

Issuing Authority: QA/QC Manager		Document Template Quality Control
Date of Issue: June 8, 2016 Rev Status: 3.0		FORM- Quality Control and Operations Documentation List Page 1 of 2

Standard Document Index

Project:	Line Heater Package
Customer:	
Customer PO:	
NWP JO# :	

Completed Package Documentation

Final Release Certificate
 Shipping Manifest (Shipped Loose Item List)
 Travel Sheets
 Pressure Piping Construction and Test Data Report (AB-83/FRM 1330)
 Hydrostatic Test Affidavit
 Paint/Coating Reports
 Electrical Documentation
 ITP's (If Required)
 PDL (BOM)
 AS Built P&ID
 AS Built General Arrangement Drawing
 MTR's

Coil Documentation

Travel Sheet
 Manufactures Data Reports AB-28
 Copy of Name Plate
 Post Weld heat Treatment Chart and Requirements
 Hydrostatic Test Affidavit
 NDE Reports
 AS Built Drawings
 Material Test Reports

Shell/Stack/Bath/Pre Heat (Shell Assembly) Documentation (If applicable)

Travel Sheets
 Hydrostatic & Pneumatic Test Affidavits
 NDE Reports
 AS Built Drawings
 Material Test Reports

Issuing Authority: QA/QC Manager		Document Template Quality Control
Date of Issue: June 8, 2016 Rev Status: 3.0		FORM- Quality Control and Operations Documentation List Page 2 of 2

Welded Piping Documentation

Pressure Piping Examination Checklist

Hydrostatic Test Affidavit

Post Weld heat Treatment Chart and Requirements

NDE Reports

AS Built Drawings

Material Test Reports

Skid/Structural Documentation

Travel Sheet

NDE (If applicable)

AS Built Drawings

Instrumentation and Other QC Documentation

PSV Data Reports and Certification

Meter Run Data Package

Valve Train Data Package (If applicable)

Scrubber Data Package

Any other certificates that are sent with the instruments for this unit will be included in the manual

Instrumentation Operations and Maintenance Manual

Any documentation available for instrumentation as per PDL (BOM) will be included

Instrument Warranty Information if any is included on the manufactures information



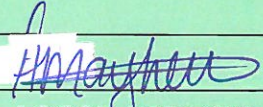




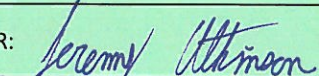
Quality Control Manual is supplied as Follows

1 USB Manual Shipped with Unit

1 USB Manual Sent to Customer















Complete Package Documentation

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: June 9, 2015		FORM-FINAL INSPECTION RELEASE CERTIFICATE
Rev 1.0		Page 1 of 1

FINAL INSPECTION RELEASE CERTIFICATE		
CUSTOMER: NWP Stock - SOLD TO BAYTEX.		
PRODUCT: 2.0 MM BTU/HR Lineheater Pkg	WO #: 09961-001	
		DATE:
FINAL INSPECTION DOCUMENTATION		
REVIEWED BY: 	ACCEPTED: 	REJECTED:
STANDARD DOCUMENTATION REQUIREMENTS: (SEE DOCUMENTS REQUIREMENT LIST)		
ADDITIONAL DOCUMENT REQUIREMENTS: (TO BE RECORDED HERE IF APPLICABLE I.E DOCUMENTS PACKAGE REQUIRED BY CUSTOMER ETC.)		
Q.C FILE CLOSURE BY: 		DATE: Feb 15, 2017
LOOSE COMPONENTS REQUIRED / PREPARED		
SHIPPING MANIFEST REVIEWED FOR SHIPLOOSE ITEMS:		
YES <input checked="" type="checkbox"/> Initial  NO <input type="checkbox"/> Initial _____		
PREPARATION FOR SHIPMENTS / STORAGE		
PREPARATION NEEDED / COMPLETED:		
BOLTS/STUDS/TORQUED: Yes <input type="checkbox"/> Initial _____ No <input checked="" type="checkbox"/> Initial 		
PRESERVATION REQUIREMENTS COMPLETE: Yes <input checked="" type="checkbox"/> Initial  No <input type="checkbox"/> Initial _____		
PIPING, VESSELS, TANK INTERNALS VERIFIED CLEAN: Yes <input checked="" type="checkbox"/> Initial  No <input type="checkbox"/> Initial _____		
S/N #NWP-09961-001		
SHIPPING INSTRUCTIONS		
CUSTOMER PDL REVIEWED: YES <input type="checkbox"/> Initial _____ NO <input type="checkbox"/> Initial _____		
SHIPPING MANIFEST REVIEWED FOR SHIPPING INSTRUCTIONS:		
YES <input type="checkbox"/> Initial _____ NO <input type="checkbox"/> Initial _____		
RELEASED TO INVENTORY:	DATE:	
RELEASED TO CUSTOMER: 	DATE: Feb. 14/2017	

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 1		FORM- Package/Product Assembly Travel Sheet

Page 1 of 2

Package / Product Assembly Travel Sheet		Approved By: 				
		Date: NOV 27 2016				
WO # 09961-001	Description: 2.0MM BTU/HR Lineheater Pkg.					
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4						
PRE HYDROSTATIC TEST:	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Thorough review of PDL and work instructions	✓	✓				NOV 23 2016
All piping and sub-assemblies level, plumb, and square	✓		RM	1.13.17		FEB 14 2017
All structural stands and supports level, plumb, and square	✓		RM	1.13.17		FEB 14 2017
Threaded piping assembled as per NWP procedure	✓		RM	1.13.17		FEB 14 2017
All tubing connections are tight as per NWP procedure	✓				NA	
If applicable, studs torqued as per NWP procedure and documented	✓		RM	1.13.17	NA	
Welding complete with all exposed edges de-burred with radius	✓		RM	1.13.17		FEB 14 2017
U-bolts tightened and visually identified	✓		RM	1.13.17		FEB 14 2017
Verify with photos that vessel internal is clean and free of debris	✓				NA	
All studs tight, centered in flanged bolt-ups, and identified	✓		RM	1.13.17		FEB 14 2017
All unions tight and initialed off	✓		RM	1.13.17		FEB 14 2017
Function test valves for ease of operation and ability to open and close without restriction	✓		RM	1.13.17		FEB 14 2017
Lock or plug all valves that are being tested against as per NWP procedure	✓		RM	1.13.17	NA	
Confirm continuity between instruments and supporting documentation	✓		RM	1.13.17		FEB 14 2017
Conduct P & ID check prior to flooding	✓	✓	RM	1.13.17		Jan.12/17
Verify off-skid projections to +/- 3/8", if not, red line drawings and submit to QC for stamping 'AS BUILT'	✓		RM	1.13.17	NA	
Test area secured with erection of barrier	✓		RM	1.13.17	NA	
Secure affidavit and select correct gauges (1.5 – 4 times test pressure)	✓	✓	RM	1.13.17		Jan.12/17
Threaded consumables counted and recorded for all Jobs identified as 'XXXXXX-001'	✓				NA	
Hydrostatic test complete as per NWP procedure with affidavit and gauges returned to QC	✓		RM	1.13.17		Jan.12/17



Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 1		FORM- Package/Product Assembly Travel Sheet

Page 2 of 2

POST HYDROSTATIC TEST:	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Slowly and safely de-pressurize system	✓		RM	1.13.17	NA	
De-water and blow down system as per NWP procedure for Draining Water From Hydro Tested Vessel Packages	✓	✓	RM	1.13.17	NA	
Verify removal of all low drain plugs	✓		RM	1.13.17	JM	FEB 14 2017
Ensure all water is removed from the tested system	✓		RM	1.13.17	JM	FEB 14 2017
Hydrostatic test fittings removed and returned to storage	✓		RM	1.13.17	NA	
Conduct pigging of coil and completion of report as needed	✓		RM	1.13.17	JM	FEB 14 2017
All mounted equipment properly secured to package	✓		RM	1.13.17	JM	FEB 14 2017
Confirm ladder bolts tight and thief hatch installation as needed					NA	
Verify re-installation of low drain plugs after adding RV antifreeze	✓	✓			NA	
PRESSURE VESSEL INTERNALS						
Verify that all removable internals have gaskets installed, bolts are correct size, sealing washer installed and bolts torqued per IFC Drawings	✓	✓			NA	
Verify with photos that vessel internal is clean and free of debris					NA	
Assembly Supervisor/Lead Hand/Plant Manager final visual inspection	✓	✓			NA	
Work area cleaned up and Package / Product ready for Masking and Sandblasting	✓		RM	1.13.17	NA	

Comments:

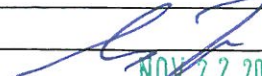
Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 1		FORM- Paint / Blast Final Inspection Checklist Page 1 of 1

Sandblasting / Painting / Coating Travel Sheet		Approved By: 				
		Date: NOV 22 2016				
WO # 09961-001		Description: 2.0MM BTU/HR Lineheater Pkg.				
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4						
PRE-BLAST:	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Thorough review of PDL	✓	✓	TV	Jan 13		FEB 14 2017
All sensitive instruments, valve handles, tags, etc. adequately masked	✓	✓	TV		NA	
All flange faces covered and protected	✓	✓	TV		NA	
Open ends capped / plugged or masked	✓	✓	TV		NA	
Removal of excessive grease and oils if required	✓	✓	TV		NA	
Blast integrity recorded on Paint/Coating Report	✓	✓	TV		JA	FEB 14 2017
POST BLAST:						
All residual sand blown down and removed	✓	✓	MC		JA	FEB 14 2017
Review paint colours and painting requirements	✓	✓	MC		JA	FEB 14 2017
Potential moisture/rusting areas caulked	✓	✓	MC		JA	FEB 14 2017
Column caps installed as required	✓	✓	MC		NA	
Environmental conditions recorded on Paint/Coating Report	✓	✓	MC		JA	FEB 14 2017
Visual inspection to verify full coverage, absence of runs and dry spray	✓	✓	MC		JA	FEB 14 2017
DFT's recorded on Paint/Coating Report	✓	✓	MC		JA	FEB 14 2017
Gasket surfaces on internal attachments free of runs. No excessive coating in bolt holes.		N/A	MC		NA	
Required foam insulation thickness on underside of skid measured and recorded on Foam Application Report		N/A	MC		NA	
Required foam insulation thickness measured and recorded on Foam Application Report		N/A	MC		NA	
Visual inspection of elastomer coating for full coverage and recorded on Foam Application Report		N/A	MC		NA	
Ensure all masking material has been removed.	✓	✓	MC		JA	FEB 14 2017
Work area cleaned up and product ready for Building/Cladding if applicable	✓	✓	MC	Jan 13	NA	

Comments:

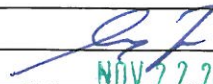
Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 1		FORM- Buildings Final Inspection Checklist

Page 1 of 1

Building / Cladding / Insulating Travel Sheet		Approved By: 				
		Date: NOV 22 2016				
WO # 09961-001		Description: 2.0MM BTU/HR Lineheater Pkg.				
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4						
Buildings:	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Thorough review of PDL and Building Material Over Counter Pick sheet	✓	✓	KJS	2017 Jan 14	JA	FEB 14 2017
Skid leveled and adequately supported	✓		KJS		NA	
Perimeter C channel properly attached	✓		KJS		NA	
Verify panels to be installed level, plumb, square and of same colour/shade/finish	✓		KJS		JA	FEB 14 2017
Inspect panels for no gap, and corner/roof connections are tight	✓		KJS		JA	FEB 14 2017
Lifting Lugs – Verify no lifting sling interference with building components	✓		KJS		JA	FEB 14 2017
Correct installation of windows, drain at bottom, and functional ease of operation	✓		KJS		NA	
Building louvers and patches are square, tidy and sealed.	✓		KJS		JA	FEB 14 2017
Doors installed level and plumb with all hardware, and functional ease of operation	✓		KJS		JA	FEB 14 2017
Visual inspection of ice rakes if required	✓		NA		NA	
All building envelope breaches are caulked inside and out	✓		KJS		JA	FEB 14 2017
Building Material Over Counter Pick complete and submitted to Warehouse	✓		KJS		NA	
Cladding:						
Thorough review of PDL and Building Material Over Counter Pick sheet	✓	✓	KJS		JA	
Skid leveled and adequately supported	✓		KJS		NA	
Cladding installed and sealed correctly	✓		KJS		JA	
Banding is orderly, tight, and cut close to clamps	✓		KJS		JA	
Visual inspection of expansion tank if required	✓		KJS		NA	
Building Material Over Counter Pick complete and submitted to Warehouse	✓		KJS		NA	
Work area cleaned up and product ready for E & I if applicable	✓				NA	

Comments:

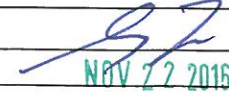
Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 1		FORM- Instrumentation Final Inspection Checklist Page 1 of 1

Instrumentation Travel Sheet		Approved By: 				
		Date: NOV 22 2016				
WO # 09961-001		Description: 2.0MM BTU/HR Lineheater Pkg.				
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4						
Instrumentation:	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Thorough review of PDL, P & ID, and work instructions.	✓	✓	SG	Jan 18	JA	FEB 14 2017
Verify tubing weights and grades as per NWP procedure.	✓		SG		JA	FEB 14 2017
Confirm all instruments match NWP PDL description to include make, model, serial number, range, set pressure, etc.	✓		SG		JA	FEB 14 2017
Review of Client specifications if applicable.			SG		NA	
All instruments installed as per NWP procedure and industry recognized practices.	✓		SG		JA	FEB 14 2017
All tubing lines installed level, plumb, and square and supported per NWP procedure.	✓		SG		JA	FEB 14 2017
Verify instruments and tubing does not obstruct lifting slings if used on lifting lugs.			SG		JA	FEB 14 2017
Verify instruments and tubing do not obstruct operation of valves, equipment, and process piping.	✓		SG		JA	FEB 14 2017
All tubing lines and connections are free of scratches and not collapsed.	✓		SG	—	JA	FEB 14 2017
Test area secured with erection of barrier.	✓		SG	Jan 19	NA	
Secure affidavit and correct gauges. (1.5 – 4 times test pressure)	✓		SG		JA	Jan. 31/17
Function/Pneumatic/Hydrostatic test complete as per NWP QC Manual and procedures.	✓	✓	SG		JA	Jan. 31/17
Test affidavits and gauges returned to QC.	✓		SG		JA	Jan. 31/17
Reinstallation of instrument tubing after testing as per NWP procedure.	✓		SG	—	JA	FEB 14 2017
All vents terminated 1m minimum from any building openings as per NWP procedure.	✓		SG	Jan 15	JA	FEB 14 2017
All vents are 1.5 meters minimum from any electrical boxes as per NWP procedure.	✓		SG		JA	FEB 14 2017
All tubing lines exiting building bent down at 45° and sealed as per NWP procedure.	✓		SG		JA	FEB 14 2017
All building envelope penetrations caulked neat and tidy, both inside and out.	✓		SG		JA	FEB 14 2017
Work area cleaned up, Instrumentation complete.	✓		SG	—	NA	

Comments:

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: July 4, 2016 Rev Status: 2		FORM- Instrumentation Final Inspection Checklist

Page 1 of 1

Electrical Travel Sheet		Approved By: 	
		Date: NOV 22 2016	
WO # 09961-001	Description: 2.0MM BTU/HR Lineheater Pkg.		
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4			
Electrical:	REQ.	HOLD	EMPLOYEE INT. DATE
Thorough review of PDL, P & ID, and work instructions	✓	✓	KC Jan 26/11
Confirm all electrical components match NWP PDL description to include make, model, serial number, etc.	✓		KC
Review of Client specifications if applicable			KC
All electrical components installed as per NWP procedure and Canadian Electrical Code	✓		KC
All conduit lines sized according to service, application, and Canadian Electrical Code	✓		KC
All conduit lines installed level, plumb, square, and supported per NWP procedure and Canadian Electrical Code.	✓		KC
Verify electrical components do not obstruct lifting slings, if used on lifting lugs.	✓		KC
Verify electrical components do not obstruct operation of valves, equipment, and process piping	✓		KC
Secure test affidavit and required meter from QC and perform Loop Check test	✓		KC
Secure test affidavit and required meter from QC and perform Megger Check test	✓		KC
Return of affidavits to QC	✓		KC
Re-terminate electrical components as per NWP procedure	✓		KC
Confirm covers replaced on fittings after test	✓		KC
Ensure all labels are heat shrunk	✓		KC
All seals tagged and identified as 'NOT PACKED & POURED'	✓		KC
Lamacoids installed as required	✓		KC
All junction boxes clean and free of debris	✓		KC
Package is properly grounded and/or bonded	✓		KC
FAT Test if applicable	✓		KC
All building envelope penetrations caulked neat and tidy, both inside and out	✓		KC
Work area cleaned up, Electrical complete	✓		KC

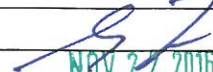





























QC Final Review

QC Inspector: 

Date: FEB 14 2017

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Oct 19, 2015 Rev Status: 0		FORM- Utility / Finished Product Final Inspection Checklist

Page 1 of 2

Utility / Finished Package / Product Travel Sheet		Approved By: 				
		Date: NOV 22 2016				
WO # 09961-001	Description: 2.0MM BTU/HR Lineheater Pkg.					
Drawing # 09961-001-P-001 Rev 0, 08574-001-G-000 Rev 0, , NWPL-00030 Rev 4						
	REQ	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Thorough review of PDL and work instructions	√	√		FEB 08 2017		FEB 14 2017
NWP decal on door, square, level and tidy	√			FEB 08 2017		FEB 14 2017
All instruments installed and tubing complete as per both P & ID and NWP procedure	√		SG	Jan 19		FEB 14 2017
All electrical installations complete as per both P & ID and NWP procedure	√		SG	Jan 19		FEB 14 2017
Test area secured with erection of barrier	√		SG	Jan 19	NA	
Function/Pneumatic/Hydrostatic test complete as per NWP QC Manual and procedures	√	√	SG	Jan 19		Jan 31 /17
Affidavits and gauges returned to QC	√		SG	Jan 19		Jan. 31 /17
Reinstall instrument tubing as per NWP procedure	√		SG	Jan 19		FEB 14 2017
Re-terminate electrical as per NWP procedure	√					FEB 14 2017
Verify removal of all low plug drains	√			FEB 08 2017		FEB 14 2017
Verify reinstallation of all low plug drains after adding RV antifreeze	√			FEB 08 2017		FEB 14 2017
If applicable, installation of internals complete with photos for verification	√		N/A		NA	
If applicable, verify all change orders complete and signed off	√			FEB 08 2017		FEB 14 2017
All openings either plugged or capped	√			FEB 08 2017		FEB 14 2017
All flanges on outside of building covered as per Customer's specification	√			FEB 08 2017		FEB 14 2017
All tubing lines exiting building bent down at 45° and sealed off with electrical tape	√		SG	Jan 19		FEB 14 2017
Threaded or Welded vents pointing down complete with screens.	√			FEB 08 2017		FEB 14 2017
Drains clean and either plugged or capped	√			FEB 08 2017		FEB 14 2017
If product/package internally coated, all removable attachments installed	√		N/A		NA	
Tank is clean and free of debris with condition of tank recorded on photos before installation of manway cover	√		N/A		NA	
Touch up paint as required	√			FEB 08 2017		FEB 14 2017
Floors clean and painted if required	√			FEB 08 2017		FEB 14 2017

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Oct 19, 2015 Rev Status: 0		FORM- Utility / Finished Product Final Inspection Checklist <div style="text-align: right;">Page 2 of 2</div>

	REQ	HOLD	EMPLOYEE INT.	DATE	QC INIT.	DATE
Windows clean and locked for shipping	√		N/A		NA	
Ship loose PSV's secured in the upright position	√		CD	FEB 08 2017	NA	
Ship loose items preserved in a neat and orderly fashion complete with an itemized list	√		CD		h	FEB 14 2017
All ship loose items painted and accounted for to include ladders, platforms, stacks, etc.	√		CD		h	FEB 14 2017
Final Release document endorsed by members of Manufacturing, Quality Control, and Warehouse	√	√	CD	FEB 08 2017	h	FEB 14 2017
Doors locked and banded, barrel bolts wired shut	√				NA	
Photos taken and ownership transferred to the Warehouse	√		CD	FEB 08 2017	h	FEB 14 2017
Bin / lot location determined, package / product ready to ship	√		CD	FEB 08 2017	h	FEB 14 2017
Work instructions retrieved and returned to Document Control	√		CD	FEB 08 2017	h	FEB 14 2017

Comments:



the pressure equipment safety authority

PRESSURE PIPING CONSTRUCTION AND TEST DATA REPORT

In accordance with the provisions of the PESR Section 31(1)

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: NWP Industries LP Owner's Job No: 09961-001
(Name of ABSA authorized primary contractor or subcontractor)
4017 60th Ave Innisfail AB T4G 1S9
(Address)
- Certificate of Authorization Permit No. AQP-1253 Expiry Date: Feb 12, 2018
2. Constructed For: NA
(Name of primary contractor if different from above)
NA
(Address)
- Certificate of Authorization Permit No. AQP-NA Expiry Date: NA
(Required when the primary contractor undertakes some/all of the quality functions, e.g., NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)
3. Owner: Baytex Energy Ltd.
(Name and address)
15-02-42-12 W5M
(Location of installation)
- Certificate of Authorization Permit No. AQP-NA Expiry Date: NA
(Required when the owner undertakes some/all of the quality functions, e.g., NDE, PWHT, Tie-in, fabrication, hydro test, final assembly etc.)
4. Piping Design Alberta Registration No.: PP-NA
(Required if aggregate piping volume is over 0.5m³)
5. Design Responsibility: Owner ☐; Contractor ☒
6. WP No.: WP-1604.2 ; Company: NWP Industries LP Owner's WP No. (If used): WP-NA
(Alberta Registration No.) (Alberta Registration No.)
WPS No(s). used: NWP-1 ; Owner's WPS No(s). (If used): NA
7. Code: ASME B31.1 Non Boiler External Piping ☐; ASME B31.1 Boiler External Piping ☐;
B31.5 ☐; B31.9 ☐; CSA Z662 Steam Pipelines ☐;
ASME B31.3 ☒ - Service Category: Normal ☒, D ☐, M ☐, High Pressure ☐; Severe Cyclic Condition ☐
High Purity ☐

Drawing No. Rev. No. Line No.	Fluid (Air/Stm. Etc.)	Des. Press. psi	Des. Temp. °F (Max. & Min.)	Pressure Test psi	Test Medium	Pipe Mat'l Spec. & Grade	C.A. in	Pipe NPS & Schedule	Flange Material & Rating	PWHT/ Preheat Temp. °F	NDE
LH2001-D0- 100 Rev 0 FG-1"-X- 160C-0702	Hydrocarbons	1440	200 / -20	2160	Water	SA-333-GR6	1/16	1" SCH160	NA	NA / 50	10% RT 100% VT
09961-001-P- 001 Rev 0 FG-1"-W- 80B-0700, 0701, 0703	Hydrocarbons	150	100 / -20	165	Air	SA-106-B SA-213 316L	1/16	3/8" 0.035 WT 1" SCH80	NA	NA / 50	100% VT

Partial Data Reports certified by sub-contractors are listed below and attached to this Data Report ☐

No.	Line No.	Spool No.	Dwg. No. (with Rev. No.)	Sub-contractor (Name)	AQP No. (if from Alberta)	Expiry (if from Alberta)

Remarks: For partial data report provide information about the code work that was not completed by the subcontractor (e.g., hydrostatic test, PWHT etc.). For final data report provide information about the code work that was not completed by subcontractors and subsequently completed by the primary contractor (e.g., hydrostatic test of entire assembly, PWHT etc.)

Endorse certificate 'A' or 'B'	
<p style="text-align: center;">A. CERTIFICATE OF COMPLIANCE</p> <p>Signed by the subcontractor when supplying this certificate as a Partial Data Report</p> <p>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).</p> <p>Date: _____</p> <p style="text-align: right;">Contractor</p> <hr/> <p>Print Authorized Representative's Name Signature</p> <p>This certificate is not valid unless it forms part of a Final Data Report signed by Primary Contractor</p>	<p style="text-align: center;">B. CERTIFICATE OF COMPLIANCE</p> <p>Signed by the primary contractor when supplying this certificate as a Final Data Report</p> <p>We certify that the statements in this Data Report are correct and that piping job no. <u>09961-001</u> 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).</p> <p>Date: <u>Jan 31, 2017</u> <u>NWP Industries LP</u></p> <p style="text-align: right;">Contractor</p> <hr/> <p><u>Jeremy Atkinson</u></p> <p>Print Authorized Representative's Name Signature</p>

CERTIFICATE OF INSPECTION

I, the undersigned, employed by Baytex Energy have verified that all required examination and testing has been completed, and inspected the piping described in this construction data report to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the Code and of the engineering design, and state that, to the best of my knowledge and belief, the contractor has constructed this piping in accordance with the Alberta Safety Codes Act and Regulations. By signing this certificate neither the inspector nor his or her employer makes any warranty, expressed or implied, concerning the piping described in this construction data report. Furthermore, neither the inspector nor his or her 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: Jan 31, 2017 Date: _____

Dwayne Bunch

Owner's Inspector Name (please print)

Dwayne Bunch Cert# 000276

Owner's Inspector Signature:

ABSA Safety Codes Officer (please print)
(BOILER EXTERNAL PIPING ONLY)

ABSA Safety Codes Officer's Signature

Issuing Authority: QA/QC Manager

Date of Issue: Jan 29 2015

Rev Status: 10.0



Document Template 2013

Quality Control

FORM-Hydrostatic test affidavit

Page 1 of 1

EXHIBIT 16.2 HYDROSTATIC TEST AFFIDAVIT

Customer: **Baytex Energy**

JO# 09961-001

Project: 2.0mm line heater threaded function air test

Project#

Test Pressure: 165 PSI AIR

Hold Time: 15 minutes

Code Requirements: ASME B31.3 NFS 2014 edition

All Personnel Advised of Test ☒ All Signs & Flagging Posted ☒

Prior to Filling = Fitting/Hoses & Component Meet Required Test Pressure, Pressure Test Examination Guide Completed

Initials: SG Supervisor: Dave Tester: Scm

Date: 31/01/2017

Product Description:

1. FG-1"-W-80B-0700, 0701, 0703, ALL ASSOCIATED INSTRUMENT AIR TUBING = 165 PSI AIR

- test fire of pilot, function test of valves.

50% Test Pressure Leak/Systems Check Completed ☒

1. 50% = 83 PSI AIR

Test Temperature: _____ °F

Equipment Drained & Flushed to Prevent Freezing:

Yes: ☐

No: ☐


See NWP Procedure for Draining Water from Hydro Tested Vessel Package

Start Time:	Finish Time:
<u>7:45 AM</u>	<u>8:40 AM</u>

Test Gauge Identification #	Pressure Range	Calibration Date
NWPG- 300 <u>3</u>	0-300 PSI	<u>Jan 25 / 2018</u>
NWPG- 300 <u>5</u>	0-300 PSI	<u>Oct. 26 / 2017</u>
NWPG-	PSI	
NWPG-	PSI	
NWPG-	PSI	

Test By: <u>Scm</u>	Date: 31/01/2017
NWP Representative: <u>Jeremy Utterman</u>	Date: 31/01/2017
Customer Representative: <u>Alvin Bunch</u>	Date: 31/01/2017

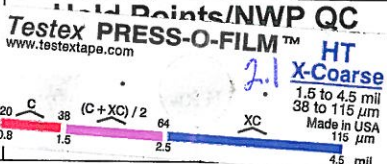
Cell # 000276

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: May 5, 2015		FORM- Foam Application Report
Rev Status: 2.0		Page 1 of 1

NWP W/O: 09961-001

Equipment#: _____ Line #: _____

	Specification	Colour Code	DFT (µm) Req'd	DFT (µm) Actual
Surface Preparation	Sp-6	N/A	1.5-4.5	2.1
Primer				
Tank	N/A			
Underskid	N/A			

Surface Preparation	Comments	Hold Points/NWP QC	Initial	Date
Blast Media Approved	No clay based media		TL	Jan 13
Atmospheric Conditions Correct	Temp ≥ 10°C			
Welds and Welded Areas Clean	No Splatter/Slag			
Profile Depth Correct	<40 µm/ >>25 µm			

Primer	Comments	Hold Points/ NWP QC	Initial	Date
Ambient Temperature	Measurements	N/A		
Finished Appearance	Visual			
Batch Number				

Foam	Comments	Hold Points / NWP QC	Initial	Date
Proper Coating	Print/Spec. Reviewed	N/A		
Relative Humidity	Measurements			
Ambient Temperature	Measurements			
Batch Number				


Foam	Comments	Hold Points / NWP QC	Initial	Date
Proper Coating	Print/Spec. Reviewed	N/A		
Relative Humidity	Measurements			
Ambient Temperature	Measurements			
Batch Number				

Black Ultra Flex Elastomer	Comments	Hold Points / NWP QC	Initial	Date
Relative Humidity	Measurements	N/A		
Ambient Temperature	Measurements			
Batch Number				

Comments and Remarks _____

Name: _____
 Signature: Michael J. Connors
 Date: Jan 13

Name: _____
 Signature: _____
 Date: _____

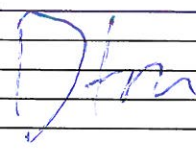
Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: April 21, 2015		FORM- Paint /Coatings Report
Rev Status: 1.0		Page 1 of 1


NWP W/O: 89961-001

Equipment#: _____ Line #: _____

	Specification	Colour Code	DFT (µm) Req'd	DFT (µm) Actual
Surface Preparation		N/A		
Primer				
Mid-Coat				
Finish Coat	Close/Idle Area	F-34	2-4	2.5-4

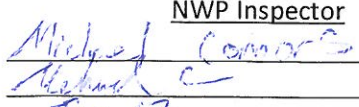
Surface Preparation	Comments	Hold Points/NWP QC	Initial	Date
Blast Media Approved	No clay based media	Place Blast Profile Here		
Atmospheric Conditions Correct	Temp ≥ 10°C			
Welds and Welded Areas Clean	No Splatter/Slag			
Profile Depth Correct	<40 µm/ >>25 µm			

Primer	Comments	Hold Points/ NWP QC	Initial	Date
Proper Coating	Print/Spec. Reviewed			
Surface Clean	Visual			
Mixed/Thinned Properly	Manufacturer Specs.			
Relative Humidity	Measurements			
Ambient Temperature	Measurements			
Applied Properly	50% Overlap			
Dry Time	Manufacturer Specs.			
Finished Appearance	Visual			
Batch Number				

Mid-Coat	Comments	Hold Points / NWP QC	Initial	Date
Proper Coating	Print/Spec. Reviewed			
Surface Clean	Visual			
Mixed/Thinned Properly	Manufacturer Specs.			
Relative Humidity	Measurements			
Ambient Temperature	Measurements			
Applied Properly	50% Overlap			
Dry Time	Manufacturer Specs.			
Finished Appearance	Visual			
Batch Number				

Top-Coat	Comments	Hold Points / NWP QC	Initial	Date
Proper Coating	Print/Spec. Reviewed	✓	MC	Jan 13
Surface Clean	Visual	✓		
Mixed/Thinned Properly	Manufacturer Specs.	✓		
Relative Humidity	Measurements	23.6		
Ambient Temperature	Measurements	17.9		
Applied Properly	50% Overlap	✓		
Dry Time	Manufacturer Specs.	✓		
Finished Appearance	Visual	✓	MC	Jan 13
Batch Number				

Comments and Remarks _____

Name: _____
 Signature: 
 Date: Jan 13

Name: _____
 Signature: _____
 Date: _____

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Oct 13, 2016 Rev Status: 1		FORM-ELECTRICAL CABLE & CONDUIT SEAL INSPECTION CHECKLIST Page 1 of 1

Electrical Cable and Conduit Seal Inspection Checklist

Client: Beytex Work Order No.: 09961-001

Please initial only, no checkmarks.

Action	Checked By:	Verified By:
Verify that type of conduit seal fitting is correct.	KC	BB
Verify that sufficient spacing is provided to pour compound into conduit seal.	KC	BB
Verify that conduit seal fittings are at boundaries of each hazardous area division, and where required with the hazardous area.	KC	BB
Ensure adequate temperature exists for curing time as per manufacturer's instruction, before pouring compounds mixed with water.	KC	BB
Verify that conduit sealing fittings are not installed where they are not required, such as dual sealed fittings, factory sealed fittings, and intrinsically safe systems.	KC	BB
Check cable connections for use hazardous are correct type for division and group and are correct size.	KC	BB
Verify cable jackets, shields, and properly prepared correctly before conduit seals and cable glands are sealed.	KC	BB
Check for compliance of manufacturer's instructions for mixing and installing sealing compounds.	KC	BB
Verify all teck connectors and conduit unions are tight and initialled.	KC	BB

Checked by: Print Name: Kevin C Signature: [Signature] Date: Jan / 26 / 20 17
 Verified By: Print Name: Bretta Signature: [Signature] Date: Jan / 26 / 20 17

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Aug 17, 2016 Rev Status: 1		FORM-ELECTRICAL TERMINATION CHECKLIST

Page 1 of 1

Electrical Termination Checklist


Client: Baytex Work Order No.: 09961-001

***NOTE: Terminations must be verified by someone other than the person who wired the junction box & end devices**

Please initial only, no checkmarks.

Action	Checked By:	Verified By:
Verify all wires fully engaged under terminal screw.	KC	BB
Verify all wires are tightened under terminal screw; Use pull tug method.	KC	BB
Verify all heat shrinks are shrunk.	KC	BB
Verify all heat shrinks are legible and able to read.	KC	BB
Verify proper size of wire terminal is used under screw.	KC	BB
Verify that all wires will not be damaged by the screw.	KC	BB
Check to ensure polarity on end devices is correct.	KC	BB
120VAC → BLK(+) WHT(-) Discrete → WHT(+) BLK(-) Analog → WHT(+) BLK(-) Triad → WHT(+) BLK(-) RED(sig)	KC	BB

Checked by: Print Name: Kevin C Signature: [Signature] Date: Jan / 26 / 20 17
 Verified By: Print Name: Brett B Signature: [Signature] Date: Jan / 26 / 20 17

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: DEC 1 2014 Rev Status: 1		FORM-ELECTRICAL TESTING REPORT Page 2 of 2

Cable Number	Test Voltage	Test Resistance	Function Test	Point To Point	Initial

Company

Representative: Print Name: Brett B Signature: [Signature] Date: Jan. 26/17

Client

Representative Print Name: _____ Signature: _____ Date: _____

Tester

Print Name: Kevin C Signature: [Signature] Date: Jan. 26/17



INSPECTION AND TEST PLAN-ELECTRICAL INSTALLATION

Work Order #: 09961-001		Project Name:		Date: Jan. 26 / 17		Rev: 0	
Client:		NWP Quality Rep: Kevin L		Client Rep:			
LEGEND:	H-HOLD	R-RECORD REVIEW	I-INSPECTION	V-VERIFY	W-WITNESS	N/A-NOT APPLICABLE	
Quality Control Activity		NWP Record Required Y=Yes N=No	NWP Insp. Requirements	Acceptance Criteria (Reference Documents)	Client Insp. Requirements	ITP Review/Verification	
						Mid Project Review NWP Quality Initial	Final Project Review Client Rep. Initial
GENERAL/SUBMITTALS							
1	Codes and Standards		R	IFC Drawing, This ITP			KC
2	NWP E&I QA/QC ITP		R	Scope of work as per PO, Owner approved and signed off			KC
3	Drawings and Specifications		R	IFC Drawing, Canadian Electrical Code, Owner approved & signed off			KC
4	Measure and Test Equipment		R	NWP QC Quality Manual, Measure Test & Calibration/Verification Log			KC
5	Non-Conformance Reports		R	NWP QC Quality Manual, NCR Form			KC
6	Punch List		R	Electrical Punch List			KC
MATERIAL RECEIVING							
7	Heat Trace		I	Clients contract & Specifications, Electrical Heat Trace Receiving Log			N/A
ELECTRICAL INSTALLATION							
8	Cable Trays		I	Clients contract & Specifications, Electrical Cable Tray Installation Checklist			N/A
9	Cable and Conduit Installation		I	IFC Drawing, Electrical Cable & Conduit Installation Checklist			KC
10	Wire and Cable Continuity Test		TEST	IFC Drawing, Electrical Testing Report			KC
11	Wire and Cable Meggar Test		TEST	IFC Drawing, Electrical Testing Report			KC



INSPECTION AND TEST PLAN-ELECTRICAL INSTALLATION

LEGEND:		H-HOLD	R-RECORD REVIEW	I-INSPECTION	V-VERIFY	W-WITNESS	N/A-NOT APPLICABLE			
Quality Control Activity		NWP Record Required Y=Yes N=No	NWP Insp. Requirements	Acceptance Criteria (Reference Documents)	Client Insp. Requirements	ITP Review/Verification				
						Mid Project Review NWP Quality Rep Initial	Client Rep. Initial	Final Project Review NWP Quality Rep Initial	Client Rep. Initial	
12	Junction Box Installation		I	IFC Drawing, Electrical Junction box installation checklist					KC	
13	Heat Trace Installation		I	Client's Contract & Electrical Heat Trace Installation Checklist					N/A	
14	Heat Trace Test		TEST	Client's Contract & Specifications, Electrical Heat Trace Test Record					N/A	
15	Function Test		TEST	Proper Instrument Range Functionality as per Vendor Spec., NWP FAT Test Report					KC	
FINAL INSPECTION										
16	Electrical Document Turnover Notice		COMPILE & REVIEW	VDDR					KC	
17.	QA/QC Turnover Package		COMPILE & REVIEW	Clients contract & Specifications, Owner Approved & Signed off					KC	

If more spaces are required for additional project specific requirements attach pages to the end of this ITP checklist and note above that they are attached.

If more spaces are required for additional project specific requirements attach pages to the end of this ITP checklist and note above that they are attached.

ITP AGREEMENT

The signatures below indicate that the activities in this ITP reflect applicable code/ standard(s), NWP's Quality Management System and Contractual requirements. It is the intention that this ITP meet all contract requirements.

NWP Quality Representative	DATE (MM/DD/YY)	Signature
Print/Type Name: Kevin L.	Jan. 26 / 17	
Title: Electrician		
Client Representative	DATE (MM/DD/YY)	Signature
Print/Type Name:		
Title:		

NOV 21, 2016
09961-001 Rev 0



4017 - 60th AVE Box 6280, Innisfail AB. T4G 1S9 Phone (403) 227 4100 Fax (403) 227 4102

**Project Data List
BUILD TO NWP STOCK**

ORIGINAL

Work Orders 09961

Date: November 7, 2016

Project Coordinator: Shannon Fischer

Reference P&ID:

Estimate Reference:

Client: NWP Stock

Contact:
Email:
Phone:

1.0 GENERAL DESCRIPTION

Quantity

Description

1

2.0 MM BTU / Hr Lineheater Package

- 62" x 20'-0" Horizontal Lineheater
- 4" 2500# RTJ x 4" 1500# RTJ Split Process Coil, 8 pass each
- Fuel Gas Scrubber
- Skidded, insulated with all B149.3 compliant instrumentation
- Ex Works: Innisfail, Alberta

2.0 VESSEL**1.1 GENERAL DESCRIPTION**

Tag #: H-200

- 62" OD x 20'-0" Long
- Horizontal design
- 20" Sch 10, 0.25" SA-53-ERW removable non code firetube, Flux Rate: 10,000 BTU/ft2
- Rated at 2,000,000 BTU / Hr
- 20" Ø x 0.25" wall firetube stack
- 20" Ø x 0.25" wall 120" Surge Tank c/w (TH-200) Thief Hatch, 16 oz pressure, 0.4 oz vacuum
- Two support saddles

ORIGINAL

3.0 COILS

- **COIL A** - only 4" Sch. XXH, SA-333-Gr6, eight pass preheat coil with 2500# ANSI RTJ flanged outer ends, 5171 PSIG @ -20° to 200° F, 100% Radiography, Post Weld Heat Treat, 1/16" C.A., constructed in accordance with ASME B31.3 Normal Fluid Service. ABSA Registration
- **COIL B** - only 4" Sch. 160, SA-333-Gr6, eight pass reheat coil with 1500# ANSI RTJ flanged outer ends, 3375 PSIG @ -20° to 200° F, 100% Radiography, Post Weld Heat Treat, 1/16" C.A., constructed in accordance with ASME B31.3 Normal Fluid Service. ABSA Registration
- Preheat Fuel Gas Line - 1" Sch. 160, SA-106-B, socket-weld, 6000# fittings. Hydro tested to 2160 PSIG

4.0 INSTRUMENTATION

Tag #	Quantity	Description
BE 200	(1)	Flame Arrested Burner Enardo Model FAH32/18-18A 2,000,000 BTU/Hr c/w 32" flame cell element ACL-M200 air/gas mixer ACL-B20016 venturi barrel ACL-ON20020 High Efficiency burner nozzle. Two piece aluminium construction to fit 20" tube
BMS-200	(1)	Burner Ignition Controller - ACL Model 5100 Microprocessor based flame fail/ignition system with auto relight, shutdown input, remote stop and remote start, proof of closure contacts and alarm output relay. 24 VDC operation CSA approved for Class 1, Div 2 location CSA approved C22.2 No 199-M89. Combustion Safety Controls and Solid State Ignitors for Gas & Oil Burning Equipment. Meets and exceeds CSA B149.3 guidelines. NEMA 4x enclosure, corrosion resistant and weather
LG-200 LGV-200	(1)	Level Gauge - Tubular Glass Level Gauge 5/8" Redline tube, c/w Conbraco 20-150-03 valves
LSL-200	(1)	Level Switch - SOR Model 1510B-G2A-C-L9-ES-CSNCCV Level Switch, 2" NPT, electric, 24 VDC, Low Power SPST 25 Watts Max c/w 2" x 3" SS float, std service

PI-200	(1)	Pressure Gauge – CPW Hydropoise Model 402 ^{Wika} 233.53 Liquid filled 2 1/2 inch dia. face 1/4-inch NPT bottom mount end connection Aluminum case and SS internals 0 to 300 PSIG, dual scale
PI-107	(1)	Pressure Gauge – Wika Model 233.53 Liquid filled 2-1/2 inch dia. face 1/4-inch NPT bottom mount end connection Stainless Steel 0 to 30 PSIG, Dual Scale
PRV-200	(1)	Instrument Gas Regulator - Fisher Model 67CFR Regulator 1/4" FNPT connections, Tapped Bonnet 0-60 PSIG Adjustable spring range, 5 micron filter c/w 0-60 psi gauge
PRV-201	(1)	Instrument Gas Regulator - Fisher Model 67CFR Regulator 1/4" FNPT connections, Tapped Bonnet 0-125 PSIG Adjustable spring range, 5 micron filter c/w 0-160 psi gauge
PSV-200	(1)	Relief Valve – Taylor Model 8200, 1" MNPT x 1" FNPT Size "D" Orifice (0.128 sq. in.) set @ 150 psi, std service
TC-200	(1)	Temperature Controller - Kimray Model HT-12 Temperature Controller, 1/2" MNPT, -30 F to 750 F Temp range 5 to 30 psig output signal, 12" probe
TW-200	(1)	1/2" FNPT x 1" MNPT x 12" long SS separable socket
TI-201/TW-201	(1)	Temperature Indicator - Trend Model 33060 Temperature Gauge, 1/2" NPT Back Mount connection, 0-250 F dual scale 3" dial, 6" stem c/w 304 SS thermowell 1/2" FNPT x 1" MNPT x 6" "U" dimension length 304 SST thermowell
TSHH-202	(1)	High Temperature Shut-down – CCS Model CCS6900TE14 High Temp. Shut-down Switch 1/2" MNPT End Connection 24 VDC, Factory set @ 90 C
TW-202	(1)	1/2" FNPT x 1" MNPT x 4.5" "U" 316SS thermowell (Part 113-34-1-316)
SC-200	(1)	Speed Control Valve , Model NAS4000-No2 1/4" NPT, 150 Psi MAWP

5.0 VALVE TRAIN

Tag #	Quantity	Description
BF025G	(4)	1/4" Ball Valve, NEO 2500, Two-Piece Full Bore, SS,

2000 psi WOG, Lockable Handle
CSA 3.16 Certified

- BF100G** (2) **1" Ball Valve, NEO 2500**, Two-Piece Full Bore, SS, 2000 psi WOG, Lockable Handle
CSA 3.16 Certified
- NM025** (2) **Anderson Greenwood**, 1/4" Needle Valve
6000#, Model #H1VDS22
1/4" F x 1/4" M STRAIGHT, 316SS BODY
Delrin Seat
- PI 104/105** (2) **Pressure Gauges**
2-1/2" Dial, SS
1/4" NPT, 0 - 30 psi
Liquid Filled/ Dual Scale
Center Back Mount
Wika Model 233.53
- PSHH 100** (1) **High Fuel Pressure Shutdown Switch**
CCS Dual Snap Model 6900GZE12
1/2" NPT, SS CONSTRUCTION, CSA APPROVED
SET @ 14 psi Rising
CALIBRATION CERTIFICATE IS REQUIRED
- PSLL 100** (1) **Low Fuel Pressure Shutdown Switch**
CCS Dual Snap Model 6900GZE12
1/2" NPT, SS CONSTRUCTION, CSA APPROVED
SET @ 4 psi Falling
CALIBRATION CERTIFICATE IS REQUIRED
- PRV 102** (1) **Main Regulator - Fisher 627R**
Maximum Inlet Pressure 250 PSIG
Outlet Pressure Range 5 to 20 PSIG Spring Range
1" FNPT / Orifice Size 1/2"
3/4" Tapped Bonnet
Body Material: Ductile Iron
Spring Case Material: Aluminum
Nitrile Disk
Set @ 9PSI
- PRV 103** (1) **Pilot Regulator - Fisher 67CFR c/w PI**
1/4" NPT Tapped-Bonnet
Maximum Inlet Pressure 250 psig
Outlet Pressure Range 0-35 psig / c/w gauge
Adjustable spring range, 5 micron filter
Adjustable screw with closing cap
Temperature Range: -40 to 180 Deg F
- SDV-UY 100** (1) **Fossil Main Gas Safety Valve**, Pneumatic Actuator
Fossil Series 1" ESD 24 VDC
Series 88 - Explosion Proof Class 1 Div 1 - Fail Closed
P/N: 9650-0240-2006-1112-0022
Connection: 1" NPT Cv:34
Body Type: 3 Piece Design, Reduced Port
Body Material: CF8M
Ball & Trim: 316SS

ORIGINAL

ORIGINAL

EF8551ACC MMS

01.31.17
8

Seats: PTFE
End Connection NPT
Actuator: Rack and Pinion Spring Return
Actuator Min Air Pressure: 70psig
Actuator Max Air Pressure: 120 psig
Limit Switch: 2 SPDT switches with Beacon Indicator, Classified, Class 1, Div 1
Solenoid: ASCO EF8320G202 24 VDC (1.6 watts), Hazardous Area Classified, Class 1, Div 1
Approvals:
CSA 6.5-2000/ANSI Z21.21-Automatic Valves for Gas Appliances
CGA 3.9-M94 Automatic Safety Shut-Off Gas Valves
CSA C/I - Commercial/Industrial
API 604 4th Edition Firesafe
Temperature Range -49 - 122 Deg.F

- | | | |
|---------|-----|--|
| SY100 | (1) | Y STRAINER 1" - 3000 ALTA
Model YS 3000
1/32 Perf 304SS Strainer
ASTM A105N Body
1/2" Drain Connection |
| TCV 100 | (1) | Fisher Pneumatic Temperature Control Valve
Fisher Model 119
1" NPT - 9/16" Port
5-35 PSI Range
Cast Iron Body
150 PSI MAWP, STD Service |
| UY 101 | (1) | ASCO 3-Way Solenoid
1/4" NPT Pilot Solenoid
Model EF8314H301
130 psig Maximum Operating Pressure Differential
1/4" NPT SST Body
24VDC Coil, CSA Approved Explosion Proof
Low Power 0.55 Watts |

6.0 SKID/ENCLOSURE

- | | | |
|--------|-----|---|
| SK-200 | (1) | Wide Flange 12" @ 50 Skid
7'-0" wide, 25'-0" long |
| E-200 | (1) | Foam Panel Enclosure
24" W x 60" L x 72" H
1-1/2" polyurethane foam panel
Galvalume Interior/Exterior |

7.0 FUEL GAS SYSTEM

- | | | |
|----------|-----|---|
| V-200 | (1) | Vertical Fuel Gas Scrubber
8"-5/8 X 23" 285 PSI c/w Alberta, BC and Saskatchewan registration
1" NPT inlet, 2" NPT outlet, 3/4" NPT drain
MAWP: 285PSIG @ 100degF / MDMT: -50degF @ 285PSIG
CA: 1/8" CRN: OH0939-213 |
| HLSD-200 | (1) | PVC float construction |

8.0 MANUAL VALVES

BF025	(2)	¼" NPT, 2000#, Nutron Ball Valve, FP, CS, Std Trim Model: T3F02S20BZ
BF050	(2)	½" NPT, 2000#, Nutron Ball Valve, FP, CS, Std Trim Model: T3F05S20BZ
BR075	(1)	¾" NPT RP, 2000#, MA Stewart Barstock Ball Valve
BR100	(1)	1" NPT RP, 3000#, Nutron Ball Valve, RP, Std Trim Model: T3R10S20BZ
BR200	(1)	2" NPT RP, 2000#, MA Stewart Barstock Ball Valve
NM025	(2)	¼" NPT M x F, Huber Magnum Needle Valve, 6000#, SS Body

ORIGINAL

9.0 PACKAGE MATERIALS

<u>Coil</u>	
Flanges:	SA 350 LF2 RTJWN
Piping:	SA 333-Gr6 Sch 160 (B) / Sch XXH (A)
Fittings:	SA 420-WPL6
Bolts/Nuts:	SA 193-B7M / SA 194-2HM
Gaskets:	Spiral wound 316SS Flexitallic
Structural Material:	SA 36
<u>Firetube</u>	SA 53 ERW Sch 20, 0.375"
<u>Threaded Piping</u>	
Pipe Fuel gas:	SA-106-B, Sch 80 SMLS
Threaded Fittings:	SA-105-N, 3000#
<u>Welded Piping</u>	
Pipe:	NA
Flanges:	NA
Weld Fittings:	NA
Threaded and Couplings:	NA
Gaskets:	1/8-inch, 316 S.S. Flex.
Bolting:	SA-193-B7M, SA-194-2HM
Tubing:	316 SS
Fittings:	CS
Ferrules:	CS

10.0 TESTING / POST WELD HEAT TREAT (PWHT)

Hydro-Testing:	Pressure Vessels:	As per ASME Section VIII Div 1
	Pressure Piping:	As per B31.3
Radiography:	Scrubber:	Exempt as per UW11(c)
	Piping:	N/A
	Process Coil:	100%
	Firetube:	None
PWHT:	Process Coil:	Yes
	Piping:	N/A
Ultrasonic Test:	None Included	
Hardness Test:	None Included	

11.0 PAINT

- SSPC-SP 6-63 Commercial Blast, (1) coat Cloverdale Clovacoat 300 Epoxy to insulated areas.
- Uninsulated areas will have (2) coats Cloverdale Clovacoat 300 Epoxy, Warm Grey.
- Fire tube stack painted high heat black.

12.0 INSULATION

- Heater shell (no ends) is insulated with 1-1/2" Fiber Glass (Microflex) Insulation with 0.020 stucco embossed aluminum outer cladding held with stainless steel banding

13.0 ELECTRICAL

- BMS electrical components wired to skid edge as per Class 1, Div 1 Canadian Electrical Code specifications.

14.0 DOCUMENTATION

- One equipment manual on CD is supplied. Hard copies are available at \$500 per copy

15.0 ADDITIONAL NOTES

- Package will be dismantled only to the extent required for shipping.

ORIGINAL

LINE TYPE LEGEND

	MAJOR PROCESS LINE
	UTILITY LINE
	BUILDING LIMITS
	ENCLOSURE LIMITS
	ALTERNATE LIMITS
	CUST/VENDOR SUPPL. LIMITS
	HIDDEN LINE
	EQUIPMENT OUTLINE
	INSTRUMENT PNEUMATIC LINE
	PROCESS/UTILITY TUBING LINE
	INSTRUMENT CAPILLARY LINE
	ELECTRICAL DATALINK LINE
	ELECTRICAL CONNECTION LINE
	HYDRAULIC LINE
	MECHANICAL LINK LINE

INSULATION LEGEND

	2.5" PP	* THICKNESS C=COLD H=HOT PP=PERSONEL PROTECTION
	3" C	
	25H ET	* THICKNESS c/w TRACING ET=ELEC. TRACE GT=GLYCOL TRACE OT=OIL TRACE ST=STEAM TRACE
	3H GT	

VALVE SYMBOL LEGEND

	BALL VALVE
	SPRING RETURN BALL VALVE
	GLOBE VALVE
	GATE VALVE
	CHECK VALVE
	PLUG VALVE
	NEEDLE VALVE
	INLINE CHOKE VALVE
	4-WAY VALVE
	3-WAY VALVE
	BUTTERFLY VALVE
	BASKET/CONE STRAINER
	TEE STRAINER
	Y STRAINER
	RUPTURE DISC
	PRESSURE RELIEF VALVE
	ANGLE VALVE
	ANGLE CHOKE VALVE
	GAUGE VALVE
	BLOCK & BLEED NEEDLE VALVE
	MULTIPORT MANIFOLD

VALVE CONNECTION LEGEND

	THRD VALVE
	THRD/SW VALVE
	SW VALVE
	FLANGED VALVE

TOPWORKS SYMBOL LEGEND

	DIAPHRAGM ACTUATOR
	ACTUATOR WITH HANDWHEEL
	ACTUATOR WITH POSITIONER
	REGULATOR WITH HANDWHEEL
	BACK PRESS. REGULATOR
	PRESS. REDUCING REGULATOR
	PISTON ACTUATOR
	ACTUATOR WITH POSITIONER
	ROTARY PISTON ACTUATOR
	ROTARY MOTOR ACTUATOR
	SOLENOID

METERING

	METER RUN
	ORIFICE METER
	FLOW CONDITIONER
	VORTEX METER
	POSITIVE DISPLACEMENT METER
	TURBINE/PROPELLER METER
	MASS FLOW METER
	FLOW INDICATOR

MISC TAG SYMBOL LEGEND

	IG 1	INSTR. GAS TO AND FROM
	IA 1	INSTR. AIR TO AND FROM
	RTU	RTU
	I/P	ELECTRO PNEUMATIC

MISC SYMBOLS LEGEND

	FLANGE / BLIND FLANGE
	BW CAP / THRD CAP
	UNION
	TOL/CPLG w/PLUG
	BREAK
	CONCENTRIC REDUCER
	CONCENTRIC SWAGE
	ECC REDUCERS
	SKID EDGE SCARFED VENT
	FLEXIBLE HOSE
	CAMLOCK CONNECTION
	SPEC. BLIND-CLOSED/OPEN
	PIPE/TUBING FLOW ARROW
	SPEC/RESPONSIBILITY BREAK
	FLANGED NOZZLE
	MANWAY
	PANEL LOAD
	GROUND
	SKID DRAIN
	PIG BAR

GENERAL NOTES

1. SHOP INSTALL ADDITIONAL PIPE SUPPORTS WHERE REQ'D.
2. SHIP LOOSE ITEMS TO BE BOXED AND SEALED PRIOR TO SHIPMENT.
3. PLUG AND PROTECT ALL OUTLETS PRIOR TO SHIPMENT.
4. ROUTE PIPING TO ENSURE NO LIQUID TRAPS.
5. ALL PIPING MATERIAL TO BE STANDARD TEMP U.N.O.
6. HYDROTEST PROCESS PIPING TO 1.5 x M.A.W.P.
7. ALL PIPING AND PROCESS TUBING LINES TO BE TESTED PER ASME B31.3 NFS.
8. INSTRUMENT SUPPLY LINES TO BE TESTED PER ABSA AB-522 DIRECTIVE.

CUSTOMER NOTES

- A. VENT TERMINATIONS MUST HAVE SCREENS AND POINT DOWNWARDS.
- B. ACL DRIVERS MAY BE SUPPLIED FOR LOW WATTAGE APPLICATIONS.

ORIGINAL

REV A

ABBREVIATIONS

ASSY - ASSEMBLY	HPV - HIGH POINT VENT	MISC. - MISCELLANEOUS
ATM - ATMOSPHERE	HS - HYDRAULIC SUPPLY	PD - POSITIVE DISPLACEMENT
BBL - BARREL	HT - HEAT TRACE	P/I - PNEUMATIC TO CURRENT
BD - BLOWDOWN	IA - INSTRUMENT AIR	P/L - PIPELINE
BTU - BRITISH THERMAL UNITS	ID - INSIDE DIAMETER	PLC - PROGRAMMABLE LOGIC CONTR.
CC - CORROSION COUPON	IG - INSTRUMENT GAS	PO - PUMP OUT
CP - CORROSION PROBE	INJ. PT - INJECTION POINT	RF - RAISED FACE
CSC - CAR SEAL CLOSED	I/P - CURRENT TO PNEUMATIC	RO - RESTRICTION ORIFICE
CSO - CAR SEAL OPEN	I/S - INSIDE	RP - REDUCED PORT
c/w - COMPLETE WITH	LLL - LOW LIQUID LEVEL	RTJ - RING TYPE JOINT
DB&B - DOUBLE BLOCK & BLEED	LPD - LOW POINT DRAIN	RTU - REMOTE TRANSMITTING UNIT
ESD - EMERGENCY SHUTDOWN	LSO - LEGAL SUBDIVISION	SP - SAMPLE POINT
ET - ELECTRICAL TRACE	MAWP - MAX. ALLOW. WORK PRES.	s/c - SHOP COAT
FC - FAIL CLOSE	MDMT - MIN. DESIGN METAL TEMP.	SG - SPECIFIC GRAVITY
FFSD - FAIL CLOSE	MCC - MOTOR CONTROL CENTER	SS - STAINLESS STEEL
FO - FAIL OPEN	MISC. - MISCELLANEOUS	S/S - SEAM TO SEAM
FRD - FLOAT RELEASE DEVICE	NC - NORMALLY CLOSED	TK - TANK
FP - FULL PORT	NLL - NORMAL LIQUID LEVEL	T/T - TANGENT TO TANGENT
GO - GEAR OPERATED	NO - NORMALLY OPEN	UNO - UNLESS NOTED OTHERWISE
GT - GLYCOL TRACE	HTS - NOT TO SCALE	VH - VENT HEADER
HC - HOSE CONNECTION	OD - OUTSIDE DIAMETER	ZSC - POSITION/LIMIT SWITCH CLOSE
HLL - HIGH LIQUID LEVEL	O/S - OUTSIDE	ZSO - POSITION/LIMIT SWITCH OPEN

INSTRUMENTATION IDENTIFICATION AS PER ANSI/ISA-5.1-2009

LETTER	FIRST LETTERS		SUCCEEDING LETTERS		
	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	MEASURED/INITIATING VARIABLE	VARIABLE MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT/ACTIVE FUNCTION	FUNCTION MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	CLOSE
D	USER'S CHOICE	DIFFERENCE, DIFFERENTIAL			DEVIATION
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		
F	FLOW, FLOW RATE	RATIO			
G	USER'S CHOICE		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER		SCAN		
K	TIME, SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE				MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTALIZE	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD		RUN
S	SPEED, FREQUENCY	SAFETY		SWITCH	STOP
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL, PROBE		
X	UNCLASSIFIED	X-AXIS	ACCESSORY DEVICES, UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y-AXIS		AUXILIARY DEVICES	
Z	POSITION, DIMENSION	Z-AXIS, SAFETY INSTRUMENTED SYSTEM		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

VALVE TAGGING

REV A.1	BALL VALVE (FULL PORT) - BF	XX XXX XX	G - GAS SERVICE
	BALL VALVE (REG. PORT) - BR		H - HIGH PRESSURE
	BUTTERFLY VALVE - BU		L - LOW TEMP.
	CHECK VALVE (BALL) - CB	025 - 1/4"	N - NACE
	CHECK VALVE (PISTON) - CP	038 - 3/8"	Z - BOM CLARIFIER (1,2,...)
	CHECK VALVE (SWING) - CS	050 - 1/2"	
	CHECK VALVE (WAFFER) - CW	075 - 3/4"	
	GATE VALVE - GA	100 - 1"	
	GLOBE VALVE - GL	200 - 2"	
	STRAINER (BASKET) - SB	201 - 2" 150 ANSI	
	STRAINER (T) - ST	303 - 3" 300 ANSI	
	STRAINER (Y) - SY	406 - 4" 600 ANSI	
	SWAGelok - SW	609 - 6" 900 ANSI	
	NEEDLE VALVE (FEMALE x FEMALE) - NF	815 - 8" 1500 ANSI	
	NEEDLE VALVE (MALE x FEMALE) - NM	1025 - 10" 2500 ANSI	
	MANIFOLD - MF		

LINE TAGGING

DRAIN - D	EMULSION - E	FUEL GAS - FG	GLYCOL - G	HYDROCARBON - HC	INSTRUMENT AIR/GAS - IA/IG	PROCESS GAS - PG	PRESSURE RELIEF - PR	WATER - W	VENT (ATMOS) - V
NOMINAL PIPE SIZE									0100-0199 EMULSION
									0200-0299 PROCESS GAS
									0300-0399 HYDROCARBON
									0400-0499 WATER
									0500-0599 DRAIN
									0600-0699 PROCESS FLUID
									0700-0799 FUEL GAS
									0800-0899 PRESSURE RELIEF
									0900-0999 OTHER
									1000-1099 VENT (NO TESTING)
									A - 316 SS TUBING w/ 316 SS FITTINGS
									B - 316 SS TUBING w/ CS FITTINGS
									C - NOT APPLICABLE

TAG LEGEND

	LOCALLY MOUNTED	PRIMARY LOC. OR PANEL NORMALLY ACCESS. TO OPER.	AUXILIARY LOC. OR PANEL NORMALLY ACCESS. TO OPER.	PRIMARY LOC. OR PANEL MOUNTED ON BACK OF PANEL	AUXILIARY LOC. OR PANEL MOUNTED ON BACK OF PANEL
DISCRETE					
SHARED DISPLAY, SHARED CONTROL DISTRIBUTION, CONTROL VIDEO DISPLAY					
COMPUTER FUNCTION, SOFTWARE FUNCTION					
PROGRAMMABLE LOGIC CONTROL					

ISSUED FOR CONSTRUCTION

SIGNED:
DATE: NOV. 21, 2016
W.O. 09961-001
S/N NWP-09961-001

NWP INDUSTRIES LP

P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

NWP INDUSTRIES LP
STANDARD 2.0MM LINEHEATER

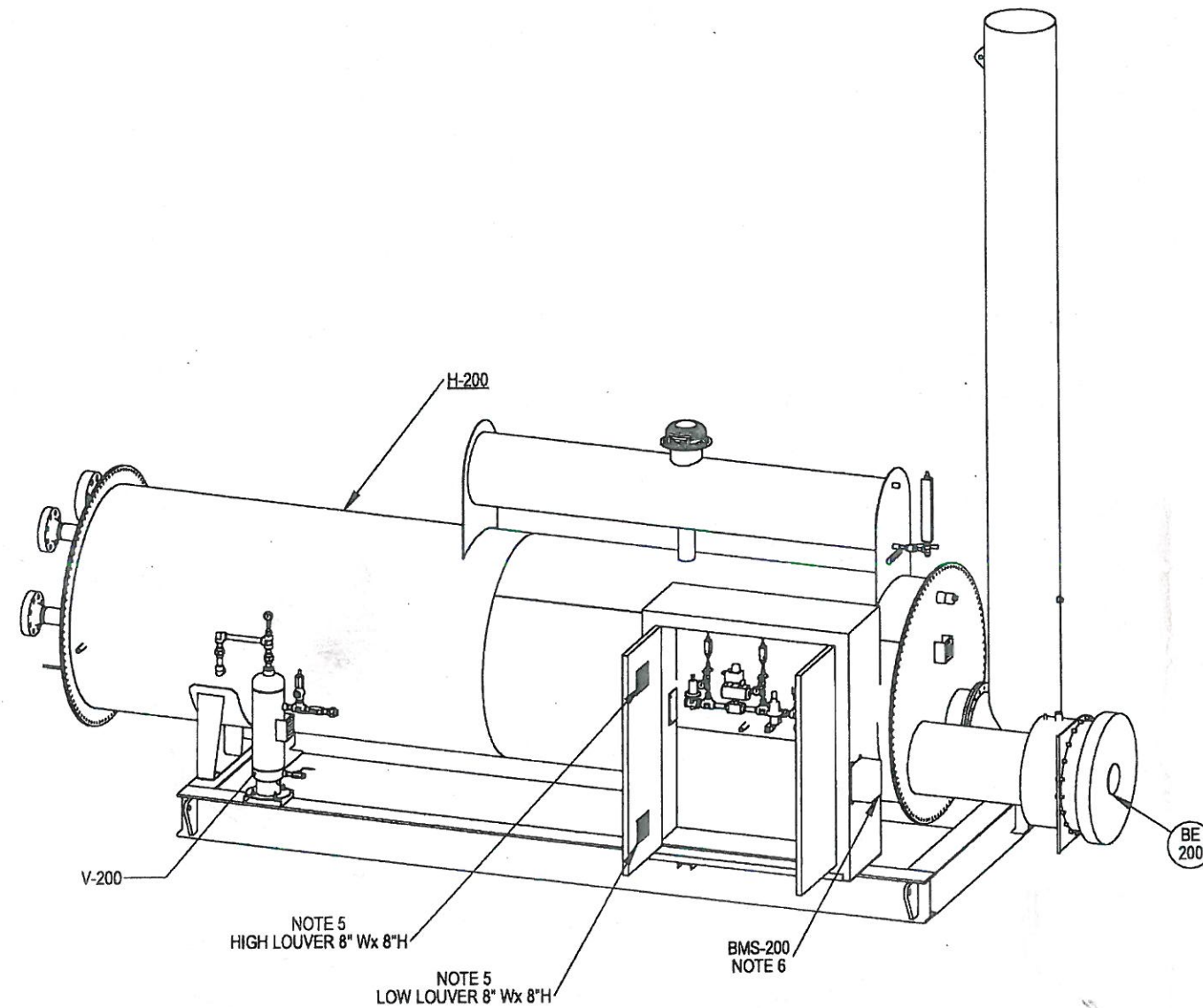
PIPING AND INSTRUMENTATION LEGEND

DWN: SF	CHK: A	APP: ST
DATE: NOV 07/16	DATE: NOV 15 2016	DATE: NOV 14 2016
SHEET: 2 OF 2	DWG: 09961-001-P-001	REV: 0

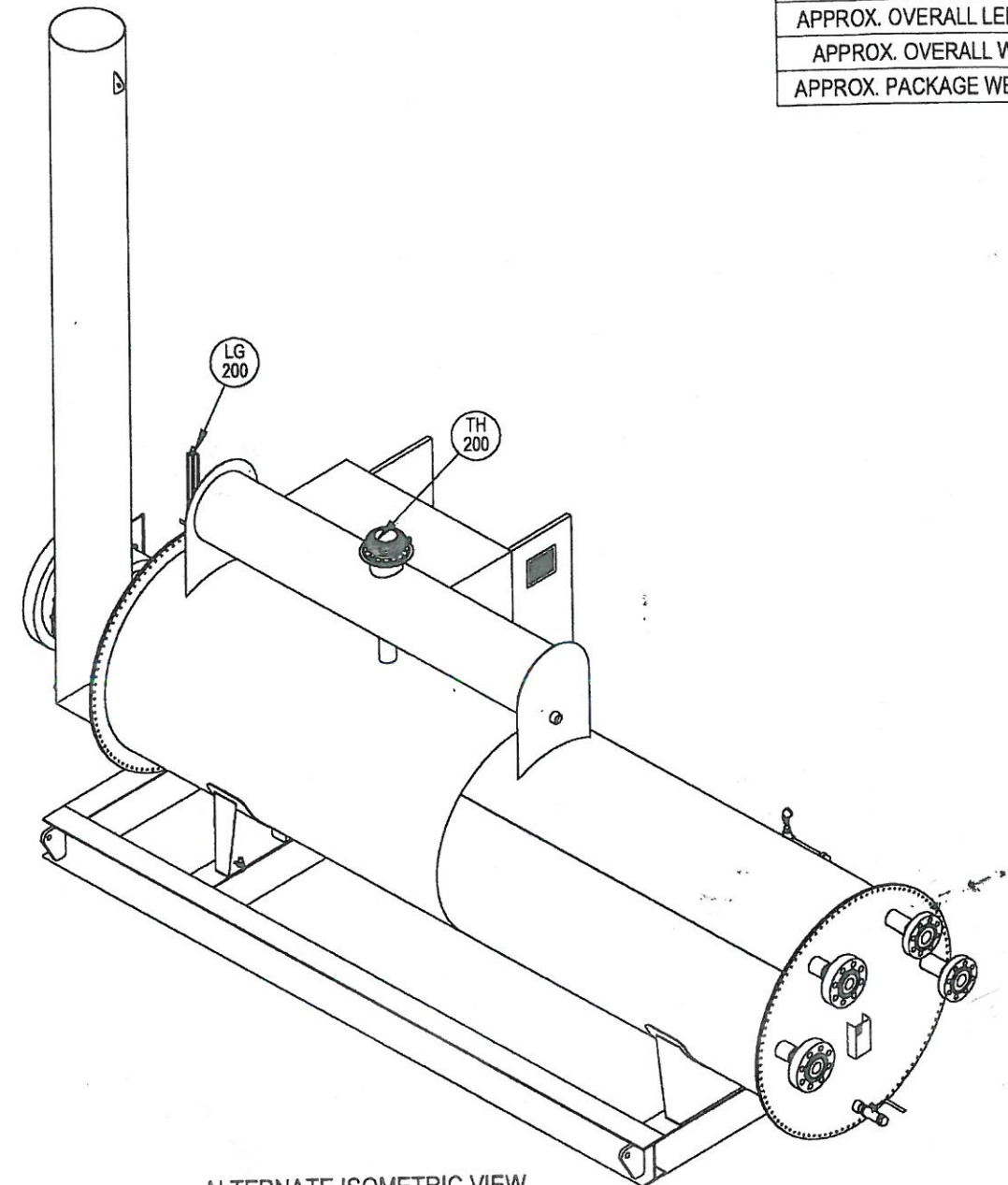
BATH CAPACITY = 298.42 CU. FT.

SHIPPING DATA

APPROX. OVERALL HEIGHT:	122 3/4"
APPROX. OVERALL LENGTH:	310 11/16"
APPROX. OVERALL WIDTH:	99 3/16"
APPROX. PACKAGE WEIGHT:	22,505 LBS



DIMETRIC VIEW
SCALE: 1:45



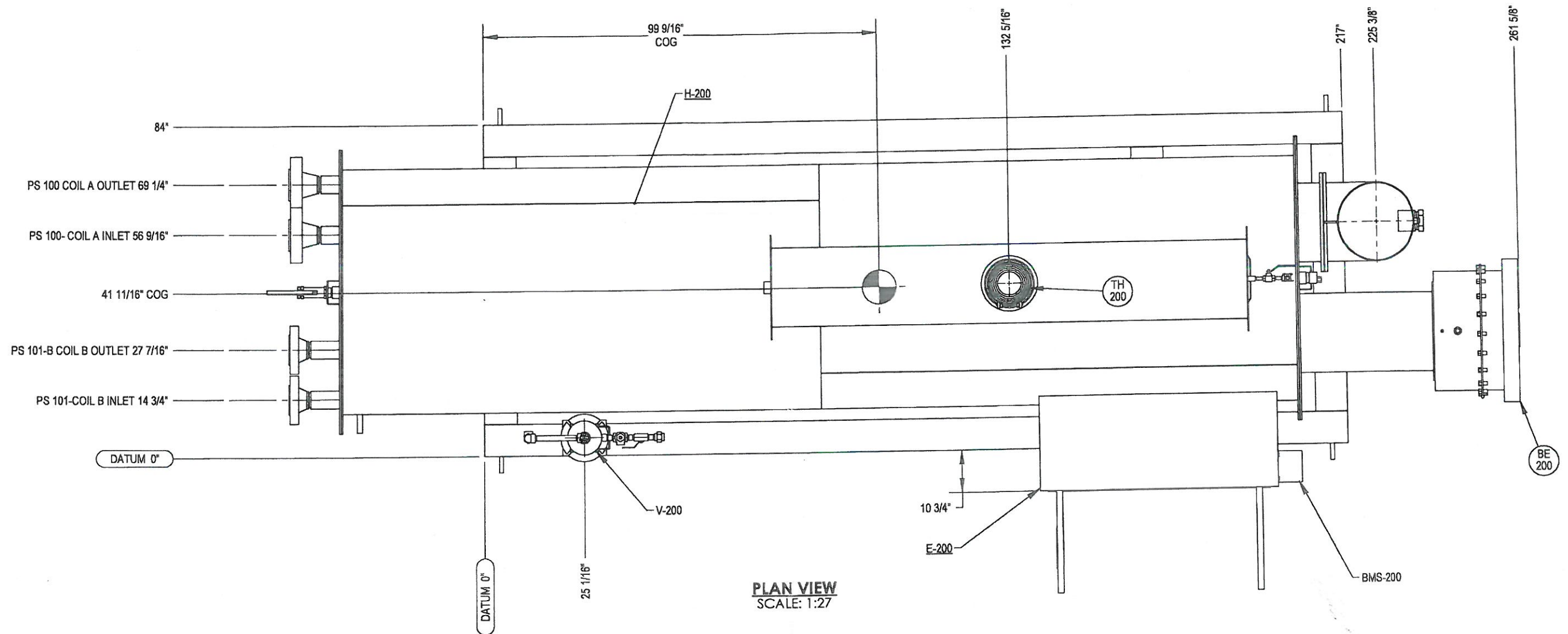
ALTERNATE ISOMETRIC VIEW
SCALE: 1:45

ORIGINAL

NOTES

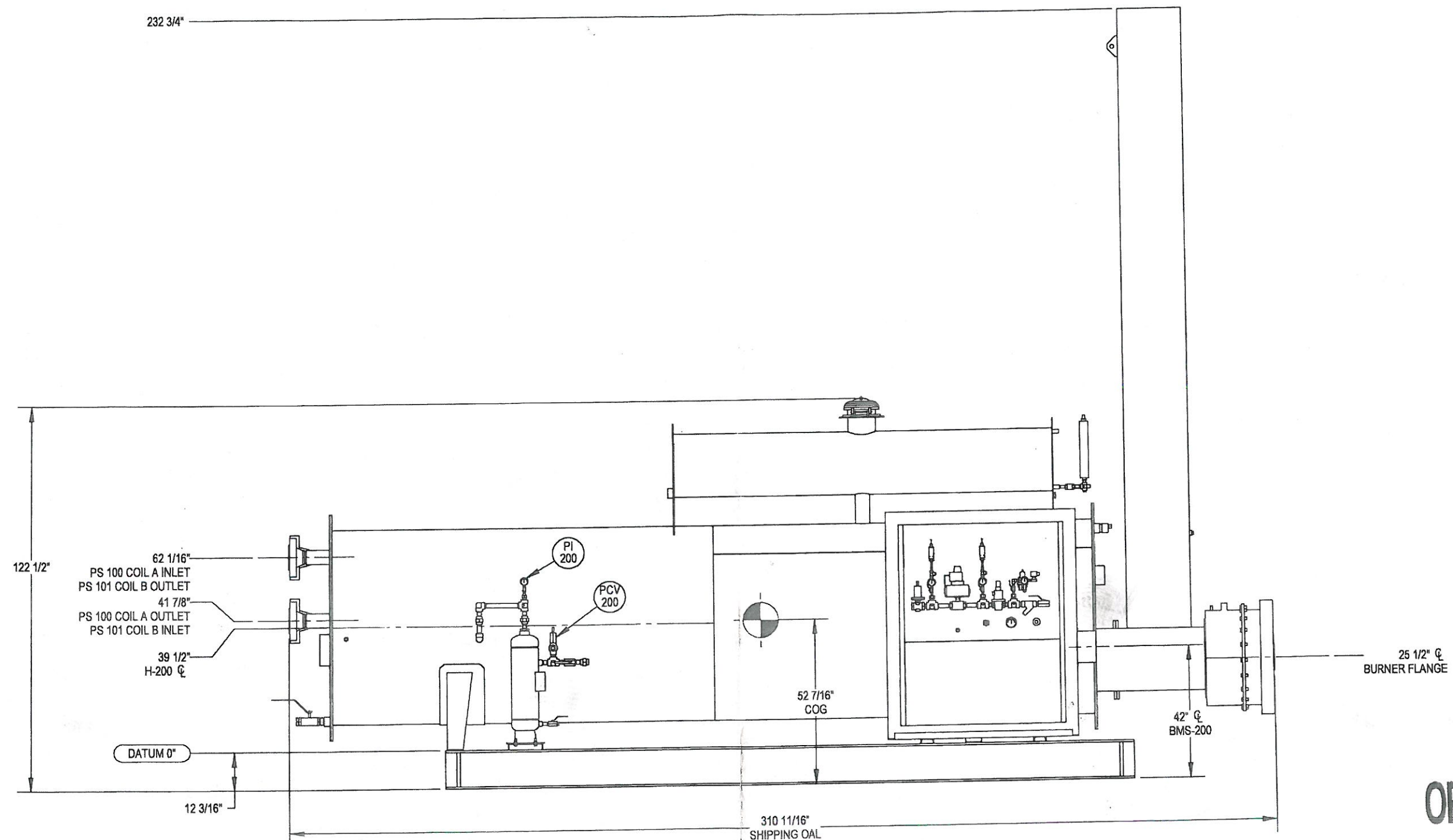
- 1.24 oz. PNEUMATIC TEST REQUIRED ON SHELL & FIRETUBE.
- 2.PIPE SUPPORTS WHERE REQUIRED.
- 3.SHIP LOOSE ITEMS TO BE BOXED AND SEALED PRIOR TO SHIPMENT.
- 4.PLUG ALL OUTLETS PRIOR TO SHIPMENT.
- 5.LOUVERS MUST BE LOCATED AS SHOWN IN THIS ORIENTATION.
- 6.BMS-100 MUST HAVE CONTROLS ROTATED 90° TO FACE PLATFORM SUPPLIED IN FIELD. & INSTALLED APPROX 5' FROM GROUND LEVEL.

<p>ISSUED FOR CONSTRUCTION</p> <p>SIGNED: <i>[Signature]</i></p> <p>DATE: <i>Nov 21, 2016</i></p> <p>W.O. <i>09961-001</i></p> <p>S/N <i>NWP-09961-001</i></p> <p>ALL DIMENSIONS IN INCHES</p>					<p>NWP</p> <p>INDUSTRIES INC. LP</p> <p>Total oilfield supply.</p> <p>P.O. BOX 6280, INNISFAIL, AB T4G 1S9</p> <p>PH: (403) 227-4100 FAX: (403) 227-4102</p>		<p>NWP INDUSTRIES</p> <p>2.0 MMBTU/HR LINEHEATER</p> <p>62" OD x 240" S/S</p> <p>GENERAL ARRANGEMENT</p>																													
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<p>DRAWING REVISIONS</p>					<p>PROJECTION: <i>[Symbol]</i> SCALE: AS NOTED</p> <p>WEIGHT: 22,505 (APPROX. LB.)</p>		<p>SHEET: 1 OF 4 DWG: 08574-001-G-000 REV: 0</p>																													



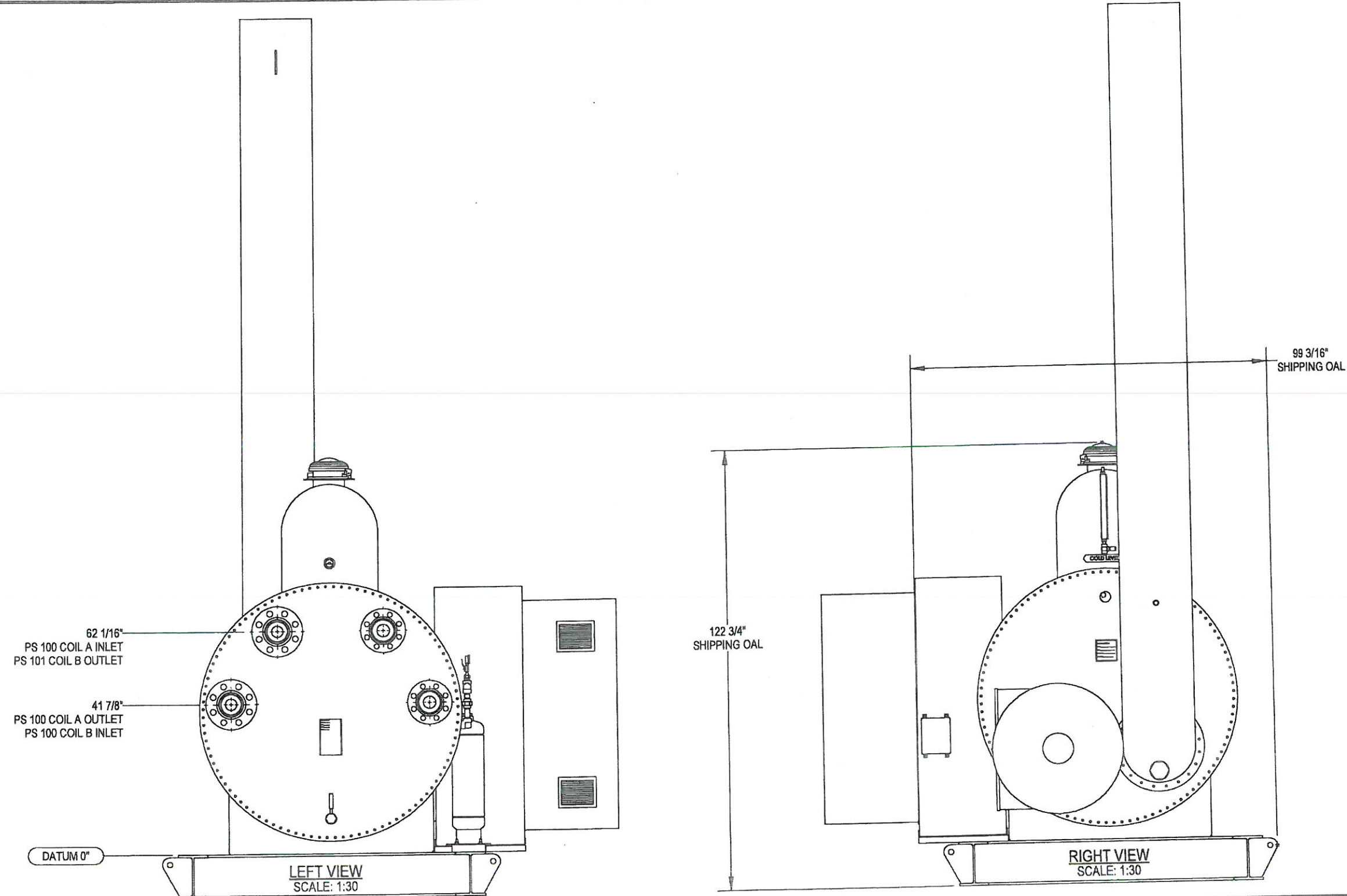
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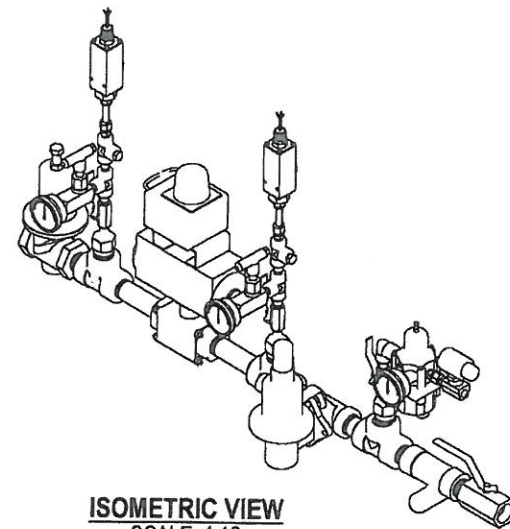
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<p>DRAWING REVISIONS</p>						<p>ALL DIMENSIONS IN INCHES</p>		<p>GENERAL ARRANGEMENT</p>		<table border="1"> <tr> <td>DWN: CT</td> <td>CHK: <i>[Signature]</i></td> <td>APP: <i>[Signature]</i></td> </tr> <tr> <td>DATE: MAY 17/14</td> <td>DATE: DEC 10 2014</td> <td>DATE: DEC 09 2014</td> </tr> <tr> <td>SHEET: 3 OF 4</td> <td>DWG: 08574-001-G-000</td> <td>REV: 0</td> </tr> </table>			DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>	DATE: MAY 17/14	DATE: DEC 10 2014	DATE: DEC 09 2014	SHEET: 3 OF 4	DWG: 08574-001-G-000	REV: 0								
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SHEET: 3 OF 4	DWG: 08574-001-G-000	REV: 0																											

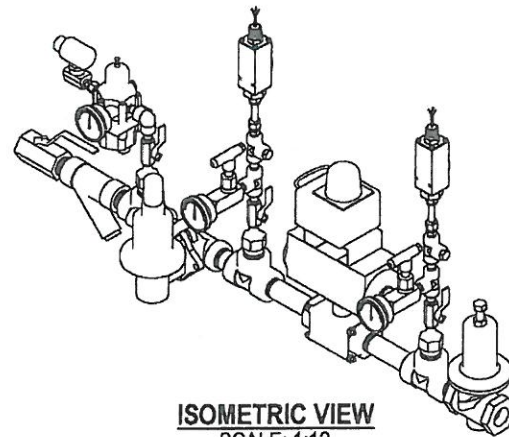


ORIGINAL

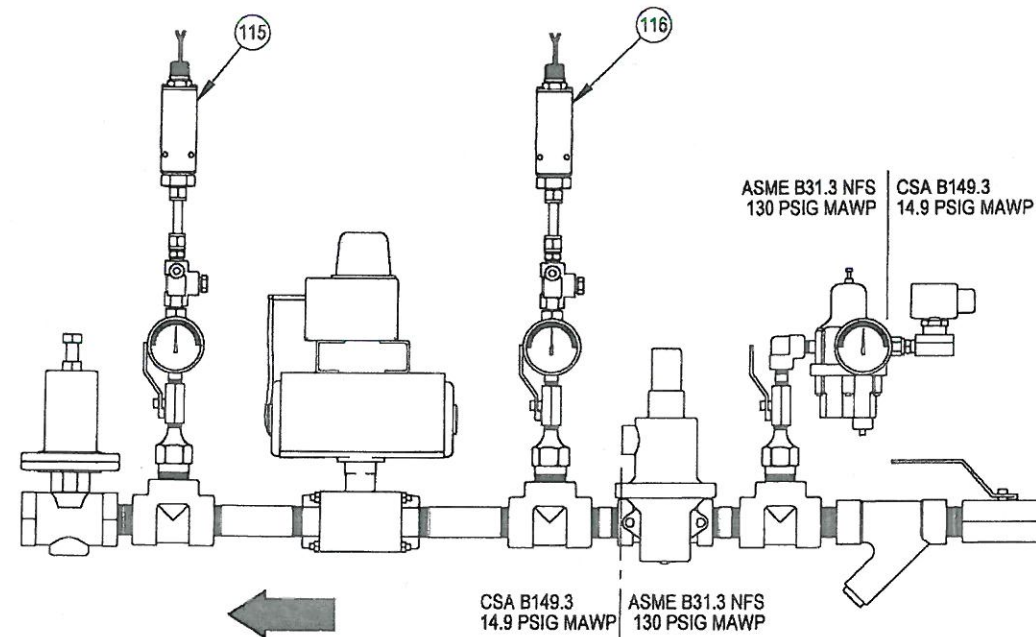
<table border="1"> <tr> <th>REV.</th> <th>DATE</th> <th>BY:</th> <th>CHK:</th> <th>APP:</th> <th>DESCRIPTION</th> </tr> <tr> <td>0</td> <td>JUNE 06/14</td> <td>EB</td> <td></td> <td></td> <td>ISSUED FOR CONSTRUCTION</td> </tr> <tr> <td>A</td> <td>MAY 17/14</td> <td>CT</td> <td></td> <td></td> <td>ISSUED FOR APPROVAL</td> </tr> </table>					REV.	DATE	BY:	CHK:	APP:	DESCRIPTION	0	JUNE 06/14	EB			ISSUED FOR CONSTRUCTION	A	MAY 17/14	CT			ISSUED FOR APPROVAL	<p>ISSUED FOR CONSTRUCTION</p> <p>SIGNED: <i>[Signature]</i></p> <p>DATE: Nov. 21, 2016</p> <p>W.O. 09961-001</p> <p>S/N NWP-09961-001</p>		<p>NWP INDUSTRIES INC. <i>LP</i> Total oilfield supply.</p> <p>P.O. BOX 6280, INNISFAIL, AB T4G 1S9 PH: (403) 227-4100 FAX: (403) 227-4102</p>		<p>NWP INDUSTRIES 2.0 MMBTU/HR LINEHEATER 62" OD x 240" S/S</p> <p>GENERAL ARRANGEMENT</p>		
					REV.	DATE	BY:	CHK:	APP:	DESCRIPTION																			
0	JUNE 06/14	EB			ISSUED FOR CONSTRUCTION																								
A	MAY 17/14	CT			ISSUED FOR APPROVAL																								
<p>DRAWING REVISIONS</p> <p>ALL DIMENSIONS IN INCHES</p>		<p>PROJECTION: </p> <p>SCALE: AS NOTED</p> <p>WEIGHT: 22,505 (APPROX. LBS)</p>		<table border="1"> <tr> <td>DWN: CT</td> <td>CHK: <i>[Signature]</i></td> <td>APP: <i>[Signature]</i></td> </tr> <tr> <td>DATE: MAY 17/14</td> <td>DATE: DEC 10 2014</td> <td>DATE: DEC 09 2014</td> </tr> <tr> <td>SHEET: 4 OF 4</td> <td>DWG: 08574-001-G-000</td> <td>REV: 0</td> </tr> </table>			DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>	DATE: MAY 17/14	DATE: DEC 10 2014	DATE: DEC 09 2014	SHEET: 4 OF 4	DWG: 08574-001-G-000	REV: 0														
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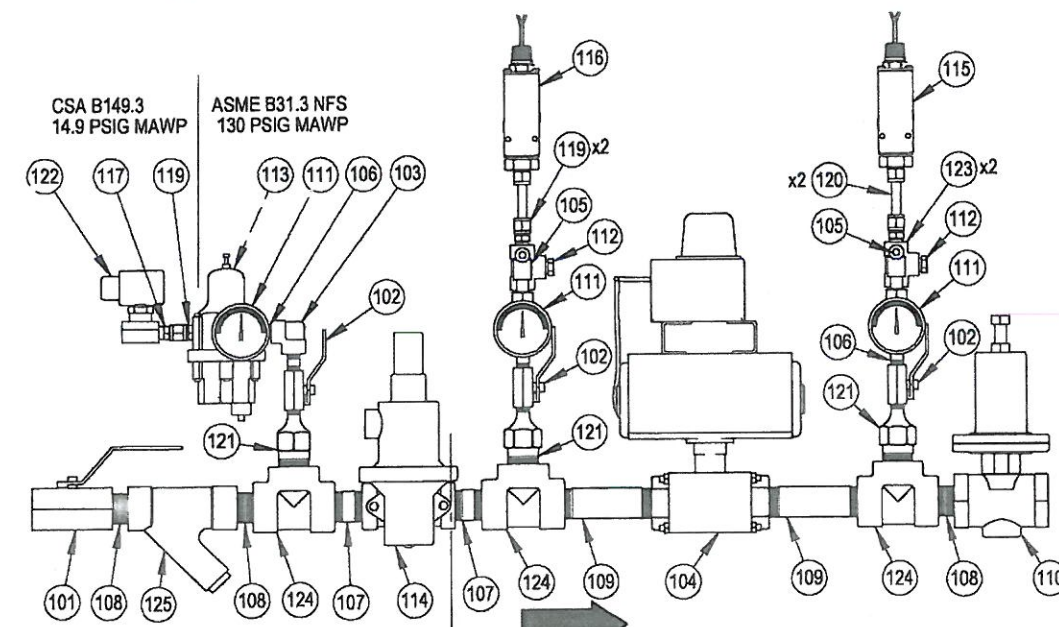
ISOMETRIC VIEW
SCALE: 1:12
RIGHT TO LEFT



ISOMETRIC VIEW
SCALE: 1:12
LEFT TO RIGHT



RIGHT TO LEFT FLOW
FRONT VIEW
SCALE: 1:8



LEFT TO RIGHT FLOW
FRONT VIEW
SCALE: 1:8

MAX 130 PSI
INLET PRESSURE

ORIGINAL

ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	QTY	MTR #
101	BA-NEO-BF100GT		NEO 2500 BALL VALVE 1" 2000 PSI WOG, SS, Lockable Handle	SST	1	
102	BA-NEO-BF025GT		NEO 2500 BALL VALVE 1/4" 2000 PSI WOG, SS, Lockable Handle	SST	3	
103	ELBTH90.25WA		ELBOW 90 DEG 1/4" 3M THRD	SA-105N	1	
104	FOSSIL-8320-24		PROOF OF CLOSURE VALVE FOSSIL 1" NPT	CS	1	
105	NE-MF-25-SS		VALVE NEEDLE MAGNUM 1/4" 6000 PSI MF-25-SS	SST	2	
106	NIP.251.5Y80EA		NIPPLE 1/4" x 1 1/2" SCH XH/80	SA-106B	6	
107	NIP1(2.5)80C		NIPPLE 1" x 2 1/2" SCH XH/80	SA-106B	2	
108	NIP1(2)80C		NIPPLE 1 x 2" SCH XH/80	SA-106B	3	
109	NIP1(5)80C		NIPPLE 1" x 5" SCH XH/80	SA-106B	2	
110	PCV-119(5-35)1.0		Fisher 119 1" NPT 9/16" Orifice Spring Range: 5 to 35 psig		1	
111	PI-233.53(0-30)2.5F-CBM		PRESSURE GAUGE WIKA 2 1/2" FACE 1/4" NPT, 0-30 PSI, MODEL NO. 233.53 CENTER BACK MOUNT	SS	3	
112	PLH.25HYEE		PLUG HEX 1/4" 6M THRD	SA-105N	2	
113	PRV-67CF1663330892		PRESSURE REGULATOR FISHER 67CFR 0-35 PSI SPRING STD TRIM ORIFICE, TAPPED BONNET		1	
114	PRV-627121729855		627-489 5-20 PSI STD 0.5in ORIFICE		1	
115	PS-6900GZE12.14R		PRESSURE SWITCH CCS MODEL 6900GZE12 SET @ 14 PSI RISING		1	
116	PS-6900GZE12.4F		PRESSURE SWITCH CCS MODEL 6900GZE12 SET @ 4 PSI FALLING		1	
117	SS-6-TA-1-4		TUBE ADAPTOR 3/8" TUBE x 1/4" MNPT MDL SS-6-TA-1-4		1	
118	SS-600-1-8		TUBING, STRAIGHT CONNECTOR, 3/8" TUBING x 1/2" MNPT, SS-600-1-8	316 SS	2	
119	SS-600-11-4		TUBING, STRAIGHT CONNECTOR, 3/8" TUBING x 1/4" MNPT, SS-600-1-4	316 SS	3	
120	SS-T6-S-035-20		TUBING, 0.035" WT SMLS 3/8"	316 SS	2	
121	SWCTE1(25)80A		SWAGE 1" x 1/4" SCH XH/80 THRD	SA105N	3	
122	SY-HV426716002		SOLENOID VALVE ASCO 1/4" NPT, ASCO 24VDC SOLENOID C/I RATED, 10.8 WATTS		1	
123	TESTH.25WA		TEE 1/4" 3M THRD	SA-105	4	
124	TESTH1WA		TEE 1" 3M THRD	SA-105	3	
125	YS-YS3000-1.0		STRAINER ALTA STRAINER 1" NPT CL 3000 MDL YS3000		1	

REV.	DATE	BY:	CHK:	APP:	DESCRIPTION
4	FEB 20/15	EB	aw	JA	UPDATE POC VALVE
3	MAR 19/14	RMM			ADDED PRESSURE RATING LINE
2	NOV 26/13	CT			UPDATED NIPPLE LENGTH

DRAWING REVISIONS

ISSUED FOR
CONSTRUCTION

SIGNED: *[Signature]*

DATE: NOV. 21, 2016

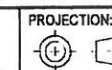
W.O. 09961-001

SIN: NWP 09961-001

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102



SCALE: AS NOTED
WEIGHT: 65 LBS

NWP INDUSTRIES LP
VALVE TRAIN ASSEMBLY
ASSEMBLY DRAWING

DWN: CT CHK: *[Signature]* APP: *[Signature]*
DATE: JUL 23/13 DATE: FEB 25 2015 DATE: MAR 04 2015

SHEET: 1 OF 1

DWG: NWPL-00030

REV: 4

LINE TYPE LEGEND

	MAJOR PROCESS LINE
	UTILITY LINE
	BUILDING LIMITS
	ENCLOSURE LIMITS
	ALTERNATE LIMITS
	CUST/VENDOR SUPPL. LIMITS
	HIDDEN LINE
	EQUIPMENT OUTLINE
	INSTRUMENT PNEUMATIC LINE
	PROCESS/UTILITY TUBING LINE
	INSTRUMENT CAPILLARY LINE
	ELECTRICAL DATA LINK LINE
	ELECTRICAL CONNECTION LINE
	HYDRAULIC LINE
	MECHANICAL LINK LINE

INSULATION LEGEND

	2.5" PP	* THICKNESS C=COLD H=HOT PP=PERSONNEL PROTECTION
	3" C	
	2.5H ET	* THICKNESS c/w TRACING ET=ELEC. TRACE GT=GLYCOL TRACE OT=OIL TRACE ST=STEAM TRACE
	3"H GT	

VALVE SYMBOL LEGEND

	BALL VALVE
	SPRING RETURN BALL VALVE
	GLOBE VALVE
	GATE VALVE
	CHECK VALVE
	PLUG VALVE
	NEEDLE VALVE
	INLINE CHOKE VALVE
	4-WAY VALVE
	3-WAY VALVE
	BUTTERFLY VALVE
	BASKET/CONE STRAINER
	TEE STRAINER
	Y STRAINER
	RUPTURE DISC
	PRESSURE RELIEF VALVE
	ANGLE VALVE
	ANGLE CHOKE VALVE
	GAUGE VALVE
	BLOCK & BLEED NEEDLE VALVE
	MULTIPOINT MANIFOLD

VALVE CONNECTION LEGEND

	THRD VALVE
	THRD/SW VALVE
	SW VALVE
	FLANGED VALVE

TOPWORKS SYMBOL LEGEND

	DIAPHRAGM ACTUATOR
	ACTUATOR WITH HANDWHEEL
	ACTUATOR WITH POSITIONER
	REGULATOR WITH HANDWHEEL
	BACK PRESS. REGULATOR
	PRESS. REDUCING REGULATOR
	PISTON ACTUATOR
	ACTUATOR WITH POSITIONER
	ROTARY PISTON ACTUATOR
	ROTARY MOTOR ACTUATOR
	SOLENOID

METERING

	METER RUN
	ORIFICE METER
	FLOW CONDITIONER
	VORTEX METER
	POSITIVE DISPLACEMENT METER
	TURBINE/PROPELLER METER
	MASS FLOW METER
	FLOW INDICATOR

MISC SYMBOLS LEGEND

	FLANGE / BLIND FLANGE
	BW CAP / THRD CAP
	UNION
	TOL/CPLG w/PLUG
	BREAK
	CONCENTRIC REDUCER
	CONCENTRIC SWAGE
	ECC REDUCERS
	SKID EDGE SCARFED VENT
	FLEXIBLE HOSE
	CAMLOCK CONNECTION
	SPEC. BLIND-CLOSED/OPEN
	PIPE/TUBING FLOW ARROW
	SPEC/RESPONSIBILITY BREAK
	FLANGED NOZZLE
	MANWAY
	PANEL LOAD
	GROUND
	SKID DRAIN
	PIG BAR

MISC TAG SYMBOL LEGEND

	IG	INSTR. GAS TO AND FROM
	IA	INSTR. AIR TO AND FROM
	RTU	RTU
	I/P	I/P ELECTRO PNEUMATIC

GENERAL NOTES

1. SHOP INSTALL ADDITIONAL PIPE SUPPORTS WHERE REQ'D.
2. SHIP LOOSE ITEMS TO BE BOXED AND SEALED PRIOR TO SHIPMENT.
3. PLUG AND PROTECT ALL OUTLETS PRIOR TO SHIPMENT.
4. ROUTE PIPING TO ENSURE NO LIQUID TRAPS.
5. ALL PIPING MATERIAL TO BE STANDARD TEMP. U.N.O.
6. HYDROTEST PROCESS PIPING TO 1.5 x M.A.W.P.
7. ALL PIPING AND PROCESS TUBING LINES TO BE TESTED PER ASME B31.3 NPS.
8. INSTRUMENT SUPPLY LINES TO BE TESTED PER ABSA AB-522 DIRECTIVE.

CUSTOMER NOTES

- A. VENT TERMINATIONS MUST HAVE SCREENS AND POINT DOWNWARDS.
- B. ACL DRIVERS MAY BE SUPPLIED FOR LOW WATTAGE APPLICATIONS.

ORIGINAL

REV A

REV A

ABBREVIATIONS

ASSY - ASSEMBLY	HPV - HIGH POINT VENT	MISC. - MISCELLANEOUS
ATM - ATMOSPHERE	HS - HYDRAULIC SUPPLY	PD - POSITIVE DISPLACEMENT
BEL - BARREL	HT - HEAT TRACE	P/A - PNEUMATIC TO CURRENT
BD - BLOWDOWN	IA - INSTRUMENT AIR	P/L - PIPELINE
BTU - BRITISH THERMAL UNITS	ID - INSIDE DIAMETER	PLC - PROGRAMMABLE LOGIC CONTR.
CC - CORROSION COUPON	IG - INSTRUMENT GAS	PO - PUMP OUT
CP - CORROSION PROBE	INJ. PT - INJECTION POINT	RF - RAISED FACE
CSC - CAR SEAL CLOSED	I/P - CURRENT TO PNEUMATIC	RO - RESTRICTION ORIFICE
CSD - CAR SEAL OPEN	I/S - INSIDE	RP - REDUCED PORT
c/w - COMPLETE WITH	LLL - LOW LIQUID LEVEL	RTJ - RING TYPE JOINT
DB&B - DOUBLE BLOCK & BLEED	LPD - LOW POINT DRAIN	RTU - REMOTE TRANSMITTING UNIT
ESD - EMERGENCY SHUTDOWN	LSO - LEGAL SUBORDINATION	SP - SAMPLE POINT
ET - ELECTRICAL TRACE	MAIP - MAX. ALLOW. WORK PRES.	s/c - SHOP COAT
FC - FAIL CLOSE	MDMT - MIN. DESIGN METAL TEMP.	SG - SPECIFIC GRAVITY
FTSD - FAIL TO STOP	MCC - MOTOR CONTROL CENTER	SS - STAINLESS STEEL
FO - FAIL OPEN	MISC. - MISCELLANEOUS	S/S - SEAM TO SEAM
FRD - FLOAT RELEASE DEVICE	NC - NORMALLY CLOSED	TK - TANK
FP - FULL PORT	NLL - NORMAL LIQUID LEVEL	T/T - TANGENT TO TANGENT
GO - GEAR OPERATED	NO - NORMALLY OPEN	UNO - UNLESS NOTED OTHERWISE
GT - GLYCOL TRACE	MTS - HOT TO SCALE	VH - VENT HEADER
HC - HOSE CONNECTION	OD - OUTSIDE DIAMETER	ZSC - POSITION/LIMIT SWITCH CLOSE
HLL - HIGH LIQUID LEVEL	O/S - OUTSIDE	ZSD - POSITION/LIMIT SWITCH OPEN

INSTRUMENTATION IDENTIFICATION AS PER ANSI/ISA-5.1-2009

LETTER	FIRST LETTERS		SUCCEEDING LETTERS		
	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	MEASURED/INITIATING VARIABLE	VARIABLE MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT/ACTIVE FUNCTION	FUNCTION MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	
D	USER'S CHOICE	DIFFERENCE, DIFFERENTIAL			CLOSE
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		DEVIATION
F	FLOW, FLOW RATE	RATIO			
G	USER'S CHOICE		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER		SCAN		
K	TIME, SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE				MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTALIZE	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	RUN
T	TEMPERATURE			TRANSMIT	STOP
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL, PROBE		
X	UNCLASSIFIED	X-AXIS	ACCESSORY DEVICES, UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y-AXIS		AUXILIARY DEVICES	
Z	POSITION, DIMENSION	Z-AXIS, SAFETY INSTRUMENTED SYSTEM		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

VALVE TAGGING

REV A.1	BALL VALVE (FULL PORT) - BF	XX XXX XX	G - GAS SERVICE
	BALL VALVE (REG. PORT) - BR		H - HIGH PRESSURE
	BUTTERFLY VALVE - BU		L - LOW TEMP.
	CHECK VALVE (BALL) - CB	025 - 1/4"	N - NACE
	CHECK VALVE (PISTON) - CP	038 - 3/8"	Z - BOW CLARIFIER (1,2,...)
	CHECK VALVE (SWING) - CS	050 - 1/2"	
	CHECK VALVE (WAFFER) - CW	075 - 3/4"	
	GATE VALVE - GA	100 - 1"	
	GLOBE VALVE - GL	200 - 2"	
	STRAINER (BASKET) - SB	201 - 2" 150 ANSI	
	STRAINER (Y) - ST	303 - 3" 300 ANSI	
	STRAINER (Y) - SY	406 - 4" 600 ANSI	
	SWAGelok - SW	609 - 6" 800 ANSI	
	NEEDLE VALVE (FEMALE x FEMALE) - NF	815 - 8" 1500 ANSI	
	NEEDLE VALVE (MALE x FEMALE) - NM	1025 - 10" 2500 ANSI	
	MANIFOLD - MF		

LINE TAGGING

REV A.1	DRAIN - D	0100-0199 EMULSION
	EMULSION - E	0200-0299 PROCESS GAS
	FUEL GAS - FG	0300-0399 HYDROCARBON
	GLYCOL - G	0400-0499 WATER
	HYDROCARBON - HC	0500-0599 DRAIN
	INSTRUMENT AIR/GAS - IA/IG	0600-0699 PROCESS FLUID
	PROCESS GAS - PG	0700-0799 FUEL GAS
	PRESSURE RELIEF - PR	0800-0899 PRESSURE RELIEF
	VENT (ATMOS) - V	0900-0999 OTHER
		1000-1099 VENT (NO TESTING)
		A - 316 SS TUBING w/ 316 SS FITTINGS
		B - 316 SS TUBING w/ CS FITTINGS
		C - NOT APPLICABLE

REV A

TAG LEGEND

	LOCALLY MOUNTED	PRIMARY LOC. OR PANEL NORMALLY ACCESS. TO OPER.	AUXILIARY LOC. OR PANEL NORMALLY ACCESS. TO OPER.	PRIMARY LOC. OR PANEL MOUNTED ON BACK OF PANEL	AUXILIARY LOC. OR PANEL MOUNTED ON BACK OF PANEL
DISCRETE					
SHARED DISPLAY, SHARED CONTROL, DISTRIBUTION, CONTROL VIDEO DISPLAY					
COMPUTER FUNCTION, SOFTWARE FUNCTION					
PROGRAMMABLE LOGIC CONTROL					

0	NOV 07/16	SF	D	ISSUED FOR CONSTRUCTION
REV	DATE	BY	CHK	APP
				DESCRIPTION

DRAWING REVISIONS

ISSUED FOR CONSTRUCTION

SIGNED:
DATE: NOV. 21, 2016
W.O. 09961-001
S/NWDP-09961-001



P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

NWP INDUSTRIES LP
STANDARD 2.0MM LINEHEATER

PIPING AND INSTRUMENTATION LEGEND

OWN:	SF	CHK:	D	APP:	SF
DATE:	NOV 07/16	DATE:	NOV 15 2016	DATE:	NOV 14 2016
SHEET:	2 OF 2	DWG:	09961-001-P-001	REV:	0

MTR'S (Material Test Reports)

HT 015010340 3/4" SCH 80 SA106B

PG 1 of 3

CE=.28

VT. 151 Low

PO 730154
Conforms with ASME
Sec II, Part A 2015 Edition

Aug 11/16 JF

E.S

HENGYANG VALIN
STEEL TUBE CO.,LTD

MILL TEST CERTIFICATE

(ACCORDING TO EN10204 3.1B)

Add: 10 Dalixincun, Hengyang City, Hunan, P.R.China P.C.:421001

Tel and Fax: +86 734 8873739

E-mail: hysic@hysteeltube.com

CUSTOMER				CERTIFICATE NO.	YCHYST2014095-02		
CONTRACT-ITEM NO.	2111001452-02	P.O.NO.	113968	DATE:	2015-3-10	PAGE:	1/3
PRODUCT	SEAMLESS STEEL LINE PIPE			DELIVERY CONDITION	N		
SPECIFICATION	SEE SPECIFICATION NOTE			HEAT TREATMENT			
GRADE	B/X42, GR 290			DIMENSIONS	3/4"x0.154"x20FT		
TOTAL BUNDLES:	9	TOTAL PIECES:	1080	TOTAL LENGTH:	21594.470 ft	TOTAL WEIGHT:	14.474 mt

NO.	BATCH No.	HEAT No.	BUNDLES	PIECES	LENGTH	WEIGHT	TENSILE TEST ASTM A370						COLD BENDING TEST	
					ft	mt	SAMPLE TYPE/ ORIENTATION / SIZE(mm)/GAUGE LENGTH(mm):FL/50							
						W1	TS(psi)	YS(psi)	RT0.5	EL(%)	R.A. (%)	YS/TS		
1	WL1412-053	W11409492	1	82	1639.580	1.099	68875		46545		33.5		0.68	ACCEPTABLE
2	WL1501-196	015010340	1	137	2739.299	1.836	66700		45385		34.5		0.68	ACCEPTABLE
3	WL1501-198	015010340	7	861	17215.592	11.539	68150		46545		33.0		0.68	ACCEPTABLE

NO.	IMPACT TEST								NON METALIC INCLUSION	GRAIN SIZE	HARDNESS TEST		
	NOTCH TYPE/ORIENTATION/TEMPERATURE(C)/SIZE (mm) :										NACE MR0175/ISO 15156/ MR0103		
	ii				iii						FRC		
	AK1 (J)	Av.(J)	% SHEAR AREA	LE	AK2 (J)	Av.(J)	% SHEAR AREA	LE					
1	/				/						11.000000	✓	
2	/				/						11.000000		
3	/				/						11.000000		

NOTES:												
W1--THEORETICAL WEIGHT				SAMPLE ORIENTATION: L--LONGITUDINAL T--TRANSVERSE				N--NORMALIZING		HE--HOT EXPANDED		
W2--ACTUAL WEIGHT				SAMPLE TYPE: S--STRIP C-- CLUBBED F--FULL-SECTION				A--ANNEALING		HR--HOT ROLLED		
NR--NORMALIZING ROLLED				Q&T--QUENCHING AND TEMPERING				Av--AVERAGE		N&T--NORMALIZING AND TEMPERING		
AK1--ABSORB ENERGY FOR THE FIRST SET				AK2--ABSORB ENERGY FOR THE SECOND SET				LE--SIDE EXPANSION				

HENGYANG VALIN
STEEL TUBE CO.,LTD

MILL TEST CERTIFICATE

(ACCORDING TO EN10204 3.1B)

Add: 10 Dalixincun, Hengyang City, Hunan, P.R.China
P.C.:421001
Tel and Fax: +86 734 8873739
E-mail: hsiicc@hysteeltube.com

CUSTOMER		CERTIFICATE NO.		YCHYST2014095-02	
CONTRACT-ITEM NO.	2111001452-02	P.O.NO.	113968	DATE:	2015-3-10
PRODUCT	SEAMLESS STEEL LINE PIPE		DELIVERY CONDITION	N	
SPECIFICATION	SEE SPECIFICATION NOTE		HEAT TREATMENT		
GRADE	B/X42,GR 290		DIMENSIONS	3/4"x0.154"x20FT	
TOTAL BUNDLES:	9	TOTAL PIECES:	1080	TOTAL LENGTH:	21594.470
				R	TOTAL WEIGHT: 14,474
				mm	

NO	HEAT No. BATCH No.	Type	CHEMICAL COMPOSITION (%)																													
			C	Si	Mn	Cr	Mo	W	Cu	Ni	P	Al	Sn	As	Pb	Sb	Nb	Ti	Zr	N	Bi	S	V	B	Ca	CE	SUM1	SUM2	SUM3	R1	R2	R3
			*100																									*100	*1000			
		P																														
1	W11409492	H	11	25	109	20	3		20	10	10	41					30	24		10		30	30	3	20	30	56	33	57			9.9
	WL1412-053	P	12	26	110	20	4		20	11	9	41					28	23		12		26	33	3	24	31	58	31.3	54.3			9.2
	WL1412-053	P	12	26	108	20	5		21	10	9	40					28	24		11		25	30	2	20	31	59	31	55			9.0
2	015010340	H	✓11	✓35	✓100	✓15	✓3		✓30	✓20	✓7	25					32	26		10		✓10	✓10	4	20	28	✓69	33	59			9.1
	WL1501-196	P	12	32	100	15	2		30	20	8	26					32	29		12		10	10	3	24	29	68	33	62			8.3
	WL1501-196	P	12	32	105	15	4		30	20	8	26					31	28		11		15	13	4	20	30	70	32.3	60.3			8.8
3	015010340	H	11	35	100	15	3		30	20	8	25					32	26		10		10	10	4	20	28	69	33	59			9.1
	WL1501-198	P	12	32	100	15	3		30	20	7	25					32	29		12		12	13	3	24	29	69	33.3	62.3			8.3
	WL1501-198	P	12	32	105	15	3		30	20	7	26					31	29		11		15	13	4	20	30	69	32.3	61.3			8.8

NON-DESTRUCTIVE TEST			
POSITION	PIPE BODY	PIPE END	END SURFACE(GROOVE)
NDT Type(Level)	RT/L2	UT/L2	
LAMINAR			
TEST RESULT	ACCEPTABLE	ACCEPTABLE	N/A
RESIDUAL MAGNETISM	≤20GS	ACCEPTABLE	
UT THICKNESS MEASUREMENT		N/A	
HYDROSTATIC TEST	Min(psi/s)	3000'6	ACCEPTABLE

PE	
ACCEPTABLE	
VISUAL & DIMENSION	
ACCEPTABLE	
COATING	
ACCEPTABLE	

NOTES:	H-HEAT ANALYSIS	P-PRODUCT ANALYSIS	CE-EQUIVALENT CARBON	R-RATIO	R1=Ca /S	R2=Al /N	R3=Mn /C
	CEIW=C+Mn/6+(Cr+Mo+V)/5+(Cu+Ni)/15	CEPCM=C+S/30+(Mn+Cr+Cu)/20+Ni/60+Mo/15+V/10+5*B	SUM1=C+Cr+Mo+Ni+V	SUM2=Nb+V	SUM3=Nb+V+Ti		
	ET-ISO10893-2-2011, UT-ISO10893-10-2011, MPI-ISO10893-5-2011, EMI-ISO10893-3-2011, WT-ISO10893-12-2011, LaminationT-ISO-10893-8-2011						
	L4/L3/L2-ACCEPT LEVEL L4/L3/L2,NOTCH DEPTH IS 12.5% /10% /5% THE SPECIFIED WALL THICKNESS.						

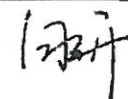
HENGYANG VALIN
STEEL TUBE CO.,LTD

MILL TEST CERTIFICATE

(ACCORDING TO EN10204 3.1B)

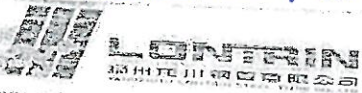
Add: 10 Dalixincun, Hengyang
City, Hunan, P.R.China P.C.:421001
Tel and Fax: +86 734 8873739
E-mail: hsiac@hysteeltube.com

CUSTOMER				CERTIFICATE NO.	YCHYST2014095-02	
CONTRACT-ITEM NO.	2111001452-02	P.O.NO.	113968	DATE:	2015-3-10	PAGE: 3/3
PRODUCT	SEAMLESS STEEL LINE PIPE			DELIVERY CONDITION	N	
SPECIFICATION	SEE SPECIFICATION NOTE		HEAT TREATMENT			
GRADE	B/X42,GR 290			DIMENSIONS	3/4"x0.154"x20FT	
TOTAL BUNDLES:	9	TOTAL PIECES:	1080	TOTAL LENGTH:	21594.470	mt
			REMARK: STEEL IS FULLY KILLED			

SPECIFICATION NOTE	API 5L(45th)PSL1, ASTM/ASME A/SA106B-2013, CSA Z245.1 GR.290 CAT 1, SS, NACE MR 0175/ISO15156-2009/MR0103-2012(ONLY FOR HARDNESS)	
We hereby certify that material herein described has been manufactured in accordance with the standards and specifications required in your order and satisfies the corresponding requirements.		Quality Manager: 
This certificate is issued by a computerized system and it is valid with electronic signature. In case the owner of the certificate would release a copy of it, he must attest its conformity to the original one taking upon himself the responsibility for any unlawful or not allowed use.		
Any alteration and/or falsification will be subject to the law.		
If you need to assure the authenticity of this certificate, please do not hesitate to contact Hengyang Valin Steel Tube CO.,LTD, E-mail: hsiac@hysteeltube.com		
CUSTOMER THIRD PARTY		Certificate-maker: 杨强

1" SCH 80 SA106B WT 4D8794
CE = .37 VT .161 Low

PG 1 of 1



YANGZHOU LONTRIN STEEL TUBE CO., LTD.
MILL TEST CERTIFICATE (EN10204-3.1)

CUSTOMER: MAX METAL MATERIAL CO LIMITED

PRODUCT: SEAMLESS STEEL PIPE

SPEC: API 5L/ASTM/ASME A/SA106 GR.B/NACE MR-01-75 ISO15156

ISO REGISTRATION NO: 44 100 072544

CONTRACT NO: PQ#1-15353

CERTIFICATE NUMBER: 15EX01035-2-01

TOTAL:		8 BUNDLES		497 PIECES		10344 KG		3195.5 METERS		PACKING IN BUNDLES											
NO.	HEAT NO.	LOT NO.	STEEL GRADE	SIZE	PCS	WEIGHT KG															
							C ≤0.23	Si ≤0.35	Mn ≤1.35	P ≤0.025	S ≤0.025	Cr	Ni	Cu	Mo	V	Co	Mn/C ≥3.0	CE ≤0.02		
1	4D8794	15041A0180	GR.B	1" SCH80*SRL 33.4mm x 4.55mm Length 6-6.7M	378	7991	0.18	0.22	1.09	0.017	0.008	0.03	0.01	0.02	0.002	0.004	0.002	6.06	0.37		
2	4D8794	15041A0181	GR.B	1" SCH80*SRL 33.4mm x 4.55mm Length 6-6.7M	119	2353	0.18	0.22	1.09	0.017	0.008	0.03	0.01	0.02	0.002	0.004	0.002	6.06	0.37		

NO.	MECHANICAL PROPERTIES					TECHNOLOGICAL PROPERTIES			H.T ≥SS	NONDESTRUCTIVE TEST		SURFACE QUALITY		DIMENSION TOLERANCE	
	REEL (MPa) YIELD STRENGTH	Rm (MPa) TENSILE STRENGTH	ELONGATION A%	HARDNESS BHN	IMPACT TEST	FLATTENING TEST	FLARING TEST	BENDING		ET	UT	IN	OUT	O.D.	W.T.
	≥245	≥415	≥30	≤200											
1	395	520	46	80	—	—	—	Satisfactory	2500PSI	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
2	389	520	46	81	—	—	—	Satisfactory	2500PSI	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory

REMARKS: Delivery condition: Normalized.

Certificate remarks: The material meets the requirements of ASTM/ASME A/SA-106 Grade B Sour Service.

MANAGING REPRESENTATIVE:

STAMPER:

DATE:

April 10, 2015

PO 730876
Conforms with ASME
Sec II, Part A 2015 Edition
OCT 18/16 JF



ES

Benteler Steel/T
Postfach 13 40
33043 Paderborn
Deutschland
Tel.: + 49.5254.81-0 Fax: + 49.5254.13666

BENTELER ✓
Steel/Tube

ABNAHMEPRÜFZEUGNIS EN 10204-3.1
INSPECTION CERTIFICATE EN 10204-3.1
CERTIFICAT DE RECEPTION EN 10204-3.1
EN 10204:2005-01

Benteler Steel/Tube GmbH - Postfach 1340 - 33043 Paderborn - Deutschland

SEAMLESS STEEL PIPE LTD.
6868 - 81 STREET SE
CALGARY AB T2C 5B8
CANADA

Dokument-Nr.: 65-865927/001/P

Document No.:
No. du document:

Kunden-Bestell-Nr.: 46003137/I-15344

Purchase Order No.:
No. de commande du client:

Benteler Auftrags-Nr.: 1606485

Benteler Order No.:
No. de commande Benteler:

Versandanzeigen-Nr.: 6571545

Dispatch Note No.:
No. d'avis d'expédition:

Produkt: NAHTLOSE STAHLROHRE
Product: SEAMLESS STEEL TUBES
Produit: TUBES D'ACIER SANS SOUDURE

Prüf-Nr.:
Inspection No.:
No. du certificat:

Blatt: 1 / 5
Page:
Page:

Hersteller: Warmrohrwerk Dinslaken
Manufacturer: [DIN EN ISO 9001, ISO/TS-16949 CERTIFIED BY TUEV NORD CERT]
Producteur: [PED 97/23/EC CERTIFIED BY TUEV NORD SYSTEMS]

Herstellerzeichen:
Manufacturer's brand:
Marque du producteur:

Stempel des Abnahmebeauftragten: WA
Stamp of the inspection representative:
Poinçon du contrôleur:

Stahlschmelzungsverfahren: ELEKTROSTAHL
Steelmaking process: ELECTRIC FURNACE
Procédé d'élaboration de l'acier: FOUR ELECTRIQUE

Lieferbedingungen: ASTM-A 106-2013, ASTM-A 333-2010-HF, ASME SA-106, ASME Section II Part A Edition 2013, ASME
Terms of delivery: SA-333-HF, ASME Section II Part A Edition 2013, CSA Standard Z245.1-14 Category II, Sour Service,
Conditions de livraison: ANSI/NACE MR0175/ISO 15156-1: 2009, ANSI/NACE MR0175/ISO 15156-2: 2009

Maße - Toleranzen: ASME SA-106, ASME Section II Part A Edition 2013, ASTM-A 106-2013, ASME SA-999 ASME Section II Part A Edition
Dimensions-tolerances: 2013, ASTM-A 999-2013
Dimensions-tolérances:

Stahlsorte: GRADE 1, GRADE 290, GRADE 6, GRADE B

Steel grade:
Nuance d'acier:

Lieferzustand: Normalized

Delivery condition:
État de livraison:

Produktkennzeichnung: FS: BENTELER Z.245.1-14 - A / SA-106 / A / SA-333 B/1/6/290 CATEGORIE 2 SS HEAT-NO.

Product marking: M45C SMLS HN DIMENSION TEST PRESSURE S6 WA GERMANY P.O. I-15344 DIMENSIONS SCHEDULE

Marquage du produit: PS: HEAT-NO. DIMENSIONS SCHEDULE B/1/6/290 SS

AEZ = Ätztintenbeschriftung, Etching ink marking, Gravure à l'encre . FK = Farbkennzeichnung, colour marking, marquage par couleur . FS = Farbschablonierung, paint stencilling, marquage par peinture . FSD = Farbstrahldrucker, Colour jet printer, Imprimante à jet d'encre de couleur . LK = Laserkennzeichnung, Laser marking, Marquage laser . PKE = Etikettenkennzeichnung, tag marking, marquage sur étiquette . PS = Prägestempel, die stamp, marquage par poinçonnage . TS = Tintenstrahlkennzeichnung, Ink jet spray marking, imprimante à jet d'encre .

Pos.	Stück	Maße	Länge	Gewicht	Schmelzen-Nr.	Prüfdruck	Rohr-Nr.-Gruppe	Vielfachlängen
Item	Number	Dimensions	Length	Weight	Heat No.	Test pressure	Tube number group	Multiple lengths
Poste	Nombre	Dimensions	Longueur	Poids	No. de coulée	Pression d'épreuve	Série de no. des tubes	Longueurs multiples
			feet	lbs		PSI	s	
0010	57	2" NPS * Sched. 80 38 FT - 42 FT	2333,23	11795	591111	3000	5	

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INSPECTION CERTIFICATE EN 10204-3.1
CERTIFICAT DE RECEPTION EN 10204-3.1

Dokument-Nr.: 65-865927/001/P
Document No.:
No. du document:

Prüf-Nr.:
Inspection No.:
No. du certificat:

Blatt: 2 / 5
Page:
Page:

Schmelzenanalyse [%] / Heat analysis [%] / Analyse sur coulée [%]

Pos.	Schmelzen-Nr.	C	SI	MN	P	S	CR	MO	NI	CU	V	NB	TI	B
Item	Heat No.													
Poste	No. de coulée													
0010	591111	0,120	0,200	0,75	0,005	0,003	0,07	0,02	0,05	0,06	0,002	0,011	0,002	0,0001

- Formel: $CE_{IIW} = C + (Mn/6) + ((Cr + Mo + V)/5) + ((Cu + Ni)/15) \leq 0,42 \%$
- Formel: $CEV = C + F \cdot ((Mn/6) + (Si/24) + (Cu/15) + (Ni/20) + ((Cr + Mo + V + Nb)/5) + (5 \cdot B)) \leq 0,40 \%$
- Formel: $Mn/C \geq 3/1$
- Formel: $Cr + Cu + Mo + Ni + V \leq 1,00 \%$

Formelergebnisse / Formula results / Résultats des formules

Pos.	Schmelzen-Nr.	1. Formel	2. Formel	3. Formel	4. Formel
Item	Heat No.	1. Formula	2. Formula	3. Formula	4. Formula
Poste	No. de coulée	1. Formule	2. Formule	3. Formule	4. Formule
0010	591111	0,271	0,241	6,250	0,202

Produktanalyse [%] / Product analysis [%] / Analyse sur produit [%]

Pos.	Schmelzen-Nr.	C	SI	MN	P	S	CR	MO	NI	CU	V	NB	TI	B
Item	Heat No.													
Poste	No. de coulée													
0010	591111	0,130	0,190	0,76	0,004	0,003	0,08	0,03	0,05	0,05	0,001	0,012	0,002	0,0001

- Formel: $CE_{IIW} = C + (Mn/6) + ((Cr + Mo + V)/5) + ((Cu + Ni)/15) \leq 0,42 \%$
- Formel: $CEV = C + F \cdot ((Mn/6) + (Si/24) + (Cu/15) + (Ni/20) + ((Cr + Mo + V + Nb)/5) + (5 \cdot B)) \leq 0,40 \%$
- Formel: $Mn/C \geq 3/1$
- Formel: $Cr + Cu + Mo + Ni + V \leq 1,00 \%$

Formelergebnisse / Formula results / Résultats des formules

Pos.	Schmelzen-Nr.	1. Formel	2. Formel	3. Formel	4. Formel
Item	Heat No.	1. Formula	2. Formula	3. Formula	4. Formula
Poste	No. de coulée	1. Formule	2. Formule	3. Formule	4. Formule
0010	591111	0,285	0,262	5,846	0,211

Benteler Steel/Tube GmbH
Postfach 13 40
33043 Paderborn
Deutschland
Tel.: + 49.5254.81-0 Fax: + 49.5254.13666

BENTELER 
Steel/Tube

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Dokument-Nr.: 65-865927/001/P
Document No.:
No. du document:

Prüf-Nr.:
Inspection No.:
No. du certificat:

Blatt: 3 / 5
Page:
Page:

Prüfergebnisse / Test results / Résultats des essais

Die Rohre sind auf Dichtheit geprüft durch: The tubes have been submitted to a leak tightness test by: Les tubes ont passé un contrôle d'étanchéité par:	Hydrostatic test: acc. to CSA Z245.1, holding time min 5 seconds, Test pressure/Time-record	PASSED
Die Rohre wurden zerstörungsfrei geprüft: The tubes are non destructive tested: Les tubes ont passé un essai non destructif:	ET-test: acc. to CSA Z245.1; for imperfections; drilled hole: 3,20 mm	PASSED
Augensichtkontrolle: Visual inspection: Examen visuel:	PASSED	
Biegeversuch: Bending test: Essai de cintrage:	PASSED	
Maßkontrolle: Dimensions examination: Vérification des dimensions:	PASSED	
Ringfaltversuch: Flattening test: Essai d'aplatissement:	PASSED	

Ergebnisse der mechanischen Prüfung / Results of mechanical testing / Résultats des essais mécaniques

Die Probennahme erfolgte an Vielfachlängen.
The sampling was carried out on multiple lengths.
L'échantillonnage était réalisé aux longueurs multiples.

