HUSKY OIL OPERATIONS LTD.

LSD:

OPERATION MANUAL

16" x 7'6" s/s 600 ANSI SEPARATOR/METER SKID UNIT, 3 PHASE CONTROLS, SCADA, 3" SENIOR METER RUN, 15,000 LITRE TANK, 2" 900# INLET ESDV VALVE

Manufactured By:

R.J.V. Gas Field Services

4901-Bruce Road, Vegreville, Alberta, T9C 1C3 Phone (780) 632-7774 - Fax (780) 632-6820

R.J.V JOB# NO.: 07-4220

UNIT NO.: 14072

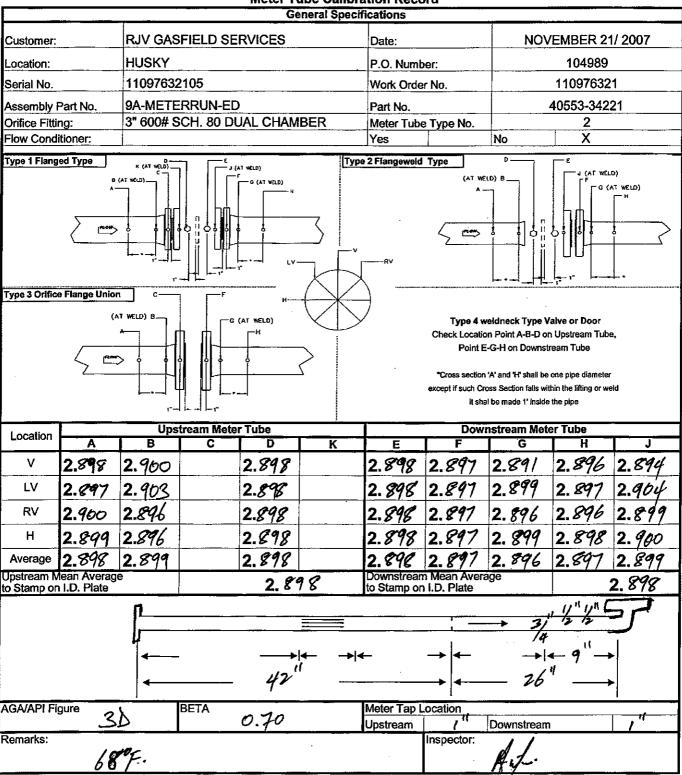
R.J.V. GAS FIELD SERVICES LTD. UNIT IDENTIFICATION SHEET

		UNIT IDENTIFIC	CATION SHEET						
COMPANY: HUS	KY OIL OPERA	TIONS	JOB # 07-4220	UNIT# 140	72				
PO#	AFE#		SO#	# 07-4220 - 1					
REQUESTED BY:	SAEED DEVARI	LOCATIO	ON:	AREA:					
			ASE VERTICAL MIST						
			NIT c/w 3" 600 ANSI :	SENIOR MET	ER RUN, 3" 600# Al	NSI			
INLET AND OUTLE DESCRIPTION	T CONNECTION	MAKE	MODEL		SERIAL				
		Nu Flo	3" 600# Sch 40 SR		11097632105				
METER RUN		Fisher	Model Flo Boss 103		17958142				
MVS			Model TC		116389-75				
RTD	CMITTED	Aircom Wika	Model E-10, 0-3000	DSI	2601D9D				
PRESSURE TRAN	SWITTER	R.J.V. Gas Field	16" x 7'6"s/s 600# 3		11373	A#584719			
SEPARATOR		- ·····	2 2" NPT, Type L2	TIAOL	18184110	18184098			
LEVEL CONTROL	VALVE		2 1" NPT, Type D2		10104110	10101000			
LEVEL CONTROL SIGHT GLASS	VALVE	Penburthy	#1TM5 & 1RL5 Refl	ex c/w #330.1	GAUGE COCKS				
PRESSURE	VESSEL	Taylor	1" x 1" NPT, Model		37395-306				
SAFETY VALVE	FUEL GAS	Taylor	1" x 1" NPT, Model		37628-70				
PREAMP	I OLL GAS	Nu Flo	7 7 1, 1, 11, 11, 11, 11, 11, 11, 11, 11		1131				
TURBINE		Turbines Inc			2491-83				
ELECTRO-MAGNE	TIC PICK LIP	Turbines Inc	K-Factor		912.85				
METHANOL INJEC			2 Model CL113		2762	2759			
PSV	7770117 0711	Tarpon	750-1500 psi		EDV-327				
PSV		Tarpon	3000-4000 psi		EDV-804				
PRESSURE CONT	ROLLER	Dyna Flo	Model 4000		P126112-01				
PRESSURE REGU		Kimray	3" 600# ANSI RF M	lotor Valve	2073470164				
PRESSURE PILOT		cvs	Type 7970		PP9615				
HI LO PRESSURE		Fisher	Type 4660		P126112-22				
SWITCHING VALV		Amot	1/4" NPT Model 40	57D025H2	T2737				
SOLENOID VALVE		Asco	1/4" NPT EF8314G		A13440				
HEATER			2 BX24X24 24,000 E		366660	366661			
GLOBE VALVE		Panam	1" 800# npt		P181				
GLOBE VALVE		Panam	2" 800# npt		P2266				
GLOBE VALVE		Panam	3" 1500# RF		P4802				

COMPANY: HUS	SKY OIL OPERA	TIONS JOB #07-4220 U		UNIT# 14072				
PO#	AFE#		SO#	DRAWING	# 07-4220 - 1			
REQUESTED BY:	SAEED DEVARI	LOCATIO	on:	AREA:	AREA:			
ESDV		Dyna Flo	Model DSR-100 c/w 2	" 1500# b/v	942114-007			
RADIO CONTROL	вох	R.J.V. Gas Field	36" x 42" x 16" L-Shaj	ped	070307			
FUEL GAS SCRUE	BBER	R.J.V. Gas Field	8" x 30" S/S, 975 PSI	SPRING RA	NGE	11309		
TANK		Hugesteel	15,000L DW Above G	Ground	52071888			
PRESSURE	FUEL GAS	Bel Gas	1" NPT, P627, 70-150 PSI, SPRING RANGE					
REGULATOR	INSTRUMENT	Bel Gas	1/4" NPT, Type P50, 0-60 PSI, SPRING RANGE					
VALVES	INSTRUMENT	Bel Gas	1/4" NPT, Type P50, 0-120 PSI, SPRING RANGE					
	INSTRUMENT	Bel Gas	5 1/4" NPT, Type P50,	1/4" NPT, Type P50, 0-60 PSI, SPRING RANGE				
SKID		R.J.V. Gas Field	10'x21'4" c/w 6"@ 8.2 C	:H, 6"@15 Та	ank Beams, 3/16" CH PL			
BUILDING		R.J.V. Gas Field	10' x 16' x 10' -9'6" EA	AVE PANEL	TYPE WHITE/WHITE			
HLSD Wellmark			ST2TP-97					
		TESTER: MARVIN H	HOMENIUK		TANK: 500G D/W 65070466			
TESTING DATE: J		SHIPPING DATE:		DELIVERY:				



Meter Tube Calibration Record





www.c-a-m.com Phone: 780.468.2941 5151-67th Ave., Edmonton, AB. T6B 2R8 rev.3 01/02/07





Certificate of Authorization

Quality Control Program

Expiry Date: December 9, 2007

Reg. No.: AQP-5046

This is to certify that:

NUFLO MEASUREMENT SYSTEMS A NUFLO TECHNOLOGIES COMPANY

9207 - 34A AVENUE EDMONTON, ALBERTA

having complied with the provisions of the SAFETY CODES ACT, is hereby authorized to:

Manufacture Category 'F' Fittings in accordance with CSA B51 at the above SHOP address.



Dated at Edmonton, this 3rd day of March, 200

Chief Inspector and Administrato

Certificate No.: 4486

Form No. AB-121



Meter Tube Calibration Record

Meter Tube Calibration Record General Specifications											
Customer: RJV GASFIELD SERVICES Date: NOVEMBER 21/ 2007											
			ILLD SLIVIOLS			7 2001					
Location:		HUSKY	405		P.O. Number: 104989						
Serial No.		11097632			Work Order	NO.		11097632			
Assembly F		9A-METE	RRUN-ED CH. 80 DUAL CHAM	DED	Part No.	Type No	<u> </u>	40553-3422 2	21		
Orifice Fittin		3 000# 3	SH. 60 DUAL CHAIN	BEN	Meter Tube	туре но.	No	X			
Type 1 Flanged Type CAT WELD) B CAT WELD) CAT											
<u> </u>	<u> </u>	Upsi	ream Meter Tube	. [1	Dow	nstream Met	er Tube			
Location	Α	В	C D	К	E	F	G	Н	J		
٧	2.898	2.960	2.898	170	2.898	2.897	2.89/	2.896	2.894		
LV	2.897	2.903	2.898		2.898	2.897	2.899	2.897	2.904		
RV	2.900	2.896	2.898	·	2.898	2.897	2.896	2.896	2.899		
Н	2.899	2.896	2.898		2.898	2.897	2.899		2.900		
Average		2.899	2.898				2.896	2.897	2.899		
Upstream M	ean Average		2.8	98	Downstream to Stamp or	n Mean Aver		-	2.898		
AGA/API Figure BETA BETA O.70 Meter Tap Location Downstream Meter Tap Location Meter Tap L											
Remarks: Inspector:											



P.T. NO. 40553-34221 SIZE 3.0 BORE 2.900

W.P. 1440 FLG. 600 SER. NO. 11097632105

C.R.N. NO. OF1120.213 TRIM SWEET

TO REMOVE PLATE FROM DUAL CHAMBER

(1) CLOSE ORIFICE CHAMBER (INDEX ORIFICE OUT OF OPERATION)

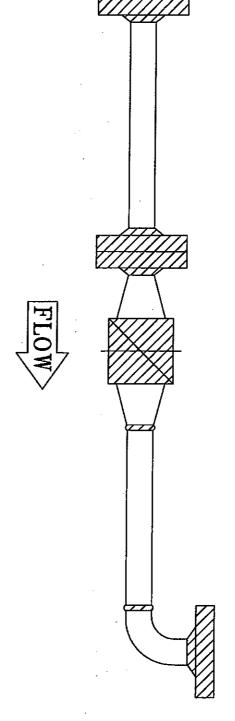
(2) OPEN BLEED VALVE (3) OPEN CHAMBER LID (REMOVE ONLY TWO TOP NUTS) (4) REMOVE ORIFICE PLATE (PRY ON HOLES IN RETAINER HANDLE)

TO PLACE ORIFICE PLATE IN OPERATION

(1) REPLACE ORIFICE WITH 'OUTLET' ON PLATE AND SEAL RETAINER FACING UPWARD (2) CLOSE LID (3) CLOSE BLEED VALVE (4) OPEN EQUALIZING VALVE (MAKES INDEXING EASY) (5) OPEN ORIFICE CHAMBER (INDEX ORIFICE INTO OPERATION) (6) CLOSE EQUALIZING VALVE

A NuFlo Measurement Systems EDMONTON, ALBERTA, CANADA											
METER RUN ASSY, NO.	9A-ME	TERRU	MAX, BORE								
SER. NO.	11097632105	U.S.(D)	2.898	D.\$. (D)	2.898						
PIPE SIZE	3.0	SCH.	80	RATING	600						
AGA / API	3D	d/D	0.70	CALIBRATION							
W.O. NO.	110976321	DATE	11/07	CERTIFIED BY							

IDENTIFICATION MAP WELD



DESCRIPTION: 9A-METERRUN-ED
SERIAL No.: 11097632105
CUSTOMER: RJV GASFIELD SERVICE
P/O No.: 104989 TAG No.:
W/O No.: 110976321 END USER: HUSKY
RADIOGRAPHY UNIT:

asurement	Car
t System	Cameron

5151-67th AVENUE EDMONTON, ALBERTA T6B 2R8

WELDER: KENLMARTIN

DATE: NOVEMBER 26/07

SYMBOL:

QUALITY ASSURANCE INSPECTOR

CORINNE HAMILTON

FILE No.: W-2398

Grade "B" Pressure Welder's Certificate of Competency

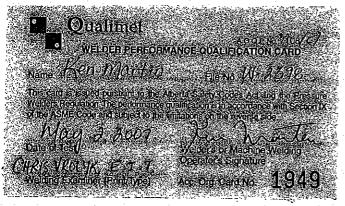
This is to Certify that: Ken Martin

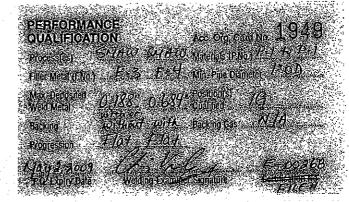
having complied with provisions of the Boilers and Pressure Vessels Act is hereby granted a Grade "B" Pressure Welder's Certificate of Competency, and is authorized to engage in pressure welding in accordance with the prescribed Regulations.

W- 02398

Dated at Edmonton, this Second day of June 19 93

Nº 8759





A Pa			A.O.Q.P. No. 7	'106 (c)
LUDWIG	G & A	SSOCI	ates	LID.
WELDER PERFOR	erials and Welding		CARD	
Name: Ken Martin	ABSA F	ile No. W	2398	
This card is issued pursuant to the Alberta The performance qualification is in accorda the limitations on the reverse side.	Safety Codes Ac	t and the Pressure	Welders Regulat	
October 19, 2006 Date of Test	Signature	of Welder or I	Machine On	k
James Hitchings Welding Examiner (Printtype)	Card No	pro-	79	
1				

PERFORM	ANCE QUALI	FICATION	E	7976
Process(es)	GMAW	FCAW	Materials (P.No	5) . <u>* Pl</u>
Filler Metal Group (F.No.)	F6	F6	Min.Outside Diameter	1.0 in 0.D. Ww:5P0-45*
Max. Deposite Weld Metal	d.110in.	0.672:0.	GN Position(s) Qualified FC	AW: FLAT
Backing	WITHOUT.	WITH	Backing Gas	withor without
Progression	Vert. Down	N/A	- 	
P.O. Expiry D	2008 (ersal la	things	E - 00272

Product# Customer Part# 40713-001 40713-001

Customer

NUFLO MEASUREMENT SYSTEMS

ACCOUNTS PAYABLE 7944 10TH STREET N E CALGARY AB T2E 8W1

CANADA

Order/Item#

28227 /

Customer P O # XP60868

3" DUAL CHAMBER BODY

Approved by

Shyan Smith

Quality Assurance Technician

Melt#	Quantity	Date	Heat	Treat	BATCH	#	Specification .
4-7823	20	6/29/06		2. 1 & Million (1)	AX2 -	7	- ASTM A216 GRADE WCB

CHEMICALS
C 1820 MN 8810 SI 4570 P 0170
S 0120 NI 0700 CR 1460 MO 0390
CU 1390 V 0130

PHYSICALS

YIELD KSI 51 0 ELONGATION % 34

TENSILE KSI 74 4 RED OF AR % 65

CE: 0.3824





MST1201 10/27/06

Highland Foundry Ltd. CHEMICAL AND PHYSICAL ANALYSIS

Page 1 10:11:31

Product#. . : 40703-005

Customer Part#: 40703-005

Customer. . .: NUFLO MEASUREMENT SYSTEMS

ACCOUNTS PAYABLE 7944 10TH STREET N.E. CALGARY AB T2E 8W1

CANADA

Order/Item# . : 28629 / 4

Customer P.O.#: XP61603

3" DUAL CHAMBER LID

Approved by: Shyan Smith

Quality Assurance Technician

Melt#	Quantity	Date	Heat Treat	BATCH #	:	Specification
2-6885	5	10/03/06	32-00-00-00-00-00-00-00-00-00-00-00-00-00	DI2 -	_	ASTM A216 GRADE WCB
The second of th	.1900 .0140 .1100	MN: NI: V:	.6600 .1000 .0100	S1:.5100 CR:.4000		P:.0190 Mo:.0300
	D KSI	 48.4 34	РНҮ		SILE	KSI 75.1 AR. % 58

CE: .4020





ū

ASCOMETAL

DOCUMENT DE CONTROLE

Inspection Documents / Prülbeschemigungen

AFFAIRE SUIVIE PAR YOUR CONTACT IS / BEARDEITER

QUANTITY MENGE

Inspection Certificate 3.1 NFEN 10204 / DIN EN 10204 / ISO R 404

ORDRE DE FABRICATION F3875AN



030000031107 0080089477/000005

DATE 07/07/2006

DATE EDITION ממ

Déparispent Métallurgie Qualité Usine des Danes Balto postale 41

599+1 Danksmue eedex 2 Télépape 03 28 29 60 00

Télécopie 03 28 29 60 03

07/28/2006 01/25/2006

DATE/DATUM

V/REF .17510 507624/38B XOUR ORDER / TRUE 2016 CHEN

COULEE CAST/SCHMELZE • F3875

DESTINATAIRE DOCUMENT

Company INTEGRIS METALS LTD A DIVISION OF RIO ALGOM LTD 7945, CORONET ROAD EDMONTONALB T6E 4N7

D000002429

CANADA

CCU

PRODUIT A105 ROL ROUNDS CLESS TURN 6,250 IN NORMALISED PRODUCT DESCRIPTION / RESCHREIBUNG

ASTM AND HAUSOLF2+AB96GRC+AP16A45K

SPECIFICATION CLIENT
SPECIFICATION / SPECIFICATION

T WILSON

N/REFERENCE 500515406 / 000010 (70016748)

4 195

IND SANS TATE 00 00 2001

SPECIFICATION SUPP DATE! DATUM : SANS ANALYSE CHIMIQUE DE COULEE /LADLE ANALYSIS/SCHMELZEANALYSE

N٥

LS mt.

NUANCE - A105 GRADE/WERKSTOFF

Elément (%) ELEMENT ELEMENT TEIL Μ'n Sı Ċ١ Nī Μa Сц P 8 V Αl MINI SPEC MIN MUNI 600 150 VALEUR ACTUAL WERTE 160 1 094 284 237 081 กรถ 150 010 011 024 D16 DCAM SPEC MAX MAXI 1 350 300 40Ò 120 400 035 080

Element (%) ELEMENT ELEMENT Съ 77211 SPEC MIN ACTUAL MINI MINI WERTE VALEUR DOĞO SPEC MAX MAXI MAX 0200

Contramtes groupées Combined requirements / verbunde auforderungen

ELBMENT MINI VALEUR. IXAM CEq 418 430 Ni+Cr+Mo+Cu+V 1 000

287 320

DURETE /HARDNESS/HÄRTE

Cr+Mp

Nappe / Batch number / Los Nummer - B824 / * mid radius tested

BLEMENY ELEMENT ΉB MINI SPEC MIN MMI VALEUR WERTE ACTUAL MAXI SPEC MAX MAX 187

CARACTERISTIQUES MECANIQUES / MECHANICAL PROPERTIES / MECHANISCHE KENNWERTE

Traction / Tensile test / Zugversuch Nappe / Batch number / Los Nummer : B824 / *

Diameter of test coupon (in) 50

Longitudinal test

tend radius tested Tensile test temperature (°F) 70

ELEMENT ELEMENT E% (2m) RAWYS.2% PSI UTS PSI TEIL MINI SPEC MIN MINI 22.6 45000 70500 74240 VALEUR ACTUAL WERTE 35 4 71 47517 MAXI SPEC MAX MAXI 95000

Résilience / Impact test / Kerbschlagproben Nappe/Batch number/Los Nummer B824/*

notch test 10 x 10 Charpy V notch

Mid radius testing Longitudinal test

Impact test temperature ("F)-50

ELEMENT TEIL Ft/Lbs FULDS Mils LE Mils LE Mils LE ELEMENT Pt/Lbs MIN SPEC MIN MINI 150 150 150 **VALEUR** ACTUAL WERTE 79 7 917 43 D 40 0 49 0 MAXI SPEC MAX MAXI



Nous centificat que les produits en-dessus sont conformes suit nanočavne svriššijo di kajinogan, pomenano ni ob spodanosna 2000/53/CE du 18 acroembre 2000 et mé entent un niveau de radioscuvić su plas čazi i la radiozativić umblame.

We hereby coriefy the above meatlemed products are complying with the order requirements, are respectful of the September 18th 2000 2000/53/CB coronean directive and have a melitarity level which does not excood that present in the environment.

Wie beständen hiermit dass die obertrentenden Erzeutrasse den Beneilungversehriften, der EU Ruchtlung 2000/53/CE von i Bacolumbur 2000 encarreches und dis geligiarius Produkte Reso Rathouktivität, die Höher ist ale middische Strabbing der Artwelt

Ascomeral SA à directoire et conseil de surveillance au capital de 65 285 430 cures RCS Nanterie B 331 048 132 Siège social Immeuble LE COLISEE, 10 Avenue de l'Arche, Faubourg de l'Arche, 92419 Courbevois Cedex

ASCOMETAL



F3875

Département Métatturgle Qualité Unne des Dunce Bollo possale 41 59941 Dunkernne erries 2 Téléphone 03 28 29 60 00 Téléropie 03 28 29 60 03

DOCUMENT DE CONTROLE

Inspection Documents / Prilibescheinigungen

Inspection Certificate 3 I NFEN 10204 / DIN EN 10204 / ISO R 404

930000031107 0080089477/000005

LS int. V/REF 17510 507624/38B YOUR OF DER / IHRE ZEICHEN

DATE 07/07/2006

DATE EDITION

07/28/2006 01/25/2006

DATE / DATUM

ORDRE DE FABRICATION F3875AN WORKS ORDER NUMBER/WERKBESTELLUNG AFFAIRE SUIVIE PAR YOUR CONTACT IS / BEARBEITER T WILSON

N/REFERENCE 500515406 / 000010 (70016748)

4 195 NUANCE A105 DESTINATAIRE DOCUMENT

Company INTEGRIS METALS LTD A DIVISION OF RIO ALGOM LTD 7945, CORONET ROAD

EDMONTONALB TEE 4N7 CANADA

CCU

45 D

PRODUIT A105 ROLLROUNDS CLESS TURN 6,250 IN NORMALISED PRODUCT DESCRIPTION / BESCHREIGUNG

SPECIFICATION CLIENT SPECIFICATION

ASTM A105+A350LFz+A696GRC+AP16A45K

SPECIFICATION SUPP

DATE DATE

00 00,2001

D000002429

SANS Nappe / Batch number / Los Nummer B824 / *

notch test 10 x 10

Mid radius testing Longatudunal test

Charpy V noich Impact test temperature ("F) -60

ACTUAL

ELEMENT ELEMENT TEIL. MINI SPEC MIN

FULbs WERTE 70 B

Ft/Lbs 87.2

FVLbs Mils LE Mils LE Mils LE 85.2 380 46 0

SPEC MAX MAXI Nappe/Batch number/Los Nummer B824/*

notch test 10×10

Mid radius resung

321

Impact test temperature (*F) -60

Charpy V notch transverse test

MINI

MAXI

MUNI

MAXI

MAXI

VALEUR

ELEMENT ELEMENT SPEC MIN ACTUAL VALEUR

TEIL. MINI WERTE SPEC MAX MAXI

Ft/Lbs 39 3

50 Q

FULDS Mils LE Mils LE Mils LE

500 50 Q

TRAITEMENT THERMIQUE / HEAT TREATMENT / WARMBEHANDLUNG

Pt/Lbs

Normalized air cooled

Normatemp (°F)
Norm holding time (hrs)

Val Val 1652 3 75

DURETE SURFACE / SURFACE HARDNESS / RANDHÄRTE TEIL

ELEMENT ELEMENT SPEC MIN MINI VALEUR

ACTUAL SPEC MAX

WERTE MAXI

MINI 187

AUTRES RESULTATS / OTHER RESULTS / ANDERE PROFERGEBNISSE

BHN 10p

Electric furnace - vacuum degassed Ultrasonic testing satisfactory per ASTM A388

Conforms to NACE MR 01-75 Conforms to ASME SA105/SA350LF2 class 1 Conforms to ASTM A696 gr C - ASME SA696 gr C No welding performed

Gram size M-Quaid Ehn

Reduction ratio

Val

419

Max

easuremen.

Nous contitions que los protents en des us sont sonformes sux presegrations de la commando, respectent la directivo suropétant 2000/53/CE du Le exprembre 2000 et présentent un suvenit de radioactivité au pius égal à la radioactivité ambiante.

We becopy certally the above meaningest products are complying with the order requirements are respectful of the Soptember 18th 2000 2000/51/CE european directive, and have a radioactivity level which does not exected that present in the environment.

Wir berütigen hiermit dass die obtenge Besmilungvorschriften, der EU-Rachthaus 2000/53/CE von 18 september 2000 entsprochen vog die getiefanen Produkte keute Radioakhville, die Höher im als nahurische Strabhung der Amwelt. autweisen

Ascometal SA a directoire et conseil de surveillance su capital de 65 285 430 curos RCS Nantetre B 331 048 132

Sièce social immeuble LE COLISER, 10 Avenue de l'Arche, Faubourg de l'Arche, 92419 Courbevoie Cedex

ASCOMETAL



Département Métalluraire Qualité Usine des Duses Boile possale 41 \$9941 Dunkerque sedan 2 Tóléphone 03 21 29 60 00 Telécopie 93 28 29 60 03

DOCUMENT DE CONTROLE

Inspection Documents / Prutbescheinigungen

Inspection Certificate 3 1
NFEN 10204 / DIN EN 10204 / ISO R 404

030000031107

0080089477/000005 LS mt. V/REF 17510 507624/383

YOUR ORDER / SHIRE ZEICHEN

COULES CAST/SCHMELZE

DATE 07/07/2006

DATE EDITION 07/28/2006 DU

01/25/2006 DATE / DATUM

ORDRE DE FABRICATION- F3875AN WORKS ORDER NUMBER/WERKBESTELLUNG

AFFAIRE SUIVIE PAR YOUR CONTACT IS / BEARBEITER

T WILSON

N/REFERENCE 500515406 / 000010 (70016748)

4.195

NUANCE A105

Company INTEGRIS METALS LTD A DIVISION OF RIO ALGOM LTD 794S, CORONET ROAD EDMONTONALB T6E 4N7

DESTINATAIRE DOCUMENT DOCUMENT FOR / EMPFANGER

CANADA

SPECIFICATION CLIENT SPECIFICATION

PRODUCT DESCRIPTION / PESCHASIALING A 105 ROL ROUNDS CLESS TURN 6,250 IN NORMALISED PRODUCT DESCRIPTION / PESCHASIALING astm a10bfa350Lfz+/a696GRC+apiga45K

SANS

DATE/DATUM

00 00.2001

CCU

D000002429

SPECIFICATION SUPP Continuous cast

Conforms to ASTM A105 - A350LF2

HOT ROLLED CARBON STEEL ROUND BARS ROUGH TURNED CFR DUTY UNPAID VANCOUVER (CAN)
LUCCHINI USA, SOC-11601/CFO-507624/38B
COLOR CODE BLACK AND GOLD
COUNTRY OF ORIGIN FRANCE

> Visa du chef de service Stamp of inspection supervisor Der Werkssachverständige G Giroud

Notes certificia que les produits cl-desnu sont confimees aux presumptions so la commande, respectent la directive ouropéenne 2000/53/CE du 18 septembre 2000 et présentent un niveau de radioactivité au plus égal à la radioactivité ambiante.

We hereby seruly the above menuoned products are complying with the order requirements, are respectful of the September 18th 2000 2000/53/CE - cumpean directive, and have a radioactivity level which does not exceed that present on the environment.

Wir bestängen hierzeit dass die obenganzmen Erzengnisse den Bestellungvosschriften, der EU-Richtlane 2000/53/CE von 18 september 2000 entropresion and the galacierum Produktu komo Radioskhwitte, die Höher en als natürkehe Strahlung der Amweit,

Basuremen

	26. 2007 <u></u> 2:40 <u>PM</u> 1	۷A	N LEEU	··· - · ·	7		<u> </u>	,	1	iail Bil	∷NO.	1970	E P. 2/2
ORI	31057 31058 31058 58058 31057 31057 48962 31079 310912 310912 310912 310912 310912	HEAT		4946-105 1 4964-105 1 5026-105 3 23885-105 23887-105 23887-105	4895-105 4907-105 4917-105 4917-105	3 X C	1	ORGED CARBON	70	" tt	7-372	LANE	IG STEEL
GERTIFY TH ABOVE SPECI DER AND IS T	517.80 517.80 517.80 517.80 516.27.80 536.80 536.80	485	STREAGIE STREAGIE STREAGIE	200 BLB 200 BLB 200 TERP 200 TERP 200 TERP 200 BLB 200	BOO WHEF IS SO WHEF IS SO WHEF IS	X I P I	 	STEEL	RODUC	saneng sts.se	4249 07- 2923 07-	GT, KAOHS	份有限 FORGING(
THAT THE MATER ECIFICATION AND S THAT WHICH HAD	335 335 3315 3315 3315 3315 3315 3315 3	250 HIN	(YAR) ELBNAELS OTELL	3/4 1 1/2 2 7487381602	1 1/2 3 60 1 1/2	0 2	. [FLANGES	P3 	ed.net.tw	371 2934 371 2846	G STREE	수 편 30., LTD
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CLIENTE / Customer / Chent

VAN LEEUWEN PIPE AND TUBE -CAN 2875-84TH AVENUE EDMONTON - ALBERTA T6P 1R1 CANADA

PRODUCTO
Article - Produit

FLANGES

SU PEDIDO Nº
Your Order No
Votro Cde Nº

45000593 (19 05 06)

DE of - de 19/05/2008

Certified acc PED 97/23/EC by TÜV Rheinland N • 01 202 E/Q 02 7443

FECHA Date

06/09/2006

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108486

Page A

NORMAS APLICABLES
Requirements - Normes Applicables

ASME B16 5-96

Material Correspondent - Qualité
MODO DE FUSION (*)
Steel Making Elaboration de l'acier

E = Elec

Y = Oxigeno bésico

PARTIDA Item Poste

CANTIDAD Quantity Quantité

DESCRIPCION
Description
Description

Observations Remarks *IBSERVACIONES*

COLADA N S Coulée

RESISTENCIA Resist Rupt T Strength N/mm2

Heat No

3

AAAAA

288A6 273A6 278A6 278A6 264A6 241V6 278A6

514 520 515 517 520

3 3 3 3 3 7 7

4907 4907 9 24051 3 24120 24142 24148

WN 3 600LB S40 RF A105N WN 3 600LB S80 RF A105N WN 3 900LB S80 RF A105N WN 4 600LB SIXXS RF A105N BLIND 4 1500LB RF A105N

BLIND 3 900LB RF A105N

MATERIAL CORRESPONDIENTE

ASTMA105N-05 ASME SA105N-05

NACE MR-01-75/03 CAN/CSA-Z245 12 Gr 248 CAT 1

Works Certificate - Certificat d'Usine CERTIFICADO DE INSPECCION

DIN EN 10204 / 3 1 ISO 10474 / 3 1









ULMA FORJA, S COOP

8° Zubilege 3 - Apdo 14 20560 ONATI (Gipuzkoa) SPAIN Fax 34-943 781808 Tel 34 943 780552

Mark of factory

53921

E-mail ulma@ulmapiping.com

Marque du fabricant MARCA DEL FABRICANTE

317 32 80 84 00 327 32,90 83 00 327 33,70 66,50 317 32 80 64,00	UMITE ELAST ALARGAM (ESTRUCCION RESILENCIA Y Strength Allongement Red Area Impact test Linde Bast Lo. 4 d Shidon Resillence Avenus Nithma 96 96 Joules More	DEPARTAMENTO QUALITY ASSURANCE Section Department
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Hardness			Impact test	Red Area	Elongation	Y Strength
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Los materiales citados cumplen las normas aplicables

COLADA Nª Heat No NªCoulée

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CEO

COMPOSICION QUIMICA - STEEL MARKER'S LADLE ANALYSIS - ANALYSE CHIMIQUE

241V6 264A6 268A6 273A6 278A6

0 180 0 180 0 200 0 200

0 220 0 230 0 220 0 240 0 240

0 830 0 840 0 810 0 850 0 870

0 012 0 013 0 028

0 190 0 070 0 130 0 070

0,000/

99999

0 220 0 200 0 220 0 220 0 210

0 385 0 360 0 351 0 383 0 387

- · Manufacturing requirements are satisfied
- Les normes applicables sont respectees

EL INSPECTOR
Works inspector L'inspecteur



Measuremant

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



uF/o

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ROUTED

HEAT NUMBER

56940

TRANS AM PIPING PRODUCTS - REV'D BY

Shipment/Seq # S 6 -



1/2X3/4-36 CL 3000 FS THREADED PIPET A105N



Munufacturer of Piping & Pressure Vessel Companents

4407 Havgood St Houston, TX 77022 Phone 713 695 3633 Fax 713 695 3528 A Division of <u>BONNEY FORGE</u>

This product has not come in direct contact with mercury or any of its compounds, nor with any mercury containing device employing a single boundary of containment \o welding performed

We certify that the contents of this report are correct and accurate and that all test results and operations performed by WFI or its subcontractors are in compliance with the material specification and requirements of the referenced code of standard and that the material conforms to the dimensional requirements of the order. This document is in accordance with EN10204.3.1

Page:

SOLD TO: TRANS AM PIPING (CALGARY)
7025 - 44TH STREET S E
CALGARY, AB, CN T2C 4EB

MTR #: 119585

PD #: CI-06-744

SALES ORDER #: C613159 DATE: 11/07/2006

CERTIFIED MATERIAL TEST REPORT

HEAT CODE: 56940

MATERIAL: A/SA105N 01

ITEM

Quantity

antity

26

Description

36 - 3/4 X 1/2 3000 THP



CHENICAL COMPOSITION:

LADLE

C. 200 NN P. S. SI CU NI CR 0.200 1.060 0.010 0.019 0.190 0.210 0.040 0.050 NO V NB 0.020 0.000 0.016

CARBON EQUIVALENCY: MECHANICAL PROPERTIES: LADLE

0.407

TENSILE PSI YIELD PSI

ELONG X

RA %

HARDNESS

PRODUCT 74, 250

51, 125

33.50%

67. 90%

135 BHN 137 BHN

Normalized

Pete Ogg
____ Duality Assurance Representative



HEAT NUMBER 57055
TRANS AM PIPING PRODUCTS - REV'D BY Shipment/Seq # S 7 - 5474 4

3/4X11/2-36 CL 3000 FS THREADED PIPET A105N



Manufacturer of Piping & Pressure Vessel Components

4407 Haygood St Houston, TX 77022 Phone 713 695 3633 Fax 713 695 3528 A Division of BONNEY FORGE

This product has not come in direct contact with mercury or any of its compounds, nor with any mercury containing device employing a single boundary of containment \hat\text{\text{o}} welding performed

We certify that the contents of this report are correct and accurate and that all test results and operations performed by WFI or its subcontractors are in compliance with the material specification and requirements of the referenced code or standard and that the material conforms to the dimensional requirements of the order This document is in accordance with EN10204 3 1

Page: 41

SOLD TO: TRANS AM PIPING (EDMON) 233061 ENDEAVOR DRIVE S.E. CALGARY, ALB, CN T2P2G6

MTR #: 129111

PD #: PI-07-35469

SALES ORDER #: C705880 DATE: 05/04/2007

CERTIFIED MATERIAL TEST REPORT

MATERIAL: A/SA105N 01

HEAT CODE: 57055

ITEM Quantity Description

4 192 36 - 1 1/2 X 3/4 3000 THP
A/SA105N

10 1589 36 - 1 1/2 X 3/4 3000 SWP
A/SA105N

CHEMICAL COMPOSITION:

LADLE C MN P S S1 CU NI CR 0.200 1.070 0.007 0.019 0.200 0.090 0.020 0.040 0.010 0.010 0.000 0.013

CARBON EQUIVALENCY: MECHANICAL PROPERTIES:

LADLE 0.396

TENSILE PSI YIELD PSI

LD PSI ELONG / RA %

HARDNESS

PRODUCT 75,500

500 51,000

89.00%

70.00% 144 BHN

Normalized

Marie Dehmer Quality Assurance Representative



E-No.

