.9	101	180	282	463
950	56.4	103	185	290	475
1000	57.9	106	189	298	488
1050	59.3	109	194	305	—
1100	60.7	111	199	312	—
1150	62.1	114	203	319	—
1200	63.4	116	208	326	—
1250	64.7	119	212	333	—
1300	66.0	121	216	339	—
1350	67.3	123	220	346	—
1400	68.5	126	224	352	—
1450	69.7	128	228	359	—
1500	70.9	130	232	365	—
1550	72.1	132	236	371	—
1600	73.2	134	240	377	—
1650	74.4	136	244	—	—
1700	75.5	138	247	—	—
1750	76.6	140	251	—	—
1800	77.7	142	254	—	—
1850	78.7	144	258	—	—
1900	79.8	146	261	—	—
2000	81.9	150	268	—	—
2100	83.9	154	275	—	—
2200	85.9	157	281	—	—
2300	87.8	161	288	—	—
2400	89.7	164	294	—	—
2500	91.5	168	300	—	—
2600	93.4	171	—	—	—
2700	95.1	174	—	—	—
2800	96.9	178	—	—	—
2900	98.6	181	—	—	—
3000	100	184	—	—	—
3500	108	199	—	—	—
4000	115	212	—	—	—
4500	122	225	—	—	—
5000	129	238	—	—	—
5500	135	—	—	—	—
6000	141	—	—	—	—
6500	147	—	—	—	—

General Notes:

1. Capacities at 30 PSIG and below are based on 3 PSI overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.
3. To determine capacity at 25% overpressure, multiply the capacity at 10% by 1.066.

Selection Tables - Metric - Conventional



THREADED CONNECTIONS-MNPT X FNPT

Orifice Area Sq. mm	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, Bar G	Max. Back Pressure Bar G at 37.8° C	Materials	
			-28.9° C to 399° C		Body / Bonnet	Spring
43.87	1/2 x 1	27CA13-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CA23-M20	172			
	3/4 x 1	27CA23H-M20	345			
	1 x 1	27CA33-M20	172			
	1 x 1	27CA33H-M20	448			
80.65	1/2 x 1	27DA13-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DA23-M20	110			
	3/4 x 1	27DA23H-M20	345			
	1 x 1	27DA33-M20	110			
	1 x 1	27DA33H-M20	345			
143.87	1 1/2 x 1 1/2	27EA34-M20	172	28	316 St. St. / Carb. St.	Stainless Steel
225.81	1 1/2 x 2	27FA45-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
369.68	1 1/2 x 2 1/2	27GA46-M20	69	28	316 St. St. / Carb. St.	Stainless Steel

General Notes:

- Available with optional elastomer or Teflon seat design as illustrated. Change the fourth digit of the type number from "A" to "C" for soft seat, "A" to "T" for Teflon. Examples: 27DC23-M20 for soft seat, 27DT23-M20 for Teflon. For O-ring pressure and temperature limits, see selection table on page 6.
- Above type numbers indicate the standard materials of construction. To select corrosive or low temperature materials, add type number suffix as indicated on pages 3 and 5. Example: 27FA45-M20/S4.
- Available in materials suitable for sour gas (H2S) service to NACE Standard MR0175: add "/S7" to the type number. Example: 27DA23-M20/S7.
- For open or packed levers, change the second digit of the type number suffix. Examples: 27FA45-M70 for open lever, 27GA46-M40 for packed lever.
- For socket weld or welding nipple connections, change the first digit of the type number suffix to "S" for socket weld or "W" for welding nipple inlet and outlet. Examples: 27DA33-S20 for socket weld, 27DA33-W20 for welding nipple.



Selection Tables - Metric - Conventional

FLANGED CONNECTIONS

Orifice Area Sq. mm	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, Bar G			Max. Back Pressure Bar G at 37.8° C	Materials		
		Inlet RF	Outlet RF		-28.9° C to 37.8° C	204° C	399° C		Body / Bonnet	Spring	
43.87	1/2 x 1	150#	150#	27CA13-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA13-220	51	44	35	20			
		600#	150#	27CA13-320	102	88	69	20			
		900#	300#	27CA13-420	153	131	104	28			
		1500#	300#	27CA13H-520	255	218	174	28			
		2500#	300#	27CA13H-620	345	345	290	28			
	3/4 x 1	150#	150#	27CA23-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA23-220	51	44	35	20			
		600#	150#	27CA23-320	102	88	69	20			
		900#	300#	27CA23-420	153	131	104	28			
		1500#	300#	27CA23H-520	255	218	174	28			
		2500#	300#	27CA23H-620	345	345	290	28			
	1 x 1	150#	150#	27CA33-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27CA33-220	51	44	35	20			
		600#	150#	27CA33-320	102	88	69	20			
		900#	300#	27CA33-420	153	131	104	28			
		1500#	300#	27CA33H-520	255	218	174	28			
		2500#	300#	27CA33H-620	425	364	290	28			
80.65	1/2 x 1	150#	150#	27DA13-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA13-220	51	44	35	20			
		600#	150#	27DA13-320	102	88	69	20			
		900#	300#	27DA13H-420	153	131	104	28			
	3/4 x 1	150#	150#	27DA23-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA23-220	51	44	35	20			
		600#	150#	27DA23-320	102	88	69	20			
		900#	300#	27DA23H-420	153	131	104	28			
		1500#	300#	27DA23H-520	255	218	174	28			
		2500#	300#	27DA23H-620	345	345	290	28			
	1 x 1	150#	150#	27DA33-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27DA33-220	51	44	35	20			
		600#	150#	27DA33-320	102	88	69	20			
		900#	300#	27DA33H-420	153	131	104	28			
		1500#	300#	27DA33H-520	255	218	174	28			
		2500#	300#	27DA33H-620	425	364	290	28			
	143.87	1 x 1 1/2	150#	150#	27EA34-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
			300#	150#	27EA34-220	51	44	35	20		
600#			150#	27EA34-320	102	88	69	20			
900#			300#	27EA34-420	153	131	104	28			
225.81	1 1/2 x 2	150#	150#	27FA45-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27FA45-220	51	44	35	20			
		600#	150#	27FA45-320	102	88	69	20			
369.68	1 1/2 x 2 1/2	150#	150#	27GA46-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel	
		300#	150#	27GA46-220	51	44	35	20			
		600#	150#	27GA46-320	69	69	69	20			

Selection Tables - Metric - Balanced Design



THREADED CONNECTIONS - MNPT X FNPT

Orifice Area Sq. mm	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, Bar G	Max. Back Pressure Bar G at 37.8° C	Materials	
			-28.9° C to 232° C		Body / Bonnet	Spring
43.87	1/2 x 1	27CC13B-M20	102	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CC23B-M20				
	1 x 1	27CC33B-M20				
80.65	1/2 x 1	27DC13B-M20	102	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DC23B-M20				
	1 x 1	27DC33B-M20				

FLANGED CONNECTIONS

Orifice Area Sq. mm	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, Bar G		Max. Back Pressure Bar G at 37.8° C	Materials	
		Inlet RF	Outlet RF		-28.9° C to 37.8° C	204° C		Body / Bonnet	Spring
43.87	1/2 x 1	150#	150#	27CC13B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC13B-220	51	44	20		
		600#	150#	27CC13B-320	102	88	20		
		900#	300#	27CC13B-420	102	88	28		
	3/4 x 1	150#	150#	27CC23B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC23B-220	51	44	20		
		600#	150#	27CC23B-320	102	88	20		
		900#	300#	27CC23B-420	102	88	28		
	1 x 1	150#	150#	27CC33B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC33B-220	51	44	20		
		600#	150#	27CC33B-320	102	88	20		
		900#	300#	27CC33B-420	102	88	28		
80.65	1/2 x 1	150#	150#	27DC13B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC13B-220	51	44	20		
		600#	150#	27DC13B-320	102	88	20		
	3/4 x 1	150#	150#	27DC23B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC23B-220	51	44	20		
		600#	150#	27DC23B-320	102	88	20		
	1 x 1	150#	150#	27DC33B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC33B-220	51	44	20		
		600#	150#	27DC33B-320	102	88	20		



Capacity Tables - Metric Units

ASME PRESSURE VESSEL CODE, SECTION VIII (UV) STAMP

AIR					
10% OVERPRESSURE					
Capacities in Standard Cubic Meters Per Minute at 15.6° C					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	1.0	1.8	3.3	5.1	8.4
2	1.4	2.7	4.7	7.4	12.2
3	1.9	3.6	6.3	10.0	16.3
4	2.4	4.5	8.0	12.5	20.5
5	2.9	5.4	9.6	15.1	24.6
6	3.4	6.3	11.2	17.6	28.8
7	3.9	7.2	12.8	20.1	33.0
8	4.4	8.1	14.5	22.7	37.1
9	4.9	9.0	16.1	25.2	41.3
10	5.4	9.9	17.7	27.8	45.5
12	6.4	11.7	20.9	32.8	53.8
14	7.4	13.5	24.2	37.9	62.1
16	8.4	15.4	27.4	43.0	70.4
18	9.3	17.2	30.6	48.1	78.8
20	10.3	19.0	33.9	53.2	87.1
25	12.8	23.5	42.0	65.9	107.9
30	15.3	28.1	50.1	78.6	128.7
35	17.7	32.6	58.2	91.3	149.5
40	20.2	37.2	66.3	104.0	170.3
45	22.7	41.7	74.4	116.7	191.1
50	25.1	46.2	82.5	129.5	211.9
55	27.6	50.8	90.6	142.2	232.7
60	30.1	55.3	98.7	154.9	253.6
65	32.5	59.9	106.8	167.6	274.4
70	35.0	64.4	114.9	180.3	295.2
75	37.5	68.9	123.0	193.0	—
80	40.0	73.5	131.1	205.7	—
85	42.4	78.0	139.2	218.4	—
90	44.9	82.5	147.3	231.1	—
95	47.4	87.1	155.4	243.9	—
100	49.8	91.6	163.5	256.6	—
105	52.3	96.2	171.6	269.3	—
110	54.8	100.7	179.7	282.0	—
115	57.2	105.2	187.8	—	—
120	59.7	109.8	195.9	—	—
125	62.2	114.3	204.0	—	—
130	64.7	118.9	212.1	—	—
135	67.1	123.4	220.2	—	—
140	69.6	127.9	228.3	—	—
145	72.1	132.5	236.4	—	—
150	74.5	137.0	244.5	—	—
155	77.0	141.6	252.6	—	—
160	79.5	146.1	260.7	—	—
165	81.9	150.6	268.8	—	—
170	84.4	155.2	276.9	—	—
175	86.9	159.7	—	—	—
180	89.3	164.3	—	—	—
185	91.8	168.8	—	—	—
190	94.3	173.3	—	—	—
195	96.8	177.9	—	—	—
200	99.2	182.4	—	—	—
220	109.1	200.6	—	—	—
240	119.0	218.7	—	—	—
260	128.9	236.9	—	—	—
280	138.7	255.1	—	—	—
300	148.6	273.2	—	—	—
320	158.5	291.4	—	—	—
340	168.4	309.5	—	—	—
360	178.2	—	—	—	—
380	188.1	—	—	—	—
400	198.0	—	—	—	—
420	207.9	—	—	—	—
440	217.8	—	—	—	—
448	221.7	—	—	—	—

WATER					
10% OVERPRESSURE					
Capacities in Litres Per Minutes at 21° C ³					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	27.6	50.8	90.7	142	233
2	37.4	68.7	122	192	315
3	45.7	84.0	150	235	385
4	52.8	97.0	173	271	445
5	59.0	108	193	303	497
6	64.6	118	212	332	545
7	69.8	128	229	359	588
8	74.6	137	244	384	629
9	79.2	145	259	407	667
10	83.5	153	273	429	703
12	91.4	168	300	470	770
14	98.8	181	324	508	832
16	105	194	346	543	890
18	112	205	367	576	944
20	118	217	387	607	995
25	132	242	433	679	1112
30	144	265	474	744	1218
35	156	287	512	804	1316
40	167	307	547	859	1407
45	177	325	580	911	1492
50	186	343	612	961	1573
55	195	360	642	1008	1650
60	204	376	670	1052	1723
65	212	391	698	1095	1794
70	220	406	724	1137	1861
75	228	420	750	1177	—
80	236	434	774	1215	—
85	243	447	798	1253	—
90	250	460	821	1289	—
95	257	473	844	1324	—
100	264	485	866	1359	—
105	270	497	887	1392	—
110	276	509	908	1425	—
115	283	520	928	—	—
120	289	531	948	—	—
125	295	542	968	—	—
130	301	553	987	—	—
135	306	564	1006	—	—
140	312	574	1024	—	—
145	318	584	1042	—	—
150	323	594	1060	—	—
155	328	604	1078	—	—
160	334	614	1095	—	—
165	339	623	1112	—	—
170	344	632	1129	—	—
175	349	642	—	—	—
180	354	651	—	—	—
185	359	660	—	—	—
190	364	669	—	—	—
195	368	677	—	—	—
200	373	686	—	—	—
220	391	720	—	—	—
240	409	752	—	—	—
260	425	782	—	—	—
280	441	812	—	—	—
300	457	840	—	—	—
320	472	868	—	—	—
340	486	895	—	—	—
360	501	—	—	—	—
380	514	—	—	—	—
400	528	—	—	—	—
420	541	—	—	—	—
440	553	—	—	—	—
448	558	—	—	—	—

General Notes:

1. Capacities at 2.0 BarG set pressure and below are based on 0.2 Bar overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.
3. To determine water capacity at 25% overpressure, multiply the capacity at 10% by 1.066.

Capacity Tables - Metric Units



ASME PRESSURE VESSEL CODE, SECTION VIII (UV) STAMP

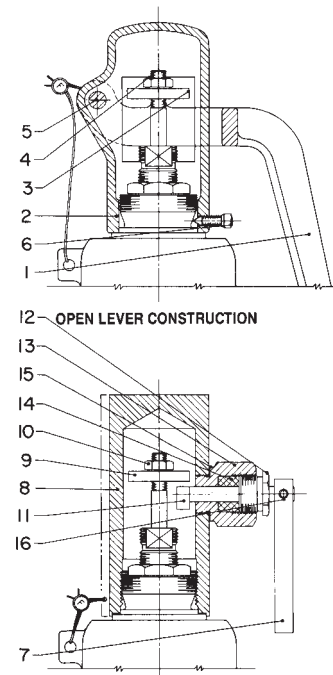
STEAM					
10% OVERPRESSURE					
Capacities in Kilograms Per Hour at Saturation Temperature					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	44	82	147	231	378
2	65	119	213	335	548
3	87	160	286	448	734
4	109	201	358	563	921
5	132	242	431	677	1109
6	154	283	504	792	1296
7	176	323	577	906	1483
8	198	364	650	1020	1671
9	220	405	723	1135	1858
10	243	446	796	1249	2045
12	287	528	942	1478	2420
14	332	610	1087	1707	2794
16	376	691	1233	1936	3169
18	420	773	1379	2165	3544
20	465	855	1525	2393	3918
25	576	1059	1889	2965	4854
30	687	1263	2253	3537	5791
35	798	1467	2618	4109	6727
40	909	1672	2982	4681	7664
45	1021	1876	3347	5253	8600
50	1132	2080	3711	5825	9537
55	1243	2284	4076	6397	10473
60	1354	2489	4440	6969	11409
65	1465	2693	4805	7541	12346
70	1576	2898	5169	8113	13282
75	1687	3102	5533	8685	14219

General Notes:

1. Capacities at 2.0 BarG set pressure and below are based on 0.2 Bar overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.

Cap Constructions

Cap Construction	Item No.	Part Name	Standard Materials	316 St. St.		Monel		Hastelloy C	
				S4	S7	M1 & M2	M4	H1 & H2	H4
M70 Open Lever	1	Test Lever	Iron	—	—	—	—	—	—
	2	Cap, O.L.	Iron	—	—	—	—	—	—
	3	Stem Test Washer	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	4	Stem Jam Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	5	Button Head Rivet	Steel	—	—	—	—	—	—
	6	Set Screw	Steel	—	—	—	—	—	—
M40 Packed Lever	7	Test Lever	Steel	—	—	—	—	—	—
	8	Cap, Packed	Steel	316 St. St.	—	—	Monel	—	Hast. C
	9	Stem Test Washer	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	10	Stem Jam Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	11	Cam	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	12	Gland	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	13	Gland Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	14	Packing Ring	Graphite	—	—	—	—	—	—
	15	Gland Nut Gasket	Flexible Graphite	PTFE, Filled	PTFE, Filled	—	PTFE, Filled	—	PTFE, Filled
	16	Groove Pin	Steel Plt'd	—	—	—	—	—	—



General Notes:

1. Any part denoted with a dash is standard material.
2. "S4" trim suitable for cryogenic service.

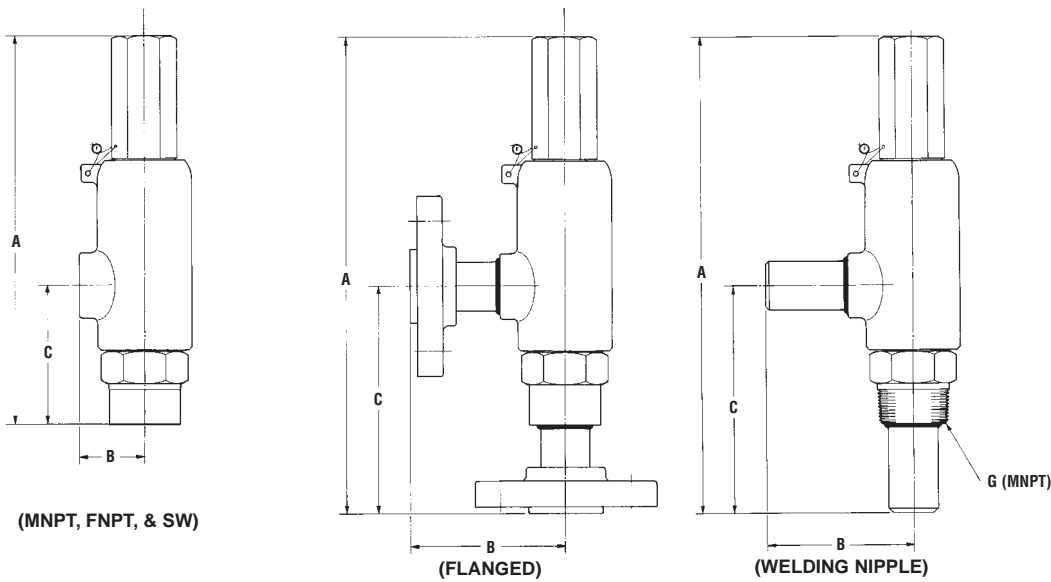


THREADED CONNECTIONS (MNPT X FNPT)								
Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	11 1/4	1 3/4	3 9/16	282	45	91	8	3.6
3/4 x 1	11 1/4	1 3/4	3 9/16	286	45	91	8	3.6
3/4 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
1 x 1	11 1/2	1 3/4	3 3/4	292	45	95	8	3.6
1 x 1 H.P.	13 5/8	1 1/2	3 3/4	346	64	95	14	6.3
E Orifice								
1 x 1 1/2	13 5/8	2 1/2	3 1/2	346	64	89	16	7.2
F Orifice								
1 1/2 x 2	14 9/16	3	3 7/8	370	76	98	17	7.7
G Orifice								
1 1/2 x 2 1/2	14 9/16	3	4 1/8	370	76	105	18	8.1

WELDING NIPPLE CONNECTIONS								
Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	13	3 3/16	5 1/4	330	81	133	9	4
1/2 x 1 H.P.	15 3/16	3 15/16	5 5/16	386	100	135	15	6.8
3/4 x 1	12 15/16	3 3/16	5 3/16	329	81	132	9	4
3/4 x 1 H.P.	15 1/8	3 15/16	5 1/4	384	100	133	15	6.8
1 x 1	12 7/8	3 3/16	5 1/8	327	81	130	9	4
1 x 1 H.P.	15 1/16	3 15/16	5 3/16	383	100	132	15	6.8
E Orifice								
1 x 1 1/2	14 13/16	3 13/16	4 15/16	376	97	125	17	7.7
F Orifice								
1 1/2 x 2	15 7/8	5 3/16	5 3/16	403	132	132	18	8.1
G Orifice								
1 1/2 x 2 1/2	15 7/8	5 3/16	5 7/16	403	132	128	19	8.6

SOCKET WELD & FNPT X FNPT CONNECTIONS								
Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
1/2 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
3/4 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
3/4 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
1 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
1 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
E Orifice								
1 x 1 1/2	13 3/8	2 1/2	3 1/2	340	64	89	16	7.2
F Orifice								
1 1/2 x 2	14 9/16	3	3 7/8	370	76	98	17	7.7
G Orifice								
1 1/2 x 2 1/2	14 9/16	3	4 1/8	370	76	105	18	8.1

Note: H.P. designates the high pressure version of a given inlet size.



FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		US Customary Units (Inches)				Metric Units (millimeters)			Weight	
		Inlet RF	Outlet RF	A (Max.)	B	C	G ¹ (MNPT)	A (Max.)	B	C	Lbs.	Kgs.
0.068 & 0.125	1/2 x 1	150#	150#	14	5 3/16	6 1/4	1	356	132	159	15	6.8
		300#	150#									
	600#	150#	16 1/8	5 15/16	6 1/4	1	410	151	159	22	9.9	
	900#	300#										
	3/4 x 1	150#	150#	13 15/16	5 3/16	6 3/16	1 1/4	354	132	157	15	6.8
		300#	150#									
600#		150#	16 1/8	5 15/16	6 1/4	1 1/4	410	151	159	22	9.9	
900#		300#										
1 x 1	150#	150#	14 7/8	5 3/16	7 1/8	1 1/2	378	132	181	15	6.8	
	300#	150#										
0.223	1 x 1/2	600#	150#	16 13/16	5 13/16	6 15/16	1 1/2	427	148	176	26	11.7
		900#	300#									
0.350	1 1/2 x 2	150#	150#	17 7/8	8 3/16	7 3/16	2	454	208	183	30	13.6
		300#	150#									
0.573	1 1/2 x 2 1/2	150#	150#	17 1/8	8 3/16	7 7/16	2	435	208	189	32	14.5
		300#	150#									
		600#	150#									

General Note:

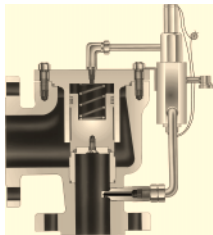
1. Same pipe thread connections also used on socket weld models with corresponding inlet sizes.

Process Pressure Relief Valves



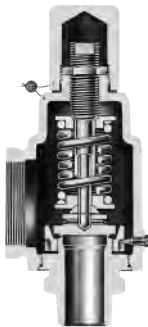
SERIES 2600

- ASME NB Certified: Air, Steam & Water
- Sizes: 1" x 2" to 20" x 24"
- Pressure Range: 15 psig to 6000 psig
- Temperature Range: -450° F to +1500° F
- Materials: Carbon Steel, Stainless, Monel & Hastelloy C
- Options: Balanced Bellows, O-Ring Seat, Open Bonnet



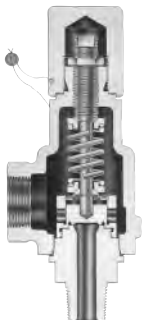
SERIES 3800 Pilot Operated

- ASME NB Certified: Air & Water
- Sizes: 1" x 2" to 12" x 16"
- Pressure Range: 20 psig to 6170 psig
- Temperature Range: -450° F to +500° F
- Materials: Steel Body & Bonnet, Stainless Steel Trim
- Options: Modulating Pilot Control, Complete 316 Stainless Steel Construction



SERIES 2850

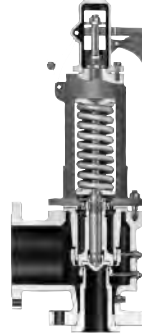
- ASME NB Certified: Air & Steam
- Sizes: 3/4" x 1" to 1 1/2" x 2"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +750° F
- Materials: Stainless Steel Body & Trim with Carbon Steel Bonnet



SERIES 1890

- ASME NB Certified: Air, Steam & Water
- Sizes: 1/2" x 1" & 3/4" x 1"
- Pressure Range: 15 psig to 800 psig
- Temperature Range: -450° F to +750° F
- Materials: Stainless Steel Body & Trim with Carbon Steel Bonnet

Steam Safety Valves



SERIES 6400/6600

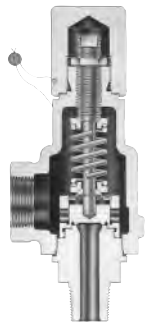
- ASME Section I NB Certified: Steam & Air
- Sizes: 1" x 2" to 4" x 6"
- Pressure Range: 15 psig to 1500 psig
- Temperature Range: -20° F to +1000° F
- Materials: Carbon & Stainless Steel
- Options: Exposed Spring & Closed Bonnet

Special Purpose Pressure Relief Valves



SERIES 2856

- ASME NB Certified: Air & Steam
- Sizes: 3/4" x 1 1/4" to 2" x 3"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +400° F
- Materials: Brass Body & Trim, Bronze Bonnet



SERIES 1896M

- ASME NB Certified: Air, Steam & Water
- Sizes: 1/2" x 3/4" & 3/4" x 3/4"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +400° F
- Materials: Brass Body & Trim, Bronze Bonnet

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Types 1051 and 1052 Styles F and G Size 40, 60, and 70 Rotary Actuators

Contents

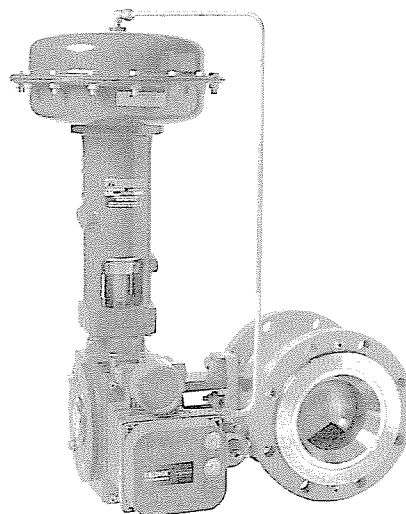
Introduction	1
Scope of Manual	1
Description	3
Specifications	3
Installation	3
Actuator Mounting	4
Valve Flow Direction	6
Loading Connection	7
Turnbuckle Adjustment	7
Type 1052 Spring Adjustment	8
Initial Setting	8
Stroking Range	8
Principle of Operation	9
Maintenance	9
Disassembly	9
Assembly	11
Changing Actuator Mounting	13
Top-Mounted Handwheels and Adjustable Travel Stops	14
Principle of Operation for Handwheels	14
Handwheel Maintenance and Adjustable Travel Stop	15
Locking Mechanism	17
Installing the Locking Mechanism	17
Operating the Locking Mechanism	18
Pipe-Away Vent	20
Parts Ordering	21
Parts Reference	21

Introduction

Scope of Manual

This instruction manual includes installation, adjustment, maintenance, and parts ordering information for the Type 1051 (size 40 and 60) and Type 1052 (Size 40, 60, and 70) pneumatic piston rotary actuator with F and G mounting adaptations (see figure 1).

The G mounting adaptation is for Type 7600 and 9500 valves, and the F mounting adaptation is for all



W8509-2

Figure 1. Vee-Ball Valve with Type 1052 Actuator and Type DVC6020 Positioner

other ēdisc® or Vee-Ball® valves. Also, this instruction manual provides information for the optional top-mounted handwheel, up and down travel stops, locking mechanism, and pipe-away vent.

Instructions for the control valve, positioner, accessories, and other sizes of actuators are covered in separate instruction manuals.

Top-Mounted handwheels can be applied for infrequent service as a manual handwheel actuator. Also, an adjustable up travel stop can be added to the actuator to limit its stroke in the upward direction, or an adjustable down travel stop can be added to limit actuator stroke in the downward direction.

No person may install, operate, or maintain a Type 1051 or 1052 actuator without first • being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher® sales office before proceeding.



1051 & 1052 F & G Actuators

Table 1. Type 1051 and 1052 Actuator Specifications

<p>Operation</p> <p>Direct Acting: Increasing loading pressure extends the diaphragm rod out of the spring barrel</p> <p>Service: <i>Type 1051:</i> For on-off or throttling service with positioner <i>Type 1052:</i> For on-off or throttling service with or without a positioner</p> <p>Actuator Sizes</p> <p>Type 1051: ■ 40 and ■ 60 Type 1052: ■ 40, ■ 60, and ■ 70</p> <p>Maximum Diaphragm Sizing Pressure⁽¹⁾</p> <p>Size 40: 4.5 bar (65 psig) Size 60: 2.8 bar (40 psig) Size 70: 3.8 bar (55 psig)</p> <p>Maximum Diaphragm Casing Pressure⁽³⁾</p> <p>Size 40: 5.2 bar (75 psig) Size 60: 3.4 bar (50 psig) Size 70: 4.5 bar (65 psig)</p> <p>Maximum Valve Shaft Rotation</p> <p>90 degrees rotation (standard) travel stop, or 60 degrees (optional) travel stop for Type 1051 and 1052 actuators, or 75 degrees (optional) travel stop for Type 1052 actuators</p> <p>Valve Shaft Diameters, mm (Inches)</p> <p>Size 40: ■ 12.7 (1/2), ■ 15.9 (5/8), ■ 19.1 (3/4), ■ 22.2 (7/8), ■ 25.4 (1), or ■ 31.8, (1-1/4) Size 60: ■ 19.1 (3/4), ■ 22.2 (7/8), ■ 25.4 (1), ■ 31.8 (1-1/4), ■ 38.1 (1-1/2), ■ 44.5 (1-3/4), or ■ 50.8 (2)</p>	<p>Size 70: ■ 31.8 (1-1/4), ■ 38.1 (1-1/2), ■ 44.5 (1-3/4), or ■ 50.8 (2)</p> <p>Stroking Time</p> <p>Dependent on actuator size, rotation, spring rate, initial spring compression, and supply pressure. If stroking time is critical, consult your Fisher sales office</p> <p>Material Temperature Capabilities⁽²⁾</p> <p>Nitrile Diaphragm: -40 to 82°C (-40 to 180°F) Silicone Diaphragm: -40 to 149°C (-40 to 300°F) Nitrile O-Rings: -40 to 82°C (-40 to 180°F), Nitrile O-rings are used in optional top-mounted handwheel, adjustable down travel stop, and adjustable up travel stop assemblies</p> <p>Travel Indication</p> <p>Graduated disc and pointer combination located on actuator end of valve shaft</p> <p>Pressure Connections</p> <p>Standard: 1/4 inch NPT female thread Optional: ■ 1/2 or ■ 3/4 inch NPT female, and ■ 3/4 inch NPT female thread for pipe-away vent</p> <p>Mounting Positions</p> <p>See figure 3.</p> <p>Approximate Weights</p> <p>See table 2.</p> <p>Additional Specifications</p> <p>For casing pressure ranges and for material identification of the parts, see the Parts List</p>
---	---

1. Use this value to determine the maximum torque output allowed.
 2. The pressure/temperature limits in this manual and any applicable standard or code limitation for valve should not be exceeded.
 3. This maximum casing pressure is not to be used for normal operating pressure. Its purpose is to allow for typical regulator supply settings and/or relief valve tolerances.

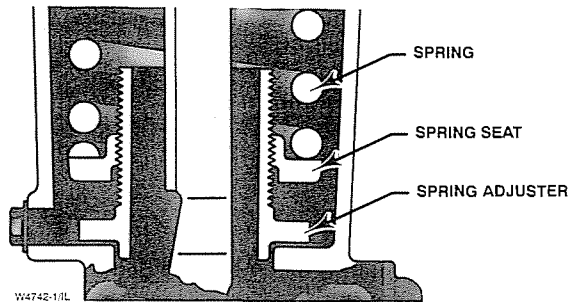


Figure 2. Typical Type 1052 Actuator Adjustable Spring Seat

Note

Neither Emerson®, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

Description

The Type 1051 and 1052 diaphragm rotary actuators are pneumatic spring-return actuators for use with rotary-shaft control valves. The Type 1051 actuator can be used for on-off service, or it can be used for throttling service when equipped with a valve positioner. The Type 1052 actuator can be used for on-off service, or it can be used for throttling service when equipped with or without a valve positioner. The Type 1052 actuator spring is adjustable (see figure 2).

Table 2. Approximate Actuator Weights

SIZE	TYPE 1051		TYPE 1052		TOP-MOUNTED HANDWHEEL	
	Kg	Lb	Kg	Lb	Kg	Lb
40	43	94	45	99	7.3	16
60	89	197	92	203	11	24
70	- - -	- - -	123	272	21	47

Specifications

Specifications are shown in table 1. Specifications for actuator operation, as it originally comes from the factory, are stamped on the nameplate attached to the actuator.

Installation

When an actuator and valve body are shipped together, the actuator is normally mounted on the valve. Follow the valve body instructions when installing the control valve in the pipeline, and then perform the procedures presented in the Loading Connection section. If the actuator is shipped separately or if it is necessary to mount the actuator on the valve, perform the procedures presented in the Actuator Mounting section. And, if the actuator requires a pipe-away vent, or if a retrofit pipe-away kit needs to be installed, refer to the Pipe-Away Vent section.

⚠ WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations. Be aware of pinching parts during installation operations.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

1051 & 1052 F & G Actuators

Table 3. Recommended Bolting Torques

DESCRIPTION, KEY NUMBER	ACTUATOR SIZE								
	40			60			70		
	Size	N•m	lbf•ft	Size	N•m	lbf•ft	Size	N•m	lbf•ft
Diaphragm Casing, 5	3/8-24	27	20	3/8-24	27	20	3/8-24	27	20
Casing to spring barrel, 7	3/8-16	41	30	3/8-16	41	30	1/2-13	102	75
Diaphragm to rod, 9 (1051)	1/2-13	34	25	3/4-10	102	75	---	102	75
Diaphragm to rod, 9 (1052)	1/2-20	34	25	3/4-16	102	75	3/4-16	102	75
Rod end bearing, 16	1/2-20	34	25	5/8-18	61	45	3/4-16	102	75
Turnbuckle to lever, 18	1/2-13	81	60	5/8-11	163	120	3/4-10	271	200
Spring barrel to housing, 21	5/16-18	23	17	7/16-14	68	50	5/8-18	68	50
Housing to yoke, 23	3/8-16	34	25	1/2-13	81	60	1/2-13	81	60
Travel stop to lever, 28	1/2-13	81	60	5/8-11	163	120	3/4-10	271	200
Side of housing, 34 304/4200/PMV	3/8-16	34	25	1/2-13	81	60	1/2-13	81	60
Handwheel top, 54	1/2-20	34	25	5/8-18	34	25	---	34	25
Diaphragm head to rod/Adjustable down travel stop, 54 (1051)	1/2-13	27	20	3/4-10	66	49	---	69	51
Diaphragm head to rod/Adjustable down travel stop, 54 (1052)	1/2-20	27	20	3/4-16	66	49	3/4-16	69	51
Rod end to turnbuckle, 58	3/4-16-LH	102	75	7/8-14-LH	163	120	7/8-14-LH	163	120
Handwheel to actuator, 141	3/8-16	41	30	3/8-16	41	30	1/2-13	81	60

CAUTION

To avoid parts damage, do not use an operating pressure that exceeds the Maximum Diaphragm Casing Pressure (table 1) or produces a torque greater than the Maximum Allowable Valve Shaft Torque (see Catalog 14). Use pressure-limiting or pressure-relieving devices to prevent the diaphragm casing pressure from exceeding its limit.

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

Actuator Mounting

Use the following steps to connect a valve and an actuator. Key numbers are shown in figure 8 for Type 1051 actuators and in figure 9 for Type 1052 actuators.

WARNING

To avoid personal injury, perform the steps in the WARNING at the beginning of the Maintenance section to isolate the control valve and actuator.

1. Unscrew cap screws and washers (keys 34 and 63), and remove the cover (key 33).
2. Refer to figure 3 for available mounting styles and positions. When mounting on a Vee-Ball Design V150, V200 or V300 valve, check the valve manual to determine if it is Series B. The actuator is normally positioned vertically with the valve in a horizontal pipeline (see figure 3).

Instruction Manual

Form 5062
August 2005

1051 & 1052 F & G Actuators

MOUNTING	ACTION ⁽¹⁾	VALVE SERIES OR DESIGN				VALVE SERIES OR DESIGN		
		BALL/PLUG ROTATION TO CLOSE	V250	V150, V200 & V300	CV500 V500	DISC/BALL ROTATION TO CLOSE	V250	8510B, 8532, 8560 & 9500
Right-Hand	PDTC	CCW	A	A	A	CW	NA	B
	PDTO	CCW	B	B	B	CW	NA	A
Left-Hand	PDTC	CCW	NA	D	D	CW	C	C
	PDTO	CCW	NA	C	C	CW	D	D
Left-Hand (Optional) ⁽²⁾	PDTC	CW	NA	C	NA	NA	NA	NA
	PDTO	CW	NA	D	NA	NA	NA	NA

1. PDTC—Push-down-to-close, and PDTO—Push-down-to-open.
2. A left hand ball will be required for the 3- through 12-inch Series B and the 14- to 20-inch, with or without attenuator.

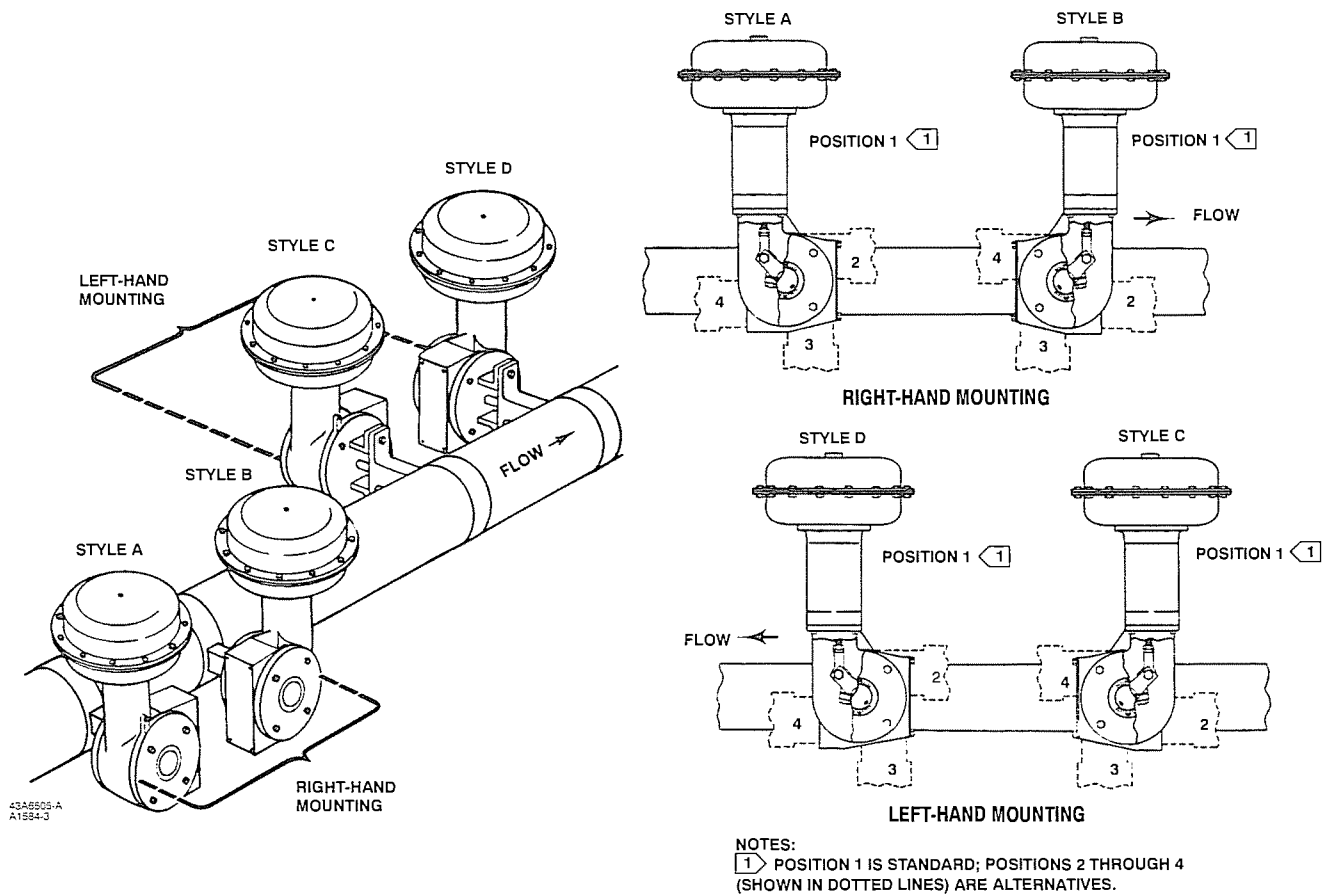


Figure 3. Mounting Styles and Positions for the Type 1051 and 1052 Actuator

WARNING

To avoid personal injury or property damage, the Type 1052 size 70 actuator, due to its weight, must be externally supported if mounted in the horizontal position.

3. When mounting the actuators, make sure that the bushing (key 67) and valve shaft are in-line so that the bushing will slide onto the valve shaft without damage.

4. Mount the actuator on the valve body and secure it with the valve mounting screws. The torque for 1/2 to 1-inch shafts is 88 N•m (65 lbf•ft); for 1-1/4 to

1051 & 1052 F & G Actuators

1-1/2 inch shafts is 136 N•m (100 lbf•ft); for 1-3/4 to 2-inch shafts is 183 N•m (135 lbf•ft).

CAUTION

Exceeding any torque requirement may impair the safe operation of this actuator by causing broken or damaged parts. Refer to table 3 for the bolting torque requirements.

5. Screw the left-hand threaded locknut (key 58) onto the diaphragm rod (key 10) as far as possible.
6. Screw the turnbuckle (key 57) as far as it will go onto the actuator rod.
7. Screw the locknut (key 16) as far as it will go onto the rod end bearing (key 17). Thread this assembly completely into the turnbuckle (key 57).
8. If the lever (key 27) is attached to the rod end bearing, remove the cap screw and hex nut (keys 18 and 19).
9. If the Type 1052 spring adjustment has been changed, complete the Initial Setting portion of the Type 1052 Spring Adjustment section before proceeding.
10. Consult the appropriate valve instruction manual's Installation section for lever/valve shaft orientation marks, and slide the lever into place (see figure 4). Clamp with the cap screw (key 28).
11. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by moving the actuator off its up travel stop with a regulated air source and adjusting the turnbuckle (key 57) slightly.
12. Apply sealant (key 77) or equivalent thread-locking compound to the threads of the cap screw (key 18).
13. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19). Tighten the cap screw to the recommended bolt torque shown in table 3.
14. Note the valve position and direction of rotation. Position the travel indicator (key 37) accordingly.
 - a. If no handwheel actuator is to be used, position the travel indicator (key 37) according to

the valve position just noted. Replace the cover (key 33), and secure with washers and cap screws (keys 34 and 63). If holes in the cover and housing (key 20) do not align, temporarily loosen the cap screws (key 23), and shift the housing slightly.

CAUTION

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

- b. If a manual handwheel actuator is to be used, refer to the separate handwheel actuator instruction manual for mounting instructions.
15. Replace the cover (key 33), and secure with cap screws and washers (keys 34 and 63). If the holes in the cover and housing (key 20) do not align, use a regulated air source to move the actuator slightly off the up travel stop. If the hole alignment cannot be obtained in this manner, temporarily loosen the cap screws (key 23), and shift the housing slightly.

CAUTION

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

16. Follow the instructions given in the Turnbuckle Adjustment section before proceeding to the Loading Connection section.

Valve Flow Direction

Valve construction can change the flow direction for a control valve assembly. It is important to observe the flow direction in all valve applications **before** installing the valve in the pipeline (see figure 3). Refer to the appropriate valve bulletin or instruction manual.

Note

Observe all warnings and cautions provided in the appropriate valve instruction manual Installation section.

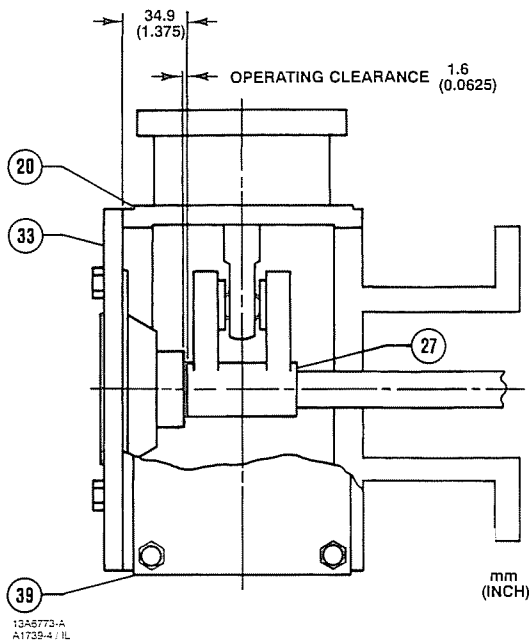


Figure 4. Lever Operating Clearance

Loading Connection

1. Connect the loading pressure piping to the pressure connection in the top of the diaphragm casing.
 - a. **For size 40 through 60 actuators:** Run either 1/4 inch pipe or 3/8 inch tubing between the 1/4 inch pressure connection and the instrument.
 - b. **For size 70 actuators:** Run either pipe or tubing between the pressure connection and the instrument. If necessary, remove the 1/4 inch bushing in the pressure connection to increase connection size.
2. Keep the length of pipe or tubing as short as possible to avoid transmission lag in the control signal. If an accessory (such as a volume booster or a valve positioner) is used, be sure that the accessory is properly connected to the actuator. If a valve positioner is part of the assembly, the pressure connection to the actuator will normally be made at the factory.

Table 4. Wrench Size Required for Turnbuckle Adjustment, Inches

ACTUATOR		TURN- BUCKLE (KEY 57)	LOWER LOCKNUT (KEY 16)	UPPER LOCKNUT (KEY 58)
Type	Size			
1051 &	40	1-1/8	3/4	1-1/8
1052	60	1-5/16	15/16	1-5/16
1052	70	1-5/16	1-1/8	1-5/16

3. When the control valve is completely installed and connected to the instrument, check for correct action (air-to-open or air-to-close) to match the controlling instrument. For successful operation, the actuator stem and valve shaft must move freely in response to the loading pressure change on the diaphragm.

Adjustment

Turnbuckle Adjustment

Correct turnbuckle adjustment ensures that the valve is correctly closed when the actuator is against its travel stops. The turnbuckle adjustment is the only adjustment necessary on the Type 1051 actuator. Key numbers are shown in figure 8 for Type 1051 actuators and in figure 9 for Type 1052 actuators.

For accurate adjustment to the zero-degree valve disc or ball position, remove the valve from the pipeline. Refer to the valve instruction manual for instructions.

A regulated air supply will be required to stroke the actuator. Refer to table 4 for the sizes of the three open-end wrenches required for this procedure.

1. Remove the access plate (key 59). Also remove the machine screws (key 60), if present.

Note

For the most accurate adjustment of the actuator, do not remove the cover (key 33) during this procedure.

2. Loosen the lower locknut (key 16).
3. Make sure the actuator housing (key 20) is clear of any tools or other instruments that could obstruct the actuator stroke path. Pressure the diaphragm casing enough to stroke the actuator down so that the left-hand threaded upper locknut (key 58) is accessible through the access opening. Loosen the locknut.
4. Consult the appropriate valve instruction manual for determining the closed position of the valve. Then use one of the following:

1051 & 1052 F & G Actuators

a. **Push-down-to-close**—Slowly stroke the actuator to the down travel stop. Adjust the turnbuckle (key 57) until the valve is in the closed position. Lock this adjustment with the left-hand threaded locknut (key 58). Stroke the actuator to the mid-travel position, and tighten the locknut (key 16).

b. **Push-down-to-open**—Release all pressure from the diaphragm casing, making sure the diaphragm is against its up travel stop. Be sure that the optional handwheel is adjusted to its topmost position so that the zero position of the actuator and valve can be reached simultaneously. Check the valve position. Stroke the actuator so the turnbuckle (key 57) is accessible through the access opening. Adjust the linkage. Release pressure to the actuator, and check the new adjustment. Continue this procedure until the valve is in the closed position when the actuator is resting on its up travel stop. Stroke the actuator to the mid-travel position, and tighten the locknut (key 16). Stroke the actuator, and tighten the left-hand threaded locknut (key 58).

5. Replace the access plate (key 59).

6. Loosen the self-tapping screws (key 38), adjust the travel indicator (key 27), and re-tighten the self-tapping screws.

Type 1052 Spring Adjustment

Initial Setting

The Type 1052 nameplate specifies an initial spring setting, which is the initial setting adjusted into the actuator spring. Initial setting is the casing pressure at which the diaphragm and diaphragm rod begin to move away from the up travel stop **with the actuator disconnected from the valve**. (With the actuator connected to the valve and pressure applied to the valve, a higher pressure will be required to start actuator travel).

The initial setting was selected (based upon the service conditions specified when the actuator was ordered) so that, when the actuator and valve are in service, the valve will seat properly and full travel will be obtained within a diaphragm casing range of 0 to 1.2, 0 to 2.3, 0 to 2.8, or 0 to 3.8 bar (0 to 18, 0 to

33, 0 to 40, or 0 to 55 psig) depending on specific actuator size and construction.

If the actuator has been disassembled or if the spring adjustment was changed, and it is desired to match the initial setting stated on the nameplate, make sure the rod end bearing (key 17, figure 8 or 9) has been disconnected from the lever (key 27, figure 8 or 9). Adjust the spring so that the diaphragm rod just starts to travel at the spring set pressure specified on the nameplate.

Be sure the rod end bearing does not hit the lever as the diaphragm and diaphragm rod move away from the up travel stop. To adjust the spring, insert a round rod into one of the holes in the lower bearing seat (key 73, figure 9). Hole diameter is 9.5 mm (3/8 inch) for size 40 actuators, 15.9 mm (5/8 inch) for size 60 actuators, and 10.1 mm (3/4 inch) for size 70 actuators. Rotate the bearing seat to move it toward the casing to increase initial setting or away from the casing to decrease initial setting (keys 1 and 2, figure 9).

Stroking Range

The initial spring setting listed on the nameplate has been determined to be the optimum setting, and it is not recommended to make spring adjustments that will cause this value to change or be exceeded. For push-down-to-open valve action, the initial spring setting is the maximum allowable to provide the maximum spring closing force.

CAUTION

Any increase of this setting will over-stress the spring at full travel and may shorten the fatigue life of the spring.

For push-down-to-close valve action, the initial spring set has been determined to be the optimum balance between the air-to-close and the spring-to-open breakout torque.

If the Type 1052 actuator is to be changed from one valve action to another (i.e., push-down-to-close to push-down-to-open), first, refer to the table for key 11 in the Parts List section to determine the proper initial spring setting; then, adjust the unit according to the procedures in the Initial Settings portion of the Type 1052 Spring Adjustment section.

Principle of Operation

The diaphragm rod moves down as loading pressure is increased on top of the diaphragm. As the loading pressure is decreased, the spring forces the diaphragm rod upward.

The spring and diaphragm have been selected to meet the requirements of the application and, in service, the actuator should produce full travel of the valve with the diaphragm pressure as indicated on the nameplate.

Consult the separate positioner instruction manual for actuator principle of operation with positioner.

Maintenance

Actuator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions. Key numbers are shown in figure 8 for Type 1051 actuators and in figure 9 for Type 1052 actuators.



WARNING

Avoid personal injury or property damage from sudden release of process pressure or uncontrolled movement of parts. Before performing any maintenance operations:

- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury. Be aware of pinching parts during maintenance operations.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.

- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

- The valve packing box may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings, or when loosening the packing box pipe plug.

- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

CAUTION

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

Disassembly

The following procedure describes how to completely disassemble the actuator. When inspecting and replacing parts, perform only those steps necessary to accomplish the repair.

Do **not**, under ordinary circumstances, remove the cap screws (keys 7, 8, and 21) at this time.

CAUTION

Cap screw (key 18) must be disengaged from the lever (key 27) before removing the diaphragm casing (key 1). Failure to do so will allow the spring precompression to rotate the valve beyond its fully open or closed position. This could cause damage to the valve components and/or seal.

1. Perform the steps in the **WARNING** at the beginning of the Maintenance section to isolate the control valve and actuator.
2. Remove the tubing or piping from the top of the actuator.
3. Remove the positioner, if used. If necessary, refer to the positioner instruction manual for removal instructions.
4. Unscrew the cap screws and washers (keys 34 and 63), and remove the cover (key 33).

1051 & 1052 F & G Actuators

5. Remove the retaining ring (key 30), and slide the hub (key 29) from the cover. If necessary, remove the travel indicator (key 37) from the hub (key 29).
6. Inspect, and if necessary, replace the cover bushing (key 31). Remove the travel indicator scale (key 35) by removing the self-tapping screws (key 36). Press the bushing out of the cover (key 33).
7. Remove the cap screw and hex nut (keys 18 and 19).
8. Make note of the lever/valve shaft orientation, and then loosen the cap screw (key 28).

CAUTION

When removing the actuator from the valve, do not use a hammer or similar tool to drive the lever (key 27) off the valve shaft. Driving the lever could damage internal valve parts. On some valve types, driving the lever off the shaft could move the valve disc or ball and bearings away from the centered position, causing subsequent damage to valve parts as the valve is operated.

A wheel puller may be used to remove the lever. It is okay to tap the wheel puller screw lightly to loosen the lever, but hitting the screw with excessive force could also damage valve parts or disrupt the centered position of the valve disc and bearings.

9. Rotate the handwheel (if one is used) counterclockwise until the handwheel is not compressing the spring (key 11).

WARNING

To avoid personal injury from pre-compressed spring force suddenly thrusting the upper diaphragm casing (key 1) away from the actuator, relieve Type 1052 spring compression, or carefully remove Type 1051 casing cap screws before proceeding further.

10. To relieve spring compression:

- a. *For Type 1051 actuators:*

- Loosen, but do not remove, all casing cap screws and hex nuts (keys 5 and 6). Make sure

there is no spring force to the upper diaphragm casing.

- Unscrew and remove the cap screws and hex nuts (keys 5 and 6), and then remove the upper diaphragm casing and the diaphragm (key 3).

- b. *For Type 1052 actuators:*

- Insert a round rod into one of the holes in the lower bearing seat (key 73). Use the rod to rotate the lower bearing seat, and move it away from the actuator casings. Continue rotating the lower bearing seat until spring compression is completely removed. Rod hole diameter is 9.5 mm (3/8 inch) for size 40 actuators, 15.9 mm (5/8 inch) for size 60 actuators, and 19.1 mm (3/4 inch) for size 70 actuators.

- Unscrew and remove the cap screws and hex nuts (keys 5 and 6), and then remove the upper diaphragm casing and the diaphragm (key 3).

11. Removing the diaphragm plate (key 4):

- a. *For Type 1051 actuators:*

- Pull the diaphragm plate (key 4) and attached parts out of the actuator. The spring (key 11), diaphragm rod (key 10), cap screw (key 9), spring seat (key 13), hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) will be attached to the diaphragm head assembly.

- The diaphragm plate (key 4) may be wedged against the diaphragm rod (key 10), thereby preventing the spring compression from being relieved as the cap screw (key 9) is loosened.

WARNING

Dislodge the diaphragm plate (key 4) from the diaphragm rod (key 10) *before* completely removing the cap screw (key 9). Failure to comply with this requirement could cause personal injury due to the sudden release of spring compression.

- Dislodge the diaphragm plate (key 4) from the diaphragm rod (key 10) by loosening the cap screw (key 9) one full turn and tapping the underside of the diaphragm plate until it follows the cap screw as it is being removed. Failure to check for this condition before completely removing the cap screw (key 9) could cause personal injury due to the sudden release of spring compression.

- Slowly remove the cap screw (key 9) while making sure that the diaphragm head assembly is following the cap screw disassembly. **Note—Make sure that spring load is zero before the cap screw is completely removed. See the WARNING on the preceding page.** If necessary, separate the remaining parts of the assembly.

b. *For Type 1052 actuators:*

(1.) Remove the rod end bearing (key 17), the hex nut (key 16), turnbuckle (key 57), and the hex nut (key 58) from the diaphragm rod (key 10).

(2.) Pull the diaphragm plate (key 4) and attached parts out of the actuator. Then remove the cap screw (key 9) to separate the diaphragm plate and the diaphragm rod.

(3.) Proceed as appropriate:

- *For Size 40 and 60 actuators:* Remove the actuator spring (key 11) from the actuator. If it is necessary to remove the adjusting screw (key 74) from the spring barrel during this procedure, heat the base of the adjusting screw to 177°C (350°F) long enough for the thread-locking compound (key 77) to lose its holding strength. Then, unscrew the adjusting screw from the spring barrel. If the spring seat and the lower bearing seat (keys 13 and 73) are to be replaced, unscrew the lower bearing seat from the adjusting screw, and then remove the thrust bearing and the bearing races (keys 71 and 72) from the lower bearing seat.

- *For Size 70 actuators:* Remove the actuator spring (key 11) from the actuator. Remove the cap screws (key 21), then remove the spring barrel (key 12) from the actuator housing. If it is necessary to remove the spring adjustment parts, loosen the set screw (key 75), and unscrew the spring adjusting screw (key 74) from the spring barrel (key 12).

12. Unscrew the cap screws (key 23), and remove the actuator housing assembly (key 20).

13. Unbolt the mounting yoke (key 22) from the valve.

14. Check the bushing (key 67) in the mounting yoke. Press out and replace the bushing if necessary.

Assembly

This procedure assumes that the actuator was completely disassembled. If the actuator was not completely disassembled, start these instructions at the appropriate step. This procedure also assumes that the valve is removed from the pipeline for ease in actuator assembly and adjustment.

Key numbers are shown in figure 8 for Type 1051 actuators and in figure 9 for Type 1052 actuators.

1. Installing the spring barrel (key 12):

a. *For Type 1051 actuators:* Place the spring barrel onto the housing (key 2). Secure the spring barrel with cap screws (key 21). Tighten the cap screws to the torque value shown in table 3.

b. *For Type 1052 actuators:* If the spring barrel (key 12) was removed from the housing (key 20), align the spring barrel to the housing as described below to ensure that the offset hole in the base of the spring barrel will be located properly.

- *For Size 40 and 60 actuators:* Note that one of the accessory mounting bosses on the spring barrel is closer to the diaphragm end of the spring barrel. Place the spring barrel onto the housing with the upper boss (the one closer to the diaphragm end) on the same side as the boss located on the housing (see figures 8 and 9). This ensures proper positioning of the offset hole. Secure the spring barrel with cap screws (key 21). On final assembly, tighten the screws to the torque value shown in table 3.

- *For Size 70 actuators:* The spring barrel need not be aligned in any particular position when placing it on the housing.

2. If the bushing (key 67) was removed, press in the new bushing. The end of the bushing should be flush with the bottom of the recess in the mounting yoke (key 22).

3. Slide the mounting yoke over the valve shaft, and secure it to the valve with the valve mounting cap screws.

4. Tighten the valve mounting cap screws to the bolting torque listed in step 6 of the Installation procedures.



Exceeding any torque requirement may impair the safe operation of the

1051 & 1052 F & G Actuators

actuator and lead to possible personal injury or property damage.

5. Refer to figure 4 for the desired orientation of the housing (key 20). Secure the housing to the mounting yoke with cap screws (key 23).
6. Coat with lithium grease (key 93) lubricant or equivalent on the cap screw threads (key 9), and the tapered end of the diaphragm rod (key 10).
7. Proceed as appropriate:
 - a. **For Type 1051 actuators (see figure 8)**
 - Assemble the diaphragm rod, spring seat (key 13), spring (key 11), and diaphragm plate (key 4), and secure with the cap screw (key 9). Tightening the cap screw will compress the spring. Be certain the tapered end of the diaphragm rod is seated in the corresponding hole in the diaphragm plate, that the spring is seated in the spring seat, and that the cap screw is tightened to the torque specified in table 3.
 - Install the hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) onto the diaphragm rod.
 - Be certain the travel stops (key 8) are located as shown in figure 5.
 - Install the diaphragm plate and attached parts into the actuator.
 - Be sure the warning nameplate (key 56) is in place. Install the diaphragm (key 3) and the upper diaphragm casing (key 1). Install the cap screws and hex nuts (keys 5 and 6). Tighten the cap screws evenly in a crisscross pattern to compress the spring and secure the upper diaphragm casing. Refer to table 3 for torque values.
 - b. **For Type 1052 actuators (see figure 9):**
 - *For actuator designs without a set screw (key 75) in the spring barrel (key 12):* if the adjusting screw and attached parts were removed, first clean and then lubricate the upper threads of the adjusting screw (key 74) with a lubricant (key 76) or equivalent as shown in figure 9. Install the lower bearing seat (key 73), the thrust bearing (key 71), the thrust bearing races (key 72), and the spring seat (key 13) onto the adjusting screw.
 - First, clean and then coat the lower end of the adjusting screw with sealant (key 77) or equivalent

thread-locking compound as shown in figure 9, and install the entire assembly into the spring barrel (key 12). Let the adjusting screw stand undisturbed for at least two hours after installation to allow the thread-locking compound to cure.

CAUTION

Apply lubricant to the upper threads and thread-locking compound to the lower threads of the adjusting screw. Do not overlap the coat of lubricant with the coat of thread-locking compound since this will adversely affect the performance quality of both substances.

- *For actuator designs with a set screw (key 75),* if the adjusting screw (key 74) and attached parts were removed, lubricate the threads of the adjusting screw with the lubricant (key 76) or equivalent. Install the lower bearing seat (key 73), the thrust bearing (key 71), the thrust bearing races (key 72), and the spring seat (key 13) onto the adjusting screw. Install this assembly into the spring barrel (key 12). Secure the adjusting screw with the set screw (key 75).
8. Coat the tapered end of the diaphragm rod (key 10) and the threads of the cap screw (key 9) with the lubricant (key 76) or equivalent. Bolt the diaphragm plate to the diaphragm rod.
 9. Be certain the travel stops (key 8) are located as shown in figure 5.
 10. Install the spring (key 11) into the spring barrel. Install the diaphragm plate and diaphragm rod into the actuator. Attach the hex nut (key 58), turnbuckle (key 57), hex nut (key 16), and rod end bearing (key 17) to the diaphragm rod.
 11. **Installing the diaphragm:**
 - Place the upper diaphragm casing (key 1) onto the lower diaphragm casing (key 2). If necessary, rotate the lower bearing seat (key 73) so that the upper diaphragm casing travel stop will not contact the diaphragm when the casing cap screws and nuts (key 5 and 6) are tightened.
 - Secure the upper diaphragm casing with the cap screws and hex nuts (keys 5 and 6). Be sure the warning nameplate is in place on the casing. Tighten the nuts on the cap screws to the torque value shown in table 3.
 12. **For Type 1052 actuators,** complete the Initial Setting portion of the 1052 Spring Adjustment section before proceeding.

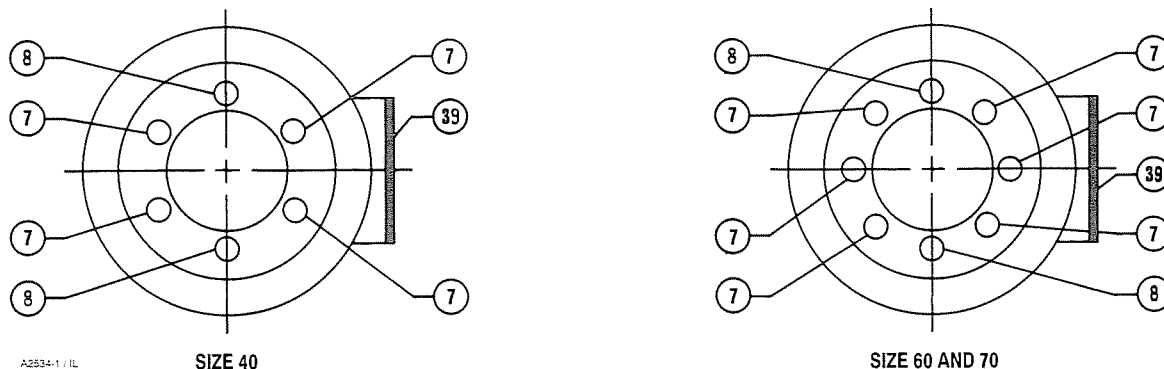


Figure 5. Travel Stop Orientation

13. Refer to the appropriate valve instruction manual for lever/valve shaft orientation marks, and slide the lever (key 27) into place; see figure 4 for correct lever operating clearance. Clamp with the cap screw (key 28, figure 9).

14. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by carefully stroking the actuator off its up travel stop with a regulated air source.

15. Apply sealant (key 77) or equivalent thread-locking compound to the threads of the cap screw (key 18).

16. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19). Tighten the nut on the cap screw (see table 3).

17. Coat the bearing surfaces of the hub (key 29), and cover (key 33) with lubricant (key 76) or equivalent. Install the bushing (key 31) and hub into the cover. Secure with the retaining ring (key 30).

18. Install the travel indicator scale (key 35), and secure it with the self-tapping screws (key 36). Then install the travel indicator (key 37), and secure it with the self-tapping screws (key 38).

19. Note the valve disc or ball position, and direction of rotation. Position the travel indicator (key 37) accordingly.

20. Replace the cover (key 33), and secure with cap screws and washers (keys 34 and 63). If the holes in the cover and housing (key 20) do not align, use a regulated air source to move the actuator slightly off the up travel stop. If hole alignment cannot be obtained in this manner, temporarily loosen cap screws (key 23), and shift the housing slightly.

CAUTION

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

21. If a valve positioner is to be used, consult the separate valve positioner instruction manual for proper positioner installation.

22. Follow the instructions in the Turnbuckle Adjustment section.

Changing Actuator Mounting

The actuator is normally positioned vertically in a horizontal pipeline. However, four mounting styles and four positions for each style are possible (see figure 3).

Note

Due to its weight, the Type 1052, size 70 actuator must be externally supported if mounted in the horizontal position.

Correct lever/valve shaft positioning is important to ensure proper valve action. Consult the appropriate valve instruction manual.

Style A is right-hand mounted, while style D is left-hand mounted. In all other ways, the styles A and D are identical.

Style B is right-hand mounted, while style C is left-hand mounted. In all other ways, the styles B and C are identical.

Use the following procedure along with figures 8 and 9, for key number references, to convert from

1051 & 1052 F & G Actuators

styles A and D to styles B and C or visa versa or to change the mounting position.

WARNING

To avoid personal injury, perform the steps in the WARNING at the beginning of the Maintenance section to isolate the control valve and actuator.

1. Remove the tubing or piping from the top of the actuator.
2. Remove the cover (key 33) by unscrewing and removing the cap screws and washers (keys 34 and 63).
3. Unscrew cap screw (key 18). Loosen cap screw (key 28).

CAUTION

When removing the actuator from the valve body, do not use a hammer or similar tool to drive the lever (key 27) or actuator off the valve shaft. Driving the lever or actuator could damage internal valve parts. On some valve types, driving the lever (key 27) could move the valve disc and bearings away from the centered position causing subsequent damage to valve parts.

A wheel puller may be used to remove the lever. It is okay to tap the wheel puller screw lightly to loosen the lever, but hitting the screw with excessive force could also damage valve parts or disrupt the centered position of the valve disc and bearings.

4. If changing styles,
 - Unscrew cap screws (key 23), and remove the actuator housing (key 20) from the mounting yoke (key 22).
 - Rotate the housing 180 degrees, maintaining the appropriate position (1, 2, 3, or 4), and place the actuator onto the mounting yoke (key 22).
5. If changing positions, unscrew cap screws (key 23), and rotate the actuator housing to the desired position.

6. Secure actuator housing (key 20) to the mounting yoke (key 22) with cap screws (key 23). Consult table 3 for appropriate bolt torques.

7. Consult the appropriate valve instruction manual for lever/valve shaft orientation marks, and slide the lever (key 27) into place; see figure 4 for correct lever operating clearance. Clamp with the cap screw (key 28).

8. Rotate the lever (key 27) to align with the rod end bearing (key 17). This connection can be aided by stroking the actuator off its up travel stop with a regulated air source.

9. Apply sealant (key 77) or equivalent thread-locking compound to the threads of the cap screw (key 18).

10. Connect the lever (key 27) and the rod end bearing (key 17) with the cap screw and hex nut (keys 18 and 19). Tighten cap screw to the recommended bolt torque shown in table 3. This connection can be aided by stroking the actuator from its up travel stop with a regulated air source.

11. Note the valve position and direction of rotation. Position the travel indicator (key 37) accordingly. Replace the cover (key 33), and secure it with cap screws and washers (keys 34 and 63).

- If the holes in the cover and housing (key 20) do **not** align, use a regulated air source to move the actuator slightly off the up travel stop.

- If hole alignment **cannot** be obtained in this manner, temporarily loosen cap screws (key 23) and shift the housing slightly.

CAUTION

To avoid parts damage, do not stroke the actuator while cover (key 33) is off.

12. Follow the instructions given in the Turnbuckle Adjustment section.

Top-Mounted Handwheels and Adjustable Travel Stops

Principle of Operation for Handwheels

Note

If repeated or daily manual operation is expected or desired, the unit should

be equipped with a manual handwheel actuator. Refer to the separate manual handwheel actuator instruction manual for mounting instructions.

Top-Mounted Handwheel Assembly is attached to a special upper diaphragm casing (key 1, figures 8 and 9) with cap screws (key 141, figure 10). A hex nut (key 137, figure 11) locks the handwheel in position. Turning the handwheel (key 51, figure 10) clockwise into the upper diaphragm casing forces the pusher (key 135, figure 10) against the diaphragm and diaphragm plate (keys 3 and 4, figures 8 and 9) to compress the spring (key 11, figures 8 and 9) and move the diaphragm rod downward.

Turning the handwheel counterclockwise allows the actuator spring to move the diaphragm rod upward.

- If the valve is push-down-to-close, full opening can be restricted by positioning the handwheel at the desired position.

- If the valve is push-down-to-open, full closing of the valve can be restricted by use of the handwheel.

Adjustable Up Travel Stop (figure 11) limits the actuator stroke in the upward direction. To make adjustments, first relieve actuator loading pressure before removing the closing cap (key 187) as it is a pressure retaining part. Remove the closing cap (key 187). Also, for size 70 actuators, the hex nut (key 137) must be loosened. Then turn the stem (key 133) clockwise into the diaphragm case to move the actuator stem downward or counterclockwise to allow the spring to move the actuator stem upward.

- If the valve has push-down-to-close action, full opening can be restricted by the position of the adjustable travel stop. Or,

- If the valve has push-down-to-open action, full closing can be restricted by the position of the adjustable travel stop.

For size 70, tighten the hex nut and replace the closing cap after adjustment.

Adjustable Down Travel Stop (figure 12) limits the actuator stroke in the downward direction. To make adjustments, first relieve actuator loading pressure before removing the closing cap (key 187) as it is a pressure retaining part. Remove the closing cap (key 187). Loosen the hex jam nut (key 189) and either turn the hex nut (key 63 for size 40 and 70 actuators; or key 54 for size 60 actuators) down on the stem (key 133) to limit travel, or up on the stem

to allow more travel. Lock the jam nut against the hex nut, and replace the closing cap after the adjustment has been made.

Handwheel Maintenance and Adjustable Travel Stop

If loading pressure seems to be leaking from either the handwheel or adjustable up stop, the O-rings (key 138 and 139, figures 10 and 11) may need replacement. If the adjustable down stop leaks, the O-ring (key 139, figure 12) may need replacement or possibly the closing cap (key 187, figure 11) is not tight. To tighten the closing cap, apply a good grade of thread sealant to the closing cap threads.

For ease of operation, the stem threads (key 133, figures 10, 11, and 12) may need an occasional application of lubricant (key 241) or equivalent. A grease fitting (key 169, figures 10 and 11) is provided for this purpose in the size 70. The size 70 may also need to have the thrust bearing (key 175, figures 10 and 11) packed with lubricant (key 241) or equivalent. Travel stops for the smaller casings can be lubricated between the stem and pusher (key 135, figures 10 and 11) with the lubricant (key 241) or equivalent.

The following disassembly procedures are separated where appropriate between the top-mounted handwheel and adjustable up travel stop assemblies (figures 10 and 11) and the adjustable down travel stop assembly (figure 12).

WARNING

To avoid personal injury, perform the steps in the WARNING at the beginning of the Maintenance section to isolate the control valve and actuator.

1. Remove the tubing or pipe from the handwheel body (key 142, figures 10, 11, and 12).

WARNING

To avoid personal injury from the pre-compressed spring force thrusting the upper diaphragm casing (key 1, figures 8 and 9) away from the actuator, either relieve Type 1052 spring compression, or carefully remove Type 1051 casing cap screws by following the instructions that are referenced in the steps below before removing the casing.

1051 & 1052 F & G Actuators

2. Relieve all actuator spring compression by following the procedures presented in the Disassembly portion of the Maintenance section. Then, rotate either the handwheel (key 51, figure 10) or the travel stop stem (key 133, figures 11 and 12) counterclockwise until the handwheel or travel stop assembly is no longer compressing the spring.

CAUTION

For Type 1051 actuators with disc valves and push-down-to-open action, the cap screw (key 18, figure 8) should be disengaged from the lever (key 27, figure 9) before removing the diaphragm casing (key 1, figure 8) as specified in the following steps. Failure to do so will allow the spring precompression to rotate the valve beyond its closed position. This could cause damage to the valve seal, seat, or other valve components.

3. Proceed as appropriate:

For Adjustable Up Travel Stops:

- a. Remove the upper diaphragm casing (key 1, figures 8 and 9) by following steps 1, 3, 7, 9, 10, and 11 of the Disassembly portion of the Maintenance section.
- b. Remove the cap screws (key 141, figures 10 and 11), and separate the assembly from the upper casing.
- c. Loosen the locknut (key 137, figure 10), or remove the closing cap (key 187, figure 11).
- d. Turn the stem (key 133, figures 10 and 11) clockwise out of the valve body. On handwheel assemblies, the cotter pin and hex nut (keys 247 and 54, figure 10) will have to be removed so that the handwheel (key 51, figure 10) and locknut can be taken off the stem first.
- e. Remove and inspect the O-rings (keys 138 and 139, figures 10 and 11); replace them if necessary.
- f. To complete disassembly:

For sizes 40 and 60: Drive out the groove pin (key 140, figures 10 and 11), and slide the pusher (key 135, figures 10 and 11) off the stem.

For size 70: The pusher unit is held to the stem by a retaining screw (key 174, figures 10, 11 or 12). Removing the retaining screw and pusher exposes the thrust bearing (key 175, figures 10 and 11) for inspection.

For Adjustable Down Travel Stops:

Key numbers are shown in figure 12 unless otherwise noted. For ease of operation, the stem (key 133) threads may need an occasional application of lubricant.

- a. Remove the closing cap (key 187), and unscrew the jam nut and hex nut (keys 189 and 63 for size 40 and 70 actuators; or keys 189 and 43 for size 60 actuators) off the stem (key 133).
- b. Remove the upper diaphragm casing (key 1, figures 8 and 9) and travel stop body (key 142) by following steps 1, 3, 7, 9, 10, and 11 of the Disassembly portion of the Actuator Maintenance section.
- c. Unscrew cap screws (key 141), and remove the body from the diaphragm case.
- d. Check the condition of the O-ring (key 139), and replace it if necessary.
- e. Loosen the hex nut (key 54), and then unscrew the travel stop stem (key 133) out of the actuator stem. The lower diaphragm plate (key 82) can now be removed and the rest of the actuator disassembled.

4. Reassemble by reversing the order of the disassembly steps, being sure to apply lubricant as previously mentioned and as shown by the lubrication boxes (key 241) in figures 10 and 11. For size 70 handwheels or up travel stop assemblies, coat the threads of the retaining screws (key 174, figures 10 and 11) with sealant (key 242) or equivalent thread-locking compound.

5. Readjust the spring to obtain the appropriate travel stop restriction by following the steps in the Top Mounted Handwheel Assembly section, and then return the unit to operation.

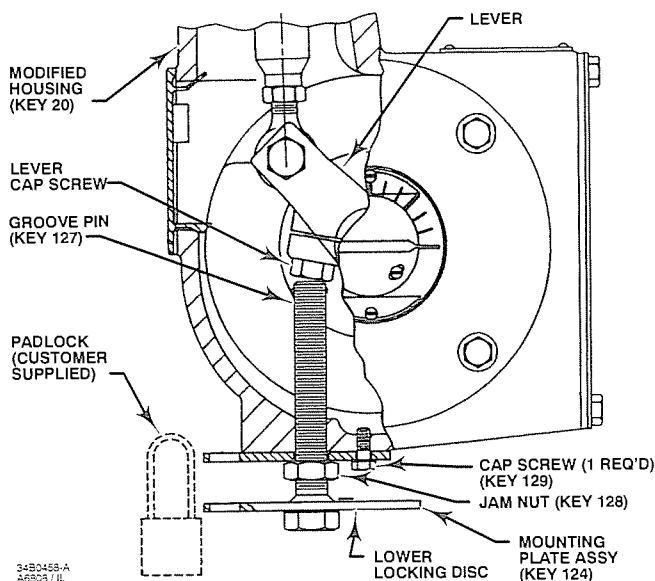


Figure 6. Actuator Locking Mechanism

Locking Mechanism

Refer to figure 6 when installing, operating, and locking the mechanism. Key numbers are shown in figure 6 unless otherwise noted.

Installing the Locking Mechanism

WARNING

To avoid personal injury, perform the steps in the WARNING at the beginning of the Maintenance section to isolate the control valve and actuator.

1. To add the locking mechanism to an existing actuator, contact your Fisher sales office to purchase the required parts. The required parts are the locking mechanism and a modified actuator housing.
2. To remove the old housing, use the Disassembly procedures in the Maintenance section.
3. Attach the mounting plate (key 123) to the modified housing (key 20) as shown in figure 6.

Attach it with the cap screw (key 129). Make sure the hole in the center of the mounting plate lines up with the large tapped hole in the housing.

4. Make sure the jam nut (key 128) is threaded onto the threaded bolt before threading it into the housing.

5. After the bolt is threaded into the housing, install the groove pin (key 127) into the end of the bolt. (Note: The groove pin will prevent the threaded bolt from being totally unthreaded from the actuator housing.)

6. Make sure that the bolt is not threaded in so far that it will interfere with reassembly of the actuator.

7. Reassemble actuator using the Assembly procedure in the Maintenance section.

8. Make sure the actuator diaphragm rod is retracted fully. This will be the locked position of the valve. For a push-down-to-close valve and actuator, the valve will be fully open when locked. For a push-down-to-open valve and actuator, the valve will be fully closed when locked.

9. Screw the threaded bolt into the housing until it contacts the head on the lever cap screw (see figure 6).

10. Insert the padlock (customer supplied) to connect the mounting plate (key 123) with the lower locking disc on the mounting plate assembly (key 124). You might have to back off the lower locking disc a slight amount to line up the holes for the padlock.

CAUTION

In the larger sized actuators, the layers of the mounting plate assembly may be far enough apart that you will need to purchase a padlock with a longer loop. Do not attempt to force the layers closer to fit a small looped padlock, as property damage may result.

11. Tighten the jam nut (key 128) against the mounting plate.

1051 & 1052 F & G Actuators

Operating the Locking Mechanism

To Unlock the Actuator

1. Remove the padlock. Loosen the jam nut (key 128), and unscrew the threaded bolt until it is stopped by the groove pin (key 127) in the threaded bolt.

CAUTION

For normal operation of the actuator, the threaded bolt must be unscrewed far enough so that the actuator lever will not contact the bolt, which could lead to property damage.

2. If you are going to leave the bolt threaded into the housing, lock it by tightening the jam nut (key 128) against the mounting plate so that it cannot be screwed into the housing and interfere with normal actuator operation.

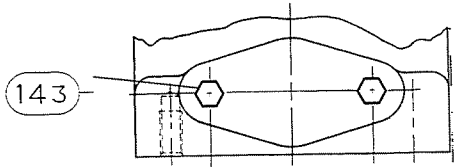
To Lock the Actuator

1. Make sure the actuator diaphragm rod is retracted fully. This will be the locked position of the valve. For a push-down-to-close valve and actuator, the valve will be fully open when locked. For a push-down-to-open valve and actuator, the valve will be fully closed when locked.

2. Make sure the jam nut (key 128) is loose. Screw the threaded bolt into the housing until it contacts the head on the lever cap screw (see figure 6).

3. Rotate the threaded bolt until one of the holes in the lower locking disc (which is welded to the bolt) is in line with the hole in the mounting plate (key 123). Tighten the jam nut against the mounting plate.

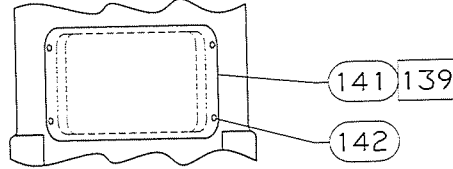
4. Lock the plate and disc together with a padlock. (The padlock is customer supplied.)



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NOTE:
IF ACCESSORIES ARE NOT INSTALLED ON THE MOUNTING BOSS, INSTALL CAP SCREWS (KEY 143) TO PLUG OPENINGS. A MOUNTING BOSS IS LOCATED ON BOTH SIDES OF THE SPRING BARREL.

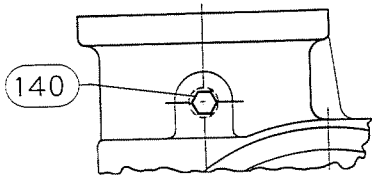
ACCESSORIES MOUNTING BOSS



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NOTE:
FOR FIELD CONVERSION OF TYPE 1052 ACTUATORS, ATTACH COVER (KEY 141) OVER THE SPRING BARREL ADJUSTMENT OPENING WITH SELF-TAPPING SCREWS (KEY 142). USE KEY 141 AS A DRILLING TEMPLATE. USE DRILL SIZE 2.6 mm (A #37 DRILL) (0.104-INCH) BY 9.6 mm (0.38-INCH) DEEP.
□ APPLY SEALANT

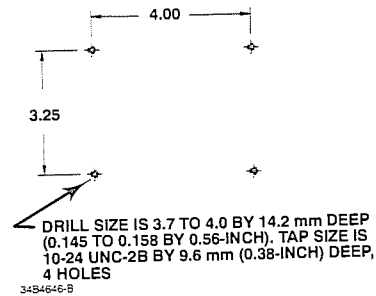
**TYPE 1052 SPRING BARREL
ACCESS COVER**



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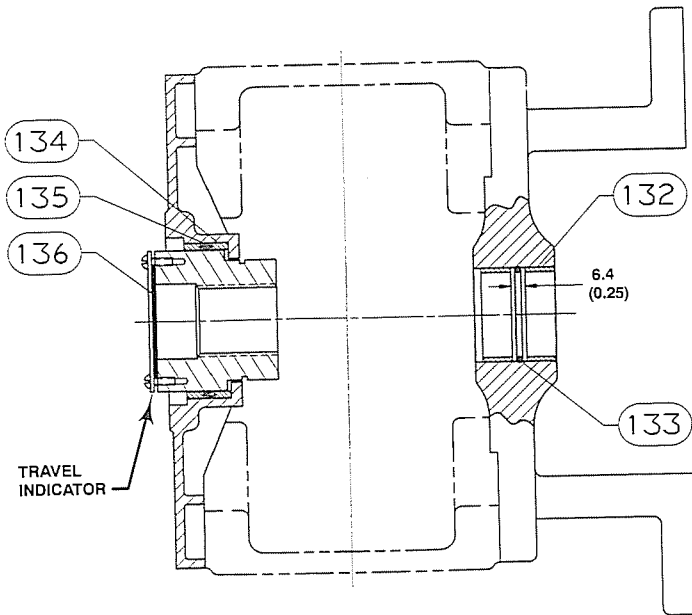
NOTE:
INSTALL THE HEX HEAD PLUG (KEY 140) INTO THE VENT OPENING LOCATED IN THE ACTUATOR HOUSING.

HOUSING VENT PLUG LOCATION



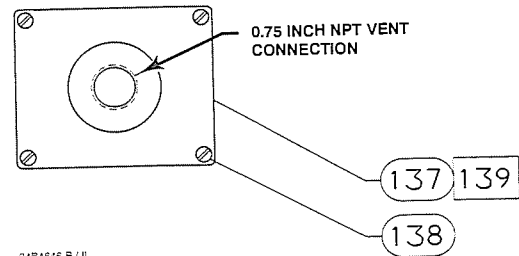
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**DRILLING AND TAPPING PATTERN
ACCESS PLATE ASSEMBLY**



34B4646-B / IL

MOUNTING YOKE AND COVER ASSEMBLY



34B4646-B / IL

NOTE:
FOR FIELD CONVERSION, DRILL AND TAP HOLE PATTERN IF HOUSING HAS A NON-METALLIC ACCESS PLATE. USE KEY 137 AS A DRILLING TEMPLATE IF DESIRED. OR, USE THE DIMENSIONS PROVIDED IN THIS FIGURE FOR DRILLING AND TAPPING.
□ APPLY SEALANT

ACCESS PLATE ASSEMBLY

mm
(INCH)

Figure 7. Pipe Away Vent Assembly

1051 & 1052 F & G Actuators

Key 11. Spring⁽¹⁾ for Type 1052 Actuator Only (Steel)
Key 13. Spring Seat⁽¹⁾ for Type 1052 Actuator Only (Steel)

CASING PRESSURE		ACTUATOR SIZE	KEY 11 SPRING PART NUMBER	KEY 13 SPRING SEAT PART NO.
Bar	Psig			
0 to 1.2	0 to 18	40	1L217427042	12A9447X012
		60	1K162727082 1N937327082 1N937327082	12A9450X012 12A9448X012 12A9449X012
0 to 2.3	0 to 33	40	1L217327042 1P637127082	12A9446X012 12A9447X012
		60	1K162827082 1K162827082 1N937327082 1N937327082	12A9448X012 12A9449X012 12A9448X012 12A9449X012
0 to 2.8	0 to 40	40	1L217327042	12A9446X012
		60	1K162827082 1K162829082	12A9448X012 12A9449X012
0 to 3.8	0 to 55	40	1L217327042	12A9446X012
0.2 to 1.0	3 to 15	60	1K162727082	12A9450X012
0.2 to 2.1	3 to 30	40	1L217327042 1P637127082	12A9446X012 12A9447X012
		60	1K162827082 1N937327082	12A9449X012 12A9449X012

Key 11. Spring⁽¹⁾ for Type 1052 Actuators Only (Steel)

CASING PRESSURE		ACTUATOR SIZE	INITIAL SPRING COMPRESSION				KEY 11 SPRING PART NUMBER
Bar	Psig		Push-down-to-open		Push-down-to-close		
			Bar	Psig	Bar	Psig	
0 to 1.2	0 to 18	40	0.2	3.0	0.2	3.0	1L217427042
			0.3	4.3	0.2	3.0	1P637127082
	0 to 18	60	0.3	3.7	0.2	3.0	1K162727082
			0.2	3.5	0.2	3.0	1N937327082
0 to 2.3	0 to 33	40	0.3	4.3	0.3	4.3	1P637127082
			0.4	6.0	0.2	3.0	1L217327042
			0.3	4.4	0.2	3.0	1N844027082
	0 to 33	60	0.2	3.5	0.2	3.5	1N937327082
			0.5	7.0	0.2	3.0	1K162827082
			0.5	6.8	0.2	3.0	1P270227042
0 to 33	70	0.7	10.1	0.2	3.0	1R676027082	
0 to 2.8	0 to 40	40	0.3	4.4	0.2	3.0	1N844027082
			0.4	6.0	0.2	3.0	1L217327042
	0 to 40	60	0.5	6.8	0.2	3.0	1P270227042
			0.5	7.0	0.2	3.1	1K162827082
0 to 40	70	0.7	10.1	0.2	3.3	1R676027082	
0 to 3.8	0 to 55	40	0.3	4.4	0.2	3.5	1N844027082
	0 to 55	70	0.7	10.1	0.7	10.1	1R676027082
0.2 to 1.0	3 to 15	40	- - -	- - -	0.2	3.0	1L217427042
	3 to 15	60	0.3	3.7	0.2	3.0	1K162727082
0.2 to 2.1	3 to 30	40	0.3	4.3	0.3	4.3	1P637127082
			0.4	6.0	0.2	3.0	1L217327042
			- - -	- - -	0.2	3.0	1N844027082
	3 to 30	60	0.2	3.5	0.2	3.5	1N937327082
			0.5	7.0	0.2	3.0	1K162827082
			- - -	- - -	0.2	3.0	1P270227042
3 to 30	70	0.7	10.1	0.2	3.0	1R676027082	

1. For more detailed ordering information concerning spring selection to obtain the torque required by the valve, consult your Fisher sales office.

Instruction Manual

Form 5062
August 2005

1051 & 1052 F & G Actuators

Keys 22 and 67^{(1)*}- Mounting Yoke Assembly

VALVE DESIGN	ACTUATOR SIZE	VALVE SHAFT DIAMETER	VALVE SHAFT DIAMETER	KEY 22 YOKE CAST IRON		KEY 67 BUSHING, PTFE
		mm	Inches			
CV500, V100, V150, V200, V250, V300, 8510, 8532, and 8560	40	12.7	1/2	12A9799X0A2	- - -	1U902599402
		15.9	5/8	12A9799X0B2	- - -	12A9555X012
		19.1	3/4	12A9799X0C2	- - -	12A9556X012
	40	22.2	7/8	12A9799X0E2	- - -	12A9557X012
		25.4	1	12A9799X0G2	- - -	12A9775X012
		31.8	1-1/4	12A9799X112	- - -	12A9558X012
	60	19.1	3/4	12A9799X0D2	- - -	12A9556X012
		22.2	7/8	12A9799X0F2	- - -	12A9557X012
		25.4	1	12A9799X0H2	- - -	12A9775X012
	60 and 70	31.8	1-1/4	12A9799X0J2	- - -	12A9558X012
		38.1	1-1/2	12A9799X0K2	- - -	12A9559X012
		44.5	1-3/4	12A9799X0L2	- - -	10A3848X012
50.8		2	12A9799X0M2	- - -	12A9715X012	
9500 for G Mounting	40	12.7	1/2	- - -	32A9755X012	1U902599402
		15.9	5/8	- - -	32A9742X012	12A9555X012
		19.1	3/4	- - -	32A9743X012	12A9556X012
	40	25.4	1	- - -	32A9757X012	12A9575X012
		31.8	1-1/4	- - -	32A9746X012	12A9558X012
	60	19.1	3/4	- - -	32A9750X012	12A9556X012
		25.4	1	- - -	32A9778X012	12A9775X012
	60 and 70	31.8	1-1/4	- - -	32A9753X012	12A9558X012
		38.1	1-1/2	- - -	32A9754X012	12A9559X012
		44.5	1-3/4	- - -	35A9704X012	12A9560X012
		50.8	2	- - -	35A9705X012	12A9561X012

1. The yokes in this column are available as yoke-bushing assemblies. However, the bushings are available as replacement parts.

1051 & 1052 F & G Actuators

Instruction Manual

Form 5062
August 2005

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Vee-Ball® Design V150, V200 and V300 Rotary Control Valves Sizes 1- through 12-Inch

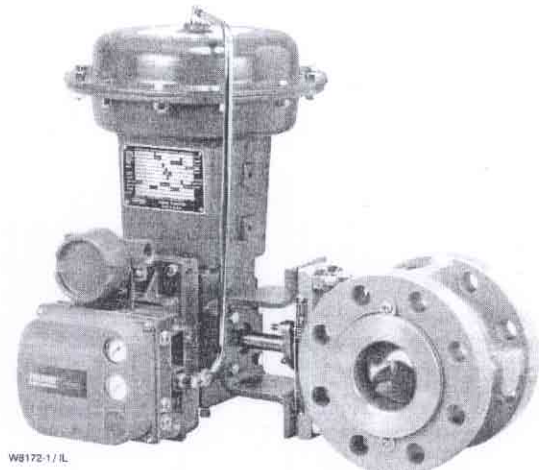
Contents

Introduction	1
Scope of Manual	1
Specification table	2
Description	2
Installation	2
Maintenance	6
Packing Maintenance	6
Replacing Packing	7
Disassembly	7
Assembly	8
Replacing the Ball Seal	8
Disassembly	8
Assembly	10
HD Metal Seal Lubrication	15
Bearing and Ball Maintenance	15
3- through 12-inch valve	15
Disassembly	16
Assembly	16
Welded Taper Key Replacement	18
1- through 2-inch valves	18
Disassembly	19
Assembly	20
Actuator Mounting	23
3- through 12-inch without Attenuator	23
Determining Mounting Position	24
Determining Closed Position	24
Parts Ordering	30
Parts Kits	32
Parts List	33
Appendix A	36
Instructions for Non-Series B	36

Introduction

Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts information for the Vee-Ball® Design V150 (1- through 12-inch sizes), V200 (1- through 10-inch sizes), and V300



WB172-1/L

Figure 1. Type Vee-Ball with Type 1052 Actuator and DVC5020 Positioner

(1- through 12-inch sizes) rotary control valves (see figure 1). Sizes 3- through 12-inch without an attenuator currently in production are referred to as Series B (for more information on this distinction see Appendix A).

For larger valves (14-, 16-, and 20-inch size), refer to a separate instruction manual. For information on ENVIRO-SEAL® packing, see the ENVIRO-SEAL Packing System for Rotary Valves instruction manual (form 5305). Refer to separate manuals for information concerning the actuator, positioner and accessories.

No person may install, operate, or maintain Designs V150, V200, and V300 valves without first • being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office before proceeding.



Vee-Ball Valves

Table 1. Specifications

<p>Valve Sizes and End Connection Styles</p> <p>Design V150: ■ 1, ■ 1.5, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, ■ 10, and ■ 12-inch sizes with Class 150 raised-face flanges</p> <p>Design V200: ■ 1, ■ 1.5, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, and ■ 10-inch flangeless valves that mate with Class 150, 300, or 600 (for size 1 through 8-inches) raised-face flanges</p> <p>Design V300: ■ 1, ■ 1.5, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, ■ 10, and ■ 12-inch valves with Class 300 raised-face flanges</p> <p>Standard Flow Direction</p> <p>Forward (into the convex face of the Vee-ball)</p>	<p>Actuator Mounting</p> <p>■ Right-hand, standard or ■ left-hand, optional, as viewed from upstream end of valve (see figure 23 and the Actuator Mounting section)</p> <p>Maximum Ball Rotation</p> <p>Standard: Ball rotates counterclockwise to close when viewed from actuator side of valve</p> <p>Optional: Ball rotates clockwise to close</p> <p>Ball rotation is 90 degrees</p> <p>Valve/Actuator Action</p> <p>With diaphragm or piston rotary actuator, field-reversible between: ■ push-down-to-close (extending actuator rod closes valve) and ■ push-down-to-open (extending actuator rod opens valve.) See actuator manual for details</p>
--	--

1. The pressure/temperature limits in this manual, and any applicable code or standard limitation, should not be exceeded.

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for the selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

Description

The Designs V150, V200, and V300 Vee-Ball valves (figure 1) with a V-notch ball are used in throttling or on-off service. The Design V200 is a flangeless construction. The Design V150 and V300 valves are raised-face flanged constructions. The splined valve shaft of all these valves connect to a variety of rotary-shaft actuators.

Specification

Specifications for these valves are shown in table 1 and in bulletin 51.3:Vee-Ball.

Installation

Separate installation steps are provided in this section for Design V150 and V300 flanged valves, and for Design V200 flangeless valves. Key numbers in installation procedures are shown in figures 24, 25 and 26 unless otherwise indicated.

Some types of ceramic trim, including VTC, can create a spark under certain conditions. If an edge of a ceramic part is struck against a second ceramic part with enough force, it can produce a spark.

 WARNING

Avoid personal injury and property damage from ignition of process fluid caused by sparks from ceramic trim. Do not use ceramic trim where the process fluid is unstable or if it is an explosive mixture (such as ether and air).

Table 2. Flange Stud Lengths Required for Seal Protector Ring End of Design V150 and V300 Valves

VALVE SIZE, INCHES	DESIGN V150				DESIGN V300	
	ISA S75.04 Face-to-Face		ASME B16.10 Short Face-to-Face		ISA S75.04 Face-to-Face	
	mm	Inches	mm	Inches	mm	Inches
1	70	2.75	95	3.75	89	3.50
1.5	83	3.25	127	5.00	102	4.00
2	95	3.75	146	5.75	95	3.75
3	95	3.75	133	5.25	121	4.75
4	108	4.25	146	5.75	127	5.00
6	114	4.50	152	6.00	140	5.50
8	121	4.75	171	6.75	152	6.00
10	133	5.25	165	6.50	171	6.75
12	140	5.50	159	6.25	184	7.25

WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

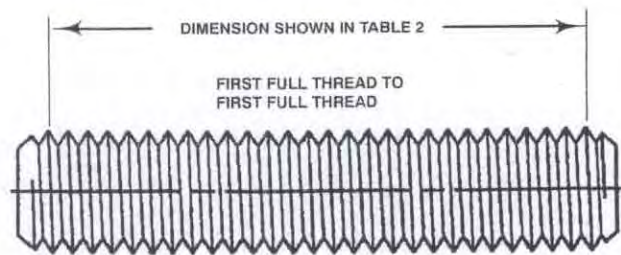
Personal injury or equipment damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed either the valve body rating or the mating pipe flange joint rating. To avoid such injury or damage, provide a relief valve for overpressure protection as required by government or accepted industry codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

CAUTION

When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop, and controlled fluid conditions. Responsibility for the safety of process media and compatibility of valve materials with process media rests solely with the purchaser and end-user. Because some valve/trim material combinations are limited in



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Figure 2. Flange Stud Length for Seal Protector End

their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Fisher sales office.

WARNING

The valve drive shaft is not necessarily grounded to the pipeline when installed. Personal injury or property damage could result from an explosion caused by a discharge of static electricity from valve components if the process fluid or the atmosphere around the valve is flammable. If the atmosphere around the valve or the process fluid is flammable, electrically bond the drive shaft to the valve.

Note

Standard PTFE packing is composed of a partially conductive carbon-filled PTFE female adaptor with PTFE V-ring packing. Standard graphite packing is composed of all conductive graphite ribbon packing. Alternate shaft-to-valve body bonding is

Vee-Ball Valves

available for hazardous service areas where the standard packing is not sufficient to bond the shaft to the valve (see the following step).

Attach the optional bonding strap assembly (key 131, figure 3) to the valve drive shaft (key 6) with the clamp (key 130, figure 3) and connect the other end of the bonding strap assembly to the valve body with the cap screw (key 23).

1. If the valve is to be stored before installation, protect the flange mating surfaces and keep the valve body cavity dry and free of foreign material.
2. Install a three-valve bypass around the control valve assembly if continuous operation will be necessary during inspection and maintenance of the valve.
3. The valve is normally shipped as part of a control valve assembly, with an actuator mounted on the valve. If the valve and actuator have been purchased separately or if the actuator has been removed, mount the actuator according to the Actuator Mounting section and the appropriate actuator instruction manual.
4. Standard flow direction is with the seal protector ring (key 3) facing upstream.
5. Install the valve in a horizontal or vertical pipeline with the drive shaft in a horizontal position.

CAUTION

Do not allow the valve to be installed in the pipeline with the drive shaft in the vertical position because of excessive wear to valve component parts.

6. The actuator can be right- or left-hand mounted with the shaft in a horizontal orientation as shown in figure 1. If necessary, refer to the appropriate actuator instruction manual for actuator installation and adjustment procedures.
7. Be certain the valve and adjacent pipelines are free of any foreign material that could damage the valve sealing surfaces.
8. Be sure the pipeline flanges are in line with each other.

Installing Design V150 and V300 Valves

1. Install the Design V150 and V300 valve using studs (keys 32 and 33, not shown) and nuts to

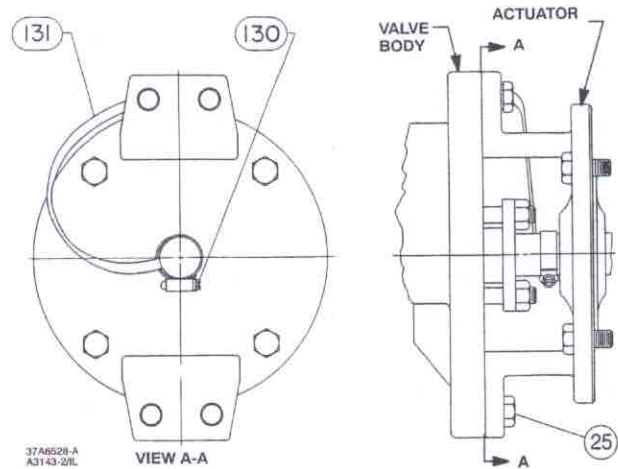


Figure 3. Optional Shaft-to-Body Bonding Strap Assembly

connect the valve flanges to the pipeline flanges. The seal protector ring (key 3) end of the valve requires longer line flange studs (key 32) than standard. Do not use standard-length line flange studs for the seal protector ring end of the valve.

2. See table 2 and figure 2 for length of studs for the seal protector ring end of Design V150 and V300 valves. Lubricate the studs with Never-Seez Nickel Special or equivalent lubricant.
3. Insert flat-sheet line flange gaskets (or spiral-wound gaskets with compression-controlling center rings) that are compatible with the flowing media.
4. Connect pressure lines to the actuator as indicated in the actuator instruction manual. When an auxiliary manual actuator is used with a power actuator, install a bypass valve on the power actuator (if one is not supplied) for use during manual operation.

WARNING

Personal injury could result from packing leakage. Valve packing was tightened before shipment; however the packing might require some readjustment to meet specific service conditions. Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

DESIGN V200 VALVE SIZE, INCHES	DIMENSION						
	A		B	M			
	Standard ISA S75.04 ⁽¹⁾	Class 150 ASME B16.10 ⁽²⁾ Short (Optional)		Standard Class 150 S75.04 ⁽¹⁾	Class 150 ASME B16.10 ⁽²⁾ Short (Optional)	Class 300	Class 600
mm							
1	102	127	58	176	202	202	202
1.5	114	165	64	189	240	224	224
2	124	178	57	211	268	237	237
3	165	203	87	254	286	279	286
4	194	229	92	286	321	305	343
6	229	267	119	343	381	362	423
8	243	292	119	343	394	387	426
10	297	330	151	419	451	---	---
Inches							
1	4.00	5.00	2.29	6.94	7.94	7.94	7.94
1.5	4.50	6.50	2.50	7.44	9.44	8.81	8.81
2	4.88	7.00	2.25	8.31	10.56	9.31	9.31
3	6.50	8.00	3.44	10.00	11.25	11.00	11.25
4	7.62	9.00	3.62	11.25	12.62	12.00	13.50
6	9.00	10.50	4.69	13.50	15.00	14.25	16.25
8	9.56	11.50	4.69	13.50	15.50	15.25	16.75
10	11.69	13.00	5.94	16.50	17.75	---	---

1. IEC 534-3-2 face-to-face dimensions are equivalent to S75.04 face-to-face dimensions.
2. 150 lb class only.

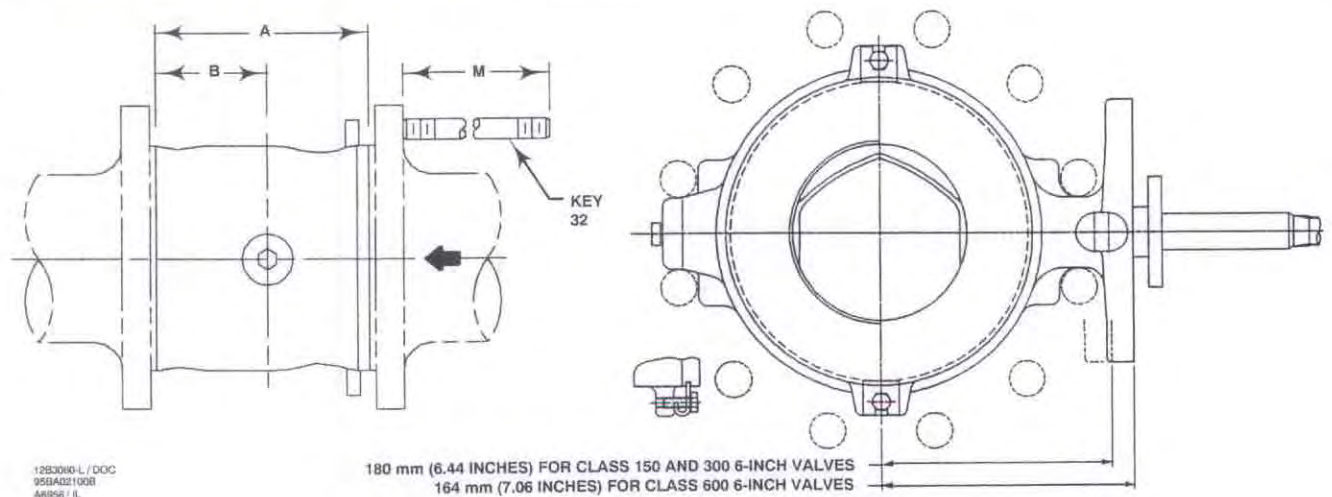


Figure 4. Design V200 Dimensions and Required Clearances for Installation

If the valve has ENVIRO-SEAL live-loaded packing installed, this initial re-adjustment will probably not be required. See ENVIRO-SEAL Packing System for Rotary Valves instruction manual (form 5305) for packing instructions.

Installing Design V200 Valves

Stud length dimensions are shown in figure 4 for the seal protector ring end of the valve. For Design V200, ANSI Class 600, the dimension from the

center line of the valve bore to the mounting flange face is larger than a Class 150 or 300 valve.

1. Install the Design V200 valve using long studs (key 32, figure 4) to connect the two pipeline flanges. Refer to figure 4 for the size of studs required. Lubricate the studs with Never-Seez Pure Nickel Special or equivalent lubricant.
2. Install two studs in the flanges before you place the valve in the line. Place the two studs so they will contact the line-centering notches at the bottom of the valve body.

Vee-Ball Valves

3. Insert flat-sheet line flange gaskets (or spiral-wound gaskets with compression-controlling center rings) that are compatible with the process fluid.
4. Place the valve on the two studs. Install all remaining studs. Measure carefully to be sure the valve is centered on the pipeline flanges, and tighten the flange stud nuts. Tighten the nuts in a criss-cross sequence to be sure the flange gaskets are properly torqued.
5. Connect pressure lines to the actuator as indicated in the actuator instruction manual. When an auxiliary manual actuator is used with a power actuator, install a bypass valve on the power actuator (if one is not supplied) for use during manual operation.

WARNING

Personal injury could result from packing leakage. Valve packing was tightened before shipment; however the packing might require some readjustment to meet specific service conditions. Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Maintenance

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for the selection, use, and maintenance of any Fisher products rests solely with the purchaser and end-user.

Valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement depends upon the severity of service conditions.

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise noted.

WARNING

The Vee-ball closes with a shearing, cutting motion, which could result in personal injury. To avoid injury, keep hands, tools, and other objects away from the Vee-ball while stroking the valve.

Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:

- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.

- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.

- Vent the power actuator loading pressure and relieve any actuator spring precompression.

- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations.

- The valve packing area may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings.

- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Packing Maintenance

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise noted. A detailed view of the packing is also shown in figure 5.

If the valve is equipped with the ENVIRO-SEAL Packing System, refer to:

- the separate ENVIRO-SEAL Packing System for Rotary Valves instruction manual (form 5305) for maintenance instructions, and
- the Parts List section of this manual for retrofit kits, parts kits, and individual parts.

If the packing is relatively new and tight on the drive shaft (key 6), and if tightening the packing follower nuts does not stop leakage, it is possible that the drive shaft is worn or nicked so that a seal cannot be made. If the leakage comes from the outside diameter of the packing, it is possible that the leakage is caused by nicks or scratches on the packing box wall. Inspect the drive shaft and packing box wall for nicks or scratches while performing the following procedure.

Replacing Packing

When using this procedure, it is recommended that the actuator **not** be removed from the valve while the valve is still in the pipeline or between flanges. Valve/actuator adjustments must be made with the valve out of the pipeline. Refer to the Determining Closed Position portion of the Actuator Mounting section.

Disassembly

WARNING

Observe the steps in the WARNING at the beginning of the Maintenance section.

1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve. If using a power actuator, shut off all pressure lines to the power actuator, release pressure from the actuator, and disconnect the pressure lines from the actuator. Use lock-out procedures to be sure that the above measures stay in effect while you are working on the equipment.
2. Remove line bolting, remove the control valve from the pipeline, and place the valve/actuator assembly on a flat surface with the seal protector ring facing up.

3. Remove the actuator cover. Take note of the orientation of the actuator with respect to the valve body and the lever orientation with respect to the valve drive shaft (see figure 6).

WARNING

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position after the actuator is removed.

CAUTION

When removing the actuator from the valve, do not use a hammer or similar tool to drive the lever or actuator off the valve shaft. Driving the lever or actuator off the valve shaft could damage the ball, seal, and valve.

If necessary, use a puller to remove the lever or actuator from the valve shaft. It is okay to tap the puller screw lightly to loosen lever or actuator, but hitting the screw with excessive force could damage the ball, seal, and valve.

4. Remove the clamped lever (do not loosen the actuator turnbuckle adjustment), remove the actuator mounting screws and nuts (keys 23 and 24), and remove the actuator. (If necessary, refer to the actuator instruction manual for assistance.)
5. If applicable, remove the bonding strap assembly before attempting to remove the packing (see figure 3).
6. Remove the packing follower nuts and packing follower (keys 17 and 20). For alloy packing constructions, the packing follower (key 17) and a separate packing flange (key 40) must be removed if present.

If the valve is equipped with the ENVIRO-SEAL packing system, refer to the ENVIRO-SEAL Packing System for Rotary Valves instruction manual (form 5305) for disassembly.

7. Remove the packing parts (see figure 5, keys 16, 17, 35, and 39 depending on construction) using a formed wire hook with a sharp end. Pierce the rings with the sharp end of the hook in order to remove them. Do not scratch the drive shaft or packing box

Vee-Ball Valves

wall; scratching these surfaces could cause leakage. Clean all accessible metal parts and surfaces to remove particles that would prevent the packing from sealing.

Assembly

If the valve is equipped with the ENVIRO-SEAL packing system, refer to the ENVIRO-SEAL Packing System for Rotary Valves instruction manual (form 5305) for assembly.

Series B only

1. For 8-, 10-, and 12-inch valves, install the packing spacer (key 34) if it has been removed.
2. To help ensure correct centering of the Vee-ball (key 2) on the seal (key 11), make sure the ball is closed while you install or tighten new packing. Insert a screw driver, pry bar, or similar tool between the lower ear of the ball and the valve body. Use the pry to move the ball tightly against the bearing on the actuator side of the valve (see figure 6). Keep the ball in that position until you have completed packing installation and adjustment.
3. Install the new packing parts using the parts sequence shown in figure 5. Install the packing follower (key 17). Alloy constructions have a packing follower (key 17) and a separate packing flange (key 40) that must be replaced.
4. Secure the packing follower with the packing follower nuts (key 20). Tighten the nuts far enough to stop leakage under operating conditions.

Handle the seal protector ring, seal, and other parts carefully to prevent damage. A new gasket (key 15) is required whenever the seal protector ring (key 3) (figure 11) is removed.

Flow ring construction does not use a seal, shims, or spring seal. Use this procedure to remove the seal protector ring from flow ring constructions, but disregard any instructions calling for the seal, shims, or spring seal.

Note

If the valve is equipped with a bonding strap assembly (figure 3), re-install the assembly.

5. Reconnect the actuator and lever in accordance with the orientations that were noted in step 3 of the disassembly procedures. If necessary, use figure 23 to identify the correct index marks.

6. Refer to the appropriate actuator instruction manual to complete actuator assembly and adjustment.

7. When the control valve is in operation, check the packing follower for leakage and retighten the packing follower nuts (key 20) as necessary.

Replacing the Ball Seal

Disassembly

Perform this procedure if the control valve is not shutting off properly or if seal inspection is necessary. If you find upon inspection that the ball, shaft, or bearings need to be replaced, use this procedure to remove the ball seal. Then, proceed to the Bearing and Ball Maintenance procedures. Then, return to this procedure and begin with the assembly of the ball seal steps.

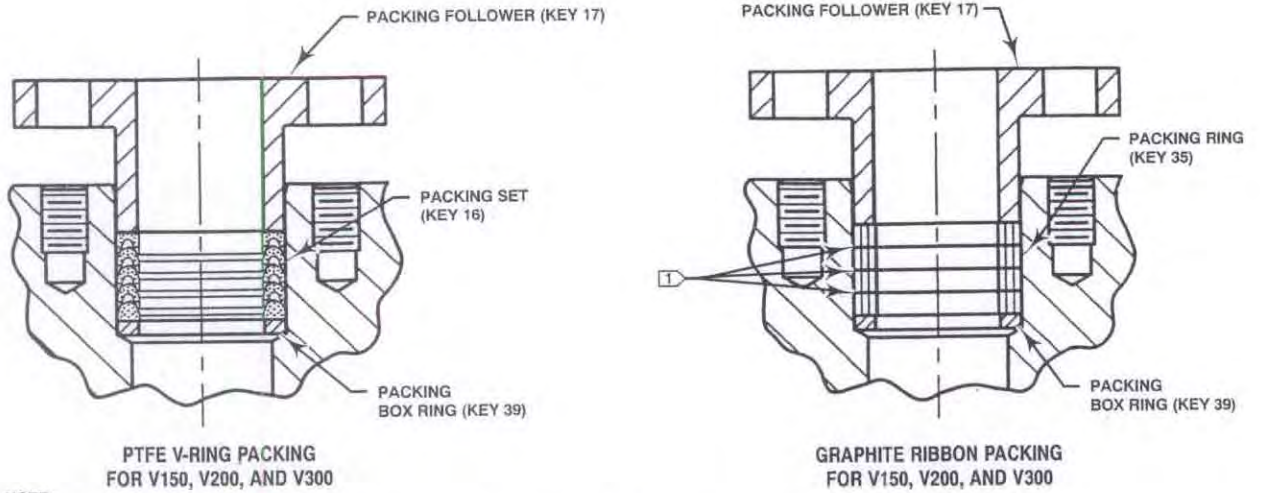
While the actuator/valve assembly must be removed from the pipeline, the actuator may remain mounted on the valve as you replace the ball seal.

Key numbers are shown in figures 24, 25, and 26, unless otherwise indicated. Ball Seal assembly details (with key numbers) are also shown in figures 8, 9 and 10.

WARNING

Perform the steps in the WARNING at the beginning of the Maintenance section of this manual.

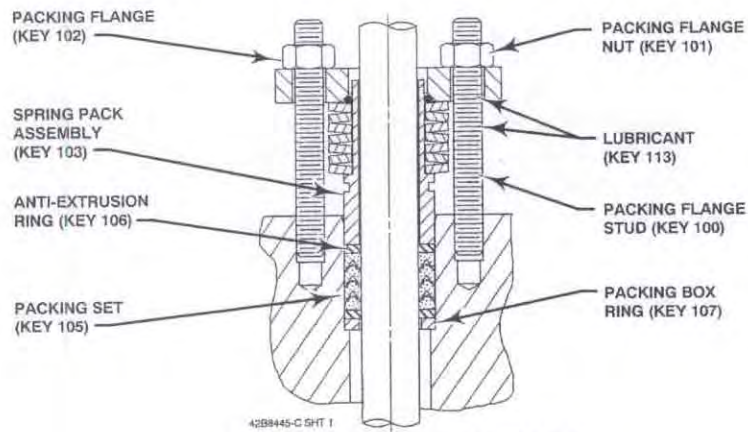
1. Remove line bolting, remove the control valve from the pipeline, and place the valve on a flat surface with the seal protector ring facing up. Carefully rotate the ball to the open position.
2. Remove protector ring screws and washers (keys 21 and 22). Carefully remove the seal protector ring and gasket (keys 3 and 15). (For flow ring constructions, go to step 4.)
 - a. **For a Fisher TCM seal**, remove the seal (key 11) from the valve body. For 1-, 1.5, and 2-inch valves, also remove the backup ring (key 14, figure 8) from the valve body.
 - b. **For a flat metal seal**, remove the spring seal, seal, and shims (keys 13, 11, and 12). (Note: It may be necessary to re-use some of the original shims when reassembling the flat metal seal.)



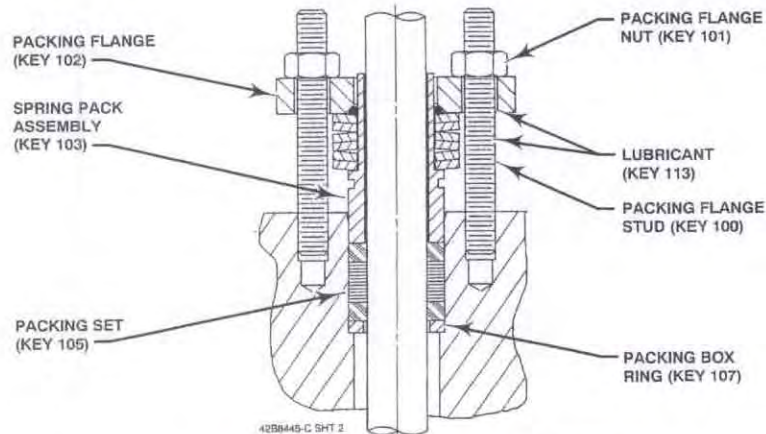
NOTE:
T INCLUDES ZINC WASHERS (KEY 36) FOR GRAPHITE RIBBON PACKING ONLY.

28B5170 / DOC

STANDARD PACKING



ENVIRO-SEAL PTFE PACKING SYSTEM



ENVIRO-SEAL GRAPHITE PACKING SYSTEM

B2412-1 / IL

Figure 5. Packing Arrangements

Vee-Ball Valves

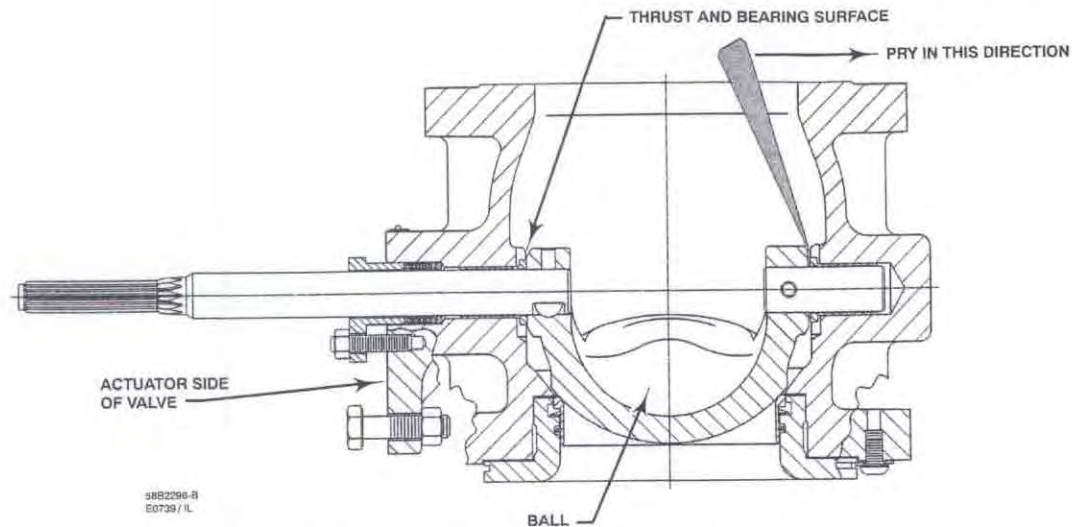


Figure 6. Typical Vee-Ball Valve Showing Pry Bar

c. For an HD metal seal or a high temperature HD metal seal, once the protector ring has been removed from the valve, push the metal seal (key 11) out of the seal protector ring (key 3). Remove the wave spring (key 13), and on the HD metal seal, the radial seal (key 37).

Note

The high temperature HD metal seal also has a piston ring (key 133) that will need to be removed. It will be in two pieces for the 1, 1.5 and 2-inch valves, and one piece with a break in it for the 3- through 12-inch valves.

- It might be necessary to remove the HD metal seal by carefully tapping it with a soft punch and hammer. Take care not to damage the seal protector ring.
- **3- through 12-inch valves**, if the seal is difficult to push out, it is recommended that a seal removal plate be used to press the HD metal seal out of the seal protector ring. Refer to figure 12 for dimensions of the seal removal plate.
- **10- and 12-inch valves with an attenuator only**: Remove the retaining ring (key 41) in the seal protector ring. This retaining ring is an octagonal-shaped support wire. To remove the retaining ring, find one of the free ends of the ring. Use a

screwdriver or similar tool to pry inward and upward until the ring is removed.

3. Inspect the gasket and sealing surfaces on the valve body (key 1 or 1A), the seal protector ring (key 3), Vee-ball (key 2), and the retaining ring (key 41 for 10- and 12-inch valves with an attenuator only). Be sure the sealing surfaces are not damaged.
4. If replacement of the ball, shafts (keys 6 or 9), or bearings (key 10) is needed, proceed to the Bearing and Ball Maintenance procedure. If only the seal is to be replaced, proceed to the Assembly steps below.

Assembly

Refer to figures 8, 9, and 10 for key number locations during seal installation. Valve key number locations are shown in figures 24, 25, and 26.

1. Thoroughly clean all parts that are to be re-used and obtain replacement parts. Be sure that all sealing surfaces are in good condition without scratches or wear. If the valve has been installed between line flanges and the flange studs and nuts have been tightened, always replace the gasket (key 15) with a new gasket.
2. To help ensure correct side-to-side centering of the ball (key 2) on the seal (key 11), make sure the ball is closed while you install the seal or flow ring and seal protector ring. Insert a screw driver, pry bar, or similar tool between the lower ear of the ball and the valve body (see figure 6).

Instruction Manual

Form 5290
September 2004

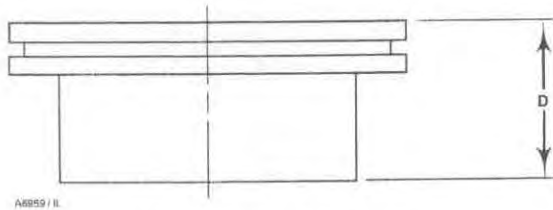
Vee-Ball Valves

Valve Size, Inches	Construction (1)	TCM Seal "D"	HD Seal "D"	Flow Ring "D"
mm				
1	New	37.6	44.7	39.6
	Old	25.1	33.0	26.9
1.5	New	39.1	44.5	40.9
	Old	27.4	32.8	29.2
Inches				
1	New	1.48	1.76	1.56
	Old	0.99	1.30	1.06
1.5	New	1.54	1.75	1.61
	Old	1.08	1.29	1.15

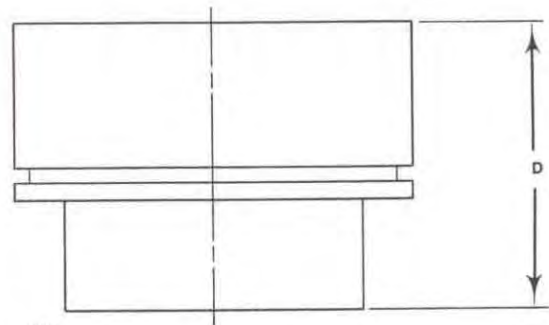
1. See the Note on page 14 of this Instruction Manual.

Valve Size, Inches	Construction (1)	TCM Seal "D"	HD Seal "D"	Flow Ring "D"
mm				
1	New	63.0	70.1	65.0
	Old	50.5	58.4	52.3
1.5	New	89.9	95.3	91.7
	Old	78.2	83.6	80.0
Inches				
1	New	2.48	2.76	2.56
	Old	1.99	2.30	2.06
1.5	New	3.54	3.75	3.61
	Old	3.08	3.29	3.15

1. See the Note on page 14 of this Instruction Manual.



ISA S75.04 FACE-TO-FACE VALVE



CLASS 150 ANSI B16.10 (SHORT) FACE-TO-FACE VALVE

Figure 7. 1 and 1.5 Inch Seal Protector Ring Measurements

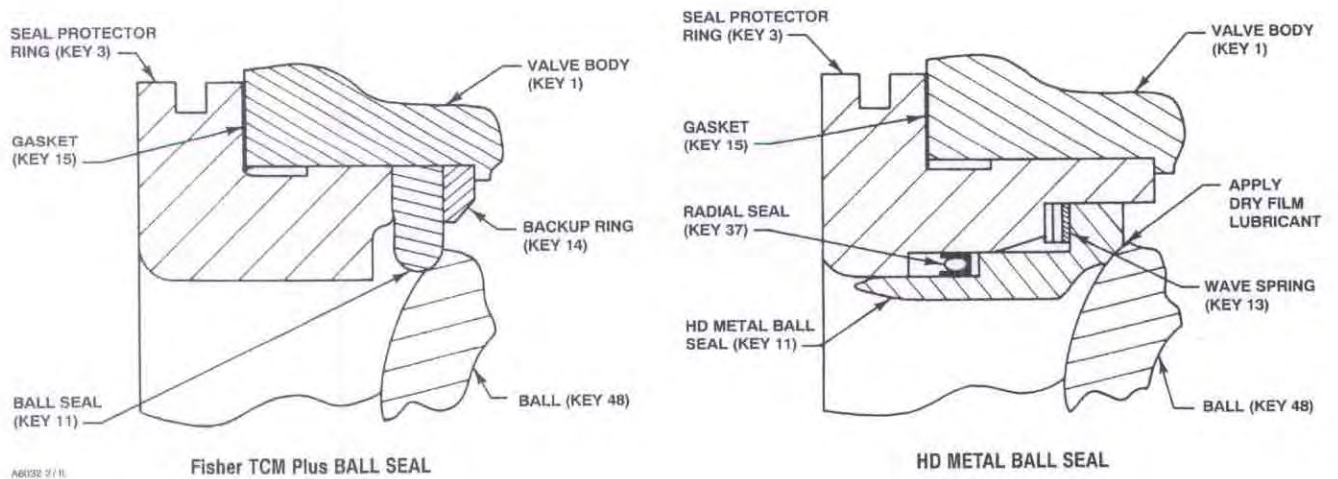
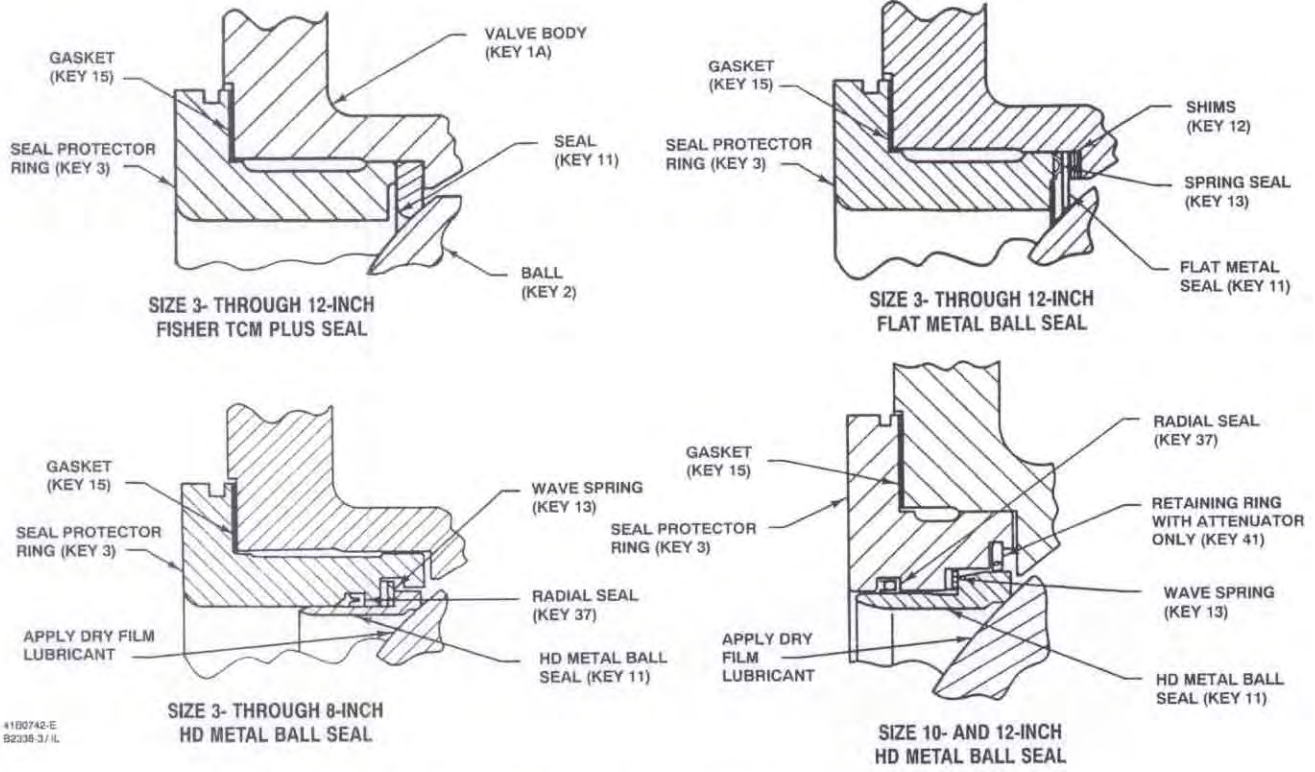


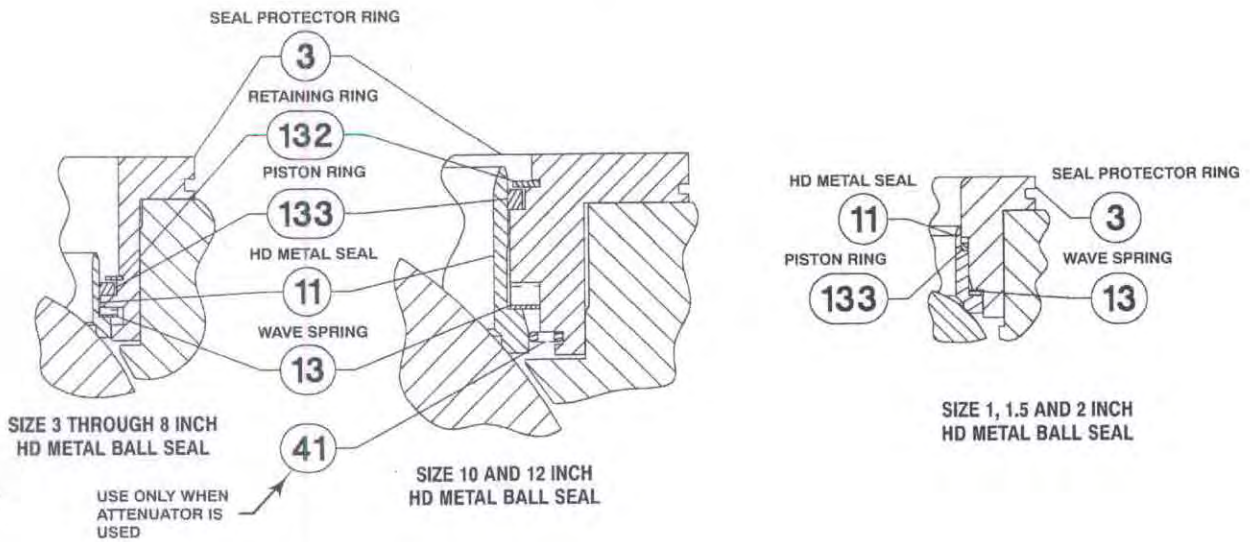
Figure 8. Ball Seal Assembly for Size 1, 1.5, and 2-Inch Valves

Vee-Ball Valves



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92238-3/IL

Figure 9. Ball Seal Assembly for Size 3 through 12-inch Valves



280962-A
E0261/IL

Figure 10. High Temperature HD Metal Seal Details

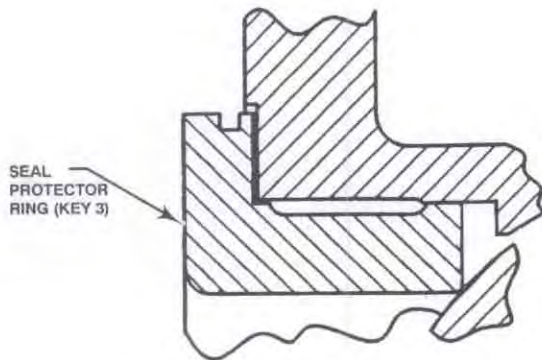


Figure 11. Seal Protector Ring

VALVE SIZE, INCHES	DIMENSION A	
	Minimum-Maximum, mm	Minimum-Maximum, Inches
3	75.9-76.2	2.990-3.000
4	95.0-95.3	3.740-3.750
6	126.7-127.0	4.990-5.000
8	158.5-158.8	6.240-6.250
10	212.5-212.7	8.365-8.375
12	263.3-263.5	10.365-10.375

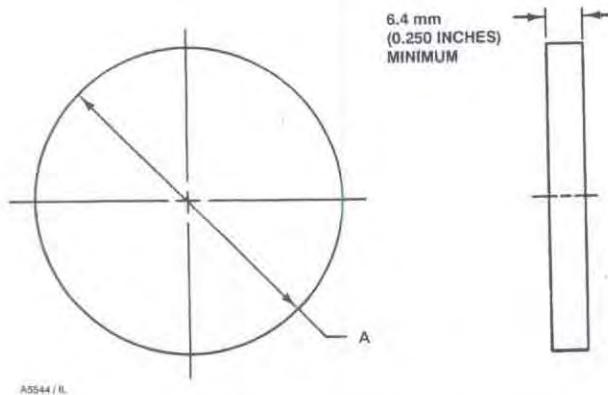


Figure 12. HD Seal Removal Plate Dimensions

3. Use the pry to move the ball tightly against the bearing on the actuator side of the valve. Be careful, excessive force may damage the ball. Keep the ball in that position until you have completed seal or flow ring installation. Check the ball's position periodically, and re-center if necessary, during lever assembly and packing adjustments.

WARNING

The Vee-Ball closes with a shearing, cutting motion, which could result in

personal injury. To avoid injury or property damage, keep hands, tools, and other objects away from the Vee-Ball while stroking the valve.

4. Install the seal.

CAUTION

Due to the Vee-ball shape, take care to never completely rotate either the front skirted edge or the circular back edge of the ball out of the ball seal as the seal could be damaged.

Installing Fisher TCM Plus or Extra ball seals:

a. **1-, 1.5, and 2-inch valves:** Install the backup ring (key 14). Install the Fisher TCM seal (key 11) into the valve body. Refer to figure 7.

- Install the gasket (key 15) on the valve body.

- Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.

b. **3- through 12-inch valves:** Install the Fisher TCM seal (key 11) into the valve body.

- Install the gasket (key 15) on the valve body.

- Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.

Installing flat metal seals:

a. Install 12 shims in the valve and install the flat metal seal on top of the shims.

b. Install the spring seal (key 13) on the flat metal seal (key 11) with the convex side of the spring seal facing the ball.

c. Install the seal protector ring, and install the protector ring screws and washers (keys 21 and 22). Tighten the screws.

d. Add or remove shims under the ball seal as necessary to obtain zero ball seal deflection as accurately as possible.

Note

Zero ball seal deflection for a flat metal seal is the point at which the addition

Vee-Ball Valves

of one 0.13 mm (0.005 inch) thick shim causes contact between the ball and ball seal to be broken. Hold the parts tightly together when determining zero deflection, or improper zero deflection might result.

e. After zero deflection is reached, remove the seal protector ring, spring seal, seal and 4 shims. Final assembly of the control valve should not exceed a maximum of 9 shims for zero deflection. If more than 9 shims are required, contact your Fisher sales office.

f. Install the gasket (key 15) on the valve body.

g. Install the seal protector ring (key 3) into the valve body. Now go to step 5 in this procedure.

Installing HD metal seals:

Note

The older and newer designs of the 1- and 1.5 inch seal protector ring are functionally the same, but are different lengths and not interchangeable. All 1- and 1.5 inch sizes of Design V150 and V300 valves are the newer design. The change in seal protector ring length occurred in the 1992/1993 timeframe and affects 1- and 1.5 inch Design V200 valves only. To determine whether you have the older or newer design, measure the length of the seal protector ring (key 3, figure 26) from its pipeline flange mating surface to its opposite end. Compare your measurement to those listed in figure 7.

a. **For 1-, and 1.5 inch valves:** The older and newer designs of the 1- and 1.5 inch seal protector rings are functionally the same, but are different lengths and not interchangeable. Refer to figure 7 for protector ring dimensions.

- Install the wave spring (key 13) onto the ball seal.

- Lubricate and install the radial seal (key 37) onto the ball seal (key 11). Make sure the open side of the radial seal faces away from the ball.

- Push the ball seal assembly into the seal protector ring (key 3).

- Go to step 5 in this procedure.

b. For all 3- through 8-inch valves and 10- and 12-inch valves without attenuator:

- Lubricate and install the radial seal (key 37) into the appropriate groove in the seal protector ring making sure the open side of the radial seal faces away from the ball.

- Install the wave spring (key 13) into the seal protector ring (key 3).

- Install the HD metal seal (key 11) into the seal protector ring (key 3), past the radial seal. While pushing it past the radial seal, make sure the HD metal seal is level. Go to step 5 in this procedure.

c. For 10- and 12-inch valves with attenuator:

- Lubricate the radial seal with Lubriplate, or equivalent, and install the radial seal (key 37) into the appropriate groove in the seal protector ring making sure the open side of the radial seal faces away from the ball.

- Install the wave spring (key 13) into the seal protector ring (key 3).

- To install the retaining ring (key 41), find one of the free ends of the ring. Insert the free end into the groove in the seal protector ring. Work around the ring, pressing it into the groove until the ring is completely in its groove.

- Install the HD metal seal (key 11) into the seal protector ring (key 3), past the radial seal. While pushing it past the radial seal, make sure the HD metal seal is level.

- The HD metal seal uses a retaining ring (key 41) for 10- and 12-inch sizes only. This retaining ring is an octagonal-shaped support wire. Go to step 5 in this procedure.

Installing high temperature HD metal seals:

a. **For 1-, 1.5 and 2-inch valves:** The older and newer designs of the 1- and 1.5 inch seal protector rings are functionally the same, but are

different lengths and not interchangeable. All part numbers in this manual are for the newer design. Refer to figure 7 for ring dimensions.

- Place the wave spring (key 13) on top of the HD metal seal (key 11).

- Break the piston ring (key 133) into two approximately equal pieces either by placing the ring over a pencil or similar object and applying pressure down-wards on the ring until the ring snaps. Be sure to match the broken ends together as you install it on the HD metal seal (key 11).

- Lay the HD metal seal (key 11) down on a flat surface and push the seal protector ring (key 3) into place. Make sure the seal is level. Go to step 5 in this procedure.

b. **For 3- through 8-inch valves:**

- Place the piston ring (key 133) and retaining ring (key 132) into the appropriate groove in the seal protector ring (key 3). The piston ring has one break in it; do **not** break it further.

- Lay the HD metal seal (key 11) down on a flat surface and push the seal protector ring (key 3) past the piston ring (key 133) and into place. Make sure the seal is level. Go to step 5 in this procedure.

c. **For 10- and 12-inch valves:**

- Place the piston ring (key 133) and retaining ring (key 132) into the appropriate groove in the seal protector ring (key 3). The piston ring has one break in it; do **not** break it further.

- Install the wave spring (key 13) into the seal protector ring (key 3).

- If the valve has an attenuator, install the retaining ring (key 41). The octagonal shaped support wire ring has two free ends. Place one of the free ends into the groove in the seal protector ring. Then starting at the inserted end, press the rest of the ring into the groove completely.

- Lay the HD metal seal (key 11) down on a flat surface and push the seal protector ring (key 3) past the piston ring (key 133) and into place. Make sure the seal is level. Go to step 5 in this procedure.

5. Install a replacement gasket (key 15) on the valve body (key 1 or 1A). Install the HD metal ball seal/seal protector ring assembly into the valve body (key 1 or 1A).

6. Install washers (or clips), and screws that clamp the seal protector ring to the valve body [keys 3, 21, and 22; the Design V200 valve uses clips (key 22) in place of washers].

7. If necessary, refer to the Packing Maintenance procedures to install the packing. Install the actuator using the Actuator Mounting procedures or to the appropriate actuator instruction manual.

HD Metal Seal Lubrication

To assist with break-in of the HD metal seals, it is recommended that the ball and seal be lubricated with Dow Corning 321 dry film lubricant or equivalent moly disulfide.

Bearing and Ball Maintenance



Before performing the steps in this section, observe the WARNING at the beginning of the Maintenance section on page 6.

3- through 12-Inch Valves

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the ball seal and valve packing are removed from the valve.

Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.

Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

Vee-Ball Valves

Table 3. Continuous Threaded Rod

Valve Size, Inches	Threaded Rod Thread Size	Thread Depth in Follower Shaft
3	0.25-20	0.5
4	0.25-20	0.5
6	0.25-20	0.5
8	0.3125-18	0.62
10	0.3125-18	0.62
12	0.3125-18	0.94

Disassembly

WARNING

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position at the bottom of the valve body cavity. Make sure the ball will not rotate.

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise indicated.

1. A taper key (key 4, figures 14, 24, 25 and 31) is used to connect the ball and drive shaft in 3- through 12-inch valves.
2. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.
3. Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

For tack welded taper keys, driving the taper key out of the ball ear will shear the tack welding.

4. Locate the small end of the taper key (key 4, see figures 14, 24, 25 and 31). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.
5. Pull the drive shaft (key 6) out of the actuator side of the valve body.
6. The ball will be free to move when both shafts are removed. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.

a. Unscrew the pipe plug (key 25) if one is installed. Use a punch to drive the follower shaft (key 9) into the center of the ball.

b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the ball. Refer to the table 3 for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.

7. Carefully remove the follower shaft and ball (key 2) from the valve body.

For 4-inch valves with attenuator, remove the ball/attenuator through the inlet of the valve. Taking hold of the follower shaft ear on the ball/attenuator, you must position the scalloped edge of the attenuator against the valve bore opening and then pivot, or roll, the ball/attenuator out of the valve body (see figure 18).

For 6-, 8-, 10-, and 12-inch valves with attenuator, remove the ball/attenuator through the outlet of the valve by carefully turning and manipulating the ball. The 6-, 8-, 10-, or 12-inch ball/attenuator will not come straight out of the valve body.

8. Remove the bearings (key 10) by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure.

- To remove the follower shaft bearings, use a blind-hole bearing puller similar to CG2545AB, which is made by Snap-On Tools. If you do not have such a tool, you can machine the bearing out.

9. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.
2. Install the replacement bearings (key 10) by hand. The bearing flanged end should touch the valve body.
3. **Installing the Vee-Ball:**

WARNING

The ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the

sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.

Note

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in the following applications:

- 3-inch valve without ball/attenuator
- 4- through 12-inch valves with ball/attenuator.

Carefully install the ball into the valve body cavity.

- For Vee-Ball with attenuator (sizes 4 through 12-inch valves), carefully install the ball into the valve body cavity. For 4-inch valves, install the ball/attenuator through the inlet of the valve. For 6-, 8-, 10-, and 12-inch valves, install the ball/attenuator through the outlet of the valve. Taking hold of the follower shaft ear on the ball/attenuator, you must position the scalloped edge of the attenuator against the valve bore opening and then carefully pivot, or roll, the ball/attenuator into the valve body (see figure 18).

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

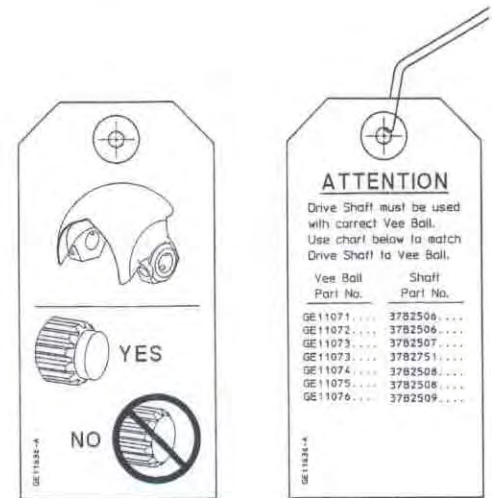
4. Installing the follower shaft (key 9):

- For 3-inch valves: The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

- For 4-inch and larger valves: Insert the follower shaft (key 9) through the ball, and into the valve body bearing (key 10).

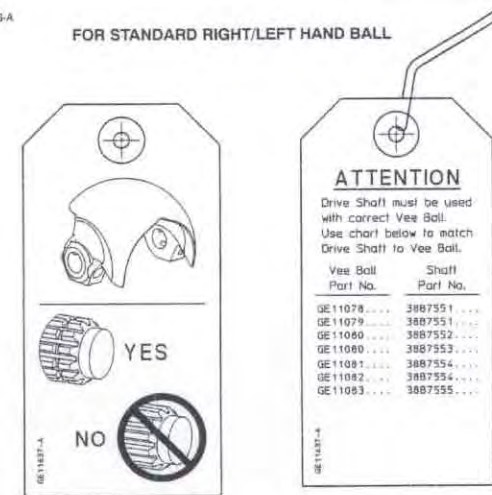
- For 4- through 12-inch valves with ball/attenuator: The follower shaft (key 9) should already have been inserted into the ball/attenuator before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

Then for all sizes, align the hole in the follower shaft with the holes in the ball. Insert the small end of the groove pin (key 7) into the hole in the ball and



GE11636-A

FOR STANDARD RIGHT/LEFT HAND BALL



GE11627-A

FOR OPTIONAL LEFT HAND BALL

Figure 13. Informational Tag

into the follower shaft. The pin will hold the parts in place while the drive shaft (key 6) is being installed.

5. Installing the Drive Shaft:

CAUTION

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the

Vee-Ball Valves

shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.

CAUTION

Make sure the drive shaft is free of oil or grease, otherwise the taper pin or taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

- a. Insert the drive shaft into the valve body bearing (key 10), and into the ball ear. Align the hole in the drive shaft with the holes in the ball.
- b. Insert the taper key into the ball and drive shaft as shown in figure 14.

• Installing the Taper Key

Current standard construction materials for all 3-through 12-inch valves require the taper key (key 4, figure 14) to be tack welded in place **after properly seating**, using the following procedure. Use standard welding preparations when preparing parts for reassembly.

CAUTION

Make sure the drive shaft (key 6) is free of oil or grease, otherwise the taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

6. Install the drive shaft (key 6) into the valve body through the ball and into the lower bearing.
7. Insert the taper key (key 4) into ball and drive shaft (keys 2 and 6) as shown in figure 14. The taper key inserts, with the flat side of the key, facing the drive shaft (key 6).

Table 4. Taper Key Minimum Depth

Valve Size, Inches	Minimum Depth To Drive Taper Key After Initial Solid Contact, mm (Inches)
3, 4, 6	4.8 (0.188)
8, 10, 12	5.6 (0.219)

Table 5. Taper Key Maximum Depth

Valve Size, Inches	Maximum Depth To Drive Taper Key After Initial Solid Contact, mm (Inches)
3, 4	7.1 (0.281)
6	7.9 (0.312)
8, 10	9.5 (0.375)
12	10.3 (0.406)

8. Using a flat end punch, drive the groove pin (key 7) into the ball ear and follower shaft until it is flat with the ball ear surface. Stake both ends of the pin hole with a center punch to ensure the groove pin does not come out.

9. Using a flat end punch, drive the taper key (key 4) into the ball ear and drive shaft (key 6) until solid, heavy contact is obtained between the key and shaft.

10. Measure the position of the taper key head.

11. Drive the taper key in further using the minimum distance shown in table 4.

12. Inspect the ball/shaft taper key connection to verify that the taper key spans the entire shaft flat width. If not, the taper key must be driven in further until this condition is satisfied. However, do not exceed the maximum depths shown in table 5.

Note

All valve taper keys are tack welded, except titanium.

13. When the above conditions are met, tack weld the taper key (key 4) to the ball ear on the head end of the key (see figures 24 and 25). Use a:

- 0.125 inch diameter weld on 3- through 6-inch valves,
- 0.1875 inch diameter weld on an 8- through 10-inch valves, and
- 0.25 inch diameter weld on 12-inch valves.

For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

1- through 2-Inch Sizes

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the

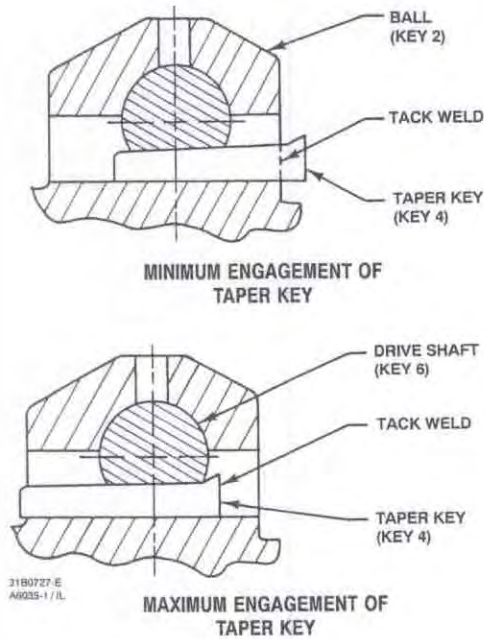


Figure 14. Taper Key Installation

ball seal and valve packing are removed from the valve.

Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.

Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

Disassembly

WARNING

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position at the bottom of the valve body cavity. Make sure the ball will not rotate.

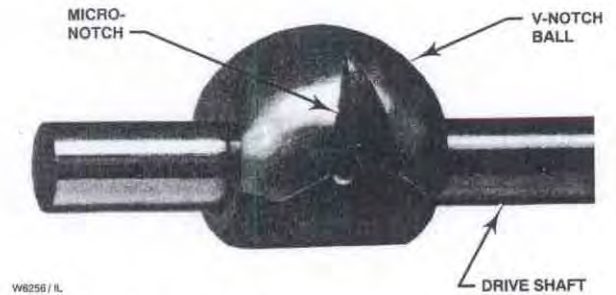


Figure 15. Typical Metal Micro-Notch™ Ball and Drive Shaft

Key numbers in this procedure are shown in figures 24, 25, and 26, unless otherwise indicated.

1. A taper pin (key 4, figure 20) is used in the 1-, 1.5, and 2-inch size valves, and in the 1-inch size Metal Micro-Notch valve (figure 21).

2. **Ceramic Micro Notch ball constructions:** A screw (key 4, figure 22) is used to attach the ball to the drive shaft.

a. The parts are held together with a screw and an adhesive. Remove the screw (key 4) and separate the drive shaft from the ball. In some cases, a small amount of heat can be applied to help loosen the adhesive. However, excessive heat may damage other valve component parts.

b. Once the shafts have been removed from the valve body, the ball may fall. To avoid personal injury or damage to the sealing surfaces, provide support for the ball to prevent it from falling as the shaft(s) are being removed.

3. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.

4. Unscrew the pipe plug (key 25). (The pipe plug is optional and may not be available.)

5. Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

Note

All 1-inch Micro-Notch constructions use a one piece shaft. They do not have a follower shaft.

Vee-Ball Valves

Table 6. Continuous Threaded Rod

Valve Size, Inches	Threaded Rod Thread Size	Thread Depth in Follower Shaft
1	0.25-20	0.5
1.5	0.25-20	0.5
2	0.25-20	0.5

VALVE SIZE, INCHES	NEW - WITHOUT THRUST WASHER		OLD - WITH THRUST WASHER	
	mm	inches	mm	inches
1	32.9	1.29	31.8	1.25
1.5	48.6	1.91	47.7	1.88
2	64.5	2.54	63.4	2.50

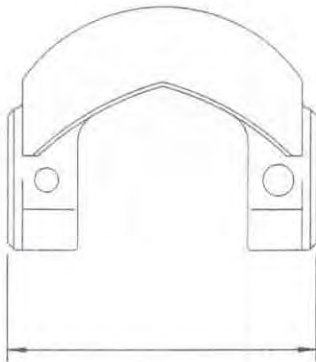


Figure 16. Dimensions of Ball in Ball / Shaft Assembly

6. Locate the small end of the taper key (key 4, figure 14). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.

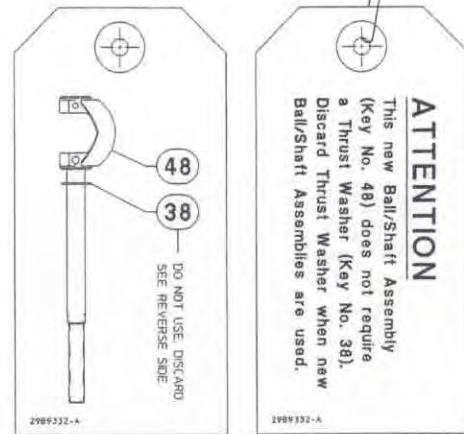
7. Pull the drive shaft (key 6) out of the actuator side of the valve body.

Note

The new ball/shaft assembly (key 48) does not require a thrust washer (key 38) in valves ordered after November 01, 2001.

Discard the thrust washer in valves ordered prior to this date when new ball/shaft assemblies are used as spare parts.

Figure 17 shows the informational tag that is attached with the new ball/shaft



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Figure 17. Informational Tag

assembly when shipped as a spare part. Refer to figure 16 for dimensions of the ball in the ball/shaft assembly.

8. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.

a. If a pipe plug (key 25) is installed, use a punch to drive the follower shaft (key 9) into the center of the ball.

b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the ball. Refer to the table 6 shown below for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.

9. **Remove the ball** (key 2) by carefully removing the follower shaft and ball from the valve body.

10. **Remove the bearings** (key 10) by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure.

11. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.

2. **Install bearings** (key 10) by hand. The bearing flanged end should touch the body.

3. **Installing the ball (key 2):**

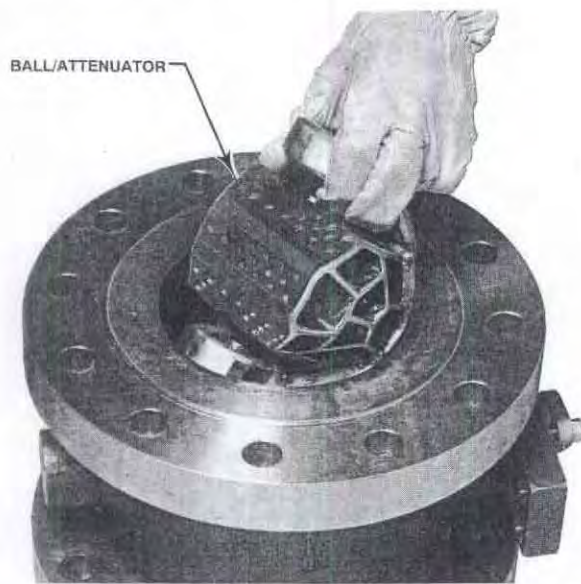


Figure 18. Ball/Attenuator Installation and Removal Method

WARNING

The Vee-Ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.

Note

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in a 3-inch valve without ball/attenuator

Carefully install the ball into the valve body cavity.

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

4. Installing the follower shaft (key 9):

- **For 1- through 2-inch valves:** The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

Note

All 1-inch Micro-Notch constructions use a one piece shaft. They do not have a follower shaft.

5. Installing the Drive Shaft for Valves with Taper Pins

CAUTION

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.

CAUTION

Make sure the drive shaft is free of oil or grease, otherwise the taper pin will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

6. Insert the drive shaft into the valve body bearing (key 10), and into the ball ear (or ball, for Micro-Notch constructions). Align the hole in the drive shaft with the holes in the ball.

Note

There is an indicator hole drilled in all Micro-Notch balls. This indicator hole must be oriented closest to the follower end of the ball/shaft assembly. See figure 19.

7. Insert the taper pin into the ball and drive shaft as shown in figures 20 and 21. The small end of the taper pin must be inserted into the larger hole side of the ball ear (or ball, for Micro-Notch constructions), and into the large hole side of the drive shaft.

Vee-Ball Valves

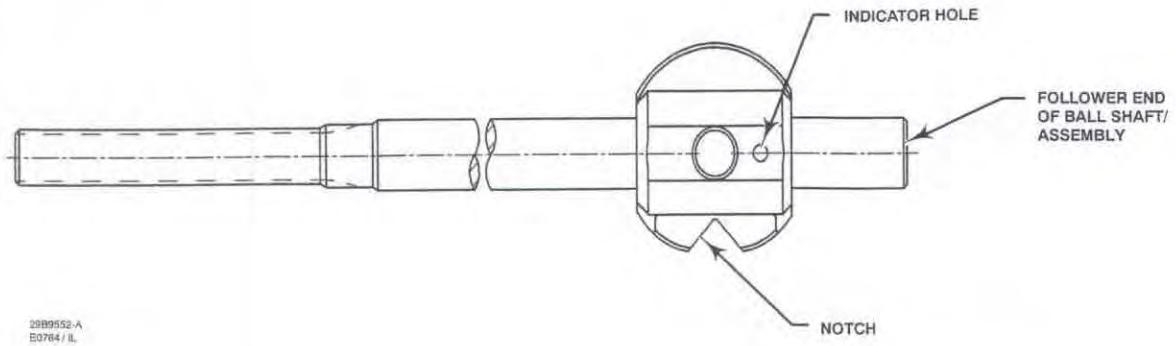


Figure 19. Location of Indicator Hole in Micro-Notch Vee-Balls

Note

The taper pin will not fit correctly if inserted in the wrong direction through the ball ear (or ball, for Micro-Notch constructions) or through the drive shaft. Make sure the drive shaft and ball ear (or ball, for Micro-Notch constructions) are in the correct orientation for installing the pin.

- Installing Taper Pins in 1-, 1.5, and 2-inch Valves

Note

For 1-, 1.5, and 2-inch valves, the taper pins (figure 20) do not require welding.

Using a flat-end punch, drive the taper pin into the ball ear (or ball, for Micro-Notch constructions) and drive shaft until solid heavy contact is felt. Make sure the taper pin spans the width of the ball.

Using a flat end punch, drive the groove pin (key 7) into the ball and follower shaft until it is flat with the ball surface.

Installing the Drive Shaft in VTC Ceramic Vee-Ball Valves

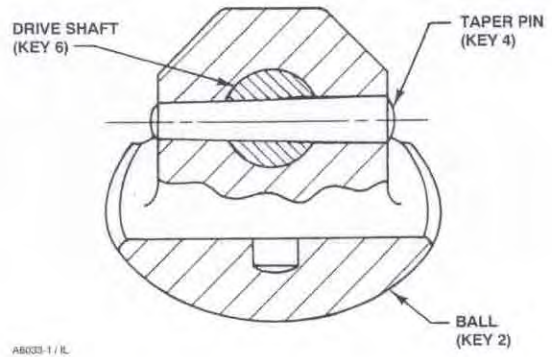


Figure 20. Taper Pin Installation for Design V150, V200, and V300 Sizes 1, 1.5, and 2-Inch Valves.

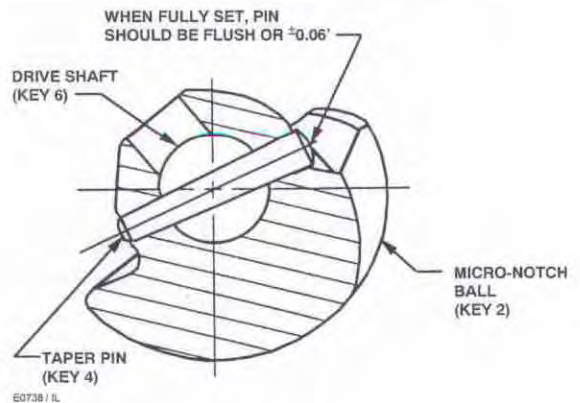


Figure 21. Taper Pin Installation for Design V150, V200, and V300 Size 1-Inch Valves with Micro-Notch Ball Construction

CAUTION

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned

with the slash mark, the valve will not function correctly and seal damage may result.

Valves with 1-inch ceramic micro-notch balls use a screw with a threaded valve shaft to connect the ball to the shaft. An adhesive is used to lock the screw in the valve shaft (keys 4 and 6, figure 22).

Note

There is an indicator hole drilled in all Micro-Notch balls. The orientation of this hole in the ceramic Vee-Ball is to the right of the screw in the ball, and must be located closest to the follower end of the ball/shaft assembly. See figures 19 and 22.

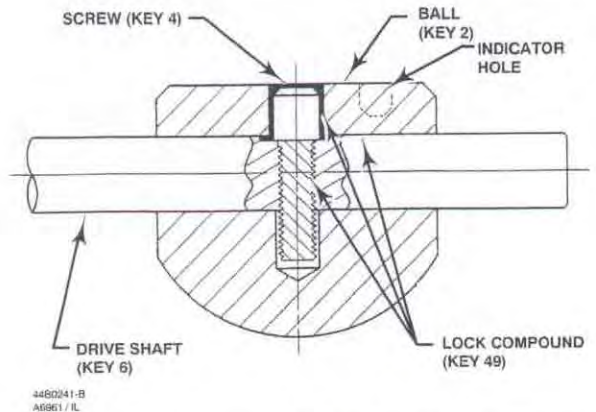


Figure 22. Screw Installation for Design V200, Size 1-Inch Valves with VTC Ceramic Micro-Notch Ball Construction

WARNING

Avoid personal injury and property damage from ignition of process fluid caused by sparks from ceramic trim.

Do not use ceramic trim where the process fluid is unstable or if it is an explosive mixture (such as ether and air).

Within the valve body:

8. The threaded hole in the shaft, the screw and screw clearance hole in the ball must be free of oil and grease before applying an activator.
9. Apply Loctite Depend Activator 7387 to threaded hole, screw and ball clearance hole. Assemble the ball onto the shaft while aligning threaded shaft hole within the ball clearance hole.
10. The flat on the shaft must be oriented so that the head of the cap screw seats on the flat.
11. Apply 5 drops of Loctite Depend 330 into the hole in the ball.
12. Thread the screw into the shaft tightening it to 9.2 N•m (81 in•lbs) torque. Remove excess adhesive, Allow four hours to cure fully before continuing with assembly.

For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

Actuator Mounting

Use the appropriate actuator instruction manual, this section of this manual, and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

1. To help ensure correct centering of the Vee-Ball (key 2) on the seal (key 11), be sure the ball is closed when mounting the actuator (for applications other than Spring Return Fail-Open).
2. Clean the valve shaft and actuator lever splines to be sure the actuator lever will slide on easily. Only drive the lever in if absolutely necessary.
3. Carefully wedge the ball solidly against the actuator-side bearing, using a screwdriver or similar tool inserted between the lower ear of the ball and the valve body. This will center the ball. See figure 6.
4. Keep the wedge in place while installing the lever, if necessary. Remove the wedge after you have clamped the actuator lever on the valve shaft and have connected the lever to the actuator piston rod or diaphragm rod.

Determining Mounting Position

The actuator can be either right or left-hand mounted, with the actuator on the right or left side when viewed from upstream (see figure 23).

The Series B Vee-Ball, sizes 4- through 12-inch with attenuator, and the 1-inch micro-notch Vee-Ball have one V-notch. For **right-hand mounting (standard)**, the ball will be in the top of the valve body when the valve is open and the shaft is horizontal. In this position the ball rotates CCW to Close. For **left-hand mounting (standard)**, the ball will be in the bottom of the valve body when the valve is open

Vee-Ball Valves

and the shaft is horizontal. In this position the ball rotates CCW to Close. An optional ball for **left-hand mounting**, which rotates into the top of the valve body when the shaft is horizontal, is also available. In this position the ball rotates CW to Close.

The 1- through 2-inch has two notches, and can be rotated in either direction.

Determining Closed Position

1. The valve must be removed from the line to check the position of the ball.



WARNING

The Vee-Ball closes with a shearing, cutting motion. To avoid personal injury, keep hands, tools, and other objects away from the ball while stroking the valve.

2. Rotate the ball to the closed position.
3. Position the ball in the proper location

For Series B:

- When viewed from the valve body inlet, the ball is in the proper position when the flat spot on the top of the ball is exactly in the center of the seal package.

Make a copy of the centering template in figure 28 out of a suitable stiff material. Place the centering template in the opening at the seal (See figure 27). Find the center of the template and make sure the spot on the ball is centered directly below it.

For valves with attenuators and 1-, 1.5, and 2-inch sizes: Follow one of the procedures below:

- When viewed from the valve body inlet, the ball is in the proper position when both V-notches of the ball are centered between the machined diameter of the ledge that supports the seal.

- If the ball has a spot machined on the top, align that spot to the exact center of the seal cavity.

4. Adjust the actuator linkage as described in the appropriate actuator instruction manual until the ball is centered in the closed position. A line is stamped on the actuator end of the drive shaft (see figure 23) to indicate the ball position.

Use the appropriate actuator instruction manual and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

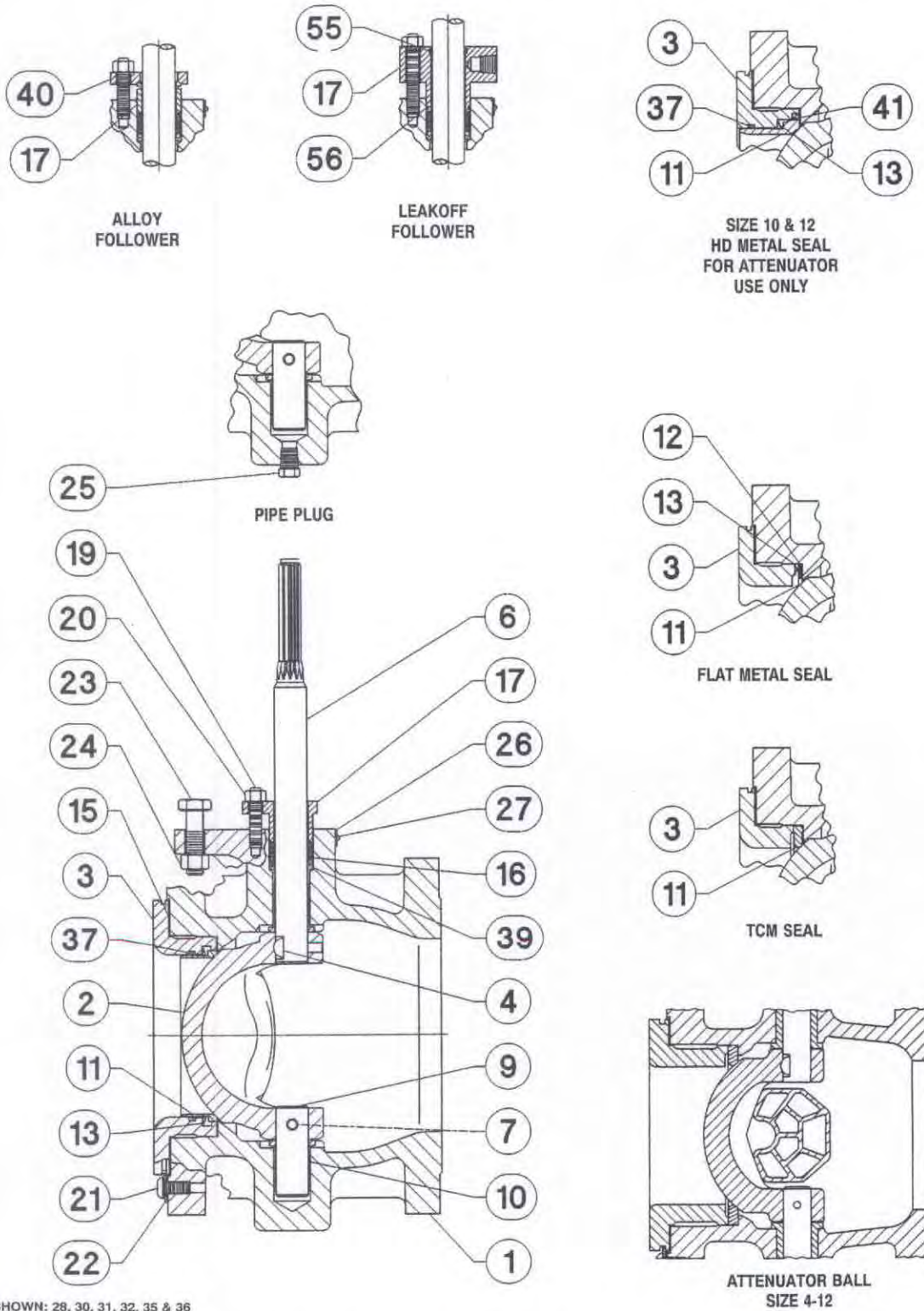
The Micro-Notch ball closed position is approximately 5 degrees closed from the first point of flow. This establishes the zero degree position for the ball.

ACTUATOR		VALVE OPEN	ACTUATOR POSITION			
MOUNTING	STYLE		1	2	3	4
(STANDARD) RIGHT-HAND	STYLE A PUSH DOWN TO CLOSE					
	STYLE B PUSH DOWN TO OPEN					
(STANDARD) LEFT-HAND	STYLE C PUSH DOWN TO OPEN					
	STYLE D PUSH DOWN TO CLOSE					
(OPTIONAL) ⁽²⁾ LEFT-HAND	STYLE C PUSH DOWN TO CLOSE					
	STYLE D PUSH DOWN TO OPEN					

NOTE:
1. ARROW ON LEVER INDICATES DIRECTION OF ACTUATOR THRUST TO CLOSE VALVE.
2. THE OPTIONAL LEFT-HAND ORIENTATION IS NOT AVAILABLE FOR MICRO-NOTCH VEE-BALLS.

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Figure 23. Index Marks for Actuator Lever Orientation for 1- through 12-inch Valves with or without Attenuator



PARTS NOT SHOWN: 28, 30, 31, 32, 35 & 36
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Figure 24. Design V150 or V300 Size 3- through 12-inch Valve Assembly
(Details are typical for Design V200, except Design V200 does not have flanges).

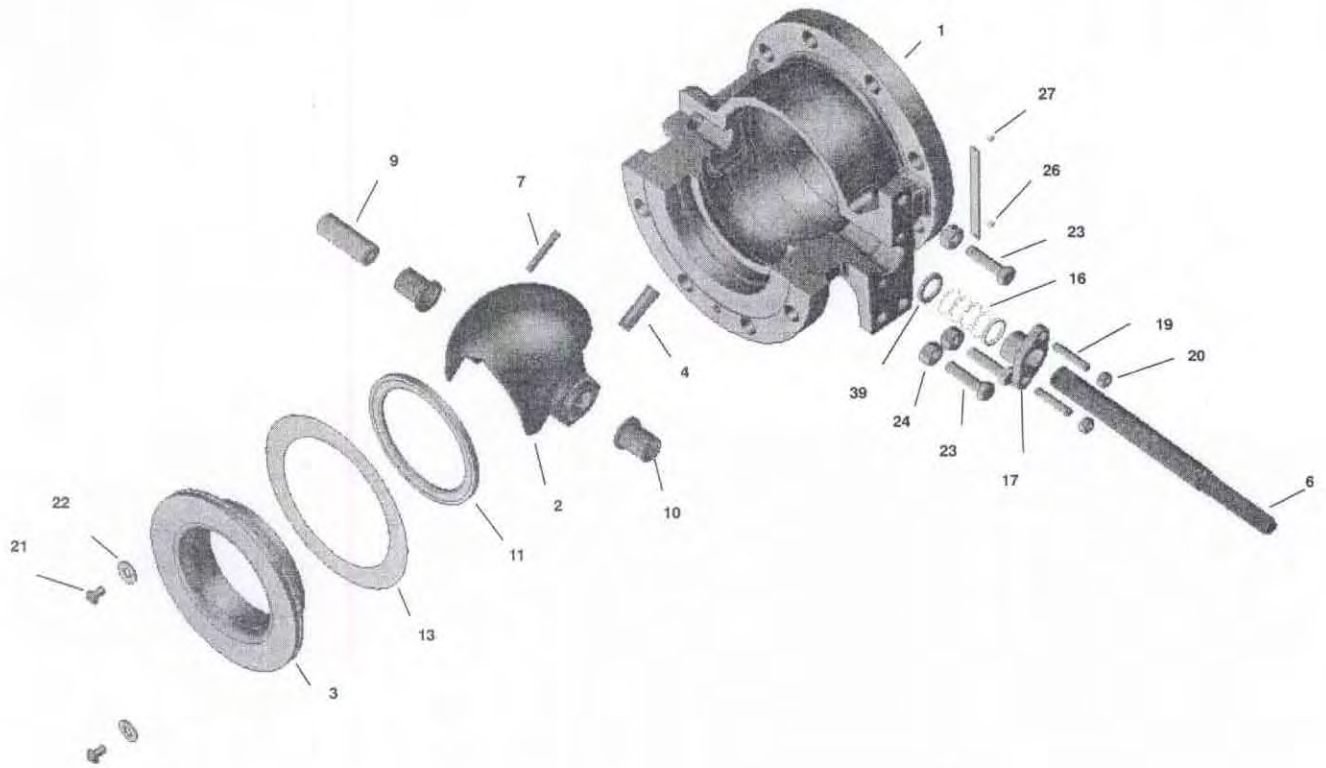
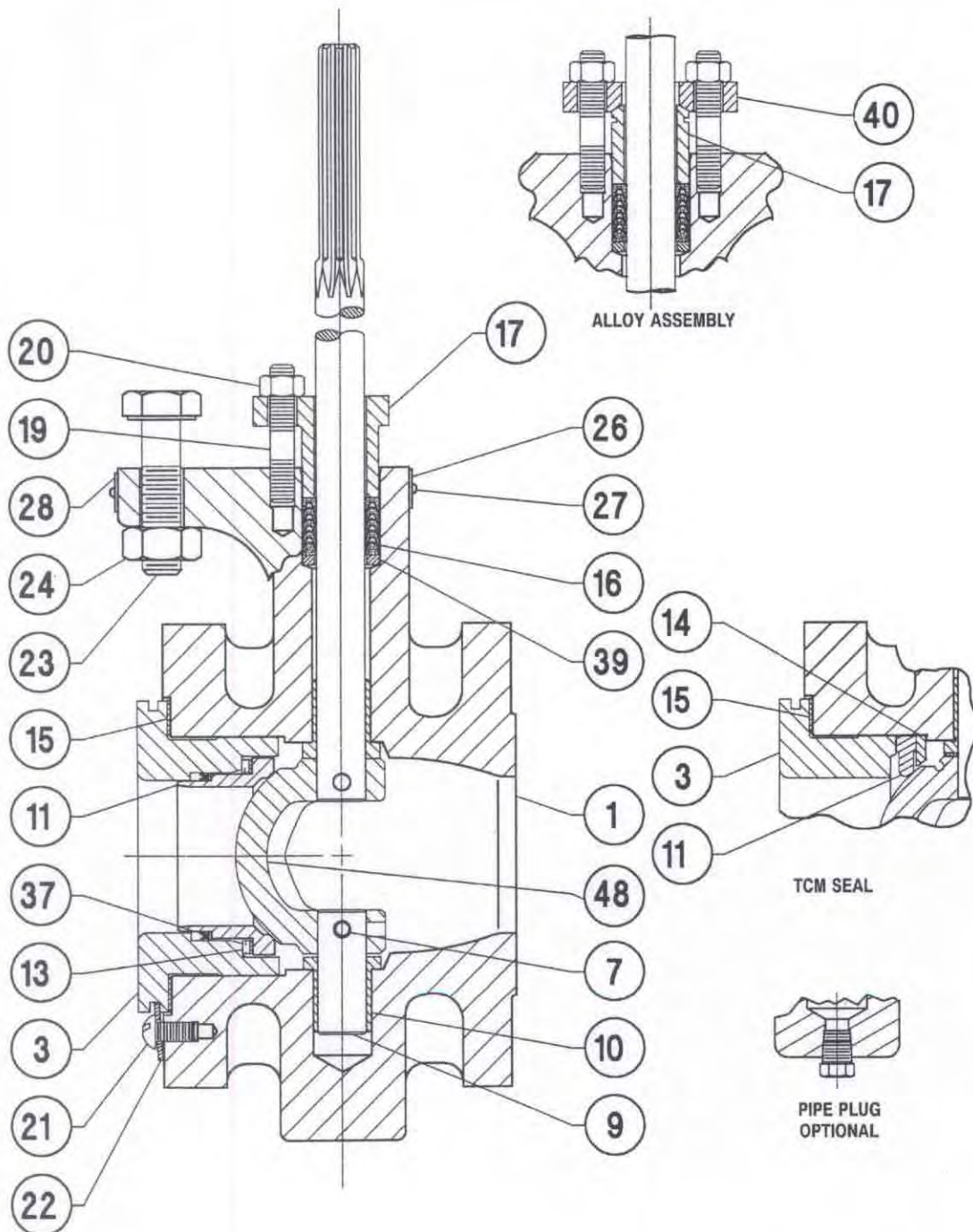
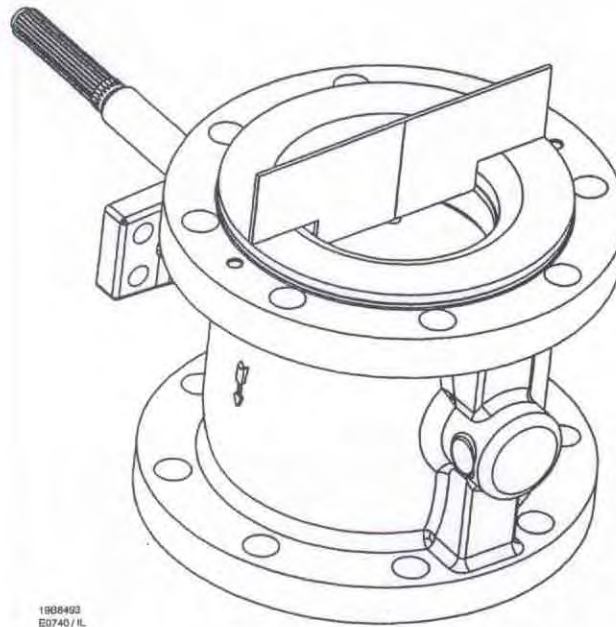


Figure 25. Exploded View, Design V150 and V300 Sizes 3- through 12-inch without Attenuator Assembly.



NOTE:
PARTS NOT SHOWN: 30, 31, 32, 33, 35 & 36
4482228-B / DOC

Figure 26. Design V150 or V300 Size 1, 1.5, and 2-Inch Valve Assembly
(Details are typical for Design V200, except Design V200 does not have flanges)

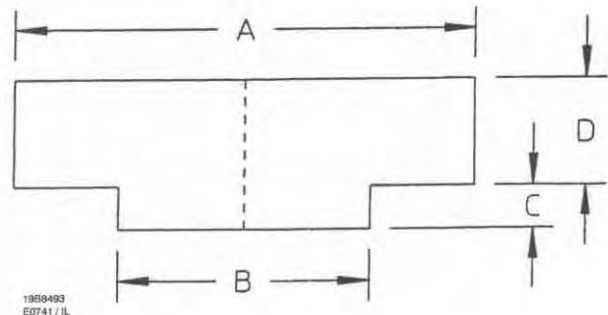


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Figure 27. Centering Template in Use

VALVE SIZE, INCHES	A (FOR ANSI VALVES)	A (FOR DIN VALVES)	B ⁽¹⁾	C ⁽¹⁾ (ISA S75.04)	C (ASME B16.10 Short ⁽²⁾)	D ⁽¹⁾
mm						
1	63	68	19	35	61	25
1.5	82	88	28	34	85	25
2	102	102	38	31	85	25
3	127	138	63	24	62	38
4	157	157	82	36	71	44
6	216	212	117	21	59	51
8	270	268	139	12	61	57
10	324	320	203	2	35	60
12	381	378	254	2	20	63
Inches						
1	2.50	2.68	0.75	1.40	2.40	1.00
1.5	3.25	3.46	1.12	1.34	3.34	1.00
2	4.02	4.02	1.50	1.22	3.34	1.00
3	5.00	4.55	2.50	0.94	2.44	1.50
4	6.19	6.19	3.25	1.42	2.80	1.75
6	8.50	8.35	4.62	0.82	2.32	2.00
8	10.62	10.55	5.50	0.48	2.42	2.25
10	12.75	12.60	8.00	0.09	1.40	2.38
12	15.00	14.88	10.00	0.09	0.78	2.50

1. These dimensions are the same for ANSI and DIN valves.
2. Note that ASME B16.10 Short dimensions are actually longer than ISA S75.04 dimensions.



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Figure 28. Centering Template Dimensions

Vee-Ball Valves

Parts Ordering

A serial number is assigned to each valve and stamped on the nameplate. Always refer to the valve serial number when corresponding with your Fisher sales office regarding spare parts or technical information. When ordering replacement parts, also specify the complete 11-character part number from the parts kits or parts list information.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and might jeopardize worker and workplace safety.

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

Note

For the 2-inch Design V150 valve, this manual covers valves with serial numbers 12551183 and higher. Always reference the serial number of your valve when corresponding with your Fisher sales office.

Retrofit Kits

Retrofit Kits include parts to convert existing valves to HD metal ball seal construction. See following table.

HD Metal Ball Seal Retrofit Kits for ISA S75.04 Face-to-Face Valves

VALVE SIZE, INCHES		RETROFIT KIT NUMBER FOR HD METAL BALL SEAL	
For WCC Steel Seal Protector Ring		CF10SMnN (Nitronic 60) Seal Material	CD7MCuN (Alloy 255 Duplex SST) Seal Material
2 ⁽¹⁾		RV150X0R012	RV150XCR012
2 ⁽²⁾		RV150X0R152	RV150XCR152
3		RV150X0R022	RV150XCR022
4		RV150X0R032	RV150XCR032
6		RV150X0R042	RV150XCR042
8		RV150X0R052	RV150XCR052
10		RV150X0R062	RV150XCR062
12 ⁽³⁾		RV150X0R072	RV150XCR072
For CG8M (317 SST) Seal Protector Ring		CF10SMnN Seal Material	CD7MCuN Seal Material
2 ⁽¹⁾		RV150X0R082	RV150XCR082
2 ⁽²⁾		RV150X0R162	RV150XCR162
3		RV150X0R092	RV150XCR092
4		RV150X0R102	RV150XCR102
6		RV150X0R112	RV150XCR112
8		RV150X0R122	RV150XCR122
10		RV150X0R132	RV150XCR132
12 ⁽³⁾		RV150X0R142	RV150XCR142
Parts Included in Kit		Quantity in Kit	
Key No.	Description		
3	Seal Protector Ring	1	1
11	Ball seal	1	1
13	Wave spring	1	1
15	Gasket	1	1
21	Retainer screw	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾
22	Retainer washer	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾
37	Radial seal	1	1
41 ⁽⁵⁾	Retaining ring	1	1

1. V150's only for serial numbers below 12551183.
 2. V150's for serial numbers 12551183 and above. All V200's and V300's.
 3. Design V200 is not available in 12-inch sizes.
 4. A quantity of 2 is supplied for 1- through 8-inch valves, and a quantity of 4 is supplied for 10- and 12-inch valve kits.
 5. Retaining rings (key 41) are supplied for sizes 10- and 12-inch valve kits.

Retrofit Kits for ENVIRO-SEAL Packing

Retrofit kits include parts to convert existing V150, V200 and V300 valves with shallow (single packing depth) packing box to the ENVIRO-SEAL packing box construction. Retrofit kits include single PTFE packing. See following table.

ENVIRO-SEAL Packing Retrofit Kits

SHAFT DIAMETER ⁽¹⁾		PART NUMBER	
mm	Inches	Single PTFE	Graphite
12.7	0.5	RRTYXRT0012	RRTYXRT0312
15.9	0.625	RRTYXRT0022	RRTYXRT0322
19.1	0.75	RRTYXRT0032	RRTYXRT0332
25.4	1	RRTYXRT0052	RRTYXRT0352
31.8	1.25	RRTYXRT0062	RRTYXRT0362
38.1	1.5	RRTYXRT0072	RRTYXRT0372
Parts Included in Kit			
Key	Description	Quantity	
100	Packing stud	2	2
101	Packing nut	2	2
102	Packing flange	1	1
103	Spring pack assembly	1	1
105	Packing set	1	1
106	Anti-extrusion washer	2	- - -
107	Packing box ring ⁽²⁾	1	1
- - -	Tag	1	1
- - -	Tie Cable	1	1

1. Diameter through the packing box.
2. Not required for all sizes of Design V150 and V200 or for V300 with 1.25 or 1.5 inch diameter shafts.

Repair Kits for ENVIRO-SEAL Packing

Repair kits include valves parts for shallow (single packing depth) for ENVIRO-SEAL packing box construction. Repair kits include single PTFE or graphite packing. See following table.

ENVIRO-SEAL Packing Repair Kits

SHAFT DIAMETER ⁽¹⁾		PART NUMBER	
mm	Inches	PTFE	Graphite
12.7	0.5	RRTYX000012	13B8816X012
15.9	0.625	RRTYX000022	13B8816X032
19.1	0.75	RRTYX000032	13B8816X052
25.4	1	RRTYX000052	13B8816X092
31.8	1.25	RRTYX000062	13B8816X112
38.1	1.5	RRTYX000072	13B8816X142
Parts Included in Kit			
Key	Description	Quantity	
105	Packing set	.1	1
106	Anti-extrusion washer	2	- - -(2)

1. Diameter through the packing box.
2. Included in key 105.

Vee-Ball Valves

Repair Kits

Seal repair kits include recommended spare parts for Fisher TCM Plus, S31600 stainless steel,

CF10SMnN, or CD7MCuN ball seal constructions.

The following table indicates the repair kit part number and the quantity of parts included in the kit.

Design V150, V200, and V300 Repair Kits

VALVE SIZE, INCHES		KIT PART NUMBER			
		Ball Seal Material			
		TCM Plus	---	Alloy 6	CD7MCuN (Alloy 255 Duplex SST)
1	RV150X00CA2	---	RV150XHDAA2	RV150XHDCA2	
1.5	RV150X00CB2	---	RV150XHDAB2	RV150XHDCB2	
VALVE SIZE, INCHES		Ball Seal Material			
		TCM Plus	S31600 (316 SST)	CF10SMnN (Nitronic 60)	CD7MCuN (Alloy 255 Duplex SST)
		2 ⁽¹⁾	RV150X00C12	RV150X00M12	RV150X0HD12	RV150XHDC12
2 ⁽²⁾	RV150X00C82	---	RV150X0H082	RV150XHDC82	
3	RV150X00C22	RV150X00M22	RV150X0HD22	RV150XHDC22	
4	RV150X00C32	RV150X00M32	RV150X0HD32	RV150XHDC32	
6	RV150X00C42	RV150X00M42	RV150X0HD42	RV150XHDC42	
8	RV150X00C52	RV150X00M52	RV150X0HD52	RV150XHDC52	
10	RV150X00C62	RV150X00M62	RV150X0HD62	RV150XHDC62	
12	RV150X00C72	RV150X00M72	RV150X0HD72	RV150XHDC72	
Parts Included in Kit		Quantity in Kit			
Key No.	Description				
11	Ball seal	1	1	1	1
12	Shim seal ⁽³⁾	---	4	---	---
13	Spring seal	---	1	---	---
13	Wave spring	---	---	1	1
15	Gasket	1	1	1	1
37	Radial seal	---	---	1	1
21	Retainer screw	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾
22	Retainer washer	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾	2 or 4 ⁽⁴⁾
<p>1. V150's only for serial numbers below 12551183. 2. V150's for serial numbers 12551183 and above. All V200's and V300's. 3. Fewer shim seals are furnished in the parts kits than are used in the original construction of the valve. Most original shim seals can be reused. 4. A quantity of 2 is supplied for 2- through 8-inch valves, and a quantity of 4 is supplied for 10- and 12-inch valves.</p>					

Parts List

Note

Part numbers are shown for recommended spares only. For other part numbers, contact your Fisher sales office.

Common Parts (figures 24, 25 & 26)

Key	Description	Part Number
1	If you need a valve body as a replacement part, order by valve size, serial number, and desired valve body material. Contact your Fisher sales office for assistance.	
2	Ball	
2	Ball w/ attenuator	
3	Seal Protector Ring	
4*	Taper Key	
	R30006 (cobalt alloy 6 casting)	
	3 and 4-inch	12B9530X012
	6-inch	12B9531X012
	8- & 10-inch	12B9532X012
	12-inch	12B9533X012
	N10276 (Hastelloy C)	
	3 and 4-inch	11B0674X032
	6-inch	11B0695X032
	8- & 10-inch	11B0722X032
	12-inch	11B4684X032
6	Drive Shaft	
6	Drive Shaft w/ attenuator	
7*	Groove Pin	
	S31600 (316 stainless steel)	
	1-inch	13B0345X012
	1.5 inch and 2-inch	11B0705X012
	3- and 4-inch	18A6135X012
	6-inch	18A6138X012
	8-inch	11B0738X012
	10- and 12-inch	11B8596X012
	N10276	
	1-inch	13B0345X022
	1.5 inch and 2-inch	11B0705X022
	3- and 4-inch	18A6135X022
	6-inch	18A6138X032
9	Follower Shaft	
9	Follower Shaft w/ attenuator	
10*	Bearing (2 req'd)	
	PEEK/PTFE	
	1-inch	14B3351X012
	1.5 inch	14B3352X012
	2-inch	14B3353X012
	3- and 4-inch	17B7142X012
	6-inch	27B7136X012
	8 and 10-inch	27B7775X012
	12-inch	27B9470X012
	Alloy 6B	
	1-inch	23B0342X012
	1.5 inch	23B6819X022
	2-inch	23B6682X012
	3- and 4-inch	27B9673X012
	6-inch	27B9670X012
	8 and 10-inch	27B9547X012
	12-inch	27B9471X012

Key	Description	Part Number
10*	Bearing (2 req'd) (continued)	
	Silver-plated alloy 6B	
	1-inch	23B0343X012
	1.5 inch	23B6820X012
	2-inch	23B6683X012
	3- and 4-inch	28B2950X012
	6-inch	28B2951X012
	8 and 10-inch	28B2952X012
	12-inch	28B2953X012
	316L SST Nitride	
	1-inch	23B0342X032
	1.5 inch	23B6819X032
	2-inch	23B6682X032
	3- and 4-inch	27B9673X022
	6-inch	27B9670X022
	8 and 10-inch	27B9547X022
	12-inch	27B9471X022
	Carbon-filled PTFE with N10276 sleeve	
	1-inch	13B0349X012
	1.5 inch	13B6822X012
	2-inch	13B6685X012
	3- and 4-inch	17B9675X012
	6-inch	27B9672X012
	8 and 10-inch	27B9549X012
	12-inch	27B9472X012
	Glass-filled PTFE with N10276 sleeve	
	1-inch	13B0349X042
	1.5 inch	13B6822X042
	2-inch	13B6685X022
	3- and 4-inch	17B9675X022
	6-inch	27B9672X022
	8 and 10-inch	27B9549X022
	12-inch	27B9473X022
11*	Ball Seal	
	Fisher TCM Plus	
	1-inch	13B0339X052
	1.5 inch	13B6815X062
	2-inch	13B6686X062
	3-inch	13A2565X102
	4-inch	13A2585X102
	6-inch	13A2619X102
	8-inch	13A2645X072
	10-inch	13A2662X052
	12-inch	13A2677X062
	Fisher TCM Ultra	
	1-inch	13B0339X062
	1.5 inch	13B6815X072
	2-inch	13B6686X072
	3-inch	13A2565X112
	4-inch	13A2585X112
	6-inch	13A2619X112
	8-inch	13A2645X082
	10-inch	13A2662X062
	12-inch	13A2677X072
	Flat Metal	
	S31600	
	3-inch	11B4688X012
	4-inch	11B5704X012
	6-inch	11B5708X012
	8-inch	11B5712X012
	10-inch	11B5717X012
	S30200	
	12-inch	11B5722X012

Key	Description	Part Number	Key	Description	Part Number
11*	Ball Seal (continued)		15*	Gasket	
	HD (Heavy-Duty) Metal			Graphite laminate (Standard)	
	CF10SMnN (Nitronic 60 SST)			1-inch	13B0344X032
	2-inch	33B6676X012		1.5 inch	13B6823X042
	3-inch	34B4766X012		2-inch	13B6687X052
	4-inch	34B4767X012		3-inch	11B0660X042
	6-inch	34B4768X012		4-inch	11B0672X052
	8-inch	34B4769X012		6-inch	11B0681X032
	10-inch	34B3365X012		8-inch	11B0693X032
	12-inch	34B3366X012		10-inch	11B0720X022
	CD7MCuN (alloy 255 duplex SST)			12-inch	11B4682X022
	1-inch	33B0341X022		Graphite for Oxygen Service	
	1.5 inch	33B6817X022		1-inch	13B0344X022
	2-inch	33B6676X022		1.5 inch	13B6823X022
	3-inch	34B4766X022		2-inch	13B6687X022
	4-inch	34B4767X022		3-inch	11B0660X052
	6-inch	34B4768X022		4-inch	11B0672X062
	8-inch	34B4769X022		6-inch	11B0681X042
	10-inch	34B3365X022		8-inch	11B0693X042
	12-inch	34B3366X022		10-inch	11B0720X032
	R30006 cobalt alloy 6 casting			12-inch	11B4682X032
	1-inch	33B0341X012	16*	Packing Set, PTFE and carbon-filled PTFE V-ring	
	1.5 inch	33B6817X032		1-inch	12A9016X022
	2-inch	33B6676X032		1.5 inch and 2-inch	1R5795X0012
	3-inch	34B4766X032		3 and 4-inch	12A8995X022
	4-inch	34B4767X032		6-inch	12A8832X022
	6-inch	34B4768X032		8 and 10-inch	12A8951X022
	8-inch	34B4769X032		12-inch	12A8935X022
	S31700 (317 SST) w/ alloy 6 seat		17	Packing Follower w/integral flange	
	10-inch	34B3365X032	17	Packing Follower w/o integral flange	
	12-inch	34B3366X032	19	Packing Follower Stud	
12*	Shim Seal, S31600 (12 req'd)		20	Packing Follower Nut	
	Use w/flat metal seal only		21	Seal Protector Screw	
	3-inch	11B4689X012	22	Seal Protector Clip	
	4-inch	11B5706X012	23	Actuator Mounting Screw	
	6-inch	11B5710X012	24	Actuator Mounting Nut	
	8-inch	11B5714X012	25	Pipe Plug (Optional) (not shown)	
	10-inch	11B5718X012	26	Identification Nameplate	15A0460X012
	12-inch	11B5721X012	27	Drive Screw	
13*	Spring Seal, S31600		28	Flow Arrow	
	Use w/ flat metal seal only		30	Nameplate	
	3-inch	21B4687X012	31	Nameplate Wire (not shown)	
	4-inch	21B5705X012	32	Line Flange Stud	
	6-inch	21B5707X012	33	Line Flange Stud	
	8-inch	21B5713X012	34	Spacer	
	10-inch	21B5716X012	35*	Packing Ring, graphite ribbon (4 req'd)	
	12-inch	21B5720X012		1-inch	12A9134X012
13*	Wave Spring, N07750 Inconel (NACE)			1.5 and 2-inch	12A9135X012
	use w/ HD Metal Seal only			3- and 4-inch	12A9136X012
	1-inch	23B0347X012		6-inch	12A9137X012
	1.5 inch	23B6825X012		8- and 10-inch	12A9138X012
	2-inch	23B6689X012		12-inch	12A9139X012
	3-inch	24B4760X012	36*	Packing Washer, zinc	
	4-inch	24B4761X012		1-inch (3 req'd)	14A8362X012
	6-inch	24B4762X012		1.5 and 2-inch	14A9771X012
	8-inch	24B4763X012		3- and 4-inch (3 req'd)	14A8363X012
	10-inch	22B4509X012		6-inch (3 req'd)	14A8365X012
	12-inch	22B4514X012		8- and 10-inch (3 req'd)	14A8366X012
14	Backup Ring (Composition seal only)			12-inch (3 req'd)	14A8367X012

Vee-Ball Valves

Appendix A Instructions for Non-Series B

The Series B changes affected only the 3- through 12-inch valves without attenuators. To determine if a Vee-Ball valve is Series B, you will need to examine several of the internal parts. Compare the distinctive skirted V-notch outline of the forward side and the circular edge on the reverse side of the Series B design ball to the V-notch on both sides of the non-series B design ball. Then look for bushings. The lack of bushings indicates the valve body is Series B.

All Vee-Ball valves 3- through 12-inch valves produced before the Series B design changes use the Specifications table, the Installation, Maintenance, Packing Maintenance, Replacing Packing, and Replacing the Ball Seal instructions found elsewhere in this manual. Bearing and Vee-Ball Maintenance and Actuator Mounting instructions for these valves may be found below.

Maintenance

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for the selection, use, and maintenance of any Fisher products rests solely with the purchaser and end-user.

WARNING

The Vee-ball closes with a shearing, cutting motion, which could result in personal injury. To avoid injury, keep hands, tools, and other objects away from the Vee-ball while stroking the valve.

Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:

- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.

- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.

- Vent the power actuator loading pressure and relieve any actuator spring precompression.

- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.

- The valve packing area may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids may spray out under pressure when removing the packing hardware or packing rings.

- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Procedures for disassembly and assembly of the bearings and ball cannot be accomplished until the ball seal and valve packing are removed from the valve.

1. Refer to the Replacing Packing procedures to remove the actuator, and to remove the packing flange and packing follower from the valve. When the packing disassembly steps are complete, return to this section.
2. Refer to the Replacing the Ball Seal procedures to remove the ball seal from the valve.

Disassembly

WARNING

When the actuator is removed from the valve, the ball/shaft assembly may suddenly rotate, with a shearing, cutting motion, which could result in personal injury. To avoid injury, carefully rotate the ball to a stable position. Make sure the ball will not rotate.

Key numbers in this procedure are shown in figures 24, 26, and 31, unless otherwise indicated. A taper key (key 4, figure 14) is used in 3- through 12-inch Non-Series B valves.

3. Carefully rotate the ball to the open position after the actuator is disconnected. Make sure the ball will not rotate (see warning above). Provide support for the ball during the following disassembly.

4. Unscrew the pipe plug (key 25). (With newer valve constructions, the pipe plug is optional and may not be available.)

5. Working from the small end of the groove pin (key 7), use a pin punch to drive the groove pin out of the ball ear and follower shaft.

For tack welded taper keys, driving the taper key out of the ball ear will shear the tack welding.

6. Locate the small end of the taper key (key 4, see figure 14). Using a pin punch on the smaller end of the taper key, drive it out of the ball (key 2) and drive shaft (key 6). Note: driving the taper key in the wrong direction will tighten it.

7. Pull the drive shaft (key 6) out of the actuator side of the valve body.

8. Make sure the sealing surface of the ball is not damaged while removing the follower shaft.

a. If a pipe plug (key 25) is installed, use a punch to drive the follower shaft (key 9) into the center of the ball.

b. If a pipe plug is not installed, use a piece of continuous threaded rod as a removal rod when moving the follower shaft (key 9) into the center of the V-notch ball. Refer to the table 7 for a description of the size threaded rod needed. The length of the rod should allow easy working room from the valve body.

9. **Remove the ball** (key 2) by carefully removing the follower shaft and ball from the valve body.

10. Remove the packing box spacer (key 34) for 8-, 10-, and 12-inch valves.

11. **Removing the bearings (key 10):**

a. **For composition bearings**, remove the bearings by hand. If the bearings are tight in the valve body, then pull or drive them out with a slight pressure. Allow the bushings (key 5 or 8) to remain in the valve body.

Table 7. Continuous Threaded Rod

Valve Size, Inches	Threaded Rod Thread Size	Thread Depth in Follower Shaft
3	0.25-20	0.5
4	0.25-20	0.5
6	0.25-20	0.5
8	0.3125-18	0.62
10	0.3125-18	0.62
12	0.3125-18	0.94

b. **For metal bearings**, use a press and ram to remove the drive shaft bearings out of the valve body. Refer to figure 30 ram dimensions. The bushings (key 5 or 8) will normally remain in the valve body.

To remove the follower shaft bearings, use a blind-hole bearing puller similar to CG2545AB, which is made by Snap-On Tools. If you do not have such a tool, you can machine the bearing out.

Note

For proper shutoff performance, the ball and seal require the bearing (key 10) to be positioned correctly. If you removed the bearings (key 10), be sure to locate the new bearings as shown in figure 30.

12. Thoroughly clean surfaces of all parts that are to be re-used or obtain replacement parts.

Assembly

1. Inspect all sealing surfaces to ensure they are in good condition and without scratches or wear.

2. **Installing bearings (key 10):**

a. **For composition bearings**, install the bearings by hand. The bearing flanged end should touch the bushing (key 5 or 8).

b. **For metal bearings:**

- Use a press and ram to install the bearings (key 10). Refer to figure 30.

- Press the bearings in until each bearing is flush with the bushing (key 5 or 8). The acceptable tolerance for bearing location is: flush with the bushing to 1.52 mm (0.060 inches) inside the bushing. That is, the bearings should not protrude into the flow cavity of the valve, and they should not be more than 1.52 mm (0.060 inches) inside the bushing.

Vee-Ball Valves

- Take care not to change the position of the bushings (key 5 or 8) when pressing in new bearings (key 10), otherwise the ball will not center in the valve body and seal.

3. Installing the Vee-Ball (key 2):

WARNING

The Vee-Ball might be damaged if it is allowed to fall into the valve body. To avoid personal injury or damage to the sealing surfaces, support the ball to prevent it from falling into or out of the valve body cavity.

Note

For ease of assembly, the follower shaft (key 9) should be inserted into the ball before installing the ball in a 3-inch valve without ball/attenuator

Carefully install the ball into the valve body cavity.

After you have installed the ball (key 2) into the valve body assembly, firmly support the ball while installing the shafts.

4. Installing the follower shaft (key 9):

- **For 3-inch valves:** The follower shaft (key 9) should already have been inserted into the ball before the ball was put into the valve body. Insert the follower shaft (key 9) into the valve body bearing (key 10).

- **For 4-inch and larger valves without attenuator:** Insert the follower shaft (key 9) through the ball, and into the valve body bearing (key 10).

Then for all sizes, align the hole in the follower shaft with the holes in the ball. Insert the small end of the groove pin (key 7) into the hole in the ball and into the follower shaft. The pin will hold the parts in place while the drive shaft (key 6) is being installed.

5. Insert the drive shaft (key 6) into the valve body bearing (key 10), and into the ball ear. Align the hole in the drive shaft with the holes in the ball.

CAUTION

The drive shaft must be used with the correct Vee-Ball. Refer to the tag (see figure 13) attached to the Vee-Ball and to the drive shaft.

Failure to use the correct Vee-Ball/shaft combination may result in the ball not being in the position indicated by the slash mark on the end of the shaft. If the ball is not properly aligned with the slash mark, the valve will not function correctly and seal damage may result.

6. Installing the Taper Key (key 4):

Current standard construction materials for all 3 through 12-inch valves require the taper key (key 4, figure 14) to be tack welded in place using the following procedure. Use standard welding preparations when preparing parts for reassembly.

CAUTION

Make sure the drive shaft (key 6) is free of oil or grease, otherwise the taper key will not seat properly. Failure to properly set the taper pin or taper key could result in it coming loose while in service. Loosening of the taper key in service could result in improper valve function and equipment damage.

1. Install the drive shaft (key 6) into the valve body through the ball and into the lower bearing.
2. Insert the taper key (key 4) into ball and drive shaft (keys 2 and 6) as shown in figure 14. The taper key inserts, with the flat side of the key, facing the drive shaft (key 6).
3. Using a flat end punch, drive the groove pin (key 7) into the ball ear and follower shaft until it is flat with the ball ear surface.
4. Using a flat end punch, drive the taper key (key 4) into the ball ear and drive shaft (key 6) until solid, heavy contact is obtained between the key and shaft.
5. Measure the position of the taper key head.
6. Drive the taper key in further using the minimum distance shown in table 7.

Table 8. Taper Key Minimum Depth

VALVE SIZE, INCHES	MINIMUM DEPTH TO DRIVE TAPER KEY AFTER INITIAL SOLID CONTACT, mm (INCHES)
3, 4, 6	4.8 (0.188)
8, 10, 12	5.6 (0.219)

Table 9. Taper Key Maximum Depth

VALVE SIZE, INCHES	MAXIMUM DEPTH TO DRIVE TAPER KEY AFTER INITIAL SOLID CONTACT, mm (INCHES)
3, 4	7.1 (0.281)
6	7.9 (0.312)
8, 10	9.5 (0.375)
12	10.3 (0.406)

7. Inspect the ball/shaft taper key connection to verify that the taper key spans the entire shaft flat width. If not, the taper key must be driven in further until this condition is satisfied. However, do not exceed the maximum depths shown in table 8.

Note

When welding standard valves that have a CG8M (317 SST) or CF3M (316L SST) ball, use 309 or 309L filler rod material.

Alloy valve taper keys are normally not welded.

8. When the above conditions are met, tack weld the taper key (key 4) to the ball ear on the head end of the key (see figure 26). Use a:

- 0.125 inch diameter weld on 3- through 6-inch valves,
- 0.1875 inch diameter weld on 8- through 10-inch valves, and
- 0.25 inch diameter weld on 12-inch valves.

For all constructions: Refer to Replacing the Ball Seal, Packing Maintenance, and other procedures as necessary to complete the assembly of the valve.

Actuator Mounting

Use the appropriate actuator instruction manual and figure 23 of this manual when mounting the actuator or changing actuator styles and positions.

To help ensure correct centering of the ball (key 2) on the seal (key 11), be sure the ball is closed when mounting the actuator. Do not use a hammer or

other tool to drive the actuator lever onto the valve shaft.

Clean the valve shaft and actuator lever splines to be sure the actuator lever will slide on easily. If the lever does not slide on easily, carefully wedge the ball solidly against the actuator-side bearing using a screw driver or similar tool inserted between the lower ear of the ball and the valve body.

Keep the wedge in place while installing the lever, but again, do not drive on the lever. Remove the wedge after you have clamped the actuator lever on the valve shaft and connected the lever to the actuator piston rod or diaphragm rod.

Determining Mounting Position

The actuator can be either right or left-hand mounted.

Note

Right-hand mounting—Actuator is on the right side of the valve when viewed from valve inlet.

Left-hand mounting—Actuator is on the left side of the valve when viewed from valve inlet.

The preferred location of the ball is in the top of the valve body when the valve is open. To convert from right to left hand-mounting, turn the valve to position the actuator mounting pad on the left and rotate the ball to the top of the valve.

The number one V-notch controls flow on right-hand mounting. Turn the valve 180 degrees, and rotate the ball to the top of the valve to obtain left-hand mounting. The number two V-notch controls flow for this construction. See figure 29.

Vee-Ball Valves

Determining Closed Position

1. The valve must be removed from the line to check the position of the ball.



WARNING

The ball closes with a shearing, cutting motion. To avoid personal injury, keep hands, tools, and other objects away from the ball while stroking the valve.

2. Rotate the ball to the closed position.
3. Follow one of the procedures below:
 - When viewed from the valve body inlet, the ball is in the proper position when both V-notches of the ball are centered between the machined diameter of the ledge that supports the seal.
 - If the ball has a spot machined on the top, align that spot to the exact center of the seal cavity.
4. Adjust the actuator linkage as described in the appropriate actuator instruction manual until the condition described in step 3 exists. A line is stamped on the actuator end of the drive shaft (see figure 23) to indicate the ball position.

Note

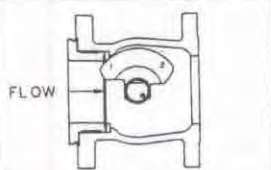
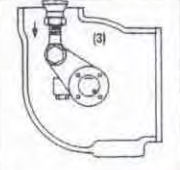
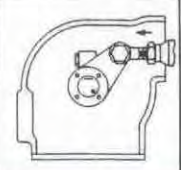
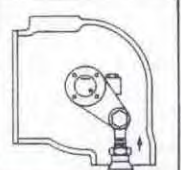
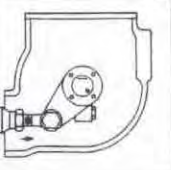
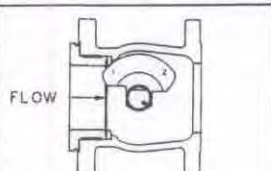
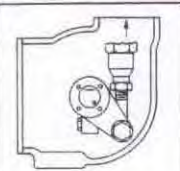
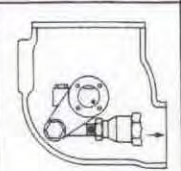
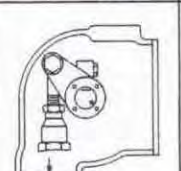
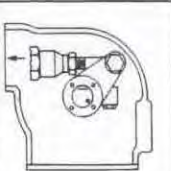
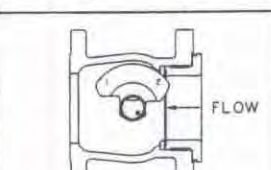
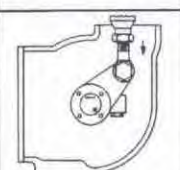
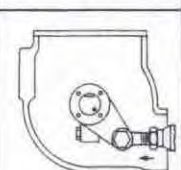
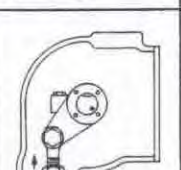
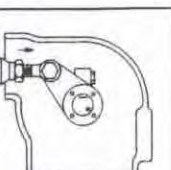
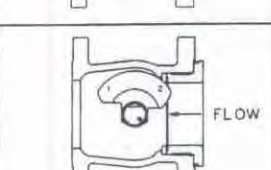
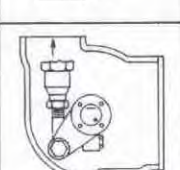
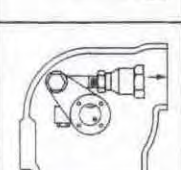
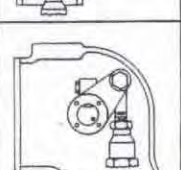
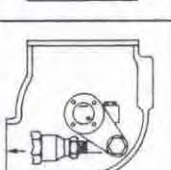
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Non-Series B Design Parts (figure 31)

Note

Part numbers are shown for recommended spares only. For part numbers not shown, contact your Fisher sales office.

Key	Description	Part Number
2	Ball	
2	Ball with attenuator (RH mtg in Common parts section)	
6	Drive Shaft	
9	Follower Shaft	
10*	Bearing (2 req'd)	
	PEEK	
	3- and 4-inch	14B3354X012
	6-inch	14B3355X012
	8 and 10-inch	14B3356X012
	12-inch	14B3357X012
	S44004 (440C SST)	
	2-inch	23B6682X022
	3- and 4-inch	14A5698X012
	6-inch	14A4618X012
	8 and 10-inch	14A5699X012
	12-inch	14A6549X012
	Alloy 6B	
	3- and 4-inch	14A6546X012
	6-inch	14A6547X012
	8 and 10-inch	14A6548X012
	12-inch	14A6550X012
	Silver-plated alloy 6B	
	3- and 4-inch	14A6537X012
	6-inch	14A2498X012
	8 and 10-inch	14A6538X012
	12-inch	14A6539X012
	Carbon-filled PTFE with N10276 sleeve	
	3- and 4-inch	12B5944X012
	6-inch	12B5945X012
	Glass-filled PTFE with N10276 sleeve	
	3- and 4-inch	12B5944X042
	6-inch	12B5945X042

ACTUATOR		VALVE OPEN	ACTUATOR POSITION			
MOUNTING	STYLE		1	2	3	4
RIGHT-HAND ⁽¹⁾	STYLE A (PDTC) ⁽²⁾					
	STYLE B (PDTO) ⁽²⁾					
LEFT-HAND ⁽¹⁾	STYLE C (PDTC) ⁽²⁾					
	STYLE D (PDTO) ⁽²⁾					

1. Right-hand mounting controls with v notch no. 1; Left-hand mounting controls with v notch no. 2
 2. PDTC-push down to close; PDTO-push down to open
 3. Arrow on lever indicates direction of actuator thrust to close valve

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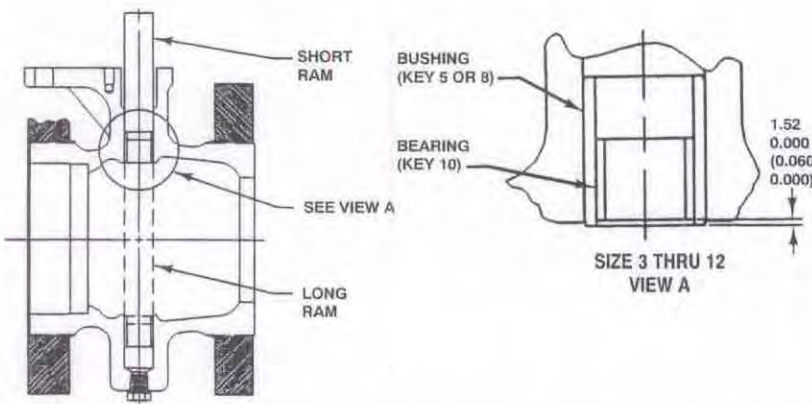
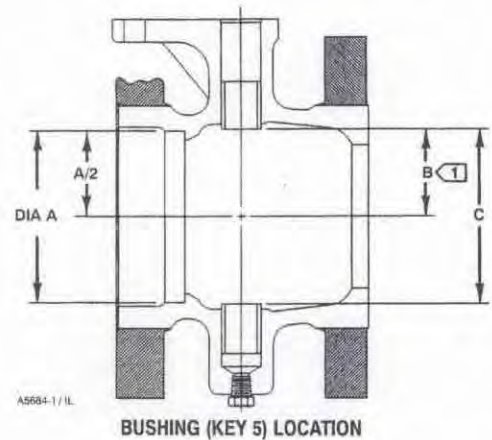
Figure 29. Index Marks for Actuator Lever Orientation for Non-Series B Design Valves

Vee-Ball Valves

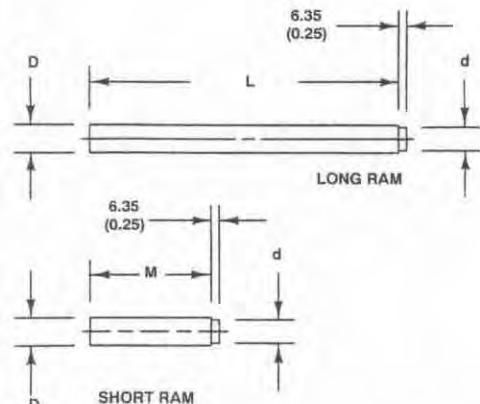
VALVE SIZE, INCHES	BEARING RAM DIMENSIONS								BUSHING RAM DIMENSIONS					
	Ram Lengths				Ram Diameters				Ram Diameters					
	L		M		D		d		D		Long Ram d		Short Ram d	
	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
3 & 4	201.42	7.930	95.25	3.750	22.86	0.900	19.05	0.750	28.19	1.110	19.05	0.750	22.86	0.900
	MIN	MIN ⁽¹⁾	MIN	MIN	22.61	0.890	18.80	0.740	27.94	1.100	18.80	0.740	22.61	0.890
6	247.65	9.750	95.25	3.750	29.21	1.150	25.40	1.000	34.54	1.360	25.40	1.000	29.21	1.150
	MIN	MIN	MIN	MIN	28.96	1.140	25.15	0.990	34.29	1.350	25.15	0.990	28.96	1.140
8	338.75	13.310	139.70	5.500	35.56	1.400	31.75	1.250	40.89	1.610	31.75	1.250	35.56	1.400
	MIN	MIN	MIN	MIN	35.31	1.390	31.50	1.240	40.64	1.600	31.50	1.240	35.31	1.390
10	396.75	15.620	139.70	5.500	35.56	1.400	31.75	1.250	40.89	1.610	31.75	1.250	35.56	1.400
	MIN	MIN	MIN	MIN	35.31	1.390	31.50	1.240	40.64	1.600	31.50	1.240	35.31	1.390
12	476.25	18.750	152.40	6.000	41.91	1.650	38.10	1.500	50.42	1.985	38.10	1.500	41.91	1.650
	MIN	MIN	MIN	MIN	41.66	1.640	37.85	1.490	50.17	1.975	37.85	1.490	41.66	1.640

1. MIN = Minimum.

VALVE SIZE, INCHES	DIMENSION			
	B	C	B	C
	Millimeters		Inches	
3	48.26	100.38	1.960	3.952
	50.04	100.63	1.970	3.962
4	60.10	121.01	2.366	4.764
	60.35	121.26	2.376	4.774
6	83.59	168.00	3.291	6.614
	83.85	168.25	3.301	6.624
8	106.20	213.21	4.181	8.394
	106.45	213.46	4.191	8.404
10	135.33	271.48	5.328	10.688
	135.59	271.73	5.338	10.698
12	169.67	340.16	6.680	13.392
	169.93	340.41	6.690	13.402



NOTES:
 [T] DIMENSION B IS THE DISTANCE BETWEEN THE GUIDE BUSHING AND THE CENTER OF DIAMETER A.



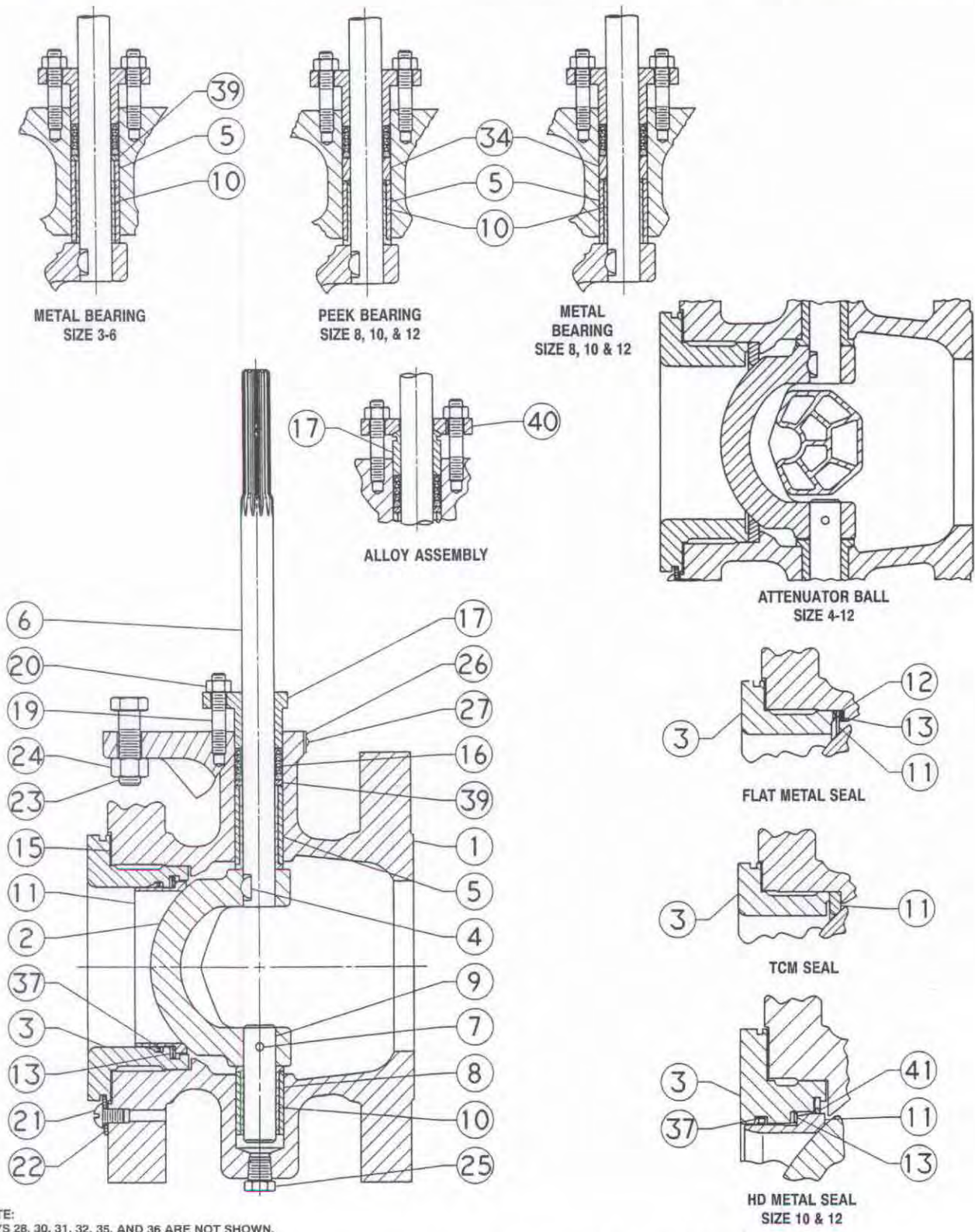
mm
(INCHES)

Figure 30. Metal Bearing Ram and Bushing Location

Instruction Manual

Form 5290
September 2004

Vee-Ball Valves



NOTE:
KEYS 28, 30, 31, 32, 35, AND 36 ARE NOT SHOWN.
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Figure 31. Designs V150 and V300 Non-Series B Valve Assembly (3- 12- Inch Sizes)
(Details are typical for Design V200 Valves except Design V200 does not have flanges)

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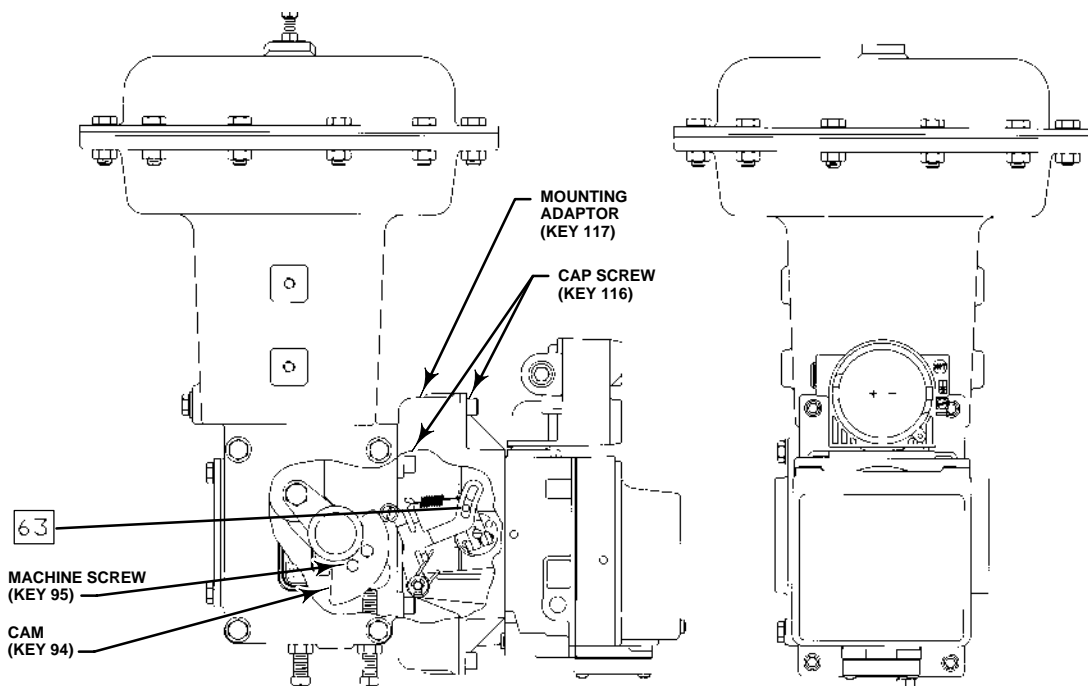
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Mounting Type DVC5020 or DVC6020 Digital Valve Controllers on Fisher Type 1051 and 1052

Installation Instructions

November 2004



□ APPLY LUB, SEALANT
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Figure 1. Type DVC5020 or DVC6020 Digital Valve Controller Mounted on Type 1052 Size 33 Actuator

Use these instructions to mount a FIELDVUE® Type DVC5020 or DVC6020 digital valve controller on Fisher Type 1051 and 1052 actuators.

WARNING

Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:

- Always wear protective clothing and eyewear.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.

- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.

- Vent the pneumatic actuator loading pressure and relieve any actuator spring precompression.

- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

- Check with your process or safety engineer for any additional safety measures that must be taken to protect against process media.



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Mounting Type DVC5020 or DVC6020 Digital Valve Controllers on Fisher Type 1051 and 1052

Installation Instructions
November 2004

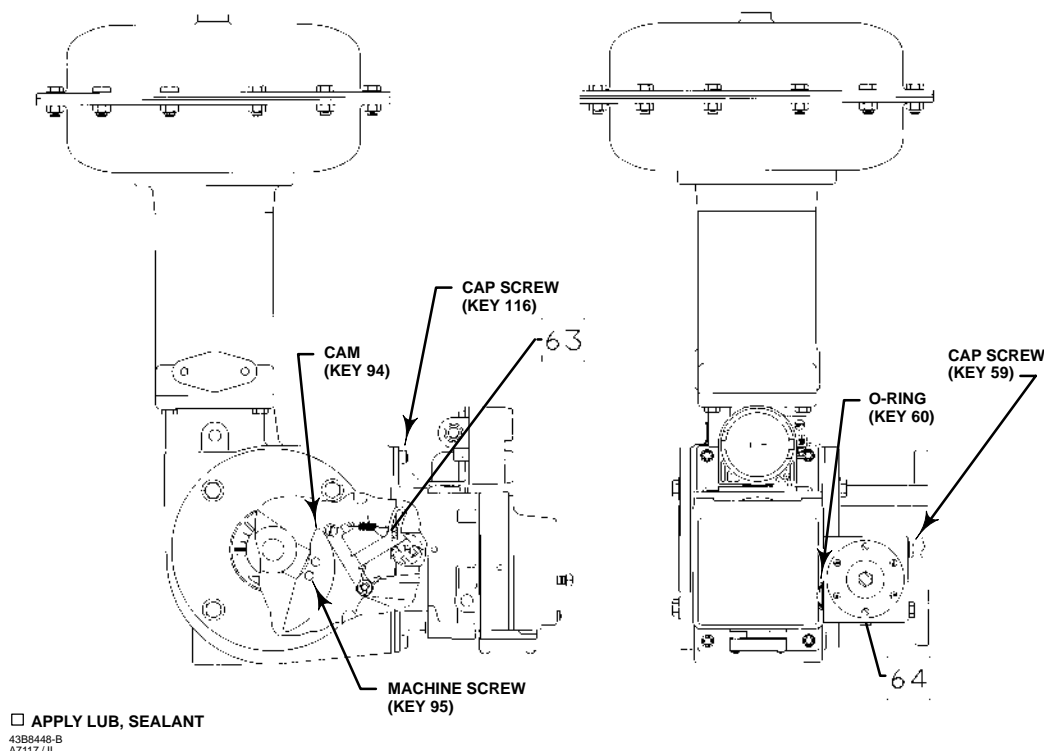


Figure 2. Type DVC5020 or DVC6020 Digital Valve Controller with Integrally Mounted Filter Regulator Mounted on Type 1051 Size 40 Actuator

Unless otherwise noted, refer to figure 1 or 2 for key number locations.

1. Isolate the control valve from the process line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve. Shut off all pressure lines to the pneumatic actuator, releasing all pressure from the actuator. Use lock-out procedures to be sure that the above measures stay in effect while working on the equipment.

Note

Go to step 12 if the actuator already has the cam (key 94) installed.

2. Mark the positions of the travel indicator and actuator cover. Then, remove the actuator travel indicator machine screws, travel indicator, and actuator cover cap screws.
3. Remove the cover plate from the actuator housing.

Note

For information on the various actuator mounting styles and positions, see figure 3. Also refer to the appropriate actuator instruction manual.

4. See figure 3. For actuator mounting styles A and D, proceed to the note before step 8. For actuator mounting styles B and C, continue with step 5.
5. Disconnect the actuator turnbuckle from the lever arm.

Note

Do not change the position of the rod end bearing on the end of the turnbuckle.

6. Loosen the lever clamping bolt in the lever.
7. Mark the lever/valve shaft orientation, and remove the lever.

Mounting Type DVC5020 or DVC6020 Digital Valve Controllers on Fisher Type 1051 and 1052

Installation Instructions
November 2004

MOUNTING	ACTION ⁽¹⁾	VALVE SERIES OR DESIGN				VALVE SERIES OR DESIGN		
		BALL/PLUG ROTATION TO CLOSE	V250	V150, V200 & V300	CV500 V500	DISK/BALL ROTATION TO CLOSE	V250	8510B, 8532, 8560 & 9500
Right-Hand	PDTC	CCW	A	A	A	CW	NA	B
	PDTO	CCW	B	B	B	CW	NA	A
Left-Hand	PDTC	CCW	NA	D	D	CW	C	C
	PDTO	CCW	NA	C	C	CW	D	D
Left-Hand (Optional) ⁽²⁾	PDTC	CW	NA	C	NA	NA	NA	NA
	PDTO	CW	NA	D	NA	NA	NA	NA

1. PDTC—Push-down-to-close, and PDTO—Push-down-to-open.
2. A left hand ball will be required for the 3- through 12-inch Series B and the 14- to 20-inch, with or without attenuator.

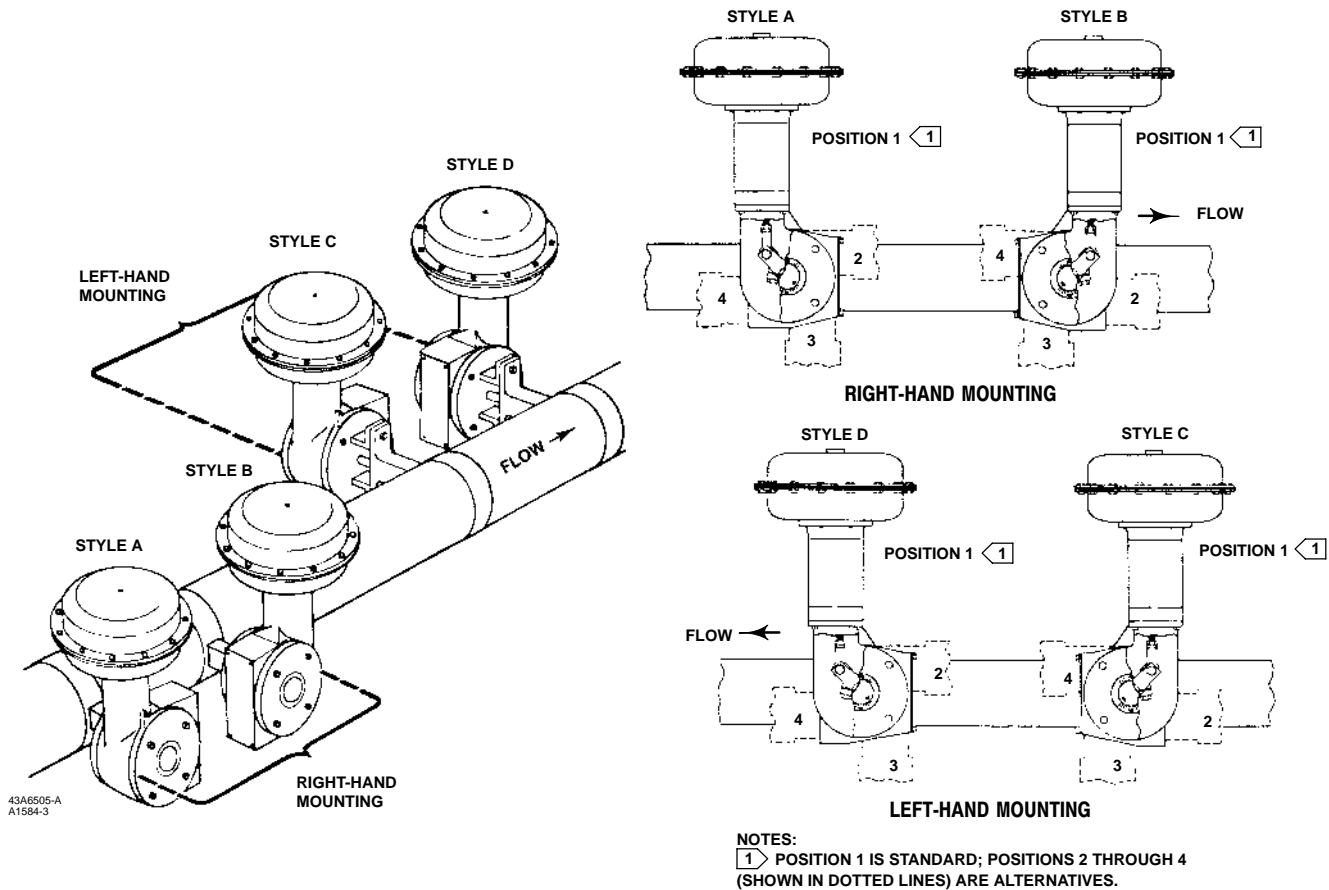


Figure 3. Mounting Styles and Positions for the Type 1051 and 1052 Actuator

Note

The cam has the letter D (direct acting) on one side and the letter R (reverse acting) on the other side. Always install the cam with the letter D on the same side as the cam mounting screw heads (key 95).

8. Install the cam (key 94) on the actuator lever with the cam mounting screws (key 95).
9. For actuator styles A and D, proceed to step 12. For actuator styles B and C, continue with step 10.
10. Slide the lever/cam assembly (cam side first) onto the valve shaft. Orient the lever with the shaft as noted in step 7, and tighten the lever clamping bolt.

Mounting Type DVC5020 or DVC6020 Digital Valve Controllers on Fisher Type 1051 and 1052

Installation Instructions
November 2004

Note

Refer to the appropriate actuator instruction manual to determine the distance required between the housing face and the lever face and to determine the proper tightening torque for the lever clamping bolt.

11. Connect the turnbuckle and the lever arm.
12. **For Type 1051 size 33 and 1052 size 20 and 33 actuators**, attach an adaptor (key 117) to the actuator with four screws (key 116). Then attach the digital valve controller assembly to the adaptor. The roller on the digital valve controller feedback arm will contact the actuator cam as it is being attached. Install and tighten four screws (key 116).
- For other size 1051 and 1052 actuators**, attach the digital valve controller assembly to the front access opening of the actuator. The roller on the digital valve controller feedback arm will contact the actuator cam as it is being attached. Install and tighten four screws (key 116).
13. Replace the actuator cover and the travel indicator in the positions that were marked in step 2.

Note

Actuator cover alignment on the Type 1052 actuator can be aided by moving the actuator slightly away from its up travel stop using a regulated air source. If hole alignment cannot be obtained in this manner, temporarily loosen the cap screws that secure the housing to the mounting yoke, and shift the housing slightly.

CAUTION

To avoid parts damage, do not completely stroke the actuator while the cover is removed.

WARNING

To avoid personal injury from moving parts, keep fingers and tools clear while stroking the actuator with the cover removed.

For additional information concerning mounting, setup, calibration and maintenance, refer to the FIELDVUE DVC5000 Series Digital Valve Controllers Instruction Manual - Form 5335 for DVC5010 digital controllers, and the FIELDVUE DVC6000 Series Digital Valve Controllers Instruction Manual - Form 5647 for DVC6010 digital valve controllers.

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FIELDVUE® DVC6000 Series Digital Valve Controllers

FIELDVUE® DVC6000 Series digital valve controllers (figures 1 and 2) are communicating, microprocessor-based current-to-pneumatic instruments. In addition to the traditional function of converting a current signal to a valve-position pressure signal, DVC6000 Series digital valve controllers, using HART® communications protocol, give easy access to information critical to process operation. This can be done using a Model 375 Field Communicator at the valve or at a field junction box, or by using a personal computer or a system console within the control room. Using HART communication protocol, information can be integrated into a control system or received on a single loop basis.

DVC6000 Series digital valve controllers can be used on single- or double-acting actuators. The digital valve controller receives feedback of the valve travel position plus supply and actuator pneumatic pressure. This allows the instrument to diagnose

not only itself, but also the valve and actuator to which it is mounted. This provides you with very cost effective maintenance information, as the required maintenance can be performed on the instrument and valve when there really is a need.

Wiring is economical because DVC6000 Series digital valve controllers use two-wire 4 to 20 mA loop power. This provides for low cost replacement of existing analog instrumentation. The DVC6000 Series digital valve controller's two-wire design avoids the high cost of running separate power and signal wiring.

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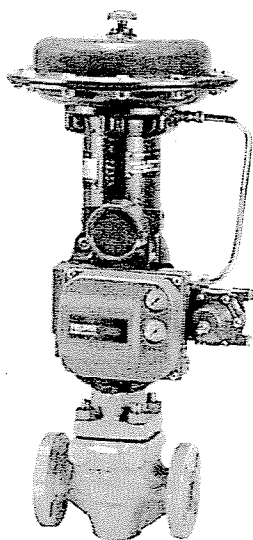


Figure 1. Type DVC6010 Digital Valve Controller Mounted on a Sliding-Stem Valve Actuator

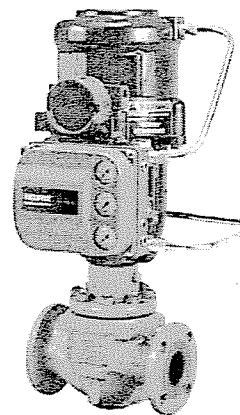


Figure 2. Type DVC6010 Digital Valve Controller Mounted on Type 585C Piston Actuator



Specifications

Available Configurations

Valve-Mounted Instrument:

DVC6010: Sliding-stem applications
DVC6020: Rotary applications and long-stroke sliding-stem applications
DVC6030: Quarter-turn rotary applications

Remote-Mounted Instrument⁽¹⁾:

DVC6005: Base unit for 2-inch pipestand or wall mounting
DVC6015: Feedback unit for sliding-stem applications
DVC6025: Feedback unit for rotary or long-stroke sliding-stem applications
DVC6035: Feedback unit for quarter-turn rotary applications

DVC6000 Series digital valve controllers can be mounted on Fisher and other manufacturers rotary and sliding-stem actuators.

Input Signal⁽²⁾

Point-to-Point:

Analog Input Signal: 4–20 mA dc, nominal; split ranging available
 Minimum Voltage Available at Instrument Terminals must be 10.5 volts dc for analog control, 11 volts dc for HART communication (see instrument instruction manual for details)
Minimum Control Current: 4.0 mA
Minimum Current w/o Microprocessor Restart: 3.5 mA

Maximum Voltage: 30 volts dc
Overcurrent Protection: Input circuitry limits current to prevent internal damage
Reverse Polarity Protection: No damage occurs from reversal of loop current

Multi-drop:

Instrument Power: 11 to 30 volts dc at approximately 8 mA
Reverse Polarity Protection: No damage occurs from reversal of loop current

Output Signal⁽²⁾

Pneumatic signal as required by the actuator, up to 95% of supply pressure
Minimum Span: 0.4 bar (6 psig)
Maximum Span: 9.5 bar (140 psig)
Action: ■ Double, ■ Single Direct, and ■ Single Reverse

Supply Pressure⁽³⁾

Minimum Recommended: 0.3 bar (5 psig) higher than maximum actuator requirements
Maximum: 10.0 bar (145 psig) or maximum pressure rating of the actuator, whichever is lower

Steady-State Air Consumption^(4,5)

Standard Relay:

At 1.4 bar (20 psig) supply pressure: Less than 0.38 normal m³/hr (14 scfh)
At 5.5 bar (80 psig) supply pressure: Less than 1.3 normal m³/hr (49 scfh)

Low Bleed Relay⁽⁶⁾:

At 1.4 bar (20 psig) supply pressure: Average value 0.056 normal m³/hr (2.1 scfh)
At 5.5 bar (80 psig) supply pressure: Average value 0.184 normal m³/hr (6.9 scfh)

Maximum Output Capacity^(4,5)

At 1.4 bar (20 psig) supply pressure: 10.0 normal m³/hr (375 scfh)
At 5.5 bar (80 psig) supply pressure: 29.5 normal m³/hr (1100 scfh)

Independent Linearity^(2,7)

±0.50% of output span

Electromagnetic Interference (EMI)

Tested per IEC 61326-1 (Edition 1.1). Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance is shown in table 2.

IEC 61010 Compliance Requirements (Valve-Mounted Instruments Only)

Power Source: The loop current must be derived from a separated extra-low voltage (SELV) power source
Environmental Conditions: Installation Category I

(continued)

Specifications (continued)

Electrical Classification

Hazardous Area:



Explosion proof, Division 2, Dust-Ignition proof, Intrinsically Safe



Explosion proof, Non-incendive, Dust-Ignition proof, Intrinsic Safety

ATEX Flameproof, Type n, Intrinsic Safety

IECEX Flameproof, Type n, Intrinsic Safety

Refer to tables 3, 4, 5, and 6 for specific approval information

Electrical Housing: Meets NEMA 4X, CSA Type 4X, IEC 60529 IP66

Connections

Supply Pressure: 1/4-inch NPT female and integral pad for mounting 67CFR regulator

Output Pressure: 1/4-inch NPT female

Tubing: 3/8-inch metal, recommended

Vent (pipe-away): 3/8-inch NPT female

Electrical: 1/2-inch NPT female conduit connection. **optional**—M20 female conduit connection, spring clamp terminal connection⁽⁸⁾

Operating Ambient Temperature Limits⁽³⁾

–40 to 80°C (–40 to 176°F) for most approved valve-mounted instruments

–40 to 125°C (–40 to 257°F) for remote-mounted feedback unit.

–52 to 80°C (–62 to 176°F) for valve-mounted instruments utilizing the Extreme Temperature option (fluorosilicone elastomers).

Construction Materials

Housing, module base and terminal box:

ASTM B85 A03600 low copper aluminum alloy (standard)

CF8M (cast 316 stainless steel) (optional for

valve-mounted instruments only)

Cover: Thermoplastic polyester

Elastomers

Standard: Nitrile

Optional: Fluorosilicone

Stem Travel

DVC6010, DVC6015:

0 to 102 mm (4 inches) maximum travel span

0 to 9.5 mm (3/8 inches) minimum travel span

DVC6020, DVC6025: 0 to 606 mm (23-7/8 inches) maximum travel span

Shaft Rotation (DVC6020, DVC6025, DVC6030 and DVC6035)

0 to 50 degrees minimum

0 to 90 degrees maximum

Mounting

Designed for direct actuator mounting or remote pipestand or wall mounting. Mounting the instrument vertically, with the vent at the bottom of the assembly, or horizontally, with the vent pointing down, is recommended to allow drainage of moisture that may be introduced via the instrument air supply.

Weight

Valve-Mounted Instruments.

Aluminum: 3.5 kg (7.7 lbs)

Stainless steel: 7.7 kg (17 lbs)

Remote-Mounted Instruments.

DVC6005 Base Unit: 4.1 kg (9 lbs)

DVC6015 Feedback Unit: 1.3 kg (2.9 lbs)

DVC6025 Feedback Unit: 1.4 kg (3.1 lbs)

DVC6035 Feedback Unit: 0.9 kg (2.0 lbs)

Options

- Supply and output pressure gauges or
- Tire valves,
- Integral mounted filter regulator,
- Stainless steel housing, module base and terminal box (valve-mounted instruments only),
- Low-Bleed Relay, ■ Extreme Temperature

1. 3-conductor shielded cable, 22 AWG minimum wire size, is recommended for connection between base unit and feedback unit. Pneumatic tubing between base unit output connection and actuator has been tested to 15 meters (50 feet) maximum without performance degradation.

2. These terms are defined in ISA Standard S51.1.

3. The pressure/temperature limits in this document and any other applicable code or standard should not be exceeded.

4. Normal m³/hour – Normal cubic meters per hour at 0°C and 1.01325 bar, absolute. Scfh – Standard cubic feet per hour at 60°F and 14.7 psia.

5. Values at 1.4 bar (20 psig) based on a single-acting direct relay; values at 5.5 bar (80 psig) based on double-acting relay.

6. The Low Bleed Relay is offered as standard relay for DVC6000 SIS tier, used for On/Off applications.

7. Typical value. Not applicable for Type DVC6020 digital valve controllers in long-stroke applications or remote-mounted Type DVC6005 digital valve controllers with long pneumatic tubing lengths.

8. ATEX/IEC approvals only.

Table 1. DVC6000 Product Level Capabilities

CAPABILITY	DIAGNOSTIC TIER LEVEL					
	AC	HC	AD	PD	SIS ⁽¹⁾	ODV
Auto Calibration	X	X	X	X	X	X
Burst Communication		X	X	X	X	X
Custom Characterization	X	X	X	X	X	X
Alerts		X	X	X	X	X
Step Response, Drive Signal Test & Dynamic Error Band, Valve Signature			X	X	X	X
Performance Tuner			X	X	X	X
Travel Control – Pressure Fallback			X	X		X
Performance Diagnostics				X		X
Partial Stroke Testing					X	X
Lead/Lag Input Filter ⁽²⁾						X

1. Refer to Bulletin 62.1:DVC6000 SIS for information on FIELDVUE[®] DVC6000 Series digital valve controllers for Safety Instrumented System (SIS) Solutions.
2. Refer to brochure part # D351146X012 / D351146X412 for information on Fisher optimized digital valves for compressor antisurge applications.

Features

- Improved Control**—Two-way digital communications give you current valve conditions. You can rely on this real-time information to make sound process management decisions. By analyzing valve dynamics through AMS ValveLink[®] Software you can identify control areas needing improvement and maintain a high level of system performance.

- Environmental Protection**—You can avoid additional field wiring by connecting a leak detector or limit switch to the auxiliary terminals in the DVC6000 Series digital valve controller. In this way, the instrument will issue an alert if limits are exceeded.

- Enhanced Safety**—You can check instrument and valve operation and keep the process running smoothly and safely from a remote location. Access is possible at a field junction box, marshalling panel, or within the safety of the control room using either a 375 Field Communicator, a notebook PC, or a system workstation. Your exposure to hazardous environments is minimized and you can avoid having to access hard-to-reach valve locations.

- Hardware Savings**—DVC6000 Series digital valve controllers, when used in an integrated system, allow you to realize significant hardware and installation cost savings by replacing other devices in the process loop, such as positioners and limit switches, with a FIELDVUE digital valve controller.

- Built to Survive**—Field-tough DVC6000 Series digital valve controllers have fully encapsulated printed wiring boards that resist the effects of vibration, temperature, and corrosive atmospheres. A separate weather-tight field wiring terminal box isolates field-wiring connections from other areas of the instrument.

- Increased Uptime**—With the self-diagnostic capability of DVC6000 Series digital valve controllers, you can answer questions about a valve's performance, without pulling the valve from the line. You can run diagnostics (I/P and relay integrity, travel deviation, and on-line friction and deadband analysis and trending) while the valve is in service and operating. You can also compare the present valve/actuator signature (bench set, seat load, friction, etc.) against previously stored signatures to discover performance changes, before they cause process control problems.

- Faster Commissioning**—The two-way communication capability allows you to quickly commission loops by remotely identifying each instrument, verifying its calibration, reviewing stored maintenance notes, and more.

- Easy Maintenance**—DVC6000 Series digital valve controllers are modular in design. The module base can be removed from the instrument housing without disconnecting the field wiring, pneumatic connections or stem linkages. This module contains the critical sub-modules so component removal is quick and simple.

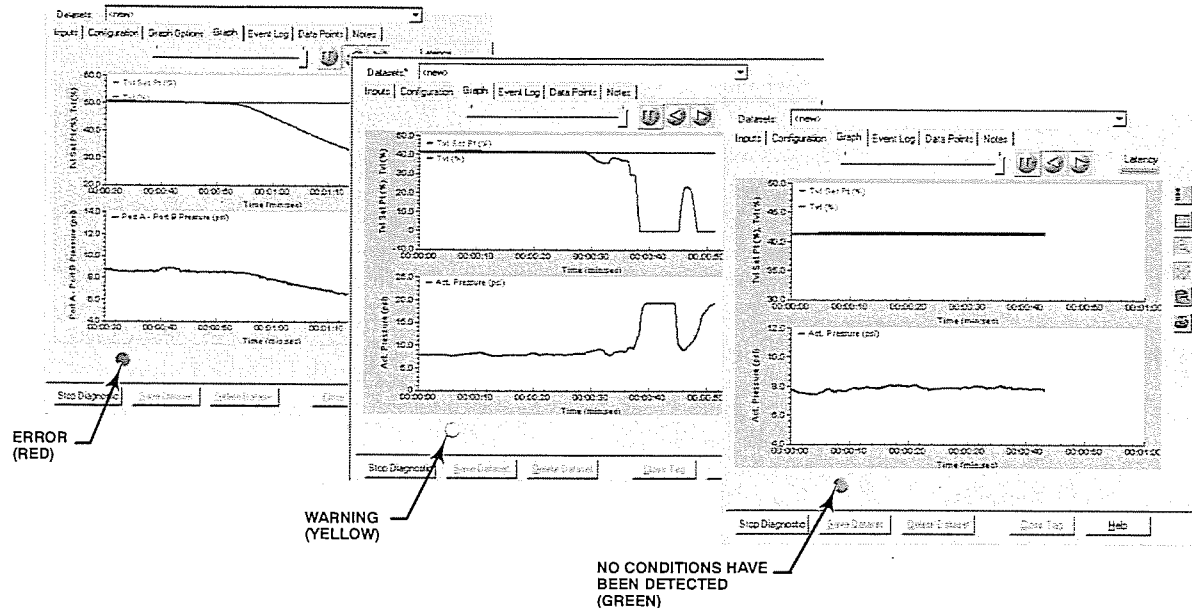


Figure 3. Red/Yellow/Green Condition Indicators, Shown in AMS ValveLink[®] Software

• **Travel Control — Pressure Fallback**—Valve position feedback is critical to the operation of a digital valve controller. Without this feedback, the control valve assembly traditionally goes to its fail safe position. DVC6000 Series digital valve controllers can detect position feedback problems caused by a travel sensor failure or linkage failure and continue to operate in “pressure control” mode. If a problem with the valve position feedback is detected, the instrument will automatically disable the travel sensor, send an alert, and control its output pressure much like an I/P transducer. This allows the valve assembly to continue to operate with reduced accuracy until maintenance can be scheduled.

Diagnostics

DVC6000 Series digital valve controllers are packed with user-configurable alerts and alarms. When integrated with a HART communication-based system, these flags provide real-time notification of current and potential valve and instrument problems. With AMS ValveLink Software, tests can be performed to identify problems with the entire control

valve assembly. Diagnostic capabilities available are Performance Diagnostics (PD) and Advanced Diagnostics (AD). Refer to table 1 for details on the capabilities of each diagnostic tier.

Performance Diagnostics

Performance Diagnostics enables the use of diagnostics while the valve is in service and operating.

- Red/Yellow/Green Condition Indicator (see figure 3)
- I/P and Relay Integrity Diagnostic
- Travel Deviation Diagnostic
- One-Button Diagnostic

The One-Button Diagnostic, (shown in figure 4), is a 20 second sweep which runs the I/P and Relay Integrity, Relay Adjustment Travel Deviation, Supply Pressure, and Air Mass Flow Performance Diagnostic tests. When the sweep is complete, AMS ValveLink Software will show any errors, possible causes, and recommended actions to resolve the error(s).

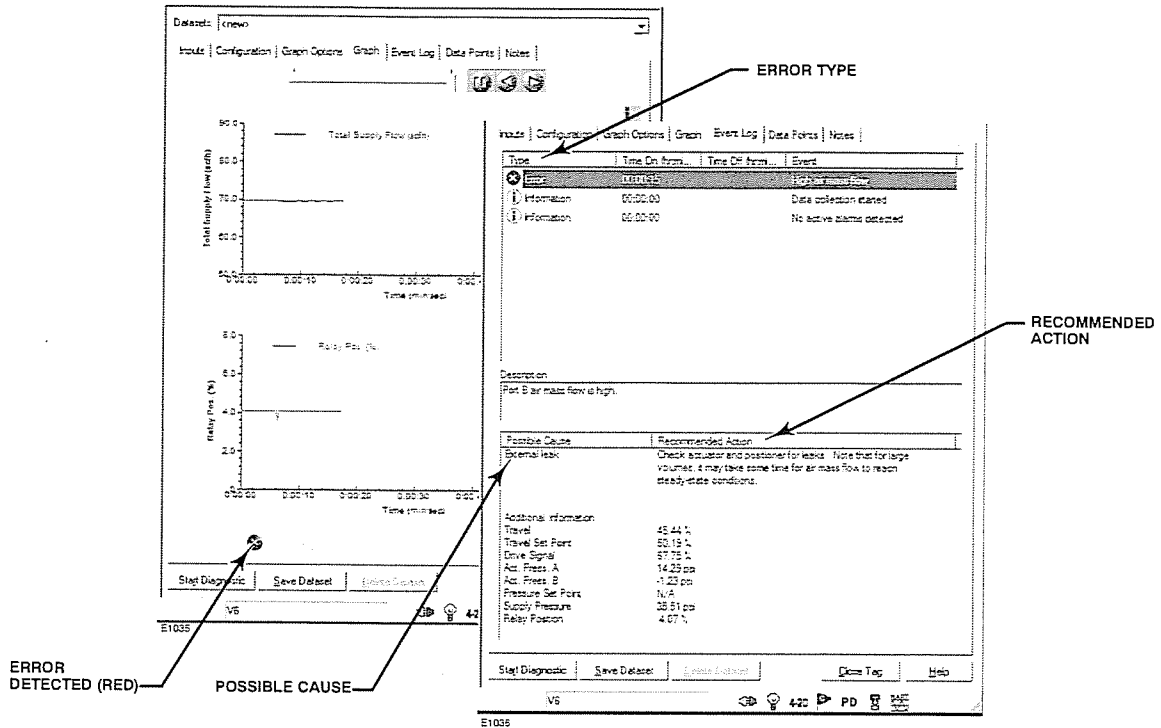


Figure 4. One-Button Sweep—Air Mass Flow Diagnostic

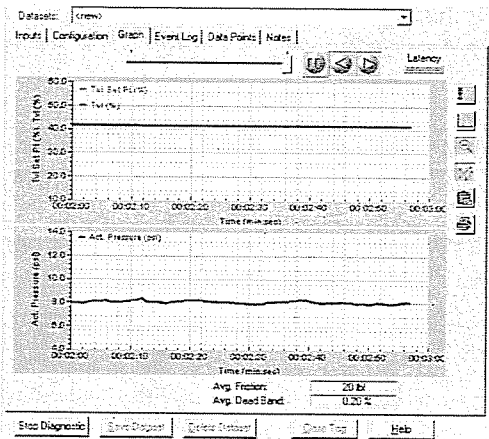


Figure 5. Valve Friction and Deadband Analysis

- On-Line/In-Service Friction and Deadband Analysis (see figure 5)
- Friction and Deadband Trending

While all diagnostics can be run while the valve is inline, only the Performance Diagnostics can be performed while the valve is in service and operating.

Advanced Diagnostics

Advanced Diagnostics include the following dynamic scan tests:

- Valve Signature (see figure 6)
- Dynamic Error Band
- Instrument Drive Signal

These diagnostic scans vary the positioner set point at a controlled rate and plot valve operation to determine valve dynamic performance. The valve signature test allows you to determine the valve/actuator friction, bench set, spring rate, and seat load. The Dynamic Error Band test is a combination of hysteresis and deadband plus “slewing.” Hysteresis and deadband are static measurements. However, because the valve is moving, a dynamic error, or “slewing” error is introduced.

Dynamic scan tests give a better indication of how the valve will operate under process conditions which are dynamic, not static.

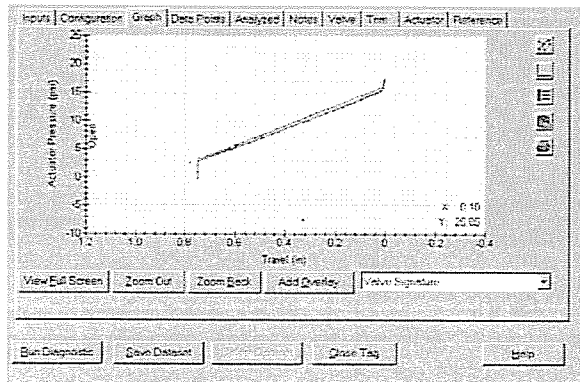


Figure 6. The Valve Signature Display

The Step Response Test checks the valve assemblies response to a changing input signal, and plots travel versus time. The end results of this test allow you to evaluate the dynamic performance of the valve. The Performance Step Test (25 pre-configured points) provides a standardized step test with which to evaluate your valve performance. It utilizes small, medium and large changes.

Advanced Diagnostics are performed with AMS ValveLink Software. The valve must be out of service for Advanced Diagnostics to be performed.

Integration

- **Non-HART® Systems**—Because DVC6000 Series digital valve controllers operate with a traditional 4 to 20 mA control signal, they directly replace older analog instruments. Microprocessor-based electronics provide improved performance along with repeatable and reliable configuration and calibration.

- **Modbus with AMS ValveLink® Software and HART® Multiplexers**—HART communication allows you to extract more value from DVC6000 Series digital valve controllers beyond their inherent improved performance. When integrated into a multiplexer network and using AMS ValveLink Software, the device and valve information is

real-time. From the safety of a control room, multiple instruments can be monitored for alerts and alarms. Additionally, tasks such as configuration, calibration and diagnostic testing do not require special trips to the field. AMS ValveLink Software can communicate via Modbus to the distributed control system (DCS) to provide critical information such as valve travel alerts and alarms (figure 7).

- **Integrated Control System**—A control system with HART communication capabilities has the ability to directly gather information from DVC6000 Series digital valve controllers. Information such as valve travel, alerts and alarms can be seamlessly accessed to provide a view into the field device from the safety of the control room.

Communication

HART® Protocol Overview

The HART (Highway Addressable Remote Transducer) protocol gives field devices the capability of communicating instrument and process data digitally. This digital communication occurs over the same two-wire loop that provides the 4 to 20 mA process control signal, without disrupting the process signal (figure 8). In this way, the analog process signal, with its faster response, can be used for control. At the same time, the HART digital communication gives access to calibration, configuration, diagnostic, maintenance, and additional process data. The protocol provides total system integration via a host device.

The HART protocol gives you the capability of multidropping, where you can network several devices to a single communications line. This process is well suited for remote applications such as pipelines, custody transfer sites, and tank farms.

Model 375 Field Communicator

You can perform configuration and calibration at the valve or anywhere on the two-wire loop via a Model 375 Field Communicator (figure 9). Powerful tools such as the Setup Wizard and Auto Travel Calibration automate the tasks of commissioning DVC6000 Series digital valve controllers. These automation tools not only save time, but also provide accurate and repeatable results.

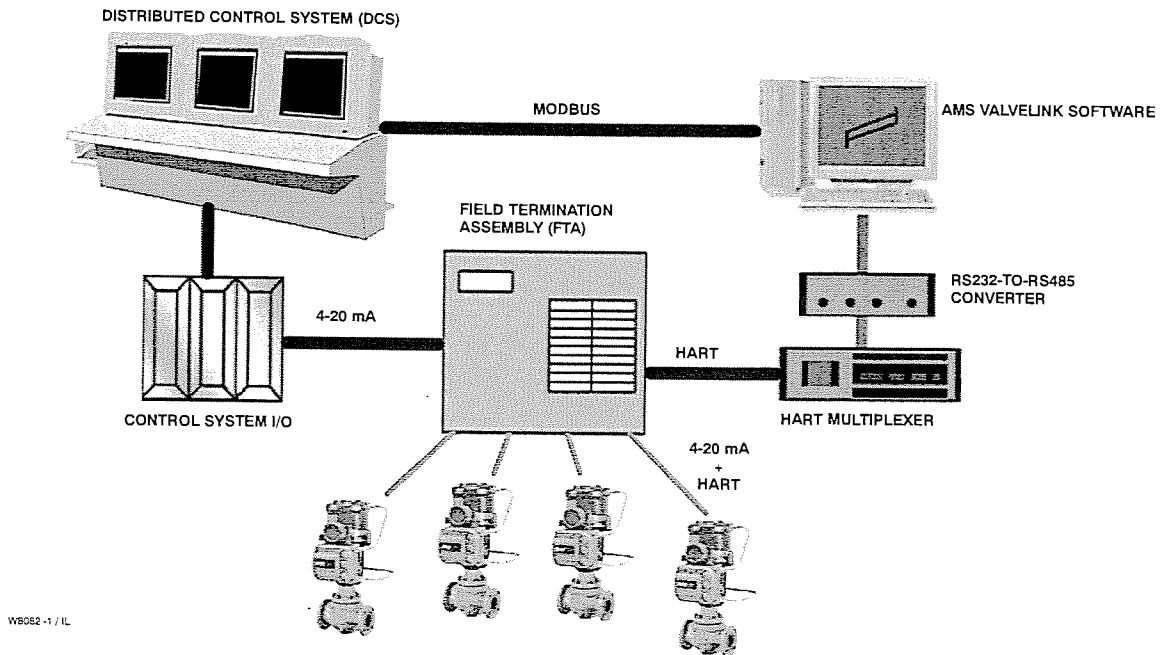


Figure 7. Integrate Information from the Digital Valve Controller into a Non-HART® Compatible Control System With AMS ValveLink® Software's Modbus Interface

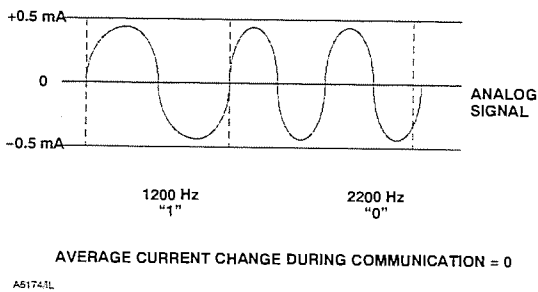


Figure 8. HART® Frequency Shift Keying Technique

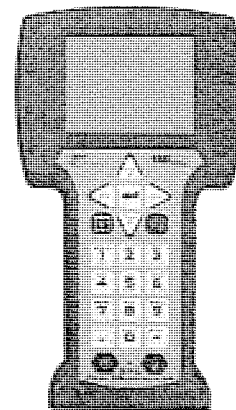


Figure 9. Perform Configuration and Calibration at the Valve or Anywhere on the 4 to 20 mA Loop with the Model 375 Field Communicator

AMS ValveLink® Software

AMS ValveLink Software is a Windows®-based software package that allows easy access to the information available from DVC6000 Series digital valve controllers.

Using AMS ValveLink Software, you can monitor the performance characteristics of the valve and obtain vital information without having to pull the valve from the line. I/P and Relay Integrity and Travel Deviation

Diagnostics, as well as On-Line Friction and Deadband Analysis and Trending can be run while the valve is in service and operating. Valve Signature, Dynamic Error Band, and Step Response are displayed in an intuitive user-friendly environment that allows easy interpretation of data.

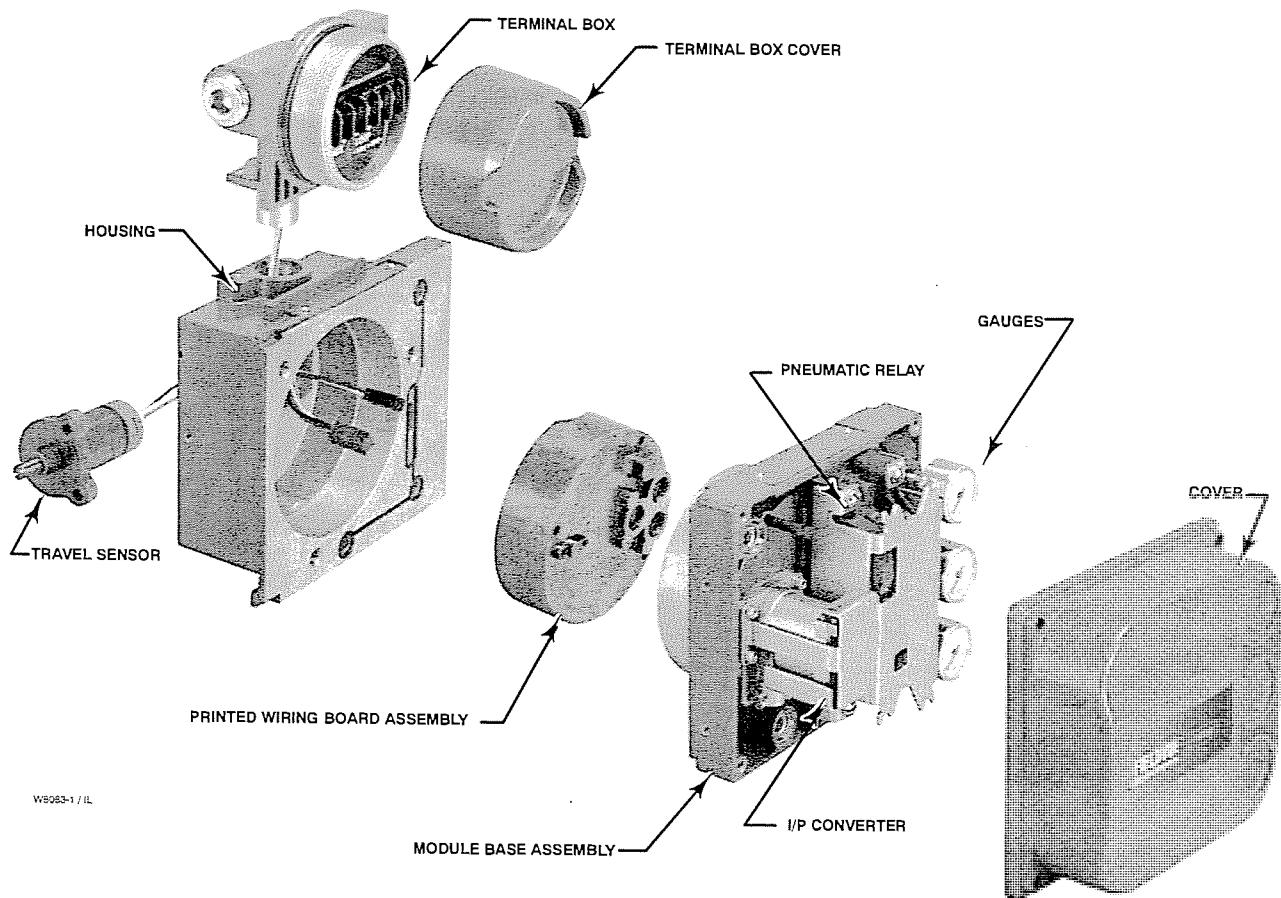


Figure 10. DVC6000 Series Digital Valve Controller Assembly (Valve-Mounted Instrument)

Diagnostic graphs can be superimposed over those previously stored to view areas of valve degradation. This allows plant personnel to concentrate efforts on equipment that needs repair, avoiding unnecessary maintenance. This diagnostic capability is readily accessible and available to you either in the control room or on the plant floor. In addition to the diagnostic features, AMS ValveLink Software contains an Audit Trail, Batch Runner for automating repetitive tasks, and Trending to view valve performance.

AMS ValveLink Software provides integration into AMS and DeltaV™, with HART and Fieldbus communications.

Principle of Operation

DVC6000 Series instruments (figures 10 and 11) receive a set point and position the valve where it needs to be.

- The input signal provides electrical power and the set point simultaneously. It is routed into the terminal box through a twisted pair of wires.
- The input signal is then directed to the printed wiring board assembly where the microprocessor runs a digital control algorithm resulting in a drive signal to the I/P converter.
- The I/P converter assembly is connected to supply pressure and converts the drive signal into a pressure output signal.

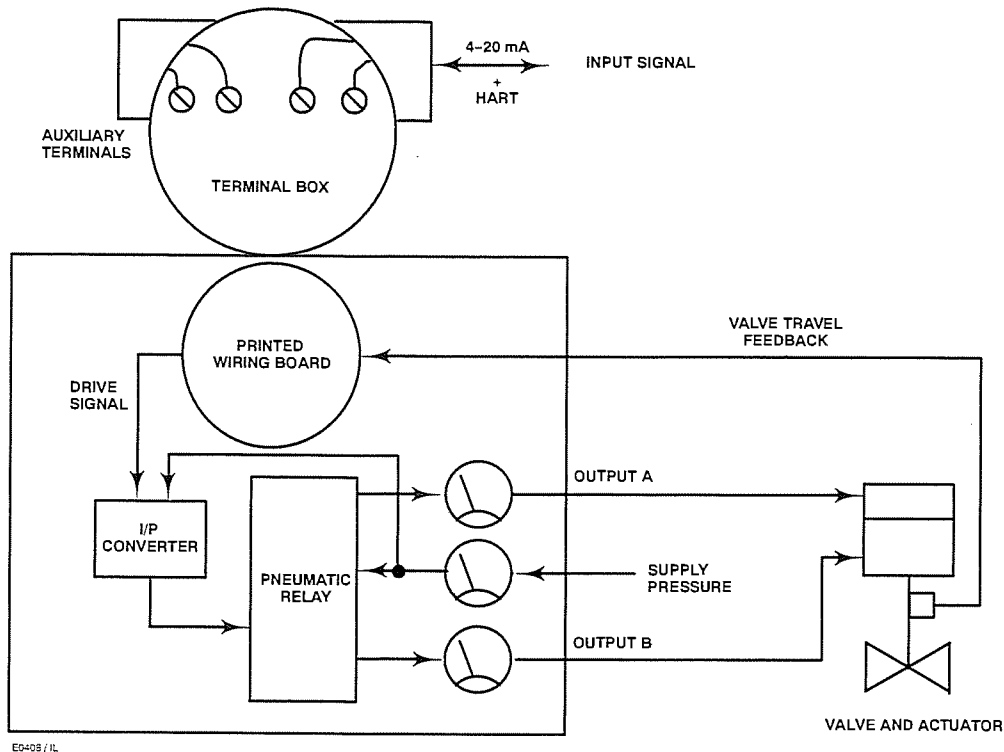


Figure 11. DVC6000 Series Digital Valve Controller Block Diagram

- The I/P output is sent to the pneumatic relay assembly. The relay is also connected to supply pressure and amplifies the small pneumatic signal from the I/P converter into a single larger pneumatic output signal used by a single-acting actuator. For double-acting actuators, the relay accepts the pneumatic signal from the I/P converter and provides two pneumatic output signals.

- The change in relay output pressure to the actuator causes the valve to move.

- Valve position is sensed through the feedback linkage by the instrument's travel sensor. The travel sensor is electrically connected to the printed wiring board to provide a travel feedback signal used in the control algorithm.

The valve continues to move until the correct position is attained.

Installation

The Type DVC6010 digital valve controller is designed for yoke mounting to sliding stem actuators. Type DVC6020 digital valve controllers are designed for mounting to rotary actuators or long stroke sliding stem actuators (over 4-inches travel). Type DVC6030 digital valve controllers are designed for mounting on virtually any quarter-turn actuator. Dimensions for valve-mounted instruments are shown in figures 12, 13, and 14. Dimensions for remote-mounted instruments are shown in figures 15 and 16.

The Type DVC6005 digital valve controller base unit may be remote mounted on 2-inch pipestand or wall. The remote-mounted DVC6005 base unit connects to the DVC6015, DVC6025, or DVC6035 feedback unit mounted on the actuator. Feedback wiring and pneumatic tubing to the control valve assembly must be connected in the field.

Product Bulletin

62.1:DVC6000
July 2006

DVC6000 Series

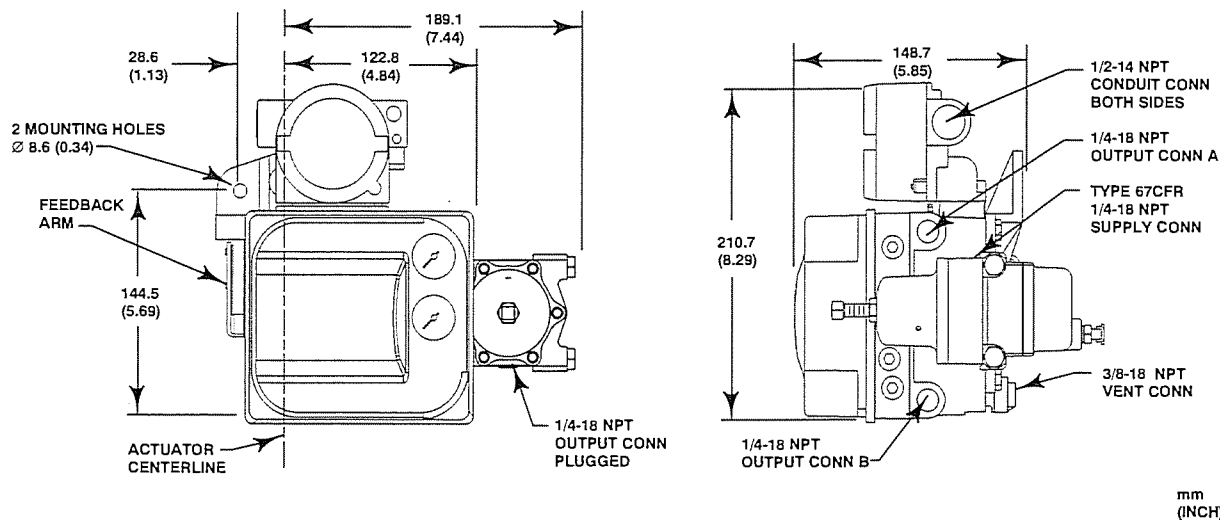


Figure 12. Dimensions for Type DVC6010 Digital Valve Controller with Integrally Mounted Filter Regulator

The digital valve controllers are 4 to 20 mA loop powered and do not require additional power. Electrical connections are made in the terminal box.

All pressure connections on the digital valve controllers are 1/4-inch NPT female connections. The digital valve controller outputs are typically connected to the actuator inputs using 3/8-inch diameter tubing. Remote venting is available.

- Supply pressure regulator
- Supply and output gauges
- HART filter
- Stainless steel housing (valve-mounted instruments only)
- Remote mounting

Ordering Information

When ordering, specify:

- Actuator type and size
- Maximum actuator travel or rotation
- Options

Note

Neither Emerson, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use and maintenance of any product remains with the purchaser and end-user.

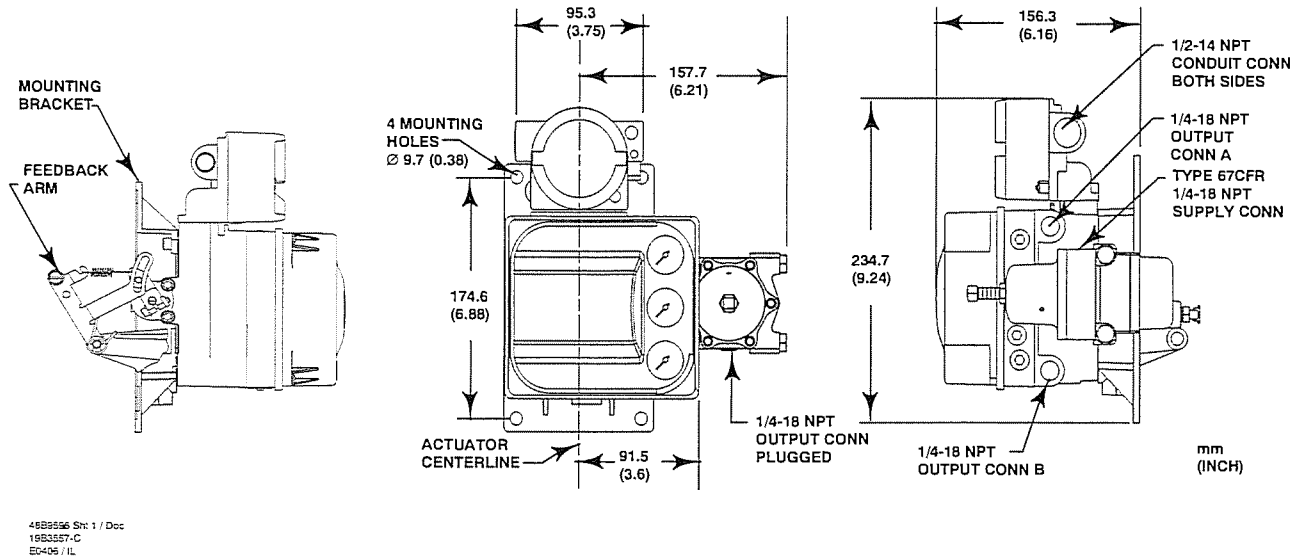


Figure 13. Dimensions for Type DVC6020 Digital Valve Controller with Integrally Mounted Filter Regulator

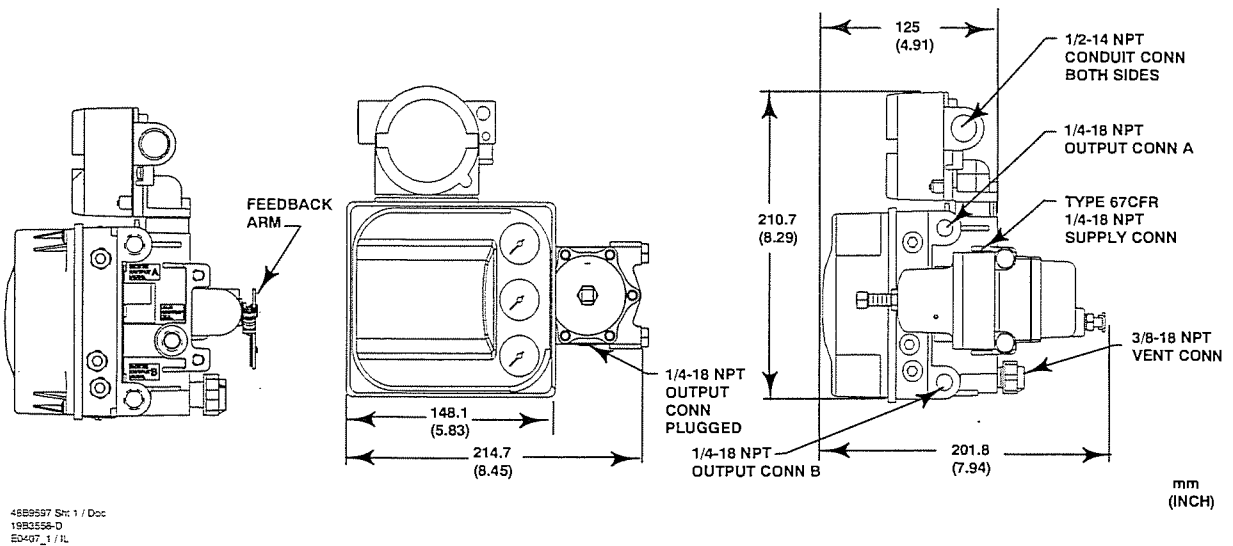
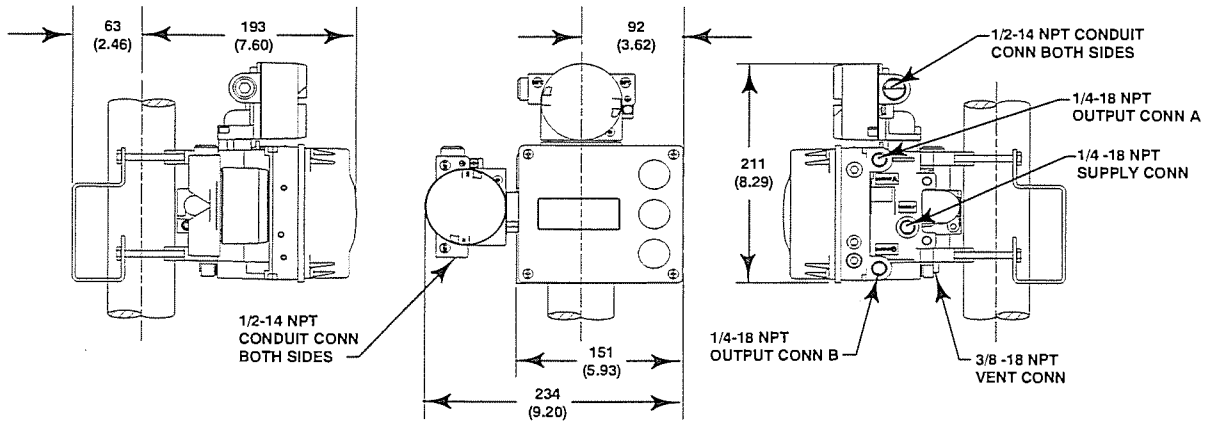
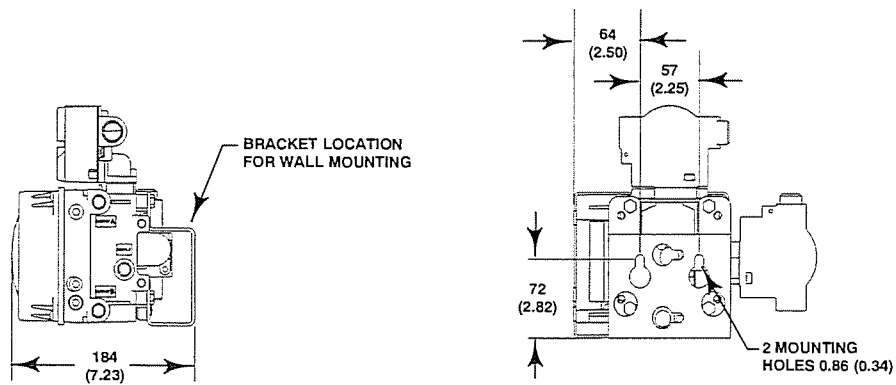


Figure 14. Dimensions for Type DVC6030 Digital Valve Controller with Integrally Mounted Filter Regulator



PIPESTAND MOUNTED

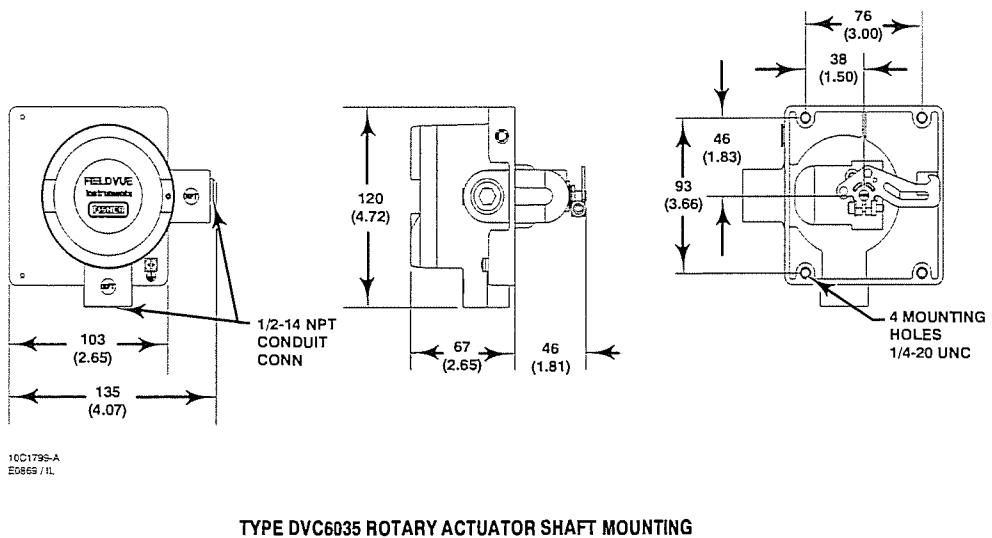
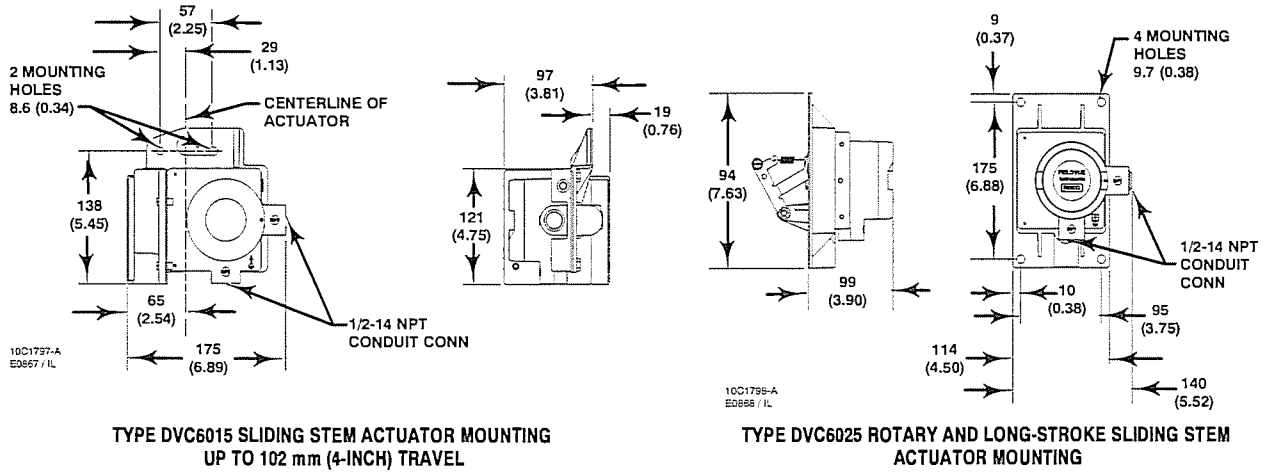


WALL MOUNTED

mm
(INCH)

10C1795-A / DDC
 10C1796-A / DDC
 E1039

Figure 15. Dimensions for Remote-Mounted Instruments—Type DVC6005 Base Unit



mm
(INCH)

Figure 16. Dimensions for Remote-Mounted Instruments—Feedback Units

Product Bulletin

62.1:DVC6000

July 2006

DVC6000 Series

Table 2. Immunity Performance

Port	Phenomenon	Basic Standard	Performance Criteria ⁽¹⁾	
			Point-to-Point Mode	Multi-drop Mode
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	A ⁽²⁾	A
	Radiated EM field	IEC 61000-4-3	A	A
	Rated power frequency magnetic field	IEC 61000-4-8	A	A
I/O signal/control	Burst	IEC 61000-4-4	A ⁽²⁾	A
	Surge	IEC 61000-4-5	A ⁽²⁾	A
	Conducted RF	IEC 61000-4-6	A	A

1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering.
 2. Excluding auxiliary switch function, which meets Performance Criteria B.

Table 3. Type DVC6000 Series, Hazardous Area Classifications for Canada—CSA

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING		TEMPERATURE CODE	ENCLOSURE RATING	
CSA	DVC60x0 DVC60x0S (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3428	$V_{max} = 30$ Vdc $I_{max} = 226$ mA $C_i = 5$ nF $L_i = 0.55$ mH		T5($T_{amb} \leq 80^\circ\text{C}$)	4X	
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D		---	T6($T_{amb} \leq 80^\circ\text{C}$)	4X	
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1		---	T6($T_{amb} \leq 80^\circ\text{C}$)	4X	
	DVC6005	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D,E, F,G per drawing 29B3520	$V_{max} = 30$ Vdc $I_{max} = 226$ mA $C_i = 5$ nF $L_i = 0.55$ mH	$V_{oc} = 9.6$ Vdc $I_{sc} = 3.5$ mA $C_a = 3.6$ μ F $L_a = 100$ mH		T6($T_{amb} \leq 60^\circ\text{C}$)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP C,D		---	T6($T_{amb} \leq 60^\circ\text{C}$)	4X	
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1		---	T6($T_{amb} \leq 60^\circ\text{C}$)	4X	
	DVC60x5 (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3520	$V_{max} = 10$ Vdc $I_{max} = 4$ mA $C_i = 0$ nF $L_i = 0$ mH			T4($T_{amb} \leq 125^\circ\text{C}$) T5($T_{amb} \leq 95^\circ\text{C}$) T6($T_{amb} \leq 80^\circ\text{C}$)	4X
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D		---		T4($T_{amb} \leq 125^\circ\text{C}$) T5($T_{amb} \leq 95^\circ\text{C}$) T6($T_{amb} \leq 80^\circ\text{C}$)	4X
		Class I Division 2 GP A,B,C,D Class II Division 1 GP E,F,G Class III Division 1		---		T4($T_{amb} \leq 125^\circ\text{C}$) T5($T_{amb} \leq 95^\circ\text{C}$) T6($T_{amb} \leq 80^\circ\text{C}$)	4X

DVC6000 Series

Table 4. Type DVC6000 Series, Hazardous Area Classifications for United States—FM

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING		TEMPERATURE CODE	ENCLOSURE RATING	
FM	DVC60x0 DVC60x0S (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D,E, F,G per drawing 29B3427	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 226 \text{ mA}$ $C_i = 5 \text{ nF}$ $L_i = 0.55 \text{ mH}$ $P_i = 1.4 \text{ W}$		$T5(T_{amb} \leq 80^\circ\text{C})$	4X	
		(Explosion Proof) Class/Division Class I, Division 1 GP B,C,D	---		$T6(T_{amb} \leq 80^\circ\text{C})$	4X	
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	---		$T6(T_{amb} \leq 80^\circ\text{C})$	4X	
	DVC6005	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3521	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 226 \text{ mA}$ $C_i = 5 \text{ nF}$ $L_i = 0.55 \text{ mH}$ $P_i = 1.4 \text{ W}$	$V_{oc} = 9.6 \text{ Vdc}$ $I_{sc} = 3.5 \text{ mA}$ $C_a = 3.6 \mu\text{F}$ $L_a = 100 \text{ mH}$ $P_o = 8.4 \text{ mW}$	$T6(T_{amb} \leq 60^\circ\text{C})$		4X
		(Explosion Proof) Class/Division Class I, Division 1 GP C,D	---		$T6(T_{amb} \leq 60^\circ\text{C})$	4X	
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	---		$T6(T_{amb} \leq 60^\circ\text{C})$	4X	
	DVC60x5 (x = 1,2,3)	(Intrinsic Safety) Class/Division Class I,II,III Division 1 GP A,B,C,D, E,F,G per drawing 29B3521	$V_{max} = 10 \text{ Vdc}$ $I_{max} = 4 \text{ mA}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$ $P_i = 10 \text{ mW}$	$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$		4X	
		(Explosion Proof) Class/Division Class I, Division 1 GP A,B,C,D	---		$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$	4X	
		Class I Division 2 GP A,B,C,D Class II,III Division 1 GP E,F,G Class II,III Division 2 GP F,G	---		$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$	4X	

Table 5. Type DVC6000 Series, Hazardous Area Classifications—ATEX

CERTIFICATE	TYPE	CERTIFICATION OBTAINED	ENTITY RATING		TEMPERATURE CODE	ENCLOSURE RATING
ATEX	DVC60x0 DVC60x0S (x = 1,2,3)	Ⓔ II 1 G D Gas EEx ia IIC T5/T6—Intrinsic Safety Dust T85°C (T _{amb} ≤ 80°C)	U _i = 30 Vdc I _i = 226 mA C _i = 5 nF L _i = 0.55 mH P _i = 1.4 W		T5(T _{amb} ≤ 80°C) T6 (T _{amb} ≤ 75°C)	IP66
		Ⓔ II 2 G D Gas EEx d IIB+H2 T5/T6—Flameproof Dust T90°C (T _{amb} ≤ 85°C)	---		T5(T _{amb} ≤ 85°C) T6 (T _{amb} ≤ 75°C)	IP66
		Ⓔ II 3 G D Gas EEx nCL IIC T5/T6—Type n Dust T85°C (T _{amb} ≤ 80°C)	---		T5(T _{amb} ≤ 80°C) T6 (T _{amb} ≤ 75°C)	IP66
	DVC6005	Ⓔ II 1 G D Gas EEx ia IIC T5/T6—Intrinsic Safety Dust T85°C (T _{amb} ≤ 80°C)	U _i = 30 Vdc I _i = 226 mA C _i = 5 nF L _i = 0.55 mH P _i = 1.4 mW	U _o = 9.6 Vdc I _o = 3.5 mA C _o = 3.6 uF L _o = 100 mH P _o = 8.4 mW	T5(T _{amb} ≤ 80°C) T6(T _{amb} ≤ 75°C)	IP66
		Ⓔ II 2 G D Gas EEx d IIB T5/T6—Flameproof Dust T90°C (T _{amb} ≤ 80°C)	---		T5(T _{amb} ≤ 80°C) T6 (T _{amb} ≤ 70°C)	IP66
		Ⓔ II 3 G D Gas EEx nL IIC T5/T6—Type n Dust T85°C (T _{amb} ≤ 80°C)	---		T5(T _{amb} ≤ 80°C) T6 (T _{amb} ≤ 75°C)	IP66
	DVC60x5 (x = 1,2,3)	Ⓔ II 1 G D Gas EEx ia IIC T4/T5/T6—Intrinsic Safety Dust T130°C (T _{amb} ≤ 125°C)	U _i = 10 Vdc I _i = 4 mA C _i = 0 nF L _i = 0 mH P _i = 10 mW		T4(T _{amb} ≤ 125°C) T5(T _{amb} ≤ 95°C) T6(T _{amb} ≤ 80°C)	IP66
		Ⓔ II 2 G D Gas EEx d IIC T4/T5/T6—Flameproof Dust T130°C (T _{amb} ≤ 125°C)	---		T4(T _{amb} ≤ 125°C) T5(T _{amb} ≤ 95°C) T6(T _{amb} ≤ 80°C)	IP66
		Ⓔ II 3 G D Gas EEx nA IIC T4/T5/T6—Type n Dust T130°C (T _{amb} ≤ 125°C)	---		T4(T _{amb} ≤ 125°C) T5(T _{amb} ≤ 95°C) T6(T _{amb} ≤ 80°C)	IP66

Table 6. Type DVC6000 Series, Hazardous Area Classifications—IECEX

CERTIFICATE	TYPE	CERTIFICATION OBTAINED	ENTITY RATING		TEMPERATURE CODE	ENCLOSURE RATING	
IECEX	DVC60x0 DVC60x0S (x = 1,2,3)	Gas Ex ia IIC T5/T6—Intrinsic Safety	$U_i = 30 \text{ Vdc}$ $I_i = 226 \text{ mA}$ $C_i = 5 \text{ nF}$ $L_i = 0.55 \text{ mH}$ $P_i = 1.4 \text{ W}$		$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
		Gas Ex d IIB+H2 T5/T6—Flameproof	---		$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
		Gas Ex nC IIC T5/T6—Type n	---		$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
	DVC6005	Gas Ex ia IIC T5/T6—Intrinsic Safety	$U_i = 30 \text{ Vdc}$ $I_i = 226 \text{ mA}$ $C_i = 5 \text{ nF}$ $L_i = 0.55 \text{ mH}$ $P_i = 1.4 \text{ W}$	$U_o = 9.6 \text{ Vdc}$ $I_o = 3.5 \text{ mA}$ $C_o = 3.6 \mu\text{F}$ $L_o = 100 \text{ mH}$ $P_o = 8.4 \text{ mW}$	$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
		Gas Ex d IIB T5/T6—Flameproof	---		$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
		Gas Ex nC IIC T5/T6—Type n	---		$T5(T_{amb} \leq 80^\circ\text{C})$ $T6(T_{amb} \leq 75^\circ\text{C})$	IP66	
	DVC60x5 (x = 1,2,3)	Gas Ex ia IIC T4/T5/T6—Intrinsic Safety	$U_i = 10 \text{ Vdc}$ $I_i = 4 \text{ mA}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$ $P_i = 10 \text{ mW}$			$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$	IP66
		Gas Ex d IIC T4/T5/T6—Flameproof	---		$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$	IP66	
		Gas Ex nA IIC T4/T5/T6—Type n	---		$T4(T_{amb} \leq 125^\circ\text{C})$ $T5(T_{amb} \leq 95^\circ\text{C})$ $T6(T_{amb} \leq 80^\circ\text{C})$	IP66	

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**Errata Sheet
for**

The following Instruction Manuals and Quick Start Guides

Title	Form Number	Date	Page Number
FIELDVUE [®] DVC6000 Series Digital Valve Controller Instruction Manual	5647	May 2005	1-5
FIELDVUE [®] DVC6000 Series Digital Valve Controllers Quick Start Guide	5654	May 2005	4-1
FIELDVUE [®] DVC6000f Series Digital Valve Controller Instruction Manual	5774	March 01, 2005	1-5 and 1-6
FIELDVUE [®] DVC6000f Series Digital Valve Controllers Quick Start Guide	5778	April 2005	4-1 and 4-2

Please replace the Steady-State Air Consumption and the Maximum Output Capacity data found in the Specification table of each of the documents listed above with the following, updated data. Note that the footnotes currently associated with this data remain the same.