Zugversuch längs Streifenprobe / Tensile test longitudinal Strip test specimen / Essai de traction longitudinale Bande decoupee sur tube

Pos. Item Poste	Proben-Nr. Specimen No. No. de l'éprouvette	Schmelzen-Nr. Heat No. No. de coulée	Probenabmessung Specimen dimensions Dimensions de l'éprouv.	Streckgrenze Yield strength Limite élastique	Zugfestigkeit Tensile strength Résistance à la traction	Dehnung Elongation Allongement	Einschnürung Area reduction Coefficient de striction
Anforderungen Requirements Exigences			mm	RT 0,5 % PSI	Rm PSI	A2" %	1. Formel 1. Formula 1. Formule
				42061-71794	60191-90649	MIN 30,00	
0010	000001	591111	19,00 X 5,40	46992	65847	40,00	
0010	000002	591111	19,00 X 5,50	46847	65992	40,00	
0010	000003	591111	19,00 X 5,50	47137	66717	40,00	
0010	000004	591111	19,00 X 5,50	46122	64832	38,00	

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Postfach 13 40
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Deutschland
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INSPECTION CERTIFICATE EN 10204-3.1
CERTIFICAT DE RECEPTION EN 10204-3.1

Dokument-Nr.:
Document No.:
No. du document:

65-865927/001/P

Prüf-Nr.:
Inspection No.:
No. du certificat:

Blatt: 4 / 5
Page:
Page:

Härteprüfung / Hardness test / Essai de dureté

Pos. Item Poste	Proben-Nr. Specimen No. No. de l'éprouv.	Schmelzen-Nr. Heat No. No. de coulée	Härte Hardness Dureté					
Anforderungen Requirements Exigences			HRC	HB	HV	HRB	HBW	
				MAX 200				
0010	000001	591111		136				
0010	000002	591111		135				
0010	000003	591111		135				
0010	000004	591111		134				

Kerbschlagbiegeversuch Notched bar impact test / Essai de flexion par choc (résilience) [1 CHARPY_V]

Pos. Item Poste	Proben-Nr. Specimen No. No. de l'éprouv.	Schmelzen-Nr. Heat No. No. de coulée	Probenabmessung Specimen dimensions Dimensions de l'éprouvette			Probenlage Specimen position Position de l'éprouvette	Prüftemperatur Test temperature Température d'essai	Kerbschlagarbeit Absorbed energy Energie absorbée		Laterale Breitung Lateral expansion Expansion latérale	Verf.-Bruchanteil Shear-fracture Rupture ductile	
Anforderungen Requirements Exigences			Länge Length Longueur	Breite Width Largeur	Höhe Height Hauteur	längs (L) longitudinal (L) longitudinal (L)		einzel single individuelle	mittel average moyenne		einzel single individuelle	mittel average moyenne
			mm	mm	mm	quer (Q) transversal (Q) transversal (Q)	GRAD °C	J MIN 011	J	mm min. 0,38	%	%
0010	000001	591111	55	4,00	10,00	L	-54	63			60	
				4,00	10,00			63			60	
				4,00	10,00			65	64	1,66	60	60

Wärmebehandlung / Heat treatment / Traitement thermique

Normalizing temperature: 890°C, Holding time: 5 min.; Cooling: Air

Restmagnetismus / Demagnetize / Démagnétiser

demagnetized tubes; 1 measurement per 4 hours on both tube ends Two readings 180° apart around the circumference. Average value max 3.0 Millitesla (24 A/cm), individual value max 3.5 Millitesla (28 A/cm)

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Dokument-Nr.: 65-865927/001/P
Document No.:
No. du document:

Prüf-Nr.:
Inspection No.:
No. du certificat:

Blatt: 5 / 5
Page:
Page:

Vermerk / Remark / Remarque

NACE Standard: Hardness acc. to NACE Standard MR0175 HRC max. 22., The material meets the requirements of NACE MR0103, Region 3, in accordance to Figure 1 and Appendix A.2, ANSI/NACE MR0175/ISO 15156-2:2009; Certificate remarks: Sour Service, The Material is Aluminium deoxydized and inclusion shape controlled with Calcium-Silicon treatment, It is the end user's responsibility to ensure that all environmental requirements as well as the requirements regarding engineering, construction and operation of facilities are fulfilled in the country of use. Fit for purpose of the parts as well as homologation is not the scope of this contract., Steelmaking: Benteler Steel Mill Lingen, This is to confirm that the seamless linepipe supplied by Benteler and verified to CSA Standard Z245.1-14 meets the requirement for micro hardness of max. 248 HV 500 gf., No weld repair has been carried out; Bend test: mandrel diameter 12D; Bending angle: 90 °

Grain size: acc. to ASTM-E 112; Grain size and finer: 6

Verkäufer(in) / Sales personnel / Personne chargée : Mrs Heggemann, Tel.: 05254/81-4335, Fax: 4388

Dinslaken, 01.04.2015, TEL.: 02064.623-5360 FAX: 02064.623-5390

Abnahmebeauftragter
Inspection representative
Contrôleur

DR. BASEL KEITA / SEMIZ

Es wird bestätigt, daß die gelieferten Erzeugnisse den techn. Lieferbedingungen des Auftrages entsprechen. Dieses Dokument wurde mittels EDV erstellt und ist ohne Unterschrift rechtsgültig.
We certify that the supplied products comply with the order specification. This document was prepared by means of electronic data processing and is valid without signature.
Nous attestons que les produits livrés sont conformes aux stipulations de la commande. Ce document a été établi par traitement électronique de l'information et est valide sans signature.



CapProducts, Ltd.
25 Winnipeg St
Vanastra, ON N0M 1L0

Phoenix * Capitol * Camco
CapProducts

Commanding a Higher Standard_{sm}

Certified Mill Test Report

Printed: 2/13/2015

Customer

MRC CANADA ULC
7072 - 112 AVE SE
CALGARY, AB T2C 4Z1

Certified: 11/06/2014

P.O. C 740 379545 6J0

Tag

Heat No 22397

Heat Code 83IQ

Phoenix Order # 1100110

Material ASTM A333 GR6 2011/ASME SA333 GR6 2010 Edition

Part Number

15110304LT

Description

1/4 X 2 XHSML BK STL NIPL A333-6

Chemical Properties

C	Mn	P	S	Si	Cu	Ni	Cr	C Eq. Long	
0.1800	0.7800	0.0100	0.0120	0.2300	0.1700	0.0700	0.0400	0.3392	
Mo	V	Co	Al	Cb	N	Pb	Sn	Ta	Ti
0.0200	0.0060			0.0020					0.0020

Additional Chemical Properties

					Cr + Cu + Ni
					0.2800

Mechanical Properties

Tensile (PSI)	Yield (PSI)	Elong. % in 2 in. or 4D	R of A	HBW	HBW2
71,920	52,640	42.4%	0.0%	118	0

Charpy Minimum Impact - ft/lbs

Test 1	Test 2	Test 3	Average
N/A	N/A	N/A	N/A

* Hydro test passed. at 2500 psi.

* Eddy Current test passed.

* Bend test passed.

We hereby certify that these parts were manufactured, sampled, tested, and inspected in accordance with the product specifications stated and were found to meet the requirements.

We further certify that this material was inspected using independent inspectors conforming to the requirements of EN 10204

3.1. These products meet the requirements of the latest editions of NACE MR0175, NACE MR0103, and ISO 15156. No weld repair has been performed on these products. This material was not exposed to mercury or any other metal alloy that is liquid at ambient temperatures during processing or while in our possession.

Conforms with ASME
Sec II, Part A 2015 Edition
Feb 2/16

KG

WESTBROOK

MATERIAL TEST REPORT

Page 1

PO Box 53591
Edmonton, AB T6X0P0

Voice 780 490 4976
Fax 780 490 0471

Sold To: Trans AM Piping Prods
Order No.: 124029 Order Date: 5/15/2015

Purchase Order: CL-15-8468

Printed: 5/15/2015

Line: Description:
1 1/2 X 1/4 S80 A420 WPL6 CONC SWG TBE

***** Specifications - Heat Code H00799: *****
A350/A350M-11 LF2, SA350 LF2, A105, SA105, A420-10A WPL6,
SA420 WPL6, A234-11 WPB, SA234 WPB, A788, ASME B16.5,
B16.9, B16.11, B16.47, B1.20.1, MSS SP-25, SP-44, SP-79,
SP-83, SP-95, API 605, A.W.W.A.
STARTING MATERIAL: BAR

Chemical Composition:

C:	Mn:	P:	S:	Si:	Cr:	Ni:	Mo:
0.200	1.000	0.010	0.006	0.240	0.080	0.300	0.020
Cu:	V:	Al:	Cb:	C.E.:			
0.130	0.020	0.030	0.000	.419			

Mechanical Properties:

Tensile(PSI):	Yield(PSI):	Elong(%):	RA(%):	Hardness:
80500	54500	34.00	70.00	BHN 159

Impact Results:

Test Temp:	Achieved Values:
-50F	75-69-74 FT/LBS

Comments:

Normalized.
Cold drawn.
Meets Nace MR-01-75/2009, MR-01-03/2010 and ISO 15156/2009.

MATERIAL CONFORMS
TO CUSTOMER
SPECIFICATIONS
AS PER P.O.
REQUIREMENTS

CONFORMS WITH ASME SEC II, PART A
2015 EDITION
JANUARY 4, 2016 ER

Dec. 4/15

We hereby certify that the contents of this Material Test Report are correct and accurate to the best of our knowledge and belief, that all test results are in compliance with the material specifications and that all material meets the dimensional requirements of the order. The products described have not come into contact with mercury or any of its components. Westbrook's USA Quality System is registered to ISO 9001, Certificate No. 32813. This document is in accordance with EN10204:2004 3.1 / DIN50049 3.1B and was electronically transmitted. This inspection certificate is issued under the authority of Westbrook Mfg's Quality Control Manager.

COIL DOCUMENTATION

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: FEB 12, 2014 Rev Status: 10.1		FORM-INDIRECT FIRE HEATER COIL TRAVEL SHEET Page 1 of 1

EXHIBIT 24.1 INDIRECT FIRED HEATER COIL TRAVEL SHEET REV NO: 0

DO NOT START WITHOUT AI REVIEW			AI REVIEW: <i>J. T. [Signature]</i>			DATE: <i>29 Nov 2016</i>				
WO NO: 09961-001-A			COIL TYPE: <i>4" - 1500 ANSI RTJ (8 Pass) Re Heat SPLIT Coil</i>							
SERIAL NO: NWP-09961-001-A										
DWG NO: LH2001-A0-000			DWG REV NO: 0			TRAVEL SHEET INITIATION BY: <i>[Signature]</i>				
CRN NO: <i>P9417.213</i>										
SEQ	ITEM	HOLD	COMMENTS	Q.C.I	DATE	A.I HOLD POINTS	A.I	DATE	OWNER	DATE
1	Calculations in file			LR	Nov 24/16	"	<i>[Signature]</i>	11-29-16		
2	Release of App'd DWG.			LR	Nov 24/16	"	<i>[Signature]</i>	11-29-16		
3	Heat #'s Recorded			LR	Jan 3/17	"	<i>[Signature]</i>	1-12-17		
4	MTR's Checked			LR	Jan 3/17	"	<i>[Signature]</i>	1-12-17		
5	Materials Accepted	✓		LR	Jan 3/17		<i>[Signature]</i>			
6	W.P.S Checked			LR	Nov 24/16	"	<i>[Signature]</i>	1-12-17		
7	Welders Qualified	✓		LR	Nov 24/16	"	<i>[Signature]</i>	1-12-17		
8	Thickness Recorded			LR	Jan 3/17		<i>[Signature]</i>			
9	Fit-up Examination(s)			LR	Jan 9/17					
10	Impact Tests <i>N/A</i>			LR	Nov 24/16					
11	Welds Examined			LR	Jan 10/17	"	<i>[Signature]</i>	1-12-17		
12	Welder I.D Checked			LR	Jan 10/17	"	<i>[Signature]</i>	1-12-17		
13	Final External Inspection	✓		LR	Jan 12/17	"	<i>[Signature]</i>	1-12-17		
14	Radiography	✓		LR	Jan 10/17	"	<i>[Signature]</i>	1-12-17		
15	Other N.D.E		<i>N/A</i>	LR	Jan 12/17					
16	Final Ext. Prior to P.W.H.T	✓		LR	Jan 10/17	"	<i>[Signature]</i>	1-12-17		
17	PWHT Chart Checked	✓		LR	Jan 12/17	"	<i>[Signature]</i>	1-12-17		
18	Hydrostatic Test	✓		LR	Jan 12/17	"	<i>[Signature]</i>	1-12-17	<i>*DNAB</i>	<i>01/12/2017</i>
19	CRN Drawing Reviewed <i>P9417.213</i>			LR	Nov 24/16	"	<i>[Signature]</i>	11-29-16		
20	N.C.R. #									
21	Nameplate Stamping			LR	Jan 12/17	"	<i>[Signature]</i>	1-12-17		
22	Data Report (AB-28) Completed			LR	Jan 12/17	"	<i>[Signature]</i>	1-12-17		
23	Nameplate Installation			LR	Jan 17/17		<i>[Signature]</i>			

The Authorized Inspector shall be presented with the Travel Sheet prior to construction so that he can designate additional inspection point and/or Hold Points. Any revisions shall be marked with a delta symbol with revision number and described at the bottom of this page.

* Denotes a A.I Inspection Point

** Denotes an A.I Hold Point

PARTIAL ☐

A# 657441

Manufactured By: NWP Industries LP 4017 60th Ave, Innisfail Alberta, T4G 1S9

Manufactured For: Baytex Energy Corp. Centennial Place, East Tower 2800, 520 - 3rd Avenue SW, Calgary, AB T2P 0R3

Ultimate Owner: Baytex Energy Corp. Centennial Place, East Tower 2800, 520 - 3rd Avenue SW, Calgary, AB T2P 0R3

Location of Installation: 15-02-42-12 W5M

Manufacturer's Serial No.	Construction Drawing No.	CODE: ASME B31.3	Year Built
NWP-09961-001-A	LH2001-A0-000 REV.0	Edition 2014	2017

CONSTRUCTION

Coil ID/Purpose	Design Pressure	Design Temp	Design Minimum Temp	Corrosion Allowance	Registered Drawing No.	CRN
a Coil A - Preheat	5171 PSIG	200 F	-20 F	0.0625"	BDD-400A REV.1	P9417.213
b Coil B - Reheat	3375 PSIG	200 F	-20 F	0.0625"	BDD-400A REV.1	P9417.213
c						
d						
e						

COIL

Tubes			End Closures				Openings		
Mat'l Spec.	Diameter	Thickness	Return Bend	Flanges	Mat'l Spec.	Rating	Mat'l Spec.	Size/Type	Rating
a SA-333-GR6	4" NPS	SCH XXS	SA-420-WPL6	SCH XXS	SA-350-LF2 CL1	CL 2500	N/A	N/A	N/A
b SA-333-GR6	4" NPS	SCH 160	SA-420-WPL6	SCH 160	SA-350-LF2 CL1	CL 1500	N/A	N/A	N/A
c									
d									
e									

HEADERS/MANIFOLDS

HEADERS AND CDS										
	Purpose	Size	Shell		Ends		Openings			
			Mat'l Spec.	Thickness	Mat'l Spec.	Thickness	No	Mat'l Spec	Size/Type	Rating
f	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
g	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TEST PRESSURE, NDE, POSTWELD HEAT TREATMENT AND SIZE

Hydrostatic Test Pressure	Radiography (100% or % Random)	Other NDE (MT) (PT) (UT)	Postweld Heat Treatment		Overall Length	Heating Surface	Volume
			Temp.	Time			
a 7757 PSIG	100%	N/A	1150 F	60 min.	234.875"	1034 SQ. FT.	8.107 CU. FT.
b 5063 PSIG	100%	N/A	1150 F	60 min.	237.625"	174.7 SQ. FT.	9.64 CU. FT.
c							
d							
e							
f							
g							

IMPACT TESTING: Exempt per Table 323.2.2 Column A

REMARKS:

CERTIFICATE OF COMPLIANCE

We certify that the statements in this report are correct and that all details of design, material, construction, and workmanship of this coil bundle are in accordance with the above Provincial Registered Design.

Date Jan, 12, 2017

Signed Lance Raven

(Signature)
(Representative)

For NWP Industries LP

(Manufacturer)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, a duly authorized boiler and pressure vessel inspector employed by Alberta Boilers Safety Association (ABSA) of Alberta have inspected the above Heater Coils and state that, to the best of my knowledge and belief, the constructed is in accordance with the Alberta Safety Codes Act and Regulations. By signing this certificate, neither the inspector nor his or her employer makes any warranty, expressed or implied, concerning the vessel described in this manufacturer's data report. Furthermore, neither the inspector nor his or her 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 Jan, 12, 2017

Signed

(Signature)

NB 12995 A, B

AB 261

W
RT - 100%
HT

CERTIFIED BY

NWP
INDUSTRIES LP
MADE IN CANADA

SERIAL NO. NWP- 09901-001-A

COIL A PREHEAT

MAWP 5171 PSI AT 200 °F

MDMT -20 °F AT 5171 PSI

CRN P9417.213 YEAR BUILT 2017

COIL B REHEAT

MAWP 3375 PSI AT 200 °F

MDMT -20 °F AT 3375 PSI

CRN P9417.213

COIL C

MAWP PSI AT °F

MDMT °F AT PSI

CRN

COIL D

MAWP PSI AT °F

MDMT °F AT PSI

CRN

667441



EXHIBIT 14.1 HEAT TREATMENT REQUIREMENTS

Serial# NWP-09961-001-A

PO# 732203

JOB NO.: 09961-001-A

CUSTOMER: Baytex Energy

DATE: Jan 10, 2017

COMPONENT DESCRIPTION

DWG. NO. AND LINE NO.	DIAMETER	THICKNESS	MATERIAL	LENGTH	WEIGHT
LH2001-A0-000 Rev 0 - Page 2	4" NPS	XXS	SA-333-GR6	22 ft approx	4358 lbs
LH2001-A0-000 Rev 0 - Page 3	4" NPS	SCH 160	SA-333-GR6	22 ft approx	3704 lbs

TYPE OF HEAT TREATMENT: PRESSURE VESSEL or Process Piping STRESS RELIEVE P1 and Materials

HEATING

Temperature to be raised from 800°F (425°C) to 1150°F (621°C) at a maximum rate of 400 °F

() °C per hour. NOTE: THIS VALUE MUST NEVER EXCEED 400°F (222°C) PER HOUR.

[Calculated rate = 400 degrees F/hr. (222 degrees C/hr) Divided by the maximum metal thickness of the shell or head plate in inches]

HOLDING

Temperature to be held in range of 1150°F ± 25°F for 60 minutes.

[Holding time to be determined by Table UCS-56 for Nominal Thickness as specified in UW-40(f)]

COOLING

Temperature to be lowered from 1150°F (621°C) to 800°F (427°C) at a maximum rate of 500 °F

() °C per hour. NOTE: THIS VALUE MUST NEVER EXCEED 500°F (260°C) PER HOUR.

[Calculated rate = 500 degrees F/hr. (260 degrees C/hr.) Divided by the maximum metal thickness of the shell or head plate in inches]

From 800°F (427°C) items may be cooled in still air.

Additional Requirements:

- ☐ Job number and description required on heat treatment charts along with the operator's signature & date.
- ☐ Reporting of thermocouple attachment method and location, and verification of furnace thermocouple calibration is required.
- ☐ A sufficient number of thermocouples shall be located to control and maintain uniform distribution of temperature on all vessels and parts. Thermocouples shall be directly attached to the item or provision shall be made for thermocouple placement at bottom, centre and top of the furnace charge in accordance with the ASME Code.
- ☐ During the heating period, there shall not be a greater variation in temperature throughout the portion of the vessel being heated than 250° F (140° C) within any 15 ft. (4.6 m) interval of length. An adequate number of thermocouples must be used to ensure this Code requirement is met.
- ☐ During the holding period, there shall not be a greater difference than 150° F (83° C) between the highest and lowest temperature throughout the portion of the vessel being heat treated, except where the range is further limited by these instructions.
- ☐ If Capacitor Discharge welding is used to attach thermocouples an ASME Code Section IX Welding Procedure Specification is required (WPS qualification is not required), and the energy output must be limited to 125 Watt-Seconds.
- ☐ No other welding is permitted on vessels or parts. [0.5 x Capacitance in farads X Voltage² = W-Sec.]
- ☐ The method of thermocouple removal shall not damage the heat treated item.

Q.C. Inspector Signature

Date: Jan. 10, 2017

Thermocouple Attachment Method: CAPACITOR DISCHARGE

Location (s)

Furnace Heat Number B F 3 2 - 1 7 - 0 1 1

On Coil NWP-099961-001-A TC# 3
Top, TC# 5 Middle, TC# 6 Bottom
January 11, 2017

Furnace Operator Signature

Date:

Form Prepared by: Holly Mayhew

Date: Jan 10, 2016



Date: January 11, 2017

°F TC's:3

Recorder: IR-181

Client: NWP Industries Inc.

Job #: 09961-001-A PO #: 732203

Operator: Mitchell Coumont

Chart Speed: 50mm/hr

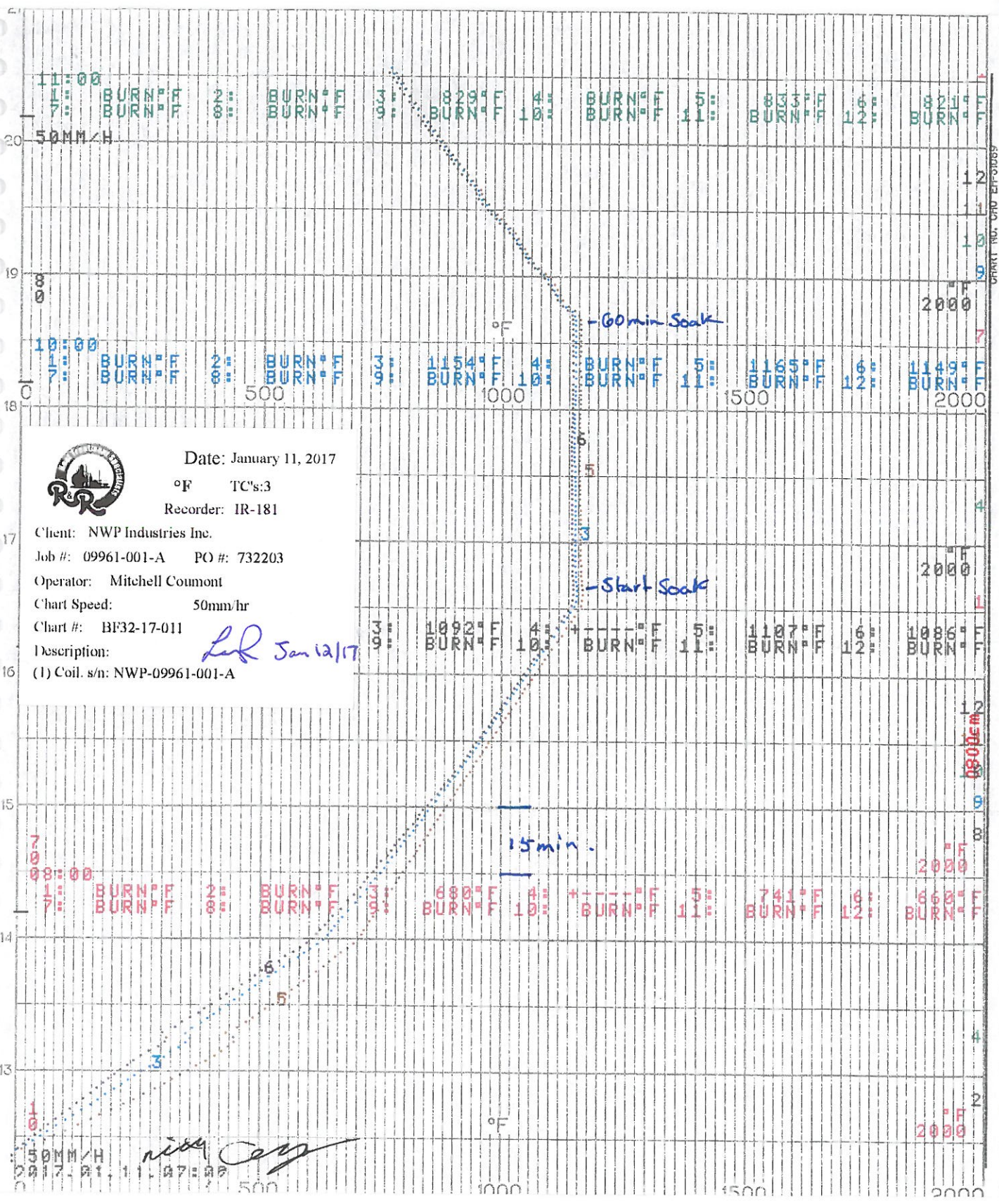
Chart #: BF32-17-011

Description:

(1) Coil, s/n: NWP-09961-001-A

Let Jan 12/17

nick





R & R Stress Relieving Service Ltd.

Nisku: 2103 - 6th Street, T9E 7X8 Tel: (780) 955-7559 Fax: (780) 955-2903
Blackfalds: #15 Burbank Industrial Park Tel: (403) 885-2280 Fax: (403) 885-0177
Toll Free: 1-800-499-HEAT(4328)

CERTIFICATE OF CONFORMANCE OF RECORDING INSTRUMENTS

CERTIFIED BY:	R & R Stress Relieving Service Ltd.
TEST NUMBER:	RR1116
DATE:	November 29, 2016
DATE DUE:	February 28, 2017
INSTRUMENT MFG:	Chino
MODEL NUMBER:	AH-3725 N00
SERIAL NUMBER:	AH-057C171
RECORDER NUMBER:	IR-181

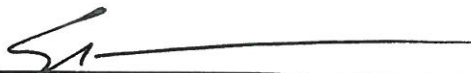
This instrument has been calibrated and it is within the manufacturers specifications.

REFERENCE STANDARDS

DIGI MITE 311600 S/N48430-5522

Certification Date: 12/11/15

The calibration of all standards and measuring instruments used in the calibration are traceable to the National Research Council of Canada in Ottawa or to the National Bureau of Standards in Washington, D.C.


Shane Stimson

Issuing Authority: QA/QC Manager

Date of Issue: Jan 29 2015
Rev Status: 10.0Document Template 2013
Quality Control
FORM-Hydrostatic test affidavit

Page 1 of 1

EXHIBIT 16.2 HYDROSTATIC TEST AFFIDAVIT

Customer: Baytex

JO# 09961-001-A

Project: 4" coil for a 2.0 BTU Lineheater Pkg.

Project#

Test Pressure: 5063 PSI and 7757 PSI

Hold Time: 15 min.

Code Requirements: ASME B31.3 NFS 2014 EditionAll Personnel Advised of Test ☒ All Signs & Flagging Posted ☒

Prior to Filling - Fitting/Hoses & Component Meet Required Test Pressure, Pressure Test Examination Guide Completed

Initials:

Supervisor: COTester: BNDate 12/01/2017

Product Description:

S/N : NWP-09961-001-A

1. Coil A = 7757 PSIG

2. Coil B = 5063 PSIG

50% Test Pressure Leak/Systems Check Completed ☒

1. 50% = 3879 PSIG

2. 50% = 2532 PSIG

Test Temperature: _____ °F

Equipment Drained & Flushed to Prevent Freezing:

Yes: ☒No: ☐


See NWP Procedure for Draining Water from Hydro Tested Vessel Package

Start Time:	Finish Time:
<u>12:30</u>	<u>3:30 pm.</u>

Test Gauge Identification #	Pressure Range	Calibration Date
NWPG- 20000 - <u>20001</u>	0 - 20,000 PSI	<u>Oct. 17 / 2017</u>
NWPG- 20000 - <u>20002</u>	0 - 20,000 PSI	<u>Oct. 17 / 2017</u>
NWPG- 10000 - <u>18</u>	0 - 10,000 PSI	<u>July. 19 / 2017</u>
NWPG- 10000 - <u>19</u>	0 - 10,000 PSI	<u>July. 19 / 2017</u>
NWPG-	PSI	
NWPG-	PSI	

Test By: <u>Ben Nissen</u>	Date <u>12/01/2017</u>
NWP Representative: <u>Jeremy Altman</u>	Date: <u>12/01/2017</u>
Customer Representative: <u>Wayne Bunch</u>	Date: <u>12/01/2017</u>

Cert # 000276

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Feb 20 2015 Rev Status: 0		FORM-Checklist for Cleaning of Indirect Fired Heater Coils

Page 1 of 1

CHECKLIST FOR CLEANING OF INDIRECT FIRED HEATER COILS

Initial

- ☒ Operator has reviewed safe work practice and signed permit
- ☒ Operator has inspected pig receiver to ensure it is in good operating condition and verified that transition spools are correct size and rating for coil to be cleaned
- ☒ Operator has verified system is not under pressure
- ☒ Operator has ensured
 - block valve is in the proper position
 - valves and seal on blind flange are tight and secure
 - closure on receiver is properly installed and secure
 - working pressure of the system and pig receiver are not exceeded
- ☒ Operator has reported to supervisor any material collected
- ☒ Operator certifies that indirect fired heater coil is free of debris

Serial Number: NWP-09961-001-A

Date: JAN 17 2017

Operator: Ryan McGowan
Print

[Signature]
Signature

Witness: Tyler Stinson
Print

[Signature]
Signature

**N.D.E Requirements**

#3

Client: BaytexJO# 09961-001-AProject: 2.0mm lineheater coilDate: 27/12/2016

(COILS)

Welded Piping: ☐ Pressure Vessel: ☐ Tank: ☐ Coil: ☒ Threaded Piping: ☐ Other: ☐

<input type="checkbox"/> X-Ray	<input checked="" type="checkbox"/> 100%	<input type="checkbox"/> Client Specification	<input type="checkbox"/> CSA W59 CL.11 (static)
<input checked="" type="checkbox"/> Gamma Ray	<input type="checkbox"/> Full	<input checked="" type="checkbox"/> ASME B31.3 NFS	<input type="checkbox"/> CSA W59 CL.12 (dynamic)
<input type="checkbox"/> Ultrasonics	<input type="checkbox"/> 20%	<input type="checkbox"/> ASME B31.3 S/C	<input type="checkbox"/> ASME Section VIII Div 1 Appendix 6 (MPI)
<input type="checkbox"/> Liquid Penetrant	<input type="checkbox"/> 15%	<input type="checkbox"/> ASME Section VIII-UW-11(a)	<input type="checkbox"/> ASME Section VIII-UW-53 Appendix 12(UT)
<input type="checkbox"/> Magnetic Particle	<input type="checkbox"/> 10%	<input type="checkbox"/> ASME Section VIII-UW-11(a)5(b)	
<input type="checkbox"/> Black/ White <input type="checkbox"/> Wet Florescent			SURFACE CONDITION:
<input type="checkbox"/> Hardness, Max 200 BHN	<input type="checkbox"/> Spot	<input type="checkbox"/> As-Welded/ Bare Metal	
	Other (define)	<input type="checkbox"/> After PWHT	

NFS

General Instructions:

P1 Material

Welder ID L

Shell-T=

Pipe-T= 4" SCH160, 4" XXHTotal Welds Start shooting package at X-1. Please label the X #'s.

Please use wire type iQi

Please Note locations of all indications on films on reports

Please include O.F.D-S.O.D S.F.D on reports

Coil/Vessel S/N

1482-896-833

16BW

X-1
↓

(All "C")

Special Requirements:

Buttweld Xray to be identified as X-#

Gap Shots to be identified as GS-#

Threaded Shots to be identified as XT-#

Identify on Envelope part of package being shot ie. Coil, Piping, ect.

Flashes must contain: Client, JO#, Xray number, Welder's ID Symbol, Date, NWP, Vessel or Coil SN#, Code and Client Spec if applicable

Mark all indicated repairs on the project with blue ribbon

Shots

X-16

NOTE:

Encana Spec for Vessels is Zero Elongated Indications in or alongside the root pass in Cat. A, B and C Welds

Encana Spec for Socket Welds-acceptance is minimum 1/16" gap

Shell Canada Spec for Socket Welds-acceptance is minimum 1/16" gap

HT is a 5 Point Traverse

Please specify surface condition for MPI

Prepared By: Jeremy AtkinsonDate: 27/12/2016



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Ticket #: 1482-896-833
Client Name: NWP Industries LP
Work Performed On: Tuesday, Dec 27, 2016
Client Reference: NWP Client: Baytex, Job: 09961-001-A, Coil S/N: NWP-09961-001-A

Mistras Traveller #:
200B16-DS-0006

Client Name:
NWP Industries LP

Client Reference:
NWP Client: Baytex, Job: 09961-001-A, Coil S/N:
NWP-09961-001-A

Work Performed On:
Tuesday, Dec 27, 2016

Location(s) of Work:
Innisfail, AB

Technician:
Dustin Fikowski RTII/MTII CGSB# 17460/SNT-TC-1A

Crew:
Curtis Eklund, Jonathan Hum, Blair Mickelberry, David Hollingsworth

Unit #:
177

Work performed in:
AB

Exposure Device:
D10294

Daily work contract has been reviewed with client representative.

Description	Units	Quantity
Radiography - 2 man unit - regular plus shift differential (shift beginning between 1:00pm and 6:00am)	hr	3
Radiography - 2 man unit - regular plus shift differential (shift beginning between 1:00pm and 6:00am)	hr	3
4" welds over sch 80	ea	16
Mileage charge	shift	0.25
Environmental and licensing charges	hr/ft unit	6

This ticket is not an invoice. Pay upon receipt of invoice.

Dustin Fikowski RTII/MTII CGSB# 17460/SNT-TC-1A
Ticket #: 1482-896-833

Client representative *B.S. Se 02/17*



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Client Reference: NWP Client: Baytex, Job: 09961-001-A, Coil S/N: NWP-09961-001-A

Ticket #: 1482-896-833

Client Name: NWP Industries LP

Work Performed On: Tuesday, Dec 27, 2016

Radiography Inspection

Inspection description: 2.0mm Lineheater Coil
Location of work: Inistail, AB

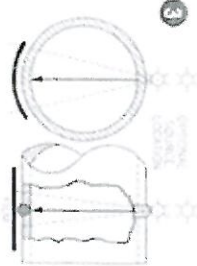
Inspection Procedure: 200-NDT-RT01-Radiography Procedure & Technique (ASME V, Article 2) Rev 9

Code Acceptance Criteria: ASME B31.3 (2014) Normal Fluid Service, Table 341.3.2 Inspection Standard: ASME V, Article 2

Client Specification: not applicable

Exposure Device: D10294 Radiation Source: Iridium 192 Focal Spot/Source Size: 4.0MM Film: KODAK

Techniques Used



Seq #	Weld #	Location	Mat	Size	Thick	Welder	Tech	Shots	Film	#Cass	OFD	SOD	Exp	View	Result	Remarks
1.	X-1	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
2.	X-2	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
3.	X-3	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	Film Mark @ 12cm
4.	X-4	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
5.	X-5	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
6.	X-6	CS	4"	XXH	L	RT3	RT3	5	T200/C4	1	0.799"	3.701"	DW	SW	accept	Film Mark @ 5cm
7.	X-7	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
8.	X-8	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
9.	X-9	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
10.	X-10	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
11.	X-11	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
12.	X-12	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
13.	X-13	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	Film Mark @ 34.5cm
14.	X-14	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
15.	X-15	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
16.	X-16	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	

Accept: No rejectable indications apparent at time of inspection, SZ: Size
Reject: See remarks for explanation, DW: Double wall
Info Only: No code acceptance criteria applied, WT: Wall thickness
Technical reports included in this ticket are an interpretation and do not constitute a guarantee of any kind.

Auditor

Dustin Fikowski RT/MT/II CGSB# 17460/SNT-TC-1A

Ticket #: 1482-896-833

Client representative



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Ticket #: 1484-010-412

Client Name: NWP Industries LP
Work Performed On: Monday, Jan 9, 2017
Client Reference: NWP Client: Baytex, Job: 09961-001-A, Coil S/N: NWP-09961-001-A

Mistras Traveller #:
200B17-CA-0002

Client Name:
NWP Industries LP

Client Reference:
NWP Client: Baytex, **Job:** 09961-001-A, **Coil S/N:**
NWP-09961-001-A

Work Performed On:
Monday, Jan 9, 2017

Locations(s) of Work:
Innisfail, AB

Technician:
Charles Lasouski RT2/PT2/MT2 CGSB#11295

Crew:
Curtis Eklund, Jonathan Hum

Unit #:
156

Work performed in:
AB

Exposure Device:
D10294

Daily work contract has been reviewed with client representative.

Description	Units	Quantity
Radiography - 2 man unit - regular plus shift differential (shift beginning between 1:00pm and 6:00am)	hr	3
Radiography - 2 man unit - regular overtime plus shift differential (shift beginning between 1:00pm and 6:00am)	hr	1
4" welds over sch 80	ea	16
Mileage charge	shift	0.25
Environmental and licensing charges	hr/rt unit	4

This ticket is not an invoice. Pay upon receipt of invoice.

Charles Lasouski RT2/PT2/MT2 CGSB#11295
Ticket #: 1484-010-412

Jan 10, 2017
Client representative



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Client Reference: NWP Client: Baytex, Job: 09961-001-A, Coil S/N: NWP-09961-001-A

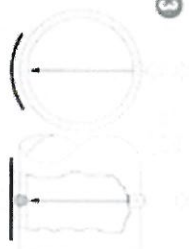
Ticket #: 1484-010-412
Client Name: NWP Industries LP
Work Performed On: Monday, Jan 9, 2017

Radiography Inspection

Inspection description: 2.0mm Lineheater coil
Location of work: Inistail, AB

Inspection Procedure: 200-NDT-RT01-Radiography Procedure & Technique (ASME V, Article 2) Rev 9
Code Acceptance Criteria: ASME B31.3 (2014) Normal Fluid Service, Table 341.3.2 Inspection Standard: ASME V, Article 2
Client Specification: not applicable
Exposure Device: D10294 Radiation Source: Iridium 192 Focal Spot/Source Size: 3.1mm Film: KODAK

Techniques Used



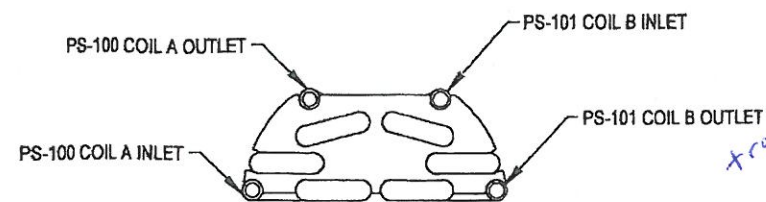
Seq #	Weld #	Location	Mat	Size	Thick	Welder	Tech	Shots	Film	#/Cass	OFD	SOD	Exp	View	Result	Remarks
1.	X-17	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
2.	X-18	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
3.	X-19	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
4.	X-20	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
5.	X-21	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	Film Mark @0
6.	X-22	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
7.	X-23	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
8.	X-24	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
9.	X-25	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
10.	X-26	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
11.	X-27	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
12.	X-28	CS	4"	Sch 160	L	RT3	RT3	4	T200/C4	1	0.656"	3.844"	DW	SW	accept	
13.	X-29	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
14.	X-30	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	
15.	X-31	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	Film Mark @30cm
16.	X-32	CS	4"	XXH	L	RT3	RT3	4	T200/C4	1	0.799"	3.701"	DW	SW	accept	

Accept: No rejectable indications apparent at time of inspection, Reject: See remarks for explanation, Info Only: No code acceptance criteria applied, Technical reports included in this ticket are an interpretation and do not constitute a guarantee of any kind.
SZ: Size SW: Single wall DW: Double wall WT: Wall thickness

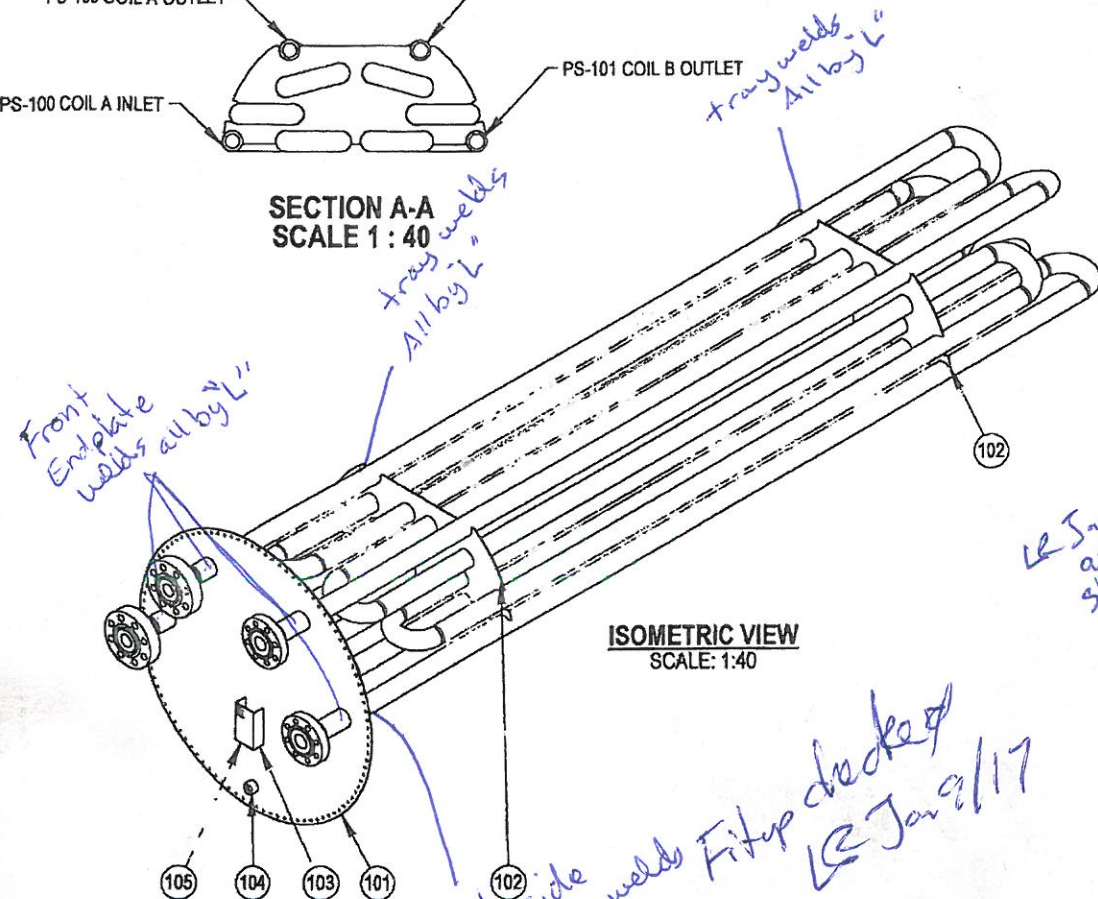
Auditor

Charles Lasowski RT2/PT2/MT2 CGSB#11295
Ticket #: 1484-010-412

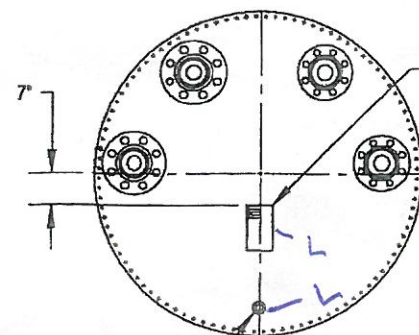
Client representative



SECTION A-A
SCALE 1:40

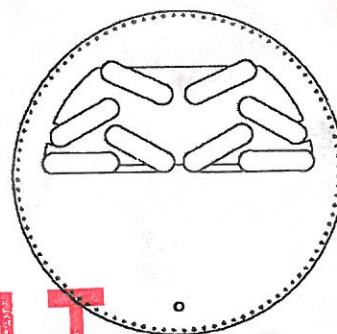


ISOMETRIC VIEW
SCALE: 1:40



FRONT VIEW
SCALE: 1:40

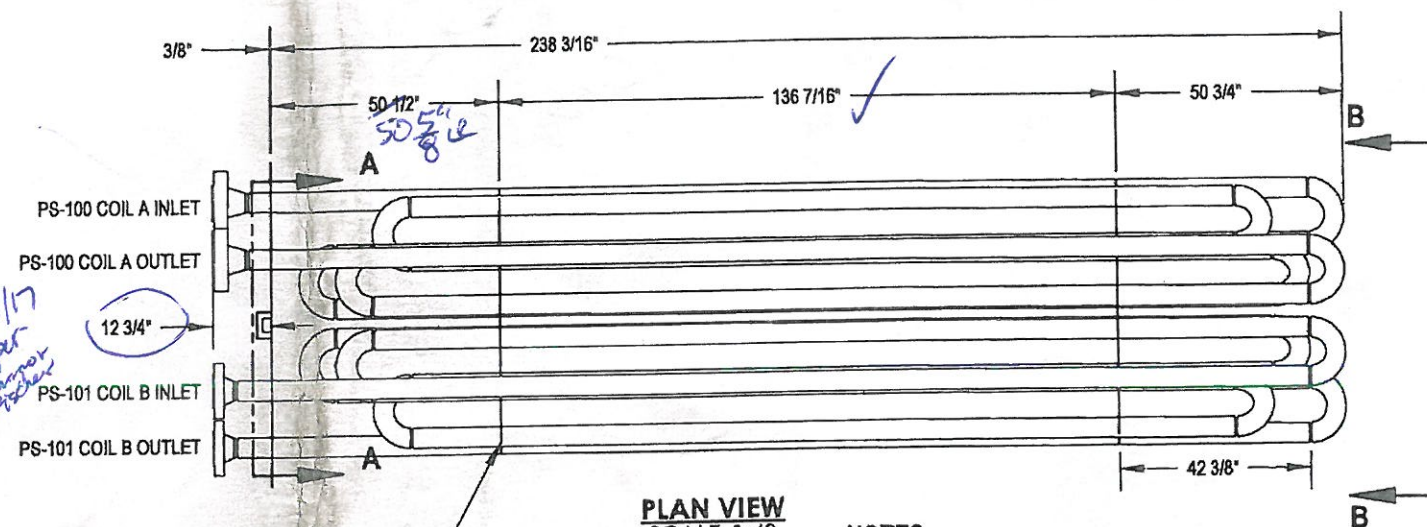
WPS NWP-4, 3
NOV 21 2016



SECTION B-B
SCALE 1:40

AS BUILT
LR Jan 17/17

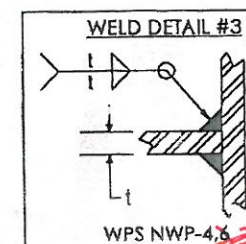
BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
101	SEE SHEET 4		COIL END PLATE 3/8" x 72"	G40.21-44W		1
102	SEE SHEET 4		COIL TRAY PLATE 1/4"	G40.21-44W		2
103	BRACKET-NAME-3		COIL NAME PLATE BRACKET 3/16"x3"x6"x3" OD 10" LG	G40.21-44W		1
104	COUPLER-2WA		COUPLING HALF 2" 3M THRD	SA-105N		1
105	COIL-NAMEPLATE-1		COIL NAME PLATE BLACK/SILVER DEEP ETCHED	ALUMINUM		1
106	SEE SHEET 2		PS-100/ COIL A DETAIL			1
107	SEE SHEET 3		PS-101/ COIL B DETAIL			1



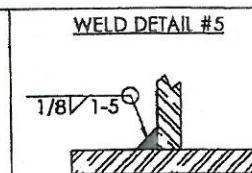
PLAN VIEW
SCALE: 1:40

NOTES

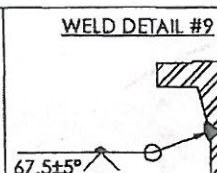
1. ALL DIMENSIONS SHALL HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
2. ALL BOLT HOLES STRADDLE COMMON CENTER LINE.
3. $1/8"$ ROOT GAP ACCOUNTED FOR ON ALL BUTT WELDS.
4. COIL TO BE CLEANED WITH ALL OPENINGS PLUGGED BEFORE SHIPMENT.
5. USE WELD PROCEDURE NWP-4 REV 4 OR NWP-5 REV 2 FOR ALL TACK WELDS.
6. SHOP TO FLUSH PIG THROUGH COIL PRIOR TO SHIPMENT.
7. MATERIAL SPECIFICATIONS MAY BE UPGRADED AS FOLLOWS:
WELD FITTING (B16.5, B16.11): SA-105N TO SA-333-GR 6 SMLS
FORGING (B16.5, B16.11): SA-105N TO SA-350-LF2 CLASS 1
8. ITEM# 104 TO BE "SET ON" NOT SET THROUGH. FILLET WELD OUTSIDE ONLY.



WPS NWP-4, 3



WPS NWP-4, 3



WPS NWP 4, 3

ORIGINAL

ORIGINAL

ISSUED FOR CONSTRUCTION					SIGNED: <i>[Signature]</i>	
DATE: NOV 21, 2016					W.O.: 09961-001-A	
S/N: NWP-09961-001-A					P.O. BOX 6280, INNISFAIR, AB T4G 1S9	
ALL DIMENSIONS IN INCHES					PH: (403) 227-4100 FAX: (403) 227-4102	
0	JULY 21/14	EB	<i>[Signature]</i>	<i>[Signature]</i>	ISSUED FOR CONSTRUCTION	
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION	
DRAWING REVISIONS					ALL DIMENSIONS IN INCHES	



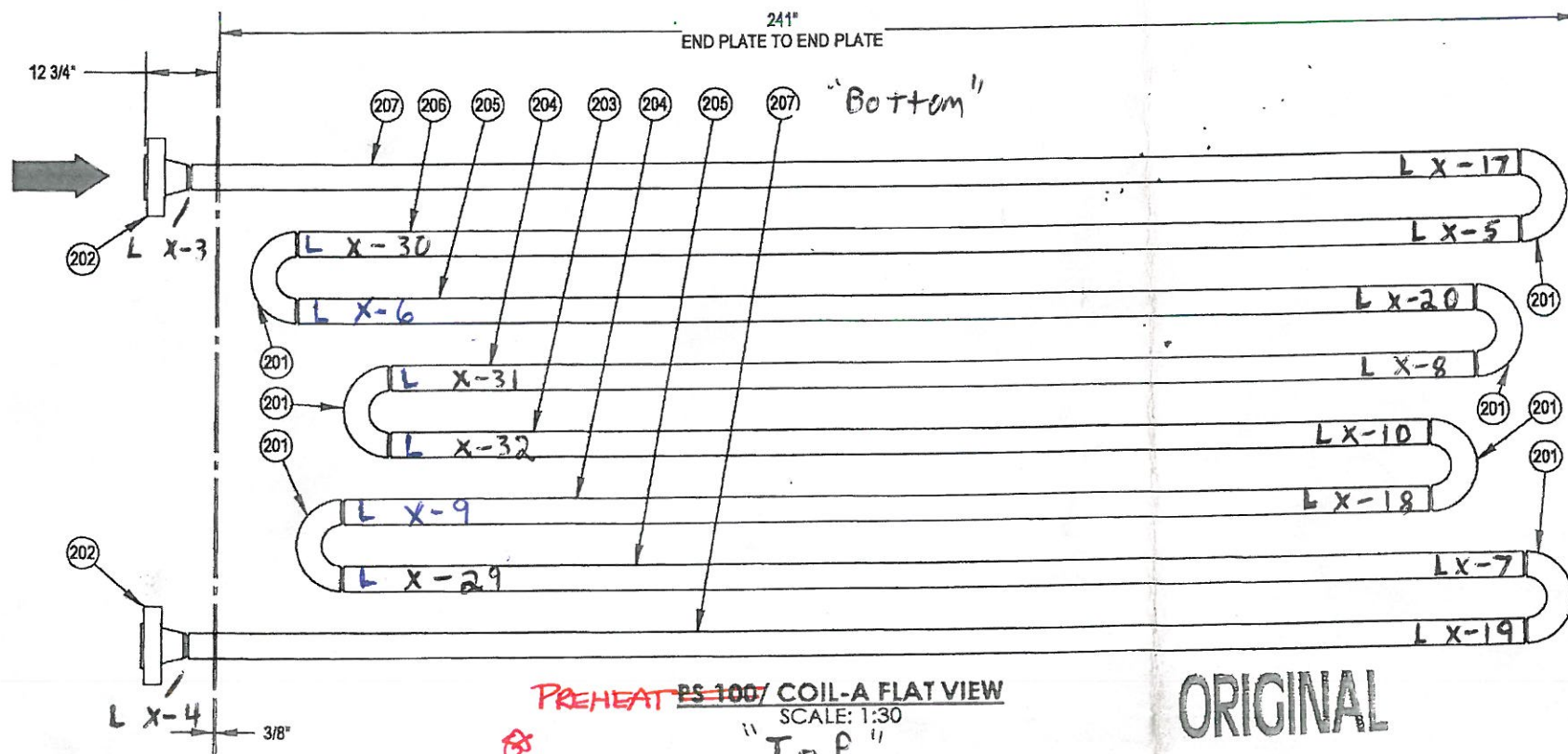
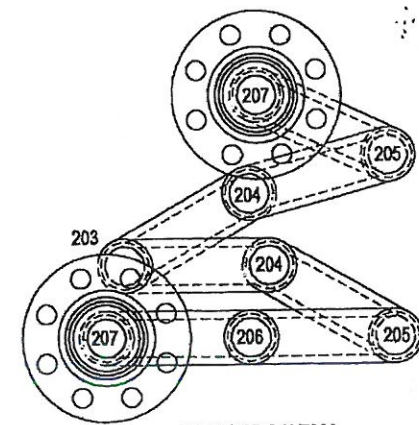
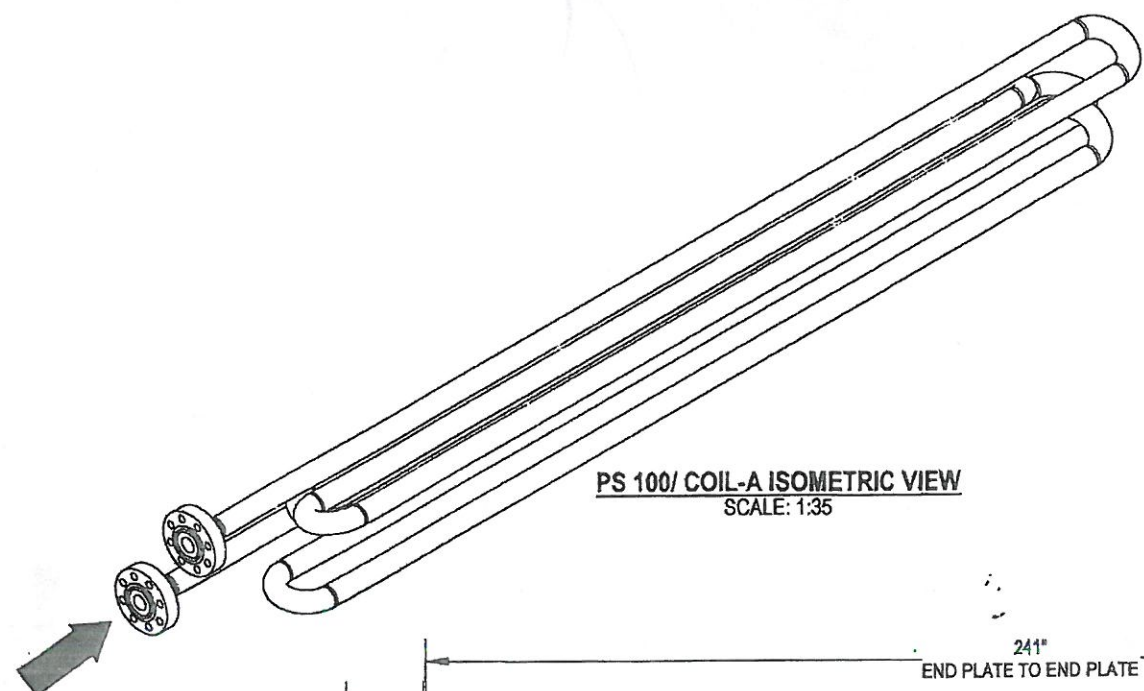
P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION: *[Symbol]* SCALE: AS NOTED
WEIGHT: (APP. * LBS)

NWP INDUSTRIES Baxtex Energy Corp.
4"-2500 ANSI RTJ (8 PASS) PRE-HEAT COIL
4"-1500 ANSI RTJ (8 PASS) RE-HEAT COIL
FOR 62" OD x 240"
2.0MM BTU LINE HEATER

DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>
DATE: MAY 18/14	DATE: JUL 22 2014	DATE: JUL 22 2014
SHEET: 1 OF 5	DWG: LH2001-A0-000	REV: 0

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
201	ELBBW180L4XXHBL		Return 180 Deg 4" LR S/XXH BW	SA420-WPL6		1
202	FRJWN4FXXSAL		FLANGE 4" 2500 ANSI SCH XXS RTJWN	SA350-LF2-CL1	176M2	2
203	PIP4XXSCL		PIPE 4"S/XXS	SA-333-GR6 SMLS	182 1/2"	1
204	PIP4XXSCL		PIPE 4"S/XXS	SA-333-GR6 SMLS	180 3/4"	2
205	PIP4XXSCL		PIPE 4"S/XXS	SA-333-GR6 SMLS	207 1/4"	2
206	PIP4XXSCL		PIPE 4"S/XXS	SA-333-GR6 SMLS	215 1/2"	1
207	PIP4XXSCL		PIPE 4"S/XXS	SA-333-GR6 SMLS	234 7/8"	2



PS-100 COIL A DESIGN DATA	
DESIGN AND FABRICATE TO:	ANSI / ASME B31.3 NFS 2012 EDITION
DESIGN PRESSURE:	5171 PSI
MAX. DESIGN METAL TEMPERATURE:	200 °F
MIN. DESIGN METAL TEMPERATURE:	-20 °F
IMPACT TEST:	EXEMPT PER TABLE 323.2.2 COLUMN A
RADIOGRAPHY:	100%
OTHER NDE:	+/- 25 F LR Not. 29/16
POST WELD HEAT TREATMENT:	1150 °F TO 4475 °F ±50 °F FOR 1 HOUR MIN.
HYDROSTATIC TEST PRESSURE:	7767 PSI
CORROSION ALLOWANCE:	1/16"
PRE-HEAT:	50 °F
WEIGHT EMPTY:	4358 LBS
WEIGHT FULL:	4864 LBS
CAPACITY:	8.107 cu. ft.
SURFACE AREA:	174.7 sq. ft.
QUALITY CONTROL PROGRAM:	AQP-1253
WELDING PROCEDURE REGISTRATION NO.:	1604.2
WELD PROCEDURES:	NWP-4, NWP-6, 3, 2
SERVICE:	HYDROCARBON
CRN NO.:	P9417.213
DESIGN REGISTRATION DRAWINGS:	BDD-400A REV 1
REFERENCE CALCULATIONS:	BDD-400A REV 5

AS BUILT
 LR Jan 17/17

REV.	DATE	BY:	CHK:	APP:	DESCRIPTION
0	JULY 21/14	EB	D	5	ISSUED FOR CONSTRUCTION
DRAWING REVISIONS					

ORIGINAL

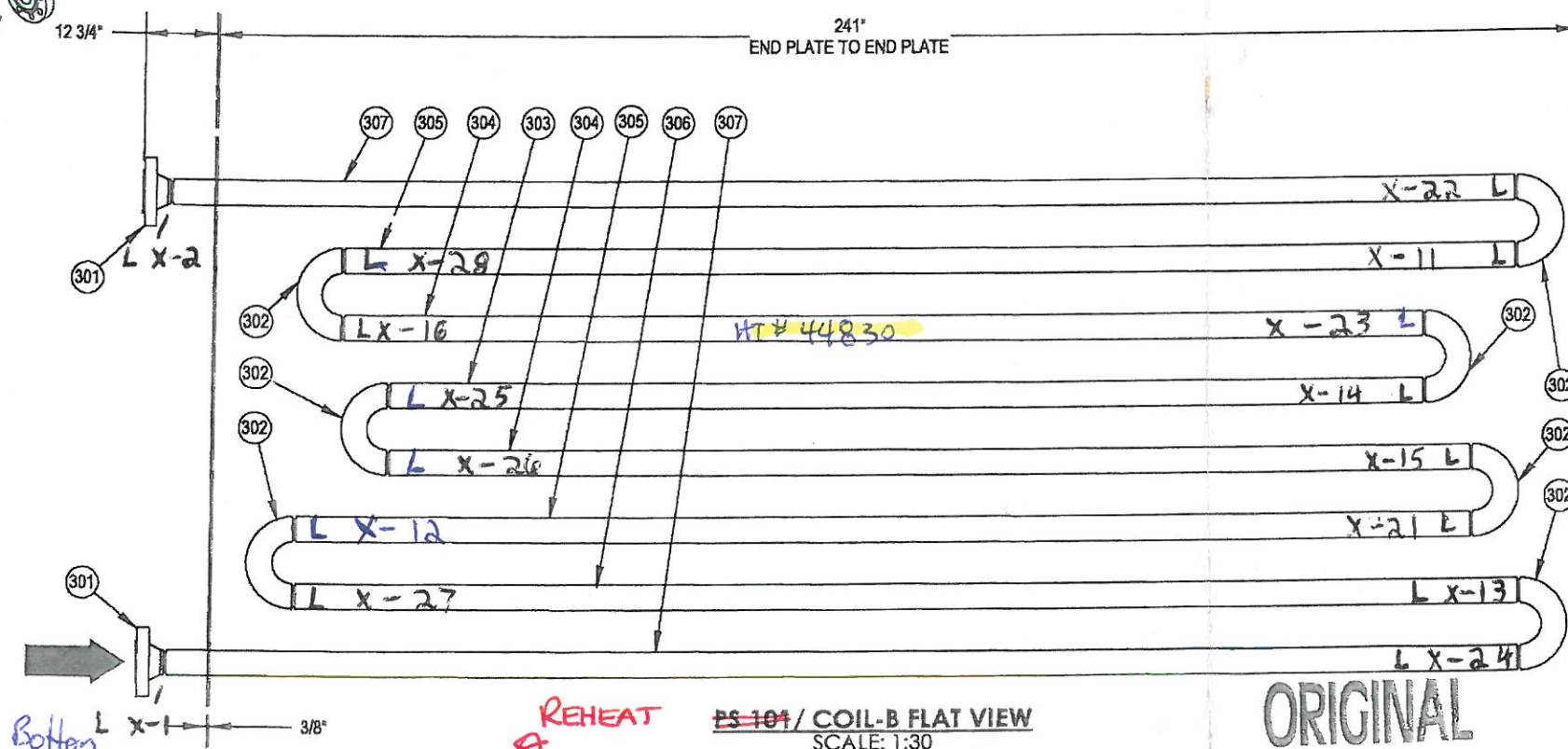
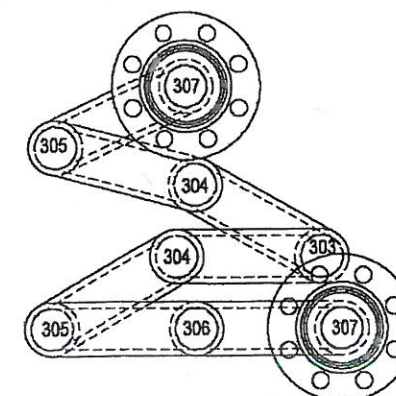
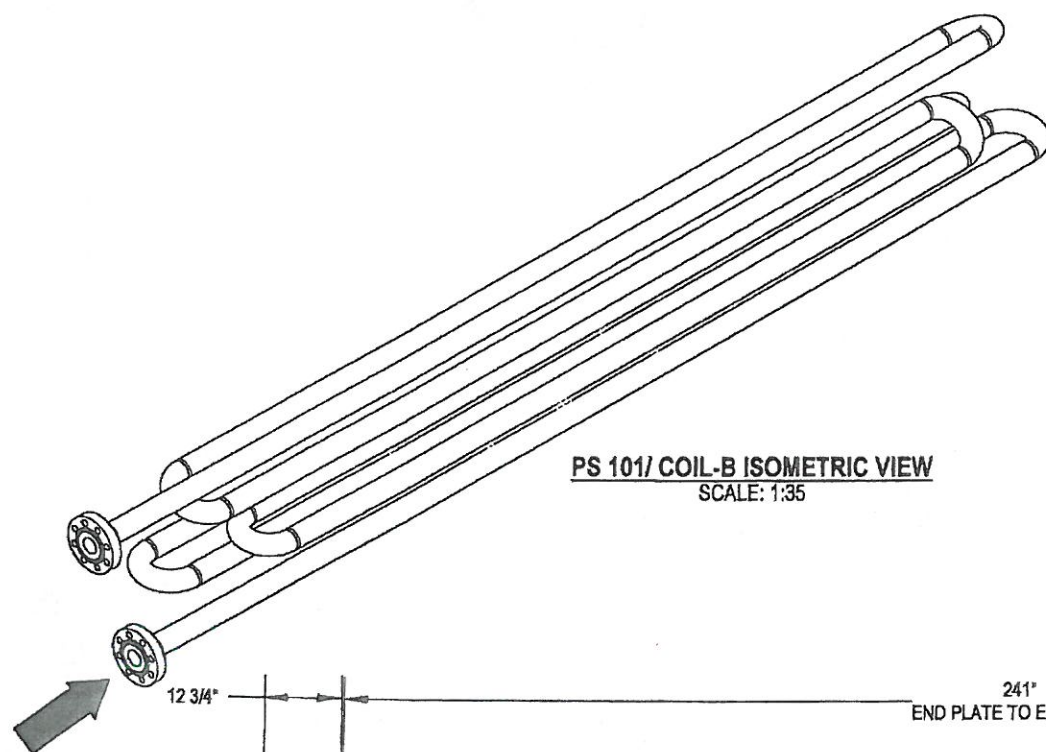
ISSUED FOR CONSTRUCTION
 SIGNED: _____
 DATE: Nov. 21, 2016
 W.O.: 09961-001-A
 S/N: NWP-09961-001-A

NWP INDUSTRIES INC.
 Total oilfield supply.
 P.O. BOX 6280, INNISFAIL, AB T4G 1S9
 PH: (403) 227-4100 FAX: (403) 227-4102

NWP INDUSTRIES Baytex Energy Corp.
 4"-2500 ANSI RTJ (8 PASS) PRE-HEAT COIL
 4"-1500 ANSI RTJ (8 PASS) RE-HEAT COIL
 FOR 62" OD x 240"
 2.0MM BTU LINE HEATER
 PS-100/ COIL A DETAIL

DWN:	CT	CHK:	D	APP:	5
DATE:	MAY 18/14	DATE:	JUL 22 2014	DATE:	JUL 22 2014
SHEET:	2 OF 5	DWG:	LH2001-A0-000	REV:	0

ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY	MTR #
301	FRJWN4E160AL		Flange 4" 1500 ANSI S/160 RTJWN	SA350-LF2-CL1		2	0102450
302	ELBBW180L4160BL		RETURN 180 DEG 4" SCH 160 LR BW	SA420-WPL6		7	11601023
303	PIP4160B		PIPE 4" S/160 SA333-6		182 1/2"	1	1402466
304	PIP4160B		PIPE 4" S/160 SA333-6		190 3/4"	2	44830/1402466
305	PIP4160B		PIPE 4" S/160 SA333-6		207 1/4"	2	1402466
306	PIP4160B		PIPE 4" S/160 SA333-6		215 1/2"	1	1402466
307	PIP4160B		PIPE 4" S/160 SA333-6		237 5/8"	2	1402466



REHEAT PS-101 COIL B DESIGN DATA	
DESIGN AND FABRICATE TO:	ANSI / ASME B31.3 NFS 2012 EDITION
DESIGN PRESSURE:	3375 PSIG
MAX. DESIGN METAL TEMPERATURE:	200 °F
MIN. DESIGN METAL TEMPERATURE:	-20 °F
IMPACT TEST:	EXEMPT PER TABLE 323.2.2 COLUMN A
RADIOGRAPHY:	100%
OTHER NDE:	± 25°F LR Nov 29/16
POST WELD HEAT TREATMENT:	1150 °F TO 1175 °F ± 50 °F FOR 1 HOUR MIN.
HYDROSTATIC TEST PRESSURE:	5063 PSIG
CORROSION ALLOWANCE:	1/16"
PRE-HEAT:	50 °F
WEIGHT EMPTY:	3704 LBS
WEIGHT FULL:	4305 LBS
CAPACITY:	9.64 CU.FT.
SURFACE AREA:	174.7 SQ.FT.
QUALITY CONTROL PROGRAM:	AQP-1253
WELDING PROCEDURE REGISTRATION NO.:	18042
WELD PROCEDURES:	NWP-4 REV 1, NWP-8 REV 2 3 NOV 21 2016
SERVICE:	HYDROCARBONS
CRN NO.:	P-9417.213
DESIGN REGISTRATION DRAWINGS:	BDD-400A REV.1
REFERENCE CALCULATIONS:	BDD.400A REV.5

AS BUILT

LR Jan 17/17

ORIGINAL

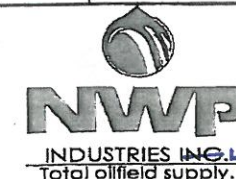
ISSUED
FOR
CONSTRUCTION

SIGNED

NOV. 21, 2016

09961-001-A

NWP-09961-001-A



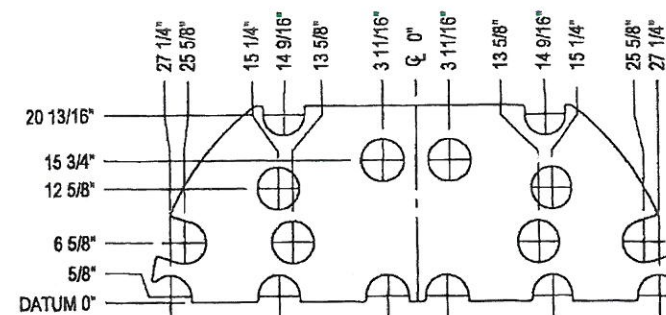
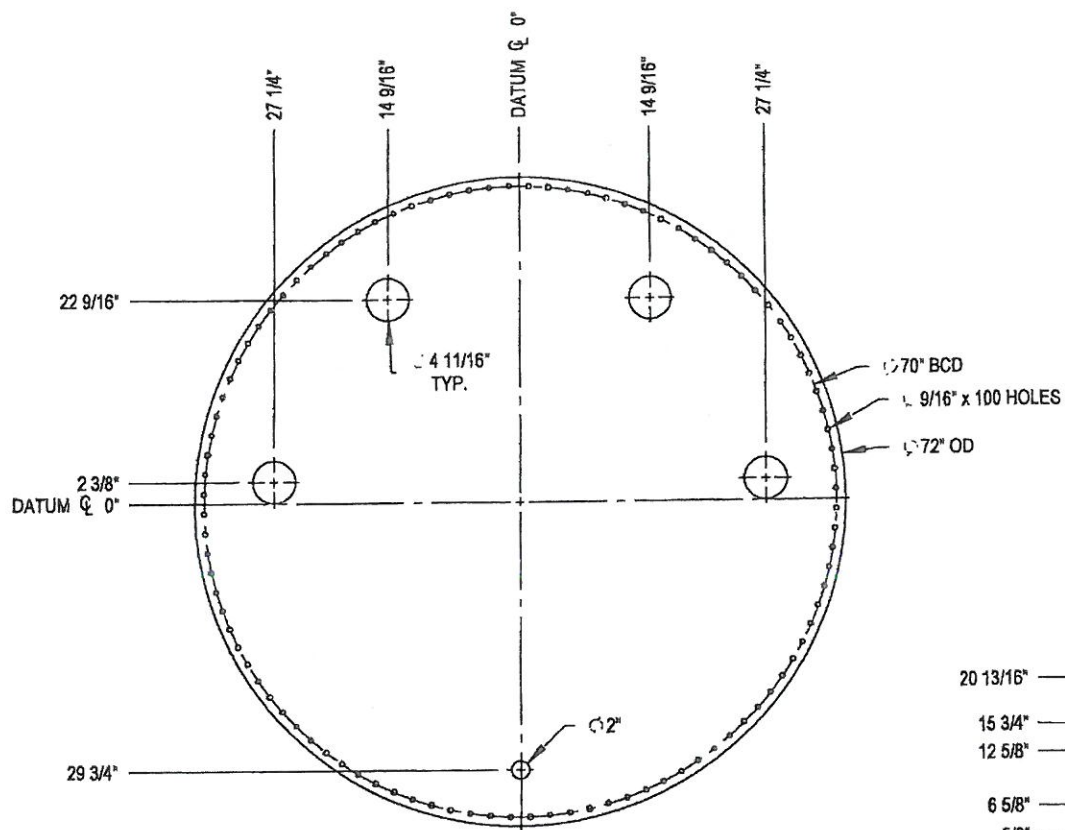
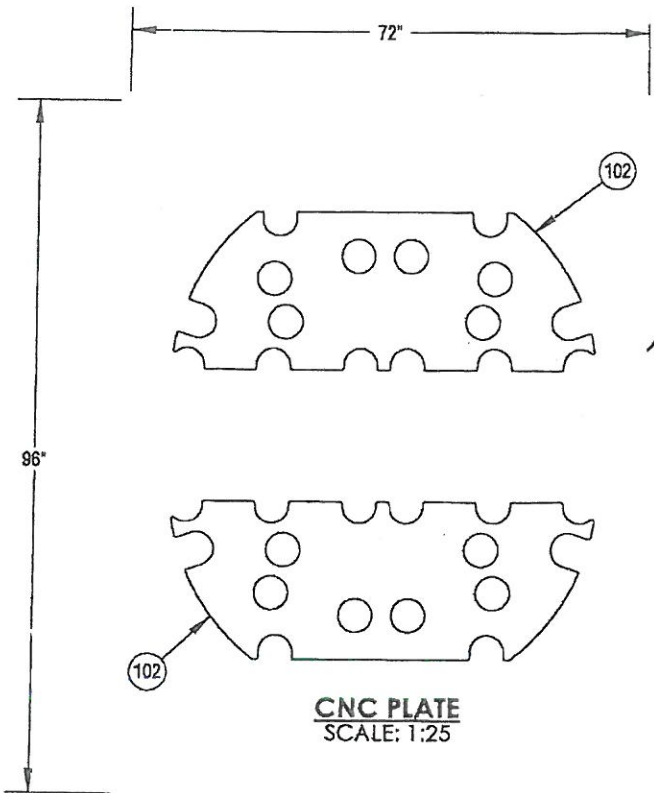
P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102



SCALE: AS NOTED
WEIGHT: (APPX 30 LBS)

NWP INDUSTRIES - Baytex Energy Corp.
4"-2500 ANSI RTJ (8 PASS) PRE-HEAT COIL
4"-1500 ANSI RTJ (8 PASS) RE-HEAT COIL
FOR 62" OD x 240"
2.0MM BTU LINE HEATER
PS-101/ COIL B DETAIL

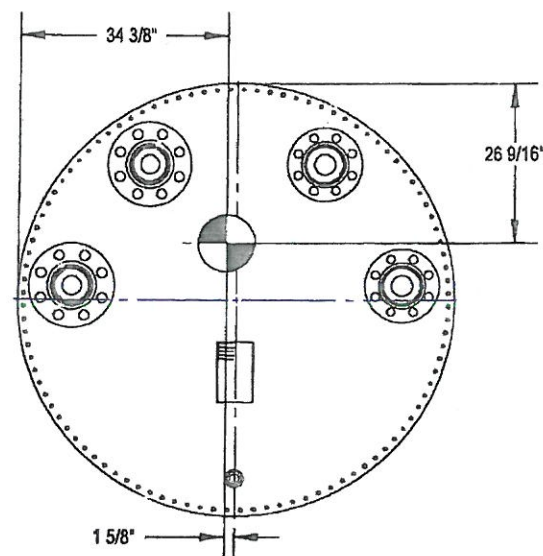
OWN:	CT	CHK:	APP:
DATE:	MAY 18/14	DATE:	JUL 22 2014
SHEET:	3 OF 5	DWG:	LH2001-A0-000
REV:	0		



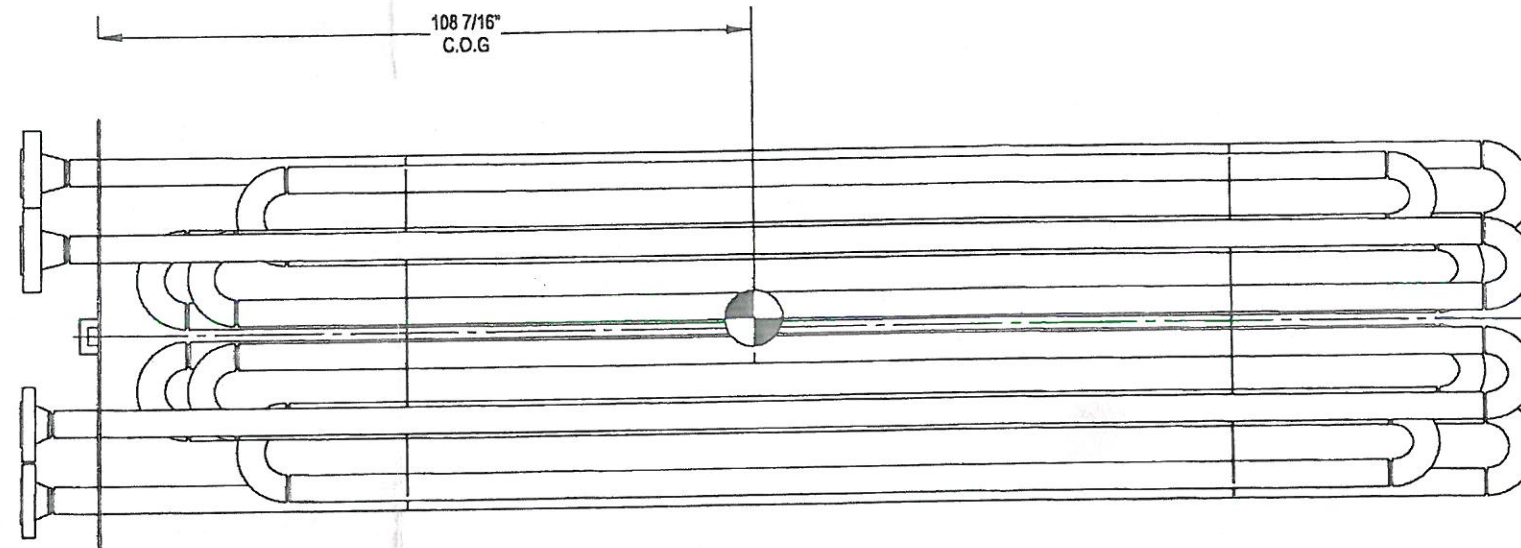
AS BUILT

ORIGINAL

0 JULY 21/14 EB <i>Q</i> <i>AS</i> ISSUED FOR CONSTRUCTION REV. DATE BY: CHK: APP: DESCRIPTION					ISSUED FOR CONSTRUCTION SIGNED: <i>Nov. 21, 2016</i> V. <i>09961-001-A</i> S. <i>NWP-09961-001-A</i>		 P.O. BOX 6280, INNISFAIR, AB T4G 1S9 PH: (403) 227-4100 FAX: (403) 227-4102		NWP INDUSTRIES <i>Baytex Energy Corp.</i> 4"-2500 ANSI RTJ (8 PASS) PRE-HEAT COIL 4"-1500 ANSI RTJ (8 PASS) RE-HEAT COIL FOR 62" OD x 240" 2.0MM BTU LINE HEATER CNC DETAIL					
DRAWING REVISIONS					ALL DIMENSIONS IN INCHES		PROJECTION: SCALE: AS NOTED WEIGHT: 122		DWN: CT DATE: MAY 18/14 SHEET: 4 OF 5		CHK: <i>Q</i> DATE: JUL 22 2014 DWG: LH2001-A0-000		APP: <i>8</i> DATE: JUL 22 2014 REV: 0	



FRONT VIEW
SCALE: 1:30



PLAN VIEW
SCALE: 1:30

AS BUILT

LR Jan 17/17

ORIGINAL

<table border="1"> <tr> <td>0</td> <td>JULY 21/14</td> <td>EB</td> <td>2</td> <td>4</td> <td>ISSUED FOR CONSTRUCTION</td> </tr> <tr> <td>REV.</td> <td>DATE</td> <td>BY:</td> <td>CHK:</td> <td>APP:</td> <td>DESCRIPTION</td> </tr> </table>					0	JULY 21/14	EB	2	4	ISSUED FOR CONSTRUCTION	REV.	DATE	BY:	CHK:	APP:	DESCRIPTION	ISSUED FOR CONSTRUCTION SIGNED: <i>[Signature]</i> DATE: Nov. 21, 2016 NO: 09961-001-A S/N: NWP-09961-001-A		 NWP INDUSTRIES INC. LP Total oilfield supply. P.O. BOX 6280, INNISFAIL, AB T4G 1S9 PH: (403) 227-4100 FAX: (403) 227-4102		NWP INDUSTRIES <i>Baytex Energy Corp.</i> 4"-2500 ANSI RTJ (8 PASS) PRE-HEAT COIL 4"-1500 ANSI RTJ (8 PASS) RE-HEAT COIL FOR 62" OD x 240" 2.0MM BTU LINE HEATER C.O.G DETAIL			
					0	JULY 21/14	EB	2	4	ISSUED FOR CONSTRUCTION														
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION																			
PROJECTION: SCALE: AS NOTED WEIGHT: (NOT TO SCALE)		DWN: CT DATE: MAY 18/14 SHEET: 5 OF 5		CHK: <i>[Signature]</i> DATE: JUL 22 2014 DWG: LH2001-A0-000		APP: <i>[Signature]</i> DATE: JUL 22 2014 REV: 0																		

MTR'S

(Material Test Reports)



SAN ENG STEEL FORGING CO., LTD.
311, Jen Hsin Road, Jen Wu District,
Kaohsiung, Taiwan, R.O.C.
TEL: 07-3724249, FAX: 07-3713507
URL: www.saneng.com.tw
e-mail: saneng@ksts.seed.net.tw

MILL TEST CERTIFICATE

EN10204-3.1.B(DIN50049/3.1.B)
Customer: TRANS AM PIPING PRODUCTS LTD.
Order No: 7009559(8)-7/A

Certificate No: SE 9582H
Date: 06/16/2015
Page: 1 OF 1

Conforms with ASME
Sec II, Part A 2015 Edition

now 18/16

PRODUCT			MATERIAL SPECIFICATIONS										DIMENSIONAL SPECIFICATIONS									
FORGED CARBON STEEL FLANGES			ASTM A-350 LF2-15 CL 1/ASME SA-350 LF2-15CL.1										ASME B16.5-13 CSA Z245.12									
Item No.	CODE NO.	DESCRIPTION	QUANTITY	CHEMICAL COMPOSITION (%)																		CE(*3)
				Min	C	Si	Mn	P	S	Cu	Cr	Ni	Mo	V	Nb	N						
1		300 WNRF STD 14" LF2	10 PCE	Max	0.300	0.150	0.600	0.035	0.040	0.400	0.300	0.400	0.120	0.080	0.020	-	-	-	-	-	-	0.414
2		300 WNRF S100(SC) 24" LF2	3 PCE		0.210	0.200	1.020	0.015	0.009	0.110	0.110	0.030	0.010	0.001	0.001	0.009						0.409
3		600 WNRTJ XS 4" LF2	5 PCE		0.200	0.190	1.030	0.011	0.008	0.120	0.110	0.040	0.020	0.001	0.001	0.008						0.409
4		600 WNRTJ S160 4" LF2	10 PCE		0.190	0.200	1.060	0.024	0.005	0.160	0.110	0.080	0.018	0.004	0.001	0.008						0.409
5		900 WNRTJ XS 3" LF2	50 PCE		0.190	0.200	1.060	0.015	0.005	0.110	0.010	0.050	0.017	0.009	0.001	0.009						0.385
6		1500 WNRTJ XXS(SC) 4" LF2	15 PCE		0.200	0.210	1.030	0.019	0.004	0.190	0.090	0.080	0.015	0.003	0.001	0.009						0.411
7		2500 BLRTJ 12" LF2	3 PCE		0.200	0.180	1.020	0.012	0.009	0.110	0.120	0.040	0.020	0.001	0.001	0.008						0.408

Item No.	Heat No.	T.S. (*1) (MPA)	Y.S. (*1) (MPA)	E.L. (*1) (%)	Hardness (HB)	R.A. (*1) (%)	Impact Test Temp: -46°C Minimum: 20.0 Joule			Material Supplier	HEAT TREATMENT (*2)	
							1	2	3		<input checked="" type="checkbox"/> N	REMARKS
1	Y401775	525.0	376.0	36.4	153/151	69.5	49.0	70.0	34.0	KOTOBUKI		890°CX4HRS
2	Y402260	512.0	380.0	34.0	152/150	70.4	47.0	91.0	68.0	KOTOBUKI		CONFORMS WITH NACE MRO103-12 AND NACE
3	0102451	531.0	376.0	35.8	154/152	70.4	59.0	82.0	94.0	WEI CHIH STEEL		MRO175/ISO15156.2-09 CLAUSE 7.2.1.4 REGION 3
4	0102451	531.0	376.0	35.8	154/152	70.4	59.0	82.0	94.0	WEI CHIH STEEL		AND ANNEX A.
5	94411	516.0	362.0	38.4	152/150	71.3	108.0	142.0	113.0	WEI CHIH STEEL		CONFORMS WITH Z245.12 CAT II GR248 SOUR
6	0102450	525.0	374.0	34.6	154/151	71.3	67.0	84.0	130.0	WEI CHIH STEEL		SERVICE-08 (FOR USE AS WELDING NECK AND
7	Y402257	524.0	356.0	33.0	153/151	69.5	51.0	63.0	115.0	KOTOBUKI		BLIND FLANGES ONLY)

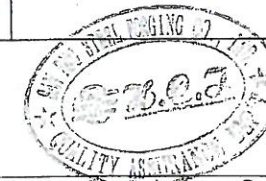
*1: T.S. = Tensile Strength, Y.S.=Yield Strength, E.L.=Elongation, R.A.=Reduction of Area.

*2: N=Normalized, A=Annealed, Q=Quenched, T=Tempered, S.T=Solution Treated, S.R=Stress Relieved, A.C=Air Cooled, F.C=Furnace Cooled, W.C=Water Cooled, O.C=Oil Cooled.

*3: C.E. Value = C + (Mn /6) + (Cr + Mo +V) / 5 + (Ni + Cu) / 15

We hereby certify that the material has been tested in accordance with the above specification and also with the requirements called for by the above order.

Manager of Quality Assurance Dept





ESSAR STEEL ALGOMA INC., 105 West Street, Sault Ste. Marie, Ontario, Canada P6A 7B4



63A022482

STEEL

SO No./Item & Date: 8034955 000010 2015/08/17 Shipment No. & Date: 1200003822 2015/08/23 TC No., Date & Time: ESA-264396 2015/09/01 - 11:17:42

Sold to Customer Name and Address: ALBERTA INDUSTRIAL METALS, 78TH STREET 4821, RED DEER, Alberta, Canada Ship to Customer Name and Address: ALBERTA INDUSTRIAL METALS, 78TH STREET 4821, RED DEER, Alberta, Canada Customer PO NO./Item: M63027687 / 1

BOL NO.: 1200003822

Cust. Part No.: 41218

Carrier: CN (CAD FUNDS) - CN 622671

Customer Specification: HR STEEL PLATE Carbon Multi Cert CSA G40.21 38W (13) / CSA G40.21 44W (13) / ASTM A36 (14) / ASME SA36 (2013) As Rolled Sld Thickness Tol Structural Steel Top and Bottom Standard Surface Flatness 1/2 A6 Fine Grain Fully Killed

Supplementary Instructions: Test Cert 1:aperry@russeimetal.com

Insp TIR: Test Report As Per Spec

ESSAR STEEL ALGOMA INC. HEREBY CERTIFIES THAT THE MATERIAL HEREIN DESCRIBED WAS MADE AND TESTED IN ACCORDANCE WITH THE RULES OF THE SPECIFICATION SHOWN. ALL RESULTS ARE RETAINED IN ACCORDANCE WITH THE COMPANY'S STANDARD RECORD KEEPING PRACTICES. THIS MILL TEST REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL WITHOUT WRITTEN APPROVAL OF ESSAR STEEL ALGOMA INC. IF YOU RECEIVE THIS DOCUMENT AND ARE NOT THE INTENDED RECEIVER, PLEASE CALL (705)945-4095 FOR INSTRUCTIONS ON METHOD OF DISPOSAL OF DOCUMENT. THIS TEST REPORT HAS BEEN GENERATED BY A COMPUTERIZED SYSTEM AND IS VALID WITHOUT A PHYSICAL SIGNATURE.

MEETS EN 10204:2004 TYPE 3.1 ISO QUALITY AND ENVIRONMENTAL CERTIFICATES AVAILABLE AT WWW.ESSARSTEELALGOMA.COM

ALL HEATS FULLY KILLED. HEATS INDICATED WITH (*) FINE GRAINED. HEATS INDICATED WITH (+) Made in Canada for NAFTA duty preference and NAFTA marking purposes.

Dimensions (T x W x L)		Batch No.	Heat No-MS	Quantity	No. of Pcs	Dimensions (T x W x L)		Batch No.	Heat No-MS	Quantity	No. of Pcs				
0.3750 " x 96.000 " x 288.00 "		AS3513	0675B3-60	8,820 LB	3	0.3750 " x 96.000 " x 288.00 "		AS3514	0675B3-60	8,820 LB	3				
0.3750 " x 96.000 " x 288.00 "		AS3524A	0675B3-60	5,880 LB	2	0.3750 " x 96.000 " x 288.00 "		AS3524B	0675B3-60	5,880 LB	2				
CHEMICAL PROPERTIES															
Heat No. (wt%)	C	Mn	P	S	Si	Cr	NI	Cu	Mo	Al	Nb	V	B	TI	DO
0675B3* +	0.16	1.17	0.015	0.005	0.340	0.04	0.03	0.04	0.01	0.033	0.000	0.040	0.0003	0.002	0.38
MECHANICAL PROPERTIES															
Tensile Tests															
Heat No.	Batch No.	SRCE	LAB	GAUGE	COND	METH	DIR	LOC	YIELD(KSI)	TENSILE(KSI)	EL SCALE	ELONG(%)			
0675B3		166"	ALG	0.3750	AR	2	T	F	59.0	77.0	8"	22			
0675B3		166"	ALG	0.3750	AR	2	T	F	58.0	77.0	8"	25			

3/8" 96" x 84" SA36/44W HT 0675B3-60

CONFORMS WITH ASME
SEC. II PART A 2015 EDITION
APRIL 5 / 2016 JF.

KASHIF REHMAN
MANAGER METALLURGICAL SERVICES

WARNING THE TEST RESULTS AND VALUES REPORTED HEREIN INDICATE ONLY THAT THE MATERIAL TESTED FOR WHICH THIS CERTIFICATE IS ISSUED MEETS THE MINIMUM SPECIFIED YIELD STRENGTH AND (2) THE ANALYSIS AND PHYSICAL PROPERTIES OF SUCH STEEL ARE IN CONFORMANCE WITH THE REQUIREMENTS OF THE SPECIFICATION INDICATED. THE RESULTS OR VALUES REPORTED HEREIN CAN NOT BE USED TO QUALIFY THE STEEL FOR ANY SPECIFICATION OTHER THAN THE ONE INDICATED AND CAN NOT BE RELIED UPON FOR ANY PURPOSE (INCLUDING DESIGN OR CALCULATIONS) REPRESENTING THE ACTUAL STRENGTH OF SUCH STEEL.

TRANS-AM PIPING PRODUCTS LTD

INSPECTION CERTIFICATE

TO EN 10204 3.1

Thai Benkan Co., Ltd.

17/20, Sukhumvit 104, Bangkok, Thailand

Standard: ISO 9001:2015

Order No. C-11-317

(MILL TEST REPORTS)

14/02/2012

Certificate No. T-2012060196

E No	Specification for Material Made from Seamless Pipe		Specification for Inspection		Visual Examination	Dimensional Inspection											
MC-426	ASTM A420-10a/ ASME SA420-10 WPL6 <small>USA 245 11 01 24144 CAT 155 ANSINACE WR01/50X 15156-7 2008</small>		ASME B16.9-2007, B16.25-2007		Good	Good											
MFG No. (Heat Identification No.)	Product & Size		(T.D.)		Quantity	Hardness Actual Data											
11G01023	180 EL WPL6 4 S180					HB: 125-140											
Material Manufacturer		Material Heat No.															
		J1L3439															
Specification	Chemical Composition %													*2 Tension Test		Hardness Max 197 HB : GOOD	
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	Al	V	Nb	C.E	Y.S	T.S	E	Impact Test (J)
	X 100	X 100	X 100	X 1000	X 1000	X 100	X 100	X 100	X 100	X 1000	X 1000	X 1000	X 100	MPa		%	10 X 10 X 2V AT -45 °C
Min.		15	50											240	415	30	338
Max	30	40	135	35	40	40	40	30	12		80	20			585		336
	12	24	132	10	1	1	2	12	1		0	0	37	315	463	49	289
<p>AVERAGE: 321</p>																	

ORIGINAL

NORMALIZING 910 C X 0.5 HR. AIR COOLING

The fittings was manufactured, sampled, tested, and inspected in accordance with the specification, and was found to meet the requirements

Conforms with ASME
Sec II, Part A 2015 Edition

C.E. C Mn S Cr Mo V Nb Ni Cu TS

MAGNETIC PARTICLE EXAMINATION FOR TPI ONLY

We hereby certify that the product described herein has been manufactured in accordance with the specifications concerned and also with the purchaser's requirements and that the test results shown herein are correct.

*1: *2: Tensile strength, Yield strength, *3: T.S. Yield strength, T.S. Tensile strength, E. Elongation.
Percent (%).

Quality Assurance Manager

Thai Benkan Co., Ltd

NOV 18/16
[Signature]

4" SCH 160 SA333 HT 1402466
CE=.39 VT.499 Low

PG 1 of 1



YANGZHOU LONTRIN STEEL TUBE CO.,LTD.
MILL TEST CERTIFICATE (EN10204-3.1)

CUSTOMER: MAX METAL MATERIAL CO LIMITED

PRODUCT: SEAMLESS STEEL PIPES

SPEC: SMLS ASTM/ASME A/SA-333 GR 6 / NACE MR-01-75 ISO 15156

ISO. REGISTRATION NO: 44 100 072544

CONTRACT NO: I-14286

CERTIFICATE NUMBER: 14EX04222-1-02

TOTAL: 2 BUNDLES		26 PIECES		10374 KG		PACKING IN BUNDLES																																																																									
NO.	HEAT NO.	LOT NO.	STEEL GRADE	SIZE (IN)	PCS	WEIGHT KG	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	V	Cb	Mn/C	CE																																																												
1	1402466	14062B014	GR.6	4" SCH160(0.531") 114.3mmX13.49mm D.R/L B.B.E	26	10374	0.17	0.25	1.26	0.010	0.004	0.03	0.01	0.03	<0.001	<0.001	<0.001	7.41	0.39																																																												
<table border="1"> <thead> <tr> <th rowspan="3">NO.</th> <th colspan="5">MECHANICAL PROPERTIES</th> <th colspan="3">TECHNOLOGICAL PROPERTIES</th> <th rowspan="3">H.T ≥SS</th> <th colspan="2">NONDESTRUCTIVE TEST</th> <th colspan="2">SURFACE QUALITY</th> <th colspan="2">DIMENSION TOLERANCE</th> </tr> <tr> <th>ReL (MPa) YIELD STRENGTH</th> <th>Rm (MPa) TENSILE STRENGTH</th> <th>ELONGATION A%</th> <th>HARDNESS BHN</th> <th>IMPACT TEST 10*5*55mm L, -45°C.(J)</th> <th>FLATTENING TEST</th> <th>FLARING TEST</th> <th>BENDING</th> <th>ET</th> <th>UT</th> <th>IN</th> <th>OUT</th> <th>O.D.</th> <th>W.T.</th> </tr> <tr> <th>≥240</th> <th>≥415</th> <th>≥27</th> <th>≤200</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>372/368</td> <td>520/530</td> <td>44/42</td> <td>149/150</td> <td>82/55/56</td> <td>Satisfactory</td> <td>—</td> <td>—</td> <td>2800PSI</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> </tr> </tbody> </table>																				NO.	MECHANICAL PROPERTIES					TECHNOLOGICAL PROPERTIES			H.T ≥SS	NONDESTRUCTIVE TEST		SURFACE QUALITY		DIMENSION TOLERANCE		ReL (MPa) YIELD STRENGTH	Rm (MPa) TENSILE STRENGTH	ELONGATION A%	HARDNESS BHN	IMPACT TEST 10*5*55mm L, -45°C.(J)	FLATTENING TEST	FLARING TEST	BENDING	ET	UT	IN	OUT	O.D.	W.T.	≥240	≥415	≥27	≤200											1	372/368	520/530	44/42	149/150	82/55/56	Satisfactory	—	—	2800PSI	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
NO.	MECHANICAL PROPERTIES					TECHNOLOGICAL PROPERTIES			H.T ≥SS	NONDESTRUCTIVE TEST		SURFACE QUALITY		DIMENSION TOLERANCE																																																																	
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1	372/368	520/530	44/42	149/150	82/55/56	Satisfactory	—	—	2800PSI	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory																																																																

REMARKS: Delivery condition: Normalized.

MANAGING REPRESENTATIVE:

Mythor

STAMPER:



DATE:

July.11,2014

PO 731327
Conforms with ASME
Sec II, Part A 2015 Edition
Nov 18/16 JF

4th XXS SA333 HT 15-631104

LE = .38
VT 703 Low

Siam Steel Pipe Company Limited

SIAM STEEL PIPE COMPANY LIMITED

บริษัท สยาม สตีล ไพป์ จำกัด
MILL TEST CERTIFICATE

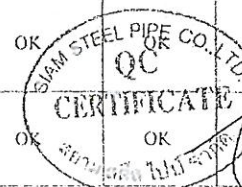
ใบรับประกันคุณภาพสินค้า
EN10204 3.1

P0731286 Pg 1 of 1
Conforms with ASME
Sec II, Part A 2015 Edition
Nov 10/16 JF
NO: SSP/QR 10-18

CONTRACT NO.	2015THWM128	PRODUCT	CARBON STEEL SEAMLESS PIPE					SPECIFICATION	ASTM/ASME A53-333 GR6	DELIVERY CONDITION	N	Forming Method	HOT ROLLING								
CUSTOMER	CCD STEEL TRADERS LTD								DATE OF ISSUE	28/12/2015	LICENCE	5L-0971		NO	0362						
NO	HEAT NO.	STEEL GRADE	SIZE	QUANTITY	LENGTH (M)	TENSILE TEST			Rys/ft	IMPACT TEST -45°C			Hardness								
				PIECES		Y.S MPa	T.S MPa	EL. %		Or.	SIZE (mm)	AKV(J)		BHN							
1	15-601101	GR.6	1"SCH160*6400	48	307.2	320	490	38		L	5*10*55	20/23/24	170								
2	15-601102	GR.6	2"SCH160*11800	30	354.0	320	460	33		L	5*10*55	34/36/37	160								
3	15-601103	GR.6	4"SCH80*9200	30	274.5	325	475	35		L	5*10*55	45/41/40	150								
4	15-601104	GR.6	4"XXH*9500	100	945.0	315	480	32		L	5*10*55	40/41/43	150								
5	15-601105	GR.6	4"XXH*12500	96	1200.0	325	480	34		L	5*10*55	44/45/43	160								
TOTAL				304	3080.7	/	/	/	/	/	/	/	/								
NO.	Analysis	CHEMICAL COMPOSITION (%)														NDT	STRAIGHTNESS	HYDROSTATIC PRESSURE (C=SS)	VISUAL TEST	Flattening	DIMENSIONS & WEIGHT TEST
		C	Si	Mn	P	S	Cr	Ni	Cu	Ti	Mo	V	Al	B	Nb						
1	HEAT	0.16	0.25	1.00	0.018	0.005	0.020	0.030	0.024	/	0.007	0.005	/	0.001	0.002	OK	OK	OK	OK	OK	OK
2	HEAT	0.16	0.27	0.98	0.019	0.007	0.020	0.030	0.025	/	0.008	0.004	/	0.001	0.002	OK	OK	OK	OK	OK	OK
3	HEAT	0.17	0.28	0.99	0.015	0.015	0.020	0.015	0.020	/	0.008	0.005	/	0.001	0.002	OK	OK	OK	OK	OK	OK
4	HEAT	0.20	0.25	1.01	0.018	0.021	0.050	0.018	0.025	/	0.007	0.004	/	0.001	0.002	OK	OK	OK	OK	OK	OK
5	HEAT	0.15	0.26	0.96	0.019	0.018	0.030	0.026	0.024	/	0.007	0.003	/	0.001	0.002	OK	OK	OK	OK	OK	OK
RESULT: ALL TEST RESULTS ABOVE COMPLY WITH THE REQUIREMENTS IN ASTM/ASME A/SA-333 GR 6. HARDNESS ACCORDING NACE MR-0175/ISO 15156-2. THIS IS CERTIFY THAT IN ACCORDANCE WITH THE RELEVANT SPECIFICATIONS AND CONTRACTS, THE STEEL PIPES WERE TESTED QUALIFIED BY OUR QUALITY CONTROL DEPARTMENT AND ARE IN ACCEPTANCE CONDITIONS. CERTIFY THAT GOODS ARE SUPPLIED AS PER THE PURCHASE ORDER AND SPECIFICATION REQUIREMENTS COUNTRY OF ORIGINAL THAILAND.																					

RESULT: ALL TEST RESULTS ABOVE COMPLY WITH THE REQUIREMENTS IN ASTM/ASME A/S A-333 GR 6. HARDNESS ACCORDING NACE MR-0175/ISO 15156-2. THIS IS CERTIFY THAT IN ACCORDANCE WITH THE RELEVANT SPECIFICATIONS AND CONTRACTS, THE STEEL PIPES WERE TESTED QUALIFIED BY OUR QUALITY CONTROL DEPARTMENT AND ARE IN ACCEPTANCE CONDITIONS CERTIFY THAT GOODS ARE SUPPLIED AS PER THE PURCHASE ORDER AND SPECIFICATION REQUIREMENTS COUNTRY OF ORIGINAL THAILAND.

Address: 210/17 Moo 12, Tungsukla, Sriracha, Chonburi, 20230, Thailand



CLIENTE / Customer / Client

CCTF CORPORATION (EDMONTON)
5407 - 53 AVENUE NW
EDMONTON, AB T6B 3G2
CANADA

CERTIFICADO DE INSPECCION

Inspection Certificate - Certificat de Réception

DIN EN 10204 / 3.1
ISO 10474 / 3.1



FECHA:
Date: 05/09/2014

N.º
No. 166706

HOJA:
Page: 2

SGI 1922164

SGI 6009236

SGI 6009587

ULMA FORJA, S.COOP.

Management Systems certified by LRQA

PRODUCTO
Article - Produit

FLANGES

SU PEDIDO N.º
Your Order No. 4810410-00/S759259986
Votre Cde. N.º

DE
of. - de 26/05/2014

Certified acc. PED 97/23/EC+AD2000-W0
by TÜV Rheinland
N.º 01 202 E/Q 02 7443

Bº Zubillaga, 3 - Apdo. 14
20560 ONATI (Gipuzkoa) SPAIN
Tel.: 34 - 943 780552
Fax: 34 - 943 781808
E-mail: ulma@ulmapiping.com

NORMAS APLICABLES
Requirements - Normes Applicables

ASME B16.5-13

MATERIAL CORRESPONDIENTE
Material Correspondent - Qualité

ASME SA350LF2CL1-13, ASTM A350LF2CL1-13

MODO DE FUSION (*)
Steel Making - Elaboration de l'acier
E = Elec Y = Origeno básico

NACE MR0175/ISO15156-2-09 & MR0103-12
Clause 7.2.1.4, Annex A.2 and SSC Region 3.
CSA-Z245.12-13 GR248 CAT II-SS (WN & BLIND FLANGES ONLY)

MARCA DEL FABRICANTE
Mark of factory
Marque du fabricant



Packing List: 111394

DEPARTAMENTO
Section
Département

QUALITY ASSURANCE

PARTIDA Item Poste	CANTIDAD Quantity Quantité	DESCRIPCION Description Description	LOTE	OBSERVACIONES Remarks Observations (*)	COLADA N.º Heat No N.º Coulée	RESISTENCIA T.Strength Resist Rupt N/mm2	LIMITE ELAST Y.Strength 0.2 % N/mm2	ALARGAM Elongation Allongement Lo: 4 d %	ESTRICCION Red. Area Striction %	RESILIENCIA Impact test Résilience Joules	CHARPY V 10x10mm MEDIA Average C	DUREZA Hardness Dureté HBW
138 17C10234	20	WN 10 150LB STD/40 RF A350LF2	22L14	NE	B1AV4	509	314	33,80	59,40	57	55	64
145 17C12070	10	WN 3 900LB XS/80 RF A350LF2	27F14M	NE	A26V4	518	304	25,50	59,10	62	51	68
146 17C10801	8	WN 4 2500LB XXS RTJ A350LF2	08J14	NE	176M2	534	377	26,50	54,80	73	82	82
146 17C10801	2	WN 4 2500LB XXS RTJ A350LF2	28F14	NE	176M2	523	376	30,50	52,60	73	84	80
171 17C12013	10	WN 3 900LB S160 RF A350LF2	603	NE	664V2	519	309	28,40	58,20	62	59	57
184 17C10759	5	WN 3 2500LB S160 RTJ A350LF2	16L14	NE	A55V4	513	314	29,80	60,00	51	56	65
193 17C12022	5	WN 6 900LB S160 RF A350LF2	26J14	NE	A26M4	509	373	36,90	60,80	62	72	76
197 17C16669	5	WN 6 900LB S120 RF A350LF2	26J14	NE	A26M4	509	373	36,90	60,80	62	72	76

COLADA N.º Heat No N.º Coulée	COMPOSICION QUIMICA - STEEL MAKER'S LADLE ANALYSIS - ANALYSE CHIMIQUE														
	C %	Si %	Mn %	P %	S %	Cr %	Ni %	Mo %	Nb %	V %	Cu %	Al %	Ti %	CEq %	
176M2	0,160	0,230	1,220	0,009	0,008	0,110	0,080	0,050	0,001	0,066	0,180	0,037	0,000	0,426	
664V2	0,200	0,200	0,940	0,015	0,007	0,060	0,110	0,020	0,000	0,004	0,328	0,024	0,000	0,403	
A26M4	0,165	0,223	1,210	0,008	0,003	0,045	0,046	0,008	0,002	0,067	0,044	0,025	0,002	0,397	
A26V4	0,200	0,170	0,980	0,020	0,003	0,040	0,070	0,013	0,004	0,009	0,200	0,025	0,000	0,394	
A55V4	0,190	0,200	1,040	0,009	0,004	0,060	0,060	0,010	0,005	0,002	0,160	0,035	0,000	0,392	
B1AV4	0,190	0,250	1,000	0,013	0,004	0,100	0,160	0,030	0,001	0,001	0,200	0,042	0,000	0,407	

- Las dimensiones y la condición superficial se hallaron satisfactorias.
- Dimension and surface condition were found acceptable.
- Les dimensions et états de surface sont satisfaisants.

- Los materiales citados cumplen las normas aplicables.
- Manufacturing requirements are satisfied.
- Les normes applicables sont respectées.

MATERIAL CONFORMS
TO CUSTOMER
SPECIFICATIONS
AS PER P.O.
REQUIREMENTS

EL INSPECTOR
Works Inspector - L'inspecteur
ULMA
ULMA FORJA S. COOP.
Dpto. de Garantía de calidad
Quality Assurance Dept.

(*) OBSERVACIONES:
Remarks
Observations

N_NORMALIZED AT 900 C AND ALLOWED TO COOL IN STILL AIR.

Conforms with ASME
Sec II Part A 2015 Edition
LR Jan.3, 2017

Name: Encana
Date: Feb.9/15

VT

531-555

147 4483c

COMP# 105448



INSPECTION CERTIFICATE

(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SIDERCA S.A.U.C.
Dr Jorge A. Simini / 250
(02804MHA) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer	COMCO PIPE & SUPPLY CO.	Expediente/ Manufacturing Order	5/784.08	Número / Number	595956	Fecha / Date	24/05/2014	Pág./Page	1 / 7
Producto / Product	CARBON STEEL FOR LOW TEMPERATURE SERVICE	Orden de Compra/ Purchase Order	EI-1847 y REV.1, 2 y 3	Item	00010	Referencia del Cliente / Customer Reference			

Norma / Standard	ASTM/A5333+CSA Z245.1-07 CATT SSPSP00374/1+NACE MR0175/03+IPRO L.P-006	Grado / Grade	1/6/359 CATT II SS	Extremos / Ends	BEVELLED AT 30 DEG. ASTM
Dimensiones / Dimensions	114.30 x 13.49 mm	Schedule	160	Peso Nominal / Nominal Weight	33.54 KG/MET
4 1/2 x	0.531 inches	Longitud / Length	22.51 LB/FT	Superficie / Surface	INT BARE /EXT VARINISHED
					72 Pz 842.66 m 28243 Kg
					72 Pcs 2794.63 Ft 62265 Lb

ENSAYOS DE TRACCION / TENSILE TEST

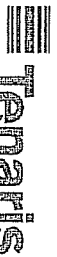
Cola da Ensayo	Condición de la probeta	Temp de Ensa	Dimensiones	Sección	Fuerza / Yield Strength										Rotura / U.T.S				Relación FR	Alargamiento Elongation				Red. de área	Dureza / Hardness Tipo / type: BHN	
					Offset Method		EUL Method								YS/UTS Ratio	Lo 2"	Req. Min	V. obt		Area Red.	Req. Min	V. Obt.	Req. Max			
					Req. Min	V. obt	EUL Req. Min	V. obt	Req. Max	Req. Min	V. obt	Req. Max	Req. Max													
Heat Test Nº	Zone	Estado	Ext.	Nº	Tipo	Temp	Size	Area																		
						°C	mm	mm2	Mpa		%				Mpa		Mpa									
44830	795171	C/B	PRO		ST	L	TaRT	24.64 X 13.47	338.14	0.5	359	404.6	✓	455	497.3	✓	625	0.93	0.81	50.9	35.0	40.0	✓	188		
44830	795173	C/B	PRO		ST	L	TaRT	24.81 X 12.93	324.14	0.5	359	403.8	✓	455	497.7	✓	625	0.93	0.81	50.6	35.0	37.3	✓	175		
44830	795176	C/B	PRO		ST	L	TaRT	24.64 X 13.69	343.69	0.5	359	404.7	✓	455	503.5	✓	625	0.93	0.80	50.8	35.0	38.7	✓	175		
44830	795180	C/B	PRO		ST	L	TaRT	24.82 X 13.00	326.04	0.5	359	393.7	✓	455	498.6	✓	625	0.93	0.79	50.8	35.0	40.4	✓	175		

Conforms with ASME Sec II,

PART A 2015 EDITION
DEC 15 / 2016 JF.

APPROVED
By Kasha at 11:11 am, Jul 11, 2014

TEST TECNOLÓGICO / TECHNOLOGICAL TEST										NOTA / NOTE:									
Apilamiento	Curvado	Abocinado	Pestariado	Ens. De anillo expandido	Ens. De Tracción de anillo														
Flareado	Bend test	Flaring test	Flange test	Ring expanding Test	Ring tensile Test														
Satisfact.	N/A	N/A	N/A	N/A	N/A														
Pro =	Procesos	PMHT =	Post Weld Heat Treatment	RE =	Rectangular														
N =	Normalizada	Normalized		CI =	Cilindrica/ Cylindrical														
DIST =	Distorsionada	Stress Relief		ST =	Segmento Tubular /														
Q & T =	Templeado y Revenido	Quenched & Tempered		TI =	Tubular segmen														
TART =	Temp. Ambiente	Room Temperature																	



INSPECTION CERTIFICATE

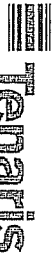
(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SIDERCA S.A.I.C.
Dr. Jorge A. Simini 250
(02304)H.A. Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer COMCO PIPE & SUPPLY CO.		Expediente/ Manufacturing Order 5/7784.08		Número / Number 595956		Fecha / Date 24/05/2011		Pág./Page 2 / 7	
Producto / Product CARBON STEEL FOR LOW TEMPERATURE SERVICE		Orden de Compra/ Purchase Order E1-1847 y REV.1, 2 y 3		Item 00010		Referencia del Cliente / Customer Reference			
Norma / Standard ASTM/A516/A516M CSA Z245.1-07 CATT SSPSP003741+NACE MR0175/0103+IPRO LP-006		Grado / Grade 1/6/359 CATT II SS		Extremos / Ends BEVELLED AT 30 DEG. ASTM					
Dimensiones / Dimensions 114.30 x 13.49 mm 4 1/2 x 0.531 inches		Peso Nominal / Nominal Weight 33.54 KG/MT 22.51 LB/FT		Longitud / Length MF 11800 mm		Superficie / Surface INT BARE /EXT VARNISHED		Cantidades / Quantities 72 Pz 842.66 m 28243 Kg 72 Pcs 2764.63 Ft 62266 Lb	

ENSAYOS QUIMICOS / CHEMICAL ANALYSES																					
		x 100										x 10000									
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		
C	SI	Mn	Cr	Mo	W	Co	P	S	Ni	V	Al	Sn	Cu	As	Nb	Ti	Pb	Sb	Co		
Heat	25	50	135				25	25	1000	110					110	110					
Heat	Min	10	40																		
Heat	Max	25	50	135			25	25	1000	110					110	110					
Ensayo	Prod	Max	25	50	135																
Test	Min	10	40																		
44830	Heat	25	50	135			25	25	1000	110					110	110					
(795171)	Prod	Max	25	50	135																
(795172)	Prod	Min	10	40																	
(795176)	Prod	Max	25	50	135																
(795180)	Prod	Min	10	40																	

NOTAS / NOTES:		H = Analisis de coque / Heat Analysis.		P = Analisis de producto / Product Analysis		Ce = Carbono Equivalente/Equivalent Carbon		R = Ratio		* = PPM / Part per million	
CEQ 1 =		C+Fe/(Mn/9)+(Si/23)+(Cu/15)+(Ni/20)+(Cr+Mo+V+Nb/5+(S/5))		CEQ 2 =		PCM =		R 1 =		R 2 =	
Sum 1 =				SUM 2 =				R 3 =		SUM 3 =	
R 1 =				R 2 =				R 3 =			



INSPECTION CERTIFICATE

(BS EN 10204 3.1: 2004 - ISO 10474 3.1B: 1991)

SIDERICA S.A.I.C.
Dr Jorge A. Simini 250
(02804MHA) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer	COMCO PIPE & SUPPLY CO.	Expediente/ Manufacturing Order	57884.08	Número / Number	595956	Fecha / Date	24/05/2011	Pág./Page	3 / 7
Producto / Product	CARBON STEEL FOR LOW TEMPERATURE SERVICE	Orden de Compra/ Purchase Order	EI-1847 y REV.1, 2 y 3	Item	00010	Referencia del Cliente / Customer Reference			
Norma / Standard	ASTM/A533+CSA Z245.1-07 CATT SSPSP00374/1+NACE MR0175/03+IPRO L.P-006	Grado / Grade	1/6/359 CAT II SS	Extremos / Ends	BEVELLED AT 30 DEG. ASTM				
Dimensiones / Dimensions	114.30 x 13.49 mm 4 1/2 x 0.531 inches	Schedule	160	Peso Nominal / Nominal Weight	33.54 KG/MT 22.51 LB/FT	Longitud / Length	MF 11800 mm	Superficie / Surface	INT BARE /EXT VARINISHED
				Quantities	72 Pz 72 Pcs		842.66 m 2764.63 Ft		28243 Kg 62265 Lb

ENSAYOS DE IMPACTO / IMPACT TEST

Colada Heat	Ensayo Test	Zona	Método	Entalla	Condición de la probeta / Specimen condition		Temper.		Energía Absorbida / Absorbed Energy			Área dúctil / Shear Area (%)			Expansión Lateral/Lateral Exp. (MM)		
					Orient.	Orient.	°C	T/E	Unit	Req.	P/A	Req.	P/A	Req.	P/A	Req.	P/A
					Size	mm				Min	P/A	Min	P/A	Min	P/A	Min	P/A
44830	795171	C/B	CHAPPY	V	10.00 x 10.00		T	-45	Joules	18	27	50.0	50.0	100.0	100.0	100.0	100.0
44830	795171	C/B	CHAPPY	V	10.00 x 10.00		L	-45	Joules	18	27	50.0	50.0	100.0	100.0	100.0	100.0

NOTE: Req = Requisitos / Requirements C/B = Cuerpo / Body RU = Recalque / Upset Orient = Orientación / Orientation V = Valor / Value P/A = Promedio / Average Min = Mínimo / Minimum T/E = Temp. Ens. / Test Temp.

CAU17505



INSPECTION CERTIFICATE

SIDERCA S.A.I.C.
Dr. Jorge A. Simini 250
(B2300AMHA) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer COMCO PIPE & SUPPLY CO.		Expediente/ Manufacturing Order 5/784.08		Número / Number 595956	Fecha / Date 24/05/2011	Pág./Page 4 / 7
Producto / Product CARBON STEEL FOR LOW TEMPERATURE SERVICE		Orden de Compra/ Purchase Order E1-1847 y REV.1, 2 y 3		Item 00010	Referencia del Cliente / Customer Reference	
Norma / Standard ASTM/A533+CSA Z245.1-07 CATTI SSPSP00374/1+NACE MR0175/0103+IPRO LP-006		Grado / Grade 1/8/359 CAT II SS		Extremos / Ends BEVELLED AT 30 DEG. ASTM		
Dimensiones / Dimensions 114.30 x 13.49 mm 4 1/2 x 0.531 inches		Peso Nominal / Nominal Weight 33.54 KG/MT 22.57 Lb/FT		Longitud / Length MIF 11800 mm INT BARE /EXT VARINISHED		
		Superficie Externa / External Surface		Cantidad / Quantities 72 Pz 842.66 m 28243 Kg 72 Pcs 2784.63 Ft 62265 Lb		

Valores Requeridos / Required Values	Individuales			Promedios			Tipo de dureza Hardness type
	Individuals			Average			
	Max	Min	Var	Max	Min	Var	
				248			

ENSAYO DE DUREZA/ HARDNESS TEST

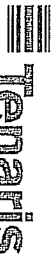
Cuadrante	Colada/ Heat	44830	Obtenidos/ Obtained					
	Ensayo/ Test	795171	Valor Individual/ Individual Value					
1	Tubo/ Pipe	5	1	2	3	4	Max	Min
	Extremo / End	E / B	176	174	174	175	176.0	174.8
	Diametro Ext/ External Diam.		157	159	158	156	159.0	157.5
	Centro/ Mid-wall		152	151	150	152	152.0	151.3
	Diametro Int/ Internal Diam.						150.0	151.3

Cuadrante	Colada/ Heat	44830	Obtenidos/ Obtained					
	Ensayo/ Test	795173	Valor Individual/ Individual Value					
1	Tubo/ Pipe	25	1	2	3	4	Max	Min
	Extremo / End	O / B	183	180	175	189	183.0	169.0
	Diametro Ext/ External Diam.		154	154	159	156	159.0	154.0
	Centro/ Mid-wall		142	148	145	142	148.0	144.3
	Diametro Int/ Internal Diam.						142.0	144.3

Cuadrante	Colada/ Heat	44830	Obtenidos/ Obtained					
	Ensayo/ Test	795176	Valor Individual/ Individual Value					
1	Tubo/ Pipe	45	1	2	3	4	Max	Min
	Extremo / End	E / B	165	162	166	165	166.0	162.0
	Diametro Ext/ External Diam.		148	155	155	152	155.0	148.0
	Centro/ Mid-wall		149	149	149	146	149.0	148.3
	Diametro Int/ Internal Diam.						146.0	148.3

Cuadrante	Colada/ Heat	44830	Obtenidos/ Obtained					
	Ensayo/ Test	795180	Valor Individual/ Individual Value					
1	Tubo/ Pipe	65	1	2	3	4	Max	Min
	Extremo / End	O / B	159	160	156	161	161.0	156.0
	Diametro Ext/ External Diam.		156	156	153	151	156.0	151.0
	Centro/ Mid-wall		143	143	143	141	143.0	141.0
	Diametro Int/ Internal Diam.						141.0	142.5

Ind = Individual Val. = Valor/ Value Min = Mínimo/ Minimum Max = Máximo/ Maximum P/A = Promedio/ Average Var = Variación/ Variation M = Medio/ Middle
E / B = Stencil starting - Comienzo marcado/ Cuerpo - Body O / B = Opposite extreme to E-Extremo opuesto al E/ Cuerpo - Body
E / U = Stencil starting - Comienzo marcado/ Recalque-Upset O / U = Opposite extreme to E-Extremo opuesto al E/ Recalque-Upset
E / VU = Vanishing upset - Desvanecimiento de rebalque/ Cuerpo - Body O / VU = Vanishing upset - Desvanecimiento de rebalque/ Recalque - Upset

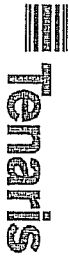


INSPECTION CERTIFICATE

SIDERCA S.A.L.C.
Dr Jorge A. Simini 250
(B2804MHA) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer COMCO PIPE & SUPPLY CO.		Expediente/ Manufacturing Order 5/7884.08		Número / Number 595956		Fecha / Date 24/05/2011		Pág./Page 5 / 7	
Producto / Product CARBON STEEL FOR LOW TEMPERATURE SERVICE		Orden de Compra/ Purchase Order E1-1847 y REV.1, 2 y 3		Item 00010		Referencia del Cliente / Customer Reference			
Norma / Standard ASTM/A533+CSA Z245-1-07 CATT SSPSP0037/1+NACE MR0175/0103+IPRO LP-006		Grado / Grade 1/6/359 CATT II SS		Extremo / Ends BEVELLED AT 30 DEG. ASTM					
Dimensiones / Dimensions 14.30 x 13.49 mm 4 1/2 x 0.531 inches		Peso Nominal / Nominal Weight 33.54 KG/MT 22.51 LB/FT		Longitud / Length MF 11800 mm		Superficie / Surface INT BARE /EXT VARNISHED		Cantidades / Quantities 72 Pz 842.66 m 20243 Kg 72 Pcs 2764.63 Ft 62266 Lb	
& = Monograma / Monogram SIDERCA MM.YY = Mes / Año Month / Year		NNNNN = Número de tubo / Nbr of pipe Y/T = Año / Trimestre Year / Quarter		Marcas / Marking LLL = Longitud / length HNXXXXX = Colada / Heat		PPP = Peso / Weight @ = Monograma / Monogram API			
Presión / Pressure		Tiempo / Time		Resultado / Results					
Unidad / Unit		Valor / Value		Segundos / Seconds		Satisfactorio / Satisfactory			
PSI		3000		5.00					
Estandar (Tubo) / Stencilling (Pipe) TENARIS SD MM.YY ASTM/A533+CSA Z245-1-07 SCH 160 1/6/359 CATT II SS HQ QT M45C LT-45C SEAMLESS 207KPAX 100 NDE CSA Z245-1-07 MADE IN ARGENTINA HNXXXXX NNNNN LLLL PPPP									
FABRICADO POR TENARIS SIDERCA		*MANUFACTURED BY TENARIS SIDERCA*							
PROCESO DE ACERACIÓN FABRICACIÓN DE ACERO: FUNDICIÓN POR ARCO ELÉCTRICO Y COLADO CONTINUO - ACERO CALMADO AL ALUMINIO. -LA PRACTICA DE AFINO EN EL HORNO - CUCHARA INCLUYE AGITACION POR ARGON Y UNA INYECCION FINAL DE UNA VARILLA DE SILICIOURO DE CALCIO PARA OBTENER UNA FORMA GLOBULAR DE EVENTUALES MICROINCLUSIONES. -MATERIAL LIBRE DE CONTAMINACIÓN DE MERCURIO.		*ACIERAGE PROCESS* STEEL MAKING PROCESS: E.A.F.L.F. AND CONTINUOUS CASTING - FULL ALUMINIUM KILLED AND FINE GRAIN PRACTICE. -THE LF PRACTICE INCLUDES ARGON RINSE AND A FINAL INJECTION OF CALCIUM SILICIDE WIRE FOR MICROINCLUSION SHAPE CONTROL. -MATERIAL FREE FROM MERCURY CONTAMINATION.							
PROCESO DE LAMINACIÓN -FABRICACIÓN DE TUBO: LAMINADO EN CALIENTE Y SIN COSTURA.		*ROLLING PROCESS* -MANUFACTURING PROCESS : SEAMLESS HOT ROLLED.							
CONTROLES -CONTROL VISUAL Y DIMENSIONAL: SATISFACTORIO.		*CONTROLS* -VISUAL AND DIMENSIONAL INSPECTION : SATISFACTORY.							
CONDICIONES DEL MATERIAL -NO REPARADO POR SOLDADURA.		*MATERIAL CONDITIONS* -NOT REPAIRED BY WELDING.							
-LA DUREZA CUMPLE CON LA NACE MR-01-75/ISO-15156-2		-HARDNESS ACCORDING TO NACE MR-01-75/ISO-15156-2							

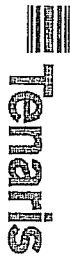
CAU 17505



INSPECTION CERTIFICATE

SIDERCA S.A.I.C.
Dr Jorge A. Sirtoli 250
B2804(Mrta) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

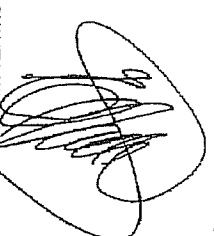
Cliente / Customer COMCO PIPE & SUPPLY CO.		Expediente/ Manufacturing Order 517884.08		Número / Number 595956	Fecha / Date 24/05/2011	Pág./Page 6 / 7
Producto / Product CARBON STEEL FOR LOW TEMPERATURE SERVICE		Orden de Compra/ Purchase Order E1-1847 y REV.1, 2 y 3		Item 00010	Referencia del Cliente / Customer Reference	
Norma / Standard ASTM/A533+CSA Z245.1-07 CATTI SSPSP0374/1+NACE MR0175/103+IPRO LP-006		Grado / Grade 1/6/359 CAT II SS		Extremo / Ends BEVELLED AT 30 DEG. ASTM		
Dimensiones / Dimensions 114.30 x 13.49 mm 4 1/2 x 0.531 inches		Peso Nominal / Nominal Weight 33.54 KG/MT 22.51 LB/FT	Longitud / Length M/F 11800 mm	Superficie / Surface INT BARE /EXT VARNISHED		Caridades / Quantities 72 Pz 842.66 m 72 Pcs 2764.63 Ft 28243 Kg 62265 Lb
-EL MATERIAL CUMPLE CON LOS REQUERIMIENTOS NACE MR-0103.		-MATERIAL COMPLIES WITH NACE MR 0103.				
NORMAS -EDICIÓN DE LA NORMA: ASTM A 333-10 -EDICIÓN DE LA NORMA: ASME SA 333/ 2007 -EDICIÓN DE LA NORMA: NACE MR 01-75 - ISO 15156-2 : 2003 - EDICIÓN DE LA NORMA: NACE MR-01-03 EDITION 2007 EDICIÓN DE LA NORMA : CSAZ245: 2007		*STANDARDS* -EDITION OF REGULATION: ASTM A 333-10 -EDITION REGULATION: ASME SA 333/ 2007 -EDITION OF REGULATION: NACE MR 01-75 - ISO 15156-2 : 2003 -EDITION OF REGULATION: NACE MR-01-03 EDITION 2007 -EDITION OF REGULATION : CSA Z245 : 2007				
Observaciones / Remarks NON DESTRUCTIVE TEST: SATISFACTORY. INSPECTION METHODS: U.T. LONG.(EXT.) NOTCH 5 % (INT.) NOTCH 10 % + TRANSV. (EXT./ INT.) NOTCH 10 % + M.P.L. LONG./TRANSV. (EXT./INT.) ON ENDS + W.M.P.L. ON BEVELS. UT 100% LAMINATIONS CONTROL: SATISFACTORY.						
ONE YELLOW BAND (RAL 1023) ON EACH END						
Tratamiento térmico (Tubo) Heat treatment (Pipe): Tipo / Type Temperatura / Temp QUENCHED 890°C TEMPERED 665°C		QUENCHED AND TEMPERED Rango / Range (°C) - 10 + 10 - 5 + 5		Duración / Duration 42 min 70 min		
Método de enfriamiento del tratamiento térmico (Tubos) / Quench media of heat treatment process (Pipes): Magnetismo remanente/Residual magnetism (max): 30 GAUSS		WATER				
Protectores / End Protectors: NON LIFTABLE CLOSED PLASTIC PROTECTOR FOR FLAT / BEVELED PIPE. SUPPLIER METALCENTRO.						