MA-561

45000492

Purchase Order No.

Job No.

PARTICIPAC CONTRACTOR

TO EN10204 3.1

Thei Boulean Co., Ltd. meterskama, 10130 Theiband.

U Cartificate No.

24/10/2007

70 Y

56 Soi Wattermai, Bungiou, Prepadaong,

3 Ċ 4 ເນ u Ç N 4 Material Heat No. 760086 68M1846 Specification Max. Min. MFG, No. * CSA 2245.11 Gr. 241 Call #OUN SERVICE" NACE NESSTENSO 15199-2001 06N00034 06M00022 8 16 ଞ 8 Ŋ 엉 8 × 8 Š 18 18 72 3 8 8 X 80 EL WPB 3 S80 90 EL WPB 3 S80 61 1000 1000 8 Made from Seambes Pipe ASTM AZX BASSAS SAZX OF GIMPH T. ž X Chemical Composition % 83 Product & Size Ø Specification for Material 15 ~ 8 꺙 8 δ 00 8× 8 Z ŝe. 중` 8 Ω 8 햐 8 7 1000 3 8 N 7 7 8 8 z 724/1,500 128/1,500 Quantity 용 3 8 CE ಭ Specification for laspection **COCK-6:019 BINSY** 8 笠 YS 245 M.P. Heat Treatmen Tension Test *2 (Note 1) > 7 8 8 8 5 IJ 8 35 엉 Œ æ Viscol Examination HARDNESS MAX 197 HB: GOOD Good * 15 To T- 2007040103 Dimonsibusi Inspectio Good

(Note 1) A : Het formed with final temperature between 620 °C-980°C, Air Cooling N : Normalizing 910°Cx0.5 HR. Air Cooling 910°Cx0.5 HR. Air Cooling (Specification for material made from plate) | Stress Releiving 675°Cx0.5 HR. Air Cooling NACE MR0103 : 2003 4

C.E. = C+Ma/6+(Cr+Mo+V)/5+(Ni+Cu)/15

MAGNETIC PARTICLE EXAMINATION FOR THE ONLY:

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

* 1: "I" symbolized wall thickness in mm. * 2: YS Yield strength TS = Tensile strength E = Elongation Form 1Z-6A/2

Quality Assurance Manager Thai Benkan Co., Ltd.

ų į

Printed the 09.01.2007 to 10:13:56

vallourec précision Z.I. MAROLLES EN 10204 Norm/3.1 Pattern Mill Test Report

> Customer: SCOT INDUSTRIES INC Date : 04.01.2007

> > Page 1/

Packing List # : 20344495 : 216349 / 000001

/ 10.07.2006

SCOT INDUSTRIES INC. 51303 VITRY LE FRANCOIS Cedex

étirage

1501 F.M. 1489 SOUTH

Purchase Order / Date: 113-12280

77423 BROOKSHIRE (TEXAS) E.U. D'AMERIQUE Attention to : M. DERBY WILLIAM (BILL) K

36/V 25/105, E

Туре Product Mechanical Tube COLD DRAWN SEAMLESS (T_MECA)

Grade Your reference Final Status NORMALIZED

GRADE B

Specification ASTM A106(+SPEC, COMPLEM.) DANIEL SPEC; MS 00022 REV. H + API 5L X42

Marking on tubes SPECIFIED TEXTE SPEC - NUANCE - DIMENSION - HEAT N° - N° COMMANDE CLIENT- COUNTRY OF ORIGIN - FRANCE-

Shipped quantities Batches OIV

	a)	Batches (III)
	UI 006.7		IV D
	3.500 In		00
	104 2 900.262 ft 30 289.3		Inickness Unit Length No Pieces Total engits Wold
	35 F		94
12000	VS42655		Heat
00000	306837		PR1 # PR3 #

Cast Analysis

Г	-
Results	Min Spec Viax Spec Unit
SVS)
42655	neat
0.154	0.280 4 ₀
0.815	0,290 1,060 %
0.195	0 100 3 100
0.018	0,030
0.005	96 0.030 0.030
0.092	Cr 0:490 %
0.028	Mo 0.150 94
0.069	Vi 0.400 %
0.167	Cu 0.400 9 ₆

Cast Analysis

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Mechanical Properties

	Hesuits	Min Spec. Max Spec. Unit
		Test
	306837	Prod Batch
	SVS42655	Heat
921		
	48705	¥S 12061 PSI
	69282	TS 60191 PSI
	42.72	96.00 00.00 00198009
	52.0	Flaterning 52.0 mm

EN 10204 Norm/3.1 Pattern Mill Test Report

Date : 04.01.2007

Customer: SCOT INDUSTRIES INC. Packing List #: 20344495

: 216349 / 000001

51303 VITRY LE FRANCOIS Cedex

ROCKWELL C HARDNESS: Non Destructive Tests
Test Frod Batch
Results 306837

| Heat | Eddy Citest | Visual Inspec | SVS42655 | 100% BATCH | 100% BATCH

THE VALUES: 22 MAXI 2500 PSI HYDRAULIC TEST

egarding grade, quality and heat treatment throughout their whole length

Page 2/ 2

Taylor Valve Technology, Inc

8300 Southwest 8th Street Oklahoma City, Oklahoma

Serial Number: 37395-306 telephone: 405.787.0145 facsimile: 405.789.8198

OG1316.2C er

email: info@taylorvalve.com

Customer: KINGS ENERGY SERVICES

277, 28042 HWY 11

RED DEER COUNTY, ALBERTA

T4S 2L4

Date: 03-Dec-07

Certificate Number: 39419.5752

Sales Order #: 37395 Customer P.O. #: 104218-00

Safety Relief Valve Certification

Taylor Valve Technology, Inc. Safety Relief Valves are designed, manufactured and tested in accordance with the provisions of the ASME Boiler and Pressure Vessel Code, Section VIII. This Valve is certified to relieve within plus or minus 2 psi of the set pressure 70 psig or below, and plus or minus 3% of set point for pressures above 70 psig, as allowed for within the provisions of ASME. The published relieving capacities have been certified by the National Board of Boiler and Pressure Vessel Inspectors.

Valve Specifications

Model Number: Taylor Model 8200 Soft Seat Orifice: E

Body Size: 1 Inch
Part Number: 82E4351311

Body Configuration: 1" MNPT X 1" FNPT

Operating Temperature: 70 °F

Spring Range: 101-225 PSI

Set Pressure: 150 PSIG

Materials

Body: WCB Carbon Steel Spring: 17.7 PH Stainless Steel
Seat Frame: Carbon Steel Guide: 304 Stainless Steel

Seat Housing: 17.4 PH H900 Stainless Steel Adjustment Screw: Carbon Steel with EN Plating

Trim: Standard Options: None

Seat: FKM 90d

Set Pressure Specifications

Customer Units ASME Units

Set Pressure: 150 psig Set Pressure: 150 psig

ASME High Set Limit: 155 psig ASME High Set Limit: 155 psig

ASME Low Set Limit: 146 psig ASME Low Set Limit: 146 psig

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

Certifying Fluid: Air 582 SCFM Spec Gravity: 1.00 Temp: 60 oF

API 520 (100%) calculated capacity at set pressure for indicated fluid, specific gravity and temperature.

Test Fluid : Air 640 SCFM Spec Gravity : 1.00 Temp : 60 oF

Prepared by: **MELISSA BREWER**

Department: Customer Service Signed MEJBASA BREWER

Approved by: MELISSA BREWER

Department: Quality Signed MELISSA BREWER

Taylor Valve Technology, Inc

8300 Southwest 8th Street Oklahoma City, Oklahoma

Serial Number: 37628-70

OG1316.2C

telephone: 405.787.0145 facsimile: 405.789.8198

email: info@taylorvalve.com

Customer: KINGS ENERGY SERVICES

277, 28042 HWY 11

RED DEER COUNTY, ALBERTA

T4S 2L4

Date: 03-Dec-07

Certificate Number: 39419.5549

Sales Order #: 37628 Customer P.O. #: 104218-00

Safety Relief Valve Certification

Taylor Valve Technology, Inc. Safety Relief Valves are designed, manufactured and tested in accordance with the provisions of the ASME Boiler and Pressure Vessel Code, Section VIII. This Valve is certified to relieve within plus or minus 2 psi of the set pressure 70 psig or below, and plus or minus 3% of set point for pressures above 70 psig, as allowed for within the provisions of ASME. The published relieving capacities have been certified by the National Board of Boiler and Pressure Vessel Inspectors.

Valve Specifications

Model Number: Taylor Model 8200 Soft Seat

Orifice:

F

Body Size: 1 Inch

Orifice Diameter:

0.520 Inches 0.212 In2

Part Number: 82E4351311

Body Configuration: 1" MNPT X 1" FNPT

Orifice Area: Operating Temperature:

70 °F

Spring Range:

101-225 PSI

Set Pressure:

150 PSIG

Materials

Body: WCB Carbon Steel

Spring: 17.7 PH Stainless Steel

Seat Frame: Carbon Steel

Guide: 304 Stainless Steel

Seat Housing: 17.4 PH H900 Stainless Steel

Adjustment Screw: Carbon Steel with EN Plating

Trim: Standard

Options: None

Seat: FKM 90d

Set Pressure Specifications

Customer Units

ASME Units

Set Pressure:

150 psig

Set Pressure: ASME High Set Limit: 150 psig

ASME High Set Limit:

155 psig

ASME Low Set Limit:

155 psig

ASME Low Set Limit:

146 psig

146 psig

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

Certifying Fluid: Air

582 SCFM

Spec Gravity: 1.00

Temp: 60 oF

API 520 (100%) calculated capacity at set pressure for indicated fluid, specific gravity and temperature. Test Fluid: Air

Spec Gravity: 1.00

Temp: 60 oF

640 SCFM

Prepared by: MELISSA BREWER

Signed MELLANA BREVER

Approved by: MELISSA BREWER

Department: Quality

Department: Customer Service

Signed MEJJAJA BASWER



CALIBRATION REPORT

PREPARED	FOR	EDMONTO	N VAI VE	4503-93 ST
FREFARED	\cdot		4 4 / / [4 [7000 00 O.

INSTRUMENT INFORMATION

MANUFACTURER: SWAGELOK MODEL NUMBER: SS-4R3A5-EP

IDENTIFICATION NUMBER: EDV-327 ACCURACY: N/A

JOB: 408905-1 RANGE: 750-1500 PSI

TARPON NUMBER: TARED-P-EDV-327 TYPE: PSV

CALIBRATION DATE: 23-NOV-07 CALIBRATION DUE: 23-NOV-08

CALIBRATION DATA

CRACK SET POINT	ACTUAL	FOUND	LEFT
0	0	0	0
N/A	N/A	N/A	N/A
	1440 PSI	N/A	1440 PSI
1440PSI	1440 7 31	18/7-3	

TEST EQUIPMENT USED

SERIAL NO.	MAKE	MODEL NO.	CALIBRATION DATE
404643	CRYSTAL	5KPSIXP21	18-OCT-07

COMMENTS: The instrument was calibrated against laboratory standards that are either traceable to the National Institute of Standards and Technology, (NIST), National Research Council, (NRC), or are derived by approved ratio techniques.

CALIBRATION TECHNICIAN: CHRIS JAMES



CALIBRATION REPORT

PREPARED FOR EDMONTON VALVE 4503-93 ST

INSTRUMENT INFORMATION

MANUFACTURER: SWAGELOK	MODEL NUMBER: SS-4R3A5-EP
IDENTIFICATION NUMBER: EDV-804	ACCURACY: N/A
JOB: 407174	RANGE: 3000-4000 PSI
TARPON NUMBER: TARED-P-EDV804	TYPE: PSV
CALIBRATION DATE: 01-May-07	CALIBRATION DUE: 01-May-08

CALIBRATION DATA

		·	
CRACK SET POINT	ACTUAL	FOUND	LEFT
0	0	0	0
N/A	N/A	N/A	N/A
3700 PSI	3700 PSI	N/A	3700 PSI

TEST EQUIPMENT USED

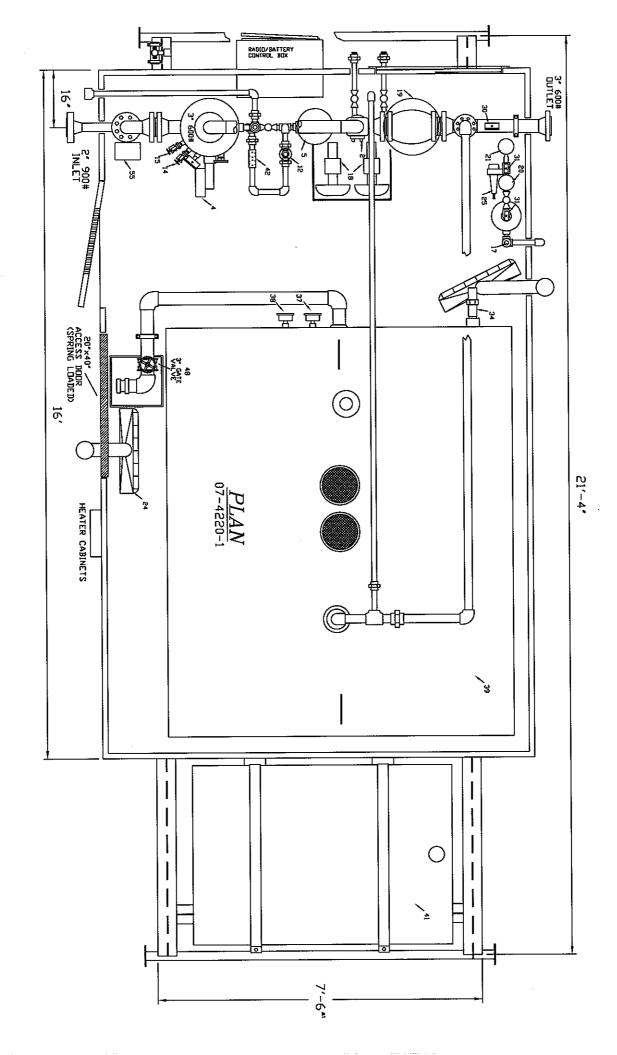
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404643	CRYSTAL	5KPSIXP21	23-Feb-07

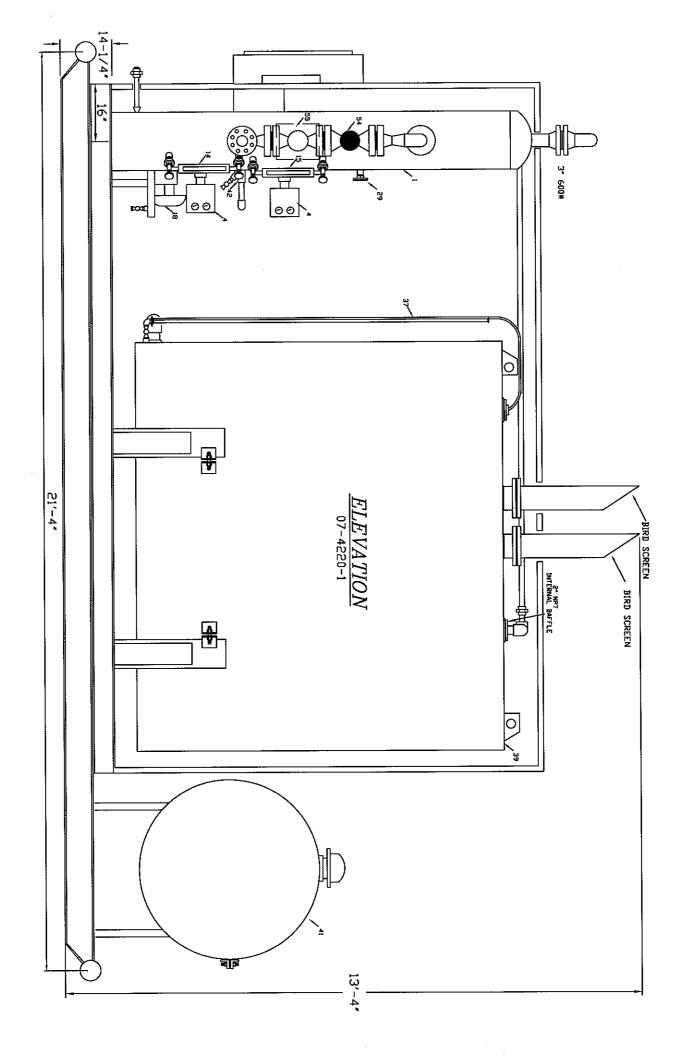
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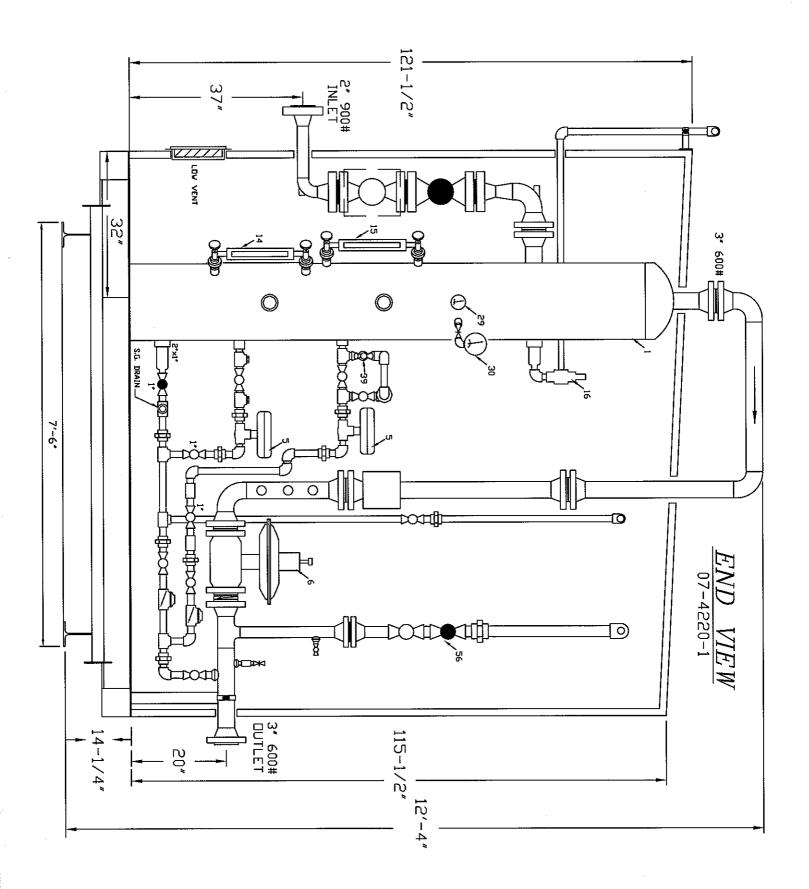
CALIBRATION TECHNICIAN: Andre Brochu

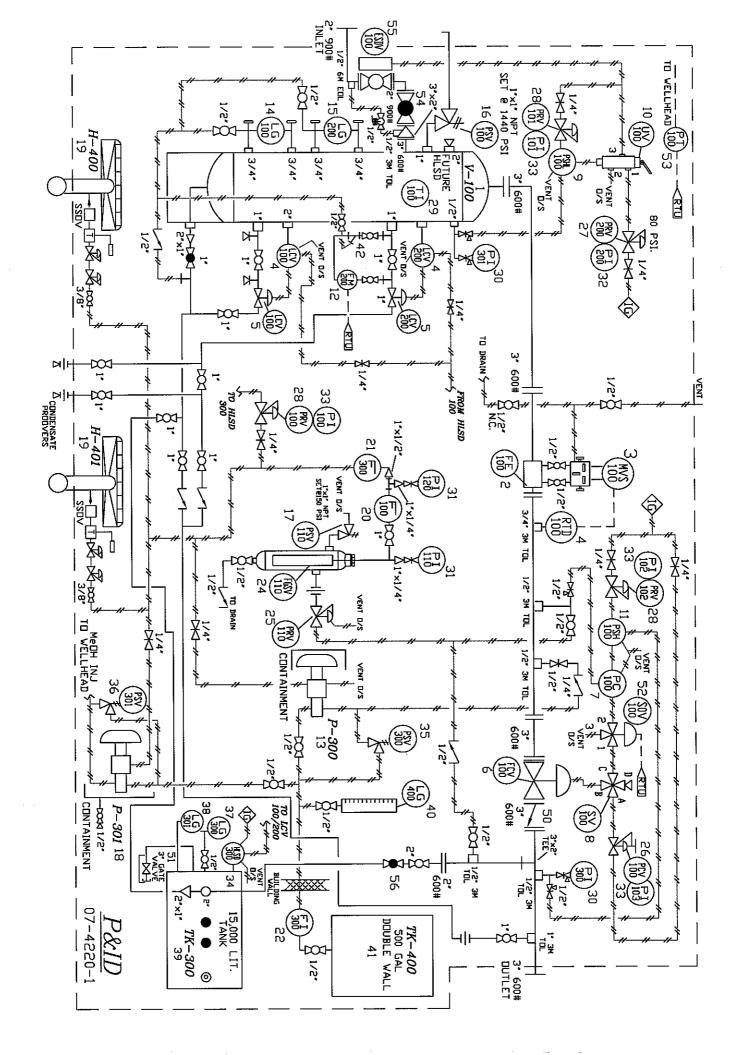
SHIPPING DETAILS

T[T[TOTAL WIDTH- 10'-8" TOTAL LENGTH- 21'-4" TOTAL HEIGHT- 12'-4" APROX. WEIGHT- 14800 LBS						
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SCALE: NTS	y shall urpose, t of,		RJV JDB # 07-4220	METER ADA, TANK	74	VEGREVILLE, ALTA	CES.









<i>EQUIPMENT</i>	&	<i>MATERIAL</i>
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£	QU	TP	WENI & MAIERIAL
TAG#	ITEM	QTY	DESCRIPTION
V-100	1	1	RJV 16'X7'6' 5/5 600 ANSI, 1440 PSJ, 3 PHASE VERTICAL MISTEX SEPARATOR C/* 1/16" CORRUSION ALLOWANCE.
FE-100	2	1	MISTEX SEPARATOR C/W 1/16' CORRISSION ALLOWANCE. NORTHSTAR 3' 600 ANSI SCH 40 (SENDOR) ORIFICE FITTING AGA FIG 30, 7 BETA RATID, 3 TAPS- 1, 3/4" & 2, 1/2" NPT, C/W 1 304 SST DEFICE PLATE/RETAINER, A0701 (66" CIA*) FISHER BCC 103 TRANSMITTER C/W RTD ASSEMBLY, 0-2000 PSI. STATIC PRESSURE, N-673-SDJ PGI 5-VALVE MANIFOLD, FM/CSA. FISHER 2' NPT TYPE L2 LEVEL CONTROL, LCC LOW TEMP., SNAP ACTING, FAILL CLOSED, C/W 1-7/8" x 12" PVC DISPLACER., FISHER 1'NPT TYPE D2, LCC LOW TEMP., NACE SPEC., RATED 900# ANSI. 0-35 PSI SIGNAL, ADJUSTABLE 1/4"/3/8"/1/2" TRIM. KINRAY 3" 600# ANSI. R*, MOTOR VALVE, 1,500 PSI. MDP., STD. SERVICE, 2" INNER VALVE, CARBON STEEL BODY. FISHER TYPE 4150K-R PRESSURE CONTROLLER, DIRECT ACTING.
MV2-100	3	1	FISHER ROC 103 TRANSMITTER C/W RTD ASSEMBLY, 0-2000 PSI. STATIC PRESSURE, M-673-SDJ PGI 5-VALVE MANIFOLD, FM/CSA.
CC-100/500	4	5	FISHER 2" NPT TYPE L2 LEVEL CONTROL, LCC LOW TEMP., SNAP ACTING, FAILL CLOSED, c/w 1-7/8" x 12" PVC DISPLACER.,
FCA-100\500	5	5	FISHER 1' NPT TYPE D2, LCC LOW TEMP., NACE SPEC., RATED 900# ANSI., 0-35 PSI SIGNAL, ADJUSTABLE 1/4*/3/8*/1/2* TRIM.
FCV-100	6	1	KIMRAY 3" 600# ANSI RF., MUTUR VALVE, 1,500 PSI MUP., STU- SERVICE, 2" INNER VALVE, CARBON STEEL BUDY.
PC-100 SV-100	7	1 1	FISHER TYPE 4150K-R PRESSURE CONTROLLER, DIRECT ACTING, 0/1500 PSI 316 STAINLESS STEEL BOURDON TURE, RE-CONDITION CONTROLLER AND THE SECOND TO THE SECOND TO THE SECOND THE SECOND THE SECOND THE SECOND THE SECOND THE SEC
PSHL-100	9	1	3-WAY SELECTOR/316 SST CONSTRUCTION. RE-CONC. FISHER TYPE 4660 HT-LD PRESSURE PROT. 0-1500 PSI.
UV-100	10	1	FISHER TYPE 4150K-R PRESSURE CONTROLLER, DIRECT ACTING, 0/1500 PSI 316 STAINLESS STEEL BOURDON TUBE, RE-CONDITION CONANT 1/4* NPT. MODEL 38351ALT MANUAL SELECTOR VALVE, 3-WAY SELECTOR/316 SST CONSTRUCTION. RE-CONC. FISHER TYPE 4660 HI-LD PRESSURE PILOT, 0-1500 PSI. BOURDON TUBE, STANDARD, 1380 PSI RISING, 100 PSI. FALLING. AMDI 1/4* NPT SWITCHING VALVE, MODEL #4057002549. STD. SERVICE, 125 PSIG. ALL PORTS, STD. SERVICE.
52H-100	11	1	
FM-200 P-300	12	1	SENSOR, TWO POSITION, 3-WAY PILOT, AUTO RESET. NUFLO 1" X 1" NPT. TURBINE METER 5-50 USCAM FLOW RANGE,
F-300	1.3	'	CAVEN DIL CLS100 METHAND. INJECTION PUMP, 3/8° PLUNGER PNEUMATIC MICRO VALVE, 7.9 GPD, HARD PACKING, 6000 PSI MVP. ICVV PRESSURE REGULATOR & PRESSURE GUAUGE,
LG-100	14	1	IPENRIPTHY MEDEL ITMS TRANSPARENT GARGE GLASS C/# 303.0
LG-200 LG-V29	15 16	1 1	PENBURTHY MODEL IRLS REFLEX GALGE GLASS, C/# 303J GAUGE CDCKS, C/W 1/2" NPT DRAIN BALL VALVE.
PSV-110	17	ı .	CS BUNNET & CAP, 128" DRIFICE, SET @ 1440 PSIG. TAYOR 1" MAPT x 1" FAPT, MODEL T-8200-1 SST BODY,
P-301	18	1	CS BUNNET & CAP, 128" DRIFICE, SET & 150 PSIG. CAVEN DIL CLSTON HETHANDL INJECTION PUMP, 3/8" PLUNGER.
H-400/401	19	2	CAUGE CICKS, C.V 1/2" NPT DRAIN BALL VALVE. PENBURTHY MODEL IRIS REFLEX BAUE GLASS, C/# 303J GAUGE CICKS, C./W 1/2" NPT DRAIN BALL VALVE. TAYOR !" MNPT X !" FAPT, HOBEL !" -1-8200-1 SST BIDBY, CS BUNNET & CAP, !28" ORFICE, SET @ 1440 PSIG. TAYOR !" MNPT X !" FAPT, HOBEL !" -1-8200-1 SST BIDBY, CS BUNNET & CAP, !28" ORFICE, SET @ 150 PSIG. CAVEN DIL CL500 METHANDI. INJECTION PUMP ,3/8" PLUNGER. PNEUMATIC MICRO VALVE, 7-9 GPD, MARD PACKING. 6000 PSI MVP. C/W PRESSURE REGULATIOR & PRESSURE GAUGUE. CATADYNE BX64X64 24,000 BTU, 12 VDC, NATUAL GAS HEATER C/W STANDS, SSOUN, REQULATIORS, 5-5 IT CABLES, THERMOSTAT, GRIELL, VENT HODD & ELECTRICAL AS PER CEC REGULATIONS.
F-100	20	1	GRILL, VENT HOOD & ELECTRICAL AS PER CEC REGULATIONS. WATERGUARD 1° NPT MODEL VGF12100 FILTER HEAD ASSEMBLY, MODEL VG40510SP VATER REMOVING FILTER.
F-300 FI-300	21 22	1 1	HEADLINE 1/2" NPT. MODEL #360A c/w P/N 25-64-70C ELEMENTS
V-110 FGSV-110	23 24	i	RJV 8'X30' S/S FUEL GAS SCRUBBER 975 PSI DESIGN PRESS.
PRV-110	25	i	RJV 8*X30" 5/5 FUEL GAS SCRUBBER 975 PSI DESIGN PRESS. RJV 8*X30" 5/5 FUEL GAS SCRUBBER 975 PSI DESIGN PRESS. RJV 2*X1" FUEL GAS SHUIT DEF VALVE C/* DEMISTER WRAP BELGAS 1" NPT TYPE P627 REG. CARBUN STEEL CONST. L/8" ERFFICE, 70-150 PSI SPRING RANGE, SET 8 100 PSIG. BELGAS 1/4" NPT TYPE PSD REGULATOR, STD SERVICE, L-CO BSI SORDING BANGE MANIAL HAND LUIET.
PCV-100	56	1	
PRV-200	27	1	BELGAS 1/4" NPT TYPE PSO REGULATOR, STD SERVICE, 0-120 PSI SPRING RANGE, SET 80 PSI, CUV-100 SUPPLY)
PRV-100/101 102 TI-100	58	3	BELGAS 1/4" NPT TYPE P50 REGULATOR, STD SERVICE, 0-60 PSI, RANGE (PSNL-100, HLSD-300, PSH-100)
PI-300/301	30	1	TREND MOD 33, 3" DIAL, DS, -40/120°F, c/w 304 SST TOV, 4" STEM ON SEPARATOR. "YIKA M233.54 4" DIAL 1/2" NPT BOT CONN. LIQUID FILLED, DS, D/1500M PSI c/w AGCO M9RIC-44 1/2" NPT ISOLATION/BLEED
PI-110/120	31	2	VALVES, CSEPARATOR & DUTLET PIPINGS. WIKA M233-53 2 1/2' DIAL 1/4' NPT BOT CONN. LIQUID FILLED, DS. c/w AGCO HSRDC-2 1/4' ISOLATION/BLEED VALVES
PI-200	35	1	0/200 PSI (FUEL GAS SCRUBBER/ON DOWNSTREAM OF FILTER). WIKA M233-53 Z 1/2* DIAL 1/4* NPT BOT CONN. LIQUID FILLED, 0/100 PSI (UV-200 IG REGULATER). WIKA #233-53 Z 1/2* DIAL 1/4* NPT BOT CONN. LIQUID FILLED.
PI-100/101 102/103	33	4	IN/AN PSI.
HLSD-300 PSV-380	34	1	VELLMARK 2" NPT SNAPTROL 7400 SERIES PNEUMATIC LEVEL SVITCH, STANDARD SERVICE, c/w PNEUMATIC MICRO VALVE. NUPRO 1/4" #SS-4R3A5-EP/177-R3A-K1-C, SET @ 1,440 PSIG. NUPRO 1/4" #SS-4R3A5-EP/177-R3A-K1-C, SET @ 3,700 PSIG.
PSV-301 LG-300 LG-301	35 36 37 38	1	
LG-301 TK-300	38 39	1	RJV 5700-4-CVR METH. TANK METERING/LEVEL GUAGE. 4IN. WESTELL 1500 LITERDUBLE VALLED ABOVE GROUND DITARNAME.
LG-400 TK-400	40 41	1	IRJV 5700-8UVR METH TANK METERING/LEVEL GUAGE BURN IRJV 5700-4-UVR METH TANK METERING/LEVEL GUAGE. 41N WESTEEL 15,000 LITREDUBLE WALLED ABOVE GROUND TANK IRJV 85428 METERING/LEVEL GAUGE, 48° VISIBLE LENGHT. WESTEEL 500 GAL DOUBLE WALL METH STORAGE TANK ALBERTA STRAIMER I'NPT. FIGS YSGOD, LASO PSI. VP.
	41 42 43	1 1	LEGISTIC IN ALL SHAPES BACK CHECK (MELINAUNC FATE LOTAL).
	44 45	3 2	PLAINSMAN 1/2° NPT 3000M CB-50 BALL CHECK. NAVCO 1° FNPT 3,000M MCDEL CSPR1050BAB, SVING TYPE CHECK. NAVCO 1/2° NPT 2000M MHI-F05S20-B BALL VALVES.
1	46 47 48	16 13 8	NAVCO 1/2" NPT 2000# #HI-F05S20-B BALL VALVES. NAVCO 1' NPT 2000# #HI-R10S20-B BALL VALVES.
	49 50	5	NAVCO 1' NPT 2000# #HI-RIOSZO-B BALL VALVES. AGCO 1/4' NPT 6000# #HSRDC-2 NEEDLE VALVES. AGCO 1/2' NPT 6000# #HSVC-440 NEEDLE VALVES. WHEATLEY 3' 600# ANSI FIG# 910-035 144101 SWING CHECK
201-100	51 52	1 1	
PT-100 PCV-100	53 54	1 1	ASCO 1/4" MPT RED HAT SILENDID, P/N EF8314G301, 24V DC ROSENDUNY 2088 CASING PRESSURE TRANSMITTER, 0-1500 PSI, RANGE, 1/2" FNPY CONNECTION, CALIBRATICH 0-3000 PSI, PANHA 2" 9008 F108 215-FC82, MANUAL GLOBE VALVE, CS. BODY RADIUS ACTUATOR 6/8 2" 9008 MERIDIAN BALL VALVE, RIUS BODY
ESDV-100	55 56	i	RADIUS ACTUATOR C/M 2' 9000 MERIDIAN BALL VALVE, AUS BUDY RADIUS ASOGOA ACTUATOR, FALL CLUSSE, SUPPLY 80 PSI, PAMAN 2' MPT 8000 FIG.#F6/838 GLUBE VALVE, STD. TRIM NAVCO 1' NPT 8000 FIG.#F6/838 GLUBE VALVE, STD. TRIM
	57 58	l	MAYCO 1' MPT 800H FIG.#F6/838 GLUBE VALVE, STD. TRIM NAYCO 2' NPT 2000H BHI-F02S20-B BALL VALVES. TUBING- 3/8' & 1/2' DD 035 VT STAINLESS STEEL.
			TUBE FITTINGS- SWAGELOK STAINLESS STEEL FR PRESSURE SENSING LINES & FG TAKE-DFFS SHALL BE 1/2" 00
1			SKID- RJV 10'x21'4' c/w 6'08.2 CHANNEL IRON(PERIPHERY), 6'015 TANK BEAMS) 6'08.2 CHANNEL IRON(CHECKER FLOGRING SUPPORTS
			8-815 WF BEAM FLOOR RUNNERS 3/16" CHECKERED PLATE(FLOORING), 3" POLYURETHANE UNDERSKID INSULATION AND 3 1/2" PULL BARS EACH END
			UNDERSKID INSULATION AND 3 1/2" PULL BARS EACH END BUILDING- 10'x16'x10'-9'6' URETHANE INJECTED PANEL TYPE C/W SHED ROUF,30 GAUGE PREPAINTED STEEL EXTERIOR WHITE VALLS
			RIZ INSULATION VALUE 30 GAUGE WHITE STEEL INTERIOR
			DOIR- 3"X7" URETHANE INJECTED PANEL TYPE, c/* PANIC LOCK WEATHER STRIPPING, IWG VINDOW, DOOR SWEEP, DOG DOIR WINDOW- 1, 36"356" DG SLIDER c/* SCREENS. IVG VINDOW
			VENTS- 2, 12"X12" INSULATED ALUMINUM LOUVRED C/W SCREENS.
			FLANGES: SA-105N 600 ANSI: 2" SCH 80, \$ 3" SCH 40. VELD FITTINGS: SA-234-VPB: 2" SCH 80 \$ 3" SCH 40.
		1	SCREVED FITTINGS: SA-105N 3000W FS. SCREVED UNIONS: SA-105N 3000W FS. D-LETS: SA-105N 3000W FS.
			PIPE AND NIPPLES: SA-106 GR B SEAMLESS.
			THREADED PIPE/NIPPLES/SWAGES 150N- SCH 80, 600N- SCH 160 BOLTING: ASTM A193 GR 87 STUDS/ASTM A194 GR 2H NUTS. GASKETS: 304 SST FLEXATALLIC GRAPHITE.
		1	ALL PIPING DESIGNED TO 831-3 CODE VELDED PIPING SHALL BE SUBJECTED TO 10% RADIOGRAPHY.
		1	WELDED PIPING SHALL BE HYDRO-TESTED TO 2160 PSI. ALL VENTING CONTROLS AND INSTRUMENTS SHALL BE VENTED TO SKID EDGE AND ALL CONTROLS DEPARTIONALLY AIR TESTED. ALL METAL SUFFACES SHALL BE HECHANICALLY CLEANED TO SSPC-SP-2, I COAT OF ZINC CHROWATE PRIMER AND I FINISH COAT OF ENAMEL PAINT SHALL BE APPLIED AS FOLLOWS-
			ALL METAL SURFACES SHALL BE MECHANICALLY CLEANED TO SSPC-SP-2, I COAT OF ZINC CHROMATE PRINER AND I FINISH
			TOUCKERED PLATE SCUDKING WAXN OKE:
			STEEL SKIDS, EQUIPMENT, PIPING & TANKS: WARM GREY ANTENNA WINCH TOWER

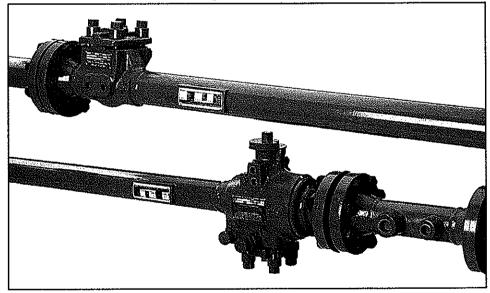
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NuFlo™

Orifice Fittings and Equipment

User Manual

Dual Chamber Orifice Fittings • Single Chamber Orifice Fittings Orifice Flange Unions • Orifice Plates • Orifice Meter Runs



Sold as North Ster Flow Products in Canada

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Model 4055 Dual Chamber Orifice Fittings

NuFlo Model 4055 Dual Chamber Orifice Fittings are compact, streamlined and rugged featuring a simple and rapid method for changing or inspecting orifice plates under pressure. The orifice fittings feature a ball-type construction for opening and closing "without" a complicated gear mechanism.