Steady-State Air Consumption

Standard Relay: At 1.4 bar (20 psig) supply pressure: Less than 0.38 normal m³/hr (14 scfh)
At 5.5 bar (80 psig) supply pressure: Less than 1.3 normal m³/hr (49 scfh)

Low Bleed Relay: At 1.4 bar (20 psig) supply pressure: Average value 0.056 normal m³/hr (2.1 scfh)
At 5.5 bar (80 psig) supply pressure: Average value 0.184 normal m³/hr (6.9 scfh)

Maximum Output Capacity

At 1.4 bar (20 psig) supply pressure:
10.0 normal m³/hr (375 scfh)
At 5.5 bar (80 psig) supply pressure:
29.5 normal m³/hr (1100 scfh)

Note

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Note: Normal m³/hour – Normal cubic meters per hour at 0° C and 1.01325 bar, absolute. Scfh – Standard cubic feet per hour at 60° F and 14.7 psia



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Fisher Controls

Instruction Manual

Type 119 Control Valve

June 1990

Form 5204

Introduction**Scope of Manual**

This instruction manual provides installation, spring adjustment, maintenance, and parts information for the Type 119 control valve.

Description

The Type 119 control valve (figure 1) is used for on-off or throttling control of noncorrosive or mildly corrosive liquids and gases. It is designed to meet the low-pressure liquid and gas application requirements in many varied industries.

As loading pressure is applied to the Type 119 control valve diaphragm, the disk holder is pulled off the orifice. As loading pressure is reduced, the opposing spring force moves the disk holder toward the closed position, resulting in spring-close action should a loss of supply pressure occur.

Specifications

Table 1 lists specifications for the Type 119 control valve. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate (figure 2) located on the spring case flange.

Installation**WARNING**

To avoid personal injury or property damage caused by controlled process fluid or bursting of pressure-retaining parts, be

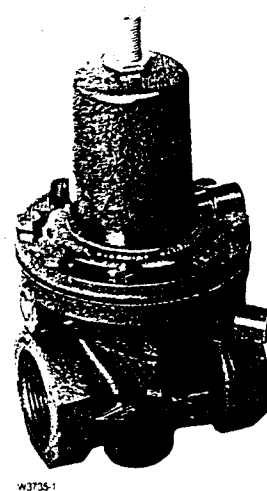


Figure 1. Type 119 Control Valve

certain the service conditions do not exceed the limits shown in table 1. The leak-off and spring case vents must be kept open. To avoid danger of fire or explosion from venting of flammable or otherwise hazardous fluid into a closed or poorly vented location, pipe the vents to a well-ventilated location, away from any buildings or windows so as not to create a further hazard.

1. Before installing the valve, be sure the valve body and associated equipment are free of damage and foreign material.

2. The control valve can be installed in any position, but the normal orientation is with the actuator portion vertical above the body. If installing the control valve at an outside location, point the spring case and bonnet vents in the downward direction to protect them from moisture or foreign materials.

Table 1. Specifications

Maximum Inlet Pressure⁽¹⁾ 150 psig (10.3 bar)	Material Temperature Capabilities⁽¹⁾ With Nitrile Elastomers: - 20 to 170°F (- 29 to 77°C) With Fluoroelastomers: 0 to 250°F (- 18 to 121°C) Note: Not for use with hot water or ammonia.
Spring Ranges See table 2	Flow Direction Up through the seat ring
Maximum Control Pressure to Diaphragm 150 psig (10.3 bar)	Spring Case Vent and Bonnet Leak-Off Connection 1/4-inch NPT female
Maximum Pressure Drop⁽¹⁾ 150 psi (10.3 bar) for all port diameters	Approximate Weight 6 lb (2.7 kg)

1. The pressure and temperature limitations in this manual, and any applicable code limitation, should not be exceeded.

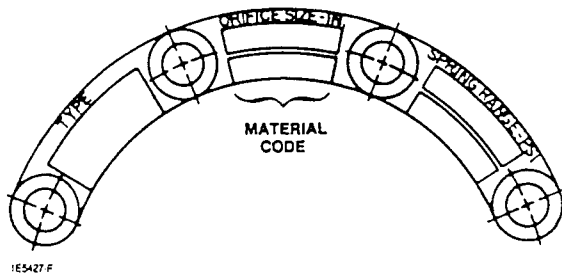


Table 2. Spring Selection

SPRING RANGE		SPRING PART NUMBER	SPRING COLOR CODE
Psig	Bar		
3-15	0.2-1.0	1D8923 27022	Red
5-20	0.3-1.4	1D7515 27022	Cadmium
5-35	0.3-2.4	1D6659 27022	Blue
30-60	2.1-4.1	1D7455 27142	Green

Material Code	Orifice Seat Disk Material
Al/N	Aluminum/Nitrile
SST/N	Stainless steel/Nitrile
SST/V	Stainless steel/Fluoroelastomer

Figure 2. Type 119 Nameplate

3. Install the valve using accepted piping practices. Make sure that the valve is oriented so that flow through the body will match the flow direction arrow on the body.

4. If continuous operation is required during maintenance and inspection, install a three-valve bypass around the control valve.

5. Connect the control pressure line to the 1/4-inch NPT connection in the valve body bonnet marked PILOT.

Spring Adjustment

The control valve spring has been selected to meet the pressure condition requirements of the application as specified on the order. This pressure condition is stamped on the actuator nameplate.

The spring has a fixed pressure span over which loading pressure will stroke the valve. Adjustment of the spring compression shifts the span so that more or less loading pressure is required to start travel. Since the span does not change, there will be a corresponding increase or decrease in the pressure requirements at the end of the valve stroke.

If the control valve has been disassembled or pressure conditions have changed, the spring may need adjustment to make the valve travel coincide with the diaphragm pressure range. Make the adjustment in the following manner. Key numbers refer to figure 3.

1. Loosen the locknut (key 13) on the spring case.
2. Turn the adjusting screw (key 12) clockwise to compress the spring (key 16) or counterclockwise to decrease spring compression. Increased spring compression results in increased loading pressure necessary to start travel. Decreased spring compression results in less loading pressure required to start travel.
3. After adjustment, tighten the locknut. Note that the spring can be identified by the color code. Depending on how much conditions are changed, it may be necessary to install a new spring, using appropriate steps in the Maintenance section. After changing the spring, adjust the valve using the above steps in this section, and indicate the new spring range on the nameplate.

Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. Inspection and maintenance depends on the severity of the service conditions.

WARNING

To avoid personal injury or property damage caused by sudden release of pressure or uncontrolled process fluid, isolate the control valve from the pressure system, and release all pressure from the valve body and actuator before performing maintenance operations.

The following describes the procedure for complete disassembly and assembly of the actuator-valve body combination. When inspection or repairs are required, disassemble only those parts necessary to accomplish the job. Key numbers refer to figure 3.

Disassembly

1. Isolate the control valve from all pressure, and release pressure from the valve body and actuator. Loosen the locknut (key 13), and remove all spring compression from the control valve by turning the adjusting screw (key 12) out of the spring case.
2. Remove the two bonnet cap screws (key 15, not shown) that secure the bonnet to the body, and lift the spring case, bonnet, and trim assembly from the body.
3. Examine the seating edge of the orifice (key 3). If it is nicked or rough, unscrew it from the body with a thinwall 7/8-inch socket wrench, and replace it with a new seat ring of the proper size.

4. Remove the bonnet O-ring (key 11), and inspect it for wear and damage.

5. Unscrew and remove the spring case cap screws (key 14). Remove the spring case, upper spring seat, and spring (keys 2, 17 and 16). Do not lose the nameplate (key 20) when removing the spring case.

6. Pull the hair pin clip (key 6) from the stem and remove the disk holder assembly (key 4).

7. Pull the diaphragm/stem assembly (key 5) out of the bonnet (key 9), and inspect for damage or deterioration. If necessary, replace the entire diaphragm assembly.

8. Without removing the O-rings and bushing spacers (keys 8 and 7) inspect their inside diameter surfaces for damage or deterioration.

Note

The following step should be performed only when there is an indication of O-ring or bushing spacer failure.

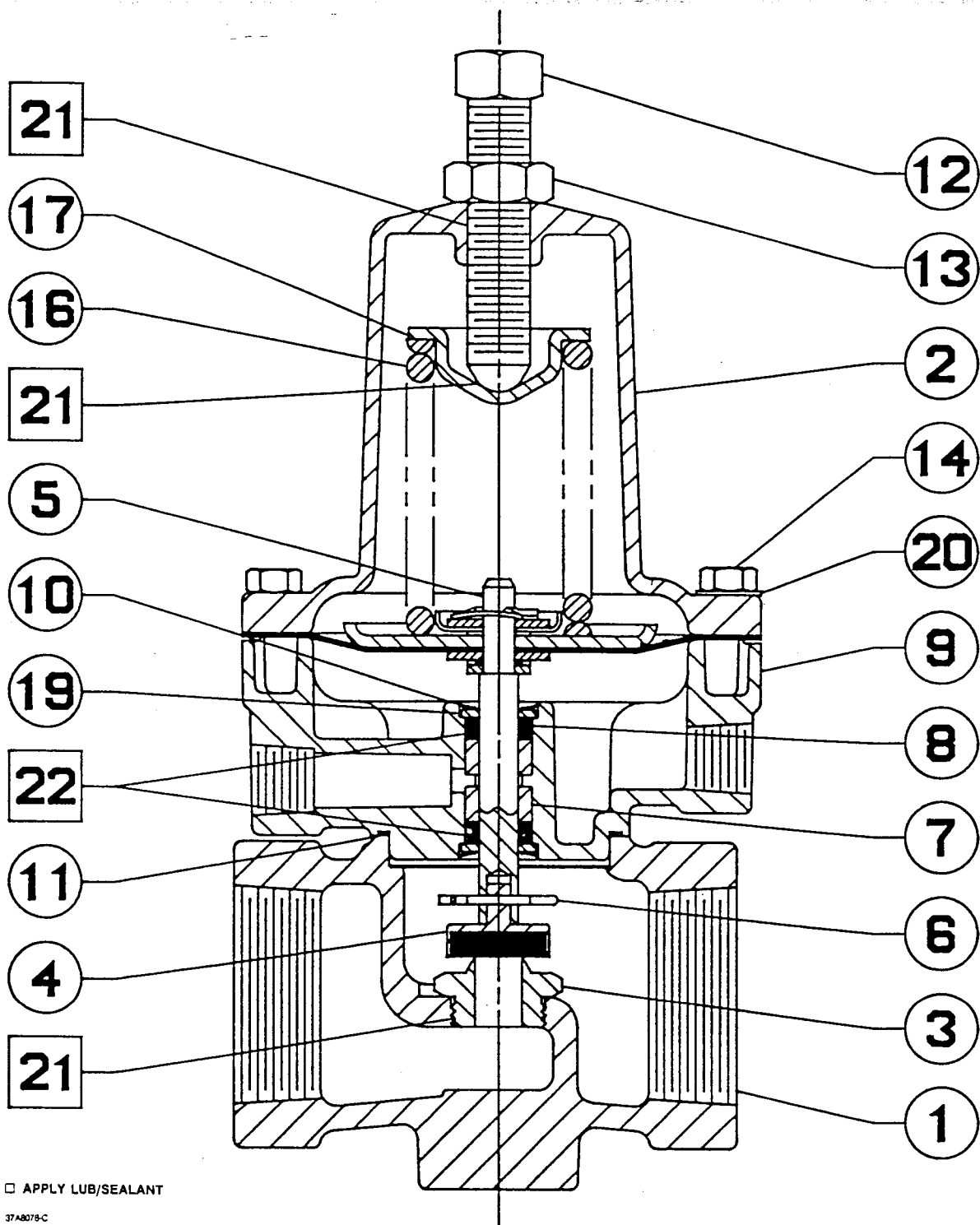
9. Remove the internal retaining rings, stem wipers, O-rings, and bushing spacers (keys 10, 19, 8 and 7). Inspect these parts for wear or deterioration, and replace if necessary.

Assembly

This procedure assumes that the control valve has been completely disassembled. If the control valve has been only partially disassembled, start these instructions at the appropriate step.

1. If the orifice (key 3) was removed during disassembly, lubricate the threads with Never-Seez⁽¹⁾ lubricant (key 21) or equivalent, and screw it into the valve body using a thinwall 7/8-inch socket wrench.
2. Lubricate the bushing spacers, O-rings, stem wipers, and internal retaining rings (keys 7, 8, 19 and 10) with Dow Corning⁽²⁾ No. 111 silicon-base subricant (key 22) or equivalent, and install as shown in figure 3.
3. Carefully slide the diaphragm assembly (key 5) into and through the O-rings and bushing cavity. Turn the diaphragm assembly to line up the diaphragm holes with the bonnet holes.
4. Slide the disk holder assembly (key 4) all the way into the stem. Connect the disk holder assembly with the hair pin clip (key 6).
5. Coat the bonnet O-ring (key 11) with Dow Corning No. 111 lubricant (key 22) or equivalent. Install the O-ring in the recessed notch in the bonnet (key 9).

1. Trademark of Never-Seez Corp.
2. Trademark of Tretolite Div. of Petrolite Corp.



□ APPLY LUB/SEALANT

37A8078-C

Figure 3. Type 119 Control Valve

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Key	Description	Part No.	Key	Description	Part No.
4*	Disk Holder Assembly ⁽¹⁾		8*	O-Ring ⁽¹⁾ (2 req'd)	
	Aluminum/nitrile			Nitrile	18A7019 X012
	1/2 and 9/16-inch	1C4248 000B2		Fluoroelastomer (high-temperature, corrosion)	18A7019 X022
	Stainless steel/nitrile			Nace MR-01-75, fluoroelastomer	18A7019 X022
	1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm), 5/16 (7.9 mm) & 3/8 (9.5 mm) inch orifices	1A8328 000A2	9	Bonnet, aluminum	48A7025 X012
	1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices	1C4248 000A2	10	Internal Retaining Ring ⁽¹⁾ (2 req'd)	
	Stainless steel/fluoroelastomer			Nitrile & fluoroelastomer	18A7020 X022
	1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm) 5/16 (7.9 mm) & 3/8 (9.5 mm) inch orifices	1A8328 000M2		Nace MR-01-75, fluoroelastomer	18A7020 X032
	1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices	1C4248 X0052	11*	Bonnet O-Ring ⁽¹⁾	
	Nace MR-01-75, aluminum/fluoroelastomer			Nitrile	1K5949 06562
	1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm) 5/16 (7.9 mm) & 3/8 (9.5 mm) inch orifices	1A8328 X0122		Fluoroelastomer (high-temperature, corrosion) & Nace MR-01-75	13A5559 X012
	1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices	1C4248 X0182	12	Adjusting Screw, zinc plated steel	1D9954 48702
5*	Diaphragm/Stem Assembly ⁽¹⁾		13	Locknut, zinc plated steel	1A3537 24122
	Aluminum/nitrile	17A8080 X032	14	Cap Screw, zinc plated steel (8 req'd)	1A3917 24052
	Stainless steel/nitrile	17A8080 X022	15	Cap Screw, zinc plated steel (2 req'd) (not shown)	1B7877 24052
	Stainless steel/fluoroelastomer	17A8080 X012	16	Actuator Spring, zinc plated steel	See table 2
	Nace MR-01-75, Aluminum/fluoroelastomer	19A0348 X022	17	Upper Spring Seat, zinc plated steel	1D6671 25072
6	Hair Pin Clip ⁽¹⁾		18	Type Y602-12 Vent (not shown)	27A5516 X012
	All except NACE	19A0347 X012	19	Stem Wiper ⁽¹⁾ , TFE (2 req'd)	18A7024 X012
	NACE MR-01-75	19A0347 X022	20	Nameplate, aluminum	1E5427 11992
7	Bushing Spacer, Delrin 500 ⁽²⁾ (2 req'd)	18A7021 X012	21	Never-Seez Lubricant, 1 gal (3.81 L) can (not furnished with valve)	1M5239 06992
			22	Dow Corning 111 Lubricant, 10 lb (4.53 kg) can (not furnished with valve)	1M5283 06992
			23	Vent Screen, stainless steel (not shown)	0L0783 43062
			24	Nace Tag	19A6034 X012
			25	Tag Wire	1U7581 X0022

*Recommended spare part.
1. Included in repair kit.
2. Trademark of DuPont Co.

6. Mount the bonnet (key 9) on the valve body (key 1), insert two cap screws (key 15, not shown), and tighten to 7 foot-pounds (9 newton-meters).

7. Put the spring (key 16) on the diaphragm assembly (key 5), and place the upper spring seat (key 17) in the end of the spring.

8. Lubricate the point and threads of the adjusting screw (key 12) with Never Seez lubricant (key 21) or equivalent.

9. Position the spring case (key 2) and nameplate (key 20) on the diaphragm assembly (key 5). Insert the cap screws (key 14).

10. Tighten all cap screws until finger tight. Then, following a crisscross pattern, tighten each cap screw.

11. Connect the control piping to the control connection in the bonnet.

12. Adjust the spring by following the procedures in the Spring Adjustment section, and remark the nameplate if necessary.

Parts Ordering

When contacting your Fisher sales office or sales representative for technical assistance or ordering replacement parts, include the type number and all other pertinent information stamped on the nameplate attached to the spring case.

When ordering replacement parts, also be sure to include the 11-character part number for each part required from the following parts list.

Parts List

Key	Description	Part No.
-----	-------------	----------

Note

In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the National Association of Corrosion Engineers (NACE) standard MR-01-75.

Key	Description	Part No.
	Parts Kits	
	Kits include keys 4, 5, 6, 8, 10, 11, and 19.	
	For 1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm), 5/16 (7.9 mm), & 3/8 (9.5 mm) inch orifices w/aluminum disk holder nitrile diaphragm, and nitrile disk & O-rings	R119X 000A12
	For 1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices w/aluminum disk holder, nitrile diaphragm and nitrile disk & O-rings	R119X 000A22
	For 1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm), 5/16 (7.9 mm), & 3/8 (9.5 mm) inch orifices w/stainless steel disk holder, nitrile diaphragm and nitrile disk & O-rings	R119X 00SN12
	For 1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices w/stainless steel disk holder, nitrile diaphragm and nitrile disk & O-rings	R119X 00SN22
	For 1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm), 5/16 (7.9 mm), & 3/8 (9.5 mm) inch orifices w/stainless steel disk holder and fluoroelastomer diaphragm, disk, & O-rings and stainless steel disk holder	R119X 00SV12
	For 1/2 (12.7 mm) & 9/16 (14.3 mm) inch orifices w/stainless steel disk holder and fluoroelastomer diaphragm, disk & O-rings	R119X 00SV22
	NACE Construction	
	For 1/8 (3.2 mm), 3/16 (4.8 mm), 1/4 (6.4 mm), 5/16 (7.9 mm), and 3/8 (9.5 mm) inch orifices w/aluminum disk holder, fluoroelastomer diaphragm, disk and O-rings	R119X N0SV32
	For 1/2 (12.7 mm) and 9/16 (14.3 mm) inch orifices w/aluminum disk holder, fluoroelastomer diaphragm, disk and O-rings	R119X N0SV42
1	Valve Body	
	Cast iron	
	3/4-inch	1E9871 19012
	1-inch	1E9873 19012
	1-1/4-inch	1E9875 19012
	Steel	
	3/4-inch	1E9871 X0012
	1-inch	1E9873 X0012
2	Spring Case	
	Aluminum	2P9015 08012
3*	Orifice	
	Aluminum	
	1/8-inch (3.2 mm) diameter	1A9367 09012
	3/16-inch (4.8 mm) diameter	009912 09012
	1/4-inch (6.4 mm) diameter	0B0420 09012
	5/16-inch (7.9 mm) diameter	0B0421 09012
	3/8-inch (9.5 mm) diameter	0B0422 09012
	1/2-inch (12.7 mm) diameter	1A9288 09012
	9/16-inch (14.3 mm) diameter	1E9852 09022
	Stainless steel	
	1/8-inch (3.2 mm) diameter	1A9367 35032
	3/16-inch (4.8 mm) diameter	009912 35032
	1/4-inch (6.4 mm) diameter	0B0420 35032
	5/16-inch (7.9 mm) diameter	0B0421 35032
	3/8-inch (9.5 mm) diameter	0B0422 35032
	1/2-inch (12.7 mm) diameter	1A9288 35032
	9/16-inch (14.3 mm) diameter	1C4252 35032

*Recommended spare part.

627 Series Pressure Reducing Regulators

Introduction

Scope of Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering for the 627 Series regulators. These regulators usually are shipped separate for line installation, although sometimes they are shipped installed on other equipment. Refer to the instruction manual for the other equipment for installation and operating instructions.

Description

The 627 Series self-operated pressure reducing regulators (figure 1) are for high and low pressure systems. These regulators can be used with natural gas, air, or a variety of other gases. Performance characteristics vary according to construction (see the AVAILABLE CONFIGURATIONS specification in table 1).

Specifications

Table 1 gives some general specifications for the 627 Series regulators. The nameplates (figure 2) gives detailed information for a particular regulator as it comes from the factory.

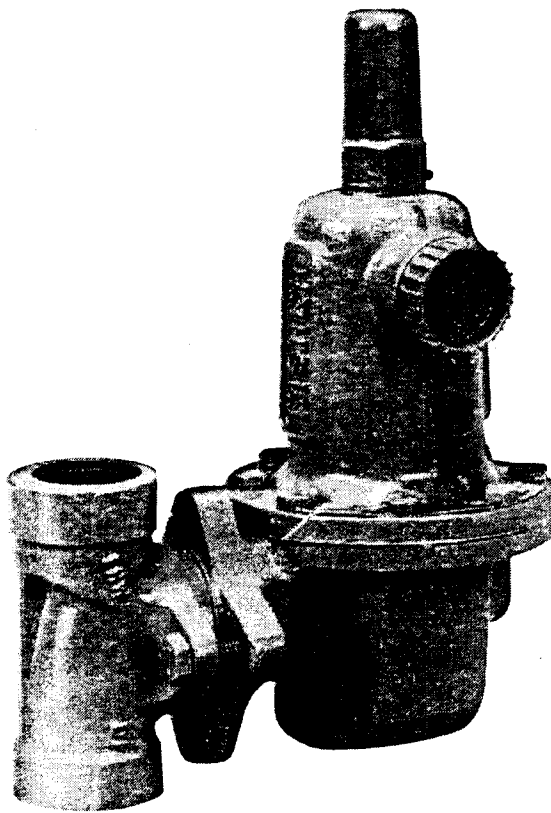


Figure 1. Typical 627 Series Self-Operated Pressure Reducing Regulator

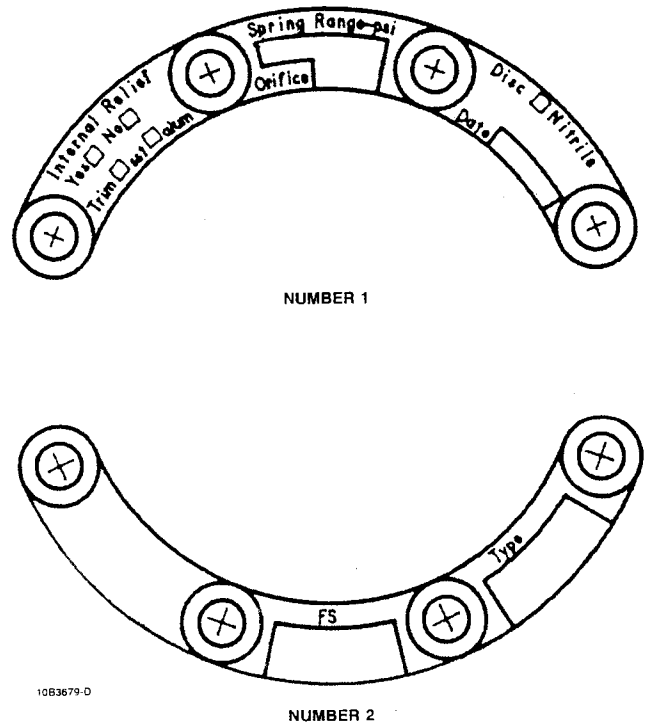


Figure 2. Nameplates

627 Series

Table 1. Specifications

Available Constructions

Type 627: Self-operated pressure reducing regulator equipped with a pitot tube for greater regulated capacities (figure 7)

Type 627R: Type 627 with internal relief and with an open throat (figure 8)

Type 627M: Type 627 with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4-inch NPT downstream control line connection (figure 9)

Type 627MR: Type 627M with internal relief (figure 10)

Type 627H: Type 627 with a diaphragm limiter to deliver a higher outlet pressure (figure 11)

Type 627HM: Type 627H with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through two 1/4-inch NPT downstream control line connections (figure 12)

Body Sizes

3/4, 1, or 2-inch

End Connection Styles

3/4, 1, or 2-inch body sizes: NPT

1 or 2-inch body sizes: ANSI Class 300 or 600 RF flanged

Maximum Inlet Pressure⁽¹⁾ (Body Rating)

2000 psig (138 bar) for NPT steel, 1480 psig (102 bar) for RF flanged steel, or 1000 psig (69 bar) for ductile iron

Maximum Valve Disk Inlet Pressure Rating⁽¹⁾

2000 psig (138 bar) for nylon disk or 1000 psig (69 bar) for nitrile disk

Maximum Operating Inlet Pressure, Pressure Differential, and Outlet Pressure Ranges⁽¹⁾

See table 2 for pressures by port and spring range

Maximum Spring and Diaphragm Casing Pressure⁽¹⁾

See table 3

Maximum Body Outlet Pressure⁽¹⁾ (Type 627M, 627MR, and 627HM Only)

2000 psig (138 bar) for screwed steel, 1480 psig (102 bar) for RF flanged steel, or 1000 psig (69 bar) for ductile iron. (Type 627 and 627R are limited by maximum diaphragm casing pressure)

Port Diameters

See table 2

Internal Relief Performance

Type 627R: See table 4

Type 627MR: Limited by field-installed control line piping

Temperature Capabilities⁽¹⁾

-20 to 180°F (-29 to 82°C)

Pressure Registration

Type 627, 627H or 627R: Internal

Type 627M, 627HM or 627MR: External through 1/4-inch NPT control line connection in the diaphragm casing

De-Icer System

See figure 3 and Type 627M Regulator De-Icer System Application section

Relief Indicator

For 627R and 627MR (see figures 8 and 9)

Spring Case Vent Connection

3/4-inch NPT female with removable screened vent assembly

Control Line Connection (Type 627M, 627HM or 627MR Only)

1/4-inch NPT female

Approximate Weight

Ductile Iron or Steel Casings: 10 pounds (4,5 kg)

Aluminum Casings: 6.3 pounds (2.8 kg)

1. The pressure/temperature limits in this instruction manual or any applicable standard limitation should not be exceeded.

Table 2. Maximum Inlet Pressures, Differential Pressures, and Outlet Pressure Ranges

TYPE NUMBER	OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	ORIFICE SIZE, INCHES (mm)	MAXIMUM INLET PRESSURE, PSIG (bar)	MAXIMUM DIFFERENTIAL PRESSURE, PSID (bar)
627 and 627M ⁽³⁾	5 ⁽²⁾ to 20 psig (0,34 to 1,4 bar) 10B3076X012 Yellow	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾
		3/16 (4,8)	750 (51,7)	750 (51,7)
		1/4 (6,4)	500 (34,5)	500 (34,5)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	250 (17,2)	250 (17,2)
	15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	1500 (103) ⁽¹⁾	1500 (103) ⁽¹⁾
		3/16 (4,8)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾
		1/4 (6,4)	750 (51,7)	750 (51,7)
		3/8 (9,5)	500 (34,5)	500 (34,5)
		1/2 (12,7)	300 (20,7)	300 (20,7)
	35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		3/16 (4,8)	1750 (121) ⁽¹⁾	1750 (121) ⁽¹⁾
		1/4 (6,4)	1500 (103) ⁽¹⁾	1500 (103) ⁽¹⁾
3/8 (9,5)		1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾	
1/2 (12,7)		750 (51,7)	750 (51,7)	
70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾	
	1/8 (3,2)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾	
	3/16 (4,8)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾	
	1/4 (6,4)	1750 (121) ⁽¹⁾	1750 (121) ⁽¹⁾	
	3/8 (9,5)	1250 (86,2) ⁽¹⁾	1250 (86,2) ⁽¹⁾	
	1/2 (12,7)	750 (51,7)	750 (51,7)	
627R and 627MR	5 ⁽²⁾ to 20 psig (0,34 to 1,4 bar) 10B3076X012 Yellow	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾
		3/16 (4,8)	750 (51,7)	750 (51,7)
		1/4 (6,4)	500 (34,5)	500 (34,5)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	200 (13,8)	200 (13,8)
	15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	1500 (103) ⁽¹⁾	1500 (103) ⁽¹⁾
		3/16 (4,8)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾
		1/4 (6,4)	750 (51,7)	750 (51,7)
		3/8 (9,5)	300 (20,7)	300 (20,7)
		1/2 (12,7)	200 (13,8)	200 (13,8)
	35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	1750 (121) ⁽¹⁾	1750 (121) ⁽¹⁾
		3/16 (4,8)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾
		1/4 (6,4)	750 (51,7)	750 (51,7)
3/8 (9,5)		300 (20,7)	300 (20,7)	
1/2 (12,7)		200 (13,8)	200 (13,8)	
70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾	
	1/8 (3,2)	1000 (69) ⁽¹⁾	1000 (69) ⁽¹⁾	
	3/16 (4,8)	500 (34,5)	500 (34,5)	
	1/4 (6,4)	300 (20,7)	300 (20,7)	
	3/8 (9,5)	200 (13,8)	200 (13,8)	
	1/2 (12,7)	200 (13,8)	200 (13,8)	
627H and 627MH ⁽³⁾	140 to 250 psig (9,7 to 17,2 bar) 10B3078X012 Blue	3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		3/16 (4,8)	1750 (121) ⁽¹⁾	1750 (121) ⁽¹⁾
		1/4 (6,4)	1500 (103) ⁽¹⁾	1000 (69) ⁽¹⁾
		3/8 (9,5)	1000 (69) ⁽¹⁾	500 (34,5)
	240 to 500 psig (16,5 to 34,5 bar) 10B3079X012 Red	1/2 (12,7)	750 (51,7)	250 (17,2)
		3/32 (2,4)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		1/8 (3,2)	2000 (138) ⁽¹⁾	2000 (138) ⁽¹⁾
		3/16 (4,8)	1750 (121) ⁽¹⁾	1750 (121) ⁽¹⁾
		1/4 (6,4)	1500 (103) ⁽¹⁾	1000 (69) ⁽¹⁾

1. For inlet pressure in excess of 1000 psig (69 bar), refer to the maximum body and disk pressure ratings in the specification table.

2. For pressure settings under 10 psig (0,69 bar), inlet pressure should be limited to approximately 100 psig (6,9 bar) so the setpoint adjustment can be obtained.

3. The unbalance forces change from the wide-open monitor mode to an active regulator mode such that the Type 627M or 627MH should have a 3/8-inch (9,5 mm) or larger orifice when used as a wide-open monitor.

Table 3. Maximum Spring and Diaphragm Casing Pressure(1)

MAXIMUM PRESSURE DESCRIPTION	SPRING AND DIAPHRAGM CASING STYLE	TYPE 627, PSIG (bar)	TYPE 627R, PSIG (bar)	TYPE 627M, PSIG (bar)	TYPE 627MR, PSIG (bar)	TYPE 627H AND 627HM, PSIG (bar)
Maximum pressure to spring and diaphragm casings to prevent leak to atmosphere other than relief action (internal parts damage may occur)	Die cast aluminum	250 (17,2)	250 (17,2)	Not Available	Not Available	Not Available
	Die cast aluminum	250 (17,2)	250 (17,2)	250 (17,2)	Not Available	Not Available
	Steel	250 (17,2)	250 (17,2)	250 (17,2)	250 (17,2)	800 (55,2)
Maximum pressure to spring and diaphragm casings to prevent burst of casings during abnormal operation (leak to atmosphere and internal parts damage may occur)	Die cast aluminum	375 (25,9)	375 (25,9)	Not Available	Not Available	Not Available
	Ductile iron	465 (32)	465 (32)	465 (32)	465 (32)	Not Available
	Steel	1500 (103)	1500 (103)	1500 (103)	1500 (103)	1500 (103)
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts	All styles	60 (4,1)	120 (8,3)	60 (4,1)	120 (8,3)	120 (8,3)

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your Fisher Sales Representative.



WARNING

Personal injury, property damage, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts may result if this regulator is over-pressured or is installed where service conditions could exceed the limits given in tables 1, 2, 3, and 4, or where conditions exceed any ratings of the adjacent piping or piping connections.

To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation, or standard) to prevent service conditions from exceeding those limits. The Type 627R or 627MR regulator with internal relief will provide downstream overpressure protection within the limits given in tables 1, 2, 3 and 4. If these limits are exceeded additional downstream overpressure protection must be provided by the user.

Additionally, physical damage to the regulator could cause personal injury or property damage due to escaping gas. To avoid such injury or damage, install the regulator in a safe location.

Installation

Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. A regulator should be inspected for damage periodically and after any overpressure condition. Key numbers referenced in this section are shown in figures 7 through 12. Ensure that the operating temperature capabilities listed in table 1 are not exceeded.

Like most regulators, 627 Series regulators have outlet pressure ratings that are lower than their inlet pressure ratings. A pressure relieving or pressure limiting device must be provided by the user for the Type 627, 627H, 627M, and 627HM regulators if the inlet pressure can exceed the outlet pressure rating, since these regulators do not have internal relief.

Type 627R regulators provide internal relief which limits the total outlet pressure buildup over setpoint. Use table 4 to determine the total outlet pressure. This internal relief may be adequate for the application, if not, provide additional pressure relief or a pressure limiting device downstream.

Note

If the regulator is shipped mounted on another unit, install that unit according to the appropriate instruction manual.

Perform steps 1 through 6 for all types of regulators:

1. Only personnel qualified through training and experience should install, operate, or maintain this regulator.
2. For a regulator that is shipped separately, make sure that there is no damage to, or foreign material in, the regulator.
3. Ensure that all tubing and piping have been blown free of foreign debris.
4. The regulator may be installed in any position as long as the flow through the body is in the direction indicated by the arrow cast on the body.
5. If continuous operation is required during inspection or maintenance, install a three-valve bypass around the regulator.

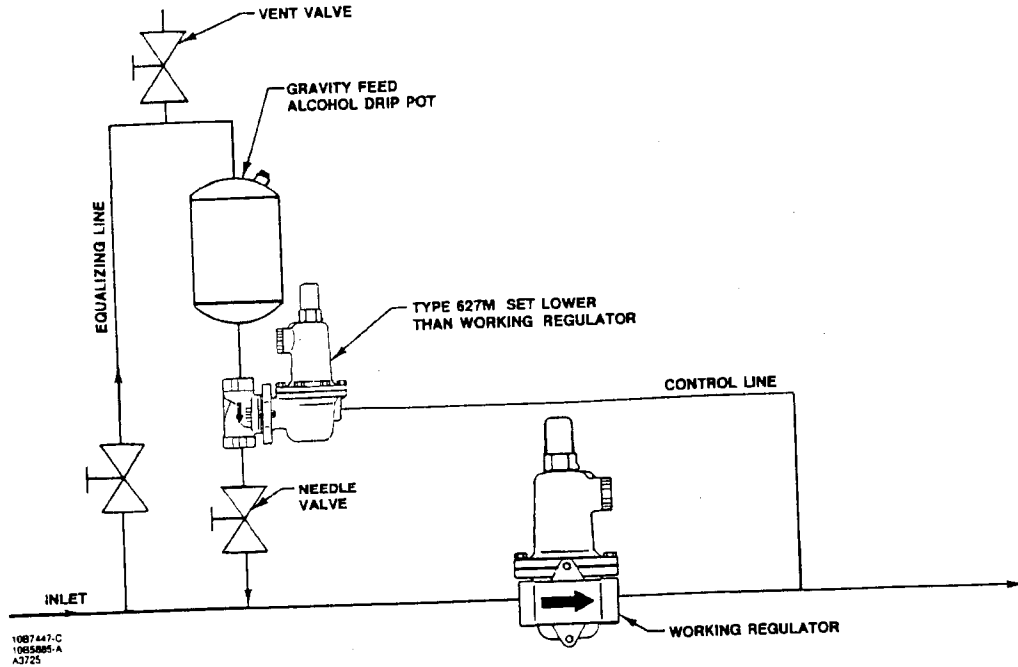


Figure 3. Schematic of De-Icer System



WARNING

A regulator may vent some gas to the atmosphere. In hazardous or flammable gas service, vented gas may accumulate and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous area. The vent line or stack opening must be protected against condensation or clogging.

6. Position the body (key 1) and/or diaphragm spring case (key 29) so it will not collect moisture or debris into the screened vent. If the regulator requires repositioning, refer to the body area maintenance procedures and/or the diaphragm case area maintenance procedures in the Maintenance section to reposition the screened vent for the application.

Perform steps 7 through 9 for Types 627M, 627HM, and 627MR regulators only:

7. A Type 627M, 627HM, or 627MR regulator requires a downstream control line. Install the control line before putting the regulator into operation.
8. Ensure that the downstream control line piping is at least 3/8-inch or larger outside diameter tubing and

connected to a straight section of outlet piping 10 diameters downstream of the regulator.

9. A hand valve should be installed in the control line. This hand valve can be used to throttle down and dampen outlet pulsations in control pressure which may cause instability or cycling of the regulator.

Remote Vent Line Installation

All 627 series regulators have a vent assembly installed in the 3/4-inch NPT spring case vent opening. The vent assembly can be removed to install a remote vent line if necessary. Remote vent lines must have the largest practical diameter. The vent line should be as short as possible with a minimum number of bends or elbows.

Protect the remote vent opening against entrance of rain, snow, or any other foreign material that may plug the vent or vent line and prevent proper operation of the regulator. Periodically check the vent opening to be sure it is not plugged with foreign debris.

Type 627M or 627HM Regulator De-Icer System Application

For the Type 627M or 627HM regulator de-icer system, refer to the application shown in figure 3. With a large pressure drop across the working regulator, ice can

627 Series

Table 4. Type 627R Internal Relief Performance⁽¹⁾

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	OUTLET PRESSURE SETTING, PSIG (bar)	MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE, PSIG (bar)	MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED, PSIG (bar) ⁽²⁾					
			Orifice Size, Inches (mm)					
			3/32 (2,4)	1/8 (3,2)	3/16 (4,8)	1/4 (6,4)	3/8 (9,5)	1/2 (12,7)
5 ⁽³⁾ to 20 psig (0,34 to 1,4 bar) 10B3076XC12 Yellow	10 (0,69)	60 (4,1)	1250 (86,2)	740 (51,1)	320 (22,1)	190 (13,1)	95 (6,56)	75 (5,18)
		100 (6,9)	2000 (138)	1500 (103)	620 (42,7)	390 (26,9)	180 (12,4)	130 (8,97)
		125 (8,6)	2000 (138)	1900 (131)	830 (57,2)	480 (33,1)	220 (15,2)	160 (11,0)
	15 (1,0)	175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	450 (31,0)	320 (22,1)
	20 (1,4)	60 (4,1)	1000 (69,0)	620 (42,7)	260 (17,9)	170 (11,7)	90 (6,2)	70 (4,8)
		100 (6,9)	2000 (138)	1400 (96,5)	610 (42,1)	370 (25,5)	170 (11,7)	130 (8,97)
		125 (8,6)	2000 (138)	1900 (131)	810 (55,8)	480 (33,1)	220 (15,2)	160 (11,0)
15 to 40 psig (1,0 to 2,8 bar) 10B3077X012 Green	15 (1,0)	175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	450 (31,0)	320 (22,1)
	20 (1,4)	60 (4,1)	850 (58,6)	490 (33,8)	210 (14,5)	130 (9,0)	80 (5,52)	65 (4,49)
		100 (6,9)	2000 (138)	1300 (89,6)	600 (41,4)	360 (24,8)	170 (11,7)	120 (8,28)
		125 (8,6)	2000 (138)	1800 (124)	800 (55,2)	480 (33,1)	220 (15,2)	160 (11,0)
	30 (2,1)	175 (12,1)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	320 (22,1)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1300 (89,6)	770 (53,1)	360 (24,8)	260 (17,9)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	960 (66,2)	460 (31,7)	320 (22,1)
40 (2,8)	100 (6,9)	2000 (138)	950 (65,5)	450 (31,1)	260 (17,9)	140 (9,66)	110 (7,59)	
	125 (8,6)	2000 (138)	1500 (103)	670 (46,2)	400 (27,6)	190 (13,1)	150 (10,3)	
	175 (12,1)	2000 (138)	2000 (138)	1000 (69,0)	610 (42,1)	300 (20,7)	220 (15,2)	
40 (2,8)	200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	760 (52,4)	360 (24,8)	260 (17,9)	
	250 (17,2)	2000 (138)	2000 (138)	1600 (110)	970 (66,9)	460 (31,7)	320 (22,1)	
	100 (6,9)	1500 (103)	700 (48,3)	330 (22,8)	200 (13,8)	120 (8,28)	108 (7,45)	
40 (2,8)	125 (8,6)	2000 (138)	1300 (89,6)	560 (38,6)	340 (23,4)	180 (12,4)	140 (9,66)	
	175 (12,1)	2000 (138)	1800 (124)	1000 (69,0)	550 (37,9)	290 (20,0)	220 (15,2)	
	200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	730 (50,3)	350 (24,1)	250 (17,2)	
40 (2,8)	250 (17,2)	2000 (138)	2000 (138)	1600 (110)	970 (66,9)	460 (31,7)	320 (22,1)	

form with in this regulator. The formation of ice decreases the size of the port opening, so the regulator is unable to supply enough flow to satisfy the downstream demand. When the downstream pressure falls below the outlet pressure setting of the Type 627M or 627HM regulator, the disk assembly of the Type 627M or 627HM regulator moves off its seat ring, permitting alcohol to flow into the main gas line. The alcohol carried to the main regulator by the flow stream prevents additional ice from forming on the seat ring. When normal flow resumes, and as pressure in the downstream system is restored, the Type 627M or 627HM regulator shuts off.

Startup and Adjustment

Startup



WARNING

To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during startup, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.

Table 4. Type 627R Internal Relief Performance⁽¹⁾ (continued)

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	OUTLET PRESSURE SETTING, PSIG (bar)	MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE, PSIG (bar)	MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED, PSIG (bar) ⁽²⁾					
			Orifice Size, Inches (mm)					
			3/32 (2,4)	1/8 (3,2)	3/16 (4,8)	1/4 (6,4)	3/8 (9,5)	1/2 (12,7)
35 to 80 psig (2,4 to 5,5 bar) 10B3078X012 Blue	40 (2,8)	125 (8,6)	2000 (138)	1100 (75,8)	500 (34,5)	300 (20,7)	170 (11,7)	140 (9,66)
		150 (10,3)	2000 (138)	1600 (110)	750 (51,7)	440 (30,3)	230 (15,9)	180 (12,4)
		175 (12,1)	2000 (138)	2000 (138)	980 (67,6)	580 (40,0)	290 (20,0)	220 (15,2)
		200 (13,8)	2000 (138)	2000 (138)	1200 (82,7)	720 (49,6)	340 (23,4)	250 (17,2)
		250 (17,2)	2000 (138)	2000 (138)	1600 (110)	940 (64,8)	450 (31,0)	320 (22,1)
	50 (3,4)	125 (8,6)	1400 (96,5)	820 (56,5)	400 (27,6)	230 (15,9)	150 (10,3)	140 (9,66)
		150 (10,3)	2000 (138)	1400 (96,5)	650 (44,8)	370 (25,5)	210 (14,5)	170 (11,7)
		175 (12,1)	2000 (138)	1900 (131)	700 (48,3)	530 (36,5)	270 (18,6)	210 (14,5)
		200 (13,8)	2000 (138)	2000 (138)	1100 (75,8)	670 (46,2)	330 (22,8)	240 (16,5)
		250 (17,2)	2000 (138)	2000 (138)	1500 (103)	920 (63,4)	430 (29,6)	320 (22,1)
	60 (4,1)	125 (8,6)	900 (62,1)	450 (31,1)	270 (18,6)	190 (13,1)	140 (9,66)	130 (8,97)
		150 (10,3)	1700 (117)	1100 (75,8)	540 (37,2)	300 (20,7)	190 (13,1)	160 (11,0)
		175 (12,1)	2000 (138)	1700 (117)	780 (53,8)	470 (32,4)	250 (17,2)	200 (13,8)
		200 (13,8)	2000 (138)	2000 (138)	1000 (69,0)	610 (42,1)	310 (21,4)	230 (15,9)
		250 (17,2)	2000 (138)	2000 (138)	1400 (96,5)	880 (60,7)	420 (29,0)	310 (21,4)
	70 (4,8)	150 (10,3)	1200 (82,7)	850 (58,6)	430 (29,6)	250 (17,2)	170 (11,7)	160 (11,0)
		175 (12,1)	2000 (138)	1400 (96,5)	670 (46,2)	400 (27,6)	230 (15,9)	190 (13,1)
		200 (13,8)	2000 (138)	2000 (138)	920 (63,4)	550 (37,9)	280 (19,3)	230 (15,9)
		250 (17,2)	2000 (138)	2000 (138)	1300 (89,6)	830 (57,2)	400 (27,6)	310 (21,4)
		150 (10,3)	800 (55,2)	500 (34,5)	300 (20,7)	200 (13,8)	160 (11,0)	150 (10,3)
80 (5,5)	175 (12,1)	1500 (103)	1200 (82,7)	550 (37,9)	330 (22,8)	210 (14,5)	190 (13,1)	
	200 (13,8)	2000 (138)	1700 (117)	800 (55,2)	480 (33,1)	270 (18,6)	220 (15,2)	
	250 (17,2)	2000 (138)	2000 (138)	1200 (82,7)	770 (53,1)	390 (26,9)	300 (20,7)	
	175 (12,1)	1900 (131)	600 (41,4)	400 (27,6)	260 (17,9)	200 (13,8)	175 (12,1)	
	200 (13,8)	2000 (138)	1200 (82,7)	630 (43,4)	380 (26,2)	250 (17,2)	210 (14,5)	
70 to 150 psig (4,8 to 10,3 bar) 10B3079X012 Red	70 (4,8)	250 (17,2)	2000 (138)	2000 (138)	1100 (75,8)	680 (46,9)	360 (24,8)	290 (20,0)
		175 (12,1)	1400 (96,5)	250 (17,2)	240 (16,5)	200 (13,8)	190 (13,1)	175 (12,1)
		200 (13,8)	2000 (138)	960 (66,2)	520 (35,9)	330 (22,8)	240 (16,5)	210 (14,5)
	80 (5,5)	250 (17,2)	2000 (138)	2000 (138)	1000 (69,0)	620 (42,7)	350 (24,1)	280 (19,3)
		200 (13,8)	1500 (103)	250 (17,2)	240 (16,5)	230 (15,9)	210 (14,5)	210 (14,5)
100 (6,9)	250 (17,2)	2000 (138)	1600 (110)	770 (53,1)	520 (35,9)	320 (22,1)	270 (18,6)	
125 (8,6)	250 (17,2)	2000 (138)	1000 (69,0)	500 (34,5)	390 (26,9)	290 (20,0)	260 (17,9)	
150 (10,3)	250 (17,2)	1200 (82,7)	260 (17,9)	260 (17,9)	260 (17,9)	260 (17,9)	260 (17,9)	

1. The internal relief performance values are obtained by removing the disk assembly.
 2. For inlet pressures in excess of 1000 psig (69 bar), refer to the maximum body and disk pressure ratings in the specifications table.
 3. For pressure settings under 10 psig (0,69 bar), inlet pressure should be limited to approximately 100 psig (6,9 bar) so the setpoint adjustment can be obtained.
 - Shaded areas indicate maximum inlet pressures allowed during system malfunction only. Table 6 gives the maximum inlet pressure for normal regulator operation.

In order to avoid an overpressure condition and possible equipment damage, pressure gauges should always be used to monitor pressures during startup.

1. Slowly open the upstream shutoff valve.
2. Slowly open the downstream shutoff valve.
3. Check all connections for leaks.
4. Make final control spring adjustments according to the adjustment procedures.

Adjustment

The range of allowable pressure settings is marked on the nameplate (figure 2). If a pressure setting beyond this range is necessary, substitute the appropriate regulator control spring. Change the nameplate to indicate the new pressure range.

Before increasing the setting, refer to tables 2, 3, or 4. Review the pressure limits for the control spring range being used and be certain that the new pressure setting will not result in an overpressure condition.

Table 5. Maximum Torque Values

KEY NUMBER ⁽¹⁾	DESCRIPTION	MAXIMUM TORQUE, FOOT-POUNDS (N•m)
2	Seat ring	25 (34)
3	Cap screw (w/ aluminum diaphragm casing)	16 (22)
	Cap screw (w/ ductile iron or steel diaphragm casing)	25 (34)
18	Lever cap screw	7 (9)
22	Diaphragm connector nut	17 (23)
26	Guide retainer (for Type 627R and 627MR only)	3 (4)
37	Spring case cap screw (w/ aluminum or ductile iron diaphragm casing)	7 (9)
	Spring case cap screw (w/ steel diaphragm casing)	35 (47)
46	Diaphragm cap screw (w/Type 627 or 627M)	7 (9)
	Diaphragm cap screw (w/Type 627H or 627MH)	14 (19)

1. Refer to figures 7 through 10 for key number locations.

Note

Always use a pressure gauge to monitor pressure when making adjustments.

Refer to figures 7 through 12 for key number locations.

1. Remove the adjusting screw cap (key 36).
2. Loosen the locknut (key 34).
3. Increase the outlet pressure setting by turning the adjusting screw (key 35) clockwise. Decrease the outlet pressure setting by turning the adjusting screw counter-clockwise.
4. When the desired pressure is obtained, hold the adjusting screw (key 35) in place and tighten the locknut (key 34).

Shutdown



To avoid personal injury or property damage due to explosion or damage to regulator or downstream components during shutdown, release downstream pressure to prevent an overpressure condition on the diaphragm of the regulator.

1. Close the nearest upstream shutoff valve.
2. Close the nearest downstream shutoff valve.

3. Open the vent valve between the regulator and the downstream shutoff valve nearest to it.

4. For a Type 627, 627H, or 627R regulator, the regulator will open to release pressure between the upstream shutoff valve and the regulator.

5. A Type 627M, 627HM, or 627MR regulator requires venting the control line and downstream pressure from the regulator before maintenance. The pressure between these shutoff valves is released through the open regulator because the disk assembly remains open in response to the decrease in control line pressure.

Maintenance

Unless otherwise specified, the following maintenance procedures apply to all types of regulators. For a summary of maximum torque values required for all types of regulators, refer to table 5.

Due to normal wear, damage from external sources, or debris in the air or gas line, regulator parts such as the disk assembly, seat ring, and diaphragm must be inspected periodically and replaced as necessary to ensure correct performance. The frequency of inspection and replacement depends upon the severity of conditions and the requirements of state and federal laws. Normal wear of the seat ring and disk assembly is accelerated with high pressure drops and with large amounts of impurities in the flow stream. Instructions are given below for replacing the disk assembly, seat ring, diaphragm, and O-rings. These procedures may also be used for disassembly required for inspection and replacement of other parts.

Problem Indication for Type 627R and 627MR Regulators



WARNING

Isolate the regulator from all pressure to avoid personal injury and equipment damage due to explosion or sudden release of process pressure. Cautiously release pressure from the regulator before attempting disassembly.

The vent assembly is equipped with a relief indicator (key 49, figure 4). The cap for the relief indicator snaps over the vent assembly opening. If the relief valve opens wide, exhaust gas pops the cap off the screen vent assembly opening indicating a problem with the regulator. If the cap pops off, refer to the shutdown and to the body area maintenance procedures to inspect the disk assembly and seat ring.

If the disk assembly and seat ring are not damaged, refer to the diaphragm and spring case area maintenance procedures in this section.

The disk assembly and seat ring can be inspected, removed, and replaced without removing the regulator body from the line connections. Refer to the body area maintenance procedures.

Body Area Maintenance Procedures

These procedures are for gaining access to the disk assembly, seat ring, diaphragm casing O-ring and stem assembly. All pressure must be released from the diaphragm casing before the performing these steps.

While using the following procedures, refer to figures 7 through 12 for key number locations.

Replacing the Disk Assembly or Seat Ring

1. To inspect and replace the disk assembly (key 9) or seat ring (key 2), remove the cap screws (key 3, figure 5), and separate the diaphragm casing (key 5) from the body (key 1).

2. Inspect and, if necessary, remove the seat ring (key 2). If removed, coat the threads of the replacement seat ring with lubricant (key 38) and torque to 25 foot-pounds (34 N•m).

3. Inspect the disk assembly and, if necessary, remove the hair pin clip (key 13) that holds the disk assembly (key 9) in place. If replacing the disk assembly is the only maintenance required, skip to step 16.

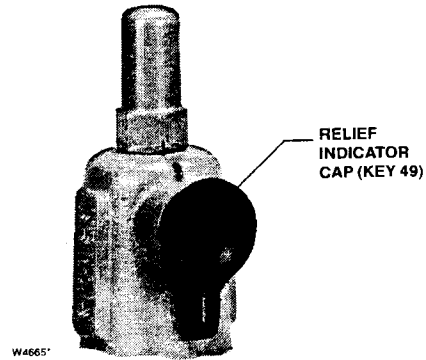


Figure 4. Relief Indicator

Replacing the Stem Assembly

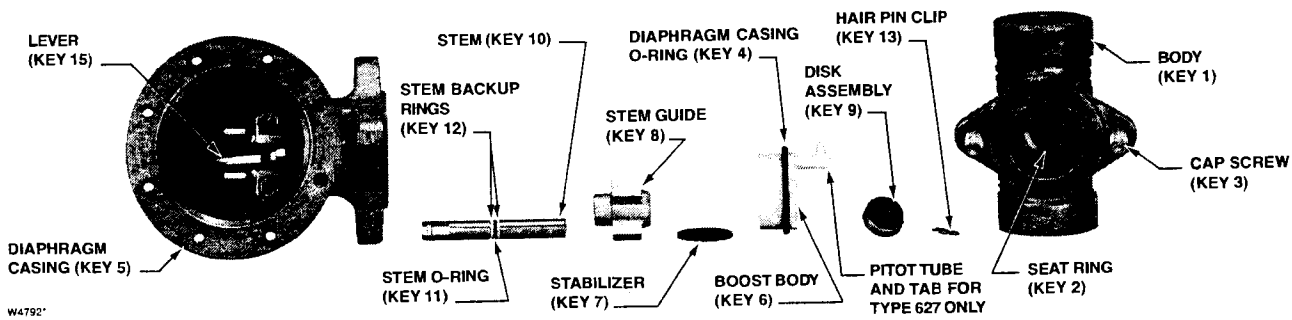
If it is necessary to perform maintenance on the stem assembly, continue with steps 4 through 8 and 15 through 19 for Type 627, 627H, and 627R regulators, or steps 9 through 19 for Type 627M, 627HM, and 627MR regulators.

Perform steps 4 through 8 for Type 627, 627H, and 627R Regulators only:

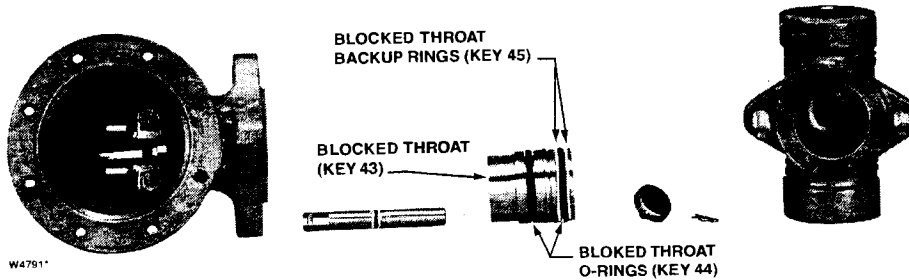
4. For Type 627, 627H, and 627R regulators (figure 5), use steps 5 through 8 to remove and replace the stem assembly.
5. Remove the boost body (key 6), stabilizer (key 7), and stem guide (key 8) from the diaphragm casing (key 5). Unhook and remove the stem (key 10) from the diaphragm casing (key 5).
6. Remove and inspect the diaphragm casing O-ring (key 4, figure 7, 8, or 11) and replace it if necessary.
7. Apply lubricant (key 42) to a replacement diaphragm casing O-ring (key 4, figure 7, 8, or 11) and install it onto the boost body (key 6). Skip to step 14.
8. For the Type 627 or 627H regulators, be sure to insert the pitot tube (tab) into the outlet side of the body (see figure 7 or 11). Skip to step 14.

Perform steps 9 through 19 for Type 627M, 627HM, and 627MR Regulators only:

9. For Type 627M, 627HM, and 627MR regulators (figure 5), use steps 10 through 14 to remove and replace the stem assembly.
10. To remove the blocked throat (key 43), insert a screw driver blade into the groove provided in the throat and pry it out of the diaphragm casing (key 5). Inspect and replace parts as necessary.



Type 627 and 627R



Type 627M and 627MR

Figure 5. Stem Assemblies

11. Inspect and, if necessary, replace the blocked throat O-rings (key 44, figure 5) and backup rings (key 45, figure 5).

12. Apply lubricant (key 42) to replacement blocked throat O-rings (key 44) and backup rings (key 45).

13. Apply lubricant (key 42) to the replacement stem O-ring (key 11) and stem backup rings (key 12) and install them on the stem (key 10).

14. For assembly, insert the stem (key 10) into the diaphragm casing (key 5) and hook it on the lever (key 15).

15. Insert parts into the diaphragm casing (key 5) that were removed in steps 5 and 6 or step 10 (see figure 5).

16. Install the the disk assembly (key 9), line up the hole in the disk assembly and stem (key 10) and insert the hair pin clip (key 13).

17. Position the diaphragm casing plus attached parts in relation to the body (key 1) so that they are correct for the application.

18. Secure the diaphragm casing to the body with the cap screws (key 3, figure 5). For an aluminum diaphragm casing (key 5), torque the cap screws (key 3) to 16 foot-pounds (22 N•m). For ductile iron or steel diaphragm casings, torque the cap screws (key 3) to 25 foot-pounds (34 N•m).

19. It may be necessary to reposition the diaphragm spring case to prevent rain, ice, and foreign debris from entering the spring case. Refer to the diaphragm and spring case area maintenance procedures, steps 1, 2, and 21 through 25.

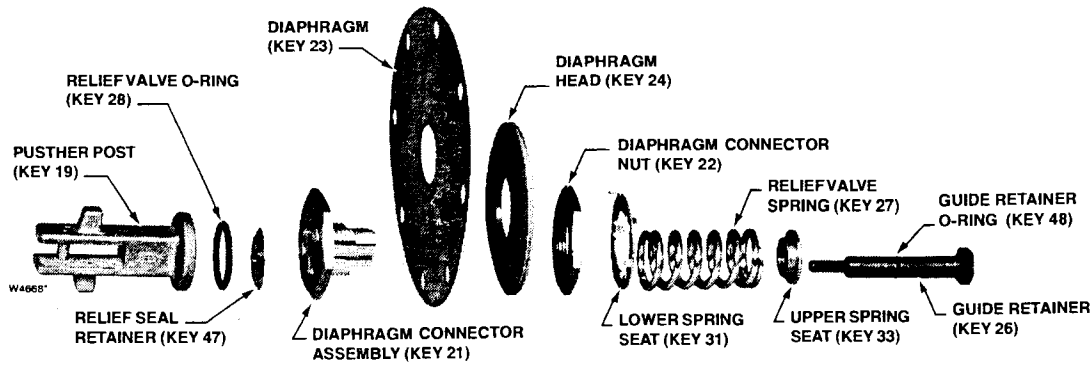
Diaphragm and Spring Case Area Maintenance Procedures

These procedures are for gaining access to the control spring, diaphragm assembly, and lever assembly. All spring pressure must be released from the diaphragm casing before these steps can be performed.

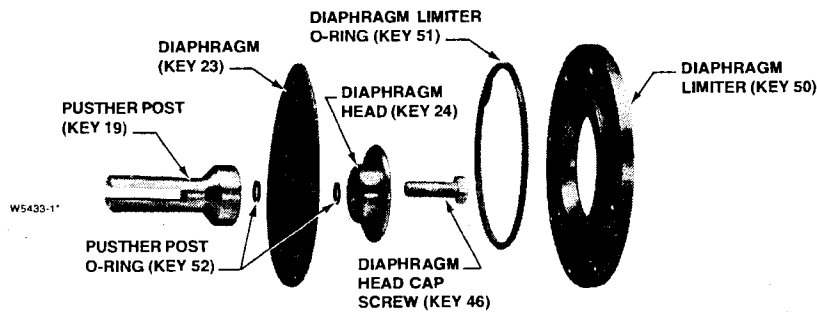
While using the following procedures, refer to figures 7 through 12 for key number locations.

1. Remove the adjusting screw cap (key 36), loosen the lock nut, and turn the adjusting screw (key 35) counterclockwise until all compression is removed from the control spring (key 32).

2. Remove the spring case cap screws (key 37), the nameplates, and lift off the spring case (key 29). If changing the control spring (key 32) or repositioning the spring case (key 29) is the only maintenance required, install the replacement control spring or rotate the spring case so it is correct for the application. Skip to step 21. For diaphragm area maintenance, continue with step 3.



Type 627, 627R, 627M, or 627MR



Type 627H and 627HM

Figure 6. Diaphragm Assemblies

3. Remove the diaphragm limiter and O-ring (keys 50 and 51, on the Type 627H or 627HM only). Remove the diaphragm assembly by tilting it so that the pusher post (key 19) slips off the lever (key 15).

4. If it is necessary to replace the lever assembly, remove the lever cap screws (key 18).

5. Install the replacement lever (key 15) into the lever retainer (key 16) by inserting the lever pin (key 17). Secure the lever assembly into the diaphragm casing with the cap screws (key 18) and torque the cap screws to 7 foot-pounds (9 N•m).

If it is necessary to perform maintenance on the diaphragm assembly, continue with steps 6 through 11 and step 20 for Type 627, 627H, 627M, and 627HM regulators, or steps 12 through 19 for Type 627R and 627MR regulators.

Perform steps 6 through 11 for Type 627, 627H, 627M, and 627HM Regulators only:

6. For Type 627, 627H, 627M, and 627HM regulators (figures 5 & 6), use steps 7 through 11 to disassemble and reassemble the diaphragm assembly.

7. Remove the diaphragm head cap screw (key 46), lower spring seat (key 31, Type 627 or 627M only), and diaphragm head (key 24). On the Type 627H or 627HM, remove the diaphragm cap screw O-rings (key 52). Separate the diaphragm (key 23) from the pusher post (key 19).

8. Install the diaphragm (key 23), in reverse order in step 7, on the pusher post (key 19), insert and finger tighten the diaphragm head cap screw (key 46).

9. Hook the pusher post on the lever (key 15), then turn the diaphragm (key 23) to match the holes in the diaphragm with the holes in the spring casing.

10. Unhook the pusher post from the lever and torque the diaphragm head cap screw (key 46) to 7 foot-pounds (9 N•m) for the Type 627 or 627M. On the Type 627H or 627HM torque the diaphragm head cap screw to 14 foot-pounds (18 N•m).

11. Hook the pusher post on the lever (key 15) and check the hole alignment. If necessary, loosen the cap screw (key 46) and reposition the diaphragm (key 23) on the pusher post (key 19). Retorque the screw (see step 10). Skip to step 20.

627 Series

Perform steps 12 through 19 for Type 627R and 627MR Regulators only:

12. For Type 627R and 627MR regulators (figure 6), use steps 13 through 19 to disassemble and reassemble the diaphragm assembly:

13. Remove the guide retainer (key 26) and separate the diaphragm parts. Refer to figure 6 for the sequence of parts.

14. To remove the diaphragm (key 23), remove the diaphragm connector nut (key 22) and lift off the diaphragm head (key 24) and diaphragm (key 23) from the connector assembly (key 21). Do not attempt to disassemble the connector assembly (key 21).

15. Position the replacement diaphragm (key 23) on the connector assembly (key 21), install the diaphragm head (key 24) and connector nut (key 22), then torque to 17 foot-pounds (32 N•m).

16. If necessary, replace the guide retainer O-ring (key 48) and, set the guide retainer (key 26) aside, ready for assembly.

17. On the pusher post (key 19) install the relief seal O-ring (key 28) and lubricate (key 42). Also, install the relief seal retainer (key 47), diaphragm connector assembly (key 21, with attached parts) relief spring (key 27), upper relief spring seat (key 33), and guide retainer (key 26). Torque the guide retainer (key 26) to 3 foot-pounds (4 N•m).

18. Hook the pusher post (with attached parts) on the lever (key 15) to check the alignment of the holes in the diaphragm with the holes in the spring casing. If the holes do not line up, unhook the pusher post from the lever, hold the pusher post, and rotate the diaphragm to the correct position.

19. Install the lower spring seat (key 31) over the relief spring so it rests flat on the connector nut (key 22).

20. Insert the diaphragm assembly into the diaphragm casing (key 5) and hook the pusher post on the lever (key 15).

21. Install the control spring (key 32) and upper spring seat (key 33), and apply lubricant (key 38) to the upper spring seat (key 33).

22. Install the spring case (key 29) so that the screened vent assembly (key 30) is in the correct position for the application. Place the nameplates (key 39) over the screw holes, insert the spring case cap screws (key 37), and finger tighten.

23. Screw in the adjustment screw to put slack into the diaphragm (key 23).

24. Using a crisscross pattern, finish tightening the spring case cap screws (key 37) to 7 foot-pounds (9 N•m) of torque.

25. If necessary, refer to the installation and/or the startup and adjustment procedures.

26. Install the adjusting screw cap (key 34) after regulator adjustment.

Parts Ordering

When corresponding with your Fisher sales office or sales representative about this regulator, always reference the type number which is found on the nameplate (key 39, figures 7 through 12).

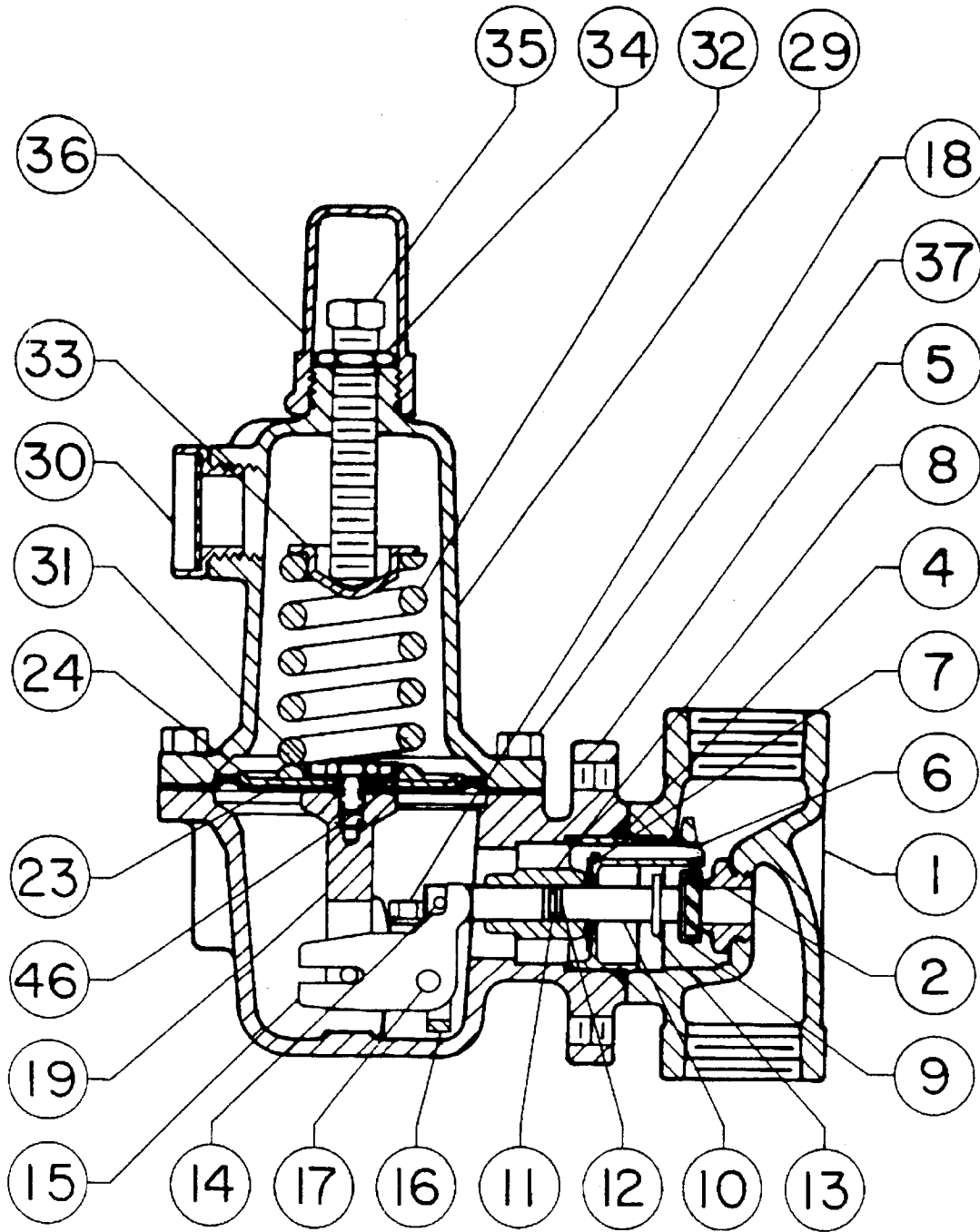
When ordering replacement parts, reference the key number of each needed part as found in the following parts list.

Parts List

Key	Description	Part Number
	Type 627 Parts Kit with aluminum/nitrile trim (includes keys 4, 9, 11, 12, and 23)	R627X000A12
	Type 627 Parts Kit with stainless steel/nitrile trim (includes keys 4, 9, 11, 12, and 23)	R627X000S12
	Type 627R Parts Kit with aluminum/nitrile trim (includes keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00A12
	Type 627R Parts Kit with stainless steel/nitrile trim (includes keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00S12
1	Body	
	Ductile iron	
	1000 psig (69 bar) max inlet pressure	
	3/4-inch NPT size	30B3046X012
	1-inch NPT size	30B3048X012
	2-inch NPT size	30B3096X012
	Steel	
	2000 psig (138 bar) max inlet pressure	
	3/4-inch NPT size	30B3050X012
	1-inch NPT size	30B3051X012
	2-inch NPT size	30B7452X012
	Steel, ANSI Class 600 RF flanged	
	1480 psig (102 bar) max inlet pressure	
	1-inch size	40B6754X012
	2-inch size	40B6756X012
2*	Seat ring	
	Aluminum	
	3/32-inch (2.4 mm) port diameter	0R044109022
	1/8-inch (3.2 mm) port diameter	1A936709012
	3/16-inch (4.8 mm) port diameter	00991209012
	1/4-inch (6.4 mm) port diameter	0B042009012
	3/8-inch (9.5 mm) port diameter	0B042209012
	1/2-inch (12.7 mm) port diameter	1A928809012
	303 Stainless steel	
	3/32-inch (2.4 mm) port diameter	0R044135032
	1/8-inch (3.2 mm) port diameter	1A936735032
	3/16-inch (4.8 mm) port diameter	00991235032
	1/4-inch (6.4 mm) port diameter	0B042035032
	3/8-inch (9.5 mm) port diameter	0B042235032
	1/2-inch (12.7 mm) port diameter	1A928835032

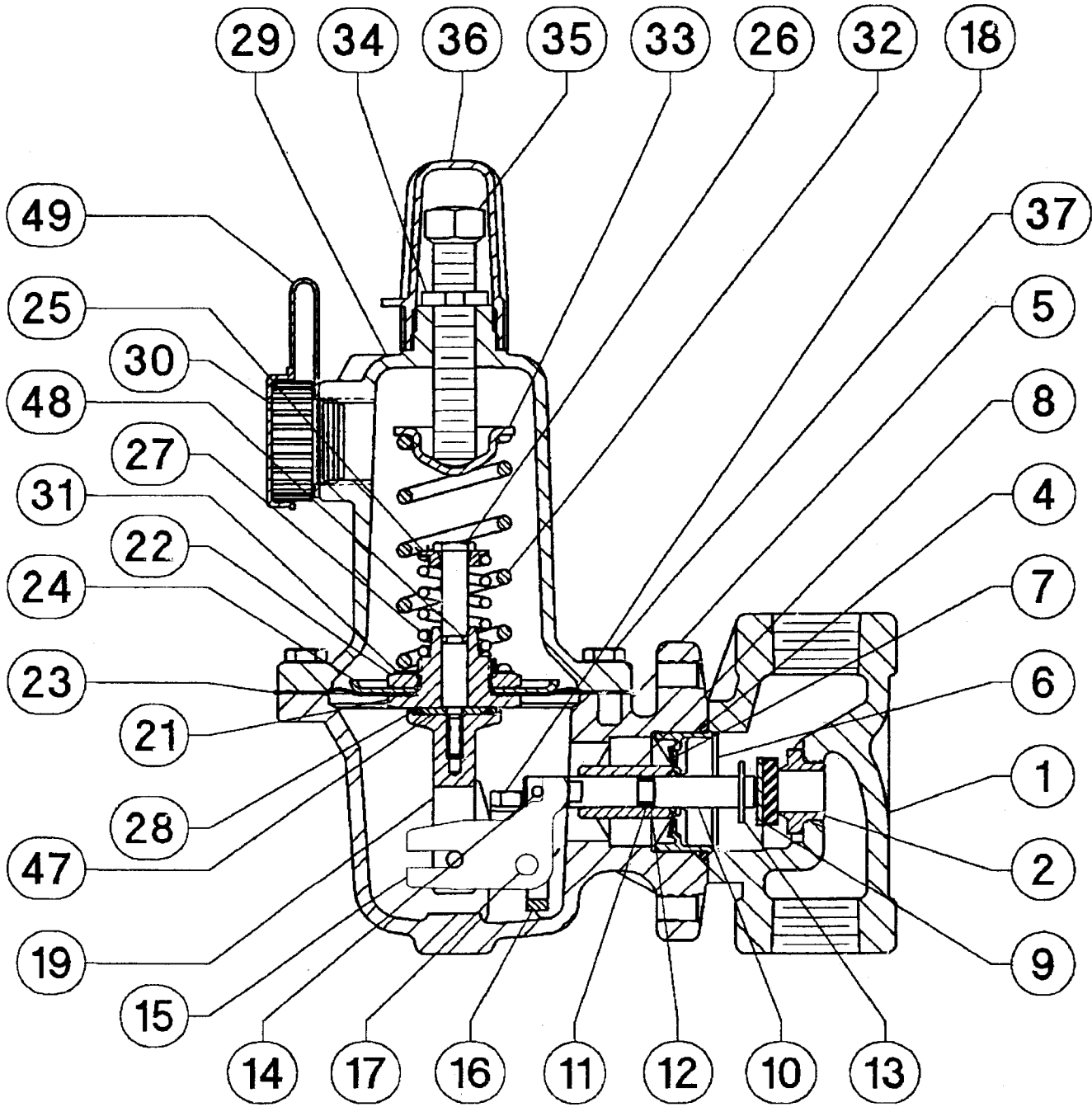
*Recommended spare part.

Key	Description	Part Number	Key	Description	Part Number
2*	Seat ring (continued) 316 Stainless steel, NACE ⁽¹⁾ construction only		23*	Diaphragm, nitrile (continued) For Type 627 or 627M w/steel	
	3/32-inch (2.4 mm) port diameter	0R0441X0012		diaphragm case	10B8735X012
	1/8-inch (3.2 mm) port diameter	1A9367X0022		For Type 627R or 627MR w/aluminum	
	3/16-inch (4.8 mm) port diameter	009912X0012		or ductile iron diaphragm case	10B3068X012
	1/4-inch (6.4 mm) port diameter	0B0420X0012		For Type 627R or 627MR w/steel	
	3/8-inch (9.5 mm) port diameter	0B0422X0012		diaphragm case	10B8736X012
	1/2-inch (12.7 mm) port diameter	1A9288X0012		For Type 627H or 627HM w/steel	
3	Cap Screw (not shown), (2 req'd) Type 627 and 627R w/aluminum		24	Diaphragm Head, plated steel For Type 627 or 627M, plated steel	1D666428982
	diaphragm case, pl steel	18A1087X012		For Type 627R or 627MR, plated steel	10B3071X012
	All Types w/ductile iron			For Type 627H or 627HM, 416 stainless steel	12B0175X012
	diaphragm case, pl steel	1C403824052			
	or steel diaphragm case, pl steel	1C403024052	25	Relief Spring Seat (for Type 627R or	
4*	Diaphragm Case O-Ring (Type 627, 627H, or			627MR only), steel	10B7446X012
	627R only), nitrile	17A2325X022	26	Guide Retainer (for Type 627R or	
5	Diaphragm Case			627MR only), stainless steel	10B7450X012
	For Type 627 or 627R		27	Relief Spring (for Type 627R or 627MR	
	Aluminum w/o 1/8-inch gauge tap	40B3084X012		only), plated steel	10B6757X012
	Aluminum with 1/8-inch gauge tap		28*	Relief Seal O-Ring (for Type 627R or	
	for Type 627 only	11B5380X012		627MR only), nitrile	1J108506992
	Ductile iron w/o 1/8-inch gauge tap	30B3053X012	29	Spring Case	
	Ductile iron with 1/8-inch gauge tap			For Type 627 or 627R	
	for Type 627 only	31B0641X012		Aluminum	40B3086X012
	Steel	30B3104X012		Ductile iron	30B3055X012
	For Type 627M or 627MR			Steel	30B3102X012
	Ductile iron	39A5987X012		For Type 627M or 627MR	
	Steel	30B8734X012		Ductile iron	30B3055X012
	For Type 627H, steel	30B3104X012		Steel	30B3102X012
	For Type 627HM, steel	30B8734X012		For Type 627H or 627HM	
6	Boost Body (not for Type 627M, 627HM,			Steel	30B3102X012
	or 627MR), Delrin ⁽²⁾		30	Screened Vent Assembly, plastic	10B3093X012
	For Type 627 or 627H	30B3056X012	31	Lower Spring Seat, plated steel	
	For Type 627R	30B3057X012		For Type 627 or 627M	1D666625072
7	Stabilizer (for Type 627, 627H, and 627R			For Type 627R or 627MR	20B3073X012
	only), nitrile	10B3060X012	32	Control Spring, pl steel	
8	Stem Guide (for Type 627, 627H, and 627R			5 to 20 psig (0.34 to 1.4 bar), yellow	10B3076X012
	only), powdered metal	20B3061X012		15 to 40 psig (1.0 to 2.8 bar), green	10B3077X012
9*	Disk Assembly (for all port diameters)			35 to 80 psig (2.4 to 5.5 bar), blue	10B3078X012
	Aluminum holder and nitrile disk	1C4248X0212		70 to 150 psig (4.8 to 10.3 bar), red	10B3079X012
	303 Stainless steel holder and nitrile disk	1C4248X0202		140 to 250 psig range (9.6 to 17.2 bar),	
	Aluminum holder and nylon disk	1C4248X00A2		blue, used in a Type 627H or 627HM	10B3078X012
	303 Stainless steel holder and nylon disk	1C4248X0062		240 to 500 psig range (16.5 to 34.5 bar),	
	NACE construction only			red, used in a Type 627H or 627HM	10B3079X012
	Aluminum holder and nitrile disk	1C4248X0212	33	Upper Spring Seat, plated steel	1D667125072
	316 Stainless steel holder and nitrile disk	1C4248X0252	34	Locknut, plated steel	1D667728982
	Aluminum holder and nylon disk	1C4248X00A2	35	Adjusting Screw, pl steel	
	316 Stainless steel holder and nylon disk	1C4248X0262		For Type 627 or 627M	10B3081X012
10	Stem			For Type 627H or 627HM	10B3081X012
	303 stainless steel	10B3059X012		For Type 627R or 627MR	10B3080X012
	316 stainless steel (NACE)	10B3059X022	36	Adjusting Screw Cap, plastic	20B3082X012
11*	Stem O-Ring, nitrile	1D687506992	37	Spring Case Cap Screw, pl steel (8 required)	
12	Stem Backup Ring, TFE (2 required)	1K786806992		For aluminum or ductile iron diaphragm case	1A391724052
13	Hair Pin Clip, stainless steel	10B3058X012		For steel diaphragm case	10B8737X012
14	Drive Pin, plated steel	1A953228982		For Type 627H/HM, steel diaphragm case	1A346424052
15	Lever, plated steel	20B3063X012		Nameplate	-----
16	Lever Retainer, plated steel	30B3097X012	39	Blocked Throat (for Type 627M, 627HM or	
17	Lever Pin			627MR only), stainless steel	10B3085X012
	Stainless steel	10B3083X012	43	Blocked Throat O-Ring (for Type 627M,	
	316 stainless steel (NACE)	10B3083X022		627HM, or 627MR only), nitrile (2 required)	1E264306992
18	Lever Cap Screw (2 required)		44	Blocked Throat Backup Ring (for Type 627M,	
	Plated steel	10B7454X012		627HM, or 627MR only), TFE (2 required)	10B3106X012
	316 stainless steel (NACE)	10B7454X022	45	Diaphragm Head Cap Screw, steel	
19	Pusher Post, aluminum			For Type 627 or 627M	1K920724052
	For Type 627 or 627M	10B3098 X012		For Type 627H or 627HM	1C379124052
	For Type 627R or 627MR	10B3098 X022	46	Relief Seal Retainer (for Type 627R or	
	For Type 627H or 627HM,			627MR only), stainless steel	10B7445X012
	416 stainless steel	10B3098 X032	47	Guide Retainer O-Ring (for Type 627R	
21	Diaphragm Connector (for Type 627R			or 627MR only), nitrile	1D682506992
	or 627MR only), stainless steel	10B6758X012	48*	Relief Indicator (for Type 627R or	
22	Diaphragm Connector Nut (for Type			627MR only), rubber (not shown)	30B3100X012
	627R or 627MR only), stainless steel	10B7449X012	49	Diaphragm Limiter	22B0176X012
23*	Diaphragm, nitrile		50	Diaphragm Limiter O-Ring	1K877606992
	For Type 627 or 627M w/aluminum or		51*	Pusher Post O-Ring (2 required)	1C853806992
	ductile iron diaphragm case	10B3069X012	52*		



30B3092-D

Figure 7. Type 627 Regulator Components



3083089-D

Figure 8. Type 627R Regulator Components

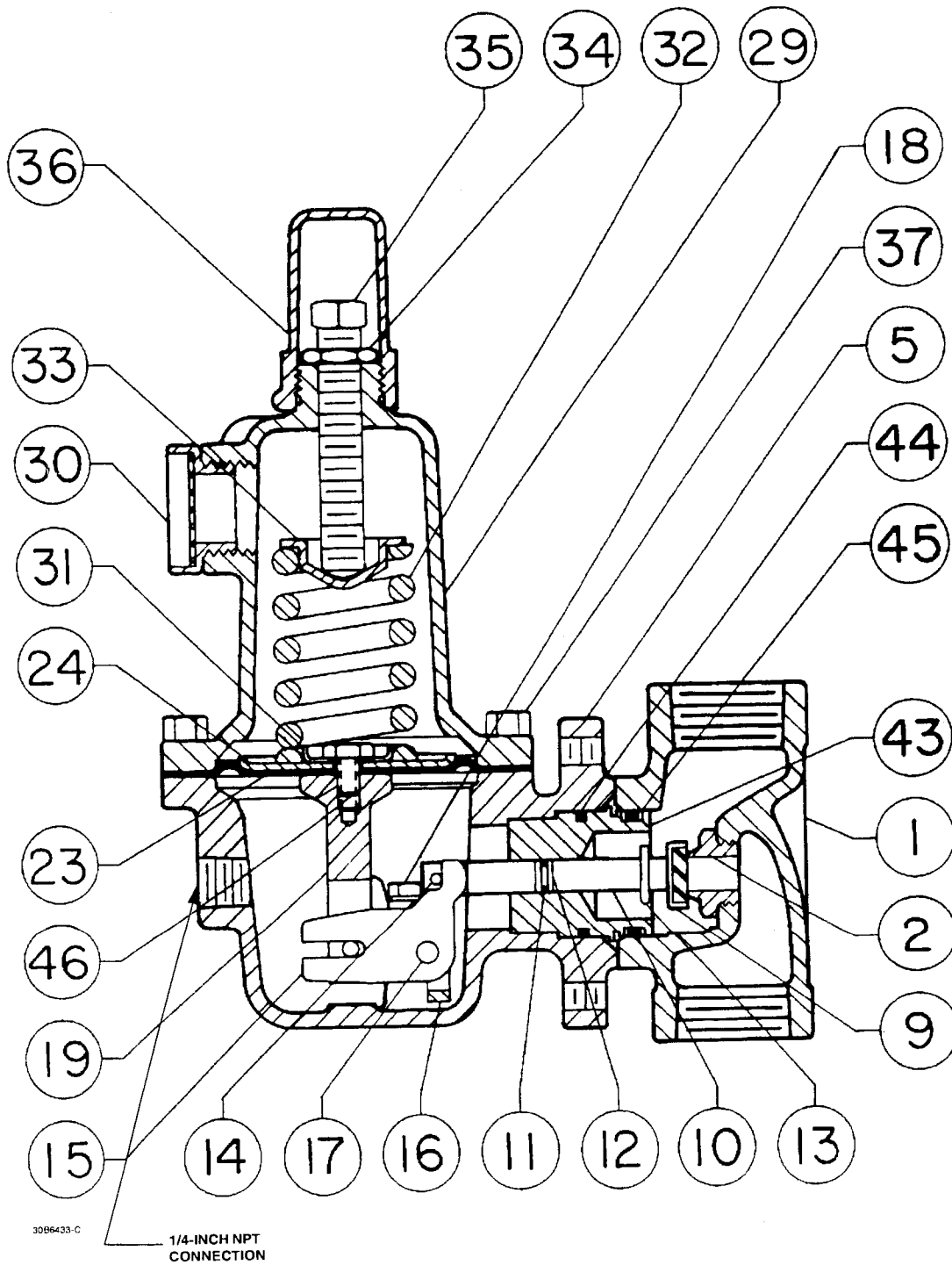


Figure 9. Type 627M Regulator Components

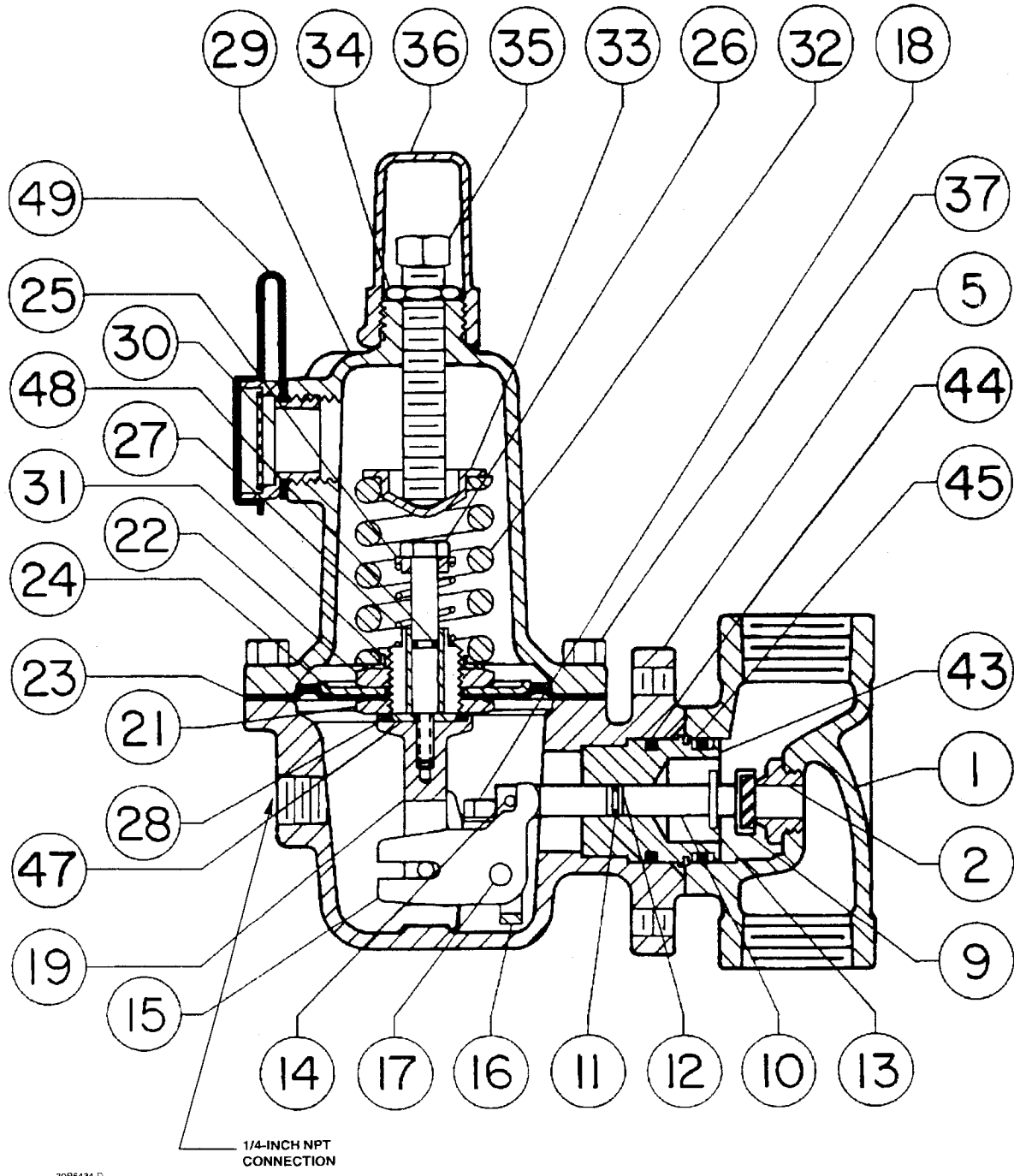
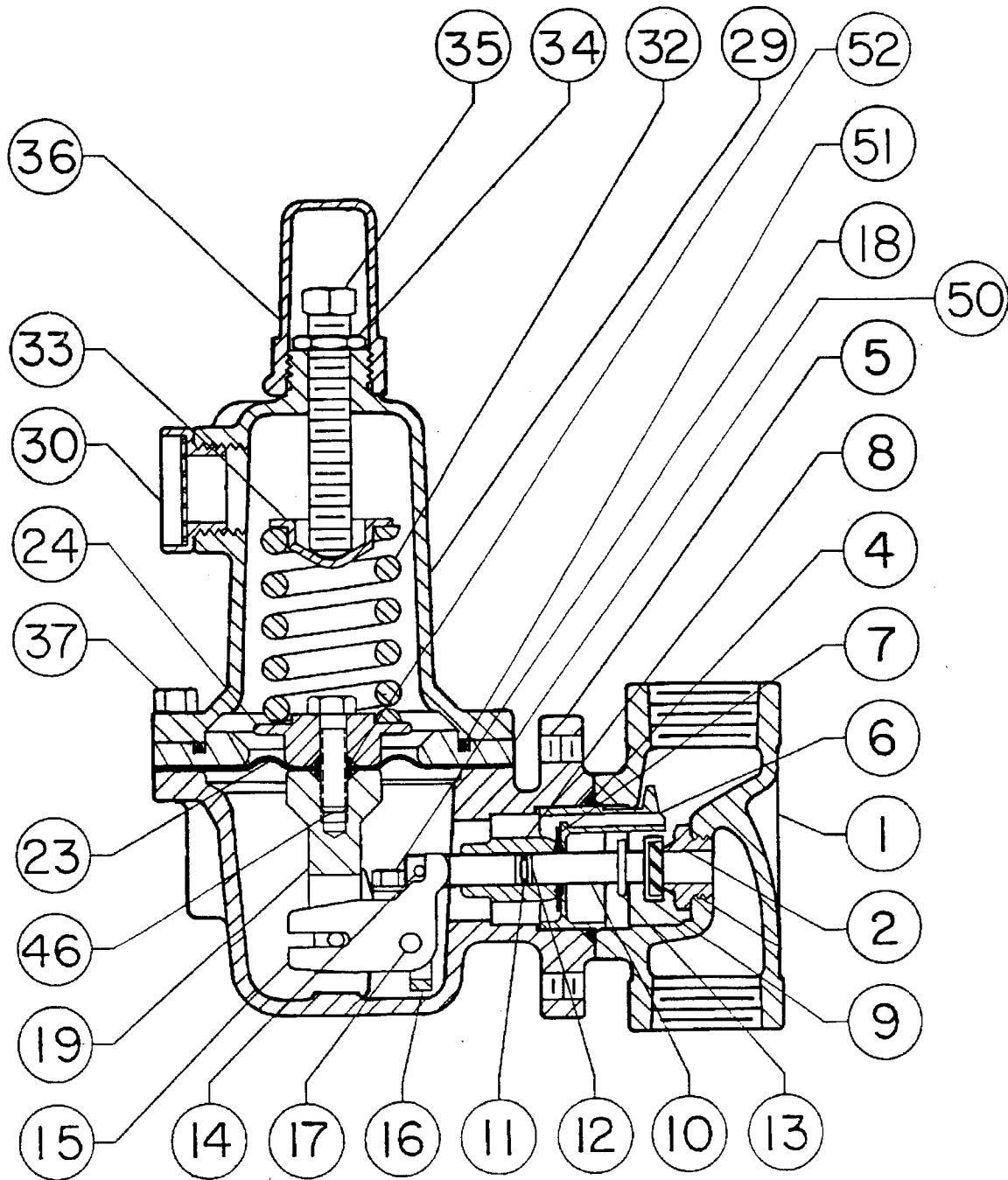
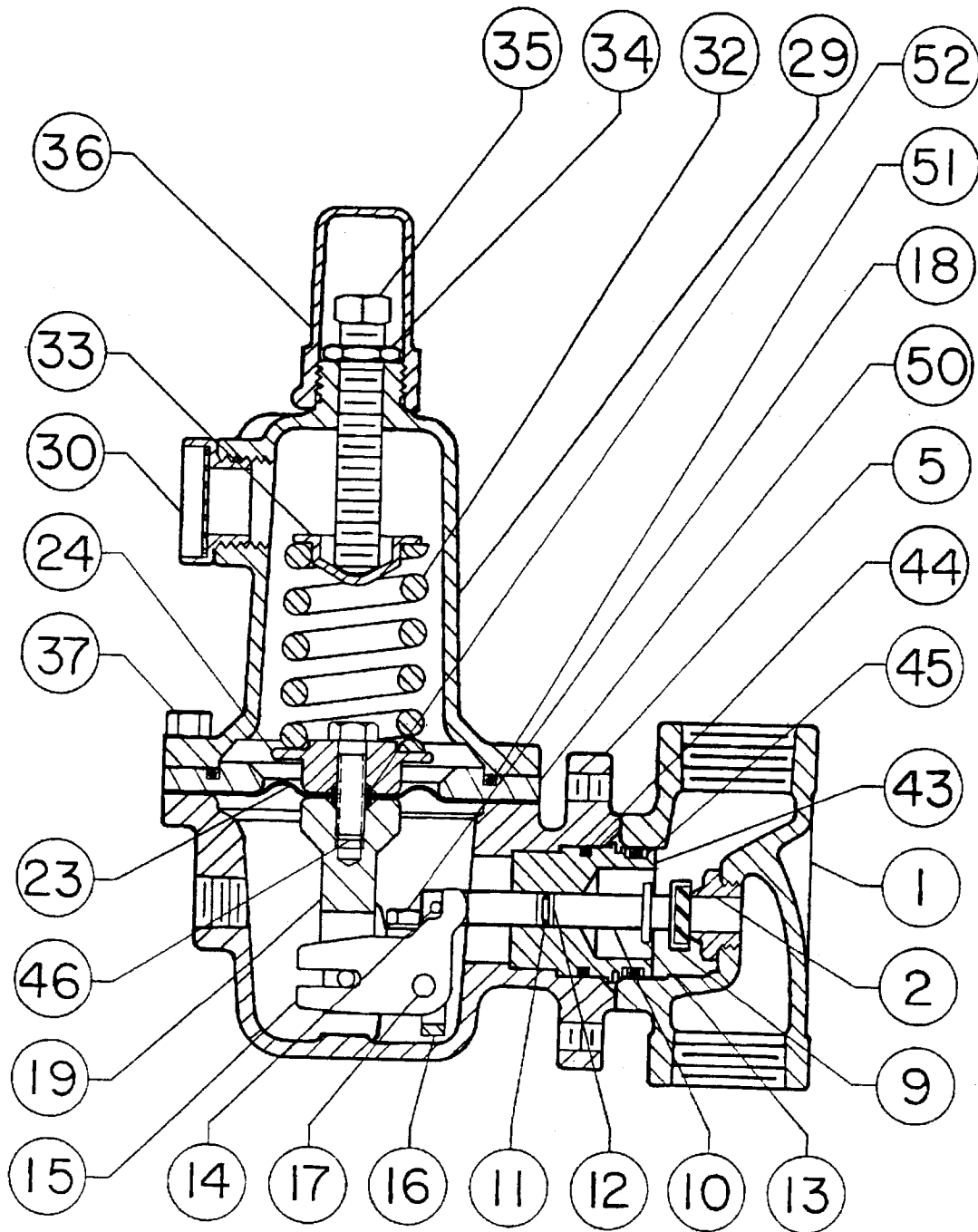


Figure 10. Type 627MR Regulator Components



3185374-E

Figure 11. Type 627H Regulator Components



31B9872-B

Figure 12. Type 627HM Regulator Components

Errata Sheet for

627 Series
Form 5252, July 1989

This errata sheet includes information covering the Type 627LB extended body regulator. This new body style is available on all 627 Series configurations and will be an addition to key 1 in the Parts List. The pressure ratings on the Type 627LB bodies will be identical to the existing specifications stated in the current 627 Series Instruction Manual. Each bullet on this errata sheet refers to a section of the 627 Series Instruction Manual (form 5252) where this information needs to be added.

- Add the following to the Available Constructions section of Table 1. Specifications on page 2.
- Add the following figure to the end of page 18.

Type 627LB: A 627 Series construction with an extended NPT screwed body. Note: The pressure ratings and capacities for a Type 627LB depend on the 627 Series construction. See the above listed constructions for ratings and specifications.

- Add the following to the Parts List on page 12.

Key	Description	Part Number
1	Body	
	Type 627LB - Ductile iron	
	1000 psig (69 bar) max inlet pressure	
	3/4-inch NPT screwed body	39B2450X012
	1-inch NPT screwed body	39B2451X012
	2-inch NPT screwed body	39B0414X012
	Type 627LB - Steel	
	2000 psig (138 bar) max inlet pressure	
	3/4-inch NPT screwed body	39B0411X012
	1-inch NPT screwed body	39B0412X012
2-inch NPT screwed body	39B0415X012	

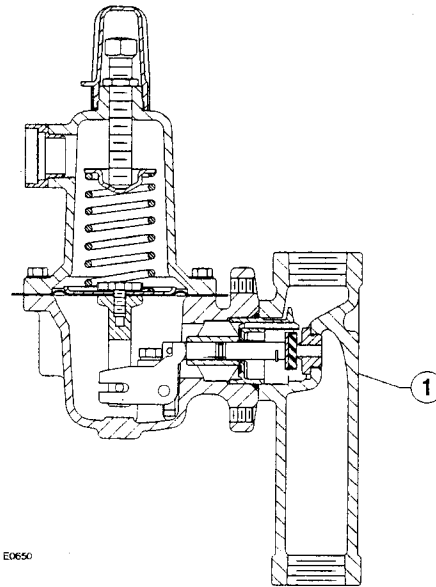


Figure 13. Type 627LB Regulator Body

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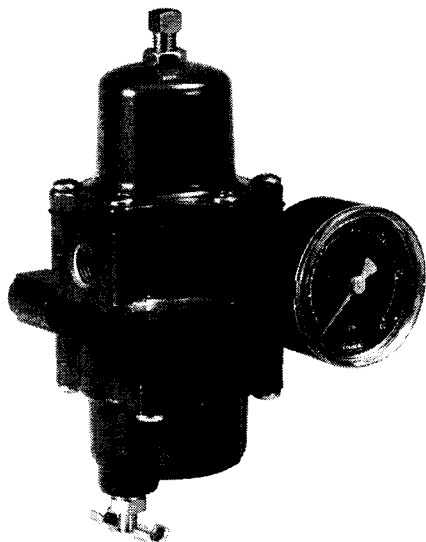
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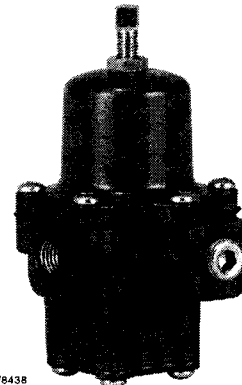
March 2004

67C Series Instrument Supply Regulators



W7412

**TYPE 67CF FILTER REGULATOR
WITH OPTIONAL GAUGE**



W8438

**TYPE 67C OR 67CR
REGULATOR**

Figure 1. Typical 67C Series Regulators

Introduction

Scope of Manual

This manual provides instructions and parts lists for 67C Series instrument supply regulators. Instructions and parts lists for other equipment mentioned in this instruction manual, as well as for other 67 Series regulators, are found in separate manuals.

Product Descriptions

The 67C Series direct-operated regulators are typically used to provide constantly controlled, reduced pressures to pneumatic and electropneumatic controllers and other instruments. They are suitable for most air or gas applications. Other applications include providing reduced pressures to air chucks, air jets, and spray guns.

- The Type 67C and 67CS is the standard instrument supply regulator without a filter or internal relief.
- The Type 67CF and 67CFS are equipped with a filter for removing particles from the supply gas.
- The Type 67CR and 67CSR has an internal relief valve with a soft seat for reliable shutoff with no discernible leakage.
- The Type 67CFR and 67CFSR have a filter and internal relief valve with a soft seat for reliable shutoff with no discernible leakage.

Specifications

Some general 67C Series ratings and other specifications are given on page 2. A label on the spring case gives the control spring range for a given regulator as it comes from the factory.



Specifications

Body Size, Inlet and Outlets Connection Style

1/4-inch NPT

Maximum Inlet Pressure (Body Rating)⁽¹⁾

All except 67CS and 67CSR: 250 psig (17,2 bar)

Type 67CS and 67CSR: 400 psig (27,6 bar)

Outlet Pressure Ranges

See table 1

Maximum Emergency Outlet Pressure⁽¹⁾

50 psi (3,4 bar) over outlet pressure setting

Accuracy

Inlet Sensitivity: Less than 0.2 psig (0,014 bar) change in outlet pressure for every 25 psig (1,72 bar) change in inlet pressure

Repeatability: 0.1 psig (0,0069 bar)⁽²⁾

Air Consumption: testing repeatedly shows no discernible leakage

Type 67CR, 67CSR, 67CFR, and 67CFSR Internal Relief Performance

Low capacity for minor seat leakage only; other overpressure protection must be provided if inlet pressure can exceed the maximum pressure rating of downstream equipment or exceeds maximum outlet pressure rating of the regulator.

Regulator Temperature Capabilities

With Nitrile (NBR)

Standard Bolting: -20 to 180°F (-29 to 82°C)

Stainless Steel Bolting: -40 to 180°F (-40 to 82°C)

With Fluoroelastomer (FKM):

0 to 300°F (-18 to 149°C)

With Silicone (VMQ)⁽³⁾ Diaphragm and Low

Temperature bolting: -60 to 180°F (-51 to 82°C)

With Gauges: -20 to 180°F (-29 to 82°C)

Smart Bleed™ Check Valve Setpoint

6 psi (0,4 bar) differential

Type 67CF, 67CFR, 67CFS, and 67CFSR Filter Capabilities

Free Area: 12 times pipe area

Micron Rating: Cellulose Element: 40 microns

Glass Fiber Element: 5 microns

Stainless Steel Element: 40 microns

Drain Valve and Spring Case Vent Location

Aligned with inlet standard, other positions optional

Pressure Registration

Internal

Options

All Types

- Handwheel adjusting screw
- Inlet screen
- NACE MR0175 or NACE MR0103 construction⁽⁴⁾
- Panel mount (includes spring case with 1/4-inch vent, handwheel, and panel mounting nut)
- Closing cap (available on spring case with 1/4-inch NPT vent)
- Fluoroelastomer (FKM) elastomers for high temperatures and/or corrosive chemicals
- Silicone (VMQ) elastomers for cold temperatures
- Fixed Bleed Restriction
- Triple scale outlet pressure gauge (brass or stainless steel)
- Stainless steel stem on the valve plug
- Tire valve or pipe plug in second outlet

Types 67CFR only

- Smart Bleed™ internal check valve

Types 67CF and 67CFR only

- Stainless steel drain valve

1. The pressure/temperature limits in this manual and any applicable standard or code limitation should not be exceeded.
2. Repeatability is the measure of the regulator's ability to return to setpoint consistently when traveling from steady state to transient to steady state.
3. Silicone is not compatible with hydrocarbon gas.
4. Product complies with the material requirements of NACE MR0175. Environmental limits may apply.

Table 1. Outlet Pressure Ranges and Control Spring Data

Type	OUTLET PRESSURE RANGES, PSIG (bar)	CONTROL SPRING DATA			
		Color	Material	Part Number	Wire Diameter, Inch (mm)
67C, 67CR, 67CF, 67CFR	0 to 20 (0 to 1,4)	green stripe	Music Wire	GE07809T012	0.135 (3,43)
	0 to 35 (0 to 2,4)	silver		T14059T0012	0.156 (3,96)
	0 to 60 (0 to 4,1)	blue stripe		T14058T0012	0.170 (4,32)
	0 to 125 (0 to 8,6)	red stripe		T14060T0012	0.207 (5,26)
	0 to 35 (0 to 2,4)	silver stripe		Inconel	T14113T0012
	0 to 60 (0 to 4,1)	blue	Inconel	T14114T0012	0.172 (4,37)
67CS, 67CSR, 67CFS, 67CFSR	0 to 125 (0 to 8,6)	red	Inconel	T14115T0012	0.207 (5,26)
	0 to 20 (0 to 1,4)	green	Inconel	10C1729X012	0.135 (3,43)
	0 to 35 (0 to 2,4)	silver stripe		T14113T0012	0.156 (3,96)
	0 to 60 (0 to 4,1)	blue		T14114T0012	0.172 (4,37)
	0 to 125 (0 to 8,6)	red		T14115T0012	0.207 (5,26)
	0 to 150 (0 to 10,3)	black		10C1730X012	0.250 (6,35)

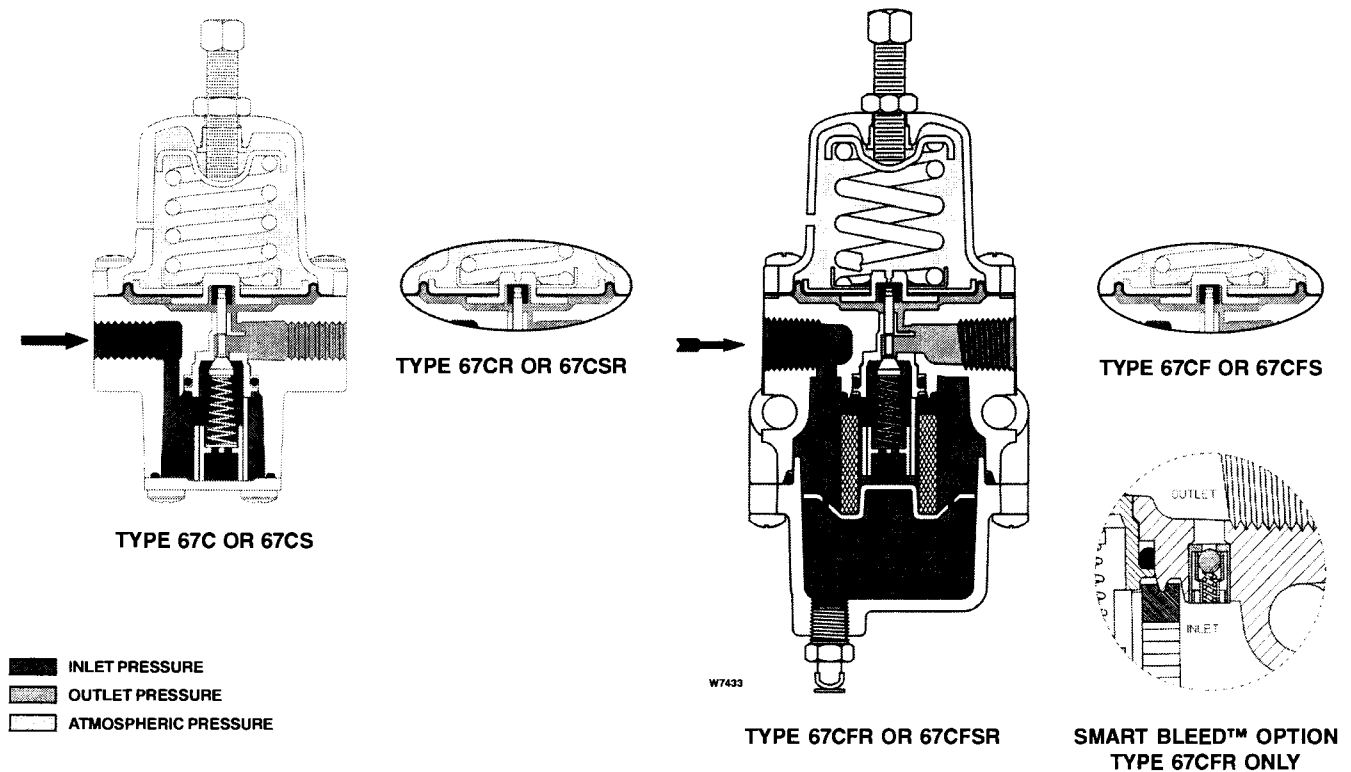


Figure 2. 67C Series Operational Schematics

Principle of Operation

Downstream pressure is registered internally on the lower side of the diaphragm. When the downstream pressure is at or above the set pressure, the valve plug is held against the orifice and there is no flow through the regulator. When demand increases, downstream pressure drops slightly allowing the spring to extend, moving the stem down and the valve plug away from the orifice. This allows flow through the regulator.

Internal Relief (Types 67CR, 67CSR, 67CFR, and 67CFRSR)

If for some reason, outside of normal operating conditions, the downstream pressure exceeds the set point of the regulator, the force created by the downstream pressure will lift the diaphragm until the diaphragm is lifted off the relief seat. This allows flow through the token relief. The relief valve on the Type 67CR, 67CSR, 67CFR, or 67CFRSR is an elastomer plug that prevents leakage of air from the downstream to atmosphere during normal operation, thereby conserving plant air.

Smart Bleed™ Airset

In some cases, it is desired to exhaust downstream pressure if inlet pressure is lost or drops below the setpoint of the regulator. For example, if the regulator is installed on equipment that at times has no flow demand but is expected to backflow on loss of inlet pressure. The Type 67CFR can be ordered with the Smart Bleed™ option which includes an internal check valve for this application. During operation, if inlet pressure is lost, or decreases below the setpoint of the regulator, the downstream pressure will back flow upstream through the regulator and check valve. This option eliminates the need for a fixed bleed downstream of the regulator, thereby conserving plant air.

Overpressure Protection

The 67C Series regulators have maximum outlet pressure ratings that are lower than their maximum inlet pressure ratings. A pressure relieving or pressure limiting device is needed if inlet pressure can exceed the maximum outlet pressure rating.

67C Series

Types 67CR, 67CSR, 67CFR, 67CFSR have a low capacity internal relief valve for minor seat leakage only. Other overpressure protection must be provided if the maximum inlet pressure can exceed the maximum pressure rating of the downstream equipment or exceeds the maximum outlet pressure rating of the regulator.

Installation

Note

If the regulator is shipped mounted on another unit, install that unit according to the appropriate instruction manual.



WARNING

Personal injury, property damage, equipment damage, or leakage due to escaping gas or bursting of pressure-containing parts may result if this regulator is overpressured or is installed where service conditions could exceed the limits given in the specifications, or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation, or standard) to prevent service conditions from exceeding those limits.



WARNING

The internal relief valve of the Type 67CR, 67CSR, 67CFR, or 67CFSR does not provide full overpressure protection. The internal relief valve is designed for minor seat leakage only. If maximum inlet pressure to the regulator exceeds maximum pressure ratings of the downstream equipment or exceeds maximum allowable outlet pressure of the regulator, additional overpressure protection is required.



WARNING

A regulator may vent some gas to the atmosphere. In hazardous or flammable

gas service, vented gas may accumulate and cause personal injury, death, or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous area. The vent line or stack opening must be protected against condensation or clogging.

Before installing a Type 67C, 67CR, 67CS, 67CSR, 67CF, 67CFR, 67CFS, or 67CFSR regulator, be sure the installation complies with the following installation guidelines:

1. Regulator operation within ratings does not preclude the possibility of damage from debris in the lines or from external sources. Regulators should be inspected for damage periodically and after any overpressure condition.
2. Only personnel qualified through training and experience should install, operate, and maintain a regulator. Make sure that there is no damage to or foreign material in the regulator. Also ensure that all tubing and piping is free of debris.
3. Install the regulator so that flow is from the IN to the OUT connection as marked on the regulator body.
4. For best drainage, orient the drain valve (key 2) to the lowest possible point on the dripwell (key 5). This orientation may be improved by rotating the dripwell with respect to the body (key 1).
5. A clogged spring case vent hole may cause the regulator to function improperly. To keep this vent hole from being plugged (and to keep the spring case from collecting moisture, corrosive chemicals, or other foreign material) orient the vent to the lowest possible point on the spring case or otherwise protect it.

Inspect the vent hole regularly to make sure it is not plugged. Spring case vent hole orientation may be changed by rotating the spring case with respect to the body. A 1/4-inch NPT spring case vent may be remotely vented by installing obstruction-free tubing or piping into the vent. Protect the remote vent by installing a screened vent cap on the remote end of the vent pipe.
6. For use in regulator shutdown, install upstream block and vent valves and downstream block and vent valves (if required), or provide some other suitable means of properly venting the regulator inlet and outlet pressures. Install a pressure gauge to monitor instruments on startup.

7. Apply a good grade of pipe compound to the male pipe threads before making connections, making sure not to get the pipe compound inside the regulator.

8. Install tubing fitting or piping into the 1/4-inch NPT inlet connection on the body (key 1) and into the 1/4-inch NPT body outlet connection.

9. The second 1/4-inch NPT outlet can be used for a gauge or other use. If not used, it must be plugged.

Installing a 67CF Series Regulator in an Existing Installation

When installing a 67CF Series regulator in an existing installation, it may be necessary to use spacers (key 34, figure 13) to adapt the installation. If the mounting bolts are too long, place a spacer on the bolt (see figure 13). To be sure the regulator is secure, the bolts should have at least two full threads of engagement.

Startup and Adjustment

Key numbers are referenced in figure 3 through 9.

1. With proper installation completed and downstream equipment properly adjusted, slowly open the upstream and downstream shutoff valve (when used) while using pressure gauges to monitor pressure.



WARNING

To avoid personal injury, property damage, or equipment damage caused by bursting of pressure containing parts or explosion of accumulated gas, never adjust the control spring to produce an outlet pressure higher than the upper limit of the outlet pressure range for that particular spring. If the desired outlet pressure is not within the range of the control spring, install a spring of the proper range according to the diaphragm parts maintenance procedure.

2. If outlet pressure adjustment is necessary, monitor outlet pressure with a gauge during the adjustment procedure. The regulator is adjusted by loosening the locknut (key 19), if used, and turning the adjusting screw or handwheel (key 18) clockwise to increase or counterclockwise to decrease the outlet

pressure setting. Retighten the locknut to maintain the adjustment position.

Shutdown

First, close the nearest upstream block valve and then close the nearest downstream block valve (when used). Next, open the downstream vent valve. Since the regulator remains open in response to the decreasing downstream pressure, pressure between the closed block valves will be released through the open vent valve.

Maintenance

Regulator parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and replacement of parts depends on the severity of service conditions and applicable codes and government regulations. Open the Type 67CF, 67CFR, 67CFS, or 67CFSR drain valve (key 2) regularly to empty accumulated liquid from the dripwell (key 5).

Note

If sufficient clearance exists, the body (key 1) may remain mounted on other equipment or in a line or panel during maintenance unless the entire regulator will be replaced.



WARNING

To avoid personal injury, property damage, or equipment damage caused by sudden release of pressure or explosion of accumulated gas, do not attempt any maintenance or disassembly without first isolating the regulator from system pressure and relieving all internal pressure from the regulator.

Type 67C, 67CR, 67CS, and 67CSR

Trim Maintenance

Key numbers are referenced in figures 3, 4 and 12.

1. Remove four bottom plate screws (key 3) from the bottom plate (key 39) and separate the bottom plate and O-ring (key 4) from the body (key 1).

67C Series

2. Inspect the removed parts for damage and debris. Replace any damaged parts.

3. To remove the valve cartridge assembly, grasp the end of cartridge and pull it straight out of body (key 1). Replace with new cartridge assembly. The cartridge assembly may be disassembled and parts may be cleaned or replaced. If the soft seat (key 15) was removed, make sure it is properly snapped into place before installing the valve cartridge assembly.

4. Check O-ring (key 14) for wear and replace, if necessary. Apply lubricant to the O-ring and place in the body. Align cartridge key to keyway in body and insert. Reinstall the O-ring (key 4), secure the bottom plate (key 39) with screws (key 3), and torque to 15 to 30 inch-pounds (1,9 to 3,9 N•m).

Diaphragm Maintenance

Key numbers are referenced in figures 3 and 4.

1. Back out the adjusting screw or handwheel (key 18) until compression is removed from the spring (key 17).

2. Remove the spring case screws (key 3) to separate the spring case (key 7) from the body (key 1). Remove the upper spring seat (key 20) and spring (key 17).

3. Remove the diaphragm assembly (key 16), inspect the diaphragm, and replace the assembly, if necessary.

4. Place the diaphragm assembly (key 16) on the body (key 1) as shown in figure 3 or 4. Push down on the diaphragm assembly to make sure the valve plug (key 11) strokes smoothly and approximately 1/16-inch (2 mm).

Note

In step 5, if installing a control spring of a different range, be sure to delete the spring range originally appearing on the label and indicate the new spring range.

5. Stack the control spring (key 17) and upper spring seat (key 20) onto the diaphragm assembly (key 16).

6. Install the spring case (key 7) on the body (key 1) with the vent oriented to prevent clogging or entrance of moisture. Install the six spring case screws (key 3) using a crisscross pattern and torque to 15 to 30 inch-pounds (1,9 to 3,9 N•m).

Note

On Types 67CS and 67CSR, lubricate the adjusting screw (key 18) thread to reduce galling of the stainless steel.

7. When all maintenance is complete, refer to the Startup and Adjustment section to put the regulator back into operation and adjust the pressure setting. Tighten the locknut (key 19) if used, and install the closing cap (key 33) if used.

Types 67CF, 67CFR, 67CFS, and 67CFSR

Filter Element and Trim Maintenance

Key numbers are referenced in figures 5, 6, and 12.

1. Remove four dripwell screws (key 3) from the dripwell (key 5) and separate the dripwell and O-ring (key 4) from the body (key 1). The filter retainer (key 9), thrust washer (key 37), filter element (key 6), and gasket (key 26) may come off with dripwell. If not, remove these parts.

2. Inspect the removed parts for damage and debris. Replace any damaged parts. If a replacement is not available, the filter element may be cleaned.

3. To remove the valve cartridge assembly, grasp the end of cartridge and pull it straight out of body (key 1). Replace with new cartridge assembly. The cartridge assembly may be disassembled and parts may be cleaned or replaced. If the soft seat (key 15) was removed, make sure it is properly snapped into place before installing the valve cartridge assembly.

4. Check O-ring (key 14) for wear and replace, if necessary. Apply lubricant to the O-ring (key 14), then align cartridge key to keyway in body and insert. Reinstall the gasket (key 26), filter element (key 6), thrust washer (key 37), and filter retainer (key 9). Reinstall the O-ring (key 4), secure the dripwell with screws (key 3), and torque to 15 to 30 inch-pounds (1,9 to 3,9 N•m).

Diaphragm Maintenance

Key numbers are referenced in figures 5 and 6.

1. Back out the adjusting screw or handwheel (key 18) until compression is removed from the spring (key 17).

2. Remove the six spring case screws (key 3) to separate the spring case (key 7) from the body (key 1). Remove the upper spring seat (key 20) and spring (key 17).

3. Remove the diaphragm assembly (key 16), inspect the diaphragm, and replace the assembly, if necessary.

4. Place the diaphragm assembly (key 16) on the body (key 1) as shown in figure 4. Push down on the dia-

phragm assembly to make sure the valve plug (key 11) strokes smoothly and approximately 1/16-inch (2 mm).

Note

In step 5, if installing a control spring of a different range, be sure to delete the spring range originally appearing on the label and indicate the new spring range.

5. Stack the control spring (key 17) and upper spring seat (key 20) onto the diaphragm assembly (key 16).

6. Install the spring case (key 7) on the body (key 1) with the vent oriented to prevent clogging or entrance of moisture. Install the six spring case screws (key 3) using a crisscross pattern and torque to 15 to 30 inch-pounds (1,9 to 3,9 N•m).

Note

On Types 67CFS and 67CFSR, lubricate the adjusting screw (key 18) thread to reduce galling of stainless steel.

7. When all maintenance is complete, refer to the Startup and Adjustment section to put the regulator back into operation and adjust the pressure setting. Tighten the locknut (key 19) if used, and install the closing cap (key 33) if used.

Parts Ordering

When corresponding with the Fisher Sales Office or Sales Representative about this regulator, include the type number and all other pertinent information printed on the label. Specify the eleven-character part number when ordering new parts from the following parts list.

Parts List

Key	Description	Part Number
	Parts Kits	
	Types 67C, 67CR, 67CS, and 67CSR - Includes valve cartridge assembly (contains keys 10, 11, 12, 13, 14, and 15), O-ring (key 4), diaphragm assembly (key 16), and four screws (key 3)	
	Type 67C (without relief)	
	Brass stem with nitrile plug	R67CX000012
	Aluminum stem with nitrile plug (NACE)	R67CX000N12
	Type 67CR (with relief)	
	Brass stem with nitrile plug	R67CRX00012
	Aluminum stem with nitrile plug (NACE)	R67CRX00N12
	Type 67CS (without relief)	
	Stainless steel stem with nitrile plug (NACE)	R67CSX00012
	Type 67CSR (with relief)	
	Stainless steel stem with nitrile plug (NACE)	R67CSRX0012

Key	Description	Part Number
	Parts Kits (continued)	
	Types 67CF, 67CFR, and 67CFSR - Includes valve cartridge assembly (contains keys 10, 11, 12, 13, 14, and 15), diaphragm assembly (key 16), O-ring (key 4), filter element (key 6), filter gasket (key 26), thrust washer (key 37), and four screws (key 3)	
	Type 67CF (without relief)	
	Brass stem with nitrile plug	R67CFX00012
	Aluminum stem with nitrile plug (NACE)	R67CFX00N12
	Type 67CFR (with relief)	
	Brass stem with nitrile plug	R67CFRX0012
	Aluminum stem with nitrile plug (NACE)	R67CFRX0N12
	Type 67CFSR (with relief)	
	Stainless steel stem with nitrile plug (NACE)	R67CFSRX012
	Valve Cartridge Assembly Only⁽²⁾	
	Type 67C, 67CR, 67CF, or 67CFR	
	Brass stem	
	With nitrile plug	T14121T0012
	With fluoroelastomer plug	T14121T0022
	Aluminum stem	
	with nitrile plug	T14121T0042
	with nitrile plug (NACE)	T14121T0052
	Type 67CS, 67CSR, 67CFS or 67CFSR	
	316 Stainless steel stem	
	with nitrile plug and O-rings (NACE)	T14121T0092
	with Fluoroelastomer plug and O-rings	T14121T0102
	with nitrile plug and Silicone O-rings	T14121T0112
1	Body	
	Type 67C or 67CR, Aluminum	T40643T0RG2
	Type 67CS or 67CSR, Stainless Steel	GE00909X012
	Type 67CF or 67CFR, Aluminum	T80432T0012
	Type 67CFS or 67CFSR, Stainless steel	40C1887X012
	Type 67CFR with Smart Bleed™, Aluminum	GE03477X012
2	Drain Valve	
	Type 67CF or 67CFR	
	Brass	1K418918992
	18-8 Stainless steel	AH3946X0012
	Type 67CFS or 67CFSR	
	316 Stainless steel	AH3946X0032
3	Flange Screw	
	Type 67C, 67CR, 67CF, or 67CFR	
	Standard spring case and spring case with 1/4-inch NPT vent (10 required)	T13526T0012
	For wire seal	
	Flange Screw (9 required)	T13526T0012
	Flange Screw (1 required)	14B3987X012
	Type 67CS, 67CSR, 67CFS or 67CFSR (10 required)	T13526T0042
4 ⁽¹⁾	O-Ring	
	Type 67C, 67CR, 67CS, or 67CSR	
	Nitrile (NBR)	T14380T0012
	Fluoroelastomer (FKM)	T14380T0022
	Silicone (VMQ)	T14380T0032
	Type 67CF, 67CFR, 67CFS, or 67CFSR	
	Nitrile (NBR)	T14057T0012
	Fluoroelastomer (FKM)	T14057T0022
	Silicone (VMQ)	T14057T0032
5	Dripwell	
	Type 67CF or 67CFR	T21040T0012
	Type 67CFS or 67CFSR	20C1726X012
6 ⁽¹⁾	Filter Element (Type 67CF, 67CFR, 67CFS, 67CFSR)	
	Cellulose(40 microns)(67CF, 67CFR Standard)	1F257706992
	Glass fiber (5 microns)	17A1457X012
	Stainless steel (40 microns)	
	(67CFS, 67CFSR Standard)	15A5967X022

1. Recommended Spare Part

2. Valve cartridge assembly includes keys 10, 11, 12, 13, 14, and 15.

67C Series

Key	Description	Part Number
7	Spring Case Type 67C, 67CR, 67CF, or 67CFR, Aluminum Drilled hole vent (standard) 1/4-inch NPT vent	T14070T0012 T14070T0022
9	Filter Retainer Type 67CF or 67CFR Type 67CFS, 67CSR, 67CFS or 67CFSR, Stainless steel	20C1727X012
10 ^(1, 2)	Valve Cartridge Type 67CF or 67CFR Type 67CFS or 67CFSR	T14052T0012 T14052T0022
11 ^(1, 2)	Valve Plug Type 67C, 67CR, 67CF, or 67CFR Brass stem, nitrile plug Aluminum stem, fluoroelastomer plug Aluminum stem, nitrile plug Type 67CS, 67CSR, 67CFS, or 67CFSR Stainless steel stem, nitrile plug Stainless steel stem, fluoroelastomer plug	T14053T0012 T14053T0022 T14053T0032 T14053T0042 T14053T0052
12 ^(1, 2)	Valve Spring Type 67C, 67CR, 67CF, or 67CFR Stainless steel Inconel (NACE) Type 67CS, 67CSR, 67CFS or 67CFSR, Inconel (NACE)	T14105T0012 T14116T0012 T14116T0012
13 ^(1, 2)	Valve Retainer Type 67C, 67CR, 67CF, or 67CFR Type 67CS, 67CSR, 67CFS or 67CFSR, Inconel (NACE)	T14071T0012
14 ^(1, 2)	O-Ring Nitrile (NBR) Fluoroelastomer (FKM) Silicone (VMQ)	T14063T0012 T14063T0022 T14063T0032
15 ^(1, 2)	Soft Seat Nitrile (NBR) Fluoroelastomer (FKM)	T14055T0012 T14055T0022
16 ⁽¹⁾	Diaphragm Assembly Type 67C or 67CF (without relief) Nitrile (NBR) Fluoroelastomer (FKM) Type 67CR or 67CFR (with relief) Nitrile (NBR) Fluoroelastomer (FKM) Silicone (VMQ) Type 67CS or 67CFS (without relief) Nitrile (NBR) Fluoroelastomer (FKM) Type 67CSR or 67CFSR (with relief) Nitrile (NBR) Fluoroelastomer (FKM) Silicone (VMQ)	T14119T0022 T14119T0042 T14119T0012 T14119T0032 T14119T0052 T14119T0062 T14119T0072 T14119T0082 T14119T0092 T14119T0102
17	Spring Type 67C, 67CR, 67CF, or 67CFR, Plated steel (standard) 0 to 20 psig (0 to 1,4 bar), Green stripe 0 to 35 psig (0 to 2,4 bar), Silver 0 to 60 psig (0 to 4,1 bar), Blue stripe 0 to 125 psig (0 to 8,6 bar), Red stripe Type 67CR or 67CFR (NACE), Inconel (NACE) 0 to 35 psig (0 to 2,4 bar), Silver stripe 0 to 60 psig (0 to 4,1 bar), Blue 0 to 125 psig (0 to 8,6 bar), Red Type 67CS, 67CSR, 67CFS or 67CFSR, Inconel (NACE) 0 to 20 psig (0 to 1,4 bar), Green 0 to 35 psig (0 to 2,4 bar), Silver stripe 0 to 60 psig (0 to 4,1 bar), Blue 0 to 125 psig (0 to 8,6 bar), Red 0 to 150 psig (0 to bar), Black	GE07809T012 T14059T0012 T14058T0012 T14060T0012 T14113T0012 T14114T0012 T14115T0012 10C1729X012 T14113T0012 T14114T0012 T14115T0012 10C1730X012

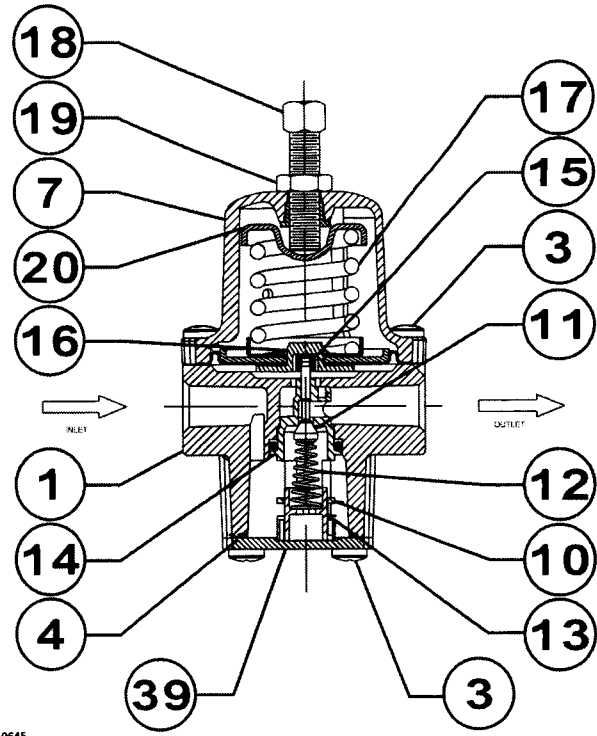
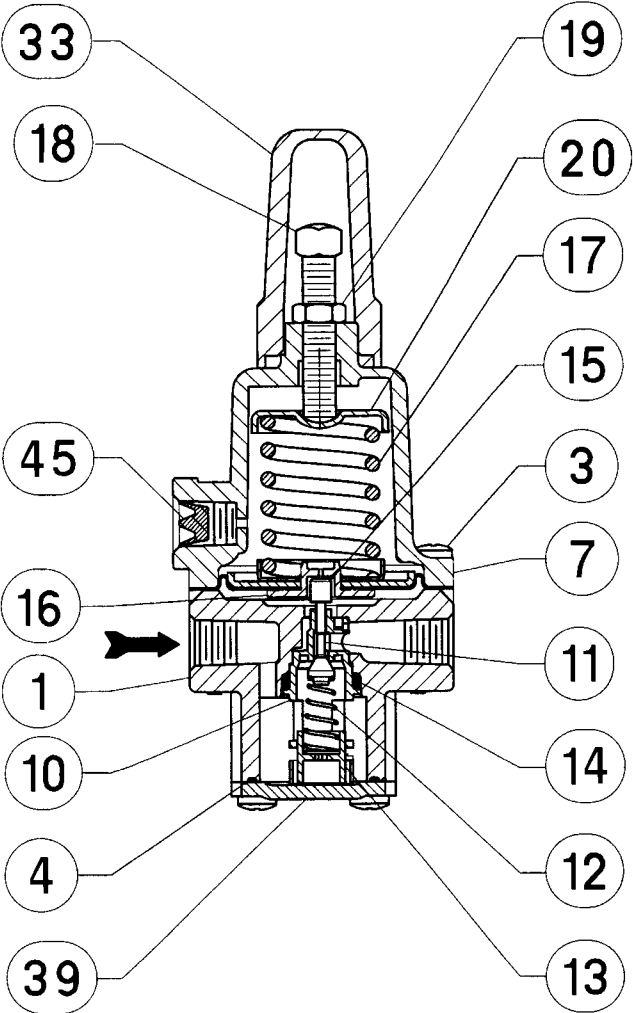


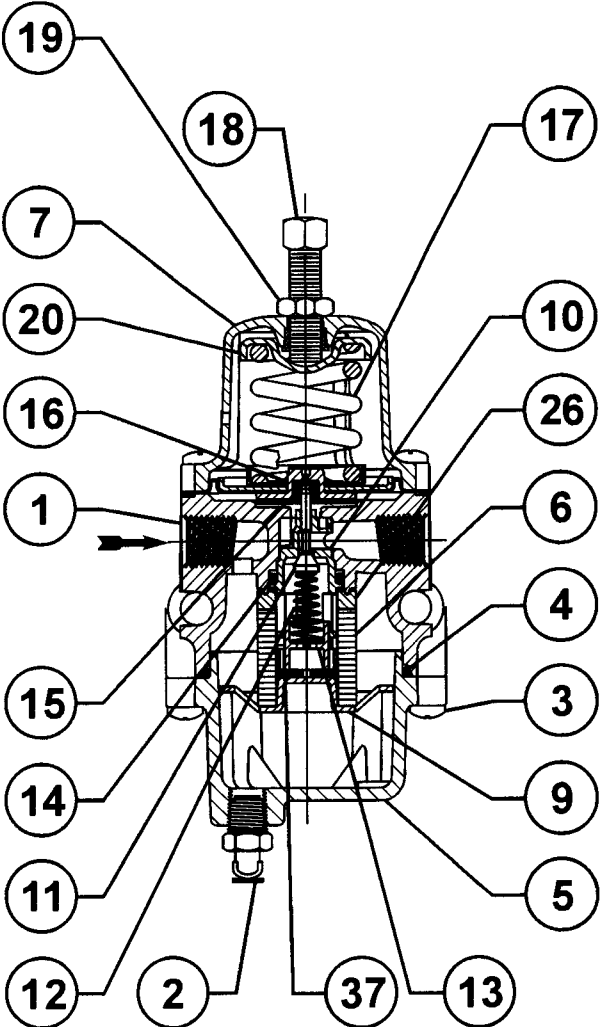
Figure 3. Type 67C or 67CR Assembly Drawing

Key	Description	Part Number
18	Adjusting Screw Type 67C, 67CR, 67CF, or 67CFR For standard spring case Square head (standard) Handwheel Wire seal (not shown) For spring case with 1/4-inch NPT vent Square head for closing cap Handwheel Wire seal (not shown) Type 67CS, 67CSR, 67CFS or 67CFSR Square head with or without closing cap Handwheel	T14061T0012 T14102T0012 T14104T0012 T14101T0012 T14103T0012 T14198T0012 T14101T0022 T14103T0012
19	Locknut Type 67C, 67CR, 67CF, or 67CFR Type 67CS, 67CSR, 67CFS or 67CFSR	1A946324122 1A9463X0042
20	Upper Spring Seat Type 67C, 67CR, 67CF, or 67CFR Type 67CS, 67CSR, 67CFS or 67CFSR	T14051T0012 10C1725X012
22	Pressure Gauge (not shown) Brass 0 to 30 psig/0 to 2 bar/0 to 0,2 MPa 0 to 60 psig/0 to 4 bar/0 to 0,4 MPa 0 to 160 psig/0 to 11 bar/0 to 1,1 MPa Stainless Steel 0 to 30 psig/0 to 2 bar/0 to 0,2 MPa 0 to 60 psig/0 to 4 bar/0 to 0,4 MPa 0 to 160 psig/0 to 11 bar/0 to 1,1 MPa	11B8579X022 11B8579X032 11B8579X042 11B9639X012 11B9639X022 11B9639X032



GE03521

Figure 4. Type 67CS or 67CSR Assembly Drawing



T40573-2

Figure 5. Type 67CF or 67CFR Assembly Drawing

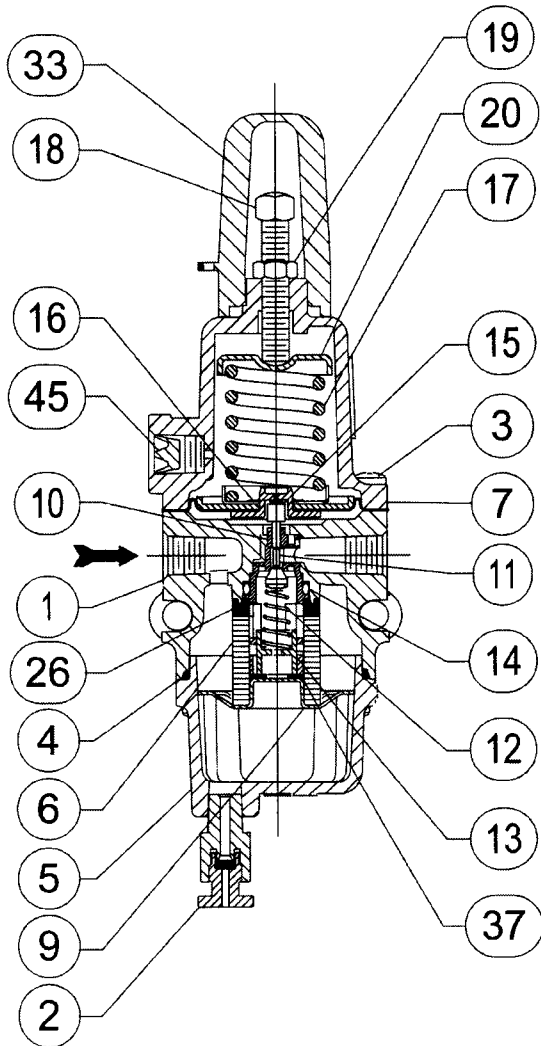
Key	Description	Part Number
23	1/4-Inch Pipe Plug (not shown) Socket head, steel Hex head, stainless steel	1C333528992 1A767535072
24	Tire Valve (not shown)	1H447099022
25	Information Label (not shown)	-----
26 ⁽¹⁾	Filter Gasket Nitrile (NBR) Fluoroelastomer (FKM)	T14081T0012 T14081T0022
30	NACE Tag (not shown)	19A6034X012
31	Panel Mounting Nut	10B2657X012
32	Wire Seal (not shown)	1U7581000A2
33	Closing Cap, resin	23B9152X012
34	Spacer (2 required) (figure 9) Type 67CF or 67CFR Type 67CFS or 67CFSR	T14123T0012 T14123T0022

Key	Description	Part Number
37 ⁽¹⁾	Thrust Washer (Type 67CF, 67CFR, 67CFS, or 67CFSR) Nitrile (NBR) Fluoroelastomer (FKM)	T14196T0012 T14196T0022
39	Bottom Plate Type 67C or 67CR Type 67CS or 67CSR	GE03520XRG2 GE03520X012
45	Screen Vent	0L078343062

Parts for Mounting on Fisher 2500 Series Controller

35	Mounting adaptor plate (not shown)	T21043T0012
36	O-ring (not shown)	1E591406992
38	Gasket (not shown)	1C898603012

67C Series



40C1728

Figure 6. Type 67CFS or 67CF SR Assembly Drawing

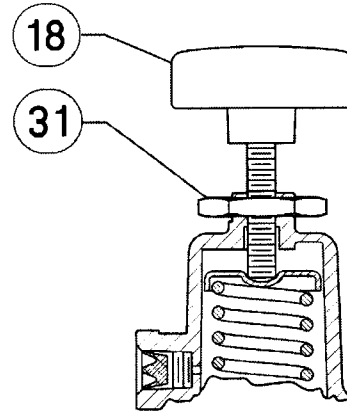
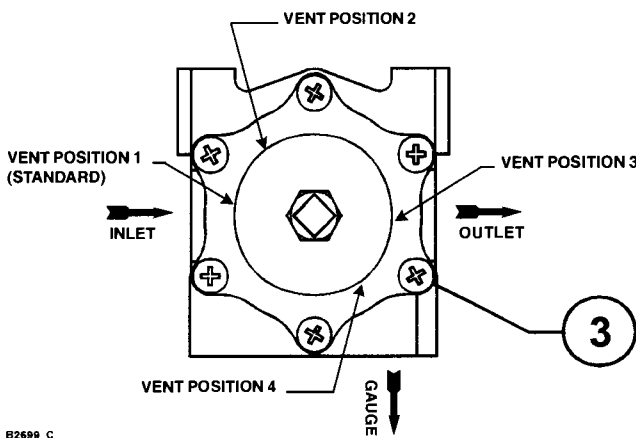
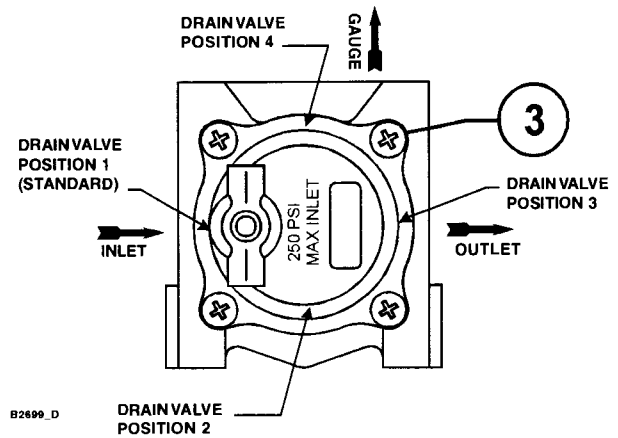


Figure 7. 67C Series Optional Panel Mount



B2699_C

Figure 8. 67C Series Spring Case Vent Positions



B2699_D

Figure 9. Type 67CF, 67CFR, 67CFS, and 67CF SR Drain Valve Positions

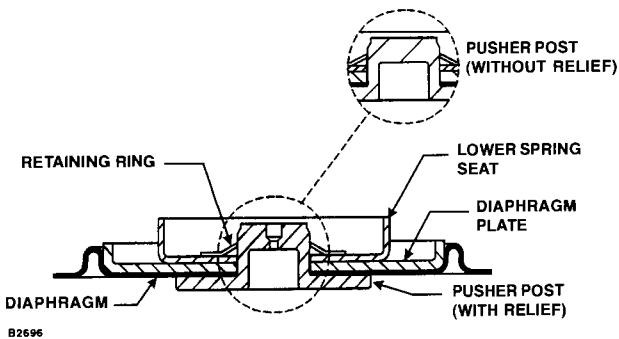


Figure 10. Diaphragm Assembly (Key 16)

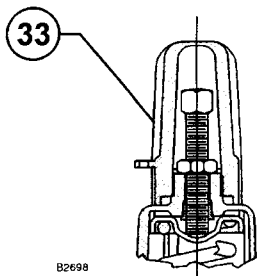
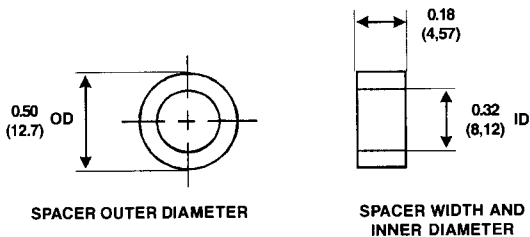


Figure 11. Optional Closing Cap
(Only Available with the 1/4-inch Spring Case Vent)



SPACER OUTER DIAMETER

SPACER WIDTH AND INNER DIAMETER

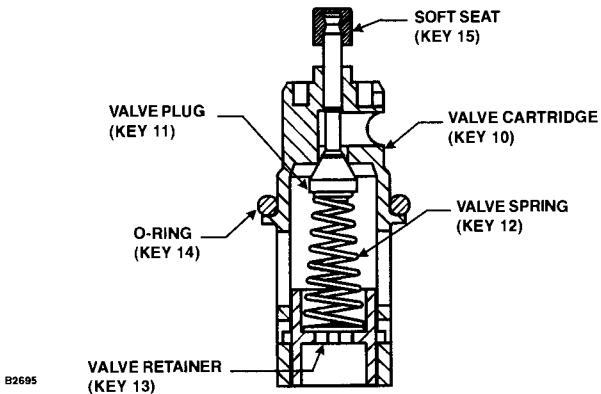


Figure 12. Valve Cartridge Assembly

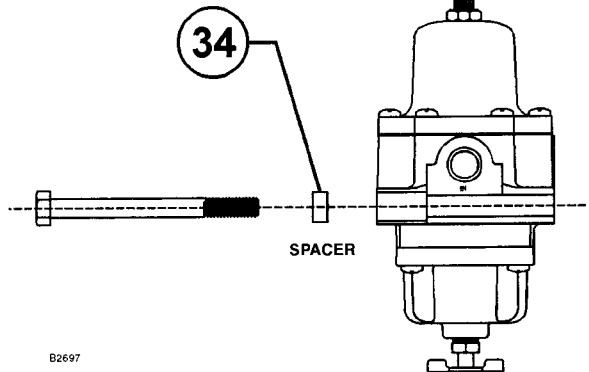


Figure 13. Spacer Diameter and Assembly
(For Installing in an Existing Installation
if the Mounting Bolts are too Long)

67C Series

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Type 667 Diaphragm Actuator Sizes 30-76 and 87

Contents

Introduction	2
Scope of Manual	2
Description	2
Specifications	3
Maximum Pressure Limitations	3
Installation	4
Mounting the Actuator on the Valve	5
Discussion of Bench Set	6
Bench Set Spring Adjustment	6
For Direct Acting Valves (PDTC)	7
For Reverse Acting Valves (PDTO)	7
Installing the Stem Connector Assembly	8
Deadband Measurement	9
Loading Connection	9
Maintenance	9
Actuator	10
Actuator Disassembly	10
Actuator Assembly	11
Top-Mounted Handwheel Assembly (Adjustable Down Travel Stop)	11
Disassembly for Top-Mounted Handwheel	12
Assembly for Top-Mounted Handwheel	13
Side-Mounted Handwheel Assembly for Size 34 through 60 Actuators	14
Disassembly for Side-Mounted Handwheel (34-60)	14
Assembly for Side-Mounted Handwheel (34-60)	15
Side-Mounted Handwheel Assembly for Size 70, 76, and 87 Actuators	15
Disassembly for Side-Mounted Handwheel (70, 76, and 87)	15
Assembly for Side-Mounted Handwheel Handwheel (70, 76, and 87)	16
Casing-Mounted Travel Stops	17
Parts Kits	19



Figure 1. Type 667 or 667-4 Actuator Mounted on easy-e® Valve

Side-Mounted Handwheels Retrofit Kits	19
Top-Mounted Handwheel Retrofit Kits	19
Actuator Repair Kits	19
Parts List	19
Actuator Assembly	19
Top-Mounted Handwheel	21
Side-Mounted Handwheel (30-60)	23
Side-Mounted Handwheel (70, 76, and 87)	23
Casing Mounted Travel Stops	24



667 Size 30-76 and 87 Actuators

Table 1. Specifications

SPECIFICATION ⁽¹⁾		ACTUATOR SIZE										
		30	34	40	45	46	50	60	70 ⁽¹⁾	76	87 ⁽¹⁾	
Nominal Effective Area	Sq cm	297	445	445	667	1006	677	1006	1419	1006	1419	
	Sq Inch	46	69	69	105	156	105	156	220	156	220	
Yoke Boss Diameter	mm	54	54	71	71	71	90	90	90	90	125	
	Inch	2.125	2.125	2.8125	2.8125	2.8125	3.5625	3.5625	3.5625	3.5625	5	
Acceptable Valve Stem Diameter	mm	9.5	9.5	12.7	12.7	12.7	19.1	19.1	19.1	19.1	25.4	
	Inch	0.375	0.375	0.5	0.5	0.5	0.75	0.75	0.75	0.75	1	
Maximum Allowable Output Thrust ⁽⁴⁾	N	10,230	10,230	12,010	25,131	33,582	25,131	30,246	39,142	30,246	39,142	
	LB	2300	2300	2700	5650	7550	5650	6800	8800	6800	8800	
Maximum Travel ⁽²⁾	Standard	mm	19	29	38	51	51	51	51	76 ⁽³⁾	51	76 ⁽³⁾
		Inch	0.75	1.125	1.5	2	2	2	2	3 ⁽³⁾	2	3 ⁽³⁾
	Top-Loaded	mm	---	19	---	19	---	---	29	---	29	76
		Inch	---	0.75	---	0.75	---	---	1.125	---	1.125	3
Maximum Casing Pressure for Actuator Sizing ^(4,6)	Bar	3.8	4.8	4.8	4.5	3.5	4.5	3.5	3.4	3.4	3.4	
	Psig	55	70	70	65	55	65	55	50	50	50	
Maximum Excess Diaphragm Pressure ^(4,5)	Bar	3.9	1.4	1.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
	Psig	55	20	20	10	10	10	10	10	10	10	
Maximum Diaphragm Casing Pressure ^(4,6,7)	Bar	7.6	6.2	6.2	5.2	4.5	5.2	4.5	4.1	4.1	4.1	
	Psig	110	90	90	75	65	75	65	60	60	60	
Approximate Weight	Kg	15	22	23	41	55	43	55	115	86	118	
	Pounds	34	48	50	90	121	94	122	254	190	260	
Material Temperature Capabilities	Nitrile Elastomers	-40 to 82°C (-40 to 180°F)										
	Silicone Elastomers	-54 to 149°C (-65 to 300°F)										

1. These values also apply to the Type 667-4 actuator construction.
 2. Actuator travel may be less than the value listed after connected to the valve.
 3. Maximum actuator travel for Type 667-4 is 102 mm (4 inches).
 4. See also the Specification portion of the introduction section.
 5. Additional pressure may be added when the actuator is at full travel. If the Maximum Excess Diaphragm Pressure is exceeded, damage to the diaphragm or diaphragm casing might result. See the Maximum Pressure Limitation section.
 6. Maximum diaphragm casing pressure must not be exceeded and must not produce a force on the actuator stem greater than the maximum allowable actuator output thrust or the maximum allowable stem load. See the Maximum Pressure Limitation section.
 7. This maximum casing pressure is not to be used for normal operating pressure. Its purpose is to allow for typical regulator supply settings and/or relief valve tolerances.

Introduction

Scope of Manual

This instruction manual provides information on installation, adjustment, maintenance, and parts ordering for the Type 667 actuator in sizes 30 through 76 and size 87. The Type 667-4 actuator in sizes 70 and 87 is also covered. Refer to separate instruction manuals for information about the valve positioner and other accessories used with these actuators.

No person may install, operate, or maintain a Type 667 actuator (see figure 1) without first ● being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and ● carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office before proceeding.

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

Description

The Type 667 actuator (figure 1) and the Type 667-4 actuator are reverse-acting, spring-opposed diaphragm actuators. They provide automatic operation of control valves. The Type 667 actuator provides 76 mm (3 inches) maximum actuator travel. The Type 667-4 actuator provides 102 mm (4 inches) maximum actuator travel. Both actuators position the valve plug in response to varying pneumatic loading pressure on the diaphragm. Figure 2 shows the operation of these actuators.

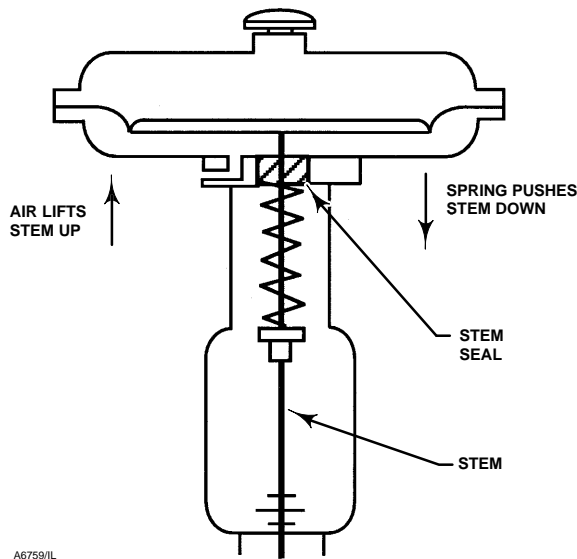


Figure 2. Schematic of Type 667 and 667-4 Actuators

A Type 667 or 667-4 actuator can be furnished with either a top-mounted or a side-mounted handwheel assembly. A top-mounted handwheel assembly is normally used as an adjustable down travel stop. (A down travel stop limits actuator travel in the down direction [when the stem is traveling out of the actuator]. Travel in the up direction is when the stem is traveling into the actuator.) A side-mounted handwheel assembly is normally used as an auxiliary manual actuator. The side-mounted handwheel can also be used as an adjustable up or down travel stop. Casing-Mounted adjustable up or down travel stops are also available on this actuator.

Note

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as a manual operator.

Specifications

Refer to table 1 for Specifications of the Type 667 and 667-4 actuators. See the actuator nameplate for specific information for your actuator.

WARNING

To avoid personal injury or damage to equipment that may result in the malfunction of the control valve or loss of control of the process caused by excessive pressure, do not exceed the Maximum Pressures listed in table 1. Refer to the Maximum Pressure Limitations section below.

Maximum Pressure Limitations

The casing and diaphragm of Type 667 actuators are pressure operated. This air pressure provides energy to compress the spring, to stroke the actuator, and to seat the valve. The following explanations describe the maximum pressure limits for an actuator. Refer to the nameplate or table 1 for maximum values for your actuator.

- **Maximum Casing Pressure for Actuator Sizing:** This is the maximum pressure that can be applied at less than full travel of the actuator. If this stroking pressure is exceeded before the upper diaphragm plate contacts the travel stop, damage to the stem or other parts might result.

- **Maximum Excess Diaphragm Pressure:** Additional pressure may be added when the actuator is at full travel. If the Maximum Excess Diaphragm Pressure is exceeded, damage to the diaphragm or diaphragm casing might result.

Because the actuator has traveled its specified travel, and the diaphragm head is physically stopped from movement, the energy from any additional air pressure is transmitted to the diaphragm and diaphragm casings. The amount of air pressure that can be added once the actuator has traveled to the stops is limited by the resultant adverse effects that may occur. Exceeding this limiting factor could result in leakage or casing fatigue due to the deformation of the upper diaphragm casing.

- **Maximum Diaphragm Casing Pressure:** If the Maximum Diaphragm Casing Pressure is exceeded,

667 Size 30-76 and 87 Actuators

damage to the diaphragm, diaphragm casing, or actuator might result.

Installation

WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations. Check with your process or safety engineer for any other hazards that may be present from exposure to process media. If installing into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section in this instruction manual.

Key number locations are shown in figures 6, 7, and 8, unless otherwise noted. Also, refer to figure 3 for location of parts.

CAUTION

To avoid parts damage, do not use an operating pressure that exceeds the **Maximum Diaphragm Casing Pressure** (table 1) or produces a force on the actuator stem greater than the **Maximum Allowable Output Thrust** (table 1) or the **Maximum Allowable Valve Stem Load**.

- **Valve/Actuator Assembly:** If the actuator and valve are shipped together as a control valve assembly, it has been adjusted at the factory, and may be installed in the pipeline. After installing the valve in the pipeline, refer to the Loading Connection procedures.

- **Actuator Mounting:** If the actuator is shipped separately or the actuator has been removed from the valve, it is necessary to mount the actuator on the valve before placing the valve in the pipeline. Refer to the following actuator mounting procedures before placing the valve in service. It is recommended that you perform the Bench Set Spring Adjustment procedures in this section to

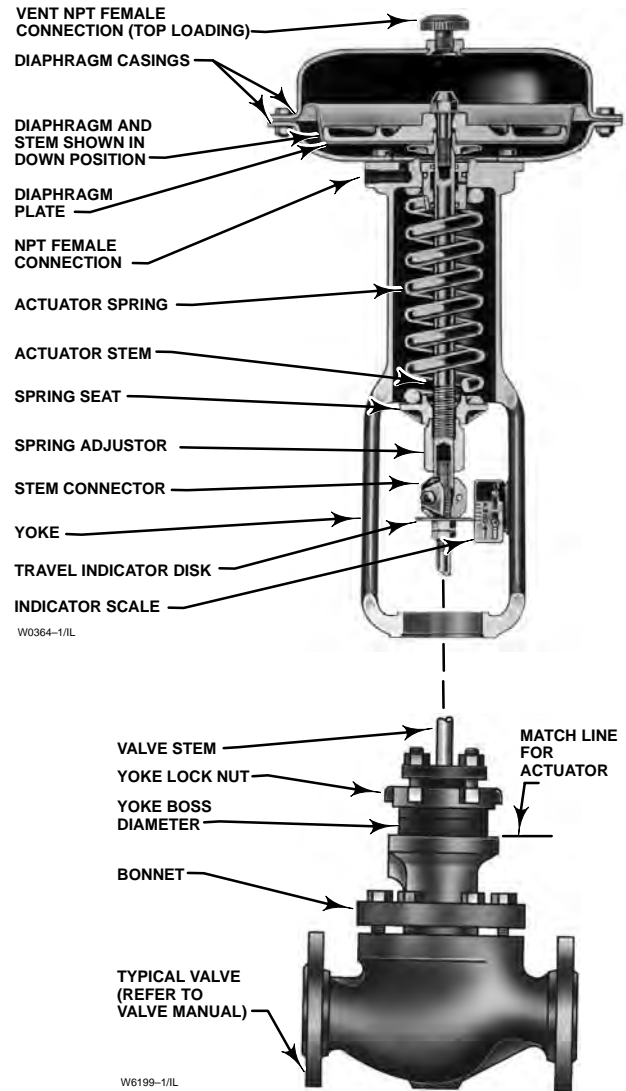
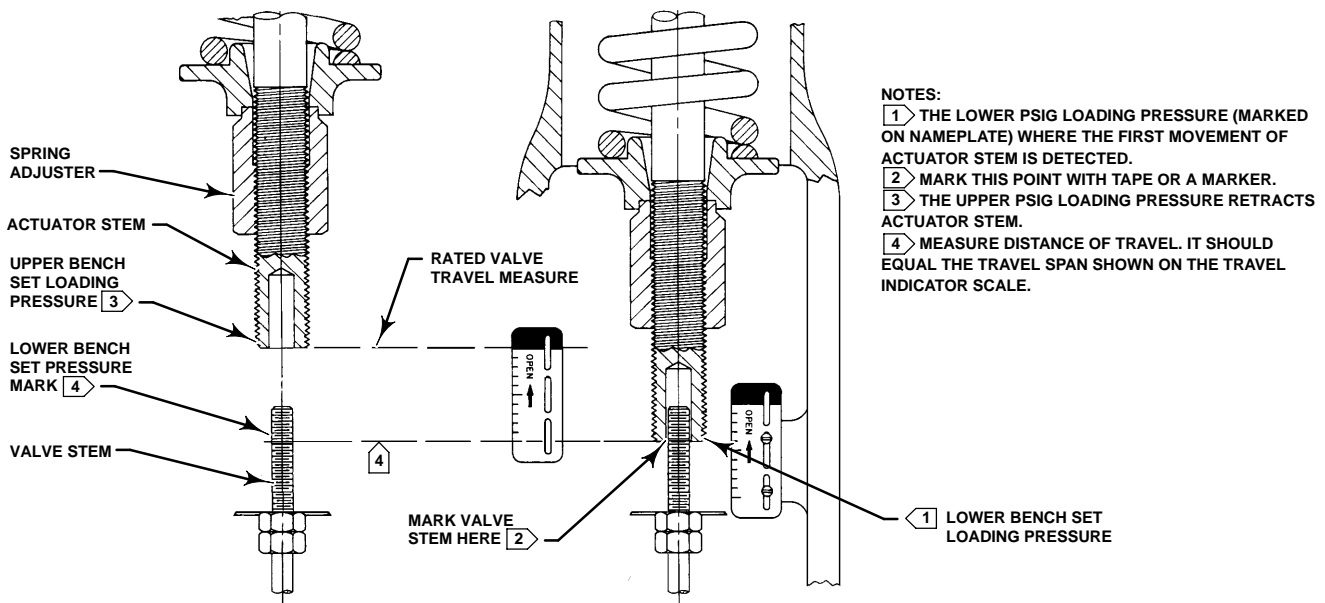


Figure 3. Actuator-Mounting Components for Size 30 through 70 Actuators

confirm that the actuator is adjusted correctly for the valve travel.

- **Positioner:** If a positioner is installed, or is to be installed on the actuator, refer to the positioner instruction manual for installation. During the adjustment procedures, it will be necessary to provide a temporary loading pressure to the actuator diaphragm.

- **Handwheel Cap:** If the handwheel cap (key 247, figures 9, 11, or 16) is not in place, install the cap by pushing it on by hand until it snaps into place.



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Figure 4. Bench Set Adjustment

Mounting the Actuator on the Valve



WARNING

CAUTION

The Type 667 actuator spring load pushes the stem down out of the actuator yoke (see figure 2), and it can come in contact with the valve stem during actuator mounting.

If the valve stem is allowed to remain in the up position (towards the actuator) during actuator mounting, it can interfere with the actuator stem during mounting. It is possible to damage valve stem threads or bend the valve stem. Be sure the valve stem is pushed down (into the valve body), away from the actuator while mounting.

It may be necessary to apply a temporary loading pressure to the actuator to move the actuator stem away from the valve during installation.

If it is not possible to provide a temporary loading pressure, be very careful when lowering the actuator over the valve stem to prevent damage to valve stem and threads.

When moving the actuator stem with loading pressure applied, exercise caution to keep hands and tools out of the actuator stem travel path. If the loading pressure is accidentally disconnected, personal injury and property damage may result if something is caught between the actuator stem and other control valve parts.

1. Provide a vise or some other method of supporting the valve and the weight of the actuator during assembly. For direct or reverse acting valves, push the valve stem down away from the actuator while mounting the actuator.
2. Screw the stem locknuts all the way onto the valve stem. With the concave side of the travel indicator disk (key 34) facing the valve, install the travel indicator disk on the valve stem. (Note: The travel indicator disk is not used with size 87 actuators.)
3. Lift or hoist the actuator onto the valve bonnet:
 - a. **For size 87 actuators:** Slowly lower the actuator down onto the valve while guiding the valve stem into the opening in the end of the the actuator stem (see figure 4). Once the actuator is

667 Size 30-76 and 87 Actuators

in place, insert the cap screws and tighten the hex nuts, securing the actuator to the bonnet.

b. For all other size actuators:

- Slowly lower the actuator down onto the valve. As the yoke passes over the end of the valve stem, place the yoke locknut over the valve stem. (Note: On small size actuators, it may be necessary to remove the indicator disk and re-install it while lowering the actuator onto the valve because the disk will not go through the actuator yoke opening).

- Continue to lower the actuator while guiding the valve stem into the opening in the end of the actuator stem until the actuator is in place (see figure 4).

- Screw the yoke locknut onto the valve bonnet and tighten the locknut.

4. Do not connect the actuator stem to the valve stem at this time. Whenever the actuator is installed on the valve, it is recommended that you perform the Bench Set Spring Adjustment procedures below, to verify that the actuator is still adjusted correctly.

Discussion of Bench Set

The bench set pressure range is used to adjust the initial compression of the actuator spring with the valve-actuator assembly “on the bench.” The correct initial compression ensures that the valve-actuator assembly will function properly when it is put into service and the proper actuator diaphragm operating pressure is applied.

The bench set range is established with the assumption that there is no packing friction. When attempting to adjust the spring in the field, it is very difficult to ensure that there is no friction being applied by “loose” packing.

Accurate adjustment to the bench set range can be made during the actuator mounting process by making the adjustment before the actuator is connected to the valve (see the Bench Set Spring Adjustment Procedure).

If you are attempting to adjust the bench set range after the actuator is connected to the valve and the packing tightened, you must take friction into account. Make the spring adjustment so full actuator travel occurs at the bench set range (a) plus the friction force divided by the effective diaphragm area with increasing diaphragm pressure or (b) minus the friction force divided by the effective diaphragm area with decreasing diaphragm pressure.

For an assembled valve-actuator assembly, the valve friction may be determined by following the procedure described below:

1. Install a pressure gauge in the actuator loading pressure line that connects to the actuator diaphragm casing.

Note

Steps 2 and 4 require that you read and record the pressure shown on the pressure gauge.

2. Increase the actuator diaphragm pressure and read the diaphragm pressure as the actuator reaches its mid-travel position.

3. Increase the actuator diaphragm pressure until the actuator is at a travel position greater than its mid-travel position.

4. Decrease the actuator diaphragm pressure and read the diaphragm pressure as the actuator reaches its mid-travel position.

The difference between the two diaphragm pressure readings is the change in the diaphragm pressure required to overcome the friction forces in the two directions of travel.

5. Calculate the actual friction force:

$$\text{Friction Force, pounds} = 0.5 \left(\begin{array}{c} \text{Difference} \\ \text{in pressure} \\ \text{readings, psig} \end{array} \right) \times \left(\begin{array}{c} \text{Effective} \\ \text{diaphragm area,} \\ \text{inches}^2 \end{array} \right)$$

Refer to table 1 for the effective diaphragm area.

When determining valve friction, you can make diaphragm pressure readings at a travel position other than mid-travel if you desire. If you take readings at zero or at the full travel position, take extra care to ensure that the readings are taken when the travel just begins or just stops at the position selected.

It is difficult to rotate the spring adjustor (key 74, figure 6, 7, and 8) when the full actuator loading pressure is applied to the actuator. Release the actuator loading pressure before adjusting. Then re-apply loading pressure to check the adjustment.

Bench Set Spring Adjustment

The term “bench set” means that the actuator is **not** connected to the valve, or any other loads. Ensure that the actuator diaphragm is at the bottom of its travel as shown in figure 4. (Note: Some spring compression is required to move the diaphragm to the **bottom** of its travel.)

Also, provide a certified pressure gauge that will accurately read the diaphragm pressure from 0 through the upper bench set pressure marked on the nameplate. Apply loading pressure to the diaphragm.

Stroke the actuator a few times to ensure that the pressure gauge is working correctly, and that the actuator is functioning properly. It is important to be sure that the actuator assembly is **not** binding or producing any friction on the actuator stem movement.

Key numbers are shown in figures 6, 7, and 8.

For Direct-Acting Valves (PDTC)

1. If not already accomplished, push the valve stem down away from the actuator to the closed position.
2. Set the diaphragm loading pressure to 0.3 bar (5 psig) over the upper bench set pressure. The upper travel stop should be contacting the diaphragm casing.
3. Slowly decrease the pressure towards the upper bench set pressure while checking for the **first** movement of the actuator stem.

Note

Before turning the spring adjuster on size 70, 76, or 87 actuators, assemble the stem connector around the actuator stem and the anti-rotating lug on the yoke. Mark the actuator stem as a visual reference to verify that stem rotation does not occur. Remove the stem connector before rechecking the bench set.

4. If movement occurs before or after the upper pressure is reached, adjust the spring adjuster (see figure 4). Thread the adjuster up or down on the actuator stem until the actuator stem movement is **first** detected at the upper bench set pressure. (Note: You may need to lower the loading pressure to reduce spring compression, allowing the spring adjuster to turn.)
5. Be sure the spring adjuster is adjusted to meet the requirements of step 4 above.
6. Apply the lower bench set loading pressure to the diaphragm. This will extend the actuator stem toward the valve. Mark the end of the actuator stem on a nearby surface using tape or some other method.
7. Slowly increase the diaphragm pressure until the upper bench set loading pressure is applied. Again,

the travel stop should be against the diaphragm casing.

8. Measure the distance between the mark or tape to the end of the actuator stem. This distance should match the travel span shown on the travel indicator scale (key 32).
9. If the span of travel is correct, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.
10. If the travel span is not exact, remember the free-length and load rate tolerances for the spring may produce a slightly different span than specified. Contact your Fisher sales office for assistance.

For Reverse-Acting Valves (PDTO)

1. If not already accomplished, push the valve stem down away from the actuator to the open position. Later, when installing the connector, pull up the valve stem to the closed position.
2. Set the diaphragm loading pressure to a value less than the lower bench set pressure (near zero). The down travel stop should be contacting the yoke.
3. Slowly increase the pressure towards the lower bench set pressure while checking for the **first** movement of the actuator stem.

Note

Before turning the spring adjuster on size 70, 76, or 87 actuators, assemble the stem connector around the actuator stem and the anti-rotating lug on the yoke. Mark the actuator stem as a visual reference to verify that stem rotation does not occur. Remove the stem connector before rechecking the bench set.

4. If movement occurs before or after the lower pressure is reached, adjust the spring adjuster (see figure 4). Thread the adjuster up or down on the actuator stem until the actuator stem movement is **first** detected at the lower bench set pressure.
5. Apply the upper bench set loading pressure to the diaphragm. This will retract the actuator stem away from the valve. Mark the end of the actuator stem on a nearby surface using tape or some other method.
6. Slowly decrease the diaphragm pressure until the lower bench set loading pressure is applied. Again, the down-stops should be against the yoke.
7. Measure the distance between the mark or tape to the end of the actuator stem. This distance should

667 Size 30-76 and 87 Actuators

match the travel span shown on the travel indicator scale (key 32).

8. If the span of travel is correct, bench set is complete. Proceed to the Installing the Stem Connector Assembly subsection.
9. If the travel span is not exact, remember the free-length and load rate tolerances for the spring may produce a slightly different span than specified. Contact your Fisher sales office for assistance.

Installing the Stem Connector Assembly

When installing the stem connector assembly (key 31), the actuator and valve stem threads should engage the threads of the stem connector by a distance equal to the diameter of the stem.

Note

Replacement stem connectors are an assembly of two stem connector halves, cap screws, and a spacer between the connector halves. Remove the spacer and discard it, if present, before clamping the actuator and valve stems together.

1. If necessary, push the valve stem down so that the valve plug is touching the seat ring on direct-acting valves. For reverse-acting valves, pull the stem up to the closed position. Always start with the valve plug on the seat.
2. If necessary, screw the valve stem locknuts down, away from the connector location. For all actuators except size 87, ensure that the travel indicator disk (key 34) is on top of the locknuts.
3. Adjust the diaphragm pressure to the lower bench set pressure. (Or, the upper bench set pressure for reverse-acting valves.) This should be the same pressure used in the bench set steps, and it is marked on the nameplate.
4. Place the stem connector half with the threaded holes, approximately half way between the actuator and valve stems. Refer to figures 6, 7, and 8 to help locate the connector position.

Be sure that the actuator and valve stem threads are engaging the threads of the stem connector by a distance equal to one diameter of the stem.

CAUTION

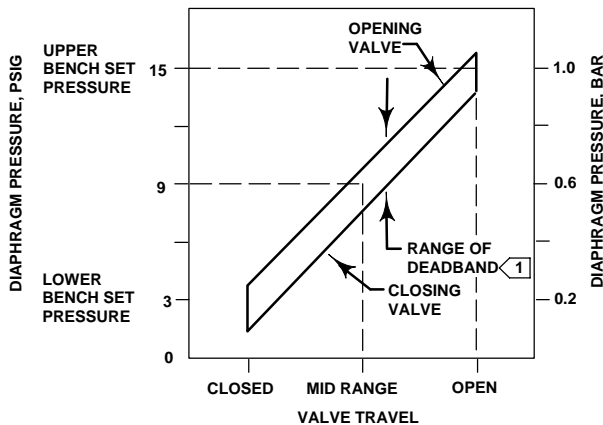
Incomplete engagement of either the valve stem or actuator stem in the stem connector can result in stripped threads or improper operation. Be sure that the length of each stem clamped in the stem connector is equal to or greater than one diameter of that stem. Damage to threads on either stem or in the stem connector can cause the parts to be replaced prematurely.

5. Install the other half of the stem connector and insert the cap screws and tighten them. If installing a positioner, also attach the feedback bracket at the same time.
6. Screw the valve stem locknuts up until the indicator disk contacts the bottom of the stem connector, or for size 87 actuators, tighten the locknuts against the stem connector. Do not overtighten the locknuts.
7. Slowly increase and then decrease pressure several times, stroking the valve from the lower bench set pressure to the upper pressure.

Be sure that the valve is in the closed position (up or down, depending on valve action). Loosen the screws on the travel scale, and align it with the travel indicator disk. Stroke the valve full travel to ensure that the travel matches the valve travel on the travel indicator plate. If valve travel is not correct, repeat the stem connector procedure.

Note

For push-down-to-close valves, the valve plug seat is the limit for downward travel and the actuator up-stop is the limit for upward (away from the valve) movement. For push-down-to-open valves, the actuator down-stop is the limit for downward movement, and the valve seat is the limit for upward (away from the valve) movement. For Type 667 actuators, a down-stop (key 77, figure 6) is installed to limit actuator diaphragm downward movement when the actuator provides the limit.



NOTE:
1 DEADBAND IS CAUSED BY FRICTION.
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Figure 5. Typical Reverse-Acting Valve Response to Deadband

Deadband Measurement

Deadband is caused by packing friction, unbalanced forces, and other factors in the control valve assembly. Deadband is the range a measured signal can vary without initiating a response from the actuator (see figure 5). Each actuator spring has a fixed spring rate (force). You have verified that the right spring was installed in the actuator by completing the Bench Set Spring Adjustment steps.

Deadband is one factor that affects the control valve assembly operation during automatic loop control. The control loop tolerance for deadband varies widely depending on the loop response. Some common symptoms of the deadband being too wide are no movement, a "jump" movement, or oscillating movements of the actuator during automatic loop control. The following steps are provided to determine the span of deadband. The percent of deadband is helpful in troubleshooting problems with the process control loop.

1. Start at a pressure near the lower bench set pressure, slowly increase pressure until the valve is approximately at mid-travel. Note this pressure reading.
2. Slowly decrease pressure until movement of the valve stem is detected, and note this pressure.
3. The difference between these two pressures is deadband, in psi.

4. Calculate the percent of deadband by:

Deadband, psi

$$\text{Deadband} = \frac{\text{Deadband, psi}}{\text{Bench Set Span, psi}} = \text{nn \%}$$

Loading Connection

Key number locations are shown in figures 6, 7, and 8, unless otherwise noted.

The loading pressure connections are made at the factory if the valve, actuator, and positioner come as a unit. Keep the length of tubing or piping as short as possible to avoid transmission lag in the control signal. If a volume booster, valve positioner or other accessory is used, be sure that it is properly connected to the actuator. Refer to the positioner instruction manual or other manuals as necessary. For actuators shipped separately or whenever the actuator pressure connections are installed, use the following steps:

1. Connect the loading pressure piping to the NPT female connection in the side of the yoke (key 73).
2. For size 70 and 87 actuators, if necessary, remove the 0.25 inch NPT bushing if a 0.5 inch NPT female connection is needed to increase connection size. The connection can be made with either piping or tubing.
3. Cycle the actuator several times to be sure that the valve stem travel is correct when the correct pressure ranges are applied to the diaphragm.
4. If valve stem travel appears to be incorrect, refer to the Bench Set Spring Adjustment procedures at the beginning of this section. Do not place the valve in service if it is not reacting correctly to diaphragm loading pressure changes.

Maintenance

Actuator parts are subject to normal wear and must be inspected regularly and replaced when necessary. The frequency of inspection and replacement depends on the severity of service conditions.



Avoid personal injury or property damage from sudden release of process pressure or uncontrolled movement of parts. Before performing any maintenance operations:

667 Size 30-76 and 87 Actuators

- **Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.**
- **Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.**
- **Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.**
- **Vent the power actuator loading pressure and relieve any actuator spring pre-compression.**
- **Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.**
- **The valve packing box may contain process fluids that are pressurized, even when the valve has been removed from the pipeline. Process fluids may spray out under pressure when removing the packing hardware or packing rings, or when loosening the packing box pipe plug.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

The maintenance instructions are divided into several sections: Actuator, Top-Mounted Handwheel Assembly (Adjustable Down Travel Stop), Side-Mounted Handwheel Assembly for Size 34 through 60 Actuators (Manual Actuator), Side-Mounted Handwheel Assembly for Size 70, 76 and 87 Actuators (Manual Actuator), and Casing-Mounted Travel Stops.

Actuator

This procedure describes how the actuator can be completely disassembled and assembled. When inspection or repairs are required, disassemble only those parts necessary to accomplish the job; then, start the assembly at the appropriate step.

Key numbers are shown in figures 6, 7, or 8, unless otherwise noted. Figure 6 shows the size 30 through 60 actuators, figure 7 shows the size 70 actuator, and figure 8 shows the size 87 actuator.

Actuator Disassembly

Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve. Also shut off all pressure lines to the power actuator, release all pressure from the actuator. Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.

1. Remove the tubing or piping from the connection in the top of the yoke (key 73). For a top-loaded construction, also remove the piping or tubing from the connection in the upper diaphragm casing (key 1).
2. Turn the spring adjuster (key 74) counterclockwise (**toward the valve body**) until all spring compression is relieved.



WARNING

To avoid personal injury due to the sudden uncontrolled movement of parts, do not loosen the stem connector cap screws when the stem connector has spring force applied to it.

3. If necessary, remove the actuator from the valve body by separating the stem connector (key 31). Loosen the stem locknuts for the size 87 actuator, and remove the stem connector nuts. For all other sizes, separate the stem connector by loosening the stem locknuts (keys 69 and 75) and unscrewing the two stem connector cap screws.
4. Unscrew the spring adjuster (key 74) from the actuator stem (key 144). Also lift the spring seat and spring (key 19 and 18) out of the yoke.
5. Remove the diaphragm casing cap screws and nuts (keys 13 and 14), and lift off the upper diaphragm casing (key 1).
6. Remove the following connected parts: the diaphragm (key 3), upper diaphragm plate (key 4), spacer (key 2), cap screw (key 12), lower diaphragm plate (key 71), and actuator stem (key 144). Be careful when pulling the threads of the actuator stem through the seal bushing (key 7) to avoid damaging the O-rings (key 8).

7. Remove the cap screw (key 12) to separate the parts of this assembly.

8. To remove the seal bushing, remove the snap ring (key 72), and lift out the bushing. Inspect, and if necessary, replace O-rings (8 and 9).

9. Remove cap screws (key 30), and take off the lower diaphragm casing (key 64) and the gasket (key 70, size 30 through 60 and 76) or O-ring (key 70, size 70 or 87). If necessary, the down travel stops (key 77) can be removed.

Actuator Assembly

1. Coat the O-rings (key 70, sizes 70 and 87) with lubricant (key 237 or equivalent). Or, coat the gasket with sealant (key 237 or equivalent). Place a new gasket or O-ring (key 70) on the yoke (key 73). Position the lower diaphragm casing (key 64) on the yoke, align the holes, and insert and tighten the cap screws (key 30). If down travel stops (key 77) were removed, insert and tighten them.

2. Coat the O-rings (keys 8 and 9) with lubricant (key 237 or equivalent) and place the O-rings in the seal bushing (key 7).

3. Fill the seal bushing with lubricant (key 237 or equivalent), slide the bushing into the yoke (key 73), and install the snap ring (key 72).

4. Assemble the actuator stem (key 144), lower diaphragm plate (key 71), diaphragm (key 3), upper diaphragm plate (key 4), and the travel stop cap screw and spacer (keys 12 and 2). Coat the cap screw threads with Lubriplate Mag-1 or equivalent (key 237). Tighten the cap screw (key 12) to 41 N•m (30 lbf•ft) torque for size 30 actuators, 68 N•m (50 lbf•ft) torque for size 34 and 40 actuators, or 183 N•m (135 lbf•ft) torque for size 45 to 76 and 87 actuators. Place this assembly in the actuator. Take care when pushing the actuator stem through the seal bushing so that the threads do not damage the O-rings.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

CAUTION

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

Note

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.

5. Install the upper diaphragm casing (key 1), and install the cap screws and nuts (keys 13 and 14). Tighten the diaphragm cap screws and nuts in the following manner.

6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N•m (10 lbf•ft).

7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).

8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).

9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).

10. After the last bolt is tightened to 27 N•m (20 lbf•ft), all of the bolts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.

11. Once completed, no more tightening is recommended.

12. Install the actuator spring (key 18) and spring seat (key 19). Apply lubricant (key 239 or equivalent) to the threads of the actuator stem and to the surface of the spring adjuster (key 74) that contacts the spring seat. Thread the spring adjuster onto the actuator stem.

13. Mount the actuator onto the valve in accordance with the procedures in the Installation section.

Top-Mounted Handwheel Assembly (Adjustable Down Travel Stop)

Actuator key numbers are shown in figures 6, 7, and 8. And, top-mounted handwheels are shown in figures 9, 11, and 12.

667 Size 30-76 and 87 Actuators

Note

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as a manual operator.

A top-mounted handwheel assembly (figures 9, 11, and 12) is usually used as an adjustable down travel stop to limit full extension of the actuator stem. Turning the handwheel counterclockwise pulls the extension rod (key 150, figures 9, 11, and 12) up, retracting the actuator stem.

Instructions are given below for complete disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then, begin the assembly at the appropriate step.

Disassembly for Top-Mounted Handwheel

1. Bypass the control valve, reduce loading pressure to atmospheric, and remove the tubing or piping from the connection in the top of the yoke (key 73, figures 6, 7, and 8).
2. Turn the handwheel (key 58) clockwise so that the handwheel assembly is not causing any spring compression.
3. Turn the actuator spring adjuster (key 74) to relieve all the compression from the spring (key 18).
4. If servicing just the thrust bearing, races, and handwheel screw (keys 180, 181, and 160), use the following steps:
 - Remove the cap and take out the cotter pin. Remove the castle nut, bearing retainer, thrust bearing, and races (keys 247, 167, 166, 180, and 181).
 - Use the handwheel to remove the handwheel screw (key 160) from the handwheel body (key 148).
 - If necessary, remove the extension rod (key 150) at this time. Most maintenance procedures do not require the rod to be removed.
 - Clean and inspect all parts or replace parts as necessary. Upon re-assembly, lubricate handwheel threads, bearings, and races with Never-Seez Nickel Special (key 239) or equivalent.

- Lubricate and re-install the handwheel screw into handwheel body (key 148). Lubricate and replace the races, bearing, and retainer (keys 181, 180, and 182). Replace the castle nut (key 166), tighten it, and insert the cotter pin (key 167). Replace the handwheel cap (key 247).

5. For size 30 through 60 and 76 actuator handwheels (figures 9 and 11):

- Remove the cap screws (key 161). Make sure that the guide plate can turn between the handwheel body and the mounting plate (keys 157, 148 and 158).
- Remove the cap (key 247) and cotter pin (key 167). Remove the castle nut (key 166) and, if necessary, unscrew the extension rod (key 150). Remove the rod, the handwheel body (key 148), and the attached parts.
- Remove the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1) and the mounting plate (key 158).
- Turn the handwheel (key 58) to remove the handwheel screw (key 160) from the handwheel body (key 148). Remove the retaining ring (key 60) if the handwheel (key 58) must be separated from the handwheel screw.

- If necessary, perform other actuator maintenance before returning to the following assembly steps.

6. For size 70 and 87 actuator handwheels (figure 12):

- Remove the cap (key 247). Take out the cotter pin (key 167) and remove the castle nut, the bearing retainer, and thrust bearing (keys 166, 182, 181, and 180). It is not necessary to remove the extension rod (key 150) at this time.
- Remove the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1), handwheel body (key 148) and attached parts.
- If travel stops (key 152) are used, note and record their position relative to the cap screws (key 154) for use in assembly. Remove the travel stops and cap screws, and remove either the mounting plate (key 158, figure 12) or the handwheel body (key 148, figure 12) and attached parts.
- Turn the handwheel (key 58) to remove the handwheel screw (key 160) from the handwheel

body (key 148). Remove the retaining ring (key 60) if the handwheel (key 58) must be separated from the handwheel screw.

- If necessary, perform other actuator maintenance before returning to the following assembly steps.

Assembly for Top-Mounted Handwheel

For size 30 through 60 and 76 actuator handwheels:

Refer to figures 9 and 11 for top-mounted handwheel assemblies.

1. If it was removed, slide the handwheel (key 58) onto the end of the handwheel screw (key 160), and snap the retaining ring (key 60) into place. Also, install the guide post (key 150) if it was removed.
2. Generously coat the threads of the handwheel screw (key 160) with lubricant (key 239 or equivalent). Turn the screw into the handwheel body (key 148).
3. Install the mounting plate (key 158) to the diaphragm casing (key 1, figures 6, 7, and 8) with the cap screws (key 154). Finger tighten the screws.
4. If travel stops were used, install the travel stops to their original positions as recorded in the preceding Disassembly steps. Tighten the screws and travel stops.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

CAUTION

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

Note

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.

5. Position the diaphragm casing (key 1, figures 6, 7, and 8), mounting plate (key 158), travel stops (key 152), if used, and cap screws (key 154) on the diaphragm. Install the cap screws and hex nuts (keys 13 and 14, figures 6, 7, and 8) and tighten in the following manner.
6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N•m (10 lbf•ft).
7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).
8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).
10. After the last bolt is tightened to 27 N•m (20 lbf•ft), all of the bolts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.
11. Once completed, no more tightening is recommended.
12. If necessary, screw the extension rod (key 150) into the connector (key 27). Slide the guide plate (key 157) onto the extension rod (key 150). For size 45 through 76, place the spacer (key 253) on top of the guide plate (key 157). If necessary, replace the extension rod (key 150). Slide the handwheel body (key 148) over the extension rod, position the handwheel body on the spacer (key 253), align the holes, and insert and tighten the cap screws (key 161).
13. Lubricate and install the thrust bearings (keys 181 and 180), install the bearing retainer (key 182), install the castle nut (key 166) on the extension rod. Do not overtighten the castle nut on the bearing.

667 Size 30-76 and 87 Actuators

Install the cotter pin (key 167). Replace the cap (key 247).

14. Refer to the Assembly portion of the Actuator maintenance section.

For size 70 and 87 actuators handwheels (figure 12):

Refer to figure 12 for top-mounted handwheel assemblies.

1. If removed, slide the handwheel (key 58) onto the end of the handwheel screw (key 160), and snap the retaining ring (key 60) into place.
2. Generously coat the threads of the handwheel screw (key 160) with lubricant (key 239 or equivalent). Turn the screw into the handwheel body (key 148).
3. If necessary, install the extension rod (key 150) into the connector (key 27) and tighten it. Position the handwheel body (key 148) on the diaphragm casing (key 1, figures 6, 7, and 8), and align the holes. Insert the cap screws (key 154). Finger tighten the screws.
4. If travel stops were used, return the travel stops to their original positions as recorded in the preceding Disassembly steps. Tighten the screws and travel stops.

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

CAUTION

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

Note

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.

5. Slide the extension rod (key 150) into the handwheel screw (key 160), and position the diaphragm casing (key 1, figures 6, 7, and 8) with the attached parts on the diaphragm. Install the cap screws and hex nuts (keys 13 and 14, figures 6, 7, and 8) and tighten in the following manner.

6. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N•m (10 lbf•ft).

7. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).

8. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).

9. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).

10. After the last bolt is tightened to 27 N•m (20 lbf•ft), all of the bolts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.

11. Once completed, no more tightening is recommended.

12. Lubricate and install the thrust bearings (keys 180 and 181), install the bearing retainer (key 182), install the castle nut (keys 166) on the extension rod. Do not overtighten the castle nut on the bearing. Install the cotter pin (key 167). Replace the cap (key 247).

13. Refer to the Assembly portion of the Actuator maintenance section.

Side-Mounted Handwheel Assembly for Size 34 through 60 Actuators

A side-mounted handwheel assembly (figures 13 and 14) is usually used as a manual actuator. This design is frequently used to drive the valve open or closed under loading conditions. Turning the handwheel clockwise past the neutral position always closes a push-down-to-close valve. A pair of levers (key 146, figure 13) on a handwheel assembly close the valve by moving the valve stem.

Instructions are given below for disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then begin the assembly at the appropriate step.

Disassembly for Side-Mounted Handwheel (34-60)

1. If desired, the handwheel assembly can be removed from the actuator yoke. To do this, remove

the nuts (keys 147 and 170) from the U-bolts (keys 166 and 143) that hold the assembly to the yoke.

2. Remove the retaining ring (key 154), and drive out the lever pivot pin (key 153).
3. Two screws (key 156) hold the right- and left-hand levers (key 146) together. Remove the screw from the top of the levers so that the levers will drop down out of the assembly. Disassemble further, if necessary, by removing the other screw.
4. Remove the screw (key 161) and pointer mounting bolt (key 159, not shown) located behind the pointer (key 160).
5. Remove the nut (key 54), lockwasher (key 150), and washer (key 149), and take off the handwheel (key 51). Be careful not to lose the small ball (key 55) and spring (key 56).
6. Unscrew the bearing retainer (key 136) after loosening the locking set screw (key 168, not shown).
7. Pull the screw assembly (key 145) out of the handwheel body. The operating nut (key 132) will come out with the screw. Also, remove the bushing (key 151) on sizes 34 and 40.
8. If required, remove the bearings (key 152), one from the bearing retainer and the other from the handwheel body.

Assembly for Side-Mounted Handwheel (Sizes 34-60)

1. Pack the bearings (key 152) with lubricant (key 239 or equivalent). Insert one bearing and the bushing (key 151) in the handwheel body (key 142) as shown in figure 13 or 14. The bushing is not used in a handwheel assembly for size 45 through 60 actuators.
2. Coat the screw threads with lubricant (key 239) or equivalent, and thread the operating nut onto the screw. Slide the second bearing (key 152) onto the screw, and insert the end of the screw into either the bushing (key 151) as shown in figure 13 or 14 or into the bearing.
3. Thread the bearing retainer (key 136) into the body (key 142). Completely tighten the bearing retainer, and then loosen it one-quarter turn. Tighten the set screw (key 168, not shown) to hold the bearing retainer in place.
4. Coat the groove in the handwheel body (key 142) with lubricant (key 237 or equivalent). Insert the spring (key 56) and ball (key 55) into the handwheel (key 51). Holding the ball and spring in the handwheel, put the handwheel (key 51), the washer

(key 149), the lockwasher (key 150), and the hex nut (key 54) on the end of the screw (key 145). Tighten the hex nut.

5. Position the pointer mounting bolt (key 159, not shown) and the pointer (key 160) as shown in figure 13 or 14. Insert and tighten the screw (key 161).
6. Assemble the two levers (key 146) with the cap screws (key 156) for handwheel assemblies for size 45, 50, and 60 actuators or with the machine bolts (key 156) for handwheel assemblies on size 34 and 40 actuators.
7. If the handwheel assembly was removed from the yoke, remount the handjack assembly to the yoke using the dowel pins for alignment. Position the U-bolts (keys 166 and 143) on the yoke, and hand-tighten the hex nuts (keys 170 and 147) to hold the handwheel assembly in position. Cap screws (key 163) should be tight against the yoke legs to provide stability. Tighten nuts (key 144). Finish tightening the U-bolt nuts to 163 N•m [120 lbf•ft] (key 170) and 41 N•m [30 lbf•ft] (key 147). Be sure the handwheel assembly remains flat against the mounting pad and perpendicular to the yoke.
8. Position the levers (key 146) as shown in figure 13 or 14. Insert the lever pivot pin (key 153), and snap the retaining ring (key 154) onto the lever pivot pin.

Side-Mounted Handwheel Assembly for Size 70, 76, and 87 Actuators

A side-mounted handwheel assembly (figure 15) is usually used as a manual actuator. Turning the handwheel clockwise past the neutral position always closes the valve body. A sleeve (key 123, figure 15) on a handwheel assembly for a size 70, 76 or 87 actuator opens the valve body by moving the valve stem.

Instructions are given below for complete disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; and then begin the assembly at the appropriate step.

Disassembly for Side-Mounted Handwheel (Sizes 70, 76, and 87)

1. Bypass the control valve. Reduce the loading pressure to atmospheric. Disconnect the loading pressure tubing or piping at the yoke.
2. Remove the cover band (key 87), and relieve spring compression by turning the spring adjuster (key 74) counterclockwise.
3. Remove the cap screws and nuts (keys 13 and 14) and lift off the upper diaphragm casing (key 1).

667 Size 30-76 and 87 Actuators

4. Remove the travel stop screw (key 12) and spacer (key 2), and take off the diaphragm plate (key 4), the diaphragm (key 3), and the lower diaphragm plate (key 71).
5. Unscrew the cap screws (key 90) and remove the following connected parts: the lower diaphragm casing (key 64), the O-ring (key 70), spring case adaptor (key 89), the seal bushing, O-rings, and snap ring (keys 7, 8, 9, and 72).
6. Remove the snap ring (key 72), and slide the seal bushing and O-rings (keys 7, 8, and 9) out of the spring case adaptor (key 89).
7. Take out the actuator spring (key 18).
8. Remove the stem connector (key 31) and stem connector cap screws.
9. Pull the actuator stem (key 144) up and out of the yoke. The spring seat (key 19), spring adjuster (key 74), thrust bearing (key 128), and the pinned adjusting screw (key 131) will come out with the actuator stem.
10. Turn the handwheel so that the lower sleeve (key 123) extends out of the bottom of the yoke. DO NOT move the neutral indicator scale (key 125).
11. Loosen two set screws (key 121), and unscrew the bearing retainer flange (key 45). Take out the worm gear and two thrust bearings (key 132), one on each side of the gear.
12. The worm shaft (key 51) and associated parts can be disassembled, if desired, by first removing the handwheel nut (key 127) and the handwheel (key 58). Do not lose the small ball (key 141) and spring (key 142).
13. Loosen the set screw (key 52) for each worm shaft retainer (keys 48 and 49). Unscrew the two worm retainers (keys 48 and 49). The ball bearings (key 50) will come out with the retainers.
3. Coat the worm shaft (key 51) threads with lubricant (key 239 or equivalent), and slide the shaft into the yoke so that the end of the shaft fits snugly into the back bearing retainer.
4. Insert the bearing in the front bearing retainer (key 49), and thread the retainer and ball bearing into the yoke. Align the slot in the retainer with the hole in the yoke, insert the set screw (key 52), and tighten it.
5. Put the spring and ball (keys 141 and 142) in the handwheel (key 58). Slide the handwheel onto the worm shaft (key 51). Thread the hex nut (key 127) onto the worm shaft.
6. Pack the two needle bearings (key 132) and coat the worm gear (key 44) threads with lubricant (key 239) or equivalent. Insert the key (key 122), the bearings, and the worm gear in the yoke (key 73) as shown in figure 15.
7. Slots are cut in the threads of the bearing retainer flange (key 45). Thread the flange into the yoke so that the slots and the holes for the set screws (key 121) align. Insert the screws, and tighten them.
8. The lower sleeve (key 123) has a milled groove in one end. Coat the sleeve threads with lubricant (key 239 or equivalent), slide the end of the lower sleeve with the groove into the bearing retainer flange, turn the handwheel, and feed the sleeve through the worm gear so that the slot in the lower sleeve engages the key (key 122) in the yoke. Continue turning the handwheel until the lower sleeve protrudes 81 mm (3.19 inches) below the surface of the yoke. The bottom of the lower sleeve should be even with the bottom of the extension on the neutral indicator.
9. Pack the thrust bearing (key 128) with lubricant (key 239) or equivalent. Slide the actuator stem (key 144) and the attached adjusting screw (key 131), pin (key 130), thrust bearing (key 128), spring seat (key 19), and spring adjuster (key 74) into the yoke. The lower end of the stem slides through the lower sleeve (key 123) and the lower sleeve slides into the adjusting screw (key 131), as shown in figure 15.

Assembly for Side-Mounted Handwheel (Sizes 70, 76, and 87)

1. The front and back worm retainers (keys 48 and 49) each have a slot in their threads for a set screw (key 52). Pack the ball bearings (key 50) with lubricant (key 239) or equivalent, and insert one ball bearing in the back worm retainer (key 49) as shown in figure 15.
2. Thread the back bearing retainer and ball bearing (keys 49 and 50) into the yoke. Align the slot in the bearing retainer with the set screw hole in the yoke, insert the set screw (key 52), and tighten it.
10. Position the actuator stem (key 144) against the valve stem. Clamp both stems between the two halves of the stem connector (key 31), and be sure the threads are engaged properly on both stems. The stem connector should not be closer than 3.2 mm (0.125 inches) to the lower sleeve when the actuator stem is in the retracted position. This adjustment will provide approximately 3.2 mm (0.125 inches) of free travel of the lower sleeve in either direction for manual operation. Fasten the halves together with the cap screws.

11. Put the actuator spring (key 18) in the yoke on the spring seat (key 19).
12. Coat the O-rings (keys 8 and 9) with lubricant (key 237) or equivalent, and insert them in the seal bushing (key 7). Slide the seal bushing and O-rings into the spring case adaptor (key 89).
13. Install the snap ring (key 72).
14. Slide the seal bushing and O-rings (keys 7, 8, and 9) over the actuator stem (key 144), and position the spring case adaptor (key 89), lower diaphragm casing (key 64), and O-ring (key 70) on the yoke.
15. Insert and tighten the cap screws (key 90).
16. Slide the lower diaphragm plate (key 71), the diaphragm (key 3) with the patterned side up, the diaphragm plate (key 4), the spacer (key 2), and the cap screw (key 12) on the actuator stem (key 144). Tighten the cap screw.
17. Put the diaphragm casing (key 1) on the diaphragm. Align the holes in the diaphragm (key 3) and the diaphragm casings (keys 1 and 64).

Note

When you replace actuator diaphragms in the field, take care to ensure the diaphragm casing bolts are tightened to the proper load to prevent leakage, but not crush the material. Perform the following tightening sequence with a manual torque wrench for size 30-76 and 87 actuators.

CAUTION

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

Note

Do not use lubricant on these bolts and nuts. Fasteners must be clean and dry.

18. Install the cap screws and hex nuts (keys 13 and 14) and tighten in the following manner.
19. The first four bolts tightened should be diametrically opposed and 90 degrees apart. Tighten these four bolts to 13 N•m (10 lbf•ft).

20. Tighten the remaining bolts in a clockwise, criss-cross pattern to 13 N•m (10 lbf•ft).
21. Repeat this procedure by tightening four bolts, diametrically opposed and 90 degrees apart, to a torque of 27 N•m (20 lbf•ft).
22. Tighten the remaining bolts in a clockwise, criss-cross pattern to 27 N•m (20 lbf•ft).
23. After the last bolt is tightened to 27 N•m (20 lbf•ft), all of the bolts should be tightened again to 27 N•m (20 lbf•ft) in a circular pattern around the bolt circle.
24. Once completed, no more tightening is recommended.
25. Return the actuator to service after completing the Loading Connection procedure in the Installation section and the procedures in the Adjustments section.

Casing-Mounted Travel Stops

Note

If repeated or daily manual operation is expected, the actuator should be equipped with a side-mounted handwheel rather than a casing-mounted travel stop or top-mounted handwheel. The side-mounted handwheel is designed for more frequent use as manual operator.

Casing-mounted adjustable travel stops (shown in figures 16 through 20) are available to limit travel in the down direction (extending the actuator stem) or in the up direction (retracting the actuator stem). The travel stop in figure 16 is a down travel stop, the travel stop in figure 17 is an up and down travel stop, and the travel stops in figures 18, 19, and 20 are up travel stops.

Use the locknuts (key 151, figures 16 and 17), stem (key 150, figure 18), handwheel (key 58, figure 19) or cap screw (key 177, figure 20) to set the point at which the travel stop limits travel. Be sure to tighten the locknuts and replace the cap (key 149, figures 16 and 18; key 247, figure 17) after setting the travel stop.

Instructions are given below for disassembly and assembly. Perform the disassembly only as far as necessary to accomplish the required maintenance; then, begin the assembly at the appropriate step.

667 Size 30-76 and 87 Actuators

Key numbers are shown in figures 16 through 20.

1. Remove the cap (key 149 or 247) if the travel stop uses one. For down travel stops, loosen the locknuts (key 151, figures 16 and 17) so that the stop is not causing any spring compression.
2. Bypass the control valve, reduce loading pressure to atmospheric, and remove the tubing or piping from the connection on top of the yoke (key 73, figures 6, 7, and 8).
3. For down travel stops, turn the spring adjuster (key 74, figures 6, 7, and 8) out of the yoke toward the stem connector (key 31) to relieve all the compression in the spring (key 18).
4. **For style 11 travel stops (figure 17)**, unscrew the cap screws (key 161), and make sure that the guide plate (key 157) can turn between the handwheel body (key 148) and the mounting plate (key 158).
5. Use a wrench on the nuts (key 151) to unscrew the extension rod (key 150). Remove the rod, the handwheel body (key 148), and the attached parts.
6. Unscrew the hex nuts and cap screws (keys 14 and 13, figures 6, 7, and 8) from the diaphragm casings. Lift off the upper diaphragm casing (key 1, figures 6, 7, and 8) and, for the style 11 travel stop, the mounting plate (key 158). For styles 10, 12 and 13, the travel stop assembly will be removed with the casing.
7. Note and record the position of travel stops (key 152) relative to the cap screws (key 154) for use in assembly. Unscrew the travel stops and cap screws, and remove either the mounting plate (key 158) or the handwheel body (key 148) and attached parts.
8. Separate the stem (key 150) and screw (key 160, figure 17) from the handwheel body.
9. Before reassembling, lubricate parts indicated by key 239 in figures 16 through 20. Use lubricant (key 239 or equivalent).
10. Reassemble parts in the reverse order of removal.
11. When replacing the cap screws (key 154) and, if used, the travel stops (key 152), be sure to return them to their original position as recorded in step 6.

CAUTION

Over-tightening the diaphragm cap screws and nuts (keys 13 and 14), figures 6, 7, and 8 can damage the

diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

12. Install the cap screws and nuts (keys 13 and 14, figures 6, 7, and 8) and finger tighten. Tighten the diaphragm cap screws and nuts to 27 N•m (20 lbf•ft) torque in a crisscross pattern.
13. Return the spring adjuster (key 74, figure 6, 7, and 8) to its original position. Re-adjust the travel stop.

Parts Ordering

Each actuator has a serial number stamped on the nameplate. Always mention this number when corresponding with your Fisher sales office regarding technical information or replacement parts. Also, reference the complete 11-character part number of each needed part as found in the following Parts Kits and Parts List sections.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and might jeopardize worker and workplace safety.

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

Parts Kits

Side-Mounted Handwheels Retrofit Kits

Key	Description	Part Number
Retrofit Kit includes parts to add a Side-Mounted Handwheel.		
	Size 34 Push-Down-To-Close	30A8778X0E2
	Size 34 Push-Down-To-Open	30A8778X0F2
	Size 40 Push-Down-To-Close	30A8778X0G2
	Size 40 Push-Down-To-Open	30A8778X0H2
	Size 45 & 46 Push-Down-To-Close	40A8779X0A2
	Size 45 & 46 Push-Down-To-Open	40A8779X0B2
	Size 50 & 60 Push-Down-To-Close	40A8779X0C2
	Size 50 & 60 Push-Down-To-Open	40A8779X0D2

Top-Mounted Handwheels Retrofit Kits

Retrofit Kit includes parts to add a Top-Mounted Handwheel. Kit number 1 includes the handwheel assembly only. Kit number 2 includes Kit number 1 and a new diaphragm case that is required to mount the handwheel assembly.

Key	Description	Part Number
Kit 1		
	Size 30	30B3940X102
	Sizes 34	39B3940X022
	Size 40	39B3940X042
	Sizes 45 & 50	33B9224X012
	Sizes 46, 60, AND 76	33B9224X012
	Sizes 70 & 87	CV8060X0012
Kit 2		
	Size 30	30B3940X052
	Size 34	30B3940X062
	Size 40	30B3940X092
	Sizes 45 & 50	33B9224X022
	Sizes 46, 60, & 76	33B9224X032
	Sizes 70 & 87	CV8060X0022

Actuator Repair Kits

Parts kit includes keys 8, 9, and 70. O-ring material is nitrile, and gasket material is composition.

Key	Description	Part Number
	Size 30	R667X000302
	Sizes 34 & 40	R667X000402
	Sizes 45 through 60	R667X000502
	Sizes 70 & 87	R667X000702
	Size 76	R667X000762

Parts List

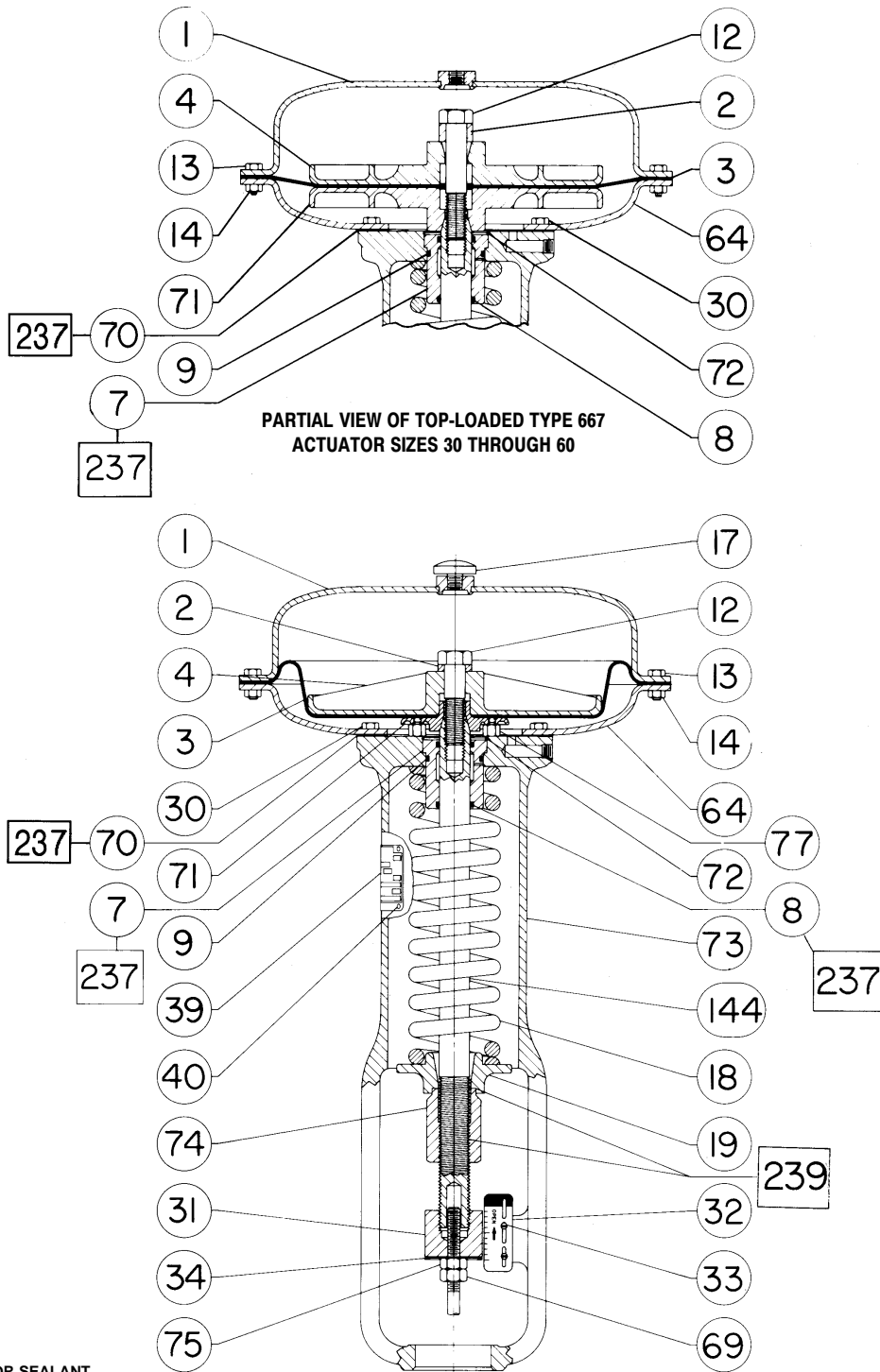
Note

Part numbers are shown for recommended spares only. For part numbers not shown, contact your Fisher sales office.

Actuator Assembly

Key	Description	Part Number	Qty
1	Upper Diaphragm Casing		
2	Travel Stop Spacer		
3*	Diaphragm		
	Molded Nitrile/Nylon		
	Size 30	2E800002202	1
	Sizes 34 & 40	2E669902202	1
	Sizes 45 & 50	2E859602202	1
	Sizes 46, 60 & 76	2E859802202	1
	Sizes 70 & 87	2N130902202	1
	Molded Silicone/Polyester		
	Size 30	18B2713X012	1
	Sizes 34 & 40	18B2713X022	1
	Sizes 45 & 50	18B2713X032	1
	Sizes 46, 60 & 76	18B2713X042	1
	Sizes 70 & 87	18B2713X052	1
4	Upper Diaphragm Plate		
7*	Bushing, Seal		
	Brass		
	Size 30	1E791214012	1
	Sizes 34 & 40	1E682814012	1
	Sizes 45 through 60	1E845714012	1
	Sizes 70, 76 & 87	1N1316X0052	1
	S41600 [416 stainless steel (SST)]		
	Size 30	1E7912X0012	1
	Sizes 34 & 40	1E6828X0012	1
	Sizes 45 through 60	1E8457X0012	1
	PTFE w/25% Glass		
	Sizes 70, 76 & 87	1N1316X0042	1
8*	O-Ring		
	Nitrile		
	Size 30	1E5914X0052	2
	Sizes 34 & 40	1D237506992	2
	Sizes 45 through 60	1C5622X0022	2
	Sizes 70, 76 & 87	1E736906992	2
	Fluoroelastomer		
	Size 30	1E5914X0062	2
	Sizes 34 & 40	1D237506382	2
	Sizes 45 through 60	1N285406382	2
	Sizes 70, 76, & 87	1N1633X0012	2
9*	O-Ring		
	Nitrile		
	Sizes 30 through 40	1C415706992	1
	Sizes 45 through 87	1E845806992	1
	Fluoroelastomer		
	Sizes 30 through 40	1C4157X0032	1
	Sizes 45 through 87	1E8458X0022	1
12	Screw, Cap, hex hd		
13	Hex hd Cap Screw		
14	Hex Nut		
17	Vent Assembly		
18	Spring		
19	Seat, Lower Spring		
27	Extension Rod Conn		
30	Hex hd Cap Screw		
31	Stem Connector Assembly		
32	Travel Indicator Scale		
33	Screw, Self Tapping		
33	Screw, Mach, Fill hd		
34	Disk, Travel Indicator		
39	Nameplate		
40	Screw, Drive		
64	Lower Diaphragm Casing		

667 Size 30-76 and 87 Actuators



50A8379-C

50A8379-C/IL

Figure 6. Type 667 Actuator Sizes 30 through 60

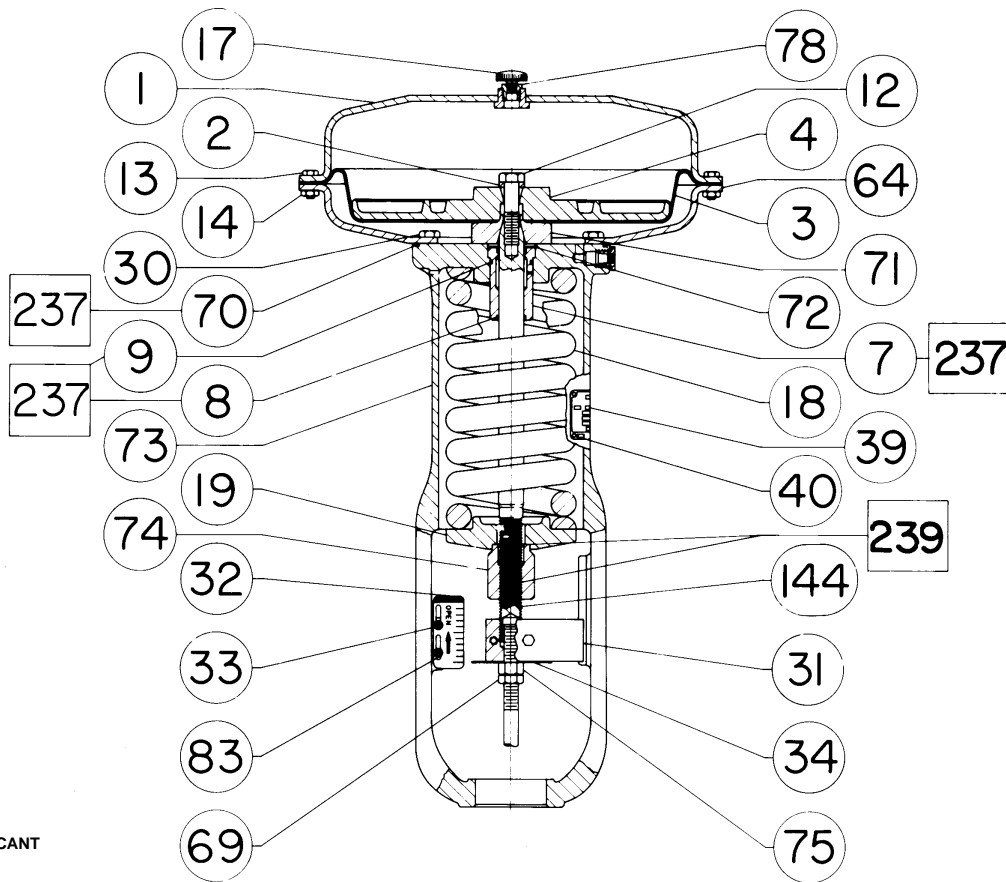


Figure 7. Type 667 Size 70 and 76 Actuator

Key	Description	Part Number	Qty	Key	Description	Part Number	Qty
69	Nut, Hex, Jam			144	Actuator Stem		
70*	Gasket			227	Washer, Plain		
	Composition [up to 232°C (450°F)]			228	Stem Disk Spacer		
	Sizes 30 through 40	1E801204022	1	237	Lubricant, Lubriplate MAG-1		
	Sizes 45 through 60 & 76	1E845404022	1		or equivalent		
70*	O-Ring				not furnished with actuator		
	Nitrile			239	Lubricant, Anti-Size Lub-3		
	Size 70 & 87	1D269106992	1		Never-Seez or equivalent		
71	Lower Diaphragm Plate				not furnished with actuator		
72	Ring, Snap			254	Caution Nameplate		
73	Yoke						
74	Spring Adjuster						
75	Nut, Hex						
76	Nut, Speed, Twin						
77	Stop, Travel						
78	Bushing, Pipe, Hex						
79	Screw, Mach, Flat Hd						
81	Screw, Mach, Rd Hd						
82	Indicator, Travel, Adaptor						
83	Washer, Plain						
89	Spring Case Adaptor						
90	Screw, Cap						
102	Plug, Pipe, Hex Hd						

Top-Mounted Handwheel (figures 9, 11, and 12)	
58	Handwheel
60	Retainer Ring
148	Handwheel Body
150	Extension Rod
152	Travel Stop
154	Cap Screw
156	Vent Assembly
157	Guide Plate
158	Mounting Plate

667 Size 30-76 and 87 Actuators

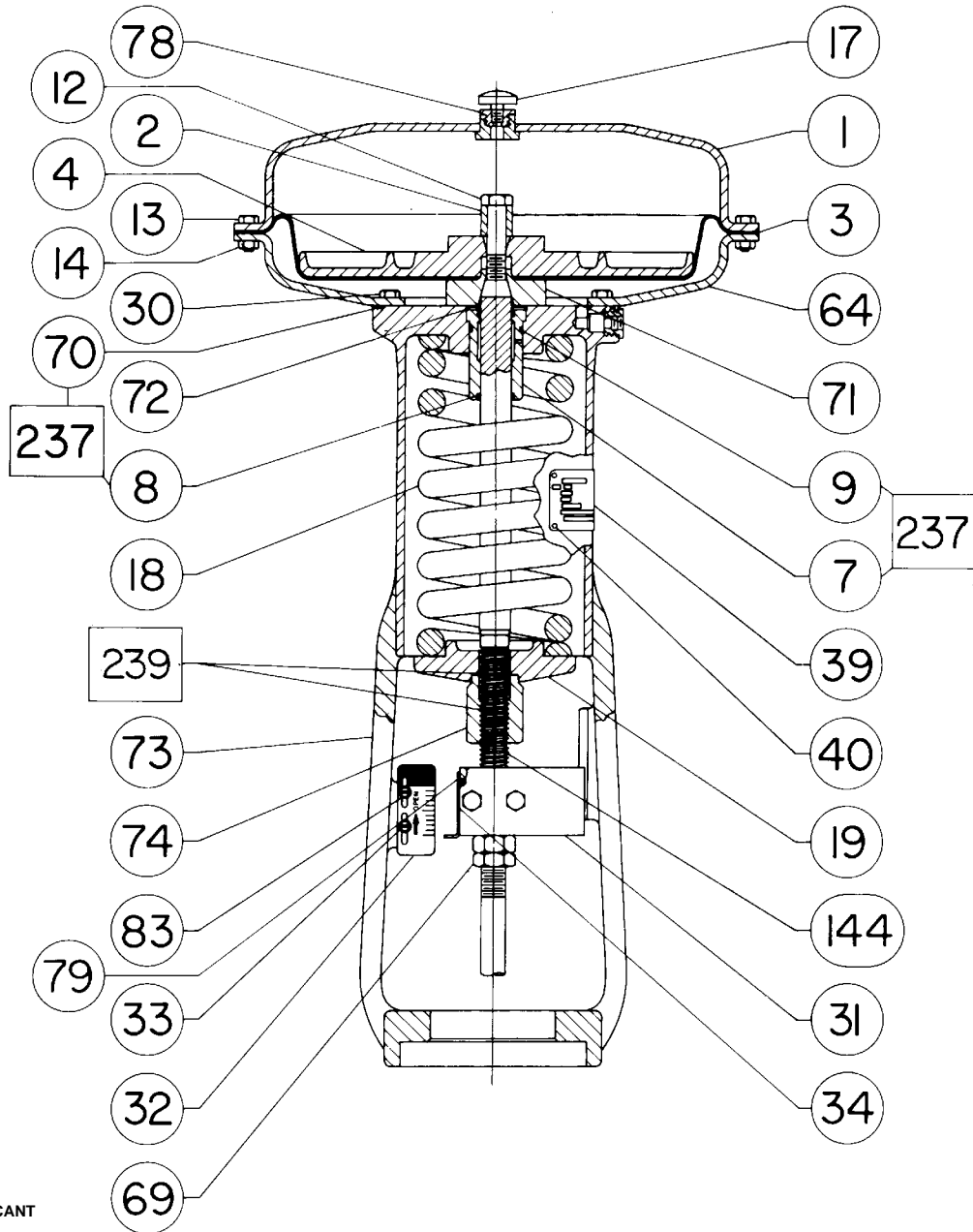
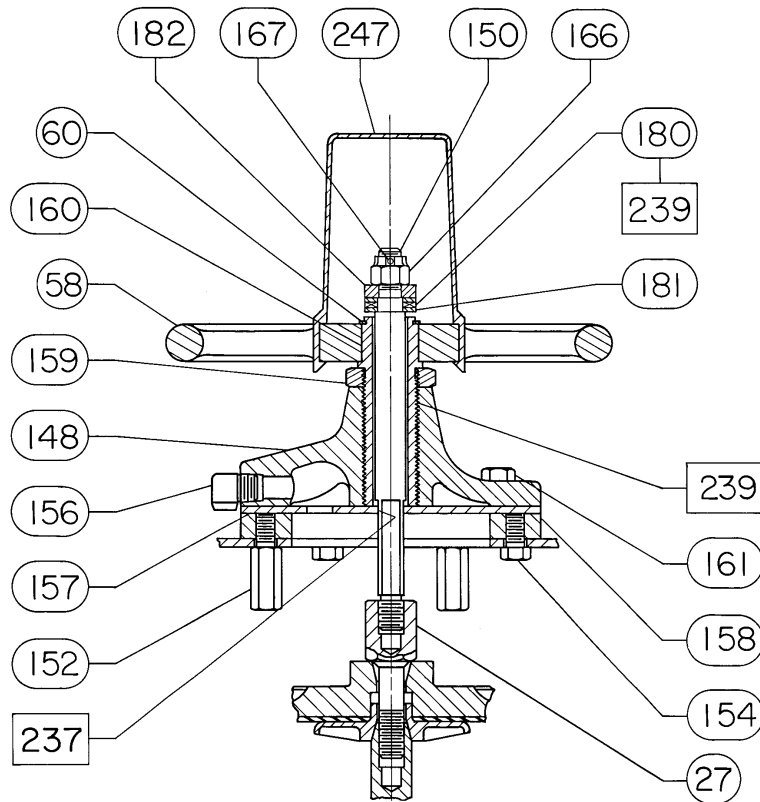


Figure 8. Type 667 Size 87 Actuator

Key	Description	Part Number	Key	Description	Part Number
159	Lock Nut		180	Thrust Bearing	
160	Handwheel Screw		181	Thrust Race	
161	Cap Screw		182	Bearing Retainer	
166	Castle Nut		183	Pipe Nipple	
167	Cotter Pin		239	Lubricant, Anti-Seize Lub-3	
178	Machine Screw			Never-Seez or equivalent not furnished with handwheel	
179	Lockwasher		247	Handwheel Cap	
			253	Spacer, Handjack	



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NOTE:
THE TOP MOUNTED HANDWHEEL IS NOT DESIGNED FOR USE UNDER
HEAVY LOAD OR FREQUENT USE.

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Figure 9. Top-Mounted Handwheel Assembly for Size 30 through 40 Actuators

**Side-Mounted Handwheel, Size 30-60
(figures 13 and 14)**

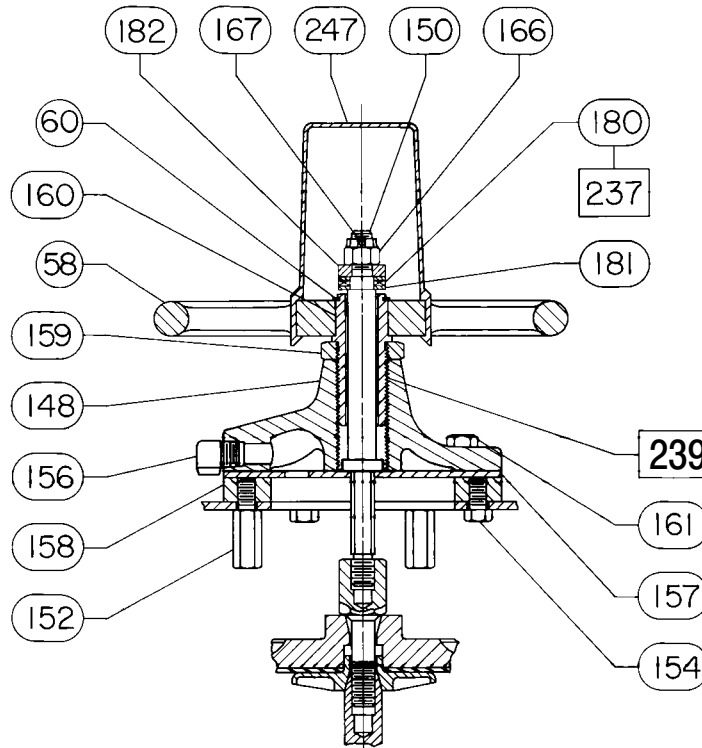
Key	Description	Part Number
51	Handwheel	
54	Hex Jam Nut	
55	Ball	
56	Spring	
132	Operating Nut	
136	Bearing Retainer	
142	Handwheel Body	
143	Mounting Bolts	
144	Hex Nut	
145	Handwheel Screw	
146	Lever & Pin Assembly	
147	Hex Jam Nut	
148	Dowel Pin	
149	Washer	
150	Lockwasher	
151	Bushing	
152	Ball Bearing	
153	Lever Pivot Pin	
154	Retaining Ring	
155	Spacer	
156	Screw	

Key	Description	Part Number
157	Lockwasher	
158	Hex Nut	
159	Pointer Mounting Bolt	
160	Pointer	
161	Machine Screw	
162	Indicator Plate (Aluminum)	
163	Cap Screw	
166	U-Bolt	
167	Guide Bolt	
168	Set Screw	
169	Grease Fitting	
170	Hex Nut	
177	Spring Cap	
178	Machine Screw	
241	Lubricant, Lubriplate MAG-1 or equivalent Not furnished with handwheel	
244	Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent Not furnished with handwheel	

**Side-Mounted Handwheel, Size 70, 76
and 87 (figure 15)**

29	Handgrip
38	Handgrip Bolt

667 Size 30-76 and 87 Actuators



□ APPLY LUBRICANT

30B3942-A

Figure 10. Top-Mounted Handwheel Assembly, Style P2 for Size 45, 50, 60, and 76 Actuators

Key	Description	Part Number	Key	Description	Part Number
44	Worm Gear				
45	Bearing Retainer Flange				
48	Back Worm Retainer				
49	Front Worm Retainer				
50	Ball Bearing				
51	Worm Shaft				
52	Set Screw				
57	Grease Fitting				
58	Handwheel		58	Handwheel	
87	Cover Band Ass'y		102	Plug, Pipe	
89	Spring Case Adaptor		127	Hex Nut	
90	Cap Screw		148	Travel Stop Body	
121	Set Screw		149	Travel Stop Cap	
122	Key		150	Extension Rod	
123	Lower Sleeve		150	Travel Stop Stem	
125	Handwheel Indicator		151	Hex Jam Nut	
127	Handwheel Cap		152	Travel Stop	
128	Needle Bearing		153	Nut, Hex	
129	Needle Bearing Race		154	Screw, Cap, Hex Hd	
130	Roll Pin		155	Washer, Lock, Split	
131	Spring Adjusting Screw		156	Vent	
132	Needle Bearing		157	Guide Plate	
133	Needle Bearing Race		158	Mounting Plate	
141	Ball		159	Nut, Travel Stop	
142	Spring		160	Screw, Handwheel	
237	Lubricant, Lubriplate MAG-1 or equivalent Not Furnished with Handwheel		161	Screw, Cap, Hex Hd	
239	Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent Not Furnished with Handwheel		162	Washer	
245	Yoke Extension		177	Travel Stop Screw	
			184	Nipple, Pipe, NPT	
			237	Lubricant, Lubriplate MAG-1 or equivalent	
			239	Lubricant, Anti-Seize Lub-3 Never-Seez or equivalent	
			247	Travel Stop Cap	
			248	Mounting Plate	

Casing-Mounted Travel Stops (figures 16 through 20)

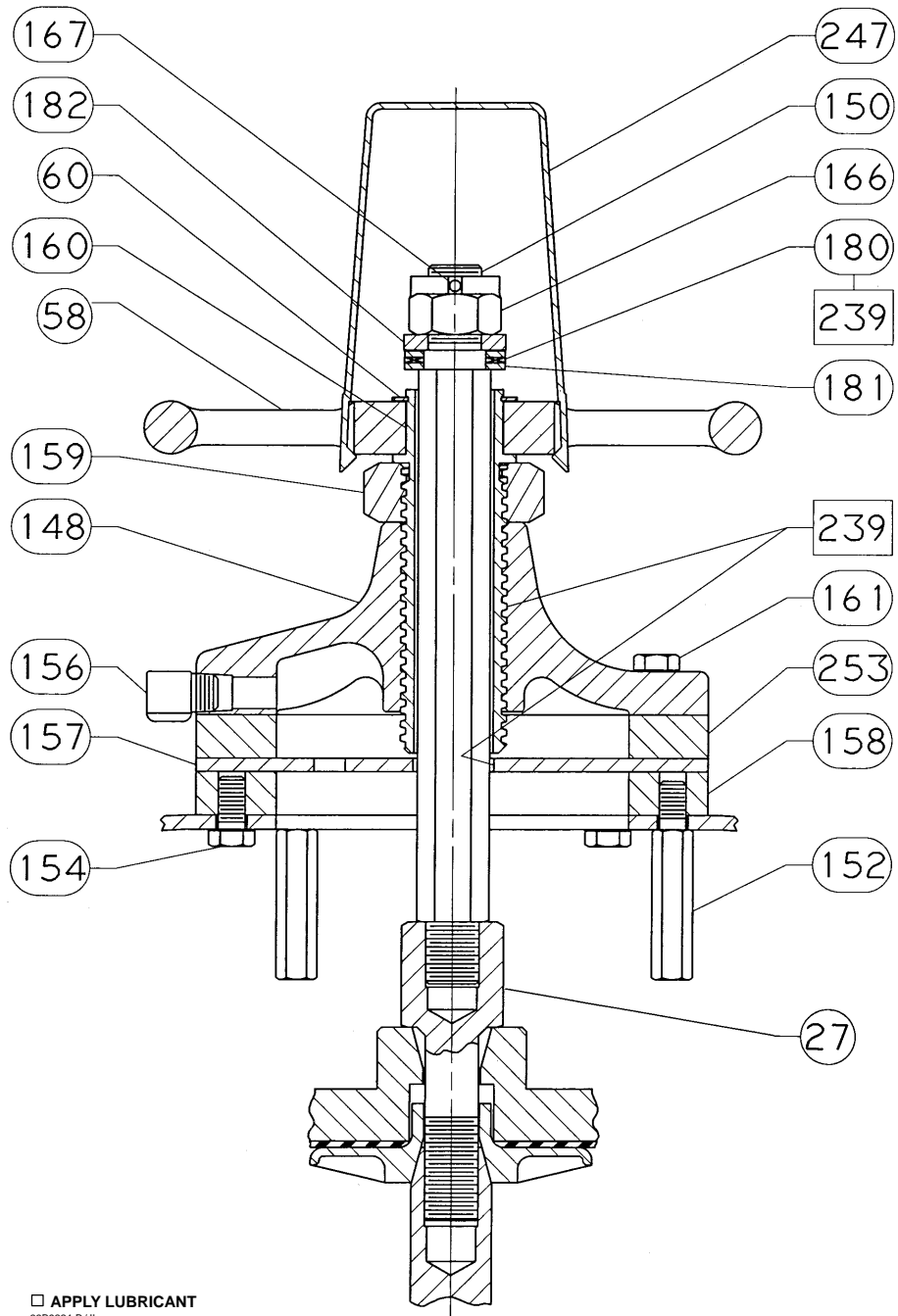


Figure 11. Top-Mounted Handwheel Assembly for Size 45-76 Actuators

667 Size 30-76 and 87 Actuators

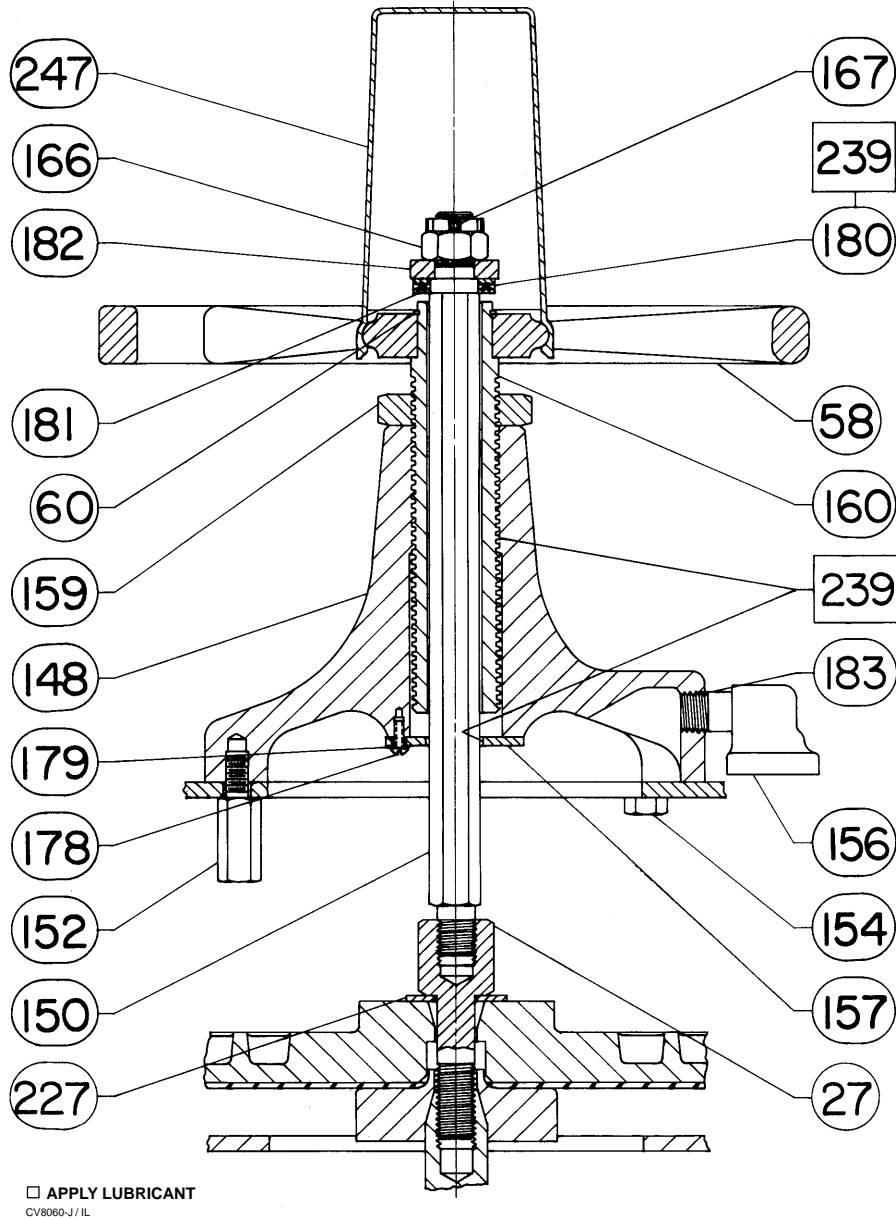
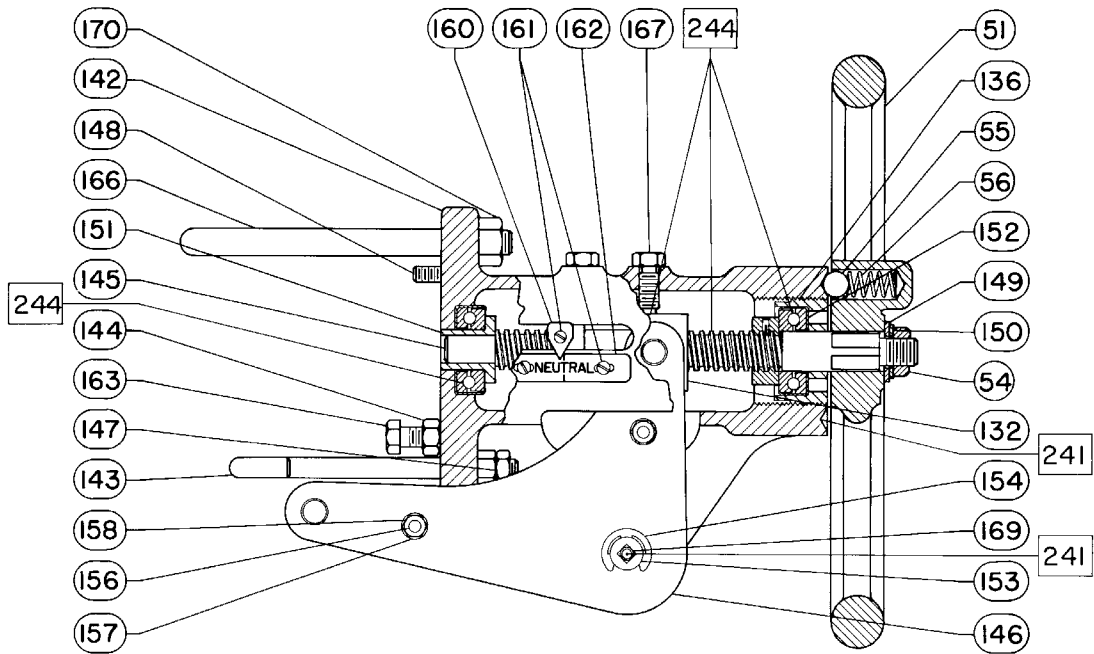
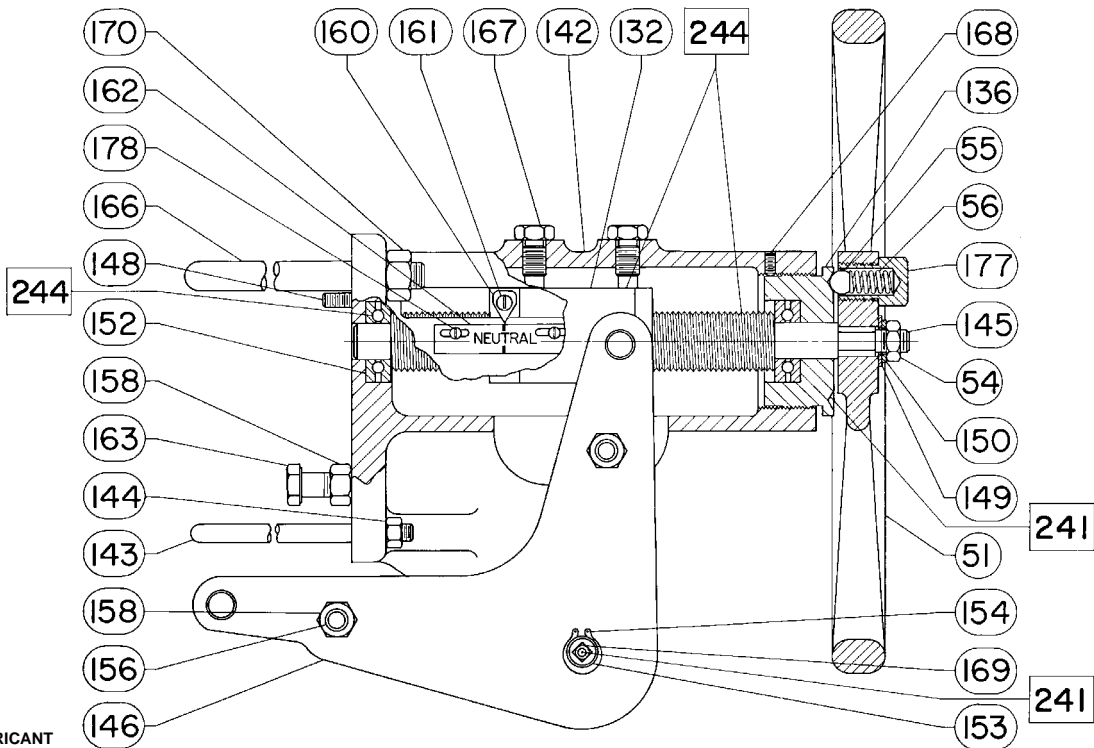


Figure 12. Top-Mounted Handwheel Assembly for Size 70 and 87 Actuators



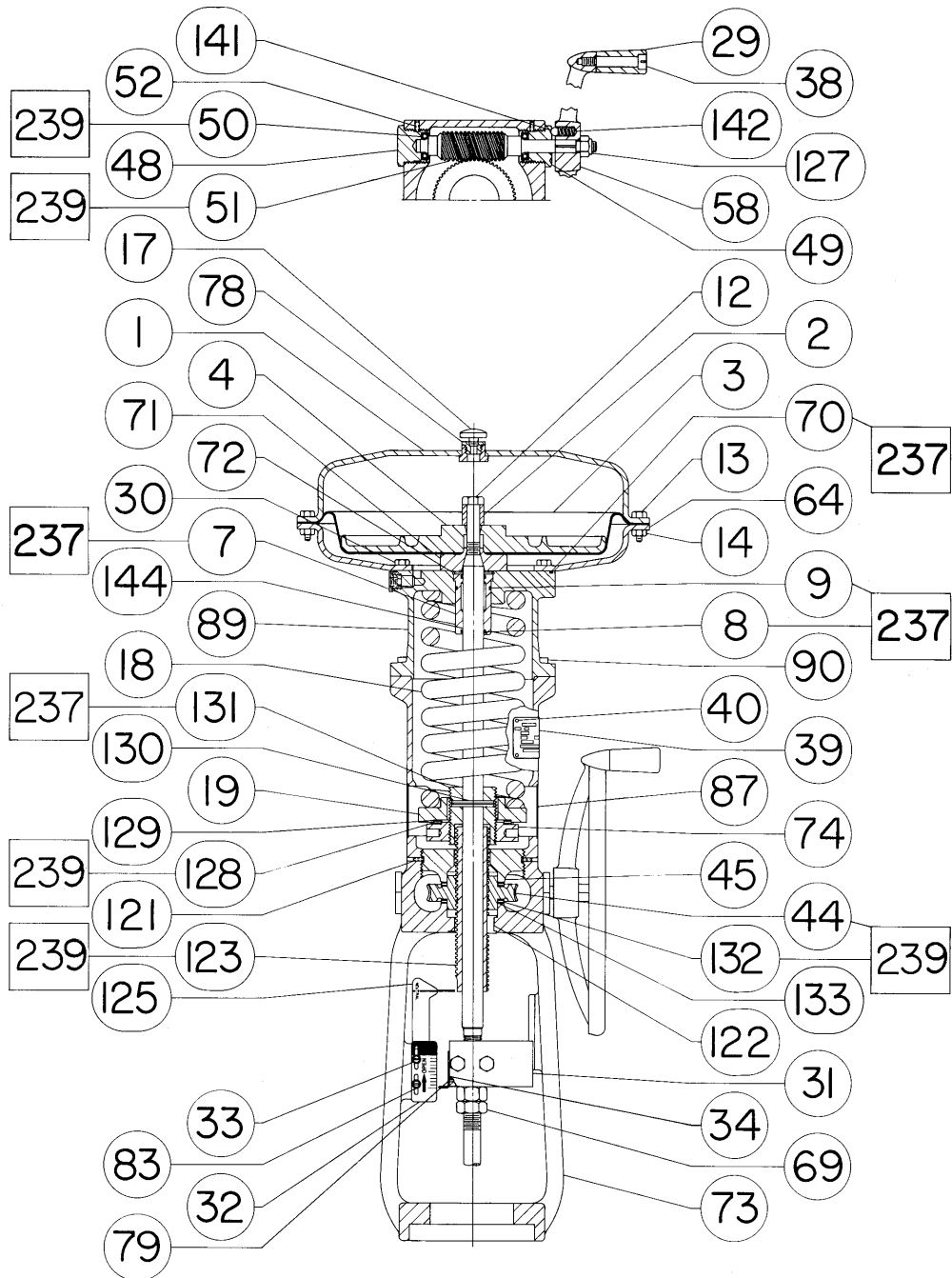
□ APPLY LUBRICANT
30A8778-D/IL

Figure 13. Side Mounted Handwheel Assembly for Size 34 and 40 Actuators



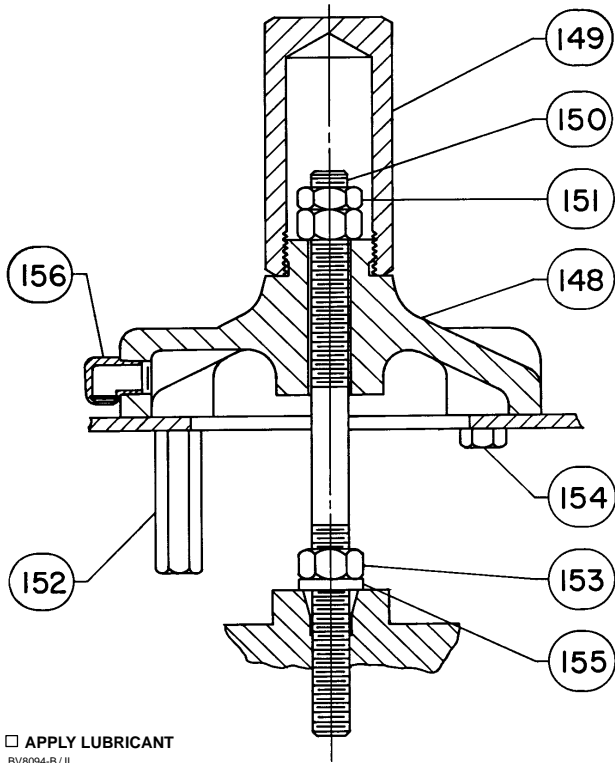
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Figure 14. Side-Mounted Handwheel Assembly for Size 45 and 60 Actuators



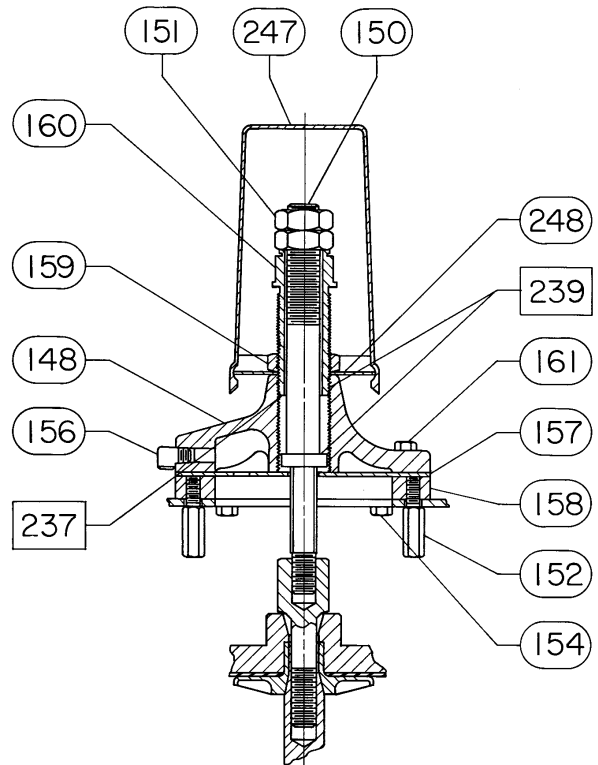
PART NOT SHOWN: 57
 APPLY LUBRICANT
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Figure 15. Size 70, 76, and 87 Actuator with Side Mounted Handwheel Assembly



□ APPLY LUBRICANT
BV8094-B/IL

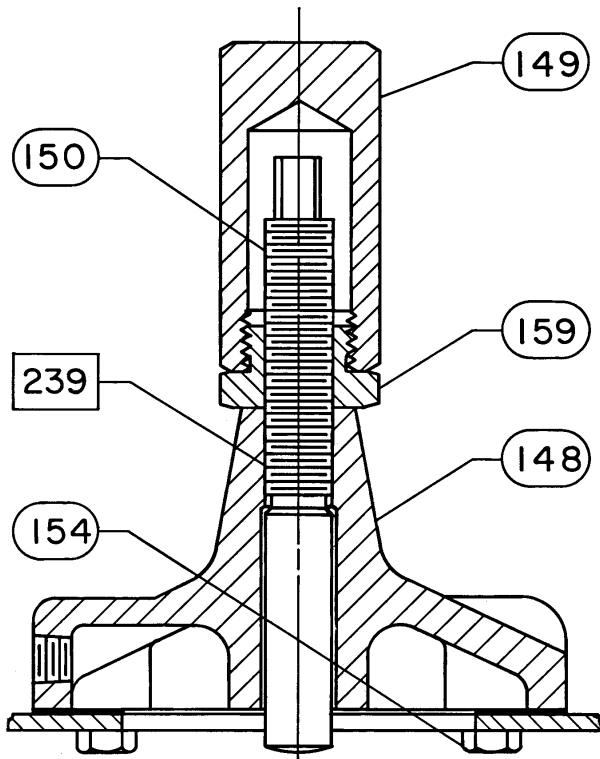
Figure 16. Style 10 Down Travel Stop (Casing Mounted)



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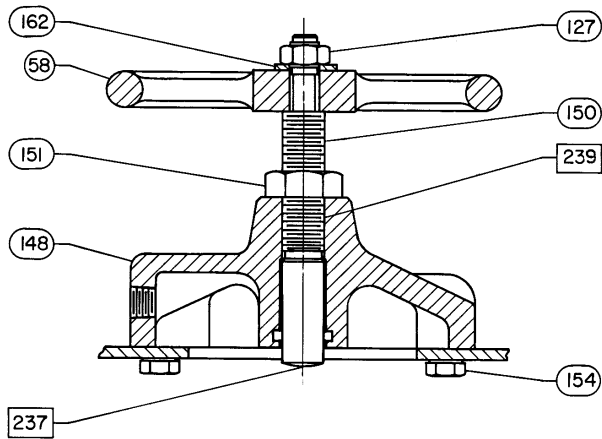
Figure 17. Style 11 Up Or Down Travel Stop (Casing Mounted)

667 Size 30-76 and 87 Actuators



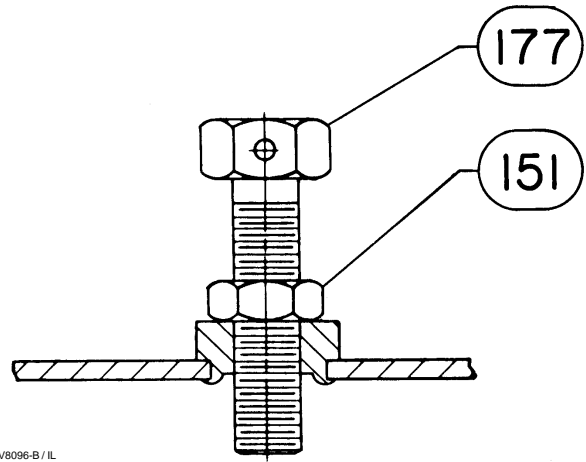
□ APPLY LUBRICANT
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Figure 18. Style 12 Up Travel Stop (Casing Mounted)



□ APPLY LUBRICANT
28A1204-B/IL

Figure 19. Style 13 Up Travel Stop (Casing Mounted), size 30 shown



AV8096-B/IL

Figure 20. Style 14 Up Travel Stop (Casing Mounted)

667 Size 30-76 and 87 Actuators

Instruction Manual

Form 1203
September 2004

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Design D4 Control Valve Assembly

Contents

Introduction	1
Scope of Manual	1
Description	1
Specifications	1
Installation	3
Spring Adjustment	5
Maintenance	5
Valve Plug and Seat Ring	6
Valve Packing	7
Actuator	8
Parts Ordering	10
Repair Kits	10
Parts List	11

Introduction

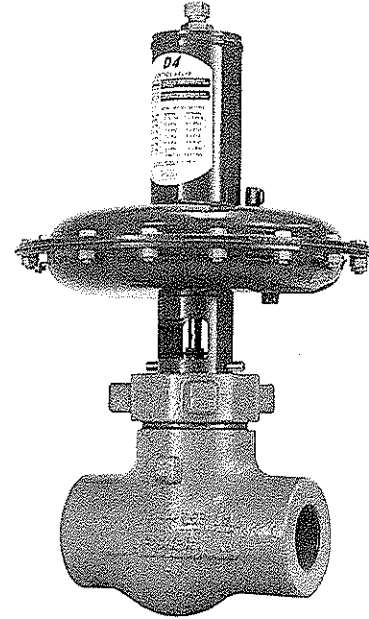
Scope of Manual

This instruction manual provides installation, maintenance, and parts information for the Design D4 control valve.

No person may install, operate, or maintain a Design D4 control valve without first • being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher® sales office before proceeding.

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W8531/L

Figure 1. Design D4 Control Valve

Description

The Design D4 control valve is a compact, rugged valve designed primarily for high-pressure throttling applications. This valve is ideal for use on pressure and flow control applications within the oil and gas production industry. The Design D4 valve also makes an excellent dump valve for high-pressure separators and scrubbers.

Specifications

Table 1 lists specifications for the Design D4 control valve. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate located on the actuator spring barrel.



Table 1. Specifications

<p>Available Configurations Spring-to-Close Spring-to-Open</p> <p>Valve Body Sizes and End Connection Styles⁽¹⁾ See table 2</p> <p>Maximum Inlet Pressures and Temperatures⁽¹⁾ If the valve nameplate shows an ASME pressure-temperature class, maximum inlet pressure and temperature is consistent with the applicable class per ASME B16.34. If the nameplate does not show an ASME class, it will show a maximum cold working pressure at 38°C (100°F) (for example, 248 bar [3600 psi])</p> <p>Maximum Pressure Drops⁽¹⁾ See tables 3, 4, 5, and 6</p> <p>Input Signal to Actuator See tables 3, 4, 5, and 6</p> <p>Actuator Maximum Casing Pressure⁽¹⁾ 3.4 bar (50 psig)</p> <p>Shutoff Classification per ANSI/FCI 70-2 and IEC 60534-4 Class IV</p>	<p>Material Temperature Capabilities⁽¹⁾ Actuator Assembly: -40 to 93°C (-40 to 200°F) Valve Body Assembly: <i>Standard Bonnet O-Ring:</i> -46 to 149°C (-50 to 300°F) <i>Optional Fluoroelastomer Bonnet O-Ring:</i> -23 to 204°C (-10 to 400°F)</p> <p>Flow Characteristic Equal percentage</p> <p>Flow Direction Flow up only</p> <p>Port Diameters See table 2</p> <p>Valve Plug Travel 19 mm (0.75 inch)</p> <p>Valve Plug Style Micro-Form™ valve plug</p> <p>Actuator Diaphragm Effective Area 452 cm² (69 inches²)</p> <p>Actuator Pressure Connection Size 1/4 inch NPT female</p>
--	---

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.

Table 2. Valve Sizes and Connection Styles

VALVE SIZE, INCHES	PORT DIAMETER, (INCHES)	SCREWED	RAISED FACE (RF) FLANGED				RING TYPE JOINT (RTJ) FLANGED	
		3600 psi	Class 150	Class 300	Class 600	Class 900 and 1500	Class 600	Class 900 and 1500
1	0.25, 0.375, 0.5, 0.75	X	X	X	X	X	X	X
2	0.25, 0.375, 0.5, 0.75, 1, 1.25	X	X	X	X	X	X	X

X = Available construction.

*Table 3. Maximum Shutoff Pressure Drops⁽¹⁾ for Design D4 Control Valves (Spring-to-Close)
When Used with Typical Control Instrumentation⁽²⁾*

INPUT SIGNAL TO ACTUATOR		0 to 1.2 Bar (0 to 18 Psig)		0 to 1.4 Bar (0 to 20 Psig)		0 to 2.0 Bar (0 to 30 Psig)		0 to 2.3 Bar (0 to 33 Psig)		0 to 2.4 Bar (0 to 35 Psig)		0 to 3.4 Bar (0 to 50 Psig)	
SPRING		Light Rate						Heavy Rate					
INITIAL SPRING SETTING		0.77 Bar (11.2 Psig)		0.77 Bar (11.2 Psig)		0.85 Bar (12.4 Psig)		1.05 Bar (15.3 Psig)		1.18 Bar (17.1 Psig)		1.18 Bar (17.1 Psig)	
PORT DIAMETER		Maximum Pressure Drop											
mm	Inches	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi
6.4	0.25	259 ⁽³⁾	3750 ⁽³⁾	259 ⁽³⁾	3750 ⁽³⁾	259	3750	259	3750	259	3750	259	3750
9.5	0.375	259 ⁽³⁾	3750 ⁽³⁾	259 ⁽³⁾	3750 ⁽³⁾	259	3750	259	3750	259	3750	259	3750
12.7	0.5	191	2765	191	2765	219	3180	259	3750	259	3750	259	3750
19.1	0.75	80	1160	80	1160	92	1340	123	1785	143	2080	143	2080
25.4	1	42	610	42	610	49	715	67	965	78	1130	78	1130
31.8	1.25	25	365	25	365	30	430	41	590	48	700	48	700

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.
2. For example, use the column marked 0-1.4 bar (0-20 psig) for a 0.21-1.0 bar (3-15 psig) pneumatic controller with 1.4 bar (20 psig) supply pressure.
3. For applications with downstream pressure in excess of 196 bar (2845 psig), use 196 bar (2845 psig) for Maximum Shutoff Pressure.

*Table 4. Maximum Shutoff Pressure Drops⁽¹⁾ for Design D4 Control Valves (Spring-to-Close)
When Used with Instrumentation with Restricted Output Range⁽²⁾*

INPUT SIGNAL TO ACTUATOR		0.2 to 1.0 Bar (3 to 15 Psig)				0.4 to 2.0 Bar (6 to 30 Psig)			
SPRING		Light Rate				Heavy Rate			
INITIAL SPRING SETTING		0.67 Bar (9.7 Psig)				0.97 Bar (14.0 Psig)			
PORT DIAMETER		Maximum Pressure Drop							
mm	Inches	Bar		Psi		Bar		Psi	
6.4	0.25	259 ⁽³⁾		3750 ⁽³⁾		259 ⁽⁴⁾		3750 ⁽⁴⁾	
9.5	0.375	152 ⁽³⁾		2205 ⁽³⁾		210 ⁽⁴⁾		3045 ⁽⁴⁾	
12.7	0.5	80		1160		113		1635	
19.1	0.75	31		445		45		655	
25.4	1	14		210		23		330	
31.8	1.25	7.6		110		13		185	

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.
2. For example, an Electro-Pneumatic Transducer calibrated for 0.21-1.0 bar (3-15 psig) output pressure.
3. For applications with downstream pressure in excess of 85 bar (1240 psig), use 85 bar (1240 psig) for Maximum Shutoff Pressure.
4. For applications with downstream pressure in excess of 118 bar (1715 psig), use 118 bar (1715 psig) for Maximum Shutoff Pressure.

Installation



Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

To avoid personal injury or property damage caused by bursting of pressure-retaining parts or by uncontrolled process fluid, be certain the service conditions do not exceed

the limits shown on the valve nameplate and in tables 1, 3, 4, 5, and 6. Use pressure-relieving devices required by government or accepted industry codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.

Table 5. Maximum Shutoff Pressure Drops⁽¹⁾ for Design D4 Control Valves (Spring-to-Open) When Used with Typical Control Instrumentation⁽²⁾

INPUT SIGNAL TO ACTUATOR		0 to 1.2 Bar (0 to 18 Psig)		0 to 1.4 Bar (0 to 20 Psig)		0 to 2.0 Bar (0 to 30 Psig)		0 to 2.3 Bar (0 to 33 Psig)		0 to 2.4 Bar (0 to 35 Psig)		0 to 3.4 Bar (0 to 50 Psig)	
SPRING		Light Rate						Heavy Rate					
INITIAL SPRING SETTING		0.23 Bar (3.4 Psig)		0.23 Bar (3.4 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)		0.28 Bar (4.0 Psig)	
PORT DIAMETER		Maximum Pressure Drop											
mm	Inches	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi	Bar	Psi
6.4	0.25	259 ⁽³⁾	3750 ⁽³⁾	259 ⁽³⁾	3750 ⁽³⁾	259	3750	259	3750	259	3750	259	3750
9.5	0.375	259 ⁽³⁾	3750 ⁽³⁾	259 ⁽³⁾	3750 ⁽³⁾	259	3750	259	3750	259	3750	259	3750
12.7	0.5	187	2715	233	3380	259	3750	259	3750	259	3750	259	3750
19.1	0.75	78	1135	99	1430	147	2130	178	2575	198	2875	259	3750
25.4	1	41	600	53	765	80	1160	97	1410	109	1575	195	2830
31.8	1.25	24	355	32	465	49	715	60	875	68	985	123	1785

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.
 2. For example, use the column marked 0-1.4 bar (0-20 psig) for a 0.21-1.0 bar (3-15 psig) pneumatic controller with 1.4 bar (20 psig) supply pressure.
 3. For applications with downstream pressure in excess of 190 bar (2760 psig), use 190 bar (2760 psig) for Maximum Shutoff Pressure.

Table 6. Maximum Shutoff Pressure Drops⁽¹⁾ for Design D4 Control Valves (Spring-to-Open) When Used with Instrumentation with Restricted Output Range⁽²⁾

INPUT SIGNAL TO ACTUATOR		0.2 to 1.0 Bar (3 to 15 Psig)				0.4 to 2.0 Bar (6 to 30 Psig)			
SPRING		Light Rate				Heavy Rate			
INITIAL SPRING SETTING		0.43 Bar (6.2 Psig)				0.69 Bar (10.0 Psig)			
PORT DIAMETER		Maximum Pressure Drop							
mm	Inches	Bar		Psi		Bar		Psi	
6.4	0.25	226 ⁽³⁾		3275 ⁽³⁾		259 ⁽⁴⁾		3750 ⁽⁴⁾	
9.5	0.375	91 ⁽³⁾		1315 ⁽³⁾		259 ⁽⁴⁾		3750 ⁽⁴⁾	
12.7	0.5	46		660		196		2845	
19.1	0.75	15		220		82		1195	
25.4	1	---		---		43		630	
31.8	1.25	---		---		26		380	

1. The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.
 2. For example, an Electro-Pneumatic Transducer calibrated for 0.21-1.0 bar (3-15 psig) output pressure.
 3. For applications with downstream pressure in excess of 51 bar (740 psig), use 51 bar (740 psig) for Maximum Shutoff Pressure.
 4. For applications with downstream pressure in excess of 202 bar (2925 psig), use 202 bar (2925 psig) for Maximum Shutoff Pressure.

CAUTION

When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop, and controlled fluid conditions. Responsibility for the safety of process media and compatibility of valve materials with process media rests solely with the purchaser and end-user. Since some body/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Fisher sales office.

To avoid product damage, inspect the valve before installation for any

damage or any foreign material that may have collected in the valve body. Also remove any pipe scale, welding slag, or other foreign material from the pipeline.

1. Before installing the control valve assembly, inspect it for any damage and for any foreign material that may have collected in the valve body.
2. Remove any pipe scale, welding slag, and other foreign material from the pipeline.
3. The control valve can be installed in any position, but normally the actuator is vertical above the valve. Install the valve so the flow direction arrow on the side of the valve indicates the direction of the process flow.
4. Install the valve following local and national piping codes when they apply to the application. For screwed connections, treat the male pipe threads with a good grade pipe compound. For flanged

valves, use suitable gaskets between valve and pipeline flanges.

5. If continuous operation is required during maintenance and inspection, install a conventional three-valve bypass around the valve.
6. Connect loading pressure for the Spring-to-Open configuration to the 1/4-18 NPT connection in the upper casing assembly (key 23) as shown in figure 4. The Spring-to-Close configuration loading pressure connection is in the lower casing assembly (key 39) as shown in figure 3.

Spring Adjustment

The spring has a fixed pressure span over which loading pressure will stroke the valve. Adjustment of the spring compression shifts the span so that more or less loading pressure is required to start travel. Since the span does not change, there will be a corresponding increase or decrease in the pressure requirements at the end of the valve stroke.

In order to maximize shutoff pressure drop values, the actuator spring must be accurately adjusted for each Input Signal Pressure Range. If the actuator has been disassembled or pressure conditions have changed, the spring may require adjustment. Refer to tables 2 and 3 to determine the Initial Spring Set values based on the Input Signal range that is available to the actuator. These values include packing friction.

Spring-to-Close

Refer to figure 3.

1. Loosen the adjusting screw nut (key 44).
2. Turn the adjusting screw (key 31) clockwise to compress the spring or counterclockwise to decrease spring compression.
3. After adjustment, tighten the adjusting screw nut (key 44).

Spring-to-Open

Refer to figure 4.

1. Unscrew the spring case assembly (key 27).
2. Turn the adjusting stem nut (key 44) clockwise to compress the spring or counterclockwise to decrease spring compression.

3. After adjustment, replace the spring case assembly (key 27).

Maintenance

Refer to figure 3.

Valve parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and maintenance depends on the severity of the service conditions.

WARNING

Avoid personal injury from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:

- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve. Drain the process media from both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- The valve packing box may contain process fluids that are pressurized, *even when the valve has been removed from the pipeline.* Process fluids may spray out under pressure when removing the packing hardware or packing rings.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Valve Plug and Seat Ring

The Design D4 control valve is designed to allow easy access to the valve plug and seat ring without disturbing the packing. Refer to other sections of this instruction manual if additional maintenance is required.

Disassembly

1. Remove the loading pressure tubing and any accessories that may hamper disassembly.
2. Break the hammer nut (key 6) loose with a hammer. Continue turning the hammer nut by using a hammer or a large adjustable wrench, tightened around one ear of the hammer nut. If the bonnet is stuck on the valve, continue to unscrew the hammer nut. The hammer nut will contact the spring pins (key 7) and will force the bonnet out of the valve. Carefully lift the actuator, bonnet, and valve plug assembly from the valve body.

Note

The spring pins must always be in place during valve operation. They provide a safeguard against injury when the unit is being disassembled.

3. Use a socket wrench to loosen the seat ring (key 3).
4. Remove the seat ring (key 3) and seat ring gasket (key 9) from the valve body.
5. Inspect parts for wear or damage that would prevent proper operation of the valve body. Carefully clean the seat ring gasket surfaces and seat ring threads.

CAUTION

Be careful to avoid damaging the seating surface on the valve plug or seat ring as damage in these areas will allow excessive leakage at shutoff. Avoid damaging the highly polished valve stem surface. A damaged valve stem could cut the packing and allow process fluid to leak to the atmosphere.

6. **For spring-to-close only:** To remove the valve plug (key 2), drive out the groove pin (key 4) and unscrew the valve plug from the stem (key 47). If the groove pin (key 4) is not exposed, verify that

downward movement of the stem is not restricted by instrument linkages attached to the stem (key 47).

Table 7. Torque for Seat Ring (Key 3)

VALVE SIZE		RECOMMENDED TORQUE	
mm	Inches	N•m	Lbf•ft
25.4	1	407	300
50.8	2	698	515

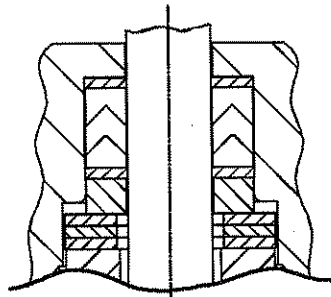
If the valve plug cannot be easily unscrewed from the stem, use a punch to keep the stem from turning as the plug is removed.

7. **For spring-to-open only:** To remove the valve plug (key 2), first remove the spring case assembly (key 27). Remove the adjustment screw nut (key 44), the upper spring seat (key 29), and the spring (key 30). Push the adjustment stem (key 31) fully downward until the diaphragm plate (key 40) contacts the cap screws (key 38), exposing the groove pin (key 4) in the plug. If the groove pin (key 4) is not exposed, verify that downward movement of the stem is not restricted by instrument linkages attached to the stem (key 47). Drive out the groove pin (key 4) and unscrew the valve plug from the stem (key 47).

If the valve plug cannot be easily unscrewed from the stem, use a punch to keep the stem from turning as the plug is removed.

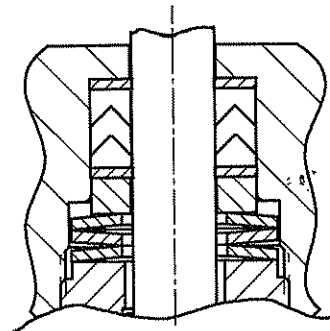
Assembly

1. Make sure the bonnet O-ring (key 8) is on the bonnet and lubricated with lithium grease or equivalent (key 49).
2. Install the plug (key 2) on the stem (key 47) and insert a new groove pin (key 4).
3. Thoroughly clean the seat ring and bonnet threads in the valve body (key 1). Also clean the valve body seat ring gasket surfaces.
4. Apply anti-seize lubricant or equivalent (key 54) to the threads of the seat ring (key 3), and its mating threads in the valve body.
5. Apply anti-seize lubricant or equivalent (key 54) to the seat ring gasket (key 9) and install into the valve body.
6. Screw the seat ring into the valve body. Use a socket wrench to tighten the seat ring to the torque values shown in table 7. Remove all excess lubricant after tightening.
7. Lubricate (key 54) the threads on the valve body and hammer nut and the contact surfaces of the bonnet and hammer nut flange. Install the bonnet and actuator assembly with pinned valve plug onto the valve body. Tighten the hammer nut using an



BELLEVILLE SPRINGS REASONABLY TIGHT TO SEAT THE PACKING

ED862



BELLEVILLE SPRINGS FINGER TIGHT, THEN TIGHTEN 5/6 TURN (5 FLATS ON THE RETAINER)

Figure 2. Design D4 Belleville Spring Procedure

adjustable wrench until the nut stops turning. A few hammer blows will be required to ensure that the assembly is tight.

8. See the actuator assembly and spring adjustment sections of this manual.

Valve Packing

WARNING

Observe the warning at the start of the Maintenance section.

The valve stem packing can only be accessed from within the valve body. If packing maintenance is required, first disassemble per steps 1, 2, and 6 or 7 in the Valve Plug and Seat Ring Disassembly section of this document.

Disassembly

1. Loosen the packing retainer locknut (key 22) with a spanner wrench or with a punch and hammer.
2. Unscrew the packing retainer (key 10) from the bonnet (key 5).
3. Remove the three Belleville springs (key 11), packing spacer (key 14), packing (key 13), and two anti-extrusion rings (key 12) from the bonnet, using a formed wire hook.
4. Clean and inspect the packing box wall to ensure that the packing surfaces are not damaged. If the

surface condition is damaged, and cannot be improved by light sanding, replace the bonnet by contacting your Fisher sales office.

5. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.

Assembly

Refer to figures 2 and 3.

1. Install new packing and Belleville springs according to the packing arrangement shown in figure 2.
2. Apply a light film of lubricant (key 54) to the threads of the packing retainer (key 10).
3. Install the packing retainer into the bonnet and tighten until the Belleville springs (key 11) are reasonably tight to fully seat the packing and anti-extrusion rings.
4. Completely loosen the packing retainer to relieve all Belleville spring compression.
5. Retighten the packing retainer by hand until the packing retainer firmly contacts the Belleville springs.
6. Tighten the packing retainer clockwise 5/6 turn (5 flats on the retainer).
7. Lock the packing retainer (key 10) solidly in place by tightening the packing retainer locknut (key 22) using a spanner wrench, or a hammer with a punch or chisel.

D4 Valve

Actuator (Spring-to-Close)

WARNING

Observe the warning at the start of the Maintenance section.

Refer to figure 3.

Before disassembling the actuator, disassemble the valve plug, seat ring, and packing according to instructions in this manual.

Disassembly

1. Loosen the adjusting screw nut (key 44) and turn the adjusting screw (key 31) counterclockwise to remove all spring compression.
2. Unscrew the casing cap screws and hex nuts (keys 45 and 46), and remove the upper casing assembly (key 23) from the lower casing (key 39).
3. Remove the spring seat (key 29) and actuator spring (key 30).
4. Lift out the diaphragm, diaphragm plate, and stem assembly. Remove the travel indicator (key 32) when the bottom of the stem enters the yoke window.
5. To replace the diaphragm (key 15), separate the diaphragm assembly by using a wrench on the hex nuts (key 42) to unscrew the assembly.
6. Separate the parts—diaphragm washer, actuator O-ring (keys 41 and 25), diaphragm, and diaphragm plate, (keys 15 and 40).
7. Inspect the diaphragm and the actuator O-ring for damage or deterioration, and replace if necessary. If the diaphragm is replaced, a new O-ring should also be installed.
8. Inspect the stem O-ring (key 19) and bonnet bushing (key 20); replace if necessary. To inspect the casing O-ring (key 18), remove the cap screws (key 38) and lift off the lower casing (key 39). Replace the O-ring if necessary.
9. If the hammer nut needs to be removed from the bonnet, the spring pins (key 7) can be removed with locking pliers.

Assembly

1. Before starting assembly, make sure all parts are clean and in good condition. There should be no

burrs or sharp edges on any threads or surfaces that might cut or damage an O-ring, bushing, the packing, or the diaphragm. When replacing O-rings and bushings, be sure the O-ring or bushing groove is clean and undamaged. Using a general purpose lubricant (key 49), lubricate all bushings and O-rings and the threads of parts that have to pass through the bushings and O-rings.

CAUTION

The threads on factory-produced valve stems have been specially machined to avoid O-ring, bushing, or packing damage during trim maintenance. Use of other than a factory-produced valve stem may result in early stem O-ring, bushing, and packing failure.

Note

Do not lubricate cap screws (key 38) before inserting them in the following procedure.

2. Place the hammer nut and spring pins on the bonnet, if removed. Install the casing O-ring (key 18), the stem O-ring (key 19), and the bonnet bushing (key 20). Position the lower casing (key 39) on the bonnet. Insert the nonlubricated cap screws (key 38), and torque to 49 N•m (36 lbf•ft).

Note

Spring pins must always be in place during valve operation, acting as a safeguard against injury when the unit is being disassembled.

3. Assemble the diaphragm plate assembly. Place the patterned side of the diaphragm (key 15) against the diaphragm plate (key 40). Be sure to turn the diaphragm washer (key 41) so that the side that is beveled on the inside diameter is against the O-ring (key 25). Also, make sure that it is assembled for installation with the diaphragm on the loading pressure side and the lockwasher (key 43) and lower spring seat (key 28) are on the spring side.
4. Fasten the diaphragm and diaphragm plate assembly on the stem with hex nuts (key 42). Place the diaphragm and diaphragm plate, and stem assembly into the lower casing and bonnet. Install the travel indicator (key 32) on the stem as the bottom of the stem enters the yoke window.

CAUTION

Over-tightening the diaphragm casing cap screws and nuts (keys 45 and 46) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

5. Replace the spring (key 30) on the diaphragm plate (key 40). Replace the upper spring seat (key 29). Position the upper casing (key 23) on the lower casing (key 39). Insert the cap screws (key 45) and tighten the hex nuts (key 46). Torque the casing cap screws evenly to 27 N•m (20 lbf•ft) using a crisscross pattern.
6. Adjust the initial spring set per the Spring Adjustment section in this manual.

Actuator (Spring-to-Open)

WARNING

Observe the warning at the start of the Maintenance section.

Refer to figure 4.

Before disassembling the actuator, disassemble the valve plug, seat ring, and packing according to instructions in this manual.

Disassembly

1. Unscrew the spring case assembly (key 27). Turn the adjusting screw nut (key 44) counterclockwise to remove all spring compression. Remove the adjusting screw nut, upper spring seat, and spring (keys 44, 29, and 30).
2. Unscrew the casing cap screws and hex nuts (keys 45 and 46), and remove the upper casing assembly (key 23) from the lower casing (key 39). Remove the cotter pin (key 36) and unscrew the adjusting stem (key 31).
3. Lift out the diaphragm (key 15), diaphragm plate (key 40), and stem assembly. Remove the travel indicator (key 32) when the bottom of the stem enters the yoke window.
4. To replace the diaphragm (key 15), separate the diaphragm assembly by using a wrench on the hex nuts (key 42) to unscrew the assembly.
5. Separate the parts—diaphragm washer, actuator O-ring (keys 41 and 25), diaphragm, and diaphragm plate, (keys 15 and 40).

6. Inspect the diaphragm and the actuator O-ring for damage or deterioration, and replace if necessary. If the diaphragm is replaced, a new O-ring should also be installed.

7. Inspect the stem O-ring (key 19) and bonnet bushing (key 20); replace if necessary. To inspect the casing O-ring (key 18), remove the cap screws (key 38) and lift off the lower casing (key 39). Replace the O-ring if necessary. Inspect the adjusting stem bushing (key 26) and actuator stem O-ring (key 53). Replace if necessary.

8. If the hammer nut needs to be removed from the bonnet, the spring pins (key 7) can be removed with locking pliers.

Assembly

1. Before starting assembly, make sure all parts are clean and in good condition. There should be no burrs or sharp edges on any threads or surfaces that might cut or damage an O-ring, bushing, the packing, or the diaphragm. When replacing O-rings and bushings, be sure the O-ring or bushing groove is clean and undamaged. Using a general purpose lubricant (key 49), lubricate all bushings and O-rings and the threads of parts that have to pass through the bushings and O-rings.

CAUTION

The threads on factory-produced valve stems have been specially machined to avoid O-ring, bushing, or packing damage during trim maintenance. Use of other than a factory-produced valve stem may result in early stem O-ring, bushing, and packing failure.

Note

Do not lubricate cap screws (key 38) before inserting them in the following procedure.

2. Place the hammer nut and spring pins on the bonnet, if removed. Install the casing O-ring (key 18), the stem O-ring (key 19), and the bonnet bushing (key 20). Position the lower casing (key 39) on the bonnet. Insert the nonlubricated cap screws (key 38), and torque to 49 N•m (36 lbf•ft).
3. Assemble the diaphragm plate assembly. Place the patterned side of the diaphragm (key 15) against the diaphragm plate (key 40). Be sure to turn the diaphragm washer (key 41) so that the side that is beveled on the inside diameter is against the O-ring

D4 Valve

(key 25). Also, make sure that it is assembled for installation with the diaphragm on the loading pressure side and the lockwasher (key 43) and diaphragm washer (key 41) are on the upper side.

Note

Spring pins must always be in place during valve operation, acting as a safeguard against injury when the unit is being disassembled.

4. Fasten the diaphragm and diaphragm plate assembly on the stem with hex nuts (key 42). Place the diaphragm and diaphragm plate, and stem assembly into the lower casing and bonnet. Install the travel indicator (key 32) on the stem as the bottom of the stem enters the yoke window.

5. Screw the adjusting stem (key 31) onto the stem (key 47) and secure the cotter pin (key 36). Make sure the bushing and O-ring are in place in the upper casing.

CAUTION

Over-tightening the diaphragm casing cap screws and nuts (keys 45 and 46) can damage the diaphragm. Do not exceed 27 N•m (20 lbf•ft) torque.

6. Position the upper casing (key 23) on the lower casing (key 39). Insert the cap screws (key 45) and tighten the hex nuts (key 46). Torque the casing cap screws evenly to 27 N•m (20 lbf•ft) using a crisscross pattern.

7. Replace the spring (key 30), spring seat (key 29), and adjusting stem nut (key 44) over the adjusting stem. Replace the spring case assembly (key 27).

8. Adjust the initial spring set per the Spring Adjustment section in this manual.

Parts Ordering

Each Design D4 control valve is assigned a serial number, which can be found on the nameplate. Refer to the number when contacting your Fisher representative for assistance or when ordering replacement parts.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher valve, because they will void your warranty, might adversely affect the performance of the valve, and might jeopardize worker and workplace safety.

Note

Neither Emerson, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

Repair Kits

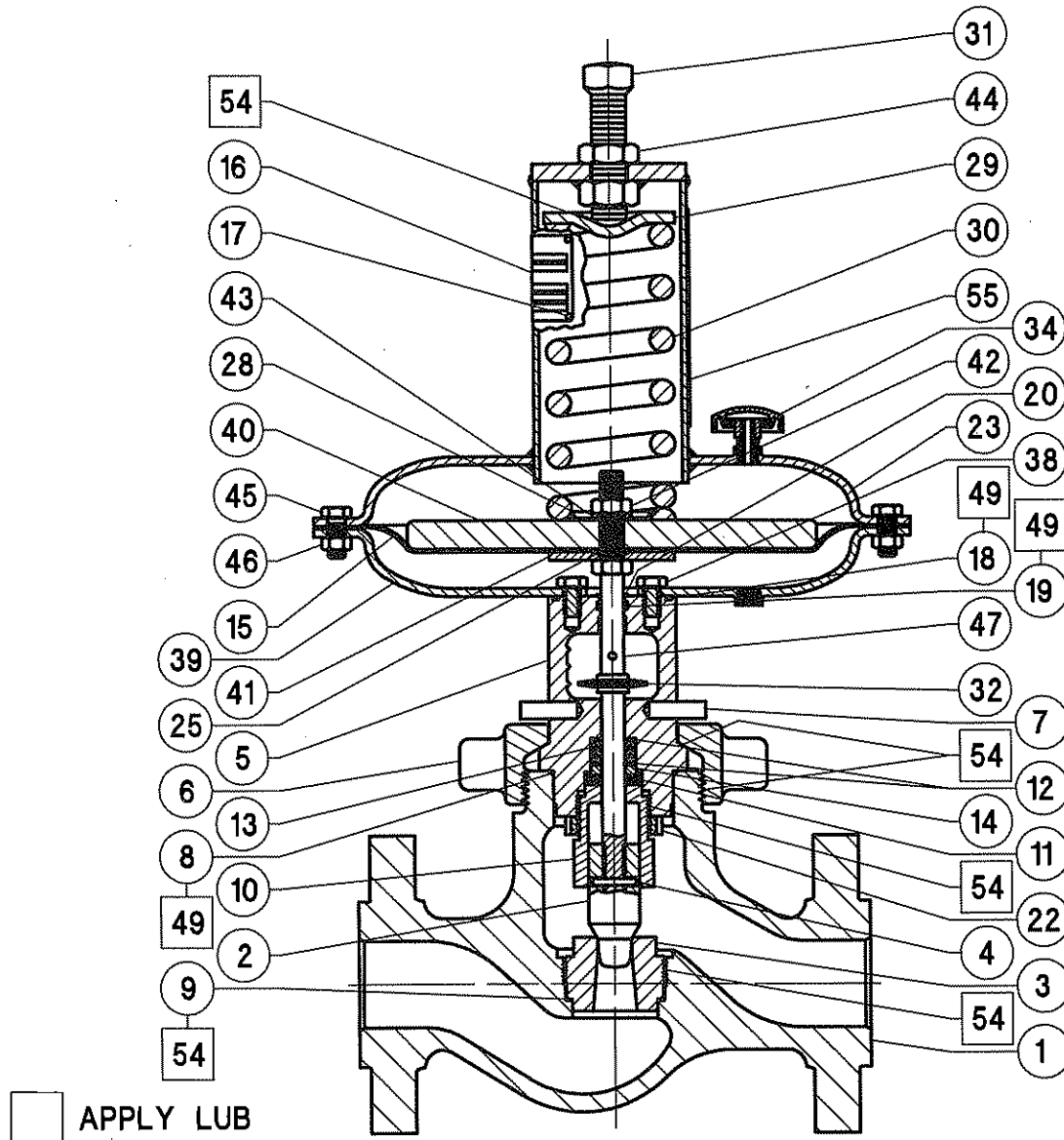
Note

All repair kits are supplied with hydrogenated nitrile bonnet O-ring. Viton bonnet O-ring must be ordered separately when required.

Description	Part Number
* Packing Repair Kit Includes key numbers 4, 8, 12 (2 req'd), and 13	RD4X0000012
* Actuator Repair Kit Includes key numbers 4, 8, 12 (2 req'd), 13, 15, 18, 19, 20, 25, 26, 36, and 53	RD4X0000022

Parts List

Key	Description	Part Number	Key	Description	Part Number
1	Valve Body			2-inch valve	
2*	Valve Plug			0.25 inch port diameter	GE07389X012
	S41000 / S41600 HT			0.375 inch port diameter	GE07394X012
	1-inch valve			0.5 inch port diameter	GE07397X012
	0.25 inch port diameter	20C3692X012	4*	0.75 inch port diameter	GE07398X012
	0.375 inch port diameter	20C3693X012	5	1-inch port diameter	GE07399X012
	0.5 inch port diameter	20C3694X012	6	1.25 inch port diameter	GE07406X012
	0.75 inch port diameter	GE01557X012	7		
	2-inch valve		8*	Groove Pin	GE01163X012
	0.25 inch port diameter	GE00992X012		Bonnet	
	0.375 inch port diameter	GE00993X012		Hammer Nut	
	0.5 inch port diameter	GE00994X012		Spring Pin	
	0.75 inch port diameter	GE01558X012		Bonnet O-ring	
	1-inch port diameter	GE01561X012		Hydrogenated Nitrile	
	1.25 inch port diameter	GE01555X012		-46 to 149°C (-50 to 300°F)	10C3680X012
	S17400 H1150 Dbl			Viton, -23 to 204°C (-10 to 400°F)	10C3680X022
	1-inch valve		9*	Seat Ring Gasket	
	0.25 inch port diameter	20C3692X032		For 1-inch valve	1B198836042
	0.375 inch port diameter	20C3693X032		For 2-inch valve	1B198836042
	0.5 inch port diameter	20C3694X032	10	Packing Retainer	
	0.75 inch port diameter	GE01557X032	11	Belleville Springs	
	2-inch valve		12*	Anti-Extrusion Washer, 2 req'd	12B6335X022
	0.25 inch port diameter	GE00992X032	13*	Packing Set	12B6667X012
	0.375 inch port diameter	GE00993X032	14	Packing Spacer	
	0.5 inch port diameter	GE00994X032	15*	Diaphragm	22B3521X012
	0.75 inch port diameter	GE01558X032	16	Nameplate	
	1-inch port diameter	GE01561X032	17	Drive Screw	
	1.25 inch port diameter	GE01555X032	18*	Casing O-ring	1F9141X0142
	Tungsten Carbide		19*	Stem O-ring	1K7561X0072
	1-inch valve		20*	Bonnet Bushing	17A7112X012
	0.25 inch port diameter	20C3696X012	22	Locknut	
	0.375 inch port diameter	20C3697X012	23	Upper Casing Assembly	
	0.5 inch port diameter	20C3698X012	25*	Actuator O-ring	1K7561X0072
	0.75 inch port diameter	20C3699X012	26*	Adjusting Stem Bushing (spring-to-open only)	17A4059X012
	2-inch valve		27	Spring Case Assembly	
	0.25 inch port diameter	20C3682X012	28	Lower Spring Seat	
	0.375 inch port diameter	20C3683X012	29	Upper Spring Seat	
	0.5 inch port diameter	20C3685X012	30	Spring	
	0.75 inch port diameter	20C3686X012		Spring-to-Close, Light Rate	1F176827092
	1-inch port diameter	20C3687X012		Spring-to-Close, Heavy Rate	1E792427082
	1.25 inch port diameter	20C3688X012		Spring-to-Open, Light Rate	1F176727032
				Spring-to-Open, Heavy Rate	1F714327092
3*	Seat Ring		31	Adjustment Screw or Stem	
	S17400 H1150 Dbl		32	Travel Indicator	
	1-inch valve		34	Vent Assembly	
	0.25 inch port diameter	GE00982X032	36*	Cotter Pin (spring-to-open only)	1C608035022
	0.375 inch port diameter	GE00983X032	37	Pipe Plug	
	0.5 inch port diameter	GE00984X032	38	Cap Screw	
	0.75 inch port diameter	GE00985X032	39	Lower Casing	
	2-inch valve		40	Diaphragm Plate	
	0.25 inch port diameter	GE00986X032	41	Diaphragm Washer	
	0.375 inch port diameter	GE00987X032	42	Hex Nut	
	0.5 inch port diameter	GE00988X032	43	Lockwasher	
	0.75 inch port diameter	GE00989X032	44	Adjustment Screw Nut	
	1-inch port diameter	GE00990X032	45	Cap Screw	
	1.25 inch port diameter	GE00991X032	46	Hex Nut	
	Tungsten Carbide		47*	Valve Stem	
	1-inch valve			Nitronic 50, Reverse Acting	20C3681X022
	0.25 inch port diameter	GE07347X012		Nitronic 50, Direct Acting	20C3716X022
	0.375 inch port diameter	GE07363X012	49	Lubricant (lithium grease or equivalent)	
	0.5 inch port diameter	GE07364X012	50	NACE Tag (not shown)	
	0.75 inch port diameter	GE07365X012	51	Drive Screw	
			53*	Actuator Stem O-ring (spring-to-open only)	1C7821X0182
			54	Lubricant (anti-seize or equivalent)	
			55	Spring Setting Label (not shown)	



GE02332-A

Figure 3. Design D4 Valve Assembly (Spring-to-Close)

D4 Valve

Instruction Manual

Form 5755
September 2005

D4 Valve

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Errata Sheet
for

Design D4 Control Valve Assembly,
Form 5755, September 2005

D4 Bonnet Design Change

The old design bonnet (GE00215X012) is obsolete and replaced by the new design bonnet (GE22013X012) and new packing spacer (GE22033X012). Refer to figures 1 and 2 in this errata sheet.

Note

The old design bonnet (GE00215X012) can be remachined to match the new design bonnet (GE22013X012). Additionally, three (3) packing spacers (19B5916X012) can be substituted for packing spacer (GE22033X012).

The newly designed bonnet has more clearance around the stem and a deeper packing box bore. The additional depth of the packing box bore is equal to the height of 3 stainless steel packing spacers (19B5916X012).

These improvements help to prevent a condition where the formation of corrosion could cause the valve to lock up.

1. If the new packing spacer (GE22033X012) is not available, install 3 stainless steel packing spacers (19B5916X012) into the bonnet.
2. Then install the packing according to normal Valve Packing, Assembly procedures in the Design D4 instruction manual, Form 5755.