INSPECTION CERTIFICATE

SIDERCA S.A.I.C.
Dr Jorge A. Strilli 250
02804(MHA) Campana
Buenos Aires, Argentina
(54) 3489 433100 tel.
(54) 3489 433405 fax

Cliente / Customer COMCO PIPE & SUPPLY CO.				Expediente/ Manufacturing Order 5/7884.08		Número / Number 5995956		Fecha / Date 24/05/2011		Pág./Page 7 / 7	
Producto / Product CARBON STEEL FOR LOW TEMPERATURE SERVICE				Orden de Compra/ Purchase Order E1-1847 y REV.1, 2 y 3				Item 00010		Referencia del Cliente / Customer Reference	
Norma / Standard ASTM/A533+CSA Z245.1-07 CATTI SSPSP003741+NACE MR0175/0103+IPRO LP-006				Grado / Grade 1/8/359 CAT II SS				Extremo / Ends BEVELLED AT 30 DEG. ASTM			
Dimensiones / Dimensions 114.30 x 13.49 mm 4 1/2 x 0.531 inches		Schedule 160		Peso Nominal / Nominal Weight 33.54 KG/MT 22.51 LB/FT		Longitud / Length MMF 11800 mm		Superficie / Surface INT BARE /EXT VARNISHED		Cantidades / Quantities 72 Pz 842.66 m 28243 Kg 72 Pcs 2764.63 Ft 62265 Lb	

Por la presente certificamos que el material aquí descrito ha sido fabricado de acuerdo con las normas y especificaciones solicitadas en vuestra orden y satisfacen los correspondientes requerimientos.	We hereby certify that material herein described has been manufactured in accordance with the standards and specifications required in your order and satisfies the corresponding requirements.	 QUALITY CERTIFICATION DEPT. D.T.O. CERTIFICACION DE CALIDAD EDUARDO A. AYERBE
Este certificado se emite mediante un sistema computarizado y es válido con firma electrónica. El certificado original presenta el logo Tenaris (verde claro). Impreso en la parte inferior de la hoja. En caso que el poseedor del certificado entregue una copia del mismo, deberá garantizar la conformidad con el original, haciéndose responsable por cualquier uso ilegal o indebido. Cualquier alteración y/o falsificación estará sujeta a la ley. Si necesita asegurar la autenticidad de este certificado, contactarse con Siderca SAIC, e-mail: ay@siderca.com	This certificate is issued by a computerized system and it is valid with electronic signature. On the original certificate the trade-mark Tenaris light-green coloured at the bottom of the page is stamped. In case the owner of the certificate would release a copy of it, he must attest its conformity to the original one taking upon himself the responsibility for any unlawful or not allowed use. Any alteration and/or falsification will be subject to the law. If you need to assure the authenticity of this certificate, please do not hesitate to contact Siderca SAIC through this e-address: ay@siderca.com	

Test Certificate

Form TCI: Revision 1: Date 31 Oct 2000

Customer: VARSTEEL LTD. 330-220 4TH STREET LETHBRIDGE AB T1J4J7				Customer P.O. No.: RD-961707				Mill Order No.: 41-248313-02				Shipping Manifest : CT032724									
				Product Description: CSA G40.21(2004)44W/300W / ASTM A36(05) A709(01A)36/ASME SA36(01ED)								Ship Date: 12 Mar 13 Cert Date: 12 Mar 13				Cert No: 051064442 (Page 1 of 1)					
				Size: 0.250 X 48.00 X 96.00 (IN)																	
Tested Pieces				Tensiles								Charpy Impact Tests									
Heat Id	Piece Id	Piece Dimensions	Tst Loc	YS (PSI)	UTS (PSI)	%RA	Elong % 2in 8in	Tst Dir	Average Hardness	Abs. Energy(FTLB) 1 2 3 Avg				% Shear 1 2 3 Avg				Tst Tmp	Tst Dir	Tst Siz (mm)	BDWTT Tm %Shr
492475	A0148	0.245 X 48.00 (CUT)	L C	60000 64000	71000 75000		42 24 37 18	T T													
Heat Id	Chemical Analysis																ORGN				
	C	Mn	P	S	Si	Tot Al	Cu	Ni	Cr	Mo	Ch	V	Ti	B	N						
492475	.06	.77	.006	.008	.27	.032	.32	.16	.13	.08	.022	.001	.020	.0002	.0104		CAN				
<p>MERCURY IS NOT A METALLURGICAL COMPONENT OF THE STEEL AND NO MERCURY WAS INTENTIONALLY ADDED DURING THE MANUFACTURE OF THIS PRODUCT</p> <p>MATERIAL MARKED WITH AN ASTERISK IS PRODUCED FROM COIL</p> <p>* 492475 A0148 PCES: 10, WGT: 3267</p>																					
<div style="border: 2px solid red; padding: 10px; color: red;"> Conforms with ASME Sec II Part A , 2015 Edition LR June 15, 2016 </div>										MATERIAL CONFORMS TO CUSTOMER SPECIFICATIONS AS PER P.O. REQUIREMENTS											
										Name: _____ Date: <u>APR 01 2013</u>											
(u) Cust Part # :										WE HEREBY CERTIFY THAT THIS MATERIAL WAS TESTED IN ACCORDANCE WITH THE APPROPRIATE SPECIFICATION								Jason Wall CHECKED BY _____			

CLIENTE / Customer / Client
ALLIED FITTING CANADA
 172 TURBO DRIVE
 SHERWOOD PARK, ALBERTA
 T8H 2J6 - CANADA

CERTIFICADO DE INSPECCION

Inspection Certificate - Certificat de Réception

DIN EN 10204 / 3.1
 ISO 10074 / 3.1



ULMA
 ULMA FORJA, S.COOP.
 Bº Zabalgara, 3 - Apdo. 14
 20560 ORMAIZTEGUI (Gipuzkoa) SPAIN
 Tel.: 34 - 943 780552
 Fax: 34 - 943 781808
 E-mail: ulma@ulmapiping.com

PRODUCTO
 Article - Produit
FLANGES
 SU PEDIDO N.º
 Your Order No. **050112AES-EDMONTON**
 Vostro Cde. N.º

NORMAS APPLICABLES
 Requirements - Normes Applicables
ASME B16.05-09

MATERIAL CORRESPONDIENTE
 Material Correspondent - Qualifié
ASTM/AASME A5SA350LF2CL1-11 A5SA105N-11
 MODO DE FUSION (*)
 Welding Method - Elaboración de la Juntura
NACE MR0175/ISO15156-2-09 & MR0103-12
 Clause 7.2.1.4, Annex A.2 and SSC Region 3.
 CSA-Z245.12-09 Gr.248 CAT II-SS (WN & BLIND FLANGES ONLY)

DE
 of - de **02/05/2012**

Certified acc. PED 97/23/EC-AD2000-4/0
 by TDV Rheinland
 N.º 01 202 EQ 02 7443

MARCA DEL FABRICANTE
 Mark of factory
 Marque du fabricant



Packing List: 100837

DEPARTAMENTO
 Department
QUALITY ASSURANCE

PARTIDA Item Poste	CANTIDAD Quantity Quantité	DESCRIPCION Description	LOTE	OBSERVACIONES Remarks Observations (*)	COLADA N.º Heat No N.º Coudre	RESISTENCIA T. Strength Tensile Rupt N/mm²	LONGITUD L. Length Longueur mm	ALARGUE Elongation Le. 4 d %	ESTRICCION Red. Area Striction %	RESISTENCIA Impact test Resistance Joules	CHARPY V 10x10mm Average Moynne	TEMPERATURA T. Temperature Température °C	DUREZA Hardness Dureté HBW
31	60	WN 2 300LB STD 40 RF A350LF2	423	NE	659M2	537	374	25.40	54.00	91	100	94	155
34	144	WN 4 300LB STD 40 RF A350LF2	253	NE	659M2	519	365	32.70	65.00	76	86	80	149
63	10	WN 2 2500LB XXS RTJ A350LF2	1132	NE	204V2	524	335	27.20	56.10	59	53	61	159
63	40	WN 2 2500LB XXS RTJ A350LF2	423	NE	665V2	527	316	26.40	55.50	60	67	60	150
65	104	WN 4 2500LB XXS RTJ A350LF2	353	NE	545V2	519	312	27.40	56.60	66	69	66	151



MATERIAL CONFORMS
 TO CUSTOMER
 SPECIFICATIONS
 AS PER P.O.
 REQUIREMENTS

- Las dimensiones y la condición superficial se hallaron satisfactorias.
- Dimension and surface condition were found acceptable.
- Les dimensions et états de surface sont satisfaisants.
- Los materiales citados cumplen las normas aplicables.
- Manufacturing requirements are satisfied.
- Les normes applicables sont respectées.


EL INSPECTOR
 Works Inspector - L'inspecteur
ULMA FORJA, S.COOP.
 Dpto. de Garantía de calidad
 Quality Assurance Dept.

Conforms with ASME
Sec II, Part A 2015 Edition
Mar 10/16
KG

(*) OBSERVACIONES:
 Remarks
 Observations
N NORMALIZED AT 900 C AND ALLOWED TO COOL IN STILL AIR

 erne fittings gmbh A-6824 Schilfs Hauptstrasse 48 Austria/Europe Telefon +43/5524 501-0 Telefax +43/5524 501-930 Reg. No. 12 100 3034		Abnahmeprüfzeugnis Inspection Certificate EN 10204 - 3.1		Artikelbezeichnung [designation] elbows LR-180-S-WPL6-4"-XXS	
Kunde [customer] TRANS AM Piping Products Ltd. Attn: Svava 9335 Endeavor Drive S.E. CDN-T3S 0A1 Calgary, Alberta		Zeugnis Nr. [cert. no.] 046586/15-HG Rev.		Datum [date] 10/12/2015 Ident Nr. [ident no.]	
		Code-Nr. [code no.] 6T4J9 Unsere Auftrags-Nr./Art.Nr. [our order no./item no.] 173019PH-0130 / 133487 Ihre Bestell Nr. [your order no.] CI-15-400 Menge [quantity]		Anforderungen der Bestellung [requirements of the order] ASME B16.9-2012 LR WPL6/ASTM A 420/A 420M-13/ASME SA-420/SA-420M-13/NACE MR0175/ISO 15156-2:2009A.2/NACE MR0103-2012 2.1 and 4 Anal/Technol. req. acc. CANCSA Z245.11 Cat.2 Gr. 241, EN 10204/3.1/ASME B16.25-2012 Fig. 2(a), Millistandard, Dimensional report (16 points), M45C-SS, Seamless	
Vormaterial [base material] seamless pipe					
Analyse [analysis] Schmelze Nr. E Erschmelzungsart [melting process] 1 = Schmelzeanalyse [heat analysis] CEQ [CEQ]: C + (Mn / 6) + (Cr + Mo + V) / 5 + (Cu + Ni) / 15					
Index 591732 C 0.15 ✓ Si 0.27 ✓ Mn 0.87 ✓ P 0.008 ✓ S 0.003 ✓ Cr 0.13 ✓ Mo 0.05 ✓ Ni 0.11 ✓ Cu 0.20 ✓ V 0.002 ✓ Nb 0.001 ✓ Al 0.029 B 0.0004 Ti 0.002 N 0.0086 Ceq 0.35					
Mech.-technologische Prüfung [mech. technological test]					
Proben [test no.] IDM 530 L		Zugversuch [tensile test] Pr.-Lage [pos. of sample] Temp. +22 °C 417 ✓ Dehnggr. [yield str.] Rp 0.2 ✓ Zugfestigkeit [tensile str.] Rm (MPa) 535 ✓ Dehnung [elon- gation] A5 (%) 32 ✓ PR-Lage [pos. of sample] L		Kerbschlagbiegeversuch [notched bar impact test] Form: ISO-V Querschnitt [cross sec.] (mm²) 248-234-234 Kerbschlagarbeit [impact values] (J) 166-173 HB Härteprüfung [hardness test] Wärmebehandlung [heat treatment] quenched and tempered 940 °C / 640 °C 25 MIN, 60 MIN Cooling in water (in motion) / in still air	
Conforms with ASME Sec II, Part A 2015 Edition March 24/16 ER					
Kennzeichnung [marking]  AUSTRIA / A/ SA420 / WPL6 / 6T4J9 / 4" / XXS		Zusatzmarkierung [add. mark.] M45C-SS			
Besichtigung und Ausmessung [visual inspection and dimensional check] o.B./o.K.		Die gelieferten Produkte erfüllen die in der Bestellung festgelegten Anforderungen. [The products supplied are in compliance with the requirements of the order.] The products were manufactured, sampled, tested and inspected in accordance with the specifications and were found to meet the requirements.			
Bemerkungen [remarks] hot formed over mandrel This material meets the chem. & mech. requirements according to CSA Z245.11-13 Gr.241 Cat. II		Abnahmebeauftragter [inspection representative] 10/12/15 Grabherr Harald Dieses Dokument wurde elektronisch erstellt und ist ohne Unterschrift gültig. [The certificate is issued by the computerized system and is valid without signature.]			

Zertifiziert nach DGR 97/23/EG Anhang I - Absatz 4.3 durch TÜV SÜD Industrie Service, Benannte Stelle 0036, Zertifikat Nr. 12912002/MUC [Certified acc. to PED 97/23/EG Annex I, Paragraph 4.3 by TÜV SÜD Industrie Service, Notified Body 0036, Certificate No. 129/2002/MUC]


 I.M.L. - INDUSTRIA MECCANICA LIGURE S.P.A. Via Giancarlo Farina, 25 - 16030 Casarza Ligure - GE - ITALY Tel. +39 0185 467661 - Fax +39 0185 466510 - E-mail quality.imal@farinagroup.com MATERIAL TEST DEPARTMENT		COMPANY WITH QUALITY SYSTEM ISO 9001: 2008 CERTIFIED BY RINA CERT. N° 23/91/S																																											
INSPECTION CERTIFICATE EN 10204:2004 / 3.1		Nr ^{A03} 2015-C_IML-26191 Data / Dated 22.01.2015 Z02																																											
FORGED FLANGES & FITTINGS LTD CASTLE HOUSE, STATION RD NEW BARNET-EN5 1PE - UNITED KINGDOM		Ordine / PO 4128 Item 47 DDT / Delivery note 2015-2E301-0000081 Packing List Fattura / Invoice Nr. rif. / Our ref. 2014-2E201-0001580-0047																																											
Dest. D&D DIXY'S TRUCKING INC 901 77 AVENUE, NW T6P 1M8 EDMONTON, ALBERTA		CA																																											
Cod. colata Heat Code K470	Nr. colata Heat Nr 1376969	Quantita Quantity 1.005,00	Descrizione Description FITTING HALF COUPL THRD NPT 3M 2" A105N																																										
Mat. In acc. a / Mat. In acc. to B02 ASME SA ASTM A105-13 NACE MR 0175 - ISO 15156 Ed. 2009 / NACE MR 0103 Ed. 2012 P.E.D. 97/23/EC ANNEX 1 PAR. 4.3																																													
Ann. mat. / Mat. remarks B02 MATERIAL FULLY KILLED & FINE GRAIN PRACTICED																																													
<table border="1"> <thead> <tr> <th>Elementi / Elements</th> <th>C</th> <th>Si</th> <th>Mn</th> <th>S</th> <th>P</th> <th>Cr</th> <th>Ni</th> <th>Mo</th> <th>Ti</th> <th>Cu</th> <th>V</th> <th>Nb</th> <th>N</th> </tr> </thead> <tbody> <tr> <td>LADLE ANALYSIS</td> <td>0,190</td> <td>0,230</td> <td>0,880</td> <td>0,008</td> <td>0,011</td> <td>0,080</td> <td>0,040</td> <td>0,010</td> <td>0,021</td> <td>0,120</td> <td>0,003</td> <td>0,002</td> <td>0,000</td> </tr> <tr> <td>LADLE ANALYSIS</td> <td>0,025</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0,366</td> <td>0,337</td> <td>0,253</td> <td>0,090</td> <td>-</td> </tr> </tbody> </table>				Elementi / Elements	C	Si	Mn	S	P	Cr	Ni	Mo	Ti	Cu	V	Nb	N	LADLE ANALYSIS	0,190	0,230	0,880	0,008	0,011	0,080	0,040	0,010	0,021	0,120	0,003	0,002	0,000	LADLE ANALYSIS	0,025								0,366	0,337	0,253	0,090	-
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CE LF=C+Mn/8+(Cr+Mo+V)/5+(Ni+Cu)/15 CE SF=C+Mn/6 F1=Cu+Ni+Cr+Mo+V F2=Cr+Mo																																													
<table border="1"> <thead> <tr> <th>Provetta</th> <th>Forma</th> <th>Temperatura</th> <th>Snervamento</th> <th>Snervamento</th> <th>Rottura</th> <th>Allungamento</th> <th>Contrazione</th> </tr> <tr> <th>Test specimen</th> <th>Shape</th> <th>°C</th> <th>>0,2%</th> <th>>1,0%</th> <th>Tensile</th> <th>Elongation</th> <th>Reduction of area</th> </tr> <tr> <th>Sez/Sect mm2 L mm</th> <th>1=0-2=□</th> <th></th> <th>MPa</th> <th>MPa</th> <th>MPa</th> <th>%</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>122,65 50,00</td> <td>1 20</td> <td></td> <td>322,0</td> <td>-</td> <td>505,0</td> <td>32,8</td> <td>58,4</td> </tr> </tbody> </table>				Provetta	Forma	Temperatura	Snervamento	Snervamento	Rottura	Allungamento	Contrazione	Test specimen	Shape	°C	>0,2%	>1,0%	Tensile	Elongation	Reduction of area	Sez/Sect mm2 L mm	1=0-2=□		MPa	MPa	MPa	%	%	122,65 50,00	1 20		322,0	-	505,0	32,8	58,4										
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DUREZZA / HARDNESS HBW 171,0 - 176,0 Tipo/Type KV 10x10mm																																													
RESILIENZA / IMPACT TEST 1-Joule 2-Joule 3-Joule Media/Average -10 68 71 73 70,7																																													
Tratt. Term. / Heat treatment Normalized at 880°-920°C / Air Cool ELECTRIC FURNACE																																													
Dim In acc. a / Dim. acc. to B14 ASME B16.11 Ed.2011 - ASME B1.20.1 Ed.2013 - MSS SP25 Ed.2013																																													
Marcatura In acc. B06 Marking In acc. to		MSS SP25 Ed. 2013 Vis. & Dim. SATISFACTORY Origine Origin of Steel ITALY																																											

Note / Notes
 100% MANUFACTURED IN ITALY
 SUPPLIED MATERIAL MEETS SPECIFICATIONS AND P.O. REQUIREMENTS
 MATERIAL IS FREE FROM MERCURY CONTAMINATION & RADIATION

Conforms with ASME
 Sec II, Part A 2015 Edition

NOX. 30/16

VERIFIED TRUE COPY
 OF ORIGINAL
 FORGED FLANGES & FITTINGS
 LIMITED

UFFICIO CONTROLLO QUALITA' QUALITY CONTROL DEPARTMENT Boris Fizzotti - Q.C. Manager	ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY	MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL IML or 
--	---	--

Conform with ASME
Sec II, Part A 2015 Edition
Jan 27/16

KG

HT N30270

검사증명서

MILL TEST CERTIFICATE

HYUNDAI STEEL

당진제철소 : 충남 당진시 송악읍 북부산업로 1480
1480 Bukusarup-Ro, Songak-Eup, Daejeon-Si, Chungnam, Korea

주문번호
Order No. : E141000187

품명
Commodity : Hot Rolled Steel Plate

제품규격
Specification : CSA 44W/38W/ASTM A36

고객사
Customer : WILKINSON

주문자
Contractor : HYUNDAI CANADA INC.

증명서 번호
Certificate No. : 20141128-PS-034-011

발행일자
Date of Issue : 2015-01-16

Specification										인장시험 Tensile Test										화학성분 Chemical Composition(%)										단위 Unit 2 : x 100 3 : x 1,000 4 : x 10,000 5 : x 100,000				
제품치수 Dimension	수량 Quantity	중량 Weight (Kg.)	제강번호 Heat No.	제품번호 Product No.	Position	YS				EL (%)	RA (%)	YR (%)	YP Mid	D ₅ (mm)	C	S	Mn	P	S	Cr	N	B	Cu	Mo	Nb	Ti	V	Si	Al					
						YS	(N/mm ²)	YS	(N/mm ²)																									
																														YS	(N/mm ²)			
0.375" x 96" x 288"	1	1,333	N30270	FB12010705	T	331.3	505.3	27				U	L	1,835	152	1,054	124	33	2	1	3	17	0	35	0	1	1	17						
0.375" x 96" x 288"	1	1,333	N30270	FB12010706	T	331.3	505.3	27				U	C	1,764	154	1,072	125	33	2	1	3	17	0	35	0	1	1	17						
*** Sub Total(Q04) *** 35 46,655(Kg)																																		
*** Condition of supply : As-Rolled ***																																		
0.375" x 96" x 480"	1	2,222	N30274	FA50402401	T	436.2	537.8	21				U	L	1,750	180	1,063	116	29	2	1	4	15	0	32	0	2	1	29						
0.375" x 96" x 480"	1	2,222	N30270	FB11946501	T	344.9	506.7	27				U	C	1,674	189	1,030	145	30	2	1	3	14	0	35	0	1	1	33						
0.375" x 96" x 480"	1	2,222	N30270	FB11946501	T	344.9	506.7	27				U	C	1,835	152	1,054	124	33	2	1	3	17	0	35	0	1	1	21						
0.375" x 96" x 480"	1	2,222	N30270	FB11946501	T	344.9	506.7	27				U	C	1,764	154	1,072	125	33	2	1	3	16	0	35	0	1	1	17						
0.375" x 96" x 480"	1	2,222	N30270	FB11946502	T	344.9	506.7	27				U	C	1,835	152	1,054	124	33	2	1	3	16	0	35	0	1	1	21						
0.375" x 96" x 480"	1	2,222	N30270	FB11946503	T	344.9	506.7	27				U	C	1,764	154	1,072	125	33	2	1	3	16	0	35	0	1	1	17						
0.375" x 96" x 480"	1	2,222	N30270	FB11946503	T	344.9	506.7	27				U	C	1,835	152	1,054	124	33	2	1	3	17	0	35	0	1	1	21						

* Position - T: Top, M: Middle, B: Bottom
* Tensile test - Direction: Transverse, Gauge length: 200mm (Rectangular), YP Mid: 2 (0.2% off-set), 5 (0.5% underload), U (Upper yield point), L (Lower yield point)
* Division - C: Check analysis, L: Ladle analysis

NOTE

* Plate to meet material requirements of API 650 GR III 12th (12th Edition), killed & made to line grain practice.

WE HEREBY CERTIFY THAT THE MATERIAL HAS BEEN MADE AND TESTED IN ACCORDANCE WITH THE ABOVE SPECIFICATION AND THE REQUIREMENTS

Signature


S. B. Park

SURVEYOR TO: Chief Of Quality Assurance Team



본 검사증명서는 복사방지마크와 이차원 바코드 등 보안시스템이 탑재된 증명서로서, 불법적인 목적으로 위변조 시 사문서 위조 (형법231조)로 불이익을 당하실 수 있습니다.

Shell/Stack/Bath/Pre Heat (Shell Assembly) Documentation

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: FEB 12, 2014 Rev Status: 10.1		FORM-PRESSURE PIPING EXAMINATION CHECKLIST

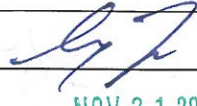
Page 1 of 1

EXHIBIT 21.2 PRESSURE PIPING EXAMINATION CHECKLIST


NOV 21 2016

Drawing No. / Revision No. LH2001-D0-100 Pre-Heat Line for 2.0MM Lineheater Pkg. WO#09961-001-D				
NO.	FUNCTION	HOLD	SIGNATURE OR INITIAL & DATE	
			QC INSPECTOR	OWNER'S INSPECTOR
1	DRAWINGS: ABSA registration over 0.5 Cu. M Approved by Owner, Approved for Construction (signed & dated)		NA	
2	Owner's Inspector Notified.		NA	
3	Registered Welding Procedures Specifications, Q.C Manual and Forms available at site, Job File started.		NA NOV 23 2016	
4	Welders qualified for WPS's and have valid Performance cards. Welders Log completed. WPS reviewed with Welders	✓	NA NOV 23 2016	
5	Material Checked against P.O., Drawings, and Specifications. Identification confirmed. Color Coding applied.	✓	NA Jan. 10/17	
6	Sample of each Welder's work examined, including root spacing, alignment, cleaning, joint preparation, preheat and electrode control.		NA Jan. 10/17	
7	Non-destructive Examination completed. Reports and radiographs reviewed, signed by Level II or III, Radiograph I.D. detailed on drawings.	✓	NA Jan 11/17	
8	Visual Examination of all completed welds, Welder's I.D. Stamped and recorded on drawings.		NA Jan. 10/17	
9	Heat Treatment verified and recorded on drawings.	N/A	NA	
10	Each system checked against specifications and drawings before test.		NA JAN 12 2017	
11	All deficiencies recorded and signed off by Q.C.I and Owner's Inspector before test. Pressure test examination guide completed.		NA JAN 12 2017	
12	Pressure Test checked. Gauge calibration verified, gauge #'s recorded	✓	NA JAN 12 2017	NA 01/14/17
13	Systems checked after Test. Deficiencies recorded and corrected.		NA JAN 12 2017	
14	Construction Data Reports (AB-83) prepared and signed by Q.C.I and Owner's Inspector.		NA	
15	Declaration form (AB-28) submitted to ABSA		NA	
16	As built drawings accepted by Owner		NA	

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: June 8, 2015		FORM-Bath & Expansion Tank Travel Sheet
Rev Status: 1.0		Page 1 of 1

Bath & Expansion Tank Travel Sheet		APPROVED BY: 				
		DATE: NOV 21 2016				
WO # 09961-001-D		DESCRIPTION: Bath & Expansion Tank for 2.0MM Lineheater Pkg.				
DRAWING # LH2001-D0-100						
	REQ	HOLD	EMPLOYEE INITIAL	DATE COMPLETE	QC INITIAL	DATE
Work Instructions/Drawings Issued	✓		BH 144	Jan 3/17	Jn	NOV 23 2016
Work Instructions/Drawings Reviewed	✓	✓	BH 144	"	Q	03/01/17
Material & Parts Released	✓	✓	BH 144	"	Q	1
Welding Personnel Assigned	✓	✓	BH 144	"	Q	✓
BATH:						
Long Seam Orientation	✓		063 144	Jan 3	Q	03/01/17
Flange: Fit-Up & 2 Hole	✓		063 144	"	Q	03/01/17
Pre-Cut Layout	✓		063 144	"	Q	05/01/17
Fit-Up Check	✓		063 144	Jan 4	Q	06/01/17
Pedestal Cross Square	✓		063 144	"	Q	05/01/17
Dimensional & Visual Inspection	✓	✓	063 144	"	Q	03/01/17
EXPANSION TANK:						
Layout / Indexing Check	✓		BH 063	Jan 3/17	Q	03/01/17
Fit-Up Check	✓		BH 063	"	Q	03/01/17
Dimensional & Visual Inspection	✓	✓	BH 063	"	BW	Jan 03/17
FINAL:						
Expansion Tank To Bath Fit-Up	✓		063	Jan 9	BW	Jan 09/17
Installation of All Welded Components	✓		063	Jan 9	BW	Jan 09/17
Final Dimension & Visual Inspection	✓	✓	063	Jan 9	BW	Jan 09/17
Pre-Heat , Hydro	✓	✓			Jn	Jan 12/17
Pneumatic Test	✓	✓	Q	JAN 13/17	Jn	Jan 13/17
ACCEPTED BY CUSTOMER:			DATE:			

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: June 8, 2015		FORM-Fire Tube & Stack Travel Sheet
Rev Status: 1.0		Page 1 of 1

Fire Tube & Stack Travel Sheet		APPROVED BY: 				
		DATE: NOV 21 2016				
WO # 09961-001-D		DESCRIPTION: Firetube & Stack for 2.0MM Lineheater Pkg.				
DRAWING # LHLH2001-D0-300 Rev 0						
	REQ	HOLD	EMPLOYEE INITIAL	DATE COMPLETE	QC INITIAL	DATE
Work Instructions/Drawings Issued	✓		BH 719	Jan 2/17	ja	NOV 23 2016
Work Instructions/Drawings Reviewed	✓	✓	BH 719	"		
Material & Parts Released	✓	✓	BH 719	"		
Welding Personnel Assigned	✓	✓	BH 719	"		
STACK:						
Pre-cut Layout Check	✓		BH	Jan 2/17	Q	02/01/17
Layout/Fit-Up/Flange	✓		BH	Jan 2/17	Q	02/01/17
Installation of All Welded Components	✓		BH	Jan 2/17	BW	Jan 03/17
Final Dimensional & Visual Inspection	✓		BH	Jan 2/17	BW	Jan 03/17
FIRE TUBE:						
Pre-Cut Layout Check	✓		719	Jan 4/17		
Internal Weld Check	✓	✓	719	Jan 9/17	BW	Jan 09/17
Layout/Fit-Up/Flange	✓		719	Jan 10/17	BW	Jan 10/17
Tube Sheet Fit-Up Check	✓		719	Jan 10/17		
Installation of All Welded Components	✓		719	Jan 11/17	BW	Jan 11/17
Final Dimensional & Visual Inspection	✓		719	Jan 11/17	BW	Jan 11/17
Pneumatic Test	✓	✓	Q	JAN 12/17	ja	Jan 12/17
Verify Tube blown out with compressor			719	Jan 11/17	BW	Jan 11/17
ACCEPTED BY CUSTOMER:			DATE:			


Issuing Authority: QA/QC Manager		Document Template 2013 Quality Control
Date of Issue: Jan 29 2015 Rev Status: 10.0		FORM-Hydrostatic test affidavit
		Page 1 of 1

EXHIBIT 16.2 HYDROSTATIC TEST AFFIDAVIT

Customer: <u>Baytex Energy Corp.</u>	JO# 09961-001-D
Project: <u>2.0mm line heater welded preheat line</u>	Project#
Test Pressure: <u>2160 PSI</u>	Hold Time: <u>15 minutes</u>
Code Requirements: <u>ASME B31.3 NFS 2014 edition</u>	
All Personnel Advised of Test <input checked="" type="checkbox"/> All Signs & Flagging Posted <input checked="" type="checkbox"/>	
Prior to Filling - Fitting/Hoses & Components Meet Required Test Pressure, Pressure, Test Examination Guide Completed	
Initials: Supervisor: <u>[Signature]</u> Tester: <u>[Signature]</u>	Date: <u>12/01/2017</u>

Product Description:

1. FG-1"-X-160C-0701 = 2160 PSI

50% Test Pressure Leak/Systems Check Completed ☒

1. 50% = 1080 PSI

Test Temperature: _____ °F

Equipment Drained & Flushed to Prevent Freezing: Yes: ☐ No: ☐


See NWP Procedure for Draining Water from Hydro Tested Vessel Package

Start Time:	Finish Time:
<u>1:00 pm</u>	<u>1:30 pm</u>

Test Gauge Identification #	Pressure Range	Calibration Date
NWPG- 5000 - <u>13</u>	0-5000 PSI	<u>June 6/2017</u>
NWPG- 5000 - <u>18</u>	0-5000 PSI	<u>June 28/2017</u>
NWPG-	PSI	
NWPG-	PSI	
NWPG-	PSI	

Test By: <u>[Signature]</u>	Date: 12/01/2017
NWP Representative: <u>[Signature]</u>	Date: 12/01/2017
Customer Representative: <u>[Signature]</u>	Date: 12/01/2017

Cert # 000276

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Feb 18, 2015 Rev Status: 1.0		FORM- Pneumatic Test Affidavit

Page 1 of 1

PNEUMATIC TEST AFFIDAVIT

Customer: Baytex Energy
 Project: Shell Assembly
 Test Pressure: 24 oz
 Code Requirements: CSA W47.1 and W59. API 12F

WO# 09961-001-D
 Project# 2.0mm Lineheater
 Hold Time: AS REQUIRED
 Date: Jan 12, 2017

Product Description:

Tank Serial # DWG# LH2001-D0-100 REV# 0

Test- NO LEAKS (✓)

#1.All Welded and Bolted Connections

Repairs

Ground to sound metal by:	Repair preparation. QC witness by:
Reweld using E7018. QC:	Repaired by:
Procedure approved by QC:	Completed repair checked by QC:

Additional Comments

PSV Used:	Range:	Calibration Due:
<u>1409-48</u>	<u>28 oz</u>	<u>FEB 15.17</u>

Test #	Test By:	Q.C.	Date	Test Gauge ID.	Range	Calibration Due:
1	<u>(Signature)</u>	<u>(Signature)</u>	JAN 13 2017	NWPG- <u>126</u>	0-5 PSI	<u>FEB 23.17</u> <u>FEB 23.17</u>
Test(s) Approved By: Brian Weaver				Date: Jan 12, 2017		

Issuing Authority: QA/QC Manager

Date of Issue: Feb 17 2015
Rev Status: 10.1

Quality Control

FORM-N.D.E Requirements

Page 1 of 1

N.D.E Requirements

#1

Client: Baytex Energy

JO# 09961-001-D

Project: 2.0mm lineheater preheat line

Date: 05/01/2017

Welded Piping: ☐ Pressure Vessel: ☐ Tank: ☐ Coil: ☐ Threaded Piping: ☐ Other: ☐

<input type="checkbox"/> X-Ray	<input type="checkbox"/> 100%	<input checked="" type="checkbox"/> Client Specification 1.6mm min	<input type="checkbox"/> CSA W59 CL.11 (static)
<input checked="" type="checkbox"/> Gamma Ray	<input type="checkbox"/> Full	<input type="checkbox"/> ASME B31.3 NFS	<input type="checkbox"/> CSA W59 CL.12 (dynamic)
<input type="checkbox"/> Ultrasonics	<input type="checkbox"/> 20%	<input type="checkbox"/> ASME B31.3 S/C	<input type="checkbox"/> ASME Section VIII Div 1 Appendix 6 (MPI)
<input type="checkbox"/> Liquid Penetrant	<input type="checkbox"/> 15%	<input type="checkbox"/> ASME Section VIII-UW-11(a)	<input type="checkbox"/> ASME Section VIII-UW-53 Appendix 12(UT)
<input type="checkbox"/> Magnetic Particle	<input checked="" type="checkbox"/> 10%	<input type="checkbox"/> ASME Section VIII-UW-11(a)5(b)	SURFACE CONDITION:
<input type="checkbox"/> Black/ White <input type="checkbox"/> Wet Florescent			
<input type="checkbox"/> Hardness, Max 200 BHN	<input type="checkbox"/> Spot	<input type="checkbox"/> As-Welded/ Bare Metal	
	Other (define)		<input type="checkbox"/> After PWHT

General Instructions:

P1 Material

Welder ID 8

Shell-T=

Pipe-T= 1" SCH160

Total Welds 1 x GS, GS-1. Weld is flagged and labeled.

Coil/Vessel S/N

1483-663-573

IGS

GS-1 1" sch160 8

Please use wire type iQi

Please Note locations of all indications on films on reports

Please include O.F.D-S.O.D S.F.D on reports

Special Requirements:**Shots**

Buttweld Xray to be identified as X-#

Gap Shots to be identified as GS-#

Threaded Shots to be identified as XT-#

Identify on Envelope part of package being shot ie. Coil, Piping, ect.

Flashes must contain: Client, JO#, Xray number, Welder's ID Symbol, Date, NWP, Vessel or Coil SN#, Code and Client Spec if applicable

Mark all indicated repairs on the project with blue ribbon

NOTE:

Encana Spec for Vessels is Zero Elongated Indications in or alongside the root pass in Cat. A, B and C Welds

Encana Spec for Socket Welds-acceptance is minimum 1/16" gap

Shell Canada Spec for Socket Welds-acceptance is minimum 1/16" gap

HT is a 5 Point Traverse

Please specify surface condition for MPI

Prepared By: Jeremy Atkinson

Date: 05/01/2017



MISTRAS
CANADA INC.

6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Mistras Traveller #:
200B17-CA-0002

Client Name:
NWP Industries LP

Client Reference:
NWP Client: Baytex Energy , **Job:** 09961-001-D

Work Performed On:
Thursday, Jan 5, 2017

Locations(s) of Work:
Innisfail, AB

Technician:
Charles Lasouski RT2/PT2/MT2 CGSB#11295

Crew:
Curtis Eklund, Jonathan Hum

Unit #:
177

Work performed in:
AB

Exposure Device:
D8569

Daily work contract has been reviewed with client representative.

Ticket #: 1483-663-573

Client Name: NWP Industries LP

Work Performed On: Thursday, Jan 5, 2017

Client Reference: NWP Client: Baytex Energy , **Job:** 09961-001-D

Description	Units	Quantity
Radiography - 2 man unit - regular plus shift differential (shift beginning between 1:00pm and 6:00am)	hr	0.5
2.75 x 8.5 film-d5	ea	1
Mileage charge	shift	0.125
Environmental and licensing charges	hr/rt unit	0.5

This ticket is not an invoice. Pay upon receipt of invoice.

Charles Lasouski RT2/PT2/MT2 CGSB#11295
Ticket #: 1483-663-573

JAN 11 2017

Client representative



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Ticket #: 1483-663-573
Client Name: NWP Industries LP
Work Performed On: Thursday, Jan 5, 2017
Client Reference: NWP Client: Baytex Energy , Job: 09961-001-D

Radiography Inspection

Inspection Procedure: 200-NDT-RT01-Radiography Procedure & Technique (ASME V, Article 2) Rev 9
Code Acceptance Criteria: Client Information
Inspection Standard: ASME V, Article 2
Client Specification: 1.6mm minimum
Exposure Device: D8569
Radiation Source: Iridium 192
Focal Spot/Source Size: 3.1mm
Film: KODAK

Inspection description: 2.0mm lineheater preheat line
Location of work: Inntail, AB

Techniques Used



Seq #	Weld #	Location	Mat	Size	Thick	Welder	Tech	Shots	Film	#/Cass	OFD	SOD	Exp	View	Result	Remarks
1.	GS-1		CS	1"	Sch 160	8	RT8	1	T200/C4	1	1,800"	18"	DW	DW	accept	4mm

Accept: No rejectable indications apparent at time of inspection,
SZ: Size

Reject: See remarks for explanation,
SW: Single wall

Info Only: No code acceptance criteria applied,
WT: Wall thickness

Technical reports included in this ticket are an interpretation and do not constitute a guarantee of any kind.

Auditor

Charles Lasouski RT2/PT2/MT2 CGSB#11295

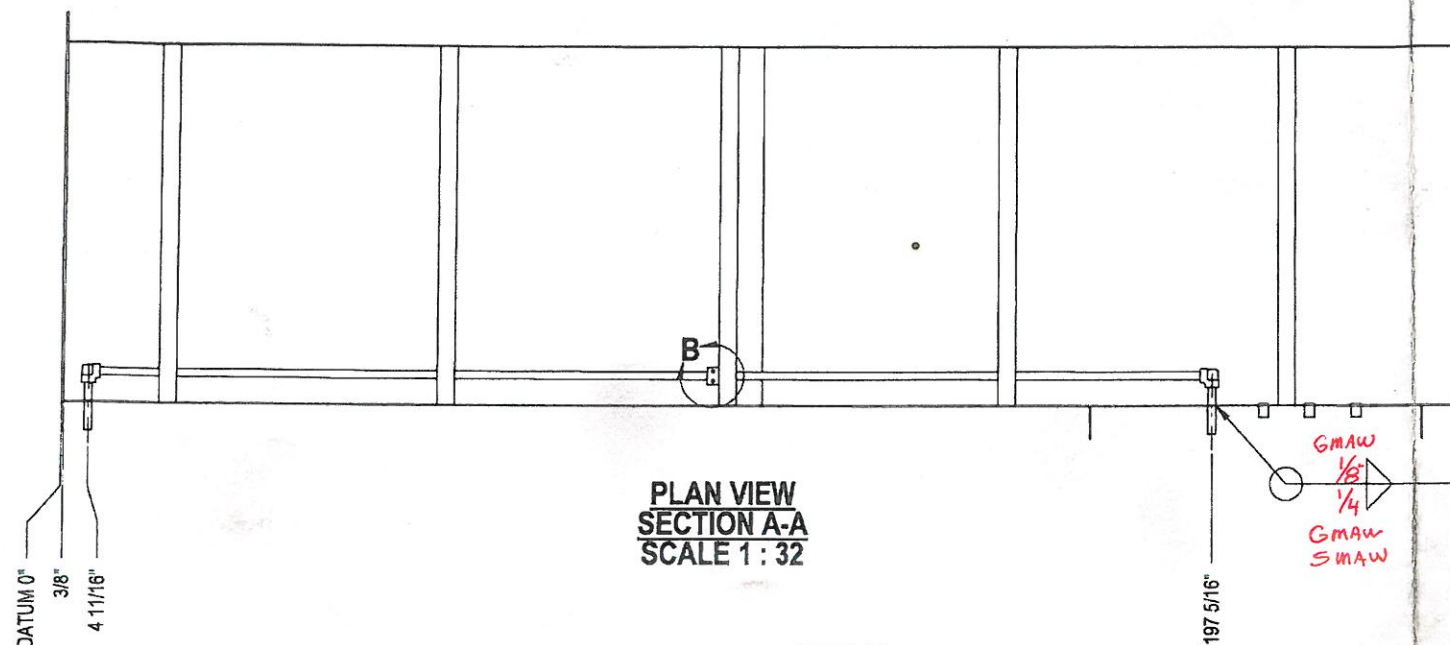
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Client representative

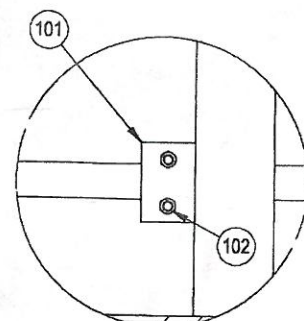
Page 2 of 2

JAN 11 2017

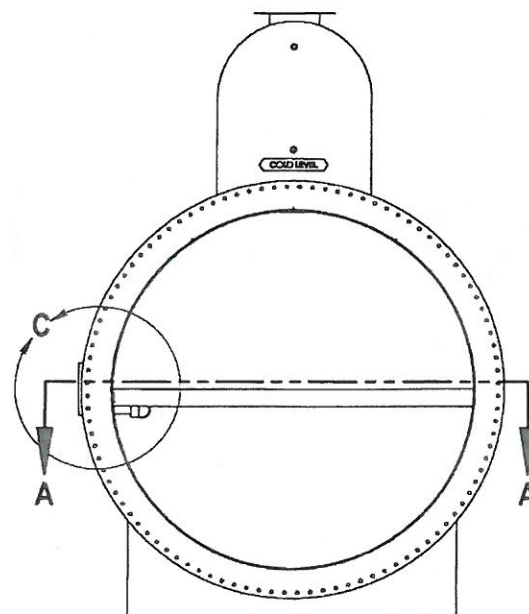
BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
101	SEE SHEET 4		2"x1/4" PLATE 3" LONG	G40.21-44W		1
102	UBO1.375		U-BOLT, 1" x 3/8" c/w 4 NUTS FIG 137	MILD STEEL		1
200		LH2001-D0-200	BATH WELDMENT: 62" OD x 10' LG x 1/4" THK	G40.21-44W		2



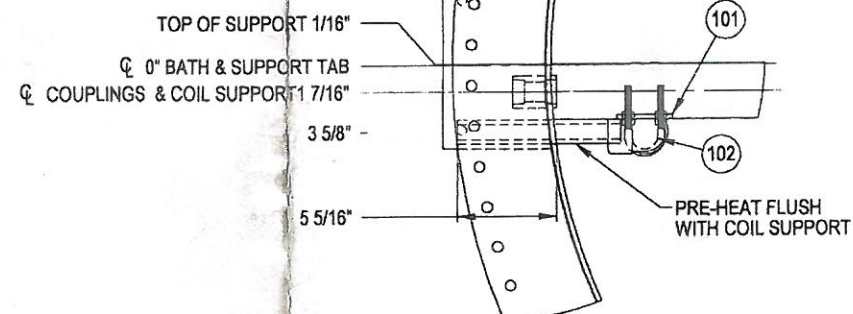
PLAN VIEW
SECTION A-A
SCALE 1:32



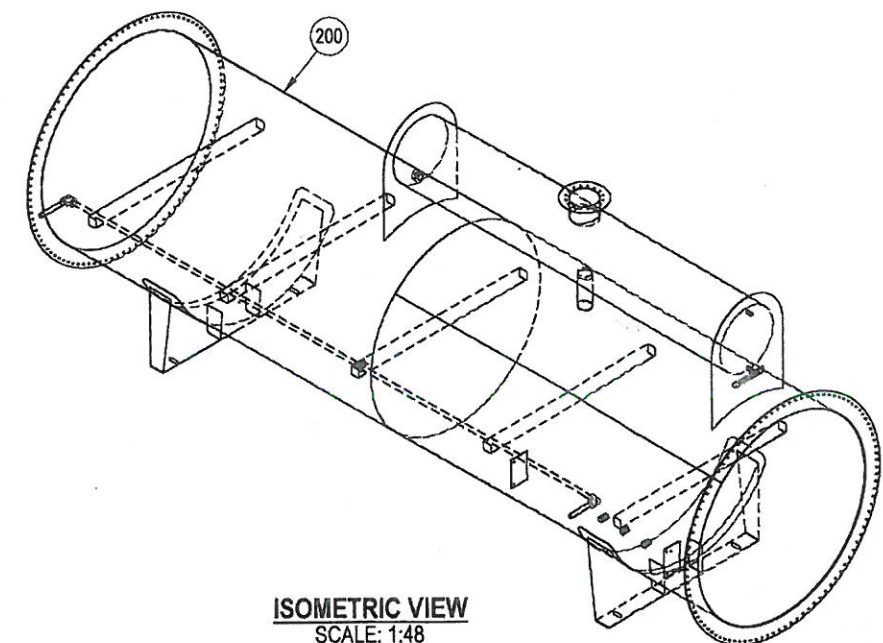
DETAIL B
SCALE 1:7



RIGHT VIEW
SCALE 1:32



DETAIL C
SCALE 1:10



ISOMETRIC VIEW
SCALE: 1:48

ORIGINAL

- NOTES**
1. FABRICATE TO CSA W47.1 AND W59.
 2. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
 3. DEBURR AND RADIUS ALL SHARP EDGES.
 4. WELD PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS-FC1-15, FC1-10.
 5. ALL WELDS TO BE $1/4"$ CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.

AS BUILT

0	JUNE 06/14	EB			ISSUED FOR CONSTRUCTION
A	MAY 30/14	CT			ISSUED FOR APPROVAL
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION

DRAWING REVISIONS

ISSUED FOR
CONSTRUCTION

SIGNED: *[Signature]*
DATE: Nov. 21, 2016
W.O. 09961-001-D

SM *[Signature]*
ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

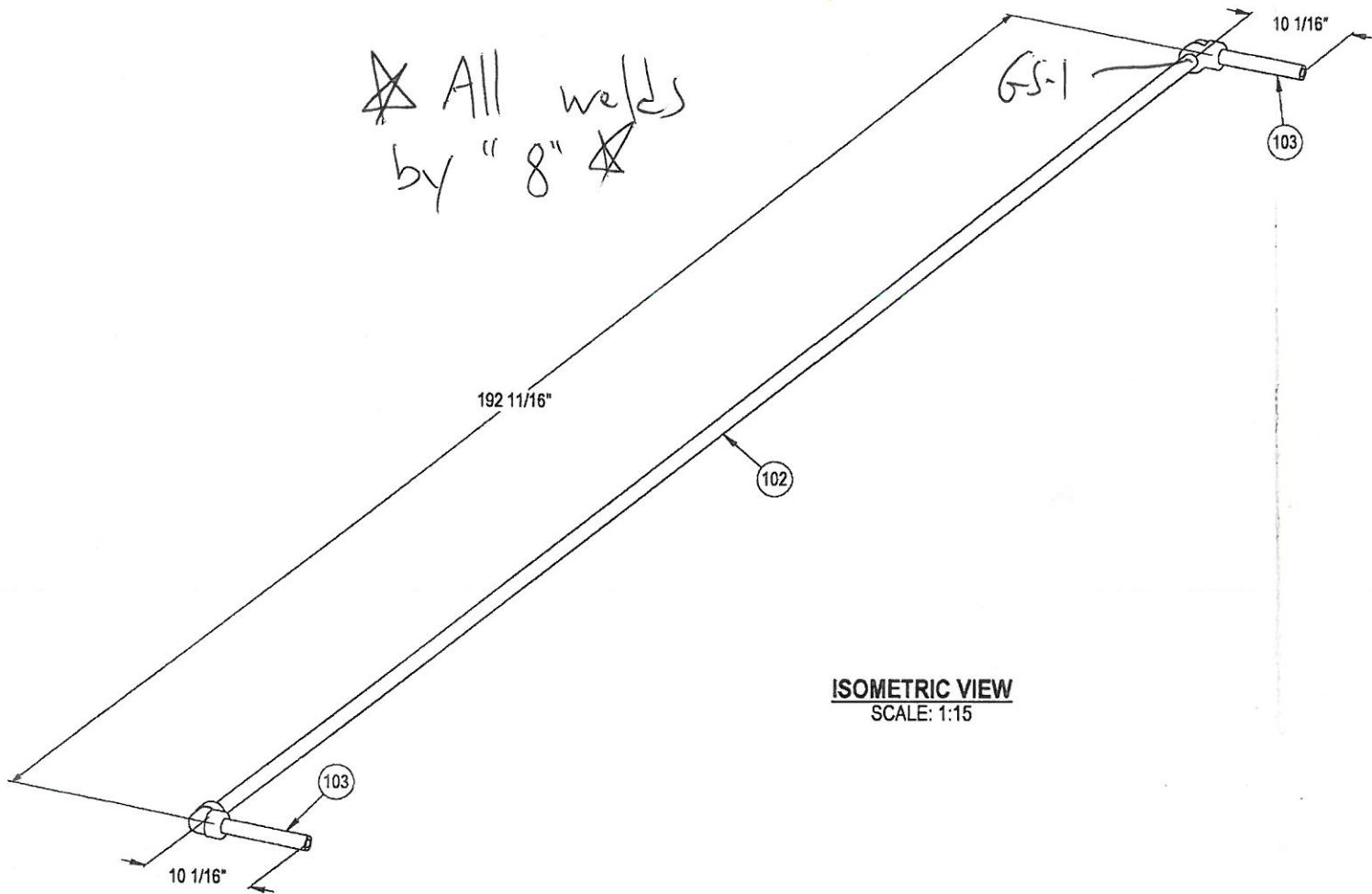
PROJECTION: *[Symbol]*
SCALE: AS NOTED
WEIGHT: APPROX LB.

NWP INDUSTRIES
LINEHEATER PACKAGES
2.0 MMBTU/HR
62" OD x 240' LONG

PRE-HEAT & SUPPORT LOCATIONS

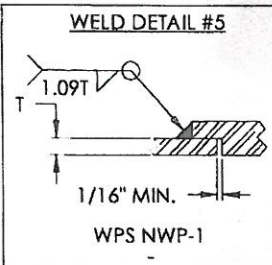
DWN:	CT	CHK:	<i>[Signature]</i>	APP:	<i>[Signature]</i>
DATE:	MAY 30/14	DATE:	JUL 31 2014	DATE:	JUL 31 2014
SHEET:	1 OF 2	DWG:	LH2001-D0-100	REV:	0

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
101	ELBSW901XA		ELBOW 90 DEG 1" 6M SW	SA-105N		2
102	PIP1160C		PIPE 1" SCH 160	SA-106B	190 7/16	1
103	PIP1160CL		PIPE 1" SCH 160 PE x NPT	SA-333-GR6 SMLS	8 3/4"	2





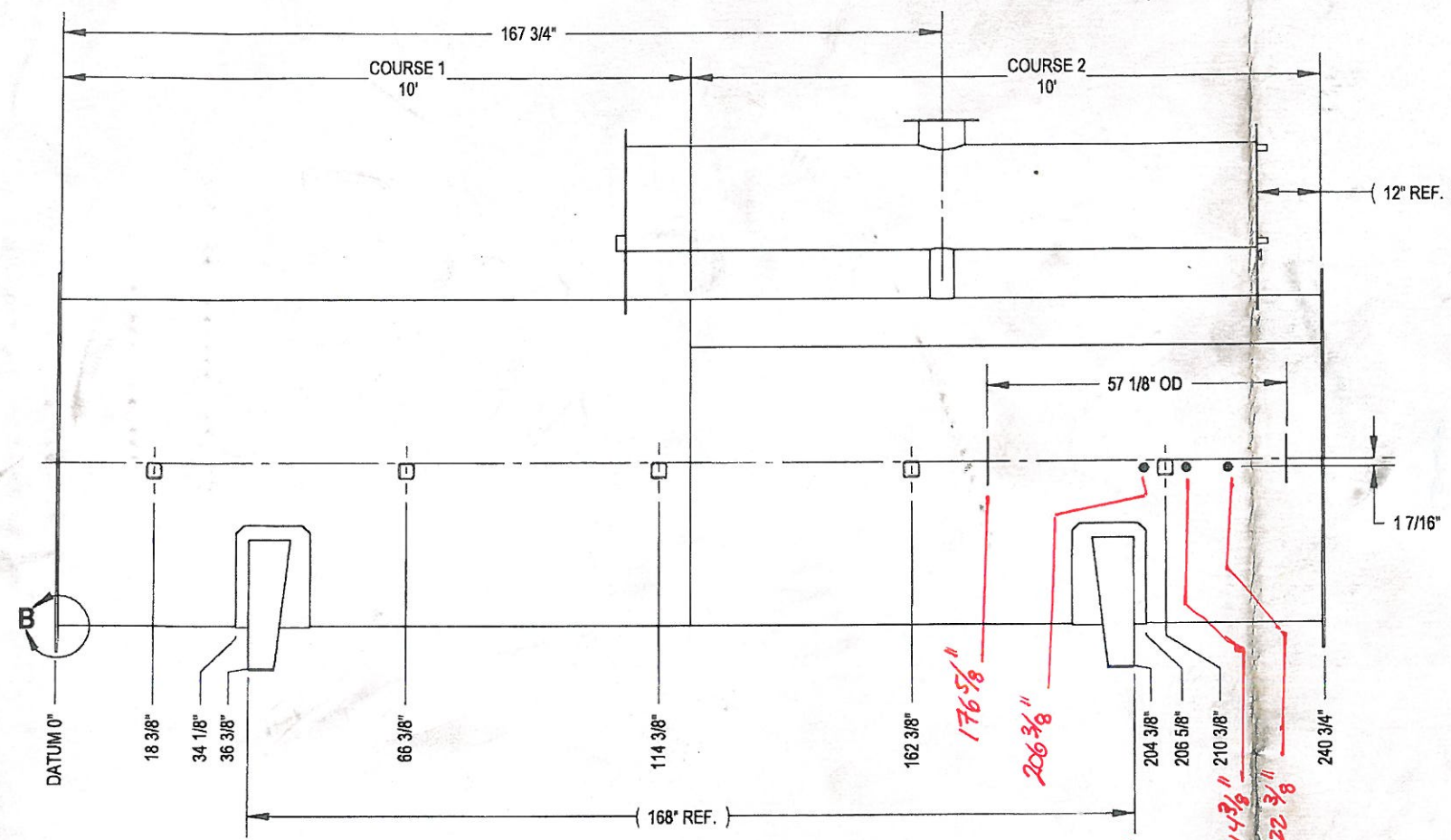
ORIGINAL

- NOTES**
1. ALL DIMENSIONS SHALL HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
 2. CUT LENGTHS FOR PIPE ARE FOR REFERENCE ONLY.

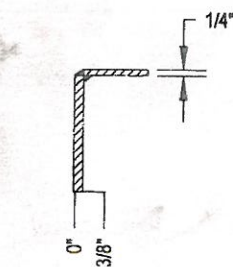


DESIGN DATA	
LINE NUMBER:	FG-1"-X-160C-0701
CLIENT SPECIFICATION:	ANSI/ASME B31.3 NPS 2012 EDITION
DESIGN & FABRICATE TO:	ANSI/ASME B31.3 NPS 2012 EDITION
DESIGN PRESSURE:	1440 PSI
MAXIMUM DESIGN TEMPERATURE:	200 °F
MINIMUM DESIGN TEMPERATURE:	-20 °F
SERVICE:	HYDROCARBONS
HYDROSTATIC TEST PRESSURE:	2160 PSI
RADIOGRAPHY:	10% OF SW FOR GAP
OTHER NDE:	NONE
POST WELD HEAT TREATMENT:	NONE
CORROSION ALLOWANCE:	1/16"
Q.C. PROGRAM NO.:	AQP-1253
WELDING PROCEDURE REGISTRATION NO.:	WP-1604.2

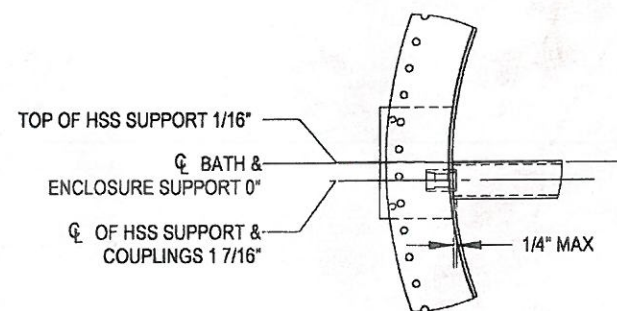
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<div style="display: flex; justify-content: space-between;"> <div> SIGNED: _____ DATE: Nov. 21, 2016 W: 09961-001-0 </div> <div> P.O. BOX 6280, INNISFAIL, AB T4G 1S9 PH: (403) 227-4100 FAX: (403) 227-4102 </div> </div>					DWN: CT DATE: MAY 30/14		CHK: [Signature] DATE: JUL 31 2014		APP: [Signature] DATE: JUL 31 2014																			
<table border="1" style="width: 100%;"> <tr> <th>REV.</th> <th>DATE</th> <th>BY:</th> <th>CHK:</th> <th>APP:</th> <th>DESCRIPTION</th> </tr> <tr> <td>0</td> <td>JUNE 06/14</td> <td>EB</td> <td>[Signature]</td> <td>[Signature]</td> <td>ISSUED FOR CONSTRUCTION</td> </tr> <tr> <td>A</td> <td>MAY 30/14</td> <td>CT</td> <td></td> <td></td> <td>ISSUED FOR APPROVAL</td> </tr> </table>					REV.	DATE	BY:	CHK:	APP:	DESCRIPTION	0	JUNE 06/14	EB	[Signature]	[Signature]	ISSUED FOR CONSTRUCTION	A	MAY 30/14	CT			ISSUED FOR APPROVAL	PROJECTION: 		SCALE: AS NOTED WEIGHT: 50.3221		SHEET: 2 OF 2 DWG: LH2001-D0-100	
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION																							
0	JUNE 06/14	EB	[Signature]	[Signature]	ISSUED FOR CONSTRUCTION																							
A	MAY 30/14	CT			ISSUED FOR APPROVAL																							
DRAWING REVISIONS					ALL DIMENSIONS IN INCHES						REV: 0																	



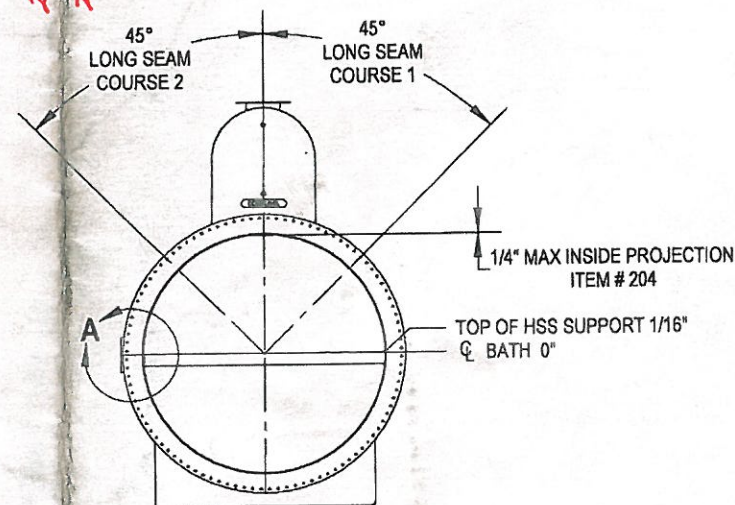
ELEVATION VIEW
SCALE: 1:32



DETAIL B
SCALE 1:8

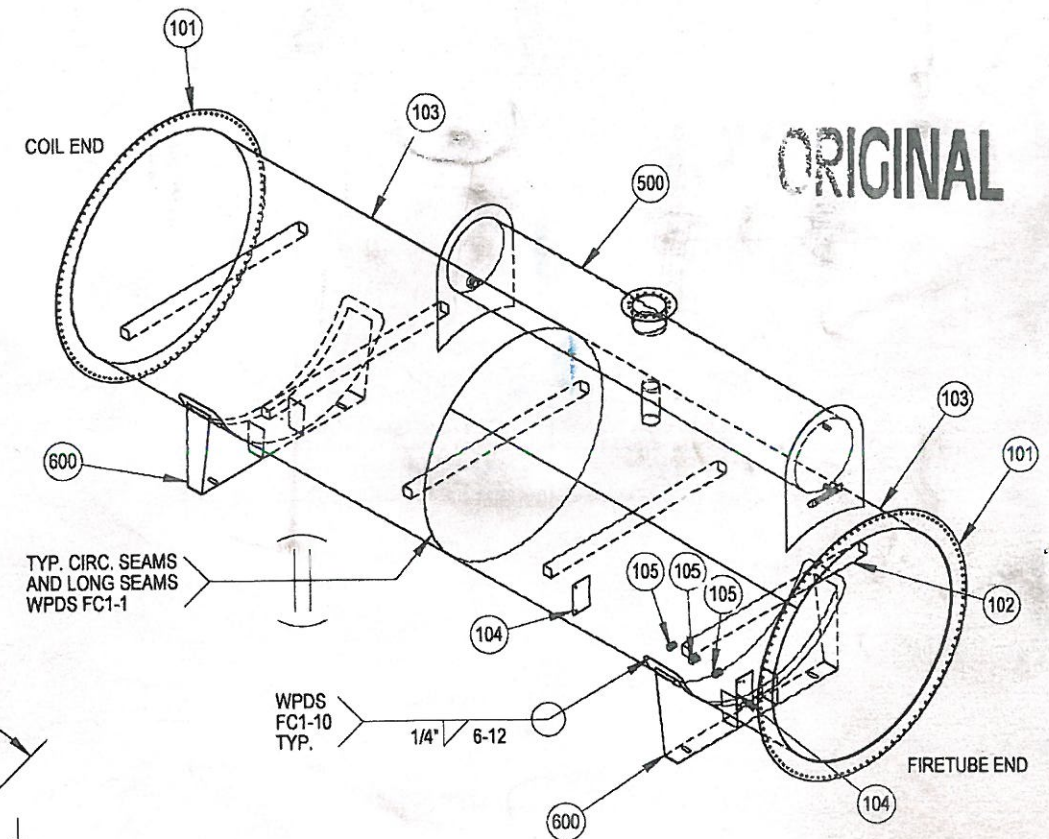


DETAIL A
SCALE 1:15



RIGHT VIEW
SCALE: 1:48

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
101	SEE SHEET 4		PLATE: 3/8" THK x 72" O.D. x 62 1/8" I.D.	G40.21-44W		2
102	HSS.25(33)U		HSS: 3" x 3" x 1/4"	CSA-G40.21-50W	61 1/4"	5
103	LH-SHELL-6210.25		LH BATH SHELL 62" OD x 10' LG x 1/4" THK	G40.21-44W		2
104	SEE SHEET 4		PLATE: 1/4" THK x 6"	G40.21-44W		2
105	COFTH1WA		COUPLING FULL 1" 3M THRD	SA-105N		3
500	SEE SHEET 2		SEE EXPANSION TANK DETAIL			1
600	SEE SHEET 3		SEE SADDLE DETAIL			2



ISOMETRIC VIEW
SCALE: 1:45

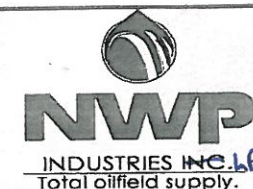
- NOTES**
1. FABRICATE TO CSA W47.1 AND W59.
 2. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
 3. DEBURR AND RADIUS ALL SHARP EDGES.
 4. WELD PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS-FC1-15, FC1-10.
 5. ALL WELDS TO BE 1/4" CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
 6. ALL BOLT HOLES TO STRADDLE COMMON CENTERLINE.

AS BUILT

0	JUNE 06/14	EB	DG	ISSUED FOR CONSTRUCTION
A	MAY 20/14	CT		ISSUED FOR APPROVAL
REV.	DATE	BY:	CHK:	APP:
DRAWING REVISIONS				

ISSUED FOR
CONSTRUCTION

SIGNED: *[Signature]*
DATE: **Nov. 21, 2016**
W.O. **09961-001-0**
S/N: **---**
ALL DIMENSIONS IN INCHES



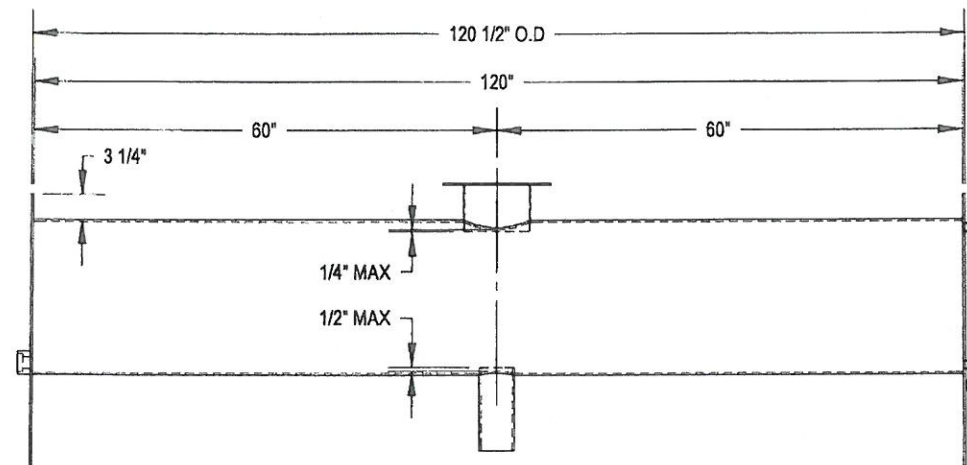
P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION: SCALE: AS NOTED
WEIGHT: 5025

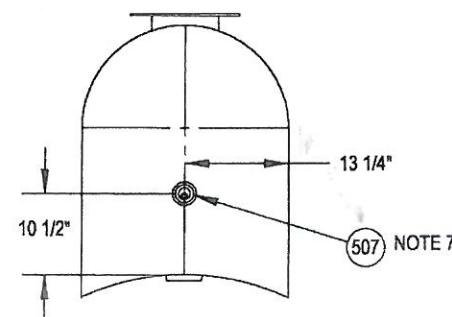
NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

BATH DETAILS

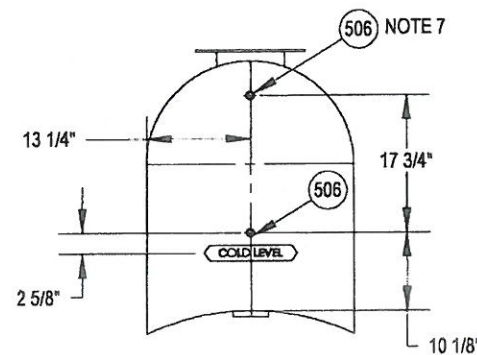
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DATE: MAY 20/14	DATE: JUL 31 2014	DATE: JUL 31 2014
SHEET: 1 OF 4	DWG: LH2001-D0-200	REV: 0



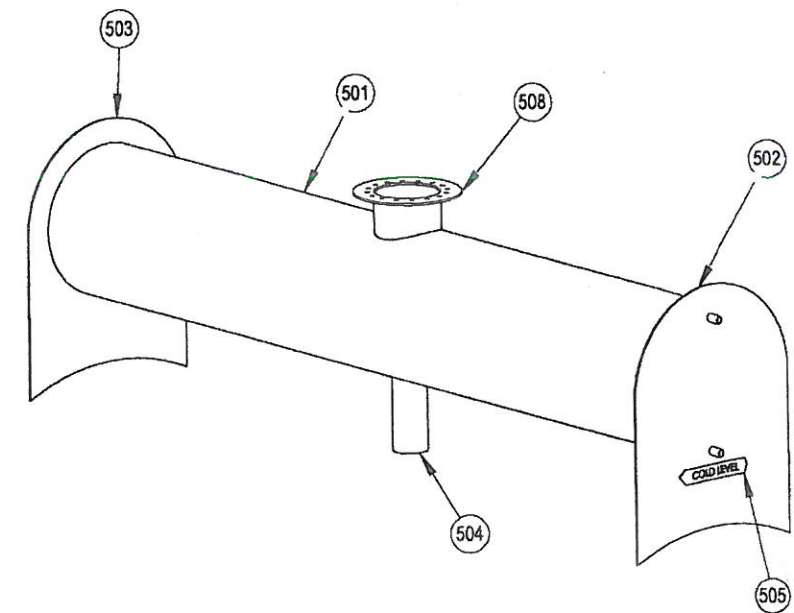
FRONT VIEW
SCALE: 1:24



LEFT VIEW
SCALE: 1:24



RIGHT VIEW
SCALE: 1:24



ISOMETRIC VIEW
SCALE: 1:24

BILL OF MATERIAL

ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY	MTR #
501	PIP2010E		PIPE 20" SCH 10	SA-53-B-ERW	120"	1	
502	SEE SHEET 4		PLATE: 1/4" THK x 22 1/2"	G40.21-44W		1	
503	SEE SHEET 4		PLATE: 1/4" THK x 22 1/2"	G40.21-44W		1	
504	PIP440A		PIPE 4" SCH STD/40	SA-106B	10 3/4"	1	
505	COLDLEVEL-1		LH COLD LEVEL INDICATOR	A1011		1	
506	COPTH.5WA		COUPLING FULL 1/2" 3M THRD	SA-105N		2	
507	COPTH2WA		COUPLING HALF 2" 3M THRD	SA-105N		1	
508	THIEFBASE-1		THIEF HATCH BASE ASSEMBLY: 8 5/8" O.D. x 6 1/4" O/A	G40.21-44W/SA-53-B-ERW		1	

NOTES

1. FABRICATE TO CSA W47.1 AND W59.
2. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
3. DEBURR AND RADIUS ALL SHARP EDGES.
4. WELD PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS-FC1-15, FC1-10.
5. ALL WELDS TO BE 1/4" CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
6. ALL BOLT HOLES TO STRADDLE COMMON CENTERLINE.
7. ITEM # 506 & 507 TO BE "SET ON" NOT SET THROUGH. FILLET WELD OUTSIDE ONLY.

AS BUILT

REV.	DATE	BY:	CHK:	APP:	DESCRIPTION
0	JUNE 06/14	EB			ISSUED FOR CONSTRUCTION
A	MAY 20/14	CT			ISSUED FOR APPROVAL

DRAWING REVISIONS

ISSUED FOR
CONSTRUCTION

SIGNED: *[Signature]*
DATE: **NOV. 21, 2016**
W.O. **09961-001-0**

S.N. **-----**

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

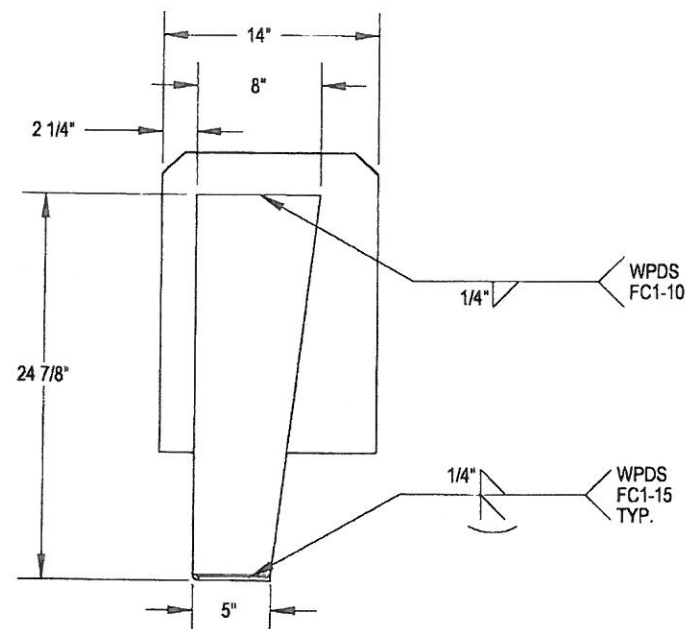
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WEIGHT: 698 (APPROX. LBS)

NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

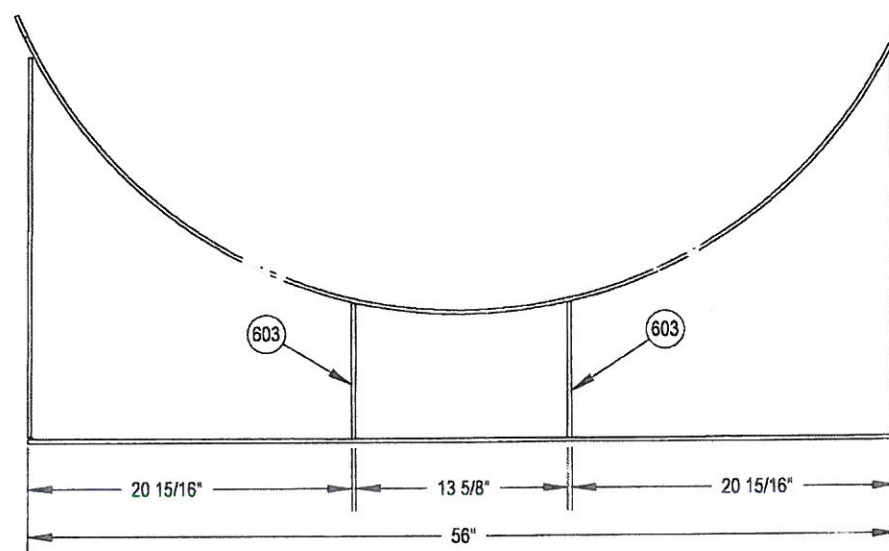
EXPANSION TANK DETAILS

DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>
DATE: MAY 20/14	DATE: JUL 31 2014	DATE: JUL 31 2014
SHEET: 2 OF 4	DWG: LH2001-DO-200	REV: 0

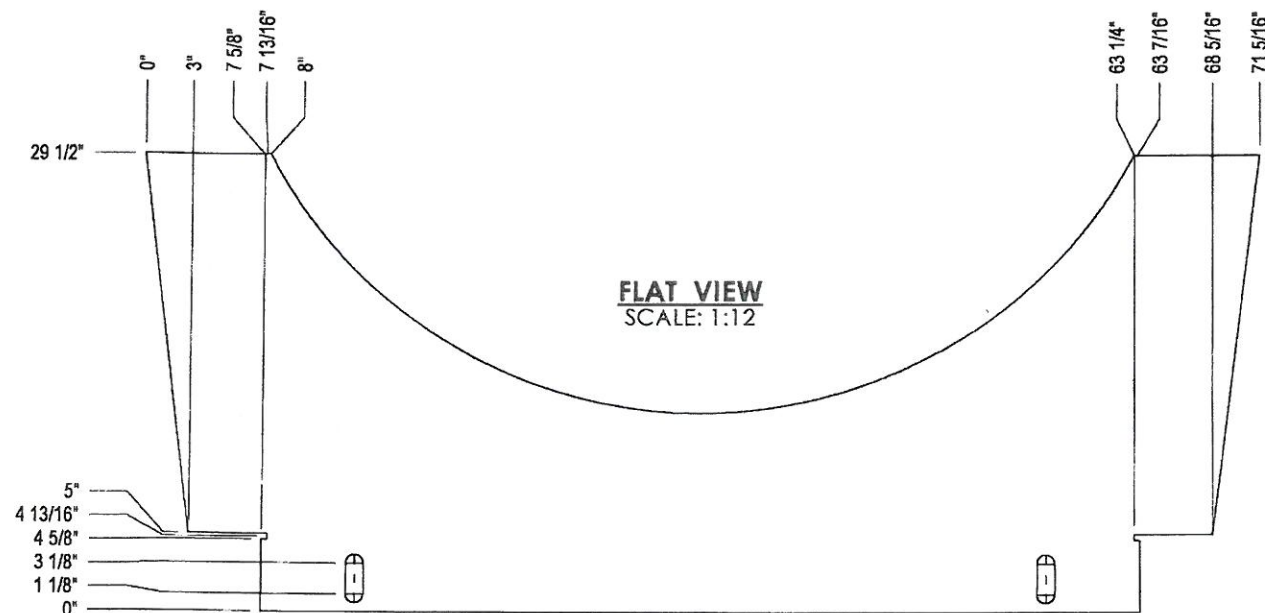
ORIGINAL



RIGHT VIEW
SCALE: 1:12



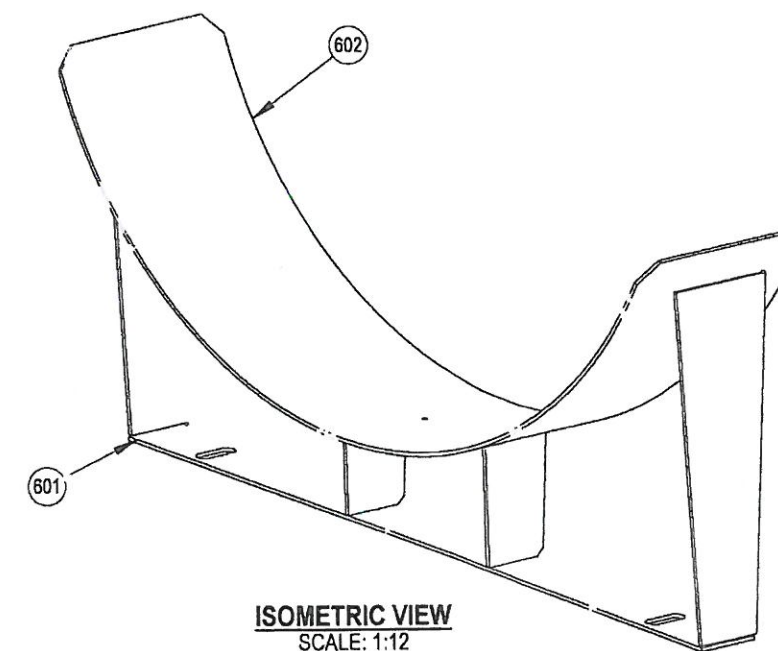
BACK VIEW
SCALE: 1:12



FLAT VIEW
SCALE: 1:12

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
601	SEE SHEET 4		PLATE: 1/4"THK x 29 1/2"	G40.21-44W		1
602	SEE SHEET 4		PLATE: 1/4"THK x 14"	G40.21-44W		1
603	SEE SHEET 4		PLATE: 1/4"THK x 8 3/4"	G40.21-44W		2

2 SADDLES REQUIRED



ISOMETRIC VIEW
SCALE: 1:12

NOTES

1. FABRICATE TO CSA W47.1 AND W59.
2. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8$ " UNLESS OTHERWISE SPECIFIED.
3. DEBURR AND RADIUS ALL SHARP EDGES.
4. WELD PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS-FC1-15, FC1-10.
5. ALL WELDS TO BE 1/4" CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
6. ALL BOLT HOLES TO STRADDLE COMMON CENTERLINE.

ORIGINAL

AS BUILT

ISSUED FOR CONSTRUCTION

SIGNED: *[Signature]*
DATE: NOV. 21, 2016
W O: 09961-001-0



P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

SADDLE DETAILS

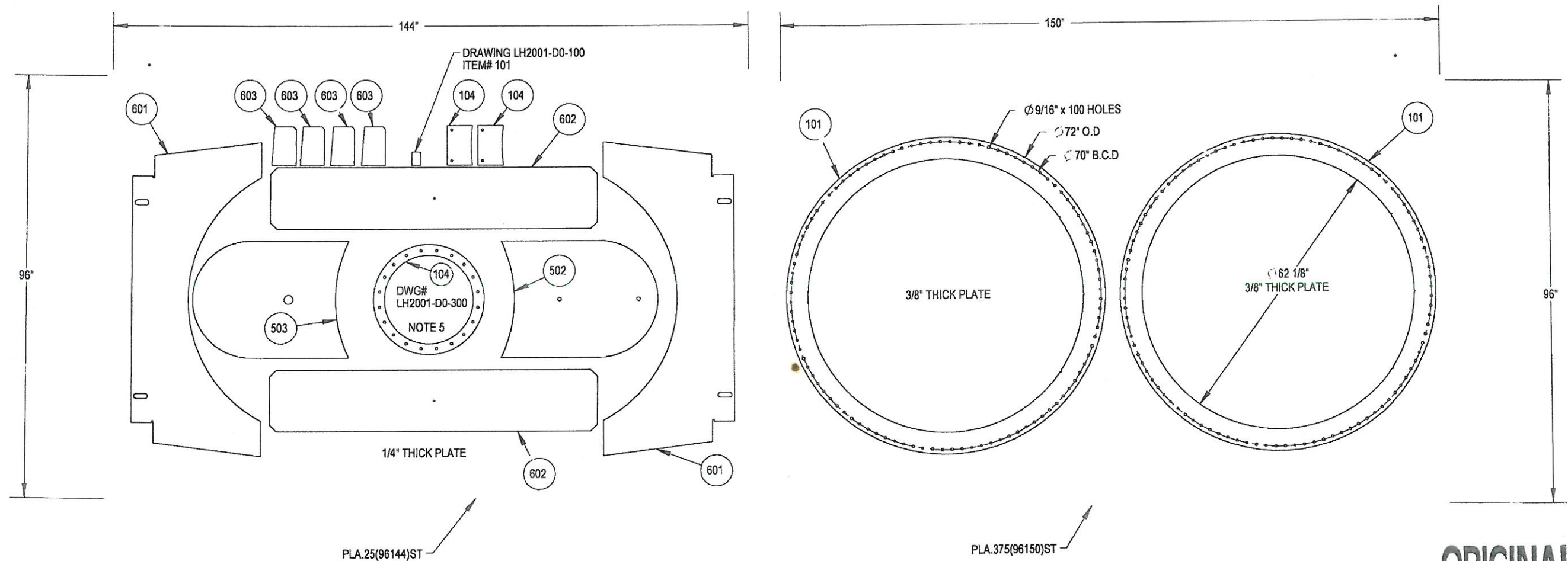
0	JUNE 06/14	EB	2	5	ISSUED FOR CONSTRUCTION
A	MAY 20/14	CT			ISSUED FOR APPROVAL
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION

DRAWING REVISIONS

ALL DIMENSIONS IN INCHES

PROJECTION: SCALE: AS NOTED
WEIGHT: 177
(APPROX. LBS)

DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>
DATE: MAY 20/14	DATE: JUL 31 2014	DATE: JUL 31 2014
SHEET: 3 OF 4	DWG: LH2001-D0-200	REV: 0



ORIGINAL

NOTES

1. HEAT NUMBER TO BE CLEARLY MARKED ON EACH PIECE WITH PAINT PEN AS A MINIMUM.
2. ALL DOCUMENTATION MUST ACCOMPANY SHIPMENT OF PARTS IF PART IS OUTSOURCED.
3. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
4. DEBURR AND RADIUS ALL SHARP EDGES.
5. DRAWING LH2001-D0-300 BURNER FLANGE CUT WITH BATH PARTS.

AS BUILT

ISSUED FOR
CONSTRUCTION

SIGNED:

DATE: NOV. 21, 2014

W.O. 09961-001-D

S.N.

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION:

SCALE: AS NOTED

WEIGHT: 681
(APPROX. LB.)

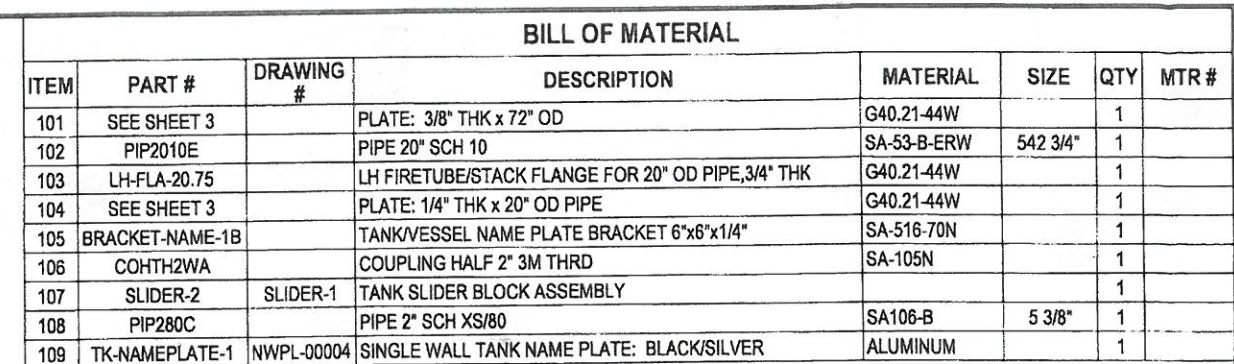
NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

CNC DETAILS

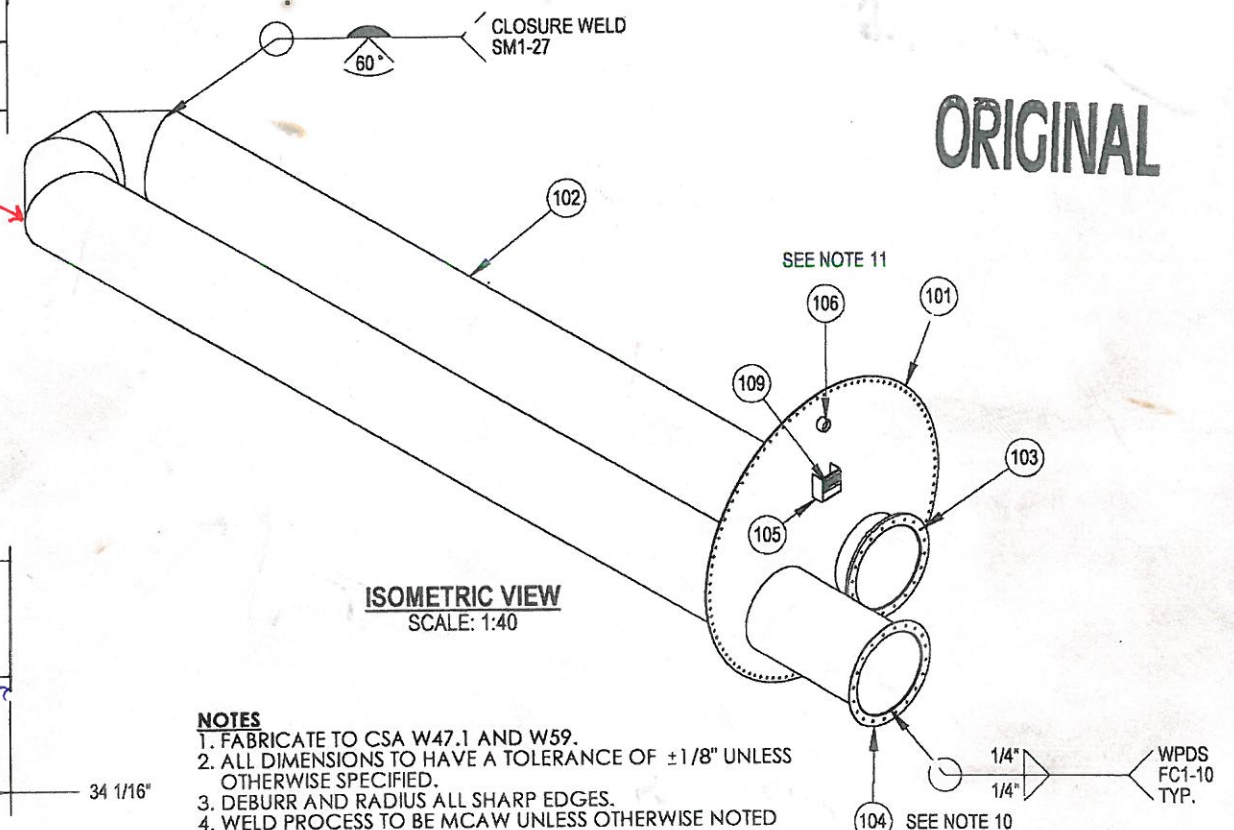
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DATE: MAY 20/14	DATE: JUL 31 2014	DATE: JUL 31 2014
SHEET: 4 OF 4	DWG: LH2001-D0-200	RE: 0

REV.	DATE	BY:	CHK:	APP:	DESCRIPTION
0	JUNE 06/14	EB	2	2	ISSUED FOR CONSTRUCTION
A	MAY 20/14	CT			ISSUED FOR APPROVAL

DRAWING REVISIONS





PLAN VIEW
SCALE: 1:32



FRONT VIEW
SCALE: 1:32



AS BUILT

O	JULY 31/14	EB			ISSUED FOR CONSTRUCTION
A	MAY 23/14	CT			ISSUED FOR APPROVAL
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION

DRAWING REVISIONS

ISSUED FOR
CONSTRUCTION

SIGNED.

DATE: NOV. 21, 2016

W.O. 69961-001-D

S.N. 4

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION:

SCALE: AS NOTED

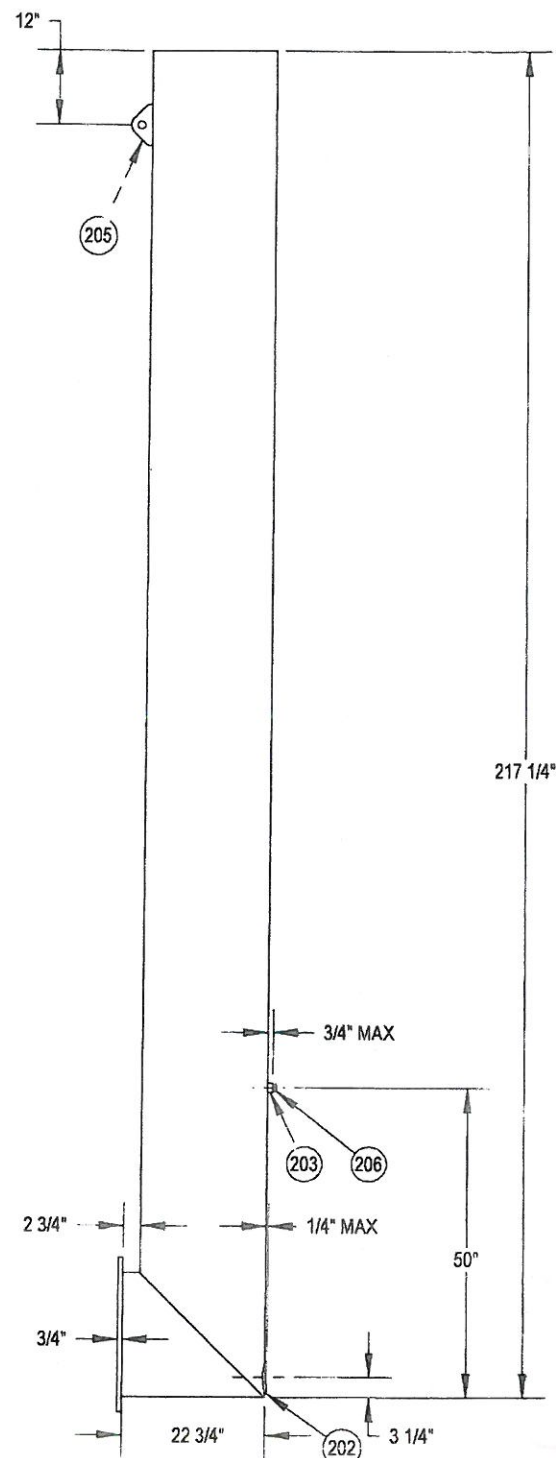
AS NOTED

NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

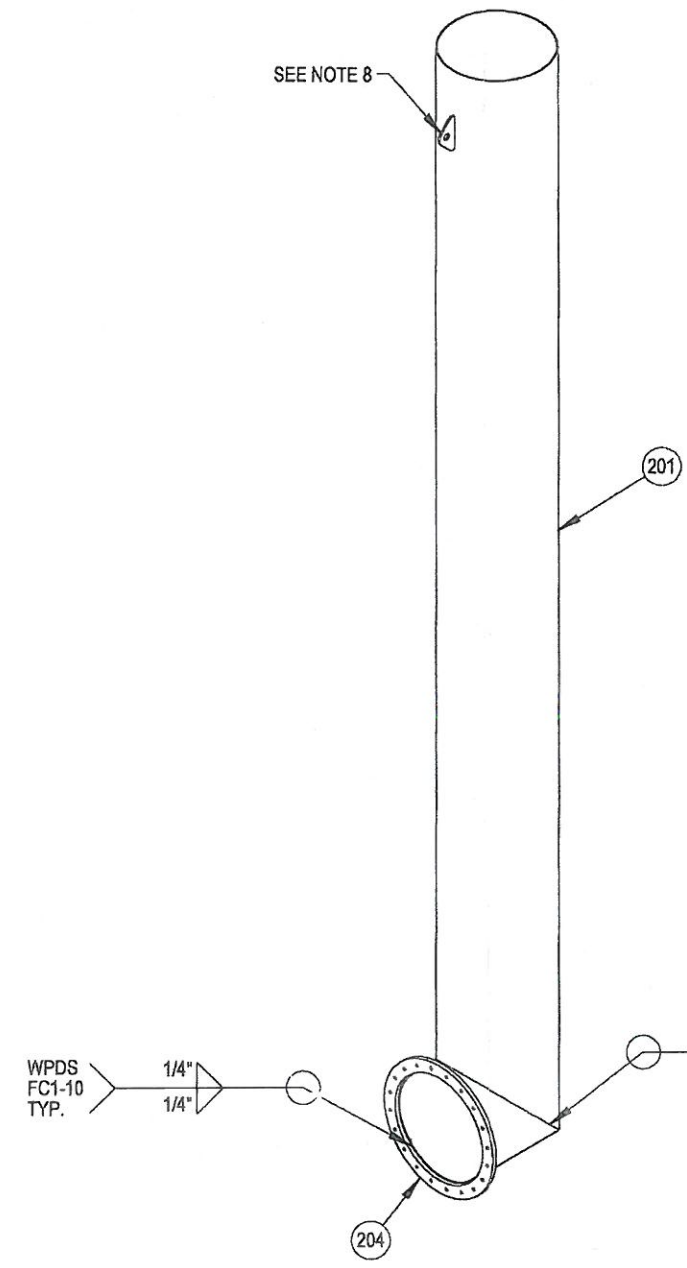
FIRETUBE DETAILS

DWN:	CT	CHK:	<i>[Signature]</i>	APP:	<i>[Signature]</i>
DATE:	MAY 23/14	DATE:	JUL 31 2014	DATE:	JUL 31 2014

D	SHEET: 1 OF 3	DWG: 1 H2001-DO-300	REV: 0
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RIGHT VIEW
SCALE: 1:30



ISOMETRIC VIEW
SCALE: 1:30

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
201	BUY		20" SCH. 10 PIPE	SA-53	240"	1
202	COFTH4CS		FULL COUPLING 4" STEEL STD THRD	SA-105N		1
203	COHTH.75WA		HALF COUPLING: 3/4" CL3000 THRD	SA-105N		1
204	LH-FLA-20.75		3/4" THK. FLANGE			1
205	LL-D63A	NWPL-00009	LIFT LUG UNIVERSAL 6-5/8" X 3-3/8"	G40.21-44W	6 5/8"	1
206	PLHTH.75XA		PLUG (HEX): 3/4" CL6000 THRD	SA-105N		1

ORIGINAL

- NOTES**
1. FABRICATE TO CSA W47.1 AND W59.
 2. ALL DIMENSIONS TO HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
 3. DEBURR AND RADIUS ALL SHARP EDGES.
 4. WELD PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS FC1-10, FC1-15.
 5. ALL WELDS TO BE 1/4" CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
 6. WIND VELOCITY CALCULATIONS APPLY
 7. ALL BOLT HOLES TO STRADDLE COMMON CENTERLINE.
 8. SHOP TO STAMP COMPLETE WO# ON BOTH SIDES OF LIFT LUG, QC TO VERIFY

AS BUILT

ISSUED FOR CONSTRUCTION
SIGNED: *[Signature]*
DATE: NOV. 21, 2016
W.O. 09961-001-D
S.N. _____



P.O. BOX 6280, INNISFAIL, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

STACK DETAILS

DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>
DATE: MAY 23/14	DATE: JUL 31 2014	DATE: JUL 31 2014

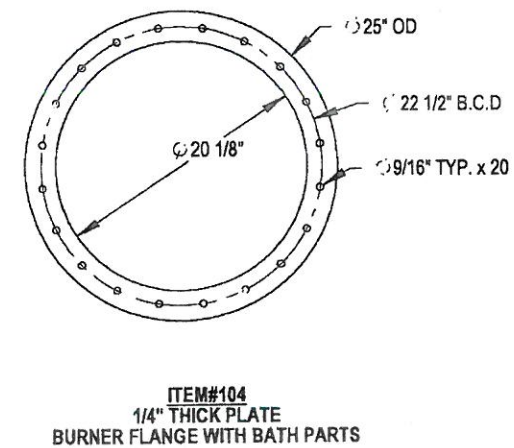
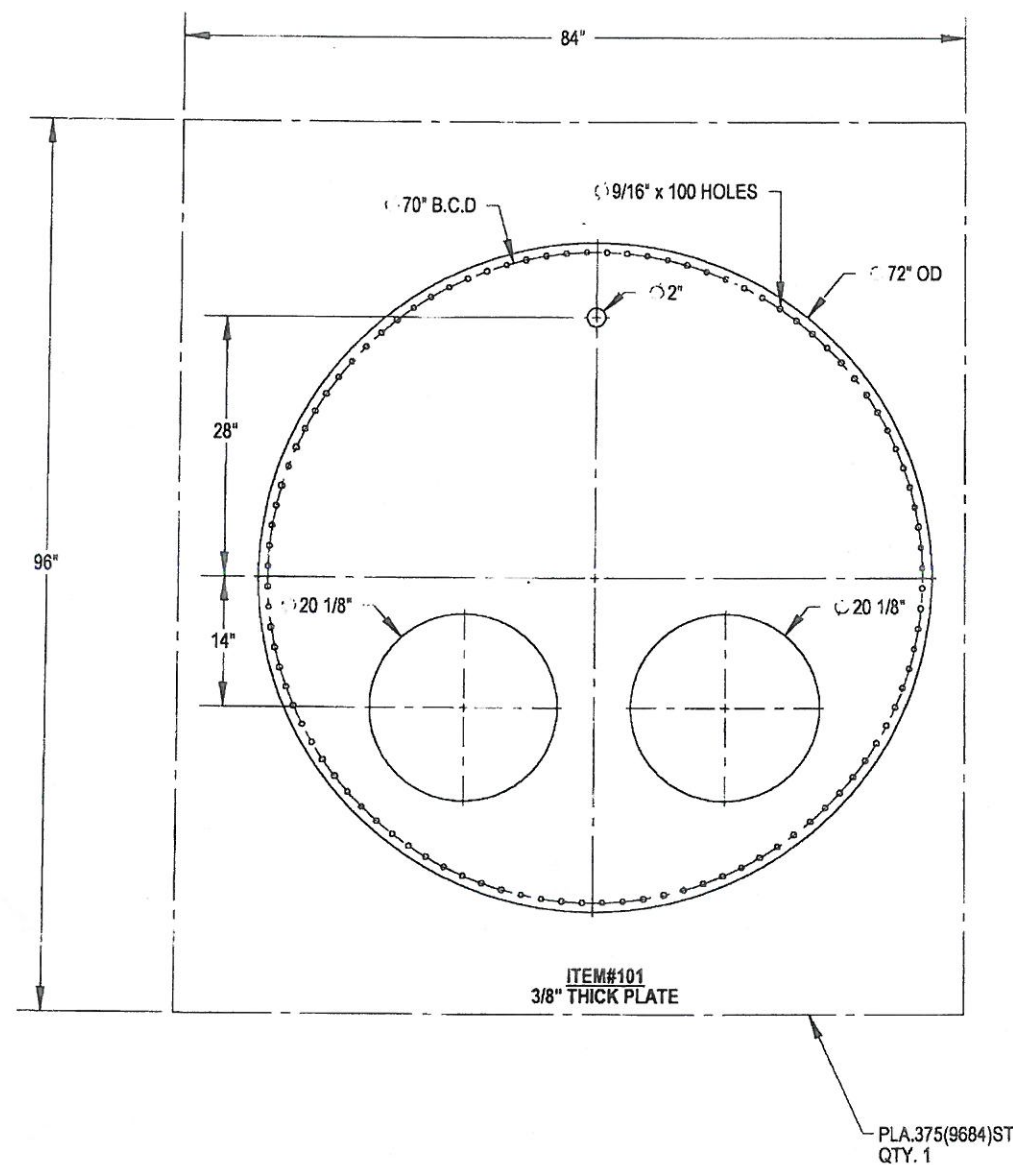
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION
0	JULY 31/14	EB	<i>[Signature]</i>	<i>[Signature]</i>	ISSUED FOR CONSTRUCTION
A	MAY 23/14	CT			ISSUED FOR APPROVAL

DRAWING REVISIONS

ALL DIMENSIONS IN INCHES

PROJECTION:	SCALE: AS NOTED
WEIGHT: (APPX. LBS)	

SHEET: 2 OF 3	DWG: LH2001-D0-300	REV: 0
---------------	--------------------	--------



ORIGINAL

AS BUILT

ISSUED FOR
CONSTRUCTION

SIGNED:

DATE: NOV. 21, 2016

W.O. 09961-001-D

S/N

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION:



SCALE: AS NOTED

WEIGHT:
(APPROX. LBS)

NWP INDUSTRIES
2.0 MMBTU/HR LINEHEATER
62" OD x 240" S/S

CNC DETAILS

DWN: CT	CHK: 2	APP: 8
DATE: MAY 23/14	DATE: JUL 31 2014	DATE: JUL 31 2014

SHEET: 3 OF 3	DWG: LH2001-D0-300	REV: 0
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MTR'S (Material Test Reports)

1" S/100 ASTM/ASME A/SA-333 GR6 HT 014030693



YANGZHOU LONTRIN STEEL TUBE CO.,LTD.
MILL TEST CERTIFICATE (EN10204-3.1)

PG 1 of 1

CUSTOMER: MAX METAL MATERIAL CO LIMITED

PRODUCT: SEAMLESS STEEL PIPES

SPEC: SMLS ASTM/ASME A/SA-333 GR 6 / NACE MR-01-75 ISO 15156

ISO REGISTRATION NO: 44 100 072544

CONTRACT NO: 1-14286

CERTIFICATE NUMBER: 14EX04222-1-01

CE = .35 VT. 236 Low

TOTAL: 3 BUNDLES		160 PIECES		4066 KG		PACKING IN BUNDLES																																																																									
NO.	HEAT NO.	LOT NO.	STEEL GRADE	SIZE	PCS	WEIGHT KG	C	SI	Mn	P	S	Cr	Ni	Cu	Mo	V	Cb	Mn/C	CE																																																												
1	014030693	14051A238	GR.6	1" SC11160(0.250") 33.4mmX6.35mm S R/L P.E	160	4066	0.19	0.21	0.91	0.011	0.004	0.04	0.03	0.02	<0.001	<0.001	<0.001	4.79	0.35																																																												
<table border="1"> <thead> <tr> <th rowspan="3">NO.</th> <th colspan="5">MECHANICAL PROPERTIES</th> <th colspan="3">TECHNOLOGICAL PROPERTIES</th> <th rowspan="3">H.T ≥SS</th> <th colspan="2">NONDESTRUCTIVE TEST</th> <th colspan="2">SURFACE QUALITY</th> <th colspan="2">DIMENSION TOLERANCE</th> </tr> <tr> <th>ReL (MPa) YIELD STRENGTH</th> <th>Rm (MPa) TENSILE STRENGTH</th> <th>ELONGA- TION A%</th> <th>HARD- NESS BHN</th> <th>IMPACT TEST 10*5*55mm -45°C,(J)</th> <th>FLATTEN- ING TEST</th> <th>FLARING TEST</th> <th>BENDING</th> <th>ET</th> <th>UT</th> <th>IN</th> <th>OUT</th> <th>O.D.</th> <th>W.T.</th> </tr> <tr> <th>≥240</th> <th>≥415</th> <th>≥30</th> <th>≤200</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>352/362</td> <td>505/510</td> <td>48/48</td> <td>152/153</td> <td>25/34/31</td> <td>—</td> <td>—</td> <td>Satisfactory</td> <td>2500PSI</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> <td>Satisfactory</td> </tr> </tbody> </table>																				NO.	MECHANICAL PROPERTIES					TECHNOLOGICAL PROPERTIES			H.T ≥SS	NONDESTRUCTIVE TEST		SURFACE QUALITY		DIMENSION TOLERANCE		ReL (MPa) YIELD STRENGTH	Rm (MPa) TENSILE STRENGTH	ELONGA- TION A%	HARD- NESS BHN	IMPACT TEST 10*5*55mm -45°C,(J)	FLATTEN- ING TEST	FLARING TEST	BENDING	ET	UT	IN	OUT	O.D.	W.T.	≥240	≥415	≥30	≤200											1	352/362	505/510	48/48	152/153	25/34/31	—	—	Satisfactory	2500PSI	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
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REMARKS: Delivery condition: Normalized.

MANAGING REPRESENTATIVE:

[Signature]

STAMPER:




DATE:

July.11,2014

PO 730876
 Conforms with ASME
 Sec II, Part A 2015 Edition
 OCT 19/16 JF

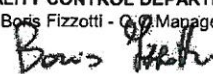

ES

 I.M.L. - INDUSTRIA MECCANICA LIGURE S.P.A. Via Giancarlo Farina, 25 - 16030 Casarza Ligure - GE - ITALY Tel. +39 0185 467661 - Fax +39 0185 466510 - E-mail quality.imi@farinagroup.com MATERIAL TEST DEPARTMENT		COMPANY WITH QUALITY SYSTEM ISO 9001: 2008 CERTIFIED BY RINA CERT. N° 23/91/S																																											
INSPECTION CERTIFICATE EN 10204:2004 / 3.1		Nr 2015-C_IML-26540 Data / Dated 01.04.2015																																											
TRANS AM PIPING PRODUCTS LTD. 9335 Endeavor Drive S.E. Calgary, Alberta T3S 0A1		Ordine / PO CI-15-165 Item 30 DDT / Delivery note 2015-2E301-0000517 Packing List 2015-2E401-0000496 Fattura / Invoice 2015-2E401-0000496 Ns. rif. / Our ref. 2015-2E201-0000170-0030																																											
Dest. TRANS AM PIPING PRODUCTS LTD. 9335 - Endeavor Drive S.E. Calgary, Alberta T3S 0A1																																													
Cod. colata Heat Code 6A	Nr. colata Heat Nr 14/71710	Descrizione Description FITTING 90 ELB. THRD NPT 3M 1" A105N																																											
Mat. in acc. a / Mat. in acc. to ASME SA ASTM A105/A105M-14 NACE MR 0175 - ISO 15156 Ed. 2009 / NACE MR 0103 Ed. 2012 P.E.D. 97/23/EC ANNEX 1 PAR. 4.3																																													
Ann. mat. / Mat. remarks MATERIAL FULLY KILLED & FINE GRAIN PRACTICED																																													
<table border="1"> <thead> <tr> <th>Elementi / Elements</th> <th>C</th> <th>Si</th> <th>Mn</th> <th>S</th> <th>P</th> <th>Cr</th> <th>Ni</th> <th>Mo</th> <th>Ti</th> <th>Cu</th> <th>V</th> <th>Nb</th> <th>N</th> </tr> </thead> <tbody> <tr> <td>LADLE ANALYSIS</td> <td>0,180</td> <td>0,200</td> <td>0,900</td> <td>0,010</td> <td>0,015</td> <td>0,100</td> <td>0,070</td> <td>0,010</td> <td>0,017</td> <td>0,170</td> <td>0,004</td> <td>0,003</td> <td>0,000</td> </tr> <tr> <td>LADLE ANALYSIS</td> <td>0,023</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0,369</td> <td>0,330</td> <td>0,354</td> <td>0,110</td> <td>-</td> </tr> </tbody> </table>				Elementi / Elements	C	Si	Mn	S	P	Cr	Ni	Mo	Ti	Cu	V	Nb	N	LADLE ANALYSIS	0,180	0,200	0,900	0,010	0,015	0,100	0,070	0,010	0,017	0,170	0,004	0,003	0,000	LADLE ANALYSIS	0,023								0,369	0,330	0,354	0,110	-
Elementi / Elements	C	Si	Mn	S	P	Cr	Ni	Mo	Ti	Cu	V	Nb	N																																
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CE LF=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15 CE SF=C+Mn/6 F1=Cu+Ni+Cr+Mo+V F2=Cr+Mo																																													
<table border="1"> <thead> <tr> <th>Provetta</th> <th>Forma</th> <th>°C</th> <th>Snervamento>0,2%</th> <th>Snervamento>1,0%</th> <th>Rottura</th> <th>Allungamento</th> <th>Contrazione</th> </tr> <tr> <th>Test specimen</th> <th>Shape</th> <th></th> <th>Yield Strength>0,2%</th> <th>Yield Strength>1,0%</th> <th>Tensile</th> <th>Elongation</th> <th>Reduction of area</th> </tr> </thead> <tbody> <tr> <td>Sez/Sect mm2 L. mm</td> <td>1=O - 2=□</td> <td></td> <td>MPa</td> <td>MPa</td> <td>MPa</td> <td>%</td> <td>%</td> </tr> <tr> <td>122,65 50,00</td> <td>1</td> <td>20</td> <td>322,0</td> <td>-</td> <td>508,0</td> <td>32,6</td> <td>57,3</td> </tr> </tbody> </table>				Provetta	Forma	°C	Snervamento>0,2%	Snervamento>1,0%	Rottura	Allungamento	Contrazione	Test specimen	Shape		Yield Strength>0,2%	Yield Strength>1,0%	Tensile	Elongation	Reduction of area	Sez/Sect mm2 L. mm	1=O - 2=□		MPa	MPa	MPa	%	%	122,65 50,00	1	20	322,0	-	508,0	32,6	57,3										
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DUREZZA / HARDNESS HBW RESILIENZA / IMPACT TEST																																													
152,0 - 158,0 Tipo/Type KV Provetta / Test Specimen 10x10mm °C 1-Joule 2-Joule 3-Joule Media/Average																																													
Tratt. Term. / Heat treatment Normalized at 880°-920°C / Air Cool ELECTRIC FURNACE																																													
Dim in acc. a / Dim. acc. to ASME B16.11 Ed.2011 - ASME B1.20.1 Ed.2013 - MSS SP25 Ed.2013																																													
Marcatura in acc. Marking in acc. to MSS SP25 Ed. 2013		Origine Origin of Steel ITALY																																											


Note / Notes 100% MANUFACTURED IN ITALY
SUPPLIED MATERIAL MEETS SPECIFICATIONS AND P.O. REQUIREMENTS

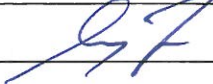







Conforms with ASME
Sec II, Part A 2013 Edition


June 10/15 EE

UFFICIO CONTROLLO QUALITA' QUALITY CONTROL DEPARTMENT Boris Fizzotti - Q.C. Manager 	ENTE UFFICIALE DI COLLAUDO INSPECTION AUTHORITY	MARCHIO PRODUZIONE MANUFACTURER'S SYMBOL IML or 
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Skid / Structural Documentation

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: April 14, 2015 Rev Status: 2.0		FORM-SKID TRAVEL SHEET Page 1 of 1

SKID TRAVEL SHEET		APPROVED BY: 					
		DATE: NOV 21 2016					
WO # 09961-001-C	DESCRIPTION: 2.0MM BTU/HR Lineheater Pkg.						
DRAWING# LH2001-C0-000REV 0							
	REQ.	HOLD	EMPLOYEE INT.	DATE	QC INIT.	OWNER INSPECTION 3 RD PARTY	DATE
WORK INSTRUCTIONS/DRAWINGS ISSUED	✓		051 063	28/12/16		Nov. 23/16	
WORK INSTRUCTIONS/DRAWINGS REVIEWED	✓	✓				28/12/16	
MATERIAL & PARTS RELEASED	✓	✓					
WELDING PERSONNEL ASSIGNED	✓						
LAYOUT/FIT-UP/CROSS SQUARE	✓	✓					
SKID DECK SECURE AND PREPPED TO FLIP	✓	✓	N/A				
FINAL VISUAL SKID UNDERSIDE	✓	✓	051 063	29/12/16	BW		Dec 29/16
LAYOUT/FIT-UP/ATTACHMENTS	✓						
FINAL VISUAL INSPECTION	✓						
SURFACE PREP./SANDBLAST	N/A						
PRIMER PAINT	N/A						
FINAL PAINT	N/A						
NDE VERIFIED COMPLETE	✓				BW		Jan 04/17
QC INSPECTION AND FINAL RELEASE	✓	✓			BW		Jan 04/17
ACCEPTED BY CUSTOMER:		DATE:					

LIFT LUGS VERIFIED BY:  28/12/16
 WELDED BY: 051 29/12/16

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Feb 17 2015 Rev Status: 10.1		FORM-N.D.E Requirements Page 1 of 1

N.D.E Requirements

Client: Beytex Energy		JO# 09961-001-C	
Project: Skid for Lineheater Pkg.		Date: 29/12/2016	

Welded Piping: <input type="checkbox"/>	Pressure Vessel: <input type="checkbox"/>	Tank: <input type="checkbox"/>	Coil: <input type="checkbox"/>	Threaded Piping: <input type="checkbox"/>	Other: <input checked="" type="checkbox"/>
---	---	--------------------------------	--------------------------------	---	--

<input type="checkbox"/> X-Ray <input type="checkbox"/> Gamma Ray <input type="checkbox"/> Ultrasonic <input type="checkbox"/> Liquid Penetrant <input checked="" type="checkbox"/> Magnetic Particle <input checked="" type="checkbox"/> Black/ White <input type="checkbox"/> Wet Florescent <input type="checkbox"/> Hardness, Max 200 BHN	<input type="checkbox"/> 100% <input checked="" type="checkbox"/> Full <input type="checkbox"/> 20% <input type="checkbox"/> 15% <input type="checkbox"/> 10% <input type="checkbox"/> Spot <input type="checkbox"/> Other (define)	<input type="checkbox"/> Client Specification <input type="checkbox"/> ASME B31.3 NFS <input type="checkbox"/> ASME B31.3 S/C <input type="checkbox"/> ASME Section VIII-UW-11(a) <input type="checkbox"/> ASME Section VIII-UW-11(a)5(b)	<input type="checkbox"/> CSA W59 CL.11 (static) <input checked="" type="checkbox"/> CSA W59 CL.12 (dynamic) <input type="checkbox"/> ASME Section VIII Div. 1 Appendix 6 (MPI) <input type="checkbox"/> ASME Section VIII-UW-53 Appendix 12(UT) SURFACE CONDITION: <input checked="" type="checkbox"/> As-Welded/ Bare Metal <input type="checkbox"/> After PWHT
---	---	---	--

General Instructions:

Serial Number = _____

P1 Material

Welder ID = 051

Shell-T=

Pipe-T=

Total Welds = 4 x MPI on skid lift lugs. Start at MT-1

Please use wire type iQi
 Please Note locations of all indications on films on reports
 Please include O.F.D-S.O.D S.F.D on reports

Special Requirements:

Shots

Buttweld Xray to be identified as X-#
 Gap Shots to be identified as GS-#
 Threaded Shots to be identified as XT-#
 Identify on Envelope part of package being shot ie. Coil, Piping, ect.
 Flashes must contain: Client, JO#, Xray number, Welder's ID Symbol, Date, NWP, Vessel or Coil SN#, Code and Client Spec if applicable
 Mark all indicated repairs on the project with blue ribbon

NOTE:

Encana Spec for Vessels is Zero Elongated Indications in or alongside the root pass in Cat. A, B and C Welds
 Encana Spec for Socket Welds-acceptance is minimum 1/16" gap
 Shell Canada Spec for Socket Welds-acceptance is minimum 1/16" gap
 Encana Spec for Threaded Piping- acceptance is 7 threads engaged or 3/4" engaged
 HT is a 5 Point Traverse
 Please specify surface condition for MPI

Prepared By: Brian Weaver

Date: 29/12/2016



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Ticket #: 1483-029-943
Client Name: NWP Industries LP
Work Performed On: Thursday, Dec 29, 2016
Client Reference: **Job:** 09961-001-C, **Client:** Beytex Energy, **Project:** Skid for Lineheater Pkg.

Mistras Traveller #:
200B16-DS-0006

Client Name:
NWP Industries LP

Client Reference:
Job: 09961-001-C, **Client:** Beytex Energy, **Project:** Skid for Lineheater Pkg.

Work Performed On:
Thursday, Dec 29, 2016

Locations(s) of Work:
Innisfail Shop

Technician:
Charles Lasouski RT/MT/PT Level II CGSB#11295

Crew:

Unit #:
226

Work performed in:
AB

Exposure Device:

Daily work contract has been reviewed with client representative.

Description	Units	Quantity
Magnetic particle - 1 man unit	hr	1
Flourescent mpi kit	day	.2
Lpi/mpi consumables	ea	.2

This ticket is not an invoice. Pay upon receipt of invoice.

Charles Lasouski RT/MT/PT Level II CGSB#11295

Ticket #: 1483-029-943

Bus Dec 29/16
Client representative



6207 - 46 Street Olds, AB T4H 1L7
Toll-free: (888) 551-1350
Fax: (403) 556-1355

Ticket #: 1483-029-943
Client Name: NWP Industries LP
Work Performed On: Thursday, Dec 29, 2016
Client Reference: Job: 09961-001-C, Client: Beytex Energy, Project: Skid for Lineheater Pkg.

Magnetic Particle Inspection

Inspection description: Lifting Lugs
Location of work: Innisfail Shop

Code Acceptance Criteria: CSA W59(2013), CL 12.5.4.2 / 12.5.4.4 Cyclically Loaded Structures
Inspection Procedure: 200-NDT-MT03 Magnetic Particle Procedure & Technique (CSA W59) Rev 6
Client Specification: not applicable
Inspection Standard: ASTM Standard E 709
Surface Condition: As welded
Yoke Current Type: A/C

Equipment Type	Manufacturer	Model #	Serial #	Calibration Date	Consumable Type	Manufacturer	Batch #
Yoke	Parker	B-300	24538	2016-12-29	White Contrast Paint WCP-2	Magnaflux	15E02K
Weight 4.5 kgs (10 lbs)	Western Instruments W-PT		1043	2015-09-15	Black Magnetic Particles 7HF	Magnaflux	14G25K
Flashlight (LED)	Min 30 cms	n/a	n/a				

Seq #	Weld #	Location	Material	Dimensions	Technique	Welder	Result	Remarks
1.	MT-1	Skid Lugs	CS	Fillet Weld, All Around	Black on White	051	accept	
2.	MT-2	Skid Lugs	CS	Fillet Weld, All Around	Black on White	051	accept	
3.	MT-3	Skid Lugs	CS	Fillet Weld, All Around	Black on White	051	accept	
4.	MT-4	Skid Lugs	CS	Fillet Weld, All Around	Black on White	051	accept	

Accept: No rejectable indications apparent at time of inspection. **Reject:** See remarks for explanation. **Info Only:** No code acceptance criteria applied. **Technical reports included in this ticket are an interpretation and do not constitute a guarantee of any kind.**

Auditor

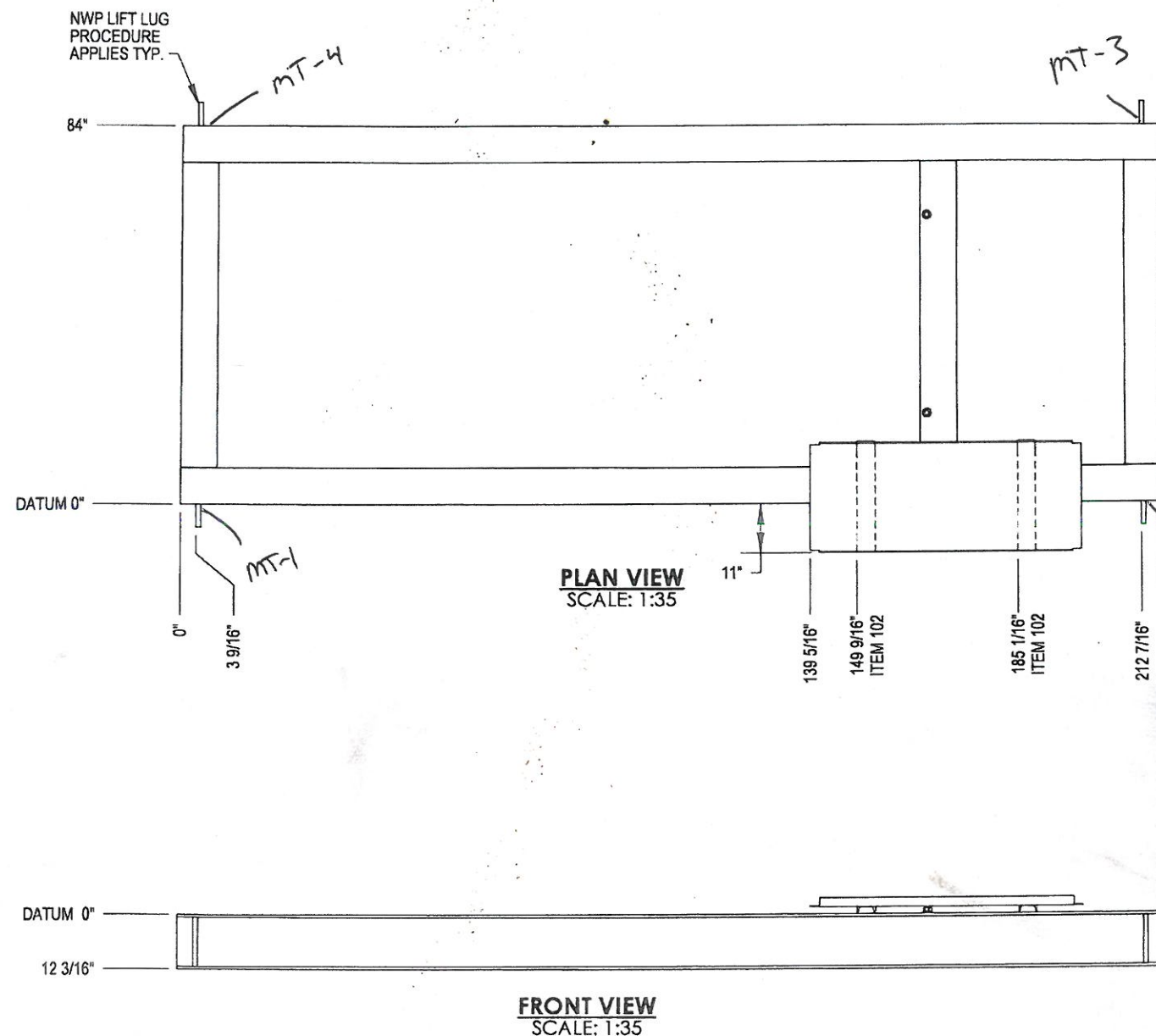
Charles Lasouski RT/MT/PT Level II CGSB#11295

Ticket #: 1483-029-943

Client representative

Page 2 of 2

* Lugs by "OSI" *



NOTES

1. FABRICATE TO CSA W47.1 AND W59
2. ALL DIMENSIONS SHALL HAVE A TOLERANCE OF $\pm 1/8$ " UNLESS OTHERWISE SPECIFIED.
3. COPE STRUCTURAL MEMBERS AS REQUIRED.
4. RADIUS ALL SHARP EDGES.
5. ALL WELDS TO BE 1/4" CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
6. SHOP TO VERIFY ALL I-BEAM CUT LENGTHS PRIOR TO SECTIONING BEAMS.
7. WELDS PROCESS TO BE MCAW UNLESS OTHERWISE NOTED. WPDS FC1-15 AND FC1-10.
8. MPI ON LIFT LUG WELDMENT.