The unique construction incorporating a ball closure with spring-loaded, self-lubricating, Moly-filled Teflon[®] floating seals eliminates any need for periodic lubrication. All NuFlo dual chamber orifice fittings are manufactured in accordance with ANSI and ATSM standards and available in 2", 3", 4" and 6" sizes.

Features

- · Compact construction
- · Rapid method for changing orifice plates under pressure
- Self-lubricating Moly-filled Teflon® seals (periodic lubrication not required)
- · Orifice plate O-ring seal provides positive seal around orifice plate
- Positive orifice plate alignment assured with closure of chamber lid and internal ball stop

Standard Specifications

Meter Connections: All NuFlo orifice fittings are provided with two sets of flange taps located 1" on each side of the orifice plate. Flange tap meter connections are 1/2" NPT, internal tap hole sizes follow latest AGA/API recommendations. Internal edges of tap holes are free from burrs and slightly rounded.

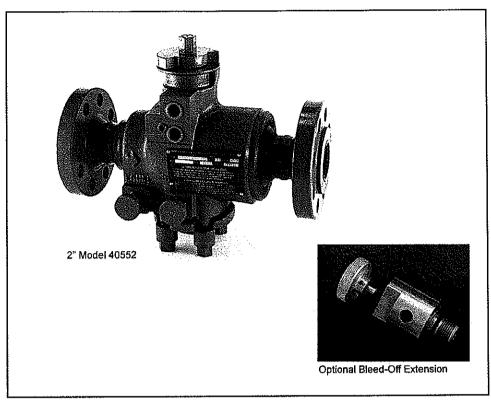
Two types of NuFlo orifice fittings are available:

- · Flanged Type, either raised face or ring joint
- · Flangeweld Type, having a weldneck inlet and a flanged outlet

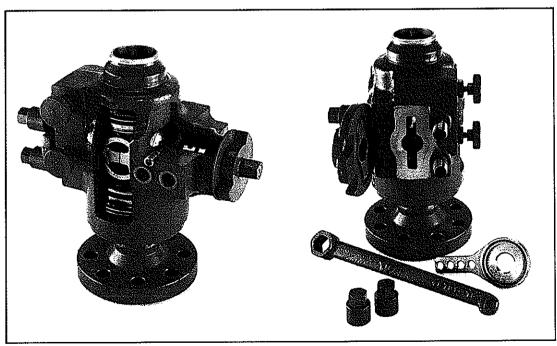
When Ordering, Specify:

- Ouantity
- · Assembly part number
- Type of dual chamber orifice fitting (flanged, flangeweld)
- Service (sweet, (H₂S) sour)
- Flange rating
- Flange type (raised face, ring type joint)
- · Pipe schedule
- Orifice plate bore size(s)

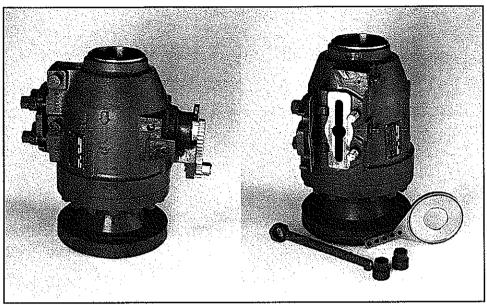
ORIFICE FITTING SIZES	2"	3"	4"	6"
ASSEMBLY PART NUMBER	40552	40553	40554	40556
ANSI FLANGE PRESSURE RATINGS	150 THROUGH 1500	150 THROUGH 1500	150 THROUGH 1500	150 THROUGH 600
INTERNAL DIAMETERS	SCH 40 THROUGH SCH 160	SCH 40 THROUGH SCH 160	SCH 40 THROUGH SCH 160	SCH 40 THROUGH SCH 80



Dual chamber orifice fitting, flanged type



Cut-away, dual chamber orifice fitting, flangeweld type (2, 3 and 4 in.)



Dual chamber orifice fitting, flangeweld type (6 in.)

Installation and Maintenance

It is recommended that the NuFlo Dual Chamber Orifice fitting be placed in the line with the two 1/2" NPT flange taps and instruction plate facing upward. The flow arrow cast on the body must correspond with flow direction of line. The orifice fitting is shipped with an orifice plate installed in operating position. It is suggested that the orifice plate be removed before flushing or purging the flow line.

The spring-loaded, self-lubricated Moly-filled Teflon® ball seals eliminate any need for periodic lubrication. *Grease is not required for sealing*.

Operating Instructions

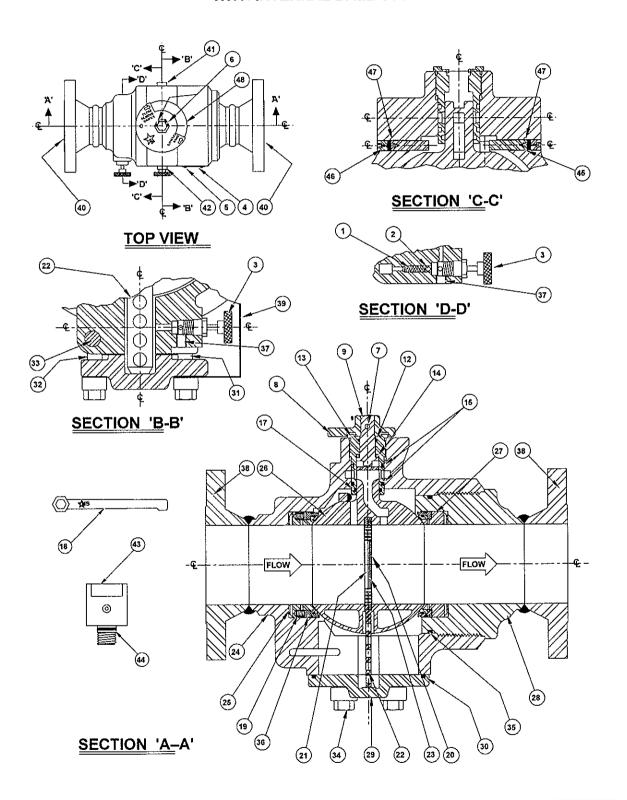
Removing an Orifice Plate

- Close main orifice fitting. This rotates the orifice plate out of operation and places the bypass section into the orifice fitting bore.
- 2. Insure "EQUALIZER" valve is closed.
- Open the "BLEED" valve. This vents the pressure around the orifice plate and chamber lid.
- Open the chamber lid by loosening the hinge bolt cap nuts and removing the two top cap nuts. This will allow the chamber lid to open freely.
- 5. Remove orifice plate and retainer with the wrench supplied with unit.

Replacing an Orifice Plate

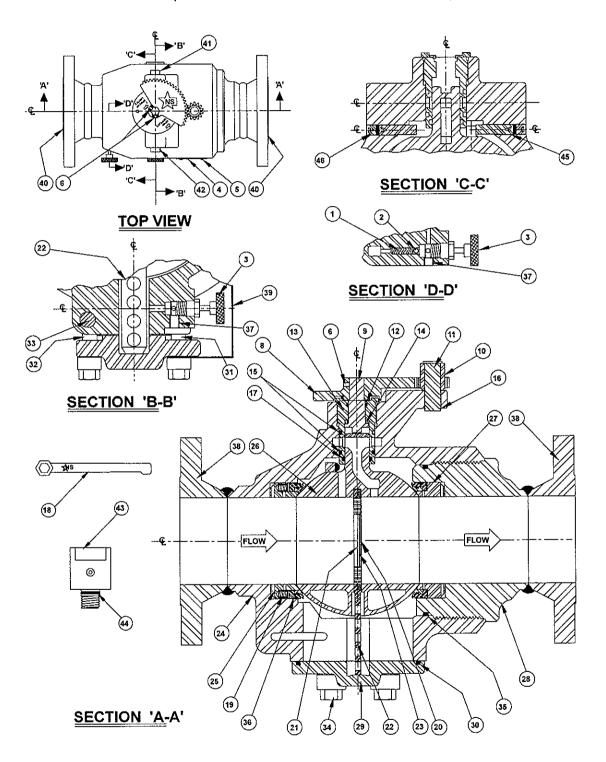
- Place orifice plate and retainer into the ball slot with "OUTLET" on plate holder facing "OUTLET" stamped on body casting.
- Close chamber lid and tighten the four cap nuts.
- 3. Close "BLEED" valve.
- 4. Open "EQUALIZER" valve to equalize ball seal pressure.
- Open main orifice fitting. This places orifice plate into operation and removes bypass section from the bore.
- 6. Close "EQUALIZER" valve.

2" and 3" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP



4" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP

(SEE PAGE 8 FOR 6" DUAL CHAMBER FITTING DRAWING)



PARTS LIST 2", 3" and 4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP

	WITH INTERNAL BALL-STOP											
ITEM	DESCRIPTION	QTY.	ASSY. NO. 40552 (2") PART NO.	ASSY. NO. 40553 (3") PART NO.	ASSY, NO. 40554 (4") PART NO.							
1	SPRING	1	40701-053-04000	40701-053-04000	40701-053-04000							
2	0.250 316 S.S. BALL	1	01001-030-04300	01001-030-04300	01001-030-04300							
3	BLEED VALVE ASSEMBLY	2	40701-J00-06000	40701-J00-06000	40701-J00-06000							
4	INSTRUCTION PLATE	1	40701-009-04000	40701-009-04000	40701-009-04000							
5	DRIVE SCREW#4 - 1/4" TYPE U	4	NCN	NCN	NCN							
6	SET SCREW (ALLEN HEAD)	2	NA	5/16" - 18 TP! X 1/4"	3/8" - 16 TPI X 1/2"							
7	ROLL PIN	1	1/8" X 7/8"									
8	BALL STOP	1	40552-119-04000	40553-130-04000	40554-138-04000							
9	BALL STEM	1	40552-046-04000	40553-048-04000	40554-042-04000							
10	SPUR GEAR				40704-004-04000							
11	SPUR GEAR STEM	1			40704-046-04000							
12	O-RING STEM RETAINER	1	40700-060-06000	40713-035-06000	40714-046-06000							
13	STEM RETAINER	1	40552-027-04000	40703-016-04000	40704-033-04000							
14	STEM RING	1	40701-014-04000	40703-018-04000	40704-034-04000							
15	O-RING STEM RETAINER	2	40700-061-06000	40714-047-06000	40714-048-06000							
16	STEM LOCK	1			40704-050-04000							
17	O-RING STEM RETAINER	1	40700-059-06000	40713-036-06000	40714-047-06000							
18	ORIFICE FITTING WRENCH	1	40701-075-00000	40703-045-00000	40704-031-00000							
19	WAVE SPRING (STANDARD) WAVE SPRING (H ₂ S) SOUR	5	40700-009-03000 40700-020-06000	40703-088-03000 40703-093-06000	40704-082-04000 40704-087-06000							
20	DOVETAIL RING	1	40712-001-04000	40713-006-04000	40714-010-04000							
21	STANDARD ORIFICE PLATE 316 S.S	1	40552-052-00000	40553-055-00000	40554-049-00000							
22	STANDARD ORIFICE PLATE RE- TAINER ORIFICE PLATE RETAINER ORIFICE PLATE RETAINER (TEFLON)	1	40552-062-04000 40552-069-04000	40553-062-04000 40553-065-04000	40554-063-04000 40554-065-04000							
23	O-RING PLATE RETAINER O-RING (TEFLON) PLATE RETAINER	1	40700-005-06000 40552-059-06000	40702-025-06000 40553-060-06000	40714-052-06000 40554-059-06000							
24	ORIFICE FITTING BODY 150# - 600# RATING SCH - 40 150# - 600# RATING SCH - 80 150# - 600# RATING SCH - 160 900 - 1500# RATING SCH - 80 900 - 1500# RATING SCH -160	1	40552-023-04000 40552-024-04000 40552-025-04000 40552-024-04000 40552-025-04000	40553-023-04000 40553-034-04000 40553-035-04000 40553-036-04000 40553-037-04000	40554-017-04000 40554-025-04000 40554-026-04000 40554-035-04000 40554-030-04000							
25	UPSTREAM SEAL RETAINER SCH - 40 BORE SCH - 80 BORE SCH - 160 BORE	1	40552-031-04000 40552-032-04000 40552-033-04000	40553-025-04000 40553-028-04000 40553-031-04000	40554-019-04000 40554-021-04000 40554-023-04000							
26	BYPASS BALL SCH - 40 SCH - 80 SCH - 160	1	40552-115-04000 40552-116-04000 40552-117-04000	40553-124-04000 40553-125-04000 40553-126-04000	40554-135-04000 40554-136-04000 40554-137-04000							
27	DOWNSTREAM SEAL RETAINER SCH - 40 SCH - 80 SCH - 160	1	40552-035-04000 40552-036-04000 40552-037-04000	40553-026-04000 40553-029-04000 40553-032-04000	40554-020-04000 40554-022-04000 40554-024-04000							
28	DOWNSTREAM WELDNECK SCH - 40 SCH - 80 SCH - 160	1	40552-038-03000 40552-039-03000 40552-040-03000	40553-024-03000 40553-027-03000 40553-030-03000	40554-027-03000 40554-028-03000 40554-029-03000							
29	CHAMBER LID	1	40552-043-04000	40553-033-04000	40554-018-04000							
		-	•									

PARTS LIST 2", 3" and 4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS WITH INTERNAL BALL-STOP (cont'd)

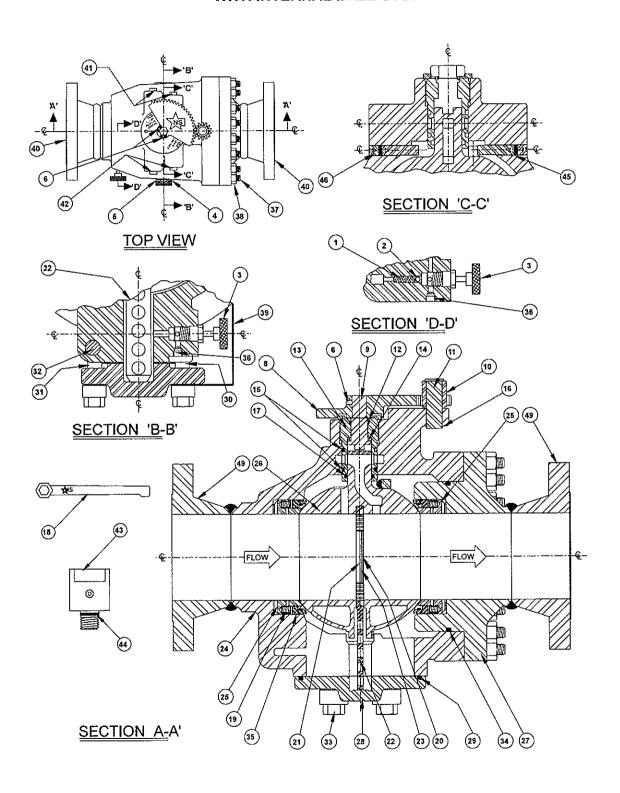
(SEE PAGES 9 & 10 FOR 6" DUAL CHAMBER FITTING PARTS LIST)

ITEM	DESCRIPTION	QTY.	ASSY. NO. 40552 (2") PART NO.	ASSY. NO. 40553 (3") PART NO.	ASSY. NO. 40554 (4") PART NO.
30	O-RING CHAMBER LID	1	40552-051-06000	40553-051-06000	40714-059-06000
31	STUD BOLT	2	40726-006-04000	40703-026-04000	40704-019-04000
32	HINGE BOLT	2	40726-005-04000	40703-027-04000	40704-018-04000
33	HINGE PIN	1	40726-008-04000	40703-024-04000	40704-020-04000
34	HEX NUT	4	40701-021-04000	40703-025-04000	40704-021-04000
35	O-RING DOWNSTREAM WELDNECK	1	40552-054-06000	40553-052-06000	40714-060-06000
36	BALL SEAL ASSY. FOR 150# AND 300# RATING FOR 600# TO 1500# RATING	2	40552-C00-04000 40552-A00-04000	40703-D00-04000 40703-P00-04000	40704-D00-04000 40704-P00-04000
ITEM	DESCRIPTION	QTY	ASSY. NO. 40552 ASSY. NO. 40553 (2") PART NO. (3") PART NO.		ASSY. NO. 40554 (4") PART NO.
37	PIPE PLUG 1/16" - 27 NPT	1	NCN NCN		NCN
38	FLANGES FLANGED FLANGEWELD	2	SPECIFIED E	BY TYPE AND PRESSU	RE RATING
39	ORIFICE FITTING GUARD W/O BLEED-OFF-EXTENSION (STAN-DARD) W/BLEED-OFF-EXTENSION	1	40700-039-04000 40701-101-04000	40702-013-04000 40701-102-04000	40702-013-04000 40701-102-04000
40	PLASTIC BORE PLUG	2	NCN	NCN	NCN
41	PIPE PLUG 1/2"	2	35364-004-04000	35364-004-04000	35364-004-04000
42	PLASTIC PIPE PLUG 1/2"	2	NCN	NCN	NCN
43	BLEED-OFF EXTENSION (H2S) SOUR	1	40701-S00-06000	40701-S00-06000	40701-S00-06000
44	O-RING	1	40714-061-06000	40714-061-06000	40714-061-06000
45	SET SCREW 1/2" - 20 UNF	2	40700-068-04000	40700-068-04000	40700-070-04000
46	PLUG 1/2" - 20 UNF	2	40700-069-04000	40700-069-04000	40700-069-04000
47	NYLON LOCKING PELLET	4	10008-006-04000	10008-006-04000	N/A
48	BALL STOP PLATE	1	40552-118-04000	40553-127-04000	

NOTE: ANSI FLANGE PRESSURE RATINGS 150# THROUGH 1500# WHEN ORDERING SPARE PARTS, SPECIFY:

- NOMINAL SIZE SCHEDULE
 TYPE OF SERVICE (SWEET, (H2S) SOUR)
- SERIAL NUMBER

6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP



PARTS LIST
6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP

ITEM	DESCRIPTION	QTY	ASSY. NO. 40556 (6") PART NO.
1	SPRING INCONNEL	1	40701-053-04000
2	T.C. BALL 0.250	1	01001-030-04300
3	BLEED VALVE ASSEMBLY	2	0701-J00-06000
4	INSTRUCTION PLATE	1	40701-009-04000
5	DRIVE SCREW#4 - 1/4" TYPE U	4	NCN
6	SET SCREW (ALLEN HEAD)	2	3/8 - 16 TPI X 1/2"
7	N/A		
8	BALL STOP	1	40706-055-04000
9	BALL STEM	1	40556-034-04000
10	SPUR GEAR	1	40704-004-04000
11	SPUR GEAR STEM	1	40704-046-04000
12	O-RING STEM RETAINER	1 1	40713-036-06000
13	STEM RETAINER	1 1	40706-032-04000
14	STEM RING	1 1	40706-033-04000
15	O-RING STEM RETAINER	2	40706-095-06000
16	STEM LOCK	1	40704-050-04000
17	O-RING STEM RETAINER	1 1	40706-094-06000
18	ORIFICE FITTING WRENCH	1	40704-031-00000
	COIL SPRING (STANDARD)		40706-047-04000
19	COIL SPRING (H.S) SOUR	16	40706-046-06000
20	DOVETAIL RING	1	40706-080-04000
21	STANDARD ORIFICE PLATE 316 S.S.	1 1	40556-046-00000
	ORIFICE PLATE RETAINER (STANDARD)	1 1	40556-076-04000
22	ORIFICE PLATE RETAINER (TEFLON)	1	40556-083-04000
23	O-RING PLATE RETAINER	1 1	40706-098-06000
	O-RING (TEFLON) PLATE RETAINER	2	40556-074-06000
24	ORIFICE FITTING BODY SCH 40 SCH 80	1	40556-066-04000 40556-065-04000
25	SEAL RETAINER SCH 40 SCH 80	2	40556-018-04000 40556-020-04000
26	BY-PASS BALL SCH 40 SCH 80	1	40556-137-04000 40556-138-04000
27	DOWNSTREAM WELDNECK SCH 40 SCH 80	1	40556-086-03000 40556-087-03000
28	CHAMBER LID	1	40706-093-04000
29	O-RING CHAMBER LID	1	40556-038-06000
30	STUD BOLT	2	40704-019-04000
31	HINGE BOLT	2	40704-018-04000
32	HINGE PIN	1	40706-018-04000
33	HEX NUT	4	40704-021-04000
34	O-RING DOWNSTREAM WELDNECK	1	40706-096-06000
35	BALL SEAL ASSEMBLY FOR 150 AND 300# RATING FOR 600# RATING	2	40706-A00-04000 40706-P00-04000

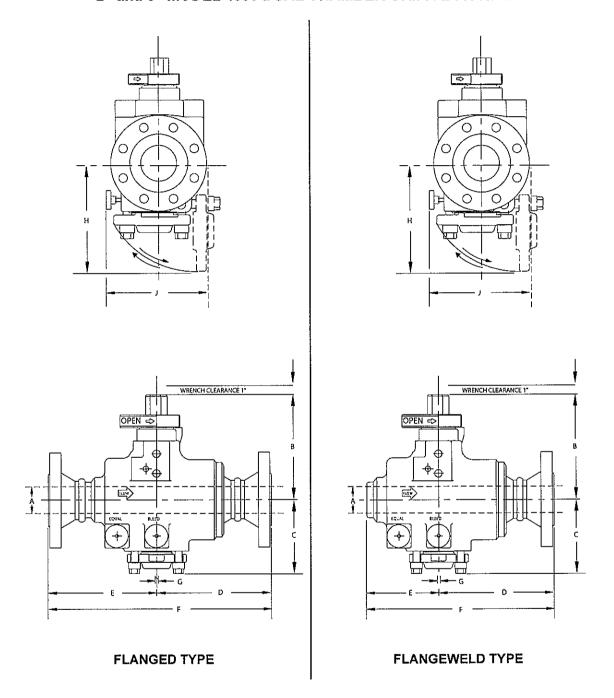
PARTS LIST (cont'd) 6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING WITH INTERNAL BALL-STOP

ITEM	DESCRIPTION	QTY	ASSY. NO. 40556 (6") PART NO.
36	PIPE PLUG 1/16" - 27 NPT	1	NCN
37	MILL STUD	16	40706-052-06000
38	HEX NUT	16	C1408-006-06000
39	ORIFICE FITTING GUARD W/O BLEED-OFF-EXTENSION (STANDARD) W/ BLEED-OFF-EXTENSION	1	40556-035-04000 40701-103-04000
40	PLASTIC BORE PLUG	2	NCN
41	PIPE PLUG 1/2"	2	35364-004-04000
42	PLASTIC PIPE PLUG 1/2"	2	NCN
43	BLEED-OFF-EXTENSION (H2S) SOUR	1	40701 -S00-06000
44	O-RING	1	40714-061-06000
45	SET SCREW 5/8" - 18 UNF	2	40700-071-04000
46	PLUG 5/8"- 18 UNF	2	40700-072-04000
47	NYLON LOCKING PELLET		N/A
48	BALL STOP PLATE		N/A
49	FLANGES FLANGED FLANGEWELD	2 1	SPECIFIED BY TYPE AND PRESSURE RATING

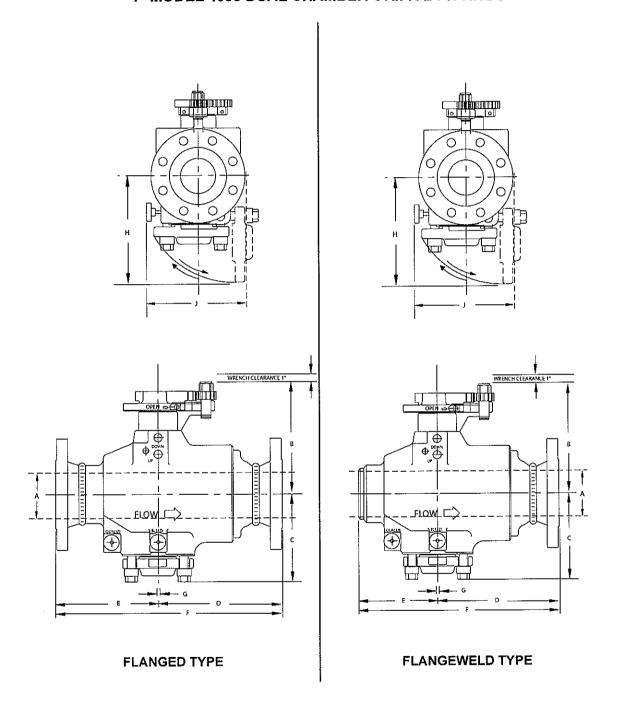
WHEN ORDERING SPARE PARTS, SPECIFY:

- NOMINAL SIZE SCHEDULE
 TYPE OF SERVICE (SWEET, (H2S) SOUR)
- SERIAL NUMBER

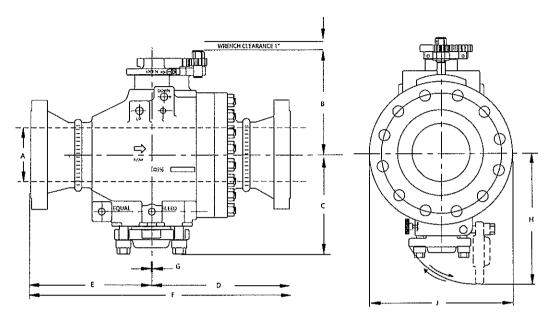
DIMENSIONAL DATA 2" and 3" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS



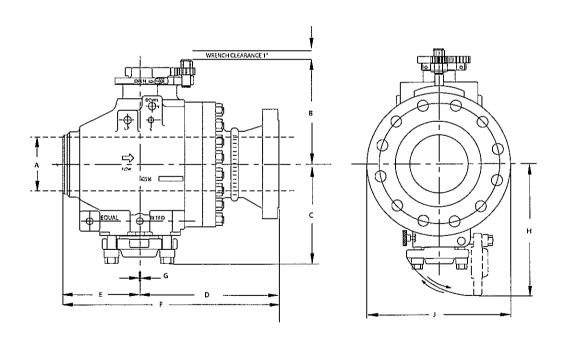
DIMENSIONAL DATA 4" MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS



DIMENSIONAL DATA 6" MODEL 4055 DUAL CHAMBER ORIFICE FITTING



FLANGED TYPE



FLANGEWELD TYPE

MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS DIMENSIONS—FLANGED TYPE WITH RAISED FACE FLANGES

SIZE	DIAMETER OF INTERNAL BORE	CENTERLINE TO TOP	CENTERLINE TO BOTTOM	DOWNSTREAM LENGTH FROM CENTERLINE TO FACE AT END	UPSTREAM LENGTH FROM CENTERLINE TO FACE AT END	OVERALL LENGTH END TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	BODY CLEARANCE	APPROXIMATE WEIGHT, LBS.	HYDROSTATIC TEST PRESSURE, TEMP. LESS THAN 125°F
	Α	В	С	D	Е	F	G	Н	J		
		FL	ANGED T	YPE, 150LB.	A.N.S.I RA	ISED FACE	FLANG	E - 285 PSI. (C.W.P.		
2	2.067*	6-7/16	5-3/8	8 5/64	7-7/16	15-33/64	1/8	6-7/8	6-1/4	67	450 PSI
3	3.068*	7-3/8	6-3/4	9-1/4	8-5/16	17-9/16	1/8	8-5/16	7-3/4	95	
4	4.026*	9-3/4	8	11-7/8	10-1/16	21-15/16	1/8	10-7/8	8-9/16	182	
6	6.065*	11-7/8	10-3/4	13-3/4	12-3/16	25-61/64	1/8	13-1/2	14	170	
	FLANGED TYPE, 300LB. A.N.S.I RAISED FACE FLANGE - 740 PSI. C.W.P.										
2	2.067*	6-7/16	5-3/8	8-21/64	7-11/16	16-1/64	1/8	6-7/8	6-1/4	71	1125 PSI
3	3.068*	7-3/8	6-3/4	9-21/32	8-11/16	18-11/32	1/8	8-5/16	8-1/2	105	
4	4.026*	9-3/4	8	12-1/4	10-7/16	22 -11/16	1/8	10-7/8	9-1/8	202	
6	6.065*	11-7/8	10-3/4	14-1/8	12-9/16	26-45/64	1/8	13-1/2	14	420	
		FL	ANGED T	YPE, 600LB.	A.N.S.I RA	ISED FACE	FLANGE	- 1480 PSI.	C.W.P.		
2	2.067*	6-7/16	5-3/8	8-11/16	8-1/16	16-3/4	1/8	6-7/8	6-1/4	75	2225 PSI
3	3,068*	7-3/8	6-3/4	10-1/64	9-1/16	19-5/64	1/8	8-5/16	8-1/2	105	
4	4.026'	9-3/4	8	13-1/4	11-5/16	24-9/16	1/8	10-7/8	9-1/2	225	
6	6.065*	11-7/8	10-3/4	15-1/8	13-9/16	28-45/64	1/8	13-1/2	14	490	
		FL	ANGED T	YPE, 900LB.	A.N.S.I RA	ISED FACE	FLANGE	- 2220 PSI.	C.W.P.		
2	1.939'	6-7/16	5-3/8	9-13/16	9-1/4	19-1/16	1/8	6-7/8	8-5/16	108	3350 PSI
3	2.900*	7-3/8	6-3/4	10-3/4	9-7/8	20-5/8	1/8	8-5/16	9	127	
4	3.826*	9-3/4	8	13-5/8	11-7/8	25-1/2	1/8	10-7/8	9-1/2	251	
L		FLA	NGED TY	PE, 1500LB.	A.N.S.I RA	AISED FACE	FLANG	E - 3705 PSI.	. C.W.P.		
2	**	6-7/16	5-3/8	9-13/16	9-1/4	19-1/16	1/8	6-7/8	7-3/4	108	5575 PSI
3	**	7-3/8	6-3/4	11-13/32	10-1/2	22-5/16	1/8	8-5/16	9	165	
4		9-3/4	8	14	12-1/4	26-1/4	1/8	10-7/8	9-1/2	251	
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MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS DIMENSIONS—FLANGED TYPE WITH RING TYPE JOINT FLANGES