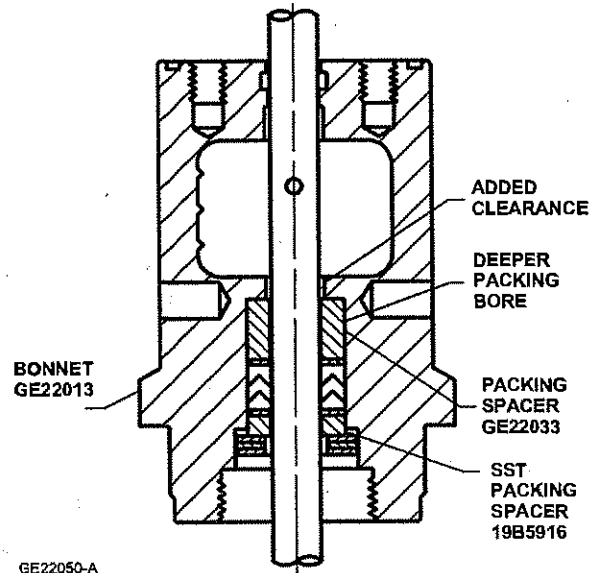
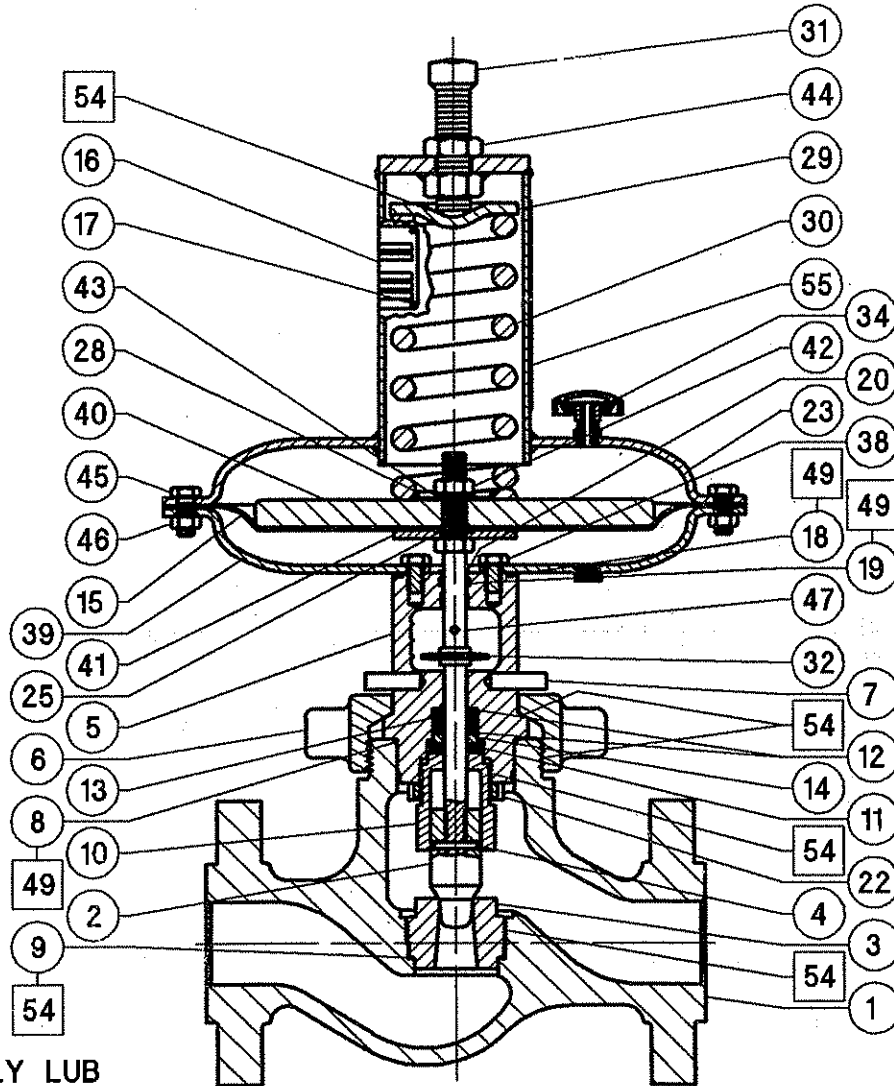


Figure 1. Detail of D4 Bonnet Revision





GE02332-A

Figure 2. Design D4 Valve Assembly (Spring-to-Close) Showing Current Packing Bore Configuration

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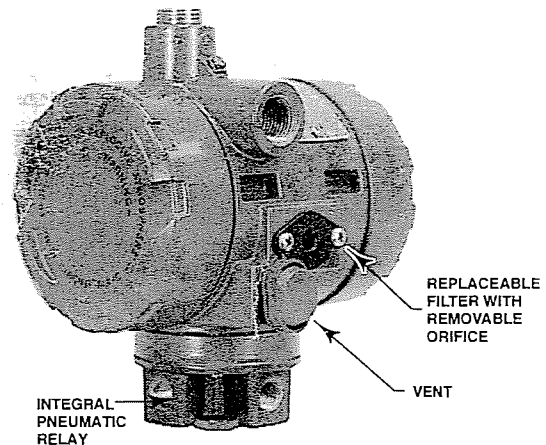


Incorporates Errata dated May 2005. See page 20.

Type i2P-100 Electro-Pneumatic Transducers

Contents

Introduction	1
Scope of Manual	1
Description	1
Specifications	5
Educational Services	5
Installation	6
Mounting	7
Pneumatic Connections	7
Supply Pressure Requirements	7
Diagnostic Connections	8
Vent	9
Electrical Connections	9
Operating Information	10
Calibration	10
Equipment Required	10
Calibration Procedure	11
Principle of Operation	12
Maintenance	12
Troubleshooting	13
Converter Module Replacement	13
Electronics Module Replacement	14
Relay Maintenance	14
Parts Ordering	15
Parts List	15



W9710

Figure 1. Type i2P-100 Electro-Pneumatic Transducer

Introduction

Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts ordering information for the Type i2P-100 transducer (see figure 1). Refer to separate manuals for instructions covering equipment used with the transducer.

No person may install, operate or maintain a Type i2P-100 electro-pneumatic transducer without first • being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance, and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher® sales office.

Description

The transducer, shown in figure 2, receives a 4 to 20 milliamper dc input signal and transmits a proportional user field-configurable pneumatic output pressure to a final control element. The pneumatic output ranges are typically 0.2 to 1.0 bar (3 to 15 psig) and 0.4 to 2.0 bar (6 to 30 psig). A typical application is in electronic control loops where the final control element is a control valve assembly that is pneumatically operated. The input signal and output pressure range of the transducer is indicated on the nameplate, attached to the housing.

CAUTION

Dropping or rough handling of the transducer can cause damage to the converter module resulting in a shifted output or a minimum output.



Table 1. Specifications

Input Signal(1)

Available as standard with 4–20 mA.
User configurable by dip switch for split ranging, see table below.

Output Signal(1)

Available as standard 0.2 to 1.0 bar (3 to 15 psig) or 0.4 to 2.0 bar (6 to 30 psig). User configurable by dip switch selection and zero and span potentiometer adjustment, see table below.

INPUT SIGNAL	OUTPUT PRESSURE	
	BAR	PSIG
4 to 20 mA dc	0.2 to 1.0	3 to 15
	0.4 to 2.0	6 to 30
4 to 12 mA dc	0.2 to 1.0	3 to 15
12 to 20 mA dc	0.2 to 1.0	3 to 15

Equivalent Circuit

The Type i2P–100 equivalent circuit is a series circuit consisting of a constant voltage drop (battery) of approximately 4 V dc and a total resistance of 40 ohms. Input is shunted by two 6.8 V zener diodes (see figure 9).

Supply Pressure(1,5)

Recommended: 0.3 bar (5 psi) higher than upper range limit of output signal

Maximum: 3.4 bar (50 psig)

Medium: Air or Natural Gas(4)

Average Steady State Flow Rate(1,2)

OUTPUT RANGE							
0.2 to 1.0 bar (3–15 psig)				0.4 to 2.0 bar (6–30 psig)			
SUPPLY PRESSURE							
1.5 bar (20 psig)				2.4 bar (35 psig)			
OUTPUT		FLOW RATE		OUTPUT		FLOW RATE	
Bar	Psig	Normal m ³ /h	Scfh	Bar	Psig	Normal m ³ /h	Scfh
0.2	3	0.08	3.0	0.4	6	0.09	3.6
0.6	9	0.12	4.5	1.2	18	0.19	7.0
1.0	15	0.17	6.3	2.1	30	0.27	10.2

Maximum Output Air Capacity(2)

8.0 m³/hr (5.0 scfm) at 1.4 bar (20 psig) supply pressure

Performance(3)

Reference Accuracy: ±1.0% of full scale output span; includes combined effects of hysteresis, linearity, and deadband

Independent Linearity(1): ±0.75% of full scale output span

Hysteresis(1): 0.4% of full scale output span

Frequency Response(1): Gain is attenuated 3 dB at 6 Hz with transducer output signal piped to a typical instrument input

Temperature Effect: ±0.14% per degrees Celsius (±0.75% per degrees Fahrenheit) of span

Supply Pressure Effect: 0.2% of full scale output span per bar supply pressure change (0.2% of full scale output span per psi supply pressure change)

Vibration Effect: Less than 1% of full scale output span when tested to ISA S75.13



Electromagnetic Interference (EMI)(1): Tested per IEC 61326-1 (Edition 1.1). Conforms to the European EMC Directive. Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance shown in table 2.

Operating Ambient Temperature Limits(5)

–40 to 85°C (–40 to +180°F)

(continued)

Table 1. Specifications (continued)

<p>Electrical Classification</p> <p>Hazardous Area⁽⁶⁾:</p> <p> Explosion proof, Dust-Ignition proof, Intrinsically Safe</p> <p> Explosion proof, Non-incendive, Dust-Ignition proof, Intrinsically Safe</p> <p>ATEX Intrinsically Safe, Type n and Flameproof</p> <p>IECEX Intrinsically Safe, Type n and Flameproof</p> <p>Refer to the Hazardous Area Classification bulletins, tables 3 and 4, and figures 15 and 16 for specific approval information.</p> <p>Approved for use with natural gas⁽⁴⁾</p> <p>Electrical Housing:</p> <p>NEMA 4X, CSA enclosure 4X & IP66 when remote vented, otherwise</p> <p>NEMA 3R, CSA enclosure 3R & IP64</p> <p>Declaration of SEP</p> <p>Fisher Controls International LLC declares this product to be in compliance with Article 3 paragraph 3 of the Pressure Equipment Directive (PED) 97 / 23 / EC. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.</p> <p>However, the product <i>may</i> bear the CE marking to indicate compliance with <i>other</i> applicable EC Directives.</p>	<p>Connections</p> <p>Supply and Output Pressure: 1/4-inch NPT female connection</p> <p>Vent: 1/4-inch NPT female</p> <p>Electrical: ■ Standard 1/2-inch NPT</p> <p>Wire Size: 18 to 22 AWG</p> <p>Adjustments⁽⁷⁾</p> <p>Zero and Span: Trim potentiometers (20 turn) for zero and span adjustments are located under the housing cap (see figure 10).</p> <p>Switch: Allows input signal split range and user-configurable 0.2 to 2 bar (3 to 30 psig) output.</p> <p>Mounting Position</p> <p>■ Actuator ■ pipestand or ■ surface</p> <p>Approximate Weight (Transducer Only)</p> <p>2.5 kg (5.5 lbs)</p> <p>Actuator Stroking Time</p> <p>See figure 3</p>
--	---

1. These terms are defined in ISA Standard S51.1.
 2. Normal m³/hr—Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh—Standard cubic feet per hour (60°F and 14.7 psia).
 3. Performance values are obtained using a transducer with a 4 to 20 mA dc input signal and a 0.2 to 1.0 bar (3 to 15 psig) output signal at an ambient temperature of 24°C (75°F).
 4. This product is approved for use with Natural Gas. Natural gas to contain no more than 20 ppm of hydrogen sulphide.
 5. The pressure and temperature limits in this manual and any applicable standard or code limitation should not be exceeded.
 6. Some approvals are pending. Contact your Fisher Sales office for information on pending approvals.
 7. For other ranges, zero and span adjustments are needed.

Table 2. Immunity Performance

Port	Phenomenon	Basic Standard	Performance Criteria ⁽¹⁾
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	A
	Radiated EM field	IEC 61000-4-3	A
	Rated power frequency magnetic field	IEC 61000-4-8	A
I/O signal/control	Burst (fast transients)	IEC 61000-4-4	A
	Surge	IEC 61000-4-5	A
	Conducted RF	IEC 61000-4-6	A

Specification limit = ±1% of span
 1. A=No degradation during testing. B = Temporary degradation during testing, but is self-recovering.

Table 3. Hazardous Area Classifications for North America

CERTIFICATION BODY	CERTIFICATION BODY	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07471	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 5 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	4X*
	(Explosion Proof) Zone •Ex d IIC T5/T6 Class/Division •Class I, Division 1 GP, A, B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 2, GP E, F, G Class III	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
FM	(Intrinsic Safety) Zone •Class I Zone 0 AEx ia IIC T3/T4/T5 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07470	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	4X*
	(Explosion Proof) Zone •Class I Zone 1 AEx d IIC T5/T6 Class/Division •Class I, Division 1, GP B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	(Type n) Zone •Class I Zone 2 AEx nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 2, GP F, G Class III	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*

* When remotely vented.

Table 4. Hazardous Area Classifications for Europe and Asia-Pacific

CERTIFICATE (AGENCY)	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
ATEX (KEMA)	(Intrinsic Safety) Zone •EEx ia IIC T3/T4/T5	$U_i = 30 \text{ Vdc}$ $I_i = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	IP66*
	(Flameproof) Zone •EEx d IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	IP66*
	(Type n) Zone •EEx nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	IP66*
IECEx (CSA)	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5	$U_i = 30 \text{ Vdc}$ $I_i = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 0 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	IP66*
	(Flameproof) Zone •Ex d IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	IP66*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	IP66*

* When remotely vented.

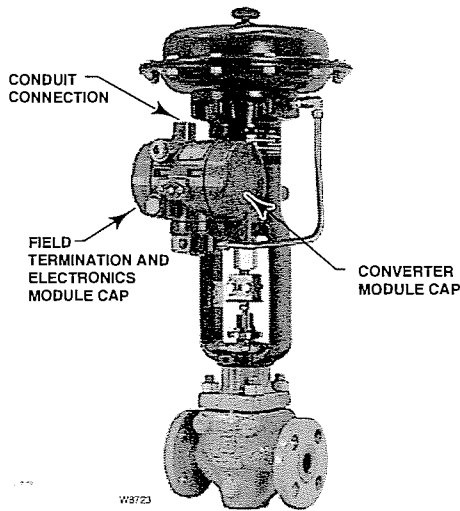


Figure 2. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 30 667 Sliding-Stem Actuator

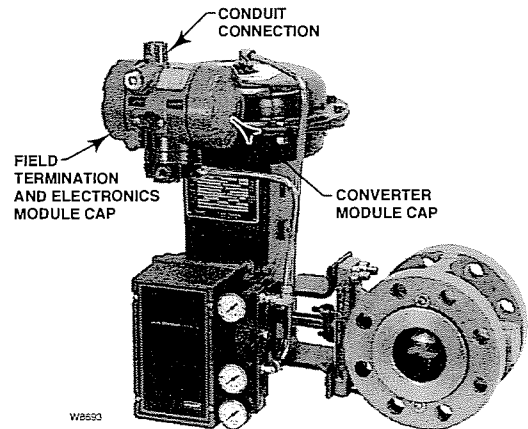


Figure 4. Type i2P-100 Electro-Pneumatic Transducer Mounted on a Size 33 1052 Rotary Actuator, 3610J Positioner and V300B Rotary Valve.

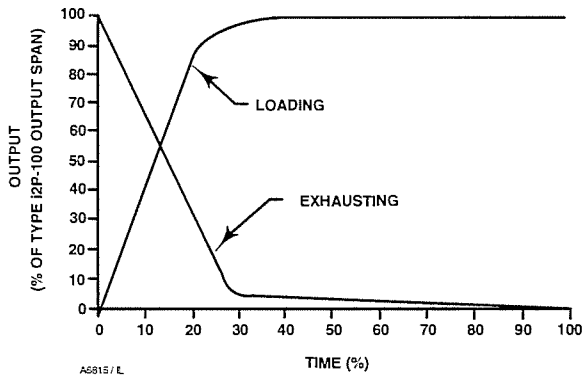


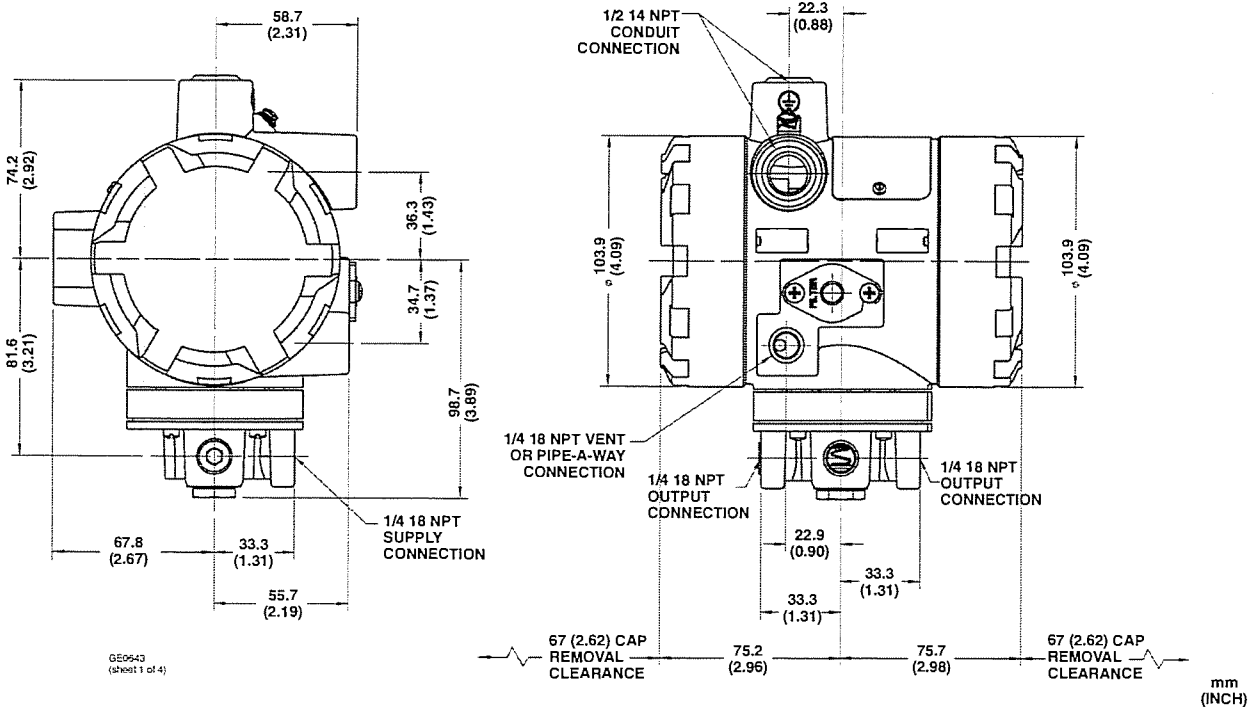
Figure 3. Output-Time Relationships for Type i2P-100 Transducer

Specifications

Specifications for the Type i2P-100 transducer are listed in table 1.

⚠ WARNING

This product is intended for a specific current range, temperature range and other application specifications. Applying different current, temperature and other service conditions could result in malfunction of the product, property damage or personal injury.



Educational Services

For information on available courses for the Type i2P-100 electro-pneumatic transducer, as well as a variety of other products, contact:

Emerson Process Management
Educational Services, Registration
P.O. Box 190; 301 S. 1st Ave.
Marshalltown, IA 50158-2823
Phone: 800-338-8158 or
Phone: 641-754-3771
FAX: 641-754-3431
e-mail: education@emersonprocess.com

Note

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Installation

The i2P-100 transducer has been designed and approved for use with either air or natural gas as the supply medium. If using natural gas as the pneumatic supply medium, natural gas will be used in the pneumatic output connections of the transducer to any connected equipment. In normal operation the unit will vent the supply medium into the surrounding atmosphere unless it is remotely vented. When using natural gas as the supply medium in a non-hazardous location, remote venting of the unit is required. Failure to do so could result in personal injury, property damage, and area re-classification. For hazardous locations remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury, property damage, and area re-classification.

 **WARNING**

To avoid personal injury or property damage from the sudden release of pressure, air, or natural gas:

- Always wear protective clothing and eyewear when performing any installation operations.
- If installing into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section of this instruction manual.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

 **WARNING**

This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous location with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so could result in personal injury or property damage from fire or explosion, and area re-classification.

When installing this unit in a hazardous location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.

Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

Mounting

When a transducer is ordered as part of a control valve assembly, the factory mounts the transducer on the actuator and connects the necessary tubing, then adjusts the transducer as specified on the order. See figure 2 and 4 for typical mounting configurations.

Transducers also can be ordered separately for mounting on a control valve assembly already in service, or for mounting on a 2-inch diameter pipestand, or a flat surface. The transducer may be ordered either with or without mounting parts.

Mounting parts include a mounting plate and bolts and, if ordered for pipestand mounting, a pipe clamp. Tubing is not included if the transducer is not factory mounted. Use 3/8-inch diameter tubing for all input and output connections. The length of tubing between the transducer output and the final control element should be as short as possible. Transducer overall dimensions are shown in figure 5. If weatherproofing is required, mount the transducer so that the vent can drain. Do not allow moisture or condensate to collect in the vent.

CAUTION

Do not mount the vent in a downward position, as the vent will not drain properly, and may become blocked with ice or debris, resulting in process instability.

Pneumatic Connections

As shown in figure 5, all pressure connections on the transducer are 1/4-inch NPT female connections. Use 3/8-inch tubing for all pressure connections. Refer to the vent subsection below for remote vent connections.

Supply Pressure Requirements

 **WARNING**

Severe personal injury or property damage could result from an unstable process if the instrument supply medium is not clean, dry, oil-free and non-corrosive. While use and regular maintenance of a filter that removes particles larger than 40 microns in diameter will suffice in most applications, check with a Fisher Field office and Industry Instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.

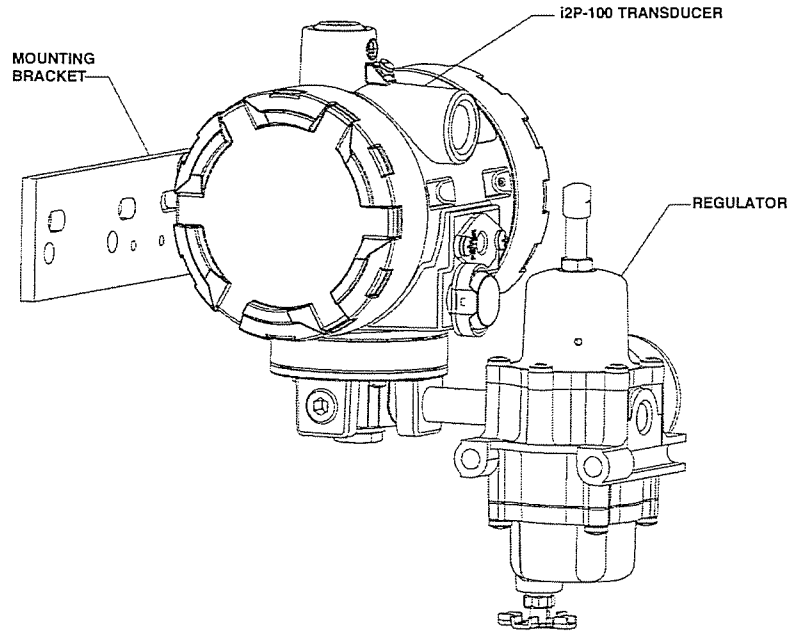


Figure 6. Typical Type i2P-100 Mounting With Type 67CFR Filter Regulator

Supply pressure must be clean, dry air or noncorrosive gas. Use a Fisher Type 67CFR Filter Regulator, or equivalent, to filter and regulate supply air. The filter regulator can be mounted on a bracket with the transducer as shown in figure 6 or mounted on the actuator mounting boss. An output pressure gauge may be installed on the regulator to indicate the supply pressure to the transducer. Also, as an aid for calibration, a second gauge may be installed on the transducer to indicate transducer output pressure.

Connect the nearest suitable supply source to the 1/4-inch NPT IN connection on the filter regulator (if furnished) or to the 1/4-inch NPT SUPPLY connection on the transducer case (if the filter regulator is not attached).

Diagnostic Connections

To support diagnostic testing of valve/actuator/positioner packages, special connectors and hardware are available. Typical

connector installations are shown in figure 7. The hardware used includes a 1/4-inch NPT pipe nipple and pipe tee with a 1/8-inch NPT pipe bushing for the connector. The connector consists of a 1/8-inch NPT body and body protector.

Note

If the Type i2P-100 transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.

Install the connectors and hardware between the Type i2P-100 transducer and the actuator.

1. Before assembling the pipe nipple, pipe tee, pipe bushings, actuator piping, and connector body, apply sealant to all threads.
2. Turn the pipe tee to position the connector body and body protector for easy access when doing diagnostic testing.

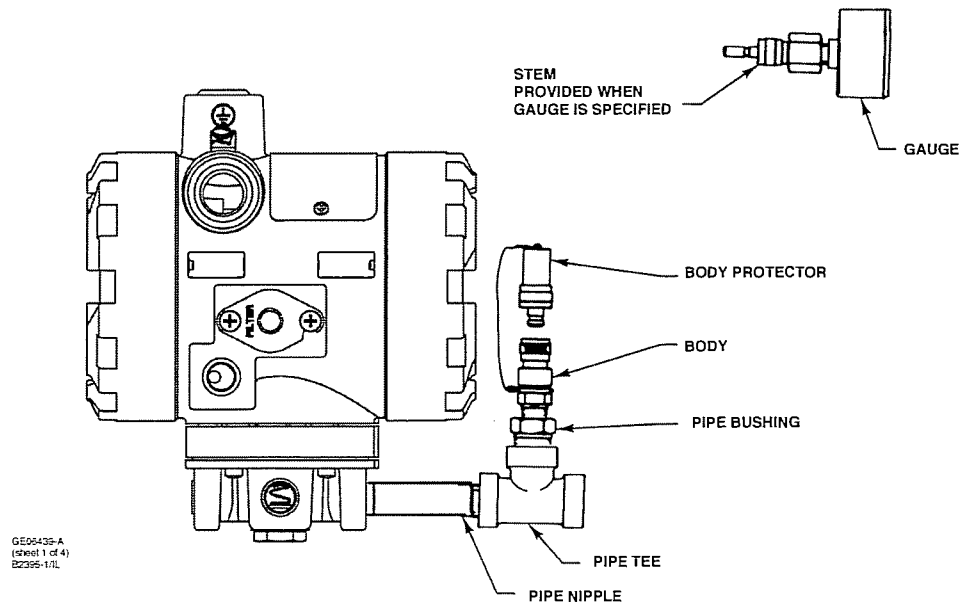


Figure 7. Diagnostics Hookup for Type i2P-100 Transducer

Vent

WARNING

This unit vents the supply medium into the surrounding atmosphere. When installing this unit in a non-hazardous location with natural gas as the supply medium, you must remotely vent this unit to a safe location. Failure to do so could result in personal injury or property damage from fire or explosion, and area re-classification.

When installing this unit in a hazardous location remote venting of the unit may be required, depending upon the area classification, and as specified by the requirements of local, regional, and federal codes, rules and regulations. Failure to do so when necessary could result in personal injury or property damage from fire or explosion, and area re-classification.

Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

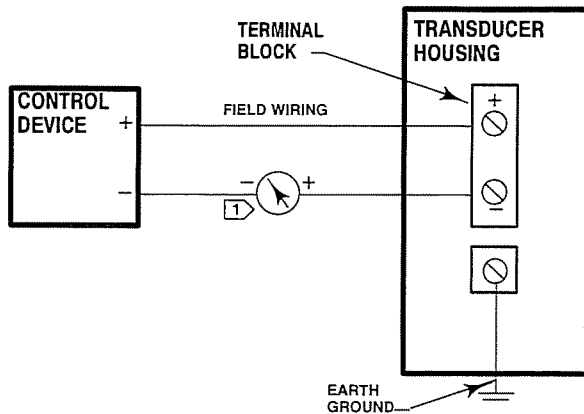
If a remote vent is required, the vent line must be as short as possible with a minimum number of bends and elbows. To connect a remote vent, remove the plastic vent (key 71, figure 13). The vent connection is 1/4-inch NPT female. Use 3/8-inch tubing to provide a remote vent.

Electrical Connections

WARNING

For explosion-proof applications, or when using natural gas as the supply medium, disconnect power before removing the housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing the cap.

For intrinsically safe installations, refer to the nameplate or to instructions provided by the barrier manufacturer, for proper wiring and installation.



NOTE:
FOR TROUBLESHOOTING OR MONITORING OPERATION,
AN INDICATING DEVICE CAN BE A VOLTMETER ACROSS
A 250 OHM RESISTOR OR A CURRENT METER.
A3875/L

Figure 8. Typical Field Wiring Diagram

Note

For North American applications, the i2P-100 has been designed such that a conduit seal is not required. For all other applications install the product as per local, regional, or national code, rules, and regulations.

Use the 1/2-inch NPT conduit connection, shown in figure 5, for installation of field wiring.

Refer to figures 8, 9, and 10 when connecting field wiring from the control device to the transducer. Connect the positive wire from the control device to the transducer "+" terminal and, the negative wire from the control device to the transducer "-" terminal. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in.). Connect the transducer grounding terminal to earth ground. Grounding terminals are provided both inside and outside the transducer housing.

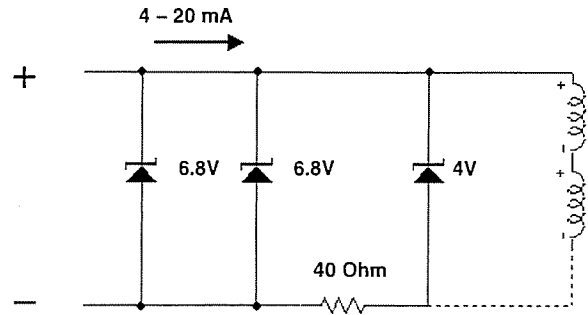


Figure 9. Equivalent Circuit

Operating Information

During normal operation, the output of the Type i2P-100 transducer is connected to the final control element.

Calibration

WARNING

On explosion-proof instruments, or when using natural gas as the supply medium, remove electrical power before removing either of the the housing caps in a hazardous area. Personal injury or property damage may result from fire or explosion if power is applied to the transducer with the cap removed in a hazardous area.

For intrinsically safe areas, current monitoring during operation must be with a meter approved for use in hazardous areas.

Equipment Required

Choose a current or voltage source that is capable, without switching ranges, of driving the transducer through its entire input range. Switching ranges on a current or voltage source will produce spikes or mid-scale reverses in the input signal presented to the transducer, causing errors. The current source should be capable of delivering 30 mA with 30 V dc maximum compliance voltage.

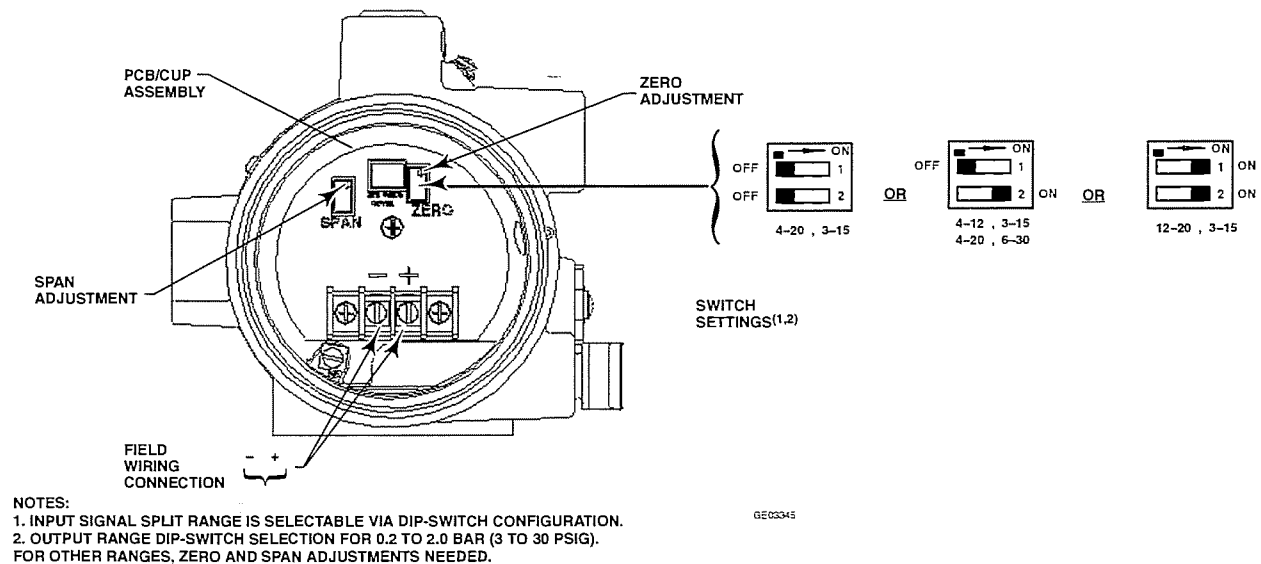


Figure 10. Zero and Span Adjustments and Switch Settings

Calibration Procedure

WARNING

To avoid personal injury or property damage due to an uncontrolled process provide some temporary means of process control before beginning the calibration procedure.

Refer to figure 10 for adjustment locations.

Note

The following steps are for a 4–20 mA, 0.2 to 1.0 bar (3 to 15 psig) configured unit. The same procedure is used for other configurations.

1. Remove electronics module cover (cover adjacent to conduit entry, see figure 2 and 4).
2. Input and output ranges are selectable by dip switch selection. Refer to figure 10 for dip switch settings. Adjust dip switch settings and zero and span as necessary to achieve the desired input/output range.
3. If a current source other than the control device is used as the input source, disconnect the control device and connect the current source positive terminal to the transducer “+” terminal and the current source negative terminal to the transducer “-” terminal.

If an external meter is used, connect the current source positive terminal to the transducer “+” terminal. Connect the meter positive terminal to the transducer “-” terminal and the meter negative terminal to the current source negative terminal as shown in figure 8.

4. Check the supply pressure to ensure it is at the recommended pressure. Refer to table 1, the Specifications table, for supply pressure recommendations.
5. Adjust the input current to the low milliamperes dc.
6. The output pressure should be 0.2 bar (3 psig). If not, adjust the ZERO potentiometer until the output pressure is 0.2 bar (3 psig).
7. Adjust the input current to the high milliamperes dc.
8. The output pressure should be 1.0 bar (15 psig). If not, adjust the SPAN potentiometer until the output pressure is 0.8 bar (15 psig).
9. Repeat steps 5 through 8 until the output pressure is within the referenced accuracy requirements without further adjustment.
10. If a current source other than the control device was used, disconnect the current source and reconnect the control device.

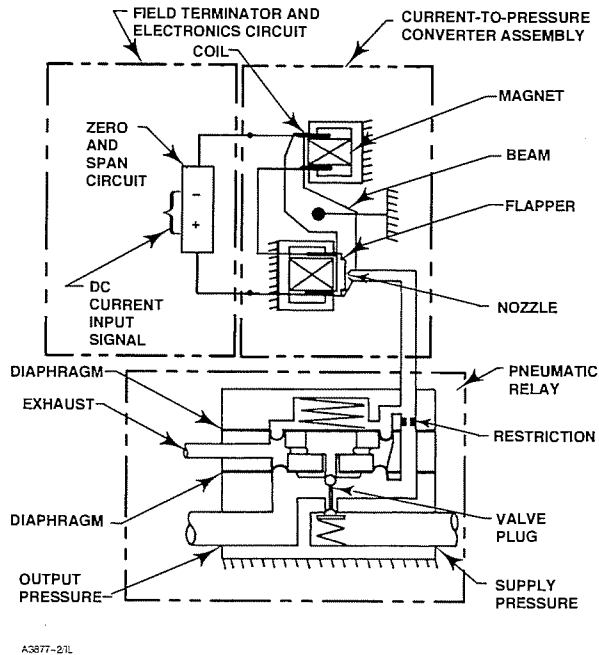


Figure 11. Type i2P-100 Transducer Schematic

Principle of Operation

The converter module receives a standard dc current input signal from a control device to operate coils in a force balanced beam system which in turn, controls bleed air through an integral nozzle/flapper arrangement. The nozzle pressure provides the input signal to operate the relay as shown in figure 1.1. Relay output pressure is applied, through tubing, directly to the final control element or valve/actuator assembly.

Maintenance

Due to normal wear or damage from external sources such as debris in the supply medium, periodic maintenance or repair of the transducer may be necessary. Maintenance of the transducer consists of troubleshooting, removal for inspection, and replacement of component parts, as well as removal and inspection of the external removable filter/restriction and cleaning or replacing as necessary (see figure 1).

WARNING

To avoid personal injury or property damage from the sudden release of pressure, air or natural gas:

- Always wear protective clothing and eyewear when performing any maintenance operations.
- Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

WARNING

When using natural gas as the supply medium, or for explosion proof applications, the following warnings also apply:

- Remove electrical power before removing either housing cap. Personal injury or property damage from fire or explosion may result if power is not disconnected before removing either cap.
- Remove electrical power before disconnecting any of the pneumatic connections or removing the external removable filter/restriction,.

When disconnecting any of the pneumatic connections or the external removable filter/restriction, natural gas will seep from the unit and any connected equipment into the surrounding atmosphere. Personal injury or property damage may result

from fire or explosion if preventative measures are not taken, such as adequate ventilation and the removal of any nearby ignition sources.

CAUTION

When replacing components, use only components specified by the factory. Always use proper component replacement techniques, as presented in this manual. Improper techniques or component selection may invalidate the approvals and the product specifications, as indicated in table 1. It may also impair operations and the intended function of the device

The converter module and the electronics module are non-repairable. If troubleshooting or alignment attempts indicate a faulty converter or electronics module, replace the module or return the transducer to your Fisher sales office for repair.

Troubleshooting

Electrical

The following procedures require taking the control valve/actuator assembly out of service. Provide some temporary means of process control before taking the control valve out of service.

1. Ensure terminal lug connections from the control device to the transducer are of the correct polarity (refer to the electrical connection procedures in the Installation section of this manual).
2. At the transducer, ensure that the milliampere dc signal is applied, and ensure that it is within the 4 to 20 milliampere range.
3. Check switches and ensure that they are properly set. Refer to figure 10.
4. If the problem has not been resolved, see Electronics Module Replacement in this manual.

Pneumatic

Provide a 4 to 30 milliampere dc current source, supply pressure, and a gauge to monitor the output pressure when checking transducer operation. Refer to figure 13 for key number locations.

1. Ensure that supply pressure to the transducer meets your requirements [0.3 bar (5 psi) higher than upper range limit of output signal, with a maximum of 3.4 bar (50 psi)].
2. Ensure that the filter (key 11) and restrictor (key 10) are open and clean. Remove the two screws (key 14), the filter cap (key 13) and the O-ring (key 12) to access the filter and restrictor.
3. If a filter/regulator is used, ensure that it is working correctly. If not, ensure the dripwell is not plugged because of excessive moisture accumulation. If necessary, drain off any moisture, and clean or replace the filter element.
4. Force the converter module to maximum output pressure with a 30 milliampere dc signal. Output pressure should build up to the approximate value of the supply pressure [maximum of 3.4 bar (50 psi)].
5. When the input current is removed, the transducer output pressure should drop to less than 0.14 bar (2 psig). If it does not, check to ensure the vent and exhaust air passageway is free from foreign material.
6. To inspect the relay assembly, refer to the Relay Maintenance procedures in this manual.
7. If the problem has not been resolved, see Converter Module Replacement in this manual.

Converter Module Replacement

Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap farthest away from the conduit). Note that the two set screws (key 8) need to be loosened to remove the cap.
2. Unscrew the two captive screws (key 52) and remove the converter module from the housing.
3. Inspect the O-ring (key 55) and replace if necessary.

Replacement

1. Lubricate the O-ring (key 55) with a lubricating compound such as Dow Corning III before replacing the converter module in the housing.
2. Insert the converter module into position in the housing (key 1). Replace the two screws (key 52) and tighten them.
3. Replace the housing cap (key 2), making sure to re-tighten the two set screws (key 8).
4. Electrically calibrate the unit using the procedure in the Calibration section of this manual.

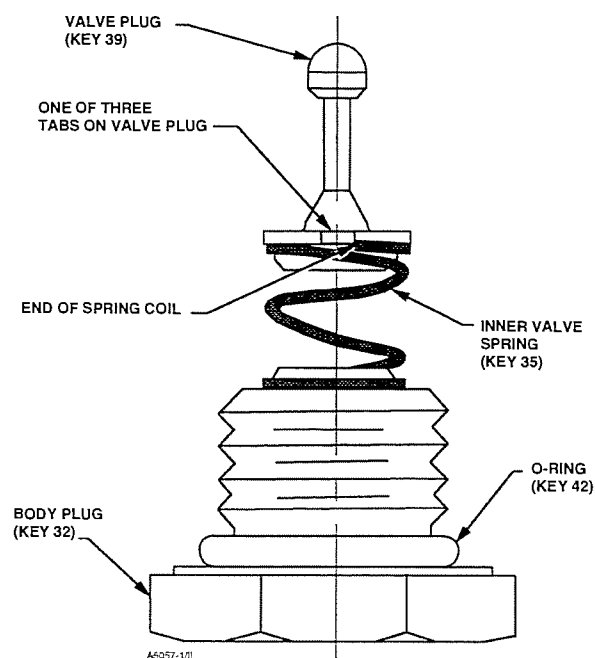


Figure 12. Valve Plug, Inner Valve Spring and Body Plug Assembly

Electronics Module Replacement

Removal

Refer to figure 13 for key number locations.

1. Remove the housing cap (key 2) (the cap closest to the conduit). Note that the two set screws (key 8) need to be loosened to remove the cap.
2. Note the location of the wires, then remove the electrical wiring from the terminal block.
3. Remove the three screws (key 26) and remove the electronics module from the housing.

Replacement

1. Insert the electronics module into position in the housing (key 1). Replace the three screws (key 26) and tighten them.
2. Replace the electrical wiring removed in step 1 of the removal procedures. Do not overtighten the terminal screws. Maximum torque is 0.45 N•m (4 lbf•in).
3. Electrically calibrate the unit using the procedure in the Calibration section of this manual.
4. Replace the housing cap (key 2), making sure to re-tighten the set screw (key 8).

Relay Maintenance

Refer to figures 12 and 14 for key number locations.

Removal

1. Remove the four mounting screws (key 36, shown in figure 14) and remove the relay from the transducer. Be careful not to lose the bias spring (key 34) and input diaphragm (key 38).
2. Remove the body plug (key 32) that holds the inner valve spring (key 35) and valve plug (key 39) in place from the relay body assembly.
3. Remove the exhaust port assembly (key 33) from the relay assembly.
4. Inspect the springs, exhaust seat, valve plug, and other parts for wear or damage; replace as necessary. Note: the valve plug supply seat is an insert in the relay body (key 41). If this insert is bad, replace the relay body.
5. Make sure all parts of the relay are clean and that all passages are clear of foreign matter.

Assembly

1. Assemble the inner valve spring (key 35) onto the body plug (key 32) and fit the valve plug (key 39) onto the inner valve spring as shown in figure 12. To assure best alignment between the valve plug, inner valve spring, and body plug; fit the valve plug onto the inner valve spring so that one of the three tabs at the base of the valve plug sets at the end of the last coil of the inner valve spring.
2. Lubricate the O-ring (key 42) with Dow Corning III (key 37). Insert the assembled valve plug, inner valve spring, and body plug into the relay body (key 41). Compress the spring and thread the body plug (key 5) into place. Then, tighten the body plug.
3. Insert two of the mounting screws (key 36) into two opposite holes of the relay body (key 41). Hold the screws in place while assembling the following parts on the relay body. The screws serve as studs to align the parts as they are being assembled.
4. When replacing the exhaust port assembly (key 33), make sure all passages and screw holes are aligned and that the hole in the center of the exhaust port assembly fits over the valve plug (key 39). Place the exhaust port assembly on the relay body (key 41). Hold assembled parts in place.
5. Make sure the tabs on the body block (key 40) align with the tabs on the relay body (key 41) and that the side with 5 holes faces the relay body. Place the body block on the assembled parts. Hold assembled parts in place.

6. When replacing the input diaphragm (key 38), make sure all passages and screw holes are aligned. Place the input diaphragm on the body block (key 40). Hold assembled parts in place.
7. Install the bias spring (key 34) into the transducer housing assembly (key 1). Make sure the tabs on the body block and relay body align with the tab on the transducer housing assembly. Place the assembled parts onto the transducer housing assembly. Thread the two mounting screws (key 36) into the transducer housing assembly. Install the remaining two mounting screws. Tighten all mounting screws to 2 N•m (20 lbf•in).
8. Perform the procedure in the Calibration section of this manual.

Note

Neither Emerson, Emerson Process Management, nor Fisher assume responsibility for the selection, use and maintenance of any product. Responsibility for the selection, use and maintenance of any Fisher product remains solely with the purchaser and end-user.

Parts Kits

Description	Part Number
Repair Kit for Type i2P-100 electro-pneumatic transducer Contains O-rings (keys 4, 9, 12, and 55) and Filter (key 11)	R2P100X0012

Parts Ordering

A serial number is assigned to each transducer and stamped on the nameplate. Always refer to this serial number when corresponding with your Fisher sales office regarding spare parts or technical information. When ordering replacement part, also specify the complete 11-character part number from the Parts list.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Fisher will void your warranty, might adversely affect the performance of the instrument, and might jeopardize worker and workplace safety.

Parts List (see figure 13)

Housing

Key	Description	Part Number
1	Housing, Aluminum	
2	Cover (2 req'd)	48B6515X022
3	Configuration Label	GE03345X012
4*	O-Ring ⁽¹⁾ (2 req'd)	
6	Feed Thru (2 req'd)	
7	Wire Retainer (2 req'd)	16A2821X012
8	Set Screw (2 req'd)	1B4556X0012
9*	O-Ring ⁽¹⁾	
10	Restrictor, Primary	10C2233X012
11*	Filter ⁽¹⁾	
12*	O-Ring ⁽¹⁾	
13	Filter Cap	GB0122X0012
14	Machine Screw (2 req'd)	19B0821X012
15	Flame Arrestor	GE06959X012
16	Flame Arrestor	GE02963X012
17	Sealant, Silicone (not furnished with transducer)	
18	Loctite 271 Sealant or equivalent (not furnished with transducer)	
19	Adhesive	
55	O-Ring ⁽¹⁾	
69	Nameplate, CSA approvals, aluminum	---
70	Screw (2 req'd)	1P426928982
71	Vent Assembly	GE06162X012
76	Pipe Plug	1H5137X0012

*Recommended spare parts
1. Available in the Repair Kit.

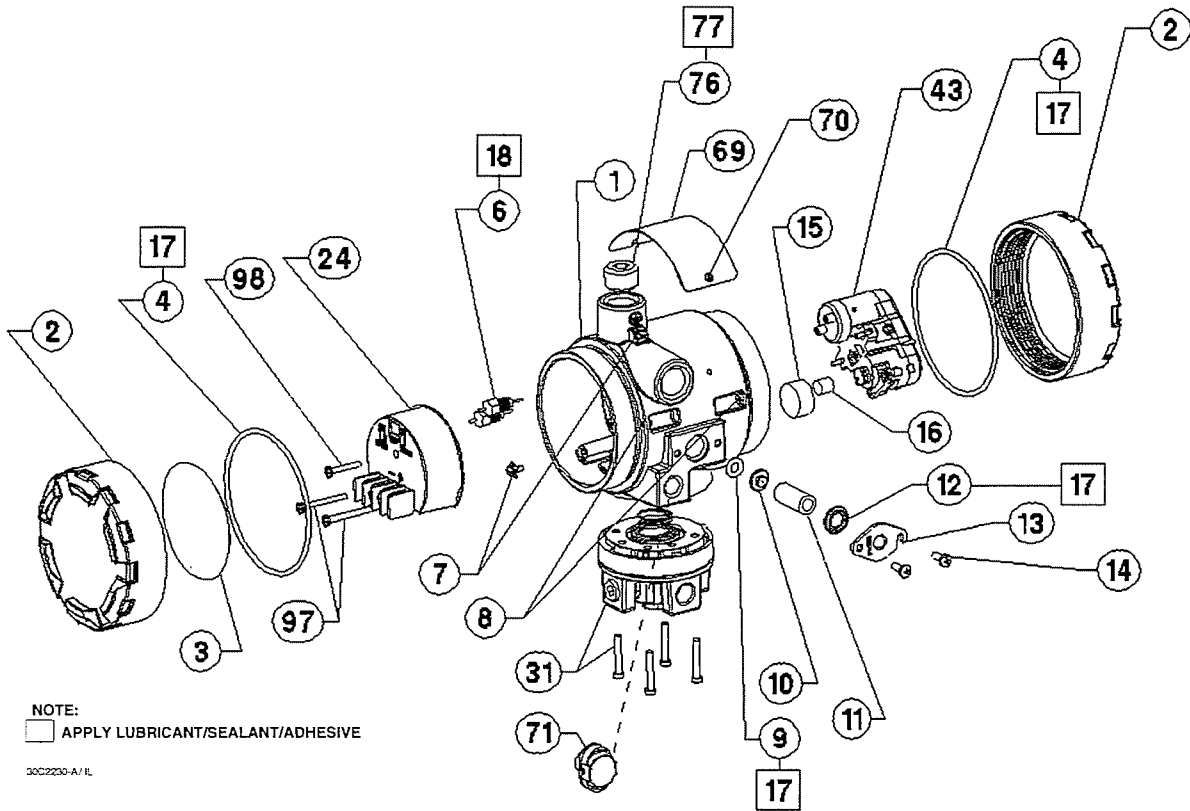


Figure 13. Type i2P-100 Transducer Assembly

PWB/Cup Assembly

24*	PWB/Cup Assembly	GE10168X012
97	Machine Screw (2 req'd)	GE11776X012
98	Machine Screw	GE11777X012

I/P Converter Assembly

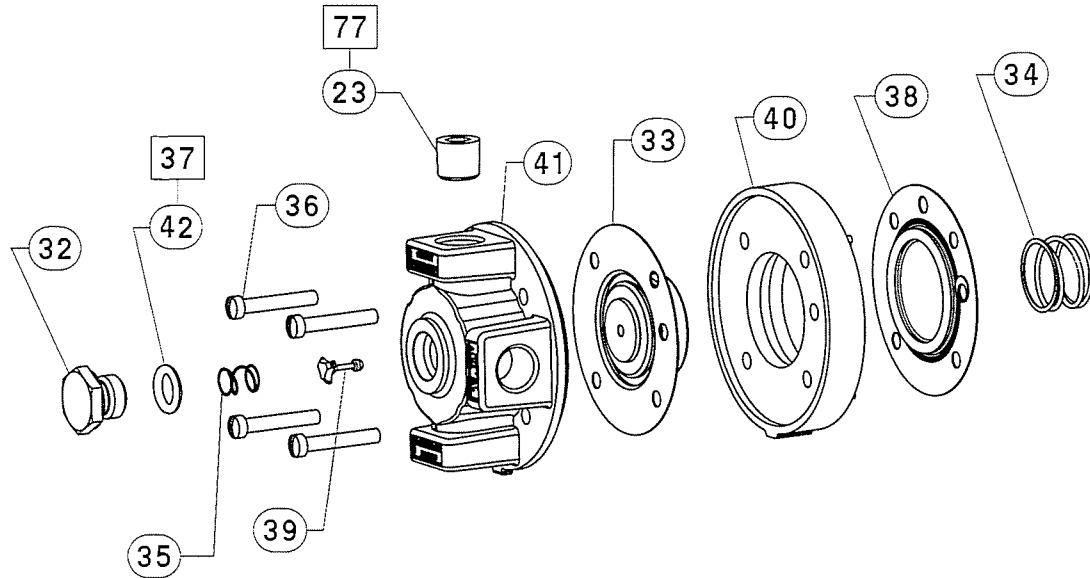
43*	I/P Converter Assembly	30C2218X012
-----	------------------------	-------------

Relay Assembly (see figure 14)

41	Relay / Body Assembly	GE03512X012
42	O-Ring	1E5477X0062
36	Machine Screw, fill hd (4 req'd)	1H1581X0012
32	Body Plug	11B2363X012
33	Exhaust Port Assembly	11B2364X012
34	Spring	11B2369X012
35	Spring	11B6843X012
38	Upper Diaphragm	21B2362X012
39	Valve Plug	21B2370X012
40	Body Block	31B2356X012

Gauge/Pipe Plug

23	Pipe plug, use when gauge is not specified (not shown)	
	Alloy steel pl	1C333528992
	Stainless steel	1C3335X0032
23	Gauge, (not shown)	
	0-30 psig/0-0.2 MPa/0-2 bar	11B8579X022
	0-60 psig/0-0.4 MPa/0-4 bar	11B8579X032



NOTE:
□ APPLY LUBRICANT/SEALANT/ADHESIVE

30C2259-B/1L

Figure 14. Type i2P-100 Relay Assembly

Key	Description	Part Number	Key	Description	Part Number
-----	-------------	-------------	-----	-------------	-------------

Diagnostic Connections

FlowScanner™ diagnostic system hook-up

Includes pipe tee, pipe nipple, pipe bushings, connector body, and body protector. See figure 7 for part identification. Also, part number provides correct quantities of each item.

Note

If the Type i2P-100 Transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the Type i2P-100. The hook-up for diagnostic testing should be installed at the positioner.

Side Output

For units with gauges

SST fittings	12B8040X052
Brass fittings	12B8040X062

For units without gauges

SST fittings	12B8040X072
Brass fittings	12B8040X082

Mounting Parts

Yoke Mounting

Type 470 size 23 through 64

80	Mounting Bracket, steel	3P426825022
81	Washer, steel pl (4 req'd)	1B865928982
82	Cap Screw, steel pl (4 req'd)	1A381624052

480 Series actuator boss

80	Mounting Bracket, steel	3P426825022
81	Washer, steel pl (4 req'd)	1B865928982
82	Cap Screw, steel pl (4 req'd)	1A381624052
83	Screw, steel pl (2 req'd)	1C5958X0022
85	Mounting Bracket, Steel	3L276725092
86	Hex Nut, steel pl (2 req'd)	1A352724122

Type 585C size 25 and 50

80	Mounting Bracket, steel	3P426825022
81	Washer, steel pl (4 req'd)	1B865928982
82	Cap Screw, steel pl (4 req'd)	1A381624052
83	Screw, steel pl (2 req'd)	1A352624052

i2P-100 Transducer

Key	Description	Part Number	Key	Description	Part Number
	Type 585C (470) size 60, 68, 100, and 130 ; Type 657 and 667 size 30, 34, 40, 45, 50, 60, 70, 80 & 87; Type 1051 and 1052 size 40, 60 and 70; Type 1061 all sizes			Type 1051 and 1052 size 20, 33, 40, 60 and 70	
80	Mounting Bracket, steel	3P426825022	80	Mounting Bracket, steel	1F401225072
81	Washer, steel pl (4 req'd)	1B865928982	81	Washer, steel pl (2 req'd)	1B865928982
82	Cap Screw, steel pl (4 req'd)	1A381624052	82	Cap Screw, steel pl (2 req'd)	1A381624052
83	Screw, steel pl (2 req'd)	1C870224052	83	Screw (req'd)	1A582824052
84	Spacer	1K766824092		Type 1250 and 1250R all sizes	

Casing Mounting

	Type 657 and 667 size 30, 34, 40, 45, 50 and 60	
80	Mounting Bracket, steel	1F401225072
81	Washer, steel pl (2 req'd)	1B865928982
82	Cap Screw, steel pl (2 req'd)	1A381624052
83	Screw (req'd)	1A582824052
	Type 657 and 667 size 70	
80	Mounting Bracket, steel	1F401225072
81	Washer, steel pl (2 req'd)	1B865928982
82	Cap Screw, steel pl (2 req'd)	1A381624052
83	Screw (2 req'd)	1A368324052

Pipestand Mounting

80	Mounting Bracket, steel	3P426825022
81	Washer, steel pl (4 req'd)	1B865928982
82	Cap Screw, steel pl (2 req'd)	1A381624052
88	Pipe Clamp, steel pl	1P427028982

Surface Mounting

80	Mounting Bracket, Steel	GE07077X012
82	Cap Screw	1B6098X0012

Errata Sheet for

Type i2P-100 Electro-Pneumatic Transducers Instruction Manual,
Form 5777, March 2005


This errata sheet contains updated hazardous area classifications information for North America and the CSA/FM approvals nameplate. Please replace table 3 in the i2P-100 Electro-Pneumatic Transducers Instruction Manual – Form 5777, dated March 2005, with the updated table 3 below.

Table 3. Hazardous Area Classifications for North America

CERTIFICATION BODY	CERTIFICATION BODY	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07471	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 5 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^{\circ}\text{C}$) T4 ($T_{amb} \leq 81^{\circ}\text{C}$) T5 ($T_{amb} \leq 46^{\circ}\text{C}$)	4X*
	(Explosion Proof) Zone •Ex d IIC T5/T6 Class/Division •Class I, Division 1 GP, A, B, C, D	---	T5 ($T_{amb} \leq 85^{\circ}\text{C}$) T6 ($T_{amb} \leq 75^{\circ}\text{C}$)	4X*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^{\circ}\text{C}$) T6 ($T_{amb} \leq 75^{\circ}\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, 2, GP E, F, G Class III	---	T5 ($T_{amb} \leq 85^{\circ}\text{C}$) T6 ($T_{amb} \leq 75^{\circ}\text{C}$)	4X*
FM	(Explosion Proof) Zone •Class I Zone 1 AEx d IIC T5/T6 Class/Division •Class I, Division 1, GP B, C, D	---	T5 ($T_{amb} \leq 85^{\circ}\text{C}$) T6 ($T_{amb} \leq 75^{\circ}\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II Division1, GP E, F, G	---	T5 ($T_{amb} \leq 85^{\circ}\text{C}$) T6 ($T_{amb} \leq 75^{\circ}\text{C}$)	4X*
	Class II, Division 2, GP F, G	---	T4 ($T_{amb} \leq 80^{\circ}\text{C}$)	4X*

* When remotely vented.

TYPE i2P-100		US PATENTS - 4836011 - 4595029 OTHER PATENTS PENDING	20 mA DC == MAX, 30 VDC == MAX, 50 PSI MAX AMB. TEMP: -40 TO 85°C APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM CSA ENCLOSURE 3: NEMA 3	FISHER CONTROLS INTL LLC MARSHALLTOWN, IOWA, USA MFG LOCATION:
SERIAL NO.		FACTORY CALIBRATED AS: INPUT: 4-20 mA DC == OUTPUT: 3-15 PSI <input type="checkbox"/> 6-30 PSI <input type="checkbox"/>		
SEAL NOT REQUIRED. CL I DIV 1 GP ABCD T5; CL I DIV 2 GP ABCD T5 CL II DIV 1 GP EFG T5; CL II DIV 2 GP FG T5 Ex ia INTRINSICALLY SAFE CL I/II/III DIV 1 GP ABCDEFG T3(Tamb ≤ 85°C) T4(Tamb ≤ 81°C) T5(Tamb ≤ 46°C) WHEN INSTALLED PER DRAWING GE07471 Ex ia IIC T3(Tamb ≤ 85°C) T4(Tamb ≤ 81°C) T5(Tamb ≤ 46°C) U _i , V _{max} = 30V E _i , I _{max} = 150mA P _i = 1.0W C _i = 0nF L _i = 0uH Ex d IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C) Ex nC IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C) WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. OPEN CIRCUIT BEFORE REMOVING COVER.		CONDUIT SEAL NOT REQUIRED XP: CL I DIV 1 GP ABCD T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C) NI: CL I DIV 2 GP ABCD T4(Tamb ≤ 80°C) DIP: CL II DIV 1 GP EFG T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C) S: CL II DIV 2 GP FG T4(Tamb ≤ 80°C) CLASS I ZONE 1 AEx d IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C)		
INPUT	OUTPUT	FIELD CALIBRATED AS:		
4-20 mA DC <input type="checkbox"/>	3-15 PSI <input type="checkbox"/> 6-30 PSI <input type="checkbox"/>	0.2-1.0 BAR <input type="checkbox"/>	0.4-2.0 BAR <input type="checkbox"/>	0.2-1.0 Kg/cm ² <input type="checkbox"/> 0.4-2.0 Kg/cm ² <input type="checkbox"/>
4-12 mA DC <input type="checkbox"/>	3-15 PSI <input type="checkbox"/>	0.2-1.0 BAR <input type="checkbox"/>	0.2-1.0 Kg/cm ² <input type="checkbox"/>	
12-20 mA DC <input type="checkbox"/>	3-15 PSI <input type="checkbox"/>	0.2-1.0 BAR <input type="checkbox"/>	0.2-1.0 Kg/cm ² <input type="checkbox"/>	
--- mA DC <input type="checkbox"/>	--- PSI <input type="checkbox"/>	--- BAR <input type="checkbox"/>	--- Kg/cm ² <input type="checkbox"/>	



GE13955

GE13955

CSA/FM APPROVALS NAMEPLATE

Note

Neither Emerson™, Emerson Process Management, Fisher®, nor any of their affiliated entities assumes responsibility for the selection, use, and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

i2P-100 Transducer

Instruction Manual

Form 5777

March 2005

Instruction Manual

Form 5777
March 2005

i2P-100 Transducer



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Sao Paulo 05424 Brazil

Singapore 128461

www.Fisher.com



Errata Sheet
for

Type i2P-100 Electro-Pneumatic Transducers Instruction Manual,
Form 5777, March 2005


This errata sheet contains updated hazardous area classifications information for North America and the CSA/FM approvals nameplate. Please replace table 3 in the i2P-100 Electro-Pneumatic Transducers Instruction Manual – Form 5777, dated March 2005, with the updated table 3 below.

Table 3. Hazardous Area Classifications for North America

CERTIFICATION BODY	CERTIFICATION BODY	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	(Intrinsic Safety) Zone •Ex ia IIC T3/T4/T5 Class/Division •Class I, II, III Division 1 GP A, B, C, D, E, F, G per drawing GE07471	$V_{max} = 30 \text{ Vdc}$ $I_{max} = 150 \text{ mA}$ $P_i = 1.0 \text{ W}$ $C_i = 5 \text{ nF}$ $L_i = 0 \text{ mH}$	T3 ($T_{amb} \leq 85^\circ\text{C}$) T4 ($T_{amb} \leq 81^\circ\text{C}$) T5 ($T_{amb} \leq 46^\circ\text{C}$)	4X*
	(Explosion Proof) Zone •Ex d IIC T5/T6 Class/Division •Class I, Division 1 GP, A, B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	(Type n) Zone •Ex nC IIC T5/T6	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II, Division 1, 2, GP E, F, G Class III	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
FM	(Explosion Proof) Zone •Class I Zone 1 AEx d IIC T5/T6 Class/Division •Class I, Division 1, GP B, C, D	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class I, Division 2, GP A, B, C, D Class II Division1, GP E, F, G	---	T5 ($T_{amb} \leq 85^\circ\text{C}$) T6 ($T_{amb} \leq 75^\circ\text{C}$)	4X*
	Class II, Division 2, GP F, G	---	T4 ($T_{amb} \leq 80^\circ\text{C}$)	4X*
* When remotely vented.				

i2P-100 Transducer

Errata Sheet
May 2005

TYPE i2P-100		US PATENTS - 4836011 - 4595029 OTHER PATENTS PENDING	20 mADC == MAX, 30 VDC == MAX, 50 PSI MAX AMB. TEMP: -40 TO 85°C APPROVED FOR NATURAL GAS AS SUPPLY MEDIUM CSA ENCLOSURE 3; NEMA 3	FISHER CONTROLS INTL LLC MARSHALLTOWN, IOWA, USA MFG LOCATION:
SERIAL NO.	<input type="text"/>	FACTORY CALIBRATED AS:	INPUT: 4-20 mADC == OUTPUT: 3-15 PSI <input type="checkbox"/> 6-30 PSI <input type="checkbox"/>	
SEAL NOT REQUIRED.		CONDUIT SEAL NOT REQUIRED		
CL I DIV 1 GP ABCD T5; CL I DIV 2 GP ABCD T5		XP: CL I DIV 1 GP ABCD T5(Tamb≤85°C) T6(Tamb≤75°C)		
CL II DIV 1 GP EFG T5; CL II DIV 2 GP FG T5		NI: CL I DIV 2 GP ABCD T4(Tamb≤80°C)		
Ex ia INTRINSICALLY SAFE CL I/II/III DIV 1 GP ABCDEFG		DIP: CL II DIV 1 GP EFG T5(Tamb≤85°C) T6(Tamb≤75°C)		
T3(Tamb ≤ 85°C) T4(Tamb ≤ 81°C) T5(Tamb ≤ 46°C)		S: CL II DIV 2 GP FG T4(Tamb≤80°C)		
WHEN INSTALLED PER DRAWING GE07471		CLASS I ZONE 1 AEx d IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C)		
Ex ia IIC T3(Tamb ≤ 85°C) T4(Tamb ≤ 81°C) T5(Tamb ≤ 46°C)				
Ui,Vmax = 30V Ii,Ijmax = 150mA Pi = 1.0W Ci = 0nF Li = 0uH				
Ex d IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C)				
Ex nC IIC T5(Tamb ≤ 85°C) T6(Tamb ≤ 75°C)				
WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. OPEN CIRCUIT BEFORE REMOVING COVER.				
FIELD CALIBRATED AS:				
INPUT	4-20 mADC <input type="checkbox"/>	OUTPUT	3-15 PSI <input type="checkbox"/> 6-30 PSI <input type="checkbox"/> 0.2-1.0 BAR <input type="checkbox"/> 0.4-2.0 BAR <input type="checkbox"/> 0.2-1.0 Kg/cm2 <input type="checkbox"/> 0.4-2.0 Kg/cm2 <input type="checkbox"/>	 GE13955
	4-12 mADC <input type="checkbox"/>		3-15 PSI <input type="checkbox"/> 0.2-1.0 BAR <input type="checkbox"/> 0.2-1.0 Kg/cm2 <input type="checkbox"/>	
	12-20 mADC <input type="checkbox"/>		3-15 PSI <input type="checkbox"/> 0.2-1.0 BAR <input type="checkbox"/> 0.2-1.0 Kg/cm2 <input type="checkbox"/>	
	___ mADC <input type="checkbox"/>		___ PSI <input type="checkbox"/> ___ BAR <input type="checkbox"/> ___ Kg/cm2 <input type="checkbox"/>	

GE13955

CSA/FM APPROVALS NAMEPLATE

Note

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Emerson Process Management

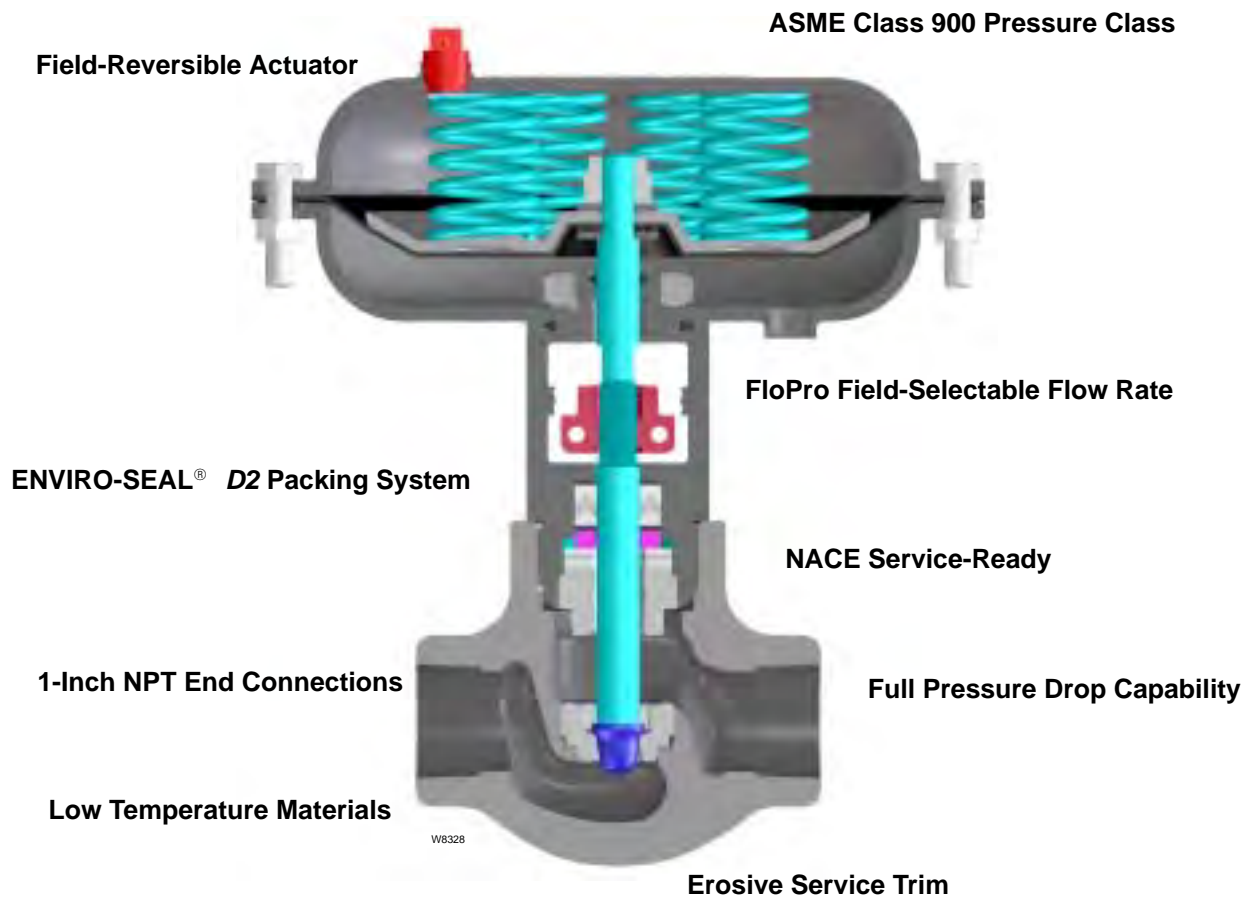
Fisher
Marshalltown, Iowa 50158 USA
Cernay 68700 France
Sao Paulo 05424 Brazil
Singapore 128461

www.Fisher.com



Type D2 FloPro™ Control Valve

**One Standard Construction
Patents Pending**



NOW.....Everything you've asked for in a 1-inch, high-pressure, dump valve is available in a single product. Prove it to yourself by reviewing D2's standard (and only) construction in this bulletin

Figure 1. Type D2 FloPro Control Valve





Figure 2. Type D2 FloPro Control Valve

The Type D2 FloPro™ control valve (patents pending) (figure 2) is a compact, rugged valve designed for on-off control. This valve is ideal for use as a dump valve on gas separators and scrubbers. It is also well suited for other high pressure applications in natural gas production, compression, and processing. The Type D2 FloPro valve has threaded end connections and is available in a 1-inch globe style body.

Features

- **Field-Selectable Flow Rates**—The FloPro feature allows easy setting of 1/4, 3/8, and 1/2 inch flow rates, eliminating the need for more than one port size.
- **Erosive Service Trim**—The valve plug and seat ring are constructed from solid R30006 (Alloy 6), providing excellent wear capability for erosive service and longer trim life.
- **Full Pressure Drop Capability**—Compact and rugged, the D2 FloPro controls a variety of fluids at inlet pressures up to 155 bar (2250 psig) and downstream pressures of up to 82 bar (1200 psig) for Spring-to-Close actuator action or up to 103 bar (1500 psig) for Spring-to-Open actuator action.
- **ASME Class 900**—Valve assembly is designed and specified for ASME B16.34 Class 900 service.
- **NACE Service-Ready**—NACE trim is the standard construction for the D2 FloPro control valve. The valve body, bonnet, and trim materials comply with the recommendations of NACE MR0175 (National Association of Corrosion Engineers).
- **ENVIRO-SEAL D2 Packing System**—The ENVIRO-SEAL D2 packing system provides a superior stem seal to prevent the loss of valuable or hazardous process fluids or gases. It features a live-loading feature, providing reduced packing maintenance.
- **Low Temperature Materials**—Valve and actuator construction materials allow use in low temperature applications of -46°C .
- **Field-Reversible Actuator**—The Type D2 FloPro actuator can be converted in the field from Spring-to-Close to Spring-to-Open actuator action using a Spring-to-Open Spring Kit.
- **Easy Installation**—Compact design allows installation where space is a premium.
- **Easy Maintenance**—Screwed bonnet/body joint allows repair or maintenance with a minimum of tools, without removing the valve body from the piping system.

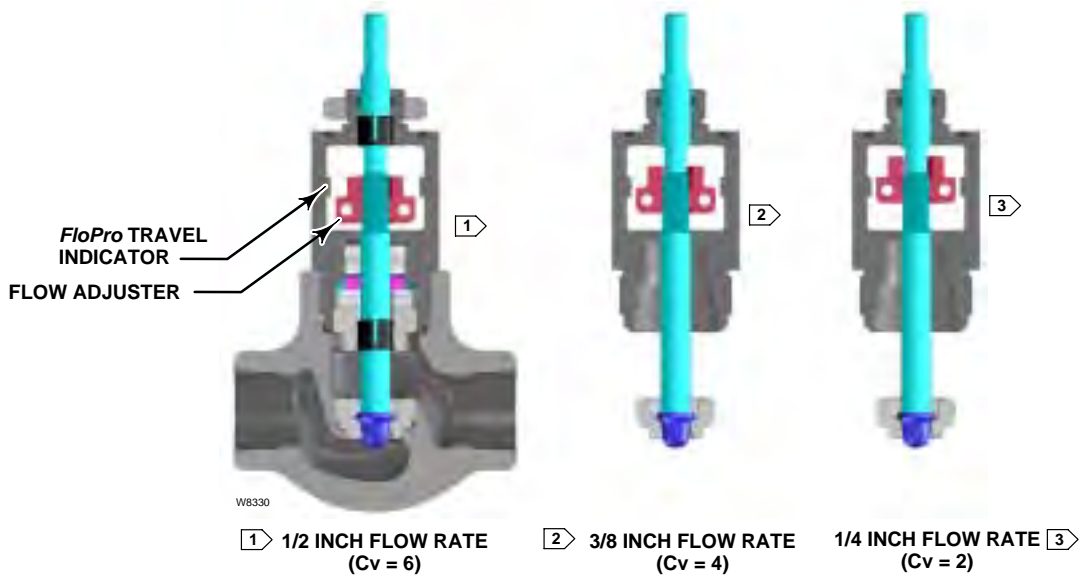


Figure 3. Travel and Flow Coefficients

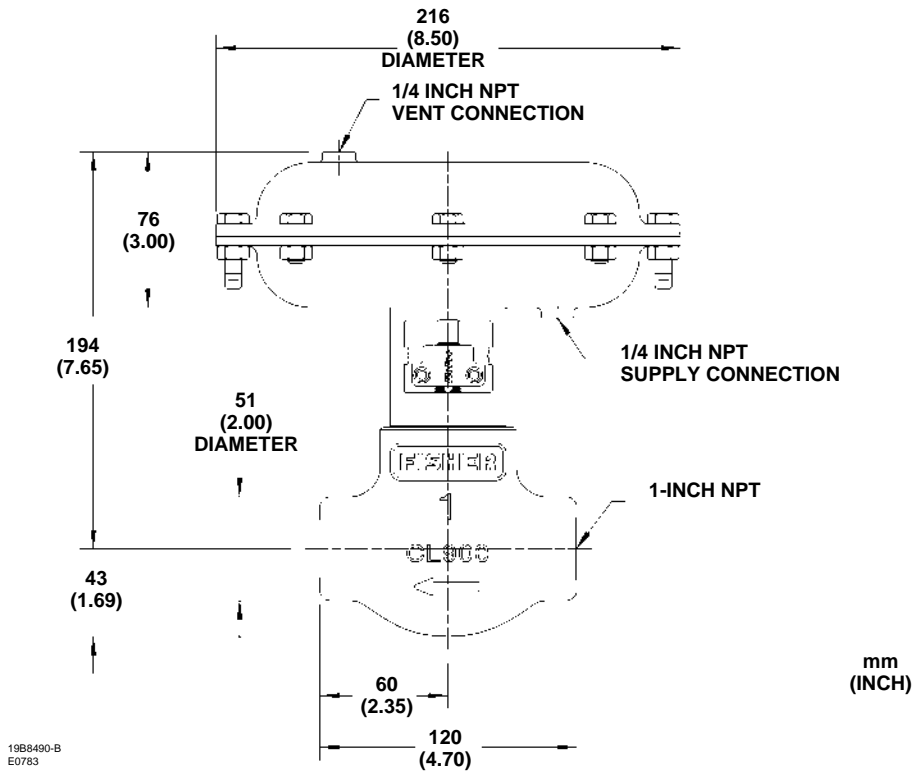


Figure 4. Type D2 Dimensions (Spring-to-Close Configuration Shown)

Specifications

Valve Assembly Pressure Class

ASME B16.34 Class 900

Maximum Inlet Pressure and Temperature

155 bar from -46 to 93°C, and 150 bar at 149°C.
(2250 psig from -50 to 200°F, and 2185 psig at 300°F)

Maximum Pressure Drop

155 bar (2250 psig)

Maximum Downstream Pressure

Spring-to-Close: 82 bar (1200 psig)
Spring-to-Open: 103 bar (1500 psig)

Shutoff Classification

ANSI Class IV ANSI/FCI 70-2 and IEC 60534-4

Construction Materials

Valve Body and Bonnet: ASME SA 352 LCC
Stress relieved
Valve Plug and Seat: (R0006) Alloy 6
Valve Stem: (S31600) 316 SST
O-Rings: (HNBR) Hydrogenated Nitrile
Packing: PTFE/Carbon PTFE
Packing Springs: (N07718) Inconel 718
Stem Bushing: (Ryton) PPS
Actuator Diaphragm: Nitrile/Polyester
Actuator Springs: Zinc-plated steel

Flow Characteristic

FloPro Characterized

Flow Direction

Flow down

Flow Coefficients

See figure 3

Port Diameter

13 mm (1/2 inch)

Maximum Travel

13 mm (1/2 inch)

Valve Travel Indications

See figure 3

Approximate Weight

7.7 kg (17 lb)

Dimensions

See figure 4

Material Temperature Capabilities

Valve Body Assembly: -46 to 149°C
(-50 to 300°F)

Actuator Assembly: -46 to 93°C (-50 to 200°F)

Bonnet/Body Connection

Screwed with leakoff bleed

Actuator Configuration

The *D2 FloPro* actuator is an on-off spring-and-diaphragm. Actuator action is Spring-to-Close from the factory.

For Spring-to-Open actuator action, a Spring-to-Open Spring Kit (10C1998X012) must be used

Maximum Actuator Casing Pressure

2.4 bar (35 psig)

Minimum Required Actuator Casing Pressure

2.1 to 2.4 bar (30 to 35 psig)

Actuator Diaphragm Effective Area

194 cm² (30 square inches)

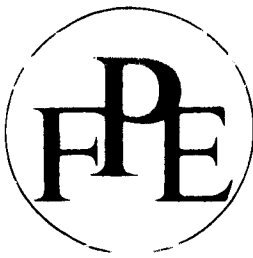
Actuator Pressure Connections

1/4 inch NPT female; see figure 4 for locations

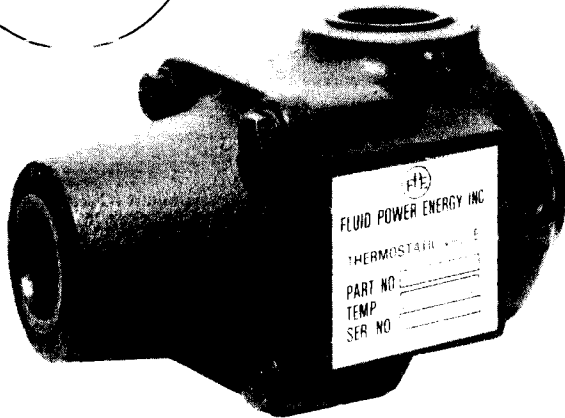
Ordering Information

Note

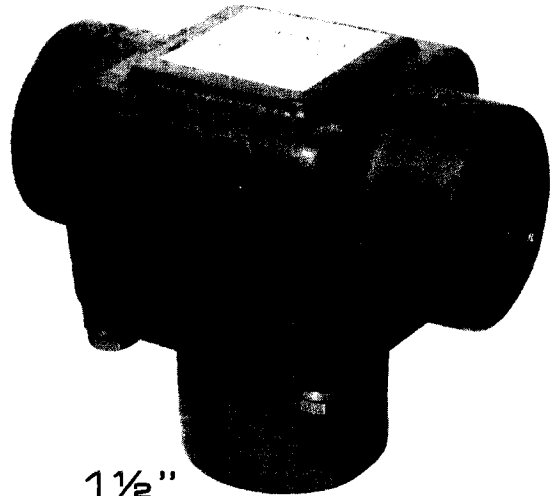
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THREE-WAY THERMOSTATIC VALVES



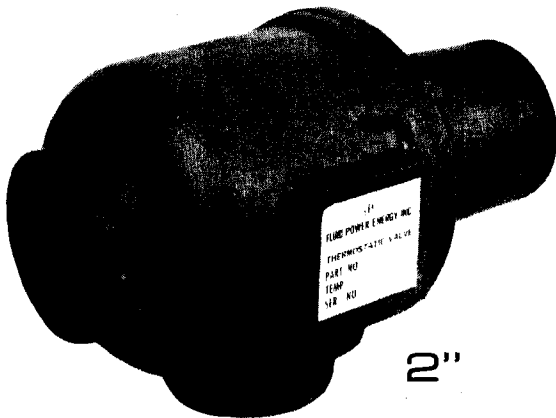
1/2" 3/4" 1"



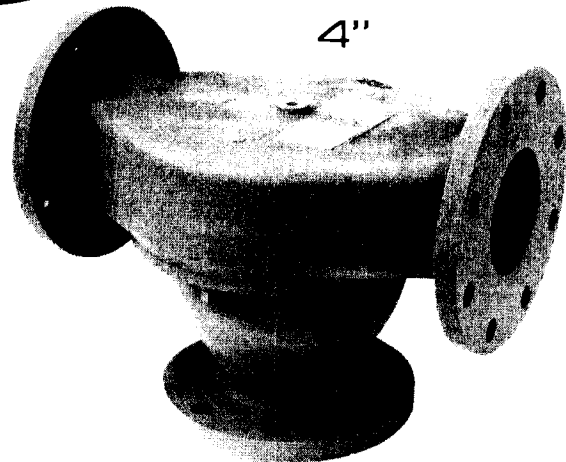
1 1/2"

SELF-CONTAINED
OPERATES IN ANY POSITION
NON-ADJUSTABLE • COMPACT
TAMPER-PROOF • HEAVY-DUTY
WIDE RANGE OF TEMPERATURES
RUGGED CONSTRUCTION
REPLACABLE ELEMENT

SIZES 1/4, 3/4, 1.
1 1/2, 2, 4.



2"



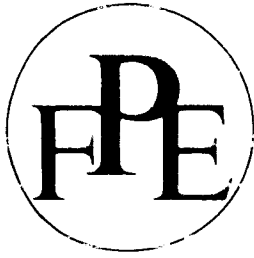
4"

NOV 28 2000

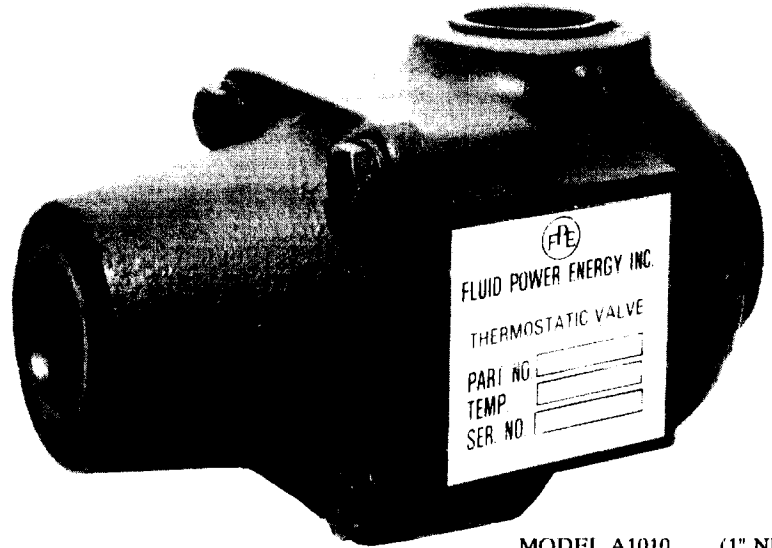


FLUID POWER ENERGY, INC.

W229 N591 Foster Court • Waukesha, WI 53186 • (414) 548-6220



1/2" 3/4" 1" THREE-WAY THERMOSTATIC VALVE



MODEL A1010	(1" NPT)
A1110	(3/4" NPT)
A1210	(1/2" NPT)
A1010J8	(SAE #8)
A1010J12	(SAE #12)
A1010J16	(SAE #16)

FEATURES

SELF-CONTAINED • NON-ADJUSTABLE • TAMPER-PROOF • COMPACT
WIDE RANGE OF TEMPERATURES • HEAVY-DUTY • REPLACEABLE ELEMENT
RUGGED CONSTRUCTION • OPERATE IN ANY POSITION

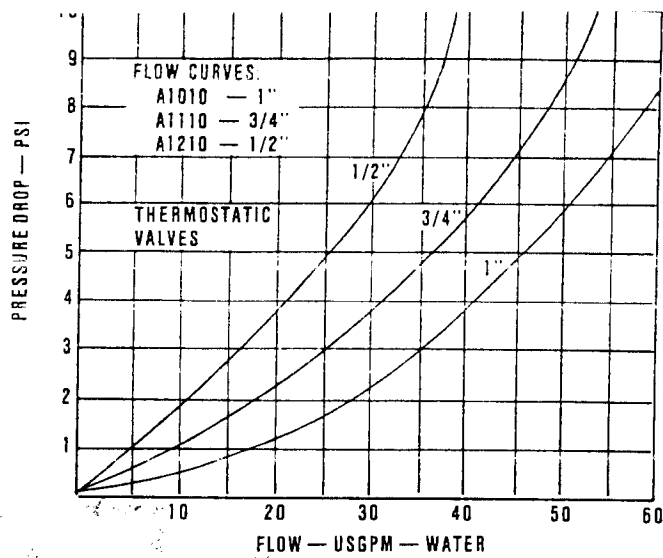
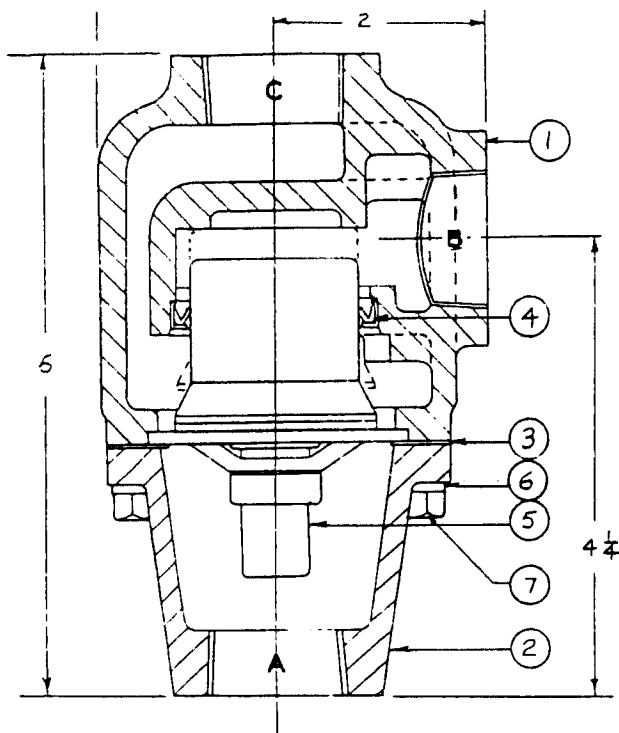
DESCRIPTION

FPE thermostatic valves utilize the principle of expanding wax, which in the semi-liquid state undergoes large expansion rates within a relatively narrow temperature range. The self-contained power element activates a stainless steel sliding sleeve which provides positive three-way valve action. All FPE thermostatic valves are factory set at predetermined temperatures; no further adjustments are necessary. A wide range of temperatures are available for water and oil temperature control applications.

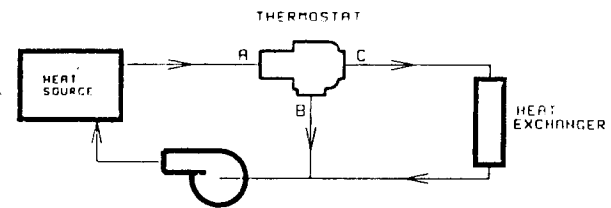
On starting, the total fluid flow is in a by-pass mode. As fluid temperature rises to the control range,

some fluid is diverted to the cooling system. As fluid temperature continues to increase, more flow is diverted, and when in a fully stroked condition, all fluid flow is positively directed to the cooling system. FPE thermostatic valves may be used for either mixing or diverting applications. In normal operation, fluid temperatures are controlled to within a few degrees.

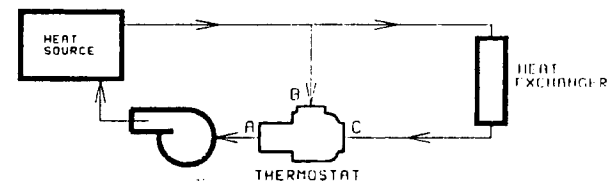
Standard FPE thermostatic valve housings are made from high quality grey iron castings; however, steel and bronze housings are available.



ITEM NO.	P/N	DESCRIPTION
1	1010	VALVE BODY (1" NPT)
2	1020	VALVE COVER (1" NPT)
3	1572	O-RING
4	1071	LIP SEAL (TEFLON)
*5	1060	ELEMENT
6	1603	LOCKWASHER 5/16
7	1602	CAPSCREW 5/16 - 18 x 7/8
8	1590	NAME PLATE



DIVERTING APPLICATION

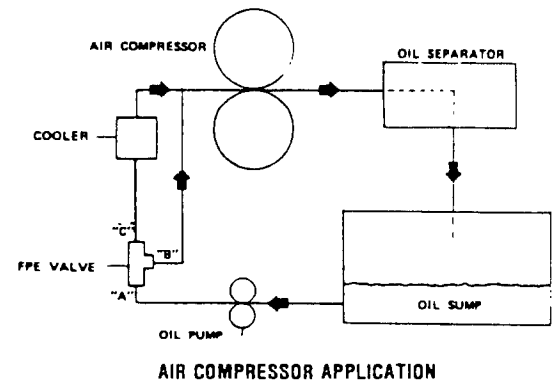


MIXING APPLICATION

* PART NO. 1060 - CARRIES A DASH NUMBER INDICATING THE NOMINAL TEMPERATURE

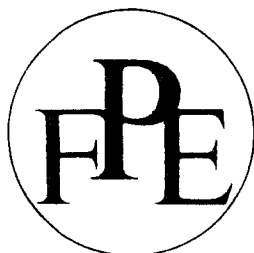
MATERIAL	PRESSURE RATING	MODEL NUMBER
CAST IRON	150 PSI	A1010
STEEL	500 PSI	S1010
ALUMINUM	150 PSI	AL1010
BRONZE	150 PSI	B1010
DUCTILE IRON	250 PSI	D1010
STAINLESS STEEL	500 PSI	SS1010

MATERIAL	PRESSURE RATING	MODEL NUMBER
CAST IRON	150 PSI	A2010
STEEL	500 PSI	S2010
BRONZE	150 PSI	B2010
STAINLESS STEEL	500 PSI	SS2010



AIR COMPRESSOR APPLICATION

HOW TO ORDER: Specify Model Number, nominal temperature desired, and housing material.



FLUID POWER ENERGY, INC.

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FLUID POWER ENERGY

MODEL CODE SYSTEM

AL

1010

N

160

TEMPERATURE SETTING

ELEMENT ASSEMBLY P / N		2050	2096
USED IN	1060	1560	2096
MODEL	1010	1011	AMDT
NDS	1110	1511	200-1 EQUIVALENTS
	1210	1530	2510
		3010	3010
		4010	4010
		5010	5010
		6010	6010

ELEMENT ASSEMBLY NUMBER		2050	2096
NOMINAL (DEG F)	1060	1560	2096
45		35-55*	35-55*
55		45-65	45-65
65		55-76	55-76*
75		68-86	68-86
80	70-88	70-90	80-95
90	80-100	80-100	86-104
95	80-100*		86-104
100	90-110	90-110	93-108*
105			95-113
110	100-120	100-120	100-117
115			104-122
120	110-130	110-130	110-130
130	120-140	120-140	124-140
135	125-145	125-145	129-145
140	130-150	130-150	135-150
150	140-160	140-160	145-160
155			150-165
160	150-170	150-170	155-172
165			160-175
170	163-180	163-180	165-180
175	170-185	170-185	175-180
180	175-190	175-190	180-195
185			185-195
190	185-195	185-200	185-200
195	185-200	188-208	188-208
200	190-210	190-210	200-220
205	198-218		200-215
210	200-220		210-225
220	210-230		220-240
230	220-240	220-240	230-250
240			240-260
250			250-270
260			

VALVE SIZE

0750	3/4" NPT	(1210 BODY SIZE)
1210	1/2" NPT	(1210 BODY SIZE)
1110	3/4" NPT	(1210 BODY SIZE)
1010	1" NPT	(1210 BODY SIZE)
1010J8	SAE #8 THREADS	(1210 BODY SIZE)
1010J12	SAE #12 THREADS	(1210 BODY SIZE)
1010J16	SAE #16 THREADS	(1210 BODY SIZE)
1011	1" NPT	(TWO WAY 1211)
1411	1 1/4" NPT	(TWO WAY 1211)
1511	1 1/2" NPT	(TWO WAY 1211)
1530	1 1/2" NPT	(THREE WAY)
1530J18	SAE #18	(THREE WAY)
1530J20	SAE #20	(THREE WAY)
1530J24	SAE #24	(THREE WAY)
2010-1	1 1/2" NPT	(2010 BODY)
2010	2" NPT	(2010 BODY)
2010J24	SAE #24	THREADS
2010J32	SAE J32	THREADS
2510	2 1/2" FF FLG.	
3010	3" FF FLG.	
4010	4" FF FLG.	
5010	5" FF FLG.	
6010	6" FF FLG.	

BODY MATERIAL

A	CAST IRON
AF	CAST IRON FLG. (STD. VALVE IS NPT)
B	BRONZE
D	DUCTILE
AL	ALUMINUM
S	STEEL
SF	STEEL, FLANGED (STD. VALVE IS NPT)
SS	STAINLESS STEEL

SPECIAL DESIGNATION

C	NO COVER
E	NEDPRENE O-RING
G	PRIVATE LABEL
H	STAINLESS STEEL ELEMENT
K	BLACK PAINT FINISH
L	SS CHANNEL
M	MANUAL OVERRIDE
N	NO NAME PLATE
P	NICKEL PLATED ELEMENT
S	STUDS
T	PRESSURE TEST # T20 = 200 W. PRESS. T22 = 220 W. PRESS. T24 = 240 W. PRESS. ETC...
V	VITON O-RING
V	VEEP HOLE FOLLOWED BY SIZE IN 3RDS OF AN INCH V1 = 1/32" VEEP HOLE V2 = 2/32" VEEP HOLE V3 = 3/32" VEEP HOLE ETC...
X	SPECIAL DESIGNATION

Fluid Power Energy, Inc.
 W229 N591 Foster Court
 Waukesha, WI 53186
 Phone: (262)-548-6220
 Fax: (262)-548-6239

FORM: J:\DCAD\FPE\MODEL-PN.DWG (R14)
 REV. 00 (3/93)
 REV. 01 (6/94)
 REV. 02 (11/94)
 REV. 03 (1/95) ECN #011995
 REV. 04 (10/96) ECN #1029

FLUID POWER ENERGY, INC.
W229 NO. 1 FORTY COURT
WAUKESHA, WI 53186
(414) 542-6220

THERMOSTATIC VALVES

Instruction and Application Guidelines

Your FPE Thermostatic Valve has been manufactured with extreme care and tested to insure that it had no detectable defects at the time it left the factory. If the valve is correctly applied and installed it will give years of service under reasonable operating conditions. This instruction manual will give you service information for nearly all normal operating conditions, but for the unusual situations it may be necessary to contact your FPE representative or the FPE factory. All FPE valves use the "Expanding wax" type of temperature sensing element set to their nominal rating under closely controlled conditions, and cannot be altered once they are set. If it is ever necessary to change the nominal rating of the valve, a different set of elements must be used.

INSPECTING THE VALVE UPON RECEIPT

Immediately upon receipt of your valve, check it over carefully for damage received in shipping, and be sure you have received the proper unit. In checking the model number of the valve against your order you may find that the nominal temperature rating is stamped below the part number, which is not how it was ordered. This numbering system merely allows us to identify the construction and thermostat setting on a more exact basis. If you have any questions do not hesitate to call the factory or your representative.

INSTALLATION

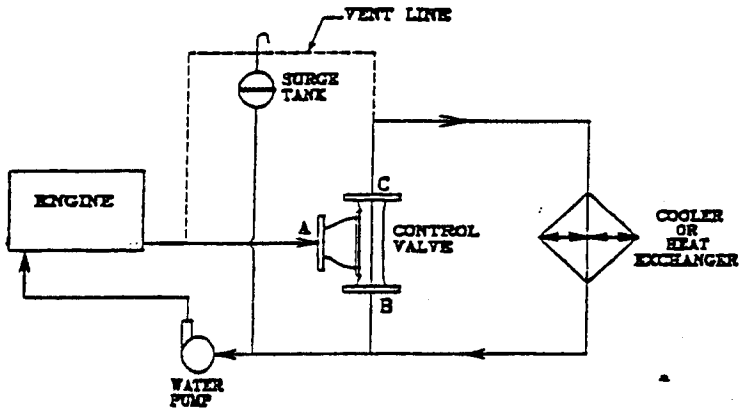
FPE valve dimensions are given on an attached sheet, a copy of which is supplied with each valve order, and which should be checked against the actual valve on receipt of the order. If special engineered drawings have been prepared, these drawings and FPE standard instructions should be resolved before the valve is put into service. On pages 3-4 of this bulletin, there are several recommended methods of applying FPE valves. Figure 1 illustrates a cooling water diverting system using a radiator. Figure 2 is a cooling water mixing system using a heat exchanger. Please note the difference between a diverting system and a mixing system. In the diverting system the three-way thermostatic control valve diverts part of the fluid out of the C port into the cooler, and part of the fluid out of the B port to bypass the cooler. In a mixing situation part of the flow comes from the cooler or heat exchanger into the C port, the other part of the fluid comes from the B port or by-pass, mixes in the valve and comes out the A port at the desired temperature. In comparing these two systems, diverting and mixing, it has been found that the diverting system will provide a better and more even temperature control than the mixing system. This is because the diverting system has introduced a more temperature-even homogeneous fluid to the sensing element. On the other hand a mixing system requires two different fluid temperatures to mix in a small volume of the valve in order to exit through the temperature sensing unit. You will note that in all of the piping diagrams, a mixing system controls the temperature of the fluid going into the engine or the compressor. The diverting system controls the temperature coming out of the engine or compressor.

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W229 N581 FOSTER COURT
WAUKECHA, WI 53186
(414) 543-6220

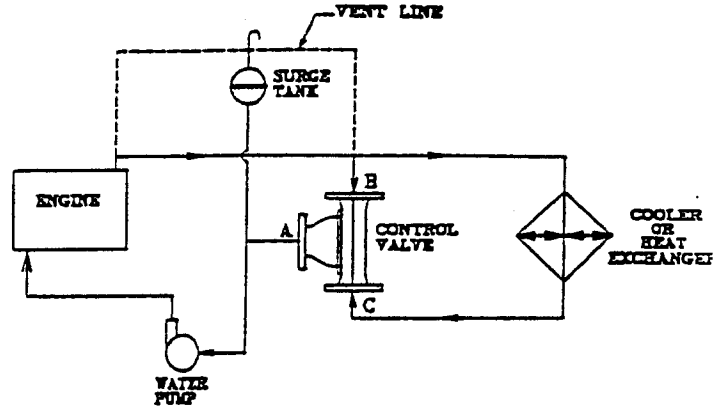
OPERATION

After installation of the valve has been completed into the system, and operating of the valve has been started, system temperatures should be monitored so that the circuit is performing satisfactorily. Water cooling systems generally operate at a temperature at or slightly below the nominal temperature of the valve. Oil systems or more viscous fluids operate at temperatures at or slightly above the nominal temperature. To check an element's temperature, place the element in a water bath at a temperature 5 degrees below the opening temperature of the element. Make sure you stir the water vigorously with the element for at least five minutes. Check the sliding valve to make sure it is not off its seat. Next, place the element in the same water bath at 25 degrees above the full open temperature reading and again stir vigorously for five minutes. Check the element and it should now be fully stroked. This can be determined by placing the element back into the FPE valve housing and pushing the element's spider fully into the counterbore. FPE valves have an overtravel spring which can be felt by pushing the element down into the counterbore. If this resistance is felt, the element is now fully stroke. Since the element has a tendency to cool quickly, you must do this last step before the element has cooled. Do not use oil as a test bath. On very high temperature elements you may use glycol solution or water.

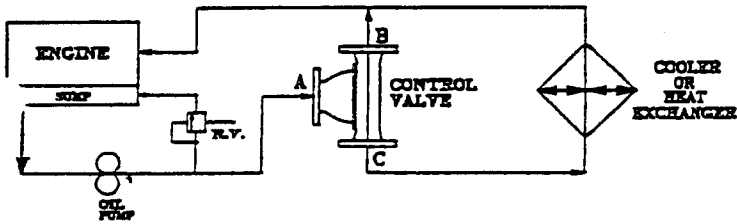
APPLICATION CHARTS



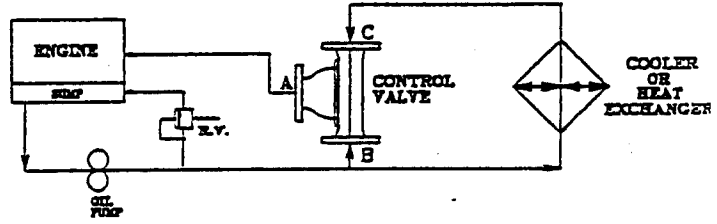
COOLING WATER DIVERTING SYSTEM
FIGURE (1)



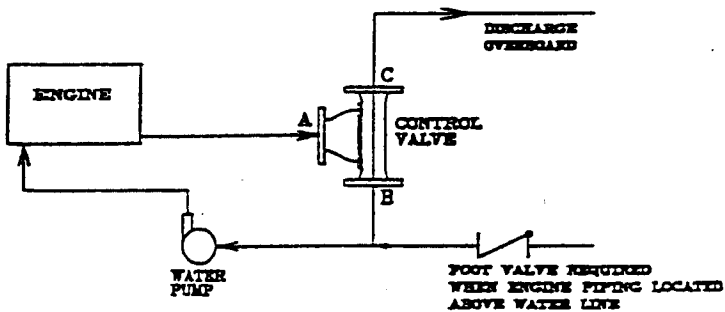
COOLING WATER MIXING SYSTEM
FIGURE (2)



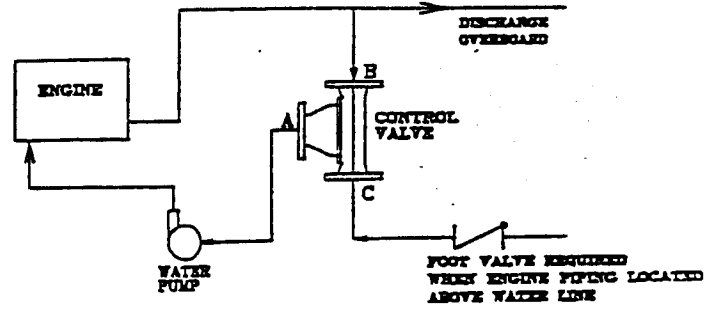
LUBE OIL TEMPERATURE CONTROL DIVERTING SYSTEM
FIGURE (3)



LUBE OIL TEMPERATURE CONTROL MIXING SYSTEM
FIGURE (4)

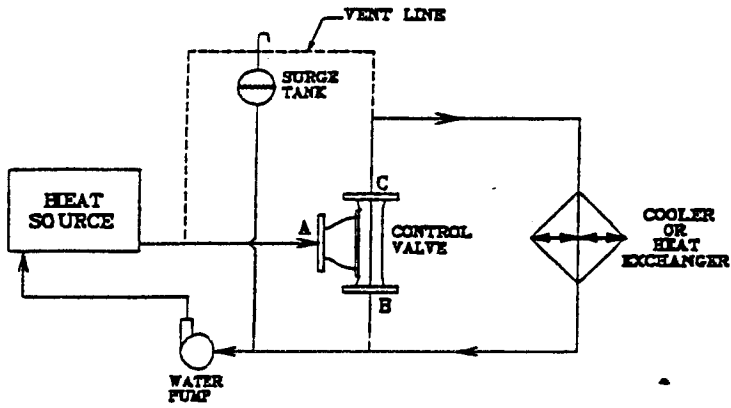


DIRECT COOLING DIVERTING SYSTEM USING WATER (140 F OR LESS)
FIGURE (5)



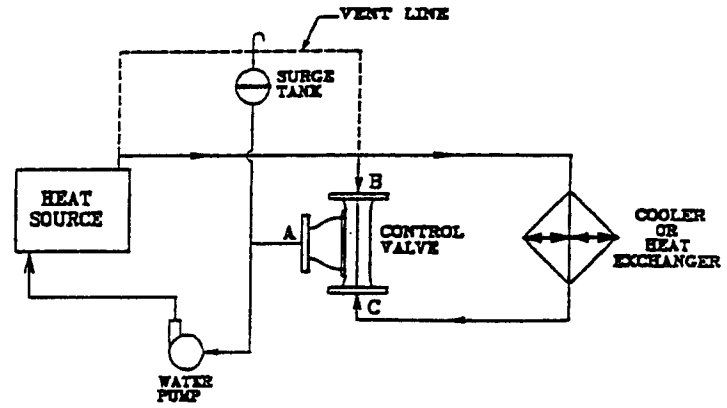
DIRECT COOLING MIXING SYSTEM USING WATER (140 F OR LESS)
FIGURE (6)

APPLICATION CHARTS



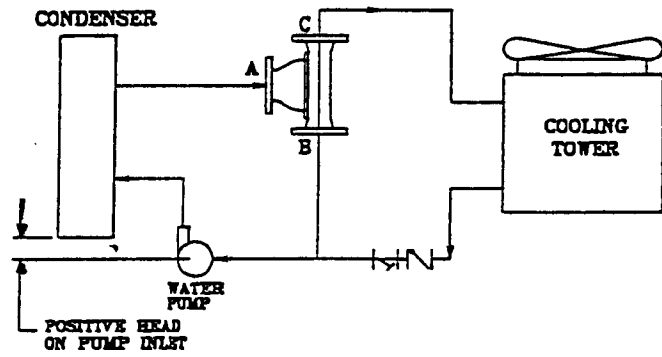
COOLING - ELECTRIC SYSTEM - DIVERTING MODE

FIGURE (7)



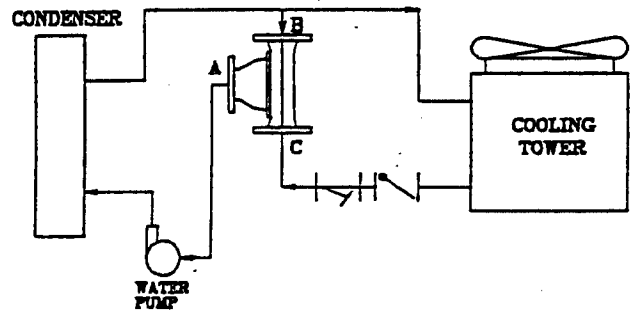
COOLING - ELECTRIC SYSTEM - MIXING MODE

FIGURE (8)



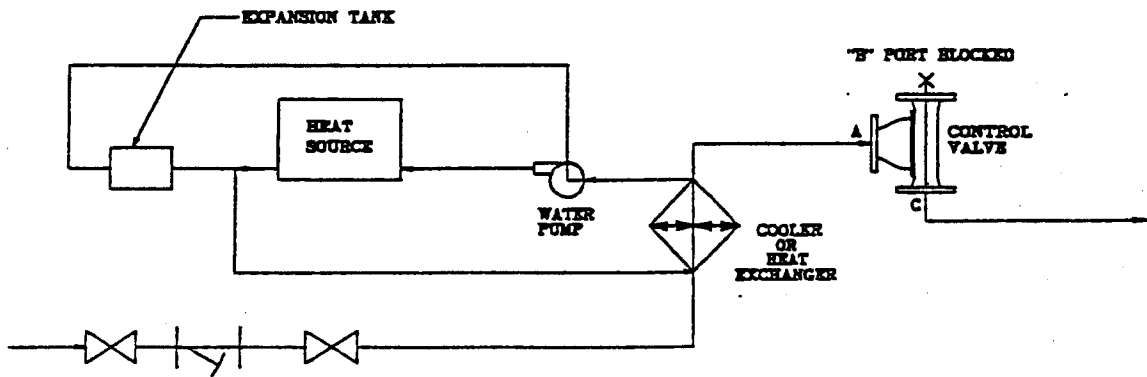
DIVERTING SYSTEM - AIR CONDITIONING

FIGURE (9)



MIXING SYSTEM - AIR CONDITIONING

FIGURE (10)



WATER SAVING APPLICATIONS

FIGURE (11)

MATERIALS

FPE valves are available in cast iron, steel, ductile iron, aluminum and bronze. For information concerning these different materials, please contact your factory representative. Sometimes electrolysis may be encountered in a system. If this is the case, a zinc or magnesium waste plug can be installed in the valve at part A. If the valve is installed in a seawater, cast iron housings are not generally satisfactory. In this type of installation, bronze valves must be used. In mounting the valve in a system, the valve must be properly vented so that the possibility of trapping air in the valve or around the elements is eliminated. A good rule to follow on systems is to place air vents so that air can be bled from the system to a single collection point. Please note the vent lines in the different piping diagrams.

MAINTENANCE

FPE thermostatic valves probably require less maintenance than any other type of similar use. Elements in normal service should be good for 6 to 10 years. Excessive temperatures, chemical, electrolytic or cavitation attack will of course shorten the life of the elements and seats which are replaceable. Carbonates, scale and other solids must not be permitted to build up on sliding valve or sensing cup surfaces. FPE does not recommend that a large stock of spare parts be maintained at the valve installation. Most commonly used elements and seals are immediately available from FPE's stocking area representatives, or from the factory direct. Seals and composition gaskets are rated for a shelf life of one year from date of shipment. If adequately sealed from air, they may be good for longer periods. The shelf life of an FPE element is from one to two years, depending on storage conditions.

TROUBLE SHOOTING

I. SYSTEM TEMPERATURE RUNNING TOO HOT

- A. Presence of foreign objects, dirt and solid buildup inside the valve (e.g. sliding piston, piston's seat, and lip seal area) may prevent proper operation of the valve. *Example:* By-pass port will not close.
- B. Valve's by-pass and cooler ports (port B & C) installed backward. As port B closes due to temperature increase, flow is greatly restricted to cooler.
- C. Valve is undersized, causing increase in pressure drop and possibly cavitation.
- D. Thermostatic wax element may have been exposed to temperature higher than the recommended maximum temperature.

Trouble Shooting continued

- E. Excessive pressure drop (in excess of 25psi) may cause one or more of the following conditions:
 - 1. Thermostatic wax element failure.
 - 2. Lip seal dislocation.
 - 3. O-ring damage.
 - 4. Improper piston movement.
 - F. Improper system cooling capacity.
 - G. Improper sizing of the valve in a mixing application. If the valve is sized too large for the application it could result in poor mixing, which could cause the temperature to run either too hot or too cold.
- II. SYSTEM TEMPERATURE RUNNING TOO COLD
- A. Incorrect selection of valve's nominal temperature.
 - B. Valve's by-pass and cooler ports (port B & C) installed backward. This condition forces fluid to cooler at lower temperature.
 - C. Worn teflon lip seal.
 - D. Presence of foreign objects, dirt and solid buildup inside of valve (e.g. sliding piston, piston's seat, and lip seal area) may prevent proper operation of the valve.
 - E. Excessive pressure drop. Refer to part I, Item E above.
 - F. Thermostatic control valve is oversized.
 - G. Outlet temperature is not maintained due to insufficient heat rejected to coolant.
- III. ADDITIONAL ITEMS THAT MAY BE CHECKED ARE:
- A. System thermometers should be regularly checked to make sure that they are operational.
 - B. Thermometers should be located on the side of horizontal pipe runs whenever possible and particularly on oil systems
 - C. Thermometers should be as far as possible downstream from the valve in a mixing application.
 - D. The system should not have any by-passes or "sneak circuits" which prevent proper operation of thermostatic control valve.

Trouble Shooting continued

- E. Cracked or broken valves may be caused by:
 1. Piping too short; and therefore, over-tightening bolts.
 2. Lack of expansion isolation between piping and valve.
 3. Misalignment of piping.
 4. Excessive weight.
 5. Allowing untreated water to freeze in the system.



REPAIR INSTRUCTIONS

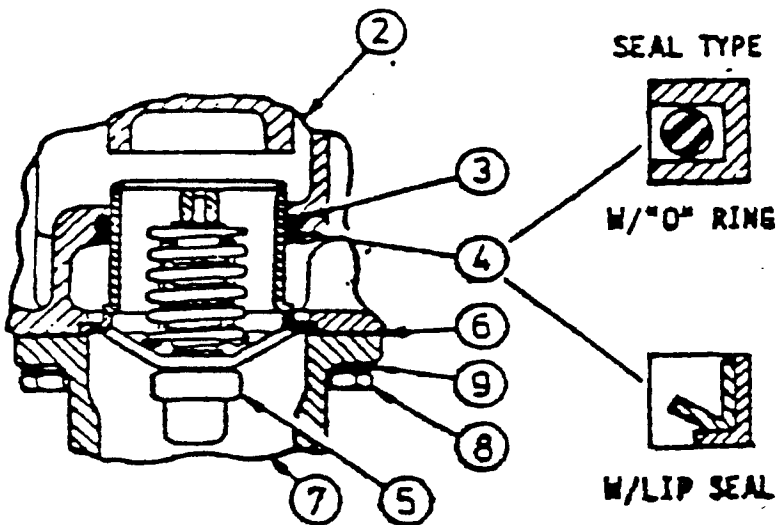
Thermostatic Valve Maintenance Kit

ELEMENT TESTING

Place element in water at a temperature 15° F. to 20° F. above its nominal setting and stir water vigorously with the element for five minutes. The temperature stamped on the side of the element is not the nominal temperature, it is the temperature at which the element is set to open. The nominal temperature is usually 10° F. to 15° F. higher than the nominal. After stirring vigorously immediately place the element in the housing. If the element is fully stroked, the seating and over-travel spring can be felt as it is pushed down. To determine if the element will close at a specific temperature, place the element in a bath of water approximately 5° F. below the start to open temperature. This is the number stamped on the element. Due to the effect of hysteresis the element will close 5° F. below the start to open temperature.

ELEMENT REPLACING

Remove four capscrews (8), lockwashers (9) and separate housings ref. (2) and (7). Remove element assembly (5) and seal (4). Remove housing gasket (6). Clean housing sections, remove any scale or foreign material from seal faces. Lubricate new element seal (4) and slide in place over top of element assembly (5) into position shown in section view. Place new housing gasket (6) in recess of upper housing (2). Insert element (5) into upper housing (2) to position shown in section view. Place lower housing (7) over exposed section of element (5) against face of upper housing (2). Secure housings with capscrews (8) and lockwashers (9).



Ref. No.	Description
2	Upper Housing
3	Sleeve
4	"O" Ring or Lip Seal
5	Element Assembly
6	Gasket
7	Lower Housing
8	Capscrew
9	Lockwasher

FLUID POWER ENERGY, INC.

W229 N591 Foster Court, Waukesha, WI 53186 414/548-6200; FAX 414/548-6239

FLUID POWER ENERGY, INC.
W229 N.W. 11th COURT
WALTON, FL 32587
(414) 271-3220

RETURNED GOODS POLICY

NEW, COMPLETE PRODUCTS

Most standard new and unused thermostatic valves which are suitable for resale may be returned for exchange at a 20% or \$25.00 restock charge—whichever is greater.

Thermostatic valves being returned for credit because of overstock or because of cancellations will be subject to a 25% or \$25.00 restock charge—whichever is greater.

Certain non-standard items such as plated elements, specially set high temperature valves, etc., will require a 40% or \$50.00 charge, whichever is greater.

USED PRODUCTS

FPE does not generally accept used material for exchange or credit (except elements as noted below). If a customer desires to ship any unit to us prepaid, we will inspect it and advise if any salvage credit is possible. This should be discouraged however, as it often costs more to clean and inspect a valve than can be gained in salvage.

EXCHANGING UNUSED ELEMENT ASSEMBLIES

When a customer decides the wrong temperature was selected and wished to exchange the elements before they were placed in use, he may order units of the new setting, and advise on his purchase order that he is returning the original elements. The valve model and serial number should be provided within 45 days after the replacement shipment is made, credit less a 25% restock charge (and less any postage or freight) will be allowed. If the 25% charge is less than \$25.00, the minimum \$25.00 amount will be deducted from the credit.

New element exchanges will not be made after one year from the date of original shipment.

EXCHANGING USED ELEMENT ASSEMBLIES

Sometimes a customer will install an FPE thermostatic valve and decide after several days of operation that he has the wrong temperature. If the installation has not been in operation for over 90 days, these used elements may be exchanged at a 40% (or \$25.00) cleaning and restock charge. Again the limitation of one year from original shipment applies and used elements must be received within 45 days of the replacement shipment. The purchase order for replacement elements must give the serial number of the original valve and state the original elements are being returned.

IMPORTANT

On returns of either new or used elements, the customer may be cautioned *to use care in removing elements from the valves. They may be bent or damaged by careless handling of the heavy housings.* Customers should also use care in packaging these elements for return. If the elements are damaged in any way, no credit can be issued and the elements will be returned to the customer as his property.

rev 6/29/95

FPE.WPS



FLUID POWER ENERGY, INC.

TERMS OF SALE

1. Invoices will be issued as of the date of shipment and shall become due and payable in lawful money of the United States, within thirty days of the issuance thereof, unless otherwise specifically agreed in writing.
2. All unpaid items shall bear interest at the rate of 12% per annum beginning with the first day of the second month following date of shipment

CONDITIONS OF SALE

1. The seller is not responsible for delays or failures of shipments caused by fires, strikes, trade disputes, floods, accidents, embargoes delays in transportation, shortage of materials and/or labor, action by Federal or local government or its agencies, and any other cause beyond control of the seller.
2. Where terms and conditions as shown on the customers' order are at variance with the terms and conditions of the seller, then the terms and conditions of the seller as herein or otherwise expressed shall apply.
3. The merchandise of the seller is warranted for a period of one year from date of shipment and such warranty shall cover only the replacement or repair of defective parts or workmanship, and shall not cover any cost of work done on them by the customer. The sellers' responsibility is limited to the replacement or repair of the defective parts. Should the parts be damaged in any way by the customer, or if the parts have been tampered with in any way, such as disassembling, etc., then the warranty as herein stated shall not apply and the seller shall not be responsible for the replacement or repair of such parts.
4. Merchandise may only be returned upon specific approval, in writing, by the seller. Merchandise returned without this approval is subject to return to the customer, freight charges collect. Returned merchandise must be returned freight prepaid by the customer, and no allowance shall be made for any freight charges applicable to the returned merchandise. Merchandise returned and for which credit will be given, shall be subject to a minimum restocking charge of twenty-five percent (25%) of the value of the merchandise; or twenty-five dollars (\$25.00) whichever is greater.
5. Cancellation of any order, either in part or in its entirety, shall be subject to cancellation charges in such amounts as may be determined by the seller at the time of the cancellation. Cancellation of any order, either in part or in its entirety, cannot be accepted by the seller without prior written consent by the seller.
6. Customers are advised that caution must be used in the storage of parts containing rubber or other materials subject to aging without use. Parts should be stored so that oldest items are used first.
7. All sales are made pursuant to these conditions and all orders are received with the understanding that they are placed under these conditions.

FLUID POWER ENERGY, INC.
W229 N501 FOSTER COURT
WAUKESHA, WI 53186
(414) 543-6220

WARRANTY

The merchandise of the seller is warranted for a period of one year from date of shipment, and such warranty shall not cover any cost of work done on them by the customer. The seller's responsibility is limited to the replacement or repair of the defective parts. Should the parts be damaged in any way by the customer, or if the parts have been tampered with in any way, such as disassembling, etc., then the warranty as herein stated shall not apply and the seller shall not be responsible for the replacement or repair of such parts.



HY-T PLUS™ (CLASSICAL)



Part No: B75

B .66" Top Width – Classical Profile
75 Approximate 75" Inside Length

LESS STRETCH IS THE KEY TO PERFORMANCE

Whether your talking about rubber belts or metal chains, all materials will stretch when put to use. The secret to reliable performance isn't to eliminate elongation, but to control it so that it is minimal, predictable, and uniform. To achieve these criteria, Goodyear developed the Vytacord tensile member and an exclusive 3-T tempering process.

Vytacord provides the high-strength, high horsepower rating capacity needed to effectively transmit today's drive power. It's even tough enough to tolerate slight sheave misalignment that would quickly destroy ordinary belts.

The 3-T process removes excessive stretch and imparts exceptional dimensional stability. As a result, each belt of a given size will match every other belt of that size, no matter when or where it was produced.

The exceptional dimensional stability properties of Hy-T Plus eliminates matching problems, improves performance, and increases service life.

IMPROVED MATERIALS ARE THE KEY TO THE DURABILITY AND VERSATILITY OF HY-T PLUS

The vast improvements in all components of Hy-T Plus construction complement the quality of the Vytacord tensile member.

Plioflex, Goodyear's premium heat and oil resistant rubber compound, is used in both the cushion and insulation sections of Hy-T Plus. Plioflex provides the optimum blends of fiber-loaded synthetic rubbers to produce materials

APPLICATIONS

Designed for operating at high speeds over small diameter pulleys and short center distances. Also for use in multiple V-belt drives where high shock load and heavy-duty loads are encountered.

KEY FEATURES & BENEFITS

- Universal classical profile.
- High-strength Vytacord® tensile members.
- Wingprene-impregnated Wingflex® envelope.
- Goodyear's Plioflex® cushion and insulation.
- Dual branded (Classical and FHP part numbers).
- Oil, heat, ozone, and abrasion resistant.
- Matchmaker® to eliminate mismatch.
- Static conductive.

especially suited for the demands placed on today's V-belts. The unique fiber length and blend provide flexibility on small pulleys. As a result the belt is able to serve a dual purpose for both classical and FHP, while offering more versatility than any other classical belt.

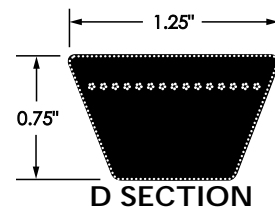
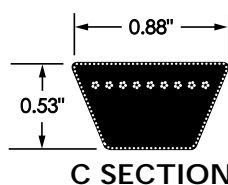
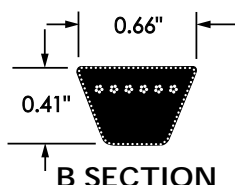
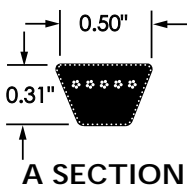
Wingflex, Hy-T Plus' new envelope construction, is based on a cotton/synthetic-blend fabric created from a new weaving process. This weaving process assures optimum wrap and fill thread angle, providing unsurpassed belt flexibility. In addition, the fabric is treated with Goodyear's exclusive Wingprene compound for long wear and resistance to heat, oil, and other environmental hazards. The envelope also assures that the belt dissipates static electricity, as specified in RMA bulletin IP3-3.

The cushion is also crush-resistant and cool running to maintain its shape, fit and strength longer. And with the longer service life achieved by Hy-T Plus belts, replacement belts are less frequent. Overall, belt costs are reduced, downtime is minimized, and equipment productivity is maintained.

LESS INVENTORY REQUIRED

The Hy-T Plus dual brand allows both distributor and end user to consolidate their existing classical V-belt sizes and fractional horsepower sizes into a single belt line that can handle both classical and FHP applications.

The result is a reduced inventory that equates to dollars taken off the shelves and into your pockets.





HY-T PLUS™ (CLASSICAL)

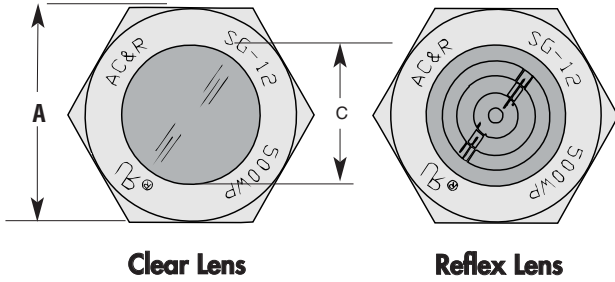
Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)
A20 (4L220)	22.0	A39 (4L410)	41.0	A58 (4L600)	60.0	A77 (4L790)	79.0	A96 (4L980)	98.0
A21 (4L230)	23.0	A40 (4L420)	42.0	A59 (4L610)	61.0	A78 (4L800)	80.0	A97 (4L990)	99.0
A22 (4L240)	24.0	A41 (4L430)	43.0	A60 (4L620)	62.0	A79 (4L810)	81.0	A98 (4L1000)	100.0
A23 (4L250)	25.0	A42 (4L440)	44.0	A61 (4L630)	63.0	A80 (4L820)	82.0	A100 (4L1020)	102.0
A24 (4L260)	26.0	A43 (4L450)	45.0	A62 (4L640)	64.0	A81 (4L830)	83.0	A103	105.0
A25 (4L270)	27.0	A44 (4L460)	45.0	A63 (4L650)	65.0	A82 (4L840)	84.0	A105	107.0
A26 (4L280)	28.0	A45 (4L470)	47.0	A64 (4L660)	66.0	A83 (4L850)	85.0	A110	112.0
A27 (4L290)	29.0	A46 (4L480)	48.0	A65 (4L670)	67.0	A84 (4L860)	86.0	A112	114.0
A28 (4L300)	30.0	A47 (4L490)	49.0	A66 (4L680)	68.0	A85 (4L870)	87.0	A120	122.0
A29 (4L310)	31.0	A48 (4L500)	50.0	A67 (4L690)	69.0	A86 (4L880)	88.0	A128	130.0
A30 (4L320)	32.0	A49 (4L510)	51.0	A68 (4L700)	70.0	A87 (4L890)	89.0	A133	135.0
A31 (4L330)	33.0	A50 (4L520)	52.0	A69 (4L710)	71.0	A88 (4L900)	90.0	A136	138.0
A32 (4L340)	34.0	A51 (4L530)	53.0	A70 (4L720)	72.0	A89 (4L910)	91.0	A144	146.0
A33 (4L350)	35.0	A52 (4L540)	54.0	A71 (4L730)	73.0	A90 (4L920)	92.0	A158	160.0
A34 (4L360)	36.0	A53 (4L550)	55.0	A72 (4L740)	74.0	A91 (4L930)	93.0	A173	175.0
A35 (4L370)	37.0	A54 (4L560)	56.0	A73 (4L750)	75.0	A92 (4L940)	94.0	A180	182.0
A36 (4L380)	38.0	A55 (4L570)	57.0	A74 (4L760)	76.0	A93 (4L950)	95.0		
A37 (4L390)	39.0	A56 (4L580)	58.0	A75 (4L770)	77.0	A94 (4L960)	96.0		
A38 (4L400)	40.0	A57 (4L590)	59.0	A76 (4L780)	78.0	A95 (4L970)	97.0		

Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)
B22 (5L250)	25.0	B45 (5L480)	48.0	B68 (5L710)	71.0	B91 (5L940)	94.0	B144	147.0
B23 (5L260)	26.0	B46 (5L490)	49.0	B69 (5L720)	72.0	B92 (5L950)	95.0	B148	151.0
B24 (5L270)	27.0	B47 (5L500)	50.0	B70 (5L730)	73.0	B93 (5L960)	96.0	B150	153.0
B25 (5L280)	28.0	B48 (5L510)	51.0	B71 (5L740)	74.0	B94 (5L970)	97.0	B154	157.0
B26 (5L290)	29.0	B49 (5L520)	52.0	B72 (5L750)	75.0	B95 (5L980)	98.0	B158	161.0
B27 (5L300)	30.0	B50 (5L530)	53.0	B73 (5L760)	76.0	B96 (5L990)	99.0	B162	165.0
B28 (5L310)	31.0	B51 (5L540)	54.0	B74 (5L770)	77.0	B97 (5L1000)	100.0	B173	176.0
B29 (5L320)	32.0	B52 (5L550)	55.0	B75 (5L780)	78.0	B98 (5L1010)	101.0	B180	183.0
B30 (5L330)	33.0	B53 (5L560)	56.0	B76 (5L790)	79.0	B99 (5L1020)	102.0	B190	193.0
B31 (5L340)	34.0	B54 (5L570)	57.0	B77 (5L800)	80.0	B100	103.0	B195	198.0
B32 (5L350)	35.0	B55 (5L580)	58.0	B78 (5L810)	81.0	B101	104.0	B205	208.0
B33 (5L360)	36.0	B56 (5L590)	59.0	B79 (5L820)	82.0	B103	106.0	B210	213.0
B34 (5L370)	37.0	B57 (5L600)	60.0	B80 (5L830)	83.0	B105	108.0	B225	227.0
B35 (5L380)	38.0	B58 (5L610)	61.0	B81 (5L840)	84.0	B108	111.0	B240	242.0
B36 (5L390)	39.0	B59 (5L620)	62.0	B82 (5L850)	85.0	B111	114.0	B255	257.0
B37 (5L400)	40.0	B60 (5L630)	63.0	B83 (5L860)	86.0	B112	115.0	B270	272.0
B38 (5L410)	41.0	B61 (5L640)	64.0	B84 (5L870)	87.0	B116	119.0	B285	287.0
B39 (5L420)	42.0	B62 (5L650)	65.0	B85 (5L880)	88.0	B120	123.0	B300	302.0
B40 (5L430)	43.0	B63 (5L660)	66.0	B86 (5L890)	89.0	B124	127.0	B315	317.0
B41 (5L440)	44.0	B64 (5L670)	67.0	B87 (5L900)	90.0	B128	131.0		
B42 (5L450)	45.0	B65 (5L680)	68.0	B88 (5L910)	91.0	B133	136.0		
B43 (5L460)	46.0	B66 (5L690)	69.0	B89 (5L920)	92.0	B136	139.0		
B44 (5L470)	47.0	B67 (5L700)	70.0	B90 (5L930)	93.0	B140	143.0		

Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)
C51	55.0	C85	89.0	C109	113.0	C158	162.0	C270	272.0
C55	59.0	C90	94.0	C112	116.0	C162	166.0	C285	287.0
C60	64.0	C94	100.0	C115	119.0	C173	177.0	C300	302.0
C68	72.0	C100	101.0	C120	124.0	C180	184.0	C315	317.0
C71	75.0	C101	103.0	C124	128.0	C195	199.0	C330	332.0
C72	76.0	C103	104.0	C128	132.0	C210	214.0	C345	347.0
C75	79.0	C104	105.0	C136	140.0	C225	227.0	C360	362.0
C78	82.0	C105	109.0	C144	148.0	C240	242.0	C390	392.0
C81	85.0	C108	112.0	C150	154.0	C255	257.0	C420	422.0

Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)	Part Number	Approx. Outside Length (in.)
D112	117.0	D162	167.0	D225	228.0	D300	303.0	D390	393.0
D120	125.0	D173	178.0	D240	243.0	D315	318.0	D420	423.0
D128	133.0	D180	185.0	D255	258.0	D330	333.0	D450	453.0
D144	149.0	D195	200.0	D270	273.0	D345	348.0	D480	483.0
D158	163.0	D210	215.0	D285	388.0	D360	363.0	D540	543.0

V-BELT



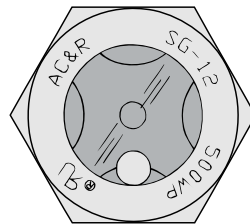
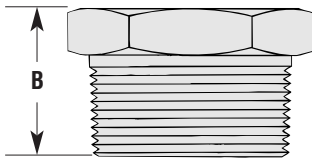
Clear Lens

Reflex Lens

These sight glasses are available in three basic styles; Clear Lens; Reflex Lens; and Clear Lens with Floating Ball. All sight glasses feature a nickel plated steel body, hermetically sealed viewing lens, American standard tapered pipe thread, 500 PSI maximum working pressure. These sight glasses are suitable for most standard refrigerants, and other industrial fluids non-corrosive to glass and steel (for R-11 applications, an aluminum ball is available for the SG-1200's add "C" suffix i.e. SG-1206C).

The SG-1000's & SG-1100's are rated for a maximum temperature of 500°F (260°C). The SG-1200's are rated for a maximum temperature of 300°F (148°C). The SG-1100's (Reflex Lens) look dark when liquid is present and light when liquid is absent.

Catalog Number			Dimensions (Inch)			Thread
Clear	Reflex	Clear w/Ball	Hex. A	B	Dia. C	Size M. P.T.
SG-1004	SG-1104	SG-1204	.94	.90	.56	1/2"
SG-1006	SG-1106	SG-1206	1.12	1.06	.75	3/4"
SG-1008	SG-1108	SG-1208	1.38	1.32	.94	1"
SG-1010	SG-1110	SG-1210	1.75	1.25	1.19	1 1/4"
SG-1012	SG-1112	SG-1212	2	1.41	1.31	1 1/2"
SG-1016	SG-1116	SG-1216	2.50	1.28	1.63	2"



**Clear Lens
with Floating Ball**
*Not for ammonia service

ATTN: SCOTT CAVE



Hydro Flex Hose (Western) Limited
 9624-45 Ave, Edmonton AB T6E 5Y9
 Ph: (780) 436-9271 Fax: (780) 436-8601

HYDRO-FLEX Molded Expansion Joints Series 240

Hydro-Flex Series 240 Non-Metallic Expansion Joints are designed for tough demanding industrial applications found in: Air Conditioning-Heating and Ventilation Systems, Chemical-Petrochemical and Industrial Piping System, Water-Wastewater-Sewage and Pollution Control Systems. Installed next to equipment or between the anchor points of a piping system, they Absorb Pipe/ Movement/ System Noise, Isolate Vibration, Compensate Alignment/Offset, Eliminate Electrolysis, Protect Against Surge Forces.

Spherical Shapes – Stronger - More Efficient.

Featuring an engineered molded style single design bellows, the Hydro-Flex Series 240 is inherently strong. Internal pressure within a sphere is exerted in all directions, distributing forces evenly over a large spherical design "flowing arch" reduces turbulence, sediment build up, thrust area and the effect on the piping system equipment.

Greater movements are available with the Hydro-Flex Series 240. Spherical type expansion joints absorb axial compression, elongation, deflection and angular movements in the system. These joints are forgiving and thus easier to install in non-standard openings, caused by equipment shifting or settling. Compressing or pre-extending the bellows to the required length, there will still be enough movement for operation.

Easy Installation With Alignment Flanges. The floating metallic flanges freely rotate on the bellows compensating for mating flange misalignment, thus speeding up installation time. Gaskets are not required with the Series 240.

Less System Strain With Thin Wall Design. Manufactured by high pressure molding of elastomer with fabric reinforcement, the Series 240 have a thinner wall section and lighter weight. Lower stresses are therefore required, reducing piping/ flange/ equipment stress-strain-damage. Hydro-Flex Series 240 is acceptable for use with plastic piping systems where even lower deflection forces are required.

Specifications. The Hydro-Flex Series 240 is designed to meet or exceed the pressure, temperature and dimensional rate of the "Spool" Arch Types as shown in the Rubber Expansion Joint Division, Association "Technical Handbook - Sixth Edition" Table V.

Absorbs Vibration-Noise-Shock. The Hydro-Flex Series 240 quiet operating is a replacement for "transmitting" metallic expansion joints. Sound loses energy travelling axially through the elastomer. Water hammer pumping impulses and water-borne noises are cushioned and absorbed by the mold thin-wall structure. Install the Series 240 in a system to enable isolated equipment to move without vibration mountings, or to reduce vibration transmission when the piping section beyond the expansion joint is anchored or sufficiently rigid.

Flange Materials/ Drilling. All Hydro-Flex Series 240 connectors are furnished complete with plate flanges for corrosion protection and are tapped to ANSI 150# standards. Stainless Steel flanges upon special order.

Chemical Service Capability At Minimal Cost. Expensive, exotic metal expansion joints for chemical service can be replaced with the Hydro-Flex Series 240. Molded with low cost chemical resistant elastomer.

Neoprene, Nitrile, Hypalon, EPDM, and Chlorobutyl; insures an expansion joint is compatible with pumped or piped.

Wide Service Range With Low Cost. Engineered to operate up to 300psi and 265 ° F, the Hyd 240 can be specified for a wide range of piping requirements.



HYDRO-FLEX STYLE 240 Rubber Expansion Joints

AVAILABLE STYLES/ MATERIALS

240- A	240- C	240- AV,D,E,M	242- A,B,C	Hydro- Flex Material Code	Cover Elastomer	Tube Elastomer	Maximum Operating Temp. ° F
		X	X	/BB	Butyl	Butyl	250
	X	X	X	/EE	EPDM	EPDM	250
	X			/EE-9	EPDM	EPDM	265
	X			/ET-9	EPDM	Teflon	265
	X			/HH	Hypalon	Hypalon	230
		X	X	/NH	Neoprene	Hypalon	230
	X			/NJ	Neoprene	FDA-Nitrile	230
		X	X	/NN	Neoprene	Neoprene	230
X	X	X	X	/NP	Neoprene	Nitrile	230
X	X			/NT	Neoprene	Teflon	230

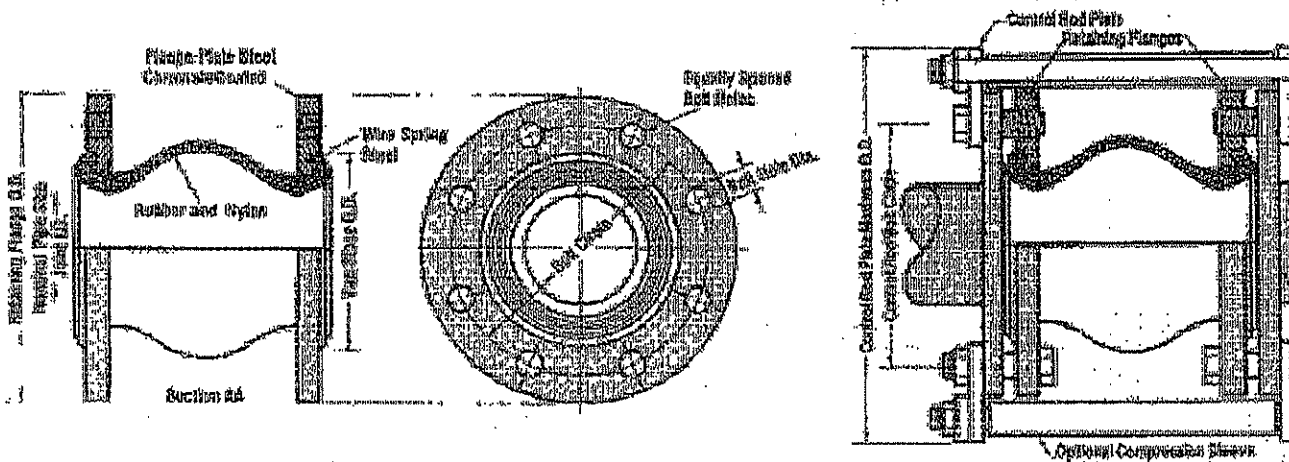
240 SERIES EXPANSION JOINTS ~ SIZES ~ MOVEMENTS ~ PRESSURE ~ FLANGE STANDARDS ~ WEIGHTS

Nominal Pipe Size I.D.	Neutral Length	Hydro- Flex Style Number	Axial Com- pression Inches	Axial Extension Inches	± Lateral Deflection Inches	± Angular Deflection Degrees	Thrust Factor	Positive PSIG	Vacuum Inches Hg	Flange O.D.	Circle Holes	No. Holes	Bolt Hole Thread
2"	6"	240-AV	0.50"	0.37"	0.50"	20	7.07	225	26	6.0"	4.75"	4	5/8-11 unc
2 ½"	6"	240-AV	0.50"	0.37"	0.50"	17	11.05	225	26	7.0"	5.5"	4	5/8-11 unc
3"	6"	240-AV	0.50"	0.37"	0.50"	14	13.36	225	26	7.5"	6.0"	4	5/8-11 unc
4"	6"	240-AV	0.75"	0.50"	0.50"	14	22.69	225	26	9.0"	7.5"	8	5/8-11 unc
5"	6"	240-AV	0.75"	0.50"	0.50"	11	30.02	225	26	10.0"	8.5"	8	¾-10

Hydro-Flex Hose - Rubber Expansion Joints

6"	6"	240-AV	0.75"	0.50"	0.50"	9	41.28	225	26	11.0"	9.5"	8	unc ¾-10 unc
8"	6"	240-AV	0.75"	0.50"	0.50"	7	63.62	225	26	13.5"	11.75"	8	¾-10 unc
10	8"	240-AV	1.00"	0.62"	0.75"	7	103.87	225	26	16.0"	14.25"	12	7/8-9 unc

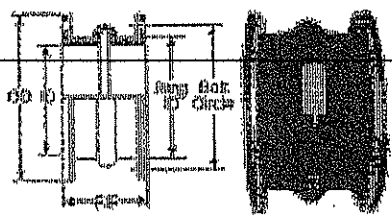
Hydro-Flex 240 Rubber Expansion Joints



SJ-21 Expansion Joint

This is the industry standard spool type expansion joint. It is available with 0 - 4 arches depending on the movements required, and 3 standard pressure ratings. This joint is hand built in a variety of elastomers for the most unusual and difficult applications. It can be constructed with filled arches to eliminate settling of solids in the arch and Teflon liners may be incorporated for the more severe chemical applications. This joint is also available in concentric or eccentric tapers for connecting piping of different sizes.

Hydro-Flex Hose - Rubber Expansion Joints



SR = Standard Pressure (psi) LP = Low Pressure (psi) HP = High Pressure (psi) AM^(A) = Allowable Movement (in.) TF^(A) = Total Force (lbs.)

Size ID	Flange OD/In	Bolt Circle	Bolts No.	Holes Dia.	Ring ID	FF (per Inch) ⁽¹⁾				Work Pressure			Axial Comp.		Axial Ext.		Transverse Def.		Est. Weight Joint Rings	
						1	2	3	4	SR	LP	HP	AM	TF	AM	TF	AM	TF		
1	4-1/4	3-1/8	4	5/8	2-3/8	6	10	12	14	185	15	200	1/2	103	1/4	78	1/2	175	2	2.25
1-1/4	4-5/8	3-1/2	4	5/8	2-5/8	6	10	12	14	185	15	200	1/2	129	1/4	98	1/2	219	2.5	2.25
1-1/2	5	3-7/8	4	5/8	2-7/8	6	10	12	14	185	15	200	1/2	154	1/4	115	1/2	262	3	3
2	6	4-3/4	4	3/4	3-5/8	6	10	12	14	185	15	200	1/2	185	1/4	135	1/2	350	4	4
2-1/2	7	5-1/2	4	3/4	4-1/8	6	10	12	14	185	15	200	1/2	232	1/4	172	1/2	381	4.5	4.5
3	7-1/2	6	4	3/4	4-5/8	6	10	12	14	185	15	200	1/2	278	1/4	207	1/2	412	5.5	6
4	9	7-1/2	8	3/4	5-7/8	8	10	12	14	185	15	200	1/2	371	1/4	278	1/2	478	8	7.5
5	10	8-1/2	8	7/8	6-7/8	8	10	12	14	185	15	200	1/2	453	1/4	344	1/2	548	9	8
6	11	9-1/2	8	7/8	7-7/8	8	10	12	16	165	15	200	1/2	558	1/4	419	1/2	617	11	9
8	13-1/2	11-3/4	6	7/8	9-7/8	8	10	14	16	140	15	190	3/4	971	3/8	689	1/2	753	15	12
10	16	14-1/4	12	1	12-1/8	8	12	14	18	140	15	190	3/4	1214	3/8	861	1/2	809	23	16
12	18	17	12	1	14-1/2	8	12	14	18	140	15	190	3/4	1456	3/8	1033	1/2	948	34	22
14	21	18-3/4	12	1-1/8	16-1/2	8	12	16	20	85	15	130	3/4	1274	3/8	904	1/2	1117	40	25
16	23-1/2	21-1/4	16	1-1/8	18-1/2	8	12	18	20	85	15	110	3/4	1456	3/8	1033	1/2	1286	47	27
18	25	22-3/4	16	1-1/4	20-1/2	8	12	18	20	85	15	110	3/4	1828	3/8	1163	1/2	1420	58	29
20	27-1/2	25	20	1-1/4	22-5/8	8	12	18	20	85	15	110	7/8	2152	3/8	1305	1/2	1585	67	35
22	29-1/2	27-1/4	20	1-3/8	24-5/8	10	14	18	22	85	15	110	7/8	2387	7/16	1358	1/2	1646	70	44
24	32	29-1/2	20	1-3/8	26-5/8	10	14	18	22	85	15	110	7/8	2562	7/16	1307	1/2	1706	70	49
26	34-1/4	31-3/4	24	1-3/8	28-7/8	10	14	18	22	55	15	90	1	2869	1/2	1600	1/2	1829	100	50
28	36-1/2	34	28	1-3/8	30-7/8	10	14	18	22	55	15	90	1	3090	1/2	2143	1/2	1952	102	58
30	38-3/4	36	28	1-3/8	32-7/8	10	14	18	22	55	15	90	1	3311	1/2	2297	1/2	2075	117	55
34	43-3/4	40-1/2	32	1-5/8	37	10	14	18	22	55	15	90	1	3752	1/2	2602	1/2	2301	112	81
36	46	42-3/4	32	1-5/8	39	10	14	18	22	55	15	90	1	3973	1/2	2756	1/2	2184	143	98
40	50-3/4	47-1/4	36	1-5/8	43	10	14	18	22	55	15	90	1	4414	1/2	3062	1/2	3398	173	108
42	53	49-1/2	36	1-5/8	45-1/4	12	14	18	24	55	15	80	1-1/8	4732	1/2	3253	1/2	3423	153	110
44	55-1/4	51-3/4	40	1-3/4	47-1/4	12	14	18	24	55	15	80	1-1/8	4953	1/2	3407	1/2	3571	108	126
46	57-1/2	53	44	1-5/8	51-1/4	12	14	18	24	55	15	80	1-1/8	5409	1/2	3717	1/2	3859	211	154
50	61-3/4	57-1/4	44	1-7/8	53-1/4	12	14	18	24	55	15	80	1-1/8	5834	1/2	3872	1/2	4012	240	163
54	65-1/4	61-3/4	44	2	57-1/4	12	14	18	24	55	15	80	1-1/8	6085	1/2	4182	1/2	4303	265	185
58	69-3/4	65	48	2	61-1/4	12	14	18	24	55	15	80	1-1/8	6310	1/2	4341	1/2	4446	288	203
60	73	69-1/4	52	2	63-1/4	12	14	18	24	55	15	80	1-1/8	6761	1/2	4651	1/2	4738	309	218
62	75-3/4	71-3/4	52	2	65-1/4	12	14	18	24	55	15	80	1-1/8	7150	1/2	4690	1/2	4820	325	230
66	80	76	52	2	69-1/4	12	14	18	24	55	15	80	1-1/8	7437	1/2	5118	1/2	5108	360	255
72	88-1/2	82-1/2	60	2	75-1/4	12	14	18	24	45	15	70	1-1/8	8119	1/2	5591	1/2	5477	385	300
78	93	88-3/4	60	2-1/8	81-1/4	12	14	18	24	45	15	70	1-1/8	8783	1/2	6048	1/2	5851	410	325
84	100-3/4	95-1/2	64	2-1/4	87-1/2	12	14	18	24	45	15	70	1-1/8	9465	3/16	6511	1/2	6426	435	350
96	113-1/4	108-1/2	68	2-1/2	93-5/8	12	18	18	24	45	15	70	1-1/8	10817	3/16	7441	1/2	7375	485	400
102	120	114-1/2	72	2-5/8	--	12	18	20	24	45	15	70	2	12650	1	12650	1/2	8331	535	450
108	128-3/4	120-3/4	72	2-5/8	--	12	18	20	24	46	15	70	2	21815	1	14800	1/2	8785	585	500

SJ-205 Expansion Joint

This style of expansion joint is interchangeable with the Style SJ-21 series, but this joint has a streamlined arch shape which is self cleaning, eliminating the need for filled arches.

ID	2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	22	24	26	28-40	42-48
FF	8	8	8	8	8	8	8	8	8	8	8	8	8	10	10	10	10	12
Pressure Rating																		
LP	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
SR	150	150	150	150	150	150	150	150	150	65	65	65	65	65	65	65	55	55
HP	200	200	200	200	200	200	200	200	200	125	125	125	125	125	125	90	90	80
Axial																		
Comp.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1	1	1	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2
Ext.	1/4	1/4	1/4	1/4	1/4	1/4	3/8	3/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Lateral																		
Offset	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

MJ-60 Expansion Joint

A low cost double wide arch joint, externally reinforced, molded butyl expansion joint with twice the movement capacity of the standard joints. Commonly used in pulp and paper mills, as well as water and waste treatment applications. Special hand made versions of this joint are available in different elastomers and multiple arch configurations for other types of applications.

ID	1	1-1/2	2	2-1/2	3	4	5	6	8	10	12	14	16	18	20	24	30	36	
FF	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	10	10	10	
Pressure	150	150	150	150	150	150	150	150	150	150	150	150	150	110	110	110	100	100	60
Vacuum	20	20	20	20	20	15	15	15	15	15	10	10	10	10	10	10	26	26	
Axial																			
Comp.	5/8	5/8	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	2	2	2	2-1/4	2-1/4	2-1/4
Force	220	230	220	260	330	450	550	670	740	830	970	1190	1270	1430	1500	2145	2700	3300	
Elong.	1/4	1/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1
Force	120	130	120	150	180	250	310	370	410	530	590	670	780	810	900	1240	1565	1912	
Deflection																			
Lateral	1/4	1/4	3/4	3/4	3/4	3/4	3/4	1	1	1	1	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	
Force	160	170	160	170	190	210	260	370	460	660	870	780	870	960	1070	1160	1461	1779	
Angular	25	25	35	30	30	25	25	20	20	15	15	12	12	9	9	9	5	5	
Weight	4.0	6.0	9.0	9.0	10	14	17	19	25	34	52	60	69	79	93	118	-	-	

WATER FILLER CAP ASSEMBLY



MODEL 390 WITH 1" MNPT

The Model 390 has an automotive type radiator cap. It is supplied with a 3/16" hole in the filler neck. Two choices of radiator caps are available.

Model Number	Radiator Cap Pressure Rating
390-7	7 lb.
390-1K	15 lb.



MODEL 29508 WITH 1" MNPT

The Model 29508 has an automotive type radiator cap. It is supplied with a 1/4" OD vent tube in the filler neck. Two choices of radiator caps are available.

Model Number	Radiator Cap Pressure Rating
29508-7	7 lb.
29508-15	15 lb.

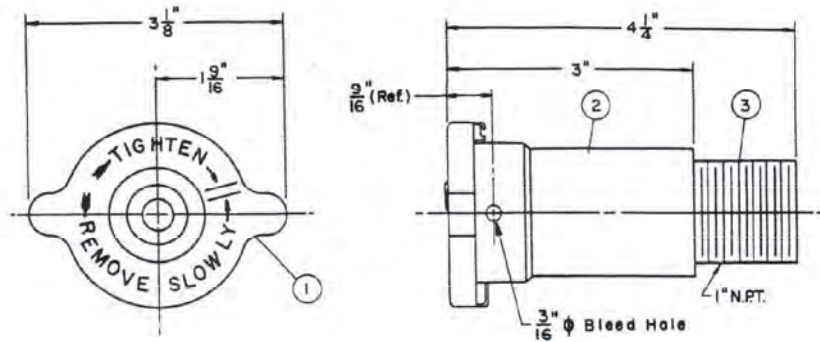


MODEL 1794 WITH 2" MNPT

The Model 1794 has a truck radiator cap. It is supplied with a 5/16" OD vent tube in the filler neck. Two choices of radiator caps are available.

Model Number	Radiator Cap Pressure Rating
1794-7	7 lb.
1794-15	15 lb.

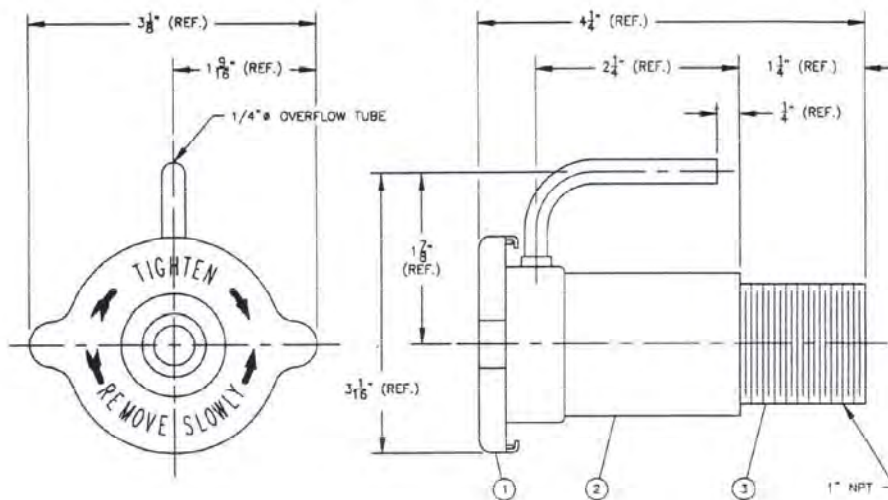
MODEL 390 FILLER CAP ASSEMBLY



REPLACEMENT RADIATOR CAP

	P/N
7#	A-3352
15#	A-733

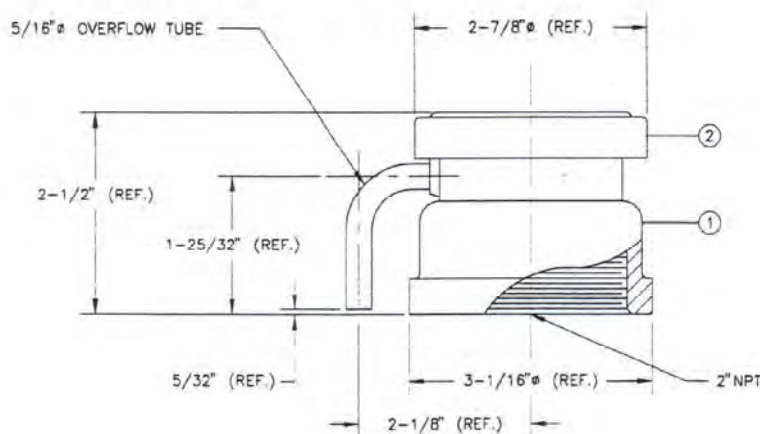
MODEL 29508 FILLER CAP ASSEMBLY



REPLACEMENT RADIATOR CAP

	P/N
7#	A-3352
15#	A-733

MODEL 1794 FILLER CAP ASSEMBLY



REPLACEMENT RADIATOR CAP

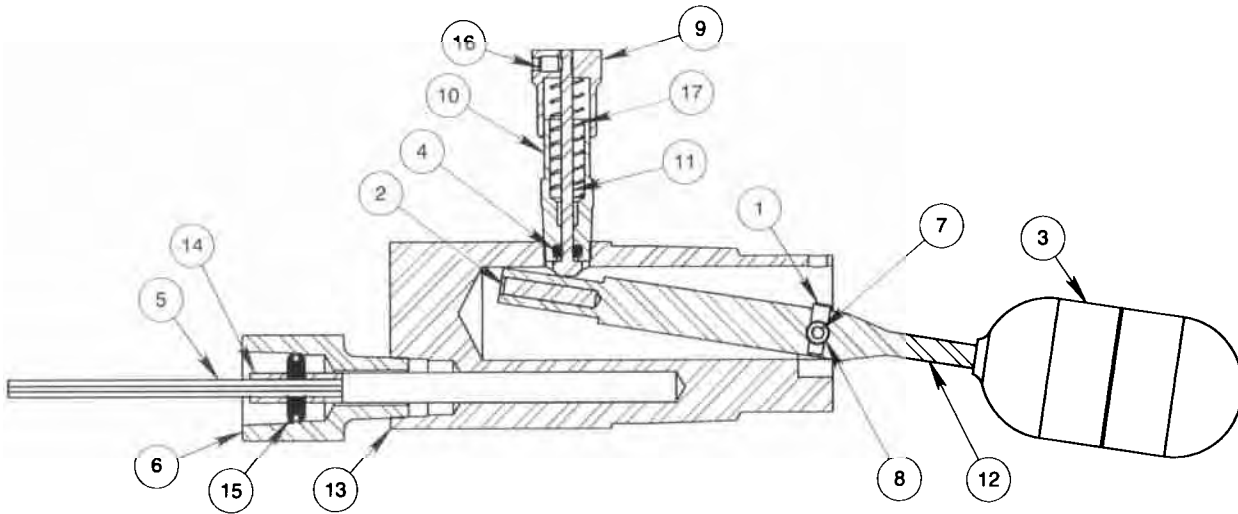
P/N

Represented by:

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1-1/2" & 2" NPT SLS
 316 STAINLESS STEEL
 2000 & 5000 lbs. W.P.



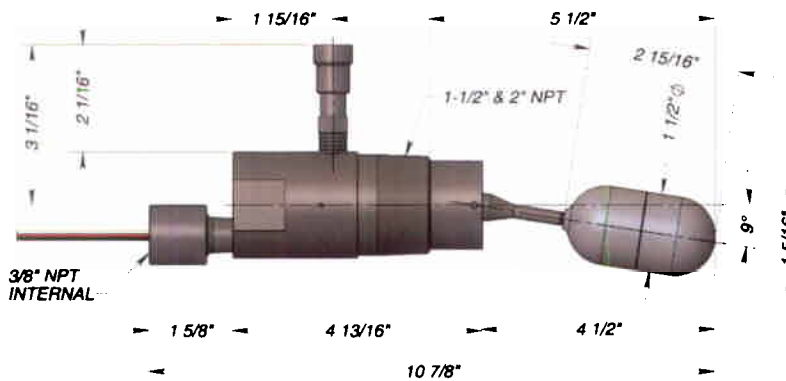
ITEM #	PART #	COMMON PARTS	QTY.
1	1519	SET SCREW	1
2	3206	MAGNET	1
4	5410	O-RING	1
5	5413	SWITCH CARTRIDGE	1
6	5414	CONDUIT ADAPTOR	1
8	5416	LEVER SPACER	2
9	5417	PUSH CAP	1
10	5418	OVERRIDE FITTING	1
11	5419	STEM	1
12	5420	FLOAT LEVER	1
14	5423	GROMMET INSERT	1
15	5424	GROMMET	1
16	5426	SET SCREW	1
17	5429	SPRING	1

ITEM #	PART #	BODIES	QTY.
13	5434	2 IN NPT	1
13	5425	1 1/2 IN NPT	1
13	5433	2 IN NPT M.O.	1
13	5421	1 1/2 IN NPT M.O.	1

ITEM #	PART #	FLOATS	QTY.
3	3216	316 SS	1
3	5431	POLY	1

ITEM #	PART #	LEVER PINS	QTY.
7	5415	LEVER PIN 1 1/2" BODY	1
7	5432	LEVER PIN 2" BODY	1

DIMENSIONS



**HORIZONTAL ELECTRONIC LEVEL SWITCH
 AVAILABLE: STAINLESS STEEL**

CAT. NO.	ORIFICE SIZE	LEVEL CONTROL	DES. PRESS.	OPER. PRESS.
CEB1	1 1/2" NPT	1200 SLS SS6 FLOAT	2000	2000
CEB2	1 1/2" NPT	1200 SLS SS6 FLOAT M/O	2000	2000
CEC1	2" NPT	2200 SLS SS6 FLOAT	2000	2000
CEC2	2" NPT	2200 SLS SS6 FLOAT M/O	2000	2000

M/O stands for Manual Override

**HORIZONTAL ELECTRONIC LEVEL SWITCH
 AVAILABLE: POLY**

CAT. NO.	ORIFICE SIZE	LEVEL CONTROL	DES. PRESS.	OPER. PRESS.
CEB1-PP	1 1/2" NPT	1500 SLS POLY FLOAT	5000	5000
CEB2-PP	1 1/2" NPT	1200 SLS POLY FLOAT M/O	2000	2000
CEC1-PP	2" NPT	2500 SLS POLY FLOAT	5000	5000
CEC2-PP	2" NPT	2200 SLS POLY FLOAT M/O	2000	2000

M/O stands for Manual Override



MANUAL CHAIN HOIST

CF SERIES

Model CF4

ASBESTOS-FREE

Asbestos-Free Friction Plate and
Reliable Brake Performance

EASY MAINTENANCE

Extremely Limited in Parts Number;
Easy Disassemble and Assemble

HIGH EFFICIENCY

Ball Bearings for the Body and the Top Level
in the World in Efficiency

SUPER-LOAD CHAIN

World-Renowned Ultra Strong Load Chain;
Breaking Stress of $1000\text{N}/\text{mm}^2$ ($100\text{kgf}/\text{mm}^2$)

HIGH DURABILITY

Solid Construction and Sturdily Built

HOOK WITH LATCH

Heat-Treated Durable Hooks and Easy Loading

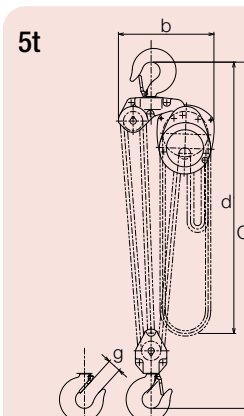
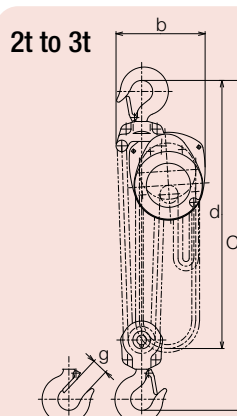
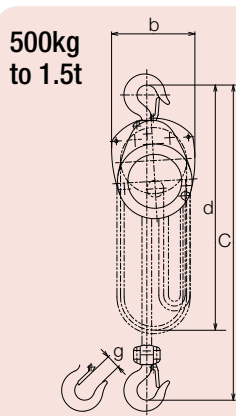
ALUMINIUM DIE-CASTING BODY

Lighter Weight and Easy Handling

Note: All measurements used in this catalogue
are based on metric figures(SI unit system).



HOIST



Model	Code	Capacity (t)	Std. Lift (m)	Min. Headroom :C (mm)	Chain Pull to Lift Full Load (N (kgf))	Chain O'hauled to Lift Load One Meter (m)	Test Load (t)	Mass (Net Weight) (kg)	Shipping Mass (Weight) (Approx.) (kg)	Load Chain Fall (lines)	Mass (Weight) for Additional One Meter of Lift (kg)	b (mm)	d (m)	g (mm)
CF4	CF005	0.5	2.5	325	294 (30)	19	0.75	10	11	1	1.5	150	2.5	27
CF4	CF010	1	2.5	370	353 (36)	31	1.5	12	13	1	1.8	174	2.5	29
CF4	CF015	1.5	2.5	440	412 (42)	41	2.36	17	18	1	2.1	203	2.5	34
CF4	CF020	2	3.0	510	392 (40)	63	3	21	22	2	2.7	204	3.0	36
CD4	CF030	3	3.0	590	451 (46)	81	4.75	28	30	2	3.2	240	3.0	42.5
CF4	CF050	5	3.0	620	451 (46)	134	6.3	37	39	3	4.3	342	3.0	46.5

Any lift of chains are available on request. KITO chains are heat-treated. NEVER attempt to lengthen the load chain by welding. The chain must be replaced with a new one of desired length. When ordering, specify the lifting height.

KITO TF Series Universal Trolley Model TF2

Economical Type



500kg to 3t Capacity



Plain Type

Geared Type

5t Capacity



Plain Type

Geared Type

- Life Time Lubricated Ball Bearing Equipped
- Adjustable for Both Tapered and Flat Flanged
- Load Equalization and Smooth Operation with Pivot Mounted Trolley Frames
- Extremely Small Min. Radius for Curve (500kg to 3t Capacity)

Model	Code		Capacity (t)	Beam Width Adjustability (mm)			Min. Radius for Curve (mm)	Mass (Net Weight) (kg)		Hand Chain Folded Length (m)
	Plain Trolley	Geared Trolley		Standard	Option			TFP	TFG	
					W20*	W30*				
TF2	TFP005	—	0.5	50 to 102	102 to 203	203 to 305	350	4.0	—	—
TF2	TFP010	TFG010	1	58 to 127	127 to 203	203 to 305	450	7.0	11	2.5
TF2	TFP015	TFG015	1.5	82 to 153	—	153 to 305	550	13	17	2.5
TF2	TFP020	TFG020	2	82 to 153	—	153 to 305	550	13	17	3.0
TF2	TFP030	TFG030	3	82 to 153	—	153 to 305	650	21	25	3.0
TF2	TFP050	TFG050	5	125 to 178	—	178 to 305	2000	43	47	3.5

*W20 and W30 mean 203 and 305mm beam width adjustability as option.
In case of only straight I-beam, 500kg plain trolley can be used on 58mm and less width beam, and 1 t plain trolley and geared trolley can be used on 74mm and less width beam.

Specifications and dimensions are subject to change without notice.



KITO CORP

3-37-4 Yoyogi, Shibuya-ku, Tokyo 151-0053, Japan

TEL: +81 3-5371-7341 FAX: +81 3-5371-7349

E-mail: overseas@kito.co.jp

URL: http://www.kito.co.jp

Distributed by:



Printed in Japan 14.06(CK.H)CF01-10

FRONT MOUNTING LIQUID LEVEL GAGES - WITH AND WITHOUT THERMOMETER

A patented dual purpose closed circuit style liquid level gage that provides both instant and positive visual check of fluid levels and temperature in either hydraulic or oil reservoirs. Maximum sight protection is provided by the heavy precision machined bar stock body. Thermometer series gages have a protected sensing element that extends well into the tank - unaffected by unrelated ambient temperature. Gages are furnished complete including O-ring seals and hex nuts for mounting. A .06 (1.52mm) alignment adjustment at each stud facilitates mounting. This gage can be installed from the outside on 1/2-20UNF tapped holes when reservoirs do not have access to the interior and tank wall thickness permits tapping. For installations where gage is bolted to cylindrical tank wall, conical sleeves are available. **Please specify** when ordering. Front mounting gages can be made to order with mounting centers up to 142.00 (3606.80mm) in 1.00 (25.40mm) increments. Stainless steel dial thermometer: 1.38 (35.05mm) dia. dual scale Fahrenheit (50° to 300°), Centigrade (10° to 150°). For back mount gages see our SERIES G610 and G620 on Bulletin F327-10/-20.

STANDARD MATERIALS:

- Aluminum construction
- Buna N seals
- Borosilicate glass with redline on white background for distinct level reading and maximum fluid compatibility

OPERATING CONDITIONS:

- See ENG. STD. 109

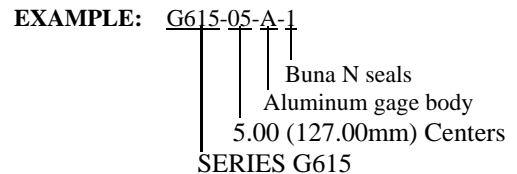
HOW TO ORDER:

Use code letters for body material: Use code number for seal material:

- | | |
|--|-------------------------------|
| A - Aluminum gage body (standard) | 1 - Buna N seals (standard) |
| B - Brass gage body (optional) | 2 - Butyl seals (optional) |
| S - Steel gage body (optional) | 3 - Viton A® seals (optional) |
| Y - Stainless Steel gage body (optional) | 4 - Ethylene propylene seals |
| | 10- Neoprene seals (optional) |

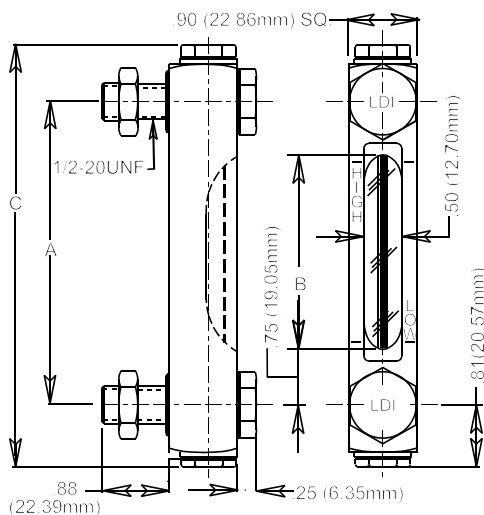
First, specify series number, then mounting centers, then kind of metal, and finally seal material, separating each with a dash (-):

SERIES G605 WITHOUT THERM.	SERIES G615 WITH THERM.	A - CENTERS INCHES (mm)	B - SIGHT INCHES (mm)	C - LENGTH INCHES (mm)
G605	G615	03 (76.20)	1.50 (38.10)	4.62 (117.35)
G605	G615	04 (101.60)	2.50 (63.50)	5.62 (142.75)
G605	G615	05 (127.00)	3.50 (88.90)	6.62 (168.15)
G605	G615	06 (152.40)	4.50 (114.30)	7.62 (193.55)
G605	G615	07 (177.80)	5.50 (139.70)	8.62 (218.95)
G605	G615	08 (203.20)	6.50 (165.10)	9.62 (244.35)
G605	G615	09 (228.60)	7.50 (190.50)	10.62 (269.75)
G605	G615	10 (254.00)	8.50 (215.90)	11.62 (295.15)
G605	G615	11 (279.40)	9.50 (241.30)	12.62 (320.55)
G605	G615	12 (304.80)	10.50 (266.70)	13.62 (345.95)

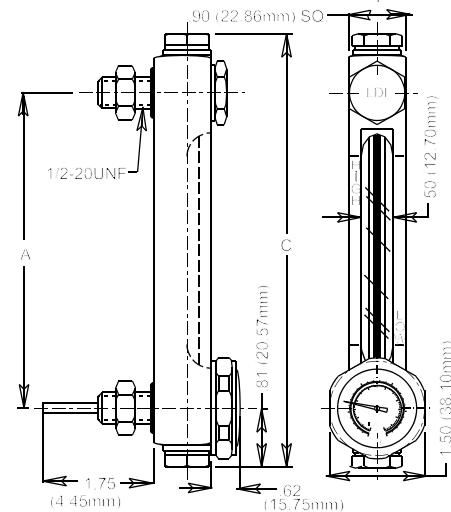


NOTE: The sight opening in all cases is 1.50 (38.10mm) less than mounting centers and overall length is 1.62 (41.15mm) greater than mounting centers. Gages with 13.00 (330.20mm) and greater mounting centers are furnished with spacer sleeves to space gage from tank allowing for bowing of the tank wall in larger reservoirs. Center mounting kits are furnished with gages 48.00 (1219.20mm) and greater mounting centers.

SERIES G605 - SIGHT ONLY



SERIES G615 WITH DIAL THERMOMETER



LUBE DEVICES, INC.

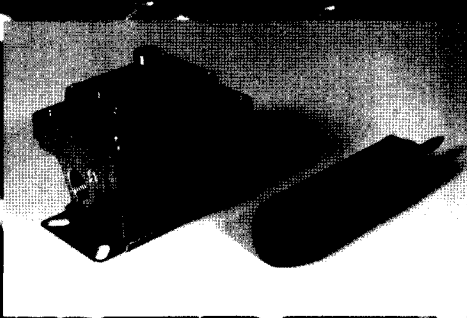
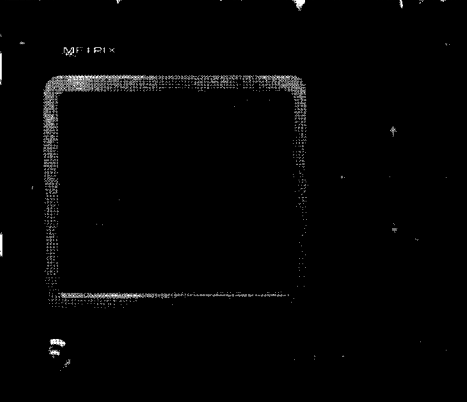
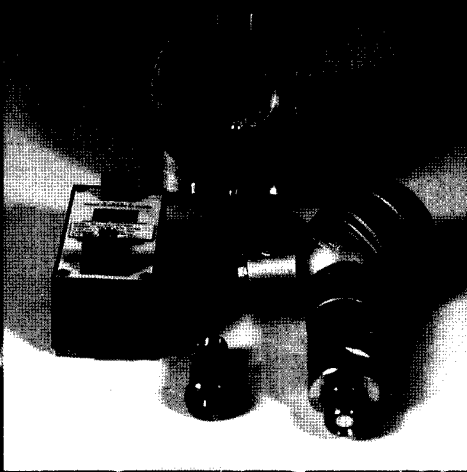
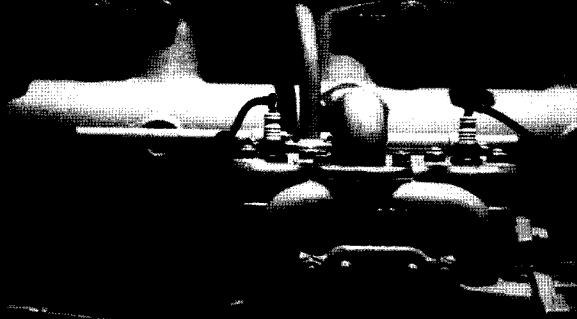
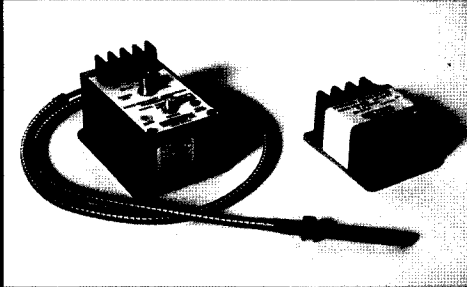
1864 NAGLE AVE., P.O. BOX 1810, MANITOWOC, WI 54221-1810
 PHONE: (920) 682-6877 FAX: (920) 684-7210
 E-MAIL: sales@lubedevices.com WEBSITE: www.lubedevices.com

FRONT MOUNTING LIQUID LEVEL GAGES - WITH AND WITHOUT THERMOMETER

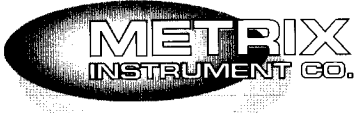
3/04 **BULLETIN F327-5 / -15**

METRIX
INSTRUMENT CO.

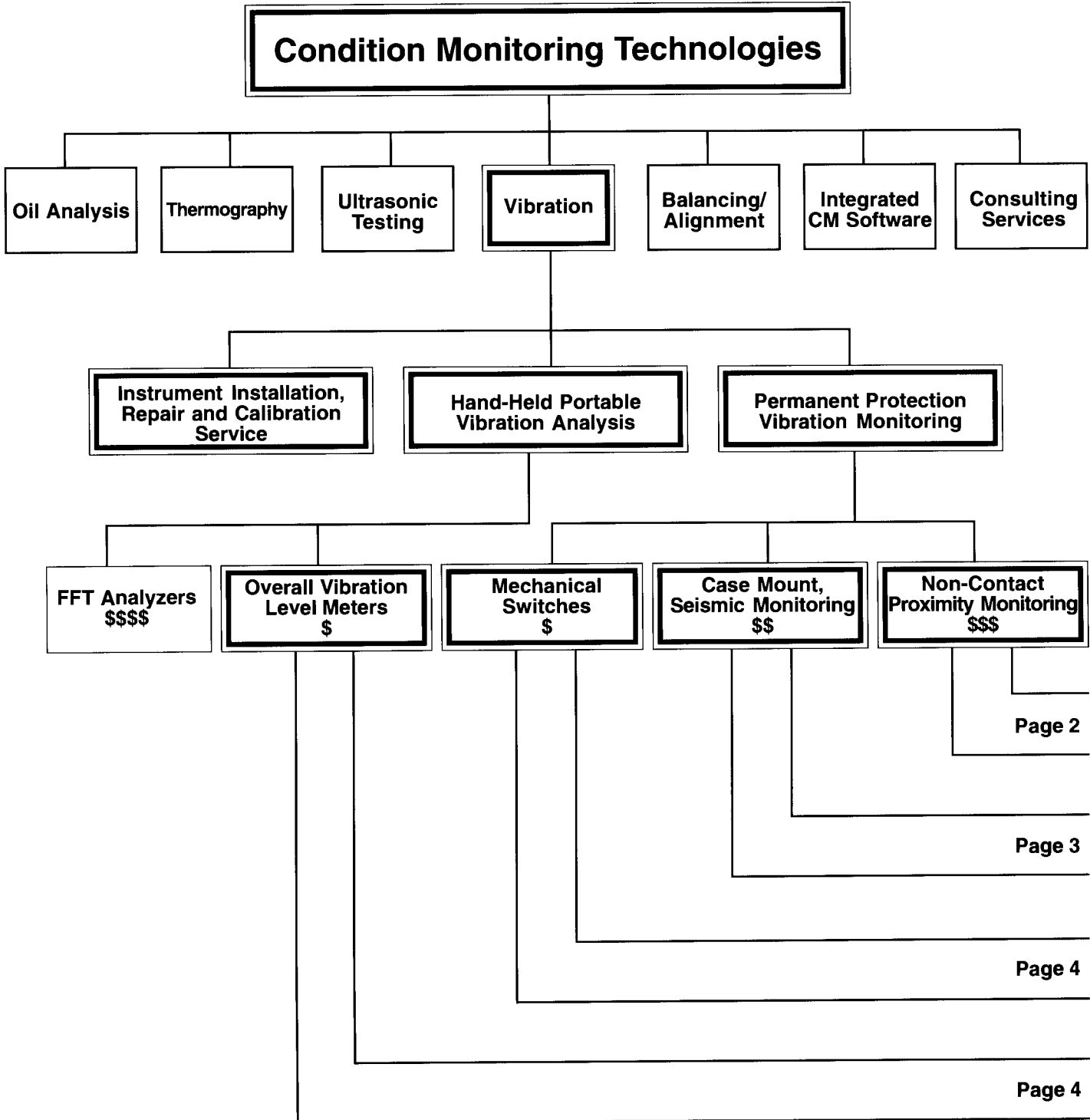
Vibration Instrumentation Product Brochure



Brochure
No. 3.1



MACHINE CONDITION MONITORING MARKET OVERVIEW

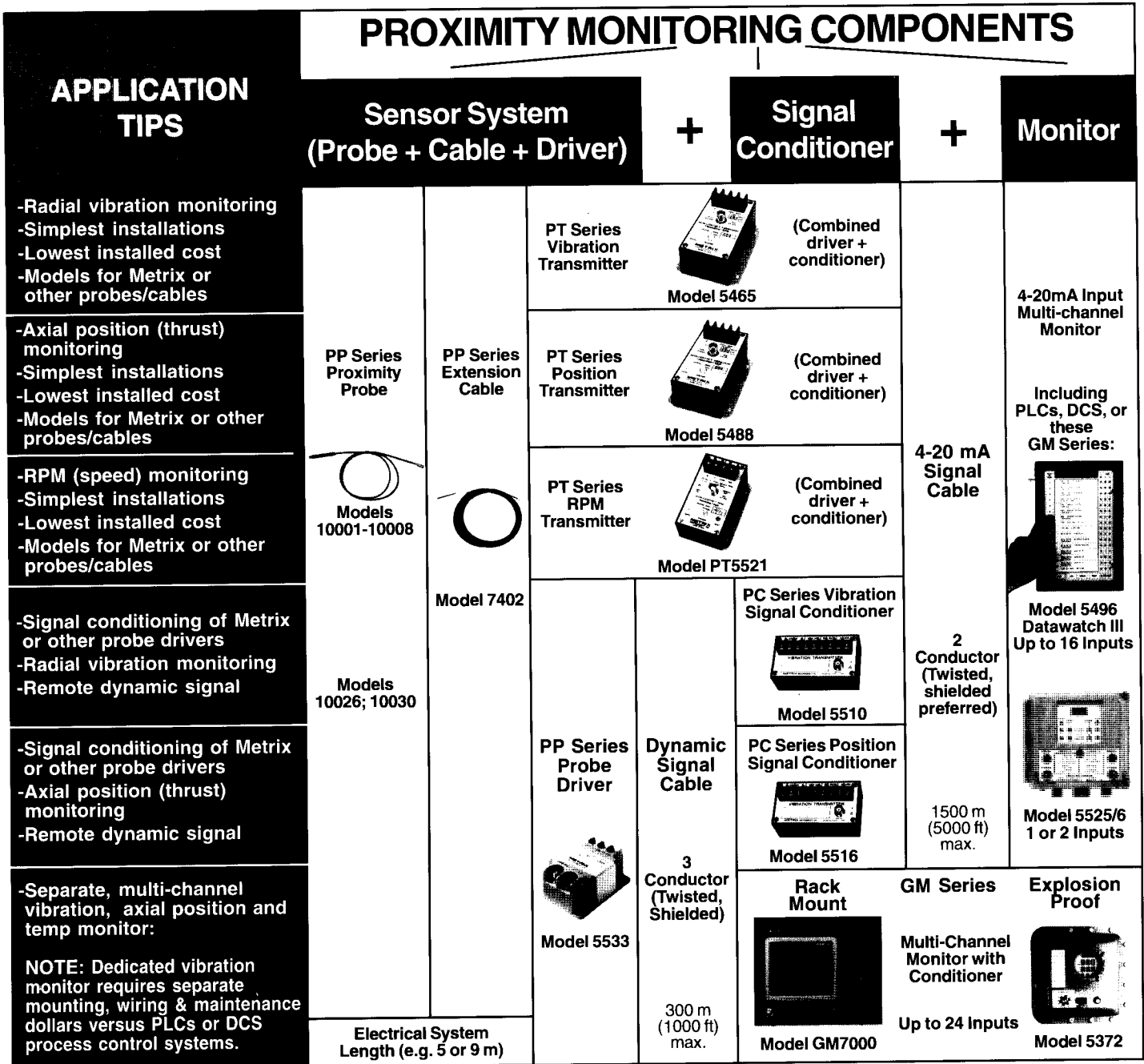


NOTE: Highlighted boxes  represent current Metrix products/markets.



NON-CONTACT PROXIMITY MONITORING INSTRUMENTATION BLOCK DIAGRAM

(Employing Proximity Probes)



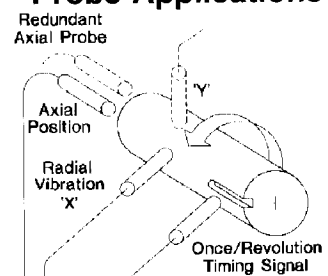
Typical Applications of Proximity Monitoring

- Oil lubricated bearing machines
 - Centrifugal process pumps
 - Turbo compressors
 - Steam turbines
 - Fans and blowers
 - Gear box shafts
 - Generators
 - Electric motors

Typical Measurements

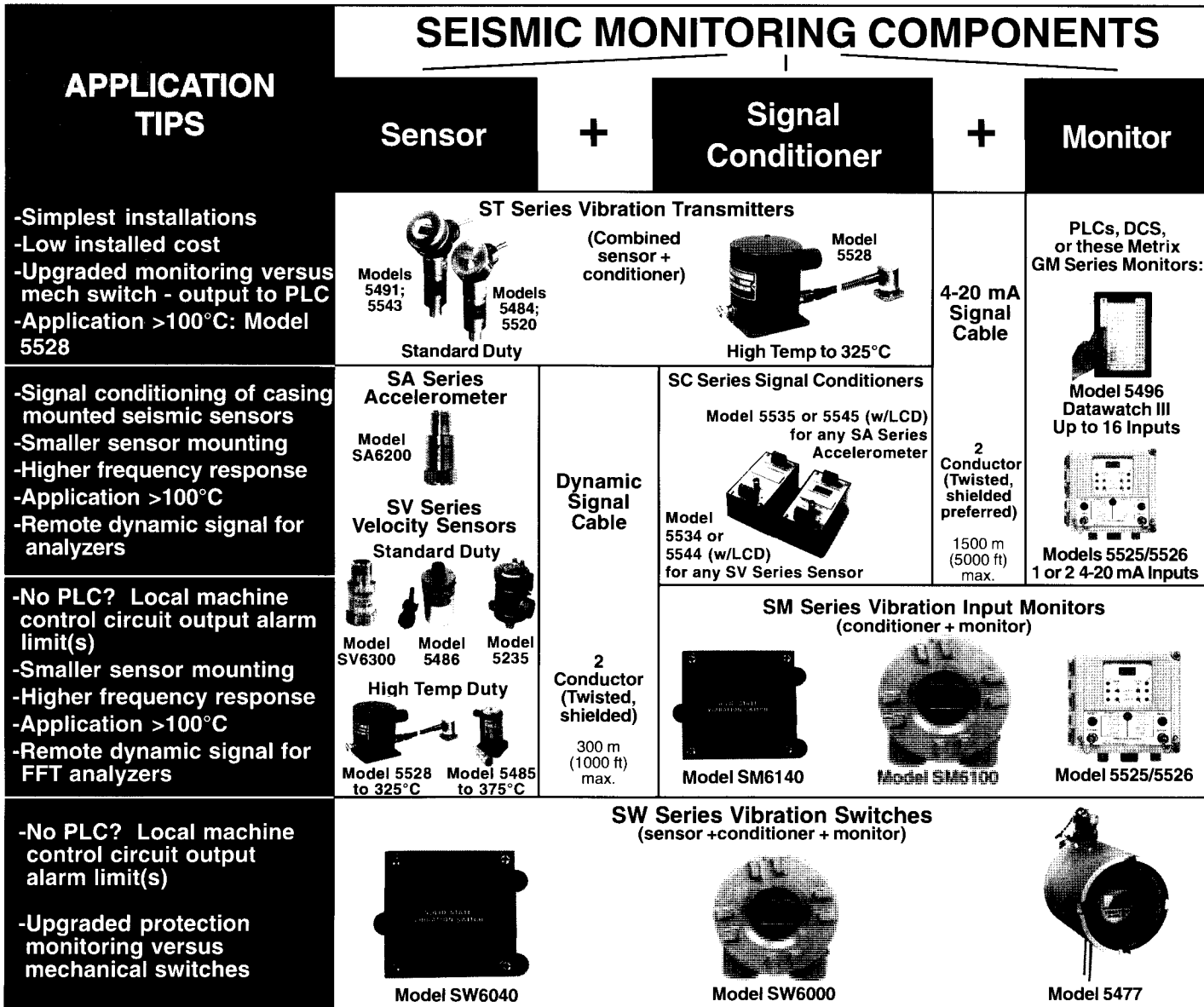
- Radial vibration
- Axial (thrust) position
- RPM
- Vibration phase reference

Probe Applications



SEISMIC (CASING) VIBRATION MONITORING INSTRUMENTATION BLOCK DIAGRAM

(Employing Velocity or Accelerometer Sensors)

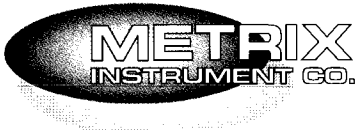


Typical Applications of Seismic (Casing) Monitoring

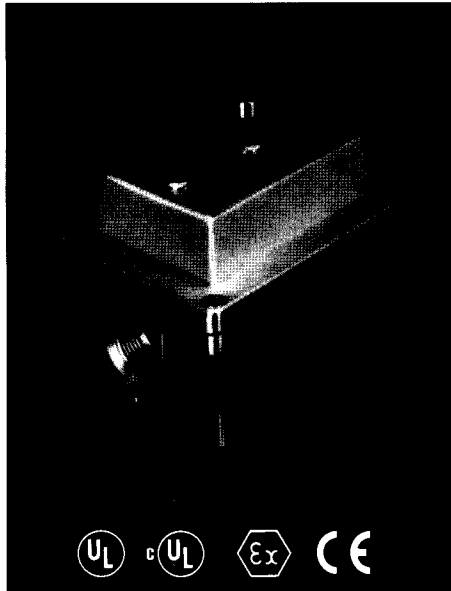
- Large Industrial Fans
- Motors & Generators
- Process Pumps
- Centrifuges
- Antifriction Bearings (e.g. Ball Bearing)
- Heat Exchangers
- Reciprocating Compressors
- Natural Gas/Diesel Engines
- Gear Boxes
- Paper Machines
- Rotor Blade Pass Sensing
- Turbocharger Engine Vibration
- Cooling Towers
- Electric Motors

Typical Casing Mounting





MECHANICAL VIBRATION SWITCH



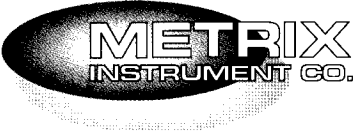
MODEL 5550

Features

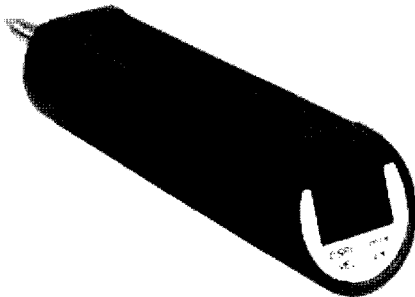
- Meets all requirements for mechanical switches in one package
- Weatherproof and optional hazard area rating
- Local and optional remote reset with startup delay
- SPDT or (2) SPDT switch output contacts

Typical Applications

- Heat Exchanger Fans
- Cooling Tower Fans
- Reciprocating Engines
- Reciprocating Compressors



PORTABLE VIBRATION METERS



**MODELS
5500 & 5500B**

Typical Applications

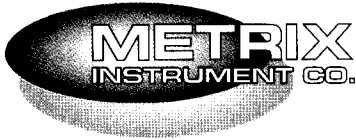
- Quick Check of Vibration Level
- Seismic (Casing) Vibration Measurements
- Velocity/Displacement Readings
- Supplement to Analyzer Program
- Model 5500 is Intrinsically Safe



**VIBRALOG™
MODEL 5487**

Typical Applications

- Vibration Level Recording with Model 5493 Database Software
- Seismic (Casing) Vibration Measurements
- Velocity/Displacement Readings with Date and Time



COMPANY PROFILE

Mission Statement

Dedicated to providing quality solutions for machine condition monitoring. Committed to continuous improvement to meet the changing needs of a global market.

History

Metrix Instrument Co. was founded in 1965. We were the first company in the market to manufacture 4-20 mA vibration transmitters which greatly simplified and cost reduced vibration monitoring.

In 1992, we received our ISO 9001 quality systems certification. In 1995, after being acquired by Roper Industries (NYSE=ROP), the company vastly expanded its global presence, opening three additional regional sales and service offices.

Metrix manufactures a complete line of value-oriented vibration equipment to measure, monitor and provide early warning of potential machinery failure as well as provide personnel protection. Our product lines include vibration switches, transmitters, sensors, alarm monitors and portable meters for turbomachinery, cooling towers, compressors, pumps and gear boxes. We support the industrial marketplace including chemical, power generation, oil refineries, gas processing and paper and steel production facilities.

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Germany
E-mail: europe@metrix1.com
Tel: [49] (9) 832-65889
Fax: [49] (9) 832-65890



ISO 9001

Certificate 30058

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Fax: [7] (95) 240-2735

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Singapore 199597
E-mail: asia@metrix1.com
Tel: [65] 293-4330
Fax: [65] 293-3307

After Hours - Technical Services
1-713-299-4029

The quality system used for design, manufacture and testing of our products is certified to International Standard ISO 9001.

For more information about our products and services, please visit our website.

<http://www.metrix1.com>



NORTH AMERICAN VALVE COMPANY LTD.

1-PC. INVESTMENT CAST BALL VALVE
REDUCED BORE MODEL C1
1/4" to 2"

Available in:

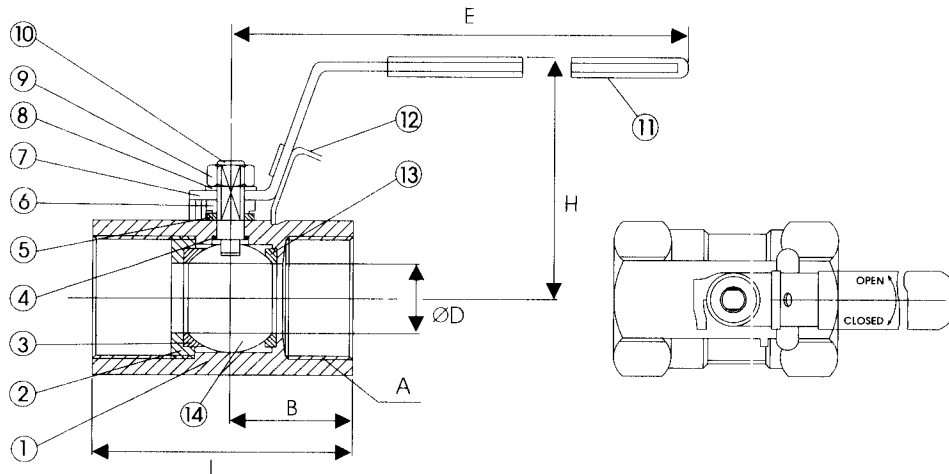
- Carbon Steel
- Stainless Steel
- Carbon Steel Low Temp



FEATURES:

- Pipe thread in accordance with ANSI B2.1, BS 21, DIN 259/2999
- Blowout-proof stem
- Investment cast body
- 2000 W.O.G. (1/4" to 2")
- Locking device, Lug body
- Material: ASTM A351-CF8M, A216-WCB & A352-LCC
- Screwed end
- Mounting pad
- NACE MR-01-75 as a standard

TECHNICAL DATA - 1-PC. REDUCED BORE MODEL C1



SIZE	D (mm / in.)	B (mm / in.)	L (mm / in.)	E (mm / in.)	H (mm / in.)	A (mm / in.)
1/2"	9.2 / .36	31.5 / 1.24	65 / 2.56	90 / 3.54	49 / 1.93	1/2" NPT
3/4"	12.5 / .49	34.55 / 1.36	70 / 2.76	90 / 3.54	52 / 2.05	3/4" NPT
1"	15 / .59	38.65 / 1.52	80 / 3.15	110 / 4.33	54 / 2.13	1" NPT
1 1/4"	20 / .79	40.5 / 1.59	95 / 3.74	110 / 4.33	64 / 2.52	1 1/4" NPT
1 1/2"	25 / .98	42.6 / 1.68	100 / 3.94	140 / 5.51	68 / 2.68	1 1/2" NPT
2"	32 / 1.26	47.9 / 1.89	114 / 4.49	140 / 5.51	75 / 2.95	2" NPT

ITEM	PARTS	STYLE		
		NACE	NACE & LowTemp	Stainless Steel
1	BODY	A216-WCB	A352-LCC	A351-CF8M
2	END PLUG	A216-WCB	A352-LCC	A351-CF8M
3	BIG SEAT	RTFE	RTFE	RTFE
4	THRUST WASHER	PTFE	PTFE	PTFE
5	STEM PACKING	PTFE	PTFE	PTFE
6	PACKING FOLLOWER	Carbon Steel	Carbon Steel	304 SS
7	HANDLE	304 SS	304 SS	304 SS
8	WASHER	304 SS	304 SS	304 SS
9	STEM NUT	304 SS	304 SS	304 SS
10	STEM	316 SS	316 SS	316 SS
11	HANDLE COVER	Plastic	Plastic	Plastic
12	LOCKING DEVICE	304 SS	304 SS	304 SS
13	SEAT	RTFE	RTFE	RTFE
14	BALL	316 SS or CF8M	316 SS or CF8M	316 SS or CF8M

For additional technical information, please consult North American-Nutron Company[®]
We reserve the right to change dimensions or substitute materials.

Marketing & Distribution:

CANADA

North American-Nutron Company Ltd.
4420 - 76 Avenue
Edmonton, Alberta
T6B 0A5 Canada
Phone: (780) 469-2557
Fax: (780) 440-1354

USA

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1 Greenway Plaza, Suite 900 P.O. Box 891737
Houston, Texas Oklahoma City, Oklahoma
TX 77046 USA OK 73189 USA
Phone: (713) 681-8696 Phone: (405) 631-9444
Fax: (713) 681-7703 Fax: (405) 631-9454

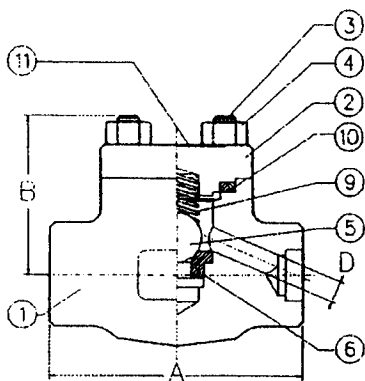
NAVCO®

CHECK VALVE

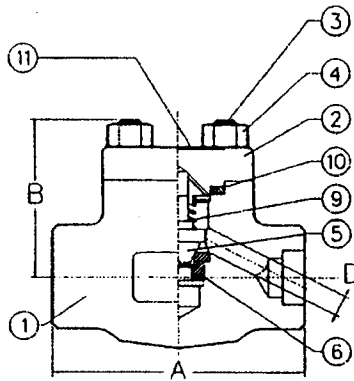
SW/NPT – 800/1500

#	Ball	Piston	Swing	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	Body	Body	A105N	A105N	A350 LF2
2	Cap	Cap	Cap	A105N	A105N	A350 LF2
3	Body Studs	Body Studs	Body Studs	A193 B7	A193 B7M	A320 L7M
4	Body Nuts	Body Nuts	Body Nuts	A194 2H	A194 2HM	A194 7M
5	Ball	Piston	Disc	A182 F6	A182 F316	A182 F316
6	Seat	Seat	Seat	F6 HF	F316 HF	F316 HF
7			Swing Arm	A182 F6	A182 F316	A182 F316
8			Disc Nut	A194 2H	A194 2HM	A194 7M
9	Spring	Spring		Stainless Steel		
10	Gasket	Gasket	Gasket	S.S Spiral Wound Graphite		
11	Nameplate	Nameplate	Nameplate	Aluminum		

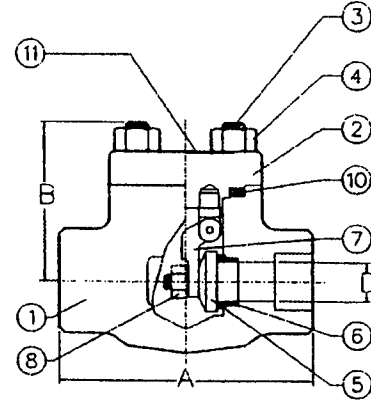
Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
800	1975 psi @ 100°F
1500	3705 psi @ 100°F



BALL



PISTON



SWING

		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2		
Class 800	A	in/mm	3.11	79	3.11	79	3.15	80	3.54	90	4.33	110	5.00	127	6.10	155	6.69	170
	B	in/mm	2.40	61	2.40	61	1.97	50	2.20	56	2.91	74	3.11	79	3.94	100	4.29	109
	D	in/mm	0.28	7	0.28	7	0.35	9	0.49	12.5	0.69	17.5	0.89	22.5	1.10	28	1.26	32
	Wt	lb/kg	3.31	1.5	3.09	1.4	2.4	1.1	4.0	1.8	5.7	2.6	7.9	3.6	12.1	5.5	18.5	8.4

		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2		
Class 1500	A	in/mm	3.54	90	3.54	90	3.54	90	4.33	110	5.00	127	6.10	155	6.69	170	8.27	210
	B	in/mm	2.20	56	2.20	56	2.20	56	2.91	74	3.11	79	3.94	100	4.29	109	5.31	135
	D	in/mm	0.26	6.5	0.35	9	0.39	10	0.51	13	0.71	18	0.91	23	1.10	28	1.34	34
	Wt	lb/kg	4.9	2.2	4.9	2.2	4.9	2.2	6.6	3	9.0	4.1	13.7	6.2	20.7	9.4	29.3	13.3

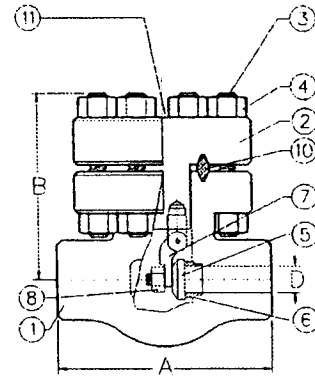
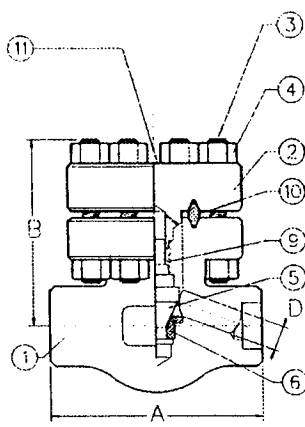
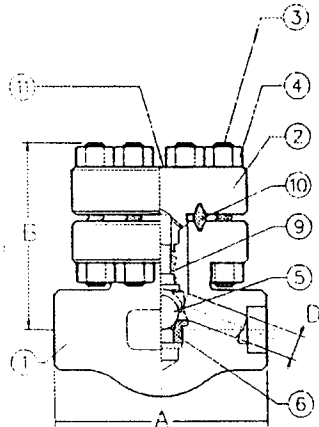
NAVCO®

CHECK VALVE

SW/NPT – 1500/2500 (RTJ Bonnet)

#	Ball	Piston	Swing	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	Body	Body	A105N	A105N	A350 LF2
2	Cap	Cap	Cap	A105N	A105N	A350 LF2
3	Body Studs	Body Studs	Body Studs	A193 B7	A193 B7M	A320 L7M
4	Body Nuts	Body Nuts	Body Nuts	A194 2H	A194 2HM	A194 7M
5	Ball	Piston	Disc	A182 F6	A182 F316	A182 F316
6	Seat	Seat	Seat	F6 HF	F316 HF	F316 HF
7			Swing Arm	A182 F6	A182 F316	A182 F316
8			Disc Nut	A194 2H	A194 2HM	A194 7M
9	Spring	Spring		Stainless Steel		
10	Gasket	Gasket	Gasket	S.S Ring Gasket		
11	Nameplate	Nameplate	Nameplate	Aluminum		

Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
1500	3705 psi @ 100°F
2500	6170 psi @ 100°F



Class 1500		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2		
	A	in/mm	-	-	-	-	4.33	110	4.72	120	5.12	130	-	-	8.27	210	9.45	240
	B	in/mm	-	-	-	-	3.66	93	4.29	109	4.80	122	-	-	6.22	158	6.73	171
	D	in/mm	-	-	-	-	0.43	11	0.57	14.5	0.75	19	-	-	1.22	31	1.48	37.5
	Wt	lb/kg	-	-	-	-	8.4	3.8	13.0	5.9	15.0	6.8	-	-	41.4	18.8	52.2	23.7

Class 2500		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2		
	A	in/mm	-	-	-	-	4.33	110	4.72	120	5.12	130	-	-	8.27	210	9.45	240
	B	in/mm	-	-	-	-	3.78	96	4.06	103	4.96	126	-	-	6.46	164	7.13	181
	D	in/mm	-	-	-	-	0.39	10	0.51	13	0.71	18	-	-	1.10	28	1.34	34
	Wt	lb/kg	-	-	-	-	3.1	1.4	13.9	6.3	16.1	7.3	-	-	43.2	19.6	54.7	24.8

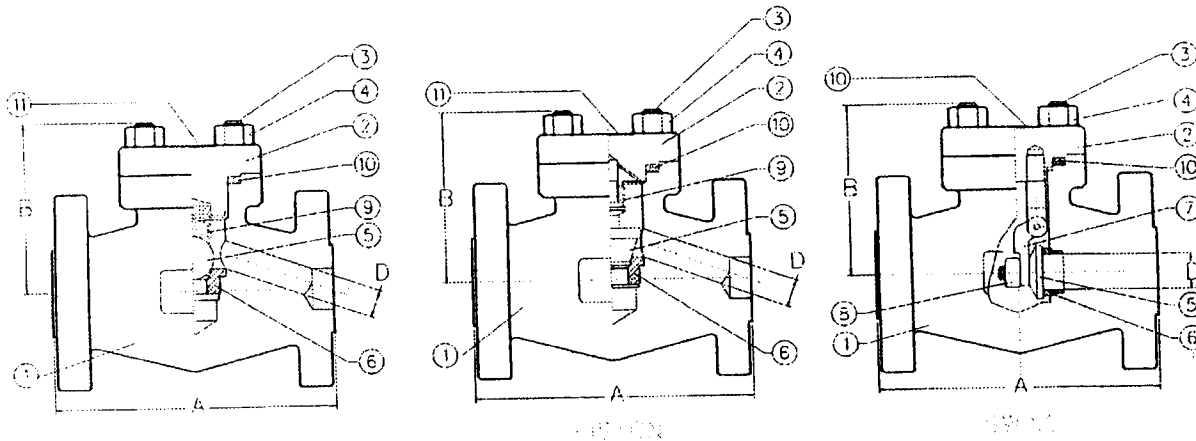
NAVCO®

CHECK VALVE

Flanged – ANSI 150/300/600/1500

#	Ball	Piston	Swing	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	Body	Body	A105N	A105N	A350 LF2
2	Cap	Cap	Cap	A105N	A105N	A350 LF2
3	Body Studs	Body Studs	Body Studs	A193 B7	A193 B7M	A320 L7M
4	Body Nuts	Body Nuts	Body Nuts	A194 2H	A194 2HM	A194 7M
5	Ball	Piston	Disc	A182 F6	A182 F316	A182 F316
6	Seat	Seat	Seat	F6 HF	F316 HF	F316 HF
7			Swing Arm	A182 F6	A182 F316	A182 F316
8			Disc Nut	A194 2H	A194 2HM	A194 7M
9	Spring	Spring		Stainless Steel		
10	Gasket	Gasket	Gasket	S.S Spiral Wound Graphite		
11	Nameplate	Nameplate	Nameplate	Aluminum		

Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
150	285 psi @ 100°F
300	740 psi @ 100°F
600	1480 psi @ 100°F
1500	3705 psi @ 100°F



Class 150		in/mm	1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
			-	-	-	-	4.25	107.9	4.63	117.5	5.00	127	-	-	6.50	165.1	8.00	203.2
	B	in/mm	-	-	-	-	3.27	83	3.35	85	3.66	93	-	-	3.82	97	4.84	123
	D	in/mm	-	-	-	-	0.35	9	0.49	12.5	0.69	17.5	-	-	1.10	28	1.26	32
	Wt	lb/kg	-	-	-	-	5.7	2.6	8.4	3.8	11.2	5.1	-	-	18.5	8.4	31.3	14.2

Class 300		in/mm	1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
			-	-	-	-	6.00	152.4	7.00	177.8	8.00	203.2	-	-	11.36	288.6	10.50	266.7
	B	in/mm	-	-	-	-	1.97	50	2.20	56	2.91	74	-	-	3.94	100	4.29	109
	D	in/mm	-	-	-	-	0.35	9	0.49	12.5	0.69	17.5	-	-	1.10	28	1.26	32
	Wt	lb/kg	-	-	-	-	6.2	2.8	10.4	4.7	12.6	5.7	-	-	26.2	11.9	36.2	16.4

Class 600		in/mm	1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
			-	-	-	-	6.50	165.1	7.50	190.5	8.50	215.9	-	-	9.50	241.3	11.50	292.1
	B	in/mm	-	-	-	-	1.97	50	2.20	56	2.91	74	-	-	3.94	100	4.29	109
	D	in/mm	-	-	-	-	0.35	9	0.49	12.5	0.69	17.5	-	-	1.10	28	1.26	32
	Wt	lb/kg	-	-	-	-	6.8	3.1	11.0	5	16.1	7.3	-	-	26.5	12	36.6	16.6

Class 1500		in/mm	1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
			-	-	-	-	8.50	215.9	9.00	228.6	10.00	254.0	-	-	12.00	304.8	14.50	368.3
	B	in/mm	-	-	-	-	2.20	56	2.91	74	3.11	79	-	-	4.29	109	5.31	135
	D	in/mm	-	-	-	-	0.39	10	0.51	13	0.71	18	-	-	0.94	24	1.10	28
	Wt	lb/kg	-	-	-	-	18.04	8.2	19.8	9.0	28.4	12.9	-	-	53.7	24.4	88.2	40.1

* A = Raised face dimensions, RTJ dimension see page TI2

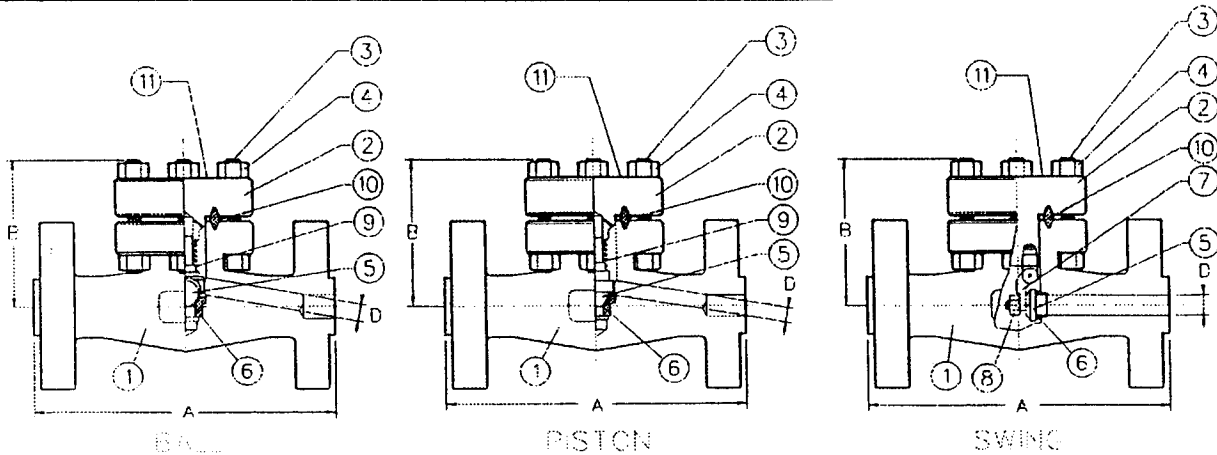
NAVCO®

CHECK VALVE

Flanged – ANSI 1500/2500 (RTJ Bonnet)

#	Ball	Piston	Swing	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	Body	Body	A105N	A105N	A350 LF2
2	Cap	Cap	Cap	A105N	A105N	A350 LF2
3	Body Studs	Body Studs	Body Studs	A193 B7	A193 B7M	A320 L7M
4	Body Nuts	Body Nuts	Body Nuts	A194 2H	A194 2HM	A194 7M
5	Ball	Piston	Disc	A182 F6	A182 F316	A182 F316
6	Seat	Seat	Seat	F6 HF	F316 HF	F316 HF
7			Swing Arm	A182 F6	A182 F316	A182 F316
8			Disc Nut	A194 2H	A194 2HM	A194 7M
9	Spring	Spring		Stainless Steel		
10	Gasket	Gasket	Gasket	S.S Ring Gasket		
11	Nameplate	Nameplate	Nameplate	Aluminum		

Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
1500	3705 psi @ 100°F
2500	6170 psi @ 100°F



Class 1500		1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2
	A	in/mm	-	-	-	8.50 / 215.9	9.00 / 228.6	10.00 / 254	12.00 / 304.8	14.50 / 368.3
B	in/mm	-	-	-	3.66 / 93	4.29 / 109	4.80 / 122	6.22 / 158	6.73 / 171
D	in/mm	-	-	-	0.43 / 11	0.57 / 14.5	0.75 / 19	1.22 / 31	1.48 / 37.5
Wt	lb/kg	-	-	-	16.5 / 7.5	24.0 / 10.9	31.7 / 14.4	66.8 / 30.3	97.0 / 44

Class 2500		1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2
	A	in/mm	-	-	-	10.37 / 263.5	10.75 / 273	12.13 / 308	15.13 / 384.2	17.75 / 450.8
B	in/mm	-	-	-	3.78 / 96	4.06 / 103	4.96 / 126	6.46 / 164	7.13 / 181
D	in/mm	-	-	-	0.39 / 10	0.51 / 13	0.71 / 18	1.10 / 28	1.34 / 34
Wt	lb/kg	-	-	-	22.7 / 10.3	32.2 / 14.6	23.8 / 10.8	93.0 / 42.2	133.8 / 60.7

* A = Raised face dimensions, RTJ dimension see page T12

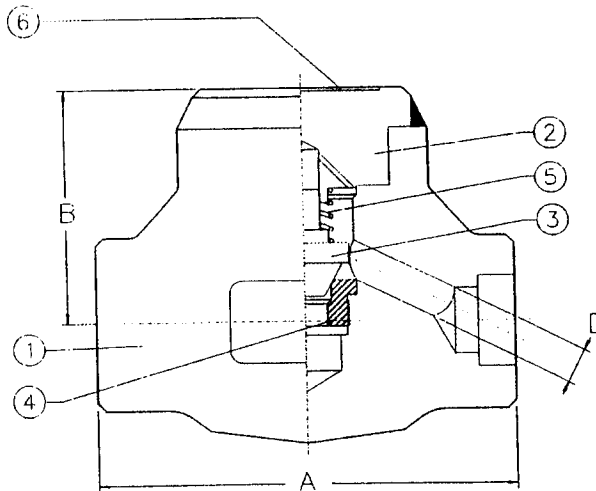
NAVCO®

CHECK VALVE

Welded Bonnet SW/NPT/BW – 800/1500/2500

#	Piston	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	A105N	A105N	A350 LF2
2	Cap	A105N	A105N	A350 LF2
3	Piston	A182 F6	A182 F316	A182 F316
4	Seat	F6 HF	F316 HF	F316 HF
5	Spring	Stainless Steel		
6	Nameplate	Aluminum		

Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
800	1975 psi @ 100°F
1500	3705 psi @ 100°F
2500	6170 psi @ 100°F



		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 800	A	in/mm	3.11 / 79	3.11 / 79	3.15 / 80	3.54 / 90	4.33 / 110	5.00 / 127	6.10 / 155	6.69 / 170	7.3 / 185	8.27 / 210	9.45 / 240	10.8 / 274	12.6 / 320	14.6 / 370	16.1 / 408
	B	in/mm	2.40 / 61	2.40 / 61	1.89 / 48	2.01 / 51	2.48 / 63	2.80 / 71	3.39 / 86	3.90 / 99	4.5 / 114	5.1 / 129	5.8 / 147	6.6 / 168	7.5 / 190	8.5 / 216	9.6 / 244
	D	in/mm	0.28 / 7	0.28 / 7	0.35 / 9	0.49 / 12.5	0.69 / 17.5	0.89 / 22.5	1.10 / 28	1.26 / 32	1.4 / 35.5	1.6 / 40.6	1.8 / 45.7	2.0 / 50.8	2.3 / 58.4	2.6 / 66	3.0 / 76.2
	Wt	lb/kg	3.53 / 1.6	3.31 / 1.5	1.8 / 0.8	2.4 / 1.1	4.4 / 2	7.3 / 3.3	10.8 / 4.9	16.1 / 7.3	21.6 / 9.8	28.3 / 12.8	36.3 / 16.4	45.7 / 20.7	57.7 / 26.1	72.3 / 32.8	89.6 / 40.6

		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 1500	A	in/mm	3.54 / 90	3.54 / 90	3.54 / 90	4.33 / 110	5.00 / 127	6.10 / 155	6.69 / 170	7.3 / 185	8.27 / 210	9.45 / 240	10.8 / 274	12.6 / 320	14.6 / 370	16.1 / 408	
	B	in/mm	1.97 / 50	1.97 / 50	1.97 / 50	2.20 / 56	2.64 / 67	3.23 / 82	3.90 / 99	4.76 / 121	5.5 / 139	6.4 / 163	7.5 / 190	8.7 / 220	10.1 / 256	11.6 / 293	
	D	in/mm	0.26 / 6.5	0.35 / 9	0.39 / 10	0.51 / 13	0.71 / 18	0.91 / 23	1.10 / 28	1.34 / 34	1.6 / 40.6	1.9 / 48.3	2.2 / 55.9	2.6 / 66	3.0 / 76.2	3.5 / 88.9	
	Wt	lb/kg	3.1 / 1.4	3.1 / 1.4	3.1 / 1.4	5.1 / 2.3	8.4 / 3.8	12.3 / 5.6	18.3 / 8.3	29.5 / 13.4	42.6 / 19.3	58.4 / 26.5	77.1 / 34.9	99.6 / 45.2	126.7 / 57.7	158.5 / 71.9	

		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 2500	A	in/mm	- / -	- / -	- / -	4.33 / 110	5.00 / 127	6.10 / 155	6.69 / 170	7.3 / 185	8.27 / 210	9.45 / 240	10.8 / 274	12.6 / 320	14.6 / 370	16.1 / 408	
	B	in/mm	- / -	- / -	- / -	2.20 / 56	2.64 / 67	3.90 / 99	4.76 / 121	5.5 / 139	6.4 / 163	7.5 / 190	8.7 / 220	10.1 / 256	11.6 / 293		
	D	in/mm	- / -	- / -	- / -	0.39 / 10	0.51 / 13	0.71 / 18	0.91 / 23	1.10 / 28	1.34 / 34	1.6 / 40.6	1.9 / 48.3	2.2 / 55.9	2.6 / 66		
	Wt	lb/kg	- / -	- / -	- / -	4.0 / 1.8	6.6 / 3	10.1 / 4.6	14.6 / 6.6	20.3 / 9.2	28.3 / 12.8	38.6 / 17.5	51.4 / 23.3	67.7 / 30.7	88.6 / 40.2		

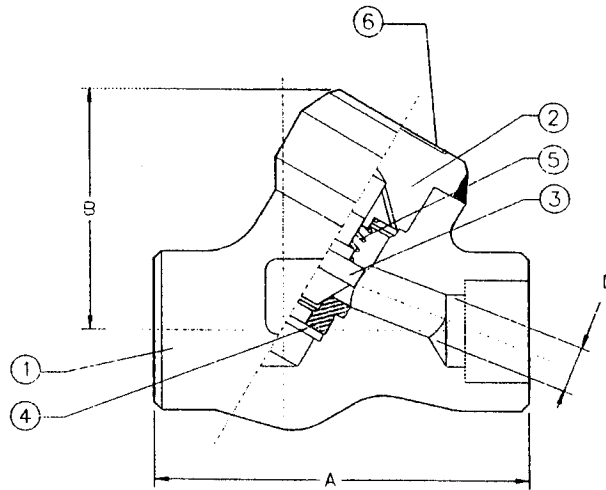
NAVCO®

CHECK VALVE

Welded Angle Pattern SW/NPT – 800/1500/2500

#	Piston	Standard Service	NACE Sour	NACE (-50°F) Low Temp
1	Body	A105N	A105N	A350 LF2
2	Cap	A105N	A105N	A350 LF2
3	Piston	A182 F6	A182 F316	A182 F316
4	Seat	F6 HF	F316 HF	F316 HF
5	Spring	Stainless Steel		
6	Nameplate	Aluminum		

Pressure Ratings (ASTM A105/A350 Gr. LF2)	
Class	Pressure
800	1975 psi @ 100°F
1500	3705 psi @ 100°F
2500	6170 psi @ 100°F



		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 800	A	in/mm	3.15 / 80	3.15 / 80	3.15 / 80	3.94 / 100	4.33 / 110	4.92 / 125	6.30 / 160	7.48 / 190							
	B	in/mm	2.36 / 60	2.36 / 60	2.36 / 60	2.95 / 75	3.35 / 85	3.94 / 100	4.53 / 115	5.51 / 140							
	D	in/mm	0.31 / 8	0.35 / 9	0.49 / 12.5	0.71 / 18	0.89 / 22.5	1.16 / 29.5	1.38 / 35	1.79 / 45.5							
	Wt	lb/kg	3.3 / 1.5	3.3 / 1.5	3.3 / 1.5	5.5 / 2.5	6.6 / 3	12.1 / 5.5	13.2 / 6	19.8 / 9							

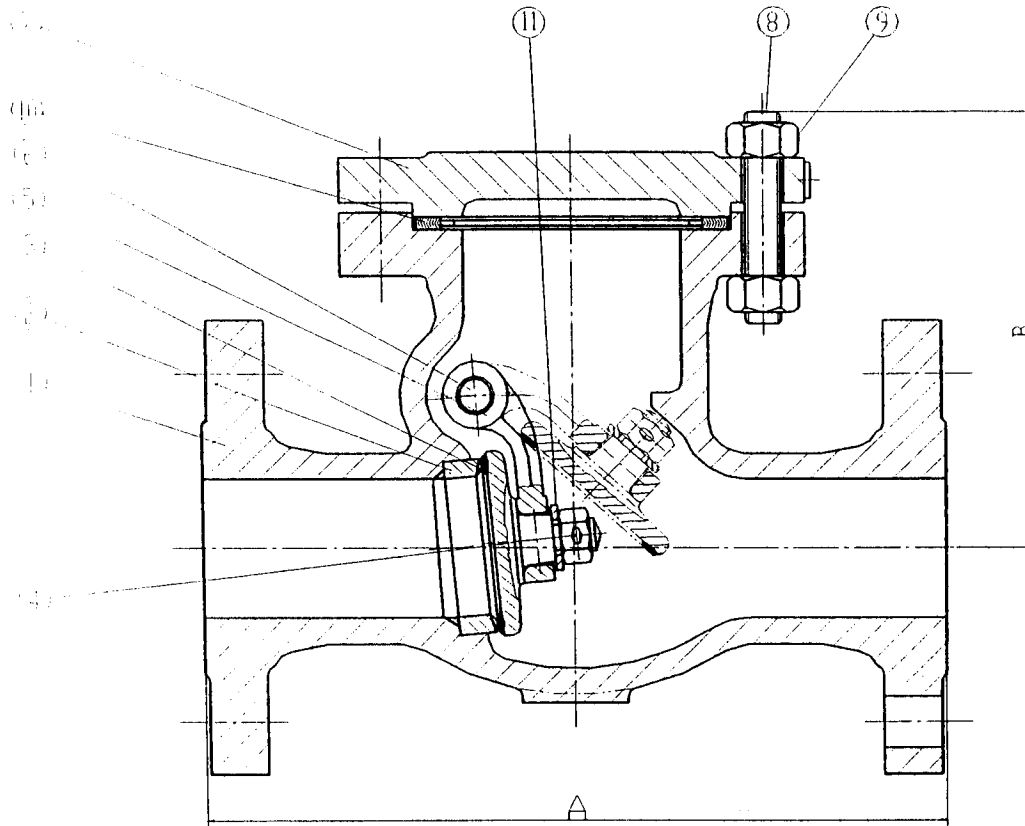
		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 1500	A	in/mm	- / -	- / -	- / -	3.94 / 100	4.33 / 110	4.92 / 125	5.91 / 150	6.30 / 160	7.48 / 190						
	B	in/mm	- / -	- / -	- / -	2.95 / 75	3.35 / 85	3.35 / 85	4.53 / 115	4.53 / 115	5.51 / 140						
	D	in/mm	- / -	- / -	- / -	0.43 / 11	0.57 / 14.5	0.75 / 19	1.06 / 27	1.22 / 31	1.48 / 37.5						
	Wt	lb/kg	- / -	- / -	- / -	5.5 / 2.5	6.6 / 3	9.9 / 4.5	12.1 / 5.5	14.3 / 6.5	20.9 / 9.5						

		1/4		3/8		1/2		3/4		1		1 1/4		1 1/2		2	
Class 2500	A	in/mm	- / -	- / -	- / -	4.33 / 110	4.92 / 125	6.30 / 160	6.30 / 160	7.48 / 190	8.27 / 210						
	B	in/mm	- / -	- / -	- / -	3.35 / 85	3.35 / 85	4.53 / 115	4.53 / 115	5.51 / 140	5.91 / 150						
	D	in/mm	- / -	- / -	- / -	0.39 / 10	0.47 / 12	0.71 / 18	0.94 / 24	1.10 / 28	1.34 / 34						
	Wt	lb/kg	- / -	- / -	- / -	6.6 / 3	9.9 / 4.5	13.2 / 6	14.3 / 6.5	19.8 / 9	26.5 / 12						

NAVCO®

SWING CHECK VALVE

150/300/600/900/1500



Part	Standard Service	NACE Sour	NACE Low Temp (-50°F)	Pressure Rating		
				Class	Pressure @ 100°F	
1 Body	A216 WCB	A216 WCB	A352 LCC			
2 Seat Ring	F6a+HF / A105+HF	A182 F316+ HF	A182 F316 + HF			
2b Seat Insert	PTFE	PTFE	PTFE			
3 Disc	A182 F6a	A182 F316	A182 F316			
4 Disc Nut	A182 F304	A182 F304	A182 F304			
5 Hinge	A216 WCB	A216 WCB	A352 LCC			
6 Hinge Pin	A182 F6a	A182 F316	A182 F316			
7 Cover	A216 WCB/A105	A216 WCB/A105	A352 LCC/LF2			
8 Cover Bolt	A193 B7	A193 B7M	A320 L7M			
9 Cover Nut	A194 2H	A194 2HM	A194 7M			
10 Gasket	*See below	*See below	*See below			
11 Washer	Carbon Steel	AISI 316	AISI 316			

Standards Applicable		
ANSI B16.5, B16.10, B16.25, B16.34		
API 598, BS 1868		

2b – Soft Seat Seal (Optional)

*Class 150, 300, 600 - Spiral Wound SS316 with Graphoil filler

Class 900, 1500 - Standard Trim - Soft Iron ring Gasket

- NACE Sour, NACE Low Temp – SS316 Ring Gasket

NAVCO® reserve the right to substitute materials listed above with alternative material approved for designated service.

ANSI Class 150

		1 1/2"		2"		2 1/2"		3"		4"		6"		8"	
A	in/mm	6.5	165.1	8.0	203.2	8.5	215.9	9.5	241.3	11.5	292.1	14.0	355.6	19.5	495.3
B	in/mm	6.0	152.4	6.8	171.5	7.1	181.0	7.4	187.3	8.5	215.9	10.3	260.4	11.9	301.6
C	in/mm														
Wt _{RF}	lb/kg	24.3	11	33.1	15	57.3	26	59.5	27	92.6	42	165.3	75	273.4	124
Wt _{BW}	lb/kg	18.7	8.5	26.5	12	37.5	17	39.7	18	70.5	32	132.3	60	233.7	106

		10"		12"		14"		16"		18"		20"		24"	
A	in/mm	24.5	622.3	27.5	698.5	31.0	787.4	34.0	863.6	38.5	977.9	38.5	977.9	51.0	1295
B	in/mm	13.9	352.4	15.8	400.1	17.8	450.9	19.0	482.6	21.3	539.8	25.6	650.9	26.8	679.5
C	in/mm														
Wt _{RF}	lb/kg	440.9	200	683.4	310	943.6	428	1224	555	1709	775	1841	835	2866	1300
Wt _{BW}	lb/kg	383.6	174	568.8	258	811.3	368	1065	483	1510	685	1587	720	2536	1150

ANSI Class 300

		1 1/2"		2"		2 1/2"		3"		4"		6"		8"	
A	in/mm	9.5	241.3	10.5	266.7	11.5	292.1	12.5	317.5	14.0	355.6	17.5	444.5	21.0	533.4
B	in/mm	6.4	161.9	6.8	171.5	7.4	187.3	8.5	215.9	9.3	235.0	11.9	301.6	13.4	339.7
C	in/mm														
Wt _{RF}	lb/kg	33.1	15	46.3	21	66.1	30	86.0	39	154.3	70	275.6	125	418.9	190
Wt _{BW}	lb/kg	24.3	11	33.1	15	48.5	22	66.1	30	97.0	44	216.1	98	330.7	150

		10"		12"		14"		16"		18"		20"		24"	
A	in/mm	24.5	622.3	28.0	711.2	33.0	838.2	34.0	863.6	38.5	977.9	40.0	1016	53.9	1368
B	in/mm	13.9	352.4	16.6	422.3	18.9	479.4	20.5	520.7	23.6	600.1	26.4	669.9	29.6	752.5
C	in/mm														
Wt _{RF}	lb/kg	639.3	290	992.1	450	1543	700	1706	774	2205	1000	2806	1273	3638	1650
Wt _{BW}	lb/kg	507.1	230	826.7	375	1080	490	1411	640	1874	850	2425	1100	3086	1400

ANSI Class 600

		1 1/2"		2"		2 1/2"		3"		4"		6"		8"	
A	in/mm	-	-	11.5	292.1	13.0	330.2	14.0	355.6	17.0	431.8	22.0	558.8	26.0	660.4
B	in/mm	-	-	6.9	174.6	7.9	200.0	9.1	231.8	11.6	295.3	14.3	362.0	15.8	400.1
C	in/mm														
Wt _{RF}	lb/kg	-	-	61.7	28	83.8	38	114.6	52	191.8	87	493.8	224	780.4	354
Wt _{BW}	lb/kg	-	-	44.1	20	66.1	30	88.2	40	143.3	65	293.2	133	617.3	280

		10"		12"		14"		16"		18"		20"		24"	
A	in/mm	31.0	787.4	33.0	838.2	35.0	889.0	39.0	990.6	43.0	1092	47.0	1194	55.0	1397
B	in/mm	18.1	460.4	20.5	520.7	22.1	562.0	25.6	650.9	28.8	730.3	31.6	800.1	35.5	901.7
C	in/mm														
Wt _{RF}	lb/kg	1380	626	1742	790	1967	892	2646	1200	3527	1600	5335	2420	6945	3150
Wt _{BW}	lb/kg	1168	530	1477	670	1668	752	2249	1020	2976	1350	4619	2050	6997	2720

ANSI Class 900

		1 1/2"		2"		2 1/2"		3"		4"		6"		8"	
A	in/mm	-	-	14.5	368.3	16.5	419.1	15.0	381.0	18.0	457.2	24.0	609.6	29.0	736.6
B	in/mm	-	-	9.9	250.8	10.6	269.9	9.1	231.8	12.3	311.2	14.3	362.0	17.0	431.8
C	in/mm														
Wt _{RF}	lb/kg	-	-	152.1	69	205.0	93	187.4	85	319.7	145	683.4	310	1102	500
Wt _{BW}	lb/kg	-	-	132.3	60	172.0	78	154.3	70	264.6	120	584.2	265	848.8	385

		10"		12"		14"		16"		18"		20"		24"	
A	in/mm	33.0	838.2	38.0	965.2	40.5	1029	44.5	1130	48.0	1219	52.0	1321	61.0	1549
B	in/mm	18.9	479.4	22.0	558.8	24.9	631.8	27.6	701.7	29.6	752.5	33.5	850.9	39.4	1000
C	in/mm														
Wt _{RF}	lb/kg	1702	772	2381	1080	3042	1380	3990	1810	5291	2400	7716	3500	10362	4700
Wt _{BW}	lb/kg	1323	600	1896	860	2513	1140	3329	1510	4519	2050	6834	3100	9259	4200

ANSI Class 1500

		1 1/2"		2"		2 1/2"		3"		4"		6"		8"	
A	in/mm	-	-	14.5	368.3	16.5	419.1	18.5	469.9	21.5	546.1	27.8	704.9	32.8	831.9
B	in/mm	-	-	9.9	250.8	10.6	269.9	11.9	301.6	13.0	330.2	17.8	450.9	19.8	501.7
C	in/mm														
Wt _{RF}	lb/kg	-	-	152.1	69	205.0	93	264.6	120	518.1	235	1190	540	2083	945
Wt _{BW}	lb/kg	-	-	132.3	60	172.0	78	198.4	90	407.9	185	992.1	450	1731	785

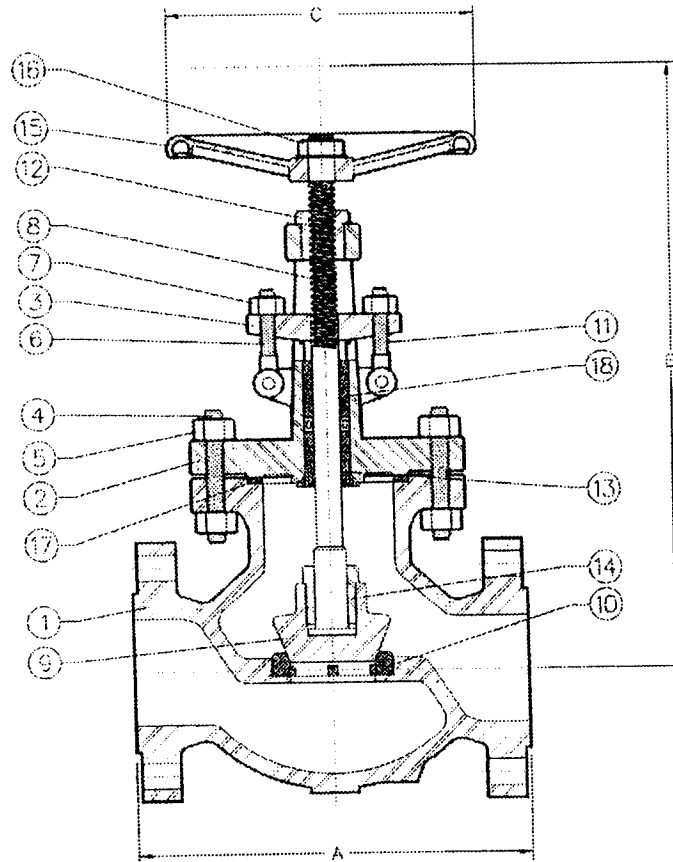
		10"		12"		14"		16"		18"		20"		24"	
A	in/mm	39.0	990.6	44.5	1130	49.5	1257	54.5	1384	60.5	1537	65.5	1664	76.5	1943
B	in/mm	22.1	562.0	22.6	574.7	29.6	752.5	31.5	800.1	35.5	901.7	39.4	1000	47.3	1200
C	in/mm														
Wt _{RF}	lb/kg	2811	1275	4123	1870	5644	2560	7187	3260	8995	4080	13118	5950	17637	8000
Wt _{BW}	lb/kg	2348	1065	3417	1550	4630	2100	5952	2700	7496	3400	11464	5200	15653	7100

SWING CHECK VALVE

NAVCO®

GLOBE VALVE

150/300/600/900/1500



# Part	Standard Service	NACE Sour	NACE Low Temp (-50°F)	Pressure Rating		
				Class	Pressure @ 100°F	
1 Body	A216 WCB	A216 WCB	A352 LCC			
2 Bonnet	A216 WCB	A216 WCB	A352 LCC			
3 Gland Flange	A105/WCB	A105/WCB	LF2/LCC	150	285 psi	290 psi
4 Bonnet Bolt	A193 B7	A193 B7M	A320 L7M	300	740 psi	750 psi
5 Bonnet Nut	A194 2H	A194 2HM	A194 7M	600	1480 psi	1500 psi
6 Gland Eyebolt	A193 B7	A193 B7M	A320 L7M	900	2220 psi	2250 psi
7 Gland Nut	A194 2H	A194 2HM	A194 7M	1500	3705 psi	3750 psi
8 Stem	T410	316	F316			
9 Disc	T410/A105+ER410	F 316	F 316			
10 Seat Ring	A105+HF	A182 F316+ HFS	A182 F316+ HF			
11 Gland	T420	A182 F316	A182 F316			
12 Stem Nut		A 439 Gr. D2				
13 Backseat	T420	A182 F316	A182 F316			
14 Disc Nut	T420	A182 F316	A182 F316			
15 Handwheel		Ductile Iron				
16 Handwheel Nut		Carbon Steel				
17 Gasket		See below*				
18 Stem Packing		Graphite/Graphoil				

Standards Applicable
ANSI B16.5, B16.10, B16.25, B16.34
API 598, BS 1873

*Class 150, 300, 600 - Spiral Wound SS316 with Graphoil filler
Class 900, 1500 - Standard Trim - Soft Iron Ring Gasket
- NACE Sour, NACE Low Temp - SS316 Ring Gasket

NAVCO® reserve the right to substitute materials listed above with alternative material approved for designated service.

ANSI Class 150

		1 1/2"		2"		2 1/2"		3"		4"		6"	
A	in/mm	6.5	165.1	8.0	203.2	8.5	215.9	9.5	241.3	11.5	292.1	16.0	406.4
B	in/mm	13.5	342.9	15.0	381.0	17.1	435.0	18.3	463.6	20.9	530.2	25.6	650.9
C	in/mm	8.0	203.2	8.0	203.2	10.0	254.0	10.0	254.0	12.0	304.8	14.0	355.6
Wt _{RF}	lb/kg	35.3	16	48.5	22	66.1	30	81.6	37	134.5	61	242.5	110
Wt _{EW}	lb/kg	30.9	14	41.9	19	59.5	27	75.0	34	112.4	51	194.0	88

		8"		10"		12"		14"		16"		18"	
A	in/mm	19.5	495.3	24.5	622.3	27.5	698.5	31.0	787.4	36.0	914.4	-	-
B	in/mm	30.0	762.0	33.9	860.4	39.4	1000	41.4	1051	45.3	1149	-	-
C	in/mm	16.0	406.4	20.0	508.0	24.0	609.6	24.0	609.6	30.0	762.0	-	-
Wt _{RF}	lb/kg	370.4	168	524.7	238	903.9	410	992.1	450	1402	636	-	-
Wt _{EW}	lb/kg	321.9	146	474.0	215	815.7	370	881.8	400	1213	550	-	-

ANSI Class 300

		1 1/2"		2"		2 1/2"		3"		4"		6"	
A	in/mm	9.0	228.6	10.5	266.7	11.5	292.1	12.5	317.5	14.0	355.6	17.5	444.5
B	in/mm	16.0	406.4	16.8	425.5	18.3	463.6	20.9	530.2	24.0	609.6	31.1	790.6
C	in/mm	8.0	203.2	8.0	203.2	10.0	254.0	10.0	254.0	12.0	304.8	16.0	406.4
Wt _{RF}	lb/kg	57.3	26	59.5	27	88.2	40	116.8	53	176.4	80	341.7	155
Wt _{EW}	lb/kg	44.1	20	46.3	21	72.8	33	97.0	44	145.5	66	282.2	128

		8"		10"		12"		14"		16"		18"	
A	in/mm	22.0	558.8	24.5	622.3	28.0	711.2	33.0	838.2	34.0	863.6	-	-
B	in/mm	34.3	870.0	41.0	1041	44.9	1140	47.3	1200	55.1	1400	-	-
C	in/mm	20.0	508.0	20.0	508.0	24.0	609.6	30.0	762.0	34.0	863.6	-	-
Wt _{RF}	lb/kg	529.1	240	749.6	340	1091	495	1433	650	1874	850	-	-
Wt _{EW}	lb/kg	463.0	210	617.3	280	903.9	410	1146	520	1543	700	-	-

ANSI Class 600

		1 1/2"		2"		2 1/2"		3"		4"		6"	
A	in/mm	-	-	11.5	292.1	13.0	330.2	14.0	355.6	17.0	431.8	22.0	558.8
B	in/mm	-	-	18.8	476.3	20.3	514.4	23.0	584.2	26.5	673.1	35.0	889.0
C	in/mm	-	-	10.0	254.0	10.0	254.0	12.0	304.8	14.0	355.6	18.0	457.2
Wt _{RF}	lb/kg	-	-	88.2	40	125.7	57	158.7	72	266.8	121	551.2	250
Wt _{EW}	lb/kg	-	-	79.4	36	99.2	45	134.5	61	213.8	97	489.4	222

		8"		10"		12"		14"		16"		18"	
A	in/mm	26.0	660.4	31.0	787.4	33.0	838.2	35.0	889.0	39.0	990.6	-	-
B	in/mm	37.3	946.2	41.0	1041	50.5	1283	53.1	1349	61.0	1549	-	-
C	in/mm	20.0	508.0	24.0	609.6	30.0	762.0	34.0	863.6	38.0	965.2	-	-
Wt _{RF}	lb/kg	992.1	450	1543	700	1984	900	2458	1115	3263	1480	-	-
Wt _{EW}	lb/kg	784.8	356	1296	588	1764	800	1984	900	2425	1100	-	-

ANSI Class 900

		1 1/2"		2"		2 1/2"		3"		4"		6"	
A	in/mm	-	-	14.5	368.3	16.5	419.1	15.0	381.0	18.0	457.2	24.0	609.6
B	in/mm	-	-	23.6	600.1	26.0	660.4	28.1	714.4	31.5	800.1	40.0	1016
C	in/mm	-	-	12.0	304.8	14.0	355.6	14.0	355.6	20.0	508.0	24.0	609.6
Wt _{RF}	lb/kg	-	-	191.8	87	286.6	130	269.0	122	401.2	182	956.8	434
Wt _{EW}	lb/kg	-	-	176.4	80	253.5	115	224.9	102	368.2	167	848.8	385

		8"		10"		12"		14"		16"		18"	
A	in/mm	29.0	736.6	33.0	838.2	38.0	965.2	40.5	1029	44.5	1130	-	-
B	in/mm	45.1	1146	53.5	1359	63.4	1610	65.0	1651	70.9	1800	-	-
C	in/mm	24.0	609.6	30.0	762.0	34.0	863.6	38.0	965.2	38.0	965.2	-	-
Wt _{RF}	lb/kg	1609	730	2469	1120	3594	1630	4409	2000	5842	2650	-	-
Wt _{EW}	lb/kg	1367	620	2094	950	3109	1410	3880	1760	5181	2350	-	-

ANSI Class 1500

		1 1/2"		2"		2 1/2"		3"		4"		6"	
A	in/mm	-	-	14.5	368.3	16.5	419.1	18.5	469.9	21.5	546.1	27.8	704.9
B	in/mm	-	-	23.6	600.1	26.0	660.4	30.4	771.5	33.5	850.9	45.0	1143
C	in/mm	-	-	12.0	304.8	14.0	355.6	20.0	508.0	20.0	508.0	24.0	609.6
Wt _{RF}	lb/kg	-	-	191.8	87	286.6	130	551.2	250	959.0	435	1190	540
Wt _{EW}	lb/kg	-	-	176.4	80	253.5	115	485.0	220	848.8	385	992.1	450

		8"		10"		12"		14"		16"		18"	
A	in/mm	32.8	831.9	39.0	990.6	44.5	1130	49.5	1257	54.5	1384	-	-
B	in/mm	53.0	1346	59.5	1511	73.6	1870	76.8	1949	86.6	2200	-	-
C	in/mm	24.0	609.6	30.0	762.0	34.0	863.6	38.0	965.2	44.0	1118	-	-
Wt _{RF}	lb/kg	2138	970	3351	1520	4850	2200	5952	2700	7893	3580	-	-
Wt _{EW}	lb/kg	1742	790	2910	1320	4321	1960	5291	2400	7165	3250	-	-



NORTH AMERICAN VALVE COMPANY LTD.

1-PC. HEX BALL VALVE MODEL H1
REDUCED BORE
1/2" to 2"

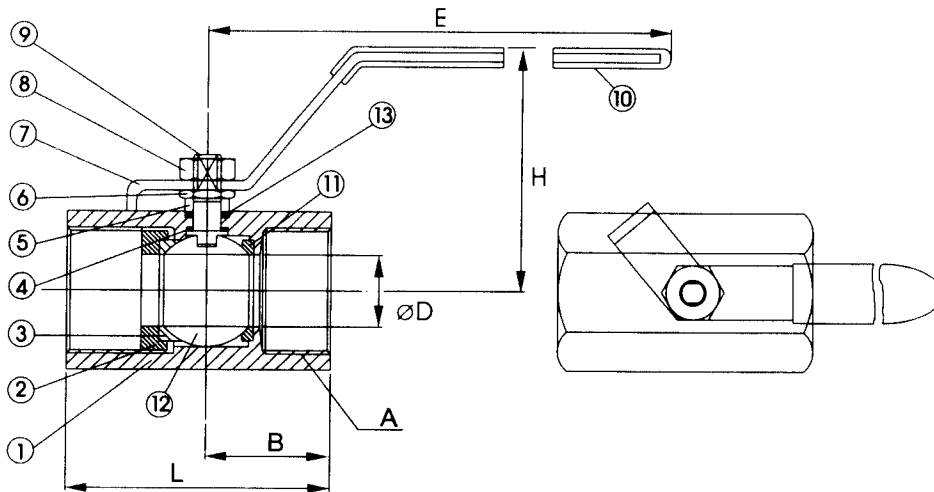
Carbon Steel



FEATURES:

- Pipe thread in accordance with ANSI B2.1, BS 21, DIN 259/2999
- Blowout-proof stem
- 2000 W.O.G.
- Carbon Steel
- Female NPT
- NACE MR-01-75 as a standard

TECHNICAL DATA - HEX BAR REDUCED BORE MODEL H1



1/2"	9.0 / .35	35 / 1.38	70 / 2.76	110 / 4.33	63.3 / 2.49	1/2" NPT
3/4"	12.5 / .49	34 / 1.34	68 / 2.68	110 / 4.33	62 / 2.44	3/4" NPT
1"	15 / .59	40 / 1.57	80 / 3.15	121 / 4.76	66.7 / 2.63	1" NPT
1 1/4"	20 / .79	48 / 1.89	96 / 3.78	146 / 5.75	82.6 / 3.25	1 1/4" NPT
1 1/2"	25 / .98	51.5 / 2.03	103 / 4.06	146 / 5.75	82.6 / 3.25	1 1/2" NPT
2"	32 / 1.26	59.5 / 2.34	119 / 4.68	152 / 5.98	87.4 / 3.44	2" NPT

1	BODY	1	Carbon Steel
2	END PLUG	1	Carbon Steel
3	BIG SEAT	2	RTFE
4	THRUST WASHER	1	PTFE
5	GLAND	1	304 SS
6	GLAND NUT	1	304 SS
7	HANDLE	1	Carbon Steel
8	STEM NUT	1	304 SS
9	STEM	1	304 SS
10	HANDLE COVER	1	Plastic
11	SEAT	1	RTFE
12	BALL	1	304 SS
13	STEM PACKING	1	PTFE

For additional technical information, please consult North American-Nutron Company®
We reserve the right to change dimensions or substitute materials.

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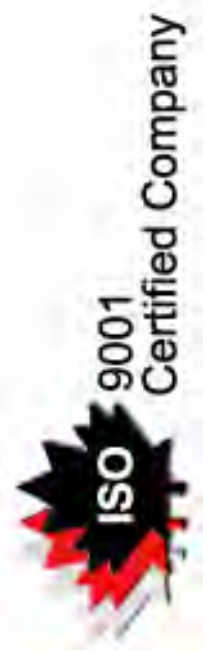


MILLENNIUM Combustible Gas Detector

User Manual

Models:

- MLP-A/R/D-SC1100
- MLP-LP-A/R/D-SC1100



IMPORTANT INFORMATION

This manual is for informational purposes only. Although every effort has been made to ensure the correctness of the information, technical inaccuracies may occur and periodic changes may be made without notice. Net Safety Monitoring Inc., assumes no responsibility for any errors contained within this manual.

If the products or procedures are used for purposes other than as described in the manual, without receiving prior confirmation of validity or suitability, Net Safety Monitoring Inc., does not guarantee the results and assumes no obligation or liability.

No part of this manual may be copied, disseminated or distributed without the express written consent of Net Safety Monitoring Inc.

Net Safety Monitoring Inc., products are carefully designed and manufactured from high quality components and can be expected to provide many years of trouble free service. Each product is thoroughly tested, inspected and calibrated prior to shipment. Failures can occur which are beyond the control of the manufacturer. Failures can be minimized by adhering to the operating and maintenance instructions herein. Where the absolute greatest of reliability is required, redundancy should be designed into the system.

Warranty

Net Safety Monitoring Inc., warrants its sensors against defective parts and workmanship for a period of 24 months from date of purchase; other electronic assemblies for 36 months from date of purchase.

No other warranties or liability, expressed or implied, will be honoured by Net Safety Monitoring Inc.

Contact Net Safety Monitoring Inc., or an authorized representative for details.

We welcome your input at Net Safety Monitoring. If you have any comments please contact us at the phone/address below or visit our web site and complete our on-line customer survey: www.net-safety.com.

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TABLE OF CONTENTS

Important Information	
Warranty	
Contact Information	
Introduction	1
The Product	1
The Sensor	1
The Controller	1
The Manual	1
Step 1 — Plan	2
Locate Controller/Sensor	2
Figure 1: Locate Sensor/Controller—Separated	2
Figure 2: Dimensional Drawings	3
Step 2 — Install	3
Unpack	3
Figure 3: Components	3
Mount	4
Step 3 — Wire	4
Field Installation	4
Seal	4
Connecting Wires	4
Board Assembly	5
Figure 4: Millennium Module Boards	5
Figure 5: Wiring—Controller and Sensor	6
Sensor and Controller	6
Table 1: Controller/Sensor Terminal Connections	6
Relay Board	6
RS-485 Communication	6
Sensor Separation	7
Figure 6: Wiring—Sensor Separation	7
Non-Isolated/Isolated Wiring	8
Terminal Connection	8
Figure 7: Non-isolated Terminal Connection	8
Figure 8: Isolated Terminal Connection	8
Current Output	8
Figure 9: Jumper Positions	8
Remote Reset	9
Figure 10: Remote Reset	9
MODBUS Termination	9
Figure 11: Modbus Termination Jumpers	9
Step 4 — Operate	10
Figure 12: Controller Functionality	10
Table 2: Status LEDs, Display Messages and Current Loop	11
RTU Registers	11
Table 3: RTU Status Register (400002) Read Only (binary)	11
Calibration Button	11
Magnetic Reed Switch	12
Power Up	12
Current Loop Measurement (Test Jacks)	12
Status LED	12
The Main Menu	12
Accessing the Main Menu	12
Main Menu Functionality	12
Step 5 — Calibrate	13
Calibration Procedure	13
Figure 13: Calibration Procedure	13
Calibration Procedure	13
Remote Calibration	14
Abort Calibration	14
Sensor Life Check	14
Calibration Failure	14
Step 6 — Monitor	14
Review Relay Settings	14
Set Relay Option	14
Table 4: Default Relay Settings	14
Setting Relay Options	14
Enter Restricted Menu	15
Extend Sensor Separation	15
Set Low Power Options - Optional	16
Select Display Language	16
Modbus Options	16
Node Address	16
Baud Rate	16
Alarms	17
Sensor Fault	17
Sensor Drift	17

Gas Present 17

Sensor Life 17

 Sensor Guard 17

Reset 18

 Manual Reset 18

 Remote Reset 18

Outputs 18

 Relays (Optional) 18

 Modbus 18

 Current 18

Step 7 — Maintain 19

 Periodic Response Check 19

 Troubleshoot 19

How to Return Equipment 19

Spare Parts/Accessories 20

 Table 5: Part Numbering 20

 Face Rotation Option 21

 Figure 14: Non-standard Orientations 21

 Rotate PCB Assembly 21

Appendix A: Electrostatic Sensitive Device (ESD) 22

Appendix B: Resistance Table 23

 Table 6: Wire Resistance In Ohms 23

Appendix C: Specifications 24

INTRODUCTION

The Millennium series is Net Safety's latest innovation in a line of continuously evolving industrial gas detectors and sensors. The microcontroller based system provides fast, accurate and continuous monitoring of gases in extreme environments.

THE PRODUCT

The Sensor

The SC1100 combustible gas sensor is a proven, poison resistant, pellistor sensor utilizing active and reference catalytic beads in a Wheatstone Bridge configuration. Its integrated design ensures accurate and repeatable response in the most severe environments.

The Controller

The Millennium Controller has an explosion-proof Housing, rated Class I, Division I, Groups B, C, and D for hazardous applications. It was designed for either a 1-man, intrusive calibration or 2-man non-intrusive calibration.

The Controller has convenient user interface functionality to make installation, operation and maintenance easy.

The Manual

The manual has been designed to make installation of the Millennium product easy. To ensure proper installation, follow the steps outlined in the following pages. If you encounter problems during operation, consult the troubleshooting section or contact your sales representative.

Step 1 — PLAN

Step 2 — INSTALL

Step 3 — WIRE

Step 4 — OPERATE

Step 5 — CALIBRATE

Step 6 — MONITOR

Step 7 — MAINTAIN

STEP 1 — PLAN

LOCATE CONTROLLER/SENSOR

Prior to the installation process, a location plan for placing the Controller and Sensor should be developed. Although there are no absolute rules for determining the quantity and location of a sensor or controller, the following points should be considered when planning the installation.

- Locate the Controller where it will be accessible and visible.
- Carefully locate Sensor in an area where gases may potentially accumulate.
- Use redundant systems to enhance protection and reliability.
- Light gases tend to rise; heavy gases tend to accumulate in low areas.
- Consider air movement patterns within the facility.
- Consider the construction of the facility (such as trenches where heavy gases may accumulate or peaks where light gases may accumulate).
- Seek advice from experts knowledgeable about the primary gas to be detected.
- Use common sense and refer to various regulatory publications that discuss general guidelines for your industry.

The two most common installation options are as follows.

Option 1

Locate Sensor separate from Controller using a Junction Box.

The Controller is located near eye-level. Conduit is run from the Controller to the Sensor. A Junction Box is used to connect the conduit from the Controller to the Sensor. A Calibration Cup can be attached to the Sensor. Tubing can be run from the calibration cup to a convenient location accessible for calibration gas to be injected.

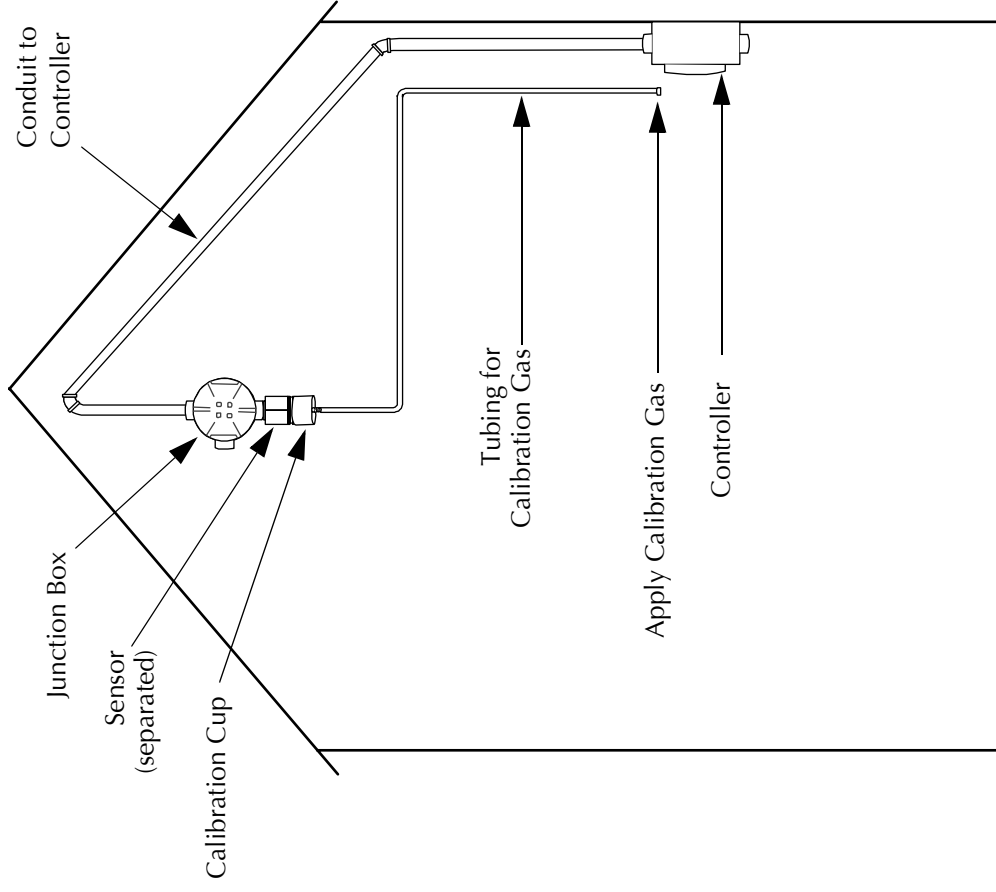
See "Sensor Separation" on page 7 for detailed instructions.

Option 2

The Sensor is attached directly to the Controller. A Calibration Cup and tubing may also be used to facilitate calibration.

See "Wiring—Controller and Sensor" on page 6 for detailed instructions.

Figure 15: Locate Sensor/Controller—Separated



TIP:

The Calibration Cup allows for tubing to be affixed to a Sensor mounted in remote locations. The tubing is directed to a level, usually close to the Controller, for easy injection of calibration gas. The Calibration Cup can also act as a splash guard, protecting sensors when mounted low to the ground.

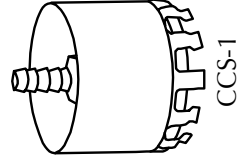
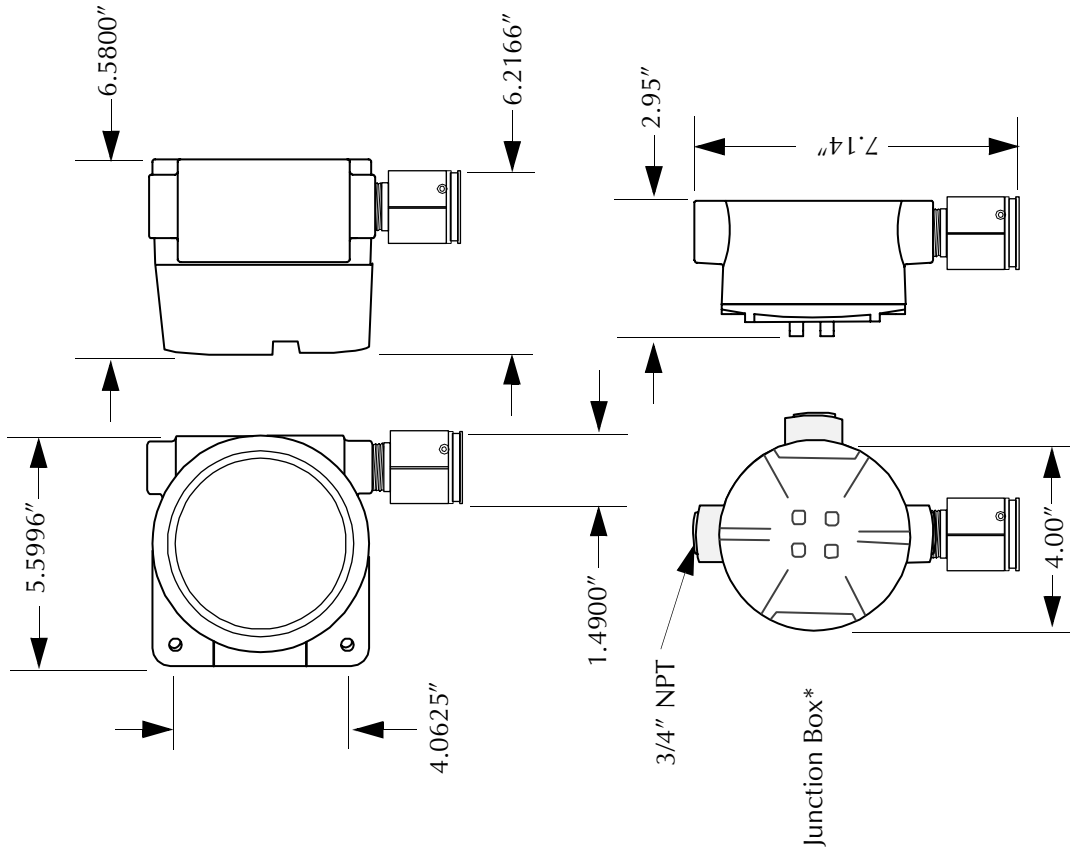


Figure 16: Dimensional Drawings



* A Junction Box is only used when Sensor and Controller are separated. Refer to "Sensor Separation" on page 7 for instructions.

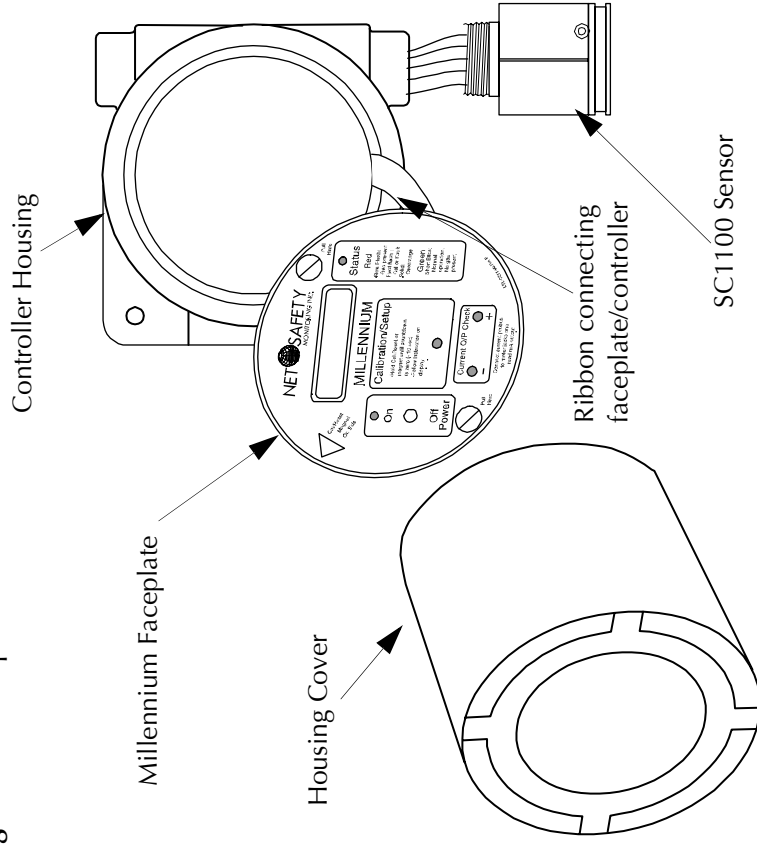
STEP 2 — INSTALL

UNPACK

Carefully remove all components from the packaging. Check components against the enclosed packing list and inspect all components for obvious damage such as broken or loose parts.

If you find any components missing or damaged, notify the representative or Net Safety Monitoring immediately.

Figure 17: Components



External Equipment

It is necessary that reliable monitoring and indicating devices or systems be connected to the detector. These devices must be designed to produce clear visual and audible danger signals when high signal levels occur.

Mount

The Controller should be mounted near eye-level and be easily accessible for calibration and maintenance purposes. The Sensor should be placed where gas is likely to accumulate.

Ensure all devices are securely mounted, taking into consideration all requirements.

Use the Face Rotation Option to mount the Millennium Controller at a different orientation (refer to "Face Rotation Option" on page 21 for detailed instructions).

STEP 3 — WIRE

FIELD INSTALLATION

WARNING: ⚠ Wiring codes and regulations may vary. Wiring must comply with applicable regulations relating to the installation of electrical equipment in a hazardous area and is the responsibility of the installer. If in doubt, consult a qualified official before wiring the system.

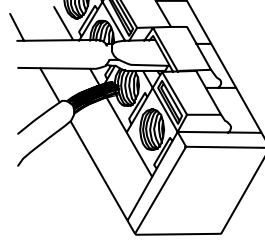
- If the 4-20 mA signal is not used, connect a jumper between the 4-20 terminal and the Common terminal.
- The use of shielded cable is highly recommended for signal, input, output and power wires to protect against interference caused by extraneous electrical or electromagnetic 'noise'.
- In applications where the wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment.
- The maximum distance between the Sensor and Controller is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used.
- When developing a RS-485 chain of devices, the last device in the chain requires end of line termination.
- RS-485 connection 2-wire, multipoint serial line.

SEAL

- Water-proof and explosion-proof conduit seals are recommended to prevent water accumulation within the enclosure.
- Seals should be located as close to the device as possible and not more than 18 inches (46 cm) away.
- Explosion-proof installations may require an additional seal where conduit enters a non-hazardous area. Ensure conformity with local wiring codes.
- When pouring a seal, use a fibre dam to assure proper formation of the seal. Seals should never be poured at temperatures below freezing.
- The jacket and shielding of the cable should be stripped back to permit the seal to form around the individual wires. This will prevent air, gas and water leakage through the inside of the shield and into the enclosure.
- It is recommended that explosion-proof drains and conduit breathers be used. In some applications, alternate changes in temperature and barometric pressure can cause 'breathing' which allows moist air to enter and circulate inside the conduit. Joints in the conduit system are seldom tight enough to prevent this 'breathing'.

Connecting Wires

1. Use a small screw driver to gently press down and hold the spring connector open.
2. Insert appropriate wire into open connector hole.
3. Release screw driver to secure wire.

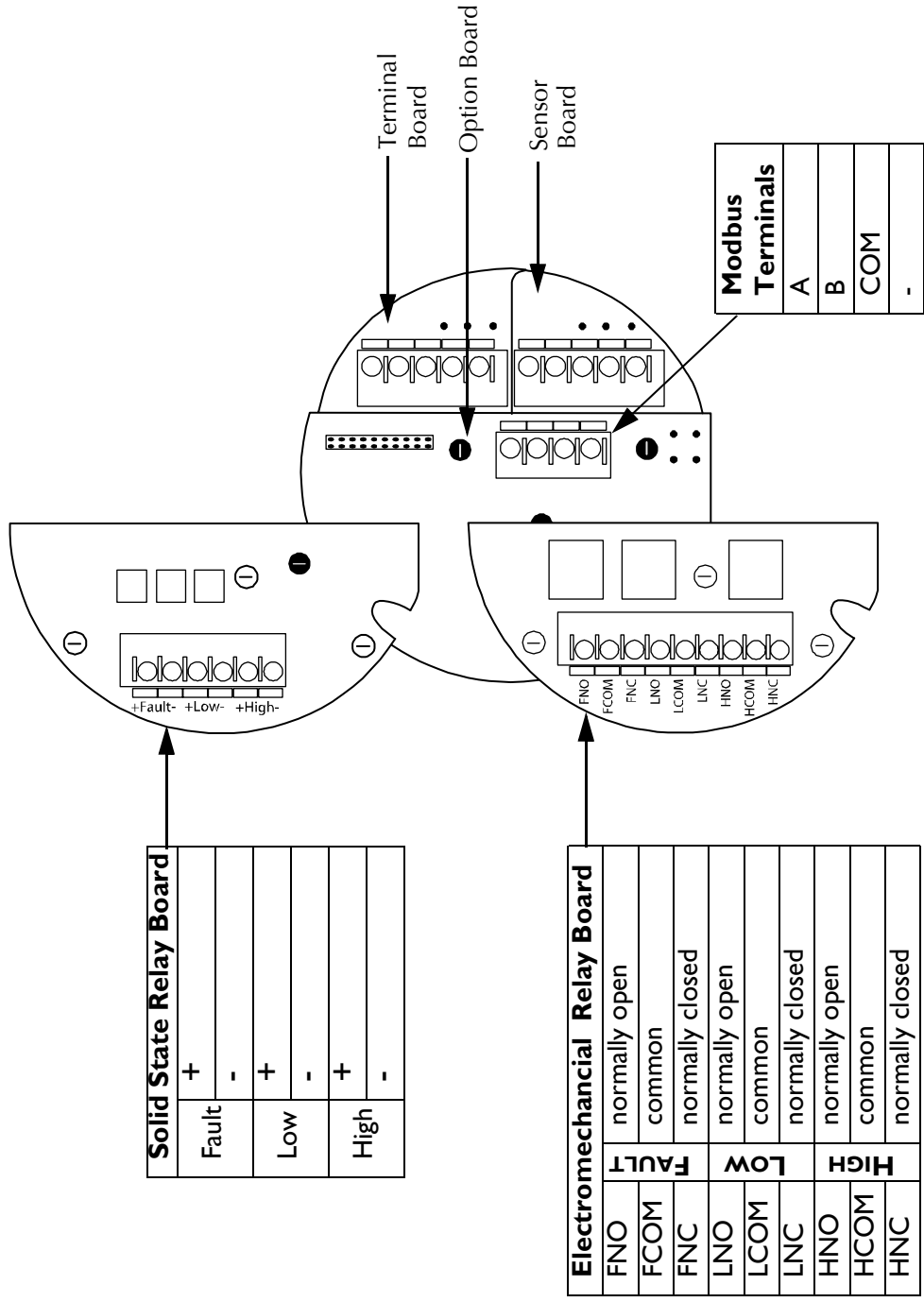


Board Assembly

There are three different fixed boards, two optional relay boards and an optional Modbus board which make up the PCB Assembly. Depending upon requirements, either a Electromechanical or Solid State Relay Board module can be used. Boards are field replaceable. Simply loosen the three locking standoffs, remove one board, insert the other board and tighten screws.

Note: Boards are susceptible to ESD. Refer to Appendix A, "Electrostatic Sensitive Device (ESD)", on page 22.

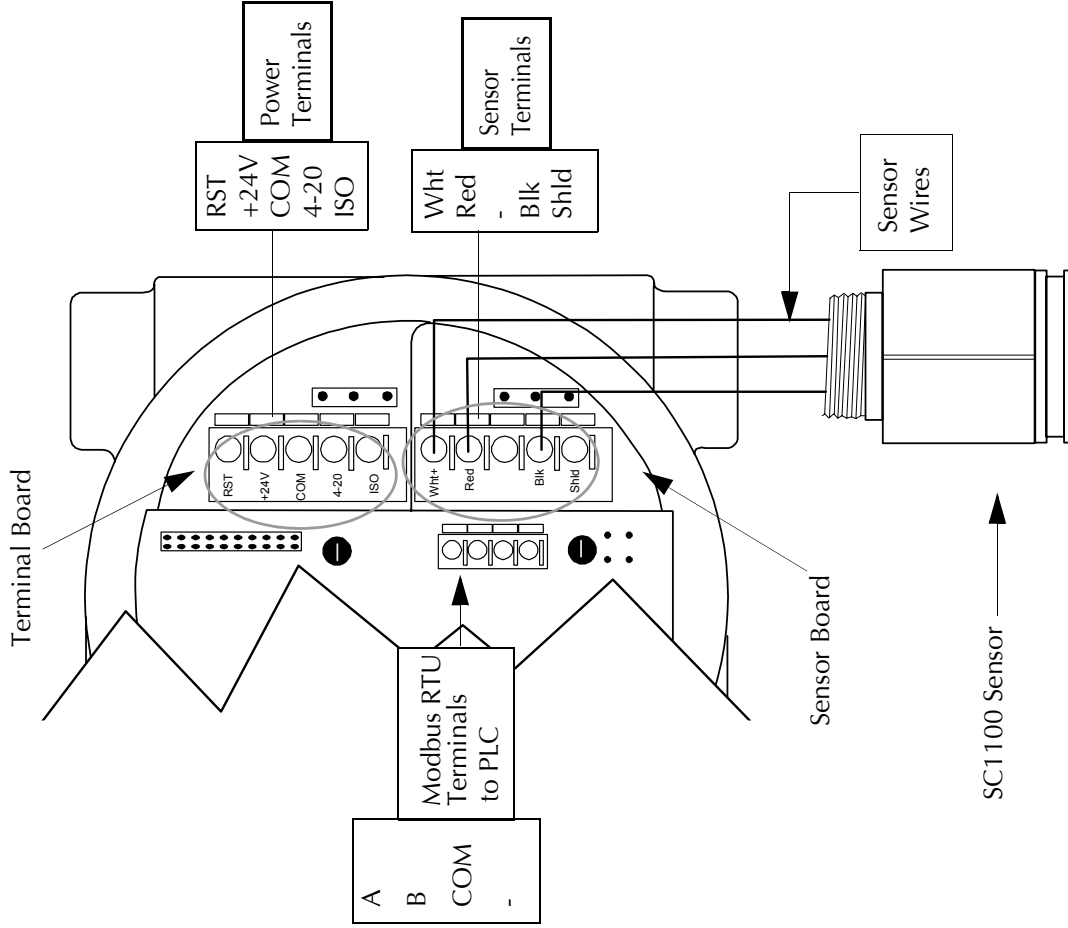
Figure 18: Millennium Module Boards



Solid State Relay Board	
+	
-	
+	
-	
+	
-	

Electromechanical Relay Board	
FNO	normally open
FCOM	common
FNC	normally closed
LNO	normally open
LCOM	common
LNC	normally closed
HNO	normally open
HCOM	common
HNC	normally closed

Figure 19: Wiring—Controller and Sensor



Note: If the 4 mA signal is not used, connect a jumper between the 4-20 terminal and the COM terminal on the Terminal Board.

SENSOR AND CONTROLLER

WARNING: ⚠ Power to the unit must be OFF before wiring.

Note: The Sensor may be factory installed to the Controller. If so, you need only connect the Power Terminals.

4. Remove the Controller's Housing Cover.
5. Connect the Sensor to the Sensor Terminals (if necessary) and the Output Terminals to the output signal wires.

Table 1: Controller/Sensor Terminal Connections

Sensor Terminals		Power Terminals	
Sensor Wire	Controller (Sensor Board)	Controller (Terminal Board)	Power Connections
-	-	RST	= Remote Reset
White	= Wht (+)	+24V	= Power (+)
Red	= Red (Sig)	COM	= Power (-)
Black	= Blk (-)	4-20	= Current Loop Output
-	Shld	ISO	= +24 V isolated 4-20

Note: For Sensor Separation instructions, see Figure 20, "Wiring—Sensor Separation", on page 7.

6. Replace the Controller's Housing Cover.
7. Turn Controller On.
8. Ensure display reads start delay, Status LED is Red Slow Flash and current output displays 3.0 mA. This is the start-up delay sequence which will last approximately 90 seconds.

Relay Board

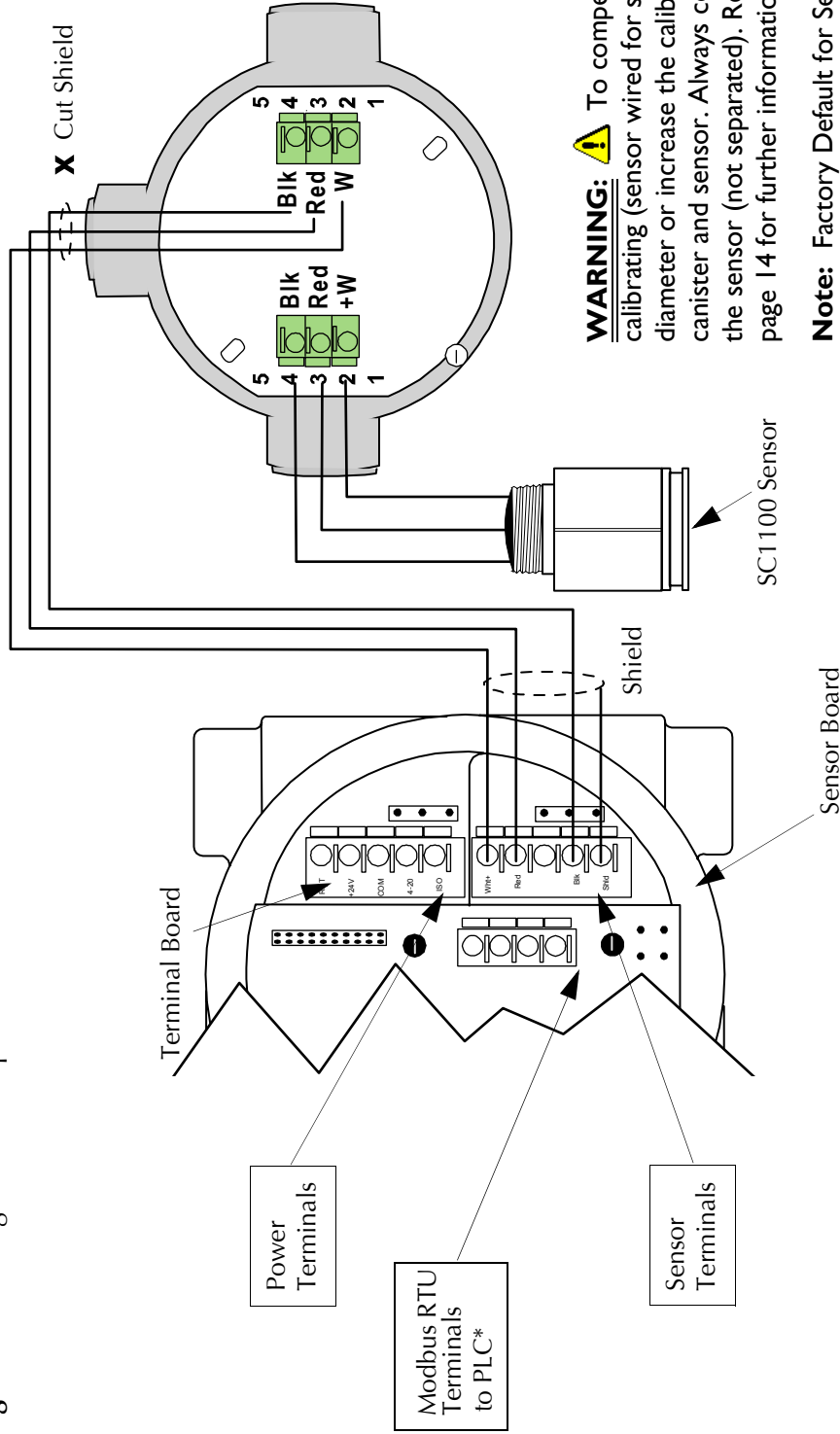
Refer to Figure 18, "Millennium Module Boards", on page 5 for location and explanation of relay termination.

RS-485 Communication

Connect devices in a chain via the Modbus terminals. The last device in the chain requires end of line termination (refer to "MODBUS Termination" on page 9).

SENSOR SEPARATION

Figure 20: Wiring—Sensor Separation



WARNING: To compensate for distance when remotely calibrating (sensor wired for separation), decrease the tubing diameter or increase the calibration gas flow rate between gas canister and sensor. Always confirm calibration by applying gas at the sensor (not separated). Refer to "Remote Calibration" on page 14 for further information.

Note: Factory Default for Sensor Separation is 0-75 feet.

As the Sensor must be located where gas is likely to accumulate and the Controller where it can be easily reached, it is often necessary to "separate" the Controller and Sensor.

The Sensor separation kit (SEP) is composed of a junction box and terminal strip. Refer to Option 1, Figure 15, "Locate Sensor/Controller—Separated", on page 2 for an example.

Shielded copper instrument wire (minimum 18 AWG) should be used for separations up to 75 feet. Shielded copper instrument wire (minimum 16 AWG) should be used for separations up to 150 feet.

Note: Refer to Table 1, "Controller/Sensor Terminal Connections", on page 6 for Terminal definitions. The actual physical distance between the Sensor and Controller must be defined (see "Extend Sensor Separation" on page 15 for instructions on setting the sensor separation distance).

Ensure that the appropriate wire is used for Class I/Division I hazardous applications.

Note: If the 4-20 mA signal is not used, connect a jumper between the 4-20 terminal and the COM terminal on the Terminal Board.

NON-ISOLATED/ISOLATED WIRING

Terminal Connection

Figure 21: Non-isolated Terminal Connection

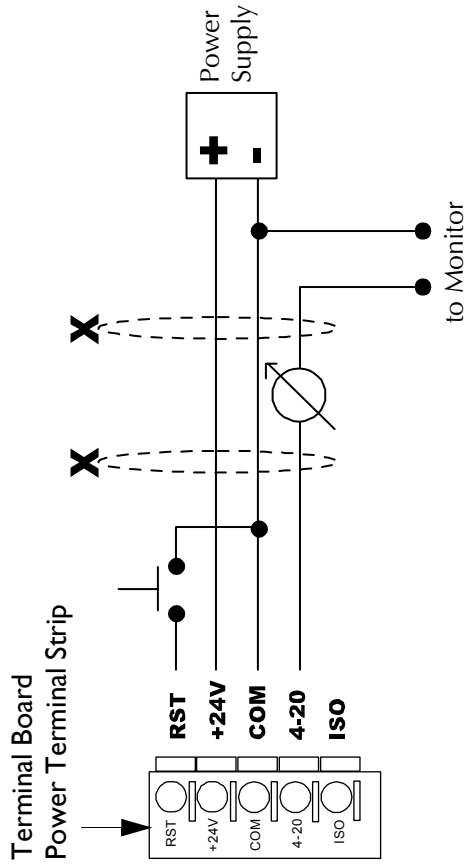
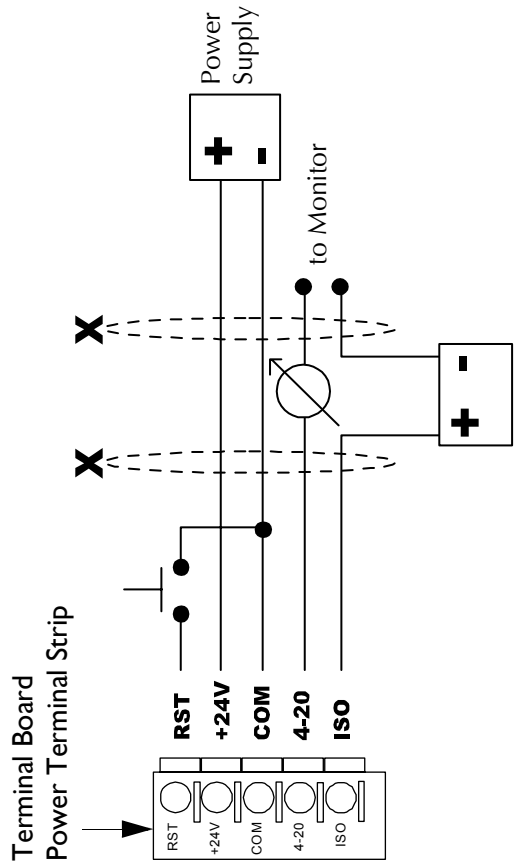


Figure 22: Isolated Terminal Connection

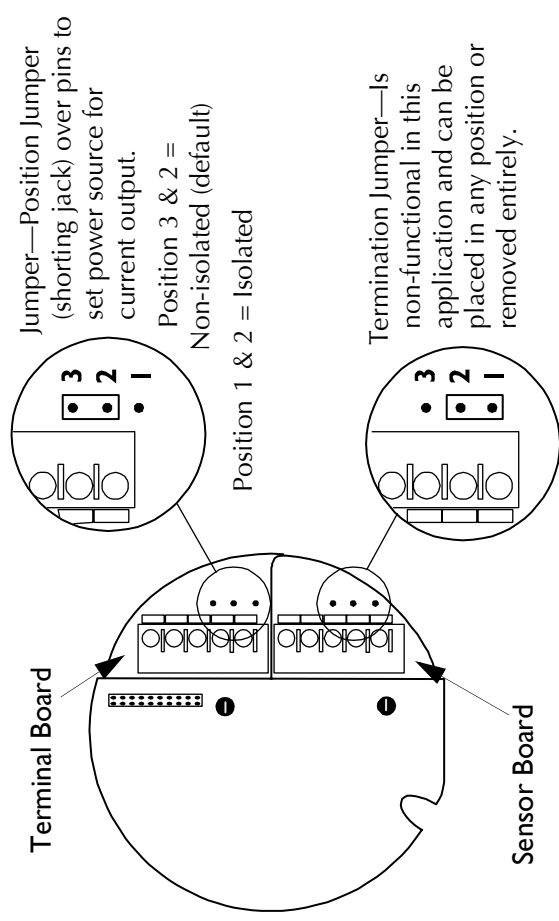


Current Output

To set an isolated current output, simply move the Jumper (shorting jack) to either the isolated or non-isolated current position (refer to Figure 23, "Jumper Positions", on page 8).

Note: Unless otherwise specified, all models ship with non-isolated current output.

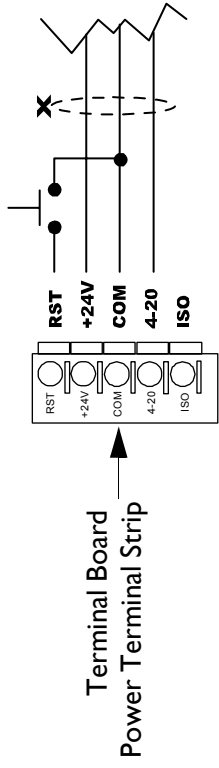
Figure 23: Jumper Positions



REMOTE RESET

The Millennium can be set for remote reset. A normally open Push Button Switch must be connected between the RST and the COM terminals on the Terminal Board and the Relay Option Latch Status must be set to Latching.

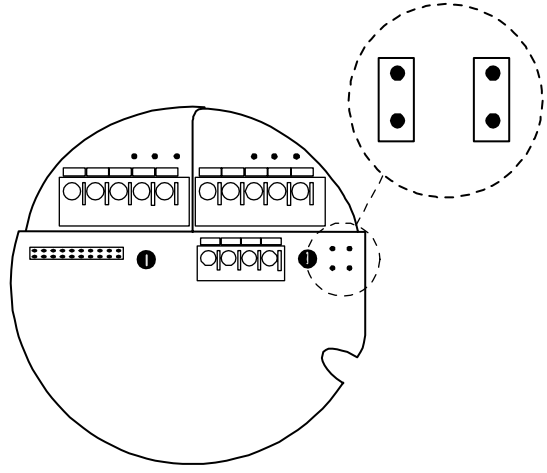
Figure 24: Remote Reset



MODBUS TERMINATION

Devices are networked in a daisy chain. The device located at the end of the chain requires end of line termination. Place both jumpers over the pins, as shown in Figure 25, "Modbus Termination Jumpers", on page 9, for end of line termination.

Figure 25: Modbus Termination Jumpers



STEP 4 — OPERATE

The Controller faceplate contains most functional elements of the user interface. Below is a description of that functionality.

Figure 26: Controller Functionality

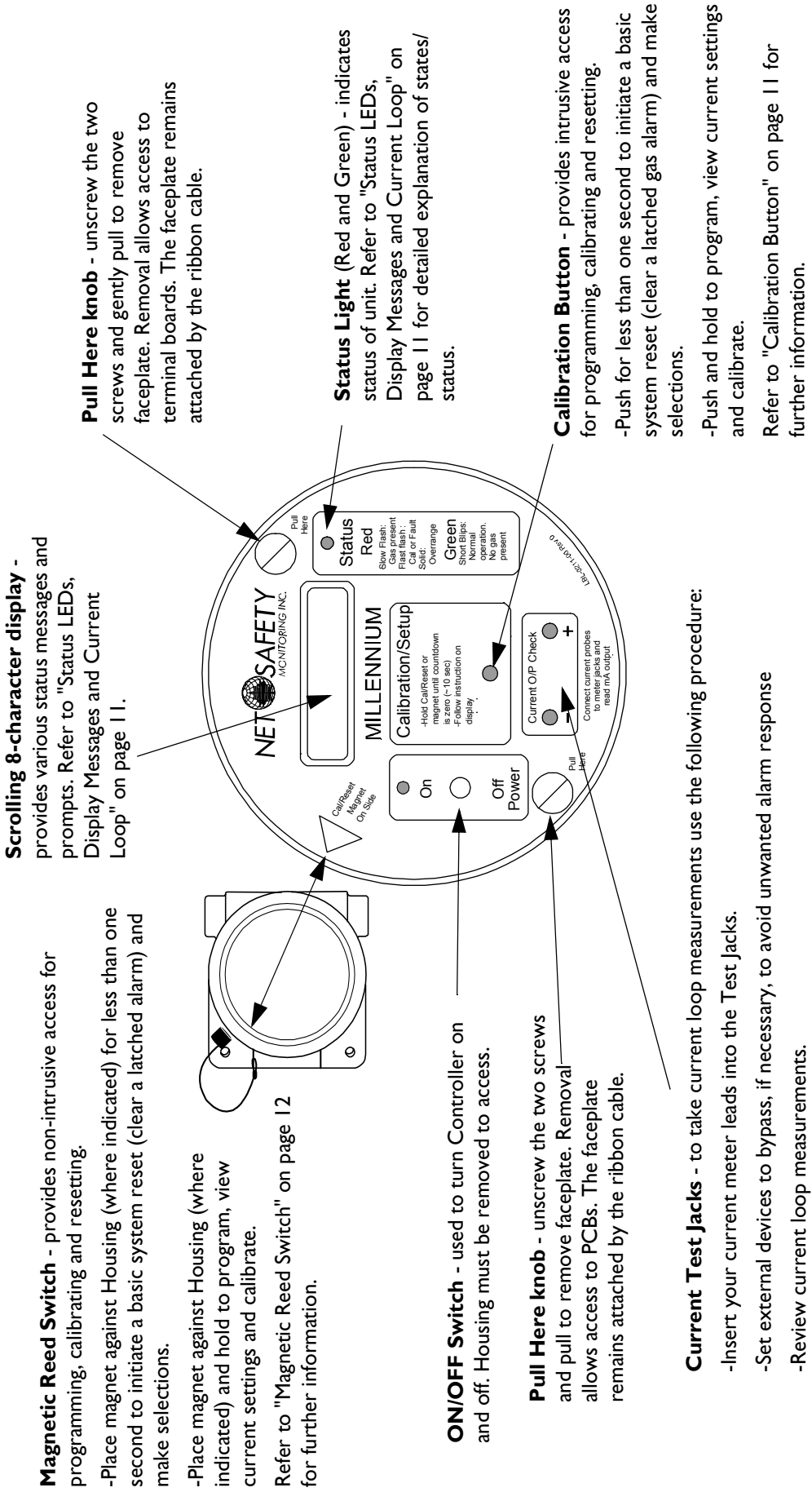


Table 2: Status LEDs, Display Messages and Current Loop

State	Current O/P	Status LED		Display
		RED or GREEN		
Calibrate Sensor Set Relay Options Review Settings	3.0 mA	n/a		n/a
Normal operation	4.0 mA		Blip/blink	00 %LEL
Start-up delay (90 sec)	3.0 mA	Slow flash		Start Delay
Access Main Menu	3.0 mA		n/a	Switch On 10-0
Memory Error (contact factory)	2.5 mA	Slow flash		Memory Error
White, Red or Black Sensor lead open	2.5 mA	Slow flash		Sensor Fault
Excess drift (>10%)	2.5 mA	Blip/blink		Neg Drift
Auto zero set	3.0 mA		Solid	Apply Clean Air
Apply calibration gas	3.3 mA	Fast flash		Apply 50% Span Gas
Span is set, remove gas	3.6 mA		Solid	Remove gas
Return to normal operation	3.6 mA		Solid	Cal. complete
Sensor Guard	20.0 mA	Solid		100% LEL
Gas present	>4.0-20.0 mA	Blip/blink		1 to 100% full Scale
Calibration procedure failed/Sensor failed	3.0 / 3.3 mA	Flash	Flash	Fail Cal

RTU Registers

Register 40001 = LEL Output (read only)

Register 40002 = RTU Status (read only)

Register 40101 = Reset latched relays (write)

Table 3: RTU Status Register (40002) Read Only (binary)

RTUstat_fault	0x0001	fault (sensor...)
RTUstat_low_alarm	0x0002	low alarm tripped
RTUstat_high_alarm	0x0004	high alarm tripped
RTUstat_low_alarm_latched	0x0008	low alarm latched
RTUstat_high_alarm_latched	0x0010	high alarm latched
RTUstat_lel_60_latched	0x0020	60% LEL latched
RTUstat_lel_100_latched	0x0040	100% LEL latched
RTUstat_powerUp	0x0080	power up delay
RTUstat_cal_cycle	0x0100	calibration cycle in progress
RTUstat_zeroing	0x0200	
RTUstat_apply_span_gas	0x0400	
RTUstat_calibrating	0x0800	
RTUstat_remove_gas	0x1000	
RTUstat_cal_complete	0x2000	
RTUstat_mem_error	0x4000	memory error

Calibration Button

The Calibration Button provides access to the Millennium's Main Menu, which in turn allows calibration and options to be reviewed and set. Refer to Figure 26, "Controller Functionality", on page 10 for more information.