AS BUILT

O	JULY 31/14	EB	2	8	ISSUED FOR CONSTRUCTION
A	MAY 14/14	CT			ISSUED FOR APPROVAL
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION

DRAWING REVISIONS

ISSUED FOR CONSTRUCTION

SIGNED: *[Signature]*

DATE: NOV. 21, 2016

W.O. 09961-001-C

S/N: - - - - -

ALL DIMENSIONS IN INCHES



P.O. BOX 6280, INNISFAIR, AB T4G 1S9
PH: (403) 227-4100 FAX: (403) 227-4102

PROJECTION:

SCALE: AS NOTED

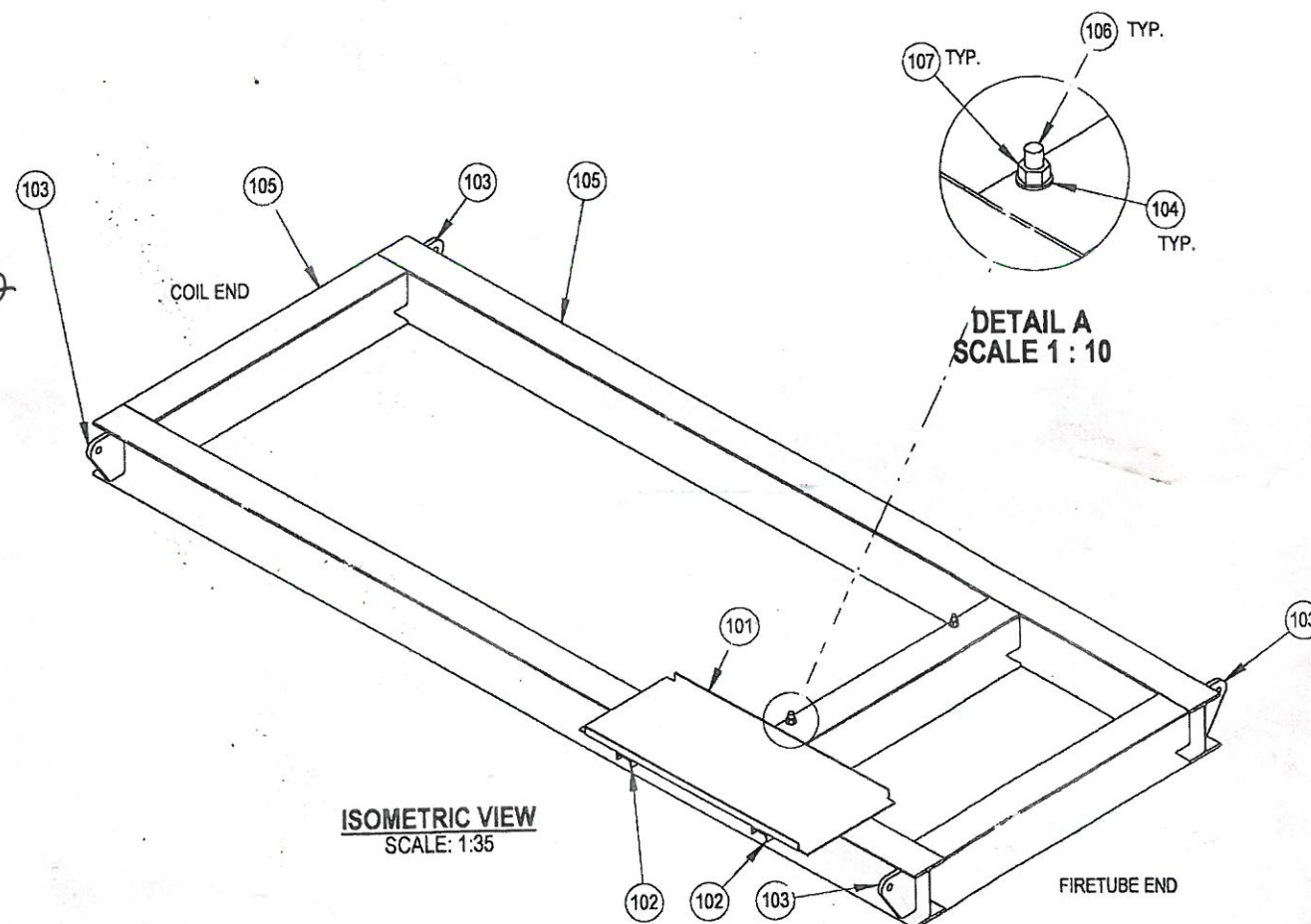
WEIGHT: (APPROX LBS)

NWP INDUSTRIES
LINEHEATER PACKAGES
2.0 MMBTU/HR
62" OD x 240" LONG

SKID DETAILS

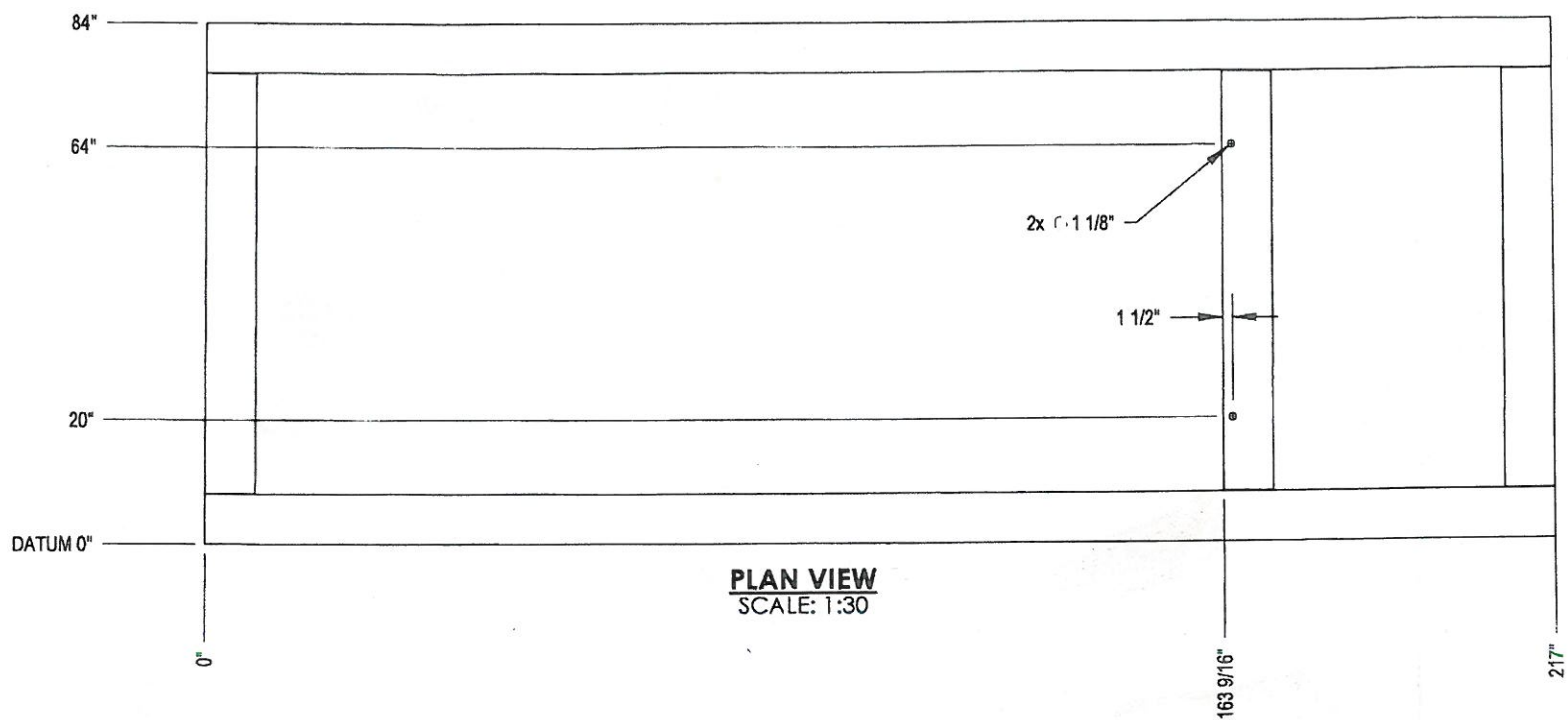
DWN: CT	CHK: <i>[Signature]</i>	APP: <i>[Signature]</i>
DATE: MAY 14/14	DATE: JUL 31 2014	DATE: JUL 31 2014
SHEET: 1 OF 2	DWG: LH2001-C0-000	REV: 0

BILL OF MATERIAL						
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY
101	SEE SHEET 2		5x2' 1/4" FORMED ENCLOSURE TRAY	G40.21-44W		1
102	CHA45.4T		CHANNEL 4" @ 5.4#	G40.21-44W	24 3/4"	2
103	LL-TEMP-NWPL-00006-0		LIFT LUG TEMPLATE 1" THICK x 8" WIDE. AS PER DRAWING NWPL-00006 REV 0			4
104	WAS1YAYA		FLAT WASHER 1" PLATED	GRADE 8		2
105	SEE SHEET 2		SKID BASE DETAILS			1
106	BOL13AAA		BOLT 1" x 3" LG HEX HEAD PLATED	GRADE 8		2
107	NUT1YAAA		NUT 1" HEX PLATED	GRADE 8		2

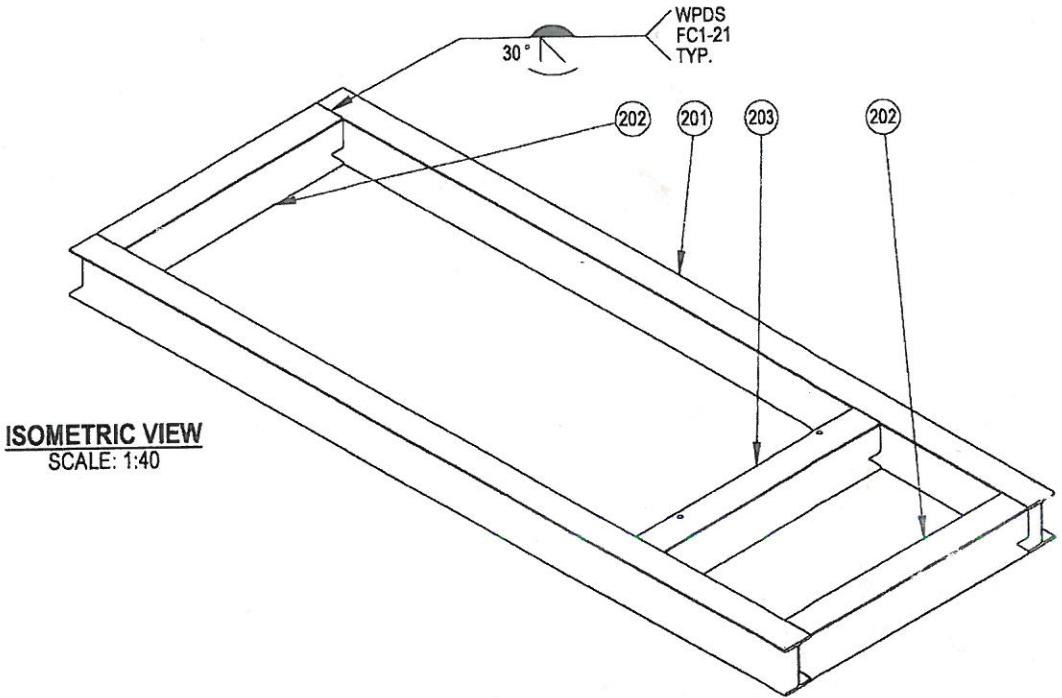


ORIGINAL

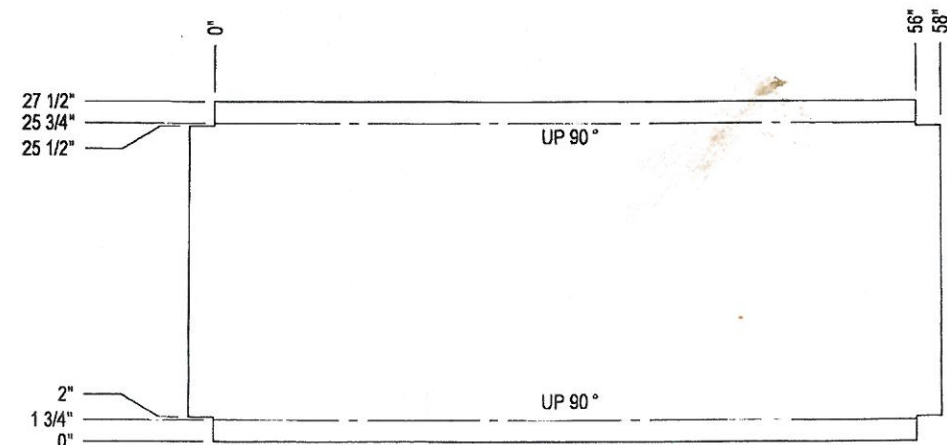
ITEM	PART #	DRAWING #	DESCRIPTION	MATERIAL	SIZE	QTY	MTR #
201	WFL1250T		WIDE FLANGE: 12" x 50#	G40.21-50W	217"	2	
202	WFL1250T		WIDE FLANGE: 12" x 50#	G40.21-50W	75 3/8"	2	
203	WFL1250T		WIDE FLANGE: 12" x 50#	G40.21-50W	75 3/8"	1	



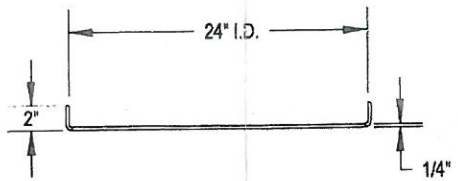
PLAN VIEW
SCALE: 1:30



ISOMETRIC VIEW
SCALE: 1:40





FLAT VIEW OF ITEM # 101
SCALE: 1:15



DETAIL ITEM # 101
SCALE: 1:15

ORIGINAL

- NOTES
- 1.FABRICATE TO CSA W47.1 AND W59
 - 2.ALL DIMENSIONS SHALL HAVE A TOLERANCE OF $\pm 1/8"$ UNLESS OTHERWISE SPECIFIED.
 - 3.COPE STRUCTURAL MEMBERS AS REQUIRED.
 - 4.RADIUS ALL SHARP EDGES.
 - 5.ALL WELDS TO BE $1/4"$ CONTINUOUS FILLET WELDS UNLESS OTHERWISE NOTED.
 - 6.SHOP TO VERIFY ALL I-BEAM CUT LENGTHS PRIOR TO SECTIONING BEAMS.
 - 7.WELDS PROCESS TO BE MCAW UNLESS OTHERWISE NOTED.
 - 8.MPI ON LIFT LUG WELDMENT.

<div style="text-align: center; font-size: 2em; color: red; font-weight: bold;">AS BUILT</div>					ISSUED FOR CONSTRUCTION SIGNED: <i>[Signature]</i> DATE: NOV. 21, 2016 W.O. 09961-001-C		<div style="text-align: center;">  NWP INDUSTRIES INC. LP Total oilfield supply. </div>		NWP INDUSTRIES LINEHEATER PACKAGES 2.0 MMBTU/HR 62" OD x 240" LONG																			
					P.O. BOX 6280, INNISFAIL, AB T4G 1S9 PH: (403) 227-4100 FAX: (403) 227-4102				SKID BASE DETAILS																			
<table border="1"> <thead> <tr> <th>REV.</th> <th>DATE</th> <th>BY:</th> <th>CHK:</th> <th>APP:</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>O</td> <td>JULY 31/14</td> <td>EB</td> <td><i>[Signature]</i></td> <td><i>[Signature]</i></td> <td>ISSUED FOR CONSTRUCTION</td> </tr> <tr> <td>A</td> <td>MAY 14/14</td> <td>CT</td> <td></td> <td></td> <td>ISSUED FOR APPROVAL</td> </tr> </tbody> </table>					REV.	DATE	BY:	CHK:	APP:	DESCRIPTION	O	JULY 31/14	EB	<i>[Signature]</i>	<i>[Signature]</i>	ISSUED FOR CONSTRUCTION	A	MAY 14/14	CT			ISSUED FOR APPROVAL	PROJECTION:  SCALE: AS NOTED WEIGHT: (APPROX) LBS		DWN: CT DATE: MAY 14/14 SHEET: 2 OF 2		CHK: <i>[Signature]</i> DATE: JUL 31 2014 DWG: LH2001-C0-000 REV: 0	
REV.	DATE	BY:	CHK:	APP:	DESCRIPTION																							
O	JULY 31/14	EB	<i>[Signature]</i>	<i>[Signature]</i>	ISSUED FOR CONSTRUCTION																							
A	MAY 14/14	CT			ISSUED FOR APPROVAL																							

Instrumentation & Other QC Documentation



Taylor Valve Technology

8300 Southeast 8th Street

Oklahoma City, Oklahoma

telephone: 405.787.0145 fsscsimile: 405.789.8198

email: info@taylorvalve.com

Date : 19-Dec-16

Sales Order # : 053979

Serial # : **053979-5**

Part # : **82D3341311**

Customer : **KINGS ENERGY SERVICES LTD**

277 Burnt Park Drive

Red Deer County

T4S 0K7

Customer PO # : 33630

Safety Relief Valve Certification

Valve Specifications

Model Number :	Taylor Model 8200 Soft Seat	Orifice :	D
Body Size :	1 Inch	Diameter :	0.404 Inches
Part Number :	82D3341311	Area :	0.128 In2
Body Configuration :	1' MNPT X 1' FNPT	Temperature :	70 oF
Inlet Connection :		Spring Range :	101-215 PSIG
Outlet Connection :		Set Pressure :	150.0 PSIG

Materials

Body :	WCC Carbon Steel	Spring :	17.7 PH Stainless Steel
Seat Frame :	Carbon Steel	Guide :	304 Stainless Steel
Seat Housing :	17-4 PH H900 Stainless Steel	Adj Screw :	Carbon Steel with EN Plating
Trim :	Standard	Options :	None
Seat :	FKM 90d		

Set Pressure Specifications

Set Pressure : 150.0 psig

ASME High Set Limit 154.5 psig

:

ASME Low Set Limit 145.5 psig

:

ASME (90%) rated capacity at set pressure for indicated fluid, specific gravity and temperature.

Certifying Fluid : Air 354 SCFM Spec Gravity : 1.00 Temp : 60 °F

Tested By :

Department : **Manufacturing**

Name : *Garnau Desai*

Approved By :

Department : **Engineering**

Name : *Art Barker*



INSPECTION AND TEST REPORT



ja MAR 16 2016

www.kingsenergy.com
1-866-660-KING

Owner:	NWP	AFE:		Date:	01/04/2016	Job:	77414
Instructions:	<input type="checkbox"/> Rental	<input type="checkbox"/> Quote	<input type="checkbox"/> Pretest	<input checked="" type="checkbox"/> Repair	<input type="checkbox"/> Test Only	<input type="checkbox"/> New	<input type="checkbox"/> Reset
L.S.D.:		Loc:		Plant/Area:	INNISFAIL	Unit/Vessel:	RE-BOILER

Valve Data:	-	Seal:	Intact	Style:	Threaded	Inlet:	MNPT	Outlet:	FNPT
		Seal ID:		Bonnet:	Closed	Inlet Size:	1.00 inches	Outlet Size:	1.00 inches
Make:	Taylor	NamePlate:	Orig/Dupl.	Cap:	Closed	Inlet Rating:		Outlet Rating:	
CRN:	0G1316.2C	Service:	Gas	Orifice:		Capacity:	0 N/A	Cold Diff Set	28 OZ/IN ²
Asset No:	PSV-28262	Product:	Gas	Orifice Area:		Code Stmp:	Non-Code	Set Press:	28 OZ/IN ²
Data Plate:	84-410103	Serial No:	1409-48	Replacing:					

Pilot Data:		Model:		Serial No:	
-------------	--	--------	--	------------	--

Pretest Data:	Test1:	Test2:	Test3:	Units:	Notes1:	Customer Request	Pretest By:	Russ Spencer
Pressures:	27.5	27.5	0	OZ/IN ²	Notes2:			
Media:	Air	Method:	Bench					

Disassembly:	-	Height:		Upper BDR:		Lower DBR:		Dis By:	Carsten Schm
--------------	---	---------	--	------------	--	------------	--	---------	--------------

Inspection:	-	Replaced:	N	Converted:	N	Inspected By:	Russ Spencer
Seat Matl:	316ss	Bonnet Matl:		Sizing Basis:	Blocked Flow	Inlet Condition:	Clean
Body Matl:	Carbon Steel	Bellows Matl:		Spring No:	05-001615	Outlet Cond:	Clean

Part No \ Desc:	Bin Loc:	Condition 1	Condition 2	Recommendation	Work Done	CD Actual
107032 : POLY THERMAL TAG (PTT)	CUPBOARD					
1213772 : DUPLICATE DATA TAG	69J01	Req's Replacing			Replaced	
08-12221910 : 8400 SERIES QUAD RIN	69G04E3	Worn			Replaced	
O ring V216		Worn			Replaced	

Assembly:	-	Converted From:		Converted To:		Assembled By:	Russ Spencer
-----------	---	-----------------	--	---------------	--	---------------	--------------

Final Test:	-	Set Press:	28 OZ/IN ²	Gauge 1:	DG5-1	Vacuum Set:		-	-
-	-	Back Press:	0 OZ/IN ²	Gauge 2:	M-08A	Leakage Vac:		Test Date:	01/12/2016
Media:	Air	Temp:	60 °F	BLD %:		Vacuum Act:		Tested By:	Russ Spencer
Method:	Bench	Corr Factor:	1	Meas Lift:		-	-	Witness:	
Simmer:		Cold Diff Set:	28 OZ/IN ²	Leakage:	0 BPM	Set Press Def:	Initial Audible	-	-
Re-Seat:		Act Test Press:	28 OZ/IN ²	-	-	-	-	-	-

Final Insp:	Tag:	Painted:	Pallet:	Sealed:	End Protect:	Flex Gasket:	Inspector:	Russ Spencer
-	Yes	Yes	No	Yes	Yes	No	Sign Off:	Tim Hansen

Pre-Test Comments:	-
Reset Comments:	
Inspection Comments:	data tag requires updating to reflect new model number. VALVE RANGE IS 2.2 OZ - 4 LBS
Final Test Comments:	-
Sign Off Comments:	

NON CODE

#62



INSPECTION AND TEST REPORT

MAR 16 2016

www.kingsenergy.com
1-866-660-KING



Owner:	NWP	AFE:		Date:	01/04/2016	Job:	77414		
Instructions:	<input type="checkbox"/> Rental	<input type="checkbox"/> Quote	<input type="checkbox"/> Pretest	<input checked="" type="checkbox"/> Repair	<input type="checkbox"/> Test Only	<input type="checkbox"/> New	<input type="checkbox"/> Reset	<input type="checkbox"/> B.E.R	<input type="checkbox"/> VR Update
L.S.D.:		Loc:		Plant/Area:	INNISFAIL	Unit/Vessel:	RE-BOILER		

Valve Data:	-	Seal:	Intact	Style:	Threaded	Inlet:	MNPT	Outlet:	FNPT
		Seal ID:	KRD	Bonnet:	Closed	Inlet Size:	1.00 inches	Outlet Size:	1.00 inches
Make:	Taylor	NamePlate:	Orig/Dupl.	Cap:	Closed	Inlet Rating:		Outlet Rating:	
CRN:	0G1316.2	Service:	Gas	Orifice:		Capacity:	N/A	Cold Diff Set	28 OZ/IN ²
Asset No:	PSV-66661	Product:	Gas	Orifice Area:		Code Stmp:	Non-Code	Set Press:	28 OZ/IN ²
Data Plate:	84-410103	Serial No:	7543-399	Replacing:					

Pilot Data:		Model:		Serial No:	
-------------	--	--------	--	------------	--

Pretest Data:	Test1:	Test2:	Test3:	Units:	Notes1:	Customer Request	Pretest By:	Russ Spencer
Pressures:	28.5	28.5	0	OZ/IN ²	Notes2:			
Media:	Air	Method:	Bench					

Disassembly:	-	Height:		Upper BDR:		Lower DBR:		Dis By:	Tim Hansen
--------------	---	---------	--	------------	--	------------	--	---------	------------

Inspection:	-	Replaced:	N	Converted:	N	Inspected By:	Russ Spencer
Seat Matl:	316ss	Bonnet Matl:		Sizing Basis:	Blocked Flow	Inlet Condition:	Clean
Body Matl:	Carbon Steel	Bellows Matl:		Spring No:	05-001615	Outlet Cond:	Clean

Part No \ Desc:	Bin Loc:	Condition 1	Condition 2	Recommendation	Work Done	CD Actual
107032 : POLY THERMAL TAG (PTT)	CUPBOARD					
08-12221910 : 8400 SERIES QUAD RIN	69G04E3	Worn			Replaced	
1213772 : DUPLICATE DATA TAG	69J01	Req's Replacing			Replaced	
O ring V216		Worn			Replaced	

Assembly:	-	Converted From:		Converted To:		Assembled By:	Russ Spencer
-----------	---	-----------------	--	---------------	--	---------------	--------------

Final Test:	-	Set Press:	28 OZ/IN ²	Gauge 1:	DG5-1	Vacuum Set:		-	-
-	-	Back Press:	0 OZ/IN ²	Gauge 2:	M-08A	Leakage Vac:		Test Date:	01/12/2016
Media:	Air	Temp:	60 °F	BLD %:		Vacuum Act:		Tested By:	Russ Spencer
Method:	Bench	Corr Factor:	1	Meas Lift:		-	-	Witness:	
Simmer:		Cold Diff Set:	28 OZ/IN ²	Leakage:	0 BPM	Set Press Def:	Initial Audible	-	-
Re-Seat:		Act Test Press:	28 OZ/IN ²	-	-	-	-	-	-

Final Insp:	Tag:	Painted:	Pallet:	Sealed:	End Protect:	Flex Gasket:	Inspector:	Russ Spencer
-	Yes	Yes	No	Yes	Yes	No	Sign Off:	Tim Hansen

Pre-Test Comments:	-
Reset Comments:	VALVE IS NON CODE
Inspection Comments:	duplicate data required to reflect corrected model number and set pressure. SPRING RANGE IS 2.2 OZ - 4 LBS
Final Test Comments:	-
Sign Off Comments:	

NON CODE

#61

Certificate of Calibration

Harvie Instruments Ltd. Certifies that this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

/s/ **MAR 09 2016**

Pressure Standard #1 TB-1 Hydraulic Dead Weight Tester 573
Pressure Standard #2 HPTB-2

Client:	NWP Industries	Date:	March 8, 2016
		Cal Due:	March 7, 2017
Device:	Wet Pressure Gauge	Device Accuracy Rating	
Serial #:	NWP-10000-18		1.0 % of Span
Pressure Range:	10,000	PSI	

Final Comparison Results					
Step #	% Scale	Standard PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	1,000	995	-5	-0.1
3	20	2,000	2,010	10	0.1
4	40	4,000	4,010	10	0.1
5	60	6,000	6,005	5	0.1
6	80	8,000	8,010	10	0.1
7	100	10,000	10,015	15	0.2
8	50	5,000	5,005	5	0.1
9	0	0	0	0	0.0
Maximum Deviation				15	0.2

ACCEPTED AT STATED ACCURACY

Calibrated/Certified by or under the direct supervision of:

J. Vincent
J. Vincent
Calibration Technician

Remarks:	Date of First use: July 19/2010.
Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.	



6879A - 52 Ave

Red Deer, AB. Canada T4N 4L2

Ph: 403-347-6001

#55

Certificate of Calibration

Harvie Instruments Ltd. Certifies that this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

MAR 09 2016

Pressure Standard #1 TB-1 Hydraulic Dead Weight Tester 573

Pressure Standard #2 HPTB-2

Client:	NWP Industries	Date:	March 8, 2016
		Cal Due:	March 7, 2017
Device:	Wet Pressure Gauge	Device Accuracy Rating	
Serial #:	NWP-10000-19		1.0 % of Span
Pressure Range:	10,000	PSI	

Final Comparison Results					
Step #	% Scale	Standard PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	1,000	1,010	10	0.1
3	20	2,000	2,015	15	0.2
4	40	4,000	4,015	15	0.2
5	60	6,000	6,010	10	0.1
6	80	8,000	8,040	40	0.4
7	100	10,000	10,070	70	0.7
8	50	5,000	5,000	0	0.0
9	0	0	0	0	0.0
Maximum Deviation				70	0.7

ACCEPTED AT STATED ACCURACY

Calibrated/Certified by or under the direct supervision of:


J. Vincent
Calibration Technician

Remarks:
Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.



6879A - 52 Ave

Red Deer, AB, Canada T4N 4L2

Ph: 403-347-6001

Certificate of Calibration

SEP 11 2015

Harvie Instruments Ltd. Certifies that this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Pressure Standard #1 HPTB #1

Pressure Standard #2 TB-2

Client:	NWP Industries	Date:	September 8, 2015
		Cal Due:	September 7, 2016
Device:	Wet Pressure Gauge	Device Accuracy Rating	
Serial #:	NWP 20001		1.00 % of Span
Pressure Range:	20,000	PSI	

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	2,000	1,925	-75	-0.38
3	20	4,000	3,940	-60	-0.30
4	40	8,000	7,900	-100	-0.50
5	60	12,000	11,840	-160	-0.80
6	80	16,000	15,925	-75	-0.38
7	100	20,000	19,985	-15	-0.08
8	50	10,000	9,850	-150	-0.75
9	0	0	0	0	0.00
Maximum Deviation				160	0.80

ACCEPTED AT STATED ACCURACY

Calibrated/Certified by or under the direct supervision of:

D. Schulze
D. Schulze
Calibration Technician

Date of First Use: Oct 15/2015

Remarks:

Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.



6879A - 52 Ave

Red Deer, AB. Canada T4N 4L2

Ph: 403-347-6001

#4

Certificate of Calibration

SEP 11 2015

Harvie Instruments Ltd. Certifies that this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Pressure Standard #1 HPTB #1

Pressure Standard #2 TB-2

Client:	NWP Industries	Date:	September 8, 2015
		Cal Due:	September 7, 2016
Device:	Wet Pressure Gauge	Device Accuracy Rating	
Serial #:	NWP 20002		1.00 % of Span
Pressure Range:	20,000	PSI	

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	2,000	1,900	-100	-0.50
3	20	4,000	3,935	-65	-0.33
4	40	8,000	7,960	-40	-0.20
5	60	12,000	11,985	-15	-0.08
6	80	16,000	15,990	-10	-0.05
7	100	20,000	20,050	50	0.25
8	50	10,000	9,975	-25	-0.13
9	0	0	0	0	0.00
Maximum Deviation				100	0.50

ACCEPTED AT STATED ACCURACY

Calibrated/Certified by or under the direct supervision of:

Derry Schulze

D. Schulze

Calibration Technician

Date of First Use: Oct 15/2015

Remarks:

Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.



6879A - 52 Ave

Red Deer, AB. Canada T4N 4L2

Ph: 403-347-6001

#29

Issuing Authority: QA/QC Manager

Date of Issue: June 14, 2016
Rev Status: 3



Quality Control

FORM-Certificate of Calibration Form

Page 1 of 1

NWP Industries LP. Certifies this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Calibration Equipment Used: Hydraulic Dead Weight Tester S/N: 2798160

Date: Nov 10 2016
Cal Date: Nov 10th / 2016
Device: Wet Pressure Gauge
Serial #: NWP-300-3
Pressure Range: 0-300 PSI
Device Accuracy Rating
 1.0 % of Span

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	30	33	+3	1.0
3	20	60	62	+2	0.67
4	40	120	119	-1	0.33
5	60	180	179	-1	0.33
6	80	240	240	0	0
7	100	300	300	0	0
8	50	150	148.5	-1.5	0.5
9	0	0	0	0	0
10					
Maximum Deviation				<u>3 PSI</u>	<u>1%</u>

Temperature Range: °C / °F – choose applicable
 Temperature Bath Recorder Deviation
N/A

*Note needs to be $\pm 1^{\circ}\text{C}$ or $\pm 1.8^{\circ}\text{F}$

ACCEPTED AT STATED ACCURACY

Calibration/Certified by or under the direct supervision of:

HAOR O.
Calibration Technician

Remarks: Zero adjusted
 Date of first use:

Issuing Authority: QA/QC Manager



Quality Control

Date of Issue: June 14, 2016

Rev Status: 3

FORM-Certificate of Calibration Form

Page 1 of 1

NWP Industries LP. Certifies this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Calibration Equipment Used: Hydraulic Dead Weight Tester S/N: 2798160

Device: <u>Wet Pressure Gauge</u> Serial #: <u>NWP-2000-81</u> Pressure Range: <u>0-2000</u> PSI	Date: <u>Nov 10 2016</u> Cal Date: <u>Nov 10th / 2016</u> Device Accuracy Rating 1.0 % of Span
---	---

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	200	199	-6	0.3
3	20	400	398	-2	0.1
4	40	800	795	-5	0.25
5	60	1200	1200	0	0
6	80	1600	1600	0	0
7	100	2000	1997	-3	0.15
8	50	1000	997	-3	0.15
9	0	0	0	0	0
10					
Maximum Deviation				<u>6 PSI</u>	<u>0.38</u>

Temperature Range: °C / °F – choose applicable		
Temperature Bath	Recorder	Deviation
	<u>N/A</u>	

*Note needs to be $\pm 1^{\circ}\text{C}$ or $\pm 1.8^{\circ}\text{F}$

ACCEPTED AT STATED ACCURACY

Calibration/Certified by or under the direct supervision of:

Hor O.
Calibration Technician

Remarks:
<u>zero adjusted</u>
Date of first use:

Issuing Authority: QA/QC Manager

Date of Issue: June 14, 2016

Rev Status: 3



Quality Control

FORM-Certificate of Calibration Form

Page 1 of 1

NWP Industries LP. Certifies this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Calibration Equipment Used: Hydraulic Dead Weight Tester S/N: 2798160

Device: <u>Wet Pressure Gauge</u>	Date: <u>Nov 10 2016</u>
Serial #: <u>NWP-1012</u>	Cal Date: <u>Nov 10th / 2016</u>
Pressure Range: <u>0-1000</u> PSI	Device Accuracy Rating 1.0 % of Span

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	100	100	0	0
3	20	200	205	+ 5	0.5
4	40	400	404	+ 4	0.4
5	60	600	606	+ 6	0.6
6	80	800	807	+ 7	0.7
7	100	1000	1009	+ 9	0.9
8	50	500	505	+ 5	0.5
9	0	0	0	0	0
10					
Maximum Deviation				+9 PSI	0.9%

Temperature Range: °C / °F – choose applicable		
Temperature Bath	Recorder	Deviation
	<u>N/A</u>	

*Note needs to be $\pm 1^{\circ}\text{C}$ or $\pm 1.8^{\circ}\text{F}$

ACCEPTED AT STATED ACCURACY

Calibration/Certified by or under the direct supervision of:

Heor O.

Calibration Technician

Remarks:

Date of first use:

Step Wedge Comparison Film Verification Check

NOV 02 2016

As per the requirements ASME V, Article 2, Section T-262.2 and Section T-262.3, the step wedge comparison film noted below has been verified to be within the tolerances of the allowable limits. This verification check is valid for 1 year from the date of verification.

Step Tablet Mfg	Step Tablet s/n	Original Issue	Verification Date	Expiry Date
ESECO	100813-1	Oct 8, 2013	Oct 31, 2016	Oct. 31, 2017

Step #	Stated Density	Actual Density	Deviation (Tolerance +/- 0.1)	Results
0	0.00	0.00	0.00	-
1	0.14	0.14	-0.01	Acceptable
2	0.27	0.28	+0.02	Acceptable
3	0.48	0.48	-0.01	Acceptable
4	0.64	0.65	+0.01	Acceptable
5	0.80	0.77	-0.02	Acceptable
6	0.98	0.97	-0.01	Acceptable
7	1.15	1.14	0.00	Acceptable
8	1.39	1.39	0.00	Acceptable
9	1.61	1.62	+0.01	Acceptable
10	1.77	1.78	+0.01	Acceptable
11	1.99	2.01	+0.01	Acceptable
12	2.21	2.22	+0.01	Acceptable
13	2.41	2.43	+0.02	Acceptable
14	2.58	2.58	0.00	Acceptable
15	2.82	2.81	-0.03	Acceptable
16	3.03	3.04	+0.01	Acceptable
17	3.24	3.22	-0.01	Acceptable
18	3.37	3.37	-0.02	Acceptable
19	3.58	3.59	+0.02	Acceptable
20	4.00	3.98	-0.02	Acceptable
21	4.58	4.58	+0.01	Acceptable

Verification was preformed with LCNDT DT-100 Densitometer S/N: 121279. A copy of the calibration Certificate can be obtained at 1-888-551-1350

Dustin Fikowski
(Mistras Canada Examiner Name)

[Signature]
(Mistras Canada Rep Signature)

Oct 31/16
Date dd/mm/yyyy)

Issuing Authority: QA/QC Manager

Date of Issue: June 14, 2016

Rev Status: 3



Quality Control

FORM-Certificate of Calibration Form

Page 1 of 1

NWP Industries LP. Certifies this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards. *for Sept. 6/2016*

Calibration Equipment Used: Hydraulic Dead Weight Tester S/N: 2798160

Date: <u>Sept 6 /16</u> Cal Date: <u>Sept 6 /16</u>		Device Accuracy Rating 1.0 % of Span
Device: <u>Wet Pressure Gauge</u>		
Serial #: <u>NWP-300-5</u>		
Pressure Range: <u>0-300</u> PSI		

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	30	27	-3	1%
3	20	60	59	-1	0.33
4	40	120	118	-2	0.67
5	60	180	178	-2	0.67
6	80	240	239	-1	0.33
7	100	300	298	-2	0.67
8	50	150	149	-1	0.33
9	0	0	0	0	0
10					
Maximum Deviation				3 PSI	1%

Temperature Range: °C / °F – choose applicable		
Temperature Bath	Recorder	Deviation
<i>N/A</i>		

*Note needs to be $\pm 1^{\circ}\text{C}$ or $\pm 1.8^{\circ}\text{F}$

ACCEPTED AT STATED ACCURACY

Calibration/Certified by or under the direct supervision of:

HEOR D.
 Calibration Technician

Remarks:
Date of first use:

Certificate of Calibration

OCT 16 2015

Harvie Instruments Ltd. Certifies that this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards.

Pressure Standard #1 TB-1 Hydraulic Dead Weight Tester 573

Pressure Standard #2 TB-2 Hydraulic Dead Weight Tester

Client:	NWP Industries	Date:	October 8, 2015
		Cal Due:	October 7, 2016
Device:	Wet Pressure Gauge	Device Accuracy Rating	
Serial #:	NWPG 5000-13		1.0 % of Span
Pressure Range:	5,000	PSI	

Final Comparison Results					
Step #	% Scale	Standard psi	Gauge psi	Deviation psi	% Span
1	0	0	0	0	0
2	10	500	505	5	0.1
3	20	1,000	1,005	5	0.1
4	40	2,000	1,995	-5	-0.1
5	60	3,000	2,970	-30	-0.6
6	80	4,000	3,954	-46	-0.9
7	100	5,000	4,960	-40	-0.8
8	50	2,500	2,480	-20	-0.4
9	0	0	0	0	0.0
Maximum Deviation				46	0.9

ACCEPTED AT STATED ACCURACY

Calibrated/Certified by or under the direct supervision of:

J. Vincent

Calibration Technician

Remarks:

Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.




6879A - 52 Ave

Red Deer, AB. Canada T4N 4L2

Ph: 403-347-6001

#24

Issuing Authority: QA/QC Manager		Quality Control
Date of Issue: Jan 04, 2016 Rev Status: 1		FORM-Certificate of Calibration Form

Page 1 of 1

NWP Industries LP. Certifies this instrument was calibrated using measurement standards traceable to the National Research Council, Institute for National Measurement Standards. *ja* **MAR 16 2016**

Device: <u>Wet Pressure Gauge</u> Serial #: <u>NWP-5000-18</u> Pressure Range: <u>0-5000</u> PSI	Date: _____ Cal Date: <u>March 15/16</u> Device Accuracy Rating 1.0 % of Span
---	---

Calibration Equipment used: Hydraulic Dead Weight Tester S/N: 2798160

Final Comparison Results					
Step #	% Scale	DW PSI	Gauge PSI	Deviation PSI	% Span
1	0	0	0	0	0
2	10	500	503	+3	0.06
3	20	1000	1020	+20	0.4
4	40	2000	2040	+40	0.8
5	60	3000	3050	+50	1.8
6	80	4000	4040	+40	0.8
7	100	5000	5010	+10	0.2
8	50	2500	2550	+50	1.8
9	0	0	0	0	0
10					
Maximum Deviation				50 PSI	+1%

Temperature Range: °C / °F – choose applicable		
Temperature Bath	Recorder	Deviation
<u>N/A</u>		

*Note needs to be $\pm 1^{\circ}\text{C}$ or $\pm 1.8^{\circ}\text{F}$

ACCEPTED AT STATED ACCURACY

Calibration/Certified by or under the direct supervision of:

Hor O.
Calibration Technician

Remarks:
Any number of factors can cause the gauge to drift out of tolerance at any time following its calibration.

#77

Instrument Operations & Maintenance Manual

ACL

Manufacturing Inc.

ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HIGH EFFICIENCY BURNER ASSEMBLY PATENTED BURNER

WARNING

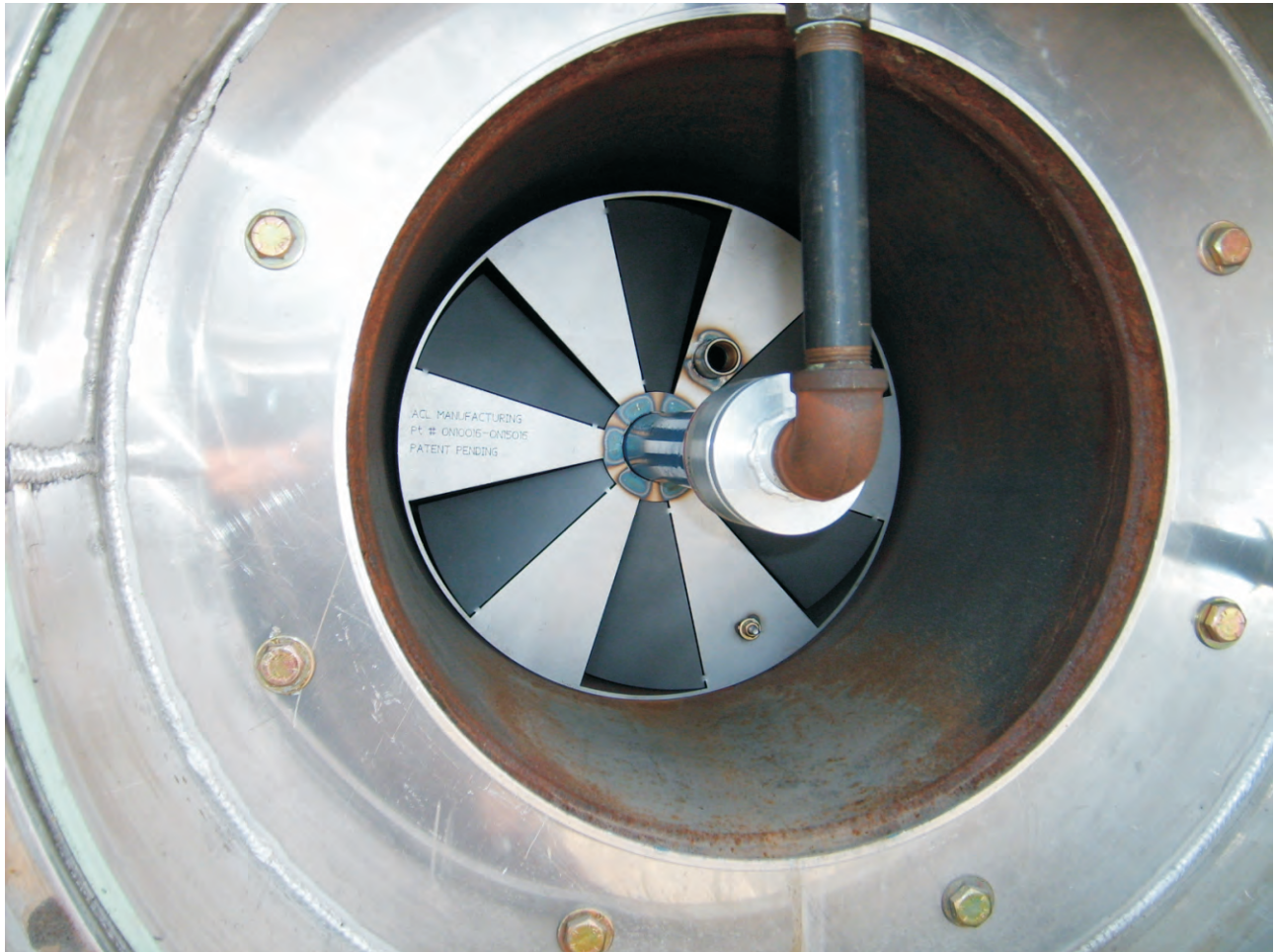
This manual must be read in its entirety before installation of this burner. Installation must be performed by a qualified technician and must adhere to the standards set by the local regulatory authorities.

ACL is not responsible for the misuse or incorrect application of this product.

ACL HIGH EFFICIENCY BURNER ASSEMBLY

Application

The ACL HE-ON burner assembly has been designed for use with atmospheric, natural draft fire tube heating appliances (line heaters, reboilers, dehydrators, tank heaters, etc.) to provide highly efficient and reliable operation. A wide range of burner sizes, easily positioned into any fire tube, are available to meet specific heating requirements. Complete burner assembly includes ACL M series mixer, ON nozzle, pilot, ignitor/flame rod, pre-drilled orifice, and venturi barrel. With the addition of an ACL combustion safety controller and engineered valve train, it completes a cost effective system for safely igniting, monitoring, and controlling the heating process.



ACL HIGH EFFICIENCY BURNER ASSEMBLY

Features

Patented Burner

Primary air control

Low fire / High fire through single burner or separate pilot

High efficiencies (typically 80%)

Safe and reliable ignition / flame sensing

Extremely stable at wide range of pressures (0.5-15 psi)

Ideal for burning low pressure gases such as tank vapors

Quiet operation

Reduced emissions (No CO and low Nox)

No flame impingement on firetubes

No flame lift-off

Unique flame profile that maximizes heat transfer

Easy to install

SST nozzles available upon request



ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL M Series Mixers



M100



M150



M200

ACL ON Nozzles



Single Burner
ON Nozzle



Dual Burner
ON Nozzle

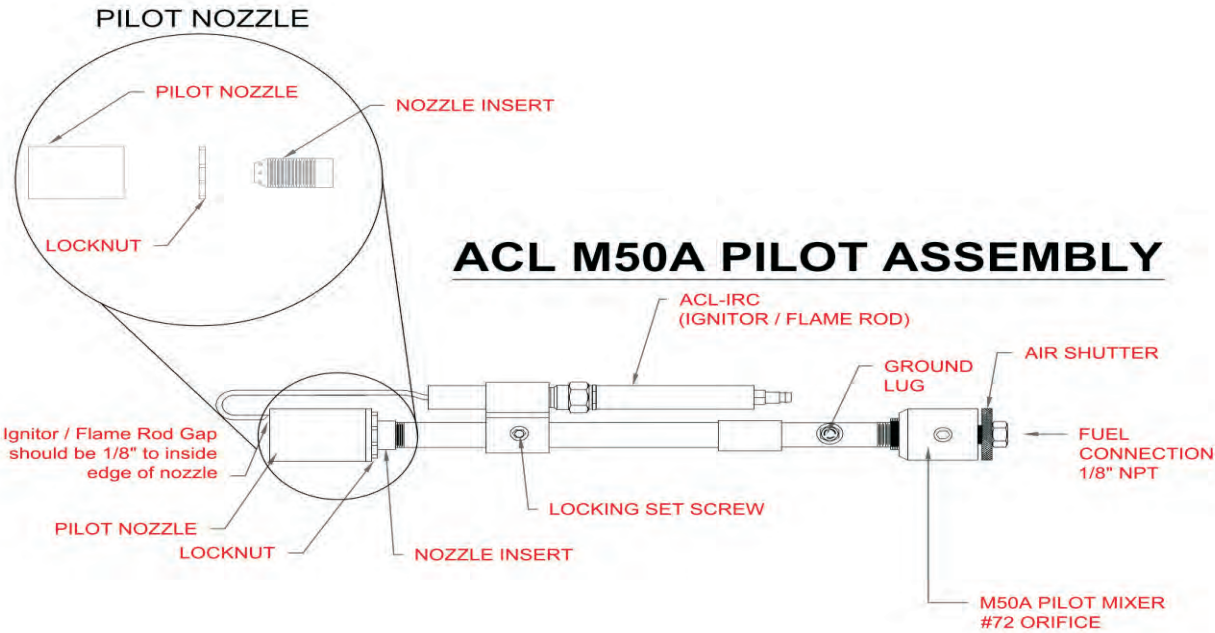
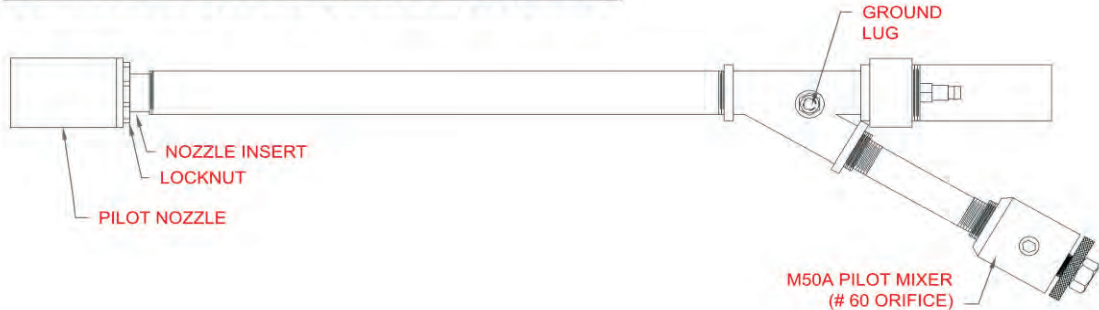


Triple Burner
ON Nozzle

ACL PILOT ASSEMBLIES

ACL-PILOTS

ACL 1500 PILOT ASSEMBLY



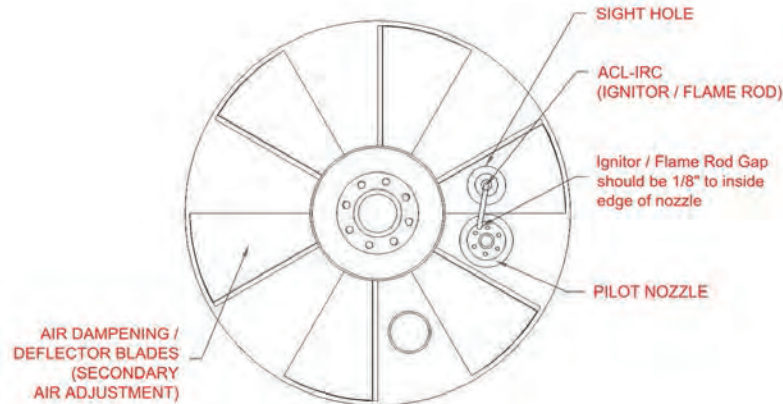
ACL PILOT

Pilot Assemblies		BTU Range	Fuel Connection Size	Auxiliary Air Inlet	Orifice Size	Recommended Application
M50A	Pilot Assembly	Up to 19,000	1/8" NPT	1/4" NPT	#72	Standard Fuel Capacity-Natural Gas/Propane Optional heat return tube to prevent freezing For ideal fuel gas conditions
ACL 1500 PILOT	Pilot Assembly	Up to 48,000	1/8" NPT	1/4" NPT	#60	Larger Fuel Capacity-Natural Gas/Propane Optional heat return tube to prevent freezing For less than ideal fuel conditions
Pilots operate at a recommended pressure range of 2 psi to 7 psi to a maximum of 15 psi Pilots are recommended for burners over 1,000,000 BTU The ACL 1" Burner Assembly accommodate a low fire/high fire pilot up to 1,000,000 BTU. Therefore, no separate pilot is required						

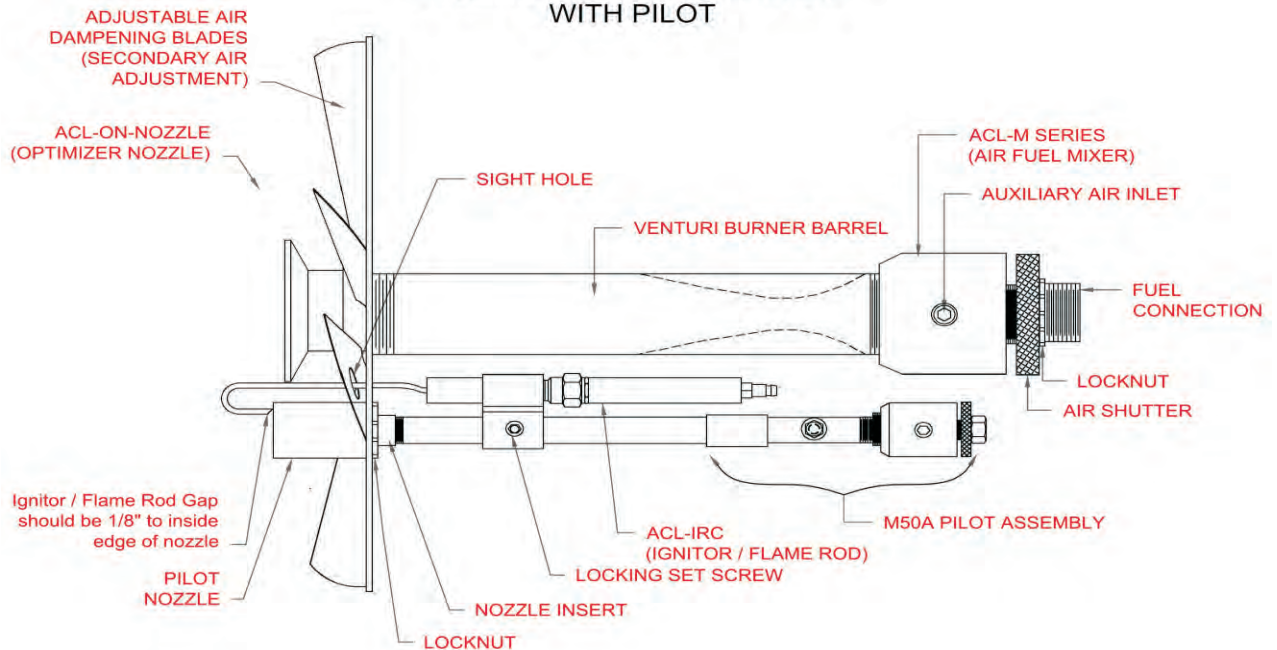
ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HE-ON SINGLE BURNER

ACL HE-ON SINGLE BURNER WITH PILOT
FRONT VIEW



ACL HE-ON SINGLE BURNER
WITH PILOT



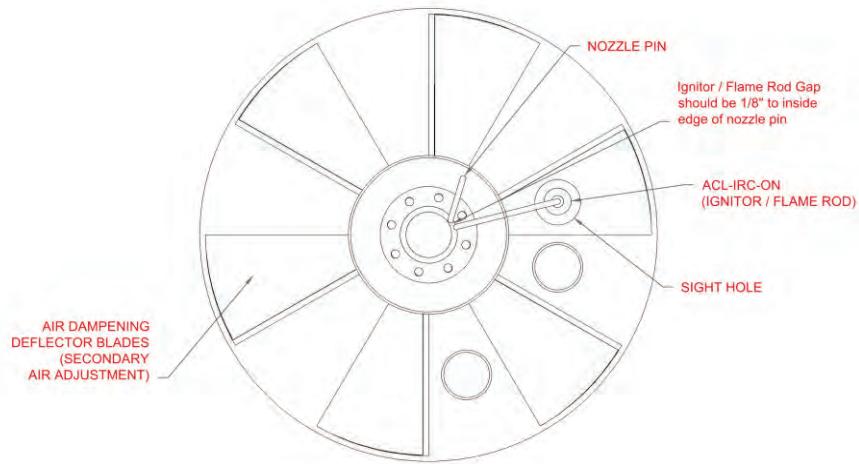
ACL HE - ON SINGLE BURNER

ACL M Series Mixer	Mixer Connection Size	BTU Range	Fuel Connection Size	Auxiliary Air Inlet	Burner Barrel XX=Length Length Range 10" to 36"	ON Nozzle XX=Fire Tube Diameter Diameter Range 4" to 48"
M100	1" NPT	Up to 1,000,000	1/4" NPT	3/8"NPT	B100XX	ON100XX
M150	1½" NPT	Up to 1,500,000	3/4" NPT	1/2" NPT	B150XX	ON150XX
M200	2" NPT	Up to 2,500,000	3/4" NPT	1/2" NPT	B200XX	ON200XX

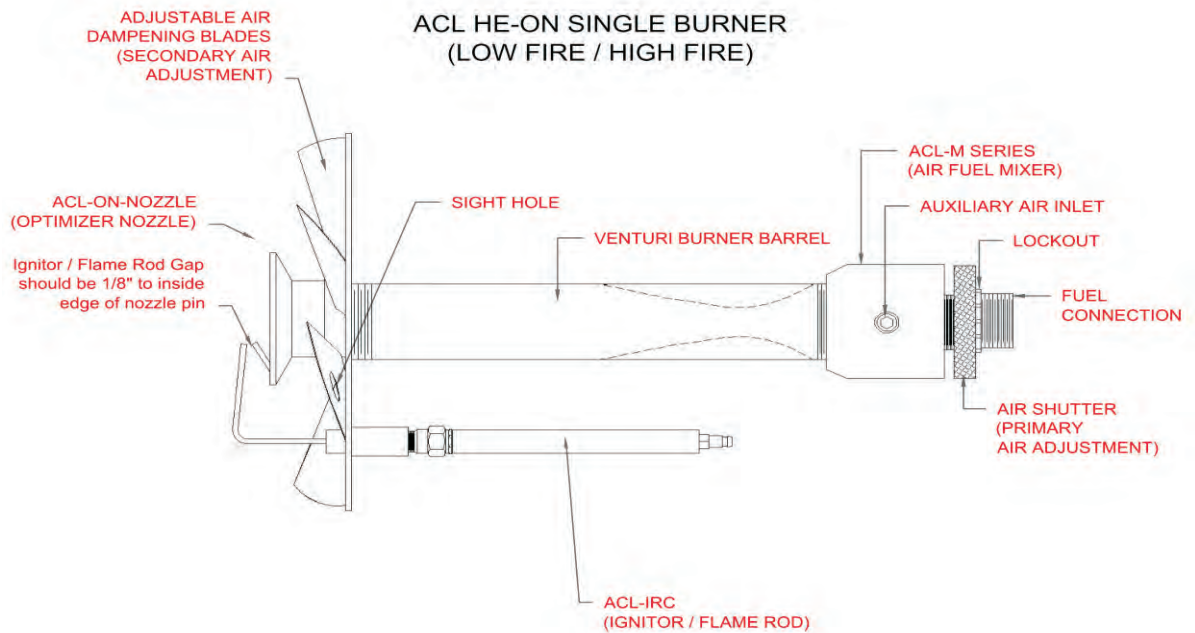
ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HE-ON SINGLE BURNER LOW FIRE / HIGH FIRE

ACL HE-ON SINGLE BURNER LOW FIRE / HIGH FIRE FRONT VIEW



ACL HE-ON SINGLE BURNER
(LOW FIRE / HIGH FIRE)



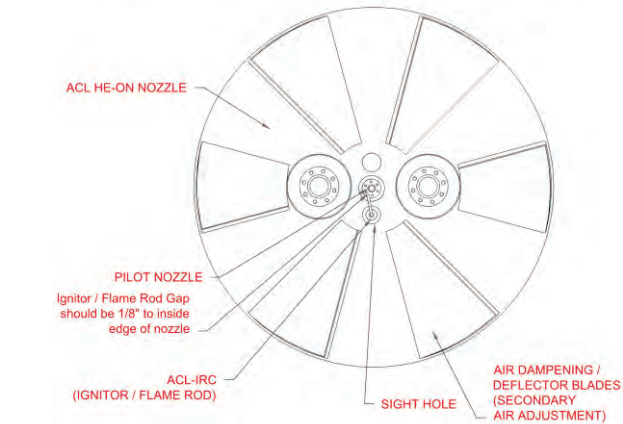
ACL HE - ON SINGLE BURNER

ACL M Series Mixer	Mixer Connection Size	BTU Range	Fuel Connection Size	Auxiliary Air Inlet	Burner Barrel XX=Length Length Range 10" to 36"	ON Nozzle XX= Fire Tube Diameter Diameter Range 4" to 48"
M100	1" NPT	Up to 1,000,000	1/4" NPT	3/8" NPT	B100XX	ON100XX
M150	1 1/2" NPT	Up to 1,500,000	3/4" NPT	1/2" NPT	B150X	ON150XX
M200	2" NPT	Up to 2,500,000	3/4" NPT	1/2" NPT	B200XX	ON200XX

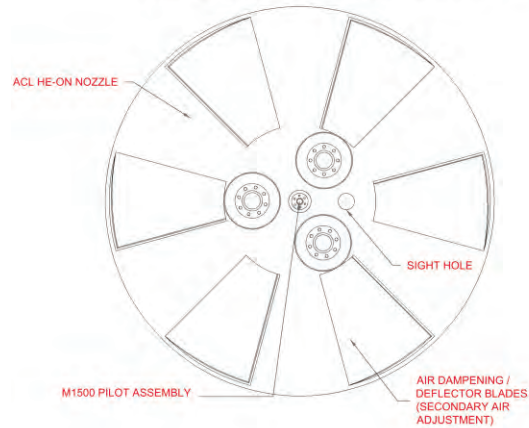
ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HE-ON MULTIPLE BURNER OPTIONS

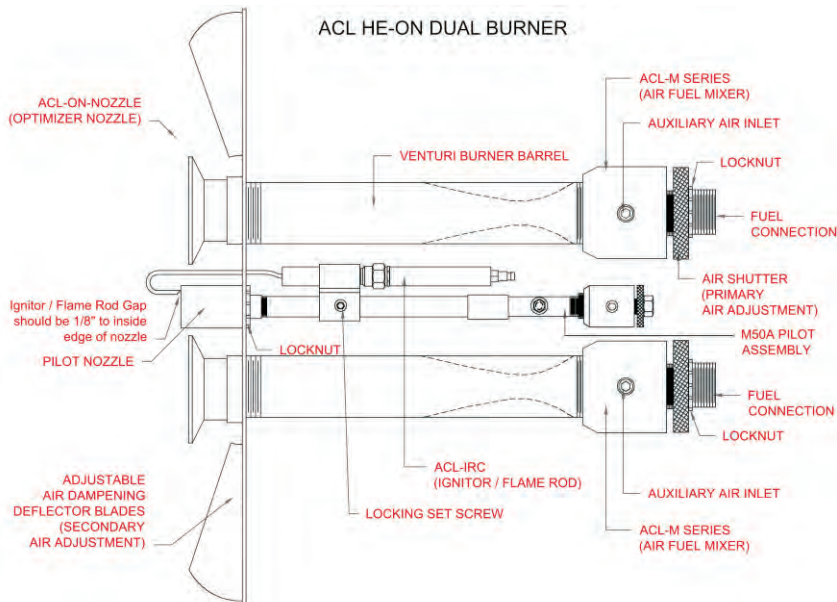
ACL HE-ON DUAL BURNER WITH M50A PILOT FRONT VIEW



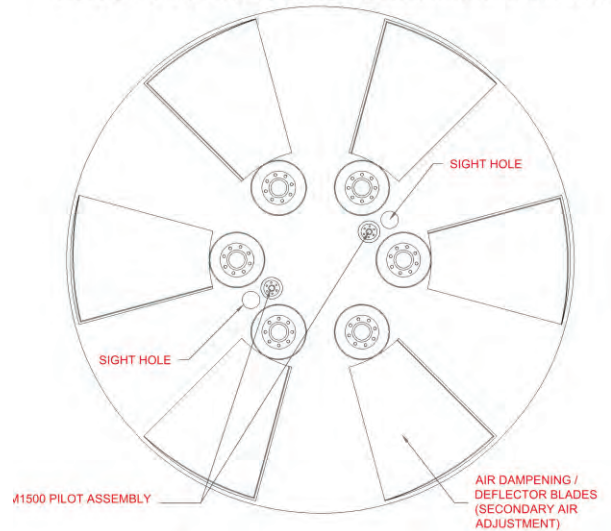
ACL HE-ON TRIPLE BURNER WITH 1500 PILOT FRONT VIEW



ACL HE-ON DUAL BURNER



ACL HE-ON SIX BURNER WITH DUAL M1500 PILOT FRONT VIEW



ACL HE - ON WITH MULTIPLE BURNER OPTIONS

ACL M Series Mixer	Mixer Connection Size	BTU Range	Fuel Connection Size	Auxiliary Air Inlet	Burner Barrel XX=Length Length Range 10" to 36"	ON Nozzle XX=Fire Tube Diameter Diameter Range 4" to 48"
(2) M150	1-1/2" NPT	Up to 3,000,000	(2) 3/4" NPT	1/2" NPT	(2) B150XX	ON2X150XX
(2) M200	2" NPT	Up to 5,000,000	(2) 3/4" NPT	1/2" NPT	(2) B200XX	ON2X200XX
(3) M200	2" NPT	Up to 7,500,000	(3) 3/4" NPT	1/2" NPT	(3) B200XX	ON3X200XX
(6) M200	2" NPT	Up to 15,000,000	(6) 3/4" NPT	1/2" NPT	(6) B200XX	ON6X200XX

Burners are sized at a recommended 9 psi. Operating pressure range is 1 psi to 15 psi

ACL HIGH EFFICIENCY BURNER ASSEMBLY

Mixer / Primary Air Adjustment

ACL M Series Mixers are designed to mix the primary air with the fuel supply to achieve optimum combustion. The amount of primary air coming through the mixer can be altered by adjusting the air shutter. Closing the air shutter allows less primary air to flow and opening the shutter allows more primary air to flow. Also, incorporated into the design of each mixer is an auxiliary air inlet for the addition of pressurized air to be used, if supplied, or the installation of a heat return tube (see Heat Return Tube below.) Each mixer comes with an orifice that can be sized to meet the BTU requirements of the heating application. Orifice size is based on field applications that have proven efficiencies when operating at a fuel gas operating pressure of 9 PSI. Recommended ACL Mixer / Orifice Size for use with propane or natural gas can be found on pages 10 and 11.

ON Nozzle/ Secondary Air Adjustment

ACL ON Nozzles with adjustable air dampening/deflector blades are to regulate the amount of secondary air flow to achieve optimum combustion and a stable flame profile that ensures even heat distribution to the fire tube. Blades are factory set at 30° to control the secondary air, however, further field adjustments may be required to achieve optimum efficiency. Closing the adjustable blades allows less secondary air to flow and opening the adjustable blades allows more secondary air to flow. The low pressure zone, established by the unique design of the ACL ON nozzle, ensures there is no flame lift-off. A Low fire / High fire option is available on 1" ON nozzles up to 1,000,000 BTU.

Burner Barrel

Air/ fuel mixing is maximized by the **ACL Venturi Burner Barrel**. With the ACL M Series Mixer placed in the flame arrestor chamber, the length of the burner barrel should be sufficient to position the ON Nozzle into the wetted section of the fire tube. Ensure proper directional flow of fuel mixture through venturi.

Pilot Assembly

To incorporate the **ACL M50A** pilot assembly, place pilot nozzle insert into non-flexable sight hole on front side of ON nozzle. Attach pilot nozzle to pilot nozzle insert, from backside of ON nozzle until tight. Secure lock nut on front side of ON nozzle. (See diagram on page 5.)

To incorporate the **ACL 1500** pilot assembly, insert barrel/ignitor rod through non-flexable sight hole on front side of ON nozzle. Attach pilot nozzle from backside of ON nozzle until tight. Secure lock nut on front side of ON nozzle. If required, insert heat return tube through flexible sight hole and attach to auxiliary air inlet on mixer.

Heat Return Tube

The **Heat Return Tube** is a 3/8" stainless steel tubing line inserted into the auxiliary air inlet of the ACL M Series mixer and extends into the pilot flame through the sight hole in the ON nozzle. The purpose of this tube is to bring back heat into the mixer, preventing hydrates from forming on the orifice and plugging off gas stream. The amount of heat can be regulated by closing and opening the air shutter on the mixer. Closing the mixer shutter forces more hot air to be drawn into the tube to prevent freezing. The heat return tube may be used on both the pilots and as well as the main burners. All ACL M Series mixers have auxiliary air inlets to provide for this feature.

Ignitor/Flame Rod

Flame acknowledgment and reliable ignition is established by proper positioning of **ACL Ignitor/Flame Rod**. For strongest flame sensing, the Ignitor/Flame Rod gap should be 1/8" to inside edge of pilot nozzle or ON nozzle pin.

Operation

Completely close the air shutter on the ACL HE-ON burner assembly, then open two full turns before igniting. Upon ignition and with stable fuel gas operating pressure, adjust air shutter to achieve a strong blue flame with visible orange tips. Use the locking nut to secure the air shutter in position. For further tuning, the use of a flue gas analyzer is recommended.

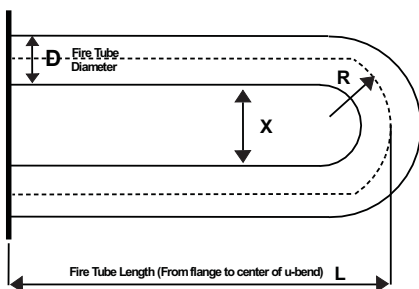
ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HIGH EFFICIENCY BURNER ASSEMBLY

Recommended ACL Mixer/Orifice Size (Propane)

Fire Tube Diameter	Fire Tube Length	Total Net Heat 1. (BTU/HR)	ACL Net Heat Required 2. (BTU/HR)	ACL Mixer	MTD Orifice Size	DIA. IN. Orifice Size
6"	6	221,124	170,095	M100	MTD-51	1/16"
	7.5	273,157	210,120	M100	MTD-48	5/64"
	9	325,190	250,146	M100	MTD-46	5/64"
8"	8	378,200	290,923	M100	MTD-43	3/32"
	10	468,520	360,400	M100	MTD-41	3/32"
	11.5	536,261	412,508	M100	MTD-37	7/64"
10"	10	583,261	448,662	M100	MTD-36	7/64"
	12	696,527	535,790	M100	MTD-31	1/8"
	14	809,100	622,385	M100	MTD-30	1/8"
12"	11	759,354	584,118	M100	MTD-30	1/8"
	14	959,631	738,177	M150	MTD-29	9/64"
	17	1,159,907	892,235	M150	MTD-24	5/32"
14"	12	907,104	697,772	M150	MTD-29	9/64"
	15	1,127,016	866,935	M150	MTD-25	5/32"
	18	1,346,927	1,036,097	M150	MTD-19	11/64"
16"	14	1,204,242	926,340	M150	MTD-24	5/32"
	17	1,455,570	1,119,670	M150	MTD-18	11/64"
	20	1,706,897	1,313,000	M200	MTD-13	3/16"
18"	16	1,543,268	1,187,129	M200	MTD-18	11/64"
	20	1,920,259	1,477,122	M200	MTD-11	3/16"
	23	2,203,003	1,694,617	M200	MTD-51	7/32"
20"	18	1,924,182	1,480,140	M200	MTD-9	13/64"
	22	2,343,061	1,802,354	M200	MTD-3	7/32"
	25	2,657,220	2,044,000	M200	MTD-1	15/64"

Please call for fire tubes not listed for more precise orifice sizing.



Actual ACL M Series Mixer and orifice size may vary by application (values are approximate). Recommended fuel gas operating pressure of 9 psi .

1. Maximum heat transfer of tube.
2. Approximate maximum heat required when using ACL Burner.

D=Fire Tube Inside Diameter

L= Fire Tube Length from
flange to center of U bend

X= Distance between Inside of
Fire Tube

R= Radius of Fire Tube U Bend

ACL HIGH EFFICIENCY BURNER ASSEMBLY

ACL HIGH EFFICIENCY BURNER ASSEMBLY

Recommended ACL Mixer/Orifice Size (Natural Gas)

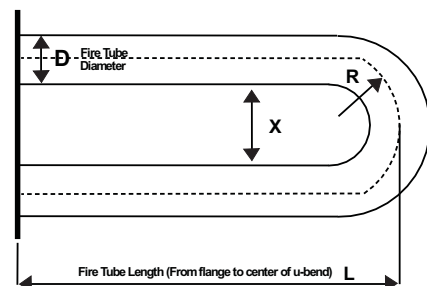
Fire Tube Diameter	Fire Tube Length	Total Net Heat 1. (BTU/HR)	ACL Net Heat Required 2. (BTU/HR)	ACL Mixer	MTD Orifice Size	DIA. IN. Orifice Size
6"	6	221,124	170,095	M100	MTD-44	3/32"
	7.5	273,157	210,120	M100	MTD-42	3/32"
	9	325,190	250,146	M100	MTD-38	7/64"
8"	8	378,200	290,923	M100	MTD-36	7/64"
	10	468,520	360,400	M100	MTD-31	1/8"
	11.5	536,261	412,508	M100	MTD-30	1/8"
10"	10	583,261	448,662	M100	MTD-29	1/8"
	12	696,527	535,790	M100	MTD-27	9/64"
	14	809,100	622,385	M100	MTD-22	5/32"
12"	11	759,354	584,118	M100	MTD-23	5/32"
	14	959,631	738,177	M100	MTD-16	11/64"
	17	1,159,907	892,235	M100	MTD-10	3/16"
14"	12	907,104	697,772	M100	MTD-18	11/64"
	15	1,127,016	866,935	M100	MTD-11	3/16"
	18	1,346,927	1,036,097	M100	MTD-4	7/32"
16"	14	1,204,242	926,340	M100	MTD-9	13/64"
	17	1,455,570	1,119,670	M150	MTD-3	7/32"
	20	1,706,897	1,313,000	M150	MTD-B	15/64"
18"	16	1,543,268	1,187,129	M150	MTD-2	7/32"
	20	1,920,259	1,477,122	M150	MTD-E	1/4"
	23	2,203,003	1,694,617	M150	MTD-H	17/64"
20"	18	1,924,182	1,480,140	M150	MTD-E	1/4"
	22	2,343,061	1,802,354	M200	MTD-J	9/32"
	25	2,657,220	2,044,000	M200	MTD-L	9/32"

Please call for fire tubes not listed for more precise orifice sizing.

Actual ACL M Series Mixer and orifice size may vary by application (values are approximate). Recommended fuel gas operating pressure of 9 psi .

1. Maximum heat transfer of tube.
2. Approximate maximum heat required when using ACL Burner.

D=Fire Tube Inside Diameter X= Distance between Inside of
L= Fire Tube Length from Fire Tube
flange to center of U bend R= Radius of Fire Tube U Bend



ACL

Manufacturing Inc



Website: www.aclmfg.com

Limited Warranty

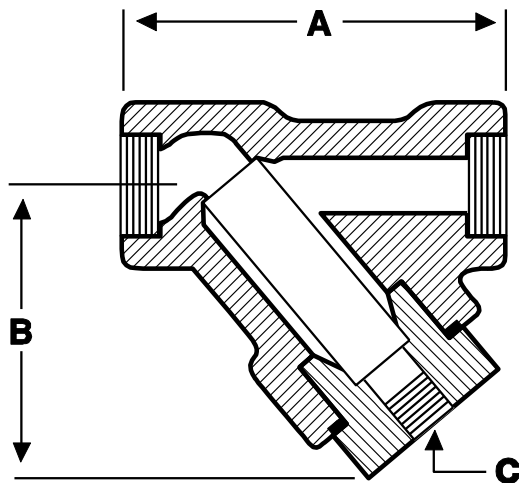
Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any product which is found to be defective in such workmanship or material will be repaired or replaced by Seller for a period of one year from purchase date. Warranty of such items do not include shipping, installation or set-up.

Liability Statement

ACL Manufacturing Inc. Shall not be liable for any special, indirect, consequential or other damages of a like general nature, including, without limitation, loss of profits or production, or loss of expenses of any nature incurred by the buyer or any third party.

805 Main Ave West - Box 2002 Sundre, Alberta T0M 1X0
Phone: (403) 638-5234 - Fax: (403) 638-4973
E-mail: aclmfg@telus.net

ALTA	MODEL YS 3000 CLASS 3000 CARBON STEEL SCREWED / SOCKET WELD "Y" STRAINER	DRAWING A 101
-------------	---	----------------------



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	20670	3000

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
25	1	117	4 5/8	89	3 1/2	15	1/2	1.8	4

FEATURES

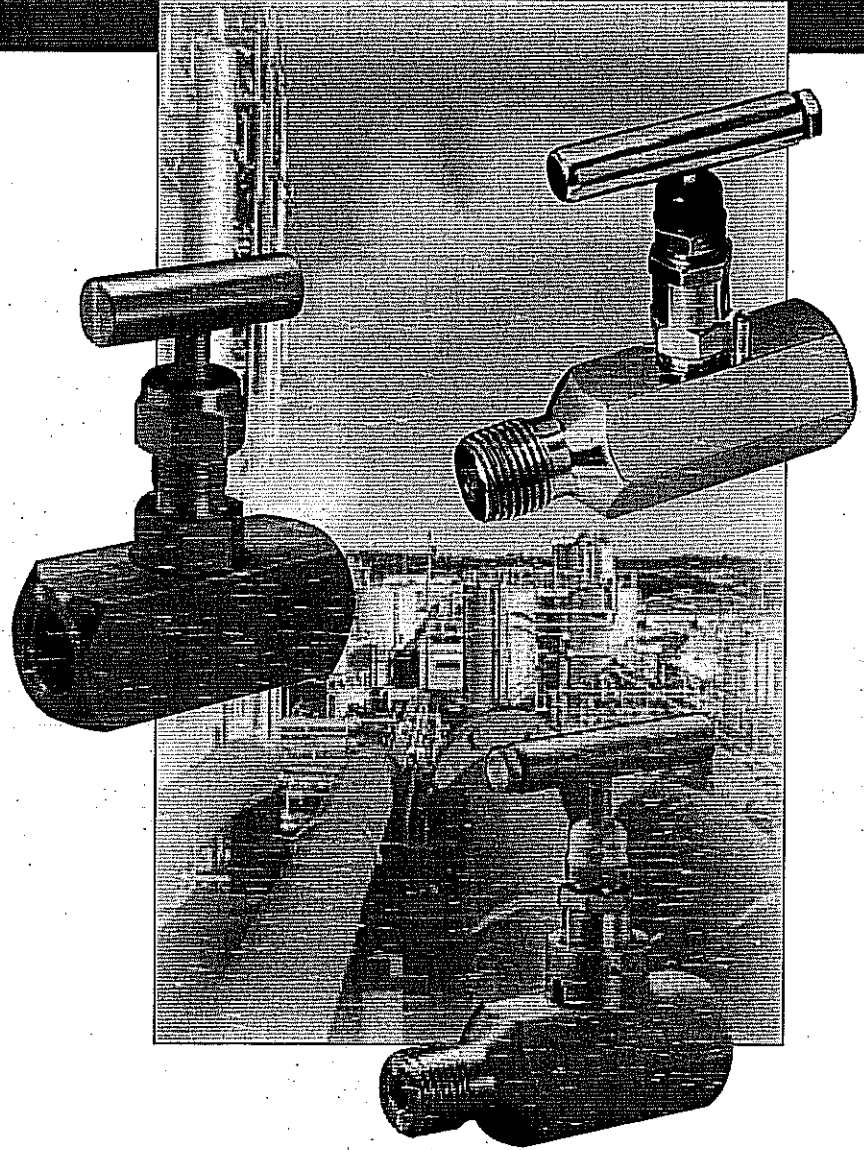
BODY HAS A MACHINED SEAT TO HOLD SCREEN SECURELY.

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.

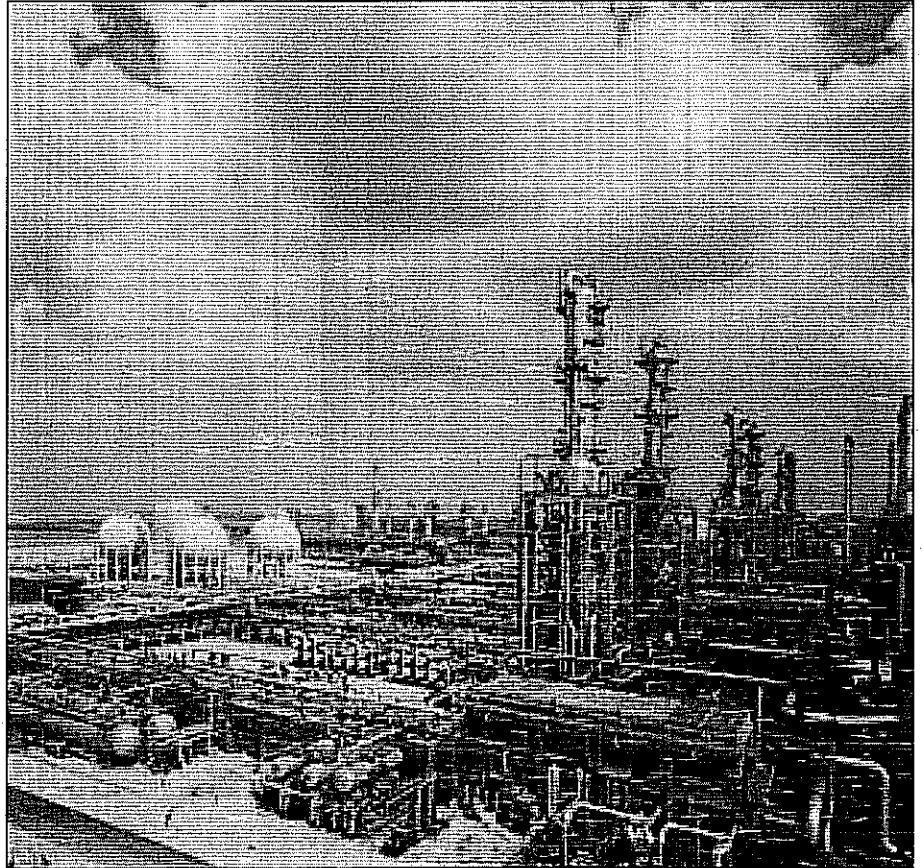
Anderson Greenwood Instrumentation Products - Hand Valves and Accessories

Total Flow Control Solutions™



tyco / *Flow Control*

ANDERSON GREENWOOD INSTRUMENTATION PRODUCTS



Anderson Greenwood is the industry leader in instrument valve technology and the original innovator of the 3-valve manifold. Our capabilities include over 50 years of research, design and manufacture of instrumentation products. Our products are designed to be maintenance free, and are offered with numerous configurations, materials, end connections and special requirements.

Anderson Greenwood Instrumentation Products is either a trademark or registered trademark of Tyco International Services AG or its affiliates in the United States and/or other countries. All other brand names, product names, or trademarks belong to their respective holders.

Contents

Bonnet Technology

1 - 2

Soft Seated Valves: H1 3/16-inch [4.8 mm] and 1/4-inch [6.4 mm] orifice

Product Overview – Features and Benefits	3
Dimensions	4 - 5
Materials	6
Flow Characteristics	7
Pressure/Temperature Ratings	8 - 9
Ordering Information	10 - 11

Soft Seated Valves: H1 3/8-inch [9.5 mm]

Product Overview – Features and Benefits	12
Dimensions	13
Materials and Pressure/Temperature Ratings	14
Flow Characteristics	15
Ordering Information	16

Hard Seated Valves: H7 and H71

Product Overview – Features and Benefits	17
Dimensions and Materials	18 - 19
Pressure/Temperature Ratings	20
Options	21
Ordering Information	22 - 23

Hard Seated Valves: H7 ASME B31.1

Features and Benefits	24
ASME Specifications and Pressure/Temperature Ratings	25
Ordering Information	26

Mini-Valves: H5

Product Overview – Features and Benefits	27
Dimensions	28
Materials and Flow Characteristics	29
Pressure/Temperature Ratings	30 - 31
Options	32
Ordering Information	33

Gauge Siphon: C17

Product Overview – Features and Benefits	34
Dimensions/Materials/Ratings	35
Heat Loss Data	36

Gauge Adapter: GA-HP

Product Overview – Features and Benefits	37
Specifications	38

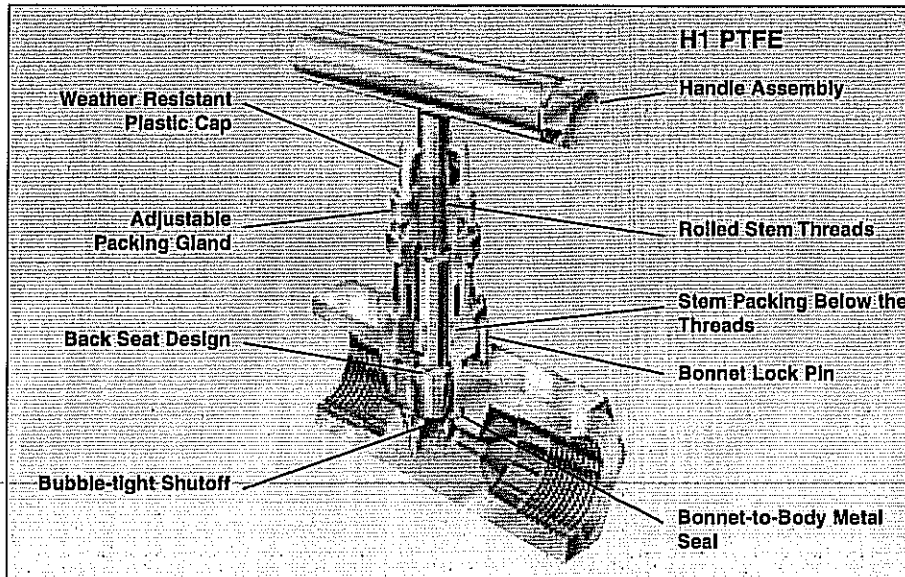
Flow Check Adapter: FCA

Product Overview – Features and Benefits	39
Specifications	40

Bonnet Technology

Soft-Seated Bonnet Assembly

The soft-seated bonnet assembly has a one-piece rotating stem and plug. The stem threads are rolled and lubricated to prevent galling and reduce operating torque. Available with a patented PTFE packing gland, which is adjustable in service, or with a Vilon® O-ring and PTFE backup ring. A protective dust cap is fitted to contain stem lubricant and prevent the ingress of contaminants. The standard hand valves have either 3/16-inch [4.8 mm] or 1/4-inch [6.4 mm] diameter orifice size. All bonnets are assembled with a bonnet locking pin to prevent accidental removal while in service.

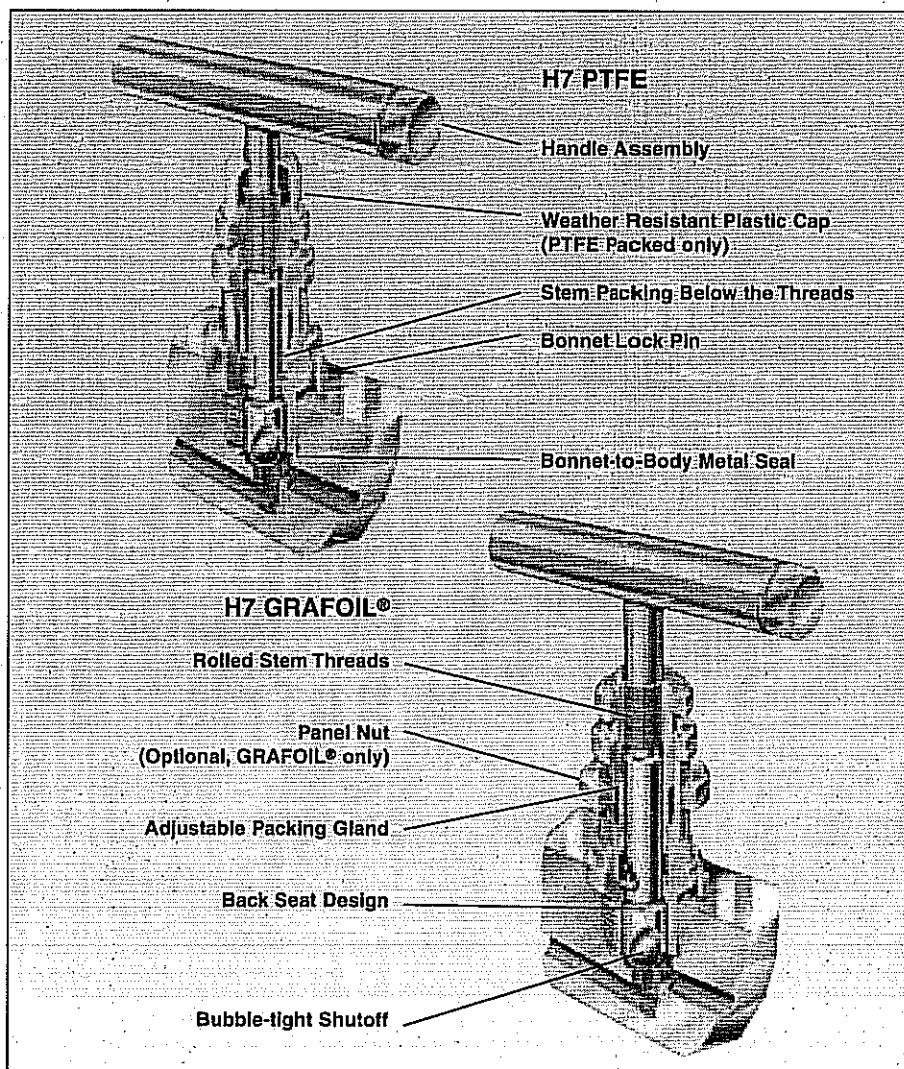


Metal-Seated Bonnet Assembly

The metal-seated bonnet assembly has a rotating stem with free swivel ball-type seat. The stem threads are rolled and lubricated to prevent galling and reduce operating torque. The stem seal is a patented PTFE packing gland which is adjustable in service. A protective dust cap is fitted to contain stem lubricant and prevent the ingress of contaminants. The specially hardened ball seat is ideal for both gas and liquid service. All bonnets are assembled with a bonnet locking pin to prevent accidental removal while in service.

The 10,000 psig [689 barg] bonnet assembly uses a strengthened stem and bonnet. The stem seal is a patented PTFE packing gland which is adjustable in service. A protective dust cap is fitted to contain stem lubricant and prevent the ingress of contaminants. This bonnet is also fitted with a larger size T-bar handle.

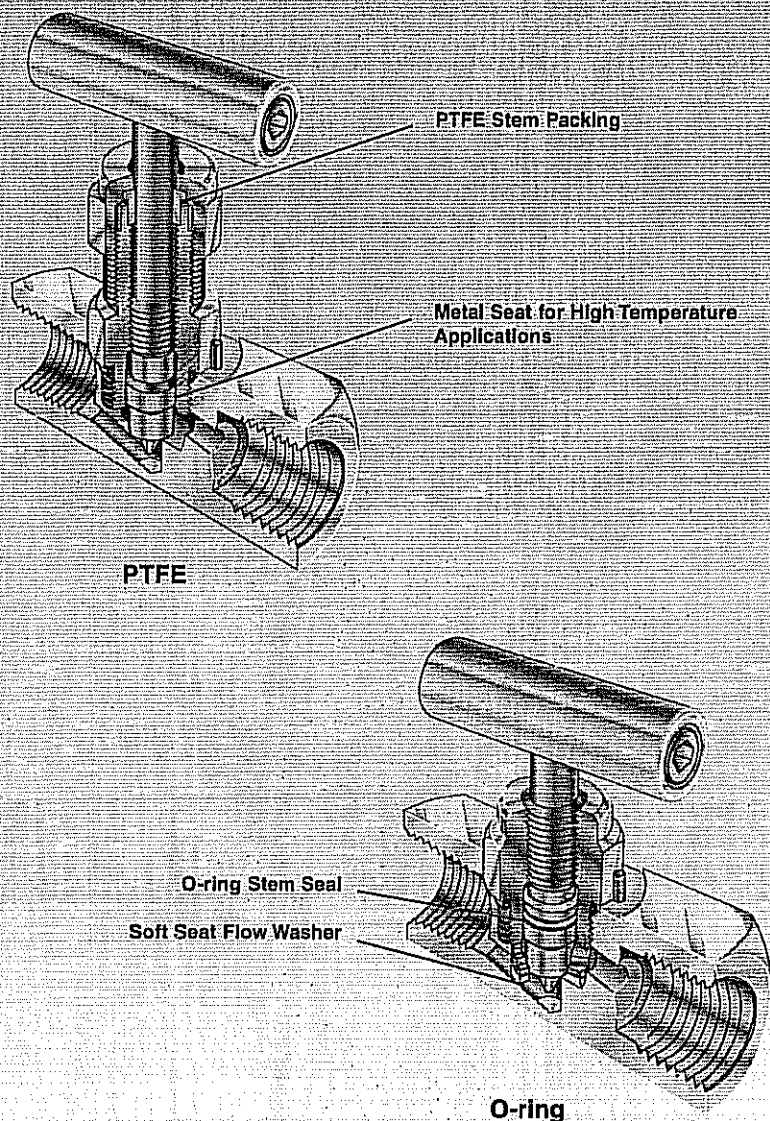
The high-temperature bonnet assembly utilizes a similarly designed stem and bonnet, and incorporates adjustable GRAFOIL® rings and backup pressure rings to ensure a leak-free stem seal.



Notes

1. Vilon® is a registered trademark of the E.I. duPont de Nemours Company.
2. GRAFOIL® is a registered trademark of UCAR Carbon.

Bonnet Technology, continued



Mini-Valve Bonnet Assembly

The mini-valve bonnet assembly has a compact design with a one-piece rotating stem which is 'V' tipped for accurate flow control. The stem threads are rolled and lubricated to prevent galling, and reduce operating torque.

The SS bonnet is fitted with an adjustable PTFE stem packing and is suitable for panel mounting via external bonnet threads. CS and brass bonnets are fitted with a Viton® O-ring stem seal.

A GRAFOIL® packed bonnet suitable for temperatures of up to 500°F [260°C] is available for SS valves only.

Arctic Lube

The low temperature rating for standard Anderson Greenwood carbon steel and 316 stainless steel instrumentation products is -20°F [-29°C] (standard products - standard lubrication). Our -AL (Arctic Lube) option extends the lower temperature limit to -70°F [-57°C] on all carbon steel and stainless steel models.

Soft Seated Hand Valves – H1

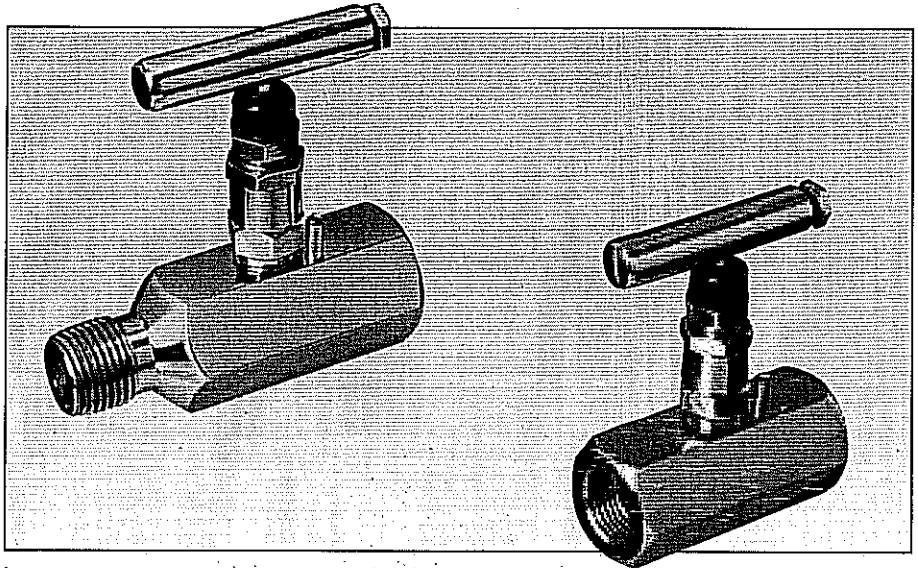
$3/16$ -inch [4.8 mm] and $1/4$ -inch [6.4 mm] Orifice: 6000 and 10,000 psig [414 and 689 barg]

Product Overview

The H1 Series valves are designed for maximum system reliability. The design criteria includes repetitive bubble-tight closure, safety, and a long, trouble-free life with easy maintenance.

Anderson Greenwood utilizes a replaceable soft seat that gives premium tightness at closure, even in dirty service. The H1's straight-through rising plug design provides good regulation and high capacity with bi-directional flow, and is also roddable for easy cleaning.

These valves are standard with a variety of end connections, seat materials, and stem packing, in SS or CS, and are available to meet the requirements of NACE MR0175-2002. All valves are 100 percent pressure tested with material traceability of the body available on request.



Features and Benefits

- **Replaceable soft seat** allows replacement of the soft seat insert without removing the valve from the line. It operates in dirty service with repetitive bubble-tight shutoff.
- **Packing below threads** prevents lubricant washout, thread corrosion, and keeps solids from entering the thread area, which can cause galling. It also prevents process contamination.
- **Adjustable Teflon® packing** adjusts easily: loosen jam nut, tighten bushing slightly, then retighten jam nut. Decreases packing replacement downtime and increases valve life.
- **Dust cover** prevents lubricant washout and keeps contaminants (dirt, rain, etc.) out of bonnet assembly.
- **Safety back seating** prevents stem blowout or accidental removal while in operation and provides a metal-to-metal secondary stem seal while in the full open position.
- **Chrome plating of 316 SS stem** prevents galling or freezing of stem threads when similar metals mate. CS valves use a 303 SS stem.
- **Rolled threads** provide additional thread strength. The stem, bonnet, and male NPT threads are rolled, not cut.
- **Mirror stem finish** burnished to a 16 RMS finish in the packing area enables smooth stem operation and extends packing life.
- **Straight-through flow path** provides high flow capacity, bi-directional flow, and rodding capabilities.
- **Body-to-bonnet seal** is metal-to-metal in constant compression below the bonnet threads. Prevents bonnet thread corrosion, eliminates possible tensile breakage of bonnet, and gives a reliable seal point.

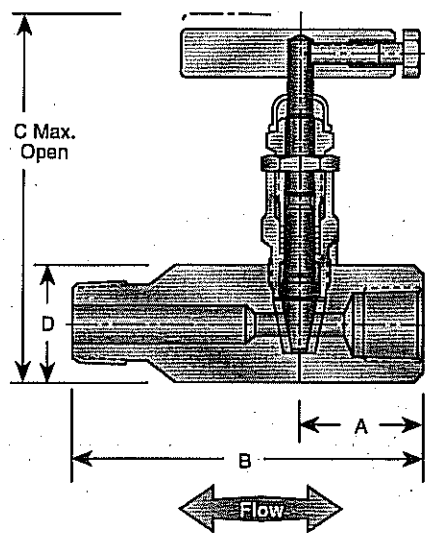
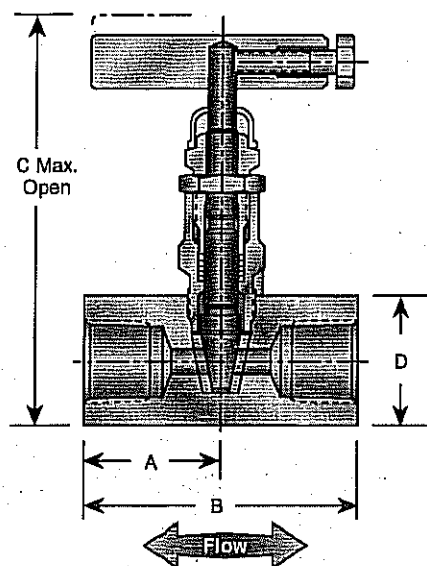
Note

1. Teflon® is a registered trademark of the E.I. duPont de Nemours Company.

H1 Specifications³

³/₁₆-inch [4.8 mm] and ¹/₄-inch [6.4 mm] Orifice: 6000 psig [414 barg]

Dimensions, inches [mm]



FNPT by FNPT

Valve ¹	A	B	C ²	D
¹ / ₄ " F x ¹ / ₄ " F	1.05 [26.7]	2.10 [53.3]	3.70 [94.0]	1.00 [25.4]
¹ / ₂ " F x ¹ / ₂ " F	1.35 [34.3]	2.70 [68.6]	3.85 [97.8]	1.25 [31.7]

FNPT by MNPT

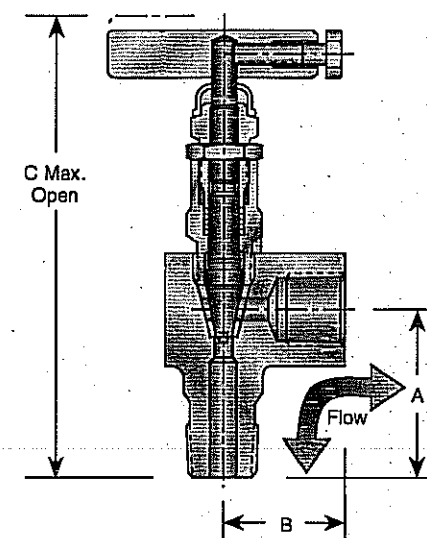
Valve ¹	A	B	C ²	D
¹ / ₄ " F x ¹ / ₄ " M	1.18 [30.0]	3.50 [88.9]	3.70 [94.0]	1.00 [25.4]
¹ / ₄ " F x ¹ / ₂ " M	1.18 [30.0]	3.50 [88.9]	3.70 [94.0]	1.00 [25.4]
¹ / ₂ " F x ¹ / ₂ " M	1.35 [34.3]	3.50 [88.9]	3.85 [97.8]	1.25 [31.7]

Notes

1. Approximate valve weight: 1.3 lb [0.6 kg].
2. Valve C_v maximum
³/₁₆-inch [4.8 mm] – 0.83.
¹/₄-inch [6.4 mm] – 1.40.
3. For Hastelloy® and -SG3 call factory for dimensions and weights.
4. Hastelloy is a registered trademark of Haynes International.

FNPT by MNPT (Angle)

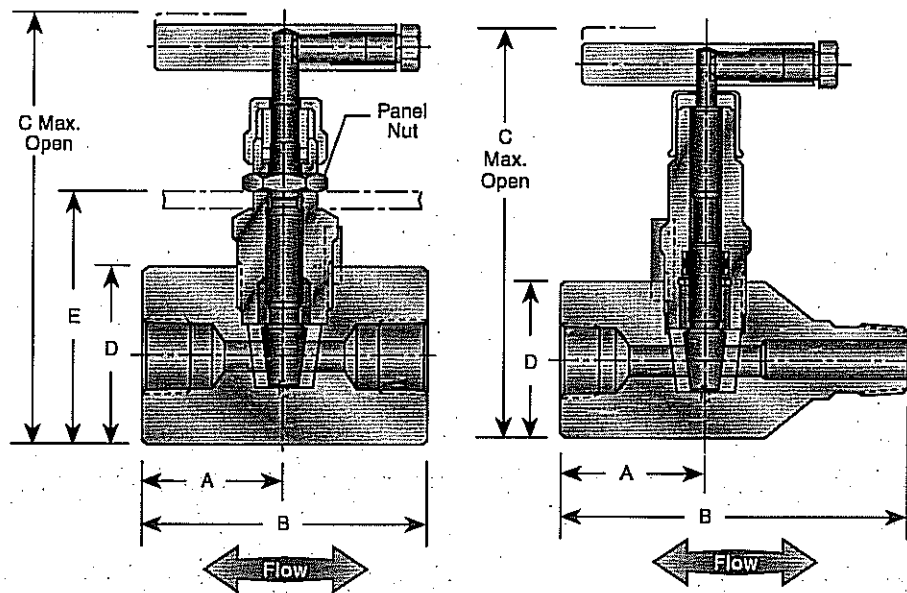
Valve	A	B	C
¹ / ₂ " F x ¹ / ₂ " M	1.73 [43.9]	1.40 [35.6]	5.00 [127.0]



H1 Specifications³

1/4-inch [6.4 mm] Orifice: 10,000 psig [689 barg]

Dimensions, Inches [mm]



Dimensions

Valve ¹	A	B	C ²	D	E
O-ring Packed, Teflon® Packed 1/2" F x 1/2" F	1.50 [38.1]	3.00 [76.2]	4.82 [122.4]	1.75 [44.5]	1.98 [50.3]
O-ring Packed 1/2" F x 1/2" M	1.38 [35.1]	3.70 [94.0]	4.82 [122.4]	1.75 [44.5]	—

Notes

1. Approximate valve weight:
Female x Female 2.7 lb [1.2 kg].
Male x Female 3.0 lb [1.3 kg].
2. Valve C_v 1.4 maximum.
3. For Hastelloy® and -SG3 call factory for dimensions and weights.

H1 Specifications

Standard Materials

H1 — 1/16-inch [4.8 mm] and 1/4-inch [6.4 mm] Orifice: 6000 psig [414 barg]

Valve	Body and Bonnet ¹	Stem	Packing ²	Seat ³
CS	A108	A581-303	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®
SS	A479-316	A276-316 Chrome Plated	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®
SG ⁴	A479-316	Monel® 400	Teflon®	Delrin®
SG3 ⁷	Hastelloy® C-276	Hastelloy® C-276	Teflon®	Delrin®

Standard Materials

H1 — 1/4-inch [6.4 mm] Orifice: 10,000 psig [689 barg]

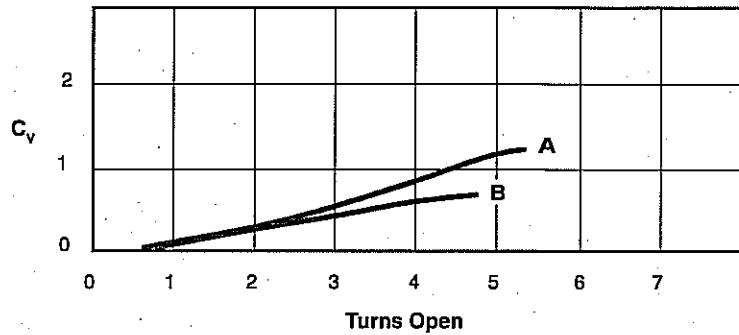
Valve	Body and Bonnet ¹	Stem	Packing ²	Seat ³
CS	A108	A581-303	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®
SS	A479-316	Monel® K500	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®
SG ⁴	A479-316	Monel® K500	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®
SG3 ⁷	Hastelloy® C-276	Hastelloy® C-276	Teflon® or Viton® O-ring with Teflon® backup ring	Delrin®

Notes

1. CS is zinc cobalt plated to prevent corrosion.
2. Teflon® packing is patented.
3. PCTFE (Polychlorotrifluoroethylene is the exact equivalent of Kel-F®), PEEK, and Teflon® seats are also available.
4. SG (Sour Gas) meets the requirements of NACE MR0175-2002.
5. Monel® is a registered trademark of International Nickel Company.
6. Delrin® is a registered trademark of the E.I. duPont de Nemours Company.
7. SG3 (Sour Gas) meets the requirements of NACE MR0175-2003.

H1 Specifications

Flow Characteristics – 3/16-Inch [4.8 mm] and 1/4-Inch [6.4 mm] Orifice



A = 1/4-inch [6.4 mm] orifice, valve C_v 1.4 maximum

B = 3/16-inch [4.8 mm] orifice, valve C_v .83 maximum

Formulas

Liquids

$$Q_L = C_v \sqrt{\frac{(P_1 - P_2) (62.4)}{\rho}}$$

Gases (Where $P_2 > .5P_1$)

$$Q_v = (23.18) C_v \sqrt{\frac{(P_1 - P_2) P_2}{(\text{S.G.}) T}}$$

Gases (Where $P_2 < .5P_1$)

$$Q_v = \frac{(11.59) P_1 C_v}{\sqrt{\text{S.G.} (T)}}$$

Where:

Q_L = Flow (gpm)

Q_v = Flow (scfm)

ρ = Density of Liquid (lb/ft³)

P_1 = Upstream Pressure (psia)

P_2 = Downstream Pressure (psia)

T = Flowing Temperature (°R)
(°R = °F + 460)

ρ (Water) = 62.4 lb/ft³ @ 60°F [16°C]

S.G. = Specific Gravity of Gas
(M.W. of Air/28.96)

S.G. Air = 1.000

S.G. Nitrogen = 0.967

S.G. Oxygen = 1.105

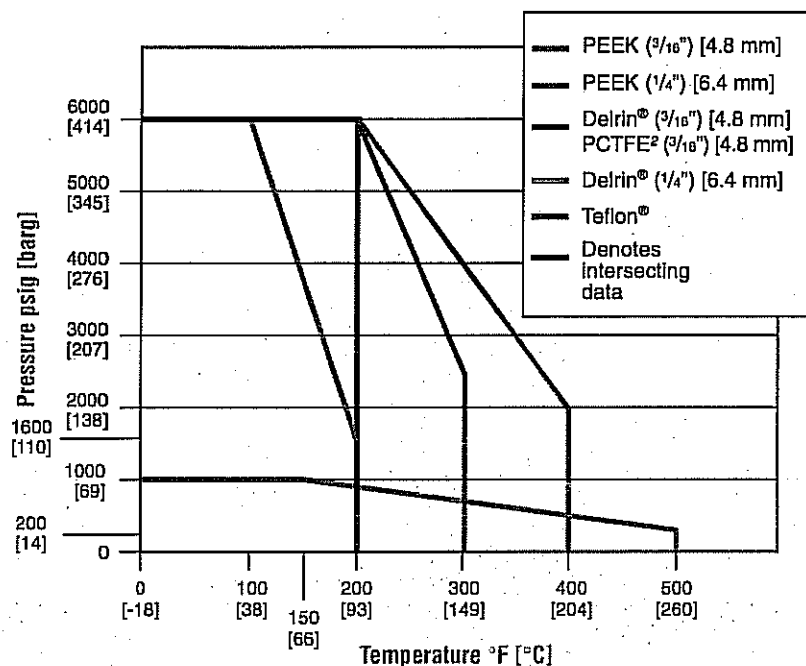
S.G. Helium = 0.138

S.G. Hydrogen = 0.0696

H1 Specifications

3/16-inch [4.8 mm] and 1/4-inch [6.4 mm] Orifice: 6000 psig [414 barg]

Pressure vs. Temperature



Pressure and Temperature Ratings

Valve	3/16-inch [4.8 mm] Orifice	
Delrin® and PCTFE ¹ Seat	6000 psig @ 200°F	[414 barg @ 93°C]
PEEK Seat	6000 psig @ 200°F	[414 barg @ 93°C]
	2000 psig @ 400°F	[138 barg @ 204°C]
Teflon® Seat	1000 psig @ 150°F	[69 barg @ 66°C]
	200 psig @ 500°F	[14 barg @ 260°C]

Valve	1/4-inch [6.4 mm] Orifice	
Delrin® Seat	6000 psig @ 100°F	[414 barg @ 38°C]
	1600 psig @ 200°F	[110 barg @ 93°C]
PEEK Seat	6000 psig @ 200°F	[414 barg @ 93°C]
	2500 psig @ 300°F	[172 barg @ 149°C]

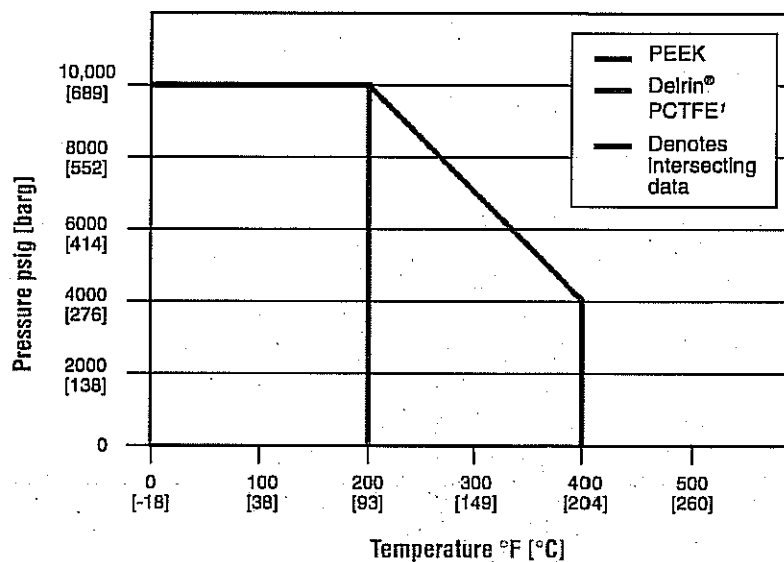
Note

1. PCTFE (Polychlorotrifluoroethylene) is the exact equivalent of Kel-F®.

H1 Specifications

1/4-inch [6.4 mm] Orifice: 10,000 psig [689 barg]

Pressure vs. Temperature



Pressure and Temperature Ratings

Valve	1/4-inch [6.4 mm] Orifice	
Delrin® and PCTFE' Seat	10,000 psig @ 200°F	[689 barg @ 93°C]
PEEK Seat	10,000 psig @ 200°F	[689 barg @ 93°C]
	4,000 psig @ 400°F	[276 barg @ 204°C]

Note

1. PCTFE (Polychlorotrifluoroethylene) is the exact equivalent of Kel-F®.

H1 Specifications

3/16-inch [4.8 mm] and 1/4-inch [6.4 mm] Orifice: 6000 psig [414 barg]

Ordering Information

H1 V D S - 44Q - SG

Packing

- V - Teflon®
- R - Viton® O-ring with Teflon® backup ring

Seat

- D - Delrin® (standard)
- K - PCTFE¹
- E - PEEK
- V - Teflon®

Material

- C - CS
 - S - 316 SS
 - M - Monel® (Teflon® packed only)
 - J - Hastelloy®
- Special alloys available on request.

Connections (Bidirectional)

3/16-inch [4.8 mm] Orifice

- 2 - 1/4-inch F x 1/4-inch F
- 22 - 1/4-inch F x 1/4-inch M
- 24 - 1/4-inch F x 1/2-inch M
- 4Q - 1/2-inch F x 1/2-inch F
- 44Q - 1/2-inch F x 1/2-inch M
- 44QA - 1/2-inch F x 1/2-inch M (Angle)

1/4-inch [6.4 mm] Orifice (Delrin® and PEEK Seats only)

- 4QR - 1/2-inch F x 1/2-inch F
- 44QR - 1/2-inch F x 1/2-inch M

Options

- BL - Bonnet Lock Device (patent protected) (page 21)
- PHB - Phenolic Black Round Handle
- SG - Sour Gas meets the requirements of NACE MR0175-2002 (316 SS only)
- SP - Special Requirements - please specify
- SG3 - Sour Gas meets the requirements of NACE MR0175-2003

Note

1. PCTFE (Polychlorotrifluoroethylene) is the exact equivalent of Kel-F®.

H1 Specifications

H1 1/4-inch [6.4 mm] Orifice: 10,000 psig [689 barg]

Ordering Information

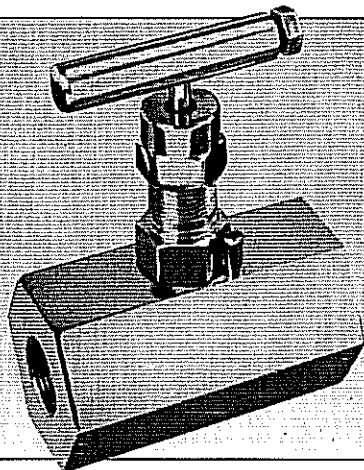
H1	V	D	C	- 4R10	- SP
Packing					
V – Teflon® (Packed bonnet available in CS only)					
R – Viton® O-ring with Teflon® backup ring					
Seat					
D – Delrin® (standard)					
K – PCTFE ²					
E – PEEK					
Body Materials					
C – CS					
S – 316 SS					
J – Hastelloy®					
Connections (Bidirectional)					
4R10 – 1/2-Inch F x 1/2-Inch F					
44R10 – 1/2-Inch M x 1/2-Inch F					
Options					
SG – Sour Gas meets the requirements of NACE MR0175-2002 (316 SS only)					
SP – Special Requirements - please specify					
SG3 – Sour Gas meets the requirements of NACE MR0175-2003					

Note

1. PCTFE (Polychlorotrifluoroethylene) is the exact equivalent of Kel-F®.

Large Bore Hand Valves – H1

$\frac{3}{8}$ -inch [9.5 mm] Diameter Orifice, General Purpose Valve



Product Overview

The $\frac{3}{8}$ -inch [9.5 mm] general purpose, soft-seated hand valve is designed for safe, repetitive bubble-tight closure, simple maintenance, and a long, reliable cycle life.

For premium tightness at closure, even in dirty service, a replaceable soft seat is incorporated on these valves. The straight-through, rising-plug design also provides superior regulation and high capacity (with bi-directional flow), and is roddable for easy cleaning.

This valve is standard with a variety of end connections, seat materials, and stem packing, in SS or CS, and is available to meet the requirements of NACE MR0175-2002. All valves are 100 percent pressure tested with material traceability of the body available on request.

Features and Benefits

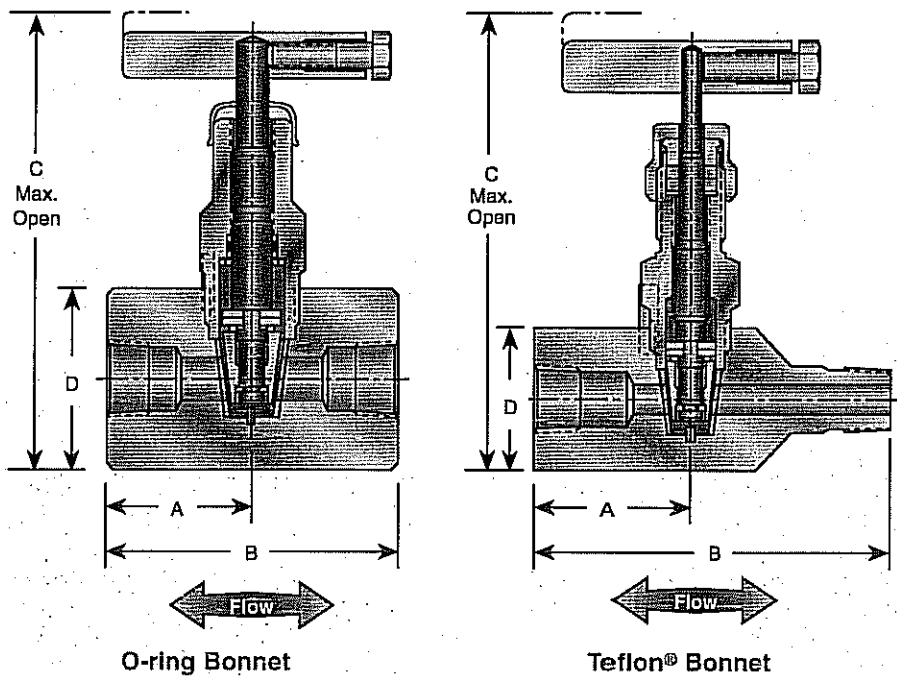
- **Replaceable soft seat** allows replacement of the soft seat insert without removing the valve from the line. It operates in dirty service with repetitive bubble-tight shutoff.
- **Packing below threads** prevents lubricant washout, thread corrosion, and keeps solids from entering the thread area, which can cause galling. It also prevents process contamination.

- **Dust cover** prevents lubricant washout and keeps contaminants (dirt, rain, etc.) out of bonnet assembly.
- **Safety back seating** prevents stem blowout and accidental removal while in operation.
- **Chrome plating of 316 SS stem** prevents galling or freezing of stem threads when similar metals mate. CS valves use a 303 SS stem.
- **Rolled threads** provide additional thread strength. The stem, bonnet, and male NPT threads are rolled, not cut.
- **Mirror stem finish** burnished to a 16 RMS finish in the packing area enables smooth stem operation and extends packing life.
- **Straight-through flow path** provides high flow capacity, bi-directional flow, and rodding capabilities.
- **Body-to-bonnet seal** is metal-to-metal in constant compression, isolating the bonnet threads from process fluid corrosion. Eliminates possible tensile breakage of bonnet, and gives a reliable seal point.

H1 Specifications²

³/₈-inch [9.5 mm] Diameter Orifice

Dimensions, Inches [mm]



Dimensions

End Connection ¹	A	B	C O-ring	C Teflon®	D	Valve Weight lb [kg]
1/2" F x 1/2" F	1.50 [38.1]	3.00 [76.2]	5.76 [146.3]	5.49 [139.4]	1.75 sq [44.5]	3.6 [1.6]
1/2" M x 1" F	1.68 [42.6]	4.38 [111.3]	5.76 [146.3]	5.49 [139.4]	1.75 sq [44.5]	3.6 [1.6]
3/4" F x 3/4" F	2.00 [50.8]	4.00 [101.6]	6.26 [159.0]	6.00 [152.4]	2.25 hex [57.2]	5.4 [2.5]
3/4" M x 3/4" F	2.00 [50.8]	5.00 [127.0]	6.26 [159.0]	6.00 [152.4]	2.25 hex [57.2]	5.4 [2.5]
1" F x 1" F	2.00 [50.8]	4.00 [101.6]	6.26 [159.0]	6.00 [152.4]	2.25 hex [57.2]	5.4 [2.5]
1" M x 1" F	2.00 [50.8]	5.00 [127.0]	6.26 [159.0]	6.00 [152.4]	2.25 hex [57.2]	5.4 [2.5]

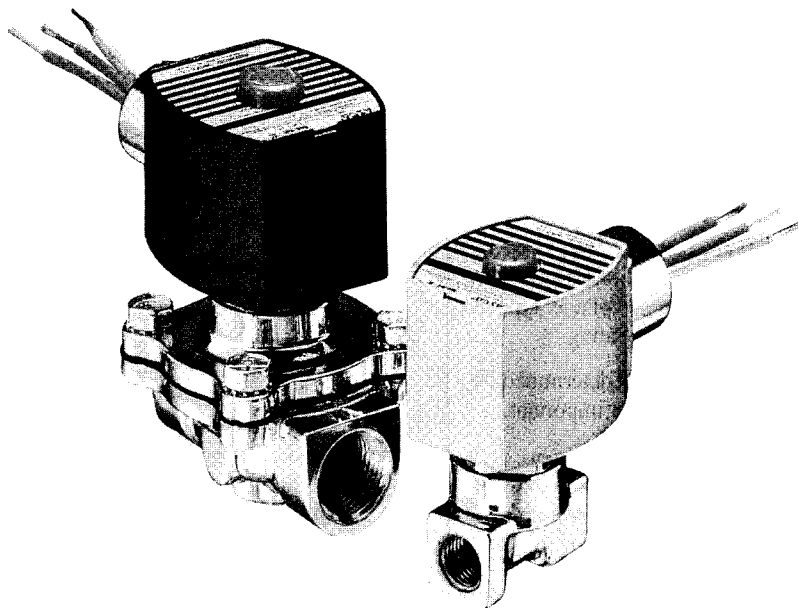
Notes

1. Valve C_v 3.0 maximum.
2. For Hastelloy® and -SG3 call factory for dimensions and weights.

ASCO[®] Red-Hat[®] and *Red-Hat II*[®]

Solenoid Valves

**SELECTION
INSTALLATION/MAINTENANCE
TROUBLESHOOTING**



ASCO[®]

ASCO Valve Canada

HOW TO SELECT

ASCO® Red-Hat and Red-Hat II Solenoid Valves

ASCO Red-Hat and Red Hat II^① solenoid valves for the control of fluids are available in thousands of varieties, each designed to meet specific requirements. Many features are readily apparent and easily understandable; others are more complex and require special knowledge to select the best valve for your control application.

For example, selecting a valve too large for the application will usually involve needless initial cost; selecting a valve too small will usually lead to poor fluid control for the application.

Valves fall into four basic construction groups:

Two way Valves – have one inlet and one outlet pipe connection and are available for normally closed and normally open operations. Normally closed valves are closed when the valve is de-energized and open when the proper voltage is applied to the coil. Normally open valves are open when de-energized and close when the coil is energized.

Three way Valves – have three pipe connections and two orifices which are alternately open or closed. These valves are available normally closed, normally open, or with universal construction which can be used as normally closed or normally open. Three way valves are generally used as pilots for larger control valves, to actuate single-acting cylinders, or to divert the flow of fluids.

Four way Valves – usually have four pipe connections: one for pressure, one for exhaust, and two to operate double-acting cylinders. They are also used to pilot larger control valves.

Manual Reset Valves – must be opened or closed manually, then revert to their original position when, depending on the construction, they are energized or de-energized. They are used to prevent inadvertent startup of critical systems.

After determining the basic valve type, consideration must be given to pipe size; orifice size, flow rate, pressure rating, medium to be controlled, ambient and fluid temperatures, voltage, type of solenoid enclosure, cycling rate and required life rating.

Although the relative importance of each factor is determined by the application itself, valve size is usually the most important.

Valve Sizing

Valve configuration and orifice size, as well as the viscosity, specific gravity and temperature of the controlled medium have the greatest influence on determining proper valve size.

All variables affecting the selection have been reduced to a single parameter known as the flow coefficient (Cv.). ASCO provides graphs for determining Cv values, and displays those Cv values for each valve in its product catalogue. This makes it easier to select the proper valve to meet your particular flow requirements.

Pressure Ratings

Pressure rating is directly related to orifice size. For direct acting valves which operate from zero to maximum pressure, the pressure rating decreases as orifice size increases.

Large valves, and those rated for high pressures, are offered in

pilot-operated versions in which fluid line pressure operates the valve. These valves have a pilot and bleed orifice, and are usually of the diaphragm or piston type. For proper operation, a minimum pressure differential of 2 to 10 psi (depending on construction) is required between the inlet and exhaust ports.

The minimum and maximum pressure ratings for these valves are listed in the ASCO catalogue and are shown on the valve nameplate. Special care must be taken not to excessively oversize an internally piloted valve. Pressure drop or flow through the valve may be insufficient to lift the piston or diaphragm off the orifice, resulting in little or no flow.

In some designs, heavy-duty solenoid coils are used to increase the pressure rating for a given orifice size.

Pressure ratings should be as close as practicable to system pressure.

A valve will not open against pressure significantly higher than the valve's rating. The solenoid's magnetic circuit will not be completed, causing the coil to draw excessive current and burn out.

Conversely, if the system pressure is significantly lower than the valve's rating, the high impact of the solenoid core against the plug nut will cause excessive wear and reduced life.

For best results, select a valve with a pressure rating which is only slightly greater than system pressure.

Medium Compatibility

Valve materials and constructions are compatible with a wide variety of media: air, water, oil, steam, and corrosive and non-corrosive gases and liquids. It is essential that the valve you select be compatible with your controlled medium.

ASCO valve bodies and internal parts are stainless and carbon steel, aluminum, brass, and a wide variety of plastics and elastomers. The ASCO catalogue specifies media compatibility for each valve.

Solenoid Coil Insulation

A coil's worst enemy is heat. Prolonged periods at excessive temperatures lead to thermal degradation of coil insulation. This heat may come from high-temperature fluids passing through the valve, from the electrical energy spent in the coil, or simply from the air around it. The temperature which results from all these sources will determine the required coil insulation class.

Nominal maximum permissible ambient temperatures are based on test conditions used by Underwriter's Laboratories, Inc. to determine safe coil insulation temperatures. Tests are conducted with coils continuously energized and valves at maximum fluid temperatures.

The epoxy-molded coils and solenoids used in ASCO Red-Hat and Red-Hat II valves are resistant to thermal degradation; they dissipate heat more effectively than paper-section coils. They also resist moisture, chemical attack, fungi, and mechanical stress, significantly increasing their life.

^① ASCO's new generation of solenoid valves, Red-Hat II, features one-piece epoxy encapsulated solenoids.

Coil Operating Voltage

Standard voltage ratings are 6, 12, 24, 120, 240, and 480 volts AC, and 6, 12, 24, 120 and 240 volts DC.

Red-Hat and Red-Hat II valves operate satisfactorily on voltage reductions as much as 10 - 15% below nominal (depending on construction), and can withstand as much as 10% over voltage for brief periods.

Power Consumption

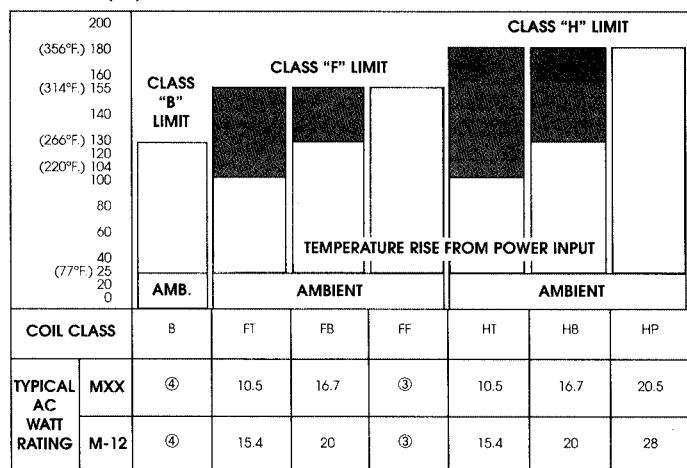
Power consumption can be determined from the ratings shown for each valve series shown in the ASCO catalogue. For AC valves, the watts, volt-ampere "inrush" (the high, momentary surge occurring at coil energization) and volt-ampere "holding" (the continuous draw following inrush) are given.

The current rating for inrush and holding may be determined by

ENCLOSURE TYPE DESIGNATIONS

Enclosure Type	Location	Application Criteria
1	Indoor	General purpose; normal atmospheric conditions
2	Indoor	Drip-proof.
3	Outdoor	Dust-tight, rainproof, and sleet (ice) resistant.
3S	Outdoor	Dust-tight, rainproof, and sleet (ice) proof.
4	Indoor	Watertight and dust-tight.
4X	Indoor	Watertight, dust-tight, and corrosion resistant.
6	Indoor/Outdoor	Submersible, watertight, dust-tight, and sleet (ice) resistant.
7	Indoor	Hazardous locations. Suffix to type (Class I and Group A, B, C or D) complete designation from definitions in National Electrical Code.
9	Indoor	Hazardous locations, combustible dust. Class I and Group E, F or G suffixes from National Electrical Code.

FINAL TEMP. (°C.)



INDUSTRIAL TEMPERATURE LIMITATIONS^① AND THERMAL CHARACTERISTICS OF ASCO RED-HAT SOLENOIDS AND COILS

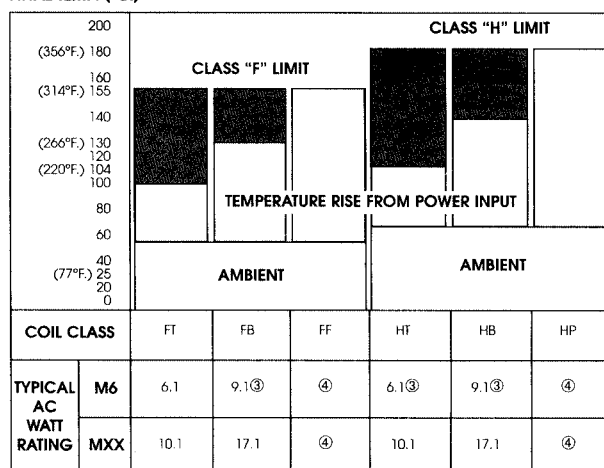
The typical watt ratings given show the relationship between different classes of coil insulation and the watt ratings to achieve higher temperature capabilities. The information contained in these tables applies only to non-explosionproof constructions.^⑤



② Excess margin for higher fluid or ambient temperature

- ① As measured by the "Resistance Method"
 ② Ambient temperatures are directly additive to coil rise - fluid temperature is not.
 ③ Only available in limited watt ratings. Consult ASCO when required.
 ④ Only available in M-5 and MLXX solenoid sizes.
 ⑤ Because of explosionproof codes and surface temperature limitations, the maximum listed ambients for specific valves should not be exceeded. Consult factory concerning explosionproof applications where higher than listed ambients are encountered.