SIZE	DIAMETER OF INTERNAL BORE	CENTERLINE TO TOP	CENTERLINE TO BOTTOM	DOWNSTREAM LENGTH FROM CENTERLINE TO FACE AT END	UPSTREAM LENGTH FROM CENTERLINE TO FACE AT END	OVERALL LENGTH END TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	BODY CLEARANCE	APPROXIMATE WEIGHT, LBS.	HYDROSTATIC TEST PRESSURE, TEMP. LESS THAN 125°F
		FLAN	IGED TYP	E, 600LB. A.	N.S.I RING	TYPE JOIN	T FLAN	GE - 1480 PS	I. C.W.P.		
2	2.067'	6-7/16	5-3/8	8-3/4	8-1/8	16-7/8	1/8	6-7/8	6-1/4	75	2225 PSI
3	3.068*	7-3/8	6-3M	10-1/64	9-1/16	19-5/64	1/8	8-5/16	8-1/2	105	
4	4.026*	9-3/4	8	13-1/4	11-5/16	24-9/16	1/8	10-7/8	9-1/2	225	
6	6.065*	11-7/8	10-3/4	15-1/8	13-9/16	28-45/64	1/8	13-1/2	14	491	
		FLAN	IGED TYP	E, 900LB. A.	N.S.I RING	TYPE JOIN	T FLAN	GE - 2220 PS	I. C.W.P.		
2	1.939*	6-7/16	5-3/8	9-7/8	9-5/16	19-3/16	1/8	6-7/8	7-3/4	108	3350 PSI
3	2.900*	7-3/8	6-3/4	10-29/32	10	20-29/32	1/8	8-5/16	9	127	
4	3.826*	9-3/4	8	13-3/4	12	25-3/4	1/8	10-7/8	9-1/2	251	
		FLAN	GED TYP	E, 1500LB. A	.N.S.I RIN	S TYPE JOIN	IT FLAN	IGE - 3705 P	SI. C.W.P.		
2	业务	7-3/8	5-3/8	9-7/8	9-1/4	19-1/8	1/8	6-7/8	7-3/4	108	5575 PSI
3	**	7-3/8	6-3/4	11-13/32	10-1/2	21-29/32	1/8	8-5/16	9	165	
4	**	9-3/4	8	14	12-1/4	26-1/4	1/8	10-7/8	9-1/2	251	
		OTHER E									

MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS DIMENSIONS—FLANGEWELD TYPE WITH RAISED FACE FLANGES

SIZE	DIAMETER OF INTERNAL BORE	CENTERLINE TO TOP	CENTERLINE TO BOTTOM	DOWNSTREAM LENGTH FROM CENTERLINE TO FACE AT END	UPSTREAM LENGTH FROM CENTERLINE TO FACE AT END	OVERALL LENGTH END TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	BODY CLEARANCE	APPROXIMATE WEIGHT, LBS.	HYDROSTATIC TEST PRESSURE, TEMP. LESS THAN 125°F
	Α	В	С	D	E	F.	G	Н	J		
		FLA	NGEWEL	D TYPE, 15	OLB, A.N.S.	I RAISED F	ACE FLA	NGE - 285 F	SI, C.W.F	·.	
2	2.067*	6-7/16	5-3/8	8-5/64	4-7/8	12-15/16	1/8	6-7/8	6-1/4	61	450 PSI
3	3.068*	7-3/8	6-3/4	9-1/4	5-1/2	14-3/4	1/8	8-5/16	7-3/4	81	
4	4.026*	9-3/4	8	11-57/64	7	18-57/64	1/8	10-7/8	8-9/16	166	
6	6.065*	11-7/8	10-3/4	13-3/4	8-5/8	22-3/8	1/8	13-1/2	14	350	
FLANGEWELD TYPE, 300LB. A.N.S.I RAISED FACE FLANGE - 740 PSI. C.W.P.											
2	2.067*	6-7/16	5-3/8	8-21/64	4-7/8	13-3/16	1/8	6-7/8	6-3/4	63	1125 PSI
3	3.068*	7-3/8	6-3/4	9-21/32	5-1/2	15-9/64	1/8	8-5/16	8-1/2	87	
4	4.026*	9-3/4	8	12-1/4	7	19-1/4	1/8	10-7/8	9-1/8	176	
6	6.065*	11-7/8	10-3/4	14-1/8	8-5/8	22-3/4	1/8	13-1/2	14	380	
		FLA	NGEWEL	D TYPE, 600	DLB. A.N.S.I	RAISED F	ACE FLA	NGE - 1480	PSI. C.W.	Р.	
2	2.067*	6-7/16	5-3/8	8-11/16	4-7/8	13-37/64	1/8	6-7/8	6-3/4	65	2225 PSI
3	3.068*	7-3/8	6-3/4	10-1/64	5-1/2	15-33/64	1/8	8-5/16	8-1/2	87	
4	4.026'	9-3/4	8	13-1/8	7	20-1/8	1/8	10-7/8	9-1/2	187	
6	6.065*	11-7/8	10-3/4	15-1/8	8-5/8	23-3/4	1/8	13-1/2	14	420	
		FLA	NGEWEL	D TYPE, 90	OLB. A.N.S.	I RAISED F	ACE FLA	NGE - 2220	PSI. C.W.	P.	
2	1.939'	6-7/16	5-3/8	9-13/16	4-7/8	14-11/16	1/8	6-7/8	8-5/16	84	3350 PSI
3	2.900*	7-3/8	6-3/4	10-3/4	5-1/2	16-1/4	1/8	8-5/16	9	98	
4	3.826*	9-3/4	8	13-5/8	7	20-5/8	1/8	10-7/8	9-1/2	200	
		FLAI	NGEWEL	D TYPE, 150	OLB. A.N.S	I RAISED I	ACE FLA	NGE - 3705	PSI. C.W		
2	**	6-7/16	5-3/8	9-13/16	4-7/8	14-11/16	1/8	6-7/8	8-3/4	84	5575 PSI
3	**	7-3/8	6-3/4	11-13/16	5-1/2	17-5/16	1/8	8-5/16	9	117	
4	**	9-3/4	8	14	7	21	1/8	10-7/8	9-1/2	200	
	NLABLE I										

MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS DIMENSIONS—FLANGEWELD TYPE WITH RING TYPE JOINT FLANGES

SIZE	DIAMETER OF INTERNAL BORE	CENTERLINE TO TOP	CENTERLINE TO BOTTOM	DOWNSTREAM LENGTH FROM CENTERLINE TO FACE AT END	UPSTREAM LENGTH FROM CENTERLINE TO FACE AT END	OVERALL LENGTH END TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	BODY CLEARANCE	APPROXIMATE WEIGHT, LBS.	HYDROSTATIC TEST PRESSURE, TEMP. LESS THAN 125°F
		FLANC	SEWELD	TYPE, 600L	B. A.N.S.I	RING TYPE	JOINT FL	ANGE - 148	D PSI. C.V	V.P.	
2	2.067'	6-7/16	5-3/8	8-3/4	4-7/8	13-5/8	1/8	6-7/8	6-3/4	65	2225 PSI
3	3.068*	7-3/8	6-3M	10-1/64	5-1/2	15-33/64	1/8	8-5/16	8-1/2	87	
4	4.026*	9-3/4	8	13-1/4	7	20-1/4	1/8	10-7/8	9-1/2	187	
6	6.065*	11-7/8	10-3/4	15-1/8	8-5/8	23-3/4	1/8	13-1/2	14	421	
		FLAN	GEWELD	TYPE, 900L	B, A.N.S.I	RING TYPE	JOINT FL	ANGE - 222	0 PSI. C.\	V.P.	
2	1.939*	6-7/16	5-3/8	9-7/8	4-7/8	14-3/4	1/8	6-7/8	7-3/4	84	3350 PSI
3	2.900*	7-3/8	6-3/4	10-29/32	5-1/2	16-13/32	1/8	8-5/16	9	98	
4	3.826*	9-3/4	8	13-3/4	7	20-3/4	1/8	10-7/8	9-1/2	200	<u> </u>
		FLANG	EWELD .	TYPE, 1500!	B, A.N.S.I.	- RING TYPE	JOINT FI	_ANGE - 370)5 PSI. C.	W.P.	
2	**	7-3/8	5-3/8	9-15/16	4-7/8	14-13/16	1/8	6-7/8	7-3/4	84	5575 PSI
3	**	7-3/8	6-3/4	11-13/32	5-1/2	16-29/32	1/8	8-5/16	9	117	
4	**	9-3/4	8	14	7	21	1/8	10-7/8	9-1/2	251	
		N OTHER E SPECIF									

RECOMMENDED SPARE PARTS MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS

SIZE	DESCRIPTION	PART NO.	QTY.
2"	Dovetail Ring O-Ring for Orifice Plate O-Ring for Chamber Lid	40712-001-04000 40700-005-06000 40552-051-06000	1 2 2
3"	Dovetail Ring O-Ring for Orifice Plate O-Ring for Chamber Lid	40713-006-04000 40702-025-06000 40553-051-06000	1 2 2
4"	Dovetail Ring O-Ring for Orifice Plate O-Ring for Chamber Lid	40714-010-04000 40714-052-06000 40714-059-06000	1 2 2
6"	Dovetail Ring O-Ring for Orifice Plate O-Ring for Chamber Lid	40706-080-04000 40706-098-06000 40556-038-06000	1 2 2



Use only spare parts identified in this manual. NuFlo bears no legal responsibility for the performance of a product that has been serviced or repaired with parts that are not authorized by NuFlo.

REDRESS KITS MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS

SIZE	DESCR	IPTION		PART NO.
	ORIFICE FITTING PART NO. 40552	SWEET	150# - 300#	40837-X00-03000
2"		(H ₂ S) SOUR	150# - 300#	40837-X00-06000
2		SWEET	600# - 1500#	40837-Y00-03000
		(H ₂ S) SOUR	600# - 1500#	40837-Y00-06000
	ORIFICE FITTING PART NO. 40553	SWEET	150# - 300#	40838-X00-03000
3"		(H ₂ S) SOUR	1500# - 300#	40838-X00-06000
3		SWEET	600# - 1500#	40838-Y00-03000
		(H ₂ S) SOUR	600# - 1500#	40838-Y00-06000
	ORIFICE FITTING PART NO. 40554	SWEET	150# - 300#	40839-X00-03000
4"		(H ₂ S) SOUR	150# - 300#	40839-X00-06000
4		SWEET	600# - 1500#	40839-Y00-03000
		(H₂S) SOUR	600# - 1500#	40839-Y00-06000
6"	ORIFICE FITTING PART NO. 40556	SWEET	150# - 300#	40840-X00-03000
		(H₂S) SOUR	150# - 300#	40840-X00-06000
		SWEET	600#	40840-Y00-03000
		(H₂S) SOUR	600#	40840-Y00-06000

NOTE: Specify pressure rating when ordering redress kits.

Model 4042 Single Chamber Orifice Fittings

The NuFlo Single Chamber Orifice Fitting is designed for use in installations in which the line can be depressurized to change or inspect the orifice plate. Economical and lightweight, the single chamber features a simplicity of design with a minimum number of parts. A quick and easy method for removing orifice plates minimizes shutdown time. The interchangeability of the orifice plates and retainers between the NuFlo Dual Chamber and Single Chamber orifice fittings also provides an economy in inventory requirements.

Standard Specifications

Single chamber orifice fittings are available in flangeweld and weldneck types. All NuFlo single chamber orifice fittings meet AGA/API specifications. Two sets of 1/2" NPT flange taps are provided on all single chamber orifice fittings. They are available in 2", 3" and 4" sizes.

When Ordering, Specify:

- · Quantity
- · Assembly part number
- Type of single chamber orifice fitting (flangeweld, weldneck)
- Service (sweet, (H,S) sour)
- · Flange rating
- Flange type (raised face, ring type joint)
- · Pipe schedule
- Orifice plate bore size(s)

Installation and Maintenance

Install the NuFlo single chamber orifice fitting with the two 1/2" NPT flange taps and instruction plate facing upward. The flow arrow cast on the body chamber lid must correspond with flow direction of line. The orifice fitting is shipped with an orifice plate installed. Remove the orifice plate before flushing or purging the line. Maintenance is minimal; lubrication is not required.

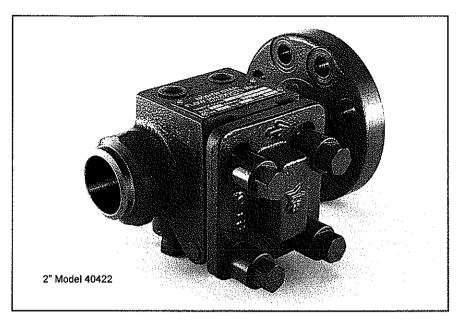
Operating Instructions

Removing Orifice Plate

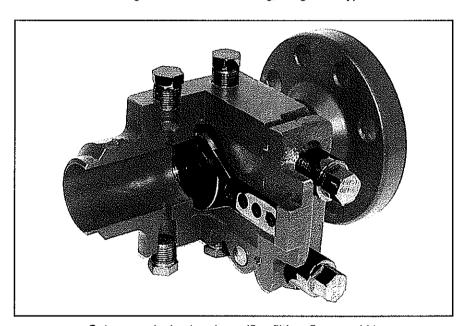
- 1. Depressurize line.
- 2. Open chamber lid by loosening the hinge bolt cap nuts and removing the two top cap nuts. This will allow the chamber lid to open freely.
- Remove orifice plate and retainer.

Replacing Orifice Plate

- 1. Place orifice plate and retainer into the slot of the fitting with "OUTLET" facing same direction as flow arrow on chamber lid.
- 2. Close chamber lid and tighten the four cap nuts.
- 3. Pressurize line.



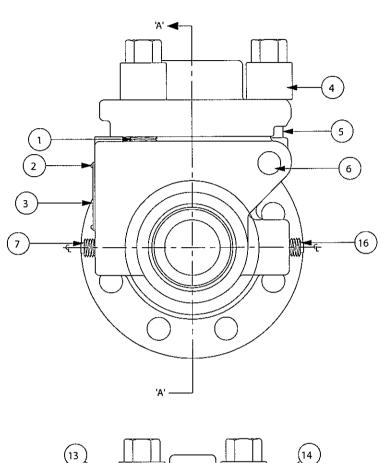
Single chamber orifice fitting, flangeweld type

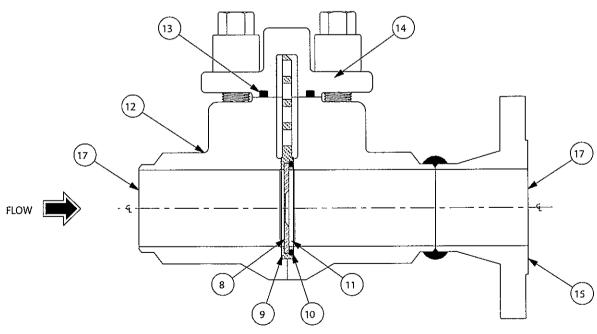


Cut-away, single chamber orifice fitting, flangeweld type

ORIFICE FITTING SIZES	2"	3"	4"
ASSEMBLY PART NUMBER	40422	40423	40424
ANSI FLANGE	150	150	150
PRESSURE	THROUGH	THROUGH	THROUGH
RATINGS	1500	1500	1500
INTERNAL DIAMETER	SCH 40	SCH 40	SCH 40
	THROUGH	THROUGH	THROUGH
	SCH XX	SCH 160	SCH 160

MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS





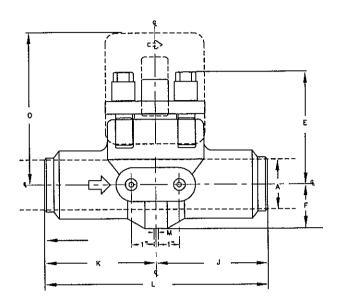
SECTION A-A

PARTS LIST 2", 3" AND 4" MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS

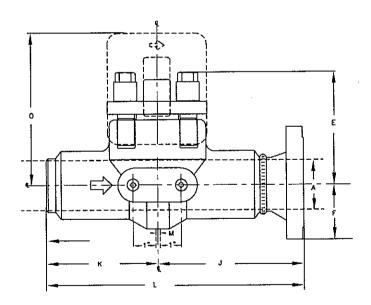
ITEM	DESCRIPTION	QTY.	ASSY.NO.40422	(2")	ASSY.NO.40422	(3")	ASSY.NO.40422	(4")
			PART NO.	NOTE	PART NO.	NOTE	PART NO.	NOTE
1	STUD BOLT	2	40726-006-04000	С	40703-026-04000	O	40704-019-04000 40724-002-04000	A B
2	DPI VE SCREW #4 - 1/4" TYPE U	4	NCN		NCN		NCN	
3	IDENTIFICATION PLATE	1	40726-014-04000		40726-014-04000		40726-014-04000	
4	HEX NUT	4	40701-021-04000	С	40703-025-04000	С	40704-021-04000	С
5	HINGE BOLT	2	40726-005-04000	С	40703-027-04000	С	40704-018-04000 40424-001-04000	A B
6	HINGE	1	40726-008-04000	С	40728-011-04000	С	40729-008-04000 40424-008-04000	A B
7	PLASTIC PIPE PLUG	2	NCN		NCN		NCN	
8	STANDARD ORIFICE PLATE 316 S.S.	1	40552-052-00000		40553-055-00000		40554-049-00000	
9	STANDARD ORIFICE PLATE RETAINER ORIFICE PLATE RETAINER (TEFLON)	1	40552-062-04000 40552-069-04000	A B	40553-062-04000 40553-065-04000	A B	40554-063-04000 40554-065-04000	A B
10	O-RING PLATE RETAINER O-RING (TEFLON) PLATE RE- TAINER	1	40700-005-06000 40552-059-06000	1	40702-025-06000 40553-060-06000		40714-052-06000 40554-059-06000	
11	DOVETAIL RING	1	40712-001-04000		40713-006-04000		40714-010-04000	
12	ORIFICE FITTING BODY WELDNECK 150# - 600# RATING SCH 40 WELDNECK 150# - 600# RATING SCH 80	1	40726-010-04000 40726-020-04000		40728-007-04000 40728-014-04000		40729-010-04000 40729-025-04000	
	WELDNECK 900# - 1500# RATING WELDNECK 900# - 1500# RATING	1	40726-020-04000 40726-042-04000	D E	40728-026-04000 40728-024-04000	D E	40424-003-04000 40424-004-04000	D E
13	O-RING CHAMBER LID	1	40552-051-06000	С	40553-051-06000	С	40714-059-06000	
14	CHAMBER LID	1	40726-032-04000	С	40728-021-04000	С	40729-021-04000 40424-006-04000	A B
15	FLANGE 150# RF SCH 40	1	40552-001-04000		40553-001-04000	_	40554-001-04000	
	300# RF SCH 40	1	40552-002-04000		40553-002-04000		40554-002-04000	<u> </u>
	600# RF SCH 40 600# RF SCH 80	1	40552-005-04000 40552-003-04000		40553-004-04000 40553-006-04000		40554-003-04000 40554-005-04000	
	600# RTJ SCH 40 600# RTJ SCH 80 900# RF SCH 40	1	40552-016-04000 40552-017-04000 40552-014-04000		40553-040-04000 40553-041-04000		40554-032-04000 40551-033-04000	
	900# RF SCH 80 900# RF SCH 160 900# RTJ SCH 40	1	40552-009-04000 40552-007-04000 40552-020-04000		40553-010-04000		40554-007-04000	
	900# RTJ SCH 80 900# RTJ SCH 160 1500# RF SCH 80	1	40552-019-04000 40552-018-04000 40552-009-04000		40553-043-04000 40553-014-04000		40551-034-04000	
	1500# RF SCH 160 1500# RTJ SCH 80	1	40552-007-04000 40552-019-04000		40553-044-04000		40554-036-04000	
	1500# RTJ SCH 160	1	40552-018-04000					
16	1/2" STEEL PIPE PLUG	2	35364-004-04000		35364-004-04000		35364-004-04000	
17	PLASTIC BORE PLUGS	2	NCN		NCN		NCN	

NOTES: A) FOR 150# THROUGH 600# RATING
B) FOR 900# THROUGH 1500# RATING
C) FOR 150# THROUGH 1500# RATING
D) SCH 80
E) SCH 160

DIMENSIONAL DATA MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS



FLANGEWELD TYPE SINGLE CHAMBER



WELDNECK TYPE SINGLE CHAMBER

MODEL 4042 SINGLE CHAMBER DIMENSIONS—FLANGEWELD TYPE WITH RAISED FACE FLANGES

SIZE	DIAMETER OF INTERNAL BORE	m CENTERLINE TO TOP	CENTERLINE TO BOTTOM	CENTERLINE OF C ORIFICE PLATE TO FACE AT END	CENTERLINE OF S ORIFICE PLATE TO FACE AT END	OVERALL LENGTH FACE TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	APPROXIMATE WEIGHT, LB
2	2.067*	5-1/4	3	6-5/8	4	10-5/8	1/8	7	33
3	3.068*	6-3/8	6-3/4	7	4-1/8	11-1/8	1/8	9	57
4	4.026*	7-3/8	4-1/2	7-11/16	4-9/16	12-1/4	1/8	10-3/4	79
<u> </u>					I RAISED	<u> </u>		<u> </u>	
2	2.067*	5-1/4	3-1/4	6-7/8	4	10-7/8	1/8	7	36
3	3.068*	6-3/8	4-1/8	7-3/8	4-1/8	11-1/2	1/8	9	63
4	4.026*	7-3/8	5	8-1/16	4-9/16	12-5/8	1/8	10-3/4	89
	FLAI	NGEWELD	TYPE, 60	0 LB. A.N.S.	I RAISED	FACE FLAN	IGE -1480	PSI. C.W.P.	
2	2.067*	5-1/4	3-1/4	7-1/4	4	11-1/4	1/8	7	38
3	3.068*	6-3/8	4-1/8	7-3/4	4-1/8	11-7/8	1/8	9	63
4	4.026*	7-3/8	5-3/8	8-15/16	4-9/16	13-1/2	1/8	10-3/4	99
	FLAN	GEWELD	TYPE, 90	0 LB. A.N.S.	I RAISED I	ACE FLAN	GE - 2220	PSI. C.W.P.	
2	1.939*	5-1/4	4-1/4	8-3/8	4	12-3/8	1/8	7	51
3	2.900*	6-3/8	4-3/4	8-1/2	4-1/8	12-5/8	1/8	9	79
4	3.826*	7-3/8	5-3/4	9-7/16	4-9/16	14	1/8	10-3/4	127
	FLAN	GEWELD	TYPE, 150	00 LB. A.N.S	I RAISED	FACE FLAI	NGE - 370	5 PSI. C.W.P.	
2	**	5-1/4	4-1/4	8-3/8	4	12-3/8	1/8	7	51
3	**	6-3/8	5-1/4	9-1/8	4-1/8	13-1/4	1/8	9	98
4	**	7-3/8	6-1/8	9-13/16	4-9/16	14-3/8	1/8	10-3/4	145
	ILABLE IN ORE TO BE								

MODEL 4042 SINGLE CHAMBER DIMENSIONS—FLANGEWELD TYPE WITH RING TYPE JOINT FLANGES

SIZE	DIAMETER OF INTERNAL BORE	т CENTERLINE TO TOP	The CENTERLINE TO BOTTOM	CENTERLINE OF ORIFICE PLATE TO FACE AT END	CENTERLINE OF CORIFICE PLATE TO FACE AT END	OVERALL LENGTH FACE TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	APPROXIMATE WEIGHT, LB
	FLANG	SEWELD T	YPE, 600	LB. A.N.S.I.	- RING TYPE	JOINT FLA	ANGE -14	80 PSI, C.W.I	
2	2.067*	5-1/4	3 -1/4	7-5/16	4	11-5/16	1/8	7	38
3	3.068*	6-3/8	4-1/8	7-3/4	4-1/8	11-7/8	1/8	9	63
4	4.026*	7-3/8	5-3/8	8-15/16	4-9/16	13-1/2	1/8	10-3/4	99
	FLANG	EWELD T	YPE, 900	LB. A.N.S.I	RING TYPE	JOINT FLA	ANGE - 22	20 PSI. C.W.	Р.
2	1.939*	5-1/4	4-1/4	8-1/2	4	12-1/2	1/8	7	51
3	2.900*	6-3/8	4-3/4	8-5/8	4-1/8	12-3/4	1/8	9	79
4	3.826*	7-3/8	5-3/4	9-7/16	4-9/16	14	1/8	10-3/4	127
	FLANG	EWELD T	YPE, 1500	LB. A.N.S.I.	- RING TYPE	JOINT FL	ANGE - 37	705 PSI. C.W	.P.
2	**	5-1/4	4-1/4	8-1/2	4	12-1/2	1/8	7	51
3	**	6-3/8	5-1/4	9-1/8	4-1/8	13-1/4	1/8	9	98
4	**	7-3/8	6-1/8	9-13/16	4-9/16	14-3/8	1/8	10-3/4	145
		I OTHER E SPECIFI							

MODEL 4042 SINGLE CHAMBER DIMENSIONS—WELDNECK TYPE

	DIAMETER OF INTERNAL BORE	CENTERLINE TO TOP	CENTERLINE TO BOTTOM	CENTERLINE OF ORIFICE PLATE TO FACE AT END	CENTERLINE OF ORIFICE PLATE TO FACE AT END	OVERALL LENGTH FACE TO END	ORIFICE PLATE THICKNESS	OPERATING CLEARANCE FROM CENTER WITH CHAMBER LID OPEN	APPROXIMATE WEIGHT, LB
SIZE	DIAN	CEN	CEN	CENTER ORIFICE FACE AT	CEN ORIF FACI	OVE	ORIF	OPE CLE CEN CHA	APP
	Α	Е	F	J	К	L	М	0	
WELDNECK TYPE, 600 LB. A.N.S.I1480 PSI. C.W.P.									
2	2.067*	5-1/4	1-15/16	4	4	8	1/8	7	27
3	3.068*	6-3/8	2-1/2	4-1/8	4-1/8	8-1/4	1/8	9	45
4	4.026*	7-3/8	2-7/8	4-9/16	4-9/16	9-1/8	1/8	10-3/4	62
		1	WELDNEC	K TYPE, 900	LB. A.N.S.I.	2220 PSI	. C.W.P.		
2	1.939*	5-1/4	1-15/16	4	4	8	1/8	7	27
3	2.900*	6-3/8	2-1/2	4-1/8	4-1/8	8-1/4	1/8	9	50
4	3.826*	7-3/8	2-7/8	4-9/16	4-9/16	9-1/8	1/8	10-3/4	76
		٧	VELDNEC	K TYPE, 150	0 LB. A.N.S.I	l 3705 PS	I. C.W.P.		
2	**	5-1/4	1-15/16	4	4	8	1/8	7	27
3	**	6-3/8	2-1/2	4-1/8	4-1/8	8-1/4	1/8	9	50
4	**	7-3/8	2-7/8	4-9/16	4-9/16	9-1/8	1/8	10-3/4	76
1	ILABLE IN								

^{**} BORE TO BE SPECIFIED

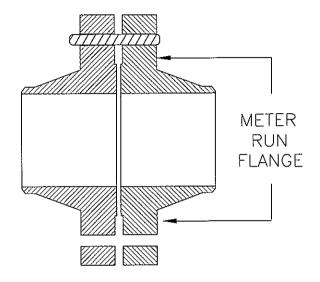
Meter Runs

The meter runs are fabricated by trained manufacturing personnel with complete facilities for machining, welding, gauging and inspection. This produces a product with quality and metering accuracy not possible with field-fabricated units.

All meter runs are factory-aligned and welded with special equipment that guarantees a straight, smooth meter run without defects. Standard lengths meet AGA/API requirements.

Meter Run Alignment

Orifice fitting to meter run alignment can be specified with dowel pins. This option assures proper bore alignment.

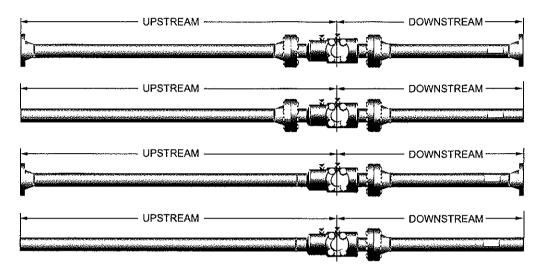


Technical Data

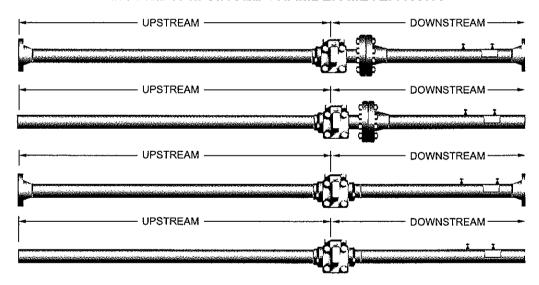
METER RUN I.D. FOR NOMINAL DIMENSIONS										
SCH	SCH 2" 3" 4" 6"									
40	2.607	3.068	4.026	6.065						
80	1.939	2.900	3.826	5.761						
160	1.687	2.624	3.438	5.187						

ANSI Rating	Working Pressure (psi)	Test Pressure (psi)					
150	285	450					
300	740	1125					
600	1480	2225					
900	2220	3350					
1500	3705	5575					
TEMPERATURE: -20°F TO 100°F							

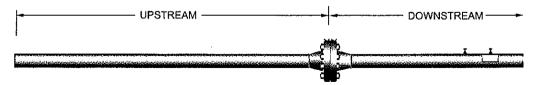
MODEL 4055 DUAL CHAMBER METER RUNS



MODEL 4042 SINGLE CHAMBER METER RUNS



ORIFICE FLANGE UNION METER RUNS



NOTES: METER RUNS CAN BE MANUFACTURED TO SPECIFIC CUSTOMER REQUIREMENTS. METER RUNS CAN BE SUPPLIED WITH THREADOLETS FOR 1/2", 3/4" AND 1" NPT AND ANY COMBINATION OF BEVELED FOR WELDING OR FLANGED ENDS.

Orifice Flange Unions

Orifice flange unions are available in 300 lb. ANSI through 2500 lb. ANSI. They are available in SA 105N, SA350 LF2, 304 ST/STL, 316 ST/STL or MONEL materials. All flanges conform to the ANSI B16.5 Flange Piping Code. All flanges are machined to close tolerances and are carefully inspected before shipment. Orifice flange assemblies are provided with studs, nuts, gaskets, jack screws and pipe plugs.

Paddle Type Orifice Plates

Note: Paddle type orifice plates must be ordered separately.

NuFlo paddle type orifice plates are designed for use between orifice flange unions. The line size, flange rating, material and bore size are stamped on the handle. Paddle plates are available in type 304 or 316 stainless steel. Other materials are available on special order.

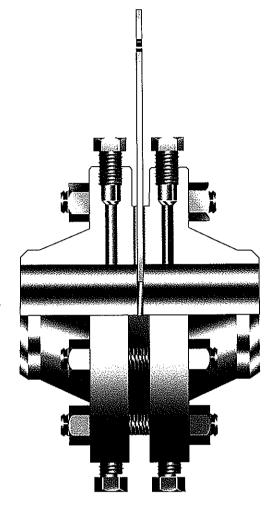
When Ordering, Specify:

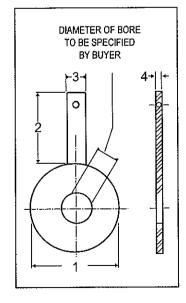
- · Quantity
- · Size, flange rating, pipe schedule
- · Material (flange, studs, nuts and gaskets)
- · Orifice bore size
- · Orifice plate thickness
- Orifice plate material

Paddle Plate Dimensions

	300 lb ANSI	600 lb ANSI		All Pressure Ra 00 - 1500 lb AN	
SIZE *	1	1	2	3	4
2"	4-3/8"	4-3/8"	4"	1"	1/8"
3"	5-7/8"	5-7/8"	4°	1-1/4"	1/8"
4"	7-1/8"	7-5/8"	4"	1-1/4"	1/8"

^{*}Other sizes available on request





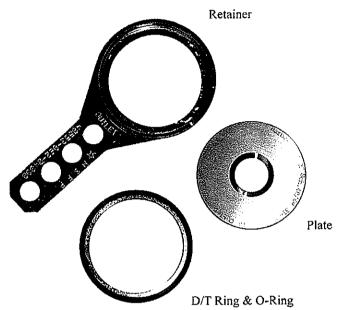
Orifice Plate Assembly

The orifice plate retainer assembly is used in both the dual and single chamber orifice fittings. The orifice retainer and chamber lid are designed to assure the center alignment of orifice bore with the line bore. The chamber lid cannot be closed without centering the orifice in the correct position. If the plate is not correctly centered, closing the lid will align the plate automatically. The plate retainer and the dovetail ring

are nickel plated for corrosion resistance. The orifice retainer, dovetail ring and O-ring together hold the orifice plate in a rigid position and perpendicular to the bore at all times.

Universal orifice plates are stocked in 1/8-in. increments, beginning at 0.125 inch. The orifice bore size and outlet are clearly etched on each plate. All AGA/API requirements are specifically met.

The NuFlo orifice plate is interchangeable with other universal type plates. Standard orifice plates are constructed of 316 stainless steel; however, they are available in other material upon special request. Each orifice plate has a 15-30 micro-inch finish.



Universal Orifice Plates and Plate Dimensions

ŞİZE	2"	3"	4"	6"	NOTES
PLATE	40552-062-04000	40553-062-04000	40554-063-04000	40556-076-04000	150 - 600# RATING
RETAINERS	40552-069-04000	40553-065-04000	40554-065-04000	40556-083-04000	900 - 1500# RATING
DOVETAIL RING	40712-001	40713-006	40714-010	40706-080-04000	
O-RING	40700-005-06000	40702-025-06000	40714-052-06000	40706-098-06000	150 - 600# RATING
	40552-059-04000	40553-060-06000	40554-059-06000	40556-074-06000	900 - 1500# RATING

	Material: 304 S.S.	Material: 316 S.S.		
Size	Part Number	Part Number		
2°	40700-022	40552-052		
3"	40702-003	40553-055		
4"	40704-091	40554-049		
6"	40706-023	40556-046		
8"	40558-061	40558-070		
10"	40540-012	40540-024		

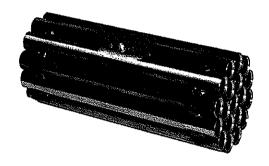
Size	Plate Thickness	Plate Dlameter
2"	1/8	2.437
3"	1/8	3.437
4"	1/8	4.406
6"	1/8	6.437
8"	1/8	8.437
10"	1/8	10.687

Straightening Vanes

The use of straightening vanes in meter runs serves a twofold purpose: (1) the turbulence often created in a complex piping system is straightened and smoothed to a normal flow pattern and (2) the amount of straight pipe required preceding an orifice is reduced. NuFlo offers both flanged and pin type straightening vanes.

Vanes are available with carbon steel, 304 or 316 stainless steel tubing welded together and securely attached into the meter run. The tubes are reamed as thin as is practical at both ends and are constructed so as to minimize the possibility of vibration. All vanes are manufactured according to the latest AGA/API specifications.