- **Press and hold** the Calibration Button to Calibrate and access Main Menu.
- **Briefly press** to make a selection (select yes?).

WARNING: 

Opening the Controller's Housing should be avoided when the presence of gas is possible (when in a hazardous environment). Do not power up the system, with the Housing removed, unless the area has been de-classified.

Magnetic Reed Switch

The Magnetic Reed Switch is provided to avoid opening the Housing in an environment where gas may be present. The Magnetic Reed Switch functions in the same manner as the Calibration Button but in a non-intrusive manner. Refer to Figure 26, "Controller Functionality", on page 10 for more information.

Attached to the side of the Controller is a magnet:

- **Place and hold** the magnet to the Controller's Housing (10 o'clock position) to Calibrate and access Main Menu.
- **Briefly place** the magnet to the Controller's Housing (10 o'clock position) to make a selection (select **YES?**).

Power Up

Turn power switch On. A 90 second warm-up routine will begin. The display reads **Start Delay Millennium Net safety**, Status LED is Red Slow Flash and current output displays 3.0 mA.

When power is applied, the system is automatically tested to ensure proper functionality.

After warm-up, the Controller will enter normal operation, the display reads 00 **%LEL**, Status LED will Green Blip/blink and analog output will change to 4.0 mA.

Current Loop Measurement (Test Jacks)

Use a standard meter to measure current loop during various states. The Controller's Housing cover must be removed to access the Test Jacks.

Refer to Table 2, "Status LEDs, Display Messages and Current Loop," on page 11 for a detailed list and Figure 26, "Controller Functionality", on page 10 for more information.

Status LED

The Status LED will remain solid, flash, blip and/or blink, in either Red or Green, to indicate various states. Refer to Table 2, "Status LEDs, Display Messages and Current Loop," on page 11 for a detailed list.

THE MAIN MENU

The Main Menu provides access to various functional settings and viewing of current settings.

- Calibrate Sensor.
- Review Relay Settings (optional) - Review the current Fault, Low and High alarm settings. This is a read only section.
- Set Relay Options (optional) - Set the Low and High alarm settings.
- Restricted Menu - Set the sensor separation distance and choose low power options.
- Select a display language - English, Spanish or French.
- Select Modbus Options.

Note: The current output will drop to 3.0 mA while in the Main Menu.

Accessing the Main Menu

There are two ways to access the Main Menu:

- Calibration Button found on the faceplate (the Housing cover must be removed to access)
- Magnetic Reed Switch (a magnet must be used to activate)

Main Menu Functionality

1. Ensure that the Controller has been turned on and no fault is present.
2. Hold the magnet against the Reed Switch or press and hold the Calibration Button until the message **switch on** displays and the countdown (10 to 0) finishes.
3. An option will scroll across the display followed by the prompt **YES?**.
4. To select an option, momentarily place the magnet to the Reed Switch or press the Calibration Button at the **YES?** prompt.
5. If you do not wish to select that option wait until the next option appears and then select **YES?**.
6. A selection is acknowledged with a flashing **YES**.
7. If no option is selected, the Controller returns to 00 **%LEL** (normal operation).

STEP 5 — CALIBRATE

CALIBRATION PROCEDURE

WARNING: ⚠ The calibration procedure requires about 5 minutes to complete. If gas is not applied at the appropriate time, a calibration failure may occur (refer to "Calibration Failure" on page 14 for specific information).

For accurate performance, the Millennium should be calibrated using 50% span of the specific gas of concern. The concentration of gas, corresponding to 100% of full scale, is converted to a linear 4 to 20 mA output signal which can be powered from the primary dc supply of the instrument. Power up the unit for at least 4 hours BEFORE first calibration.

The following calibration procedure should be followed to ensure an accurate correlation between the 4 to 20 mA output signal and the gas concentration.

WARNING: ⚠ To compensate for distance when remotely calibrating (sensor wired for separation), decrease the tubing diameter or increase the calibration gas flow rate between gas canister and sensor. Always confirm calibration by applying gas at the sensor (not separated).

Figure 27: Calibration Procedure

Display	Calibrate Sensor YES?	Methane?	Apply Clean Air	Apply 50% Span Gas	Calibrating	Remove Gas	Cal Complete
Action	Select YES?	Select YES? or ignore message and wait for next prompt	Apply clean (zero air)	Apply specific gas		Remove gas	Apply clean air to purge system

Calibration Procedure

Refer to "Remote Calibration" on page 14 if remote calibration is to be performed.

1. Confirm successful power up of Controller—LED Green Blip/blink every 2 seconds; no fault indicated.
2. Flow certified ZERO AIR at a rate of 0.5 litres per minute through the calibration cup for 1 minute to ensure clean air environment.
3. Press and hold the Calibration Button or use the Reed Switch to access the Main Menu and wait for countdown (10-0) to complete.
4. When calibrate sensor YES? displays, use the Calibration Button or Reed Switch to select YES? Selection will be confirmed by a flashing YES.
5. The prompt Methane YES? will display. If calibrating for methane use the Calibration Button or Reed Switch to select otherwise ignore and wait for next prompt. (See "Sensor Life Check" on page 14 for detailed information.)
6. When Apply Clean Air displays apply clean air.
7. Wait for Apply 50% Span Gas to display and apply specific gas at a rate of 0.5 litres per minute (use 1.0 litres per minute for remote calibration).
8. The display will show Calibrating as gas detected.
9. Remove span gas when the message Remove Gas displays (Status LED Green solid and 3.6 mA output).
10. The message Cal Complete will display when calibration is complete.
11. Apply zero gas (clean air) again to purge system.

Note: Always apply test gas after calibration to verify operation.

Remote Calibration

The preferred tubing has an inside diameter of 3/16"; stainless steel tubing is excellent, plastic tubing is good. Within 10ft/35m, a flow rate of 0.5 litres per minute can be used but 1.0 litres per minute is recommended. Always use 1.0 litres per minute for distances between 10ft to 100ft. Contact Net Safety if a remote calibration distance is greater than 100 ft/30m is required.

Abort Calibration

The Calibration procedure may be aborted. When the display shows **apply 50% span gas**, press and hold the Reed Switch or Calibration Button until the countdown 10-0 completes and the display returns to **00 %LEL**.

Sensor Life Check

Low Power units, calibrated for methane only, indicate life expectancy of the sensor. Once calibration is complete, one of the following messages **may** display if the sensor needs replacing.

Sensor Near End of Life - indicates the sensor will reach end of life before the next calibration can be completed. Replace sensor as soon as possible. Press the Calibration Button or use the Reed Switch to clear this message.

End of Sensor Life, Replace sensor - indicates sensor has reached end of life and needs to be replaced immediately.

Press the Calibration Button or use the Reed Switch to clear this message. The unit will remain in Fault Mode until the sensor is replaced.

Calibration Failure

If the calibration procedure fails, the display shows **Fail cal**, the Status LED alternates Red/Green flashes and the analog output changes back and forth from 3.0 to 3.3 mA.

The unit remains in a failed state until manually reset. After the Manual Reset, the unit will return to normal operation based on previous calibration values. See "Manual Reset" on page 18 for instructions.

STEP 6 — MONITOR

REVIEW RELAY SETTINGS

This is a **read-only mode**; changes cannot be made.

Step 1: Press and hold the Calibration Button or the magnet to the Reed Switch to enter the Main Menu; wait for the countdown, from 10 to 0, to end.

Step 2: When **Review Relay Settings** displays press the Calibration Button or use the Reed Switch to select. The flashing **yes** confirms the selection.

Step 3: The Fault Alarms are **fixed** (**Energized / Non-Latching**) and display first. Then the Low Alarm level, coil and latch status display, followed by the High Alarm level, coil and latch status.

Step 4: At this point, the option to set **Relay Options YES?** is displayed.

SET RELAY OPTION

Use to set the alarm level, coil status and latch status for the Low and High relays (Fault Alarm is fixed).

The following table describes the default settings for the sensor.

Table 4: Default Relay Settings

Millennium Model Number	Alarm Levels			Coil Status		
	Low	High	Fault	Latching	Non Latching	Energized
MLP-A/R/D-SCI100 / MLP-LP-A/R/D-SCI100	20%	40%	Energ./ Non-latching		*	*

Setting Relay Options

There are two settings for Relay Options: Low and High. The Fault Relay is fixed as Energized/Non-latching and cannot be changed. The low alarm level, coil energization and latch status for low alarm are set first; high alarm level, coil energization and latch status for high alarm are then set. All ranges are in %LEL.

- Step 1:** When set `Relay Options YES?` displays press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection.
- Step 2:** The message set `Low` displays. Low Alarm set-points are then displayed in increments of 5 (0 to 55).
- Step 3:** When the required level displays, press the Calibration Button or use the Reed Switch to select. The level selected will flash to confirm the selection.
- Step 4:** The message `coil status displays`. The display then shows `Energized YES?` and then `De-Energized YES?`.
- Step 5:** Press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection. If no selection is made, Coil Status option is repeated.
- Step 6:** The message `Latch status displays`. The display then shows `Latching YES?` and then `Non-Latching YES?`.
- Step 7:** Press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection. If no selection is made, Latch Status option is repeated.
- Step 8:** The message set `High` displays. The High Alarm level cannot be set to a value lower than the Low Alarm level (as set in Step 3), nor higher than the maximum of 55% LEL. The High Alarm level is displayed in increments of 5 **greater** than the Low Alarm level (as set in Step 3).
- Step 9:** Repeat Steps 3 through 7 to complete the High Alarm level, coil and latch status settings.
- Note:** If no selection is made, a 5 minute timer expires, in which case the unit returns to normal operation.

ENTER RESTRICTED MENU

The Restricted Menu allows you to select:

- Sensor Separation Distance
- Low Power Options (optional)

- Step 1:** Press and hold the Calibration Button or the magnet to the Reed Switch to enter the Main Menu; wait for the countdown, from 10 to 0, to end.
- Step 2:** When `Enter restricted menu YES?` displays press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection.
- Step 3:** When `Are you sure? YES?` displays press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection.

Extend Sensor Separation

- Step 1:** Enter the Restricted Menu (refer to "Enter Restricted Menu" on page 15).
- Step 2:** When `Extend sensor separation YES?` displays press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection.
- Step 3:** `Sensor Separation = 75 to 150 feet YES?` displays first then `Sensor Separation = 0 to 75 feet YES?`. Press the Calibration Button or use the Reed Switch to select. The flashing `YES` confirms the selection.
- Note:** The sensor separation distance, as set for this option, must be the same as the physical length of the wire.

WARNING:

To avoid damaging the sensor, the factory default of 0-75 Feet must be used UNLESS the Controller and Sensor are separated. Refer to "Sensor Separation" on page 7 for further information.

Set Low Power Options - Optional

Some Millennium versions have two optional low power features to reduce overall power consumption. Use this option to:

- Dim the LED display although display will still be visible in most lighting conditions (default setting)
- Disable the 4 to 20 mA analog output for applications requiring only relay output (default setting)

- Step 1:** Enter the Restricted Menu (refer to "Enter Restricted Menu" on page 15).
- Step 2:** When set `Low Power Options YES?` displays press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.
- Step 3:** When `Lower Display Brightness YES?` displays press the Calibration Button or use the Reed Switch to select or wait until `Display Full Brightness YES?` displays and select.
The flashing `YES` confirms the selection.
- Step 4:** When `Disable 4 - 20mA O/P YES?` displays press the Calibration Button or use the Reed Switch to select or wait until `Enable 4 - 20mA O/P YES?` displays and select.
The flashing `YES` confirms the selection.

SELECT DISPLAY LANGUAGE

Display language selection appears after the Restricted Menu.

- Step 1:** After the Restricted Menu the option `select Display Language YES?` displays. Press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.
- Step 2:** When the required language displays (`English, Español, Français`) press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.
- Note:** Factory default is English.

MODBUS OPTIONS

The digital RS-485 Modbus RTU protocol is used. There are two Modbus options: Node Address and Baud Rate.

Node Address

Each device connected to the chain must be assigned a unique node address. The last number in the address is selected first.

- Step 1:** When `Modbus setup? YES?` displays press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.
- Step 2:** The current node address will display `Node: 000`.
- Step 3:** Wait for the prompt `New Address? YES?` and press the Calibration Button or use the Reed Switch to select.
- Step 4:** Use the Calibration Button or Reed Switch to select each of three numbers in the new address:
- select the last number in the address first: 0 thru 9.
- select the next number in the address: 0 thru 9.
- select the first number in the address last: 0 1 2.

Baud Rate

The transmission speed must be defined.

- Step 1:** When `Modbus setup? YES?` displays press the Calibration Button or use the Reed Switch to select.
The flashing `YES` confirms the selection.
- Step 2:** After setting the Node Address, the current Baud Rate will display `xx.x BPS`.
- Step 3:** Wait for the prompt `New Baud Rate? YES?` and press the Calibration Button or use the Reed Switch to select.
- Step 4:** The available baud rates will display: `2400s, 4800s, 9600s, 14.4s, 19.2s, 28.8s, 38.4s, 57.6s`.
- Step 5:** Use the Calibration Button or use the Reed Switch to select baud rate when it displays.
- Step 6:** The flashing `YES` confirms the selection.

ALARMS

Sensor Fault

WARNING: 

The fault detection circuitry does not monitor the operation of external response equipment or the external wiring to these devices. It is important that these devices be checked periodically to ensure they are operational.

Self-testing circuitry continuously checks for problems that could prevent proper response. When power is applied, the microcontroller automatically tests the system to ensure that it is functioning properly. During normal operation, it continuously monitors the signal from the internal sensor source. In addition, a "watchdog" timer is maintained to ensure the program is running correctly. When a system fault is detected, the Status LED will Red Slow flash, the display show `sensor fault` and analog output changes to 2.5 mA.

Sensor Drift

It is a normal characteristic of gas sensors to exhibit a slow drift from zero. When the amount of drift exceeds 10%, since the last calibration, the analog output switches to 2.5 mA, the Status LED will Red Blip/blink and the display shows `neg drift`. This message will remain until manually reset and the system is re-calibrated. Refer to "Manual Reset" on page 18 for reset instructions. When the analog output switches to 2.5 mA due to drift, the sensor will still respond and transmit reasonable analog output signals if gas is present.

Gas Present

When gas is present 1 to 100% Full scale will display, the analog output switches between 4 and 20 mA and the Status LED Blip/blinks Red.

Sensor Life

Depending on various factors, sensor response may slowly deteriorate over a period of years. If calibration becomes impossible for any reason, the display will show `fault cal`, the analog output will switch repeatedly between 3.0 mA and 3.3 mA and the Status LED alternates Red and Green flashes.

Note: Refer to "Sensor Life Check" on page 14 if calibrating for methane gas.

Sensor Guard

SensorGuard is a proprietary firmware feature that protects the pellistor sensor from the damage and/or response shift commonly caused by exposure to high concentrations of combustible gas. With this feature, repeated or lengthy exposure to high gas concentrations has negligible affect on sensor performance. Sensor life is prolonged and calibration frequency is reduced. This does not eliminate the necessity of periodic sensor response checks which should be performed as part of an effective maintenance schedule.

If a gas signal exceeds 100% LEL the analog output will latch at 20 mA, the Status LED turn Solid Red and the display show 100 % LEL.

Note: At this point, power to the Sensor module will be terminated. Simultaneously the SensorGuard feature is activated to protect the sensor from damage that can be caused by the oxidation of high gas concentrations. This protective feature extends the useful lifetime of the sensor and reduces or eliminates disruption of its calibration. As an extra safety precaution the system should be checked for accuracy after such over-range exposure and if necessary re-calibrated. The system will need to be reset to clear the latched output (refer to "Reset" on page 18).

Flooding of pellistor sensors with high percentage levels of combustible gas results in a rapid response followed by a rapid return to zero which can be misleading and dangerous. CSA and ISA require that a reading of at least 60% LEL is reached under such conditions. To be safe, alarm signals should latch at 60% LEL and require a manual reset action to restore normal operation.

SensorGuard includes a unique safety feature where high alarm relays and the analog output latch when 60% LEL is exceeded. SensorGuard includes an analog ratchet so that LEL values above 60% are recorded and latched until reset manually. This encourages the acknowledgement and investigation of all high readings. Refer to "Reset" on page 18 for further information.

WARNING: 

Any type of gas sensor is susceptible to damage when exposed to high levels of gas, therefore, check the sensor for accurate response and if necessary perform a calibration or replace the sensor after any high level alarm.

RESET

Manual Reset

A Manual Reset is required after a calibration failure or to clear a latched relay alarm. Simply place and hold the magnet against the Reed Switch or press and hold the Calibration Button for 3-5 seconds. The unit will return to normal operation using previous calibration values.

Remote Reset

If Relay Option is set to *Latching* (refer to "Setting Relay Options" on page 15) and an open Push Button Switch is connected between the RST terminal and the COM terminal on the Terminal Board, Remote Reset is possible. Also refer to "Remote Reset" on page 9 for details.

OUTPUTS

Relays (Optional)

Note: The fault relay output is not used to activate an automatic shutdown procedure. The fault output indicates a potential problem with the Controller not an alarm condition.

Standard electro-mechanical relay outputs have Form C SPDT contacts rated 5 Amps at 30 V dc/ 250 V ac. Three relay outputs are available; one for Fault; one for Low alarm; and one for High alarm. All relays have normally open and normally closed contacts available at the output terminals.

The fault relay is set for normally energized operation and is non-latching. If a system fault is detected, the fault relay becomes de-energized. The fault relay is factory set and cannot be altered. The Low alarm and High alarm relays can be selected for either normally energized or normally de-energized operation and latching/non-latching.

An optional low power solid state relay board comes with Form A contacts rated 2.5 Amps at 60 V ac/dc and selectable energized/de-energized, latching/non-latching configurable low and high alarms. Fault relay is factory set as energized, non-latching and cannot be modified.

Modbus

Digital RS-485 Modbus RTU protocol is used.

Register 40001 = LEL output (read only)

Register 40002 = Status (read only)

Register 40101 = Reset latched alarms (write)

Note: Many registers are used by the controller. Please do not write outside the three registers.

Current

A 4-20 mA dc current output is used to transmit the alarm status and fault codes to other devices. This output can be wired for isolated or non-isolated operation. A 4.0 mA output indicates normal operation; a 4.0 - 20.0 mA output indicates the presence of gas. Current output of 2.5 mA indicates the presence of a system fault.

STEP 7 — MAINTAIN

PERIODIC RESPONSE CHECK

We recommend the Millennium be verified or calibrated every 3 months. A typical response check involves the application of calibration gas to the sensor, then the observation of the response LEDs, analog output, display and external monitoring equipment. Be sure to prevent unwanted response of external monitoring devices and equipment during this procedure. If the Millennium response to calibration gas is within its specified accuracy then it is not necessary to perform a calibration. For example, when 50% of full scale is applied, the response is expected to be between 11.5 mA (47% of full scale) and 12.5 mA (53% of full scale). An additional consideration is the accuracy tolerance of the calibration gas which may be + or - a few percent. If the calibration gas is + or - 10% of full scale then the reading may be from 10.7 mA (42% of full scale) to 13.3 mA (58% of full scale).

TROUBLESHOOT

Response to the input should be checked and, if necessary, calibration should be performed whenever any of the following occur. Refer to "Calibration Procedure" on page 13 for calibration instructions.

- Excess negative drift is indicated by 2.5 mA current output
- Sensor or transmitter is connected or disconnected
- Long term or high concentration exposure to gas

The Millennium is not designed to be repaired in the field. If a problem should develop, first calibrate the device and carefully check for faulty wiring. If it is determined that the problem is caused by an electronic failure, the device must be returned to the factory for repair. Refer "How to Return Equipment" on page 19 for detailed instructions.

HOW TO RETURN EQUIPMENT

A Material Return Authorization number is required in order to return equipment. Please contact Net Safety Monitoring at **(403) 219-0688** before returning equipment or consult our Service Department to possibly avoid returning equipment.

If you are required to return equipment, include the following information:

1. A Material Return Authorization number (provided over the phone to you by Net Safety).
2. A detailed description of the problem. The more specific you are regarding the problem, the quicker our Service department can determine and correct the problem.
3. A company name, contact name and telephone number.
4. A Purchase Order, from your company, authorizing repairs or request for quote.
5. Ship all equipment, prepaid to:

Net Safety Monitoring Inc

3rd Floor, 2711 39th Ave., N. E.
Calgary, Alberta, Canada
TIY 4T8

6. Mark all packages: **RETURN for REPAIR**

Waybills, for shipments from outside Canada, must state:

Equipment being returned for repair All charges to be billed to the sender

Also, please ensure a duplicate copy of the packing slip is enclosed inside the box indicating item 1-4 along with the courier and account number for returning the goods.

All Equipment must be Shipped prepaid. Collect shipments will not be accepted.

Pack items to protect them from damage and use anti-static bags or aluminum-backed cardboard as protection from electrostatic discharge.

SPARE PARTS/ACCESSORIES

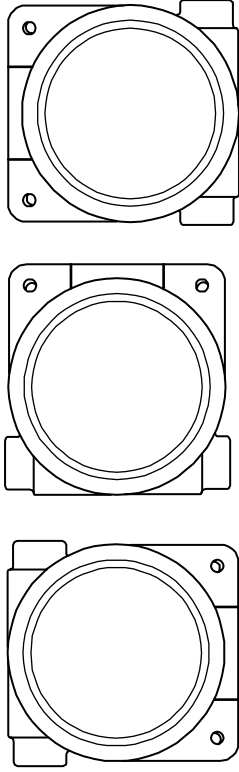
Table 5: Part Numbering

Description	Net Safety Part Number
SCI100 Combustible Sensor (0-100% LEL of most Hydrocarbons and Hydrogen)	SCI100
SCI100 Combustible Sensor Stainless Steel (0-100% LEL of most Hydrocarbons and Hydrogen)	SCI100SS
Separation Kit	SEP
Solar Shield, 1-channel Relay Output for Toxic sensor or Combustible sensor (electromechanical)	SSI-R-SXXXXXX
Solar Shield, 1-channel Relay Output for Combustible sensor (solid state)	SSI-S-SXXXXXX
Solar Shield, 2-channel Analog/Relay Output for Toxic and Combustible sensors or Fire Detectors	SS2-AR-SXXXXXX
Solar Shield, 1-channel Controller Terminal Box	SSI-HSG-ASSY
Solar Shield, 2-channel Controller Terminal Box	SS2-HSG-ASSY
2-Battery Enclosure	SS-2BAT-ASSY
Pole Installation Assembly	SS-POLE-ASSY
50 Ft Power Cable Extension	CAB-0025
Battery Box Interconnect cable	

FACE ROTATION OPTION

In some applications, it is necessary for the Millennium Controller to be mounted in a non-standard orientation. To accommodate such installations and ensure that the display will appear at the correct angle for viewing, the PCB Assembly can be rotated inside the Controller.

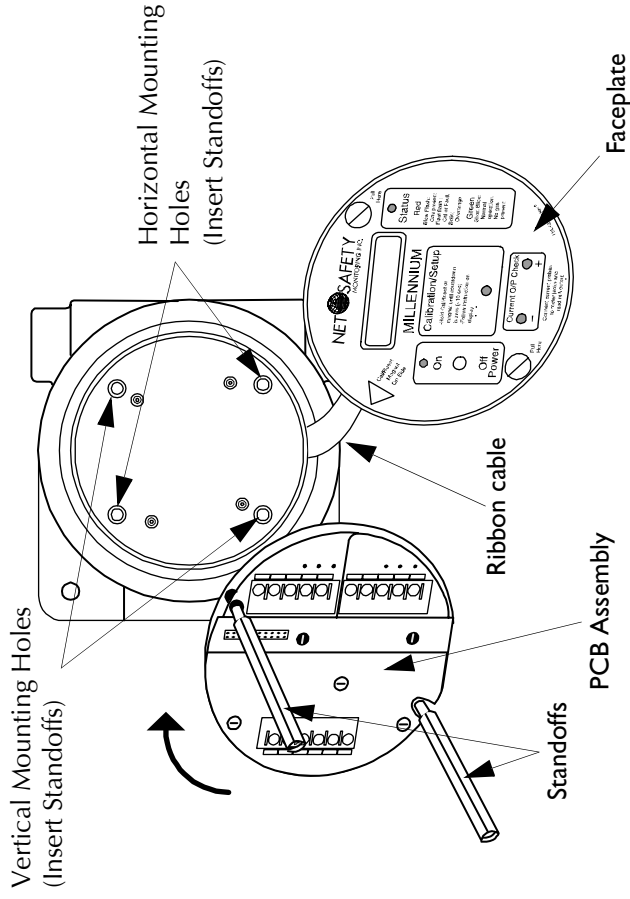
Figure 28: Non-standard Orientations



Note: Ensure orientation allows for connections and excess wire within Controller Housing.

Rotate PCB Assembly

1. Remove the Controller's Housing Cover.
2. Turn the power to the detector off.
3. Unscrew both the knobs marked "Pull Here".
4. Lift Controller faceplate from Housing and allow to hang from ribbon cable.
5. Unscrew the two metal standoffs.
6. Carefully remove the PCB Assembly from the Housing.
7. The Rotator plate is secured to the bottom of the Housing and is accessible after the PCB Assembly has been removed.
8. Rotate the PCB Assembly to desired position and line up the standoffs with the mounting holes.
9. Insert standoffs in the appropriate horizontal or vertical mounting holes.
10. Tighten standoffs to secure PCB Assembly.
11. Replace faceplate and tighten "Pull Here" knobs.
12. Return power to detector and replace Housing Cover.



WARNING: ⚠ See Appendix A, "Electrostatic Sensitive Device (ESD)", on page 22 for handling instructions of electronic components.

Appendix A: ELECTROSTATIC SENSITIVE DEVICE (ESD)

Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy—ESD! If the charge is sufficient and occurs near electronic components, it can damage or destroy those components.

In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by metal shields—taking care not to touch electronic components
 - Wear grounded wrist or foot straps, or ESD shoes or heel grounders to dissipate unwanted static energy
 - Prior to handling boards, dispel any charge in your body or equipment
 - Ensure components are transported and stored in static safe packaging
 - When returning boards, carefully package in the original carton and static protective wrapping
 - Ensure ALL personnel are educated and trained in ESD Control Procedures
- In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices.

A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.



Appendix B: RESISTANCE TABLE

Table 6: Wire Resistance In Ohms

Distance (Feet)	AWG #20	AWG #18	AWG #16	AWG #14	AWG #12	AWG #10	AWG #8
100	1.02	0.64	0.40	0.25	0.16	0.10	0.06
200	2.03	1.28	0.80	0.51	0.32	0.20	0.13
300	3.05	1.92	1.20	0.76	0.48	0.30	0.19
400	4.06	2.55	1.61	1.01	0.64	0.40	0.25
500	5.08	3.20	2.01	1.26	0.79	0.50	0.31
600	6.09	3.83	2.41	1.52	0.95	0.60	0.38
700	7.11	4.47	2.81	1.77	1.11	0.70	0.44
800	8.12	5.11	3.21	2.02	1.27	0.80	0.50
900	9.14	5.75	3.61	2.27	1.43	0.90	0.57
1000	10.20	6.39	4.02	2.53	1.59	1.09	0.63
1250	12.70	7.99	5.03	3.16	1.99	1.25	0.79
1500	15.20	9.58	6.02	3.79	2.38	1.50	0.94
1750	17.80	11.20	7.03	4.42	2.78	1.75	1.10
2000	20.30	12.80	8.03	5.05	3.18	2.00	1.26
2250	22.80	14.40	9.03	5.68	3.57	2.25	1.41
2500	25.40	16.00	10.00	6.31	3.97	2.50	1.57
3000	30.50	19.20	12.00	7.58	4.76	3.00	1.88
3500	35.50	22.40	14.10	8.84	5.56	3.50	2.21
4000	40.60	25.50	16.10	10.00	6.35	4.00	2.51
4500	45.70	28.70	18.10	11.40	7.15	4.50	2.82
5000	50.10	32.00	20.10	12.60	7.94	5.00	3.14
5500	55.80	35.10	22.10	13.91	8.73	5.50	3.46
6000	61.00	38.30	24.10	15.20	9.53	6.00	3.77
6500	66.00	41.50	26.10	16.40	10.30	6.50	4.08
7000	71.10	44.70	28.10	17.70	11.10	7.00	4.40
7500	76.10	47.90	30.10	19.00	12.00	7.49	4.71
8000	81.20	51.10	33.10	20.20	12.70	7.99	5.03
9000	91.40	57.50	36.10	22.70	14.30	8.99	5.65
10 000	102.00	63.90	40.20	25.30	15.90	9.99	6.28

Note: Resistance shown is one way. This figure should be doubled when determining closed loop resistance.

Appendix C: SPECIFICATIONS

SENSOR SPECIFICATIONS

- Operating Temperature Range: -40°C to +85°C (-40F to +185F)
- Weight: 0.1 Kg (0.2 lb)
- Enclosure Material: Powder Coated or Anodized Aluminum (optional stainless steel)
- Range of Detection: 0 to 100% LEL of most hydrocarbons and hydrogen
- Accuracy: ±3% LEL up to 50% LEL ±5% LEL above 50% LEL
- Response Time: <10 seconds to T50 <30 seconds to T90
- Linearity/Repeatability: ±3% LEL / ±2% LEL
- Certification: CSA and NRTL/C certified for hazardous locations. Class I, Division I, Groups B, C and D. IEC Rating Ex d IIB+H2 T5. Performance certified to CSA C22.2 No. 152

CONTROLLER SPECIFICATIONS

MILLENNIUM	4-20 mA ANALOG OUTPUT	Low Power Board 4-20 mA ANALOG OUTPUT and RELAY OUTPUT (solid state) display dimmed	4-20 mA with RELAY OUTPUT MODULE	Low Power Board 4-20 mA ANALOG OUTPUT and RELAY OUTPUT (solid state) display dimmed	Low Power Board 4-20 mA ANALOG OUTPUT (disabled) and RELAY OUTPUT (solid state) display dimmed	RS-485 MODBUS RTU DIGITAL COMMUNICATIONS
Operating Temperature Range	Operational -50°C to +85°C / Certified -58F to +185F) / Certified -40°C to +85°C (-40F to +185F)					
Power Consumption 12 V dc @ 50 Span	Nominal 1.8 W Maximum 1.82 W	Maximum 1.84 W	Nominal 2.52 W Maximum 3.45 W	Maximum 1.5 W		
Power Consumption 24 V dc @ 50 Span	Nominal 2.04 W Maximum 2.06 W	Maximum 2.08 W	Nominal 2.76 W Maximum 3.48 W	Maximum 1.68 W		
In-Rush Current		12 V dc 2.88 W/230 mA 24 V dc 3.02 W/120 mA		12 V dc 2.58 W/215 mA 24 V dc 2.59 W/108 mA		
Humidity Range	0 to 100% Relative humidity, non-condensing					
Operating Voltage Range	10.5 to 32.0 V dc					
Enclosure Material	Powder coated Copper Free Cast Aluminum					
Certifications	CSA and NRTL/C certified for hazardous locations. Class I, Division 1, Groups B, C and D. Temperature Code T5. Rating Ex d IIB+H2 T5 (Class I, Zone 2, Group IIB+H2T5). Maximum operating ambient of 85°C. Enclosure Type 4X. Note: Electronics only-CSA and NRTL/C certified for hazardous locations Class I, Division 2 Groups A,B,C and D.					
Weight	3.2 Kg (7.0 lb)					
Output	<ul style="list-style-type: none"> - 4 to 20 mA - Into a maximum loop impedance of 800 Ohms at 32 V dc or 150 Ohms at 10.5 V dc. Isolated or non-isolated loop supply. - Premium version Form C contacts rated 5 Amps at 30 V dc / 250 V ac. Selectable energized / de-energized, latching/non-latching configurable low and high alarms. Fault relay is factory set as energized, non-latching and cannot be modified. - Low Power Version Form A contacts rated 2.5 Amps at 60 V ac/dc. Selectable energized / de-energized, latching/non-latching configurable low and high alarms. Fault relay is factory set as energized, non-latching and cannot be modified. - Digital RS 485 Modbus RTU Protocol 					



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www.netsafety.com

Distributed by:



**Unitized
Ultraviolet
Flame Detector**

User Manual

Model:

UVS-A or AR



ISO 9001:2000



Part Number: MAN-0039-00 Rev 7
May 2006

IMPORTANT INFORMATION

This manual is for informational purposes only. Although every effort has been made to ensure the correctness of the information, technical inaccuracies may occur and periodic changes may be made without notice. Net Safety Monitoring Inc., assumes no responsibility for any errors contained within this manual.

If the products or procedures are used for purposes other than as described in the manual, without receiving prior confirmation of validity or suitability, Net Safety Monitoring Inc., does not guarantee the results and assumes no obligation or liability.

No part of this manual may be copied, disseminated or distributed without the express written consent of Net Safety Monitoring Inc.

Net Safety Monitoring Inc., products are carefully designed and manufactured from high quality components and can be expected to provide many years of trouble free service. Each product is thoroughly tested, inspected and calibrated prior to shipment. Failures can occur which are beyond the control of the manufacturer. Failures can be minimized by adhering to the operating and maintenance instructions herein. Where the absolute greatest of reliability is required, redundancy should be designed into the system.

Warranty

Net Safety Monitoring Inc., warrants its sensors against defective parts and workmanship for a period of 24 months from date of purchase; other electronic assemblies for 36 months from date of purchase.

No other warranties or liability, expressed or implied, will be honoured by Net Safety Monitoring Inc.

Contact Net Safety Monitoring Inc., or an authorized representative for details.

We welcome your input at Net Safety Monitoring. If you have any comments please contact us at the phone/address below or visit our web site and complete our on-line customer survey: www.net-safety.com.

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TABLE OF CONTENTS

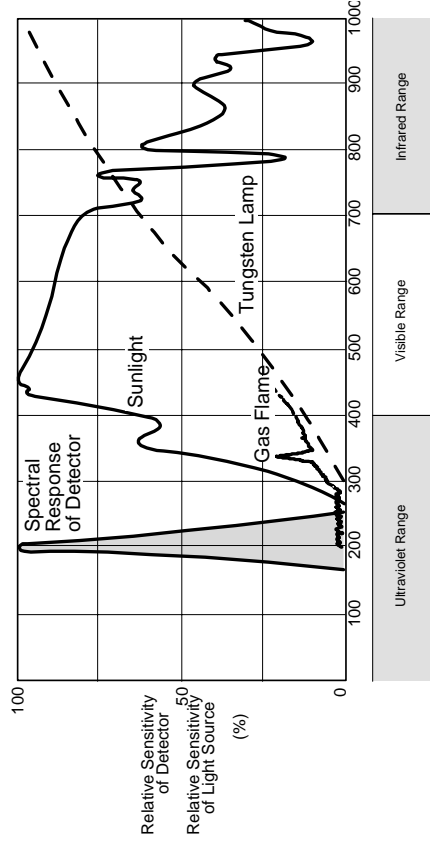
Important Information	
Warranty	
Contact Information	
Introduction	1
Spectral Sensitivity Range	1
Locate Detector	1
Typical applications	1
Potential ignition sources	1
Potential inhibitors	1
Absorbing Gases	1
Field of View	2
Effective Field of View	2
Range	2
Table 1: Summary of Distances	2
Field of View	2
Installation Considerations	2
Unpack	3
Figure 1: Detector Housing and Swivel Mount	3
Figure 2: Dimensional Drawing	3
Positioning	4
Figure 3: Position of VI Reflector	4
Field Installation	4
Wiring	4
Grounding	4
Sealing	4
Connecting	5
Figure 4: Junction Box Connection — Analog	5
Figure 5: Junction Box Connection — Analog/Relay	6
Figure 6: Stainless Steel Junction Box Connection — Analog/Relay	7
Detector Setup	8
System Sensitivity	8
DIP Switch Access	8
Figure 7: DIP Switch Location	8
Sensitivity Setting	8
Time Delay Setting	8
Table 2: Sensitivity and Time Delay Settings (Sensor Module)	8
Closing the Housing	8
Relay Settings	9
Coil and Latch Status	9
Table 3: Relay Setting (Junction Box)	9
Remote Reset	9
Final Setup	9
Detector Functionality	9
Detector Window	9
Figure 8: Detector Viewing Window	9
Start up Procedure	9
System Check	10
Monitor	10
Condition Status—LEDs	10
Condition Status—Current Output	10
Table 4: Status LEDs and Current Output	10
Detector Maintenance	11
Testing	11
Manual Check Procedure	11
Automatic Visual Integrity (VI) Test	11
Manual VI Test	11
Cleaning Window and Reflector	12
O-ring	12
How to Return Equipment	12
Troubleshoot	13
Table 5: Possible Problems and Solutions	14
Appendix A: Common UV Absorbing Gases	15
Appendix B: Electrostatic Sensitive Device (ESD)	16
Appendix C: Resistance Table (Ohms)	17
Appendix D: Specification	18
Appendix E: Response Testing	19

INTRODUCTION

The UVS is a smart, stand-alone ultraviolet flame detector. The detector is designed to respond to UV radiation emitted by a wide range of fires including hydrocarbon, hydrogen and metal based fires. The UVS is ideal for a variety of applications and has been proven reliable in even the most extreme environments.

Spectral Sensitivity Range

The UVS fire detector responds to UV radiation wavelengths of 185 to 260 nanometres (1850 to 2600 angstroms). Note that UV radiation, reaching the earth from the sun does not extend into the sensitivity range of the detector nor does radiation from normal artificial lighting, such as fluorescent, mercury vapour and incandescent lamps.



Locate Detector

When positioning fire detectors, consider such factors as distance to the fire, type of fuel and temperature as well as any environmental factors which may influence the detector's response to radiation.

Typical applications

- automotive-manufacturing and paint spray booths
- aircraft hangars (commercial and military)

- automotive-manufacturing and paint spray booths
- offshore platforms, refineries, pipelines and production ships
- printing industry facilities
- oil, gas and petrochemical refineries/production/storage/off loading/shipping
- various production, processing and storage facilities
- munitions handling
- warehouses (flammable liquids/toxic gases) and tank farms (floating/non-floating)
- power generation pumps, generators and unmanned stations

Potential ignition sources

A hydrocarbon fuel-based fire can erupt in areas where the following are found:

- alcohol
- gasoline
- paint
- aviation fuel
- acetylene
- natural gas
- solvents
- heptane/naphtha
- diesel and hydraulic fuel
- liquefied natural gas (LNG)
- liquefied petroleum gas (LPG)
- propane/methane/butane

The UVS also detects metal based fires, hydrogen and sulphur fires as well as high-pressure Natural Gas fires.

Potential inhibitors

A potential inhibitor is anything located between the detector and a potential fire source which could prevent the UVS from detecting a fire or reduce its sensitivity to fire. Possible inhibitors include but are not limited to the following:

- Solid objects such as machinery, glass or plexiglass between the detector and potential fire source
- Water, fog, rain, dirt or dust on the detector window or heavy smoke between the detector and potential fire source

Absorbing Gases

A further potential inhibitor may be the presence of UV absorbing gases or chemical vapours between the detector and source of potential fire. Such gases could impede the detectors ability to detect a UV flame source. Small concentrations of these gases may not be sufficient to obstruct the sensor but high concentrations may impede the UV sensor. Moving the detectors closer to the probable fire source and increasing the sensitivity can, in some circumstances, overcome this issue (refer to Appendix A).

RANGE

The practical application distance is directly related to the intensity of the ultraviolet radiation source.

Table 1: Summary of Distances

Fuel	Size	Distance
n-heptane	1' x 1'	50 feet
methanol	1' x 1'	30 feet
diesel	1' x 1'	35 feet
H2	16" plume	34 feet
JP-4	1' x 1'	50 feet
lube oil	1' x 1'	35 feet
propane	16" plume	90 feet
paper	2' x 2'	70 feet

Field of View (as per FM and NFPA definition)

The area in front of a flame detector, where a standardized flame can be detected and which is specified by distance and angle off the central axis, is the Field of View. The referenced flame is moved to 50% of the maximum on-axis detection distance and then moved off-axis horizontally and vertically to the limit of detection. These off-axis angle limits specify Field of View.

According to this definition the Field of View is 70 degrees vertical and 120 degrees horizontal.

Effective Field of View (up to 120 degrees)

There are numerous factors which contribute to the effective Field of View including the reflected energy from a fire. Note that a flame can be detected well beyond the specified Field of View if it is closer to the detector, if the flame becomes larger, fuel composition changes, temperature shifts or other factors lead to increased intensity of infrared energy reaching the detector.

Installation Considerations

The following should be considered when mounting flame detectors.

- Point detector toward where the flame is expected.
- Ensure an unobstructed view of the area to be monitored.
- Employ more than one detector to ensure the hazard is fully covered.
- Mount the detector a few feet (about 1 metre) below the ceiling so it can respond before being blocked by smoke accumulation at the ceiling.
- If dense smoke is likely to accumulate prior to flame (as in an electrical fire), supplement UV detector(s) with other protection such as Net Safety Monitoring's Airborne Particle Monitor.
- The detector should be accessible for cleaning the window and reflector surfaces.
- Tilt detector downward a minimum of 10 to 20° to reduce dirt and dust accumulation which could obscure the detector's viewing window.
- Securely mount detector so as to reduce vibration as much as possible.
- When located outside, detector sensitivity can be reduced by heavy fog, rain and/or ice.
- Consider shortening the time delay settings when smoke is expected to accumulate before or during a fire (refer to "System Sensitivity" on page 8).
- Reduce sensitivity setting if false alarms, related to surrounding activities, occur (refer to "System Sensitivity" on page 8).
- When installed near or on water (such as an off shore platform), be sure to take into account the low horizon level when tilting detector downward.
- UV radiation, other than that produced by an actual fire, is referred to as "background UV". An example of a high level of background UV could be a flare stack situated outside of a building. The UV radiation produced by this flare may be detected as fire when a door to the building is opened. Windows or other reflective surfaces may also cause unusually high levels of UV radiation to enter the building from the flare. In a situation like this, the fire detection system response must be carefully checked and the sensitivity level adjusted high enough so that this "background UV" will not cause false alarms.

- UV fire detectors respond to radiation other than ultraviolet. X-rays can activate the detector. Since X-rays are often used in industrial inspection it may be necessary to disable the system when inspections are conducted nearby.

UNPACK

Carefully remove all components from the packaging. Check components against the enclosed packing list and inspect all components for obvious damage such as broken or loose parts.

If you find any components missing or damaged, notify the representative or Net Safety Monitoring immediately.

Figure 1: Detector Housing and Swivel Mount

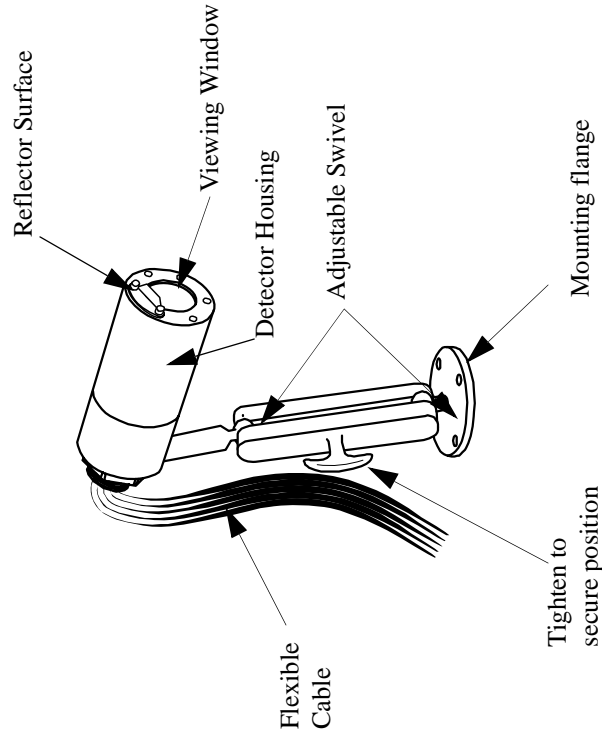
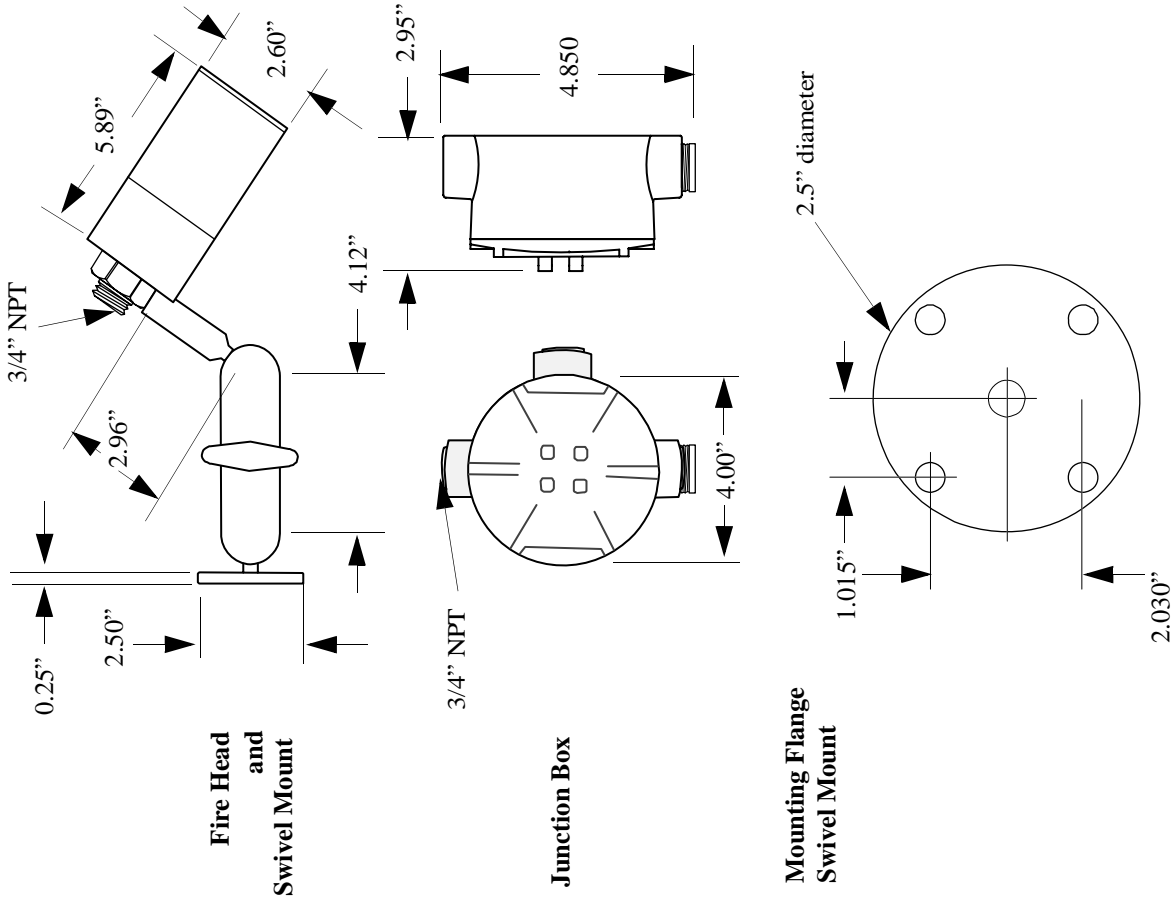


Figure 2: Dimensional Drawing

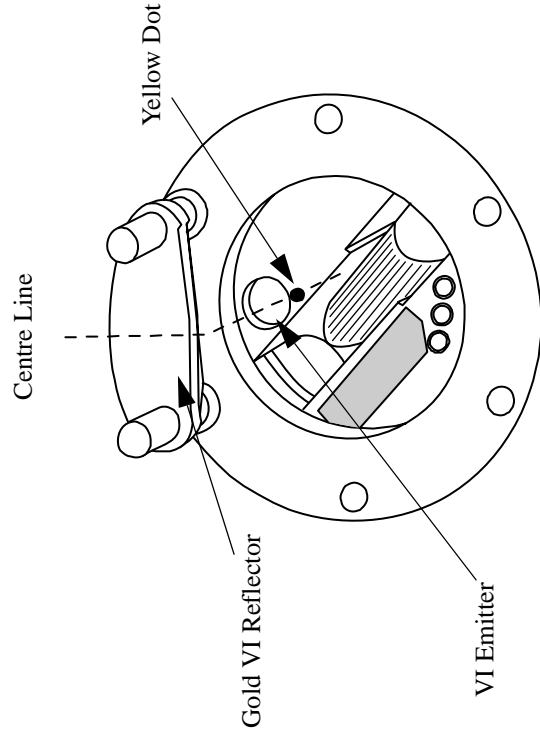


Note: Units are factory sealed.


Positioning

Ensure the external gold VI reflector is placed directly over the VI emitter (refer to Figure 8, "Detector Viewing Window", on page 9 for VI source location). Also ensure the detector is mounted with the VI reflector in the top position, centred over the yellow dot.

Figure 3: Position of VI Reflector



FIELD INSTALLATION

WARNING:  Compliance with regulations is the responsibility of the installer. Wiring must comply with applicable regulations relating to the installation of electrical equipment in a hazardous area.

WIRING

The use of shielded cable run through conduit is highly recommended for power input and signal wires to protect against interference caused by extraneous electrical 'noise'. Recommended detector cable is four conductor (or greater), shielded 18 AWG rated 300 V for distances up to 150 feet. When wiring cable is installed in conduit, the conduit must not be used for wiring to other electrical equipment. Detectors can be located over 150 feet and up to 2000 feet if 16 AWG shielded conductor is used. The maximum distance between the sensor and controller is limited by the resistance of the connecting wiring, which is a function of the gauge of the wire being used. Refer to Appendix C, "Resistance Table (Ohms)", on page 15.

Grounding

Proper shielding and grounding procedures, for the specific area of installation, should always be followed.

SEALING

Water-proof and explosion-proof conduit seals are recommended to prevent the accumulation of moisture within the junction box. Seals should be located as close to the device as possible and not more than 18 inches (46 cm) away. Explosion-proof installations may require an additional seal where conduit enters a non-hazardous area. When pouring a seal, use a fibre dam to ensure proper formation of the seal. Seals should never be poured at temperatures below freezing.

The jacket and shielding of the cable should be stripped back to permit the seal to form around the individual wires. This will prevent air, gas and water leakage through the inside of the shield and into the enclosure.

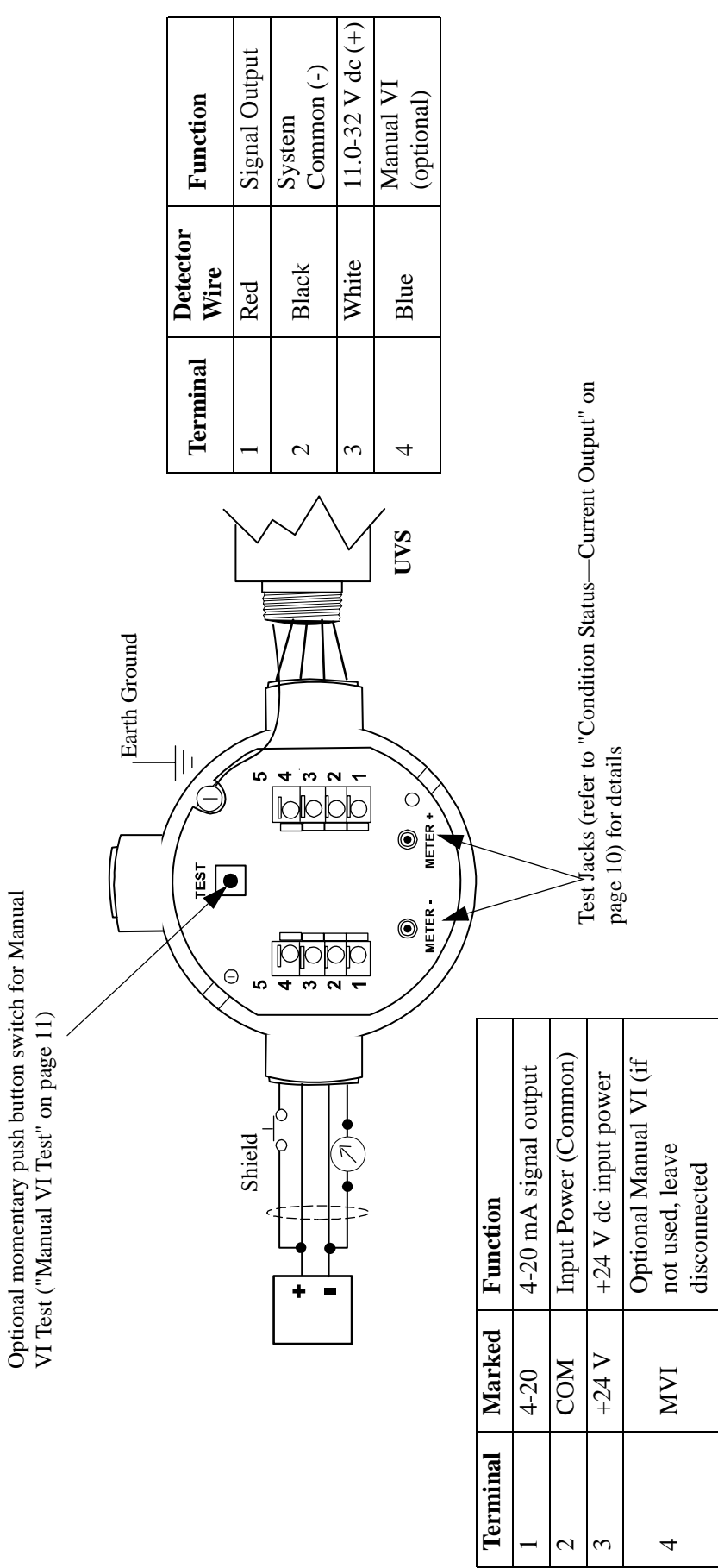
It is recommended that explosion-proof drains and conduit breathers be used. Changes in temperature and barometric pressure can cause 'breathing' which allows moist air to enter conduit. Joints are seldom enough to prevent 'breathing'.

CONNECTING

There are two configurations of the UVS available: Analog (A) and Analog/Relay (A/R). Review the following figures for wiring and other settings specific to the A or A/R board configurations.

WARNING: ⚠️ Prior to wiring, ensure power is disconnected. Improper wiring can cause damage to the detector.

Figure 4: Junction Box Connection — ANALOG

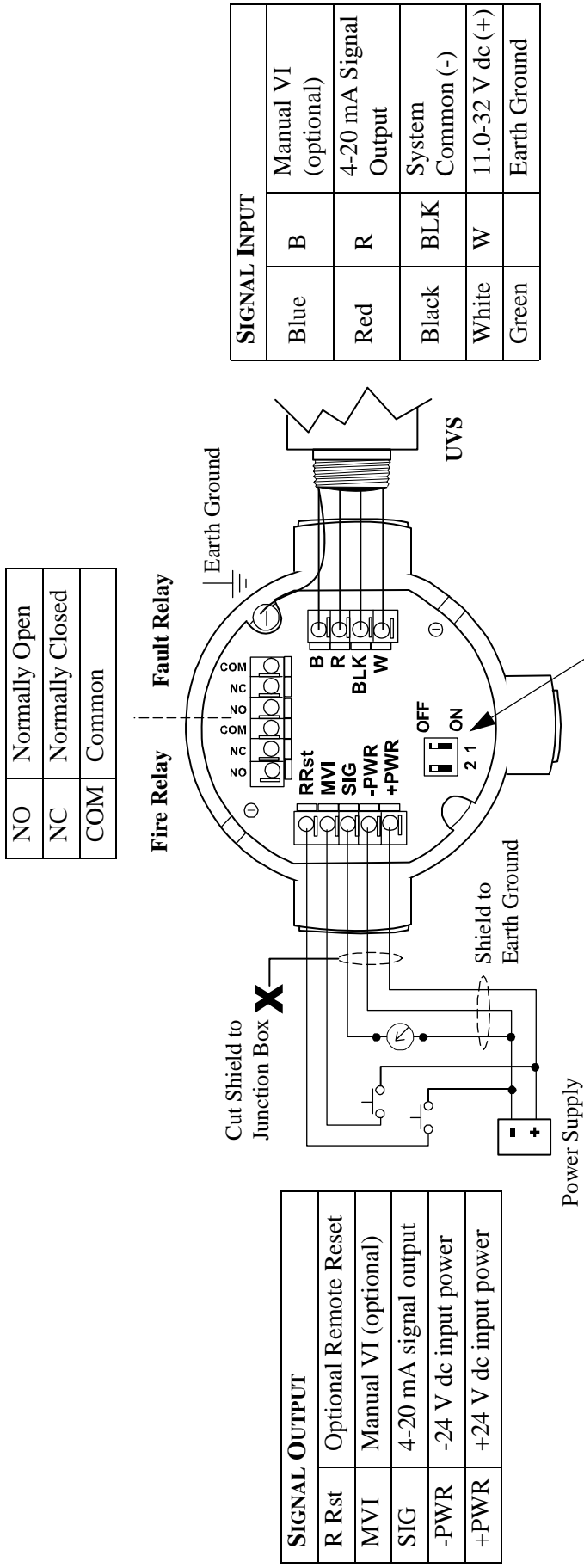


Optional momentary push button switch for Manual VI Test ("Manual VI Test" on page 11)

Test Jacks (refer to "Condition Status—Current Output" on page 10) for details

Terminal	Detector Wire	Function
1	Red	Signal Output
2	Black	System Common (-)
3	White	11.0-32 V dc (+)
4	Blue	Manual VI (optional)

Figure 5: Junction Box Connection — ANALOG/RELAY

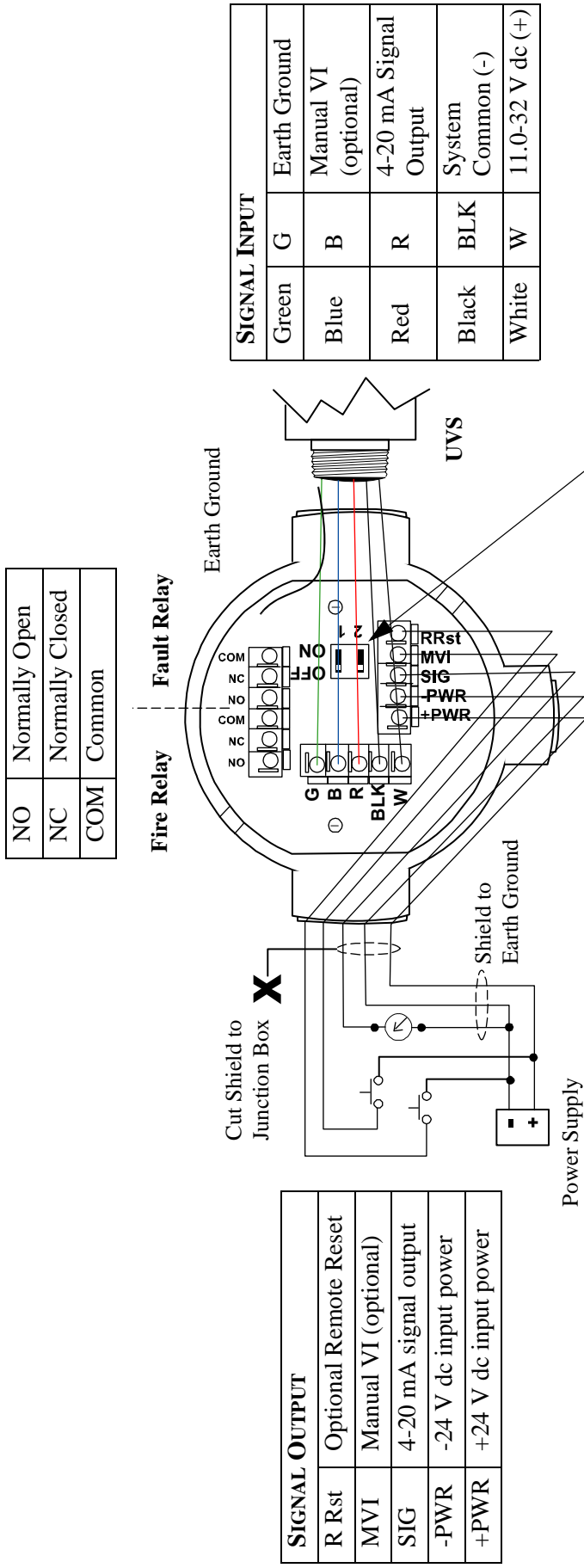


DIP Switch refer to "Relay Settings" on page 9 for details

Note: If the 4-20 mA signal is not used, connect a jumper between the terminals for 4-20 mA signal output (SIG) and -24 V dc input power (-PWR) on the Signal Output terminal block.

WARNING: Net Safety manufactures two different Relay junction boxes. If you have the stainless steel model (JB-F-R-SS), then refer to Figure 6, "Stainless Steel Junction Box Connection (JB-F-R-SS)— Analog/Relay" on page 7.

Figure 6: Stainless Steel Junction Box Connection (JB-F-R-SS)—ANALOG/RELAY



DIP Switch refer to "Relay Settings" on page 9 for details

Note: If the 4-20 mA signal is not used, connect a jumper between the terminals for 4-20 mA signal output (SIG) and -24 V dc input power (-PWR) on the Signal Output terminal block.

WARNING: Net Safety manufactures two different Relay junction boxes. If you do not have the stainless steel model (JB-F-R-SS), then refer to Figure 5, "Junction Box Connection — Analog/Relay" on page 6.

DETECTOR SETUP

SYSTEM SENSITIVITY

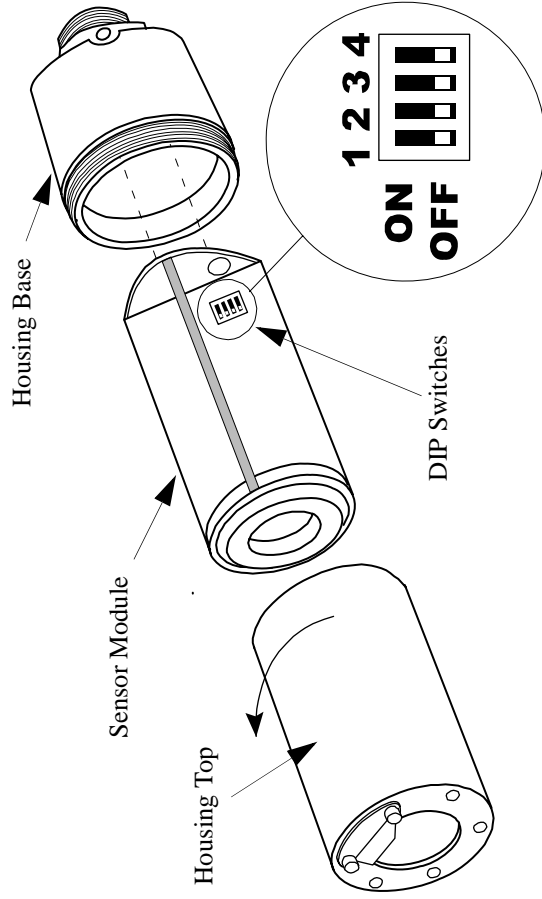
The UVS fire detector can be adjusted to various sensitivity levels by setting the detector to respond at a predetermined detector count rate. The count rate is dependent upon the intensity of the ultraviolet radiation reaching the detector, which in turn depends on the type of fuel, temperature, flame size and distance of flame from the detector.

DIP Switch Access

DIP Switches are used to set the detector's sensitivity and time delay settings. The DIP Switches are located on the internal Sensor module of the UVS.

1. Unscrew the Housing Top counter clockwise.
2. Slide a DIP Switch to the ON or OFF position. Refer to Figure 7, "DIP Switch Location", on page 8 and Table 2, "Sensitivity and Time Delay Settings (Sensor Module)", on page 8 for DIP Switch positioning instructions.

Figure 7: DIP Switch Location



WARNING: ⚠ Do not touch internal components other than the DIP Switches (see Appendix B, "Electrostatic Sensitive Device (ESD)", on

page 14).

Sensitivity Setting

The adjustable Sensitivity setting is used to optimize the UVS for various installations.

When selecting a Sensitivity setting, consider the following points:

- Size of potential fire
- Distance between possible fire and detector
- Type of flammable substance to be detected
- Environmental factors

Time Delay Setting

Defining the Time Delay allows the Fire alarm signal to delay (for the specified time), before indicating an alarm. This feature can be beneficial depending upon the conditions/activities surrounding the detector.

Table 2: Sensitivity and Time Delay Settings (Sensor Module)

	Sensitivity			Time Delay		
	Position 1	Position 2	Position 3	Position 3	Position 4	Position 4
8 counts CPS	ON	ON	ON	3 seconds	ON	ON
16 counts CPS	ON	OFF	OFF	4 seconds	ON	OFF
24 counts CPS	OFF	ON	ON	5 seconds	OFF	ON
32 counts CPS	OFF	OFF	OFF	7 seconds	OFF	OFF

Note: Default settings are Sensitivity 8 Counts Per Second (CPS) and a 3 second Time Delay.

Closing the Housing

When closing the Housing Cover, be sure that the top and bottom are screwed together tightly.

TIP: It is extremely important that the VI reflector is centred over the yellow dot (refer to "Positioning" on page 4 for details).

RELAY SETTINGS

Coil and Latch Status

The Junction Box (Relay only) has a two-position DIP Switch to define the Coil and Latch Status for the Fire Relay. Refer to Figure 5, "Junction Box Connection — Analog/Relay", on page 6 for DIP Switch location.

Note: The default Fire Relay is normally De-energized/Non-Latching. The Fault Relay is factory set to normally Energized/Non-latching and cannot be modified.

Table 3: Relay Setting (Junction Box)

Coil and Latch Status		
Fire Relay	Position 1	Position 2
De-energized / Non-latching	ON	ON
Energized / Non-latching	ON	OFF
De-energized / Latching	OFF	ON
Energized / Latching	OFF	OFF

Remote Reset

The UVS can be connected to allow for the Remote Reset of a latched alarm. The Latch Status must be set to Latching (refer to "Relay Settings" on page 9). To reset the latched alarm the terminals marked R.Rst and -PWR on the Junction Box (Relay only) must be momentarily connected.

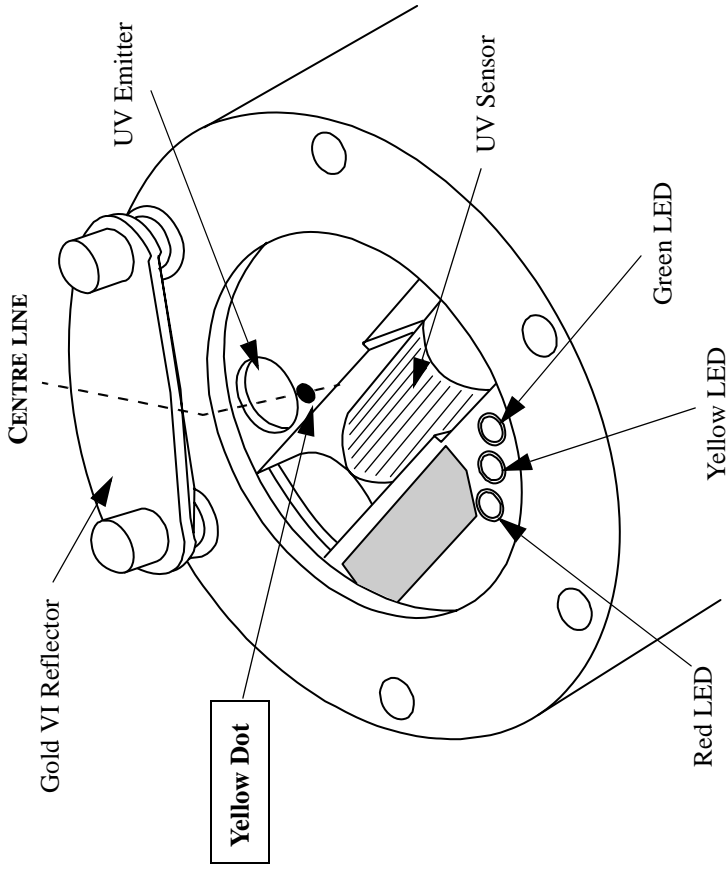
Final Setup

- Ensure all internal settings complete
- Securely close Housing
- Ensure reflector positioned over emitter
- Clean detector lens
- Mount and align detector

DETECTOR FUNCTIONALITY

DETECTOR WINDOW

Figure 8: Detector Viewing Window




START UP PROCEDURE

Once powered up, the UVS will begin a 90 second start up routine. During this time, the current output will be 3 mA and the Green power LED will be on. Once the start up procedure has finished, and no faults are present, the detector will begin Normal operation (current output 4 mA and Green LED will remain on).

System Check

Once powered up the system should be checked. Refer to the section entitled "Manual Check Procedure " on page 11 for instructions.

WARNING:  When testing the system, ensure all external equipment is disabled to prevent unwanted activation during testing and enabled once testing complete.

MONITOR

The Detector's status can be determined by monitoring the current loop and/or the condition LEDs.

Condition Status—LEDs

There are three (3) LEDs used to indicate the status of the detector (refer to Table 4, "Status LEDs and Current Output", on page 10).

Condition Status—Current Output

The Current Loop status can also be measured to determine detector condition. Test Jacks are available on the Analog board in the Junction Box. The area must be de-classified prior to opening the Junction Box. Also, the detector can be monitored using the 4-20 mA Signal Output. Refer to the section entitled "Connecting" on page 5 for wiring instructions.


Table 4: Status LEDs and Current Output

LED Status	Current O/P	Green LED (Power)	Red LED (Alarm)	Yellow LED (Fault)
Internal Power Fault or system power out of range	1 mA	off	off	Solid
Automatic or manual VI Test Failure	2 mA	off	off	Flashing
Power up - 90 second start delay	3 mA	Solid	off	off
Normal Operation	4 mA	Solid	off	off
Background UV source	6 mA	Solid	off	off
Manual VI Testing Adequate	10 mA	Solid	off	off
Manual VI Testing Good	11 mA	Solid	Solid	off
Manual VI Testing Excellent	12 mA	Solid	Solid	off
Early Warning - Intermittent UV detected	16 mA	Solid	off	off
Fire confirmed	20 mA	Solid	Flashing	off

DETECTOR MAINTENANCE

The UVS does not require calibration. Although an automatic testing of the optics is done every 30 seconds, the system should be periodically checked. To maintain maximum sensitivity, the viewing window and reflector should be cleaned on a routine basis depending on the type and amount of contaminants in the area.

TESTING

WARNING:  When testing the system, ensure all external equipment is disabled to prevent unwanted activation.

Manual Check Procedure

The whole system should be checked periodically with a Net Safety UV test lamp to make sure that the detectors are not obstructed, that the area covered by the detector has not changed and that there is no fault in the VI circuit.

1. Direct the UV test lamp into the detector viewing window. The current output will change with the amount of radiation being detected and the Red LED will flash (refer to "Status LEDs and Current Output" on page 10).
2. Turn off the UV test lamp and repeat steps 1 & 2 for all detectors in the system.
3. After all detectors have been checked, return the system to the normal operating mode and enable any external equipment.

Automatic Visual Integrity (VI) Test

The detector performs an automatic Visual Integrity (VI) test every 30 seconds during normal operation. If the automatic VI Test fails, three consecutive times, the Yellow LED will Flash and O/P drop to 2 mA indicating a dirty window, dirty reflector or failed sensor. The detector will remain in this condition until the problem is corrected.

The detector window should be promptly cleaned (refer to "Cleaning Window and Reflector" on page 12) or the obstruction removed. Also refer to Table 5, "Possible Problems and Solutions," on page 13.

If the obstruction was only temporary, the detector will return to normal operation with the next VI test.

Manual VI Test


The test procedure can assist with maintenance planning. The Manual VI test will return one of three current output responses depending upon the cleanliness of the detector window and reflector.

- Adequate (10 mA) clean optical surfaces
- Good (11 mA) no action required - surface moderately clean
- Excellent (12 mA) no action required - surface perfectly clean

The detector has a manual VI input. The manual VI test is performed by:

- connecting Manual VI to system power by a direct connection OR
- connecting a momentary contact push button between system power and the manual VI input OR
- using the Manual VI Test Button, located in the Analog Junction Box (area MUST be de-classified prior to opening the Junction Box).

Note: The manual VI feature is optional on the UVS-A (if not used, leave the manual VI input unconnected or tied to system common).

WARNING:  The detector will stay in the manual VI test mode as long as the manual VI input is held at the system power voltage. During the manual VI test all other detector functions are disabled. It is therefore imperative that after this test is performed the manual VI test input be released.

Test Procedure

1. Connect the manual VI test input terminal to system power by either a direct connection or manual push button or use the Manual VI Test Push Button (once area de-classified).
2. Hold the manual VI input at this voltage for at least two seconds. The Red LED will be activated for the duration of the test.
3. Two seconds after the test has commenced, the detector will output a current that corresponds to the quality of the VI reading obtained (see Table 4, "Status LEDs and Current Output", on page 10).
4. Release the manual VI test input. The detector will immediately return to normal operation if a VI fault is not present.
5. If a VI fault is present, the current output will indicate 2 mA and the Yellow LED will flash.

CLEANING WINDOW AND REFLECTOR

When cleaning the window and reflector use the cloth and the cleaning solution provided with the detector. Use only the provided cleaning solution as some cleaners can leave a residue.

To minimize dirt accumulation around the VI surface, a product such as Net Safety's Air Shield should be purchased to minimize particulate build up on the viewing window.

WARNING:  Always bypass Alarm Output when performing maintenance tasks and ensure all external equipment has been disconnected/deactivated.

O-ring

The rubber o-ring on the detector housing is used to ensure the detector is watertight. The housing should be opened periodically and the o-ring inspected for breaks, cracks or dryness. To test the o-ring, remove it from the detector housing and stretch it slightly. If cracks are visible, the o-ring should be replaced. If it feels dry to the touch, a thin coating of lubricant should be applied (such as polyalphaolefin grease). When re-installing the o-ring, be sure that it is properly seated in the groove on the housing.

The o-ring must be properly installed and in good condition to prevent water from entering the detector and causing failure. The life expectancy of rubber o-rings varies depending on the type and amount of contaminants present in the area. The person who maintains the system must rely on experience and common sense to determine how frequently the rings should be inspected. A coating of lubricant should also be applied to the enclosure threads before reassembling the detector to help prevent moisture from entering.

HOW TO RETURN EQUIPMENT

A Material Return Authorization number is required in order to return equipment. Please contact Net Safety Monitoring at **(403) 219-0688** before returning equipment or consult our Service Department to possibly avoid returning equipment.

If you are required to return equipment, include the following information:

1. A Material Return Authorization number (provided over the phone to you by Net Safety).
2. A detailed description of the problem. The more specific you are regarding the problem, the quicker our Service department can determine and correct the problem.
3. A company name, contact name and telephone number.
4. A Purchase Order, from your company, authorizing repairs or request for quote.
5. Ship all equipment, prepaid to:

Net Safety Monitoring Inc
2721 Hopewell Place NE
Calgary, Alberta, Canada
TTY 7J7

6. Mark all packages: **RETURN for REPAIR**

Waybills, for shipments from outside Canada, must state:

Equipment being returned for repair
All charges to be billed to the sender

Also, please ensure a duplicate copy of the packing slip is enclosed inside the box indicating item 1-4 along with the courier and account number for returning the goods.

All Equipment must be Shipped prepaid. Collect shipments will not be accepted.

Pack items to protect them from damage and use anti-static bags or aluminium-backed cardboard as protection from electrostatic discharge.

TROUBLESHOOT

The occurrence of a false alarm may be due to various factors. In order to determine the source of a false alarm, keep accurate records including time, date, weather conditions, activities in area, etc.

Consult the following table for possible solutions to false alarm conditions.

Table 5: Possible Problems and Solutions

Current O/P	False Alarm Condition			Possible Problem	Possible Solution
	Green LED	Yellow LED	Red LED		
0 mA		Solid/off		Shorted signal Output Loss of Power Loose Wire(s)	Check wiring Check fuses (3 AMP fuse on bottom PCB) (any in-line power fuse) Check power source at unit
1 mA		Solid		Internal power fault System power out of range	Check power supply (should be between 11.0-32 V dc)
2 mA		Flashing		VI (visual integrity) fault	Clean window (use Net Safety Monitoring Lens cleaner only) Check for obstruction(s) within Field of View Check reflector position and alignment Check UV source bulb If not using 4-20 output ensure jumper is in correct position (Figure 5, "Junction Box Connection — Analog/Relay", on page 6)
6 mA	Solid			Background UV source	Confirm external UV source by covering detector window so it is blind to all radiation. - If signal goes away, background UV is present. Field of View should be cleared of UV sources/activities (i.e., cracked lenses on sodium/mercury vapour bulbs, welding, grinding, flare stacks, etc.); realign detector coverage area; redefine Time Delay; reset Sensitivity setting. - If signal persists, electrical wiring or detector electronics may be at fault
10 mA	Solid		Solid	Manual VI test (adequate)	Clean all optical surfaces (use Net Safety Monitoring Lens cleaner only)
11 mA	Solid		Solid	Manual VI test (good)	No action required, optics are moderately clean
12 mA	Solid		Solid	Manual VI test (excellent)	No action required, all optical surfaces are perfectly clean

Appendix A: COMMON UV ABSORBING GASES

Since the UVS fire detector is designed to detect fires by responding to the ultra-violet (UV) radiation they emit, it is very important to be aware of UV absorbing gases that may be present between the detector and the sources of potential fires. Small concentrations of these types of gases may not absorb enough UV radiation to cause a problem, but when higher concentrations of these gases are present the detectors may become blind as not enough ultra-violet radiation can reach them to activate an alarm. Moving detectors closer to the probable source of fire and increasing the sensitivity of the detector can help to overcome this problem in some cases. Following is a list of common UV absorbing gases:

<ul style="list-style-type: none"> • Acetaldehyde • Acetone • Acrylonitrile • Ethyl Acrylate • Methyl Acrylate • Ethanol • Ammonia • Aniline • Benzene • 1, 3 Butadiene • 2-Butanone • Butylamine • Chlorobenzene • 1-Chloro-1-Nitropropane • Chloroprene 	<ul style="list-style-type: none"> • Cumene • Cyclopentadiene • O-Dichlorobenzene • P-Dichlorobenzene • Methyl Methacrylate • Alpha-Methylstyrene • Naphthalene • Nitroethane • Nitrobenzene • Nitromethane • 1-Nitropropane • 2-Nitropropane • 2-Pentanone • Phenol • Phenyl Glycide Ether • Pyridine 	<ul style="list-style-type: none"> • Hydrogen Sulfide • Styrene • Tetrachloroethylene • Toluene • Trichloroethylene • Vinyl Toluene • Xylene
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Appendix B: ELECTROSTATIC SENSITIVE DEVICE (ESD)

Electrostatic discharge (ESD) is the transfer, between bodies, of an electrostatic charge caused by direct contact or induced by an electrostatic field.

The most common cause of ESD is physical contact. Touching an object can cause a discharge of electrostatic energy—ESD! If the charge is sufficient and occurs near electronic components, it can damage or destroy those components. In some cases, damage is instantaneous and an immediate malfunction occurs. However, symptoms are not always immediate—performance may be marginal or seemingly normal for an indefinite period of time, followed by a sudden failure.

To eliminate potential ESD damage, review the following guidelines:

- Handle boards by metal shields—taking care not to touch electronic components
 - Wear grounded wrist or foot straps, or ESD shoes or heel grounders to dissipate unwanted static energy
 - Prior to handling boards, dispel any charge in your body or equipment
 - Ensure components are transported and stored in static safe packaging
 - When returning boards, carefully package in the original carton and static protective wrapping
 - Ensure ALL personnel are educated and trained in ESD Control Procedures
- In general, exercise accepted and proven precautions normally observed when handling electrostatic sensitive devices.

A warning label is placed on the packaging, identifying product using electrostatic sensitive semiconductor devices.



Appendix C: RESISTANCE TABLE (OHMS)

Distance (Feet)	AWG #20	AWG #18	AWG #16	AWG #14	AWG #12	AWG #10	AWG #8
100	1.02	0.64	0.40	0.25	0.16	0.10	0.06
200	2.03	1.28	0.80	0.51	0.32	0.20	0.13
300	3.05	1.92	1.20	0.76	0.48	0.30	0.19
400	4.06	2.55	1.61	1.01	0.64	0.40	0.25
500	5.08	3.20	2.01	1.26	0.79	0.50	0.31
600	6.09	3.83	2.41	1.52	0.95	0.60	0.38
700	7.11	4.47	2.81	1.77	1.11	0.70	0.44
800	8.12	5.11	3.21	2.02	1.27	0.80	0.50
900	9.14	5.75	3.61	2.27	1.43	0.90	0.57
1000	10.20	6.39	4.02	2.53	1.59	1.09	0.63
1250	12.70	7.99	5.03	3.16	1.99	1.25	0.79
1500	15.20	9.58	6.02	3.79	2.38	1.50	0.94
1750	17.80	11.20	7.03	4.42	2.78	1.75	1.10
2000	20.30	12.80	8.03	5.05	3.18	2.00	1.26
2250	22.80	14.40	9.03	5.68	3.57	2.25	1.41
2500	25.40	16.00	10.00	6.31	3.97	2.50	1.57
3000	30.50	19.20	12.00	7.58	4.76	3.00	1.88
3500	35.50	22.40	14.10	8.84	5.56	3.50	2.21
4000	40.60	25.50	16.10	10.00	6.35	4.00	2.51
4500	45.70	28.70	18.10	11.40	7.15	4.50	2.82
5000	50.10	32.00	20.10	12.60	7.94	5.00	3.14
5500	55.80	35.10	22.10	13.91	8.73	5.50	3.46
6000	61.00	38.30	24.10	15.20	9.53	6.00	3.77
6500	66.00	41.50	26.10	16.40	10.30	6.50	4.08
7000	71.10	44.70	28.10	17.70	11.10	7.00	4.40
7500	76.10	47.90	30.10	19.00	12.00	7.49	4.71
8000	81.20	51.10	33.10	20.20	12.70	7.99	5.03
9000	91.40	57.50	36.10	22.70	14.30	8.99	5.65
10 000	102.00	63.90	40.20	25.30	15.90	9.99	6.28

Note: Resistance shown is one way. This figure should be doubled when determining closed loop resistance.

Appendix D: SPECIFICATION

UVS	UVS-A (Analog)	UVS-AR (Analog/Relay)
Operating Voltage	11.0 to 32.0 V dc	
Power Consumption (at 24 V dc)	Nominal 70 mA/1.7 W Maximum 120 mA/2.9 W	Nominal 90 mA/2.2 W Maximum 135 mA/3.3 W
Inrush Current	600 mA for 2.5 ms	800 mA for 2.5 ms
Operating Temperature	-40°C to +75°C (-40F to +167F)certified / -50°C to +75°C (-58F to +167F)operational	
Field of View	120 degrees horizontal / 70 degrees vertical	
Spectral Range	UV radiation over the range of 185 to 260 nanometres (1850 to 2600 angstroms)	
Time Delay	DIP switch selectable 3, 4, 5, 7 seconds	
Sensitivity Settings	DIP switch selectable 8, 16, 24 or 32 counts per seconds	
Enclosure Material	Anodized Aluminum (optional stainless steel)	
Humidity Range	0 to 100% relative humidity, non-condensing	
Weight (with swivel)	2.1 Kg/4.5 lbs (Stainless Steel Option 3.4 Kg/7.5 lbs)	
Certification	CSA and NRTL/C certified for hazardous locations. Class I, Division 1, Groups B, C and D. Temperature code T5. Enclosure type NEMA 4X. IEC Rating Ex d IIB+H2 T5. CE Ex II 2 G, Ex d II B+H2 T5 Factory Mutual (FM) flame detector performance certification.	
Current Output	0 to 20 mA - Into a maximum loop impedance of 800 Ohms @ 32 V dc or 150 Ohms @ 11.0 V dc. Non-isolated loop supply.	
Relay Output	Form C contacts rated 1 Amp @ 30 V dc, 0.5 Amp @ 125 V ac. Selectable energized/de-energized, latching/non-latching Fire relay. Fault relay fixed as energized/non-latching.	

Note: Units are factory sealed.

Appendix E: RESPONSE TESTING

	Fuel	Size	Distance	Notes
Detector Range (high sensitivity)	n-heptane	1' x 1'	50 feet	
	methanol	1' x 1'	30 feet	
	diesel	1' x 1'	35 feet	
	H2	16" plume	34 feet	
	JP-4	1' x 1'	50 feet	full burn
	lube oil	1' x 1'	35 feet	full burn
	propane	16" plume	90 feet	
	paper (crumpled newspaper 10" high)	2' x 2'	70 feet	full burn
Typical Response Time	Response time for the UVS fire detector is as little as 5 seconds, with a mean response time of 10 seconds depending on conditions such as wind, temperature and smoke.			
False Stimuli Response	False Alarm Source	Immunity Distance	Response	Flame Source
	radio frequency interference	2 feet		2" methanol
	vibration	--		
	sunlight (direct/reflected)	--		
	1500 W heater (modulated/unmodulated)	20 feet	No Alarm	AAR
	250 W halogen light	10 feet		
	incandescent light	25 feet		
	fluorescent light	25 feet		
arc welding	n/a			

Note: AAR = Accurate alarm response

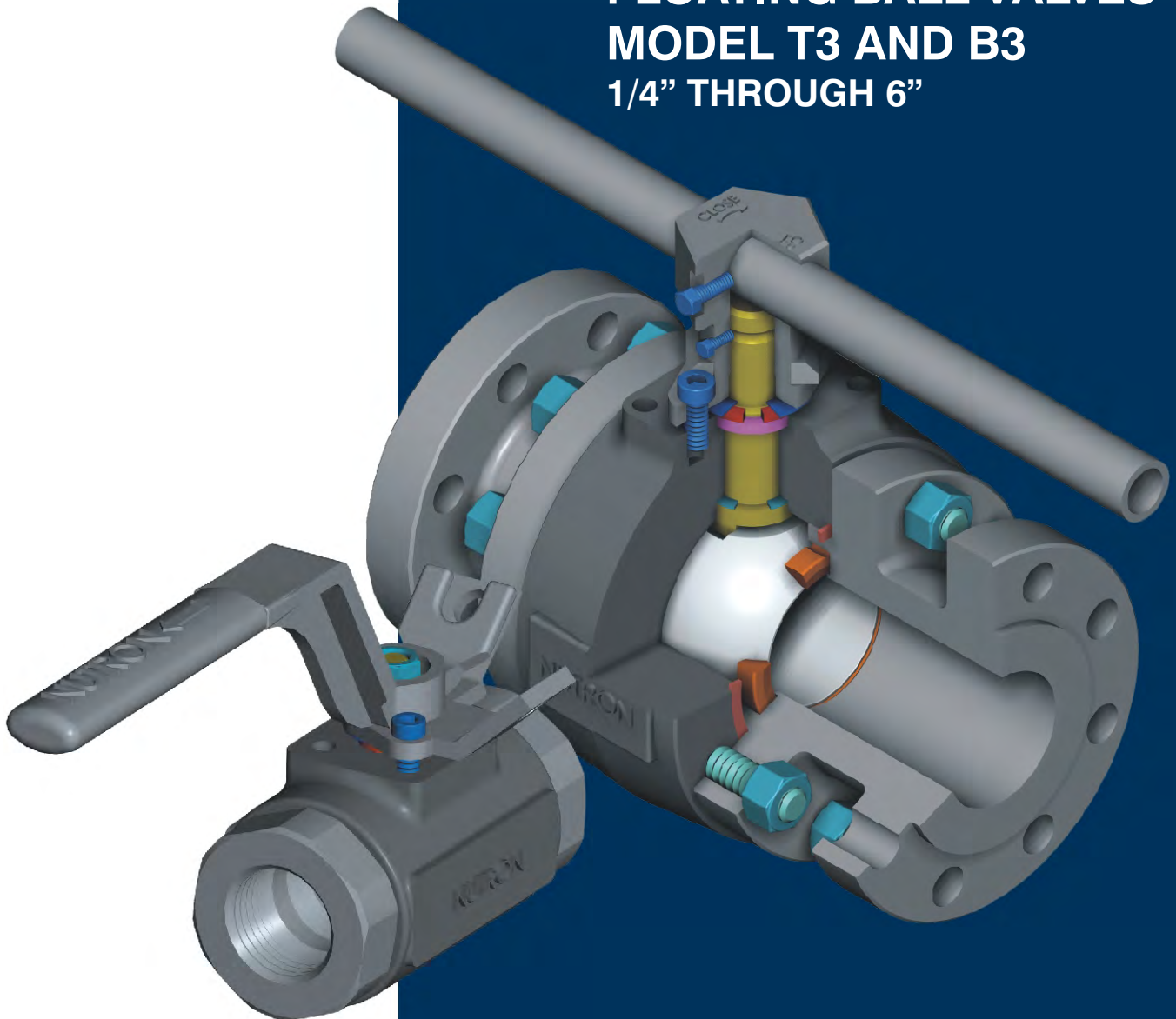


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FLOATING BALL VALVES
MODEL T3 AND B3
1/4" THROUGH 6"



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NUTRON® brand ball valves, API 6D swing check valves, chokes and NAVCO® brand gate, globe and check valves are products used by our customers in oil, gas, petrochemical, refinery, pipeline, pulp and paper, mining and other industrial applications.

For many years, NUTRON® has developed an ability to meet customer requirements for custom valve products for critical and corrosive service utilizing special stainless steel alloys.

NUTRON® Plastics supplies valve seats, thrust washers and flange protectors for NUTRON® brand ball valves.

As a policy and goal, all NUTRON® Industries products must reflect the highest quality standards. Their design, development, manufacturing and tested performance are of paramount importance. As a commitment to this policy and goal, we have constructed a fire test facility to test the fire safe features of our valve products.

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COMPLIANCE TO SPECIFICATIONS

ISO 9001: Registered Quality System

API 6A, 6D, 598, 607 4th Edition (Fire Safe), Q1 (Quality Specification)

ASME B16.34, B16.10

NACE MR0175 Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

CSA Z245.15 Steel Valves

ASME Section VIII Division 1 Boiler and Pressure Vessel Code

Canadian Registration Number (CRN)





STANDARD FEATURES

CAP SCREWS

Dual purpose; allows for easy stem packing adjustment without handle removal while providing a stop for the handle.

PACKING

Self-adjusting by means of a Belleville washer. Allows for long service life before manual packing adjustment is necessary.

BALL

The floating ball design allows for positive shut-off in either flow direction. Includes pressure equalization hole to prevent trapping of pressure in the body cavity.

BODY SEALS

Body seal O-rings are placed ahead of the body cap threads to protect the threads from the flow media.

STEM

Blowout-proof stem is back-seated through the valve body.

THRUST WASHER

Acts as a bearing between the body and stem.

SEATS

Materials available are Teflon®, Delrin®, PEEK and Devlon®.

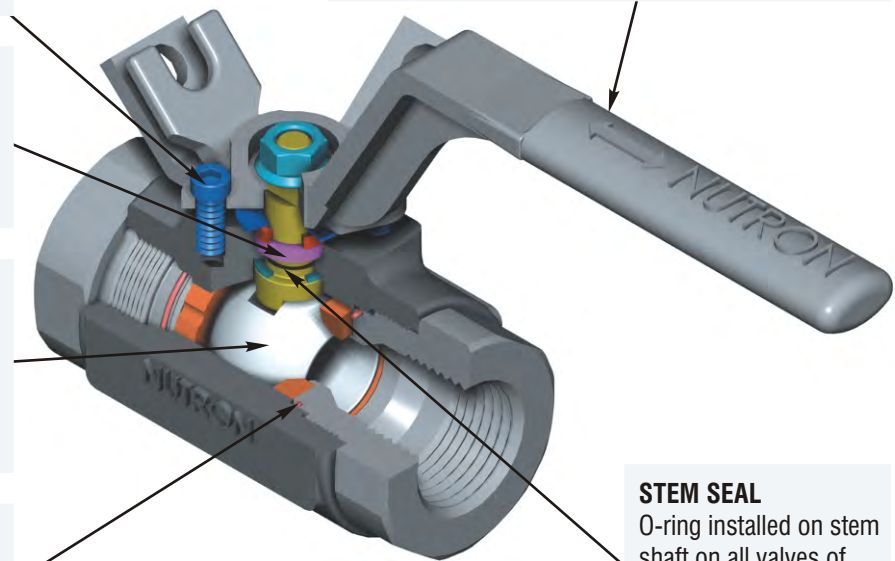
BODY CONSTRUCTION

Forged steel three-piece threaded (T3) or bolted (B3) construction. A machined pad area is drilled and tapped for actuation as a standard. Threaded and bolted construction allows for combinations of end connections.

HANDLE

Rugged cast handle for long life. Handle position indicates flow position. When the handle is positioned in line with the pipe, the valve is open. When the handle is positioned perpendicular to the pipe, the valve is closed. Locking handle is standard for all 2" reduced bore and smaller valves with either socket weld or FNPT end connections.

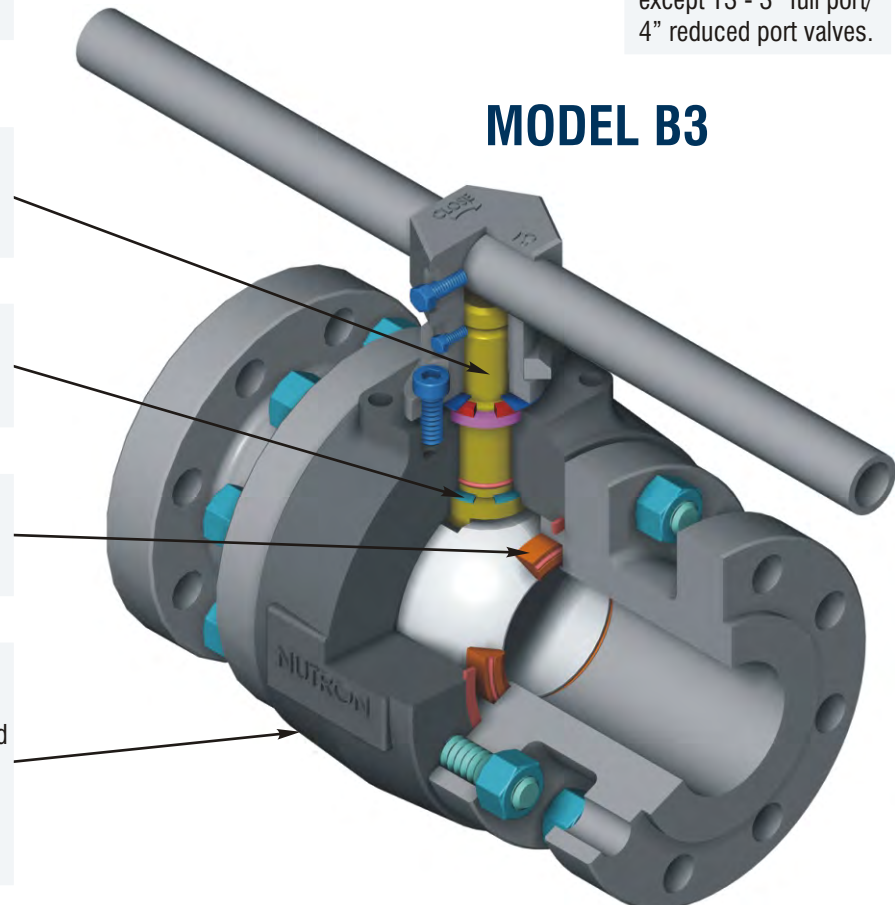
MODEL T3



STEM SEAL

O-ring installed on stem shaft on all valves of 1 1/2" and larger bores except T3 - 3" full port/4" reduced port valves.

MODEL B3

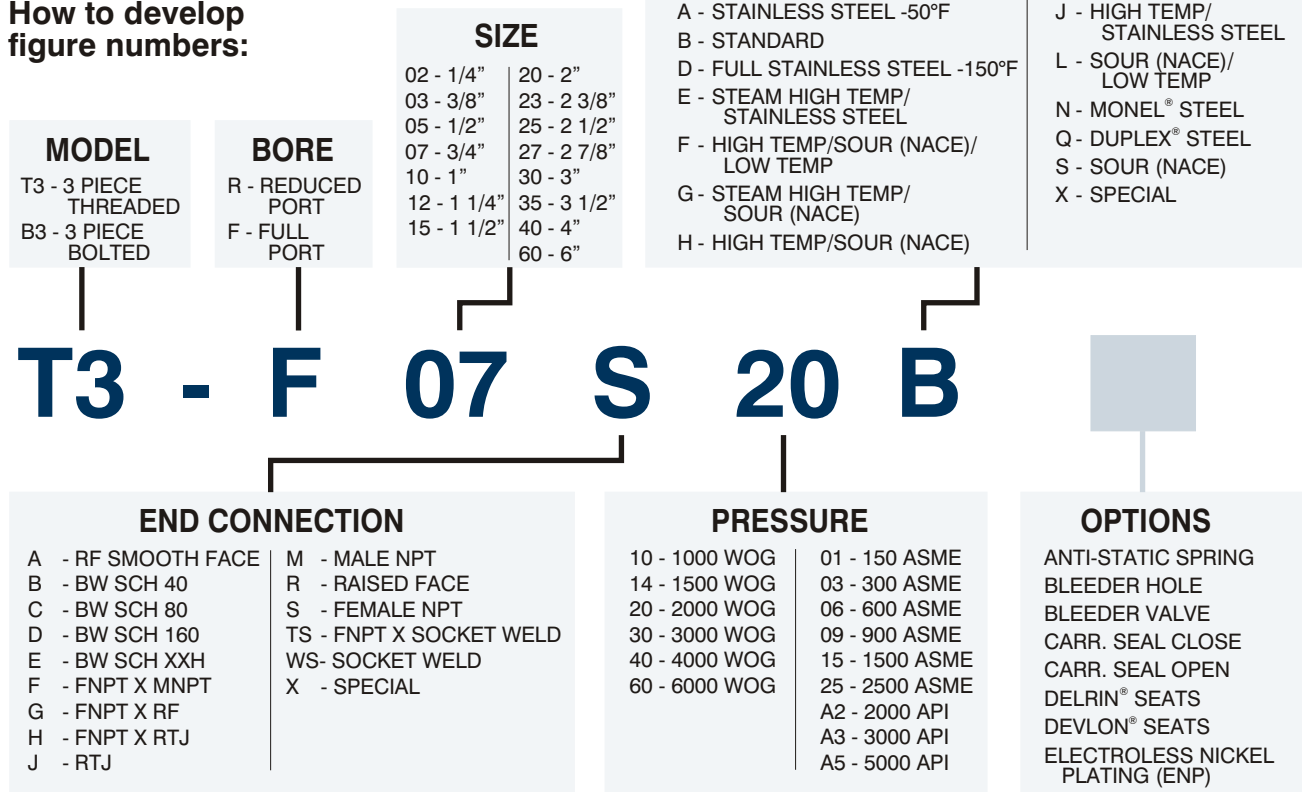


SIZES AVAILABLE (INCHES)

ASME CLASS	150	300	600	900	1500	2500
T3 - Full Port	1/2 thru 3	1/2 thru 3	1/2 thru 2	1/2 thru 2	1/2 thru 2	1/2 thru 2
T3 - Reduced Port	3/4 thru 4	3/4 thru 4	3/4 thru 3	3/4 thru 3	3/4 thru 3	3/4 thru 3
B3 - Full Port	4	4	2, 3	2, 3	2, 3	
B3 - Reduced Port	6	6	3, 4	3, 4	3, 4	
WOG	1000	2000	3000	4000	6000	
T3 - Full Port, Threaded		3	1/4 thru 3	1/4 thru 2	1/4 thru 2	1/4 thru 2
T3 - Reduced Port, Threaded		4	3/4 thru 3	3/4 thru 3	3/4 thru 3	3/4 thru 3
T3 - Full Port, Socket Weld			1/2 thru 2	1/2 thru 2	1/2 thru 2	1/2 thru 2
T3 - Reduced Port, Socket Weld			3/4 thru 3	3/4 thru 3	3/4 thru 3	3/4 thru 2
B3 - Full Port, Threaded			3		3	
B3 - Reduced Port, Threaded			4			

ORDERING INFORMATION

How to develop figure numbers:



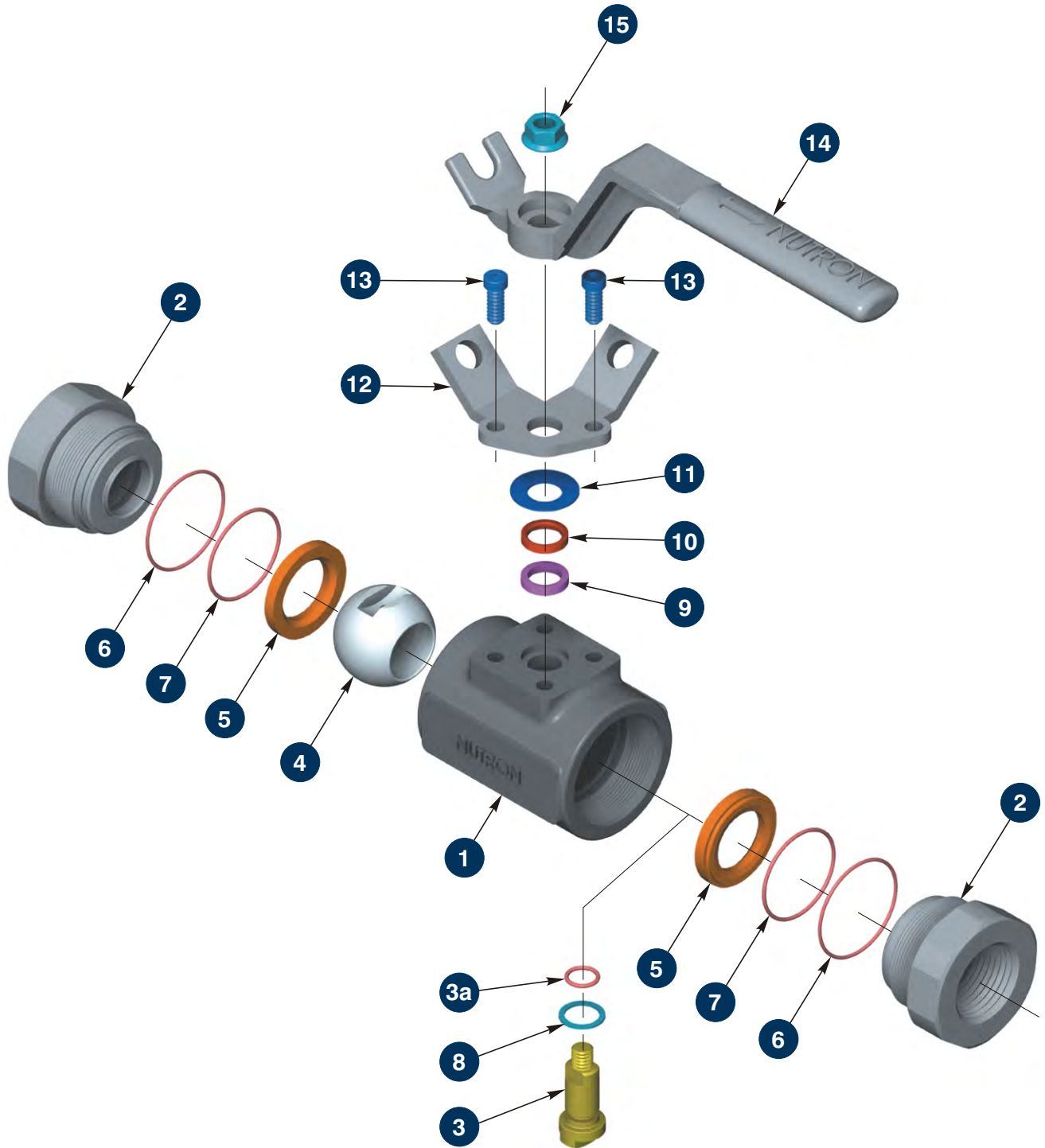
Examples:

- T3-F07S20B = Model T3, Full Port, 3/4", Female NPT, 2000 WOG, Standard Valve.
- B3-R40R06L = Model B3, Reduced Port, 4", Raised Face Flanges, 600 ASME, Sour (NACE)/Low Temp Valve.
- T3-R10TS30S = Model T3, Reduced Port, 1", Female NPT x Socket Weld, 3000 WOG, Sour (NACE) Valve.

* Consult NUTRON® Industries Sales Department for detailed valve style descriptions, full range of options, materials, actuation packages or for a particular special valve service application.



THREADED END CONNECTIONS





MATERIALS LIST - THREADED END CONNECTIONS

ITEM	PART	WORKING PRESSURE	STANDARD	SOUR (NACE)
1	Body	All	ASTM A105	ASTM A105
2	End Caps	All	ASTM A105	ASTM A105
†	3	Stem	2000 & 3000 4000 & 6000	ASTM A108, Plated ASTM A564 17-4 PH ASTM A564 17-4 PH
††	3a*	Stem O-Ring	2000, 3000 & 4000 6000	Nitrile HSN Viton HSN
†	4	Ball	2000, 3000 & 4000 6000	ASTM A576 CHR. PL. ASTM A564 17-4 PH ASTM A351 Gr. CF8M ASTM A564 17-4 PH
††	5	Seats	2000 3000 & 4000 6000	Teflon Delrin PEEK Teflon Delrin PEEK
††	6	Body O-Rings	2000, 3000 & 4000 6000	Nitrile Teflon Viton Teflon
††	7	Seat O-Rings	3000 & 4000	Nitrile Viton
††	8	Thrust Washer	2000 3000 & 4000 6000	Teflon Delrin PEEK Teflon Delrin PEEK
††	9	Packing	All	Teflon Teflon
	10	Packing Follower	All	Carbon Steel, Plated Stainless Steel
	11	Belleville Washer	All	Carbon Steel Stainless Steel
	12	Gland Flange **	All	Carbon Steel, Plated Carbon Steel, Plated
	13	Cap Screws	All	Carbon Steel Stainless Steel
	14	Handle	All	Carbon Steel Carbon Steel
	15	Handle Nut	All	Carbon Steel, Plated Carbon Steel, Plated

ITEM	PART	WORKING PRESSURE	SOUR (NACE) & LOW TEMP	STAINLESS STEEL -50°F
1	Body	All	ASTM A350 LF2	ASTM A479 TYPE 316
2	End Caps	All	ASTM A350 LF2	ASTM A479 TYPE 316
†	3	Stem	All	ASTM A564 17-4 PH ASTM A564 17-4 PH
††	3a*	Stem O-Ring	2000, 3000 & 4000 6000	Viton HSN HSN HSN
†	4	Ball	2000, 3000 & 4000 6000	ASTM A351 Gr. CF8M ASTM A564 17-4 PH ASTM A351 Gr. CF8M ASTM A564 17-4 PH
††	5	Seats	2000 3000 & 4000 6000	Teflon Delrin PEEK Teflon PEEK PEEK
††	6	Body O-Rings	2000, 3000 & 4000 6000	Viton Teflon Teflon Teflon
††	7	Seat O-Rings	3000 & 4000	Viton N/A
††	8	Thrust Washer	2000 3000 & 4000 6000	Teflon Delrin PEEK Teflon PEEK PEEK
††	9	Packing	All	Teflon Teflon
	10	Packing Follower	All	Stainless Steel Stainless Steel
	11	Belleville Washer	All	Stainless Steel Stainless Steel
	12	Gland Flange **	All	Carbon Steel, Plated Carbon Steel, Plated
	13	Cap Screws	All	Stainless Steel Stainless Steel
	14	Handle	All	Carbon Steel Carbon Steel
	15	Handle Nut	All	Carbon Steel, Plated Carbon Steel, Plated

* Item 3a is only available on bore sizes 1 1/2" and larger except 3" full port/4" reduced port valves.

† Major repair kit.

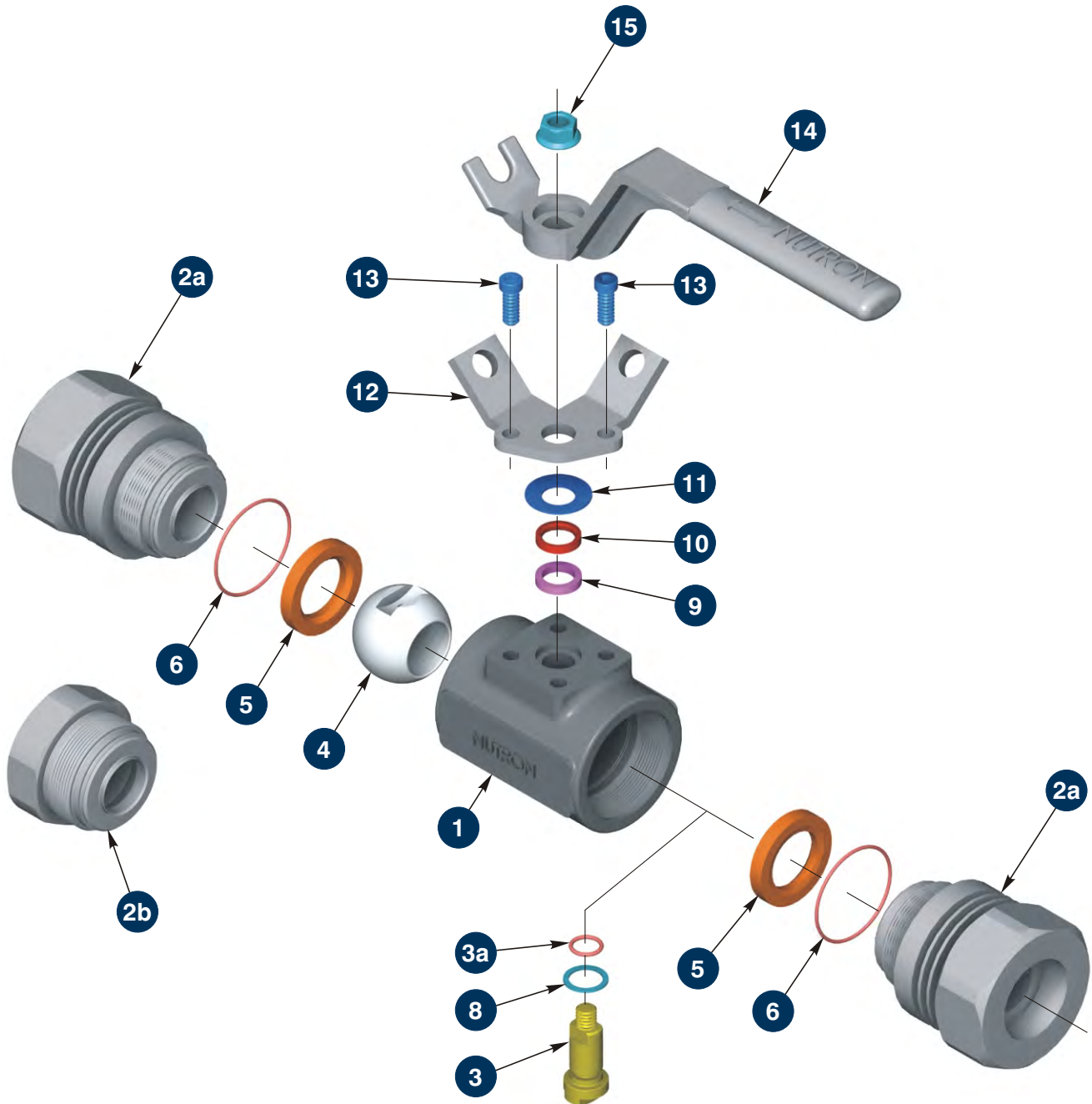
** Locking device standard on 1/4" to 2" RP. Consult NUTRON® Industries Sales Department for fire safe trim.

‡ Minor repair kit.



FLOATING BALL VALVE

SOCKET WELD or THREADED x SOCKET WELD END CONNECTIONS





MATERIALS LIST - SOCKET WELD or THREADED x SOCKET WELD END CONNECTIONS

ITEM	PART	WORKING PRESSURE	STANDARD	SOUR (NACE)
1	Body	All	ASTM A105	ASTM A105
2a	End Caps - SW	All	ASTM A350 Gr. LF2	ASTM A350 Gr. LF2
2b	End Cap - NPT	All	ASTM A105	ASTM A105
†	3	Stem 2000 & 3000 4000 & 6000	ASTM A108, Plated ASTM A564 17-4 PH	ASTM A564 17-4 PH ASTM A564 17-4 PH
††	3a*	Stem O-Ring	HSN	HSN
†	4	Ball 2000 3000, 4000 & 6000	ASTM A351 Gr. CF8M ASTM A564 17-4 PH	ASTM A351 Gr. CF8M ASTM A564 17-4 PH
††	5	Seats 2000 3000, 4000 & 6000	Teflon PEEK	Teflon PEEK
††	6	Body O-Rings	Teflon	Teflon
††	8	Thrust Washer 2000 3000, 4000 & 6000	Teflon PEEK	Teflon PEEK
††	9	Packing	Teflon	Teflon
10	Packing Follower	All	Carbon Steel, Plated	Stainless Steel
11	Belleville Washer	All	Carbon Steel	Stainless Steel
12	Gland Flange **	All	Carbon Steel, Plated	Carbon Steel, Plated
13	Cap Screws	All	Carbon Steel	Stainless Steel
14	Handle	All	Carbon Steel	Carbon Steel
15	Handle Nut	All	Carbon Steel, Plated	Carbon Steel, Plated

ITEM	PART	WORKING PRESSURE	SOUR (NACE) & LOW TEMP	STAINLESS STEEL -50°F
1	Body	All	ASTM A350 LF2	ASTM A479 TYPE 316
2a	End Caps - SW	All	ASTM A350 LF2	ASTM A479 TYPE 316 L
2b	End Cap - NPT	All	ASTM A350 LF2	ASTM A479 TYPE 316
†	3	Stem	ASTM A564 17-4 PH	ASTM A564 17-4 PH
††	3a*	Stem O-Ring	HSN	HSN
†	4	Ball 2000 3000, 4000 & 6000	ASTM A351 Gr. CF8M ASTM A564 17-4 PH	ASTM A351 Gr. CF8M ASTM A564 17-4 PH
††	5	Seats 2000 3000, 4000 & 6000	Teflon PEEK	Teflon PEEK
††	6	Body O-Rings	Teflon	Teflon
††	8	Thrust Washer 2000 3000, 4000 & 6000	Teflon PEEK	Teflon PEEK
††	9	Packing	Teflon	Teflon
10	Packing Follower	All	Stainless Steel	Stainless Steel
11	Belleville Washer	All	Stainless Steel	Stainless Steel
12	Gland Flange **	All	Carbon Steel, Plated	Carbon Steel, Plated
13	Cap Screws	All	Stainless Steel	Stainless Steel
14	Handle	All	Carbon Steel	Carbon Steel
15	Handle Nut	All	Carbon Steel, Plated	Carbon Steel, Plated

* Item 3a is only available on bore sizes 1 1/2" and larger.

** Locking device standard on 1/4" to 2" RP. Consult NUTRON® Industries Sales Department for fire safe trim.

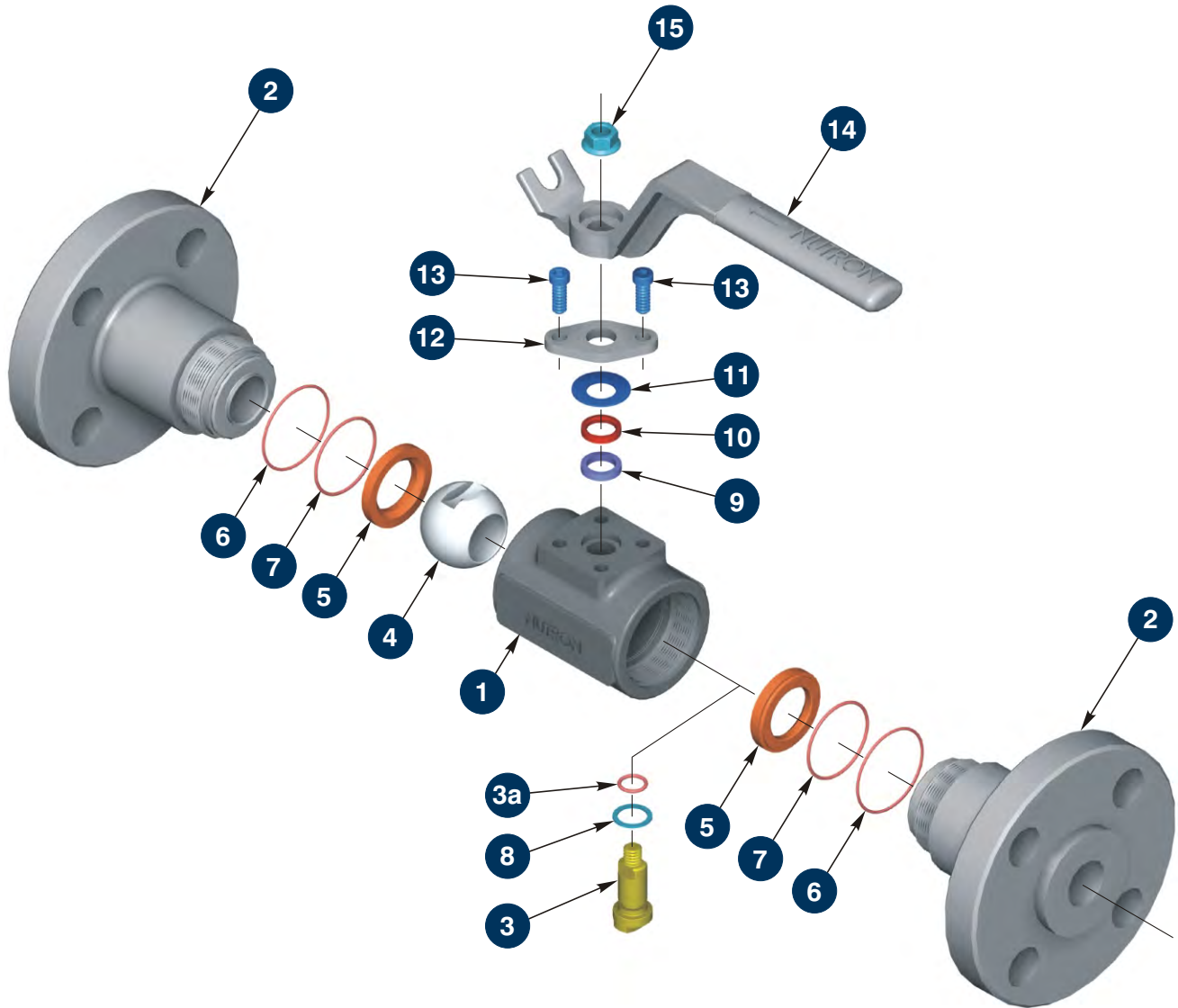
† Major repair kit.

†† Minor repair kit.



FLOATING BALL VALVE

FLANGED END CONNECTIONS





MATERIALS LIST - FLANGED END CONNECTIONS

ITEM	PART	ASME CLASS	STANDARD	SOUR (NACE)	
1	Body	All	ASTM A105	ASTM A105	
2	End Caps	All	ASTM A105	ASTM A105	
†	3	Stem	150, 300, 600 & 900 1500 & 2500	ASTM A108, Plated ASTM A564 17-4 PH	ASTM A564 17-4 PH ASTM A564 17-4 PH
††	3a*	Stem O-Ring	150 thru 1500 2500	Nitrile HSN	Viton HSN
†	4	Ball	150 thru 1500 2500	ASTM A576 Gr. 1020 H. CHR. PL. ASTM A564 17-4 PH	ASTM A351 Gr. CF8M ASTM A564 17-4 PH
††	5	Seats	150 thru 1500 2500	Delrin PEEK	Delrin PEEK
††	6	Body O-Rings	150 thru 1500 2500	Nitrile Teflon	Viton Teflon
††	7	Seat O-Rings	150 thru 1500	Nitrile	Viton
††	8	Thrust Washer	150 thru 1500 2500	Delrin PEEK	Delrin PEEK
††	9	Packing	All	Teflon	Teflon
	10	Packing Follower	All	Carbon Steel, Plated	Stainless Steel
	11	Belleville Washer	All	Carbon Steel	Stainless Steel
	12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
	13	Cap Screws	All	Carbon Steel	Stainless Steel
	14	Handle	All	Carbon Steel	Carbon Steel
	15	Handle Nut	All	Carbon Steel, Plated	Carbon Steel, Plated

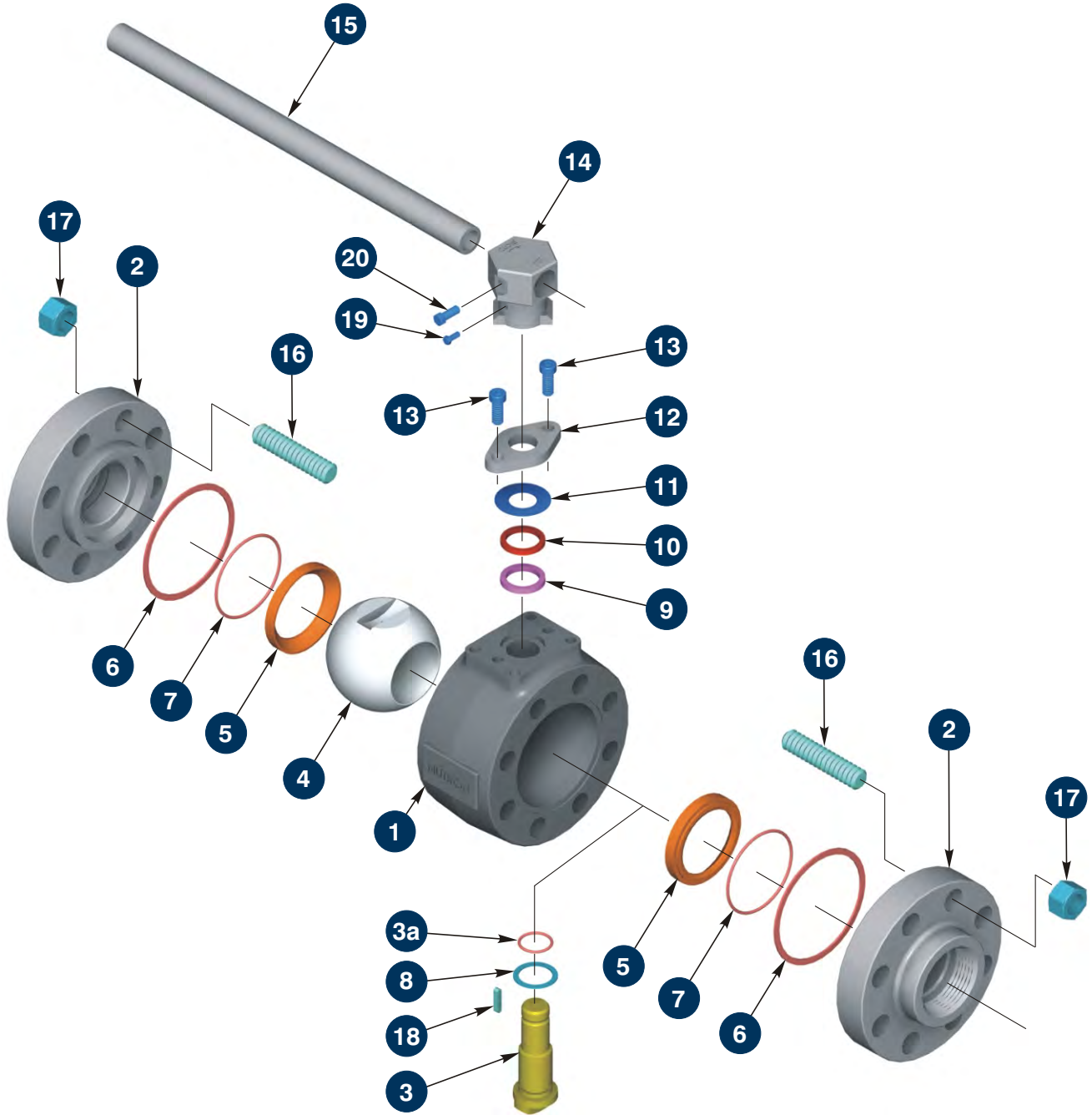
ITEM	PART	ASME CLASS	SOUR (NACE) & LOW TEMP	STAINLESS STEEL -50°F	
1	Body	All	ASTM A350 LF2	ASTM A479 TYPE 316	
2	End Caps	All	ASTM A350 LF2	ASTM A479 TYPE 316	
†	3	Stem	All	ASTM A564 17-4 PH	ASTM A564 17-4 PH
††	3a*	Stem O-Ring	150 thru 1500 2500	Viton HSN	HSN HSN
†	4	Ball	150, 300 & 600 900 & 1500 2500	ASTM A351 Gr. CF8M ASTM A351 Gr. CF8M ASTM A564 17-4 PH	ASTM A351 Gr. CF8M ASTM A564 17-4 PH ASTM A564 17-4 PH
††	5	Seats	150, 300 & 600 900 & 1500 2500	Delrin Delrin PEEK	Teflon PEEK PEEK
††	6	Body O-Rings	150 thru 1500 2500	Viton Teflon	Teflon Teflon
††	7	Seat O-Rings	150 thru 1500	Viton	N/A
††	8	Thrust Washer	150, 300 & 600 900 & 1500 2500	Delrin Delrin PEEK	Teflon PEEK PEEK
††	9	Packing	All	Teflon	Teflon
	10	Packing Follower	All	Stainless Steel	Stainless Steel
	11	Belleville Washer	All	Stainless Steel	Stainless Steel
	12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
	13	Cap Screws	All	Stainless Steel	Stainless Steel
	14	Handle	All	Carbon Steel	Carbon Steel
	15	Handle Nut	All	Carbon Steel, Plated	Carbon Steel, Plated

* Item 3a is only available on bore sizes 1 1/2" and larger except 3" full port/4" reduced port valves.
Consult NUTRON® Industries Sales Department for fire safe trim.
Teflon seat material available as an option on 150, 300 and 600 ASME.

† Major repair kit.
‡ Minor repair kit.



THREADED END CONNECTIONS





MATERIALS LIST - THREADED END CONNECTIONS

ITEM	PART	WORKING PRESSURE	STANDARD	SOUR (NACE)
1	Body	All	ASTM A105	ASTM A105
2	End Caps	All	ASTM A105	ASTM A105
†	3	2000 & 4000	ASTM A322 Gr. 4130, Plated	ASTM A564 17-4 PH
††	3a	All	HSN	HSN
†	4	All	ASTM A675 CHR. PL.	ASTM A351 Gr. CF8M
††	5	2000 4000	Teflon Delrin	Teflon Delrin
††	6	All	Spiral Wound Gasket	Spiral Wound Gasket
††	7	4000	Nitrile	Viton
††	8	2000 4000	Teflon Delrin	Teflon Delrin
††	9	All	Graphite	Graphite
10	Packing Follower	All	Carbon Steel, Plated	Stainless Steel
11	Belleville Washer	All	Carbon Steel	Stainless Steel
12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
13	Cap Screws	All	Carbon Steel	Stainless Steel
14	Handle Nut	All	Carbon Steel	Carbon Steel
15	Pipe	All	Carbon Steel	Carbon Steel
16	Studs	All	ASTM A193 B7	ASTM A193 B7M
17	Nuts	All	ASTM A194 2H	ASTM A194 2HM
18	Key	All	Carbon Steel	Carbon Steel
19	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated
20	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated

ITEM	PART	WORKING PRESSURE	SOUR (NACE) & LOW TEMP	STAINLESS STEEL -50°F
1	Body	All	ASTM A350 LF2	ASTM A479 TYPE 316
2	End Caps	All	ASTM A350 LF2	ASTM A479 TYPE 316
†	3	All	ASTM A564 17-4 PH	ASTM A564 17-4 PH
††	3a	All	HSN	HSN
†	4	All	ASTM A351 Gr. CF8M	ASTM A351 Gr. CF8M
††	5	2000 4000	Teflon Delrin	Teflon PEEK
††	6	All	Spiral Wound Gasket	Spiral Wound Gasket
††	7	4000	Viton	N/A
††	8	2000 4000	Teflon Delrin	Teflon PEEK
††	9	All	Graphite	Graphite
10	Packing Follower	All	Stainless Steel	Stainless Steel
11	Belleville Washer	All	Stainless Steel	Stainless Steel
12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
13	Cap Screws	All	Stainless Steel	Stainless Steel
14	Handle Nut	All	Carbon Steel	Carbon Steel
15	Pipe	All	Carbon Steel	Carbon Steel
16	Studs	All	ASTM A320 L7M	ASTM A320 L7M, Coated
17	Nuts	All	ASTM A194 L7M	ASTM A194 L7M, Coated
18	Key	All	Carbon Steel	Carbon Steel
19	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated
20	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated

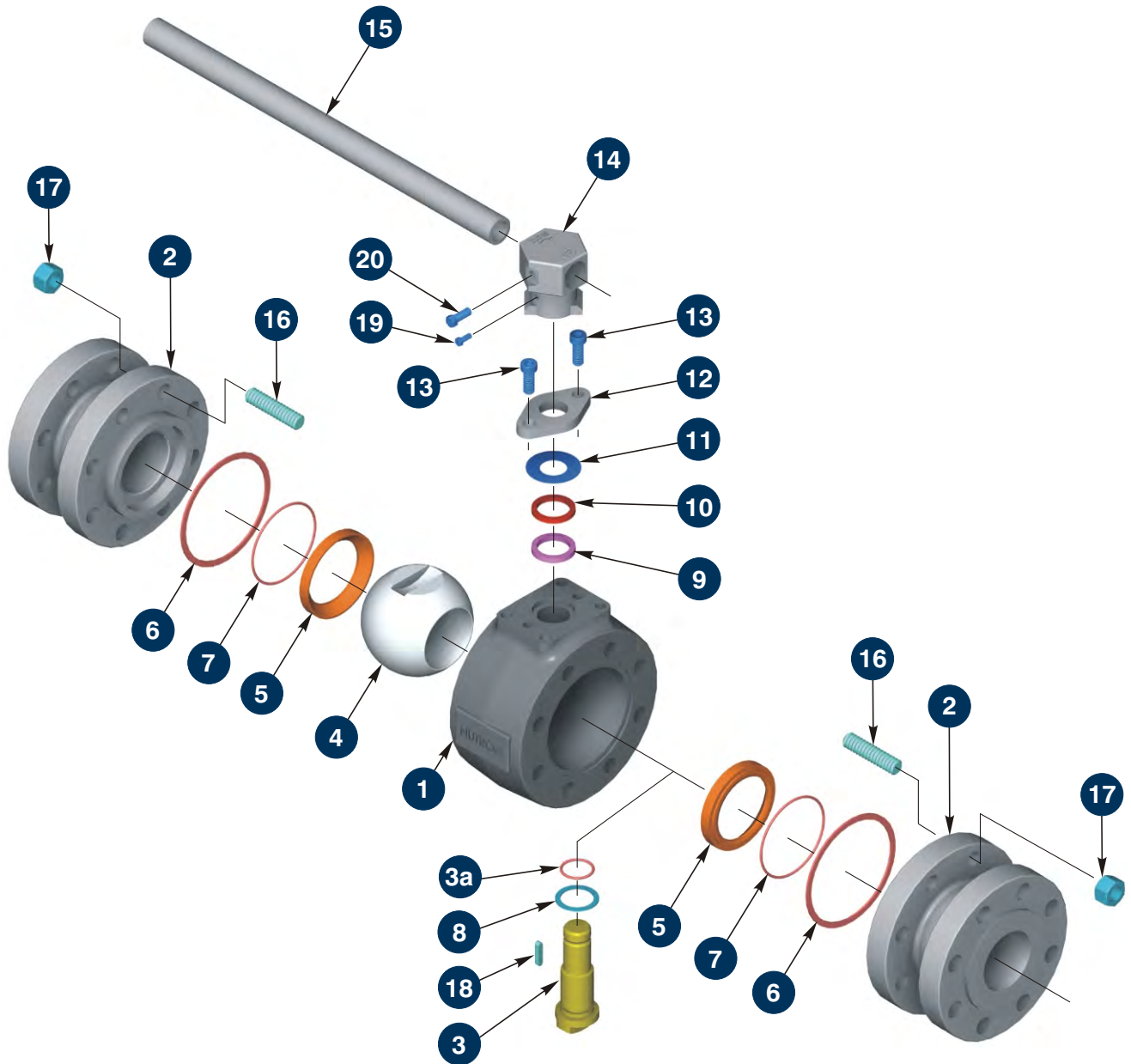
† Major repair kit.

†† Minor repair kit.



FLOATING BALL VALVE

FLANGED END CONNECTIONS





MATERIALS LIST - FLANGED END CONNECTIONS

ITEM	PART	ASME CLASS	STANDARD	SOUR (NACE)	
1	Body	All	ASTM A105	ASTM A105	
2	End Caps	All	ASTM A105	ASTM A105	
†	3	Stem	600, 900 & 1500	ASTM A322 Gr. 4130, Plated	ASTM A564 17-4 PH
††	3a	Stem O-Ring	600, 900 & 1500	HSN	HSN
†	4	Ball	600, 900 & 1500	ASTM A675 CHR. PL.	ASTM A351 Gr. CF8M
††	5	Seats	600 900 & 1500	Teflon Delrin	Teflon Delrin
††	6	Body Seals	600, 900 & 1500	Spiral Wound Gasket	Spiral Wound Gasket
††	7	Seat O-Rings	900 & 1500	Nitrile	Viton
††	8	Thrust Washer	600 900 & 1500	Teflon Delrin	Teflon Delrin
††	9	Packing	All	Graphite	Graphite
	10	Packing Follower	All	Carbon Steel, Plated	Stainless Steel
	11	Belleville Washer	All	Carbon Steel	Stainless Steel
	12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
	13	Cap Screws	All	Carbon Steel	Stainless Steel
	14	Handle Nut	All	Carbon Steel	Carbon Steel
	15	Pipe	All	Carbon Steel	Carbon Steel
	16	Studs	All	ASTM A193 B7	ASTM A193 B7M
	17	Nuts	All	ASTM A194 2H	ASTM A194 2HM
	18	Key	All	Carbon Steel	Carbon Steel
	19	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated
	20	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated

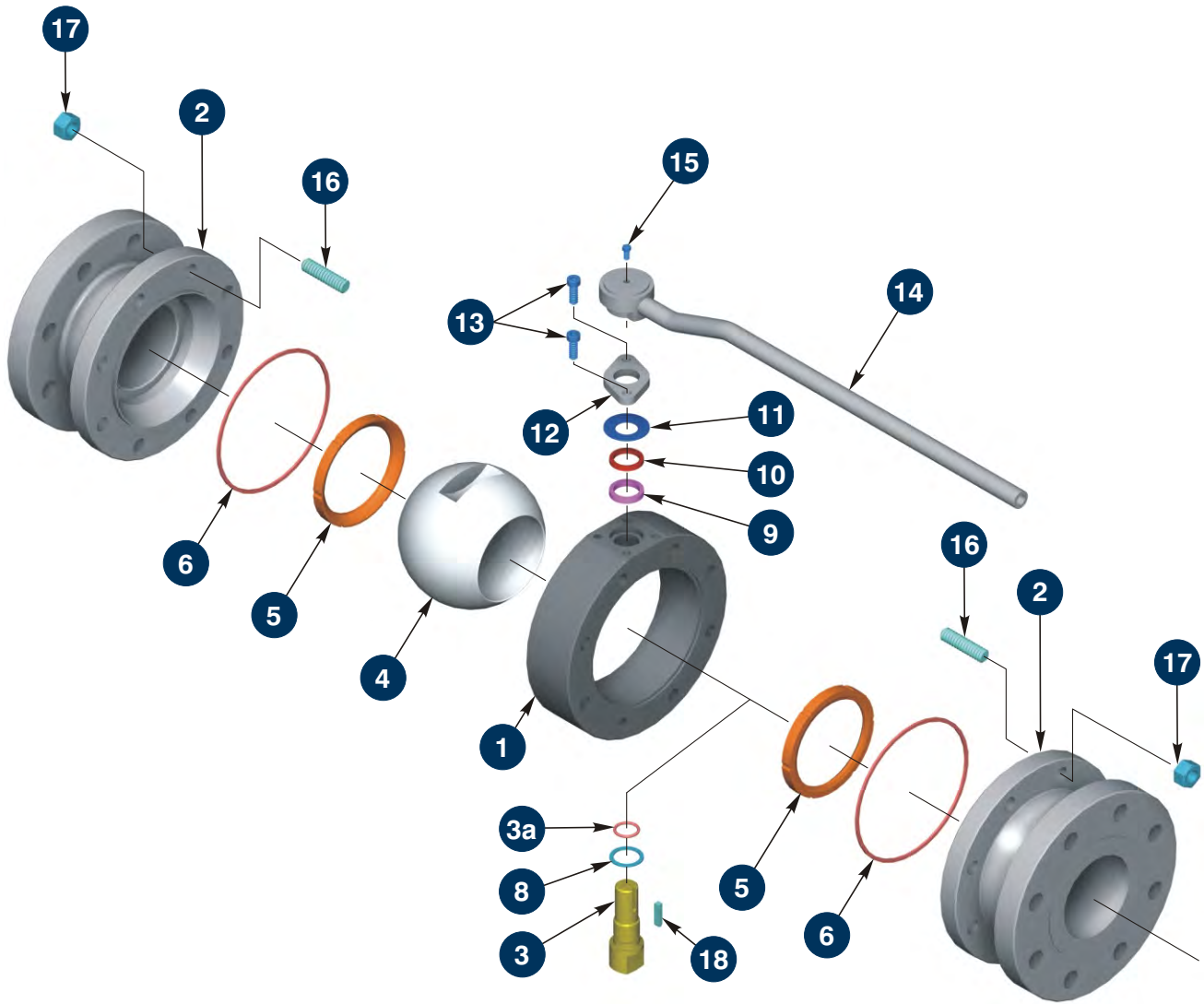
ITEM	PART	ASME CLASS	SOUR (NACE) & LOW TEMP	STAINLESS STEEL -50°F	
1	Body	All	ASTM A350 LF2	ASTM A479 TYPE 316	
2	End Caps	All	ASTM A350 LF2	ASTM A479 TYPE 316	
†	3	Stem	600, 900 & 1500	ASTM A564 17-4 PH	ASTM A564 17-4 PH
††	3a	Stem O-Ring	600, 900 & 1500	HSN	HSN
†	4	Ball	600, 900 & 1500	ASTM A351 Gr. CF8M	ASTM A351 Gr. CF8M
††	5	Seats	600 900 & 1500	Teflon Delrin	Teflon PEEK
††	6	Body Seals	600, 900 & 1500	Spiral Wound Gasket	Spiral Wound Gasket
††	7	Seat O-Rings	900 & 1500	Viton	N/A
††	8	Thrust Washer	600 900 & 1500	Teflon Delrin	Teflon PEEK
††	9	Packing	All	Graphite	Graphite
	10	Packing Follower	All	Stainless Steel	Stainless Steel
	11	Belleville Washer	All	Stainless Steel	Stainless Steel
	12	Gland Flange	All	Carbon Steel, Plated	Carbon Steel, Plated
	13	Cap Screws	All	Stainless Steel	Stainless Steel
	14	Handle Nut	All	Carbon Steel	Carbon Steel
	15	Pipe	All	Carbon Steel	Carbon Steel
	16	Studs	All	ASTM A320 L7M	ASTM A320 L7M, Coated
	17	Nuts	All	ASTM A194 L7M	ASTM A194 L7M, Coated
	18	Key	All	Carbon Steel	Carbon Steel
	19	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated
	20	Screw	All	Carbon Steel, Plated	Carbon Steel, Plated

† Major repair kit.
 ‡ Minor repair kit.



FLOATING BALL VALVE

4" FULL PORT / 6" REDUCED PORT



MATERIALS LIST - FLANGED END CONNECTIONS



ITEM	PART	ASME CLASS	SOUR (NACE)	SOUR (NACE) & LOW TEMP	
1	Body	150 & 300	ASTM A105	ASTM A350 LF2	
2	End Caps	150 & 300	ASTM A105	ASTM A350 LF2	
†	3	Stem	150 & 300	ASTM A564 17-4 PH	ASTM A564 17-4 PH
†‡	3a	Stem O-Ring	150 & 300	HSN	HSN
†	4	Ball	150 & 300	ASTM A351 Gr. CF8M	ASTM A351 Gr. CF8M
†‡	5	Seats	150 & 300	Teflon	Teflon
†‡	6	Body O-Rings	150 & 300	Viton	Viton
†‡	8	Thrust Washer	150 & 300	Teflon	Teflon
†‡	9	Packing	150 & 300	Graphite	Graphite
	10	Packing Follower	150 & 300	Stainless Steel	Stainless Steel
	11	Belleville Washer	150 & 300	Stainless Steel	Stainless Steel
	12	Gland Flange	150 & 300	Carbon Steel, Plated	Carbon Steel, Plated
	13	Cap Screws	150 & 300	Stainless Steel	Stainless Steel
	14	Handle	150 & 300	Carbon Steel	Carbon Steel
	15	Cap Screw, Hex Head	150 & 300	Carbon Steel	Carbon Steel
	16	Studs	150 & 300	ASTM A193 B7M	ASTM A320 L7M
	17	Nuts	150 & 300	ASTM A194 2HM	ASTM A194 L7M
	18	Key	150 & 300	Carbon Steel	Carbon Steel

ITEM	PART	ASME CLASS	STAINLESS STEEL -50°F	
1	Body	150 & 300	ASTM A479 TYPE 316	
2	End Caps	150 & 300	ASTM A479 TYPE 316	
†	3	Stem	150 & 300	ASTM A564 17-4 PH
†‡	3a	Stem O-Ring	150 & 300	HSN
†	4	Ball	150 & 300	ASTM A351 Gr. CF8M
†‡	5	Seats	150 & 300	Teflon
†‡	6	Body O-Rings	150 & 300	Teflon
†‡	8	Thrust Washer	150 & 300	Teflon
†‡	9	Packing	150 & 300	Graphite
	10	Packing Follower	150 & 300	Stainless Steel
	11	Belleville Washer	150 & 300	Stainless Steel
	12	Gland Flange	150 & 300	Carbon Steel, Plated
	13	Cap Screws	150 & 300	Stainless Steel
	14	Handle	150 & 300	Carbon Steel
	15	Cap Screw, Hex Head	150 & 300	Carbon Steel
	16	Studs	150 & 300	ASTM A320 L7M, Coated
	17	Nuts	150 & 300	ASTM A194 L7M, Coated
	18	Key	150 & 300	Carbon Steel

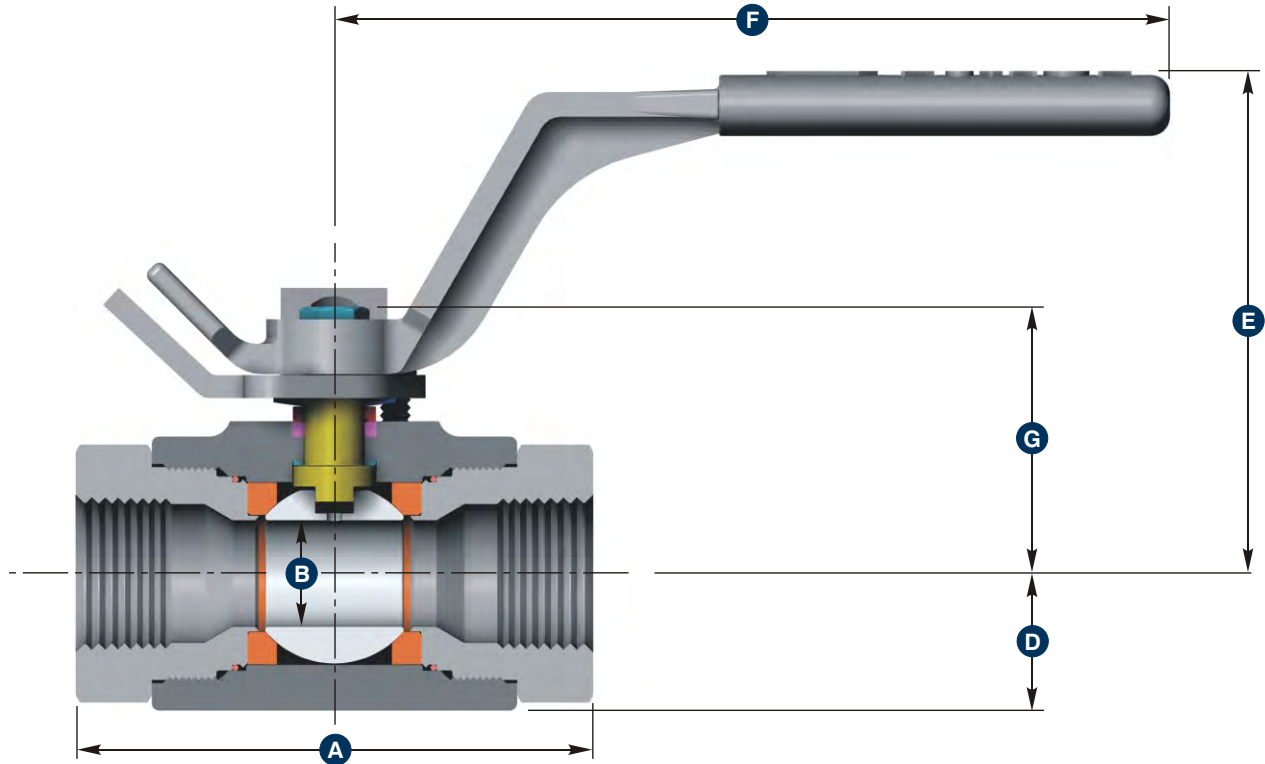
† Major repair kit.

‡ Minor repair kit.



FLOATING BALL VALVE

FULL PORT - THREADED



DIMENSIONS

SIZE in/mm	WOG	A	B	D	E	F	G	C _v	WEIGHT lb/kg
1/4 /6.4	2000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.5/1.1
	3000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.5/1.1
	4000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.5/1.1
	6000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.5/1.1
3/8 /9.5	2000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.4/1.0
	3000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.4/1.0
	4000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.4/1.0
	6000	3.88/98	.50/13	.82/21	3.29/83	4.82/122	1.73/44	9	2.4/1.0
1/2 /12.7	2000	3.88/98 ¹	.50/13	.82/21	3.29/83	4.82/122	1.73/44	26	2.2/0.9
	3000	3.88/98 ¹	.50/13	.82/21	3.29/83	4.82/122	1.73/44	26	2.2/0.9
	4000	3.88/98 ¹	.50/13	.82/21	3.29/83	4.82/122	1.73/44	26	2.2/0.9
	6000	4.38/111	.50/13	.82/21	3.29/83	4.82/122	1.73/44	26	2.2/0.9
3/4 /19.1	2000	4.25/108	.88/22	1.12/29	4.4/112	6.75/172	2.16/55	50	4.8/2.1
	3000	4.25/108	.88/22	1.12/29	4.4/112	6.75/172	2.16/55	50	4.8/2.1
	4000	4.25/108	.88/22	1.12/29	4.4/112	6.75/172	2.16/55	50	4.8/2.1
	6000	4.25/108	.88/22	1.50/38	4.4/112	6.75/172	2.16/55	50	6.5/2.9
1 1/2 /38.1	2000	6.25/159	1.5/38	1.98/50	5.62/143	11.0/279	3.52/89	260	18.0/8.1
	3000	6.25/159	1.5/38	1.98/50	5.62/143	11.0/279	3.52/89	260	18.0/8.1
	4000	6.25/159	1.5/38	1.98/50	5.62/143	11.0/279	3.52/89	260	18.0/8.1
	6000	6.25/159	1.5/38	1.98/50	5.62/143	11.0/279	3.52/89	260	18.0/8.1
2 /50.8	2000	6.25/159	2.0/51	2.53/64	6.96/177	11.88/302	4.83/123	480	30.0/13.6
	3000	6.25/159	2.0/51	2.53/64	6.96/177	11.88/302	4.83/123	480	30.0/13.6
	4000	6.25/159	2.0/51	2.53/64	6.96/177	11.88/302	4.83/123	480	30.0/13.6
	6000	6.25/159	2.0/51	2.53/64	6.96/177	11.88/302	4.83/123	480	30.0/13.6
3 /76.2	1000	9.70/246	3.0/76	3.50/89	8.26/210	23.88/607	5.37/137	1300	67.0/30.4
	2000	9.70/246	3.0/76	3.50/89	8.26/210	23.88/607	5.37/137	1300	67.0/30.4

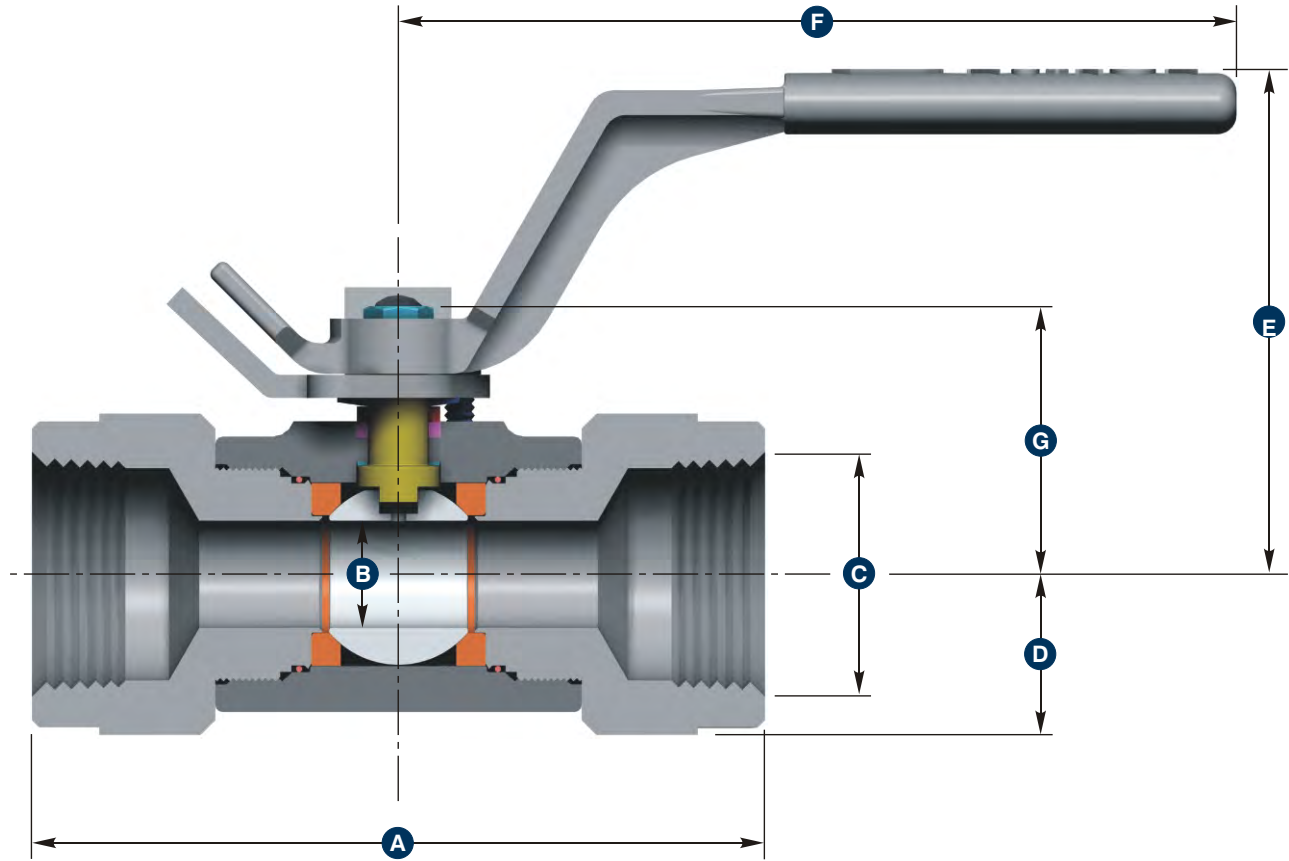
¹ 4.38"/111.2 mm in SLT and SS valves.

NOTE: " A " dimension to be within ± 0.062"/1.5 mm.



FLOATING BALL VALVE

REDUCED PORT - THREADED



DIMENSIONS

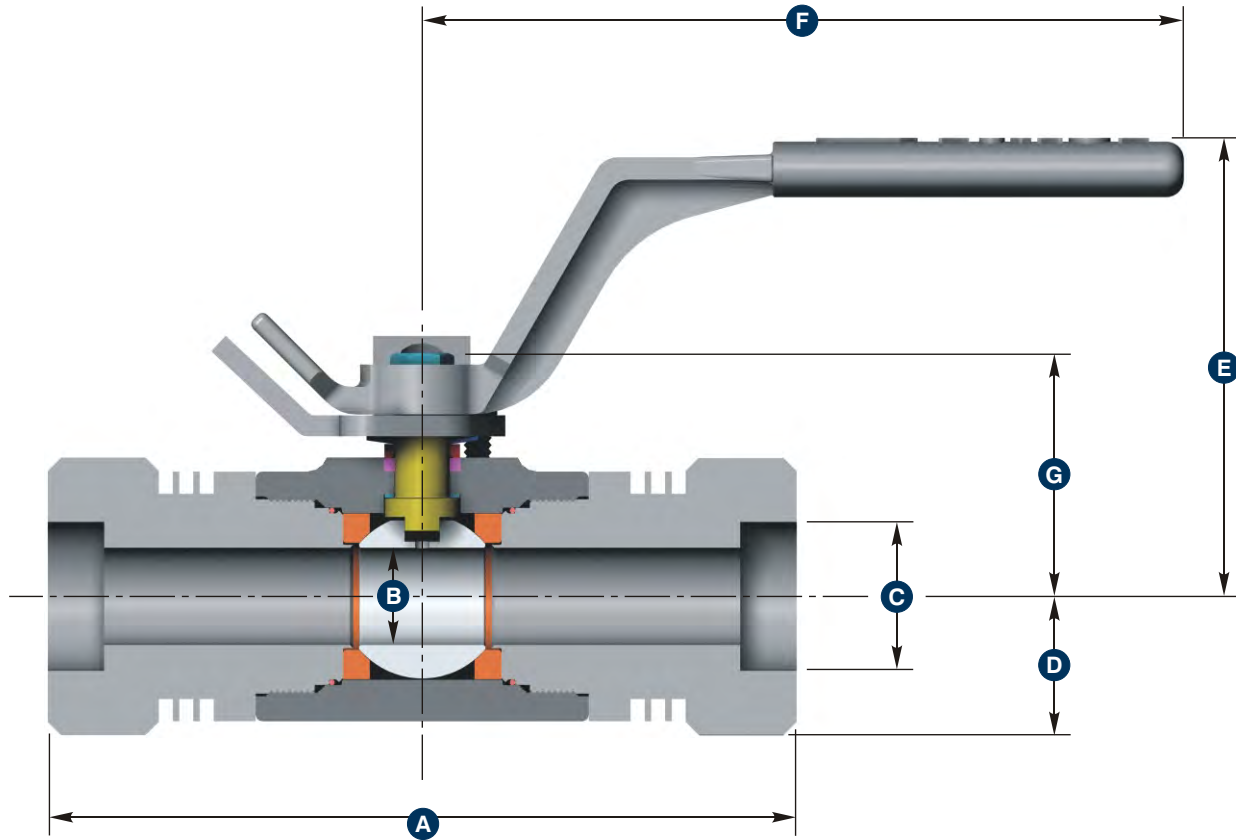
SIZE in/mm	WOG	A	B	C	D	E	F	G	C _v	WEIGHT lb/kg
3/4 /19.1	2000	4.38/111	.50/13	.75/19	.82/21	3.29/83	4.82/122	1.73/44	14	2.5/1.1
	3000	4.38/111	.50/13	.75/19	.82/21	3.29/83	4.82/122	1.73/44	14	2.5/1.1
	4000	4.38/111	.50/13	.75/19	.82/21	3.29/83	4.82/122	1.73/44	14	2.5/1.1
	6000	4.38/111	.50/13	.75/19	.82/21	3.29/83	4.82/122	1.73/44	14	2.5/1.1
1 /25.4	2000	4.25/108	.88/22	1.0/25	1.12/28	4.4/112	6.75/172	2.16/55	35	4.5/2.0
	3000	4.25/108	.88/22	1.0/25	1.12/28	4.4/112	6.75/172	2.16/55	35	4.5/2.0
	4000	4.25/108	.88/22	1.0/25	1.12/28	4.4/112	6.75/172	2.16/55	35	4.5/2.0
	6000	5.25/133	.88/22	1.0/25	1.5/38	4.4/112	6.75/172	2.16/55	35	7.5/3.4
1 1/4 /31.8	2000	6.0/152	.88/22	1.25/32	1.3/33	4.4/112	6.75/172	2.16/55	35	8.0/3.6
	3000	6.0/152	.88/22	1.25/32	1.3/33	4.4/112	6.75/172	2.16/55	35	8.0/3.6
2 /50.8	2000	6.25/159	1.5/38	2.0/51	1.98/50	5.62/143	11.0/279	3.52/89	100	17.5/7.9
	3000	6.25/159	1.5/38	2.0/51	1.98/50	5.62/143	11.0/279	3.52/89	100	17.5/7.9
	4000	6.25/159	1.5/38	2.0/51	1.98/50	5.62/143	11.0/279	3.52/89	100	17.5/7.9
	6000	7.25/184	1.5/38	2.0/51	1.98/50	5.62/143	11.0/279	3.52/89	100	21.0/9.5
3 /76.2	2000	10.0/254	2.0/51	3.0/76	2.53/64	6.96/177	11.88/302	4.83/123	420	39.0/17.6
	3000	10.0/254	2.0/51	3.0/76	2.53/64	6.96/177	11.88/302	4.83/123	420	39.0/17.6
	4000	10.0/254	2.0/51	3.0/76	2.53/64	6.96/177	11.88/302	4.83/123	420	39.0/17.6
	6000	10.0/254	2.0/51	3.0/76	2.53/64	6.96/177	11.88/302	4.83/123	420	48.0/21.8
4 /101.6	1000	9.5/241	3.0/76	4.0/102	3.50/89	8.26/210	23.88/607	5.37/137	770	80.0/36.3

NOTE: "A" dimension to be within ± 0.062"/1.5 mm.



FLOATING BALL VALVE

FULL PORT - SOCKET WELD or THREADED x SOCKET WELD

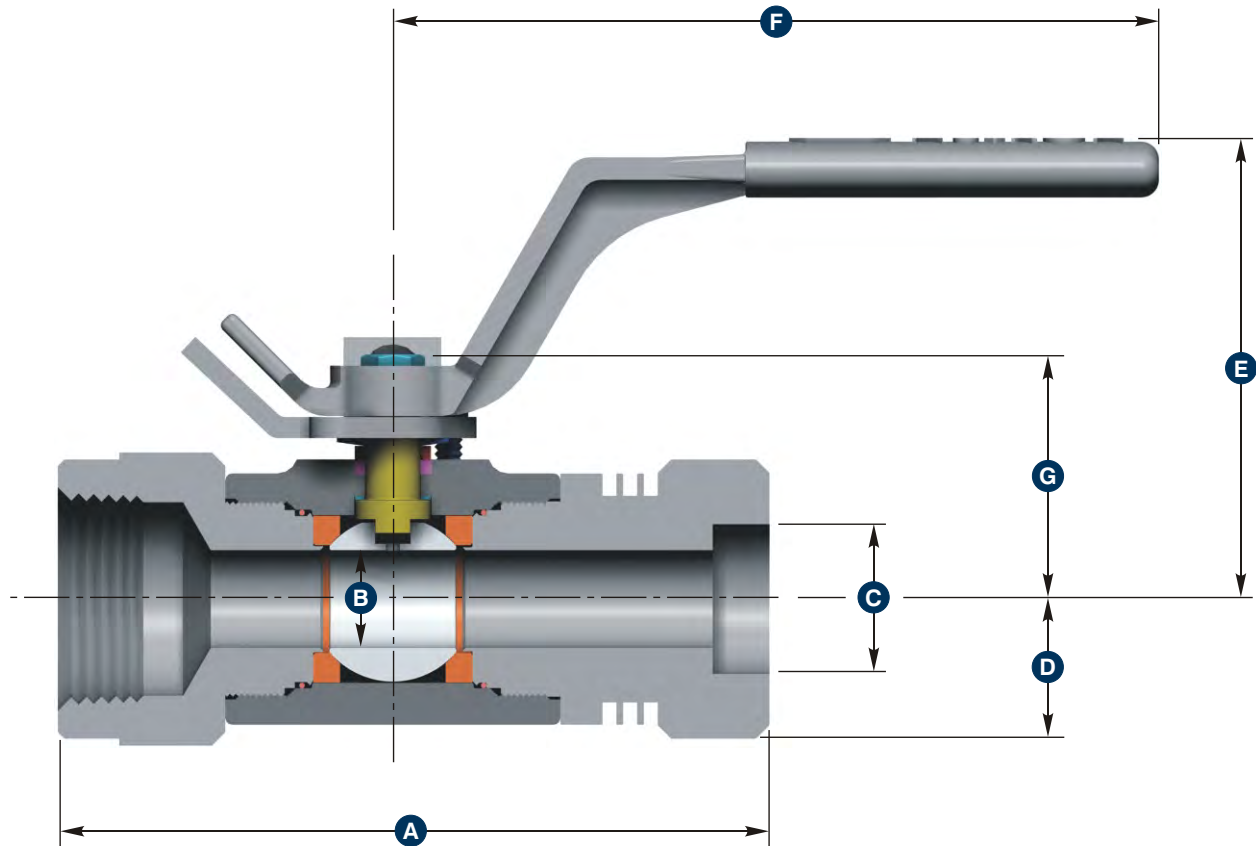


DIMENSIONS

SIZE in/mm	WOG	A		B	C		D	E	F	G	C _v	WEIGHT lb/kg	
		FNPTxSW	SW		FNPTxSW	SW						FNPTxSW	SW
1/2 /12.7	2000	4.44/113*	5.00/13	.50/13	.50/13	.86/22	.94/24	3.29/83	4.82/122	1.73/44	26	3.5/1.5	4.8/2.1
	3000	4.44/113*	5.00/13	.50/13	.50/13	.86/22	.94/24	3.29/83	4.82/122	1.73/44	26	3.5/1.5	4.8/2.1
	4000	4.44/113*	5.00/13	.50/13	.50/13	.86/22	.94/24	3.29/83	4.82/122	1.73/44	26	3.5/1.5	4.8/2.1
	6000	4.69/119	5.00/13	.50/13	.50/13	.86/22	.94/24	3.29/83	4.82/122	1.73/44	26	3.5/1.5	4.8/2.1
3/4 /19.1	2000	5.50/140	6.75/172	.88/22	.75/19	1.07/27	1.25/32	4.4/112	6.75/172	2.16/55	50	5.7/2.5	6.4/2.9
	3000	5.50/140	6.75/172	.88/22	.75/19	1.07/27	1.25/32	4.4/112	6.75/172	2.16/55	50	5.7/2.5	6.4/2.9
	4000	5.50/140	6.75/172	.88/22	.75/19	1.07/27	1.25/32	4.4/112	6.75/172	2.16/55	50	5.7/2.5	6.4/2.9
	6000	5.50/140	6.75/172	.88/22	.75/19	1.07/27	1.50/38	4.4/112	6.75/172	2.16/55	50	8.6/3.9	9.2/4.1
1 1/2 /38.1	2000	7.4/188	8.54/217	1.5/38	1.5/38	1.92/49	2.50/64	5.62/143	11.0/279	3.52/89	260	21.9/9.9	25.7/11.6
	3000	7.4/188	8.54/217	1.5/38	1.5/38	1.92/49	2.50/64	5.62/143	11.0/279	3.52/89	260	21.9/9.9	25.7/11.6
	4000	7.4/188	8.54/217	1.5/38	1.5/38	1.92/49	2.50/64	5.62/143	11.0/279	3.52/89	260	21.9/9.9	25.7/11.6
	6000	7.4/188	8.54/217	1.5/38	1.5/38	1.92/49	2.50/64	5.62/143	11.0/279	3.52/89	260	21.9/9.9	25.7/11.6
2 /50.8	2000	9.50/241	12.75/324	2.0/51	2.0/51	2.41/61	2.53/64	6.96/177	11.88/302	4.83/123	480	38.3/17	46.5/21.0
	3000	9.50/241	12.75/324	2.0/51	2.0/51	2.41/61	2.53/64	6.96/177	11.88/302	4.83/123	480	38.3/17	46.5/21.0
	4000	9.50/241	12.75/324	2.0/51	2.0/51	2.41/61	2.53/64	6.96/177	11.88/302	4.83/123	480	38.3/17	46.5/21.0
	6000	9.50/241	12.75/324	2.0/51	2.0/51	2.41/61	2.53/64	6.96/177	11.88/302	4.83/123	480	38.3/17	46.5/21.0

* -4.69/119.1 in SLT and SS valves.

REDUCED PORT - SOCKET WELD or THREADED x SOCKET WELD



DIMENSIONS

SIZE in/mm	WOG	A		B	C		D	E	F	G	C _v	WEIGHT lb/kg	
		FNPTxSW	SW		FNPTxSW	SW						FNPTxSW	SW
3/4 /19.1	2000	5.56/141	6.75/172	.50/13	.75/19	1.07/27	1.19/30	3.29/83	4.82/122	1.73/44	14	3.5/1.5	4.4/1.9
	3000	5.56/141	6.75/172	.50/13	.75/19	1.07/27	1.19/30	3.29/83	4.82/122	1.73/44	14	3.5/1.5	4.4/1.9
	4000	5.56/141	6.75/172	.50/13	.75/19	1.07/27	1.19/30	3.29/83	4.82/122	1.73/44	14	3.5/1.5	4.4/1.9
	6000	5.56/141	6.75/172	.50/13	.75/19	1.07/27	1.19/30	3.29/83	4.82/122	1.73/44	14	3.5/1.5	4.4/1.9
1 /25.4	2000	5.50/140*	6.75/172	.88/22	1.0/25	1.34/34	1.25/32	4.4/112	6.75/172	2.16/55	35	5.4/2.4	6.2/2.8
	3000	5.50/140*	6.75/172	.88/22	1.0/25	1.34/34	1.25/32	4.4/112	6.75/172	2.16/55	35	5.4/2.4	6.2/2.8
	4000	5.50/140*	6.75/172	.88/22	1.0/25	1.34/34	1.25/32	4.4/112	6.75/172	2.16/55	35	5.4/2.4	6.2/2.8
	6000	6.00/152	6.75/172	.88/22	1.0/25	1.34/34	1.5/38	4.4/112	6.75/172	2.16/55	35	8.3/3.7	9.0/4.0
2 /50.8	2000	7.40/188	8.55/217	1.5/38	2.0/51	2.42/62	2.50/64	5.62/143	11.0/280	3.52/90	100	22.5/10.2	26.0/11.7
	3000	7.40/188	8.55/217	1.5/38	2.0/51	2.42/62	2.50/64	5.62/143	11.0/280	3.52/90	100	22.5/10.2	26.0/11.7
	4000	7.40/188	8.55/217	1.5/38	2.0/51	2.42/62	2.50/64	5.62/143	11.0/280	3.52/90	100	22.5/10.2	26.0/11.7
	6000	7.90/201	8.55/217	1.5/38	2.0/51	2.42/62	2.50/64	5.62/143	11.0/280	3.52/90	100	22.5/10.2	26.0/11.7
3 /76.2	2000	11.38/289	12.75/324	2.0/51	3.0/76	3.55/90	2.53/64	6.96/177	11.88/302	4.83/123	420	49.0/22	60.0/27.2
	3000	11.38/289	12.75/324	2.0/51	3.0/76	3.55/90	2.53/64	6.96/177	11.88/302	4.83/123	420	49.0/22	60.0/27.2
	4000	11.38/289	12.75/324	2.0/51	3.0/76	3.55/90	2.53/64	6.96/177	11.88/302	4.83/123	420	49.0/22	60.0/27.2

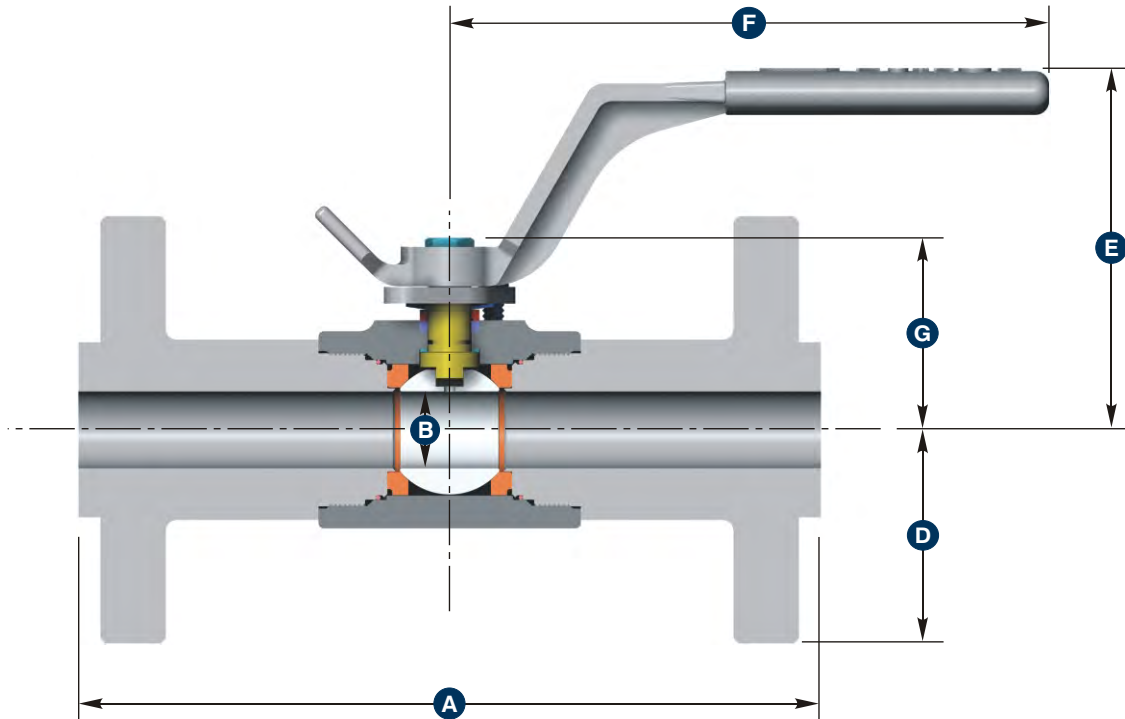
* -4.69/119.1 in SS valves.

NOTE: " A " dimension to be within $\pm 0.062"/1.5$ mm.



FLOATING BALL VALVE

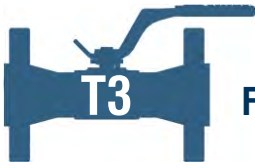
FULL PORT - FLANGED



DIMENSIONS

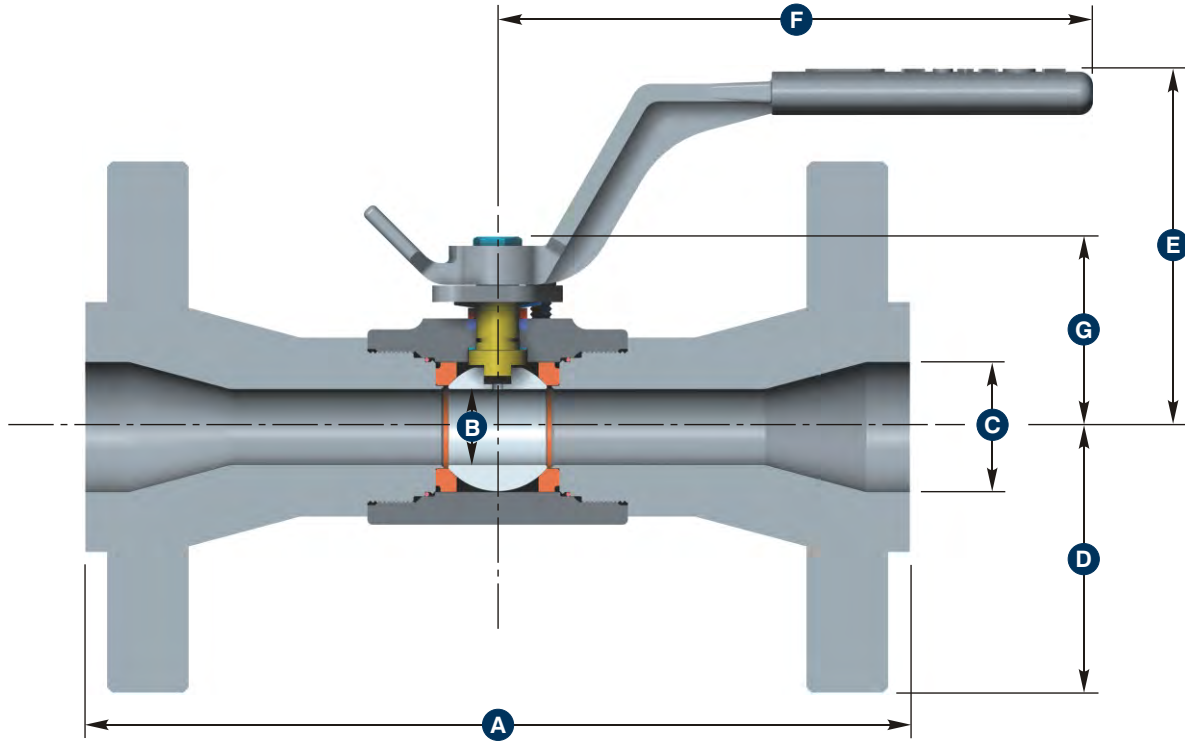
SIZE in/mm	ASME CLASS	A		B	D	E	F	G	C _v	WEIGHT lb/kg
		RF	RTJ							
1/2 /12.7	150	4.25/108		.50/13	1.75/45	3.29/83	4.82/122	1.73/44	26	4.0/1.8
	300	5.5/140	5.94/151	.50/13	1.87/48	3.29/83	4.82/122	1.73/44	26	4.4/1.9
	600	6.5/165	6.5/165	.50/13	1.87/48	3.29/83	4.82/122	1.73/44	26	5.5/2.4
	900/1500	8.5/216	8.5/216	.50/13	2.37/60	5.73/146	8.0/203	1.73/44	26	11.0/4.9
	2500	10.37/264	10.37/264	.50/13	2.63/67	5.73/146	8.0/203	1.73/44	26	17.5/7.9
3/4 /19.1	150	4.62/117		.88/22	1.94/49	4.4/112	6.75/172	2.16/55	50	10.3/4.6
	300	6.0/152	6.5/165	.88/22	2.31/59	4.4/112	6.75/172	2.16/55	50	10.3/4.6
	600	7.5/191	7.5/191	.88/22	2.31/59	4.4/112	6.75/172	2.16/55	50	13.3/6.0
	900/1500	9.0/229	9.0/229	.88/22	2.56/65	4.4/112	6.75/172	2.16/55	50	16.3/7.3
	2500	10.75/273	10.75/273	.88/22	2.75/70	6.2/158	8.12/206	2.16/55	50	22.8/10.3
1 1/2 /38.1	150	6.5/165	7.0/178	1.5/38	2.5/64	5.62/143	11.0/279	3.52/89	260	21.0/9.5
	300	7.5/191	8.0/203	1.5/38	3.06/78	5.62/143	11.0/279	3.52/89	260	29.0/13.1
	600	9.5/241	9.5/241	1.5/38	3.06/78	5.62/143	11.0/279	3.52/89	260	32.5/14.7
	900/1500	12.0/305	12.0/305	1.5/38	3.5/89	5.62/143	11.0/279	3.52/89	260	46.0/20.8
	2500	15.12/384	15.25/387	1.5/38	4.0/102	5.62/143	11.0/279	3.52/89	260	74.0/33.5
2 /50.8	150	7.12/181	7.5/191	2.0/51	3.0/76	6.96/177	11.88/302	4.83/123	480	36.2/16.4
	300	8.5/216	9.12/232	2.0/51	3.25/83	6.96/177	11.88/302	4.83/123	480	43.3/19.6
	600	11.5/292	11.62/295	2.0/51	3.25/83	6.96/177	11.88/302	4.83/123	480	51.5/23.3
	900/1500	14.5/368	14.62/371	2.0/51	4.25/108	6.96/177	11.88/302	4.83/123	480	81.0/36.7
	2500	17.75/451	17.87/454	2.0/51	4.62/118	6.96/177	11.88/302	4.83/123	480	121.0/54.8
3 /76.2	150	8.0/203	8.5/216	3.0/76	3.75/95	8.26/210	23.89/607	5.37/137	1300	58.0/26.3
	300	11.12/282	11.75/299	3.0/76	4.12/105	8.26/210	23.89/607	5.37/137	1300	77.5/35.1

NOTE: " A " dimension to be within ± 0.062"/1.5 mm.



FLOATING BALL VALVE

REDUCED PORT - FLANGED



DIMENSIONS

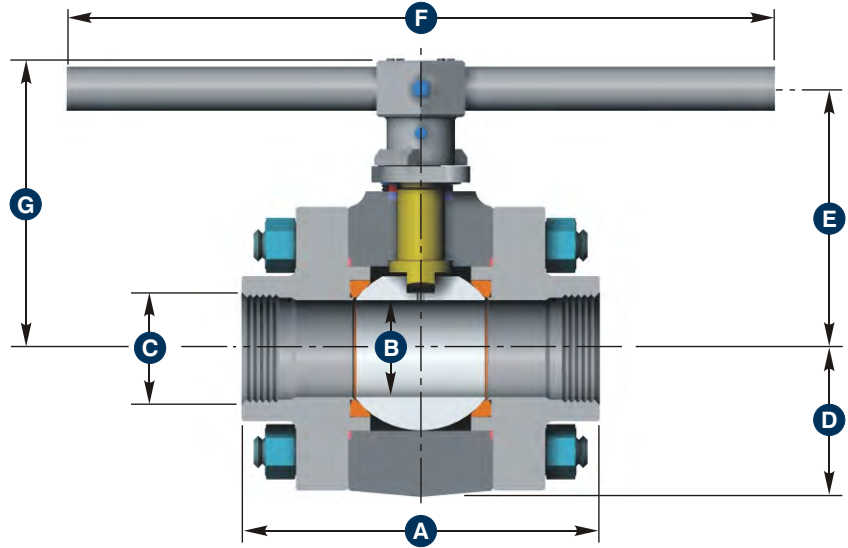
SIZE in/mm	ASME CLASS	A		B	C	D	E	F	G	C _v	WEIGHT lb/kg
		RF	RTJ								
3/4 /19.1	150	4.63/118		.50/13	.75/19	1.94/49	3.29/83	4.82/122	1.73/44	14	5.0/2.2
	300	6.0/152	6.5/165	.50/13	.75/19	2.31/59	3.29/83	4.82/122	1.73/44	14	7.0/3.1
	600	7.5/191	7.5/191	.50/13	.75/19	2.31/59	3.29/83	4.82/122	1.73/44	14	9.0/4.0
	900/1500	9.0/229	9.0/229	.50/13	.75/19	2.56/65	5.73/146	8.0/203	1.73/44	14	14.0/6.3
	2500	10.75/273	10.75/273	.50/13	.75/19	2.75/70	5.73/146	8.0/203	1.73/44	14	20.5/9.2
1 /25.4	150	5.0/127	5.5/140	.88/22	1.0/25	2.12/54	4.4/112	6.75/172	2.16/55	35	8.0/3.6
	300	6.5/165	7.0/178	.88/22	1.0/25	2.44/62	4.4/112	6.75/172	2.16/55	35	11.5/5.2
	600	8.5/216	8.5/216	.88/22	1.0/25	2.44/62	4.4/112	6.75/172	2.16/55	35	13.8/6.2
	900/1500	10.0/254	10.0/254	.88/22	1.0/25	2.94/75	4.4/112	6.75/172	2.16/55	35	23.0/10.4
	2500	12.12/308	12.12/308	.88/22	1.0/25	3.13/79	6.2/158	8.12/206	2.16/55	35	32.0/14.5
2 /50.8	150	7.0/178	7.5/191	1.5/38	2.0/51	3.0/76	5.62/143	11.0/279	3.52/89	100	27.0/12.2
	300	8.5/216	9.12/232	1.5/38	2.0/51	3.25/83	5.62/143	11.0/279	3.52/89	100	32.0/14.5
	600	11.5/292	11.62/295	1.5/38	2.0/51	3.25/83	5.62/143	11.0/279	3.52/89	100	38.0/17.2
	900/1500	14.5/368	14.62/371	1.5/38	2.0/51	4.25/108	5.62/143	11.0/279	3.52/89	100	72.0/32.6
	2500	17.75/451	17.87/454	1.5/38	2.0/51	4.62/118	5.62/143	11.0/279	3.52/89	100	107.5/48.7
3 /76.2	150	8.0/203	8.5/216	2.0/51	3.0/76	3.75/95	6.96/177	11.88/302	4.83/123	420	50.0/22.6
	300	11.12/282	11.75/299	2.0/51	3.0/76	4.12/105	6.96/177	11.88/302	4.83/123	420	63.2/28.6
	600	14.0/356	14.12/359	2.0/51	3.0/76	4.12/105	6.96/177	11.88/302	4.83/123	420	76.0/34.4
	900	15.0/381	15.12/384	2.0/51	3.0/76	4.75/121	6.96/177	11.88/302	4.83/123	420	97.0/43.9
	1500	18.5/470	18.62/473	2.0/51	3.0/76	5.25/133	6.96/177	11.88/302	4.83/123	420	134.0/60.7
	2500	22.75/578	23.00/584	2.0/51	3.0/76	6.0/152	7.77/197	23.89/607	4.83/123	420	223.0/101.1
4 /101.6	150	9.0/229	9.5/241	3.0/76	4.0/102	4.5/114	8.26/210	23.89/607	5.37/137	770	72.5/32.8
	300	12.0/305	12.63/321	3.0/76	4.0/102	5.0/127	8.26/210	23.89/607	5.37/137	770	99.0/44.9

NOTE: " A " dimension to be within ± 0.062"/1.5 mm.



FLOATING BALL VALVE

THREADED
3" FULL PORT
4" REDUCED PORT



DIMENSIONS

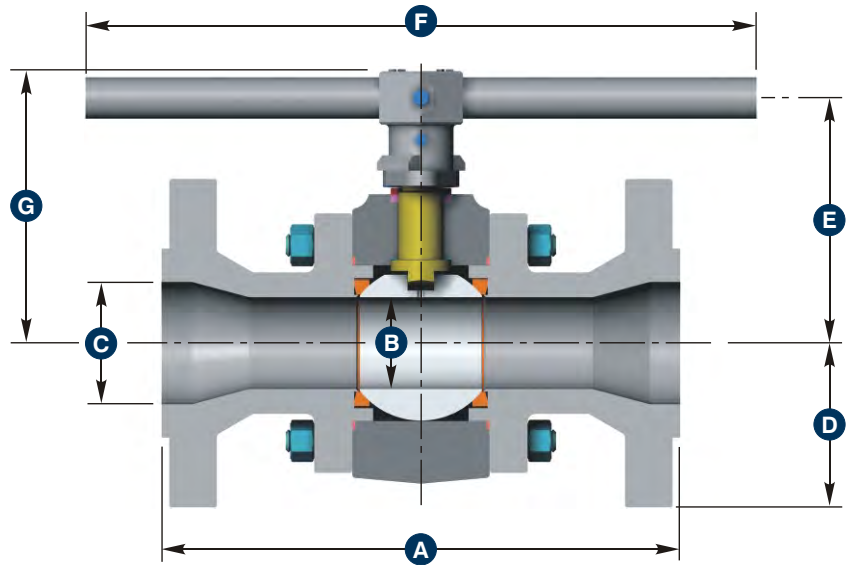
SIZE in/mm	WOG	A	B	C	D	E	F	G	C _v	WEIGHT lb/kg
3 FP / 76.2	2000	10.0/254	3.0/76	3.0/76	4.45/113	7.55/192	11.0/279	7.55/192	1300	131.0/59.4
	4000	10.0/254	3.0/76	3.0/76	4.45/113	7.55/192	11.0/279	7.55/192	1300	131.0/59.4
4 RP / 101.6	2000	12.0/305	3.0/76	4.0/102	4.45/113	7.55/192	11.0/279	7.55/192	770	145.0/65.7

NOTE: "A" dimension to be within ± 0.062 "/1.5 mm.



FLOATING BALL VALVE

FLANGED
3" FULL PORT
4" REDUCED PORT



DIMENSIONS

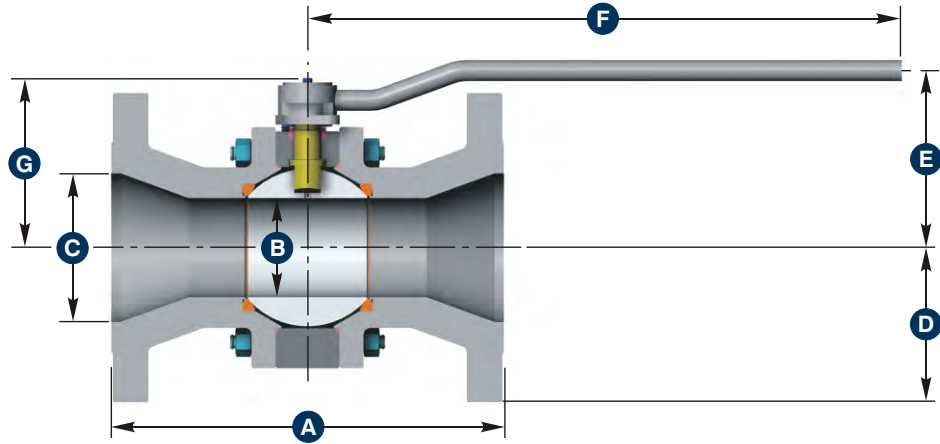
SIZE in/mm	ASME CLASS	RF	A RTJ	B	C	D	E	F	G	C _v	WEIGHT lb/kg
3 FP / 76.2	600	14.0/356	14.12/359	3.0/76	3.0/76	4.12/105	7.55/192	11.0/279	7.55/192	1300	161.0/73.0
	900	15.0/381	15.12/384	3.0/76	3.0/76	4.75/121	7.55/192	11.0/279	7.55/192	1300	191.0/86.6
	1500	18.5/470	18.62/473	3.0/76	3.0/76	5.25/133	7.55/192	11.0/279	7.55/192	1300	239.0/108.4
4 RP / 101.6	600	17.0/432	17.12/435	3.0/76	4.0/102	5.37/136	7.55/192	11.0/279	7.55/192	770	211.0/95.7
	900	18.0/457	18.12/460	3.0/76	4.0/102	5.75/146	7.55/192	11.0/279	7.55/192	770	242.0/109.7
	1500	21.5/546	21.62/549	3.0/76	4.0/102	6.12/155	7.55/192	11.0/279	7.55/192	770	292.0/132.4

NOTE: "A" dimension to be within ± 0.062 "/1.5 mm.



FLOATING BALL VALVE

**FLANGED
4" FULL PORT
6" REDUCED PORT**



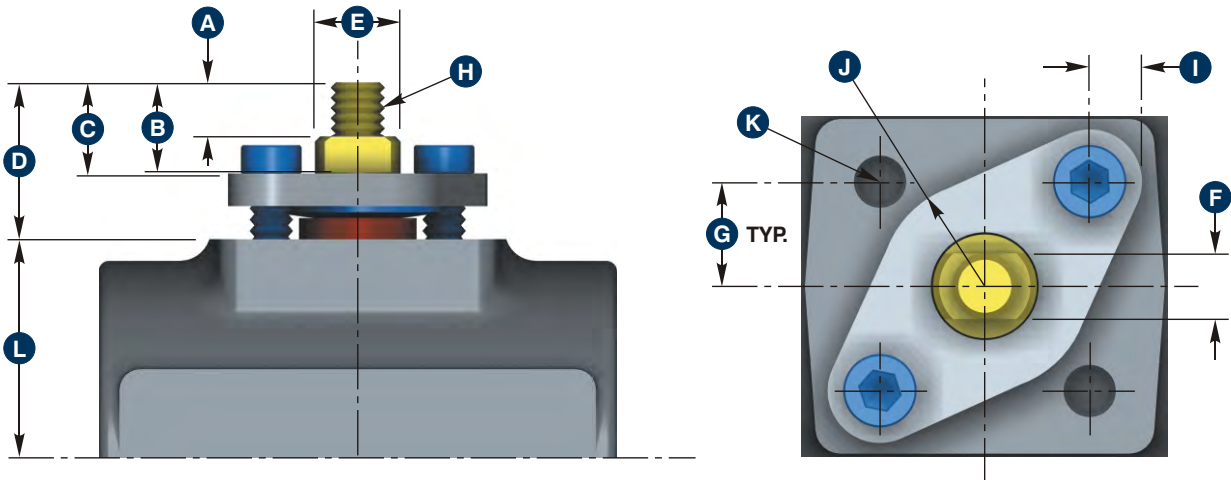
DIMENSIONS

SIZE in/mm	ASME CLASS	A	B	C	D	E	F	G	C _v	WEIGHT lb/kg
4 FP / 101.6	150	9.00/229	4.00/102	4.00/102	4.88/124	7.60/193	24.00/610	6.65/169	2300	101.0/45.8
	300	12.00/305	4.00/102	4.00/102	5.00/127	7.60/193	24.00/610	6.65/169	2300	143.0/64.8
6 RP / 152.4	150	10.5/267	4.00/102	6.00/152	5.50/140	7.60/193	24.00/610	6.65/169	1800	128.0/58.0
	300	15.88/403	4.00/102	6.00/152	6.25/160	7.60/193	24.00/610	6.65/169	1800	143.0/64.8

ACTUATOR MOUNTING DIMENSIONS



ACTUATOR MOUNTING DIMENSIONS



DIMENSIONS

SIZE inches	A	B	C	D	E	F	G	H	I	J	K	L
1/4 FP	.300	.440	.500	.725	.464	.253	.468	.250-20 UNC	.23	.50	#10-32 UNF-2B X .31DP	1.002
3/8 FP	.300	.440	.500	.725	.464	.253	.468	.250-20 UNC	.23	.50	#10-32 UNF-2B X .31DP	1.002
1/2 FP / 3/4 RP	.300	.440	.500	.725	.464	.253	.468	.250-20 UNC	.23	.50	#10-32 UNF-2B X .31DP	1.002
3/4 FP / 1 RP	.312	.515	.560	.905	.496	.314	.498	.312-18 UNC	.25	.50	.25-28 UNF-2B X .30DP	1.250
1 1/2 FP / 2 RP	.475	.826	.900	1.270	.811	.441	.737	.438-14 UNC	.40	.75	.312-24 UNF-2B X .437 DP	2.250
*2 FP / 3 RP	.690	1.180	1.225	1.821	1.000	.628	.875	.625-11 UNC	.41	1.00	.375-24 UNF-2B X .50 DP	3.000
3 FP / 4 RP	.690	1.180	1.225	1.821	1.000	.628	.875	.625-11 UNC	.41	1.00	.375-24 UNF-2B X .50 DP	3.500

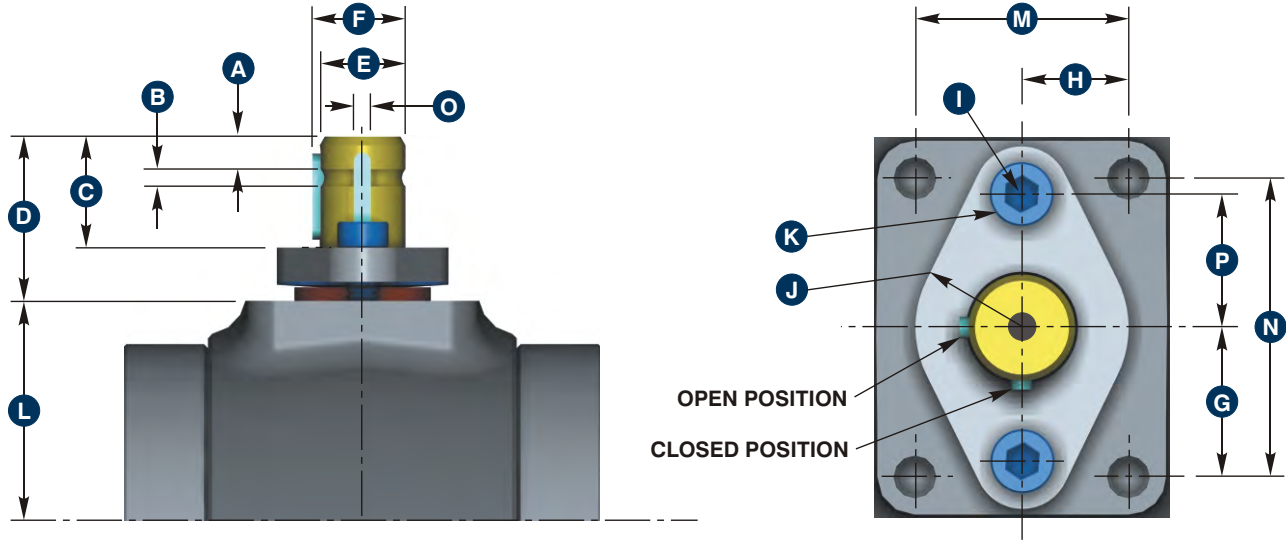
* Also Applies to B3 2" full port valve 600, 900, 1500.



ACTUATOR MOUNTING DIMENSIONS*

3" FULL PORT

4" REDUCED PORT



DIMENSIONS

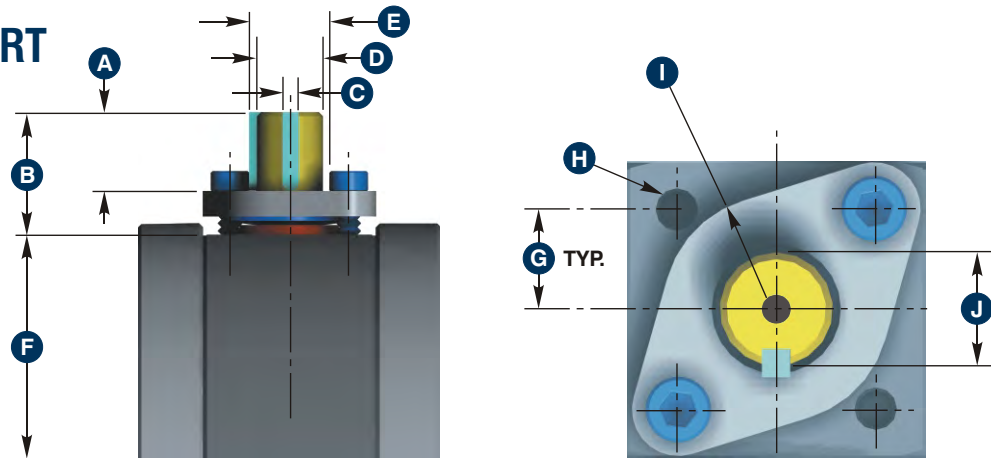
SIZE inches	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
3 FP / 4 RP (ASME 600-1500, WOG 2000-4000)	.475	.250	1.640	2.395	1.248	1.362	1.750	1.250	.56R	1.25R	.500-13UNC-2B X .62 DP	4.875	2.500	3.500	.250	1.566



ACTUATOR MOUNTING DIMENSIONS

4" FULL PORT

6" REDUCED PORT



DIMENSIONS

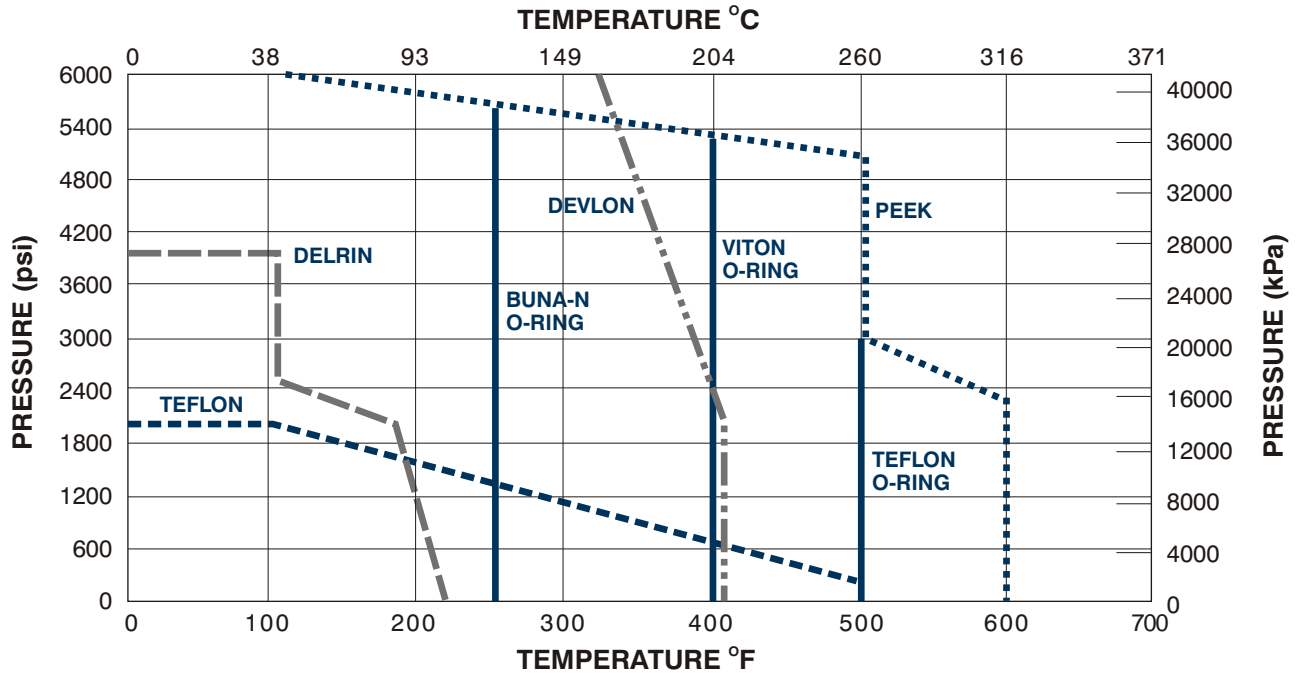
SIZE inches	A	B	C	D	E	F	G	H	I	J
4 FP / 6 RP (ASME 150 / 300)	1.255	1.85	0.25	1.00R	1.11	4.688	0.877	.375-24 UNF-2BX0.50 DEEP	1.00	1.00

* For B3 2" full port valve mounting dimensions see footnote on page 25.



FLOATING BALL VALVE

PRESSURE/TEMPERATURE RATINGS (SEATS AND SEALS)*



* Consult ASME B16.34 for Body and Adapter Material Pressure/Temperature Ratings.

BREAKAWAY TORQUE DATA

Torque = inch-pounds

ASME CLASS Pressure (psi)		0	150	300	600	900	1500	2500					
		0	285	740	1000	1480	2000	2220	3000	3705	4000	5000	6000
Bore Size	Seat Material												
1/2"	Peek	72	84	96	108	120	132	144	156	180	192	216	240
	Devlon	72	84	96	108	120	132	144	156	180	192	216	240
	Delrin	60	72	84	96	108	120	132	144	168	180	-	-
	Teflon	60	72	84	96	108	120	-	-	-	-	-	-
7/8"	Peek	276	276	276	276	276	300	324	360	420	444	540	660
	Devlon	96	108	120	132	144	156	168	180	192	204	240	300
	Delrin	96	108	120	132	144	156	168	180	192	204	-	-
	Teflon	96	108	120	132	144	156	-	-	-	-	-	-
1 1/2"	Peek	600	648	696	744	792	840	864	936	1020	1080	1200	1500
	Devlon	360	420	480	576	660	720	792	900	960	1020	1080	1260
	Delrin	336	396	480	576	660	720	792	900	960	1020	-	-
	Teflon	336	360	396	420	456	504	-	-	-	-	-	-
2"	Peek	840	1080	1440	1680	1920	2100	2280	2700	3120	3300	3600	4200
	Devlon	600	720	900	1080	1200	1500	1680	1920	2160	2400	2400	2880
	Delrin	600	720	900	1080	1320	1560	1740	2040	2280	2520	-	-
	Teflon	600	636	816	936	1128	1344	-	-	-	-	-	-
3"	Peek	960	1440	2760	3840	4800	5760	6480	7200	8400	9000	-	-
	Devlon	720	1200	1920	2400	2880	3360	3600	4080	4800	5760	-	-
	Delrin	840	1380	2280	2640	3000	3600	3900	4200	4800	5760	-	-
	Teflon	720	1320	1920	2400	2880	3600	-	-	-	-	-	-
4"	Peek	1440	2400	3840	-	-	-	-	-	-	-	-	-
	Devlon	1200	2040	3120	-	-	-	-	-	-	-	-	-
	Teflon	1080	1944	2820	-	-	-	-	-	-	-	-	-

Torque values shown are to be used as a guide for actuator selection. All above torque values are based upon clean liquid service. Additional factors such as media characteristics, number of cycles and temperature may require an additional safety factor. Please contact the actuator supplier/manufacturer for these factors.

ADDITIONAL PRODUCTS



MARKETING AND DISTRIBUTION

CANADA

Email: sales@nutron.ca

Sales Office/Order Desk/Warehouse:

Edmonton, Alberta.

Phone: (780) 469-2557 Fax: (780) 440-1354

Sales Offices:

Calgary, Alberta.

Phone: (403) 294-9510 Fax: (403) 294-9556

Grande Prairie, Alberta.

Phone: (780) 513-7427 Fax: (780) 513-7461

Halifax, Nova Scotia.

Phone: (902) 461-7722 Fax: (902) 461-8196

USA

Email: us.sales@nutron.ca

Sales Office/Order Desk/Warehouse:

Houston, Texas.

Phone: (713) 681-8696 Fax: (713) 681-7703

International Marketing Department:

Houston, Texas.

Phone: (713) 626-7310 Fax: (713) 552-1731

Sales Office/Order Desk/Warehouse:

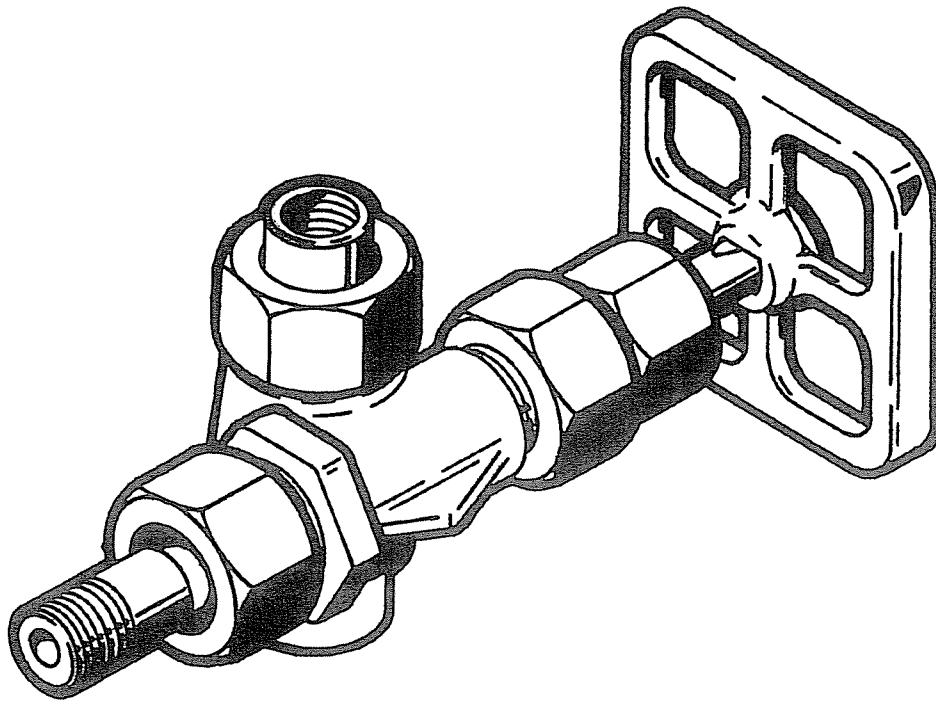
Oklahoma City, Oklahoma.

Phone: (405) 631-9444 Fax: (405) 631-9454

PENBERTHY®

Armored Gagecocks

Series 100, 200, 300 and 400



Installation, Operation and Maintenance Instructions

TABLE OF CONTENTS

Product Warranty	. . . . .	iii
1.0 About the Manual	. . . . .	1
2.0 Introduction	. . . . .	1
2.1 System Description	. . . . .	2
3.0 Available Models	. . . . .	2,3
3.1 Design Ratings at Max. and Min. Operating Temperatures	. . . . .	3
3.2 Steam Application	. . . . .	3
4.0 Inspection	. . . . .	4
4.1 User Rating Inspection	. . . . .	4
5.0 Installation	. . . . .	4
5.1 Piping Strain	. . . . .	4
5.2 Differential Thermal Expansion	. . . . .	4
5.3 Mounting	. . . . .	5
6.0 Operation	. . . . .	5
6.1 Hydrostatic Test	. . . . .	5
7.0 Maintenance	. . . . .	6
7.1 Preventative Maintenance	. . . . .	6
7.2 Ball Check Shut-Off	. . . . .	6,7
7.3 Troubleshooting	. . . . .	7
8.0 Removal - Disassembly and Reassembly	. . . . .	8
8.1 Disassembly	. . . . .	8
8.2 Reassembly	. . . . .	8
9.0 Disposal at End of Useful Life	. . . . .	8
10.0 Telephone Assistance	. . . . .	9
11.0 Exploded Parts Drawing	. . . . .	10

TABLES AND FIGURES		page
Table 1	Armored Gagecock Standard Features	2
Table 2	Armored Gagecock Standard Features	3
Table 3	Design Ratings for Threaded or Welded Connections	3
Figure 1	Teflon [®] Tape Wrapping	5
Figure 2	Exploded Parts Drawing	10
Figure 3	Optional Gasket Union Connection	10

PENBERTHY PRODUCT WARRANTY

Tyco Valves & Controls Prophetstown warrants its Penberthy products as designed and manufactured by TV&C Prophetstown to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. TV&C Prophetstown will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to TV&C Prophetstown and obtain written authorization to return the product. Thereafter, the product shall be returned to TV&C in Prophetstown, Illinois, with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of TV&C Prophetstown factory, or if it has been subject to misuse, neglect or accident.

The responsibility of TV&C Prophetstown hereunder is limited to repairing or replacing the product at its expense. TV&C Prophetstown shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that TV&C Prophetstown is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

THIS IS TV&C PROPHETSTOWN'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of TV&C Prophetstown unless made in writing and signed by the General Manager or Director of Engineering of TV&C Prophetstown.

INSTALLATION, OPERATION and MAINTENANCE MANUAL FOR PENBERTHY SERIES 100, 200, 300 and 400 GAGECOCKS

1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance.

SAFETY INSTRUCTIONS

Penberthy does not have any control over the manner in which its gagecocks are handled, installed or used. Penberthy cannot and will not guarantee that a gagecock is suitable or compatible for the user's specific application.



WARNING

Vessel fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a gagecock. Failure to follow *any* instruction could possibly result in a malfunction of the gagecock with resulting sudden release of pressure, severe physical injury or property damage.

2.0 Introduction

Penberthy armored gagecocks are used to isolate gage glass, magnetic gages or other apparatus from the holding or pressure vessel when it becomes necessary to drain and service the gage. Penberthy Series 100, 200, 300 and 400 gagecocks are supplied in pairs, (upper and lower), and are available with socketweld, flanged and NPT connections.

These gagecocks are equipped, as a standard feature, with a floating shank union vessel connection, which permits up to 3/8" (10 mm) variation in center to center distance and with ball check shut-offs to prevent leakage of contained fluid in case of accidental gage glass breakage.

Series 100, 200, 300 and 400 gagecocks for process use should include ball check shut-off feature. Gagecocks without the ball check shut-off feature will not automatically stop leakage of contained fluid in the event of accidental gage glass breakage.

2.1 System Description

Penberthy armored gagecocks are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gagecock. Use the exploded parts view in Section 11.0 as additional reference material.

Body- a pressure retaining structure through which liquid passes to enter a gage glass or other apparatus. Provides a rigid, union, or spherical union connection to the vessel and seating surfaces for most gagecock components. Series 100 and 200 are straight pattern bodies; Series 300 and 400 are offset pattern bodies.

Ball Checks- sphere installed loosely within the body of the gagecock that seats to prevent significant leakage when a differential pressure surge occurs (e.g., mechanical failure). Ball checks for ASME steam service incorporate a vertically rising lower and leaky horizontal upper or omit ball checks completely. "Reverse acting" ball checks are available for vacuum service.

Trim- wetted parts that mechanically control the liquid path from the vessel to the gage glass or other apparatus. The ball and stem act to seal and release the liquid. In the event of mechanical failure, the ball will seat to prevent large quantities of the contained fluid from exiting the vessel. Liquid is allowed to exit the vessel into the gage glass or other apparatus when the stem is screwed away from its seated position. The liquid is sealed when the stem is screwed into its seated position.

The stem packing retainer provides a compression surface between the process liquid and the stem packing. A stem packing gland is used to compress the packing against the retainer and around the stem to prevent leakage.

Stem Packing- under compression the stem packing is forced to mold around the stem and prevent leakage of media during operation.

Gage Connection- provides connection between the gagecock and the gage glass or other apparatus. A union, spherical union or rigid connection may be used. A union connection can move in a plane parallel to the vessel connection.

Handwheel/Lever- rotated to engage threads and provide screw action of stem.

3.0 Available Models

Armored gagecock standard features are listed in chart below.

Features	Model Number							
	120	130	220	230	320	330	420	430
Straight Pattern	x	x	x	x				
Offset Pattern					x	x	x	x
Integral Bonnet	x	x			x	x		
Union Bonnet			x	x			x	x
Union Gage Connection	x		x		x		x	
Rigid Gage Connection		x		x		x		x
Union Vessel Connection	x	x	x	x	x	x	x	x
Screwed in Seat			x	x			x	x

Table 1

Additional gagecock models are available with gasketed union connections. The gaskets are a spiral wound style, stainless steel/graphite, which are inserted into the body at the union connection to provide a gasketed seal between the body and tailpipe as opposed to the standard metal-to-metal joint. These gaskets provide a seal even with small angular misalignments and with less closure force than the standard metal-to-metal seals.

Features	Model Number															
	121	122	123	131	221	222	223	231	321	322	323	331	421	422	423	431
Straight Pattern	x	x	x	x	x	x	x	x								
Offset Pattern									x	x	x	x	x	x	x	x
Integral Bonnet	x	x	x	x					x	x	x	x				
Union Bonnet					x	x	x	x					x	x	x	x
Metal Union Gage Connection	x				x				x				x			
Rigid Gage Connection				x				x				x				x
Metal Union Vessel Connection		x				x				x				x		
Screwed in Seat					x	x	x	x					x	x	x	x
Gasket Union Gage Connection		x	x			x	x			x	x			x	x	
Gasket Union Vessel Connection	x		x	x	x		x	x	x		x	x	x		x	x

Table 2

3.1 Design Ratings at Maximum and Minimum Operating Temperatures

To determine the maximum allowable working pressure for a specific temperature within the design limits stated below, the user must refer to Penberthy Application Reports, or when provided, the specifically stated design limits on a Penberthy product proposal.

DESIGN RATINGS FOR THREADED OR WELDED CONNECTIONS

Gagecock Series	Material of Construction	Maximum Allowable Working Pressure	
		Teflon [®] packing	Grafoil [®] packing
100 200 300 400	Carbon Steel	4000 psig [27580 kPa] at -20°F [-29°C] to +100°F [38°C] 3525 psig [24300 kPa] at 500°F [260°C]	4000 psig [27580 kPa] at -20°F [-29°C] to +100°F [38°C] 2620 psig [18060 kPa] at 750°F [399°C]
	316 STS Construction	4000 psig [27580 kPa] at -300°F [-184°C] to +100°F [38°C] 3525 psig [24300 kPa] at 500°F [260°C]	4000 psig [27580 kPa] at -300°F [-184°C] to +100°F [38°C] 2755 psig [18990 kPa] at 750°F [399°C]

For other materials or connections consult factory

Table 3



NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gagecock components resulting in serious personal injury or property damage.

3.2 Steam Application

Penberthy series 100, 200, 300 and 400 gagecocks are designed for process conditions. In low pressure steam/water applications (≤ 350 psig [2410 kPa] at 434°F [223°C]), Penberthy allows the use of 300 and 400 series gagecocks because the potential mechanical stress imposed on the gagecock assembly by the thermodynamic steam environment is relatively small. Request Penberthy Application Reports for more detailed information.

4.0 Inspection

Upon receipt of a gagecock set, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt any installation. Notify carrier immediately and request damage inspection. Refer to exploded view drawing in Section 11.0 to inventory parts.

4.1 User Rating Inspection

The user should confirm that:

1. The gagecock set model number and pressure/temperature rating stamped on nameplate conforms to the description on the user's purchase order
2. The operating conditions described in the purchase order agree with the actual operating conditions at the installation site
3. The actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to previously
4. The materials of construction of the gagecock set are compatible with both the contained fluid and the surrounding atmosphere in the specific application.

SAFETY INSTRUCTIONS

If the size, model or performance data of the gagecock set as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gagecock can result in unacceptable performance and potential damage to the gage.

5.0 Installation

Installation should only be undertaken by qualified personnel who are familiar with this equipment. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for specific size and model gagecock.

Penberthy recommendations on gagecock installations are not necessarily related to the installation of flat glass liquid level gages. The number of different types of gage and gagecock installations is too great to adequately explain in an installation manual. Therefore, it is the user's responsibility to assure that knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the guidelines that should be employed.

5.1 Piping Strain

The gagecock should be mounted and connected so that it can support the gage without binding. Torsional stresses can make it difficult or impossible to seal tailpipes. Although union connections will allow marginal errors in piping alignment, misalignment can still create unusual strain on connectors. Gages not properly supported by brackets may subject the gagecock to stresses that can cause leaks or mechanical failure. Typical gage load should NOT exceed 50 lbs (22.7kg) per gagecock.

5.2 Differential Thermal Expansion

High mechanical loading may be imposed on a gagecock by expanding and contracting gages due to hot or cold service. Such mechanical loads on the gagecock must be minimized by controlling process conditions in the system or by using expansion loops.

5.3 Mounting

1. Prior to installation, turn the handwheel of each gagecock clockwise until the stem closes against the seat.
2. Remove union vessel connections from gagecocks, where applicable, and apply heavy grease (where allowable) to tailpipe seat. (The grease minimizes galling of the seat surfaces when tightening the coupling nuts.)
3. Wrench tighten tailpipes of upper and lower gagecocks to the vessel using Teflon[®] tape, or equivalent, on all male tapered pipe thread connections as shown in Figure 1. If the gagecock is flanged or weld mount, use proper industry standard procedures.
4. If installing with a flat glass gage, follow all installation instructions for the specific liquid level gage as there are many points to consider on gage installation; among them, piping strain, differential thermal expansion, weight and bolt torque.
5. Install gage tailpipes to union gage connections, where applicable, making sure that the coupling nuts are in place.

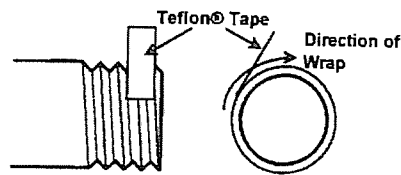


Figure 1

6.0 Operation

Before initializing gagecock operation, check that all installation procedures have been completed. Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight.

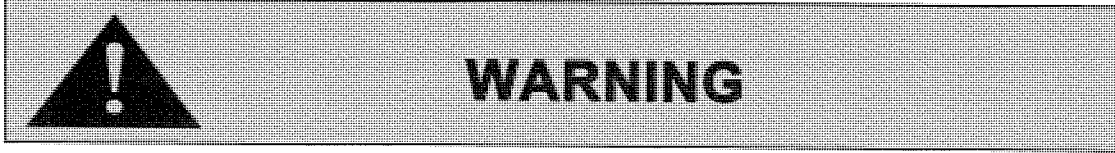


Gagecock installations should be brought into service slowly. Gagecocks should be opened slightly, and the gagecock assembly temperature and pressure allowed to slowly equalize. If the gagecocks are equipped with ball checks, the gagecocks must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball check in the event of gage glass failure. Failure to follow the recommended operating procedures can result in severe personal injury or property damage.

6.1 Hydrostatic Test

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatic pressure test all installations to 100 psig (690 kPa) and correct any leakage before proceeding.

7.0 Maintenance



Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

The user must create maintenance schedules, safety manuals and inspection details for each gagecock. These will be based upon the users own operating experience with their specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved.

During system shutdown, the gagecocks should be left open to permit the gage to lose pressure and cool with the rest of the system. Failure to leave the gagecock open during system shutdown may trap high-pressure fluid in the gage.

7.1 Preventative Maintenance

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

1. Leakage around stem area
2. Internal stem leak
3. Leakage around union connections
4. Internal or external corrosion

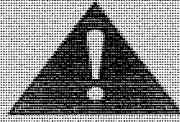
The user must determine, upon evaluation of his or her own operating experience, an appropriate maintenance schedule necessary for his or her own specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

7.2 Ball Check Shut-Off



Ball checks, when installed, may fail to seat due to corrosion of the ball or seat, foreign material in ball chamber or viscous material in the ball chamber. A routine operational test of the ball check can prevent significant seepage of liquid in the event of glass breakage.

An operational check can be performed on the gagecock ball check by closing both the upper and lower gagecock stems completely. Drain contents from and relieve pressure on liquid gage to an appropriate safe container/area. **NOTE:** Some loss of process fluid to the drain line is expected with this test procedure.



WARNING

Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

With drain line in place, open **BOTTOM** gagecock as rapidly as possible. Listen for "click" sound, which will indicate that the ball has seated. If possible, observe the quantity of flow from the drain line. Flow should either stop completely or be no greater than single drips (no solid stream). Close lower gagecock. Repeat above procedure for **UPPER** gagecock. There must be a pressure differential of at least 5 psig (35 kPa) for the above procedure to work properly.

If the above procedure is not successful, the only alternative is to isolate the gage and gagecock assembly from the vessel or to shut the process down completely. Disassemble the gagecock as outlined in section 8.1 using the exploded parts drawing in Section 11.0 as a reference. Visibly inspect ball check and ball seats in the gagecock body. Remove any foreign matter and/or replace with new ball checks if inspection indicates this is required. If the ball seat is damaged, consider replacing the gagecock or the seat (if it is removable). Reassemble gagecocks as outlined in Section 8.2.

7.3 Troubleshooting

STEM PACKING LEAKAGE can often be stopped by tightening the stem packing nut. If leak persists, the stem packing should be replaced by following steps 1) through 5) of the Disassembly and 1) through 7) of the Reassembly instructions

INTERNAL SEAT LEAKAGE is an indication of a worn or damaged stem or seat. To replace the stem follow steps 1) through 5) of the Disassembly and 1) through 7) of the Reassembly instructions. To renew the seat surface, follow steps 1) and 2) of the Disassembly instructions. Renew the seats by using a fine lapping compound and a mandrel the same size, shape and seat angle as the stem. Flush the gagecock body clean and reassemble by following steps 4) and 5) of the Reassembly instructions.

Renewable Threaded Seats (Series 200 and 400). Remove the seat by inserting a 1/4" (6 mm) square driver in the seat and turning it counterclockwise. Install the new seat by turning it clockwise using the square driver, making sure that the ball check, if used, is replaced in the body. Tighten the seat in place.

LEAKAGE AROUND UNION connections can often be stopped by tightening union coupling nut or remake connection using Teflon[®] tape, or equivalent on all male pipe threads as shown in Figure 1.

INTERNAL OR EXTERNAL CORROSION could be an indication of a misapplication. An investigation should immediately be carried out to determine the cause of the problem. It is the user's responsibility to choose a material of construction compatible with both the contained fluid and the surrounding atmosphere.

8.0 Removal - Disassembly - Reassembly



Use only qualified experienced personnel who are familiar with gagecock equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the gagecock assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

8.1 Disassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the gagecocks.

- 1) Remove handwheel nut (30), nameplate (163) and handwheel (28) or lever (261) from stem.
- 2) Loosen and remove stem packing nut (26)
- 3) Remove stem by turning counterclockwise, along with stem packing gland (19), stem packing (25) and stem packing retainer (18).
- 4) Slip the stem packing gland (19), stem packing (25) and stem packing retainer (18) off stem (17).
- 5) On Series 200 and 400 gagecocks, remove bonnet nut (21) and bonnet (20).
- 6) To replace seat on Series 200 and 400 gagecocks, follow instructions as described in maintenance procedures, section 7.3.

8.2 Reassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the gagecocks.

- 1) Prepare for installation of new packing by cleaning all packing chambers and glands of upper and lower gagecocks.
- 2) On Series 200 and 400 gagecocks, replace bonnet (20) and bonnet nut (21) and tighten securely in place.
- 3) Slip packing retainer (18) on stem (17)
- 4) Install new stem packing (25) and stem packing gland (19)
- 5) Thread stem assembly into gagecock by turning clockwise until stem seats and then back off one turn (1/8 turn with quick close stem)
- 6) Assemble stem packing nut (26) and tighten in place
- 7) Assemble handwheel (28) or lever (261), nameplate (163) and handwheel nut (30) on stem and tighten securely in place.
- 8) Close both gagecocks by turning handwheel or lever clockwise until stem seats.

Refer to Section 6.0 for operation of the gagecock when returned to service.

9.0 Disposal at End of Useful Life

Penberthy Series 100, 200, 300 and 400 gagecocks are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the Series 100, 200, 300 and 400 gagecocks must incur before their disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and TV&C - Prophetstown Material Specification sheets for materials of construction.

10.0 Telephone Assistance

If you are having difficulty with your Penberthy Series 100, 200, 300 and 400 gagecocks, contact your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model #
- Name of the company from whom you purchased the Penberthy Series 100, 200, 300 and 400 gagecocks
- Invoice # and date
- Process conditions (pressure, flow rates, tank shape, etc)
- A brief description of the problem
- Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your Penberthy Series 100, 200, 300 and 400 gagecocks to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from TV&C Prophetstown before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- "Ship To" address

There is a minimum charge for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but is not defective, the minimum charge will apply.

Teflon[®] is a registered trademark of E. I. duPont de Nemours and Company
Grafoil[®] is a registered trademark of Graftech, Inc.

11.0 Exploded Parts Drawing

SPARE PARTS

Ref. No.	Item	Min. Qty.
18	Retainer, Stem Packing	1
19	Gland, Stem Packing	1
25	Packing, Stem	1
30	Nut, Handwheel	1

RECOMMENDED MAXIMUM QUANTITIES SHOULD PROVIDE SPARE PARTS FOR 10% OF THE GAGECOCKS IN SERVICE

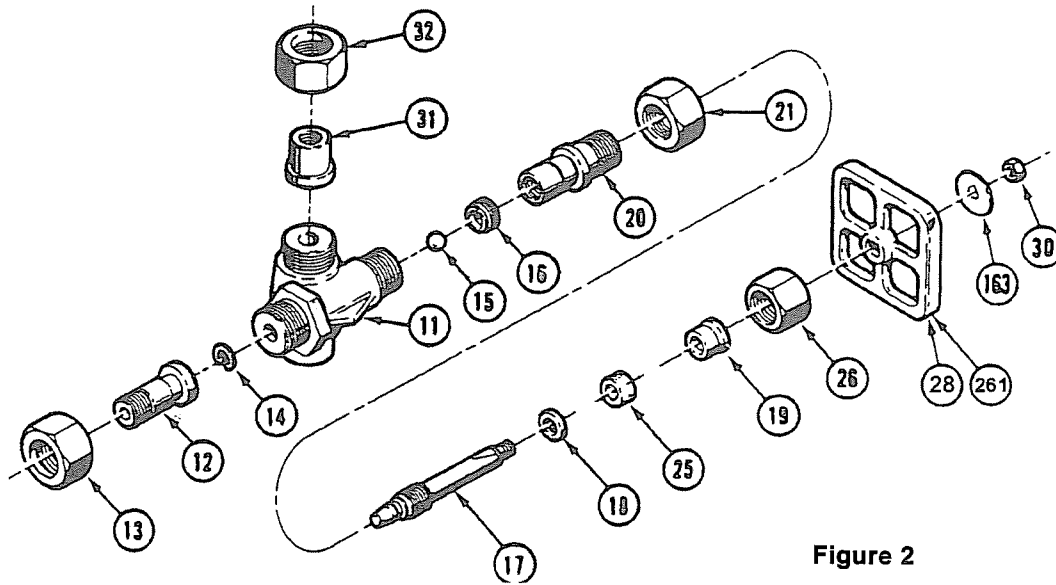


Figure 2

- 7 Gasket
- 11 Body
- 12 Tailpipe
- 13 Nut, Vessel Coupling
- 14 Retainer, Ball Check
- 15 Ball
- 16 Seat
- 17 Stem
- 18 Retainer, Stem Packing
- 19 Gland, Stem Packing
- 20 Bonnet
- 21 Nut, Bonnet
- 25 Packing, Stem
- 26 Nut, Stem Packing
- 28 Handwheel
- 30 Nut, Handwheel
- 31 Tailpipe, Gage
- 32 Nut, Gage Coupling
- 163 Nameplate
- 261 Lever

Note: Seat (16), Bonnet (20) and Nut (21) are to be used on Series 200 and 400 gagecocks only.

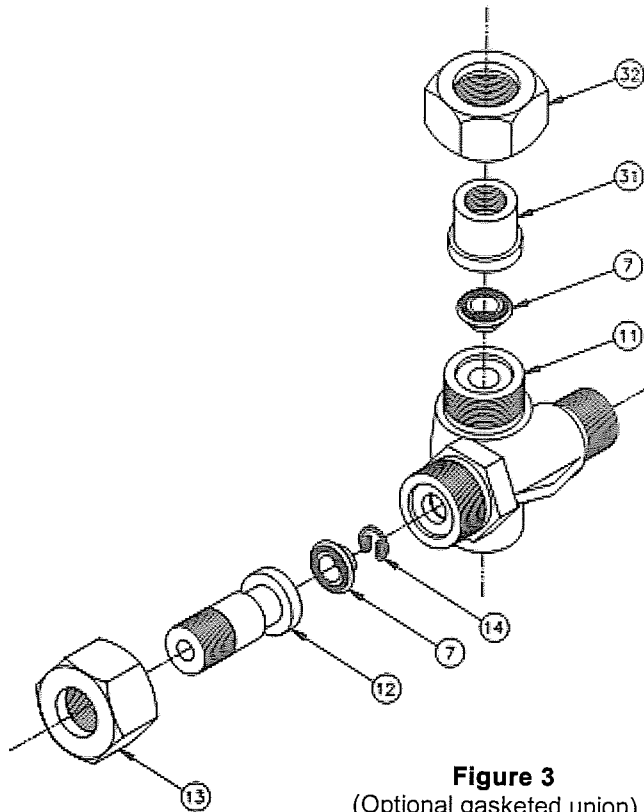


Figure 3
(Optional gasketed union)

NOTES

NOTES

tyco / Flow Control / **Tyco Valves
& Controls**
Penberthy

Tyco Valves & Controls, L.P. Prophetstown
320 Locust St., Prophetstown, Illinois 61277
Phone: 815-537-2311
FAX: 815-537-5764
Printed in USA
Part No. 14912-009

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MPI 24VDC Generator

This high output unit provides 24 VDC power to operate most engine control systems. In remote applications, the generator will provide power for engine ignition systems, electronic governors, control panels, communication systems, and intermittent plant lighting. The unit is belt driven from the engine drive pulley and is provided with a standard mounting bracket and tension adjustment. The unit provides designed output at a speed range of between 2000 and 3600 RPM.



- ⊕ Class I Div 2 Groups C&D
- ⊕ 50 Amps Usable Output
- ⊕ Regulated 24 VDC

Custom Designed Battery Box

PIC has designed a custom battery box, for use with the Holley Generator, to meet the rigors of our climate and environment. Four 6 VDC deep cycle batteries provide exceptional characteristics for output and recharging. The battery box comes complete with stand, handles, vent, and 45' of tech cable to complete the installation of the generator to plant equipment. The optional undervoltage shutdown includes a bypass timer for startup use and complete gas detection equipment interface.



- ⊕ 200 Amp-Hr of 24 VDC Power
- ⊕ Fused Inputs and Outputs
- ⊕ Optional Undervoltage Shutdown and Gas Detection Interface

“Engine and Compressor Control Specialists”

305 - 27 Street SE
Calgary, AB
(403) 207-0700

9604 - 41 Avenue
Edmonton, AB
(780) 436-9047

11419 - 98 Avenue
Grande Prairie, AB
(780) 539-1161

10919 Alaska Road
Fort St. John, B.C.
(250) 785-0285

104, 19329 Enterprise Way
Surrey, B.C.
(604) 596-7344

498 Henderson Drive
Regina, SK
(306) 721-6925

206B, 2750 Faithful Ave
Saskatoon, SK
(306) 934-3484

MPI 24VDC Generator

This high output unit provides 24 VDC power to operate most engine control systems. In remote applications, the generator will provide power for engine ignition systems, electronic governors, control panels, communication systems, and intermittent plant lighting. The unit is belt driven from the engine drive pulley and is provided with a standard mounting bracket and tension adjustment. The unit provides designed output at a speed range of between 2000 and 3600 RPM.



- ⊕ Class I Div 2 Groups C&D
- ⊕ 50 Amps Usable Output
- ⊕ Regulated 24 VDC

Division 2 Battery Box

PIC has designed a Class 1 Div 2 battery box for use with the MPI Generator to meet the rigors of our climate and environment. Two 12 VDC flooded deep cycle batteries provide exceptional characteristics for output and recharging. The battery box comes complete with enclosure, batteries, vent, and fuses necessary to complete the installation of the generator to plant equipment. The optional undervoltage shutdown includes a pushbutton bypass for startup.



- ⊕ 100 Amp-Hr of 24 VDC Power
- ⊕ Fused Inputs and Outputs
- ⊕ Optional Undervoltage Shutdown
- ⊕ Approved for Div 2
- ⊕ Optional Gas Detection Shutdown



“Engine and Compressor Control Specialists”

305 - 27 Street SE
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11419 - 98 Avenue
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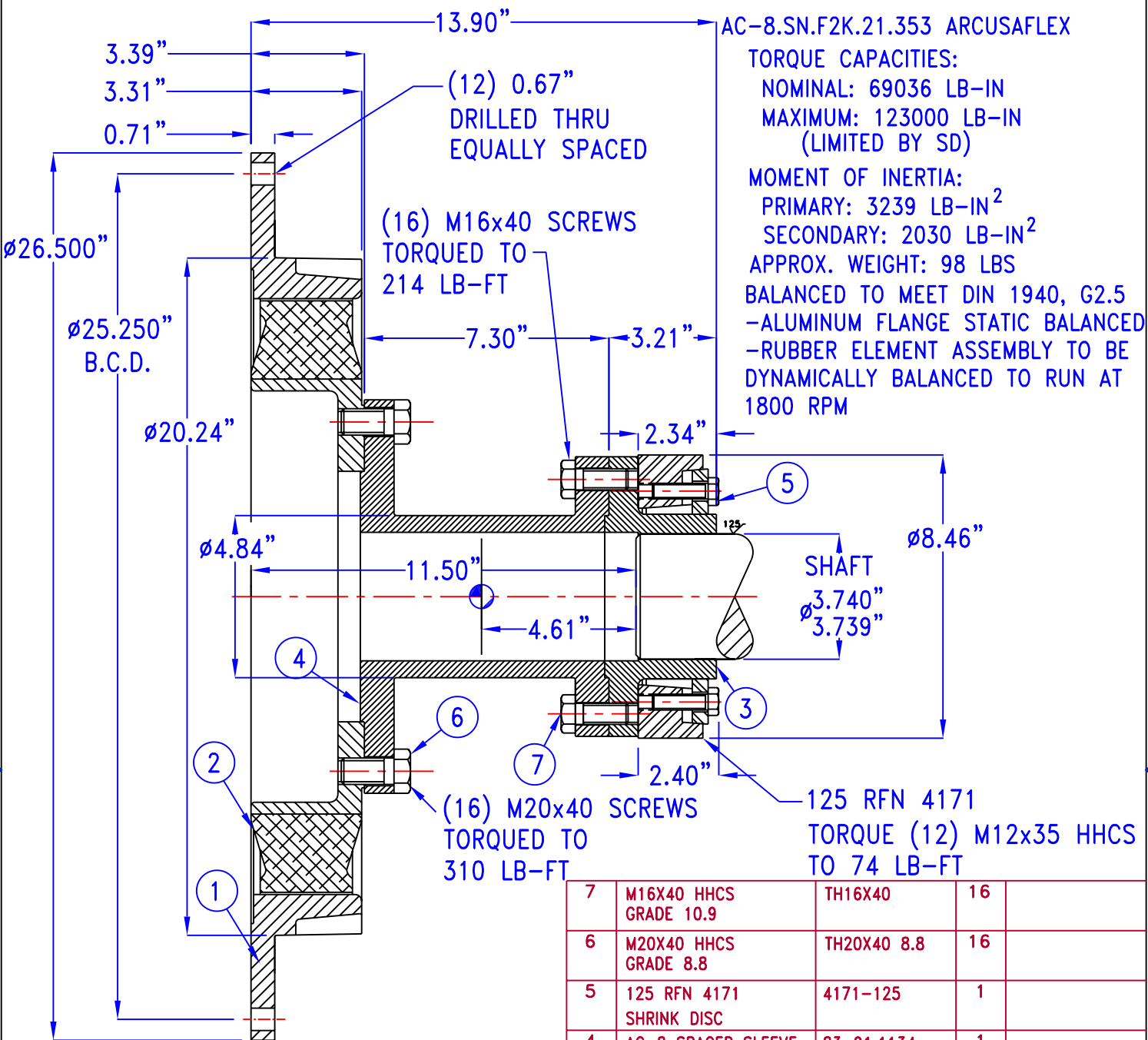
10919 Alaska Road
Fort St. John, B.C.
(250) 785-0285

104, 19329 Enterprise Way
Surrey, B.C.
(604) 596-7344

498 Henderson Drive
Regina, SK
(306) 721-6925

206B, 2750 Faithful Ave
Saskatoon, SK
(306) 934-3484

SH
DWG



AC-8.SN.F2K.21.353 ARCUSAFLEX
 TORQUE CAPACITIES:
 NOMINAL: 69036 LB-IN
 MAXIMUM: 123000 LB-IN
 (LIMITED BY SD)
 MOMENT OF INERTIA:
 PRIMARY: 3239 LB-IN²
 SECONDARY: 2030 LB-IN²
 APPROX. WEIGHT: 98 LBS
 BALANCED TO MEET DIN 1940, G2.5
 -ALUMINUM FLANGE STATIC BALANCED
 -RUBBER ELEMENT ASSEMBLY TO BE
 DYNAMICALLY BALANCED TO RUN AT
 1800 RPM

CUSTOMER APPROVAL _____
 DATE _____

7	M16X40 HHCS GRADE 10.9	TH16X40	16	
6	M20X40 HHCS GRADE 8.8	TH20X40 8.8	16	
5	125 RFN 4171 SHRINK DISC	4171-125	1	
4	AC-8 SPACER SLEEVE	83-91.1134	1	
3	AC-8.F2K. HUB ϕ 3.74" FOR 125 RFN 4171	83-91.1135	1	
2	AC-8.SN.K RUBBER ELEMENT	83-91.2848	1	
1	AC-8.21 ALUMINUM FLANGE	83-91.1041	1	
ITEM	DESCRIPTION	PART NO.	QTY	REMARKS

BILL OF MATERIAL

C	RUBBER FROM UN	4/19/06	SEM
REV.	DESCRIPTION	DATE	APVD

REVISIONS

This drawing and the information contained on it are confidential and proprietary, and any reproduction, distributions or disclosure of this drawing or information or any manufacturing of the products or parts depicted on it are expressly prohibited without the written consent of Ringfeder Corporation.

All function values, dimensions and technical data stated in our design proposals are based on proven methods of calculation, backed by our empirical values and therefore, apply to original RINGFEDER® products only.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. THOSE IN [] ARE mm
 DECIMALS FRACTIONS ANGLES
 .X = ±.015
 .XX = ±.010 ±1/64 ±.5'
 .XXX = ±.005
 SURFACE FINISH R_a = 125 OR BETTER

DRAWN: DATE:
 EMC 2/17/06
 CHECKED: DATE:
 APPROVED: DATE:



TITLE AC-8.SN.F2K.21.353 ARCUSAFLEX COUPLING WITH 3.74" BORE & 125 RFN 4171			
SIZE	CAGE NO.	DRAWING NO.	REV
A	60372	43-91.3327	C
SCALE	NTS	PLOT SCALE	SHEET
		1:4.5	

RITE QUICK COUPLINGS



**FOR
LIQUID
AND
GAS
TRANSFER
SYSTEMS**



Ritepro Corporation
Montreal, Canada

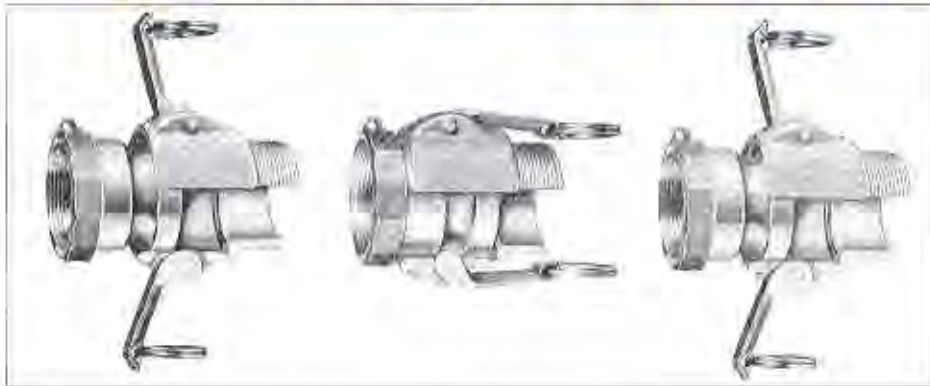
A growth industry

Since the invention of cam and groove quick couplings, demand has grown steadily because they excel all other methods in ease of use and reliability. In addition to the hundreds of known uses, industrial engineers are finding new ones daily. Usage has expanded so rapidly that the standards in this catalogue are accepted world-wide for most liquid, gas and bulk transfer systems.

Ritepro has manufactured reliable, high-speed cam and groove quick couplings for the past decade. We maintain high inventories and also manufacture many specialty couplings. Our engineering and quality control standards are rigidly exact to ensure perfect interchangeability wherever our couplings may be in use. Parts are manufactured to specification A-A 59326 (Superseding MIL-C27487).

If you do not find the solution to your coupling problem, contact us for additional information and design services.

How to make a quick connection



To make connection, simply extend coupler arms and slip the adaptor smoothly inside the coupler.

When adaptor makes contact against the gasket, press the cam levers down until they are parallel to body of coupler with normal hand pressure. The cam bears on the groove keeping adaptor and coupler securely locked together in a permanent leakproof connection until released.

Uncoupling is just as quick and easy. Again, using normal hand pressure, lift locking arms or levers and slide adaptor out of the coupler. Gasket remains securely in place ready for the next connection.

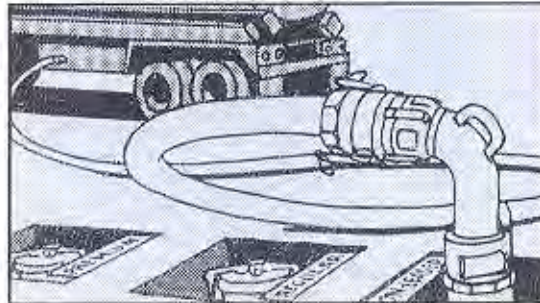
INDEX	PAGE
Construction features	4
Eight basic parts described	4
Secondary Lock Systems for Rite Couplers	5
Part sizes and numbers	6-7
General dimensions	8
Line pressure ratings	9
Other adaptors and couplers	9
Body Material	10
Guide to gasket materials	10
How to order	10
Guide to materials and applications.	11



Rite Quick Couplings save labor, time and material

Flexible, portable Tight-fill system facilitates rapid switching from one product to another speeding up delivery schedules.

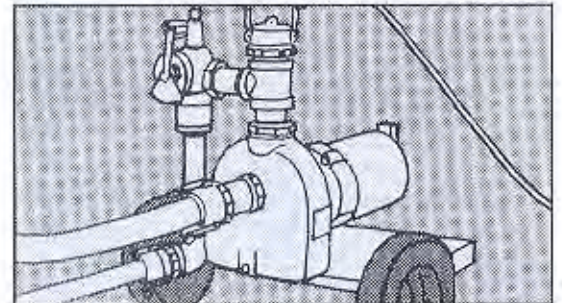
Quick couplings are easy to handle require no threading, no tools, no twisting, no springs and no snaps. Operators prefer their smooth, easy operation and prolonged hose life.



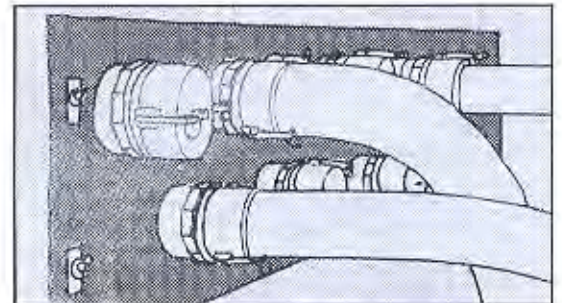
Rugged quick couplings ensure maximum utilization of mobile equipment. Their rugged construction will stand up to years of heavy use. This is especially important in developing areas where replacement and repair costs are abnormally high. Special metals and gasket materials are available to handle problems of pressure, corrosion, volatility and temperature.

Cam and groove quick couplings save labor because they are so quick and easy to use. Installation is simple; operators need little or no training; their rugged construction stands up well to heavy use.

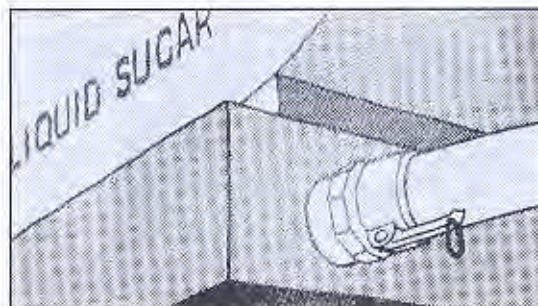
Quick couplings save time because of the great flexibility they bring to any liquid or gas handling transfer system, or for that matter, anything that flows. When there is a need to accommodate rapid shift in supply and demand they facilitate immediate change in product flow between manufacturing, storage and distribution facilities. Losses and interruption of flow are kept to a minimum.



Quick coupling systems are simple to plan and set up. They save material and space eliminating the redundancy of piping and fittings associated with permanent installations. Their portability and flexibility permit greater utilization.



Couplings are designed so that the pressure in the system completes the seal. If pressure increases, locking pressure increases too. This feature ensures complete safety when handling hazardous materials.



Quick couplings reduce or eliminate delays at key measuring and blending stations when there are frequent product changes. This is only one of many ways in which they may be used to increase productivity of expensive machinery and equipment.



Speedy, leakproof coupling ensure minimum interruption of throughput minimum loss of product or contamination.

Engineered to give years of leak-proof connections



Precision machined for complete interchangeability

Any adaptor (male) may be coupled with any coupler (female) of the same size. This provides maximum flexibility in setting up the most convenient and efficient quick coupling system needed for the job.

Adaptors and couplers are available with either male or female national pipe or hose shank connection. Each part carries a letter prefix which designates whether it is an adaptor or a coupler and whether it is threaded male or female or hose shank. The letter system is standard in the industry and facilitates proper identification of the basic parts available. Examples are illustrated below.



(Upper) Part A
adaptor with female thread
(Lower) Part D
coupler with female thread.



(Upper) Part F
adaptor with male thread
(Lower) Part B
coupler with male thread.



(Upper) Part E
shank adaptor
(Lower) Part C
shank coupler.

Secondary Lock Systems for Rite Couplers

The design of cam and groove couplings is such that an increase in internal pressure will increase the clamping force on the cam (handle). Handles will not open due to pressure alone.

However, there are applications that for **hazardous and safety reasons** a secondary lock may be desirable.

This is often the case in the chemical industry where dangerous fluids are often present. In many cases a lock is required where a separate and deliberate movement must be performed before the coupling handles can be opened and the coupling halves separated.



Figure 1



Figure 2

In many locations, pins or other removable mechanical devices are used to provide a lock. These are often difficult to use if the operator is wearing protective equipment and the components are small. Ritepro's secondary locks are an integral part of the coupling and so they do not need to be removed. They are easy to operate, even while wearing gloves.

The Anti-Vibration Spring (**Figure 1**) clamps the handles in position. The spring remains attached to one of the handles when open so it cannot be lost.

This lock is easily field retrofit to existing couplers. Just remove the finger ring, slide the spring on and reinstall the ring. A secondary motion is required to place the Spring in lock position.

The Spring Clip (**Figure 2**) locks automatically when the handle is closed. To open the lock, press the Clip to the side and open the handle normally. This system can be retrofit, however, the handle rivets need to be removed.

This option is best ordered from the factory.

The Secondary Coupling Lock (**figure 3**) is an integral part of the coupling design. When the rotational lock is closed, the handles cannot be opened. A secondary motion is required to lock or unlock this device. This is ideal when space is at a premium, i. e. batching where multiple connections are arranged on a manifold.



Figure 3

These locks are available to fit on all coupling styles, B, C, D, and DC as well as all materials aluminium, brass, stainless steel etc.. All the locks are stainless steel for corrosion resistance.

More detailed information on the Secondary Coupling Lock (Figure 3) can be found on Standard Specification Sheet SCL.

For further information on any of these secondary locks, contact your distributor.

Eight standard parts —



A

Part A Adaptor Female Thread

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050A	075A	100A	125A	150A	200A
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250A	300A	400A	500A	600A	800A

Part B Coupler Male Thread

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050B	075B	100B	125B	150B	200B
Size	2 1/2"	3"	4"	5"	6"	
Part No.	250B	300B	400B	500B	600B	

B



C

Part C Hose Shank Coupler

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050C	075C	100C	125C	150C	200C
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250C	300C	400C	500C	600C	800C

Part F Adaptor Male Thread

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050F	075F	100F	125F	150F	200F
Size	2 1/2"	3"	4"	5"	6"	
Part No.	250F	300F	400F	500F	600F	

F



each one in 12 sizes



D

Part D Coupler Female Thread

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050D	075D	100D	125D	150D	200D
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250D	300D	400D	500D	600D	800D



E

Part E Hose Shank Adaptor

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050E	075E	100E	125E	150E	200E
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250E	300E	400E	500E	600E	800E

Part DC Dust Cap For adaptors

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050DC	075DC	100DC	125DC	150DC	200DC
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250DC	300DC	400DC	500DC	600DC	800DC

Part DP Dust Plug For Couplers

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Part No.	050DP	075DP	100DP	125DP	150DP	200DP
Size	2 1/2"	3"	4"	5"	6"	8"
Part No.	250DP	300DP	400DP	500DP	600DP	800DP

DC



DP



Note: Available with NPT or BSP threads. All 1/2" couplers have only one handle. All 8" couplers have four handles.

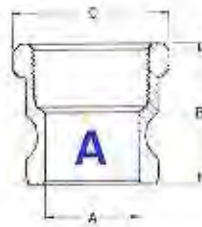
Rite standard dimensions

Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	2	$2\frac{1}{2}$	3	4	5	6
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{2}$	$3\frac{1}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$2\frac{1}{8}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$4\frac{3}{4}$	$5\frac{3}{4}$
C	$1\frac{1}{8}$	1	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$

Millimetres

SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	20.6	24.6	28.6	35.7	46.0	55.6	73.0	97.6	122.2	149.2
B	38.9	41.3	44.5	55.6	27.2	61.9	69.9	69.9	79.3	87.3	88.9
C	29.4	39.1	44.5	55.6	39.7	74.9	92.1	106.4	139.1	163.5	193.7



Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	4	$4\frac{1}{2}$	$4\frac{1}{2}$
E	1	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$
G	1	2	$2\frac{1}{4}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$10\frac{1}{2}$

Millimetres

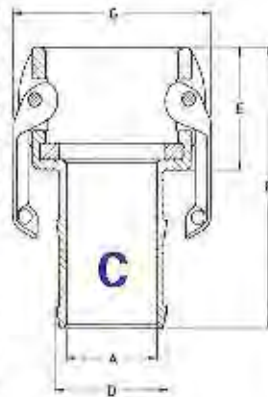
SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	20.6	23.8	28.6	35.7	49.2	55.6	73.0	97.6	123.8	149.2
B	47.6	55.5	60.3	69.9	73.0	79.4	88.9	90.5	100.0	103.2	104.8
E	31.8	33.3	38.5	47.6	47.5	54.0	57.2	58.7	61.9	65.1	66.7
G	42.9	50.8	61.9	79.4	86.5	86.8	109.5	130.7	168.3	193.7	268.3

Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	2	$2\frac{1}{2}$	3	4	5	6	
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	1	1	$1\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$2\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{3}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$	$9\frac{1}{4}$
D	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$
E	1	$1\frac{1}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{3}{4}$
G	$1\frac{1}{4}$	2	$2\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$	$10\frac{1}{4}$

Millimetres

SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	13.5	23.8	25.4	31.8	42.9	54.0	66.7	88.9	117.5	146.1
B	88.7	84.1	92.3	104.8	108.0	123.8	126.5	133.2	149.3	167.3	228.1
D	15.1	21.4	27.4	34.1	40.5	33.2	66.7	79.4	104.8	130.2	155.6
E	31.8	33.3	38.1	47.6	47.6	54.0	57.2	58.7	61.9	65.1	66.7
G	42.9	50.8	61.9	79.4	86.5	96.9	109.5	139.7	168.3	193.7	268.3



Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$4\frac{3}{4}$	$4\frac{3}{4}$	$4\frac{3}{4}$
E	1	$1\frac{1}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$
G	$1\frac{1}{4}$	2	$2\frac{1}{8}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{3}{8}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{1}{2}$	$10\frac{1}{2}$

Millimetres

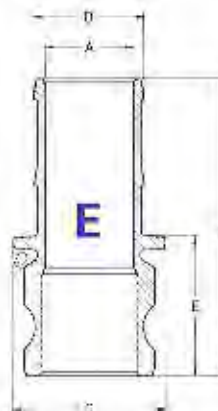
SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	20.6	23.8	25.4	31.8	42.9	55.6	73.0	97.6	122.2	149.2
B	46.0	52.4	63.3	69.3	69.9	91.0	85.7	88.9	103.0	103.2	104.8
E	31.8	32.3	38.1	47.6	47.6	54.0	57.2	58.7	61.9	65.1	66.7
G	42.9	50.8	61.9	79.4	83.5	86.8	109.5	139.7	168.3	193.7	268.3

Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$2\frac{1}{8}$	3	$3\frac{1}{2}$	$4\frac{1}{4}$	$4\frac{1}{2}$	$5\frac{1}{8}$	$5\frac{1}{2}$	$6\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{4}$	$9\frac{1}{4}$
C	$\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$
D	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$
E	$1\frac{1}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$

Millimetres

SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	13.5	20.6	25.4	31.9	42.9	54.0	66.7	88.9	117.5	146.0
B	61.1	78.2	90.5	108.4	112.7	131.8	148.7	169.3	175.4	200.0	247.0
C	21.4	31.8	36.5	50.8	50.7	73.0	80.2	103.2	131.0	154.0	191.0
D	15.1	21.4	27.4	34.1	40.5	53.2	66.7	79.4	104.8	130.2	155.6
E	26.2	25.4	33.3	49.2	52.4	61.9	60.3	68.7	67.5	69.9	75.4



Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
A	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$
B	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{1}{8}$	3	$3\frac{3}{8}$	4	$4\frac{1}{8}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{3}{4}$
C	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{8}$	$5\frac{1}{8}$	$6\frac{1}{4}$	$7\frac{1}{4}$
E	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{1}{4}$

Millimetres

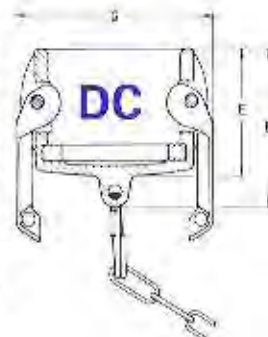
SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
A	14.3	20.6	24.6	28.6	35.7	46.0	55.6	73.0	97.6	122.2	149.2
B	57.2	63.5	67.5	77.8	82.5	87.3	101.6	103.2	117.5	118.1	120.7
C	29.4	38.1	44.5	55.6	63.7	74.6	92.1	108.4	138.1	162.5	193.7
E	38.9	41.3	44.5	54.0	55.5	61.9	63.0	69.9	77.8	77.8	79.4

Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
B	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{3}{4}$	$4\frac{1}{4}$
E	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	2	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$
G	$1\frac{1}{2}$	2	$2\frac{1}{4}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$	$8\frac{1}{4}$	$10\frac{1}{4}$

Millimetres

SIZE DIM	15	20	25	32	40	50	65	80	100	125	150
B	42.9	46.1	54.0	63.5	63.5	88.9	78.8	79.4	85.7	90.5	104.8
E	38.4	36.5	41.3	50.8	50.8	57.2	61.9	63.5	66.7	68.3	73.0
G	42.9	50.8	61.9	79.4	86.5	96.8	109.5	139.7	168.3	193.7	268.3



Inches

Size Dimension	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
B	<										

Available in Aluminium, Bronze, Ductile Iron and Stainless Steel

Overall width with Cams open

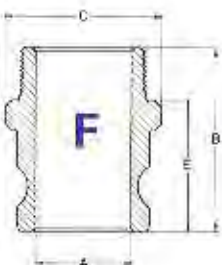
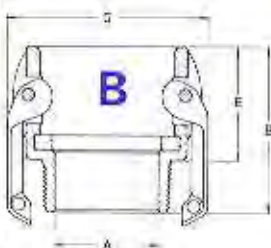
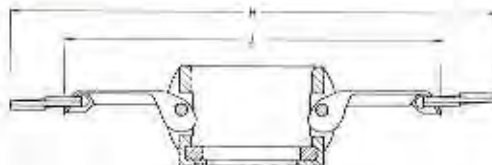
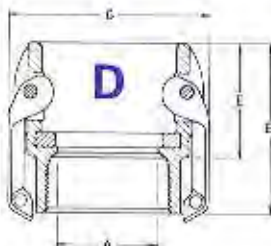
Inches

Size Dimensions	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
H	5 5/8	6 3/8	7 1/8	9 1/4	9 5/8	10	10 1/2	12 1/4	14 1/2	19 1/2
J	4 1/4	4 3/4	5 1/2	7 3/8	7 5/8	7 3/4	8 7/8	9 1/2	10 1/2	16 1/2

Millimetres

SIZE DIM.	15	20	25	32	40	50	65	80	100	125	150
H	149.2	157.2	181.0	235.0	244.5	254.0	286.7	311.2	359.7	369.3	487.4
J	103.2	111.1	139.7	182.6	188.9	200.0	211.1	247.7	276.2	304.8	419.1

*One handle only (divide "J" & "H" by two)



Standard units for special jobs

We have illustrated in the two pictures opposite, only eight variations of our standard parts for special applications. We have many more in stock. Call or write us if you have a special application. If we don't already have it in stock we will design and make one to your specifications.

Upper left picture

1. Combination Coupler and Adaptor for connecting different sizes of pipe or hose.
2. Spool Adaptor to connect two lengths of hose when both have coupler ends.
3. Spool Adaptor and reducer.
4. Spool Coupler and reducer for two lengths of hose with adaptor ends. Available in all sizes for reducing and increasing.

Lower left picture

5. 90° Elbow Coupler
6. Tank car Adaptor with female thread.
7. FLB Tank Truck Round Flange Coupler
8. FLA Tank Truck Round Flange Adaptor.

Line Pressure Ratings

Inches/psi

Size	Aluminium, Bronze Ductile Iron	Stainless Steel Steel & Monel
3/4	150	150
1	250	250
1 1/4	250	250
1 1/2	250	250
2	250	250
2 1/2	150	225
3	125	200
4	100	100
5	75	100
6	75	100
8	75	100

Millimetres/kg/cm²

Size	Aluminium, Bronze Ductile Iron	Stainless Steel Steel & Monel
15	10.54	10.54
20	17.58	17.58
25	17.58	17.58
32	17.58	17.58
40	17.58	17.58
50	17.58	17.58
65	10.54	15.82
80	8.79	14.06
100	7.03	7.03
125	5.27	7.03
150	5.27	7.03
200	5.27	7.03

For information about sizes other than shown on these pages, please contact your distributor.

Available in Aluminium, Bronze, Ductile Iron and Stainless Steel

All eight basic parts are available in Aluminium, Bronze, Ductile Iron and Stainless Steel. You may order parts in other materials. If you need special materials, call or write us. We will be pleased to supply specifications and prices.

There is a table on the inside back cover of this catalogue which lists suggested materials and product applications. Do not hesitate to contact us to discuss your requirements.

A general guide to gasket materials

Be sure to specify gasket materials when ordering couplers. We have listed below a brief recommendation for the five different gasket materials which are available.

Special gasket applications are listed in the table on the inside back cover of this catalogue.

Please write or call us if you would like additional information.

BUNA N: Buna N is standard specification. It is recommended for petroleum derivatives, neutral or slightly acidic salt solutions, alcohols, ethers, glycols, fats, oils and greases. This compound will give good service from -40 F. to 250 F.

NEOPRENE: Neoprene is recommended for alkaline and acid salt solutions and aldehydes.

VITON: Viton is recommended for aromatics, hydrocarbons, liquid chlorine, carbon disulfide and molten sulphur. It is not recommended for esters or the ketone family. It is servicable from -20 F. to +400 F.

BUTYL: Butyl is recommended for anhydrous ammonia, Skydrol, acetone, methyl ethyl ketone and oxidizing chemicals.

TEFLON: The standard teflon gasket is an envelope with a Buna N core. Viton core gaskets are also available. Teflon is recommended for highly oxidizing fluids, esters, ketones and other liquids not generally handled by either natural or synthetic rubbers.

Gaskets are available made from a wide variety of compounds such as Thiokol, Pure Gum, Silicone, and Hypalon. Write us for further information.

How to order

Use the following code in ordering adaptors, couplers and gasket materials.



Size in inches:	1/2	3/4	1"	1 1/2"	1 3/4"	2"	2 1/2"	3"	4"	5"	6"	8"
Code Number	050	075	100	125	150	200	250	300	400	500	600	800

Description	Adaptor Female Thread	Adaptor Male Thread	Adaptor Hose Shank
Code Letter	A	F	E

Description	Coupler Female Thread	Coupler Male Thread	Coupler Hose Shank
Code Letter	D	B	C

Description	Dust Plug	Dust Cap
Code Letter	D.P.	D.C.

Body Material	Aluminum	Bronze	Ductile	Stainless Steel
Code Letter	A	B	D	S

Gasket Material	Buna N	Neoprene	Viton	Butyl	Teflon
Code Letter	B	N	V	Bu	T

The complete code number should be written in this order:

SIZE, PART DESCRIPTION, BODY MATERIAL, GASKET MATERIAL

5 only 100 F.A. = 5 only 1" Adaptor with male thread, aluminium construction.

5 only 200 C.BB. = 5 only 2" Coupler with hose shank, bronze construction, Buna gasket.

Prices and Quotations

Prices quoted do not include taxes and are F.O.B. our plant. All quotations by our distributors are subject to confirmation and acceptance by head office. Quotations are firm for 30 days.

Cancellations and Returns

Firm orders accepted by us may only be cancelled subject to recovery of costs incurred. No goods may be returned for credit unless authorized by head office and subject to restocking and handling charges.

Couplers and adaptors manufactured for special applications cannot be returned for credit.

Warranty

Ritepro Corporation warrants any of its products against defects of materials or workmanship for a period of one year from date of shipment and is limited to repair, replacement or refunding of purchase price. We will not be responsible for any claims for labour or any other expenses or consequential or secondary damages in any case.

Registration

Couplings are registered in all Canadian Provinces under the authority of the Boiler and Pressure Vessels Act, as detailed in CSA Standard B51.

Base Canadian Registration Number OA 0577.6



Ritepro Corporation

A subsidiary of Bray International Inc.



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ritepro@bray.com

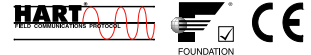
Distributed by:



Rosemount 3051 Pressure Transmitter

HART® AND FOUNDATION™ FIELDBUS PROTOCOLS

- *Best-in-Class performance, 0.04% High Accuracy option*
- *Industry first five-year stability under actual process conditions*
- *Unmatched Dynamic Performance*
- *Coplanar™ platform enables integrated pressure, flow, and level solutions*
- *Advanced PlantWeb® Functionality*



Contents

Product Offering	page 3
Specifications	page 4
Product Certifications	page 12
HART Protocol	page 12
Fieldbus Protocol	page 15
Dimensional Drawings	page 17
Ordering Information	page 25
HART Protocol C1 Option Configuration Data Sheet	page 39

Setting the Standard for Pressure Measurement

Industry's best total performance, a flexible *Coplanar* platform, and guaranteed 5- year stability, has made the Rosemount 3051 the standard in pressure measurement.

Industry's best total performance of $\pm 0.15\%$

Total performance is the true measure of "real-world" transmitter performance. Using superior sensor technology and engineered for optimal performance, the 3051 delivers unprecedented $\pm 0.04\%$ reference accuracy, resulting in total operating performance of $\pm 0.15\%$. Superior total performance equates to reduced variability and improved plant safety.

Five year installed stability of $\pm 0.125\%$

Transmitter stability is a critical measure of transmitter performance over time. Through aggressive simulation testing beyond standard IEC 770 testing, the 3051 has proven its ability to maintain performance over a five year period under the most demanding process conditions. Superior transmitter stability reduces calibration frequency to save operation and maintenance costs.

Unmatched dynamic performance

In dynamic applications, speed of measurement is as important as repeatability. The 3051 responds up to eight times faster than the typical pressure transmitter to detect and control variations quickly and efficiently. Superior dynamic response yields more accurate measurements to reduce variability and increase profitability.

Coplanar platform enables complete point solutions

The versatile *Coplanar* platform design enables the best process connection for pressure, flow and level applications. Right out of the box, the solution arrives factory calibrated, pressure-tested, and ready to install. Only the 3051 has a flexible design to reduce engineering and inventory costs.

Advanced *PlantWeb* Functionality



The 3051 powers the *PlantWeb* architecture by delivering the best sensor and transmitter, best installation practices, and best in class field intelligence. One component is the enhanced diagnostic capabilities in *FOUNDATION* fieldbus that provide an increase in process visibility, enabling proactive maintenance and improving process availability.

Rosemount Pressure Solutions

Rosemount 3051S Series of Instrumentation

Scalable pressure, flow and level measurement solutions improve installation and maintenance practices.

Rosemount 3095MV Mass Flow Transmitter

Accurately measures differential pressure, static pressure and process temperature to dynamically calculate fully compensated mass flow.

Rosemount 305 and 306 Integral Manifolds

Factory-assembled, calibrated and seal-tested manifolds reduce on-site installation costs.

Rosemount 1199 Diaphragm Seals

Provides reliable, remote measurements of process pressure and protects the transmitter from hot, corrosive, or viscous fluids.

Orifice Plate Primary Element Systems: Rosemount 1495 and 1595 Orifice Plates, 1496 Flange Unions and 1497 Meter Sections

A comprehensive offering of orifice plates, flange unions and meter sections that is easy to specify and order. The 1595 Conditioning Orifice provides superior performance in tight fit applications.

Annubar[®] Flowmeter Series: Rosemount 3051SFA, 3095MFA, and 485

The state-of-the-art, fifth generation Rosemount 485 *Annubar* combined with the 3051S or 3095MV MultiVariable transmitter creates an accurate, repeatable and dependable insertion-type flowmeter.

Compact Orifice Flowmeter Series: Rosemount 3051SFC, 3095MFC, and 405

Compact Orifice Flowmeters can be installed between existing flanges, up to a Class 600 (PN100) rating. In tight fit applications, a conditioning orifice plate version is available, requiring only two diameters of straight run upstream.

ProPlate[®] Flowmeter Series: Rosemount *ProPlate*, *Mass ProPlate*, and 1195

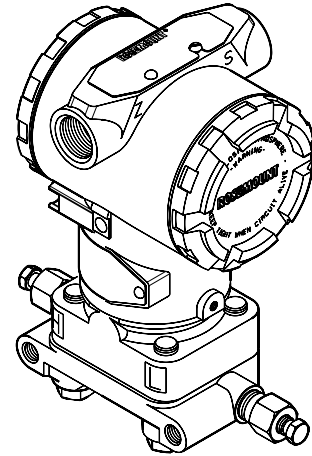
These integral orifice flowmeters eliminate the inaccuracies that become more pronounced in small orifice line installations. The completely assembled, ready to install flowmeters reduce cost and simplify installation.

Product Offering

Rosemount 3051C Differential, Gage, and Absolute

See ordering information on page 25.

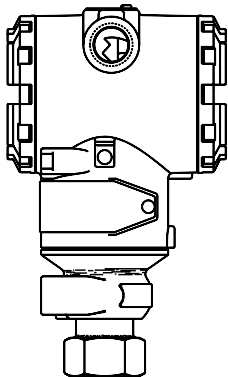
- Performance up to 0.04% accuracy
- Five year installed stability of 0.125%
- *Coplanar* platform enables integrated manifold, primary element and diaphragm seal solutions
- Calibrated spans/ranges from 0.1 inH₂O to 4000 psi (0,25 mbar to 276 bar)
- 316L SST, *Hastelloy*® C276, *Monel*®, Tantalum, Gold-plated *Monel*, or Gold-plated 316L SST process isolators



Rosemount 3051T Gage and Absolute

See ordering information on page 29.

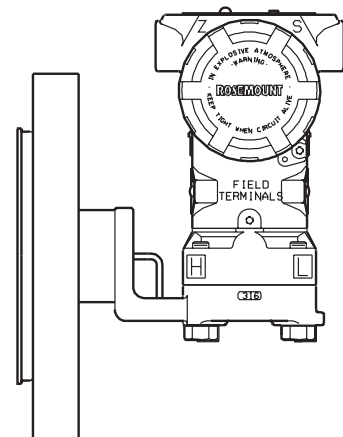
- Performance up to 0.04% accuracy
- Five year installed stability of 0.125%
- Calibrated spans from 0.3 to 10000 psi (10,3 mbar to 689 bar)
- Multiple process connections available
- 316L SST and *Hastelloy* C276 process isolators



Rosemount 3051L Liquid Level

See ordering information on page 31.

- Performance up to 0.075% accuracy
- Welded fill fluid system provides best-in-class system reliability
- Flush and extended diaphragms
- Multiple fill fluids and wetted materials available



Specifications

PERFORMANCE SPECIFICATIONS

Total Performance is based on combined errors of reference accuracy, ambient temperature effect, and static pressure effect. This product data sheet covers both HART and fieldbus protocols unless specified.

Conformance To Specification ($\pm 3\sigma$ (Sigma))

Technology leadership, advanced manufacturing techniques and statistical process control ensure specification conformance to at least $\pm 3\sigma$.

Reference Accuracy⁽¹⁾

Models	Standard	High Accuracy Option
3051CD, 3051CG		
Range 0 (CD)	$\pm 0.10\%$ of span For spans less than 2:1, accuracy = $\pm 0.05\%$ of URL	
Range 1	$\pm 0.10\%$ of span For spans less than 15:1, accuracy = $\pm \left[0.025 + 0.005 \left(\frac{URL}{Span} \right) \right] \%$ of Span	
Ranges 2-5	$\pm 0.065\%$ of span For spans less than 10:1, accuracy = $\pm \left[0.015 + 0.005 \left(\frac{URL}{Span} \right) \right] \%$ of Span	Ranges 2-4 High Accuracy Option, P8 $\pm 0.04\%$ of span For spans less than 5:1, accuracy = $\pm \left[0.015 + 0.005 \left(\frac{URL}{Span} \right) \right] \%$ of Span
3051T		
Ranges 1-4	$\pm 0.065\%$ of span For spans less than 10:1, accuracy = $\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \%$ of Span	Ranges 2-4 High Accuracy Option, P8 $\pm 0.04\%$ of span For spans less than 5:1, accuracy = $\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \%$ of Span
Range 5	$\pm 0.075\%$ of span For spans less than 10:1, accuracy = $\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \%$ of Span	
3051CA		
Ranges 1-4	$\pm 0.065\%$ of span For spans less than 10:1, accuracy = $\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \%$ of Span	Ranges 2-4 High Accuracy Option, P8 $\pm 0.04\%$ of span For spans less than 5:1, accuracy = $\pm \left[0.0075 \left(\frac{URL}{Span} \right) \right] \%$ of Span
3051H/3051L		
All Ranges	$\pm 0.075\%$ of span For spans less than 10:1, accuracy = $\pm \left[0.025 + 0.005 \left(\frac{URL}{Span} \right) \right] \%$ of Span	

(1) For FOUNDATION fieldbus transmitters, use calibrated range in place of span. For zero based spans, reference conditions, silicone oil fill, SST materials, Coplanar flange (3051C) or 1/2 in. - 18 NPT (3051T) process connections, digital trim values set to equal range points.

Total Performance

For $\pm 50\text{ }^\circ\text{F}$ ($28\text{ }^\circ\text{C}$) temperature changes, up to 1000 psi (6,9 MPa) line pressure (CD only), from 1:1 to 5:1 rangedown.

Models	Total Performance
3051C	Ranges 2-5 $\pm 0.15\%$ of span
3051T	Ranges 1-4 $\pm 0.15\%$ of span

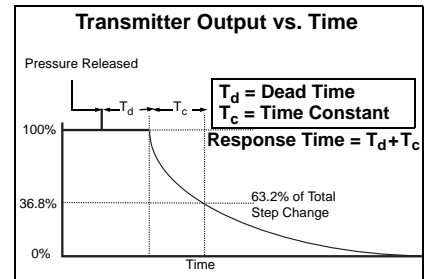
Long Term Stability

Models	Long Term Stability
3051C	Ranges 2-5 $\pm 0.125\%$ of URL for 5 years $\pm 50\text{ }^\circ\text{F}$ ($28\text{ }^\circ\text{C}$) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.
3051CD Low/Draft Range	Ranges 0-1 $\pm 0.2\%$ of URL for 1 year
3051T	Ranges 1-4 $\pm 0.125\%$ of URL for 5 years $\pm 50\text{ }^\circ\text{F}$ ($28\text{ }^\circ\text{C}$) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.
Rosemount 3051H	Ranges 2-3 $\pm 0.1\%$ of URL for 1 year Ranges 4-5 $\pm 0.2\%$ of URL for 1 year

Dynamic Performance

	4 - 20 mA (HART protocol) ⁽¹⁾	Fieldbus protocol ⁽³⁾	Typical HART Transmitter Response Time
Total Response Time ($T_d + T_c$)⁽²⁾:			
	3051C, Ranges 2-5: 100 ms	152 ms	
	Range 1: 255 ms	307 ms	
	Range 0: 700 ms	752 ms	
	3051T: 100 ms	152 ms	
	3051H/L: Consult factory	Consult factory	
Dead Time (T_d)	45 ms (nominal)	97 ms	
Update Rate	22 times per second	22 times per second	

(1) Dead time and update rate apply to all models and ranges; analog output only
 (2) Nominal total response time at $75\text{ }^\circ\text{F}$ ($24\text{ }^\circ\text{C}$) reference conditions.
 (3) Transmitter fieldbus output only, segment macro-cycle not included.



3051-3051_17A

Line Pressure Effect per 1000 psi (6,9 MPa)

For line pressures above 2000 psi (13,7 MPa), see user manual (Rosemount publication number 00809-0100-4001).

Models	Line Pressure Effect
3051CD	Zero Error ⁽¹⁾
	Range 0 $\pm 0.125\%$ of URL/100 psi (6,89 bar)
	Range 1 $\pm 0.25\%$ of URL/1000 psi (68,9 bar)
	Ranges 2-3 $\pm 0.05\%$ of URL/1000 psi (68,9 bar) for line pressures from 0 to 2000 psi (0 to 13,7 MPa)
	Span Error
	Range 0 $\pm 0.15\%$ of reading/100 psi (6,89 bar)
	Range 1 $\pm 0.4\%$ of reading/1000 psi (68,9 bar)
	Ranges 2-3 $\pm 0.1\%$ of reading/1000 psi (68,9 bar)
3051HD	Zero Error ⁽¹⁾
	All Ranges $\pm 0.1\%$ of URL/1000 psi (68,9 bar) for line pressures from 0 to 2000 psi (0 to 13,7 MPa)
	Span Error
	All Ranges $\pm 0.1\%$ of reading/1000 psi (68,9 bar)

(1) Can be calibrated out at line pressure.

Ambient Temperature Effect per 50°F (28°C)

Models	Ambient Temperature Effect
3051CD/CG	Range 0 $\pm(0.25\% \text{ URL} + 0.05\% \text{ span})$ Range 1 $\pm(0.1\% \text{ URL} + 0.25\% \text{ span})$ Ranges 2-5 $\pm(0.0125\% \text{ URL} + 0.0625\% \text{ span})$ from 1:1 to 5:1 $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 5:1 to 100:1
3051T	Range 1 $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 10:1 $\pm(0.05\% \text{ URL} + 0.125\% \text{ span})$ from 10:1 to 100:1 Range 2-4 $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 30:1 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span})$ from 30:1 to 100:1 Range 5 $\pm(0.1\% \text{ URL} + 0.15\% \text{ span})$
3051CA	All Ranges $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 30:1 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span})$ from 30:1 to 100:1
3051H	All Ranges $\pm(0.025\% \text{ URL} + 0.125\% \text{ span} + 0.35 \text{ inH}_2\text{O})$ from 1:1 to 30:1 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span} + 0.35 \text{ inH}_2\text{O})$ from 1:1 to 30:1
3051L	See Rosemount Inc. Instrument Toolkit™ software.

Mounting Position Effects

Models	Mounting Position Effects
3051C	Zero shifts up to $\pm 1.25 \text{ inH}_2\text{O}$ (3,11 mbar), which can be calibrated out. No span effect.
3051H	Zero shifts up to $\pm 5 \text{ inH}_2\text{O}$ (12,43 mbar), which can be calibrated out. No span effect.
3051L	With liquid level diaphragm in vertical plane, zero shift of up to $1 \text{ inH}_2\text{O}$ (2,49 mbar). With diaphragm in horizontal plane, zero shift of up to $5 \text{ inH}_2\text{O}$ (12,43 mbar) plus extension length on extended units. All zero shifts can be calibrated out. No span effect.
3051T/CA	Zero shifts up to $2.5 \text{ inH}_2\text{O}$ (6,22 mbar), which can be calibrated out. No span effect.

Vibration Effect

All Models

Measurement effect due to vibrations is negligible except at resonance frequencies. When at resonance frequencies, vibration effect is less than $\pm 0.1\%$ of URL per g when tested between 15 and 2000 Hz in any axis relative to pipe-mounted process conditions.

Power Supply Effect

All Models

Less than $\pm 0.005\%$ of calibrated span per volt.

RFI Effects

All Models

$\pm 0.1\%$ of span from 20 to 1000 MHz and for field strength up to 30 V/m.

Transient Protection (Option Code T1)

All Models:

Meets IEEE C62.41, Category B

6 kV crest (0.5 μs - 100 kHz)

3 kV crest (8 \times 20 microseconds)

6 kV crest (1.2 \times 50 microseconds)

Meets IEEE C37.90.1, Surge Withstand Capability

SWC 2.5 kV crest, 1.25 MHz wave form

General Specifications:

Response Time: < 1 nanosecond

Peak Surge Current: 5000 amps to housing

Peak Transient Voltage: 100 V dc

Loop Impedance: < 25 ohms

Applicable Standards: IEC61000-4-4,

IEC61000-4-5

NOTE:

Calibrations at 68 °F (20 °C) per ASME Z210.1 (ANSI)

FUNCTIONAL SPECIFICATIONS

Range and Sensor Limits

TABLE 1. 3051CD, 3051CG, 3051L, and 3051H Range and Sensor Limits

Range	Minimum Span				Range and Sensor Limits			
	3051CD ⁽¹⁾ , CG, L, H	Upper (URL)	3051C Differential	3051C/ Gage	Lower (LRL)			
					3051L Differential	3051L Gage	3051H Differential	3051H Gage
0	0.1 inH ₂ O (0,25 mbar)	3.0 inH ₂ O (7,47 mbar)	-3.0 inH ₂ O (-7,47 mbar)	NA	NA	NA	NA	NA
1	0.5 inH ₂ O (1,2 mbar)	25 inH ₂ O (62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	NA	NA	NA	NA
2	2.5 inH ₂ O (6,2 mbar)	250 inH ₂ O (0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)
3	10 inH ₂ O (24,9 mbar)	1000 inH ₂ O (2,49 bar)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)
4	3 psi (0,20 bar)	300 psi (20,6 bar)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)
5	20 psi (1,38 bar)	2000 psi (137,9 bar)	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)	NA	NA	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)

(1) Range 0 only available with 3051CD. Range 1 only available with 3051CD or 3051CG.

TABLE 2. Range and Sensor Limits

Range	3051CA			Range	3051T			
	Minimum Span	Upper (URL)	Lower (LRL)		Minimum Span	Upper (URL)	Lower (LRL)	Lower ⁽¹⁾ (LRL) (Gage)
1	0.3 psia (20,6 mbar)	30 psia (2,07 bar)	0 psia (0 bar)	1	0.3 psi (20,6 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
2	1.5 psia (0,103 bar)	150 psia (10,3 bar)	0 psia (0 bar)	2	1.5 psi (0,103 bar)	150 psi (10,3 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
3	8 psia (0,55 bar)	800 psia (55,2 bar)	0 psia (0 bar)	3	8 psi (0,55 bar)	800 psi (55,2 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
4	40 psia (2,76 bar)	4000 psia (275,8 bar)	0 psia (0 bar)	4	40 psi (2,76 bar)	4000 psi (275,8 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
				5	2000 psi (137,9 bar)	10000 psi (689,4 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)

(1) Assumes atmospheric pressure of 14.7 psig.

Zero and Span Adjustment Requirements (HART and Low Power)

Zero and span values can be set anywhere within the range limits stated in Table 1 and Table 2.

Span must be greater than or equal to the minimum span stated in Table 1 and Table 2.

Service

Liquid, gas, and vapor applications

4–20 mA (Output Code A)

Output

Two-wire 4–20 mA, user-selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol.

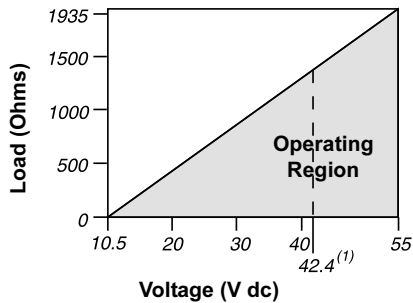
Power Supply

External power supply required. Standard transmitter (4–20 mA) operates on 10.5 to 55 V dc with no load.

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

$$\text{Max. Loop Resistance} = 43.5 (\text{Power Supply Voltage} - 10.5)$$



Communication requires a minimum loop resistance of 250 ohms.

(1) For CSA approval, power supply must not exceed 42.4 V.

FOUNDATION fieldbus (output code F) and Profibus (output code W)

Power Supply

External power supply required; transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage.

Current Draw

17.5 mA for all configurations (including LCD display option)

FOUNDATION fieldbus Function Block Execution Times

Block	Execution Time
Resource	-
Transducer	-
LCD Block	-
Analog Input 1, 2	30 milliseconds
PID	45 milliseconds
Input Selector	30 milliseconds
Arithmetic	35 milliseconds
Signal Characterizer	40 milliseconds
Integrator	35 milliseconds

FOUNDATION fieldbus Parameters

Schedule Entries	7 (max.)
Links	20 (max.)
Virtual Communications Relationships (VCR)	12 (max.)

Standard Function Blocks

Resource Block

Contains hardware, electronics, and diagnostic information.

Transducer Block

Contains actual sensor measurement data including the sensor diagnostics and the ability to trim the pressure sensor or recall factory defaults.

LCD Block

Configures the local display.

2 Analog Input Blocks

Processes the measurements for input into other function blocks. The output value is in engineering units or custom and contains a status indicating measurement quality.

PID Block

Contains all logic to perform PID control in the field including cascade and feedforward.

Backup Link Active Scheduler (LAS)

The transmitter can function as a Link Active Scheduler if the current link master device fails or is removed from the segment.

Advanced Control Function Block Suite (Option Code A01)

Input Selector Block

Selects between inputs and generates an output using specific selection strategies such as minimum, maximum, midpoint, average or first "good."

Arithmetic Block

Provides pre-defined application-based equations including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.

Signal Characterizer Block

Characterizes or approximates any function that defines an input/output relationship by configuring up to twenty X, Y coordinates. The block interpolates an output value for a given input value using the curve defined by the configured coordinates.

Integrator Block

Compares the integrated or accumulated value from one or two variables to pre-trip and trip limits and generates discrete output signals when the limits are reached. This block is useful for calculating total flow, total mass, or volume over time.

FOUNDATION fieldbus Diagnostics Suite (Option Code D01)

The 3051C FOUNDATION fieldbus Diagnostics provide Abnormal Situation Prevention (ASP) indication. The integral statistical process monitoring (SPM) technology calculates the mean and standard deviation of the process variable 22 times per second. The 3051C ASP algorithm uses these values and highly flexible configuration options for customization to many user-defined or application specific abnormal situations. The detection of plugged impulse lines is the first available predefined application.

Low Power (Output Code M)

Output

Three wire 1–5 V dc or 0.8–3.2 V dc (Option Code C2) user-selectable output. Also user selectable for linear or square root output configuration. Digital process variable superimposed on voltage signal, available to any host conforming to the *HART* protocol. Low-power transmitter operates on 6–12 V dc with no load.

Power Consumption

3.0 mA, 18–36 mW

Minimum Load Impedance

100 kΩ (V_{out} wiring)

Indication

Optional 5-digit LCD display

Overpressure Limits

Rosemount 3051CD/CG

- Range 0: 750 psi (51,7 bar)
- Range 1: 2000 psig (137,9 bar)
- Ranges 2–5: 3626 psig (250 bar)
 4500 psig (310,3 bar) for option code P9

Rosemount 3051CA

- Range 1: 750 psia (51,7 bar)
- Range 2: 1500 psia (103,4 bar)
- Range 3: 1600 psia (110,3 bar)
- Range 4: 6000 psia (413,7 bar)

Rosemount 3051H

- All Ranges: 3626 psig (25 MPa)

Rosemount 3051TG/TA

- Range 1: 750 psi (51,7 bar)
- Range 2: 1500 psi (103,4 bar)
- Range 3: 1600 psi (110,3 bar)
- Range 4: 6000 psi (413,7 bar)
- Range 5: 15000 psi (1034,2 bar)

For 3051L or Level Flange Option Codes FA, FB, FC, FD, FP, and FQ, limit is 0 psia to the flange rating or sensor rating, whichever is lower.

TABLE 3. 3051L and Level Flange Rating Limits

Standard	Type	CS Rating	SST Rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
ANSI/ASME	Class 600	1480 psig	1440 psig
<i>At 100 °F (38 °C), the rating decreases with increasing temperature.</i>			
DIN	PN 10–40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
DIN	PN 25/40	40 bar	40 bar
<i>At 248 °F (120 °C), the rating decreases with increasing temperature.</i>			

Static Pressure Limit

Rosemount 3051CD Only

Operates within specifications between static line pressures of 0.5 psia and 3626 psig (4500 psig for Option Code P9).

Range 0: 0.5 psia and 750 psig

Range 1: 0.5 psia and 2000 psig

Burst Pressure Limits

Burst pressure on *Coplanar*, traditional, or 3051H process flange is 10000 psig (69 MPa).

Burst pressure for the 3051T is

Ranges 1–4: 11000 psi (75,8 MPa)

Range 5: 26000 psig (179 MPa)

Failure Mode Alarm

Output Code A

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 3.75 mA or to 21.75 mA to alert the user. NAMUR-compliant values are available, option code C4. High or low alarm signal is user-selectable by internal jumper.

Output Code M

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 0.94 V or above 5.4 V to alert the user (below 0.75 V or above 4.4 V for Option C2). High or low alarm signal is user-selectable by internal jumper.

Output Code F and W

If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Temperature Limits

Ambient

–40 to 185 °F (–40 to 85 °C)

With integral meter: –4 to 175 °F (–20 to 80 °C)

Storage

–50 to 230 °F (–46 to 110 °C)

With integral meter: –40 to 185 °F (–40 to 85 °C)

Process

At atmospheric pressures and above. See Table 4

Rosemount 3051

TABLE 4. 3051 Process Temperature Limits

3051CD, 3051CG, 3051CA	
Silicone Fill Sensor ⁽¹⁾	
with Coplanar Flange	-40 to 250 °F (-40 to 121 °C) ⁽²⁾
with Traditional Flange	-40 to 300 °F (-40 to 149 °C) ⁽²⁾⁽³⁾
with Level Flange	-40 to 300 °F (-40 to 149 °C) ⁽²⁾
with 305 Integral Manifold	-40 to 300 °F (-40 to 149 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (-18 to 85 °C) ⁽⁴⁾⁽⁵⁾
3051H (Process Fill Fluid)	
D.C.® Silicone 200 ⁽¹⁾	-40 to 375 °F (-40 to 191 °C)
Inert ⁽¹⁾	-50 to 350 °F (-45 to 177 °C)
Neobee M-20 ⁽¹⁾	0 to 375 °F (-18 to 191 °C)
3051T (Process Fill Fluid)	
Silicone Fill Sensor ⁽¹⁾	-40 to 250 °F (-40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	-22 to 250 °F (-30 to 121 °C) ⁽²⁾
3051L Low-Side Temperature Limits	
Silicone Fill Sensor ⁽¹⁾	-40 to 250 °F (-40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (-18 to 85 °C) ⁽²⁾
3051L High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	-100 to 300 °F (-73 to 149 °C)
D.C. Silicone 704®	60 to 400 °F (15 to 205 °C)
D.C. Silicone 200	-40 to 400 °F (-40 to 205 °C)
Inert	-50 to 350 °F (-45 to 177 °C)
Glycerin and Water	0 to 200 °F (-18 to 93 °C)
Neobee M-20	0 to 400 °F (-18 to 205 °C)
Propylene Glycol and Water	0 to 200 °F (-18 to 93 °C)

- (1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio (0.6:1 ratio for the 3051H).
- (2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.
- (3) 3051CD0 process temperature limits are -40 to 212 °F (-45 to 100 °C)
- (4) 160 °F (71 °C) limit in vacuum service.
- (5) Not available for 3051CA.

Humidity Limits

0–100% relative humidity

Turn-On Time

Performance within specifications less than 2.0 seconds (10.0 s for Profibus protocol) after power is applied to the transmitter

Volumetric Displacement

Less than 0.005 in³ (0,08 cm³)

Damping

Analog output response to a step input change is user-selectable from 0 to 36 seconds for one time constant. This software damping is in addition to sensor module response time.

PHYSICAL SPECIFICATIONS

Electrical Connections

¹/₂–14 NPT, PG 13.5, G¹/₂, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block.

Process Connections

All Models except 3051L and 3051T

¹/₄–18 NPT on 2¹/₈-in. centers

¹/₂–14 NPT on 2-, 2¹/₈-, or 2¹/₄-in. centers

Rosemount 3051L

High pressure side: 2-, 3-, or 4-in., ASME B 16.5 (ANSI) Class 150, 300 or 600 flange; 50, 80 or 100 mm, PN 40 or 10/16 flange

Low pressure side: ¹/₄–18 NPT on flange ¹/₂–14 NPT on adapter

Rosemount 3051T

¹/₂–14 NPT female. A DIN 16288 Male (available in SST for

Range 1–4 transmitters only), or Autoclave type F-250-C

(Pressure relieved ⁹/₁₆–18 gland thread; ¹/₄ OD high pressure tube 60° cone; available in SST for Range 5 transmitters only).

Process-Wetted Parts

Drain/Vent Valves

316 SST, Hastelloy C276, or Monel material (Monel not available with 3051L or 3051H)

Process Flanges and Adapters

Plated carbon steel, SST cast CF-8M (cast version of 316 SST, material per ASTM-A743), C-Type cast alloy CW12MW, or Monel cast alloy M30C

Wetted O-rings

Glass-filled PTFE or Graphite-filled PTFE

Process Isolating Diaphragms

Isolating Diaphragm Material	3051CD/CG	3051T	3051CA	3051H
316L SST	•	•	•	•
Hastelloy C276	•	•	•	•
Monel	•		•	
Tantalum	•			•
Gold-plated Monel	•		•	
Gold-plated SST	•		•	

Product Data Sheet

00813-0100-4001, Rev GA

Catalog 2006 - 2007

Rosemount 3051

Rosemount 3051L Process Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process Diaphragms, Including Process Gasket Surface

- 316L SST, *Hastelloy C276*, or Tantalum

Extension

- CF-3M (Cast version of 316L SST, material per ASTM-A743), or *Hastelloy C276*. Fits schedule 40 and 80 pipe.

Mounting Flange

- Zinc-cobalt plated CS or SST

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms

- 316L SST or *Hastelloy C276*

Reference Flange and Adapter

- CF-8M (Cast version of 316 SST, material per ASTM-A743)

Non-Wetted Parts

Electronics Housing

Low-copper aluminum or CF-3M (Cast version of 316L SST, material per ASTM-A743). NEMA 4X, IP 65, IP 66

Coplanar Sensor Module Housing

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Bolts

ASTM A449, Type 1 (zinc-cobalt plated carbon steel)

ASTM F593G, Condition CW1 (Austenitic 316 SST)

ASTM A193, Grade B7M (zinc plated alloy steel)

Monel K-500

Sensor Module Fill Fluid

Silicone oil (D.C. 200) or Fluorocarbon oil (Halocarbon or Fluorinert® FC-43 for 3051T)

Process Fill Fluid (3051L and 3051H only)

3051L: Syltherm XLT, D.C. Silicone 704,

D.C. Silicone 200, inert, glycerin and water, Neobee M-20 or propylene glycol and water

3051H: inert, Neobee M-20, or D.C. Silicone 200

Paint

Polyurethane

Cover O-rings

Buna-N

Shipping Weights

Refer to "Shipping Weights" on page 38

Product Certifications

Approved Manufacturing Locations

Rosemount Inc. — Chanhassen, Minnesota USA
Emerson Process Management GmbH & Co. — Wessling, Germany
Emerson Process Management Asia Pacific Private Limited — Singapore
Beijing Rosemount Far East Instrument Co., LTD — Beijing, China

European Directive Information

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting an Emerson Process Management representative.

ATEX Directive (94/9/EC)

All 3051 transmitters comply with the ATEX Directive.