FINAL TEMP. (°C.)



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dividing the volt-ampere rating by the voltage:

$$\frac{\text{Inrush}}{\text{Amps}} = \frac{\text{volt-amp inrush}}{\text{voltage}}$$

$$\frac{\text{Holding}}{\text{Amps}} = \frac{\text{volt-amp holding}}{\text{voltage}}$$

DC valves have no inrush current. The amp rating can be determined by dividing the voltage into the DC watt rating:

$$\frac{\text{Amps}}{\text{Amps}} = \frac{\text{watts (DC)}}{\text{voltage}}$$

Solenoid Enclosures

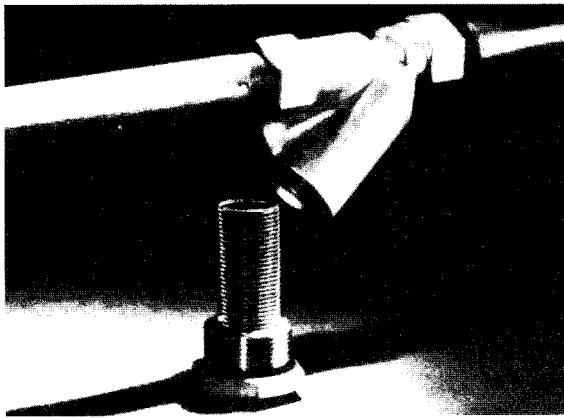
ASCO Red-Hat II solenoid enclosures have one-piece molded epoxy construction with an integral 1/2" N.P.T. conduit hub. The epoxy encapsulation serves as the enclosure. The magnetic frame is molded into the coil.

ASCO Red-Hat solenoid valves have an enclosure which is separate from the coil. The enclosure should be kept in place at all times because, with many types, it provides part of the magnetic circuit. Removal of the enclosure can reduce solenoid efficiency and expose the mechanism to damage.

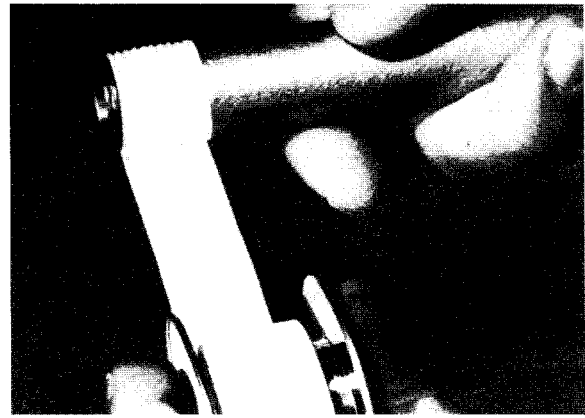
For optional electrical features such as junction boxes, spade and screw terminal coils, and DIN-type connections, consult ASCO catalogue.

Cycling Rate and Estimated Life

When controlling unlubricated air or dry, inert gas, special construction is usually required to provide long valve life. Selecting the solenoid valve to last as long as the rest of the system or equipment allows the valve to be serviced during normal maintenance downtime. Because foreign matter such as pipe scale can shorten the life of a solenoid valve, a suitable strainer should be installed as close as possible to the valve inlet.



A strainer or filter should always be installed as close as possible to the inlet of a solenoid valve.



Pipe joint compound or Teflon tape should be used on all male fittings, but should not be placed on the first two threads or on female fittings.

HOW TO INSTALL AND MAINTAIN ASCO® Red-Hat and Red-Hat II Solenoid Valves

Proper installation and maintenance procedures go a long way toward prolonging valve life. Read and follow the instruction packed with each ASCO Red-Hat and Red-Hat II valve.

Nameplate data - voltage, pressure, etc. - should be checked to ensure compatibility with system conditions. Check, too, that the type of solenoid enclosure is compatible with your operating environment.

Some Red-Hat and Red-Hat II valves are designed to operate in any mounting position, while others must be oriented in a certain way to operate properly. Whenever possible, however, all valves should be mounted with the solenoid in a vertical and upright position to reduce the possibility of foreign matter accumulating in the core tube area. The first line of defense against this occurrence, however, is the installation of a filter or strainer as close as possible to the valve inlet.

Installation Practices

Teflon tape or pipe joint compound should be used, but only on male pipe threads. To prevent foreign matter from entering the valve, do not apply either sealant to the first two male threads or

to any of the female threads.

Two wrenches should be used to attach the valve to its piping. Use a pipe wrench to turn the pipe into the valve, and a second wrench on the flat of the valve body. To prevent distortion of the valve body, apply the second wrench to the side of the valve into which the pipe is being inserted.

Because the Teflon tape or pipe joint compound reduces friction and makes turning easy, there is a tendency to over torque when installing valves. This poses potential damage to the valve body, especially aluminum or die-cast body valves.

Inlet and outlet piping must be properly supported to prevent strain on the valve body.

Wiring must comply with local codes and the Canadian Electrical Code. Be sure that the solenoid leads cannot be pulled from the coil. If you are not using flexible conduit for transition into the valve, the supply conduit must be properly supported to prevent stress on the solenoid assembly.

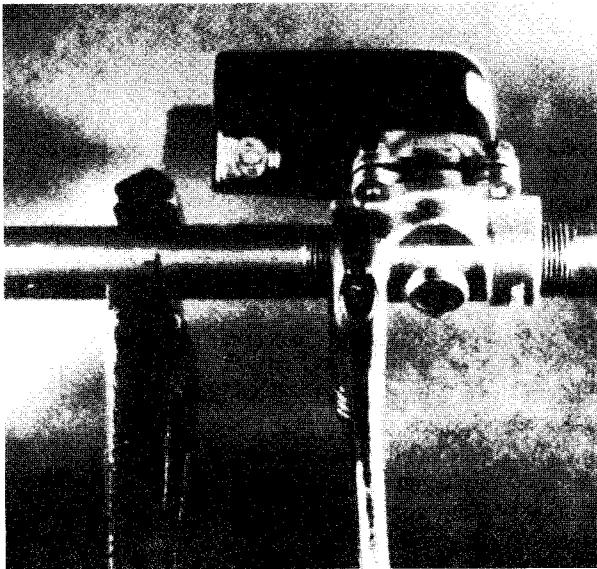
A considerable amount of foreign matter can collect in a system,

especially during new construction. So, always flush the system thoroughly before releasing it for normal operation. Clean the strainers and filters after the line pressure and electric power have been shut off, but be sure to open the strainer service cap slowly to release trapped pressure. A second flush may be necessary.

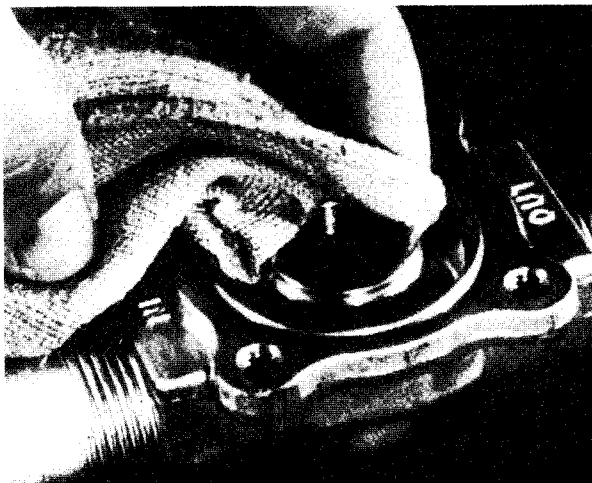
Maintenance Procedures

Cleaning of filters and strainers should be part of your normal preventive maintenance program, along with cleaning and inspection of the valve. If the valve is not operating properly, and corrective steps are required, confirm that the problem is in the valve and not caused by other conditions in the system.

Foreign matter in the valve, such as pipe joint sealant, corrosion from pipes and process vessels, mineral deposits and other solids, is a major cause of solenoid valve failure. If valve disassembly is required, always follow the instructions supplied with the valve for disassembly, cleaning and reassembly.



Two wrenches should be used when removing or installing a solenoid valve. Stress on the valve body can be prevented by placing the wrench on the same side of the valve as the pipe that is being screwed out of or into the valve.



Dirt on the valve body and on internal parts should be wiped off with a lint-free cloth.

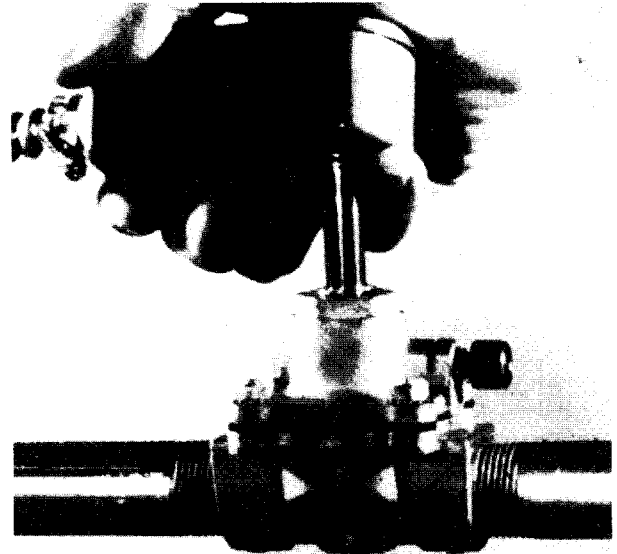
Before disassembling the valve, it's always best to have on hand those parts subject to wear which are most likely to require replacement. ASCO offers rebuild kits containing all the internal parts needed to restore the valve to its like- new condition.

Except on very old valves, you'll find the rebuild kit number listed on the valve nameplate. These kits include comprehensive instructions and an exploded view of the valve. On all valves, but especially Red-Hat II, always be sure to reinstall the nameplate. The nameplate serves as a retainer to hold the solenoid to the valve.

Maintenance Tips

Direct-Acting Valves

Always turn off electrical and fluid supplies before disassembling a valve, and loosen the solenoid base slowly to release any trapped pressure. Remove internal parts and wipe them clean with a lint-free cloth. Examine the valve body for foreign material and



After electric power and fluid line pressure have been shut off, the first step in valve disassembly is to remove the solenoid mechanism.



The solenoid core must move freely in the core tube and should be free from signs of binding and excessive wear.

deposits. Be especially careful not to scratch the valve seat or disc during cleaning.

The movable core and core tube should be examined for signs of binding and wear. If present, all internal parts should be replaced. If there is excessive wear to the valve body (e.g. wire drawing of the seat), the valve should be replaced.

The disc at the end of the movable core or piston should be checked for signs of excessive impacting. If deep impressions are noted, and the system involves liquids, a water hammer condition may exist. To protect the pipes and equipment in the system, install a water hammer cushioner close to the valve

inlet, or replace the valve with an ASCO Slow Closing valve.

After reassembly, check the valve operation by energizing the solenoid coil. A sharp metallic click should be heard if the valve is operating properly.

Pilot-Operated Valves

Cleaning and inspection procedures are essentially the same as for direct-acting valves. However, pilot operated valves also have a diaphragm or piston with bleed holes which must be cleaned. The piston should move freely in its cylinder and the piston rings should rotate freely in the groove.

HOW TO TROUBLESHOOT ASCO® Red-Hat and Red-Hat II Solenoid Valves

Because there are so many potential reasons for solenoid valves to malfunction, they are often thought to be complex, trouble-prone devices. Actually, they are quite simple and very reliable. Many of the problems originate outside the valves themselves, while others are caused by misapplication or improper installation.

Troubleshooting should begin with a check of the voltage and pressure input. The problem may be caused by an inoperative control relay or a fluctuating pressure regulator. If voltage and pressure check out, look to the valve. The main reasons a direct-acting solenoid valve fails to operate include:

- Low or no voltage
- Burned-out solenoid
- Pressure higher than the valve's rating
- Foreign matter in the valve
- Binding core or damaged core tube

To operate properly, a solenoid valve core must move within the core tube and contact the plugnut when the coil is energized. You should hear a sharp metallic click at energization. Absence of the click usually indicates an electrical problem. For most valves, voltage applied to the coil must be at least 85% of the nameplate voltage rating.

If the valve coil is receiving the proper voltage, absence of a click may mean that the line pressure is higher than the valve's rating. Check that next.

If line pressure is OK, foreign matter may be preventing the core from moving in the core tube. Core movement can also be restricted if the top of the core has been peened over by millions of operations, if the disc is swollen or cut, or if the core itself has been damaged.

A pilot-operated valve might fail to operate when energized even though a click has been heard. A no-flow condition may be caused by:

- Insufficient pressure drop across the valve
- Ruptured diaphragm or damaged piston ring
- Plugged or restricted pilot orifice

Both pilot-operated and direct-acting valves can fail to operate when de-energized because of:

- Faulty control circuit
- Scale or other foreign matter in the valve

- Binding core or damaged core tube
- Broken spring

Pilot-operated valves may also malfunction when de-energized due to:

- Plugged bleed orifice
- Damaged pilot seat or disc
- Damaged diaphragm or piston
- Insufficient pressure drop across the valve

Excessive solenoid noise (hum or chatter) can be caused by:

- Low voltage
- Faulty relay or improper electrical control signal
- Loose solenoid parts
- Foreign matter on core or plugnut face
- Worn core or plugnut face
- Damaged spring
- Excessive system pressure

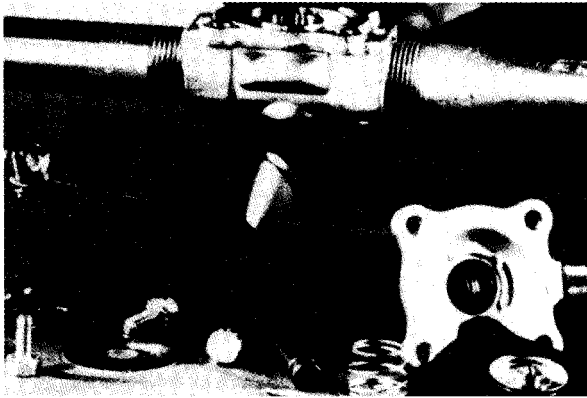
When troubleshooting 4 way valves controlling cylinders, it is important to follow the instructions provided with the valve. Some 4 way valves require an oil-mist lubricator for proper operation.

Pilot-activated 4 way valves normally require full-size piping for pressure inlet and exhaust. In some of these valves, restrictive speed control devices should be installed in the cylinder connections.

Because faulty cylinder operation is often caused by the cylinder itself, it should be checked for:

- Misalignment between the piston rod and connected load
- Lack of lubrication
- Worn and leaking piston cups which allow fluid to exhaust through the valve
- Foreign matter in the speed controls
- System overloading, low line pressure, or undersized hoses or fittings.

If the problem does not appear to be in the cylinder, the valve should be checked.



ASCO offers rebuild kits which contain all components needed to make a valve like new again.

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TROUBLESHOOTING GUIDE

Problem	Possible Cause	Probable Solution
Valve will not operate when valve circuit is energized (direct-acting valve)	Low voltage or no voltage to solenoid coil	Check voltage at coil; for most valves, voltage should be at least 85 percent on nameplate rating.
	Burned out coil	See "Coil Failure" below.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet
	Binding core or damaged core tube	Replace parts.
	Excessive fluid pressure	Reduced pressure to valve nameplate pressure rating or install suitable valve.
Valve will not operate when valve circuit is energized (pilot-operated valve)	Same causes and solutions as for direct-acting valve, plus:	
	Low pressure drop across valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
	Ruptured diaphragm or piston ring	Replace damaged parts.
Valve will not close or shift when valve circuit is de-energized (direct-acting valve)	Plugged or restricted pilot orifice	Clean valve and pilot orifice.
	Coil not de-energized	Check electrical control circuit.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet.
	Damaged disc or seat causing internal leakage	Replace with new parts.
	Binding core or damaged core tube	
Valve will not close or shift when valve circuit is de-energized (pilot-operated valve)	Damaged spring	Replace with new spring. Never elongate or shorten spring.
	Same causes and solutions as for direct-acting valve, plus:	
	Plugged bleed orifice	Clean orifice.
	Damaged pilot seat or pilot disc	Replace with new parts.
	Damaged diaphragm or piston	
	Damaged pilot spring	Replace with new spring. Never elongate or shorten spring.
Wire drawing	Insufficient pressure drop across the valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
	Dirt or foreign matter is lodged on seat	Replace valve body or install new valve; install suitable strainer close to inlet of valve.
Coil failure *	Overvoltage	Check voltage at coil; voltage must conform to nameplate rating.
	Damaged core or core tube causing inrush current to be drawn continuously	Check for damaged core and core tube, or damaged spring. Check for scale or foreign matter on the core or inside the core tube. Clean thoroughly and replace any damaged parts.
	Excessive foreign matter jamming core in core tube and causing inrush current to be drawn continuously	
	Excessive fluid pressure causing inrush current to be drawn continuously	Reduce pressure or install suitable valve.
	Excessive ambient or fluid temperature	Class A coils are limited to ambient temperatures of 77° F. For temperature up to 167° F, use Class F coils; for temperatures up to 212° F, use Class H.
	Missing solenoid parts	Install missing solenoid housing and other metal parts or properly install incorrectly assembled metal parts. The housing and other metal parts form part of the magnetic circuit and are required to provide the impedance needed to limit current draw.
	Moisture inside solenoid enclosure	Waterproof the entrance conduit to prevent entry of moisture. If valve is mounted outdoors, check to see that enclosure is weatherproof and that gaskets are in good condition; use appropriate sealant where required. If general-purpose enclosure is used in a damp or humid atmosphere, use watertight, molded coils

* In Red-Hat II Explosionproof solenoids, a binding core, high-input voltage, or excessive ambient or fluid temperature may cause the solenoid's non-resettable thermal fuse to open. If this occurs, the solenoid must be replaced.



ASCO Valve Canada a division of Emerson Electric Canada Limited

HEAD OFFICE, MANUFACTURING & MARKETING

ASCO Valve Canada

P.O. Box 160, Airport Road, Brantford, Ontario N3T 5M8

Phone (519) 758-2700

Fax (519) 758-5540 www.asco.ca

Email: ascomail@asco.ca

DISTRICT SALES OFFICES

WESTERN CANADA (British Columbia, Alberta, Saskatchewan & Manitoba)

ASCO Valve Canada

809 Manning Road, N.E.

Suite #104

Calgary, Alberta T2E 7M9

Phone (403) 207-8571 or 1-800-661-6032

Fax (403) 207-8581

For British Columbia

Phone (604)294-1767

Fax (604)294-9935

CENTRAL CANADA (Ontario)

ASCO Valve Canada

P.O. Box 160, Airport Road

Brantford, Ontario N3T 5M8

Phone (519) 758-2700 Fax (519)758-5540

Phone (416) 364-2838 (Greater Toronto Area)

EASTERN CANADA (Quebec, Ottawa Valley & Atlantic Provinces)

ASCO Valve Canada

5500 Vanden Abeele

Saint-Laurent, Quebec H4S 1P9

Phone (514) 337-8520

Fax (514) 337-8771

CAT.: #SIMT

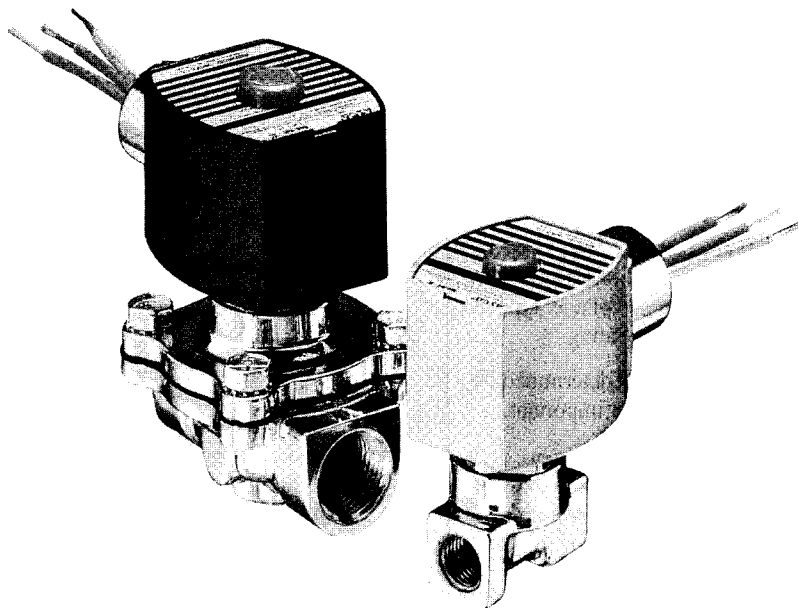
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1M-02-99

ASCO[®] Red-Hat[®] and Red-Hat II[®]

Solenoid Valves

**SELECTION
INSTALLATION/MAINTENANCE
TROUBLESHOOTING**



ASCO[®]

ASCO Valve Canada

HOW TO SELECT

ASCO® Red-Hat and Red-Hat II Solenoid Valves

ASCO Red-Hat and Red Hat II^① solenoid valves for the control of fluids are available in thousands of varieties, each designed to meet specific requirements. Many features are readily apparent and easily understandable; others are more complex and require special knowledge to select the best valve for your control application.

For example, selecting a valve too large for the application will usually involve needless initial cost; selecting a valve too small will usually lead to poor fluid control for the application.

Valves fall into four basic construction groups:

Two way Valves – have one inlet and one outlet pipe connection and are available for normally closed and normally open operations. Normally closed valves are closed when the valve is de-energized and open when the proper voltage is applied to the coil. Normally open valves are open when de-energized and close when the coil is energized.

Three way Valves – have three pipe connections and two orifices which are alternately open or closed. These valves are available normally closed, normally open, or with universal construction which can be used as normally closed or normally open. Three way valves are generally used as pilots for larger control valves, to actuate single-acting cylinders, or to divert the flow of fluids.

Four way Valves – usually have four pipe connections: one for pressure, one for exhaust, and two to operate double-acting cylinders. They are also used to pilot larger control valves.

Manual Reset Valves – must be opened or closed manually, then revert to their original position when, depending on the construction, they are energized or de-energized. They are used to prevent inadvertent startup of critical systems.

After determining the basic valve type, consideration must be given to pipe size; orifice size, flow rate, pressure rating, medium to be controlled, ambient and fluid temperatures, voltage, type of solenoid enclosure, cycling rate and required life rating.

Although the relative importance of each factor is determined by the application itself, valve size is usually the most important.

Valve Sizing

Valve configuration and orifice size, as well as the viscosity, specific gravity and temperature of the controlled medium have the greatest influence on determining proper valve size.

All variables affecting the selection have been reduced to a single parameter known as the flow coefficient (Cv.). ASCO provides graphs for determining Cv values, and displays those Cv values for each valve in its product catalogue. This makes it easier to select the proper valve to meet your particular flow requirements.

Pressure Ratings

Pressure rating is directly related to orifice size. For direct acting valves which operate from zero to maximum pressure, the pressure rating decreases as orifice size increases.

Large valves, and those rated for high pressures, are offered in

pilot-operated versions in which fluid line pressure operates the valve. These valves have a pilot and bleed orifice, and are usually of the diaphragm or piston type. For proper operation, a minimum pressure differential of 2 to 10 psi (depending on construction) is required between the inlet and exhaust ports.

The minimum and maximum pressure ratings for these valves are listed in the ASCO catalogue and are shown on the valve nameplate. Special care must be taken not to excessively oversize an internally piloted valve. Pressure drop or flow through the valve may be insufficient to lift the piston or diaphragm off the orifice, resulting in little or no flow.

In some designs, heavy-duty solenoid coils are used to increase the pressure rating for a given orifice size.

Pressure ratings should be as close as practicable to system pressure.

A valve will not open against pressure significantly higher than the valve's rating. The solenoid's magnetic circuit will not be completed, causing the coil to draw excessive current and burn out.

Conversely, if the system pressure is significantly lower than the valve's rating, the high impact of the solenoid core against the plug nut will cause excessive wear and reduced life.

For best results, select a valve with a pressure rating which is only slightly greater than system pressure.

Medium Compatibility

Valve materials and constructions are compatible with a wide variety of media: air, water, oil, steam, and corrosive and non-corrosive gases and liquids. It is essential that the valve you select be compatible with your controlled medium.

ASCO valve bodies and internal parts are stainless and carbon steel, aluminum, brass, and a wide variety of plastics and elastomers. The ASCO catalogue specifies media compatibility for each valve.

Solenoid Coil Insulation

A coil's worst enemy is heat. Prolonged periods at excessive temperatures lead to thermal degradation of coil insulation. This heat may come from high-temperature fluids passing through the valve, from the electrical energy spent in the coil, or simply from the air around it. The temperature which results from all these sources will determine the required coil insulation class.

Nominal maximum permissible ambient temperatures are based on test conditions used by Underwriter's Laboratories, Inc. to determine safe coil insulation temperatures. Tests are conducted with coils continuously energized and valves at maximum fluid temperatures.

The epoxy-molded coils and solenoids used in ASCO Red-Hat and Red-Hat II valves are resistant to thermal degradation; they dissipate heat more effectively than paper-section coils. They also resist moisture, chemical attack, fungi, and mechanical stress, significantly increasing their life.

^① ASCO's new generation of solenoid valves, Red-Hat II, features one-piece epoxy encapsulated solenoids.

Coil Operating Voltage

Standard voltage ratings are 6, 12, 24, 120, 240, and 480 volts AC, and 6, 12, 24, 120 and 240 volts DC.

Red-Hat and Red-Hat II valves operate satisfactorily on voltage reductions as much as 10 - 15% below nominal (depending on construction), and can withstand as much as 10% over voltage for brief periods.

Power Consumption

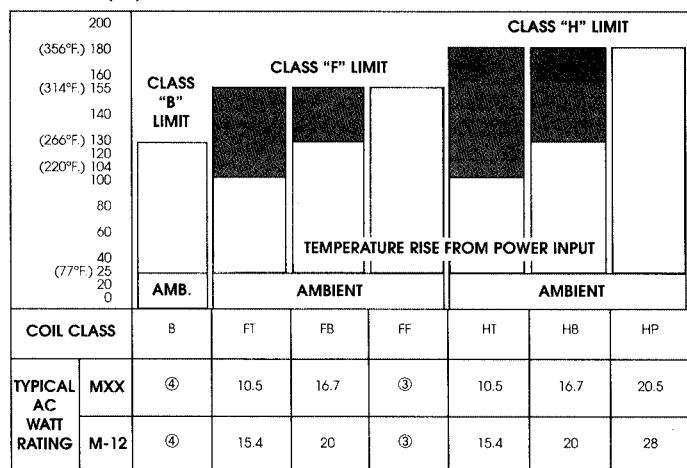
Power consumption can be determined from the ratings shown for each valve series shown in the ASCO catalogue. For AC valves, the watts, volt-ampere "inrush" (the high, momentary surge occurring at coil energization) and volt-ampere "holding" (the continuous draw following inrush) are given.

The current rating for inrush and holding may be determined by

ENCLOSURE TYPE DESIGNATIONS

Enclosure Type	Location	Application Criteria
1	Indoor	General purpose; normal atmospheric conditions
2	Indoor	Drip-proof.
3	Outdoor	Dust-tight, rainproof, and sleet (ice) resistant.
3S	Outdoor	Dust-tight, rainproof, and sleet (ice) proof.
4	Indoor	Watertight and dust-tight.
4X	Indoor	Watertight, dust-tight, and corrosion resistant.
6	Indoor/Outdoor	Submersible, watertight, dust-tight, and sleet (ice) resistant.
7	Indoor	Hazardous locations. Suffix to type (Class I and Group A, B, C or D) complete designation from definitions in National Electrical Code.
9	Indoor	Hazardous locations, combustible dust. Class I and Group E, F or G suffixes from National Electrical Code.

FINAL TEMP. (°C.)



INDUSTRIAL TEMPERATURE LIMITATIONS^① AND THERMAL CHARACTERISTICS OF ASCO RED-HAT SOLENOIDS AND COILS

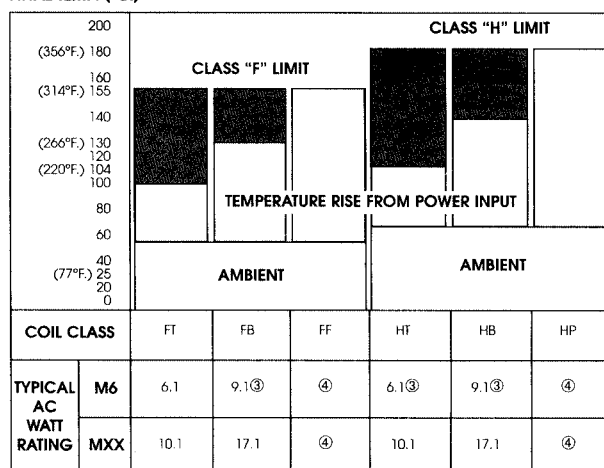
The typical watt ratings given show the relationship between different classes of coil insulation and the watt ratings to achieve higher temperature capabilities. The information contained in these tables applies only to non-explosionproof constructions.^⑤



② Excess margin for higher fluid or ambient temperature

- ① As measured by the "Resistance Method"
- ② Ambient temperatures are directly additive to coil rise - fluid temperature is not.
- ③ Only available in limited watt ratings. Consult ASCO when required.
- ④ Only available in M-5 and MLXX solenoid sizes.
- ⑤ Because of explosionproof codes and surface temperature limitations, the maximum listed ambients for specific valves should not be exceeded. Consult factory concerning explosionproof applications where higher than listed ambients are encountered.

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dividing the volt-ampere rating by the voltage:

$$\frac{\text{Inrush}}{\text{Amps}} = \frac{\text{volt-amp inrush}}{\text{voltage}}$$

$$\frac{\text{Holding}}{\text{Amps}} = \frac{\text{volt-amp holding}}{\text{voltage}}$$

DC valves have no inrush current. The amp rating can be determined by dividing the voltage into the DC watt rating:

$$\frac{\text{Amps}}{\text{Amps}} = \frac{\text{watts (DC)}}{\text{voltage}}$$

Solenoid Enclosures

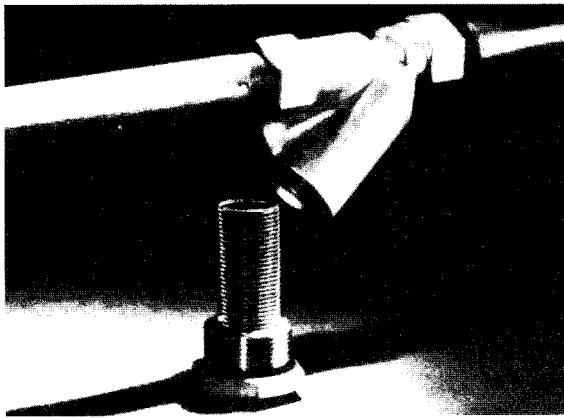
ASCO Red-Hat II solenoid enclosures have one-piece molded epoxy construction with an integral 1/2" N.P.T. conduit hub. The epoxy encapsulation serves as the enclosure. The magnetic frame is molded into the coil.

ASCO Red-Hat solenoid valves have an enclosure which is separate from the coil. The enclosure should be kept in place at all times because, with many types, it provides part of the magnetic circuit. Removal of the enclosure can reduce solenoid efficiency and expose the mechanism to damage.

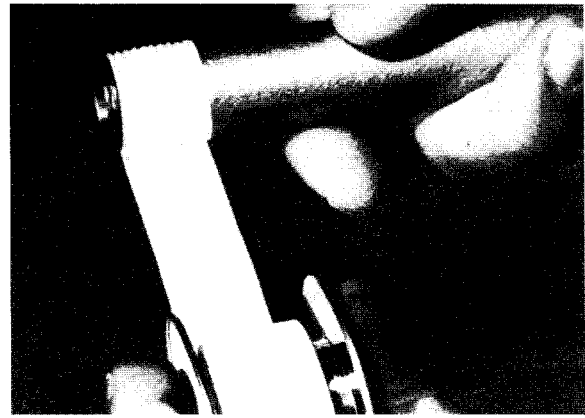
For optional electrical features such as junction boxes, spade and screw terminal coils, and DIN-type connections, consult ASCO catalogue.

Cycling Rate and Estimated Life

When controlling unlubricated air or dry, inert gas, special construction is usually required to provide long valve life. Selecting the solenoid valve to last as long as the rest of the system or equipment allows the valve to be serviced during normal maintenance downtime. Because foreign matter such as pipe scale can shorten the life of a solenoid valve, a suitable strainer should be installed as close as possible to the valve inlet.



A strainer or filter should always be installed as close as possible to the inlet of a solenoid valve.



Pipe joint compound or Teflon tape should be used on all male fittings, but should not be placed on the first two threads or on female fittings.

HOW TO INSTALL AND MAINTAIN ASCO® Red-Hat and Red-Hat II Solenoid Valves

Proper installation and maintenance procedures go a long way toward prolonging valve life. Read and follow the instruction packed with each ASCO Red-Hat and Red-Hat II valve.

Nameplate data - voltage, pressure, etc. - should be checked to ensure compatibility with system conditions. Check, too, that the type of solenoid enclosure is compatible with your operating environment.

Some Red-Hat and Red-Hat II valves are designed to operate in any mounting position, while others must be oriented in a certain way to operate properly. Whenever possible, however, all valves should be mounted with the solenoid in a vertical and upright position to reduce the possibility of foreign matter accumulating in the core tube area. The first line of defense against this occurrence, however, is the installation of a filter or strainer as close as possible to the valve inlet.

Installation Practices

Teflon tape or pipe joint compound should be used, but only on male pipe threads. To prevent foreign matter from entering the valve, do not apply either sealant to the first two male threads or

to any of the female threads.

Two wrenches should be used to attach the valve to its piping. Use a pipe wrench to turn the pipe into the valve, and a second wrench on the flat of the valve body. To prevent distortion of the valve body, apply the second wrench to the side of the valve into which the pipe is being inserted.

Because the Teflon tape or pipe joint compound reduces friction and makes turning easy, there is a tendency to over torque when installing valves. This poses potential damage to the valve body, especially aluminum or die-cast body valves.

Inlet and outlet piping must be properly supported to prevent strain on the valve body.

Wiring must comply with local codes and the Canadian Electrical Code. Be sure that the solenoid leads cannot be pulled from the coil. If you are not using flexible conduit for transition into the valve, the supply conduit must be properly supported to prevent stress on the solenoid assembly.

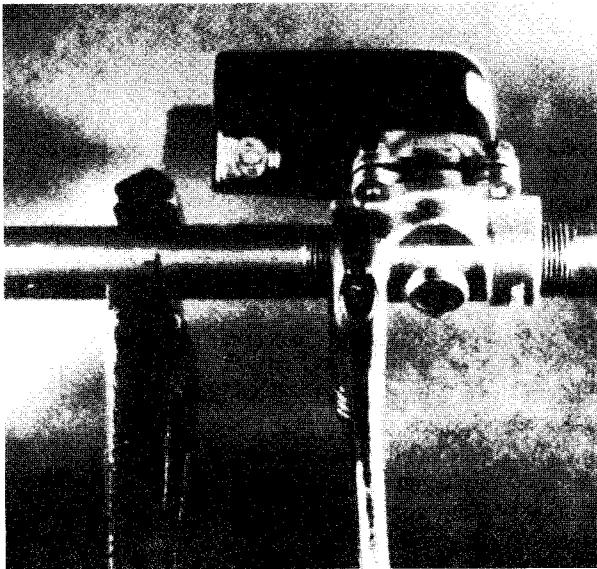
A considerable amount of foreign matter can collect in a system,

especially during new construction. So, always flush the system thoroughly before releasing it for normal operation. Clean the strainers and filters after the line pressure and electric power have been shut off, but be sure to open the strainer service cap slowly to release trapped pressure. A second flush may be necessary.

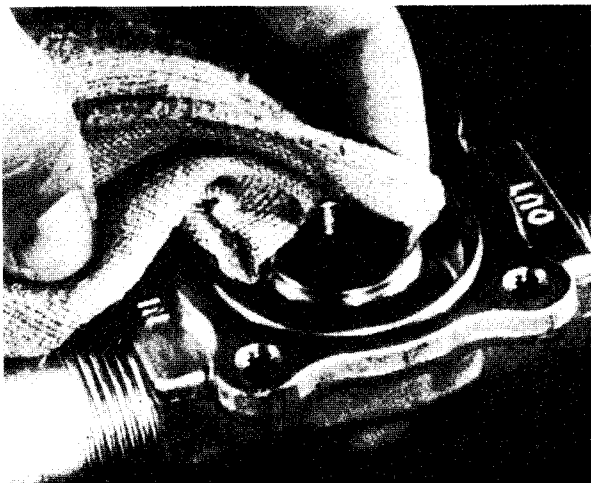
Maintenance Procedures

Cleaning of filters and strainers should be part of your normal preventive maintenance program, along with cleaning and inspection of the valve. If the valve is not operating properly, and corrective steps are required, confirm that the problem is in the valve and not caused by other conditions in the system.

Foreign matter in the valve, such as pipe joint sealant, corrosion from pipes and process vessels, mineral deposits and other solids, is a major cause of solenoid valve failure. If valve disassembly is required, always follow the instructions supplied with the valve for disassembly, cleaning and reassembly.



Two wrenches should be used when removing or installing a solenoid valve. Stress on the valve body can be prevented by placing the wrench on the same side of the valve as the pipe that is being screwed out of or into the valve.



Dirt on the valve body and on internal parts should be wiped off with a lint-free cloth.

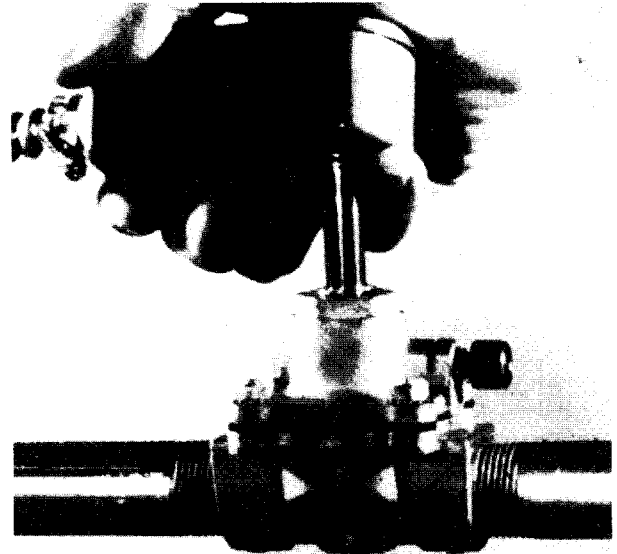
Before disassembling the valve, it's always best to have on hand those parts subject to wear which are most likely to require replacement. ASCO offers rebuild kits containing all the internal parts needed to restore the valve to its like- new condition.

Except on very old valves, you'll find the rebuild kit number listed on the valve nameplate. These kits include comprehensive instructions and an exploded view of the valve. On all valves, but especially Red-Hat II, always be sure to reinstall the nameplate. The nameplate serves as a retainer to hold the solenoid to the valve.

Maintenance Tips

Direct-Acting Valves

Always turn off electrical and fluid supplies before disassembling a valve, and loosen the solenoid base slowly to release any trapped pressure. Remove internal parts and wipe them clean with a lint-free cloth. Examine the valve body for foreign material and



After electric power and fluid line pressure have been shut off, the first step in valve disassembly is to remove the solenoid mechanism.



The solenoid core must move freely in the core tube and should be free from signs of binding and excessive wear.

deposits. Be especially careful not to scratch the valve seat or disc during cleaning.

The movable core and core tube should be examined for signs of binding and wear. If present, all internal parts should be replaced. If there is excessive wear to the valve body (e.g. wire drawing of the seat), the valve should be replaced.

The disc at the end of the movable core or piston should be checked for signs of excessive impacting. If deep impressions are noted, and the system involves liquids, a water hammer condition may exist. To protect the pipes and equipment in the system, install a water hammer cushioner close to the valve

inlet, or replace the valve with an ASCO Slow Closing valve.

After reassembly, check the valve operation by energizing the solenoid coil. A sharp metallic click should be heard if the valve is operating properly.

Pilot-Operated Valves

Cleaning and inspection procedures are essentially the same as for direct-acting valves. However, pilot operated valves also have a diaphragm or piston with bleed holes which must be cleaned. The piston should move freely in its cylinder and the piston rings should rotate freely in the groove.

HOW TO TROUBLESHOOT ASCO® Red-Hat and Red-Hat II Solenoid Valves

Because there are so many potential reasons for solenoid valves to malfunction, they are often thought to be complex, trouble-prone devices. Actually, they are quite simple and very reliable. Many of the problems originate outside the valves themselves, while others are caused by misapplication or improper installation.

Troubleshooting should begin with a check of the voltage and pressure input. The problem may be caused by an inoperative control relay or a fluctuating pressure regulator. If voltage and pressure check out, look to the valve. The main reasons a direct-acting solenoid valve fails to operate include:

- Low or no voltage
- Burned-out solenoid
- Pressure higher than the valve's rating
- Foreign matter in the valve
- Binding core or damaged core tube

To operate properly, a solenoid valve core must move within the core tube and contact the plugnut when the coil is energized. You should hear a sharp metallic click at energization. Absence of the click usually indicates an electrical problem. For most valves, voltage applied to the coil must be at least 85% of the nameplate voltage rating.

If the valve coil is receiving the proper voltage, absence of a click may mean that the line pressure is higher than the valve's rating. Check that next.

If line pressure is OK, foreign matter may be preventing the core from moving in the core tube. Core movement can also be restricted if the top of the core has been peened over by millions of operations, if the disc is swollen or cut, or if the core itself has been damaged.

A pilot-operated valve might fail to operate when energized even though a click has been heard. A no-flow condition may be caused by:

- Insufficient pressure drop across the valve
- Ruptured diaphragm or damaged piston ring
- Plugged or restricted pilot orifice

Both pilot-operated and direct-acting valves can fail to operate when de-energized because of:

- Faulty control circuit
- Scale or other foreign matter in the valve

- Binding core or damaged core tube
- Broken spring

Pilot-operated valves may also malfunction when de-energized due to:

- Plugged bleed orifice
- Damaged pilot seat or disc
- Damaged diaphragm or piston
- Insufficient pressure drop across the valve

Excessive solenoid noise (hum or chatter) can be caused by:

- Low voltage
- Faulty relay or improper electrical control signal
- Loose solenoid parts
- Foreign matter on core or plugnut face
- Worn core or plugnut face
- Damaged spring
- Excessive system pressure

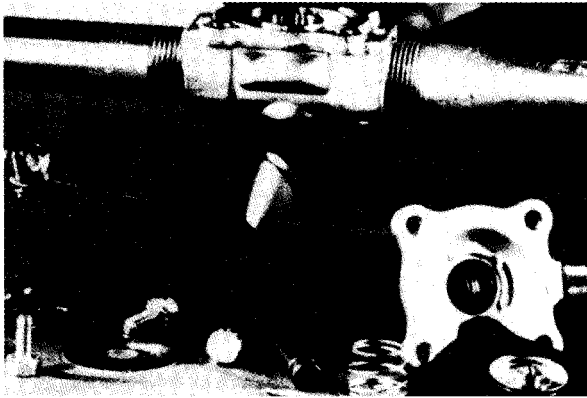
When troubleshooting 4 way valves controlling cylinders, it is important to follow the instructions provided with the valve. Some 4 way valves require an oil-mist lubricator for proper operation.

Pilot-activated 4 way valves normally require full-size piping for pressure inlet and exhaust. In some of these valves, restrictive speed control devices should be installed in the cylinder connections.

Because faulty cylinder operation is often caused by the cylinder itself, it should be checked for:

- Misalignment between the piston rod and connected load
- Lack of lubrication
- Worn and leaking piston cups which allow fluid to exhaust through the valve
- Foreign matter in the speed controls
- System overloading, low line pressure, or undersized hoses or fittings.

If the problem does not appear to be in the cylinder, the valve should be checked.



ASCO offers rebuild kits which contain all components needed to make a valve like new again.

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TROUBLESHOOTING GUIDE

Problem	Possible Cause	Probable Solution
Valve will not operate when valve circuit is energized (direct-acting valve)	Low voltage or no voltage to solenoid coil	Check voltage at coil; for most valves, voltage should be at least 85 percent on nameplate rating.
	Burned out coil	See "Coil Failure" below.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet
	Binding core or damaged core tube	Replace parts.
	Excessive fluid pressure	Reduced pressure to valve nameplate pressure rating or install suitable valve.
Valve will not operate when valve circuit is energized (pilot-operated valve)	Same causes and solutions as for direct-acting valve, plus:	
	Low pressure drop across valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
	Ruptured diaphragm or piston ring	Replace damaged parts.
	Plugged or restricted pilot orifice	Clean valve and pilot orifice.
Valve will not close or shift when valve circuit is de-energized (direct-acting valve)	Coil not de-energized	Check electrical control circuit.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet.
	Damaged disc or seat causing internal leakage	Replace with new parts.
	Binding core or damaged core tube	
	Damaged spring	Replace with new spring. Never elongate or shorten spring.
Valve will not close or shift when valve circuit is de-energized (pilot-operated valve)	Same causes and solutions as for direct-acting valve, plus:	
	Plugged bleed orifice	Clean orifice.
	Damaged pilot seat or pilot disc	Replace with new parts.
	Damaged diaphragm or piston	
	Damaged pilot spring	Replace with new spring. Never elongate or shorten spring.
	Insufficient pressure drop across the valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
Wire drawing	Dirt or foreign matter is lodged on seat	Replace valve body or install new valve; install suitable strainer close to inlet of valve.
Coil failure *	Overvoltage	Check voltage at coil; voltage must conform to nameplate rating.
	Damaged core or core tube causing inrush current to be drawn continuously	Check for damaged core and core tube, or damaged spring. Check for scale or foreign matter on the core or inside the core tube. Clean thoroughly and replace any damaged parts.
	Excessive foreign matter jamming core in core tube and causing inrush current to be drawn continuously	
	Excessive fluid pressure causing inrush current to be drawn continuously	Reduce pressure or install suitable valve.
	Excessive ambient or fluid temperature	Class A coils are limited to ambient temperatures of 77° F. For temperature up to 167° F, use Class F coils; for temperatures up to 212° F, use Class H.
	Missing solenoid parts	Install missing solenoid housing and other metal parts or properly install incorrectly assembled metal parts. The housing and other metal parts form part of the magnetic circuit and are required to provide the impedance needed to limit current draw.
	Moisture inside solenoid enclosure	Waterproof the entrance conduit to prevent entry of moisture. If valve is mounted outdoors, check to see that enclosure is weatherproof and that gaskets are in good condition; use appropriate sealant where required. If general-purpose enclosure is used in a damp or humid atmosphere, use watertight, molded coils

* In Red-Hat II Explosionproof solenoids, a binding core, high-input voltage, or excessive ambient or fluid temperature may cause the solenoid's non-resettable thermal fuse to open. If this occurs, the solenoid must be replaced.



ASCO Valve Canada a division of Emerson Electric Canada Limited

HEAD OFFICE, MANUFACTURING & MARKETING

ASCO Valve Canada

P.O. Box 160, Airport Road, Brantford, Ontario N3T 5M8

Phone (519) 758-2700

Fax (519) 758-5540 www.asco.ca

Email: ascomail@asco.ca

DISTRICT SALES OFFICES

WESTERN CANADA (British Columbia, Alberta, Saskatchewan & Manitoba)

ASCO Valve Canada

809 Manning Road, N.E.

Suite #104

Calgary, Alberta T2E 7M9

Phone (403) 207-8571 or 1-800-661-6032

Fax (403) 207-8581

For British Columbia

Phone (604)294-1767

Fax (604)294-9935

CENTRAL CANADA (Ontario)

ASCO Valve Canada

P.O. Box 160, Airport Road

Brantford, Ontario N3T 5M8

Phone (519) 758-2700 Fax (519)758-5540

Phone (416) 364-2838 (Greater Toronto Area)

EASTERN CANADA (Quebec, Ottawa Valley & Atlantic Provinces)

ASCO Valve Canada

5500 Vanden Abeele

Saint-Laurent, Quebec H4S 1P9

Phone (514) 337-8520

Fax (514) 337-8771

CAT.: #SIMT

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1M-02-99



CustomControlSensors

Hazardous Areas Adjustable Pressure Switch

6900G*E* - Diaphragm Sensor

DESCRIPTION

- Highly reliable devices utilizing the CCS Dual-Snap® Belleville disc spring principle pioneered by CCS' engineers.
- Engineering based on aerospace technology.
- Rigid, compact and internally adjustable for convenient field set point adjustment.
- Repeatable and stable set points.
- Vibration and shock resistant.
- High cycle life.
- High over-pressure capability. (System and Proof)
- Certified explosion proof hermetically sealed electrical assembly for environmental protection.
- Various options for wetted materials and electrical ratings to meet a wide range of application requirements and media compatibility.



SHIPPING WEIGHT: APPROXIMATELY 25 OUNCES (708 GRAMS)

SERIES:

6900GE*
6900GZE*

ADJUSTABLE SET POINT RANGE:

1 to 3400 PSIG
0.07 to 234 bar
6.89 to 23400 kPa

OPERATING TEMPERATURE:

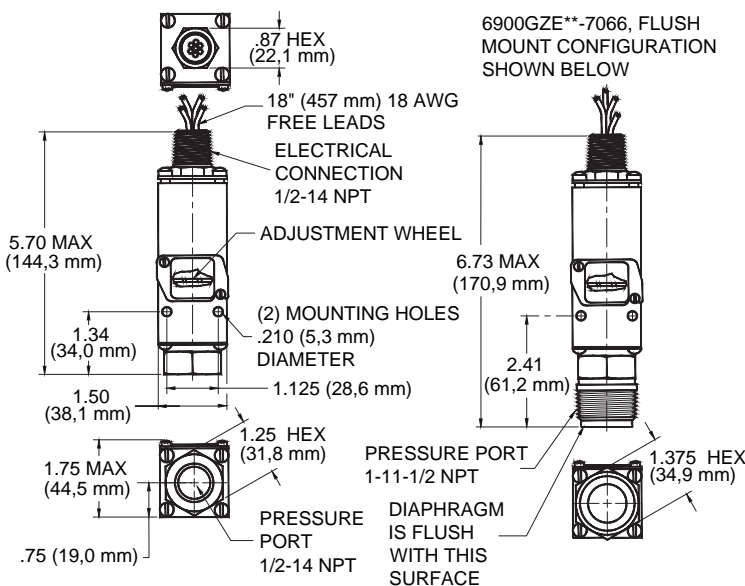
Temperature limits change with O-ring selection.

-40° to 186°F
-40° to 86°C

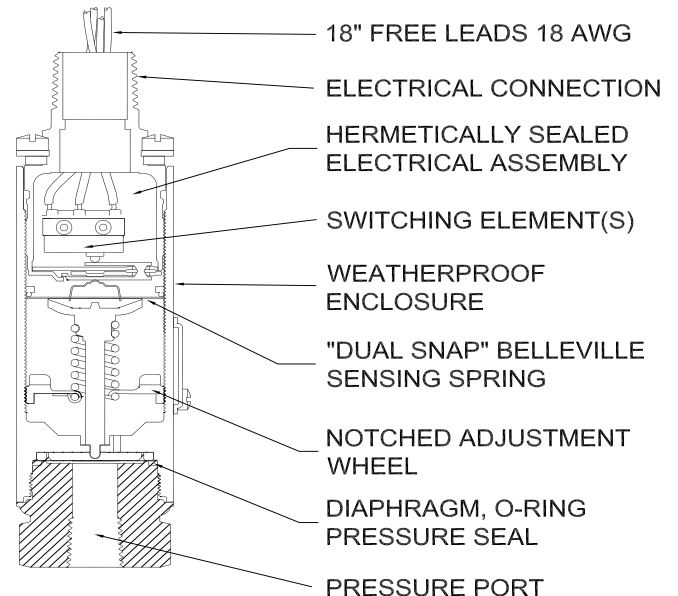
STANDARD FEATURES:

- CE Mark
- CCC
- CRN
- Dual Seal: ANSI/ISA-12.27.01
- NACE MR0175 / ISO 15156
- NEMA: 4, 7, 9, 13 / IP66
- U.L. / CSA Listed
- Hermetically Sealed Electrical Assembly
- 316 SST Electrical Assembly

INSTALLATION DRAWING



DESIGN PRINCIPLES



SERIES 6900GE

FIELD SETTING: Loosen access cover. Adjust adjustment screw using screwdriver slot as illustrated, then attach to a variable pressure source with a suitable gage, and check that the circuit continuity operates at the pressures desired. Clockwise to increase settings. Counterclockwise to decrease setting.

NOTE: DO NOT USE ELECTRICAL HEX FOR TORQUING.





CustomControlSensors

Hazardous Areas Adjustable Pressure Switch

6900G*E* - Diaphragm Sensor

OPERATING AND ORDERING DATA

SERIES 6900GE*	WETTED PARTS: 1/4"-18 NPT ALUMINUM PRESSURE PORT, POLYIMIDE DIAPHRAGM, BUNA N O-RING				
	ADJUSTABLE SET POINT RANGE		APPROX. DEAD BAND PSI (BAR)	SYSTEM PRESSURE PSIG (BAR)	PROOF PRESSURE PSIG (BAR)
	INCREASING PRESSURE PSIG (BAR)	DECREASING PRESSURE PSIG (BAR)			
6900GE*12	3-20 (0.21-1.4)	1-18 (0.07-1.2)	2 (0.14)	500 (34.5)	750 (51.7)
6900GE*14	6-75 (0.41-5.1)	2-71 (0.14-4.9)	4 (0.28)		
6900GE*16	12-150 (0.8-10.3)	4-142 (0.28-9.8)	8 (0.6)		
6900GE*18	30-375 (2.0-25.9)	10-355 (0.7-24.4)	20 (1.4)	1500 (103)	2000 (138)
6900GE*20	300-1000 (20.7-69)	250-950 (17.2-66)	50 (3.5)	2000 (138)	3000 (207)
6900GE*22	700-2200 (48.3-152)	600-2100 (41.4-145)	100 (6.9)	3000 (207)	4500 (310)
6900GE*24	1800-3400 (124-234)	1580-3180 (109-219)	220 (15.2)	5000 (345)	7500 (517)
SERIES 6900GZE*	WETTED PARTS: 1/2"-14 NPT 316 STAINLESS STEEL PRESSURE PORT & DIAPHRAGM, VITON O-RING				
	ADJUSTABLE SET POINT RANGE		APPROX. DEAD BAND PSI (BAR)	SYSTEM PRESSURE PSIG (BAR)	PROOF PRESSURE PSIG (BAR)
	INCREASING PRESSURE PSIG (BAR)	DECREASING PRESSURE PSIG (BAR)			
6900GZE*12	3-20 (0.21-1.4)	1-18 (0.07-1.2)	2 (0.14)	500 (34.5)	750 (51.7)
6900GZE*14	9-75 (0.6-5.1)	3-69 (0.21-4.8)	6 (0.41)		
6900GZE*16	18-150 (1.2-10.3)	6-138 (0.41-9.5)	12 (0.8)		
6900GZE*18	45-375 (3.1-25.9)	15-345 (1.0-23.8)	30 (2.0)	1500 (103)	2000 (138)
6900GZE*20	300-1000 (20.7-69)	225-925 (15.5-64)	75 (5.1)	2000 (138)	3000 (207)
6900GZE*22	700-2200 (48.3-152)	520-2020 (35.9-139)	180 (12.4)	3000 (207)	4500 (310)
6900GZE*24	1800-3400 (124-234)	1520-3120 (105-215)	280 (19.3)	5000 (345)	7500 (517)
SERIES 6900GZE*-7066 FLUSH MOUNT	WETTED PARTS: 1" 316 STAINLESS STEEL PRESSURE PORT & WELDED DIAPHRAGM				
	ADJUSTABLE SET POINT RANGE		APPROX. DEAD BAND PSI (BAR)	SYSTEM PRESSURE PSIG (BAR)	PROOF PRESSURE PSIG (BAR)
	INCREASING PRESSURE PSIG (BAR)	DECREASING PRESSURE PSIG (BAR)			
6900GZE*12-7066	3-15 (0.21-1.0)	1-13 (0.07-0.9)	2 (0.14)	500 (34.5)	750 (52)
6900GZE*14-7066	12-75 (0.83-5.1)	6-69 (0.41-4.8)	6 (0.41)		
6900GZE*16-7066	18-150 (1.2-10.3)	6-138 (0.41-9.5)	12 (0.8)		
6900GZE*18-7066	45-375 (3.1-25.9)	15-345 (1.0-23.8)	30 (2.0)	1500 (103)	2000 (138)
6900GZE*20-7066	300-1000 (20.7-69)	225-925 (15.5-64)	75 (5.1)	2000 (138)	3000 (207)
6900GZE*22-7066	700-2200 (48.3-152)	520-2020 (35.9-139)	180 (12.4)	3000 (207)	4500 (310)

HOW TO ORDER

Follow these steps to build your part number:

1. Specify the series based on your required set point, range, dead band, system pressure and proof pressure.
2. Add desired options model code letter.
3. Add the applicable standard suffix number.

(Ex: 6900GCE12-7044)

PRESSURE CONVERSION

1 BAR = 14.5 PSI

1 kPa = 0.145 PSI

OPTIONS MODEL CODES

A: Viton® O-Ring
(STD on GZE models)
C: 316 Stainless Steel
Welded Capsule
F: Ethylene Propylene
O-Ring
M: DPDT Electrical
Y: ATEX / GOST
Certified Electrical
Assembly
(Consult CCS Sales
Department for GOST
options and requirements.)

OPTIONAL STANDARD MODIFIED SUFFIXES

- 7008:** Gold Contacts
7042: Stainless Steel Body
7044: Monel Port and Diaphragm
7045: Hastelloy C-276
Port and Diaphragm
7054: 2 Meter Free Leads
7076: 18 inch Teflon Free Leads
(Low Temp Wire)
7081: M20 Explosion Proof Electrical
Conduit Connection
7082: 316 SST Port, Piston & Body,
E.N.P. Front cover & Locks.
1/4-18 NPT Female Pressure
port.
7085: 316 SST Port, Piston & Body,
E.N.P. Front cover & Locks.
1/4-18 NPT Female Pressure
port. 2 Meter Free Leads.
7088: 1/4" -18 NPT Female 316
Stainless Steel Pressure Port
7089: 1/2" -14 NPT Male 316
Stainless Steel Pressure Port

ELECTRICAL ENCLOSURE CERTIFICATIONS

* c-UL, U.L./CSA Explosion Proof: Div. 1, 2 hermetically sealed electrical assembly P/N 46-1058 (46-1061 for M model option), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and Canadian Standard Association (CSA) Testing Laboratories (File No. LR22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, F, and G.

* ATEX certified for potentially explosive atmospheres electrical assembly series

46-XXXXXX, Models 6****, Ex d IIC T6, Directive 94/9/EC Sira 08ATEX1046X. (Option Y)

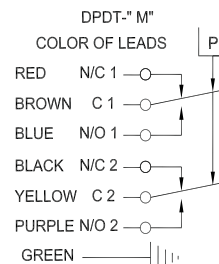
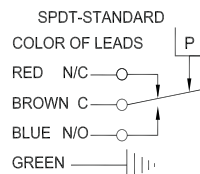
* IECEx - SIRA certified, SIR 10,0193X (Option Y)

ELECTRICAL CHARACTERISTICS SCHEMATIC AND WIRING CODE

RATING OF SWITCH ELEMENT

VOLTS	AMPERES	
	SPDT	DPDT "M"
	Res.	Res.
125 AC - 50/60 Hz	11	11
250 AC - 50/60 Hz	11	11
30 DC	5	5
125 DC	.5	.5
*125 AC - 50/60 Hz	1 max	1 max
*30 DC	1 max	1 max

*Gold Contacts -7008 Suffix



CERTIFICATIONS

Consult CCS website for complete certification and approval listing.

Note: Additional modified standard suffixes are available, consult CCS sales department or CCS Representative.

DUAL-SNAP®

ccsdualsnap.com

Models: 6900G*E*, Page 2 of 2
Form 830G, 10.22.13



CustomControlSensors

Hazardous Areas Adjustable Temperature Switch

6900TE* - Probe

DESCRIPTION



- Highly reliable devices utilizing the CCS Dual-Snap® Belleville disc spring principle pioneered by CCS' engineers.
- Engineering based on aerospace technology.
- Rigid, compact and internally adjustable for convenient field set point adjustment.
- Repeatable and stable set points.
- Vibration and shock resistant.
- High cycle life.
- High over-temperature capability. (System and Proof)
- Certified explosion proof hermetically sealed electrical assembly for environmental protection.
- Various options for electrical ratings to meet a wide range of application requirements.

SHIPPING WEIGHT: APPROXIMATELY 21 OUNCES (595 GRAMS)

SERIES:

6900TE*

ADJUSTABLE SET POINT RANGE: TEMPERATURE:

0° to 405°F

-18° to 207°C

OPERATING TEMPERATURE:

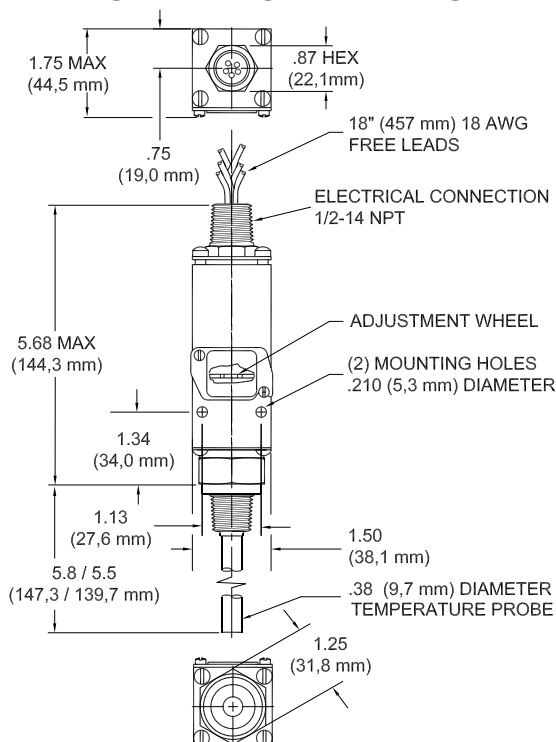
-40° to 186°F

-40° to 86°C

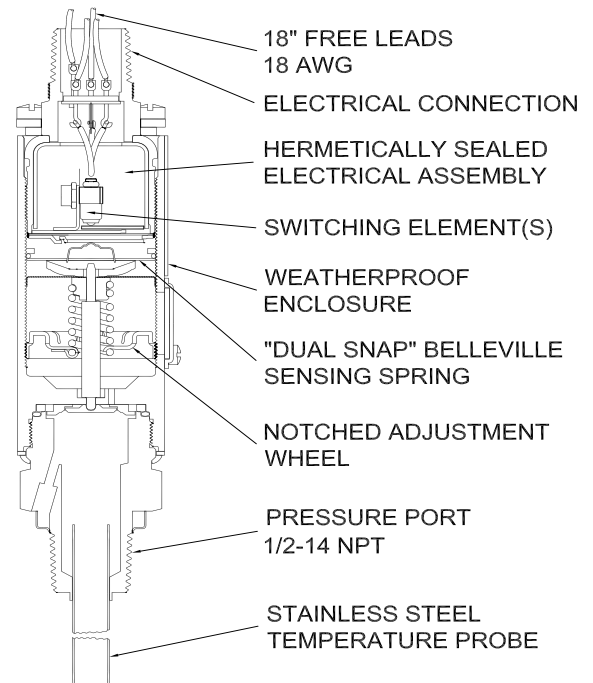
STANDARD FEATURES:

- Hermetically Sealed Electrical Assembly
- 316 SST Electrical Assembly
- CE Mark
- NACE MR0175:2003
- NEMA: 4, 7, 9, 13 / IP66
- U.L. / CSA Listed

INSTALLATION DRAWING



DESIGN PRINCIPLES



SERIES 6900TE

FIELD SETTING: Loosen access cover. Adjust adjustment screw using screwdriver slot as illustrated, then attach to a variable pressure source with a suitable gage, and check that the circuit continuity operates at the pressures desired. Clockwise to increase settings. Counterclockwise to decrease setting.

NOTE: DO NOT USE ELECTRICAL HEX FOR TORQUING.



CustomControlSensors

Hazardous Areas Adjustable Temperature Switch

6900TE* - Probe

OPERATING AND ORDERING DATA

SERIES 6900TE*	WETTED PARTS: 300 STAINLESS STEEL TEMPERATURE PROBE				
	ADJUSTABLE SET POINT RANGE		APPROXIMATE DEAD BAND		MAXIMUM PROBE TEMPERATURE DEGREES F (DEGREES C)
	INCREASING TEMPERATURE DEGREES F (DEGREES C)	DECREASING TEMPERATURE DEGREES F (DEGREES C)	AT BOTTOM OF RANGE DEGREES F (DEGREES C)	AT TOP OF RANGE DEGREES F (DEGREES C)	
6900TE*12	+20° to +120° (-7° to +49°)	+0° to +113° (-18° to +45°)	20° (11°)	5° (4°)	+200° (+93°)
6900TE*14	+80° to +205° (+27° to +96°)	+60° to +198° (+16° to +92°)	20° (11°)	5° (4°)	+300° (+149°)
6900TE*16	+185° to +315° (+85° to +157°)	+165° to +308° (+74° to +153°)	20° (11°)	5° (4°)	+400° (+204°)
6900TE*18	+280° to +405° (+138° to +207°)	+260° to +398° (+127° to +203°)	20° (11°)	5° (4°)	+500° (+260°)
EXTERNAL PROBE PRESSURE:					
System Pressure: 1250 PSIG (86 bar)			Proof Pressure: 1500 PSIG (103 bar)		

HOW TO ORDER

Follow these steps to build your part number:

1. Specify the series based on your required set point, range, dead band, system pressure and proof pressure.
2. Add desired options model code letter.
3. Add the applicable standard suffix number.

(Ex: 6900TEM16-7042)

TEMPERATURE CONVERSION

32 Deg F = 0 Deg C

OPTIONAL STANDARD MODIFIED SUFFIXES

- 7008:** Gold Contacts
7042: Stainless Steel Body
7054: 2 Meter Free Leads
7076: 18 inch Teflon Free Leads (Low Temp Wire)
7081: M20 Explosion Proof Electrical Conduit Connection

OPTIONS MODEL CODES

- M:** DPDT Electrical
Y: ATEX / GOST Certified Electrical Assembly (Consult CCS Sales Department for GOST options and requirements.)

THERMOWELLS

Order as separate line items. See accessory page for detailed information.

- 113-34-2:** 1" 316 SST 7.5" "U" Dim.
113-35-2: 3/4" 316 SST 7.5" "U" Dim.

CERTIFICATIONS

Consult CCS website for complete certification and approval listing.

ELECTRICAL ENCLOSURE CERTIFICATIONS

* c-UL, U.L./CSA Explosion Proof: Div. 1, 2 hermetically sealed electrical assembly P/N 46-1058 (46-1061 for M model option), listed by both Underwriter's Laboratories, Inc. (File No. E32961) and Canadian Standard Association (CSA) Testing Laboratories (File No. LR22921) for hazardous locations, Class 1, Groups A, B, C, and D; Class 2 Groups E, F, and G.

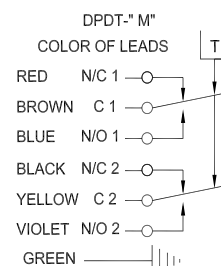
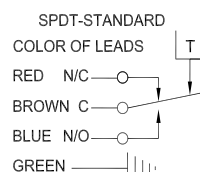
* ATEX certified for potentially explosive atmospheres electrical assembly series 46-XXXXXXX, Models 6****, Ex d IIC T6, Directive 94/9/EC Sira #08ATEX1046X. (Option Y)

* IECEx - SIRA certified, SIR 10,0193X (Option Y)

ELECTRICAL CHARACTERISTICS SCHEMATIC AND WIRING CODE

RATING OF SWITCH ELEMENT

VOLTS	AMPERES	
	SPDT Res.	DPDT "M" Res.
125 AC - 50/60 Hz	11	11
250 AC - 50/60 Hz	11	11
30 DC	5	5
125 DC	.5	.5
*125 AC - 50/60 Hz	1 max	1 max
*30 DC	1 max	1 max
*Gold Contacts -7008 Suffix		



Note: Additional modified standard suffixes are available, consult CCS sales department or CCS Representative.

DUAL-SNAP®

ccsdualsnap.com

Models: 6900TE*, Page 2 of 2
Form 830G, 4.21.11

June 1990

Type 119 Control Valve

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

1. Before installing the valve, be sure the valve body and associated equipment are free of damage and foreign material.



W3735-1

Figure 1. Type 119 Control Valve

parts, be 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.

FISHER

www.FISHERregulators.com


EMERSON
Process Management

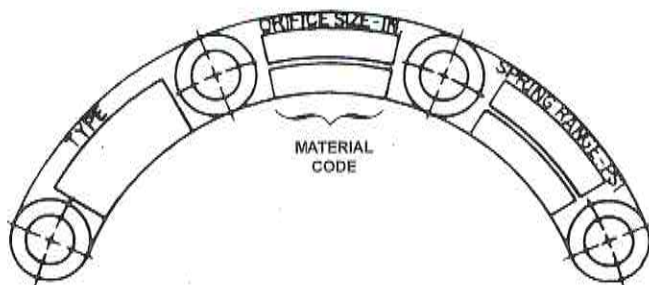
Type 119

Specifications

Table 1. Specifications

Maximum Inlet Pressure⁽¹⁾ 150 psig (10,34 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 (10,34 bar)	Spring Case Vent and Bonnet Leak-Off Connection 1/4-inch NPT female
Maximum Pressure Drop⁽¹⁾ 150 psi (10,34 bar) for all port diameters	Approximate Weight 6 pounds (2,72 kg)

1. The pressure and temperature limitations in this manual, and any applicable code limitation, should not be exceeded.



1E5427-F

MATERIAL CODE	ORIFICE SEAT DISK MATERIAL
A/N	Aluminum/Nitrile
SST/N	Stainless steel/Nitrile
SST/V	Stainless steel/Fluoroelastomer

Figure 2. Type 119 Nameplate

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

Table 2. Spring Selection

SPRING RANGE		SPRING PART NUMBER	SPRING COLOR CODE
Psig	bar		
3-15	0,21-1,03	1D892327022	Red
5-20	0,34-1,38	1D751527022	Cadmium
5-35	0,34-2,41	1D665927022	Blue
30-60	2,07-4,14	1D745527142	Green

location, point the spring case and bonnet vents in the downward direction to protect them from moisture or foreign materials.

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 (22,22 mm) 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 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 (22,22 mm) 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 lubricant (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).

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 N•m).

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.

1. Trademark of Never-Seez Corp.

2. Trademark of Tretolite Div. of Petrolite Corp.

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 Number
-----	-------------	-------------

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.

Part Kits

Kits include keys 4, 5, 6, 8, 10, 11, and 19.

For 1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm), & 3/8 inch (9,52 mm) orifices with aluminum disk holder nitrile diaphragm, and nitrile disk & O-rings	R119X000A12
---	-------------

For 1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices with aluminum disk holder, nitrile diaphragm, and nitrile disk & O-rings	R119X000A22
---	-------------

For 1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm), & 3/8 inch (9,52 mm) orifices with stainless steel disk holder, nitrile diaphragm and nitrile disk & O-rings	R119X00SN12
--	-------------

For 1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices with stainless steel disk holder, nitrile diaphragm and nitrile disk & O-rings	R119X00SN22
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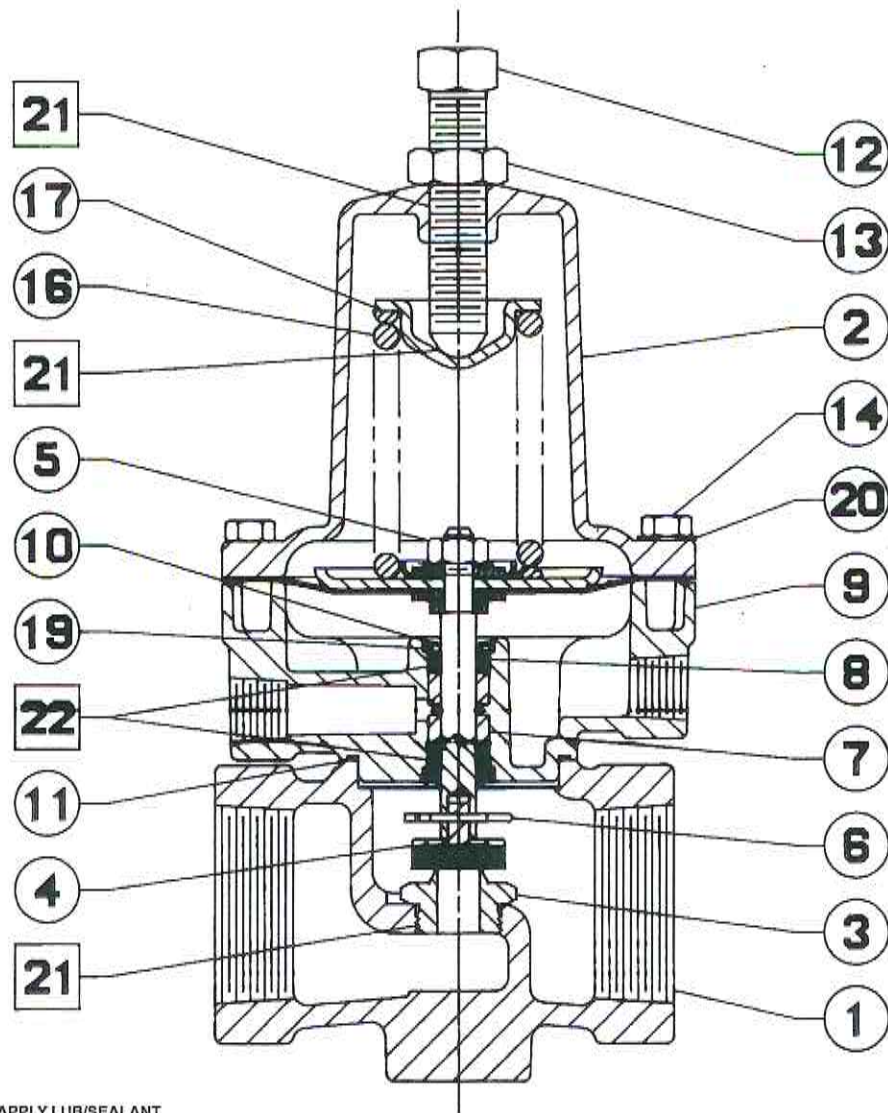
Key	Description	Part Number
	For 1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm), & 3/8 inch (9,52 mm) orifices with stainless steel disk holder and fluoroelastomer diaphragm, disk, & O-rings and stainless steel disk holder	R119X00SV12
	For 1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices w/ stainless steel disk holder and fluoroelastomer diaphragm, disk & O-rings	R119X00SV22
	NACE Construction For 1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm), and 3/8 inch (9,52 mm) orifices with aluminum disk holder, fluoroelastomer diaphragm, disk and O-rings	R119XN0SV32
	For 1/2 (12,70 mm) and 9/16 inch (14,29 mm) orifices with aluminum disk holder, fluoroelastomer diaphragm, disk and O-rings	R119XN0SV42
1	Valve Body	
	Cast Iron	
	3/4-inch (DN 20)	1E987119012
	1-inch (DN 25)	1E987319012
	1-1/4-inch (DN 32)	1E987519012
	Steel	
	3/4-inch (DN 20)	1E9871X0012
	1-inch (DN 25)	1E9873X0012
2	Spring Case	
	Aluminum	2P901508012
3*	Orifice	
	Aluminum	
	1/8-inch (3,18 mm) diameter	1A936709012
	3/16-inch (4,76 mm) diameter	00991209012
	1/4-inch (6,35 mm) diameter	0B042009012
	5/16-inch (7,94 mm) diameter	0B042109012
	3/8-inch (9,52 mm) diameter	0B042209012
	1/2-inch (12,70 mm) diameter	1A928809012
	9/16-inch (14,29 mm) diameter	1E985209022

*Recommended spare part.

Type 119

Key	Description	Part Number	Key	Description	Part Number
3*	Orifice (continuation)		8*	O-ring ⁽¹⁾ (2 required)	
	Stainless steel			Nitrile	18A7019X012
	1/8-inch (3,18 mm) diameter	1A936735032		Fluoroelastomer (high-temperature, corrosion)	18A7019X022
	3/16-inch (4,76 mm) diameter	00991235032		Nace MR-01-75, fluoroelastomer	18A7019X022
	1/4-inch (6,35 mm) diameter	0B042035032			
	5/16-inch (7,94 mm) diameter	0B042135032	9	Bonnet, aluminum	48A7025X012
	3/8-inch (9,52 mm) diameter	0B042235032			
	1/2-inch (12,70 mm) diameter	1A928835032	10	Internal Retaining Ring ⁽¹⁾ (2 required)	
	9/16-inch (14,29 mm) diameter	1C425235032		Nitrile & fluoroelastomer	18A7020X022
4*	Disk Holder Assembly ⁽¹⁾			Nace MR-01-75, fluoroelastomer	18A7020X032
	Aluminum/nitrile		11*	Bonnet O-Ring ⁽¹⁾	
	1/2 and 9/16-inch (12,70 and 14,29 mm)	1C4248000B2		Nitrile	1K594906562
	Stainless steel/nitrile			Fluoroelastomer (high-temperature, corrosion) & Nace MR-01-75	13A5559X012
	1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm) & 3/8 inch (9,52 mm) orifices	1A8328000A2	12	Adjusting Screw, zinc plated steel	1D995448702
	1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices	1C4248000A2	13	Locknut, zinc plated steel	1A353724122
	Stainless steel/fluoroelastomer		14	Cap Screw, zinc plated steel (8 required)	1A391724052
	1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm) & 3/8 inch (9,52 mm) orifices	1A8328000M2	15	Cap Screw, zinc plated steel (2 required) (not shown)	1B787724052
	1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices	1C4248X0052	16	Actuator Spring, zinc plated steel	See table 2
	Nace MR-01-75, aluminum/fluoroelastomer		17	Upper Spring Seat, zinc plated steel	1D667125072
	1/8 (3,18 mm), 3/16 (4,76 mm), 1/4 (6,35 mm), 5/16 (7,94 mm) & 3/8 inch (9,52 mm) orifices	1A8328X0122	18	Type Y602-12 Vent (not shown)	27A5516X012
	1/2 (12,70 mm) & 9/16 inch (14,29 mm) orifices	1C4248X0182	19	Stem Wiper ⁽¹⁾ , TFE (2 required)	18A7024X012
5*	Diaphragm/Stem Assembly ⁽¹⁾		20	Nameplate, aluminum	1E542711992
	Aluminum/nitrile	17A8080X032	21	Never-Seez Lubricant, 1 gal (3,78 L) can (not furnished with valve)	1M523906992
	Stainless steel/nitrile	17A8080X022	22	Dow Corning 111 Lubricant, 10 pounds (4,54 kg) can (not furnished with valve)	1M528306992
	Stainless steel/fluoroelastomer	17A8080X012	23	Vent Screen, stainless steel (not shown)	0L078343062
	Nace MR-01-75, Aluminum/fluoroelastomer	19A0348X022	24	Nace Tag	19A6034X012
6	Hair Pin Clip ⁽¹⁾		25	Tag Wire	1U7581X0022
	All except NACE	19A0347X012			
	NACE MR-01-75	19A0347X022			
7	Bushing Spacer, Delrin 500 ⁽²⁾ (2 required)	18A7021X012			

*Recommended spare part.
1. Included in repair kit.
2. Trademark of DuPont Co.



□ APPLY LUB/SEALANT
37A8076-C

Figure 3. Type 119 Control Valve

627 Series Pressure Reducing Regulators



WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher® regulators must be installed, operated, and maintained in accordance with federal, state, and local codes, rules and regulations, and Emerson Process Management Regulator Technologies, Inc. (Regulator Technologies) instructions.

If the regulator vents gas or a leak develops in the system, service to the unit may be required. Failure to correct trouble could result in a hazardous condition.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.



W4793

Figure 1. Typical 627 Direct-Operated Pressure Reducing Regulator

Introduction

Scope of the Manual

This manual provides instructions for the installation, adjustment, maintenance, and parts ordering information for the 627 Series regulators. These regulators are usually shipped separate for line installation, although sometimes they are shipped installed on other equipment. Refer to the Instruction Manual of the other equipment for installation and operating instructions.

Description

The 627 Series direct-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.



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 section, 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



627 Series

Specifications

The Specifications section gives some general specifications for the 627 Series regulators. The nameplates give detailed information for a particular regulator as it comes from the factory.

Available Constructions

Type 627: Direct-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 627LR: Type 627R with light rate relief spring (Figure 9).

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 NPT downstream control line connection (Figure 10).

Type 627MR: Type 627M with internal relief (Figure 11).

Type 627H: Type 627 with a diaphragm limiter to deliver a higher outlet pressure (Figure 12).

Type 627HM: Type 627H with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection (Figure 13).

Body Sizes and End Connection Styles

BODY SIZE		END CONNECTION STYLE	CONSTRUCTION AVAILABLE
NPS	DN		
3/4	----	NPT	All
1	25	NPT, CL150 RF, CL300 RF, CL600 RF, and Long Body	
2	50	NPT, CL150 RF, CL300 RF, CL600 RF, and Long Body	

Maximum Inlet Pressure⁽¹⁾ (Body Rating)

NPT Stainless Steel: 2000 psig / 138 bar

Flanged Stainless Steel: 1440 psig / 99.3 bar

NPT Steel: 2000 psig / 138 bar

Flanged Steel: 1500 psig / 103 bar

Ductile Iron: 1000 psig / 69.0 bar

Maximum Valve Disk Inlet Pressure Rating⁽¹⁾

Nylon (PA) Disk: 2000 psig / 138 bar

Nitrile (NBR) Disk: 1000 psig / 69.0 bar

Fluorocarbon (FKM) Disk: 300 psig / 20.7 bar

Maximum Operating Inlet Pressure, Pressure Differential, and Outlet Pressure Ranges⁽¹⁾

See Table 1 for pressures by orifice size and spring range

Maximum Spring and Diaphragm Casing Pressure⁽¹⁾

See Table 2

Maximum Body Outlet Pressure⁽¹⁾⁽²⁾

(Types 627M, 627MR, and 627HM Only)

NPT Steel: 2000 psig / 138 bar

Flanged Steel: 1500 psig / 103 bar

Ductile Iron: 1000 psig / 69.0 bar

Orifice Sizes

See Table 1

Internal Relief Performance

Type 627R: See Table 3

Type 627LR: See Table 4

Type 627MR: Limited by field-installed control line piping

Elastomer Temperature Capabilities⁽¹⁾⁽³⁾

MATERIAL	DISK/ DIAPHRAGM	TEMPERATURE	
		°F	°C
Nitrile (NBR)	Disk	-40 to 180	-40 to 82
	Diaphragm		
Fluorocarbon (FKM)	Disk	0 to 180	-18 to 82
	Diaphragm		
Nylon (PA)	Disk	-40 to 180	-40 to 82
Neoprene (CR) for Types 627H and 627HM only	Diaphragm	-40 to 180	-40 to 82

Flow Coefficients

See Table 5

IEC Sizing Coefficients

See Table 6

Pressure Registration

Type 627, 627H, 627R, or 627LR: Internal

Type 627M, 627HM, or 627MR: External through 1/4 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 Types 627R, 627LR, and 627MR (see Figures 8, 9, and 11)

Spring Case Vent Connection

3/4 NPT with removable screened vent assembly

Approximate Weights

Ductile Iron, Steel, or Stainless Steel Casings:

10 pounds / 4 kg

Aluminum Casings: 6.3 pounds / 3 kg

1. The pressure/temperature limits in this Instruction Manual or any applicable standard limitation should not be exceeded.

2. Types 627, 627H, 627R, and 627LR are limited by maximum diaphragm casing pressure.

3. Stainless steel body is rated to -40°F / -40°C. Steel and Ductile Iron bodies are rated to -20°F / -29°C.

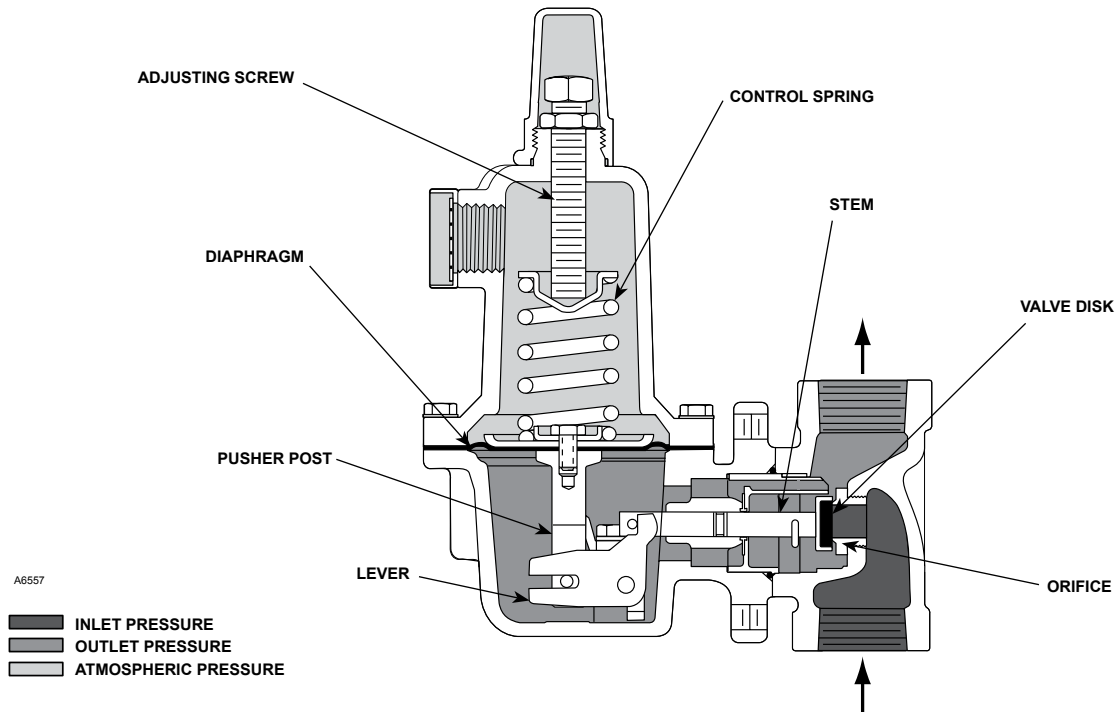


Figure 2. Type 627 Operational Schematic

those limits. The Type 627R, 627LR, or 627MR regulator with internal relief will provide downstream overpressure protection within the limits given in the Specifications section, 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.

Principle of Operation

Refer to Figure 2. When downstream demand decreases, the pressure under the diaphragm increases. This pressure overcomes the regulator setting (which is set by a spring). Through the action of the pusher post assembly, lever, and valve stem the valve disk moves closer to the orifice and reduces gas flow. If demand downstream increases, pressure under the diaphragm decreases. Spring force pushes the pusher post assembly downward and the valve disk moves away from the orifice.

Product Description

Types 627 and 627H Direct-Operated Pressure Reducing Regulators—The Types 627 and 627H regulators provide economical pressure reducing control for a variety of residential, commercial, and industrial applications. The regulator pitot tube located in a high velocity stream provides dynamic boost that compensates for outlet pressure drop.

Type 627 Long Body—The Type 627 Long Body regulator can be used as a drop-in replacement for existing Type 630 installations without the need to modify piping.

Internal Relief for Type 627R, 627LR, or 627MR Regulator—The Type 627R internal relief performance values were obtained by removing the disk assembly from the regulator. For the Type 627R, 627LR, or 627MR regulator, the internal relief across the diaphragm provides overpressure protection in many applications. As outlet pressures build up above the start-to-discharge point, the diaphragm moves off the relief valve seat allowing the excess pressure to bleed out through the screened vent.

For extra protection, should failure conditions exist which would prevent normal operation of the regulator

627 Series

Table 1. Maximum Inlet Pressures and Outlet Pressure Ranges

TYPE	OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR CODE	ORIFICE SIZE		MAXIMUM INLET PRESSURE ⁽¹⁾					
				Nylon (PA) Disk		Nitrile (NBR) Disk		Fluorocarbon (FKM) Disk	
		Inches	mm	psig	bar	psig	bar	psig	bar
627 and 627M ⁽³⁾	5 ⁽²⁾ to 20 psig / 0.34 to 1.4 bar 10B3076X012 Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	250	17.2	250	17.2	250	17.2
	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	500	34.5	500	34.5	300	20.7
		1/2	13	300	20.7	300	20.7	300	20.7
	35 to 80 psig / 2.4 to 5.5 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	1750	121	1000	69.0	300	20.7
		1/4	6.4	1500	103	1000	69.0	300	20.7
		3/8	9.5	1000	69.0	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
	70 to 150 psig / 4.8 to 10.3 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	2000	138	1000	69.0	300	20.7
		1/4	6.4	1750	121	1000	69.0	300	20.7
		3/8	9.5	1250	86.2	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
627R and 627MR	5 ⁽²⁾ to 20 psig / 0.34 to 1.4 bar 10B3076X012 Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	35 to 80 psig / 2.4 to 5.5 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1750	121	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	70 to 150 psig / 4.8 to 10.3 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	500	34.5	500	34.5	300	20.7
		1/4	6.4	300	20.7	300	20.7	300	20.7
		3/8	9.5	200	13.8	200	13.8	200	13.8
		1/2	13	200	13.8	200	13.8	200	13.8
627LR	15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	3/32	2.4			1000	69.0	300	20.7
		1/8	3.2			1000	69.0	300	20.7
		3/16	4.8			750	51.7	300	20.7
		1/4	6.4			500	34.5	300	20.7
627H and 627HM ⁽³⁾	140 to 250 psig / 9.7 to 17.2 bar 10B3078X012 Blue	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		
		3/8	9.5	1000	69.0	750	51.7		
		1/2	13	750	51.7	500	34.5		
	240 to 500 psig / 16.5 to 34.5 bar 10B3079X012 Red	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		

1. For inlet pressure in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

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 627HM should have a 3/8 inch / 9.5 mm or larger orifice.

Shaded areas indicate that Fluorocarbon (FKM) and Nylon (PA) disk material are not available.

Table 2. Maximum Spring and Diaphragm Casing Pressure⁽¹⁾

MAXIMUM PRESSURE DESCRIPTION	DIAPHRAGM CASING MATERIAL	TYPE 627		TYPES 627R AND 627LR		TYPE 627M		TYPE 627MR		TYPES 627H AND 627HM	
		psig	bar	psig	bar	psig	bar	psig	bar	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	
	Ductile iron					250	17.2	Not Available		Not Available	
	Steel or Stainless steel							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	32.1	465	32.1	465	32.1	465	32.1	Not Available	
	Steel or Stainless steel	1500	103	1500	103	1500	103	1500	103	1500	103
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts	All materials	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 local Sales Office for details.											

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your local Sales Office for details.

(for example, disk broken off or disk erosion), the pusher post contacts the lever retainer causing the relief valve assembly to open. Since the diaphragm continues to rise as downstream pressure builds, it opens the relief valve; thereby, opening the valve. This internal relief may be adequate for the application.

Downstream Control Line for Type 627M, 627HM, or 627MR Regulator—A Type 627M, 627HM, or 627MR regulator has a blocking throat stem seal with O-rings and a 1/4 NPT control line connection in the diaphragm case. A regulator with a downstream control line is used for monitoring applications or other applications where other equipment is installed between the regulator and the pressure control point. The stem seal separates the body outlet pressure from the diaphragm case.

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 13. Ensure that the operating temperature capabilities listed in Specifications section are not exceeded.

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.



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 and Spring Case Area Maintenance Procedures in the Maintenance section to reposition the screened vent for the application.

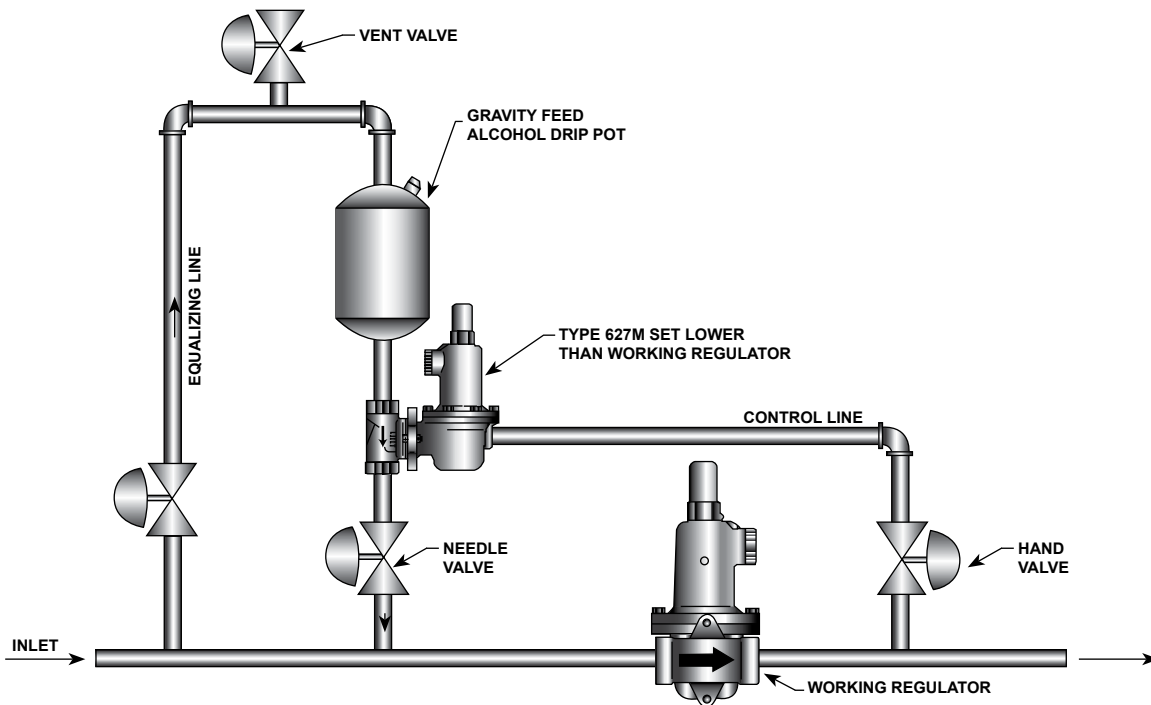


Figure 3. De-Icer System Operational Schematic

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 / 9.5 mm 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 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. It should be as short as possible with 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 form within this regulator. The formation of ice decreases the size of the orifice, 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 orifice, permitting alcohol to flow into the main gas line. The alcohol carried to the main regulator by the flowstream prevents additional ice from forming on the orifice. When normal flow resumes, and as pressure in the downstream system is restored, the Type 627M or 627HM regulator shuts off.

Overpressure Protection

627 Series regulators have outlet pressure ratings that are lower than their inlet pressure ratings. A pressure-

Table 3. Type 627R Internal Relief Performance⁽¹⁾

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR CODE	OUTLET PRESSURE SETTING		MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE		MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED ⁽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 / 13	
	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
5 ⁽³⁾ to 20 psig / 0.34 to 1.4 bar 10B3076X012 Yellow	10	0.69	60	4.1	1250	86.2	740	51.0	320	22.1	190	13.1	95	6.6	75	5.2
			100	6.9	2000	138	1500	103	620	42.7	390	26.9	180	12.4	130	9.0
			125	8.6	2000	138	1900	131	830	57.2	480	33.1	220	15.2	160	11.0
			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
	15	1.0	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	9.0
			125	8.6	2000	138	1900	131	810	55.8	480	33.1	220	15.2	160	11.0
			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	5.5	65	4.5
			100	6.9	2000	138	1300	89.6	600	41.4	360	24.8	170	11.7	120	8.3
			125	8.6	2000	138	1800	124	800	55.2	480	33.1	220	15.2	160	11.0
			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
15 to 40 psig / 1.0 to 2.8 bar 10B3077X012 Green	15	1.0	60	4.1	1000	69.0	380	26.2	210	14.5	130	9.0	80	5.5	65	4.5
			100	6.9	2000	138	1300	89.6	590	40.7	350	24.1	170	11.7	120	8.3
			125	8.6	2000	138	1800	124	800	55.2	470	32.4	220	15.2	160	11.0
			175	12.1	2000	138	2000	138	1100	75.8	640	44.1	320	22.1	220	15.2
			200	13.8	2000	138	2000	138	1300	89.6	780	53.8	370	25.5	260	17.9
			250	17.2	2000	138	2000	138	1600	66.2	960	66.2	450	31.0	320	22.1
	20	1.4	60	4.1	630	43.4	200	13.8	150	10.3	100	6.9	70	4.8	65	4.5
			100	6.9	2000	138	1200	82.7	550	37.9	330	22.8	160	11.0	120	8.3
			125	8.6	2000	138	1700	117	760	52.4	450	31.1	210	14.5	160	11.0
			175	12.1	2000	138	2000	138	1100	75.8	630	43.4	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	66.2	960	66.2	460	31.7	320	22.1
	30	2.1	100	6.9	2000	138	950	65.5	450	31.1	260	17.9	140	9.7	110	7.6
			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
			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
	40	2.8	100	6.9	1500	103	700	48.3	330	22.8	200	13.8	120	8.3	108	7.4
			125	8.6	2000	138	1300	89.6	560	38.6	340	23.4	180	12.4	140	9.7
			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
			250	17.2	2000	138	2000	138	1600	110	970	66.9	460	31.7	320	22.1

1. The internal relief performance values are obtained by removing the disk assembly.

2. For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

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 1 gives the maximum inlet pressure for normal regulator operation.

- continued -

relieving or pressure-limiting device must be provided by the user for the Types 627, 627H, 627M, and 627HM regulators if the inlet pressure can exceed the outlet pressure rating, since these regulators do not have internal relief.

Types 627R and 627LR regulators provide internal relief which limits the total outlet pressure buildup over setpoint. Use Tables 3 and 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.

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

627 Series

Table 3. Type 627R Internal Relief Performance⁽¹⁾ (continued)

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR CODE	OUTLET PRESSURE SETTING		MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE		MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED ⁽²⁾⁽³⁾											
					Orifice Size, Inches / mm											
	psig	bar	psig	bar	3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
					psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
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	9.7
			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	9.7
			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	31.0	270	18.6	190	13.1	140	9.7	130	9.0
			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
70 to 150 psig / 4.8 to 10.3 bar 10B3079X012 Red	70	4.8	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
			250	17.2	2000	138	2000	138	1100	75.8	680	46.9	360	24.8	290	20.0
	80	5.5	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
			250	17.2	2000	138	2000	138	1000	69.0	620	42.7	350	24.1	280	19.3
	100	6.9	200	13.8	1500	103	250	17.2	240	16.5	230	15.9	210	14.5	210	14.5
			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 / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.
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 1 gives the maximum inlet pressure for normal regulator operation.

Table 4. Type 627LR Internal Relief Performance⁽¹⁾

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR CODE	OUTLET PRESSURE SETTING		MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE		MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED ⁽²⁾							
					Orifice Size, Inches / mm							
	psig	bar	psig	bar	3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4	
					psig	bar	psig	bar	psig	bar	psig	bar
15 to 40 psig / 1.03 to 2.8 bar 10B3077X012 Green	30	2.1	55	3.8	500	34.5	270	18.6	110	7.6	80	5.5
			60	4.1	850	58.6	480	33.1	200	13.8	120	8.3
			66	4.5	1000	69.0	660	45.5	290	20.0	175	12.1
	40	2.8	66	4.5	380	26.2	190	13.1	85	5.9	80	5.5
			70	4.8	700	48.3	370	25.5	150	10.3	115	7.9
			75	5.2	1000	69.0	560	38.6	240	16.5	160	11.0

1. The internal relief performance values are obtained by removing the disk assembly.
2. For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

Table 5. Flow Coefficients

ORIFICE		3/4 NPT			NPS 1 / DN 25 BODY			NPS 2 / DN 50 BODY		
Inch	mm	Wide-Open C _g for External Relief Sizing	Wide-Open C _g for External Relief Sizing	C ₁	Wide-Open C _g for External Relief Sizing	Wide-Open C _g for External Relief Sizing	C ₁	Wide-Open C _g for External Relief Sizing	Wide-Open C _g for External Relief Sizing	C ₁
3/32	2.4	6.9	0.24	29.2	6.9	0.24	28.5	6.9	0.23	29.7
1/8	3.2	12.5	0.43	29.1	12.5	0.43	29.4	12.5	0.42	29.5
3/16	4.8	29	1.01	28.6	29	0.93	31.2	29	1.02	28.5
1/4	6.4	50	1.63	30.6	50	1.71	29.3	52	1.66	31.3
3/8	9.5	108	2.99	36.1	108	3.42	31.6	115	3.39	33.9
1/2	13	190	4.87	39.0	190	5.29	35.9	200	5.01	39.9

Table 6. IEC Sizing Coefficients

ORIFICE SIZE		X _T			F _D	F _L
Inch	mm	3/4 NPT Body	NPS 1 / DN 25 Body	NPS 2 / DN 50 Body		
3/32	2.4	0.539	0.514	0.558	0.50	0.85
1/8	3.2	0.536	0.547	0.539		0.79
3/16	4.8	0.517	0.616	0.514		0.85
1/4	6.4	0.592	0.543	0.620		0.87
3/8	9.5	0.824	0.632	0.727		0.89
1/2	13	0.962	0.815	1.01		0.86

Table 7. Maximum Torque Values

KEY NUMBER ⁽¹⁾	DESCRIPTION	MAXIMUM TORQUE	
		FOOT-POUNDS	N•m
2	Orifice	25	34
3	Cap screw (with aluminum diaphragm casing)	16	22
	Cap screw (with ductile iron or steel/stainless steel diaphragm casing)	25	34
18	Lever cap screw	7	9.5
22	Diaphragm connector nut	17	23
26	Guide retainer (for Types 627R, 627LR, and 627MR only)	3	4.1
37	Spring case cap screw (with aluminum or ductile iron diaphragm casing)	7	9.5
	Spring case cap screw (with steel/stainless steel diaphragm casing)	35	47
46	Diaphragm cap screw (with Type 627 or 627M)	7	9.5
	Diaphragm cap screw (with Type 627H or 627HM)	14	19

1. Refer to Figures 7 through 13 for key number locations.

pressure to prevent an overpressure condition on the diaphragm of the regulator.

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 shut-off valve.
2. Slowly open the downstream shut-off 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. 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 Table 1, 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.

Note

Always use a pressure gauge to monitor pressure when making adjustments.

627 Series

Refer to Figures 7 through 13 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 counterclockwise.
4. When the desired pressure is obtained, hold the adjusting screw (key 35) in place and tighten the locknut (key 34).

Shutdown



WARNING

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 shut-off valve.
2. Close the nearest downstream shut-off valve.
3. Open the vent valve between the regulator and the downstream shut-off valve nearest to it.
4. For a Type 627, 627H, 627R, or 627LR regulator, the regulator will open to release pressure between the upstream shut-off 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 shut-off 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 7.

Due to normal wear, damage from external sources, or debris in the air or gas line, regulator parts such as the disk assembly, orifice, and diaphragm must

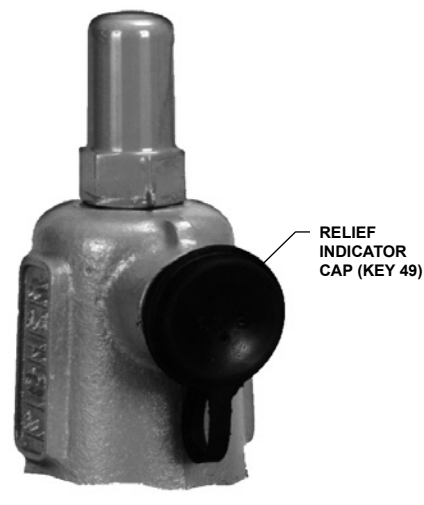


Figure 4. Relief Indicator

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 orifice and disk assembly is accelerated with high pressure drops and with large amounts of impurities in the flowstream. Instructions are given below for replacing the disk assembly, orifice, diaphragm, and O-rings. These procedures may also be used for disassembly required for inspection and replacement of other parts.

Problem Indication for Types 627R, 627LR, 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 orifice.

If the disk assembly and orifice are not damaged, refer to the Diaphragm and Spring Case Area Maintenance Procedures in this section.

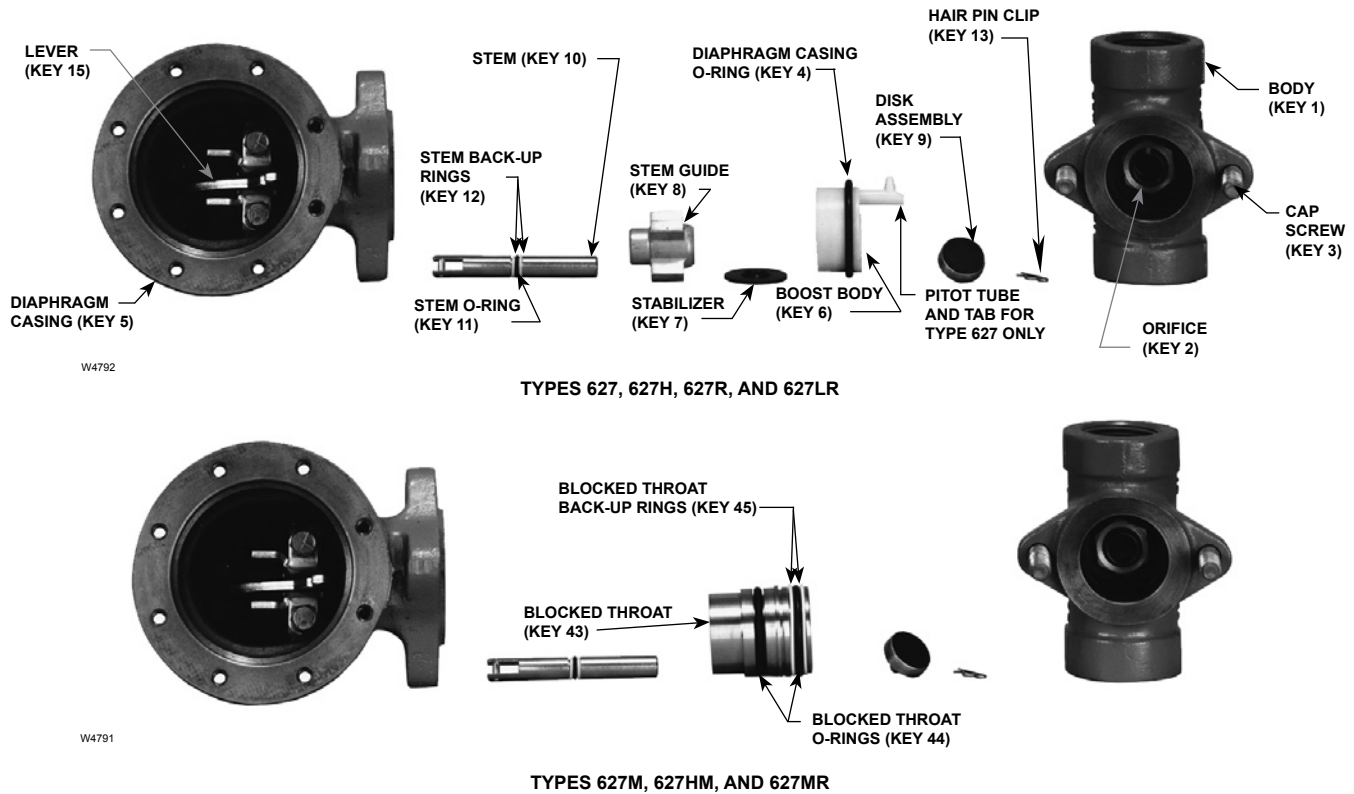


Figure 5. Stem Assemblies

The disk assembly and orifice 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, orifice, diaphragm casing O-ring, and stem assembly. All pressure must be released from the diaphragm casing before performing these steps.

While using the following procedures, refer to Figures 7 through 13 for key number locations.

Replacing the Disk Assembly or Orifice

1. To inspect and replace the disk assembly (key 9) or orifice (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 orifice (key 2). If removed, coat the threads of the replacement orifice with lubricant and torque to 25 foot-pounds / 34 N•m.

3. Inspect the disk assembly (key 9) 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.

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 Types 627, 627H, 627R, and 627LR regulators, or steps 9 through 19 for Types 627M, 627HM, and 627MR regulators.

Perform steps 4 through 8 for Types 627, 627H, 627R, and 627LR Regulators only:

4. 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, 9, or 12) and replace it if necessary.

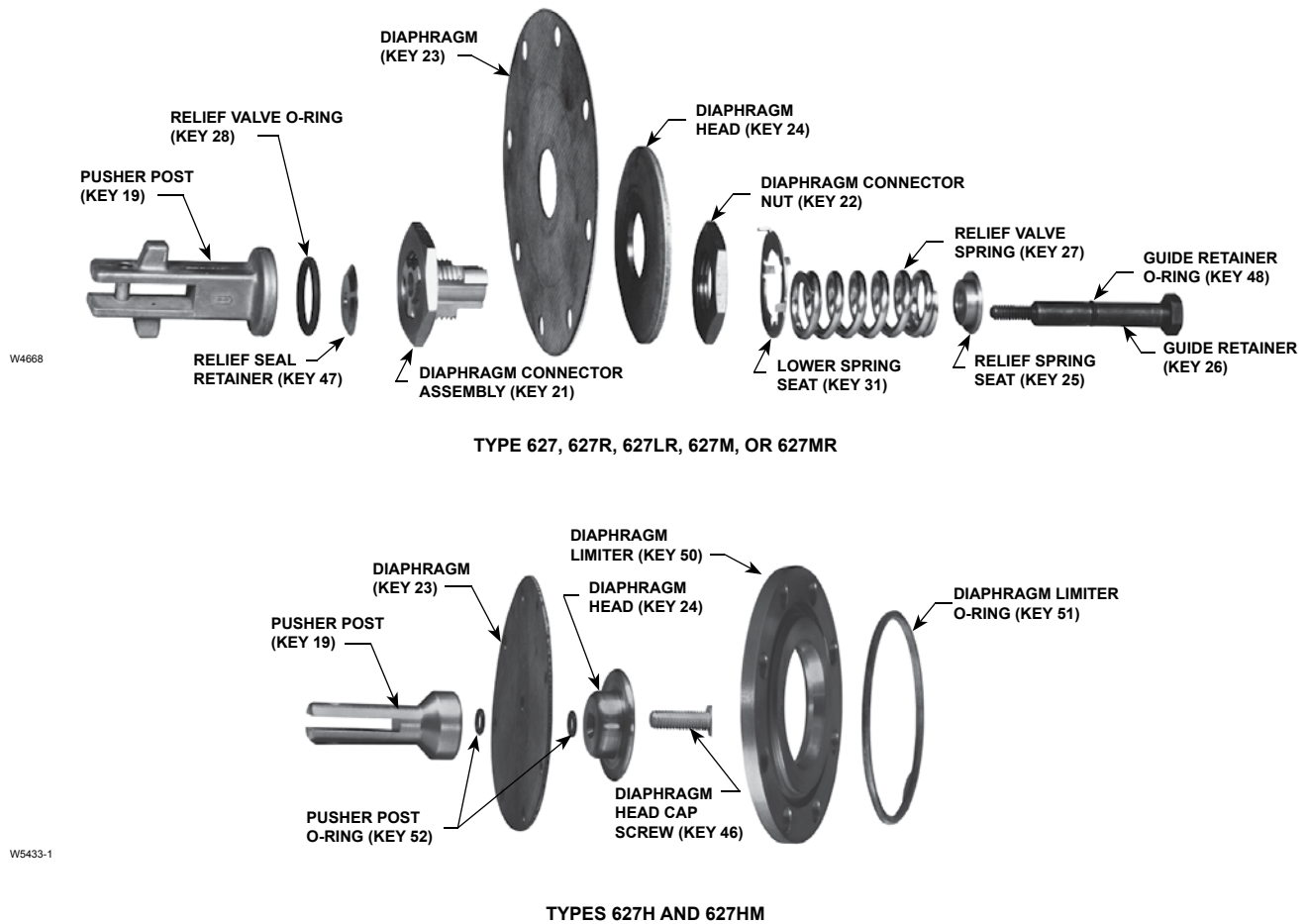


Figure 6. Diaphragm Assemblies

7. Apply lubricant to a replacement diaphragm casing O-ring (key 4, Figure 7, 8, 9, or 12) 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 12). Skip to step 14.
- Perform steps 9 through 19 for Types 627M, 627HM, and 627MR Regulators only:**
9. 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.
11. Inspect and, if necessary, replace the blocked throat O-rings (key 44, Figure 5) and back-up rings (key 45, Figure 5).
12. Apply lubricant to replacement blocked throat O-rings (key 44) and back-up rings (key 45).
13. Apply lubricant to the replacement stem O-ring (key 11) and stem back-up rings (key 12) and install them on the stem (key 10).
14. For assembly, lubricate the stem (key 10) and insert the diaphragm casing (key 5) and hook it on the lever (key 15).
15. Lubricate the contact points of the lever (key 15).
16. Insert parts into the diaphragm casing (key 5) that were removed in steps 5 and 6 or step 10 (see Figure 5).
17. Install 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).
18. Position the diaphragm casing (key 5) plus attached parts in relation to the body (key 1) so that they are correct for the application.

19. Secure the diaphragm casing (key 5) to the body with the cap screws (key 3, Figure 5). For an aluminum diaphragm casing, 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.
20. 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 13 for key number locations.

1. Remove the adjusting screw cap (key 36), loosen the lock nut (key 34), 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.
3. Remove the diaphragm limiter O-ring and diaphragm limiter (keys 51 and 50, 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 / 9.5 N•m.

If it is necessary to perform maintenance on the diaphragm assembly, continue with steps 6 through 11 and step 20 for Types 627, 627H, 627M, and 627HM regulators, or steps 12 through 19 for Types 627R, 627LR, and 627MR regulators.

Perform steps 6 through 11 for Types 627, 627H, 627M, and 627HM Regulators only:

6. For Types 627, 627H, 627M, and 627HM regulators (Figures 5 and 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 pusher post 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 (key 15) and torque the diaphragm head cap screw (key 46) to 7 foot-pounds / 9.5 N•m for the Type 627 or 627M. On the Type 627H or 627HM, torque the diaphragm head cap screw to 14 foot-pounds / 19 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.

Perform steps 12 through 19 for Types 627R, 627LR, and 627MR Regulators only:

12. For Types 627R, 627LR, 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).

627 Series

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 / 23 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 apply lubricant. 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 / 4.1 N•m.
18. Hook the pusher post (key 19) (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 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 over the screw holes, insert the spring case cap screws (key 37), and finger tighten.
23. Screw in the adjusting screw (key 35) 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 / 9.5 N•m of torque.
25. If necessary, refer to the installation and/or the Startup and Adjustment procedures.
26. Install the adjusting locknut (key 34) after regulator adjustment.

Parts Ordering

When corresponding with your local Sales Office about this equipment, always reference the equipment serial number or FS number that can be found on the nameplate.

When ordering replacement parts, reference the key number of each needed part as found in the following parts list. Separate kits containing all recommended spare parts are available.

Parts List

Note

In this parts list, parts marked NACE are intended for corrosion-resistant service as detailed in the NACE International Standard MR0175.

Key	Description	Part Number
	Type 627 Parts Kit with Aluminum/Nitrile (NBR) trim (include keys 4, 9, 11, 12, and 23)	R627X000A12
	Type 627 Parts Kit with Stainless steel/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, and 23)	R627X000S12
	Type 627H Parts Kit with SST/Nylon (PA) trim	R627HX00S12
	Type 627R Parts Kit with Aluminum/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00A12
	Type 627R Parts Kit with Stainless steel/ Nitrile (NBR) trim (include keys 4, 9, 11, 12, 23, 28, and 48)	R627RX00S12
1	Body ⁽¹⁾	
	Ductile iron	
	1000 psig / 69.0 bar maximum inlet pressure	
	3/4 NPT	30B3046X012
	1 NPT	30B3048X012
	2 NPT	30B3096X012
	Ductile iron (Long Body)	
	1000 psig / 69.0 bar maximum inlet pressure	
	1 NPT	39B2451X012
	2 NPT	39B0414X012
	Steel	
	2000 psig / 138 bar maximum inlet pressure	
	3/4 NPT	30B3050X012
	1 NPT	30B3051X012
	2 NPT	30B7452X012
	Steel (Long Body)	
	2000 psig / 138 bar maximum inlet pressure	
	1 NPT	39B0412X012
	2 NPT	39B0415X012
	Steel, CL600 RF flanged	
	1500 psig / 103 bar maximum inlet pressure	
	NPS 1 / DN 25	40B6754X012
	NPS 2 / DN 50	40B6756X012
	Steel, CL300 RF flanged	
	750 psig / 51.7 bar maximum inlet pressure	
	NPS 1 / DN 25	41B8978X012
	NPS 2 / DN 50	41B8080X012

1. Bodies can be used for both standard and NACE constructions.

Key	Description	Part Number	Key	Description	Part Number
1	Body ⁽¹⁾ (continued)		4*	Diaphragm Case O-ring	
	Steel, CL150 RF flanged			Nitrile (NBR)	
	290 psig / 20.0 bar maximum inlet pressure			For Type 627, 627H, or 627R only	17A2325X022
	NPS 1 / DN 25	43B8656X022		Fluorocarbon (FKM)	
	NPS 2 / DN 50	44B0666X012		For Types 627, 627R, and 627LR only	10A0037X012
	Steel, BWE		5	Diaphragm Case	
	1000 psig / 69.0 bar maximum inlet pressure			For Type 627, 627R, or 627LR	
	NPS 1 / DN 25	33B6723X012		Aluminum without 1/8-inch / 3.2 mm gauge tap	40B3084X012
	NPS 2 / DN 50	38B1688X012		Aluminum with 1/8-inch / 3.2 mm gauge tap	11B5380X012
	Steel, PN 16/25/40 RF			for 627 Series (except Types 627H and 627HM)	30B3053X012
	580 psig / 40.0 bar maximum inlet pressure			Ductile iron without 1/8-inch / 3.2 mm gauge tap	31B0641X012
	NPS 1 / DN 25	44B0386X012		Ductile iron with 1/8-inch / 3.2 mm gauge tap	31B0641X012
	NPS 2 / DN 50	44B3342X012		for 627 Series (except Types 627H and 627HM)	31B0641X012
	Stainless Steel ⁽²⁾ , NPT			For Type 627, 627R, or 627LR	
	2000 psig / 138 bar maximum inlet pressure			Steel	30B3104X012
	3/4 NPT	30B3050X062		Ductile iron with 1/4 NPT gauge tap for	
	1 NPT	30B3051X092		627 Series (except Types 627H and 627HM)	39A5987X012
	2 NPT	30B7452X052		Steel with 1/4 NPT gauge tap for 627 Series	
	Stainless Steel ⁽²⁾ , CL150 RF flanged			(except Type 627H)	30B8734X012
	275 psig / 18.9 bar maximum inlet pressure			For Type 627M or 627MR	
	NPS 1 / DN 25	43B8656X052		Ductile iron	39A5987X012
	NPS 2 / DN 50	44B0666X022		Steel	30B8734X012
	Stainless Steel ⁽²⁾ , CL300 RF flanged			For Type 627H, Steel	30B3104X012
	720 psig / 49.6 bar maximum inlet pressure			For Type 627, Stainless steel	30B3104X082
	NPS 1 / DN 25	41B8978X072		For Type 627HM, Steel	30B8734X012
	NPS 2 / DN 50	41B8080X072	6	Boost Body (not for Type 627M, 627HM,	
	Stainless Steel ⁽²⁾ , CL600 RF flanged			or 627MR), Delrin®	
	1440 psig / 99.2 bar maximum inlet pressure			For Type 627 or 627H	30B3056X012
	NPS 1 / DN 25	40B6754X102		For Type 627R or 627LR	30B3057X012
	NPS 2 / DN 50	40B6756X062	7	Stabilizer	
	Stainless Steel ⁽²⁾ , PN 16/25/40 RF			Nitrile (NBR)	
	580 psig / 40.0 bar maximum inlet pressure			For Types 627, 627H, 627R, and 627LR only	10B3060X012
	NPS 1 / DN 25	44B0386X032		Fluorocarbon (FKM)	
	NPS 2 / DN 50	44B3342X032		For Types 627, 627R, and 627LR only	10B3060X022
2*	Orifice		8	Stem Guide (for Types 627, 627H, 627R, and	
	Aluminum			627LR only), Powdered metal	20B3061X012
	3/32 inch / 2.4 mm	0R044109022	9*	Disk Assembly (for all Orifice Size)	
	1/8 inch / 3.2 mm	1A936709012		Aluminum holder and Nitrile (NBR) disk	1C4248X0212
	3/16 inch / 4.8 mm	00991209012		303 Stainless steel holder and Nitrile (NBR) disk	1C4248X0202
	1/4 inch / 6.4 mm	0B042009012		Aluminum holder and Nylon (PA) disk	1C4248X00A2
	3/8 inch / 9.5 mm	0B042209012		303 Stainless steel holder and Nylon (PA) disk	1C4248X0062
	1/2 inch / 13 mm	1A928809012		316 Stainless steel holder and Nylon (PA) disk	1C4248X0262
	303 Stainless steel			316 Stainless steel holder and Nitrile (NBR) disk	1C4248X0252
	3/32 inch / 2.4 mm	0R044135032		303 Stainless steel holder and	
	1/8 inch / 3.2 mm	1A936735032		Fluorocarbon (FKM) disk	1C4248X0052
	3/16 inch / 4.8 mm	00991235032		Aluminum holder and Fluorocarbon (FKM) disk	1C4248X0182
	1/4 inch / 6.4 mm	0B042035032		316 Stainless steel holder and	
	3/8 inch / 9.5 mm	0B042235032		Fluorocarbon (FKM) disk	1C4248X0192
	1/2 inch / 13 mm	1A928835032	10	Stem	
	316 Stainless steel, NACE construction only			303 Stainless steel	10B3059X012
	3/32 inch / 2.4 mm	0R0441X0012		316 Stainless steel (NACE)	10B3059X022
	1/8 inch / 3.2 mm	1A9367X0022	11*	Stem O-ring	
	3/16 inch / 4.8 mm	009912X0012		Nitrile (NBR)	
	1/4 inch / 6.4 mm	0B0420X0012		Fluorocarbon (FKM) For Types 627, 627R,	
	3/8 inch / 9.5 mm	0B0422X0012		627LR, 627M, and 627MR only	1N430406382
	1/2 inch / 13 mm	1A9288X0012	12*	Stem Back-up Ring,	
3	Cap Screw (not shown), (2 required)			Polytetrafluoroethylene (PTFE) (2 required)	1K786806992
	627 Series		13	Hair Pin Clip, Stainless steel	10B3058X012
	For Ductile iron/Steel diaphragm case	1A560724052	14	Drive Pin, Plated steel	1H3671X0012
	For Aluminum diaphragm case		15	Lever, Plated steel	20B3063X012
	(not applicable for Types 627H and 627HM)	1A352524052	16	Lever Retainer, Plated steel	30B3097X012
	Type 627 Only		17	Lever Pin	
	For Ductile iron/Steel diaphragm case	1A5607X0052		Stainless steel	10B3083X012
	For Aluminum case with Steel diaphragm case	10A3869X012		316 Stainless steel (NACE)	10B3083X022
	For SST Case and body	1A5607X0052			
	For Aluminum Case and SST body	10A3869X022			

*Recommended spare part.

1. Bodies can be used for both standard and NACE constructions.

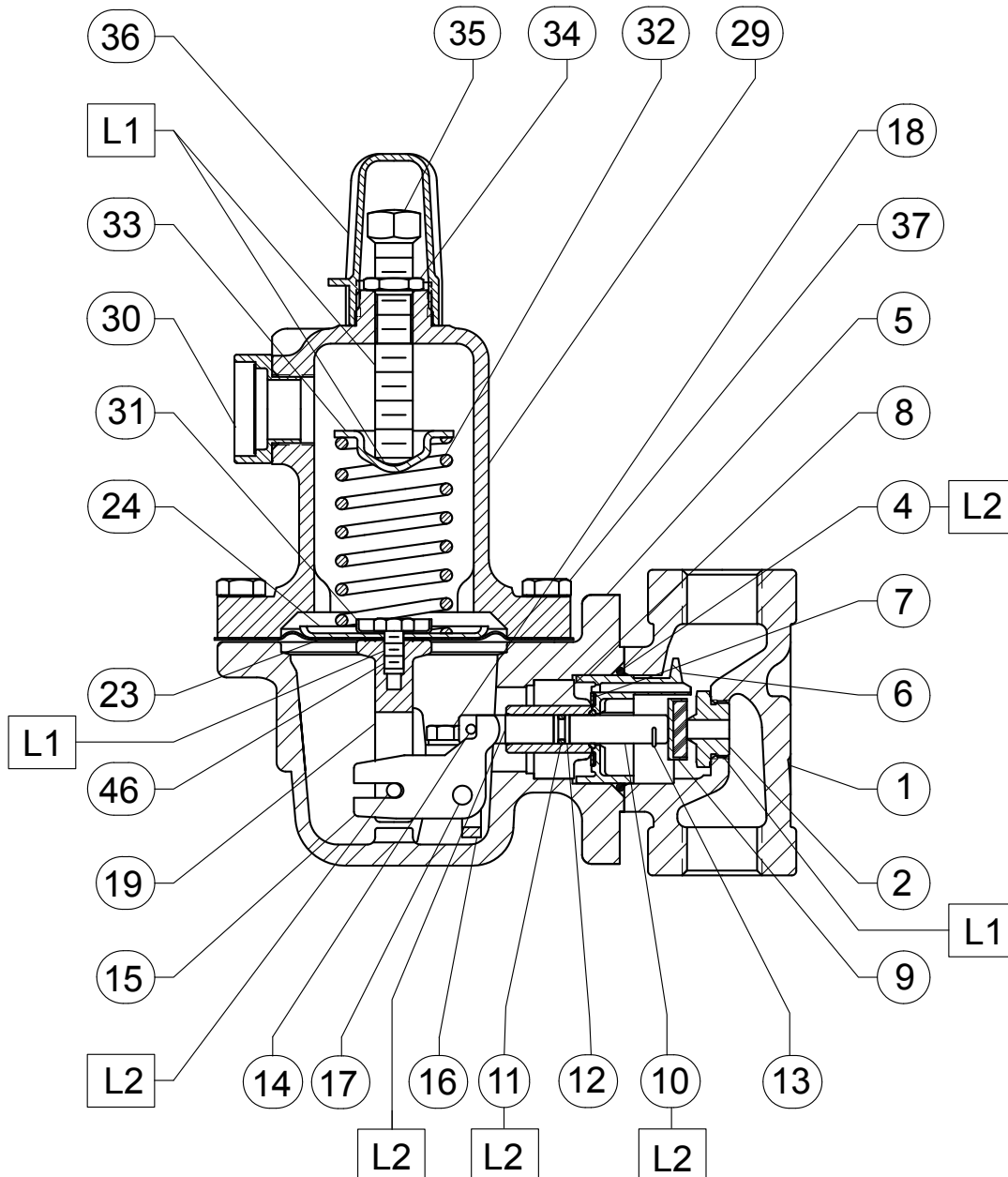
2. Stainless steel body material can be used for applications in temperature ranges down to -40°F / -40°C and are only available for Types 627, 627R, and 627H.