FLANGE TYPE

PIN TYPE

		2"		3"		4"		6"	
VANE MODEL	Carbon Steel			Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	
Flange Type	40807	40807	40813	40813	40814	40814	40818	40818	
Pin Type	40806	40806	40812	40812	40815	40815	40819	40819	
Vane Length		6"		8"		10"		12"	

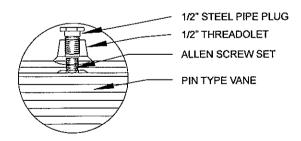
Other sizes available on request.

Installation

The flange type straightening vane is held in place by a flange ring between two pipe flanges.

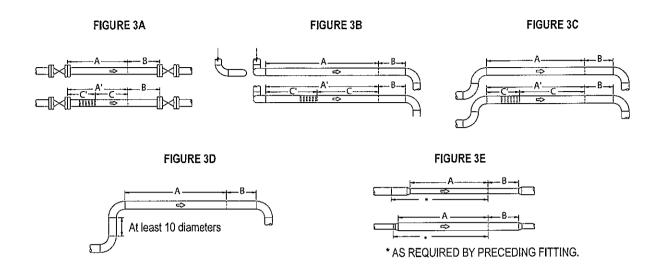
The pin type straightening vane is held in place by an allen set screw. The set screw seats into a countersunk hole in the center of a welded pad that is welded to the straightening vane itself. The tapped hole in the pipe is sealed off by welding a threadolet around the hole. A pipe plug is installed into the threadolet.

PIN TYPE INSTALLATION



When ordering specify: part number, type of material and pipe bore size.

AGA/API MINIMUM LENGTHS FOR METER RUN WITH FLANGE TAPS USING .70 BETA RATIO (AGA REP. NO. 3. -ANSI/API MPMS 14.3.2 1991)



NORMAL PIPE SIZE	2"	3"	4"	6"
A A' B C C'	78" 31" 21" 13" 18"	AGA FIGURE 3A-Fitting or Regulator 117" 47" 25" 20" 27"	155" 62" 30" 26" 36"	233" 93" 38" 39" 54"
A A' B C C'	63" 28" 21" 13" 15"	AGA FIGURE SB-Two Ells in Different Planes 95" 42" 25" 20" 22"	126" 55" 30" 26" 29"	189" 83" 38" 39" 44"
A A' B C	38" 25" 21" 13" 12"	AGA FIGURE 3C-Two Ells in Same Plane 57" 37" 25" 20" 17"	75" 49" 30" 26" 23"	113" 74" 38" 39" 34"
A A' B C	28" 21" 	AGA FIGURE 3D 42" 25" 	56" 30" 	84" 38"
A A' B C	25" 21" 	AGA FIGURE 3E Reducer 37" 25" 	49" 30" 	74" 38"

Note 1: For Pipe Taps: A, A' and C' should be increased by 2 pipe diameters.

Note 2: In Figure 3B, when two ells are closely preceded by a third which is not in the same plane as the middle or second ell, the piping requirements shown by A should be doubled.

DATA REQUIREMENTS FOR ORIFICE BORE CALCULATIONS

	Plate Type: Material: Bore: Tap Location:	Paddle	Oth 304 Nea	 arest 1/8" □	Other Other	
	Flange Rating Tag No.					
	Line No.					
	Fluid					
	Flow Temperature °F					
	Flow Pressure psig					
A.	Actual Orifice I.D.					
GENERAL	Line Flange I.D.					
핑	Meter Type (Mercury or Dry)					
	S. G. of Seal @ Ambient T. Diff. Range H,O					
	Static Range psig			ļ		
	Chart or Scale Range					
	Chart Multiplier	,				
				<u> </u>		
	Flow Units					
6	Maximum Flow					
LIQUIDS	Normal Flow					
ğ	Specific Gravity @ 60°F					
1	Specific Gravity @ Flowing C	Cond.				
	Viscosity cp @ Flowing Cond	i.				
	Flow Units					
	Maximum Flow	122				
	Normal Flow					
	Specific Gravity					
S	Molecular Weight					
ğ	Flowing Density lbs/ft3					
VAPOR/GA	Barometric Pressure or Elev. of Plant Site (approx.)					
>	Pressure Base					
	Temperature Base					
	Supercom Factor					
	@ Flowing T. & P.	· · · · · · · · · · · · · · · · · · ·				
	Viscosity cp @ Flowing T. &	P				
_	Flow Units					
STEAM	Maximum Flow					
ST	Quality % or Superheat °F					

NUFLO PRODUCTS MODEL 4055 DUAL CHAMBER METER RUN ORDERING FORM

FORM MUNBER: NS-JA REVISON MUNBER: 3 REVISION DATE: 10/26/04	None - Threaded - Beveled - Elbow @	9. Size of Upstream Reducer/ Elbow if used,	Reducer - Threaded - Elbow @_	8. Downstream Outer End of Meter Run Reveled - RF Flange - RTJ Flange	Threaded - Socket Weld		7. Downstream Connection to Orifice	Beveled - RF Flange - RTJ Flange Reducer - Threaded - Elbow @	6. Upstream Outer End of Meter Run	Threaded - Socket Weld	Fitting Wolded DE Flores DTI Flores		40 - 80 - 160	4. Wall Schedule of Meter Run		 Pressure Rating (ANSI) 150 - 300 - 600 - 900 - 1500 	2. Type of ortifice fitting: Dual Chamber	The of a factor	 Nominal Size Meter Run (inches) 2-3-4-6 		DUAL CHAMBER	90° 180°	SECTION A-A	DISTRICT DESIRED SHIPPING DATE	חאדם
	®	f used, 17. Purchase order No	10.	16	15. Special Coating:	Description	14. Install Thermowell:	3. Size of installed Orifice Plate.		င် ဗ	:		1	 Size of Downstream Couplings if used. Numbered from outer end of downstres 		None - Pin Type - Flange Type Carbon Steel - Stainless Steel	11.	None - Threaded - Beveled- Elbow @	10. Size of Downstream		UPSTREAM LENGTH	A	FILL IN APPLICABLE DIMENSIONS	QUANTITY ORDEREDORDERED BY	CUSTOMER
			Yes No	on Chapte decired with Mater Pun	None/ Prime/ Paint		Yes No	ice Plate, Inches.	C	p. F.	Orientation	1/2" 3/4" - 1" - None - 3000 Lbs 6000 Lbs.	1/2" 3/4" - 1" - None - 3000 Lbs 6000 Lbs.	Size of Downstream Couplings if used. Numbered from outer end of downstream tube	;	inge Type ess Steel	Flow Conditioner	eveled- Elbow @	Size of Downstream Reducer/ Elbow if used Inches.		H	\sim 1 1 \sim	AND CIRCLE DETAILED	L.S.D	TAG
OTHER:	WELD PROCEDURES:	AGA FIGURE#:	احجا	HYDRO REPORTS	PWHT:	X RAY:	SERVICE TEMP.:	TYPE OF SERVICE:	SPECIAL INSTRUCTIONS:	TEMPERATURE:		600	300		<u> </u>		80 1.939 160 1.687	╫	METER TUBE I.D.	!	DOWNSTREAM LENGTH	(E)	NOMENCLATURE	SHIPP	ASSEV
יו קוטטטין. טאומ	ROCEDURES: TOL'S:				YES				ONS:	-20" F TO 10	5 6	1480	740	285	WORKING			3.068 4.026	3" NO		LENGTH	(26) (23)		SHIPPING ADDRESS	ASSEMBLY NO
_	년 	BETA:	NO C	NO I	No les	8				100° F	5575	2225	1125		TEST		26 5./61 38 5.187	Ħ	6"				T		

NUFLO PRODUCTS MODEL 4042 SINGLE CHAMBER METER RUN ORDERING FORM

METER METER Inches. SCH. SCH. 40 90 90 90 90 160 90 160 90 90 90 90 90 90 90
SINGLE CHAMBER UPSTREAM LENGTH DOWNSTREAM LENGTH

NUFLO PRODUCTS ORIFICE FLANGE METER RUN ORDERING FORM

		1	
DISTRICT	QUANTITY ORDERED	VIA	SHIPPING ADDRESS
DESIRED SHIPPING DATE	ORDERED BY	END USER	
SECTION A-A	(5) FILL IN APPLICABLE DI	FILL IN APPLICABLE DIMENSIONS AND CIRCLE DETAILED NOMENCLATURE	LED NOMENCLATURE
000			
90° (6 (6) 270°	F 7		
180°	7	(9)	
ORIFICE FLANGE	UPST	UPSTREAM LENGTH	TREAM LENGTH

- 1. Nominal Size Meter Run (inches)
 1-2-3-4-6-8-10
- Type of orifice fitting: Orifice Flange
- 3. Pressure Rating (ANSI) 150 - 300 - 600 - 900 - 1500 - 2500
- Wall Schedule of Meter Run

40 - 80 - 160

- 5. Upstream Outer End of Meter Run Beveled - RF Flange - RTJ Flange Reducer - Threaded - Elbow @____
- 6. Downstream Outer End of Meter Run Beveled - RF Flange - RTJ Flange Reducor - Threaded - Elbow @____
- 7. Size of Upstream Reducer/ Elbow if used, Inches, None Threaded Beveled Elbow @____
- Size of Downstream Reducer/ Elbow if used Inches.

 None Threaded Beveled Elbow @

- Straightening Vanes/ Flow Conditioner None - Pin Type - Flange Type Carbon Steel - Stainless Steel
- 10. Size of Downstream Couplings if used.

 Numbered from outer end of downstream tube
 a. 1/2" 3/4" 1" None 3000 Lbs. 6000 Lbs.
 b. 1/2" 3/4" 1" None 3000 Lbs. 6000 Lbs.
 c. 1/2" 3/4" 1" None 3000 Lbs. 6000 Lbs.
 c. 1/2" 3/4" 1" None 3000 Lbs. 6000 Lbs.
 drientation
 a. 45° or Vertical
 b. 45° or Vertical
 c. 45° or Vertical
 c. 45° or Vertical
- 11. Size of installed Orifice Plate,
 Inches.
- 12. Install Thermowell: Yes No
 Description _____
- 13. Special Coating: None/ Prime/ Paint
- 14. Are MTR'S/ Calibration Sheets desired with Meter Run Yes No
- Purchase order No.

					-		160	80	40	SCH.	ME
250C	1500	900	600	300	150	ANSI RATING	1.687	1.939	2.067	2	METER TL
0	0)	0)	G	1.687 2.624 3.438 5.187	.939 2.900	3.068	3"	TUBE 1.D
			_			PRES:	3.438	3.826	4.026	4	FOR
6170	3705	2220	1480	740	285	WORKING PRESSURE (F	5.187	5.761	6.065	6	NOMINAL
			_		_	IG (PSI) P	80	40	30	SCH.	ıı
9275	5575	3350	2225	1125	450	TEST PRESSURE	7.625	7.981	8.071	œ	DIMENSIONS
5	S.	<u> </u>	5	5		E (PSI)	7.625 9.564	10.020	8.071 10.136	10")NS

SPECIAL INSTRUCTIONS:

TEMPERATURE: -20 °F TO 100 °F

0. 100 1		
TYPE OF SERVICE:		
SERVICE TEMP.:		
X RAY:	YES 🗆	NO 🗆
M.P.I.	YES 🗆	NO 🗆
Р₩НТ:	YES 🗆	NO 🗆
HYDRO REPORTS	YES 🗆	NO 🗆
API/AGA-3 (2000)	YES 🗆	NO 🗆
AGA FIGURE#:		BETA:
WELD PROCEDURES:	TOL'S:	
WELD PROCEDURES: PIPE, FLANGE:	PIPE, FLANG	Ü



OTHER:

STANDARD MATERIALS FOR PARTS USED ON MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS

	MIN -20°	F (-29°C)	MIN -50°	F (-45°C)	
ITEM	SWEET SERVICE	(H ₂ S) SOUR SERVICE	SWEET SERVICE	(H ₂ S) SOUR SERVICE	REMARKS
1	316 S.S.	316 S.S.	316 S.S.	316 Ş.S.	
2	316 S.S.	316 S.S.	316 S.S.	316 S.S.	
3	AISI 4130	AISI 4130	AISI 4130	AISI 4130	WINYLON SEAT & VITON, HSN O-RING & HANDLES
4	ALUMINUM	316 S.S	ALUMINUM	316 S.S	
5	SPLIT	SPLIT STL	SPLIT STL	SPLIT STL	
6	AISI 1020	AISI 1020	AISI 1020	AISI 1020	
7	N/A	N/A	N/A	N/A	
8	AISI 1020 CSTG,	AISI 1020 CSTG.	AISI 1020 CSTG.	AISI 1020 CSTG.	
9	AISI 4140	AIŞI 4140	AISI 4140	AI\$I 4140	HRc 18-22
10	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ON 4" AND 6" SIZE ONLY
11	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ON 4" AND 6" SIZE ONLY
12	VITON - B, HSN	70 DURO			
13	AISI 4140	AISI 4140	AISI 4140	AISI 4140	HRc 18-22
14	TEFLON®	TEFLON®	TEFLON®	TEFLON®	
15	VITON - B, HSN	70 DURO			
16	N/A	N/A	N/A	N/A	ON 4" SIZE ONLY
17	VITON-B, H\$N	VITON-B, HSN	VITON-B, HSN	VITON-B, HSN	70 DURO
18	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	
19	SAE1075	INCONEL X 750	SAE 1075	INCONEL X 750	INCONELX-TEMPERED
20	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ELECTROLESS NI-PLATED 0.0027SIDE
21	316 S.S.	316 S.S.	316 S.S.	316 S.S.	
22	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ELECTROLESS NI-PLATED
23	DISOGRIN, VITON, HSN OR TEFLON®	DISOGRIN, VITON, HSN OR TEFLON®	DISOGRIN, VITON, HSN OR TEFLON®	DISOGRIN, VITON, HSN OR TEFLON®	DISOGRIN, VITON, HSN OR TEFLON®
24	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-352 GR. LCC	ASTM SA-352 GR. LCC	NORMALIZED & TEMPERED TO 18-22 HRc RANGE, IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE
25	1015-18 STEEL	1015-18 STEEL	1015-18 STEEL	1015-18 STEEL	
26	ASTM SA-487 CLASS 4N	ASTM SA-487 CLASS 4N	ASTM SA-487 CLASS 4N	ASTM SA-487 CLASS 4N	NT TO HRc 18-22 RANGE ELECTRO- LESS NI-PLATED 0.002'/SIDE
27	1015-18 STEEL	1015-18 STEEL	1015-18 STEEL	1015-18 STEEL	
28	ASTM SA-105 (N)	ASTM SA-105 (N)	ASTM SA-350 LF2	ASTM SA-350 LF2	HARDNESS RANGE BETWEEN 18-22 HRc IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE
29	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-352 GR, LCC	ASTM SA-352 GR. LCC	NT TO 18-22 HRc RANGE, IMPACT TEST @-50°F (-45°C) FOR LOW TEMP SERVICE
30	VITON - B, HSN	VITON - B, HSN	VITON - B, HSN	VITON - B. HSN	70 DURO
31	ASTM SA-193 B7	ASTM SA-193 B7	ASTM SA-320 L7M	ASTM SA-320 L7M	
32	AISI 4130	AISI 4130	SA-320 L7	SA-320 L7	
33	AISI 4140	AISI 4140	SA-320 L7	SA-320 L7M	
34	ASTM SA-194 2H	ASTM SA-194 2HM	ASTM SA-320 L7	ASTM SA-320 L7M	
35	VITON - 8, HSN	VITON - B, HSN	VITON - B, HSN	VITON - B, HSN	70 DURO
36	1015-18 RING W/MOL	Y-TEFLON® SEAL INSE	RT VITON, HSN O-RIN	G	
38	ASTM SA-105 (N)	ASTM SA-105 (N)	ASTM SA-350 LF2	ASTM SA-350 LF2	
39	ASTM SA-36	ASTM SA-36	ASTM SA-36	ASTM SA-36	GA-12 PLATE

STANDARD MATERIALS FOR PARTS USED ON MODEL 4055 DUAL CHAMBER ORIFICE FITTINGS (cont'd)

ITEM	MIN -20°F (-29°C)		MIN -50°F (-45°C)		
	SWEET SERVICE	(H ₂ S) SOUR SERVICE	SWEET SERVICE	(H ₂ S) SOUR SERVICE	REMARKS
40	PLASTIC	PLASTIC	PLASTIC	PLASTIC	PLASTIC
41	ASTM SA-105 (N)	ASTM SA-105 (N)	ASTM SA-350 LF2	ASTM SA-350 LF2	AVAILABLE IN 316 S.S
45	316 S.S.	316 S.Ş.	316 S.S.	316 S.S.	
46	316 S.S.	316 S.S.	316 S.S.	316 S.S.	
47	NYLON	NYLON	NYLON	NYLON	
48	ASTM SA-36	ASTM SA-36	ASTM SA-36	ASTM SA-36	GA-12 PLATE

STANDARD MATERIALS FOR PARTS USED ON **MODEL 4042 SINGLE CHAMBER ORIFICE FITTINGS**

	MIN -20°F (-29°C)		MIN -50°F (- 45°C)		
ITEM	SWEET SERVICE	(H ₂ S) SOUR SERVICE	SWEET SERVICE	(H ₂ S) SOUR SERVICE	REMARKS
1	ASTM SA-193 B7	ASTM SA-193 B7M	ASTM SA-320 L7	ASTM SA-320 L7M	
2	SPLIT STL.	SPLIT STL.	SPLIT STL.	SPLIT STL.	
3	ALUMINUM	316 S.S.	ALUMINUM	316 S.S.	
4	ASTM SA-194 2H	ASTM SA-194 2HM	ASTM SA-320 L7	ASTM SA-320 L7M	
5	AISI 4130	AISI 4130	SA-320 L7	SA-320 L7M	
6	AISI 4140	AISI 4140	SA-320 L7	SA-320 L7M	
7	PLASTIC	PLASTIC	PLASTIC	PLASTIC	
8	316 S.S.	316 S.S.	316 S.S.	316 S.S.	
9	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ELECTROLESS NI-PLATED 0.002"/ SIDE
10	DISOGRIN, VITON, HSN OR TEFLON				
11	AISI 4130	AISI 4130	AISI 4130	AISI 4130	ELECTROLESS NI-PLATED 0.002"/ SIDE
12	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-352 GR. LCC	ASTM SA-352 GR. LCC	NORMALIZED & TEMPERED TO 18-22 Hrc RANGE, IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE
13	VITON-B, HSN	VITON-B, H\$N	VITON-B, HSN	VITON-B, HSN	70 DURO
14	ASTM SA-216 GR. WCB	ASTM SA-216 GR. WCB	ASTM SA-352 LCC	ASTM SA-352 LCC	NORMALIZED & TEMPERED TO 18-22 Hrc RANGE, IMPACT TEST @ -50°F (-45°C) FOR LOW TEMP SERVICE
15	ASTM \$A-105(N)	ASTM SA-105(N)	ASTM SA-350 LF2	ASTM SA-350 LF2	
16	ASTM SA-105(N)	ASTM SA-105(N)	ASTM SA-350 LF2	ASTM SA-350 LF2	
17	PLASTIC	PLASTIC	PLASTIC	PLASTIC	

NOTES: 1. MTR'S. HEAT TREAT CHARTS, AND OTHERS NDT RECORDS AVAILABLE UPON REQUEST.

2. WELDING PROCEDURES IN ACCORDANCE WITH ASME BOILER AND PRESSURE VESSEL CODE SECTION IX LATEST EDITION AND ADDENDA FOR GMAW AND SMAW PROCESSES. ALL POSITION, APPROVED BY ALBERTA BOILERS BRANCH, ARE AVAILABLE AT NUFLO'S EDMONTON PLANT. WELDS ARE MADE ON FITTINGS WHEN FLANGEWELD, OR FLANGED ORIFICE FITINGS OR COMPLETE METER RUNS ARE ORDERED.

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Part Number D301153X012 December 2003

FLOBOSS™ 103 FLOW MANAGER

Instruction Manual



Website: www.EmersonProcess.com/flow

Revision Tracking Sheet

December 2003

This manual is revised periodically to incorporate new or updated information. The date revision level of each page is indicated at the bottom of the page opposite the page number. A major change in the content of the manual also changes the date of the manual, which appears on the front cover. Listed below is the date revision level of each page.

Page	Revision
All Pages	12/03 (applies to version 1.20)
All Pages	10/02 (applies to version 1.10)
All Pages	04/02 (applies to version 1.0)

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ii Rev 12/03

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SECTION 1 – GENERAL INFORMATION

This section describes the FloBoss[™] 103 Flow Manager, part of the family of FloBoss flow computers manufactured by Emerson Process Management. It focuses on function and electronics.

This section contains the following information:

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1.2	Product Functions	1-7
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1.1 Product Overview

The FloBoss 103 is a 32-bit microprocessor-based Electronic Flow Computer. The FloBoss 103 Flow Manager electronically measures, monitors, and manages gas flow for a single meter run using orifice plate (differential pressure) techniques. This economical flow computer reliably and accurately performs gas flow calculations, temperature measurements, data archival, and remote communications with an optional communications card installed.

The FloBoss 103 performs minute, hourly (periodic), daily, and minimum / maximum historical data archivals for standard history and a configurable time interval archival for extended history. The FloBoss 103 is the perfect solution to electronically replace traditional paper charting. The FloBoss records the corrected gas flow across an orifice plate, stores the data, and has the ability to send the data to a remote host.

The FloBoss 103 computes gas flow for both volume and energy. The FloBoss provides on-site functionality and supports remote monitoring, measurement, data archival, communications, and control. The FloBoss design allows you to configure specific applications, including those requiring logic and sequencing control using a Function Sequence Table (FST).

The FloBoss 103 provides the following components and features:

- Weather-tight enclosure.
- ♦ Termination Board.
- ♦ 32-bit Processor Board.
- Battery Charger Board.
- Backplane Board.
- 2 MB of flash ROM (Random Access Memory), which is field upgradeable.
- ♦ 512K of battery backed-up RAM (Random Access Memory) storage.

- ◆ Integral Dual-Variable Sensor (DVS) for static pressure and differential pressure measurement using orifice metering.
- Support for a three-wire 100-ohm Resistance Thermal Detector (RTD) input.
- ♦ Internal lead-acid batteries (optional).
- ◆ Local Operator Interface (LOI) port EIA-232 (RS-232).
- ◆ EIA-485 (RS-485) Comm 1 port.
- ◆ Communications card using EIA-232 (RS-232), dial-up modem, or spread spectrum radio on Comm 2 port (optional).
- Extensive applications firmware.

Physically, the FloBoss 103 consists of a termination board with or without optional I/O points, RAM battery backup board, optional Comm 2 communications card, processor board, charger board, backplane board, and optional display housed in a compact, weather-tight case. The FloBoss is packaged in a NEMA 4 windowed enclosure that mounts on a pipestand or to an orifice plate via a three or five valve manifold. The aluminum enclosure protects the electronics from physical damage and harsh environments. Refer to Figure 1-1, Figure 1-2, and Figure 1-3.

The enclosure is fabricated from die-cast aluminum alloy with iridite plating and paint. The NEMA 4 enclosure protects the electronics from physical damage and harsh environments. The caps at either end of the enclosure can be unscrewed to allow field maintenance. The FloBoss has two ¾-14 pipe threaded holes for field conduit wiring, and communications. The DVS flange also has bracket holes that allow the enclosure and DVS to be mounted on a pipestand or mounting bracket.

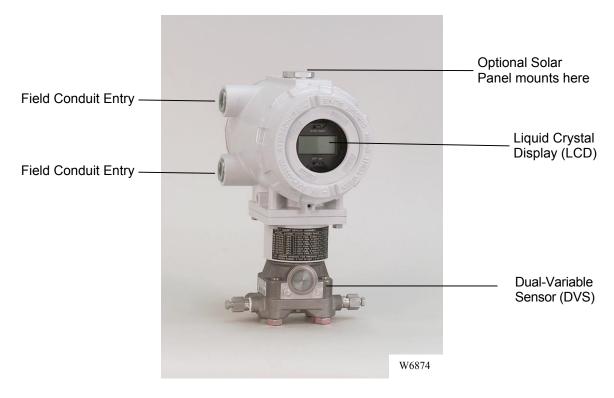


Figure 1-1. FloBoss 103 Flow Manager – LCD

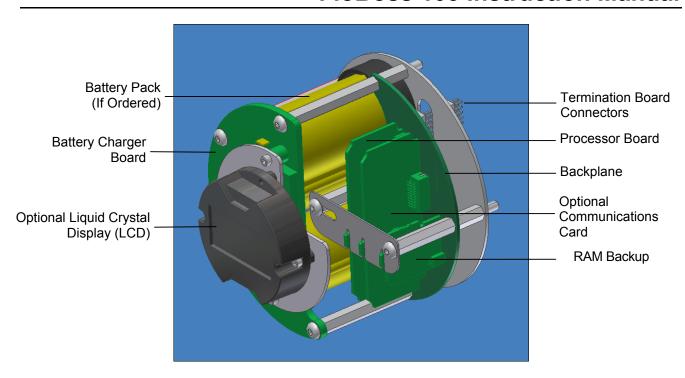


Figure 1-2. Inside the FloBoss 103 Enclosure

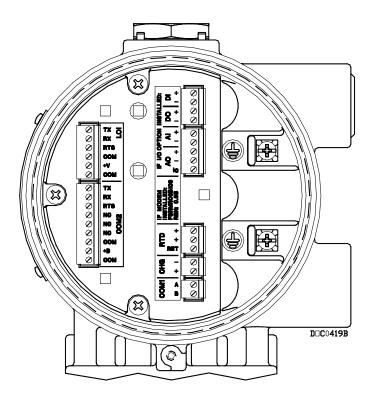


Figure 1-3. Wiring Terminals

1.1.1 Hardware

The **backplane board** provides the power regulation, the routing of the signals to the termination board, the processor board, the backup battery board, the optional communications board, the Dual-Variable Sensor (DVS), and the battery charger board. Refer to Figure 1-2.

The **termination board** provides connections to the field wiring and is located in the terminal side of the explosion proof housing. Refer to Figure 1-3. Connections include the power supply, Local Operator Interface (LOI) communications, Comm 1 EIA-485 (RS-485) communications, optional Comm 2 EIA-232 (RS-232) or dial-up modem communications, RTD wiring, and the I/O field wiring. The termination board provides surge and static discharge protection for the field wiring. Electronics include the RTD circuits and the final I/O drivers/receivers. The radio interface board mounts to the termination board. The termination board also serves as an interface to the backplane board in the electronics portion of the enclosure.

The 32-bit **processor board** contains the processor, memory (static RAM, Flash EEPROM, and boot ROM), Local Operator Interface (LOI) EIA-232 (RS-232) communications driver, Comm 1 EIA-485 (RS-485) communications driver, the reset controller, and the real-time clock. The functions for the I/O of analog conversion originate on the processor board. The processor board, also called the central processor unit (CPU), provides the Serial Peripheral Interface (SPI) buss, the Liquid Crystal Display (LCD) drivers, the Dual-Variable Sensor (DVS) control, and the optional I/O termination points control.

The microprocessor has low-power operating modes, including inactivity and low battery condition. The FloBoss comes standard with 512KB of built-in, static random access memory (SRAM) for storing data and history. The FloBoss also has 2 MB of programmable read-only memory (flash ROM) for storing operating system firmware, applications firmware, and configuration parameters.

The **charger board** controls the charging of the internal batteries, if installed. The batteries are three D-size lead-acid batteries providing 2.5 Amp-hours of current at 6.2 volts nominal. The charger board also serves as the interface to the optional LCD assembly, as well as supporting the On/Off and Norm/Reset jumpers.

A **backup battery** provides backup power for the Static RAM and the Real-Time Clock. This battery is field replaceable. Under normal conditions, the battery has a functional life in the excess of five years.

The **Dual-Variable Sensor (DVS)** measures static pressure and differential pressure for orifice flow calculation by converting the applied pressure to electrical signals and making the readings available to the processor board. The DVS housing fastens to a flanged adapter, which, in turn, mounts with four bolts to the bottom of the enclosure. The DVS cable connects into the backplane board. Refer to Section 5, Dual-Variable Sensor.

An **RTD temperature** probe typically mounts in a thermowell on the meter run. The RTD measures the flowing temperatures under a constant current drive. RTD wires should be protected either by a metal sheath or by conduit connected to a liquid-tight conduit fitting on the enclosure. The RTD wires connect directly to the RTD connector on the termination board inside the enclosure. Refer to Section 6, Input/Output and RTD.

The **built-in inputs and outputs (I/O)** on the FloBoss consist of a port for a Dual-Variable Sensor (DVS) and a 2 or 3-wire 100-ohm Resistance Thermal Detector (RTD) input interface. Three diagnostic analog inputs (AI) monitor the battery voltage, logical voltage, and enclosure/battery temperature. Refer to Section 6 for more information.

The **Local Operator Interface (LOI)** port provides for a direct, local link between the FloBoss and a personal computer (PC) through a Local Operator Interface Cable using EIA-232 (RS-232) communications. With the PC running ROCLINK software, you can configure the functionality of the FloBoss and monitor its operation.

The **Comm 1** allows for EIA-485 (RS-485) serial communication protocols. The optional EIA-232 (RS-232) or dial-up modem communication card activates **Comm 2**. Refer to Section 4, Communication Cards.

The I/O parameters, DVS inputs, flow calculations, power control, security, and FST programmability are configured and accessed using ROCLINK 800 software. Refer to *ROCLINK 800 User Manual* (Form A6121) for details concerning software capabilities.

1.1.2 Firmware

The firmware contained in flash ROM on the termination board, determines the functionality of the FloBoss and includes:

- ◆ 1992 AGA-3 flow calculations (with user-selectable AGA8 compressibility Detail, Gross I, or Gross II) for a single meter run.
- ♦ Memory logging of 240 alarms and 240 events.
- Archival of minute data from the last 60 minutes for up to 35 points (Standard History).
- Archival of 35 days of hourly data for up to 35 points (Standard History).
- Archival of 35 days of daily data for up to 35 points (Standard History).
- Archival of Min / Max historical data for today and yesterday (Standard History).
- Archival of 5040 entries for up to 15 points at user-specified interval (Extended History).
- Power control (wake up on ring) on optional internal modem.
- Logic and sequencing control using a user-defined Function Sequence Table (FST).
- Closed-loop (PID) control capabilities (requires optional I/O termination points).
- ◆ Communications based on the ROC protocol or Modbus slave, or optional host, (ASCII or RTU) protocol for use with EFM applications.
- ◆ Alarm call-in to host for Spontaneous-Report-By-Exception (SRBX).
- User level security.

1.1.3 Options and Accessories

The FloBoss 103 supports the following options and accessories:

- ♦ Communication cards for either EIA-232 (RS-232), dial-up modem, or spread spectrum radio communications.
- ◆ 4 Input/Output (I/O) termination points.
- ◆ Local Operator Interface (LOI) cable.
- ◆ Liquid Crystal Display (LCD) with two-line alpha-numeric viewing.
- ♦ Solar panel mast assembly.
- Blank plate for use when no DVS is required.

Plug-in **communication cards** allow you to customize the FloBoss installation for most communication requirements. Optional communication cards provide the ability to send and receive data.

One of the following card types can be accommodated:

- ◆ EIA-232 (RS-232) for asynchronous serial communications.
- Dial-up modem for communications over a telephone network.
- Spread Spectrum wireless radio communications.

Refer to Section 4, Communication Cards.

The local operator interface (LOI) port provides for a direct, local link using a **Local Operator Interface Cable** between the FloBoss and a personal computer. With the personal computer running ROCLINK 800 software, you can configure the functionality of the FloBoss and monitor its operation.

The optional **Liquid Crystal Display** (LCD) provides the ability to view data and configuration parameters while on site without using the local operator interface (LOI) and a PC. The LCD display plugs into the battery charger board and is visible through the window on the front of the FloBoss. The LCD can be rotated 90° in either direction. The LCD two-line display shows one line for a value and the other line for a five-character alphanumeric description of the value. The display operates from the internal 3.3 Volt supply. Through this display, you can view predetermined information stored in the FloBoss. Up to 16 items can be defined for display. The display automatically cycles through the configured list of items displaying a new value approximately every three seconds.

An external **solar panel** can be installed to recharge the backup batteries; it connects to the CHG+ / CHG- inputs on the termination board. An integral solar panel (2 W or 5 W) is available from the Flow Computer Division of Emerson Process Management; it will connect directly to the charger board assembly. Circuitry on the battery charger board monitors and regulates the charge based on battery voltage, charging voltage, and temperature. The FloBoss requires a minimum 8-volt 200 mA solar panel. Refer to Section 2, Using the FloBoss 103.

The **expansion input/output (I/O) termination points** provide additional inputs and outputs for expanded monitoring and control applications. I/O includes an analog input (AI), an analog output (AO), discrete input (DI), and discrete output (DO). The DO circuitry is optically coupled to help isolate the processor board from the output device. I/O can be used to drive a sampler or odorizer, open a valve, or monitor an additional analog input. The AO permits current or voltage control. Refer to Section 5, Input/Output Termination Points.

1.1.4 FCC Information

This equipment complies with Part 68 of the FCC rules. On the termination board is a label that contains, among other information, the FCC certification number and Ringer Equivalence Number (REN) for this equipment. If requested, this information must be provided to the telephone company.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. Typically, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line (as determined by the total RENs), contact the local telephone company.

If this equipment, dial-up modem, causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it necessary.

The telephone company may make changes to its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted service.

If trouble is experienced with this equipment, dial-up modem, for repair or warranty information, please contact Emerson Process Management, Flow Computer Division (641) 754-3923. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

1.2 Product Functions

This section describes the functions of the FloBoss 103, most of which is determined by firmware. The features and applications provided by the firmware, which must be configured by using ROCLINK 800 software, include:

- Flow calculations for an orifice meter.
- Extensive historical data archival.
- Memory logging of 240 alarms and 240 events.
- Security with local and remote password protection.
- Logic and sequencing control using a user-defined FST program.
- ◆ Spontaneous-Report-by-Exception (SRBX) capability.

1.2.1 Flow Measurement

The primary function of the FloBoss 103 is to measure the flow of natural gas through an orifice in accordance with the 1992 American Petroleum Institute (API) and American Gas Association (AGA) standards.

The primary inputs used for the orifice metering flow measurement function are differential pressure, static pressure, and temperature. The differential and static pressure inputs, which are sampled once per second, come from the Dual-Variable Sensor. The temperature input, which is sampled and linearized once per second, comes from an RTD probe.

1.2.1.1 1992 Flow Calculations for Orifice Metering

The 1992 flow calculation is in accordance with ANSI/API 2530-92 (AGA Report No. 3 1992), API Chapter 14.2 (AGA Report No. 8 1992 2nd printing 1994), and API Chapter 21.1. The 1992 flow calculation may be configured for either Metric or English units.

Flow Time

The differential pressure stored for each second is compared to the configured low flow cutoff. If the differential pressure is less than or equal to the low flow cutoff or the converted static pressure is less than or equal to zero, flow is considered to be zero for that second. Flow time for a recalculation period is defined to be the number of seconds for which the differential pressure exceeded the low flow cutoff.