European Pressure Equipment Directive (PED) (97/23/EC)

3051CA4; 3051CG2, 3, 4, 5; 3051CD2, 3, 4, 5
(also with P9 option); 3051HD2, 3, 4, 5; 3051HG2, 3, 4, 5;
3051PD2, 3; and 3051PG2, 3, 4, 5 Pressure Transmitters
— QS Certificate of Assessment - EC No. PED-H-20
Module H Conformity Assessment

All other 3051/3001 Pressure Transmitters

— Sound Engineering Practice

Transmitter Attachments: Diaphragm Seal - Process Flange - Manifold

— Sound Engineering Practice

Electro Magnetic Compatibility (EMC) (89/336/EEC)

All 3051 Pressure Transmitters meet all of the requirements of IECEN61326 and NAMUR NE-21

Ordinary Location Certification for Factory Mutual

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

HART PROTOCOL

Hazardous Locations Certifications

North American Certifications

FM Approvals

- E5** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1. T5 (Ta = 85 °C), Factory Sealed, Enclosure Type 4X
- I5** Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019; Non-incendive for Class I, Division 2, Groups A, B, C, and D. Temperature Code:T4 (Ta = 40 °C), T3 (Ta = 85 °C), Enclosure Type 4X
For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

- E6** Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed
- C6** Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C. Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

Product Data Sheet

00813-0100-4001, Rev GA
Catalog 2006 - 2007

Rosemount 3051

European Certifications


- I1** ATEX Intrinsic Safety and Dust
Certification No.: BAS 97ATEX1089X  II 1 GD
EEx ia IIC T5 ($-60 \leq T_a \leq +40 \text{ }^\circ\text{C}$)
EEx ia IIC T4 ($-60 \leq T_a \leq +70 \text{ }^\circ\text{C}$)
Dust Rating: T80 $^\circ\text{C}$ ($-20 \leq T_a \leq 40 \text{ }^\circ\text{C}$) IP66
CE 1180

TABLE 5. Input Parameters

$$U_i = 30\text{V}$$


$$I_i = 200 \text{ mA}$$

$$P_i = 0.9\text{W}$$

$$C_i = 0.012 \text{ } \mu\text{F}$$


Special Conditions for Safe Use (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

- N1** ATEX Type n and Dust
Certification No.: BAS 00ATEX3105X  II 3 GD
EEx nL IIC T5 ($-60 \leq T_a \leq +70 \text{ }^\circ\text{C}$)
 $U_i = 55 \text{ Vdc max}$
Dust rating: T80 $^\circ\text{C}$ ($-20 \leq T_a \leq 40 \text{ }^\circ\text{C}$) IP66
CE

Special Conditions for Safe Use (X):

When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500V r.m.s. test to case. This must be taken into account on any installation in which it is used, for example by assuring that the supply to the apparatus is galvanically isolated.

- E8** ATEX Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X  II 1/2 GD
EEx d IIC T6 ($-50 \leq T_a \leq 65 \text{ }^\circ\text{C}$)
EEx d IIC T5 ($-50 \leq T_a \leq 80 \text{ }^\circ\text{C}$)
Dust rating T90 $^\circ\text{C}$, IP66
CE 1180
 $V_{\text{max}} = 55 \text{ V dc}$

Special Conditions for Safe Use (X):

This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

Japanese Certifications

- E4** JIS Flame-Proof
Ex d IIC T6

Certificate	Description
C15850	3051C/D/1 4–20 mA HART — no meter
C15851	3051C/D/1 4–20 mA HART — with meter
C15854	3051T/G/1 4–20 mA HART, SST, Silicon — no meter
C15855	3051T/G/1 4–20 mA HART, Hastelloy C276, Silicon — no meter
C15856	3051T/G/1 4–20 mA HART, SST, Silicon — with meter
C15857	3051T/G/1 4–20 mA HART, Hastelloy C276, Silicon — with meter

- I4** JIS Intrinsic Safety
Ex ia IIC T4

Certificate	Description
C16406	3051CD/CG

Australian Certifications

- I7** SAA Intrinsic Safety
Certification No.: AUS Ex 1249X
Ex ia IIC T4 ($T_{\text{amb}} = 70 \text{ }^\circ\text{C}$)
Ex ia IIC T5 ($T_{\text{amb}} = 40 \text{ }^\circ\text{C}$)
IP66

When connected per Rosemount drawing 03031-1026

TABLE 6. Input Parameters

$$U_i = 30\text{V}$$

$$I_i = 200 \text{ mA}$$

$$I_i = 160 \text{ mA (output code A with T1)}$$

$$P_i = 0.9\text{W}$$

$$C_i = 0.01 \text{ } \mu\text{F}$$

$$C_i = 0.042 \text{ } \mu\text{F (output code M)}$$

$$L_i = 10 \text{ } \mu\text{H}$$

$$L_i = 1.05 \text{ mH (output code A with T1)}$$

$$L_i = 0.75 \text{ mH (output code M with T1)}$$

Special Conditions for Safe Use (X):

The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that $P_o \leq (U_o * I_o) / 4$. Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth. The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

Rosemount 3051

E7 SAA Explosion-Proof (Flame-Proof)
Certification No.: AUS Ex 03.1347X
Ex d IIC T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
Ex d IIC T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)
DIP A21 T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
DIP A21 T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)
IP66

Special Conditions for Safe Use (X):

It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

N7 SAA Type n (Non-sparking)
Certification No.: AUS Ex 1249X
Ex n IIC T4 ($T_{amb} = 70\text{ }^{\circ}\text{C}$)
Ex n IIC T5 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)
IP66

Special Conditions for Safe Use (X):

Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

- K5** E5 and I5 combination
- KB** K5 and C6 combination
- KD** K5, C6, I1, and E8 combination
- K6** C6, I1, and E8 combination
- K8** E8 and I1 combination
- K7** E7, I7, and N7 combination

FIELDBUS PROTOCOL

Hazardous Locations Certifications

North American Certifications

FM Approvals

E5 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1.

T5 (Ta = 85 °C), Factory Sealed, Enclosure Type 4X

I5 Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019; Non-incendive for Class I, Division 2, Groups A, B, C, and D.

Temperature Code:T4 (Ta = 40 °C), T3 (Ta = 85 °C), Enclosure Type 4X

For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

E6 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed

C6 Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.

Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed

For input parameters see control drawing 03031-1024.

European Certifications


I1 ATEX Intrinsic Safety and Dust
Certification No.: BAS 98ATEX1355X  II 1 GD
EEx ia IIC T4 (T_{amb} = -60 to +60 °C)
Dust Rating: T70 °C (T_{amb} -20 to 40 °C) IP66
CE 1180

TABLE 7. Input Parameters

U_i = 30V


I_i = 300 mA

P_i = 1.3 W

C_i = 0 μF

Special Conditions for Safe Use (X):

The device is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

IA ATEX FISCO Intrinsic Safety
Certification No.: BAS 98ATEX1355X  II 1 G
EEx ia IIC T4 (T_{amb} = -60 to +60 °C)
IP66

CE 1180

TABLE 8. Input Parameters

U_i = 17.5 V

I_i = 380 mA


P_i = 5.32 W

C_i = ≤ 5 μF

L_i = ≤ 10 μH


Special Conditions for Safe Use (X):

The device is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

N1 ATEX Type n and Dust
Certification No.: BAS 98ATEX3356X  II 3 GD
EEx nL IIC T5 (T_{amb} = -40 to +70 °C)
U_i = 40 Vdc max
Dust rating: T80 °C (T_{amb} = -20 to 40 °C) IP66

Special Conditions for Safe Use (X):

The device is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

E8 ATEX Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X  II 1/2 GD
EEx d IIC T6 (T_{amb} = -50 to 65 °C)
EEx d IIC T5 (T_{amb} = -50 to 80 °C)
Dust rating T90 °C, IP66
CE 1180
V_{max} = 55 V dc

Special Conditions for Safe Use (X):

This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

Rosemount 3051

Japanese Certifications

E4 JIS Flame-Proof
Ex d IIC T6

Certificate	Description
C15852	3051C/D/1 FOUNDATION Fieldbus — no meter
C15853	3051C/D/1 FOUNDATION Fieldbus — with meter
C15858	3051T/G/1 FOUNDATION Fieldbus, SST, Silicon — no meter
C15859	3051T/G/1 FOUNDATION Fieldbus, Hastelloy C276, Silicon — no meter
C15860	3051T/G/1 FOUNDATION Fieldbus, SST, Silicon — with meter
C15861	3051T/G/1 FOUNDATION Fieldbus, Hastelloy C276, Silicon — with meter

Australian Certifications

I7 SAA Intrinsic Safety
Certification No.: AUS Ex 1249X
Ex ia IIC T4 (T_{amb} = 60 °C)
IP66

When connected per Rosemount drawing 03031-1026.

TABLE 9. Input Parameters

U_i = 30 V

I_i = 300 mA

P_i = 1.3 W

C_i = 0 μF

L_i = 0 μH

Special Conditions for Safe Use (X):

The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that $P_o \leq (U_o * I_o) / 4$. Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth. The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

E7 SAA Explosion-Proof (Flame-Proof)

Certification No.: AUS Ex 1347X

Ex d IIC T6 (T_{amb} = 40 °C)

Ex d IIC T5 (T_{amb} = 80 °C)

DIP A21 T6 (T_{amb} = 40 °C)

DIP A21 T5 (T_{amb} = 80 °C)

IP65

Special Conditions for Safe Use (X):

It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

N7 SAA Type n (Non-sparking)

Certification No.: AUS Ex 1249X

Ex n IIC T4 (T_{amb} = 70 °C)

Ex n IIC T5 (T_{amb} = 40 °C)

IP66

Special Conditions for Safe Use (X):

Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

K5 E5 and I5 combination

KB K5 and C6 combination

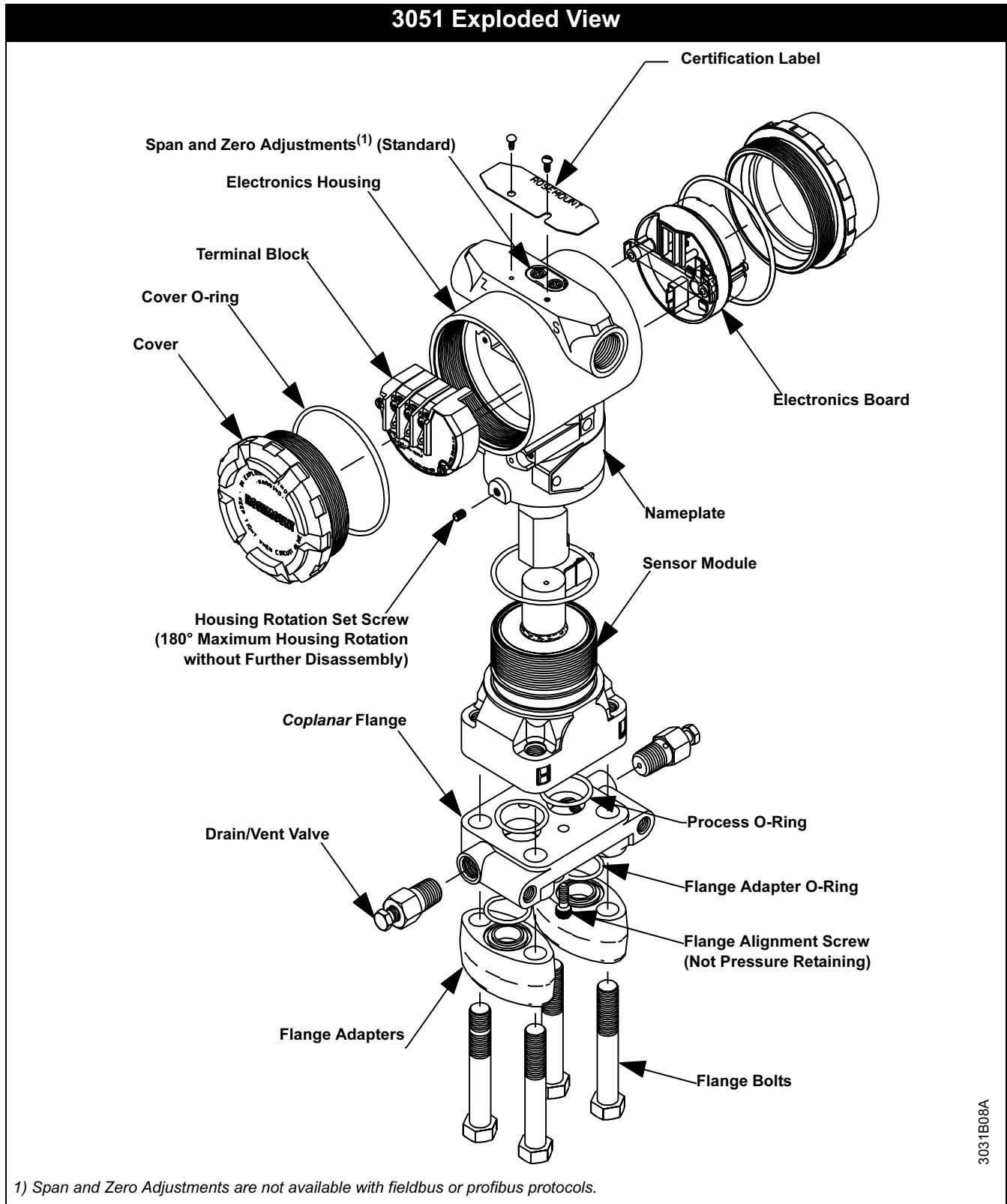
KD K5, C6, I1, and E8 combination

K6 C6, I1, and E8 combination

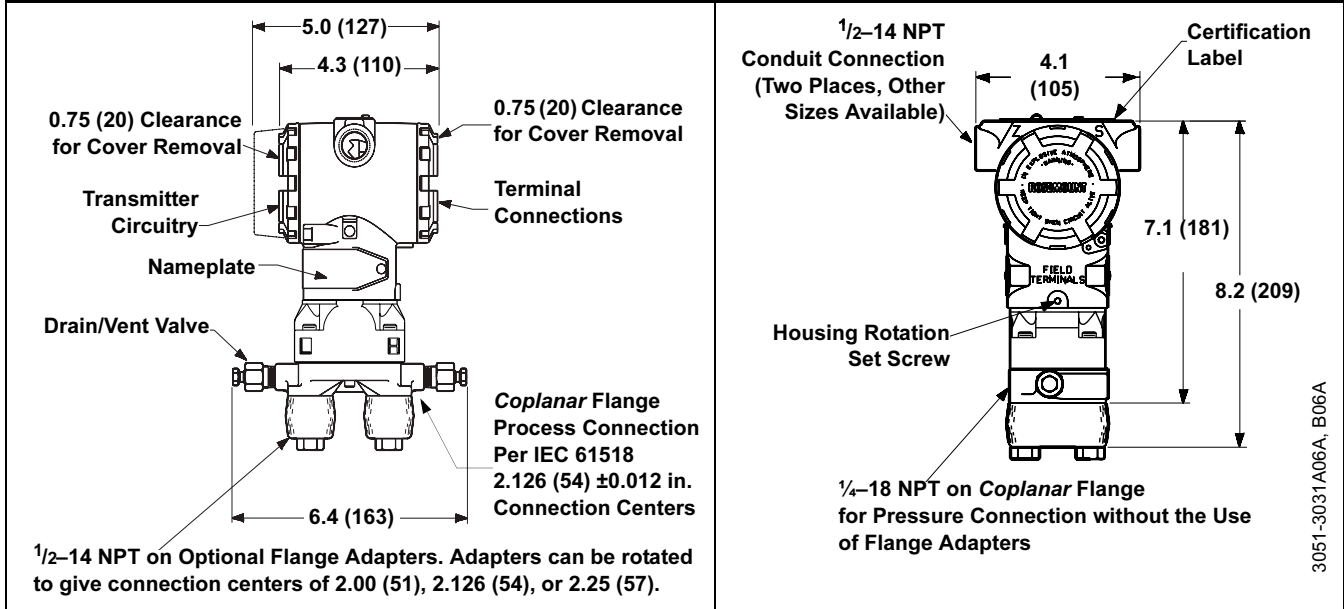
K8 E8 and I1 combination

K7 E7, I7, and N7 combination

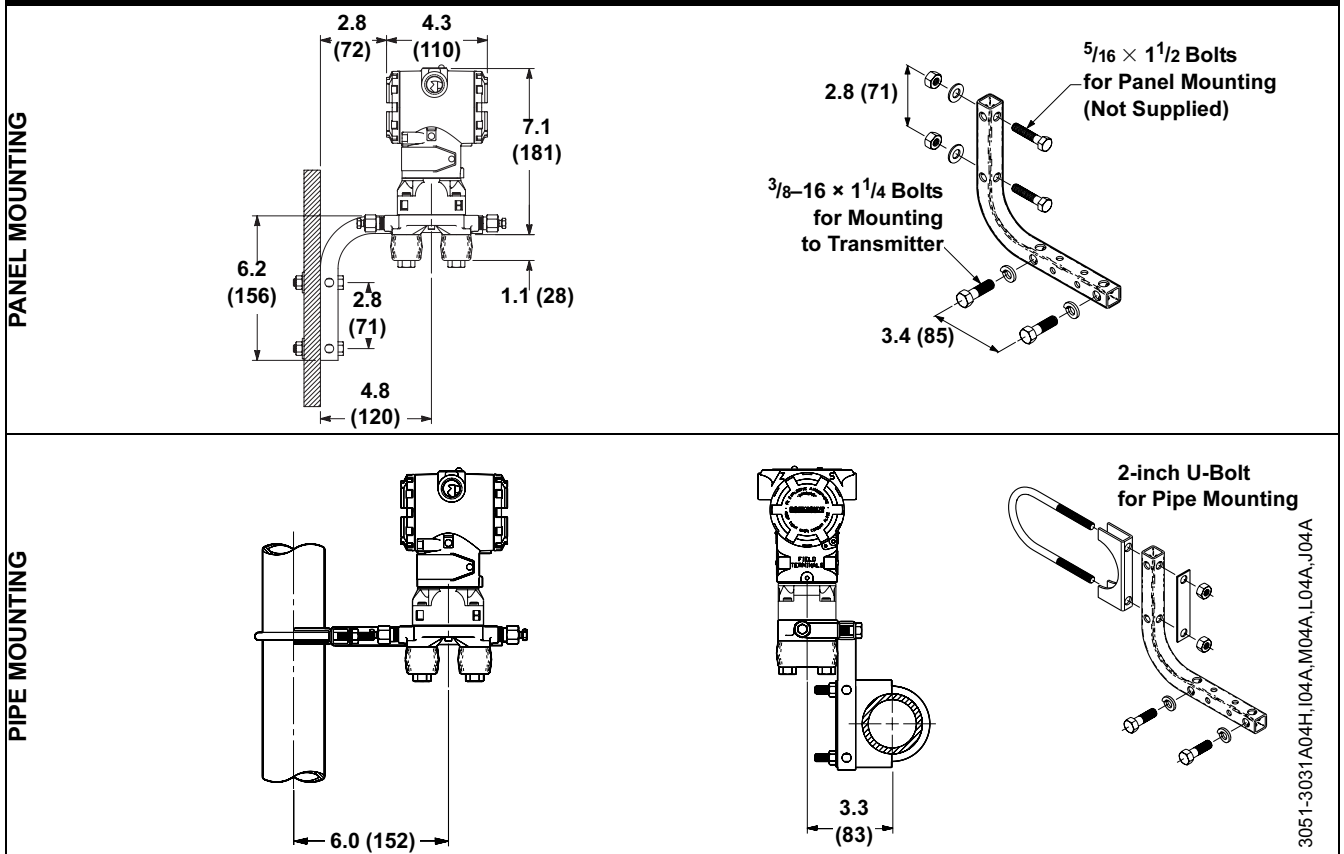
Dimensional Drawings



3051C Coplanar Flange Dimensional Drawing (Differential Pressure Transmitter Shown)



Coplanar Flange Mounting Configurations with Optional Bracket (B4) for 2-in. Pipe or Panel Mounting

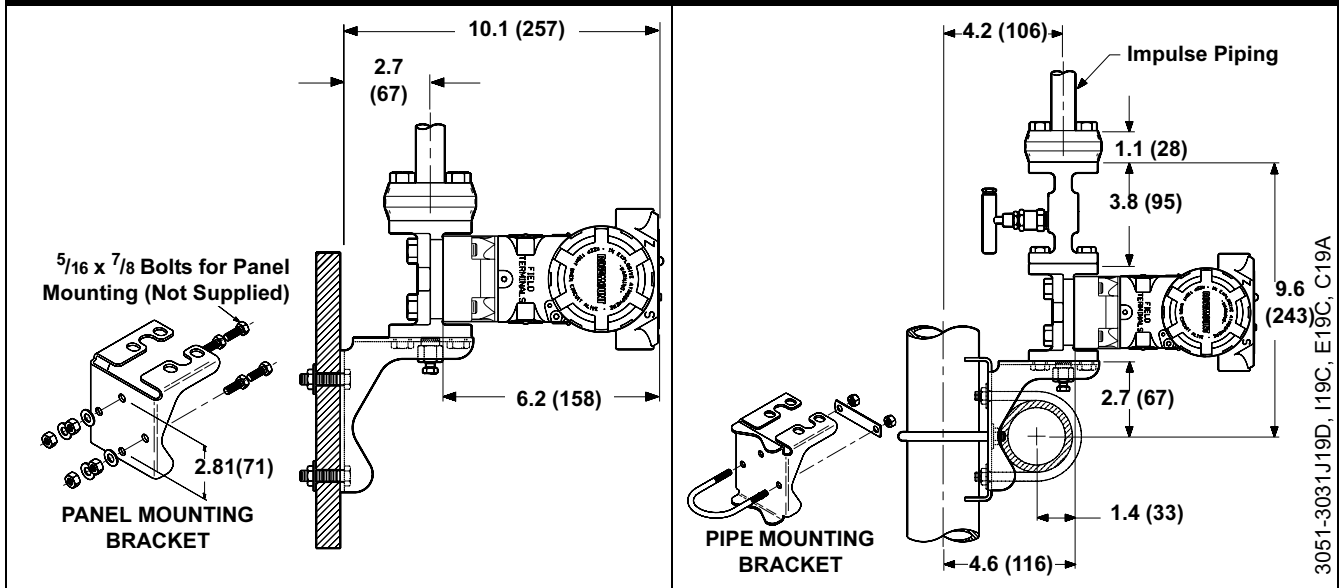


Dimensions are in inches (millimeters)

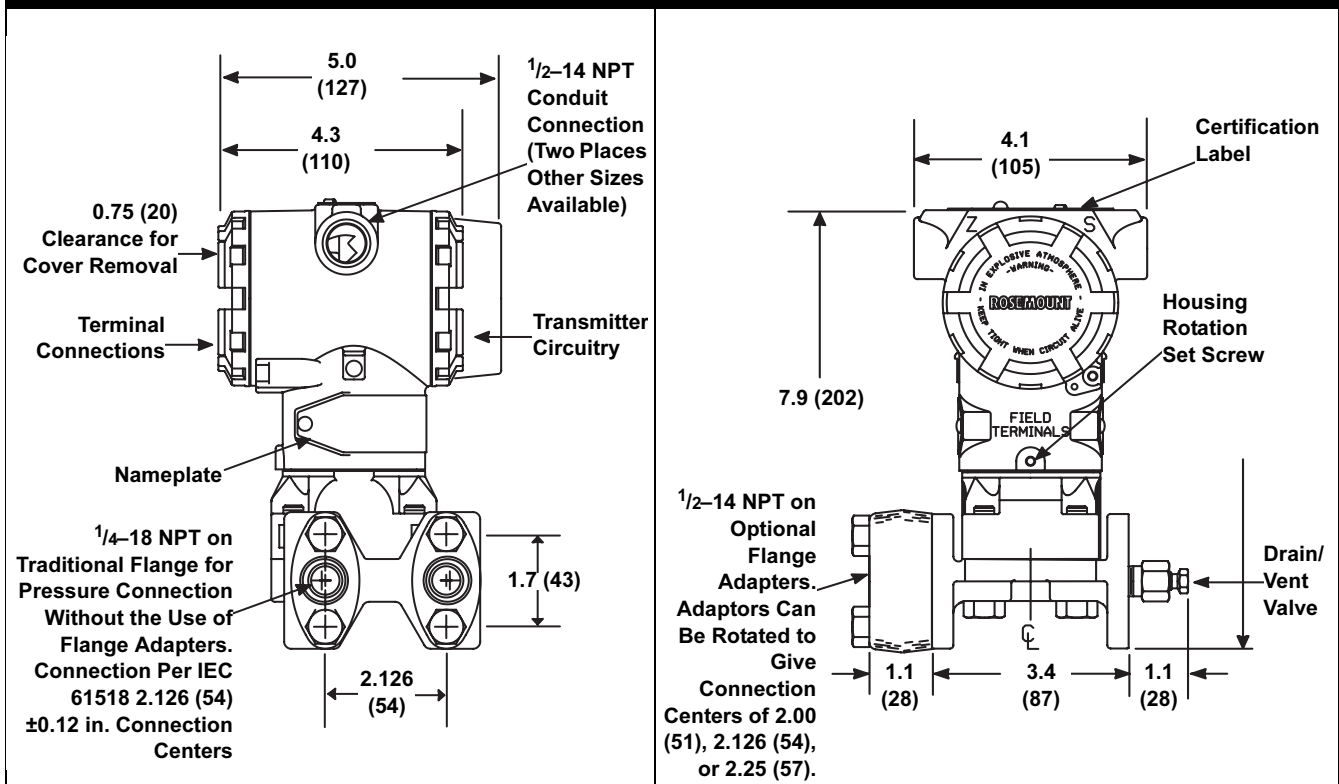
**Traditional Flange Mounting Configurations with
 Optional Brackets for 2-in. Pipe or Panel Mounting**

Traditional Flange Panel Mounting Bracket (option B2/B8)

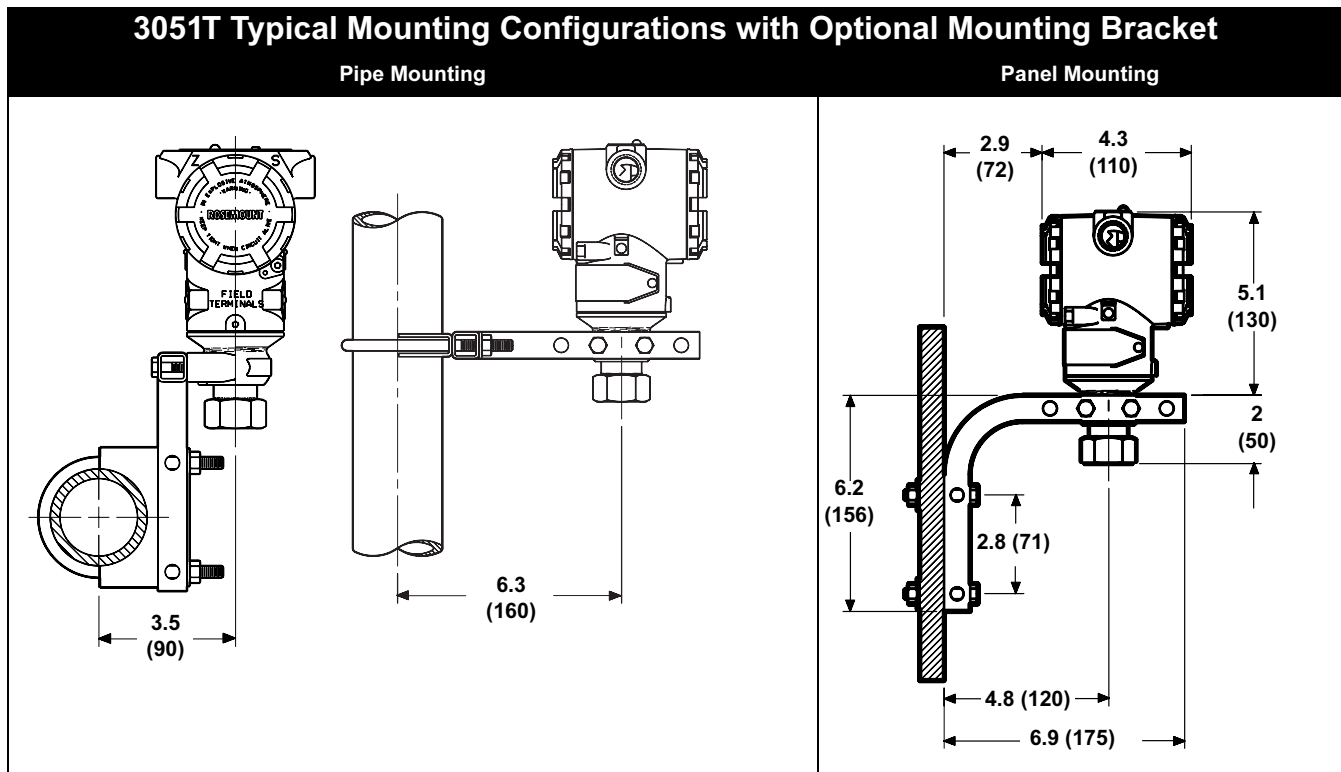
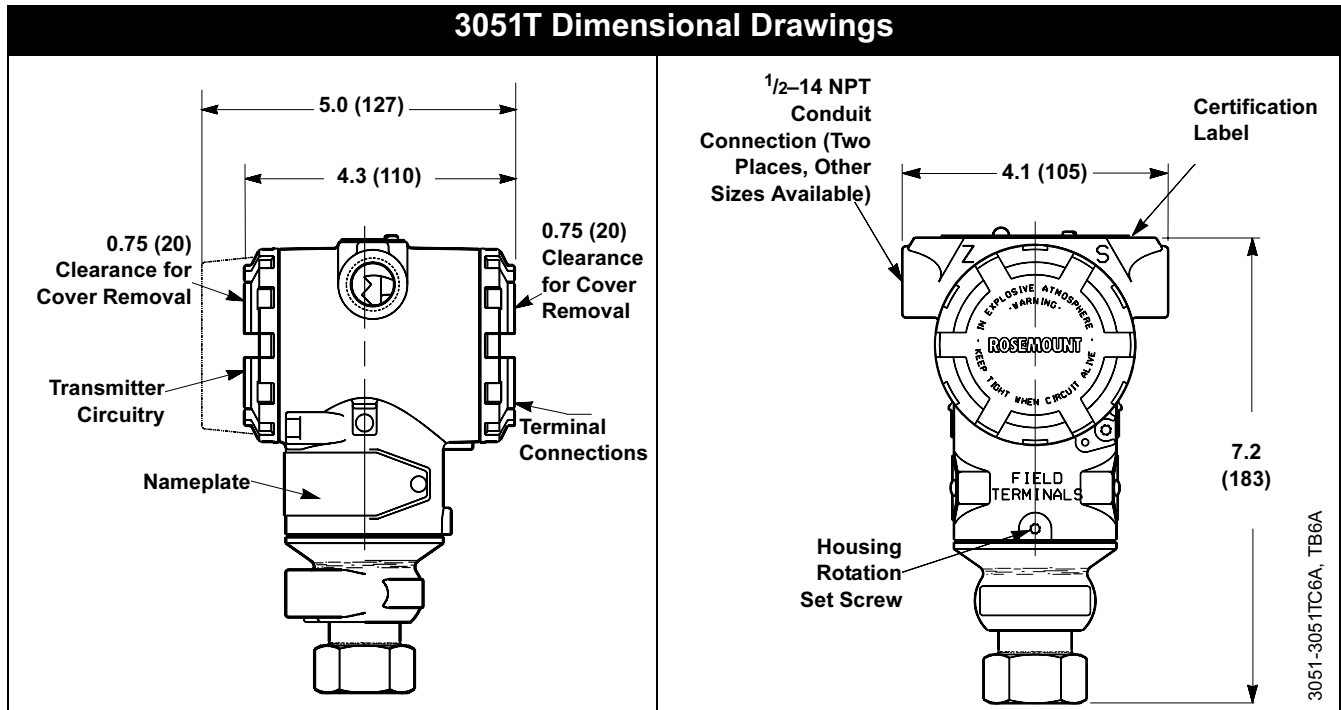
Traditional Flange 2-in. Pipe Mounting Bracket (option B1/B7/BA)



Traditional Flange (Options H2–H7) Dimensional Drawing

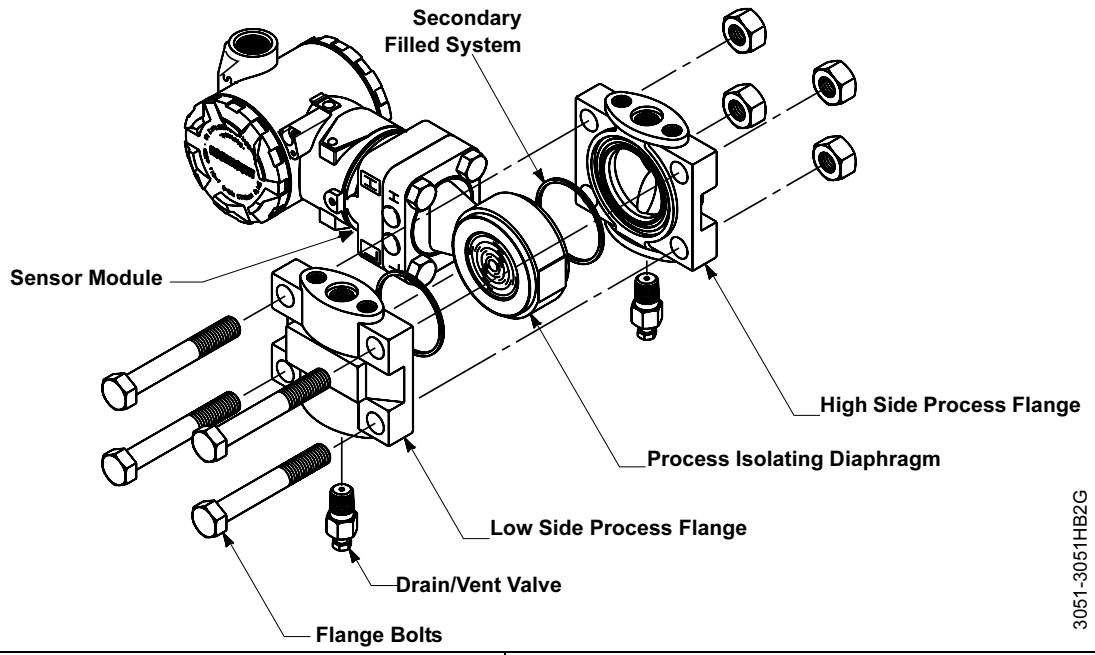


Dimensions are in inches (millimeters)

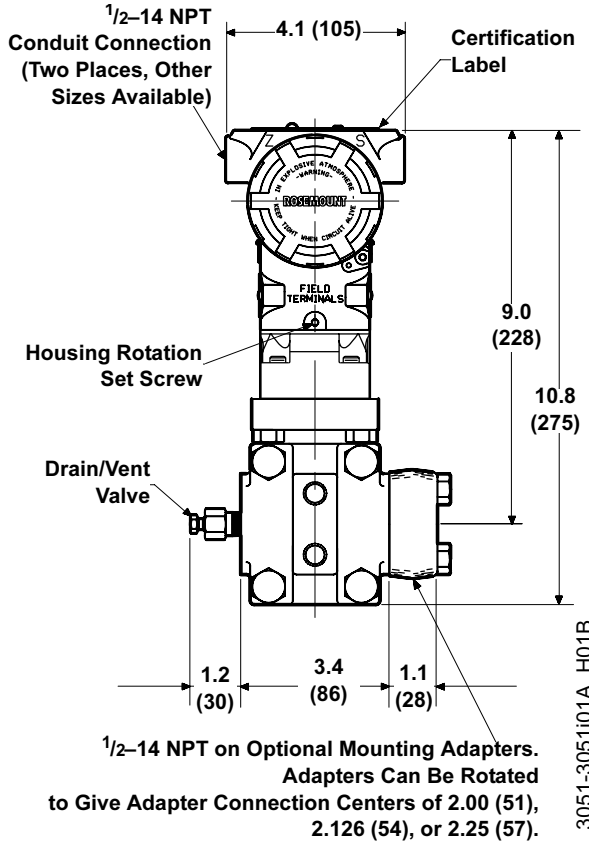
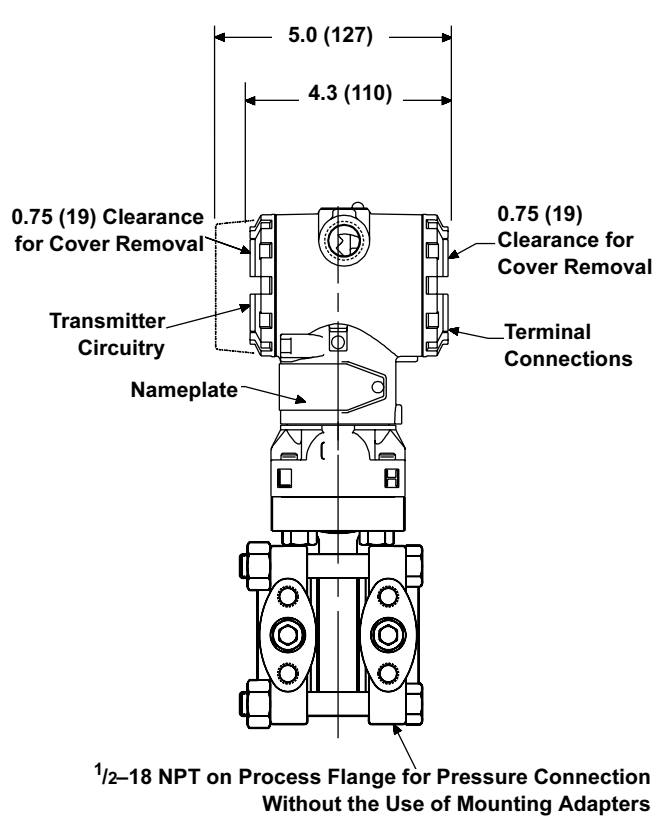


Dimensions are in inches (millimeters)

3051H Pressure Transmitter Exploded View and Dimensional Drawings



3051-3051HB2G

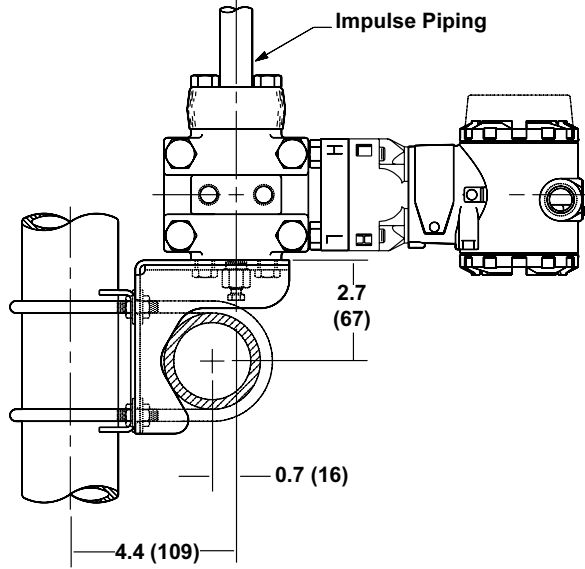
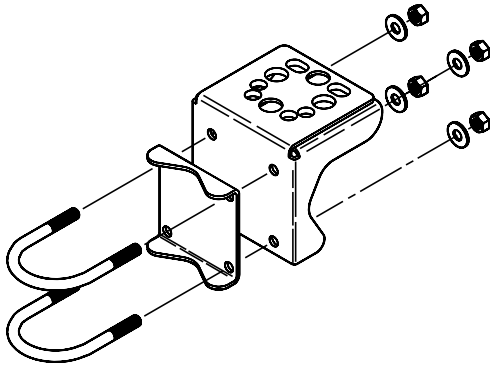


3051-3051H01A, H01B,
 3051-3051TA4A, TB4A, TC4A

Dimensions are in inches (millimeters)

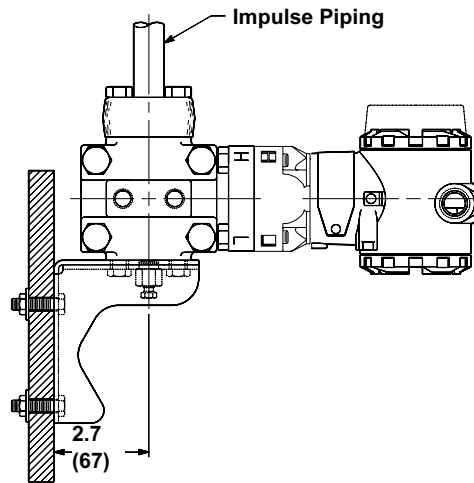
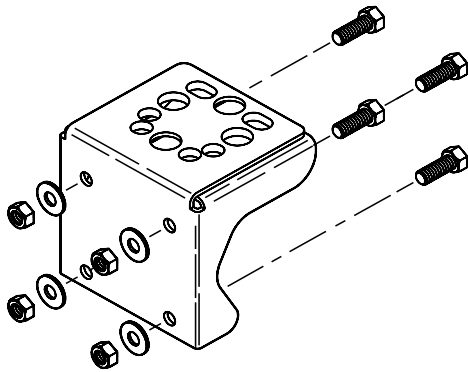
3051H Mounting Brackets for 2-in. Pipe and Panel Mount (Option Code B5/B6)

PIPE MOUNTING CONFIGURATION



PANEL MOUNTING CONFIGURATION

$\frac{7}{16}$ - $20 \times \frac{3}{4}$ Bolts Supplied for Attaching Bracket to Transmitter



3051-3031G19A, F19B, 3051HB3A, HA3B

Dimensions are in inches (millimeters)

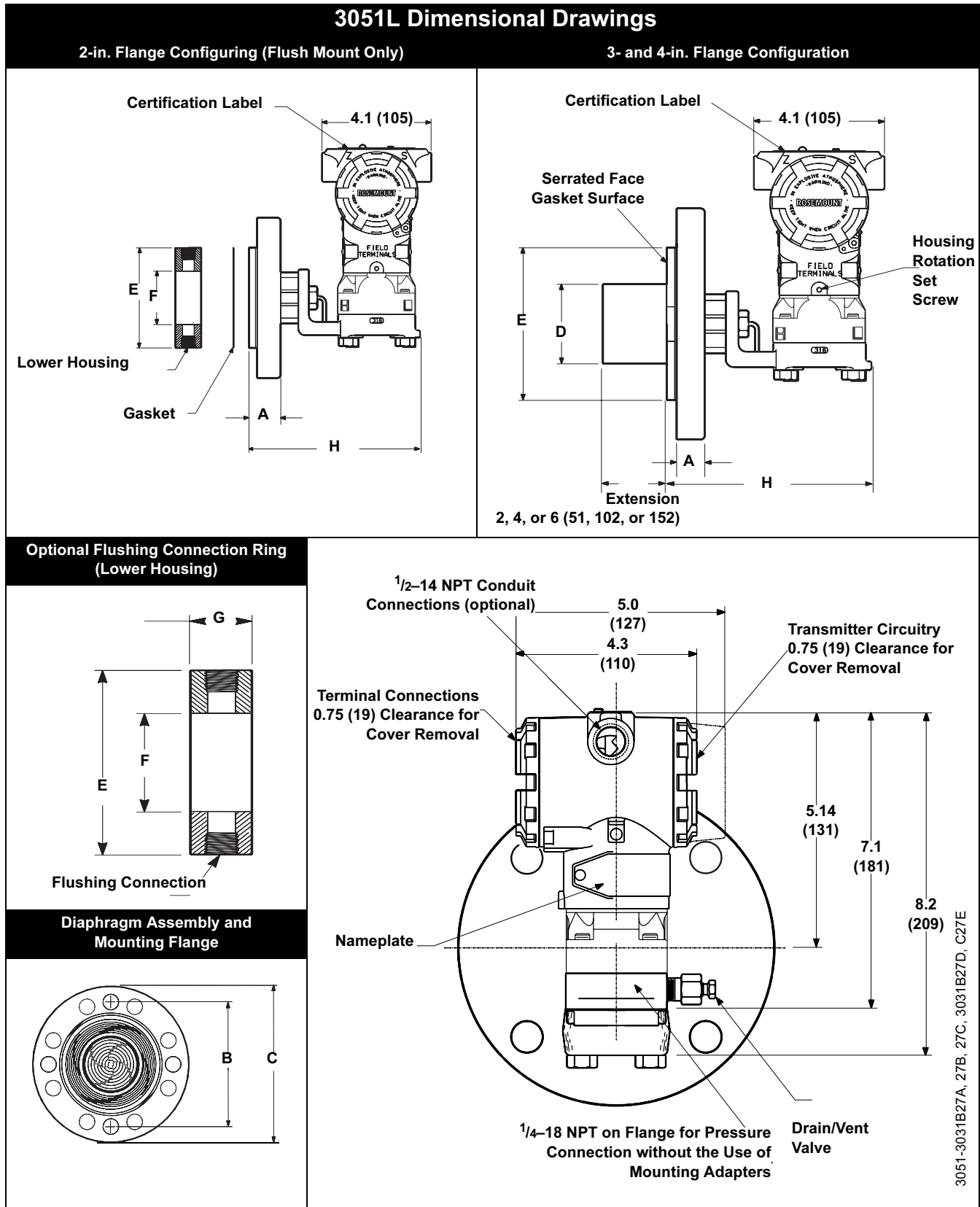


TABLE 10. 3051L Dimensional Specifications
Except where indicated, dimensions are in inches (millimeters).

Class	Pipe Size	Flange Thickness A	Bolt Circle Diameter B	Outside Diameter C	No. of Bolts	Bolt Hole Diameter	Extension Diameter ⁽¹⁾ D	O.D. Gasket Surface E
ASME B16.5 (ANSI) 150	2 (51)	0.69 (18)	4.75 (121)	6.0 (152)	4	0.75 (19)	NA	3.6 (92)
	3 (76)	0.88 (22)	6.0 (152)	7.5 (191)	4	0.75 (19)	2.58 (66)	5.0 (127)
	4 (102)	0.88 (22)	7.5 (191)	9.0 (229)	8	0.75 (19)	3.5 (89)	6.2 (158)
ASME B16.5 (ANSI) 300	2 (51)	0.82 (21)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)
	3 (76)	1.06 (27)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)
	4 (102)	1.19 (30)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.2 (158)
ASME B16.5 (ANSI) 600	2 (51)	1.00 (25)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)
	3 (76)	1.25 (32)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)
DIN 2501 PN 10–40	DN 50	20 mm	125 mm	165 mm	4	18 mm	NA	4.0 (102)
DIN 2501 PN 25/40	DN 80	24 mm	160 mm	200 mm	8	18 mm	65 mm	5.4 (138)
	DN 100	24 mm	190 mm	235 mm	8	22 mm	89 mm	6.2 (158)
DIN 2501 PN 10/16	DN 100	20 mm	180 mm	220 mm	8	18 mm	89 mm	6.2 (158)

Class	Pipe Size	Process Side F	Lower Housing G		H
			1/4 NPT	1/2 NPT	
ASME B16.5 (ANSI) 150	2 (51)	2.12 (54)	0.97 (25)	1.31 (33)	6.66 (169)
	3 (76)	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
	4 (102)	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
ASME B16.5 (ANSI) 300	2 (51)	2.12 (54)	0.97 (25)	1.31 (33)	6.66 (169)
	3 (76)	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
	4 (102)	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
ASME B16.5 (ANSI) 600	2 (51)	2.12 (54)	0.97 (25)	1.31 (33)	8.66 (219)
	3 (76)	3.6 (91)	0.97 (25)	1.31 (33)	8.66 (219)
DIN 2501 PN 10–40	DN 50	2.4 (61)	0.97 (25)	1.31 (33)	6.66 (169)
DIN 2501 PN 25/40	DN 80	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
	DN 100	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)
DIN 2501 PN 10/16	DN 100	3.6 (91)	0.97 (25)	1.31 (33)	6.66 (169)

(1) Tolerances are 0.040 (1.02), -0.020 (0.51).

Ordering Information

TABLE 11. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Model	Transmitter Type (Select One)			CD	CG	CA
3051CD	Differential Pressure Transmitter			•	—	—
3051CG	Gage Pressure Transmitter			—	•	—
3051CA	Absolute Pressure Transmitter			—	—	•
	3051CD	3051CG ⁽¹⁾	3051CA	CD	CG	CA
0 ⁽²⁾	–3 to 3 inH ₂ O/0.1 inH ₂ O (–7,5 to 7,5 mbar/0,25 mbar)	Not Applicable	Not Applicable	•	—	•
1	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)	•	•	•
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/0,1 bar)	•	•	•
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–393 to 1000 inH ₂ O/10 in H ₂ O (–0,98 to 2,5 bar/25 mbar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)	•	•	•
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)	–14.2 to 300 psi/3 psi (–0,98 to 20,7 bar/0,2 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)	•	•	•
5	–2000 to 2000 psi/20 psi (–137,9 to 137,9 bar/1,4 bar)	–14.2 to 2000 psig/20 psi (–0,98 to 137,9 bar/1,4 bar)	Not Applicable	•	•	—
Code	Output			CD	CG	CA
A	4–20 mA with Digital Signal Based on HART Protocol			•	•	•
M ⁽³⁾	Low-Power, 1–5 V dc with Digital Signal Based on HART Protocol (See Option C2 for 0.8–3.2 V dc)			•	•	•
F	FOUNDATION fieldbus Protocol			•	•	•
W	Profibus — PA			•	•	•
Code	Materials of Construction			CD	CG	CA
	Process Flange Type	Flange Material	Drain/Vent			
2	Coplanar	SST	SST	•	•	•
3 ⁽⁴⁾	Coplanar	Alloy C	Hastelloy C276	•	•	•
4	Coplanar	Monel	Monel	•	•	•
5	Coplanar	Plated CS	SST	•	•	•
7 ⁽⁴⁾	Coplanar	SST	Hastelloy C276	•	•	•
8 ⁽⁴⁾	Coplanar	Plated CS	Hastelloy C276	•	•	•
0	Alternate Flange—See Options on page 26			•	•	•
Code	Isolating Diaphragm			CD	CG	CA
2 ⁽⁴⁾	316L SST			•	•	•
3 ⁽⁴⁾	Hastelloy C276			•	•	•
4	Monel			•	•	•
5	Tantalum (Available on 3051CD and CG, Ranges 2–5 only. Not available on 3051CA)			•	•	—
6	Gold-plated Monel (Use in combination with O-ring Option Code B.)			•	•	•
7	Gold-plated SST			•	•	•
Code	O-ring					
A	Glass-filled PTFE			•	•	•
B	Graphite-filled PTFE			•	•	•
Code	Fill Fluid			CD	CG	CA
1	Silicone			•	•	•
2	Inert fill (Halocarbon)			•	•	—

Rosemount 3051

TABLE 11. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Housing Material	Conduit Entry Size	CD	CG	CA
A	Polyurethane-covered Aluminum	½–14 NPT	•	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•	•
D	Polyurethane-covered Aluminum	G½	•	•	•
J	SST	½–14 NPT	•	•	•
K	SST	M20 × 1.5 (CM20)	•	•	•
L	SST	PG 13.5	•	•	•
M	SST	G½	•	•	•
Code	PlantWeb Functionality		CD	CG	CA
A01	Advanced Control Function Block Suite		•	•	•
D01	FOUNDATION fieldbus Diagnostics Suite		•	•	•
Code	Alternate Flange Options (Requires Materials of Construction Code 0)		CD	CG	CA
H2	Traditional Flange, 316 SST, SST Drain/Vent		•	•	•
H3 ⁽⁴⁾	Traditional Flange, Alloy C, Hastelloy C276 Drain/Vent		•	•	•
H4	Traditional Flange, Monel, Monel Drain/Vent		•	•	•
H7 ⁽⁴⁾	Traditional Flange, 316 SST, Hastelloy C276 Drain/Vent		•	•	•
HJ	DIN Compliant Traditional Flange, SST, 7/16 in. Adapter/Manifold Bolting		•	•	•
HK	DIN Compliant Traditional Flange, SST, 10 mm Adapter/Manifold Bolting		•	•	•
HL	DIN Compliant Traditional Flange, SST, 12mm Adapter/Manifold Bolting (Not available on 3051CD0)		•	•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount		•	•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount		•	•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount		•	•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount		•	•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount		•	•	•
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount		•	•	•
Code	Integral Mount Manifold Options (Requires Materials of Construction Code 0)		CD	CG	CA
S5	Assemble to Rosemount 305 Integral Manifold (specified separately, see the Rosemount 305 and 306 Integral Manifolds PDS (document number 00813-0100-4733))		•	•	•
Code	Integral Mount Primary Elements (Optional)		CD	CG	CA
S4	Factory Assembly to Rosemount Primary Element (Rosemount Annubar or Rosemount 1195 Integral Orifice) <i>(With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only)</i>		•	—	—
S3	Factory Assembly to Rosemount 405 Primary Element		•	—	—
Code	Diaphragm Seal Assemblies (Optional)		CD	CG	CA
	NOTE: Standard flange and adapter bolts are austenitic 316 SST.		CD	CG	CA
S1	One Diaphragm Seal (Direct Mount or Capillary Connection Type)		•	•	•
S2	Two Diaphragm Seals (Direct Mount or Capillary Connection Type)		•	—	—
Code	Optional All Welded Diaphragm Seal Systems (for high vacuum applications)		CD	CG	CA
	NOTE: Standard flange and adapter bolts are austenitic 316 SST.		CD	CG	CA
S7	One Diaphragm Seal, All-Welded System (Capillary Connection Type)		•	•	•
S8	Two Diaphragm Seals, All-Welded System (Capillary Connection Type)		•	—	—
S0	One Diaphragm Seal, All-Welded System (Direct Mount Connection Type)		•	•	•
S9	Two Diaphragm Seals, All-Welded System (One Direct Mount and One Capillary Connection Type)		•	—	—

Product Data Sheet

00813-0100-4001, Rev GA
 Catalog 2006 - 2007

Rosemount 3051

TABLE 11. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Mounting Bracket Options	CD	CG	CA
B4	Coplanar Flange Bracket for 2-in. Pipe or Panel Mounting, all SST	•	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	•	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	•	•	•
B3	Traditional Flange Flat Bracket for 2-in. Pipe Mounting, CS Bolts	•	•	•
B7	B1 Bracket with Series 300 SST Bolts	•	•	•
B8	B2 Bracket with Series 300 SST Bolts	•	•	•
B9	B3 Bracket with Series 300 SST Bolts	•	•	•
BA	SST B1 Bracket with Series 300 SST Bolts	•	•	•
BC	SST B3 Bracket with Series 300 SST Bolts	•	•	•
Code	Hazardous Locations Certification Options	CD	CG	CA
E5	FM Explosionproof Approval	•	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•	•
K5	FM Explosionproof and Intrinsic Safety Approval	•	•	•
I1 ⁽⁵⁾	ATEX Intrinsic Safety and Dust Certification	•	•	•
N1 ⁽⁵⁾	ATEX Type N and Dust Certification	•	•	•
E8	ATEX Flame-proof and Dust Certification	•	•	•
E4 ⁽⁵⁾	JIS Flame-proof Certification			
	JIS Intrinsic Safety Certification (<i>Only available with HART Option Code A</i>)			—
C5 ⁽⁶⁾	Measurement Canada Accuracy Approval (<i>Limited availability depending on transmitter type and range. Contact an Emerson Process Management representative</i>)			
C6	CSA Explosion-proof and Intrinsic Safety Approval	•	•	•
K6 ⁽⁵⁾	CSA and ATEX Explosion-proof and Intrinsic Safety Approval (combination of C6 and K8)	•	•	•
KB	FM and CSA Explosion-proof and Intrinsic Safety Approvals (combination of K5 and C6)	•	•	•
K7	SAA Flame-proof and Intrinsic Safety Approvals (combination of I7, N7, and E7)	•	•	•
K8 ⁽⁵⁾	ATEX Flame-proof and Intrinsic Safety Approvals (combination of I1 and E8)	•	•	•
KD ⁽⁵⁾	FM, CSA, and ATEX Explosion-proof and Intrinsically Safe combination of K5, C6, I1, and E8	•	•	•
I7	SAA Intrinsic Safety Certification	•	•	•
E7	SAA Flame-proof Certification	•	•	•
N7	SAA Type N Certification	•	•	•
IA	ATEX Intrinsic Safety for FISCO; for <i>FOUNDATION</i> fieldbus protocol only	•	•	•
Code	Bolting Options	CD	CG	CA
L4	Austenitic 316 SST Bolts	•	•	•
L5	ASTM A 193, Grade B7M Bolts	•	•	•
L6	Monel Bolts	•	•	•
Code	Meters (Optional)	CD	CG	CA
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•	•

Rosemount 3051

TABLE 11. 3051C Differential, Gage, and Absolute Pressure Transmitters — = Not Applicable • = Applicable

Code	Other Options	CD	CG	CA
Q4	Calibration Data Sheet	•	•	•
Q8	Material Traceability Certification per EN 10204 3.1.B (Only available for the sensor module housing and Coplanar or traditional flanges and adapters (3051C), and for the sensor module housing and low-volume Coplanar flange and adapter (3051C with Option Code S1))			
Q16	Surface finish certification for sanitary remote seals			
QP	Calibration certification and tamper evident seal			
QS	Certificate of FMEDA Data			
J1 ⁽⁶⁾⁽⁷⁾	Local Zero Adjustment Only			
J3 ⁽⁶⁾⁽⁷⁾	No Local Zero or Span Adjustment			
T1	Transient Protection Terminal Block			
C1 ⁽⁶⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•	•
C2 ⁽⁶⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)			
C3	Gage Calibration (3051CA4 only)	—	—	•
C4 ⁽⁶⁾⁽⁸⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43			
CN ⁽⁶⁾⁽⁸⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43 Alarm Configuration—Low			
P1	Hydrostatic Testing with Certificate	•	•	•
P2	Cleaning for Special Service	•	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•	•
P4	Calibrate at line pressure (Specify Q48 on order for corresponding certificate)	•	•	•
DF	1/2 -14 NPT flange adapter(s)— Material determined by flange material	•	•	•
D7	Coplanar Flange Without Drain/Vent Ports	•	•	•
D8	Ceramic Ball Drain/Vents	•	•	•
D9	JIS Process Connection—RC 1/4 Flange with RC 1/2 Flange Adapter	•	•	•
P8	0.04% accuracy to 5:1 turndown (Range 2-4)	•	•	•
P9	4500 psig Static Pressure Limit (3051CD Ranges 2–5 only)	•	—	—
V5 ⁽⁹⁾	External Ground Screw Assembly	•	•	•
Typical Model Number: 3051CD 2 A 2 2 A 1 A B4				

- (1) 3051CG lower range limit varies with atmospheric pressure.
- (2) 3051CD0 is available only with Output Code A, Process Flange Code 0 (Alternate Flange H2, H7, HJ, or HK), Isolating Diaphragm Code 2, O-ring Code A, and Bolting Option L4.
- (3) Not available with hazardous locations certification Options Codes I1, N1, E4, K6 and K8.
- (4) Materials of Construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.
- (5) Not available with Low Power code M.
- (6) Not available with Fieldbus (output code F) or Profibus (output code W).
- (7) Local zero and span adjustments are standard unless Option Code J1 or J3 is specified
- (8) NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.
- (9) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

TABLE 12. 3051T Gage and Absolute Pressure Transmitter

Model	Transmitter Type	
3051T	Pressure Transmitter	
Code	Pressure Type	
G	Gage	
A	Absolute	
Code	Pressure Ranges (Range/Min. Span)	
	3051TG ⁽¹⁾	3051TA
1	-14.7 to 30 psi/0.3 psi (-1,01 to 2,1 bar/20,7 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)
2	-14.7 to 150 psi/1.5 psi (-1,01 to 10,3 bar/103,4 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/103,4 mbar)
3	-14.7 to 800 psi/8 psi (-1,01 to 55,2 bar/0,55 bar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)
4	-14.7 to 4000 psi/40 psi (-1,01 to 275,8 bar/2,8 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)
5	-14.7 to 10000 psi/2000 psi (-1,01 to 689,5 bar/138 bar)	0 to 10000 psia/2000 psia (0 to 689,5 bar/138 bar)
Code	Output	
A	4–20 mA with Digital Signal Based on HART Protocol	
M	Low-Power 1–5 V dc with Digital Signal Based on HART Protocol (See Option Code C2 for 0.8–3.2 V dc Output) (Not available with hazardous certification Option Codes I1, N1, E4, K6 or K8)	
F	FOUNDATION fieldbus Protocol	
W	Profibus — PA	
Code	Process Connection Style	
2B	1/2–14 NPT Female	
2C	G1/2 A DIN 16288 Male (Available in SST for Range 1–4 only)	
2F	Coned and Threaded, Compatible with Autoclave Type F-250-C (Only available in SST for Range 5)	
Code	Isolating Diaphragm	Process Connection Wetted Parts Material
2 ⁽²⁾	316L SST	316L SST
3 ⁽²⁾	Hastelloy C276	Hastelloy C276
Code	Fill Fluid	
1	Silicone	
2	Inert (Fluorinert [®] FC-43)	
Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	1/2–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G1/2
J	SST	1/2–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G1/2
Code	PlantWeb Functionality	
A01	Advanced Control Function Block Suite	
D01	FOUNDATION fieldbus Diagnostics Suite	
Code	Integral Mount Manifold (Optional)	
S5	Assemble to Rosemount 306 Integral Manifold (specified separately, see the Rosemount 305 and 306 Integral Manifolds PDS (document number 00813-0100-4733)) (Requires 1/2-in. process connection code 2B)	
Code	Remote Diaphragm Seals Assemblies (Optional)	
S1	One remote diaphragm seal (Direct Mount or Capillary Connection Type) (Requires Process Connection Style code 2B)	
Code	Mounting Brackets (Optional)	
B4	Bracket for 2-in. Pipe or Panel Mounting, All SST	

Rosemount 3051

TABLE 12. 3051T Gage and Absolute Pressure Transmitter

Code	Hazardous Locations Certifications (Optional)
E5	FM Explosion-proof Approval
I5	FM Non-incendive and Intrinsic Safety Approval
K5	FM Explosion-proof and Intrinsic Safety Approval
C5	Measurement Canada accuracy approval (<i>Limited availability depending on transmitter type and range. Contact an Emerson Process Management representative</i>)
C6	CSA Explosion-proof and Intrinsic Safety Approval
K6 ⁽³⁾	CSA and ATEX Explosion-proof and Intrinsic Safety Approval (combination of C6 and K8)
KB	FM and CSA Explosion-proof and Intrinsic Safety Approvals (combination of K5 and C6)
K7	SAA Flame-proof and Intrinsic Safety Approvals (combination of I7, N7, and E7)
K8 ⁽³⁾	ATEX Flame-proof and Intrinsic Safety Approvals (combination of I1 and E8)
KD ⁽³⁾	CSA, FM, and ATEX Explosion-proof and Intrinsic Safety Approval (combination of K5, C6, I1, and E8)
I7	SAA Intrinsic Safety Certification
E4 ⁽³⁾	JIS Flame-proof Certification
E7	SAA Flame-proof Certification
N7	SAA Type N Certification
I1 ⁽³⁾	ATEX Intrinsic Safety and Dust Certification
N1 ⁽³⁾	ATEX Type N and Dust Certification
E8	ATEX Flame-proof and Dust Certification
DW	NSF drinking water approval
IA	ATEX Intrinsic Safety for FISCO; for <i>FOUNDATION</i> fieldbus protocol only
Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option applies to the process connection only.</i>
Q16	Surface finish certification for sanitary remote seals
QP	Calibration certification and tamper evident seal
QS	Certificate of FMEDA Data
J1 ⁽⁴⁾⁽⁵⁾	Local Zero Adjustment Only
J3 ⁽⁴⁾⁽⁵⁾	No Local Zero or Span Adjustment
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)
M6	LCD display for SST Housing (Housing Codes J, K, L and M only)
T1	Transient Protection Terminal Block
C1 ⁽⁴⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2 ⁽⁴⁾	0.8–3.2 V dc Output with Digital Signal Based on <i>HART</i> Protocol (Output Code M only)
C4 ⁽⁴⁾⁽⁶⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43, 27-June-1996.
CN ⁽⁴⁾⁽⁶⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43: Low Alarm Configuration
P1	Hydrostatic Testing with Certificate
P2	Cleaning for Special Service
P3	Cleaning for <1 PPM Chlorine/Fluorine
P8	0.04% accuracy to 5:1 turndown (Range 1-4)
V5 ⁽⁷⁾	External Ground Screw Assembly
Typical Model Number: 3051T G 5 F 2A 2 1 A B4	

(1) 3051TG lower range limit varies with atmospheric pressure.

(2) Materials of Construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.

(3) Not available with low-power Option Code M.

(4) Not available with fieldbus (output code F) or Profibus protocols (output code W).

(5) Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.

(6) NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.

(7) The V5 option is not needed with T1 option; external ground screw assembly is included with the T1 option.

Product Data Sheet

00813-0100-4001, Rev GA

Catalog 2006 - 2007

Rosemount 3051

TABLE 13. 3051L Flange-Mounted Liquid Level Transmitter

Model	Transmitter Type		
3051L	Flange-Mounted Liquid Level Transmitter		
Code	Pressure Ranges (Range/Min. Span)		
2	-250 to 250 inH ₂ O/2.5 inH ₂ O (-0,6 to 0,6 bar/6,2 mbar)		
3	-1000 to 1000 inH ₂ O/10 inH ₂ O (-2,5 to 2,5 bar/25 mbar)		
4	-300 to 300 psi/3 psi (-20,7 to 20,7 bar/0,2 bar)		
Code	Output		
A	4-20 mA with Digital Signal Based on <i>HART</i> Protocol		
M	Low-Power 1-5 V dc with Digital Signal Based on <i>HART</i> Protocol (See Option Code C2 for 0.8-3.2 V dc Output) (Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8)		
F	<i>FOUNDATION</i> fieldbus Protocol		
W	Profibus - PA		
High Pressure Side			
Code	Diaphragm Size	Material	Extension Length
G0	2 in./DN 50	316L SST	Flush Mount Only
H0	2 in./DN 50	<i>Hastelloy</i> C276	Flush Mount Only
J0	2 in./DN 50	Tantalum	Flush Mount Only
A0	3 in./DN 80	316L SST	Flush Mount
A2	3 in./DN 80	316L SST	2 in./50 mm
A4	3 in./DN 80	316L SST	4 in./100 mm
A6	3 in./DN 80	316L SST	6 in./150 mm
B0	4 in./DN 100	316L SST	Flush Mount
B2	4 in./DN 100	316L SST	2 in./50 mm
B4	4 in./DN 100	316L SST	4 in./100 mm
B6	4 in./DN 100	316L SST	6 in./150 mm
C0	3 in./DN 80	<i>Hastelloy</i> C276	Flush Mount
C2	3 in./DN 80	<i>Hastelloy</i> C276	2 in./50 mm
C4	3 in./DN 80	<i>Hastelloy</i> C276	4 in./100 mm
C6	3 in./DN 80	<i>Hastelloy</i> C276	6 in./150 mm
D0	4 in./DN 100	<i>Hastelloy</i> C276	Flush Mount
D2	4 in./DN 100	<i>Hastelloy</i> C276	2 in./50 mm
D4	4 in./DN 100	<i>Hastelloy</i> C276	4 in./100 mm
D6	4 in./DN 100	<i>Hastelloy</i> C276	6 in./150 mm
E0	3 in./DN 80	Tantalum	Flush Mount Only
F0	4 in./DN 100	Tantalum	Flush Mount Only

TABLE 13. 3051L Flange-Mounted Liquid Level Transmitter

Code		Mounting Flange	
	Size	ASME B 16.5 (ANSI) or DIN Flange Rating	Material
M	2 in.	Class 150	CS
A	3 in.	Class 150	CS
B	4 in.	Class 150	CS
N	2 in.	Class 300	CS
C	3 in.	Class 300	CS
D	4 in.	Class 300	CS
P	2 in.	Class 600	CS
E	3 in.	Class 600	CS
X	2 in.	Class 150	SST
F	3 in.	Class 150	SST
G	4 in.	Class 150	SST
Y	2 in.	Class 300	SST
H	3 in.	Class 300	SST
J	4 in.	Class 300	SST
Z	2 in.	Class 600	SST
L	3 in.	Class 600	SST
Q	DN 50	PN 10-40	CS
R	DN 80	PN 40	CS
S	DN 100	PN 40	CS
V	DN 100	PN 10/16	CS
K	DN 50	PN 10-40	SST
T	DN 80	PN 40	SST
U	DN 100	PN 40	SST
W	DN 100	PN 10/16	SST

Code	Process Fill-High Pressure Side	Temperature Limits
A	<i>Syltherm XLT</i>	-100 to 300 °F (-73 to 135 °C)
C	<i>D. C. Silicone 704</i>	60 to 400 °F (15 to 205 °C)
D	<i>D. C. Silicone 200</i>	-40 to 400 °F (-40 to 205 °C)
H	Inert (Halocarbon)	-50 to 350 °F (-45 to 177 °C)
G	Glycerine and Water	0 to 200 °F (-17 to 93 °C)
N	<i>Neobee M-20</i>	0 to 400 °F (-17 to 205 °C)
P	Propylene Glycol and Water	0 to 200 °F (-17 to 93 °C)

Low Pressure Side				
Code	Configuration	Flange Adapter	Diaphragm Material	Sensor Fill Fluid
11	Gage	SST	316L SST	Silicone
21	Differential	SST	316L SST	Silicone
22	Differential	SST	<i>Hastelloy C276</i>	Silicone
2A	Differential	SST	316L SST	Inert (Halocarbon)
2B	Differential	SST	<i>Hastelloy C276</i>	Inert (Halocarbon)
31	Remote Seal	SST	316L SST	Silicone (<i>Requires Option Code S1</i>)

Code	O-ring Material
A	Glass-filled PTFE

Product Data Sheet

00813-0100-4001, Rev GA
 Catalog 2006 - 2007

Rosemount 3051

TABLE 13. 3051L Flange-Mounted Liquid Level Transmitter

Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½
Code	PlantWeb Functionality	
A01	Advanced Control Function Block Suite	
D01	FOUNDATION fieldbus Diagnostics Suite	
Code	Diaphragm Seal Assemblies (Optional)	
S1	One Diaphragm Seal (<i>requires low pressure side Option Code 31 capillary connection type</i>)	
Code	Hazardous Locations Certification Options	
E5	FM Explosion-proof Approval	
I5	FM Non-incendive and Intrinsic Safety Approval	
K5	FM Explosion-proof and Intrinsic Safety Approval	
I1 ⁽¹⁾	ATEX Intrinsic Safety and Dust Certification	
N1 ⁽¹⁾	ATEX Type N and Dust Certification	
E8	ATEX Flame-proof and Dust Certification	
E4 ⁽¹⁾	JIS Flame-proof Certification	
C6	CSA Explosion-proof and Intrinsic Safety Approval	
K6 ⁽¹⁾	CSA and ATEX Explosion-proof and Intrinsic Safety Approval (combination of C6 and K8)	
KB	FM and CSA Explosion-proof and Intrinsic Safety Approvals (combination of K5 and C6)	
K7	SAA Flame-proof and Intrinsic Safety Approvals (combination of I7, N7, and E7)	
K8 ⁽¹⁾	ATEX Flame-proof and Intrinsic Safety Approvals (combination of I1 and E8)	
KD ⁽¹⁾	CSA, FM, and ATEX Explosion-proof and Intrinsic Safety Approval (combination of K5, C6, I1, and E8)	
I7	SAA Intrinsic Safety Certification	
E7	SAA Flame-proof Certification	
N7	SAA Type N Certification	
IA	ATEX Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only	
Code	Bolt for Flange and Adapters (Optional)	
L5	ASTM A 193, Grade B7M Bolts	
Code	Meter Options	
M5	LCD display for Aluminum Housing (<i>Available with Housing codes A, B, C, and D only</i>)	
M6	LCD display for SST Housing (<i>Available with Housing codes J, K, L, and M only</i>)	

Rosemount 3051

TABLE 13. 3051L Flange-Mounted Liquid Level Transmitter

Code	Other Options					
Q4	Calibration Data Sheet					
Q8	Material Traceability Certification per EN 10204 3.1.B (<i>Available with the diaphragm, upper housing, Coplanar flange, adapter, sensor module housing, lower housing/flushing connection, and extension</i>)					
QP	Calibration certification and tamper evident seal					
J1 ⁽²⁾⁽³⁾	Local Zero Adjustment Only					
J3 ⁽²⁾⁽³⁾	No Local Zero or Span Adjustment					
T1	Transient Protection Terminal Block					
C1 ⁽²⁾	Custom Software Configuration (<i>Completed CDS 00806-0100-4001 required with order</i>)					
C2 ⁽²⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (<i>Available with Output code M only</i>)					
C4 ⁽²⁾⁽⁴⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43					
CN ⁽²⁾⁽⁴⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43: Alarm Configuration–Low					
D8	Ceramic Ball Drain/Vents					
V5 ⁽⁵⁾	External Ground Screw Assembly					
Code	Lower Housing Flushing Connections					
	Ring Material	Number	Size	2 in.	3 in.	4 in.
F1	SST	1	1/4	•	•	•
F2	SST	2	1/4	•	•	•
F3 ⁽⁶⁾	Hastelloy C276	1	1/4	•	•	•
F4 ⁽⁶⁾	Hastelloy C276	2	1/4	•	•	•
F7	SST	1	1/2	•	•	•
F8	SST	2	1/2	•	•	•
F9	Hastelloy C276	1	1/2	•	•	•
F0	Hastelloy C276	2	1/2	•	•	•
Typical Model Number:						

- (1) Not available with low-power Option Code M
- (2) Not available with fieldbus (output code F) or profibus protocols (output code W).
- (3) Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.
- (4) NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.
- (5) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.
- (6) Not available with Option Codes A0, B0, and G0.

Product Data Sheet

00813-0100-4001, Rev GA
Catalog 2006 - 2007

Rosemount 3051

TABLE 14. 3051H Pressure Transmitter for High-Temperature Processes — = Not Applicable • = Applicable

Model	Transmitter Type (Select One)	HD	HG	
3051HD	Differential Pressure Transmitter for High-Temperature Processes	•	—	
3051HG	Gage Pressure Transmitter for High-Temperature Processes	—	•	
Code	3051HD	3051HG		
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)		
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000 inH ₂ O/10 in H ₂ O (–1,01 to 2,5 bar/25 mbar)		
4	–300 to 300 inH ₂ O/3 psi (–747 to 747 mbar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)		
5	–2000 to 2000 psi/20 psi (–138 to 138 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 138 bar/1,4 bar)		
NOTE: 3051HG lower range limit varies with atmospheric pressure.				
Code	Output	HD	HG	
A	4–20 mA with Digital Signal Based on HART Protocol	•	•	
M	Low-Power 1–5 V dc with Digital Signal Based on HART Protocol (See Option Code C2 for 0.8–3.2 V dc Output) (Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8)	•	•	
F	FOUNDATION fieldbus Protocol	•	•	
W	Profibus – PA	•	•	
Code	Process Connection	HD	HG	
	Process Flange Material Drain/Vent			
2	SST SST	•	•	
7 ⁽¹⁾	SST Hastelloy C276	•	•	
Code	Process Isolating Diaphragm	HD	HG	
2	316L SST	•	•	
3 ⁽¹⁾	Hastelloy C276	•	•	
5	Tantalum	•	•	
Code	O-ring Material	HD	HG	
A	Glass-Filled PTFE	•	•	
Code	Process Fill Fluid	HD	HG	
D	D.C. 200 Silicone	•	•	
H	Inert	•	•	
N	Neobee M-20	•	•	
Code	Sensor Module Isolator Material	HD	HG	
2	SST	•	•	
Code	Sensor Module Fill Fluid	HD	HG	
1	Silicone	•	•	
2	Inert (Halocarbon)	•	•	
Code	Housing Material	Conduit Entry Size	HD	HG
A	Polyurethane-covered Aluminum	½–14 NPT	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•
D	Polyurethane-covered Aluminum	G½	•	•
J	SST	½–14 NPT	•	•
K	SST	M20 × 1.5 (CM20)	•	•
L	SST	PG 13.5	•	•
M	SST	G½	•	•
Code	PlantWeb Functionality			
A01	Advanced Control Function Block Suite			
D01	FOUNDATION fieldbus Diagnostics Suite			
Code	Integral Mount Primary Elements (Optional)	HD	HG	
S4	Factory Assembly to Rosemount Primary Element (Rosemount Annubar or Rosemount 1195 Integral Orifice) (With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only)	•	—	

Rosemount 3051

TABLE 14. 3051H Pressure Transmitter for High-Temperature Processes — = Not Applicable • = Applicable

Code	Mounting Bracket Options	HD	HG
B5	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, CS Bolts	•	•
B6	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, SST Bolts	•	•
Code	Hazardous Locations Certification Options	HD	HG
E5	FM Explosion-proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion-proof and Intrinsic Safety Approval	•	•
I1 ⁽²⁾	ATEX Intrinsic Safety and Dust Certification	•	•
N1 ⁽²⁾	ATEX Type N and Dust Certification	•	•
E8	ATEX Flame-proof and Dust Certification	•	•
E4 ⁽²⁾	JIS Flame-proof Certification	•	•
C6	CSA Explosion-proof and Intrinsic Safety Approval	•	•
K6 ⁽²⁾	CSA and ATEX Explosion-proof and Intrinsic Safety Approval (combination of C6 and K8)	•	•
KB	FM and CSA Explosion-proof and Intrinsic Safety Approvals (combination of K5 and C6)	•	•
K7	SAA Flame-proof and Intrinsic Safety Approvals (combination of I7, N7, and E7)	•	•
KB ⁽²⁾	ATEX Flame-proof and Intrinsic Safety Approvals (combination of I1 and E8)	•	•
KD ⁽²⁾	CSA, FM, and ATEX Explosion-proof and Intrinsic Safety Approval (combination of K5, C6, I1, and E8)	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flame-proof Certification	•	•
N7	SAA Type N Certification	•	•
IA	ATEX Intrinsic Safety for FISCO; for FOUNDATION fieldbus protocol only	•	•
IE	FM FISCO Intrinsic Safety; for FOUNDATION fieldbus protocol only	•	•
Code	Bolt for Flange and Adapter Options	HD	HG
L4	Austenitic 316 SST Bolts	•	•
Code	Meter Options	HD	HG
M5	LCD display for Aluminum Housing (<i>Available with Housing codes A, B, C, and D only</i>)	•	•
M6	LCD display for SST Housing (<i>Available with Housing codes J, K, L, and M only</i>)	•	•
Code	Other Options	HD	HG
Q4	Calibration Data Sheet	•	•
Q8	Material traceability certification per EN 10204 3.1.B	•	•
QP	Calibration certification and tamper evident seal	•	•
J1 ⁽³⁾	Local Zero Adjustment Only (<i>Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>)	•	•
J3 ⁽³⁾	No Local Zero or Span Adjustment (<i>Local zero and span adjustments are standard unless Option Code J1 or J3 is specified</i>)	•	•
T1	Transient Protection Terminal Block	•	•
C1 ⁽³⁾	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C2 ⁽³⁾	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (<i>Output Code M only</i>)	•	•
C4 ⁽³⁾⁽⁴⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43	•	•
CN ⁽³⁾⁽⁴⁾	Analog Output Levels Compliant with NAMUR Recommendation NE 43: Alarm Configuration—Low	•	•
P1	Hydrostatic Testing with Certificate	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
DF	1/2–14 NPT flange adapters—SST	•	•
D8	Ceramic Ball Drain/Vents	•	•
V5 ⁽⁵⁾	External Ground Screw Assembly	•	•
Typical Model Number: 3051HG 2 A 2 2 A H 2 1 A B5			

- (1) Materials of Construction comply with recommendations per NACE MR0175/ISO 15156 for sour oil field production environments. Environmental limits apply to certain materials. Consult latest standard for details. Selected materials also conform to NACE MR0103 for sour refining environments.
- (2) Not available with low-power Option Code M.
- (3) Not available with fieldbus (output code F) or profibus protocols (output code W).
- (4) NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.
- (5) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

OPTIONS

Standard Configuration

Unless otherwise specified, transmitter is shipped as follows:

ENGINEERING UNITS

Differential/Gage:	inH ₂ O (Range 0, 1, 2, and 3) psi (Range 4 and 5)
Absolute/3051T:	psi (all ranges)
4 mA (1 V dc)⁽¹⁾:	0 (engineering units above)
20 mA (5 V dc):	Upper range limit
Output:	Linear
Flange type:	Specified model code option
Flange material:	Specified model code option
O-ring material:	Specified model code option
Drain/vent:	Specified model code option
Integral meter:	Installed or none
Alarm⁽¹⁾:	Upscale
Software tag:	(Blank)

(1) Not applicable to fieldbus.

Custom Configuration HART protocol only⁽¹⁾

If Option Code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD display Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the "HART Protocol C1 Option Configuration Data Sheet" on page 39.

Tagging (3 options available)

- Standard SST hardware tag is wired to the transmitter. Tag character height is 0.125 in. (3,18 mm), 56 characters maximum.
- Tag may be permanently stamped on transmitter nameplate upon request, 56 characters maximum.
- Tag may be stored in transmitter memory (30 characters maximum). Software tag is left blank unless specified.

Commissioning tag (fieldbus only)

A temporary commissioning tag is attached to all transmitters. The tag indicates the device ID and allows an area for writing the location.

Optional Rosemount 305 or 306 Integral Manifolds

Factory assembled to 3051C and 3051T transmitters. Refer to the following Product Data Sheet (document number 00813-0100-4733) for additional information.

Optional Three-Valve Manifolds (Packaged Separately)

- Part No.1151-0150-0001: 3-Valve Manifold, Carbon Steel
- Part No. 1151-0150-0002: 3-Valve Manifold, 316 SST

(1) Not applicable to fieldbus.

Optional Diaphragm and Sanitary Seals

Refer to Product Data Sheet 00813-0100-4016 or 00813-0201-4016. for additional information.

Output Information⁽¹⁾

Output range points must be the same unit of measure. Available units of measure include:

inH ₂ O	inH ₂ O@4 °C ⁽¹⁾	psi	Pa
inHg	ftH ₂ O	bar	kPa
mmH ₂ O	mmH ₂ O@4 °C ⁽¹⁾	mbar	torr
mmHg	g/cm ²	kg/cm ²	atm

(1) Not available on low power or previous versions.

LCD display

M5 Digital Meter, 5-Digit, 2-Line LCD

- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

M6 Digital Meter with 316 Stainless Steel Cover

- For use with stainless steel housing option (housing codes J, K, and L)

Local Span and Zero Adjustment⁽²⁾

Transmitters ship with local span and zero adjustments standard unless otherwise specified.

- Non-interactive external zero and span adjustments ease calibration
- Magnetic switches replace standard potentiometer adjustments to optimize performance

J1 Local Zero Adjustment Only⁽¹⁾

J3 No Local Zero or Span Adjustment⁽¹⁾

Transient Protection

T1 Integral Transient Protection Terminal Block

- Integral transient protection terminal block
- Meets IEEE Standard 587, Category B
1 kV crest (10 × 1 000 microseconds)
3 kV crest (8 × 20 microseconds)
6 kV crest (1.2 × 50 microseconds)
- Meets IEEE Standard 472, Surge Withstand Capability
SWC 2,5 kV crest, 1 MHz wave form
- Applicable standards: IEC 801-4, 801-5

Bolts for Flanges and Adapters

- Options permit bolts for flanges and adapters to be obtained in various materials
- Standard material is plated carbon steel per ASTM A449, Type 1

L4 Austenitic 316 Stainless Steel Bolts

L5 ASTM A 193, Grade B7M Bolts

L6 Monel Bolts

(2) Not applicable to fieldbus.

Rosemount 3051C Coplanar Flange and 3051T Bracket Option

- B4** Bracket for 2-in. Pipe or Panel Mounting
- For use with the standard *Coplanar* flange configuration
 - Bracket for mounting of transmitter on 2-in. pipe or panel
 - Stainless steel construction with stainless steel bolts

Rosemount 3051H Bracket Options

- B5** Bracket for 2-in. Pipe or Panel Mounting
- For use with the 3051H Pressure Transmitter for high process temperatures
 - Carbon steel construction with carbon steel bolts
- B6** B5 Bracket with SST Bolts
- Same bracket as the B5 option with Series 300 stainless steel bolts.

Traditional Flange Bracket Options

- B1** Bracket for 2-in. Pipe Mounting
- For use with the traditional flange option
 - Bracket for mounting on 2-in. pipe
 - Carbon steel construction with carbon steel bolts
 - Coated with polyurethane paint
- B2** Bracket for Panel Mounting
- For use with the traditional flange option
 - Bracket for mounting transmitter on wall or panel
 - Carbon steel construction with carbon steel bolts
 - Coated with polyurethane paint
- B3** Flat Bracket for 2-in. Pipe Mounting
- For use with the traditional flange option
 - Bracket for vertical mounting of transmitter on 2-in. pipe
 - Carbon steel construction with carbon steel bolts
 - Coated with polyurethane paint
- B7** B1 Bracket with SST Bolts
- Same bracket as the B1 option with Series 300 stainless steel bolts
- B8** B2 Bracket with SST Bolts
- Same bracket as the B2 option with Series 300 stainless steel bolts
- B9** B3 Bracket with SST Bolts
- Same bracket as the B3 option with Series 300 stainless steel bolts
- BA** Stainless Steel B1 Bracket with SST Bolts
- B1 bracket in stainless steel with Series 300 stainless steel bolts
- BC** Stainless Steel B3 Bracket with SST Bolts
- B3 bracket in stainless steel with Series 300 stainless steel bolts

Shipping Weights

TABLE 15. Transmitter Weights without Options

Transmitter	Add Weight In lb (kg)
3051C	6.0 (2,7)
3051L	Table 16 on page 38
3051H	13.6 (6,2)
3051T	3.0 (1,4)

TABLE 16. 3051L Weights without Options

Flange	Flush lb. (kg)	2-in. Ext. lb (kg)	4-in. Ext. lb (kg)	6-in. Ext. lb (kg)
2-in., 150	12.5 (5,7)	—	—	—
3-in., 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., 300	17.5 (7,9)	—	—	—
3-in., 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
2-in., 600	15.3 (6,9)	—	—	—
3-in., 600	25.2 (11,4)	27.2 (12,3)	28.2 (12,8)	29.2 (13,2)
DN 50/PN 40	13.8 (6,2)	—	—	—
DN 80/PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

TABLE 17. Transmitter Options Weights

Code	Option	Add lb (kg)
J, K, L, M	Stainless Steel Housing(T)	3.9 (1,8)
J, K, L, M	Stainless Steel Housing (C, L, H, P)	3.1 (1,4)
M5	LCD display for Aluminum Housing	0.5 (0,2)
M6	LCD display for SST Housing	1.25 (0,6)
B4	SST Mounting Bracket for <i>Coplanar</i> Flange	1.0 (0,5)
B1 B2 B3	Mounting Bracket for Traditional Flange	2.3 (1,0)
B7 B8 B9	Mounting Bracket for Traditional Flange	2.3 (1,0)
BA, BC	SST Bracket for Traditional Flange	2.3 (1,0)
B5 B6	Mounting Bracket for 3051H	2.9 (1,3)
H2	Traditional Flange	2.4 (1,1)
H3	Traditional Flange	2.7 (1,2)
H4	Traditional Flange	2.6 (1,2)
H7	Traditional Flange	2.5 (1,1)
FC	Level Flange—3 in., 150	10.8 (4,9)
FD	Level Flange—3 in., 300	14.3 (6,5)
FA	Level Flange—2 in., 150	10.7 (4,8)
FB	Level Flange—2 in., 300	14.0 (6,3)
FP	DIN Level Flange, SST, DN 50, PN 40	8.3 (3,8)
FQ	DIN Level Flange, SST, DN 80, PN 40	13.7 (6,2)

LCD display CONFIGURATION (Software Adjustable – M5 or M6 option must be specified in model number)	
Meter Display Type ⁽⁴⁾ :	
Eng. Units only	Alternate Eng. Units &% of Range
% of Range only	Alternate Eng. Units & Custom Display ⁽⁵⁾
Custom Display only	<input type="checkbox"/> Alternate % of Range & Custom Display ⁽⁵⁾
Custom Display Configuration: (must be filled out if Custom Display is selected as meter type)	
Decimal Point Position (fixed)— indicate decimal point location:	X _□ X _□ X _□ * X X
Enter Lower Range Value (Decimal point must be in the same position as specified above.) (circle sign) + - <input type="checkbox"/> _□ <input type="checkbox"/> _□ <input type="checkbox"/> _□ <input type="checkbox"/> _□ +000.00	
Enter Upper Range Value (Decimal point must be in the same position as specified above.) (circle sign) + - <input type="checkbox"/> _□ <input type="checkbox"/> _□ <input type="checkbox"/> _□ <input type="checkbox"/> _□ +100.00	
Custom Units —spaces consume A-Z, 0-9, /, *, %, blank <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> %RNGE	
Custom Display Transfer Function (Independent of Analog Output) <input type="checkbox"/> Linear <input type="checkbox"/> Square Root	

HARDWARE SELECTABLE INFORMATION	
Alarm Option:	<input type="checkbox"/> High <input type="checkbox"/> Low
Transmitter Security:	<input type="checkbox"/> Off <input type="checkbox"/> On

Note: Specify C4 Option in model structure when ordering NAMUR-compliant alarm and saturation limits.⁽⁵⁾

SIGNAL SELECTION: (Software Selectable)	
4–20 mA with simultaneous digital signal based on HART protocol	
Burst mode of HART digital process variable ⁽⁴⁾	
Burst mode output options:	
Primary variable in engineering units	
Primary variable in percent of range	
All dynamic variables in engineering units and the primary variable mA value	
Multidrop Communication ⁽⁴⁾⁽⁶⁾	Choose transmitter address ⁽⁷⁾ (1-15): _____

(4) C1 option required for configuration of this parameter.

(5) Not available with low power output.

(6) This option fixes the transmitter analog output at 4mA.

(7) Default address is 1 if multidrop communication is selected.

3051C Differential/Gage Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	0.5	25	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.03678	1.8389	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH ₂ O	0.04167	2.08333	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH ₂ O	12.7	635.5	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.01806	0.903	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00125	0.06227	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	1.2454	62.2723	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm ²	1.26775	63.3875	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm ²	0.00127	0.0635	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	124.545	6227.23	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.12545	6.2272	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00123	0.06146	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

When using a HART communicator, ±5% adjustment is allowed on the sensor limit to allow for unit conversions.

3051L/3051H Pressure Transmitter Range Limits									
Units	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span		
	min	max	min	max	min	max	min	max	
inH ₂ O	2.5	250	10	1000	83.040	8304	553.60	55360	
inHg	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04	
ftH ₂ O	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31	
mmH ₂ O	63.553	6355	254	25421	2110.95	211095	14073	1407301	
mmHg	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430	
psi	0.0902	9.03183	0.36127	36.127	3	300	20	2000	
bar	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895	
mbar	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895	
g/cm ²	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614	
kg/cm ²	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614	
Pa	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500	
kPa	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5	
torr	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430	
atm	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092	

When using a HART communicator, ±5% adjustment is allowed on the sensor limit to allow for unit conversions.

3051T Gage and Absolute Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	8.30397	831.889	41.5198	4159.45	221.439	22143.9	1107.2	110720	55360	276799
inHg	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098	4072.04	20360.2
ftH ₂ O	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63	4613.31	23066.6
mmH ₂ O	211.10	21130	1054.60	105460.3	5634.66	563466	28146.1	2814613	1407301	7036507
mmHg	15.5145	1551.45	77.5723	7757.23	413.72	41372	2068.6	206860.0	103430	517151
psi	0.3	30	1.5	150	8	800	40	4000	2000	10000
bar	0.02068	3.06843	0.10342	10.3421	0.55158	55.1581	2.75791	275.7905	137.895	689.476
mbar	20.6843	2068.43	103.421	10342.11	551.581	55158.1	2757.91	275790.5	137895	689476
g/cm ²	21.0921	2109.21	105.461	10546.1	561.459	56145.9	2807.31	280730.6	140614	703067
kg/cm ²	0.02109	2.10921	0.10546	10.5461	0.56246	56.2456	2.81228	281.228	140.614	701.82
Pa	2068.43	206843	10342.1	1034212	55158.1	5515811	275791	27579054	13789500	68947600
kPa	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05	13789.5	68947.6
torr	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7	103430	517151
atm	0.02041	2.04138	0.10207	10.2069	0.54437	54.4368	2.72184	272.1841	136.092	680.46

When using a HART communicator, ±5% adjustment is allowed on the sensor limit to allow for unit conversions.

3051C Absolute Pressure Transmitter Range Limits									
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		
	min	max	min	max	min	max	min	max	
inH ₂ O	8.30397	831.889	41.5198	4151.98	221.439	22143.9	1107.2	110720	
inHg	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098	
ftH ₂ O	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63	
mmH ₂ O	211.10	21130	6.35308	635.308	5634.66	563466	28146.1	2814613	
mmHg	15.5145	1551.45	1055.47	105547	413.72	41372	2068.6	206860.0	
psi	0.3	30	1.5	150	8	800	40	4000	
bar	0.02068	2.06843	0.10342	10.342	0.55158	55.1581	2.75791	275.7905	
mbar	20.6843	2068.43	103.421	10342.1	551.581	55158.1	2757.91	275790.5	
g/cm ²	21.0921	2109.21	105.27	105.27	561.459	56145.9	2807.31	280730.6	
kg/cm ²	0.02109	2.10921	0.10546	10.546	0.56246	56.2456	2.81228	281.228	
Pa	2068.43	206843	10342.1	1034210	55158.1	5515811	275791	27579054	
kPa	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05	
torr	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7	
atm	0.02041	2.04138	0.10207	10.207	0.54437	54.4368	2.72184	272.1841	

When using a HART communicator, ±5% adjustment is allowed on the sensor limit to allow for unit conversions.

Rosemount 3051

Product Data Sheet
00813-0100-4001, Rev GA
Catalog 2006 - 2007

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Rosemount Model 3051 Smart Pressure Transmitters may be protected by one or more of the following U.S. Patent Nos. 4,370,890; 4,466,290; 4,612,812; 4,791,352; 4,798,089; 4,818,994; 4,833,922; 4,866,435; 4,926,340; 4,988,990; and 5,028,746. Mexico Patentado No. 154,961. May depend on model. Other foreign patents issued and pending.

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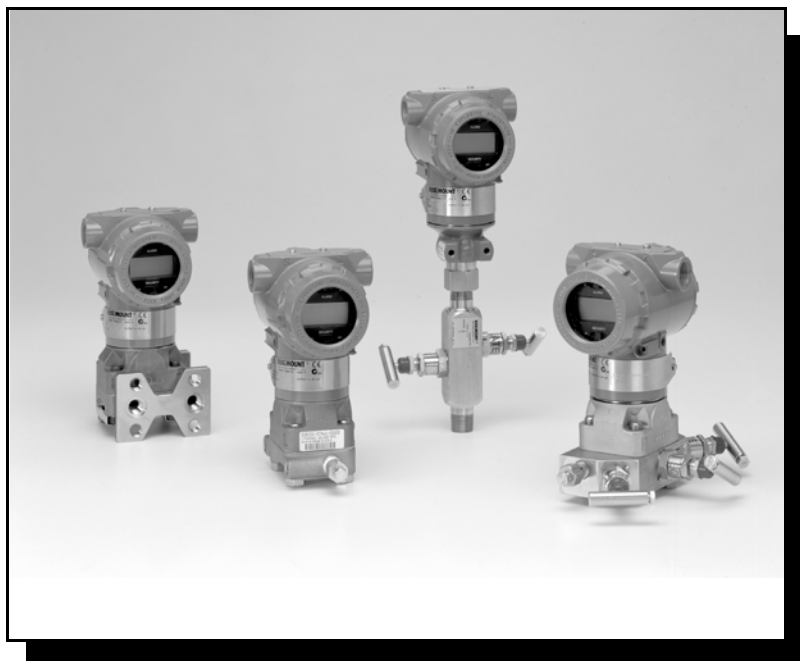
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Model 3051 Pressure Transmitter

with HART protocol[®]



ROSEMOUNT[®]

www.rosemount.com



EMERSON[™]
Process Management

Model 3051 Pressure Transmitter

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

Within the United States, Rosemount Inc. has two toll-free assistance numbers:

Customer Central

Technical support, quoting, and order-related questions.

1-800-999-9307 (7:00 am to 7:00 pm CST)

North American Response Center

Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local Rosemount® representative.

CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

Rosemount Model 3051 Smart Pressure Transmitters may be protected by one or more of the following: U.S. Patent Nos. 4466290; 4612812; 4791352; 4798089; 4818994; 4866435; 4878012; 4988990; 4926340; 5083091; 5122794; 5166678; 5248167; 5278543; 5287746; 5329818; 5333504; 5585777; 6017143; 6119047; 6295875; Des. 317266; Des. 318432; Des 342456. May depend on model. Other U.S. and foreign patents issued and pending.


 Fisher-Rosemount satisfies all obligations coming from legislation to harmonize product requirements in the European Union.



Table of Contents

SECTION 1	
Introduction	
	Using This Manual 1-1
	Service Support 1-1
	Models Covered 1-2
	Transmitter Overview 1-3
SECTION 2	
Installation	
	Overview 2-1
	Safety Messages 2-1
	Warnings 2-1
	General Considerations 2-2
	Mechanical Considerations 2-3
	Draft Range Considerations 2-3
	Environmental Considerations 2-4
	Installation Procedures 2-6
	Mount the transmitter 2-6
	Process Connections 2-11
	Consider Housing Rotation 2-13
	Set Jumpers 2-14
	Connect Wiring and Power Up 2-16
	Hazardous Locations 2-18
	Grounding the Transmitter Case 2-18
	Installing the LCD Display 2-19
	Models 305 and 306 Integral Manifolds 2-22
	Installation Procedure 2-22
SECTION 3	
Configuration	
	Overview 3-1
	Safety Messages 3-1
	Warnings 3-1
	Commissioning on the bench with HART 3-2
	Setting the Loop to Manual 3-2
	Wiring Diagrams 3-3
	Model 275 HART Communicator 3-4
	Review Configuration Data 3-7
	Check Output 3-7
	Process Variables 3-7
	Sensor Temperature 3-8
	Basic Setup 3-8
	Set Process Variable Units 3-8
	Set Output 3-9
	Rerange 3-10
	Damping 3-16

Model 3051

LCD Display	3-16
Standard display Configuration	3-17
Custom display Configuration	3-17
Detailed Setup	3-19
Failure Mode Alarm and Saturation	3-19
Alarm and Saturation Levels for Burst Mode	3-20
Alarm and Saturation Values for Multidrop Mode	3-20
Alarm Level Verification	3-20
Sensor Temperature Unit	3-20
Diagnostics and Service	3-21
Transmitter Test	3-21
Loop Test	3-21
Advanced Functions	3-22
Saving, Recalling, and Cloning Configuration Data	3-22
Burst Mode	3-24
Multidrop Communication	3-25
Changing a Transmitter Address	3-26
Communicating with a Multidropped Transmitter	3-27
Polling a Multidropped Transmitter	3-27

SECTION 4 **Operation and** **Maintenance**

Overview	4-1
Safety Messages	4-1
Warnings	4-1
Calibration	4-2
Calibration Overview	4-3
Determining Calibration Frequency	4-4
Choosing a Trim Procedure	4-6
Sensor Trim	4-6
Zero Trim	4-7
Full Trim	4-8
Recall Factory Trim	4-9
Analog Output Trim	4-10
Digital-to-Analog Trim	4-10
Digital-to-Analog Trim Using Other Scale	4-11
Compensating for Line Pressure	4-12
Diagnostic Messages	4-14
Local Zero and Span	
(Local Keys) Software Lock Out	4-19
Physical Removal of Local Zero and Span (Local Keys)	4-19
Selecting Output Range for Low-Power	4-20
Detailed Setup	4-20
Local Span and Zero Control (Local Keys)	4-20

SECTION 5 **Troubleshooting**

Overview	5-1
Safety Messages	5-1
Warnings	5-1
Before Disassembling the Transmitter	5-3
Disassembly Procedures	5-3
Remove the Transmitter from Service	5-3
Remove the Terminal Block	5-4
Remove the Electronics Board	5-4
Remove the Sensor Module from the Electronics Housing	5-5

Reassembly Procedures 5-5
 Attach the Electronics Board 5-6
 Install the Terminal Block 5-6
 Reassemble the Process Sensor Body 5-7

APPENDIX A
Reference Information

Performance Specifications A-1
Detailed Performance Specifications A-2
 Reference Accuracy A-2
 Ambient Temperature A-3
 Line Pressure Effect A-4
 Dynamic Performance A-4
 Mounting Position Effects A-5
 Vibration Effect A-5
 Power Supply Effect A-5
 RFI Effects A-5
 Transient Protection A-5
Functional Specifications A-6
 Range and Sensor Limits A-6
Physical Specifications A-11
Dimensional Drawings A-13
Ordering Information A-21
Parts List A-35
Options A-45
HART Protocol Configuration Data Sheet A-50

APPENDIX B
Product Certifications

Overview B-1
Safety Messages B-1
 Warnings B-1
Approved Manufacturing Locations B-2
European Directive Information B-2
 ATEX Directive B-2
 European Pressure Equipment Directive (PED) (97/23/EC) B-3
 Electro Magnetic Compatibility (EMC) B-3
 Other important guidelines B-3
Ordinary Location Certification for Factory Mutual B-3
Hazardous Locations Certifications B-4
 North American Certifications B-4
 European Certifications B-5
 Japanese Certifications B-7
 Australian Certifications B-7
 Combinations of Certifications B-8
Approval Drawings B-9
 Factory Mutual 03031-1019 B-9
 Canadian Standards Association (CSA) 03031-1024 B-21
 Standards Association of Australia (SAA) 03031-1026 B-30

Section 1 Introduction

USING THIS MANUAL

The sections in this manual provide information on installing, operating, and maintaining devices from the Rosemount Model 3051 Smart Pressure Transmitter Family. The sections are organized as follows:

Section 2: Installation contains considerations, mechanical and electrical installation instructions.

Section 3: Configuration contains commissioning, output check, basic setup, LCD display configuration, detailed setup, diagnostic and services, advanced functions and multidrop communication instructions.

Section 4: Operation and Maintenance contains calibration and trim procedures for HART protocol only.

Section 5: Troubleshooting provides troubleshooting techniques for the most common operating problems.

Appendix A: Reference Information supplies reference and specification data, as well as ordering information and spare parts tables.

Appendix B: Product Certifications contains European directive information, Hazardous Location Certifications, and approval drawings.

Service Support

To expedite the return process outside of the United States, contact the nearest Rosemount representative.

Within the United States, call the Rosemount National Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. The product being returned will require a copy of the required Material Safety Data Sheet (MSDS) for each substance must be included with the returned goods.

Rosemount National Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

MODELS COVERED

The following Rosemount Model 3051 Pressure Transmitters are covered by this manual:

Model 3051CD Differential Pressure Transmitter

The Model 3051CD measures differential pressures from 0.1 inH₂O to 2000 psi (0,02 to 13 800 kPa) with superior performance including 0.075% accuracy and 100:1 rangeability.

Model 3051CG Gage Pressure Transmitter

The Model 3051CG measures gage pressures from 2.5 inH₂O to 2000 psig (0,62 to 13 800 kPa) using proven Rosemount capacitance cell technology.

Model 3051CA Absolute Pressure Transmitter

The Model 3051CA measures absolute pressures from 0.167 to 4000 psia (8,6 mmHga to 27 580 kPa) using a Rosemount patented piezoresistive silicon sensor.

Model 3051T Gage and Absolute Pressure Transmitter

The Model 3051T measures absolute and gage pressures from 0.3 to 10000 psig/a (2,07 to 68 900 kPa). The Model 3051T uses a single isolator design, microprocessor-based electronics using a Rosemount patented piezoresistive silicon sensor.

Model 3051L Liquid Level Transmitter

The Model 3051L provides precise level and specific gravity measurements from 2.5 to 8310 inH₂O (0,62 to 2 070 kPa) for a wide variety of tank configurations.

Model 3051H High Process Temperature Pressure Transmitter

The Model 3051H provides high process temperature capability to 375 °F (191 °C) without the use of remote diaphragm seals or capillaries. Model 3051H transmitters are available for differential and gage configurations (3051HD and 3051HG).

Model 3051P Reference Class Pressure Transmitter

The Model 3051P, at 0.05% accuracy, is the most accurate pressure transmitter available. The Model 3051P is ideal for fiscal and allocation metering.

NOTE

For Model 3051 with FOUNDATION™ fieldbus, see Rosemount Product Manual 00809-0100-4774.

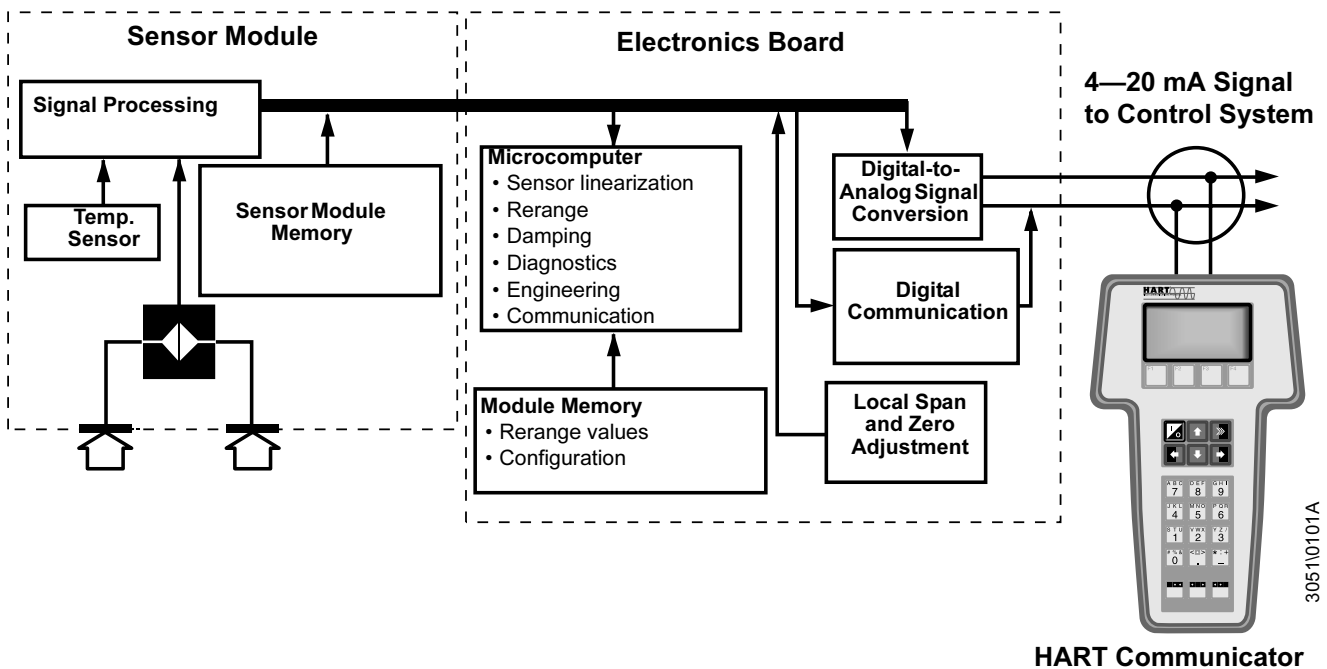
**TRANSMITTER
 OVERVIEW**

The Model 3051C Coplanar™ design is offered for Differential Pressure (DP), Gage Pressure (GP) and Absolute Pressure (AP) measurements. The Model 3051C utilizes Rosemount Inc. capacitance sensor technology for DP and GP measurements. Piezoresistive sensor technology is utilized in the Models 3051T and 3051C AP measurements.

The major components of the Model 3051 is the sensor module and the electronics housing. The sensor module contains the oil filled sensor system (isolating diaphragms, oil fill system, and sensor) and the sensor electronics. The sensor electronics are installed within the sensor module and include a temperature sensor (RTD), a memory module, and the capacitance to digital signal converter (C/D converter). The electrical signals from the sensor module are transmitted to the output electronics in the electronics housing. The electronics housing contains the output electronics board (microprocessor, memory module, digital to analog signal converter or D/A converter), the local zero and span buttons, and the terminal block. The basic block diagram of the Model 3051CD is illustrated in Figure 1-1.

For the Model 3051C design pressure is applied to the isolating diaphragms, the oil deflects the center diaphragm, which then changes the capacitance. This capacitance signal is then changed to a digital signal in the C/D converter. The microprocessor then takes the signals from the RTD and C/D converter. The microprocessor calculates the correct output of the transmitter. This signal is then sent to the D/A converter, which converts the signal back to an analog signal and superimposes the HART signal on the 4-20 mA output.

Figure 1-1. Block diagram of operation



Section 2 Installation

General Considerations	page 2-2
Mechanical Considerations	page 2-3
Draft Range Considerations	page 2-3
Environmental Considerations	page 2-4
Installation Procedures	page 2-6
Hazardous Locations	page 2-18
Installing the LCD Display	page 2-19
Models 305 and 306 Integral Manifolds	page 2-22

OVERVIEW

The information in this section covers installation considerations. Dimensional drawings for each Model 3051 variation and mounting configuration are found on page A-13.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠ WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Both transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

⚠ WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals.

⚠ WARNING

Process leaks could result in death or serious injury.

- Install and tighten all four flange bolts before applying pressure.
- Do not attempt to loosen or remove flange bolts while the transmitter is in service.

⚠ WARNING

Replacement equipment or spare parts not approved by Rosemount Inc. for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

- Use only bolts supplied with the Model 3051 or sold by Rosemount Inc. as spare parts for the Model 3051.

⚠ WARNING

Improper assembly of manifolds to traditional housing can damage sensor module.

- For safe assembly of manifold to traditional flange, bolts must break back plane of flange web (i.e., bolt hold) but must not contact module housing.

GENERAL CONSIDERATIONS

Measurement accuracy depends upon proper installation of the transmitter and impulse piping. Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. Keep in mind the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

IMPORTANT

Install the enclosed pipe plug in unused conduit openings with a minimum of five threads engaged to comply with Explosion-Proof requirements. The transmitter is shipped with the plug installed on transmitters ordered with CSA Explosion-Proof approval.

NOTE

Limit use if a continuous cyclic use of universal HART Commands if other than Commands 1, 2 or 3. If there is a requirement to conduct additional continuous cyclic HART Commands, please consult factory.

MECHANICAL CONSIDERATIONS

“Dimensional Drawings” beginning on page A-13 show dimensional drawings of Model 3051 transmitters. Figure 2-4 on page 2-10 shows installation examples.

NOTE

For Models 3051CD0 and 3051CD1, mount the transmitter solidly to prevent tilting. A tilt in the physical transmitter may cause a zero shift in the transmitter output.

NOTE

Do not blow down impulse piping through the transmitter. For steam service, first, isolate the transmitter then flush the lines and refill the lines with water before resuming measurement.

NOTE

When the transmitter is mounted on its side, position the Coplanar flange to ensure proper venting or draining. Mount the flange as shown in Figure 2-4 on page 2-10, keeping drain/vent connections on the bottom for gas service and on the top for liquid service.

NOTE

The Model 3051 transmitter incorporates two independent seals between the process connection and the conduit connection.

DRAFT RANGE CONSIDERATIONS

Installation

For the Model 3051CD0 draft range pressure transmitter, it is best to mount the transmitter with the isolators parallel to the ground. Installing the transmitter in this way reduces oil head effect and provides for optimal temperature performance.

Be sure the transmitter is securely mounted. Tilting of the transmitter may cause a zero shift in the transmitter output.

Reducing Process Noise

There are two recommended methods of reducing process noise: output damping and, in gage applications, reference side filtering.

Output Damping

The output damping for the Model 3051CD0 is factory set to 3.2 seconds as a default. If the transmitter output is still noisy, increase the damping time. If faster response is needed, decrease the damping time. Damping adjustment information is available on page 3-16.

Reference Side Filtering

In gage applications it is important to minimize fluctuations in atmospheric pressure to which the low side isolator is exposed.

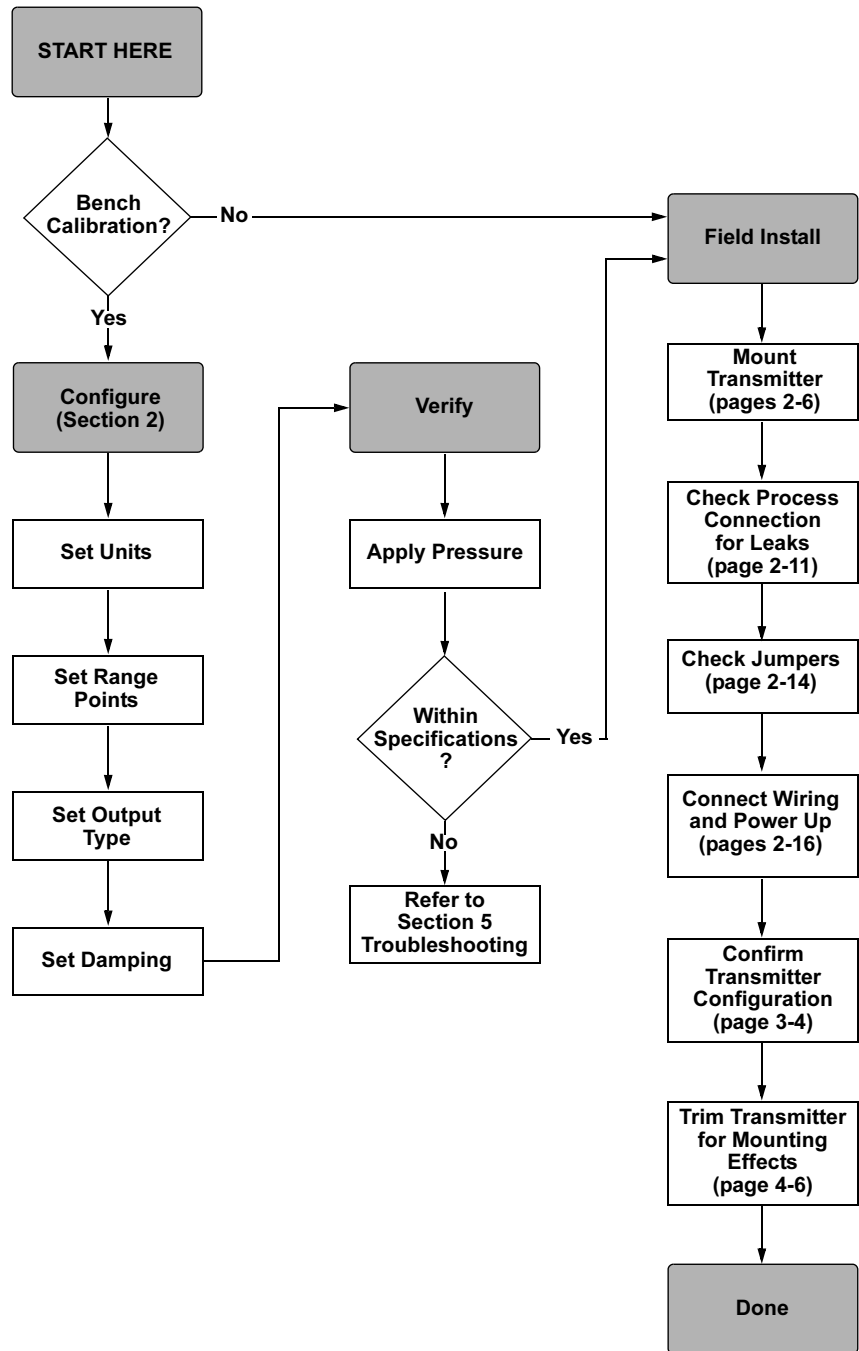
One method of reducing fluctuations in atmospheric pressure is to attach a length of tubing to the reference side of the transmitter to act as a pressure buffer.

Another method is to plumb the reference side to a chamber that has a small vent to atmosphere. If multiple draft transmitters are being used in an application, the reference side of each device can be plumbed to a chamber to achieve a common gage reference.

ENVIRONMENTAL CONSIDERATIONS

The following guidelines can help optimize transmitter performance. Mount the transmitter to minimize ambient temperature changes, vibration, mechanical shock, and to avoid external contact with corrosive materials. Appendix A: Range and Sensor Limits on page A-6 lists the transmitter temperature operating limits.

Figure 2-1. Installation Flowchart



INSTALLATION PROCEDURES

When choosing an installation location and position, take into account the need for access to the transmitter. For dimensional drawing information see page A-13.

Process Flange Orientation

Mount the process flanges with sufficient clearance for process connections. For safety reasons, place the drain/vent valves so the process fluid is directed away from you when the vents are used. In addition, consider the possible need for a testing or calibration input.

Housing Rotation

See “Consider Housing Rotation” on page 2-13.

Terminal Side of Electronics Housing

Mount the transmitter so that the terminal side is accessible. A 0.75-inch (19 mm) clearance is required for cover removal. Use a conduit plug on the unused side of the conduit opening.

Circuit Side of Electronics Housing

Provide 0.75 inches (19 mm) clearance if possible for cover removal. Three inches of clearance is required for cover removal if a display is installed.

Exterior of Electronics Housing

The integral span and zero adjustments are located under the certifications plate on the top of the transmitter. Allow a minimum of 1.0 inch of clearance above the transmitter if you intend to use the integral zero and span adjustments.

Cover Installation

Always install the electronics housing covers metal-to-metal to ensure a proper seal.

Mount the transmitter

The Model 3051C Pressure Transmitter weighs 5.7 lbs (2,6 kg) without additional options. Optional mounting brackets available with the Model 3051 allow mounting to a panel, wall, or 2-inch pipe. The B4 Bracket Option for use with the Coplanar flange and the Model 3051T is 316 SST with 316 SST bolts. “Model 3051T Dimensional Drawings” on page A-16 show bracket dimensions and mounting configurations for the B4 Option.

Mounting Brackets

Bracket options B1, B2, B3, B7, B8, and B9 are sturdy polyurethane painted carbon steel brackets designed for use in pipe or panel mounting the traditional flange (H2, H3, H4, or H7 option). The B1–B3 brackets have carbon steel bolts, while the B7–B9 brackets have stainless steel bolts. Bracket options BA and BC are stainless steel with stainless steel bolts. Dimensionally, these brackets are identical to the B1–B3 brackets used with the Rosemount Model 1151 Pressure Transmitter except for the length of the bolts used to mount the transmitter to the bracket. Bracket options B5/B6 are used for Model 3051H transmitters. These bracket styles facilitate multiple mounting configurations, see “Model 3051H Pressure Transmitter Exploded View and Dimensional Drawings” on page A-17. When installing the transmitter to one of the mounting brackets, torque the bolts to 125 inch-pounds.

NOTE

The transmitter is calibrated in a horizontal or vertical position at the factory. Mounting the transmitter in a position other than factory calibration position will cause the zero point to shift by an amount equivalent to the liquid head. To reset the zero point, refer to “Sensor Trim” on page 4-6.

Mounting Bolts

The following guidelines have been established to ensure a tight flange, adapter, or manifold seal. The Model 3051 is shipped with the Coplanar/Traditional flange installed with four 1.75-inch flange bolts or integral manifold installed with four 2.25-inch bolts. The following bolts are also available to facilitate other mounting configurations:

Differential Pressure

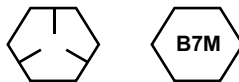
- Four 2.88-inch flange/adapter bolts for mounting the flange adapters to the Coplanar flange with DF option or as a bolt kit.
- Four 2.25-inch conventional manifold/flange bolts for mounting a three-valve manifold to the Coplanar flange when specified as an assembly or as a bolt kit. In this configuration, the 1.75-inch bolts may be used to mount the flange adapters to the process connection side of the manifold.

Gage/Absolute Pressure

- Two 2.88-inch flange/adapter bolts for mounting the flange adapters to the Coplanar flange with DF option or as a bolt kit.

Figure 2-3 shows mounting bolts and bolting configurations for a Coplanar flange. Figure 2-2 for bolting requirements for alternate mounting configurations. Stainless steel bolts supplied by Rosemount Inc. are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. No additional lubricant should be applied when installing either type of bolt. Bolts supplied by Rosemount Inc. are identified by their head markings:

Carbon Steel (CS) Head Markings



Stainless Steel (SST) Head Markings



* The last digit in the F593_ head marking may be any letter between A and M.

Bolt Installation

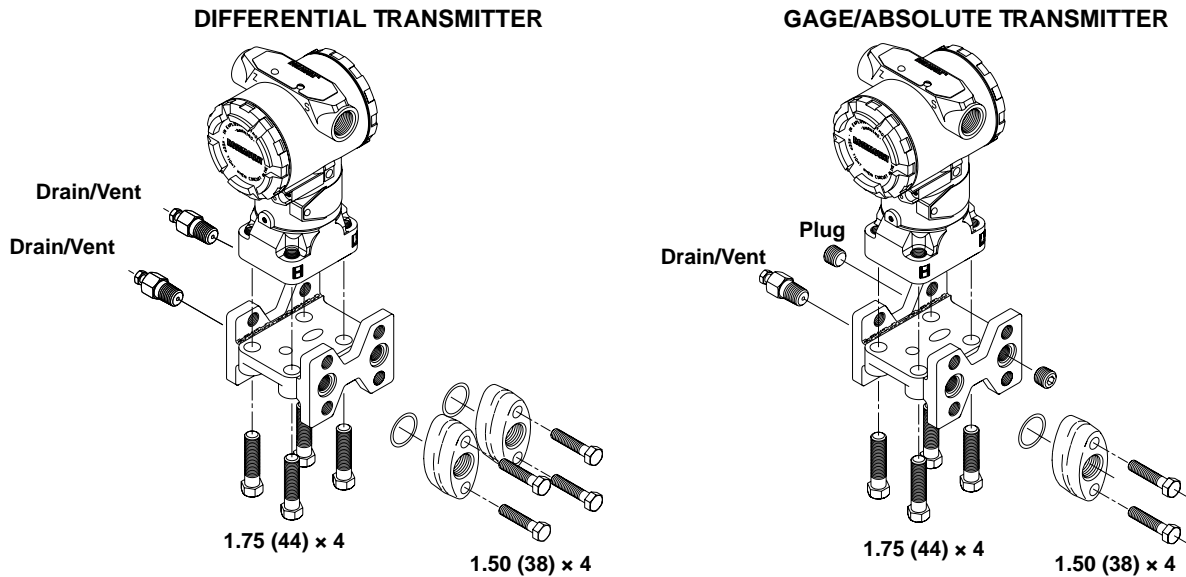
! Only use bolts supplied with the Model 3051 or sold by Rosemount Inc. as spare parts for the Model 3051 transmitter. Use the following bolt installation procedure:

1. Finger-tighten the bolts.
2. Torque the bolts to the initial torque value using a crossing pattern (see Table 2-1 for torque values).
3. Torque the bolts to the final torque value using the same crossing pattern.

Table 2-1. Bolt Installation Torque Values

Bolt Material	Initial Torque Value	Final Torque Value
CS-ASTM-A445 Standard	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
316 SST—Option L4	150 in.-lb (17 N-m)	300 in.-lb (34 N-m)
ASTM-A-193-B7M—Option L5	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
<i>Monel</i> [®] —Option L6	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)

Figure 2-2. Traditional Flange Bolt Configurations

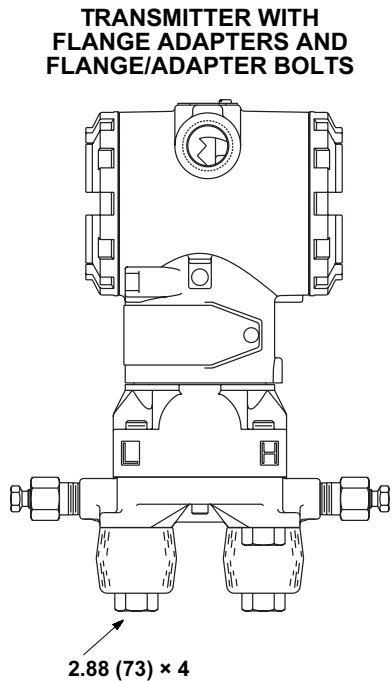
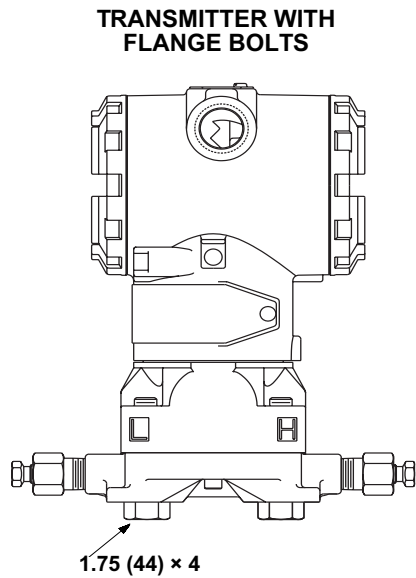


3051-3031B07P, B07O

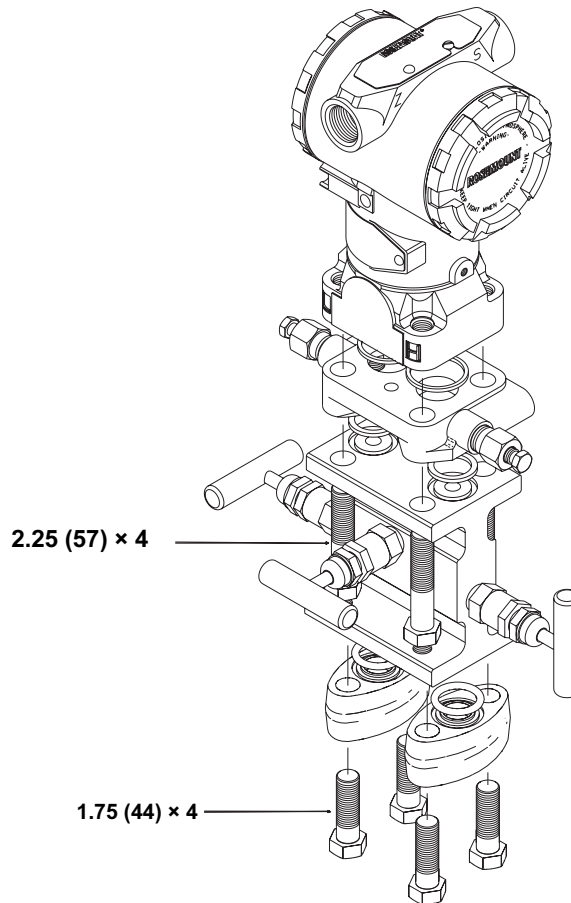
NOTE
Dimensions are in inches (millimeters).

! See "Safety Messages" on page 2-1 for complete warning information.

Figure 2-3. Mounting Bolts and Bolt Configurations for Coplanar Flange



**TRANSMITTER WITH 3-VALVE MANIFOLD
MANIFOLD/FLANGE BOLTS
FLANGE ADAPTERS
AND FLANGE/ADAPTER BOLTS**
(Differential Configuration Shown)



Description	Qty	Size in. (mm)
Differential Pressure		
Flange Bolts	4	1.75 (44)
Flange/Adapter Bolts	4	2.88 (73)
Manifold/Flange Bolts	4	2.25 (57)
Gage/Absolute Pressure ⁽¹⁾		
Flange Bolts	4	1.74 (44)
Flange/Adapter Bolts	2	2.88 (73)

(1) Model 3051T transmitters are direct mount and do not require bolts for process connection.

NOTE
Dimensions are in inches (millimeters).

3051-3031E06FD E06F; 305-3031A29P

Mounting Requirements

Refer to Figure 2-4 for examples of the following mounting configurations:

Liquid Flow Measurement

- Place taps to the side of the line to prevent sediment deposits on the transmitter's process isolators.
- Mount the transmitter beside or below the taps so gases can vent into the process line.
- Mount drain/vent valve upward to allow gases to vent.

Gas Flow Measurement

- Place taps in the top or side of the line.
- Mount the transmitter beside or above the taps so liquid will drain into the process line.

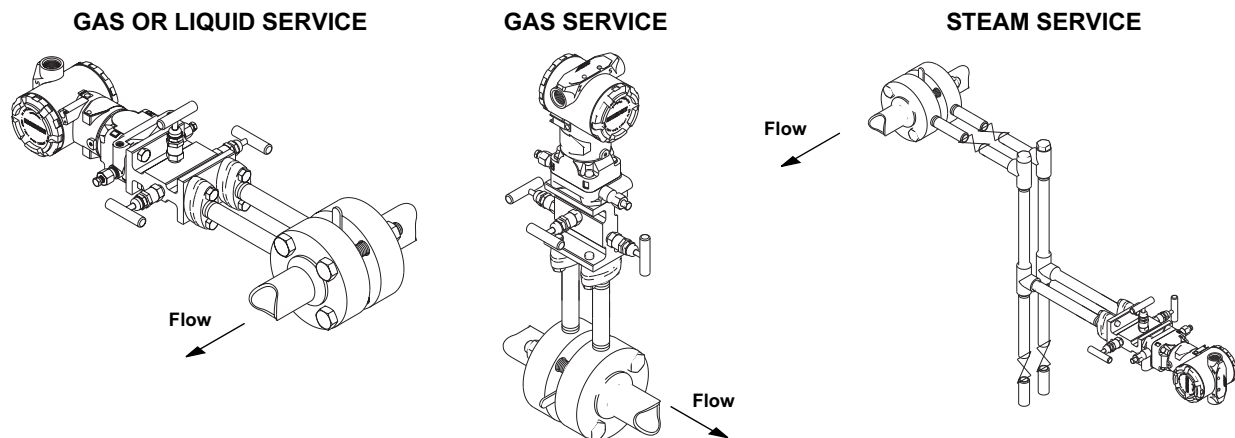
Steam Flow Measurement

- Place taps to the side of the line.
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate.
- Fill impulse lines with water to prevent the steam from contacting the transmitter directly and to ensure accurate measurement start-up.

NOTE

In steam or other elevated temperature services, it is important that temperatures at the coplanar process flanges not exceed 250 °F (121 °C) for transmitters with silicone fill or 185 °F (85 °C) for inert fill. In vacuum service, these temperature limits are reduced to 220 °F (104 °C) for silicone fill and 160 °F (71 °C) for inert fill. Models 3051L, 3051H, and the traditional flange allow higher temperatures.

Figure 2-4. Installation Examples



3051-3031A03B, B03C, C03B

Process Connections

Model 3051C process connection

Model 3051 process connections on the transmitter flange are 1/4–18 NPT. Flange adapter unions with 1/2–14 NPT connections must be ordered using the DF option. The threads are Class 2; use your plant-approved lubricant or sealant when making the process connections. The process connections on the transmitter flange are on 2 1/8-inch (54 mm) centers to allow direct mounting to a three-valve or five-valve manifold. Rotate one or both of the flange adapters to attain connection centers of 2 inches (51 mm), 2 1/8 inches (54 mm), or 2 1/4 inches (57 mm). See page 2-12 for information on the Model 3051T process connection.

⚠ Install and tighten all four flange bolts before applying pressure, or process leakage will result. When properly installed, the flange bolts will protrude through the top of the module housing. Do not attempt to loosen or remove the flange bolts while the transmitter is in service.

To install adapters to a Coplanar flange, perform the following procedure:

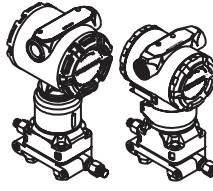
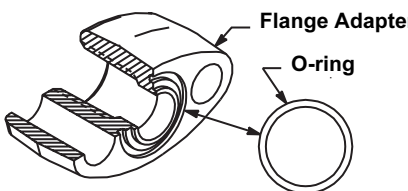
1. Remove the flange bolts.
2. Leaving the flange in place, move the adapters into position with the O-ring installed.
3. Clamp the adapters and the Coplanar flange to the transmitter module using the larger of the bolts supplied.
4. Tighten the bolts. Refer to “Mounting Bolts” on page 2-7 for torque specifications.

⚠ WARNING

Failure to install proper flange adapter O-rings can cause process leaks, which can result in death or serious injury.

The two flange adapters are distinguished by unique O-ring grooves. Only use the O-ring that is designed for its specific flange adapter, as shown below.

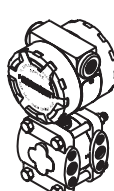
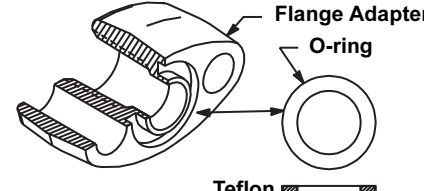
MODELS 3051S/ 3051/3001/3095/2024

Models 3051S 3051C 2024

Flange Adapter
O-ring
Teflon Based Elastomer

MODEL 1151

Flange Adapter
O-ring
Teflon Elastomer

3051-0669A01A

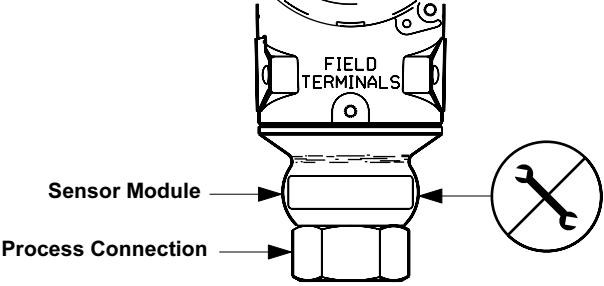
Refer to the Spare Parts list in Appendix A: Reference Data for the correct part numbers of the flange adapters and O-rings designed for Model 3051 transmitters.

When compressed, Teflon® O-rings tend to cold flow, which aids in their sealing capabilities. Whenever you remove flanges or adapters, visually inspect the Teflon O-rings. Replace them if there are any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them. If you replace the O-rings, retorque the flange bolts after installation to compensate for cold flow. Refer to the process sensor body reassembly procedure in Section 5: Troubleshooting.

Model 3051T Process Connection

⚠ WARNING

Do not apply torque directly to the sensor module. Rotation between the sensor module and the process connection can damage the electronics. To avoid damage, apply torque only to the hex-shaped process connection.



3051-3051TF6D

Impulse Piping

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements. There are five possible sources of error: pressure transfer, leaks, friction loss (particularly if purging is used), trapped gas in a liquid line, liquid in a gas line, and density variations between the legs.

The best location for the transmitter in relation to the process pipe depends on the process itself. Use the following guidelines to determine transmitter location and placement of impulse piping:

- Keep impulse piping as short as possible.
- For liquid service, slope the impulse piping at least 1 inch per foot (8 cm per m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 inch per foot (8 cm per m) downward from the transmitter toward the process connection.
- Avoid high points in liquid lines and low points in gas lines.
- Make sure both impulse legs are the same temperature.
- Use impulse piping large enough to avoid friction effects and blockage.
- Vent all gas from liquid piping legs.
- When using a sealing fluid, fill both piping legs to the same level.
- When purging, make the purge connection close to the process taps and purge through equal lengths of the same size pipe. Avoid purging through the transmitter.
- Keep corrosive or hot (above 250 °F [121 °C]) process material out of direct contact with the sensor module and flanges.
- Prevent sediment deposits in the impulse piping.
- Keep the liquid head balanced on both legs of the impulse piping.
- Avoid conditions that might allow process fluid to freeze within the process flange.

Consider Housing Rotation

The electronics housing can be rotated up to 180 degrees (left or right) to improve field access or to better view the optional LCD display. To rotate the housing, perform the following procedure:

1. Loosen the housing rotation set screw using a $\frac{9}{64}$ -in. hex wrench.
2. Turn the housing up to 180 degrees to the left or right of its original (as shipped) position. **Do not rotate the housing more than 180 degrees without first performing a disassembly procedure (see “Disassembly Procedures” on page 5-3). Over-rotation will sever the electrical connection between the sensor module and the electronics module.**
3. Retighten the housing rotation set screw.

Model 3051

Set Jumpers

Security (Write Protect)

There are three security methods with the Model 3051 transmitter:

1. Security Jumper: prevents all writes to transmitter configuration.
2. Local Keys (Local Zero and Span) Software Lock Out: prevents changes to transmitter range points via local zero and span adjustment keys. With local keys security enabled, changes to configuration are possible via HART.
3. Physical Removal of Local Keys (Local Zero and Span) Magnetic Buttons: removes ability to use local keys to make transmitter range point adjustments. With local keys security enabled, changes to configuration are possible via HART.

NOTE

If the security jumper is not installed, the transmitter will continue to operate in the security OFF configuration.

You can prevent changes to the transmitter configuration data with the write protection jumper. Security is controlled by the security (write protect) jumper located on the electronics board or display face. Position the jumper on the transmitter circuit board in the "ON" position to prevent accidental or deliberate change of configuration data.

If the transmitter write protection jumper is in the "ON" position, the transmitter will not accept any "writes" to its memory. Configuration changes, such as digital trim and reranging, cannot take place when the transmitter security is on.

Configuring Transmitter Alarm and Security Jumper Procedure

To reposition the jumpers, follow the procedure described below.



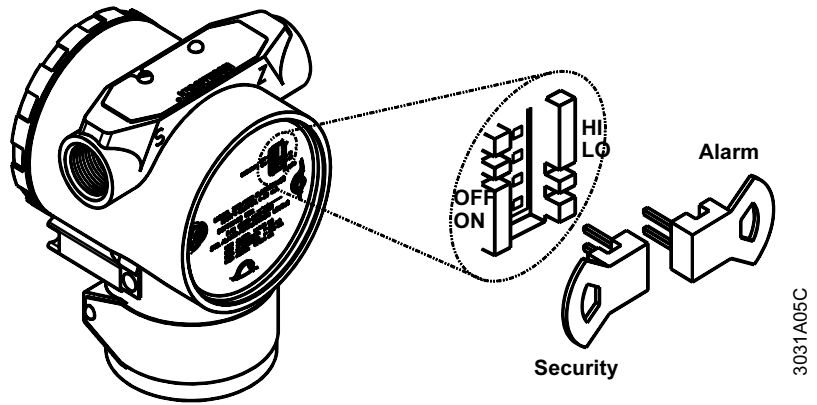
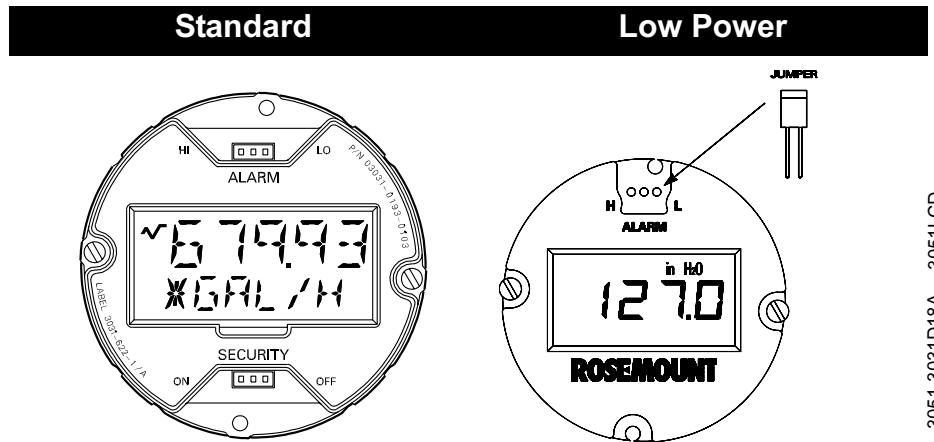
1. If the transmitter is installed, secure the loop and remove power.
-  2. Remove the housing cover opposite the field terminal side. Do not remove the transmitter covers in explosive atmospheres when the circuit is live.
3. Reposition the jumpers as desired.
 - Figure 2-5 shows the jumper positions for the electronics board.
 - Figure 2-6 shows transmitters with an optional LCD display.
 - Figure 2-7 shows the jumper positions for low-power transmitters.
-  4. Reattach the transmitter cover. Transmitter covers must be fully engaged to meet Explosion-Proof requirements.

Figure 2-5. Electronics Board



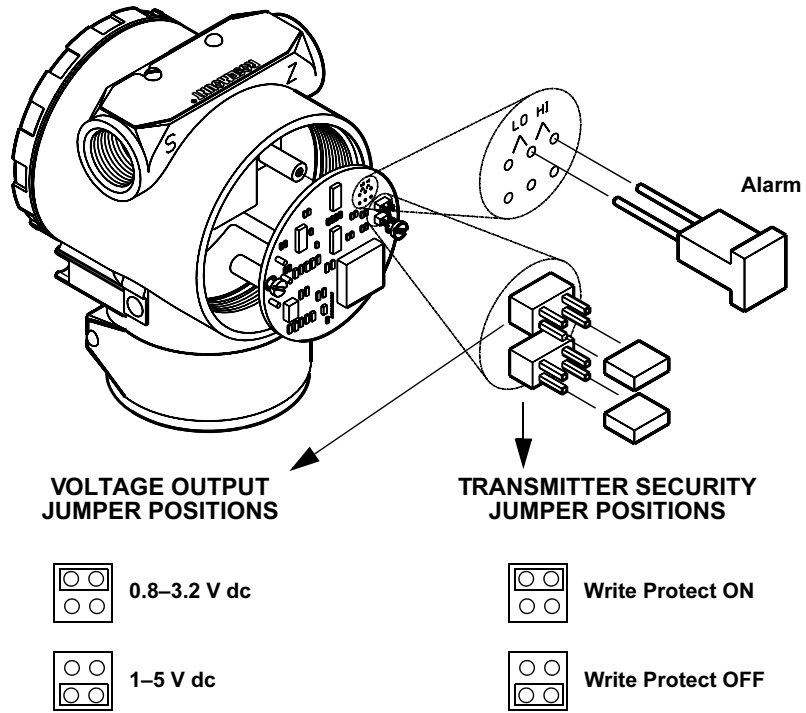
NOTE
 Security jumper not installed = Not Write Protected
 Alarm jumper not installed = High Alarm

Figure 2-6. Model 3051 with Optional LCD Display



NOTE
 Security jumper not installed = Not Write Protected
 Alarm jumper not installed = High Alarm

Figure 2-7. Low Power Transmitter Electronics Boards



NOTE

Security jumper not installed = Not Write Protected
 Alarm jumper not installed = High Alarm
 Voltage output jumper not installed = 1–5 V



Connect Wiring and Power Up

NOTE

Use shielded twisted pairs to yield best results. In order to ensure proper communication, use 24 AWG or larger wire, and do not exceed 5000 feet (1 500 meters). Installed signal wiring should not be run together and should not be in the same cable tray as AC power wiring.

The transmitter terminal block is in the compartment of the electronics housing labeled “FIELD TERMINALS.” The other compartment contains the transmitter electronics module. Connections for the HART-based communicator are attached beneath the terminal screws on the terminal block. You can connect the Rosemount Model 282 Loop Validator at the signal terminals to provide power to the transmitter temporarily for calibration or diagnostic purposes. Or you can attach it to the test connections on the terminal block of the transmitter for indication purposes. Figure 2-8 shows power supply load limitations for the transmitter.

To make connections, perform the following procedure:

-  1. Remove the housing cover on the side marked "FIELD TERMINALS." Do not remove the cover in explosive atmospheres when the circuit is live. All power to the transmitter is supplied over the signal wiring.
-  2. Connect the lead that originates at the positive side of the power supply to the terminal marked "+" and the lead that originates from the negative side of the power supply to the terminal marked "-". Avoid contact with the leads and terminals. Do not connect the powered signal wiring to the test terminals. Power could damage the test diode in the test connection.
3. Plug and seal unused conduit connections on the transmitter housing to avoid moisture accumulation in the terminal side of the housing. If you do not seal the unused connections, mount the transmitter with the electrical housing positioned downward for drainage. Install wiring with a drip loop. Arrange the drip loop so the bottom is lower than the conduit connections and the transmitter housing.

Inductive-based transient protectors, including the Rosemount Model 470, can adversely affect the output of Model 3051 4–20 mA transmitters. Do not use the Model 470 for transient protection with the Model 3051. If your application requires transient protection, install the Transient Protection Terminal Block (Section 5: Troubleshooting).

Signal Wiring Grounding

Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. You may ground the signal wiring at any one point on the signal loop, or leave it ungrounded. The negative terminal of the power supply is a recommended grounding point. Device must be properly grounded or earthed according to local electric codes.

Power Supply for 4–20 mA Transmitters

The dc power supply should provide power with less than 2 percent ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, and related pieces. Note that the resistance of intrinsic safety barriers, if used, must be included. See "Power Supply Effect" on page A-5 for additional power supply information.

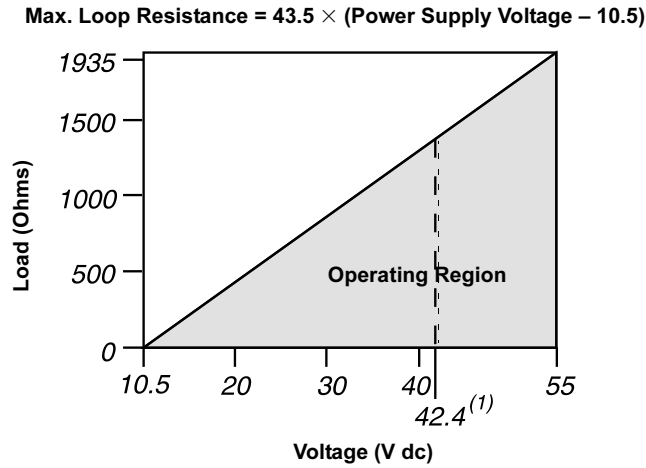
NOTE

A minimum loop resistance of 250 ohms is required to communicate with a HART Communicator. If a single power supply is used to power more than one Model 3051 transmitter, the power supply used, and circuitry common to the transmitters, should not have more than 20 ohms of impedance at 1200 Hz.

Power supply for low power transmitters

Low-power transmitters require a 6–12 V dc external power supply.

Figure 2-8. Power Supply Load Limitations, 4–20 mA Transmitters



3051-0103A

Communication requires a minimum loop resistance of 250 ohms.
(1) For CSA approval, power supply must not exceed 42.4 V.

HAZARDOUS LOCATIONS

The Model 3051 has an Explosion-Proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual transmitters are clearly marked with a tag indicating the certifications they carry. See Appendix B: Product Certifications for specific approval categories and installation drawings.

IMPORTANT NOTE

Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

Grounding the Transmitter Case


The transmitter case should always be grounded in accordance with national and local electrical codes. The most effective transmitter case grounding method is direct connection to earth ground with minimal impedance. Methods for grounding the transmitter case include:

- **Internal Ground Connection:** The Internal Ground Connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol (\oplus), and is standard on all Model 3051 transmitters.
- **External Ground Assembly:** This assembly is included with the optional transient protection terminal block (Option Code T1), and it is included with CESI/CENELEC Flame-Proof Certification (Option Code E8), BASEEFA/CENELEC Intrinsic Safety Certification (Option Code I1), and BASEEFA Type N Certification (Option Code N1). The External Ground Assembly can also be ordered with the transmitter (Option Code V5), or as a spare part (03031-0398-0001).

The meter kit includes:

- one LCD display assembly
- one extended cover with O-ring installed
- two nylon standoffs
- two captive screws
- one ten-pin interconnection header


Use the following procedure and Figure 2-9 to install the LCD display. If the display is an upgrade from a previous version, upgrade the electronics board before attempting to install the display.


1. IF the transmitter is installed in a loop, THEN secure the loop and disconnect power.
-  2. Remove the transmitter cover opposite the field terminal side. Do not remove the instrument covers in explosive environments when the circuit is alive.
3. Remove the failure mode and alarm jumpers from the electronics module and insert them in their new positions above and below the display readout on the display assembly.

NOTE

On previous versions, remove only the alarm jumper.

4. Insert the interconnection header in the ten-pin socket exposed by removal of the jumpers. (Previous versions of the display use a six-pin connector.)
5. Remove the two captive screws from the electronics module. To do so, loosen the screws to release the module, then pull out the screws until they are stopped by the captive thread inside of the circuit board standoffs. Continue loosening the screws and remove them.
6. If necessary, rotate the electronics housing up to 180 degrees (left or right) to improve field access or to better view the LCD display. To rotate the housing:
 - a. Loosen the housing rotation set screw using a $\frac{9}{64}$ -in. hex wrench.
 - b. Turn the housing up to 180 degrees to the left or right of its original (as shipped) position. **Do not rotate the housing more than 180 degrees without first performing a disassembly procedure (see “Disassembly Procedures” on page 5-3). Over-rotation will sever the electrical connection between the sensor module and the electronics module.**
 - c. Retighten the housing rotation set screw.

 See “Safety Messages” on page 2-1 for complete warning information.

7. Decide which direction to orient the display. Insert the long display screws into the two holes on the display assembly that coincide with the holes on the electronics module. You can install the display in 90-degree increments for easy viewing. Position one of the four connectors on the back of the display assembly to accept the interconnection header.
8. Attach the display assembly to the electronics module by threading the screws into the captive threads and attaching the display assembly to the interconnection pins. Tighten the screws to secure the display assembly and electronics board in place.
-  9. Attach and tighten the extended cover. Transmitter covers must be fully engaged to meet Explosion-Proof requirements and to achieve the proper environmental seal.

Note the following LCD temperature limits:

Operating: -4 to 175 °F (-20 to 80 °C)

Storage: -40 to 185 °F (-40 to 85 °C)

NOTE

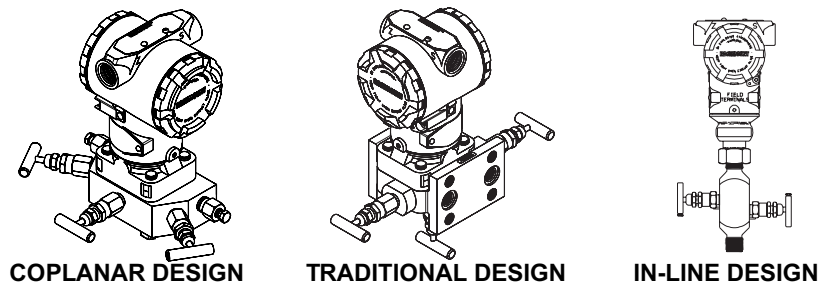
Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD display, an alarm level test is recommended before returning the transmitter to service (see page 3-19).

Model 3051

MODELS 305 AND 306 INTEGRAL MANIFOLDS

The Model 305 is available in two designs: Traditional and Coplanar. The traditional Model 305 Integral Manifold can be mounted to most primary elements with mounting adapters in the market today. The Model 306 Integral Manifold is used with In-line transmitters to provide block-and-bleed valve capabilities of up to 10000 psi (690 bar).

Figure 2-10. Integral Manifolds



Model 305 Integral Manifold Installation Procedure

To install a Model 305 Integral Manifold to a Model 3051 transmitter:

1. Inspect the Teflon sensor module O-rings. If the O-rings are undamaged, reusing them is recommended. If the O-rings are damaged (if they have nicks or cuts, for example), replace them with new O-rings.

IMPORTANT

If replacing the O-rings, take care not to scratch or deface the O-ring grooves or the surface of the isolating diaphragm while you remove the damaged O-rings.

2. Install the Integral Manifold on the sensor module. Use the four 2.25-in. manifold bolts for alignment. Finger tighten the bolts, then tighten the bolts incrementally in a cross pattern to final torque value. See "Mounting Bolts" on page 2-7 for complete bolt installation information and torque values. When fully tightened, the bolts should extend through the top of the module housing.
3. If the Teflon O-rings have been replaced, the flange bolts should be re-tightened after installation to compensate for cold flow of the O-rings.

NOTE

Always perform a zero trim on the transmitter/manifold assembly after installation to eliminate mounting effects.

Model 306 Integral Manifold Installation Procedure

The Model 306 Manifold is for use only with a Model 3051T transmitter.

1. Assemble the Model 306 Manifold to the Model 3051T transmitter with a thread sealant.

⚠ See "Safety Messages" on page 2-1 for complete warning information.

Section 3 Configuration

Commissioning on the bench with HART	page 3-2
Model 275 HART Communicator	page 3-4
Review Configuration Data	page 3-7
Check Output	page 3-7
Basic Setup	page 3-8
LCD Display	page 3-16
Detailed Setup	page 3-19
Diagnostics and Service	page 3-21
Advanced Functions	page 3-22
Multidrop Communication	page 3-25

OVERVIEW

This section contains information on commissioning and operating Model 3051 Smart Pressure Transmitters. Tasks that should be performed on the bench prior to installation are explained in this section.

For your convenience, HART communicator fast key sequences are listed for each software function. If you are unfamiliar with the communicator or how to follow fast key sequences, please refer to your communicator manual for communicator operations.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠ WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

⚠ WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

COMMISSIONING ON THE BENCH WITH HART

Commissioning consists of testing the transmitter and verifying transmitter configuration data. You may commission Model 3051 transmitters either before or after installation. Commissioning the transmitter on the bench before installation using a HART-based communicator or AMS ensures that all transmitter components are in good working order and acquaints you with the operation of the device.

⚠ To commission on the bench, connect the transmitter and the communicator as shown in Figure 3-1 and 3-2. Make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices before connecting a communicator or AMS in an explosive atmosphere. Connect the communicator leads at any termination point in the signal loop. It is most convenient to connect them to the terminals labeled “COMM” on the terminal block. Connecting across the “TEST” terminals will prevent successful communication. To avoid exposing the transmitter electronics to the plant environment after installation, set all transmitter jumpers during the commissioning stage on the bench.

For 4–20 mA transmitters, you will need a power supply capable of providing 10.5 to 55 V dc at the transmitter, and a meter to measure output current. To enable communication, a resistance of at least 250 ohms must be present between the communicator or AMS loop connection and the power supply. Do not use inductive-based transient protectors with the Model 3051.

For more information on the Model 275 HART Communicator see document 00275-8026-0002. AMS help can be found in the AMS on-line guides within the AMS system.

Setting the Loop to Manual

Whenever you are preparing to send or request data that would disrupt the loop or change the output of the transmitter, you must set your process application loop to manual. Both the HART Communicator Model 275 and AMS will prompt you to set the loop to manual when necessary. Keep in mind that acknowledging this prompt does not set the loop to manual. The prompt is only a reminder; you have to set the loop to manual yourself as a separate operation.

⚠ See “Safety Messages” on page 3-1 for complete warning information.

Wiring Diagrams

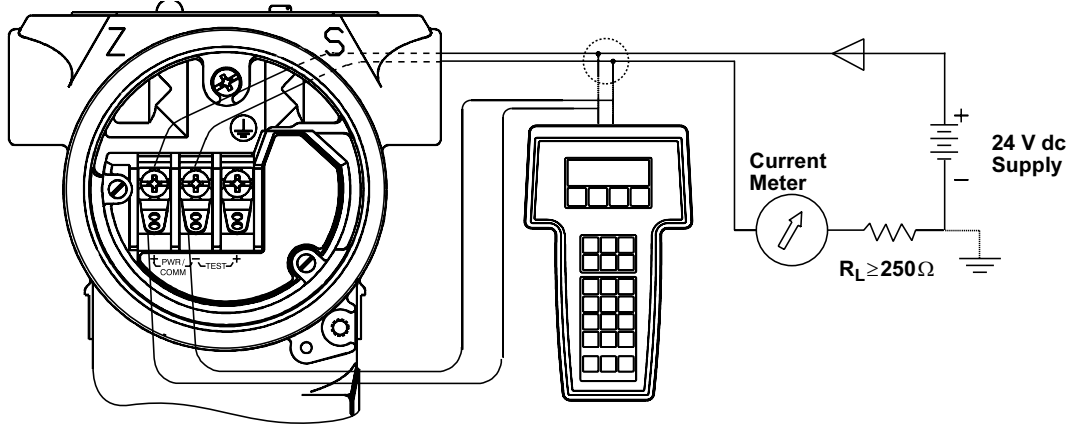
Bench Hook-up

Connect the bench equipment as shown in Figure 3-1 and 3-2, and turn on the HART-based communicator by pressing the ON/OFF key. The communicator will search for a HART-compatible device and will indicate when the connection is made. If the communicator fails to connect, it will indicate that no device was found. If this occurs, refer to Troubleshooting page 5-1.

Field Hook-up

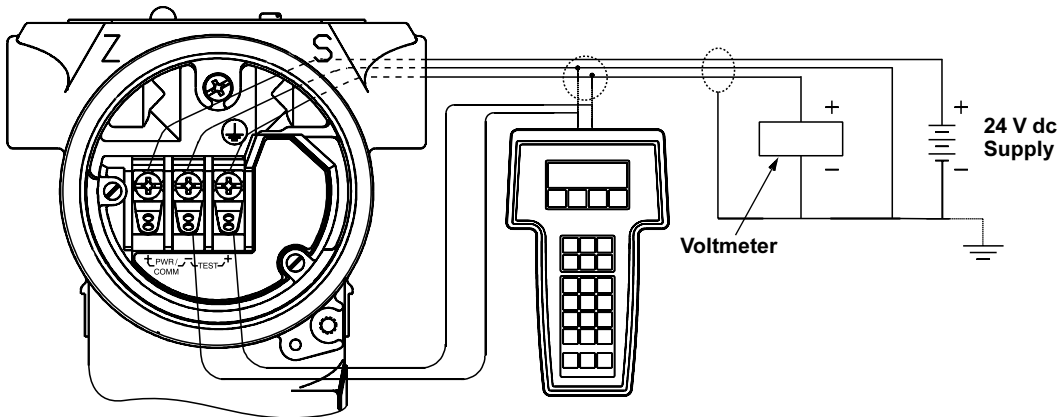
Figures 3-1 and 3-2 illustrate wiring loops for a field hook-up with a HART Communicator or AMS. Signal point may be grounded at any point or left ungrounded.

Figure 3-1. Wiring (4–20 mA)



3051-3031G02B

Figure 3-2. Wiring (Low-Power)



3051-3031I02B

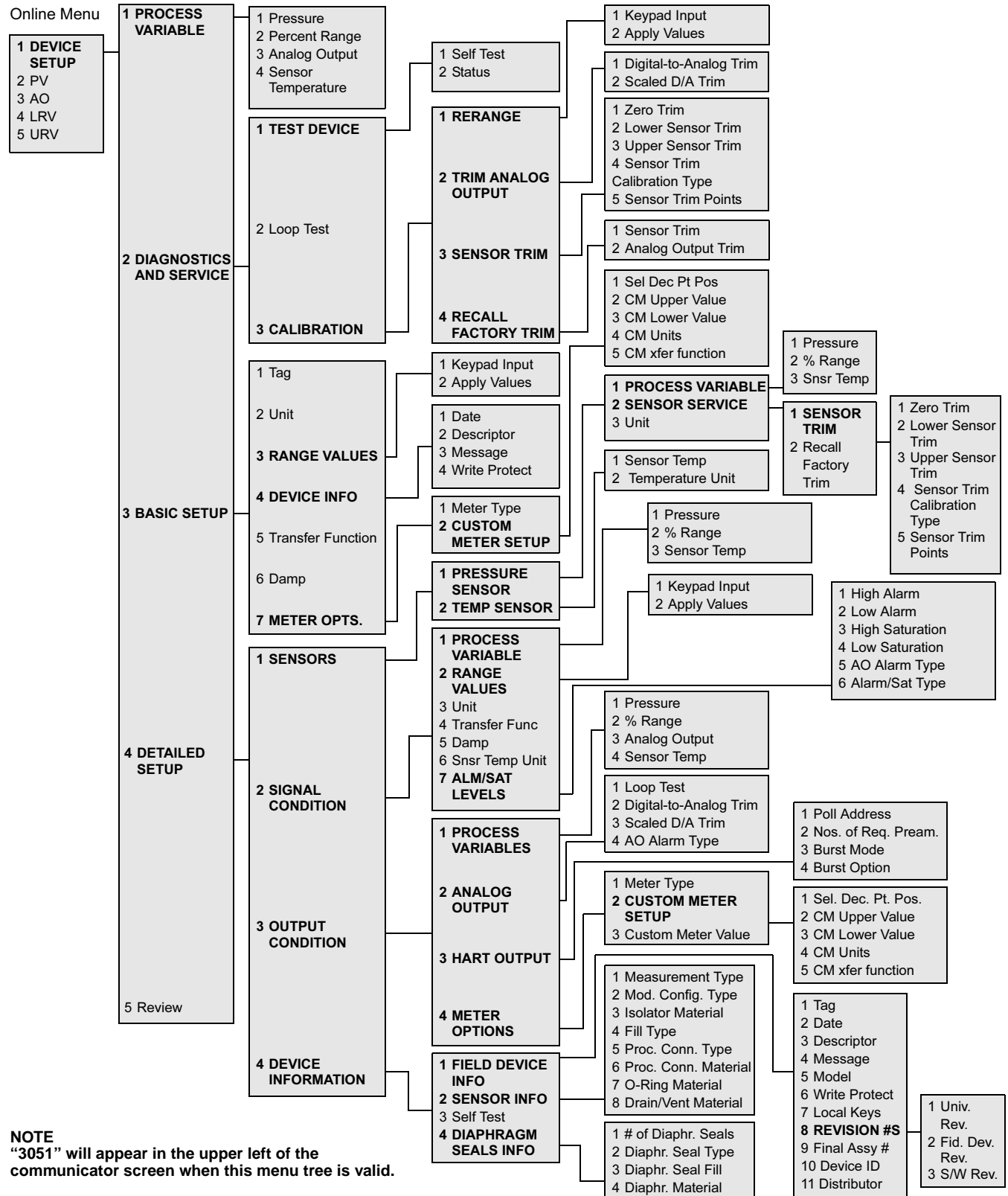
MODEL 275 HART COMMUNICATOR

A check (✓) indicates the basic configuration parameters. At minimum, these parameters should be verified as part of the configuration and startup procedure.

Table 3-1. The Model 275 HART Communicator Fast Key Sequence

Function	Fast Key Sequence
Alarm and Saturation Levels	1, 4, 2, 7
Analog Output Alarm Type	1, 4, 3, 2, 4
Burst Mode Control	1, 4, 3, 3, 3
Burst Operation	1, 4, 3, 3, 3
Custom Meter Configuration	1, 3, 7, 2
Custom Meter Value	1, 4, 3, 4, 3
✓ Damping	1, 3, 6
Date	1, 3, 4, 1
Descriptor	1, 3, 4, 2
Digital To Analog Trim (4-20 mA Output)	1, 2, 3, 2, 1
Disable Local Span/Zero Adjustment	1, 4, 4, 1, 7
Field Device Information	1, 4, 4, 1
Full Trim	1, 2, 3, 3
Keypad Input – Rerange	1, 2, 3, 1, 1
Local Zero and Span Control	1, 4, 4, 1, 7
Loop Test	1, 2, 2
Lower Sensor Trim	1, 2, 3, 3, 2
Message	1, 3, 4, 3
Meter Options	1, 4, 3, 4
Number of Requested Preambles	1, 4, 3, 3, 2
Poll Address	1, 4, 3, 3, 1
Poll a Multidropped Transmitter	Left Arrow, 4, 1, 1
✓ Range Values	1, 3, 3
Rerange	1, 2, 3, 1
Scaled D/A Trim (4–20 mA Output)	1, 2, 3, 2, 2
Self Test (Transmitter)	1, 2, 1, 1
Sensor Info	1, 4, 4, 2
Sensor Temperature	1, 1, 4
Sensor Trim Points	1, 2, 3, 3, 5
Status	1, 2, 1, 1
✓ Tag	1, 3, 1
✓ Transfer Function (Setting Output Type)	1, 3, 5
Transmitter Security (Write Protect)	1, 3, 4, 4
Trim Analog Output	1, 2, 3, 2
✓ Units (Process Variable)	1, 3, 2
Upper Sensor Trim	1, 2, 3, 3, 3
Zero Trim	1, 2, 3, 3, 1

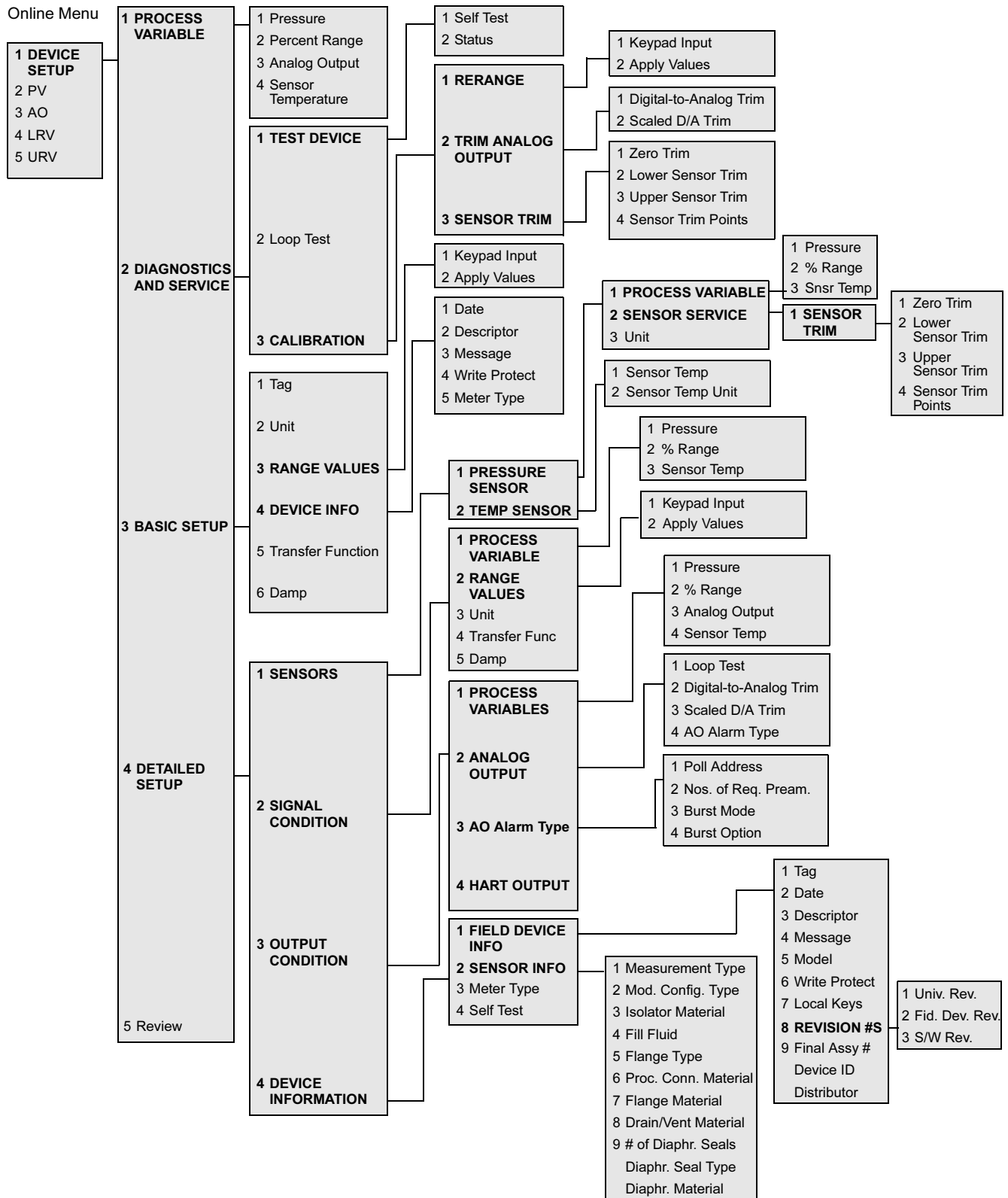
Figure 3-3. HART Communicator menu tree for Model 3051



NOTE
 "3051" will appear in the upper left of the communicator screen when this menu tree is valid.

Model 3051

Figure 3-4. HART Communicator menu tree for low power



**REVIEW
 CONFIGURATION DATA**

HART Comm	1, 5
-----------	------

NOTE

Information and procedures in this section that make use of HART Communicator fast key sequences assume that the transmitter and communicator are connected, powered, and operating correctly. If you are not familiar with the HART Communicator refer to the HART Communicator manual, document 00809-0100-4275

HART Communicator

Before you place the transmitter into operation, review the transmitter configuration data below which was set by the factory.

Transmitter Model	Type
Tag	Range
Date	Descriptor
Message	Minimum and Maximum Sensor Limits
Minimum Span	Units
4 and 20 mA points	Output (linear or sq. root)
Damping	Alarm Setting (high, low)
Security Setting (on, off)	Local Zero/Span Keys (enabled, disabled)
Integral Display	Sensor Fill
Isolator Material	Flange (type, material)
O-Ring Material	Drain/Vent
Remote Seal (type, fill fluid, isolator material, number)	Transmitter S/N
Address	Sensor S/N

AMS

Right click on the device and select "Configuration Properties" from the menu. Select the tabs to review the transmitter configuration data.

CHECK OUTPUT

Before performing other transmitter on-line operations, review the digital output parameters to ensure that the transmitter is operating properly and is configured to the appropriate process variables.

Process Variables

HART Comm.	1, 1
------------	------

HART Communicator

The process variables for the Model 3051 provide the transmitter output, and are continuously updated. The process variable menu displays the following process variables:

- Pressure
- Percent of Range
- Analog Output

The pressure reading in both Engineering Units and Percent of Range will continue to track with pressures outside of the defined range from the lower to the upper range limit of the sensor module. (Previous versions of the software will track with pressure up to 105% of span and remain there as pressure increases.)

Model 3051

NOTE

Regardless of the range points, the Model 3051 will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA points are set to 0 and 10 inH₂O, and the transmitter detects a pressure of 25 inH₂O, it digitally outputs the 25 inH₂O reading and a 250% of span reading. However, there may be up to ±5.0% error associated with output outside of the range points.

AMS

Right click on the device and select “Process Variables...” from the menu. The process variable screen displays the following process variables:

- Pressure
- Percent of range
- Analog output
- Sensor temperature

Sensor Temperature

HART Comm.	1, 1, 4
------------	---------

The Model 3051 contains a temperature sensor just above its pressure sensor in the sensor module. When reading this temperature, keep in mind that this is not a process temperature reading.

HART Communicator

Enter the fast key sequence below “Sensor Temperature” to view the sensor temperature reading.

AMS

Right click on the device and select “Process Variables...” from the menu. “Snsr Temp” is the sensor temperature reading.

BASIC SETUP

Set Process Variable Units

HART Comm.	1, 3, 2
------------	---------

The *PV Unit* command sets the process variable units to allow you to monitor your process using the appropriate units of measure. Select from the following engineering units:

- | | |
|---|--|
| <ul style="list-style-type: none"> • inH₂O • inHg • ftH₂O • mmH₂O • mmHg • psi • torr • inH₂O at 4 °C⁽¹⁾ | <ul style="list-style-type: none"> • bar • mbar • g/cm² • kg/cm² • Pa • kPa • atm • mmH₂O at 4 °C⁽¹⁾ |
|---|--|

(1) Not available with low power or previous Model 3051 transmitters.

AMS

Right click on the device and select “Configuration Properties” from the menu. In the Basic Setup tab, use “Unit” drop down menu to select units.

Set Output

HART Comm.	1, 3, 5
------------	---------

Activate the transmitter square root output option to make the analog output proportional to flow. As the input approaches zero, the Model 3051 automatically switches to a linear output in order to ensure a more smooth, stable output near zero. See Figure 3-5.

The transition from linear to square root is not adjustable. It occurs at 0.8% of ranged pressure input or 9% of full-scale flow output in transmitters with Revision 5.2 or higher software. In earlier software, the transition point occurred at 4% of ranged pressure input, or 20% of full scale flow output.

From 0 percent to 0.6 percent of the ranged pressure input, the slope of the curve is unity ($y = x$). This allows accurate calibration near zero. Greater slopes would cause large changes in output for small changes at input. From 0.6 percent to 0.8 percent, the slope of the curve equals 42 ($y = 42x$) to achieve continuous transition from linear to square root at the transition point.

HART Communicator

Enter the fast key sequence below “Set Output (Transfer function).”

AMS

Right click on the device and select “Configuration Properties” from the menu.

1. In the Basic Setup tab, use “Xfer fnctn” drop down menu to select output, click **Apply**.
2. An “Apply Parameter Modifications” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Selecting Output Range for Low-Power Output Transmitters

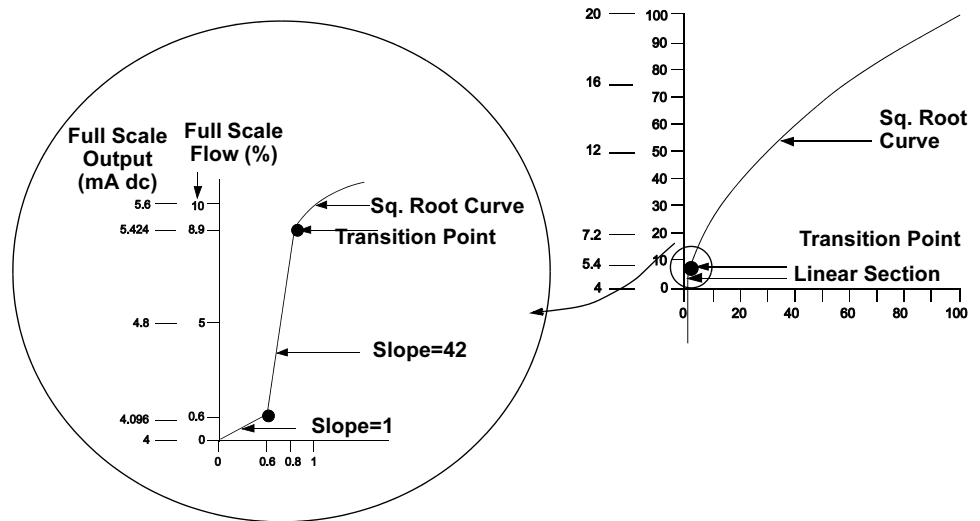
Low power transmitters output either 1–5 V dc or 0.8–3.2 V dc depending on the position of the voltage output jumper. To reposition the voltage output jumper, follow the procedure described on page 2-14.

NOTE

Default low power output is 1–5 V dc. After changing output between 1–5 V and 0.8–3.2 V, perform a low power output trim.

Model 3051

Figure 3-5. Square Root Output Transition Point



NOTE

For a flow turndown of less than 10:1 it is not recommended to perform a square root extraction in the transmitter. Instead, perform the square root extraction in the system.

Rerange

The Range Values command sets the 4 and 20 mA points (lower and upper range values). Setting the range values to the limits of expected readings maximizes transmitter performance. In practice, you may reset the transmitter range values as often as necessary to reflect changing process conditions.

NOTE

Regardless of the range points, the Model 3051 will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA points are set to 0 and 10 inH₂O, and the transmitter detects a pressure of 25 inH₂O, it digitally outputs the 25 inH₂O reading and a 250% percent of span reading. However, there may be up to $\pm 5.0\%$ error associated with output outside of the range points.

Use one of three methods to rerange the transmitter. Each method is unique; examine all three closely before deciding which method to use.

Rerange with a Communicator Only

HART Comm.	1, 2, 3, 1, 1
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Reranging using only the communicator is the easiest and most popular way to rerange the transmitter. This method changes the values of the analog 4 and 20 mA points independently without a pressure input.

NOTE

Changing the lower or upper range point results in similar changes to the span.

To rerange using only the communicator, enter the fast-key sequence above, select *Keypad input*, and follow the on-line instructions. Or enter the values directly from the **HOME** screen.

NOTE

If the transmitter security jumper is in the **ON** position, you will not be able to make adjustments to the zero and span. Refer to “Set Jumpers” on page 2-14 for the appropriate placement of the transmitter security jumper.

Rerange with a Pressure Input Source and a Communicator

HART Comm.	1, 2, 3, 1, 2
------------	---------------

Reranging using the communicator and a pressure source or process pressure is a way of reranging the transmitter when specific 4 and 20 mA points are not known. This method changes the values of the analog 4 and 20 mA points.

NOTE

When you set the 4 mA point the span is maintained; when you set the 20 mA point the span changes. If you set the lower range point to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit, and the span is adjusted accordingly.

To rerange using the communicator and a pressure source or process pressure, enter the fast-key sequence above, select *Apply values*, and follow the on-line instructions.

NOTE

If the transmitter security jumper is in the **ON** position, you will not be able to make adjustments to the zero and span. Refer to “Set Jumpers” on page 2-14 for the appropriate placement of the transmitter security jumper.

Rerange with a Pressure Input Source and the Local Zero and Span Buttons

Reranging using the local zero and span adjustments (see Figure 3-6 on page 3-12) and a pressure source is a way of reranging the transmitter when specific 4 and 20 mA points are not known and a communicator is not available.

NOTE

When you set the 4 mA point the span is maintained; when you set the 20 mA point the span changes. If you set the lower range point to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit, and the span is adjusted accordingly.

To rerange the transmitter using the span and zero buttons, perform the following procedure:

1. Loosen the screw holding the certifications label on top of the transmitter housing, and rotate the label to expose the zero and span buttons (see Figure 3-6 on page 3-12).
2. Using a pressure source with an accuracy three to ten times the desired calibrated accuracy, apply a pressure equivalent to the lower range value to the high side of the transmitter.
3. To set the 4 mA point, press and hold the zero button for at least two seconds, then verify that the output is 4 mA. If a display is installed, it will display ZERO PASS.

NOTE

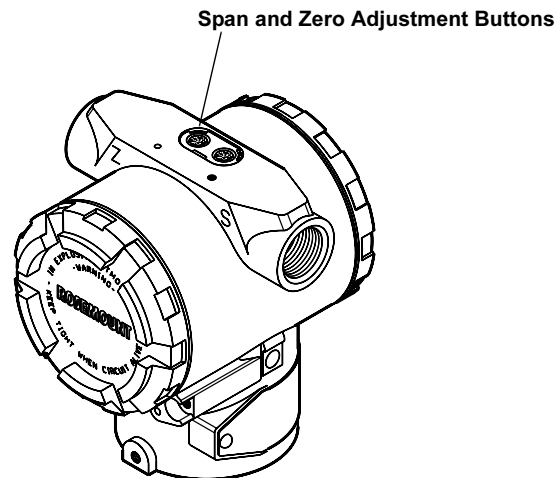
The zero and span adjustments on previous versions of the transmitter are screws instead of buttons. To activate the zero and span adjustments loosen the screws until they pop up.

4. Apply a pressure equivalent to the upper range value to the high side of the transmitter.
5. To set the 20 mA point, press and hold the span button for at least two seconds, then verify that the output is 20 mA. If a display is installed, it will display SPAN PASS.

NOTE

If the transmitter security jumper is in the **ON** position, or if the local zero and span adjustments are disabled through the software, you will not be able to make adjustments to the zero and span using the local buttons. Refer to “Set Jumpers” on page 2-14 for the proper placement of the transmitter security jumper. Or refer to “The Model 275 HART Communicator Fast Key Sequence” on page 3-4 for instructions on how to enable the span and zero buttons.

Figure 3-6. Local Zero and Span Buttons



3051-3031D02A

After you rerange the transmitter using the span and zero adjustments, it is possible to disable the adjustments to prevent further reranging.

Rerange with AMS only

Right click on the device and select “Configuration Properties” from the menu. In the Basic Setup tab, locate the Analog Output box and perform the following procedure:

1. Enter the lower range value (LRV) and the upper range value (URV) in the fields provided. Click **Apply**.
2. An “Apply Parameter Modifications” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Rerange with a Pressure Input Source and AMS

Right click on the device, select “Calibrate”, then “Apply values” from the menu.

1. Select **Next** after the control loop is set to manual.
2. From the “Apply Values” menu, follow the on-line instructions to configure lower and upper range values.
3. Select **Exit** to leave the “Apply Values” screen.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.

Model 3051C Differential/Gage Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	0.5	25	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.03678	1.8389	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH ₂ O	0.04167	2.08333	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH ₂ O	12.7	635.5	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.01806	0.903	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00125	0.06227	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	1.2454	62.2723	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm ²	1.26775	63.3875	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm ²	0.00127	0.0635	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	124.545	6227.23	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.12545	6.2272	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00123	0.06146	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE

When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051P Differential/Gage Pressure Transmitter Range Limits								
Units	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max
inH ₂ O	25	250	100	1000	830.40	8304	5536.0	55360
inHg	1.8389	18.389	7.3559	73.559	61.081	610.81	407.20	4072.04
ftH ₂ O	2.08333	20.8333	8.3333	83.3333	69.200	691.997	461.3	4613.31
mmH ₂ O	635.5	6355	2542	25421	21109.5	211095	140730	1407301
mmHg	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
psi	0.903	9.03183	3.6127	36.127	30	300	200	2000
bar	0.06227	0.62272	0.2491	2.491	2.0684	20.6843	13.7895	137.895
mbar	62.2723	622.723	249.089	2490.89	2068.43	20684.3	13789.5	137895
g/cm ²	63.3875	633.875	253.55	2535.45	2105.47	21054.7	14061.4	140614
kg/cm ²	0.0635	0.635	0.254	2.54	2.1092	21.0921	14.0614	140.614
Pa	6216.06	62160.6	24908.9	249089	206843	2068430	1378950	13789500
kPa	6.2272	62.2723	24.9089	249.089	206.843	2068.43	1378.95	13789.5
torr	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
atm	0.06146	0.61460	0.2458	2.458	2.0414	20.4138	13.6092	136.092

NOTE

When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051L/3051H Pressure Transmitter Range Limits								
Units	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max
inH ₂ O	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH ₂ O	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH ₂ O	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm ²	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm ²	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE

When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051T Gage and Absolute Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	8.30397	831.889	41.5198	4159.45	221.439	22143.9	1107.2	110720	55360	276799
inHg	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098	4072.04	20360.2
ftH ₂ O	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63	4613.31	23066.6
mmH ₂ O	211.10	21130	1054.60	105460.3	5634.66	563466	28146.1	2814613	1407301	7036507
mmHg	15.5145	1551.45	77.5723	7757.23	413.72	41372	2068.6	206860.0	103430	517151
psi	0.3	30	1.5	150	8	800	40	4000	2000	10000
bar	0.02068	3.06843	0.10342	10.3421	0.55158	55.1581	2.75791	275.7905	137.895	689.476
mbar	20.6843	2068.43	103.421	10342.11	551.581	55158.1	2757.91	275790.5	137895	689476
g/cm ²	21.0921	2109.21	105.461	10546.1	561.459	56145.9	2807.31	280730.6	140614	703067
kg/cm ²	0.02109	2.10921	0.10546	10.5461	0.56246	56.2456	2.81228	281.228	140.614	701.82
Pa	2068.43	206843	10342.1	1034212	55158.1	5515811	275791	27579054	13789500	68947600
kPa	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05	13789.5	68947.6
torr	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7	103430	517151
atm	0.02041	2.04138	0.10207	10.2069	0.54437	54.4368	2.72184	272.1841	136.092	680.46

NOTE

When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051T Gage and Absolute Pressure Transmitter Range Limits										
Units	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
	min	max	min	max	min	max	min	max	min	max
inH ₂ O	4.62254	138.399	8.30397	831.889	41.5198	4151.98	221.439	22143.9	1107.2	110720
inHg	0.34002	10.1801	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098
ftH ₂ O	0.38521	11.5333	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63
mmH ₂ O	117.510	3518.2	211.10	21130	6.35308	635.308	5634.66	563466	28146.1	2814613
mmHg	8.63642	258.575	15.5145	1551.45	1055.47	105547	413.72	41372	2068.6	206860.0
psi	0.16667	5	0.3	30	1.5	150	8	800	40	4000
bar	0.01151	0.344738	0.02068	2.06843	0.10342	10.342	0.55158	55.1581	2.75791	275.7905
mbar	11.5142	344.738	20.6843	2068.43	103.421	10342.1	551.581	55158.1	2757.91	275790.5
g/cm ²	11.74	350.91	21.0921	2109.21	105.27	105.27	561.459	56145.9	2807.31	280730.6
kg/cm ²	0.01174	0.351535	0.02109	2.10921	0.10546	10.546	0.56246	56.2456	2.81228	281.228
Pa	1151.42	34473.8	2068.43	206843	10342.1	1034210	55158.1	5515811	275791	27579054
kPa	1.15142	34.4738	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05
torr	8.63642	258.575	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7
atm	0.01136	0.34023	0.02041	2.04138	0.10207	10.207	0.54437	54.4368	2.72184	272.1841

NOTE

When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051

Damping

HART Comm.	1, 3, 6
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The Damp command changes the response time of the transmitter to smooth variations in output readings caused by rapid changes in input. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the of loop dynamics of your system. The default damping value is 0.4 seconds,⁽¹⁾ and can be reset to any of ten pre-configured damping values between 0 and 25.6 seconds.

AMS

Right click on the device and select “Configuration Properties” from the menu.

1. In the “Basic Setup” tab, enter the damping value in the “Damp” field, click **Apply**.
2. An “Apply Parameter Modifications” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

LCD DISPLAY

HART Comm.	1, 4, 3, 4
------------	------------

The Meter Options command allows you to customize the LCD display for use in your application. You can configure the display to display the following information:

- Engineering Units
- Percent of Range
- Custom Meter Display
- Alternating between Engineering Units and Percent of Range
- Alternating between Engineering Units and Custom Meter Display Installed (Arrow down - Factory Default)
- None
- Unknown
- Spcl

NOTE

The user-configurable LCD scale is a feature specific to the current 4–20 mA output transmitters. If you have a previous Model 3051 transmitter, upgrade the transmitter electronics board and LCD display to attain the current functionality.

(1) Model 3051CD0 default damping is 3.2 seconds. Model 3051CD1, with calibrations below 2.5 inH₂O (0,62 kPa), have damping set at 3.2 seconds.

Standard display Configuration

The factory default alternates between Engineering units and % Range (Factory default: INSTALLED = alt % Rnge/Eng units). To change the standard default, follow the following steps:

1. From the communicators main menu select (1) Device Setup (3) Basic Setup, (7) Meter Options.
2. Select (1) Meter Type. Using the up or down arrows scroll up or down until the desired display has been highlighted. Press ENTER (F4), SEND (F2), & HOME (F3).

NOTE

Use the up and down arrow keys to scroll through the meter type selection shown above. (Installed, None, Unknown, and Spcl are the same as Alt % rnge/Eng). These options are only present do backward software compatibility.

AMS

Right click on the device and select "Configuration Properties" from the menu.

1. In the "Local Display" tab, locate the "Meter Type" area. Select the desired options to suit your application needs, click **Apply**.
2. An "Apply Parameter Modification" screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.


Custom display Configuration

The user-configurable scale is a feature that enables the LCD display to display flow, level, or custom pressure units. With this feature you can define the decimal point position, the upper range value, the lower range value, the engineering units, and the transfer function. The display can be configured using a Model 275 HART Communicator (see Table A-1 on page 1-3) or AMS.

The user-configurable scale feature can define:

- decimal point position
- upper range values
- lower range values
- engineering units
- transfer function

To configure the display using AMS, click the **LOCAL DISPLAY** tab on the **CONFIGURATION PROPERTIES** screen. To configure the display with a HART communicator, perform the following procedure:


-  1. Connect the communicator to the transmitter. Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed according to intrinsically safe or nonincendive field wiring practices.
- 2. Change the Meter Type to “Custom Meter” by using the Fast Key sequence under “LCD Display” on page 3-16.
- 3. Next from the **ONLINE** screen, *Select 1 Device Setup, 3 Basic Setup, 7 Meter Options, 2 Meter Options, 2 Custom Meter Setup*
- 4. To specify decimal point position:
 - a. *Select 1 Sel dec pt pos.* Choose the decimal point representation that will provide the most accurate output for your application. For example, when outputting between 0 and 75 GPM, choose XX.XXX or use the decimal point examples below:

XXXXX
XXXX.X
XXX.XX
XX.XXX
X.XXXX

NOTE:

Make sure the selection has been sent and the decimal point has changed before proceeding to the next step.

- b. F2 SEND
- 5. To specify a custom upper range value:
 - a. *Select 2 CM Upper Value.* Type the value that you want the transmitter to read at the 20 mA point.
 - b. F2 SEND
- 6. To specify a custom lower range value:
 - a. *Select 3 CM Lower Value.* Type the value that you want the transmitter to read at the 4 mA point.
 - b. F2 SEND
- 7. To define custom units:
 - a. *Select 4 CM Units.* Enter the custom units (five characters maximum) that you want the display to display.
 - b. F2 SEND
- 8. To choose the transmitter transfer function for the display:
 - a. *Select 5 CM xfer fnct.* Enter the transmitter transfer function for the display. Select *sq root* to display flow units. The custom meter transfer function is independent of the analog output transfer function.
- 9. Select **F2 SEND** to upload the configuration to the transmitter.

 See “Safety Messages” on page 3-1 for complete warning information.

NOTE:

You must change the meter type to custom meter display, see “LCD Display” on page 3-16. Follow the change standard display configuration steps and select custom meter display.

DETAILED SETUP

Failure Mode Alarm and Saturation

Model 3051 transmitters automatically and continuously perform self-diagnostic routines. If the self-diagnostic routines detect a failure, the transmitter drives its output outside of the normal saturation values. The transmitter will drive its output low or high based on the position of the failure mode alarm jumper. See Table 3-2, Table 3-3, and Table 3-4 for failure mode and saturation output levels. To select alarm position, see “Set Jumpers” on page 2-14.

Table 3-2. Standard Alarm and Saturation Values

Level	4–20 mA Saturation	4–20 mA Alarm
Low	3.9 mA	≤ 3.75 mA
High	20.8 mA	≥ 21.75 mA

Table 3-3. NAMUR-Compliant Alarm and Saturation Values

Level	4–20 mA Saturation	4–20 mA Alarm
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.5 mA

Table 3-4. Low-Power Alarm and Saturation Values

Level	1–5 V Saturation	1–5 V Alarm	0.8–3.2 V Saturation	0.8–3.2 V Alarm
Low	0.97 V	≤ 0.95 V	0.78 V	≤ 0.77 V
High	5.20 V	≥ 5.4 V	3.44 V	≥ 4.0 V

NOTE

You can alter the actual transmitter mA output values by performing an analog output trim.

NOTE

When a transmitter is in an alarm condition, the hand-held HART communicator indicates the analog output the transmitter would drive if the alarm condition did not exist. The transmitter will alarm high in the event of failure if the alarm jumper is removed.

Model 3051

Alarm and Saturation Levels for Burst Mode

Transmitters set to burst mode handle saturation and alarm conditions differently.

Alarm Conditions

- Analog output switches to alarm value.
- Primary variable (pressure) is burst with a status bit set.
- Percent of range follows primary variable (pressure).
- Temperature is burst with a status bit set.

Saturation

- Analog output switches to saturation value.
- Primary variable (pressure) is burst normally.
- Temperature is burst normally.

Alarm and Saturation Values for Multidrop Mode

Transmitters set to multidrop mode handle saturation and alarm conditions differently.

Alarm Conditions

- Primary variable (pressure) is sent with a status bit set.
- Percent of range follows primary variable (pressure).
- Temperature is sent with a status bit set.

Saturation

- Primary variable (pressure) is sent normally.
- Temperature is sent normally.

Alarm Level Verification

Transmitters with shrouded design electronics boards (board version 5.3 or later) have increased functionality that allows verification testing of alarm current levels. If you repair or replace the transmitter electronics board, sensor module, or LCD display, verify the transmitter alarm level before you return the transmitter to service. This feature is also useful in testing the reaction of your control system to a transmitter in an alarm state. To verify the transmitter alarm values, perform a loop test and set the transmitter output to the alarm value (see Tables 3-2, 3-3, and 3-4 on page 3-19, and “Loop Test” on page 3-21).

Sensor Temperature Unit

HART Comm.	1, 4, 1, 2, 2
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The *Sensor Temperature Output Unit Selection* command selects between Celsius and Fahrenheit units for output of the sensor temperature. The sensor temperature output is accessible via HART only. (The Sensor Temperature Output Units command is not available on previous design transmitters or via AMS.)

DIAGNOSTICS AND SERVICE

The diagnostics and service functions listed here are primarily for use after you install the transmitter in the field. The transmitter test feature is designed to verify that the transmitter is operating properly, and can be performed either on the bench or in the field. The loop test feature is designed to verify proper loop wiring and transmitter output, and should only be performed after you install the transmitter.

Transmitter Test

HART Comm.	1, 2, 1, 1
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The transmitter test command initiates a more extensive diagnostics routine than that performed continuously by the transmitter. The transmitter test routine can quickly identify potential electronics problems.

HART Communicator

If the transmitter test detects a problem, messages to indicate the source of the problem are displayed on the communicator screen.

AMS

Right click on the device and select "Diagnostics and Test," then "Self test" from the menu.

1. Click **Next** to acknowledge test results.
2. Select **Finish** to acknowledge the method is complete.

Loop Test

HART Comm.	1, 2, 2
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The *Loop Test* command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the transmitter. To do so, either connect the meter to the test terminals on the transmitter terminal block, or shunt the power to the transmitter through the meter at some point in the loop.
2. From the **HOME** screen, select *1 Device Setup, 2 Diagnostics and Service, 2 Loop Test*, to prepare to perform a loop test.
3. Select **OK** after you set the control loop to manual (see "Setting the Loop to Manual" on page 3-2). The communicator displays the loop test menu.
4. Select a discreet milliamp level for the transmitter to output. At the **CHOOSE ANALOG OUTPUT** prompt, select *1 4mA, 2 20mA*, or select *3 other* to manually input a value. IF you are performing a loop test to verify the output of a transmitter, THEN enter a value between 4 and 20 mA. IF you are performing a loop test to verify the transmitter alarm levels, THEN enter the milliamp value representing an alarm state (see Tables 3-2, 3-4, and 3-3 on page 3-19).
5. Check the electrical current meter installed in the test loop to verify that it reads the value you commanded the transmitter to output. IF the readings match, THEN the transmitter and the loop are configured and functioning properly. IF the readings do not match, THEN you may have the current meter attached to the wrong loop, there may be a fault in the wiring, the transmitter may require an output trim, or the electrical current meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen and allows you to choose another output value or to exit loop testing.

AMS

Right click on the device and select “Diagnostics and Test,” then “Loop test” from the menu.

1. Click **Next** after setting the control loop to manual.
2. Select desired analog output level. Click **Next**.
3. Click **Next** to acknowledge output being set to desired level.
4. Check the reference meter installed in the test loop to verify that it displays the commanded output value.
 - a. If the values match, the transmitter and the loop are configured and functioning properly.
 - b. If the values do not match, the current meter may be attached to the wrong loop there may be a fault in the wiring, the transmitter may require an output trim, or the reference meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen to choose another output value or to end loop testing.

5. Select **End** and click **Next** to end loop testing.
6. Select **Next** to acknowledge the loop can be returned to automatic control.
7. Select **Finish** to acknowledge the method is complete.

ADVANCED FUNCTIONS

Saving, Recalling, and Cloning Configuration Data

HART Comm.	left arrow, 1, 2
------------	------------------

Use the cloning feature of the Model 275 HART Communicator if you need to configure several Model 3051 transmitters similarly. The cloning process involves configuring a transmitter, saving the configuration data, then sending a copy of the data to a separate transmitter. There are a number of possible procedures to use when saving, recalling, and cloning configuration data. For complete instructions refer to the HART Communicator manual, publication no. 00809-0100-4275. One common method is as follows:

1. Completely configure the first transmitter.
2. Save the configuration data:
 - a. Select **F2 SAVE** from the communicator **HOME/ONLINE** screen.
 - b. Ensure that the location to which the data will be saved is set to **MODULE**. If it is not, select *1 Location* to set the save location to **MODULE**.
 - c. Select *2 Name* to name the configuration data. The default is the transmitter tag number.
 - d. Ensure that the data type is set to **STANDARD**. IF the data type is NOT STANDARD, THEN select *3 Data Type* to set the data type to **STANDARD**.
 - e. Select **F2 SAVE**.
3. Connect and power the receiving transmitter and communicator.
4. Select the back arrow from the **HOME/ONLINE** screen. The HART Communicator menu appears.
5. Select *1 Offline, 2 Saved Configuration, 1 Module Contents* to reach the **MODULE CONTENTS** menu.

6. Use the **DOWN ARROW** to scroll through the list of configurations in the memory module, and use the **RIGHT ARROW** to select the configuration you wish to retrieve.
7. Select *1 Edit*.
8. Select *1 Mark All*.
9. Select **F2 SAVE**.
10. Use the **DOWN ARROW** to scroll through the list of configurations in the memory module, and use the **RIGHT ARROW** to select the configuration again.
11. Select *3 Send* to download the configuration to the transmitter.

When finished, the communicator informs you of the status. To configure another transmitter, repeat Steps 3 through 10.

NOTE

The transmitter receiving the cloned data must have the same software version (or later) as the original transmitter.

AMS creating a Reusable Copy

To create a reusable copy of a configuration perform the following procedure:

1. Select View then User Configuration View from the menu bar (or click the toolbar button).
2. In the User Configuration window, right click and select New from the context menu.
3. In the New window, select a device from the list of templates shown, and click **OK**.
4. The template is copied into the User Configurations window, with the tag name highlighted; rename it as appropriate and press **Enter**.

NOTE

A device icon can also be copied by dragging and dropping a device template or any other device icon from AMS Explorer or Device Connection View into the User Configurations window.

The “Compare Configurations” window appears, showing the Current values of the copied device on one side and mostly blank fields on the other (User Configuration) side.

5. Transfer values from the current configuration to the user configuration as appropriate or enter values by typing them into the available fields.
6. Click Apply to apply the values, or click **OK** to apply the values and close the window.

AMS Applying a User Configuration

Any amount of user configurations can be created for the application. They can also be saved, and applied to connected devices or to devices in the Device List or Plant Database.

NOTE

When using AMS Revision 6.0 or later, the device to which the user configuration is applied, must be the same model type as the one created in the user configuration. When using AMS Revision 5.0 or earlier, the same model type and revision number are required.

To apply a user configuration perform the following procedure:

1. Select the desired user configuration in the User Configurations window.
2. Drag the icon onto a like device in AMS Explorer or Device Connection View. The Compare Configurations window opens, showing the parameters of the target device on one side and the parameters of the user configuration on the other.
3. Transfer parameters from the user configuration to the target device as desired, Click **OK** to apply the configuration and close the window.

Burst Mode

HART Comm.	1, 4, 3, 3, 3
------------	---------------

When configured for burst mode, the Model 3051 provides faster digital communication from the transmitter to the control system by eliminating the time required for the control system to request information from the transmitter. Burst mode is compatible with use of the analog signal. Because the HART protocol features simultaneous digital and analog data transmission, the analog value can drive other equipment in the loop while the control system is receiving the digital information. Burst mode applies only to the transmission of dynamic data (pressure and temperature in engineering units, pressure in percent of range, and/or analog output), and does not affect the way other transmitter data is accessed.

Access to information other than dynamic transmitter data is obtained through the normal poll/response method of HART communication. A HART-based communicator or the control system may request any of the information that is normally available while the transmitter is in burst mode. Between each message sent by the transmitter, a short pause allows the HART-based communicator or a control system to initiate a request. The transmitter will receive the request, process the response message, and then continue "bursting" the data approximately three times per second.

HART Communicator

To configure the transmitter for burst mode, perform the following step:

1. From the HOME screen, enter the fast key sequence below "Burst Mode."

AMS

Right click on the device and select “Configuration Properties” from the menu.

1. In the “HART” tab, use the drop down menu to select “Burst Mode ON or OFF.” For “Burst option” select the desired properties from the drop down menu. Burst options are as follows:
 - PV
 - % range/current
 - Process vars/crnt
 - Process variables
2. After selecting options click **Apply**.
3. An “Apply Parameter Modification” screen appears, enter desired information and click **OK**.
4. After carefully reading the warning provided, select **OK**.

MULTIDROP COMMUNICATION

Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated. Many of the Rosemount SMART FAMILY[®] transmitters can be multidropped. With the HART smart communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines. This feature can greatly reduce wiring costs.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Communication with the transmitters can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each transmitter is identified by a unique address (1–15) and responds to the commands defined in the HART protocol. HART-based communicators can test, configure, and format a multidropped transmitter the same way as a transmitter in a standard point-to-point installation.

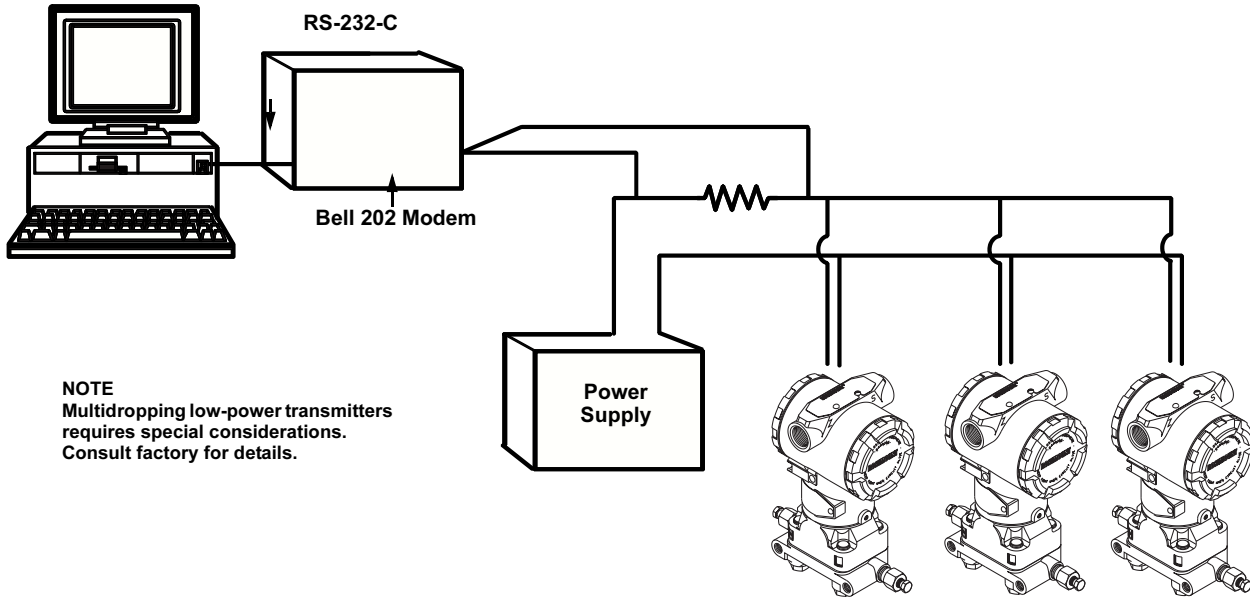
Figure 3-7 shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

NOTE

A transmitter in multidrop mode has the analog output fixed at 4 mA. If a display is installed to a transmitter in multidrop mode, it will alternate the display between “current fixed” and the specified display output(s).

Model 3051

Figure 3-7. Typical Multidrop Network



NOTE
Multidropping low-power transmitters requires special considerations. Consult factory for details.

3051-0087A, 3031A07B

NOTE

The Model 3051 is set to address 0 at the factory, allowing it to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15. This change deactivates the 4–20 mA analog output, sending it to 4 mA. It also disables the failure mode alarm signal, which is controlled by the upscale/downscale jumper position. Failure signals in multidropped transmitters are communicated through HART messages.

Changing a Transmitter Address

HART Comm.	1, 4, 3, 3, 1
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To change the address of a multidropped transmitter, follow these fast key sequences. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15, and each transmitter in a multidropped loop must have a unique address.

HART Communicator

1. From the **HOME** screen, enter the fast key sequence below “Changing a Transmitter Address.”

AMS

Right click on the device and select “Configuration Properties” from the menu.

1. In the “HART” tab, in “ID” box, enter poll address located in the “Poll addr” box, click **Apply**.
2. An “Apply Parameter Modification” screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Communicating with a Multidropped Transmitter

HART Comm.	1, 4, 3, 3, 2
------------	---------------

HART Communicator

To communicate with a multidropped transmitter, configure the HART Communicator to poll for a non-zero address.

1. From the **HOME** screen, enter the fast key sequence below “Communicating with a Multidropped Transmitter.”
2. On the polling menu, scroll down and select “Digital Poll.” In this mode, the HART Communicator automatically polls for devices at addresses 0-15 upon start up.

AMS

Click on the HART modem icon and select “Scan All Devices.”

Polling a Multidropped Transmitter

HART Comm.	Left arrow, 4, 1
------------	------------------

Polling a multidropped loop determines the model, address, and number of transmitters on the given loop.

HART Communicator

1. From the **HOME** screen, enter the fast key sequence below “Polling a Multidropped Transmitter.”

NOTE

The HART Communicator Model 275 requires you to use the **UTILITY** menu to perform and autopoll. This menu is available from the **MAIN** menu of the HART Communicator. Press the **LEFT ARROW** to move from the **ONLINE MENU** to the **MAIN** menu. Press **4** from the **MAIN** menu to access the **UTILITY** menu.

AMS

Click on the HART modem icon and select “Scan All Devices.”

Section 4 Operation and Maintenance

Calibration	page 4-2
Selecting Output Range for Low-Power	page 4-20
Detailed Setup	page 4-20

OVERVIEW

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

Model 3051

CALIBRATION

Calibrating a smart transmitter is different from calibrating an analog transmitter. The one-step calibration process of an analog transmitter is done in three steps with a smart transmitter:

- **Rerange**—sets the 4 and 20 mA points at the desired pressures;
- **Sensor Trim**—Adjusts the position of the factory characterization curve to optimize the transmitter performance over a specified pressure range or to adjust for mounting effects
- **Analog Output Trim**—Adjusts the analog output to match the plant standard or the control loop.

Smart transmitters operate differently than analog transmitters. A smart transmitter uses a microprocessor that contains information about the sensor's specific characteristics in response to pressure and temperature inputs. A smart transmitter compensates for these sensor variations. The process of generating the sensor performance profile is called factory characterization. Factory characterization also provides the ability to readjust the 4 and 20 mA points without applying pressure to the transmitter.

The trim and rerange functions also differ. Reranging sets the transmitter analog output to the selected upper and lower range points and can be done with or without an applied pressure. Reranging does not change the factory characterization curve stored in the microprocessor. Sensor trimming requires an accurate pressure input and adds additional compensation that adjusts the position of the factory characterization curve to optimize transmitter performance over a specific pressure range.

NOTE

Sensor trimming adjusts the position of the factory characterization curve. It is possible to degrade the performance of the transmitter if the sensor trim is done improperly or with inaccurate equipment. Contact your local Rosemount representative or call Rosemount Customer Central at 800-999-9307 if you have questions.

Table 4-1. Recommended Calibration Tasks

Transmitter	Bench Calibration Tasks	Field Calibration Tasks
3051CD 3051CG 3051L 3051HD 3051HG	Set output configuration parameters: <ul style="list-style-type: none"> • Set the range points. • Set the output units. • Set the output type. • Set the damping value. <i>Optional</i> , perform a full sensor trim. (Accurate pressure source required.) <i>Optional</i> , perform an analog output trim. (Accurate multimeter required.)	Reconfigure parameters if necessary. Zero trim the transmitter to compensate for mounting effects or static pressure effects.
3051CA 3051TA 3051TG	Set output configuration parameters: <ul style="list-style-type: none"> • Set the range points. • Set the output units. • Set the output type. • Set the damping value. <i>Optional</i> : Perform a full sensor trim if equipment available (accurate absolute pressure source required), otherwise perform the low trim value section of the full sensor trim procedure. <i>Optional</i> : Perform an analog output trim (multimeter required).	Reconfigure parameters if necessary. Perform low trim value section of the full sensor trim procedure to correct for mounting position effects.

NOTE:

A HART communicator is required for all sensor and output trim procedures.

Model 3051C Range 4 and Range 5 transmitters require a special calibration procedure when used in differential pressure applications under high static line pressure (see “Compensating for Line Pressure” on page 4-12).

Model 3051TG Range 5 transmitters use an absolute sensor that requires an accurate absolute pressure source to perform the optional full sensor trim.

Calibration Overview

Complete calibration of the Model 3051 Pressure Transmitter involves the following tasks:

Configure the Analog Output Parameters

Set Process Variable Units (page 3-8)

Set Output Type (page 3-9)

Rerange (page 3-10)

Set Damping (page 3-16)

Calibrate the Sensor

Full Trim (page 4-8)

Zero Trim (page 4-7)

Calibrate the 4–20 mA Output

4–20 mA Output Trim (page 4-10) or

4–20 mA Output Trim Using Other Scale (page 4-11) or

Low-Power 1–5 V dc or Low-Power 0.8–3.2 V dc (page 4-10)

Figure 4-1 illustrates the Model 3051 transmitter data flow. This data flow can be summarized in four major steps:

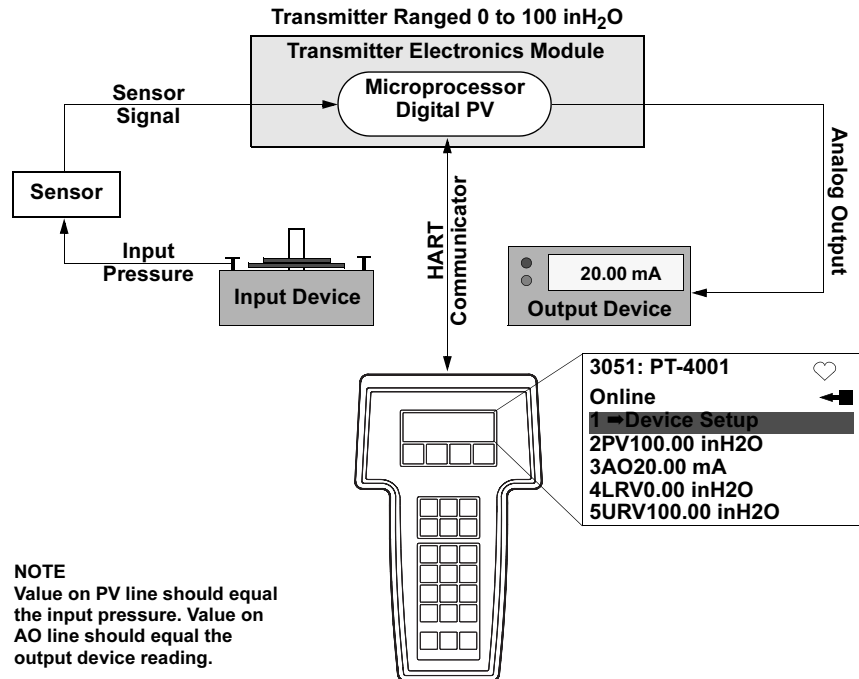
1. A change in pressure is measured by a change in the sensor output (Sensor Signal).
2. The sensor signal is converted to a digital format that can be understood by the microprocessor (Analog-to-Digital Signal Conversion).
3. Corrections are performed in the microprocessor to obtain a digital representation of the process input (Digital PV).
4. The Digital PV is converted to an analog value (Digital-to-Analog Signal Conversion).

Figure 4-1 also identifies the approximate transmitter location for each calibration task. Note that the data flows from left to right, and a parameter change affects all values to the right of the changed parameter.

Not all calibration procedures should be performed for each Model 3051 transmitter. In addition, some procedures are appropriate for bench calibration but should not be performed during field calibration. Table 4-1 identifies the recommended calibration procedures for each type of Model 3051 transmitter for both bench and field calibration.

Model 3051

Figure 4-1. Transmitter Data Flow with Calibration Options

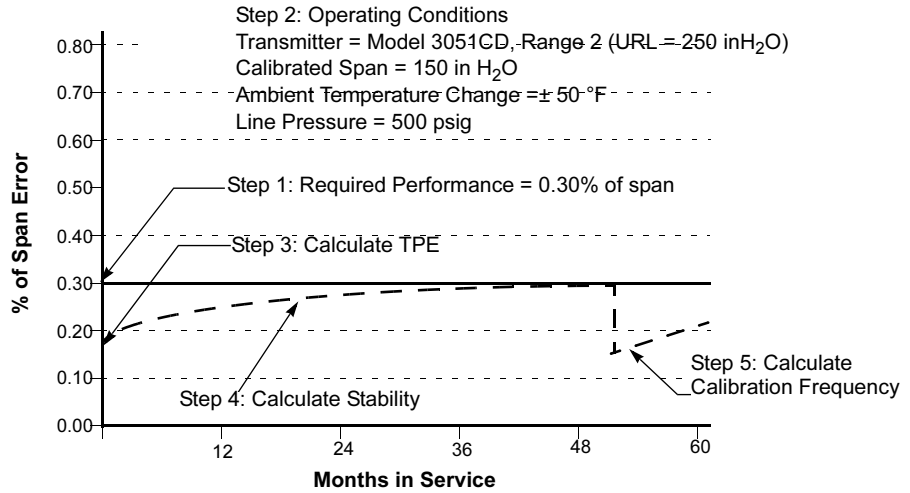


Determining Calibration Frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. The following procedure can be used as a guideline to estimate the calibration frequency. Actual calibration frequency should follow plant standard and sound engineering practice.

1. Determine the performance required for your application.
2. Determine the operating conditions.
3. Calculate the Total Probable Error (TPE).
4. Calculate the stability per month.
5. Calculate the calibration frequency.

Figure 4-2. Calculating Calibration Frequency



3051-3051_20A

Sample Calculation

Step 1: Determine the performance required for your application.

Required Performance: 0.30% of span

Step 2: Determine the operating conditions.

Transmitter: Model 3051CD, Range 2 (URL=250 inH₂O)
 Calibrated Span: 150 inH₂O
 Ambient Temperature Change: ± 50 °F
 Line Pressure: 500 psig

Step 3: Calculate total probable error (TPE).

$$TPE = \sqrt{(\text{RefAccuracy})^2 + (\text{TempEffect})^2 + (\text{StaticPressureEffect})^2} = 0.117\% \text{ of span}$$

Where:

Reference Accuracy = ± 0.075% of span

Ambient Temperature Effect =

$$\pm \left(\frac{0.0125 \times \text{URL}}{\text{Span}} + 0.0625 \right) \text{ per } 50 \text{ }^\circ\text{F} = \pm 0.0833\% \text{ of span}$$

Span Static Pressure Effect⁽¹⁾ =

0.1% reading per 1000 psi = % of range * 0.1% * Cal. Span per 1000 psi =
 0.035% of span for line pressure of 500 psig

(1) Zero static pressure effect removed by zero trimming at line pressure, assume reading is 70% of span.

Step 4: Calculate the stability per month.

$$\text{Stability} = \pm \left[\frac{0.125 \times \text{URL}}{\text{Span}} \right] \% \text{ of span for 5 years} = \pm 0.0035\% \text{ of span per month}$$

Step 5: Calculate calibration frequency.

$$\text{Cal. Freq.} = \frac{(\text{Req. Performance} - \text{TPE})}{\text{Stability per Month}} = \frac{(0.3\% - 0.117\%)}{0.0035\%} = 52 \text{ months}$$

Model 3051

Choosing a Trim Procedure

To decide which trim procedure to use, you must first determine whether the analog-to-digital section or the digital-to-analog section of the transmitter electronics is in need of calibration. To do so, refer to Figure 4-1 and perform the following procedure:

1. Connect a pressure source, a HART communicator, and a digital readout device to the transmitter.
2. Establish communication between the transmitter and the communicator.
3. Apply pressure equal to the upper range point pressure (100 inH₂O, for example).
4. Compare the applied pressure to the Process Variable (PV) line on the Communicator On-line Menu. IF the PV reading on the communicator does not match the applied pressure, and you are confident that your test equipment is accurate, THEN perform a sensor trim.
5. Compare the Analog Output (AO) line on the communicator on-line menu to the digital readout device. IF the AO reading on the communicator does not match the digital readout device, and you are confident that your test equipment is accurate, THEN perform an output trim.

Sensor Trim

You can trim the sensor using either the full trim or the zero trim function. The trim functions vary in complexity, and their use is application-dependent. Both trim functions alter the transmitter's interpretation of the input signal.

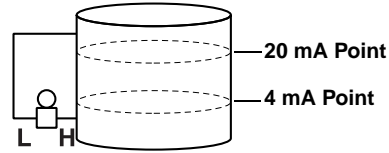
Zero trim is a single-point adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. Since this correction maintains the slope of the characterization curve, it should not be used in place of a full trim over the full sensor range.

When performing a zero trim, ensure that the equalizing valve is open and all wet legs are filled to the correct levels.

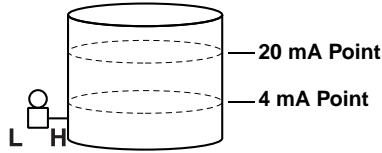
NOTE

Do not perform a zero trim on Model 3051 Absolute pressure transmitters. A zero trim is zero based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Model 3051 Absolute Pressure Transmitter, perform a low trim within the full sensor trim function. The low trim function provides a "zero" correction similar to the zero trim function but it does not require the input to be zero based.

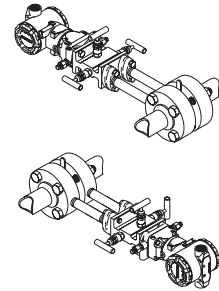
A **full trim** is a two-point sensor calibration where two end-point pressures are applied, and all output is linearized between them. You should always adjust the low trim value first to establish the correct offset. Adjustment of the high trim value provides a slope correction to the characterization curve based on the low trim value. The factory-established characterization curve is not changed by this procedure. The trim values allow you to optimize performance over your specified measuring range at the calibration temperature.



**NONZERO-BASED
 LEVEL APPLICATION**



**ZERO-BASED LEVEL
 APPLICATION**



**ZERO-BASED FLOW
 APPLICATION**

3051-3031B03D, B03C, 3051_18A

Zero Trim

HART Comm.	1, 2, 3, 3, 1
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HART Communicator

Calibrate the sensor with a HART Communicator using the zero trim function as follows:

1. Vent the transmitter and attach a communicator to the measurement loop.
2. From the communicator main menu select *1 Device setup*, *2 Diagnostics and service*, *3 Calibration*, *3 Sensor trim*, *1 Zero trim* to prepare to adjust the zero trim.

NOTE

The transmitter must be within 3% of true zero (zero based) in order to calibrate it using the zero trim function.

3. Follow the commands provided by the communicator to complete the adjustment of the zero trim.

AMS

Right click on the device and select "Calibrate," then "Zero trim" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Click **Next** to acknowledge warning.
3. Click **Next** after applying appropriate pressure to sensor.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.

Full Trim

HART Comm.	1, 2, 3, 3
------------	------------

NOTE

Use a pressure input source that is at least three times more accurate than the transmitter, and allow the input pressure to stabilize for ten seconds before entering any values.

HART Communicator

To calibrate the sensor with a HART Communicator using the full trim function, perform the following procedure:

1. Assemble and power the entire calibration system including a transmitter, HART Communicator, power supply, pressure input source, and readout device.
2. From the **HOME** screen, enter the fast key sequence below under “Full Trim.”
3. Select 2: Lower sensor trim

NOTE

Select pressure input values so that low and high values are equal to or outside the 4 and 20 mA points. Do not attempt to obtain reverse output by reversing the high and low points. The transmitter allows approximately five percent URL deviation from the characterized curve established at the factory.

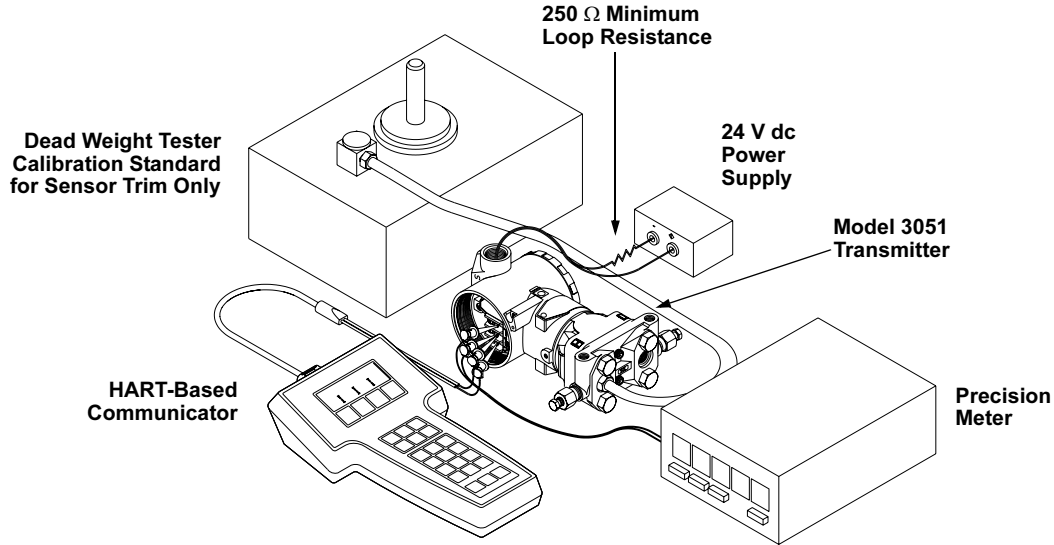
4. Follow the commands provided by the HART Communicator to complete the adjustment of the lower value.
5. Repeat the procedure for the upper value, replacing 2: Lower sensor trim with 3: Upper sensor trim in Step 3.

AMS

Right click on the device and select “Calibrate,” then “Sensor trim” from the menu.

1. Select “Lower sensor trim.”
2. Click **Next** after setting the control loop to manual.
3. Click **Next** after applying appropriate pressure to sensor.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.
6. Right click on the device and select “Calibrate,” select “Sensor trim” from the menu.
7. Select “Upper sensor trim” and repeat steps 2-5.

Figure 4-3. Digital Trim Connection Drawing (4–20 mA Transmitters)



3051-3031A01B

Recall Factory Trim

The *Recall Factory Trim* commands allow the restoration of the as-shipped factory settings of the sensor trim and analog output trim.

NOTE

The Recall Factory Trim commands are not available on previous design transmitters.

Recall Factory Trim — Sensor Trim

HART Comm.	1, 2, 3, 4, 1
------------	---------------

Resets the transmitter sensor trim to the as-shipped factory settings. The *Recall Factory Trim—Sensor Trim* command can be useful for recovering from an inadvertent zero trim of an absolute pressure unit.

HART Communicator

Enter the fast key sequence below “Recall Factory Trim — Sensor Trim” to reset the transmitter sensor trim.

Recall Factory Trim — Analog Output

HART Comm.	1, 2, 3, 4, 2
------------	---------------

Resets the transmitter analog output trim to the as-shipped factory settings. The *Recall Factory Trim—Analog Output* command can be useful for recovering from an inadvertent zero trim on an absolute pressure transmitter.

HART Communicator

Enter the fast key sequence below “Recall Factory Trim — Analog Output” to reset the analog output trim.

Model 3051

Analog Output Trim

The *Analog Output Trim* commands allow you to adjust the transmitter's current output at the 4 and 20 mA points to match the plant standards. This command adjusts the digital to analog signal conversion (see Figure 4-1 on page 4-4).

Analog Output Trim (Low Power)

HART Comm.	1, 2, 3, 2, 1
------------	---------------

The Model 3051 Low-Power Transmitter has two jumper-selectable output ranges: 1–5 V dc and 0.8–3.2 V dc. Positioning this jumper for the desired output range selects the proper coefficients for temperature corrections. The jumper position also sets the output values (1–5 or 0.8–3.2) which are communicated through HART protocol and accessed by a hand held communicator.

However, switching this jumper does not by itself select the new outputs; you must perform the "Digital-to-Analog Trim" procedure above to match the transmitter's output voltages to the new jumper selection.

Digital-to-Analog Trim

HART Comm.	1, 2, 3, 2, 1
------------	---------------

HART Communicator

To perform a digital-to-analog trim with a HART communicator, perform the following procedure.

1. From the **HOME** screen, select *1 Device setup, 2 Diag/Service, 3 Calibration, 2 D/A trim*. Select **OK** after you set the control loop to manual (see "Setting the Loop to Manual" on page 3-2).
2. Connect an accurate reference ammeter to the transmitter at the **CONNECT REFERENCE METER** prompt. To do so, connect the positive lead to the positive terminal and the negative lead to the test terminal in the transmitter terminal compartment, or shunt the transmitter power through the reference meter at some point.
3. Select **OK** after connecting the reference meter.
4. Select **OK** at the **SETTING FLD DEV OUTPUT TO 4 MA** prompt. The transmitter outputs 4,00 mA.
5. Record the actual value from the reference meter, and enter it at the **ENTER METER VALUE** prompt. The communicator prompts you to verify whether or not the output value equals the value on the reference meter.
6. Select *1 Yes* if the reference meter value equals the transmitter output value, or *2 No* if it does not.
IF you select *1 Yes*, THEN proceed to Step 7.
IF you select *2 No*, THEN repeat Step 5.
7. Select **OK** at the **SETTING FLD DEV OUTPUT TO 20 MA** prompt, and repeat Steps 5 and 6 until the reference meter value equals the transmitter output value.
8. Select **OK** after you return the control loop to automatic control.

AMS

Right click on the device and select “Calibrate,” then “D/A Trim” from the menu.

1. Click **Next** after setting the control loop to manual.
2. Click **Next** after connecting the reference meter.
3. Click **Next** at the “Setting fld dev output to 4mA” screen.
4. Record the actual value from the reference meter, and enter it at the “Enter meter value” screen and click **Next**.
5. Select **Yes**, if the reference meter value equals the transmitter output value, or **No** if it does not. Click **Next**.
 - a. If Yes is selected, proceed to Step 6.
 - b. If No is selected, repeat Step 4.
6. Click **Next** at the “Setting fld dev output to 20mA” screen.
7. Repeat Step 4 - Step 5 until the reference meter equals the transmitter output value.
8. Select **Next** to acknowledge the loop can be returned to automatic control.
9. Select **Finish** to acknowledge the method is complete.

**Digital-to-Analog Trim
Using Other Scale**

HART Comm.	1, 2, 3, 2, 2
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The *Scaled D/A Trim* command matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (1 to 5 volts if measuring across a 250 ohm load, or 0 to 100 percent if measuring from a DCS, for example). To perform a scaled D/A trim, connect an accurate reference meter to the transmitter and trim the output signal to scale as outlined in the Output Trim procedure.

NOTE

Use a precision resistor for optimum accuracy. If you add a resistor to the loop, ensure that the power supply is sufficient to power the transmitter to a 20 mA output with the additional loop resistance.

AMS

Right click on the device and select “Calibrate,” then “Scaled D/A trim” from the menu.

1. Click **Next** after setting the control loop to manual.
2. Select **Change** to change scale, click **Next**.
3. Enter Set scale-Lo output value, click **Next**.
4. Enter Set scale-Hi output value, click **Next**.
5. Click **Next** to proceed with Trim.
6. Click **Next** after connecting the reference meter.
7. Click **Next** at the “Setting fld dev output to 4 mA” screen.
8. Record the actual value from the reference meter, and enter it at the “Enter meter value” screen and click **Next**.
9. Select **Yes**, if the reference meter value equals the transmitter output value, or **No** if it does not. Click **Next**.
 - a. If Yes is selected, proceed to Step 10.
 - b. If No is selected, repeat Step 8.
10. Click **Next** at the “Setting fld dev output to 20mA” screen.
11. Repeat Step 8 - Step 9 until the reference meter equals the transmitter output value.
12. Select **Next** to acknowledge the loop can be returned to automatic control.
13. Select **Finish** to acknowledge the method is complete.

Compensating for Line Pressure

Range 4 and 5 Differential Transmitters

Model 3051 Range 4 and Range 5 pressure transmitters require a special calibration procedure when used in differential pressure applications. The purpose of this procedure is to optimize transmitter performance by reducing the effect of static line pressure in these applications. Model 3051 differential pressure transmitters (Ranges 1, 2, and 3) do not require this procedure because the optimization occurs in the sensor.

Applying high static pressure to Model 3051 Range 4 and Range 5 pressure transmitters causes a systematic shift in the output. This shift is linear with static pressure; correct it by performing the Full Trim procedure on page 2-18.

The following specifications show the static pressure effect for Model 3051 Range 4 and Range 5 transmitters used in differential pressure applications:

Zero Effect:

±0.1% of the upper range limit per 1000 psi (6,9 MPa) for line pressures from 0 to 2000 psi (0 to 13,8 MPa)

±0.2% of the upper range limit per 1000 psi (6,9 MPa) for line pressures above 2000 psi (13,8 MPa)

Span Effect:

Correctable to ±0.2% of reading per 1000 psi for line pressures from 0 to 3626 psi.

The systematic span shift caused by the application of static line pressure is – 1.00% of reading per 1000 psi for 3051C Range 4 transmitters, and –1.25% of reading per 1000 psi for Range 5 transmitters.

Use the following example to compute corrected input values.

Example

A transmitter with model number 3051CD4 will be used in a differential pressure application where the static line pressure is 1200 psi. The transmitter is ranged so that the output is 4 mA at 500 inH₂O and 20 mA at 1500 inH₂O.

To correct for systematic error caused by high static line pressure, first use the following formulas to determine corrected values for the low trim and high trim.

LT = LRV + S (LRV) P

Where:	LT =	Corrected Low Trim Value
	LRV =	Lower Range Value
	S =	–(Span shift per specification)
	P =	Static Line Pressure

HT = URV + S (URV) P

Where:	HT =	Corrected High Trim Value
	URV =	Upper Range Value
	S =	–(Span shift per specification)
	P =	Static Line Pressure

In this example:

URV =	1500 inH ₂ O
LRV =	500 inH ₂ O
P =	1200 psi
S =	± 0.01/1000

To calculate the low trim (LT) value:

LT =	500 + (0.01/1000)(500)(1200)
LT =	506 inH ₂ O

To calculate the high trim (HT) value:

HT =	1500 + (0.01/1000)(1500)(1200)
HT =	1518 inH ₂ O

To complete a Model 3051 full trim and enter the corrected values for low trim (LT) and high trim (HT), refer to “Full Trim” on page 4-8.

Enter the corrected input values for low trim and high trim through the communicator keypad after you apply the nominal value of pressure as the transmitter input.

NOTE

After calibrating Model 3051 Range 4 and Range 5 transmitters for high differential pressure applications, rerange the 4 and 20 mA points using the communicator to maintain the systematic static line pressure correction. You may re-zero the 4 mA point at line pressure after installation using the local zero button without affecting the completed calibration.

Diagnostic Messages

In addition to the output, the LCD meter displays abbreviated operation, error, and warning messages for troubleshooting the transmitter. Messages appear according to their priority, with normal operating messages appearing last. To determine the cause of a message, use a Model 275 HART Communicator to further interrogate the transmitter. A description of each LCD diagnostic message follows.

Error

Error messages appear on the LCD meter display to inform you of serious problems effecting the operation of the transmitter. The meter displays an error message until the error condition is corrected, and the analog output is driven to the specified alarm level. No other transmitter information is displayed during an alarm condition.

FAIL⁽¹⁾

The transmitter CPU board and the sensor module are incompatible. If you encounter this message, contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Fail Module

The sensor module is disconnected or is malfunctioning. Verify that the sensor module ribbon cable is connected to the back of the electronics board. If the ribbon cable is properly connected, there is a problem within the sensor module. Possible sources of problems include:

- Pressure or temperature updates are not being received in the sensor module.
- A non-volatile memory fault that will effect transmitter operation has been detected in the module by the memory verification routine.

Some non-volatile memory faults are user-repairable. Use a Model 275 HART Communicator to diagnose the error and determine if it is repairable. Any error message that ends in "FACTORY" is not repairable. In cases of non user-repairable errors, you must replace the sensor module. See "Disassembly Procedures" on page 5-3 or contact Rosemount Customer Central at 800-999-9307 if you need assistance.

(1) For previous versions of the meter, FAIL MODULE and FAIL ELECT were also grouped into the FAIL message. When dealing with a FAIL message on a previous version meter, review the information in the FAIL MODULE and FAIL ELECT sections as well.

Fail Elect

The transmitter electronics board is malfunctioning due to an internal fault. Some of the FAIL ELECT errors are user-repairable. Use a Model 275 HART Communicator to diagnose the error and determine if it is repairable. Any error message that ends in "FACTORY" is not repairable. In cases of non user-repairable errors, you must replace the electronics board. See "Disassembly Procedures" on page 5-3 or contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Fail Config

A memory fault has been detected in a location that could effect transmitter operation, and is user-accessible. To correct this problem, use a Model 275 HART Communicator to interrogate and reconfigure the appropriate portion of the transmitter memory. Contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Warnings

Warnings appear on the LCD display to alert you of user-repairable problems with the transmitter, or current transmitter operations. Warnings appear alternately with other transmitter information until the warning condition is corrected or the transmitter completes the operation that warrants the warning message.

NOTE

The warning messages on previous versions of the LCD display may vary slightly from those listed here, but they represent the same warning.

Press Limit

The process variable read by the transmitter is outside of the transmitter's range.

Temp Limit

The secondary temperature variable read by the transmitter is outside of the transmitter's range.

Curr Fixed

The transmitter is in multidrop mode. The analog output is not tracking pressure changes.

Curr Saturd

The pressure read by the module is outside of the specified range, and the analog output has been driven to saturation levels.

Loop Test

A loop test is in progress. During a loop test or 4–20 mA trim, the analog output is set to a fixed value. The meter display alternates between the current selected in milliamps and "LOOP TEST."

Xmtr Info

A non-volatile memory fault has been detected in the transmitter memory by the memory verification routine. The memory fault is in a location containing transmitter information. To correct this problem, use a Model 275 HART Communicator to interrogate and reconfigure the appropriate portion of the transmitter memory. This warning does not effect the transmitter operation. Contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Operation

Normal operation messages appear on the LCD meter to confirm actions or inform you of transmitter status. Operation messages are displayed with other transmitter information, and warrant no action to correct or alter the transmitter settings.

Zero Pass

The zero value, set with the local zero adjustment button, has been accepted by the transmitter, and the output should change to 4 mA.

Zero Fail

The zero value, set with the local zero adjustment button, exceeds the maximum rangedown allowed for a particular range, or the pressure sensed by the transmitter exceeds the sensor limits.

Span Pass

The span value, set with the local span adjustment button, has been accepted by the transmitter, and the output should change to 20 mA.

Span Fail

The span value, set with the local span adjustment button, exceeds the maximum rangedown allowed for a particular range, or the pressure sensed by the transmitter exceeds the sensor limits.

LOCAL DSBLD

This message appears during reranging with the integral zero and span buttons and indicates that the transmitter local zero and span adjustments have been disabled. The adjustments may have been disabled by the transmitter security jumper on the transmitter circuit board or through software commands from the Model 275. See "Security (Write Protect)" on page 2-14 for information on the position of the security jumper and information on software lockout.

Write Protect

This message appears if you attempt to change the transmitter configuration data while the security jumper is in the **ON** position. See "Security (Write Protect)" on page 2-14 for more information about the security jumper.

HART Communicator Diagnostics

The following table is a list of messages used by the HART Communicator (HC) and their corresponding descriptions.

Variable parameters within the text of a message are indicated with *<variable parameter>*.

Reference to the name of another message is identified by *[another message]*.

Message	Description
1k snsr EEPROM error-factory ON	Replace the sensor module
1k snsr EEPROM error-user-no out ON	Use the HART communicator to reset the following parameters: remote seal isolator, remote seal fill fluid, flange material, o-ring material, transmitter type, remote seal type, flange type, meter type, number of remote seals.
1k snsr EEPROM error-user ON	Perform a full trim to recalibrate the transmitter.
4k micro EEPROM error-factory ON	Replace the electronics board.
4k micro EEPROM error-user-no out ON	Use the hart communicator to reset the message field.
4k micro EEPROM error-user ON	Use the HART communicator to reset the following parameters: units, range values, damping, analog output, transfer function, tag, scaled meter values. Perform a d/a trim to ensure that the error is corrected.
4k snsr EEPROM error-factory ON	Replace the sensor module.
4k snsr EEPROM error-user ON	Use the HART communicator to reset the temperature units and the calibration type.
Add item for ALL device types or only for this ONE device type.	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	The communicator and the device are not communicating correctly. Check all connections between the communicator and the device and resend the information.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
CPU board not initialized ON	The electronics board is not initialized. Replace the electronics board.
CPU EEPROM write failure ON	Message sent to electronics board from HART signal failed. Replace the electronics board.
Device Busy	The connected device is busy performing another task.
Device Disconnected	The device failed to respond to a command. Check all connections between the communicator and the device and resend the command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HART communicator off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Press the SEND softkey to transfer information from the communicator memory to the device.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device-specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device-specified description edit format.
Ignore next 50 occurrences of status?	Select YES to ignore the next 50 occurrences of device status, or select no to display every occurrence.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.

Message	Description
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incompatible CPU board and module ON	Upgrade the electronics board or the sensor module to the current revision.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Local buttons operator error ON	Illegal pressure applied during zero or span operation. Repeat the process after verifying the correct pressures.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
Module EEPROM write failure ON	Message sent to the module from the HART signal failed. Replace the sensor module.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named “hotkey” defined in the device description for this device.
No pressure updates ON	No pressure updates being received from the sensor module. Verify that the sensor module ribbon cable is attached correctly. Or replace the sensor module.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No temperature updates ON	No temperature updates being received from the sensor module. Verify that the sensor module ribbon cable is attached correctly. Or replace the sensor module.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named “upload_variables” defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hotkey items. Unnecessary items should be deleted to make space available.
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK...	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
ROM checksum error ON	Checksum of transmitter software has detected a fault. Replace the electronics board.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.

Message	Description
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
Sensor board not initialized ON	The sensor module electronics board is not initialized. Replace the sensor module.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Upgrade 275 software to access XMTR function. Continue with old description?	The communicator does not contain the most recent Model 3051 Device Descriptors (DDs). Select YES to communicate using the existing DDs. Select NO to abort communication.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

Local Zero and Span (Local Keys) Software Lock Out

To enable this feature, see “Local Span and Zero Control (Local Keys)” on page 4-20.

Physical Removal of Local Zero and Span (Local Keys)

To remove the magnetic buttons used to activate the local zero and span, use a small slotted head screwdriver and pry off the small, plastic cap located under the approval tag. Remove button assemblies and discard.

NOTE

On previous versions of Model 3051, remove the magnetic screws.

NOTE

Alarm jumper not installed = High Alarm

Model 3051

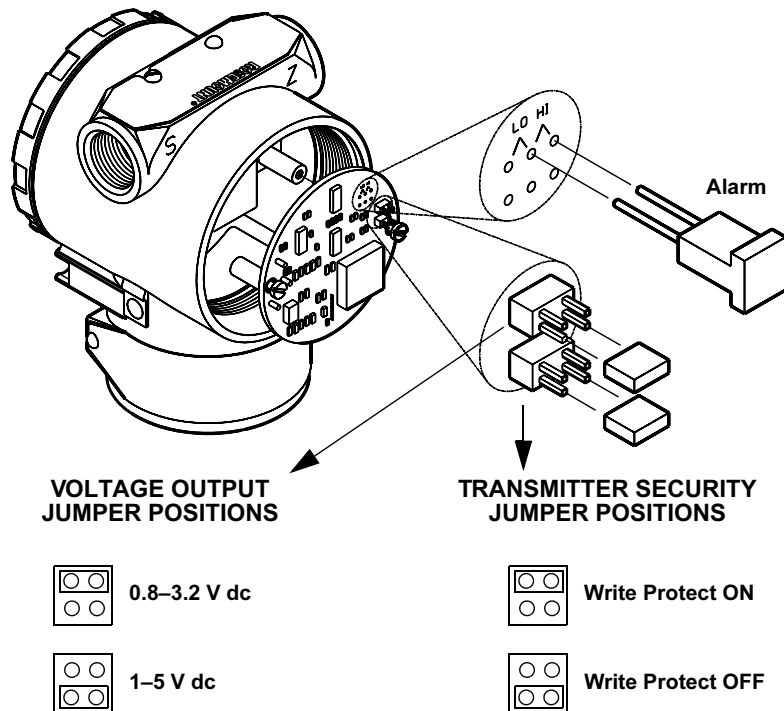
SELECTING OUTPUT RANGE FOR LOW-POWER

Low power transmitters output either 1–5 V dc or 0.8–3.2 V dc depending on the position of the voltage output jumper. To reposition the voltage output jumper, follow the procedure described on page 2-14.

NOTE

Default low power output is 1–5 V dc. After changing output between 1–5 V and 0.8–3.2 V, perform a low power output trim.

Figure 4-4. Low Power Transmitter Electronics Boards



3051-3031B05D

NOTE

Security jumper not installed = Not Write Protected
 Alarm jumper not installed = High Alarm
 Voltage output jumper not installed = 1–5 V

DETAILED SETUP

Local Span and Zero Control (Local Keys)

HART Comm.	1, 4, 4, 1, 7
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The *Local keys* command allows software control over the use of the local span and zero adjustments. To enable or disable the span and zero adjustment buttons on your transmitter, perform the fast key sequence at left.

NOTE

Disabling the local keys does not disable all transmitter configuration changes. With the local keys disabled, you can still make changes to the transmitter configuration—including range values—using a HART communicator.

Section 5 Troubleshooting

Before Disassembling the Transmitter	page 5-3
Disassembly Procedures	page 5-3
Reassembly Procedures	page 5-5

OVERVIEW

Table 5-1 provides summarized troubleshooting suggestions for the most common operating problems.

If you suspect a malfunction despite the absence of any diagnostic messages on the communicator display, follow the procedures described here to verify that transmitter hardware and process connections are in good working order. Always deal with the most likely and easiest-to-check conditions first.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠ WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Both transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure that the instruments in the loop are installed according to intrinsically safe or nonincendive field wiring practices.

⚠ CAUTION

Static electricity can damage sensitive components.

- Observe safe handling precautions for static-sensitive components.

Model 3051

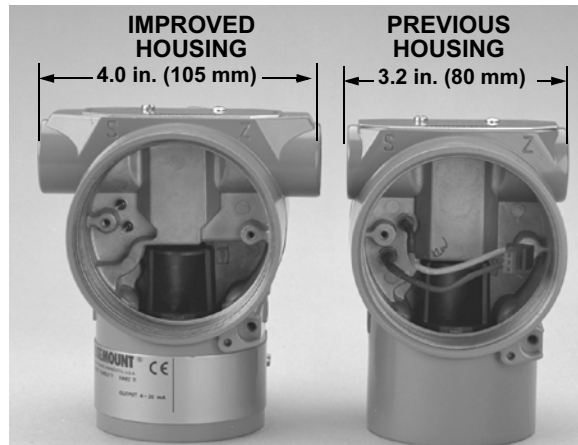
Table 5-1. Model 3051S
troubleshooting table

Symptom	Corrective Actions
Transmitter milliamp reading is zero	<ul style="list-style-type: none"> Verify power is applied to signal terminals Check power wires for reversed polarity Verify terminal voltage is 10.5 to 42.4 V dc Check for open diode across test terminal
Transmitter Not Communicating with HART Communicator	<ul style="list-style-type: none"> Verify the output is between 4 and 20 mA or saturation levels Verify clean DC Power to transmitter (Max AC noise 0.2 volts peak to peak) Check loop resistance, 250 Ω minimum (PS voltage -transmitter voltage/loop current) Check if unit is addressed properly
Transmitter milliamp reading is low or high	<ul style="list-style-type: none"> Verify applied pressure Verify 4 and 20 mA range points Verify output is not in alarm condition Verify if 4 – 20 mA output trim is required
Transmitter will not respond to changes in applied pressure	<ul style="list-style-type: none"> Check test equipment Check impulse piping or manifold for blockage Verify applied pressure is between the 4 and 20 mA set points Verify output is not in alarm condition Verify transmitter is not in Loop Test mode
Digital Pressure Variable reading is low or high	<ul style="list-style-type: none"> Check test equipment (verify accuracy) Check impulse piping for blockage or low fill in wet leg Verify transmitter is calibrated properly Verify pressure calculations for application
Digital Pressure Variable reading is erratic	<ul style="list-style-type: none"> Check application for faulty equipment in pressure line Verify transmitter is not reacting directly to equipment turning on/off Verify damping is set properly for application
Milliamp reading is erratic	<ul style="list-style-type: none"> Verify power source to transmitter has adequate voltage and current Check for external electrical interference Verify transmitter is properly grounded Verify shield for twisted pair is only grounded at one end

BEFORE DISASSEMBLING THE TRANSMITTER


Maintenance procedures differ for improved and previous style transmitter housings. Verify the specific physical characteristics of your transmitter before you begin any maintenance procedures. The width of the conduit entries is the most noticeable physical difference between the improved and the previous style housing (see Figure 5-1).

Figure 5-1. Improved and Previous Styles of the Model 3051 Transmitter Housing



DISASSEMBLY PROCEDURES

Remove the Transmitter from Service

 Do not remove the instrument cover in explosive atmospheres when the circuit is live.

NOTE

Once you have determined a transmitter to be inoperable, remove it from service.

Be aware of the following:

- Isolate and vent the process from the transmitter before removing the transmitter from service.
- Remove all electrical leads and conduit.
- Detach the process flange by removing the four flange bolts and the two alignment screws that secure it.
- Do not scratch, puncture, or depress the isolating diaphragms.
- Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.
- Whenever you remove the process flange or flange adapters, visually inspect the Teflon O-rings. Replace the O-rings if they show any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them.

The Model 3051C transmitter is attached to the process connection by four bolts and two cap screws. Remove the four bolts and separate the transmitter from the process connection manifold or flange. You can leave the process connection in place and ready for re-installation.

The Model 3051T is attached to the process by a single hex nut process connection. Loosen the hex nut to separate the transmitter from the process. Do not use wrench on neck of transmitter.

Model 3051

Remove the Terminal Block

Electrical connections are located on the terminal block in the compartment labelled "FIELD TERMINALS."


Loosen the two small screws located at the 9 o'clock and 4 o'clock positions, and pull the entire terminal block out to remove it.

NOTE

If removing the terminal block from the housing of a previous version of the transmitter, you will have to manually disconnect the power leads from the rear of the terminal block before completely separating it from the housing.

Remove the Electronics Board

The transmitter electronics board is located in the compartment opposite the terminal side. To remove the electronics board perform the following procedure:

1. Remove the housing cover opposite the field terminal side.
2.  Loosen the two captive screws that anchor the board to the housing. The electronics board is electrostatically sensitive; observe handling precautions for static-sensitive components.

NOTE

If you are disassembling a transmitter with a LCD display, loosen the two captive screws that are visible on the right and left side of the meter display. The two screws anchor the LCD display to the electronics board and the electronics board to the housing.

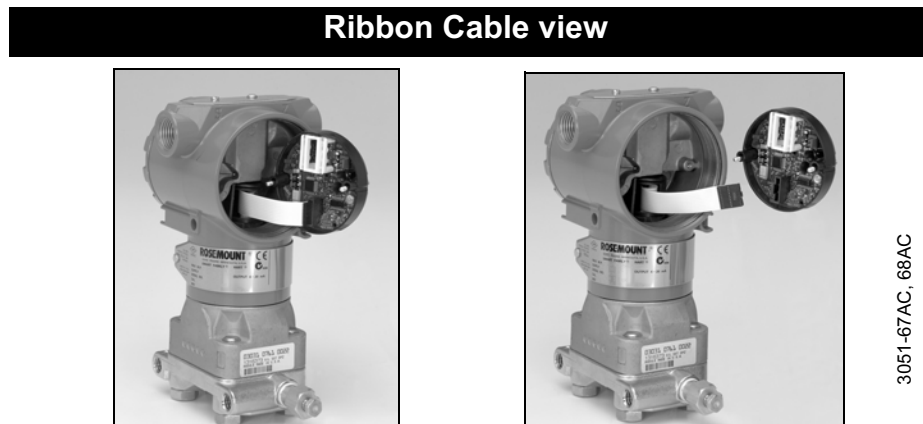
3. Slowly pull the electronics board out of the housing. With the two captive screws free of the transmitter housing, only the sensor module ribbon cable holds the board to the housing.

NOTE

Previous versions of the electronics board utilize a snap-in power plug and receptacle. Carefully unplug the power plug from the receptacle to free the board from the power cord.

4. Disconnect the sensor module ribbon cable to release the electronics board from the transmitter.

Figure 5-2. Ribbon Cable view



Remove the Sensor Module from the Electronics Housing

1. Carefully tuck the cable connector completely inside of the internal shroud.

NOTE

Do not remove the housing until after you tuck the cable connector completely inside of the internal shroud. The shroud protects the cable from damage that can occur when you rotate the housing.

2. Loosen the housing rotation set screw with a $\frac{9}{64}$ -inch hex wrench, and back off one full turn.

IMPORTANT

To prevent damage to the sensor module ribbon cable, disconnect it from the electronics board before you remove the sensor module from the electrical housing.

3. Unscrew the housing from the module, making sure the shroud and sensor cable do not catch on the housing.

IMPORTANT

Make sure the sensor ribbon cable and internal shroud remain completely free of the housing as you rotate it. Damage can occur to the cable if the internal shroud and sensor cable become hung up and rotate with the housing.

REASSEMBLY PROCEDURES

1. Inspect all cover and housing (non-process wetted) O-rings and replace if necessary. Lightly grease with silicone lubricant to ensure a good seal.
2. Carefully tuck the cable connector completely inside the internal shroud. To do so, turn the shroud and cable counterclockwise one rotation to tighten the cable.
3. Lower the electronics housing onto the module. Guide the internal shroud and cable through the housing and into the external shroud.
4. Turn the housing clockwise the fasten it to the module.

IMPORTANT

To prevent damage to the cable connector, watch the cable and shroud as you attach the housing to the module. Make sure the cable connector does not slip out of the internal shroud and begin to rotate with the housing. Reinsert the cable connector into the shroud if it escapes before the housing is fully fastened.



5. Thread the housing completely onto the sensor module. The housing must be no more than one full turn from flush with the sensor module to comply with explosion proof requirements.
6. Tighten the housing rotation set screw using a $\frac{9}{64}$ -inch hex wrench.

Model 3051

Attach the Electronics Board


NOTE

Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD meter, an alarm level test is recommended before returning the transmitter to service (see “Alarm Level Verification” on page 3-20).

1. Remove the cable connector from its position inside of the internal shroud and attach it to the electronics board.
 2. Insert the electronics board into the housing, making sure that the posts from the electronics housing properly engage the receptacles on the electronics board.
-

NOTE

If you are reassembling a previous version of the electronics board (or placing a new version of the electronics board in a previous version of the housing), attach the snap-in power connection to the receptacle on the board with the black and red wires routed toward the center of the board and below the white reed switch holder.

3. Tighten the captive mounting screws.
 4.  Replace the electronics housing cover. The transmitter covers must be engaged metal-to-metal to ensure a proper seal and to meet Explosion-Proof requirements.
-

NOTE

Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD meter, an alarm level test is recommended before returning the transmitter to service (see “Alarm Level Verification” on page 3-20).

Install the Terminal Block

Gently slide the terminal block into place, making sure the posts from the electronics housing properly engage the receptacles on the terminal block. Tighten the captive screws and replace the electronics housing cover. The transmitter covers must be fully engaged to meet Explosion-Proof requirements.

NOTE

If you are reassembling a previous version of the terminal block, attach the black and red wires to the back side of the block before you insert it into the electronics housing.

Reassemble the Process Sensor Body

1. Visually inspect the Teflon sensor module O-rings. If the O-rings are undamaged, you may reuse them. If the O-rings show signs of damage, such as nicks or cuts, or if there is any doubt about their ability to seal properly, replace them with new O-rings.

NOTE

If you are replacing the O-rings, be careful not to scratch the O-ring grooves or the surface of the isolating diaphragm when removing the damaged O-rings.

2. Install the process flange on the sensor module. To hold the process flange in place, install the two hex head alignment screws. While these screws are not pressure retaining, tighten the hex head alignment screws to 33 in-lbs to ensure proper alignment. Do not overtighten; this will affect the module/flange alignment.
3. Install the appropriate flange bolts.
 - a. IF the installation requires a 1/4-18 NPT mounting, THEN use four 1.75-inch flange bolts. Go to **step f**.
 - b. IF the installation requires a 1/2-14 NPT mounting, THEN use four 2.88-inch process flange/adaptor bolts. EXCEPTION: For gage pressure configurations, use two 2.88-inch bolts and two 1.75-inch bolts. Go to **step d**.
 - c. IF the installation uses a three-valve manifold (differential pressure applications only), THEN use four 2.25-inch manifold flange bolts. Go to **step e**.
 - d. Hold the flange adapters and adapter O-rings in place while finger-tightening the bolts. Go to **step g**.
 - e. Align the process flange with the three-valve manifold.
 - f. Finger tighten the bolts.
 - g. Tighten the bolts to the initial torque value using a crossed pattern. See Table 5-2 for appropriate torque values.
 - h. Tighten the bolts to the final torque value using a crossed pattern. See Table 5-2 for appropriate torque values. When fully tightened, the bolts should extend through the top of the module housing.
 - i. If the installation uses a three-valve manifold, then install flange adapters on the process end of the manifold using the 1.75-inch flange bolts supplied with the transmitter.

Model 3051

Table 5-2. Bolt Installation Torque Values

Bolt Material	Initial Torque Value	Final Torque Value
CS-ASTM-A445 Standard	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
316 SST—Option L4	150 in.-lb (17 N-m)	300 in.-lb (34 N-m)
ASTM-A-193-B7M—Option L5	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
<i>Monel</i> —Option L6	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)

4. IF you replaced the Teflon sensor module O-rings, THEN re-torque the flange bolts after installation to compensate for cold flow.
5. Install the drain/vent valve.
 - a. Apply sealing tape to the threads on the seat. Starting at the base of the valve with the threaded end pointing toward the installer, apply two clockwise turns of the sealing tape.
 - b. Take care to place the opening on the valve so that process fluid will drain toward the ground and away from personnel when the valve is opened.
 - c. Tighten the drain/vent valve to 350 in.-lb. (39.54 N-m).

NOTE

After replacing O-rings on Range 1 transmitters and re-installing the process flange, expose the transmitter to a temperature of 185 °F (85 °C) for two hours. Then re-tighten the flange bolts in a cross pattern, and again expose the transmitter to a temperature of 185 °F (85 °C) for two hours before calibration.

Appendix A Reference Information

Performance Specifications	page A-1
Detailed Performance Specifications	page A-2
Functional Specifications	page A-6
Physical Specifications	page A-11
Dimensional Drawings	page A-13
Ordering Information	page A-21
Parts List	page A-35
Options	page A-45
HART Protocol C1 Option Configuration Data Sheet ...	page A-50

PERFORMANCE SPECIFICATIONS

Total Performance is based on combined errors of reference accuracy, ambient temperature effect, and static pressure effect.

Model 3051C (Ranges 2–5), Model 3051T

Reference Accuracy

±0.075% of span

Total Performance

±0.15% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure (CD only), from 1:1 to 5:1 rangedown.

Stability

±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.

Dynamic Performance Total Response Time (T_d + T_c)

HART output: 100 ms

Model 3051CD, Low/Draft Range (Ranges 0–1)

Reference Accuracy

±0.10% of span

Stability

±0.2% of URL for 1 year under reference conditions

Model 3051P—Reference Class

Reference Accuracy

±0.05% of span

Total Performance

±0.10% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure, from 1:1 to 5:1 rangedown

Stability

±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure

Dynamic Performance Total Response Time (T_d + T_c)

100 ms

Model 3051L—Liquid Level

Reference Accuracy

±0.075% of span

Model 3051H—High Process Temperature

Reference Accuracy

±0.075% of span

Stability

±0.1% of URL for 12 months for Ranges 2 and 3

±0.2% of URL for 12 months for Ranges 4 and 5

**DETAILED
PERFORMANCE
SPECIFICATIONS**

For zero-based spans, reference conditions, silicone oil fill, SST materials, Coplanar flange (Model 3051C) or 1/2 in.- 18 NPT (Model 3051T) process connections, digital trim values set to equal range points.

Reference Accuracy

Stated reference accuracy includes hysteresis, terminal-based linearity and repeatability.

Model 3051CD Ranges 2–5 and 3051CG

±0.075% of span for spans less than 10:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{\text{URL}}{\text{Span}} \right) \right] \% \text{ of Span}$$

Model 3051CD Range 1

±0.10% of span for spans less than 15:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{\text{URL}}{\text{Span}} \right) \right] \% \text{ of Span}$$

Model 3051CD Range 0

±0.10% of span for spans less than 2:1, accuracy = ±0.05% of URL

Model 3051T/CA Ranges 1–5

±0.075% of span for spans less than 10:1, accuracy =

$$\pm \left[0.0075 \left(\frac{\text{URL}}{\text{Span}} \right) \right] \% \text{ of Span}$$

Model 3051CA Range 0

±0.075% of span for spans less than 5:1, accuracy =

$$\pm \left[0.025 + 0.01 \left(\frac{\text{URL}}{\text{Span}} \right) \right] \% \text{ of Span}$$

Model 3051H/3051L

±0.075% of span for spans less than 10:1, accuracy =

$$\pm \left[0.025 + 0.005 \left(\frac{\text{URL}}{\text{Span}} \right) \right] \% \text{ of Span}$$

Model 3051P

±0.05% of span

**Ambient Temperature
Effect per 50 °F (28 °C)**

Model 3051CD/CG

Range 2 - 5: $\pm(0.0125\% \text{ URL} + 0.0625\% \text{ span})$ from 1:1 to 5:1
 $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 5:1 to 100:1
Range 1: $\pm(0.1\% \text{ URL} + 0.25\% \text{ span})$ from 1:1 to 30:1
 $\pm(0.147\% \text{ URL} + 0.15\% \text{ span})$ greater than 30:1
Range 0: $\pm(0.25\% \text{ URL} + 0.05\% \text{ span})$

Model 3051CA

Range 1 - 4: $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 30:1
 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span})$ from 30:1 to 100:1
Range 0: $\pm(0.1\% \text{ URL} + 0.25\% \text{ span})$

Model 3051P

All ranges: $\pm(0.006\% \text{ URL} + 0.03\% \text{ span})$

Model 3051H

All ranges: $\pm(0.025\% \text{ URL} + 0.125\% \text{ span} + 0.35 \text{ inH}_2\text{O})$
For spans below 30:1 rangedown:
 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span} + 0.35 \text{ inH}_2\text{O})$

Model 3051L

See Rosemount Inc. Instrument Toolkit™ software.

Model 3051T

Ranges 2- 4: $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 30:1
 $\pm(0.035\% \text{ URL} + 0.125\% \text{ span})$ from 30:1 to 100:1
Range 5: $\pm(0.1\% \text{ URL} + 0.15\% \text{ span})$
Range 1: $\pm(0.025\% \text{ URL} + 0.125\% \text{ span})$ from 1:1 to 10:1
 $\pm(0.05\% \text{ URL} + 0.125\% \text{ span})$ from 10:1 to 100:1

Model 3051

Line Pressure Effect per 1000 psi (6,9 MPa)

Model 3051CD

Zero Error (can be calibrated out at line pressure)

±0.05% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)

For line pressures above 2000 psi (13,7 MPa), see "Compensating for Line Pressure" on page 4-12.

Range 0: ±0.125% of URL/100 psi (6,89 bar)

Range 1: ±0.25% of URL

Span Error

±0.1% of reading

Range 0: ±0.15% of reading/100 psi (6,89 bar)

Range 1: ±0.4% of reading

Model 3051P

Zero Error (can be calibrated out at line pressure)

±0.04% of URL

Span Error

±0.10% of reading

Model 3051HD

Zero Error (can be calibrated out at line pressure)

±0.1% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)

For line pressures above 2000 psi (13,7 MPa), see "Compensating for Line Pressure" on page 4-12.

Span Error

±0.1% of reading

Dynamic Performance

Total Response Time ($T_d + T_c$)⁽²⁾:

Model 3051C/P, Ranges 2-5: 100 ms

Range 1: 255 ms

Range 0: 700 ms

Model 3051T: 100 ms

Model 3051H/L: Consult factory

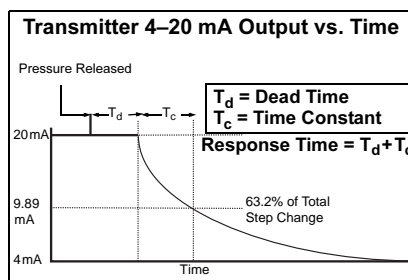
Dead Time (T_d) 45 ms (nominal)

Update Rate 22 times per second

(1) Dead time and update rate apply to all models and ranges; analog output only

(2) Nominal total response time at 75 °F (24 °C) reference conditions.

Figure A-1. Typical Smart Transmitter Response Time



Mounting Position Effects

Model 3051C/P

Zero shifts up to ± 1.25 inH₂O (3,11 mbar), which can be calibrated out. No span effect.

Model 3051H

Zero shifts up to ± 5 inH₂O (127 mmH₂O), which can be calibrated out. No span effect.

Model 3051L

With liquid level diaphragm in vertical plane, zero shift of up to 1 inH₂O (25,4 mmH₂O).

With diaphragm in horizontal plane, zero shift of up to 5 inH₂O (127 mmH₂O) plus extension length on extended units. All zero shifts can be calibrated out. No span effect.

Model 3051T/CA

Zero shifts up to 2.5 inH₂O (63,5 mmH₂O), which can be calibrated out. No span effect.

Vibration Effect

All Models

Measurement effect due to vibrations is negligible except at resonance frequencies. When at resonance frequencies, vibration effect is less than $\pm 0.1\%$ of URL per g when tested between 15 and 2000 Hz in any axis relative to pipe-mounted process conditions.

Power Supply Effect

All Models

Less than $\pm 0.005\%$ of calibrated span per volt.

RFI Effects

All Models

$\pm 0.1\%$ of span from 20 to 1000 MHz and for field strength up to 30 V/m. Shielded cable needed for 30 V/m.

Transient Protection (Option Code T1)

All Models

Meets IEEE Standard 587, Category B

- 1 kV crest (10 × 1 000 microseconds)
- 3 kV crest (8 × 20 microseconds)
- 6 kV crest (1,2 × 50 microseconds)

Meets IEEE Standard 472, Surge Withstand Capability

SWC 2,5 kV crest, 1 MHz wave form

General Specifications:

- Response Time: < 1 nanosecond
- Peak Surge Current: 5000 amps to housing.
- Peak Transient Voltage: 100 V dc.
- Loop Impedance: < 25 ohms
- Applicable Standards: IEC 801-4, IEC 801-5

NOTE:

Calibrations at 68 °F (20 °C) per ASME Z210.1 (ANSI)

Model 3051

FUNCTIONAL SPECIFICATIONS

Range and Sensor Limits

Table A-1. Model 3051CD, 3051CG, 3051P, 3051L, and 3051H Range and Sensor Limits

Range	Minimum Span		Upper (URL)	Range and Sensor Limits							
	Model 3051CD ⁽¹⁾ , CG, L, H	Model 3051P		Lower (LRL)							
				Model 3051C Differential	3051C/P ⁽²⁾ Gage	Model 3051P Differential	Model 3051L Differential	Model 3051L Gage	Model 3051H Differential	Model 3051H Gage	
0	0.1 inH ₂ O (0,25 mbar)	NA	3.0 inH ₂ O (7,47 mbar)	-3.0 inH ₂ O (-7,47 mbar)	NA	NA	NA	NA	NA	NA	NA
1	0.5 inH ₂ O (1,2 mbar)	NA	25 inH ₂ O (62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	-25 inH ₂ O (-62,3 mbar)	NA	NA	NA	NA	NA	NA
2	2.5 inH ₂ O (6,2 mbar)	25 inH ₂ O (62,3 mbar)	250 inH ₂ O (62,3 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)	-250 inH ₂ O (-0,62 bar)
3	10 inH ₂ O (24,9 mbar)	100 inH ₂ O (0,25 bar)	1000 inH ₂ O (2,49 bar)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	-1000 inH ₂ O (-2,49 bar)	0.5 psia (34,5 mbar abs)	
4	3 psi (0,20 bar)	30 psi (2,07 bar)	300 psi (20,6 bar)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	NA	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	-300 psi (-20,6 bar)	0.5 psia (34,5 mbar abs)	
5	20 psi (1,38 bar)	200 psi (13,8 bar)	2000 psi (137,9 bar)	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)	NA	NA	NA	-2000 psi (-137,9 bar)	0.5 psia (34,5 mbar abs)	

(1) Range 0 only available with Model 3051CD. Range 1 only available with Models 3051CD or 3051CG.
(2) Range 1 not available with Model 3051P.

Table A-2. Range and Sensor Limits

Range	Model 3051CA			Range	Model 3051T			
	Minimum Span	Upper (URL)	Lower (LRL)		Minimum Span	Upper (URL)	Lower (LRL)	Lower ⁽¹⁾ (LRL) (Gage)
0	0.167 psia (11,51 mbar)	5 psia (0,34 bar)	0 psia (0 bar)	1	0.3 psi (20,6 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
1	0.3 psia (20,6 mbar)	30 psia (2,07 bar)	0 psia (0 bar)	2	1.5 psi (0,103 bar)	150 psi (10,3 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
2	1.5 psia (0,103 bar)	150 psia (10,3 bar)	0 psia (0 bar)	3	8 psi (0,55 bar)	800 psi (55,2 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
3	8 psia (0,55 bar)	800 psia (55,2 bar)	0 psia (0 bar)	4	40 psi (2,76 bar)	4000 psi (275,8 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)
4	40 psia (2,76 bar)	4000 psia (275,8 bar)	0 psia (0 bar)	5	2000 psi (137,9 bar)	10000 psi (689,4 bar)	0 psia (0 bar)	-14.7 psig (-1,01 bar)

(1) Assumes atmospheric pressure of 14.7 psig.

Zero and Span Adjustment Requirements (HART and Low Power)

Zero and span values can be set anywhere within the range limits stated in Table A-1 and Table A-2.

Span must be greater than or equal to the minimum span stated in Table A-1 and Table A-2.

Service

Liquid, gas, and vapor applications

4–20 mA (Output Code A)

Output

Two-wire 4–20 mA, user-selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol.

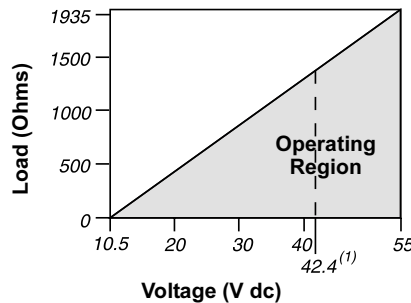
Power Supply

External power supply required. Standard transmitter (4–20 mA) operates on 10.5 to 55 V dc with no load.

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

$$\text{Max. Loop Resistance} = 43.5 (\text{Power Supply Voltage} - 10.5)$$



Communication requires a minimum loop resistance of 250 ohms.

(1) For CSA approval, power supply must not exceed 42.4 V.

Low Power (Output Code M)

Output

Three wire 1–5 V dc or 0.8–3.2 V dc (Option Code C2) user-selectable output. Also user selectable for linear or square root output configuration. Digital process variable superimposed on voltage signal, available to any host conforming to the HART protocol. Low-power transmitter operates on 6–12 V dc with no load.

Power Consumption

3.0 mA, 18–36 mW

Minimum Load Impedance

100 k Ω (V_{out} wiring)

Indication

Optional 5-digit LCD display

Overpressure Limits

Transmitters withstand the following limits without damage:

Model 3051CD/CG

Range 0: 750 psi (51,7 bar)
Range 1: 2000 psig (137,9 bar)
Ranges 2–5: 3626 psig (250 bar)

Model 3051CA

Range 0: 60 psia (4,14 bar)
Range 1: 750 psia (51,7 bar)
Range 2: 300 psia (20,7 bar)
Range 3: 1600 psia (110,3 bar)
Range 4: 6000 psia (413,7 bar)

Model 3051H

All Ranges: 3626 psig (25 MPa)

Model 3051TG/TA

Range 1: 750 psi (51,7 bar)
Range 2: 1500 psi (103,4 bar)
Range 3: 1600 psi (110,3 bar)
Range 4: 6000 psi (413,7 bar)
Range 5: 15000 psi (1034,2 bar)

Model 3051PG

Ranges 2-5: 3626 psig (250 bar)

Model 3051PD

Ranges 2 and 3: 2000 psig (13,8 MPa)

For Model 3051L or Level Flange Option Codes FA, FB, FC, FD, FP, and FQ, limit is 0 psia to the flange rating or sensor rating, whichever is lower.

TABLE 1. Model 3051L and Level Flange Rating Limits

Standard	Type	CS Rating	SST Rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
ANSI/ASME	Class 600	1480 psig	1440 psig
<i>At 100 °F (38 °C), the rating decreases with increasing temperature.</i>			
DIN	PN 10–40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
DIN	PN 25/40	40 bar	40 bar
<i>At 248 °F (120 °C), the rating decreases with increasing temperature.</i>			

Static Pressure Limit

Model 3051CD Only

Operates within specifications between static line pressures of 0.5 psia and 3626 psig (4500 psig for Option Code P9).

Range 0: 0.5 psia and 750 psig

Range 1: 0.5 psia and 2000 psig

Model 3051PD Only

Operates within specifications between static line pressures of 0.5 psia and 2000 psig.

Burst Pressure Limits

Burst pressure on Coplanar, traditional, or Model 3051H process flange is 10000 psig (69 MPa).

Burst pressure for the Model 3051T is

Ranges 1–4: 11000 psi (75,8 MPa)

Range 5: 26000 psig (179 MPa)

Failure Mode Alarm

Output Code A

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 3.75 mA or to 21.75 mA to alert the user. High or low alarm signal is user-selectable by internal jumper.

Output Code M

If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 0.94 V or above 5.4 V to alert the user (below 0.75 V or above 4.4 V for Option C2). High or low alarm signal is user-selectable by internal jumper.

Output Code F and W

If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Temperature Limits

Ambient

–40 to 185 °F (–46 to 85 °C)

With integral meter: –4 to 175 °F (–20 to 80 °C)

Storage

–50 to 230 °F (–46 to 110 °C)

With integral meter: –40 to 185 °F (–40 to 85 °C)

Process

At atmospheric pressures and above. See Table A-3

Table A-3. Model 3051 Process Temperature Limits

Model 3051CD, 3051CG, 3051CA, 3051P	
Silicone Fill Sensor ⁽¹⁾	
with Coplanar Flange	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
with Traditional Flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾⁽³⁾
with Level Flange	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
with Model 305 Integral Manifold	–40 to 300 °F (–40 to 149 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (–18 to 85 °C) ⁽⁴⁾⁽⁵⁾
Model 3051H (Process Fill Fluid)	
D.C.® Silicone 200 ⁽¹⁾	–40 to 375 °F (–40 to 191 °C)
Inert ⁽¹⁾	–50 to 350 °F (–45 to 177 °C)
Neobee M-20 ⁽¹⁾	0 to 375 °F (–18 to 191 °C)
Model 3051T (Process Fill Fluid)	
Silicone Fill Sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	–22 to 250 °F (–30 to 121 °C) ⁽²⁾
Model 3051L Low-Side Temperature Limits	
Silicone Fill Sensor ⁽¹⁾	–40 to 250 °F (–40 to 121 °C) ⁽²⁾
Inert Fill Sensor ⁽¹⁾	0 to 185 °F (–18 to 85 °C) ⁽²⁾
Model 3051L High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	–100 to 300 °F (–73 to 149 °C)
D.C. Silicone 704®	60 to 400 °F (15 to 205 °C)
D.C. Silicone 200	–40 to 400 °F (–40 to 205 °C)
Inert	–50 to 350 °F (–45 to 177 °C)
Glycerin and Water	0 to 200 °F (–18 to 93 °C)
Neobee M-20	0 to 400 °F (–18 to 205 °C)
Propylene Glycol and Water	0 to 200 °F (–18 to 93 °C)

- (1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio (0.6:1 ratio for the Model 3051H).
 (2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.
 (3) 3051CD0 process temperature limits are –40 to 212 °F (–45 to 100 °C)
 (4) 160 °F (71 °C) limit in vacuum service.
 (5) Not available for Model 3051CA.

Humidity Limits

0–100% relative humidity

Turn-On Time

Performance within specifications less than 2.0 seconds after power is applied to the transmitter

Volumetric Displacement

Less than 0.005 in³ (0,08 cm³)

Damping

Analog output response to a step input change is user-selectable from 0 to 25.6 seconds for one time constant. This software damping is in addition to sensor module response time.

**PHYSICAL
 SPECIFICATIONS**

Electrical Connections

1/2–14 NPT, PG 13.5, G1/2, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block.

Process Connections

All Models except 3051L and 3051T

1/4–18 NPT on 2 1/8-in. centers
 1/2–14 NPT on 2-, 2 1/8-, or 2 1/4-in. centers

Model 3051L

High pressure side: 2-, 3-, or 4-in., ASME B 16.5 (ANSI) Class 150, 300 or 600 flange; 50, 80 or 100 mm, PN 40 or 10/16 flange
 Low pressure side: 1/4–18 NPT on flange 1/2–14 NPT on adapter

Model 3051T

1/4–18 NPT, 1/2–14 NPT female, Non-Threaded instrument flange (available in SST for Range 1-4 transmitters only), G1/2 A DIN 16288 Male (available in SST for Range 1–4 transmitters only), or Autoclave type F-250-C (Pressure relieved 9/16–18 gland thread; 1/4 OD high pressure tube 60° cone; available in SST for Range 5 transmitters only).

Process Wetted Parts

Drain/Vent Valves

316 SST, Hastelloy C®, or Monel material (Monel not available with Model 3051L or 3051H)

Process Flanges and Adapters

Plated carbon steel, CF-8M (Cast version of 316 SST, material per ASTM-A743), Hastelloy C, or Monel

Wetted O-rings

Glass-filled TFE (Graphite-filled TFE with isolating diaphragm Option Code 6)

Process Isolating Diaphragms

Isolating Diaphragm Material	3051CD/CG	3051T	3051CA	3051P	3051H
316L SST	•	•	•	•	•
Hastelloy C-276®	•	•	•		•
Monel	•		•		
Tantalum	•				•
Gold-plated Monel	•		•		
Gold-plated SST	•		•		

Model 3051L Process-Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process Diaphragms, Including Process Gasket Surface:

316L SST, Hastelloy C-276, or Tantalum

Extension

CF-3M (Cast version of 316L SST, material per ASTM-A743), or Hastelloy C. Fits schedule 40 and 80 pipe.

Mounting Flange

Zinc-cobalt plated CS or SST

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms

316L SST or Hastelloy C-276

Reference Flange and Adapter

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Non-Wetted Parts

Electronics Housing

Low-copper aluminum or CF-3M (Cast version of 316L SST, material per ASTM-A743).
NEMA 4X, IP 65, IP 66, IP68

Coplanar Sensor Module Housing

CF-3M (Cast version of 316L SST, material per ASTM-A743)

Bolts

Plated carbon steel per ASTM A449, Type 1: Austenitic 316 SST, ASME B 16.5
(ANSI)/ASTM-A-193-B7M, or Monel

Sensor Module Fill Fluid

Silicone or inert Halocarbon™ (inert not available with Model 3051CA or Model 3051H).
Model 3051T uses Fluorinert® FC-43

Process Fill Fluid (Model 3051L and 3051H only)

3051L: Syltherm XLT, D.C. Silicone 704,
D.C. Silicone 200, inert, glycerin and water, Neobee M-20 or propylene glycol and water
3051H: inert, Neobee M-20, or D.C. Silicone 200

Paint

Polyurethane

Cover O-rings

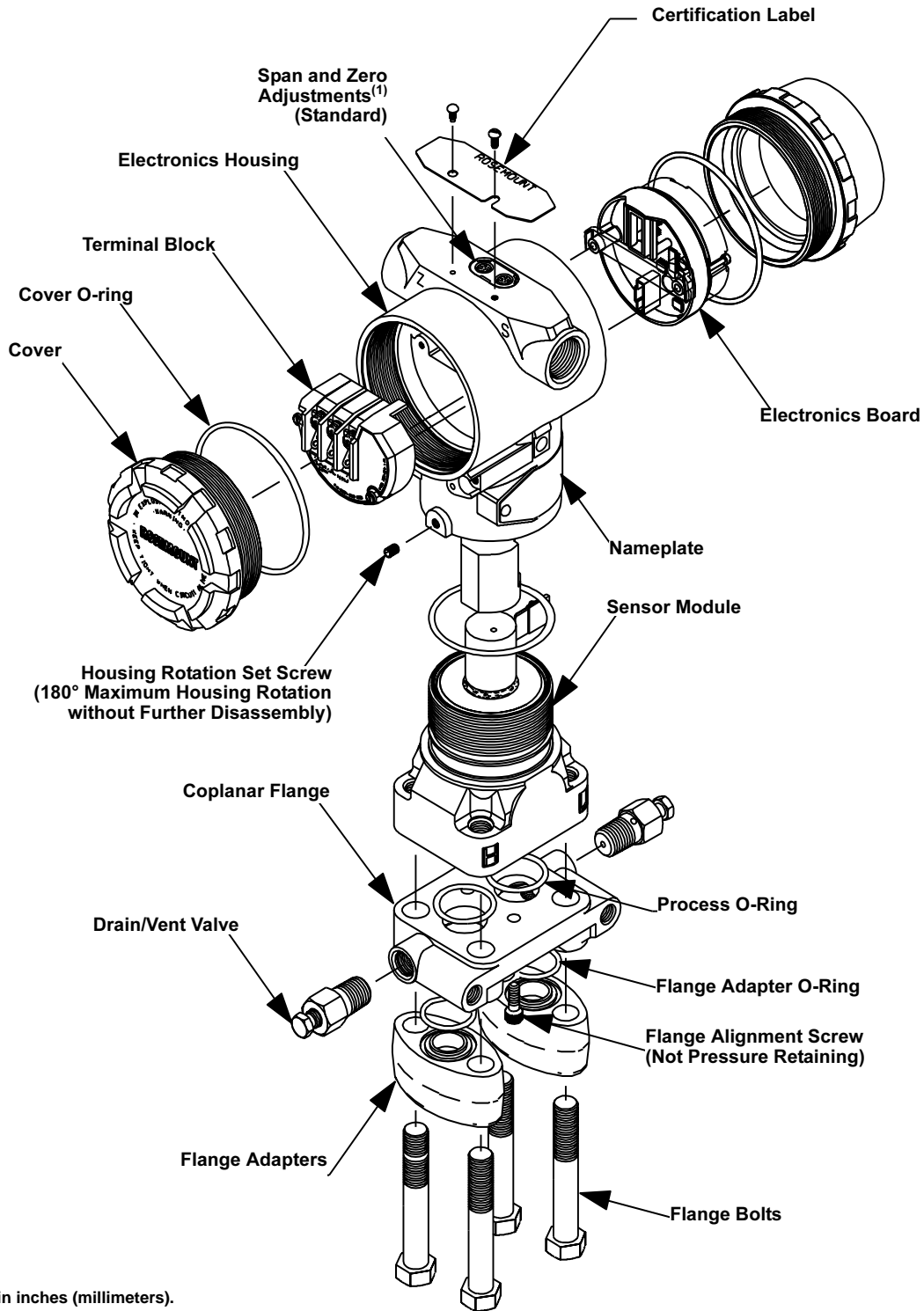
Buna-N

Shipping Weights

Refer to “Shipping Weights” on page A-49

**DIMENSIONAL
DRAWINGS**

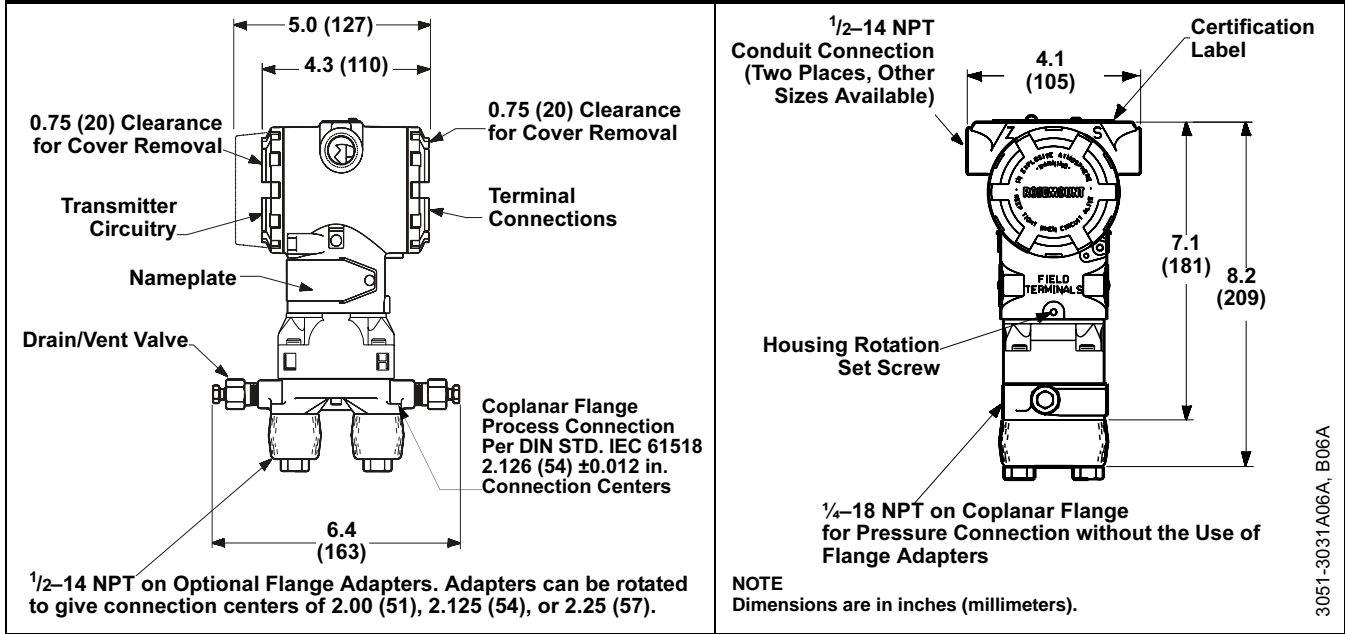
Model 3051 Exploded View



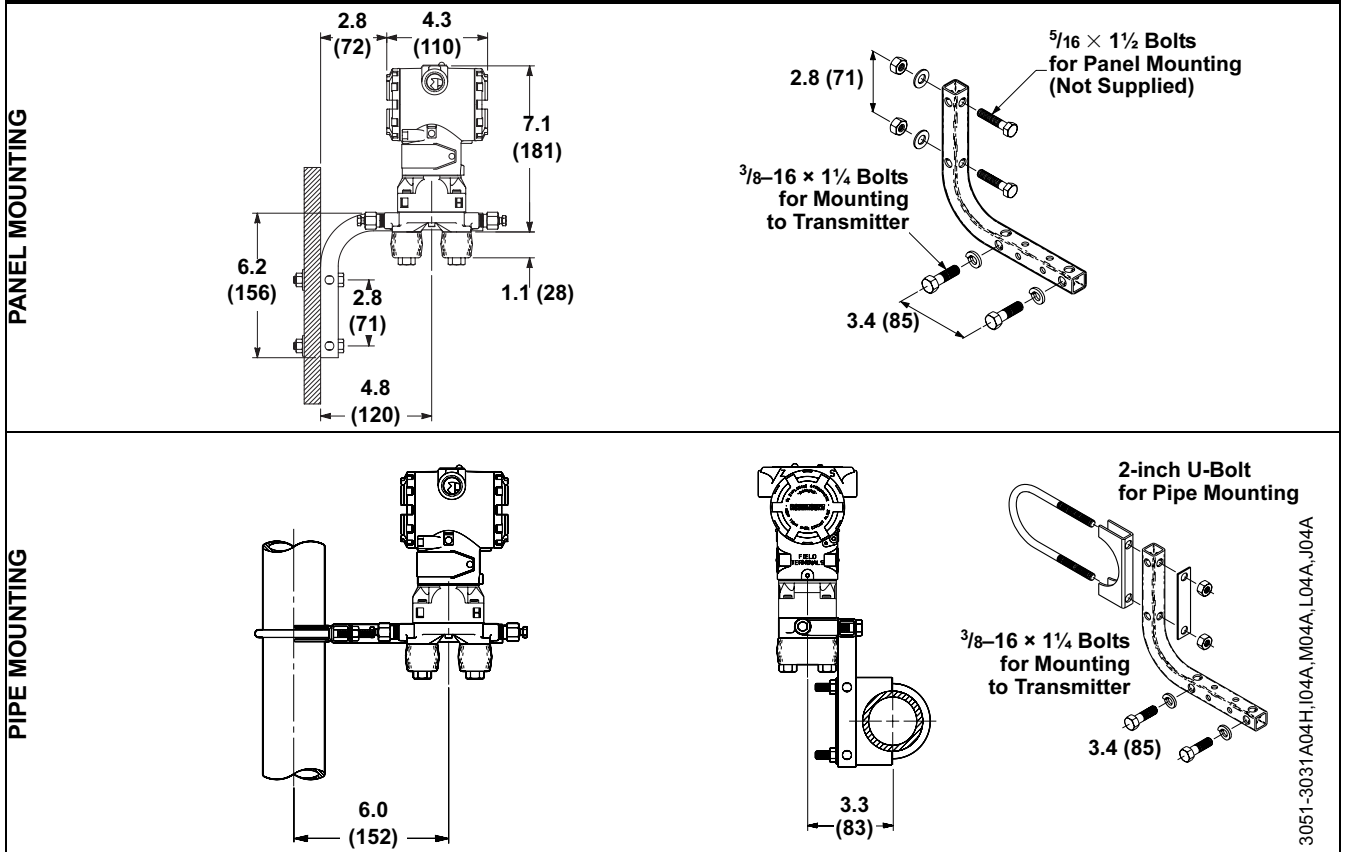
NOTE
Dimensions are in inches (millimeters).