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627 Series

Key	Description	Part Number	Key	Description	Part Number
18	Lever Cap Screw (2 required) Plated steel	10B7454X012	30	Screened Vent Assembly, Plastic	10B3093X012
	316 Stainless steel (NACE)	1B2905X0012	31	Lower Spring Seat, Plated steel For Type 627 or 627M	1D666625072
19	Pusher Post, Aluminum For Type 627 or 627M	10B3098X012		For Type 627R, 627LR, or 627MR	20B3073X012
	For Type 627R, 627LR, or 627MR	10B3098X022	32	Control Spring, Plated steel 5 to 20 psig / 0.34 to 1.4 bar, Yellow	10B3076X012
	For Type 627H or 627HM, 416 Stainless steel	10B3098X032		15 to 40 psig / 1.0 to 2.8 bar, Green	10B3077X012
	Stainless steel (NACE)	10B3098X102		35 to 80 psig / 2.4 to 5.5 bar, Blue	10B3078X012
21	Diaphragm Connector (for Type 627R, 627LR, or 627MR only), Stainless steel	28B8832X012		70 to 150 psig / 4.8 to 10.3 bar, Red	10B3079X012
22	Diaphragm Connector Nut (for Type 627R, 627LR, or 627MR only), Stainless steel	10B7449X012		140 to 250 psig range / 9.7 to 17.2 bar, Blue, used for Type 627H or 627HM	10B3078X012
23*	Diaphragm Nitrile (NBR) For Type 627 or 627M with Aluminum or Ductile iron diaphragm case	10B3069X012	33	Upper Spring Seat, Plated steel	1D667125072
	For Type 627 or 627M with Steel diaphragm case	10B8735X012	34	Locknut, Plated steel	1D667728982
	For Type 627R, 627LR, or 627MR with Aluminum or Ductile iron diaphragm case	10B3068X012	35	Adjusting Screw, Plated steel For Type 627, 627M, 627H, or 627HM	10B3081X012
	For Type 627R, 627LR, or 627MR with Steel diaphragm case	10B8736X012		For Type 627R, 627LR, or 627MR	10B3080X012
	For Type 627H or 627HM with Steel diaphragm case (diaphragm is Neoprene (CR) with Nylon (PA) fabric)	12B0178X012	36	Adjusting Screw Cap, Plastic	20B3082X012
	Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR with Steel case	10B8736X022	37	Spring Case Cap Screw, Plated steel (8 required) For Aluminum or ductile iron diaphragm case	1A391724052
	For Types 627 and 627M with Steel case	10B8735X042		For Steel diaphragm case	1A368324052
	For Types 627R, 627LR, and 627MR with Ductile Iron and Aluminum Casing	10B3068X022		For Stainless steel case and body	1A3683X0062
	For Types 627 and 627M with Ductile Iron and Aluminum Casing	10B3069X032		For Aluminum case and SST body	1A3917X0062
24	Diaphragm Head, Plated steel For Type 627 or 627M, Plated steel	1D666428982		For Type 627H/HM, steel diaphragm case	1A346424052
	For Type 627R, 627LR, or 627MR, Plated steel	10B3071X012		For Type 627H, Stainless steel case and body	1A3464X0022
	For Type 627H or 627HM, 416 Stainless steel	12B0175X012	43	Blocked Throat (For Type 627M, 627HM, or 627MR only), Stainless steel	10B3085X012
25	Relief Spring Seat (For Type 627R or 627MR only), Steel	10B7446X012	44*	Blocked Throat O-ring Nitrile (NBR) For Type 627M, 627HM, or 627MR only (2 required) Fluorocarbon (FKM) For Types 627M and 627MR only	1E264306992
26	Guide Retainer (For Type 627R, 627LR, or 627MR only), Stainless steel	10B7450X012			1E2643X0022
27	Relief Spring (For Type 627R or 627MR only), Plated steel	10B6757X012	45*	Blocked Throat Back-up Ring (For Type 627M, 627HM, or 627MR only), PTFE (2 required)	10B3106X012
	For Type 627LR	1B541327022	46	Diaphragm Head Cap Screw, Steel For Type 627 or 627M	1B290524052
28*	Relief Seal O-ring Nitrile (NBR) For Type 627R, 627LR, or 627MR only	1J108506992		For Type 627H or 627HM	1C379124052
	Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR only	1J1085X0042	47	Relief Seal Retainer (For Type 627R, 627LR, or 627MR only), Stainless steel	10B7445X012
29	Spring Case For Type 627, 627R, or 627LR		48*	Guide Retainer O-ring Nitrile (NBR) For Type 627R, 627LR, or 627MR only	1D682506992
	Aluminum	40B3086X012		Fluorocarbon (FKM) For Types 627R, 627LR, and 627MR only	1N423906382
	Ductile iron	30B3055X012	49	Relief Indicator (For Type 627R, 627LR, or 627MR only), Rubber (not shown)	30B3100X012
	Steel	30B3102X012	50	Diaphragm Limiter (For Types 627H and 627HM only)	22B0176X012
	Stainless steel (Types 627 and 627R only)	30B3102X092	51*	Diaphragm Limiter O-ring For Types 627H and 627HM only	1K877606992
29	Spring Case (continued) For Type 627M or 627MR		52*	Pusher Post O-ring (2 required) For Types 627H and 627HM only	1C853806992
	Ductile iron	30B3055X012	58	Pipe Plug, Zinc	1D8293T0022
	Steel	30B3102X012	67	Drive Screw, 18-8 Stainless steel	1A368228982
	For Type 627H or 627HM		72	Pipe Plug, Zinc-plated steel	1A767524662
	Steel	30B3102X012			
	Stainless steel (Type 627H only)	30B3102X092			

*Recommended spare part.

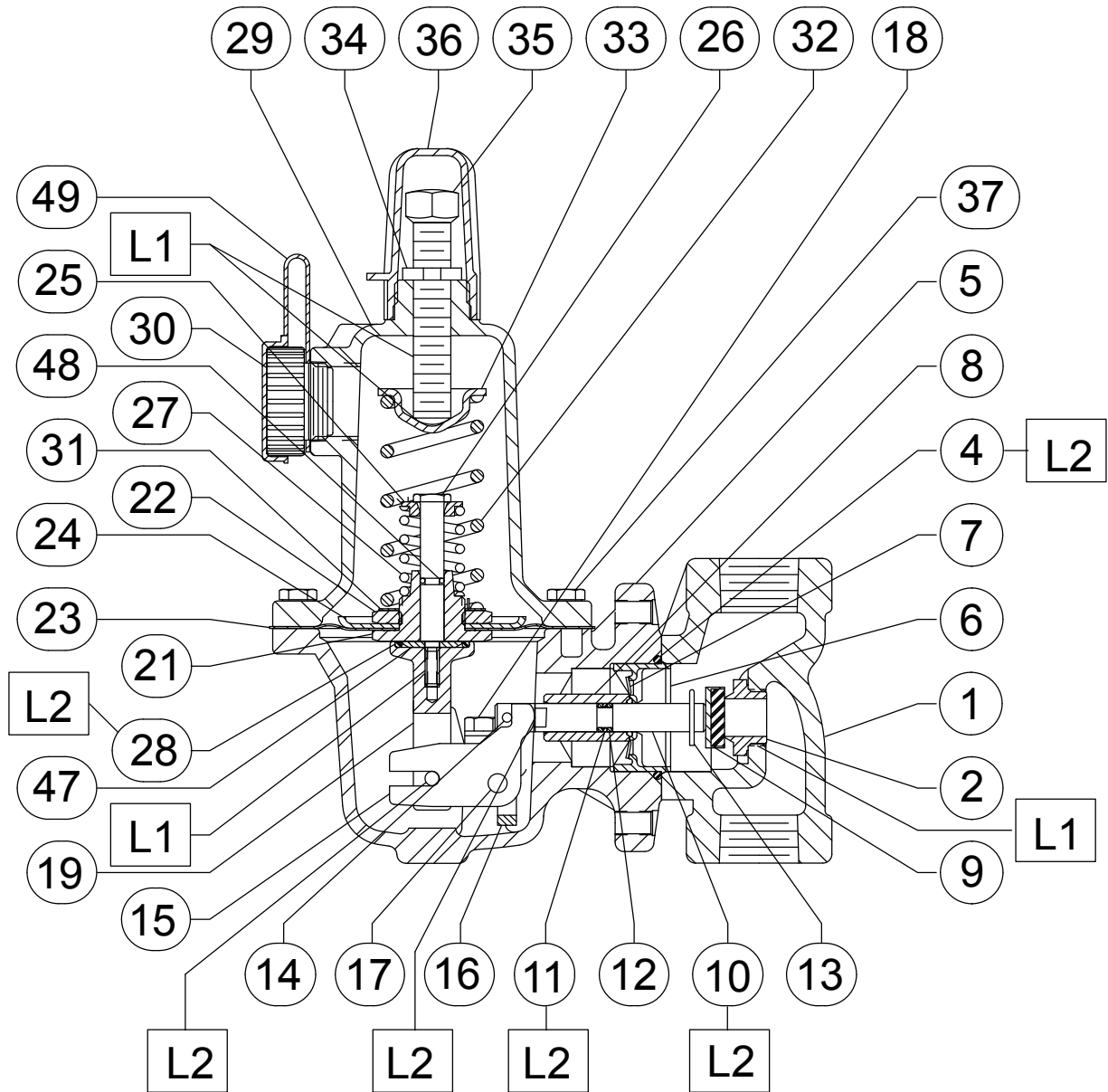


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□ **APPLY LUBRICANT⁽¹⁾**
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
 PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 7. Type 627 Regulator Assembly

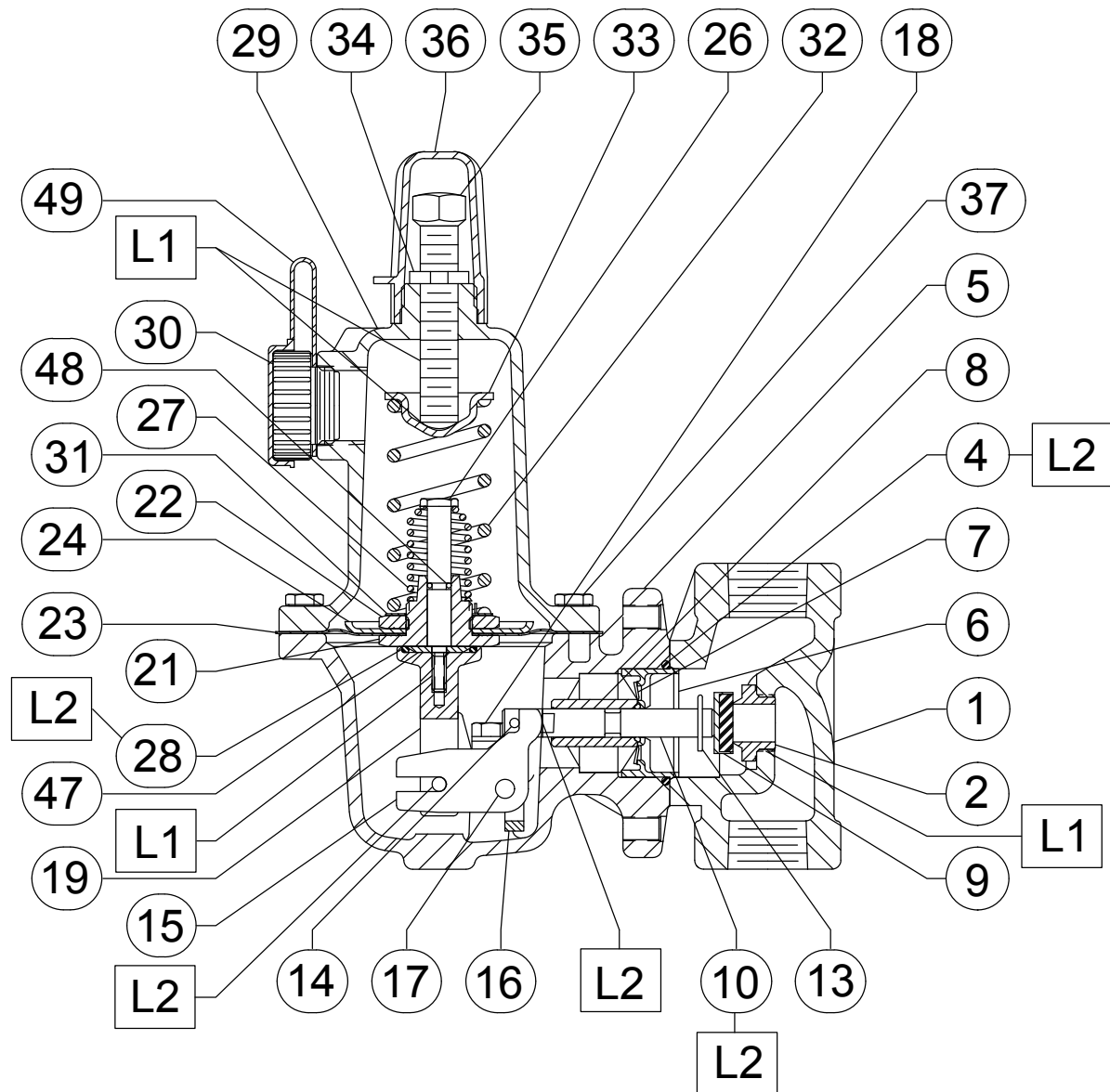


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□ APPLY LUBRICANT⁽¹⁾
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
 PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 8. Type 627R Regulator Assembly

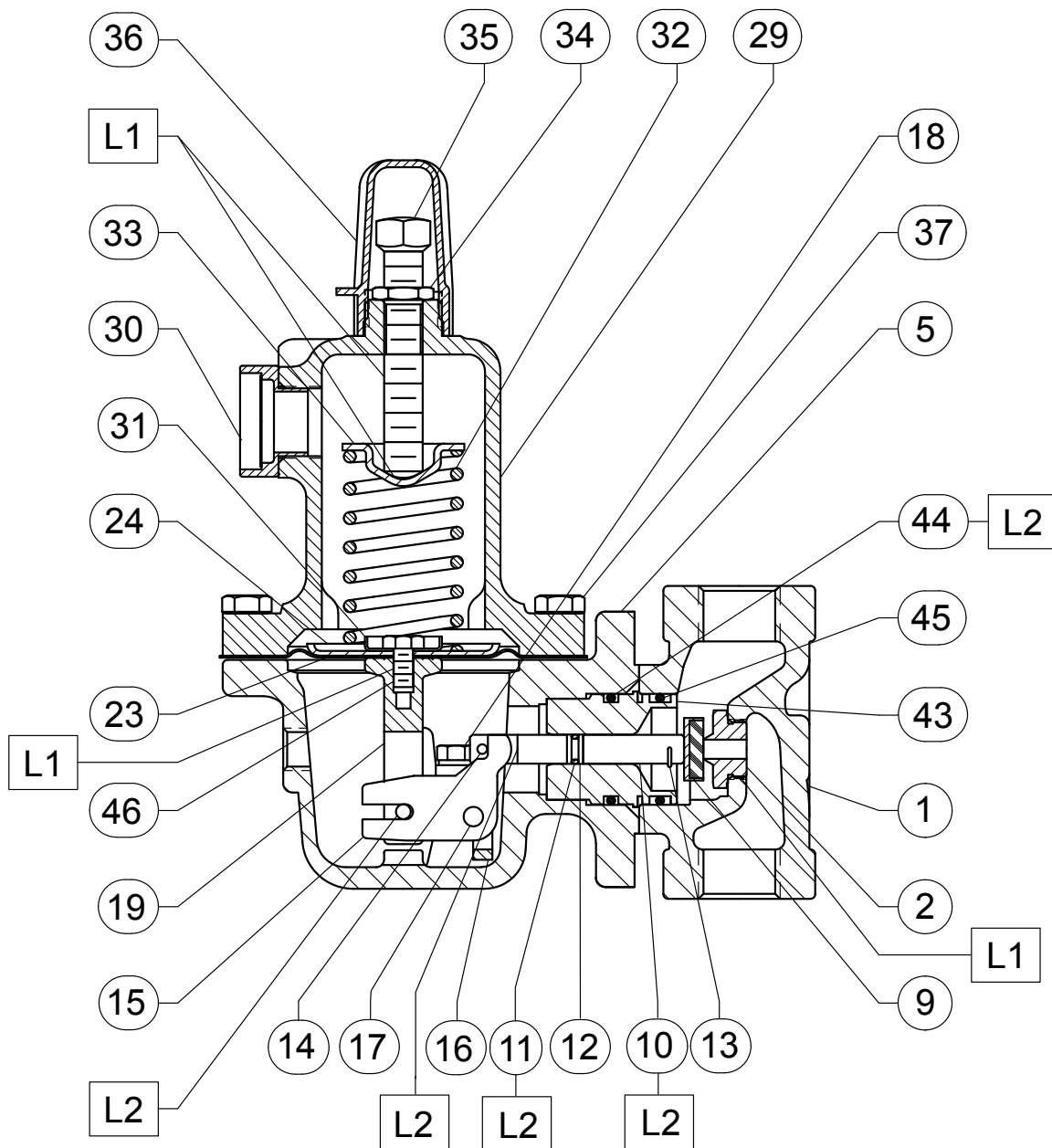


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□ **APPLY LUBRICANT⁽¹⁾**
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
 PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 9. Type 627LR Regulator Assembly

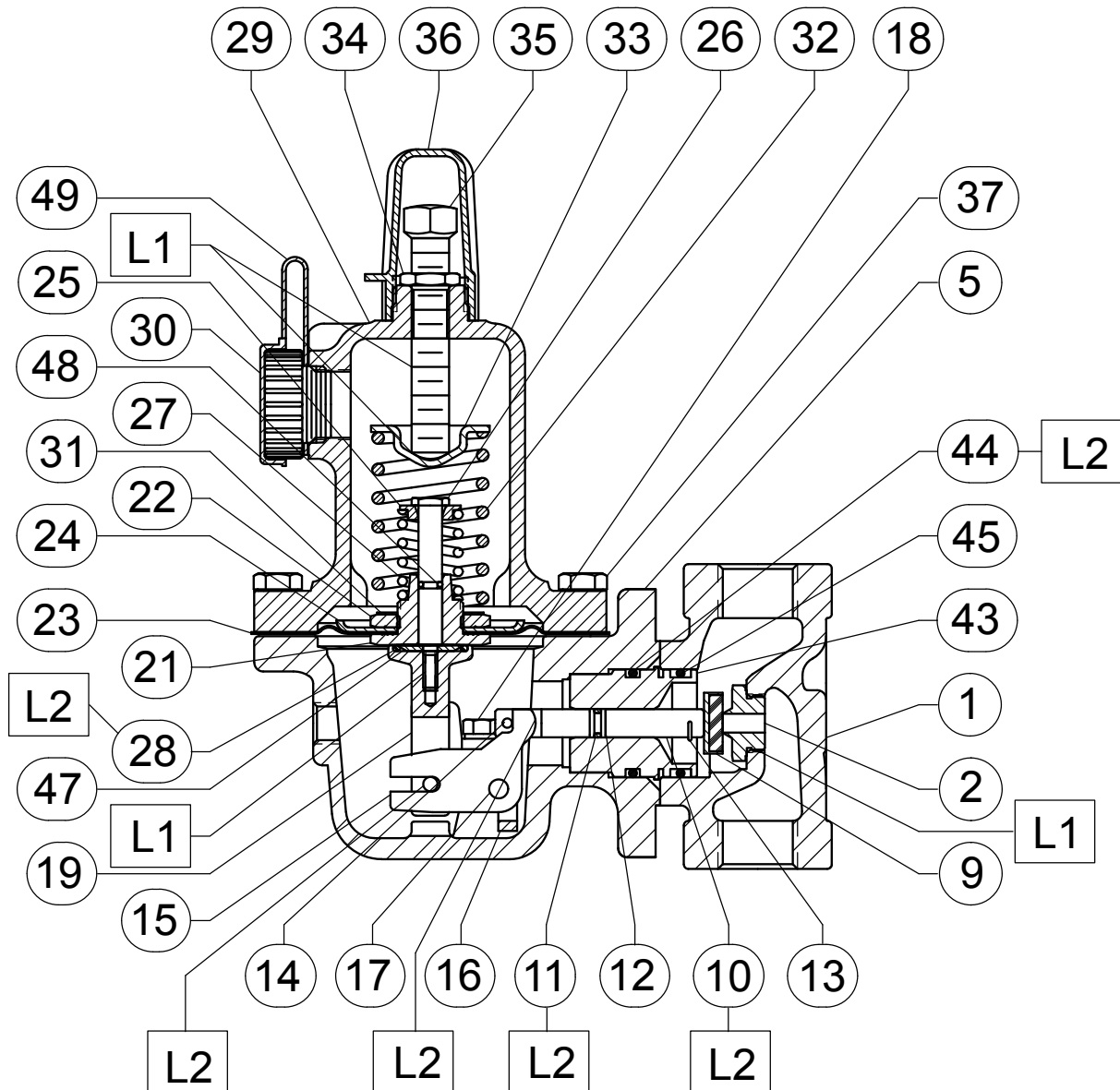


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□ **APPLY LUBRICANT⁽¹⁾**
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 10. Type 627M Regulator Assembly

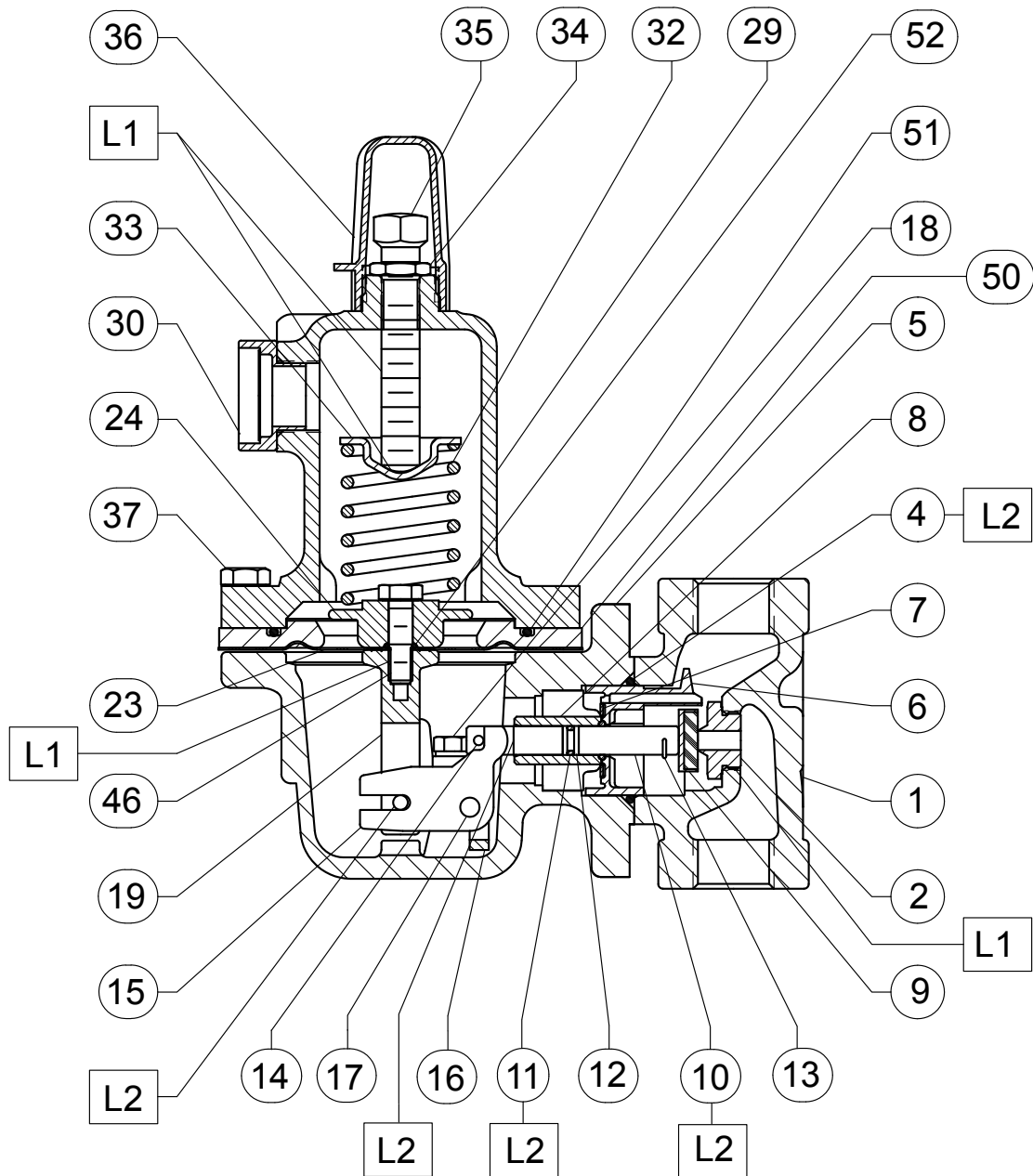


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□ **APPLY LUBRICANT⁽¹⁾**
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
 PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 11. Type 627MR Regulator Assembly



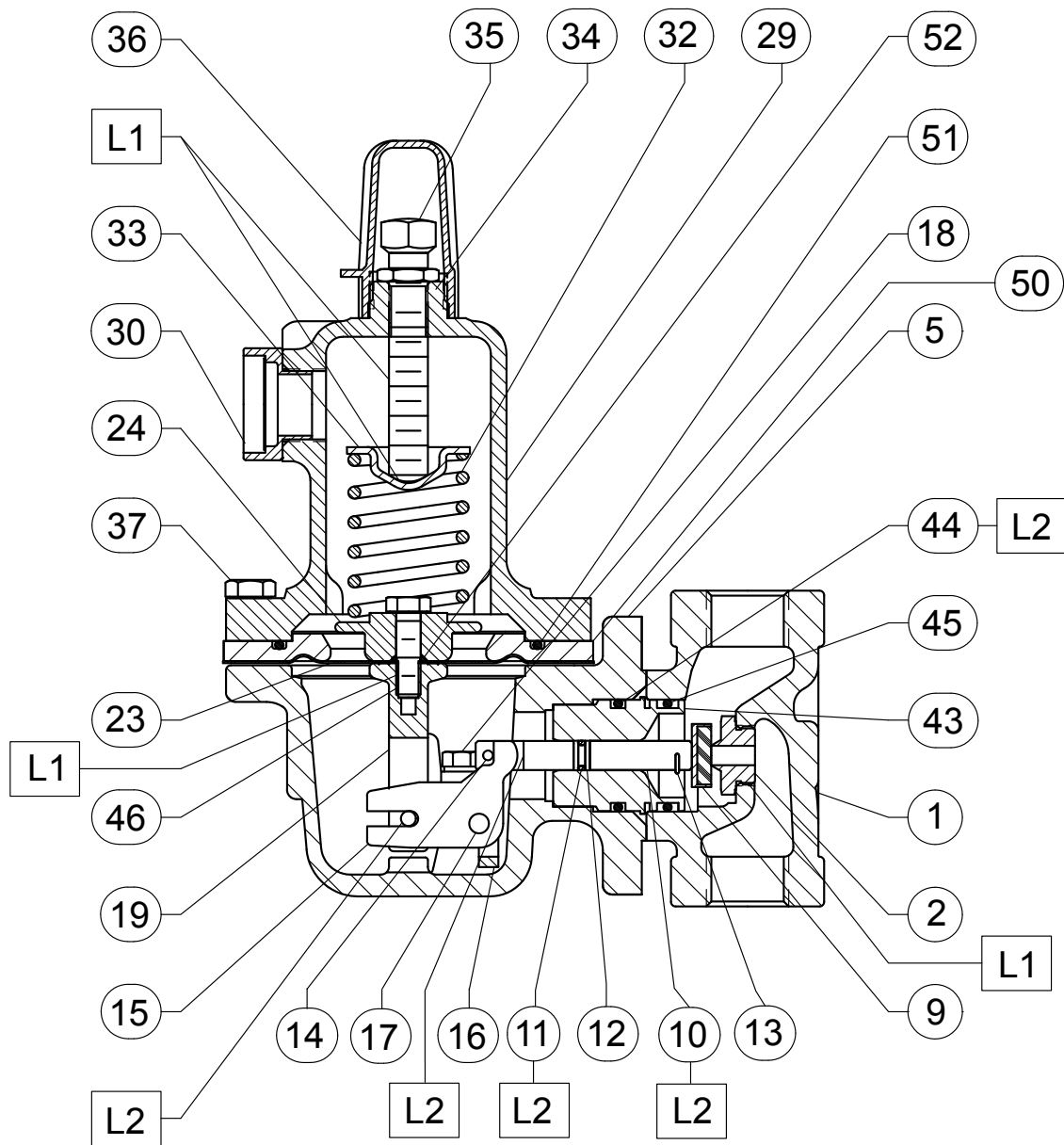
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□ **APPLY LUBRICANT⁽¹⁾**
 L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
 L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
 PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 12. Type 627H Regulator Assembly

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☐ **APPLY LUBRICANT⁽¹⁾**
L1 = MULTI-PURPOSE LITHIUM POLYMER TYPE GREASE
L2 = EXTREME LOW-TEMPERATURE BEARING GREASE
PARTS NOT SHOWN: 3

1. Lubricants must be selected such that they meet the temperature requirements.

Figure 13. Type 627HM Regulator Assembly

Industrial Regulators

Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9000

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611

Middle East and Africa
Dubai, United Arab Emirates
Tel: +971 4811 8100

Natural Gas Technologies

Emerson Process Management Regulator Technologies, Inc.

USA - Headquarters
McKinney, Texas 75069-1872, USA
Tel: +1 800 558 5853
Outside U.S. +1 972 548 3574

Asia-Pacific
Singapore 128461, Singapore
Tel: +65 6770 8337

Europe
Bologna 40013, Italy
Tel: +39 051 419 0611
Chartres 28008, France
Tel: +33 2 37 33 47 00

TESCOM

Emerson Process Management Tescom Corporation

USA - Headquarters
Elk River, Minnesota 55330-2445, USA
Tels: +1 763 241 3238
+1 800 447 1250

Europe
Selmsdorf 23923, Germany
Tel: +49 38823 31 287

Asia-Pacific
Shanghai 201206, China
Tel: +86 21 2892 9499

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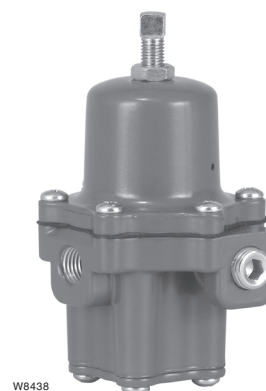
March 2004

67C Series Instrument Supply Regulators



W7412

**TYPE 67CF FILTER REGULATOR
WITH OPTIONAL GAUGE**



W6438

**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.



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67C Series

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)
67CS, 67CSR, 67CFS, 67CFSR	0 to 35 (0 to 2,4)	silver stripe	Inconel	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)

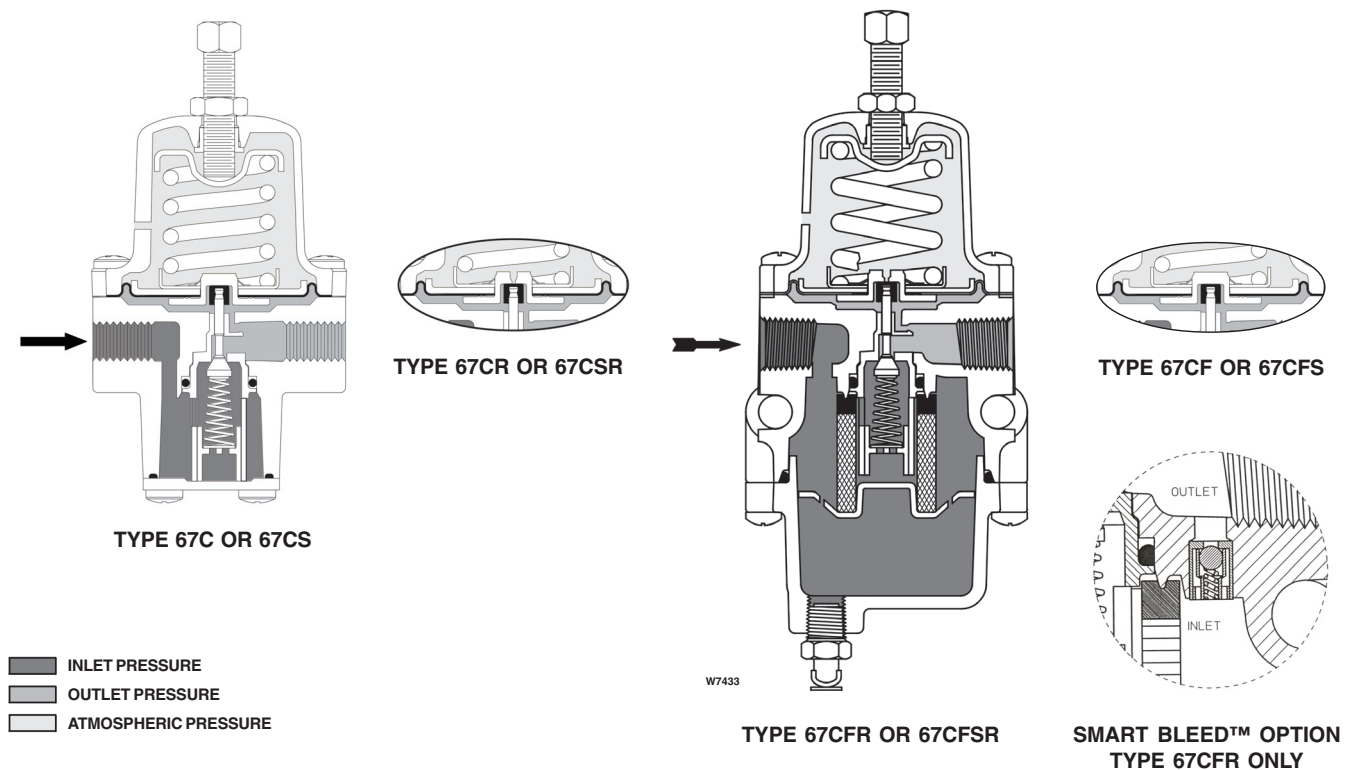


Figure 2. 67C Series Operational Schematics

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 67CFSR)

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 67CFSR 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 over-pressured 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 Type 67CS, 67CSR, 67CFS or 67CFSR, Stainless steel	T14070T0012 T14070T0022 20C1727X012
9	Filter Retainer Type 67CF or 67CFR Type 67CFS or 67CFSR	T14052T0012 T14052T0022
10 ^(1, 2)	Valve Cartridge	T80434T0012
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	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

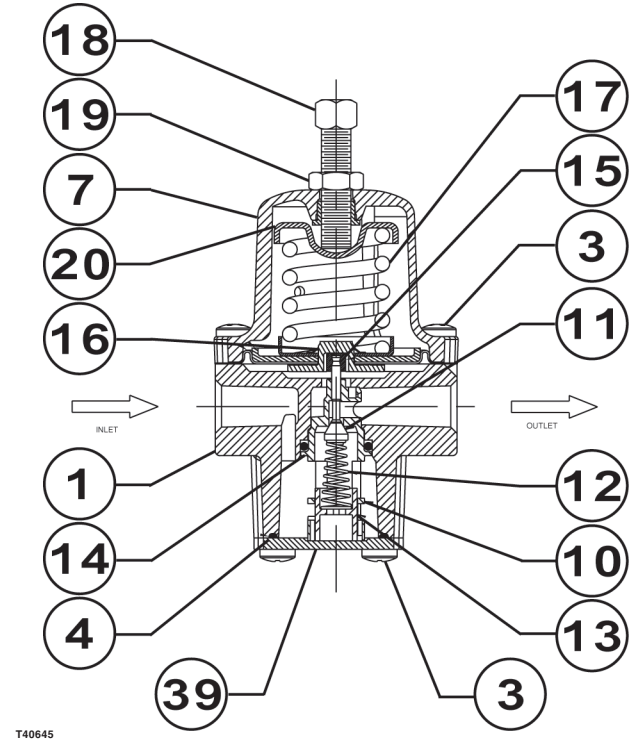
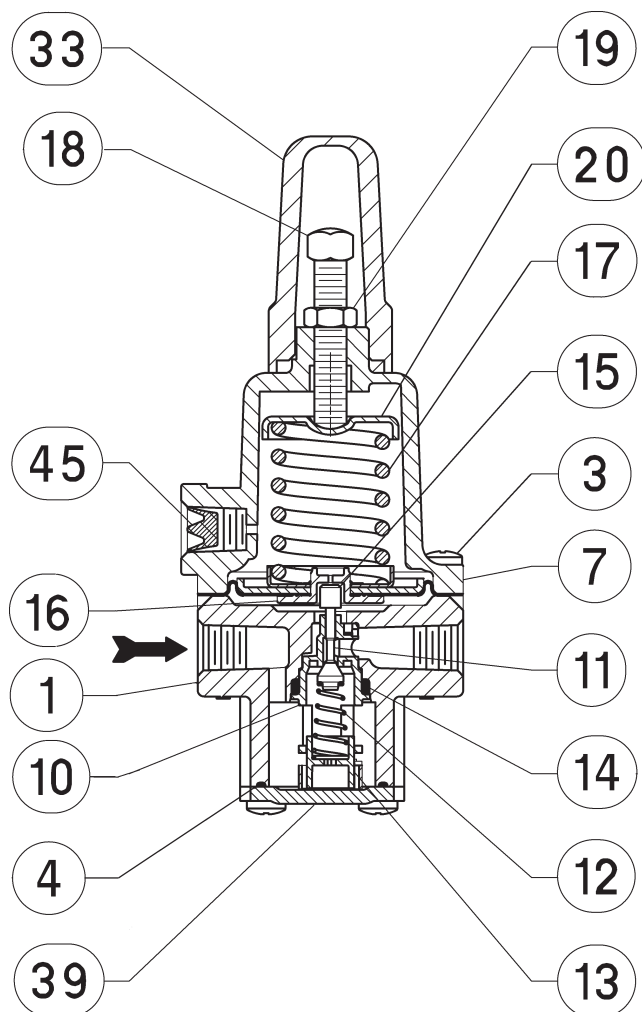


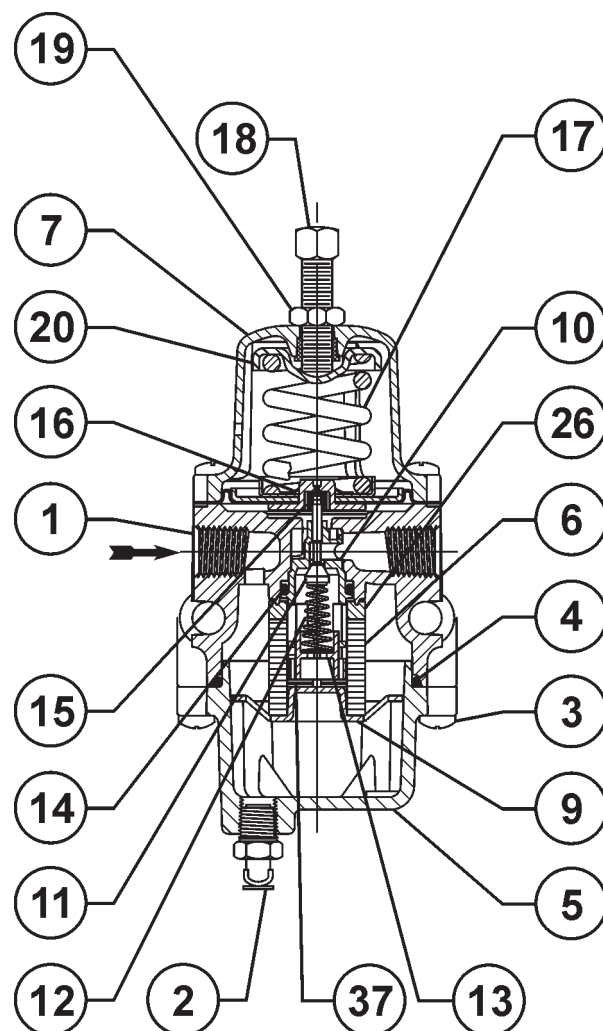
Figure 3. Type 67C or 67CR Assembly Drawing

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

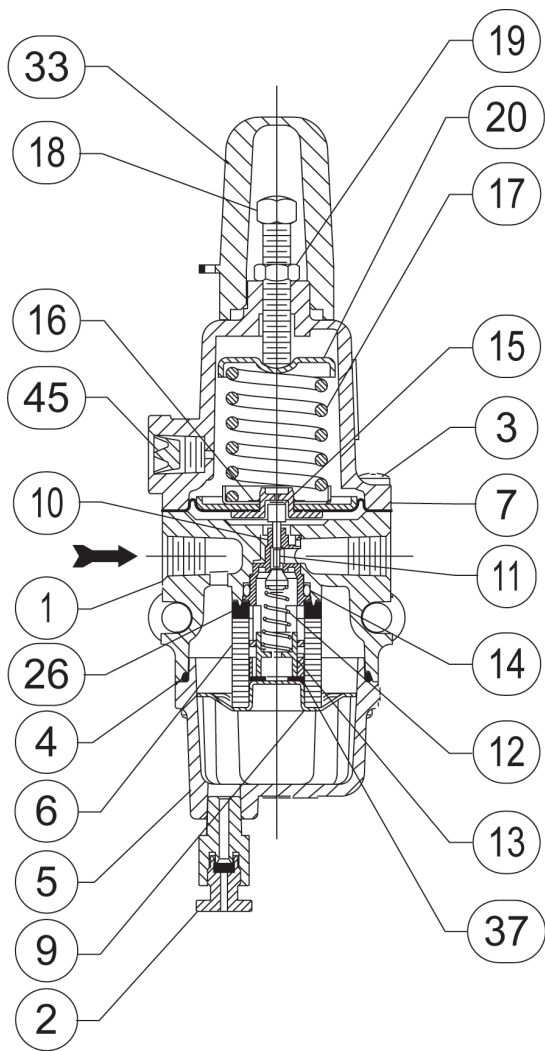
Key	Description	Part Number
23	1/4-Inch Pipe Plug (not shown) Socket head, steel Hex head, stainless steel	1C333528992 1A767535072
24	Tire Valve (not shown)	1H447099022
25	Information Label (not shown)	-----
26 ⁽¹⁾	Filter Gasket Nitrile (NBR) Fluoroelastomer (FKM)	T14081T0012 T14081T0022
30	NACE Tag (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

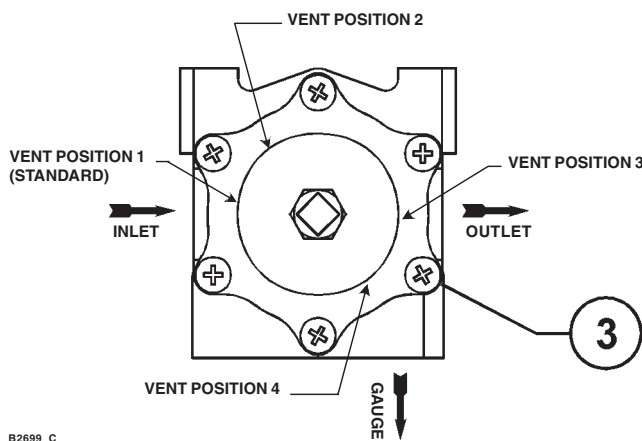
35	Mounting adaptor plate (not shown)	T21043T0012
36	O-ring (not shown)	1E591406992
38	Gasket (not shown)	1C898603012

67C Series



40C1728

Figure 6. Type 67CFS or 67CF SR Assembly Drawing



B2699_C

Figure 8. 67C Series Spring Case Vent Positions

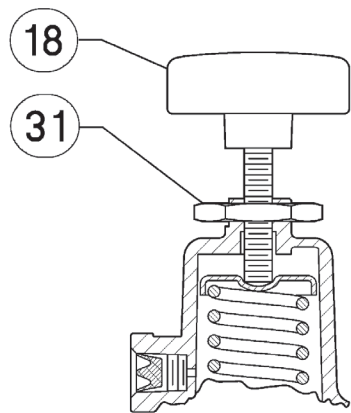
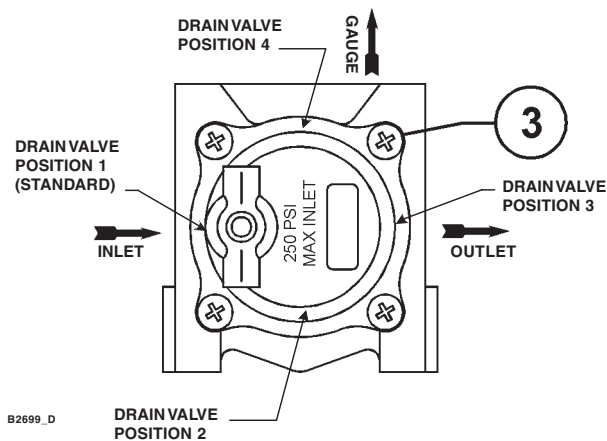


Figure 7. 67C Series Optional Panel Mount



B2699_D

Figure 9. Type 67CF, 67CFR, 67CFS, and 67CF SR Drain Valve Positions

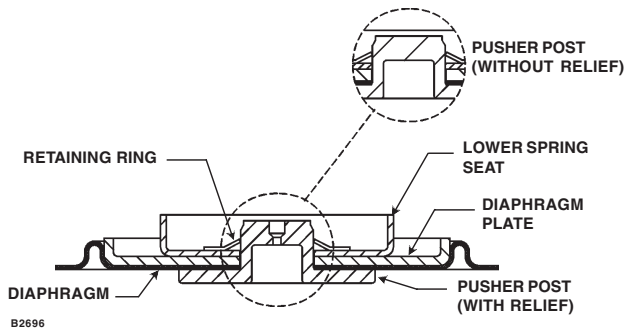


Figure 10. Diaphragm Assembly (Key 16)

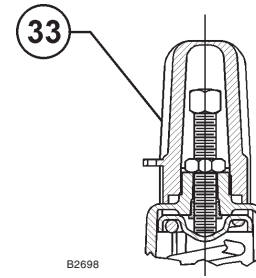


Figure 11. Optional Closing Cap
(Only Available with the 1/4-inch Spring Case Vent)

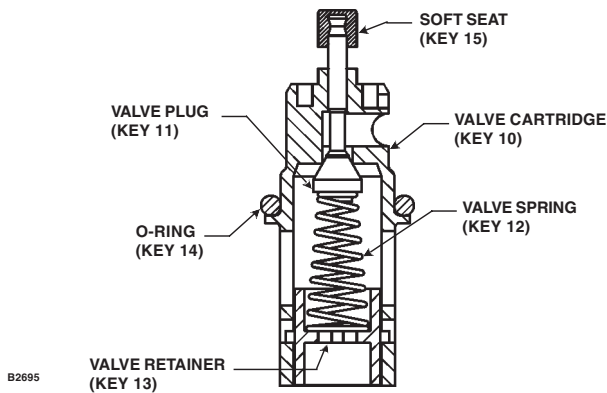


Figure 12. Valve Cartridge Assembly

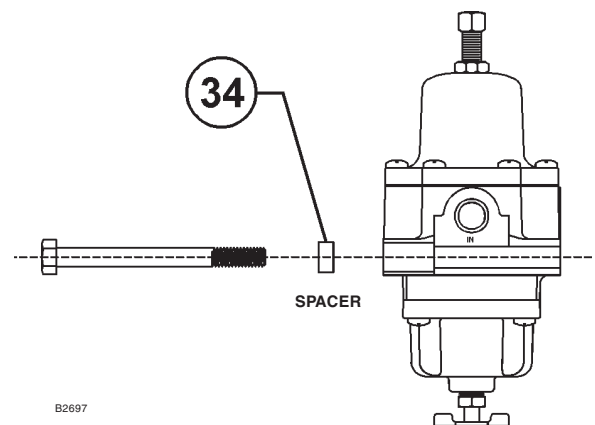
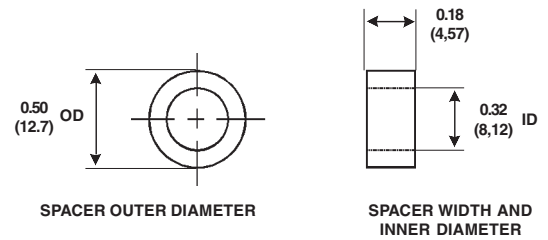


Figure 13. Spacer Diameter and Assembly
(For Installing in an Existing Installation
if the Mounting Bolts are too Long)

67C Series

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For information, contact Fisher:
Marshalltown, Iowa 50158 USA
McKinney, Texas 75070 USA
28320 Gallardon, France
40013 Castel Maggiore (BO), Italy
Sao Paulo 05424 Brazil
Singapore 128461



ACTION:

Direct action; Pilot Output Pressure (Yellow) increases with temperature rise. As long as the temperature is above the set point, the output will remain at supply pressure. If the pilot flame goes out, the pressure decreases and drops to zero.

APPLICATION:

Used as a Pilot safety shutdown or as a high stack temperature shutdown.

TEMPERATURE RANGE:

-30°F minimum to 2100°F maximum.
-34°C minimum to 1149°C maximum.

OPERATION:

This Thermostat consists of a STAINLESS TUBE for monitoring the pilot flame, which is connected by a Low Expansion Alloy Rod to a BELLOWS ASSEMBLY. The changes in the length of the STAINLESS TUBE operate a PILOT PLUG seat. The PILOT PLUG consists of two stainless balls rigidly connected together. The seat at BALL 1 is the Output Pressure vent (Yellow to Atmosphere). The seat at BALL 2 is the Supply Pressure inlet (Violet to Yellow).

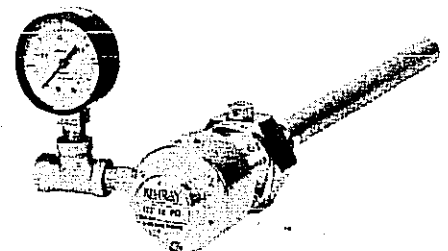
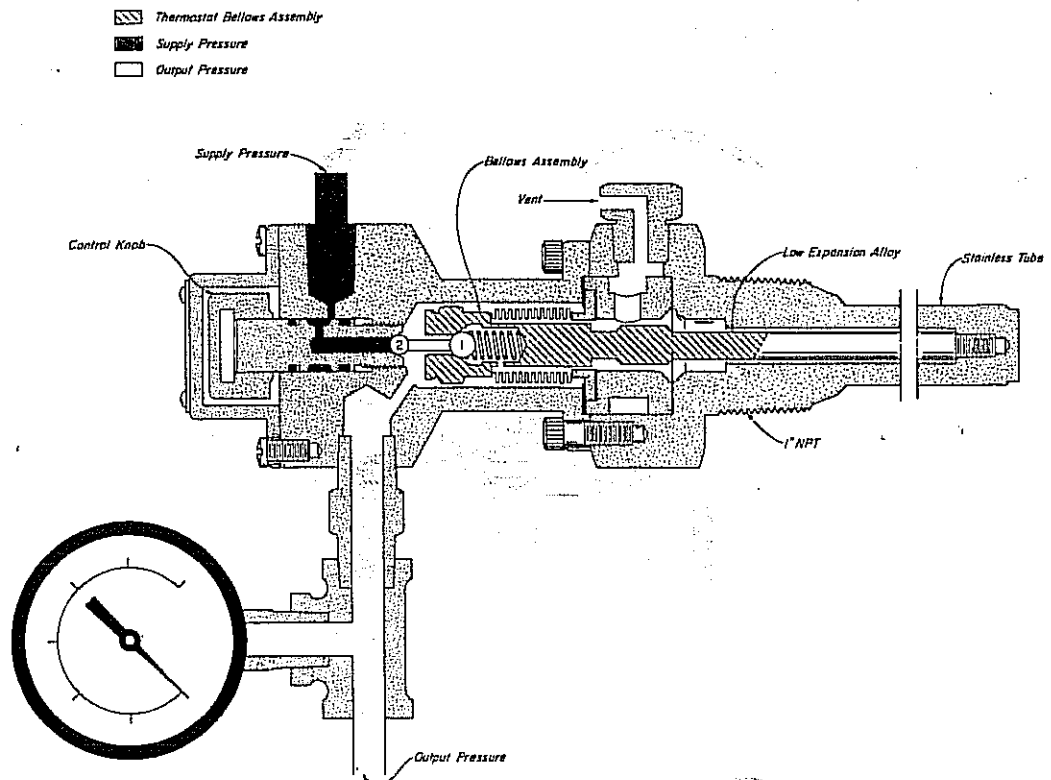
Assume the set point on the HT 12PG is above the temperature of the system. The vent at BALL 1 is open and the inlet at BALL 2 is closed. Output Pressure (Yellow) is at 0 psig or vented.

As the temperature rises in the system, the STAINLESS TUBE or outer tube increases in length to move the Thermostat Bellows Assembly in a direction to first close the seat at BALL 1 (Yellow to Atmosphere) and open the seat at BALL 2 (Violet to Yellow). This causes the Output Pressure (Yellow) to increase and hold a safety valve open.

If the temperature decreases (pilot flame goes out), the action reverses and Output Pressure (Yellow) goes to zero. This allows a safety valve to close, removing the gas supply for the burner and pilot light system.

SUPPLY PRESSURE:

5 psig minimum to 30 psig maximum.





Type 1510 Side-Mount Electric Level Switch

Form 498

Type 1510 is a horizontally mounted, float-operated level switch suitable for plant and OEM applications where open or closed contacts are required to signal presence or absence of liquid at a discrete level. The float extension arm moves a magnet which actuates (deactuates) a hermetically sealed reed switch. Actuation (deactuation) can be reversed by rotating the unit 180 degrees.



Product Specifications

Mounting	
Orientation	Horizontal mount only
Connection Size	1-1/2" through 6"
Connection Type	NPT(M) or Flanged
Maximum Process Pressure*	up to 5000 psi (345 bar)
Process Temperature Range	-40 to 400°F (-40 to 204°C)
Electrical	
Switch Type	Hermetically sealed reed switch with 18" 20 AWG wire leads
Housing	Class I, Groups A, B, C & D; Divisions 1 & 2 with CS option
Relay Housing	Class I, Groups C & D; Divisions 1 & 2 with CS option
Connection Size	1/2" NPT(F)
Minimum Specific Gravity	0.45
Design Code	ANSI B31.3
Weight	Approximately 6 lbs. (3 kg)
Agency Listing	CSA Certified (US & Canada) and ANSI/ISA 12.27.01 or ATEX and IEC approved (optional). See page 2. GOST-R Certified (Standard)

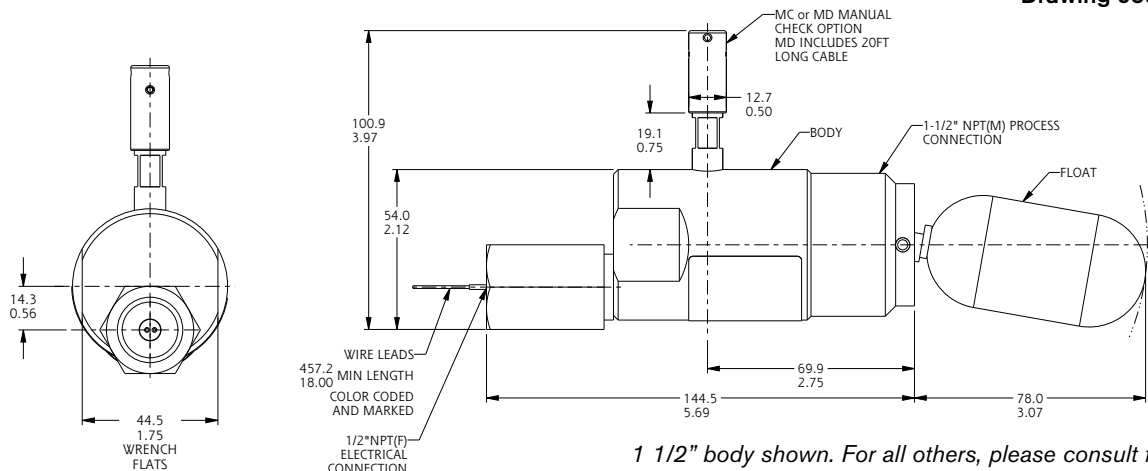
*Agency certifications may affect ratings. See Accessories for details.

Dimensions

Design and specifications are subject to change without notice.
For latest revision, see sorinc.com.

Linear = mm/inches

Drawing 0390693



Type 1510 Side-Mount Electric Level Switch

How to Order

Model Number System

1510 - B - G - 5A - C - W9 - ES - MC

5

Optional Accessories

Switch Mechanisms

4

Amperages based on resistive loads

General Purpose	SPST	1A @ 110 VAC Max 3A @ 28 VDC Max 3 Watt Minimum	W9
General Purpose	SPDT	1A @ 110 VAC Max 3A @ 28 VDC Max 3 Watt Minimum	W1
Low Power	SPST	25 Watts Max	L9
Low Power	SPDT	25 Watts Max	L1

Float Material

3

316SS (Standard)	1500 psig (103 bar) -40 to 400°F (-40 to 204°C)	C
Monel	900 psig (62 bar) -40 to 400°F (-40 to 204°C)	M
Polypropylene	5000 psig (345 bar) -40 to 150°F (-40 to 65°C)	S

Process Connections

2

Threaded:	1 1/2" NPT(M)	5A
	2" NPT(M)	2A
Flanged: (Available with 316SS body only)		
May affect process	2 1/2" 150#	7C
pressure rating.	300#	7D
	600#	7E
	3" 150#	3C
	300#	3D
	600#	3E
	4" 150#	4C
	300#	4D
	6" 150#	6C
	300#	6D

Body Material

1

303SS (Standard)	B
316 Stainless Steel	C



1510 B G 5A C W9 ES MC

BB	Insert accessory designator(s) as needed
CL*	Wetted parts are cleaned for industrial oxygen service
CR	ATEX and IECEx approved. Ex ia IIC T3 (-40°C < Ta < +125 °C)
CS*	3/4" NPT(F) conduit connection
CV	CSA Certified. Class 1, Group A, B, C, D; Divisions 1 & 2. For relay option; Class 1, Group C & D, Divisions 1 & 2. Single seal ambient & process temperatures -40°C to +125°C
MC**	Canadian Registration Number (CRN). Consult the factory for applicable pressure and additional information.
MD**	Manual check accessory (uses Viton GLT o-rings)
NC	Manual check accessory (uses Viton GLT o-rings) with 20' remote cable
PP	NACE construction - MR 01-75 / ISO 15156 2003. Available only with 316SS materials of construction
RB***	Tag, fiber. Attached with plastic wire to housing. Stamped with customer specified tagging information.
RC***	24 VDC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2.
RR	120 VAC powered DPDT relay in explosion proof terminal box. Contact rating: 10 amps @ 115 VAC. Class I, Group C, D; Divisions 1 & 2
TT	Tag, stainless steel. (Attached with stainless steel wire to housing. Stamped with customer specified tagging information. 2 lines, 18 characters and spaces per line.)
VV	Stainless steel nameplate permanently attached to housing. Stamped with customer specified tagging information.
	Fungicidal varnish. Covers exterior except working parts.

*CS or CL option is required on all flange mounted units.

**Manufacturer limits on Viton GLT are -40 to 400°F.

***Not available with L9 or L1 switch options.

← **Model Number**

Type 1510 Side-Mount Electric Level Switch

Test Certificates

1510 Electric Level Switch	Certificates	C1	C3	C4	C5	C6	C7	B5	B6	B7
	Calibration	◆						◆	◆	◆
	Inspection Report		◆					◆	◆	◆
	Compliance / Conformance			◆						◆
	Dielectric Test				◆			◆		
	Insulation Resistance					◆		◆	◆	
	QA Test Report						◆			

Replacement Parts

Part Number	Description
3130-106	W9 - SPST Hermetically Sealed Switch Capsule
3130-245	W1 - SPDT Hermetically Sealed Switch Capsule
3130-107	L9 - SPST Hermetically Sealed Switch Capsule
3130-244	L1 - SPDT Hermetically Sealed Switch Capsule
3130-052	316SS Float Assembly
3130-040	20' Remote Cable with two cable crimps*
9227-024	Manual Check Accessory (MC) (2" NPT only)*
9227-025	Manual Check Accessory with 20' remote cable (MD) (2" NPT only)*
9227-028	Manual Check Accessory (MC) (1 1/2" NPT only)*
9227-029	Manual Check Accessory with 20' remote cable (MD) (1 1/2" NPT only)*

*Unit must have originally been supplied with MC or MD option.

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.

SOR® offers a full line of commercial-grade process instruments.



We Deliver Quality On Time

SOR Inc.

14685 West 105th Street
Lenexa, Kansas 66215

Phone 913-888-2630
Toll Free 800-676-6794
Fax 913-888-0767

sorinc.com

SOR Europe, Ltd.

Farren Court
Cowfold
West Sussex RH13 8BP
United Kingdom

Phone +44 (0) 1403 864000
Fax +44 (0) 1403 864040

SOR - China

Room 903, No. 10 Building
Wan Da Plaza
No. 93 Jian Guo Road
Chao Yang District
Beijing, China 100022

Phone +86 (10) 5820 8767
Fax +86 (10) 58 20 8770

Speed Controller with One-touch Fitting Elbow Type/Universal Type Series AS

Minimizes installation time and cost

Reduces the mounting height and enables compact machinery design. Effective area is larger than the former model.

Tube swivels 360°

Universal type permits 360° piping swivel.

ø2 size added to applicable tubing sizes

- Metric size (Release button: White color)
ø2, ø3.2, ø4, ø6, ø8, ø10, ø12
- Inch size (Release button: Orange color)
ø1/8", ø5/32", ø3/16", ø1/4", ø5/16", ø3/8", ø1/2"

Maximum operating pressure 1 MPa max.

Applicable tubing materials

Nylon, soft nylon, and polyurethane tubing are applicable.

Retainer prevents accidental loss of needle.

Option

Hexagonal lock nut, Nickel plated option

Number of needle rotations has been increased (8 to 10 turns)

The increased number of needle rotations (8 to 10 turns) permits easy control at low speeds.

Model

Elbow type	Universal type	Port size	Applicable tubing O.D.														Applicable cylinder bore size (mm)
			Metric size							Inch size							
			2	3.2	4	6	8	10	12	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"	
AS12□1F-M3	AS13□1F-M3	M3 x 0.5	◎	◎						◎	◎						2.5, 4, 6
AS12□1F-M5	AS13□1F-M5	M5 x 0.8	◎ ^①	◎	◎	◎					◎	◎	◎	◎			6, 10, 16, 20 ^{①)}
AS12□1F-U10/32	AS13□1F-U10/32	10-32 UNF		◎	◎	◎					◎	◎	◎	◎			6, 10, 16, 20
AS22□1F-01	AS23□1F-01	R 1/8		◎	◎		◎	◎ ^{②)}			◎	◎	◎	◎			20, 25, 32
AS22□1F-02	AS23□1F-02	R 1/4			◎		◎	◎				◎	◎	◎	◎		20, 25, 32, 40
AS32□1F-02	AS33□1F-02	R 1/4				◎	◎	◎	◎				◎	◎	◎		40, 50, 63
AS32□1F-03	AS33□1F-03	R 3/8					◎	◎	◎					◎	◎	◎	40, 50, 63
AS42□1F-04	AS43□1F-04	R 1/2							◎	◎					◎	◎	63, 80, 100

Note 1) AS12□1F-M5-02 applicable cylinder bore sizes are 2.5, 4, 6.

Note 2) Elbow type only

Note 3) Meter-out and meter-in types can be visually differentiated by the lock nut. The lock nut on the meter-out type is electroless nickel plated, while the meter-in type is black zinc chromate plated.

Note 4) ◎ Marking is electroless nickel plated, provided as standard. (N specifications)

Specifications

Fluid	Air
Proof pressure	1.5 MPa (1.05 MPa ⁽¹⁾)
Max. operating pressure	1 MPa (0.7 MPa ⁽¹⁾)
Minl. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽²⁾)
Applicable tubing material ⁽³⁾	Nylon, Soft nylon, Polyurethane ⁽⁴⁾
Option	With seal, Hexagon lock nut ⁽⁵⁾ , Electroless nickel plated ⁽⁶⁾

Note 1) In case of AS12□1F-M3-02, AS12□1F-M5-02

Note 2) In case of AS12□1F-M5 and AS12□1F-U10/32 types.

In case of AS13□1F-M5 and AS13□1F-U10/32

AS12□1F-M5-02: 10 turns.

Note 3) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.

(Refer to pages 371 and 372 for details.)

Note 4) In case of AS12□1F-M3-02 and AS12□1F-M5-02, polyurethane only.

Note 5) M3, M5, 10-32UNF type parts are not available with seals.

Note 6) Brass parts are all electroless nickel plated.

Flow Rate and Effective Area

Model	Metric size	Inch size	Flow rate (l/min)	Effective area (mm²)	AS12□1F-M3 AS13□1F-M3 AS12□1F-M5-02	AS12□1F-M5 AS13□1F-M5	AS22□1F-01 AS23□1F-01	AS22□1F-02 AS23□1F-02	AS32□1F AS33□1F	AS42□1F AS43□1F
Tubing O.D.	ø2, ø3.2, ø4	ø1/8", ø5/32"	20	0.3	ø3.2, ø4, ø6	ø4, ø6, ø8, ø10	ø4, ø6, ø8, ø10	ø6, ø8, ø10	ø10, ø12	ø10, ø12
Controlled flow (Free flow)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)	Flow rate (l/min)
	20	100	180	230	260	390	460	660	790	920
	0.3	1.5	2.7	3.5	4	6	7	10	12	14
	24	26								

Note 1) Flow rate values are measured at 0.5 MPa and 20°C.

Note 2) U10/32 has the same specification as M5.

Elbow type

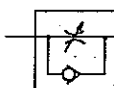
Applicable tubing O.D. ø2



Universal type



JIS Symbol



Flow Direction Symbols on Body

JIS Symbol	Flow Direction Symbols on Body	
	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Caution

Be sure to read before handling.

Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.



Made to Order
(Refer to page 422 for details.)

Speed Controller with One-touch Fitting Elbow Type/Universal Type **Series AS**

How to Order

AS 2 2 0 1F - 01 - 06 S -

Body size

1	M3, M5 standard
2	1/8, 1/4 standard
3	3/8 standard
4	1/2 standard

Type

2	Elbow
3	Universal

Control type

0	Meter-out
1	Meter-in

With One-touch fitting

Thread type

NII	Metric thread (M3, M5)
N	Unified thread (10-32 UNF)
	R
	NPT

Option

NII	None
S	With seal
K	Hexagonal lock nut
N	Electroless nickel plated

Applicable tubing O.D.

Metric size	Inch size
02	σ2
03	σ3
04	σ4
06	σ6
08	σ8
10	σ10
12	σ12

Port size

M3	M3 x 0.5
M5	M5 x 0.8
U10/32	10-32 UNF
01	1/8
02	1/4
03	3/8
04	1/2

Made to Order
(Refer to page 422 for details.)

Option

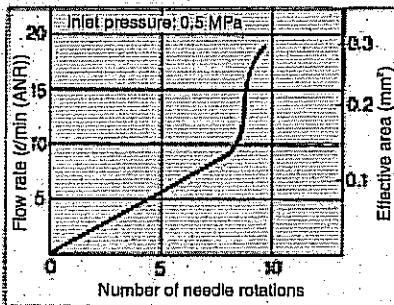
*1 If more than one option is required, write option part numbers in the order of "S", "K", "N".

*2 M3, M5, and U10/32 are not available with seals.

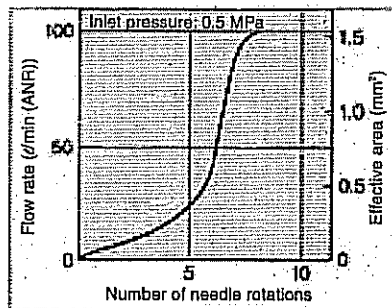
*Use σ1/8" tube.

Needle Valve/Flow Characteristics

AS1201F-M3, AS1211F-M3
AS1301F-M3, AS1311F-M3
AS1201F-M5-02, AS1211F-M5-02

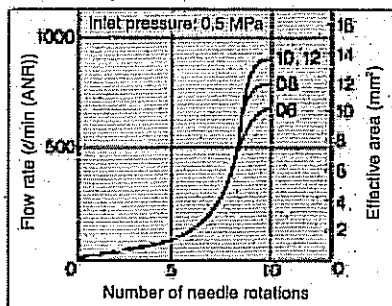


AS1201F-M5, AS1211F-M5
AS1301F-M5, AS1311F-M5

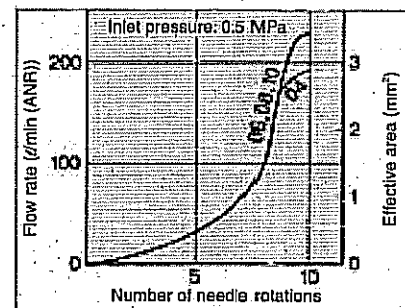


Note) "U10/32" is the same as "M5".

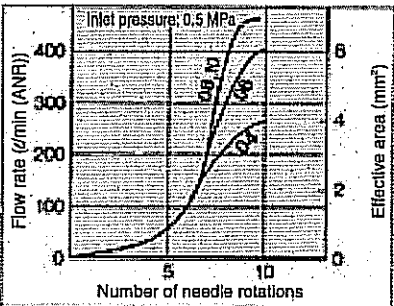
AS3201F, AS3211F
AS3301F, AS3311F



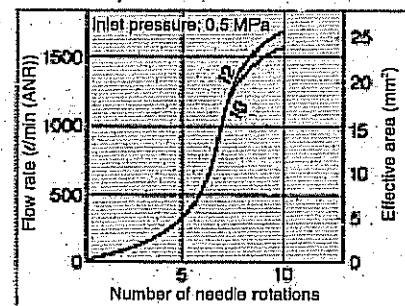
AS2201F-01, AS2211F-01
AS2301F-01, AS2311F-01



AS2201F-02, AS2211F-02
AS2301F-02, AS2311F-02



AS4201F, AS4211F
AS4301F, AS4311F

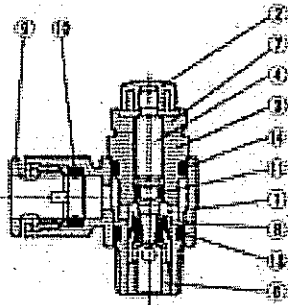


AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

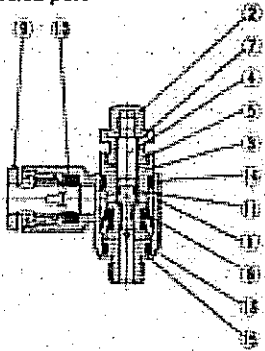
Series AS

Construction

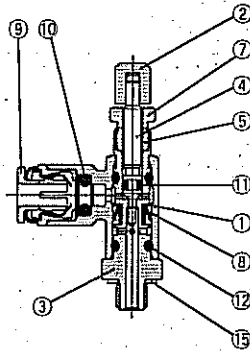
Elbow type
Meter-out type



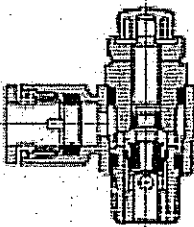
M3 port
M5 port
U10/32 port



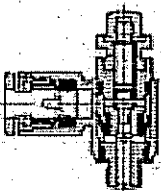
ø2 tubing type



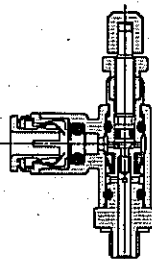
Meter-in type



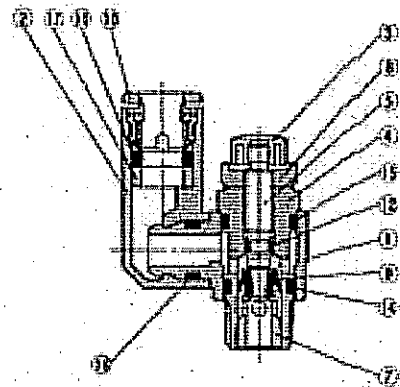
M3 port
M5 port
U10/32 port



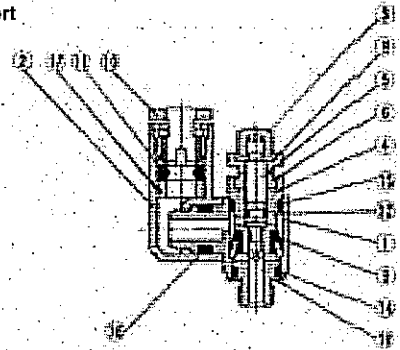
ø2 tubing type



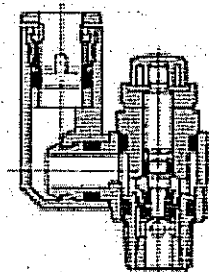
Universal type
Meter-out type



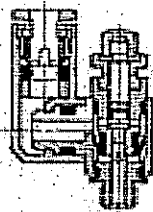
M3 port
M5 port
U10/32 port



Meter-In type



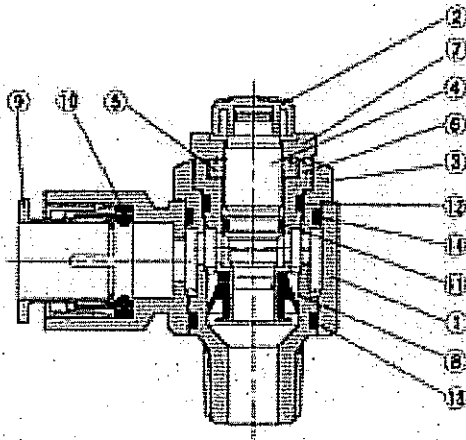
M3 port
M5 port
U10/32 port



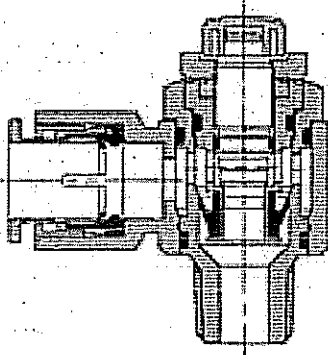
Construction

Elbow type

Meter-out type AS3201F-02



Meter-in type AS3211F-02



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT ⁽¹⁾	
3	Body B	Brass ⁽²⁾	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Seat ring	Brass ⁽³⁾	
7	Lock nut	Brass ⁽⁴⁾	Electroless nickel plated ⁽⁵⁾
8	U-packing	HNBR	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	Gasket	NBR, Stainless steel	

Note 1) AS12□1F-M3-02 and AS12□1F-M5-02 are made of electroless nickel plated brass.

Note 2) AS12□1F-M3 is made of stainless steel.

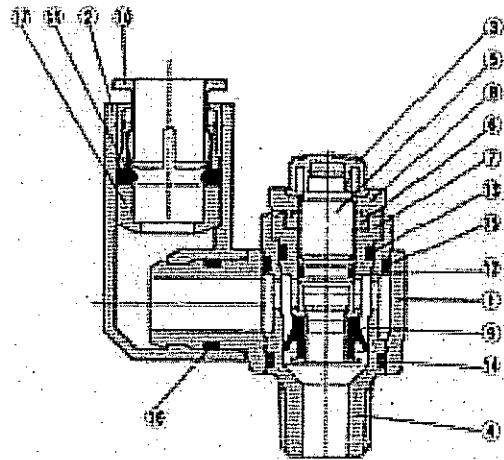
Note 3) AS22□1F, AS32□1F-02: Electroless nickel plated.

Note 4) AS2□□1F type is made of steel.

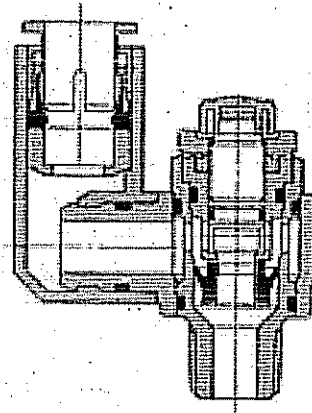
Note 5) Meter-in type is black zinc chromate plated.

Universal type

Meter-out type AS3301F-02



Meter-in type AS3311F-02



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Elbow body	PBT	
3	Handle	PBT	
4	Body B	Brass ⁽¹⁾	Electroless nickel plated
5	Needle	Brass	Electroless nickel plated
6	Needle guide	Brass	Electroless nickel plated
7	Seat ring	Brass ⁽²⁾	
8	Lock nut	Brass ⁽³⁾	Electroless nickel plated ⁽⁴⁾
9	U seal	HNBR	
10	Cassette	—	
11	Seal	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	O-ring	NBR	
16	O-ring	NBR	
17	Spacer	—	
18	Gasket	NBR, Stainless steel	

Note 1) AS13□1F-M3 is made of stainless steel.

Note 2) AS23□1F, AS33□1F-02: Electroless nickel plated.

Note 3) AS2□□1F type is made of steel.

Note 4) Meter-in type is black zinc chromate plated.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

KE

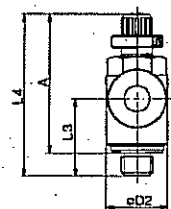
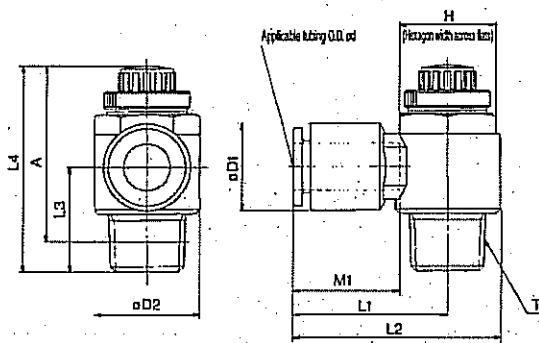
TMH

Series AS

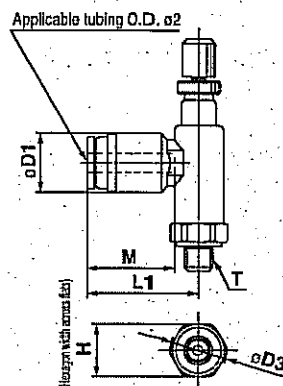
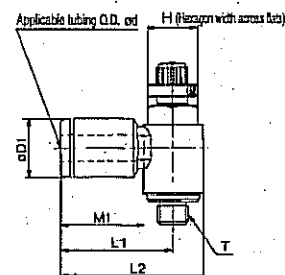
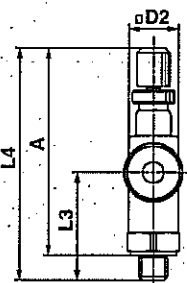


Elbow Type

M3 port
M5 port
U10/32 port



ø2 tubing type
AS12□1F-M3-02
AS12□1F-M5-02



Metric Size

Model	Applicable tubing O.D. øD1	T	H (1)	D1	D2	D3	L1	L2	L3	L4 (2)			A (2)	M1	Mass (g)
										Max.	Min.	Max.			
AS12□1F-M3-02	2	M3 x 0.5	5.5	8	5.2	7.5	11.4	—	11	20.8	24.3	24.3	21.8	8.8	2.4
AS12□1F-M5-02	3.2	M5 x 0.8	7	8.4	7.2	—	16.1	10.7	10.5	20.8	24.1	24	21.5	12.7	4
AS12□1F-M3-03	4	M3 x 0.5	5.5	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-M5-03	3.2	M5 x 0.8	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-U10/32-03	3.2	10-32UNF	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-M3-04	4	M3 x 0.5	5.5	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-M5-04	3.2	M5 x 0.8	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-U10/32-04	3.2	10-32UNF	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-M3-06	6	M3 x 0.5	5.5	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-M5-06	3.2	M5 x 0.8	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS12□1F-U10/32-06	3.2	10-32UNF	7	8.4	—	—	17.3	22.1	12.3	20.8	25.8	26	22.2	12.7	7
AS22□1F-01-23	3.2	—	—	9.3	—	—	20.4	27.5	13.4	35.2	30.2	32.1	27.1	12.7	16
AS22□1F-01-04	4	—	—	9.3	—	—	20.4	27.5	13.4	35.2	30.2	32.1	27.1	12.7	17
AS22□1F-01-06	6	1/8	12 (12.7)	11.8	14.2	—	20.4	27.5	13.4	35.2	30.2	32.1	27.1	12.7	17
AS22□1F-01-08	8	—	—	15.2	—	—	25.3	32.4	—	—	—	—	—	18.5	19
AS22□1F-01-10	10	—	—	18.5	—	—	32.1	39.2	14.1	—	—	—	—	21	21
AS22□1F-02-04	4	—	—	10.4	—	—	25.2	34.4	—	—	—	—	—	16	32
AS22□1F-02-06	6	—	—	12.8	—	—	25.2	34.4	17.7	30.9	34.9	34.4	29.4	17	32
AS22□1F-02-08	8	—	—	15.2	18.5	—	27.2	36.4	—	—	—	—	—	18.5	34
AS22□1F-02-10	10	—	—	18.5	—	—	35.3	44.5	18.5	—	—	—	—	21	36
AS32□1F-02-06	6	1/4	17 (17.5)	12.8	—	—	27.8	36.3	—	—	—	—	—	17	50
AS32□1F-02-08	8	—	—	15.2	—	—	29.5	41	—	—	—	—	—	18.5	53
AS32□1F-02-10	10	—	—	18.5	23	—	31.8	43.3	—	—	—	—	—	21	59
AS32□1F-02-12	12	—	—	20.9	—	—	32.8	44.3	—	—	—	—	—	22	69
AS32□1F-03-06	6	—	—	12.8	—	—	27.8	36.3	—	—	—	—	—	17	55
AS32□1F-03-08	8	—	—	15.2	—	—	29.5	41	—	—	—	—	—	18.5	57
AS32□1F-03-10	10	—	—	18.5	23	—	31.8	43.3	—	—	—	—	—	21	59
AS32□1F-03-12	12	—	—	20.9	—	—	32.8	44.3	—	—	—	—	—	22	61
AS42□1F-04-10	10	1/2	24 (24.5)	18.5	29.6	—	33.8	47.9	—	24.5	50.7	49.2	45.5	21	100
AS42□1F-04-12	12	—	—	20.9	—	—	34.8	48.9	—	—	—	—	—	22	101

Note 1) () are the dimensions of NPT thread.

Note 2) Reference thread dimensions after installation.

Note 3) Reference dimensions

Inch Size

Model	Applicable tubing O.D. øD1	T	H (1)	D1	D2	L1	L2	L3	L4 (2)		A (2)		M1	Mass (g)				
									Max.	Min.	Max.	Min.						
AS12□1F-M3-01	1/8"	M3 x 0.5	5.5	8.4	7.2	10.1	10.7	10.5	20.0	24.1	24	21.5	12.7	4				
AS12□1F-M3-03	5/32"			8.3				10										
AS12□1F-M5-01	1/8"			8.4				17.3							22.1			
AS12□1F-U10/32-01	1/8"	10-32UNF	6	8.6	18.3	20.0	25.4	25	22.2	12.7	7							
AS12□1F-M5-03	5/32"	M5 x 0.8										17.3	22.1					
AS12□1F-U10/32-03	5/32"	10-32UNF																
AS12□1F-M5-05	3/16"	M5 x 0.8	8	11.4	0.6	21.3	25.1	11.7	20.0	25.8	25	22.2	15.5	7				
AS12□1F-U10/32-05	3/16"	10-32UNF																
AS12□1F-M5-07	1/4"	M5 x 0.8		12									18.3	23.1	13.5	7		
AS12□1F-U10/32-07	1/4"	10-32UNF																
AS22□1F-01-01	1/8"	1/8	12 (12.7)	9.3	14.2	20.4	27.5	13.4	35.2	30.2	32.1	27.1		16				
AS22□1F-01-03	3/32"			9.3		20.4	27.5							12.7	17			
AS22□1F-01-05	3/16"			11.4		23.1	30.2							16.5	17			
AS22□1F-01-07	1/4"			13.2		23.9	31							18.5	19			
AS22□1F-01-09	5/16"			15.2	25.0	32.4	14.1						21	21				
AS22□1F-02-03	3/32"	1/4	17 (17.3)	10.4	18.5	25.2	34.4	30.9	34.9	34.4	29.4	16.5	16	32				
AS22□1F-02-05	3/16"			11.4		34.0	34.2						17.7	17	32			
AS22□1F-02-07	1/4"			13.2		25.2	34.5							18.5	34			
AS22□1F-02-09	5/16"			15.2		32.1	39.2						14.1	21	36			
AS22□1F-02-11	3/8"			17.9	35.0	44.5	18.5						21	36				
AS32□1F-02-07	1/4"	3/8	19	13.2	23	27.8	36.3	29.5	45.4	40.4	40.2	35.2	17	50				
AS32□1F-02-09	5/16"			15.2		29.4	41						21.3	40.3	42.8	37.8	18.5	53
AS32□1F-02-11	3/8"			17.9		31.8	43.3							21	59			
AS32□1F-03-07	1/4"			13.2		27.8	36.3							17	55			
AS32□1F-03-09	5/16"			15.2	29.5	41	18.8	45.4	40.4	40.2	35.2	18.5	57					
AS32□1F-03-11	3/8"			17.9	31.8	43.3							21	59				
AS42□1F-04-11	3/8"	1/2	24 (24.5)	17.9	25.6	33.8	47.9	24.5	50.7	49.2	49.0	42.1	21	100				
AS42□1F-04-13	1/2"			21.7		35.2	49.5							22	101			

Note 1) () are the dimensions of NPT thread.

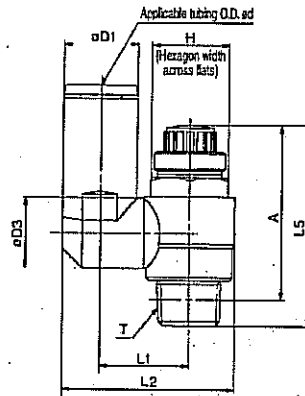
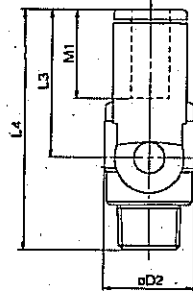
Note 2) Reference thread dimensions after installation.

Note 3) Reference dimensions

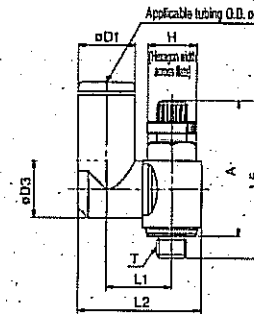
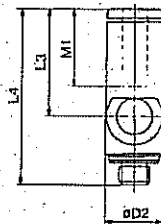
Speed Controller with One-touch Fitting Elbow Type/Universal Type **Series AS**



Universal Type



M3 port
M5 port
U10/32 port



Metric Size

Model	Applicable tubing O.D. and wall thk.	T	H ⁽¹⁾	D1	D2	D3	L1	L2	L3	L4	L5 ⁽²⁾		A ⁽³⁾		M1	Mass (g)
AS13□1F-M3-23	3/32	M3x0.5	5.5	8.4	7.2	7.2	10.1	17.9	17.6	28.3	26.6	24.1	24	21.5	12.7	4
AS13□1F-M3-04	4			8.3				18.3	17.9	28.6						5
AS13□1F-M5-23	3/32	M5x0.8	8	8.4	9.3	9.6	9.3	18.8	17.5	28.7	26.6	25.0	25	22.2	12.7	7
AS13□1F-U10/32-23	10/32 UNF			21.3				21.4								
AS13□1F-M5-04	4	M5x0.8	11.0	11.0	11.0	11.0	11.0	21.4	20.0	31.8	26.6	25.0	25	22.2	12.7	7
AS13□1F-U10/32-04	10/32 UNF							21.4	20.0	31.8						
AS13□1F-M5-06	6	M5x0.8	11.0	11.0	11.0	11.0	11.0	21.4	20.0	31.8	26.6	25.0	25	22.2	12.7	7
AS13□1F-U10/32-06	10/32 UNF							21.4	20.0	31.8						
AS23□1F-01-23	3/32	1/8	12 ⁽²⁾	8.4	14.2	9.3	13.1	24.4	17.5	30.9	35.2	30.2	32.1	27.1	12.7	17
AS23□1F-01-04	4			9.3			24.9	12.7								
AS23□1F-01-06	6	11.8	14.2	10.9	14	26.9	22.9	30.3	38.9	34.9	34.4	29.4	10.5	26	13.5	18
AS23□1F-01-08	8			15.2	12.9	15.2	30.9	28.2							40.8	16.5
AS23□1F-02-04	4	17	(17.5)	10.4	18.5	12.9	15.2	30.6	21.9	39.8	38.9	34.9	34.4	29.4	16	32
AS23□1F-02-06	6			12.6			12.8	16.4	34	26.2					42.1	17
AS23□1F-02-08	8	15.2	18.5	12.9	18.5	12.9	18.5	35.2	28.2	45.1	38.9	34.9	34.4	29.4	10.5	26
AS23□1F-02-10	10			16.5			20.2	38.7	34	47.9					21	40
AS33□1F-02-06	6	12.6	12.9	20.6	38.5	25.2	46.5	48.3	43.3	42.9	37.8	17	60	18.5	63	
AS33□1F-02-08	8			15.2												20.6
AS33□1F-02-10	10	18.5	23	43.7	32.8	53.9	48.3	43.3	42.9	37.8	17	60	18.5	63		
AS33□1F-02-12	12			20.0											23	44.9
AS33□1F-03-06	6	12.6	12.9	20.6	38.5	25.2	45	48.3	43.3	42.9	37.8	17	60	18.5	63	
AS33□1F-03-08	8			15.2												20.6
AS33□1F-03-10	10	18.5	23	43.7	32.8	52.4	48.3	43.3	42.9	37.8	17	60	18.5	63		
AS33□1F-03-12	12			20.0											23	44.9
AS43□1F-04-10	10	1/2	24	10.5	28.6	16.2	25.6	43.4	32.6	57.1	50.7	49.2	49.6	42.1	21	104
AS43□1F-04-12	12		(23.8)	21.7		18.4	28.6	52	36.3	60.8	22	100				

Note 1) () are the dimensions of NPT thread
Note 2) Reference thread dimensions after installation.
Note 3) Reference dimensions

Inch Size

Model	Applicable tubing O.D. and	T	H ⁽¹⁾	ØD1	ØD2	ØD3	L1	L2	L3	L4	L5 ⁽²⁾	A ⁽³⁾	M1	Mass (g)		
AS13□1F-M3-01	1/8"	M3x0.5	5.5	8.4	7.2	7.2	10.1	17.9	17.6	28.3	26.6	24.1	24	12.7	4	
AS13□1F-M3-03	3/32"			8.3				18.3	17.9	28.6					5	
AS13□1F-M5-01	1/8"	M5x0.8		8.4				18.8						12.7		
AS13□1F-U10/32-01	1/8"	10/32 UNF	8		9.8	9.3	10.0		17.5	28.7	26.0	25.0	25	22.2	7	
AS13□1F-M5-03	3/32"	M5x0.8			9.9			20.9								
AS13□1F-U10/32-03	3/32"	10/32 UNF														
AS13□1F-M5-05	5/16"	M5x0.8		11.4				21.3	23.3	34.5				10.5		
AS13□1F-U10/32-05	5/16"	10/32 UNF	8			9.8	9.3	10.8			26.6	25.0	25	22.2	6	
AS13□1F-M5-07	7/16"	M5x0.8			12			21.6	20.7	31.9				13.7		
AS13□1F-U10/32-07	7/16"	10/32 UNF														
AS23□1F-01-01	1/8"			8.4				24.4							17	
AS23□1F-01-03	3/32"			9.3		9.3	13.1	24.9	17.5	30.9				12.7	18	
AS23□1F-01-05	5/16"	1/8	12 (12.7)	11.8	14.2	10.9	14	26.6	22.9	37.3	35.2	30.2	32.1	27.1	18.5	
AS23□1F-01-07	7/16"			13.2		12.9	15.2	29.9	25.6	38.2				17	19	
AS23□1F-01-09	9/16"			15.2		12.9	15.2	30.9	28.2	40.8				18.5	21	
AS23□1F-02-01	3/32"			10.4		10.9	15.2	30.6	21.9	39.6				16	32	
AS23□1F-02-05	5/16"		17	11.8		10.9	18.2	31.1	23.9	42.1				16.5	33	
AS23□1F-02-07	7/16"		(17.5)	13.2	18.5	12.9	18.5	34.2	25.6	45.1	39.9	34.9	34.4	29.4	17	36
AS23□1F-02-09	9/16"			15.2		12.9	18.5	35.2	28.2	47.9				18.5	39	
AS23□1F-02-11	11/16"		1/4	18.5		20.2	38.7	34	46.5					21	40	
AS33□1F-02-07	7/16"			13.2		12.9	20.6	38.7	25.6	46.9				17	60	
AS33□1F-02-09	9/16"			15.2	20	12.9	20.6	38.7	28.2	49.5	48.3	43.3	42.9	37.9	18.5	63
AS33□1F-02-11	11/16"			18.5		18.2	23	43.7	32.8	53.9				21	66	
AS33□1F-03-07	7/16"		1/8	11.8		12.9	20.6	38.7	25.6	45.4				17	56	
AS33□1F-03-09	9/16"			15.2	25	12.9	20.6	38.7	28.2	48	45.4	40.4	40.2	35.2	18.5	59
AS33□1F-03-11	11/16"		3/8	18.5		18.2	23	43.7	32.8	52.4				21	65	
AS43□1F-04-11	3/4"		1/2	24 (23.8)	18.5	16.2	25.6	48.4	32.6	57.1	50.7	49.2	49.6	42.1	21	104
AS43□1F-04-13	1/2"			21.7	28.6	19.4	28.6	52	36.3	60.8				22	100	

Note 1) () are the dimensions of NPT thread
Note 2) Reference thread dimensions after installation.
Note 3) Reference dimensions

AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Series AS

Made to Order Specifications:

Please contact SMC for detailed dimensions, specifications, and delivery.



1 Lubricant: Vaseline X12

Ex.) AS2201F-01-04S-X12

2 Grease-free (Seal: Fluorine Coating) + Throttle Valve (Without Check Valve) X21

Ex.) AS2201F-01-04S-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

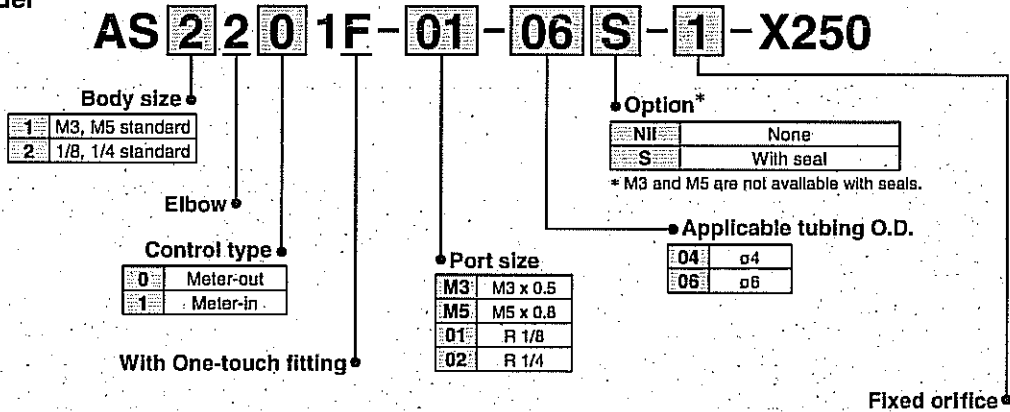
3 Throttle Valve (Without Check Valve) X214

Ex.) AS2201F-01-04S-X214

Note) Throttle valve is only compatible with the part no. of the meter-out type.

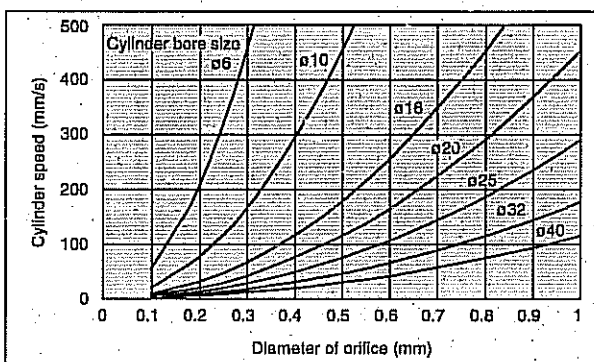
4 Fixed Throttle (No needle function) X250

How to Order



Symbol	Fixed orifice	Applicable model			
		AS12□1F-M3-04	AS12□1F-M5-04 AS12□1F-M5-06	AS22□1F-01-04 AS22□1F-01-06	AS22□1F-02-06
1	$\phi 0.1$	⊗	⊗	⊗	⊗
2	$\phi 0.2$	⊗	⊗	⊗	⊗
3	$\phi 0.3$	⊗	⊗	⊗	⊗
4	$\phi 0.4$	⊗	⊗	⊗	⊗
5	$\phi 0.5$	⊗	⊗	⊗	⊗
6	$\phi 0.6$	⊗	⊗	⊗	⊗
7	$\phi 0.7$	⊗	⊗	⊗	⊗
8	$\phi 0.8$	⊗	⊗	⊗	⊗
9	$\phi 0.9$	⊗	⊗	⊗	⊗
10	$\phi 1.0$	⊗	⊗	⊗	⊗

The graph below shows the relationship between orifices for each cylinder bore and cylinder speed. Please refer to it during selection. The cylinder speeds on the graph are theoretical values. Actual values may differ depending on the piping conditions or sliding friction, so please use this graph as a guideline only.



Speed Controller with One-touch Fittings In-line Type Series AS

Minimizes installation time and cost

Reduce the mounting height and enables compact machinery design. Effective area is larger than the former model.

ø2 size added to applicable tubing sizes

- **Metric size** (Release button: White color)
ø2, ø3.2, ø4, ø6, ø8, ø10, ø12
- **Inch size** (Release button: Orange color)
ø1/8", ø5/32", ø3/16", ø1/4", ø5/16", ø3/8", ø1/2"

Maximum operating pressure 1 MPa max.

Applicable tubing materials

Nylon, soft nylon, and polyurethane tubing are applicable.

Retainer prevents accidental loss of needle.

Option

Hexagonal lock nut,
Nickel plated option

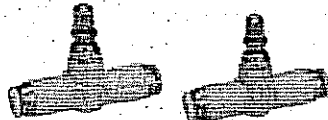
Number of needle rotations has been increased (8 to 10 turns)

The increased number of needle rotations (8 to 10 turns) permits easy control at low speeds.

In-line type

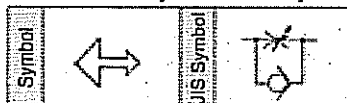


Applicable tubing O.D. ø2



Made to Order
(Refer to page 431 for details.)

Flow Direction Symbols on Body



Model

Model	Applicable tubing O.D.														Applicable cylinder bore size (mm)
	Metric size							Inch size							
	2	3.2	4	6	8	10	12	1/8	5/32	3/16	1/4	5/16	3/8	1/2	
AS1001F	○	○	○	○				○	○	●	○				6, 10, 16, 20 ⁽¹⁾
AS2001F			○	○					○	●	○				20, 25, 32
AS2051F				○	○					●	○	○			20, 25, 32, 40
AS3001F				○	○	○	○				○	○	●		40, 50, 63
AS4001F						○	○						●	●	63, 80, 100

Note 1) AS1001F-02 applicable cylinder bore sizes are 2.5, 4, 6.

Note 2) ○ Marking is electroless nickel plated, provided as standard. (N specifications)

Specifications

Fluid	Air
Proof pressure	1.5 MPa (1.05 MPa ⁽¹⁾)
Max. operating pressure	1 MPa (0.7 MPa ⁽¹⁾)
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽²⁾)
Applicable tubing material ⁽³⁾	Nylon, Soft nylon, Polyurethane ⁽⁴⁾
Option	Hexagonal lock nut, Electroless nickel plated ⁽⁵⁾

Note 1) In case of AS1001F-02

Note 2) In case of AS1001F type, AS1001F-02: 10 turns.

Note 3) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used. (Refer to pages 371 and 372 for details.)

Note 4) In case of AS1001F-02, polyurethane only.

Note 5) Brass parts are all electroless nickel plated.

Flow Rate and Effective Area

Model		AS1001F		AS2001F		AS2051F		AS3001F			AS4001F	
Tubing O.D.	Metric size	ø2	ø3.2, ø4, ø6	ø4	ø6	ø6	ø8	ø6	ø8	ø10, ø12	ø10	ø12
	Inch size	—	ø1/8", ø5/32" ø3/16", ø1/4"	ø5/32"	ø3/16", ø1/4"	ø3/16"	ø1/4", ø5/16"	ø1/4"	ø5/16"	ø3/8"	ø3/8"	ø1/2"
Controlled flow (Free flow)	Air flow L/min (ANR)	20	100	130	230	290	460	420	660	920	1050	1390
	Effective area (mm²)	0.3	1.5	2	3.5	4.5	7	6.5	10	14	16	21

Note) Flow rate values are measured at 0.5 MPa and 20°C.

How to Order

AS 400 1F - 12

Body size

100	M5 standard
200	1/8 standard
205	1/4 standard
300	3/8 standard
400	1/2 standard

With One-touch fittings

Option*

NII	None
K	Hexagonal lock nut
N	Electroless nickel plated

* If more than one option is required, write option part numbers in the order of "K", "N".

Applicable tubing O.D.

Metric size	Inch size
02 ø2	01 ø1/8"
23 ø3.2"	03 ø5/32"
04 ø4	05 ø3/16"
06 ø6	07 ø1/4"
08 ø8	09 ø5/16"
10 ø10	11 ø3/8"
12 ø12	13 ø1/2"

* Use ø1/8" tube.

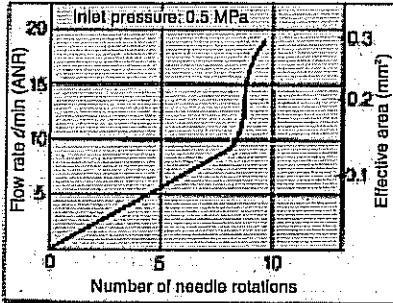
JIS Symbol



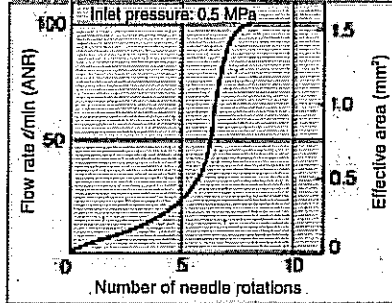
Made to Order
Refer to page 431 for details.

Needle Valve/Flow Characteristics

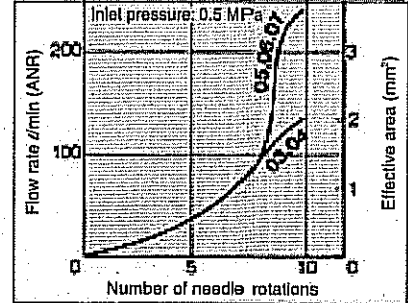
AS1001F-02



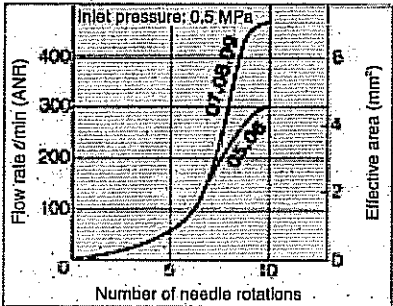
AS1001F



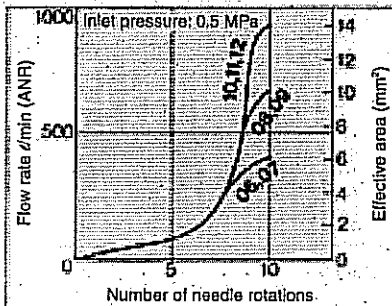
AS2001F



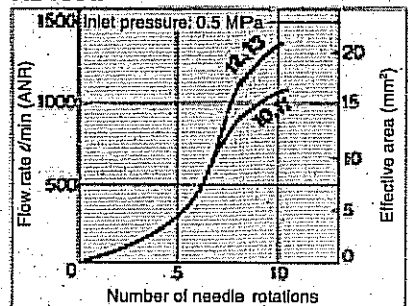
AS2051F



AS3001F



AS4001F



⚠ Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

Made to Order

Made to Order

Lubricant: Vaseline

X12

Ex.) AS2001F-04-X12

Grease-free (Seal: Fluorine Coating) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS2001F-04-X21

Note) Not particle-free

Throttle Valve (Without Check Valve)

X214

Ex.) AS2001F-04-X214

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

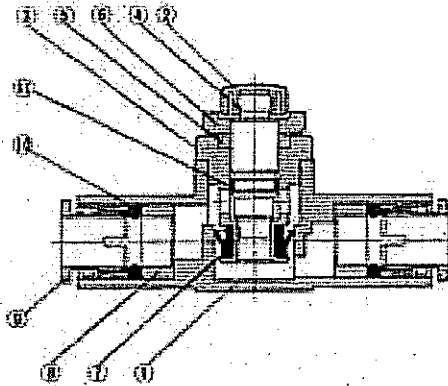
ASQ

KE

TMH

Series AS

Construction

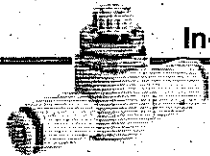


Component Parts

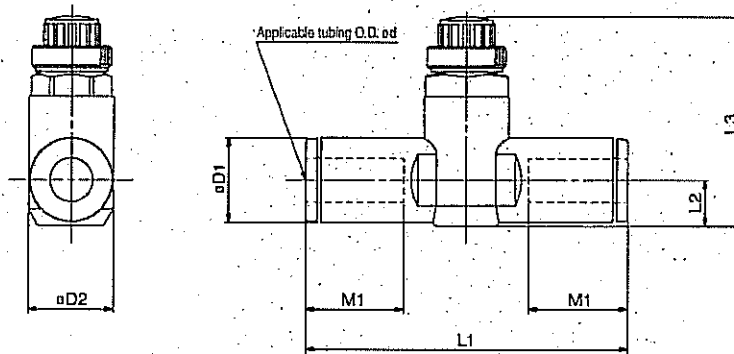
No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT (1)	
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Lock nut	Brass (2)	Electroless nickel plated
7	U seal	HNBR	
8	Spacer	—	
9	Cassette	—	
10	Packing	NBR	
11	O-ring	NBR	

Note 1) AS1001F-02 is made of electroless nickel plated brass.

Note 2) AS□□1F type is made of steel.



In-line Type



Metric Size

Model	Applicable tubing O.D. ϕd	D1	D2	L1	L2	L3 (1)		M1	Mass (g)
						Max.	Min.		
AS1001F-02	2	6	6	25.4	3.4	20.9	18.4	8.8	3
AS1001F-23	3.2	8.4		38.0	4.5	23.5	20.7	12.7	6
AS1001F-04	4	9.3	10	39.2	5.2	24.2	21.4		7
AS1001F-06	6	11.6		40.7	6.2	25.2	22.4	13.5	8
AS2001F-04	4	9.3	11.8	40.7	5.2	32.6	27.6	12.7	12
AS2001F-06	6	11.6		44.8	6.3	33.7	28.7	13.5	13
AS2051F-06	6	12.8	14.8	53.2	6.7	35.2	30.2	17	22
AS2051F-08	8	15.2		59.8	8.1	38.3	31.5	18	25
AS3001F-06	6	12.8	18.8	59	7.4	38.3	33.3	17	36
AS3001F-08	8	15.2		64.4	8.2	39.1	34.1	18	40
AS3001F-10	10	18.5		71.6	9.6	40.6	35.6	21	44
AS3001F-12	12	20.9		76	11	41.8	36.8	22	48
AS4001F-10	10	18.5	26.5	77.7		51.1	43.6	21	85
AS4001F-12	12	20.9		82.1	11.3	52.1	44.6	22	89

Note 1) Reference dimensions

Inch Size

Model	Applicable tubing O.D. ϕd	D1	D2	L1	L2	L3 (1)		M1	Mass (g)
						Max.	Min.		
AS1001F-01	1/8"	8.4	10	38	4.5	23.5	20.7	12.7	6
AS1001F-03	5/32"	9.3		39.2	5.2	24.2	21.4		7
AS1001F-05	3/16"	11.4	10	48.7	6.2	25.2	22.4	16.5	12
AS1001F-07	1/4"	12		40.7				13.7	9
AS2001F-03	5/32"	9.3	11.8	40.7	5.2	32.6	27.6	12.7	12
AS2001F-05	3/16"	11.4		50	6.2	33.6	28.6	16.5	18
AS2001F-07	1/4"	13.2		52.2	7.1	34.5	29.5	17	16
AS2051F-05	3/16"	11.4	14.8	52.2	6.2	34.6	29.6	16.5	24
AS2051F-07	1/4"	13.2		54.4	7.1	35.5	30.5	17	22
AS2051F-09	5/16"	15.2		59.8	8.1	36.5	31.5	18	25
AS3001F-07	1/4"	13.2	19.8	59	7.4	38.3	33.3	17	36
AS3001F-09	5/16"	15.2		64.4	8.2	39.1	34.1	18	40
AS3001F-11	3/8"	17.9		70.8	9.5	40.3	35.3	21	52
AS4001F-11	3/8"	17.9	26.5	76.9	10.3	51	43.5	21	93
AS4001F-13	1/2"	21.7		83.1	11.6	52.4	44.9	22	106

Note 1) Reference dimensions

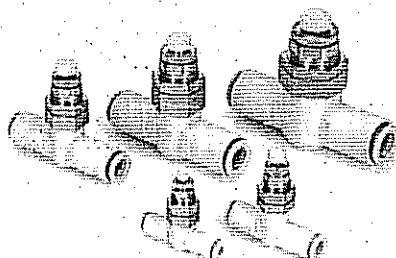
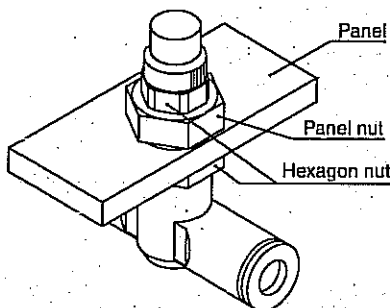
Speed Controller with One-touch Fittings In-line Type/Panel Mount Type

Series AS□□□1F-3

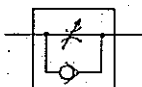
Panel mount thickness:
3.5 mm at the maximum

Easy installation and removal

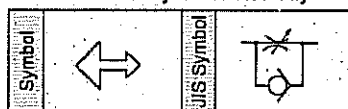
Installation of hexagon nuts on panel nuts up and down in two locations enables user to mount or remove it depending upon the situation.



JIS Symbol



Flow Direction Symbols on Body



Made to Order
(Refer to page 435 for details.)

Model

Model	Applicable tubing O.D.														Applicable cylinder bore size (mm)
	Metric size						Inch size								
	3.2	4	6	8	10	12	1/8	5/32	3/16	1/4	5/16	3/8	1/2		
AS1001F	●	●	●				●	●	●					6, 10, 16, 20	
AS2001F		●	●					●	●	●				20, 25, 32	
AS2051F			●	●					●	●	●			20, 25, 32, 40	
AS3001F			●	●	●	●				●	●	●		40, 50, 63	
AS4001F					●	●						●	●	63, 80, 100	

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽¹⁾)
Applicable tubing material ⁽²⁾	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS1001F type

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used. (Refer to pages 371 and 372 for details.)

Note 3) Brass parts are all electroless nickel plated.

Flow Rate and Effective Area

Model		AS1001F	AS2001F		AS2051F		AS3001F			AS4001F	
Tubing O.D.	Metric size	3/32, 1/4, 1/8	1/4	1/8	1/8	1/8	1/8	1/8	1/10, 1/12	1/10	1/12
	Inch size	1/8", 5/32", 3/16", 1/4"	5/32"	3/16", 1/4"	3/16"	1/4", 5/16"	1/4"	5/16"	3/8"	3/8"	1/2"
Controlled flow (Free flow)	Flow rate (L/min(ANR))	100	130	230	290	460	420	660	920	1050	1390
	Effective area (mm²)	1.5	2	3.5	4.5	7	6.5	10	14	16	21

Note) Flow rate values are measured at 0.5 MPa and 20°C.

How to Order

AS 200 1 F - 06 - 3 -

Body size

100	M5 standard
200	1/8 standard
205	1/4 standard
300	3/8 standard
400	1/2 standard

Panel mount type

Applicable tubing O.D.

Metric size	Inch size
23	3/32"
04	1/8"
05	5/32"
06	3/16"
08	1/4"
10	5/16"
12	3/8"
	1/2"

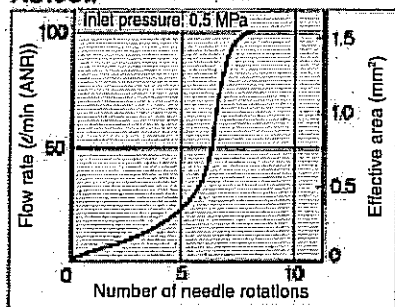
With One-touch fittings

* Use 1/8" tube.

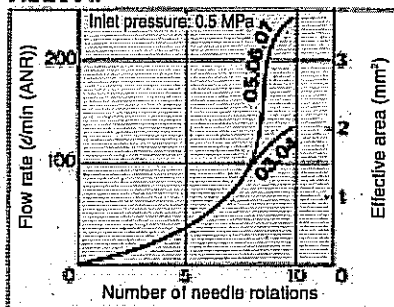
Made to Order
Refer to page 435 for details.

Needle Valve/Flow Characteristics

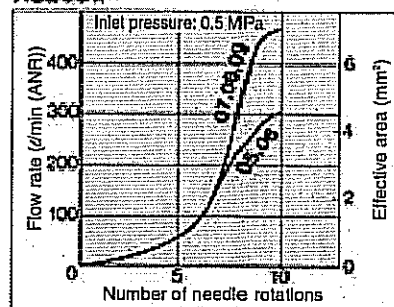
AS1001F



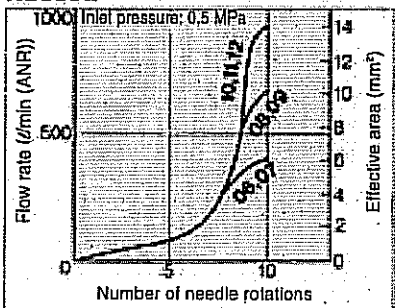
AS2001F



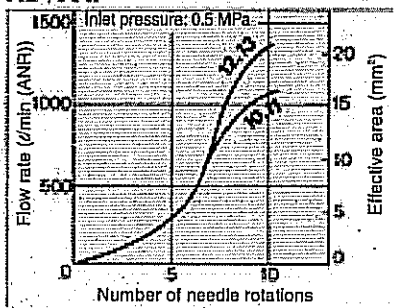
AS2051F



AS3001F



AS4001F



⚠ Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

Made to Order

Made to Order

Lubricant: Vaseline

X12

Ex.) AS2001F-04-3-X12

Grease-free (Seal: Fluorine Coating) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS2001F-04-3-X21

Note) Not particle-free

Throttle Valve (Without Check Valve)

X214

Ex.) AS2001F-04-3-X214

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

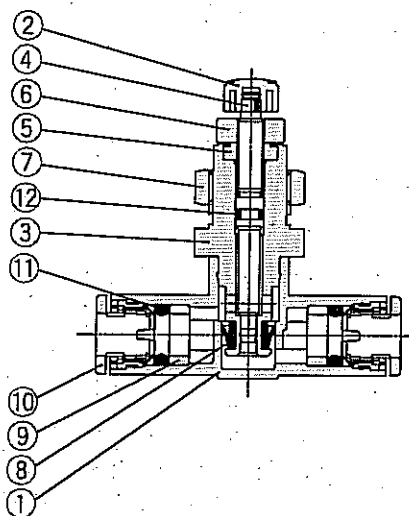
ASQ

KE

TMH

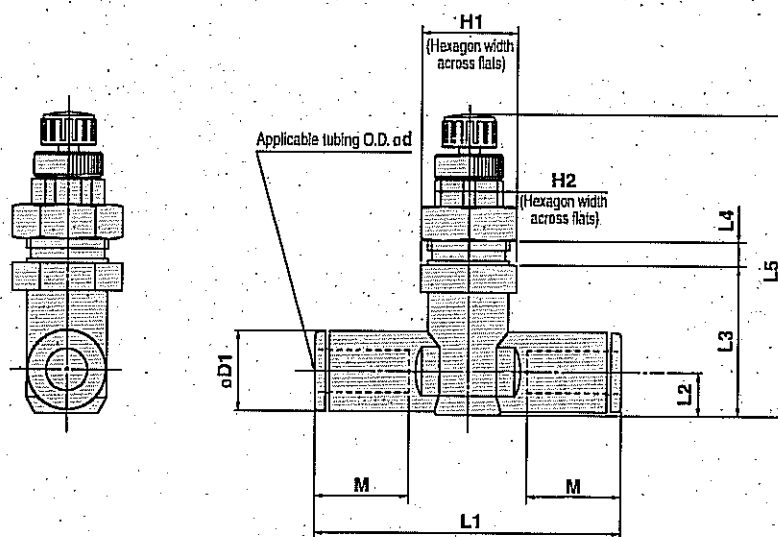
Series AS□□□1F-3

Construction



No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT	
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Lock nut	Brass	Electroless nickel plated
7	Panel nut	Brass	Electroless nickel plated
8	U seal	HNBR	
9	Spacer	—	
10	Cassette	—	
11	Packing	NBR	
12	O-ring	NBR	

Dimensions



Metric Size

Model	d	D1	H1	H2	L1	L2	L3	L4	L5(1)	M	Panel dimensions	Mass (g)
								Max.	Max.	Min.		
AS1001F-23-3	32	8.4	12	8	38	4.5	18.8	3.5	37.6	34.4	12.7	18
AS1001F-04-3	4	9.3			39.2	5.2	17.4		38.2	35	10.5	19
AS1001F-06-3	6	11.6			40.7	6.2	18.5		39.3	36.1	13.5	20
AS2001F-04-3	4	9.3	14	10	40.7	5.2	20.7	3.5	48	42.5	12.7	28
AS2001F-06-3	6	11.6			44.8	6.3	21.8		49.1	43.5	13.5	29
AS2051F-06-3	6	12.8	17	13	53.2	6.7	25.7	3.5	53.5	48.1	17	49
AS2051F-08-3	8	15.2			59.8	8.1	27		54.8	49.4	18	54
AS3001F-06-3	6	12.8			59	7.4	31.3		60.1	54.7	17	85
AS3001F-08-3	8	15.2	21	16	64.4	8.2	32.1	3.5	60.9	55.5	18	88
AS3001F-10-3	10	18.5			71.6	9.8	33.7		62.5	57.1	21	99
AS3001F-12-3	12	20.9			76	11	34.9		63.7	58.3	22	100
AS4001F-10-3	10	18.5	27	21	77.7	11.3	35	3.5	69.3	61	21	167
AS4001F-12-3	12	20.9			82.1		36		70.3	62	22	171

Note 1) Reference dimensions

Inch Size

Model	d	D1	H1	H2	L1	L2	L3	L4	L5(1)	M	Panel dimensions	Mass (g)
								Max.	Max.	Min.		
AS1001F-01-3	1/8"	8.4	12	8	38	4.5	18.8	3.5	37.6	34.4	12.7	18
AS1001F-03-3	5/32"	9.3			39.2	5.2	17.4		38.2	35	10.5	19
AS1001F-05-3	3/16"	11.4			48.7	6.2	18.5		39.3	36.1	13.5	20
AS1001F-07-3	1/4"	12			40.7				49.1	43.5	13.5	29
AS2001F-03-3	5/32"	9.3	14	10	40.7	5.2	20.7	3.5	48	42.5	12.7	28
AS2001F-05-3	3/16"	11.4			50	6.2	21.6		48.9	43.4	16.5	34
AS2001F-07-3	1/4"	13.2	14	10	52.2	7.1	22.5	3.5	49.8	44.3	17	37
AS2051F-05-3	3/16"	11.4			52.2	6.2	25.2		53	47.6	16.5	47
AS2051F-07-3	1/4"	13.2	17	13	54.4	7.1	26	3.5	53.8	48.4	17	49
AS2051F-09-3	5/16"	15.2			59.8	8.1	27		54.8	49.4	18	54
AS3001F-07-3	1/4"	13.2			59	7.4	31.3		60.1	54.7	17	84
AS3001F-09-3	5/16"	15.2	21	16	64.4	8.2	32.1	3.5	60.9	55.5	18	88
AS3001F-11-3	3/8"	17.2			70.8	9.5	33.3		62.1	56.7	21	95
AS4001F-11-3	3/8"	17.9	27	21	76.9	10.3	34.9	3.5	69.2	60.9	21	175
AS4001F-13-3	1/2"	21.7			83.1	11.8	36.3		70.6	62.3	22	188

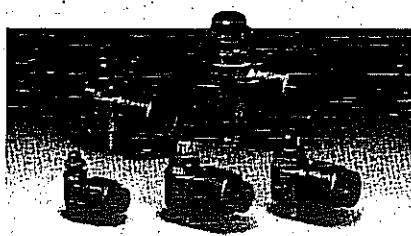
Note 1) Reference dimensions

Speed Controller with One-touch Fitting Elbow Type (Metal Body)

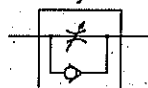
Series AS

Speed controller with One-touch fittings for metal body specifications

- Uses flame resistant resin as standard.
(UL standard V-0)



JIS Symbol



Made to Order
(Refer to page 428 for details.)

Model

Model	Part size	Applicable tubing O.D.					Applicable cylinder bore size (mm)
		4	6	8	10	12	
AS12□1-M5	M5 x 0.8	◎	◎				6, 10, 16, 20
AS22□1-01	R 1/8		◎	◎			20, 25, 32
AS22□1-02	R 1/4		◎	◎			20, 25, 32, 40
AS32□1-03	R 3/8			●	●		40, 50, 63
AS42□1-04	R 1/2				●	●	63, 80, 100

(Note) ◎ marking is electroless nickel plated, provided as standard. (N specifications)

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	- 5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽¹⁾)
Applicable tubing material	Nylon, Soft nylon, Polyurethane
Option	Hexagon lock nut, Electroless nickel plated ⁽²⁾

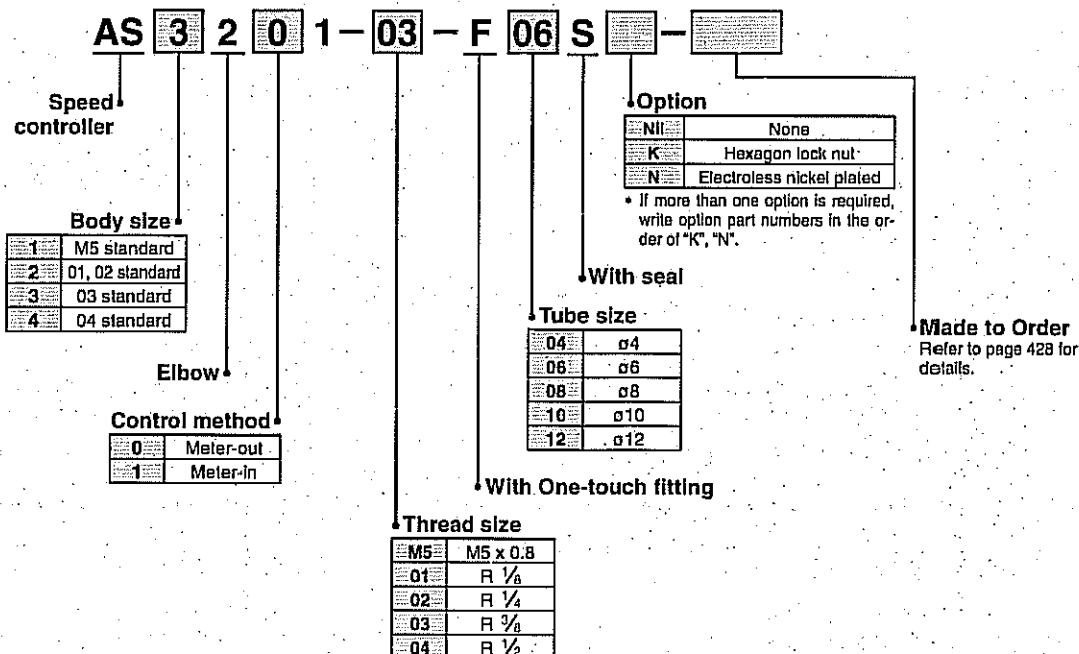
Meter-out and meter-in types can be visually differentiated by the lock nut.

The lock nut on the meter-out type is electroless nickel plated while the meter-in type is black zinc chromate plated.

Note 1) M5 size

Note 2) Brass parts are all electroless nickel plated.

How to Order



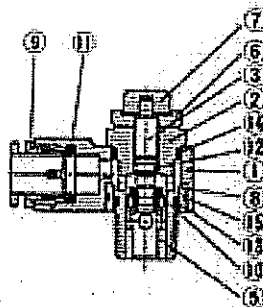
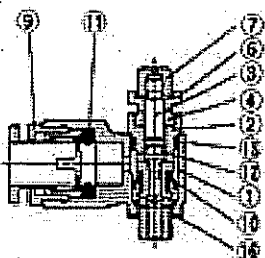
Note 1) M5 size: S (with seal) is not necessary.

Series AS

Construction

AS1201-M5

AS2201/3201/4201



Component Parts

No.	Description	Material	Note
1	Body A	Zinc alloy	Chromate plated
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Needle guide	Brass	Electroless nickel plated only with M5
5	Seat ring	Brass	(1)
6	Lock nut	Brass (2)	Electroless nickel plated (2)
7	Handle	Brass	Electroless nickel plated
8	Bushing	PBT	
9	Cassette	PBT/Stainless steel	
10	U-packing	HNBR	
11	Seal	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	O-ring	NBR	
16	Gasket	NBR/Stainless steel	M5 port only

Note 1) "AS22□1": Electroless nickel plated

Note 2) "AS22□1": Steel

Note 3) Meter-in type: Black zinc chromated

Made to Order



1 Lubricant: Vaseline **X12**

Ex.) AS1201-M5-F04-X12

2 Grease-free (Seal: Fluorine Coating) + Throttle Valve (Without Check Valve) **X21**

Ex.) AS1201-M5-F04-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

3 Throttle Valve (Without Check Valve) **X214**

Ex.) AS1201-M5-F04-X214

Note) Throttle valve is only compatible with the part no. of the meter-out type.

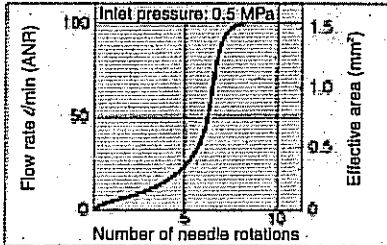
Speed Controller with One-touch Fitting Elbow Type (Metal Body) **Series AS**

Flow Rate and Effective Area

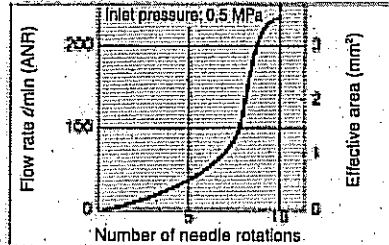
Model		AS12□1-M5	AS22□1-01	AS22□1-02		AS32□1-03		AS42□1-04	
Tubing O.D.		ø4, ø6	ø6, ø8	ø6	ø8	ø8	ø10	ø10	ø12
Controlled (Free) flow	Flow rate (l/min (ANR))	100	230	390	460	790	920	1580	1710
	Effective area (mm ²)	1.5	3.5	6	7	12	14	24	26

Needle Valve/Flow Characteristics

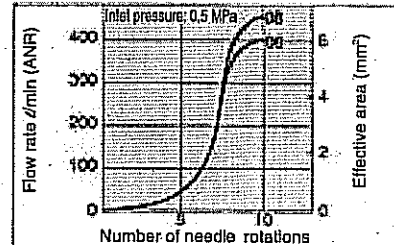
AS12□1



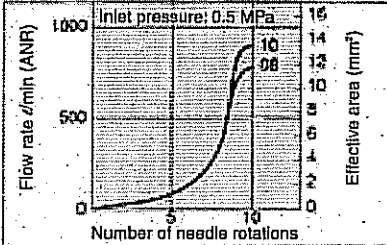
AS22□1-01



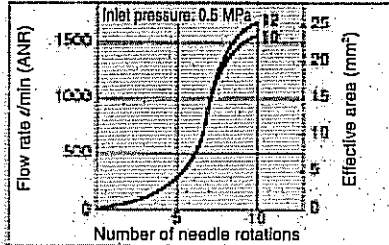
AS22□1-02



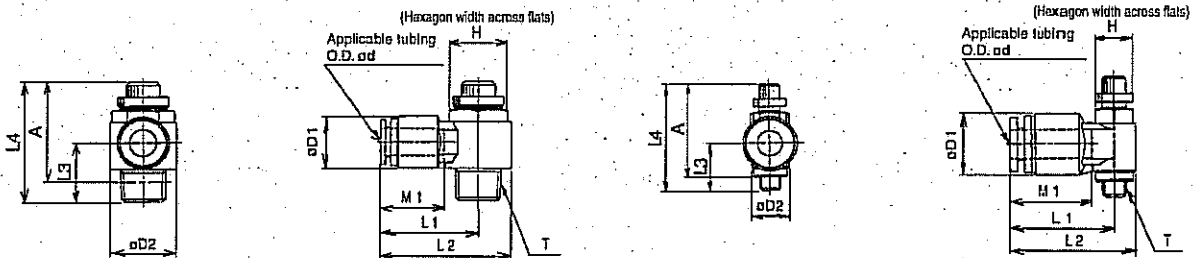
AS32□1



AS42□1



Dimensions



Model	Applicable tubing O.D. ød	T	H	D1	D2	L1	L2	L3	L4 (1)		A (2)		M1	Mass (g)
									Max.	Min.	Max.	Min.		
AS12□1-M5-F04	4	M5 x 0.8	8	13	9	21	25.5	11.2	28.3	25.5	25	22.2	16	13
AS12□1-M5-F06	6					21.5	26						17	13
AS22□1-01-F06S	6	R 1/8	12	15.5	14.6	26.6	33.9	13.8	35.5	30.5	32.4	27.4	17	34
AS22□1-01-F08S	8												18.5	31
AS22□1-02-F06S	6	R 1/4	17	15.5	19.5	28.7	38.5	17.2	40.3	35.3	34.8	29.8	17	56
AS22□1-02-F08S	8												18.5	52
AS32□1-03-F08S	8	R 3/8	19	18.2	24.3	32.7	44.9	19	45.8	40.8	40.6	35.6	18.5	93
AS32□1-03-F10S	10					33.3	45.5						21	88
AS42□1-04-F10S	10	R 1/2	24	22.3	28.5	36.1	50.4	24.6	54.7	49.7	47.4	42.4	21	154
AS42□1-04-F12S	12												22	146

Note 1) Reference dimensions

Note 2) Reference dimensions of thread M5, R after installation.