Input and Extension Calculation

Each second the FloBoss 103 stores the measured input for differential pressure, static pressure, and temperature and calculates the Integral Value (IV). IV is the square root of the absolute upstream static pressure times the differential pressure.

Flow time averages of the inputs and the IV over the configured calculation period are calculated, unless there is no flow for an entire calculation period. Averages of the inputs are recorded to allow monitoring during no flow periods.

Instantaneous Rate Calculations

The instantaneous value of the Integral Value(IV) is used with the previous calculation period's Integral Multiplier Value (IMV) to compute the instantaneous flow rate. The IMV is defined as the value resulting from the calculation of all other factors of the flow rate equation not included in the IV. The instantaneous flow rate is used with the volumetric heating value to compute the instantaneous energy rate.

Flow and Energy Accumulation

The averages of the differential and static pressure, temperature, and sum of the IV are used with the flow time to compute the flow and energy over the calculation period. The flow and energy are then accumulated and stored at the top of every hour. At the configured contract hour, the flow and energy are then stored to the Daily Historical Log and zeroed for the start of a new day (contract hour).

1.2.2 History Points

History is saved to 2 databases: Standard and Extended History. The number of entries/logs available to Standard and Extended History is configurable.

The Standard history archives up to 35 points (8 are pre-configured) of min/max, minute, hourly and daily values. The min/max values are from today and yesterday; the minute values are from the last 60 minutes; the hourly values are from the last 35 days; and the daily values are from the last 35 days.

The Extended History database creates 1 entry for up to 15 points at a user-specified interval (see Specifications table). All the points in the Extended History will be logged at the same interval.

The default setting for Extended history archives 4 points of 10-minute values (from the last 35 days). 10-minute archiving provides a monitoring resolution similar to a chart recorder.

The first eight history points are pre-configured for flow metering history and cannot be changed. They are as follows:

- **1.** Flowing Minutes Today (Accumulate archive type).
- **2.** Differential Pressure (Average).
- **3.** Static or Line Pressure (Average).
- **4.** Flowing Temperature (Average).
- **5.** IMV, Integral Multiplier Value, or C Prime (Average).
- **6.** Pressure Extension or IV, Integral Value (Average).
- **7.** Instantaneous Flow (Accumulate).
- **8.** Instantaneous Energy (Accumulate).

History Point 2, History Point 3, History Point 4, and History Point 6 are all set up as an Average Archive Type that employs one of the following techniques:

- Flow dependent time-weighted linear averaging (default).
- Flow dependent time-weighted formulaic averaging.
- ♦ Flow-weighted linear averaging.
- Flow-weighted formulaic averaging.

The Averaging Technique is selected by using ROCLINK 800 software. The selected Averaging Technique is applied to the meter inputs. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

1.2.2.1 Minute Historical Log

The FloBoss has a 60-minute historical log for every history point. The Minute Historical Log stores the last 60 minutes of data from the current minute. Each history point has Minute Historical Log entries, unless the history point is configured for FST-controlled logging.

1.2.2.2 Hourly Historical Log

The FloBoss has a total of 35 days of hourly historical logs available for every history point. The Hourly Historical Log is also called the Periodic database. Normally, the Hourly Log is recorded at the beginning of every hour. The exceptions are FST Minute and FST Second logging.

The time stamp for periodic logging consists of the month, day, hour, and minute. The exception is for FST Second logging, in which the time stamp consists of the day, hour, minute, and second.

1.2.2.3 Daily Historical Log

The FloBoss has a total of 35 daily historical logs for every history point. The Daily Log is recorded at the configured contract hour every day with a time stamp that is the same as the Hourly Log. Each history point has daily historical log entries, unless the history point is configured for FST-controlled logging.

1.2.2.4 Min / Max Historical Log

The Min / Max database displays the minimum and the maximum values for the database points over a 24-hour period for today and yesterday. The Min / Max historical log can be viewed, but not saved to disk.

1.2.2.5 Extended History Log

The FloBoss has configurable archive times which, in turn, determine the number of entries. The four default 10-Minute history points include differential pressure, static pressure, flowing temperature, and an auxiliary Analog Input.

1.2.2.6 Alarm Log

The Alarm Log contains the change in the state of any alarm signal that has been enabled for alarms. The system Alarm Log has the capacity to maintain and store up to 240 alarms in a "circular" log. The Alarm Log has information fields that include time and date stamp, alarm clear or set indicator, and either the Tag name of the point or a 14-byte detail string in ASCII format.

In addition to providing functionality for appending new alarms to the log, the Alarm Log allows host packages to request the index of the most recently logged alarm entry. Alarm logging is available internally to the system, to external host packages, and to FSTs. Alarm Logs are not stored to the flash ROM during the Save Configuration function in ROCLINK 800 software.

The Alarm Log operates in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The Alarm Log provides an audit history trail of past alarms. The Alarm Log is stored separately to prevent recurring alarms from overwriting configuration audit data.

1.2.2.7 **Event Log**

The Event Log contains changes to any parameter within the FloBoss made through the protocol. This Event Log also contains other FloBoss events, such as power cycles, cold starts, and disk configuration downloads. The Event Log provides an audit history trail of past operation and changes.

The system Event Log has the capacity to maintain and store up to 240 events in a circular log. The Event Log has information fields that includes point type, parameter number, time and date stamp, point number if applicable, the operator identification, and either the previous, current parameter values, and either the Tag name of the point or a 14-byte detail string in ASCII format.

In addition to providing functionality for appending new events to the log, the Event Log allows host packages to request the index of the most recently logged event entry. Event logging is available internally to the system, to external host packages, and to the FST.

Event Logs are not stored to flash ROM when Save Configuration is issued in ROCLINK software. The Event Log operates in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The Event Log provides an audit trail history of past operation and changes. The Event Log is stored separately to prevent recurring alarms from overwriting configuration audit data.

1.2.3 Security

The FloBoss provides for security within the unit. A maximum of 16 log-on identifiers (IDs) may be stored. In order for the unit to communicate, the log-on ID supplied to ROCLINK 800 software must match one of the IDs stored in the FloBoss. The Local Operator Interface port (Security on LOI) has security Enabled by default. The Comm 1 and Comm 2 can likewise be configured to have security protection, but is disabled by default.

1.2.4 Function Sequence Tables (FST)

The FloBoss supports FST user programmability. Two FST programs can be developed with a maximum length of 3000 bytes each (typically 300 lines of code). The number of FST lines per execution cycle can be configured in ROCLINK 800 software. The number set on the ROC > Information screen will determine both FST programs.

The FST code resides in static RAM and is backed up to flash memory when the Save Configuration function is issued through ROCLINK 800 software.

1.2.5 PID Control

PID Control is available when the optional I/O termination points are installed. PID (Proportional, Integral, and Derivative) functionality calculates both the Primary Control and Override Control change in output. PID Control then selects which Control is to be used, based upon whether the High Override Type Select or Low Override Type Select is chosen and adjusts the Output control as necessary. The Output of the PID functions can be implemented through an Analog Output (the FloBoss 103 does not have two Discrete Outputs).

1.2.6 Spontaneous-Report-By-Exception (SRBX) Alarming

The SRBX functionality allows a communications port to be set up to enable the FloBoss to contact the host computer when specified alarm conditions exist. To configure SRBX alarming, each comm port must have the SRBX parameter enabled, each point must have the alarming parameter enabled, and points must have the SRBX Set on Clear parameter set.

1.2.7 Pass Through Communications

Pass Through Communications allow the user to configure a FloBoss 103 to pass communications from one communication port to another port if the message is not intended for that ROC. For example, a FloBoss 103 can be configured to have a radio connected to the LOI port and pass communication to other FloBoss 103 devices with addresses that are connected to the EIA-485 (RS-485) comm port. In another example, the communications would pass from a Dial-up modem in COM2 out the radio connected on LOI. Many combinations are possible of Pass Through communications utilizing the LOI, COM1, and COM2 ports.

❖ NOTE: COM2 may only use a Dial-up modem if it is receiving Pass Through messages. It cannot initiate phone calls to other field devices via Dial-up modem.

1.2.8 Protocol Automatic Switching

The FloBoss 103 has the capability to communicate with ROC or Modbus protocol. With the standard version of FloBoss firmware, Modbus Slave is standard. If you require Modbus Host, contact your local sales representative.

1.2.9 User C Capability

The FloBoss 103 has User C capability that allows special features to be written which can be loaded into the FloBoss 103 unit to enhance the function of the FloBoss 103. User programs typically provide the ability to interface with alternate metering equipment, perform alternate calculation methods, or communicate with alternate protocols.

1.3 Product Electronics

This section describes the FloBoss 103 Termination Board. For Communication Cards, refer to Section 4. For the Dual-variable Sensor, refer to Section 5. For I/O Termination Points, refer to Section 6.

1.3.1 Termination Board Overview

The Termination Board (Figure 1-3) components support the functionality of the FloBoss 103 and includes:

- ◆ Local operator interface (LOI) EIA-232 (RS-232) terminations.
- ♦ EIA-485 (RS-485) communications (Comm 1) terminations.

- RTD input terminations.
- ♦ Optional I/O and terminations.
- Remote charge terminations.
- Optional Comm 2 terminations.

1.3.2 Processor and Memory

The FloBoss derives processing power from a 32-bit microprocessor. The 32-bit CMOS microprocessor features dual 32-bit internal data buses and a single 8-bit external data bus. The unit can address up to 4 MB of memory, including high-speed direct memory access.

The FloBoss has 512 KB of static random access memory (SRAM) for storing interrupt vectors, Proportional, Integral, and Derivative alarms, events, and history data.

The FloBoss also has a 2 MB flash memory chip for storing the operating system factory code, configuration parameters, and user C programs.

1.3.3 Liquid Crystal Display

An optional two-line Liquid Crystal Display (LCD) panel mounts on the Battery Charger Board.

The LCD allows you to view the current and past gas volumes on site without requiring a computer. The LCD provides you a visual indication of the status of the meter run by displaying the historical performance data to help ensure the health and integrity of your installation.

The LCD panel remains on at all times when the power is applied in the valid operating range. The panel cycles its display through a configured list of up to 16 parameter values, with the first seven being pre-configured. The first three displays show values for time, date, and battery condition and cannot be configured. The next five displays show certain flow parameters and are factory configured, but you may change their configuration.

To configure the list of values for the LCD panel, refer to the LCD User List Setup procedure in the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

1.3.4 Communications Ports

The FloBoss provides two standard and one optional communication ports:

- ◆ Standard Operator interface port EIA-232 (RS-232) LOI.
- ◆ Standard EIA-485 (RS-485) Communications Comm 1.
- ◆ Optional EIA-232 (RS-232) or Dial-up Modem Communications Comm 2.

1.3.4.1 Local Operator Interface Port – LOI

The Local Operator Interface (LOI) port provides direct communications between the FloBoss 103 and the serial port of an operator interface device, such as an IBM compatible computer using an EIA-232 (RS-232) link. The interface allows you to access the FloBoss 103 (using ROCLINK 800 software) for configuration and transfer of stored data. The LOI port is capable of initiating a message in support of Spontaneous-Report-by-Exception (SRBX) alarming.

The LOI terminal on the Termination Board provides wiring access to a built-in EIA-232 (RS-232) serial interface, which is capable of up to 19.2K bps operation. The operator interface port supports ROC or Modbus protocol communications. The LOI also supports the log-on security feature of the FloBoss 103, if the Security on LOI is Enabled in ROCLINK 800 software.

1.3.4.2 EIA-485 (RS-485) Serial Communications – Comm 1

Use Comm 1 to monitor or alter the FloBoss 103 from a remote site, using a host or ROCLINK software. Comm 1 supports baud rates up to 19.2K bps. Comm 1 also supports the log-on security feature of the FloBoss 103 if the Security on Comm 1 is Enabled in ROCLINK software.

Comm 1 sends and receives messages using the ROC or Modbus protocol. Comm 1 is capable of initiating a message in support of Spontaneous-Report-by-Exception (SRBX) alarming. Comm 1 permits EIA-485 (RS-485) serial communication protocols that meet EIA-485 (RS-485) specifications for differential, asynchronous transmission of data over distances of up to 1220 m (4000 ft). The EIA-485 (RS-485) drivers are designed for true multi-point applications with multiple devices on a single bus.

The default values for the EIA-485 (RS-485) communications are: 9600 Baud Rate, 8 Data Bits, 1 Stop Bit, No Parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. The maximum baud rate is 19.2K. To enable or disable the Comm 1 port, select Configure > Radio Power Control and select the Enable/Disable radio button under Radio Power Control (enable is default).

1.3.4.3 Optional Communication Cards – Comm 2

Two plug-in **communication cards** allow you to customize the FloBoss 103 installation for most communication requirements. The communication cards provide an interface for the host communications Comm 2 port. These cards permit serial communication protocols and dial-up modem communications. The Comm 2 port is capable of initiating a message in support of Spontaneous-Report-by-Exception (SRBX) alarming. Refer to Section 3 for additional information. One of the following card types can be accommodated:

- ◆ EIA-232 (RS-232) for asynchronous serial communications (baud rate up to 19.2K).
- Dial-up modem for communications over a telephone network (default at 2400 baud).

1.3.5 RTD Input

The FloBoss 103 supports a direct input from a Resistance Thermal Detector (RTD) sensor to measure flowing temperature. The RTD has a measurement range of -40 to 100°C (-40 to 212°F). The terminals for the RTD wires are labeled "RTD."

During operation, the RTD is read once per second. The value from the RTD is linearized, and then it is sent to processing as Analog Input (AI) Point Number A3. The AI routine converts this value to engineering units, and checks alarming. To conserve power, the RTD power is switched on and off. During calibration, the RTD power will be on constantly. Once calibration is completed, the RTD will cycle power again.

1.3.6 Real-Time Clock

The real-time clock provides the FloBoss 103 with the time of day, month, year, and day of the week. The real-time clock automatically switches to backup power when the FloBoss loses primary input power. Backup power for the real-time clock is adequate for a period in excess of five years with no power applied to the FloBoss.

1.3.7 Diagnostic Monitoring

The electronics board has three diagnostic inputs incorporated into the circuitry for monitoring battery voltage, logical voltage, and board temperature. Access these analog inputs using the I/O function of ROCLINK 800 software. The three values are available as the following Analog Input (AI) points:

- ♦ E1 logical voltage.
- ♦ E2 battery voltage.
- ♦ E5 board (battery) temperature.

1.3.8 Automatic Self Tests

The FloBoss 103 performs the following self-tests on a periodic basis:

- ♦ Battery low and battery high.
- Software and hardware watchdog.
- ◆ RTD automatic temperature compensation.
- Sensor operation.
- ♦ Memory validity.

The FloBoss 103 will operate with its internal batteries down to 5.4 VDC. The LCD becomes active when input power with the proper polarity and startup voltage (typically set greater than 8.0 Volts) is applied to the CHG+ / CHG- connector (provided the power input fusing/protection is operational). The battery and logical voltage tests ensure that the FloBoss 103 is operating in the optimum mode.

The software watchdog is controlled by the central processor unit (CPU). The software will arm the watchdog timer every second. If the watchdog timer is not armed for a period of 6 seconds, then the watchdog timer forces the FloBoss 103 unit to reset. If necessary, the software automatically resets. The hardware watchdog is controlled by the CPU and monitors the power to the hardware. If the battery voltage drops below 5.4 volts, the FloBoss 103 automatically shuts down.

The FloBoss 103 monitors its orifice-metering Dual-Variable Sensor for accurate and continuous operation.

1.3.9 Low Power Mode

Sleep mode is used to place the CPU in a low power mode. The battery voltage is monitored by low voltage detection circuitry and the low voltage limit value is set at 5.4 volts. During Sleep mode, submodules are powered down. The FloBoss 103 enters Sleep mode after one minute of inactivity on the communication ports.

Wake-up from Sleep occurs when the FloBoss 103 receives a:

- ◆ Timed interrupt from the Real-Time Clock.
- Signal from one of the communication ports.

1.4 Additional Information

The following manual includes additional information not found in this manual:

ROCLINK 800 Configuration Software User Manual – Form A6121 - Part Number D301159X12

1.5 FloBoss 103 Specifications

Main Specifications

PROCESSOR INFORMATION

32 bit, running at 3.68 MHz.

Program Memory: 2MB flash EPROM (program-

mable) for firmware and configuration.

Data Memory: 512 KB SRAM.

Boot Memory: 128 KB Flash EPROM.

TIME FUNCTIONS

Clock: Real Time. Year/Month/Day and Hour/Minute/ Second. Battery Backed. Automatically adjusts for Daylight Savings Time (selectable).

DIAGNOSTICS

These conditions are monitored and alarmed: sensor and RTD point fail, battery and internal voltages, internal temperature.

COMMUNICATIONS

Local Operator Interface: EIA-232 (RS-232C) format. Software configured, 1200 to 19,200 bps rate selectable.

EIA-485 (RS-485): Software configured, 1200 to 19,200 bps rate selectable.

Host: EIA-232 (RS-232) or Modem interface, when optional communications card is installed.

Protocols: ROC or Modbus Slave or optional Host (ASCII or RTU).

Radio: Spread-spectrum wireless radio, when optional logic card and radio are installed.

POWER

Internal Batteries: Lead-acid. Rechargeable. Nominal 6.2 Vdc, 2.5 Amp-hour.

Charging Input from optional Solar Panel: 8-10 Vdc (nominal).

External Power Charging Input: 8-28 Vdc.

Input Current: 5 mA nominal. 9.5 mA at 100% duty cycle (battery charging not included).

ENCLOSURE

Housing and Cap: Die-cast aluminum alloy with iridite plating and paint.

WEIGHT

6.58 kg (14.5 lbs).

SOLAR PANEL (OPTIONAL)

Output: 2 Watts, 9 Volts nominal.

Size: 114 mm by 159 mm (4.5 in. by 6.25 in.).

RTD INPUT

Quantity/Type: Single input for a 2 or 3-wire RTD

element with alpha of 0.00385.

Terminals: "RTD+" current source, "RTD+" signal positive input, and "RTD RET" signal negative input. **Sensing Range:** -40 to 100°C (-40 to 212°F).

Accuracy: ±0.56°C (1.0°F) over sensing range (includes linearity, hysteresis, repeatability).

Ambient Temperature Effects per 28°C (50°F): ±0.50°C (0.90°F) for process temperatures from -40

to 100°C (-40 to 212°F).

Filter: Band-pass hardware filter.

Resolution: 10 bits.

Sample Period: 1 sec minimum.

ENVIRONMENTAL

Operating Temperature: -40 to 75°C (-40 to 167°F).

LCD Display: -20 to 75°C (-4 to 167°F).

Storage Temperature: -50 to 85°C (-58 to 185°F). **Operating Humidity:** 5 to 95%, non-condensing.

Vibration: Meets SAMA PMC 31.1.

Radiated/Conducted Transmissions: Meets requirements of IEC 61326 Electrical Equipment for

Measurement, Control and Laboratory Use.

Radiated Emissions: Meets FCC Part 15, Class A.

DIMENSIONS

Enclosure: 160 mm H by 150 mm W by 135 mm D (6.3 in H by 5.9 in W by 5.3 in D) excludes mounting flange and sensor.

Pipestand Mounting: Mounts on a 2-inch pipe with U-bolt mounting kit (optional).

APPROVALS

Evaluated per the following European standards:

EN 50014 (1998) EN 50018 (2000) + A1.

Evaluated per the following North American standards:

CSA C22.2 No. 30 CSA C22.2 No. 213

UL 1203 UL 1604.

Product Markings for Hazardous Locations:

Class I. Division 1. Groups C & D. Explosion-proof

Class I, Division 2, Groups A, B, C & D T3.

EEx d IIB T5 (T_{ambient}=75°C).

SECTION 2 - INSTALLATION AND USE

This section provides generalized guidelines for successful installation and operation of the FloBoss 103. This section contains the following information:

Section		<u>Page</u>
2.1	Installation Overview	2-1
2.2	Installation Requirements	2-1
2.3	Mounting	2-3
2.4	Startup and Operation	2-6
2.5	Configuration	2-8

2.1 Installation Overview

The following steps must be taken to install a FloBoss 103 to a pipestand or orifice plate. Refer to the Table of Contents to find an explanation of each step in the appropriate sections of this manual.

- 1. If pipestand mounting, install the pipestand per the directions include with the pipestand.
- **2.** Remove the orifice/meter run from service.
- **3.** For **orifice plate** mounting, install the FloBoss 103 on the meter run using a manifold and hardware to secure the FloBoss 103 to the orifice flanges. For **pipestand** mounting, install the FloBoss 103 on the pipestand using clamps or mounting brackets.
- **4.** Connect the impulse lines.
- **5.** Install the RTD and connect it to the termination board.
- **6.** Connect the FloBoss 103 to the operator interface (ROCLINK 800 software).
- **7.** Power the FloBoss 103 unit. If powered externally, wire the unit to the external power source.
- **8.** Calibrate the Dual-Variable Sensor input.
- **9.** Calibrate the RTD input.
- **10.** Connect the FloBoss 103 unit to any other external communication devices or networks.

Place the meter run in service and monitor with ROCLINK 800 software for proper operation.

2.2 Installation Requirements

Planning helps to ensure a smooth installation. Be sure to consider location, ground conditions, climate, and site accessibility, as well as the suitability of the FloBoss application while planning an installation.

The versatility of the FloBoss allows it to be used in many types of installations. For additional information concerning a specific installation, contact your local sales representative.

❖ NOTE: The FloBoss 103 has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits provide reasonable protection against harmful interference when the equipment operates in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, the FloBoss 103 may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

2.2.1 Environmental Requirements

The FloBoss enclosure is classified as a NEMA 4 equivalent enclosure. This provides the level of protection required to keep the units operating under a variety of weather conditions.

The FloBoss 103 is designed to operate over a wide range of temperatures. However, in extreme climates it may be necessary to moderate the temperature in which the unit must operate.

The FloBoss 103 is designed to operate over a -40 to 75°C (-40 to 167°F) temperature range. The LCD temperature range is -25 to 70°C (-13 to 158°F). When mounting the unit, be aware of external devices that could have an effect on the operating temperature. Operation beyond the recommended temperature range could cause errors and erratic performance. Prolonged operation under extreme conditions could also result in failure of the unit.

Check the installation for mechanical vibration. The FloBoss 103 should not be exposed to levels of vibration that exceed 2g for 15 to 150 Hz and 1g for 150 to 2000 Hz.

2.2.2 Site Requirements

Careful consideration in locating the FloBoss 103 on the site can help prevent future operational problems. The following items should be considered when choosing a location:

- ◆ Local, state, and federal codes often place restrictions on monitoring locations and dictate site requirements. Examples of these restrictions are fall distance from a meter run, distance from pipe flanges, and hazardous area classifications.
- ◆ Locate the FloBoss 103 to minimize the length of signal and power wiring.
- When using solar-powered FloBoss 103 units, orient solar panels to face due South (not magnetic South) in the Northern Hemisphere and due North (not magnetic North) in the Southern Hemisphere. Make sure nothing blocks the sunlight from 9:00 AM to 4:00 PM.
- ♦ Antennas for radio and cellular communications must be located with an unobstructed signal path. If possible, locate antennas at the highest point on the site and avoid aiming antennas into storage tanks, buildings, or other tall structures. Allow sufficient overhead clearance to raise the antenna.

- ◆ To minimize interference with radio or cellular communications, locate the FloBoss 103 away from electrical noise sources such as engines, large electric motors, and utility line transformers
- ◆ Locate the FloBoss 103 away from heavy traffic areas to reduce the risk of being damaged by vehicles. However, provide adequate vehicle access to aid in monitoring and maintenance.

2.2.3 Compliance with Hazardous Area Standards

The FloBoss 103, without optional mast kit, has hazardous location approval for Class I, Division 1, Groups C to D exposures. The FloBoss 103 unit also has a Class I Division 2 Groups A, B, C & D approval. The Class, Division, and Group terms are defined as follows:

Class defines the general nature of the hazardous material in the surrounding atmosphere. Class I is for locations where flammable gases or vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Division defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere. Division 1 locations are presumed to be hazardous. Division 2 locations are areas where gas, dust or vapors can exist under abnormal conditions.

Group defines the hazardous material in the surrounding atmosphere. Groups A to D are defined as follows:

Group A & B – Atmosphere containing hydrogen, gases or vapors of equivalent hazards.

Group C – Atmosphere containing ethylene, gases, or vapors of equivalent hazards.

Group D – Atmosphere containing propane, gases, or vapors of equivalent hazards.

For the FloBoss 103 to be approved for hazardous locations, it must be installed according to the National Electrical Code (NEC) Article 501, and any local code requirements, if applicable.

A CAUTION

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

2.3 Mounting

When choosing an installation site, be sure to check all clearances. Provide adequate clearance for wiring and service. The optional LCD should be visible and accessible for the on-site operator. When using a solar panel, allow adequate clearance, and view of the sun should not be obstructed. Allow adequate clearance and an obstructed location for antennas when using cellular phones or radios.

The FloBoss enclosure assembly can mount directly to an orifice plate by using a 3 or 5 valve manifold or by using the standard Rosemount 2" pipe mounting kit with impulse tubing connecting the FloBoss 103 to the meter run.

The Dual-Variable Sensor factory-mounts directly on a flat flange to the FloBoss enclosure with a 4-bolt pattern. An adapter coupling provides the mounting interface between the enclosure and the DVS. See Section 4 for additional information.

The optional Blank plate is available when the FloBoss 103 is ordered without a DVS. The Blank plate factory-mounts directly on a flat flange to the FloBoss enclosure with a 4-bolt pattern. The Blank plate mounts onto a pipestand, using the standard Rosemount 2-inch pipe mounting kit and 2 user-supplied bolts (5/16 X 1 3/8) and lock washers.

2.3.1 Mounting the FloBoss 103

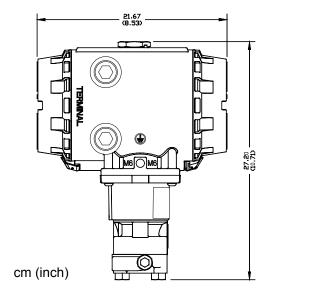
Mounting of the FloBoss 103 can be accomplished using either of the following methods:

Pipestand mounted – The FloBoss 103 can mount to a 2-inch pipestand. Ensure that the pipestand meets all weight requirements and installation conforms to local building codes.

Orifice Plate – Directly mount to an orifice plate via a 3 or 5 valve manifold.

With either mounting method, the pressure inputs must be piped to the process connections on the DVS. For more information on process connections, refer to Section 4, Dual-Variable Sensor.

Refer to Figure 2-1 and Figure 2-2 for dimensions.



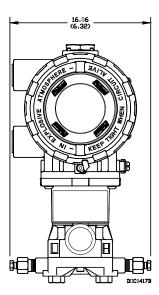


Figure 2-1. Outline and Mounting Dimensions without Solar Panel

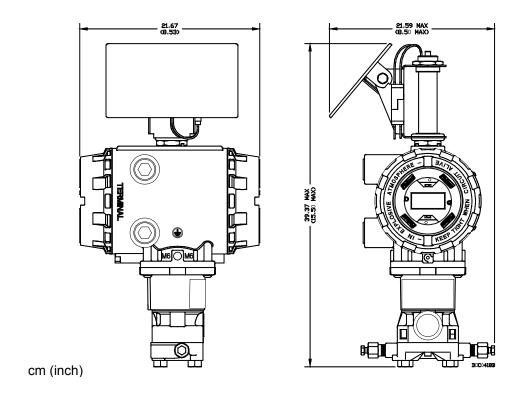


Figure 2-2. Outline and Mounting Dimensions with Solar Panel and LCD

2.3.2 How to Install the FloBoss 103 on a Pipestand

To install the FloBoss 103 on a 2-inch pipestand:

- 1. Install the pipestand per the directions included with the pipestand.
- **2.** Remove the orifice/meter run from service.
- **3.** Install the FloBoss 103 on the pipestand using clamps or mounting brackets. Refer to Figure 2-3.

2.3.3 How to Install the FloBoss 103 on an Orifice Plate

To install the FloBoss 103 on an orifice plate:

- 1. Remove the orifice/meter run from service.
- **2.** Install the FloBoss 103 on the meter run using a manifold and hardware to secure the FloBoss 103 to the orifice flanges. Refer to Figure 2-3.

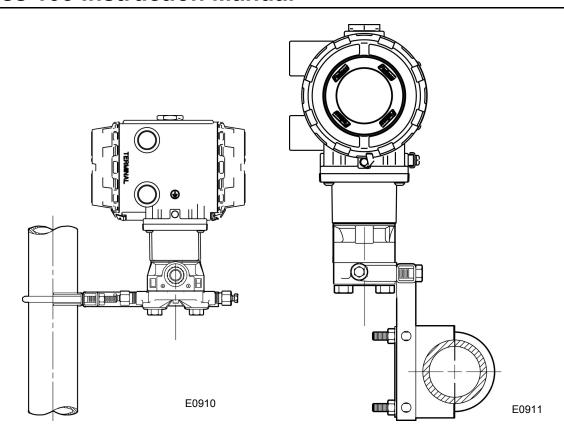


Figure 2-3. Mounting Styles

2.4 Startup and Operation

Before starting the FloBoss 103, perform the following checks to ensure the unit is properly installed.

- Check the field wiring for proper installation. Refer to Section 3.
- Make sure the input power has the correct polarity.
- * NOTE: It is important to check the input power polarity before turning on the power.

◆ Make sure the input power is fused at the power source. Plug the input power into the connector labeled CHG+ / CHG-.

A CAUTION

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

2.4.1 How to Start the FloBoss 103

The FloBoss 103 ships with the reset jumper in the OFF positions to prevent unnecessary battery drainage.

To apply power to the FloBoss 103:

- **1.** Unscrew the front end cap cover (LCD end).
- **2.** Place the power jumper (located on the LCD if installed or located at J1 on the Battery Charger Board) in the **ON** position.
- **3.** Screw the top-end cap cover (LCD end).

After the FloBoss 103 completes start-up diagnostics (RAM and other internal checks), the optional LCD displays the date and time to indicate that the FloBoss completed a valid reset sequence. If the LCD does not come on, refer to Section 8 for possible causes.

2.4.2 Operation

Once startup is successful, it is necessary to configure the FloBoss 103 to meet the requirements of the application. *ROCLINK 800 Software User Manual* (Form A6121) details the procedure for configuring the FloBoss and calibrating the I/O. Once the FloBoss is configured and calibrated, it can be placed into operation.

A CAUTION

When the enclosure end caps are unscrewed, local configuration or monitoring of the FloBoss 103 through its LOI port must be performed only in an area known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

During operation, the FloBoss 103 can be monitored (to view or retrieve current and historical data) either locally or remotely. Local monitoring is accomplished either by viewing the LCD panel or by using ROCLINK software on a PC connected through the LOI port. Remote monitoring is performed through Comm 1 or Comm 2 of the FloBoss using ROCLINK 800 software or a host system.

2.5 Configuration

The FloBoss 103 Flow Manager has a number of software settings, called parameters, which must be configured before it is calibrated and placed into operation. Configuration must be performed using ROCLINK 800 software, which runs on an IBM-compatible personal computer. The personal computer is normally connected to the LOI port of the flow computer to transfer configuration data into the FloBoss 103, although much of the configuration can be done off-line and later loaded into the unit.

Default values for all parameters exist in the firmware of the flow computer. If the default is acceptable for your application, it can be left as it is. Refer to the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

SECTION 3 – POWER CONNECTIONS

This section describes wiring of power from a dc voltage source, solar panel, and batteries and grounding. This section contains the following information:

Section		<u>Page</u>
3.1	Power Installation Requirements	3-1
3.2	Grounding Installation Requirements	3-2
3.3	How to Determine Power Requirements	3-3
3.4	Solar Powered Installations	3-4
3.5	Batteries	3-5
3.6	Wiring	3-7
3.7	How to Backup Configuration and Log Data	3-8

A CAUTION

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

3.1 Power Installation Requirements

Typical sources of primary power for FloBoss 103 installations are DC voltage sources and solar power. Care must be taken to route power away from hazardous areas, sensitive monitoring devices, and radio equipment. Local and company codes generally provide guidelines for power installations. Adhere rigorously to all local and National Electrical Code (NEC) requirements for power installations.

The FloBoss 103 accepts input voltages from 8.0 volts to 28 volts at the charge (CHG+/CHG-) terminals on the termination board. The maximum power for DC voltage sources is 130 mW, not including battery charging.

❖ NOTE: Do not allow the batteries to fully discharge. If the batteries are fully discharged, the battery charger board may enter thermal limiting.

3.2 Grounding Installation Requirements

Grounding wiring requirements for DC voltage sources equipment are governed by the National Electrical Code (NEC). When the equipment uses DC voltage sources, the grounding system must terminate at the service disconnect. All equipment grounding conductors must provide an uninterrupted electrical path to the service disconnect.

- ◆ The National Electrical Code Article 250-83 (1993), paragraph c, defines the material and installation requirements for grounding electrodes.
- ◆ The National Electrical Code Article 250-91 (1993), paragraph a, defines the material requirements for grounding electrode conductors.
- ♦ The National Electrical Code Article 250-92 (1993), paragraph a, provides installation requirements for grounding electrode conductors.
- ♦ The National Electrical Code Article 250-95 (1993) defines the size requirements for equipment grounding conductors.

3.2.1 Grounding for the FloBoss 103

Proper grounding of the FloBoss 103 helps to reduce the effects of electrical noise on the unit's operation and protects against lightning. The FloBoss provides lightning protection for built-in field wiring inputs and outputs. Install a surge protection device at the service disconnect on DC voltage source systems to protect against lightning and power surges for the installed equipment. You may also consider a telephone surge protector for the optional dial-up modem communications card.

All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. The grounding conductor should have a resistance of 1 ohm or less between the FloBoss enclosure ground and the earth ground rod or grid.

All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. The grounding conductor should have a resistance of 1 ohm or less between the FloBoss enclosure ground and the earth ground rod or grid.

The recommended cable for I/O signal wiring is an insulated, shielded, twisted-pair. The twisted pair and the shielding minimize signal errors caused by EMI (electromagnetic interference), RFI (radio frequency interference), and transients.

3.2.2 How to Install Grounding for the FloBoss 103

The FloBoss 103 has two grounding screws inside the enclosure and one grounding screw outside the enclosure. For the grounding screw locations, refer to Figure 3-1.

The grounding installation method for the FloBoss 103 depends on whether the pipeline has cathodic protection. On pipelines with cathodic protection, the FloBoss must be electrically isolated from the pipeline.

Electrical isolation can be accomplished by using insulating flanges upstream and downstream on the meter run. In this case, the FloBoss 103 could be flange mounted or saddle-clamp mounted directly on the meter run and grounded with a ground rod or grid system.

On pipelines without cathodic protection, the pipeline itself may provide an adequate earth ground and the FloBoss 103 could mount directly on the meter run using an orifice plate. Test with a ground system tester to make sure the pipeline to earth impedance is less than 2 ohms. If the pipeline provides an adequate ground, you may not need to install a separate ground rod or grid system. All grounding should terminate at a single point.