3031B08A

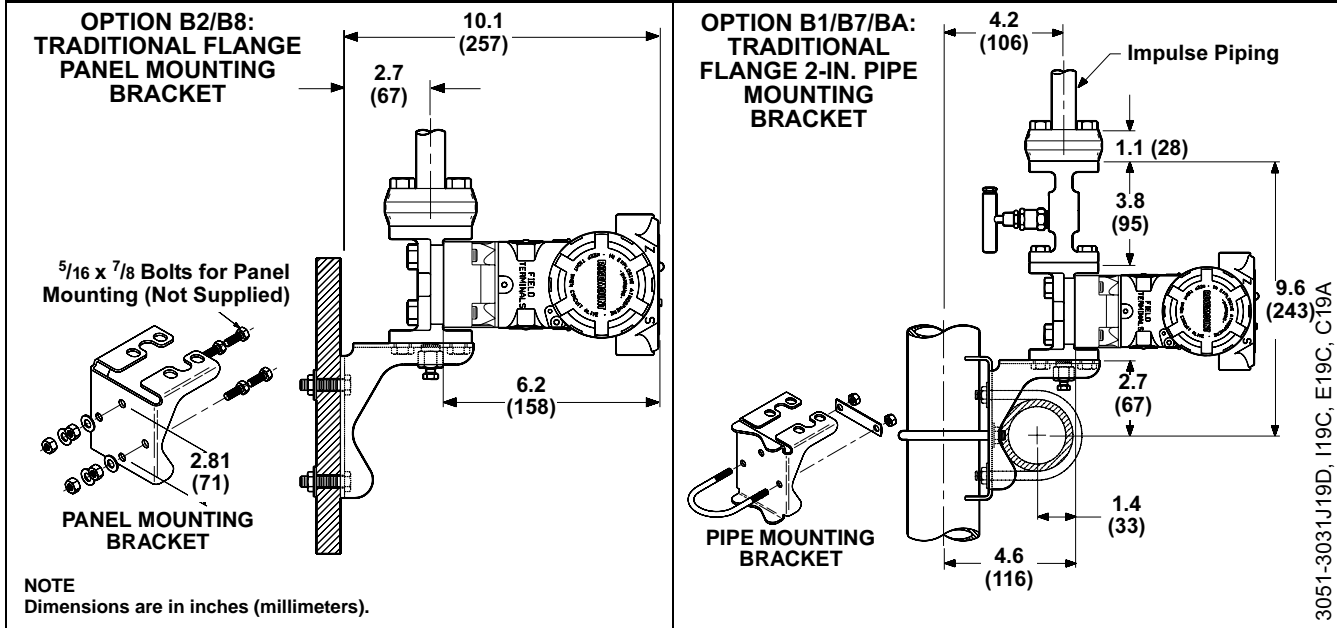
**Model 3051C Coplanar Flange Dimensional Drawing
(Differential Pressure Transmitter Shown)**



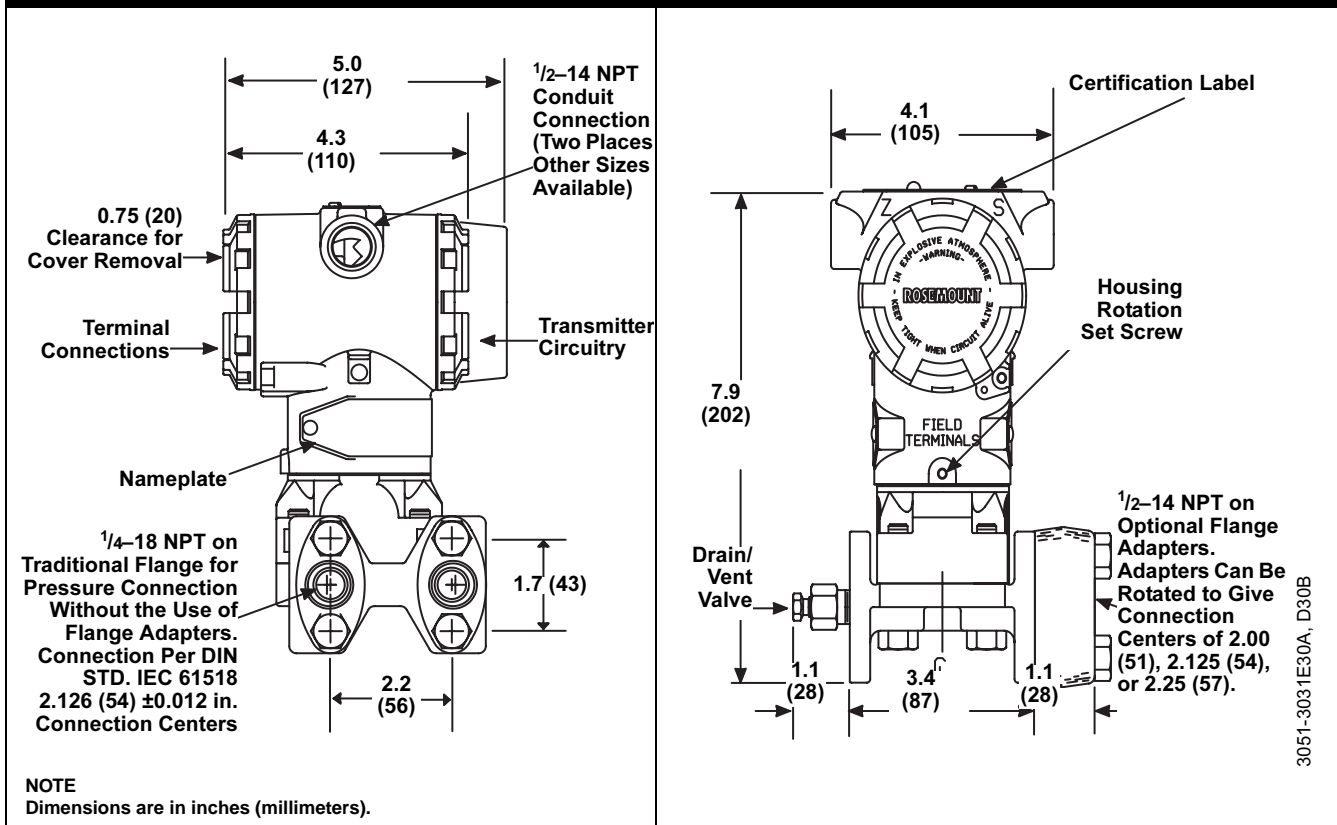
**Coplanar Flange Mounting Configurations with
Optional Bracket (B4) for 2-in. Pipe or Panel Mounting**

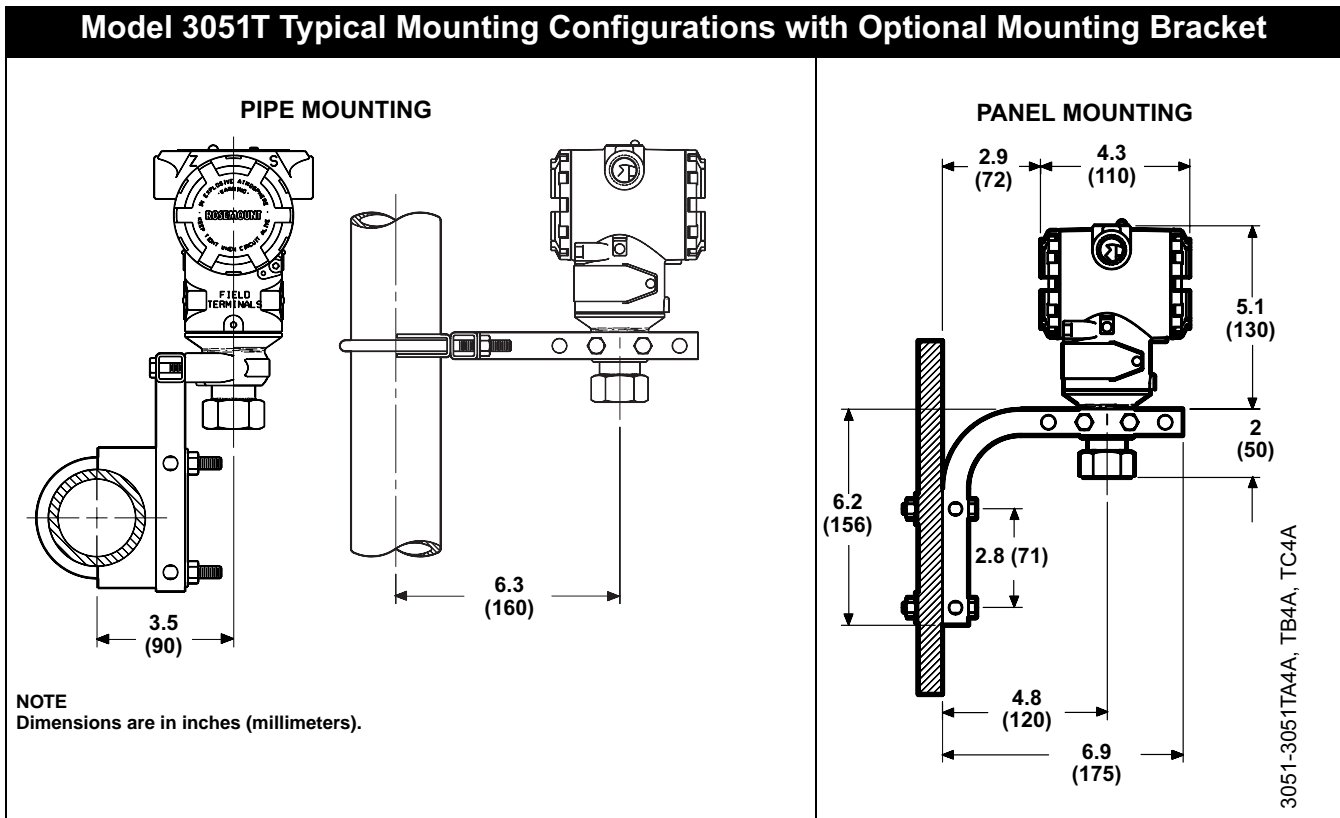
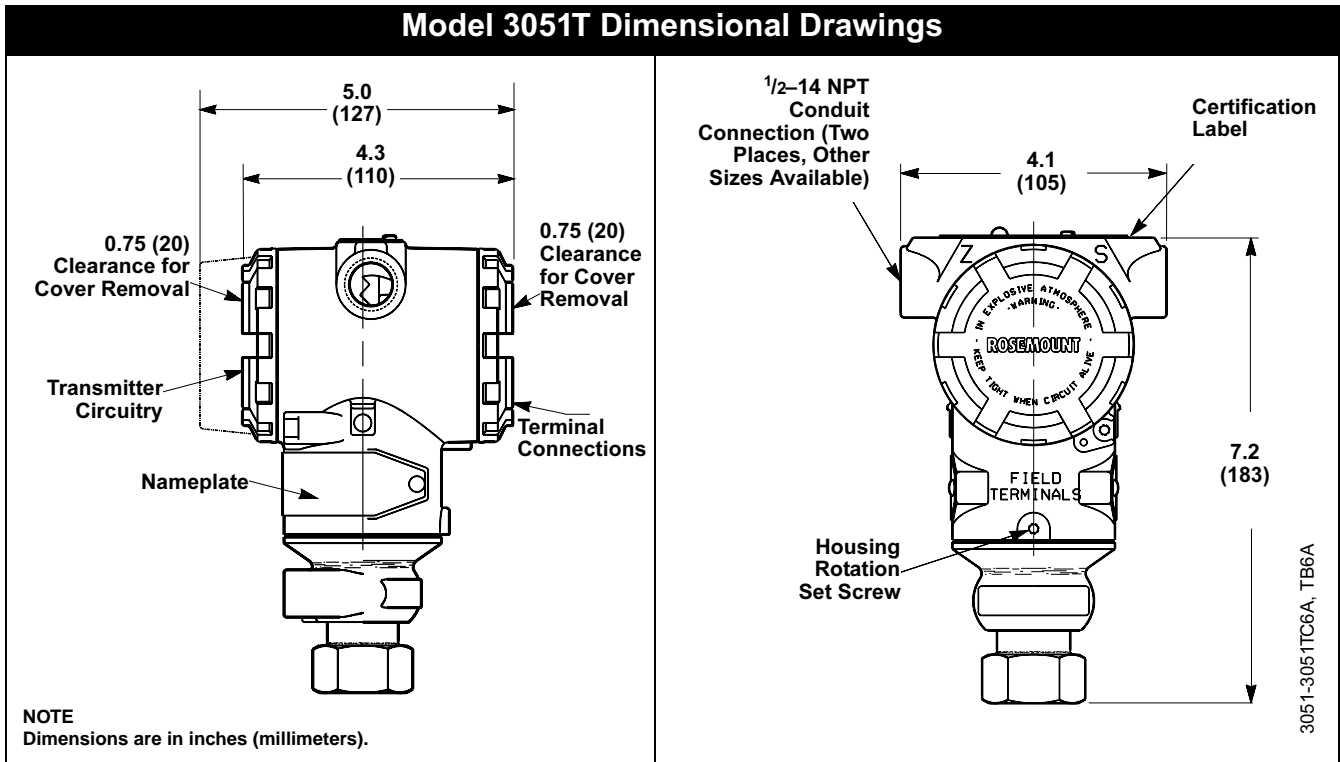


**Traditional Flange Mounting Configurations with
 Optional Brackets for 2-in. Pipe or Panel Mounting**

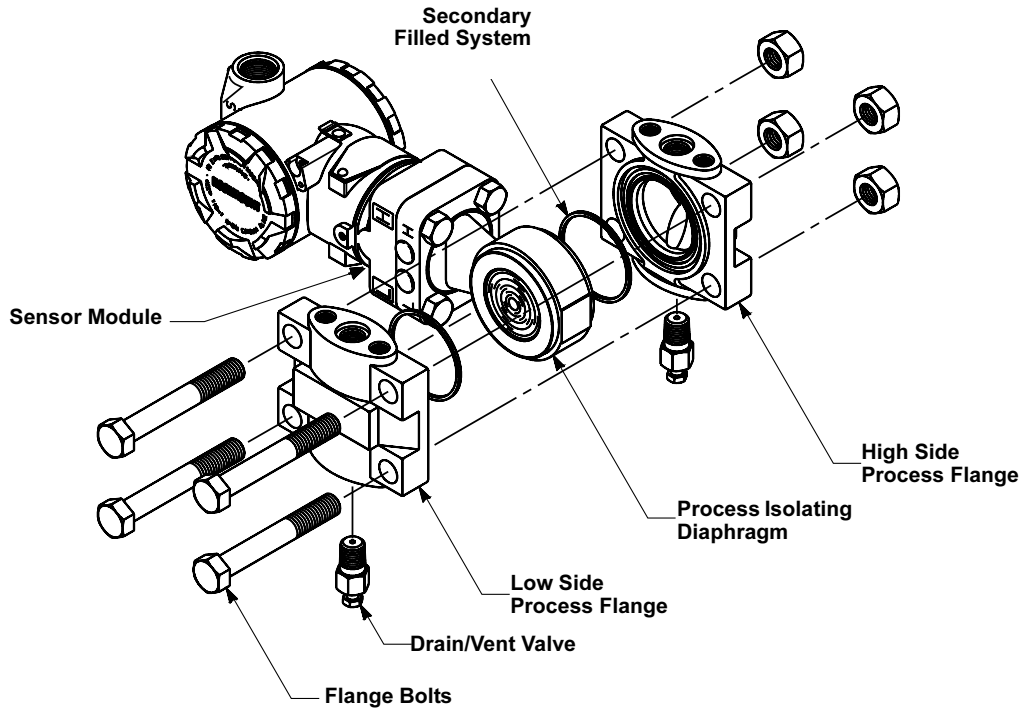


Traditional Flange (Options H2–H7) Dimensional Drawing

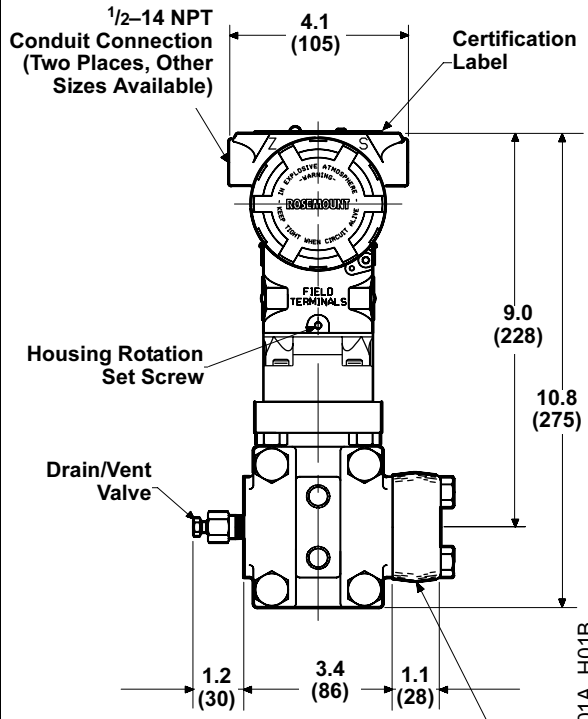
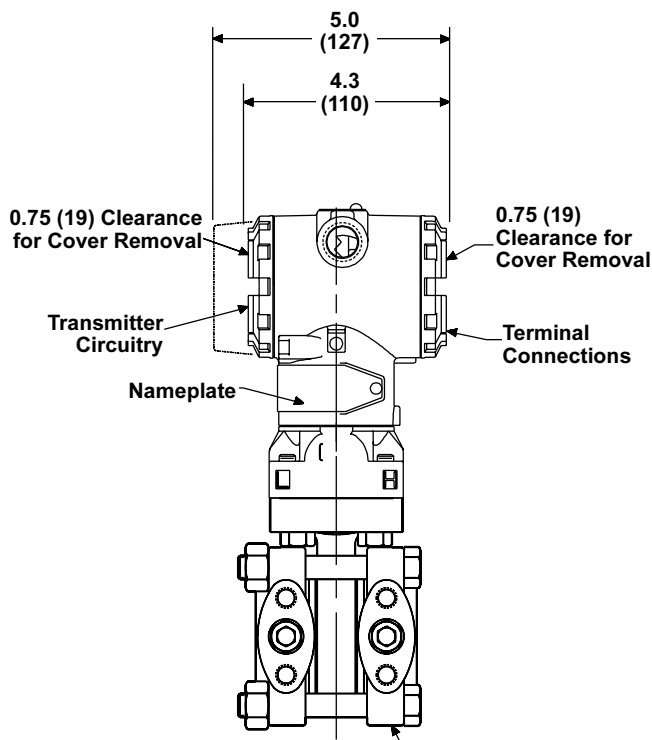




Model 3051H Pressure Transmitter Exploded View and Dimensional Drawings



3051-3051HB2G



3051-3051H01A, H01B

NOTE
 Dimensions are in inches (millimeters).

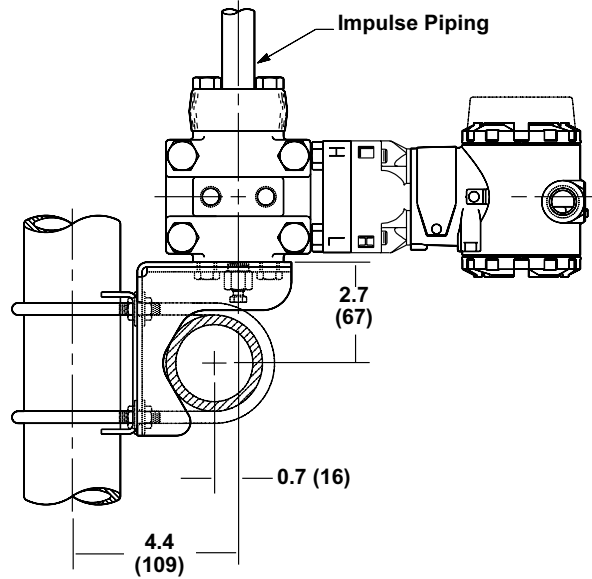
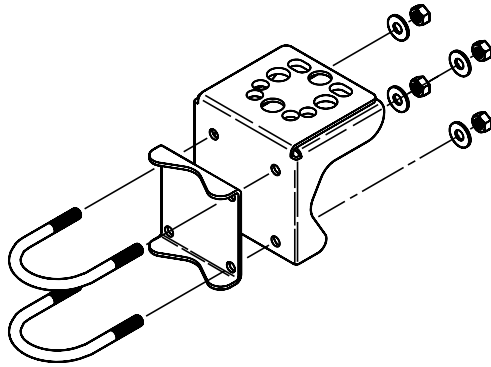
$\frac{1}{2}$ -18 NPT on Process Flange for Pressure Connection Without the Use of Mounting Adapters

$\frac{1}{2}$ -14 NPT on Optional Mounting Adapters. Adapters Can Be Rotated to Give Adapter Connection Centers of 2.00 (51), 2.1256 (54), or 2.25 (57).

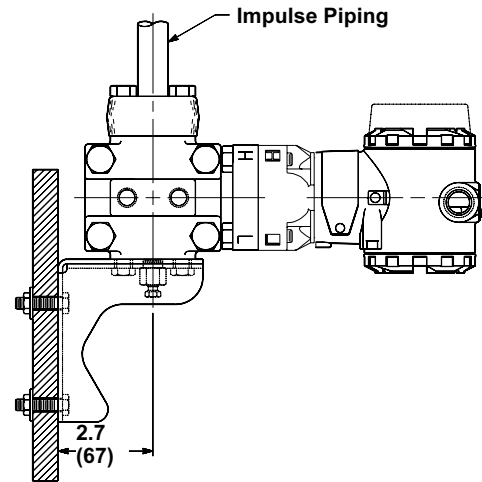
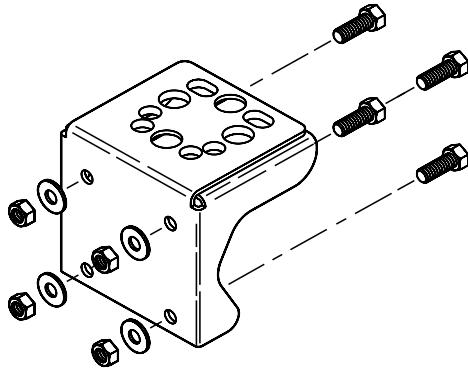
Model 3051

Model 3051H Mounting Brackets for 2-in. Pipe and Panel Mount (Option Code B5/B6)

PIPE MOUNTING CONFIGURATION



PANEL MOUNTING CONFIGURATION
 7/16-20 x 3/4 Bolts Supplied for
 Attaching Bracket to Transmitter

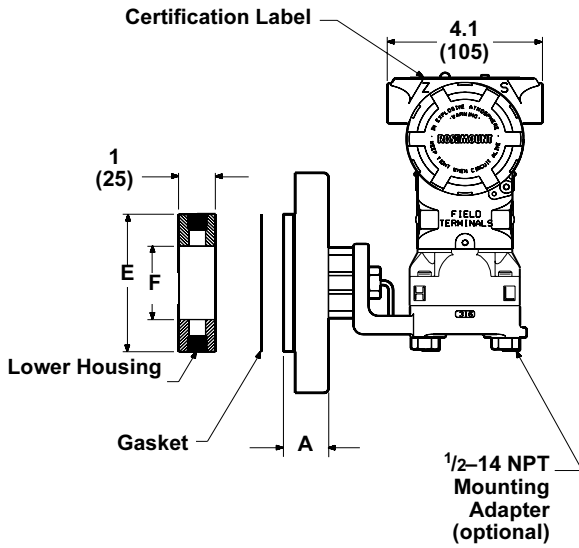


NOTE
 Dimensions are in inches (millimeters).

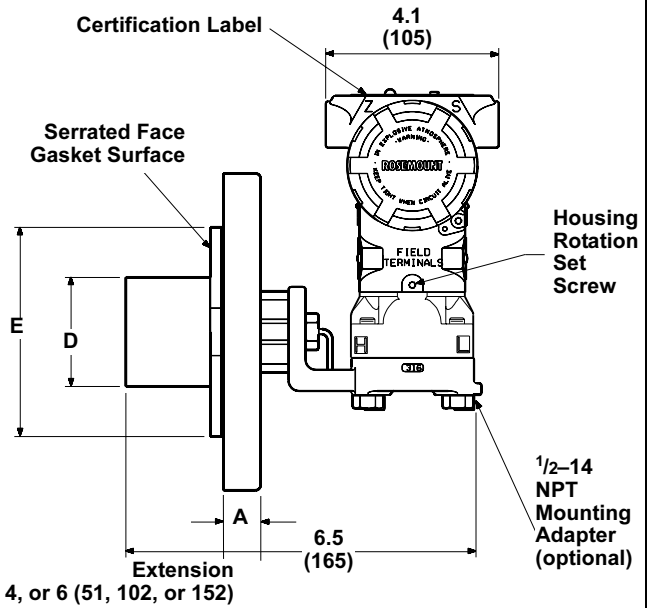
3051-3031G19A, F19B, 3051Hb3A, HA3B

Model 3051L Dimensional Drawings

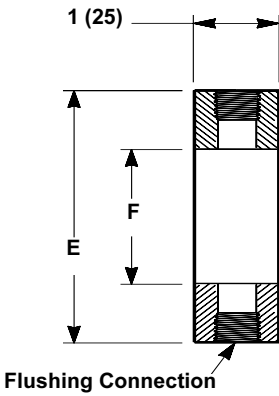
**2-IN. FLANGE CONFIGURATION
 (FLUSH MOUNT ONLY)**



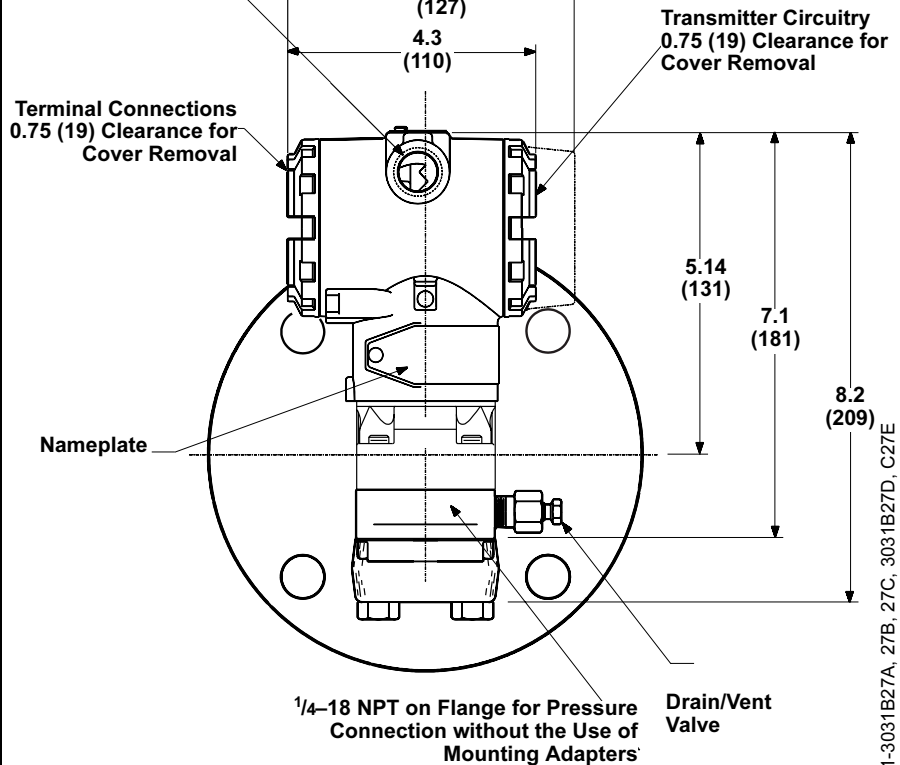
3- AND 4-IN. FLANGE CONFIGURATION



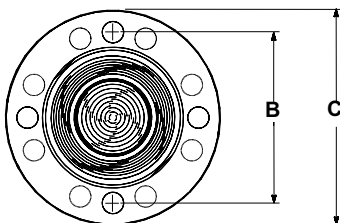
**OPTIONAL FLUSHING
 CONNECTION RING
 (LOWER HOUSING)**



**1/2-14 NPT Conduit
 Connections (optional)**



**DIAPHRAGM ASSEMBLY
 AND MOUNTING FLANGE**



NOTE
 Dimensions are in inches (millimeters).

3051-3031B27A, 27B, 27C, 3031B27D, C27E

Model 3051

Class	Pipe Size	Flange Thickness	Bolt Circle Diameter	Outside Diameter	No. of Bolts	Bolt Hole Diameter	Exten. Diam. ⁽¹⁾ D	O.D. Gask. Surf. E	Proc. Side F
ASME B 16.5 (ANSI) 150	2 (51)	1.12 (28)	4.75 (121)	6.0 (152)	4	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.31 (33)	6.0 (152)	7.5 (191)	4	0.75 (19)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.31 (33)	7.5 (191)	9.0 (229)	8	0.75 (19)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 300	2 (51)	1.25 (32)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.50 (38)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.62 (41)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 600	2 (51)	1.12 (28)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.37 (35)	6.62 (168)	6.62 (168)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
DIN PN 10–40	DN 50	26 mm	125 mm	165 mm	4	18 mm	NA	4.0 (102)	2.5 (63)
DIN PN 25/40	DN 80	30 mm	160 mm	200 mm	8	18 mm	65 mm	5.4 (138)	3.7 (94)
	DN 100	30 mm	190 mm	235 mm	8	22 mm	89 mm	6.2 (158)	4.5 (114)
DIN PN 10/16	DN 100	26 mm	180 mm	220 mm	8	18 mm	89 mm	6.2 (158)	4.5 (114)

(1) Tolerances are 0.040 (1,02), -0.020 (0,51)

**ORDERING
INFORMATION**

Model	Transmitter Type (Select One)	CD	CG	CA
3051CD	Differential Pressure Transmitter	•	—	—
3051CG	Gage Pressure Transmitter	—	•	—
3051CA	Absolute Pressure Transmitter	—	—	•

	Model 3051CD	Model 3051CG	Model 3051CA	CD	CG	CA
0 ⁽¹⁾	–3 to 3 inH ₂ O/0.1 inH ₂ O (–7,5 to 7,5 mbar/0,25 mbar)	Not Applicable	0 to 5 psia/0.167 psia (0 to 0,34 bar/11,5 mbar)	•	—	•
1	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	–25 to 25 inH ₂ O/0.5 inH ₂ O (–62,2 to 62,2 mbar/1,2 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)	•	•	•
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–623 to 623 mbar/6,2 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/0,1 bar)	•	•	•
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000 inH ₂ O/10 in H ₂ O (–1,01 to 2,5 bar/25 mbar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)	•	•	•
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)	•	•	•
5	–2000 to 2000 psi/20 psi (–137,9 to 137,9 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 137,9 bar/1,4 bar)	Not Applicable	•	•	—

NOTE: 3051CG lower range limit varies with atmospheric pressure.

Code	Output	CD	CG	CA
A	4–20 mA with Digital Signal Based on HART Protocol	•	•	•
M	Low-Power, 1–5 V dc with Digital Signal Based on HART Protocol (See Option C2 for 0.8–3.2 V dc)	•	•	•

NOTE: Not available with hazardous locations certification Options Codes I1, N1, E4, K6 and K8.

Materials of Construction

Code	Process Flange Type	Flange Material	Drain/Vent	CD	CG	CA
2	Coplanar	SST	SST	•	•	•
3	Coplanar	Hastelloy C	Hastelloy C	•	•	•
4	Coplanar	Monel	Monel	•	•	•
5	Coplanar	Plated CS	SST	•	•	•
7	Coplanar	SST	Hastelloy C	•	•	•
8	Coplanar	Plated CS	Hastelloy C	•	•	•
0	Alternate Flange—See Options on page A-22			•	•	•

NOTE: Materials of Construction Codes 3, 7, and 8 meet NACE material recommendations per MR 01-75.

Code	Isolating Diaphragm	CD	CG	CA
2	316L SST	•	•	•
3	Hastelloy C-276 (Meets NACE material recommendations per MR 01-75)	•	•	•
4	Monel	•	•	•
5	Tantalum (Available on Model 3051CD and CG, Ranges 2–5 only. Not available on Model 3051CA)	•	•	—
6	Gold-plated Monel (Use in combination with O-ring Option Code B.)	•	•	•
7	Gold-plated SST	•	•	•

Code	O-ring	CD	CG	CA
A	Glass-filled TFE	•	•	•
B	Graphite-filled TFE	•	•	•

Code	Fill Fluid	CD	CG	CA
1	Silicone	•	•	•
2	Inert fill (Halocarbon)	•	•	—

Continued on next page

Model 3051

Code	Housing Material	Conduit Entry Size	CD	CG	CA
A	Polyurethane-covered Aluminum	½–14 NPT	•	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•	•
D	Polyurethane-covered Aluminum	G½	•	•	•
J	SST	½–14 NPT	•	•	•
K	SST	M20 × 1.5 (CM20)	•	•	•
L	SST	PG 13.5	•	•	•
M	SST	G½	•	•	•

Code	Alternate Flange Options (Requires Materials of Construction Code 0)	CD	CG	CA
H2	Traditional Flange, 316 SST, SST Drain/Vent	•	•	•
H3	Traditional Flange, <i>Hastelloy C</i> , <i>Hastelloy C</i> Drain/Vent	•	•	•
H4	Traditional Flange, <i>Monel</i> , <i>Monel</i> Drain/Vent	•	•	•
H7	Traditional Flange, 316 SST, <i>Hastelloy C</i> Drain/Vent	•	•	•
HJ	DIN Compliant Traditional Flange, SST, 7/16 in. Adapter/Manifold Bolting	•	•	•
HK	DIN Compliant Traditional Flange, SST, 10 mm Adapter/Manifold Bolting	•	•	•
HL	DIN Compliant Traditional Flange, SST, 12mm Adapter/Manifold Bolting (not available on Model 3051CD0)	•	•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount	•	•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount	•	•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount	•	•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount	•	•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount	•	•	•
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount	•	•	•

NOTE: Option Codes H3 and H7 meet NACE material recommendations per MR 01-75.

Code	Integral Mount Manifold Options	CD	CG	CA
S5	Assemble to Model 305 Integral Manifold	•	•	•

Code	Integral Mount Primary Elements (Optional)	CD	CG	CA
S4	Factory Assembly to Rosemount Primary Element (<i>Annubar</i> or Model 1195 Integral Orifice) NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.	•	—	—

Code	Diaphragm Seal Assemblies (Optional) NOTE: Standard flange and adapter bolts are austenitic 316 SST.	CD	CG	CA
S1	One Diaphragm Seal (Direct Mount or Capillary Connection Type)	•	•	•
S2	Two Diaphragm Seals (Direct Mount or Capillary Connection Type)	•	—	—

Code	Optional All Welded Diaphragm Seal Systems (for high vacuum applications) NOTE: Standard flange and adapter bolts are austenitic 316 SST.	CD	CG	CA
S7	One Diaphragm Seal, All-Welded System (Capillary Connection Type)	•	•	•
S8	Two Diaphragm Seals, All-Welded System (Capillary Connection Type)	•	—	—
S0	One Diaphragm Seal, All-Welded System (Direct Mount Connection Type)	•	•	•
S9	Two Diaphragm Seals, All-Welded System (One Direct Mount and One Capillary Connection Type)	•	—	—

Continued on next page

Code	Mounting Bracket Options	CD	CG	CA
B4	Coplanar Flange Bracket for 2-in. Pipe or Panel Mounting, all SST	.	.	.
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	.	.	.
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	.	.	.
B3	Traditional Flange Flat Bracket for 2-in. Pipe Mounting, CS Bolts	.	.	.
B7	B1 Bracket with Series 300 SST Bolts	.	.	.
B8	B2 Bracket with Series 300 SST Bolts	.	.	.
B9	B3 Bracket with Series 300 SST Bolts	.	.	.
BA	SST B1 Bracket with Series 300 SST Bolts	.	.	.
BC	SST B3 Bracket with Series 300 SST Bolts	.	.	.
Code	Product Certification Options	CD	CG	CA
Hazardous Locations Certifications				
E5	FM Explosion-Proof Approval	.	.	.
I5	FM Non-incendive and Intrinsic Safety Approval	.	.	.
K5	FM Explosion-Proof and Intrinsic Safety Approval	.	.	.
I1	CENELEC Intrinsic Safety and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>	.	.	.
N1	CENELEC Type nL and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>	.	.	.
E8	CENELEC Flame-Proof and Dust Certification	.	.	.
E4	JIS Flame-Proof Certification <i>NOTE: Not available with low-power Option Code M.</i>	.	.	.
C5	Measurement Canada Accuracy Approval <i>NOTE: Limited availability depending on transmitter type and range. Contact your Rosemount representative.</i>	.	.	.
C6	Canadian Standards Association (CSA) Explosion-Proof and Intrinsic Safety Approval	.	.	.
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>	.	.	.
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	.	.	.
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	.	.	.
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>	.	.	.
I7	SAA Intrinsic Safety Certification	.	.	.
E7	SAA Flame-Proof Certification	.	.	.
N7	SAA Type N Certification	.	.	.
Code	Bolting Options	CD	CG	CA
L4	Austenitic 316 SST Bolts	.	.	.
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts	.	.	.
L6	Monel Bolts	.	.	.
Code	LCD Display (Optional)	CD	CG	CA
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	.	.	.
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	.	.	.

Continued on next page

Model 3051

Code	Other Options			
Q4	Calibration Data Sheet	.	.	.
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters (Model 3051C), and for the sensor module housing and low-volume Coplanar flange and adapter (Model 3051C with Option Code S1).</i>	.	.	.
QP	Calibration certification and tamper evident seal	.	.	.
QS	Quality Certification for safety	.	.	.
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	.	.	.
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	.	.	.
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6 or K8.</i>	.	.	.
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	.	.	.
C2	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)	.	.	.
C3	Gage Calibration (Model 3051CA4 only)	—	—	.
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	.	.	.
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	.	.	.
P1	Hydrostatic Testing	.	.	.
P2	Cleaning for Special Service	.	.	.
P3	Cleaning for <1 PPM Chlorine/Fluorine	.	.	.
P4	Calibrate at line pressure <i>Note: Specify Q48 on order for corresponding certificate</i>	.	.	.
DF	1/2 -14 NPT flange adapter(s)— Material determined by flange material	.	.	.
D7	Coplanar Flange Without Drain/Vent Ports	.	.	.
D8	Ceramic Ball Drain/Vents	.	.	.
D9	JIS Process Connection—RC 1/4 Flange with RC 1/2 Flange Adapter	.	.	.
P9	4500 psig Static Pressure Limit (Model 3051CD Ranges 2–5 only)	.	—	—
V5 ⁽²⁾	External Ground Screw Assembly	.	.	.

Typical Model Number: 3051CD 2 A 2 2 A 1 A B4

(1) Model 3051CD0 is available only with Output Code A, Process Flange Code 0 (Alternate Flange H2, H7, HJ, or HK), Isolating Diaphragm Code 2, O-ring Code A, and Bolting Option L4.

(2) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type	
3051T	Pressure Transmitter	
Code	Pressure Type	
G	Gage	
A	Absolute	
Code	PRESSURE RANGES (RANGE/MIN. SPAN)	
	3051TG	3051TA
1	-14.7 to 30 psi/0.3 psi (-1,01 to 2,1 bar/20,7 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)
2	-14.7 to 150 psi/1.5 psi (-1,01 to 10,3 bar/103,4 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/103,4 mbar)
3	-14.7 to 800 psi/8 psi (-1,01 to 55,2 bar/0,55 bar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)
4	-14.7 to 4000 psi/40 psi (-1,01 to 275,8 bar/2,8 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)
5	-14.7 to 10000 psi/2000 psi (-1,01 to 689,5 bar/138 bar)	0 to 10000 psia/2000 psia (0 to 689,5 bar/138 bar)
<i>NOTE: 3051TG lower range limit varies with atmospheric pressure.</i>		
Code	Output	
A	4-20 mA with Digital Signal Based on HART Protocol	
M	Low-Power 1-5 V dc with Digital Signal Based on HART Protocol (See Option Code C2 for 0.8-3.2 V dc Output)	
<i>NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6 or K8.</i>		
Code	Process Connection Style	
2A	1/4-18 NPT Female	
2B	1/2-14 NPT Female	
2C	G1/2 A DIN 16288 Male (Available in SST for Range 1-4 only)	
2F	Coned and Threaded, Compatible with Autoclave Type F-250-C	
61	Non-threaded Instrument flange (Available in Range 1-4 only)	
Code	Isolating Diaphragm	Process Connection Wetted Parts Material
2	316L SST	316L SST
3	Hastelloy	Hastelloy
<i>NOTE: Meets NACE requirements per MR 01-75.</i>		
Code	Fill Fluid	
1	Silicone	
2	Inert	
Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	1/2-14 NPT
B	Polyurethane-covered Aluminum	M20 x 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G1/2
J	SST	1/2-14 NPT
K	SST	M20 x 1.5 (CM20)
L	SST	PG 13.5
M	SST	G1/2
Code	Integral Mount Manifold (Optional)	
S5	Assemble to Model 306 Integral Manifold (Requires 1/2 in. process connection code 2B)	
Code	Remote Diaphragm Seals Assemblies (Optional)	
S1	One remote diaphragm seal (Direct Mount or Capillary Connection Type)	
Continued on next page		

Model 3051

Code	Mounting Brackets (Optional)
B4	Bracket for 2-in. Pipe or Panel Mounting, All SST
Code	Product Certifications (Optional)
Hazardous Locations Certifications	
E5	FM Explosion-Proof Approval
I5	FM Non-incendive and Intrinsic Safety Approval
K5	FM Explosion-Proof and Intrinsic Safety Approval
C5	Measurement Canada accuracy approval <i>Note: Limited availability depending on transmitter type and range. Contact your Rosemount representative.</i>
C6	CSA Explosion-Proof and Intrinsic Safety Approval
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals
I7	SAA Intrinsic Safety Certification
E4	JIS Flame-Proof Certification <i>NOTE: Not available with low-power Option Code M.</i>
E7	SAA Flame-Proof Certification
N7	SAA Type n Certification
I1	CENELEC Intrinsic Safety and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>
N1	CENELEC Type nL and Dust Certification <i>NOTE: Not available with low-power Option Code M.</i>
E8	CENELEC Flame-Proof and Dust Certification
DW	NSF drinking water approval
Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option applies to the process connection only.</i>
QP	Calibration certification and tamper evident seal
QS	Quality certification for safety
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)
M6	LCD display for SST Housing (Housing Codes J, K, L and M only)
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6 or K8.</i>
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Low Alarm Configuration <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
P1	Hydrostatic Testing
P2	Cleaning for Special Service
P3	Cleaning for <1 PPM Chlorine/Fluorine
V5 ⁽¹⁾	External Ground Screw Assembly
Typical Model Number: 3051T G 5 F 2A 2 1 A B4	

(1) The V5 option is not needed with T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type		
3051L	Flange-Mounted Liquid Level Transmitter		
Code	PRESSURE RANGES (RANGE/MIN. SPAN)		
2	-250 to 250 inH ₂ O/2.5 inH ₂ O (-0,6 to 0,6 bar/6,2 mbar)		
3	-1000 to 1000 inH ₂ O/10 inH ₂ O (-2,5 to 2,5 bar/25 mbar)		
4	-300 to 300 psi/3 psi (-20,7 to 20,7 bar/0,2 bar)		
Code	Output		
A	4-20 mA with Digital Signal Based on <i>HART</i> Protocol		
M	Low-Power 1-5 V dc with Digital Signal Based on <i>HART</i> Protocol (See Option Code C2 for 0.8-3.2 V dc Output)		
<i>NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.</i>			
HIGH PRESSURE SIDE			
Code	Diaphragm Size	Material	Extension Length
G0	2 in./DN 50	316L SST	Flush Mount Only
H0	2 in./DN 50	<i>Hastelloy</i>	Flush Mount Only
J0	2 in./DN 50	Tantalum	Flush Mount Only
A0	3 in./DN 80	316L SST	Flush Mount
A2	3 in./DN 80	316L SST	2 in./50 mm
A4	3 in./DN 80	316L SST	4 in./100 mm
A6	3 in./DN 80	316L SST	6 in./150 mm
B0	4 in./DN 100	316L SST	Flush Mount
B2	4 in./DN 100	316L SST	2 in./50 mm
B4	4 in./DN 100	316L SST	4 in./100 mm
B6	4 in./DN 100	316L SST	6 in./150 mm
C0	3 in./DN 80	<i>Hastelloy</i>	Flush Mount
C2	3 in./DN 80	<i>Hastelloy</i>	2 in./50 mm
C4	3 in./DN 80	<i>Hastelloy</i>	4 in./100 mm
C6	3 in./DN 80	<i>Hastelloy</i>	6 in./150 mm
D0	4 in./DN 100	<i>Hastelloy</i>	Flush Mount
D2	4 in./DN 100	<i>Hastelloy</i>	2 in./50 mm
D4	4 in./DN 100	<i>Hastelloy</i>	4 in./100 mm
D6	4 in./DN 100	<i>Hastelloy</i>	6 in./150 mm
E0	3 in./DN 80	Tantalum	Flush Mount Only
F0	4 in./DN 100	Tantalum	Flush Mount Only
Continued on next page			

Model 3051

MOUNTING FLANGE				
Code	Size	ASME B 16.5 (ANSI) or DIN Flange Rating	Material	
M	2 in.	Class 150	CS	
A	3 in.	Class 150	CS	
B	4 in.	Class 150	CS	
N	2 in.	Class 300	CS	
C	3 in.	Class 300	CS	
D	4 in.	Class 300	CS	
P	2 in.	Class 600	CS	
E	3 in.	Class 600	CS	
X	2 in.	Class 150	SST	
F	3 in.	Class 150	SST	
G	4 in.	Class 150	SST	
Y	2 in.	Class 300	SST	
H	3 in.	Class 300	SST	
J	4 in.	Class 300	SST	
Z	2 in.	Class 600	SST	
L	3 in.	Class 600	SST	
Q	DN 50	PN 10-40	CS	
R	DN 80	PN 40	CS	
S	DN 100	PN 40	CS	
V	DN 100	PN 10/16	CS	
K	DN 50	PN 10-40	SST	
T	DN 80	PN 40	SST	
U	DN 100	PN 40	SST	
W	DN 100	PN 10/16	SST	
Code	Process Fill-High Pressure Side	Temperature Limits		
A	<i>Syltherm XLT</i>	-100 to 300 °F (-73 to 135 °C)		
C	<i>D. C. Silicone 704</i>	60 to 400 °F (15 to 205 °C)		
D	<i>D. C. Silicone 200</i>	-40 to 400 °F (-40 to 205 °C)		
H	Inert (Halocarbon)	-50 to 350 °F (-45 to 177 °C)		
G	Glycerine and Water	0 to 200 °F (-17 to 93 °C)		
N	<i>Neobee M-20</i>	0 to 400 °F (-17 to 205 °C)		
P	Propylene Glycol and Water	0 to 200 °F (-17 to 93 °C)		
LOW PRESSURE SIDE				
Code	Configuration	Flange Adapter	Diaphragm Material	Sensor Fill Fluid
11	Gage	SST	316L SST	Silicone
21	Differential	SST	316L SST	Silicone
22	Differential	SST	<i>Hastelloy C-276</i>	Silicone
2A	Differential	SST	316L SST	Inert (Halocarbon)
2B	Differential	SST	<i>Hastelloy C-276</i>	Inert (Halocarbon)
31	Remote Seal	SST	316L SST	Silicone (Requires Option Code S1)
Code	O-ring Material			
A	Glass-filled TFE			

Continued on next page

Reference Manual

00809-0100-4001, Rev EA

December 2002

Model 3051

Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½
Code Diaphragm Seal Assemblies (Optional)		
S1	One Diaphragm Seal (requires low pressure side Option Code 31 capillary connection type)	
Code Product Certification Options		
Hazardous Locations Certifications		
E5	FM Explosion-Proof Approval	
I5	FM Non-incendive and Intrinsic Safety Approval	
K5	FM Explosion-Proof and Intrinsic Safety Approval	
I1	CENELEC Intrinsic Safety and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
N1	CENELEC Type n and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
E8	CENELEC Flame-Proof and Dust Certification	
E4	JIS Flame-Proof Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	
C6	CSA Explosion-Proof and Intrinsic Safety Approval	
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval <i>NOTE: Not available with low-power Option Code M.</i>	
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals <i>NOTE: Not available with low-power Option Code M.</i>	
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	
I7	SAA Intrinsic Safety Certification	
E7	SAA Flame-Proof Certification	
N7	SAA Type n Certification	
Code Bolt for Flange and Adapters (Optional)		
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts (Austenitic 316 SST bolts standard)	
Code LCD Display Options		
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	
Continued on next page		

Model 3051

Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This options is available with the diaphragm, upper housing, Coplanar flange, adapter, sensor module housing, lower housing/flushing connection, and extension.</i>
QP	Calibration certification and tamper evident seal
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.</i>
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>
D8	Ceramic Ball Drain/Vents
V5 ⁽¹⁾	External Ground Screw Assembly

Lower Housing Flushing Connections

Code	Ring Material	Number	Size	Diaphragm Size		
				2 in.	3 in.	4 in.
F1	SST	1	¼	•	•	•
F2	SST	2	¼	•	•	•
F3	Hastelloy	1	¼	•	•	•
F4	Hastelloy	2	¼	•	•	•
F7	SST	1	½	•	•	•
F8	SST	2	½	•	•	•
F9	Hastelloy	1	½	•	•	•
F0	Hastelloy	2	½	•	•	•

NOTE: Flushing Codes F3 and F4 are not available with Option Codes A0, B0, and G0.

Typical Model Number:

(1) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type (Select One)	Available		
		HD	HG	
3051HD	Differential Pressure Transmitter for High-Temperature Processes	•	—	
3051HG	Gage Pressure Transmitter for High-Temperature Processes	—	•	
Code	3051HD	3051HG		
2	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)	–250 to 250 inH ₂ O/2.5 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)		
3	–1000 to 1000 inH ₂ O/10 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000 inH ₂ O/10in H ₂ O (–1,01 to 2,5 bar/25 mbar)		
4	–300 to 300 inH ₂ O/3 psi (–747 to 747 mbar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)		
5	–2000 to 2000 psi/20 psi (–138 to 138 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 138 bar/1,4 bar)		
<i>NOTE: 3051HG lower range limit varies with atmospheric pressure.</i>				
Code	Output	HD	HG	
A	4–20 mA with Digital Signal Based on HART Protocol	•	•	
M	Low-Power 1–5 V dc with Digital Signal Based on HART Protocol (See Option Code C2 for 0.8–3.2 V dc Output)	•	•	
<i>NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.</i>				
Code	PROCESS CONNECTION		HD	HG
	Process Flange Material	Drain/Vent		
2	SST	SST	•	•
7	SST	Hastelloy	•	•
<i>NOTE: Process Connection Code 7 meets NACE material recommendations per MR 01-75.</i>				
Code	Process Isolating Diaphragm		HD	HG
2	316L SST		•	•
3	Hastelloy C-276 (Meets NACE material recommendations per MR 01-75)		•	•
5	Tantalum		•	•
Code	O-ring Material		HD	HG
A	Glass-Filled TFE		•	•
Code	Process Fill Fluid		HD	HG
D	D.C. 200 Silicone		•	•
H	Inert		•	•
N	Neobee M-20		•	•
Code	Sensor Module Isolator Material		HD	HG
2	SST		•	•
Code	Sensor Module Fill Fluid		HD	HG
1	Silicone		•	•
2	Inert (Halocarbon)		•	•
Code	Housing Material	Conduit Entry Size	HD	HG
A	Polyurethane-covered Aluminum	½–14 NPT	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•
D	Polyurethane-covered Aluminum	G½	•	•
J	SST	½–14 NPT	•	•
K	SST	M20 × 1.5 (CM20)	•	•
L	SST	PG 13.5	•	•
M	SST	G½	•	•

Continued on next page

Model 3051

Code	Integral Mount Primary Elements (Optional)	HD	HG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annubar/Model 1195 Integral Orifice) <i>NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.</i>	•	—
Code	Mounting Bracket Options	HD	HG
B5	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, CS Bolts	•	•
B6	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, SST Bolts	•	•
Code	Product Certification Options	HD	HG
Hazardous Locations Certifications			
E5	FM Explosion-Proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion-Proof and Intrinsic Safety Approval	•	•
I1	CENELEC Intrinsic Safety and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
N1	CENELEC Type n and Dust Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
E8	CENELEC Flame-Proof and Dust Certification	•	•
E4	JIS Flame-Proof Certification (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
C6	CSA Explosion-Proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals (<i>NOTE: Not available with low-power Option Code M.</i>)	•	•
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flame-Proof Certification	•	•
N7	SAA Type n Certification	•	•
Code	Bolt for Flange and Adapter Options	HD	HG
L4	Austenitic 316 SST Bolts	•	•
Code	LCD Display Options	HD	HG
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•
Code	Other Options	HD	HG
Q4	Calibration Data Sheet	•	•
Q8	Material traceability certification per EN 10204 3.1.B	•	•
QP	Calibration certification and tamper evident seal	•	•
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.</i>	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C2	0.8–3.2 V dc Output with Digital Signal Based on HART Protocol (Output Code M only)	•	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
DF	1/2–14 NPT flange adapters—SST	•	•
D8	Ceramic Ball Drain/Vents	•	•
V5 ⁽¹⁾	External Ground Screw Assembly	•	•
Typical Model Number: 3051HG 2 A 2 2 A H 2 1 A B5			

(1) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type (Select One)	PD	PG		
3051PD	Model 3051P <i>Reference Class</i> Differential Pressure Transmitter	•	—		
3051PG	Model 3051 P <i>Reference Class</i> Gage Pressure Transmitter	—	•		
Pressure Ranges (Range/Min. Span)					
Code	Model 3051 PD	Model 3051 PG			
2	–250 to 250 inH ₂ O/25 inH ₂ O (–0,62 to 0,62 bar/62,3 mbar)	–250 to 250 inH ₂ O/25 inH ₂ O (–0,62 to 0,62 bar/6,2 mbar)	• •		
3	–1000 to 1000 inH ₂ O/100 inH ₂ O (–2,5 to 2,5 bar/25 mbar)	–407 to 100 inH ₂ O/100 in H ₂ O (–1,01 to 2,5 bar/250 mbar)	• •		
4	Not Applicable	–14.7 to 30 psi/30 psi (–1,01 to 20,7 bar/207 mbar)	— •		
5	Not Applicable	–14.7 to 200 psig/200 psi (–1,01 to 138 bar/1,4 bar)	— •		
<i>NOTE: 3051PG lower range limit varies with atmospheric pressure.</i>					
Code	Output	PD	PG		
A	4–20 mA with Digital Signal Based on <i>HART</i> Protocol	•	•		
MATERIALS OF CONSTRUCTION					
Code	Process Flange Type	Flange Material	Drain/Vent	PD	PG
2	<i>Coplanar</i>	SST	SST	•	•
0 ⁽¹⁾	Alternate Flange—See Alternate Flange Options page A-33.			•	•
Code	Isolating Diaphragm			PD	PG
2	316L SST			•	•
Code	O-ring Material			PD	PG
A	Glass-Filled TFE			•	•
Code	Fill Fluid			PD	PG
1	Silicone			•	•
2	Inert (Halocarbon)			•	•
Code	Housing Material	Conduit Entry Size		PD	PG
A	Polyurethane-covered Aluminum	½–14 NPT		•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)		•	•
C	Polyurethane-covered Aluminum	PG 13.5		•	•
D	Polyurethane-covered Aluminum	G½		•	•
J	SST	½–14 NPT		•	•
K	SST	M20 × 1.5 (CM20)		•	•
L	SST	PG 13.5		•	•
M	SST	G½		•	•
Code	Alternate Flange Options (Requires Materials of Construction Code 0)			PD	PG
H2	Traditional Flange, 316 SST Drain/Vent, SST Flange Adapter			•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount			•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount			•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount			•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount			•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount			•	•
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount			•	•
Code	Integral Mount Manifold Options			PD	PG
S5	Assemble to Model 305 Integral Manifold			•	•
Code	Integral Mount Primary Elements (Optional)			PD	PG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annubar/Model 1195 Integral Orifice)			•	—
<i>NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 2–3 transmitters only.</i>					

Continued on next page

Model 3051

Code	Mounting Bracket Options	PD	PG
B4	Coplanar Flange Bracket for 2-in. Pipe or Panel Mounting, All SST	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	•	•
B7	B1 Bracket with Series 300 SST Bolts	•	•
B8	B2 Bracket with Series 300 SST Bolts	•	•
BA	SST B1 Bracket with Series 300 SST Bolts	•	•
BC	SST B3 Bracket with Series 300 SST Bolts	•	•
Code	Product Certification Options		
Hazardous Locations Certifications			
E5	FM Explosion-Proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion-Proof and Intrinsic Safety Approval	•	•
I1	CENELEC Intrinsic Safety and Dust Certification	•	•
N1	CENELEC Type n and Dust Certification	•	•
E8	CENELEC Flame-Proof and Dust Certification	•	•
E4	JIS Flame-Proof Certification	•	•
C6	Canadian Standards Association (CSA) Explosion-Proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval	•	•
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals	•	•
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flame-Proof Certification	•	•
N7	SAA Type n Certification	•	•
Code	Other Options		
Q4	Calibration Data Sheet	•	
Q8	Material Traceability Certification per EN 10204 3.1.B <i>NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters.</i>	•	•
QP	Calibration Certification and Tamper Evident Seal	•	•
L4	Austenitic 316 SST Bolts	•	•
L5	ANSI/ASTM-A-193-B7M Bolts	•	•
L6	Monel Bolts	•	•
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•
J1	Local Zero Adjustment Only <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
J3	No Local Zero or Span Adjustment <i>NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.</i>	•	•
T1	Transient Protection Terminal Block <i>NOTE: Not available with hazardous locations certification Option Code I1.</i>	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration—Low <i>NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.</i>	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
P4	Calibrate at line pressure <i>NOTE: Specify Q48 on order for corresponding certificate.</i>	•	•
DF	1/2–14 NPT flange adapters—SST	•	•
D7	Coplanar Flange Without Drain/Vent Ports	•	•
V5 ⁽²⁾	External Ground Screw Assembly	•	•
Typical Model Number: 3051PD 3 A 2 2 A 1 A B4			

(1) *NOTE: May impact temperature performance under certain conditions.*

(2) *The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.*

PARTS LIST

Item numbers are references to figure callouts (pages 13–19).

Model 3051C Sensor Modules (Min. Span/Range)	Silicone Fill Part Number	Inert Fill Part Number
<i>Note: One spare part is recommended for every 50 transmitters.</i>		
<i>Note: Listed by Range and Process Isolator Order Numbers.</i>		
–3 to 3/0.1 inH₂O, Range 0 (includes Traditional SST flange and SST bolts).		
316L SST	03031-1045-0002	03031-1145-0002
–25 to 25 inH₂O/0.5 inH₂O, Range 1		
316L SST	03031-1045-0012	03031-1145-0012
Hastelloy C-276	03031-1045-0013	03031-1145-0013
Monel	03031-1045-0014	03031-1145-0014
Gold-plated Monel	03031-1045-0016	03031-1145-0016
Gold-plated 316 SST	03031-1045-0017	03031-1145-0017
–250 to 250 inH₂O/2.5 inH₂O, Range 2		
316L SST	03031-1045-0022	03031-1145-0022
Hastelloy C-276	03031-1045-0022	03031-1145-0022
Monel	03031-1045-0024	03031-1145-0024
Tantalum	03031-1045-0025	03031-1145-0025
Gold-plated Monel	03031-1045-0026	03031-1145-0026
Gold-plated 316 SST	03031-1045-0027	03031-1145-0027
–1000 to 1000 inH₂O/10 inH₂O, Range 3		
316L SST	03031-1045-0032	03031-1145-0032
Hastelloy C-276	03031-1045-0033	03031-1145-0033
Monel	03031-1045-0034	03031-1145-0034
Tantalum	03031-1045-0035	03031-1145-0035
Gold-plated Monel	03031-1045-0036	03031-1145-0036
Gold-plated 316 SST	03031-1045-0037	03031-1145-0037
–300 to 300 psi/3 psi, Range 4		
316L SST	03031-1045-2042	03031-1145-2042
Hastelloy C-276	03031-1045-2043	03031-1145-2043
Monel	03031-1045-2044	03031-1145-2044
Tantalum	03031-1045-2045	03031-1145-2045
Gold-plated Monel	03031-1045-2046	03031-1145-2046
Gold-plated 316 SST	03031-1045-2047	03031-1145-2047
–2000 to 2000/20 psi, Range 5		
316L SST	03031-1045-2052	03031-1145-2052
Hastelloy C-276	03031-1045-2053	03031-1145-2053
Monel	03031-1045-2054	03031-1145-2054
Tantalum	03031-1045-2055	03031-1145-2055
Gold-plated Monel	03031-1045-2056	03031-1145-2056
Gold-plated 316 SST	03031-1045-2057	03031-1145-2057

Model 3051

Model 3051C Gage Modules (Min. Span/Range)	Silicone Fill Part Number	Inert Fill Part Number
<i>Note: One spare part is recommended for every 50 transmitters.</i>		
<i>Note: Listed by Range and Process Isolator Order Numbers.</i>		
-250 to 250 inH₂O/2.5 inH₂O, Range 2		
316L SST	03031-1045-0022	03031-1145-0022
<i>Hastelloy C-276</i>	03031-1045-0023	03031-1145-0023
<i>Monel</i>	03031-1045-0024	03031-1145-0024
Tantalum	03031-1045-0025	03031-1145-0025
Gold-plated <i>Monel</i>	03031-1045-0026	03031-1145-0026
Gold-plated 316 SST	03031-1045-0027	03031-1145-0027
-335 to 1000 inH₂O/10 inH₂O, Range 3		
316L SST	03031-1045-0032	03031-1145-0032
<i>Hastelloy C-276</i>	03031-1045-0033	03031-1145-0033
<i>Monel</i>	03031-1045-0034	03031-1145-0034
Tantalum	03031-1045-0035	03031-1145-0035
Gold-plated <i>Monel</i>	03031-1045-0036	03031-1145-0036
Gold-plated 316 SST	03031-1045-0037	03031-1145-0037
-12 to 300 psi/3 psi, Range 4		
316L SST	03031-1045-1042	03031-1145-1042
<i>Hastelloy C-276</i>	03031-1045-1043	03031-1145-1043
<i>Monel</i>	03031-1045-1044	03031-1145-1044
Tantalum	03031-1045-1045	03031-1145-1045
Gold-plated <i>Monel</i>	03031-1045-1046	03031-1145-1046
Gold-plated 316 SST	03031-1045-1047	03031-1145-1047
-12 to 2000 psi/20 psi, Range 5		
316L SST	03031-1045-1052	03031-1145-1052
<i>Hastelloy C-276</i>	03031-1045-1053	03031-1145-1053
<i>Monel</i>	03031-1045-1054	03031-1145-1054
Tantalum	03031-1045-1055	03031-1145-1055
Gold-plated <i>Monel</i>	03031-1045-1056	03031-1145-1056
Gold-plated 316 SST	03031-1045-1057	03031-1145-1057

Model 3051C Absolute Sensor Modules (Min. Span/Range)	Silicone Fill	Inert Fill
	Part Number	Part Number
<i>Note: One spare part is recommended for every 50 transmitters.</i>		
<i>Note: Listed by Range and Process Isolator Order Numbers.</i>		
0 to 0.167 psia/5 psia, Range 0 (includes Traditional SST flange and SST bolts).		
316L SST	03031-2020-0002	—
Hastelloy C-276	03031-2020-0003	—
Monel	03031-2020-0004	—
Gold-plated Monel	03031-2020-0006	—
Gold-plated 316 SST	03031-2020-0007	—
0 to 30 psia/0.3 psia, Range 1		
316L SST	03031-2020-0012	—
Hastelloy C-276	03031-2020-0013	—
Monel	03031-2020-0014	—
Gold-plated Monel	03031-2020-0016	—
Gold-plated 316 SST	03031-2020-0017	—
0 to 150/1.5 psia, Range 2		
316L SST	03031-2020-0022	—
Hastelloy C-276	03031-2020-0023	—
Monel	03031-2020-0024	—
Gold-plated Monel	03031-2020-0026	—
Gold-plated 316 SST	03031-2020-0027	—
0 to 800 psia/8 psia, Range 3		
316L SST	03031-2020-0032	—
Hastelloy C-276	03031-2020-0033	—
Monel	03031-2020-0034	—
Gold-plated Monel	03031-2020-0036	—
Gold-plated 316 SST	03031-2020-0037	—

Model 3051T Sensor Modules ⁽¹⁾	Isolating Diaphragm	Housing Material	Silicone Fill	Inert Fill
			Part Number	Part Number
Gage Sensor Module ⁽²⁾				
0–0.3/30 psig, Range 1				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3112	03031-3112-1112
1/4–18 NPT Female	Hastelloy C	Aluminum	03031-3112-3113	03031-3112-1113
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3112	03031-3102-1112
1/2–14 NPT Female	Hastelloy C	Aluminum	03031-3102-3113	03031-3102-1113
G1/2A DIN 16288 Male	316L SST	Aluminum	03031-3132-3112	03031-3132-1112
1/4–18 NPT Female	316L SST	SST	03031-3111-3112	03031-3111-1112
1/4–18 NPT Female	Hastelloy C	SST	03031-3111-3113	03031-3111-1113
1/2–14 NPT Female	316L SST	SST	03031-3101-3112	03031-3101-1112
1/2–14 NPT Female	Hastelloy C	SST	03031-3101-3113	03031-3101-1113

Model 3051

Model 3051T Sensor Modules ⁽¹⁾	Isolating Diaphragm	Housing Material	Silicone Fill	Inert Fill
			Part Number	Part Number
Gage Sensor Module(2) 0–1.5/150 psig, Range 2				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3122	03031-3112-1122
1/4–18 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3112-3123	03031-3112-1123
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3122	03031-3102-1122
1/2–14 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3102-3123	03031-3102-1123
G ¹ / ₂ A DIN 16288 Male	316L SST	Aluminum	03031-3132-3122	03031-3132-1122
1/4–18 NPT Female	316L SST	SST	03031-3111-3122	03031-3111-1122
1/4–18 NPT Female	<i>Hastelloy C</i>	SST	03031-3111-3123	03031-3111-1123
1/2–14 NPT Female	316L SST	SST	03031-3101-3122	03031-3101-1122
1/2–14 NPT Female	<i>Hastelloy C</i>	SST	03031-3101-3123	03031-3101-1123
Gage Sensor Module(2) 0–8/800 psig, Range 3				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3132	03031-3112-1132
1/4–18 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3112-3133	03031-3112-1133
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3132	03031-3102-1132
1/2–14 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3102-3133	03031-3102-1133
G ¹ / ₂ A DIN 16288 Male	316L SST	Aluminum	03031-3132-3132	03031-3132-1132
1/4–18 NPT Female	316L SST	SST	03031-3111-3132	03031-3111-1132
1/4–18 NPT Female	<i>Hastelloy C</i>	SST	03031-3111-3133	03031-3111-1133
1/2–14 NPT Female	316L SST	SST	03031-3101-3132	03031-3101-1132
1/2–14 NPT Female	<i>Hastelloy C</i>	SST	03031-3101-3133	03031-3101-1133
Gage Sensor Module(2) 0–40/4000 psig, Range 4				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3142	03031-3112-1142
1/4–18 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3112-3143	03031-3112-1143
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3142	03031-3102-1142
1/2–14 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3102-3143	03031-3102-1143
G ¹ / ₂ A DIN 16288 Male	316L SST	Aluminum	03031-3132-3142	03031-3132-1142
1/4–18 NPT Female	316L SST	SST	03031-3111-3142	03031-3111-1142
1/4–18 NPT Female	<i>Hastelloy C</i>	SST	03031-3111-3143	03031-3111-1143
1/2–14 NPT Female	316L SST	SST	03031-3101-3142	03031-3101-1142
1/2–14 NPT Female	<i>Hastelloy C</i>	SST	03031-3101-3143	03031-3101-1143
Absolute Sensor Module(2) 0–0.3/30 psig, Range 1				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3012	03031-3112-1012
1/4–18 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3112-3013	03031-3112-1013
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3012	03031-3102-1012
1/2–14 NPT Female	<i>Hastelloy C</i>	Aluminum	03031-3102-3013	03031-3102-1013
G ¹ / ₂ A DIN 16288 Male	316L SST	Aluminum	03031-3132-3012	03031-3132-1012
1/4–18 NPT Female	316L SST	SST	03031-3111-3012	03031-3111-1012
1/4–18 NPT Female	<i>Hastelloy C</i>	SST	03031-3111-3013	03031-3111-1013
1/2–14 NPT Female	316L SST	SST	03031-3101-3012	03031-3101-1012
1/2–14 NPT Female	<i>Hastelloy C</i>	SST	03031-3101-3013	03031-3101-1013

Reference Manual

00809-0100-4001, Rev EA

December 2002

Model 3051

Model 3051T Sensor Modules ⁽¹⁾	Isolating Diaphragm	Housing Material	Silicone Fill	Inert Fill
			Part Number	Part Number
Absolute Sensor Module(2) 0–1.5/150 psig, Range 2				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3022	03031-3112-1022
1/4–18 NPT Female	Hastelloy C	Aluminum	03031-3112-3023	03031-3112-1023
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3022	03031-3102-1022
1/2–14 NPT Female	Hastelloy C	Aluminum	03031-3102-3023	03031-3102-1023
G1/2A DIN 16288 Male	316L SST	Aluminum	03031-3132-3022	03031-3132-1022
1/4–18 NPT Female	316L SST	SST	03031-3111-3022	03031-3111-1022
1/4–18 NPT Female	Hastelloy C	SST	03031-3111-3023	03031-3111-1023
1/2–14 NPT Female	316L SST	SST	03031-3101-3022	03031-3101-1022
1/2–14 NPT Female	Hastelloy C	SST	03031-3101-3023	03031-3101-1023
Absolute Sensor Module(2) 0–8/800 psig, Range 3				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3032	03031-3112-1032
1/4–18 NPT Female	Hastelloy C	Aluminum	03031-3112-3033	03031-3112-1033
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3032	03031-3102-1032
1/2–14 NPT Female	Hastelloy C	Aluminum	03031-3102-3033	03031-3102-1033
G1/2A DIN 16288 Male	316L SST	Aluminum	03031-3132-3032	03031-3132-1032
1/4–18 NPT Female	316L SST	SST	03031-3111-3032	03031-3111-1032
1/4–18 NPT Female	Hastelloy C	SST	03031-3111-3033	03031-3111-1033
1/2–14 NPT Female	316L SST	SST	03031-3101-3032	03031-3101-1032
1/2–14 NPT Female	Hastelloy C	SST	03031-3101-3033	03031-3101-1033
Absolute Sensor Module(2) 0-40/4000 psig, Range 4				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3042	03031-3112-1042
1/4–18 NPT Female	Hastelloy C	Aluminum	03031-3112-3043	03031-3112-1043
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3042	03031-3102-1042
1/2–14 NPT Female	Hastelloy C	Aluminum	03031-3102-3043	03031-3102-1043
G1/2A DIN 16288 Male	316L SST	Aluminum	03031-3132-3042	03031-3132-1042
1/4–18 NPT Female	316L SST	SST	03031-3111-3042	03031-3111-1042
1/4–18 NPT Female	Hastelloy C	SST	03031-3111-3043	03031-3111-1043
1/2–14 NPT Female	316L SST	SST	03031-3101-3042	03031-3101-1042
1/2–14 NPT Female	Hastelloy C	SST	03031-3101-3043	03031-3101-1043
Absolute Sensor Module(2) 0-2000/10000 psig, Range 5				
1/4–18 NPT Female	316L SST	Aluminum	03031-3112-3052	03031-3112-1052
1/4–18 NPT Female	Hastelloy C	Aluminum	03031-3112-3053	03031-3112-1053
1/2–14 NPT Female	316L SST	Aluminum	03031-3102-3052	03031-3102-1052
1/2–14 NPT Female	Hastelloy C	Aluminum	03031-3102-3053	03031-3102-1053
G1/2A DIN 16288 Male	316L SST	Aluminum	03031-3122-3052	03031-3122-1052
1/4–18 NPT Female	316L SST	SST	03031-3111-3052	03031-3111-1052
1/4–18 NPT Female	Hastelloy C	SST	03031-3111-3053	03031-3111-1053
1/2–14 NPT Female	316L SST	SST	03031-3101-3052	03031-3101-1052
1/2–14 NPT Female	Hastelloy C	SST	03031-3121-3053	03031-3121-1053

(1) For Model 3051TG Range 5 spare module, order absolute configuration and perform zero trim for gage calibrations.

(2) One spare part is recommended for every 50 transmitters.

Model 3051

PART DESCRIPTION	PART NUMBER	CD	CG	CA	L	H	T
Electronics Board—Assembly Required							
<i>Improved Standard (4–20 mA/HART protocol)⁽¹⁾</i>	03031-0001-0002	•	•	•	•	•	•
<i>Improved NAMUR Compliant (4–20 mA/HART protocol)⁽¹⁾</i>	03031-0001-0003	•	•	•	•	•	•
<i>Low Power (1–5/0.8–3.2 Volts)⁽¹⁾</i>	03031-0001-1001	•	•	•	•	•	•
Electronics Housing, Covers, Terminal Block							
<i>NOTE: See drawings below for Previous and Improved Electronics Boards, Housings, and Terminal Blocks. For information on ordering “Previous Design” spare parts, contact your local Rosemount office. In the U.S., call the Response Center at 1-800-654-7768.</i>							
Improved Standard (4–20 mA) Aluminum Housing							
Electronics Housing without terminal block							
½–14 NPT conduit, Includes RFI Filters	03031-0635-0001	•	•	•	•	•	•
M20×1.5 (CM20) conduit, Includes RFI filters	03031-0635-0002	•	•	•	•	•	•
PG 13.5 conduit, Includes RFI Filters	03031-0635-0003	•	•	•	•	•	•
G½ conduit, Includes RFI Filters	03031-0635-0004	•	•	•	•	•	•
Electronics Cover (Includes wiring label) ⁽²⁾	03031-0292-0001	•	•	•	•	•	•
Standard Terminal Block Assembly ⁽¹⁾	03031-0332-0003	•	•	•	•	•	•
Transient Terminal Block Assy. (Option T1) ⁽²⁾	03031-0332-0004	•	•	•	•	•	•
Local Zero and Span Kit ⁽¹⁾	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5) ⁽¹⁾	03031-0398-0001	•	•	•	•	•	•
Improved Standard (4–20 mA) 316 SST Housing							
Electronics Housing without Terminal Block							
½–14 NPT conduit, Includes RFI Filters	03031-0635-0041	•	•	•	•	•	•
M20×1.5 (CM20) conduit, Includes RFI Filters	03031-0635-0042	•	•	•	•	•	•
PG 13.5 conduit, Includes RFI Filters	03031-0635-0043	•	•	•	•	•	•
Electronics Cover (Includes wiring label) ⁽²⁾	03031-0292-0002	•	•	•	•	•	•
Standard Terminal Block Assembly ⁽¹⁾	03031-0332-0003	•	•	•	•	•	•
Transient Terminal Block Assy. (Option T1) ⁽²⁾	03031-0332-0004	•	•	•	•	•	•
Local Zero and Span Kit ⁽¹⁾	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5) ⁽¹⁾	03031-0398-0001	•	•	•	•	•	•
Improved Low Power Aluminum Housing							
Electronics Housing without Terminal Block							
½–14 NPT conduit, Includes RFI Filters	03031-0635-0101	•	•	•	•	•	•
Electronics Cover (Includes wiring label) ⁽²⁾	03031-0292-0001	•	•	•	•	•	•
Low Power Terminal Block Assembly ⁽¹⁾	03031-0332-1001	•	•	•	•	•	•
Low Power Transient Terminal Block Assembly (Option T1) ⁽²⁾	03031-0332-1002	•	•	•	•	•	•
Local Zero and Span Kit ⁽¹⁾	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5) ⁽¹⁾	03031-0398-0001	•	•	•	•	•	•
Improved Low Power 316 SST Housing							
Electronics Housing without Terminal Block							
½–14 NPT conduit, Includes RFI Filters	03031-0635-0141	•	•	•	•	•	•
Electronics Cover (Includes wiring label) ⁽²⁾	03031-0292-0002	•	•	•	•	•	•
Low Power Terminal Block Assembly ⁽¹⁾	03031-0332-1001	•	•	•	•	•	•
Low Power Transient Terminal Block Assembly (Option T1) ⁽²⁾	03031-0332-1002	•	•	•	•	•	•
Local Zero and Span Kit ⁽¹⁾	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5) ⁽¹⁾	03031-0398-0001	•	•	•	•	•	•

Flanges		CD	CG	CA	L	H	T
PROCESS FLANGES							
Differential Coplanar Flange							
Nickel-plated Carbon Steel	03031-0388-0025	•	—	—	—	—	—
316 SST	03031-0388-0022	•	—	—	—	—	—
<i>Hastelloy C</i>	03031-0388-0023	•	—	—	—	—	—
<i>Monel</i>	03031-0388-0024	•	—	—	—	—	—
Gage/Absolute Coplanar Flange							
Nickel-plated Carbon Steel	03031-0388-1025	—	•	•	—	—	—
316 SST	03031-0388-1022	—	•	•	—	—	—
<i>Hastelloy C</i>	03031-0388-1023	—	•	•	—	—	—
<i>Monel</i>	03031-0388-1024	—	•	•	—	—	—
Coplanar Flange Alignment Screw (package of 2 screws)	03031-0309-0001	•	•	•	—	—	—
Traditional Flange							
316 SST	03031-0320-0002	•	•	•	—	—	—
<i>Hastelloy C</i>	03031-0320-0003	•	•	•	—	—	—
<i>Monel</i>	03031-0320-0004	•	•	•	—	—	—
Level Flange, Vertical Mount							
2 in., Class 150, SST	03031-0393-0221	•	•	•	—	—	—
2 in., Class 300, SST	03031-0393-0222	•	•	•	—	—	—
3 in., Class 150, SST	03031-0393-0231	•	•	•	—	—	—
3 in., Class 300, SST	03031-0393-0232	•	•	•	—	—	—
DIN, DN 50, PN 40	03031-0393-1002	•	•	•	—	—	—
DIN, DN 80, PN 40	03031-0393-1012	•	•	•	—	—	—
Model 3051H Flanges							
Process Flange	02051-0072-0002	—	—	—	—	•	—
Blank Flange (GP Low Side)	02051-0236-0002	—	—	—	—	•	—
Flange Adapter Union		CD	CG	CA	L	H	T
Nickel-plated Carbon Steel	02024-0069-0005	•	•	•	—	—	—
316 SST	02024-0069-0002	•	•	•	—	—	—
<i>Hastelloy C</i>	02024-0069-0003	•	•	•	—	—	—
<i>Monel</i>	02024-0069-0004	•	•	•	—	—	—
Drain/Vent Valve Kits		CD	CG	CA	L	H	T
Differential Drain/Vent Kits(1)							
316 SST Stem and Seat Kit	01151-0028-0022	•	—	—	—	•	—
<i>Hastelloy C</i> Stem and Seat Kit	01151-0028-0023	•	—	—	—	•	—
<i>Monel</i> Stem and Seat Kit	01151-0028-0024	•	—	—	—	•	—
316 SST Ceramic Ball Drain/Vent Kit	01151-0028-0122	•	—	—	—	•	—
<i>Hastelloy C</i> Ceramic Ball Drain/Vent Kit	01151-0028-0123	•	—	—	—	•	—
<i>Monel</i> Ceramic Ball Drain/Vent Kit	01151-0028-0124	•	—	—	—	•	—
Gage/Absolute Drain/Vent Kits(1)							
316 SST Stem and Seat Kit	01151-0028-0012	—	•	•	•	•	—
<i>Hastelloy C</i> Stem and Seat Kit	01151-0028-0013	—	•	•	•	•	—
<i>Monel</i> Stem and Seat Kit	01151-0028-0014	—	•	•	•	•	—
316 SST Ceramic Ball Drain/Vent Kit	01151-0028-0112	—	•	•	•	•	—
<i>Hastelloy C</i> Ceramic Ball Drain/Vent Kit	01151-0028-0113	—	•	•	•	•	—
<i>Monel</i> Ceramic Ball Drain/Vent Kit	01151-0028-0114	—	•	•	•	•	—
<i>(Each kit contains parts for one transmitter.)</i>							

Model 3051

O-Ring Packages		CD	CG	CA	L	H	T
Electronic Housing, Cover (Std. and Meter) ⁽¹⁾	03031-0232-0001	•	•	•	•	•	•
Electronics Housing, Module ⁽¹⁾	03031-0233-0001	•	•	•	•	•	•
Process Flange, Glass-filled <i>Teflon</i> ⁽¹⁾	03031-0234-0001	•	•	•	—	—	—
Process Flange, Graphite-filled <i>Teflon</i>	03031-0234-0002	•	•	•	—	—	—
Flange Adapter, Glass-filled <i>Teflon</i> ⁽¹⁾	03031-0242-0001	•	•	•	—	—	—
Flange Adapter, Graphite-filled <i>Teflon</i>	03031-0242-0002	•	•	•	—	—	—
3051H Process Flange, TFE	02051-0167-0001	—	—	—	—	•	—
Mounting Brackets		CD	CG	CA	L	H	T
Coplanar Flange Bracket Kit							
B4 Bracket, SST, 2-in. Pipe Mount, SST Bolts	03031-0189-0003	•	•	•	—	—	—
3051T Bracket Kit							
B4 Bracket, SST, 2-in. Pipe Mount, SST Bolts	02088-0071-0001	—	—	—	—	—	•
Traditional Flange Bracket Kits							
B1 Bracket, 2-in. Pipe Mount, CS Bolts	03031-0313-0001	•	•	•	—	—	—
B2 Bracket, Panel Mount, CS Bolts	03031-0313-0002	•	•	•	—	—	—
B3 Flat Bracket for 2-in. Pipe Mount, CS Bolts	03031-0313-0003	•	•	•	—	—	—
B7 (B1 Style Bracket with SST Bolts)	03031-0313-0007	•	•	•	—	—	—
B8 (B2 Style Bracket with SST Bolts)	03031-0313-0008	•	•	•	—	—	—
B9 (B3 Style Bracket with SST Bolts)	03031-0313-0009	•	•	•	—	—	—
BA (SST B1 Bracket with SST Bolts)	03031-0313-0011	•	•	•	—	—	—
BC (SST B3 Bracket with SST Bolts)	03031-0313-0013	•	•	•	—	—	—
Model 3051H Bracket Kits							
B5 Universal Bracket for 2-in. Pipe and Panel Mount, CS Bolts	03051-1081-0001	—	—	—	—	•	—
B6 Universal Bracket for 2-in. Pipe or Panel Mount, SST Bolts	03051-1081-0002	—	—	—	—	•	—

Bolt Kits		CD	CG	CA	L	H	T
Coplanar Flange							
Flange Bolt Kit {44 mm (1.75 in.)}							
Carbon Steel (set of 4)	03031-0312-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0312-0002	•	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0312-0003	•	•	•	—	—	—
Monel	03031-0312-0004	•	•	•	—	—	—
Flange/Adapter Bolt Kit {73 mm (2.88 in.)}							
Carbon Steel (set of 4)	03031-0306-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0306-0002	•	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0306-0003	•	•	•	—	—	—
Monel	03031-0306-0004	•	•	•	—	—	—
Manifold/Flange Kit {57 mm (2.25 in.)}							
Carbon Steel (set of 4)	03031-0311-0001	•	—	—	—	—	—
316 SST (set of 4)	03031-0311-0002	•	—	—	—	—	—
ANSI/ASTM-A-193-B7M	03031-0311-0003	•	—	—	—	—	—
Monel	03031-0311-0004	•	—	—	—	—	—
Traditional Flange							
Differential Flange and Adapter Bolt Kit {44 mm (1.75 in.)}							
Carbon Steel (set of 8)	03031-0307-0001	•	—	—	—	—	—
316 SST (set of 8)	03031-0307-0002	•	—	—	—	—	—
ANSI/ASTM-A-193-B7M	03031-0307-0003	•	—	—	—	—	—
Monel	03031-0307-0004	•	—	—	—	—	—
Gage/Absolute Flange and Adapter Bolt Kit							
Carbon Steel (set of 6)	03031-0307-1001	—	•	•	—	—	—
316 SST (set of 6)	03031-0307-1002	—	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0307-1003	—	•	•	—	—	—
Monel	03031-0307-1004	—	•	•	—	—	—
Manifold/Traditional Flange Bolts							
Carbon Steel	Use bolts supplied with manifold						
316 SST	Use bolts supplied with manifold						
Level Flange, Vertical Mount							
Flange Bolt Kit							
Carbon Steel (set of 4)	03031-0395-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0395-0002	•	•	•	—	—	—
<i>(Each kit contains bolts for one transmitter.)</i>							
Model 3051H Flange							
Process Flange Bolt Kit, Carbon Steel	02051-0164-0001	—	—	—	—	•	—
FlangeBolt (set of 4)							
Flange Nut (set of 4)							
Adapter Bolts (set of 4)							
Other							
Process Flange Bolt Kit, 316 SST	02051-0164-0002	—	—	—	—	•	—
Bolt for Process Flange (set of 4)							
Nut for Process Flange (set of 4)							
Adapter Bolts (set of 4)							

(1) One spare part is recommended for every 25 transmitters.
 (2) One spare part is recommended for every 50 transmitters

Model 3051

Part Description	Part Number	CD	CG	CA	L	H	T
Meter for current Aluminum Housing							
<i>Meter Kit</i>	03031-0193-0101	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
<i>Meter Hardware Only</i>	03031-0193-0103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
<i>Cover Assembly Kit</i>	03031-0193-0002	•	•	•	•	•	•
Meter for current 316 SST Housing							
<i>Meter Kit</i> ⁽¹⁾	03031-0193-0111	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
<i>Meter Hardware Only</i>	03031-0193-0103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
<i>Cover Assembly Kit</i>	03031-0193-0012	•	•	•	•	•	•
Meter for Previous Aluminum Housing							
<i>Previous Meter Kit</i> ⁽¹⁾	03031-0193-0001	•	•	•	•	•	•
<i>NOTE: Previous Meter Kit includes meter display, captive mounting hardware, 6-pin interconnection header, and cover assembly.</i>							
<i>Improved Kit for Previous Aluminum Housing</i> ⁽¹⁾	03031-0193-1101	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
<i>Previous Meter Hardware Only</i> ⁽¹⁾	03031-0193-0003	•	•	•	•	•	•
<i>NOTE: Previous Meter Hardware includes meter display, captive mounting hardware, and 6-pin interconnection header only.</i>							
<i>Improved Meter for Previous Housing</i>	03031-0193-1103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
<i>Cover Assembly Kit</i>	03031-0193-0002	•	•	•	•	•	•
Meter for Previous 316 SST Housing							
<i>Previous Meter Kit</i> ⁽¹⁾	03031-0193-0011	•	•	•	•	•	•
<i>Improved Kit for Previous SST Housing</i> ⁽¹⁾	03031-0193-1111	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
<i>Previous Meter Hardware Only</i> ⁽¹⁾	03031-0193-0003	•	•	•	•	•	•
<i>Improved Meter for Previous Housing</i> ⁽¹⁾	03031-0193-1103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
<i>Cover Assembly Kit</i>	03031-0193-0012	•	•	•	•	•	•

OPTIONS

Standard Configuration

Unless otherwise specified, transmitter is shipped as follows:

ENGINEERING UNITS

Differential/Gage: inH₂O (Range 0, 1, 2, and 3) psi (Range 4 and 5)
Absolute/3051T: psi (all ranges)

4 mA (1 V dc): 0 (engineering units above)

20 mA (5 V dc): Upper range limit

Output: Linear

Flange type: Specified model code option

Flange material: Specified model code option

O-ring material: Specified model code option

Drain/vent: Specified model code option

Integral meter: Installed or none

Alarm: Upscale

Software tag: (Blank)

Custom Configuration HART protocol only (Option Code C1)

If Option Code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD Display Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the "HART Protocol C1 Option Configuration Data Sheet" on page 50.

Tagging

Three customer tagging options are available:

1. Standard SST hardware tag is wired to the transmitter. Tag character height is 0.125 in. (3,18 mm), 56 characters maximum.
2. Tag may be permanently stamped on transmitter nameplate upon request, 56 characters maximum.
3. Tag may be stored in transmitter memory (30 characters maximum). Software tag is left blank unless specified.

Optional Model 305 or Model 306 Integral Manifolds

Factory assembled to Model 3051C and Model 3051T transmitters. Refer to the following Rosemount document for more information: Product Data Sheet 00813-0100-4733

Optional Three-Valve Manifolds

(Packaged Separately)

Part No. 1151-0150-0001

3-Valve Manifold, Carbon Steel

Part No. 1151-0150-0002

3-Valve Manifold, 316 SST

Optional Diaphragm and Sanitary Seals

Refer to Product Data Sheet 00813-0100-4016 or 00813-0201-4016.

Output Information

Output range points must be the same unit of measure. Available units of measure include:

inH2O	inH2O@4 °C ⁽¹⁾	psi	Pa
inHg	ftH2O	bar	kPa
mmH2O	mmH2O@4 °C ⁽¹⁾	mbar	torr
mmHg	g/cm2	kg/cm2	atm

(1) Not available on low power or previous versions.

LCD Display

M5 Digital Meter, 5-Digit, 2-Line LCD

- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

M6 Digital Meter with 316 Stainless Steel Cover

- For use with stainless steel housing option (housing codes J, K, and L)

Local Span and Zero Adjustment

Transmitters ship with local span and zero adjustments standard unless otherwise specified.

- Non-interactive external zero and span adjustments ease calibration
- Magnetic switches replace standard potentiometer adjustments to optimize performance

J1 Local Zero Adjustment Only

J3 No Local Zero or Span Adjustment

Transient Protection

- Integral transient protection terminal block
- Meets IEEE Standard 587, Category B
1 kV crest (10 × 1 000 microseconds)
3 kV crest (8 × 20 microseconds)
6 kV crest (1.2 × 50 microseconds)
- Meets IEEE Standard 472,
Surge Withstand Capability
SWC 2,5 kV crest, 1 MHz wave form
- Applicable standards: 61000-4-4, 61000-4-5

T1 Integral Transient Protection Terminal Block

Bolts for Flanges and Adapters

- Options permit bolts for flanges and adapters to be obtained in various materials
- Standard material is plated carbon steel per ASTM A449, Type 1

L4 Austenitic 316 Stainless Steel Bolts

L5 ASTM-A-193-B7M Bolts

L6 Monel Bolts

Model 3051C/P Coplanar Flange and Model 3051T Bracket Option

B4 Bracket for 2-in. Pipe or Panel Mounting

- For use with the standard Coplanar flange configuration
- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

Model 3051H Bracket Options

B5 Bracket for 2-in. Pipe or Panel Mounting

- For use with the Model 3051H Pressure Transmitter for high process temperatures
- Carbon steel construction with carbon steel bolts

B6 B5 Bracket with SST Bolts

- Same bracket as the B5 option with Series 300 stainless steel bolts.

Traditional Flange Bracket Options

B1 Bracket for 2-in. Pipe Mounting

- For use with the traditional flange option
- Bracket for mounting on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B2 Bracket for Panel Mounting

- For use with the traditional flange option
- Bracket for mounting transmitter on wall or panel
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B3 Flat Bracket for 2-in. Pipe Mounting

- For use with the traditional flange option
- Bracket for vertical mounting of transmitter on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B7 B1 Bracket with SST Bolts

- Same bracket as the B1 option with Series 300 stainless steel bolts

B8 B2 Bracket with SST Bolts

- Same bracket as the B2 option with Series 300 stainless steel bolts

B9 B3 Bracket with SST Bolts

- Same bracket as the B3 option with Series 300 stainless steel bolts

BA Stainless Steel B1 Bracket with SST Bolts

- B1 bracket in stainless steel with Series 300 stainless steel bolts

BC Stainless Steel B3 Bracket with SST Bolts

- B3 bracket in stainless steel with Series 300 stainless steel bolts

Shipping Weights

Table A-4. Transmitter Weights without Options

Transmitter	Add Weight In lb (kg)
Model 3051C/P	6.0 (2,7)
Model 3051L	Table A-7 on page A-49
Model 3051H	13.6 (6,2)
Model 3051T	3.0 (1,4)

Table A-5. Model 3051L Weights without Options

Flange	Flush lb. (kg)	2-in. Ext. lb. (kg)	4-in. Ext. lb. (kg)	6-in. Ext. lb. (kg)
2-in., 150	12.5 (5,7)	—	—	—
3-in., 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., 300	17.5 (7,9)	—	—	—
3-in., 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
2-in., 600	15.3 (6,9)	—	—	—
3-in., 600	25.2 (11,4)	27.2 (12,3)	28.2 (12,8)	29.2 (13,2)
DN 50/PN 40	13.8 (6,2)	—	—	—
DN 80/PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

Table A-6. Transmitter Options Weights

Code	Option	Add lb. (kg)
J, K, L, M	Stainless Steel Housing(T)	3.9 (1,8)
J, K, L, M	Stainless Steel Housing (C, L, H, P)	3.1 (1,4)
M5	LCD Meter for Aluminum Housing	0.5 (0,2)
M6	LCD Meter for SST Housing	1.25 (0,6)
B4	SST Mounting Bracket for <i>Coplanar</i> Flange	1.0 (0,5)
B1 B2 B3	Mounting Bracket for Traditional Flange	2.3 (1,0)
B7 B8 B9	Mounting Bracket for Traditional Flange	2.3 (1,0)
BA, BC	SST Bracket for Traditional Flange	2.3 (1,0)
B5 B6	Mounting Bracket for Model 3051H	2.9 (1,3)
H2	Traditional Flange	2.4 (1,1)
H3	Traditional Flange	2.7 (1,2)
H4	Traditional Flange	2.6 (1,2)
H7	Traditional Flange	2.5 (1,1)
FC	Level Flange—3 in., 150	10.8 (4,9)
FD	Level Flange—3 in., 300	14.3 (6,5)
FA	Level Flange—2 in., 150	10.7 (4,8)
FB	Level Flange—2 in., 300	14.0 (6,3)
FP	DIN Level Flange, SST, DN 50, PN 40	8.3 (3,8)
FQ	DIN Level Flange, SST, DN 80, PN 40	13.7 (6,2)

LCD METER CONFIGURATION (Software Adjustable – M5 or M6 option must be specified in model number)

Meter Display Type⁽⁴⁾:

- | | |
|--|---|
| <input type="checkbox"/> Eng. Units only | <input type="checkbox"/> Alternate Eng. Units &% of Range ★ |
| <input type="checkbox"/> % of Range only | <input type="checkbox"/> Alternate Eng. Units & Custom Display ⁽⁵⁾ |
| <input type="checkbox"/> Custom Display only | <input type="checkbox"/> Alternate % of Range & Custom Display ⁽⁵⁾ |

Custom Display Configuration: (must be filled out if Custom Display is selected as meter type)

Decimal Point Position
 (fixed)— $X_{\square} X_{\square} X_{\square}^* X_{\square} X_{\square}$
 indicate decimal point location:

Enter Lower Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + - $\square_{\square} \square_{\square} \square_{\square} \square_{\square} \square_{\square} \square_{\square}$ +000.00 ★

Enter Upper Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + - $\square_{\square} \square_{\square} \square_{\square} \square_{\square} \square_{\square} \square_{\square}$ +100.00 ★

Custom Units—spaces consume A-Z, 0-9, /, *, %, blank

$\square \square \square \square \square$ %RNGE ★

Custom Display Transfer Function (Independent of Analog Output)

- Linear ★ Square Root

HARDWARE SELECTABLE INFORMATION

- Alarm Option: High Low
 Transmitter Security: Off On

Note: Specify C4 Option in model structure when ordering NAMUR-compliant alarm and saturation limits.⁽⁵⁾

SIGNAL SELECTION: (Software Selectable)

- 4–20 mA with simultaneous digital signal based on HART protocol★
 Burst mode of HART digital process variable ⁽⁴⁾

Burst mode output options:

- Primary variable in engineering units
 Primary variable in percent of range
 All dynamic variables in engineering units and the primary variable mA value

Multidrop Communication⁽⁴⁾⁽⁶⁾ Choose transmitter address⁽⁷⁾ (1-15): _____

⁽⁴⁾ C1 option required for configuration of this parameter.
⁽⁵⁾ Not available with low power output.
⁽⁶⁾ This option fixes the transmitter analog output at 4mA.
⁽⁷⁾ Default address is 1 if multidrop communication is selected.

Appendix B Product Certifications

Approved Manufacturing Locations	page B-2
European Directive Information	page B-2
Ordinary Location Certification for Factory Mutual	page B-3
Hazardous Locations Certifications	page B-4
Approval Drawings	page B-9

OVERVIEW

This Appendix contains information on Approved manufacturing locations, European directive information, Ordinary Location certification, Hazardous Locations Certifications and approval drawings for HART protocol.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠ WARNING

Explosions could result in death or serious injury:

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review this section of the Model 3051 reference manual for any restrictions associated with a safe installation.

- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flame-Proof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

⚠ WARNING

Cable gland and plug must comply with the requirements listed on the certificates.

Model 3051

APPROVED MANUFACTURING LOCATIONS


Rosemount Inc. — Chanhassen, Minnesota, USA
Fisher-Rosemount GmbH & Co. — Wessling, Germany
Emerson Process Management Asia Pacific Private Limited — Singapore

EUROPEAN DIRECTIVE INFORMATION


ATEX Directive

Rosemount Inc. complies with the ATEX Directive. Specific ATEX Directive Information is located within Appendix B.


Intrinsic safety Ex ia protection type in accordance with EN50 020

- Pressure transmitter with ia type protection shall operate with a certified intrinsic safety power supply only.
-  • Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- Pressure transmitter with intrinsic safety type protection is not valid if it is not connected to an intrinsic safety circuit.
- The Model 3051 with option code T1⁽¹⁾ does not pass the 500V high voltage test and using it with a shunt-diode safety barrier is not allowed. Transmitter without optioncode T1⁽¹⁾ can be tested using the 500V high voltage test.

Flame-Proof enclosure Ex d protection type in accordance with EN50 018

- Pressure transmitter with flameproof enclosure type protection shall only be opened when power is removed.
-  • Closing of entries in the device must be carried out using the appropriate EE d metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- Do not exceed the energy level, which is stated on the approval label.

Type n protection type in accordance with EN50 021

- The Model 3051 with option code T1⁽¹⁾ does not pass the 500V high voltage test and using it with a shunt-diode safety barrier is not allowed. Transmitter without optioncode T1⁽¹⁾ can be tested using the 500V high voltage test.
-  • Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.

(1) Lightning protection

**European Pressure
Equipment Directive
(PED) (97/23/EC)**

Models 3051CA4; 3051CD2, 3, 4, 5 (*also with P9 option*); 3051HD2, 3, 4, 5
Pressure Transmitters are category III equipment—
QS Certificate of Assessment - EC No. PED-H-20

All other Model 3051/3001 Pressure Transmitters —
Sound Engineering Practice

Transmitter Attachments: Diaphragm Seal - Process Flange - Manifold —
Sound Engineering Practice

Pressure transmitters that are SEP or Category I with Explosion-Proof
protection are outside the scope of PED and cannot be marked for
compliance with PED.

Mandatory CE-marking for pressure transmitters in accordance with Article 15
of the PED can be found on the transmitter body (CE 0434).

Pressure transmitters categories I – IV, use module H for conformity
assessment procedures.

**Electro Magnetic
Compatibility (EMC)**

Installed signal wiring should not be run together and should not be in the
same cable tray as AC power wiring.

Device must be properly grounded or earthed according to local electric
codes.

To improve protection against signal interference, shielded cable is
recommended, see “Connect Wiring and Power Up” on page 2-16 for more
information.

**Other important
guidelines**

Only use new, original parts.

To prevent the process medium escaping, do not unscrew or remove process
flange bolts, adapter bolts or bleed screws during operation.

When accessories are added to the transmitter, the minimum pressure rating
of any component shall not be exceeded.

Maintenance shall only be done by qualified personnel.

**ORDINARY LOCATION
CERTIFICATION FOR
FACTORY MUTUAL**

As standard, the transmitter has been examined, tested, and approved to
meet basic electrical, mechanical, and fire protection requirements by FM, a
nationally recognized testing laboratory (NRTL) as accredited by the Federal
Occupational Safety and Health Administration (OSHA).

Model 3051

HAZARDOUS LOCATIONS CERTIFICATIONS

North American Certifications

Factory Mutual (FM)

- E5** Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G.
Dust-Ignition-Proof for Class III, Division 1.
T5 (Ta = 85 °C), Factory Sealed, Enclosure Type 4x
- I5** Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D;
Class II, Division 1, Groups E, F, and G; Class III, Division 1 when
connected per Rosemount drawing 03031-1019 and 00268-0031 (When
used with a HART communicator); Non-incendive for Class I, Division 2,
Groups A, B, C, and D.
Temperature Code: T4 (Ta = 40 °C), T3 (Ta = 85 °C),
Enclosure Type 4x
For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

- E6** Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and
G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and
outdoor hazardous locations. Enclosure type 4X, factory sealed
- C6** Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class
I, Division 1, Groups A, B, C, and D when connected in accordance with
Rosemount drawings 03031-1024. Temperature Code T3C.
Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and
G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous
locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

European Certifications

I1 CENELEC Intrinsic Safety and Dust
 Certification No.: BAS 97ATEX1089X Ⓢ II 1 GD
 EEx ia IIC T5 (Tamb = -60 to +40 °C)
 EEx ia IIC T4 (Tamb = -60 to +70 °C)
 Dust Rating: T80 °C (Tamb -20 to 40 °C) IP66
 CE 1180

CENELEC I1 Input Parameters

U_i = 30 V
 I_i = 200 mA
 P_i = 0.9 W
 C_i = 0.012 µF
 L_i = 0.0

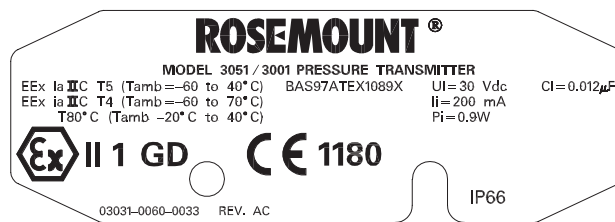
Special conditions for Safe Use (X): When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

NOTE


- a) Pressure transmitter with ia type protection shall operate with a certified intrinsic safety power supply only.
- ⚠ b) Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- c) Pressure transmitter with intrinsic safety type protection is not valid if it is not connected to an intrinsic safety circuit.

The transmitter complies with category one (highest category) and is allowed to be installed in ZONE 0.



Figure B-1. Approval Ex label example



3031_A33A

N1 CENELEC Non-incendive/Type n and Dust
Certification No.: BAS 00ATEX3105X  II 3 GD
EEx nL IIC T5 (Tamb = -40 to +70 °C)
U_i = 55 Vdc max
Dust rating: T80 °C (Tamb = -20 to 40 °C) IP66

Special Conditions for Safe Use (x): When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500V r.m.s. test to case. This must be taken into account on any installation in which it is used, for example by assuring that the supply to the apparatus is galvanically isolated.

 **E8** CENELEC Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X  II 1/2 GD
EEx d IIC T6 (T_{amb} = -50 to 65 °C)
EEx d IIC T5 (T_{amb} = -50 to 80 °C)
Dust rating T90 °C, IP66
CE 1180
Vmax = 55 V dc

Special Conditions for Safe Use (X): This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

NOTE


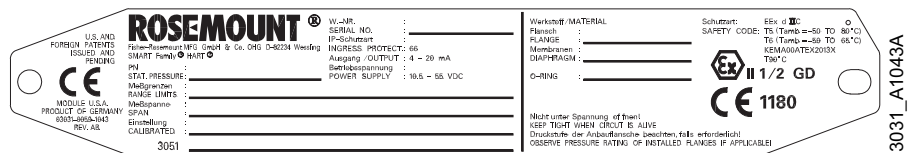
- a) Pressure transmitter with flameproof enclosure type protection shall only be opened when power is removed.
-  b) Closing of entries in the device must be carried out using the appropriate EEx d metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- c) Do not exceed the energy level, which is stated on the approval label.

Figure B-2. Transmitter neck approval label example



Japanese Certifications

E4 JIS Flame-Proof

Certificate	Description
Ex d IIC T5 + G5	
C13432	3051C/L/H/P Differential and Gauge (no meter)
C13433	3051C/L/H/P Differential and Gauge (with meter)
C13434	3051CA (no meter)
C13435	3051CA (with meter)
C13436	3051T (no meter)
C13437	3051T (with meter)
Ex d IIC T6	
C15151	3051C/D/1 4-20 mA HART (no meter)
C15152	3051C/D/1 4-20 mA HART (with meter)
C15155	3051T/G/1 4-20 mA HART, SST Silicone (no meter)
C15156	3051T/G/1 4-20 mA HART, Hast. Silicone (no meter)
C15157	3051T/G/1 4-20 mA HART, SST Silicone (with meter)
C15158	3051T/G/1 4-20 mA HART, Hast. Silicone (with meter)

I4 JIS Intrinsic Safety
 Certification No.: C13266
 Ex ia IIC T4

Australian Certifications

I7 SAA Intrinsic Safety
 Certification No.: AUS EX 1249X

Ex ia IIC T4 ($T_{amb} = 70\text{ °C}$)

Ex ia IIC T5 ($T_{amb} = 40\text{ °C}$)

IP65

When connected per Rosemount drawing 03031-1026

Special Conditions for Safe Use (X):

The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that $P_o \leq (U_o * I_o) / 4$.

Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth.

The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

SAA Approved Input Parameters

$U_i = 30\text{ V}$

$I_i = 200\text{ mA}$

$I_i = 160\text{ mA}$ (Option Code T1)

$P_i = 0.9\text{ W}$

$C_i = 0.01\text{ }\mu\text{F}$ (Output Code A)

$C_i = 0.042\text{ }\mu\text{F}$ (Output Code M)

$L_i = 10\text{ }\mu\text{H}$

$L_i = 1,05\text{ mH}$ (Output Code A with T1)

$L_i = 0,75\text{ mH}$ (Output Code M with T1)

Model 3051

E7 SAA Explosion-Proof (Flame-Proof)

Certification No.: AUS EX 1347X

Ex d IIC T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)

Ex d IIC T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)

DIP T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)

DIP T5 ($T_{amb} = 80\text{ }^{\circ}\text{C}$)

IP65

Special Conditions for Safe Use (x): It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

N7 SAA Type n (Non-sparking)

Certification No.: AUS EX 1249X

Ex n IIC T4 ($T_{amb} = 70\text{ }^{\circ}\text{C}$)

Ex n IIC T5 ($T_{amb} = 40\text{ }^{\circ}\text{C}$)

IP65

Special Conditions for Safe Use (x): Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently scratch off or mark unused approval types on the approval label.

K5 E5 and I5 combination

KB K5 and C6 combination

K6 C6, I1, and E8 combination

K8 E8 and I1 combination

K7 E7, I7, and N7 combination

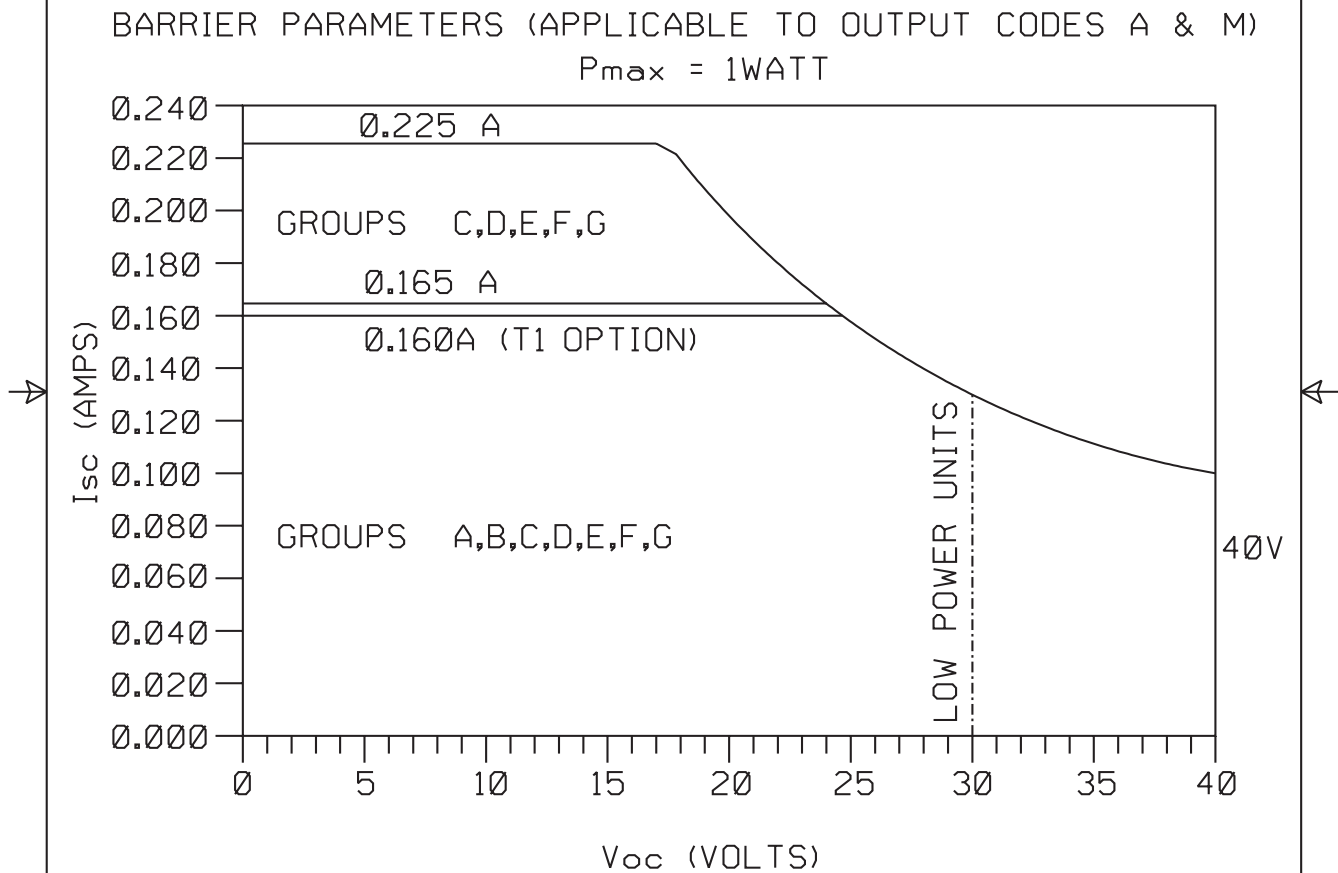
APPROVAL DRAWINGS

Factory Mutual
 03031-1019

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS																								
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE																				
	AA	ADD FIELDBUS	RTC1004088	M.L.M.	5/28/98																				
	AB	ADD PROFIBUS, NONINCENDIVE PARAMETERS	RTC1008309	P.C.S.	2/4/00																				
	AC	ADD FISCO DETAILS	RTC1011731	J.P.W.	9/19/01																				
ENTITY APPROVALS FOR 3051C 3001C 3051L 3001CL 3051P 3001CH 3051H 3001S 3051CA 3001SL 3051T 3001SH OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-4 OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 5-6 OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 7-11 ALL OUTPUT CODES NONINCENDIVE SEE SHEETS 12																									
THE ROSEMOUNT TRANSMITTERS LISTED ABOVE ARE F.M. APPROVED AS INTRINSICALLY SAFE WHEN USED IN CIRCUIT WITH F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED IN THE CLASS I, II, AND III, DIVISION I GROUPS INDICATED, TEMP CODE T4. ADDITIONALLY, THE ROSEMOUNT 751 FIELD SIGNAL INDICATOR IS F.M. APPROVED AS INTRINSICALLY SAFE WHEN CONNECTED IN CIRCUIT WITH ROSEMOUNT TRANSMITTERS (FROM ABOVE) AND F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED FOR CLASS I, II, AND III, DIVISION I, GROUPS INDICATED, TEMP CODE T4. TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.																									
CAD MAINTAINED (MicroStation)																									
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES (mm). REMOVE ALL BURRS AND SHARP EDGES, MACHINE SURFACE FINISH 125 -TOLERANCE- .X ± .1 [2,5] .XX ± .02 [0,5] .XXX ± .010 [0,25] FRACTIONS ANGLES ± 1/32 ± 2° DO NOT SCALE PRINT	CONTRACT NO. DR. MIKE DOBE 03/21/89 CHK'D APP'D. KELLY ORTH 03/22/89 APP'D. GOVT.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;"> </td> <td colspan="2" style="text-align: center;"> ROSEMOUNT® <small>8200 Market Boulevard • Chanhassen, MN 56017 USA</small> </td> </tr> <tr> <td colspan="4" style="text-align: center;"> TITLE INDEX OF I.S. & NONINCENDIVE F.M. FOR 3051C/L/P/H/T AND 3001C/S </td> </tr> <tr> <td style="width: 10%;">SIZE</td> <td style="width: 15%;">FSCM NO</td> <td colspan="2" style="width: 75%;">DWG NO. 03031-1019</td> </tr> <tr> <td style="text-align: center;">A</td> <td></td> <td style="width: 20%;">SCALE N/A</td> <td style="width: 55%;">WT. _____</td> </tr> <tr> <td colspan="2"></td> <td style="width: 20%;">SHEET 1 OF</td> <td style="width: 15%;">12</td> </tr> </table>						ROSEMOUNT® <small>8200 Market Boulevard • Chanhassen, MN 56017 USA</small>		TITLE INDEX OF I.S. & NONINCENDIVE F.M. FOR 3051C/L/P/H/T AND 3001C/S				SIZE	FSCM NO	DWG NO. 03031-1019		A		SCALE N/A	WT. _____			SHEET 1 OF	12
		ROSEMOUNT® <small>8200 Market Boulevard • Chanhassen, MN 56017 USA</small>																							
TITLE INDEX OF I.S. & NONINCENDIVE F.M. FOR 3051C/L/P/H/T AND 3001C/S																									
SIZE	FSCM NO	DWG NO. 03031-1019																							
A		SCALE N/A	WT. _____																						
		SHEET 1 OF	12																						

1019A01B

REVISIONS				
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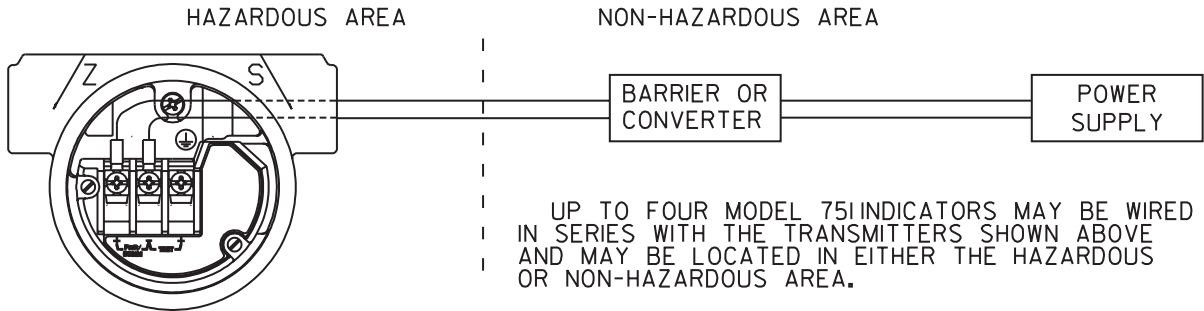
CAD MAINTAINED (MicroStation)

DR.	MIKE DOBE	SIZE	A	FSCM NO		DWG NO.	03031-1019
ISSUED		SCALE	N/A	WT.		SHEET	2 OF 12

1019A02B

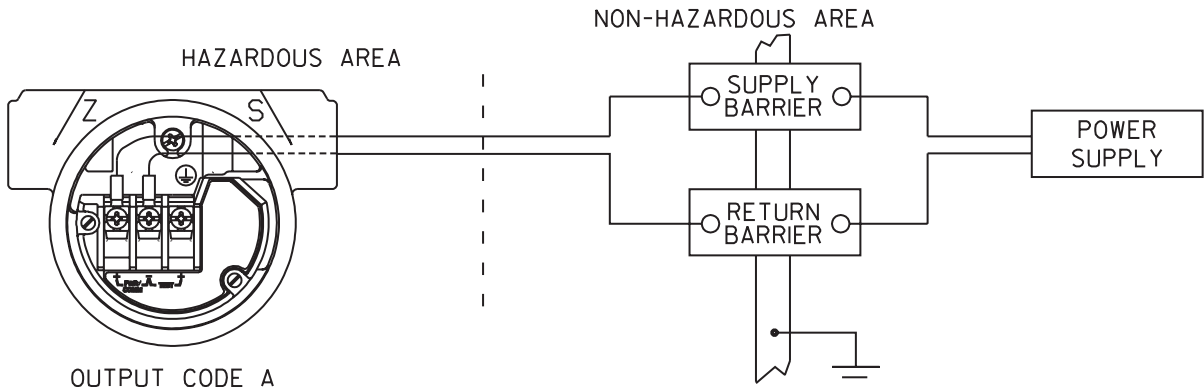
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

CIRCUIT DIAGRAM 1
 ONE BARRIER OR CONVERTER:
 SINGLE OR DUAL CHANNEL



OUTPUT CODE A
 MODELS INCLUDED
 3051C, L, P, H, T, CA
 3001C, CL, CH, S, SL, SH

CIRCUIT DIAGRAM 2
 SUPPLY AND RETURN BARRIERS
 (ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE A
 MODELS INCLUDED
 3051C, L, P, H, T, CA
 3001C, CL, CH, S, SL, SH

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 Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR.	MIKE DOBE	SIZE	A	FSCM NO.		DWG NO.	03031-1019
ISSUED		SCALE	N/A	WT.		SHEET	3 OF 12

Rev A

1019A03B



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AC				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (V_{oc} OR V_t) AND MAX. SHORT CIRCUIT CURRENT (I_{sc} OR I_t) AND MAX. POWER ($V_{oc} \times I_{sc}/4$) OR ($V_t \times I_t/4$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{max}), MAXIMUM SAFE INPUT CURRENT (I_{max}), AND MAXIMUM SAFE INPUT POWER (P_{max}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

CLASS I, DIV. 1, GROUPS A AND B

$V_{MAX} = 40V$	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
$I_{MAX} = 165mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
$P_{MAX} = 1 \text{ WATT}$	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{oc} \times I_{sc}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
$C_I = .01\mu f$	C_A IS GREATER THAN $.01\mu f$
$L_I = 10\mu H$	L_A IS GREATER THAN $10\mu H$

* FOR T1 OPTION:

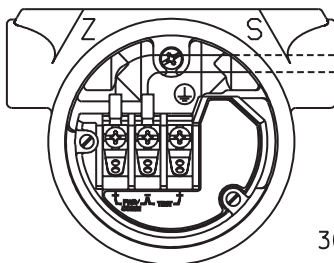
$I_{max} = 160mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 160mA
$L_I = 1.05mH$	L_A IS GREATER THAN 1.05mH

CLASS I, DIV. 1, GROUPS C AND D

$V_{MAX} = 40V$	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
$I_{MAX} = 225mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
$P_{MAX} = 1 \text{ WATT}$	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{oc} \times I_{sc}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
$C_I = .01\mu f$	C_A IS GREATER THAN $.01\mu f$
$L_I = 10\mu H$	L_A IS GREATER THAN $10\mu H$

* FOR T1 OPTION:

$L_I = 1.05mH$	L_A IS GREATER THAN 1.05mH
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HAZARDOUS AREA | NON-HAZARDOUS AREA

ASSOCIATED APPARATUS

(SEE SHEET 3)

OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

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CAD MAINTAINED (MicroStation)

DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT.	SHEET 4 OF 12

Form 3051 AC

1019A04B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

FOR OUTPUT CODE M

CLASS I, DIV. 1, GROUPS A AND B

$V_{MAX} = 30V$	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
$I_{MAX} = 165mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
$P_{MAX} = 1 \text{ WATT}$	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{OC} \times I_{SC}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
$C_T = .042\mu f$	C_A IS GREATER THAN $.042\mu f$
$L_T = 10\mu H$	L_A IS GREATER THAN $10\mu H$

* FOR T1 OPTION:

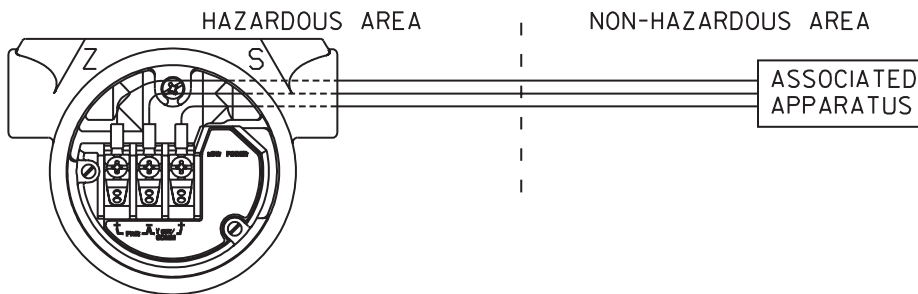
$L_T = 0.75mH$	L_A IS GREATER THAN $0.75mH$
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CLASS I, DIV. 1, GROUPS C AND D

$V_{MAX} = 30V$	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
$I_{MAX} = 225mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
$P_{MAX} = 1 \text{ WATT}$	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{OC} \times I_{SC}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
$C_T = .042\mu f$	C_A IS GREATER THAN $.042\mu f$
$L_T = 10\mu H$	L_A IS GREATER THAN $10\mu H$

* FOR T1 OPTION:

$L_T = 0.75mH$	L_A IS GREATER THAN $0.75mH$
----------------	--------------------------------



OUTPUT CODE M
 AVAILABLE FOR THE MODELS LISTED

3051C	3051H
3051L	3051CA
3051P	3051T

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 Chanhassen, MN 55317 USA

DR. **MIKE DOBE**

ISSUED

CAD MAINTAINED (MicroStation)

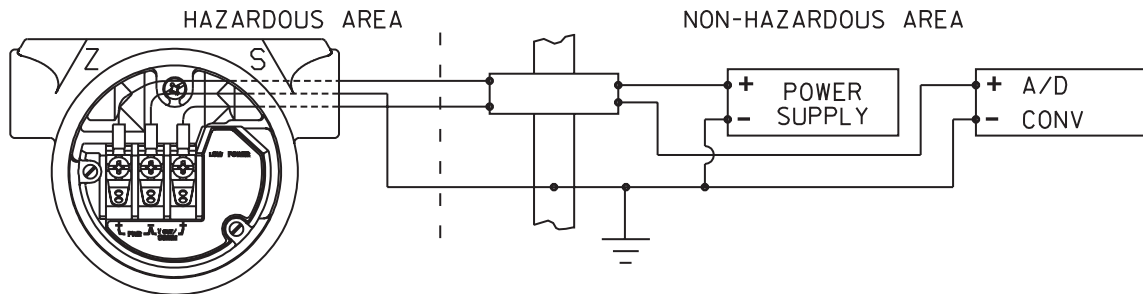
SIZE A	FSCM NO	DWG NO. 03031-1019
SCALE N/A	WT.	SHEET 5 OF 12

Form 3051 AD

1019A05B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

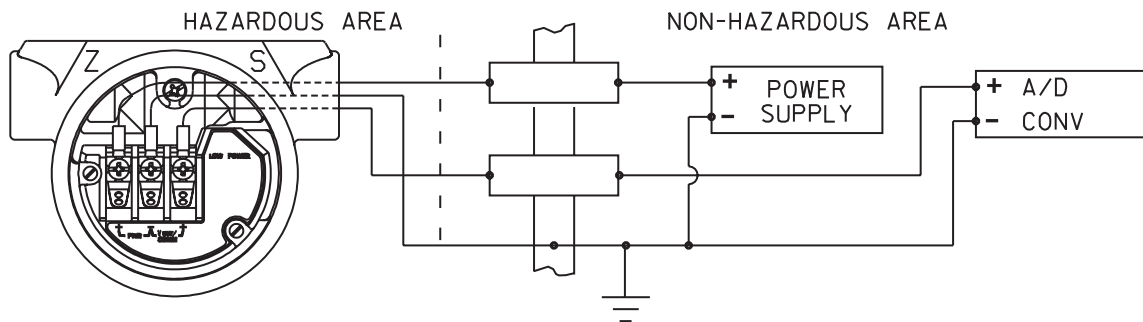
CIRCUIT DIAGRAM 3
ONE DUAL CHANNEL BARRIER



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

305IC	305IH
305IL	305ICA
305IP	305IT

CIRCUIT DIAGRAM 4
TWO SINGLE CHANNEL BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED
IN THIS CONFIGURATION)



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

305IC	305IH
305IL	305ICA
305IP	305IT

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DR. **SANDI MANSON**

ISSUED

CAD MAINTAINED (MicroStation)

SIZE A	FSCM NO	DWG NO. 03031-1019
SCALE N/A	WT.	SHEET 6 OF 12

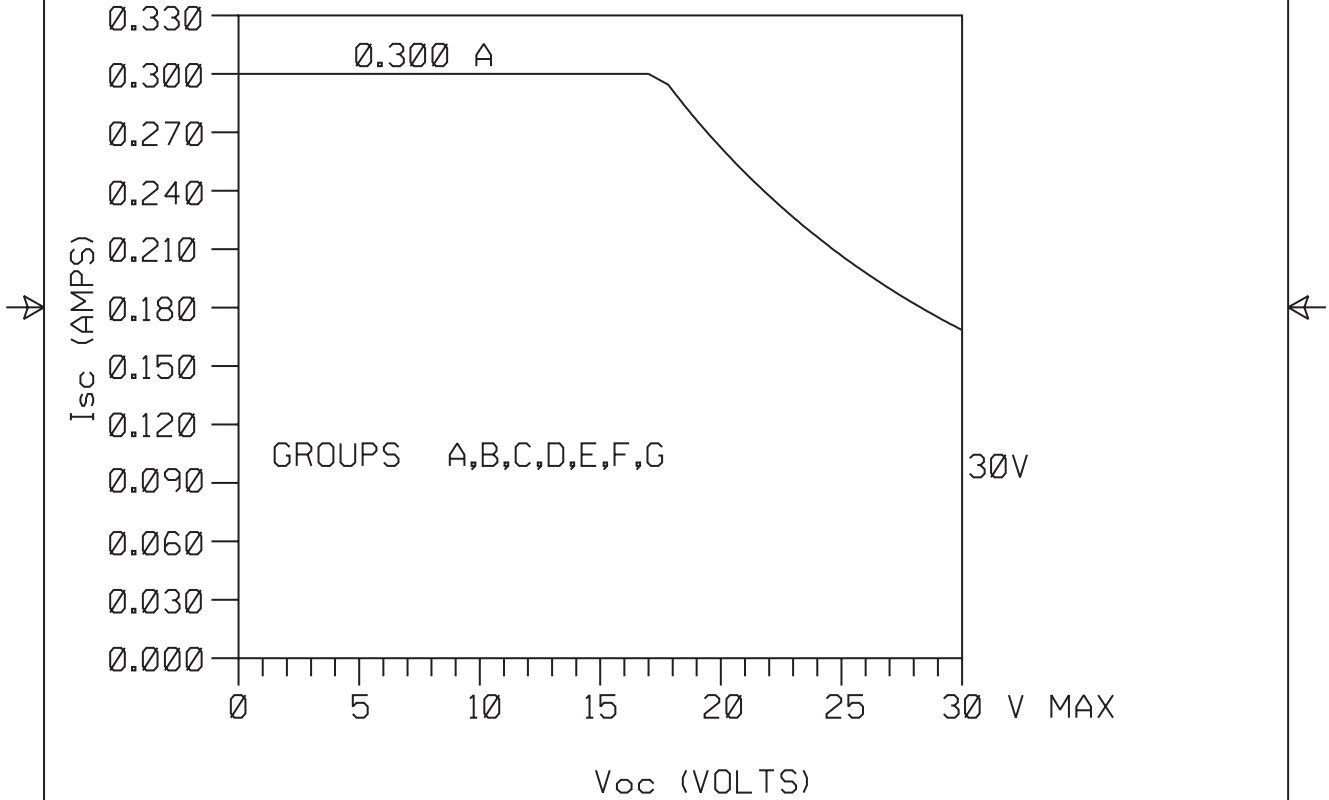
1019A06B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

3051 WITH FOUNDATION FIELDBUS OR PROFIBUS.
 (OUTPUT CODE F OR W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE F OR W)
 $P_{max} = 1.3 \text{ WATT}$



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DR. **Myles Lee Miller**

ISSUED

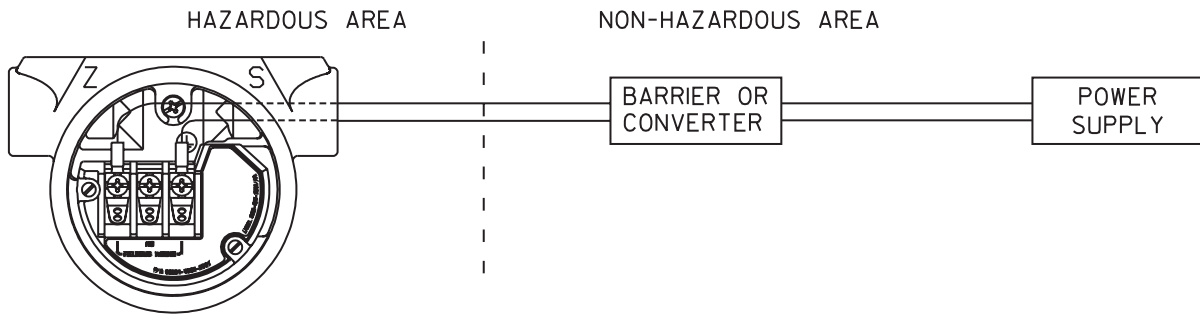
CAD MAINTAINED (MicroStation)			
SIZE A	FSCM NO	DWG NO.	03031-1019
SCALE N/A	WT.	SHEET	7 OF 12

Form 300 AG

1019A07B

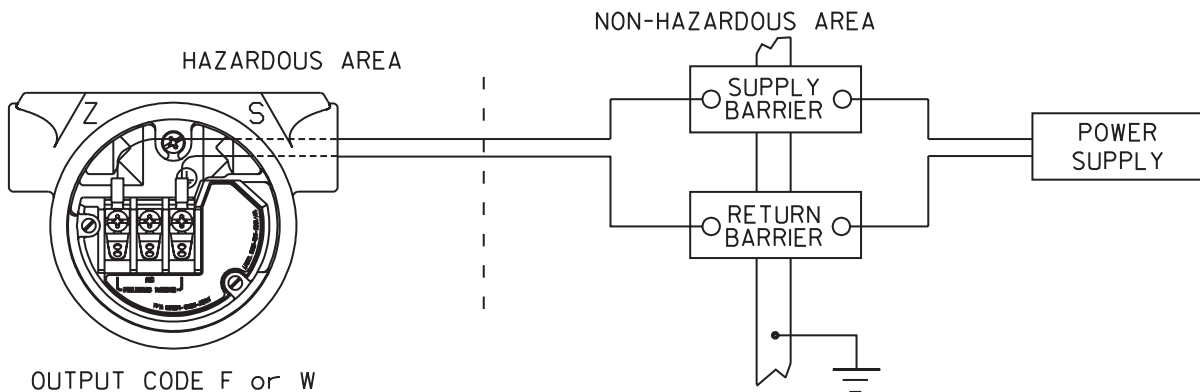
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL



OUTPUT CODE F or W
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE F or W
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH

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DR.	Myles Lee Miller
ISSUED	

CAD MAINTAINED (MicroStation)			
SIZE	FSCM NO	DWG NO.	03031-1019
A			
SCALE	N/A	WT.	
		SHEET	8 OF 12

Form 100 AC

1019A08B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

ENTITY CONCEPT APPROVALS

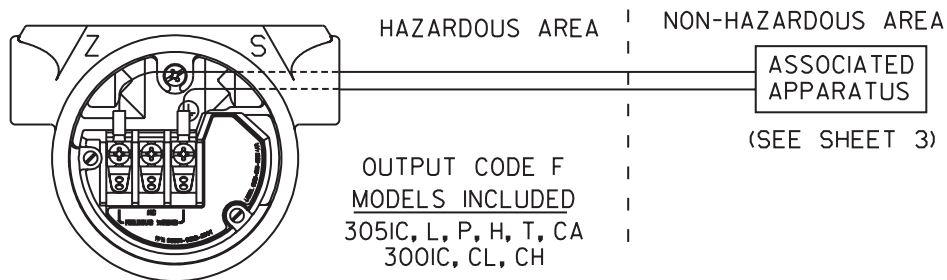
THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (V_{oc} OR V_t) AND MAX. SHORT CIRCUIT CURRENT (I_{sc} OR I_t) AND MAX. POWER ($V_{oc} \times I_{sc}/4$) OR ($V_t \times I_t/4$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{max}), MAXIMUM SAFE INPUT CURRENT (I_{max}), AND MAXIMUM SAFE INPUT POWER (P_{max}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

FOR OUTPUT CODE F or W

CLASS I, DIV. 1, GROUPS A, B, C AND D

$V_{MAX} = 30V$	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
$I_{MAX} = 300mA$	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 300mA
$P_{MAX} = 1.3$ WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{oc} \times I_{sc}}{4})$ IS LESS THAN OR EQUAL TO 1.3 WATT
$C_I = 0 \mu f$	C_A IS GREATER THAN $0 \mu f$
$L_I = 0 \mu H$	L_A IS GREATER THAN $0 \mu H$



Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	
DR. Myles Lee Miller	
ISSUED	

		CAD MAINTAINED (MicroStation)	
SIZE A	FSCM NO	DWG NO.	03031-1019
SCALE N/A	WT.	SHEET	9 OF 12

Form 3051 AC

1019A09B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_i or V_{max}), THE CURRENT (I_i or I_{max}), AND THE POWER (P_i or P_{ma}) THAT INTRINSICALLY SAFE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALLY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o , V_{oc} , or V_t), THE CURRENT (I_o , I_{sc} , or I_t), AND THE POWER (P_o or P_{max}) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_i) AND THE INDUCTANCE (L_i) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO $5nF$ AND $10\mu H$ RESPECTIVELY.

ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE U_o (or V_{oc} or V_t) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPMENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF $50\mu A$ FOR EACH CONNECTED DEVICE) SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R' : 15...150 OHM/km
 INDUCTANCE PER UNIT LENGTH L' : 0.4...1mH/KM
 CAPACITANCE PER UNLIT LENGTH C' : 80...200nF

$C' = C'$ LINE/LINE +0.5 C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
 $C' = C'$ LINE/LINE + C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE

TRUNK CABLE LENGTH: ≤ 1000 m
 SPUR CABLE LENGTH: ≤ 30 m
 SPLICE LENGTH: ≤ 1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

$R = 90...100$ OHMS $C = 2.2\mu F$

AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

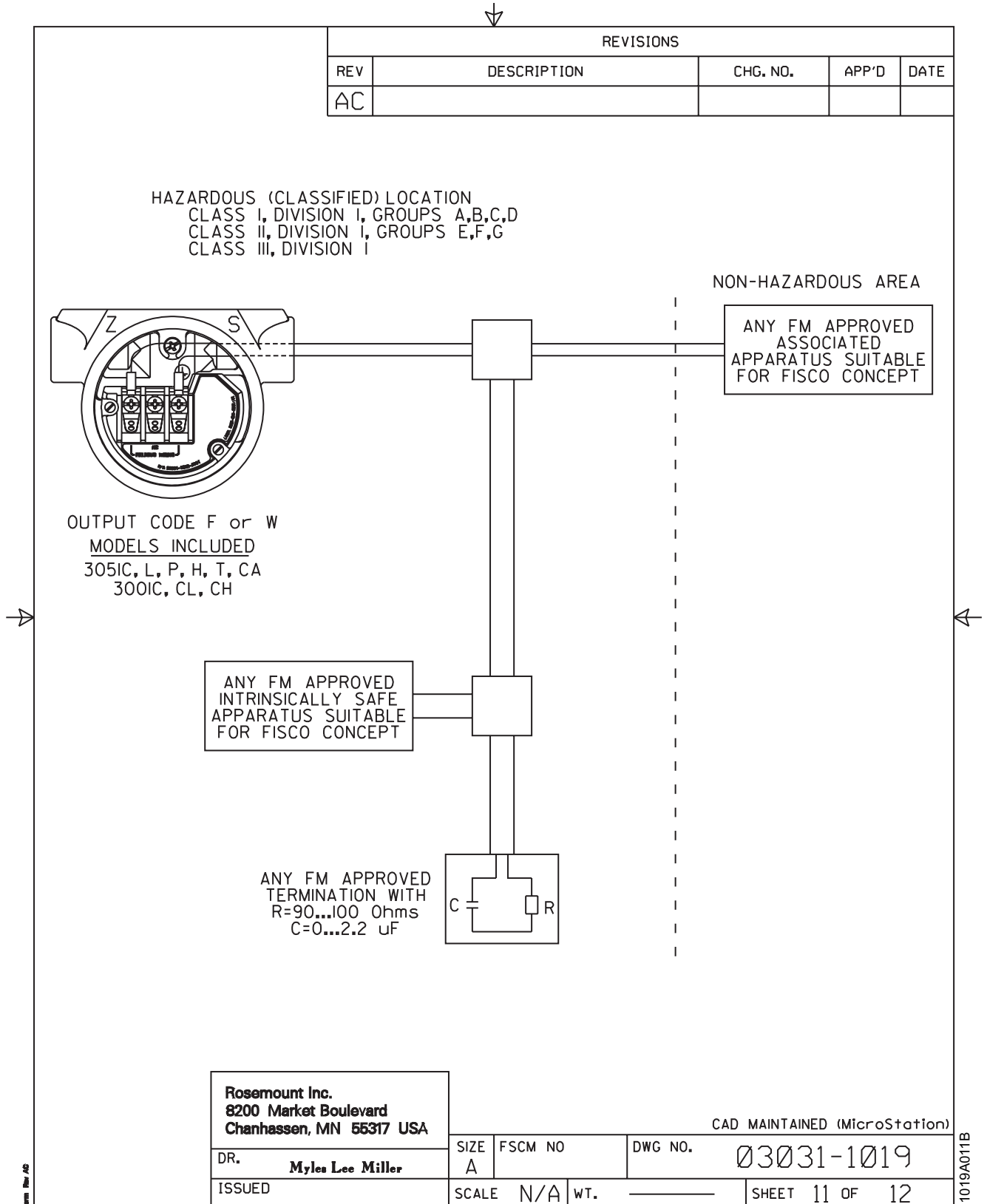
NOTES:
 INTRINSICALLY SAFE CLASS I, DIV. 1, GROUPS A, B, C, D

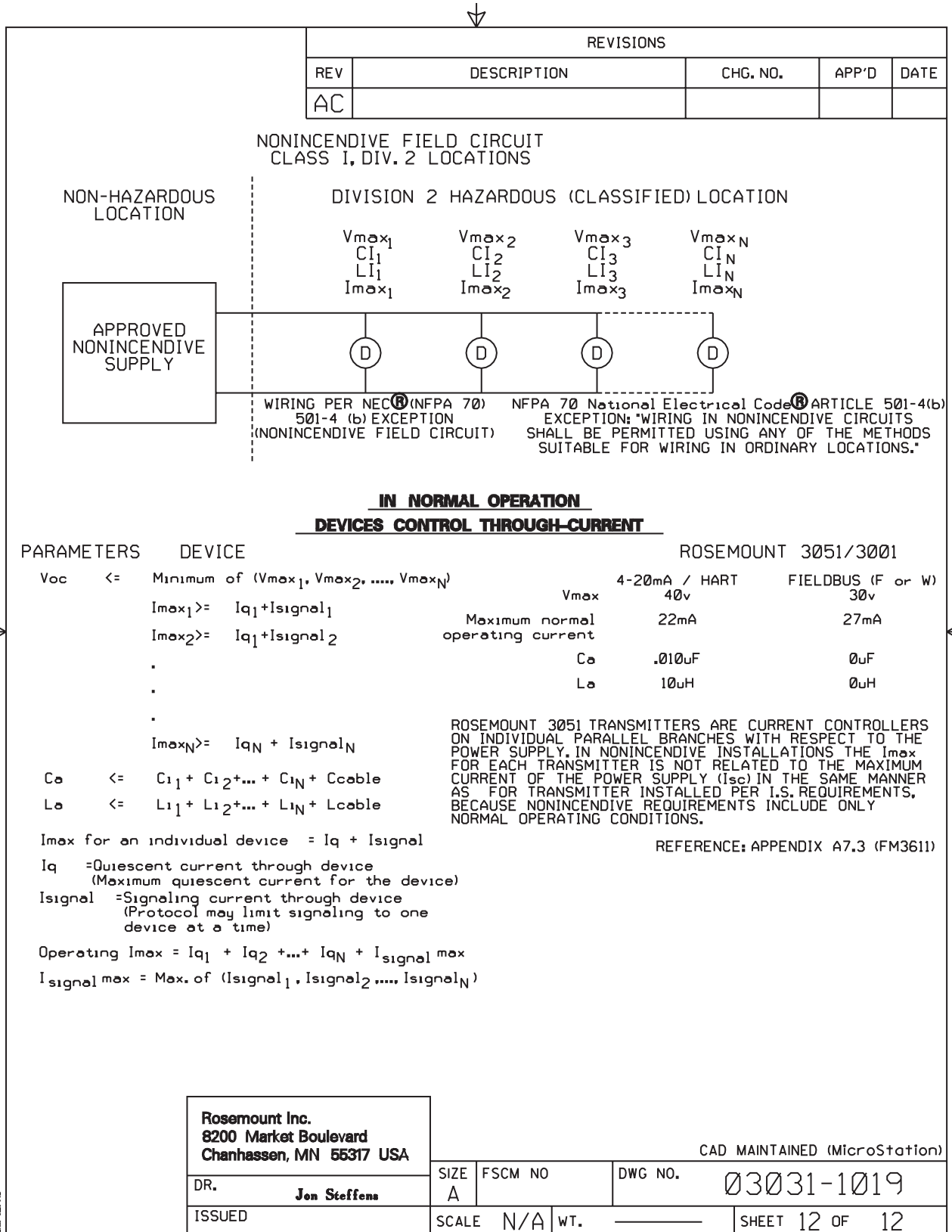
1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)		
		SIZE A	FSCM NO	DWG NO. 03031-1019
DR. Myles Lee Miller	ISSUED	SCALE N/A	WT.	SHEET 10 OF 12

Form 3051 AC

1019A010B





Canadian Standards
 Association (CSA)
 03031-1024

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS				
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	AA	ADD FIELDBUS	RTC1004232	M.L.M.	5/28/98
	AB	ADD PROFIBUS, ENTITY PARAMETERS	RTC1008326	P.C.S.	2/4/00
	AC	REM It, Vt FROM ENTITY PARAMETERS	RTC1009279	W.C.R.	7/11/00
	AD	ADD FISCO FIELDBUS	RTC1012624	J.P.W.	4/4/02

APPROVALS FOR
 3051C 3001C
 3051L 3001CL
 3051P 3001CH
 3051H 3001S
 3051CA 3001SL
 3051T 3001SH



OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-3
 OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 3-4
 OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 5-7
 OUTPUT CODES A,F,W I.S. ENTITY PARAMETERS SHEET 8-9

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

CAD MAINTAINED (MicroStation)

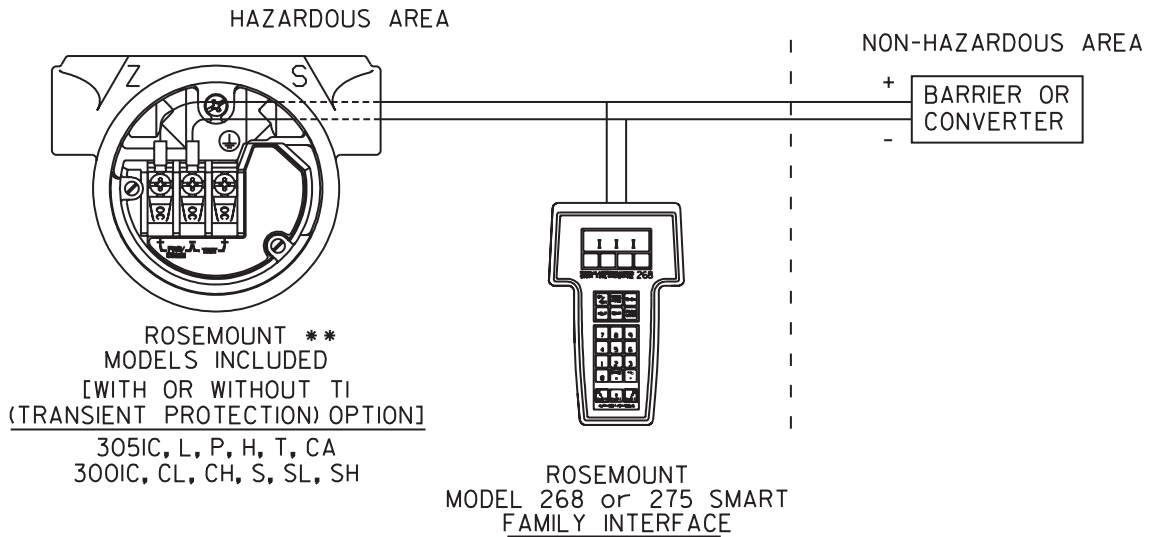
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES, MACHINE SURFACE FINISH 125 -TOLERANCE- .X ± .1 [2,5] .XX ± .02 [0,5] .XXX ± .010 [0,25] FRACTIONS ± 1/32 ANGLES ± 2° DO NOT SCALE PRINT	CONTRACT NO.	  8200 Market Boulevard • Chanhassen, MN 55317 USA		
	DR. Mike Dobe 08/27/90				TITLE INDEX OF I.S. CSA FOR 3051C/L/P/H/T & 3001C/S
	CHK'D	SIZE A FSCM NO. DWG NO. 03031-1024		
	APP'D. GLEN MONZO 8/31/90	SCALE N/A WT. _____ SHEET 1 OF 9		
	APP'D. GOVT.			

From Rev 02

1024A01B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

CSA INTRINSIC SAFETY APPROVALS
CIRCUIT CONNECTION WITH BARRIER OR CONVERTER
Ex ia
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
4-20 mA, ("A" OUTPUT CODE)



** FOR THE LOW POWER OPTION, SEE PAGE 4 FOR THE CIRCUIT CONNECTION WITH BARRIER OR CONVERTER. FOR FIELDBUS OPTIONS("F" or "W" OUTPUT CODE), SEE PAGE 5 FOR PARAMETERS AND CIRCUIT CONNECTION TO BARRIER.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	
DR.	Mike Dobe 08/27/90
ISSUED	

CAD MAINTAINED (MicroStation)			
SIZE	FSCM NO	DWG NO.	03031-1024
A			
SCALE	N/A	WT.	SHEET 2 OF 9

Form 3051 AD

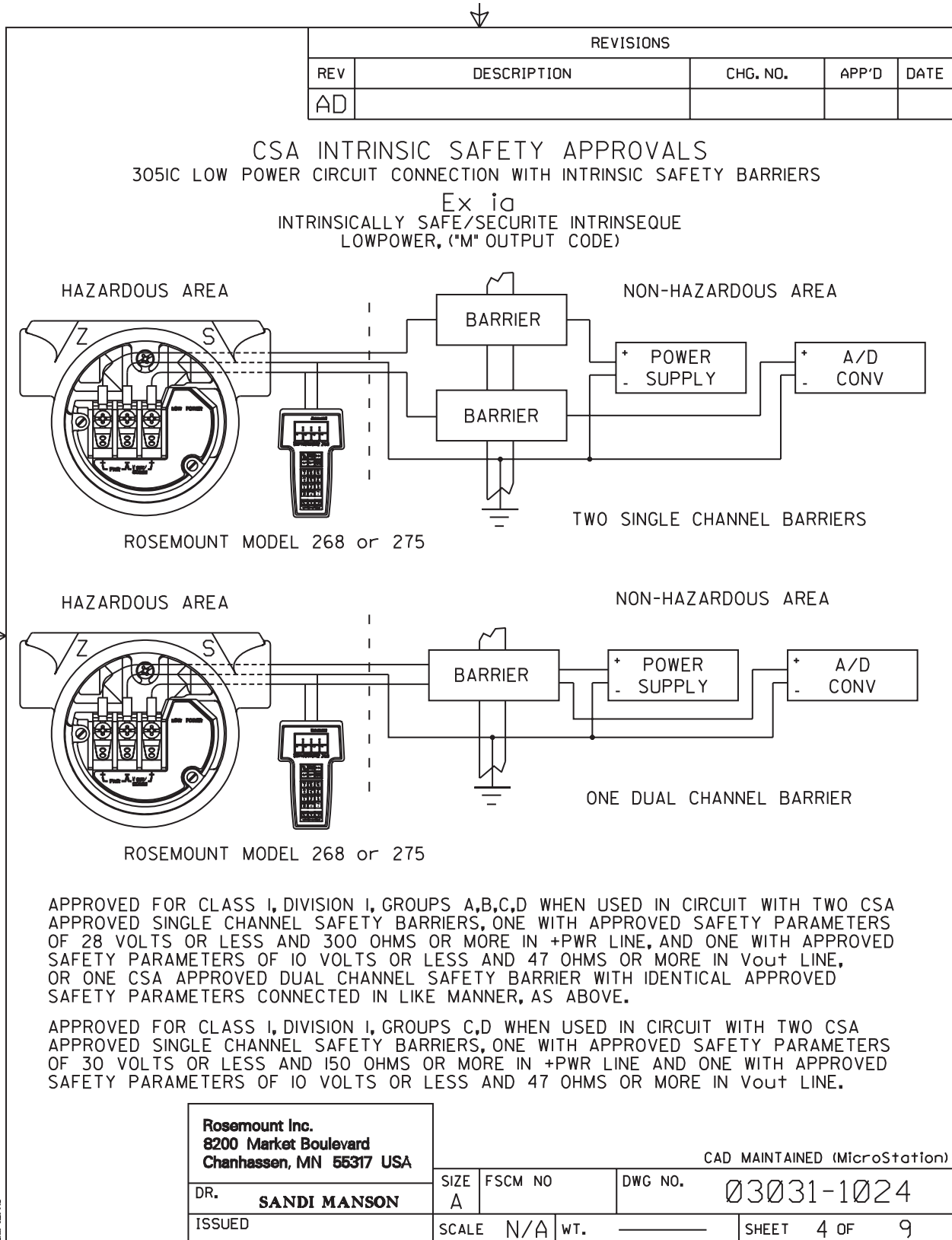
1024A02B



REVISIONS																			
REV	DESCRIPTION	CHG. NO.	APP'D	DATE															
AD																			
4-20 mA, ("A" OUTPUT CODE)																			
DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I																	
CSA APPROVED SAFETY BARRIER	30 V OR LESS * 330 OHMS OR MORE * 28 V OR LESS * 300 OHMS OR MORE 25 V OR LESS 200 OHMS OR MORE * 22 V OR LESS 180 OHMS OR MORE	GROUPS A, B, C, D																	
FOXBORO CONVERTER 2A1-I2V-CGB, 2A1-I3V-CGB, 2AS-I3I-CGB, 3A2-I2D-CGB, 3A2-I3D-CGB, 3AD-I3I-CGB, 3A4-I2D-CGB, 2AS-I2I-CGB, 3F4-I2DA		GROUPS B, C, D																	
CSA APPROVED SAFETY BARRIER	30 V OR LESS 150 OHMS OR MORE	GROUPS C, D																	
LOW POWER, ("M" OUTPUT CODE)																			
DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I																	
CSA APPROVED SAFETY BARRIER	Supply $\leq 28V, \geq 300 \Omega$ Return $\leq 10V, \geq 47 \Omega$	GROUPS A, B, C, D																	
CSA APPROVED SAFETY BARRIER	Supply $\leq 30V, \geq 150 \Omega$ Return $\leq 10V, \geq 47 \Omega$	GROUPS C, D																	
* MAY BE USED WITH ROSEMOUNT MODEL 268 or 275 SMART FAMILY INTERFACE.																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;"> Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA </td> </tr> <tr> <td style="width: 30%;">DR.</td> <td style="text-align: center;">Mike Dobe</td> </tr> </table>		Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		DR.	Mike Dobe	CAD MAINTAINED (MicroStation)													
Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA																			
DR.	Mike Dobe																		
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">SIZE</td> <td style="width: 25%;">FSCM NO</td> <td style="width: 40%;">DWG NO.</td> <td style="width: 10%;"></td> </tr> <tr> <td style="text-align: center;">A</td> <td></td> <td style="text-align: center;">03031-1024</td> <td></td> </tr> </table>		SIZE	FSCM NO	DWG NO.		A		03031-1024		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">ISSUED</td> <td style="width: 20%;">SCALE</td> <td style="width: 20%;">WT.</td> <td style="width: 30%;">SHEET</td> </tr> <tr> <td></td> <td style="text-align: center;">N/A</td> <td></td> <td style="text-align: center;">3 OF 9</td> </tr> </table>		ISSUED	SCALE	WT.	SHEET		N/A		3 OF 9
SIZE	FSCM NO	DWG NO.																	
A		03031-1024																	
ISSUED	SCALE	WT.	SHEET																
	N/A		3 OF 9																

Form 3051 AD

1024A03B





REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FIELDBUS, ("F" or "W" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV. I
CSA APPROVED SAFETY BARRIER	30 V OR LESS	GROUPS A, B, C, D
	300 OHMS OR MORE	
	28 V OR LESS	
	235 OHMS OR MORE	
	25 V OR LESS	
	160 OHMS OR MORE	
	22 V OR LESS	
	100 OHMS OR MORE	

CSA INTRINSIC SAFETY APPROVALS
 CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Ex ia
 INTRINSICALLY SAFE/SECURITE INTRINSEQUE
 FIELDBUS, ("F" or "W" OUTPUT CODE)

HAZARDOUS AREA

NON-HAZARDOUS AREA



ROSEMOUNT **
 MODELS INCLUDED
 [WITH OR WITHOUT TI
 (TRANSIENT PROTECTION) OPTION]
 3051C, L, P, H, T, CA
 3001C, CL, CH, S, SL, SH

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS
 MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS
 PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS
 DE CLASSE I, DIVISION 2.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)		
DR.	Myles Lee Miller	SIZE	FSCM NO	DWG NO.
ISSUED		A		03031-1024
		SCALE	N/A	WT. _____ SHEET 5 OF 9

Form 100 AD

1024A05B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_i or V_{max}), THE CURRENT (I_i or I_{max}), AND THE POWER (P_i or P_{ma}) THAT INTRINSICALLY SAFE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALLY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o , V_{oc} , or V_t), THE CURRENT (I_o , I_{sc} , or I_t), AND THE POWER (P_o or P_{max}) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_i) AND THE INDUCTANCE (L_i) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO $5nF$ AND $10\mu H$ RESPECTIVELY.

ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE U_o (or V_{oc} or V_t) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPMENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF $50\mu A$ FOR EACH CONNECTED DEVICE) SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R' : 15...150 OHM/km
 INDUCTANCE PER UNIT LENGTH L' : 0.4...1mH/KM
 CAPACITANCE PER UNLIT LENGTH C' : 80...200nF

$C' = C'$ LINE/LINE +0.5 C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
 $C' = C'$ LINE/LINE + C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE
 TRUNK CABLE LENGTH: ≤ 1000 m
 SPUR CABLE LENGTH: ≤ 30 m
 SPLICE LENGTH: ≤ 1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

$R = 90...100$ OHMS $C = 2.2\mu F$

AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

NOTES:
 INTRINSICALLY SAFE CLASS I, DIV. 1, GROUPS A, B, C, D

1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)		
		SIZE A	FSCM NO	DWG NO. 03031-1024
DR. Myles Lee Miller	ISSUED	SCALE N/A	WT.	SHEET 6 OF 9

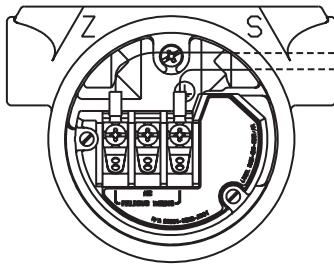
Form 3051 AD

1024A06B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

HAZARDOUS (CLASSIFIED) LOCATION
 CLASS I, DIVISION I, GROUPS A,B,C,D
 CLASS II, DIVISION I, GROUPS E,F,G
 CLASS III, DIVISION I

NON-HAZARDOUS AREA

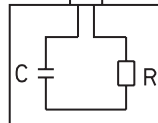


OUTPUT CODE F or W
 MODELS INCLUDED
 3051C, L, P, H, T, CA
 3001C, CL, CH

ANY CSA APPROVED
 ASSOCIATED
 APPARATUS SUITABLE
 FOR FISCO CONCEPT

ANY CSA APPROVED
 INTRINSICALLY SAFE
 APPARATUS SUITABLE
 FOR FISCO CONCEPT

ANY CSA APPROVED
 TERMINATION WITH
 $R=90\text{...}100\ \Omega$
 $C=0\text{...}2.2\ \mu\text{F}$



Rosemount Inc.
 8200 Market Boulevard
 Chanhassen, MN 55317 USA

DR. **Myles Lee Miller**

ISSUED

CAD MAINTAINED (MicroStation)			
SIZE A	FSCM NO	DWG NO.	03031-1024
SCALE N/A	WT.	SHEET	7 OF 9

Form 100 AD

1024A07B

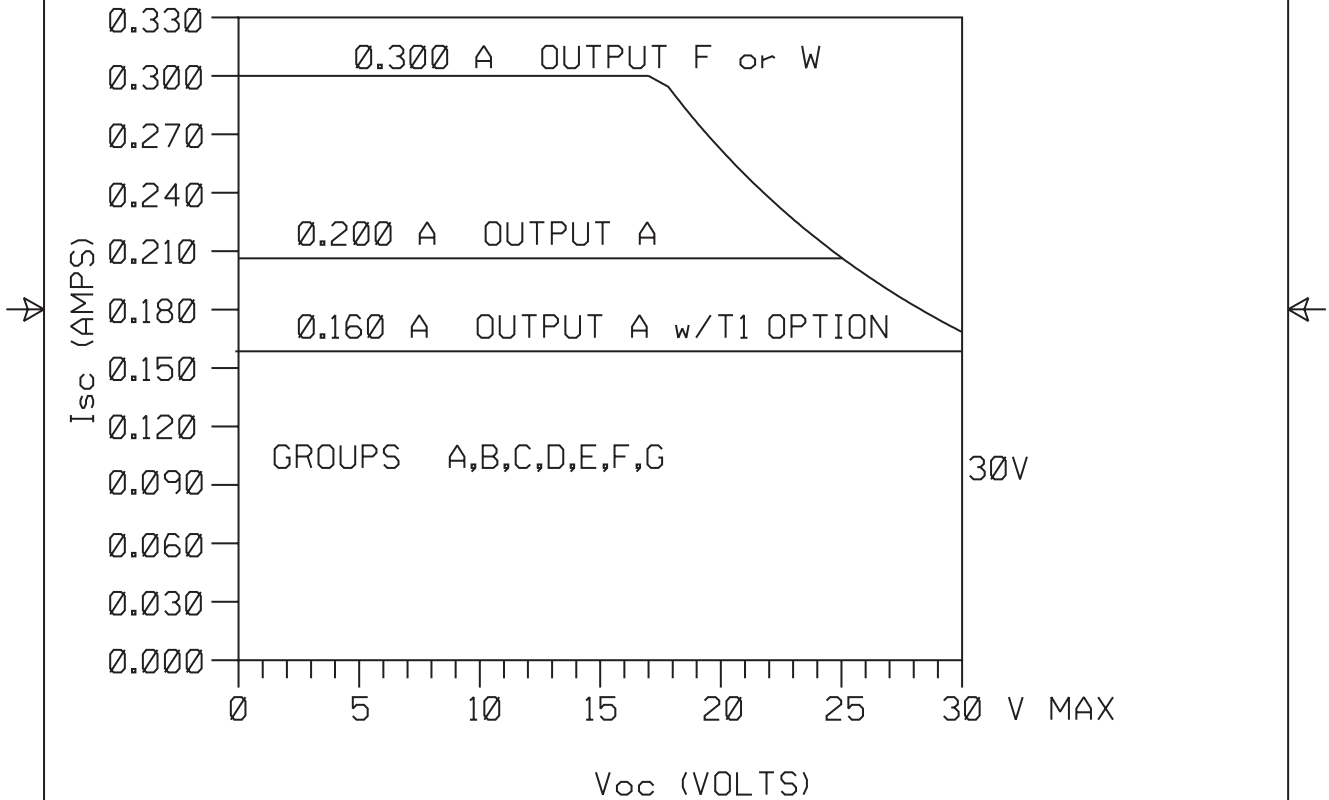


REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

3051 I.S. ENTITY PARAMETERS.
(OUTPUT CODE A,F, or W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE A,F, or W)

$P_{max} = 1.3$ WATT OUTPUT F or W
 $P_{max} = 1.0$ WATT OUTPUT A



Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

DR. **JON STEFFENS**

ISSUED

CAD MAINTAINED (MicroStation)			
SIZE A	FSCM NO	DWG NO.	03031-1024
SCALE N/A	WT.	SHEET	8 OF 9

Form 3051 AD

1024A08B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (V_{oc}) AND MAX. SHORT CIRCUIT CURRENT (I_{sc}) AND MAX. POWER ($V_{oc} \times I_{sc}/4$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{max}), MAXIMUM SAFE INPUT CURRENT (I_{max}), AND MAXIMUM SAFE INPUT POWER (P_{max}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A

CLASS I, DIV. 1, GROUPS A, B, C AND D

$V_{MAX} = 30V$	V_{OC} IS LESS THAN OR EQUAL TO 30V
$I_{MAX} = 200mA$	I_{SC} IS LESS THAN OR EQUAL TO 200mA
$P_{MAX} = 1 \text{ WATT}$	$(\frac{V_{oc} \times I_{sc}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
$C_I = .01\mu f$	C_A IS GREATER THAN $.01\mu f + C$ CABLE
$L_I = 10\mu H$	L_A IS GREATER THAN $10\mu H + L$ CABLE

* FOR T1 OPTION:

$I_{max} = 160mA$	I_{SC} IS LESS THAN OR EQUAL TO 160mA
$L_I = 1.05mH$	L_A IS GREATER THAN $1.05mH + L$ CABLE

FOR OUTPUT CODE F or W

CLASS I, DIV. 1, GROUPS A, B, C AND D

$V_{MAX} = 30V$	V_{OC} IS LESS THAN OR EQUAL TO 30V
$I_{MAX} = 300mA$	I_{SC} IS LESS THAN OR EQUAL TO 300mA
$P_{MAX} = 1.3 \text{ WATT}$	$(\frac{V_{oc} \times I_{sc}}{4})$ IS LESS THAN OR EQUAL TO 1.3 WATT
$C_I = 0\mu f$	C_A IS GREATER THAN $0\mu f + C$ CABLE
$L_I = 0\mu H$	L_A IS GREATER THAN $0\mu H + L$ CABLE

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	
DR.	JON STEFFENS
ISSUED	

		CAD MAINTAINED (MicroStation)	
SIZE A	FSCM NO	DWG NO.	03031-1024
SCALE N/A	WT.	SHEET	9 OF 9

Form 3051 AD

1024A09B

Model 3051

**Standards Association of
Australia (SAA)
03031-1026**

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS				
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	AA	UPDATE ENTITY PARAMETERS	RTC1002910	J.D.J.	12/2/97
	AB	ADD FIELDBUS AND PROFIBUS	RTC1006448	J.D.J.	4/26/99

SAA ENTITY CONCEPT APPROVALS

3051C	3001C
3051L	3001CL
3051P	3001CH
3051H	3001S
3051CA	
3051T	

OUTPUT CODE A (4-20 mA HART) SEE SHEETS 2
OUTPUT CODE M (LOW POWER) SEE SHEETS 3
OUTPUT CODE F / W (FIELDBUS, PROFIBUS) SEE SHEETS 4

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED ABOVE ARE INTRINSICALLY SAFE WHEN USED IN THE CURCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LIST ENTITY PARAMETERS.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

CAD Maintained, (MICROSTATION)

<small>UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125</small> <small>-TOLERANCE-</small> .X ± .1 [2,5] .XX ± .02 [0,5] .XXX ± .010 [0,25] <small>FRACTIONS</small> ± 1/32 <small>ANGLES</small> ± 2° DO NOT SCALE PRINT	CONTRACT NO.	ROSEMOUNT MEASUREMENT FISHER-ROSEMOUNT		Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA
	DR. Mike Dobe 12/30/91	TITLE SAA I.S. INDEX FOR 3051 & 3001		
	CHK'D	SIZE A	FSCM NO	DWG NO. 03031-1026
	APP'D. GLEN MONZO 5/8/92	SCALE N/A	WT.	SHEET 1 OF 4
APP'D. GOVT.				

1026A01B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

**OUTPUT CODE "A" (4-20MA / HART)
 SAA ENTITY CONCEPT APPROVALS**

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED BELOW ARE INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS

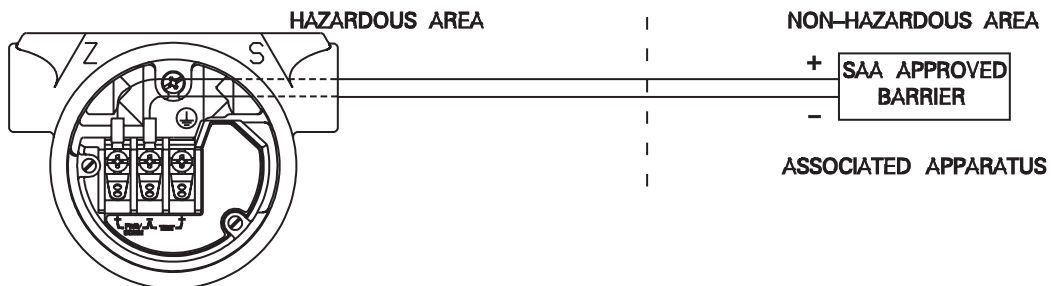
3051C	3051H	3001C	3001S
3051L	3051T	3001CL	
3051P	3051CA	3001CH	

ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
$V_{max} = 30V$ $I_{max} = 200mA$ $P_{max} = 0.9W$ $C_i = 0.01\mu F$ $L_i = 10\mu H$ FOR T1 OPTION ONLY $I_{max} = 160mA$ $L_i = 1.05mH$	V_{oc} IS LESS THAN OR EQUAL TO 30V I_{sc} IS LESS THAN OR EQUAL TO 200mA $\frac{V_{oc} * I_{sc}}{4}$ IS LESS THAN OR EQUAL TO 0.9W C_a IS GREATER THAN 0.01 MICROFARADS L_a IS GREATER THAN 10 MICROHENRIES I_{sc} IS LESS THAN OR EQUAL TO 160mA L_a IS GREATER THAN 1.05 MILLIHENRIES

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
 12001 Technology Drive
 Eden Prairie, MN 55344 USA

DR. **Mike Dobe**

ISSUED

SIZE
A

FSCM NO

SCALE N/A

WT.

CAD Maintained, (MICROSTATION)

DWG NO. 03031-1026

SHEET 2 OF 4



1026A02B

Model 3051



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

OUTPUT CODE "M" (LOW POWER) SAA ENTITY CONCEPT APPROVALS

THE ROSEMOUNT LOW POWER CONFIGURED PRESSURE TRANSMITTERS LISTED BELOW ARE SAA APPROVED AS INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS WITH LOW POWER CONFIGURATION

3051C 3051T
3051L 3051CA
3051P
3051H

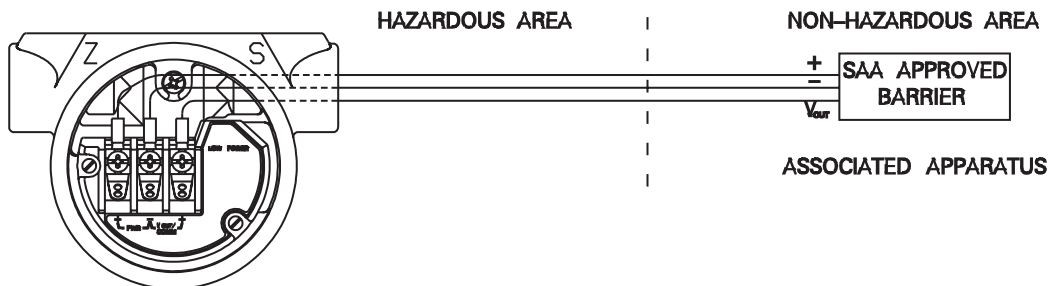
ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
$V_{max} = 30V$ $I_{max} = 200mA$ $P_{max} = 0.9W$ $C_i = 0.042\mu F$ $L_i = 10\mu H$ FOR T1 OPTION ONLY $L_i = 0.75mH$	V_{oc} IS LESS THAN OR EQUAL TO 30V I_{sc} IS LESS THAN OR EQUAL TO 200mA $\frac{V_{oc} * I_{sc}}{4}$ IS LESS THAN OR EQUAL TO 0.9W C_a IS GREATER THAN 0.042 MICROFARADS L_a IS GREATER THAN 10 MICROHENRIES L_a IS GREATER THAN 0.75 MILLIHENRIES



THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

DR. **Mike Dobe**

ISSUED

SIZE A FSCM NO

SCALE N/A WT.

CAD Maintained, (MICROSTATION)

DWG NO. 03031-1026

SHEET 3 OF 4



1026A03B



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

**OUTPUT CODE F / W (FIELD BUS, PROFIBUS)
 SAA ENTITY CONCEPT APPROVALS**

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED BELOW ARE INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS

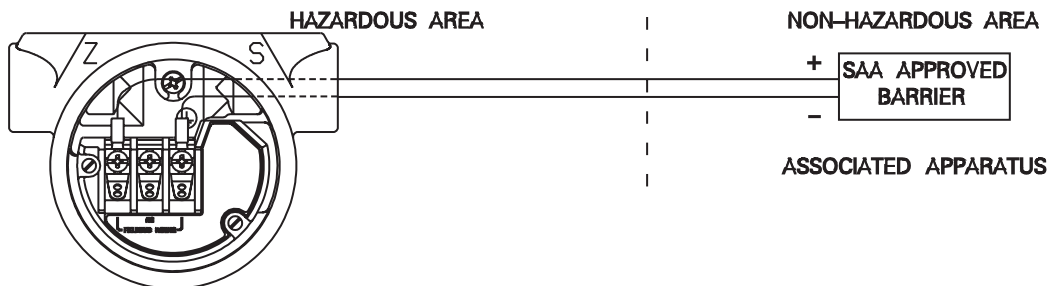
3051C	3051H	3001C	3001S
3051L	3051T	3001CL	
3051P	3051CA	3001CH	

ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
$V_{max} = 30V$ $I_{max} = 300mA$ $P_{max} = 1.3W$ $C_i = 0 \mu F$ $L_i = 0 \mu H$	V_{oc} IS LESS THAN OR EQUAL TO 30V I_{sc} IS LESS THAN OR EQUAL TO 300mA $\frac{V_{oc} * I_{sc}}{4}$ IS LESS THAN OR EQUAL TO 1.3W C_a IS GREATER THAN 0 MICROFARADS L_a IS GREATER THAN 0 MICROHENRIES

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
 12001 Technology Drive
 Eden Prairie, MN 55344 USA

DR. **Mike Dobe**
 ISSUED

SIZE A	FSCM NO	CAD Maintained, (MICROSTATION)	
DWG NO.	03031-1026		
SCALE N/A	WT.	SHEET	4 OF 4



1026A04B

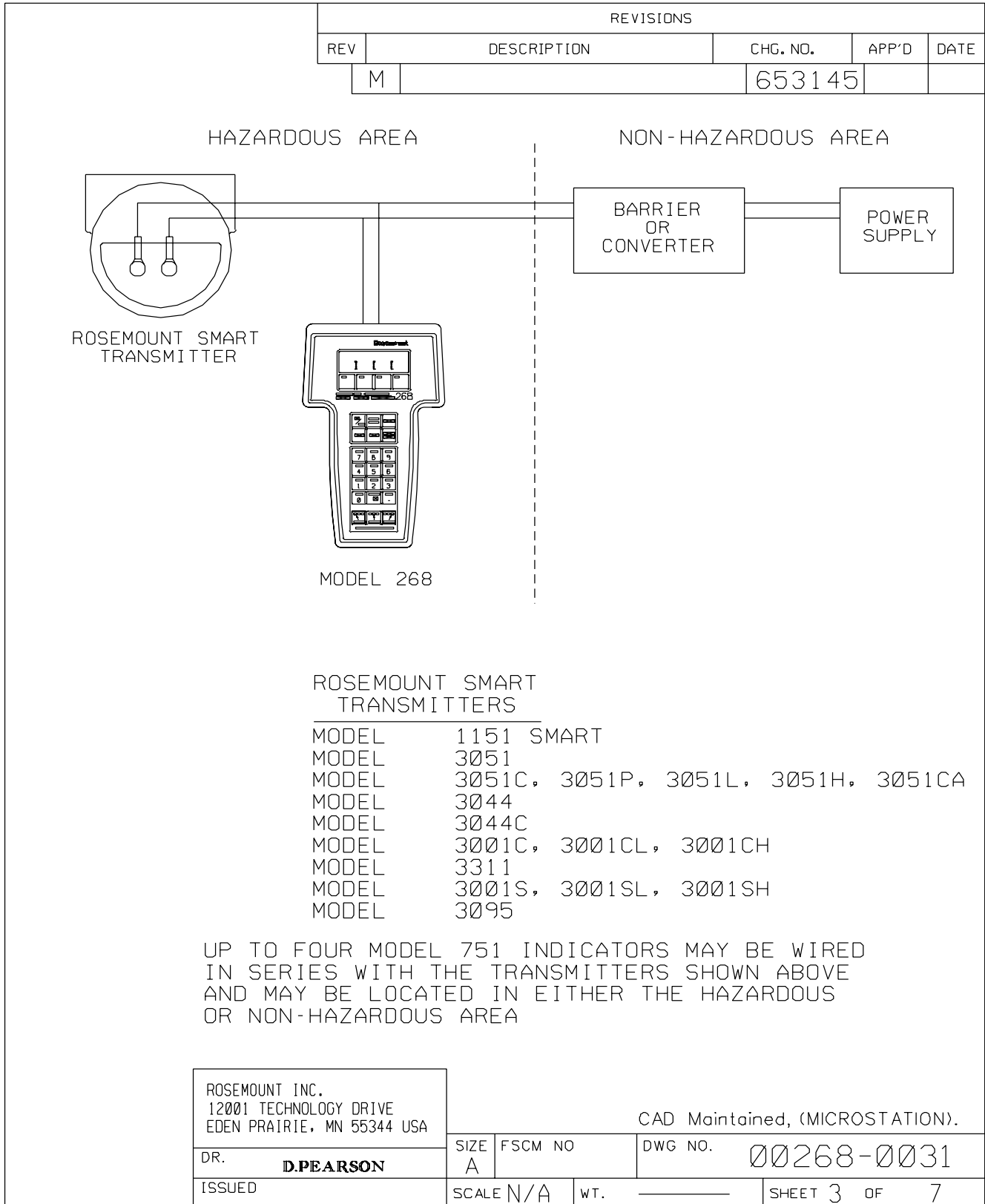
Model 3051

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS																						
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE																		
	G	ADD SHT 4&5, DELETE CLASS II & III	I. 636328	B.S.J.	08/01/90																		
	H	ADD 3051 P/L/H, 3001C CL /CH	636904	K.D.V.	09/06/90																		
	J	ADD SHT. 6, FIX TBL. 1.	638723	B.S.J.	01/02/91																		
	K	ADD 3044C	641710	W.R.K.	06/13/91																		
	L	ADD 3001S & SHT 7 FOR 3051C-LP	642380	G.E.M.	8/13/91																		
	M	ADD 3095	653145	K.D.V.	4/8/93																		
<p>THE ROSEMOUNT MODEL 268 SMART FAMILY INTERFACE IS APPROVED BY FACTORY MUTUAL AS INTRINSICALLY SAFE FOR THE CLASS I, DIVISION 1 GROUPS INDICATED WHEN USED IN CIRCUIT WITH THE BARRIERS AND CONVERTERS LISTED BELOW AND THE ROSEMOUNT SMART FAMILY TRANSMITTERS DEPICTED IN THE ACCOMPANYING CIRCUIT DIAGRAMS.</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%; text-align: center;">BARRIER MANUFACTURER</th> <th style="width: 30%; text-align: center;">MODEL</th> <th style="width: 40%; text-align: center;">APPROVED FOR CLASS I DIVISION 1, GROUPS</th> </tr> </thead> <tbody> <tr> <td>FOXBORO</td> <td>2AI-I2V-FGB 2AI-I3V-FGB 2AS-I3I-FGB 3A2-I2D-CS-E/FGB-A 3A2-I3D-CS-E/FGB-A</td> <td style="text-align: center;">A, B, C, D ↓</td> </tr> <tr> <td>HONEYWELL</td> <td>38545-000-0110-113-F5B5 38545-000-0110-111/112-F5B5</td> <td style="text-align: center;">C, D ↓</td> </tr> <tr> <td>MTL</td> <td>115 122 322 715 722</td> <td style="text-align: center;">A, B, C, D ↓</td> </tr> <tr> <td>R. STAHL</td> <td>8901/31-199/100/7 8901/30-199/100/7 8901/31-280/165/7 8901/30-280/165/7 [8903/51-200/050/7 8901/31-086/150/7 [8901/31-280/165/7 8901/31-086/150/7 9005/01-245/060 9005/01-252/100</td> <td style="text-align: center;">C, D ↓ C, D C, D A, B, C, D A, B, C, D C, D C, D A, B, C, D A, B, C, D</td> </tr> <tr> <td>TAYLOR</td> <td>5850FL81200 5851FL81200 1130FF21000 1130FF22000 1135FF21000 1135FF22000</td> <td style="text-align: center;">C, D ↓</td> </tr> </tbody> </table>						BARRIER MANUFACTURER	MODEL	APPROVED FOR CLASS I DIVISION 1, GROUPS	FOXBORO	2AI-I2V-FGB 2AI-I3V-FGB 2AS-I3I-FGB 3A2-I2D-CS-E/FGB-A 3A2-I3D-CS-E/FGB-A	A, B, C, D ↓	HONEYWELL	38545-000-0110-113-F5B5 38545-000-0110-111/112-F5B5	C, D ↓	MTL	115 122 322 715 722	A, B, C, D ↓	R. STAHL	8901/31-199/100/7 8901/30-199/100/7 8901/31-280/165/7 8901/30-280/165/7 [8903/51-200/050/7 8901/31-086/150/7 [8901/31-280/165/7 8901/31-086/150/7 9005/01-245/060 9005/01-252/100	C, D ↓ C, D C, D A, B, C, D A, B, C, D C, D C, D A, B, C, D A, B, C, D	TAYLOR	5850FL81200 5851FL81200 1130FF21000 1130FF22000 1135FF21000 1135FF22000	C, D ↓
BARRIER MANUFACTURER	MODEL	APPROVED FOR CLASS I DIVISION 1, GROUPS																					
FOXBORO	2AI-I2V-FGB 2AI-I3V-FGB 2AS-I3I-FGB 3A2-I2D-CS-E/FGB-A 3A2-I3D-CS-E/FGB-A	A, B, C, D ↓																					
HONEYWELL	38545-000-0110-113-F5B5 38545-000-0110-111/112-F5B5	C, D ↓																					
MTL	115 122 322 715 722	A, B, C, D ↓																					
R. STAHL	8901/31-199/100/7 8901/30-199/100/7 8901/31-280/165/7 8901/30-280/165/7 [8903/51-200/050/7 8901/31-086/150/7 [8901/31-280/165/7 8901/31-086/150/7 9005/01-245/060 9005/01-252/100	C, D ↓ C, D C, D A, B, C, D A, B, C, D C, D C, D A, B, C, D A, B, C, D																					
TAYLOR	5850FL81200 5851FL81200 1130FF21000 1130FF22000 1135FF21000 1135FF22000	C, D ↓																					
CAD Maintained, (MICROSTATION).																							
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES (mm). REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 -TOLERANCE- .X * .1 [2,5] .XX * .02 [0,5] .XXX * .010 [0,25] FRACTIONS * 1/32 ANGLES * 2' DO NOT SCALE PRINT	CONTRACT NO.	ROSEMOUNT MEASUREMENT		ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEM PRAIRIE, MN 55344 USA																			
	DR. MIKE DOBE 2/7/90	FISHEROSEMOUNT																					
	CHK'D	TITLE																					
	APP'D. K. CARLSON 03/13/90	INDEX OF I.S. BARRIER SYSTEMS FOR MOD. 268 SMART FAMILY INTERFACE																					
	APP'D. GOVT.	SIZE A	FSCM NO	DWG NO.	00268-0031																		
	SCALE	WT. _____	SHEET 1 OF 7																				

0031A01A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		
ENTITY CONCEPT APPROVALS				
<p>THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (V_T OR V_{OC}) AND MAXIMUM SHORT CIRCUIT CURRENT (I_T OR I_{SC}) AND MAXIMUM OUTPUT POWER ($\frac{V_{OC} \times I_{SC}}{4}$ OR $\frac{V_T \times I_T}{4}$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{MAX}), MAXIMUM SAFE INPUT CURRENT (I_{MAX}) AND MAXIMUM SAFE INPUT POWER (P_{MAX}) OF THE INTRINSICALLY SAFE APPARATUS, IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (C_A) AND INDUCTANCE (L_A) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE MAXIMUM UNPROTECTED INTERNAL CAPACITANCE (C_I) AND INDUCTANCE (L) OF THE INTRINSICALLY SAFE APPARATUS. THE APPROVED ENTITY CONCEPT PARAMETERS ARE AS FOLLOWS:</p> <p style="text-align: center;">NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.</p>				
INPUT PARAMETERS (CLASS I, DIV. 1, GROUPS A, B, C, D)				
VMAX = 32 VDC		V_T or V_{OC} of barrier must be ≤ 32 Vdc		
IMAX = 186 MA		I_T or I_{SC} of barrier must be ≤ 186 mA		
CI = 0.01 UF		C_A of barrier must be $\geq 0.01 \mu F$		
LI = 1.1 MH		L_A of barrier must be ≥ 1.1 mH		
PMAX:	1.1W	0.8W	0.6W	$\frac{V_{OC} \times I_{SC}}{4}$ of barrier must be \leq specified value.
TEMP CODE	T4A	T5	T6	
OUTPUT PARAMETERS				
VOC = 1.5 VD.C.				
ISC = 27 MA				
$C_A = 10,000 \mu F$				
$L_A = 46$ MH				
ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA		CAD Maintained, (MICROSTATION).		
DR.	D.PEARSON	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED		SCALE N/A	WT. _____	SHEET 2 OF 7

0031A02A



REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS IS DETERMINED BY ADDING 27 mA TO THE I_{sc} OF THE BARRIER ($I_m = I_{sc} + 27\text{mA}$) AND ENTERING TABLE 1 (SHT 5) AT THE RESULTING VALUE, I_m , OR THE NEXT HIGHER VALUE OF I_m , TO DETERMINE THE L_a , (THE L_a MUST INCLUDE THE L_1 OF THE MODEL 268, WHICH IS 1.1mH).

EXAMPLE #1: I_{sc} OF BARRIER = 100mA.

$I_m = 100\text{mA} + 27\text{mA} = 127\text{mA}$

ENTER TABLE AT $I_m = 130\text{mA}$; $L_a = 2.0\text{mH}$

--WARNING-- BEFORE CONNECTING THE MODEL 268 INTO THE LOOP, DETERMINE THE CONNECTED INDUCTANCE OF THE SYSTEM BY ADDING THE L_1 OF THE TRANSMITTER, CABLE, AND MODEL 268. THE SUM MUST BE LESS THAN THE L_a DETERMINED FROM THE TABLE IN ORDER FOR THE MODEL 268 TO BE CONNECTED INTO THE LOOP. IF THE CONNECTED INDUCTANCE IS GREATER THAN THE VALUE DETERMINED FROM THE TABLE, A BARRIER WITH A LOWER I_{sc} MUST BE CHOSEN.

EXAMPLE #2: BARRIER I_{sc} = 41.8mA; BARRIER L_a = 20.0mH

$I_m = 41.8\text{mA} + 27\text{mA} = 68.8\text{mA}$;

ENTER TABLE AT 70mA AND READ $L_a = 7.5\text{mH}$

ADD CONNECTED INDUCTANCE OF SYSTEM:

MODEL 268	$L_1 = 1.1\text{mH}$
MODEL 3051 TRANSMITTER	$L_1 = 0.48\text{mH}$
INDUCTANCE OF LOOP WIRING	1.0mH

 TOTAL CONNECTED INDUCTANCE = 2.58mH

TOTAL CONNECTED INDUCTANCE IS LESS THAN $L_a = 7.5\text{mH}$ AS DETERMINED ABOVE AND IS ALSO LESS THAN THE BARRIER L_a . THE MODEL 268 MAY SAFELY BE CONNECTED INTO THE LOOP. IF THE MODEL 751 INDICATORS ARE USED, THEIR TOTAL INDUCTANCE (LABEL VALUE * NUMBER OF INDICATORS) MUST ALSO BE INCLUDED.

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRATIRTE, MN 55344 USA		CAD Maintained, (MICROSTATION).		
DR. S.BARDUSON	30JUL90	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED		SCALE N/A	WT. _____	SHEET 4 OF 7

0031A04A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

Im (mA)	La (mH)
150	1.3
145	1.5
140	1.6
130	2.0
120	2.5
110	3.0
100	4.0
90	5.0
85	5.5
80	6.0
75	6.7
70	7.5
65	8.8
62	9.5
60	10.0
57	11.0
55	12.0
50	15.0
45	19.0
40	23.0
35	31.0

TABLE 1

ROSEMOUNT INC.
 12001 TECHNOLOGY DRIVE
 EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. **S.BARDUSON** 30JUL90

SIZE A FSCM NO

DWG NO. 00268-0031

ISSUED

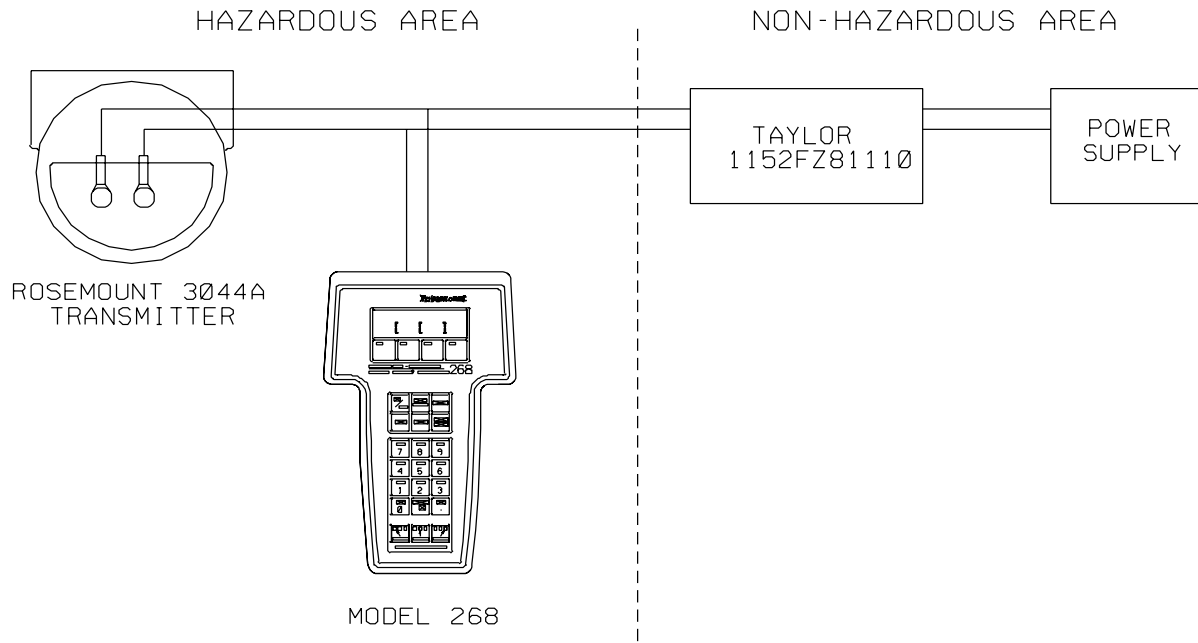
SCALE N/A WT. _____

SHEET 5 OF 7

0031A05A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE

TAYLOR_1152FZ81110_SYSTEM

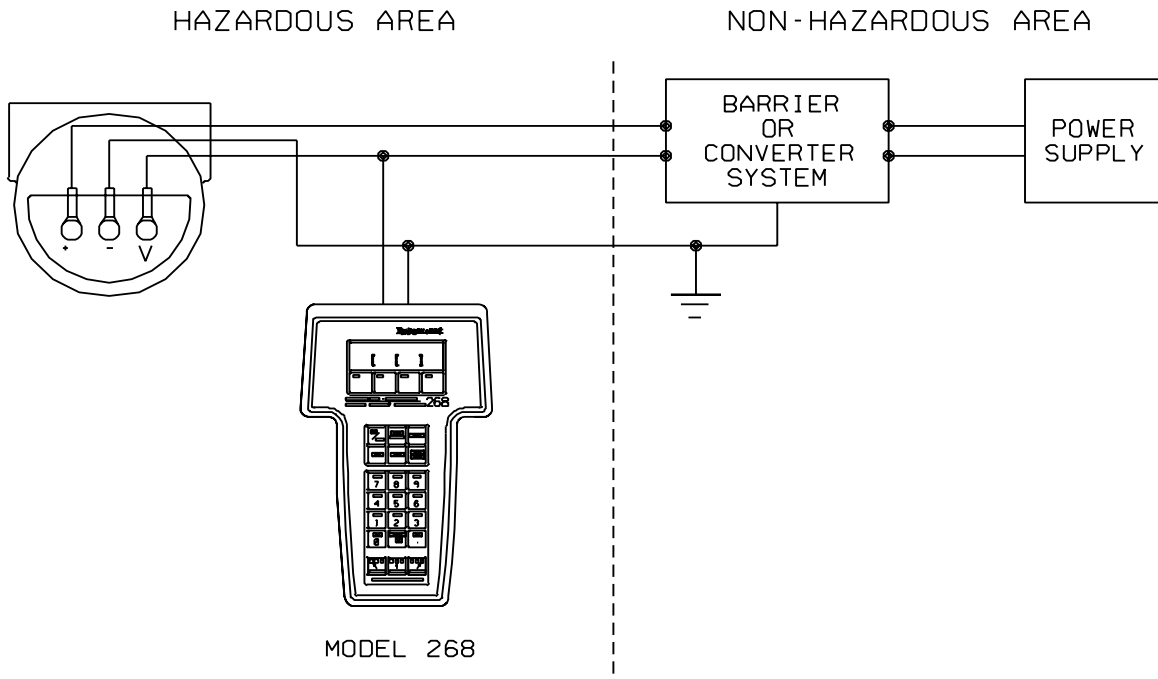


ROSEMOUNT 3044A SMART TRANSMITTERS MAY BE PLACED IN A CLASS I, DIVISION I, GROUP A, B, C, D HAZARDOUS LOCATION AS SHOWN ABOVE. THE LOOP POWER IS LIMITED BY A TAYLOR 1152FZ81110 INTRINSIC SAFETY BARRIER. THE ROSEMOUNT 268 MAY ALSO BE CONNECTED IN THE LOOP AS SHOWN. FOR CABLE WITH CAPACITANCE OF 60 PF/FT OR LESS AND INDUCTANCE OF .2 UH/FT OR LESS; CABLE LENGTHS OF UP TO 1600 FEET ARE ALLOWED .

- TRANSMITTER: ROSEMOUNT 3044A
- BARRIER: TAYLOR 1152FZ81110
- COMMUNICATOR: ROSEMOUNT 268
- CABLE: CMAX = 60 PF/FT
- LMAX = .2 UH/FT
- MAX. LENGTH = 1600 FT

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA		CAD Maintained, (MICROSTATION).		
DR. C. SCRIBNER 12/21/90	SIZE A	FSCM NO	DWG NO.	00268-0031
ISSUED	SCALE N/A	WT. _____	SHEET 6 OF	7

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



CONNECTION FOR LOW POWER VERSIONS
OF THE FOLLOWING
ROSEMOUNT SMART TRANSMITTERS

MODEL	3051C, 3051P, 3051L, 3051H, 3051CA
MODEL	3001C, 3001CL, 3001CH
MODEL	3001S, 3001SL, 3001SH

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

DR. **SANDI MANSON** 8/8/91

ISSUED

SIZE A		FSCM NO	DWG NO. 00268-0031	
SCALE N/A	WT. _____	SHEET 7 OF 7		

CAD Maintained, (MICROSTATION).

0031A07A

Index

A

AMS
 Commissioning 3-2
ATEX directive B-2
Accuracy A-2
Adapters A-47
Address
 Changing 3-26
Advanced functions
 Burst mode 3-24
 Multidrop communication . 3-25,
 3-27
 Saving, recalling, cloning . . 3-22
Alarm 3-20
 Burst mode values 3-20
 Configuration procedure . . . 2-14
 Failure mode 3-19, A-9
 Level verification 3-20
 Multidrop mode values . . . 3-20
Ambient temperature effect A-3
Analog output
 Configure parameters 4-3
 Trim 4-2, 4-10
Approval
 Drawings
 Canadian Standards
 Association B-21
 Factory Mutual B-9
 Standards Association
 Australia B-30
 Information B-1
Approval drawings B-9
Australian certifications B-7

B

Basic setup 3-8
Bench hook-up 3-3
Block diagram 1-3
Blowing down 2-3
Board, electronics 2-15

Bolts

Adapters A-47
Configurations 2-8
Flanges A-47
Head markings 2-7
Installation 2-8, 5-8
Material 2-8
Mounting 2-7
Brackets 2-6
 Options A-47, A-48
Burst mode 3-20
 Advanced functions 3-24
 Alarm and saturation values 3-20
Burst pressure limits A-9

C

Calibration 4-2
 4-20 mA Output 4-3
 Frequency, determining 4-4
 Overview 4-3
 Sensor 4-3
 Sensor trim 4-6
 Tasks 4-2
Canadian Standards Association . B-4
Certifications B-1
 ATEX directive B-2
 Electro magnetic compatibility B-3
 Hazardous locations
 certifications B-4
 Ordinary location B-3
 Pressure equipment directive B-3
Check output
 Process variables 3-7
 Sensor temperature 3-7
Circuit 2-6
Cloning 3-22
Commissioning
 AMS 3-2
 HART 3-2
Communication
 Multidrop 3-25, 3-27
Communicator 3-4, 4-16
Compensating for line pressure 4-12

Configuration 3-1

 Applying a user
 configuration 3-23
 Bolts 2-8
 Cloning 3-22
 Custom A-45
 Data sheet A-50
 Data, review 3-7
 LCD display 3-16
 Custom 3-17
 Standard 3-17
 Recalling 3-22
 Reusable copy 3-23
 Saving 3-22
 Standard A-45
Connections
 Electrical A-11
Considerations
 Draft range 2-3
 Environmental 2-4
 General 2-2
 Mechanical 2-3
Cover installation 2-6
Curr Fixed 4-15
Curr Saturd 4-15
Custom configuration
 LCD display 3-17
 Transmitter A-45

D

Damping 2-3, 3-16, A-10
Detailed setup 3-19, 4-20
Diagnostics 3-21
 Loop test 3-21
 Messages 4-14, 4-16
 Curr Fixed 4-15
 Curr Saturd 4-15
 Error 4-14
 Fail 4-14
 Fail Config 4-15
 Fail Elect 4-15
 Fail Module 4-14
 HART Communicator . . 4-16
 Local Dsbld 4-16
 Loop test 4-15
 Operation 4-16
 Press Limit 4-15

Span Fail	4-16	F		LCD display	2-19
Span Pass	4-16	Factory Mutual	B-4	Mechanical considerations . .	2-3
Temp Limit	4-15	Fail	4-14	Model 305 manifold	2-22
Warnings	4-15	Config	4-15	Model 3051 procedures	2-6
Write protect	4-16	Elect	4-15	Mounting	2-6
Zero Fail	4-16	Module	4-14	Terminal side	2-6
Zero Pass	4-16	Failure mode		Integral manifolds	2-22
Transmitter test	3-21	Alarm values	3-19, A-9	Installation	2-22
Diagrams		Saturation values	3-19	Introduction	1-1
Bench hook-up	3-3	Fast key sequences	3-4	J	
Field hook-up	3-3	Features	1-1	Japanese certifications	B-7
Low power	3-3	Field hook-up	3-3	Jumper	
Digital to analog trim	4-10	Filtering		Alarm	2-14
Dimensional drawings	A-13	Draft range	2-4	Security	2-14
Disassembly		Flange	A-47	K	
Before disassembling	5-3	Orientation	2-6	Kits	2-19
Procedures	5-3	Foundation fieldbus	1-2	L	
Remove electronics board . .	5-4	Frequency, determining calibration	4-4	LCD display	2-15, A-46
Remove terminal block	5-4	Full trim	4-6, 4-8	Custom configuration	3-17
Remove from service	5-3	Functional specifications	A-6	Installation	2-19
Sensor module	5-5	G		Options	3-16
Disassembly procedures	5-3	Grounding	2-18	Standard configuration	3-17
Draft Range	2-3	H		Level verification	
Draft range	2-3, A-1	HART Communicator		Alarm	3-20
Damping	2-3	Diagnostics	4-16	Limits	
Installation	2-3	Hazardous locations certifications . .	2-18, B-4	Burst pressure	A-9
Process noise	2-3	Australian certifications	B-7	Humidity limits	A-10
Side filtering	2-4	European certifications	B-5	Overpressure	A-8
Drawings		Japanese certifications	B-7	Range	3-13
Approval	B-9	North American certifications	B-4	Range and sensor	A-6
Canadian Standards		High process temperature	A-2	Static pressure	A-9
Association	B-21	Housing	5-3	Temperature	A-9
Factory Mutual	B-9	Circuit side	2-6	Line pressure	
Standards Association		Cover	2-6	Compensating	4-12
of Australia	B-30	Exterior	2-6	Effects	A-4
Dimensional	A-13	Remove	5-5	Liquid level	A-2
Dynamic performance	A-4	Rotation	2-6, 2-13	Local Dsbld	4-16
E		Terminal side	2-6	Local zero and span(local keys)	
EMC	B-3	Humidity limits	A-10	Control	4-20
Earthing	2-17	I		Physical removal	4-19
Electrical connections	A-11	Impulse piping	2-12	Software lock out	4-19
Electrical considerations		Installation	2-1	Loop	
Grounding	2-18	Bolts	2-8, 5-8	Setting	3-2
Electro magnetic compatibility . .	B-3	Brackets	2-6	Test	3-21, 4-15
Electronics board	2-15	Circuit side	2-6	Low power	
Installing	5-6	Cover	2-6	Analog output trim	4-10
Low power	2-16	Draft range	2-3	Diagrams	3-3
Removing	5-4	Examples	2-10	Electronics board	2-16
Environmental considerations . . .	2-4	Exterior	2-6	Menu tree	3-6
Error	4-14	Flowchart	2-5	Output range	3-9, 4-20
European Pressure		Housing rotation	2-6		
Equipment Directive	B-3	Integral manifolds	2-22		
European certifications	B-5				
Exterior	2-6				

M

Maintenance 4-1
 Manifolds 2-22
 Installation 2-22
 Manual
 Models covered 1-2
 Use of 1-1
 Mechanical considerations 2-3
 Menu tree 3-5
 Low power 3-6
 Messages
 Diagnostic 4-14
 Meter, LCD display 3-17
 Model 275 HART }
 Communicator 3-4, 3-5, 3-6
 Mounting 2-6
 Bolts 2-7
 Brackets 2-6
 Position effects A-5
 Requirements 2-10
 Multidrop communication 3-27
 Advanced functions 3-25
 Mode values 3-20
 Polling 3-27

N

NAMUR-compliant values 3-19
 Network
 Multidrop 3-26
 Noise
 Draft range 2-3
 Non-wetted parts A-12

O

Operation 4-1, 4-16
 Block diagram 1-3
 Options A-45
 Bracket A-47, A-48
 LCD display 3-16
 Ordering Information
 Model 3051C A-21
 Model 3051H A-31
 Model 3051L A-27
 Model 3051P A-33
 Model 3051T A-25
 Ordinary location certification ... B-3
 Output
 4-20 mA 4-3
 Low power 3-9, 4-20
 Set 3-9
 Square root 3-10
 Overpressure limits A-8

P

PED B-3
 PV Unit 3-8
 Parameters
 Analog output 4-3
 Parts list A-35
 Performance A-4
 Performance specifications A-1
 Reference class A-1
 Physical specifications A-11
 Piping, impulse 2-12
 Polling
 Multidrop communication .. 3-27
 Power supply
 4-20 mA transmitters 2-17
 Effect A-5
 Low power 2-17, 2-18
 Power up 2-16
 Press Limit 4-15
 Pressure equipment directive ... B-3
 Process
 Connections 2-11, A-11
 Flange 2-6
 Wetted parts A-11
 Model 3051L A-12
 Process variables 3-7, 3-8
 Units 3-8
 Product certifications B-1

R

RFI effects A-5
 Range
 Limits 3-13, A-6
 Output 3-9
 Reassembly
 Attaching electronics board . 5-6
 Attaching sensor module ... 5-5
 Installing terminal block 5-6
 Process sensor body 5-7
 Recall factory trim 4-9
 Recalling 3-22
 Reference accuracy A-2
 Reference class A-1
 Rerange 3-10, 4-2
 AMS only 3-13
 Communicator only 3-10
 Pressure input source
 With AMS 3-13
 With communicator ... 3-11
 With local zero and span ...
 3-11
 Response Time A-4
 Reusable copy 3-23
 Ribbon cable 5-4
 Rotation
 Housing 2-6

S

Saturation 3-20
 Burst mode values 3-20
 Failure mode 3-19
 Multidrop mode values ... 3-20
 Saving a configuration 3-22
 Security 2-14
 Sensor
 Calibration 4-3
 Limits A-6
 Module
 Installing 5-5
 Removing 5-5
 Temperature 3-7, 3-8
 Trim 4-2, 4-6
 Service 3-21, A-7
 Service Support 1-1
 Setting the loop 3-2
 Setup
 Basic 3-8
 Detailed 3-19, 4-20
 Shipping weights A-12, A-49
 Signal wiring grounding 2-17
 Software
 Lock out 2-14
 Span
 Adjustment requirements .. A-7,
 A-46
 Button 2-14, 3-12
 Effect 4-12
 Fail 4-16
 Pass 4-16
 Spare parts list A-35
 Specifications
 Functional A-6
 Burst pressure limit ... A-9
 Failure mode alarm ... A-9
 Humidity limits A-10
 Overpressure limits ... A-8
 Range and sensor limits A-6
 Satic pressure limit ... A-9
 Service A-7
 Span adjustment A-7
 Temperature limits ... A-9
 Turn-On time A-10
 Volumetric displacement ...
 A-10
 Zero requirements A-7
 Performance A-1, A-4
 Ambient temperature .. A-3
 Draft range A-1
 High process temperature ..
 A-2
 Line pressure effect ... A-4
 Liquid level A-2
 Mounting position effects A-5
 Power supply effect ... A-5
 RFI effect A-5

Model 3051

- Reference accuracy . . . A-2
- Reference class A-1
- Response time A-4
- Transient protection A-5
- Vibration effect A-5
- Physical A-11
 - Electrical connections . A-11
 - Non-wetted parts A-12
 - Process wetted parts . A-11
 - Process connections . . A-11
 - Process-wetted parts . . A-12
 - Shipping weights A-12
- Square root transition point 3-10
- Standard LCD display configuration . . 3-17
- Standard configuration A-45
- Static pressure limit A-9
- Steam service 2-3
- Support 1-1

T

- Tagging A-45
- Temp limit 4-15
- Temperature 3-8
 - Ambient specification A-3
 - High process A-2
 - Limits A-9
- Terminal block
 - Installing 5-6
 - Removing 5-4
- Terminals 2-6
- Test, Transmitter 3-21
- Time
 - Response A-4
 - Turn-on A-10
- Torque values 5-8
- Transient protection A-5, A-47
- Trim
 - Analog output 4-2
 - Analog output 4-10
 - Choosing a procedure 4-6
 - Digital to Analog 4-10
 - Full 4-6, 4-8
 - Low power analog output . . 4-10
 - Recall factory 4-9
 - Sensor 4-2, 4-6
 - Zero 4-6, 4-7
- Troubleshooting
 - Reference table 5-2
- Turn-On time A-10

U

- Unit
 - Process variable 3-8

V

- Vibration effect A-5
- Volumetric displacement A-10

W

- Warnings 4-15
- Weights A-12, A-49
- Wiring
 - Connect 2-16
 - Diagrams
 - Bench hook-up 3-3
 - Field hook-up 3-3
 - Low power 3-3
 - Signal wiring grounding . . . 2-17
- Write protect 2-14, 4-16

X

- Xmtr Info 4-16

Z

- Zero
 - Adjustment requirements . . . A-7, A-46
 - Button 2-14, 3-12
 - Effect 4-12
 - Fail 4-16
 - Pass 4-16
 - Trim 4-6, 4-7

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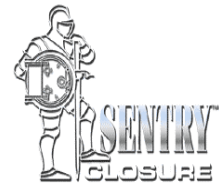


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Sentry®

Operation and Maintenance Instructions

Important Information

Note to Supervisor

Please share this information with your employees and make sure they have received training on closures prior to operation and / or maintenance.

/!\ WARNING: Do not attempt to open the closure while system is under pressure. Failure to relieve all pressure will allow the contents to escape forcefully and may cause severe injury or even death. Follow these instructions.

Closure Installation Instructions are available under separate cover and are included with each closure shipment. For a copy of these instructions, please contact our **Customer Service Department** at one of the following numbers.

Tomball, TX. U.S.A.
Phone 1-800-654-5603 or 281-351-2222
Fax (281) 351-6557
E-mail: sales@rmenergy.com

Or visit our web site: www.rmenergy.com

NOTE: Prior to operating the closure, it is recommended that the following guidelines are reviewed and that personnel become familiar with the closure components and operation.

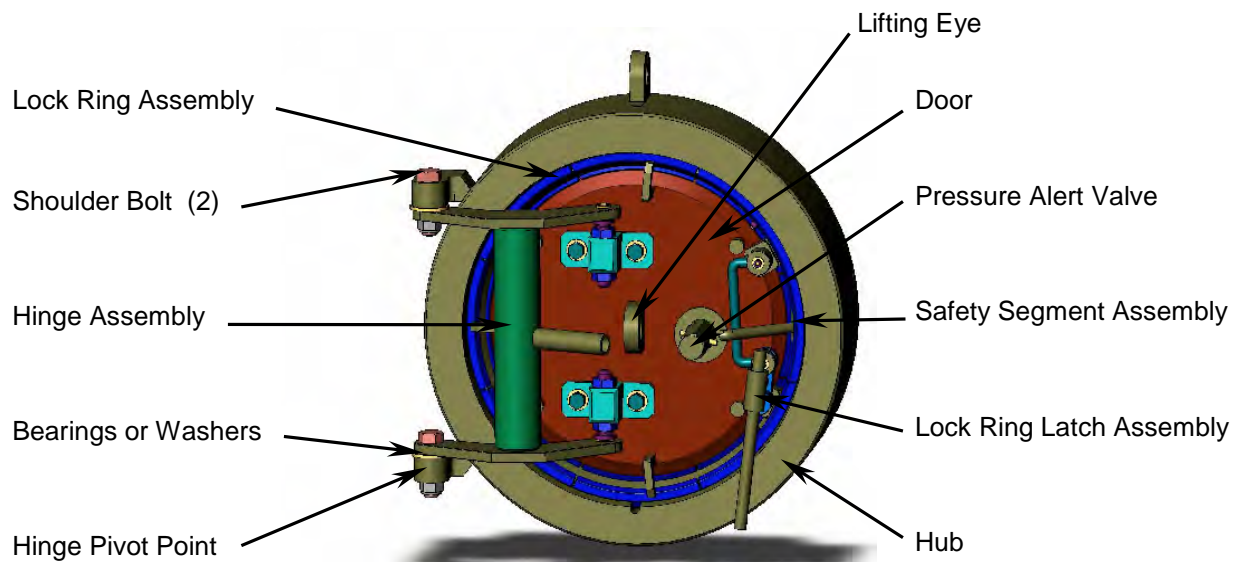


Figure 1
Horizontal Closure
(Typical)

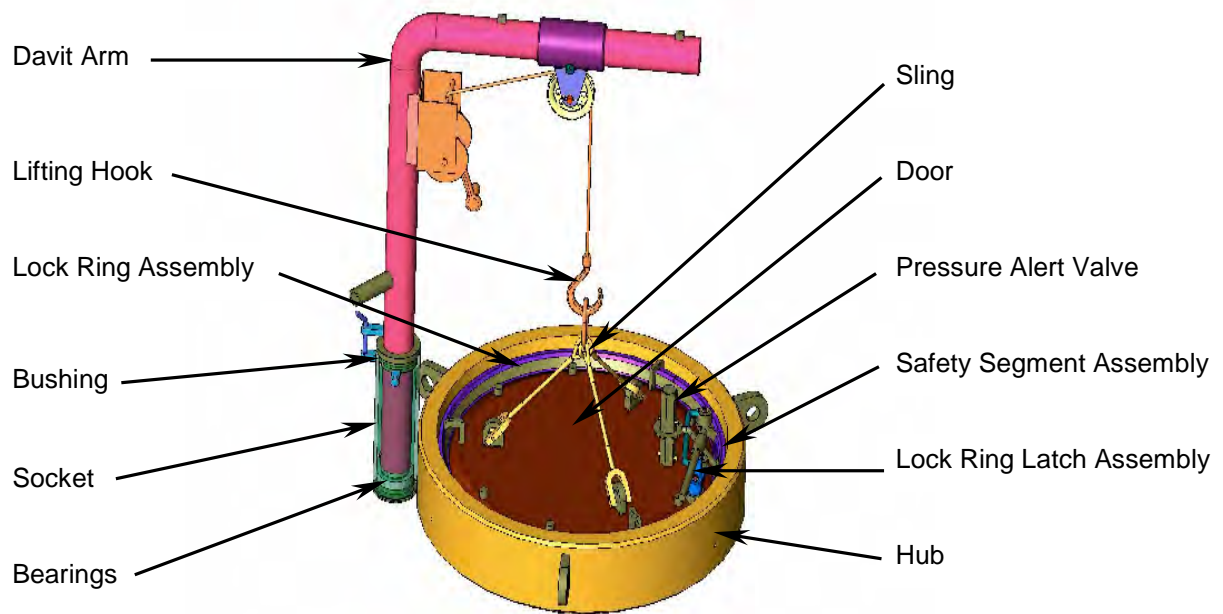


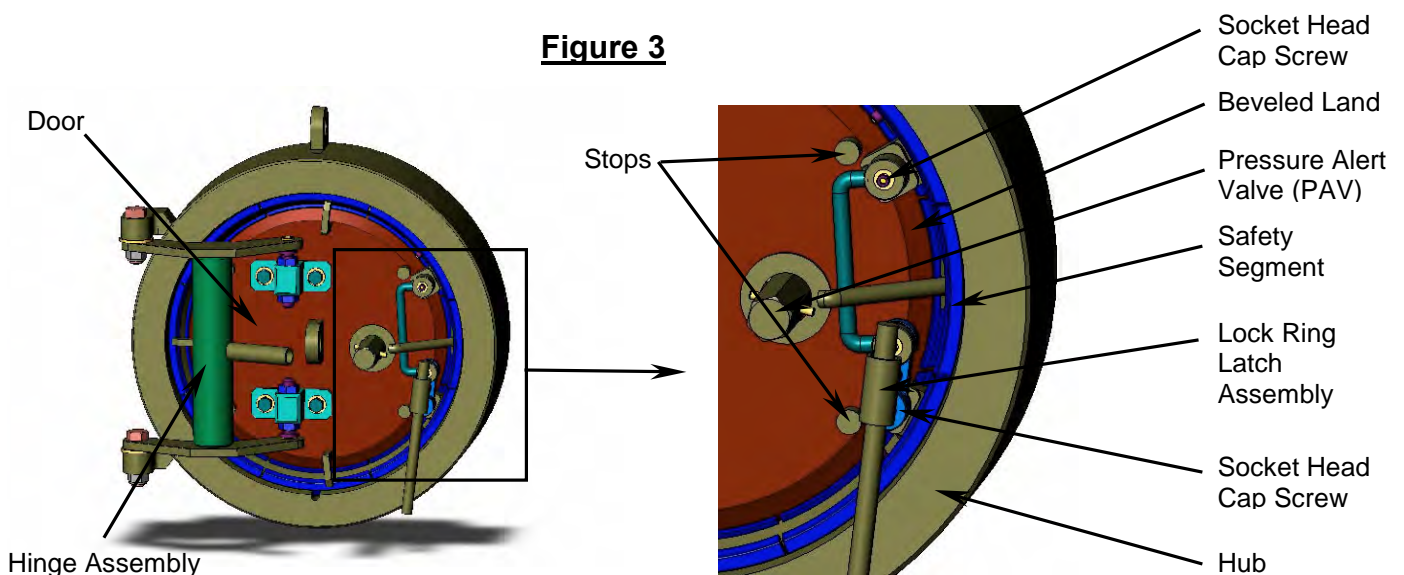
Figure 2
Vertical Closure
(Typical)

SECTION ONE: Opening Procedure for Sentry® Closure

1. Relieve internal pressure from the pipeline or vessel in a safe manner and completely drain contents.
2. After the venting and draining is complete, slowly unscrew the Pressure Alert Valve (PAV) while observing for product or internal pressure.
3. If any product or internal pressure is detected, return PAV to closed position and repeat step one.

Note: The PAV is only intended to warn the operator of residual pressure in the pipeline or pressure vessel. Under no circumstances should the PAV be used to relieve pressure from the pipeline or pressure vessel.

4. If no product or internal pressure is detected, unscrew the PAV completely.
5. Remove the PAV and Safety Segment Assembly from the hub.
6. Rotate the handle on the Lock Ring Latch Assembly counter clockwise to retract the Lock Ring Assembly into the open position. **Note:** The Lock Ring Assembly has a natural spring tendency and it is recommended that a tight handgrip be maintained on the handle of the Lock Ring Latch Assembly throughout this operation.
7. Visually verify that all locking segments are completely disengaged from hub.
8. The Door may now be swung to the open position. **Caution:** Do not place hands or fingers between the Door and Hinge Assembly while opening the closure.



SECTION TWO: Closing Procedure for Sentry® Closure

1. Clean and inspect the Seal and Back-Up Ring, sealing surfaces, and contact surfaces on the Lock Ring Assembly, Hub and Door.
2. Clean and inspect PAV. Replace the o-ring on the PAV if necessary.
3. Replace Seal and/or Back Up Ring if damaged. See page 9 of these instructions (or refer to Product Bulletin P0403).
4. Apply a thin coat of grease to all seal surfaces and to the Beveled Land on the Door.
5. Slowly, swing the Door to the closed position. **Caution:** Do not place hands or fingers between the Door and Hinge Assembly or between the Door and Hub while closing the closure.
6. While applying hand force to hinge handle, rotate the Lock Ring Latch Assembly clockwise to the closed position. **Note:** The Lock Ring Assembly has a natural spring tendency and should not be allowed to snap into position. It is recommended that a tight handgrip be maintained on the handle of the Lock Ring Latch Assembly throughout this operation.
7. Visually verify that all Locking Segments are in the fully closed position and are fully engaged around the circumference.
8. Install Safety Segment Assembly and PAV. Tighten PAV to approximately 50 ft. lbs.

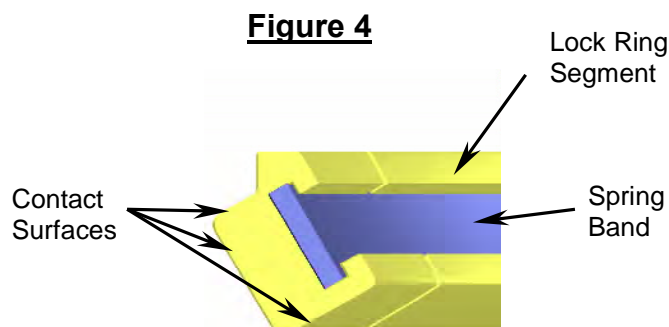
Note: Safe and prudent procedures must be followed during pressurization of the vessel. If any leakage is detected, the pressurization process must be stopped immediately and the vessel must be completely vented and drained. Leakage from the Closure indicates either a damaged Seal or contaminated Sealing Surface. Both the Seal and mating Surface should be inspected in accordance with Section Three – Maintenance.

SECTION THREE: Maintenance of Sentry® Closure

Sentry® closures require limited maintenance that can be performed with minimal downtime and effort. On a routine basis, the following procedures should be followed:

Lock Ring Segments:

1. With the Door in the open position rotate the Lock Ring Latch Assembly clockwise to allow the Lock Ring Assembly to expand to the closed position. Carefully lift the Lock Ring Assembly from the Door and rest on the Hinge Assembly (Fig. 1) or Socket (Fig 2).
2. Clean contact surfaces (see Fig. 4) of any grease, paint and debris. Take care to remove any debris on the inner surface of the Lock Ring Segments and Spring Band. Accumulations and moderate surface corrosion can be removed by hand sanding effected areas with medium grade emery paper.
3. Apply a light coating of grease to the contact surfaces.
4. Return the Lock Ring Assembly to the Door ensuring the open ends of the Lock Ring Assembly are positioned between the stops (see Fig. 3) on the Door. Rotate the Lock Ring Latch Assembly counter clockwise to contract the Lock Ring Assembly to the open position.



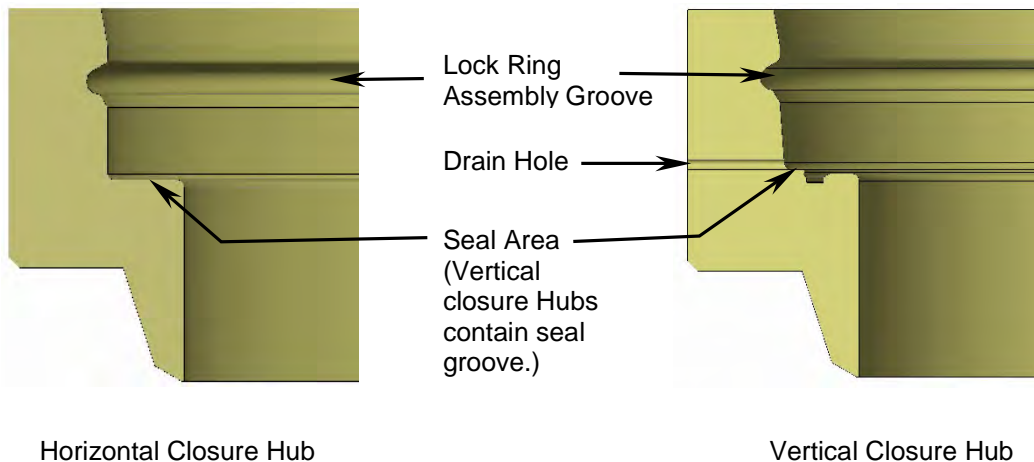
Note: The Lock Ring Segments and Spring Band are constructed of stainless steel material and do not require paint. The Contact Surfaces shall not be painted.

Closure Hub:

1. Clean the closure Hub internal contact surfaces, paying particular attention to the Lock Ring Assembly Groove and Seal Area. Carefully inspect surfaces for damage. If necessary, hand sand affected areas with medium grade emery paper.
2. Ensure all internal contact surfaces are clean and free of any debris and apply a light coating of grease to these surfaces.

Note: Vertical closures are supplied with three Drain Holes (see Fig 5) to prevent the accumulation of water. During general maintenance ensure that these Drain Holes are free of debris.

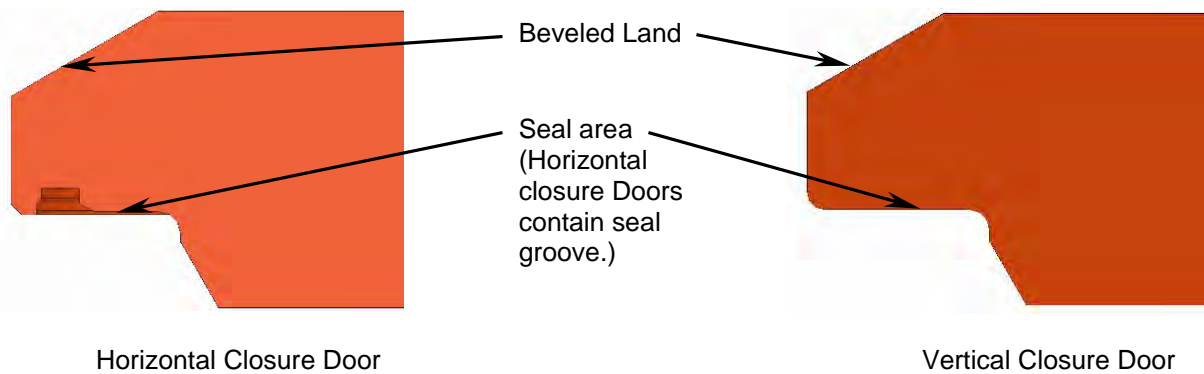
Figure 5



Closure Door:

1. Clean the closure Door contact surfaces, paying particular attention to the Beveled Land and Seal Area. Carefully inspect surfaces for damage. If necessary, hand sand affected areas with medium grade emery paper.
2. Ensure all contact surfaces are clean and free of any paint or debris. Apply a light coating of grease to these clean surfaces.

Figure 6

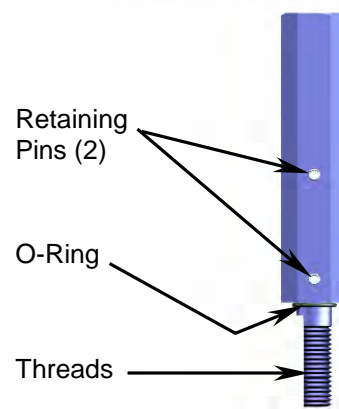


Pressure Alert Valve (PAV):

1. Remove the O-Ring from the PAV and inspect for damage. Replace if necessary.
2. Clean and inspect the PAV threads and the mating threads in the Door. Apply a light coating of grease to the o-ring and threads.

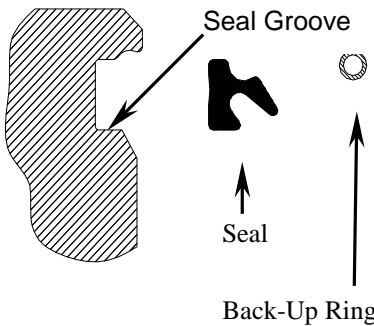
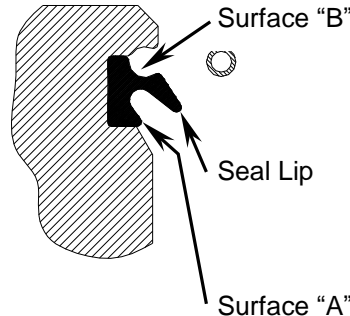
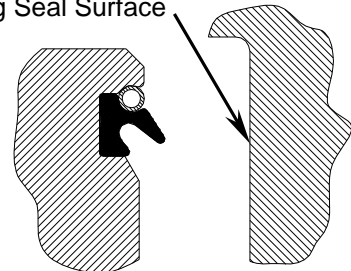
Note: The PAV is constructed of stainless steel material and does not require paint.

Figure 7



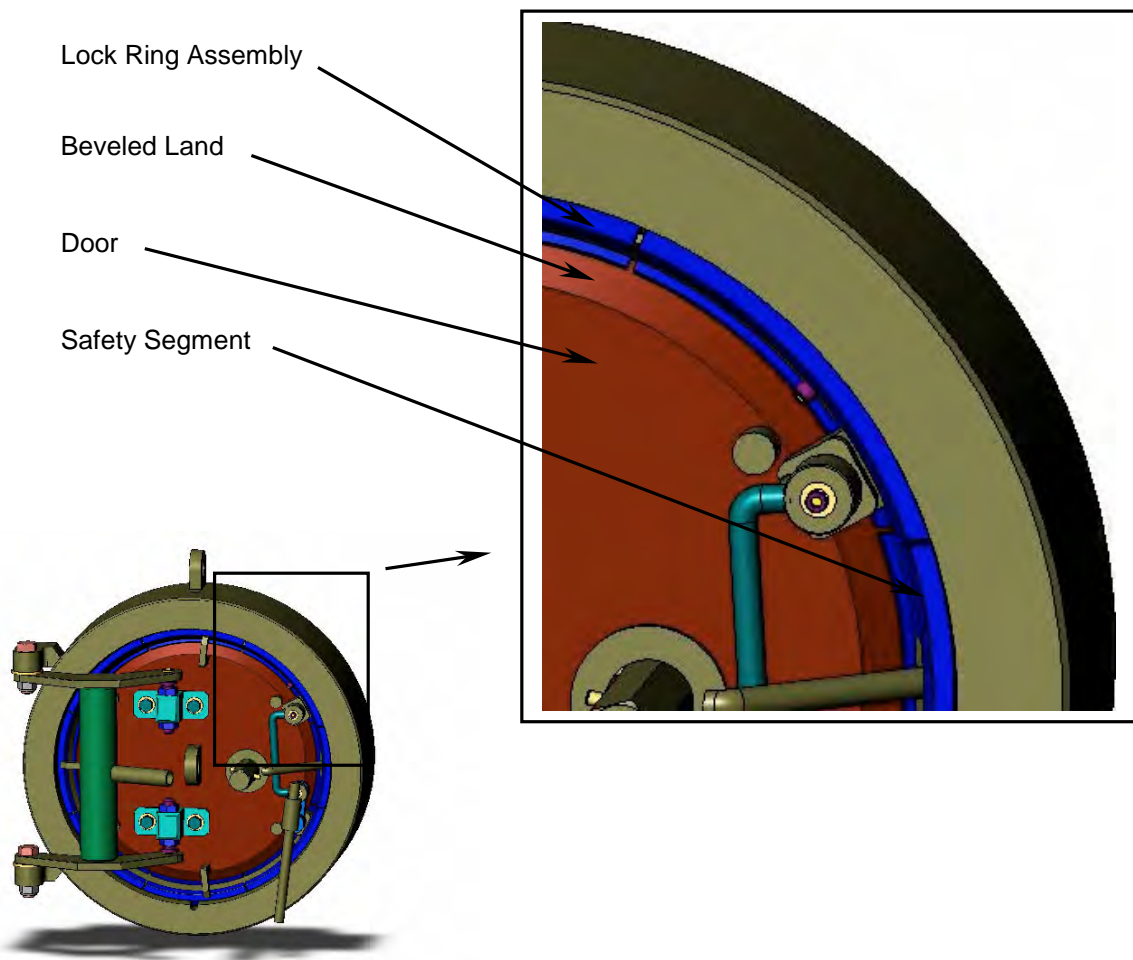
Closure Seal:

Sentry® closures utilize a two-piece sealing system consisting of a special rubber Seal and a stainless steel, spiral-wound Back-Up Ring.

<p>STEP 1</p>		<p>Each time the closure Door is opened:</p> <ol style="list-style-type: none"> 1. Remove the Seal and Back-Up Ring. 2. Inspect both pieces for damage and replace either or both as necessary. 3. Thoroughly clean the Groove. 4. IMPORTANT: Apply a thin coat of lithium grease to the Seal.
<p>STEP 2</p>		<ol style="list-style-type: none"> 1. Press the Seal into the Groove with the Seal Lip pointing toward the center of the closure. 2. Beginning at the 12 O'clock position, work in both directions around the circumference to the 3 & 9 O'clock positions and finally to the 6 O'clock position. It may be helpful to apply a small amount of lithium grease to your finger or to a round tool (such as the round side of a small Allen wrench) and work the seal into the groove by pressing on Surface "A". 3. After the seal is positioned in the groove, make sure the seal is firmly seated by pressing around the circumference on Surfaces "A" and "B".
<p>STEP 3</p>		<ol style="list-style-type: none"> 1. IMPORTANT: Apply lithium grease around the circumference of Surface "B". 2. Press the Back-Up Ring into position on Surface "B". Beginning at the 12 O'clock position, work in both directions around the circumference to the 3 & 9 O'clock positions and finally to the 6 O'clock position. Avoid stretching the Back-Up Ring when installing. 3. Thoroughly clean the Mating Seal Surface. 4. IMPORTANT: Apply a thin coat of lithium grease around the circumference of the Mating Seal Surface. 5. The Seal is now properly installed.

SECTION FOUR: Sandblasting and Painting Precautions

1. Mask off the Lock Ring Assembly, Safety Segment and Beveled Land on the Door.
2. Avoid directing the sandblasting at the masked off area.
3. Clean thoroughly after sandblasting and apply a thin coat of grease to the Beveled Land on the Door prior to painting.





SECTION FIVE: Storage of Sentry® Closure

Sentry® closures are supplied with protection for both short and long term storage. This protection includes:

Exterior surfaces: Painted with red oxide shop primer finish.

Locking surfaces: All machined and unpainted surfaces are protected with a coating of grease.

Weld bevel: Protected by suitable plywood end cap or wooden skid base.

Recommended storage for Sentry® Closures:

Short term

Preferred: Indoors away from fabrication activities.

Acceptable: Outdoors with suitable protection (such as plastic sheeting or tarpaulin) from moisture or rain.

Long term

Preferred: Indoors away from fabrication activities.



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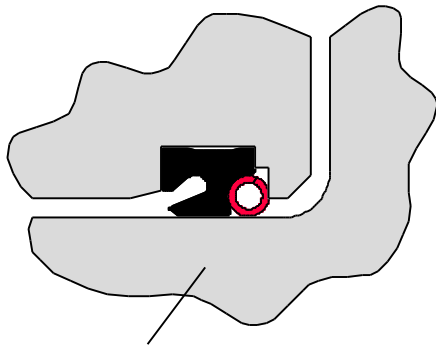
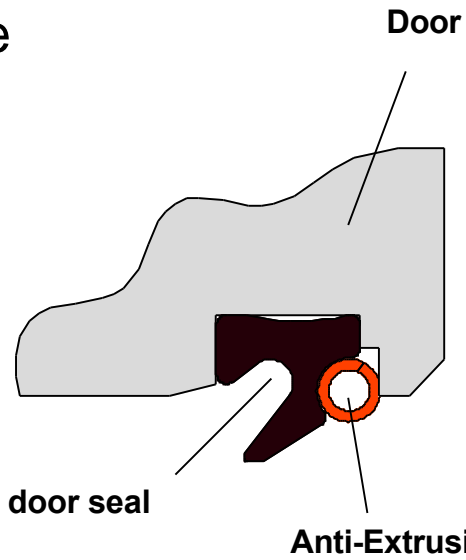
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Sentry™ Quick Opening Closure Main Door Seal

Door Open

Seal shown in neutral condition while the Door is open. The Anti-Extrusion Ring simply locks into the C-groove molded to the outer edge of the seal.



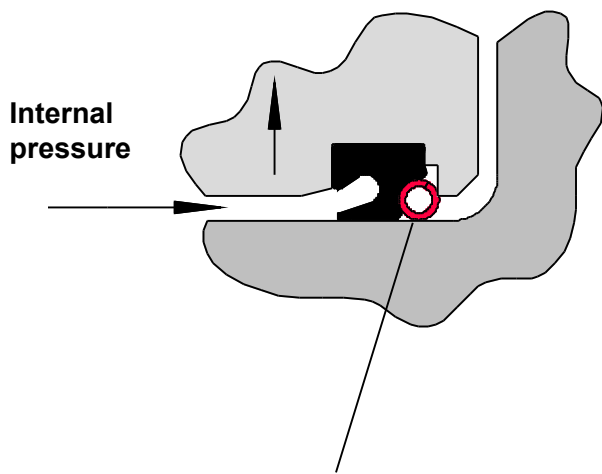
Door Closed

The closing action of the door compresses the lip of the seal to create the initial pressure boundary. The seal makes contact both within the door groove and across the length of the lip upper surface. It is capable of withstanding both vacuum and atmospheric internal pressures.

Closure Hub shown in closed position

Pressurized

The benefit of the Sentry closure design is that when pressure is introduced, it bears against the internal 'U' cup surface of the seal. This flattens the contact surfaces of the seal against both the door groove and hub sealing surface. This compression of the seal also causes the anti-extrusion device to move outwards filling the gap between the door and hub, preventing the possibility of seal extrusion under high pressure conditions.



Anti-extrusion spring moves to fill gap between door and hub

Sentry™ Closure

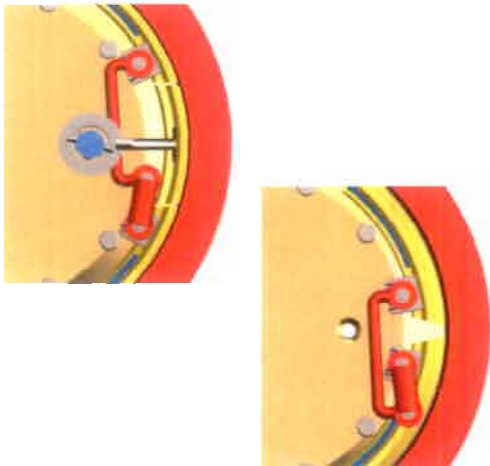
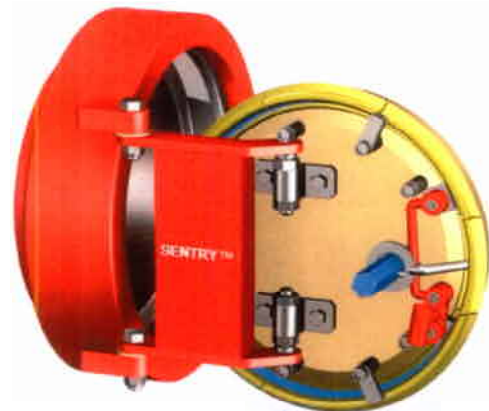
The Sentry™ closure was designed to meet a simple criteria to provide a 'Simple design incorporating an improved locking arrangement, permitting operation of any size closure in less than 90 seconds and integral safety to prevent unsafe operation'. The Sentry™ closure not only meets, but surpasses these needs.

Designed using the classical formulas of ASME Section VIII Div. 1, validated by Finite Element Analysis and verified with extensive proof testing, the Sentry™ closure can be supplied in accordance with all international design codes.

General Design

The Sentry™ closure concept relies on a simple ring of material that slides within a groove machined into the outer flange or hub. When expanded to the closed position, the locking ring securely locks the door into position.

This design methodology is well proven within the industry and provides distinct advantages of integral safety and avoids the reliance on threaded components for pressure retaining.



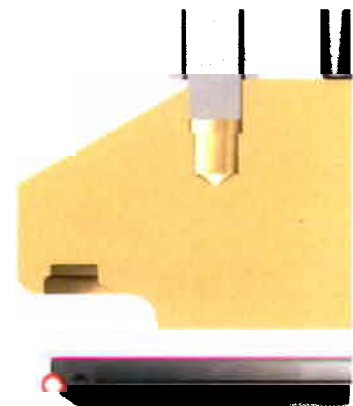
Closure Operation

The Sentry™ closure operating cycle consists of removing the Pressure Alert Valve / Safety Segment assembly and then rotation of the actuator lever 180°. This simple operation contracts the locking ring sufficiently to clear the outer flange, allowing the door to be pulled opened. Closing is simply a reversal of this operation.

Closure Sealing

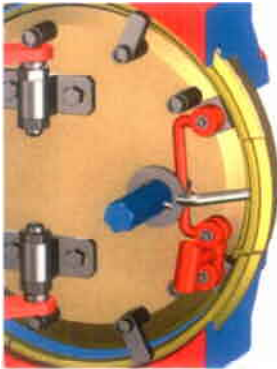
A key feature of the Sentry™ closure is the pressure energized lip seal. Located within the face of the door for protection, the seal is available in a wide range of materials and suitable for both full vacuum and ultra-high pressure ratings.

Designed to provide extended service life, the Sentry™ seal is a two part design consisting of an elastomeric seal and a separate coiled spring back up.



Closure Safety

Safety is paramount in today's industry and the Sentry™ closure not only provides speed of operation but also the benefit of integral safety to prevent unsafe operation. With the locking ring in the locked closed position, internal pressure creates a seating force that physically traps the locking element between the door and outer hub, making it impossible for the door to open.



This design characteristic is then further enhanced by the integral Pressure Alert Valve (PAV) that threads into a pressure sensing port. A small removable segment of the locking ring is attached to the PAV, preventing accidental opening.

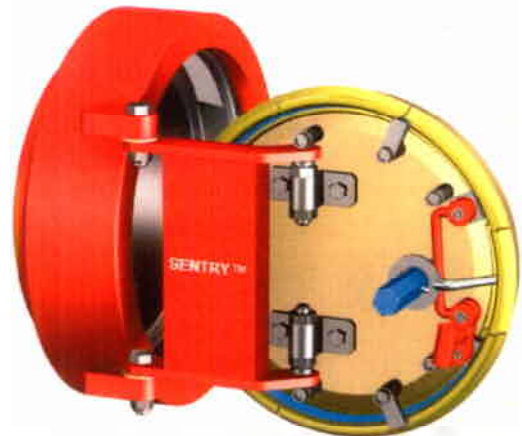
Operation of the PAV provides positive indication as to the pressurized state of the pressure vessel.

Configurations

The Sentry™ closure is available in both:

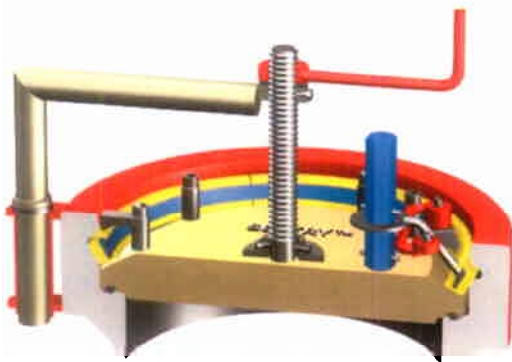
Horizontal

For horizontal operation, the Sentry™ closure is supplied with a heavy duty, double pivot hinge arrangement that fully supports the weight of the closure door, minimizes the swing radius and insures repetitive operation.



Vertical

For vertical operation, the Sentry™ closure is supplied with a heavy-duty davit arm arrangement, capable of supporting the weight of the door and being positioned to provide safe access to the vessel interior.



For larger diameter closures, where the weight of the door becomes a restraining factor, the door is supplied with three lifting eyes for use with overhead lifting equipment.

Sentry™ Closure Product Overview

<u>Size range:</u>	6" to 72" Nominal
<u>Pressures:</u>	Full vacuum to 2220 psig working pressure
<u>Ratings:</u>	ANSI 150, 300, 600, and 900
<u>Design specifications:</u>	ASME Section VIII Div. 1 'U' stamp ASME Section VIII Div. 2 ANSI B31.3, B31.4, B31.8 BS 5500
<u>Configurations available:</u>	Horizontal Vertical
<u>Materials of construction:</u>	Carbon steel Low temp carbon steel Stainless steel Duplex stainless steel Specialty alloys Clad / weld overlay alloys
<u>Sealing:</u>	Elastomeric pressure energized lip seal with stainless steel anti-extrusion back up ring. Elastomeric seal available in: Nitrile, Viton, Elast-O-Lion, Aflas and other specialty grades.
<u>Accessories:</u>	Protective weather covers Non-venting Pressure Alert Valve Key interlock system Position indicators

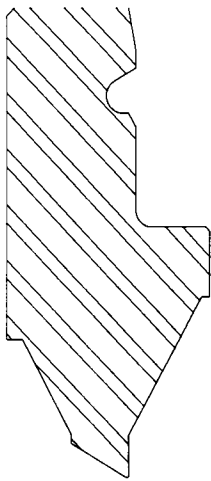
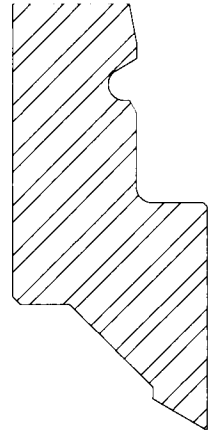
Sentry™ Design Variations

To meet the demanding requirements of pressure vessels supplied in today's market, the Sentry™ closure can be supplied in various configurations:

Standard (Full Bore)

Standard weld bevel configuration is produced in accordance with ANSI B16.5 (or applicable design code) with bevel machined to meet customers' specifications (single V, double V, J, inside or outside bevel)

The closure bore is machined to match the internal bore of the mating vessel or pipe.



Tapered Bore (Reduced Bore)

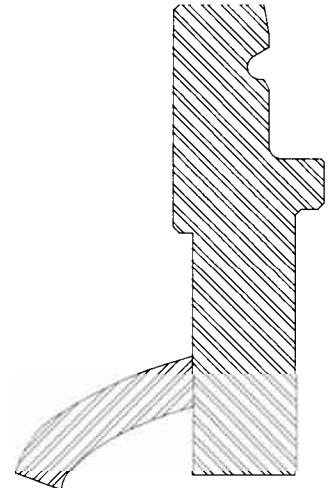
The weld joint configuration is machined to meet the customers' specification and is positioned towards the outer diameter of the closure flange. An internal taper is provided for transition to the smaller closure opening.

This configuration is especially suited for use on filtration equipment where access is required but a small reduction in opening size does not hinder removal of the filter elements.

Self reinforced

Designed specifically for access to large diameter vessels where full diameter access is not required or economically justified.

The closure hub is supplied with an extended length to provide the required nozzle projection and reinforcement to satisfy the applicable code requirements.



Customer Service Departments

U.S.A.

1-800-654-5603 or 281-351-2222

Canada

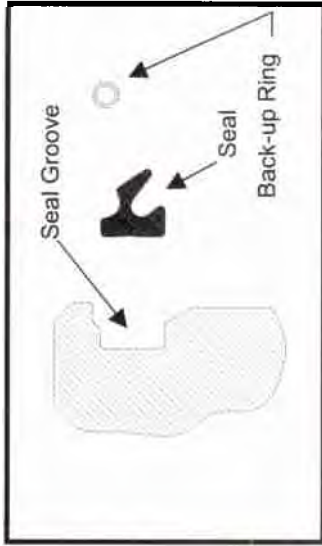
1-800-661-5659 or 780-437-6316



PRODUCT BULLETIN – P0403

Issued: November 11, 2003
Product: Sentry Quick Opening Closures
Notice: Seal Installation Guidelines
Contact: Customer Service (800-654-5603)

STEP 1

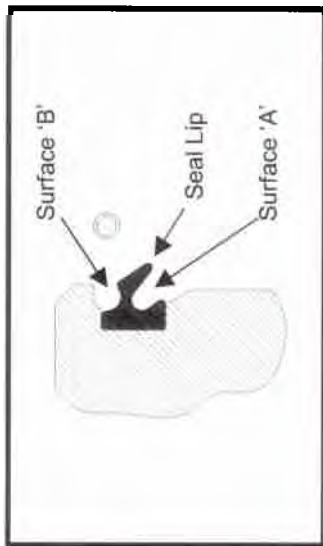


Sentry Closures utilize a two-piece sealing system consisting of
 (1) a special rubber seal and
 (2) a stainless steel spiral-wound back-up ring.

Each time the closure door is opened:

- Remove the seal and back-up ring.
- Inspect both pieces for damage and replace either or both as necessary.
- Thoroughly clean the groove.
- Apply a light coat of lithium grease to the seal.

STEP 2



- Press the seal into the groove with the seal lip pointing toward the center of the closure.
- Beginning at the 12 O'clock position, work in both directions around the circumference to the 3 & 9 O'clock positions and finally to the 6 O'clock position. It may be helpful to apply a small amount of lithium grease to your finger or to a round tool (such as the round side of a small Allen wrench) and work the seal into the groove by pressing on Surface 'A'.
- After the seal is positioned in the groove, make sure the seal is firmly seated by pressing around the circumference on Surface 'B'.

STEP 3



- Apply a light coat of lithium grease to the spiral-wound back-up ring.
- Press the back-up ring into position on Surface 'B'. Beginning at the 12 O'clock position, work in both directions around the circumference to the 3 & 9 O'clock positions and finally to the 6 O'clock position.
- Thoroughly clean the mating seal surface.
- Apply a light coat of lithium grease around the circumference of the mating seal surface.
- The seal is now properly installed.



Type 1530 Pneumatic Level Switch

Form 500

Type 1530 is a horizontally mounted, float-operated level switch suitable for plant and OEM applications where pneumatic valve operation is required to signal presence or absence of liquid at a discrete level. The float extension arm moves a magnet which actuates (deactuates) a pilot valve to operate a pneumatic amplifier. Actuation (deactuation) can be reversed by rotating the unit 180 degrees.



Product Specifications

Mounting

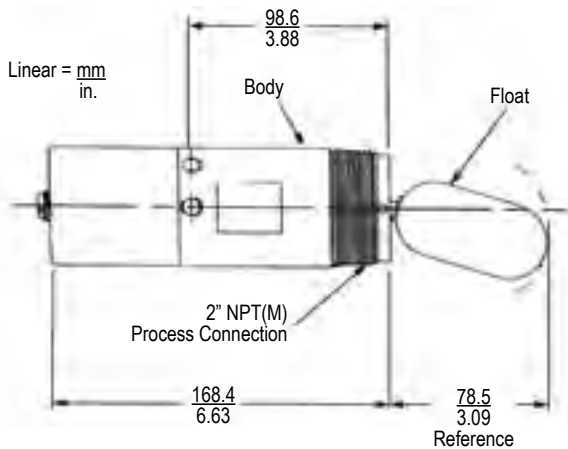
Orientation	Horizontal mount only	
Connection Size	2" NPT(M) Standard	
For	Change	To
Flange Mounting	G2A	*

*See flange table on page 2 for option designator

Maximum Process Pressure	1500 psi (103 bar)
Supply Pressure Range	20 to 60 psi (1.4 to 4.1 bar)
Supply Pressure Connection Size	1/8" NPT(F)
Minimum Specific Gravity	0.60
Design Code	ANSI B31.3
Shipping Weight	Approximately 6 lbs. (3 kg)

Design and specifications are subject to change without notice. For latest revision, see www.sorinc.com.

If supply pressure medium is natural gas, a filter/regulator is suggested on the supply line, and the valve vent port should be piped to a safe area.



How to Order

Select model number from table below. Accessory designator(s) may be added after PS if required. See page 2.

Body Material	Float Material	Process Rating		Model Number
303SS* (Standard)	316SS	1500 psi -40 to 400°F	100 BAR	1530B -G2A - C - J0 - PS
	Monel	900 psi -40 to 400°F	62 BAR	1530B -G2A - M - J0 - PS
	Polypropylene	5000 psi -40 to 150°F	345 BAR	1530B -G2A - S - J0 - PS
316SS	316SS	1500 psi -40 to 400°F	100 BAR	1530C -G2A - C - J0 - PS
	Monel	900 psi -40 to 400°F	62 BAR	1530C -G2A - M - J0 - PS
	316SS	5000 psi -40 to 150°F	345 BAR	1530C -G2A - S - J0 - PS

Note: Maximum temperature for polypropylene is 150°F.

*Also known as ASME SA 320 Grade B8F.

316SS construction only.

Designator	Raised Face Flange	
G7C	2-1/2"	150#
G7D		300#
G7E		600#
G3C	3"	150#
G3D		300#
G3E		600#

Designator	Raised Face Flange	
G4C	4"	150#
G4D		300#
G6C	6"	150#
G6D		300#

On flanged units, the float will be detached for the unit during shipping.

Optional Accessories

Add option designator(s) to end of model number.

Description	Designator
Wetted parts are cleaned for industrial oxygen service.	BB
Canadian Registration Number (CRN) - Maximum allowable pressure rating is 1500 psi. Consult the factory for details.	CV
NACE construction - MR-01-75. Available only with 316SS materials of construction.	NC
Tag, fiber. Attached with plastic wire to housing. Stamped with customer-specified tagging information.	PP
Stainless steel nameplate attached to housing with wire. Stamped with customer-specified tagging information. (2 lines, 18 characters and spaces per line.)	RR
Stainless steel nameplate permanently attached to housing. Stamped with customer-specified tagging information.	TT
Fungicidal varnish. Covers exterior and interior except working parts.	VV
Epoxy coating. Exterior only. Polyamide epoxy with 316SS pigment.	YY
ANSI B31.3 certificate of conformance.	CZ

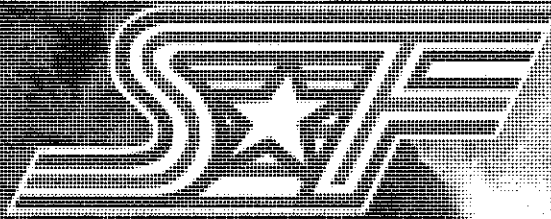
Replacement Parts

Description	Designator
Pneumatic Relay Assembly	3130 - 114
316SS Float Assembly	3130 - 052

Limited Warranty

SOR® agrees to repair or replace any switch found to be defective in material or workmanship within five years from date of shipment. The limited warranty is valid only if the switch was installed in accordance with published factory installation instructions, operated within the design limitations stated on the nameplate, and returned to the factory for inspection, freight prepaid, within the warranty period. Contact the factory for return authorization. No claim for labor or consequential damages will be allowed.





Sure Flow
Equipment Inc.

CHECK VALVES

Double Disc, Dual Disc, Wafer, Flanged,
Lug, Elastic Swing, Horizontal Swing, Vertical
Swing, Silent or Silent, Foot Valves

"THE WORLD OF CHECK VALVES"

Index

Product information 2-4
 Standard Materials of Construction 5
 Identification Code 5
 Installation Dimensions for ANSI Valves 6
 Installation Dimensions for Lug Body and Flanged Body ANSI Check Valves 7
 ANSI Stud Bolting Dimensions 8
 Installation Data 8
 Pressure Loss Through Valves 9
 Seat Options 10
 Quality policy 11
 Cast Steel & Cast 316SS, Type CD 150 -
 Wafer Double Door - Dual Disc 12
 Cast Iron Wafer Double Door 13
 Elastic Swing Check Valve 14
 Cast Iron Horizontal Swing Check Valve 15
 Wafer Swing Check Valve 16
 Silent Check Valve - Cast Iron Wafer 17
 Carbon & Stainless Steel Wafer Silent Check Valve ... 18
 Cast Iron Flanged Silent Check Valve 19
 Cast Steel Flanged Silent Check Valve 20
 Pressure Drop Charts 21
 Foot Valve 22
 Foot Valve Assembly 23
 Warranty 24

Sure Flow Equipment Inc. is a worldwide leader for industrial valves and strainers, manufacturing and distributing to over 40 countries.

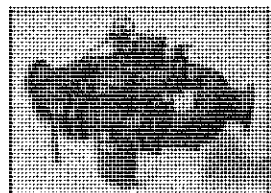
Sure Flow's initial focus was to supply the marketplace with an extensive line of Y-Type Strainers, Simplex Strainers, Duplex and Fabricated Strainers. The product line provides a solution to every filtration problem in every industry and if we haven't already solved your problem, our Engineers will develop the best answer.

In addition to Pipeline Strainers, Sure Flow offers Wafer Double Door Check Valves, Silent Check Valves, Butterfly Valves 2" to 48", Knife Gate Valves and Expansion Joints.

Sure Flow products are available in Cast Iron, Steel, Stainless, Bronze, and any exotic Alloy, in sizes from 1/4" to 60", 125 lb. to 2500 lb. Class, in NPT, Flanged, Butt Weld and Socket Weld.

Many design codes are available.

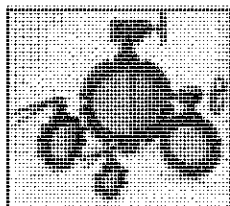
The Universe of Industrial Valves from



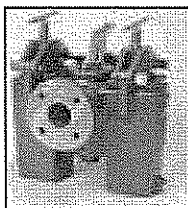
Fabricated Duplex Strainers



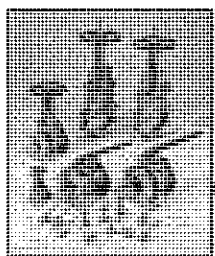
Fabricated Sanitary Dual Basket Strainers



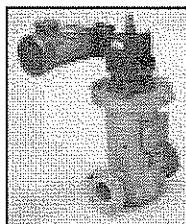
Butterfly Valves



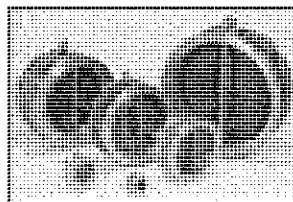
Cast Iron Duplex Silent Check Valve



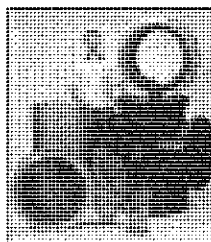
Ball Valves



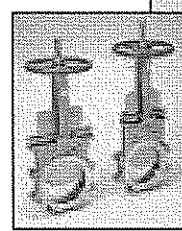
Automatic Strainers



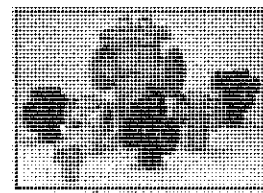
Wafer Check Valves



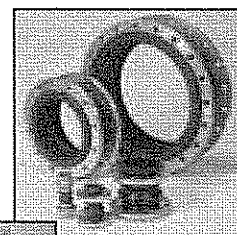
Custom Screens



Knife Gate Valves



Strainers



Pump Connectors



The Sure Flow Check wafer check valve is a precision engineered, fully developed product at the forefront of pipe system technology. Sure Flow Check can be installed with confidence into offshore or onshore pipeline systems on product or service lines, wherever non-return protection is required.

Manufactured to meet API specifications, Sure Flow Check meets all the key criteria and in the vitally important area of comparative weights is actually lighter than other wafer check valves.

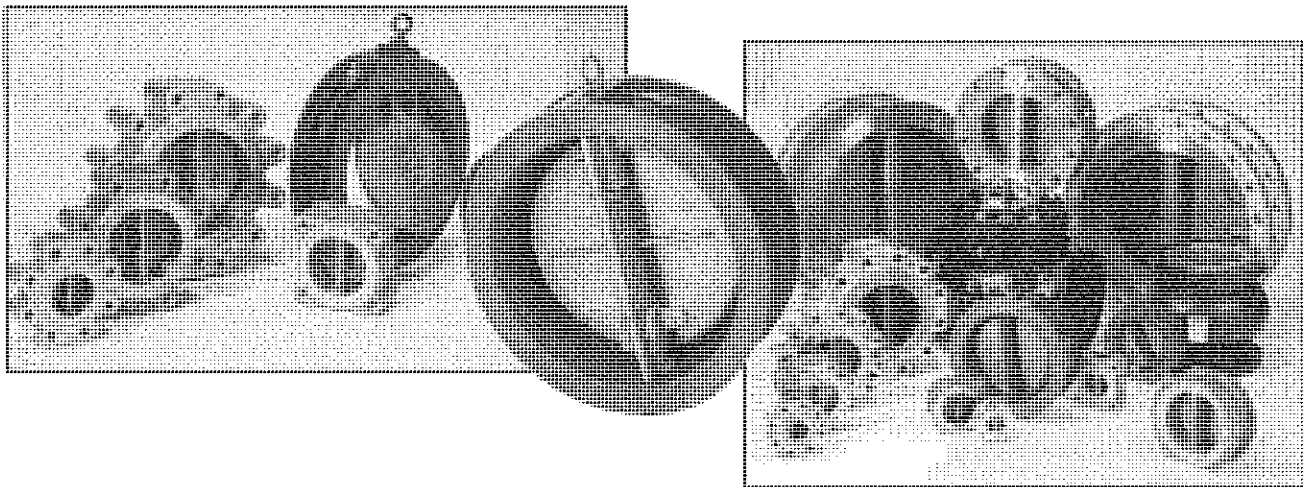
Sure Flow Check offers other operational benefits. **It is light, tight, strong, compact and cost effective.**

Sure Flow Check is a precision engineered dual plate wafer check valve. It has been designed specifically for its environment and its duty. Every component has been carefully chosen only after matching its performance requirements with value analysis criteria.

The Sure Flow Check Valve meets API 594 wafer check valve standard (except face to face dimensions of ANSI 125 cast iron valves from 2-1/2" to 12" in which case they meet the Industry Standard).

- ANSI B16.5 flange dimension
- ANSI B16.47 above 24", flange dimension
- API 594 – materials, design & face to face
- API 605 (B16.47), flange dimension
- API 6A – flange dimension & face to face
- API 6D – materials
- API 598 – testing
- ANSI B16.34 – materials, wall thickness

Double Door or Dual Disc Available Wafer • Flanged • Hub • Lug



Range of Valves

- | | |
|--|---|
| <p>Sizes: • 2" to 72"</p> <p>Pressures: • ANSI Class 125 & 250
• ANSI Class 150 to 2,500
• API 2,000# to 10,000#</p> <p>Temperatures: • Minus 400°F. to 1,200°F.</p> <p>Seating: • Resilient or Metal to Metal</p> | <p>Materials: • Cast or Forged
• Cast Iron, Cast Steel
• Stainless Steel & Bronze</p> <p>Types: • Flanged
• Flangeless (Wafer Style)
• Lug (Drilled or Threaded)
• Butt Weld
• Hub End (for Clamp Joints)</p> |
|--|---|

Lighter

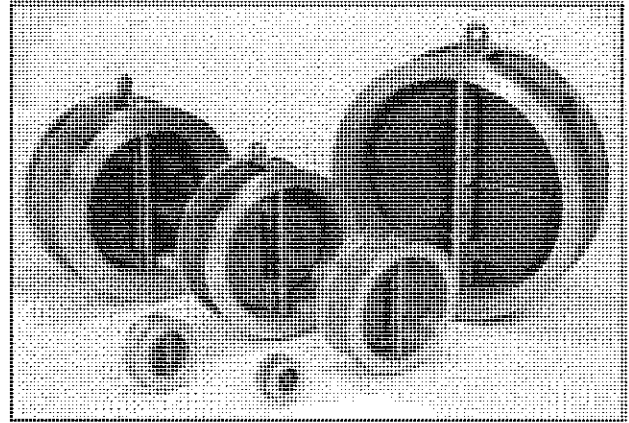
Wafer check valves are recognized as being substantially lighter in weight than conventional swing check valves of the same size and pressure class.

For example:

6" class 150 swing check weighs 175 lbs.

6" 150 Sure Flow Check weighs only 28 lbs.

This weight advantage means that the whole pipework system is lighter, consequently the pipework support structure can also be lighter and installation costs reduced.



Stronger

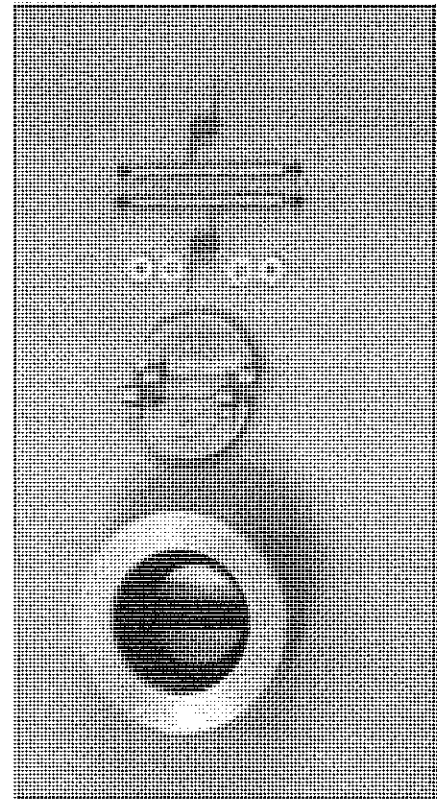
Lighter weight does not mean, however, that strength has been sacrificed. In fact a Sure Flow Check is actually stronger than the equivalent length of pipe. Ribs around the side wall support the flange faces.

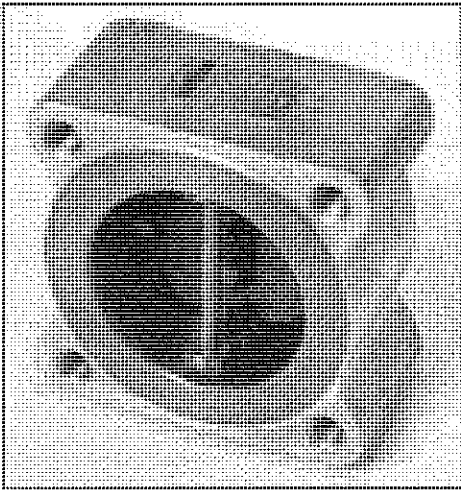
The Sure Flow Check Valve provides the following important features:

- ◆ Twin plate, flat seat design for efficient sealing.
- ◆ Long leg spring(s) allows the plates to open and close without seat scrubbing.
- ◆ Valves 14" and larger are fitted with patented independent spring(s) as a standard feature.
- ◆ Lower head loss than swing checks above 6".
- ◆ Valves with soft seats have bubble tight closure to API 6D.
- ◆ Valves with metal/hardfaced seats have low leakage in accordance with API 598.
- ◆ Simplicity of installation is a key feature.
- ◆ A wide range of seat options is available.

The strong central rib gives rigidity to the body, protects the mechanism from damage by foreign objects in the flow and also provides a broad seating area for the plate heels.

The pins which support the plates and anchor the spring are substantial in order to withstand the pressures imposed on them by the flow.





If the rib profile and size are reduced or the pins are slimmed down, the valve might not provide the safety margin in operation which is one of the main reasons for having a wafer check valve in the first place.

Compact

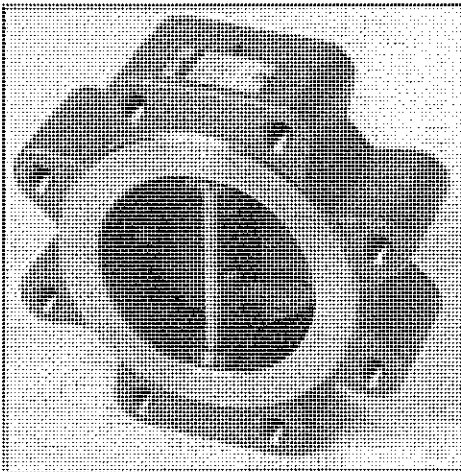
Sure Flow Check meets the internationally accepted API 594 standard for steel valves. A 6" class 150 valve has a face to face measurement of just 8-3/4" compared with a swing check valve's 14" face to face dimension. A Sure Flow Check fits completely inside the flange bolt PCD and therefore external installation is straightforward.

Non-Slam

Sure Flow Check is a non-slam check valve because it operates on flow cessation, not flow reversal. The normal position of the plates is closed, held against the seat by the unique spring design. As flow begins the heels of the two plates are lifted off the seat face on the central rib.

This cracking pressure is less than 2 psi across most of the range. As flow increases, the plates then pivot against the spring pressure. Since the heels have already lifted off the rib seat there is no scrub or wear, either on the rib, body or plate seating surfaces. A pressure of only 4 psi is required to keep the plates fully open.

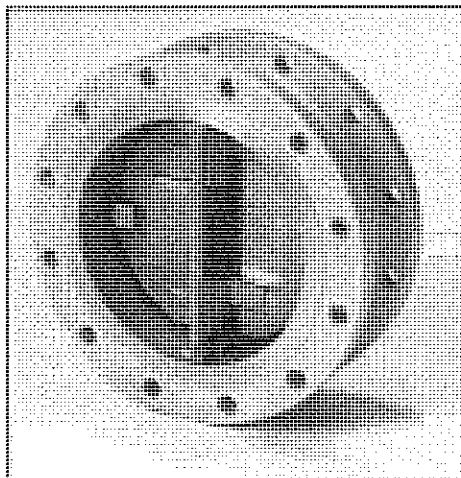
When flow stops and that pressure is removed the spring closes the plates. Flow reversal is then stopped by the closed Sure Flow Check valve and in fact any back pressure only serves to make the valve seal more tightly.



Tight

The long leg spring design - with a single anchor point - is a unique feature of the Sure Flow Check design. Coupled with floating plates for minimum seat wear and the right choice of seat to suit the service requirements, this gives the best combination to meet API 598 requirements.

The long spring leg ensures closing tension is applied to the right part of the plate whilst allowing the plate heels to float on opening. For valves 14" and larger, the spring is anchored to the stop pin to ensure that both plates open and close independently. If the spring is not anchored, then the opening of one plate transfers pressure through the spring to make it more difficult for the other plate to open.



Standard Materials of Construction

ANSI 150 through 2500 Series Body & Plate Castings

ASTM A216 Grade WCB
Carbon Steel (0.22% Carbon Max.)

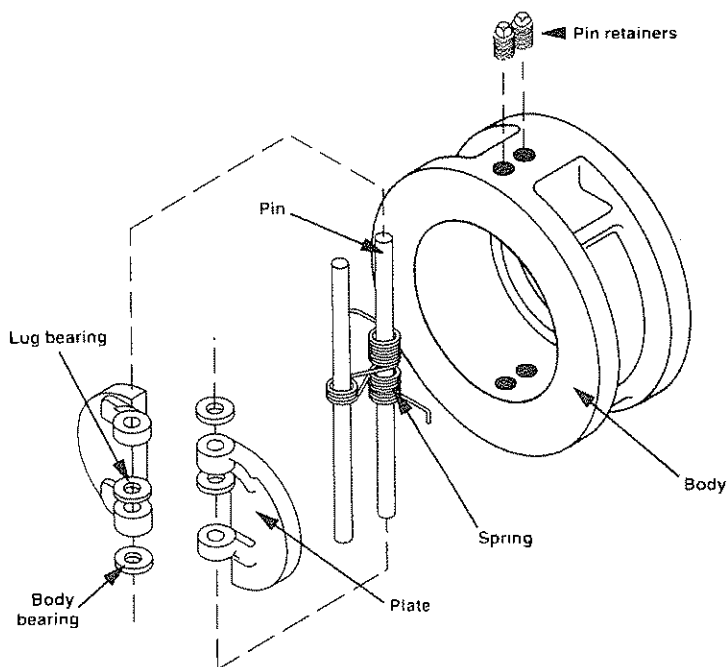
ASTM A217 Grade CA15
Stainless Steel (410)

ASTM A351 Grade CF8M
Stainless Steel (316)

BS 1400 Grade AB2 Aluminum Bronze
(ANSI 150 & 300 Series)

Other materials available on request.

Valve Parts Explosion



Springs	Max. Operating Temperature
316 SS	120°C (248°F)
Inconel 600	315°C (600°F)
Inconel X 750	537°C (1000°F)

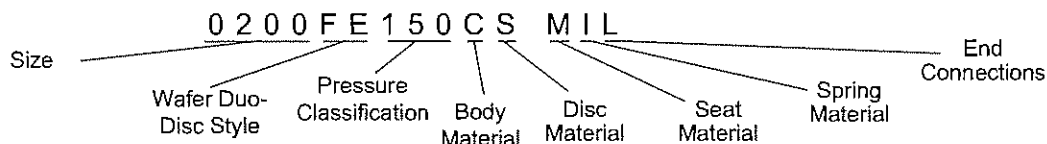
Spring Selection

For temperatures up to 315°C (600°F), Inconel springs will be furnished as standard on all valves that are ordered with metal and Viton seats. For service conditions above 315°C (600°F), Inconel X springs should be specified.

For Seal Selection Refer to Ordering Information

Identification Code/Figure Number

EXAMPLE



Pressure Classification						
Code	150	300	600	900	1500	2500
ANSI	150	300	600	900	1500	2500

Body and Flapper Materials		
Code	Material	Specification
C	Carbon Steel	ASTM A216 Grade WCB
S	Stainless Steel	ASTM A351 Grade CF8M

Seat Material	
Code	Material
M	Metal
V	Viton

Spring Material		
Code	Material	Max. Temp. F.
I	Inconel	600°F

End Connectors	
Code	Connection
R	Serrated Gasket Finish
L	Lug 2" - 10"
F	Flanged 12" - 24"

Installation Dimensions for ANSI Valves

Class 125 Model FE 125				
Size	Outside Dia.	Face to Face	Min Flange Bore	Weight lbs
2"	4 ¹ / ₈	2 ¹ / ₈	2 ¹ / ₁₆	4.5
3"	5 ³ / ₈	2 ¹ / ₄	3 ¹ / ₁₆	6.5
4"	6 ⁷ / ₈	2 ¹ / ₂	4	10
6"	8 ³ / ₄	3	6 ¹¹ / ₁₆	20
8"	11	3 ³ / ₄	7 ³¹ / ₃₂	35
10"	13 ³ / ₈	4 ¹ / ₄	10	62
12"	16 ¹ / ₈	5 ⁵ / ₈	11 ¹⁵ / ₁₆	105
14"	17 ³ / ₄	7 ¹ / ₄	12 ¹ / ₂	180
16"	20 ¹ / ₄	7 ¹ / ₂	15	253
18"	21 ⁵ / ₈	8	16 ⁷ / ₈	300
20"	23 ⁷ / ₈	8 ³ / ₈	18 ¹³ / ₁₆	355
24"	28 ¹ / ₄	8 ³ / ₄	22 ⁵ / ₈	550

Class 150 Model FE 150				
Size	Outside Dia.	Face to Face	Min Flange Bore	Weight lbs
2"	4 ¹ / ₈	2 ³ / ₈	1 ¹⁵ / ₁₆	5 ¹ / ₂
2 ¹ / ₂ "	4 ⁷ / ₈	2 ³ / ₈	2 ⁵ / ₁₆	8
3"	5 ³ / ₈	2 ⁷ / ₈	2 ²⁹ / ₃₂	12
4"	6 ¹ / ₈	2 ⁷ / ₈	3 ⁵³ / ₆₄	15
6"	8 ³ / ₄	3 ⁷ / ₈	5 ⁴⁹ / ₆₄	30
8"	11	5	7 ⁵ / ₈	64
10"	13 ³ / ₈	5 ³ / ₄	9 ⁹ / ₁₆	104
12"	16 ¹ / ₈	7 ¹ / ₈	11 ³ / ₈	188
14"	17 ³ / ₄	7 ¹ / ₄	12 ¹ / ₂	214
16"	20 ¹ / ₄	7 ¹ / ₂	15	353
18"	21 ⁵ / ₈	8	16 ⁷ / ₈	400
20"	23 ⁷ / ₈	8 ⁵ / ₈	18 ¹³ / ₁₆	540
24"	28 ¹ / ₄	8 ³ / ₄	22 ⁵ / ₈	875

Class 300 Model FE 300				
Size	Outside Dia.	Face to Face	Min Flange Bore	Weight lbs
2"	4 ³ / ₈	2 ³ / ₈	1 ¹⁵ / ₁₆	6
3"	5 ⁷ / ₈	2 ⁷ / ₈	2 ²⁹ / ₃₂	14
4"	7 ¹ / ₈	2 ⁷ / ₈	3 ⁵³ / ₆₄	15
6"	9 ⁷ / ₈	3 ⁷ / ₈	5 ⁴⁹ / ₆₄	42
8"	12 ¹ / ₈	5	7 ⁵ / ₈	78
10"	14 ¹ / ₄	5 ³ / ₄	9 ⁹ / ₁₆	112
12"	16 ⁵ / ₈	7 ¹ / ₈	11 ³ / ₈	195
14"	19 ¹ / ₈	8 ³ / ₄	12 ¹ / ₂	390
16"	21 ¹ / ₄	9 ¹ / ₈	14 ⁵ / ₁₆	410
18"	23 ¹ / ₂	10 ³ / ₈	16 ⁷ / ₈	660
20"	25 ³ / ₄	11 ¹ / ₂	17 ¹⁵ / ₁₆	810
24"	30 ¹ / ₂	12 ¹ / ₂	21 ⁹ / ₁₆	1300

Class 600 Model FE 600				
Size	Outside Dia.	Face to Face	Min Flange Bore	Weight lbs
2"	4 ³ / ₈	2 ³ / ₈	1 ¹⁵ / ₁₆	6
3"	5 ⁷ / ₈	2 ⁷ / ₈	2 ²⁹ / ₃₂	14
4"	7 ⁵ / ₈	3 ¹ / ₈	3 ⁵³ / ₆₄	18
6"	10 ¹ / ₂	5 ³ / ₈	5 ⁴⁹ / ₆₄	73
8"	12 ⁵ / ₈	6 ¹ / ₂	7 ⁵ / ₈	150
10"	15 ³ / ₄	8 ³ / ₈	9 ⁹ / ₁₆	230
12"	16 ¹ / ₂	9	11 ³ / ₈	319
14"	19 ³ / ₈	10 ³ / ₄	12 ¹ / ₂	435
16"	22 ¹ / ₄	12	14 ⁵ / ₁₆	635
18"	24 ¹ / ₈	14 ¹ / ₄	16 ¹ / ₈	890
20"	26 ⁷ / ₈	14 ¹ / ₂	17 ¹⁵ / ₁₆	1410
24"	31 ¹ / ₈	17 ¹ / ₄	21 ⁹ / ₁₆	2040

Installation Dimensions for Lug Body and Flanged Body ANSI Check Valves

Model FE150 Lug

Class 150				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
2"	4 3/4	2 3/8	2	8
3"	5	2 7/8	3	18
4"	7 1/2	2 7/8	3 7/8	33
6"	9 1/2	3 7/8	5 7/8	53
8"	11 3/4	5	7 5/8	130
10"	14 1/2	5 3/4	9 5/8	216

Model FE150 Flanged

Class 150				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
12"	19	7 1/8	11 3/8	279
14"	21	7 1/4	12 1/2	319
16"	23 1/2	7 1/2	15	387
18"	25	8	16 7/8	460
20"	27 1/2	8 5/8	18 7/8	600
24"	32	8 3/4	22 5/8	862
30"	38 3/4	12	29 1/4	1,750
36"	46	14 1/2	35	2,525
42"	53	17	41	4,220

Model FE300 Lug

Class 300				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
2"	5	2 3/8	2	18
3"	5 5/8	2 7/8	3	33
4"	7 7/8	2 7/8	3 7/8	55
6"	10 3/8	3 7/8	5 7/8	99
8"	13	5	7 5/8	143
10"	16 1/4	5 3/4	9 5/8	233

Model FE300 Flanged

Class 300				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
12"	20 1/2	7 1/8	11 3/8	336
14"	23	8 3/8	12 1/2	431
16"	25 1/2	9 1/8	14 3/8	575
18"	28	10 3/8	16 1/8	760
20"	30 1/2	11 1/2	17 7/8	1,078
24"	36	12 1/2	22 1/8	1,965
30"	43	14 1/2	28 3/4	3,525
36"	50	19	34	4,700
42"	58 3/4	22 3/8	41	9,750

Model FE600 Lug

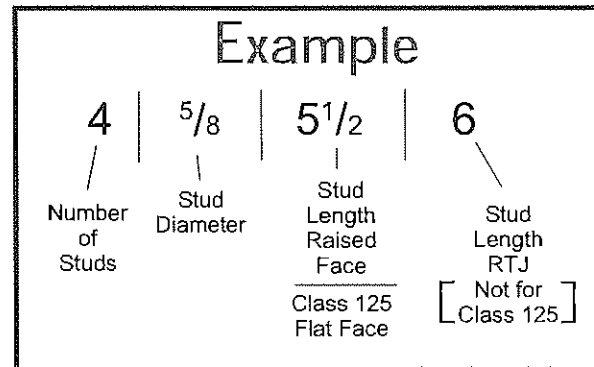
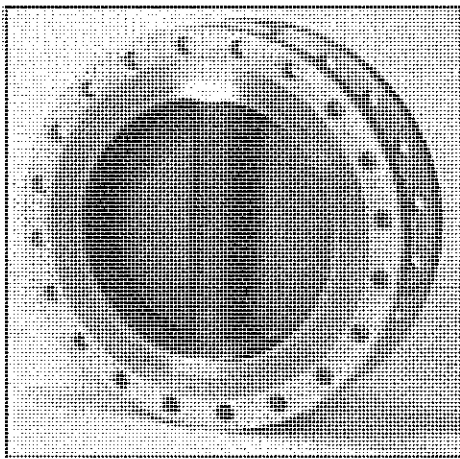
Class 600				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
2"	5	2 3/8	2	18
3"	5 5/8	2 7/8	3	33
4"	8 1/2	3 1/8	3 7/8	68
6"	11 1/2	5 3/8	5 7/8	172
8"	13 3/4	6 1/2	7 5/8	312
10"	17	8 3/8	9 5/8	515

Model FE600 Flanged

Class 600				
Size	Outside Diameter	Face to Face	Minimum Flange Bore	Wt. Lbs.
12"	22	9	11 3/8	550
14"	23 3/4	10 3/4	12 1/2	846
16"	27	12	14 3/8	1,010
18"	29 1/4	14 1/4	16 1/8	1,320
20"	32	14 1/2	18	1,700
24"	37	17 1/2	21 3/8	2,580
30"	44 1/2	19 7/8	28 3/4	5,390
36"	51 3/4	25	33 3/4	10,450
42"	55 1/4	27 5/8	39 1/2	11,700

ANSI Stud Bolting

Valve Size	Class 125				Class 150				Class 300				Class 600				Class 900				Class 1500				Class 2500						
2	4	5/8	5/4	4	5/8	5 1/2	6	8	5/8	5 3/4	6 3/4	8	5/8	6 1/2	7	8	7/8	8 1/2	8 3/4	8	7/8	8 1/2	8 3/4	8	7/8	8 1/2	8 3/4	8	1	9 3/4	10
3	4	5/8	5 3/4	4	5/8	6 1/2	7	8	3/4	7	8	8	3/4	7 3/4	8 3/4	8	7/8	9	9 1/4	8	1 1/8	10 1/4	10 1/2	8	1 1/4	12	12 1/4				
4	8	5/8	6 1/4	8	5/8	6 1/2	7	8	3/4	7 1/4	8 1/4	8	7/8	9 1/4	9 1/2	8	1 1/8	10 3/4	11	8	1 1/4	11 3/4	12	8	1 1/2	14	14 1/2				
6	8	3/4	7	8	3/4	7 3/4	8 3/4	12	3/4	8 3/4	9 3/4	12	1	12	12 1/2	12	1 3/8	14	14	12	1 3/8	16 1/2	16 3/4	8	2	20	20 1/2				
8	8	3/4	8	8	3/4	9 1/4	9 3/4	12	7/8	10 1/2	11 1/4	12	1 1/8	14 1/4	14 1/2	12	1 3/8	16 3/4	17 1/4	12	1 5/8	19 1/2	20	12	2	23 1/4	24				
10	12	7/8	9	12	7/8	10 1/2	11	16	1	12	12 3/4	16	1 1/4	16 3/4	17 1/4	16	1 3/8	18 3/4	19	12	1 7/8	23 1/4	23 1/2	12	2 1/2	29 1/2	30 1/4				
12	12	7/8	10 1/2	12	7/8	11 3/4	12 1/4	16	1 1/8	13 3/4	14 3/4	20	1 1/4	17 3/4	18	20	1 3/8	21 1/2	21 3/4	16	2	27	27 1/2	12	2 3/4	33 1/2	34 1/2				
14	12	1	12	12	1	12 1/4	13 1/4	20	1 1/8	16 1/4	16 1/4	20	1 3/8	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
16	16	1	13 1/4	16	1	13 1/4	14 1/2	20	1 1/4	16 3/4	16 3/4	20	1 1/2	22 1/2	22 1/2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
18	16	1 1/8	14	16	1 1/8	14	15 1/4	24	1 1/4	19	19	20	1 5/8	24 1/2	24 1/2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
20	20	1 1/8	14 1/4	20	1 1/8	14 1/2	15 1/2	24	1 1/4	20 1/4	21 1/4	24	1 5/8	26	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
24	20	1 1/4	16 1/2	20	1 1/4	16 3/4	16 3/4	24	1 1/2	22 1/2	22 1/2	24	1 7/8	30 1/2	30 1/2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		



Installation Data

The Sure Flow Check valve is designed so that it is centralized between the flanges when the stud bolts are in position. The outside diameter of the body is equal to the bolt circle PCD minus the diameter of one bolt.

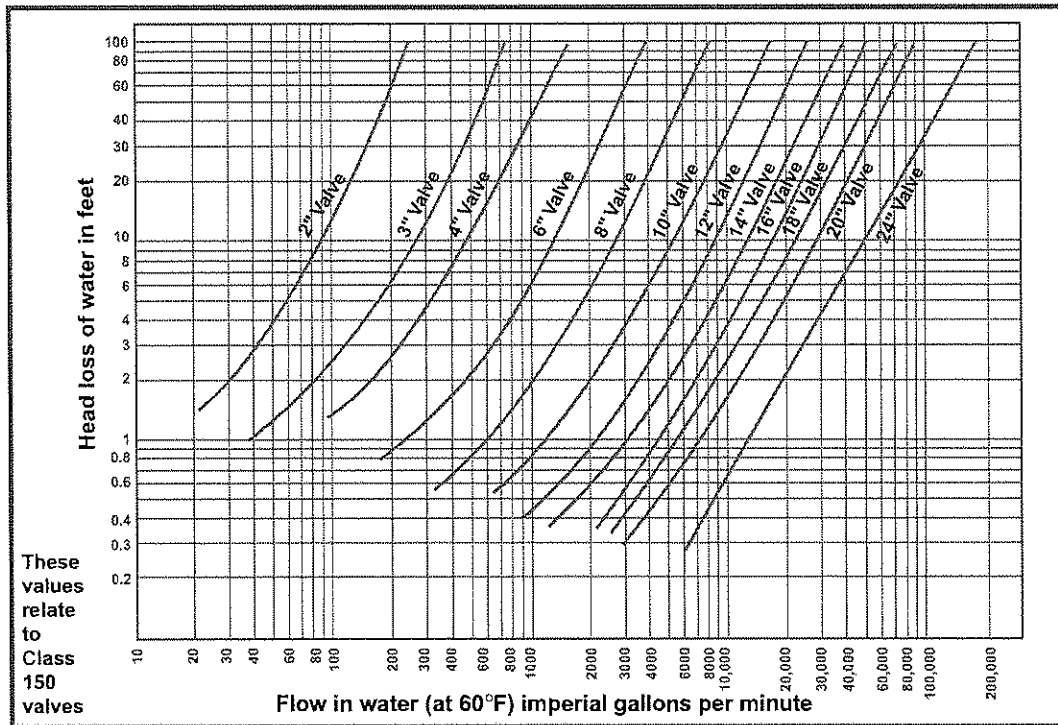
It is suitable for use in a variety of orientations. In horizontal lines the valve is installed with the pins vertical (i.e. with the pin retainers at the top). For sizes 6" and upwards the valve is tapped to take an eyebolt for lifting.

Arrows cast into the body indicate the normal direction of flow.

Before initial installation it is advisable to open the plates by hand since, if the valve is held in store for a period of time, the corrosion inhibitor may have caused the plates to stick to the body and line pressure may not be sufficient to break this seal.

If the bottom half of the studs are installed first they will serve as a platform to support the valve whilst the gaskets and other studs are put in. Similarly, if the valve is to be removed from the line, the top half of the studs should be removed and the bottom half slackened.

Pressure Loss Through Valves



- ◆ We will provide valves to match your performance requirements
- ◆ The curves shown above relate to valves provided with standard rated springs
- ◆ Higher value springs may be required to ensure faster reaction if very large changes in velocity occur
- ◆ It should be borne in mind that a media (liquid) velocity in the pipeline of 10 ft per second is considered to be desirable for normal applications

Percent of Flow Area Sure Flow Check vs Standard Steel Pipe						
Size	Pressure Class					
	150	300	600	900	1500	2500
2"	36.7	36.7	44.0	54.4	54.4	36.1
3"	39.1	39.1	43.8	46.6	46.6	32.8
4"	41.4	41.4	45.8	47.7	47.7	29.5
6"	54.0	54.0	58.5	52.9	52.9	33.4
8"	56.7	56.7	57.8	58.6	58.6	32.7
10"	56.0	56.0	67.9	70.5	52.6	30.9
12"	61.8	61.8	63.0	71.8	62.0	31.2
14"	66.7	72.5	62.9	75.4	75.4	—
16"	64.3	55.2	67.9	71.8	71.8	—
18"	74.5	69.9	64.8	76.4	74.0	—
20"	70.8	65.1	67.4	84.0	81.0	—
24"	66.0	63.4	68.3	71.4	71.0	—

Approximate performance data for Sure Flow Check valves when used with water at 60° F with a nominal 10 ft/sec velocity				
Valve Size	Flow (imperial gals/min)	Pressure drop psi	Head loss in feet	Approx. equiv. length of pipe in feet
2"	86	4.49	10.32	30
3"	192	2.97	6.83	34
4"	368	2.30	5.29	35
6"	750	1.47	3.38	37
8"	1292	1.20	2.76	40
10"	2116	0.93	2.14	41
12"	2920	0.81	1.87	44
14"	3570	0.74	1.70	45
16"	4750	0.60	1.38	47
18"	6600	0.55	1.27	47
20"	7500	0.51	1.18	50
24"	12500	0.42	0.97	52

Seat Options

The right seat is critical for the correct functioning of the valve in its designated service. Sure Flow Check offers a wide range of seat options.

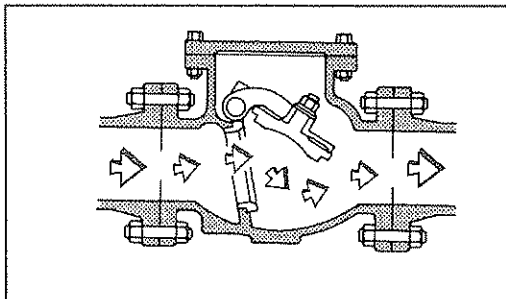
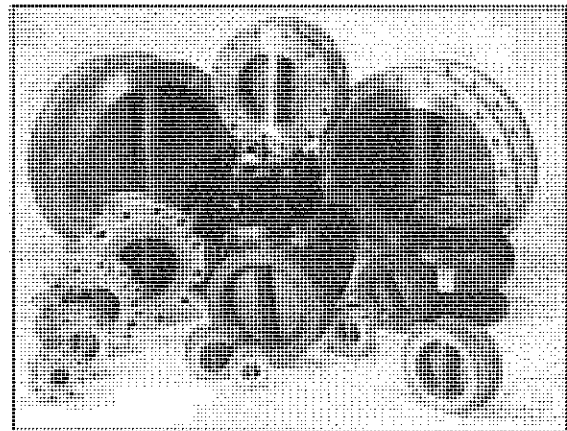
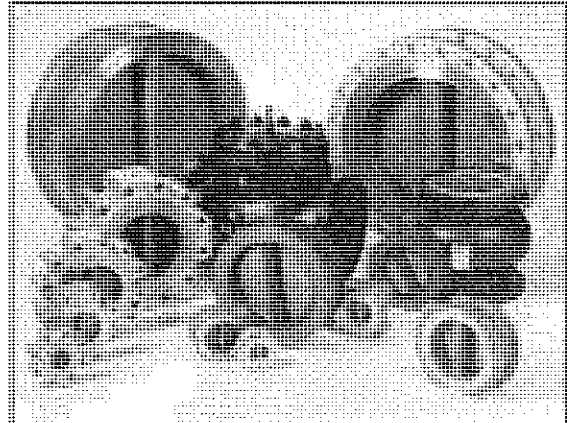
Metal to metal seats can be either the body/plate parent material or a hardfacing of other material, overlaid by deposition.

For soft seated valves standard elastomers are vulcanized for maximum security.

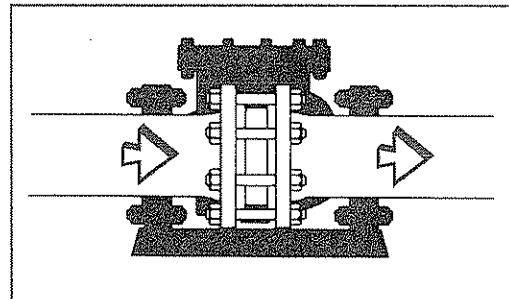
On high pressure class valves it is set into a groove for further safety.

Simple Installation

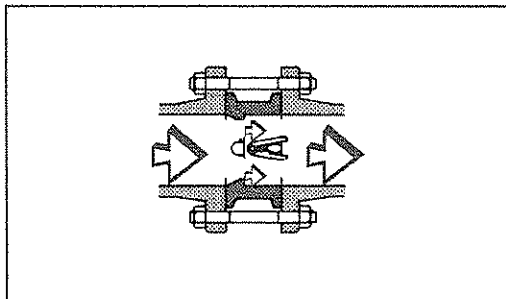
Simplicity and speed of installation are of paramount importance for the process or pipeline engineer. Sure Flow Check is simply installed between the flanges. A raised face (serrated or smooth finish), an RTJ, profile hub and butt weld ends can be provided. Only one set of studs is required as Sure Flow Check fits inside the bolt circle PCD. If the valve needs to be taken out of the line, only half the bolts need to be removed, reducing the amount of work to be done and providing a retained link for the two pipe flanges.



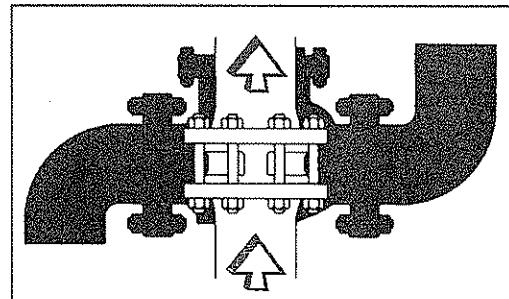
Conventional swing check valve



Horizontal Flow - rib vertical



Sure Flow Check dual plate wafer check valve



Vertical Flow

Quality From Start To Finish

Quality Counts

Our quality starts with design and engineering, continues through development and testing, to manufacture and certification. Our technical and sales support services are vital ingredients in maintaining the overall quality of our products. The stringent quality control, inspection and testing procedures we apply are contained within the Documented Quality System.

*Manufactured to API 594
and tested to API 598*

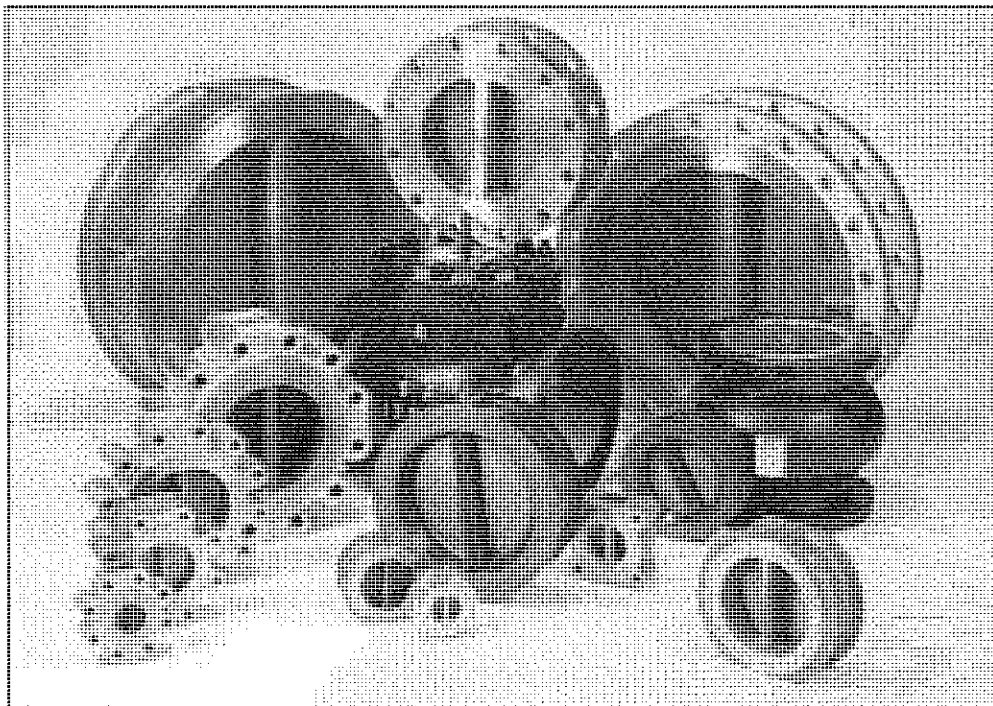
Quality is manufactured not inspected

Our operatives are responsible for the quality and accuracy of their work and for ensuring that it is in accordance with the appropriate working drawings and specifications. Our Q.A. Department checks initial compliance throughout all aspects of manufacture from the receipt of materials to the end of the machining process.

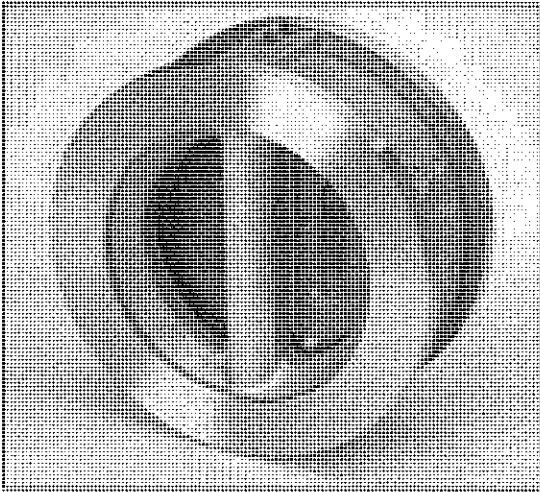
Our Quality Assurance Department remains the ultimate authority in guaranteeing that materials, engineering and methods are in full accordance with agreed specifications and established procedures. Through a combination of these procedures we can confidently fulfil all requirements for material conformity and traceability and for full certification.

When you specify Sure Flow Check valves, you can be confident that not only are you making an investment in quality and reliability, but equally important, you know the service starts with the sale.

*All requirements for
material conformity,
traceability and
certification met in full*



Type CD 150 - VIR - Wafer - Double Door - Dual Disc - Metal Hinge Check Valve

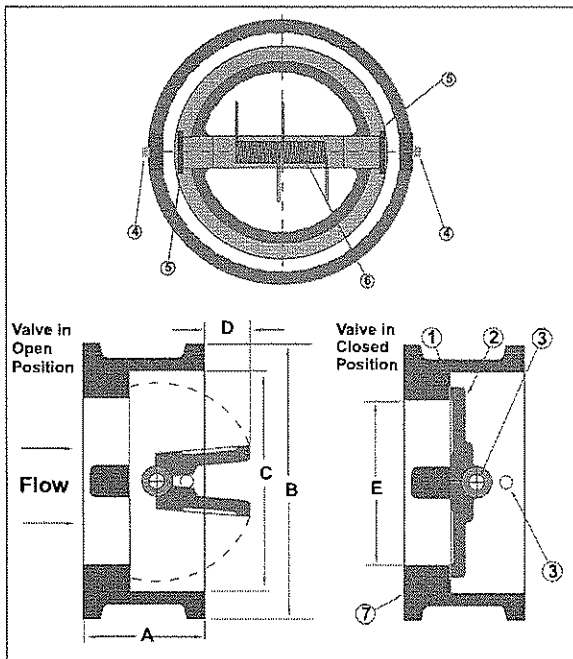


The **Eco (Economical) Dual Plate**, Metal Hinged check valve features ease of maintenance and exceptional flow characteristics.

- Body gives compact, wafer design
- Dual plate valves give maximum strength with minimum opening time
- Full contact seats maintain positive shut-off at minimum working pressure
- Torsion springs assist valve closure, preventing flow reversal
- Shaft is of extra heavy duty, corrosion resistant construction
- Shaft supports with large bearings act as stops to prevent over travel of plates
- Thrust washers reduce friction and wear of valve plate hinges.
- **Model CD150CS-VIR Carbon Steel Body/316SS Discs**
- **Model CD150SS-VIR 316SS Body**

Operating Pressures and Temperatures

Service	Size	psi	Temp
W.O.G.	2" - 12"	285	100°F



Construction

No	Name	Material	Qty
1	Seat/Seal	Viton	1
2	Disc	ASTM A351 CF8M	2
3	Shaft	316 Stainless Steel	2
4	Plugs	A105/A182	4
5	Washer	316 Stainless Steel	2
6	Torsion Spring	316 Stainless Steel	2
7	Cast Body	ASTM A216 WCB/ASTM A351 CF8M	1

Dimensional Data

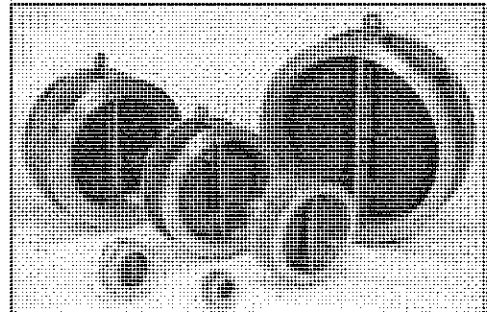
Size	Model	A	B	C	D	E	Shipping Weight (lbs)
2	0200CD150	2 3/8	4 1/8	2 3/8	1/8	1 9/16	6
2 1/2	0250CD150	2 3/8	4 7/8	3 1/2	3/8	2 1/2	8
3	0300CD150	2 7/8	5 3/8	3 1/2	3/8	2 1/2	12
4	0400CD150	2 7/8	6 7/8	4 1/2	7/8	3 1/4	15
6	0600CD150	3 7/8	8 3/4	7	1 1/2	5 1/4	30
8	0800CD150	5	11	8 5/8	2 1/8	6 3/4	64
10	1000CD150	5 3/4	13 3/8	10 3/4	2 3/4	8 3/4	104
12	1200CD150	7 1/8	16 1/8	13 1/2	3	10 1/2	188

Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

Valves are designed to operate on vertical and horizontal flow, see note 1.

NOTE 1
Horizontal Flow: Valve must be installed with disc hinge pin in the vertical position, to insure proper operation.



Ordering Information

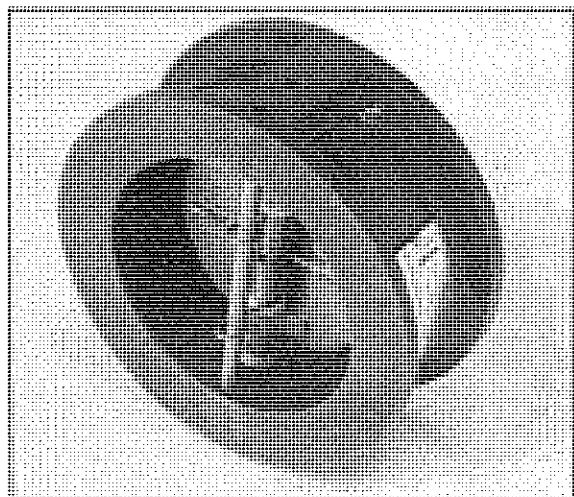
Example: Include full description

Size (Prefix) Model #

0400 - CD150SS-VIR

4", 316SS Body Wafer Check Valve,
Viton Seat, 316SS Discs.