⚠ Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

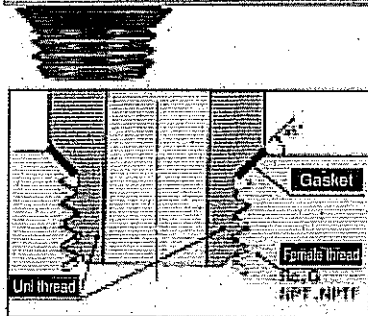
ASQ

KE

TMH

Speed Controller with Uni One-touch Fitting Series AS

New standard male threads for piping that reduces the screw-in time by 1/3.

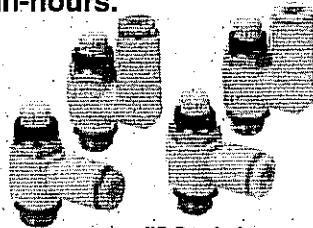


Shape of Uni thread ridge

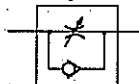
Use of the chamfered surface of the female thread as the seat surface and adoption of gaskets made by laminating NBR on both surfaces of stainless steel plates achieve secure sealing regardless of the difference of diameters due to the female thread type, deviations due to the tolerance, or the size of the chamfered corner.
(Any standard chamfered female thread can be used.)

A ridge shape has been created as a Uni thread for common applications for Rc, G, NPT and NPTF.

The male thread for piping drastically cuts piping man-hours.



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Model

Model		Connection thread Uni thread	Applicable tubing O.D.											
Elbow type	Universal type		Metric size						Inch size					
AS22□IF-U01	AS23□IF-U01	1/8	3.2	4	6	8	10	12	1/8	5/32	3/16	1/4	5/16	3/8
AS22□IF-U02	AS23□IF-U02	1/4												
AS32□IF-U02	AS33□IF-U02	1/4												
AS32□IF-U03	AS33□IF-U03	3/8												
AS42□IF-U04	AS43□IF-U04	1/2												

Note 1) * Elbow type only

Note 2) □ indicates the control type ("0" for meter-out and "1" for meter-in).

Note 3) Meter-out and meter-in types can be visually differentiated by the lock nut.

The lock nut on the meter-out type is electroless nickel plated, while that on the meter-in type is black zinc chromate plated.

Note 4) Models marked with "⊙" are nickel plated as standard.

Specifications

Fluid	Air
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Proof pressure	1.5 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns
Applicable tubing material (1)	Nylon, Soft-nylon, Polyurethane
Mounting thread	Uni-thread
Thread seal	Gasket
Option	Hexagon lock nut, Electroless nickel plated (2)

Note 1) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.
(Refer to pages 371 and 372 for details.)

Note 2) Brass parts are all electroless nickel plated.

Flow Rate and Effective Area

Model		AS22□IF-U01 AS23□IF-U02		AS22□IF-U02 AS23□IF-U02		AS32□IF AS33□IF		AS42□IF-U04 AS43□IF-U04	
Tubing O.D.	Metric size	3.2, 4	6, 8, 10	4	6	8, 10	6	8	10, 12
	Inch size	1/8, 5/32	3/16, 1/4, 5/16	5/32	3/16	1/4, 5/16, 3/8	1/4	5/16	3/8, 1/2
Controlled flow (Free flow)	Flow rate (l/min. (ANR))	180	230	260	390	460	660	790	920
	Effective area (mm²)	2.7	3.7	4	6	7	10	12	14

Note 1) Flow rate values are measured at 0.5 MPa and 20°C.

Note 2) □ indicates the control type ("0" for meter-out and "1" for meter-in).

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

KE

TMH

How to Order

AS 2 2 1 1F - U02 - 06 - - -

Body size

2	1/8, 1/4 standard
3	3/8 standard
4	1/2 standard

Type

2	Elbow
3	Universal

Control type

0	Meter-out
1	Meter-in

With One-touch fitting

Made to Order

X260 Antistatic type
Refer to page 450 for details.

Option*

NII	None
K	Hexagonal lock nut
N	Electroless nickel plated

* If more than one option is required, write option part numbers in the order of "K", "N".

Applicable tubing O.D.

Metric size	Inch size
23	ø3.2*
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12
01	1/8"
03	3/8"
05	5/8"
07	7/8"
09	9/8"
11	1 1/8"
13	1 3/8"

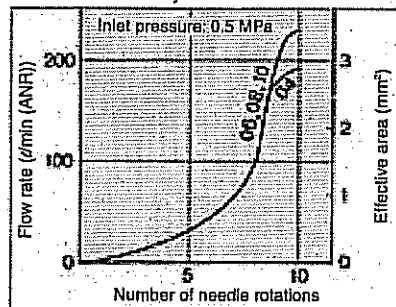
* Use ø1/8" tube.

Bore size

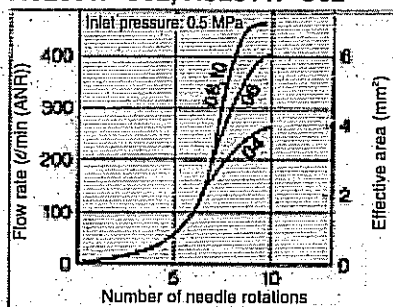
U01	Uni 1/8"
U02	Uni 1/4"
U03	Uni 3/8"
U04	Uni 1/2"

Needle Valve/Flow Characteristics

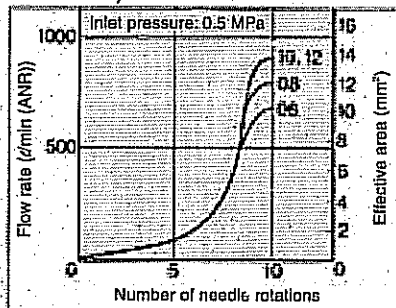
AS2201F-U01, AS2211F-U01
AS2301F-U01, AS2311F-U01



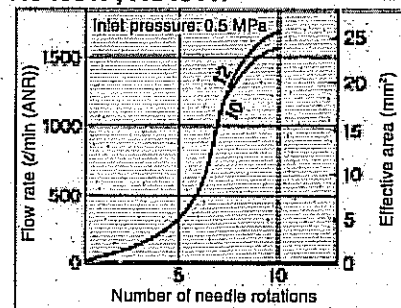
AS2201F-U02, AS2211F-U02
AS2301F-U02, AS2311F-U02



AS3201F, AS3211F
AS3301F, AS3311F

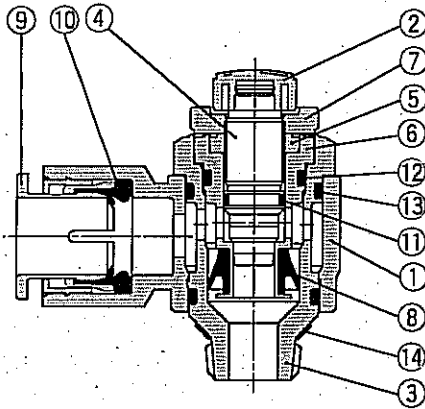


AS4201F, AS4211F
AS4301F, AS4311F

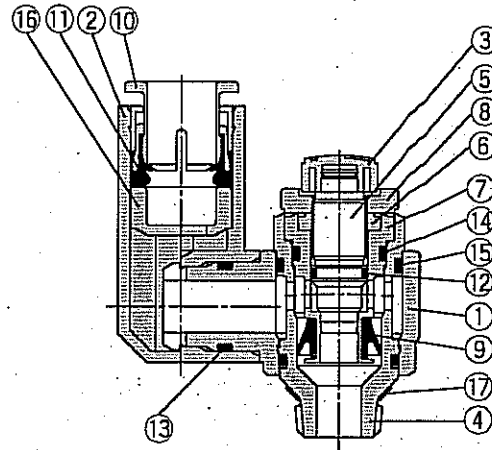


Construction/Component Parts

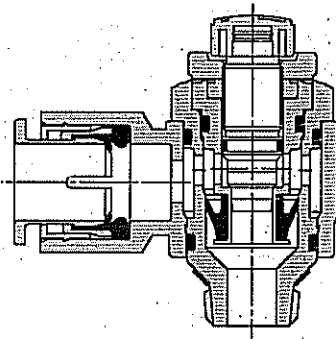
**Elbow type
Meter-out type**



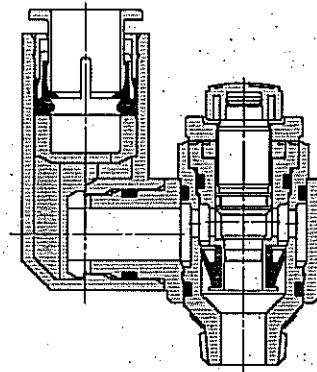
**Universal type
Meter-out type**



Meter-in type



Meter-in type



Component Parts: Elbow Type

No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT	
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Seat ring	Brass	(1)
7	Lock nut	Brass (2)	Electroless nickel plated (3)
8	U seal	HNBR	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	Gasket	NBR, Stainless steel	

Note 1) Only AS22□1F-U01 and AS32□1F-U02 are electroless nickel plated.

Note 2) AS22□1F type is made of steel.

Note 3) Meter-in type is black zinc chromate plated.

Component Parts: Universal Type

No.	Description	Material	Note
1	Body A	PBT	
2	Elbow body	PBT	
3	Handle	PBT	
4	Body B	Brass	Electroless nickel plated
5	Needle	Brass	Electroless nickel plated
6	Needle guide	Brass	Electroless nickel plated
7	Seat ring	Brass	(1)
8	Lock nut	Brass (2)	Electroless nickel plated (3)
9	U seal	HNBR	
10	Cassette	—	
11	Seal	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	O-ring	NBR	
16	Spacer	—	
17	Gasket	NBR, Stainless steel	

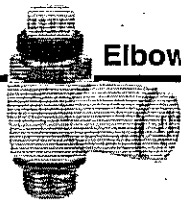
Note 1) Only AS22□1F-U01 and AS32□1F-U02 are electroless nickel plated.

Note 2) AS22□1F type is made of steel.

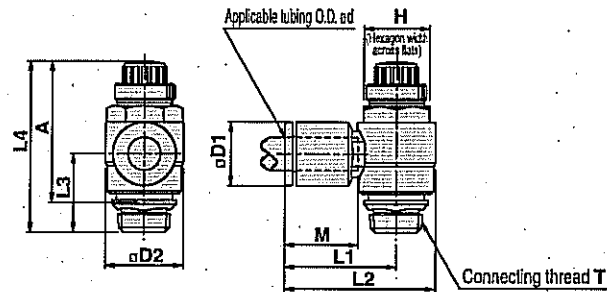
Note 3) Meter-in type is black zinc chromate plated.

AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Series AS



Elbow Type/Metric Size



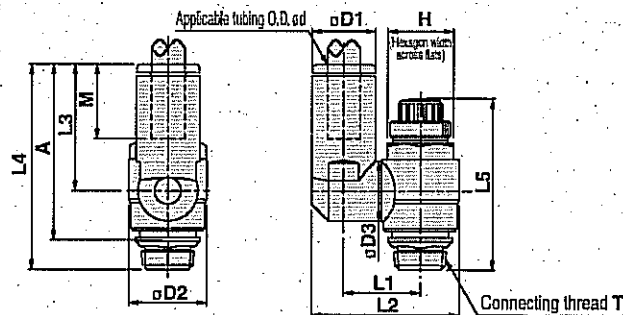
Model	Applicable tubing O.D. φd	T Unit thread	H	φD1	φD2	L1	L2	L3	L4 (1)		A (2)		M	Mass (g)
									Max.	Min.	Max.	Min.		
AS22□1F-U01-23	3.2	1/8	12	7.8	14.2	20.8	27.9	14.3	36.1	31.1	30.5	25.5	14.5	17
AS22□1F-U01-04	4			8.9		21.1	28.2						15.5	17
AS22□1F-U01-06	6			11.0		22.5	29.6						18.5	17
AS22□1F-U01-08	8			15.2		25.3	32.4						21.0	19
AS22□1F-U01-10	10			18.5		33.1	40.2						21.0	21
AS22□1F-U02-04	4	1/4	17	8.9	18.5	23.3	32.5	17.2	39.4	34.4	32.0	26.6	14.5	32
AS22□1F-U02-06	6			11.0		23.9	33.1						15.5	32
AS22□1F-U02-08	8			15.2		27.2	36.4						18.5	34
AS22□1F-U02-10	10			18.5		35.3	44.5						21.0	36
AS32□1F-U02-06	6			11.0		26.4	37.9						15.5	53
AS32□1F-U02-08	8	1/4	19	15.2	23.0	29.5	41.0	20.3	45.9	40.9	38.1	33.1	18.5	55
AS32□1F-U02-10	10			18.5		31.8	43.3						21.0	57
AS32□1F-U02-12	12			20.9		32.8	44.3						22.0	59
AS32□1F-U03-06	6			11.0		26.4	37.9						15.5	53
AS32□1F-U03-08	8			15.2		29.5	41.0						18.5	55
AS32□1F-U03-10	10	3/8	19	18.5	23.0	31.8	43.3	19.4	45.0	40.0	37.6	32.6	21.0	57
AS32□1F-U03-12	12			20.9		32.8	44.3						22.0	59
AS42□1F-U04-10	10			18.5		33.6	47.9						21.0	94
AS42□1F-U04-12	12	1/2	24	20.9	28.6	34.6	48.9	22.4	54.6	47.1	44.5	37.0	22.0	95

Note 1) Reference dimensions

Note 2) Reference dimensions of Unit thread after installation.



Universal Type/Metric Size



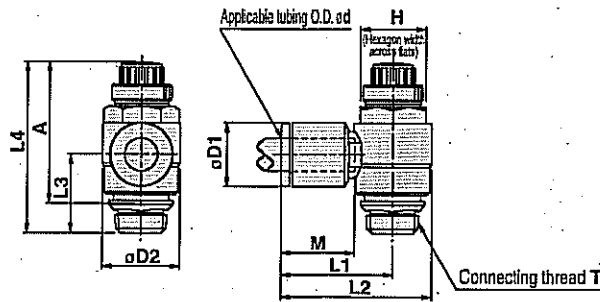
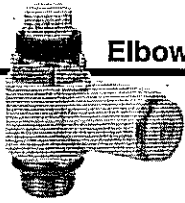
Model	Applicable tubing O.D. ϕd	T Unit thread	H	$\phi D1$	$\phi D2$	$\phi D3$	L1	L2	L3	L4	L5 (1)		A (2)		M	Mass (g)
											Max.	Min.	Max.	Min.		
AS23□1F-U01-23	3.2	$\frac{1}{8}$	12	7.8	14.2	9.3	13.4	24.8	18.9	33.2	36.1	31.1	30.5	25.5	14.5	17
AS23□1F-U01-04	4			8.9		10.9	14.5	27.1	20.6	34.9					15.5	17
AS23□1F-U01-06	6			11.0		12.9	16.2	30.9	24.7	38.2					18.5	21
AS23□1F-U01-08	8			15.2		12.9	16.2	30.9	24.7	38.2					14.5	32
AS23□1F-U02-04	4			8.9		9.3	15.6	29.2	18.9	36.1					10.5	33
AS23□1F-U02-06	6	$\frac{1}{4}$	17	11.0	18.5	10.9	16.7	31.4	20.6	37.8	39.4	34.4	32.0	26.6	18.5	36
AS23□1F-U02-08	8			15.2		18.3	35.2	24.4	40.8						21.0	40
AS23□1F-U02-10	10			18.5		12.9	19.8	38.1	26.8	43.2					15.5	54
AS33□1F-U02-06	6			11.0		10.9	18.9	35.9	20.6	42.5	45.9	40.9	38.1	33.1	18.5	57
AS33□1F-U02-08	8			15.2		12.9	20.8	39.7	24.4	43.7					21.0	61
AS33□1F-U02-10	10			18.5		16.2	22.5	43.3	28.3	48.6					22.0	63
AS33□1F-U02-12	12			20.9			23.5	45.5	29.3	49.6					15.5	54
AS33□1F-U03-06	6	$\frac{3}{8}$	19	11.0	23.0	10.8	18.9	35.9	20.6	41.6	45.0	40.0	37.6	32.6	18.5	57
AS33□1F-U03-08	8			15.2		12.9	20.6	39.7	24.4	42.8					21.0	61
AS33□1F-U03-10	10			18.5		16.2	22.5	43.3	28.3	47.7					22.0	63
AS33□1F-U03-12	12			20.9			23.5	45.5	29.3	48.7					21.0	98
AS43□1F-U04-10	10	$\frac{1}{2}$	24	18.5	28.6	16.2	25.3	48.9	28.3	50.7	54.6	47.1	44.5	37.0	22.0	100
AS43□1F-U04-12	12			20.9		19.4	26.8	51.6	30.8	53.2						

Note 1) Reference dimensions

Note 2) Reference dimensions of Unit thread after installation.

Speed Controller with Uni One-touch Fitting **Series AS**

Elbow Type/Inch Size

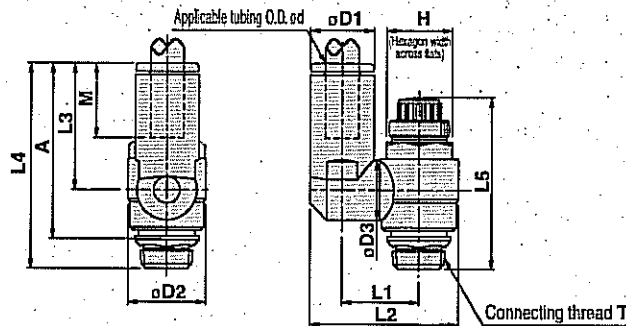


Model	Applicable tubing O.D. mm	T Uni thread	H	D1	D2	L1	L2	L3	L4 (1)		A (2)		M	Mass (g)
									Max.	Min.	Max.	Min.		
AS22□1F-U01-01	1/8"	1/8	12	7.8	14.2	20.8	27.9	14.3	36.1	31.1	30.5	25.5	14.5	17
AS22□1F-U01-03	5/32"			8.9		21.1	28.2						17	17
AS22□1F-U01-05	3/16"			11.4		23.1	30.2						16.5	18
AS22□1F-U01-07	1/4"			13.2		23.9	31.0						17.0	19
AS22□1F-U01-09	5/16"			15.2		25.3	32.4						18.5	19
AS22□1F-U02-03	5/32"	1/4	17	8.9	18.5	23.3	32.5	17.2	39.4	34.4	32.0	26.6	14.5	32
AS22□1F-U02-05	3/16"			11.4		24.9	34.2						16.5	33
AS22□1F-U02-07	1/4"			13.2		25.2	34.5						17.0	33
AS22□1F-U02-09	5/16"			15.2		27.2	36.4						18.5	34
AS22□1F-U02-11	3/8"			17.9		35.3	44.5	19					21.0	35
AS32□1F-U02-07	1/4"	1/4	19	13.2	23.0	27.8	39.3	20.3	45.9	40.9	38.1	33.1	17.0	54
AS32□1F-U02-09	5/16"			15.2		29.5	41.0						18.5	55
AS32□1F-U02-11	3/8"			17.9		31.8	43.3						21.0	57
AS32□1F-U03-07	1/4"	3/8	19	13.2	23.0	27.8	39.3	19.4	45.0	40.0	37.6	32.6	17.0	54
AS32□1F-U03-09	5/16"			15.2		29.5	41.0						18.5	55
AS32□1F-U03-11	3/8"			17.9		31.8	43.3						21.0	57
AS42□1F-U04-11	3/8"	1/2	24	17.9	18.6	33.6	47.9	22.4	54.6	47.1	44.5	37.0	21.0	94
AS42□1F-U04-13	1/2"			21.4		35.2	49.5						22.0	96

Note 1) Reference dimensions

Note 2) Reference dimensions of Uni thread after installation.

Universal Type/Inch Size



Model	Applicable tubing O.D. mm	T Uni thread	H	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A (2)		M	Mass (g)
											Max.	Min.	Max.	Min.		
AS23□1F-U01-01	1/8"	1/8	12	7.8	14.2	9.3	13.4	24.8	18.9	33.2	36.1	31.1	30.5	25.5	14.5	17
AS23□1F-U01-03	5/32"			8.9		10.3	14.2	27.0	21.5	35.9					17	17
AS23□1F-U01-05	3/16"			11.4		11.4	15.2	28.9	22.3	36.3					16.5	19
AS23□1F-U01-07	1/4"			13.2		12.9	16.2	30.9	24.7	38.2					17.0	20
AS23□1F-U01-09	5/16"			15.2		12.9	16.2	30.9	24.7	38.2					18.5	21
AS23□1F-U02-03	5/32"	1/4	17	8.9	18.5	9.3	15.6	29.2	18.9	36.1	39.4	34.4	32.0	26.6	14.5	32
AS23□1F-U02-05	3/16"			11.4		10.3	16.4	31.1	21.5	38.8					16.5	34
AS23□1F-U02-07	1/4"			13.2		11.4	17.4	33.2	22.3	39.5					17.0	34
AS23□1F-U02-09	5/16"			15.2		18.3	18.3	35.2	24.4	40.8					18.5	36
AS23□1F-U02-11	3/8"			17.9		12.9	19.6	38.1	26.8	43.2					29.4	39
AS33□1F-U02-07	1/4"	1/4	19	13.2	23.0	11.4	19.6	37.7	22.3	44.2	45.9	40.9	38.1	33.1	17.0	56
AS33□1F-U02-09	5/16"			15.2		12.9	20.6	39.7	24.4	43.7					18.5	57
AS33□1F-U02-11	3/8"			17.9		16.2	22.5	42.9	28.3	48.6					21.0	61
AS33□1F-U03-07	1/4"	3/8	19	13.2	23.0	11.4	19.6	37.7	22.3	43.3	45.0	40.0	37.6	32.6	17.0	56
AS33□1F-U03-09	5/16"			15.2		12.9	20.6	39.7	24.4	42.8					18.5	57
AS33□1F-U03-11	3/8"			17.9		16.2	22.5	42.9	28.3	47.7					21.0	61
AS43□1F-U04-11	3/8"	1/2	24	17.9	28.6	16.2	25.3	48.6	28.3	50.7	54.6	47.1	44.5	37.0	21.1	97
AS43□1F-U04-13	1/2"			21.7		19.4	26.8	52.5	30.8	53.2					22.0	100

Note 1) Reference dimensions

Note 2) Reference dimensions of Uni thread after installation.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

KE

TMH

Series AS

Made to Order Specifications

Please contact SMC for detailed dimensions, specifications, and delivery.



Antistatic Type

X260

Model

Model	Applicable tubing O.D.			
	Metric size			
	4	6	8	10
AS22□1F-U01	●	●	●	●
AS22□1F-U02	●	●	●	●
AS32□1F-U03		●	●	

Note 1) Electroless nickel plated

How to Order

AS 2 2 1 1F - U02 - 06 - X260

Body size

2	1/8, 1/4 standard
3	3/8 standard

Elbow type

Control type

0	Meter-out
1	Meter-in

With One-touch fitting

Applicable tubing O.D.

Metric size	
04	ø4
06	ø6
08	ø8
10	ø10

Port size

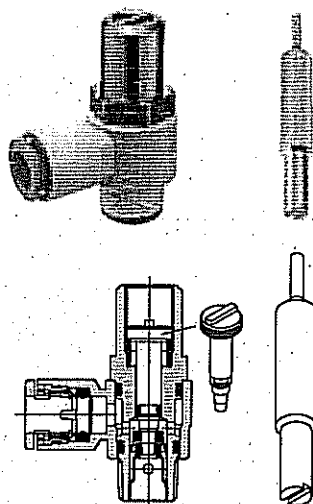
U01	Uni 1/8
U02	Uni 1/4
U03	Uni 3/8

Tamper Proof Speed Controller with One-touch Fitting Elbow Type/Universal Type

Series AS□□□1F-T

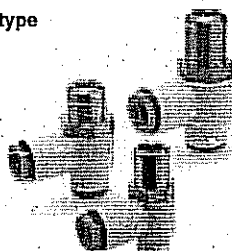
Able to adjust flow by a special tool

Prevention of an unnecessary manual operation

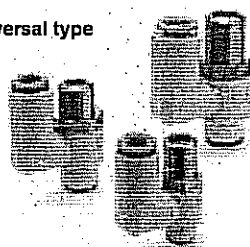


Special tool
Part number: AS-T-1

Elbow type



Universal type



Model

Elbow type	Universal type	Port size	Applicable tubing O.D.														Applicable cylinder bore size (mm)
			Metric size							Inch size							
			3.2	4	6	8	10	12	1/8	5/32	3/16	1/4	5/16	3/8	1/2		
AS12□1F-M5	AS13□1F-M5	M5 x 0.8	●	●	●												6, 10, 16, 20
AS22□1F-01	AS23□1F-01	R 1/8	●	●	●	●	●										20, 25, 32
AS22□1F-02	AS23□1F-02	R 1/4		●	●	●	●	●									20, 25, 32, 40
AS32□1F-02	AS33□1F-02	R 1/4			●	●	●	●	●								40, 50, 63
AS32□1F-03	AS33□1F-03	R 3/8			●	●	●	●	●								40, 50, 63
AS42□1F-04	AS43□1F-04	R 1/2						●	●								63, 80, 100
AS12□1F-U10/32	AS13□1F-U10/32	10-32 UNF								●	●	●	●				6, 10, 16, 20
AS22□1F-N01	AS23□1F-N01	NPT 1/8								●	●	●	●	●			20, 25, 32
AS22□1F-N02	AS23□1F-N02	NPT 1/4									●	●	●	●	●		20, 25, 32, 40
AS32□1F-N02	AS33□1F-N02	NPT 1/4										●	●	●	●		40, 50, 63
AS32□1F-N03	AS33□1F-N03	NPT 3/8											●	●	●		40, 50, 63
AS42□1F-N04	AS43□1F-N04	NPT 1/2													●	●	63, 80, 100

Note 1) * Elbow type only

Note 2) Meter-out and meter-in types can be visually differentiated by the flow direction symbol on the resin body.

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns (1))
Applicable tubing material (2)	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS12□1F-M5 and AS12□1F-U10/32 types
AS13□1F-M5, AS13□1F-U10/32

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.
(Refer to pages 371 and 372 for details.)

Note 3) Brass parts are all electroless nickel plated, provided as standard.

How to Order

AS 2 2 1 1 F - 01 - 06 S T -

Body size

1	M5 standard
2	1/8, 1/4 standard
3	3/8 standard
4	1/2 standard

Type

2	Elbow
3	Universal

Control

0	Meter-out
1	Meter-in

With One-touch fitting

Port size

M5	M5 x 0.8
01	R 1/8
02	R 1/4
03	R 3/8
04	R 1/2
U10/32	10-32 UNF
N01	NPT 1/8
N02	NPT 1/4
N03	NPT 3/8
N04	NPT 1/2

Tamper proof

Speed Controller requires a special tool for flow adjustment. Order separately with part number, AS-T-1.

With seal

Note) In case that connecting port is either M5 or 10-32 UNF thread, it is not available with seal. With gasket is provided as standard.

Applicable tubing O.D.

Metric size	Inch size
23	ø3.2"
01	ø1/8"
04	ø4
03	ø5/32"
06	ø6
05	ø3/16"
08	ø8
07	ø1/4"
10	ø10
09	ø5/16"
12	ø12
11	ø3/8"
13	ø1/2"

* Use ø1/8" tube.

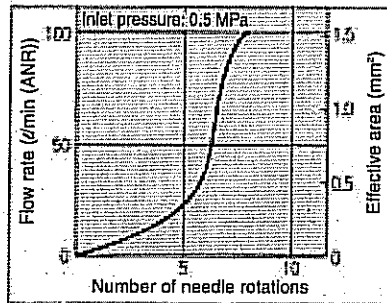
Made to Order
Refer to page 535 for details.



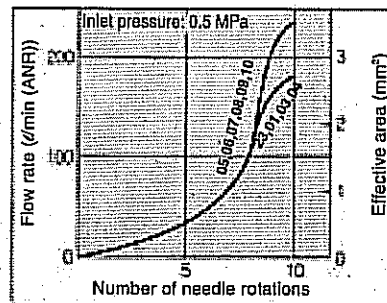
Made to Order
(Refer to page 535 for details.)

Needle Valve/Flow Characteristics

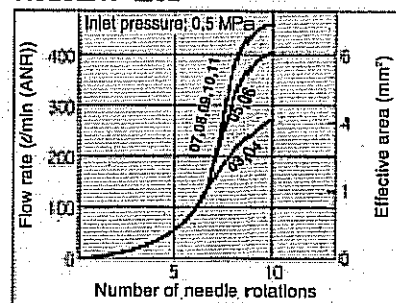
AS12□1F
AS13□1F



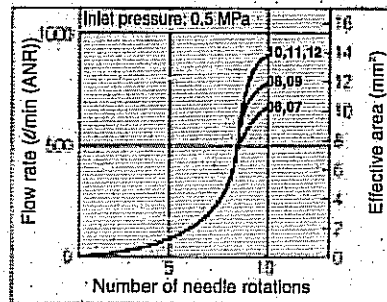
AS22□1F-□01
AS23□1F-□01



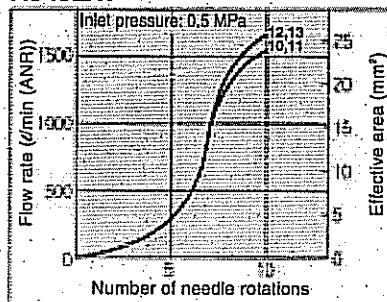
AS22□1F-□02
AS23□1F-□02



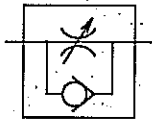
AS32□1F
AS33□1F



AS42□1F
AS43□1F



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for
Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

Flow Rate and Effective Area

Model		AS12□1F AS13□1F	AS22□1F-□01 AS23□1F-□01	AS22□1F-□02 AS23□1F-□02	AS32□1F AS33□1F	AS42□1F AS43□1F
Tubing O.D.	Metric size	ø3.2, ø4, ø6	ø12, ø4 ø8, ø8, ø10	ø4 ø6 ø8, ø10	ø6 ø8 ø10, ø12	ø10 ø12
	Inch size	ø1/8", ø5/32" ø3/16", ø1/4"	ø1/8", ø3/16", ø1/4", ø5/32", ø5/16"	ø1/8", ø3/16", ø1/4", ø5/32", ø3/8"	ø1/4", ø5/16", ø3/8"	ø3/8", ø1/2"
Controlled flow (Free flow)	Flow rate (l/min (ANR))	100	180 230	260 390 480	680 790 S20	1580 1710
	Effective area (mm²)	1.5	2.7 3.5	4 6 7	10 12 14	24 26

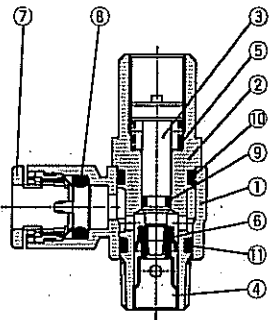
Note) Flow rate values are at a pressure of 0.5 MPa and a temperature of 20°C.

- AS
- ASP
- ASN
- AQ
- ASV
- AK
- VCHC
- ASS
- ASR
- ASQ
- KE
- TMH

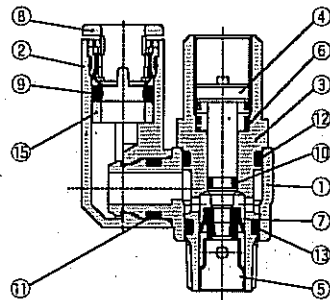
Series AS□□□1F-T

Construction

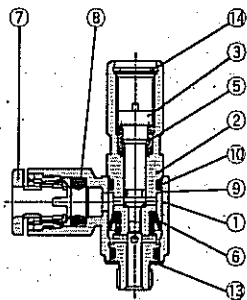
Elbow type
Meter-out type



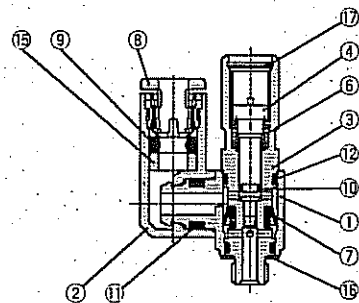
Universal type
Meter-out type



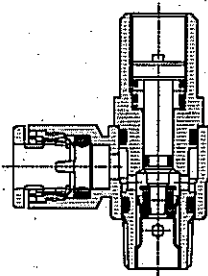
M5 type
U10/32 type



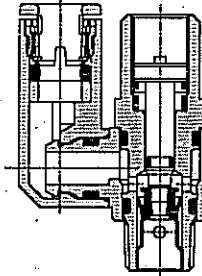
M5 type
U10/32 type



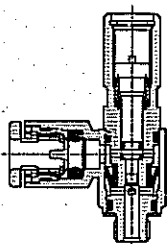
Meter-in type



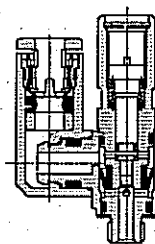
Meter-in type



M5 type
U10/32 type



M5 type
U10/32 type

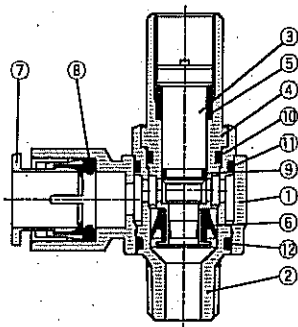


Tamper Proof Speed Controller with One-touch Fitting
Elbow Type/Universal Type Series AS□□□1F-T

Construction

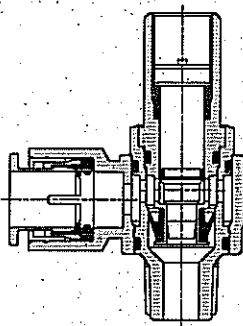
Elbow type Meter-out type

AS3201F-02



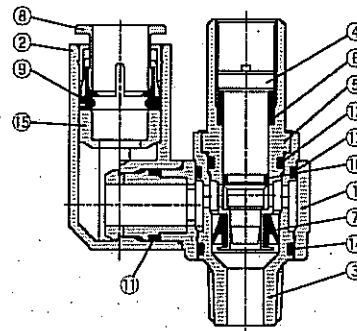
Meter-in type

AS3211F-02



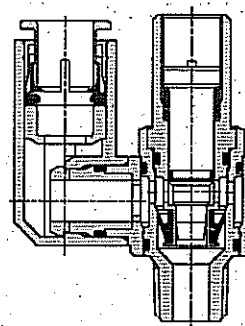
Universal type Meter-out type

AS3301F-02



Meter-in type

AS3311F-02



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Seat ring	Brass	Electroless nickel plated
5	Spring	Steel wire	
6	U seal	HNBR	
7	Cassette	—	
8	Seal	NBR	
9	O-ring	NBR	
10	O-ring	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	Gasket	NBR, Stainless steel	
14	Retaining ring for hole type C	Tool steel	

Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Elbow body	PBT	
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Seat ring	Brass	Electroless nickel plated
6	Spring	Steel wire	
7	U seal	HNBR	
8	Cassette	—	
9	Seal	NBR	
10	O-ring	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	Spacer	—	
16	Gasket	NBR, Stainless steel	
17	Retaining ring for hole type C	Tool steel	

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

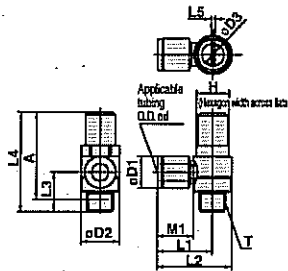
KE

TMH

Series AS□□□1F-T

Construction

Elbow type



Metric Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5	A*	M1	Mass (g)
AS12□1F-M5-23T	3.2			8.4										
AS12□1F-M5-04T	4	M5 x 0.8	8	9.3	9.6	4.5	17.3	22.1	12.3	31	0.7	27.4	12.7	10
AS12□1F-M5-06T	6			11.8			18.1	22.9	11.7				13.5	
AS22□1F-01-23ST	3.2			8.4										
AS22□1F-01-04ST	4			9.3			20.4	27.5	13.4	34.7	1.5	31.6	12.7	20
AS22□1F-01-06ST	6	R 1/8	12	11.8	14.2	7							13.5	21
AS22□1F-01-08ST	8			15.2			25.3	32.4					16.5	23
AS22□1F-01-10ST	10			18.6			33.1	40.2	14.1				21	25
AS22□1F-02-04ST	4			10.4			25.2	34.4					16	40
AS22□1F-02-06ST	6			12.8			27.2	36.4					16.5	42
AS22□1F-02-08ST	8	R 1/4	17	15.2	18.5	7				40.2	1.5	34.7	17	77
AS22□1F-02-10ST	10			18.6			35.3	44.5	19.5				21	80
AS32□1F-02-06ST	6			12.8			27.8	39.3					17	73
AS32□1F-02-08ST	8			15.2			29.5	41					18.5	76
AS32□1F-02-10ST	10	R 1/4	19	18.6	23	9.5	31.8	43.3	21.3	54.8	1.5	40.2	21	80
AS32□1F-02-12ST	12			20.9			32.8	44.3					22	82
AS32□1F-03-06ST	6			12.8			27.8	39.3					17	77
AS32□1F-03-08ST	8	R 3/8	19	15.2	23	0.5	29.5	41	10.8	52.6	1.5	47.4	18.5	79
AS32□1F-03-10ST	10			18.6			31.8	43.3					21	81
AS32□1F-03-12ST	12			20.9			32.8	44.3					22	83
AS42□1F-04-10ST	10			18.6			33.6	47.0					21	141
AS42□1F-04-12ST	12	R 1/2	24	20.9	28.6	12	34.6	48.9	24.5	62.9	1.5	55.8	22	142

* Reference dimensions of M5 x 0.8, R threads after installation.

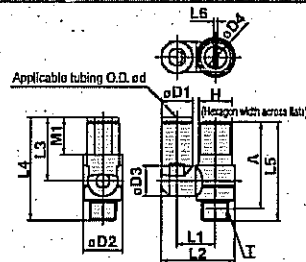
Inch Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5	A*	M1	Mass (g)
AS12□1F-U10/32-01T	1/8"			8.4										
AS12□1F-U10/32-03T	3/32"			9.3			17.3	22.1	12.3				12.7	
AS12□1F-U10/32-05T	5/32"	10-32 UNF	8	11.4	9.6	4.5	21.3	28.1		31	0.7	27.4	16.5	10
AS12□1F-U10/32-07T	7/32"			12			18.3	23.1	11.7				13.5	
AS22□1F-N01-01ST	1/8"			8.4			20.4	27.5					12.7	20
AS22□1F-N01-03ST	3/32"			9.3			23.9	31					16.5	21
AS22□1F-N01-05ST	5/32"	NPT 1/8	12.7	13.2	14.2	7	24	31.1	13.4	34.7	1.5	31.6	18.5	23
AS22□1F-N01-07ST	7/32"			15.2			25.3	32.4					21	25
AS22□1F-N01-09ST	9/32"			16.5			27.2	36.4					21	25
AS22□1F-N02-03ST	3/32"			10.4			25.2	34.4					16	40
AS22□1F-N02-05ST	5/32"			12.8			25.2	34.5					17	40
AS22□1F-N02-07ST	7/32"			15.2			25.2	34.5	17.7	40.2	1.5	34.7	18.5	42
AS22□1F-N02-09ST	9/32"	NPT 1/4	17.5	13.2	18.5	7	25.2	34.5					21	44
AS22□1F-N02-11ST	11/32"			15.2			27.2	36.4					21	44
AS32□1F-N02-07ST	7/32"			18.5			35.3	44.5	19.5				21	80
AS32□1F-N02-09ST	9/32"			13.2			27.8	39.3					17	73
AS32□1F-N02-11ST	11/32"	NPT 1/4	19	15.2	23	9.5	29.5	41	21.3	54.8	1.5	40.2	18.5	78
AS32□1F-N02-13ST	13/32"			17.9			31.8	43.3					21	80
AS32□1F-N03-07ST	7/32"			13.2			27.8	39.3					17	77
AS32□1F-N03-09ST	9/32"	NPT 3/8	19	15.2	23	9.5	29.5	41	19.9	52.6	1.5	47.4	18.5	79
AS32□1F-N03-11ST	11/32"			17.9			31.8	43.3					21	81
AS42□1F-N04-11ST	3/8"			17.9			33.6	47.0					21	141
AS42□1F-N04-13ST	1/2"	NPT 1/2	23.8	21.7	28.6	12	34.6	48.9	24.5	62.9	1.5	55.8	22	142

* Reference dimensions of 10-32 UNF and NPT threads after installation.

Dimensions

Universal type



Metric Size

Model	d	T	H	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	A*	M1	Mass (g)
AS13□1F-M5-23T	3.2			8.4												
AS13□1F-M5-04T	4	M5 x 0.8	8	9.3	9.6	4.5	10.8	20.3								
AS13□1F-M5-06T	6			11.8				21.4	20.6	31.6						
AS23□1F-01-23ST	3.2			8.4				19.1	24.4	17.5	30.9					
AS23□1F-01-04ST	4			9.3				24.9	24.9	17.5	30.9					
AS23□1F-01-06ST	6	R 1/8	12	11.8	14.2	7		14	26.9	22.9	36.3	34.7	1.5	31.6	13.5	22
AS23□1F-01-08ST	8			15.2				18.2	30.9	26.2	40.8					
AS23□1F-01-10ST	10			18.6				20.2	38.7	31	47.9					
AS23□1F-02-04ST	4			10.4				16.2	30.6	21.8	39.6					
AS23□1F-02-06ST	6			12.8				18.4	34	25.2	42.1					
AS23□1F-02-08ST	8	R 1/4	17	15.2	18.5	7		18.3	35.2	28.2	45.1	40.2	1.5	34.7	17	41
AS23□1F-02-10ST	10			18.6				20.2	38.7	31	47.9					
AS33□1F-02-06ST	6			12.8				20.6	30.5	25.2	48.5					
AS33□1F-02-08ST	8			15.2				22.9	32.7	28.2	49.5					
AS33□1F-02-10ST	10	R 1/4	19	18.6	23	9.5		33.7	32.6	32.6	52.9	54.8	1.5	40.2	21	80
AS33□1F-02-12ST	12			20.9				34.9	34.4	34.4	56.7					
AS33□1F-03-06ST	6			12.8				20.6	30.5	25.2	45					
AS33□1F-03-08ST	8			15.2				22.9	32.7	28.2	48					
AS33□1F-03-10ST	10	R 3/8	19	18.6	23	9.5		33.7	32.6	32.6	52.4	52.6	1.5	47.4	18.5	81
AS33□1F-03-12ST	12			20.9				34.9	34.4	34.4	54.2					
AS43□1F-04-10ST	10			18.6				33.6	49.4	32.6	57.1					
AS43□1F-04-12ST	12	R 1/2	24	20.9	28.6	12		34.6	48.9	32.6	60.6	62.9	1.5	55.8	21	145

* Reference dimensions of M5 x 0.8, R threads after installation.

Inch Size

Model	d	T	H	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	A*	M1	Mass (g)
AS13□1F-U12/24-01T	1/8"			8.4												
AS13□1F-U12/24-03T	3/32"			9.3												
AS13□1F-U12/24-05T	5/32"	10-32 UNF	8	11.4	9.6	4.5	10.8	21.3	23.3	34.5		31	0.7	27.4	16.5	11
AS13□1F-U12/24-07T	7/32"			12				21.6	20.7	31.9						
AS23□1F-N01-01ST	1/8"			8.4				24.4	24.4	17.5	30.9					
AS23□1F-N01-03ST	3/32"			9.3				24.9	24.9	17.5	30.9					
AS23□1F-N01-05ST	5/32"	NPT 1/8	12.7	11.4	14	10.9	7	14	28.8	23.8	37.3	34.7	1.5	31.6	18.5	22
AS23□1F-N01-07ST	7/32"			15.2				16.2	29.9	25.0	38.2					
AS23□1F-N01-09ST	9/32"			16.5				16.2	30.9	28.2	40.8					
AS23□1F-N02-03ST	3/32"			10.4				16.2	30.6	21.9	39.6					
AS23□1F-N02-05ST	5/32"			12.8				18.2	31.1	23.9	41.6					
AS23□1F-N02-07ST	7/32"	NPT 1/4	17.5	13.2	18	7		18.3	34.2	25.0	42.5	40.2	1.5	34.7	18.5	44
AS23□1F-N02-09ST	9/32"			15.2				18.3	35.2	28.2	45.1					
AS23□1F-N02-11ST	11/32"			17.9				20.2	38.7	31	47.9					
AS33□1F-N02-07ST	7/32"			13.2				20.6	30.7	25.8	46.9					
AS33□1F-N02-09ST	9/32"	NPT 1/4	19	15.2	23	9.5		33.7	32.6	32.6	52.4	54.8	1.5	40.2	18.5	76
AS33□1F-N02-11ST	11/32"			17.9				23	43.7	32.6	53.9					
AS33□1F-N03-07ST	7/32"			13.2				20.6	30.7	25.0	45.4					
AS33□1F-N03-09ST	9/32"	NPT 3/8	19	15.2	23	9.5		33.7	32.6	32.6	52.4	52.6	1.5	47.4	18.5	81
AS33□1F-N03-11ST	11/32"			17.9				23	43.7	32.6	52.4					
AS43□1F-N04-11ST	3/8"			17.9				33.6	49.4	32.6	57.1					
AS43□1F-N04-13ST	1/2"	NPT 1/2	23.8	21.7	28.6	12		34.6	48.9	32.6	60.6	62.9	1.5	55.8	21	145

* Reference dimensions of 10-32 UNF and NPT threads after installation.

Series AS□□□1F-T

Made to Order Specifications

Please contact SMC for detailed dimensions, specifications and delivery.



Lubricant: Vaseline

X12

Ex.) AS1201F-M5-23T-X12

Grease-free (Seal: Fluorine coated) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS1201F-M5-23T-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

Throttle Valve (Without Check Valve)

X214

Ex.) AS1201F-M5-23T-X214

Note) Throttle valve is only compatible with the product no. of the meter-out type.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

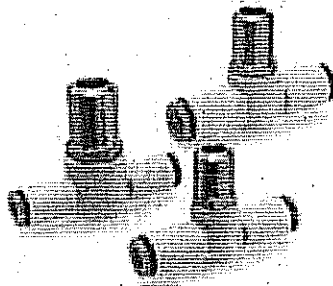
ASQ

KE

TMH

Tamper Proof Speed Controller with One-touch Fittings In-line Type

Series AS□□□1F-T



Model

Model	Applicable tubing O.D.												Applicable cylinder bore size (mm)	
	Metric size						Inch size							
	3.2	4	6	8	10	12	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"		1/2"
AS1001F	●	●	●				●	●	●	●	5/16"	3/8"	1/2"	6, 10, 16, 20
AS2001F		●	●					●	●	●				20, 25, 32
AS2051F			●	●					●	●	●			20, 25, 32, 40
AS3001F			●	●	●	●				●	●	●		40, 50, 63
AS4001F					●	●						●	●	63, 80, 100

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns (1))
Applicable tubing material (2)	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS1001F type.

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used. (Refer to pages 371 and 372 for details.)

Note 3) Brass parts are all electroless nickel plated.

Flow Rate and Effective Area

Model		AS1001F		AS2001F		AS2051F		AS3001F			AS4001F	
Tubing O.D.	Metric size	ø3.2, ø4, ø6	ø4	ø6	ø6	ø6	ø8	ø8	ø10, ø12	ø10	ø12	
	Inch size	ø1/8", ø5/32", ø3/16", ø1/4"	ø5/32"	ø3/16", ø1/4"	ø3/16"	ø1/4", ø5/16"	ø1/4"	ø5/16"	ø3/8"	ø3/8"	ø1/2"	
Controlled flow (Free flow)	Flow rate (l/min (ANR))	100	130	230	290	480	420	660	920	1050	1390	
	Effective area (mm²)	1.5	2	3.5	4.5	7	6.5	10	14	16	21	

Note) Flow rate values are measured at 0.5 MPa and 20°C.

How to Order

AS 200 1F - 06 T -

Body size

100	M5 standard
200	1/8 standard
205	1/4 standard
300	3/8 standard
400	1/2 standard

With One-touch fittings

Tamper proof

Note) Speed controller requires a special tool for flow adjustment. Order separately with part number, AS-T-1.

Applicable tubing O.D.

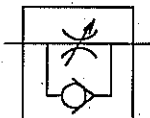
Metric size	Inch size
23	ø3.2"
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12
01	ø1/8"
03	ø5/32"
05	ø3/16"
07	ø1/4"
09	ø5/16"
11	ø3/8"
13	ø1/2"

* Use ø1/8" tube.

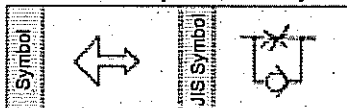
Made to Order

Refer to page 538 for details.

JIS Symbol



Flow Direction Symbols on Body



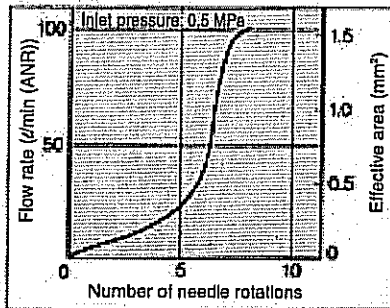
Made to Order
(Refer to page 538 for details.)

Caution

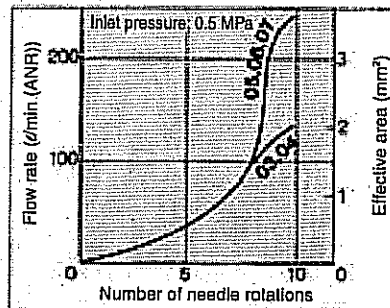
Be sure to read before handling.
Refer to front matters 58 and 59 for
Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

Needle Valve/Flow Characteristics

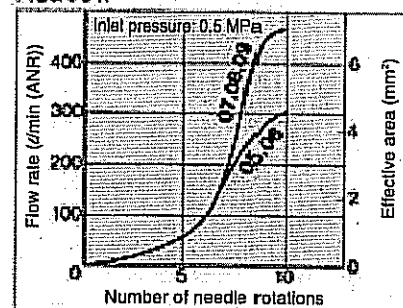
AS1001F



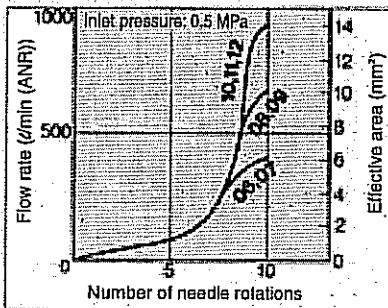
AS2001F



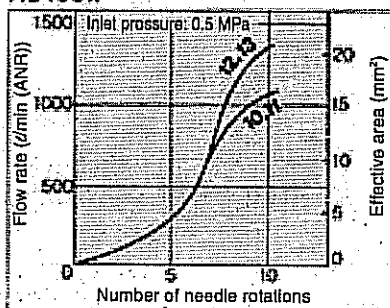
AS2051F



AS3001F

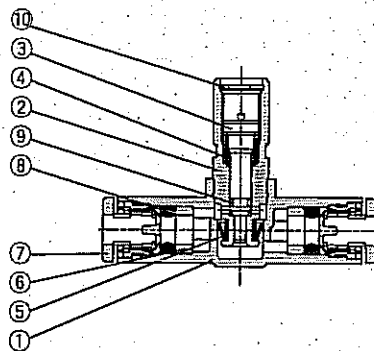


AS4001F

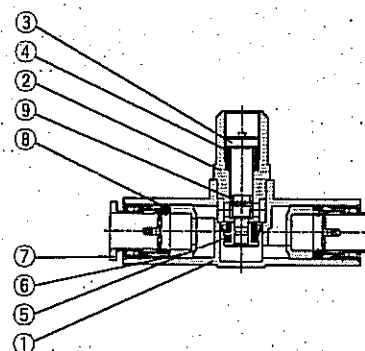


Construction

AS1001F



AS2001F to AS4001F



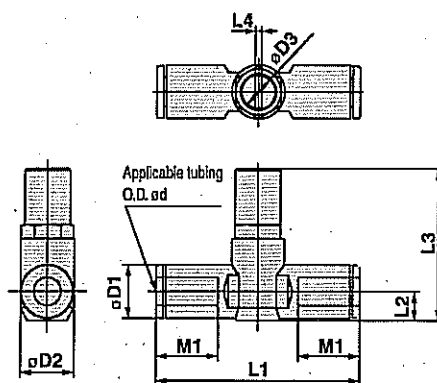
Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Spring	Steel wire	
5	U seal	HNBR	
6	Spacer	—	
7	Cassette	—	
8	Seal	NBR	
9	O-ring	NBR	
10	Retaining ring for hole type C	Tool steel	

AS
ASP
ASN
AQ
ASV
AK
VCNC
ASS
ASR
ASQ
KE
TMH

Series AS□□□1F-T

Dimensions



Metric Size

Model	d	D1	D2	D3	L1	L2	L3	L4	M1	Mass (g)
AS1001F-23T	3.2	8.4			38	4.5	26		12.7	8
AS1001F-04T	4	9.3	10	4.5	39.2	5.2	26.6	0.7	12.7	8
AS1001F-06T	6	11.6			40.7	6.2	27.7		13.5	10
AS2001F-04T	4	9.3			40.7	5.2	31.9		12.7	15
AS2001F-06T	6	11.6	11.8	7	44.8	6.3	33	1.5	13.5	10
AS2051F-06T	6	12.8			53.2	6.7	35.2		17	33
AS2051F-08T	8	15.2	14.8	7	58.8	8.1	38.5	1.5	18	36
AS3001F-06T	6	12.8			59	7.4	45		17	50
AS3001F-08T	8	15.2			64.4	8.2	45.8		18	60
AS3001F-10T	10	18.5	19.8	8.5	71.6	9.8	47.3	1.5	21	64
AS3001F-12T	12	20.9			76	11	48.5		22	68
AS4001F-10T	10	18.5	28.5	12	77.7	11.3	55.4	1.5	21	121
AS4001F-12T	12	20.9			82.1		56.4		22	125

Inch Size

Model	d	D1	D2	D3	L1	L2	L3	L4	M1	Mass (g)
AS1001F-01T	1/8"	8.4			38	4.5	26		12.7	8
AS1001F-03T	5/32"	9.3	10	4.5	39.2	5.2	26.6	0.7	12.7	8
AS1001F-05T	3/16"	11.4			40.7	6.2	27.7		13.5	14
AS1001F-07T	1/4"	12			40.7				13.7	11
AS2001F-03T	5/32"	9.3			40.7	5.2	31.9		12.7	15
AS2001F-05T	3/16"	11.4	11.8	7	50	6.2	32.8	1.5	18.5	21
AS2001F-07T	1/4"	13.2			52.2	7.1	33.7		17	19
AS2051F-06T	3/16"	11.4			52.2	6.2	34.9		18.5	35
AS2051F-08T	1/4"	13.2	14.8	7	54.4	7.1	35.7	1.5	17	33
AS2051F-09T	5/16"	15.2			59.8	8.1	36.7		18	36
AS3001F-07T	1/4"	13.2			59	7.4	45.2		17	50
AS3001F-09T	5/16"	15.2	19.8	8.5	64.4	8.2	46	1.5	18	60
AS3001F-11T	3/8"	17.8			70.8	9.5	47.2		21	72
AS4001F-11T	3/8"	17.9	26.5	12	76.9	10.3	55.5	1.5	21	129
AS4001F-13T	1/2"	21.7			83.1	11.6	58.9		22	142

Made to Order



Lubricant: Vaseline

X12

Ex.) AS1001F-23T-X12

Grease-free (Seal: Fluorine coated) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS1001F-23T-X21

Note 1) Not particle-free

Throttle Valve (Without Check Valve)

X214

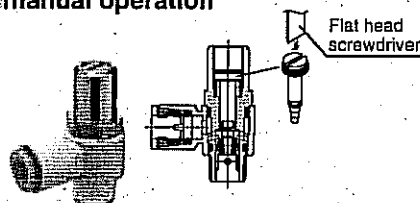
Ex.) AS1001F-23T-X214

Speed Controller Adjustable by Flat Head Screwdriver with One-touch Fitting Elbow Type/Universal Type

Series AS□□□1F-D

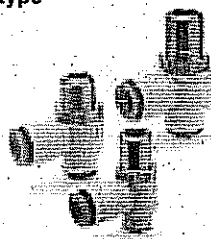
Flow adjustable
by flat head screwdriver

Prevention of an unnecessary
manual operation

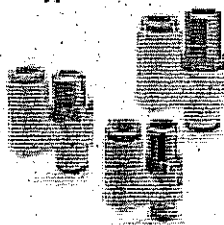


Flat head
screwdriver

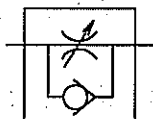
Elbow type



Universal type



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Model

Elbow type	Universal type	Port size	Applicable tubing O.D.														Applicable cylinder bore size (mm)
			Metric size							Inch size							
			3/2	4	6	8	10	12	1/8	5/32	3/16	1/4	5/16	3/8	1/2		
AS12□1F-M5	AS13□1F-M5	M5 x 0.8	●	●	●											6, 10, 16, 20	
AS22□1F-01	AS23□1F-01	R 1/8	●	●	●	●	●									20, 25, 32	
AS22□1F-02	AS23□1F-02	R 1/4		●	●	●	●									20, 25, 32, 40	
AS32□1F-02	AS33□1F-02	R 1/4			●	●	●	●								40, 50, 63	
AS32□1F-03	AS33□1F-03	R 3/8			●	●	●	●								40, 50, 63	
AS42□1F-04	AS43□1F-04	R 1/2					●	●								63, 80, 100	
AS12□1F-U10/32	AS13□1F-U10/32	10-32 UNF							●	●	●	●				6, 10, 16, 20	
AS22□1F-N01	AS23□1F-N01	NPT 1/8							●	●	●	●	●			20, 25, 32	
AS22□1F-N02	AS23□1F-N02	NPT 1/4								●	●	●	●	●		20, 25, 32, 40	
AS32□1F-N02	AS33□1F-N02	NPT 1/4									●	●	●	●		40, 50, 63	
AS32□1F-N03	AS33□1F-N03	NPT 3/8										●	●	●		40, 50, 63	
AS42□1F-N04	AS43□1F-N04	NPT 1/2												●	●	63, 80, 100	

Note 1) * Elbow type only

Note 2) Meter-out and meter-in types can be visually differentiated by the flow direction symbol on the resin body.

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽¹⁾)
Applicable tubing material ⁽²⁾	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS12□1F-M5 and AS12□1F-U10/32 types

In the case of AS13□1F-M5 and AS13□1F-U10/32 types

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.
(Refer to pages 371 and 372 for details.)

Note 3) Brass parts are all electroless nickel plated, provided as standard.

Flow Rate and Effective Area

Model		AS12□1F AS13□1F	AS22□1F-□01 AS23□1F-□01	AS22□1F-□02 AS23□1F-□02	AS32□1F AS33□1F			AS42□1F AS43□1F		
Tubing O.D.	Metric size	ø3.2, ø4, ø6	ø3.2, ø4 ø5, ø6, ø10	ø4 ø6 ø8, ø10	ø6 ø8 ø10, ø12	ø10 ø12				
	Inch size	ø1/8", ø5/32" ø3/16", ø1/4"	ø1/8", ø3/16", ø1/4", ø5/32", ø5/16"	ø3/32", ø3/16", ø1/4", ø5/16", ø3/8"	ø1/4", ø5/16", ø3/8"	ø3/8", ø1/2"				
Controlled flow (Free flow)	Flow rate (l/min (ANR))	100	180	230	260 390	460	660 780	920	1580	1710
	Effective area (mm²)	1.5	2.7	3.5	4 6	7	10 12	14	24	26

Note) Flow rate values are measured at 0.5 MPa and 20°C.

Made to Order
(Refer to page 513 for details.)

How to Order

AS 2 2 1 1 F - 01 - 06 S D -

Body size

1	M5 standard
2	1/8, 1/4 standard
3	3/8 standard
4	1/2 standard

Type

2	Elbow
3	Universal

Control

0	Meter-out
1	Meter-in

Port size

M5	M5 x 0.8
01	R 1/8
02	R 1/4
03	R 3/8
04	R 1/2
U10/32	10-32 UNF
N01	NPT 1/8
N02	NPT 1/4
N03	NPT 3/8
N04	NPT 1/2

Applicable tubing O.D.

Metric size	Inch size
23	ø3.2 *
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12

With seal
Note) In the case that port size is either M5 or 10-32 UNF thread, it is not available with seal. Gasket is provided as standard.

Type adjustable by flat head screwdriver

Made to Order
Refer to the below for details.

With One-touch fitting

Made to Order



Lubricant: Vaseline X12

Ex.) AS1201F-M5-23D-X12

Grease-free (Seal: Fluorine Coating) + Throttle Valve (Without Check Valve) X21

Ex.) AS1201F-M5-23D-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

Throttle Valve (Without Check Valve) X214

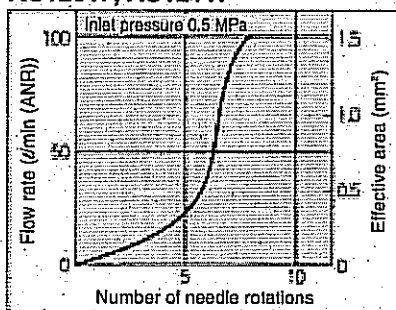
Ex.) AS1201F-M5-23D-X214

Note) Throttle valve is only compatible with the part no. of the meter-out type.

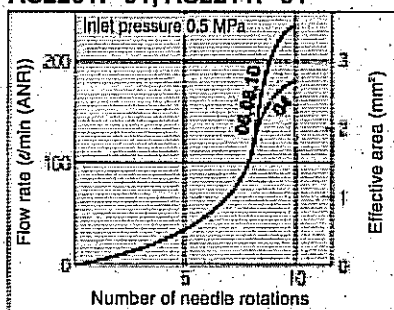
AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Needle Valve/Flow Characteristics

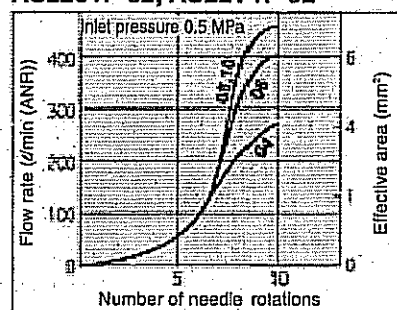
AS1201F, AS1211F



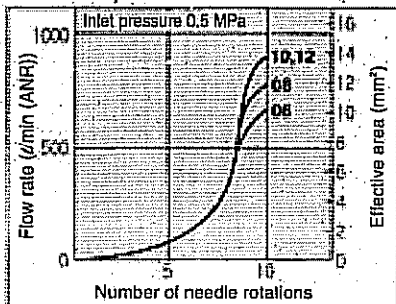
AS2201F-01, AS2211F-01



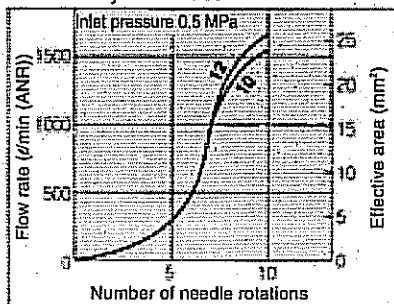
AS2201F-02, AS2211F-02



AS3201F, AS3211F



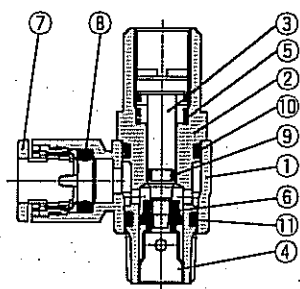
AS4201F, AS4211F



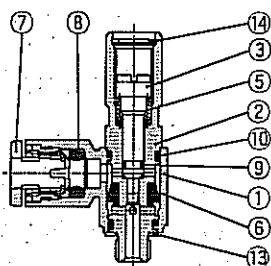
Series AS□□□1F-D

Construction

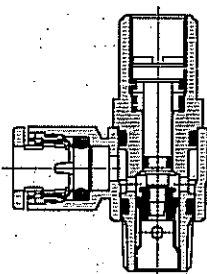
Elbow type
Meter-out type



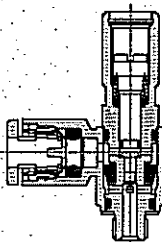
M5 type
U10/32 type



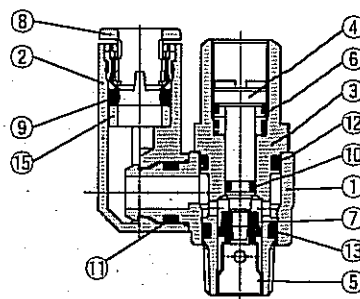
Meter-in type



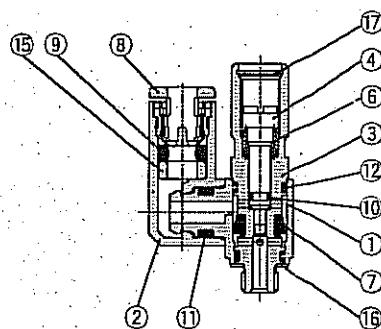
M5 type
U10/32 type



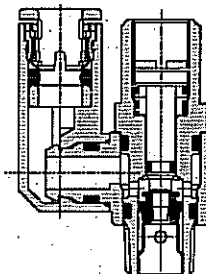
Universal type
Meter-out type



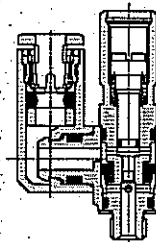
M5 type
U10/32 type



Meter-in type



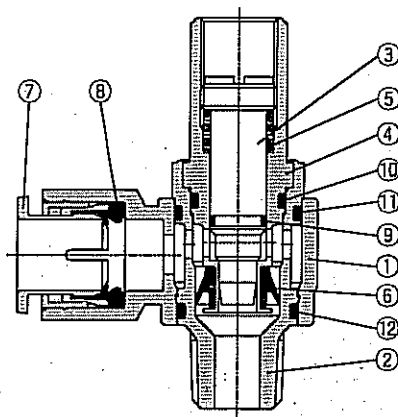
M5 type
U10/32 type



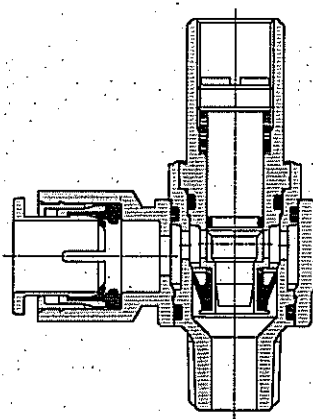
Construction

Elbow type

Meter-out AS3201F-02



Meter-in AS3211F-02

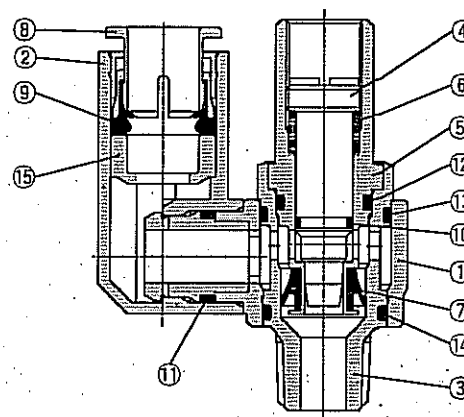


Component Parts

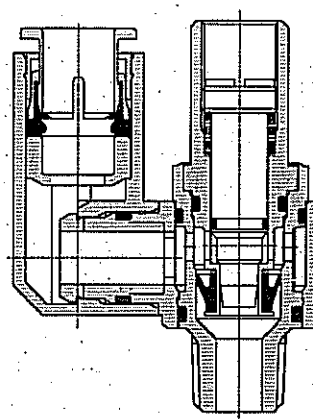
No.	Description	Material	Note
1	Body A	PBT	
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Seat ring	Brass	Electroless nickel plated
5	Spring	Steel wire	
6	U seal	HNBR	
7	Cassette	—	
8	Seal	NBR	
9	O-ring	NBR	
10	O-ring	NBR	
11	O-ring	NBR	
12	O-ring	POM	
13	Gasket	NBR, Stainless steel	
14	Retaining ring for hole type C	Tool steel	

Universal type

Meter-out AS3301F-02



Meter-in AS3311F-02



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Elbow body	PBT	
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Seat ring	Brass	Electroless nickel plated
6	Spring	Steel wire	
7	U seal	HNBR	
8	Cassette	—	
9	Seal	NBR	
10	O-ring	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	Spacer	—	
16	Gasket	NBR, Stainless steel	
17	Retaining ring for hole type C	Tool steel	

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

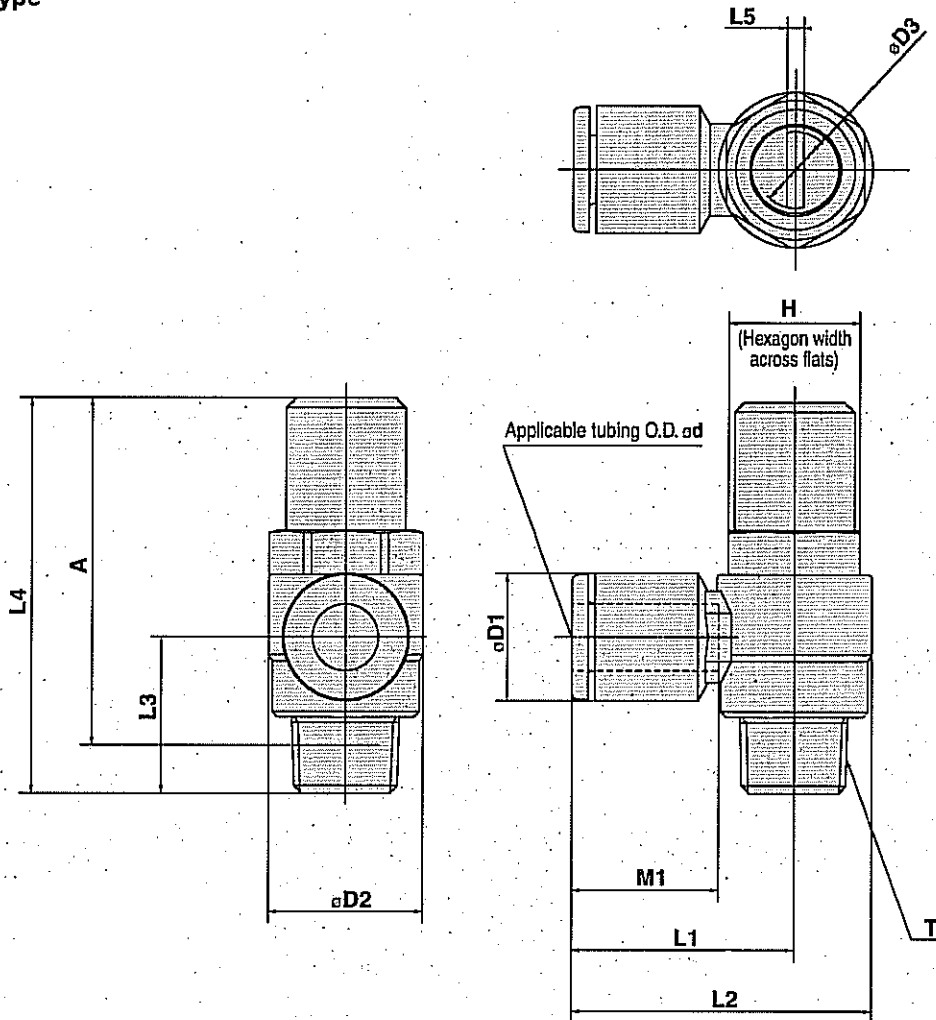
KE

TMH

Series AS□□□1F-D

Dimensions

Elbow type



Metric Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5	A*	M1	Mass (g)
AS12□1F-M5-23D	3.2			8.4			17.3	22.1	12.3	31	0.7	27.4	12.7	10
AS12□1F-M5-04D	4	M5 x 0.8	8	9.3	9.6	4.7	17.3	22.1	12.3	31	0.7	27.4	12.7	10
AS12□1F-M5-06D	6			11.8			18.1	22.9	11.7				13.5	20
AS22□1F-01-23SD	9.2			8.4			20.4	27.5		13.4	34.7	1.2	31.6	21
AS22□1F-01-04SD	4			9.3			20.4	27.5		13.4	34.7	1.2	31.6	21
AS22□1F-01-06SD	6	R 1/8	12	11.6	14.2	7.2	25.3	32.4					18.5	23
AS22□1F-01-08SD	8			15.2			25.3	32.4					18.5	23
AS22□1F-01-10SD	10			18.5			32.3	44.5	14.1				21	25
AS22□1F-02-04SD	4			10.4			25.2	34.4		17.7	40.2	1.2	34.7	17
AS22□1F-02-06SD	6			12.8	18.5	7.2	27.2	36.4					18.5	42
AS22□1F-02-08SD	8	R 1/4	17	15.2			27.2	36.4					18.5	42
AS22□1F-02-10SD	10			18.5			35.3	44.5	19.5				21	44
AS32□1F-02-06SD	6			12.8			27.8	39.3					17	73
AS32□1F-02-08SD	8			15.2	23	9.8	29.5	41		21.3	54.8	1.2	49.3	78
AS32□1F-02-10SD	10	R 3/4	19	18.5			31.8	43.3					21	80
AS32□1F-02-12SD	12			20.9			32.8	44.3					22	82
AS32□1F-03-06SD	6			12.8			27.8	39.3					17	77
AS32□1F-03-08SD	8	R 3/8	19	15.2	23	9.8	29.5	41		19.8	52.6	1.2	47.4	79
AS32□1F-03-10SD	10			18.5			31.8	43.3					21	81
AS32□1F-03-12SD	12			20.9			32.8	44.3					22	83
AS42□1F-04-10SD	10			18.5	28.6	12.4	33.6	47.9					21	141
AS42□1F-04-12SD	12	R 1/2	24	20.9			34.6	48.9		24.5	62.9	1.2	53.8	142

* Reference dimensions of M5 x 0.8, R threads after installation.

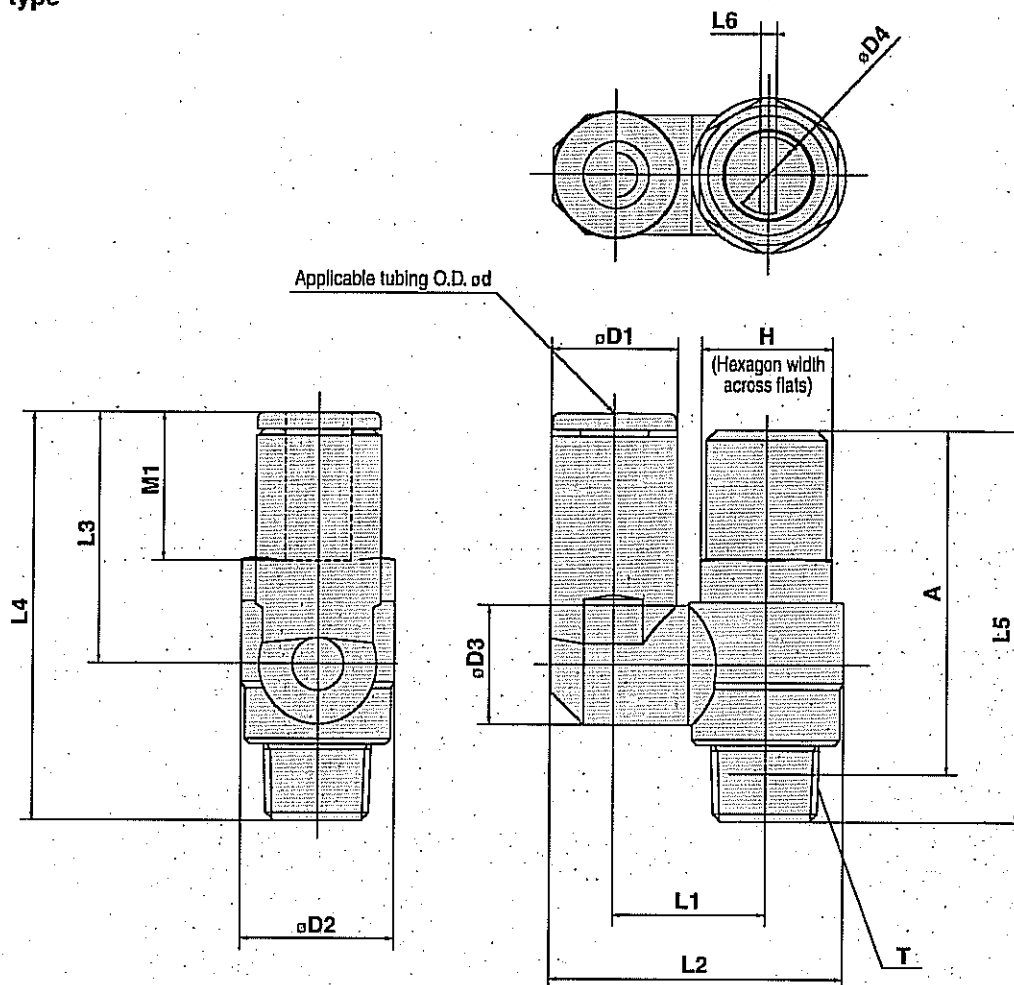
Inch Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5	A*	M1	Mass (g)
AS12□1F-U10-2-01D	1/8"			8.4			17.3	22.1	12.3	31	0.7	27.4	12.7	10
AS12□1F-U10-2-03D	3/32"	10-32 UNF	8	9.3	9.6	4.7	17.3	22.1	12.3	31	0.7	27.4	12.7	10
AS12□1F-U10-2-05D	3/16"			11.4			21.3	26.1					16.5	20
AS12□1F-U10-2-07D	1/4"			12			18.3	23.1	11.7				13.5	20
AS22□1F-N01-01SD	1/8"			8.4			20.4	27.5					12.7	21
AS22□1F-N01-03SD	3/32"	NPT 1/8	12.7	9.3			24	31.1	13.4	34.7	1.2	31.6	16.5	21
AS22□1F-N01-05SD	3/16"			11.4			21.3	26.1					16.5	23
AS22□1F-N01-07SD	1/4"			12			18.3	23.1	11.7				13.5	25
AS22□1F-N02-03SD	3/32"			10.4			25.2	34.4					16	40
AS22□1F-N02-05SD	3/16"			12.8			25.2	34.4					17	40
AS22□1F-N02-07SD	1/4"	NPT 1/4	17.5	13.2	18.5	7.2	25.2	34.5	17.7	40.2	1.2	34.7	18.5	42
AS22□1F-N02-09SD	5/16"			15.2			27.2	36.4					21	44
AS22□1F-N02-11SD	3/8"			18.3			35.3	44.5	19.5				21	44
AS32□1F-N02-07SD	1/4"			13.2			27.8	39.3					17	73
AS32□1F-N02-09SD	5/16"	NPT 1/4	19	15.2	23	9.8	29.5	41		21.3	54.8	1.2	49.3	78
AS32□1F-N02-11SD	3/8"			17.9			31.8	43.3					21	80
AS32□1F-N03-07SD	1/4"			13.2			27.8	39.3					17	77
AS32□1F-N03-09SD	5/16"	NPT 3/8	19	15.2	23	9.8	29.5	41		19.8	52.6	1.2	47.4	79
AS32□1F-N03-11SD	3/8"			17.9			31.8	43.3					21	81
AS42□1F-N04-11SD	3/8"			17.9			33.6	47.9					21	141
AS42□1F-N04-13SD	1/2"	NPT 1/2	23.8	20.9	28.6	12.4	34.6	48.9		24.5	62.9	1.2	53.8	142

* Reference dimensions of 10-32 UNF and NPT threads after installation.

Dimensions

Universal type



Metric Size

Model	d	T	H	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	A*	M1	Mass (g)
AS13□1F-M5-23D	3.2			6.4				19.8								10
AS13□1F-M5-04D	4	M5 x 0.8	0	9.3	9.3	9.3	4.7	10.8	20.3	17.5	28.7	31	0.7	27.4	12.7	10
AS13□1F-M5-06D	6			11.6				21.4	20.6	31.8					13.5	
AS23□1F-01-23SD	3.2			6.4				13.1	24.4	17.5	30.9				12.7	21
AS23□1F-01-04SD	4			9.3				14	24.9						13.5	
AS23□1F-01-06SD	6	R 1/8	12	11.6	14.2	10.9	7.2	14	26.9	22.9	36.3	34.7	1.2	31.6	18.5	22
AS23□1F-01-08SD	8			15.2		12.9		18.2	30.9	28.2	49.8				18.5	25
AS23□1F-02-04SD	4			10.4		10.9		19.2	30.6	21.9	39.6				16	40
AS23□1F-02-06SD	6			12.8				18.4	34	25.2	42.1				17	41
AS23□1F-02-08SD	8	R 1/4	17	15.2	19.5	12.9	7.2	18.3	35.2	28.2	45.1	40.2	1.2	34.7	18.5	44
AS23□1F-02-10SD	10			18.5				20.2	38.7	31	47.9				21	48
AS33□1F-02-06SD	6			12.8		12.9		20.6	38.5	25.2	46.5				17	73
AS33□1F-02-08SD	8			15.2				30.7	39.7	28.2	49.5				18.5	76
AS33□1F-02-10SD	10	R 1/4	19	18.5	23	9.8		43.7	32.6	53.9		34.8	1.2	49.3	21	80
AS33□1F-02-12SD	12			20.9		16.2		44.9	34.4	55.7					22	82
AS33□1F-03-06SD	6			12.8		12.9		20.6	38.5	25.2	45				17	78
AS33□1F-03-08SD	8			15.2				30.7	39.7	28.2	48				18.5	81
AS33□1F-03-10SD	10	R 3/8	19	18.5	23	9.8		43.7	32.6	52.4		52.6	1.2	47.4	21	85
AS33□1F-03-12SD	12			20.9		16.2		44.9	34.4	54.2					22	87
AS43□1F-04-10SD	10			18.5		16.2		25.6	46.4	32.6	57.1				21	145
AS43□1F-04-12SD	12	R 1/2	24	20.9	28.6	18.4	12.4	26.8	52	36.3	60.8	62.9	1.2	55.9	22	147

* Reference dimensions of M5 x 0.8, R threads after installation.

Inch Size

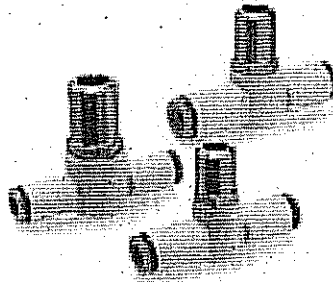
Model	d	T	H	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	A*	M1	Mass (g)
AS13□1F-0102-01D 1/8"				6.4				19.8								10
AS13□1F-0102-03D 5/32"	10-32 UNF	0		9.3	9.3	9.3	4.7	10.8	20.3	17.5	28.7	31	0.7	27.4	12.7	10
AS13□1F-0102-05D 3/16"				11.4				21.3	23.3	34.5					16.5	
AS13□1F-0102-07D 1/4"				12				21.8	20.7	31.9					13.7	11
AS23□1F-0102-01D 1/8"				6.4				13.1	24.4	17.5	30.9				12.7	21
AS23□1F-0102-03D 5/32"				9.3				14	24.9						13.5	
AS23□1F-0102-05D 3/16"				11.4				18.2	30.9	28.2	49.8				18.5	25
AS23□1F-0102-07D 1/4"	NPT 1/8	12.7	14	10.9	7.2	14	26.9	21.9	37.3	34.7	1.2	31.6	16.5			
AS23□1F-0102-09D 5/16"				13.2		12.9		16.2	28.9	25.6	38.2				18.5	23
AS23□1F-0102-11SD 3/8"				15.2				18.3	35.2	28.2	45.1	40.2	1.2	34.7	21	25
AS23□1F-0202-03SD 5/32"				10.4				16.2	30.6	21.9	39.6				16	40
AS23□1F-0202-05SD 3/16"				11.4		10.9		18.3	31.1	23.9	41.6				17	41
AS23□1F-0202-07SD 1/4"	NPT 1/4	17.5	13.2	19	7.2			18.3	34.2	25.6	42.5	40.2	1.2	34.7	18.5	44
AS23□1F-0202-09SD 5/16"				15.2		12.9		18.3	35.2	28.2	45.1				21	47
AS23□1F-0202-11SD 3/8"				17.9				20.2	38.7	31	47.9				21	48
AS33□1F-0202-03SD 5/32"				13.2		12.9		20.6	38.5	25.2	46.5				17	73
AS33□1F-0202-05SD 3/16"				15.2				30.7	39.7	28.2	49.5				18.5	76
AS33□1F-0202-07SD 1/4"	NPT 1/4	19	15.2	23	9.8			43.7	32.6	53.9		34.8	1.2	49.3	21	80
AS33□1F-0202-09SD 5/16"				17.9		16.2		44.9	34.4	55.7					22	82
AS33□1F-0302-03SD 5/32"				13.2		12.9		20.6	38.5	25.2	45				17	78
AS33□1F-0302-05SD 3/16"				15.2				30.7	39.7	28.2	48				18.5	81
AS33□1F-0302-07SD 1/4"	NPT 3/8	19	15.2	23	12.9	9.8		43.7	32.6	52.4		52.6	1.2	47.4	21	85
AS33□1F-0302-09SD 5/16"				17.9		16.2		44.9	34.4	54.2					22	87
AS43□1F-0402-11SD 3/8"				17.9				25.6	46.4	32.6	57.1				21	145
AS43□1F-0402-13SD 1/2"	NPT 1/2	23.8	21.7	29	18.4	12.4		26.8	52	36.3	60.8	62.9	1.2	55.9	22	147

* Reference dimensions of 10-32 UNF and NPT threads after installation.

AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Speed Controller Adjustable by Flat Head Screwdriver with One-touch Fittings In-line Type

Series AS□□□1F-D



Model

Model	Applicable tubing O.D.													Applicable cylinder bore size (mm)
	Metric size						Inch size							
	3.2	4	6	8	10	12	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"	
AS1001F	●	●	●				●	●	●	●				6, 10, 16, 20
AS2001F		●	●					●	●	●				20, 25, 32
AS2051F			●	●					●	●	●			20, 25, 32, 40
AS3001F			●	●	●	●				●	●	●		40, 50, 63
AS4001F					●	●						●	●	63, 80, 100

Specifications

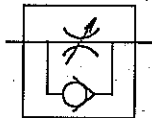
Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns (1))
Applicable tubing material (2)	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS1001F type

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.
(Refer to pages 371 and 372 for details.)

Note 3) Brass parts are all electroless nickel plated.

JIS Symbol



Flow Direction Symbols on Body



Made to Order
(Refer to page 521 for details.)

Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for
Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

Flow Rate and Effective Area

Model		AS1001F		AS2001F		AS2051F		AS3001F			AS4001F	
Tubing O.D.	Metric size	3.2, 4, 6	4	6	6	8	6	8	10, 12	10	12	
	Inch size	1/8", 5/32" 3/16", 1/4"	5/32"	3/16", 1/4"	3/16"	1/4", 5/16"	1/4"	5/16"	3/8"	3/8"	1/2"	
Controlled flow (Free flow)	Flow rate (l/min (ANR))	100	130	230	290	460	420	660	920	1050	1390	
	Effective area (mm²)	1.5	2	3.5	4.5	7	6.5	10	14	16	21	

Note) Flow rate values are measured at 0.5 MPa and 20°C

How to Order

AS 200 1F — 06 D —

Body size

100	M5 standard
200	1/8 standard
205	1/4 standard
300	3/8 standard
400	1/2 standard

With One-touch fittings

Type adjustable
by flat head screwdriver

Made to Order
Refer to page 521 for details.

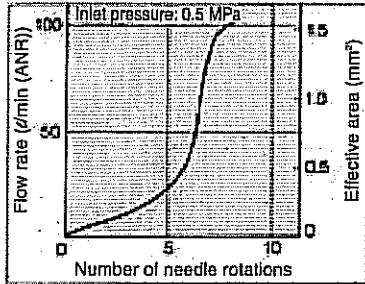
Applicable tubing O.D.

Metric size	Inch size
23	3/32"
04	1/8"
05	5/32"
08	3/16"
10	1/4"
12	5/16"
07	3/8"
09	1/2"
11	5/8"
13	3/4"

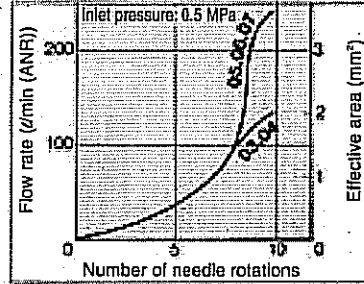
* Use 1/8" tube.

Needle Valve/Flow Characteristics

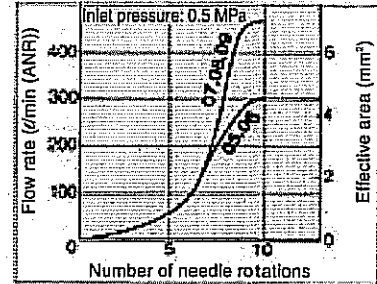
AS1001F



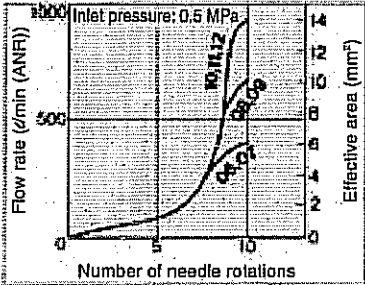
AS2001F



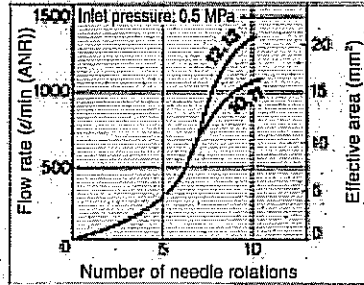
AS2051F



AS3001F

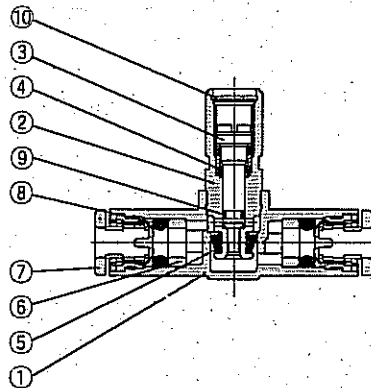


AS4001F

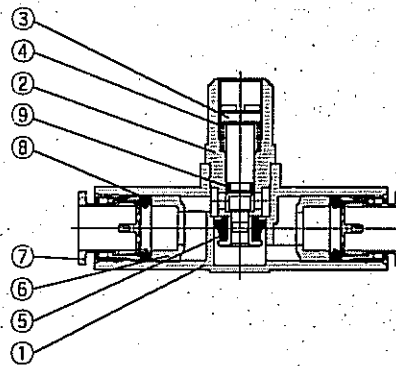


Construction

AS1001F



AS2001F to AS4001F



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Spring	Steel wire	
5	U seal	HNBR	
6	Spacer	—	
7	Cassette	—	
8	Seal	NBR	
9	O-ring	NBR	
10	Retaining ring for hole type C	Tool steel	

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

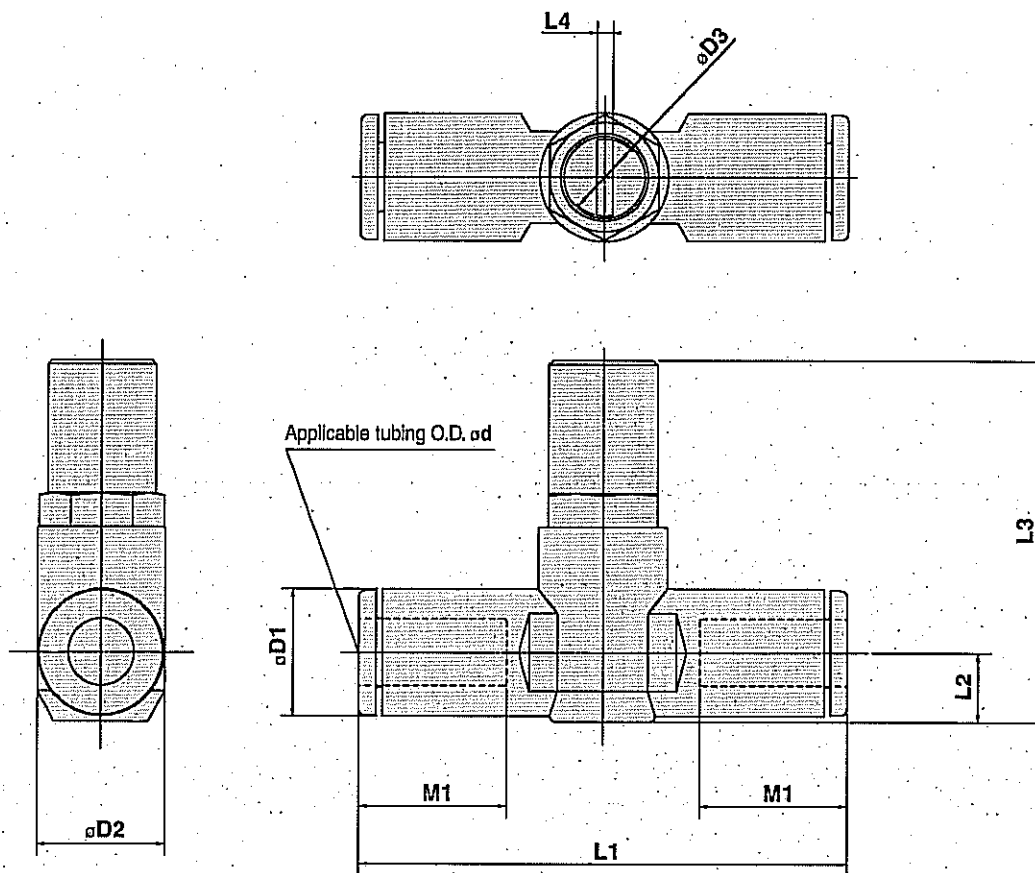
ASQ

KE

TMH

Series AS□□□1F-D

Dimensions



Metric Size

Model	d	D1	D2	D3	L1	L2	L3	L4	M1	Mass (g)
AS1001F-23D	3.2	8.4			38	4.5	26		8	
AS1001F-04D	4	9.3	10	4.7	39.2	5.2	26.6	0.7	12.7	9
AS1001F-06D	6	11.6			40.7	6.2	27.7		13.5	10
AS2001F-04D	4	9.3			40.7	5.2	31.9	1.2	12.7	15
AS2001F-06D	6	11.6	11.6	7.2	44.8	6.3	33	1.2	13.5	16
AS2051F-06D	6	12.8			53.2	6.7	35.2	1.2	17	33
AS2051F-08D	8	15.2	14.8	7.2	59.8	8.1	36.5	1.2	18	36
AS3001F-06D	6	12.8			59	7.4	45		17	58
AS3001F-08D	8	15.2			64.4	8.2	45.8		18	60
AS3001F-10D	10	18.5	19.8	9.8	71.6	9.8	47.3	1.2	21	64
AS3001F-12D	12	20.9			78	11	48.5		22	68
AS4001F-10D	10	18.5			77.7	11.3	55.4	1.2	21	121
AS4001F-12D	12	20.9	26.5	12.4	82.1		56.4		22	125

Inch Size

Model	d	D1	D2	D3	L1	L2	L3	L4	M1	Mass (g)
AS1001F-01D	1/8"	8.4			38	4.5	26		8	
AS1001F-03D	5/32"	9.3	10	4.7	39.2	5.2	26.6	0.7	12.7	9
AS1001F-05D	3/16"	11.4			48.7	6.2	27.7		16.5	14
AS1001F-07D	1/4"	12			40.7				13.7	11
AS2001F-03D	5/32"	9.3			40.7	5.2	31.9		12.7	15
AS2001F-05D	3/16"	11.4	11.6	7.2	50	6.2	32.8	1.2	16.5	21
AS2001F-07D	1/4"	13.2			52.2	7.1	33.7		17	19
AS2051F-05D	3/16"	11.4			52.2	6.2	34.9		16.5	35
AS2051F-07D	1/4"	13.2	14.8	7.2	54.4	7.1	35.7	1.2	17	33
AS2051F-09D	5/16"	15.2			59.8	8.1	36.7		18	30
AS3001F-07D	1/4"	13.2			59	7.4	45.2		17	58
AS3001F-09D	5/16"	15.2	19.8	9.8	64.4	8.2	46	1.2	18	60
AS3001F-11D	3/8"	17.9			70.8	9.5	47.2		21	72
AS4001F-11D	3/8"	17.9			78.9	10.3	55.5		21	129
AS4001F-13D	1/2"	21.7	26.5	12.4	83.1	11.6	56.9	1.2	22	142

Series **AS** ☐ ☐ ☐ **1F-D**

Made to Order Specifications

Please contact SMC for detailed dimensions, specifications and delivery.



Lubricant: Vaseline

X12

Ex.) AS1001F-23D-X12

Grease-free (Seal: Fluorine coated) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS1001F-23D-X21

Note 1) Not particle-free

Throttle Valve (Without Check Valve)

X214

Ex.) AS1001F-23D-X214

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR
ASQ

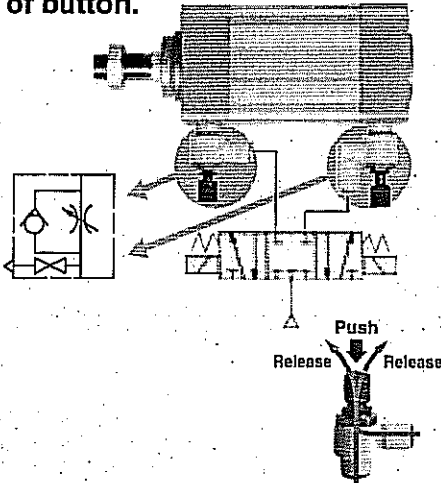
KE

TMH

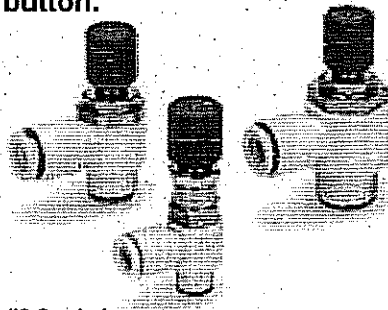
Speed Controller with Residual Pressure Release Valve with One-touch Fitting

Series AS□□□□FE

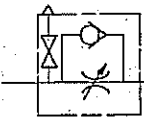
Residual pressure can be easily released with one push of button.



Eye-catching red color release button.



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		



Made to Order
(Refer to page 465 for details.)

Model

Elbow type	Universal type	Port size in the cylinder side	Applicable tubing O.D. (mm)					Applicable cylinder bore size (mm)
			ø4	ø6	ø8	ø10	ø12	
AS22□1FE-01	AS23□1FE-01	R 1/8	●	●	●	● ⁽¹⁾	20, 25, 32	
AS22□1FE-02	AS23□1FE-02	R 1/4	●	●	●	●	20, 25, 32, 40	
AS32□1FE-03	AS33□1FE-03	R 3/8		●	●	●	40, 50, 63	
AS42□1FE-04	AS43□1FE-04	R 1/2				●	63, 80, 100	

Note 1) Elbow type only

Note 2) Distinction between meter-out/meter-in types by appearance

Those are distinguished by the lock nut. The meter-out type is electroless nickel plated, while the meter-in type is black zinc chromate plated.

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1.0 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns
Effective area of residual exhaust valve	0.8 mm ²
Applicable tubing material	Nylon, Soft nylon, Polyurethane

Flow Rate and Effective Area

Model		AS22□1FE-01 AS23□1FE-01		AS22□1FE-02 AS23□1FE-02		AS32□1FE AS33□1FE		AS42□1FE AS43□1FE			
Tubing O.D.	Metric size	ø4	ø6 ø8 ø10	ø4	ø6 ø8 ø10	ø6	ø8 ø10 ø12	ø10	ø12		
Controlled flow (Free flow)	Flow rate (2/min (ANR))	180	230	260	390	460	660	790	920	1580	1710
	Effective area (mm²)	2.7	3.5	4	6	7	10	12	14	24	26

Note) Flow rate values are measured at 0.5 MPa and 20°C.

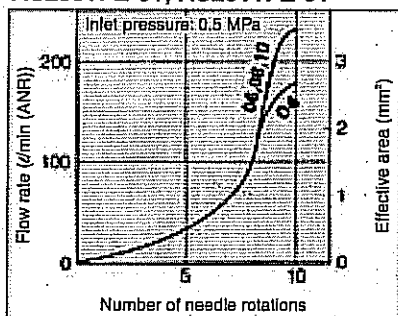
How to Order

AS 2 2 1 1 FE - 01 - 06 SK -

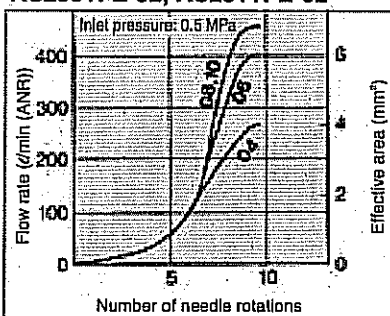
- Body size**
 - 2: 1/8, 1/4 standard
 - 3: 3/8 standard
 - 4: 1/2 standard
- Type**
 - 2: Elbow
 - 3: Universal
- Control type**
 - 0: Meter-out
 - 1: Meter-in
- Port size**
 - 01: R 1/8
 - 02: R 1/4
 - 03: R 3/8
 - 04: R 1/2
- Applicable tubing O.D. (mm)**
 - 04: ø4
 - 06: ø6
 - 08: ø8
 - 10: ø10
 - 12: ø12
- Hexagonal lock nut**
- With seal**
- With residual pressure release valve**
- With One-touch fitting**
- Made to Order**
(Refer to page 465 for details.)

Needle Valve/Flow Characteristics

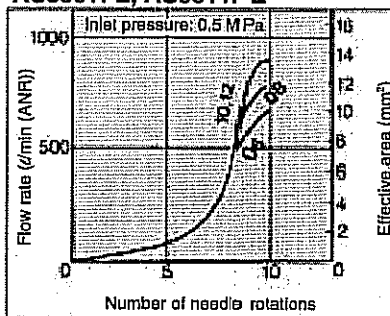
AS2201FE-01, AS2211FE-01
AS2301FE-01, AS2311FE-01



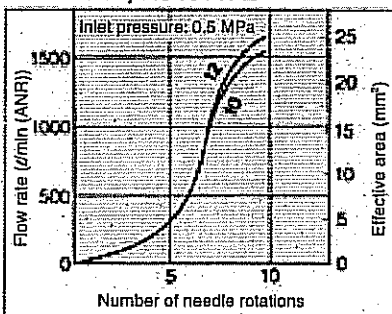
AS2201FE-02, AS2211FE-02
AS2301FE-02, AS2311FE-02



AS3201FE, AS3211FE
AS3301FE, AS3311FE



AS4201FE, AS4211FE
AS4301FE, AS4311FE



⚠ Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

Made to Order

Made to Order

Lubricant: Vaseline

X12

Ex.) AS2201FE-01-04SK-X12

Grease-free (Seal: Fluorine Coating) +
Throttle Valve (Without Check Valve)

X21

Ex.) AS2201FE-01-04SK-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

Throttle Valve (Without Check Valve)

X214

Ex.) AS2201FE-01-04SK-X214

Note) Throttle valve is only compatible with the part no. of the meter-out type.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

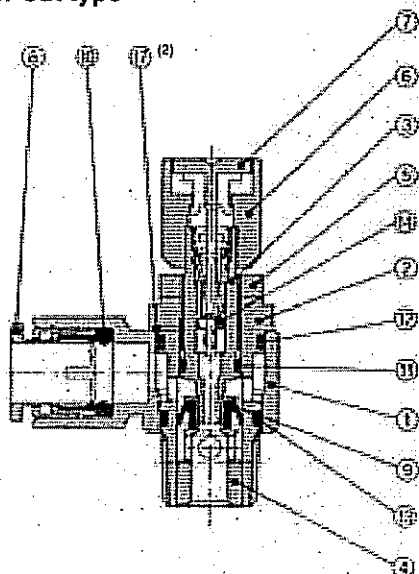
ASQ

KE

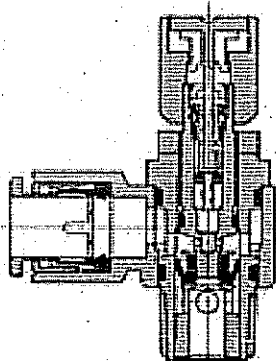
TMH

Construction

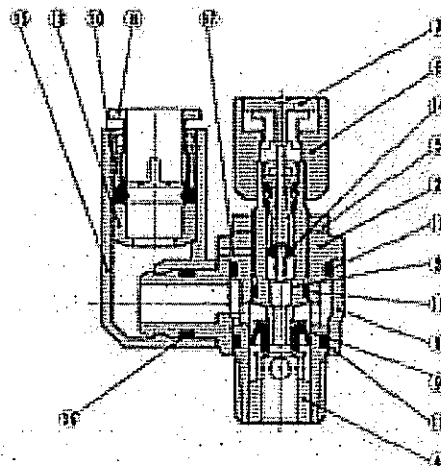
**Elbow type
Meter-out type**



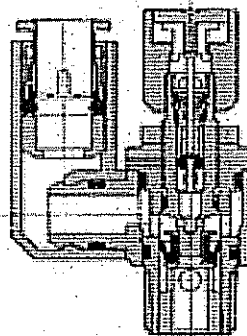
Meter-in type



**Universal type
Meter-out type**



Meter-in type



Component Parts

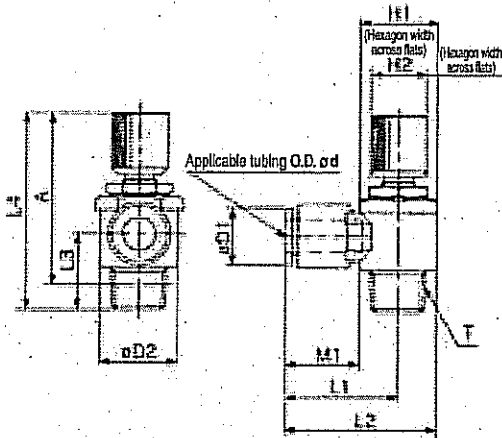
No.	Description	Material	Note
1	Body A	PBT	White
2	Body B	Brass	Electroless nickel plated
3	Needle	Brass	Electroless nickel plated
4	Seat ring	Brass	(1)
5	Lock nut	Brass	Electroless nickel plated (2)
6	Handle	Aluminum alloy	Red painted
7	Push button	POM	Red
8	Cassette	—	
9	U seal	HNBR	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	Valve core	—	
15	Elbow body	PBT	
16	O-ring	NBR	
17	Accidental release prevention screw	Stainless steel	AS2□□1FE-01 (3)
18	Spacer	—	

Note 1) AS2□□1FE type is electroless nickel plated. Note 3) Only for AS2□□1FE-01.
 Note 2) Meter-in type is black zinc chromate plated.

Speed Controller with Residual Pressure Release Valve with One-touch Fitting **Series AS□□□□FE**

Dimensions

Elbow type



Model	Tubing O.D. φd	T	H1	H2	D1	D2	L1	L2	L3	L4 (1)		A (2)		M1	Mass (g)
										Max.	Min.	Max.	Min.		
AS22□IFE-01-04SK	4	R 1/8	12	12	9.3		20.4	27.5						12.7	26
AS22□IFE-01-06SK	6				11.6	14.2	20.4	27.5	13.4	53	48	49.9	44.9	13.5	27
AS22□IFE-01-08SK	8				15.2		25.3	32.4						18.5	29
AS22□IFE-01-10SK	10				18.5		33.1	40.2	14.1					21	31
AS22□IFE-02-04SK	4	R 1/4	17	14	10.4		25.2	34.4						16	36
AS22□IFE-02-06SK	6				12.8	18.5	25.2	34.4	17.7	51.7	46.7	46.2	41.2	17	37
AS22□IFE-02-08SK	8				15.2		27.2	36.4						18.5	39
AS22□IFE-02-10SK	10				18.5		35.3	44.5	19.5					21	42
AS32□IFE-03-06SK	6	R 3/8	19	14	12.8		27.8	39.3						16	57
AS32□IFE-03-08SK	8				15.2	23	20.5	41	19.8	56.7	51.7	51.5	46.5	18.5	60
AS32□IFE-03-10SK	10				18.5		31.8	43.3						21	62
AS32□IFE-03-12SK	12				20.9		32.8	44.3						22	64
AS42□IFE-04-10SK	10	R 1/2	24	17	18.5	28.6	33.5	47.9	24.5	63.8	58.8	56.5	51.5	21	103
AS42□IFE-04-12SK	12				20.9		34.6	48.9						22	105

Note 1) Reference dimensions

Note 2) Reference dimensions of R thread after installation.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

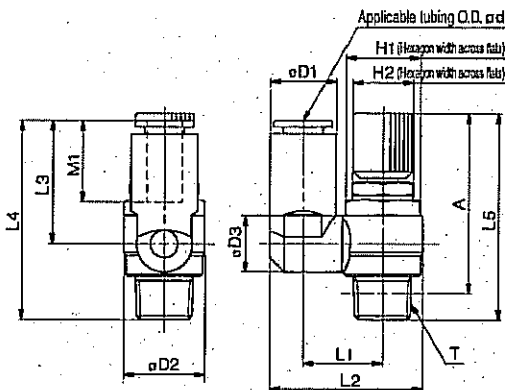
ASQ

KE

TMH

Dimensions

Universal type



Model	Tubing O.D. φd	T	H1	H2	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A (2)		M1	Mass (g)
												Max.	Min.	Max.	Min.		
AS23□IFE-01-04SK	4	R 1/8	12	12	9.3		9.3	13.1	24.9	17.5	30.9					12.7	26
AS23□IFE-01-06SK	6				11.6	14.2	10.9	14	26.9	22.9	36.3	53	48	49.9	44.9	13.5	27
AS23□IFE-01-08SK	8				15.2		12.9	16.2	30.9	28.2	40.8					18.5	29
AS23□IFE-02-04SK	4	R 1/4	14	14	10.4		10.9	16.2	30.6	21.9	39.6					16	36
AS23□IFE-02-06SK	6				12.8	18.5		18.4	34	25.2	42.1	51.7	46.7	46.2	41.2	17	37
AS23□IFE-02-08SK	8				15.2		12.9	18.3	35.2	28.2	45.1					18.5	39
AS23□IFE-02-10SK	10				18.5			20.2	38.7	31	47.9					21	42
AS33□IFE-03-06SK	6	R 3/8	19	14	12.8		12.9	20.6	38.5	25.2	45					17	57
AS33□IFE-03-08SK	8				15.2	23		39.7	28.2	48	56.7	51.7	51.5	46.5		18.5	60
AS33□IFE-03-10SK	10				18.5			43.7	32.6	52.4						21	62
AS33□IFE-03-12SK	12				20.9		16.2	23	44.9	34.4	54.2					22	64
AS43□IFE-04-10SK	10	R 1/2	24	17	18.5	28.6	16.2	25.8	48.4	32.6	57.1	63.8	58.8	56.5	51.5	21	103
AS43□IFE-04-12SK	12				21.7		18.4	26.8	52	36.3	60.8					22	105

Note 1) Reference dimensions

Note 2) Reference dimensions of R thread after installation.

Speed Controller with One-touch Fitting Stainless Steel Series Elbow Type/Universal Type Series AS-FG

Stainless specifications for use in corrosive environments. Stainless steel 303 used for metal parts.

Suitable for use on CRT lines where copper ions can cause damage, for washing food processing equipment where there is exposure to water and salt water, etc., and in clean rooms where dust from discoloration and rusting of copper materials is unacceptable.

Light colors to match equipment

White resin parts are used for bodies and release buttons.

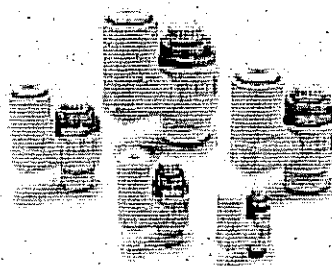
Threads with and without seal are available as standard.

Applicable tubing: Inch sizes standardized

Inch sizes are now available for all models.

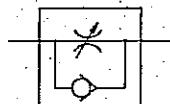


Elbow type



Universal type

JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Model

Elbow type	Universal type	Port size	Applicable tubing O.D.												Applicable cylinder bore size (mm)	
			Metric size						Inch size							
			3.2	4	6	8	10	12	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"		1/2"
AS12□1FG-M5	AS13□1FG-M5	M5 x 0.8	●	●	●											6, 10, 16, 20
AS22□1FG-01	AS23□1FG-01	R 1/8	●	●	●	●	●	*								20, 25, 32
AS22□1FG-02	AS23□1FG-02	R 1/4		●	●	●	●									20, 25, 32, 40
AS32□1FG-02	AS33□1FG-02	R 1/4			●	●	●	●								40, 50, 63
AS32□1FG-03	AS33□1FG-03	R 3/8			●	●	●	●								40, 50, 63
AS42□1FG-04	AS43□1FG-04	R 1/2					●	●								63, 80, 100
AS12□1FG-U1032	AS13□1FG-U1032	10-32 UNF							●	●	●	●				6, 10, 16, 20
AS22□1FG-N01	AS23□1FG-N01	NPT 1/8							●	●	●	●	●			20, 25, 32
AS22□1FG-N02	AS23□1FG-N02	NPT 1/4								●	●	●	●	●		20, 25, 32, 40
AS32□1FG-N02	AS33□1FG-N02	NPT 1/4									●	●	●	●		40, 50, 63
AS32□1FG-N03	AS33□1FG-N03	NPT 3/8										●	●	●		40, 50, 63
AS42□1FG-N04	AS43□1FG-N04	NPT 1/2											●	●		63, 80, 100

Note 1) Meter-out and meter-in types can be visually differentiated by the flow direction symbol on the resin body.

Note 2) * Elbow type only

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns (!))
Applicable tubing material (2)	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS12□1FG and AS13□1FG

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.

(Refer to pages 371 and 372 for details.)

Flow Rate and Effective Area

Model		AS12□1FG AS13□1FG	AS22□1FG-01 AS23□1FG-01	AS22□1FG-02 AS23□1FG-02				AS32□1FG AS33□1FG			AS42□1FG AS43□1FG	
Tubing O.D.	Metric size	φ3.2 φ4 φ6	φ3.2 φ4 φ6 φ8 φ10	φ4 φ6 φ8 φ10	φ6 φ8 φ10 φ12	φ8 φ10 φ12 φ14	φ10 φ12 φ14 φ16	φ12 φ14 φ16 φ18	φ14 φ16 φ18 φ20	φ16 φ18 φ20 φ22	φ18 φ20 φ22 φ24	φ20 φ22 φ24 φ26
	Inch size	01/8" 05/32" 03/16" 01/4"	01/8" 05/32" 01/4" 05/16"	05/32" 03/16" 01/4" 05/16"	03/16" 01/4" 05/16" 03/8"	01/4" 05/16" 03/8" 01/2"	05/16" 03/8" 01/2" 07/16"	03/8" 01/2" 07/16" 09/16"	01/2" 07/16" 09/16" 11/16"	07/16" 09/16" 11/16" 13/16"	09/16" 11/16" 13/16" 15/16"	11/16" 13/16" 15/16" 17/16"
	Flow rate (l/min (ANR))	100	180	230	260	390	460	660	790	920	1580	1710
Controlled flow (Free flow)	Effective area (mm²)	1.5	2.7	3.5	4	6	7	10	12	14	12	26

Note) Flow rate values are measured at 0.5 MPa and 20°C.



Made to Order
(Refer to page 473 for details.)

Speed Controller with One-touch Fitting Stainless Steel Series Elbow Type/Universal Type **Series AS-FG**

How to Order

AS 2 3 0 1 F G - 01 - 06 -

Body size

1	M5 standard
2	1/8, 1/4 standard
3	3/8 standard
4	1/2 standard

Control type

0	Meter-out
1	Meter-in

Type

2	Elbow
3	Universal

With One-touch fitting

Stainless steel specifications (SUS303)

Thread type

NII	Metric thread (M5)
N	Unified thread (10-32 UNF)
N	R
N	NPT

Port size

M5	M5 x 0.8
U10/32	10-32 UNF
01	1/8
02	1/4
03	3/8
04	1/2

Made to Order
(Refer to the below for details.)

Option

NII	None
S	With seal*

* M5 and U10/32 are not available with seal.

Applicable tubing O.D.

Metric size	Inch size
23	ø3.2*
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12
01	ø1/8"
03	ø5/32"
05	ø3/16"
07	ø1/4"
09	ø5/16"
11	ø3/8"
13	ø1/2"

* Use ø1/8" tube.

Made to Order



1 Lubricant: Vaseline X12

Ex.) AS1201FG-M5-23-X12

3 Throttle Valve (Without Check Valve) X214

Ex.) AS1201FG-M5-23-X214

Note) Throttle valve is only compatible with the part no. of the meter-out type.

2 Grease-free (Seal: Fluorine Coating) + Throttle Valve (Without Check Valve) X21

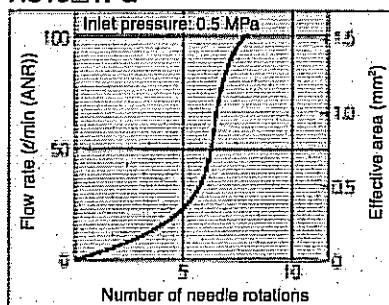
Ex.) AS1201FG-M5-23-X21

Note 1) Not particle-free

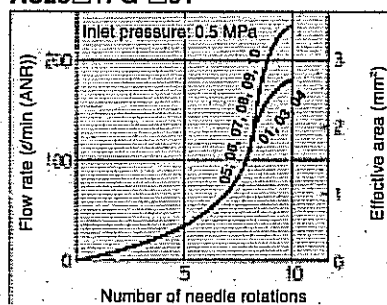
Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

Needle Valve/Flow Characteristics

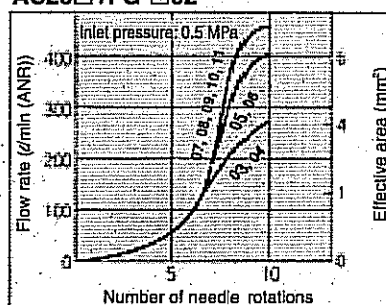
AS12□1FG
AS13□1FG



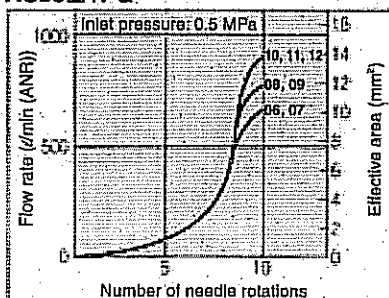
AS22□1FG-□01
AS23□1FG-□01



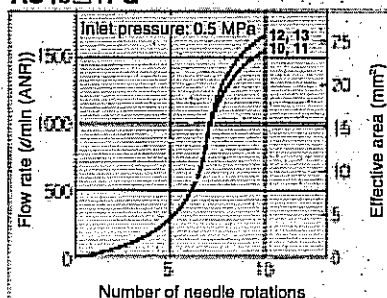
AS22□1FG-□02
AS23□1FG-□02



AS32□1FG
AS33□1FG



AS42□1FG
AS43□1FG



AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

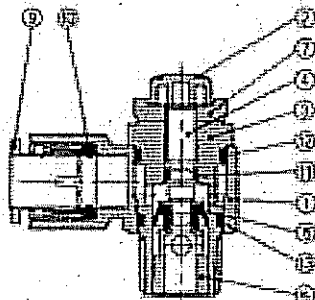
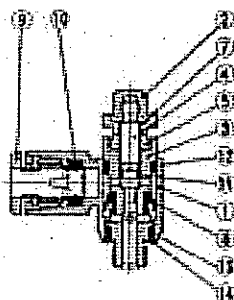
Series AS-FG

Construction: Elbow Type

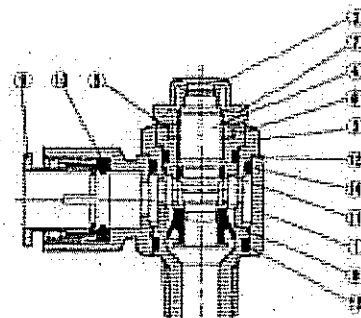
Meter-out type

M5 type

U10/32 type



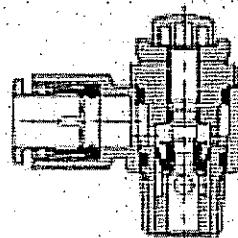
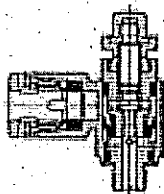
AS3201FG-02



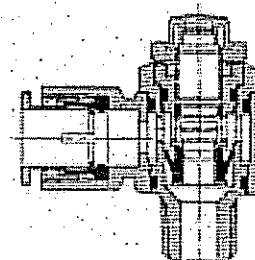
Meter-in type

M5 type

U10/32 type



AS3211FG-02



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT	
3	Body B	Stainless steel 303	
4	Needle	Stainless steel 303	
5	Needle guide	Stainless steel 303	
6	Seat ring	Stainless steel 303	
7	Lock nut	Stainless steel 303	
8	U seal	HNBR	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	Gasket	NBR, Stainless steel	M5 type only

⚠ Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

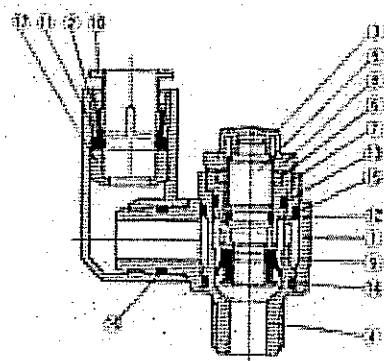
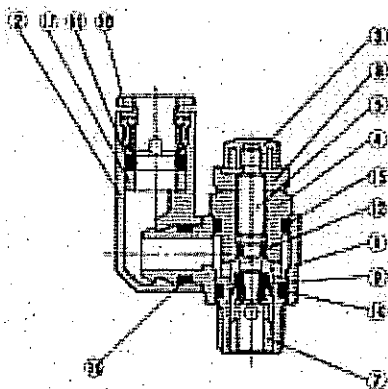
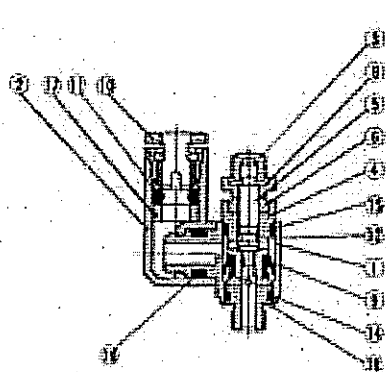
Construction: Universal Type

Meter-out type

M5 type

U10/32 type

AS3301FG-02

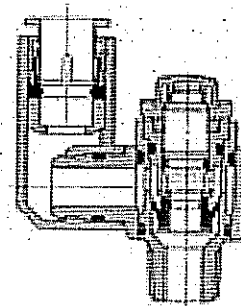
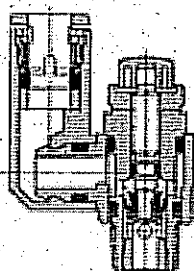
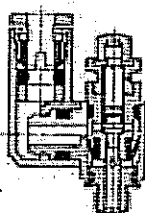


Meter-in type

M5 type

U10/32 type

AS3311FG-02



AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

KE

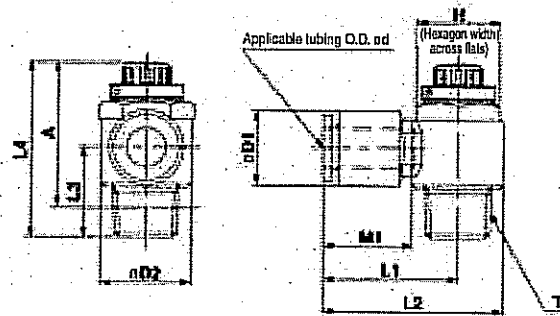
TMH

Component Parts

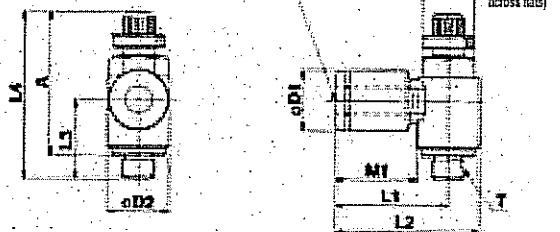
No.	Description	Material	Note
1	Body A	PBT	
2	Elbow body	PBT	
3	Handle	PBT	
4	Body B	Stainless steel 303	
5	Needle	Stainless steel 303	
6	Needle guide	Stainless steel 303	
7	Seat ring	Stainless steel 303	
8	Lock nut	Stainless steel 303	
9	U seal	HNBR	
10	Cassette	—	
11	Seal	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	O-ring	NBR	
16	O-ring	NBR	
17	Spacer	—	
18	Gasket	NBR, Stainless steel	M5 type only

Series AS-FG

Dimensions: Elbow Type



M5 type
U10/32 type



Metric Size

Model	d	T	H	D1	D2	L1	L2	L3	L4 (1)		A*		M1	Mass (g)
									Max.	Min.	Max.	Min.		
AS12□1FG-M5-23	3.2	M5 x 0.8	8	8.4	9.6	17.3	22.1	12.3	26.6	25.8	25	22.2	12.7	7
AS12□1FG-M5-04	4	M5 x 0.8	8	9.3	9.6	17.3	22.1	12.3	26.6	25.8	25	22.2	12.7	7
AS12□1FG-M5-06	6	M5 x 0.8	8	11.6	9.6	18.1	22.9	11.7	28.6	25.8	25	22.2	13.5	7
AS22□1FG-01-23	3.2	R 1/8	12	9.3	14.2	20.4	27.5	14.3	36.1	31.1	32.1	27.1	12.7	16
AS22□1FG-01-04	4	R 1/8	12	9.3	14.2	20.4	27.5	14.3	36.1	31.1	32.1	27.1	12.7	17
AS22□1FG-01-06	6	R 1/8	12	11.6	14.2	20.4	27.5	12.4	36.1	30.2	32.1	27.1	13.5	17
AS22□1FG-01-08	8	R 1/8	12	13.2	14.2	25.3	32.4		36.1	30.2	32.1	27.1	18.5	19
AS22□1FG-01-10	10	R 1/8	12	18.5	14.2	32.1	39.2	14.1	36.1	30.2	32.1	27.1	21	21
AS22□1FG-02-04	4	R 1/4	17	10.4	18.5	25.2	34.4	17.7	39.9	34.9	34.4	29.4	16	32
AS22□1FG-02-06	6	R 1/4	17	12.8	18.5	25.2	34.4	17.7	39.9	34.9	34.4	29.4	17	32
AS22□1FG-02-08	8	R 1/4	17	15.2	18.5	27.2	36.4		39.9	34.9	34.4	29.4	18.5	34
AS22□1FG-02-10	10	R 1/4	17	18.5	18.5	35.3	44.5	19.5	39.9	34.9	34.4	29.4	21	36
AS32□1FG-02-06	6	R 3/8	19	12.8	23	27.8	39.3		48.3	43.3	42.8	37.8	17	60
AS32□1FG-02-08	8	R 3/8	19	15.2	23	29.5	41		48.3	43.3	42.8	37.8	18.5	63
AS32□1FG-02-10	10	R 3/8	19	18.5	23	31.8	43.3		48.3	43.3	42.8	37.8	21	67
AS32□1FG-02-12	12	R 3/8	19	20.9	23	32.8	44.3		48.3	43.3	42.8	37.8	22	69
AS32□1FG-03-06	6	R 3/8	19	12.8	23	27.8	39.3		48.3	43.3	42.8	37.8	17	55
AS32□1FG-03-08	8	R 3/8	19	15.2	23	29.5	41		48.3	43.3	42.8	37.8	18.5	57
AS32□1FG-03-10	10	R 3/8	19	18.5	23	31.8	43.3		48.3	43.3	42.8	37.8	21	59
AS32□1FG-03-12	12	R 3/8	19	20.9	23	32.8	44.3		48.3	43.3	42.8	37.8	22	61
AS42□1FG-04-10	10	R 1/2	24	18.5	29.4	33.6	47.9		58.7	49.2	49.6	42.1	21	100
AS42□1FG-04-12	12	R 1/2	24	20.9	29.4	34.6	48.9		58.7	49.2	49.6	42.1	22	101

Note 1) Reference dimensions

Note 2) Reference dimensions of M5 x 0.8, R threads after installation.