If the pipeline to earth impedance is greater than 2 ohms, the FloBoss installation should be electrically isolated and a ground rod or grid grounding system installed.

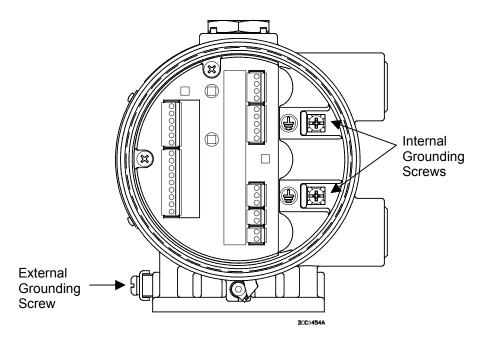


Figure 3-1. Location of Grounding Screws

3.3 How to Determine Power Requirements

To adequately meet the needs of the FloBoss system, it is important to determine the total power consumption and size of solar panel requirements accordingly. For total FloBoss power consumption, be sure to add the power consumption (in mW) of any other devices used with the FloBoss in the same power system. The maximum power for DC voltage sources is 130 mW not including the battery charging.

Convert the total value (in mW) to Watts by dividing it by 1000.

$$mW / 1000 = Watts$$

For selecting an adequate power supply, use a safety factor (SF) of 1.25 to account for losses and other variables not factored into the power consumption calculations. To incorporate the safety factor, multiply the total power consumption (P) by 1.25.

$$P_{SF} = P \times 1.25 = Watts$$

To convert P_{SF} to current consumption in amps (I_{SF}), divide P_{SF} by the system voltage (V) of 12 volts.

$$I_{SF} = P_{SF} / 12V =$$
_____ Amps

3.4 Solar Powered Installations

Solar power allows installation of the FloBoss 103 in locations where a DC voltage source is not available. Size solar panels properly for the application and geographic location to ensure continuous, reliable operation.

A 2 Watt or 5 Watt solar panel can be ordered and installed to provide charging power for the backup batteries. An external solar panel typically mounts to the same 2-inch pipe that supports the FloBoss 103. The panel wiring terminates at the charge (CHG+/CHG-) power terminals on the termination board.

The panel must face due South (not magnetic South) in the Northern Hemisphere and due North (not magnetic North) in the Southern Hemisphere. The panel must also be tilted at an angle from horizontal dependent on latitude to maximize the energy output. The angles for different latitudes are normally included in the solar panel documentation. At most latitudes, the performance can be improved by less of an angle during the summer and more of an angle during the winter.

As a site may have additional power requirements for repeaters, and other monitoring devices, power supply and converter accessories may be used to minimize the number of separate power sources required for an installation.

Solar arrays generate electrical power for the FloBoss 103 from solar radiation. The size of solar panels required for a particular installation depends on several factors, including the power consumption of all devices connected to the solar array and the geographic location of the installation.

The optional solar panel is adequate for support of API Chapter 21.1 compliant measurement and the retrieval of the historical logs once a day using the internal communication methods.

3.4.1.1 How to Size the Solar Panel

To determine solar panel output requirements, first determine the solar insolation for your geographic area. The map in Figure 3-2 shows solar insolation (in hours) for the United States during winter months. Call your local sales representative for a map detailing your specific geographic area.

Next, calculate the amount of current required from the solar array per day using the following equation. I_{SF} is the system current requirement. Refer to Section 3.3 on page 3-3.

$$I_{array} = [I_{SF} (amps) \times 24 (hrs)]/Insolation (hrs) = ____ amps$$

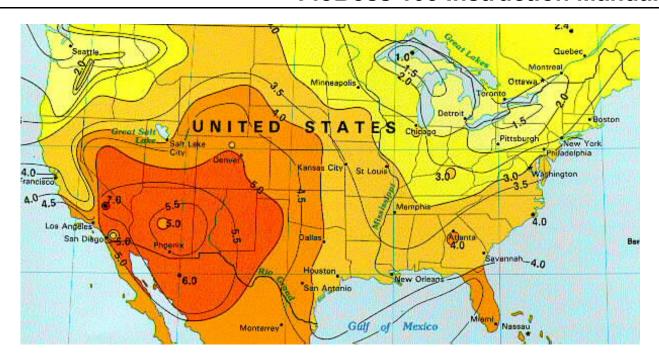


Figure 3-2. Solar Insolation in Hours for the United States

❖ NOTE: Refer to http://www.solar4power.com/solar-power-global-maps.html for global solar insolation maps.

Finally, the number of solar panels can be determined using the following equation:

Number of Panels =
$$I_{array}$$
 amps/ $(I_{panel}$ amps/panel) = _____ panels

- ❖ **NOTE:** The "I panel" value varies depending on the type of solar panel installed. Refer to the vendor's specifications for the solar panel being used.
- ❖ NOTE: The current accepted by the FloBoss 103 is limited by its charging circuit to around 1 Amp. Therefore, it is not practical to install a solar array that supplies significantly more than 1 Amp to the FloBoss. The maximum input is 28 volts.
- ❖ NOTE: Do not allow the batteries to fully discharge. If the batteries are fully discharged, the battery charger board may enter thermal limiting.

3.5 Batteries

Batteries provide power for the FloBoss 103 when the solar panels are not generating sufficient output. The batteries are three D-size lead-acid batteries providing 2.5 Amp-hours of current at 6.2 volts.

The batteries are connected in series by the Battery Charger Board to achieve the required capacity. The amount of battery capacity determines the number of days of reserve (autonomy) desired.

When the FloBoss 103 is configured as an API compliant Electric Flow Management (EFM) and requires an internal communications card, a solar panel, and the internal batteries, the FloBoss should be able to communicate the API audit trail information once a day to a remote host using no additional battery source, no additional solar panel, and maintain a 13 day autonomy in the event that the solar panel is lost.

3.5.1 How to Determine the Battery Requirements

To determine the system capacity requirements, multiply the system current load (I_{SF}) on the batteries by the amount of reserve time required. Compute " I_{SF} " as described in Section 3.3, How to Determine Power Requirements. The equation is as follows:

System Requirement = I_{SF} amps × Reserve hrs = _____ amp-hrs

3.5.2 How to Replace the Batteries

The battery pack contains three D-size lead-acid batteries providing 2.5 Amp-hours of current at 6.2 volts nominal

⚠ CAUTION

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

To replace the battery pack.

- **1.** Unscrew the front end (LCD end) cap cover.
- **2.** Place the power jumper (located at J1 on the Battery Charger Board) in the OFF position.
- **3.** Remove the four screws from the Battery Charger Board.
- **4.** Remove the ribbon cable from the Battery Charger Board to the Backplane Board.
- **5.** Remove the Battery Charger Board.
- **6.** Replace the Battery Charger Board.
- **7.** Replace the ribbon cable from the Backplane Board to the Battery Charger Board.
- **8.** Replace the four screws from the Battery Charger Board.
- **10.** Place the power jumper (located at J1 on the Battery Charger Board) in the ON position.
- **11.** Replace the front end cap cover.

3.6 Wiring Connections

The following paragraphs describe how to connect the FloBoss 103 to power, I/O devices, and communications devices. Use the recommendations and procedures described in the following paragraphs to avoid damage to equipment.

NOTE: It is important to check the input power polarity before turning on the power.

The external connections or field terminals are all located on the termination board. The terminal block accepts wires up to 16 AWG in size.

A CAUTION

Always turn off the power to the FloBoss unit before you attempt any type of wiring. Wiring of powered equipment could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

3.6.1 How to Make Wiring Connections

The FloBoss Termination Board connectors use compression terminals. The input power termination (CHG+/CHG-) uses a removable connector and accommodates wiring up to 16 AWG in size. In all cases, make connections by baring the end (¼ inch maximum) of the wire, inserting the bared end into the clamp beneath the termination screw, and then tightening the screw to 0.25 N-m (2.2 lb-in.).

NOTE: Take Caution. Do not over torque the connector screws.

The inserted wires should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

3.6.2 How to Connect Enclosure Ground Wiring

The FloBoss 103 and related components use the National Electrical Code (NEC) that governs the ground wiring requirements.

Two ground screws are located inside the back of the enclosure. It is recommended that a minimum of 14 AWG wire be used for the ground wiring.

3.6.3 How to Connect Main Power Wiring

The FloBoss 103 accepts input voltages from 8.0 volts to 28 volts at the charge terminals (CHG+/CHG-) with no external current limiting (internal current limit is 200 mA). The maximum power for DC voltage sources is 130 mW, not including battery charging.

❖ NOTE: It is important to check the input power polarity before turning on the power.

The terminals are labeled CHG+ for positive power connection and CHG- for negative power connection on a label on the termination board.

Table 3-1. CHG+ and CHG-

Pin	Pin Signal Description	
1	CHG+	Battery 8.0 to 28 V Power
2	CHG-	Battery Common

It is important that good wiring practice be used when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. The CHG+ / CHG- terminal can accommodate up to 16 AWG wire.

Make sure the hook-up polarity is correct.

❖ NOTE: Keep in mind that a solar panel size may violate certain CSA Class I, Division 1 ratings. Be sure to use approved connectors on the FloBoss 103 enclosure for routing the power wiring.

These connections provide the input voltage and power for the battery charging circuitry. The maximum voltage that can be applied to the CHG+ / CHG- terminals is 28 Volts dc.

3.7 How to Backup Configuration and Log Data

Perform this backup procedure, before removing power to the FloBoss 103 for repairs, troubleshooting, removing or adding components, or upgrades. This procedure preserves the current flow computer configuration and log data held in RAM.

⚠ CAUTION

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

- **1.** Launch ROCLINK 800 software.
- 2. Ensure that the configuration is saved in flash memory by performing a **Save to Flash Memory** (ROC > Flags). This saves all configuration settings, including the current states of the ROC Flags and calibration values.
- **3.** Select ROC > **Collect Data** and select the All checkbox. Click OK. This action saves event logs, alarm logs, report data, and history. You can specify your own file name and path if desired.

- **4.** Select File > **Save**. The Save As dialog box appears.
- **5.** Type the desired **File name** for the backup file, or use the default.
- **6.** Click **Save**. The file is saved in the default directory C:/Program Files/ROCLINK 800/Data unless you changed the directory.

SECTION 4 - COMMUNICATIONS

The FloBoss communicates to external devices through its local operator interface port (LOI), the EIA-485 (RS-485) port (Comm 1), or the optional Comm 2 port (EIA-232 (RS-232), dial-up modem, or spread spectrum wireless radio).

The communications terminals and communication cards provide communications between the FloBoss 103 and a host system or external devices. The communications cards install directly onto the backplane board and activate the host port (Comm 2) when installed. You may use the EIA-232 (RS-232) Serial Communications Card, the Dial-up Modem Communications Card, or the Spread Spectrum Wireless Radio Module.

❖ NOTE: To enable/disable the Comm 2 port, select Configure > Radio Power Control and select the Enabled/Disabled radio button under Radio Power Control.

This section contains the following information:

Section		<u>Page</u>
4.1	EIA-485 (RS-485) Communications Wiring	4-1
4.2	Local Operator Interface Port Wiring	4-2
4.3	Serial Communications Card	4-3
4.4	Dial-up Modem Communications Card	4-5
4.5	Radio Communications Cards	4-6
4.6	Communication Cards Specifications	4-8

4.1 EIA-485 (RS-485) Communications Wiring

The EIA-485 communications provides for RS-485 signals on the Comm 1 port. The Comm 1 port is on the termination board.

4.1.1 How to Wire EIA-475 (RS-485) Communications

Wiring should be twisted-pair cable. The terminals and their functions are as follows:

Table 4-1. EIA-485 (RS-485) Communications Wiring

Pin	Function	Label
1	RS-485	В
2	RS-485	А

4.2 Local Operator Interface Port Wiring

The Local Operator Interface (LOI) port provides connections for a built-in EIA-232 (RS-232) communications interface to a local configuration and monitoring device. The configuration and monitoring device typically is an IBM-compatible personal computer. A prefabricated operator interface cable is available as an accessory. Refer to Figure 4-1.

The LOI port is intended for use with a PC running ROCLINK 800 software. This LOI port is compatible with EIA-232 (RS-232) levels.

4.2.1 How to Wire the LOI Port

The Table 4-2 shows the signal routing of the Termination Board connections:

Signal	Pin	Label
Common	1	GND
LOI Power ¹	2	PWR
Common	3	GND
Ready to Send	4	RTS
Receive	5	RX
Transmit ²	6	TX

Table 4-2. Local Operator Interface Port Wiring

- 1. Do not use the LOI to power external devices.
- **2.** Transmit is the FloBoss 103 unit's EIA-232 (RS-232) transmission that connects to the field device's receive.

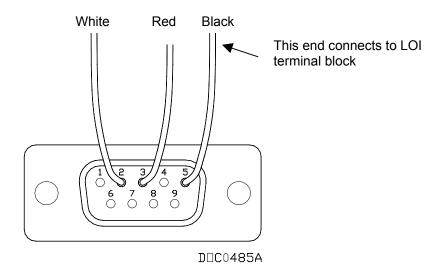


Figure 4-1. Operator Interface Wiring

Table 4-3. PC Comm Port Wiring

Signal	Pin	Label
Transmit ¹	2	TX
Receive	3	RX
Ground	5	GND

^{1.} Transmit (TX) connects to the FloBoss 103 unit's receive. Receive (RX) connects to the FloBoss 103 unit's transmit.

4.3 Serial Communications Card

The EIA-232 communications card meets all EIA-232 specifications for single-ended, RS-232 asynchronous data transmission over distances of up to 15 m (50 ft). The EIA-232 (RS-232) communications card provides transmit, receive, and modem control signals. The EIA-232 (RS-232) communications logic card activates Comm 2.

The EIA-232 (RS-232) communications card defaults are: 9600 baud rate, 8 data bits, 1 stop bit, no parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. The maximum baud rate is 19.2 K bps.

The EIA-232 (RS-232) communications card signals include RX, TX, and RTS signal/control lines. Refer to Table 4-4.

Table 4-4. Communications Card Signals

Signals	Action
RTS	The request to send signals that the modem is ready to transmit.
RX	The RXD receive data signals that data is being received at the communications card.
TX	The TXD transmit data signals that data is being transmitted from the communications card.

4.3.1 How to Wire EIA-232 (RS-232) Communications

Signal wiring connections to the communications card are made through the terminal block located on the termination board. A nine-terminal removable connector is used for the wiring of external device communications.

A EIA-232 (RS-232) communications card in the Comm 2 port provides a means to switch power to external communication devices, such as a radio, to conserve power. A label on the termination board denotes the usage of each pin on the connector. Table 4-5 displays connector signals and their functions:

<i>Table 4-5. EIA-232</i>	(RS-232)	Communications	Card	Wiring
---------------------------	----------	----------------	------	--------

Pin	Signal	Label
9	Ring / Transmit data	TX ³
8	Tip / Receive data	RX
7	Request to Send	RTS
3	Ground	GND ¹
2	Switched Power	PWR ²
1	Signal Common Negative	GND ¹

^{1.} GND at Pin 1 and GND at Pin 3 are identical. They are only separated for ease of wiring.

^{2.} Switched power is for use with an internal radio or cell phone and not for power to external devices.

^{3.} Transmit is the FloBoss 103 unit's EIA-232 (RS-232) transmission that connects to the field device's receive.

4.4 Dial-up Modem Communications Card

The dial-up modem communications card supports V.22 bis/2400 baud communications with auto-answer/auto-dial features. The modem card is FCC part 68 approved for use with public-switched telephone networks (PSTNs). A label on the termination board and Section 4.6.2 provide the FCC registration number and the ringer equivalent.

The optional modem communications logic card for the host port activates Comm 2.

The defaults for the dial-up modem communications card are: 2400 baud rate, 8 data bits, 1 stop bit, no parity, 10 millisecond Key On Delay, and 10 millisecond Key Off Delay. On power up, the modem must be set up for Auto Answer. Periodic checks are made to ensure that the modem is still in Auto Answer or that it is not left off the hook after a certain period of non-communication.

The modem card interfaces to two-wire, full-duplex telephone lines using asynchronous operation at data baud rates of 1200 and 2400. The modem can be controlled using industry-standard AT command software. A 40-character command line provides AT command set, which is compatible with EIA document TR302.2/88-08006.

The initialization Config Command modem strings are:

- ♦ 1200 Dial-up Modem ATSØØ=Ø1SØ7=Ø2
- ◆ 2400 Dial-up Modem ATSØØ=Ø1

4.4.1 How to Wire the Dial-Up Modem Communications Card

Signal wiring connections to the communications card are made through the terminal block located on the termination board. A nine-terminal removable connector is used for the wiring of external device communications. A label on the termination board denotes the usage of each pin on the connector.

The dial-up modem card interfaces to a PSTN line through the screw terminals with two wires. The dial-up modem card provides for a telephone interface on the host port that is capable of both answering and originating phone calls. The dial-up modem card also provides electronics that conserve power when the phone line is not in use. The dial-up modem card provides some protection from transients on the phone lines; however, if the potential for lightning damage is high, additional surge protection for the phone lines should be installed outside the FloBoss enclosure.

Table 4-6 displays the connector signals and their functions:

Table 4-6. Dial-Up Modem Communications Card Wiring

Pin	Signal	Label
9	Tip / Transmit data	TX
8	Ring / Receive data	RX

❖ **NOTE:** Tip and Ring are the telephone interface signals.

4.5 Radio Communications Cards

The Radio module consists of three parts: the spread spectrum wireless radio, an interface card, and a logic card. Two models of Spread Spectrum wireless radios are available for use in the FloBoss 103.

The optional radio communications interface cards provide radio communications through Comm 2. Radio power control, to provide a low power mode when the radio is not communicating, is also available through Comm 2.

Although the radio communications interface cards are intended for host communications, they may also be employed for operator access at the FloBoss. Alternatively, the LOI connection on the LOI port may be used while the radio communication card is mounted and functioning in the FloBoss housing.

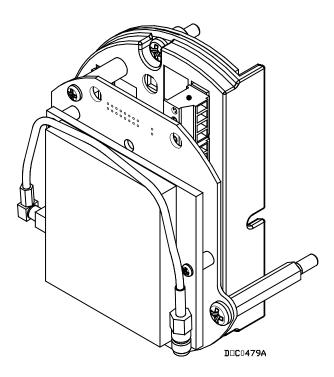


Figure 4-2. Radio and Interface Card (FreeWave shown)

4.5.1 How to Install a Radio Communications Card

If you have ordered the FloBoss 103 unit with a radio, the installation is already complete. To install a radio communications card to an existing FloBoss 103 unit, perform the following steps. Both models of radio communication cards are mounted within the enclosure in the same manner.

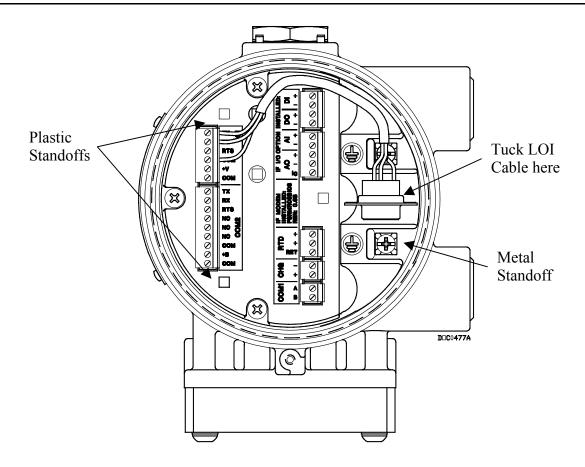


Figure 4-3. Termination Board

- **1.** If the FloBoss 103 unit does not have a communications logic card, you will need to install one. Refer to Section 4.5.2.
- **2.** Remove the termination end cap cover.
- **3.** Use a Phillips head screwdriver to unscrew the lower grounding screw to the right of the termination board. Screw the metal standoff into the hole. Refer to Figure 4-3.
- **4.** Push plastic standoffs into holes at top and bottom of the left side of the termination board. Refer to Figure 4-3.
- **5.** Tuck the LOI interface cable and connector off to the upper right corner of the termination board. Refer to Figure 4-3.
- **6.** Signal wiring connections to the communications card are made through the terminal block located on the termination board. A nine-terminal removable connector is used for the wiring of external device communications. A label on the termination board denotes the usage of each pin on the connector (Pin 1 will connect to COM). The nine-terminal connector is attached to the ribbon cable of the radio interface card.
- **7.** Center the card over the standoffs.

- **8.** Use a small Phillips head screwdriver to screw the card down to the plastic standoffs.
- **9.** Use the larger screw to attach the card to the metal standoff.
- **10.** Plug the Reverse Polarity SMA connector into a user-supplied antenna cable. This cable will have to be threaded through one of the side ports to a user-supplied antenna.
- **11.** Replace the back end cap cover.

4.5.2 How to Install a Radio Communications Logic Card

If the FloBoss 103 unit does not have a communications logic card, you will need to install one to use the Comm 2 port. The same card is used for the optional EIA-232 (RS-232), dial-up modem, and spread spectrum radio.

If you ordered an optional Comm 2 card with your FloBoss 103 unit, the communications logic card was installed at the factory, and you will not need to use this procedure.

- **1.** Unscrew the front end cap cover (LCD end).
- 2. Place the power jumper (located at J1 on the Battery Charger Board) in the OFF position.
- **3.** Remove the four screws from the Battery Charger Board.
- **4.** Remove the ribbon cable from the Battery Charger Board to the Backplane Board.
- **5.** Remove the Battery Charger Board.
- **6.** Remove the screws holding the retaining bar in front of the processor card.
- **7.** Insert a communications logic card into the communications card slot beside the processor card. See Figure 1-2 in Section 1.
- **8.** Replace the retaining bar over the communications card and the processor card.
- **9.** Replace the Battery Charger Board, and then replace the ribbon cable to the Battery Charger Board.
- **10.** Place the power jumper (located at J1 on the Battery Charger Board) in the ON position.
- **11.** Replace the front end cap cover.

4.6 Communication Cards Specifications

The following subsections list the specifications for each communications card.

4.6.1 Serial Card Specifications

Serial Card Specifications

EIA-232D CARD

Meets EIA-232 standard for single-ended data transmission over distances of up to 50 feet (15 m).

Data Rate: Selectable from 1200 to 19,200 bps.

Format: Asynchronous, 7 or 8-bit (software selectable) with full handshaking.

Parity: None, odd, or even (software selectable).

POWER REQUIREMENTS

3.3 Vdc, 0.03 W maximum, supplied by processor board. When EIA-232D card is switching power, the requirement will be higher.

DIMENSIONS

18 mm H by 51 mm W by 70 mm L (0.7 in. H by 2.0 in. W by 2.75 in. L).

ENVIRONMENTAL

Operating Temperature: -40 to 75°C (-40 to 167°F). Storage Temperature: -50 to 85°C (-58 to 185°F). Operating Humidity: To 95% relative, non-

condensing.

APPROVALS

Same as the FloBoss 103 unit in which it is installed.

4.6.2 Dial-up Modem Card Specifications

Dial-up Modem Card Specifications

OPERATION

Mode: Full-duplex 2-wire for dial-up PSTN

(Bell 212 compatible).

Data Rate: 1200, or 2400 baud. asynchronous (software selectable). **Parity:** None, odd, or even (software

selectable).

Format: 8, 9, 10, or 11 bits, including start, stop, and parity (software selectable).

Modulation: V2.1 and 103, binary phase-coherent FSK; V2.2 and 212A, 4 point DPSK at 600 baud; V2.2bis, 16 point QAM at 600 baud.

Transmit Carrier Frequencies: Originate, $1200 \text{ Hz} \pm 0.1\%$; Answer, $2400 \text{ Hz} \pm 0.1\%$.

Receive Carrier Frequencies: Originate, 2400 Hz ± 7 Hz; Answer, 1200 Hz ± 7 Hz.

Telephone Line Impedance:

600 ohm typical.

RTS to Transmission Delay: Configurable in 50 millisecond periods (software selectable).

Receiver Sensitivity: Off to On threshold, - 45 dBm. On to Off threshold, -48 dBm.

Maximum Output Level: 0 dBm nominal into 600 ohms.

Surge Protection: Conforms to FCC part 68 and DOC.

Surge Isolation: 1000 V ac and 1500 volt

peak.

Certification: FCC Part 68 approved.

DIMENSIONS

See Serial Card Specifications.

ENVIRONMENTAL

See Serial Card Specifications.

POWER REQUIREMENTS

3.3 Vdc, 0.25 W maximum, supplied by processor board.

APPROVALS

Meets CSA standards for hazardous locations as: **Model W40106** (with enclosure plug) Type 4 enclosure

Class I, Division 1, Groups C & D

Class I, Division 2, Groups A, B, C & D Temp T3.

Model W40112 (with optional solar panel mast

assembly) Type 4 enclosure

Class I, Division 2, Groups A, B, C & D Temp T3.

FCC registered modem chip.

Registration Number US:FSTMT06B103, REN 0.6B.

4.6.3 Radio Cards Specifications

FreeWave M-Series Radio Card Specifications

RADIO LINK

Frequency Range: 902-928 MHz.

Type: Frequency hopping Spread Spectrum. **Channel Capacity:** 50 to 112, user selectable.

Hopping Patterns: 15 per band, 105 total, user

selectable.

Hopping Bands: 7, user selectable.

Baud Rate: 2400 to 19.2K bps, selectable.

Radio Data Throughput: 115.2K bps standard

speed, 38.4 K bps low speed.

Range: 96 km (60 mi) line of sight.1

TRANSMITTER

Output Power: 100 mW - 1 W (+30 dBm).

RECEIVER

Sensitivity: -106 dBm for 10⁻⁶ BER. -108 dBm

for 10⁻⁴ BER.

POWER REQUIREMENTS

Input Voltage Range: 5.5 to 30 Vdc.

Current Consumption:

At 6 Vdc: Transmit 1000 mA, Receive 152 mA, Idle 40

Ma, Sleep 8 mA.

At 30 Vdc: Transmit 200 mA, Receive 43 mA, Idle 12

mA, Sleep 3 mA.

DIMENSIONS

91 mm H by 86 mm W by 15 mm D (3.6 in. H by 3.4 in.

W by 0.6 in. D).

ENVIRONMENTAL

Operating Temperature: -40 to 75°C (-40 to 167°F).

APPROVALS

Same as the FloBoss 103 unit in which it is installed.

1. Line of Sight signifies a path that is free of natural and man-made obstacles.

MaxStream 9XStream Radio Card Specifications

RADIO LINK

Frequency Range: 902 to 928 MHz, unlicensed

ISM band.

Type: Frequency hopping Spread Spectrum

transceiver.

Channel Capacity: 25 channels.

Hopping Patterns: 7 hopping sequences.

Baud Rate: 9600 bps.

Radio Data Throughput: 9600 bps.

Range: Indoor 182 – 457 m (600 – 1500 ft). Outdoor 11 km (7 mi) with dipole and 32 km (20

mi) with high gain antenna.

TRANSMITTER

Output Power: 100 mW.

RECEIVER

Sensitivity: -110 dBm.

POWER REQUIREMENTS

Input Voltage Range: 5 Vdc +/- 0.25 V.

Current Consumption: Transmit – 150 mA nominal. Receive – 50 mA nominal. Other cyclic power down

modes available.

DIMENSIONS

91 mm H by 86 mm W by 10 mm D (3.6 in. H by 3.4 in.

W by 0.4 in. D).

ENVIRONMENTAL

Operating Temperature: Standard 0 to 70°C (32 to 158°F). Industrial Version -40 to 85°C (-40 to 185°F).

APPROVALS

Same as the FloBoss 103 unit in which it is installed.

SECTION 5 – DUAL-VARIABLE SENSOR

This section describes the Dual-Variable Sensor (DVS), which provides differential pressure and static pressure inputs to the FloBoss 103 for orifice flow calculation. Note that the DVS is not equipped to provide a temperature input to the FloBoss; this input comes directly into the FloBoss by means of the built-in RTD input.

This section contains the following information:

Section		<u>Page</u>
5.1	Dual-Variable Sensor	5-1
5 2	DVS Specifications	5-3

5.1 Dual-Variable Sensor

The DVS, which uses Rosemount sensor technology, measures differential pressure and absolute or gauge (static) pressure by converting the applied pressure to electrical signals and making the readings available to the processor board. The sensor housing screws into an adapter. The adapter, in turn, mounts with four bolts to the bottom of the FloBoss enclosure.

- ❖ NOTE: The DVS Sensor should only be installed and removed at the factory.
- ❖ NOTE: The DVS cable plugs directly into the backplane board. The DVS cable should only be installed and removed at the factory.

The readings from the Dual-Variable Sensor are stored in analog inputs on the FloBoss. If the alarm for the AI point is enabled, and the DVS fails to communicate during either initialization or operation, an alarm is entered in the Alarm Log.

The DVS uses an interrupt to inform the processor board that it is ready for an update. This must occur at least once per second. The FloBoss then converts this value and stores it in the proper analog input for access by other functions within the unit. If an update does not occur in the one-second interval, the sensor is re-initialized. A point fail alarm is set if the DVS does not respond to the initialization.

The DVS pressure sensors mount to the base of the explosion proof housing and provide the measurement of the P1 pressure and the differential pressure for orifice plate flow measurement applications. The Specifications table on page 5-3 displays the DVS ranges.

For information on calibration of a DVS sensor, refer to Section 7.

❖ NOTE: Consult your local sales representative for special ranges.

5.1.1 Process Connections

Piping from the meter run connects to the Dual-Variable Sensor (DVS) of the FloBoss. Both the static and differential pressures pipe to female ½-18 NPT connections on the bottom of the DVS. The FloBoss is an **upstream** device, meaning that the static pressure line normally connects to the high pressure side (labeled "H" on the sensor body).

❖ NOTE: The FloBoss 103 is intended to be used as an upstream device.

A CAUTION

Open the by-pass valve on the valve manifold prior to isolating the sensor from the process, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. This is required when calibrating either differential or static pressure. Refer to Section 7 for the recommended sequence.

Do NOT close the by-pass valve on the valve manifold until after process pressure has been reapplied, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. Refer to Section 7 for the recommended sequence.

5.1.2 Configuration

Use ROCLINK 800 configuration software to configure the DVS.

- The differential pressure is configured at Analog Input Point Number A1.
- The static pressure (gauge or absolute) is configured at Analog Input Point Number A2.

The Analog Input Points A1-A4 can be configured for fault mode operation on the Advanced tab of the Analog Input Setup screen. The Action on Failure field will determine whether the FloBoss unit should hold the last known value or set to a specified fault value.

The defaults contained within the DVS are the initial pressures read. The initial range of the differential pressure and the static pressure are listed in the Specifications table in Section 5.2. You can re-range each sensor through the calibration routines. The turndown on the range should not be greater than the turndown value in the Specifications table on page 5-3.

The DVS also supports the conversion of values to metric units. In metric mode, both the differential pressure and the static pressure are in kPa. To enter metric mode, use ROCLINK 800 software. The FloBoss automatically adjusts the units of the differential pressure, static pressure, RTD, and enclosure/battery temperature, to the Metric mode.

❖ **NOTE:** When selecting the metric mode, the FloBoss adjusts the Units only. You must manually change all values to the proper unit of measurement.

5.2 DVS Specifications

Dual-Variable Sensor Specifications

DIFFERENTIAL PRESSURE INPUT

Range Options:

0 - 62.2 kPa (0 - 250 in. H₂O).

0 - 248.8 kPa (0 - 1000 in. H₂O).

Reference Accuracy: $\pm 0.075\%$ of span with a 10:1 turndown (includes linearity, hysteresis, and repeatability effects).

STATIC PRESSURE INPUT

Range Options: Either Absolute or Gauge:

0 - 5516 kPa (0 - 800 psia/psig).

0 - 25,000 kPa (0 - 3626 psia/psig).

Reference Accuracy: $\pm 0.075\%$ of span with a 6:1 turndown (includes linearity, hysteresis, and repeatability effects). For spans with less than 6:1 turndown, contact factory.

Stability: ±0.1% of upper range limit for 12 months.

PROCESS CONNECTIONS

1/4-18 NPT on 2-1/8 in. centers, located on bottom of Coplanar flange.

CONSTRUCTION

316 SST*. Wetted O-rings are glass-filled TFE. Coupler is stainless steel (CF8M).

ENVIRONMENTAL AND OTHER SPECS

Meets the Environmental specifications of the FloBoss 103 unit, including Temperature and Voltage Surge specifications.

Note: *Consult factory for special ranges and materials that may be available.

SECTION 6 – INPUT/OUTPUT & RTD INPUT

This section describes the optional Input/Output (I/O) termination points available on the termination board. The I/O termination points provide additional inputs and outputs for implementing expanded monitoring and control applications. This section also describes the RTD Input on the termination board.

The I/O uses the microprocessor for monitoring, control, and acquisition of data from external devices connected to the I/O channels. The I/O channels have removable plug-in terminal blocks for field wiring. I/O includes:

- ♦ Analog Input AI.
- ♦ Analog Output AO.
- ♦ Discrete Input DI.
- ♦ Discrete Output DO.

This section contains the following information:

Section		Page
6.1	I/O Wiring Requirements	6-1
6.2	Analog Input	6-1
6.3	Analog Output	6-3
6.4	Discrete Input	6-4
6.5	Discrete Output	6-5
6.6	RTD Input	6-6
6.7	I/O Termination Point Specifications	6-7

6.1 I/O Wiring Requirements

I/O wiring requirements are site and application dependent. Local, state, or NEC requirements determine the I/O wiring installation methods. Direct burial cable, conduit and cable, or overhead cables are options for I/O wiring installations.

6.2 Analog Input

The Analog Input (AI) monitors current loop and voltage input devices. The A/D signal input range is 1 to 5 volts with 10-bit resolution.

The AI is located at Point Number B1 in ROCLINK 800 software.

The diagnostic Analog Inputs — logic voltage (E1), battery voltage (E2), and board/battery temperature (E5) — are not designed to be configured or wired.

The built-in inputs are assigned to the first three Analog Input points in ROCLINK 800 Configuration Software:

- Differential pressure located at AI Point A1.
- ◆ Static pressure located at AI Point A2.
- ◆ RTD temperature located at AI Point A3.

6.2.1 How to Wire the Analog Input

The terminals for connecting analog input wiring include:

- AI+ Positive Input
- AI- Negative Input (Common)

The Analog Input has two field terminals per channel. A 250-ohm scaling resistor is required for use between the "+" and "-" analog input terminals when 4 to 20 mA is implemented.

The "+" terminal is the positive signal input and the "-" terminal is the signal common. These terminals accept a voltage signal in the 1 to 5 volt range. Because the "-" terminal is internally connected to common, the analog input channels function as single-ended inputs only.

Current inputs of 4-20 mA can be used with the addition of a 250-ohm resistor across the input terminals. When wiring a 4-20 mA current signal, leave the 250-ohm resistor installed between the "+" and "-" terminals. Refer to Figure 6-1.