Type CC125, CD125-IS Wafer - Double Door - Dual Disc- Metal Hinge Check Valve

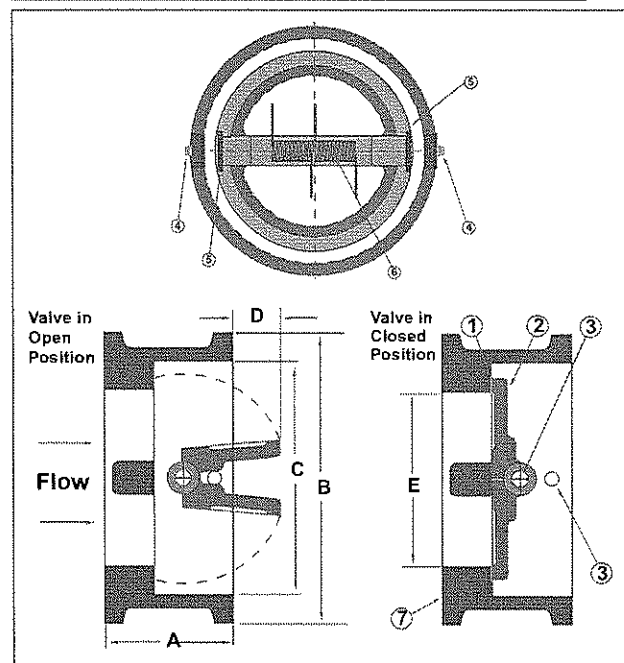


The **Eco (Economical) Dual Plate**, Metal Hinged check valve features ease of maintenance, exceptional flow characteristics.

- Body gives compact, one-piece wafer design
- Dual plate valves give maximum strength with minimum opening time
- Full contact seats maintain positive shut-off at minimum working pressure
- Torsion springs assist valve closure, preventing flow reversal
- Shaft is of extra heavy duty, corrosion resistant construction
- Shaft supports with large bearings act as stops to prevent over travel of plates
- Thrust washers reduce friction and wear of valve plate hinges.
- **Model CD125-IS with 316SS Disc**

Operating Pressures and Temperatures

Service	Size	psi	Temp
W.O.G.	2" - 48"	200	200°F



Construction

No	Name	Material	Qty
1	Seat/Seal	Buna-N	1
2	Disc	ASTM A351 CF8M	2
3	Shaft	316 Stainless Steel	2
4	Plugs	A105/A182	4
5	Washer	316 Stainless Steel	2
6	Torsion Spring	316 Stainless Steel	2
7	Cast Body	ASTM A126 GR B	1

Dimensional Data

Size	Weight	Disc Weight	Disc Thickness	Disc Diameter	Disc Hinge Pin Diameter	Disc Hinge Pin Length	Disc Hinge Pin Position
2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
11 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
36"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
36 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
41"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
41 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
43"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
43 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
44"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
44 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
46"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
46 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
47"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
47 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
48"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
48 1/2"	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Ordering Information

Example: Include full description

Size Model
 (Prefix) #

0400 - CD125IS

4", Cast Iron Wafer Check Valve,
 Buna Seat, 316SS Discs.

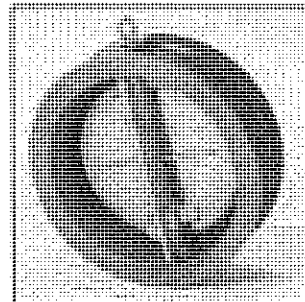
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

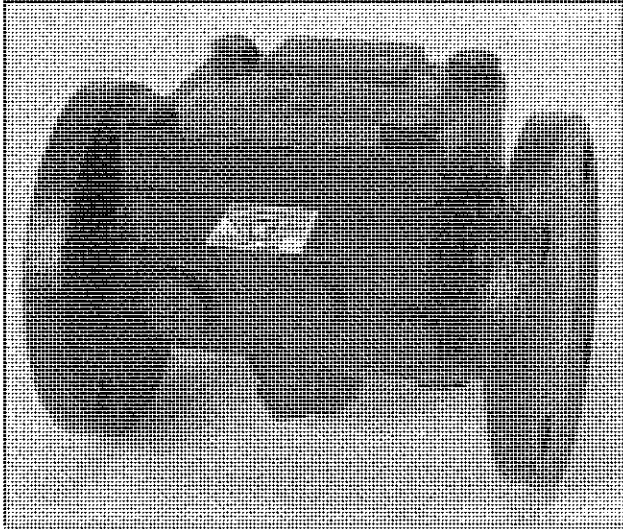
Valves are designed to operate on vertical and horizontal flow, see note 1.

NOTE 1

Horizontal Flow: Valve must be installed with disc hinge pin in the vertical position, to insure proper operation.



Type CXF-125 Flanged Elastic Swing Check Valve



The **Elastic Swing Check Valve** is suitable for municipal and industrial applications.

It is standard with a ductile iron body with flanges which comply with ANSI B16.1; Class 125 or 250. The internal body is epoxy coated. Special coatings are available upon request. The one-piece molded disc has a steel reinforced insert to insure closure. Plus, while in the open position, it will allow 100% uninterrupted flow. The one-piece disc hinge and flapper can be repaired without removal of the valve from the line.

The elastic check can be installed in a vertical or horizontal pipeline.

Construction

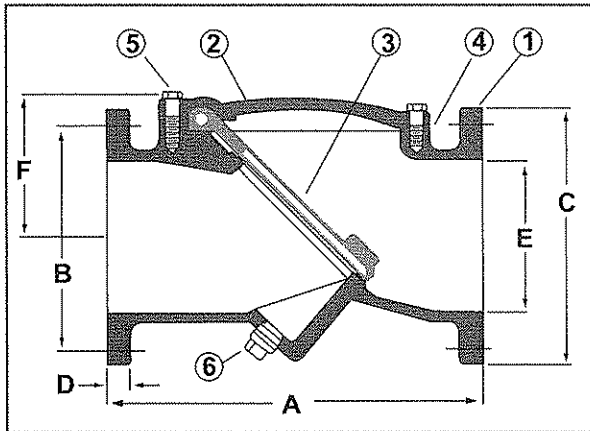
No	Name	Material	Qty
1	Body	ASTM A536 60-45-12	1
2	Cover	ASTM A536 60-45-12	1
3	Disc	Viton w/steel & fabric reinforcement	1
4	Gasket	Lexide NK-511 (non asbestos)	1
5	Cover Bolts	Alloy steel SAE Grade S	4
6	Drain	ASTM A536 60-45-12	1

*Face to face: ANSI B16.10

*Flanged End: ANSI B16.1 BS4505 PN16

Operating Pressures and Temperatures

Service	Size	psi	Temp
W.O.G.	2" - 12"	200	150°F
	14" - 24"	150	150°F



Dimensional Data

Size	Face to Face	Flange to Flange	Flange to Flange	Flange to Flange	Flange to Flange	Flange to Flange	Flange to Flange	Flange to Flange	Flange to Flange
2"	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
3"	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
4"	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
6"	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
8"	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
10"	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
12"	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50
14"	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50	16.50
16"	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50
18"	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50	20.50
20"	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
24"	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50	26.50

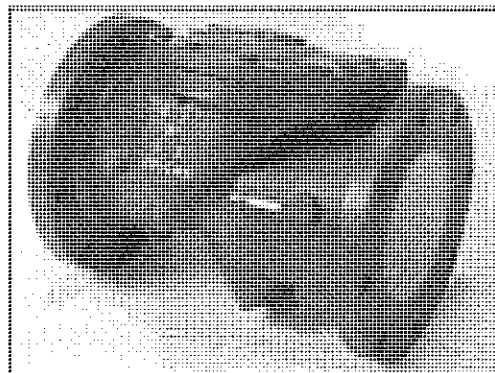
Ordering Information

Example: Include full description

Size Model
(Prefix) #

0400 - CXF125IV

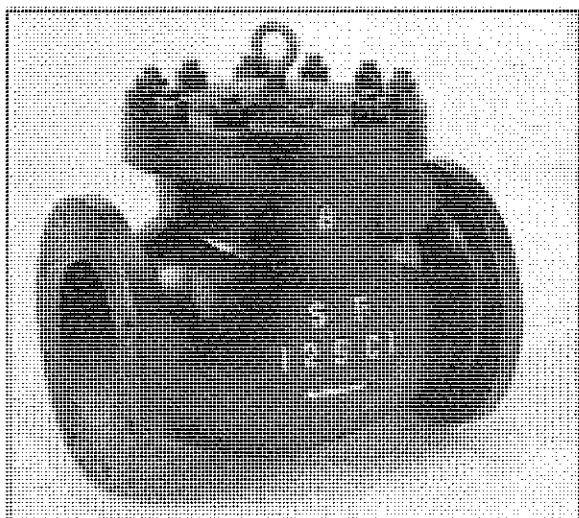
4", Ductile Iron Flanged Check Valve,
Viton Seat, 316SS Disc.



Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

Type CSF-125IB Flanged Horizontal Swing Check Valve



The **Sure Flow Horizontal Swing** Check Valve has a cast iron body, cover and disc. The valve is provided with a bronze seat ring and bronze disc ring.

Bronze being softer than a cast iron facing, it offers a more positive sealing effect than competitors' standard iron facing. At the same time, a bronze seat ring and disc ring is very versatile in its stability to temperature and various commonly handled materials.

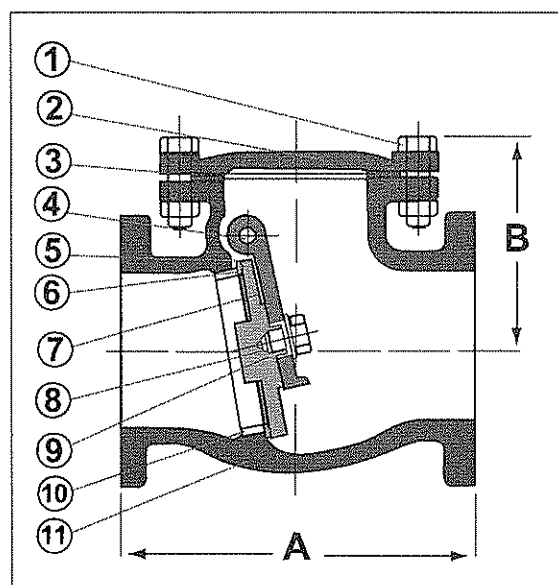
Conforming to MSS SP-71
End Flange Dimensions: ANSI B16.1
Face to Face Dimensions: ANSI B16.10.

Construction

No	Name	Material
1	Cover Bolt & Nut	Steel
2	Cover	ASTM A126 Class B
3	Gasket	Graphite
4	Hanger Pin	Stainless Steel
5	Hanger	ASTM A126 Class B
6	Disc Ring	ASTM B62
7	Disc	ASTM A126 Class B
8	Disc Washer	Steel
9	Disc Bolt	Steel
10	Seat Ring	ASTM B62
11	Body	ASTM A126 Class B

Operating Pressures and Temperatures

Service	Size	psi	Temp
W.O.G.	2" - 48"	200	200°F

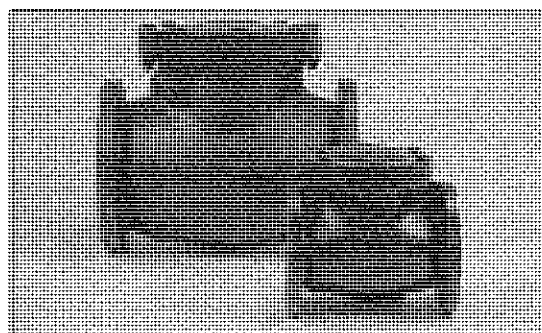


Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

Dimensional Data

Size	Weight	Face to Face	End Flange	End Flange
2"	1.5	4.5	4.5	4.5
3"	2.5	5.5	5.5	5.5
4"	4.0	6.5	6.5	6.5
6"	8.0	8.5	8.5	8.5
8"	14.0	10.5	10.5	10.5
10"	22.0	12.5	12.5	12.5
12"	32.0	14.5	14.5	14.5
16"	52.0	18.5	18.5	18.5
20"	78.0	22.5	22.5	22.5
24"	108.0	26.5	26.5	26.5



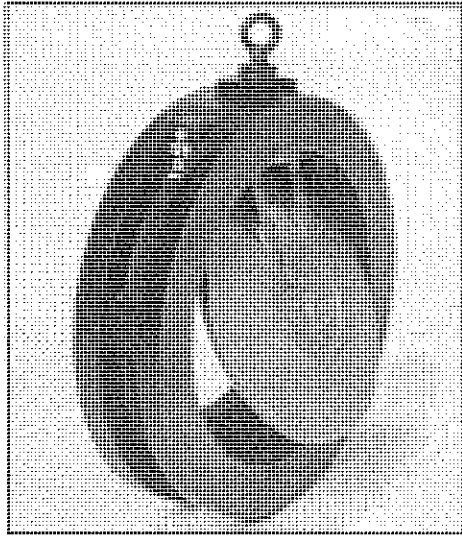
Ordering Information

Example: Include full description

Size Model
(Prefix) #
0400 - CSF125IB

4", Cast Iron Flanged Horizontal Swing
Check Valve, Bronze Seat Ring

Type CSW-125IS Wafer Swing Check Valve ANSI 125/150 Class



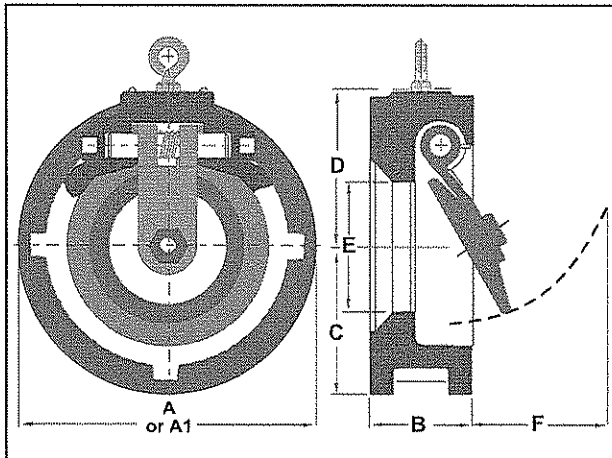
The **Wafer Swing Check Valve** incorporates several features distinguishing it from conventional check valves for silent, fast, non slam operation. The most prominent of these is the accurately machined clapper and its special quick closing action. Spring loading of the 316SS clapper assures instantaneous closure to reversing flow, preventing build-up of momentum, the cause of damaging water hammer. The hinge pin design assures free movement of the clapper and eliminates seizure under extreme conditions. Soft seat inserts are standard for positive sealing of hard-to-hold solvents and fluids. Lifting eye hook on 8" to 12" valves.

Operating Pressures and Temperatures

Service	Size	psi	Temp
W.O.G.	2" - 12"	285	100°F

Construction

No	Name	Material
1	Seat/Seal	Viton
2	Clapper	ASTM A351 CF8M
3	Arm	316 Stainless Steel
4	Plugs	A105/A182
5	Washer	316 Stainless Steel
6	Torsion Spring	316 Stainless Steel
7	Cast Body	ASTM A126 GR B



Dimensional Data

Size	A	B	C	D	E	F	A1
2"	2.125	1.625	0.375	1.125	0.625	0.125	0.625
3"	3.125	2.125	0.375	1.625	1.125	0.125	1.125
4"	4.125	3.125	0.375	2.125	1.625	0.125	1.625
6"	6.125	5.125	0.375	3.125	2.625	0.125	2.625
8"	8.125	7.125	0.375	4.125	3.625	0.125	3.625
10"	10.125	9.125	0.375	5.125	4.625	0.125	4.625
12"	12.125	11.125	0.375	6.125	5.625	0.125	5.625

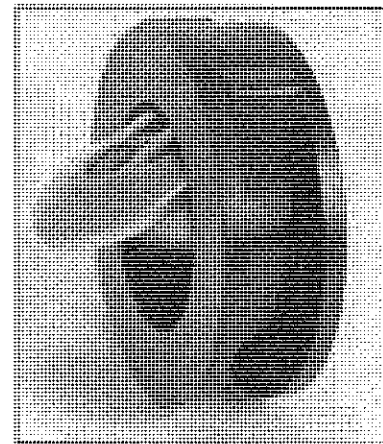
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

Valves are designed to operate on vertical and horizontal flow, see note 1.

NOTE 1

The wafer check valve is designed for installation between two pipe flanges in horizontal or vertical pipelines (in the latter case upward flow is preferred).



Ordering Information

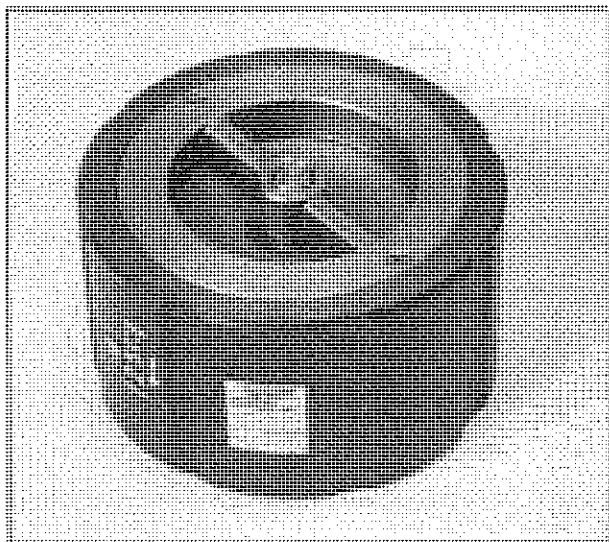
Example: Include full description

Size (Prefix) Model #

0400 - CSW125IS

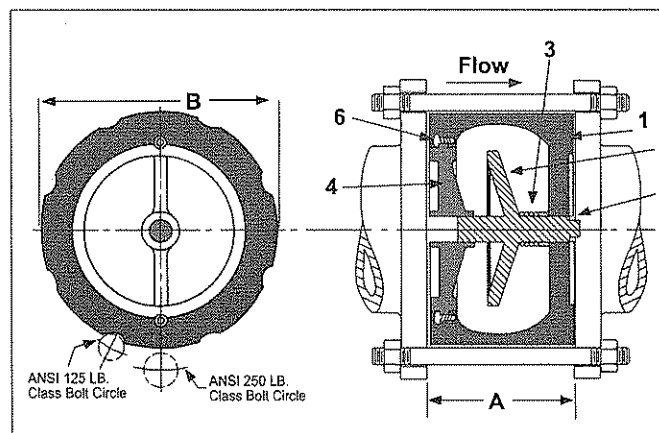
4", Cast Iron Wafer Swing Check Valve,
Viton Seat, 316SS Clapper

Type CW125IS/250 - Cast Iron Flat Face



Operating Pressures and Temperatures:

Service	Size	psi	Temp.
Liquid	2" - 12"	400	180°F



Ordering Information

Example: Include full description

Model # Type & Material

0400 - CW125IS/250

4", Flat Face Wafer Check Valve Silent, Bronze Plug

Consult factory for optional construction materials.

Resilient seating of BUNA-N or VITON available.

Sure Flow Wafer Check Valves are designed to close before the pump stops completely. This prevents flow reversal which eliminates water hammer and system surges associated with valve closure.

- Quiet Operation
- Guided Discs
- Vertical or Horizontal Installation
- Sizes 2" thru 12"

Service Applications

- Municipal Water Systems
- Industrial Class HVAC - Liquid Service
- Industrial Piping Systems
- Irrigation Systems

Construction

No	Name	Material
1	Body	Cast Iron A-126-B
2	Plug	Cast Bronze B62 or <i>Stainless Steel</i>
3	Spring	Stainless Steel
4	Seat	Cast Bronze B62 or <i>Stainless Steel</i>
5	Bushing	Cast Bronze B62 or <i>Stainless Steel</i>
6	Screw	Stainless Steel

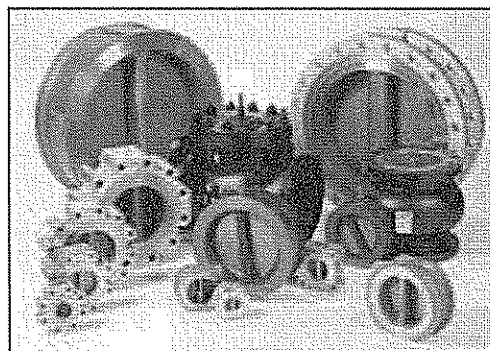
Dimensional Data

Size	Model	A	B	CV	Shipping Weight (lbs)
2	0200CW125IS/250	2 3/4	4 1/4	40	7
2 1/2	0250CW125IS/250	2 7/8	5	60	9
3	0300CW125IS/250	3 1/4	5 3/4	85	15
4	0400CW125IS/250	4	7	150	25
5	0500CW125IS/250	4 5/8	8 3/8	230	32
6	0600CW125IS/250	5 1/2	9 3/4	340	56
8	0800CW125IS/250	5 1/2	11 7/8	600	100
10	1000CW125IS/250	8 1/4	16	900	140
12	1200CW125IS/250	11 1/4	19		370

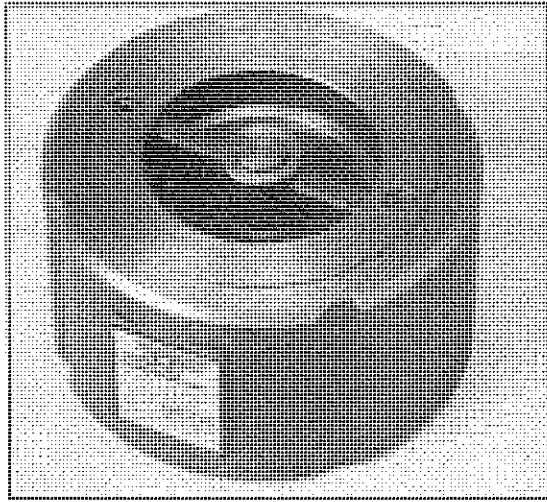
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

The Flow Coefficient (Cv) is the number of gallons per minute of water flowing through a given size restriction at a pressure drop of one psi. To obtain the Cv factor for a given size check valve refer to table above.



Type CW150/300 - Cast Steel & CW150SS/300 Cast Stainless Steel



Sure Flow Wafer Check Valves are designed to close before the pump stops completely. This prevents flow reversal which eliminates water hammer and system surges associated with valve closure.

- Quiet Operation
- Guided Discs
- Vertical or Horizontal Installation
- Sizes 2" thru 24"

Service Applications

- Municipal Water Systems
- Industrial Class HVAC - Liquid Service
- Industrial Piping Systems
- Irrigation Systems

Operating Pressures and Temperatures:

Service	Size	psi	Temp.
Liquid	2" - 24"	740	100°F

Construction - Cast Steel

No	Name	Material
1	Body	Cast Steel A-216WCB
2	Plug	Cast S. Steel A-351
3	Spring	Stainless Steel
4	Seat	Cast S. Steel A-351
5	Bushing	Cast S. Steel A-351
6	Screw	Stainless Steel

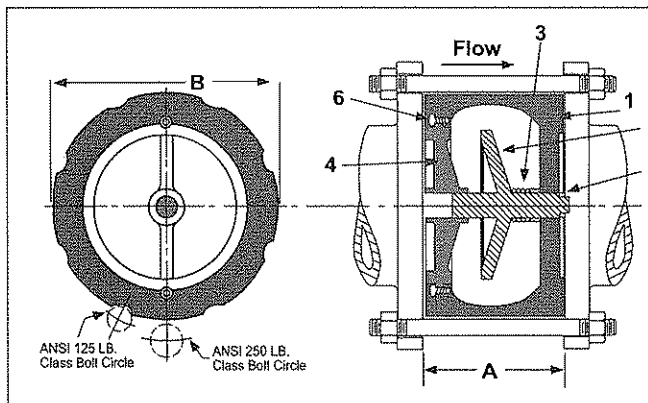
Construction - Cast Stainless Steel

All ASTM Spec A351 Grade CF8M Stainless Steel.

Dimensional Data

Size	Model	A	B	Cv	Shipping Weight (lbs)
2	0200CW150SS/300	2 5/8	4 7/8	50	7
2 1/2	0250CW150SS/300	3	5 3/4	72	9
3	0300CW150SS/300	3 3/16	6 1/2	92	15
4	0400CW150SS/300	4 1/16	7	180	25
5	0500CW150SS/300	4 7/8	8 7/8	276	32
6	0600CW150SS/300	6 1/2	9 11/16	408	56
8	0800CW150SS/300	6 5/8	11 5/8	720	100
10	1000CW150SS/300	7 1/2	14 5/8	1000	140

* Also Available in size 12", 14", 16", 18", 20" and 24".



Ordering Information

Example: Include full description

Model # Type & Material

0400 - CW150SS/300

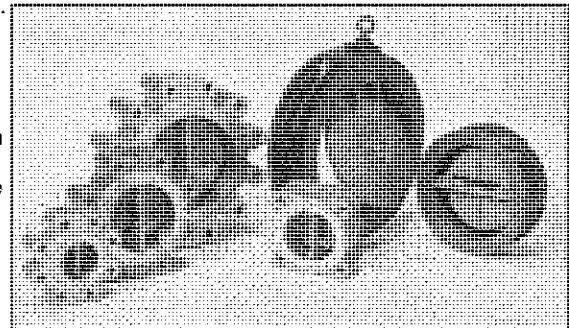
4", Raised Face Wafer Silent Check Valve,
All 316SS Construction

Consult factory for optional construction materials.
Resilient seating of BUNA-N or VITON available.

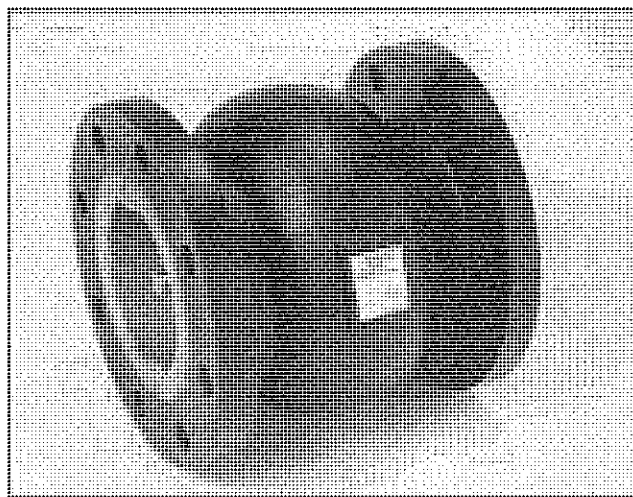
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

The Flow Coefficient (Cv) is the number of gallons per minute of water flowing through a given size restriction at a pressure drop of one psi. To obtain the Cv factor for a given size check valve refer to table above.

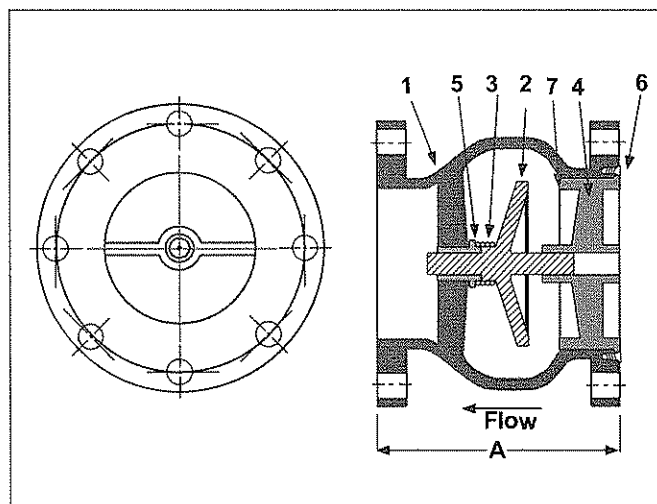


Type CF125 or CF125IS/C Cast Iron



Operating Pressures and Temperatures:

Service	Size	psi	Temp.
Liquid	2" - 16"	200	150°F



Ordering Information

Example: Include full description

Size (Prefix) Model #

0400 - CF125IS/C

4", Flat Face Flanged Cast Iron Silent Check Valve with 316SS Disc

Consult factory for optional construction materials. Resilient seating of BUNA-N or VITON available.

Sure Flow Globe Style Check Valves are designed to close before the pump stops completely. This prevents flow reversal which eliminates water hammer and system surges associated with valve closure.

- Quiet Operation
- Guided Discs
- Vertical or Horizontal Installation
- Sizes 2" thru 16"

Service Applications

- Municipal Water Systems
- Industrial Class HVAC - Liquid Service
- Industrial Piping Systems
- Irrigation Systems

Construction

No	Name	Material
1	Body	Cast Iron A-126-B
2	Plug	Cast Bronze B62 or <i>Stainless Steel</i>
3	Spring	Stainless Steel
4	Seat	Cast Bronze B62 or <i>Stainless Steel</i>
5	Bushing	Cast Bronze B62 or <i>Stainless Steel</i>
6	Screw	Stainless Steel

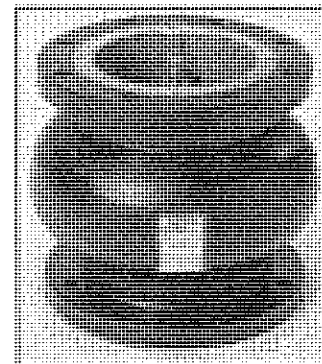
Dimensional Data

Size	Model	Flange Face to Face	Flange Face to Center	Flange Face to Disc	Flange Face to Plug
2	0200CF125	6.14	6.14	40	30
2 1/2	0254CF125	6.12	7	100	54
3	0300CF125	6	7.17	130	50
4	0400CF125	7.14	8.12	225	75
5	0500CF125	8.12	8.12	345	95
6	0600CF125	8.14	10.12	395	130
8	0800CF125	12.12	13.12	630	240
10	1000CF125	15.12	16.14	850	265
12	1200CF125	14.14	20.14	1060	300
14	1400CF125	18.14	23.14	1360	330
16	1600CF125	17.58	24.14	1610	340
18	1800CF125	23.12	25.12	1980	375
20	2000CF125	24	26	2400	410
24	2400CF125	24	24	3000	475

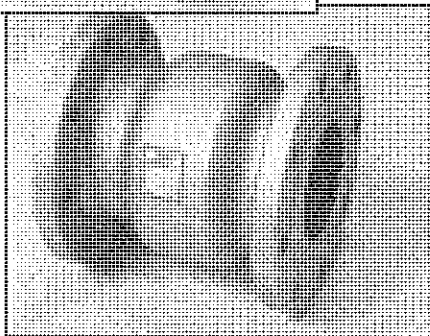
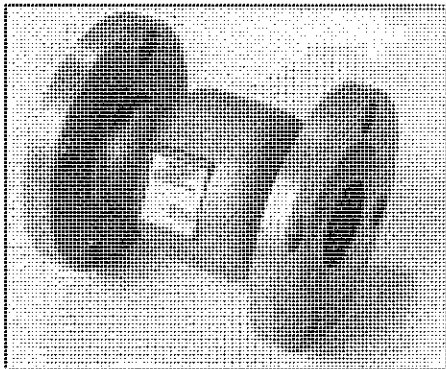
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

The Flow Coefficient (Cv) is the number of gallons per minute of water flowing through a given size restriction at a pressure drop of one psi. To obtain the Cv factor for a given size check valve refer to table above.



Type CF150 Cast Steel, Type CF150SS Stainless Steel



Sure Flow Globe Style Check Valves are designed to close before the pump stops completely. This prevents flow reversal which eliminates water hammer and system surges associated with valve closure.

- Quiet Operation
- Guided Discs
- Vertical or Horizontal Installation
- Sizes 2" thru 12"

Service Applications

- Municipal Water Systems
- Industrial Class HVAC - Liquid Service
- Industrial Piping Systems
- Irrigation Systems

Construction - Cast Steel

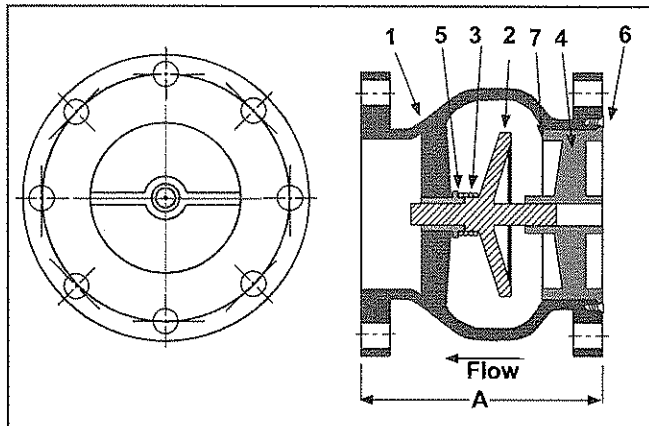
No: 1, 4, 5: Cast Steel
 2, 3, 6: Stainless Steel
 Plug: Standard Stainless Steel

Construction - Cast Stainless Steel

All ASTM Spec A351 Grade CF8M Stainless Steel.

Operating Pressures and Temperatures:

Rating	Size	psi	Temp.
150 LB. CLASS	2" - 12"	285	100°F



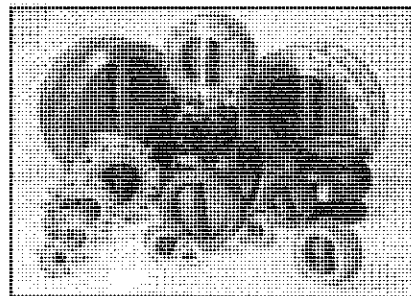
Dimensional Data

Size	Model	A	B	C
2	0200CF150	5 1/4	8.5	30
2 1/2	0250CF150	5 1/2	9	40
3	0300CF150	7 1/2	140	50
4	0400CF150	8 1/2	200	60
5	0500CF150	8 1/2	420	120
6	0600CF150	10 1/2	510	150
8	0800CF150	12	1000	300
10	1000CF150	14 1/2	1700	410
12	1200CF150	14 1/4	2400	720

Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

The Flow Coefficient (Cv) is the number of gallons per minute of water flowing through a given size restriction at a pressure drop of one psi. To obtain the Cv factor for a given size check valve refer to table above.



Ordering Information

Example: Include full description

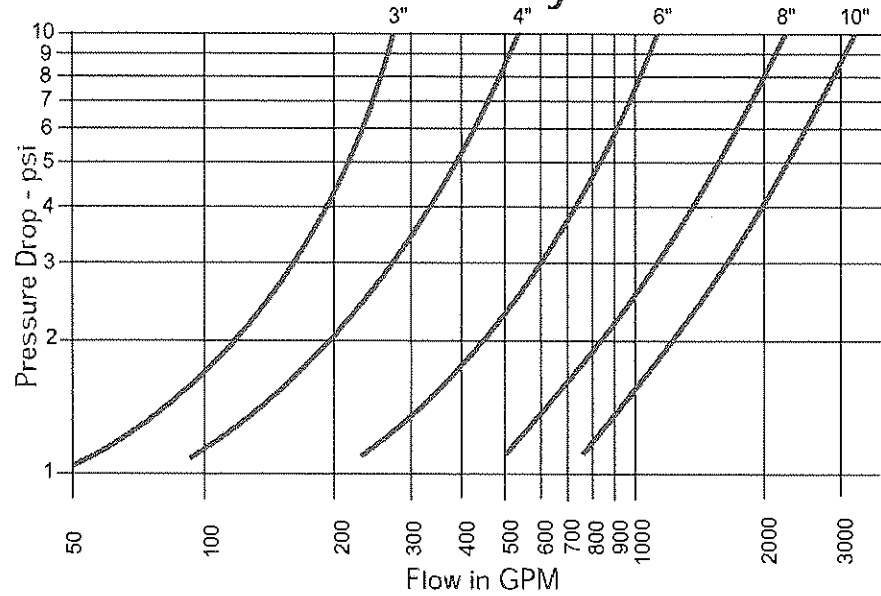
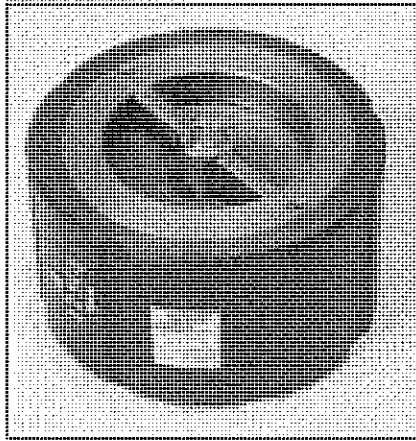
Size (Prefix) Model #
 0400 - CF150

4", 150# Raised Face Cast Steel - Silent Check Valve

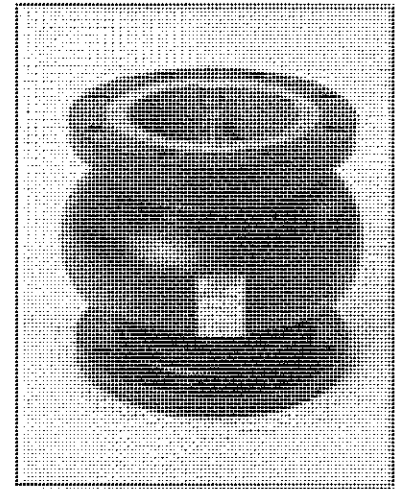
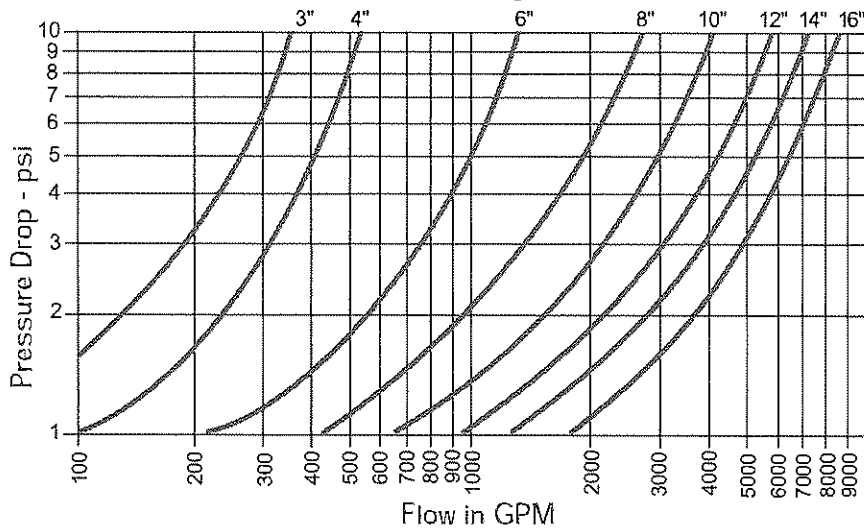
Consult factory for optional construction materials.
 Resilient seating of BUNA-N or VITON available.

Silent Check Valves

Wafer Style



Globe Style



- The above curves are based on the flow of clean water at ambient temperature.
- Preferred piping standards recommend placing check valves 5 to 10 pipe diameters from any turbulence producing device, i.e. pumps, elbows, etc.
- Maximum recommended flow velocity of 10 ft./sec.

Type FV 125 Cast Iron, Type FV150 Cast Steel, Type FV1500SS Stainless Steel Foot Valves



Construction

Design of the Sure Flow Foot Valve, available in sizes 2 inches to 30 inches, evolved through a need for a valve that could provide positive sealing actions at various pressure ranges without seat damages along with silent operation.

The Sure Flow Foot Valve, satisfies these requirements plus low head loss through its full ported area and heavy duty stainless steel basket screening.

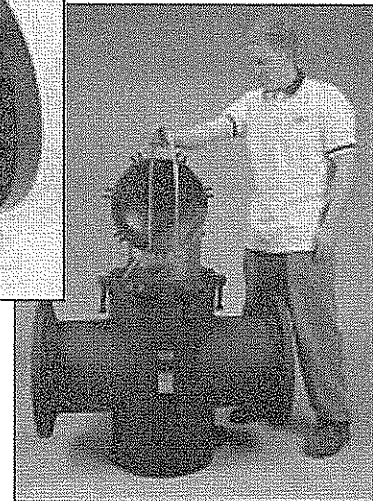
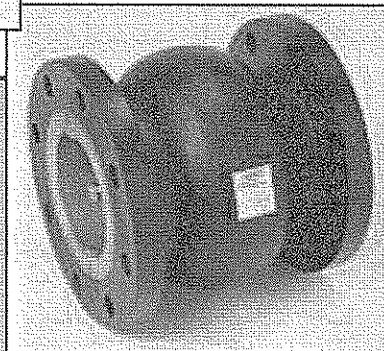
The Buna-N o-ring, provides a drop-tight seal. As the pressure increases, the Buna-N o-ring is compressed slightly and the disc makes contact with the metal portion of the valve seat, preventing any further compression of the Buna-N o-ring. The Buna-N o-ring will continue to provide the "drop-tight seating" during the higher pressure ranges without damage from the increased pressure loading.

Standard Features:

- The seating design provides positive shut-off at all pressure ranges without additional loading on the seal.
- Heavy duty stainless steel screening, with flow area 3 to 4 times that of pipe area.
- Silent operation, by design of disc, stroke and linear closing characteristics.
- Cast iron, 125 lb. ANSI Standard.

Optional Features:

- Available in carbon steel & stainless steel



Ordering Information

Example: Include full description

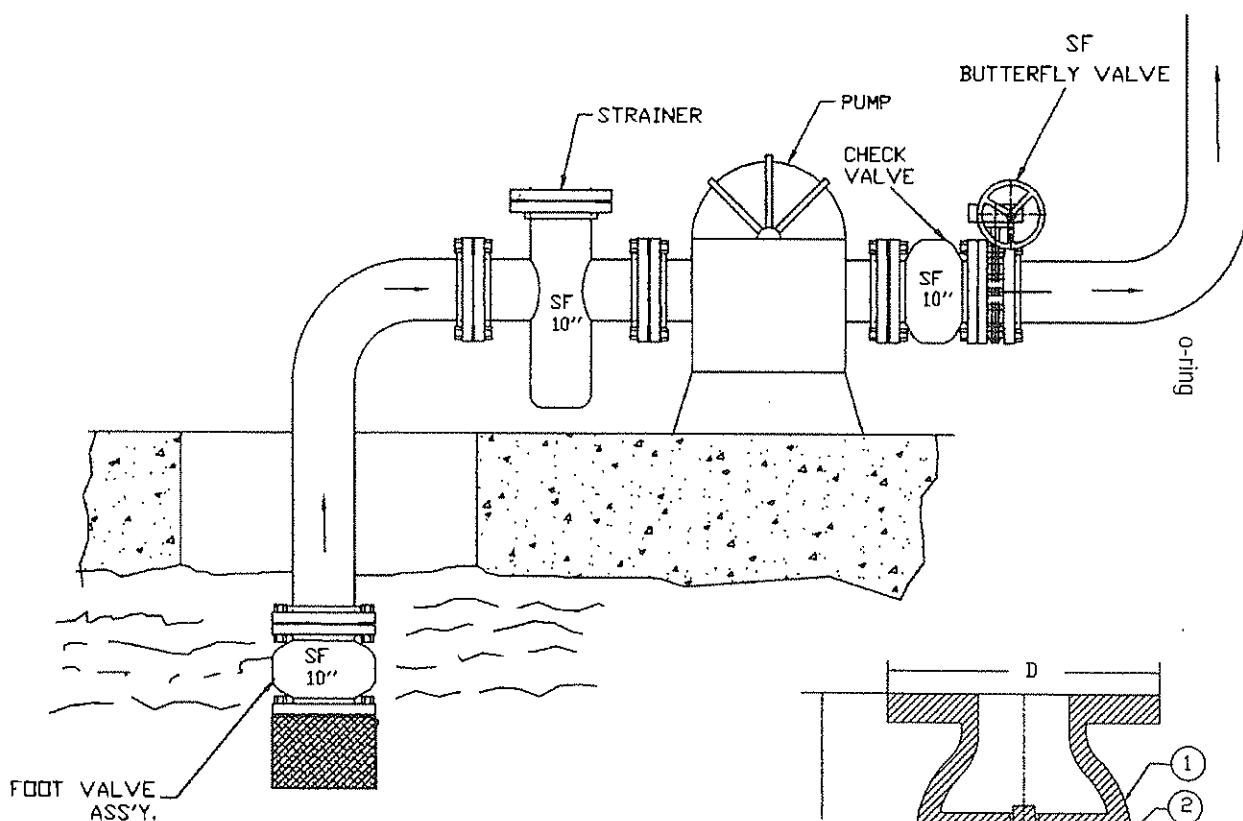
Size (Prefix)	Model #
1200 -	FV150

12", Carbon Steel Flanged Foot Valve

**Foot Valve should be used with
proper screens and materials**

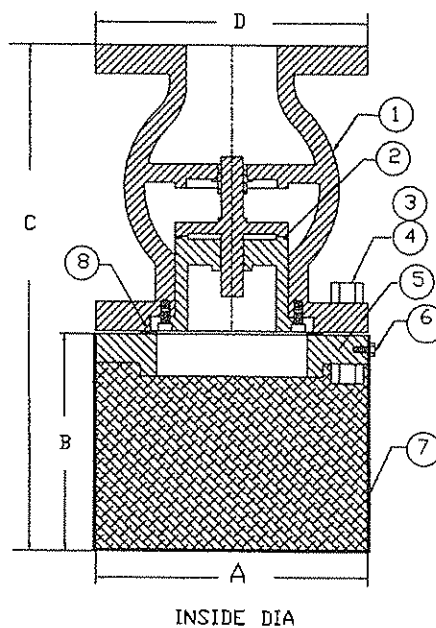
Notes

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.



Construction - Cast Steel

No	Name	Material
1	Body Ass'y	CF 125 IS/C
2	Quad Ring	Buna-N o-ring
3	Studs	SA 194 B7 Steel
4	Hex Nuts	SA 194 Steel
5	Slip-on Flng	Flat Face ASTM A105
6	Cap Screw	Stainless Steel
7	Screen	Stainless Steel
8	Gasket Ring	Red Rubber



Dimensional Data

Size	A	B	C	D	Shipping Wgt. (lbs.)	
Inches Prefix						
2	0200	6	3	9 7/16	6	25
2 1/2	0250	7	3	10 3/16	7	35
3	0300	7 1/2	3	10 11/16	7 1/2	45
4	0400	9	3	11 11/16	9	70
5	0500	10	4	13 11/16	10	90
6	0600	11	5	15 11/16	11	110
8	0800	13 1/2	6	19 11/16	13 1/2	180
10	1000	16	7	23 7/16	16	250
12	1200	19	8	28 7/16	19	400

Notes:

Manufacturer reserves the right to modify dimensions, materials, or design. Contact factory for certification.

Sure Flow Equipment Inc. — LIMITED WARRANTY —

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to below. All custom products are not subject to return, credit or refund.

If the purchaser believes a product to be defective, the purchaser shall:

- (a) Notify the manufacturer, state the alleged defect and request permission to return the product. Merchandise will not be accepted for return without a "Return Code" clearly marked on the outside of the package. Contact the office to obtain a return code.
- (b) If permission is given, return the product with the transportation prepaid. Collect shipments will not be accepted. Goods must be returned prepaid.

If the product is accepted for return and found to be defective, the manufacturer will, at its discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or issue credit for the purchase price.

Other than to repair, replace or credit as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product or use, sample or model, warnings or lack of any of the foregoing.

NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF ACT, PROMISE, DESCRIPTION OF PRODUCT OR USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF MANUFACTURER.

○ Check Valves



○ C, CA, CH, CP, and CPA Series

- Working pressures up to 6000 psig (413 bar)
- Adjustable and fixed cracking pressures
- Variety of end connections
- 316 stainless steel and brass materials

Contents

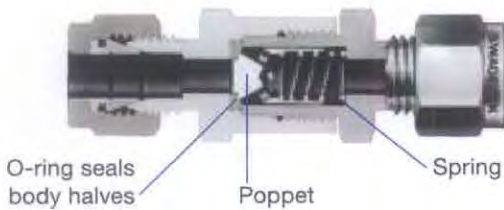
Features	2	Flow Data	7
Technical Data	3	Testing	10
Pressure-Temperature Ratings	3	Cleaning and Packaging	10
Cracking and Reseal Pressures	4	Ordering Information and Dimensions	11
Materials of Construction	5	Options and Accessories	14

Features

Fixed Cracking Pressures

From 1/3 to 25 psi (0.03 to 1.8 bar)

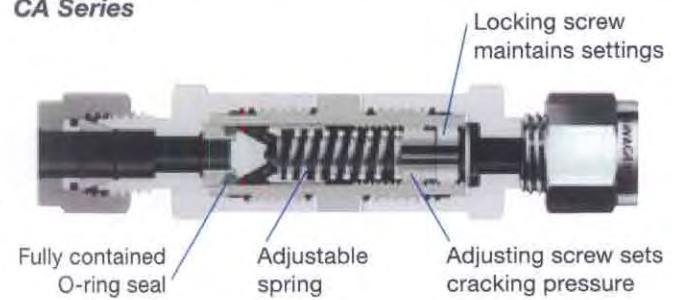
C Series



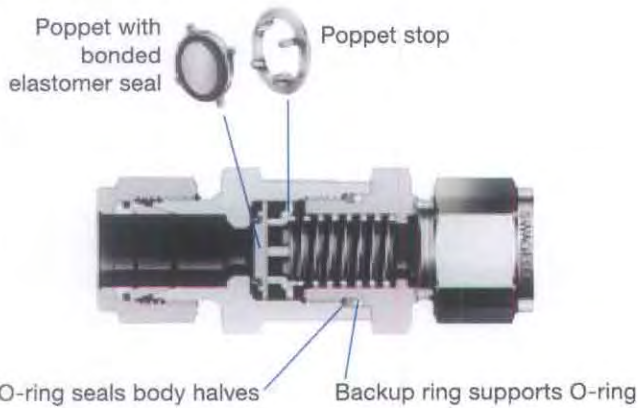
Adjustable Cracking Pressures

From 3 to 600 psi (0.21 to 41.4 bar)

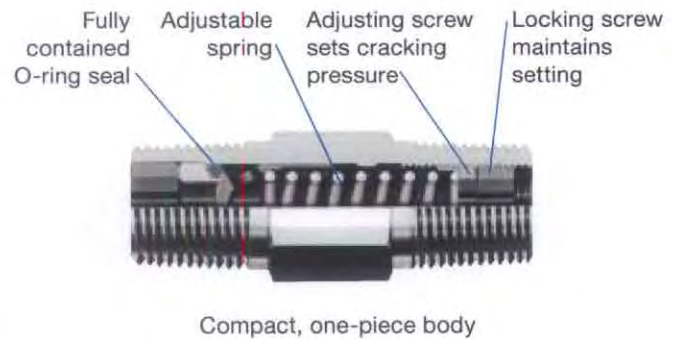
CA Series



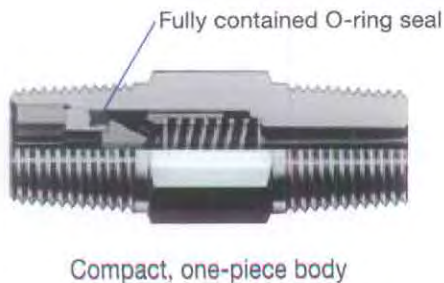
CH Series



CPA Series



CP Series



Technical Data

Cracking pressure—the upstream pressure at which the first indication of flow occurs.

Reseal pressure—the pressure at which there is no indication of flow.

⚠ For valves not actuated for a period of time, initial cracking pressure may be higher than the set cracking pressure.

Series	Maximum Flow Coefficient (C _v)	Nominal Cracking Pressure psi (bar)	Downstream Pressure at 70°F (20°C) psig (bar)
Fixed Cracking Pressure			
2C	0.10	1/3, 1, 10 and 25 (0.03, 0.07, 0.69, and 1.8)	1000 (68.9) ^①
4C	0.47		
6C	1.47		200 (13.7)
8C	1.68		
12C, 16C	4.48		
CH4	0.67	1/3, 1, 5, 10 and 25 (0.03, 0.07, 0.35 0.69, and 1.8)	6000 (413)
CH8	1.8		5000 (344)
CH16	4.7		
4CP	0.35	1/3, 1, 10 and 25 (0.03, 0.07, 0.69, and 1.8)	3000 (206)
8CP	1.20		
Adjustable Cracking Pressure			
CA	0.37	3 to 50 (0.21 to 3.5)	3000 (206)
4CPA	0.35	50 to 150 (3.5 to 10.4)	
8CPA	1.20	150 to 350 (10.4 to 24.2)	
		350 to 600 (24.2 to 41.4)	

① For cracking pressure of 25 psi (1.8 bar), downstream pressure is 3000 psig (206 bar).

Pressure-Temperature Ratings

C (2C, 4C, 6C, and 8C), CA, CP, and CPA Series

Ratings based on fluorocarbon FKM O-rings in 316 stainless steel valves and Buna N in brass valves.

Material	316 SS	Brass
Temperature, °F (°C)	Working Pressure, psig (bar)	
-10 (-23) to 100 (37)	3000 (206)	3000 (206)
200 (93)	2575 (177)	2600 (179)
250 (121)	2450 (168)	2405 (165)
300 (148)	2325 (160)	—
375 (190)	2185 (150)	—

C Series (12C and 16C)

Ratings based on fluorocarbon FKM O-rings in 316 stainless steel valves and Buna N in brass valves.

Material	316 SS	Brass
Temperature, °F (°C)	Working Pressure, psig (bar)	
-10 (-23) to 100 (37)	2000 (137)	1500 (103)
200 (93)	1715 (118)	1300 (89.5)
250 (121)	1630 (112)	1200 (82.6)
300 (148)	1545 (106)	—
375 (190)	1450 (99.9)	—

CH Series

Ratings based on fluorocarbon FKM seals.

Material	316 SS	
Series	CH4, CH8	CH16
Temperature, °F (°C)	Working Pressure, psig (bar)	
-10 (-23) to 100 (37)	6000 (413)	5000 (344) ^①
200 (93)	5160 (355)	4290 (295)
250 (121)	4910 (338)	4080 (281)
300 (148)	4660 (321)	3875 (266)
400 (204)	4280 (294)	3560 (245)

For more information about pressure ratings of valves with tube fitting end connections, see Swagelok® *Tubing Data*, MS-01-107.

① Pressure ratings may be limited by the end connection. See **Dimensions**, page 12.

Cracking and Reseal Pressures at 70°F (20°C)

Cracking pressure—the upstream pressure at which the first indication of flow occurs.

Reseal pressure—the pressure at which there is no indication of flow.

⚠ For valves not actuated for a period of time, initial cracking pressure may be higher than the set cracking pressure.

C Series

Nominal Cracking Pressure psi (bar)	Cracking Pressure Range psi (bar)	Reseal Pressure psi (bar)
1/3 (0.03)	Up to 3 (0.21)	Up to 6 (0.42) downstream pressure
1 (0.07)	Up to 4 (0.28)	Up to 6 (0.42) downstream pressure
10 (0.69)	7 to 15 (0.49 to 1.1)	3 (0.21) or more upstream pressure
25 (1.8)	20 to 30 (1.4 to 2.1)	17 (1.2) or more upstream pressure

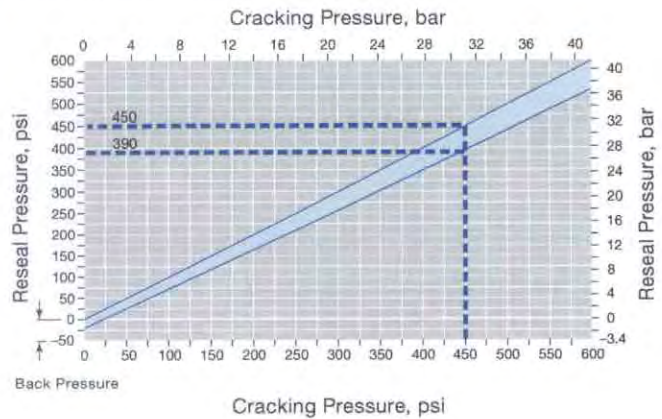
CH Series

Nominal Cracking Pressure psi (bar)	Cracking Pressure Range psi (bar)	Reseal Pressure psi (bar)
1/3 (0.03)	Up to 3 (0.21)	Up to 6 (0.42) back pressure
1 (0.07)	Up to 4 (0.28)	Up to 5 (0.35) back pressure
5 (0.35)	3 to 9 (0.21 to 0.63)	Up to 2 (0.14) back pressure
10 (0.69)	7 to 15 (0.49 to 1.1)	3 (0.21) or more upstream pressure
25 (1.8)	20 to 30 (1.4 to 2.1)	17 (1.2) or more upstream pressure

CP Series

Nominal Cracking Pressure psi (bar)	Cracking Pressure Range psi (bar)	Reseal Pressure psi (bar)
1/3 (0.03)	Up to 3 (0.21)	6 to 20 (0.42 to 1.4) downstream pressure
1 (0.07)	Up to 4 (0.28)	5 to 20 (0.35 to 1.4) downstream pressure
10 (0.69)	7 to 13 (0.49 to 0.90)	3 to 10 (0.21 to 0.69) downstream pressure
25 (1.8)	21 to 29 (1.5 to 2.0)	5 (0.35) or more upstream pressure

CA and CPA Series



Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.

Materials of Construction

C and CA Series

Component	Valve Body Materials	
	316 SS	Brass
	Material Grade/ASTM Specification	
1 Inlet body	316 SS/A479	Brass 360/B16
2 Inlet gasket (CA series)	PTFE-coated 316 SS/A240	
Inlet gasket (6C and 8C series with ≥ 50 psi [3.5 bar] spring)	PTFE-coated 316 SS/A240	
Inlet gasket (12C and 16C series)	PTFE-coated 316 SS/A240	PTFE-coated aluminum/B209
3 Insert (CA series)	316 SS/A479	Naval brass 485/B21
4 O-ring	Fluorocarbon FKM	Buna N
5 Poppet	316 SS/A479	Brass 360/B16
6 Spring	302 SS/A313	
7 Center body (CA series)	316 SS/A479	Brass 360/B16
8 Adjusting screw (CA series)	316 SS/A276	
9 Locking screw (CA series)	316 SS/A276	
10 Outlet gasket (CA series)	PTFE-coated 316 SS/A240	
11 Outlet body	316 SS/A479	Brass 360/B16
Lubricants	<i>Silicone-based and molybdenum disulfide-based (C series); PTFE-based and molybdenum disulfide-based (CA series)</i>	<i>Silicone-based (C series); PTFE-based (CA series)</i>

Wetted components listed in *italics*.

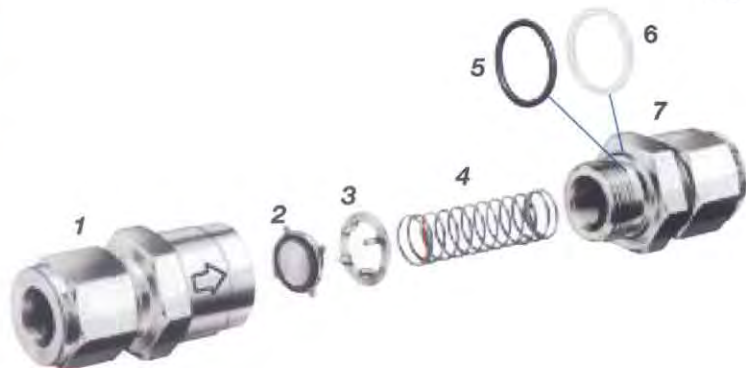


CH Series

Component	Material Grade/ASTM Specification
1 Inlet body	316 SS/A479
2 Poppet	<i>Fluorocarbon FKM-bonded^① 316 SS/A479</i>
3 Poppet stop	316 SS/A240
4 Spring	302 SS/A313
5 O-ring	Fluorocarbon FKM
6 Backup ring	PTFE/D1710
7 Outlet body	316 SS/A479
Lubricant	<i>Fluorocarbon-based</i>

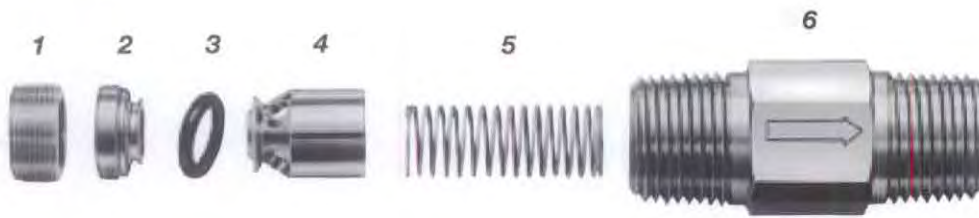
Wetted components listed in *italics*.

① Material Safety Data Sheet for bonding agent available on request.



Materials of Construction

CP Series



CPA Series



Component	Valve Body Materials				
	316 SS	Brass			
		4CP	8CP	4CPA	8CPA
	Material Grade/ASTM Specification				
1 Insert lock screw	316 SS/A276 or A479	Brass 485/ B21	Brass 360/ B16	Brass 485/ B21	Brass 360/ B16
2 Insert	316 SS/A479				
3 O-ring	Fluorocarbon FKM	Buna N			
4 Poppet	316 SS/A479	Brass 360/B16			
5 Spring		302 SS/A313			
6 Body	316 SS/A479	Brass 360/B16			
7 Adjusting screw (CPA series)	316 SS/A276	—		316 SS/A276	Brass 360 ^① / B16
8 Locking screw (CPA series)					
Lubricants	PTFE-based				

Wetted components listed in *italics*.

① Adjusting screw in valve with 150 or 350 psi (10.4 or 24.2 bar) spring is 316 SS.

Flow Data at 70°F (20°C)

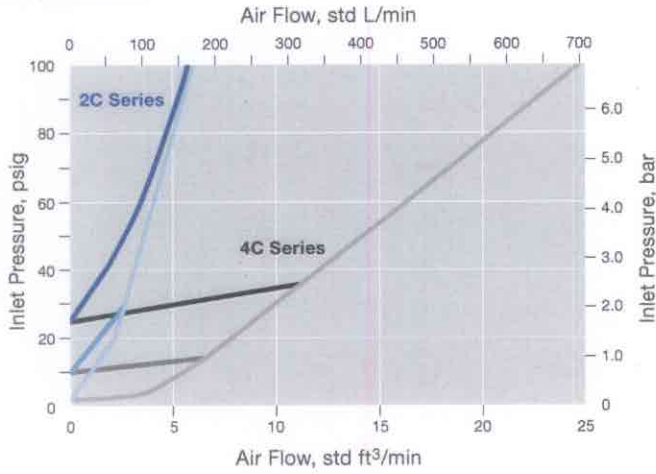
C Series

Nominal Cracking Pressures

- | | | | |
|--------------------|--------------------|---------------------|--------------------|
| 2C, 6C, 16C Series | — 1 psi (0.07 bar) | — 10 psi (0.69 bar) | — 25 psi (1.8 bar) |
| 4C, 8C Series | — 1 psi (0.07 bar) | — 10 psi (0.69 bar) | — 25 psi (1.8 bar) |

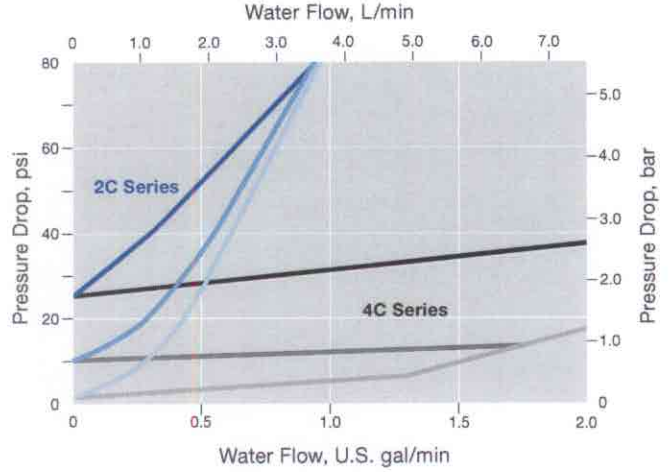
Air

2C, 4C Series

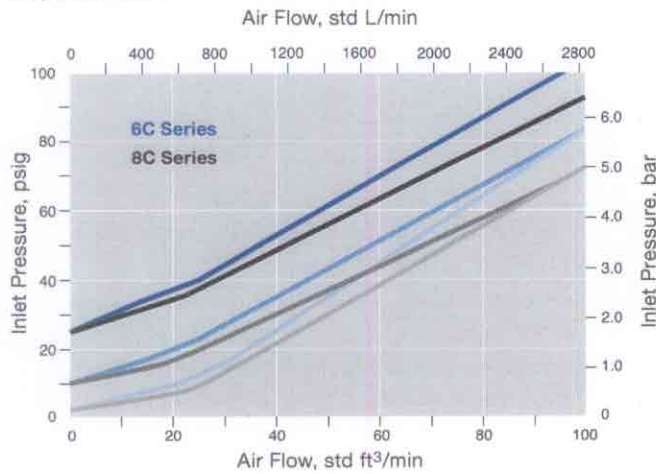


Water

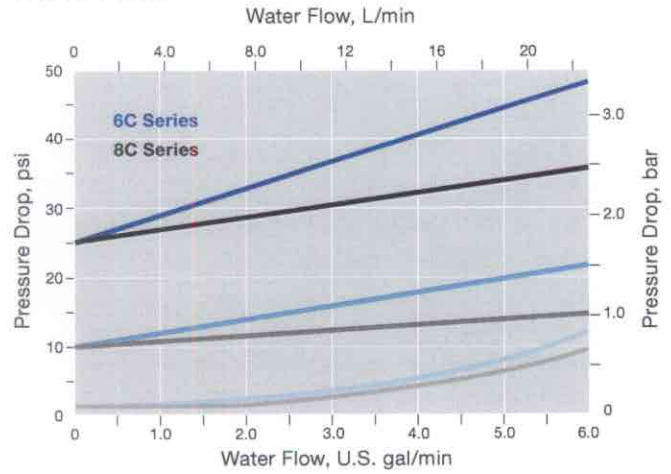
2C, 4C Series



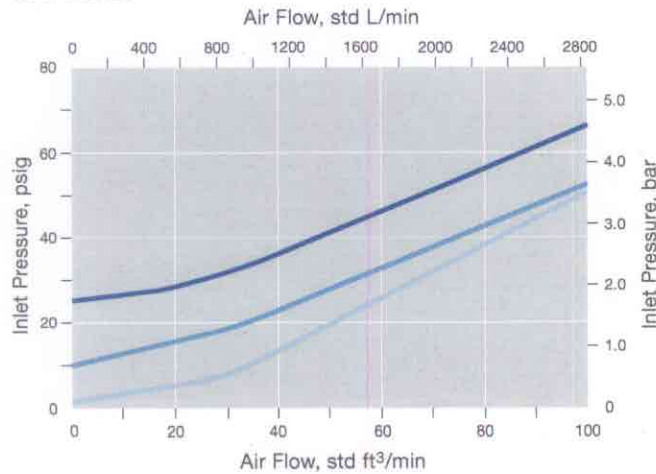
6C, 8C Series



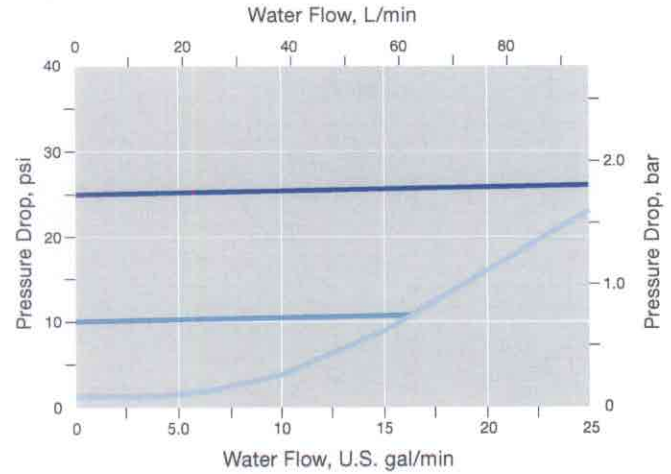
6C, 8C Series



16C Series



16C Series



Flow Data at 70°F (20°C)

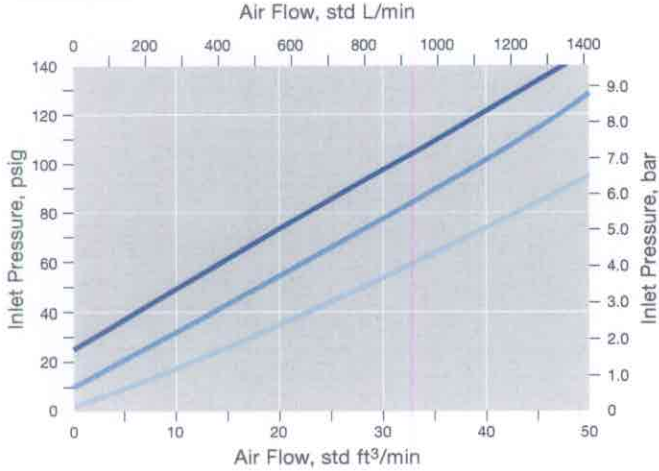
CH Series

Nominal Cracking Pressures

— 1 psi (0.07 bar) — 10 psi (0.69 bar) — 25 psi (1.8 bar)

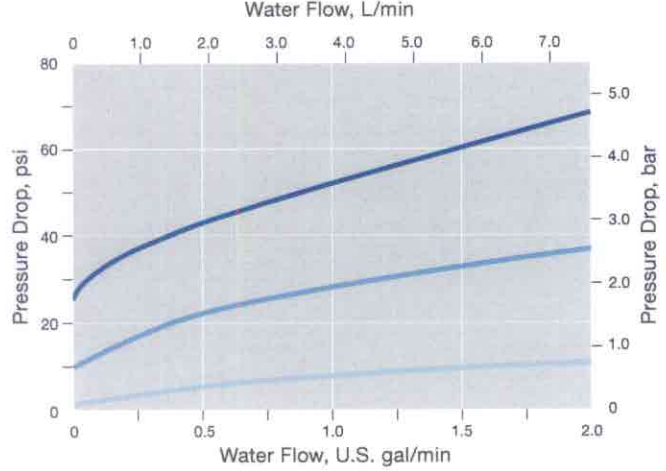
Air

CH4 Series

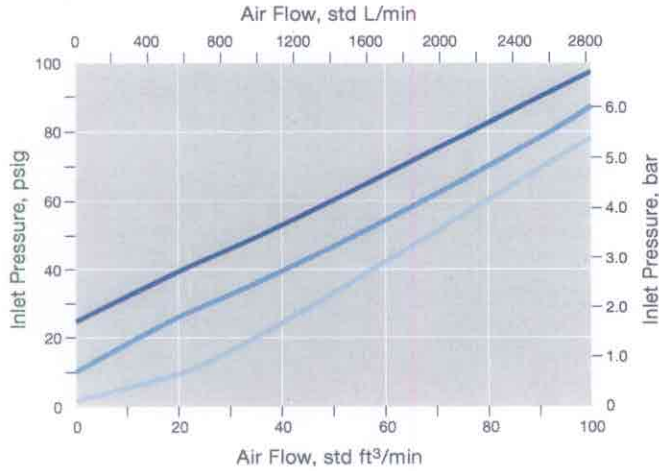


Water

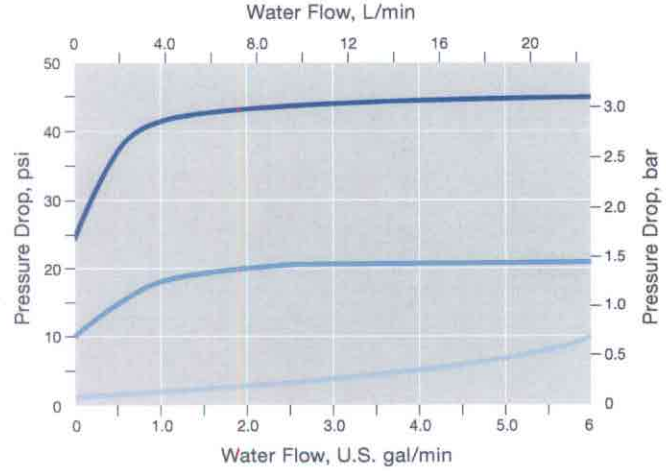
CH4 Series



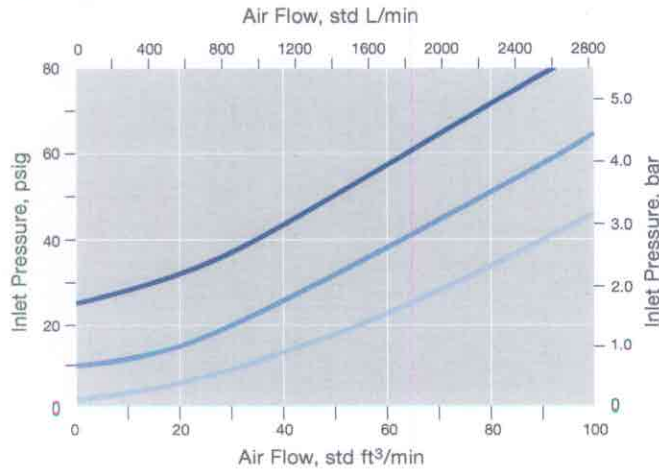
CH8 Series



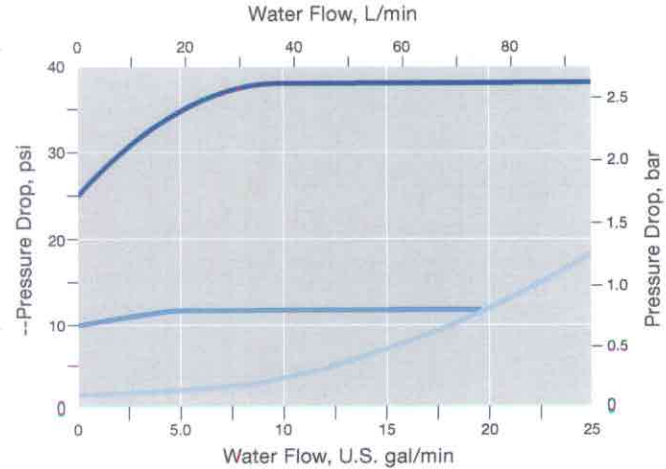
CH8 Series



CH16 Series



CH16 Series



Flow Data at 70°F (20°C)

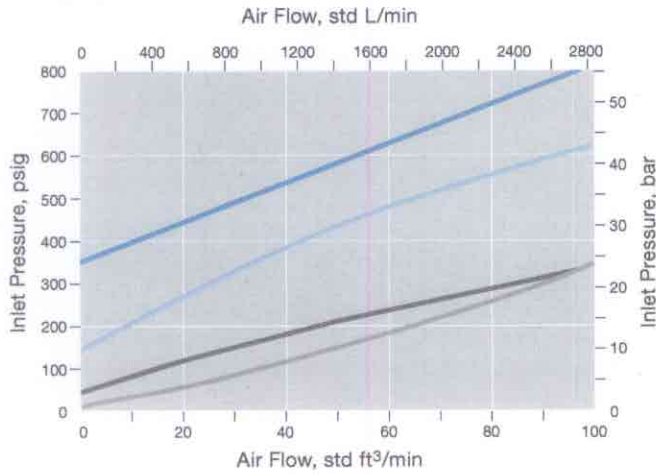
CA and CPA Series

Nominal Cracking Pressures

— 3 psi (0.21 bar) — 50 psi (3.5 bar) — 150 psi (10.4 bar) — 350 psi (24.2 bar)

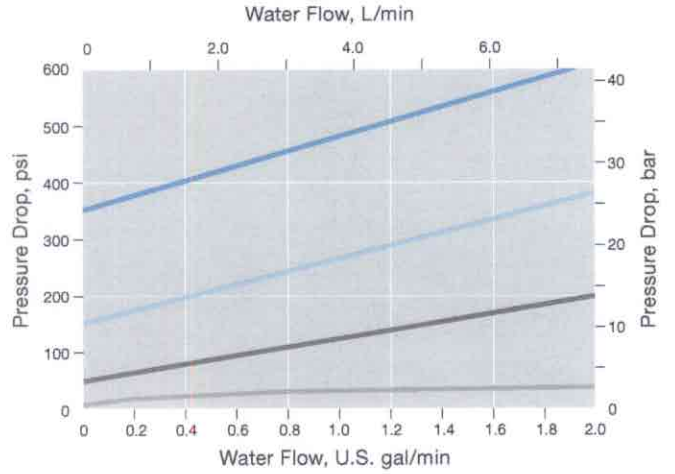
Air

CA Series

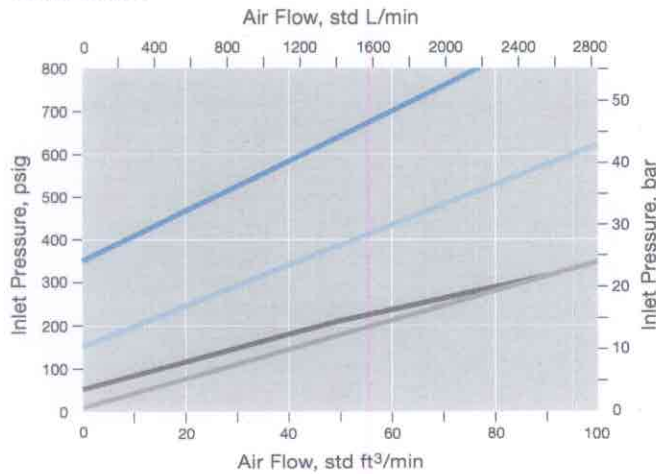


Water

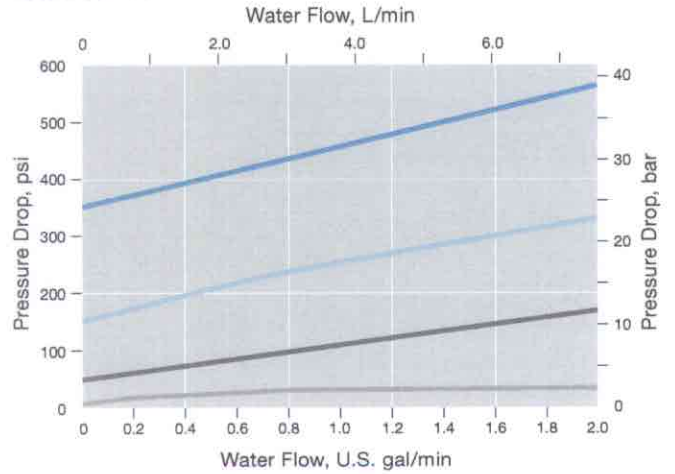
CA Series



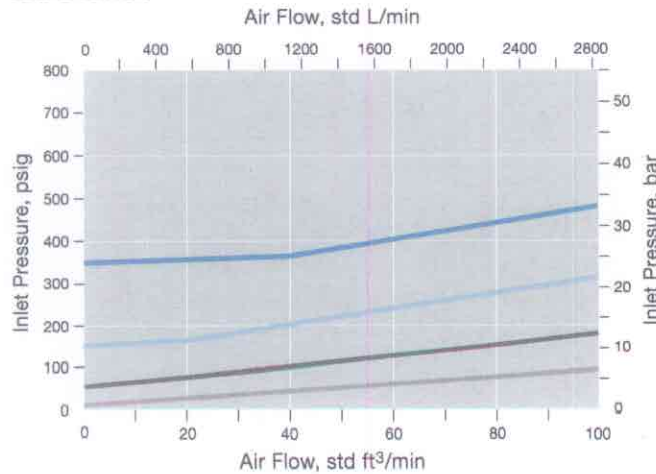
4CPA Series



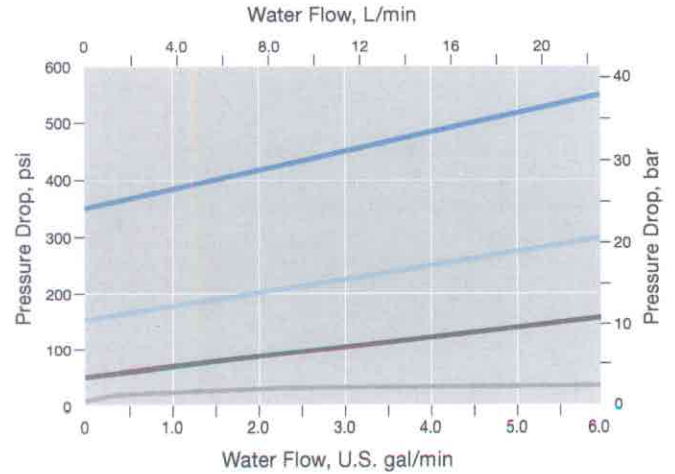
4CPA Series



8CPA Series



8CPA Series



Flow Data at 70°F (20°C)

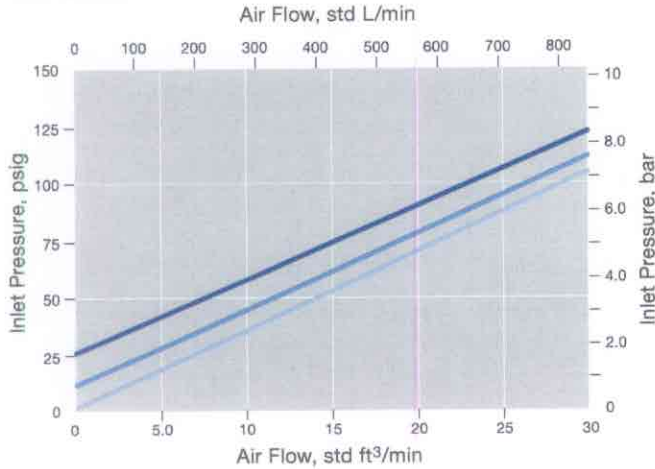
CP Series

Nominal Cracking Pressures

— 1 psi (0.07 bar) — 10 psi (0.69 bar) — 25 psi (1.8 bar)

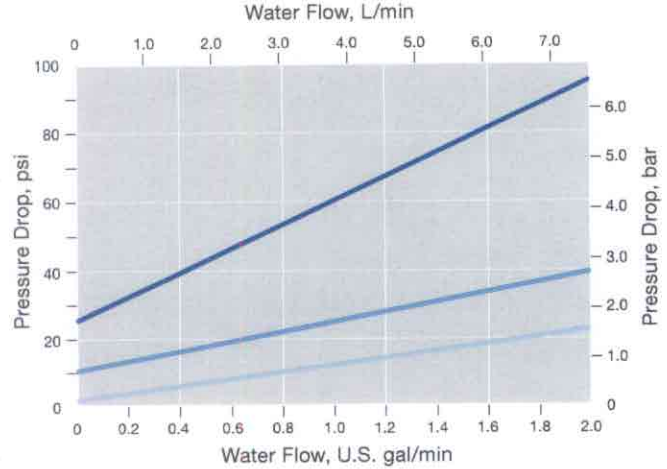
Air

4CP Series

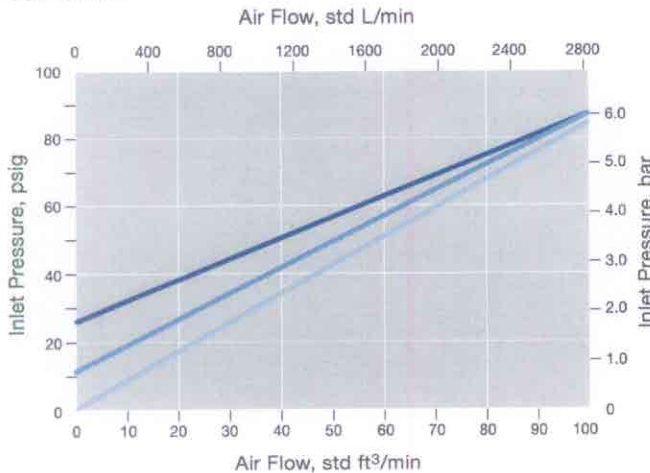


Water

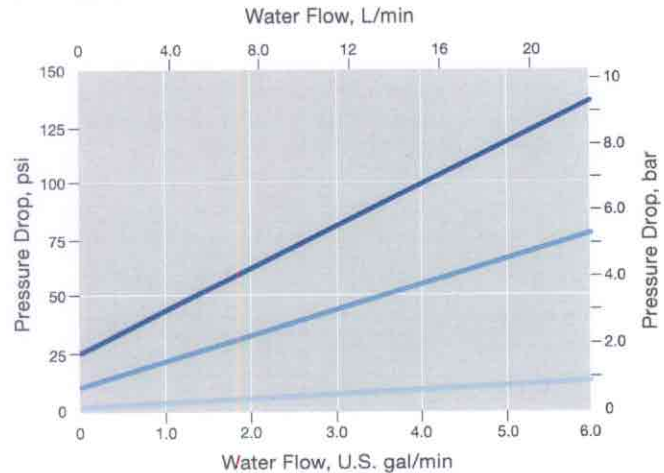
4CP Series



8CP Series



8CP Series



Testing

Every C, CA, CH, CP, and CPA series check valve is factory tested for crack and reseal performance with a liquid leak detector.

Check valves with fixed cracking pressures, C, CP, and CH series, are cycled six times prior to testing. Every valve is tested to ensure it seals within 5 s at the appropriate reseal pressure.

Check valves with adjustable cracking pressures, CA and CPA series, are tested at two pressure points. Every valve is tested at a low-pressure setting. Ten percent of the valves in each order are tested at the high-pressure setting. All valves must seal within 5 s at the appropriate reseal pressure.

Cleaning and Packaging

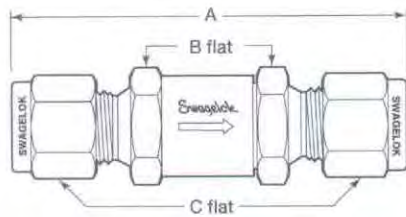
Every C, CA, and CH series check valve with VCR® or VCO® end connections is processed in accordance with Swagelok *Special Cleaning and Packaging (SC-11)*, MS-06-63, to ensure compliance with product cleanliness requirements as stated in ASTM G93 Level C.

All other C, CA, and CH series check valves, as well as every CP and CPA series check valve, are cleaned to Swagelok standard cleaning and packaging specification (SC-10), MS-06-62.

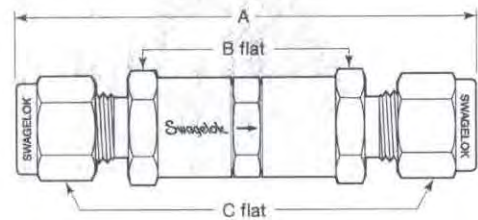
Dimensions

Dimensions, shown with Swagelok tube fitting nuts finger-tight, are for reference only and are subject to change.

C Series



CA Series



End Connections		Basic Ordering Number	Series	Dimensions, in. (mm)		
Inlet/Outlet	Size			A	B	C
Fixed Cracking Pressure, C Series						
Fractional Swagelok tube fittings	1/8 in.	SS-2C-	2C	2.19 (55.6)	5/8	7/16
	1/4 in.	SS-4C-	4C	2.35 (59.7)		9/16
	3/8 in.	SS-6C-	6C	3.17 (80.5)	7/8	11/16
	1/2 in.	SS-8C-	8C	3.42 (86.9)		7/8
	3/4 in.	SS-12C-	12C	4.32 (110)	1 1/4	1 1/8
Metric Swagelok tube fittings	6 mm	SS-6C-MM-	4C	2.36 (59.9)	5/8	(14)
	10 mm	SS-10C-MM-	8C	3.32 (84.3)	7/8	(19)
	12 mm	SS-12C-MM-		3.42 (86.9)		(22)
Female NPT	1/8 in.	SS-2C4-	2C	1.89 (48.0)	5/8	-
	1/4 in.	SS-4C4-	4C	2.15 (54.6)	3/4	
	3/8 in.	SS-6C4-	6C	2.98 (75.7)	7/8	
	1/2 in.	SS-8C4-	8C	3.58 (90.9)	1 1/16	
	3/4 in.	SS-12C4-	12C	4.08 (104)	1 1/4	
	1 in.	SS-16C4-	16C	4.84 (123)	1 5/8	
Male NPT	1/8 in.	SS-2C2-	2C	1.71 (43.4)	5/8	-
	1/4 in.	SS-4C2-	4C	2.09 (53.1)		
	3/8 in.	SS-6C2-	6C	2.78 (70.6)	7/8	
	1/2 in.	SS-8C2-	8C	3.16 (80.3)		
	3/4 in.	SS-12C2-	12C	4.08 (104)	1 1/4	
	1 in.	SS-16C2-	16C	4.52 (115)	1 5/8	
Male NPT/ Swagelok tube fitting	1/4 in.	SS-4C1-	4C	2.22 (56.4)	5/8	9/16
Male VCR fittings	1/4 in.	SS-4C-VCR-	4C	2.21 (56.1)	5/8	-
	1/2 in.	SS-8C-VCR-	8C	3.56 (90.4)	15/16	
	3/4 in.	SS-12C-VCR-	12C	4.64 (118)	1 5/8	
	1 in.	SS-16C-VCR-	16C	4.76 (121)		
Adjustable Cracking Pressure, CA Series						
Swagelok tube fittings	1/4 in.	SS-4CA-	CA	3.23 (82.0)	5/8	9/16
	6 mm	SS-6CA-MM-				(14)
	8 mm	SS-8CA-MM-				(16)
Male NPT/ Swagelok tube fitting	1/4 in.	SS-4CA1-		3.12 (79.2)		9/16
Male VCR fittings	1/4 in.	SS-4CA-VCR-		3.09 (78.5)		-

Ordering Information

Basic ordering numbers specify stainless steel material. To order brass, replace **SS** with **B** in the basic ordering number.

Example: **B-2C-**

C Series

To order, add a cracking pressure designator to the basic ordering number.

Cracking Pressure psi (bar)	Designator
1/3 (0.03)	1/3
1 (0.07)	1
10 (0.69)	10
25 (1.8)	25

Example: **SS-2C-1/3**

CA Series

To order, add a cracking pressure range designator to the basic ordering number.

Cracking Pressure psi (bar)	Designator
3 to 50 (0.21 to 3.5)	3
50 to 150 (3.5 to 10.4)	50
150 to 350 (10.4 to 24.2)	150
350 to 600 (24.2 to 41.4)	350

Example: **SS-4CA-3**

⚠ Check valves are designed for directional flow control only. Swagelok check valves should never be used as code safety relief devices.

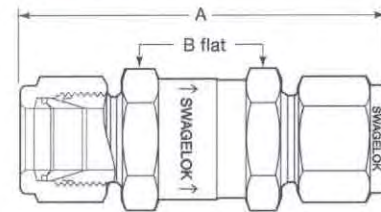
Dimensions

Dimensions, shown with Swagelok tube fitting nuts finger-tight, are for reference only and are subject to change.

End Connections		Pressure Rating at 100°F (37°) psig (bar)	Basic Ordering Number	Series	Dimensions in. (mm)		
Type	Size				A	B	
Fractional Swagelok tube fitting	1/8 in.	6000 (413)	SS-CHS2-	CH4	2.27 (57.7)	11/16	
	1/4 in.		SS-CHS4-		2.43 (61.7)		
	3/8 in.		SS-CHS6-	CH8	2.75 (69.9)		
	1/2 in.		SS-CHS8-		2.96 (75.2)		
	3/4 in.	5000 (344)	SS-CHS12-	CH16	3.52 (89.4)	1 5/8	
	1 in.	4700 (323)	SS-CHS16-		3.88 (98.6)		
Metric Swagelok tube fitting	6 mm	6000 (413)	SS-CHS6MM-	CH4	2.43 (61.7)	11/16	
	8 mm		SS-CHS8MM-		2.70 (68.6)		
	10 mm		SS-CHS10MM-	CH8	2.80 (71.1)		
	12 mm		SS-CHS12MM-		2.96 (75.2)		
	22 mm	5000 (344)	SS-CHS22MM-	CH16	3.48 (88.4)	1 5/8	
	25 mm	SS-CHS25MM-	3.88 (98.6)				
Female NPT	1/4 in.	6000 (413)	SS-CHF4-	CH4	2.13 (54.1)	11/16	
	3/8 in.	5000 (344)	SS-CHF6-		CH8		2.55 (64.8)
	1/2 in.	4600 (316)	SS-CHF8-	3.03 (77.0)			
	3/4 in.	4300 (296)	SS-CHF12-	CH16		3.23 (82.0)	1 5/8
	1 in.	4100 (282)	SS-CHF16-		3.83 (97.3)		
Male NPT	1/8 in.	6000 (413)	SS-CHM2-	CH4	1.79 (45.5)	11/16	
	1/4 in.		SS-CHM4-		2.17 (55.1)		
	3/8 in.		SS-CHM6-	CH8	2.36 (59.9)		1
	1/2 in.		SS-CHM8-		2.73 (69.3)		
	3/4 in.	5000 (344)	SS-CHM12-	CH16	3.29 (83.6)	1 5/8	
1 in.	SS-CHM16-	3.67 (93.2)					
Female ISO ^①	1/4 in.	6000 (413)	SS-CHF4RT-	CH4	2.28 (57.9)	11/16	
	1/2 in.	4600 (316)	SS-CHF8RT-	CH8	3.29 (83.6)	1 1/16	
	3/4 in.	4300 (296)	SS-CHF12RT-	CH16	3.55 (90.2)	1 5/8	
	1 in.	4100 (282)	SS-CHF16RT-		3.83 (97.3)		
Male ISO ^①	1/4 in.	6000 (413)	SS-CHM4RT-	CH4	2.17 (55.1)	11/16	
	1/2 in.		SS-CHM8RT-	CH8	2.73 (69.3)	1	
	3/4 in.	5000 (344)	SS-CHM12RT-	CH16	3.35 (85.1)	1 5/8	
	1 in.	SS-CHM16RT-	3.67 (93.2)				
Female SAE/MS	1/2 in.	4600 (316)	SS-CHF8ST-	CH8	2.74 (69.6)	1	
Male SAE/MS	1/2 in.	SS-CHM8ST-	2.48 (63.0)				
Male VCO fitting	1/4 in.	6000 (413)	SS-CHVCO4-	CH4	1.98 (50.3)	11/16	
	1/2 in.		SS-CHVCO8-	CH8	2.35 (59.7)	1	
	3/4 in.	5000 (344)	SS-CHVCO12-	CH16	2.90 (73.7)	1 5/8	
	1 in.		SS-CHVCO16-				
Male VCR fitting	1/4 in.	6000 (413)	SS-CHVCR4-	CH4	2.28 (57.9)	11/16	
	1/2 in.	3500 (241)	SS-CHVCR8-	CH8	2.73 (69.3)	1	
	3/4 in.	3000 (206)	SS-CHVCR12-	CH16	3.78 (96.0)	1 5/8	

① See specifications ISO 7/1, BS EN 10226-1, DIN-2999, JIS B0203.

CH Series



Ordering Information

To order, add a cracking pressure designator to the basic ordering number.

Cracking Pressure psi (bar)	Designator
1/3 (0.03)	1/3
1 (0.07)	1
5 (0.35)	1
10 (0.69)	10
25 (1.8)	25

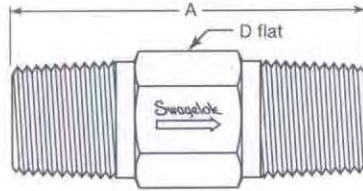
Example: SS-CHS2-1/3

⚠ Check valves are designed for directional flow control only. Swagelok check valves should never be used as code safety relief devices.

Dimensions

Dimensions, shown with Swagelok tube fitting nuts finger-tight, are for reference only and are subject to change.

CP and CPA Series



End Connections		Basic Ordering Number	Series	Dimensions, in. (mm)	
Inlet/Outlet	Size			A	D
Fixed Cracking Pressure, CP Series					
Female NPT	1/4 in.	SS-4CP4-	4CP	2.41 (61.2)	3/4
	1/2 in.	SS-8CP4-	8CP	3.71 (94.2)	1 1/16
Male NPT	1/4 in.	SS-4CP2-	4CP	1.62 (41.1)	9/16
	1/2 in.	SS-8CP2-	8CP	2.28 (57.9)	7/8
Female/male NPT	1/4 in.	SS-4CP6-	4CP	2.29 (58.2)	3/4
Male/female NPT	1/4 in.	SS-4CP5-		1.75 (44.4)	3/4
	1/2 in.	SS-8CP5-	8CP	2.83 (71.9)	1 1/16
Female ISO ^①	1/4 in.	SS-4CP4-RT-	4CP	2.54 (64.5)	3/4
Male ISO ^①	1/4 in.	SS-4CP2-RT-		1.62 (41.1)	9/16
Adjustable Cracking Pressure, CPA Series					
Female NPT	1/4 in.	SS-4CPA4-	4CPA	2.98 (75.7)	3/4
Male NPT	1/4 in.	SS-4CPA2-		1.62 (41.1)	9/16
	1/2 in.	SS-8CPA2-	8CPA	2.56 (65.0)	7/8
Male ISO ^①	1/4 in.	SS-4CPA2-RT-	4CPA	1.62 (41.1)	9/16
	1/2 in.	SS-8CPA2-RT-	8CPA	2.56 (65.0)	7/8

^① See specifications ISO 7/1, BS EN 10226-1, DIN-2999, and JIS B0203.

Ordering Information

Basic ordering numbers specify stainless steel material. To order brass, replace **SS** with **B** in the basic ordering number.

Example: **B-4CP4-**

CP Series

To order, add a cracking pressure designator to the basic ordering number.

Cracking Pressure psi (bar)	Designator
1/3 (0.03)	1/3
1 (0.07)	1
10 (0.69)	10
25 (1.8)	25

Example: **B-4CP4-1/3**

CPA Series

To order, add a cracking pressure range designator to the basic ordering number.

Cracking Pressure psi (bar)	Designator
3 to 50 (0.21 to 3.5)	3
50 to 150 (3.5 to 10.4)	50
150 to 350 (10.4 to 24.2)	150
350 to 600 (24.2 to 41.4)	350

Example: **SS-4CPA4-3**

⚠ Check valves are designed for directional flow control only. Swagelok check valves should never be used as code safety relief devices.

Options and Accessories

Seal Materials (All Series)

Fluorocarbon FKM O-rings are standard in 316 stainless steel valves; Buna N O-rings are standard in brass valves. Other elastomer seals (poppet bonding material and O-ring) are available. To order, insert the seal material designator into the valve ordering number.

Seal Material	Designator	Temperature Rating °F (°C)
Buna N	-BU	-10 to 250 (-23 to 121)
Ethylene propylene	-EP	-50 to 300 (-45 to 148)
Fluorocarbon FKM	-VI	-10 to 375 (-23 to 190)
Neoprene	-NE	-40 to 250 (-40 to 121)

Example: B-2C-**VI**-1/3

Additional seal materials are available. Contact your authorized Swagelok sales and service representative for details.

Special Alloys (All Series)

Springs of alloy 400 or alloy C-276 are available in some sizes. Valve bodies of alloy R-405, carbon steel, aluminum, or other alloys are available in some sizes. Contact your authorized Swagelok representative for more information.

Special Cleaning and Packaging (SC-11)

Every C, CA, and CH series check valve with VCR or VCO end connections is processed in accordance with Swagelok *Special Cleaning and Packaging (SC-11)*, MS-06-63, to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C.

To order special cleaning and packaging for C, CA, and CH series check valves with other end connections, add **-SC11** to the ordering number.

Example: SS-2C-1/3-**SC11**

PTFE-Coated Springs (C, CA, CP, and CPA Series)

Springs with PTFE coating are available in some sizes. Contact your authorized Swagelok representative for more information.

ECE R110-Compliant Valves (CH Series)

Stainless steel CH series check valves with 1/4 and 1/2 in. Swagelok tube fitting end connections and Buna C seals are available for use in alternative fuel service.

- Pressure rating at 70°F (20°C): 3770 psig (259 bar)
- Temperature ratings: -40 to 185°F (-40 to 85°C)

Ordering numbers: 1/4 in. size—**SS-CH4-BC**
1/2 in. size—**SS-CH8-BC**

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.

Sour Gas Valves (CH Series)

CH series valves with Swagelok tube fitting end connections are available for sour gas service. Materials for wetted components are selected in accordance with NACE Specification MR0175 for sulfide stress cracking-resistant materials.

Technical Data

Pressure Rating at 70°F (20°C)

CH4 and CH8 series: 5000 psig (344 bar)
CH16 series: 4700 psig (323 bar)

Temperature Rating

-50 to 300°F (-45 to 148°C)

Nominal Cracking Pressures

1/3, 1, and 5 psi (0.03, 0.07, and 0.35 bar)

End Connections

1/4, 3/8, 1/2, 3/4, and 1 in. Swagelok tube fittings

Materials of Construction

Body, poppet—alloy R-405/B164

Seals—ethylene propylene

Backup ring—PTFE

Spring—alloy X-750/AMS 5699

All other materials and lubricant same as standard product. See **Materials of Construction**, page 5.

Ordering Information

To order, replace **SS** with **M** and insert **-SG** into the ordering number.

Example: **M-CHS2-SG**-1/3

Deflector Cap (CP and CPA Series)

A polyethylene deflector cap is available for CP and CPA series valves with male NPT end connections. The deflector cap deflects flow from direct contact with personnel and prevents atmospheric contaminants from entering the valve. The deflector cap screws easily onto the male NPT outlet end of the valve. Maximum rating is 300 psig at 100°F (20.6 bar at 37°C).

To order, insert **-DG** for a green cap or **-DR** for a red cap into the ordering number.

Example: SS-4CPA2-**DR**-3



Maintenance Kits

Spring kits and seal kits are available for retrofit or maintenance. See the Swagelok *Check Valve Maintenance Kits* catalog, MS-02-115.

Oxygen Service Hazards

For more information about hazards and risks of oxygen-enriched systems, see the Swagelok *Oxygen System Safety* technical report, MS-06-13.

Plug Valves



P4T and P6T Series

- Working pressures up to 3000 psig (206 bar)
- Swagelok® tube fitting and NPT and ISO tapered pipe end connections
- 1/8 through 1/2 in. and 6 through 12 mm sizes
- Brass and 316 stainless steel materials

2 Plug Valves

Features

Swagelok plug valves offer low-torque, quarter-turn operation in a simple, compact design that provides positive shutoff of forward flow with up to 3000 psig (206 bar) pressure.

- Straight-through flow path
- Forward-flow throttling
- Simple design, easy to clean and maintain
 - One-piece body
 - Replaceable plug assembly
 - O-ring seal to atmosphere.

Pressure-Temperature Ratings^①

Series	P4T, P6T	P4T	P6T
Material	316 SS	Brass	
Temperature, °F (°C)	Working Pressure, psig (bar) ^②		
-10 (-23) to 100 (37)	3000 (206)	3000 (206)	2000 (137)
150 (65)	3000 (206)	2500 (172)	2000 (137)
200 (93)	3000 (206)	2000 (137)	2000 (137)
250 (121)	2000 (137)	1500 (103)	1500 (103)
300 (148)	1000 (68.9)	1000 (68.9)	1000 (68.9)
350 (176)	1000 (68.9)	1000 (68.9)	1000 (68.9)
400 (204)	1000 (68.9)	400 (27.5)	400 (27.5)

① Based on PTFE-coated fluorocarbon FKM O-rings.

② Differential pressure is limited to 150 psig (10.3 bar) maximum if reverse flow occurs. Reverse-flow throttling may damage O-ring.

Materials of Construction



Component	Valve Body Materials	
	316 SS	Brass
	Material Grade/ASTM Specifications	
1 Handle	Polyetherimide	
2 Pin	316 SS	
3 Plug	<i>PTFE-coated 316 SS/A479</i>	<i>PTFE-coated brass/B453</i>
4 O-rings	<i>PTFE-coated fluorocarbon FKM</i>	
5 Pin	316 SS	
6 Body	<i>316 SS/A479</i>	<i>Brass/B453</i>
7 Snap ring	PH 15-7 Mo [®] SS	
Lubricant	<i>Silicone-based</i>	

Wetted components listed in *italics*.

Flow Data at 70°F (20°C)

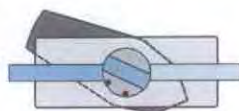
End Connections		C _v	Series	Pressure Drop to Atmosphere, psi (bar)					
				1 (0.068)	5 (0.34)	10 (0.68)	1 (0.068)	5 (0.34)	10 (0.68)
Inlet/Outlet	Size			Air Flow, std ft ³ /min (std L/min)			Water Flow, U.S. gal/min (L/min)		
Fractional Swagelok tube fittings	1/8 in.	0.10	P4T	0.3 (8.4)	0.8 (22)	1.1 (31)	0.1 (0.37)	0.2 (0.75)	0.3 (1.1)
	1/4 in.	1.6		6.0 (160)	13 (360)	18 (500)	1.6 (6.0)	3.6 (13)	5.1 (19)
	3/8 in.	1.1		4.1 (110)	8.9 (250)	12 (330)	1.1 (4.1)	2.5 (9.4)	3.5 (13)
		6.4	23 (650)	52 (1470)	72 (2030)	6.4 (24)	14 (52)	20 (75)	
Metric Swagelok tube fittings	1/2 in.	4.4	P6T	16 (450)	35 (990)	49 (1380)	4.4 (16)	9.8 (37)	13 (49)
	6 mm	1.6	P4T	6.0 (160)	13 (360)	18 (500)	1.6 (6.0)	3.6 (13)	5.1 (19)
	8 mm	6.4	P6T	23 (650)	52 (1470)	72 (2030)	6.4 (24)	14 (52)	20 (75)
	10 mm			17 (480)	39 (1100)	54 (1520)	4.8 (18)	10 (37)	15 (56)
Female NPT	12 mm	4.8							
	1/8 in.	1.2	P4T	4.4 (120)	9.7 (270)	13 (360)	1.2 (4.5)	2.7 (10)	3.8 (14)
	1/4 in.	0.9		3.3 (93)	7.3 (200)	10 (280)	0.9 (3.4)	2.0 (7.5)	2.8 (10)
		4.3	P6T	16 (450)	34 (960)	48 (1350)	4.3 (16)	9.6 (36)	13 (49)
1/2 in.	2.7	10 (280)		21 (590)	30 (840)	2.7 (10)	6.0 (22)	8.5 (32)	
Male NPT	1/8 in.	1.0	P4T	3.7 (100)	8.1 (220)	11 (310)	1.0 (3.7)	2.2 (8.3)	3.2 (12)
	1/4 in.			9.0 (250)	19 (530)	27 (760)	2.4 (9.0)	5.4 (20)	7.6 (28)
	1/2 in.	2.4	P6T	3.3 (93)	7.3 (200)	10 (280)	0.9 (3.4)	2.0 (7.5)	2.8 (10)
Male NPT/ Swagelok tube fitting	1/4 in.	0.9	P4T	3.7 (100)	8.1 (220)	11 (310)	1.0 (3.7)	2.2 (8.3)	3.2 (12)
Male/female NPT	1/4 in.	1.0		3.3 (93)	7.3 (200)	10 (280)	0.9 (3.4)	2.0 (7.5)	2.8 (10)
Female ISO	1/4 in.	0.9							
	1/2 in.	2.7	P6T	10 (280)	21 (590)	30 (840)	2.7 (10)	6.0 (22)	8.5 (32)

Operation

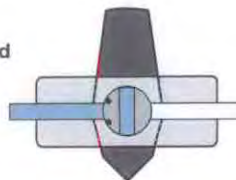
Open



Forward-Flow Throttling



Closed



Testing

Every Swagelok plug valve is factory tested for shutoff at 600 psig (41.3 bar).

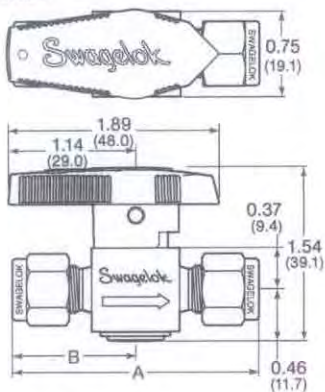
Cleaning and Packaging

Every Swagelok plug valve is cleaned and packaged in accordance with Swagelok standard cleaning and packaging specification (SC-10), MS-06-62.

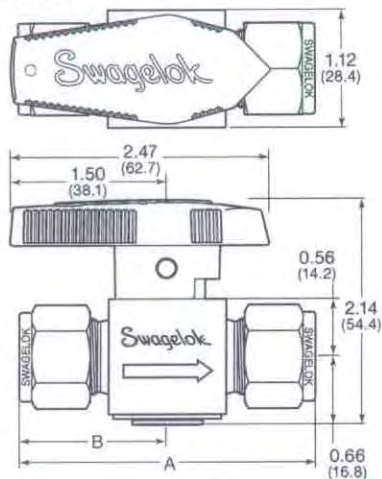
Ordering Information and Dimensions

Dimensions, in inches (millimeters), are for reference only and are subject to change.

P4T Series



P6T Series



End Connections		Ordering Numbers		Series	Dimensions, in. (mm)				
Inlet/Outlet	Size	Stainless Steel	Brass		Orifice	A	B		
Fractional Swagelok tube fittings	1/8 in.	SS-2P4T	B-2P4T	P4T	0.093 (2.3)	1.99 (50.5)	0.98 (24.9)		
	1/4 in.	SS-4P4T	B-4P4T			2.17 (55.1)	1.08 (27.4)		
	3/8 in.	SS-6P4T	B-6P4T	P6T	0.283 (7.2)	2.29 (58.2)	1.14 (29.0)		
		SS-6P6T	B-6P6T			2.66 (67.6)	1.33 (33.8)		
	1/2 in.	SS-8P6T	B-8P6T	2.88 (73.2)	1.44 (36.6)				
Metric Swagelok tube fittings	6 mm	SS-6P4T-MM	B-6P4T-MM	P4T	0.172 (4.4)	2.17 (55.1)	1.08 (27.4)		
	8 mm	SS-8P6T-MM	B-8P6T-MM	P6T		2.66 (67.6)	1.30 (33.0)		
	10 mm	SS-10P6T-MM	B-10P6T-MM			2.68 (68.1)	1.34 (34.0)		
	12 mm	SS-12P6T-MM	B-12P6T-MM			2.96 (75.2)	1.44 (36.6)		
Female NPT	1/8 in.	SS-2P4T4	B-2P4T4	P4T	0.172 (4.4)	1.78 (45.2)	0.89 (22.6)		
	1/4 in.	SS-4P4T4	B-4P4T4	P6T		0.283 (7.2)	2.09 (53.1)	1.05 (26.7)	
		SS-4P6T4	B-4P6T4		2.38 (60.5)		1.19 (30.2)		
Male NPT	1/2 in.	SS-8P6T4	B-8P6T4	P6T	0.283 (7.2)	2.88 (73.2)	1.44 (36.6)		
	1/8 in.	SS-2P4T2	B-2P4T2			P4T	0.172 (4.4)	1.53 (38.9)	0.76 (19.3)
	1/4 in.	SS-4P4T2	B-4P4T2			1.90 (48.3)		0.95 (24.1)	
Male NPT/ Swagelok tube fitting	1/2 in.	SS-8P6T2	B-8P6T2	P6T	0.283 (7.2)	2.64 (67.1)	1.32 (33.5)		
	1/4 in.	SS-4P4T1	B-4P4T1	P4T		0.172 (4.4)	2.03 (51.2)	0.95 (24.1)	
Male/female NPT	1/4 in.	SS-4P4T5	B-4P4T5		2.00 (50.8)				
Female ISO ^①	1/4 in.	SS-4P4T4-RT	B-4P4T4-RT		P6T		0.283 (7.2)	2.21 (56.1)	1.11 (28.2)
	1/2 in.	SS-8P6T4-RT	B-8P6T4-RT	3.14 (79.8)		1.57 (39.9)			

Dimensions shown with Swagelok tube fitting nuts finger-tight.

① See specifications ISO 7/1, BS21, DIN-2999, and JIS B0203.

Options

Optional Body Materials

Valve bodies and plugs of other alloys are available in some P4T models. Contact your authorized Swagelok sales and service representative for more information.

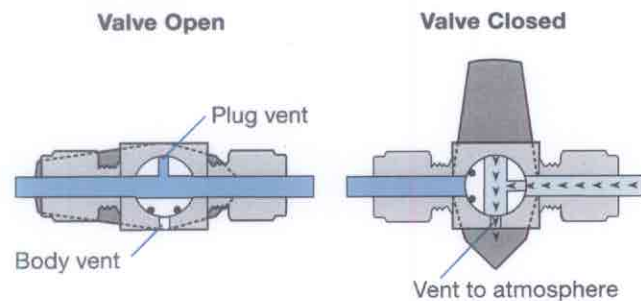
Optional O-ring Materials

PTFE-coated fluorocarbon FKM is standard. For an optional material, add a designator to the valve ordering number.

O-ring Material	Designator
Kalrez®	-KZ
PTFE-coated Buna N	-TB
PTFE-coated ethylene propylene	-TE
PTFE-coated neoprene	-TN

Example: SS-2P4T-KZ

Downstream Vent



Vented plug and valve body allow pressure release to atmosphere when valve is closed.

- 150 psig (10.3 bar) maximum operating pressure
- Red polyetherimide handle standard

To order, replace **T** with **V** in the valve ordering number.

Example: SS-2P4V

Plastic Handle Colors

Dark green is standard. For an optional color, add a handle color designator to the valve ordering number.

Handle Color	Designator
Black	-BK
Blue	-BL
Red	-RD

Example: SS-2P4T-BL

Other colors are available; contact your authorized Swagelok representative.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.

Locking Handle

Lever locks to plate to secure valve open or closed.

- Meets OSHA Lockout/Tagout Standard 29 CFR Part 1910.147, *Control of Hazardous Energy*



- Accommodates padlock shackle length of 3/4 in. (19 mm) minimum and diameter of 1/4 to 3/8 in. (6.4 to 9.5 mm)
- Nylon handle with brass insert; 316 SS lever, plate, mounting bracket, and screws

Locking handles are available factory assembled or as a retrofit kit. See the Swagelok *Locking Handles for Plug Valves* catalog, MS-02-12, for dimensions and ordering information.

Metal Handle

Removing the roll pin protects against accidental actuation—the valve opens and closes with a wrench.

- 300 series stainless steel or aluminum

To order, add **-M1** for stainless steel or **-M2** for aluminum to the valve ordering number.

Example: SS-2P4T-M1



Panel Mounting

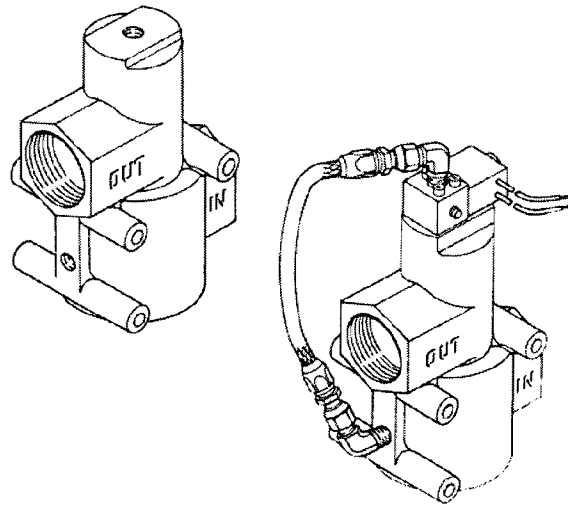


Bracket mounts to panels 1/16 to 3/8 in. (1.5 to 9.5 mm) thick.

- Includes mounting hole template and label to indicate open and closed positions
- Nylon handle with brass insert; polycarbonate label; 316 SS mounting bracket and screws

Panel mounting capability is available on factory-assembled valves or as a retrofit kit. See the Swagelok *Panel Mounting for Plug Valves* catalog, MS-02-11, for dimensions and ordering information.

OPERATING & SERVICE MANUAL



TURBO VALVE

TABLE OF CONTENTS

SECTION	SUBJECT	PAGE
1.0	General Information.....	1
2.0	<i>TURBOVALVE</i> Operation.....	1
3.0	<i>TURBOVALVE</i> Installation.....	2
4.0	<i>TURBOVALVE</i> Disassembly.....	2
5.0	<i>TURBOVALVE</i> Assembly.....	3
6.0	Disassembly/Assembly (Electrical).....	3

LIST OF ILLUSTRATIONS

FIGURES	TITLE	PAGE
1	<i>TURBOVALVE</i> (Pneumatically Controlled).....	1
2	<i>TURBOVALVE</i> (Electrically Controlled).....	2
3	Opening Pressure vs. Supply.....	2
4	Piston Removal.....	3
5	<i>TURBOVALVE</i> Dimensional Data.....	4
6	T30-I Installation Diagram (Electrical).....	5
7	T50-P Installation Diagram.....	6
8	T100 Series Installation Diagram.....	7
9	T100-V Installation Diagram.....	8
10	<i>TURBOVALVE</i> (Pneumatically Controlled).....	10
11	<i>TURBOVALVE</i> (Electrically Controlled).....	12

TDI *TURBOTWIN*TM

FROM TECH DEVELOPMENT, INC.

1.0 GENERAL INFORMATION

The TDI *TURBOVALVE* is a versatile starting air or control relay valve available in a pilot operated version or with an integrated solenoid that eliminates extra plumbing. Its high flow capacity reduces pressure drop through the valve, providing for a broad range of applications.

An auxiliary port provides a convenient point for accessing the pressure at the supply (IN port) ... using it for indication, control or pilot actuation.

FEATURES

- Low pressure pilot
- Optional integrated solenoid versions
- 450 psig Rating (Pneumatically controlled version only)
- High flow capacity
- Replaceable O-Rings
- 1-1/4" or 1-1/2" pipe sizes
- 3-Point mounting for secure attachment
- Replaces Sealco (P/N: 10900, 11900, 14900, and 110250) and Ingersoll-Rand (P/N:SRV125 and SRV150) relay valves

SPECIFICATIONS

- Valve Housing: Aluminum (Nickel plated for corrosion resistance).
- Internal Parts: Aluminum
- O-Rings: VITON or Buna N
- Operating Temperature: -20 to 200°F (-29° to 93°C)
- Valve Working Pressure Rating: 450 psig (31 Bar) (Pneumatically controlled version only)
- Weight: 2.9 pounds (1.3 kg)
- Optional Solenoid Voltages: 12, 24, 48, 110 VDC/120 or VAC/60 Hz
- Cv = 41

2.0 OPERATION

2.1 Pneumatically controlled *TURBOVALVE*

- a. Air is supplied to the Applied Pressure Port (APP), which forces the piston to the open position. The pressure required to open the relay valve is based on the supply pressure. See figure 3.
- b. The main ports (IN and OUT) open to allow flow through the valve.
- c. When the pilot pressure is released, the spring allows the piston to retract, closing the main port.

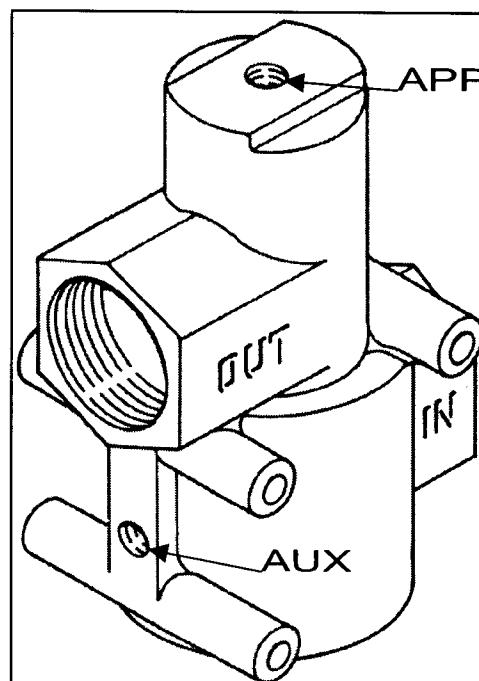


Figure 1. TurboValve-Pneumatically Controlled

2.2 Electrically controlled *TURBOVALVE*

- a. Electricity is applied to the solenoid valve allowing air to access the relay valve via the APP.

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- b. The main ports (IN and OUT) are opened to allow flow through the valve.
- c. When the start button is released, the electric solenoid vents, allowing the relay valve piston to retract, closing the main port.

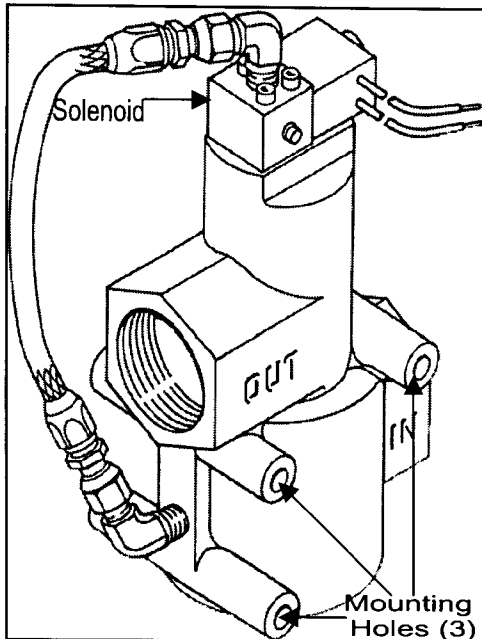


Figure 2. TurboValve-Electrically Controlled

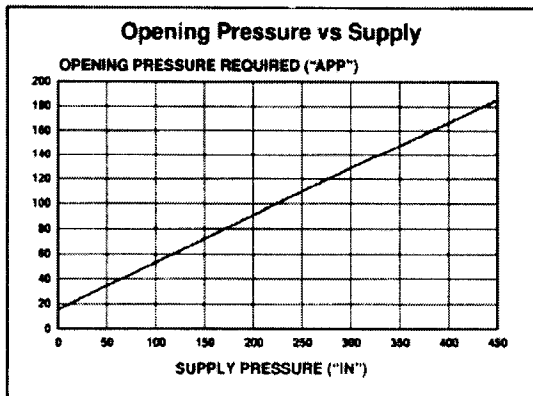


Figure 3. Opening Pressure vs. Supply

3.0 INSTALLATION

The valve may be mounted in any position using the three holes located

on the relay valve body as shown in figure 2. The air to the Applied Pressure Port (APP) should be clean and dry. Connection piping to the APP and IN ports should be cleaned to remove excess thread sealant, chips, and other foreign matter that could get trapped in the valve or the pilot chamber and cause seals to fail.

The TURBOVALVE may be ordered using the full description as shown or by specifying a Part Number using the Model Code System. Example: the Part Number for a standard pneumatic valve with a 1-1/2\" NPT threads and Buna N O-Ring is RLVA-25683-001-1-01. (Please Note: TDI RLVA-25683-001-2-00 replaces TDI 42-23356, and TDI RLVA-25683-001-1-01 replaces TDI 52-93503.)

4.0 DISASSEMBLY

WARNING

Never attempt to remove the starter relay valve or retainer snap-ring from bottom side of valve until the air pressure has been bled off. Failure to do this could result in internal parts being blown out with considerable force.

Carefully remove retaining ring (11) from relay valve housing (1).

Remove end cap (9), spring (7), and piston (4) from relay valve housing.

WARNING

If necessary, apply low pressure air to the relay valve APP to disengage the piston from valve housing. The aft end of valve must be positioned toward workbench surface to block piston as shown in figure 4.

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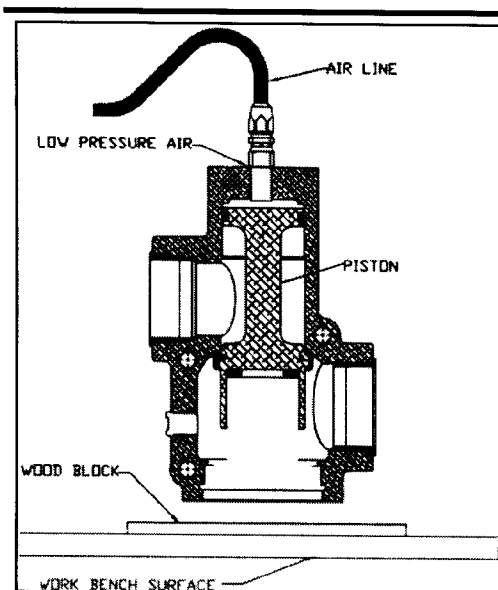


Figure 4. Piston Removal

Remove O-Rings (8,10) from end cap.

Remove O-Ring cap (6), shock dampener (5) and O-Rings (2,3) from piston (4).

5.0 ASSEMBLY

Use either 2-26119-001 (Buna N) or 2-26119-002 (Viton) repair kit to rebuild the TURBOVALVE.

Coat all O-Rings, end cap, piston, and bore of relay valve housing with a good grade of silicon based grease (TDI P/N 9-94082-001).

Place O-Rings (8,10) on end cap (9) and O-Rings (2,3) on piston (4).

Install shock dampener (5) into piston housing (4) bore.

Install O-Ring cap (6) onto piston (4) and seat over O-Ring (3).

Hand press piston assembly into relay valve housing (1) until seated.

Install spring (7) into bore of valve housing (1).

Install end cap assembly (8,9,10) into valve bore and secure with retainer ring (11).

6.0 DISASSEMBLY / ASSEMBLY (RELAY VALVE – ELECTRICALLY CONTROLLED)

Follow the above procedure to remove and install the internal parts in electrically controlled relay valve.

If necessary, rotate the connectors on the ends of the hose assembly (5) counter-clockwise to remove from relay valve assembly.

Rotate 90° elbows (4,6) counter-clockwise to remove from relay valve assembly.

Remove the screws (2) to separate the solenoid valve (1) from the relay valve housing (7).

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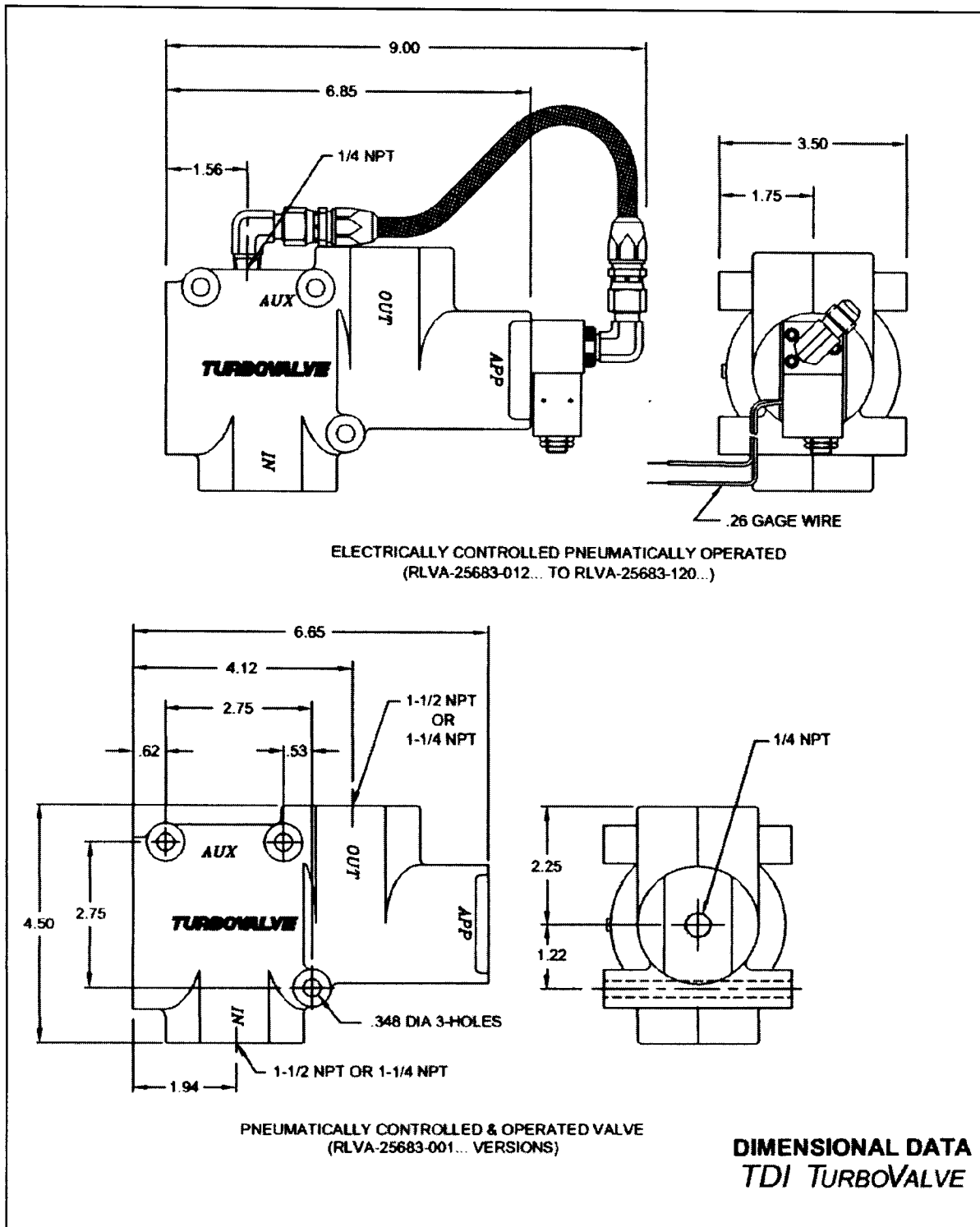


Figure 5. *TURBOVALVE* Dimensional Data

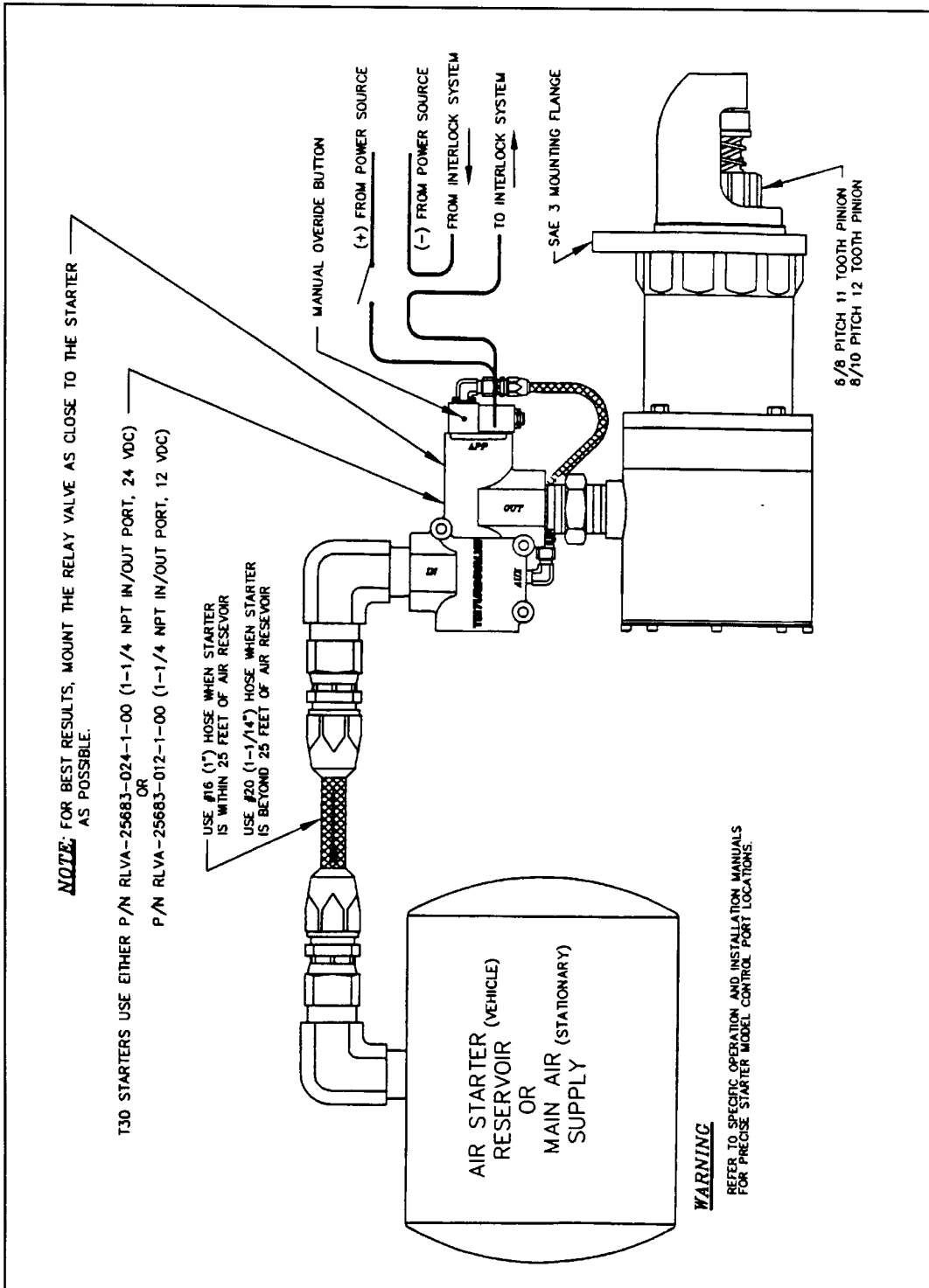


Figure 6. T30-I TURBOTWIN Air Starter Installation Diagram (Electrical)

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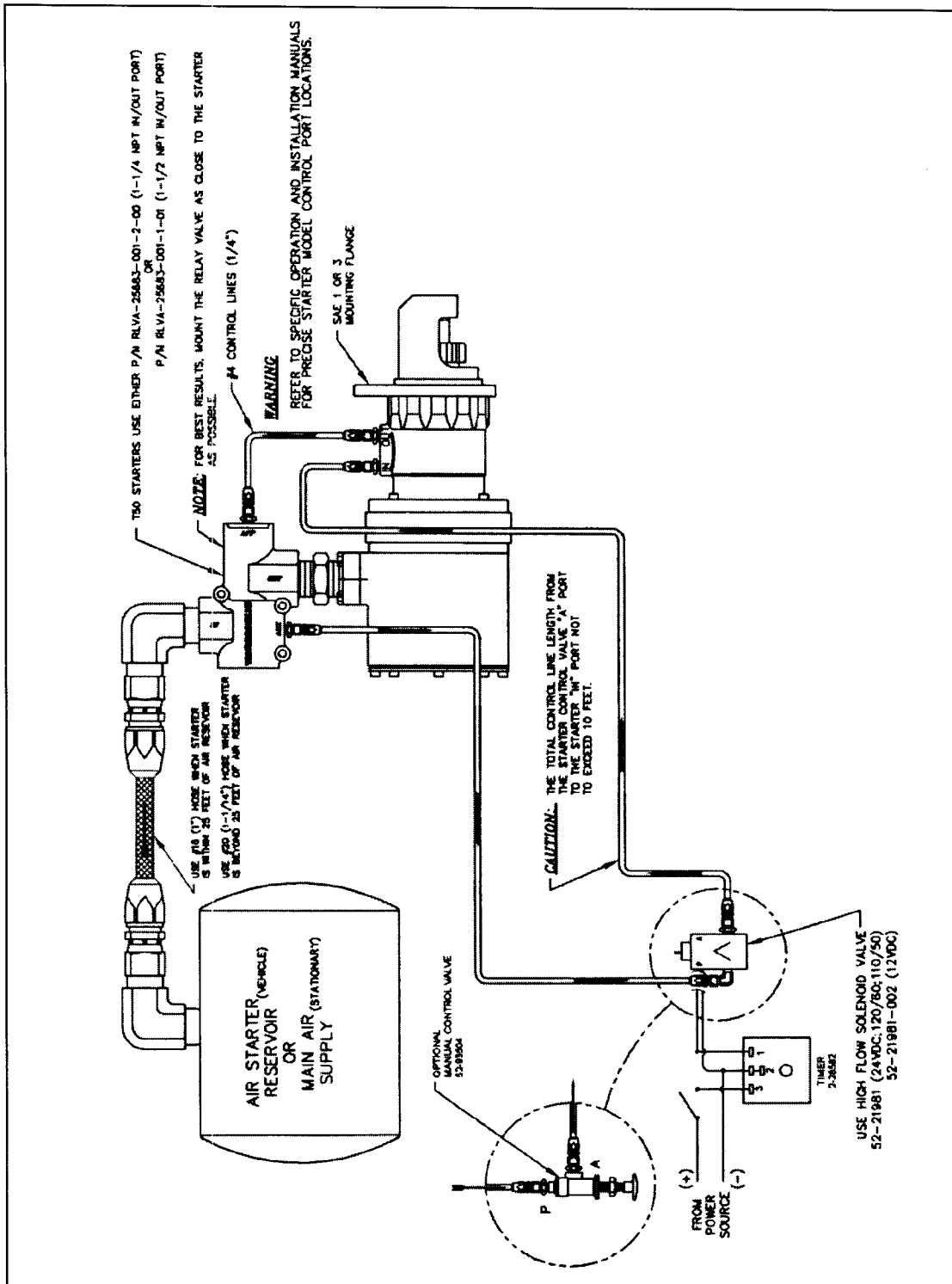


Figure 7. T50-P TURBOTWIN Air Starter Installation Diagram

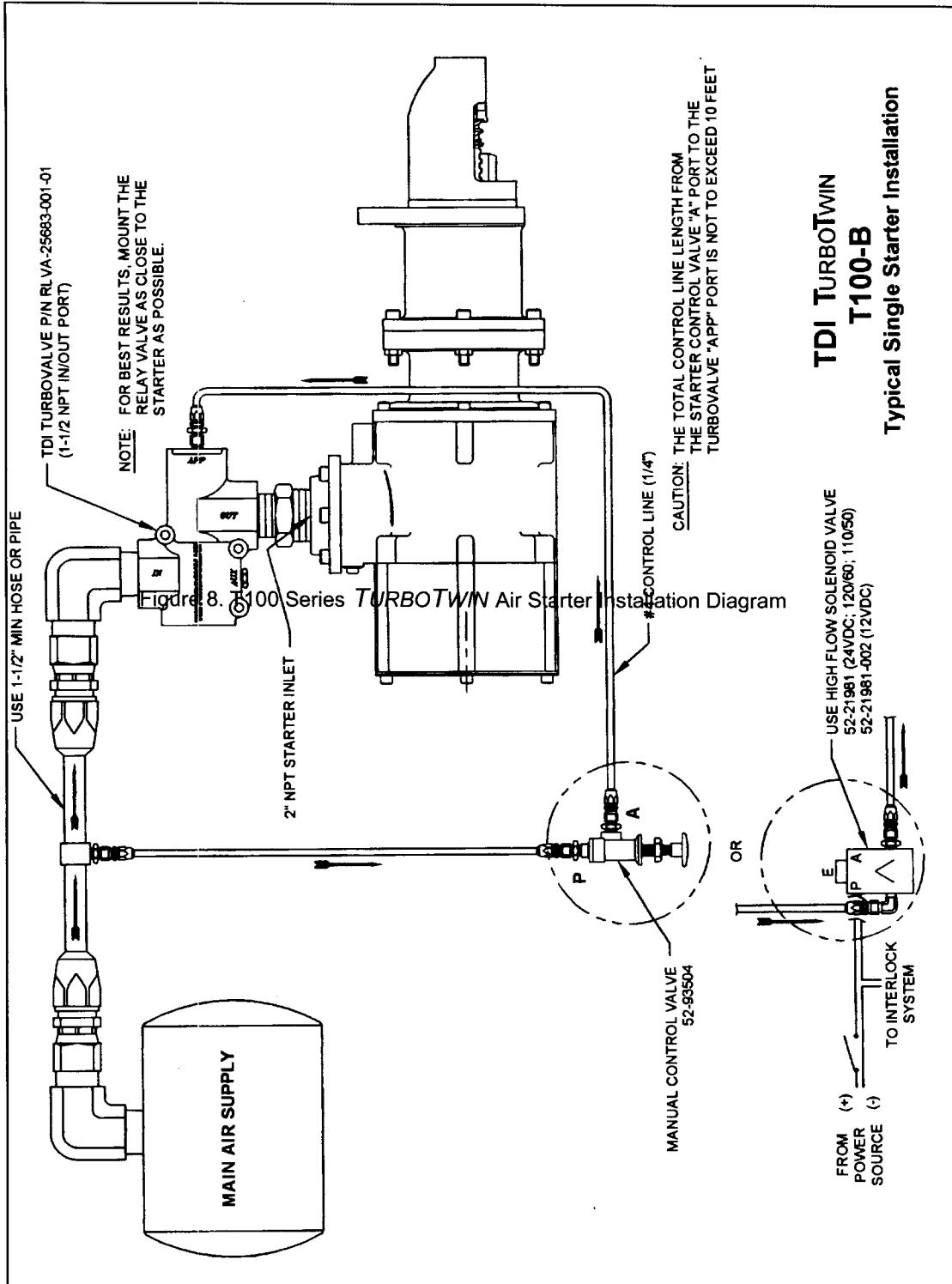


Figure 8. T100 Series *TURBOTWIN* Air Starter Installation Diagram

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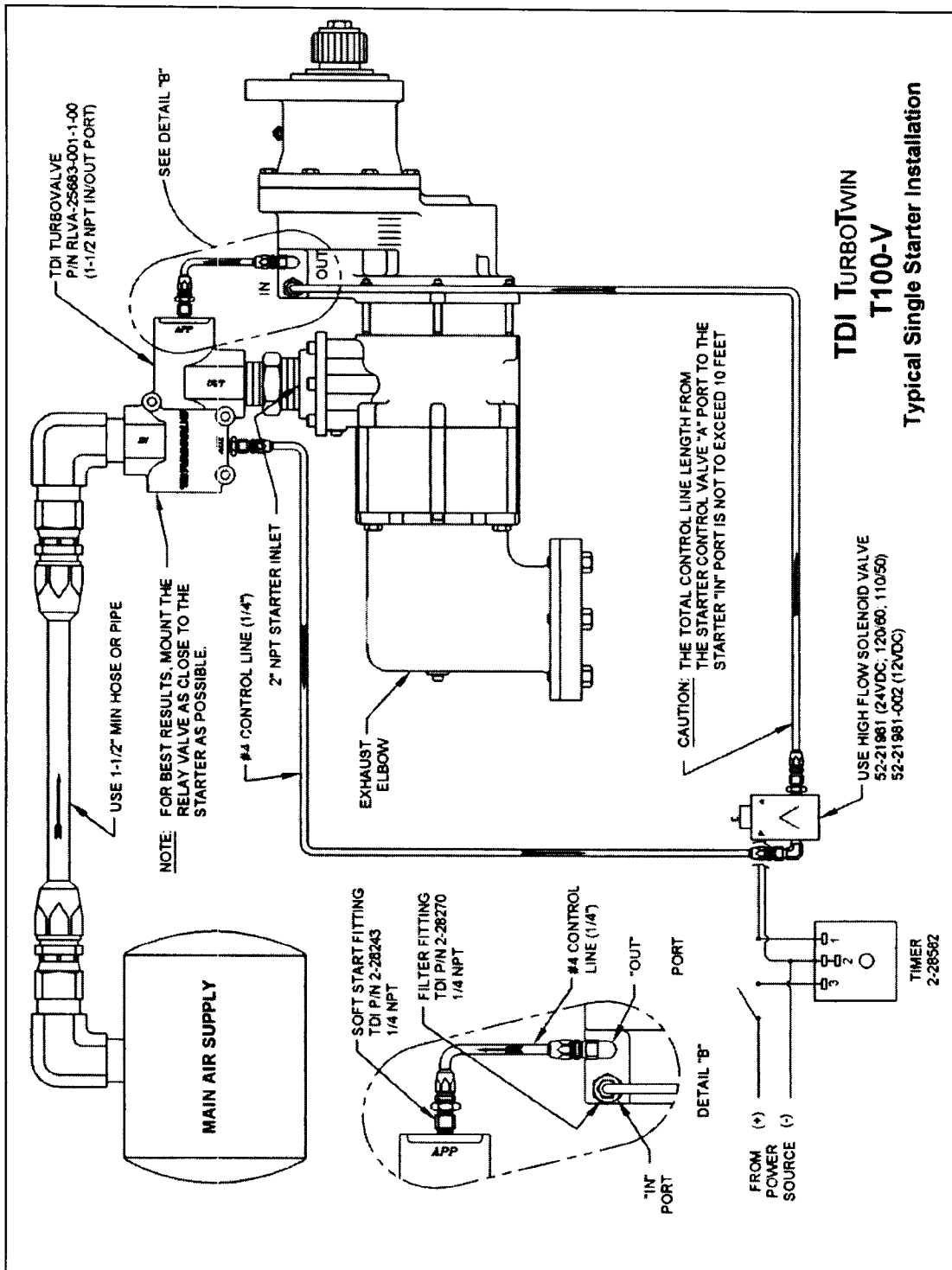


Figure 9. T100-V TURBOTWIN Air Starter Installation Diagram

6.0 ILLUSTRATED PARTS BREAKDOWN (Pneumatically Controlled)

PART NUMBER	IN PORT	OUT PORT	O-RINGS	OVERHAUL KIT
RLVA-25683-001-1	1 ¼"	1 ¼"	Buna-N	2-26119-001
RLVA-25683-001-2	1 ¼"	1 ¼"	Viton	2-26119-002
RLVA-25683-001-1-01	1 ½"	1 ½"	Buna-N	2-26119-001
RLVA-25683-001-2-01	1 ½"	1 ½"	Viton	2-26119-002

KEY NO.	DESCRIPTION	PART NUMBER
1	Housing, Relay Valve (1 ¼" NPT)	2-25764
1	Housing, Relay Valve (1 ½" NPT)	2-25764-001
2	O-Ring, Buna - N	9-90001-221
2	O-Ring, Viton	9-90002-221
3	O-Ring, Buna - N	9-90031-324
3	O-Ring, Viton	9-90030-324
4	Piston	2-25694
5	Dampener, Shock	2-25107
6	Cap, O-Ring	2-25106
7	Spring, Compression	9-90435
8	O-Ring, Buna - N	9-90001-218
8	O-Ring, Viton	9-90002-218
9	End Cap	2-25693
10	O-Ring, Buna - N	9-90001-035
10	O-Ring, Viton	9-90002-035
11	Ring, Retaining	9-92001-016

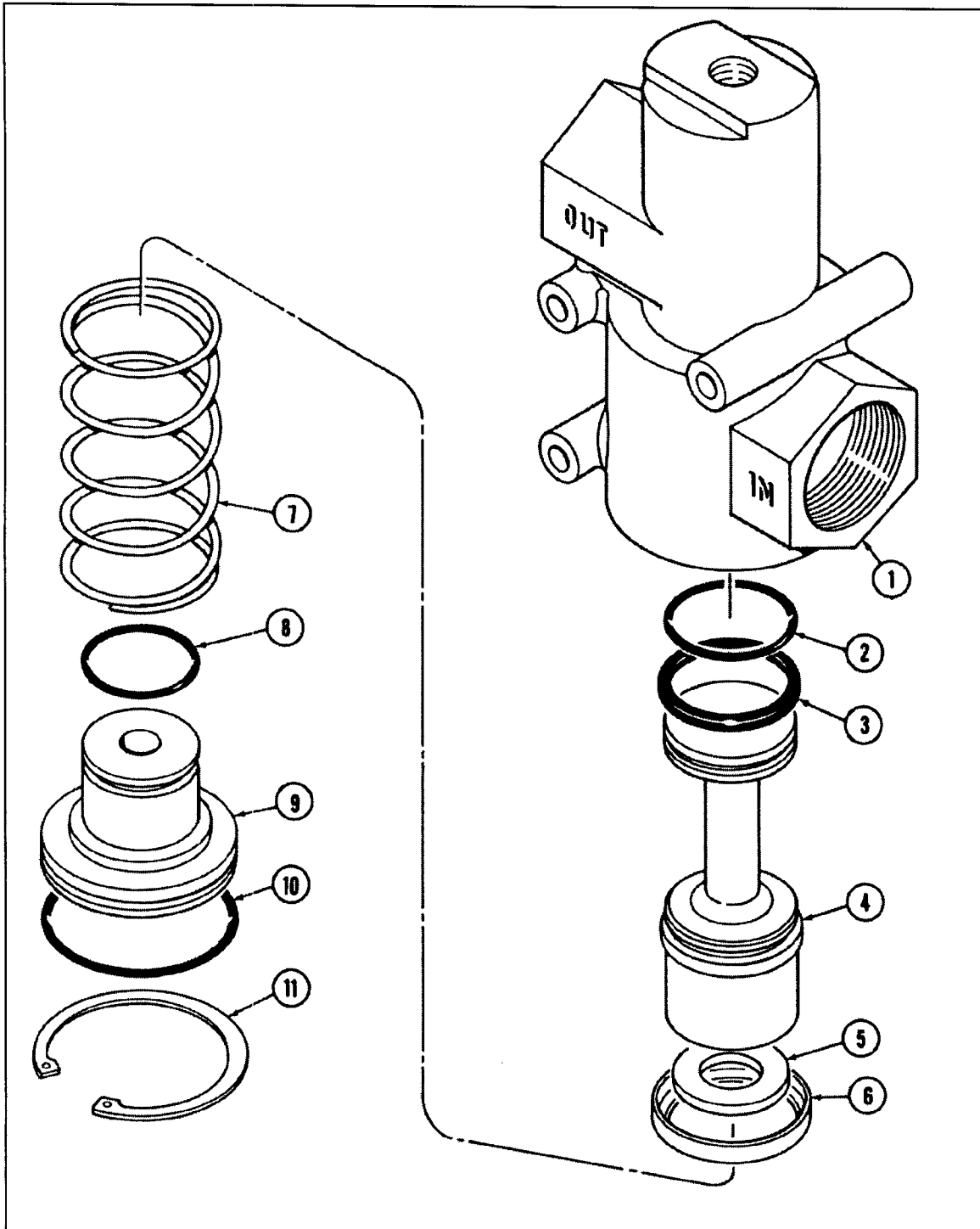


Figure 10. Exploded View of *TURBOVALVE* (Pneumatically Controlled)

7.0 ILLUSTRATED PARTS BREAKDOWN (Electrically Controlled)

PART NUMBER	IN PORT	OUT PORT	O-RINGS	VOLTAGE	VALVE PART NUMBER	OVERHAUL KIT
RLVA-25683-012-1	1 ¼"	1 ¼"	Buna-N	12 VDC	2-26324-001	2-26119-001
RLVA-25683-012-2	1 ¼"	1 ¼"	Viton	12 VDC	2-26324-001	2-26119-002
RLVA-25683-012-1-01	1 ½"	1 ½"	Buna-N	12 VDC	2-26324-001	2-26119-001
RLVA-25683-012-2-01	1 ½"	1 ½"	Viton	12 VDC	2-26324-001	2-26119-002
RLVA-25683-024-1	1 ¼"	1 ¼"	Buna-N	24 VDC	2-26324-010	2-26119-001
RLVA-25683-024-2	1 ¼"	1 ¼"	Viton	24 VDC	2-26324-010	2-26119-002
RLVA-25683-024-1-01	1 ½"	1 ½"	Buna-N	24 VDC	2-26324-010	2-26119-001
RLVA-25683-024-2-01	1 ½"	1 ½"	Viton	24 VDC	2-26324-010	2-26119-002
RLVA-25683-110-2-01	1 ½"	1 ½"	Viton	110 VDC	2-26324-003	2-26119-002
RLVA-25683-120-2-01	1 ½"	1 ½"	Viton	120 VAC	2-26324-004	2-26119-002

KEY NO.	DESCRIPTION	PART NUMBER
1	Valve (12VDC)	2-26324-001
2	Screw (3)	11F-19024-020
3	O-Ring, Buna - N	9-90001-010
3	O-Ring, Viton	9-90002-010
4	Elbow, 90° Male	9-93565-001
5	Hose Assembly	1P-23448-001
6	Elbow, 90° Male	9-93565-002
7	Housing, Relay Valve (1 ¼" NPT)	2-25692
7	Housing, Relay Valve (1 ½" NPT)	2-25692-001
8	O-Ring, Buna - N	9-90001-221
8	O-Ring, Viton	9-90002-221
9	O-Ring, Buna - N	9-90031-324
9	O-Ring, Viton	9-90030-324
10	Piston	2-25694
11	Dampener, Shock	2-25107
12	Cap, O-Ring	2-25106
13	Spring, Compression	9-90435
14	O-Ring, Buna - N	9-90001-218
14	O-Ring, Viton	9-90002-218
15	End Cap	2-25693
16	O-Ring, Buna - N	9-90001-035
16	O-Ring, Viton	9-90002-035
17	Ring, Retaining	9-92001-016

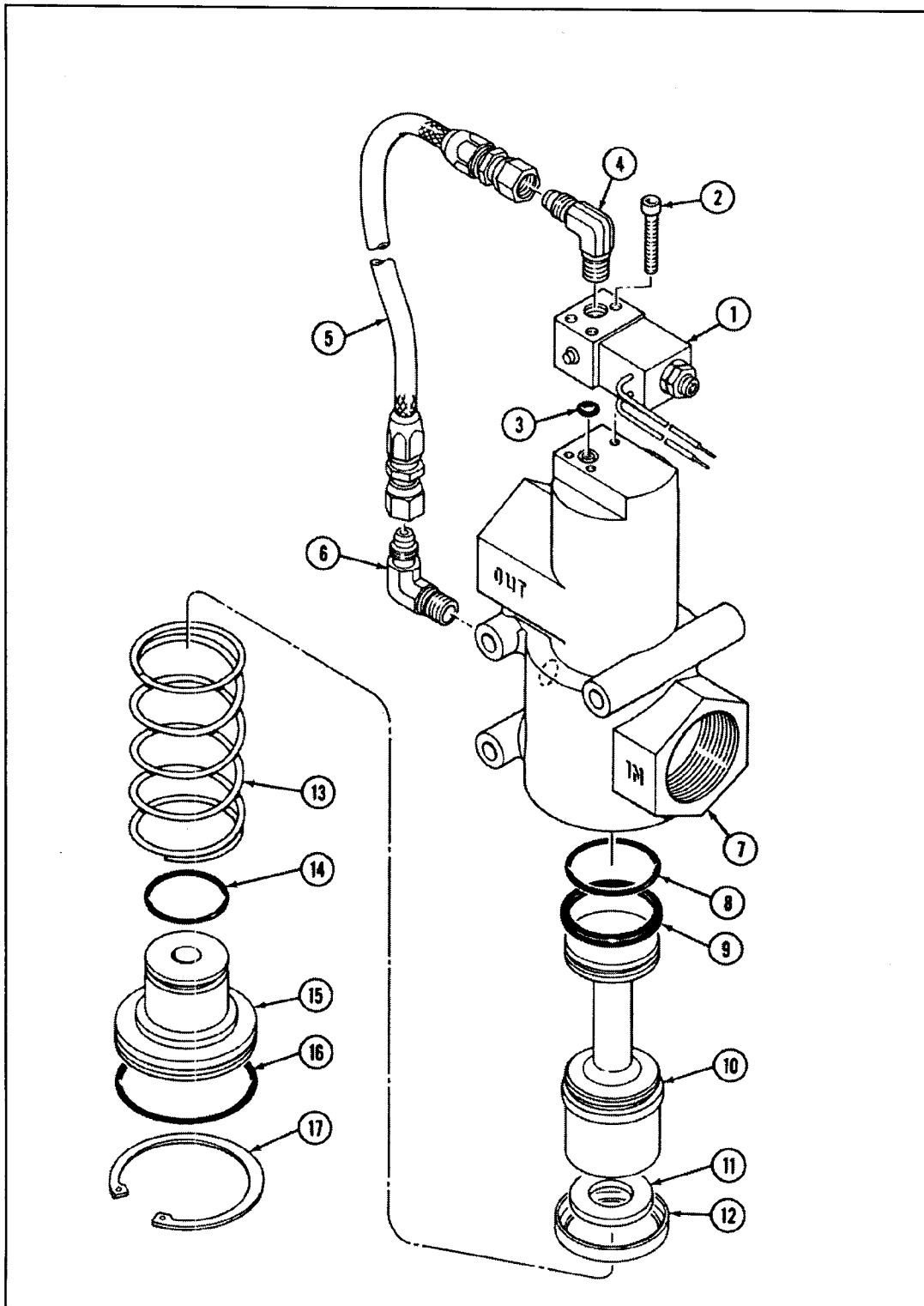
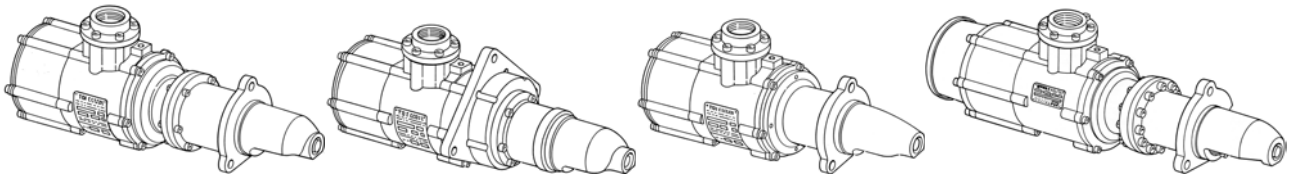


Figure 11. Exploded View of *TURBOVALVE* (Electrically Controlled)

INSTALLATION AND OPERATING MANUAL



MODELS: T100-B, T100-D, T100-F, T100-P

TURBOTWIN Engine Air Starters

TABLE OF CONTENTS

SECTION	SUBJECT	PAGE
1.0	GENERAL INFORMATION	2
1.1	DESCRIPTION	2
1.2	PRODUCT IDENTIFICATION	2
1.3	PERFORMANCE	3
2.0	ORIENTATION OF THE STARTER	3
2.1	GENERAL	3
3.0	INSTALLING THE STARTER	3
3.1	SUPPLY LINE INSTALLATION	3
3.2	NLET PRESSURE PORT	4
3.3	EXHAUST PIPING	4
3.4	NATURAL GAS INSTALLATION	4
3.5	PIPING SYSTEM	4
3.6	BACKLASH	5
4.0	STARTER OPERATION	5
4.1	BASIC OPERATION	6
4.2	AUTOMATED START PANEL	6
5.0	PREVENTIVE MAINTENANCE	6
6.0	TROUBLE SHOOTING GUIDE	7
7.0	<i>TURBOTWIN</i> WARRANTY	8

LIST OF FIGURES

1. TURBOTWIN PART NUMBER LISTING
2. MODEL T112B/T121B INSTALLATION DRAWING
3. MODEL T106F/T112F INSTALLATION DRAWING
4. MODEL T112D/T121D INSTALLATION DRAWING (STD MESH)
5. MODEL T112D/T121D INSTALLATION DRAWING

TDI *TURBOTWIN*

FROM TECH DEVELOPMENT INC

1.0 GENERAL INFORMATION

This manual provides instructions for the installation and operation of the TDI T100 *TURBOTWIN* Starters (Series: B,D,F,P). If there are questions not answered in this manual, please contact your TDI *TURBOTWIN* distributor or dealer for assistance.

The T100 *TURBOTWIN* models are turbine driven starters with an inertially engaged starter drive. Depending on the starter model and engine installation, the *TURBOTWIN* starters have applications ranging from 1200 CID (20 Liters) on diesel engines and up to 15000 CID (250 Liters) on gas engines. The *TURBOTWIN* models are suited to operate within a wide range of inlet pressures and ambient temperatures. The engine size and parasitic loading will determine the exact minimum pressure that will assure reliable starting.

The T100 *TURBOTWIN* starters are designed for operation with compressed air or natural gas; materials used are compatible with "sour" natural gas and marine environments. Small amounts of foreign matter or liquid in the air stream will not adversely affect *TURBOTWIN* starters. As with all other TDI starters, no lubrication is required in the air supply.

Please review the rest of this manual before installing the T100 *TURBOTWIN* series air starter.

WARNINGS, CAUTIONS AND NOTES

Certain types of information are highlighted in this manual for your attention:

WARNING - used where injury to personnel or damage to the equipment is likely.

CAUTION - used where there is the possibility of damage to the equipment.

NOTE - used to point out special interest information.

NOTE

Throughout this manual, the term "air" is used to designate the starter drive medium. Unless other wise stated, air " means either compressed air or natural gas.

1.1 DESCRIPTION

All models feature three basic subassemblies: a unique two stage turbine motor section, a planetary gearbox section and an inertia drive assembly.

The two stage motor section features greater stall torque than a single stage turbine plus aerodynamic speed control.

This aerodynamic speed control helps protect the *TURBOTWIN* starter from damage caused by starter motor over speed.

The T100 *TURBOTWIN*S employ a 7.5:1 or 9:1 ratio planetary gearbox. This low gear ratio allows the turbine motor to spin at low speeds for long bearing life. At a typical 3000 rpm pinion speed, the turbine is cruising at a low 22500 rpm (7.5:1 ratio). Reliability and part commonality are designed into all *TURBOTWIN*S.

A simple and reliable inertia drive delivers the torque to the pinion. The pinion is thrown out to engage the engine's ring gear by the turbine motor's acceleration. Lighter weight rotating parts used in the *TURBOTWIN* provide low inertia and even "softer" engagement. In the event of over-pressure, the friction clutch used in every *TURBOTWIN* protects ring gear teeth from static torque overloads. In addition, an inertia engaged starter eliminates the need for complex pre-engagement control plumbing...and is easier to install and maintain than pre-engaged type starters.

Compressed air or natural gas is used to power T100 *TURBOTWIN* air starters through the inlet port. The air or gas is expanded through the first nozzle or stators. The high velocity gas impinges on the first stage rotor to yield torque to the gearbox. The gas is further expanded through the second stage stators, which impart additional torque to the second stage rotor.

1.2 PRODUCT IDENTIFICATION

The starter nameplate which is attached to the turbine housing contains the following information: model number, serial number, part number, direction of rotation and the maximum rated operating pressure.

The directions of rotation are either right hand or left hand rotation as shown in Figure 1. Right Hand rotation is defined as clockwise rotation as viewed from the pinion end of the starter, and Left Hand rotation is counter clockwise rotation viewed from the pinion end of the starter.

The maximum operating pressure is also stamped on the nameplate. This pressure is measured at the check port on the starter inlet with the starter in operation.

CAUTION

Exceeding the maximum pressure shown on the nameplate may result in drive failure, damage to the starter, or damage to the engine.

The housing proof pressure is 600 psig and is also shown on the nameplate. This means the turbine housing will not burst when subjected to a static pressure of 600 psig.

TDI **TURBOTWIN**

FROM TECH DEVELOPMENT INC

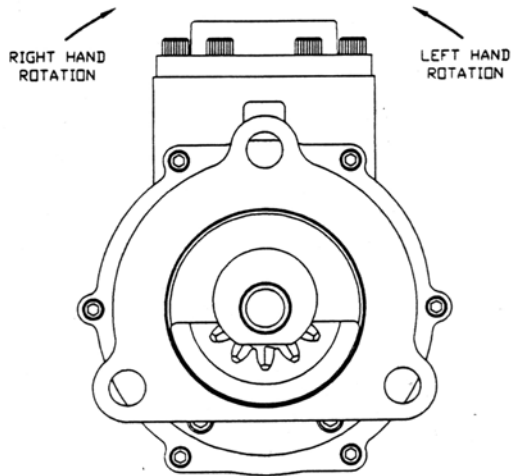


Figure 1. Direction of Rotation viewed from Pinion End.

1.3 PERFORMANCE

Graphs of the performance curves feature pinion torque versus pinion speed (rpm) at constant drive air pressures and shaft horsepower versus pinion speed at constant drive air pressures. Pinion speed is shown on the horizontal axis. The pinion torque is shown along the left edge vertical axis. The shaft horsepower is shown along the right edge vertical axis. Air consumption rates are given for the various drive pressure lines. These performance curves feature air as the drive gas and have open exhaust (standard exhaust guard) which have no back pressure.

2.0 ORIENTATION OF THE STARTER

2.1 GENERAL

If the factory orientation of the starter's pinion housing assembly in relation to the inlet port does not fit your engine installation, these components can easily be re-oriented.

All **TURBOTWIN**s have the capability to rotate the inlet port relative to the drive opening for the optimum inlet port location. The number of different positions is 6 to 12 depending on model.

3.0 INSTALLING THE STARTER

A turbine air starter does not require lubrication in the supply air. Therefore, if a vane type starter motor is being replaced, TDI recommends that all lubrication devices and lines removed to minimize flow restrictions.

WARNING

If a fuel (pulse) lubricator has previously been installed in the system, disconnect and plug the line to eliminate spraying diesel fuel on the engine.

The starter should be installed with the inlet in a position between horizontal and straight down. Any condensation will be restricted to the air lines and not in the starter.

WARNING

Do not operate this starter unless it is properly connected to an engine.

3.1 SUPPLY LINE INSTALLATION

WARNING

Be sure to either bleed the pressurized air reservoir and/or safety the system such as closing all valves prior to installing starter supply line.

The **T100 TURBOTWIN series** air starters come standard with a 2" NPT female pipe thread for the inlet connection port. The supply line consists of the line from the air source, a pressure regulator (when necessary), a manual or relay valve, and the connection to the starter inlet. Hard piping may be used, but a section of flexible tubing should be installed at the starter to prevent leaks due to engine vibration.

Care must be taken to ensure that all inlet supply line piping is no less than 1.5" and all components used are capable of passing the required air flow.

NOTE

Valves with a Cv of 40 or higher are recommended.

If the supply line must be longer than 20 feet, the inlet supply line piping should be increased to 2" in diameter to ensure proper performance by your **TURBOTWIN**.

Because turbine starters such as the **T100 TURBOTWIN series** are sensitive to flow restrictions, care must be taken to use uniform hose or tubing and fittings for connection of the supply line. Tees, elbows and line length must be kept to a minimum. TDI recommends that hose or flex couplings are installed to eliminate possible leakage caused by strain on the supply line.

Normally, an air strainer is not required. However, in dirty environments use of a #40 mesh Y-strainer is recommended. The **T100 TURBOTWIN series** is highly tolerant of dirt in the air line, however, starter life can be increased with the use of an air strainer.

TDI *TURBOTWIN*

FROM TECH DEVELOPMENT INC

A pressure regulator is required when the air supply pressure is great enough to exceed the starter operating pressure (at the inlet port) and/or the maximum torque.

A manual ball valve may be used to admit drive air/gas to the starter. The manual valve should be located in a safe position away from the engine.

A preferred valve is pilot-operated, which can be pneumatically or electrically actuated. The valve should be located close to or even on the starter inlet for best performance. Pneumatic or electrical control lines may be routed virtually anywhere for the customer's preferred operating station. This type of valve actuates from a fully closed to a fully open position very rapidly. TDI offers a variety of relay valves such as P/N RLVA-25683-001-2-01, which is a 1-1/2" port, pneumatically actuated valve.

The supply line should be dry-fitted for proper alignment/location prior to final assembly. All pipe threaded joints should be sealed with Loctite Pipe Thread Sealant (TDI P/N 9-94085) or equivalent for leak tight joints prior to final assembly. Be sure to tighten all joints to proper torque after final assembly.

CAUTION

In cold weather climates, care should be taken while designing your installation to prevent condensation from developing in the starter system. In systems with a regulator valve or relay valve, there is the possibility of freeze-ups.

A tee connection with a quick disconnect can be added to the inlet. This will allow an external air source to be used to accomplish a "blow start" if the system freezes. Once the engine has been started, the other system components may be thawed.

CAUTION

On new installations, it is strongly recommended to blow out the supply line with air to remove possible dirt and welding slag prior to final connection to the *TURBOTWIN* starter. Be sure to secure the free end of the supply line prior to blowing out the line.

3.2 INLET PRESSURE PORT

A 1/4" NPT port is located on the air inlet. This port may be used to check the supply pressure at the starter when the starter is operating. Remove the 1/4" NPT pipe plug and save for later use. Install a 1/4" minimum size tubing to the port. Route the tubing away from the starter to a safe location away from the engine. Install a pressure gauge on the tubing. This pressure monitoring line/gauge may be permanently installed. Use Loctite Pipe Thread Sealant or equivalent. Alternately, a pressure transducer may be

installed at the pressure check port and electrical lines routed to a digital display at the operator's station.

This pressure port is invaluable in diagnosing air starter and/or installation problems.

3.3 EXHAUST PIPING

The turbine exhaust may be plumbed away from the starter area. All starters using natural gas must be piped according to industry codes and local regulations.

The performance of a turbine starter will be decreased because of back pressure when smaller than recommended exhaust piping is installed. If back pressure hampers starter performance, compensation can be made by increasing the supply pressure. Consult your TDI distributor for advice.

Exhaust piping should be routed downward to help prevent any accumulation of condensation in the starter motor.

If the overhung section of the starter is not otherwise supported, TDI recommends supporting the exhaust piping with a suitable bracket(s).

Exhaust piping should be routed downward to help prevent any accumulation of condensate in the starter motor.

3.4 NATURAL GAS INSTALLATION

The installation of the starter using natural gas is similar to the air installation except all fittings, piping, valves and regulators must be compatible with natural gas.

Proper control of natural gas is a major consideration when used in the starter system. All starters using natural gas must pipe the exhaust according to industry codes and local regulations.

There is a natural gas vent port in the turbine housing that is plugged for compressed air use. This vent is used to remove any natural gas that could leak past the primary turbine shaft seal. Remove this 3/8"NPT plug and install a line to carry gas away from the starter area.

WARNING

Do not connect the turbine housing vent line to the turbine exhaust line. Exhaust gas can pressurize the housing.

3.5 PIPING SYSTEM

Only type approved metallic hose assemblies are approved in permanently pressurized compressed air lines of starters. Non-metallic hose assemblies are allowed only in case the piping system will be emptied after the starting procedure.

Pipe unions must be type approved by GL. Downstream of the pressure regulator a pressure relief valve is to be provided.

3.6 BACKLASH

Backlash is the "free play" between the mesh of two gears. Figure 15 shows the backlash between two gears. Maintaining the proper gear backlash setting allows the gears to mesh smoothly. Proper backlash and alignment allows smooth engagement/disengagement of the pinion gear and loads the tooth face surfaces evenly producing longer gear life. The correct backlash setting for 6/8 diametral pitch gearing used on larger engines is as follows:

Minimum backlash	.015 inch
Maximum backlash	.025 inch

To check the backlash, the pinion will need to be rolled out onto the end of the drive prior to starter installation. This can be accomplished by using a hex drive wrench to rotate the turbine end of the starter while holding the pinion from rotating. The pinion will simply walk to the end of the shaft. An access hole to reach the turbine screw is provided in the turbine exhaust guard. The starter must then be installed on the engine. Checking backlash can be accomplished using a dial indicator or a simple blade-type feeler gauge. Because ring gears are not usually perfectly round, it is necessary to

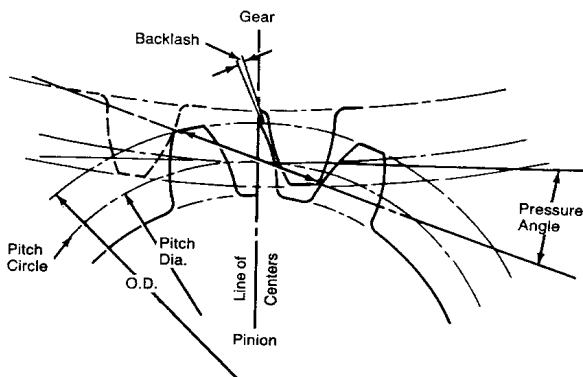


Figure 2. Checking Backlash

check backlash at several (six or more) points around the circumference of the ring gear. Average the highs and lows to allow a setting that is in the range cited above.

Setting the correct backlash may involve "shimming" and/or moving the starter bracket(s). An adjustable starter bracket design will simplify this procedure. Always re-check the backlash after a ring gear replacement.

Liberal grease the starter's drive teeth with chassis lube and then mount the **TURBOTWIN** starter on the engine. Tighten all mounting hardware as appropriate. Make sure to use Loctite Threadlocker #290 or equivalent on the starter

mounting bolts. Torque the three 5/8" screws to 100 lb-ft.

4.0 STARTER OPERATION

Prior to operation, check that all connections are tight and free from leaks. Check the 1/4" NPT pipe plug or a pressure gauge/transducer that may be connected to the pressure port on the starter inlet.

WARNING

Do not operate the TDI *TURBOTWIN* starter with air pressure greater than the pressure rating on the nameplate. This pressure is measured at the starter inlet while the starter is running.

The maximum operating pressure limit is the inlet pressure measured at the starter's inlet pressure check port. In order to check the starter, a 1/4"NPT pipe tap connection is provided in the inlet housing to attach a pressure gauge/transducer). The maximum pressure assumes an open exhaust (standard turbine exhaust guard). The standard exhaust guard causes no back pressure.

The static non-flowing supply pressure will always be higher than the operating (dynamic) pressure. The maximum pressure limit (proof pressure) that the TDI *TURBOTWIN* starter housings may be subjected to is 600 PSIG (42 BAR). System pressure that exceeds the maximum operating limit must use a pressure reducing device to ensure that the operating pressure limit to the TDI *TURBOTWIN* starter is maintained.

System static pressure that exceeds the 600 PSIG (42 BAR) limit must, in addition to pressure reducer devices incorporate a pressure relief valve set below 600 PSIG (42 BAR) in the supply air line.

NOTE

For maximum life of the starter pinion and for the protection of the engine ring gear, limit the operating pressure to that necessary to start the engine at its most difficult starting conditions.

All appropriate local pressure codes and pressure limitations on other system components must be adhered to and supersede the guidelines given in this manual.

Consult your TDI distributor if you have exhaust plumbing that creates back pressure and reduces starter performance. You may be able to increase the supply pressure to restore the lost power.

Follow the engine manufacturer's instructions for starting the engine.

4.1 BASIC OPERATION

The basic operation of the starter is as follows:

Pressurized air or natural is admitted to the starter by opening of the manual or relay valve. The air expands through the turbine, which produces shaft rotation and torque. The acceleration of the drive assembly causes the pinion to advance and engage the ring gear of the engine.

The starter motor torque causes the engine to accelerate. This acceleration causes the pinion to be disengaged from the ring gear. The fuel and ignition systems now fire the engine. Closing the relay valve stops the starter.

The operator may decrease starter life by the continual operation of the starter after the engine has started. Upon a successful engine start, turn the air off to the starter immediately. Minimizing the time the starter is operating unloaded (i.e. the engine is running) will maximize starter life. If a start is aborted, a restart may be attempted after the engine and the starter has come to rest.

CAUTION

Do not engage the starter while the engine is running.

The drive air pressure is the primary starter control parameter. It is important, especially on new installations, to measure this pressure during several engine starts. The secondary parameter is the starter pinion speed. This speed is usually measured by knowledge of the engine starting speed and the starter cranking ratio. The cranking ratio is the number of ring gear teeth divided by the number of pinion teeth. The starter pinion speed is then found by multiplying the engine speed by the cranking ratio. The pinion speed is usually 2000-3500 rpm at typical engine starting speed.

4.2 AUTOMATED START PANEL

The starter drive pressure measured at the starter inlet must be set. As noted above, for maximum life of the starter pinion and for the protection of the engine ring gear, limit the operating pressure to that necessary to start the engine at its most difficult starting conditions.

The speed control parameter will then need to be set. Engine starting speed along with the cranking ratio number can be used to determine starter pinion speed. The pinion speed is usually 2000-3500 rpm for a typical engine starting speed. Once the start sequence has begun, the air is admitted to the starter. The starter begins to accelerate the engine. Once the firing speed of the engine is reached, the automated start panel may deliver fuel to the engine. The engine will begin to accelerate under its own power. The starter should be dropped out of the sequence at a rpm higher than the firing speed, but less than the engine idle

speed.

The automated start panel should monitor engine speed to determine air on and air off. Do not simply use time as a control parameter. Avoiding excessive operation of the starter after the engine is firing will maximize the starter life.

5.0 PREVENTIVE MAINTENANCE

The TDI *TURBOTWIN* starters provide distinct advantages of size and efficiency as compared to electric motor, vane-type or other turbine-type starters. It is important to properly install the starter to receive full benefit of these advantages. Repair technicians or service organizations without turbine starter experience should not attempt to repair this machine until they receive factory approved training from TDI, or its representatives.

Proper operation and repair of your TDI *TURBOTWIN* starter will assure continued reliable and superior performance for many years.

5.1 Every Six (6) Months

Perform the following procedures at six(6) months intervals if the normal cranking cycle is 0 - 10 seconds.

5.1.1 Check the amount and condition of grease in the planetary gearbox. If gearbox requires re-greasing, only use TDI grease. Approximately one (1) pint of grease is needed to repack the gearbox.

5.1.2 Check the turbine bearing and carrier output bearings for freedom of rotation without excessive play between races. If bearings are damaged, replace them with genuine TDI parts. Refer to TDI Service Manual for part numbers.

5.1.3 Place a small amount of chassis lube on the starter's pinion teeth.

5.2 Every Three (3) Months

Follow the six (6) month procedures if there is severe starter loading or extended duration crank cycles. Also perform these procedures every three (3) months when starter is used for motoring the engine for maintenance or valve adjustments.

Motoring Crank Cycle: 10 -60 seconds

Extended Crank Cycle: 60 seconds or longer

starter, use only genuine TDI replacement parts. The component part numbers are found in the Illustrated Parts Breakdown.

6.0 TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	SOLUTION
1. Starter does not run; small air flow from exhaust.	A. Relay valve not fully open.	A. Repair or replace relay valve.
	B. Nozzle blockage.	B. Remove blockage or obstruction from nozzles.
2. Starter does not run; normal air flow from exhaust.	A. Broken turbine rotor.	A. Replace all damaged parts.
	B. Broken gear train.	B. Repair or replace geartrain.
	C. Damaged starter drive.	C. Repair or replace starter drive.
3. Reduced Starter output power.	A. Inlet air pressure too low.	A. Increase air pressure in 10 PSIG (0.6 BAR) increments; DO NOT EXCEED OPERATING LIMIT.
	B. Inlet supply piping too small.	B. Supply piping must be a minimum of 1.5" diameter.
	C. Pressure regulator orifice too small.	C. Increase orifice size or replace pressure regulator
	D. Inlet supply line valve (ball, gate, relay, plug) too small.	D. Install larger valve.
	E. In line lubricator installed in supply line.	E. Remove lubricator.
	F. Y-Strainer in supply line clogged.	F. Clean strainer.
	G. Excessive back pressure; exhaust restricted.	G. Clean exhaust piping or increase size to at least the minimum diameter recommended.
	H. Damaged turbine nozzle.	H. Replace turbine nozzle.
	I. Broken started drive.	I. Repair or replace starter drive.
	J. Wrong rotation starter.	J. Replace with starter or proper rotation.
	K. Wrong size starter.	K. Check the Application Guide for the correct starter.
4. Engine cranks too quickly.	A. Inlet air pressure too high.	A. Decrease air pressure in 10 PSIG (0.6 BAR) increments. OR If there is a manual shut-off valve in the supply line, partially close it. OR Install a restriction orifice in the inlet supply line.
	B. Wrong size starter.	B. Check the Application Guide for the correct starter.

7.0 WARRANTY

TDI TURBOTWIN ENGINE STARTER WARRANTY

Tech Development Inc. (TDI) warrants to the original user of the TDI TurboTwin™ Model T30 Series air starters to be free from defects in material and workmanship for a period of one year from date of purchase by such user. The warranty period shall begin on the actual delivery date to the original user or twelve (12) months from the date of shipment from TDI, whichever comes first. The conditions of this warranty are: **a)** TDI is notified within this period by return of such product to TDI or its authorized distributor or dealer, transportation prepaid by user; **b)** such product has been installed according to TDI's specifications; **c)** such product has not been misused, abused or improperly maintained by user; **d)** the defect is not the result of normal wear and tear; and **e)** such starter product has not been repaired with parts not manufactured or authorized by TDI, and TDI installation and repair procedures as outlined in the appropriate manual were properly followed.

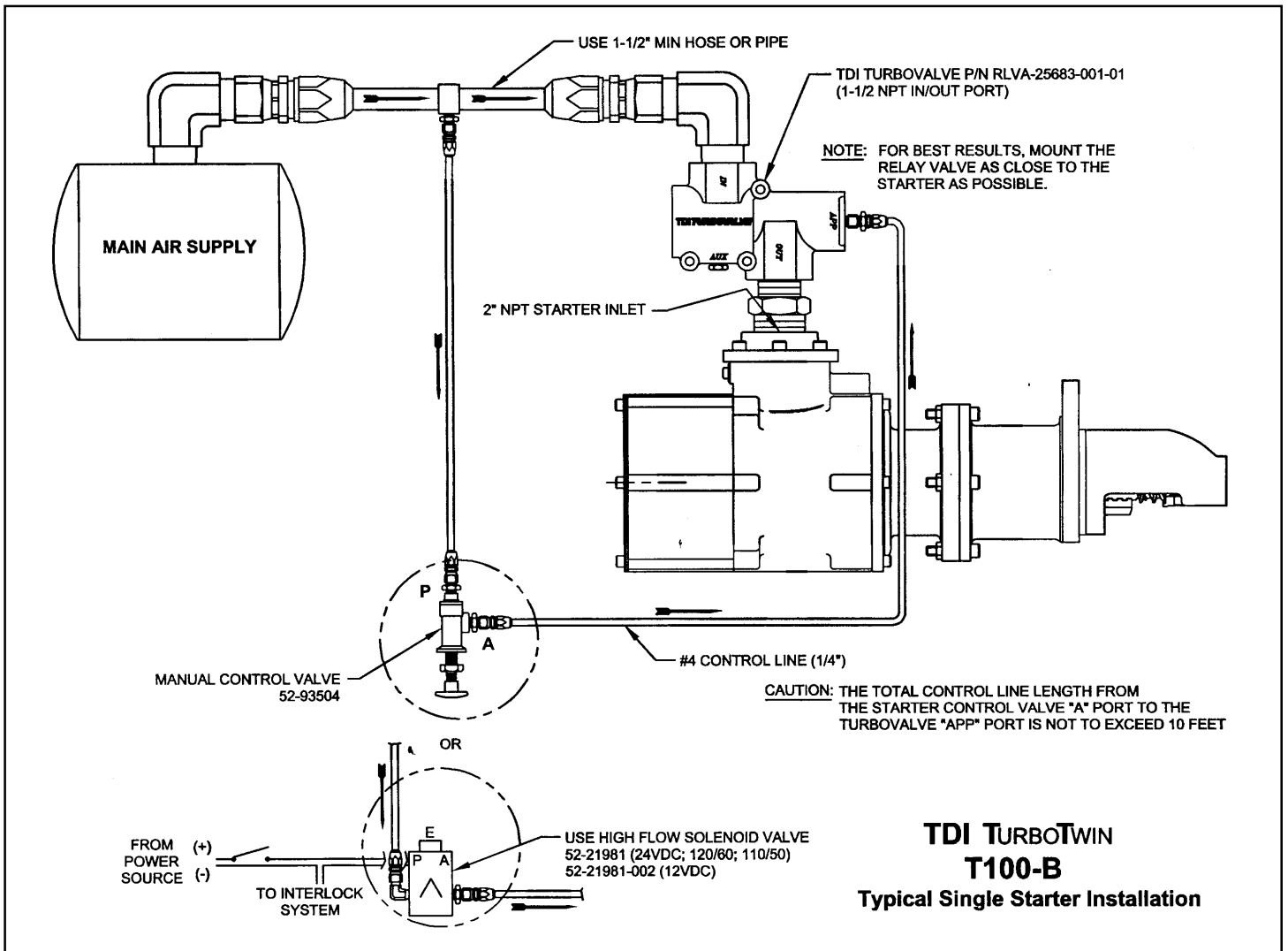
Tech Development Inc. shall, at its option, either repair or replace, without charge, any such starter product found by TDI's examination to be defective, or by mutual agreement, refund the user's purchase price in exchange for such starter product. Repairs or replacements are warranted for the remainder of the original warranty period.

Tech Development Inc. makes no other warranty, and IMPLIED WARRANTIES INCLUDING ANY WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty constitutes the entire obligation of Tech Development Inc. relating to the sale and use of such product, and TDI's maximum liability is limited to the purchase price of such product at the date of purchase. In no event shall TDI be liable for incidental, indirect, consequential or special damages of any nature arising from the sale or use of such engine starter product.

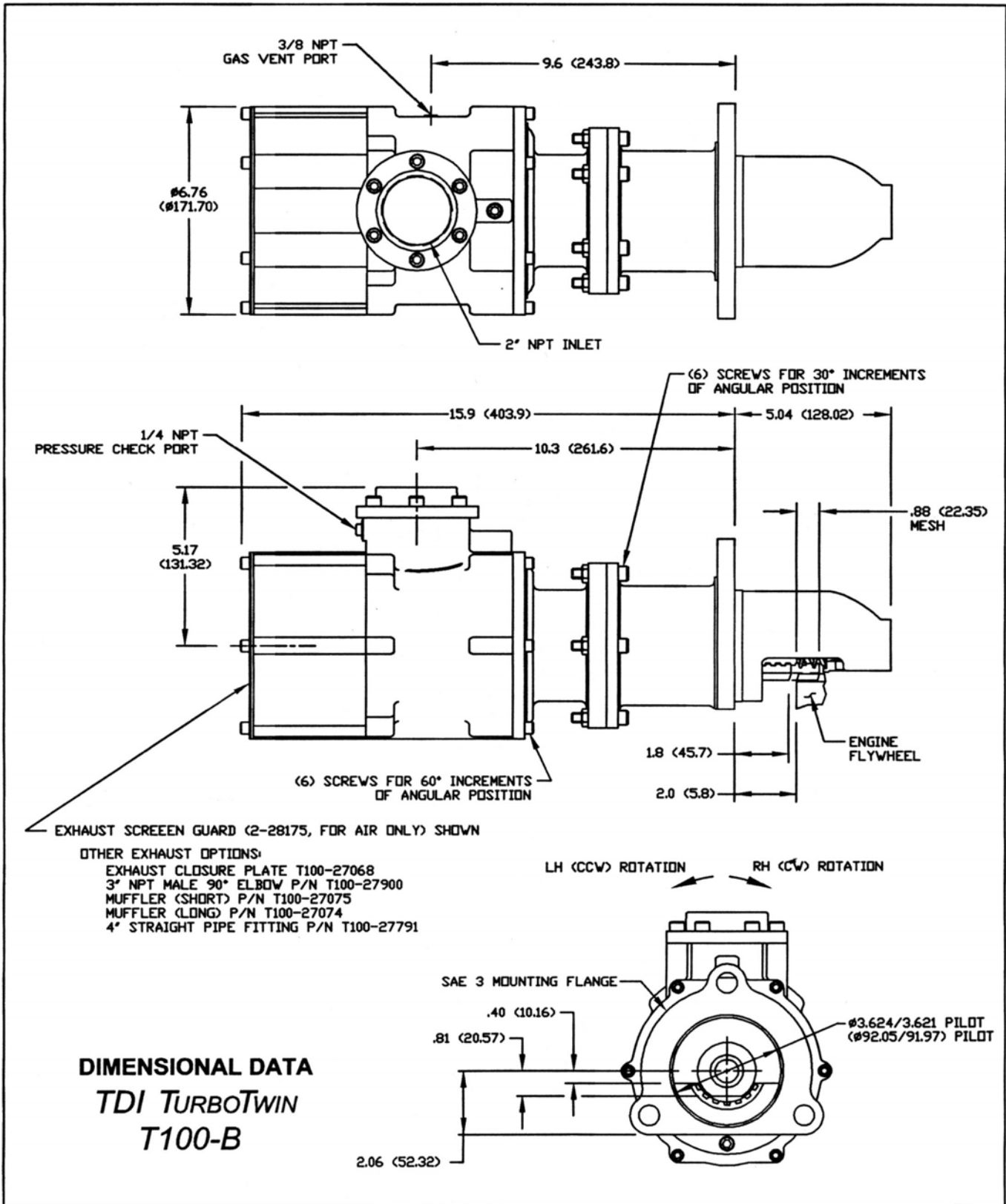
TDI TURBOTWIN

FROM TECH DEVELOPMENT INC



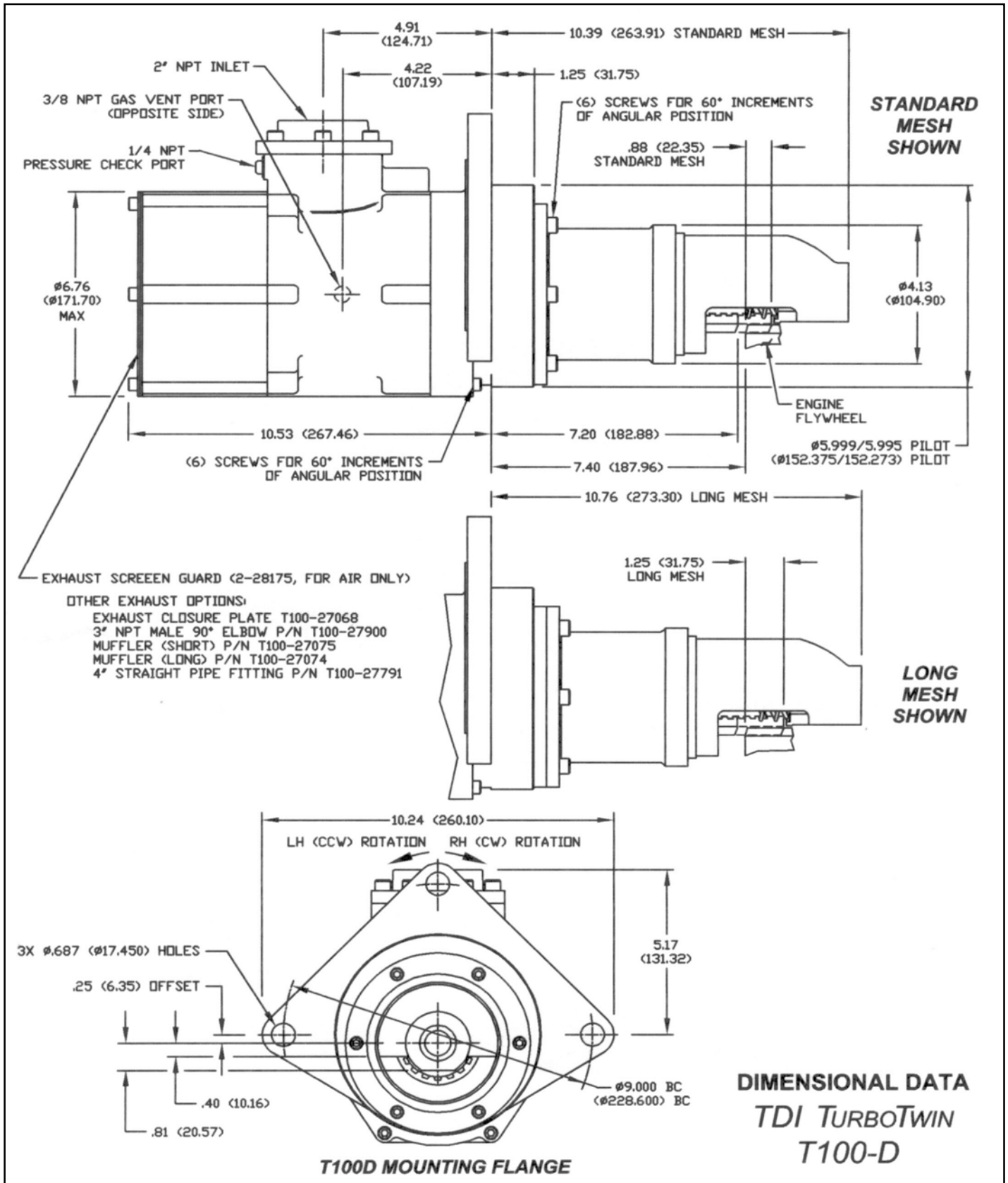
TDI TURBOTWIN

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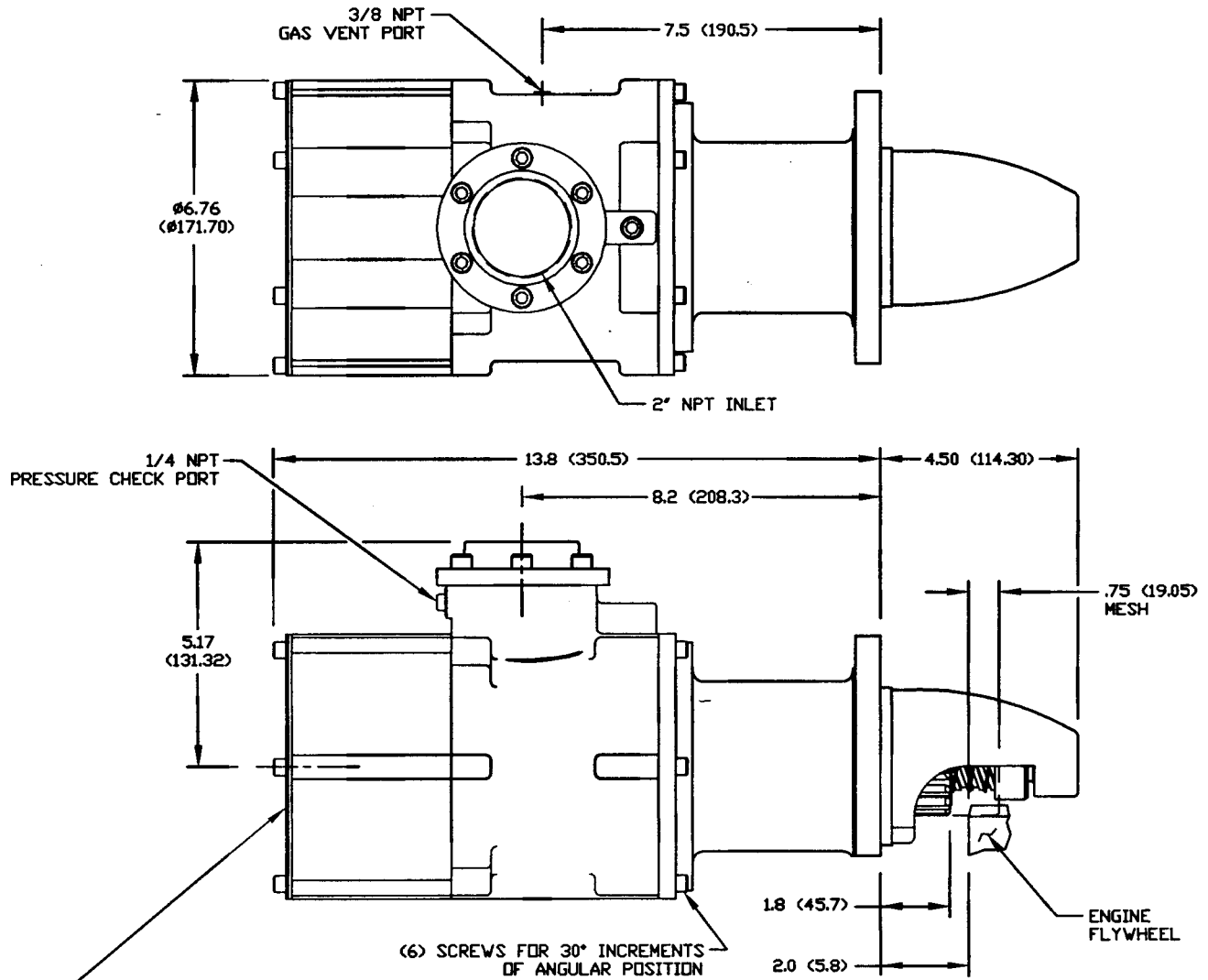
TDI TURBOTWIN

FROM TECH DEVELOPMENT INC



TDI TURBOTWIN

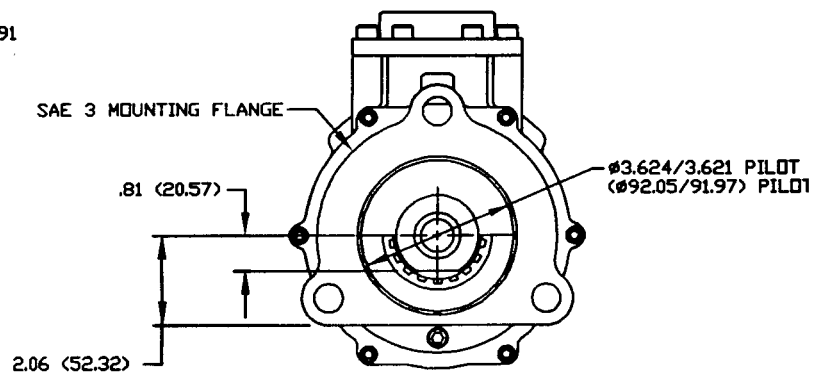
FROM TECH DEVELOPMENT INC



EXHAUST SCREEN GUARD (2-28175, FOR AIR ONLY) SHOWN

- OTHER EXHAUST OPTIONS:
- EXHAUST CLOSURE PLATE T100-27068
 - 3" NPT MALE 90° ELBOW P/N T100-27900
 - MUFFLER (SHORT) P/N T100-27075
 - MUFFLER (LONG) P/N T100-27074
 - 4" STRAIGHT PIPE FITTING P/N T100-27791

LH (CCW) ROTATION RH (CW) ROTATION



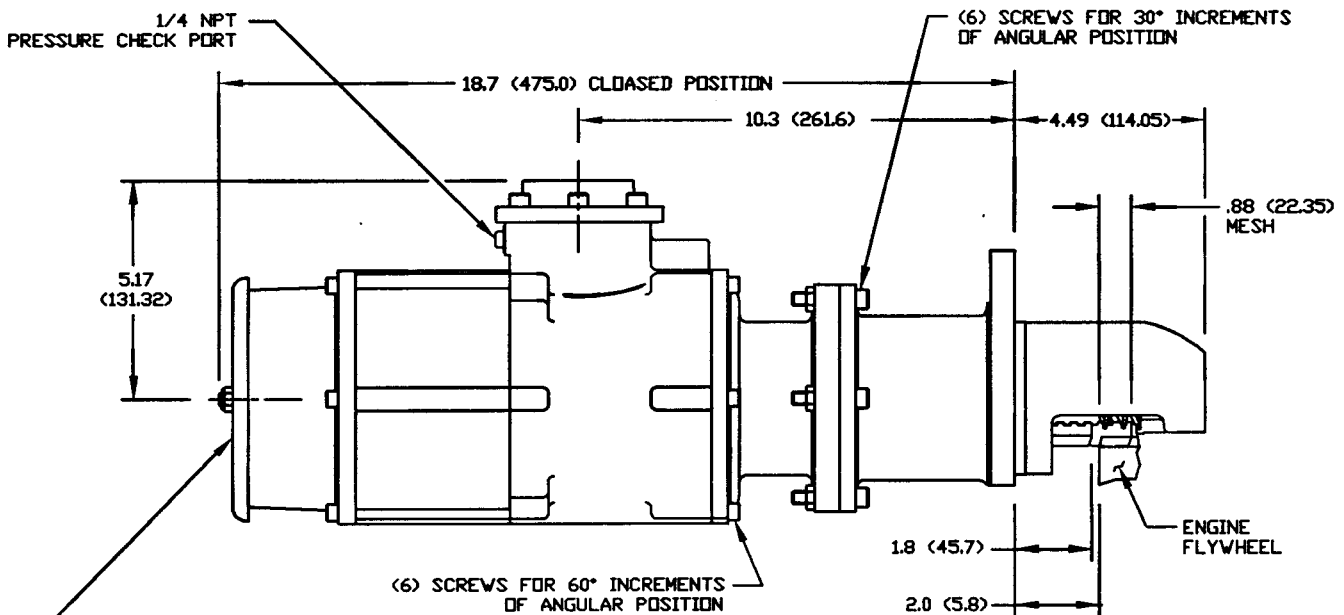
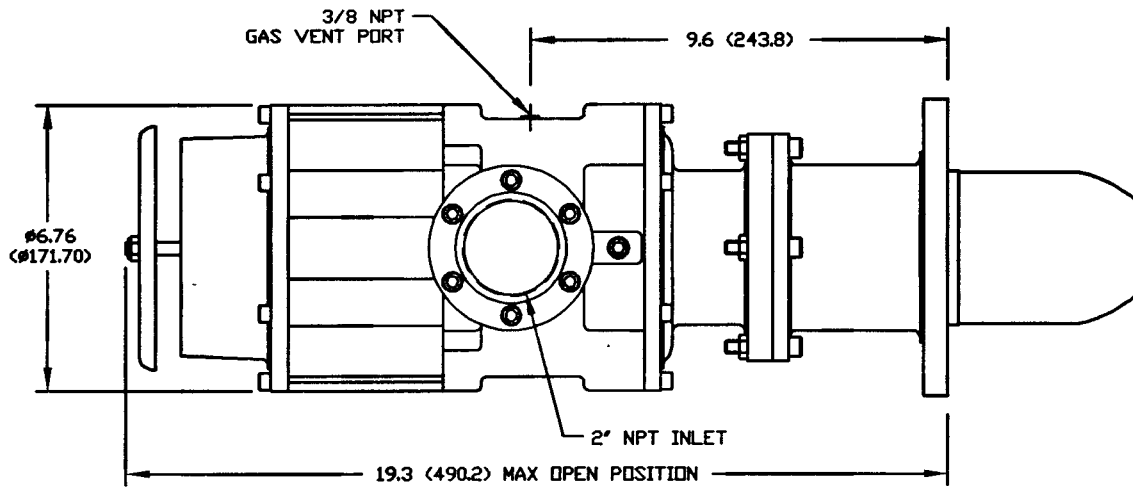
DIMENSIONAL DATA

TDI TURBOTWIN

T100-F

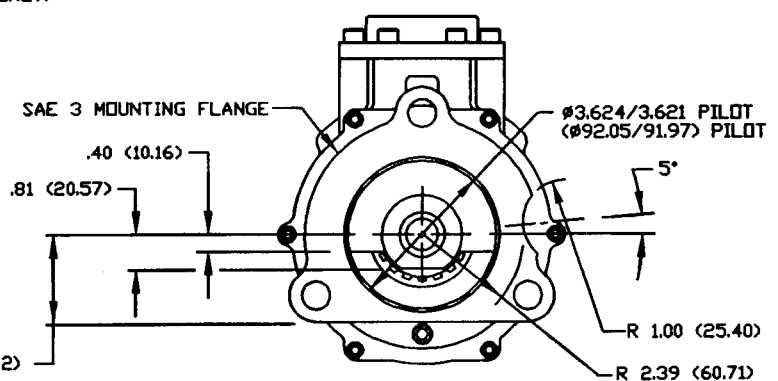
TDI TURBOTWIN

FROM TECH DEVELOPMENT INC



EXHAUST CLOSURE PLATE (2-27271 FOR AIR ONLY) SHOWN
 OTHER EXHAUST OPTIONS:
 EXHAUST SCREEN GUARD (2-28175, FOR AIR ONLY)
 3" NPT MALE 90° ELBOW P/N T100-27900
 MUFFLER (SHORT) P/N T100-27075
 MUFFLER (LONG) P/N T100-27074
 4" STRAIGHT PIPE FITTING P/N T100-27791

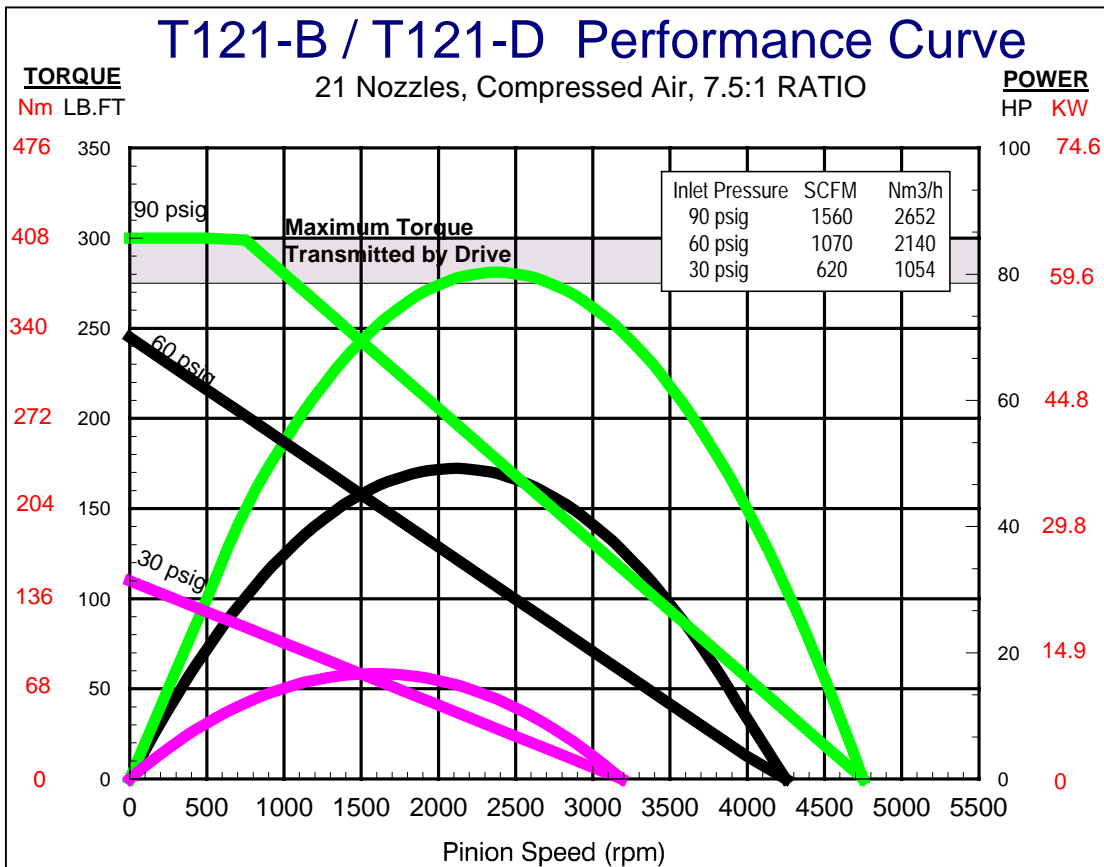
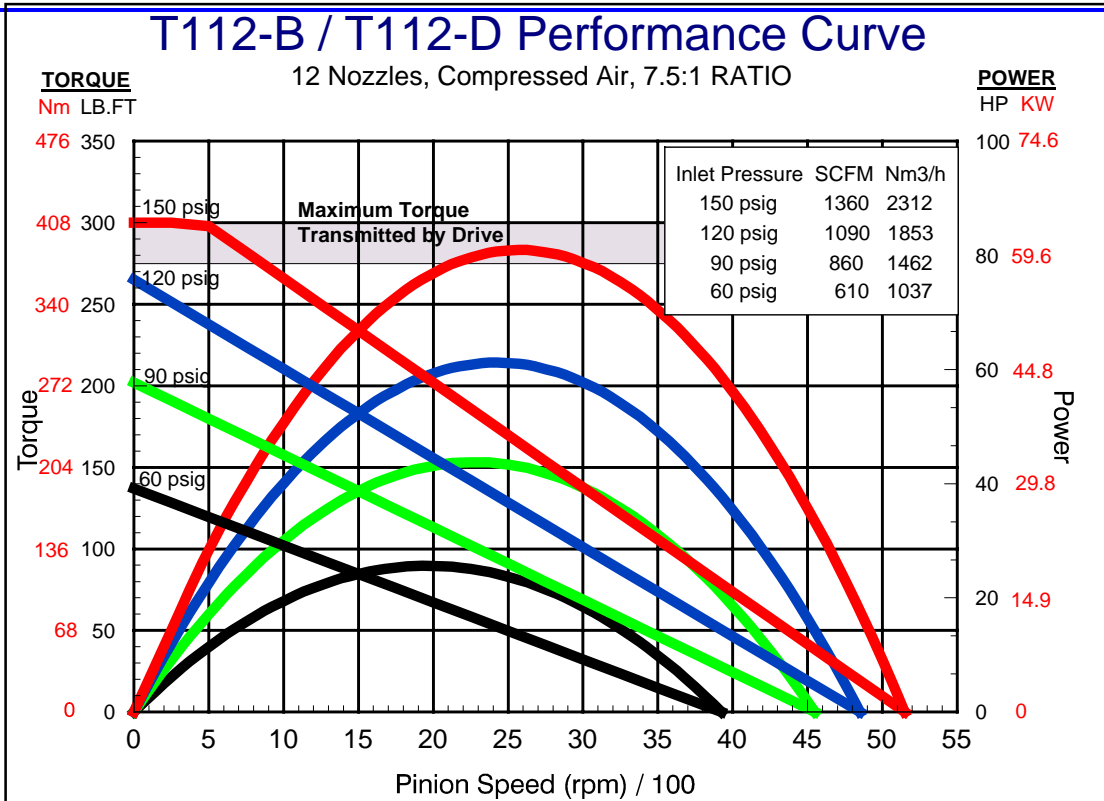
LH (CCW) ROTATION RH (CW) ROTATION

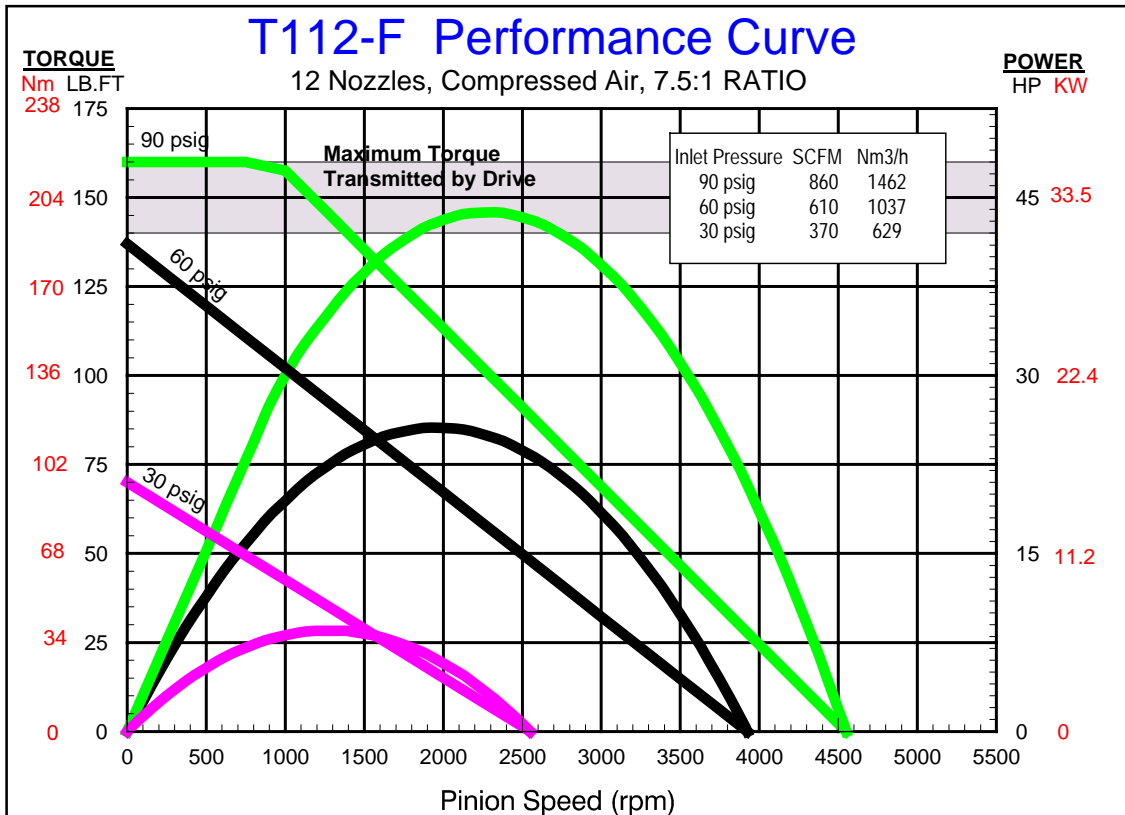
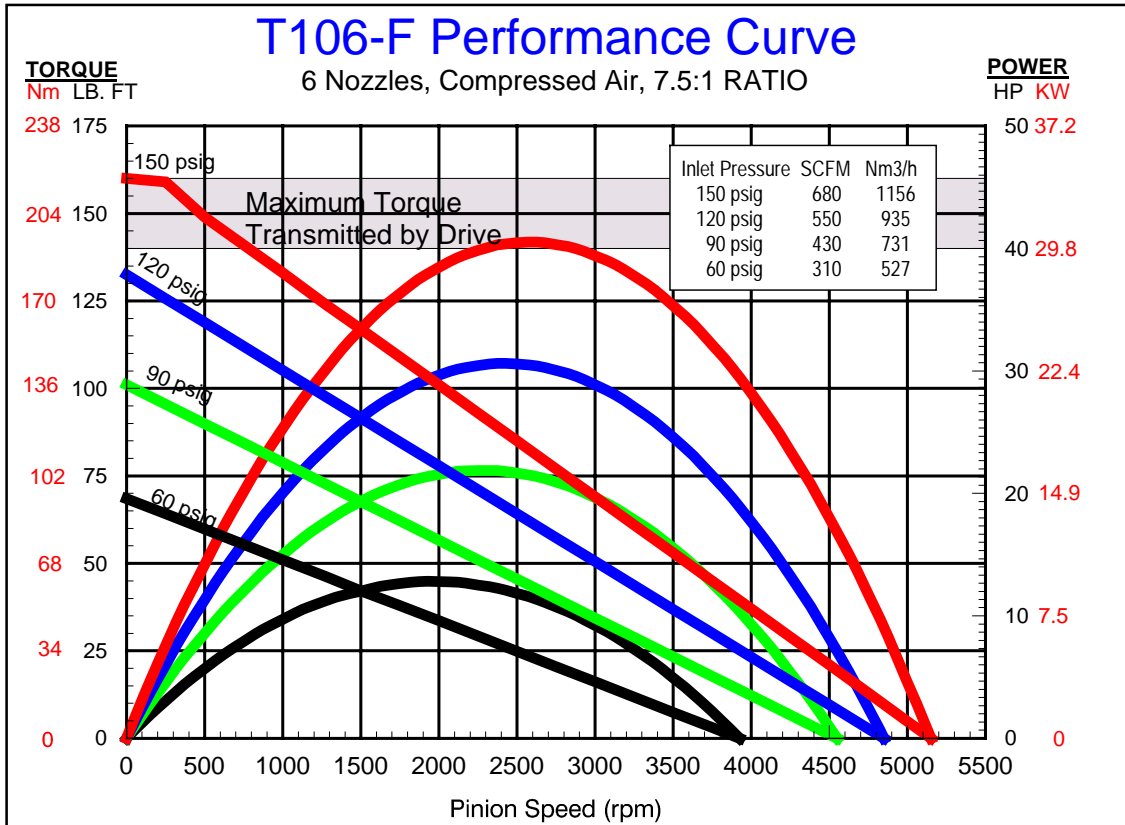


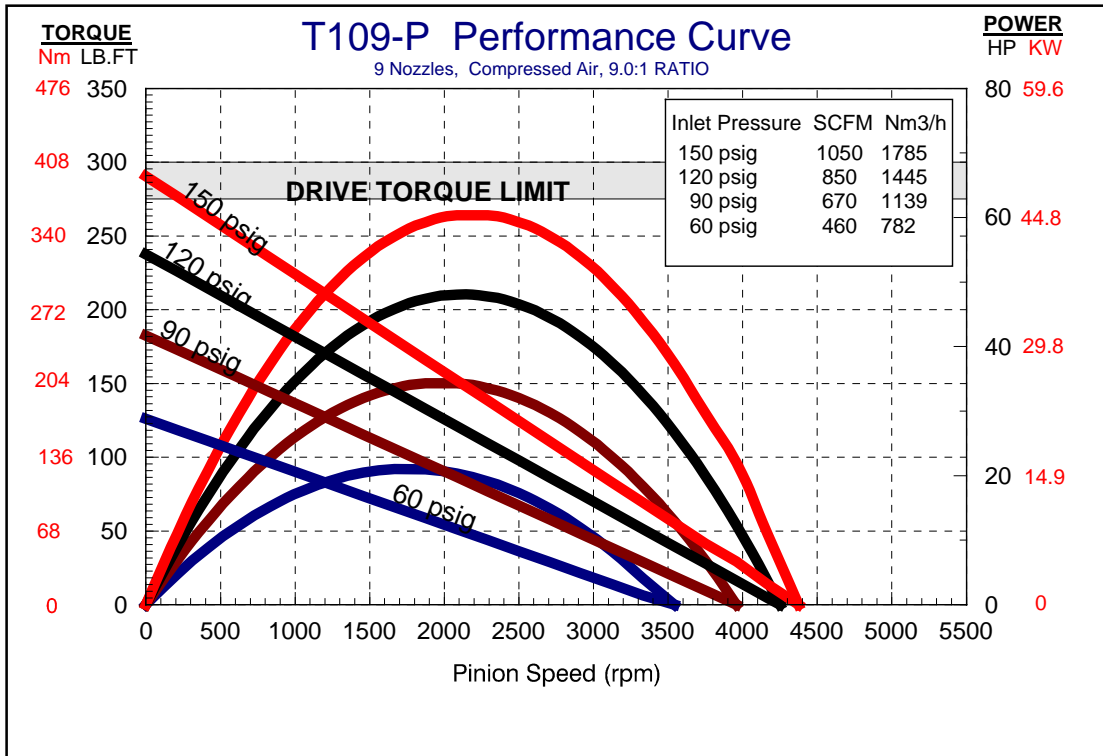
DIMENSIONAL DATA

TDI TURBOTWIN

T100-P









**CATALYTIC HEATER INFORMATION
AND OPERATING INSTRUCTIONS**

COMBI-SAFE 630

9608 – 51st Avenue
Edmonton, Alberta
T6E 5A6
Phone: (780) 463-5505
Fax: (780) 463-2273
Email: info@scottcan.com

INDEX

1.0 ABOUT YOUR *THERMCAT* HEATER

- 1.1 General Information
- 1.2 Certification
- 1.3 Warranty
- 1.4 ***THERMCAT*** Heater Sizes
- 1.5 How your ***THERMCAT*** works
- 1.6 Fuel
- 1.7 Electrical Preheat
- 1.8 Returns

2.0 INSTALLATION OF YOUR *THERMCAT* HEATER

- 2.1 General Information
- 2.2 Hazardous Area Classifications and 12 Volt Heaters
- 2.3 Minimum Clearances
- 2.4 Piping and Fuel Supply
- 2.5 Ventilation
- 2.6 Electrical

3.0 OPERATION OF YOUR *THERMCAT* HEATER

- 3.1 Starting Instruction
- 3.2 Electrical Connections
- 3.3 Battery Location for 12 Volt Heaters
- 3.4 Trouble Shooting

4.0 SAFETY WARNINGS

5.0 MAINTENANCE AND REPAIRS

- 5.1 Maintenance
- 5.2 When to repair your ***THERMCAT***
- 5.3 Repair and accessory service.

1.0 ABOUT YOUR *THERMCAT* HEATER

1.1 GENERAL INFORMATION

THERMCAT heaters can be used in all indoor well-vented industrial areas wherever infrared radiant heat is required.

THERMCAT heaters are a reliable source of heat where natural gas or propane is the fuel of choice. There is no flame and the steel surface temperatures of the heater are below the auto-ignition temperature of the gases for which they are approved.

Objects within the range of the heater absorb low intensity infrared heat produced by the ***THERMCAT***. Radiant infrared energy travels in straight lines from the face of the ***THERMCAT***, so the heater should be mounted as close as practical to the object requiring heat and there should be no physical barrier between the ***THERMCAT*** and the object.

THERMCAT heaters have been manufactured to produce safe flameless heat. Every heater is tested to ensure proper performance. Each unit is brought up to operating temperature and tested for gas leaks, consistent heat output and explosion proof capability.

1.2 CERTIFICATION

THERMCAT gas fired, flameless, infra-red catalytic heaters are approved by the Canadian Gas Association for use with natural gas or propane in industrial areas rated as Class I, Divisions 1 & 2, Group D; T2 hazardous locations, and by FM Global for Class 1, Division 2, Group D hazardous locations. Heaters are suitable for use with natural gas or propane for elevations up to 4,500 feet (1,370 meters). In addition to these approvals ScottCan Industries maintains its own quality management system.

1.3 WARRANTY

ScottCan Industries Ltd warrants all of its products against defects in material and workmanship for a period of one year from date of purchase. During the warranty period, ScottCan shall, at its option, repair or replace any defective product upon return of the product to the factory, at no charge for labour and materials. Freight sent to ScottCan must be prepaid and return shipments will be sent collect. Damage resulting from misuse, inappropriate fuel, and/or not complying with requirements of the operator's manual will not be warranted. All other costs, such as consequential or liquidated damages are not covered by the warranty.

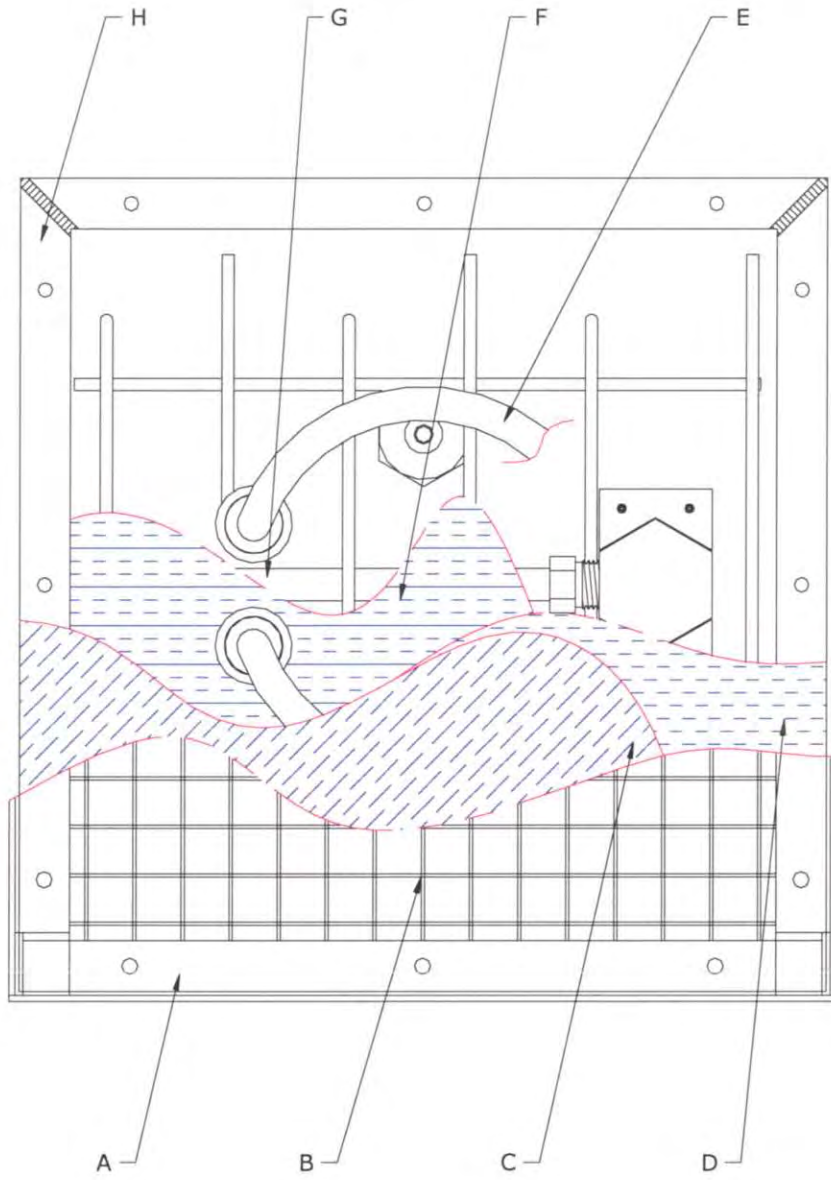
1.4 **THERMCAT** HEATER SIZES

Model Number	Available Voltage					Fuel Input (Btu/Hr)
	12	120	240	480	600	
HA6.24	X	X	-	-	-	4000
HA8.8	X	X	-	-	-	1800
HA12.12	X	X	-	-	-	4000
HA12.24	X	X	X	-	-	8000
HA12.36	-	X	X	-	-	12000
HA12.48	-	X	X	X	X	16000
HA18.24	X	X	X	X	X	12000
HA18.36	-	X	X	X	X	18000
HA18.48	-	X	X	X	X	24000
HA24.24	X	X	X	-	-	16000
HA24.30	X	X	X	-	-	20000
HA24.36	X	X	X	X	X	24000
HA24.48	-	X	X	X	X	32000

HT6.24	X	X	-	-	-	6000
HT8.8	X	X	-	-	-	2750
HT12.12	X	X	-	-	-	6000
HT12.24	X	X	X	-	-	12000
HT12.36	-	X	X	-	-	18000
HT12.48	-	X	X	X	X	24000
HT12.60	-	X	X	X	X	30000
HT12.72	-	X	X	X	X	36000
HT18.24	X	X	X	X	X	18000
HT18.36	-	X	X	X	X	27000
HT18.48	-	X	X	X	X	36000
HT18.60	-	X	X	X	X	45000
HT18.72	-	X	X	X	X	54000
HT24.24	X	X	X	-	-	24000
HT24.30	X	X	X	-	-	30000
HT24.36	X	X	X	X	X	36000
HT24.48	-	X	X	X	X	48000
HT24.60	-	X	X	X	X	60000
HT24.72	-	X	X	X	X	72000

The above heaters (Table 1) designated with the prefix of "HA" are identified for use in hazardous areas. Those certified for general industrial use are designated with the prefix "HT". Additional models are available upon request.

Figure 1



1.5 HOW YOUR **THERMCAT** WORKS

1. Fuel enters the gas tight heater box (H) through the orifice in the back of the heater.
2. The fuel is dispersed by means of the dispersion tube (G).
3. The fuel then passes through an insulation pad (F), which has two purposes. First to restrict the heat from being transferred to the back of the heater. Secondly, it aids in the dispersion of the gas by acting as a resistance to flow.
4. Next the fuel passes to the catalyst pad (D), which has been preheated to approximately 250°F by the electrical element (E). The preheat element is available in voltages shown on chart in Table 1.
5. Oxidation occurs where the fuel gas and oxygen from the air meet on the catalyst pad face, and this reaction produces heat. The catalyst pad is protected by a fiberglass cloth (C), wire screen (B) and held in place by the bezel (A).

1.6 FUEL

THERMCAT catalytic heaters are designed to operate on either propane or dry, clean natural gas. The fuel orifice supplied with the heater has been properly sized to allow for the correct amount of gas to the heater for a safe operating temperature. Enlarging the existing orifice in the heater will not increase the amount of heat output and may result in a hazardous gas leak. If for any reason the fuel needs to be changed, the heater should be sent in to the factory so that the proper replacement orifice and a new nameplate can be fitted to the heater.

Propane heaters are designed for an operating pressure of 11" w.c. Natural gas heaters are designed for operating pressure of 3.5" w.c.

1.7 ELECTRICAL PREHEAT

The electrical starting system may consist of one or two preheat elements. The voltage information for your **THERMCAT** can be found on the nameplate on the back of the heater along with the amperage that is required to properly start the heater. Heaters with only two preheat terminals have one element and heaters with four terminals have two elements. (Refer to figure 4)

1.8 RETURNS

Heaters and accessories that are returned for credit must be as originally ordered, in as new condition and must be shipped prepaid. All items are carefully inspected upon return to the factory before a credit is issued. A restocking charge may be applied to returns.

2.0 **INSTALLING YOUR THERMCAT COMBISAFE HEATER**

2.1 GENERAL INFORMATION

It is important that the following information be carefully read, understood and followed when installing your **THERMCAT COMBISAFE 630** heater. Proper installation and maintenance will provide you with years of trouble-free service. Read the warning label attached to the heater.

All **THERMCAT COMBISAFE 630** heaters must be installed by qualified personnel in accordance with CAN/CGA-B149.1 and/or CAN/CGA-B149.2 standards and all local regulations and codes.

Check that the electrical power and gas supply corresponds with the voltage and fuel details specified on the **THERMCAT** heater nameplate.

THERMCAT COMBISAFE 630 heaters should always be installed with the face mounted in a near vertical position for best results. However, if the heater is to be tilted in any way, the angle should not exceed 45°. It is important to protect the heater from the elements by mounting them in an enclosure or building of some type. If persons will be working in the proximity of the heater, a safety grill should be installed on the front of the **THERMCAT COMBISAFE 630**.

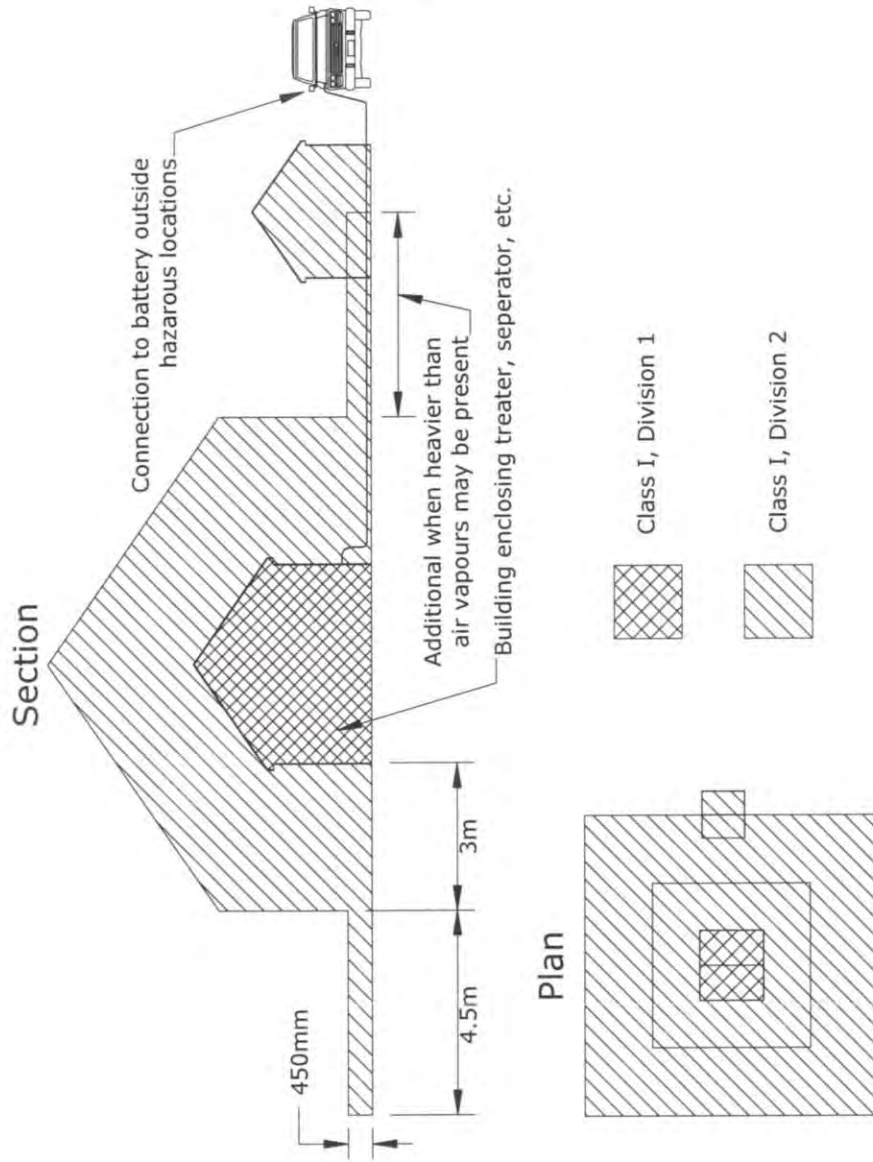
For space heating applications, it is recommended that your **THERMCAT COMBISAFE 630** heater should not be mounted any higher than 8'-0" above the floor level.

When the **THERMCAT COMBISAFE 630** is used to heat an object, it should be installed as close as possible to the object and there should be no physical barrier between the **THERMCAT** and the object. If possible objects to be heated should be painted with a dark or dull non-reflective coating.

2.2 HAZARDOUS AREA CLASSIFICATIONS AND 12 VOLT HEATERS

When installing 12-volt **THERMCAT COMBISAFE 630** heaters, the battery for starting the heater must be outside the hazardous area as shown in Figure 2. ScottCan can supply battery cables of the required length.

Figure 2



2.3 MINIMUM CLEARANCES

Where the heaters are used for space heating, Table 2 details the minimum clearances in inches from combustible materials.

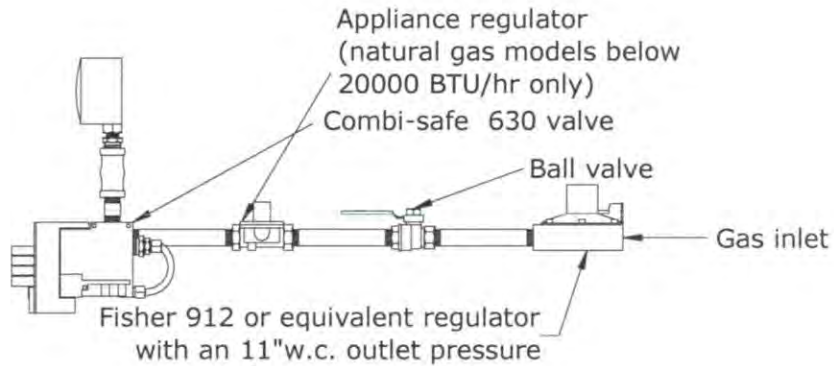
Table 2

Below 12,000 BTU/hr Input	Face	Top	Bottom	Sides
Vertical	28"	18"	12"	12"
0°-45° Up	28"	24"	12"	12"
0°-45° Down	24"	18"	24"	12"
12,000-36,000 BTU/hr Input	Face	Top	Bottom	Sides
Vertical	48"	18"	12"	12"
0°-45° Up	42"	36"	12"	12"
0°-45° Down	24"	18"	24"	12"
Above 36,000 BTU/hr Input	Face	Top	Bottom	Sides
Vertical	60"	42"	18"	12"
0°-45° Up	48"	54"	18"	12"
0°-45° Down	36"	12"	36"	12"

2.4 PIPING AND FUEL SUPPLY

The gas supply should be connected as shown in Figure 3 below and must conform to all local, national and industry codes. Some of the components shown in the diagram are optional and may not be applicable to your heater.

Figure 3



NOTES:

1. The regulators should all be installed in the upright, horizontal position.
2. The designed maximum inlet pressure to the **COMBISAFE 630** valve is ½ PSI.
3. The designed maximum inlet and outlet pressure of the appliance regulator are ½ PSI and 3.5" w.c. respectively.
4. The designed maximum inlet and outlet pressure of the service regulator are 250 PSI and 11" w.c. respectively.

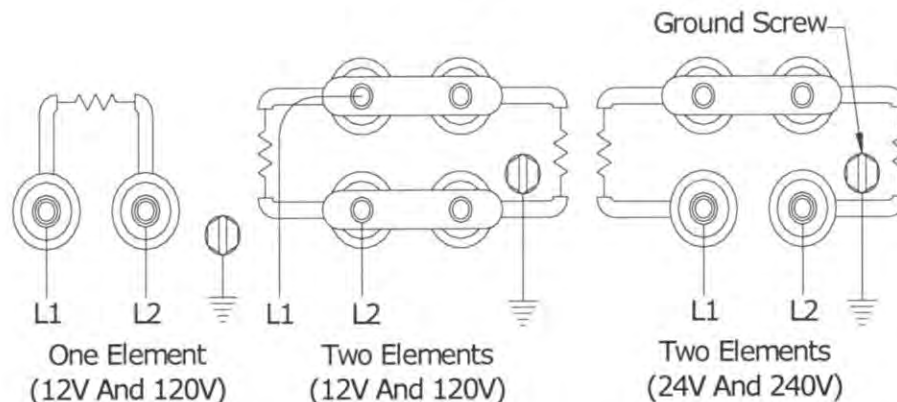
2.5 VENTILATION

There must be an adequate supply of oxygen provided for the catalytic reaction to occur. This reaction produces water vapour, carbon dioxide and infra-red energy. Provided there is sufficient ventilation there should not be any condensation buildup due to water vapour produced by the reaction. Venthood assemblies, which can assist in providing the necessary ventilation, are available as an accessory from ScottCan Industries. Please note that **THERMCAT** heaters fuelled by natural gas or LPG do not produce harmful carbon monoxide gas.

2.6 ELECTRICAL

A power supply of the correct voltage should be connected to the terminals as shown in Figure 4. All electrical connections must conform to the latest Canadian Electrical Code and/or local codes. A ground connection is required for heaters of 120 volts and higher. A ground screw is provided in the junction box for this purpose.

Figure 4



3.0 OPERATION OF YOUR THERMCAT COMBISAFE HEATER

3.1 STARTING INSTRUCTIONS

1. Verify that the **THERMCAT COMBISAFE 630** heater has been installed according to all instructions, applicable codes, and that the fuel and electrical supplies match those on the heater nameplate.
2. Set **COMBISAFE 630** valve to the OFF position.
3. Turn on the gas supply to the **THERMCAT**.
4. Ensure the supply is connected to the heater terminals first and then to the power supply. Turn on the electrical preheat supply to the **THERMCAT**.
5. Wait 10 to 15 minutes (this time may vary depending on heater temperature).
6. Rotate the control knob counter clockwise to the **PILOT** position. Press the control knob down for 10-30 seconds. Release the control knob and turn counter clockwise it to the **HI** setting. This allows gas to flow to the heater and a pressure reading will register on the gauge at that time.
7. You should notice a significant increase in temperature on the face of the **THERMCAT** within 5-10 minutes. The electrical power to the heater can be turned off 15 minutes after the fuel gas has been allowed into the heater provided that the significant temperature increase is seen. Note: Failure to disconnect the electrical supply after start-up may lead to damage of the **THERMCAT**.
8. When using the temperature control dial, it is important that the catalytic reaction be well established before turning the control valve to the desired setting.
9. You may have to reconnect the electrical supply to the **THERMCAT** and repeat the above steps if the heater does not continue to operate. Note that you will have to allow time for the thermocouple to cool before repeating procedure.
10. To shut down, turn the control knob to OFF.
11. Do not flame start the **THERMCAT COMBISAFE 630** heater.

Figure 5



3.2 ELECTRICAL CONNECTIONS

Please refer to section 2.6

3.3 BATTERY LOCATION FOR 12 VOLT HEATERS

Please refer to section 2.2

3.4 TROUBLE SHOOTING

The **THERMCAT** should continue to operate indefinitely as long as there is an adequate supply of fuel and air. If the heater will not start or if there is any change in operation or if there is a reduction in face temperature, the following should be checked:

1. Check that the fuel and voltage provided corresponds to the nameplate on the back of the **THERMCAT**. If a change is required, it is important that the heater be returned to the supplier for such modifications so that all changes can be documented.
2. If the **THERMCAT** will not heat up when preheat elements are on, check the wiring, connections and that the buss bars are orientated correctly. The connections should be tight and the wiring should be heavy enough to carry the amperage required to start the heater.
3. The gas supply pressure between the **THERMCAT** and the regulator must be checked. It should correspond to the nameplate on the back of the heater.

4. Ensure there is no physical damage to the **THERMCAT**. If there are any holes, tears, or discoloration of the catalyst pad, the heater should be returned to the manufacturer, as this is a sign that the catalytic pad may have to be replaced.
5. The gas inlet orifice should be checked for any obstructions.
6. If possible, check the output of the thermocouple. The thermocouple should generate 10-15 millivolts after 20 minutes of preheating.
7. When starting a **THERMCAT** that has a **COMBISAFE 630** valve, it is important that the **THERMCAT** be started at the maximum setting. Once the heat is established the valve setting may be turned down.
8. Check that the **THERMCAT** is mounted as instructed in the installation instructions.
9. If the **THERMCAT** is going out in the standby position, check the gas pressure shown on the pressure gauge. At "full ON" this should register 3.5" w.c for natural gas and 11"w.c. for propane gas. If it does not, remove the cap from the appliance regulator (natural gas models below 20000BTU/hr) or service regulator (for propane gas) and turn the adjustment screw clockwise until this reading is achieved. Replace the regulator cap.

4.0 SAFETY WARNING

1. Read and adhere to instruction manual.
2. Ensure that installation corresponds to all local and national electrical and gas codes.
3. Do not remove any of the labels on the heater.
4. Install only as specified in instructions.
5. Use only fuel, voltage and pressure as specified on the nameplate.
6. Use in well ventilated areas.
7. Do not tamper with **COMBISAFE 630** valve.
8. The **THERMCAT** should not be operated if any part of the heater or controls has been damaged.
9. The **THERMCAT** should not be started with an open flame.
10. The gas and electricity must be turned off and disconnected before installing and reinstalling after servicing.
11. **THERMCAT** heaters should be serviced and installed by qualified personnel.
12. This heater is not for residential use.

5.0 MAINTENANCE AND REPAIRS

5.1 MAINTENANCE

There are no moving parts in a **THERMCAT** heater and maintenance is minimal. It will continue to operate for years provided it is supplied with clean, dry fuel. It should be not subjected to compressed air, water or solvents. If any part of the heater is damaged, it should not be operated and must be returned to the factory for servicing and testing. It is extremely important that the nameplate or instruction labels not be removed or altered in any way. When the **THERMCAT** is not in use, it should be stored in a clean, dry area. This will increase the life of the heater.

5.2 WHEN TO REPAIR YOUR **THERMCAT**

Periodically you will find that your **THERMCAT** heater is in need of repair or maintenance. This can occur for several reasons. Pad contamination, pad damage, mechanical damage due to mishandling, preheat element failure, insulation breakdown or damage to the external components such as shutoff valve, thermocouple or explosion proof junction box. The following information is intended to assist you to identify when your **THERMCAT** requires maintenance or repair.

1. ***Although the THERMCAT is operating, the surface temperature is much cooler than when it was new.***

By using an infrared thermometer, you can determine the temperature on the face of the **THERMCAT**. When it is new, the average heater surface temperature will be approximately 700° F. Surface temperature reduction is normally caused by pad contamination, usually from contaminants such as salt (white powder), sulphur (yellow powder), oil (black residue) or water (red/rust stains), in the fuel gas. It is possible that contamination could be external, coming from extreme levels of dust or sand in the atmosphere around the heater. The **THERMCAT** heater is designed with a fiberglass screen over the pad face to reduce the effects and damage from external influences. Once the **THERMCAT** temperature falls to under 450°F, it is recommended that it be sent to **ScottCan** for repair. If it is left operating at this level it will result in unburned gas being passed through the **THERMCAT** into the atmosphere. To reduce the effects of fuel gas contamination, we recommend the use of a **THERMCAT** fuel gas filter, which helps eliminate some of the contaminants.

2. ***There is a hole in the catalyst pad at the front of the THERMCAT.***

Under no circumstances should the **THERMCAT** be used in this condition. Unburned gas will pass through the hole creating a fire risk once outside the controlled area. The hole has likely been caused by a high pressure water or air hose used to clean the facility, or by someone accidentally penetrating the surface with a sharp object when working around the heater. Again the **THERMCAT's** fiberglass screen will reduce the effects of external damage but cannot prevent it in all cases.

3. **Rivets are missing from the bezel.**

Again, do not use the **THERMCAT**. Unburned gas can escape at these locations creating a fire risk. Such damage is abnormal and only usually occurs due to mishandling.

4. **The THERMCAT will not heat during the preheat (startup) stage.**

This can mean that either the electric preheat elements are damaged or that the power supply does not match the heater. First, check that the power supply matches the voltage shown on the nameplate. If they agree, check that the buss-bars (brass/copper strips) which connect the element terminals inside the explosion proof junction box, match the configuration for the appropriate voltage as shown on the diagram on the rear of the heater. If this matches, then it is likely that there is a problem with the elements and the heater should be sent in for repair.

5. **Junction box is damaged or lid is missing.**

Under no circumstances should such a heater be used. The **THERMCAT** should be sent for repair immediately. In such a condition, hazardous gases can surround the electrical pre-heat element connection and the tiniest spark could cause a fire or explosion.

6. **THERMCAT housing is damaged.**

Again, under no circumstances should the **THERMCAT** be used. This heater should be sent for repair immediately. Cracking, distortion or twisting of the housing can lead to the passage of unburned gas through the heater into the atmosphere thus creating the risk of explosion or fire.

5.3 REPAIR AND ACCESSORY SERVICES

ScottCan offers a complete sales and service center for all your **THERMCAT** heater requirements including accessories.

All **THERMCAT** heaters sent to ScottCan Industries Ltd. for service and repair are disassembled, thoroughly cleaned, reassembled and tested for leaks and heat output.

Accessories available:

- Battery Cables
- Battery Cable Boxes
- Regulators
- Safety Shut Off Valves
- Thermocouples
- Venthood Assemblies
- Hoses
- Wall Brackets
- Floor Brackets
- Protection Grills
- Thermostats
- Ball Valves
- Filters

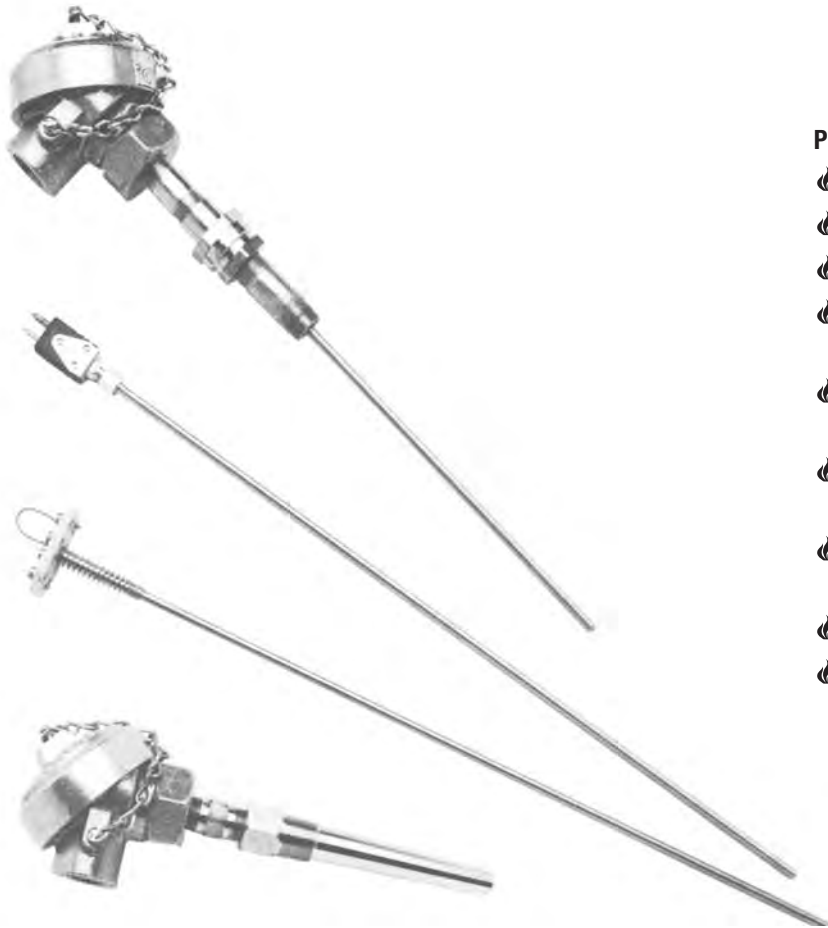
If you have any questions or wish to send your THERMCAT heater for repair, please contact or send to:

**SCOTTCAN INDUSTRIES LTD.
9608 51st Avenue
Edmonton, AB.
T6E 5A6**

**Tel: (780) 463-5505
Fax: (780) 463-2273
Email: info@scottcan.com**



T-PAK[®] Thermocouples Probes & Assemblies



PRODUCT FEATURES

- 🔥 Mineral Insulated Thermocouples
- 🔥 Rugged Construction
- 🔥 J, K, T, E and N Calibrations
- 🔥 Probes and Assemblies in all sizes and sheath configurations
- 🔥 General Purpose or Spring Loaded Mounting, with or without Thermowells
- 🔥 Nipple, Nipple-Union-Nipple or Bushing Extension Hardware
- 🔥 CSA Approved Assemblies for Hazardous Locations
- 🔥 Custom Configurations
- 🔥 Head Mounted Transmitter options

Please visit our website for our other Product Literature Guides : Resistance Temperature Detectors, Industrial Thermocouples, Thermowells, Protection Tubes

toll free 1-800-268-0967 • www.thermo-kinetics.com

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STANDARD T-PAK® THERMOCOUPLE PROBE

1 CALIBRATION CODES

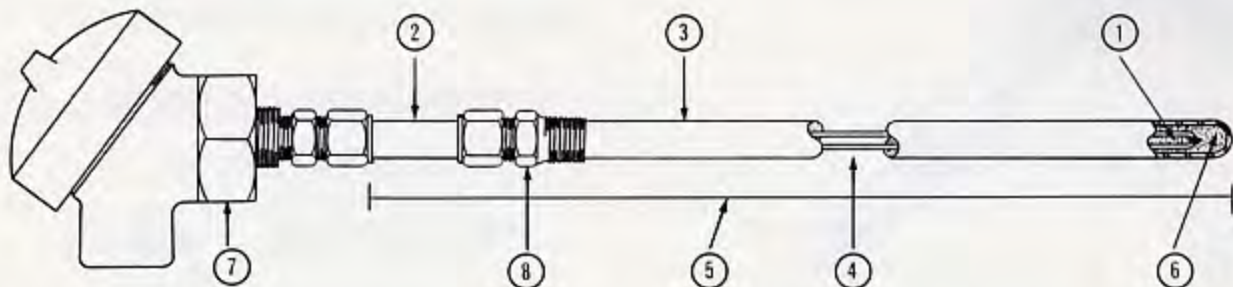
J — Type J T/C
K — Type K T/C
N — Type N T/C
T — Type T T/C
E — Type E T/C
O — Kotherm (K)

2 SHEATH DIAMETER CODES

020 — .020" OD
040 — .040" OD
063 — .063" OD
125 — .125" OD
188 — .188" OD
250 — .250" OD
313 — .313" OD
375 — .375" OD
500 — .500" OD
625 — .625" OD
750 — .750" OD

3 SHEATH MATERIAL CODES

304 — 304L SS
310 — 310S SS
316 — 316L SS
347 — 347 SS
446 — 446 SS
600 — Inconel 600
HSX — Hastelloy X
BLB — Pyrosil B
BLC — Pyrosil C



4 FORM CODES

S — Simplex
D — Duplex

5 LENGTH

Specify length in inches.

6 MEASURING JUNCTION CODES

A — Grounded Junction
B — Insulated Junction
C — Exposed Junction
E — Grounded Junction with Weld Pad
H — Insulated Junction with Weld Pad

7 TERMINATION CODES

Refer to pages 7-9.

8 COMPRESSION FITTING CODES

Z — Brass
Y — Stainless Steel

T-PAK® thermocouples are magnesium oxide (MgO) insulated, metal sheath assemblies that are accurate and sensitive. The outer sheath of stainless steel or other alloys coupled with tightly compacted MgO ensures relatively long life by protecting the thermocouple from oxidizing, reducing or other corrosive atmospheres.

T-PAK PROPERTIES

- **Long Stable Life:** Long element life is assured because the construction protects the conductors from adverse environmental effects.
- **Mechanical Strength:** The tightly compacted powder contained within the tough metal sheath locks the wires rigidly in position, permitting the cable to be bent, flattened, or twisted.
- **Electrical Shielding:** The sheath offers excellent shielding against electrostatic interference in sensitive temperature measuring circuits.
- **Insulation Resistance:** High insulation resistance is attainable over a wide range of temperature and humidity conditions.
- **Moisture/Pressure:** The homogeneous metal sheaths are impervious to most liquids and gases and will withstand high external pressures.
- **Long Lengths:** Continuous lengths up to 2000 feet are available in 1/8" diameter.
- **Ease of Installation:** The pliable construction of the cable allows it to be easily bent to a tight radius and retain its form after being bent. Its metal sheath can be welded or brazed to special attachments.
- **Corrosion Resistant:** Many sheath materials are available to ensure the proper selection depending on the detrimental elements present in specific environments.
- **Rapid Response:** The small mass and high thermal conductivity promotes rapid heat transfer from heat source to measuring junction.

RESISTANCE DATA

SHEATH	LOOP RESISTANCE (Ω /100 ft)									
	SINGLE					DUPLEX				
	J	K	T	N	E	J	K	T	N	E
.040	805	1177	669	1633	1473	—	—	—	—	—
.063	323	472	271	609	593	—	—	—	—	—
.125	81.9	117	67.7	161	148	114	178	94.0	240	219
.188	37.7	54.2	31.3	73.2	68.2	45.3	77.0	37.4	99.1	91.0
.250	21.7	31.8	17.9	41.4	39.6	27.7	42.0	25.3	56.8	52.0
.313	14.2	19.9	11.9	27.3	25.4	17.7	28.7	14.5	36.7	34.1
.375	10.4	13.4	8.8	18.4	18.0	12.3	19.7	10.1	25.7	23.5
.500	5.4	7.8	4.5	10.3	9.8	7.8	11.3	—	19.0	14.2
.625	3.5	5.0	2.8	6.6	6.3	5.0	7.1	—	12.1	9.0
.750	2.2	4.0	2.3	5.3	5.0	3.2	5.8	—	9.6	7.2

Insulation Resistance: >200 M Ω /1000 ft at 500 VDC

PHYSICAL PROPERTIES

SHEATH DIAMETER	SIMPLEX			DUPLEX		
	COND SIZE	SHEATH WALL	WEIGHT	COND SIZE	SHEATH WALL	WEIGHT
.040	.007	.006	3.4	—	—	—
.063	.011	.009	8.4	.009	.009	10
.125	.023	.016	34	.018	.019	38
.188	.033	.024	77	.028	.029	86
.250	.044	.032	130	.037	.039	139
.313	.054	.040	200	.046	.049	233
.375	.066	.048	320	.055	.058	335
.500	.088	.064	510	.073	.064	580
.625	.110	.080	565	.092	.080	644
.750	.132	.096	670	.110	.096	763

Dimensions are in inches; weight in #/mft

MgO CHEMISTRY

ELEMENT	INSULATION PURITY	
	STANDARD	HIGH*
MgO (%)	96.3-97.3	99.5-99.7
SiO ₂ (%)	1.45-2.06	.04-.14
CaO (%)	.73-1.25	.14-.21
Fe ₂ O ₃ (%)	.16-.30	.03-.10
Al ₂ O ₃ (%)	.06-.30	.03-.08
B (ppm)	85-1000	10-20
Cd (ppm)	< 10	< 10
S (ppm)	< 50	< 50
C (ppm)	< 200	< 200

*Conforms to ASTM E585-76 & E234-76

T/C MATERIAL

TYPE	POSITIVE	NEGATIVE
J	Iron	Constantan (Cu-45%Ni)
K	Chromel (Ni-10%Cr)	Alumel (MnSiAl-95%Ni)
T	Copper	Constantan
N	Nicrosil (Ni-4%Cr)	Nisil (Ni-4%Si)
E	Chromel (Ni-9%Cr)	Constantan
O	(Ni-9%Cr)	(Ni-3%Si)

SHEATH APPLICATION DATA

SHEATH MATERIAL	MELTING TEMP.	CONTINUOUS MAX. TEMP.	APPLICATION NOTES
304L SS	1400°C (2550°F)	900°C (1650°F)	Good resistance to corrosion and oxidation.
310S SS	1400°C (2550°F)	1150°C (2100°F)	High temperature strength and scale resistance. Good resistance to carburizing and reducing environments. Withstands sulphurous gas at elevated temperatures.
316L SS	1370°C (2500°F)	925°C (1700°F)	Good corrosion resistance and creep strength at elevated temperatures. Resists tendency to pit in phosphoric and acetic acids. Withstands sulphuric acid compounds.
321 SS	1400°C (2550°F)	870°C (1600°F)	Excellent scale and corrosion resistance at high temperature. Suitable for oxidizing, sulphurous and reducing atmospheres.
347 SS	1425°C (2600°F)	870°C (1600°F)	High corrosion resistance. Excellent for heating and cooling applications between 425 & 875°C (800 & 1600°F).
446 SS	1480°C (2700°F)	1100°C (2000°F)	Good high temperature oxidation resistance. Resists attack by sulphur gas. Good in oxidizing and reducing atmospheres.
Inconel 600	1400°C (2550°F)	1150°C (2100°F)	High corrosion resistance at elevated temperatures. High hot strength. Used in sulphur-free environments. Resists oxidizing and reducing atmospheres.
Hastelloy X	1285°C (2350°F)	1150°C (2100°F)	Good temperature strength and exceptional resistance to oxidation. Good for reducing conditions. Resists attack by sulphur compounds at high temperature.
Pyrosil B	1420°C (2590°F)	1250°C (2280°F)	Excellent oxidation resistance at elevated temperatures. High aqueous corrosion resistance. Minimizes contamination of thermo-element.
Pyrosil C	1420°C (2590°F)	1250°C (2280°F)	Similar to Pyrosil B. Excellent for carburizing and sulphidizing atmospheres.

SHEATH CHEMISTRY (%)

MAT	Ni	Cr	Si	Mn	C	Mo	CU	Al	Fe	Mg	Nb
304L	10	19	1	2	.03						
310S	20	25	1.5	2	.08			.1			
316L	12	17	1	2	.03	2.5					
321	10	18	1	2	.08						
347	11	18	1	2	.08						
446	.2	25	1	1.5	.2				74		
600	76	16	.5	1	.1						
HSX	45	22	1	1	.1	9	.5		.8		
BLB	81	14	1.4	.2						.15	1.8
BLC	73	24	1.4	.2						.15	.5

(Percentages are nominal.)

CALIBRATION CODES

CODE	DESCRIPTION
J	Type J (Iron-Constantan) Thermocouple
K	Type K (Chromel-Alumel) Thermocouple
T	Type T (Copper-Constantan) Thermocouple
N	Type N (Nicrosil-Nisil) Thermocouple
E	Type E (Chromel-Constantan) Thermocouple

SHEATH MATERIAL CODES

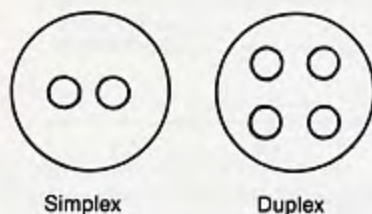
CODE	DESCRIPTION
304	304L Stainless Steel
310	310S Stainless Steel
316	316L Stainless Steel
321	321 Stainless Steel
347	347 Stainless Steel
446	446 Stainless Steel
600	Inconel 600
HSX	Hastelloy X
BLB	Pyrosil B
BLC	Pyrosil C

SHEATH DIAMETER CODES

CODE	020	040	063	125	188	250	313	375	500	625	750
Simplex	.02"	.04"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
Duplex	—	—	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	*	*	*

*Not available for type T or sheath materials 321, 347, HSX or BLB

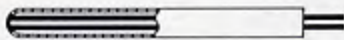
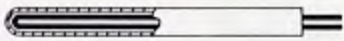

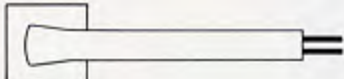
JUNCTION FORM CODES



CODE		INSULATION PURITY	LIMITS OF ERROR
SPLX	DPLX		
S	D	Standard	Standard
R	E	Standard	Special
Q	F	High	Standard
P	G	High	Special

High purity & special limits of error not available for sizes larger than .375"

MEASURING JUNCTION CODES

JUNCTION	CODE	DESCRIPTION
	A	GROUNDING JUNCTION The junction is welded directly to the sheath.
	B	INSULATED JUNCTION The junction is insulated from the sheath. Duplex junctions are also insulated from each other.
	K	INSULATED COMMON JUNCTION Duplex junctions are welded together, but are insulated from the sheath.
	C	EXPOSED JUNCTION The junction is formed beyond the end of the sheath.
	E	WELD PAD with GROUNDING JUNCTION The junction is grounded to the sheath which is welded to a 1" x 1" x 1/8" 316 S.S. pad.
	H	WELD PAD with INSULATED JUNCTION The junction is insulated from the sheath which is welded to a 1" x 1" x 1/8" 316 S.S. pad.
	M	Same as 'E' except weld pad is same alloy as sheath.
	N	Same as 'H' except weld pad is same alloy as sheath.
	NOTES: Standard weld pad construction is T/C parallel to pad. If pad is to be curved, specify tube diameter.	

COMPARATIVE RESPONSE DATA

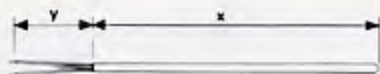
SHEATH SIZE	GROUNDING JCT		INSULATED JCT		EXPOSED JCT	
	WATER	AIR	WATER	AIR	WATER	AIR
.313	5.5	55	16	150	.5	5.0
.250	4.0	34	10	120	.3	2.5
.188	2.5	26	5	75	.2	2.0
.125	1.5	14	3	28	.1	1.0
.063	0.5	5	1	10	.05	0.5
.040	0.3	2.5	0.6	5	.01	0.05

Time constants in seconds.

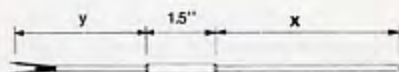
Water flow: 5 ft/sec
Air flow: 60 ft/sec

No. of Time Constants	0.1	1.0	2.3	4.6	6.9
Per Cent Change	10.0%	63.2%	90.0%	99.0%	99.9%

TERMINATION CODES



000 Exposed leadwire 2" long
Sheath sizes: .125 - .750
Specify "y" length (Standard = 2")



Potting Adaptor with flexible leadwire
(20 ga for single; 24 ga for duplex)
Sheath sizes: .040 - .750
Specify "y" length (Standard = 3")

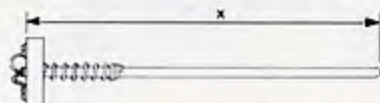
LEADWIRE INSULATION	ADDITIONAL FEATURES	LEADS ONLY	PLUG	PLUG/JACK	MINI PLUG	MINI PLUG/JK
Fiberglas (475°C)	None	10N	11N	12N	15N	16N
	Relief Spring	10R	11R	12R	15R	16R
	SS Overbraid	10S	11S	12S	15S	16S
	Armour*	10X	11X	12X	15X	16X
PVC (100°C)	None	40N	41N	42N	45N	46N
	Relief Spring	40R	41R	42R	45R	46R
	SS Overbraid	40S	41S	42S	45S	46S
	Armour*	40X	41X	42X	45X	46X
Teflon (200°C)	None	70N	71N	72N	75N	76N
	Relief Spring	70R	71R	72R	75R	76R
	SS Overbraid	70S	71S	72S	75S	76S
	Armour*	70X	71X	72X	75X	76X

*Single conductor stranded wires inside armour



Retractable Cable 100°C PVC jacket
12" coiled, extends to 60"
Sheath sizes: .063 - .375
Duplex not available

END OF CABLE TERMINATION	CODE
Stripped Leads	210
Plug	220
Plug & mating jack	230
Jack	221
Jack & mating plug	231
Mini plug	225
Mini plug & mating jack	235
Mini jack	226
Mini jack & mating plug	236

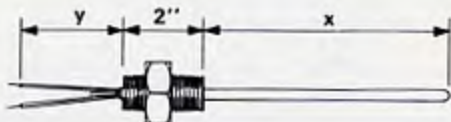


Spring-loaded, Captive T/B
(Replacement element for industrial assemblies)
Sheath sizes: .188 & .250 only

HEAD	LENGTH "X"	CODE
General Purpose	A + N + 2.0"	260
Heavy Duty	A + N + 2.25"	250

TERMINATION CODES

Mounting Adaptor, Stainless Steel, 1/2" x 1/2" NPT
Specify "y" length (Standard = 3")



CODE	PROBE ATTACHMENT TO ADAPTOR	SHEATH SIZE
310	Probe Welded to Adaptor	.125-.375
311	Integral Transition	.063-.375
312	Fixed Compression Adaptor	.250
313	Adjustable Compression Adaptor	.250
314	Probe Brazed to Adaptor	.125-.375
320	Spring-loaded	.188 & .250
330	Spring-loaded, O-Ring Seal	.188 & .250

NOTES:

If used with a thermowell:

X = A - 1/2" (for fixed probes)

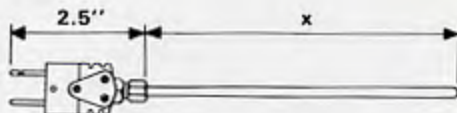
X = A (for spring-loaded probes)

where O-Ring seal rated 500 psig at 260°C.

A = bore length of thermowell

2-Pole Connectors Plug or Jack

TYPE	PLUG	PLUG/JACK*	JACK	JACK/PLUG**
Standard (200°C)	410	420	411	421
Standard (425°C)	450	460	451	461
Mini (200°C)	430	440	431	441
Mini (425°C)	470	480	471	481



NOTES:

1. Sizes: Standard: .063-.375
Mini: .040-.063

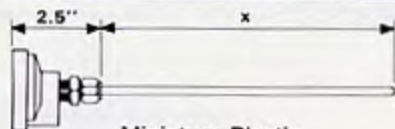
2. *Plug attached to probe
**Jack attached to probe



Open-type Micro
Connector Block

200°C	425°C
510	520

Sizes: .063-.250



Miniature Plastic
Weatherproof Head

Material	200°C	425°C
Brass C.F.	550	560
S/S C.F.	555	565

Sizes: .063-.313



Miniature Aluminum
Screw Cover Head

Brass C.F.	610
S/S C.F.	620

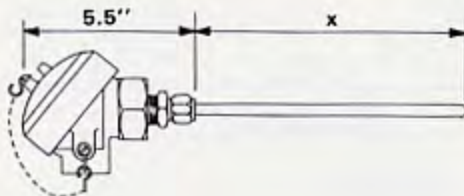
Sizes: .063-.375

Screw Cover Terminal Head

3/4" conduit thread

Mounted to probe with compression fitting

HEAD	FITTING	G.P.	H.D.
Aluminum	Brass	710	730
	Stainless Steel	720	740
Cast Iron	Brass	750	770
	Stainless Steel	760	780



NOTES:

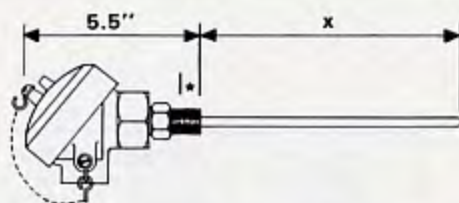
Sheath sizes: .063-500

G.P. = General purpose

H.D. = Heavy duty

TERMINATION CODES

Screw Cover Terminal Head
 3/4" conduit thread
 1/2" x 1/2" NPT SS mounting adaptor
 Heads: Aluminum or Cast Iron
 General Purpose (G.P.)
 or Heavy Duty (H.D.)



*Thread engagement = .35" fr 1/2" NPT

Probe Welded to Adaptor

NOTES

1. Sheath sizes: .063-.375
2. If used with a thermowell X = bore depth of T/W - 1/2"
3. For replacement element, refer to termination 310

HEAD	G.P.	H.D.
Aluminum	810	850
Cast Iron	910	950

Probe Spring-loaded to Captive Terminal block
 (See below for drawing)

NOTES

1. Sheath sizes: .188 & .250 only
2. X = unsprung length of probe
3. If used with a thermowell X = bore depth of T/W
4. For replacement element, refer to:
 termination 250 for H.D.
 or termination 260 for G.P.

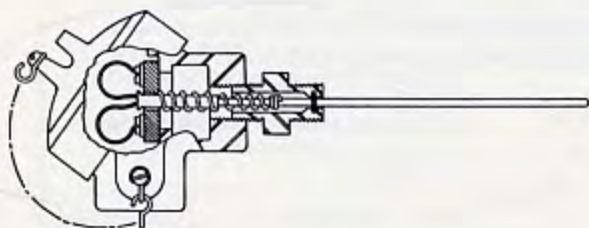
HEAD	G.P.	H.D.
Aluminum	820	860
Cast Iron	920	960
with O-Ring Seal		
Aluminum	830	870
Cast Iron	930	970

Probe Spring-loaded to Adaptor
 (See below for drawing)

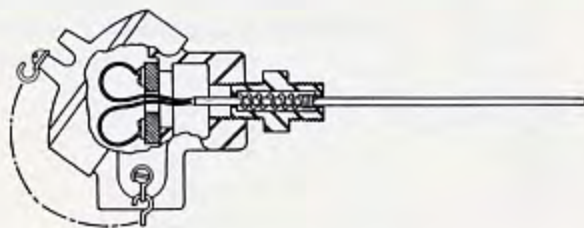
NOTES

1. Sheath sizes: .188 & .250 only
2. X = unsprung length of probe
3. If used with a thermowell X = bore depth of T/W
4. For replacement element, refer to:
 termination 320 for spring-loaded
 or termination 330 for O-Ring type

HEAD	G.P.	H.D.
Aluminum	825	865
Cast Iron	925	965
with O-Ring Seal		
Aluminum	835	875
Cast Iron	935	975

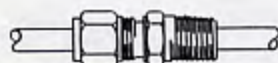


Detail of "Captive Terminal Block"



Detail of "Spring-loaded Adaptor"

COMPRESSION FITTING CODES



SEAL OR FERRULE MATERIAL	FITTING MATERIAL	
	BRASS	316 SS
Metal Ferrule	ZMX	YMX
Teflon Seal	ZTX	YTX
Grafoil Seal	ZGX	YGX
Lava Seal	ZLX	YLX

X = Mounting thread size code
Metal ferrule is same material as fitting.

SHEATH SIZE	MOUNTING THREAD SIZE (X) CODE				
	MOUNTING THREAD				
	1/8"	1/4"	3/8"	1/2"	3/4"
063	1	—	—	—	—
125	1	2	—	—	—
188	1	2	—	—	—
250	1	2	3	4	—
313	—	2	—	—	—
375	—	2	3	4	—
500	—	—	—	4	6
625	—	—	—	—	6
750	—	—	—	—	6

MOUNTING THREAD SIZE CODE	
SIZE	CODE (X)
1/8" NPT	1
1/4" NPT	2
3/8" NPT	3
1/2" NPT	4
3/4" NPT	6

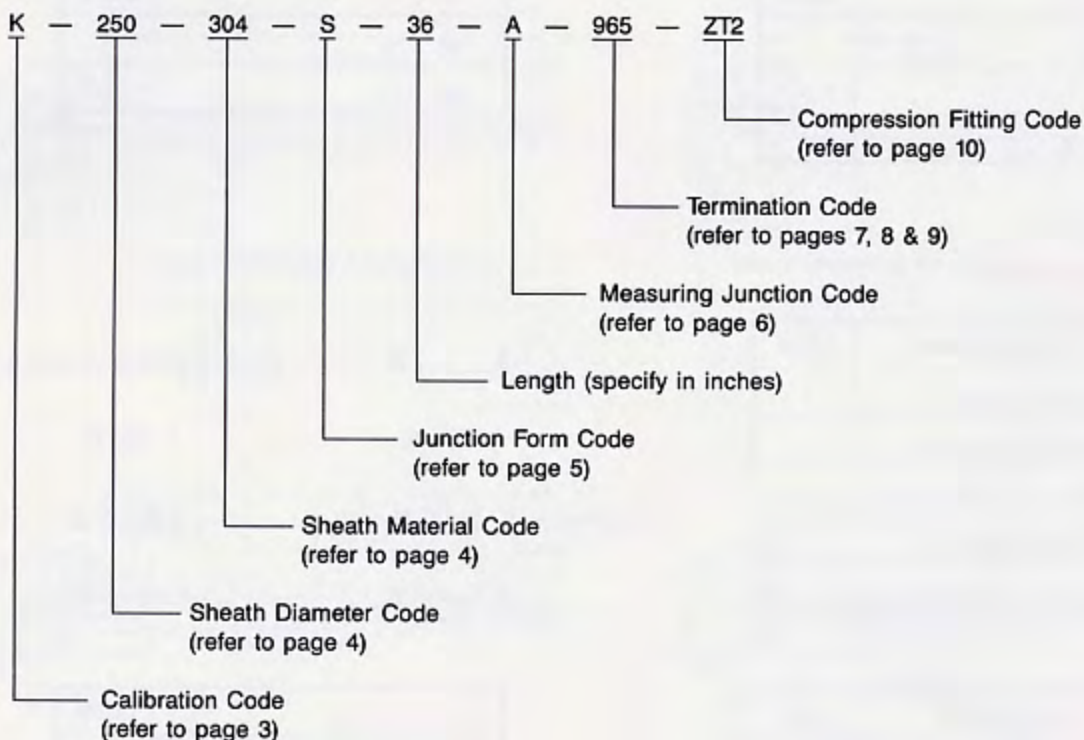
SEAL MATERIAL GUIDE

SEALANT MATERIAL	TEMPERATURE RATING	PRESSURE RATING	CHEMICAL RESISTANCE	TYPE OF MATERIAL	MATERIAL CHARACTERISTICS
Teflon (T)	-175° to 260°C	Vacuum* Up to 5,000 psi	Excellent	Tetrafluoroethylene Plastic (Thermoplastic Resin)	It is less permeable to gasses than neoprene and has moderate resistance to nuclear radiation. It is also normally reusable.
Grafoil (G)	-200 to 3000°C **	Up to 5,000 psig	Excellent	Flexible Graphite	High corrosion resistance. Moderate resistance to nuclear radiation.
Lava (L)	-175 to +1000°C	Up to 7,500 psi	Excellent	Natural Magnesium Silicate (Soap Stone)	Crushes to a powdered mass under compression and is slightly porous to gases. Not recommended for vacuum applications. The compressed powder will break away when the fitting is taken apart and therefore the seal must be replaced.

**450°C max is exposed oxidizing atmosphere. *005 Microns 5 × 10⁶ MM. Hg Abs.

ORDERING INFORMATION

An 8-part catalog number is used to specify a complete **T-PAK**[®] assembly:



Example: The above catalog number identifies a type K thermocouple, with a .250" OD 304 stainless steel sheath, a single element 36" long with grounded junction, a heavy duty cast iron screw cover head, a 1/2" x 1/2" stainless steel spring-loaded bushing and a brass compression fitting (1/4" NPT) with teflon seal.

Many variations are available on **T-PAK**[®] elements and assemblies which are not covered in this sheet. Among them are multiple probe (bundle), coiled, bent/angled type and superheater, pad-type thermocouples.

Post assembly certified traceable calibration, is available upon request.

Consult the factory for further information and part numbers.

INDUSTRIAL ASSEMBLIES

SHEATH

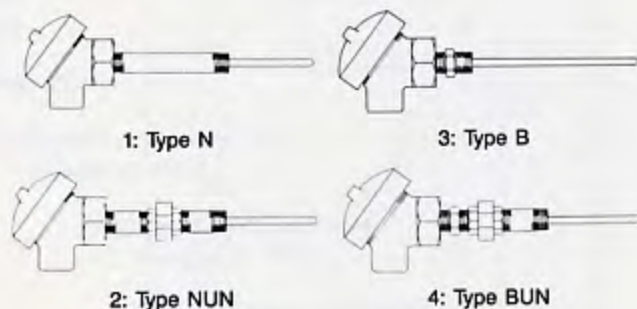
MATERIAL	CODE
304 S.S.	1
316 S.S.	2
Inconel 600	3

DIAMETER	CODE
.188" O.D.	1
.250" O.D.	2

CONFIGURATION

MOUNTING ARRANGEMENT	CODE
General Purpose (fixed)	1
Spring-Loaded, Captive T/B	2
Sprg-Ld, Captive T/B, O-Ring Seal	3
Bushing, Spring-Loaded	4

1, 3 & 4 require B or BUN extension (1/2" only)



EXTENSION HARDWARE	CODE
Nipple (N)	1
Nipple-Union-Nipple (N-U-N)	2
Bushing (B)	3
Bushing-Union-Nipple (B-U-N)	4

SIZE/MATERIAL	CODE
1/2" NPT, Galvanized	1
3/4" NPT, Galvanized	2
1/2" NPT, Stainless Steel	3
3/4" NPT, Stainless Steel	4

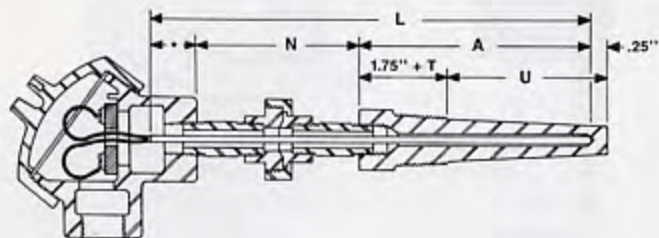
REPLACEMENT ELEMENT LENGTH (X)

HEAD	MOUNTING	TERM*	N/NUN	B/BUN
General Purpose (G.P.)	General Purpose (1)	000	A+N+0.5"	—
		310, 311	—	A+N-1.5"
	Spring Loaded, Captive T/B (2,3)	260	A+N+2"	A+N+2"
	Spring Loaded Bushing (4)	320	—	A+N-1"
Heavy Duty (H.D.)	General Purpose (1)	000	A+N+1"	—
		310, 311	—	A+N-1.5"
	Spring Loaded, Captive T/B (2,3)	250	A+N+2.25"	A+N+2.25"
	Spring Loaded Bushing (4)	320	—	A+N-1"

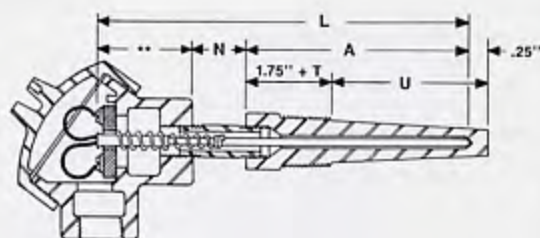
*refer to pages 7 & 8 for replacement element terminations.

INDUSTRIAL ASSEMBLIES

N or N-U-N EXTENSION

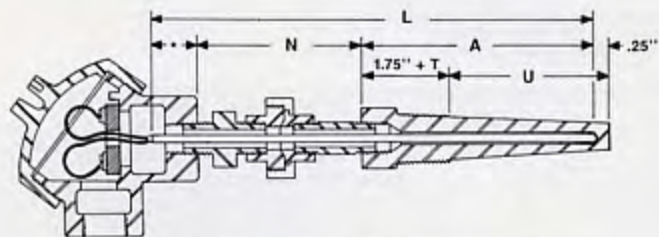


Type 1 Mounting Arrangement

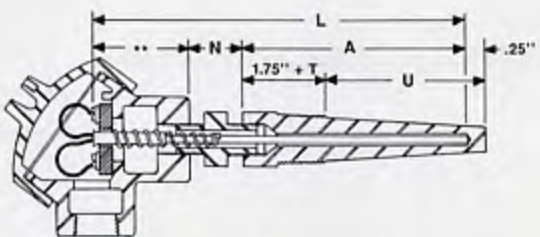


Type 2 Mounting Arrangement

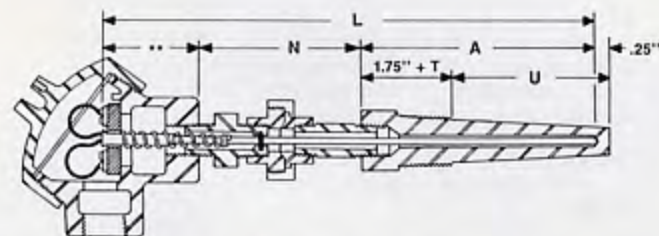
B or B-U-N EXTENSION



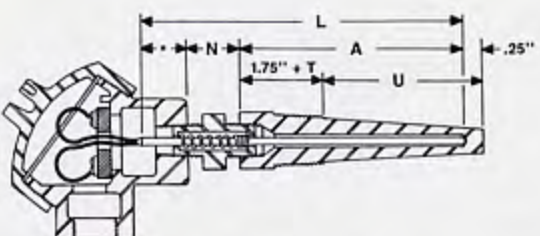
Type 1 Mounting Arrangement



Type 2 Mounting Arrangement



Type 3 Mounting Arrangement



Type 4 Mounting Arrangement

**2.0" for HD Head
1.75" for GP Head

Thread Engagement
.35" for 1/2" NPT

*1.0" for HD Head
0.5" for GP Head

"N" DIMENSION

The "N" dimension is the overall hardware length between the head and the thermowell.

"U" DIMENSION

The "U" dimension is the thermowell insertion length below the thread which is exposed to the process.

"A" DIMENSION

The "A" dimension is the element immersion length into the cavity of the thermowell.

"L" LENGTH

The "L" length is the overall length of the element. For spring loaded assemblies, an extra .25" is added to ensure contact with the bottom of the thermowell.

INDUSTRIAL ASSEMBLIES

TERMINAL HEADS

HEAD	CODE
General Purpose Aluminum	1
General Purpose Cast Iron	2
Heavy Duty Aluminum	3
Heavy Duty Cast Iron	4
Close-coupled Indicating Transmitter	I
Close-Coupled Transmitter (Isolated)	Q
Close-Coupled Transmitter (Isolated), N4x	W



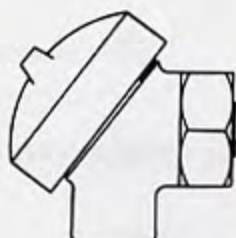
Indicating Transmitter (I)



General Purpose (GP)



Close-Coupled Transmitter (Q)



Heavy Duty (GP)

JUNCTION-CALIBRATION-FORM

CALIB	FORM	GROUNDED JUNCTION	INSULATED JUNCTION	
			SEPARATE	COMMON
J	Single	11	51	-
	Duplex	12	52	55
K	Single	21	61	-
	Duplex	22	62	65
T	Single	31	71	-
	Duplex	32	72	75
E	Single	41	81	-
	Duplex	42	82	85
N	Single	01	91	-
	Duplex	02	92	95
O	Single	24	27	-
	Duplex	25	28	68

NOTES

Separate duplex junctions are insulated from each other as well as from the sheath.

For other J-C-F arrangements (eg: premium grade wire), use 99 and describe.

OPTIONS

CODE	DESCRIPTION
OO	None
CS	CSA Type 1 Electrical Approved (Heads 1, 2, 3 & 4)
TW	Assembled to Thermowell (Ordered separately)
EX	CSA Approved, Explosion-proof rating (Class 1, Group B, C & D)*

*For selected configurations only; contact factory for details.

INDUSTRIAL ASSEMBLIES

ORDERING INFORMATION

A 6-part catalogue number is used to specify a complete **T-PAK®** industrial assembly:
(See pages 12-14 for details.)

2 2 - 2 2 1 1 - 7 2 - 3 5 - 1 2 5 - 0 0

SHEATH (Page 12)

MATERIAL

- 1 - 304 Stainless Steel
- 2 - 316 Stainless Steel
- 3 - Inconel 600

DIAMETER

- 1 - .188" O.D.
- 2 - .250" O.D.

CONFIGURATION (Page 12)

MOUNTING ARRANGEMENT

- 1 - General Purpose (Fixed)
- 2 - Spring-loaded, Captive Terminal Block
- 3 - Spring-loaded, Captive Terminal Block, O-Ring
- 4 - Spring-loaded Bushing (B or BUN extension only)

EXTENSION HARDWARE

- 1 - N Type Hardware
- 2 - NUN Type Hardware
- 3 - B Type Hardware (1/2" only)
- 4 - BUN Type Hardware (1/2" only)

SIZE/MATERIAL

- 1 - 1/2" NPT, Galvanized Fittings
- 2 - 3/4" NPT, Galvanized Fittings
- 3 - 1/2" NPT, Stainless Fittings
- 4 - 3/4" NPT, Stainless Fittings

HEAD

- | | |
|--------------------------------|---------------------------------|
| 1 - General Purpose, Aluminum | I - c/c Indic. Transmitter |
| 2 - General Purpose, Cast Iron | U - c/c Transmitter (Isolated) |
| 3 - Heavy Duty, Aluminum | T - c/c Transmitter (Non-Isol.) |
| 4 - Heavy Duty, Cast Iron | |

J-C-F CODE

Refer to table on page 14.

"N" LENGTH (Page 13)

Specify "N" length to 0.1" (eg: 35 = 3.5")

"A" LENGTH (Page 13)

Specify "A" length to 0.1" (eg: 125 = 12.5")

OPTIONS (Page 14)

- 00 - None
 - TW - Assembled to Thermowell (ordered separately)
 - EX - Explosion-proof Rating (Class 1, Group B, C & D)*
- *For selected configurations only; contact factory for details.

Example: The above catalog number specifies a 316 stainless steel .25" O.D. probe, spring-loaded captive terminal block mounting with NUN hardware, 1/2" NPT galvanized steel fittings, a general purpose aluminum head, and a type T duplex element with insulated junction; "N" length = 3.5" and "A" length = 12.5"; no options.

OPERATING RANGE

TC TYPE	RECOMMENDED MAX TEMP (°C)								
	.063	.125	.188	.250	.313	.375	.500	.625	.750
J	500	600	600	700	700	700	750	750	750
K	900	1000	1000	1100	1100	1100	1200	1200	1200
N	900	1000	1000	1100	1100	1100	1200	1250	1250
T	200	300	300	370	370	370	370	370	370
E	700	700	800	1000	1000	1000	1000	1000	1000

INITIAL CALIBRATION TOLERANCES

TC TYPE	TEMPERATURE RANGE		TOLERANCES*	
	°C	°F	STANDARD	SPECIAL
J	0 to 750°C	32 to 1400°F	±.75% or 2.2°C (4°F)	±.4% or 1.1°C (2°F)
K	0 to 1250°C -200 to 0°C	32 to 2300°F -330 to 32°F	±.75% or 2.2°C (4°F) ±2% or 2.2°C (4°F)	±.4% or 1.1°C (2°F) —
N	0 to 1260°C	32 to 2300°F	±.75% or 2.2°C (4°F)	+ .4% or 1.1°C (2°F)
T	0 to 350°C -200 to 0°C	32 to 700°F -330 to 32°F	±.75% or 1°C (1.8°F) ±1.5% or 1°C (1.8°F)	±.4% or .5°C (.9°F) ±.8% or .5°C (.9°F)
E	0 to 900°C -200 to 0°C	32 to 1600°F -330 to 32°F	±.5% or 1.7°C (3°F) ±1% or 1.7°C (3°F)	±.4% or 1°C (1.8°F) ±1°C

*Percent or fixed error, whichever is greater.

NOTE: Percent limits apply directly to temperatures in °C units, but for °F, equivalents are applied to the number of °F above or below the ice point (+32°F).

(i.e., limit (°F) = (Temp. °F - 32°F) × Percentage)

PRODUCT REFERENCE GUIDES ARE ALSO AVAILABLE FOR:

Resistance Temperature Detectors, Industrial Thermocouples, Thermowells, Protection Tubes



1-800-268-0967
www.thermo-kinetics.com

Mississauga
(905) 670-2266
Fax (905) 670-8530

Montreal
(514) 856-0370
Fax (514) 856-0373

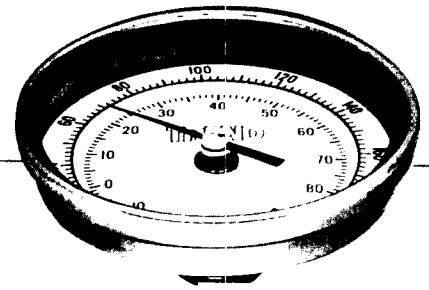
Calgary
(403) 252-2522
Fax (403) 252-2778

Edmonton
(780) 448-1580
Fax (780) 463-5164

Vancouver
(604) 231-0711
Fax (604) 270-3644

3" INDUSTRIAL Thermometer

Bi-Metal Thermometer Model 33



This high quality, low cost thermometer is designed for applications where a weather resistant, tamper proof case is required.

Specifications

Case: One Piece case/bezel design in corrosion resistant 304 stainless steel.

Dial: White matte finish with black markings. Dished form with Celsius on lower plane and Fahrenheit on raised plane. Also available with single scale on anti-parallax dial.

Crystal: Heavy duty clear glass, gasketed and sealed to insure weather tight integrity.

Stem/Connection: Type 304 stainless steel, 1/4 inch/6.35 millimeter diameter with standard lengths to 24 inches/609 millimeter. 1/2 inch NPT connection is standard.

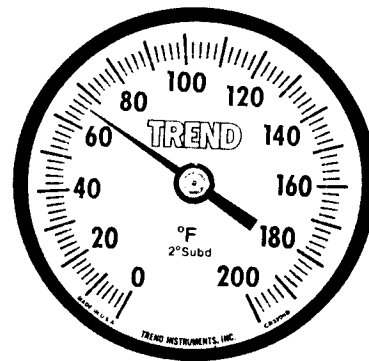
Bi-metal Element: An extremely responsive temperature sensing helix which has been carefully sized and tested, heat treated and aged to relieve inherent stresses and insure continued accuracy.

Accuracy: One percent mid-scale is standard.

Options: Special ranges, dial layouts, accuracies, stems, connections and windows.

How to Order

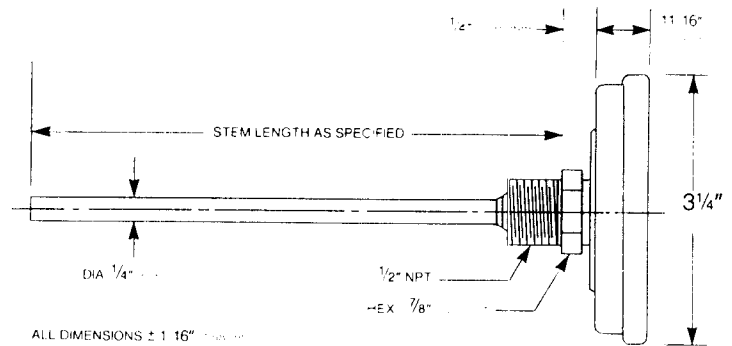
The catalog number indicates dial size, stem length and angle form. For standard stem diameter and connection pipe size, refer to the outline drawing. Please specify the catalog number and range required in your purchase order.



ZIMCO GAUGE & VALVES LTD.

5631 BURBANK ROAD S.E.
CALGARY, ALBERTA
T2H 1Z5

Ph: 253-8320
Fax: 253-9221



ALL DIMENSIONS ± 1/16" UNLESS SHOWN OTHERWISE

Standard Ranges — Dual Scale

Fahrenheit (outer scale)				Celsius (inner scale)			
Range	Fig. Interval	Div.	Range	Fig. Interval	Div.		
-100 to 150°	20°	2°	-70 to 70	10°	1°		
-40 to 120°	20°	2°	-40 to 50°	10°	1°		
**25 to 125°	10°	1°	-5 to 50°	5°	1°		
0 to 140°	10°	1°	-20 to 60°	5°	1°		
0 to 200°	20°	2°	-15 to 90°	10°	1°		
0 to 250°	20°	2°	-20 to 120°	10°	1°		
20 to 240°	20°	2°	-5 to 115°	10°	1°		
50 to 300°	20°	2°	10 to 150°	10°	1°		
50 to 400°	50°	5°	10 to 200°	20°	2°		
50 to 500°	50°	5°	10 to 260°	20°	2°		
150 to 750°	100°	10°	65 to 400°	50°	5°		
*200 to 1000°	100°	10°	*100 to 540°	50°	5°		

*Not recommended for continuous use over 800°F or 425°C

**Not available with 2.5"/63.5mm stem.

Catalog Numbers MODEL 33

Stem Length		MODEL 33
Inches	Millimeters	
2 1/2	63.5	33025
4	101.6	33040
6	152.4	33060
9	228.6	33090
12	304.8	33120
15	381.0	33150
18	457.2	33180
24	609.6	33240



Hardy:
Vibration
Transmitters &
Monitoring

4 Procedure for installing VIBRACON® SM elements

Hardy:
-Shaker Tables

BETEX®:
Induction Heaters

Laser Alignment
Systems

BETEX®:
Hydraulic
Bearing/Hub
Pullers

**Ringfeder®
Couplings:**
-rigid
-torsional soft
-flywheel

**Ringfeder®
Locking
Devices:**
-Internal
-Shring Discs®

Vibracon®:
-Adjustable
Shims

Hardy:
Process weighing
& Force
Measurement

CANSTAR3000:
Condition
Monitoring of
rotating and
reciprocating
machinery:

On line data
collection of
overalls and
spectral data

- Step 1** Check foundation quality
- a) The bottom ring area of the Vibracon® SM element should be covered by the foundation for 100%. The spherical top part of the element must have at least 75% contact with machine foot.
 - b) Foundation roughness should be sandblasted quality of Sa 2.5 minimum or machined Ra 6.3
 - c) The contact surface between foundation and bottom ring of the Vibracon® SM element should be checked using the bottom ring of the element until an evenly distributed bearing surface of a minimum which is given by the machinery manufacturer or classification society. In all other cases we recommend a minimum bearing surface of 75 %.
 - d) The taper between foundation and machine feet should be less then 4°.
 - e) Foundation and machine foot should be clean from paint and grease.

- Step 2** Check if the Vibracon® SM element thread and spherical layers are protected by Molycote® or other grease.

- Step 3** Check if the Vibracon® SM element is placed concentric with the bolt-hole.

- Step 4** Align the machine.
- a) Keep in mind while aligning the machine to add 0,10 mm (0.004") to the target alignment because of the fact that the Vibracon® SM elements will loose height at the moment the foundation bolts are secured. This will happen only the first time the element is used because of the grease inside of the thread.
 - b) Please remember: Vibracon® SM elements are not designed for lifting machinery!
 - c) Height differences after 1 cycle (pitch):

SM12	1 mm (~0.040")
SM16	1.5 mm (~0.060")
SM20 / SM42	2 mm (~0.079")
SM48 / SM64	3 mm (~0.118")

- Step 5** Tighten the foundation bolts. We recommend to do this in two steps.