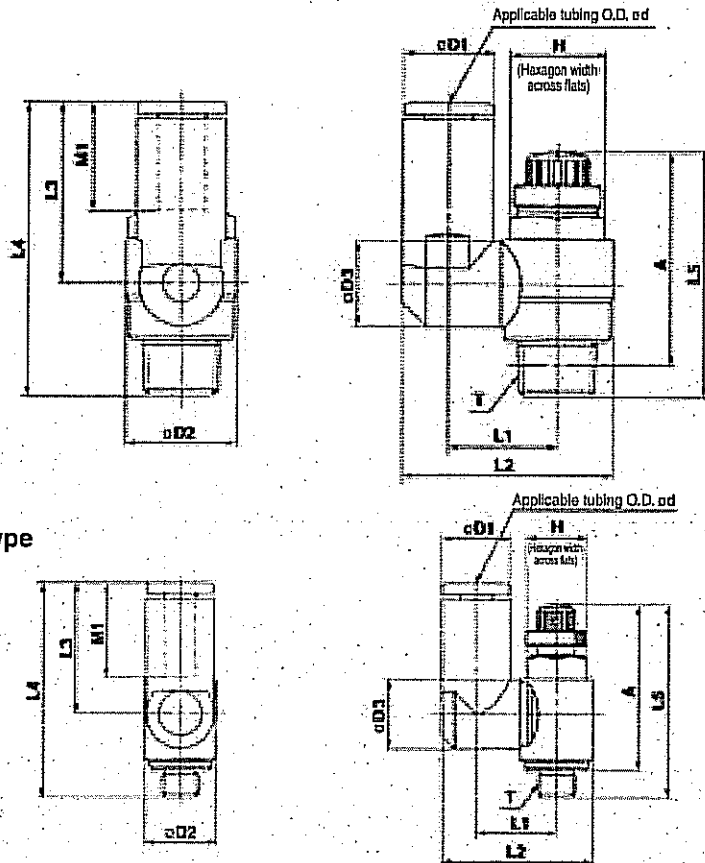
Inch Size

Model	d	T	H	D1	D2	L1	L2	L3	L4 (1)		A*		M1	Mass (g)
									Max.	Min.	Max.	Min.		
AS12□1FG-U10/32-01	1/8"	10-32 UNF	6	8.4	9.6	17.3	22.1	12.3	26.6	25.8	25	22.2	12.7	7
AS12□1FG-U10/32-03	3/32"	10-32 UNF	6	9.3	9.6	17.3	22.1	12.3	26.6	25.8	25	22.2	12.7	7
AS12□1FG-U10/32-05	3/16"	10-32 UNF	6	11.4	9.6	18.1	22.9	11.7	28.6	25.8	25	22.2	13.5	7
AS12□1FG-U10/32-07	1/4"	10-32 UNF	6	12	9.6	18.1	22.9	11.7	28.6	25.8	25	22.2	13.5	7
AS22□1FG-N01-01	1/8"	NPT 1/8	12.7	9.3	14.2	20.4	27.5	14.3	36.1	31.1	32.1	27.1	12.7	16
AS22□1FG-N01-03	3/32"	NPT 1/8	12.7	9.3	14.2	20.4	27.5	14.3	36.1	31.1	32.1	27.1	12.7	17
AS22□1FG-N01-05	3/16"	NPT 1/8	12.7	11.4	14.2	20.4	27.5	12.4	36.1	30.2	32.1	27.1	13.5	17
AS22□1FG-N01-07	1/4"	NPT 1/8	12.7	13.2	14.2	25.3	32.4		36.1	30.2	32.1	27.1	18.5	19
AS22□1FG-N01-09	5/16"	NPT 1/8	12.7	15.2	14.2	25.3	32.4	14.1	36.1	30.2	32.1	27.1	21	21
AS22□1FG-N02-03	5/32"	NPT 1/4	17.5	10.4	18.5	25.2	34.4	17.7	39.9	34.9	34.4	29.4	16	32
AS22□1FG-N02-05	3/16"	NPT 1/4	17.5	11.4	18.5	25.2	34.4	17.7	39.9	34.9	34.4	29.4	17	32
AS22□1FG-N02-07	1/4"	NPT 1/4	17.5	13.2	18.5	25.2	34.4		39.9	34.9	34.4	29.4	18.5	34
AS22□1FG-N02-09	5/16"	NPT 1/4	17.5	15.2	18.5	27.2	36.4		39.9	34.9	34.4	29.4	21	36
AS22□1FG-N02-11	3/8"	NPT 1/4	17.5	17.9	18.5	35.3	44.5	19.5	39.9	34.9	34.4	29.4	21	36
AS32□1FG-N02-07	1/4"	NPT 3/8	19	13.2	23	27.8	39.3		48.3	43.3	42.8	37.8	17	60
AS32□1FG-N02-09	5/16"	NPT 3/8	19	15.2	23	29.5	41		48.3	43.3	42.8	37.8	18.5	63
AS32□1FG-N02-11	3/8"	NPT 3/8	19	17.9	23	31.8	43.3		48.3	43.3	42.8	37.8	21	67
AS32□1FG-N03-07	1/4"	NPT 3/8	19	13.2	23	27.8	39.3		48.3	43.3	42.8	37.8	17	55
AS32□1FG-N03-09	5/16"	NPT 3/8	19	15.2	23	29.5	41		48.3	43.3	42.8	37.8	18.5	57
AS32□1FG-N03-11	3/8"	NPT 3/8	19	17.9	23	31.8	43.3		48.3	43.3	42.8	37.8	21	59
AS42□1FG-N04-11	3/8"	NPT 1/2	24	18.5	29.4	33.6	47.9		58.7	49.2	49.6	42.1	21	100
AS42□1FG-N04-13	1/2"	NPT 1/2	24	20.9	29.4	34.6	48.9		58.7	49.2	49.6	42.1	22	101

Note 1) Reference dimensions

Note 2) Reference dimensions of 10-32 UNF and NPT threads after installation.

Dimensions: Universal Type



M5 type
U10/32 type

AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Metric Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A*		M1	Mass (g)
											Max.	Min.	Max.	Min.		
AS13□1FG-M5-23	3.2			8.4			18.8								12.7	7
AS13□1FG-M5-04	4	M5x0.8	6	9.3	8.6	9.3	10.5	20.3	17.5	28.7	20.6	20.6	25	22.2		
AS13□1FG-M5-06	6			11.6			21.4	20.6	31.5						13.5	
AS23□1FG-01-23	3.2			8.4			13.1		17.5	30.9					12.7	17
AS23□1FG-01-04	4	R 1/8	32	9.3	14.2		14.9	14	26.9	22.9	35.2	30.2	32.1	27.1	13.5	18
AS23□1FG-01-06	6			11.6			12.9	15.2	30.9	28.2	45.1				18.5	21
AS23□1FG-01-08	8			15.2			18.4	34	25.2	42.1					16	32
AS23□1FG-02-04	4			12.8			12.9	18.3	35.2	28.2	45.1	39.9	34.9	34.4	18.5	36
AS23□1FG-02-06	6			15.2			12.9	18.3	35.2	28.2	45.1				17	33
AS23□1FG-02-08	8	R 1/4	17	18.5			20.2	30.7	31	47.9					21	40
AS23□1FG-C2-10	10			18.5			20.2	30.7	31	47.9					21	40
AS33□1FG-02-06	6			12.8			12.9	20.6	38.5	25.2	45.1				17	60
AS33□1FG-02-08	8			15.2			12.9	20.6	38.5	25.2	45.1				18.5	63
AS33□1FG-02-10	10	R 1/4	19	18.5	23		12.9	20.6	38.5	25.2	45.1	48.3	43.3	42.0	18.5	67
AS33□1FG-02-12	12			20.9			12.9	20.6	38.5	25.2	45.1				22	69
AS33□1FG-03-06	6			12.8			12.9	20.6	38.5	25.2	45.1				17	56
AS33□1FG-03-08	8			15.2			12.9	20.6	38.5	25.2	45.1				18.5	59
AS33□1FG-03-10	10	R 3/8	19	18.5	23		12.9	20.6	38.5	25.2	45.1	45.4	40.4	40	21	63
AS33□1FG-03-12	12			20.9			12.9	20.6	38.5	25.2	45.1				22	65
AS43□1FG-04-10	10			18.5			12.9	20.6	38.5	25.2	45.1	50.7	49.2	49.6	21	104
AS43□1FG-04-12	12	R 1/2	24	20.9	28.5		12.9	20.6	38.5	25.2	45.1				22	105

Note 1) Reference dimensions

Note 2) Reference dimensions of M5 x 0.8, R threads after installation.

Inch Size

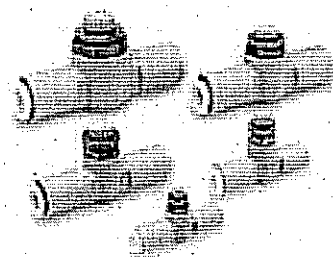
Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A*		M1	Mass (g)
											Max.	Min.	Max.	Min.		
AS13□1FG-U10/32-01	1/8"			8.4			18.8								12.7	7
AS13□1FG-U10/32-03	3/32"	10-32 UNF	1	9.3	8.6	9.3	10.5	20.3	17.5	28.7	20.6	20.6	25	22.2		
AS13□1FG-U10/32-05	3/16"			11.6			21.4	20.6	31.5						13.5	8
AS13□1FG-U10/32-07	1/4"			12			21.4	20.6	31.5						13.7	
AS23□1FG-N01-01	1/8"			8.4			13.1		17.5	30.9					12.7	17
AS23□1FG-N01-03	3/32"			9.3	14.2		14.9	14	26.9	22.9	35.2	30.2	32.1	27.1	13.5	18
AS23□1FG-N01-05	3/16"	NPT 1/8	17	11.6			12.9	15.2	30.9	28.2	45.1				18.5	21
AS23□1FG-N01-07	1/4"			15.2			18.4	34	25.2	42.1					16	32
AS23□1FG-N01-09	5/16"			18.5			20.2	30.7	31	47.9					21	40
AS23□1FG-N02-03	5/32"			10.4			12.9	18.3	35.2	28.2	45.1	39.9	34.9	34.4	18.5	36
AS23□1FG-N02-05	3/16"			11.6			12.9	18.3	35.2	28.2	45.1				17	33
AS23□1FG-N02-07	1/4"	NPT 1/4	19	15.2			12.9	18.3	35.2	28.2	45.1				21	39
AS23□1FG-N02-09	5/16"			18.5			12.9	18.3	35.2	28.2	45.1				21	40
AS23□1FG-N02-11	3/8"			20.9			12.9	18.3	35.2	28.2	45.1				22	69
AS33□1FG-N02-07	1/4"			12.8			12.9	20.6	38.5	25.2	45.1				17	60
AS33□1FG-N02-09	5/16"	NPT 1/4	19	15.2			12.9	20.6	38.5	25.2	45.1	48.3	43.3	42.0	18.5	63
AS33□1FG-N02-11	3/8"			18.5			12.9	20.6	38.5	25.2	45.1				21	69
AS33□1FG-N03-07	1/4"			12.8			12.9	20.6	38.5	25.2	45.1				17	56
AS33□1FG-N03-09	5/16"	NPT 3/8	19	15.2			12.9	20.6	38.5	25.2	45.1	45.4	40.4	40	21	63
AS33□1FG-N03-11	3/8"			18.5			12.9	20.6	38.5	25.2	45.1				22	65
AS43□1FG-N04-11	3/8"	NPT 1/2	24	20.9			12.9	20.6	38.5	25.2	45.1	50.7	49.2	49.6	21	104
AS43□1FG-N04-13	1/2"			20.9	28.5		12.9	20.6	38.5	25.2	45.1				22	105

Note 1) Reference dimensions

Note 2) Reference dimensions of 10-32 UNF and NPT threads after installation.

Speed Controller with One-touch Fittings Stainless Steel Series In-line Type

Series AS-FG



Model

Model	Applicable tubing O.D.													Applicable cylinder bore size (mm)
	Metric size						Inch size							
	3.2	4	6	8	10	12	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"	
AS1001FG	●	●	●				●	●	●	●				6, 10, 16, 20
AS2001FG		●	●					●	●	●				20, 25, 32
AS2051FG			●	●					●	●	●			20, 25, 32, 40
AS3001FG			●	●	●	●				●	●	●		40, 50, 63
AS4001FG					●	●						●	●	63, 80, 100

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (8 turns ⁽¹⁾)
Applicable tubing material ⁽²⁾	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS1001FG type.

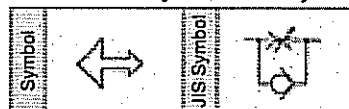
Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.
(Refer to pages 371 and 372 for details.)

Flow Rate and Effective Area

Model		AS1001FG	AS2001FG		AS2051FG		AS3001FG			AS4001FG	
Tubing	Metric size	ø3.2	ø4	ø6	ø6	ø8	ø6	ø8	ø10	ø10	ø12
		ø4							ø12		
		ø6									
O.D.	Inch size	ø1/8"	ø5/32"	ø3/16"	ø3/16"	ø1/4"	ø1/4"	ø5/16"	ø3/8"	ø3/8"	ø1/2"
		ø5/32"		ø1/4"		ø5/16"					
		ø3/16"									
Controlled flow	Flow rate (L/min (ANR))	100	130	230	290	460	420	660	920	1050	1390
(Free flow)	Effective area (mm²)	1.5	2	3.5	4.5	7	6.5	10	14	16	21

Note) Flow rate values are measured at 0.5 MPa and 20°C.

Flow Direction Symbols on Body



Made to Order
(Refer to page 479 for details.)

How to Order

AS 200 1 F G - 06 -

Body size

100	M5 standard
200	1/8 standard
205	1/4 standard
300	3/8 standard
400	1/2 standard

With One-touch fittings

Stainless steel specifications (Stainless steel 303)

Made to Order
(Refer to the below for details.)

Applicable tubing O.D.

Metric size	Inch size
23	ø3.2 *
04	ø4
06	ø6
08	ø8
10	ø10
12	ø12
01	ø1/8"
03	ø5/32"
05	ø3/16"
07	ø1/4"
09	ø5/16"
11	ø3/8"
13	ø1/2"

* Use ø1/8" tube.

Made to Order



Lubricant: Vaseline

X12

Ex.) AS1001FG-04-X12

Grease-free (Seal: Fluorine Coating) + Throttle Valve (Without Check Valve)

X21

Ex.) AS1001FG-04-X21

Note) Not particle-free

Throttle Valve (Without Check Valve)

X214

Ex.) AS1001FG-04-X214

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

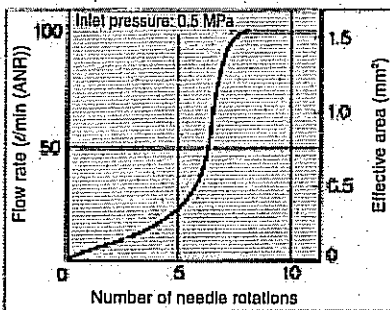
ASQ

KE

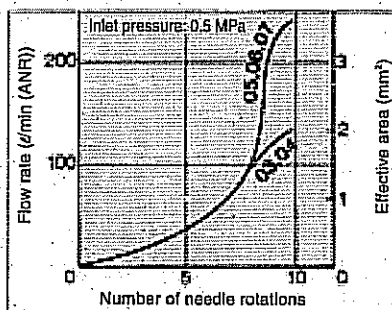
TMH

Needle Valve/Flow Characteristics

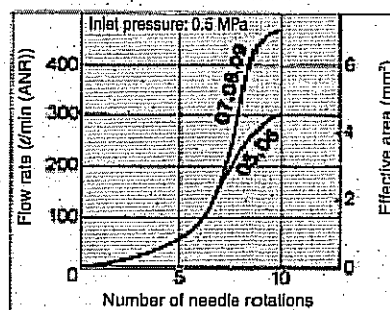
AS1001FG



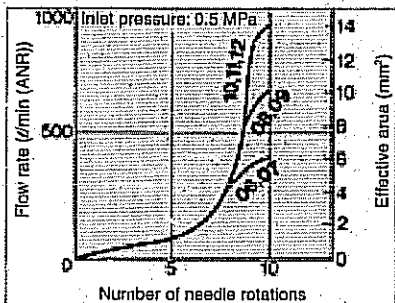
AS2001FG



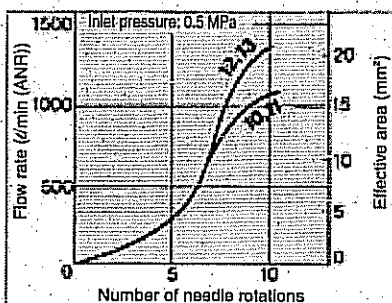
AS2051FG



AS3001FG

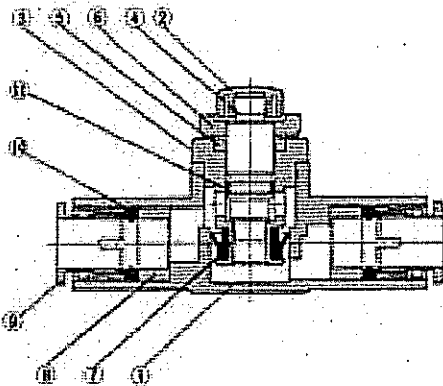


AS4001FG



Series AS-FG

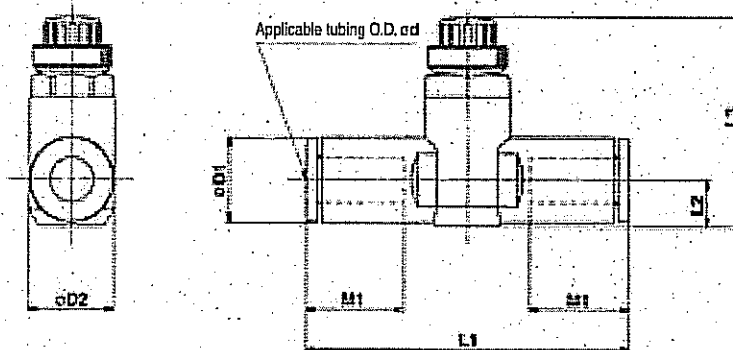
Construction



Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT	
3	Body B	Stainless steel 303	
4	Needle	Stainless steel 303	
5	Needle guide	Stainless steel 303	
6	Lock nut	Stainless steel 303	
7	U seal	HNBR	
8	Spacer	—	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	

Dimensions



Metric Size

Model	d	D1	D2	L1	L2	L3 (1)		M1	Mass (g)
						Max.	Min.		
AS1001FG-23	3.2	8.4	10	38	4.5	23.5	20.7	12.7	6
AS1001FG-04	4	9.3		39.2	5.2	24.2	21.4		7
AS1001FG-06	6	11.6		40.7	6.2	25.2	22.4		8
AS2001FG-04	4	9.3	11.8	40.7	5.2	32.6	27.6	12.7	12
AS2001FG-06	6	11.6		44.8	6.3	33.7	28.7	13.5	13
AS2051FG-06	6	12.8		53.2	6.7	35.2	30.2	17	22
AS2051FG-08	8	15.2	14.8	59.8	8.1	32.6	27.6	18	25
AS3001FG-06	6	12.8		59	7.4	38.3	33.3	17	36
AS3001FG-08	8	15.2		64.4	8.2	39.1	34.1	18	40
AS3001FG-10	10	18.5	19.8	71.6	9.8	40.6	35.6	21	44
AS3001FG-12	12	20.9		76	11	41.8	36.8	22	48
AS4001FG-10	10	18.5		26.5	77.7	11.3	51.1	43.6	21
AS4001FG-12	12	20.9	82.1		52.1		44.6	22	89

Note 1) Reference dimensions

Inch Size

Model	d	D1	D2	L1	L2	L3 (1)		M1	Mass (g)
						Max.	Min.		
AS1001FG-01	1/8"	8.4	10	38	4.5	23.5	20.7	12.7	6
AS1001FG-03	5/32"	9.3		39.2	5.2	24.2	21.4		7
AS1001FG-05	3/16"	11.4		48.7	6.2	25.2	22.4	16.5	12
AS1001FG-07	1/4"	12		40.7				13.7	9
AS2001FG-03	5/32"	9.3	11.8	40.7	5.2	32.6	27.6	12.7	12
AS2001FG-05	3/16"	11.4		50	6.2	33.6	28.8	16.5	18
AS2001FG-07	1/4"	13.2		52.2	7.1	34.5	29.5	17	16
AS2051FG-05	3/16"	11.4	14.8	52.2	6.2	34.6	29.6	16.5	24
AS2051FG-07	1/4"	13.2		54.4	7.1	35.5	30.5	17	22
AS2051FG-09	5/16"	15.2		59.8	8.1	32.6	27.6	18	25
AS3001FG-07	1/4"	13.2	19.8	59	7.4	38.3	33.3	17	36
AS3001FG-09	5/16"	15.2		64.4	8.2	39.1	34.1	18	40
AS3001FG-11	3/8"	17.9		70.8	9.5	40.3	35.3	21	52
AS4001FG-11	3/8"	17.9	26.5	76.9	10.3	51	43.5	21	93
AS4001FG-13	1/2"	21.7		83.1	11.6	52.4	44.9	22	106

Note 1) Reference dimensions

Speed Controller for Low Speed Operation with One-touch Fitting Elbow Type/Universal Type (Resin Body) **Series AS-FM**

**Ideal for low speed control at
10 to 50 mm/sec**

Since the effective area of the controlled flow is approximately 1/10 that of the standard model, it is ideal for speed control of low speed cylinders at 10 to 50 mm/sec.

The dual type is particularly suitable for low speed control of small bore cylinders.

**Low speed operating stroke and
high speed return stroke drive**

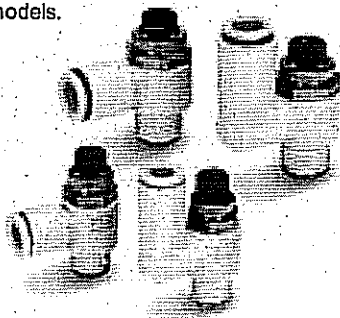
Effective area of free flow is the same as that of standard model.

**10 needle turns (20 turns for
M5 type)**

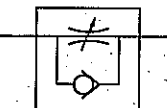
Speed control is easy, and uniform speed control is possible.

**Applicable tubing: Inch sizes
standardized**

Inch sizes are now available for all models.



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		



Made to Order
(Refer to page 495 for details.)

Model

Elbow type	Universal type	Port size	Applicable tubing O.D.											
			Metric size					Inch size						
			3.2	4	6	8	10	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	
AS12□1FM-M5	AS13□1FM-M5	M5 x 0.8	●	●	●									
AS22□1FM-01	AS23□1FM-01	R 1/8	●	●	●	●								
AS22□1FM-02	AS23□1FM-02	R 1/4		●	●	●	●							
AS12□1FM-U10/32	AS13□1FM-U10/32	10-32 UNF							●	●	●	●		
AS22□1FM-N01	AS23□1FM-N01	NPT 1/8							●	●	●	●	●	
AS22□1FM-N02	AS23□1FM-N02	NPT 1/4								●	●	●	●	●

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1.0 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (20 turns ⁽¹⁾)
Applicable tubing material ⁽²⁾	Nylon, Soft nylon, Polyurethane
Option ⁽³⁾	With seal

Note 1) In the case of AS12□1FM and AS13□1FM types

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane, or soft polyurethane tubing is used.

(Refer to pages 371 and 372 for details.)

Note 3) M5 and 10-32UNF type ports are not available with seal.

Note 4) Brass parts are all electroless nickel plated. The handle of the M5 type and the lock nut of the meter-in type are black zinc chromate plated.

Flow Rate and Effective Area

Model		AS12□1FM AS13□1FM	AS22□1FM-□01 AS23□1FM-□01	AS22□1FM-□02 AS23□1FM-□02			
Tubing O.D.	Metric size	ø3.2, ø4, ø6	ø3.2, ø4, ø6, ø8	ø4, ø6, ø8, ø10			
	Inch size	ø1/8", ø5/32", ø3/16", ø1/4"	ø1/8", ø5/32", ø3/16", ø5/16"	ø5/32", ø3/16", ø1/4", ø5/16", ø3/8"			
Controlled flow	Air flow (l/min(ANR))	7	12	35			
	Effective area (mm ²)	0.1	0.2	0.6			
Free flow	Flow rate (l/min(ANR))	100	180	230	260	390	460
	Effective area (mm ²)	1.5	2.7	3.5	4	6	7

Note) Flow rate values are measured at 0.5 MPa and 20°C.

Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for
Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

Speed Controller for Low Speed Operation with One-touch Fitting Elbow Type/Universal Type (Resin Body) **Series AS-FM**

How to Order

AS 2 2 0 1 FM - 01 - 06

Body size

1	M5 standard
2	1/8, 1/4 standard

Type

2	Elbow
3	Universal

Control type

0	Meter-out
1	Meter-in

With One-touch fitting

For low speed control

Thread type

NII	Metric thread (M5)
N	Unified thread (10-32 UNF)
N	.R
N	NPT

Option

NII	None
S	With seal

* M5 and U10/32 are not available with seal.

Applicable tubing O.D.

Metric size

23	φ3.2 *
04	φ4
06	φ6
08	φ8
10	φ10

Inch size

01	φ1/8"
03	φ5/32"
05	φ3/16"
07	φ1/4"
09	φ5/16"
11	φ3/8"

* Use φ1/8" tube.

Port size

M5	M5 x 0.8
U10/32	10-32 UNF
01	1/8
02	1/4

Made to Order
Refer to the below for details.

Made to Order

Made to Order

Lubricant: Vaseline

X12

Ex.) AS1201FM-M5-23-X12

Grease-free (Seal: Fluorine-coated) + Throttle Valve (Without Check Valve)

X21

Ex.) AS1201FM-M5-23-X21

Note 1) Not particle-free

Note 2) Throttle valve is only compatible with the part no. of the meter-out type.

Throttle Valve (Without Check Valve)

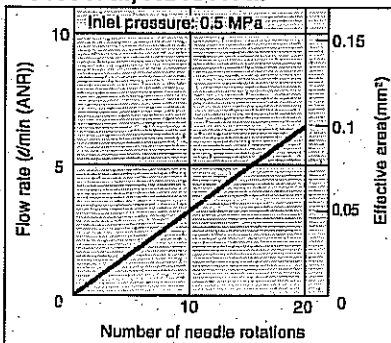
X214

Ex.) AS1201FM-M5-23-X214

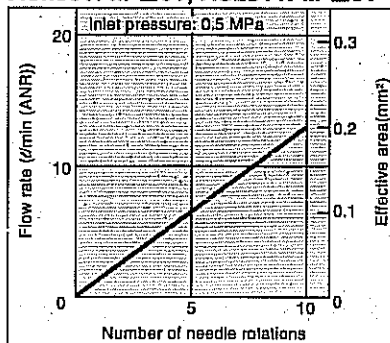
Note) Throttle valve is only compatible with the part no. of the meter-out type.

Needle Valve/Flow Characteristics

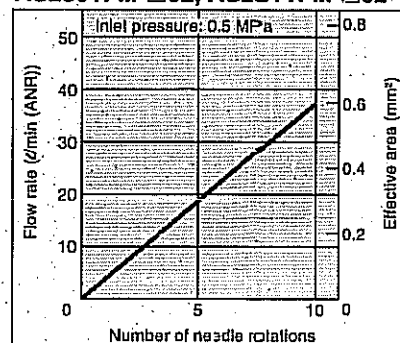
AS1201FM, AS1211FM
AS1301FM, AS1311FM



AS2201FM-□01, AS2211FM-□01
AS2301FM-□01, AS2311FM-□01



AS2201FM-□02, AS2211FM-□02
AS2301FM-□02, AS2311FM-□02



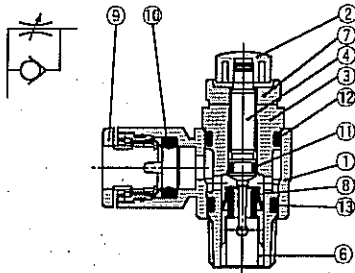
AS
ASP
ASN
AQ
ASV
AK
VCHC
ASS
ASR
ASQ
KE
TMH

Series AS-FM

Construction: Elbow Type

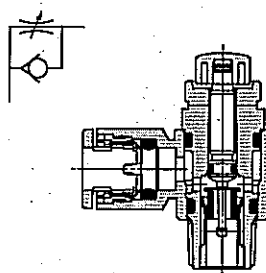
Meter-out type

JIS Symbol

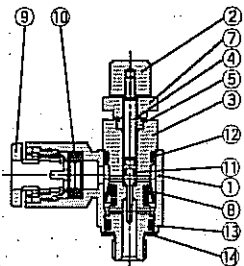


Meter-in type

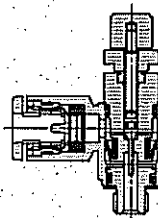
JIS Symbol



M5 type U10/32 type



M5 type U10/32 type



Component Parts

No.	Description	Material	Note
1	Body A	PBT	White
2	Handle	PBT	Black ⁽¹⁾
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated, M5 type only
6	Seat ring	Brass	Electroless nickel plated
7	Lock nut	Brass ⁽²⁾	Electroless nickel plated ⁽³⁾
8	U seal	HNBR	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	Gasket	NBR, Stainless steel	M5 type only

Note 1) M5 and U10/32 types are black zinc chromate plated.

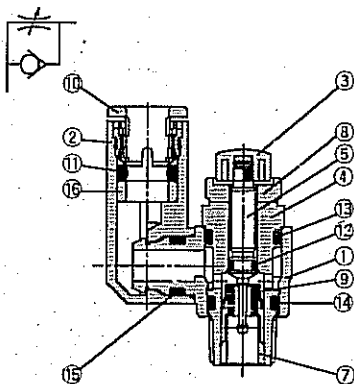
Note 2) AS22□1FM type is made of steel.

Note 3) Meter-in type is black zinc chromate plated.

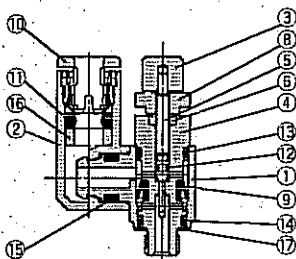
Construction: Universal Type

Meter-out type

JIS Symbol

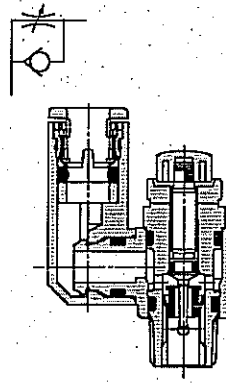


M5 type U10/32 type

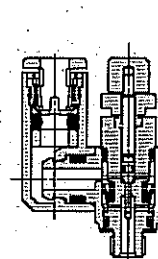


Meter-in type

JIS Symbol



M5 type U10/32 type



Component Parts

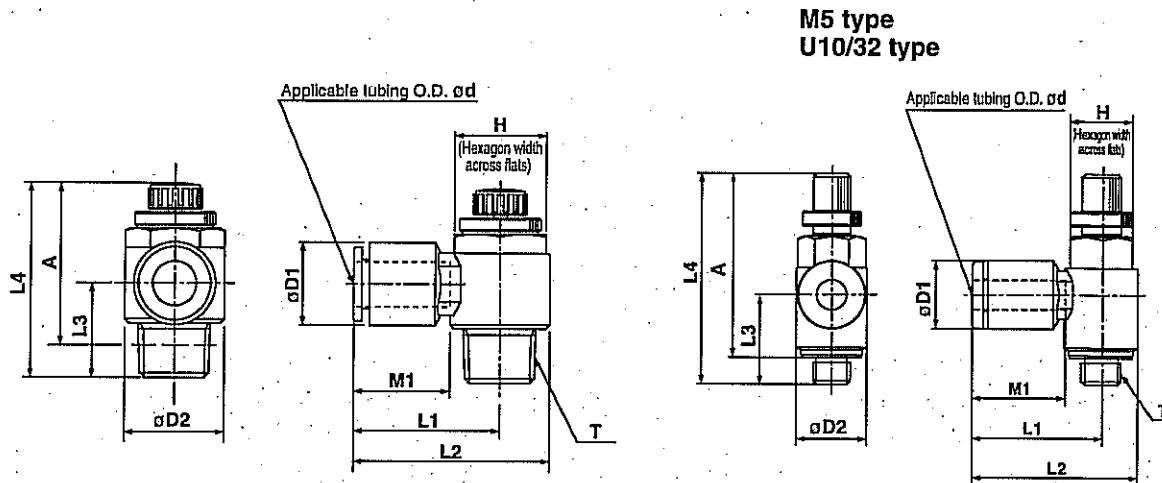
No.	Description	Material	Note
1	Body A	PBT	White
2	Elbow body	PBT	White
3	Handle	PBT	Black ⁽¹⁾
4	Body B	Brass	Electroless nickel plated
5	Needle	Brass	Electroless nickel plated
6	Needle guide	Brass	Electroless nickel plated, M5 type only
7	Seat ring	Brass	Electroless nickel plated
8	Lock nut	Brass ⁽²⁾	Electroless nickel plated ⁽³⁾
9	U seal	HNBR	
10	Cassette	—	
11	Seal	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	
15	O-ring	NBR	
16	Spacer	—	
17	Gasket	NBR, Stainless steel	M5 type only

Note 1) M5 and U10/32 types are black zinc chromate plated.

Note 2) AS23□1FM type is made of steel.

Note 3) Meter-in type is black zinc chromate plated.

Dimensions: Elbow Type



Metric Size

Model	d	T	H	D1	D2	L1	L2	L3	L4 (1) (2)		A (1) (2)		M1	Mass (g)
									Max.	Min.	Max.	Min.		
AS12□1FM-M5-23	3.2	M5 x 0.8	8	8.4	9.6	17.3	22.1	12.3	33.8	28.8	30.1	25.1	12.7	7
AS12□1FM-M5-04	4			9.3		17.3	22.1	12.3					13.5	
AS12□1FM-M5-06	6			11.6		18.1	22.9	11.7					13.5	
AS22□1FM-01-23	3.2	R 1/8	12	9.3	14.2	20.4	27.5	13.4	35.2	30.2	32.1	27.1	12.7	17
AS22□1FM-01-04	4			9.3		20.4	27.5						13.5	
AS22□1FM-01-06	6			11.6		20.4	27.5						13.5	
AS22□1FM-01-08	8	R 1/4	17	15.2	18.5	25.3	32.4	17.7	39.9	34.9	34.4	29.4	16.5	32
AS22□1FM-02-04	4			10.4		25.2	34.4						16	
AS22□1FM-02-06	6			12.8		25.2	34.4						17	
AS22□1FM-02-08	8			15.2		27.2	36.4						18.5	
AS22□1FM-02-10	10			18.5		35.3	44.5	19.5					21.0	36

Note 1) Reference dimensions

Note 2) Reference dimensions of M5 and R threads after installation.

Inch Size

Model	d	T	H	D1	D2	L1	L2	L3	L4 (1)		A (2)		M1	Mass (g)
									Max.	Min.	Max.	Min.		
AS12□1FM-U10/32-01	1/8"	10-32 UNF	8	8.4	9.6	17.3	22.1	12.3	33.8	28.8	30.1	25.1	12.7	7
AS12□1FM-U10/32-03	5/32"			9.3		17.3	22.1	12.3					13.5	
AS12□1FM-U10/32-05	3/16"			11.4		21.3	26.1	11.7					13.5	
AS12□1FM-U10/32-07	1/4"			12		18.3	23.1	11.7					13.5	
AS22□1FM-N01-01	1/8"	NPT 1/8	12.7	9.3	14.2	20.4	27.5	13.4	35.2	30.2	32.1	27.1	12.7	17
AS22□1FM-N01-03	5/32"			9.3		20.4	27.5						13.5	
AS22□1FM-N01-05	3/16"			13.2		23.9	31						16.5	
AS22□1FM-N01-07	1/4"			13.2		23.9	31						16.5	
AS22□1FM-N01-09	5/16"	NPT 1/4	17.5	15.2	18.5	25.3	32.4	17.7	39.9	34.9	34.4	29.4	21	36
AS22□1FM-N02-03	5/32"			10.4		25.2	34.4						16	
AS22□1FM-N02-05	3/16"			12.8		25.2	34.5						17	
AS22□1FM-N02-07	1/4"			13.2		25.2	34.5						18.5	
AS22□1FM-N02-09	5/16"			15.2		27.2	36.4	17.7					21	
AS22□1FM-N02-11	3/8"			18.5		35.3	44.5						21	

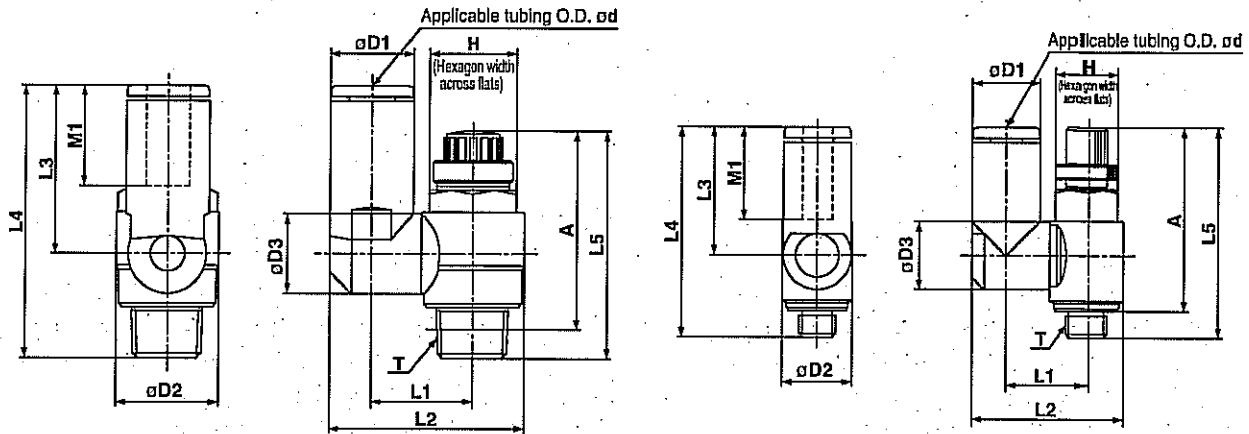
Note 1) Reference dimensions

Note 2) Reference dimensions of 10-32 UNF and NPT threads after installation.

Series AS-FM

Dimensions: Universal Type

M5 type



Metric Size

Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A (2)		M1	Mass (g)
											Max.	Min.	Max.	Min.		
AS13□1FM-M5-23	3.2	M5 x 0.8	8	8.4	9.6	9.3	10.8	19.8	17.5	28.7	33.8	28.8	30.1	25.1	12.7	8
AS13□1FM-M5-04	4			9.3				20.3							13.5	
AS13□1FM-M5-06	6			11.8				21.4							13.5	
AS23□1FM-01-23	3.2	R 1/8	12	8.4	14.2	9.3	13.1	24.4	17.5	30.9	35.2	30.2	32.1	27.1	12.7	17
AS23□1FM-01-04	4			9.3				24.0							13.5	
AS23□1FM-01-06	6			11.8				26.9							13.5	
AS23□1FM-01-08	8	R 1/4	17	15.2	18.5	12.9	16.2	30.9	28.2	40.8	39.9	34.9	34.4	29.4	18	33
AS23□1FM-02-04	4			10.4				30.6							17	
AS23□1FM-02-06	6			12.9				34							18.5	
AS23□1FM-02-08	8			15.2				35.2							18.5	
AS23□1FM-02-10	10			18.5				38.7							21	

Note 1) Reference dimensions

Note 2) Reference dimensions of M5 and R threads after installation.

Inch Size

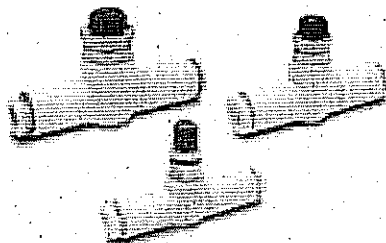
Model	d	T	H	D1	D2	D3	L1	L2	L3	L4	L5 (1)		A (2)		M1	Mass (g)
											Max.	Min.	Max.	Min.		
AS13□1FM-U10/32-01	1/8"	10-32 UNF	8	8.4	9.6	9.3	10.8	19.8	17.5	28.7	33.8	28.8	30.1	25.1	12.7	7
AS13□1FM-U10/32-03	5/32"			9.3				20.3							13.5	
AS13□1FM-U10/32-05	3/16"			11.4				21.3							16.5	
AS13□1FM-U10/32-07	1/4"			12				21.6							13.7	
AS23□1FM-N01-01S	1/8"	NPT 1/8	12	8.4	14.2	9.3	13.1	24.4	17.5	30.9	35.2	30.2	32.1	27.1	12.7	17
AS23□1FM-N01-03S	5/32"			9.3				24.0							13.5	
AS23□1FM-N01-05S	3/16"			11.4				26.8							16.5	
AS23□1FM-N01-07S	1/4"			13.2				29.9							18.5	
AS23□1FM-N01-09S	5/16"	NPT 1/4	17.5	15.2	18.5	12.9	18.3	30.9	28.2	40.8	39.9	34.9	34.4	29.4	21	21
AS23□1FM-N02-03S	5/32"			10.4				30.6							16	
AS23□1FM-N02-05S	3/16"			11.4				31.1							17	
AS23□1FM-N02-07S	1/4"			13.2				34.2							18.5	
AS23□1FM-N02-09S	5/16"			15.2				35.2							18.5	
AS23□1FM-N02-11S	3/8"			17.9				38.7							21	

Note 1) Reference dimensions

Note 2) Reference dimensions of 10-32 UNF and NPT threads after installation.

Speed Controller for Low Speed Operation with One-touch Fitting In-line Type

Series AS-FM



Model

Model	Applicable tubing O.D.									Applicable cylinder bore size (mm)
	Metric size				Inch size					
	3.2	4	6	8	1/8"	5/32"	3/16"	1/4"	5/16"	
AS1001FM	●	●	●		●	●	●	●		6, 10, 16, 20
AS2001FM		●	●			●	●	●		20, 25, 32
AS2051FM			●	●			●	●	●	20, 25, 32, 40

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Min. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns (20 turns ⁽¹⁾)
Applicable tubing material ⁽²⁾	Nylon, Soft nylon, Polyurethane

Note 1) In the case of AS1001FM type

Note 2) Use caution regarding the max. operating pressure when soft nylon or polyurethane tubing is used.

(Refer to pages 371 and 372 for details.)

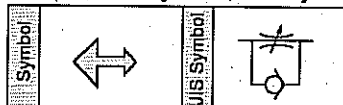
Note 3) Brass parts are all electroless nickel plated. The handle of the M5 type is black zinc chromate plated.

Flow Rate and Effective Area

Model		AS1001FM	AS2001FM		AS2051FM	
Tubing O.D.	Metric size	3.2, 4, 6	4	6	6	8
	Inch size	1/8", 5/32", 3/16" 1/4"	5/32"	3/16", 1/4"	3/16"	1/4", 5/16"
Controlled flow	Flow rate (l/min (ANR))	7	12		38	
	Effective area (mm ²)	0.1	0.2		0.6	
Free flow	Flow rate (l/min (ANR))	100	130	230	290	460
	Effective area (mm ²)	1.5	2	3.5	4.5	7

Note) Flow rate values are measured at 0.5 MPa and 20°C.

Flow Direction Symbols on Body

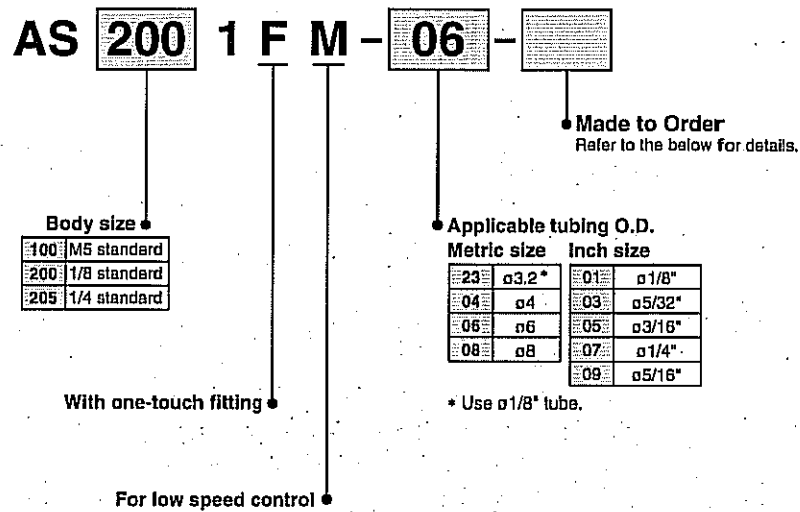


Made to Order
(Refer to page 503 for details.)

Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for
Safety Instructions and pages 412 to 414
for Flow Control Equipment Precautions.

How to Order



Made to Order



- AS
- ASP
- ASN
- AQ
- ASV
- AK
- VCHC
- ASS
- ASR
- ASQ
- KE
- TMH

Lubricant: Vaseline

X12

Ex.) AS2001FM-04-X12

Grease-free (Seal: Fluorine coated) + Throttle Valve (Without Check Valve)

X21

Ex.) AS2001FM-04-X21

Note 1) Not particle-free

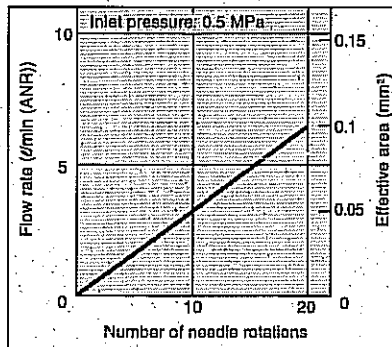
Throttle Valve (Without Check Valve)

X214

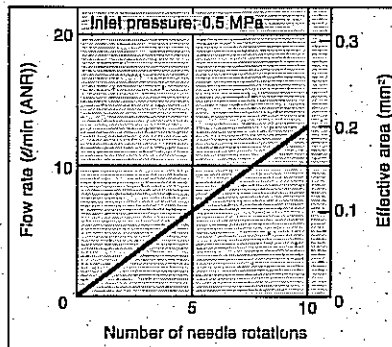
Ex.) AS2001FM-04-X214

Needle Valve/Flow Characteristics

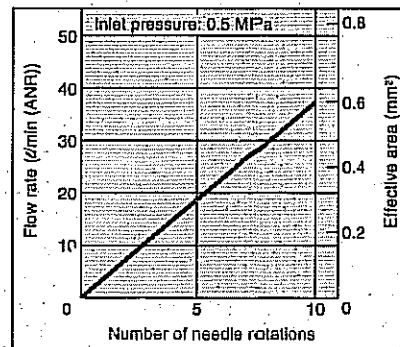
AS1001FM



AS2001FM

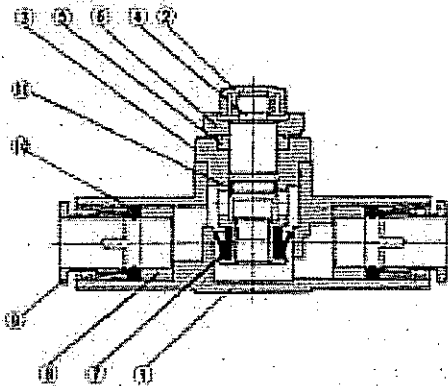


AS2051FM



Series AS-FM

Construction

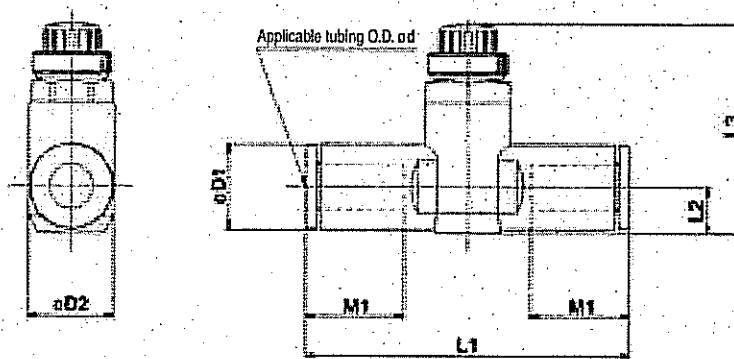


Component Parts

No.	Description	Material	Note
1	Body A	PBT	
2	Handle	PBT (1)	Black
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Lock nut	Brass (2)	Electroless nickel plated
7	U seal	HNBR	
8	Spacer	—	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	

Note 1) AS1001FM type is made of brass (black zinc chromate plated).
 Note 2) AS20□1FM type is made of steel.

Dimensions



Metric Size

Model	d	D1	D2	L1	L2	L3		M1	Mass (g)
						Max.	Min.		
AS1001FM-23	3.2	8.4	10	38	4.5	27.7	24.9	12.7	6
AS1001FM-04	4	9.3		39.2	5.2	28.5	25.5	7	
AS1001FM-06	6	11.6		40.7	6.2	29.8	26.6	13.7	8
AS2001FM-04	4	9.3	11.8	40.7	5.2	32.6	27.6	12.7	12
AS2001FM-06	6	11.6		44.8	6.3	33.7	28.7	13.7	13
AS2051FM-05	6	12.8		53.2	6.7	35.2	30.2	17	26
AS2051FM-08	8	15.2	14.8	59.8	8.1	36.5	31.5	18	31

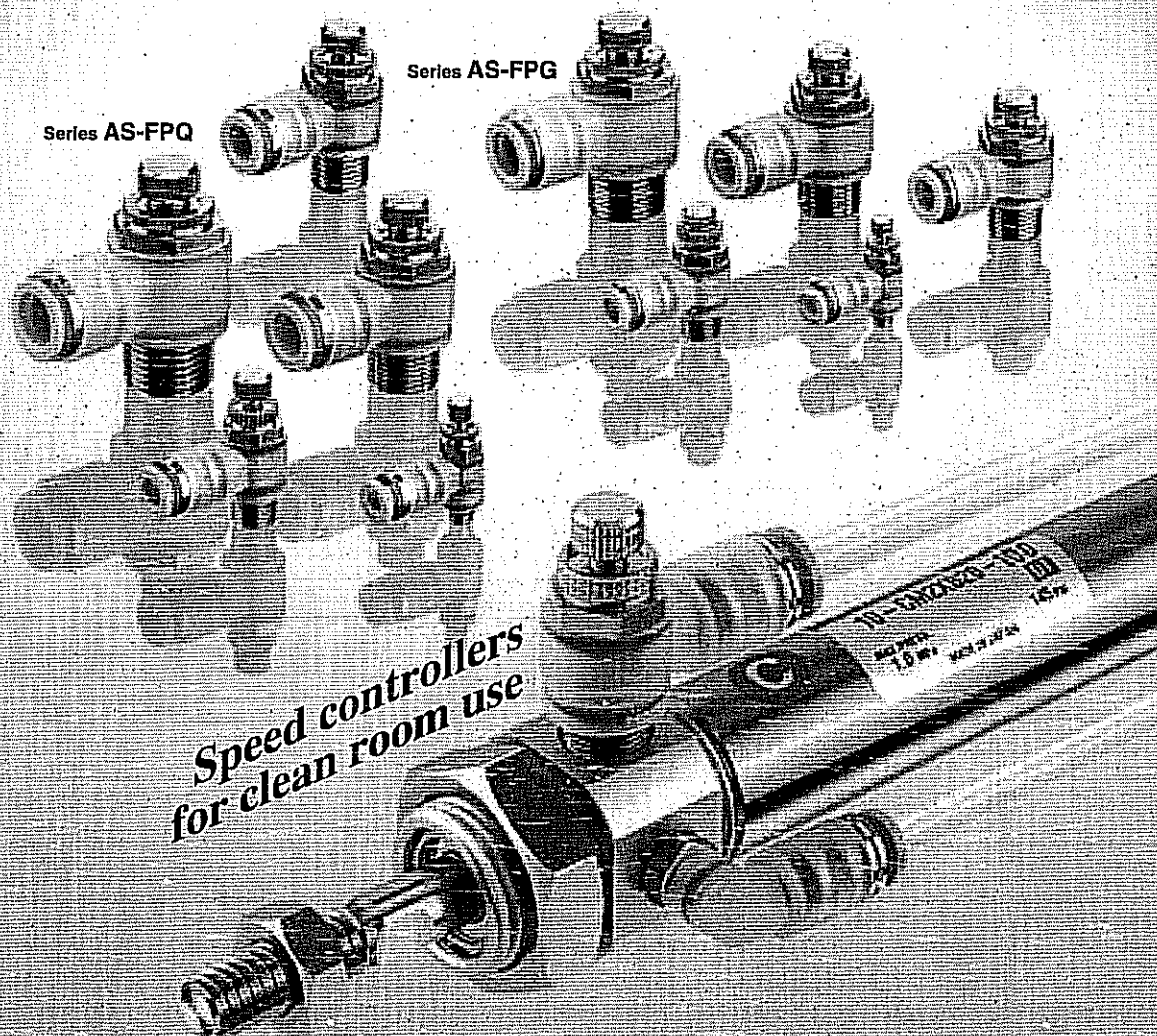
Inch Size

Model	d	D1	D2	L1	L2	L3 (1)		M1	Mass (g)
						Max.	Min.		
AS1001FM-01	1/8"	8.4	10	38	4.5	27.7	24.9	12.7	6
AS1001FM-03	5/32"	9.3		39.2	5.2	28.5	25.5	7	
AS1001FM-05	3/16"	11.4		48.7	6.2	27.7	24.7	16.5	8
AS1001FM-07	1/4"	12		40.7				13.7	9
AS2001FM-03	5/32"	9.3	11.8	40.7	5.2	32.6	29.6	12.7	12
AS2001FM-05	3/16"	11.4		50	6.2	33.6	28.6	16.5	18
AS2001FM-07	1/4"	13.2		52.2	7.1	34.5	29.5	17	21
AS2051FM-05	3/16"	11.4	14.8	52.2	6.2	34.6	29.6	16.5	24
AS2051FM-07	1/4"	13.2		54.4	7.1	35.5	30.5	17	26
AS2051FM-09	5/16"	15.2		59.8	8.1	36.5	31.5	18	31

Note 1) Reference dimensions

Clean Speed Controller with One-touch Fitting

Series AS-FPQ/AS-FPG



Speed controllers
for clean room use

AS-FPQ: Brass (electroless nickel plated) and
AS-FPG: Stainless steel 304 are now available as a series.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

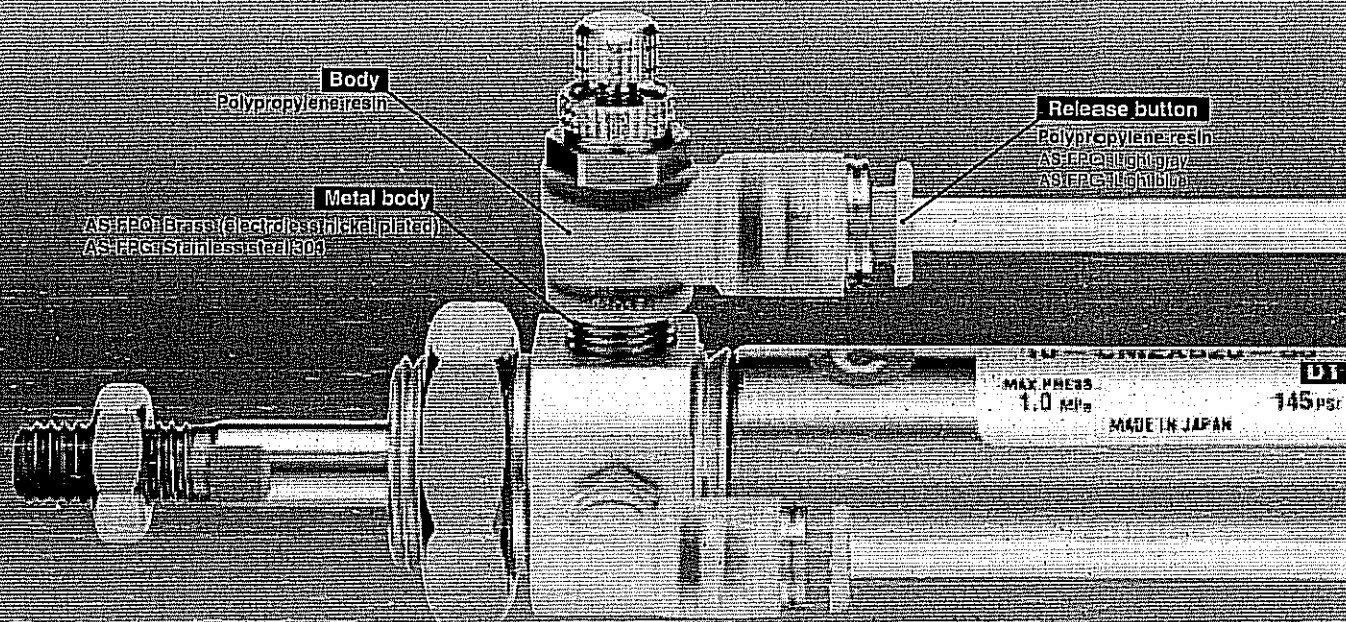
ASR

ASQ

KE

TMH

Low particulate generating speed controllers designed for use in clean rooms



Clean Speed Controller
with One-touch Fitting

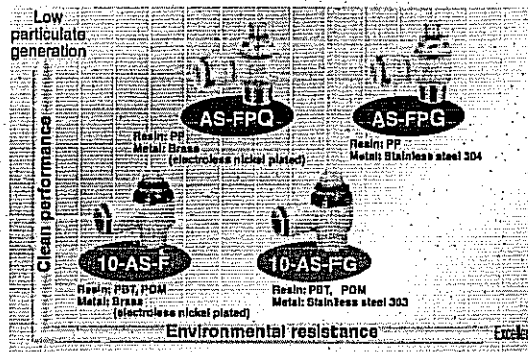
Series AS-FPQ/FPG



Series AS-FPQ
Brass (electroless nickel plated)

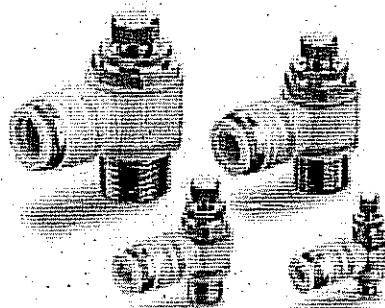
Series AS-FPG
Stainless steel 304

Elbow type	Port size	Applicable tube O.D. (mm)					Applicable cylinder bore size (mm)
		4	6	8	10	12	
AS12□1FP□-M5	M5 x 0.8	●	●	●	●	●	6, 10, 16, 20
AS22□1FP□-01	R 1/8	●	●	●	●	●	20, 25, 32
AS22□1FP□-02	R 1/4	●	●	●	●	●	20, 25, 32, 40
AS32□1FP□-03	R 3/8	●	●	●	●	●	40, 50, 63
AS42□1FP□-04	R 1/2	●	●	●	●	●	63, 80, 100

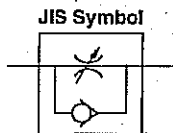
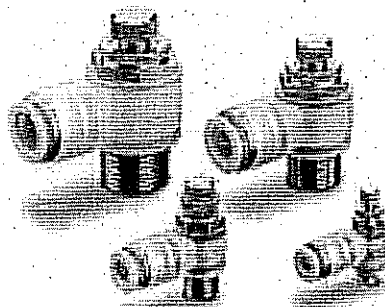


Series AS-FPQ/FPG





Release button color: Light gray



Release button color: Light blue



Flow Direction Symbols on Body

	Meter-out type	Meter-In type
Symbol		
WIS Symbol		

Elbow type	Port size	Applicable tubing O.D. (mm)					Applicable cylinder bore size (mm)
		4	6	8	10	12	
AS12□1FP□-M5	M5 x 0.8	●	●				6, 10, 16, 20
AS22□1FP□-01	R 1/8	●	●	●			20, 25, 32
AS22□1FP□-02	R 1/4	●	●	●	●		20, 25, 32, 40
AS32□1FP□-03	R 3/8		●	●	●	●	40, 50, 63
AS42□1FP□-04	R 1/2				●	●	63, 80, 100

Fluid	Air
Particulate generation grade	Grade 1 (1)
Proof pressure (20°C)	1.5 MPa (2)
Maximum operating pressure (20°C)	1 MPa (3)
Minimum operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 rotations (8 rotations (4))
Oil	Fluorine-based grease

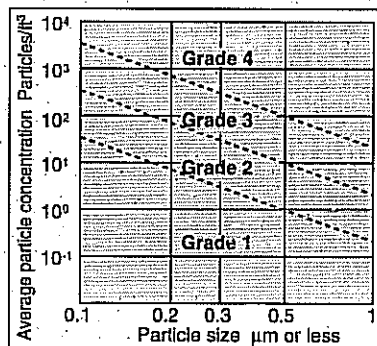
Note 4) For AS12□1FP□

Model		AS22□1FP-05	AS22□1FP-01			AS22□1FP-02			AS32□1FP-03			AS42□1FP-04	
Tubing O.D.	Metric sizes	ø4 ø6	ø4 ø6	ø6 ø8	ø4 ø6	ø6 ø8 ø10	ø6 ø8 ø10	ø6 ø8 ø10	ø8 ø10 ø12	ø10 ø12	ø10 ø12	ø12	
Controlled (free) flow	Flow rate L/min (ANR)	100	180	230	260	390	460	660	790	920	1580	1710	
	Effective area mm ²	1.5	2.7	3.5	4	6	7	10	12	14	24	26	

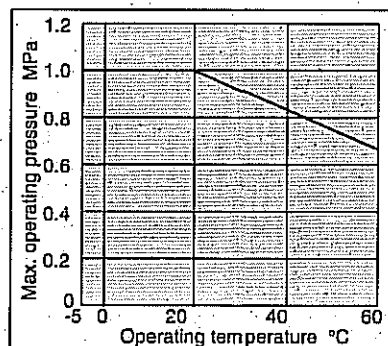
Recommended Applicable Tubing

Tubing material	Clean series polyurethane tubing: Series 10
Tubing O.D.	ø4, ø6, ø8, ø10, ø12

Particulate Generation Grade Classifications.



Relation between Operating Temp. and Max. Operating Pressure



489

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

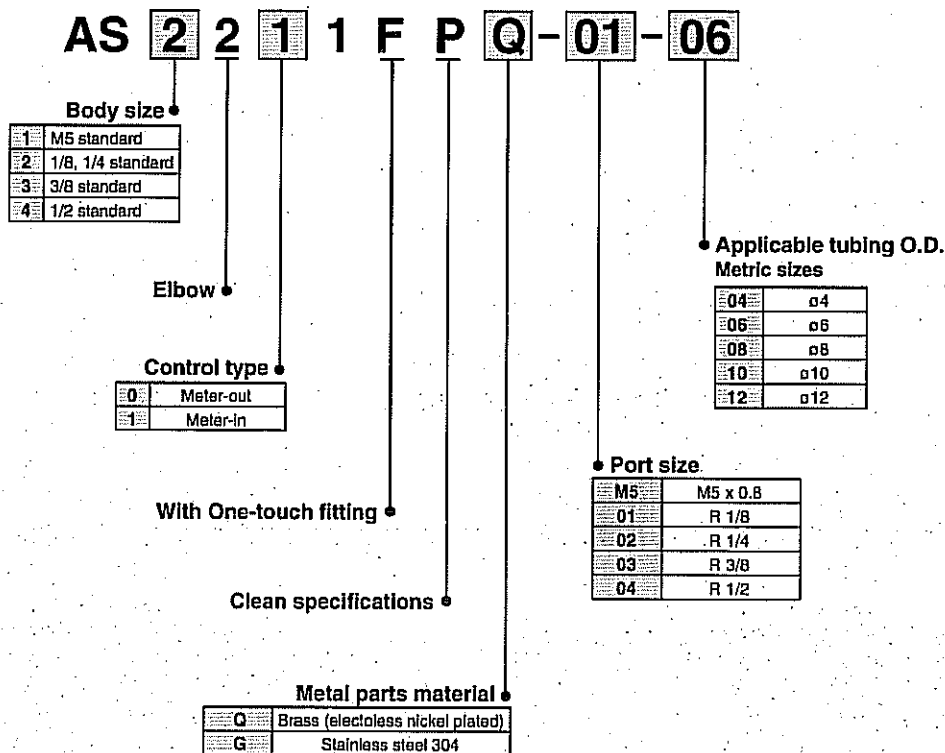
ASR

ASU

LIKE

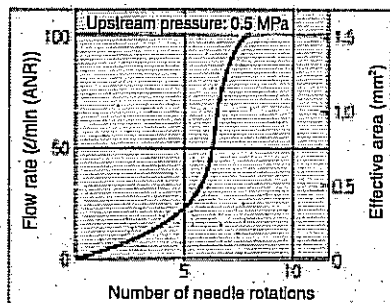
TMH

How to Order

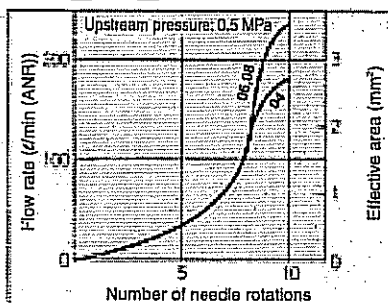


Needle Valve/Flow Characteristics

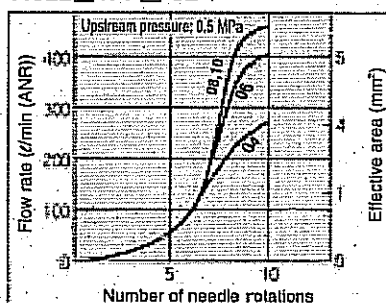
AS12□1FP□-M5



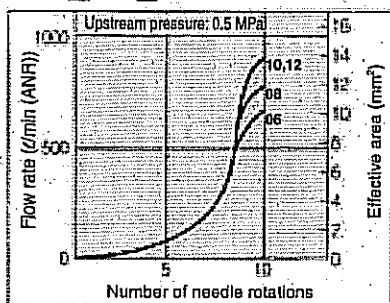
AS22□1FP□-01



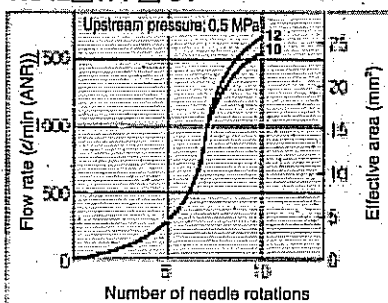
AS22□1FP□-02



AS32□1FP□-03



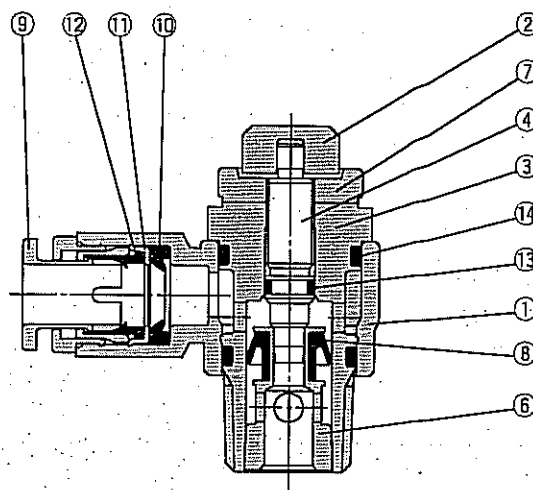
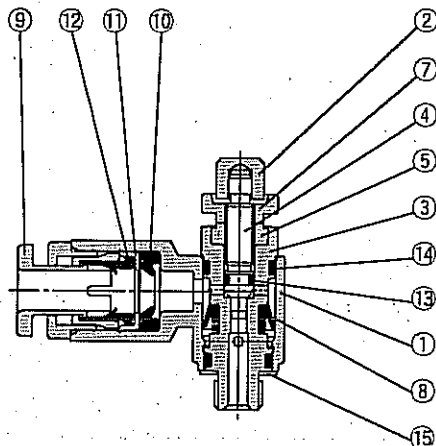
AS42□1FP□-04



Construction

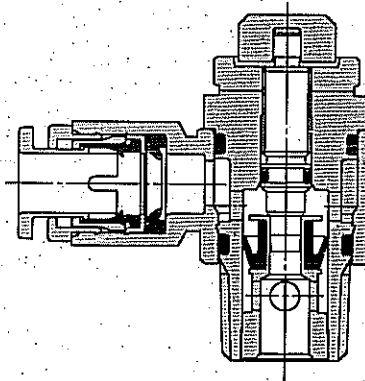
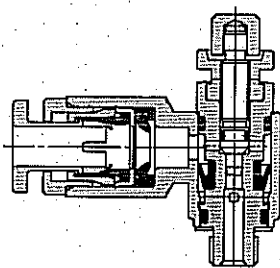
Meter-out type

M5 type



Meter-in type

M5 type



AS

ASP

ASN

AQ

ASV

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VCHC

ASS

ASR

ASQ

KE

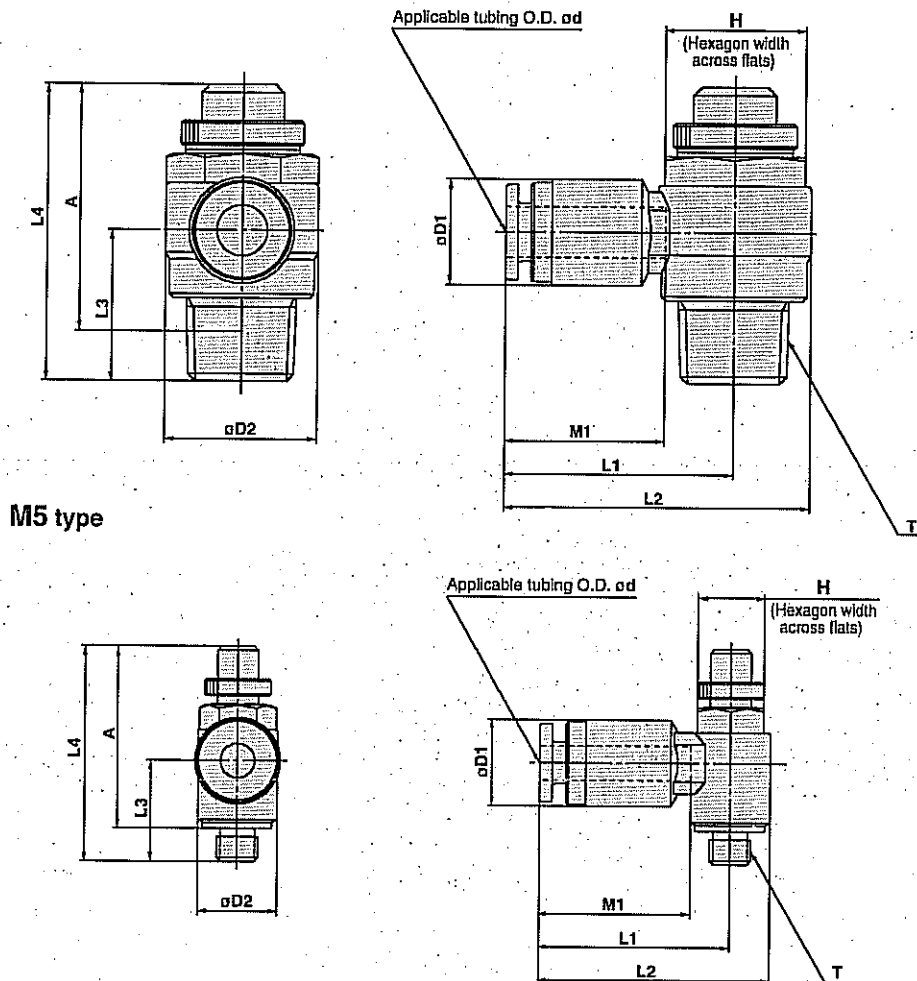
TMH

Component Parts

No.	Description	AS□□□1FPQ		AS□□□1FPG	
		Material	Note	Material	Note
1	Body A	Polypropylene resin		Polypropylene resin	
2	Knob	Brass	Electroless nickel plated	Stainless steel 304	
3	Body B	Brass	Electroless nickel plated	Stainless steel 304	
4	Needle	Brass	Electroless nickel plated	Stainless steel 304	
5	Needle guide	Brass	Electroless nickel plated	Stainless steel 304	
6	Seat ring	Brass	Electroless nickel plated	Stainless steel 304	
7	Lock nut	Brass	Electroless nickel plated	Stainless steel 304	
8	U seal	HNBR		HNBR	
9	Cassette	Polypropylene resin Stainless steel 304, Brass	Brass parts are electroless nickel plated	Polypropylene resin Stainless steel 304	
10	Seal	NBR		NBR	
11	Stopper	Stainless steel 304		Stainless steel 304	
12	Cushlon	NBR		NBR	
13	O-ring	NBR		NBR	
14	O-ring	NBR		NBR	
15	Gasket	NBR, Stainless steel 304		NBR, Stainless steel 304	

Series AS-FPQ/FPG

Dimensions



Model	Tubing O.D. d	T	H	D1	D2	L1	L2	L3 (4)	L4 (1) (4)		A (2)		M1	Mass (g) (3)	
									Max.	Min.	Max.	Min.		1*	2*
AS12□1FP□-M5-04	4	M5 x 0.8	8	10.4	9.6	22.2	27	12.2	28.8	26	25.2	22.4	17	7	7
AS12□1FP□-M5-06	6			12.8		23.2	28	(12.2)	(28.8)	(26)			18.5	8	8
AS22□1FP□-01-04	4	R 1/8	12	10.4	14.2	24.3	31.4	13.4	35.5	30.5	32.4	27.4	17	17	17
AS22□1FP□-01-06	6			12.8		25.3	32.4	(14.3)	(36.4)	(31.4)			18.5	18	18
AS22□1FP□-01-08	8	R 1/4	17	15.2	18.5	27.5	34.6				34.8	29.4	20.5	20	20
AS22□1FP□-02-04	4			10.4		26.8	36						17	33	33
AS22□1FP□-02-06	6			12.8		26.8	36	17.7	40.3	35.3			18.5	33	33
AS22□1FP□-02-08	8			15.2		29.4	38.6	(18.2)	(40.8)	(35.8)			20.5	35	35
AS22□1FP□-02-10	10	R 3/8	19	18.5	23	37.3	46.5	18.3 (18.8)			40.8	35.6	23	38	38
AS32□1FP□-03-06	6			12.8		29.4	40.9						18.5	59	55
AS32□1FP□-03-08	8			15.2		31.9	43.4	19.8	45.8	40.8			20.5	61	57
AS32□1FP□-03-10	10			18.5		33.6	45.1	(20.9)	(46.8)	(41.9)			23	63	59
AS32□1FP□-03-12	12	R 1/2	24	20.9	28.6	34.8	46.3				49.9	42.4	24	66	61
AS42□1FP□-04-10	10			18.5		35.8	49.9	24.5	57.2	49.7			23	107	100
AS42□1FP□-04-12	12			20.9		37.2	51.5	(25.4)	(58.1)	(50.6)			24	109	102

Note 1) Reference dimensions

Note 2) Reference dimension for threads after installation

Note 3) 1* is the weight for type AS□□1FPQ (brass + electroless nickel plated), 2* is the weight for type AS□□1FPG (Stainless steel 304).

Note 4) Dimensions of AS□□1FPQ, (): AS□□1FPG



Series **AS-FPQ/FPG** Specific Product Precautions

Be sure to read before handling. Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

Handling

Caution

1. Store away from direct sunlight at 40°C or less.
2. Open the inner package of the double packaging in a clean room or other clean environment.

Piping

Caution

1. Be sure to use sealant tape or liquid gasket at the taper thread part. Using without sealant tape or liquid gasket can cause air leakage.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR
ASQ

KE

TMH

Flame Resistant (Equivalent to UL-94 Standard V-0) Speed Controller with One-touch Fittings Elbow Type

Series AS

Minimizes installation time and cost

Tube swivels 360°

Application to Inch size tubing

● Metric size
ø6, ø8, ø10, ø12

Maximum operating pressure
1 MPa max.

Applicable tubing materials
FR double layer, FR soft nylon

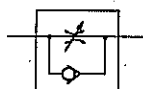
Retainer prevents accidental loss of needle.

Comes standard with seal.

Elbow type



JIS Symbol



Flow Direction Symbols on Body

	Meter-out type	Meter-in type
Symbol		
JIS Symbol		

Model

Elbow type	Port size	Applicable tubing O.D. (mm)				Applicable cylinder bore size (mm)
		6	8	10	12	
AS22□1F-01-□W2	R 1/8	●	●	●		20, 25, 32
AS22□1F-02-□W2	R 1/4	●	●	●		20, 25, 32, 40
AS32□1F-02-□W2	R 1/4	●	●	●	●	40, 50, 63
AS32□1F-03-□W2	R 3/8	●	●	●	●	40, 50, 63
AS42□1F-04-□W2	R 1/2			●	●	63, 80, 100

Note 1) Meter-out and meter-in types can be visually differentiated by the lock nut.

The lock nut on the meter-out type is electroless nickel plated, while the meter-in type is black zinc chromate plated.

Note 2) ● Marking is electroless nickel plated, provided as standard. (N specifications)

Specifications

Fluid	Air
Proof pressure	1.5 MPa
Max. operating pressure	1 MPa
Minl. operating pressure	0.1 MPa
Ambient and fluid temperature	-5 to 60°C (No freezing)
Number of needle rotations	10 turns
Applicable tubing material (Note)	FR double layer, FR soft nylon

Note) Use caution regarding the max. tubing operating pressure.
(Refer to pages 379 and 380 for details.)

Flow Rate and Effective Area

Model	AS22□1F-01	AS22□1F-02			AS32□1F				AS42□1F	
Tubing O.D. (mm)	ø6, ø8, ø10	ø4	ø6	ø8, ø10	ø6	ø8	ø10, ø12	ø10	ø12	
Controlled flow (Free flow)	Flow rate (l/min (ANR))	230	250	390	460	660	790	920	1580	1710
	Effective area (mm²)	3.5	4	6	7	10	12	14	24	26

Note) Flow rate values are measured at 0.5 MPa and 20°C.

Caution

Be sure to read before handling.
Refer to front matters 58 and 59 for Safety Instructions and pages 412 to 414 for Flow Control Equipment Precautions.

AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

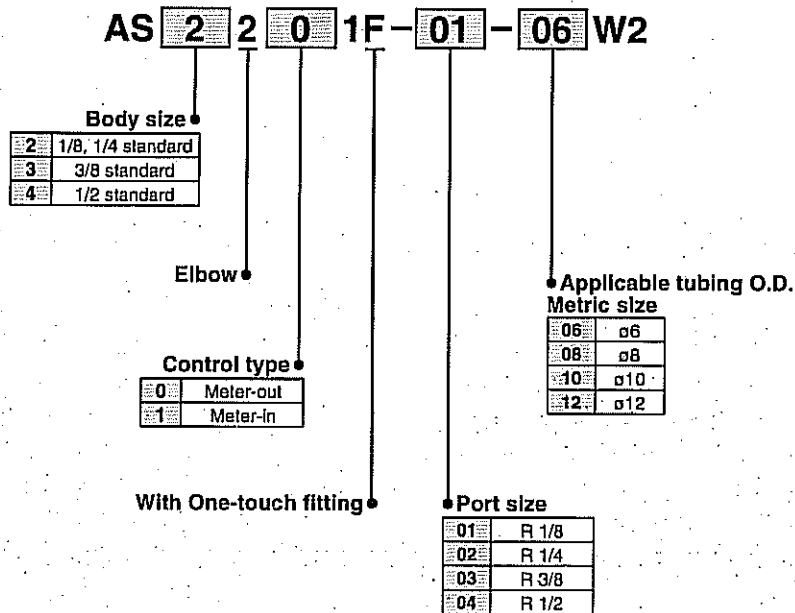
ASR

ASQ

KE

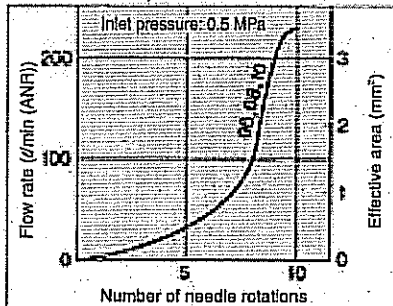
TMH

How to Order

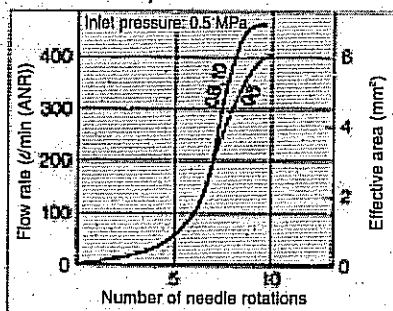


Needle Valve/Flow Characteristics

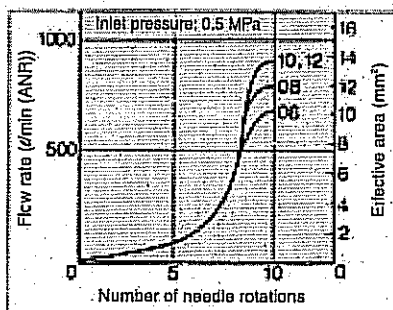
AS2201F-01, AS2211F-01



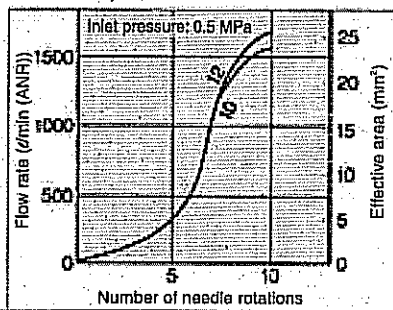
AS2201F-02, AS2211F-02



AS3201F, AS3211F

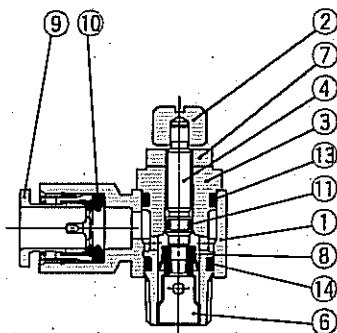


AS4201F, AS4211F

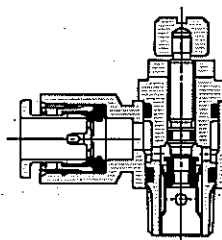


Construction

Meter-out type



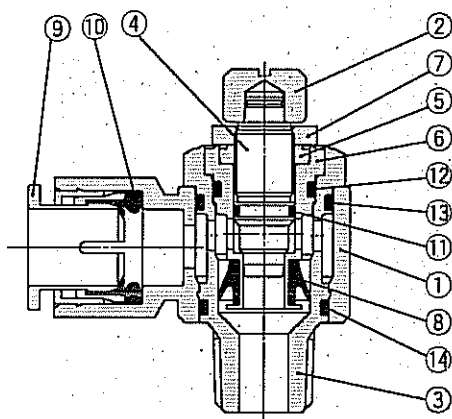
Meter-in type



AS32□1F-02

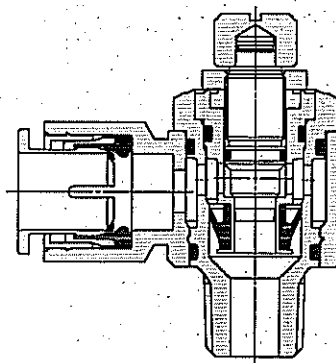
Meter-out type

AS3201F-02



Meter-in type

AS3211F-02



AS

ASP

ASN

AQ

ASV

AK

VCHC

ASS

ASR

ASQ

KE

TMH

Component Parts

No.	Description	Material	Note
1	Body A	Flame-resistant PBT	
2	Handle	Brass	Electroless nickel plated
3	Body B	Brass	Electroless nickel plated
4	Needle	Brass	Electroless nickel plated
5	Needle guide	Brass	Electroless nickel plated
6	Seat ring	Brass	(1)
7	Lock nut	Brass	Electroless nickel plated (2)
8	U-packing	HNBR	
9	Cassette	—	
10	Seal	NBR	
11	O-ring	NBR	
12	O-ring	NBR	
13	O-ring	NBR	
14	O-ring	NBR	

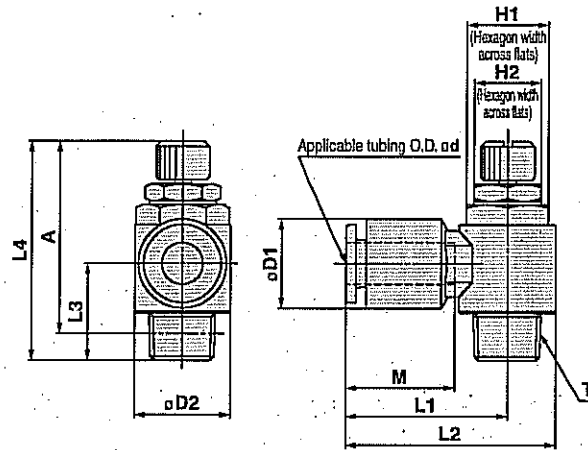
Note 1) AS22□1F, AS32□1F-02: Electroless nickel plated.

Note 2) Meter-in type is black zinc chromate plated.

Series AS



Elbow Type



Metric Size

Model	Applicable tubing O.D. od	T	H1	H2	D1	D2	L1	L2	L3	L4 ⁽¹⁾		A ⁽²⁾		M	Mass (g)
										Max.	Min.	Max.	Min.		
AS22□1F-01-06W2	6	R 1/8	12	10	13.2	14.2	23.9	31	13.4	36.4	31.4	33.3	28.3	17	19
AS22□1F-01-08W2	8				15.2		25.3	32.4						18.5	21
AS22□1F-01-10W2	10				18.5		32.1	39.2	15.2					21	23
AS22□1F-02-06W2	6		17	12	13.2	18.5	25.2	34.4		41.1	36.1	35.6	30.6	17	34
AS22□1F-02-08W2	8				15.2		27.2	36.4	17.7					18.5	36
AS22□1F-02-10W2	10				18.5		35.3	44.5	18.3					21	38
AS32□1F-02-06W2	6	R 1/4			13.2		27.8	39.3		49.9	44.9	44.4	30.4	17	63
AS32□1F-02-08W2	8				15.2		29.5	41	21.3					18.5	65
AS32□1F-02-10W2	10				18.5		31.5	43.1						21	67
AS32□1F-02-12W2	12	R 3/8	19	14	20.9	23	32.8	44.3		47.4	42.4	42.4	37.4	22	69
AS32□1F-03-06W2	6				13.2		27.8	39.3						17	58
AS32□1F-03-08W2	8				15.2		29.5	41						18.5	60
AS32□1F-03-10W2	10				18.5		31.5	43.1	19.8					21	62
AS32□1F-03-12W2	12				20.9		32.8	44.3						22	64
AS42□1F-04-10W2	10	R 1/2	24	17	18.5	28.6	33.6	47.9	24.5	58.7	51.2	51.4	43.9	21	101
AS42□1F-04-12W2	12				20.9		35.2	49.5						22	107

Note 1) Reference dimensions

Note 2) Reference thread dimensions after installation.

Assembly of 1" Safety Relief Valve 8200

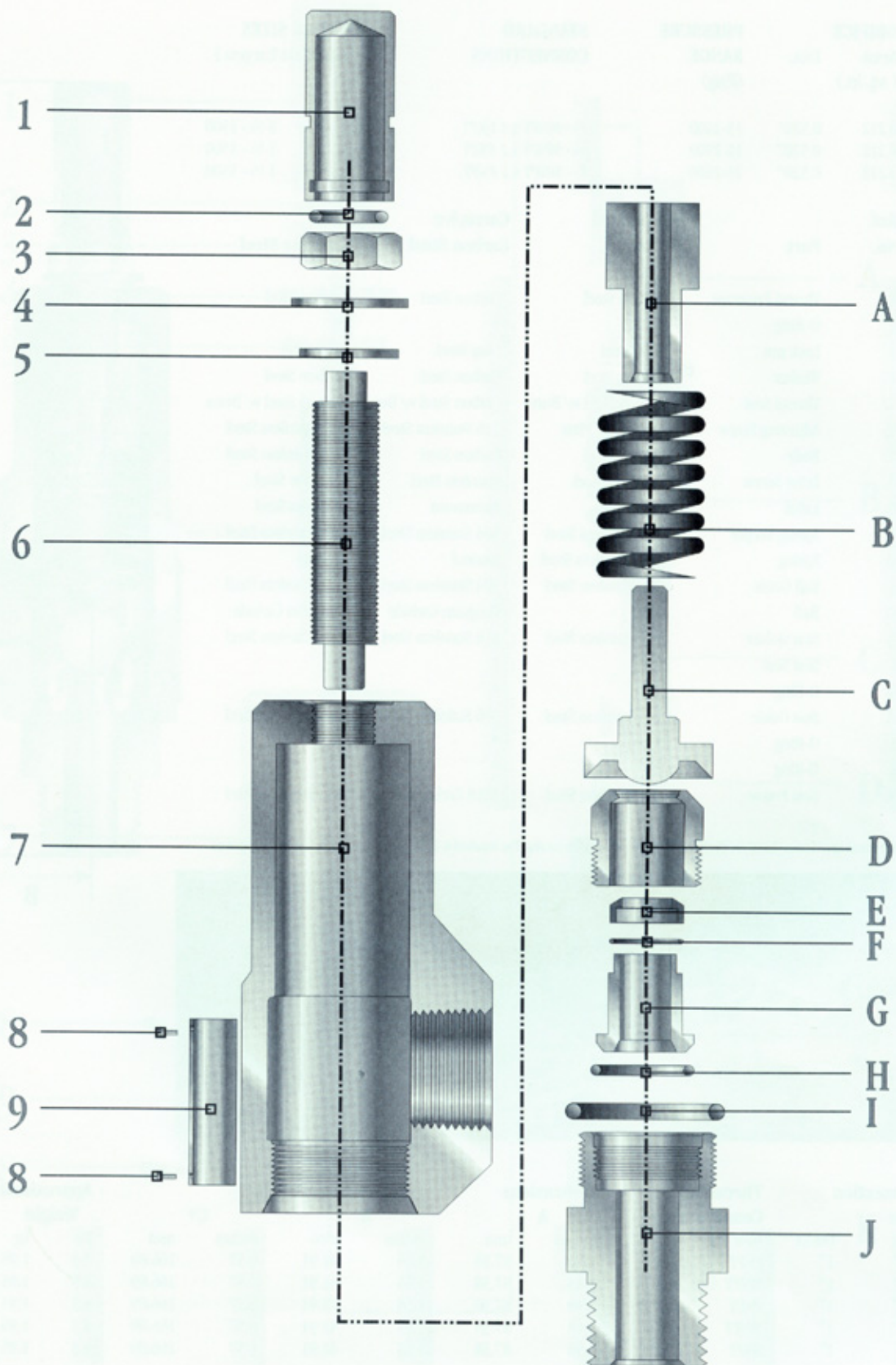
5/98

TAYLOR VALVE TECHNOLOGY, INC.

EXPLODED VIEW OF A 1 INCH A SAFETY RELIEF VALVE

SRV-98

Exploded View of 1" Safety Valve



✕

8300 SW 8th Street * Oklahoma City, Oklahoma 73128

Tel (405) 787 0145 * Fax (405) 789-8198 * Email: info@taylorvalve.com

Bill of Material 1" Safety Relief Valve 8200

5/98

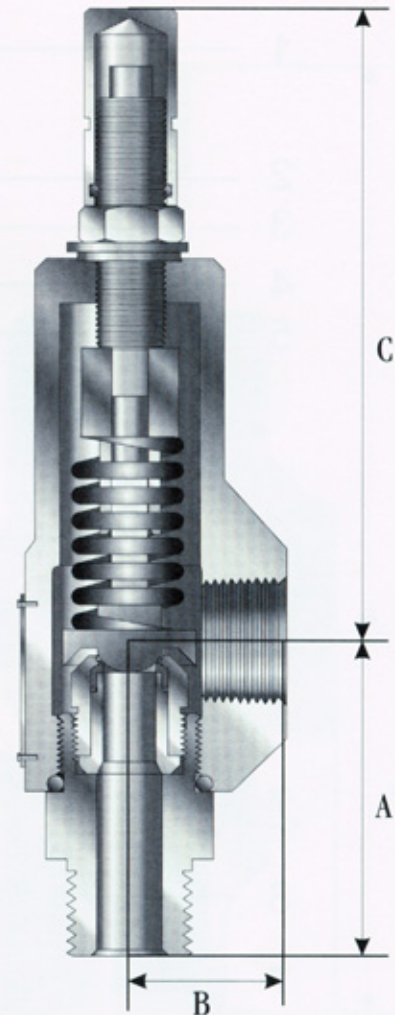
TAYLOR VALVE TECHNOLOGY, INC.

BILL OF MATERIALS 1 INCH SAFETY RELIEF VALVE

SRV-98

ORIFICE Area (sq. In.)	Dia.	PRESSURE RANGE (psig)	STANDARD CONNECTIONS	FLANGE SIZES (Smallest/Largest)	
0.128	D	15-4000	½ - MNPT x 1 FNPT	½ - 150	1 ½ - 1500
0.128	D	15-4000	¾ - MNPT x 1 FNPT	¾ - 150	1 ½ - 1500
0.128	D	15-4000	1 - MNPT x 1 FNPT	1 - 150	1 ½ - 900
0.212	E	15-2500	½ - MNPT x 1 FNPT	½ - 150	1 ½ - 900
0.212	E	15-2500	¾ - MNPT x 1 FNPT	¾ - 150	1 ½ - 900
0.212	E	15-2500	1 - MNPT x 1 FNPT	1 - 150	1 ½ - 900
0.357	F	1500-2000	¾ - FNPT x 1 FNPT	¾ - 150	1 ½ - 600
0.357	F	1500-2000	1 - FNPT x 1 FNPT	1 - 150	1 ½ - 600

Ref. No.	Part	Standard Service	Corrosive Carbon Steel	NACE Stainless Steel
1.	Thread Protector	Carbon Steel	Carbon Steel	Carbon Steel
2.	O-Ring	*	*	*
3.	Lock nut	Alloy Steel	Alloy Steel	Alloy Steel
4.	Washer	Carbon Steel	Carbon Steel	Carbon Steel
5.	Thread Seal	Carbon Steel w/ Buna	Carbon Steel w/ Buna	Carbon Steel w/ Buna
6.	Adjusting Screw	CS /w Zinc Plate	316 Stainless Steel	316 Stainless Steel
7.	Body	Carbon Steel	Carbon Steel	316 Stainless Steel
8.	Drive Screw	Stainless Steel	Stainless Steel	Stainless Steel
9.	Label	Aluminum	Aluminum	Stainless Steel
A.	Spring Keeper	304 Stainless Steel	304 Stainless Steel	304 Stainless Steel
B.	Spring	17.7 Stainless Steel	Inconel	Inconel
C.	Disc	17.4 Stainless Steel	316 Stainless Steel	316 Stainless Steel
D.	Seat Holder	303 Stainless Steel	316 Stainless Steel	316 Stainless Steel
E.	Seat Seal	*	*	*
F.	O-Ring	*	*	*
G.	Seat Guide	303 Stainless Steel	316 Stainless Steel	316 Stainless Steel
H.	O-Ring	*	*	*
I.	O-Ring	*	*	*
J.	Seat Frame	1018 Carbon Steel	1018 Carbon Steel	316 Stainless Steel



* per customer specification based on *Elastomer Chart* provided in this catalog. The Standard is a 75 or 90 durometer fluorocarbon compound.

Connection Size		Threaded Connections		Dimensions A		B		C*		Approximate Weight	
Inlet	Outlet	Inlet	Outlet	inches	mm	inches	mm	inches	mm	lbs	kg
1/2"	1"	FNPT	FNPT	3.44	87.38	1.65	41.91	6.57	166.89	4.3	1.95
1/2"	1"	MNPT	FNPT	3.44	87.38	1.65	41.91	6.57	166.89	4.3	1.95
3/4"	1"	FNPT	FNPT	3.44	87.38	1.65	41.91	6.57	166.89	4.3	1.95
3/4"	1"	MNPT	FNPT	3.44	87.38	1.65	41.91	6.57	166.89	4.3	1.95
1"	1"	FNPT	FNPT	3.44	87.38	1.65	41.91	6.57	166.89	4.3	1.95

* With a lift lever the "C" dimension is 7.66" or 194.56 mm



Bill of Materials for Safety Valve



TREND instruments, inc.
A Division of WIKA Instrument Corporation

General Specifications - Bimetal Dial Thermometers



CASE: Sturdy, corrosion resistant series 304 stainless steel case and bezel. Designed and constructed to provide a hermetic seal which prevents crystal fogging and damage caused by moisture to the working components.

DIAL: Anti parallax heavy gauge aluminum with white matte finish to reduce glare. Dished form with Celsius on lower inner plane and Fahrenheit on raised outer plane offers accurate indication of both scales.

EXTERNAL RESET: A slotted-hex adjustment head offers screwdriver or wrench use to field calibrate the thermometer. This feature allows maximum accuracy at a selected area of temperature range. O-ring gasket prevents leakage and maintains weather tight seal. Note - use well agitated bath and accurate test thermometer when making any adjustment.

CRYSTAL: Optically clear, strong glass, gasketed to maintain weather tight integrity. Acrylic and Lexan crystals are available as an option but not recommended for case temperature exceeding 200°F maximum (150°F maximum for plastic/acrylic lens).

POINTER: Balanced, lightweight aluminum with matte black finish.

STEM: 304 SS welded at tip and case connector to prevent leakage. 1/4" diameter is standard, 3/8" is available. Stem lengths to 72" are available as well as 316SS stem and connector assemblies.

IMMERSION: For accurate temperature readings, immerse the stem a minimum of 2 inches in agitated liquid or 4 inches in moving air or gas.

OVER RANGE: Temporary over or under range of 50% of scale up to 500°F or 260°C will not affect the instrument's accuracy.

BIMETAL 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: Guaranteed to be accurate to within 1% of full scale (Grade A per ASME B40.3). Calibration is to standards traceable to the National Institute of Standards and Technology.

HERMETIC SEAL: Hermetically sealed per ASME B40.3. Guaranteed not to fog up.

DAMPENING: Bimetal element is coated with viscous silicone to minimize pointer oscillation and to improve temperature transmission for ranges from -20° to 400°F.

FILLED THERMOMETER POLICY: It is not recommended that filled instruments be used for continual use at operating temperatures above of 400°F (204°C) or below -100° F (-70° C). Under no circumstances will an instrument warranty apply nor will the manufacturer assume any liability for use above these temperatures.



2" Bimetal Dial Thermometers – Model 20

Model 20 Thermometers are high-quality, economical thermometers designed for limited space and OEM applications

- ***Stainless Steel Case***
- ***Hermetically Sealed***
- ***Tamper-Proof***



CASE: 304 Stainless Steel

DIAL: Anti Parallax or flat dial, heavy gauge aluminum with white matte finish.

CRYSTAL: Fully gasketed glass standard. Lexan and acrylic available.

HERMETIC SEAL: Per ASME B40.3

STEM: 304 Stainless Steel, TIG welded at tip and case connection. 1/4" diameter standard.

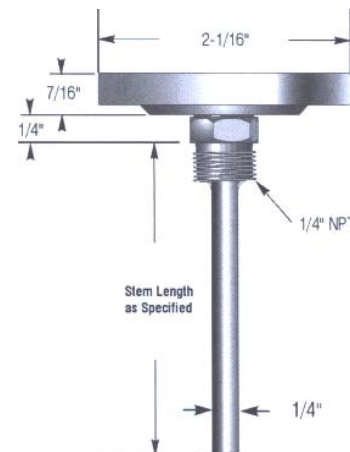
DAMPENING: Helix coated with viscous silicone to minimize pointer oscillation and improve sensitivity (ranges below 500°F).

OVER RANGE: Temporary over or under range *tolerance of* 50% of scale up to 500°F (260°C)

ACCURACY: Guaranteed to 1 % of full scale (Grade A per ASME B40.3 Standard)

CONNECTION: 1/4" NPT, 304 Stainless Steel standard, other connections available.

STEM LENGTHS: (In Inches) 2-1/2" to 24" available



Stem lengths are available from 2-1/2" to 24".

Ranges from - 100 °F (-70 °C) to 1000 °F (550 °C) are available. Please see page 15 for complete stem length, range and option selection. Silicone fill not available on this model.

Back Connected Bimetal Thermometers Model 30 & 50



- **Stainless Steel Case**
- **Hermetically Sealed**
- **External Adjustment Screw Standard**

TREND Bimetal Thermometers are ideal for most rugged industrial temperature measurement applications. The hermetically-sealed case offers protection from weather and dust, and is guaranteed against fogging up. The bimetal helix is coated with a viscous silicone to minimize pointer oscillation and improve temperature transmission.

SPECIFICATIONS

CASE: 304 Stainless Steel

DIAL: Anti Parallax, heavy gauge aluminum with white matte finish.

EXTERNAL RESET Slotted hex adjustment

CRYSTAL: Fully gasketed glass standard. Lexan, acrylic and shatterproof available.

HERMETIC SEAL: Hermetically sealed per ASME B40.3 Standard. **GUARANTEED NOT TO FOG UP**

STEM: 304 Stainless Steel, TIG welded at tip and case connection. 1/4" diameter standard; 3/8" diameter available.

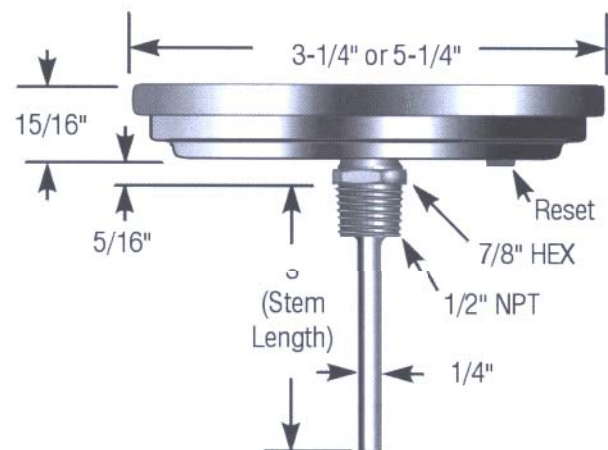
DAMPENING: Helix coated with viscous silicone to minimize pointer oscillation and improve sensitivity (ranges below 500°F).

OVER RANGE: Temporary over or under range tolerance of 50% of scale up to 500°F (250°C) **ACCURACY:** Guaranteed to 1% of full scale (Grade A per ASME B40.3 Standard)

CONNECTION: 1/2" NPT, 304 Stainless Steel standard, other connections and 316 Stainless Steel available.

STEM LENGTHS: (In Inches) 2-1/2, 4, 6, 9, 12, 15, 18, 24, up to 72" upon application.

OPTIONS: Silicone Fill, Custom Dials, Min-Max Pointer, Union Locknut, Union Connection and more available.



Back Connected (Models 30 & 50)

Bottom Connected Bimetal Thermometers Model 31 & 51

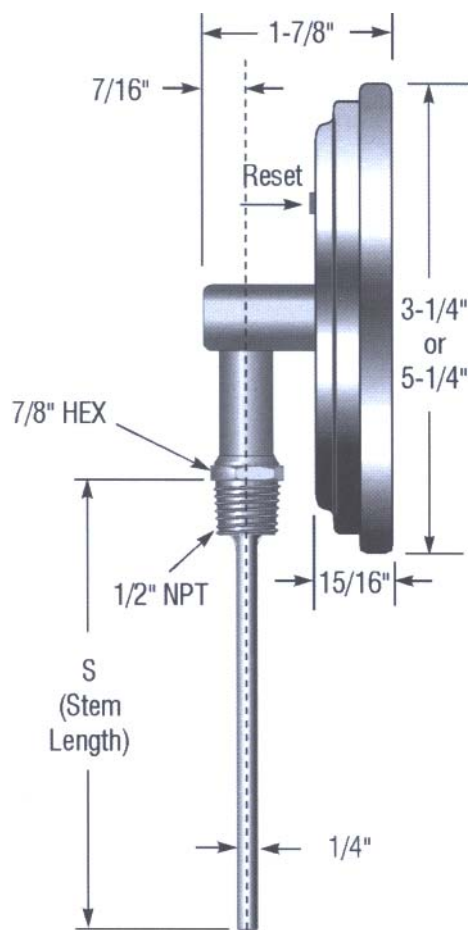


- **Stainless Steel Case**
- **Hermetically Sealed**
- **External Adjustment Screw Standard**



TREND Model 31 and 51 Bimetal Thermometers offer the same features as the Model 30 and 50, with a fixed lower mount (bottom) connection. The hermetically-sealed case offers protection from weather and dust, and is guaranteed against fogging up. The bimetal helix is coated with a viscous silicone to minimize pointer oscillation and improve temperature transmission.

SPECIFICATIONS



CASE: 304 Stainless Steel

DIAL: Anti Parallax, heavy gauge aluminum with white matte finish.

EXTERNAL RESET Slotted hex adjustment

CRYSTAL: Fully gasketed glass standard. Lexan, acrylic and shatterproof available.

HERMETIC SEAL: Hermetically sealed per ASME B40.3 Standard. GUARANTEED NOT TO FOG UP

STEM: 304 Stainless Steel, TIG welded at tip and case connection. 1/4" diameter standard; 3/8" diameter available.

DAMPENING: Helix coated with viscous silicone to minimize pointer oscillation and improve sensitivity (ranges below 500°F).

OVER RANGE: Temporary over or under range tolerance of 50% of scale up to 500°F (260°C)

ACCURACY: Guaranteed to 1 % of full scale (Grade A per ASME B40.3 Standard)

CONNECTION: 1/2" NPT, 304 Stainless Steel standard, other connections and 316 Stainless Steel available.

STEM LENGTHS: (In Inches) 2-112, 4, 6, 9, 12, 15, 18, 24, up to 72" upon application.

OPTIONS: Silicone Fill, Custom Dials, Min-Max Pointer, Union Locknut, Union Connection and more available.

Bottom Connected (Models 31 & 51)

TREND instruments, inc.
A Division of Wika Instrument Corporation

Tamper-Proof Bimetal Thermometers Models 33, 34, 53 & 54



TREND's Industrial Grade Bimetal Dial Thermometers offer performance equal to our Process-Grade thermometers, but without the reset feature and the 7Year Warranty. They are an ideal choice where a weather-resistant, tamperproof thermometer is needed. They are warranted for 1 year.

- Stainless Steel Case
- Hermetically Sealed
- Tamper-Proof

SPECIFICATIONS

CASE: 304 Stainless Steel

DIAL: Anti Parallax, heavy gauge aluminum with white matte finish.

CRYSTAL: Fully gasketed glass standard. Lexan, acrylic and shatterproof available.

HERMETIC SEAL: Per ASME B40.3

STEM: 304 Stainless Steel, TIG welded at tip and case connection. 1/4" diameter standard.

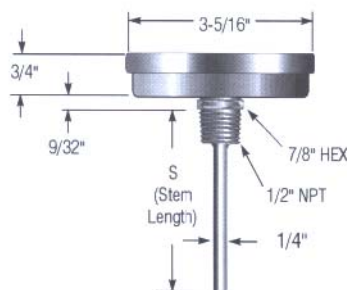
ACCURACY Guaranteed to 1 % of full scale (Grade A per ASME B40.3 Standard)

CONNECTION: 112" NPT, 304 Stainless Steel standard.

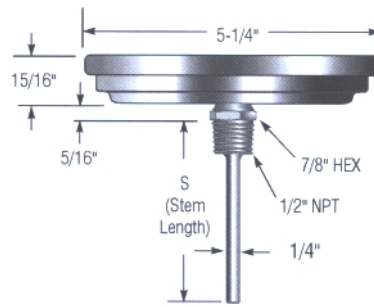
OPTIONS: Special ranges, custom dials, stems, connections and windows.

OVER RANGE: Temporary over or under range tolerance of 50% of scale up to 500°F (260°C).

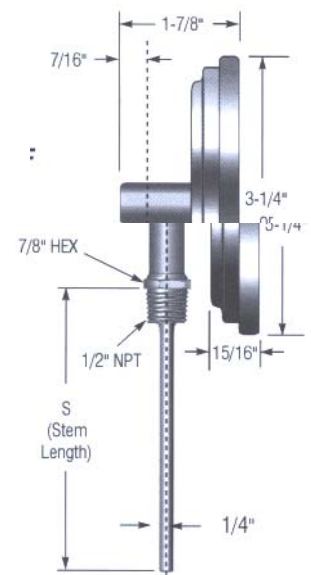
Stem lengths are available from 2-1/2" to 24". Ranges from -100°F (-70 °C) to 1000 °F (550°C) are available.



Back Connected Model 33



Back Connected Model 53



Bottom Connected (Models 34 & 54)

Adjustable Angle Bimetal Thermometers Model 32 & 52

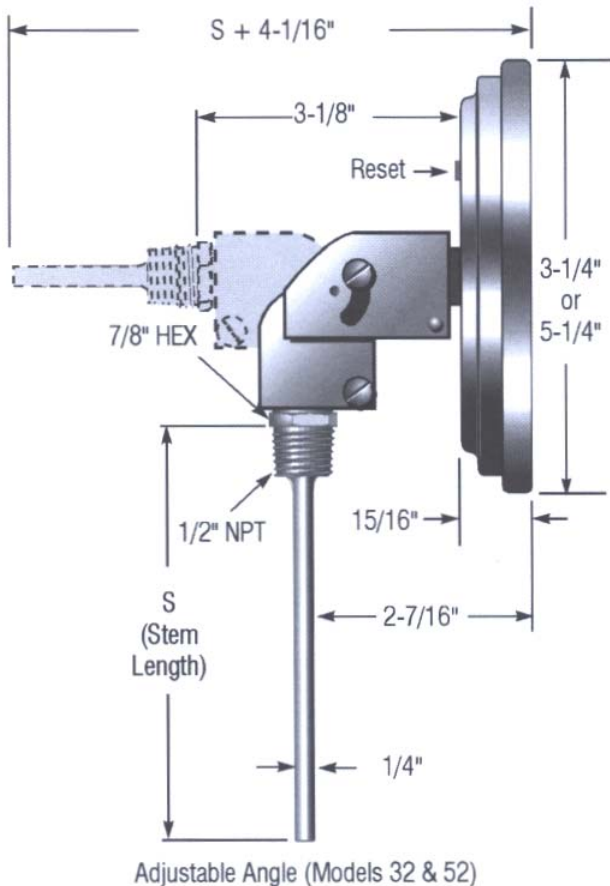


- *Dial Adjusts to Any Angle*
- *Stainless Steel Case*
- *Hermetically Sealed*
- *External Adjustment Screw Standard*



TREND Model 32 and 52 Bimetal Thermometers offer the same features as the Model 30 and 50, with the added convenience of an all-angle swivel connection. The hermetically-sealed case offers protection from weather and dust, and is guaranteed against fogging up. The bimetal helix is coated with a viscous silicone to minimize pointer oscillation and improve temperature transmission. TREND Model 32 and 52 Thermometers are guaranteed for 7 years.

SPECIFICATIONS



CASE: 304 Stainless Steel

DIAL: Anti Parallax, heavy gauge aluminum with a white matte finish.

EXTERNAL RESET: Slotted hex adjustment

CRYSTAL: Fully gasketed glass standard. Lexan, acrylic and shatterproof available.

HERMETIC SEAL: Hermetically sealed per ASME B40.3 Standard. GUARANTEED NOT TO FOG UP

STEM: 304 Stainless Steel, TIG welded at tip and case connection. 1/4" diameter standard; 3/8" diameter available.

DAMPENING: Helix coated with viscous silicone to minimize pointer oscillation and improve sensitivity (ranges below 500°F).

OVER RANGE: Temporary over or under range tolerance of 50% of scale up to 500°F (260°C)

ACCURACY: Guaranteed to 1 % of full scale (Grade A per ASME 840.3 Standard)

CONNECTION: 1/2" NPT, 304 Stainless Steel standard, other connections and 316 Stainless Steel available.

STEM LENGTHS: (In Inches) 2-1/2, 4, 6, 9, 12, 15, 18, 24, up to 72" upon application.

OPTIONS: Silicone Fill, Custom Dials, Min-Max Pointer, Union Locknut, Union Connection and more available.

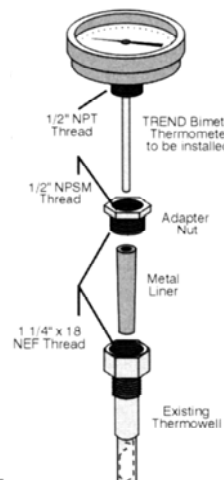
JUST -RITE* ADJUSTABLE ANGLE CASE: Simple adjustment of the heavy duty stainless steel harness allows case rotation of 360° and stem variation of more than 180°. Flexible stainless steel bellows sealed at case and stem connector protects the temperature transmission mechanism and guarantees the hermetic seal.

Bimetal Thermometer Options

I

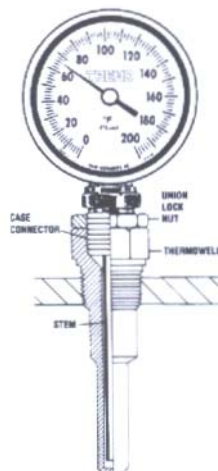
T-85 Thermowell Conversion Kit

This conversion kit offers an easy, inexpensive way to install a TREND Bimetal thermometer in a glass industrial thermometer's thermowell. For more information, please consult factory. To order, specify Part Number TA800-0T85.



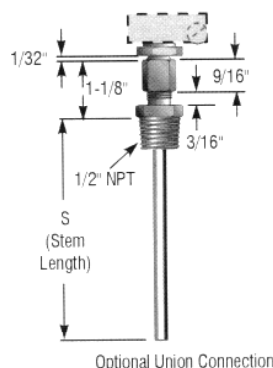
Union Lock Nut

The TREND Union Lock Nut provides a simple and inexpensive means to mount WIKA Bimetal thermometers with 112 NPT so that the dial is oriented for proper viewing. For more information, please consult factory. To order, specify part number TA600-01 11.



Adjustable Union Connection

The TREND Adjustable Union Connection allows for the installation of a Model 32 or 52 Adjustable Angle Thermometer without rotating the case. Ideal for use in a confined space. See "How To Order" on next page for this option.



Maximum or Minimum Indicating Pointer

This option allows operator to view what the highest or lowest temperature has been in the process. High vibration environments are not recommended. Please see "How To Order" on next page for this option.



Left, Right or Top Connection

All TREND 3" and 5" Bottom Connected thermometers are available with the connection oriented to the left, right or top. Please see "How to Order" on next page for this option.



Silicone

All TREND 3" and 5" Process-Grade bimetal thermometers are available with Silicone Fill, for applications where severe vibration is a factor. The silicone dampens and lubricates the internal mechanism, reducing oscillation and premature wear. (Maximum temperature: 501500°F) Please see "How to Order" on next page

Duct Flange

Part # TA800-0020



Not Shown

- Heavy duty 3/8" stems and 3/8" stems with 2-1/2" x 1/4" OD sensitive portion available.
- Thermometers may be ordered with sharp tips for piercing media to be measured.
- 316 Stainless Steel wetted parts are available.
- Paper, Aluminum and Stainless Steel tags are available options.
- Please see these options on Table 8 of "How To Order" on next page.

Other options are available. Please consult factory.

Tags and Certificates

Part #	DESCRIPTION
141100	Stainless Steel Tag
776	Certificate of Calibration
413	Factory Certificate of Accuracy

How to Order Bimetal Thermometers

Specify Complete Model Number from the following tables:

KEY	MODEL NUMBER	30	060	A	0	01	G	4	XX
TABLE 1:	BASIC MODEL								
TABLE 2:	STEM LENGTH								
TABLE 3:	DIAL TYPE (LOGO)								
TABLE 4:	SCALE TYPE (F, C OR F & C)								
TABLE 5:	RANGE								
TABLE 6:	CRYSTAL MATERIAL								
TABLE 7:	CONNECTION								
TABLE 8:	OPTIONS (3" & 5" ONLY)								

Table 1 - Model

KEY	DESCRIPTION
20	2" Back Connected (No Reset)
30	3" Back Connected (With Reset)
31	3" Bottom Connected (With Reset)
32	3" Adjustable Angle (With Reset)
33	3" Back Connected (No Reset)
34	3" Bottom Connected (No Reset)
50	5" Back Connected (With Reset)
51	5" Bottom Connected (With Reset)
52	5" Adjustable Angle (With Reset)
53	5" Back Connected (No Reset)
54	5" Bottom Connected (No Reset)

Table 2 - Stem Length

KEY	DESCRIPTION
xx.x	Length in inches with one decimal place

Table 3 - Dial Type

KEY	DESCRIPTION
A	TREND Standard
X	Special

Proceed to Table 4, top of next column.

Table 5 - Range

Key	Dual Scale						Single Scale	
	°F Range	Figure Int. Div.	Figure Int. Div.	°C Range	Figure Int. Div.	Figure Int. Div.	°F Range	°C Range
01	-100/150	20	2	-70/70	10	1	-100/150	-70/70
02	-40/120	20	2	-40/50	10	1	-40/120	-50/50
14	-20/120	20	2	-30/50	10	1	-20/120	NA
19	-40/160	20	2	-40/70	10	1	-40/160	NA
*23	0/100	10	1	-20/40	5	1/2	NA	NA
*03	25/125	10	1	-5/50	5	1/2	NA	NA
*15	30/130	10	1	0/55	5	1/2	30/130	NA
04	0/140	10	1	-20/60	5	1/2	0/140	NA
05	0/200	20	2	-15/90	10	1	0/200	0/100
06	0/250	20	2	-20/120	10	1	0/250	-20/120
07	20/240	20	2	-5/115	10	1	20/240	NA
08	50/300	20	2	10/150	10	1	50/300	0/150
09	50/400	50	5	10/200	20	2	50/400	0/200
10	50/500	50	5	10/260	20	2	50/500	NA
16	50/550	50	5	10/290	20	2	50/550	0/250
17	0/600	100	10	-20/315	50	5	0/600	NA
11	150/750	100	10	65/400	50	5	150/750	0/300
18	100/800	100	10	40/425	50	5	100/800	0/450
12	200/1000	100	10	100/450	50	5	200/1000	100/550

Table 4 - Scale Type

KEY	DESCRIPTION
0	Dual Scale Fahrenheit and Celsius
1	Single Scale Celsius Only
2	Single Scale Fahrenheit Only

Table 5 - Range (See Bottom of Page)

Table 6 - Crystal Material

KEY	DESCRIPTION
A	Acrylic Plastic (Standard w/Silicone Fill)
G	Plain Glass (Standard)
L	Lexan®
S	Shatterproof Safety Glass (3" & 5" Dials Only)

Table 7 - Connection

0	Plain (Unthreaded)
1	1/8" NPT
2	1/4" NPT (Standard on Model 20)
3	3/8" NPT
4	1/2" NPT (Standard on 3" & 5" Models)
5	1/2" BSP (Models 30 & 50 Only)
7	1/2" NPT Adjustable Union (Models 32 & 52)

Table 8 - Options (3" & 5" Models)

Blank	None
SF*	Silicone Filled - (Models 30, 31, 32, 50, 51, 52 Only)
MM	Min/Max Pointer (Models 30 and 50 Only)
LS	Left Side Connection (Models 31, 34, 51, 54 Only)
RS	Right Side Connection (Models 31, 34, 51, 54 Only)
TS	Top Connection (Models 31, 34, 51, 54 Only)
HD	3/8" Heavy Duty Stem with 2-1/2" x 1/4" O.D. Sensitive Tip
HA	3/8" Heavy Duty Stem Entire Length
ST	Sharp Tip
SS	316 Stainless Steel Wetted Parts
DF	Dry w/plug

*Requires Acrylic lens



***Not available with 2-1/2" stem on Models 31, 32, 34, 57, 52, 54**



Bourdon Tube Pressure Gauges

All Stainless Steel Construction

Industrial Series Liquid Fillable • Type 23X.53

Pressure Gauges

Application

Suitable for corrosive environments compatible with 316 stainless steel wetted parts, dry and liquid fillable case, where vibration and/or pressure pulsation occur in liquid or gaseous media which will not obstruct the pressure system.

Sizes (All sizes not stocked)

2", 2½" and 4" (50, 63 and 100 mm)

Accuracy

2", 2½" ± 1.5% of span

4" ± 1.0% of span (ASME B40.1 Grade 1A)

Ranges (All ranges not stocked)

Vacuum / Compound to 30"HG / 0 / 200 PSI

Pressure from 15 PSI to 15,000 PSI

or other equivalent units of pressure or vacuum

Working Range

2" & 2½" Steady: 3/4 of full scale value

Fluctuating: 2/3 of full scale value

Short time: full scale value

4"

Steady: Full scale value

Fluctuating: 0.9 x full scale value

Short time: 1.3 x full scale value

Operating Temperature

Ambient: -40°F to 140°F (-40°C to 60°C) ^{Note 1}

Media: max. 212°F (+100°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

Material: 316 stainless steel

Lower mount (LM)

Center back mount (CBM) 2½"

Lower back mount (LBM) 4"

1/4" or 1/2" NPT limited to wrench flat area

Bourdon Tube

Material: 316 stainless steel

30"Hg (Vac) to 1000 PSI C-type - 2" & 2½"

30"Hg (Vac) to 1500 PSI C-type - 4"

1500 PSI to 15,000 PSI helical type - 2" & 2½"

2000 PSI to 15,000 PSI helical type - 4"

Movement

Stainless steel

Dial

White aluminum with black lettering. 2½" with stop pin.

Pointer

Black aluminum, non-adjustable

Case

304 stainless steel with vent plug and SS crimping ring.

Welded case/socket connection



Weather Protection

Weather resistant (NEMA 3 / IP 54) - dry case

Weather tight (NEMA 4X / IP 65) - liquid-filled case

Standard Scale

PSI

PSI, PSI/BAR, PSI/KPA, PSI/KG/CM² (2½" CBM)

Window Gasket

Buna-N

Case Filling

232.53 - None

233.53 - Glycerine

Window

Polycarbonate

Acrylic (4")

ORDER OPTIONS (min. order may apply)

Custom dial layout

Steel zinc plated u-clamp bracket (field installable)

Stainless steel u-clamp bracket (field installable)

Pressure compensating membrane window for filled gauges

Stainless steel polished front flange (CBM or LBM only)

Stainless steel rear flange

316 SS threaded restrictor

Glycerine, silicone, or fluorolube case filling (**Type 233.53**) ^(Note 1)

Special connections limited to wrench flat area

Other pressure scales available:

Bar, kPa, MPa, Kg/cm² and dual scales

DIN standards

Cleaned for oxygen service

Externally adjustable red drag pointer (max. hand)

Externally adjustable red mark pointer (set pointer)

Note 1 Temperature Ranges (Liquid filled gauges)

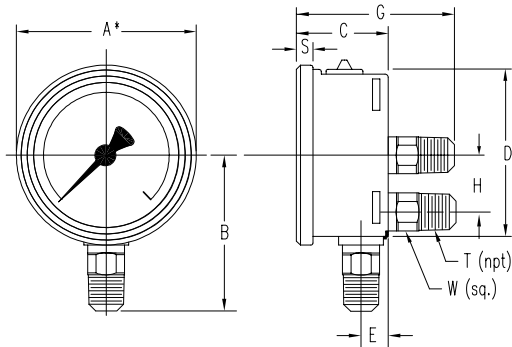
Glycerine: -4°F to 140°F (-20°C to 60°C)

Silicone: -40°F to 140°F (-40°C to 60°C)

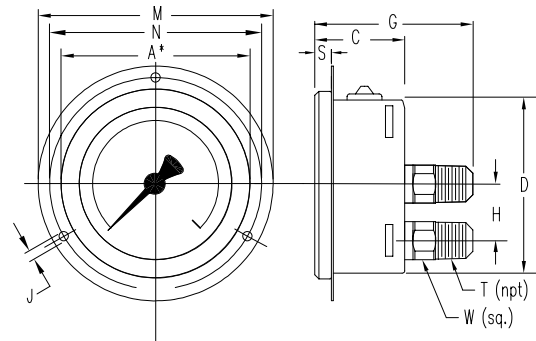
APM 23X.53

(APM 02.13)

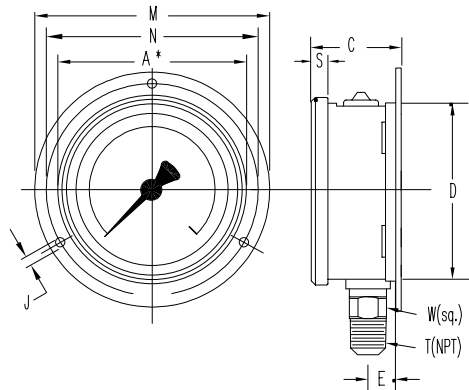
Dimensions:



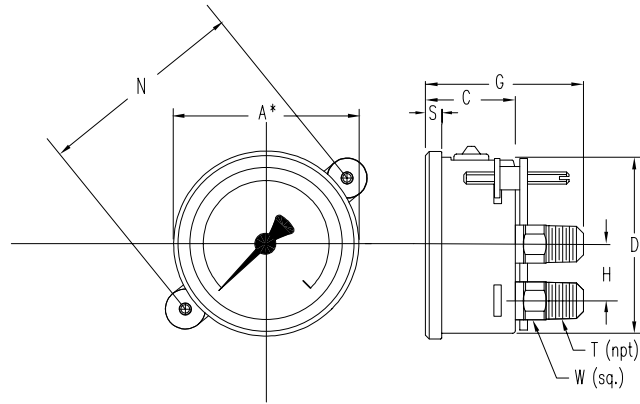
23X.53 LM/CBM/LBM



23X.53 CBM/LBM/FF



23X.53 LM/RF



23X.53 CBM/LBM/UC

A* NOMINAL SIZE

TYPE/SIZE	WEIGHT	KEY	A*	B	C	D	E	G	H	J	L	M	N	S	T	W
23X.53 2"	0.27 lbs. + 0.06 lbs. if filled	mm	50	48	30	50	12	53	--	3.6	6.5	71	60	5.5	--	14
		in	2	1.89	1.18	1.97	0.47	2.09		0.14	0.26	2.80	2.36	0.22	1/4"	0.55
23X.53 2.5"	0.36 lbs. + 0.08 lbs. if filled	mm	63	54	32	62	13	54	--	3.6	7.5	85	75	6.5	--	14
		in	2.5	2.13	1.26	2.44	0.51	2.13		0.14	0.30	3.35	2.95	0.26	1/4"	0.55
23X.53 4"	1.10 lbs. + 0.66 lbs. if filled	mm	100	87	48	100	15.5	79.5	30	4.8	9	132	116	8	--	22
		in	4	3.43	1.89	3.94	0.61	3.13	1.18	0.19	0.35	5.20	4.57	0.31	1/2"	0.87

NOTE: For 1/4" NPT connections on 3" and 4" gauges, reduce B* dimension by 5 mm / 0.02 in.

Panel cut-out dimensions: D + 1mm

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



WIK A Instrument Corporation

1000 Wiegand Boulevard

Lawrenceville, Georgia 30043-5868

Tel: 770-513-8200 Fax: 770-338-5118

<http://www.wika.com> e-mail: info@wika.com