- Step 6** During or after tightening of the foundation bolts recheck the alignment and check for "soft foot". A "soft foot" occurs if one or more of the Vibracon® SM elements are not carrying the same load as the other elements.

- Step 7** After installing the machinery provide corrosion protection of the element by painting or alternative method.

- Step 8** The bolt tension has to be checked after test run.

Canstar Instruments Inc.
8711A – 50 St NW, #202
Edmonton AB
Canada T6B 1E7

*Would you require additional information or have an questions, please call
Canstar at 780-440-1362, or cell 780-910-1265*

031126

Tel 780-440-1362
Fax 780-440-0373
canstarinstruments.com



TECHNICAL SERVICE MANUAL

SECTION	TSM 340
PAGE	1 OF 12
ISSUE	C

INSTALLATION, START UP, TROUBLESHOOTING, PREVENTIVE MAINTENANCE, DO'S & DON'TS SERIES SG-04, SG-05 & SG-07 SPUR GEAR PUMPS

CONTENTS

Installation	1
Mounting	2
Start Up	3
Troubleshooting	6
Miscellaneous	8
Do's and Don'ts	9
Warranty	10

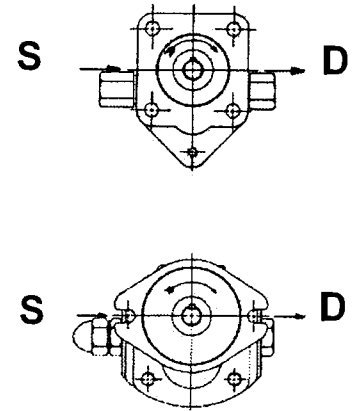


FIGURE 1

INSTALLATION

General

The following items must be considered prior to pump installation:

1. Location - locate the pump as close as possible to the liquid supply. If possible locate the pump below the liquid supply. Viking pumps are self-priming; but the better the suction conditions, the better the pump will perform.
2. Accessibility – the pump must be accessible for inspection, maintenance and repair.
3. Suction/Discharge - SG Series pumps are designed for clockwise rotation as standard (viewed from end of shaft). Refer to Figure 1.
4. Pressure Relief Valve - the SG Series is a positive displacement pump and requires some form of over pressure protection. Without pressure protection, if the discharge line is blocked or becomes closed, pressure will build up until the motor stalls, drive equipment fails, a pump part breaks, or the piping and/or other equipment in the system bursts. To prevent the possibility of any one or more of the above from occurring, the use of a pressure relief valve is recommended.
5. Storage - drain the pump and apply a light coat of non-detergent SAE 30 weight oil to all internal pump parts. Apply grease to the pump shaft extension. Viking suggests rotating the pump shaft by hand one complete revolution every 30 days to circulate the oil.

MOUNTING

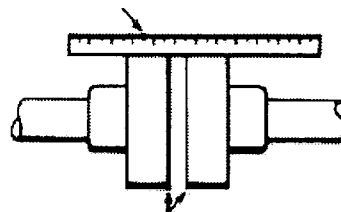
1. Surfaces to which the pump mounts must be clean and flat.
2. Use SAE Grade 5 or better capscrews to mount pump.
3. The 4 mounting capscrews for the SG-04 and SG-05 pumps must have a minimum of ½ inch thread engagement, and must be torqued evenly to 12-15 ft-lbs.
4. The 2 mounting capscrews for the SG-07 pumps must have a minimum of ½ inch thread engagement, and be evenly torqued to 50-55 ft-lbs.
5. Standard SG Series pumps are designed to be used with jaw type couplings that do not induce axial thrust on the pump shaft. If an improper type of coupling is used, internal damage may result.
6. Do not strike or press the pump drive coupling to install. Internal pump damage will result. If the coupling does not slide onto the shaft, inspect the coupling, shaft and key for nicks or burrs and remove.
7. If the pump is to be belt or gear driven, the overhung load option must be specified.
8. Once the pump has been mounted and the coupling installed, it is recommended to put lube oil into the suction port and turn the pump by hand to make sure it turns freely.

Alignment

Check alignment after mounting.

1. If the unit has a flexible coupling, remove any coupling guards or covers and check alignment of coupling halves. A straight edge (piece of key stock will work) across the coupling must rest evenly on both rims at the top, bottom and sides. See Figure 3.
2. Make a final check on alignment after the piping is hooked up.

USE STRAIGHT EDGE. THESE SURFACES MUST BE PARALLEL



CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALIPERS OR FEELER GAUGE TO BE CERTAIN THE FACES ARE EQUAL DISTANCE APART AND PARALLEL.

FIGURE 3

Piping/Hose

The cause of many pumping problems can be traced to the suction piping. It should always be as large in diameter and as short in length as possible.

Before starting the layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections. Piping larger in diameter than the port connection is sometimes required to reduce friction losses.

2. Be sure the inside of the pipe is clean before installing.
3. When approaching an obstacle to the suction line, go around instead of over it. Going over an obstacle can create an air pocket. Where practical, slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
4. A strainer on the suction side of the pump should always be considered in any pumping system. The strainer will keep foreign matter from entering the pump. The strainer mesh or perforation size should be large enough so that it does not cause excessive pressure drop, but fine enough to protect the pump. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale and other foreign objects.
5. A pressure relief valve is required in the discharge line. See Pressure Relief Valves, General page 1 item 4.
6. The pump must not be used to support the piping. Hangers, supports, stands, etc. must carry the weight of the pipes.
7. When fastening piping to the pump do not impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
8. All joints in the piping system must be tight; liquid thread sealant will help assure leak-free threaded joints. Be careful not to over tighten the fittings to the pump, as this can damage the pump. Leaks in the suction line can permit air to be drawn in, and will cause a noisy pump and reduction in capacity.
9. Drive alignment must be checked after piping is hooked up.
10. Provide a pressure relief device in any part of a pump and piping system that can be valved off and, thus, completely isolated. A rise in temperature will cause a liquid to expand. If there is no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

Danger !

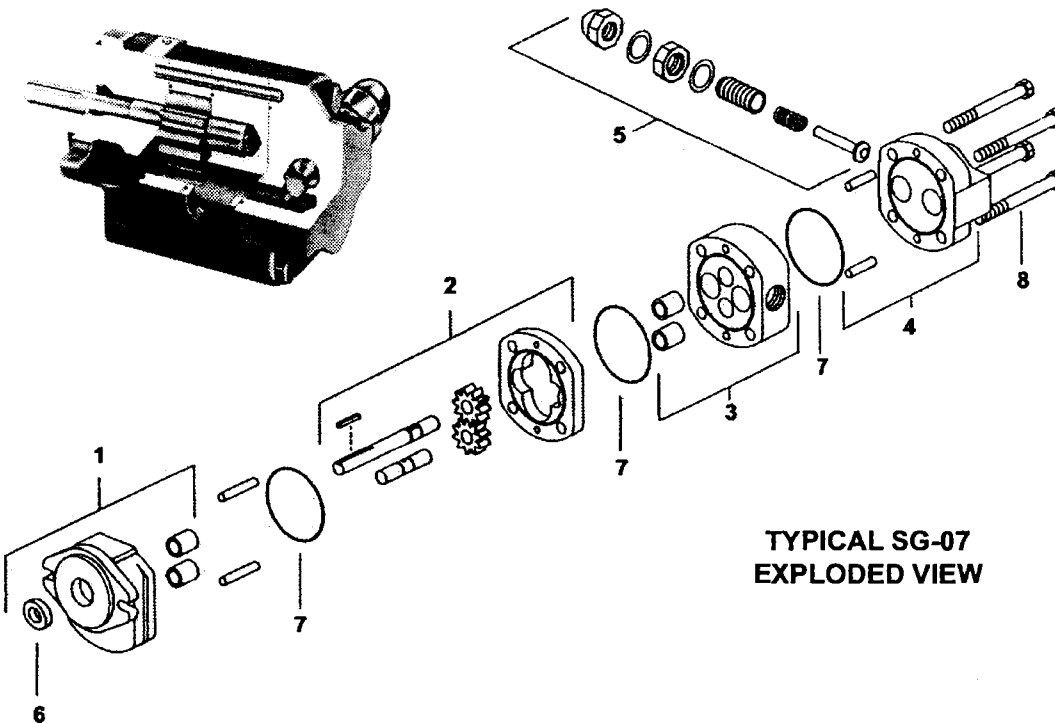
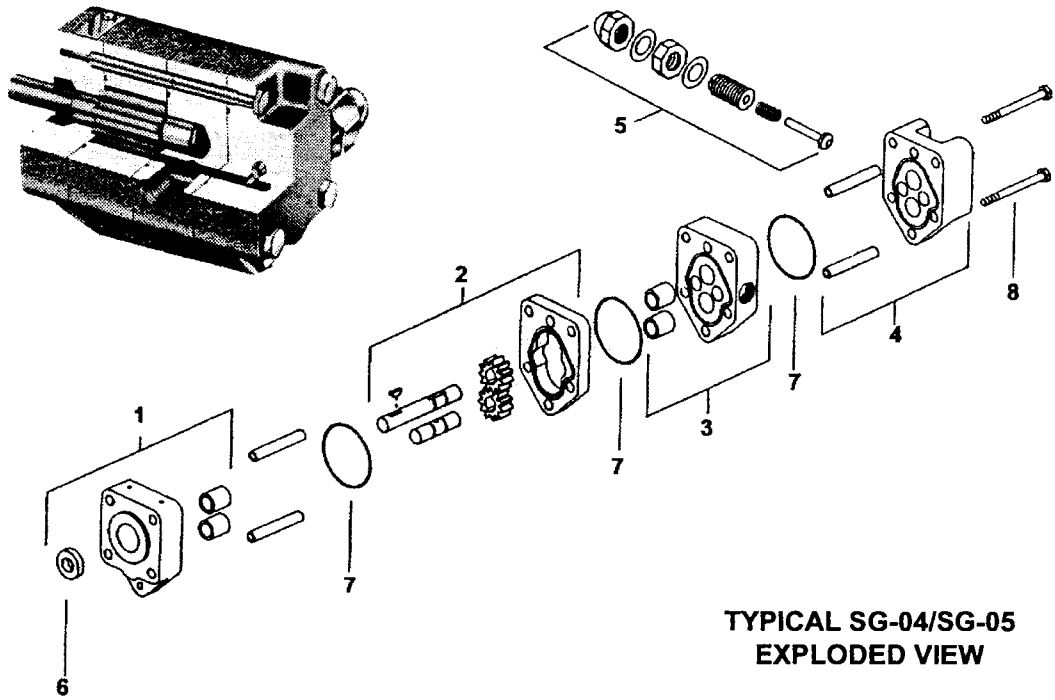
Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

START UP

Before pushing "start" button, check the following:

1. Are vacuum and pressure gauges (liquid filled) mounted on or near the pump? Gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. Is the pump is correctly aligned with the drive equipment?
3. Make sure there is no pipe strain on the pump ports.
4. Rotate the pump shaft by hand to be sure it turns freely.



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	Bracket, lipseal & bearing section	5.	Relief valve kit
2.	Match ground casing & (2) gears, driver & driven shafts	6.	Lipseal
3.	Separation plate & bearing assy.	7.	O-ring
4.	Head and alignment sleeve assy.	8.	Assembly cap screws

5. Before connecting to the motor, jog it to be sure it is running in the correct direction. Refer to "General" on page 1.
6. Is the pressure relief valve installed properly?
7. Make sure suction piping is properly connected and sealed, and valves are open.
8. Make sure the discharge piping is properly connected and sealed, valves are open, and there is a place for the liquid to go.
9. Make sure all guards are in place.
10. The above checklist is a general guideline to be used prior to starting the pump. Since Viking Pump cannot foresee every application for our product and possible system design, the final responsibility is with the user. The pump must be utilized within the catalog specifications and the pump system must be designed to provide safe working conditions.

The "start" button may now be pushed.

The pump should begin to deliver liquid within 15 seconds! If not, push the stop button. Do not run the pump without liquid flow longer than 30 seconds or the pump may be ruined.

Review Startup steps 1 through 10. Consider what the suction and discharge gauges may indicate. If everything appears in order, re-prime pump. Refer to Mounting page 2, item 8.

Push the "start" button. If nothing is flowing within 30 seconds, stop the pump. The pump is not a compressor, it will not build up much air pressure. It may be necessary to vent discharge line until liquid begins to flow.

If pump still does not deliver, consider one or more of the following:

1. The suction line has air leaks.
2. The end of the suction pipe is not submerged deeply enough in the liquid.
3. The suction lift is too great or the suction piping is too small.
4. Liquid is vaporizing in the suction line before it gets to the pump.

If after consideration of these points, the pump still does not deliver liquid, review all points given under START UP and read through the TROUBLESHOOTING guide and try again. If pump still will not deliver liquid, contact your Viking Pump supplier.

TROUBLESHOOTING

A Viking pump that is properly installed and maintained will give long satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to install a vacuum gauge in the suction line and a pressure gauge in the discharge line. Readings on these gauges often give a clue on where to start looking for trouble.

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting etc.) be sure:

- 1. That any pressure in chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.**
- 2. That the driving means (motor, turbine, engine, etc.) has been “locked out” or made non-operational so that it cannot be started while work is being done on the pump.**
- 3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.**

Failure to follow the above listed precautionary measures may result in serious injury or death.

Vacuum Gauge - Suction Port

High vacuum reading would indicate:

1. The suction line is blocked, valve closed, a strainer is plugged or a pinched suction line.
2. The suction line is too small.
3. The liquid is too viscous to flow through the piping.
4. The lift required is too high.

Low reading would indicate:

1. There may be an air leak in the suction line.
2. The end of the pipe is not in the liquid.
3. The pump is worn.
4. The pump is dry and should be primed.

Flutter, jumping or erratic reading would indicate:

1. The liquid is vaporizing.
2. Liquid is coming in to the pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
3. Vibration from cavitation, misalignment, or damaged parts.

Pressure Gauge - Discharge Port

High reading would indicate:

1. High viscosity and small diameter and/or lengthy discharge line.
2. The strainer or filter is plugged.
3. The pressure relief valve is set too high.
4. Valve in the discharge line partially closed.
5. Line may be partially plugged from build up; on the inside of the pump, solidified product or foreign object.
6. Liquid in the pipe is not up to temperature.

Low reading would indicate:

1. Pressure relief valve may be set too low.
2. Pressure relief valve poppet is not seating properly.
3. Pump mounting capscrews not torqued to specifications (SG-04 and SG-05 Series 12-15 ft.-lbs.).
4. Pump assembly bolts not torqued to specifications (SG-07 Series 50-55 ft.-lbs.).
5. The bypass around the pump is partially open.
6. Pump is damaged or worn.
7. The pump has too much internal clearance.

Flutter, jumping or erratic reading would indicate:

1. Cavitation.
2. Liquid is coming to the pump in slugs.
3. Air leak in the suction line.
4. Vibrating from misalignment or mechanical problems.

Miscellaneous

Pump does not pump:

1. The pump has lost its prime from air leak or low level in tank.
2. The suction lift is too high.
3. Rotating in the wrong direction.
4. The motor does not come up to speed.
5. The strainer is clogged.
6. The bypass valve is open, pressure relief valve set too low, or pressure relief valve poppet stuck open.
7. The pump is worn out.
8. Any changes in liquid, system or operation that would help explain the trouble, e.g. new liquid, additional lines or process changes.

Pump starts, then loses its prime:

1. The supply tank is empty.
2. The liquid is vaporizing in the suction line.
3. There is an air leak or air pockets in the suction line.
4. The pump is worn out.

Pump is noisy:

1. The pump is cavitating (liquid vaporizing in suction line) or being starved (heavy liquid cannot get to pump fast enough). Increase the suction pipe size and/or reduce the length, or decrease the pump speed. If the pump is above the liquid, raise the liquid level closer to the center line of the inlet port. If the liquid is above the pump, increase the head of the liquid.
2. Check alignment.
3. Anchor the base or piping to eliminate vibration.

Pump not delivering up to capacity:

1. The pump is starving or cavitating – see **Pump is noisy**, item 1.
2. The strainer partially clogged.
3. Air leak somewhere in the suction line.
4. Running too slow. Is the motor the correct speed and wired up correctly?
5. Pressure relief valve is set too low, stuck open or has damaged poppet seat.
6. The bypass line around the pump partially opened.
7. The pump is worn out.

Pump takes too much power (stalls motor):

1. Liquid is more viscous than the unit is sized to handle.
2. The system pressure relief valve set too high.
3. The pump is misaligned.

DO'S AND DON'TS

Do's and Don'ts for installation, operation and maintenance of Viking pumps to promote safe, long, trouble free operation.

Installation:

1. DO install the pump as close to supply tank as possible.
2. DO leave working space around the pumping unit.
3. DO use large diameter pipe with short and straight runs.
4. DO install a strainer in the suction line.
5. DO a double check of alignment after unit is mounted and piping is hooked up.
6. DO provide pressure relief valve for discharge side of pump.
7. DO check for proper rotation.
9. DO use piping, hose and fittings rated for maximum system pressure.
10. DO check to make sure all guards are in place.

Operation

1. DON'T run the pump at speeds faster than 3600 RPM.
2. DON'T allow the pump to develop pressure higher than those shown in catalog for your pump.
3. DON'T operate pumps at temperatures above or below limits shown in catalog for your pump.
4. DON'T operate unit without all guards in place.
5. DON'T operate pump without a pressure relief valve in discharge piping; be sure the valve is mounted and set correctly.
6. DON'T operate the pump with all the liquid bypassing through the internal pressure relief valve or with out any flow of liquid going through the pump for more than 30 seconds. Operation under either of these conditions may result in heat build up and damage to the pump.
7. DON'T work on the pump unless driver has been "locked out" so it cannot be started while work is being done on the pump.

Maintenance:

1. DO record pump model number and serial number and file for further use.
2. DO have spare parts, pump or stand by units available, particularly if pump is essential part of key operation process.
3. DO obtain, read and keep all maintenance instructions furnished with pump.
4. DO make sure any pump that has residual system pressure in it or that has handled high vapor pressure liquids, has been vented through the suction or discharge lines or other openings provided for this purpose.

5. DO make sure that if the pump is still hooked to the driver while maintenance is being performed that the driver has been "locked out" so that it cannot be inadvertently started while work is being done on the pump.
6. DO make sure any pump that has handled a corrosive, flammable, hot or toxic liquid has been drained, flushed, vented and/or cooled before it is disassembled.

**VIKING
PUMP**

IDEX
IDEX CORPORATION

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of IDEX Corporation or Viking Pump, Inc. is authorized to alter this warranty.

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CONTENTS

Introduction	1
Special Information	1
Health Concerns	2
Installation	2
Start Up	4
Maintenance	4
MD-A coupling: Disassembly & Assembly	6
Pump: Disassembly & Assembly	8
Trouble Shooting	9
Do's and Don'ts	10
Maintenance	11
Warranty	12

This manual deals with Model SG-804, SG-805 & SG-807 pumps mounting on the magnetic drive MD-A4 and MD-A9 couplings. Refer to Figures 1 through 14 for general configuration and nomenclature used in this manual. Pump specifications and recommendations are listed in Catalog Section 680.

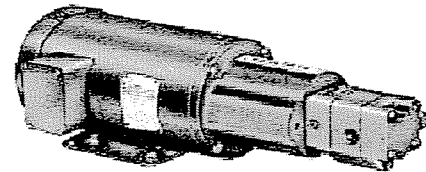


FIGURE 1
SG-80514 MD-A4M
Motor Direct Connected To Footless Bracket & Pump

INTRODUCTION

The illustrations used in this manual are for identification purposes only and cannot be used for ordering parts. Due to the nature of the pump and the close manufacturing tolerances, certain replacement parts are only available in assemblies. Instructions given are for replacing the pump or coupling parts, or entire pumping unit. Always give name of part, model and serial number of the pump when ordering repair parts. The pump model and serial number can be found on the nameplate secured to the pump. In the Viking model number system, the first number "8" indicates a magnetically coupled design. The next two numbers determine the series size and the last two numbers (underlined in TABLE 1) indicate the gear length. SG Series pumps have cast iron construction. SGN pumps feature ductile iron external construction

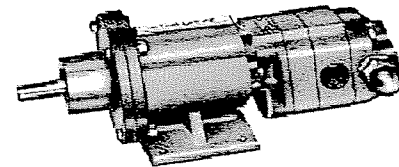


FIGURE 2
SG-80711 MD-A9B & Mounted Pump
(Counterclockwise Rotation Shaft)

TABLE 1 MODEL NUMBER CHART

UNMOUNTED PUMP	ADDITIONAL SIZES
SG-80417 thru SG-80470	18, 25, 35, 50
SG-80518 thru SG-80528 SGN-80518 thru SGN-80528	25, 35, 50, 70 10, 14, 19
SG-80741 thru SG-80732 SGN-80741 thru SGN-80732	58, 82, 11, 16, 22

TABLE 2 UNITS CHART

Units are designated by the uncounted pump model number followed by the magnetic coupling size and letter indicating the drive style provided.
D - Direct Drive
M - Motor Mounted (Close Coupled C-Flange)
B - Bearing Carrier Mounted
R - Viking Reducer Drive
P - Commercial Reducer Drive
(Example: SG-80514-MD-A4 B)

SPECIAL INFORMATION

ROTATION: Viking Mag Drive® pumps are designed to run in a designated direction (indicated on name plate). Shaft rotation determines which port is suction and which is discharge. Running the pump in the opposite direction may seriously affect the performance of the unit and the relief valve (if present) will not operate. If rotation must be reversed, contact your Viking Pump supplier for instructions and parts to change over.

1. A pressure relief valve is mounted as standard on the head of the SG series magnetically coupled pumps.
2. The SG series is a positive displacement pump and requires some form of over pressure protection. Without pressure protection, if the discharge line is blocked or becomes closed, pressure will build up until the motor stalls, drive equipment fails, a pump part breaks, or the piping and/or other equipment in the system bursts. This may be an integral pressure relief valve supplied with the pump, a torque limiting device or a rupture disk.

3. Do not use decoupling of magnets as protection from over pressure. SG Series pumps can develop potentially damaging pressure before the magnets decouple. Decoupling of the magnets may also cause damage to the magnets themselves.
4. The relief valve adjusting screw cap must always point toward suction side of pump.
5. Pressure relief valves cannot be used to control flow or regulate pressure.

For additional information on pressure relief valves. Refer to Technical Service Manual TSM000 and Engineering Service Bulletin ESB-31.

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting etc.) be sure:

1. That any pressure in chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on the pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a Material Safety Data Sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow the above listed precautionary measures may result in serious injury or death.

CAUTION !

Rare earth magnets used in these couplings have extremely strong magnetic fields capable of changing the performance or damaging items such as the following:

- Ø Pacemakers
- Ø Metal implants
- Ø Watches
- Ø Computers and discs
- Ø Credit cards

Completely assembled magnetic couplings will not affect the items listed above.

Altered performance or damage can occur only when the coupling halves are separated.

There are no known harmful effects of these magnetic fields on the human body itself.

INSTALLATION

General

The following items must be considered prior to pump installation:

1. Location - locate the pump as close as possible to supply of liquid being pumped. If possible locate the pump below liquid supply. Viking pumps are self priming; but, the better the suction conditions the better the pump will perform.
2. Accessibility - pump must be accessible for inspection, maintenance and repair.
3. Suction/Discharge - SG Series pumps are designed for clockwise rotation as standard (viewed from end of shaft). Refer to Figure 3 and Figure 4. Always check rotation arrow on nameplate before mounting and start-up.

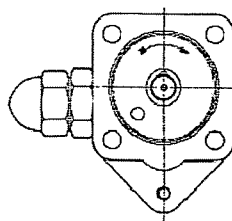


FIGURE 3
Clockwise Rotation Of
Sg-804 & Sg-805
(Viewed From Shaft End)

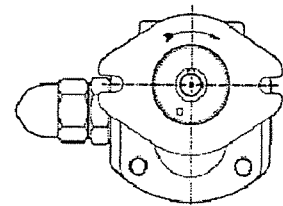


FIGURE 4
Clockwise Rotation Of
Sg-807
(Viewed From Shaft End)

Mounting

When using an M drive configuration, alignment is insured by the coupling bracket. If the unit features a bearing carrier, then a flexible coupling will be required and care should be given to properly align the bearing carrier to the motor. See "Alignment" on this page.

Since the magnetic coupling is integral to the mounting of the pump more specific information is presented under the ASSEMBLY and DISASSEMBLY sections presented elsewhere.

1. Pump mounting surface and canister outer surface must be clean and free of metal particles.
2. Use SAE Grade 5 or better capscrews to mount pump.
3. The 4 mounting capscrews for SG-804 and SG-805 pumps must have a minimum of ½ inch engagement and must be torqued evenly to 12-15 ft.-lbs.
4. The 2 mounting capscrews for the SG-807 pump must have ½ inch minimum thread engagement and should be tightened firmly; torque is not as critical on these pumps (compared to SG-804/5)
5. Do not strike or press the inner magnet coupling half to install on the pump shaft. Damage to the pump or coupling may result if the coupling does not slide onto pump shaft, inspect the coupling bore, shaft and key for nicks or burrs and remove if present.
6. Once the pump has been mounted, place a small amount of compatible liquid into the suction port and turn by hand to ensure the pump turns freely.

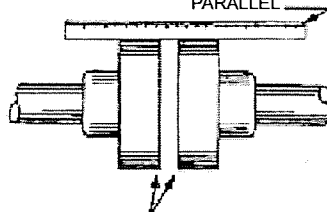
Alignment

Check alignment after mounting on units with a bearing carrier.

1. If the unit has a flexible coupling, remove any coupling guards or covers and check alignment of the coupling halves. A straight edge (piece of key stock will work) across the coupling must rest evenly on both rims at the top, bottom and sides. See Figure 5.
2. Make final check of alignment after the piping is hooked up. Replace the guards.

USE STRAIGHT EDGE. THESE SURFACES MUST BE PARALLEL

COUPLING ALIGNMENT



CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALIPERS TO BE CERTAIN THE FACES ARE EQUAL DISTANCE APART AND PARALLEL

FIGURE 5

Piping/Hose

The cause of many pumping problems can be traced to suction piping. It should always be as large in diameter and as short in length as possible.

Before starting the layout and installation of your piping system, consider the following points:

1. Never use piping smaller than the pump port connections. Piping larger in diameter than the port connection is sometimes required to reduce suction losses.
2. Be sure the inside of the pipe is clean before installing.
3. When approaching an obstacle in the suction line, go around instead of over it. Going over obstacle creates an air pocket. Where practical slope the piping so no air or liquid pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
4. A strainer on the suction side of the pump should always be considered in any pumping system. The strainer will keep foreign matter from entering the pump. The strainer mesh or perforation size should be as fine as possible to protect the pump without causing excessive pressure drop. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale and other foreign objects.
5. A pressure relief valve is required in the discharge line. See Pressure Relief Valves, SPECIAL INFORMATION, page 1.
6. Pump must not be used to support piping. The weight of the pipe must be carried by hangers, supports, stands, etc.
7. When fastening the piping to the pump, it should not be necessary to impose any strain on pump casing. "Springing" or "drawing" piping up to the pump will cause distortion, possible misalignment and probable rapid wear of the pump. Do not use pump to correct errors in piping layout or assembly.
8. All joints of piping system must be tight; pipe dope or Teflon® has excellent lubricity, be careful not over tighten fittings. The pump can be damaged with excessive tightening.
9. Drive alignment must be checked after the piping is hooked up.
10. Provide a pressure relief device if any part of a pump and piping system that can be valved off, thus completely isolated. A rise in temperature will cause liquid to expand. With no provision for pressure relief in the closed off section, there is a chance that the pump or piping will rupture.

START UP

Before pushing the "start" button, check the following:

1. Vacuum and pressure gauges (liquid filled) are mounted on or near the pump. Gauges are the quickest and most accurate way of finding out what is happening in the pump.
2. The pump is correctly aligned.

3. There is no pipe strain on the pump casing.
4. Pump turns freely by hand. If the unit features a bearing carrier then rotate the flexible coupling, but if the unit is motor mounted then carefully try to turn the motor fan blades to turn the pump over.
5. The motor has been jogged and is running in the correct direction. Refer to "General" page 2 item 3.
6. A pressure relief valve is installed properly.
7. The suction piping is connected and tight, and the valves are open.
8. The discharge piping is connected and tight, the valves are open and there is a place for liquid to go.
9. All guards are in place.

The above checklist is a general guideline to be used prior to starting pump. Since Viking Pump cannot foresee every application for our product and possible system design, final responsibility is with the user. The pump must be utilized within the catalog specifications and the pump system must be designed to provide safe working conditions.

DANGER !

Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

Push the "start" button. The pump should begin to deliver liquid within 15 seconds!

If the pump does not deliver liquid, push the stop button. Do not run the pump without liquid flow longer than 30 seconds because the pump or coupling could be damaged or ruined. Review steps just outlined. Consider what the suction and discharge gauges indicate. Since the pump will not develop much pressure when filled with air, it may be necessary to vent the discharge line until liquid begins to flow.

Reprime the pump and push the "start" button again. If the pump still does not deliver liquid, consider one or more of the following:

1. Suction line air leaks.
2. The end of the suction pipe is not submerged deep enough in liquid.
3. Suction lift is too great or suction piping is too long.
4. Liquid is vaporizing in the suction line before it gets to the pump.
5. Magnetic coupling is decoupling for some reason.

If after consideration of these points, the pump still does not deliver liquid, review all points given under START UP and read through the TROUBLESHOOTING guide (page 9) and try again. If pump still will not deliver liquid, contact your Viking Pump supplier.

MAINTENANCE

CLEANING UNIT: Keep the pump, coupling and motor as clean as possible. This will facilitate inspection, adjustment and repair work.

STORAGE: If the pump or coupling are to be stored, drain pump and pour non-detergent SAE 30 weigh oil into pump port. Apply grease to pump or coupling shaft extension, if present or accessible. Viking suggests rotating rotating pump shaft every 30 days to circulate the oil in the pump. The coupling should be stored in a dry area. **Note:** if the liquid to be pumped reacts with oil, use an acceptable alternate.

SUGGESTED REPAIR TOOLS: The following are required to properly repair a SG Series Mag Drive pump. The tools are in addition to standard mechanics tools such as open end wrenches, pliers, screw drivers, etc. Most of the items can be obtained from an industrial supply house.

1. Soft face hammer
2. Allen wrenches
3. Internal snap ring pliers (for bearing carriers only)
2-810-029-047-999
4. External snap ring pliers 2-810-029-375
5. Arbor press
6. Torque wrench

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting etc.) be sure:

1. **That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.**
2. **That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on the pump.**
3. **That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a Material Safety Data Sheet (MSDS) for the liquid to be sure these precautions are understood.**

Failure to follow the above listed precautionary measures may result in serious injury or death.

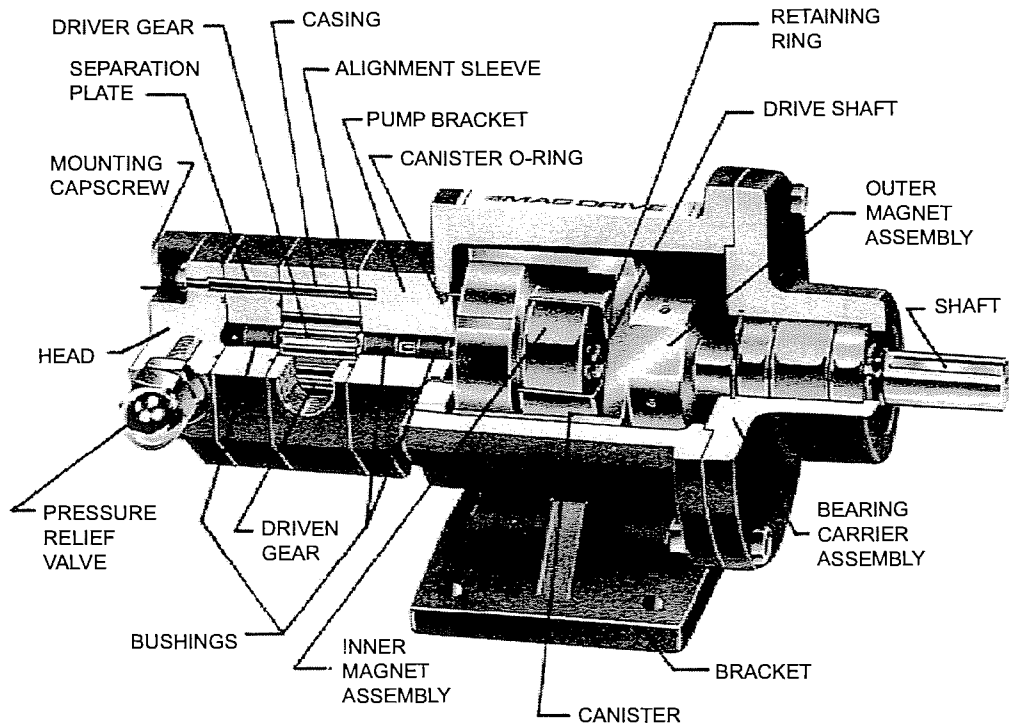


FIGURE 6
Cutaway View Mag-Drive Pump, Model SG-80514 MD-A4B Illustrated

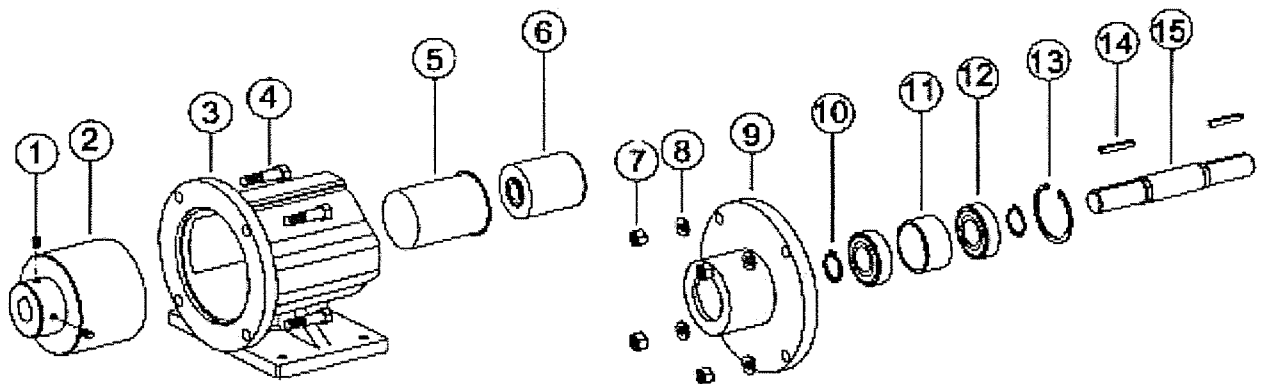


FIGURE 7
Coupling Exploded View

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Setscrews, Outer Magnets - (2 Req'd)	6	Inner Magnet Assembly - (2 Bore Sizes)	11	Bearing Housing
2	Outer Magnet Assembly - (3 Bore Sizes)	7	Hex Nut - (4 Req'd)	12	Ball Bearing (2 Req'd)
3	Bracket, Footed or Footless	8	Lock Washer - (4 Req'd)	13	Retaining Ring, Internal
4	Capscrew for Motor or B.C. (4 Req'd)	9	Bearing Housing	14	Key (2 Req'd)
5	Canister	10	Retaining Ring, External (2 Req'd)	15	Shaft

TABLE 3

DISASSEMBLY MD-A COUPLING

Read all of the instructions before proceeding with disassembly of the coupling and/or pump.

1. Remove piping from the ports and remove the mounting capscrews securing the pump to the bracket (see Figure 8). Support larger pumps with an overhead hoist if possible.

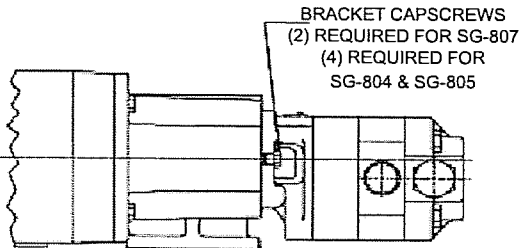


FIGURE 8

2. **CAUTION !** Do not place fingers onto the front of the pump mounting flange or mounting face of bracket (see figure 9). Using extreme caution, pull the inner magnet away from the outer magnet. If you do not completely pull the pump out it will snap back and could pinch a finger or hand. Once inner magnet is removed from bracket be careful where you set it as it will attract all ferrous objects.

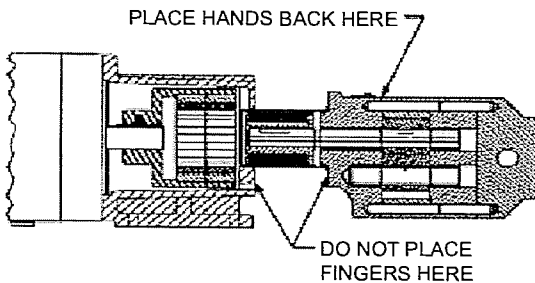


FIGURE 9

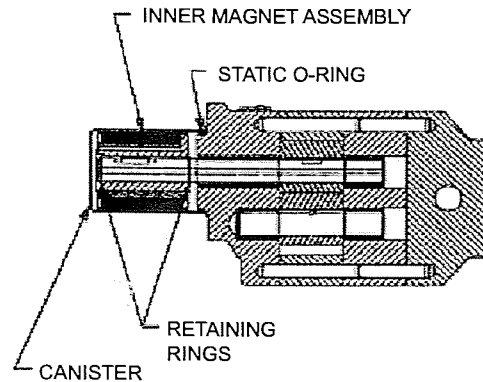


FIGURE 10

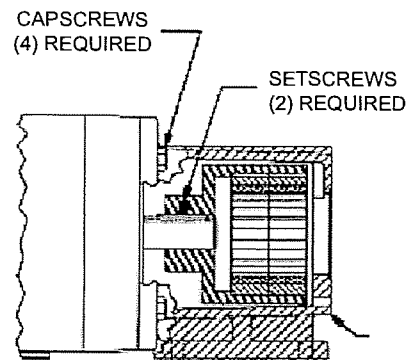


FIGURE 11

3. The canister will probably be full of liquid. Use care while removing from the pump and pull straight off. Remove the external snap ring (closest to end of shaft) and slide off the inner magnet assembly (See figure 10). Do not forget this is a very strong magnet.
4. Do not remove the O-ring unless it is bad, especially if it is Teflon® encapsulated. If a new O-ring is required, follow instructions in the PUMP ASSEMBLY section.
5. You should be able to visually inspect the outer magnets from the end of the bracket. If removal is necessary, start by removing the (4) capscrews and separating the bracket from the motor or bearing carrier (see figure 11). Loosen setscrews in outer magnet assembly to pull assembly off shaft.

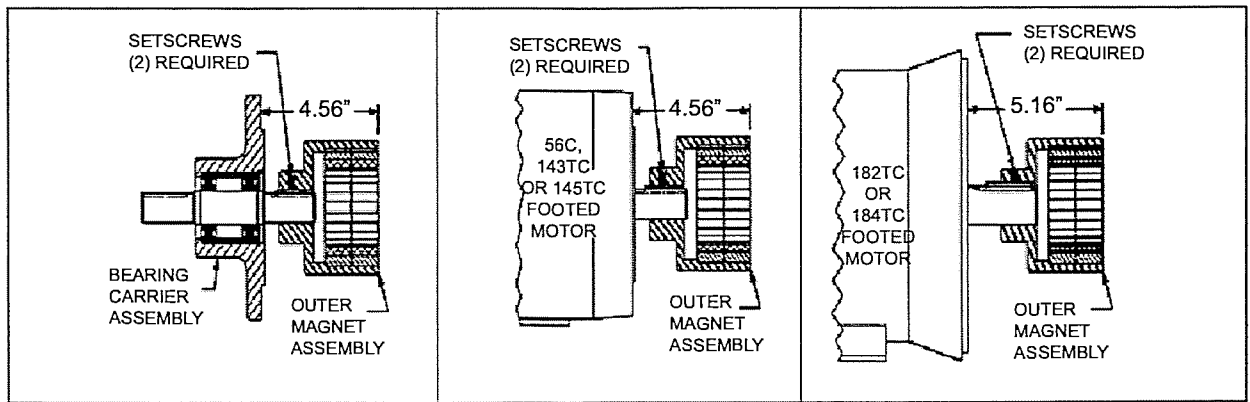


FIGURE 12

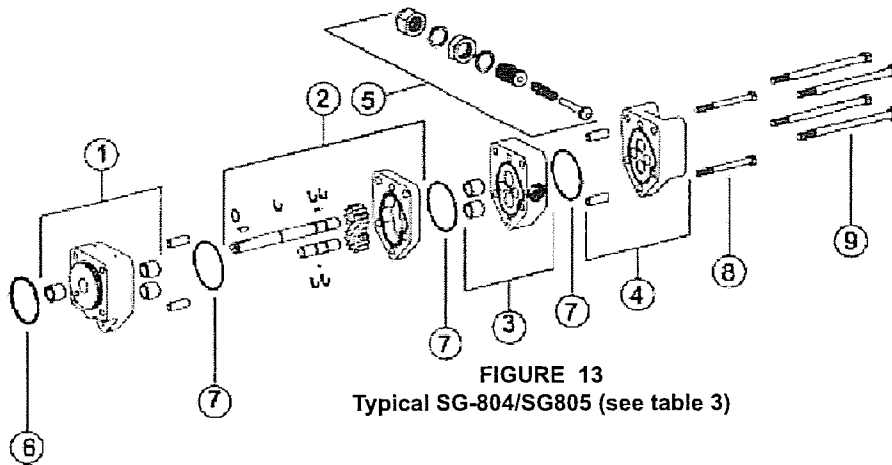


FIGURE 13
Typical SG-804/SG805 (see table 3)

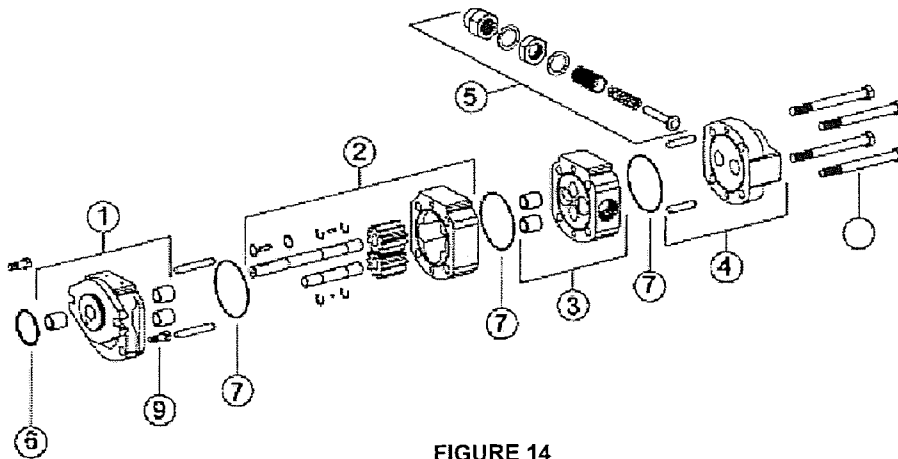


FIGURE 14
Typical SG-807 (See Table 3)

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Bracket and Bearing Assembly	6	O-ring, Bracket
2	Match Ground Casing & Gears, Driver & Driven Shafts with Snap Rings & Drive Pin/ball	7	O-ring. Between Sections
3	Separation Plate & Bearing Assembly	8	Assembly Capscrew
4	Head & Alignment Sleeve Assembly	9	Mounting Capscrew
5	Relief Valve Kit		

TABLE 3

ASSEMBLY MD-A COUPLING

DANGER !

Follow these direction exactly to avoid injury to self or damage to pumping unit. Be careful to keep inner and outer magnets at least (1) foot apart until step 4. Do not engage magnets in any other fashion.

1. Inspect magnets for any metal objects that may be attached. Remove any foreign material. Locate the outer magnet assembly per drawing (See Figure 12 on page 7). Apply Loctite to the set screw threads and tighten both setscrews on to the motor or bearing carrier shaft. The bearing carrier housing features a machined step on its mounting flange, which is the reference point for setting the position of the outer magnet.
2. Mount the bracket to the motor (or bearing carrier to footed bracket) and secure with 4 capscrews (See Figure 11 on page 6). Reach in and rotate magnets by hand to make sure there is no interference. If rubbing occurs, check the dimension. (See Figure 12 on page 7).
3. Slide the inner magnet assembly onto the pump shaft (with key and inner retaining ring in place) and secure with second retaining ring. Rotate the pump shaft and magnet to make sure they turn freely. Inspect for any foreign particles which could damage the pump. Check the bracket O-ring to make sure it is in good condition and installed properly. Place the canister on to the pump and press on until the canister is in contact with the pump bracket (See Figure 10 on page 7).
4. Remove any foreign particles from the outside of the canister, then slide the canister into the coupling bracket (See Figure 9 on page 6).

CAUTION !

Do not place fingers near mounting surface to avoid pinching (see figure 9 on page 6).

5. Finish assembly by securing the pump to the bracket (See Figure 16 for SG-807). For SG-804 and SG-805 pumps, mounting capscrews must be torqued evenly to 12-15 ft.-lbs. (See Figure 8 on page 6). With power disconnected, check to see if the pump turns over freely. This may be done by spinning the motor fan blades or bearing carrier shaft.

PUMP DISASSEMBLY

Before attempting to repair the pump, make sure that all of the details covered in "TROUBLESHOOTING" on page 9 have been checked out because disassembly of a good pump should be avoided. Due to pump construction and close tolerances used in the pump manufacture, repair is seldom economically feasible, unless it is an O-ring or such. Often when some internal part wears such as a bushing, shaft or gear, it will cause excessive wear in other mating parts. In this case more components will be required to rebuild the pump back to original condition than originally expected.

Replacement parts are only available as displayed in the table of parts (Figure 13 & Figure 14). Contact your local distributor to obtain replacement parts. Be sure to supply the pump model number and serial number.

Mark all sections of the pump during disassembly to ensure they will be reassembled in the proper order and orientation. **Note:**The pump must be separated from coupling to disassemble (See "DISASSEMBLY MD-A COUPLING" on page 6).

1. Remove the assembly capscrews (item 8, figure 13 or 14).
2. Remove the key and the second retaining ring from the driver shaft.
3. The pump is now held together only by the alignment sleeves. Hold the head of the pump and gently tap on the sides of the pump bracket with a soft face hammer, alternating sides of the pump. This should slowly separate the sections. Do not hit the sections hard or use a screwdriver to pry them apart as this may damage the mating surfaces.
4. After the pump is apart, inspect all parts for signs of wear. Look carefully at the shaft, bushings, inside of casing, gear teeth, and the flat sections that are located on each side of the casing for sign of wear.
5. Visually inspect the bracket O-ring but do not remove it unless planning to replace, especially if it is an encapsulated O-ring. If the O-ring located between the sections are Teflon® (appear to be white), it is strongly recommended to replace rather than reuse.
6. Remove the acorn nut covering the relief valve adjusting screw. Measure the distance of the relief valve adjusting screw to the pump surface and record its length. Finish disassembling the relief valve and inspect the seat in the head and the poppet for signs of wear or foreign matter on either surface.

PUMP ASSEMBLY

- The pump is ready to be reassembled after all parts have been changed and worn parts replaced.
 - Use a suitable lubricant compatible with the fluid being handled when reassembling the pump.
 - Make sure all holes machined in the bracket are clean and that the mating surfaces of each section are free of any dents or burrs. Make sure the hole in the end of the shaft is unrestricted.
1. Install the bracket O-ring. If it is encapsulated (purple or orange appearance) then follow the special instructions below.

Do not attempt to reuse this type of O-ring if it has been removed. Immerse a new O-ring in boiling water for a few minutes. Remove from water and stretch out in hands so it will fit onto the bracket hub without forcing over a sharp edge. When in place, run hot water over O-ring until it shrinks down tight into the hub O-ring groove. Dry the area with compressed air.

2. Place head down on flat surface with the O-ring groove up and place the O-ring into the groove. Install the alignment sleeves in proper holes by tapping with soft face hammer.
3. Slide the next section onto the alignment sleeves, whether it is a separation plate or a casing and install another O-ring. The pump may require more than one pair of alignment sleeves: add additional pairs when necessary.
4. After the casing is installed, place the driver and driven gears and shaft into the proper positions (refer to Figure 13 & 14) for proper positioning of driver and driver shaft assemblies.
5. After installing the casing, there should be a short length of alignment sleeve projecting out to the line up the bracket. Install the final O-ring between sections; lubricate the gears and shafts, then slide the bracket into place. Turn the pump on its side and insert assembly capscrew and tighten each capscrew until finger tight. Tighten with torque wrench as specified below:

MODEL	BOLT SIZE	QUANTITY	TORQUE SPEC. (FT-LB)
SG-804 SG-805	¼	2	7-9
SG-807	½	4	50-55

6. Reassemble the relief valve, setting the adjusting screw to the previous dimension. Place the gasket onto the adjusting screw holding the adjusting screw while tightening the locknut. Recheck the dimension, install the second gasket on other side of the locknut and install the acorn nut.
7. Install the drive key into the drive shaft keyset and the inner retaining ring into the groove closest to the pump bracket.

TROUBLE SHOOTING

A Viking pump that is properly installed and maintained will give long satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to install a vacuum gauge in the suction line and a pressure gauge in the discharge line. Readings on these gauges often give a clue on where to start looking for trouble.

Vacuum Gauge - Suction Port

High vacuum reading would indicate:

1. Suction line is blocked, a valve is closed, a strainer is plugged or a pinched suction hose.
2. Suction line is too small.
3. Liquid is too viscous to flow through piping.
4. Lift required too high.

Low reading would indicate:

1. Air leak in the suction line.
2. The end of pipe is not in the liquid.
3. The pump is worn.
4. The pump is dry and should be primed.

Flutter, jumping or erratic reading would indicate:

1. The liquid is vaporizing.
2. The liquid is coming to the pump in slugs, possibly an air leak or insufficient liquid above the end of the suction pipe.
3. Vibrating from cavitation, misalignment, or damaged parts.
4. Decoupling of magnetic coupling, possibly due to pressure spikes.

Pressure Gauge - Discharge Port

High reading would indicate:

1. High viscosity and small diameter and/or lengthy discharge line.
2. Strainer or filter plugged.
3. Pressure relief valve set too high.
4. Valve in the discharge line partially closed.
5. Line is partially plugged from build up on inside of pump, solidified product or foreign object.
6. Liquid in pipe not up to temperature.

Low reading would indicate:

1. Pressure relief valve set too low.
2. Pressure relief valve poppet not seating properly.
3. Pump mounting capscrews into torqued to specifications (SG-804 Series 12-15 ft.-lbs).
4. Pump assembly bolts not torqued into specifications (SG-807 Series 50-55 ft.-lbs).

5. Bypass around pump is partially open.
6. Too much extra clearance.
7. Pump damaged or worn.
8. Magnetic coupling is decoupling.

Flutter, jumping or erratic reading would indicate:

1. Cavitation.
2. Liquid is coming to the pump in slugs.
3. An air leak in the suction line.
4. Vibrating from misalignment or mechanical problems.

Pump does not pump:

1. Lost its prime from an air leak or low level in tank.
2. Suction lift is too high.
3. Rotating in the wrong direction.
4. Motor does not come up to speed.
5. Suction and discharge valves are not open.
6. Strainer is clogged.
7. Bypass valve open, pressure relief valve set too low or pressure relief valve poppet is stuck open.
8. Pump is worn out.
9. Any changes in liquid, system or operation that would help explain the trouble, e.g. new liquid, additional lines or process changes.
10. Temperature changes either in the liquid or the environment.
11. Magnetic coupling is decoupling. Change in application (temperature, pressure, viscosity, etc.) may require additional torque beyond coupling capabilities.

Pump starts, then loses its prime:

1. Supply tank is empty.
2. Liquid is vaporizing in the suction line.
3. Air leak or air pockets in the suction line.
4. Pump is worn out.

Pump is noisy:

1. The pump is being starved (heavy liquid cannot get to pump fast enough). Increase the suction pump size or reduce the length. If pump is above the liquid, raise the liquid level to approach the liquid level of the pump. If the liquid level is already above pump, increase the head of liquid.
2. Pump is cavitating (liquid vaporizing in suction line). Increase the suction pipe size or reduce the length. If pump is above liquid, raise the liquid level to approach the level of the pump. If the liquid level is already above pump, increase the head of liquid.
3. Check alignment.
4. Anchor the base or piping to eliminate vibration.

Pump not delivering up to capacity:

1. Starving or cavitating - increase the suction pipe size or reduce the length.
2. Strainer is particularly clogged.
3. An air leak somewhere in the suction line.
4. The pump is running too slow. Is the motor the correct speed and wired up correctly?
5. The pressure relief valve is set too low, stuck open or has a damaged poppet seat.
6. A bypass line around pump partially opened.
7. The pump worn out.

Pump takes too much power (stalls motor):

1. Liquid is more viscous than unit is sized to handle.
2. System pressure relief valve set too high.
3. Coupling is mis-aligned.
4. Bushings froze up or liquid set up in the coupling.

DO'S AND DON'TS

Do's and Don'ts for installation, operation and maintenance of Viking pumps to assure safe, long, trouble free operation.

Installation:

1. DO install pump as close to supply tank as possible.
2. DO leave working space around the pumping unit.
3. DO use large diameter pipe with short and straight runs.
4. DO install a strainer in suction line.
5. DO a double check of alignment after unit is mounted and piping is hooked up.
6. DO provide pressure relief valve for discharge side of pump.
7. DO check for proper rotation as indicated on nameplate.
8. Do use piping, hose and fittings rated for maximum system pressure.
9. Do check to make sure all guards are in place.
10. Do handle magnets with extreme caution remembering they will attract to any ferrous objects.

Operation:

1. DON'T run the pump (or coupling especially) at speeds faster than shown in catalog for that size.
2. DON'T allow the pump to develop pressure higher than those shown in catalog at that size.
3. DON'T expose the pump to coupling or temperatures above or below limits shown in catalog for that design or specific construction.
4. DON'T operate unit without all guards in place.

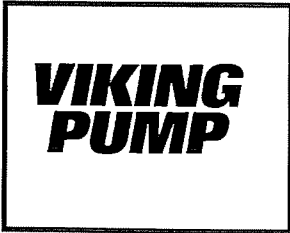
5. DON'T operate pump without a pressure relief valve in discharge piping; be sure the valve is mounted and set correctly.
6. DON'T operate the pump with all the liquid bypassing through the internal pressure relief valve or without any flow of liquid going through the pump for more than 30 seconds. Operation under either of these conditions may result in a heat build up and damage to the pump or coupling.
7. DO have spare parts, pump or complete standby unit available, particularly if the pump is an essential part of a key operation or process.

MAINTENANCE:

1. DO make sure any pump that has residual system pressure in it or that has handled high vapor pressure liquids, has been vented through the suction or discharge lines or other openings provided for this purpose.
2. DO make sure that if the pump is still hooked to driver while maintenance is being performed that the driver has been "locked out" so that it cannot be inadvertently started while work is being done on the pump.
3. DO make sure any pump that has handled a corrosive, flammable, vented and/or cooled before it is disassembled.
4. DO record pump model number and serial number and file for further use.
5. DO obtain, read and keep all maintenance instructions furnished with pump.

Pump Model Number:
Serial Number:
Date Received:
Date Installed:
Distributor:
Comments:

Teflon® - Registered trademark of E.I. Dupont Co.



TECHNICAL SERVICE MANUAL
MAGNETIC DRIVE - CAST IRON & DUCTILE IRON PUMPS
SERIES SG & SGN WITH A4 & A9 STYLE COUPLINGS
SIZES 804, 805 & 807

SECTION	TSM 341.1
PAGE	12
ISSUE	C



WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB. Cedar Falls, Iowa.

Viking assumes no liability for consequential damages of any kind and the purchaser by acceptance of delivery assumes all liability for the consequences of the use or misuse of Viking products by the purchaser, his employees or others. Viking will assume no field expense for service or parts unless authorized by it in advance.

Equipment and accessories purchased by Viking from outside sources which are incorporated into any Viking product are warranted only to the extent of and by the original manufacturer's warranty or guarantee, if any.

THIS IS VIKING'S SOLE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. No officer or employee of IDEX Corporation or Viking Pump, Inc. is authorized to alter this warranty.



SERVICE & OPERATING MANUAL



Model G1F Metallic Design Level 1

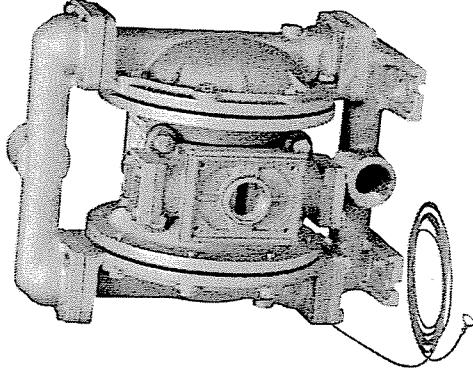
Certified to CSA Requirement 2.01 U.S. for natural gas operated diaphragm pumps.

Table of Contents

Engineering Data and Temperature Limitations	1
Explanation of Pump Nomenclature	2
Performance Curve	3
Dimensions	4
Metric Dimensions	5
Principle of Pump Operation	6
Installation and Start-Up	6
Natural Gas Supply	6
Natural Gas Valve Lubrication	6
Natural Gas Line Moisture	6
Natural Gas Inlet and Priming	6
Between Uses	6
Installation Guide	7
Troubleshooting	8
Warranty	8
Recycling	9
Important Safety Information	9
Material Codes	10



U.S. Patent #
5,996,627; 6,241,487
Other U.S. Patents
Applied for



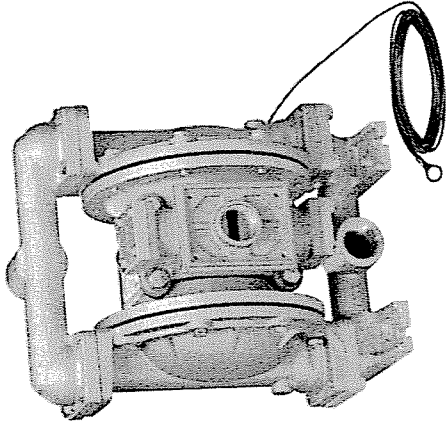
Composite Repair Parts Drawing	12
Available Service and Conversion Kits	12
Composite Repair Parts List	13
Natural Gas Distribution Valve Assembly Drawing and Parts List	14
Natural Gas Distribution Valve Servicing	15
Pilot Valve Servicing, Assembly Drawing & Parts List	16
Diaphragm Service Drawing, with Overlay	17
Diaphragm Service Drawing, Non-Overlay	17
Diaphragm Servicing	18
Overlay Diaphragm Servicing	18
Actuator Plunger Servicing	19
Check Valve Servicing	20
Check Valve Drawing	20
Provision for Piping Gas Exhaust	21
Pumping Hazardous Liquids	21
Piping Exhaust Natural Gas	21
Exhaust Illustration	21
Grounding The Pump	22

**WARREN
RUPP®**

Quality System
ISO9001 Certified

Environmental
Management System
ISO14001 Certified

IBEX
IDEX CORPORATION



II 2GD b T5



U.S. Patent #
5,996,627; 6,241,487
Other U.S. Patents
Applied for



SANDPIPER®
A WARREN RUPP PUMP BRAND

G1F Metallic
Certified to CSA
Requirement 2.01 U.S.
for natural gas operated
diaphragm pumps.

ENGINEERING, PERFORMANCE
& CONSTRUCTION DATA

INTAKE/DISCHARGE PIPE SIZE 1" NPT (Internal) 1" BSP Tapered (Internal)	CAPACITY 0 to 45 gallons per minute (0 to 170 liters per minute)	GAS VALVE No-lube, no-stall design	SOLIDS-HANDLING Up to .25 in. (6mm)	HEADS UP TO 125 psi or 289 ft. of water (8.6 Kg/cm ² or 86 meters)	DISPLACEMENT/STROKE .11 Gallon / .42 liter
CAUTION! Operating temperature limitations are as follows:					
Materials					
Buna N General purpose, oil-resistant. Shows good solvent, oil, water and hydraulic fluid resistance. Should not be used with highly polar solvents like acetone and MEK, ozone, chlorinated hydrocarbons and nitro hydrocarbons.					
Virgin PTFE Chemically inert, virtually impervious. Very few chemicals are known to react chemically with PTFE: molten alkali metals, turbulent liquid or gaseous fluorine and a few fluoro-chemicals such as chlorine trifluoride or oxygen difluoride which readily liberate free fluorine at elevated temperatures.					
			Operating Temperatures		
			Maximum		
			Minimum		
			Maximum		
			Minimum		
			Maximum		
			Minimum		

For specific applications, always consult "Chemical Resistance Chart" Technical Bulletin

These G1F SANDPIPER® models are designed to be powered only by natural gas.

Explanation of Pump Nomenclature

G1F Metallic · Design Level 1 · Ball Valve

MODEL	Pump Brand	Pump Size	Check Valve Type	Design Level	Wetted Material	Diaphragm/Check Valve Materials	Check Valve Seat	Non-Wetted Material Options	Porting Options	Pump Style	Pump Options	Kit Options	Shipping Weight lbs. (kg)
G1FB1ABTXNSX00.	G	1F	B	1	A	B	T	X	N	S	X	00.	28 (13)
G1FB1ATTXNSX00.	G	1F	B	1	A	T	T	X	N	S	X	00.	28 (13)
G1FB1SBTXNSX00.	G	1F	B	1	S	B	T	X	N	S	X	00.	43 (20)
G1FB1STTXNSX00.	G	1F	B	1	S	T	T	X	N	S	X	00.	43 (20)
G1FB1ABTXBSX00.	G	1F	B	1	A	B	T	X	B	S	X	00.	28 (13)
G1FB1ATTXBSX00.	G	1F	B	1	A	T	T	X	B	S	X	00.	28 (13)
G1FB1SBTXBSX00.	G	1F	B	1	S	B	T	X	B	S	X	00.	43 (20)
G1FB1STTXBSX00.	G	1F	B	1	S	T	T	X	B	S	X	00.	43 (20)

Pump Brand
G= Sweet Gas Operated

Pump Size
1F=1"

Check Valve Type
B= Ball

Design Level
1= Design Level

Wetted Material
S= Stainless Steel
A= Aluminum

Diaphragm Check Ball Materials
B= Buna/Buna
T=PTFE -Buna/PTFE

Check Valve Seat
T= Virgin PTFE
A= Aluminum
S= Stainless Steel

Non-Wetted Material Options
X= Unpainted Aluminum

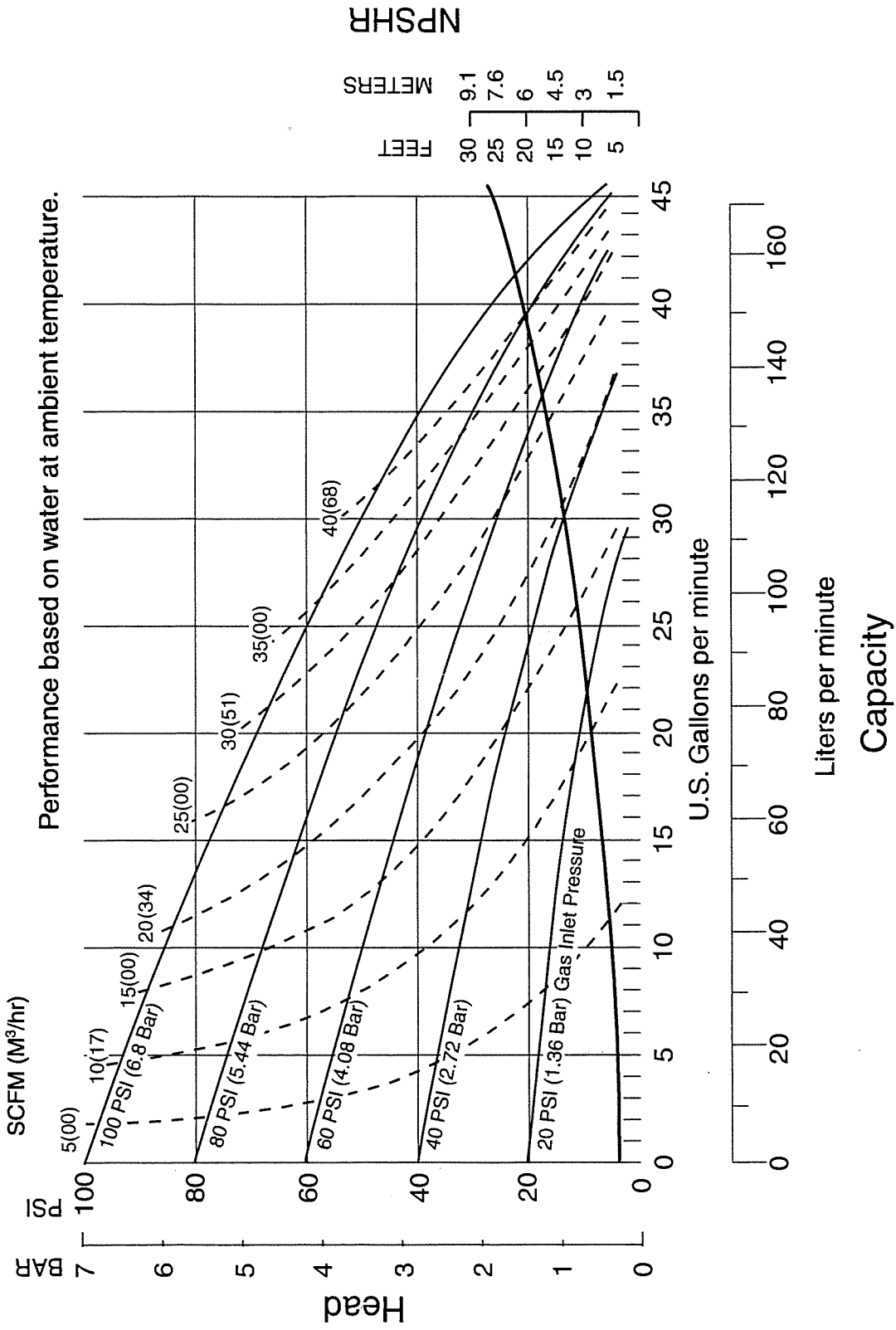
Porting Options
N=NPT Threads
B= BSPT (Tapered) Threads

Pump Style
S= Standard

Pump Options
X= No Muffler

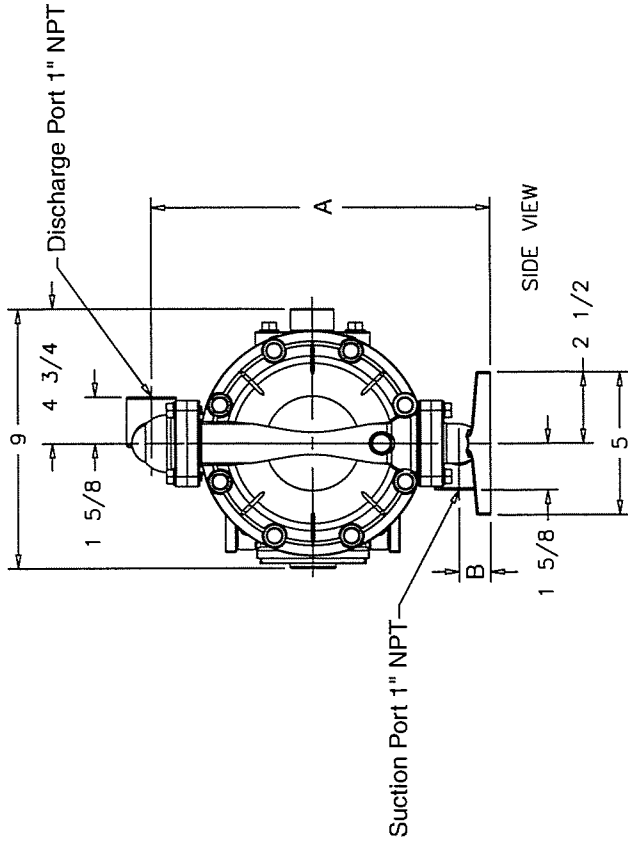
These pump models are designed to pump the following fluids:
Crude Oil, Salt Water, Drilling Mud, Condensate, Lubrication Oils,
Glycol, Caustic liquids, and Acids.

Performance Curve, G1F Model Metallic Design Level 1



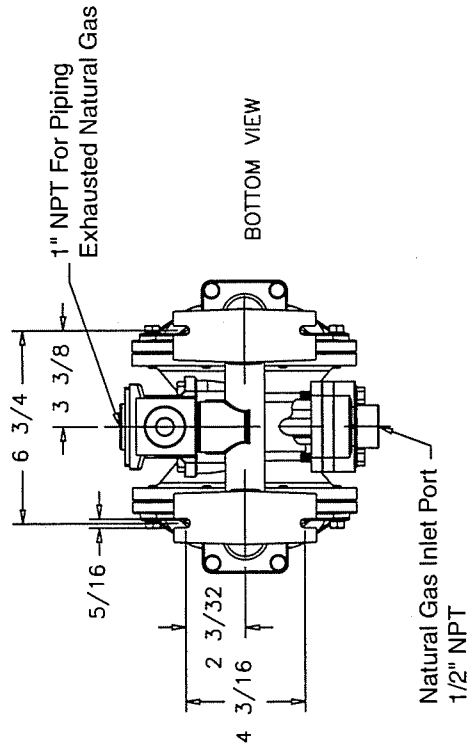
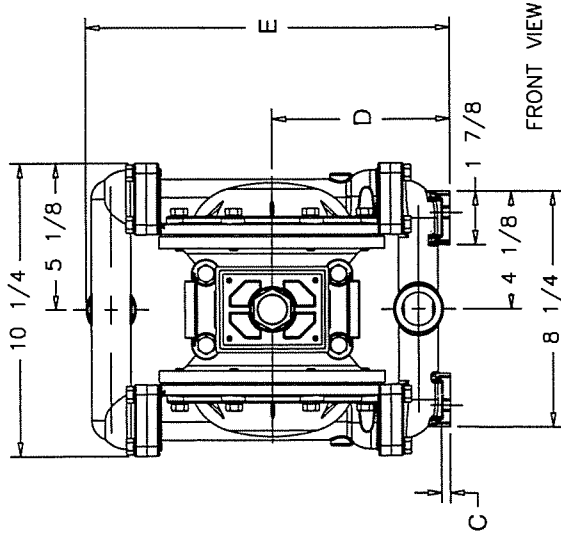
Dimensions: G1F Model Metallic

Dimensions in Inches
Dimensional Tolerance: $\pm 1/8$ "



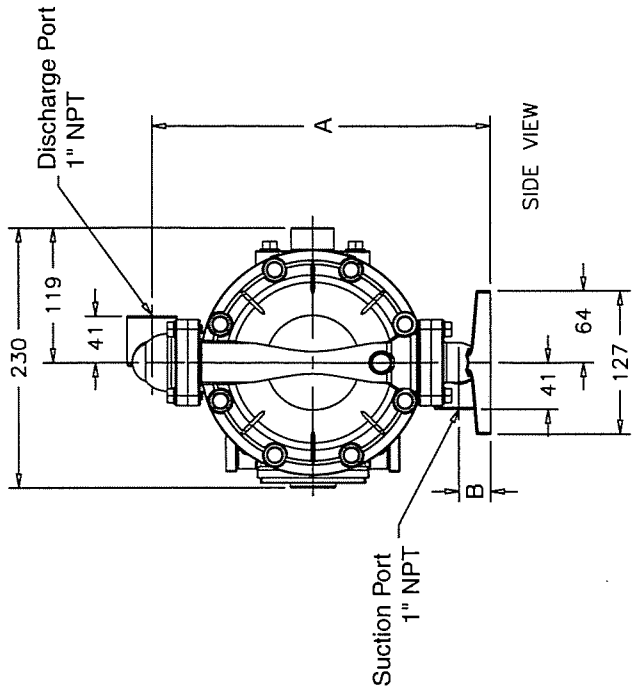
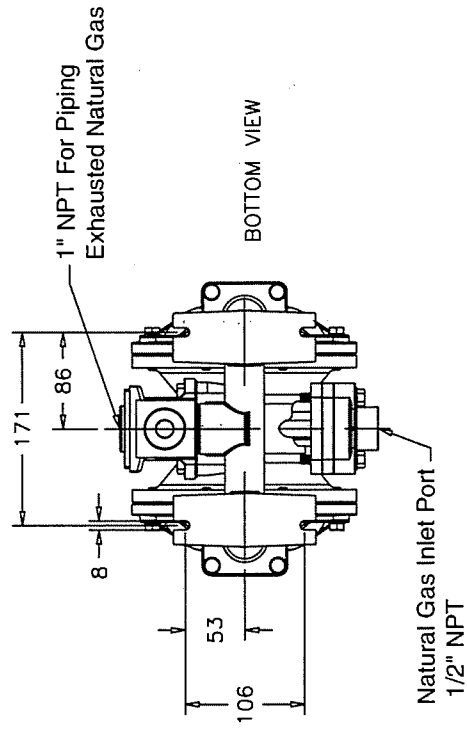
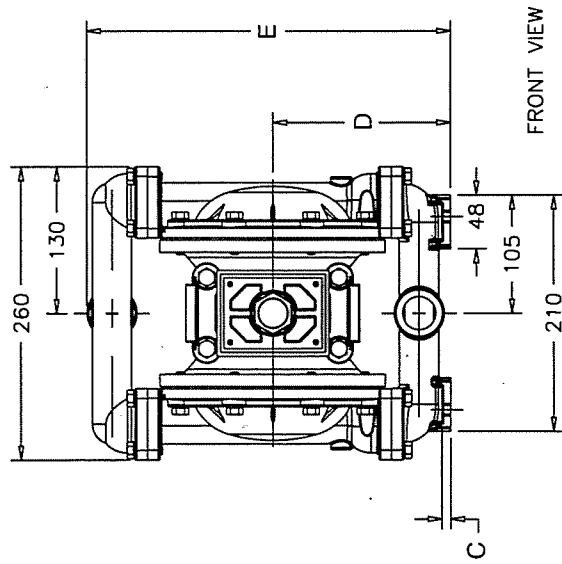
Both Suction and Discharge Ports Are With Available With 1" BSPT Tapered Threads.

Dimension	A	B	C	D	E
Aluminum	11 27/32	1 3/32	5/16	6 7/32	12 23/32
Stainless Steel	11 31/32	1 7/32	7/16	6 11/32	12 27/32



Metric Dimensions: G1F Model Metallic

Dimensions in Millimeters
Dimensional Tolerance: ± 3mm



Both Suction and Discharge Ports
are Available with 1" BSPT
Tapered Threads

Dimension	A	B	C	D	E
Aluminum	301mm	28mm	8mm	158mm	323mm
Stainless Steel	304mm	31mm	11mm	161mm	326mm

PRINCIPLE OF PUMP OPERATION

This ball type check valve pump is powered by sweet natural gas and is a 1:1 ratio design. The inner side of one diaphragm chamber is alternately pressurized while simultaneously exhausting the other inner chamber. This causes the diaphragms, which are connected by a common rod secured by plates to the centers of the diaphragms, to move in a reciprocating action. (As one diaphragm performs the discharge stroke the other diaphragm is pulled to perform the suction stroke in the opposite chamber.) Gas pressure is applied over the entire inner surface of the diaphragm while liquid is discharged from the opposite side of the diaphragm. The diaphragm operates in a balanced condition during the discharge stroke which allows the pump to be operated at discharge heads over 200 feet (61 meters) of water.

For maximum diaphragm life, keep the pump as close to the liquid being pumped as possible. Positive suction head in excess of 10 feet of liquid (3.048 meters) may require a back pressure regulating device to maximize diaphragm life.

Alternate pressurizing and exhausting of the diaphragm chamber is performed by an externally mounted, pilot operated, four way spool type gas distribution valve. When the spool shifts to one end of the valve body, inlet pressure is applied to one diaphragm chamber and the other diaphragm chamber exhausts. When the spool shifts to the opposite end of the valve


body, the pressure to the chambers is reversed. The gas distribution valve spool is moved by an internal pilot valve which alternately pressurizes one end of the valve while exhausting the other end. The pilot valve is shifted at each end of the diaphragm stroke when an actuator plunger is contacted by the diaphragm plate. This actuator plunger then pushes the end of the pilot valve spool into position to activate the gas distribution valve.

The chambers are connected with manifolds with a suction and discharge check valve for each chamber, maintaining flow in one direction through the pump.

INSTALLATION AND START-UP

Locate the pump as close to the product being pumped as possible. Keep the suction line length and number of fittings to a minimum. Do not reduce the suction line diameter.

For installations of rigid piping, short sections of flexible conductive hose should be installed between the pump and the piping. The flexible conductive hose reduces vibration and strain to the pumping system. A surge suppressor is recommended to further reduce pulsation in flow.



WARNING
Natural gas exhaust is to be vented to low pressure safe location using conductive Buna rubber hose or metal piping in accordance with local fire and environmental codes, or an industry or nationally recognized code having jurisdiction over specific installations, and/or CAN/CGA B149, Installation Codes.

NATURAL GAS SUPPLY

Natural gas inlet pressure must be regulated to 100 (7 bar) psi with a pressure regulator. Connect the pump gas inlet to an gas supply of sufficient capacity and pressure required for desired performance. When the gas supply line is solid piping, use a short length of flexible conductive hose not less than 3/4" (19mm) in diameter between the pump and the piping to reduce strain to the piping. The weight of the gas supply line, regulators and filters must be supported by some means other than the gas inlet cap. Failure to provide support for the piping may result in damage to the pump. A pressure regulating valve should be installed to insure gas supply pressure does not exceed recommended limits.

VALVE LUBRICATION

The natural gas distribution valve and the pilot valve are designed to operate WITHOUT lubrication. This is the preferred mode of operation. There may be instances of personal preference or poor quality gas supplies when lubrication of the supply is required. The pump system will operate with properly lubricated supply. Proper lubrication requires the use of an gas line lubricator (available from Warren Rupp) set to deliver one drop of SAE 10 non-detergent oil for every 20 SCFM (9.4 liters/sec.) of gas the pump consumes at the point of operation. Consult the pump's published Performance Curve to determine this.

GAS INLET AND PRIMING

To start the pump, open the gas valve approximately 1/2" to 3/4" turn. After the pump primes, the valve can be opened to increase gas flow as desired. If opening the valve increases cycling rate, but does not increase the rate of flow, cavitation has occurred. The valve should be closed slightly to obtain the most efficient gas flow to pump flow ratio.


BETWEEN USES

When the pump is used for materials that tend to settle out or solidify when not in motion, the pump should be flushed after each use to prevent damage. (Product remaining in the pump between uses could dry out or settle out. This could cause problems with the diaphragms and check valves at restart.) In freezing temperatures the pump must be completely drained between uses in all cases.

WARREN RUPP®


INSTALLATION GUIDE

Top Discharge Ball Valve Pump



WARNING

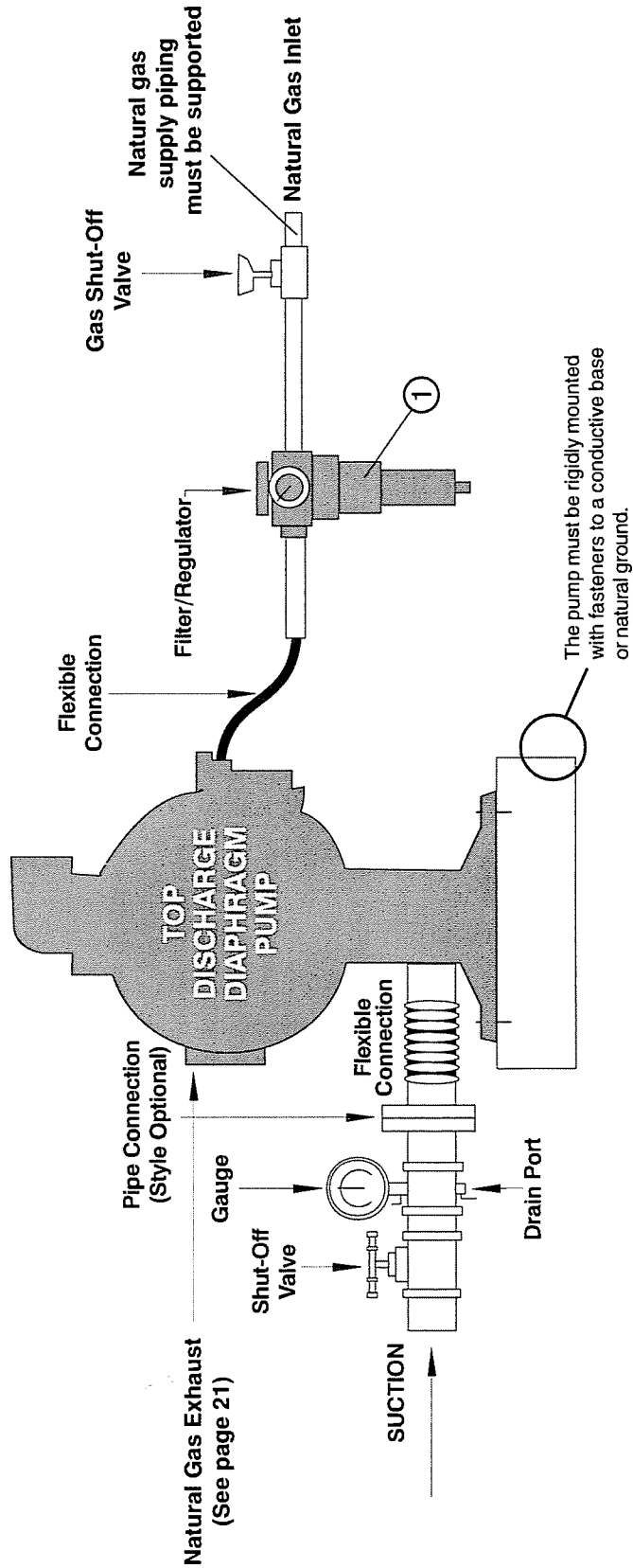
To maintain conductivity, do not paint the pump, or if painted, use a conductive paint or coating.



CAUTION

The natural gas exhaust must be piped to an area for safe disposition of the product being pumped, in the event of a diaphragm failure. (See page 21)

① Filter/Regulator



TROUBLESHOOTING

Possible Symptoms:

- Pump will not cycle.
- Pump cycles, but produces no flow.
- Pump cycles, but flow rate is unsatisfactory.
- Pump cycle seems unbalanced.
- Pump cycle seems to produce excessive vibration.

What to Check: Excessive suction lift in system.

Corrective Action: For lifts exceeding 20 feet (6 meters), filling the pumping chambers with liquid will prime the pump in most cases.

What to Check: Excessive flooded suction in system.

Corrective Action: For flooded conditions exceeding 10 feet (3 meters) of liquid, install a back pressure device.

What to Check: System head exceeds natural gas supply pressure.

Corrective Action: Increase the inlet gas pressure to the pump. Most diaphragm pumps are designed for 1:1 pressure ratio at zero flow.

What to Check: Natural gas supply pressure or volume exceeds system head.

Corrective Action: Decrease inlet gas pressure and volume to the pump as calculated on the published PERFORMANCE CURVE. Pump is cavitating the fluid by fast cycling.

What to Check: Undersized suction line.
Corrective Action: Meet or exceed pump connection recommendations shown on the DIMENSIONAL DRAWING.

What to Check: Restricted or undersized gas line.

Corrective Action: Install a larger gas line and connection. Refer to gas inlet recommendations shown in your pump's SERVICE MANUAL.

What to Check: Check the externally serviceable gas distribution system of the pump.

Corrective Action: Disassemble and inspect the natural gas distribution valve, pilot valve and pilot valve actuators. Refer to the parts drawing and valve section of the SERVICE MANUAL. Check for clogged discharge or closed valve before reassembly.

What to Check: Pumped fluid in gas exhaust line.

Corrective Action: Disassemble pump chambers. Inspect for diaphragm rupture or loose diaphragm plate assembly. Refer to the Diaphragm Replacement section of your pump SERVICE MANUAL.

What to Check: Fluid suction side air leakage or air in product.

Corrective Action: Visually inspect all suction side gaskets and pipe connections.

What to Check: Obstructed check valve.

Corrective Action: Disassemble the wet end of the pump and manually dislodge obstruction in the check valve pocket. Refer to the Check Valve section of the pump SERVICE MANUAL for disassembly instructions.

What to Check: Worn or misaligned check valve or check valve seat.

Corrective Action: Inspect check valves and seats for wear and proper seating. Replace if necessary. Refer to Check Valve section of the pump SERVICE MANUAL for disassembly instructions.

What to Check: Blocked suction line.

Corrective Action: Remove or flush obstruction. Check and clear all suction screens and strainers.

What to Check: Blocked discharge line.

Corrective Action: Check for obstruction or closed discharge line valves.

What to Check: Blocked pumping chamber.

Corrective Action: Disassemble and inspect the wetted chambers of the pump. Remove or flush any obstructions. Refer to the pump SERVICE MANUAL for disassembly instructions.

What to Check: Entrained air or vapor lock in one or both fluid pumping chambers.

Corrective Action: Purge chambers through tapped chamber vent plugs. PURGING THE CHAMBERS OF AIR CAN BE DANGEROUS! Contact the Warren Rupp Technical Services Group before performing this procedure. Any model with top-ported discharge will reduce or eliminate problems with entrained air.


If your pump continues to perform below your expectations, contact your local Warren Rupp Distributor or factory Technical Services Group for a service evaluation.

WARRANTY


Refer to the enclosed Warren Rupp Warranty Certificate.

RECYCLING

Many components of Natural Gas Operated SANDPIPER® Metallic pumps are made of recyclable materials (see chart on page 10 for material specifications). We encourage pump users to recycle worn out parts and pumps whenever possible, after any hazardous pumped fluids are thoroughly flushed.




⚠ WARNING
Do not smoke near the pump or use the pump near an open flame. Fire or explosion could result.




⚠ WARNING
This pump must not be used for fluid transfer into aircraft.


IMPORTANT SAFETY INFORMATION




⚠ IMPORTANT
Read these safety warnings and instructions in this manual completely, before installation and start-up of the pump. It is the responsibility of the purchaser to retain this manual for reference. Failure to comply with the recommendations stated in this manual will damage the pump, and void factory warranty.




⚠ WARNING
Take action to prevent static sparking. Fire or explosion can result, especially when handling flammable liquids. The pump, piping, valves, containers or other miscellaneous equipment must be grounded.



⚠ WARNING
This pump is pressurized internally with natural gas pressure during operation. Always make certain that all bolting is in good condition and that all of the correct bolting is reinstalled during assembly.



⚠ CAUTION
Before pump operation, inspect all gasketed fasteners for looseness caused by gasket creep. Re-torque loose fasteners to prevent leakage. Follow recommended torques stated in this manual.




⚠ WARNING
When used for toxic or aggressive fluids, the pump should always be flushed clean prior to disassembly.




⚠ WARNING
Before maintenance or repair, shut off the compressed natural gas line, bleed the pressure, and disconnect the gas line from the pump. The discharge line may be pressurized and must be bled of its pressure.



⚠ WARNING
Before doing any maintenance on the pump, be certain all pressure is completely vented from the pump, suction, discharge, piping, and all other openings and connections. Be certain the natural gas supply is locked out or made non-operational, so that it cannot be started while work is being done on the pump. Be certain that approved eye protection and protective clothing are worn all times in the vicinity of the pump. Failure to follow these recommendations may result in serious injury or death.



⚠ WARNING
In the event of diaphragm rupture, pumped material may enter the natural gas end of the pump, and be discharged into the atmosphere. The gas exhaust must be piped to an appropriate area for safe disposition.



⚠ WARNING
Airborne particles and loud noise hazards. Wear ear and eye protection.

Pump complies with EN809 Pumping Directive, Directive 98/37/EC Safety of Machinery, and Directive 94/9/EC Equipment for use in Potentially Explosive Environments. For reference to the directive certificates visit: www.warrenrupp.com. The technical file is stored at KEMA, notified body 0344, under document #203040000.



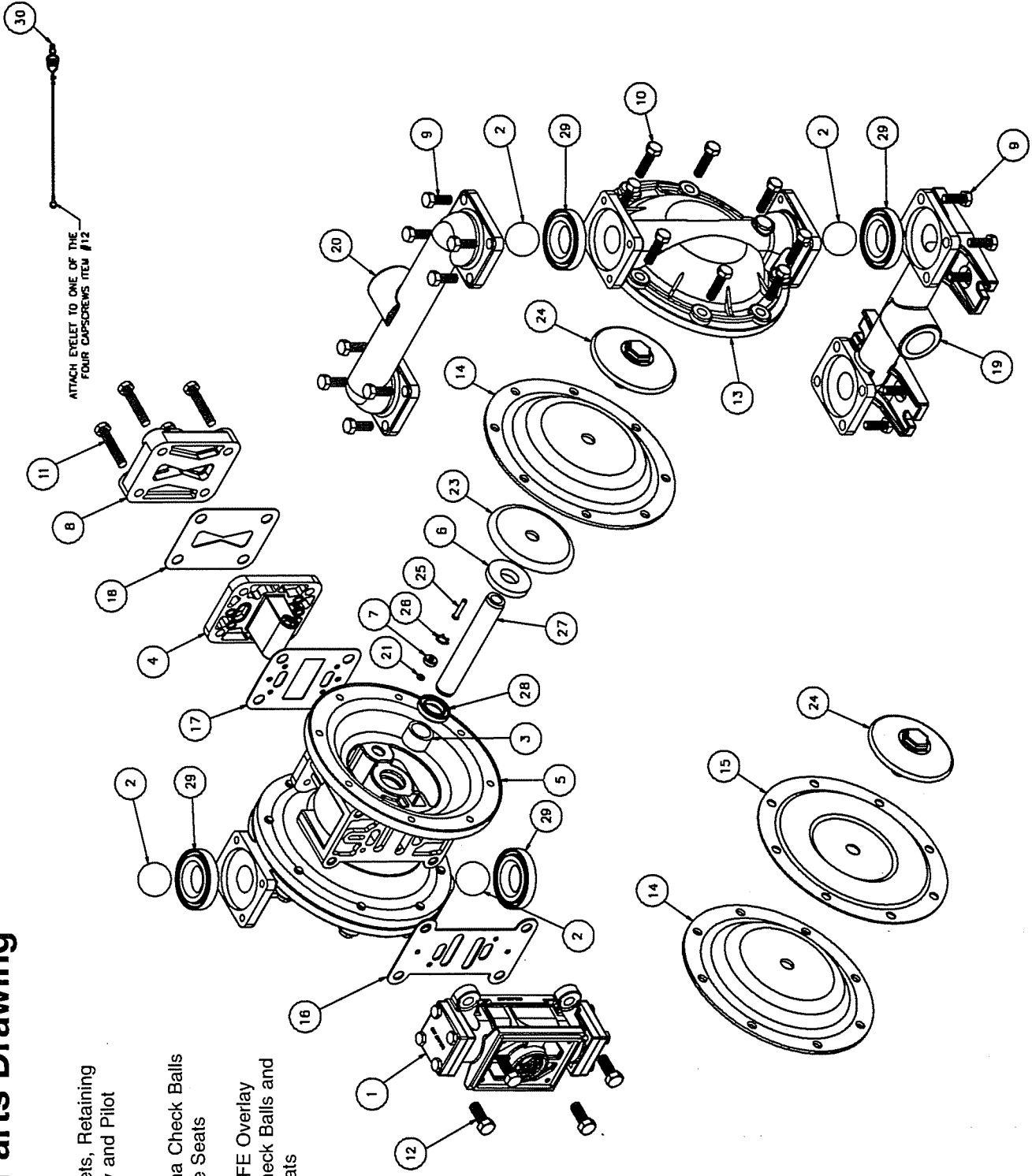
II 2GD b T5



Composite Repair Parts Drawing

Available Service Kits:

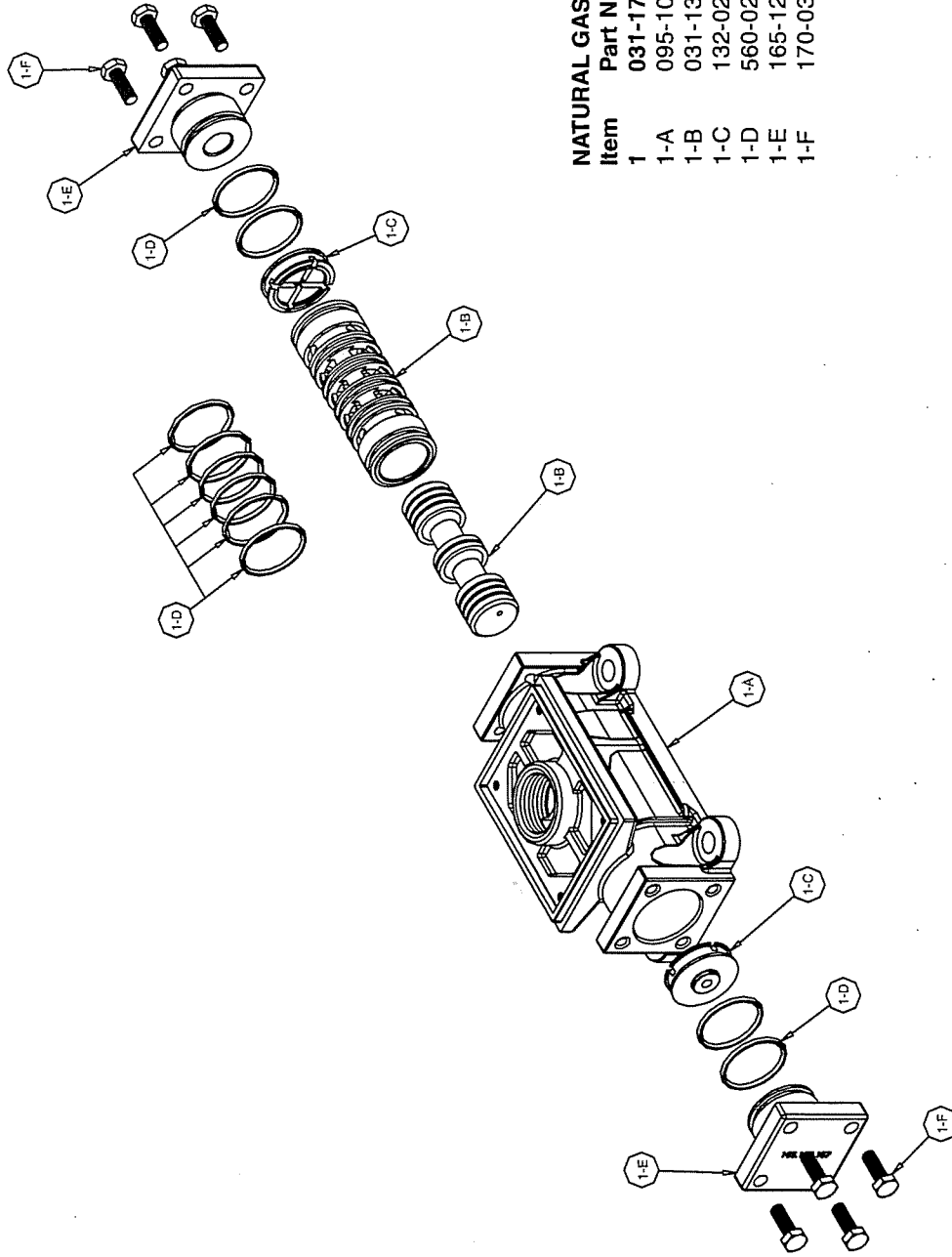
- 476-230-000 **Gas End Kit**
Seals, O-Rings, Gaskets, Retaining Rings, Valve Assembly and Pilot Valve Assembly
- 476-204-360 **Wetted End Kit**
Buna Diaphragms, Buna Check Balls and PTFE Check Valve Seats
- 476-204-649 **Wetted End Kit**
Buna Diaphragms, PTFE Overlay Diaphragms, PTFE Check Balls and PTFE Check Valve Seats



Composite Repair Parts List

ITEM	PART NUMBER	DESCRIPTION	QTY	ITEM	PART NUMBER	DESCRIPTION	QTY
1	031-178-000	Gas Valve Assembly	1	19	518-175-156	Manifold, Suction	1
2	050-028-360	Ball, Check	4		518-175-156E	Manifold, Suction 1-1/2" BSPT (Tapered)	1
	050-028-600	Ball, Check	4		518-175-110	Manifold, Suction	1
3	070-012-170	Bushing	2		518-175-110E	Manifold, Suction 1-1/2" BSPT (Tapered)	1
4	095-110-000	Pilot Valve Assembly	1	20	518-176-156	Manifold, Discharge	1
5	114-025-157	Intermediate Bracket	1		518-176-156E	Manifold, Discharge 1-1/2" BSPT (Tapered)	1
6	132-019-360	Bumper, Diaphragm	2		518-176-110	Manifold, Discharge	1
7	135-036-506	Bushing, Plunger	2		518-176-110E	Manifold, Discharge 1-1/2" BSPT	1
8	165-120-000	Cap, Gas Inlet Assembly	1	21	560-001-379	O-Ring	2
9	170-005-330	Capscrew, Hex Hd 5/16-18 X .88	16	23	612-022-330	Plate, Inner Diaphragm	2
10	170-045-330	Capscrew, Hex Hd 5/16-18 X 1.25	16	24	612-108-157	Plate, Outer Diaphragm Assembly	2
11	170-069-330	Capscrew, Hex Hd 5/16-18 X 1.75	4		612-101-110	Plate, Outer Diaphragm Assembly	2
12	170-006-330	Capscrew, Hex 3/8-16 X 1.00	4	25	620-022-115	Pin, Actuator	2
13	196-173-157	Chamber, Outer	4	26	675-042-115	Ring, Retaining	2
	196-173-110	Chamber, Outer	2	27	685-060-110	Rod, Diaphragm	1
14	286-008-360	Diaphragm	2	28	720-010-375	Seal, U-Cup	2
15	286-015-604	Diaphragm, Overlay	2	29	722-098-600	Seat, Check Valve	4
16	360-093-360	Gasket, Natural Gas Valve	2		722-098-150	Seat, Check Valve	4
17	360-103-360	Gasket, Pilot Valve	1	30	722-098-150	Seat, Check Valve	4
18	360-104-379	Gasket, Gas Inlet	1		920-025-000	Ground Strap	1
				31	560-091-360	O-ring (metallic seats only)	8
					560-091-611	O-ring (metallic seats only)	8

Natural Gas Valve Assembly Drawing, Parts List



NATURAL GAS ASSEMBLY PARTS LIST

Item	Part Number	Description	Qty
1	031-178-000	Gas Valve Assembly	1
1-A	095-109-157	Valve Body	1
1-B	031-139-000	Sleeve and Spool Set	1
1-C	132-029-357	Bumper	2
1-D	560-020-379	O-Ring	10
1-E	165-127-157	Cap, End	2
1-F	170-032-330	Capscrew	8

NATURAL GAS DISTRIBUTION VALVE SERVICING

To service the natural gas valve first shut off the compressed air, bleed pressure from the pump, and disconnect the gas supply line from the pump.

Step #1: See COMPOSITE REPAIR PARTS DRAWING.

Using a 9/16" wrench or socket, remove the four hex capscrews (items 12). Remove the air valve assembly from the pump.

Remove and inspect gasket (item 16) for cracks or damage. Replace gasket if needed.

Step #2: Disassembly of the natural gas valve.

Using a 7/16" wrench or socket, remove the eight hex capscrews (items 1-F) that fasten the end caps to the valve body. Next remove the two end caps (items 1-E). Inspect the two o-rings (items 1-D) on each end cap for damage or wear. Replace the o-rings as needed.

Remove the bumpers (items 1-C). Inspect the bumpers for damage or wear. Replace the bumpers as needed.

Remove the spool (part of item 1-B) from the sleeve. Be careful not to scratch or damage the outer diameter of the spool. Wipe spool with a soft cloth and

inspect for scratches or wear.

Inspect the inner diameter of the sleeve (part of item 1-B) for dirt, scratches, or other contaminants. Remove the sleeve if needed and replace with a new sleeve and spool set (item 1-A).

Step #3: Reassembly of the natural gas valve.

Install one bumper (item 1-C) and one end cap (item 1-E), with two o-rings (items 1-D), and fasten with four hex capscrews (items 1-F) to the valve body (item 1-A).

Remove the new sleeve and spool set (item 1-B) from the plastic bag. Carefully remove the spool from the sleeve. Install the six o-rings (item 1-D) into the six grooves on the sleeve. Apply a light coating of grease to the o-rings before installing the sleeve into the valve body (item 1-A), align the slots in the sleeve with the slots in the valve body. Insert the spool into the sleeve. Be careful not to scratch or damage the spool during installation. Install the remaining bumper and end cap (with o-rings), and fasten with the remaining hex capscrews.

Fasten the natural gas valve assembly (item 1) and gasket to the pump. Connect the compressed gas line to the pump. The pump is now ready for operation.

IMPORTANT



Read these instructions completely, before installation and start-up. It is the responsibility of the purchaser to retain this manual for reference. Failure to comply with the recommendations stated in this manual will damage the pump, and void factory warranty.

Pilot Valve Servicing, Assembly Drawing & Parts List

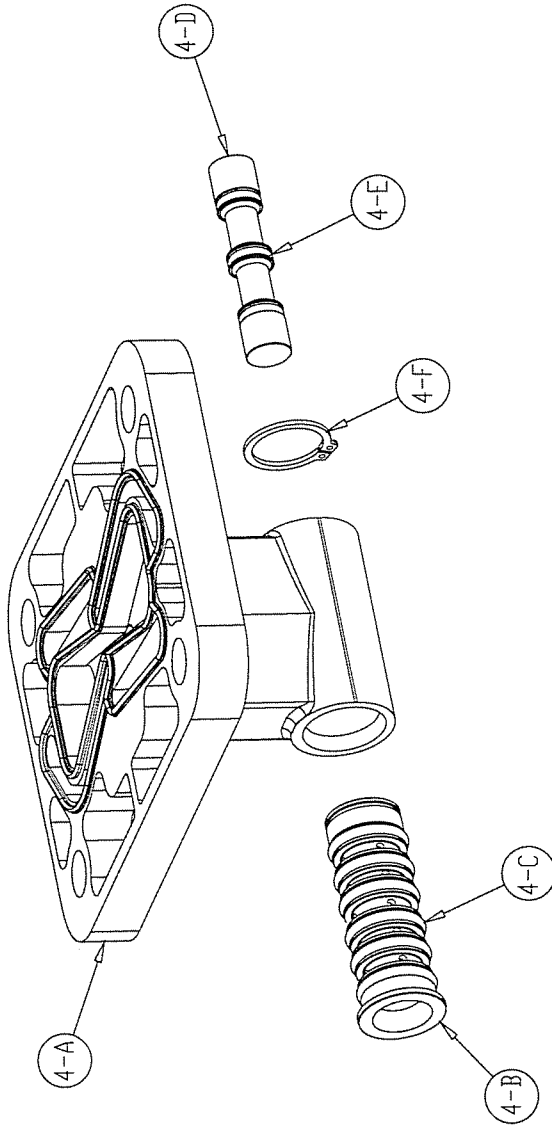
PILOT VALVE ASSEMBLY PARTS LIST

ITEM	PART NUMBER	DESCRIPTION	QTY
4	095-110-000	Pilot Valve Assembly	1
4-A	095-095-157	Valve Body	1
4-B	755-051-000	Sleeve (With O-rings)	1
4-C	560-033-379	O-ring (Sleeve)	6
4-D	775-055-000	Spool (With O-rings)	1
4-E	560-023-379	O-ring (Spool)	3
4-F	675-037-080	Retaining Ring	1

FOR PUMPS WITH CAST IRON CENTER SECTION

ITEM	PART NUMBER	DESCRIPTION	QTY
4	095-110-558	Pilot Valve Assembly	1
4-A	095-095-558	Valve Body	1

(includes all other items used on 095-110-000)



PILOT VALVE SERVICING

To service the pilot valve first shut off the compressed air supply, bleed the pressure from the pump, and disconnect the air supply line from the pump.

STEP #1: See pump assembly drawing.

Using a 1/2" wrench or socket, remove the four capscrews (item 11). Remove the air inlet cap (item 8) and air inlet gasket (item 18). The pilot valve assembly (item 4) can now be removed for inspection and service.

STEP #2: Disassembly of the pilot valve.

Remove the pilot valve spool (item 4-D). Wipe clean and inspect spool and o-rings for dirt, cuts or wear. Replace the o-rings and spool if necessary.

Remove the retaining ring (item 4-F) from the end of the sleeve (item 4-B) and remove the sleeve from the valve body (item 4-A). Wipe clean and inspect sleeve and o-rings for dirt, cuts or wear. Replace the o-rings and sleeve if necessary.

STEP #3: Re-assembly of the pilot valve.

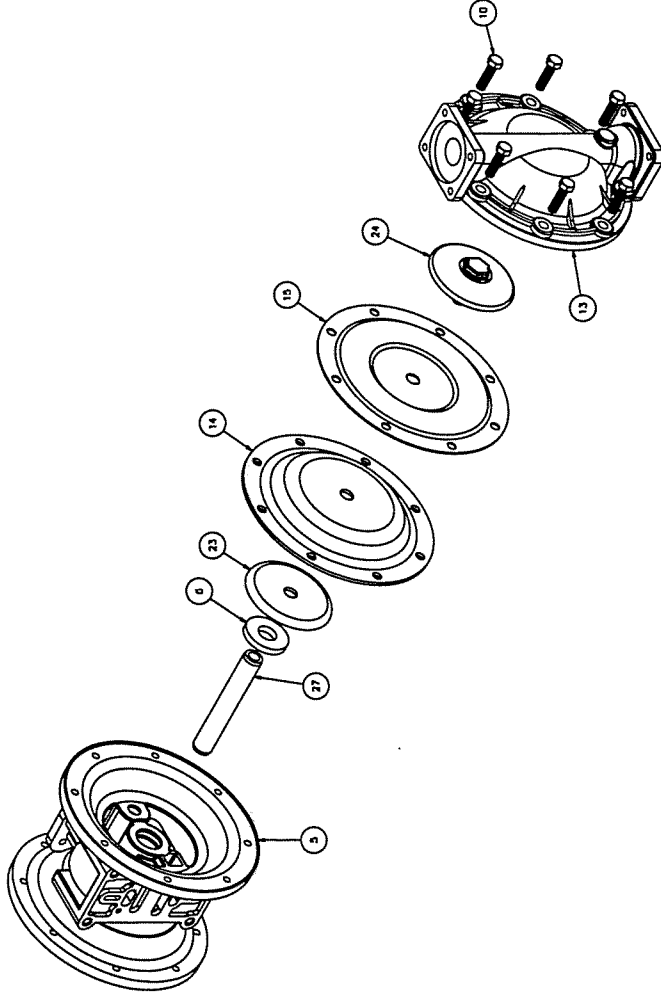
Generously lubricate outside diameter of the sleeve and o-rings. Then carefully insert sleeve into valve body. Take CAUTION when inserting sleeve, not to shear any o-rings. Install retaining ring to sleeve. Generously lubricate outside diameter of spool and o-rings. Then carefully insert spool into sleeve. Take CAUTION when inserting spool, not to shear any o-rings. Use BP-LS-EP-2 multipurpose grease, or equivalent.

STEP #4: Re-install the pilot valve assembly into the intermediate.

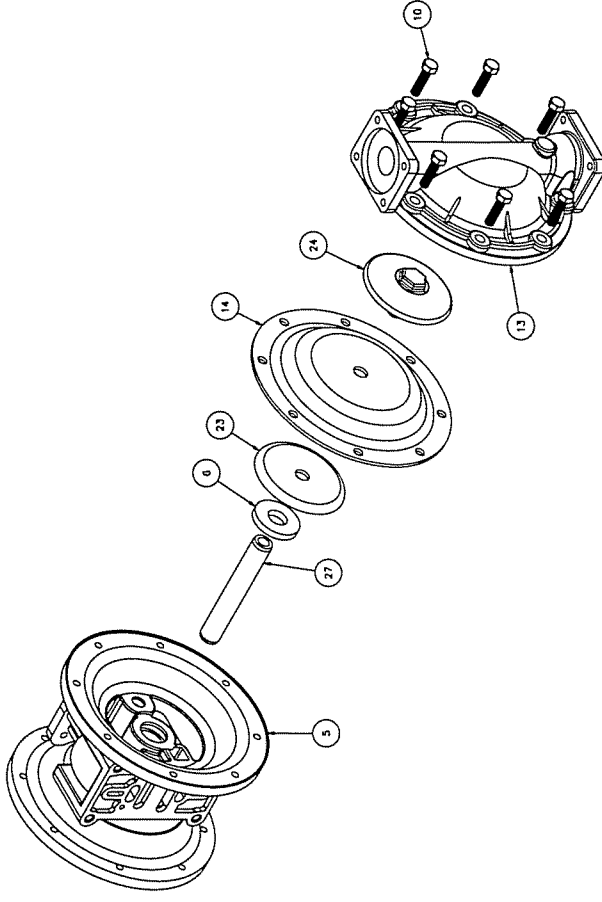
Be careful to align the ends of the pilot valve stem between the plunger pins when inserting the pilot valve into the cavity of the intermediate.

Re-install the gasket, air inlet cap and capscrews. Connect the air supply to the pump. The pump is now ready for operation.

Diaphragm Service Drawing, with Overlay



Diaphragm Service Drawing, Non-Overlay



DIAPHRAGM SERVICING

To service the diaphragms first shut off the suction, then shut off the discharge lines to the pump. Shut off the natural gas supply, bleed the pressure from the pump and disconnect the natural gas supply line from the pump. Drain any remaining liquid from the pump.

Step #1: See the pump assembly drawing and the diaphragm servicing illustration.

Using a 1/2" wrench or socket, remove the 16 capscrews (item 9) that fasten the manifolds (items 19 & 20) to the outer chambers (item 13).

Step #2: Removing outer chambers.

Using a 1/2" wrench or socket, remove the 16 capscrews (item 10), that fasten the outer chambers (item 13), diaphragms (item 14) and intermediate (item 5) together.

Step #3: Removing the diaphragms and diaphragm plates.

Use a 7/8" wrench or six point socket to remove the outer diaphragm plate assemblies (item 24), diaphragms (item 14) and inner diaphragm plates (item 23) from the diaphragm rod (item 27) by turning counterclockwise. Inspect the diaphragm for cuts, punctures, abrasive wear or chemical attack. Replace the diaphragms if necessary. **DO NOT USE A WRENCH ON THE DIAPHRAGM ROD. FLAWS ON THE SURFACE MAY DAMAGE BEARINGS AND SEALS.**

Step #4: Assembling the diaphragm and diaphragm plates to the diaphragm rod.

Push the threaded stud of one outer diaphragm plate assembly through the center of one diaphragm and through one inner diaphragm plate. Install the diaphragm with the natural bulge facing away from the diaphragm rod and make sure the radius on the inner diaphragm plate is towards the diaphragm, as indicated on the diaphragm servicing illustration. Thread the assembly onto the diaphragm rod, leaving loose.

Step #5: Installing the diaphragm and rod assembly to the pump.

Make sure the bumper (item 6) is installed over the diaphragm rod. Insert rod into pump.

On the opposite side of the pump, pull the diaphragm rod out as far as possible. Make sure the second bumper is installed over the diaphragm rod.

Push the threaded stud of the other outer diaphragm plate assembly through the center of the other diaphragm and through the other inner diaphragm plate. Make sure the radius on the inner diaphragm plate is towards the diaphragm. Thread the assembly onto the diaphragm rod. Use a 7/8" wrench or socket to hold one outer diaphragm plate. Then, use a torque wrench to tighten the other outer diaphragm plate to the diaphragm rod to 500 in. lbs. (56.5 Newton meters).

Align one diaphragm with the intermediate and install the outer chamber to the pump using the 8

capscrews. Tighten the opposite diaphragm plate until the holes in the diaphragm align with the holes in the intermediate. Then, install the other outer chamber using the 8 capscrews.

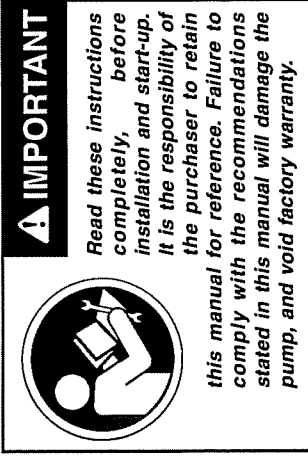
Step #6: Reinstall the manifolds to the pump using the 16 capscrews.

The pump is now ready to be reinstalled, connected and returned to operation.

OVERLAY DIAPHRAGM SERVICING

The overlay diaphragm (item 15) is designed to fit over the exterior of the standard diaphragm (item 14).

Follow the same procedures described for the standard diaphragm for removal and installation, except tighten the outer diaphragm plate assembly, diaphragms and inner diaphragm plate to the diaphragm rod to 500 in. lbs. (56.5 Newton meters).



ACTUATOR PLUNGER SERVICING

To service the actuator plunger first shut off the compressed natural gas supply, bleed the pressure from the pump, and disconnect the natural gas supply line from the pump.

Step #1: See PUMP ASSEMBLY DRAWING.

Using a 1/2" wrench or socket, remove the four capscrews (items 11). Remove the gas inlet cap (item 8) and gas inlet gasket (item 18). The pilot valve assembly (item 4) can now be removed.

Step #2: Inspect the actuator plungers.

See ILLUSTRATION AT RIGHT.

The actuator plungers (items 25) can be reached through the pilot valve cavity in the intermediate assembly (item 5).

Remove the plungers (item 25) from the bushings (item 7) in each end of the cavity. Inspect the installed o-ring (items 21) for cuts and/or wear. Replace the o-rings if necessary. Apply a light coating of grease to each o-ring and re-install the plungers in to the bushings. Push the plungers in as far as they will go.

To remove the bushings (item 7), first remove the retaining rings (item 26) by using a flat screwdriver.

NOTE: It is recommended that new retaining rings be installed.

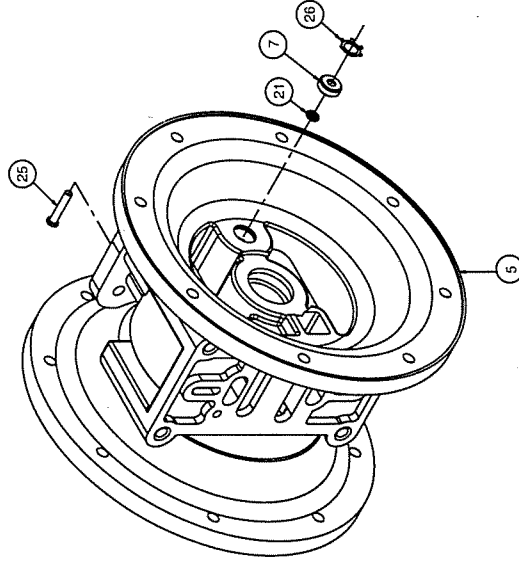
Step #3: Re-install the pilot valve assembly into the intermediate assembly.

Be careful to align the ends of the stem between the plungers when inserting the stem of the pilot valve into the cavity of the intermediate.

Re-install the gasket (item 18), natural gas inlet cap (item 8) and capscrews (item 11).

Connect the natural gas supply to the pump. The pump is now ready for operation.

ACTUATOR PLUNGER SERVICING



! IMPORTANT



Read these instructions completely, before installation and start-up. It is the responsibility of the purchaser to retain this manual for reference. Failure to comply with the recommendations stated in this manual will damage the pump, and void factory warranty.

CHECK VALVE SERVICING

Before servicing the check valve components, first shut off the suction line and then the discharge line to the pump. Next, shut off the compressed natural gas supply, bleed natural gas pressure from the pump, and disconnect the natural gas supply line from the pump. Drain any remaining fluid from the pump. The pump can now be removed for service.

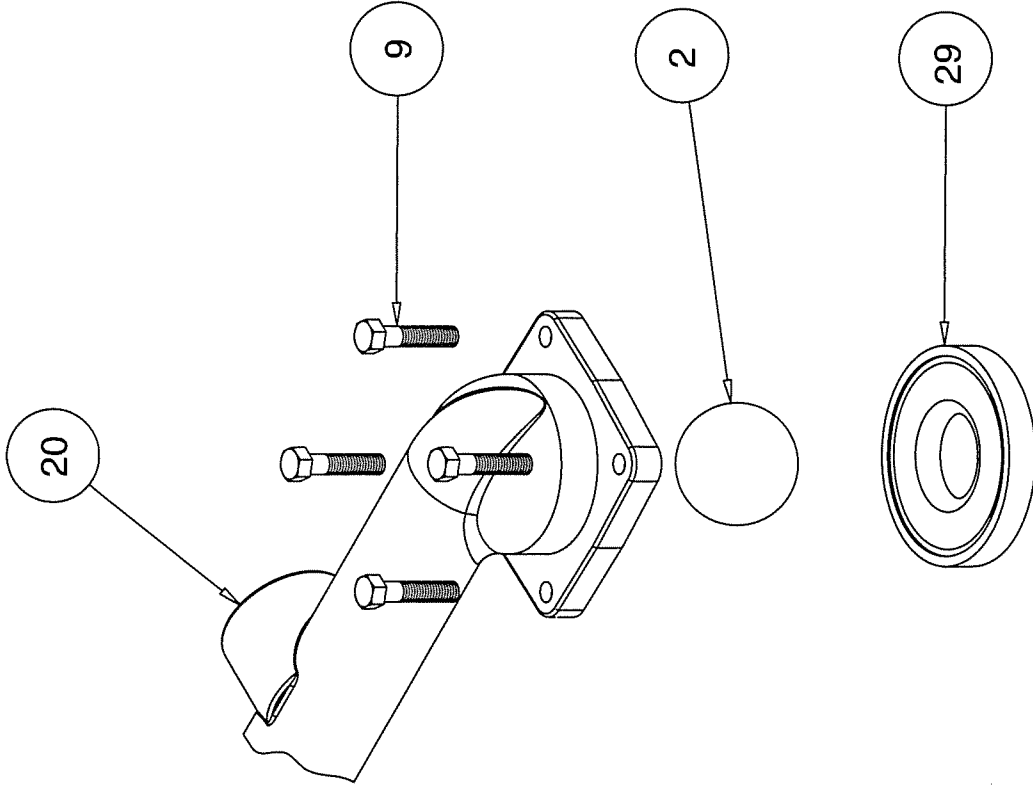
To access the check valve components, remove the manifolds (item 19 not shown). Use a 9/16" wrench or socket to remove the fasteners. Once the manifold is removed, the check valve components can be seen.

Inspect the check balls (items 2) for wear, abrasion, or cuts on the spherical surface. The check valve seats (item 29) should be inspected for cuts, abrasive wear, or embedded material on the surfaces of both the external and internal chambers. The spherical surface of the check balls must seat flush to the surface of the check valve seats for the pump to operate to peak efficiency. Replace any worn or damaged parts as necessary.

Re-assemble the check valve components. The seat should fit into the counter bore of the outer chamber.

The pump can now be reassembled, reconnected and returned to operation.

Check Valve Drawing



PUMPING HAZARDOUS LIQUIDS

When a diaphragm fails, the pumped liquid or fumes enter the natural gas end of the pump. Fumes are exhausted into the surrounding environment. When pumping hazardous or toxic materials, the exhaust gas must be piped to an appropriate area for safe disposal. See illustration #1 at right.

This pump can be submerged if the pump materials of construction are compatible with the liquid being pumped. The natural gas exhaust must be piped above the liquid level. See illustration #2 at right. Piping used for the gas exhaust must not be smaller than 1" (2.54 cm) diameter. Reducing the pipe size will restrict natural gas flow and reduce pump performance. When the pumped product source is at a higher level than the pump (flooded suction condition), pipe the exhaust gas higher than the product source to prevent siphoning spills. See illustration #3 at right.

PIPING THE NATURAL GAS EXHAUST

The following steps are necessary to pipe the exhaust gas away from the pump.

The gas distribution valve assembly (item 1) has 1" NPT threads for piped exhaust.

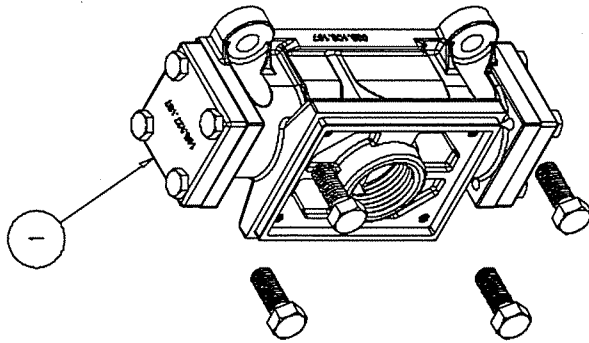
IMPORTANT INSTALLATION NOTE:

The manufacturer recommends installing a flexible conductive hose or connection between the pump and any rigid plumbing. This reduces stresses on the molded threads of the natural gas exhaust port. Failure to do so may result

in damage to the natural gas distribution valve body.

Any piping or hose connected to the pump's natural gas exhaust port must be conductive and physically supported. Failure to support these connections could also result in damage to the valve body.

If a high pressure gas spike is possible through the exhaust line, a pressure regulator is required in the exhaust piping.

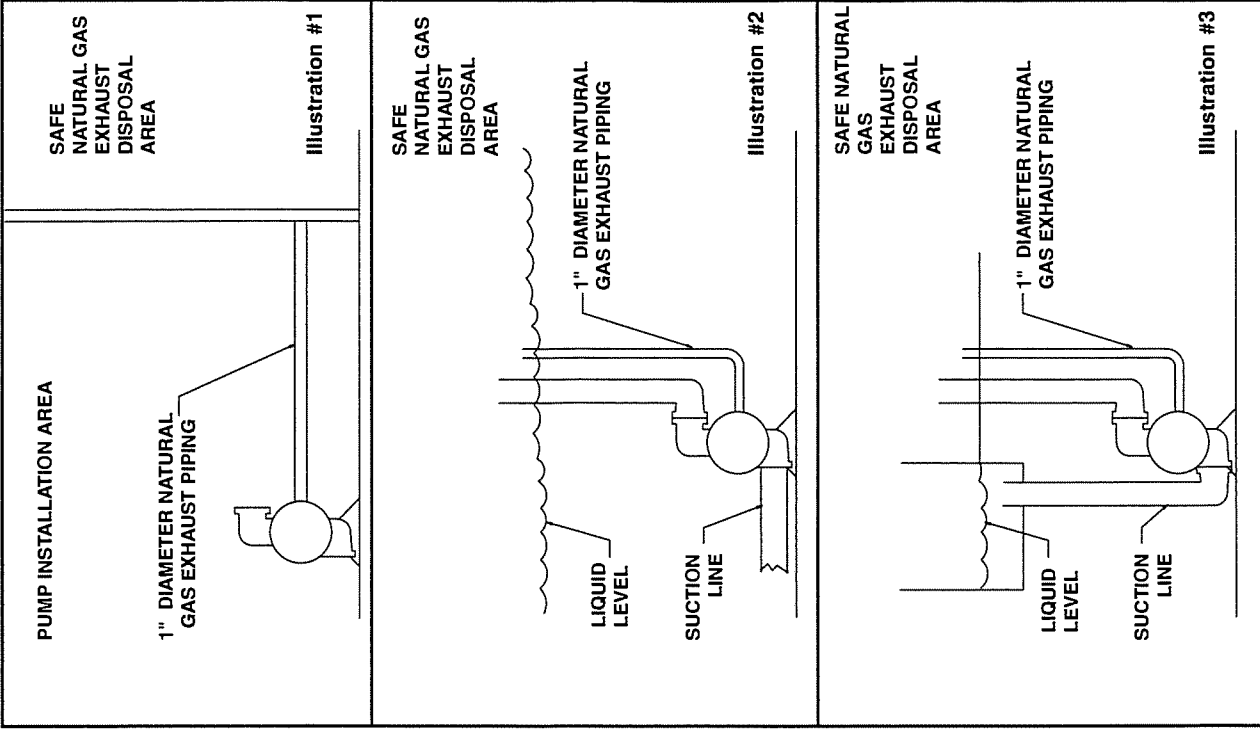


WARNING

Natural gas exhaust is to be vented to low pressure safe location using conductive Buna rubber hose or metal piping in accordance with local fire and environmental codes, or an industry or nationally recognized code having jurisdiction over specific installations, and/or CAN/CGA B149, Installation Codes.

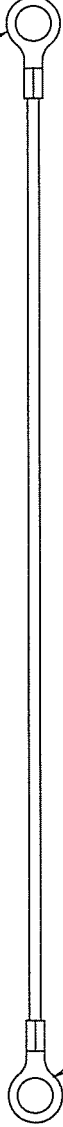


NATURAL GAS EXHAUST ILLUSTRATION



Grounding The Pump

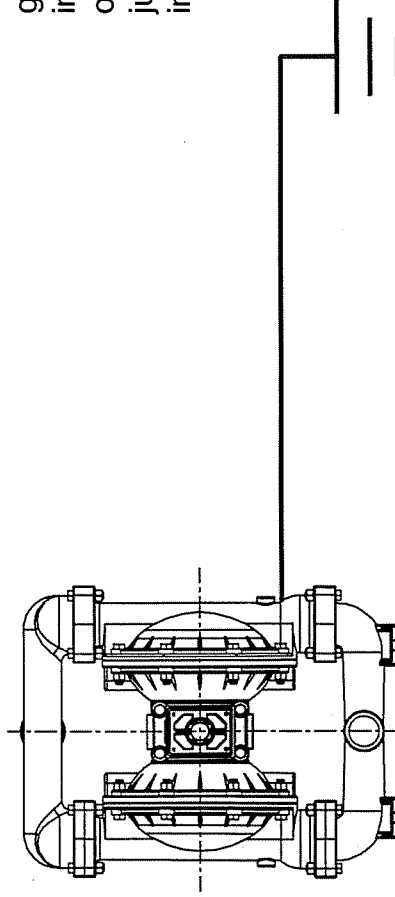
One eyelet is installed to a true earth ground. (Requires a maximum 5/16 or 8mm maximum diameter bolt)




One eyelet is fastened to the pump hardware.

This 8 foot long (244 centimeters) Ground Strap (Item 30) is shipped with the eyelet end fastened to the pump hardware.

To reduce the risk of static electrical sparking, this pump must be grounded. Check the local electrical code for detailed grounding instruction and the type of equipment required, or in the absence of local codes, an industry or nationally recognized code having jurisdiction over specific installations, and/or CAN/CGA B149, installation codes.



	WARNING Take action to prevent static sparking. Fire or explosion can result, especially when handling flammable liquids. The pump, piping, valves, containers or other miscellaneous equipment must be grounded.
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LIQUID DRAINERS

WLD1800/1800R Guided Float Type Liquid Drain Trap

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Revised 9/2004

Model	WLD1800, WLD1800R
Sizes	1/2", 3/4"
Connections	NPT
Body Material	Stainless Steel
PMO Max. Operating Pressure	400 PSIG
PMA	400 PSIG @ 500° F
TMA	500° F @ 400 PSIG



WLD1800
(Non-Repairable)



WLD1800R
(Repairable)

TYPICAL APPLICATION

The **WLD1800** is used on industrial air and gas applications for drainage of liquid from systems.

HOW IT WORKS

This liquid drainer has a float-operated valve that gives the trap a modulating flow characteristic. The amount of liquid flowing into the drainer is sensed by the float which positions the main valve to discharge the liquid at the same rate as it is received.

FEATURES

- Stainless steel body
- All stainless steel internals for longer service life
- Guided float ensures proper valve seating on every cycle
- Repairable unit available (WLD1800R model)

SAMPLE SPECIFICATION

The liquid drain trap shall have a guided-float operation with a tamper proof seal welded stainless steel body and all stainless steel internals. The unit shall be available with an in-line repairable version. All units to be equipped with FNPT threaded end connections.

INSTALLATION

The installation should include isolation valves to facilitate maintenance and an in-line strainer. The trap must be level and upright for the float mechanism to operate. Trap must be sized and properly located in the system.

MAINTENANCE

Close isolation valves prior to any maintenance. The WLD1800 is a disposable unit, but with the WLD1800R all working components can be replaced. Repair kits include float, lever & seat assembly and gaskets. For full maintenance details see Installation and Maintenance Manual.

MATERIALS

Body	Stainless Steel, AISI 304
Inlet & Outlet Fittings	Stainless Steel, AISI 304
Float Assembly	Stainless Steel, AISI 304
Valve & Lever Assembly	Stainless Steel, AISI 303
Seat	Hardened Stainless Steel
Gasket & Washer (seat)	Garlock
Bolt, Hex, HD	Stainless Steel, AISI 316
Nut, Jam	Stainless Steel, 18-8

HOW TO ORDER

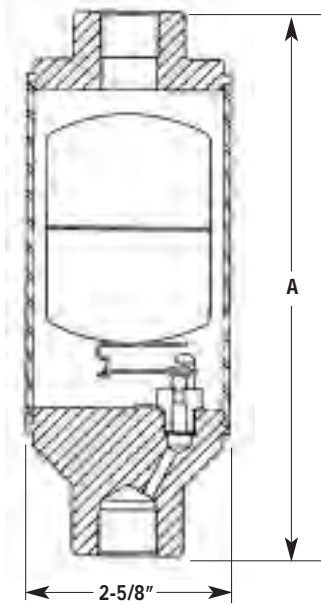
Refer to the capacity chart to determine which model is required to satisfy the condensate load. Specify model, orifice and pipe size that meets the load requirement.

LIQUID DRAINERS

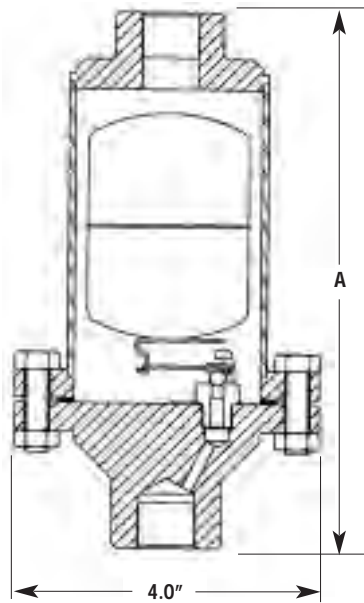
WLD1800/1800R

Guided Float Type Liquid Drain Trap

Revised 9/2004



WLD1800
(Non-Repairable)



WLD1800R
(Repairable)

DIMENSIONS – inches / pounds			
Model	Size (Inlet x Outlet)	A	Weight (lbs)
WLD1801	3/4" x 1/2"	7	4
WLD1801R	3/4" x 1/2"	7 ^{3/8}	4
WLD1802	3/4" x 3/4"	7	4
WLD1802R	3/4" x 3/4"	7 ^{3/8}	4
WLD1803	1/2" x 1/2"	7	4
WLD1803R	1/2" x 1/2"	7 ^{3/8}	4

COLD WATER CAPACITIES – (lbs/hr)																		
Model	Orifice	Differential Pressure (PSI)																
		1	2	5	10	15	20	30	50	100	150	175	200	250	275	300	350	400
WLD1800 SERIES	.078	60	80	120	130	180	260	315	400	570	700	750	800	900	940	1050	1050	1120
	#38	90	120	175	195	275	385	470	610	860	1050	1125	1200	1350	1425			
	.125	160	230	325	365	510	730	790	1150	1630	2000	2150						

CAPACITY CORRECTION FACTORS																	
Specific Gravity	1	.98	.96	.94	.92	.90	.88	.86	.84	.82	.80	.75	.70	.65	.60	.55	.50
Correction Factor	1	.99	.98	.97	.959	.949	.938	.927	.917	.906	.894	.866	.837	.806	.775	.742	.707

Note: To obtain capacity with a liquid other than water multiply water capacity by correction factor.

LIQUID DRAINERS



Bourdon Tube Pressure Gauges

ABS Plastic or Painted Steel Case
Copper Alloy Wetted Parts
Lower Mount Standard Series Type 111.10

Pressure Gauges

Application

Fluid medium which does not clog connection port or corrode copper alloy. Example: hydraulic and pneumatic systems, pumps, compressors, water systems, regulators.

Sizes (All sizes not stocked)

1½", 2", 2½" and 4" (40, 50, 63, and 100 mm)

Accuracy

± 3/2/3% of span (ASME B40.1 Grade B)

Ranges (All ranges not stocked)

Vacuum/Compound to 30"Hg / 0/ 200psi

Pressure from 15psi to 6000psi

or other equivalent units of pressure or vacuum

Receiver scales 3...15psi

Working Range

Steady: 3/4 of full scale value

Fluctuating: 2/3 of full scale value

Short time: full scale value

Operating Temperature

Ambient: -40°F to 140°F (-40°C to 60°C)

Media: max. 140°F (+60°C)

Temperature Error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection

Lower mount (LM)

1/8" or 1/4" NPT limited to wrench flat area

Bourdon Tube

Material: copper alloy

30"Hg (Vac) to 600 psi C-type

800psi to 6000 psi helical type

Movement

Copper alloy

Dial

White plastic with stop pin (1½", 2", 2½")

White aluminum with stop pin (4")

Black or black and red lettering

Pointer

Black ABS plastic (1½", 2", 2½", 4" LM)

(2 and 2½" LM - black aluminum); non-adjustable

Case

Black ABS plastic

Standard Scales

1½" psi, psi/kg/cm²

2" psi, psi/kpa, psi/kg/cm²

2½" psi, psi/kpa, psi/kg/cm² 0/100% of linear, 0/10 sq. rt.

4" psi, psi/kpa, psi/kg/cm² 0/100% of linear, 0/10 sq. rt.



Bezel

None (1½", 2", 2½", & 4")

Window

Snap-in acrylic (1½", 2", 2½", & 4")

Order Options (min. order may apply)

Brass threaded or press fit restrictor¹

Accuracy ± 2/1/2% of span (ASME B40.1 Grade A)

Slip-fit or friction ring

Case with blow-out plug

Glass window

Black painted steel case

Stainless steel case

Brass polished case and friction ring (2½" only)

Special case colors

Special connections (limited to wrench flat area)

Cleaned for oxygen service

Nickel plated connection

Medical specification

Rubber cover (2", 2½")

Custom dial layout

Other pressure scales available:

Bar, kPa, MPa, kg/cm² and dual scales

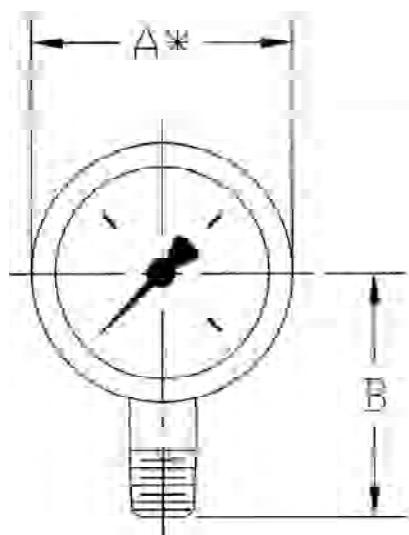
DIN standards

Red set pointer on aluminum dial or on snap-on window

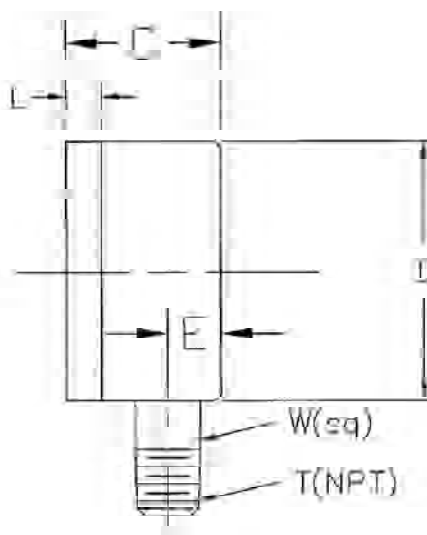
Externally adjustable red drag pointer (2½" only) (max. hand)

Note: ¹Press-fit brass restrictor standard for 111.10B,

1000psi to 6000psi



111.10 LM



111.10 LM

A* Nominal Size

TYPE/SIZE	WEIGHT	KEY	A	B	C	D	E	L	T	W
111.10 1.5" LM	0.16 lbs.	mm	40	36	23	41	8	-	1/8" NPT	12
		in	1.57	1.42	0.91	1.61	0.31	-		0.47
111.10 2" LM	0.22 lbs.	mm	50	45	27	49	10	-	1/8" or 1/4" NPT	14
		in	1.97	1.77	1.06	1.93	.039	-		0.55
111.10 2.5"	0.29 lbs.	mm	63	53.5	28	61.5	10	-	1/8" or 1/4" NPT	14
		in	2.48	2.11	1.1	2.42	0.39	-		0.55
111.10 2.5" with polished brass case option	0.29 lbs.	mm	63	52	27	61.5	9.5	10	1/4" NPT	14
		in.	2.5	2.05	1.06	2.42	.37	.39		0.55
111.10 4"	0.46 lbs.	mm	100	83.5	30	99	11.5	-	1/8" or 1/4" NPT	14
		in	3.94	3.29	1.18	3.9	0.45	-		0.55

THE MEASURE OF
Total Performance™

Ordering Information:

State computer part number (if available) / type number / size / range / connection size and location / options required.

Specifications given in this price list represent the state of engineering at the time of printing. Modifications may take place and the specified materials may change without prior notice

05/02



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Bourdon Tube Pressure Gauges

Economical Stainless Steel Gauge

Type 132.53 - Dry Case

Type 133.53 - Liquid-filled Case

WIKA Data Sheet 13X.53

Applications

- With liquid filled case for applications with high dynamic pressure pulsations or vibration
- Suitable for corrosive environments and gaseous or liquid media that will not obstruct the pressure system
- Process industry: chemical/petrochemical, power stations, mining, on and offshore, environmental technology, mechanical engineering and plant construction

Special features

- All stainless steel construction
- Economical design
- Positive pressure ranges to 15,000 PSI

Standard Features

Design

ASME B40.100 & EN 837-1

Sizes

4" (100mm)

Accuracy class

± 3/2/3% of span (ASME B40.100 Grade B)

Ranges

Pressure from 30 psi to 15,000 psi
or other equivalent units of pressure

Working pressure

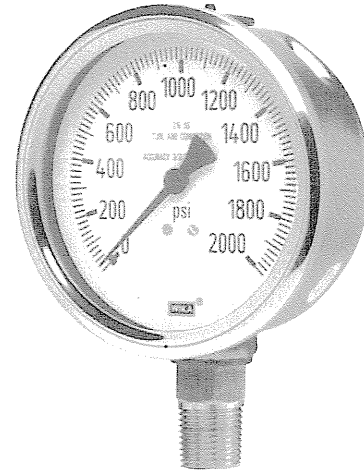
Steady: 3/4 scale value
Fluctuating: 2/3 full scale value
Short time: full scale value

Operating temperature

Ambient: -40°F to +140°F (-40°C to +60°C) - dry
-4°F to +140°F (-20°C to +60°C) - glycerine filled
-40°F to +140°F (-40°C to +60°C) - silicone filled
Medium: +212°F (+100°C) maximum

Temperature error

Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.



Bourdon Tube Pressure Gauge Model 132.53

Weather protection

Weather resistant (NEMA 3 / IP 54) - dry case
Weather tight (NEMA 4X / IP65) - filled case

Pressure connection

Material: 316L stainless steel
Lower mount (LM)
1/4" or 1/2" NPT

Bourdon tube

Material: 316L stainless steel
≤ 1,000 PSI: C-type
≥ 1,500 PSI: helical type

Movement

Stainless steel

Dial

White aluminum with black lettering

Pointer

Black aluminum, non-adjustable

Case

304 stainless steel with vent plug and SS polished crimp ring.
Case welded to pressure connection.

Window

Acrylic with Buna-N gasket

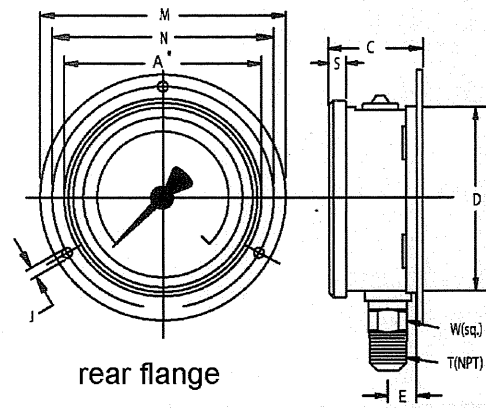
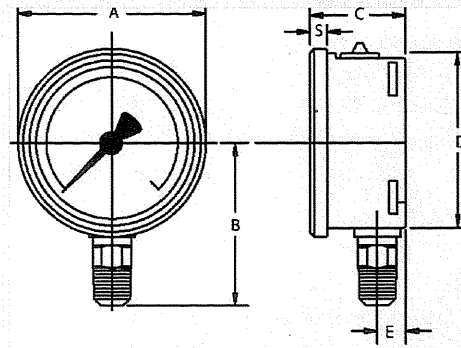
Case fill

Glycerine 99.7% (Type 133.53)

Optional extras

- Other pressure connections
- Customer dial layout
- Rear flange, SS
- Stainless steel restrictor
- Silicone or Fluorolube case filling
- Other pressure scales available:
bar, kPa, mPa, Kg/cm² and dual scales

Dimensions



rear flange

Size		A	B	C	D	E	J	M	N	S	T	W	Weight
4"	mm	100	87	39	100	15.5	4.8	132	116	8		22	
	in	4	3.43	1.53	3.94	0.61	0.19	5.20	4.57	0.31	1/2"	0.87	1.10 lb.

* Weight without optional accessories

Ordering information

Pressure gauge model / Nominal size / Scale range / Size of connection / Optional extras required
 Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.
 Modifications may take place and materials specified may be replaced by others without prior notice.



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Intrinsically Safe Pressure Transmitter for applications in hazardous environments

Models IS-20-S, IS-21-S, IS-20-F, IS-21-F

WIKA Data Sheet PE 81.50



Applications

- Chemical, Petrochemical
- Oil and gas refining
- Food & Beverage
- Mechanical engineering

Special Features

- Pressure ranges from 0 ... 0.1 bar to 0 ... 1,000 bar
- Ex- protection EEx ia I/II C T6 according to ATEX for:
 - Gases, vapours and mist: Zone 0, Zone 1 and Zone 2
 - Dust: Zone 20, Zone 21 and Zone 22
 - Mining: Category M1 and M2
- FM, CSA approval for
 - Intrinsically safe Class I, II und III Division 1, Group A, B, C, D, E, F, G
 - Dust Class II und III Division 1, Group E, F, G
 - Class I, Zone 0, AEx ia II C

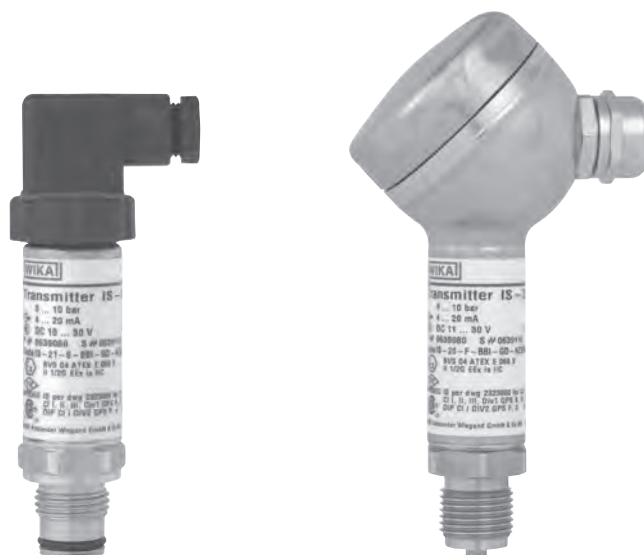


Fig. left: Pressure transmitter IS-21-S
Fig. right: Pressure transmitter IS-20-F

Description

To meet highest standards

The intrinsically safe pressure transmitters have been specially designed to comply with the most difficult requirements of industrial applications and represent an ideal solution for almost any task in hazardous environments.

These pressure transmitters meet approvals such as ATEX, FM, CSA, which are relevant throughout the world. All data required in connection with the approval is included on the product label. The globality of the product is thus given special emphasis.

A stock program ensures short delivery times.

Structure

All wetted parts are made of stainless steel and are completely welded. Therefore there are no restrictions of the sealing material based on the pressure media. The

compact case is also made of stainless steel and provides IP 65 ingress protection (special versions up to IP 68).

The model IS-21-S and IS-21-F with flush diaphragm is particularly suitable for the measurement of viscous fluids or media containing particulates that may clog the pressure connection of standard industrial transmitters. Thus, a trouble-free pressure measurement is ensured.

Model IS-2*-F features a field case connection, which enables use in aggravated operating conditions and enables direct wiring of the cables.

The transmitters are supplied via appropriate intrinsically safe line transformers, or via typical zener diode barriers with an input power of 10 ... 30 V. The output signal is 4 ... 20 mA, 2-wire.

Specifications without model designation apply for all models.

Pressure ranges ^{*)}	bar	0.1	0.16	0.25	0.4	0.6	1	1.6	2.5	4	6	10
Over pressure safety	bar	1	1.5	2	2	4	5	10	10	17	35	35
Burst pressure	bar	2	2	2.4	2.4	4.8	6	12	12	20.5	42	42
Pressure ranges ^{*)}	bar	16	25	40	60	100	160	250	400	600	1000 ¹⁾	
Over pressure safety	bar	80	50	80	120	200	320	500	800	1200	1500	
Burst pressure	bar	96	96	400	550	800	1000	1200	1700 ²⁾	2400 ²⁾	3000	
{Vacuum, gauge pressure, compound range, absolute pressure are available}												
¹⁾ Only Model IS-20												
²⁾ For model IS-21: the value specified in the table applies only when sealing is realised with the Sealing ring underneath the hex. Otherwise max. 1500 bar applies.												
Materials	(other materials see WIKA diaphragm seal program)											
■ Wetted parts	Stainless steel											
> Models IS-20-S, IS-20-F ^{*)}	Stainless steel {Hastelloy C4}											
> Models IS-21-S, IS-21-F	O-ring: NBR {FPM/FKM or EPDM}											
■ Case	Stainless steel											
Internal transmission fluid ³⁾	Synthetic oil {Halocarbon oil for oxygen applications}											
	{Listed by FDA for Food & Beverage}											
³⁾ Not for Model IS-20 with pressure ranges > 25 bar.												
Power supply U _B	DC V	10 < U _B ≤ 30 (11 < U _B ≤ 30 with Model IS-2*-F)										
Signal output and		4 ... 20 mA, 2-wire										
Maximum load R _A		R _A ≤ (U _B - 10 V) / 0.02 A - (length of flying leads in m x 0.14 Ohm)										
> Model IS-2*-S		R _A ≤ (U _B - 11 V) / 0.02 A										
> Model IS-2*-F		with R _A in Ohm and U _B in Volt										
Test circuit signal / max. load R _A		R _A < 15 Ohm (only for Model IS-2*-F)										
Adjustability zero/span	%	± 10 using potentiometers inside instrument										
Response time (10 ... 90 %)	ms	≤ 1										
Dielectric strength		Insulation complies with EN 50020, 6.4, 12										
Accuracy	% of span	≤ 0.25 {0.125} ⁴⁾ (BFSL)										
	% of span	≤ 0.5 {0.25} ^{4) 5)}										
⁴⁾ For pressure ranges beyond 0 ... 0.25 bar.												
⁵⁾ Including non-linearity, hysteresis, non-repeatability, zero point and full scale error (corresponds to error of measurement per IEC 61298-2). Adjusted in vertical mounting position with lower pressure connection.												
Non-linearity	% of span	≤ 0.2 (BFSL) according to IEC 61298-2										
1-year stability	% of span	≤ 0.2 (at reference conditions)										
Permissible temperature												
■ Medium ^{6) 9) *)}		-20 ... +80 °C ⁷⁾					-4 ... +176 °F ⁷⁾ {extended temperature ranges see Page 6} ⁸⁾					
■ Ambience ^{6) 9)}		-20 ... +80 °C ⁷⁾					-4 ... +176 °F ⁷⁾					
■ Storage ⁶⁾		-30... +105 °C					-22 .. +221 °F					
⁶⁾ Also complies with EN 50178, Tab. 7, Operation (C) 4K4H, Storage (D) 1K4, Transport (E) 2K3												
⁷⁾ Other temperature ranges are possible, depending on the electrical connection; see EC-type examination certificate, e.g. -30...+105 °C / -22 ... +221 °F												
⁸⁾ Response time IS-20: ≤ 10 ms at medium temp. below < -30 °C (-22 °F) for pressure ranges up to 25 bar Response time IS-21: ≤ 10 ms at medium temp. below < -30 °C (-22 °F).												
Compensated temperature range		0 ... +80°C					32 ... +176°F					
Temperature coefficients within compensated temp range												
■ Mean TC of zero	% of span	≤ 0.2 / 10 K (< 0.4 for pressure range ≤ 250 mbar)										
■ Mean TC of range	% of span	≤ 0.2 / 10 K										
⊕ -protection	ATEX	Category ⁹⁾ 1G, 1/2G, 2G, 1D, 1/2D, 2D, M1, M2										
Ignition protection type		Ex ia I/II C T4, Ex ia I/II C T5, Ex ia I/II C T6										
Ex -protection	FM, CSA	Class I, II und III										
Ignition protection type		Intrinsically safe Class I, II, III Division 1, Group A, B, C, D, E, F, G und Class I, Zone 0 AEx ia II C										
⁹⁾ Read the operating conditions and safety-relevant data in the EC-type examination certificate in any case (BVS 04 ATEX E 068 X)												

Specifications

Models IS-20-S, IS-21-S, IS-20-F, IS-21-F

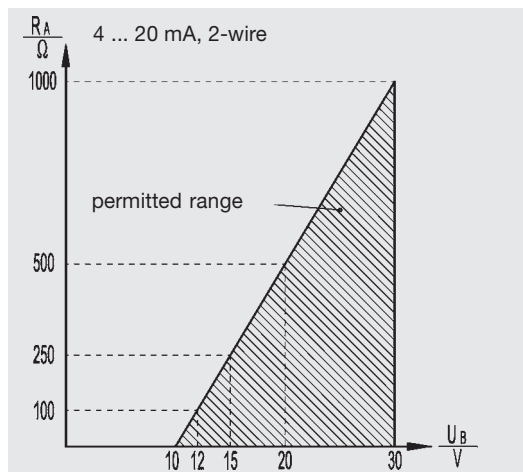
CE- conformity		89/336/EEC interference emission and immunity see EN 61 326, interference emission limit class A and B EN 50 014 (general part), EN 50 020 (intrinsic safety), {EN 50 284 (Zone 0)}, {EN 50 281-1 (dust-Ex)}, {EN 50 303 (mining industry)}
FM, CSA		FM standards according to FMRC 3600, 3610, 3611 (including supplement #1), ISA-S12.0.01, IEC 60 529 (including amendment #1) CSA standard C22.2 No. 0-M1991 / 142-M1987 / 157-M1992 UL 50, Eleventh Edition / UL 508, Seventeenth Edition / UL 913, Sixth Edition
HF-immunity	V/m	10
BURST	KV	2
Shock resistance		
➤ Model IS-2*-S	g	1000 according to IEC 60068-2-27 (mechanical shock)
➤ Model IS-2*-F	g	600 according to IEC 60068-2-27 (mechanical shock)
Vibration resistance		
➤ Model IS-2*-S	g	20 according to IEC 60068-2-6 (vibration under resonance)
➤ Model IS-2*-F	g	10 according to IEC 60068-2-6 (vibration under resonance)
Wiring protection		Protected against reverse polarity and short circuiting on the instrument side
Mass		
➤ Model IS-2*-S	kg	Approx. 0.2
➤ Model IS-2*-F	kg	Approx. 0.35

*) In an oxygen version model IS-21 is not available. In an oxygen version model IS-20 is only available in gauge pressure ranges ≥ 0.25 bar with media temperatures between $-20 \dots +60$ °C / $-4 \dots +140$ °F and using stainless steel or Elgiloy[®] wetted parts.

{ } Items in curved brackets are optional extras for additional price.

Output signal and admissible load

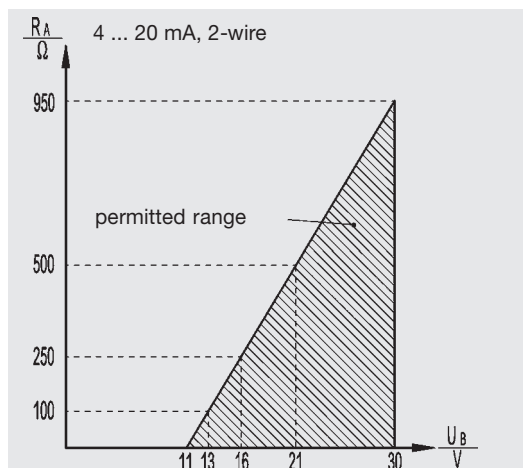
Model IS-2*-S



Output current (2-wire)

$$4 \dots 20 \text{ mA: } R_A \leq (U_B - 10 \text{ V}) / 0.02 \text{ A}$$

Model IS-2*-F



Output current (2-wire)

$$4 \dots 20 \text{ mA: } R_A \leq (U_B - 11 \text{ V}) / 0.02 \text{ A}$$

Dimensions in mm

Electrical connections IS-2*-S

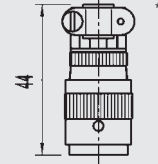
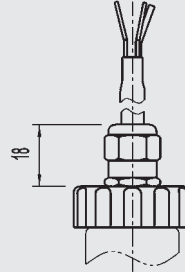
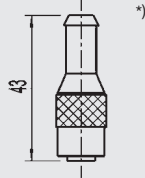
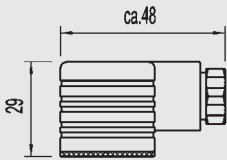
Ingress Protection IP per IEC 60 529

L-connector
DIN EN 175301-803,
Form A
conductor outer diameter
6 - 8 mm
IP 65
Order code: A4
ATEX: 1/2 G, M1

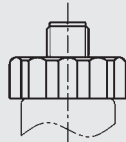
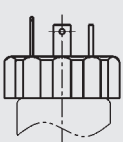
Circular connector,
M 12x1, 4-pin
IP 67
Order code: M4
ATEX: 1/2 G, M1

Flying leads
conductor outer
diameter 6.8 mm, PUR
IP 67
Order code: DL
ATEX: 1/2 G, M1

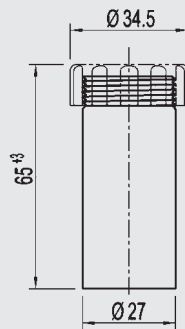
Bayonet connector
6-pin
IP 67
Order code: C6
ATEX: 1/2 G
(not with mining)



Others on request



Case



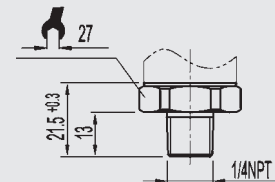
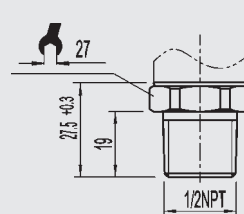
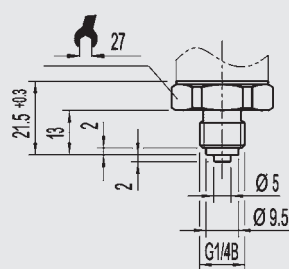
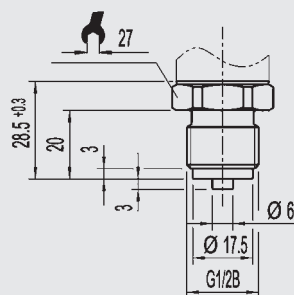
Pressure connections IS-20-S and IS-20-F

G 1/2
EN 837
Order code: GD

G 1/4
EN 837
Order code: GB

1/2 NPT
per „Nominal size for
US standard tapered
pipe thread NPT“
Order code: ND

1/4 NPT
per „Nominal size for
US standard tapered
pipe thread NPT“
Order code: NB



Others on request

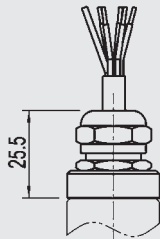
For installation and safety instructions see the operating instructions for this product.

For tapped holes and welding sockets please see Technical Information IN 00.14 for download at www.wika.de -Service

*) Connectors are not included in delivery.

Electrical connections IS-2*-S

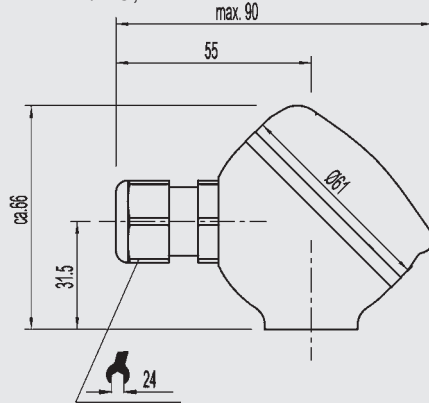
Flying leads, zero/span not adjustable, conductor outer diameter 6.8 mm, PUR IP 68
 Order code: EM
 ATEX: 1/2 G, M1



Others on request

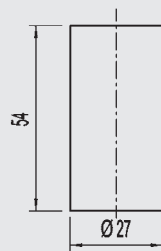
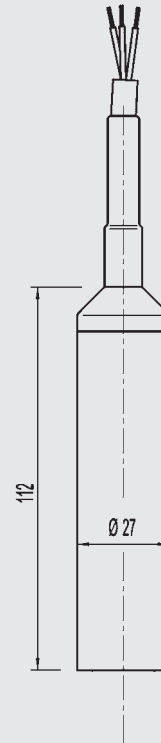
Electrical connections IS-2*-F

Field case with internal spring clip terminals, conductor outer diameter 7 - 13 mm, IP 68
 Order code:
 FH (threaded connection brass nickel-plated)
 FC (threaded connection stainless steel)
 ATEX: 1/2 G, M1



Electrical connections IS-2*-S

Flying leads, zero/span not adjustable, conductor outer diameter 7.5 mm, PUR {FEP} IP 68
 Order code: DM
 ATEX: II A 1G, 1D, M1
 II C 1/2G, 2G

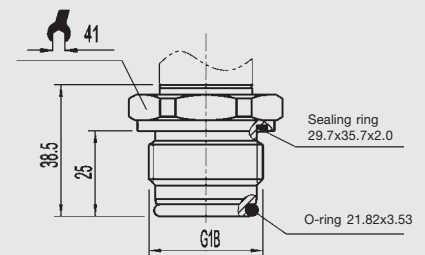
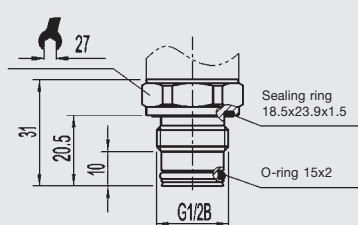
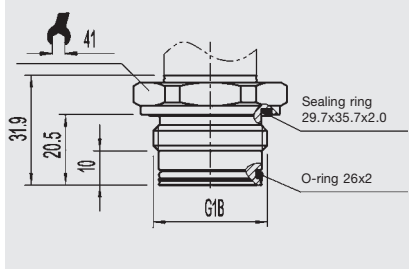


Pressure connections IS-21-S and IS-21-F, flush diaphragm

G 1
 0 ... 0.1 up to 0 ... 1.6 bar
 Order code: 85

G 1/2
 0 ... 2.5 up to 0 ... 600 bar
 Order code: 86

G 1
 according to EHEDG **)
 0 ... 0.1 up to 0 ... 16 bar
 Order code: 83



Others on request

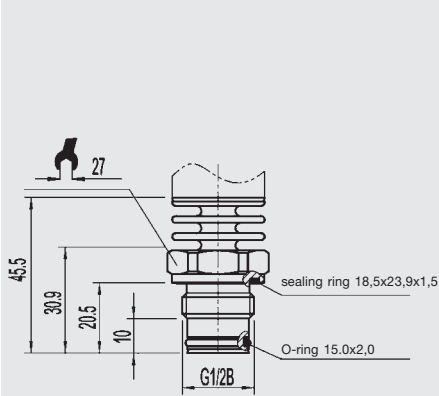
**) European Hygienic Equipment Design Group

{ } Items in curved brackets are optional extras for additional price.

Pressure connections high temperature

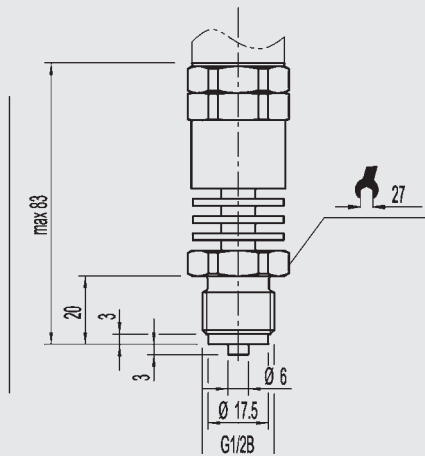
IS-21-S and IS-21-F, flush diaphragm
-20 ... 150 °C

G 1/2
with 2 cooling fins (version **A**)
0 ... 2.5 up to 0 ... 600 bar
Order code: 86 and C



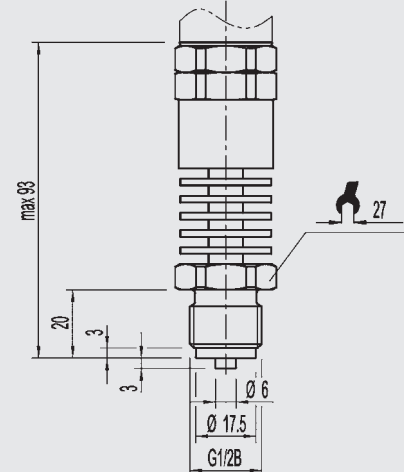
IS-20-S and IS-20-F
-40 ... 150 °C

G 1/2
with 3 cooling fins (version **B**)
0 ... 1000 bar
Order code: GD and 8

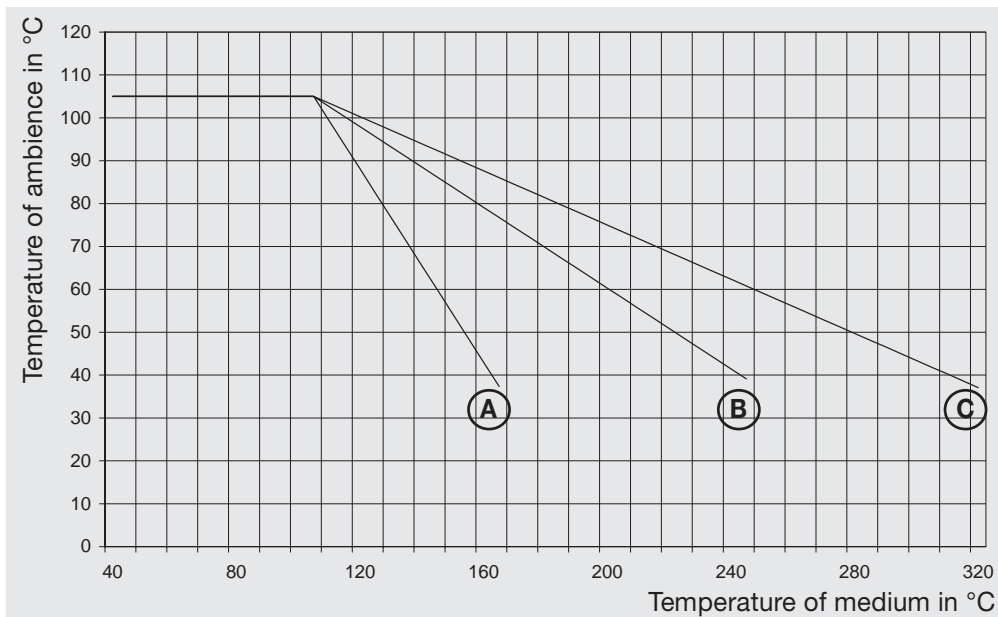


IS-20-S and IS-20-F
-40 ... 200 °C

G 1/2
with 5 cooling fins (version **C**)
0 ... 1000 bar
Order code: GD and 9



Relation of medium temperature to ambient temperature



Version	A	B	C
Cooling fin	2	3	5
Constant K	0.47	0.68	0.76

Calculation of cooling element:

$$T_B = T_{med} - (T_{med} - T_{amb}) \times K$$

T_B = Operation temperature of transmitter

T_{med} = max. temperature of process medium

T_{amb} = max. temperature of ambience

K = Constant of cooling element

Max. permitted temperature of ambience:

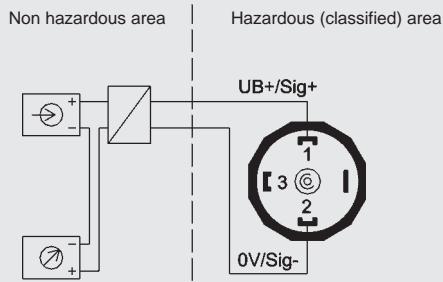
$$T_{amb} = T_{med} + (T_B - T_{med}) / K$$

Wiring

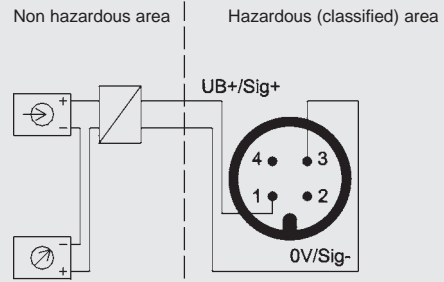
Model IS-2*-S

2-wire

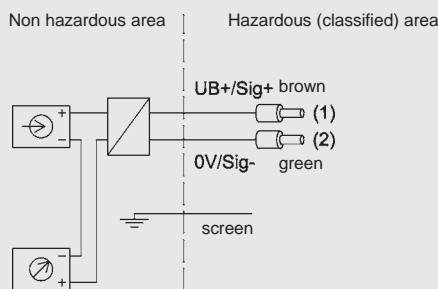
L-connector



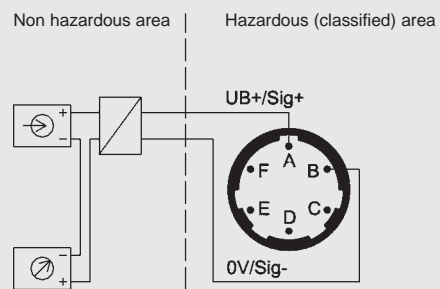
Circular connector M 12x1



Flying leads with 1.5 m of cable



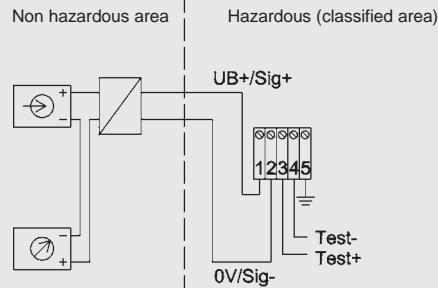
Bayonet connector



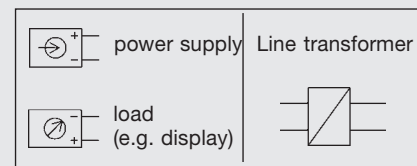
Model IS-2*-F

2-wire

Field case (internal spring clip terminal)



Legend



Hazardous areas (zone classification according to ATEX)

Group II: Electrical equipment for use in all areas (except mines) which are endangered by an explosive atmosphere.

Zone	Category	Occurrence of explosive atmosphere
Zone 0	Category 1G (gas)	Continuous
Mounting to zone 0	Category 1/2 G	
Zone 20	Category 1D (dust)	
Mounting to zone 20	Category 1/2 D	Intermittent
Zone 1	Category 2G	
Zone 21	Category 2D	
Zone 2	Category 3G	Hazard under abnormal conditions
Zone 22	Category 3D	

Group I: Electrical equipment for use in mines (hazard due to mine gas)

Zone	Category	Requirements
	Category M1	Very high degree of safety
	Category M2	High degree of safety (instruments have to be turned off if they are exposed to an explosive atmosphere)

Hazardous areas (ATEX in comparison with FM, CSA)

	ATEX Group	FM / CSA Class	Group
Above ground	Gases and Vapours	IIA / IIB / IIC	A / B / C / D / E / F / G
	Dusts		
	Fibres		
Mining	Gas / Dusts	I	ID / IIF

	Flammable material present continuously	Flammable material present intermittently	Flammable material normally not present
ATEX	Zone 0 (Zone 20 Dust)	Zone 1 (Zone 21 Dust)	Zone 2 (Zone 22 Dust)
FM / CSA	Zone 0	Zone 1	Zone 2
	Division 1		Division 2
FM (NEC505)	Zone 0	Zone 1	Zone 2

Further information

You can obtain further information (data sheets, instructions, etc.) via Internet address www.wika.de



Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing. Modifications may take place and materials specified may be replaced by others without prior notice.



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www.wika.de



Pressure Transmitters

Industrial Grade • Ranges 10 INWC to 25 INWC • Model 891.13.501

• Ranges 50 INWC to 300 PSI • Model 891.13.500

• Ranges 400 PSI to 40,000 PSI • Model 891.23.510

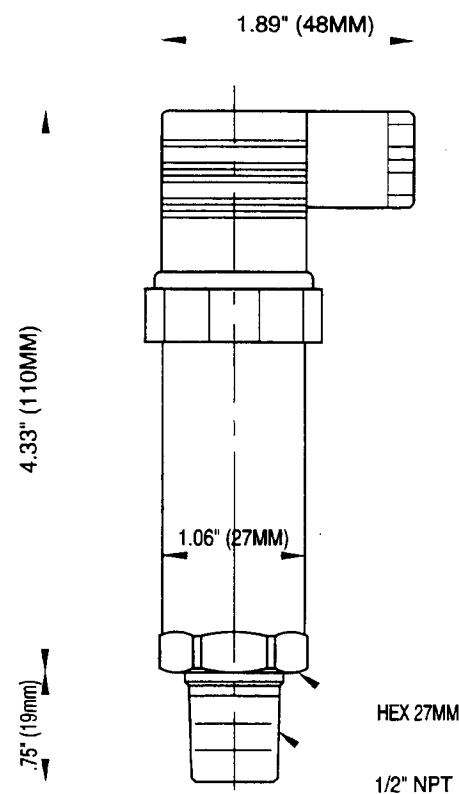
Tronic

WIKA piezoresistive and thin film pressure transmitters are precision engineered to fit the majority of industrial pressure measurement applications. Each unit undergoes quality control testing and calibration to achieve an accuracy of 0.25% full scale. The printed circuit board uses state-of-the-art surface mount technology and is potted in silicone gel for protection against vibration, shock and humidity. Each unit is temperature compensated to assure accuracy and long term stability under severe ambient temperature variations.

The compact design provides a rugged transmitter suitable for various applications in hydraulics & pneumatics, vacuum, test equipment, liquid level measurement, press control, compressor control, pump protection and numerous other processing and control operations.

Specifications for the 891.13.500 (vacuum, compound and ranges to 0-300 PSI) and 891.23.510 (0-400 PSI and higher) are given below. The 891.13.501 is an extremely low pressure version suitable for dry, inert media.

RANGE	STANDARD RANGES	
	MAXIMUM*	BURST**
Model 891.13.501		
0-10 INWC	100 INWC	100 INWC
0-15 INWC	100 INWC	100 INWC
0-25 INWC	100 INWC	100 INWC
Model 891.13.500		
30"-0 HgVac	70 PSI	70 PSI
30"-0-30 PSIG	250 PSI	250 PSI
30"-0-60 PSIG	500 PSI	500 PSI
30"-0-100 PSIG	500 PSI	500 PSI
30"-0-160 PSIG	500 PSI	500 PSI
30"-0-200 PSIG	1100 PSI	1100 PSI
0-50 INWC	30 PSI	30 PSI
0-100 INWC	30 PSI	30 PSI
0-5 PSIG	30 PSI	30 PSI
0-10 PSIG	60 PSI	60 PSI
0-15 PSIG(A)	70 PSI	70 PSI
0-25 PSIG(A)	145 PSI	145 PSI
0-30 PSIG	145 PSI	145 PSI
0-50 PSIG(A)	250 PSI	250 PSI
0-60 PSIG	250 PSI	250 PSI
0-100 PSIG(A)	500 PSI	500 PSI
0-160 PSIG	500 PSI	500 PSI
0-200 PSIG	500 PSI	500 PSI
0-250 PSIG(A)	1100 PSI	1100 PSI
0-300 PSIG	1100 PSI	1100 PSI
Model 891.23.510		
0-400 PSIG	725 PSI	3600 PSI
0-500 PSIG(A)	1100 PSI	5800 PSI
0-600 PSIG	1100 PSI	5800 PSI
0-750 PSIG	1100 PSI	5800 PSI
0-1000 PSIG	1750 PSI	8000 PSI
0-1500 PSIG	2900 PSI	11,600 PSI
0-2000 PSIG	4600 PSI	14,500 PSI
0-3000 PSIG	4600 PSI	14,500 PSI
0-5000 PSIG	11,600 PSI	25,000 PSI
0-8000 PSIG	17,400 PSI	35,000 PSI
0-10,000 PSIG	17,400 PSI	35,000 PSI
0-15,000 PSIG	21,750 PSI	43,500 PSI



For higher pressures up to 100,000 PSI please contact factory

Notes:

- * Maximum pressure, causing no permanent changes in specifications but may lead to adjustable zero and span shifts.
- ** Burst pressure, leading to permanent, non-adjustable changes in specifications (i.e. zero offsets) or destruction of transmitter.
- (A) Standard ranges available with absolute pressure reference.

Specifications

Input

10-30 VDC
(14-30 VDC for 0-10V Output Signal)

Output & load limitations

4-20mA 2-wire $R_{(max)} = (V_s - 10V) / 0.02 A$
 0-5 V 3-wire $R_{(min)} = 5 k \text{ Ohm}$
 0-10 V 3-wire $R_{(min)} = 10 k \text{ Ohm}$
 0-100 mV 4-wire $R_{(min)} = 1000 k \text{ Ohm}$

Accuracy

Linearity (B.F.S.L.) $\leq 0.25\%$ of span
 Hysteresis $\leq 0.1\%$ of span
 Repeatability $\leq 0.05\%$ of span
 1 yr. stability $\leq 0.2\%$ of span
 Response time $\leq 1 \text{ ms}$
 (10-90% full scale)
 Zero & span adjustment Approximately +/- 5.0% full scale

Temperature

Temperature compensated (+32°F to 175°F) (0°C to 80°C)
 Media (-25°F to 212°F) (-30°C to 100°C)
 Ambient (-5°F to 175°F) (-20 to 80°C)
 Storage (-40°F to 212°F) (-40°C to 100°C)

Temperature error (reference temperature 70 °F)

On zero (% of span/18 °F) ≤ 0.2
 On span (% of span/18 °F) ≤ 0.2

Process connection

1/2" NPT
 See price sheet for other options

Electrical connection

DIN 43650 Solderless Screw Terminal
 (IP 65 / NEMA 5)
 See options under wiring

Material

Wetted parts 316 stainless steel
 (891.13.501 - 316 SS,
 aluminum, silicon, gold)
 Body material 304 stainless steel

Transmitting liquid

Silicone oil
 Fluorocarbon oil available for O₂ service

Electrical protection

Protected against reverse polarity, short circuit output
 and suppressor diode for high-voltage protection

Vibration protection

Internal electronics 100% potted in silicone gel

Shock and vibration resistance

Shock: 1000g, 1ms per DIN IEC 68-2
 Vibration: 15-2000 Hz, 15g per DIN IEC 68-2

Wiring

2-Wire Current Loop

SIGNAL	DIN PLUG	WIRE COLOR
Supply +	Pin 1	Brown
Signal -	Pin 2	Green

3-Wire Voltage Output

SIGNAL	DIN PLUG	WIRE COLOR
Supply +	Pin 1	Brown
Supply-Signal-	Pin 2	Green
Signal+	Pin 3	White

Use pin 4 or blue wire for shield



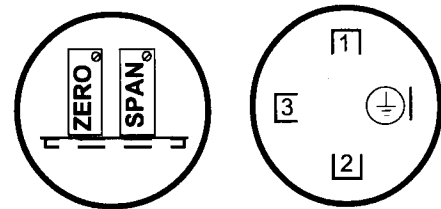
Electrical Connector Options

(Indicate connector part number in addition to transmitter part number or description.)

4 pin Mil Plug (PTO2E-8-4P IP65/NEMA 5)	8990935
6 pin Mil Plug (PTO2E-10-6P IP65/NEMA 5)	9744460
1.5 meter cable with free end (IP67 / NEMA 4)	9744479
DIN 43650 w/ 1/2" NPTF conduit connection (IP 65/NEMA 5)	1632159
DIN 43650 w/ integral 2 meter cable (IP 65 / NEMA 5)	9734821
DIN 43650 w/ integral RFI protection (IP 65 / NEMA 5)	1242733

All WIKA transmitters are calibrated at the factory. In the event calibration is required as a maintenance procedure, please use the following steps:

1. Remove cap
2. Set zero pot
3. Test zero
4. Set span pot
5. Test span
6. Replace cap



Ordering Information:

State computer part number (if available) / model number / range / output / connections required. See price sheet for special options.

WIKA reserves the right to make design changes without prior notice.

WIKA Instrument Head Office

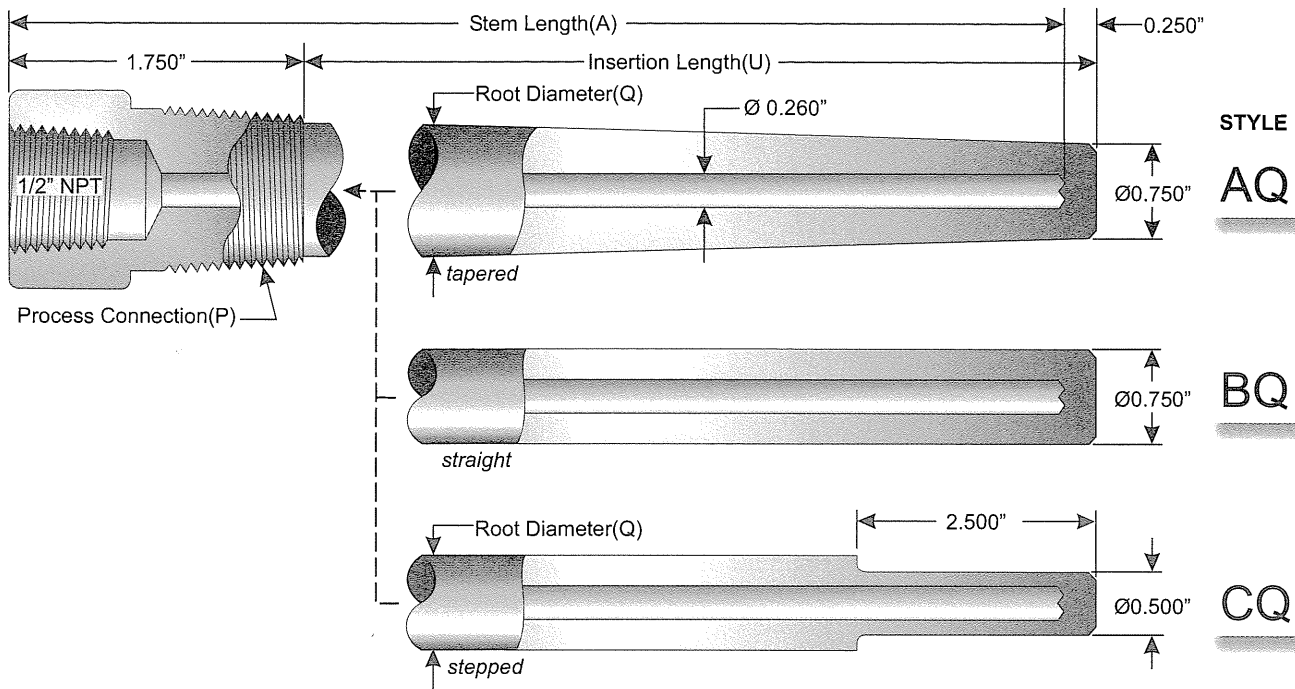
WIKA Instruments Canada Ltd.
 9220 - 25 Avenue, Edmonton, Alberta T6N 1E1
 TEL (780) 438-6662 FAX (780) 437-0889

WIKA Branch Office

1535 Meyerside Drive, Unit #6
 Mississauga, Ontario L5T 1M9
 TEL (905) 795-1677 Fax (905) 795-1669
<http://www.wika.ca>

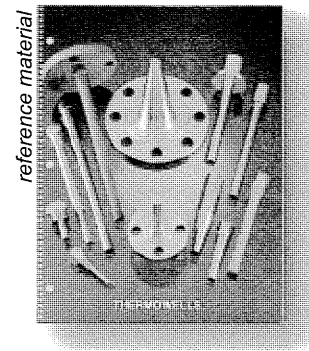
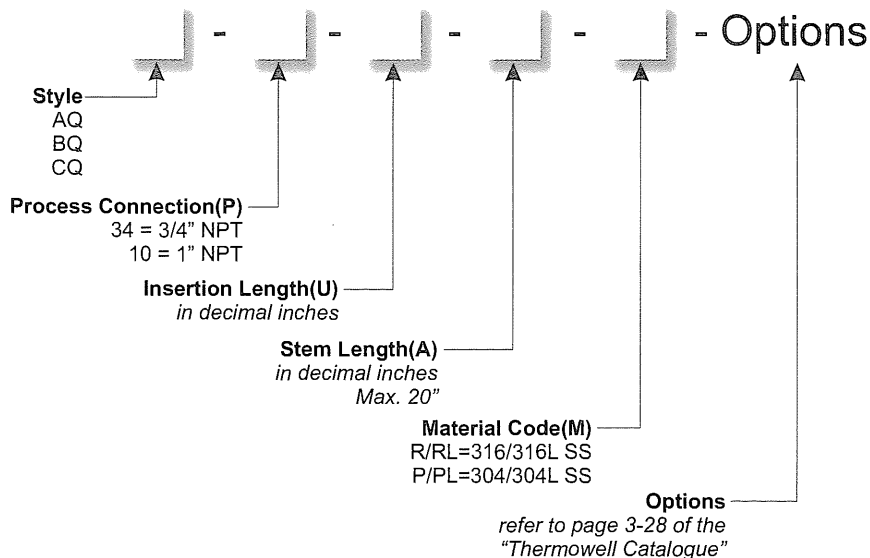


Quick Order Thermowells Styles A, B & C



Note:
The thermowell styles on this page have the following default fixed values of:
Root Diameter (Q).....0.875" dia. For 3/4" NPT, 1.063" dia. For 1" NPT, style AQ only
0.750" dia. For 3/4" NPT, 0.875" dia. For 1" NPT, style CQ only
Please refer to the WIKA Instruments "Thermowell Catalogue" for customized solutions to the above values.

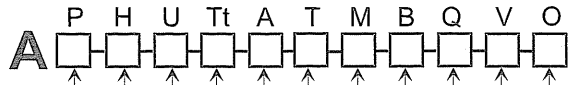
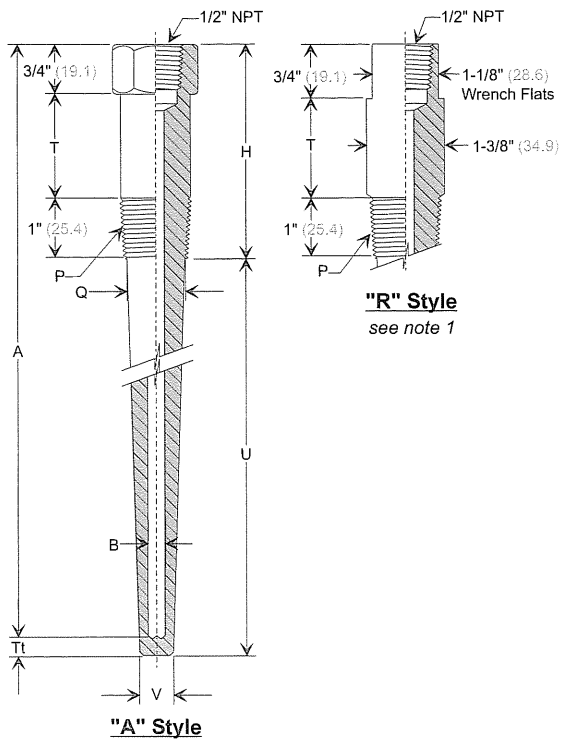
Ordering Code



WIKA Instruments
Thermowell Catalogue

Sample Order Code: AQ-10-6 000-7.500-R/RL - options

A-Style Threaded Tapered Thermowells

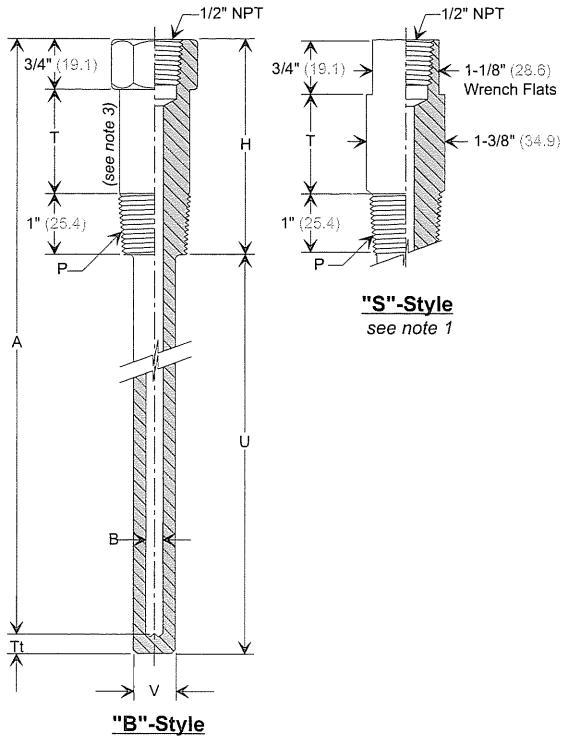


- P - Process Connection**
 34 = 3/4" NPT
 10 = 1" NPT
 Other
- H - Head Length**
 1.750" (44.5), min.
 Other
- U - Insertion Length**
 decimal units
- Tt - Tip Thickness**
 0.250" (6.4)
 Other
- A - Stem Length**
 decimal units
- T - Lag Length**
 decimal units
- M - Material**
 refer to table 2.0 on page 3-29
- B - Bore Size**
 0.260" (6.6)
 0.385" (9.8)
 Other
- Q - Root Diameter**
 1.063" (27.0), for 1" NPT
 0.875" (22.2), for 3/4" NPT
 Other
- V - Tip Diameter**
 0.625" (15.9)
 0.750" (19.1)
 Other
- O - Options**
 refer to page 3-28

Sample Part No.: A34 - 4.000" - 6.000" - 0.250" - 9.750" - 2.250" - R/RL - 0.260" - 0.875" - 0.750" - DR11a, SC3

Notes

1. Use an 'R-Style' thermowell when the Stem Length 'A' is greater than 20" (508) or when using round bar.
 Refer to table 2.0 on page 3-29 for readily available bar types
2. Contact a sales representative when requiring a thermowell not listed in this catalogue.
3. Metric dimensions are in brackets.



B P H U Tt A T M B V O

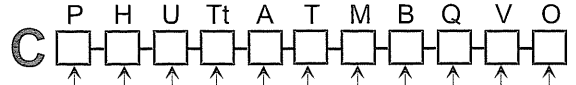
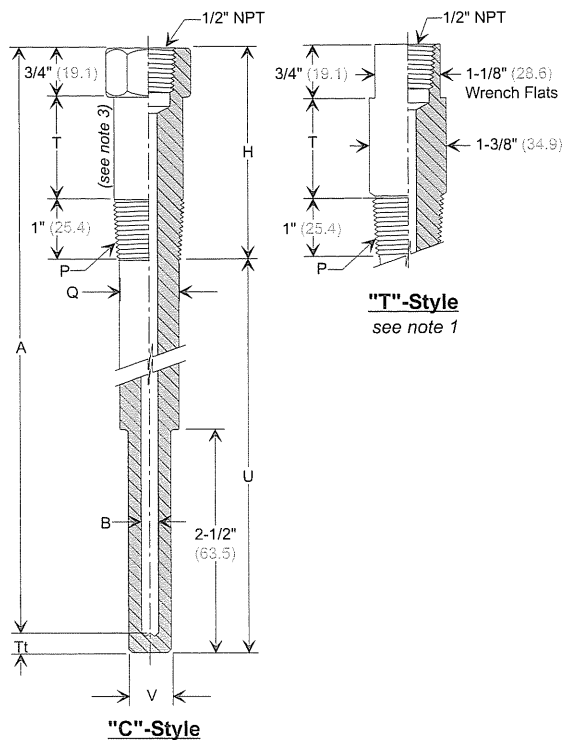
- P - Process Connection**
 12 = 1/2" NPT, *see note 3*
 34 = 3/4" NPT
 10 = 1" NPT
 Other
- H - Head Length**
 1.750" (44.5), *min. for 3/4" & 1" NPT*
 2.000" (50.8), *min. for 1/2" NPT, see note 3*
 Other
- U - Insertion Length**
 decimal units
- Tt - Tip Thickness**
 0.250" (6.4)
 Other
- A - Stem Length**
 decimal units
- T - Lag Length**
 decimal units
- M - Material**
refer to table 2.0 on page 3-29
- B - Bore Size**
 0.260" (6.6)
 0.385" (9.8)
 0.512" (13.0)
 0.702" (17.8)
 Other
- V - Tip Diameter**
 0.625" (15.9), *for 1/2" NPT*
 0.750" (19.1), *for 3/4" NPT*
 0.875" (22.2), *for 1" NPT*
 Other
- O - Options**
refer to page 3-28

Sample Part No.: B34 - 4.000" - 6.000" - 0.250" - 9.750" - 2.250" - R/RL - 0.260" - 0.750" - DR11a, SC3

Notes

1. Use an 'S-Style' thermowell when the Stem Length 'A' is greater than 20" (508) or when using round bar.
 Refer to table 2.0 on page 3-29 for readily available bar types.
2. Contact a sales representative when requiring a thermowell not listed in this catalogue.
3. For 1/2" NPT process connection the hex length is 1-1/8" (28.6) and the thread length is 7/8" (22.2).
4. Metric dimensions are in brackets.

C-Style Threaded Stepped Thermowells



- P - Process Connection**
 12 = 1/2" NPT, *see note 3*
 34 = 3/4" NPT
 10 = 1" NPT
 Other
- H - Head Length**
 1.750" (44.5), *min. for 3/4" & 1" NPT*
 2.000" (50.8), *min. for 1/2" NPT, see note 3*
 Other
- U - Insertion Length**
 decimal units
- Tt - Tip Thickness**
 0.250" (6.4)
 Other
- A - Stem Length**
 decimal units
- T - Lag Length**
 decimal units
- M - Material**
refer to table 2.0 on page 3-29
- B - Bore Size**
 0.260" (6.6)
 Other
- Q - Root Diameter**
 0.625" (15.9), *for 1/2" NPT*
 0.750" (19.1), *for 3/4" NPT*
 1.000" (25.4), *for 1" NPT*
 Other
- V - Tip Diameter**
 0.500" (12.7)
 Other
- O - Options**
refer to page 3-28

Sample Part No.: C34 - 4.000" - 6.000" - 0.250" - 9.750" - 2.250" - R/RL - 0.260" - 0.750" - 0.500" - DR11a, SC3

Notes

1. Use an 'T-Style' thermowell when the Stem Length 'A' is greater than 20" (508) or when using round bar. Refer to table 2.0 on page 3-29 for readily available bar types.
2. Contact a sales representative when requiring a thermowell not listed in this catalogue.
3. For 1/2" NPT process connection the hex length is 1-1/8" (28.6) and the thread length is 7/8" (22.2).
4. Metric dimensions are in brackets.

ENERFLEX

MATERIAL SAFETY DATA SHEETS

Carbon Monoxide, Carbon Dioxide and Oxides of Nitrogen.

===== SECTION V - REACTIVITY DATA =====

CHEMICAL STABILITY: STABLE

CONDITIONS TO AVOID

Excessive heat, Poor ventilation, Corrosive atmospheres, Excessive aging.

INCOMPATIBILITY (MATERIALS TO AVOID)

Alkaline materials, strong acids and oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

HAZARDOUS POLYMERIZATION: Will not occur.

===== SECTION VI - TOXICOLOGICAL DATA =====

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause respiratory irritation, dizziness, breathing difficulty, headaches and loss of co-ordination.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Eye Contact: May cause severe irritation, tearing, redness and blurred vision.

Skin Contact: May cause irritation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May dry and defat skin causing cracks, irritation and dermatitis.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause gastrointestinal irritation, vomiting, nausea and diarrhea.

HEALTH HAZARDS (ACUTE AND CHRONIC)

Acute health hazards are as listed above.

No chronic health hazards.

SENSITIZING CAPABILITY: NONE KNOWN

CARCINOGENICITY: NTP CARCINOGEN: No IARC MONOGRAPHS: Yes OSHA REGULATED: No
Ethylbenzene has been classified by the IARC as a Group 2B substance on the basis of sufficient evidence for carcinogenicity in laboratory animals but inadequate evidence for cancer in humans.

TERATOGENICITY AND EMBRYOTOXICITY

High exposures to xylenes in some animal studies have been reported to cause health effects on the developing embryo/fetus. These effects were often at levels toxic to the mother. The significance of these findings to humans has not been determined.

REPRODUCTIVE TOXICITY

Not available.

MUTAGENICITY

Not available.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS

None known.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Anesthesia, respiratory tract irritation, dermatitis, nausea, vomiting.

===== SECTION VII - PREVENTIVE MEASURES =====

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Eliminate ignition sources. Provide good ventilation or wear appropriate breathing apparatus. Absorb small spills with non-flammable absorbent. Contain spills by diking with non-flammable absorbent. Notify environmental agency.

WASTE DISPOSAL METHOD

Reclaim or dispose of through a licensed waste disposal company according to Federal, Provincial and local regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Flammable. Store in a cool, dry, well ventilated area away from heat and ignition sources. Keep containers closed when not in use. Avoid breathing vapours or mist and prolonged or repeated contact with skin. Launder contaminated clothing prior to re-use. Use good personal hygiene. Product is a static accumulator. Transfer equipment should be grounded or bonded.

OTHER PRECAUTIONS

Smoking in the area where this material is used must be strictly prohibited.

RESPIRATORY PROTECTION

NIOSH approved for organic vapours and particulate matter.

VENTILATION

General mechanical ventilation or local exhaust should be suitable to keep vapour concentrations below TLV. Ventilation equipment must be explosion proof. Make up air should be supplied to balance air exhausted.

PROTECTIVE GLOVES

Solvent impervious e.g. Viton,Nitrile,PVC.

EYE PROTECTION

Chemical safety glasses, goggles or face shield.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Use impermeable aprons and protective clothing whenever possible to prevent skin contact.

WORK/HYGIENIC PRACTICES

Eye washes and safety showers in the workplace are recommended.

===== SECTION VIII - FIRST AID MEASURES =====

INHALATION OVEREXPOSURE: Move person to fresh air. If breathing stops, apply artificial respiration and seek immediate medical attention.

EYE CONTACT: Flush with water for at least 15 minutes. Seek medical attention:

SKIN CONTACT: Wash thoroughly with mild soap and water.

INGESTION: Do not induce vomiting. Aspiration of solvents in this product can cause inflammation of the lungs.

===== SECTION IX - PREPARATION =====

PREPARED BY: TECHNICAL DEPARTMENT

===== SECTION X - DISCLAIMER =====

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AUTO-IGNITION TEMPERATURE:
Not available

SENSITIVITY TO STATIC DISCHARGE: Yes

HAZARDOUS COMBUSTION PRODUCTS:
Carbon Monoxide, Carbon Dioxide and Oxides of Nitrogen.

===== SECTION V - REACTIVITY DATA =====

CHEMICAL STABILITY: STABLE

CONDITIONS TO AVOID:
Excessive heat, poor ventilation, corrosive atmospheres, excessive aging.

INCOMPATIBILITY (MATERIALS TO AVOID)
Alkaline materials, strong acids and oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

HAZARDOUS POLYMERIZATION:
Will not occur.

===== SECTION VI - TOXICOLOGICAL DATA =====

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May cause respiratory irritation, dizziness, breathing difficulty, headaches and loss of co-ordination.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Eye Contact: May cause severe irritation, tearing, redness and blurred vision.
Skin Contact: May cause irritation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May dry and defat skin causing cracks, irritation and dermatitis.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May cause gastrointestinal irritation, vomiting, nausea and diarrhea.

HEALTH HAZARDS (ACUTE AND CHRONIC)
Acute health hazards are as listed above. No chronic health hazards.

SENSITIZING CAPABILITY: NONE KNOWN

CARCINOGENICITY: NTP CARCINOGEN:No IARC MONOGRAPHS:Yes OSHA REGULATED:No
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REPRODUCTIVE TOXICITY
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MUTAGENICITY
Not available.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS
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EYE PROTECTION

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OTHER PROTECTIVE CLOTHING OR EQUIPMENT

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INCOMPATIBILITY (MATERIALS TO AVOID)

Alkaline materials, strong acids and oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

HAZARDOUS POLYMERIZATION:

Will not occur.

===== SECTION VI - TOXICOLOGICAL DATA =====

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause respiratory irritation, dizziness, breathing difficulty, headaches and loss of co-ordination.

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INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause gastrointestinal irritation, vomiting, nausea and diarrhea.

HEALTH HAZARDS (ACUTE AND CHRONIC)

Acute health hazards are as listed above. No chronic health hazards.

SENSITIZING CAPABILITY: NONE KNOWN

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REPRODUCTIVE TOXICITY

Not available.

MUTAGENICITY

Not available.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS

None known.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Anesthesia, respiratory tract irritation, dermatitis, nausea, vomiting.

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Chemical safety glasses, goggles or face shield.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

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M A T E R I A L S A F E T Y D A T A S H E E T

Prod.ID: 83203

===== SECTION I - PRODUCT IDENTIFICATION =====

PRODUCT NAME: HI-HEAT ALUMINUM

PRODUCT IDENTIFIER: 83203

HMIS CODES: H 1 F 2 R 0 P H

PRODUCT USE: General purpose coating.

PRODUCT IDENTIFICATION NUMBER: UN1263

WHMIS INFO:

MANUFACTURER'S NAME: Cloverdale Paint Inc

ADDRESS : 6950 King George Hwy

Surrey, BC,

EMERGENCY PHONE : 613-996-6666

REVISION DATE : 31-Mar-04

INFORMATION PHONE : 604-596-6261

ABBREVIATIONS : N/AP - NOT APPLICABLE N/AV - NOT AVAILABLE

===== SECTION II - HAZARDOUS INGREDIENTS =====

REPORTABLE COMPONENTS	CAS NUMBER	WEIGHT PERCENT	O.E.L.
*XYLENE	1330-20-	15-40	
	7		ACGIH TLV: 100 PPM LD50: ORAL:4g/kg rat, LC50: 6500 ppm/4H(RAT) LD50: SKIN:5000 mg/kg (RABBIT)
*TOLUENE	108-88-	7-13	
	3		ACGIH TLV: 100 ppm LD50: >2g/kg ORAL RAT, LC50: 8000 ppm/4H(RAT)
ETHYLBENZENE	100-41-	5-10	
	4		TWA: 100ppm LD50 (ORAL-RAT): 3500 mg/kg LD50: SKIN:17800 mg/kg (RABBIT)
*ALUMINUM POWDER	7429-90-	5-10	
	5		TWA: 10 mg/m3
STODDARD SOLVENT	8052-41-	1-5	
	3		ACGIH TLV: 100 ppm LD50: ORAL:>5g/kg (RAT), LC50:>5g/M3/4H (RAT)

* Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.

===== SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS =====

BOILING POINT: Not available. SPECIFIC GRAVITY (H2O=1): 1.00
 VAPOR DENSITY: Heavier than air. PHYSICAL STATE: Liquid.
 EVAPORATION RATE: Slower than n-Butyl Acetate.
 COATING V.O.C.: 634 g/l
 SOLUBILITY IN WATER: Insoluble.
 APPEARANCE AND ODOR: Moderately thick liquid; Aromatic odor.
 FREEZING POINT: Not available. pH: Not available.
 COEFFICIENT OF WATER/OIL DIST: N/AV ODOR THRESHOLD:1-30 ppm

===== SECTION IV - FIRE AND EXPLOSION HAZARD DATA =====

FLASH POINT: 6 C METHOD USED: Not available.
 FLAMMABLE LIMITS IN AIR BY VOLUME- LOWER: 1.0 UPPER: 7.1

EXTINGUISHING MEDIA:
 Foam, CO2, dry chemical, water fog.

SPECIAL FIREFIGHTING PROCEDURES
 Respiratory equipment should be worn to avoid inhalation of concentrated vapours. Water should not be used except as a fog to keep nearby containers cool.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Handle as a flammable liquid. Vapours form an explosive mixture in air between the upper and lower explosive limits, which, can be ignited by many sources such as pilot lights, open flames, electrical

boxes and switches. Vapour may travel along the ground and flashback along vapour trail may occur.

FLAMMABILITY - T.D.G.R. CLASS:
TDG CLASS 3

SENSITIVITY TO IMPACT: NO

AUTO-IGNITION TEMPERATURE:
Not available

SENSITIVITY TO STATIC DISCHARGE: Yes

HAZARDOUS COMBUSTION PRODUCTS:
Carbon Monoxide, Carbon Dioxide and Oxides of Nitrogen.

===== SECTION V - REACTIVITY DATA =====

CHEMICAL STABILITY: STABLE

CONDITIONS TO AVOID:
Excessive heat, poor ventilation, corrosive atmospheres, excessive aging.

INCOMPATIBILITY (MATERIALS TO AVOID)
Alkaline materials, strong acids and oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

HAZARDOUS POLYMERIZATION:
Will not occur.

===== SECTION VI - TOXICOLOGICAL DATA =====

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May cause respiratory irritation, dizziness, breathing difficulty, headaches and loss of co-ordination.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE
Eye Contact: May cause severe irritation, tearing, redness and blurred vision.
Skin Contact: May cause irritation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May dry and defat skin causing cracks, irritation and dermatitis.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE
May cause gastrointestinal irritation, vomiting, nausea and diarrhea.

HEALTH HAZARDS (ACUTE AND CHRONIC)
Acute health hazards are as listed above. No chronic health hazards.

SENSITIZING CAPABILITY: NONE KNOWN

CARCINOGENICITY: NTP CARCINOGEN:No IARC MONOGRAPHS:Yes OSHA REGULATED:No
Ethylbenzene has been classified by the IARC as a Group 2B substance on the basis of sufficient evidence for carcinogenicity in laboratory animals but inadequate evidence for cancer in humans.

TERATOGENICITY AND EMBRYOTOXICITY
High exposures to xylenes in some animal studies have been reported to cause health effects on the developing embryo/fetus. These effects were often at levels toxic to the mother. The significance of these findings to humans has not been determined.

REPRODUCTIVE TOXICITY
Not available.

MUTAGENICITY
Not available.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS
None known.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
Anesthesia, respiratory tract irritation, dermatitis, nausea, vomiting.

=====
SECTION VII - PREVENTIVE MEASURES
=====

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

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WASTE DISPOSAL METHOD

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OTHER PRECAUTIONS: Smoking in the area where this material is used must be strictly prohibited.

RESPIRATORY PROTECTION

NIOSH approved for organic vapours and particulate matter.

VENTILATION

General mechanical ventilation or local exhaust should be suitable to keep vapour concentrations below TLV. Ventilation equipment must be explosion proof. Make up air should be supplied to balance air exhausted.

PROTECTIVE GLOVES

Solvent impervious e.g. Viton, Nitrile, PVC.

EYE PROTECTION

Chemical safety glasses, goggles or face shield.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Use impermeable aprons and protective clothing whenever possible to prevent skin contact.

WORK/HYGIENIC PRACTICES

Eye washes and safety showers in the workplace are recommended.

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SECTION VIII - FIRST AID MEASURES
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PREPARED BY: TECHNICAL DEPARTMENT

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INCOMPATIBILITY (MATERIALS TO AVOID)
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HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

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MATERIAL SAFETY DATA SHEET

Print date: 30-Aug-2006

Revision Number: 0

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product name: NGP-150
Synonyms: No information available
Chemical characterisation: No data is available on the product itself.

Supplier:
Summit Industrial Products
9010 County Road 2120
Tyler, Texas 75707
Phone: (903) 534-8021
Fax: (903) 581-4376

Emergency telephone number CHEMTREC: 1-800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS-No	ACGIH (TWA mg/m ³):	OSHA:
Distillates (Petroleum), Hydrotreated Heavy Paraffinic	64742-54-7	None	None

3. HAZARDS IDENTIFICATION

Properties affecting health: None.
Principle routes of exposure: Skin.
Skin contact: May cause eye/skin irritation.
Eye contact: May cause slight irritation.
Inhalation: Avoid breathing vapors or mists.
Ingestion: Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea

4. FIRST AID MEASURES

General advice: No hazards which require special first aid measures.
Skin contact: Wash off immediately with soap and plenty of water.
Inhalation: In the case of inhalation of aerosol/mist consult a physician if necessary. Move to fresh air.

Eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
Ingestion: Consult a physician if necessary. Drink 1 or 2 glasses of water. Never give anything by mouth to an unconscious person.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media:
Dry chemical, Carbon dioxide (CO₂), Foam, Water spray

Extinguishing media which must not be used for safety reasons:
No information available..

Special protective equipment for firefighters:
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Specific hazards: No information available.
Unusual hazards: No hazards resulting from the material as supplied
Specific methods: In the event of fire, cool tanks with water spray

Flash point: > 400 (°F)
Method: Cleveland Open Cup
Autoignition temperature: No information available

Flammability Limits in Air:
Lower No information available
Upper No information available

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Contaminated surfaces will be extremely slippery.
Environmental precautions: Do not flush into surface water or sanitary sewer system.
Methods for cleaning up: Absorb spill with inert material (e.g. dry sand or earth), then place in a chemical waste container.

7. HANDLING AND STORAGE

Handling
Technical measures/precautions: No special technical protective measures required.
Safe handling advice: No special precautions required

Storage
Technical measures/storage conditions: Keep containers dry and tightly closed to avoid moisture absorption and contamination.
Incompatible products: No special restrictions on storage with other products.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure:
In case of insufficient ventilation wear suitable respiratory equipment..

Personal Protective Equipment
Respiratory protection: Not required; except in case of aerosol formation.
Hand protection: Nitrile rubber.

Skin and body protection: Usual safety precautions while handling the product will provide adequate protection against this potential effect.

Eye protection: Safety glasses

Hygiene measures: Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid	Appearance:	Liquid
Color:	Clear	Odor:	Mild
Specific gravity:	0.875	Boiling point/range	No information available
Evaporation rate:	Not determined	Vapor density:	Not determined
Vapor pressure:	Not determined	Solubility:	Insoluble

10. STABILITY AND REACTIVITY

Stability:	Stable under recommended storage conditions.
Polymerization:	Hazardous polymerisation does not occur.
Hazardous decomposition products:	None under normal use
Materials to avoid:	Oxidising agents (strong).
Conditions to avoid:	Stable at normal conditions

11. TOXICOLOGICAL INFORMATION

Acute toxicity No data available

12. ECOLOGICAL INFORMATION

Mobility: No information available.

Bioaccumulative potential: Not determined.

Ecotoxicity effects: No data is available on the product itself..

Aquatic toxicity: No information available.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products: In accordance with local and national regulations.

Contaminated packaging: Empty containers should be taken for local recycling, recovery or waste disposal

14. TRANSPORT INFORMATION

DOT

Proper shipping name: Not Applicable

TDG (Canada)

Proper shipping name: Not Applicable

IMO / IMDG

Proper shipping name: Not Applicable

ICAO

Proper shipping name: Not Applicable

IATA

Proper shipping name: Not Applicable

15. REGULATORY INFORMATION

International Inventories

- PICCS:** This product does not comply with phil:
- TSCA:** Listed in TSCA
- DSL:** All of the components in this product are listed in DSL
- ENCS:** This product does not comply with JPENCS
- CHINA:** This product complies with china:
- AICS:** This product does not comply with AICS
- KECL:** This product does not comply with korea:
- EINECS/ELINCS** This product complies with EINECS/ELINCS

U.S. Regulations:

Sara (311, 312) hazard class:

Canada

WHMIS hazard class:
Non-controlled

16. OTHER INFORMATION

NFPA	Health:	1	Flammability:	1	Instability:	0
HMIS	Health:	1	Flammability:	1	Physical Hazard:	0

NFPA symbol:



Reason for revision: Not applicable
Prepared by: Health & Safety

The information and recommendations contained herein are based upon tests believed to be reliable. However, your company does not guarantee their accuracy or completeness NOR SHALL ANY OF THIS INFORMATION CONSTITUTE A WARRANTY, WHETHER EXPRESSED OR IMPLIED, AS TO THE SAFETY OF THE GOODS, THE MERCHANTABILITY OF THE GOODS, OR THE FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE. Adjustment to conform to actual conditions of usage maybe required. Your company assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied.



WHMIS (Pictograms)	WHMIS (Classification)	Protective Clothing	TDG (pictograms)
	Not controlled		

Section 1. Chemical Product and Company Identification			
Product Name	SENTRON 445	Code	460-110, STL445
Synonym	Not available	Validated on	6/29/2006.
Manufacturer	PETRO-CANADA P.O. Box 2844 Calgary, Alberta T2P 3E3	In case of Emergency	Petro-Canada: 403-296-3000 Canutec Transportation: 613-996-6666 Poison Control Centre: Consult local telephone directory for emergency number(s).
Material Uses	Sentron oils are designed for use in stationary, spark-ignition, natural gas fuelled engines.		

Section 2. Composition and Information on Ingredients						
				<i>Exposure Limits (ACGIH)</i>		
Name	CAS #	% (V/V)	TLV-TWA(8 h)	STEL	CEILING	
Mixture of severely hydrotreated and hydrocracked base oil (petroleum) and other proprietary, non-hazardous additives.	Mixture	100	5 mg/m ³ (oil mist)	10 mg/m ³ (oil mist)	Not established	
Manufacturer Recommendation	Not applicable					
Other Exposure Limits	Consult local, state, provincial or territory authorities for acceptable exposure limits.					

Section 3. Hazards Identification.	
Potential Health Effects	Prolonged or repeated contact may cause skin irritation, defatting, drying and dermatitis. Not expected to cause more than slight skin or eye irritation. With its relatively low vapour pressure, this product is not expected to be inhaled in any appreciable quantity at ambient conditions. If heated to high temperatures or subjected to mechanical actions which produce vapours or mists, inhalation may cause respiratory tract irritation. Ingestion may produce a laxative effect. For more information refer to Section 11 of this MSDS.

Section 4. First Aid Measures	
Eye Contact	No effects expected. If irritation does occur, flush contaminated eye(s) with lukewarm, gently flowing water for 5 minutes or until the chemical is removed. If irritation persists, obtain medical advice.
Skin Contact	Quickly and gently, blot or brush away excess chemical. Wash gently and thoroughly with water and non-abrasive soap for 5 minutes or until chemical is removed. Remove contaminated clothing, shoes and leather goods (e.g., watchbands, belts, etc.). If irritation persists, repeat flushing. Obtain medical advice immediately. Completely decontaminate clothing, shoes and leather goods before reuse or discard.
Inhalation	Remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
Ingestion	NEVER give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. DO NOT INDUCE VOMITING. Have victim drink 240 to 300 mL (8 to 10 oz) of water to dilute material in stomach. If vomiting occurs naturally, rinse mouth and repeat administration of water. Obtain medical attention.
Note to Physician	Not available

Section 5. Fire-fighting Measures			
Flammability	May be combustible at high temperature.	Flammable Limits	Not available
Flash Points	Open cup: 230°C (446°F) (Cleveland.).	Auto-ignition Temperature	Fire Point: 278°C (532.4°F)
Fire Hazards in Presence of Various Substances	Low fire hazard. This material must be heated before ignition will occur.	Explosion Hazards in Presence of Various Substances	Do not cut, weld, heat, drill or pressurize empty container. Containers may explode in heat of fire.

Products of Combustion	Carbon oxides (CO, CO ₂), nitrogen oxides (NO _x), sulphur oxides (SO _x), phosphorus compounds (PO _x), zinc oxides (ZnO _x), calcium oxides (CaO _x), smoke and irritating vapours as products of incomplete combustion.
Fire Fighting Media and Instructions	NAERG2004, GUIDE 171, Substances (low to moderate hazard). If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (0.5 mile) in all directions; also, consider initial evacuation for 800 meters (0.5 mile) in all directions. Shut off fuel to fire if it is possible to do so without hazard. If this is impossible, withdraw from area and let fire burn out under controlled conditions. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Cool containing vessels with water spray in order to prevent pressure build-up, autoignition or explosion. SMALL FIRE: use DRY chemicals, foam, water spray or CO ₂ . LARGE FIRE: use water spray, fog or foam. For small outdoor fires, portable fire extinguishers may be used, and self contained breathing apparatus (SCBA) may not be required. For all indoor fires and any significant outdoor fires, SCBA is required. Respiratory and eye protection are required for fire fighting personnel.

Section 6. Accidental Release Measures

Material Release or Spill	Consult current National Emergency Response Guide Book (NAERG) for appropriate spill measures if necessary. Ensure clean-up personnel wear appropriate personal protective equipment. Extinguish all ignition sources. Stop leak if safe to do so. Dike spilled material. Use appropriate inert absorbent material to absorb spilled product. Collect used absorbent for later disposal. Avoid contact with spilled material. Avoid contaminating sewers, streams, rivers and other water courses with spilled material. Notify appropriate authorities immediately.
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Section 7. Handling and Storage

Handling	Avoid contact with any sources of ignition, flames, heat, and sparks. Avoid skin contact. Avoid eye contact. Avoid inhalation of product vapours or mists. Wear proper personal protective equipment (See Section 8). Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse containers without commercial cleaning and/or reconditioning. Personnel who handle this material should practice good personal hygiene during and after handling to help prevent accidental ingestion of this product. Properly dispose of contaminated leather articles including shoes that cannot be decontaminated.
Storage	Store in dry, cool, well-ventilated area. Keep container tightly closed. Store away from incompatible and reactive materials (See section 5 and 10).

Section 8. Exposure Controls/Personal Protection

Engineering Controls	For normal application, special ventilation is not necessary. If user's operations generate vapours or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit. Make-up air should always be supplied to balance air removed by exhaust ventilation. Ensure that eyewash station and safety shower are close to work-station.
Personal Protection - <i>The selection of personal protective equipment varies, depending upon conditions of use.</i>	
Eyes	As a minimum, safety glasses with side shields should be worn when handling this material.
Body	If this material may come in contact with the body during handling and use, we recommend wearing appropriate protective clothing to prevent contact with the skin. (Contact your PPE provider for more information.)
Respiratory	A NIOSH-approved air-purifying respirator with an organic vapour cartridge or canister with a dust, fume or mist filter (R, or P series) may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. A NIOSH-approved positive-pressure, air-supplied respirator or self-contained breathing apparatus may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.
Hands	If this material may come in contact with the hands during handling and use, we recommend wearing gloves of the following material(s): neoprene, nitrile, polyvinyl alcohol (PVA), fluoro-elastomer. Consult your PPE provider for breakthrough times and the specific glove that is best for you based on your use patterns. It should be realized that eventually any material regardless of their imperviousness, will get permeated by chemicals. Therefore, protective gloves should be regularly checked for wear and tear. At the first signs of hardening and cracks, they should be changed.
Feet	Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section 9. Physical and Chemical Properties

Physical State and Appearance	Viscous liquid.	Viscosity	125.5 cSt @ 40°C (104°F), 13.3 cSt @ 100°C (212°F), VI=101
Colour	Light amber or yellow.	Pour Point	-24°C (-11°F)
Odour	Mild petroleum oil like.	Softening Point	Not applicable
Odour Threshold	Not available	Dropping Point	Not applicable
Boiling Point	Not available	Penetration	Not applicable
Density	0.8775 kg/L @ 15°C (59°F).	Oil / Water Dist. Coefficient	Not available

Vapour Density	Not available	Ionicity (in water)	Not available
Vapour Pressure	Negligible at ambient temperature and pressure.	Dispersion Properties	Not available
Volatility	Not available	Solubility	Insoluble in water.

Section 10. Stability and Reactivity

Corrosivity	Not available		
Stability	The product is stable under normal handling and storage conditions.	Hazardous Polymerization	Will not occur under normal working conditions.
Incompatible Substances / Conditions to Avoid	Reactive with oxidizing agents and acids.	Decomposition Products	May release CO _x , H ₂ S, SiO _x , methacrylate monomers, aldehydes, smoke and irritating vapours when heated to decomposition.

Section 11. Toxicological Information

Routes of Entry	Skin contact, eye contact, inhalation and ingestion.
Acute Lethality	Acute toxicity information is not available for the product as a whole, therefore, data for the base oils are provided below: Acute Oral toxicity (LD50): >5000 mg/kg (rat) Acute Dermal toxicity (LD50): >2000 mg/kg (rabbit)
Chronic or Other Toxic Effects	
Dermal Route:	Prolonged or repeated contact may defat and dry skin, and cause dermatitis. Short-term exposure is expected to cause only slight irritation, if any.
Inhalation Route:	With its relatively low vapour pressure, this product is not expected to be inhaled in any appreciable quantity at ambient conditions. If heated to high temperatures or subjected to mechanical actions which produce vapours or mists, inhalation may cause respiratory tract irritation.
Oral Route:	Ingestion of this product may lead to aspiration of the liquid, especially if vomiting occurs. This may result in chemical pneumonitis (inflammation of the lungs) and/or pulmonary edema (an accumulation of fluid in the lungs). May produce a laxative effect.
Eye Irritation/Inflammation:	Short-term exposure is expected to cause only slight irritation, if any.
Immunotoxicity:	Not available
Skin Sensitization:	Contact with this product is not expected to cause skin sensitization, based upon the available data and the known hazards of the components.
Respiratory Tract Sensitization:	Contact with this product is not expected to cause respiratory tract sensitization, based upon the available data and the known hazards of the components.
Mutagenic:	This product is not known to contain any components at $\geq 0.1\%$ that have been shown to cause mutagenicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a mutagen.
Reproductive Toxicity:	This product is not known to contain any components at $\geq 0.1\%$ that have been shown to cause reproductive toxicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a reproductive toxin.
Teratogenicity/Embryotoxicity:	This product is not known to contain any components at $\geq 0.1\%$ that have been shown to cause teratogenicity and/or embryotoxicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a teratogen/embryotoxin.
Carcinogenicity (ACGIH):	This product is not known to contain any chemicals at reportable quantities that are listed as Group A1 or A2 carcinogens by ACGIH.
Carcinogenicity (IARC):	This product is not known to contain any chemicals at reportable quantities that are listed as Group 1, 2A, or 2B carcinogens by IARC.
Carcinogenicity (NTP):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by NTP.
Carcinogenicity (IRIS):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by IRIS.
Carcinogenicity (OSHA):	This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by OSHA.
Other Considerations	No additional remark.

Section 12. Ecological Information

Environmental Fate	Not available	Persistence/ Bioaccumulation Potential	Not available
BOD5 and COD	Not available	Products of Biodegradation	Not available
Additional Remarks No additional remark.			

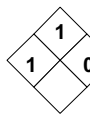
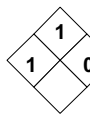
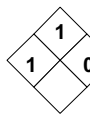
Section 13. Disposal Considerations

Waste Disposal	Spent/ used/ waste product may meet the requirements of a hazardous waste. Consult your local or regional authorities. Ensure that waste management processes are in compliance with government requirements and local disposal regulations.
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Section 14. Transport Information

TDG Classification	Not controlled under TDG (Canada).	Special Provisions for Transport	Not applicable.
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Section 15. Regulatory Information

Other Regulations	<p>This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List).</p> <p>All components of this formulation are listed on the US EPA-TSCA Inventory.</p> <p>This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.</p> <p>Please contact Product Safety for more information.</p>																																																										
DSD/DPD (Europe)	For European classification and inventory information please see the European version of this MSDS.	HCS (U.S.A.)	Does not meet the definitions of a health or physical hazard according to the OSHA - Hazard Communication Standard. (United States)																																																								
ADR (Europe) (Pictograms)	<p>NOT EVALUATED FOR EUROPEAN TRANSPORT</p> <p>NON ÉVALUÉ POUR LE TRANSPORT EUROPÉEN.</p>	DOT (U.S.A) (Pictograms)	<p>Not evaluated for transport</p> <p>Non évalué pour le transport</p>																																																								
HMIS (U.S.A.)	<table border="1"> <tr> <td>Health Hazard</td> <td>1</td> </tr> <tr> <td>Fire Hazard</td> <td>1</td> </tr> <tr> <td>Reactivity</td> <td>0</td> </tr> <tr> <td>Personal Protection</td> <td>B</td> </tr> </table>	Health Hazard	1	Fire Hazard	1	Reactivity	0	Personal Protection	B	NFPA (U.S.A.)	<table border="1"> <tr> <td>Health</td> <td>1</td> <td>Fire Hazard</td> <td>0</td> <td>Reactivity</td> <td>0</td> </tr> <tr> <td colspan="6" style="text-align: center;">  </td> </tr> <tr> <td colspan="6">Rating</td> </tr> <tr> <td colspan="6">0 Insignificant</td> </tr> <tr> <td colspan="6">1 Slight</td> </tr> <tr> <td colspan="6">2 Moderate</td> </tr> <tr> <td colspan="6">3 High</td> </tr> <tr> <td colspan="6">4 Extreme</td> </tr> </table>	Health	1	Fire Hazard	0	Reactivity	0							Rating						0 Insignificant						1 Slight						2 Moderate						3 High						4 Extreme					
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Section 16. Other Information

References	<p>Available upon request.</p> <p>* Marque de commerce de Petro-Canada - Trademark</p>
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Glossary

ACGIH - American Conference of Governmental Industrial Hygienists	HCS - Hazardous Communication System
ADR - Agreement on Dangerous goods by Road (Europe)	HMIS - Hazardous Material Information System
ASTM - American Society for Testing and Materials	IARC - International Agency for Research on Cancer
BOD5 - Biological Oxygen Demand in 5 days	IRIS - Integrated Risk Information System
CAS - Chemical Abstract Services	LD50/LC50 - Lethal Dose/Concentration kill 50%
CEPA - Canadian Environmental Protection Act	LDLo/LCLo - Lowest Published Lethal Dose/Concentration
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act	NFPA - National Fire Prevention Association
CFR - Code of Federal Regulations	NIOSH - National Institute for Occupational Safety & Health
CHIP - Chemical Hazard Information and Packaging Approved Supply List	NPRI - National Pollutant Release Inventory
COD - Chemical Oxygen Demand	NSNR - New Substances Notification Regulations (Canada)
CPR - Controlled Products Regulations	NTP - National Toxicology Program
DOT - Department of Transportation (U.S.A.)	OSHA - Occupational Safety & Health Administration
DSCL - Dangerous Substances Classification and Labeling (Europe)	PEL - Permissible Exposure Limit
DSD/DPD - Dangerous Substance or Dangerous Preparations Directives (Europe)	RCRA - Resource Conservation and Recovery Act
DSL - Domestic Substance List (Canada)	SARA - Superfund Amendments and Reorganization Act
EEC/EU - European Economic Community/European Union	STEL - Short Term Exposure Limit (15 minutes)
EINECS - European Inventory of Existing Commercial Chemical Substances	TDG - Transportation Dangerous Goods (Canada)
EPCRA - Emergency Planning And Community Right-To-Know Act	TDLo/TCLo - Lowest Published Toxic Dose/Concentration
FDA - Food and Drug Administration	TLV-TWA - Threshold Limit Value-Time Weighted Average
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act	TLm - Median Tolerance Limit
	TSCA - Toxic Substances Control Act
	USEPA - United States Environmental Protection Agency
	USP - United States Pharmacopoeia
	WHMIS - Workplace Hazardous Material Information System

For Copy of MSDS

The Canadian Controlled Products Regulations (CPR) (Under the Hazardous Products Act, part of the WHMIS legislation) only apply to WHMIS Controlled (i.e., hazardous) products. Therefore, the CPR and the 3-year update rule specified therein do not apply to WHMIS Non-Controlled products. Although this is true, customarily Petro-Canada reviews and updates Non-Controlled product MSDS if a customer requests such an update. These Non-Controlled product updates are given a lower priority than Controlled products but are handled as soon as practicable. If you would like to verify if the MSDS you have is the most current, or you require any further information, please contact:

Internet: www.petro-canada.ca/msds

Lubricants:

Western Canada, telephone: 1-800-661-1199; fax: (780) 464-9564

Ontario & Central Canada, telephone: 1-800-268-5850 and (905) 822-4222; fax: 1-800-201-6285

Quebec & Eastern Canada, telephone: 1-800-576-1686; fax: 1-800-201-6285

For Product Safety Information: (905) 804-4752

Prepared by Product Safety - JDW on 6/29/2006.

Data entry by Product Safety - DSR.

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

2. COMPOSITION INFORMATION

Component: Ethylene glycol

CAS # %: 107-21-1

W/W: >=40.

Hazard: <=70% Toxic

Component: Water and processing additives

CAS# %: Not available

W/W: >=30.

Hazard: <60% WHMIS: Not Hazardous

Component: Dipotassium hydrogen phosphate

CAS# %: 7758-11-4

W/W: >=0.5

Hazard: <=1.5% WHMIS: Not Hazardous

3. HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Appearance: Transparent colorless

Physical State: Liquid

Odor: Mild

Hazards of product DANGER! HARMFUL OR FATAL IF SWALLOWED.

CAUSES EYE IRRITATION.

PROLONGED OR REPEATED BREATHING OF AEROSOL OR VAPOR IS HARMFUL.

MAY CAUSE KIDNEY AND NERVOUS SYSTEM DAMAGE. CONTAINS ETHYLENE GLYCOL - CAUSES BIRTH DEFECTS IN LABORATORY ANIMALS.

3.2 POTENTIAL HEALTH EFFECTS

Potential Effects of a Single Acute Exposure

Inhalation: May cause irritation of the nose and throat with headache, particularly from mist. High vapor concentrations caused, for example, by heating the material in an enclosed and poorly ventilated workplace, may produce nausea, vomiting, headache, dizziness, and irregular eye movements.

Eye Contact: Injury to the cornea is not expected. Liquid, vapor, or mist causes irritation, experienced as stinging, excess blinking and tear production, with excess redness of the conjunctiva.

Skin Contact No evidence of harmful effects from available information.

Skin Absorption information: No evidence of harmful effects from available

Swallowing: May cause abdominal discomfort or pain, nausea, vomiting, dizziness, drowsiness, malaise, blurring of vision, irritability, lumbar pain, oliguria, uremia, and central nervous system effects, including irregular eye movements, convulsions and coma. Cardiac failure and pulmonary edema may develop. Severe kidney damage follows the swallowing of large volumes of ethylene glycol. May be fatal. A few reports have been published describing the development of weakness of the facial muscles, diminished hearing, and difficulty with swallowing, during the late stages of severe poisoning.

Chronic, Prolonged or Repeated Exposure

Potential Effects of Repeated Exposure: Repeated inhalation of ethylene glycol mist may produce signs of central nervous system involvement, particularly dizziness and nystagmus.

Other Potential Effects of Exposure: Repeated skin contact with ethylene glycol may, in a very small of cases, cause sensitization with the development of allergic contact dermatitis. The incidence is significantly less than 1% with the undiluted material.

Medical Conditions Aggravated by Exposure

May aggravate an existing kidney disease

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

See Section 12 for Ecological Information.

4. FIRST AID PROCEDURES

4.1 INHALATION Remove to fresh air. Obtain medical attention if symptoms persist

4.2 EYE CONTACT

Flush eyes thoroughly with water for several minutes. Remove contact lenses, if worn.

4.3 SKIN CONTACT

Remove contaminated clothing. Wash skin thoroughly with soap and water, Obtain immediate medical attention for thermal burns. Wash clothing before reuse.

4.4 SWALLOWING

If patient is fully conscious, give two glasses of water. Induce vomiting. This should be done only by medical or experienced first-aid personnel. Obtain medical attention without delay. If medical advice is delayed, and if the person has swallowed a moderate volume of material (a few ounces), then give three to four ounces of hard liquor, such as whiskey. For children, give proportionally less liquor, according to weight.

4.5 NOTES TO PHYSICIAN

It is estimated that the lethal oral dose of ethylene glycol to adults is of the order of 1.0 ml/kg. Ethylene glycol is metabolized by alcohol dehydrogenase to various metabolites including glycoaldehyde, glycolic acid, and oxalic acid, which cause an elevated anion-gap metabolic acidosis and renal tubular injury. The signs and symptoms in ethylene glycol poisoning are those of metabolic acidosis, CNS depression, and kidney injury. Urinalysis may show albuminuria, hematuria and oxaluria. Clinical chemistry may reveal anion-gap metabolic acidosis and uremia. The currently recommended medical management of ethylene glycol poisoning includes elimination of ethylene glycol and metabolites, correction of metabolic acidosis, and prevention of kidney injury.

It is essential to have immediate and follow-up urinalysis and clinical chemistry. There should be particular emphasis on acid-base balance and renal function tests. A continuous infusion of 5% sodium bicarbonate with frequent monitoring of electrolytes and fluid balance is used to achieve correction of metabolic acidosis and forced diuresis. As a competitive substrate for alcohol dehydrogenase, ethanol is antidotal. Given in the early stages of intoxication, it blocks the formation of nephrotoxic metabolites. A therapeutically effective blood concentration of ethanol is in the range 100-150 mg/dl, and should be achieved by a rapid loading dose and maintained by intravenous infusion. For severe and/or deteriorating cases, hemodialysis may be required. Dialysis should be considered for patients who are symptomatic, have severe

metabolic acidosis, a blood ethylene glycol concentrations greater than 25 mg/dl, or compromise of renal functions. 4-Methylpyrazole, a potent inhibitor of alcohol dehydrogenases, has been effectively used to decrease the metabolic consequences of ethylene glycol poisoning before metabolic acidosis, coma, seizures, and renal failure have occurred. Additional therapeutic measures may include the administration of cofactors involved in the metabolism of ethylene glycol. Thiamine (100 mg) and pyridoxine (50 mg) should be given every six hours.

Pulmonary edema with hypoxemia has been described in a number of patients following poisoning with ethylene glycol. The mechanism of production has not been elucidated, but it appears to be non-cardiogenic in

origin in several cases. Respiratory support with mechanical ventilation and positive end expiratory pressure may be required. There may be cranial nerve involvement in the late stages of toxicity from swallowed ethylene glycol. In particular, effects have been reported involving the seventh, eighth and ninth cranial nerves, presenting with bilateral facial paralysis, diminished hearing, and dysphagia.

5. FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Flash Point - Closed Cup: Pensky-Martens Closed Cup ASTM D 93 None.

Flash Point - Open Cup: Not currently available

Autoignition Temperature: Not currently available

Flammable Limits In Air: Lower Not determined. Upper Not determined.

5.2 EXTINGUISHING MEDIA

Non-flammable (aqueous solution): After water evaporates, remaining material will burn. Use alcohol-type or all-purpose-type foam, applied by manufacturer's recommended techniques for large fires. Use carbon dioxide or dry chemical media for small fires.

5.3 EXTINGUISHING MEDIA TO AVOID

No information currently available.

5.4 SPECIAL FIRE FIGHTING PROCEDURES

No information currently available

5.5 SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS

Use self-contained breathing apparatus and protective clothing.

5.6 UNUSUAL FIRE AND EXPLOSION HAZARDS

None known.

5.7 HAZARDOUS COMBUSTION PRODUCTS

Burning can produce the following combustion products: Carbon monoxide and/or carbon dioxide. Carbon monoxide is highly toxic if inhaled; carbon dioxide in sufficient concentrations can act as an asphyxiant.

6. ACCIDENTAL RELEASE MEASURES

Steps to be taken if Material is Released or Spilled:

Large spills should be contained and collected. Small spills can be collected or may be absorbed with appropriate liquid absorbing material. All spill response and disposal should be carried out in accordance with federal, provincial, and local regulations.

Personal Precautions: Wear suitable protective equipment. See Section

8.2 - Personal Protection.

7. HANDLING AND STORAGE

7.1 HANDLING

General Handling Do not swallow.
Avoid contact with eyes.
Avoid prolonged or repeated breathing of aerosol and vapor.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

FOR INDUSTRY USE ONLY

Ventilation

General (mechanical) room ventilation may be adequate, if handled at ambient temperatures or in covered equipment. If ambient temperatures are exceeded or operations exist which may produce misting, local exhaust ventilation or other engineering controls may be required.

Other Precautions

The maximum recommended skin temperature on the heat transfer fluid side of a heat exchanger is 1601 C. If the fluid is exposed to excessively high temperatures, thermal degradation can occur, organic acids and other irritating fumes could result. Respiratory protection, such as an air-supplied mask, may be needed until the fumes can be removed. UCARTHERM(R) PM-6195 is not suitable for use in any system where contamination of drinking water supply is possible.

7.2 STORAGE

No information currently available

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

8.1 EXPOSURE LIMITS

Component: Ethylene glycol
Exposure Limits: 100 mg/m³ CEILING ACGIH
100 mg/m³ CEILING UCC
39.4 ppm CEILING UCC

Skin Form: Aerosol
Aerosol and Vapor
Aerosol and Vapor

Consult local authorities for recommended exposure limits

In the Exposure Limits Chart above, if there is no specific qualifier (i.e., Aerosol) listed in the Form Column for a particular limit, the listed limit includes all airborne forms of the substance that can be inhaled.

A "Yes" in the Skin Column indicates a potential significant contribution to overall exposure by the cutaneous (skin) route, including mucous membranes and the eyes, either by contact with vapors or by direct skin contact with the substance. A "Blank" in the Skin Column indicates that exposure by the cutaneous (skin) route is not potential significant contributor to overall exposure.

8.2 PERSONAL PROTECTION

Respiratory Protection

If personnel exposure exceeds exposure limits 39.4 ppm (100 mg/m³) (aerosol and vapor combined) at any time, select respiratory protection equipment. NIOSH-approved atmosphere-supplying respirator or a NIOSH-approved air-purifying respirator with organic vapor cartridge and dust/mist pre-filter is recommended.

Ventilation:

General (mechanical) room ventilation may be adequate, if handled at ambient temperatures or in covered

equipment. If ambient temperatures are exceeded or operations exist which may produce misting, local exhaust ventilation or other engineering controls may be required.

Eye Protection: Monagoggles or faceshield

Protective Gloves:

Natural Rubber

Neoprene Nitrile (NBR)

PVC-coated

Butyl

Other Protective Equipment: Eye Bath, Safety Shower

8.3 ENGINEERING CONTROLS

PROCESS HAZARD: Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without the presence of obvious ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Any use of this product in elevated-temperature processes should be thoroughly evaluated to establish and maintain safe operating conditions. Further information is available in a technical bulletin entitled "Ignition Hazards of Organic Chemical Vapors."

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid

Appearance: Transparent colorless

pH: Not currently available

Solubility in Water (by weight): 100 %

Odor: Mild

Percent Volatiles : - 97

Boiling Point 760 mmHg): 104 - 115/C 219.2 - 239 /F

Freezing Point: -260 - -25/C -43 6 - - 13

Specific Gravity (H2O = 1): ~ 1.064 - 1.10 20/C / 20/C

Vapor Pressure at 20C: 20C 10-15 mmHg 1. 3 - 1. 9 kPa

Vapor Density (air = 1): 1.2 - 9.9

Evaporation Rate (Butyl Acetate = 1):

0.7 - 0.8

Melting Point: Not applicable

10. STABILITY AND REACTIVITY

10.1 STABILITY/INSTABILITY Stable

Incompatible Materials: Explosive decomposition may occur if combined with strong acids or strong bases and subjected to elevated temperatures. Therefore, avoid strong acids and strong bases at elevated temperatures.

Avoid contamination with strong oxidizing agents and materials reactive with hydroxyl compounds.

10.2 HAZARDOUS POLYMERIZATION Will Not Occur

10.3 INHIBITORS/STABILIZERS

11. TOXICOLOGICAL INFORMATION

PEROPAL

Toxicology for the Component

Ethylene glycol

Rat LD50 4700 mg/kg

PERCUTANEOUS Toxicology for the Component

Ethylene glycol

Rabbit LD50 9530 =ul/kg

Incompatible Materials: Explosive decomposition may occur if combined with strong acids or strong bases and subjected to elevated temperatures. Therefore, avoid strong acids and strong bases at elevated temperatures. Avoid contamination with strong oxidizing agents and materials reactive with hydroxyl compounds.

Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. The no-effect doses for developmental toxicity for ethylene glycol given by gavage over the period of organogenesis has been shown to be 150 mg/kg/day for the mouse and 500 mg/kg/day for the rat. Also, in a preliminary study to assess the effects of exposure of pregnant rats and mice to aerosols at concentrations of 150, 1000 and 2500 mg/m³ for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentration, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol, percutaneous absorption of ethylene glycol from contaminated skin, or swallowing of ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure resulted in maternal toxicity (1000 and 2500 mg/m³) and developmental toxicity with minimal evidence of teratogenicity (2500 mg/m³). The no-effects concentration (based on maternal toxicity) was 500 mg/m³. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to skin of pregnant mice over the period of organogenesis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen. There is currently no available information to suggest that ethylene glycol has caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental toxicity. Exposure to high aerosol concentrations is only minimally effective in producing developmental toxicity. The major route for producing developmental toxicity is perorally. Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence, or a different pattern of tumors compared with untreated, controls. The absence of a carcinogenic potential for ethylene glycol has been supported by numerous in vitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

12. ECOLOGICAL INFORMATION

12.1 ENVIRONMENTAL FATE

Partial information may be available, call Union Carbide.

12.2 ECOTOXICITY

Partial information may be available, call Union Carbide.

12.3 FURTHER INFORMATION

None

13. DISPOSAL CONSIDERATIONS

13.1 WASTE DISPOSAL METHOD

Ethylene glycol from many applications is readily reclaimed; reclamation of ethylene glycol from spent fluids is encouraged where possible. At low concentrations in water this product is biodegradable in a biological wastewater treatment plant. Where ethylene glycol reclamation or sewerage are not viable, this product may be incinerated where permitted under appropriate federal, provincial, and local regulations. Dispose in accordance with all applicable federal, provincial, and local environmental regulations. Empty containers should be recycled or disposed of through an approved waste management facility.

13.2 DISPOSAL CONSIDERATIONS

Section 13.1

Disposal methods identified are for the product as sold. For proper disposal of used material, an assessment must be completed to determine the proper and permissible waste management options permissible under applicable rules, regulations and/or laws governing your location.

14. TRANSPORT INFORMATION

14.1 TDG - CANADA

SMALL CONTAINER

Proper Shipping Name: NOT REGULATED

LARGE CONTAINER

Proper Shipping Name: NOT REGULATED

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

FEDERAL/PROVINCIAL

WHMIS CLASSIFICATION

D2A Very Toxic Materials Causing Other Effects

D2B Toxic Materials Causing Other Effects

ACCELERATED REDUCTION/ELIMINATION OF TOXICS

None of the components of this product are listed on the Accelerated Reduction/Elimination of Toxics (ARET) lists A-1, B-2, or B-3.

CEPA - NATIONAL POLLUTANTS RELEASE INVENTORY

At least one component of this product is on the National Pollutant Release Inventory (NPRI) at a concentration equal to or greater than 1%:

Component: Ethylene glycol

CAS #: 107-21-1

Amount
<= 70.0000 %

CEPA - TOXIC SUBSTANCES

None of the components of this product are on the CEPA lists of toxic substances (Schedule 1, Schedule 3-1, or Schedule 3-2).

CPR COMPLIANCE

This product has been classified with the hazard criteria of the CPR, and the MSDS contains all the information required by CPR.

TOXIC SUBSTANCES CONTROL ACT (TSCA)

All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements.

EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS):

The components of this product are on the EINECS inventory.

CEPA - DOMESTIC SUBSTANCES LIST (DSL)

The components of this product are on the DSL

VOC : Vapor pressure 12.223 mmHg at 20 /C
29.28 g/l VOC

This section provides selected regulatory information on this product including its components. This is not intended to include all regulations. It is the responsibility of the user to know and comply with all applicable rules, regulations and laws relating to the product being used.

OTHER INFORMATION

16.1 AVAILABLE LITERATURE AND BROCHURES

ADDITIONAL INFORMATION: Additional product safety information on this product may be obtained by calling your Union Carbide Sales or Customer Service contact. Ask for the brochure:

16.2 SPECIFIC HAZARD RATING SYSTEM

HMIS ratings for this product are:

H - 1
F - 0
S - 0

NFPA ratings for this product are:

H - 1
F - 0
S - 0

These ratings are part of specific hazard communications program(s) and should be disregarded where individuals are not trained in the use of these hazard rating systems. You should be familiar with the hazard communication applicable to your workplace.

16.3 RECOMMENDED USES AND RESTRICTIONS

Heat transfer fluid

FOR INDUSTRY USE ONLY

16.4 REVISION

Version: 1.

Revision: 1999.09.15

Most recent revisions are noted by the bold, double bars in left-hand margin throughout this document.

16.5 LEGEND

TS Trade Secret

N/A Not available

W/W Weight/Weight

The opinions expressed herein are those of qualified experts within Union Carbide. We believe that the information contained herein is current as of the date of this material Safety Data Sheet. Since the use of this information and the conditions of the use of the product are not under the control of Union Carbide, it is the user's obligation to determine conditions of safe use of the product.

MATERIAL SAFETY DATA SHEET

Product Name: UCARTHERM(R) PM-6195 Aqueous Dilution

Effective Date: 1999.09.15

MSDS#: 26705

Page 13 of 13

UNION CARBIDE CANADA INC. MATERIAL SAFETY DATA SHEET

Product Name: UCARTHERM(R) PM-6195 Aqueous Dilution

Effective Date: 1999.09.15

MSDS#: 26705 Page

1 of 13

Copyright 1999, Union Carbide.

UCARTHERM(R) is a registered trademark of Union Carbide.

ENERFLEX

QC DATA



the pressure equipment safety authority

Please submit to:
9410 - 20th Avenue
Edmonton, AB T6N 0A4
Tel (780) 437-9100 Fax (780) 437-7787

AB-10 2007-03

BOILER AND PRESSURE VESSEL STATUS REPORT

This status report form has been provided to report changes to boilers and/or pressure vessels. If you complete the form below, we would be pleased to make the required changes to our records and credit your account if credits are due.

Re: Vessel (A) 1) 572763 2) 3)
Serial No. 065070.3
CRN T6624.213

Vessel(s) sold. Please transfer the registration of the vessel(s) to:

Name of New Owner: Encana Oil & Gas Partnership c/o DPH Engineering

Mailing Address: 150 - 9 Ave. S.W. Calgary, AB T2P 2S5

Location of Vessel: Encana Stock; Chinook, AB

Contact Person: Colleen Van Wyk Tel: 403 243-8380

Date of Sale: April 13, 2006 PO No.: EFX Job# 060430 (sweet)

Vessel(s) removed from service on:

Vessel(s) relocated to:

Vessel(s) operating outside of the Province of Alberta since (Date).

Please remove from annual registration.

The above vessel(s) returned to service on: (Date).

Inspected on: (Date). Inspection Report attached

The above vessel(s) are unfit for service and were destroyed and/or disposed of as scrap material on: (Date).

The Alberta Identification (A) Number has been obliterated.

NOTE: Scrapped and Destroyed vessels Shall Not return to service.

Company Name: ENERFLEX SYSTEMS LTD., EFX COMPRESSION

Position Title: Senior Quality Inspector Tel: (403) 720-1240

(Please print name): Dave Maberley E-mail: david.maberley@enerflex.com

Signature: [Handwritten Signature] Date: May 7, 2007

Note: The owner of the boiler or pressure vessel is responsible for ensuring that the above equipment is inspected by ABSA prior to it being returned to service in the Province of Alberta

Please note ABSA's new address

1271153

CERTIFIED BY

EFX Compression



MAWP	245	PSI	250		
W	MDMT	-20	PSI	245	
RT-2	SN	060430-01	YEAR	2007	
	CRN	T6812.213	QA	0.0625	
	SH. THK	0.500	IN	MTL	SA516-70N
	HD. THK	0.4375	IN	MTL	SA516-70N
REG. NO.	(A) 572688				

127126C

CERTIFIED BY:

EFX Compression

CALGARY ALBERTA CANADA

U

MAWP 400 PSI @ 300 F

W MIDMT 20 PSI @ 400 PSI

HT-2 SN 060430-02 YEAR 2007

CRN 167189.213 C.A. 0.0625 IN

SH THK 0.750 IN MTL SA516-70N

HD THK 0.0875 IN MTL SA516-70N

REG. NO

(A)

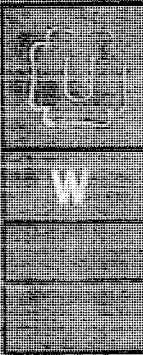
572657

12/31/11

CERTIFIED BY:

EFX Compression

CALGARY ALBERTA CANADA



MAWP 285 PSI @ 100 °F

W MDMT 20 °F @ 285 PSI

SN 060430-03 YEAR 2007

CRN K63632135 C.A. 0.0625 IN

SH. THK 0.392 IN MTL SA 106 B

HD. THK 1.00 IN MTL SA 516 70N

REG. NO. (A) 572562

May 10, 2006

Azhar Tariq
ENERFLEX SYSTEMS LTD, EFX COMPRESSION
4700 47 STREET SE
CALGARY, AB T2B 3R1

Dear Azhar Tariq,

The drawings, specifications and/or information received on May 02, 2006 are accepted for registration as follows:

CRN : T6812.2

Accepted on: May 10, 2006

Tracking No. : 2006-03454

Reg Type : New Design

Drawing No. : 127115 Rev 0

Description	MAWP	Design Temperature	MDMT
Internal Pressure	1689 kPa	121°C	-29°C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed are stamped prints for your reference.

Sincerely,



LIEBL, ERICK, P. Eng.
Design Survey Engineer



pressure equipment safety authority

9410 - 20 Ave N.W.
Edmonton, Alberta, Canada T6N 0A4
Tel: (780) 437-9100 / Fax: (780) 437-7787

May 26, 2006

Azhar Tariq
ENERFLEX SYSTEMS LTD, EFX COMPRESSION
4700 47 STREET SE
CALGARY, AB T2B 3R1

Dear Azhar Tariq,

The drawings, specifications and/or information received on May 15, 2006 are accepted for registration as follows:

CRN : 0H07734.2
Tracking No. : 2006-03828
Reg Type : New Design
Drawing No. : 127200 Rev 0
Fitting Desc: 4" BRIDLE

Accepted on: May 26, 2006

Expiry Date: May 26, 2016

Description	MAWP	Design Temperature	MDMT
Internal Pressure	1689 kPa	121 ^o C	-29 ^o C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed are stamped prints for your reference.

Sincerely,

LIEBL, ERICK, P. Eng.
Design Survey Engineer



the pressure equipment safety authority

9410 - 20 Ave N.W.
Edmonton, Alberta, Canada T6N 0A4
Tel: (780) 437-9100 / Fax: (780) 437-7787

July 14, 2006

Karun Shill
ENERFLEX SYSTEMS LTD, EFX COMPRESSION
4700 47 STREET SE
CALGARY, AB T2B 3R1

Dear Karun Shill,

The drawings, specifications and/or information received on June 30, 2006 are accepted for registration as follows:

CRN : 0H07810.2 **Accepted on:** July 14, 2006
Tracking No. : 2006-05196 **Expiry Date:** July 14, 2016
Reg Type : New Design
Drawing No. : 127518 Rev 0
Fitting Desc: EXTERNAL CAGE (SWEET)

Description	MAWP	Design Temperature	MDMT
Internal Pressure	2758 kPa	149 ^o C	-29 ^o C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed are stamped prints for your reference.

Sincerely,

LIEBL, ERICK, P. Eng.
Design Survey Engineer

July 14, 2006

Karun Shill
ENERFLEX SYSTEMS LTD, EFX COMPRESSION
4700 47 STREET SE
CALGARY, AB T2B 3R1

Dear Karun Shill,

The drawings, specifications and/or information received on June 30, 2006 are accepted for registration as follows:

CRN : 0H07810.2 **Accepted on:** July 14, 2006
Tracking No. : 2006-05196 **Expiry Date:** July 14, 2016
Reg Type : New Design
Drawing No. : 127518 Rev 0
Fitting Desc: EXTERNAL CAGE (SWEET)

Description	MAWP	Design Temperature	MDMT
Internal Pressure	2758 kPa	149°C	-29°C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed are stamped prints for your reference.

Sincerely,



LIEBL, ERICK, P. Eng.
Design Survey Engineer

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
 (Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
 As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

(A) 572657

1. Manufactured and certified by ENERFLEX SYSTEMS LTD., EFX COMPRESSION, 4700 47 STREET SE CALGARY, AB T2B 3R1
 (Name and address of Manufacturer)

2. Manufactured for ENCANA OIL & GAS PARTNERSHIP, 150 - 9 AVENUE S.W. CALGARY, AB T2P 2S5
 (Name and address of Purchaser)

3. Location of installation ENCANA STOCK, ENERFLEX YARD
 (Name and address)

4. Type OIL SEPARATOR 060430-02 T6489.213 127126 REV 0 -- 2007
 (Horiz. or vert. tank) (Mfg'r's serial No.) (CRN) (Drawing no.) (Nat'l Bd. No.) (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2004
 Year

to 2006 -- --
 Addenda (Date) Code Case Nos. Special Service per UG 120(d)

6. Shell: SA-516-70N 0.750" 0.0625" 3' 10.5" 8' 6"
 Mat'l. (Spec. No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7. Seams: TYPE 1 FULL 100 N/A N/A TYPE 1 SPOT* 70 1
 Long. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) H.T. Temp (°F) Time (hr) Girth (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot, or Full) Eff (%) No. of Courses

8. Heads: (a) Mat'l. SA-516-70N (b) Mat'l. SA-516-70N
 (Spec No., Grade) (Spec No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	TOP	0.6875"	0.0625"	--	--	2:1	--	--	--	CONCAVE
(b)	BOTTOM	0.6875"	0.0625"	--	--	2:1	--	--	--	CONCAVE

If removable, bolts used (describe other fastenings) --
 (Mat'l., Spec. No., Gr., Size, No.)

9. MAWP 400 N/A psi at max. temp. 300 N/A °F
 (internal) (external) (internal) (external)

Min. design metal temp. -20 °F at 400 psi. Hydro., pneu., or comb. Test pressure HYDRO AT 520 psi.

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Mat'l.	Nom. Thk.	Reinforcement Mat'l.	How Attached	Location
INLET	1	6"	RFWN CL 300	SA105N/SA106B	0.864"	SA-516-70N	FIG UW-16.1 (h)	SHELL
OUTLET	1	6"	RFWN CL 300	SA105N/SA106B	0.864"	--	FIG UW-16.1 (h)	SHELL
OIL OUT	1	3"	RFWN CL 300	SA105N/SA106B	0.600"	--	FIG UW-16.1 (h)	SHELL
DRAIN	1	2"	RFWN CL 300	SA105N/SA106B	0.343"	SA-516-70N	FIG UW-16.1 (c)	HEAD
OIL FILL,LS,FUTURE	3	1"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
TW/TI, DPI,SCAV	3	0.75"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
PI/DPI,LG,RTD	3	0.75"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
INSPECTION	1	6"	S.O. CL 300	SA105N	3.250"	--	FIG UW-16.1 (c)	SHELL
FUTURE	1	2"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
FILTER ACC/INSP	1	14"X18"	ELLIP. CLOSURE	SA516-70N/SA106C	0.750"	SA-516-70N	FIG UW-16.1 (h)	HEAD

11. Supports: Skirt YES Lugs 2 Legs N/A Other N/A Attached HEADS WELDED
 (Yes or No) (No.) (No.) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report: NONE
 (Name of part, item number. Mfg'r's name and identifying stamp)

SERVICE: SWEET GAS PSV ON PIPE AS PER UG-125
 CONST. DRAWING NO.: V060430B REV 2 RADIOGRAPHY: *SPOT PER UW-11(a)5(b)
 TESTING: NO CHARPY IMPACT TEST REQUIRED PER UG-20(f) 1 THROUGH 5 CUBIC CAPACITY: 119.51 CUBIC FEET

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 30961 expires APRIL 15, 2008.
 Date MARCH 16, 2007 Co. name Enerflex Systems Ltd., EFX Compression Signed [Signature]
 (Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Enerflex Systems Ltd. EFX Compression at CALGARY, ALBERTA, CANADA.
 I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of ALBERTA and employed by ABSA have inspected the component described in this Manufacturer's Data Report on MAR 16 2007, 2007, and state that, to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.
 Date MAR 19 2007 Signed Nilanjan Nag Commissions ALBERTA 242
 (Authorized Inspector) (Nat'l Board. (incl. endorsements) State, Prov. and No.)

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
 (Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only) **A 572562**
 As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by ENERFLEX SYSTEMS LTD., EFX COMPRESSION, 4700 47 STREET SE CALGARY, AB T2B 3R1
 (Name and address of Manufacturer)

2. Manufactured for ENERFLEX SYSTEMS LTD., EFX COMPRESSION, 4700 47 STREET SE CALGARY, AB T2B 3R1
 (Name and address of Purchaser)

3. Location of installation EFX COMPRESSION STOCK
 (Name and address)

4. Type FUEL GAS SCRUBBER 060430-03 K6363.2315Y VE5.4002 REV 8 -- 2007
 (Horiz. or vert. tank) (Mfg'r's serial No.) (CRN) (Drawing no.) (Nat'l Bd. No.) (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2004
 Year

to 2006 -- --
 Addenda (Date) Code Case Nos. Special Service per UG 120(d)

6. Shell: SA-106B 0.322" 0.0625" 0' 7.98" 4' 3.25"
 Matl. (Spec. No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7. Seams: SMLS N/A 85 N/A N/A TYPE 7 N/A* N/A 1
 Long. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) H.T. Temp (°F) Time (hr) Girth (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff (%) No. of Courses

8. Heads: (a) Matl. SA-105N (b) Matl. SA-516-70N
 (Spec No., Grade) (Spec No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	TOP	1.125"	0.0625"	--	--	--	--	--	13.50"	FLAT
(b)	BOTTOM	1.000"	0.0625"	--	--	--	--	--	14.56"	FLAT

If removable, bolts used (describe other fastenings) SA193-B7M: 3/4" STUD X 5" LONG: 8
 (Matl., Spec. No., Gr., Size, No.)

9. MAWP 285 N/A psi at max. temp. 100 N/A °F
 (internal) (external) (internal) (external)

Min. design metal temp. -20 °F at 285 psi. Hydro., pneu., or comb. Test pressure HYDRO AT 428 psi.

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Matl.	Nom. Thk.	Reinforcement Matl.	How Attached	Location
INLET	1	1.5"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	SHELL
OUTLET	1	1.5"	TOL	SA106B	CL 3000	--	FIG UW-16.1 (A)	SHELL
EVEL SWITCH	1	2"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	SHELL
LEVEL CONTROLLER	1	2"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	SHELL
UPPER FILTER DR'N	1	1"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	SHELL
BTM DRAIN/INSP	1	1"	F. CPLG CL 3000	SA105N/SA333-6	0.250"	--	FIG UW-16.1 (C)	SHELL
LEVEL GAUGE	2	0.75"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	SHELL
CLEANOUT/INSP	1	8"	RFSO CL 150	SA105N	1.750"	--	WLD	SHELL
VENT	1	0.75"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (A)	HEAD
--	--	--	--	--	--	--	--	--

11. Supports: Skirt NO Lugs N/A Legs N/A Other 1 SOLE PLATE Attached BOTTOM HEAD WELDED
 (Yes or No) (No.) (No.) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report: NONE

(Name of part, item number, Mfg'r's name and identifying stamp)

SERVICE: SWEET GAS PSV ON PIPE AS PER UG-125
 CONST. DRAWING NO.: V060430C REV 2 RADIOGRAPHY: *NONE PER UW-11(c)
 TESTING: NO CHARPY IMPACT TEST REQUIRED PER UG-20(F) 1 THROUGH 5 CUBIC CAPACITY: 1.87 CUBIC FEET

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 30961 expires APRIL 15, 2008.
 Date DECEMBER 6, 2006 Co. name Enerflex Systems Ltd., EFX Compression Signed [Signature]
 (Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Enerflex Systems Ltd, EFX Compression at CALGARY, ALBERTA, CANADA.
 I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of ALBERTA and employed by ABSA have inspected the component described in this Manufacturer's Data Report on FEB 08 2007, 2007, and state that, to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.
 Date FEB 13 2007 Signed Nilanjan Nay Commissions ALBERTA 242
 (Authorized Inspector) (Nat'l Board. (incl. endorsements) State, Prov. and No.)

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
 (Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
 As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

(A) 572698

1. Manufactured and certified by ENERFLEX SYSTEMS LTD., EFX COMPRESSION, 4700 47 STREET SE CALGARY, AB T2B 3R1
 (Name and address of Manufacturer)

2. Manufactured for ENCANA OIL & GAS PARTNERSHIP, 150 - 9 AVENUE S.W. CALGARY, AB T2P 2S5
 (Name and address of Purchaser)

3. Location of installation ENCANA STOCK, EFX COMPRESSION YARD
 (Name and address)

4. Type HORIZONTAL INLET SEPARATOR 060430-01 T6812.213 127115 REV 0 -- 2007
 (Horiz. or vert. tank) (Mfg's serial No.) (CRN) (Drawing no.) (Nat'l Bd. No.) (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2004
 Year

to 2006 -- --
 Addenda (Date) Code Case Nos. Special Service per UG 120(d)

6. Shell: SA-516-70N 0.500" 0.0625" 4' 0" 10' 0"
 Matl. (Spec. No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7. Seams: TYPE 1 FULL 100 N/A N/A TYPE 1 SPOT* 70 1
 Long. (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot or Full) Eff. (%) H.T. Time (hr) Girth (Welded, Dbl., Sngl., Lap, Butt) R.T. (Spot, or Full) Eff (%) No. of Courses

8. Heads: (a) Matl. SA-516-70N (b) Matl. SA-516-70N
 (Spec No., Grade) (Spec No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	END	0.4375"	0.0625"	--	--	2:1	--	--	--	CONCAVE
(b)	END	0.4375"	0.0625"	--	--	2:1	--	--	--	CONCAVE

If removable, bolts used (describe other fastenings) --
 (Matl., Spec. No., Gr., Size, No.)

9. MAWP 245 N/A psi at max. temp. 250 N/A °F
 (internal) (external) (internal) (external)

Min. design metal temp. -20 °F at 245 psi. Hydro., pneu., or comb. Test pressure HYDRO AT 319 psi.

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Matl.	Nom. Thk.	Reinforcement Matl.	How Attached	Location
INLET	1	10"	RFWN CL 150	SA105N/SA106B	0.500"	--	FIG UW-16.1 (h)	SHELL
OUTLET	1	10"	RFWN CL 150	SA105N/SA106B/SA234WBP	0.500"	SA-516-70N	FIG UW-16.1 (c)	SHELL
PSV	1	3"	RFWN CL 150	SA105N/SA106B	0.438"	--	FIG UW-16.1 (c)	SHELL
BRIDLE	1	2"	S.O. CL 150	SA105N	1.750"	--	FIG UW-16.1 (c)	SHELL
BRIDLE	1	2"	RFWN CL 150	SA105N/SA106B	0.344"	--	FIG UW-16.1 (c)	SHELL
DRAIN/EQ, WD	2	2"	TOL	SA105N	CL 3000	--	FIG UW-16.1 (a)	SHELL
PDI, PI, TI	4	0.75"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
EQUALIZING	1	1"	TOL	SA105N	CL 6000	--	FIG UW-16.1 (a)	SHELL
DRAIN	1	2"	RFWN CL 150	SA105N/SA106B	0.344"	--	FIG UW-16.1 (c)	SHELL
MANWAY/INSP	1	20"	CLOSURE	SA516-70N/SA350-LF2/SA106B	0.500"	SA-516-70N	FIG UW-16.1 (c)	HEAD

11. Supports: Skirt NO Lugs 2 Legs N/A Other 2 SADDLES Attached SHELL WELDED
 (Yes or No) (No.) (No.) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report:
SENTRY CLOSURE / S.N. QA 752 / R & M ENERGY SYSTEMS / CERTIFICATION # 10052
 (Name of part, item number. Mfg's name and identifying stamp)

SERVICE: SWEET GAS PSV ON PIPE AS PER UG-125
 CONST. DRAWING NO.: V060430A REV 1 RADIOGRAPHY: *SPOT PER UW-11(A)5(B)
 TESTING: NO CHARPY IMPACT TEST REQUIRED PER UG-20(F) 1 THROUGH 5 CUBIC CAPACITY: 146.64 CUBIC FEET

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 30961 expires APRIL 15, 2008.
 Date 20th April, 2007 Co. name Enerflex Systems Ltd., EFX Compression Signed [Signature]
 (Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by Enerflex Systems Ltd., EFX Compression at CALGARY, ALBERTA, CANADA.
 I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of ALBERTA and employed by ABSA have inspected the component described in this Manufacturer's Data Report on APR 02 2007, 2007, and state that, to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.
 Date APR 04 2007 Signed Nilanjana Nag Commissions ALBERTA 242
 (Authorized Inspector) (Nat'l Board. (incl. endorsements) State, Prov. and No.)

SO No 8555624-1

PO No 8-10143

FORM U-2A MANUFACTURER'S PARTIAL DATA REPORT (ALTERNATE FORM)

A Part of a Pressure Vessel Fabricated by One Manufacturer for Another Manufacturer As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by R&M ENERGY SYSTEMS 10908 FM 2920 TOMBALL, TEXAS 77375
(Name and address of Manufacturer)

2. Manufactured for TRIUMPH PIPING TECHNOLOGY P.O. BOX 98 OKOTOKS, ALBERTA, CANADA T1S 1A4
(Name and address of User)

3. Location of Installation UNKNOWN
(Name and address)

4. Type: (3) 20" HORZ. SENTRY CLOSURES QA751 thru QA753 DH5992.2513
(Describe type of vessel part (shell, head, flange, nozzle, etc.)) (Mfg. & Serial No.) (CAN)

N/A 370326 R&M ENERGY SYSTEMS 2007
(Mfg. ID No.) (Drawing No.) (Company name/addr.) (Year built)

5. ASME Code, Section VIII, Div. 1 2004 ADDENDA 2006 N/A N/A
(Edition and Addenda (Date)) (Code Case No.) (Special conditions per UG-126(f))

6. Shell (a) No. of courses(s) 1 (b) Overall length (ft. and in.): 0-07.5

Course(s)	Material		Thickness, in.		Long Joint (Cal. A)			Circum. Joint (Cal. A, B, & C)			Heat Treatment			
	No.	Designation	Min.	Max.	Type	Full	Spot	None	Full	Spot	None	Eff.	Temp., F	Time
1	19,000	0-07.5	SA 350 LF2	0.500	0.063	S	NONE			1	S	NONE		
			CLASS 1											

7. Heads: (a) SA 516-70 N (b) N/A
(Mfg. Spec. No., Code or Type) (M.T. & Type and Temp.) (Mfg. Spec. No., Code or Type) (M.T. & Type and Temp.)

Location (Top, Bottom, End)	Thickness, in.		Elevation		Elliptical		Circular		Manufactured		Stitch		Edge to Edge		Edge to Edge		
	Min.	Max.	From	To	Ratio	Angle	Radius	Diameter	Convex	Concave	Type	Full	Spot	None	Eff.		
(a) END	1.313	0.063									21.308				S	NONE	1
(b)																	

8. MAWP 245 PSI @ max temp. = 250 *F. Min Design Metal Temp -20 *F at 245 PSI
(Internal external) (Internal external) (Mfg. Spec. No., Code, Size, No.)

9. Impact test Yes - DOOR & HUB, No - Locking Band per UHA-51(a) At a test temp of -50 & -50 *F
(Indicate type and size of component(s) tested)

10. Hydro., pneu., or comb. Test pressure SEE REMARKS Proof Test: N/A

11. Nozzle, inspection, and safety valve openings: UG-125(a) At PSIG

Purpose (Inlet, Outlet, Drain, etc.)	No.	Dia. or Size, in.	Flange Type	Material		Nozzle Thickness, in.		Reinforcement Material	How Attached		Location (Insp. Open)
				Nozzle	Flange	Norm.	Corr.		Nozzle	Flange	
SEE REMARKS											
PAV	1	3/4-10UNC	THD	SA 516-70 N		N/A	N/A	INHERENT	INT THD		DOOR

12. Supports: Skirt Lugs Legs Others Attached
(Type or No.) (No.) (No.) (Type or No.)

13. Remarks: THIS TEMPERATURE APPLICABLE TO CLOSURE METAL COMPONENTS ONLY. ACTUAL SERVICE TEMPERATURE IS DETERMINED BY TEMPERATURE LIMITATIONS OF SEAL MATERIAL, UG-120, c.2 DESIGN & CALCULATION BY R&M ENERGY SYSTEMS. CLOSURE ASSEMBLY IS NOT HYDROSTATICALLY TESTED. PAV FURNISHED.

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of material, construction, and workmanship of this pressure vessel part conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

U Certificate of Authorization No. 10952 Expires July 16, 2008

Date: 03/09/07 Name: R&M ENERGY SYSTEMS Signed: [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of TEXAS and employed by MSB CT of CONNECTICUT have inspected the pressure vessel part described in this Manufacturer's Data Report on 3/9, 2007 and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel part in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel part described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date: 3/9/07 Signed: [Signature] Commissions: TEXAS 912
(Authorized Inspector) (National Board/Inc. Endorsement, State, Province and No.)



the pressure equipment safety authority

9410 - 20 Ave N.W.
Edmonton, Alberta, Canada T6N 0A4
Tel: (780) 437-9100 / Fax: (780) 437-7787

April 19, 2006

Vedud Subasic
ENERFLEX SYSTEMS LTD, EFX COMPRESSION
4700 47 STREET SE
CALGARY, AB T2B 3R1

Dear Vedud Subasic,

The drawings, specifications and/or information received on March 29, 2006 are accepted for registration as follows:

CRN : T6489.2

Accepted on: April 19, 2006

Tracking No. : 2006-02361

Reg Type : New Design

Drawing No. : 127126 Rev 0

Description	MAWP	Design Temperature	MDMT
Internal Pressure	2758 kPa	149°C	-29°C

An invoice covering survey and registration fees will be forwarded from our Revenue Accounts.

Enclosed are stamped prints for your reference.

Sincerely,

LIEBL, ERICK, P. Eng.
Design Survey Engineer



CONSTRUCTION DATA REPORT FOR PIPING SYSTEMS

In accordance with the provisions of the Safety Codes Act

Shop Construction ; Field Construction ; Final Data Report ;
 Partial Data Report (from one ABSA-authorized Contractor to another ABSA-authorized Contractor).

Complete both sides of this Form

1. Constructed By: Enerflex Systems Ltd, EFX Compression Owner's Job No: 060430
(Name of ABSA authorized primary contractor or subcontractor)
4700 – 47th St. SE, Calgary AB, T2B 3R1

(Address)

Alberta Quality Program No. AQP-1044 Expiry Date: APRIL 15, 2008

2. Constructed For: N/A
(Name of primary contractor if different from above)

N/A

(Address)

Alberta Quality Program No. AQP- Expiry Date:
(Required when the primary contractor undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

3. Owner: ENCANA CORPORATION, 150 – 9 AVENUE S.W. CALGARY, AB T2P 2S5
(Name and address)

ENCANA STOCK; CHINOOK, AB

(Location of installation)

Alberta Quality Program No. AQP- N/A Expiry Date: N/A
(Required when the owner undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

4. Piping Design Alberta Registration No.: PP-N/A

(Required if aggregate piping volume is over 0.5m³)

5. WP No.: WP-807.2 ; Company: Enerflex Systems Ltd. ; Owner's WP No. (If used): WP-N/A
(Alberta Registration No.) (Alberta Registration No.)

WPS No(s). used: ESL-101/103/121 ; Owner's WPS No(s). (If used): N/A

6. Code: ASME B31.1 Non Boiler External Piping ; ASME B31.1 Boiler External Piping ;

ASME B31.3 - Service category: Normal , D , M , High Pressure ; B31.5 ; B31.9 .

Drawing No. Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. PSI	Des. Temp. °F	Test Press. PSI	Test Medium	Pipe Mat'l Spec. & Grade	C.A. mm	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °F	R.T. %	Other NDE
1D1	GAS	655	300	1125	H ₂ O	SA106B	1/16"	6"STD	SA105N 300#	50	10	VIS
1D2	GAS	655	300	1125	H ₂ O	SA106B		6"STD	SA105N 300#	50	10	VIS
1D3	GAS	655	300	1125	H ₂ O	SA106B		6"STD	SA105N 300#	50	10	VIS
1S1	GAS	655 / 230	300	1125 / 450	H ₂ O	SA106B		10"STD 8"STD	SA105N 300# 150#	50	10	VIS
1S2	GAS	230 / 655	300	450 / 1125	H ₂ O	SA106B		10"STD	SA105N 300# 150#	50	10	VIS



CONSTRUCTION DATA REPORT FOR PIPING SYSTEMS

In accordance with the provisions of the Safety Codes Act

Shop Construction ; Field Construction ; Final Data Report ;
 Partial Data Report (from one ABSA-authorized Contractor to another ABSA-authorized Contractor).

Complete both sides of this Form

1. Constructed By: Enerflex Systems Ltd, EFX Compression Owner's Job No: 060430
(Name of ABSA authorized primary contractor or subcontractor)
4700 – 47th St. SE, Calgary AB, T2B 3R1

(Address)

Alberta Quality Program No. AQP-1044 Expiry Date: APRIL 15, 2008

2. Constructed For: N/A
(Name of primary contractor if different from above)

N/A

(Address)

Alberta Quality Program No. AQP- Expiry Date:
(Required when the primary contractor undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

3. Owner: ENCANA CORPORATION, 150 – 9 AVENUE S.W. CALGARY, AB T2P 2S5
(Name and address)

ENCANA STOCK; CHINOOK, AB

(Location of installation)

Alberta Quality Program No. AQP- N/A Expiry Date: N/A
(Required when the owner undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

4. Piping Design Alberta Registration No.: PP-N/A

(Required if aggregate piping volume is over 0.5m³)

5. WP No.: WP-807.2 ; Company: Enerflex Systems Ltd. ; Owner's WP No. (If used): WP-N/A
(Alberta Registration No.) (Alberta Registration No.)

WPS No(s). used: ESL-101/103/121 ; Owner's WPS No(s). (If used): N/A

6. Code: ASME B31.1 Non Boiler External Piping ; ASME B31.1 Boiler External Piping ;

ASME B31.3 - Service category: Normal , D , M , High Pressure ; B31.5 ; B31.9 .

Drawing No. Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. PSI	Des. Temp. °F	Test Press. PSI	Test Medium	Pipe Mat'l Spec. & Grade	C.A. mm	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °F	R.T. %	Other NDE
AC1	GAS	655	300	1125	H ₂ O	SA106B	1/16"	6"STD	SA105N 300#	50	10	VIS
AC2	GAS	655	300	1125	H ₂ O	SA106B		4"STD 6"STD	SA105N 300#	50	10	VIS
BC1	GAS	230	300	450	H ₂ O	SA106B		2"XS	SA105N 150#	50	10	VIS
BC2	GAS	230	300	450	H ₂ O	SA106B		2"XS	SA105N 150#	50	10	VIS
BP1	GAS	655	300	1125	H ₂ O	SA106B		2"XS	SA105N 300#	50	10	VIS



CONSTRUCTION DATA REPORT FOR PIPING SYSTEMS

In accordance with the provisions of the Safety Codes Act

Shop Construction ; Field Construction ; Final Data Report ;
 Partial Data Report (from one ABSA-authorized Contractor to another ABSA-authorized Contractor).

Complete both sides of this Form

1. Constructed By: Enerflex Systems Ltd, EFX Compression Owner's Job No: 060430
(Name of ABSA authorized primary contractor or subcontractor)
4700 – 47th St. SE, Calgary AB, T2B 3R1

(Address)

Alberta Quality Program No. AQP-1044 Expiry Date: APRIL 15, 2008

2. Constructed For: N/A
(Name of primary contractor if different from above)

N/A

(Address)

Alberta Quality Program No. AQP- Expiry Date:
(Required when the primary contractor undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

3. Owner: ENCANA CORPORATION, 150 – 9 AVENUE S.W. CALGARY, AB T2P 2S5
(Name and address)

ENCANA STOCK; CHINOOK, AB

(Location of installation)

Alberta Quality Program No. AQP- N/A Expiry Date: N/A
(Required when the owner undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

4. Piping Design Alberta Registration No.: PP-N/A

(Required if aggregate piping volume is over 0.5m³)

5. WP No.: WP-807.2 ; Company: Enerflex Systems Ltd. ; Owner's WP No. (If used): WP-N/A
(Alberta Registration No.) (Alberta Registration No.)

WPS No(s). used: ESL-101/103/121 ; Owner's WPS No(s). (If used): N/A

6. Code: ASME B31.1 Non Boiler External Piping ; ASME B31.1 Boiler External Piping ;

ASME B31.3 - Service category: Normal , D , M , High Pressure ; B31.5 ; B31.9 .

Drawing No. Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. PSI	Des. Temp. °F	Test Press. PSI	Test Medium	Pipe Mat'l Spec. & Grade	C.A. mm	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °F	R.T. %	Other NDE
BP2	GAS	655	300	1125	H ₂ O	SA106B	1/16"	2"XS	SA105N 300#	50	10	VIS
BP3	GAS	655	300	1125	H ₂ O	SA106B		2"XS	SA105N 300#	50	10	VIS
DR1	GAS	230	300	450	H ₂ O	SA106B		2"XS	SA105N 150#	50	10	VIS
DR2	GAS	645	350	1125	H ₂ O	SA106B		2"XS	SA105N 300#	50	10	VIS
HP1	GAS	230	300	450	H ₂ O	SA106B		6"STD	SA105N 150#	50	10	VIS



CONSTRUCTION DATA REPORT FOR PIPING SYSTEMS

In accordance with the provisions of the Safety Codes Act

Shop Construction ; Field Construction ; Final Data Report ;
 Partial Data Report (from one ABSA-authorized Contractor to another ABSA-authorized Contractor).

Complete both sides of this Form

1. Constructed By: Enerflex Systems Ltd, EFX Compression Owner's Job No: 060430
(Name of ABSA authorized primary contractor or subcontractor)
4700 – 47th St. SE, Calgary AB, T2B 3R1

(Address)

Alberta Quality Program No. AQP-1044 Expiry Date: APRIL 15, 2008

2. Constructed For: N/A
(Name of primary contractor if different from above)

N/A

(Address)

Alberta Quality Program No. AQP- Expiry Date:
(Required when the primary contractor undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

3. Owner: ENCANA CORPORATION, 150 – 9 AVENUE S.W. CALGARY, AB T2P 2S5
(Name and address)

ENCANA STOCK; CHINOOK, AB

(Location of installation)

Alberta Quality Program No. AQP- N/A Expiry Date: N/A
(Required when the owner undertakes some/all of the quality functions, e.g., Mat'l supply, NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)

4. Piping Design Alberta Registration No.: PP-N/A

(Required if aggregate piping volume is over 0.5m³)

5. WP No.: WP-807.2 ; Company: Enerflex Systems Ltd. ; Owner's WP No. (If used): WP-N/A
(Alberta Registration No.) (Alberta Registration No.)

WPS No(s). used: ESL-101/103/121 ; Owner's WPS No(s). (If used): N/A

6. Code: ASME B31.1 Non Boiler External Piping ; ASME B31.1 Boiler External Piping ;

ASME B31.3 - Service category: Normal , D , M , High Pressure ; B31.5 ; B31.9 .

Drawing No. Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. PSI	Des. Temp. °F	Test Press. PSI	Test Medium	Pipe Mat'l Spec. & Grade	C.A. mm	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °F	R.T. %	Other NDE
BP2	GAS	655	300	1125	H ₂ O	SA106B	1/16"	2"XS	SA105N 300#	50	10	VIS
FG/SG	GAS	1036	100	1140	H ₂ O	SA106B		2"XS 1"XS	SA105N 300#	--	--	VIS
BD	GAS	760	100	1140	H ₂ O	SA106B		1"XS	SA105N 300#	--	--	VIS
BP	GAS	760	100	1180	H ₂ O	SA106B		1"XS	SA105N 300#	--	--	VIS

Partial Data Reports, properly identified and certified by ABSA-authorized contractors, as listed below are attached to and form part of this Data Report

No.	Line No.	Spool No.	Drg. No. (with Rev. No.)	Contractor (Name)	AQP No.	Expiry date

Remarks: Provide additional comments including noting any code work that was not performed by the ABSA- authorized contractor(s) supplying this document as a Partial Data Report but which must be completed by another ABSA-authorized contractor who assumes overall responsibility for conformance with the Safety Codes Act & Regulations and applicable ASME Codes, and who assures that all required code work is completed prior to putting the piping system into service.

Endorse certificate 'A' or 'B'

A. CERTIFICATE OF COMPLIANCE

Signed by the subcontractor when supplying this certificate as a Partial Data Report

We certify that the statements in this Data Report are correct and that materials, construction and workmanship of the piping fabrication conform to the registered quality system and the applicable Piping code(s).

Date: _____
Subcontractor

Print Authorized Representative's Name Signature

This certificate is not valid unless it forms part of a Final Data Report signed by Primary Contractor

B. CERTIFICATE OF COMPLIANCE

Signed by the primary contractor when supplying this certificate as a Final Data Report

We certify that the statements in this Data Report are correct and that piping job no. 060430 described in this Data Report was constructed in accordance with the Province of Alberta Safety Codes Act and Regulations, and applicable ASME Piping Code(s).

Date: MAY 08/07 ENERFLEX SYSTEMS LTD., EFX COMPRESSION
Primary Contractor

G. MOODY G. Moody
Print Authorized Representative's Name Signature

CERTIFICATE OF INSPECTION

I, the undersigned, employed by Caliper Inspection Ltd. have inspected the piping job no. 060430 described in this Construction Data Report and state that, to the best of my knowledge and belief, the Contractor has constructed this piping in accordance with the applicable Sections of the ASME Piping Codes and Province of Alberta Safety Codes Act and Regulations.

Date: JUN 21 2007

Keith Godin [Signature]
Print Owner's Inspector's Name Owner's Inspector's Signature

Date: _____
Name: _____ Sign.: _____

ABSA Safety Codes Officer
(BOILER EXTERNAL PIPING ONLY)



Relief Device Single Data Sheet

Owner ENERFLEX
 Plant CALGARY
 Date March 13, 2007

Valve Data

Job Number	SO22351-1	Tag Number		Most Recent Status	Yes (Relief Valve) Active
Unit / Vessel		Serial Number	TP90502	Purchase Price	\$ US
Manufacturer	Consolidated	Equipment Location		Model Number	19096MCF-2-CC-MS-31-MT-FT-LA
Valve Size	1 1/2 IN ²	Bonnet	Closed	Cap Type	Screwed
Traveller	Threaded	Inlet	MNPT	Outlet	FNPT
Style	Threaded	Bellows Material		Soft Seat Mat'l	
Spring Number	W4080NC	Spring Material	17-7 PH SS	From / To	291 to 311
Service	Non-compressible	ASME Code Stamp	Sec VIII	App. Capacity	170.31 L/MIN
Set Pressure	2068 KPA-GA	Back Pressure	0 KPA-GA	BP Is / Constant	
MAWP	PSIG	Cold Diff Set Press	PSIG	Operating Temp	65 C
ASME Capacity	170.31 L/MIN	Operating Press	PSIG	Req'd Blow Down %	=
Restricted Lift	IN	Mfg Lift	IN	Orifice	= IN ²

Received & Pre-Test Data

Date Received	2007-03-07	Scheduled Maintenance For	No	Pretest	No
Received By	NICOLE	Special Cleaning	CHECKSET ONLY	Prepop Reason	
Nameplate	Original	Dismb / Insp By	Jay	Prepop Results	
Seal	Intact	Comp Screw Recd	IN	Pre-Popped @	PSIG
Seal ID	CCM	Valve Converted	No	Leaked / @	BPM @
		Valve Replaced	No	Set Press Changed	No

Final Test Data

Date Tested	2007-03-12	Due Date	(12)	Cold Diff Set	PSIG
Assembled By		Set Pressure	2068 KPA-GA	Final Test Press	2275 KPA-GA
Test Media	Water	Tested By	Greg	Witnessed By	M.MASSIE (11477)
S/N Gauge -- EVT	H003A/B	Test Method	Bench	Comp Screw Set	IN
Simmer Point		Reseat Press	1724 PSIG	Blow Down	PSIG
Measured Lift	IN	Leakage Rate / @	NVL BPM @ 1862	BP Test / @	Yes @ 689
BD Ring - Up	Notches	BD Ring - Lower	Notches	Overlap Collar	IN
Next Maint For		Next Maint Date	2009/03/12 (24)	Next Test Date	2008/03/12 (12)

Check List / Quality Control

Shipped Upright	N/A
Visual Inspection	Yes
PSV Painted	No
PSV Taped	No
PSV Sealed	Yes
PSV Complete	Yes
Meets API	Yes
Coordinator Notified	Yes
Stamp Repair VR	No
Main Valve Test	Yes

Critical Dim's

Measured	
Nozzle Length Min	
Noz Seat Step Max	
Nozzle Bore Min	
Noz Seat Width Min	
Disk Min Thickness Min	
Disc Seat Step Min	
Guide I.D. Max	
Holder O.D. Min	
Spindle Max	

Mfg

Replace Valve Next Repair | No
 Comment

CHECKSET ONLY. WITNESS TEST

QC Inspector

Sign Off & Date *JK* March 13/07

CENTRAL VALVE CALGARY

P.R.V. INSPECTION REPORT

A Division of EcoMax Energy Services Ltd.

DATE:	Feb 21 07	W.O.#:	060451	I.D.#:	16371-2
CUSTOMER:	EFF Compression	LOCATION:		PO:	0760257
MAKE:	Taylor	TYPE/MODEL:	82F4061311	S/N:	32519-5
CONNECTION TYPE:	SE	INLET SIZE:	1 x 1/2	TAG / PSV:	
SET PRESSURE:	150	BACK PRESS:		CAPACITY:	932 SCFM 742 SCFM
COLD/DIFF SET PRESS:		TEMP:		CRN:	
CAP ASSEMBLY:	el	CODE SYMBOL:		ORIFICE:	F
RESET REQ:	Yes	REQUIRED SPRING #:		STD / NACE:	
NEW SET PRESS:	110 PSI	NEW CAPACITY:	932 SCFM 742 SCFM	SPECIFIC INSTRUCTIONS:	witness TEST
SEAL CONDITION:		INSIGNIA:			
DATE OF LAST SERVICE:		DATA PLATE CONDITION:			

TEST PRESSURE: RESULTS:

ITEM / DESCRIPTION	CHECK	AS FOUND CONDITION	REPAIR ACTIONS
BT	DIM		
COIL	DIM		
AC HOLDER	DIM		
SE	DIM		
HANDLE STEM	VIS		
OPER. BUTTONS	VIS		
OPER. LAMP	VIS		
SCREWS	PER		
PLATETS - O-RINGS	VIS		
REP.	VIS		
VALVE	VIS		
PTS REQUIRED NEXT SERVICE			
REMARKS			

DISASSEMBLY: INSPECTION: REASSEMBLY:

MEDIUM: SET PRESS: COLD SET:

TEST RESULTS:

SHOULDR: 108 SET POINT: 110.3 BLOWDOWN: 88

BACK PRESS. TEST: 125 LEAKAGE: 0 TEST GAUGE ID: BGC# 14

BLOWDOWN RING SETTINGS: UPPER: 110.4 LOWER: 110.4

TESTED BY: Keith Pent 102-28-07

FINAL INSPECTION: DATE: 2007/02/28 CUST/INSPECTOR: Keith Pent

COMMENTS:

DATE:	Feb 21 07	W.O.#:	060481	I.D.#:	16371-1
CUSTOMER:	EFF Compression	LOCATION:		PO:	0760257
MAKE:	Taylor	TYPE/MODEL:	82F4661311	SIN:	32518-10
CONNECTION TYPE:	SE	INLET SIZE:	1 x 1/2	TAG / PSV:	982 SCFM
SET PRESSURE:	150	BACK PRESS:		CAPACITY:	2742 SCFM
COLD/DIFF SET PRESS:		TEMP:		CRN:	
CAP ASSEMBLY:	01	CODE SYMBOL:		ORIFICE:	F
RESET REQ:	Yes	REQUIRED SPRING #:		STD / NACE:	
NEW SET PRESS:	110 PSI	NEW CAPACITY:	982 SCFM 742 SCFM	SPECIFIC INSTRUCTIONS:	WITNESS TEST
SEAL CONDITION:		INSIGNIA:			
DATE OF LAST SERVICE:		DATA PLATE CONDITION:			

RE-TEST:

UP PRESSURE: RESULTS:

COMPONENT INSPECTION	CHECK	AS FOUND CONDITION	REPAIR ACTIONS
HSC	DIM		
NOZZLE	DIM		
HSC HOLDER	DIM		
FACE	DIM		
PINDLE / STEM	VIS		
PRP BUTTONS	VIS		
LOWER RING	VIS		
BELLOWS	PER		
GASKETS / O-RINGS	VIS		
OTHER	VIS		
OTHER	VIS		
PARTS REQUIRED NEXT SERVICE			
COMMENTS			

DISASSEMBLY: INSPECTION: REASSEMBLY:

MEDIUM: ACK SET PRESS: ~~150~~ 110 COLD SET:

FINAL TEST:

SIMMER: 109 SET POINT: 109.7 BLOWDOWN: 88

BACK PRESS. TEST: 125 LEAKAGE: 0 TEST GAUGE ID: BGC# H

BLOWDOWN RING SETTINGS: UPPER: N/A LOWER: N/A

TESTED BY: [Signature] 02-28-07

FINAL INSPECTION: DATE: 2007/02/28 CUST INSPECTOR: [Signature]

COMMENTS:



Farris Pressure Management
a Division of Spartan Controls

FARRIS PRESSURE MANAGEMENT

EDMONTON FACILITY INSPECTION TEST REPORT

CUSTOMER	ORDER#	Farris WO#	Metal Tag:
Enerflex Systems Ltd.	775193	775193-01	Inlet Sep
PO: 0760258			
			Sup. Tag:

MODEL:	TYPE:	VALVE SIZE:	ORIFICE	FactorySerial#	CRN#
27DA33-M20/00	2700	1"MNPTx1"FNPT	D	497017-39-KE	OG0386.9C

SERVICE:

SERVICE: Gas StampSymbol: UV NB

CAPACITY: 16.1 M3/MIN Metric Only: Yes (Per CC:2116)

Set Pressure	Back Pressure	Diff	Cold Diff	Temp. Corr.	Temperature
1689 KPAG 245 PSI	0 KPAG	1689 KPAG	1689 KPAG	0 KPAG	250 F (121 C)

MATERIAL/HEAT NUMBER ASSIGNMENT:

Body P1083 Nozzle

Bonnet K8 Disc 4403718

PERFORMANCE TEST DATA:

TEST FLUID Air Water Air-Over Water

Final Test Pressure 1689 PSIG 1689 KPAG

Upper B.D.R. Setting: Lower B.D.R. Setting: Shop Test Gauges Used: 1. 11H 2. 7d

BACK PRESSURE TEST:

Not Applicable, (Open Bonnet / Cap Design)

120 PSIG Air

SEAT TIGHTNESS TEST: API-527

TEST FLUID Req'd At Leak Test Pressure PSIG 1520 KPAG

Air 90% No Visible Leaks

Water 95% Of Set Pressure Leak Rate 8 B.P.M.

Air Over Water

Final Inspection / Tech Tested: [Signature] Date Tested: 13/03/2007

FOR WITNESS TESTING ONLY

Tested By: [Signature] Emil Kellinger Date: 13/03/07

Customer Witness: [Signature] Marky Mason Farris Witness: _____



FARRIS PRESSURE MANAGEMENT

EDMONTON FACILITY INSPECTION TEST REPORT

Farris Pressure Management
a Division of Spartan Controls

CUSTOMER	ORDER#	Farris WO#	Metal Tag:
Enerflex Systems Ltd.	775193	775193-02	Oil Sep
PO: 0760258			
			Sup. Tag:

MODEL:	TYPE:	VALVE SIZE:	ORIFICE	FactorySerial#	CRN#
26KA12-120/00	2600	3"300RFx4"150RF	K	510331-1-A10	OG8442.5C

SERVICE:

SERVICE: Gas StampSymbol: UV NB

CAPACITY: 267.4 M3/MIN Metric Only: Yes (Per CC:2116)

<u>Set Pressure</u>	<u>Back Pressure</u>	<u>Diff</u>	<u>Cold Diff</u>	<u>Temp. Corr.</u>	<u>Temperature</u>
1750 KPAG 253 psig	0 KPAG	1750 KPAG	1750 KPAG	0 KPAG	300 F (149 C)

MATERIAL/HEAT NUMBER ASSIGNMENT:

Body	Y9307	Nozzle	P4943
Bonnet	Y8779	Disc	895383

PERFORMANCE TEST DATA:

TEST FLUID Air Water Air Over Water

Final Test Pressure 1750 PSIG KPAG

Upper B.D.R. Setting: -6 Notches

Lower B.D.R. Setting: 7F 136 Notches

Shop Test Gauges Used: 1. 7F 2. 136

BACK PRESSURE TEST:

Not Applicable, (Open Bonnet / Cap Design)

120 PSIG Air

SEAT TIGHTNESS TEST: API-527

TEST FLUID Air Water Air Over Water

Req'd At 90% 95% Of Set Pressure

Leak Test Pressure 1575 PSIG KPAG

No Visible Leaks Leak Rate 0 B.P.M.

Final Inspection / Tech Tested BJZ

Date Tested 3/13/07

FOR WITNESS TESTING ONLY

Tested By: [Signature] Date: 3/13/07

Customer Witness: [Signature] Farris Witness: _____



Farris Pressure Management
a Division of Spartan Controls

FARRIS PRESSURE MANAGEMENT

EDMONTON FACILITY INSPECTION TEST REPORT

CUSTOMER	ORDER#	Farris WO#	Metal Tag:
Enerflex Systems Ltd.	865853	865853-05	
PO: 0761506			
			Sup. Tag:

MODEL:	TYPE:	VALVE SIZE:	ORIFICE	FactorySerial#	CRN#
27EA34-M20/00	2700	1"MNPTx1.5"FNPT	E	520410-22-KE	0G0386.9C

SERVICE:

SERVICE: Liquid **StampSymbol:** UV NB

CAPACITY: 393 L/MIN **Metric Only:** Yes (Per CC:2116)

Set Pressure	Back Pressure	Diff	Cold Diff	Temp. Corr.	Temperature
2068 KPAG	0 KPAG	2068 KPAG	2068 KPAG	0 KPAG	151 F (66 C)

MATERIAL/HEAT NUMBER ASSIGNMENT:

Body T4 **Nozzle**

Bonnet F13 **Disc** 4405342

PERFORMANCE TEST DATA:

TEST FLUID Air Water Air Over Water

Final Test Pressure 2068 KPAG

Upper B.D.R. Setting: Notches

Lower B.D.R. Setting: Fixed Notches

Shop Test Gauges Used: 1: 7E 2: 13G

BACK PRESSURE TEST:

Not Applicable, (Open Bonnet / Cap Design)

120 PSIG Air

SEAT TIGHTNESS TEST: API-527

TEST FLUID Air Water Air Over Water

Req'd At 90% 95% Of Set Pressure

Leak Test Pressure 1861 PSIG **KPAG**

No Visible Leaks

Leak Rate 0 B.P.M.

Final Inspection / Tech Tested [Signature]

Date Tested 9/26/07

FOR WITNESS TESTING ONLY

Tested By: [Signature] **Date:** 9/26/07

Customer Witness: Monty Masnik 11458 **Farris Witness:** _____

CIL: 000752