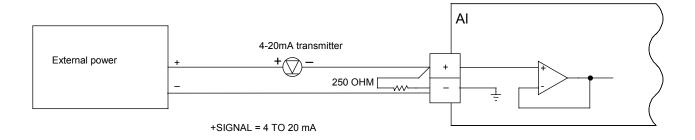


Figure 6-1. Current Signal on Analog Input

❖ NOTE: When connecting the analog input channel to a voltage device, be sure to remove the 250-ohm resistor from the analog input terminal block.

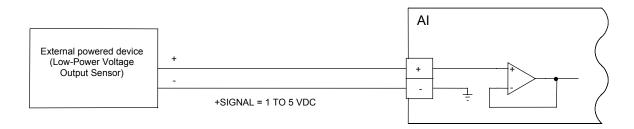


Figure 6-2. Voltage Signal on Analog Input

6.3 Analog Output

The Analog Output (AO) provides either a 1-5 volt signal or a 4-20 mA current control. The analog outputs use a 8-bit D/A converter with A/D values of 0 and 250.

The AO is located at Point Number B2.

6.3.1 How to Wire the Analog Output

The Analog Output provided on the I/O termination board connects as follows:

AO+ Positive

IC Current control

AO- Common

Figure 6-3 shows wiring for the Analog Output.

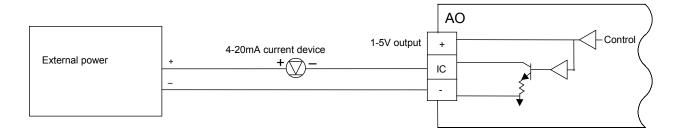


Figure 6-3. 4-20 mA Analog Output Current Control

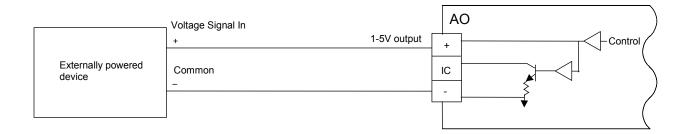


Figure 6-4. 1-5 Volts Analog Output Voltage Control

6.4 Discrete Input

The Discrete Input (DI) monitors the status of relays, solid-state switches, or open collector devices. DI functions support discrete latched inputs and discrete status inputs.

When a field device, such as a relay contact or open collector is connected across "+" and "-," the closing of the contacts completes the circuit which causes a flow of current between Vs and ground at terminal "-." This current flow activates and is sensed in the DI circuitry that, in turn, signals the FloBoss electronics indicating that the relay contacts have closed. When the contacts open, current flow is interrupted and the DI circuit signals to the FloBoss electronics that the relay contacts have opened.

The I/O termination board provides a Discrete Input channel located at Point Number B3.

6.4.1 How to Wire the Discrete Input

The DI connects as follows:

DI+ Positive

DI- Common

The Discrete Input operates by providing a closed contact across terminals "+" and "-". Refer to Figure 6-5.

⚠ CAUTION

The Discrete Input is designed to operate only with non-powered discrete devices, such as "dry" relay contacts, open collector devices, or isolated solid state switches. Use of the DI channel with powered devices may cause improper operation or damage.

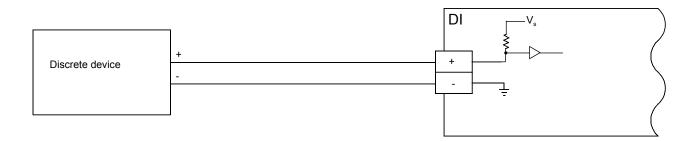


Figure 6-5. Discrete Input Wiring

6.5 Discrete Output

The Discrete Output (DO) provides a solid-state switch to control relays and power small electrical loads. The DO circuitry is optically coupled to help isolate the processor board from the input signal. Refer to Figure 6-6.

DO functions include:

- Sustained discrete outputs.
- ♦ Momentary discrete outputs.
- ♦ Slow pulse-train outputs.

The I/O termination board provides a Discrete Output channel located at Point Number B4.

The Discrete Output channel is a normally-open, FET switch. The Discrete Output is a solid-state switch enabled by individual signals from the processor I/O lines and capable of handling 50 Vdc at 0.2 A maximum.

The Discrete Output on the I/O termination board can be used in:

- ♦ Toggle mode.
- ♦ Latched mode.
- ◆ Timed discrete output (TDO) mode.

6.5.1 How to Wire the Discrete Output

The Discrete Output is connected as follows:

DO + Normally open contact

DO - Common

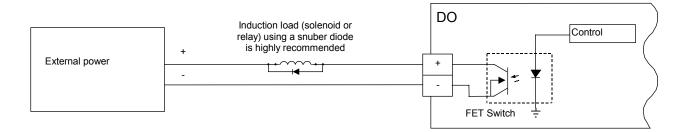


Figure 6-6. Solid State Relays – Discrete Outputs

6.6 RTD Input

The temperature is input through the Resistance Temperature Detector (RTD) probe and circuitry. The RTD temperature probe mounts directly to the piping using a thermowell, outside the FloBoss enclosure. RTD wires should be protected either by a metal sheath or by conduit connected to a liquid-tight field conduit wiring fitting on the enclosure.

6.6.1 How to Wire the RTD Input

The RTD wires connect to the three screw terminals designated "RTD" on the Termination Board.

The FloBoss 103 provides terminations for a three-wire or two-wire 100-ohm platinum RTD with a DIN 43760 curve. The RTD has an alpha equal to 0.00385.

Wiring between the RTD probe and the FloBoss 103 should be shielded wire, with the shield grounded only at one end to prevent ground loops. Ground loops cause RTD input signal errors.

Table 6-1 displays the connections at the RTD terminals for the various RTD probes.

Terminal Designation 3-Wire RTD 2-Wire RTD RTD + Signal positive input RTD + RTD + RTD + Signal positive input RTD + Jumper to RTD + RTD RET Return reference RTD RET RTD RET

Table 6-1. RTD Signal Routing

6.7 I/O Termination Point Specifications

I/O Termination Points Specifications

ANALOG INPUT

Type: Single-ended, voltage-sense analog inputs

(current loop if scaling resistor is used).

Signal: 1 to 5 Vdc, software configurable. 4 to 20 mA, with 250Ω resistor installed across "+" and "-"

terminals.

Accuracy: 0.5% over -40 to 65°C (-40 to 149°F)

range.

Isolation: None.

Input Impedance: 1 M Ω . Filter: Single pole. Resolution: 10 bits.

Sample Period: 1.0 second minimum.

ANALOG OUTPUT

Type: 1-5 V output, or 4-20 mA current control.

Terminals:

"+" positive voltage output and "-" common or "IC" positive current point and "-" common.

Resolution: 8 bits.

Accuracy: 0.1% of full-scale output.

Reset Action: Output goes to last value (software configurable) on power-up (warm start) or on

watchdog time-out.

DISCRETE INPUT

Type: Contact-sense discrete input.

Terminals: "+" positive input; "COM" negative input

(common).

Current Rating: 35 μ A in the active (on) state, 0 μ A

in the inactive (off) state.

Isolation: None.

Frequency: 0.5 Hz maximum.

Sample Period: 1.0 second minimum.

DISCRETE OUTPUT

Type: Solid-state switch.

Terminals: "+" normally-open contact; "-" common.

Switch Rating: 50 Vdc, 0.2 A maximum.

Isolation: 3000 V from processor.

CLASSIFICATION

FCC Class A and CISPR 22 computing device.

SECTION 7 - CALIBRATION

This section describes the calibration procedures for the Analog Input, RTD Input and Dual-Variable Sensor Inputs. For information on wiring and process connections, refer to Sections 5 and 6.

This section contains the following information:

Section		<u>Page</u>
7.1	Calibration (AI, RTD & DVS)	7-1
7.2	How to Perform a Calibration	7-1
7.3	How to Verify a Calibration	7-8

7.1 Calibration (AI, RTD & DVS)

Use ROCLINK 800 software to perform initial calibration or re-calibration, such as after a change in an orifice plate in the meter run handled by the FloBoss unit.

The calibration routines support 5-point calibration, with the three mid-points calibrated in any order. The low-end or zero reading is calibrated first, followed by the high-end or full-scale reading. The three mid-points can be calibrated next, if desired.

The diagnostic analog inputs — logic voltage (E1), battery voltage (E2), and board/battery temperature (E5) — are not designed to be calibrated.

The built-in inputs may be calibrated with the 5-point routine. The built-in inputs are assigned to the first three Analog Input points:

- Differential pressure located at AI Point A1.
- ◆ Static pressure located at AI Point A2.
- ◆ RTD temperature located at AI Point A3.

The Analog Input on the optional I/O termination board the can be calibrated with the 5 point routine. The optional Analog Input is located at AI Point B1.

7.2 How to Perform a Calibration

Perform the following steps:

1. Launch ROCLINK 800 Configuration software and connect to the FloBoss 103.

2. Select either Meter > Calibration or Configure > I/O > Analog Input > AI Calibration tab. If you are calibrating the Analog Input on the optional I/O termination board, you must select Configure > I/O > Analog Input > AI Calibration tab.

The current reading displays under each meter input as the Freeze Value. The FloBoss uses these values in the flow calculations while calibrating the points.

3. Click Freeze.

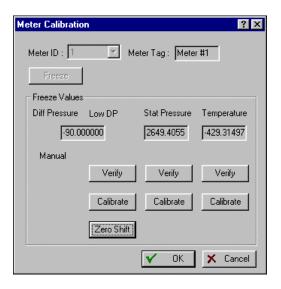


Figure 7-1. Meter Calibration

4. If you are calibrating a **pressure input**, read the following Caution, and then **isolate** the **Dual-Variable Sensor** from the process.

If you are calibrating a RTD temperature input, proceed to Step 6. If you are calibrating the optional AI (AI Point Number B1), proceed to Step 8.



Open the by-pass valve on the valve manifold prior to isolating the sensor from the process, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. This is required when calibrating either differential or static pressure. Refer to Figure 7-2 for the recommended sequence.

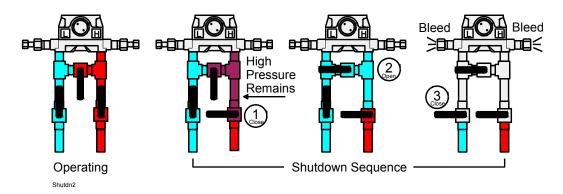


Figure 7-2. Removing the DVS from Service

5. If you are calibrating a **pressure input**, set up the pressure calibrator and make the necessary connections to the DVS. Refer to Figure 7-3 for the line orientation during the calibration.

CAUTION

Do not exceed the Differential Pressure range on the DVS to protect the differential cell of the Dual-Variable Sensor. Refer to the Specifications table in Section 7 for the range.

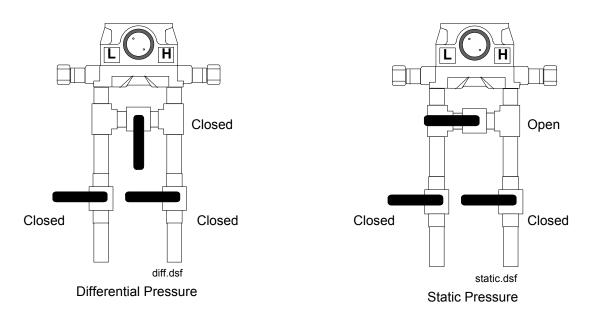


Figure 7-3. Pressure Calibration Open/Close Orientation

- **6.** If you are calibrating a **temperature input**, disconnect the RTD sensor and connect a decade box (or comparable equipment) to the RTD terminals of the FloBoss.
- **7.** Click **Calibrate** under the desired input to calibrate Diff Press, Stat Press, or Temperature. This displays the Set Zero calibration window as in Figure 7-4.



Figure 7-4. Set Zero Calibration Example

- **8.** Apply the **low (zero) value**. For a pressure input, this would typically be open to atmosphere.
- **9.** Enter the applied value in the **Dead Weight** / **Tester Value** field of the Set Zero dialog. Refer to Figure 7-4. For static pressure on an absolute-pressure device, remember to enter the actual current atmospheric pressure, such as 14.73 psi.
- **10.** When the displayed Live Reading is stable, click **Set Zero** to calibrate the zero reading. The Set Span window then appears, as in Figure 7-5.

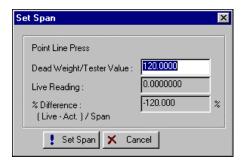


Figure 7-5. Set Span

- **11.** Apply the desired **high value** to the input (the top end of the expected operating range). To maintain rated accuracy, be sure to observe the turndown limits listed in the Specifications table in Sections 5 and 6.
- **12.** Enter the applied value in the **Dead Weight** / **Tester Value** field of the Set Span dialog. For static pressure on an absolute-pressure device, add the actual atmospheric pressure, such as 300 + 14.73.
- **13.** When the Live Reading is stable, click **Set Span** to calibrate the high reading. The window advances to the Set Midpoint 1 window, as in Figure 7-6.

7-4 Calibration Rev 12/03

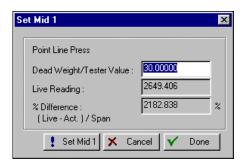


Figure 7-6. Set Midpoint 1

- **14.** If you are performing a **two-point** calibration, click **Done**. Calibration for this input is complete.
- **15.** To calibrate Midpoints, apply the desired pressure or temperature and enter the applied value in the **Dead Weight / Tester Value** field. Note that you can calibrate the midpoints in any order.
- **16.** When the Live Reading is stable, click **Set Mid 1** to calibrate this reading. The display advances to the Set Midpoint 2 window, as in Figure 7-7.



Figure 7-7. Set Midpoint 2

- **17.** If you are performing a **three-point** calibration, click **Done**. Calibration for this input is complete.
- **18.** To calibrate additional Midpoints, apply the desired pressure or temperature and enter the applied value in the **Dead Weight / Tester Value** field.
- **19.** When the Live Reading is stable, click **Set Mid 2** to calibrate this reading. The display advances to the Set Midpoint 3 window, as in Figure 7-8.

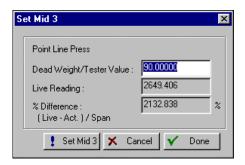


Figure 7-8. Set Midpoint 3

- **20.** If you are performing a **four-point** calibration, click **Done**. Calibration for this input is complete.
- **21.** To calibrate a third Midpoint, apply the desired pressure or temperature and enter the applied value in the **Dead Weight / Tester Value** field.
- **22.** When the Live Reading is stable, click **Set Mid 3** to calibrate this reading. The calibration is complete, and the display returns to the Meter Calibration window.
- **23.** When the calibration for a selected point is complete, you have the choice to calibrate another input, to verify the calibration or to close the calibration screen.

When the calibration is complete and you calibrated **pressure inputs**, read the following Caution and return the Dual-Variable Sensor to service.

⚠ CAUTION

Do NOT close the by-pass valve on the valve manifold until after process pressure has been reapplied, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. Refer to Figure 7-9.

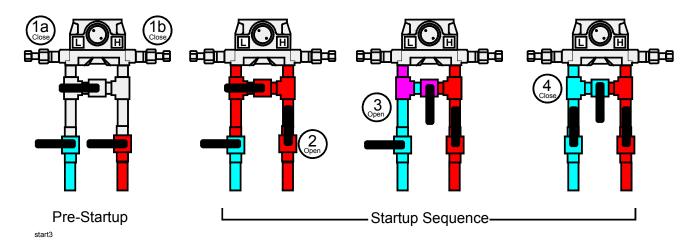


Figure 7-9. Returning the DVS to Service

- ❖ **NOTE:** If you calibrated the Differential Pressure input, refer to Section 7.2.1, Zero Shift, before completing the last step.
 - **4.** Click **OK** to close the calibration window, cancel freeze values (unfrozen) and enable live readings for use in the flow calculations. The Event Log records all calibration settings that were changed.

7.2.1 Zero Shift

If desired, use the Zero Shift procedure after calibrating the Differential pressure input. The Differential Pressure is calibrated without line pressure being applied to the sensor. When the sensor is connected back to the process after calibration, a shift in the differential pressure can occur due to the influence of the line pressure. This effect can be canceled out with a Zero Shift adjustment.

7.2.1.1 How to Adjust for Zero Shift

To check or adjust for Zero Shift, leave the sensor by-pass valve open (to simulate a no-flow condition), with either line pressure or a normal operating static pressure from the calibrator applied to the sensor. This applies the same pressure to both sides of the differential pressure diaphragm to give a zero differential pressure reading.

Perform the following steps:

- **1.** Ensure ROCLINK 800 software is connected to the FloBoss 103 and running the calibration procedure.
- **2.** If the meter inputs were already released from the freeze condition, click **Freeze**. This returns the Meter Calibration window as shown in Figure 7-11.
- **3.** Under the Diff Press input, click **Zero Shift** to open the Set Zero Shift window shown in Figure 7-10.

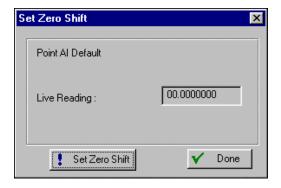


Figure 7-10. Set Zero Shift

- **4.** Check the **Reading** to determine if you need to perform a Zero Shift correction.
- **5.** If the reading is not zero, click **Set Zero Shift** to adjust the Zero Shift. If adjustment is zero, click Done or after you click, Set Zero Shift, click Done.
- **6.** The Meter Calibration window displays. Refer to Figure 7-1. Click **OK** to close the calibration window, cancel the freeze values, and cause the FloBoss 103 to begin using live readings for the flow calculations.

7.3 How to Verify a Calibration

ROCLINK 800 software can verify the calibration to check if the DVS requires re-calibration. To verify, perform the following steps:

- 1. Launch ROCLINK 800 software and connect to the FloBoss 103.
- 2. Select Meter > Calibration.
- **3.** Click **Freeze**. This opens the Meter Calibration window. Refer to Figure 7-11. The current reading displays under each meter input as the Freeze Value. The FloBoss uses these values in the flow calculations while verifying the points.

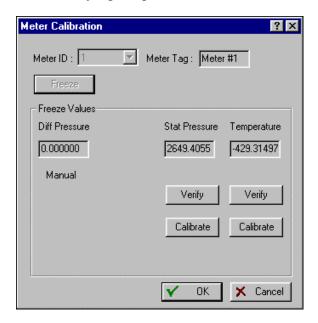


Figure 7-11. Meter Calibration Window

A CAUTION

Open the by-pass valve on the valve manifold prior to isolating the sensor from the process, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. This is required when calibrating either differential or static pressure. Refer to Figure 7-2 on page 7-3 for the recommended sequence.

- **4.** While observing the previous Caution, apply the desired **pressure** setting to the input.
- **5.** Click **Verify** listed under the input you desire to calibrate.

7-8 Calibration Rev 12/03

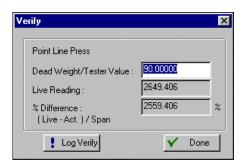


Figure 7-12. Verify Calibration

- **6.** To log the Tester Value and the Live Reading to the Event Log as a record of the verification, click **Log Verify**.
- 7. Click Done.
- 8. Continue to verify all required pressures/values.
- **9.** When the verification for a selected point is complete, you have the choice to verify another input, perform a calibration, or close the calibration screen. When complete, read the following Caution and connect the **Dual-Variable Sensor** back to the process.

A CAUTION

Do NOT close the by-pass valve on the valve manifold until after process pressure has been reapplied, to protect the differential cell of the Dual-Variable Sensor. This keeps one side of the differential sensor from being subjected to high pressure while the other side has no pressure applied. Refer to Figure 7-9 on page 7-6.

10. Click **OK** to close the calibration window, to cancel freeze values (unfrozen) and to enable live readings for use in the flow calculations. The Event Log records all calibration settings that were changed.

SECTION 8 – TROUBLESHOOTING

This section provides generalized guidelines for troubleshooting of the FloBoss 103. The procedures in this chapter should be performed before removing power for any reason, after restoring power, and if the unit is disassembled.

The following tools are required for troubleshooting:

- ◆ IBM-compatible personal computer.
- ♦ ROCLINK 800 software.
- ◆ Flat-head and Philips screwdrivers.

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8.2	Troubleshooting Checklists	8-1
8.3	Procedures	8-3

8.1 Troubleshooting Guidelines

When you are attempting to diagnose a problem with the FloBoss 103:

- Remember to write down what steps you have taken,
- Note the order in which you remove components,
- Note the orientation of the components before you alter or remove them,
- Save the configuration and log data (see Section 8.3.1),
- Read and follow all Cautions in this manual.

When you are done troubleshooting, perform the restart procedure in Section 8.3.3.

8.2 Troubleshooting Checklists

If you are experiencing troubles with an internal **dial-up modem**:

- Check to make sure power is applied to the FloBoss unit. Check the ON/OFF jumper, the wiring connections at CHG+ and CHG-, and the wiring at the power source.
- Check the wiring to the modem. Refer to Section 4.
- Check the communication port settings in ROCLINK 800 Configuration Software. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).

• Check the modem INIT string. It will be displayed in the communication port settings in ROCLINK 800 Configuration Software. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).

If you are experiencing troubles with a **serial communications** connection (LOI, EIA-232, or EIA-485):

- Check to make sure power is applied to the FloBoss unit. Check the ON/OFF jumper, the wiring connections at CHG+ and CHG-, and the wiring at the power source.
- Check the wiring to the modem. Refer to Section 4.
- Check the communication port settings in ROCLINK 800 Configuration Software. Refer to *ROCLINK 800 Configuration Software User Manual* (Form A6121).

If you are experiencing troubles with an **I/O point** (Analog Input, Analog Output, Discrete Input, or Discrete Output):

- Check to see how the channel is configured using ROCLINK 800 software.
- If the configuration looks correct, then simulate an input (within the range of the input) or force an output to be produced using ROCLINK 800 software.
- If an input channel is in question, you may be able to use one of the outputs (known to be in working order) to simulate the required input. Likewise, if an output channel is in question, you may able to connect it to a working input channel and check the results.
- ❖ NOTE: No field repair or replacement parts are associated with the I/O termination points.

If you are experiencing problems with the FloBoss 103 that appear to be **software**-related, try resetting the FloBoss 103.

- Use a Warm Start to restart without losing configuration or log data. To perform a Warm Start, open ROCLINK 800 software, connect to the FloBoss 103 and select ROC > Flags. Refer to ROCLINK 800 Configuration Software User Manual (Form A6121).
- Use a Cold Start to restart without a portion of the configuration, log data, or programming that may be the trouble. To perform a Cold Start, open ROCLINK 800 software, connect to the FloBoss 103 and select ROC > Flags. Refer to ROCLINK 800 Configuration Software User Manual (Form A6121).
- Use the RESET button on the FloBoss unit to restore the unit to factory defaults without connecting to ROCLINK 800 software. Refer to Section 8.3.2.
- * NOTE: If these methods do not solve the problem, contact your local sales representative.

If you are experiencing trouble with **powering** up the FloBoss 103:

- Check the ON/OFF jumper, the wiring connections at CHG+ and CHG-, and the wiring at the power source.
- Check the batteries for voltage. The battery pack contains three D-size lead-acid batteries providing 2.5 Amp-hours of current at 6.2 volts nominal. If the batteries are below the nominal voltage, replace them. Refer to Section 3.

If your Dual-Variable Sensor (**DVS**) is not responding:

- 1. Launch ROCLINK software.
- **2.** Select Configure >I/O > AI Points.
- **3.** Select **Analog Inputs 1** (Point Number A1).
- **4.** Ensure that the DVS is not in manual mode by setting the **Scanning** field to **Enabled**.
- **5.** If the DVS is still not responding, reset the DVS to factory defaults to clear invalid calibration data.

No field repair or replacement parts are associated with the DVS, DVS input or RTD input. Return the FloBoss to your local sales representative for repair or replacement.

❖ **NOTE:** The DVS should only be installed and removed at the factory.

8.3 Procedures

8.3.1 How to Preserve Configuration and Log Data

Perform this backup procedure, before removing power to the FloBoss 103 for repairs, troubleshooting, removing or adding components, or upgrades. This procedure preserves the current flow computer configuration and log data held in RAM.

A CAUTION

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

- 1. Launch ROCLINK 800 software.
- **2.** Ensure that the configuration is saved in flash memory by performing a Save to Flash Memory (ROC > Flags). This saves all configuration settings, including the current states of the ROC Flags and calibration values.

- **3.** Select ROC > Collect Data and select the All checkbox. Click OK. This action saves event logs, alarm logs, report data, and history. You can specify your own file name and path if desired.
- **4.** Select File > Save. The Save As dialog box appears.
- **5.** Type the desired File name for the backup file, or use the default.
- **6.** Click Save. The file is saved in the default directory C:/Program Files/ROCLINK 800/Data unless you changed the directory.

8.3.2 How to Reset the FloBoss 103

The Reset jumper is located on the LCD (if installed) or on the Battery Charger Board. It can be used to perform a special type of cold start. This jumper permits a power-up reset to re-establish a known operating point. This includes re-initializing the Communication Ports to the factory default configuration.

This cold start does not include any of the clearing options available in a Cold Start performed using ROCLINK 800 software.

- ❖ NOTE: This type of reset restores the communications ports to the factory configuration defaults. Some user-entered configuration parameters may be lost. Therefore, try to back up any required data before performing this reset.
- **1.** Refer to Section 8.3.1 and perform the backup procedure.
- **2.** Unscrew the front end cap cover (LCD end).
- **3.** Place the reset jumper (located on the LCD, if installed, or on the Battery Charger Board at J2) in the **RST** position.
- **4.** Cycle the power.
- **5.** Remove the reset (RST) jumper and install it in the normal (**NORM**) position.
- **6.** Replace the front end cap cover (LCD end).
- **7.** Refer to Section 8.3.3 and perform the Restart and Reconfigure procedure.

This reset action loads the factory default values into the communication ports.

8.3.3 How to Restart and Reconfigure

After removing power to the FloBoss 103 and performing maintenance or repair as needed, perform the following steps to start your FloBoss 103 and reconfigure your data. The procedure assumes you are using ROCLINK 800 software.

A CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power. An unsafe state could result in property damage.

When installing equipment in a hazardous area, ensure that all components are approved for use in such areas. Check the product labels. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

- 1. Reconnect power to the FloBoss 103 by inserting the CHG+ / CHG- power terminal.
- 2. Launch ROCLINK 800 software, log in, and connect to the FloBoss 103.
- **3.** Verify that the configuration is correct. If it is not, continue by configuring the required items. If major portions or the entire configuration needs to be reloaded, perform the remaining steps.
- 4. Select File > Download.
- **5.** From the **Open** dialog box, select the backup configuration file (has extension *.800).
- **6.** Select the portions of the configuration you want to download (restore).
- 7. Click **Download** to restore the configuration.

8.3.4 How to Connect the Termination Board to the Backplane

The FloBoss 103 is shipped with the termination board connected to the backplane through a 34-pin interface connector. You may have a shrouded connector which ensures the correct polarity. If for any reason you must disconnect the termination board from the backplane, be careful to re-connect the shrouded connector using the following steps.

- **1.** Insert the 34-pin interface connector into the backplane connector. Make sure that the connector shell faces away from the backplane and toward the termination board. See Figure 8-1.
- **2.** Once the connection has been made to the backplane, use the connector shell to guide the pins of the 34-pin interface connector into the termination board connector. See Figure 8-2. Use caution; you will not be able to see the connection being made within the housing.
- ❖ NOTE: If the 34-pin interface connector and boards are not re-assembled in this manner, the pins may be misaligned and not make a full connection. The FloBoss 103 will not function correctly. Depending on which connections are made, the unit may appear to be working if the LCD is present.

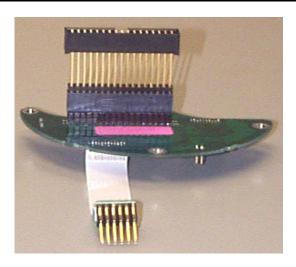


Figure 8-1 . Backplane with 34-Pin Interface Connector

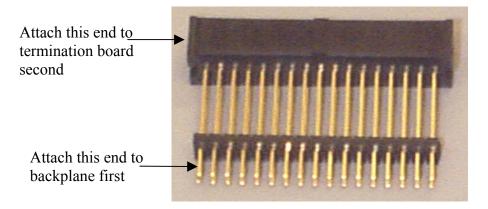


Figure 8-2 . 34-Pin Interface Connector

GLOSSARY OF TERMS

Α

AGA – American Gas Association.

AI – Analog Input.

AO – Analog Output.

Analog – Analog data is represented by a continuous variable, such as an electrical current signal.

AP – Absolute Pressure.

ASCII – American (National) Standard Code for Information Interchange.

В

Built-in I/O – I/O channels that are fabricated into the FloBoss and do not require a separate option. Also called "on-board" I/O.

C

Configuration – Typically, the software setup of a device, such as a FloBoss, that can often be defined and changed by the user. Can also mean the hardware assembly scheme.

CSA – Canadian Standards Association.

CTS – Clear To Send modem communications signal.

D

DB – Database.

dB – Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.

DCD – Data Carrier Detect modem communications signal.

DI – Discrete Input.

Discrete – Input or output that is non-continuous, typically representing two levels such as on/off.

DO – Discrete Output.

Download – To send data, a file, or a program to the FloBoss unit.

DP – Differential Pressure.

- **DSR** Data Set Ready modem communications signal.
- **DTR** Data Terminal Ready modem communications signal.
- **Duty Cycle** Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and such.
- **DVM** Digital voltmeter.
- **DVS** Dual-Variable Sensor. Provides static and differential pressure inputs to a FloBoss.

E

- **ESD** Electronic Static Discharge.
- **EIA-232** Serial Communications Protocol using three or more signal lines, intended for short distances. Also referred to as RS-232.
- **EIA-485** Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion. Also referred to as RS-485.
- **EMI** Electro-magnetic interference.
- **EU** Engineering Units.

F

- **Firmware** Internal software that is factory-loaded into a form of ROM. In the FloBoss, the firmware supplies the software used for gathering input data, converting raw input data calculated values, storing values, and providing control signals.
- **Flash ROM** A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory and requires no backup power.
- **FSK** Frequency shift keyed.
- **FST** Function Sequence Table, a type of program that can be written by the user in a high-level language designed by Emerson Process Management Flow Computer Division.

G

- **GFA** Ground fault analysis.
- **GND** Electrical ground, such as used by the FloBoss power supply.
- **GP** Gauge Pressure.

Н

hw – Differential pressure.

I, J

I/O – Input/Output.

IEC – Industrial Electrical Code.

K

KB – Kilobytes.

kHz – Kilohertz.

L

LCD – Liquid Crystal Display. Display only device used for reading data.

LOI – Local Operator Interface. Refers to the serial (RS-232) port on the FloBoss through which local communications are established, typically for configuration software running on a PC.

M

mA – Milliamp(s); one thousandth of an ampere.

mW – Milliwatts, or 0.001 watt.

mV – Millivolts, or 0.001 volt.

Ν

NEC – National Electrical Code.

NEMA – National Electrical Manufacturer's Association.

0

OH – Off-Hook modem communications signal.

Off-line – Accomplished while the target device is not connected (by a communications link). For example, off-line configuration is configuring a FloBoss in an electronic file that is later loaded into the FloBoss.

Ohms – Units of electrical resistance.

On-line – Accomplished while connected (by a communications link) to the target device. For example, on-line configuration is configuring a ROC while connected to it, so that current parameter values are viewed and new values can be loaded immediately.

Opcode – Type of message protocol used by the FloBoss to communicate with ROCLINK software, as well as host computers with ROC driver software.

P, Q

Parameter – A property of a point that typically can be configured or set by the user. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.

Pf – Flowing pressure.

PC – Personal computer.

Point – Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.

Point Number – The number of an I/O point as installed in the FloBoss system.

PRI – Primary PID control loop.

Protocol – A set of standards that enables communication or file transfers between two computers. Parameters include baud rate, parity, data bits, stop bit, and the type of duplex.

PSTN – Public Switched Telephone Network.

PT – Process Temperature.

PTC – Positive Temperature Coefficient.

PTT – Push-to-Talk signal.

Pulse – Transient variation of a signal whose value is normally constant.

R

RAM – Random Access Memory. In a FloBoss, it is used to store history, data, most user programs, and additional configuration data.

RFI – Radio frequency interference.

RI – Ring Indicator modem communications signal.

ROC – Remote Operations Controller is a microprocessor-based unit that provides remote monitoring and control.

ROCLINK Software – Configuration software used to configure FloBoss units.

ROM – Read-only memory. Typically used to store firmware.

RTD – Resistance Temperature Detector.

RTS – Ready to Send modem communications signal.

RXD – Received Data communications signal.

S

Script – An uncompiled text file (such as keystrokes for a macro) that is interpreted by a program to perform certain functions. Typically, scripts can be easily created or edited by the end-user to customize the software.

SP – Setpoint, or Static Pressure.

SPK – Speaker.

SRAM – Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.

System Variables – Parameters configured that describe the FloBoss unit. These parameters are set in the Device Information screen of ROCLINK software.

T-Z

Tf – Flowing temperature.

TLP – Type (of point), Logical (or point) number, and Parameter number.

TXD – Transmitted Data communications signal.

Upload – Send data, a file or a program from the FloBoss unit to a configuration PC or the Host.

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If you have comments or questions regarding this manual, please direct them to your local sales representative or contact:

Emerson Process Management Flow Computer Division Marshalltown, IA 50158 U.S.A. Houston, TX 77065 U.S.A. Pickering, North Yorkshire UK Y018 7JA Website: www.EmersonProcess.com/flow

RTDs

Application and Technical Data (cont.)

Calibration

Occasionally, the interchangeability tolerance listed for a sensor is unacceptable for an application. On those occasions there are three types of calibrations available. Thermo Sensors maintains a laboratory with equipment traceable to the National Bureau of Standards to furnish these calibrations.

- 1. If there is only one temperature of interest, or the interest is over a narrow range, elements can be selected by calibration to have a closer interchangeability tolerance of no more than .25% of the tem perature. This selection calibration makes field adjustment of the measurement instrument unnecessary when elements are changed in critical applications.
- 2. Elements can be calibrated at a particular temperature of interest. Also if there are temperatures of interest over a narrow range, a two or three point calibration will provide the user with information for interpolation within that range so that the measurement instrument can be adjusted.
- 3. a complete computer generated resistance/temperature table can be provided for a platinum sensor over the range of 0°C to its maximum useful temperature. These tables can be provided in °F or °C with temperature increments from .01° to 1° as specified by the customer.

Matched Pairs

When using two platinum sensors to measure the differential temperature of chilled water, standard \pm 0.12% elements can produce an error as much as 0.6°C. Usually this is unacceptable in critical applications. In those cases, sensors having a differential of down to \pm 0.6°C at 0°C or .25% of a selected temperature can be furnished by calibration at additional cost.

Lead Wire Compensation

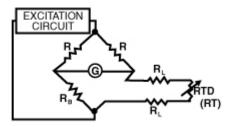
Since the readout instrumentation for sensors is normally remoted considerable distances from the sensors themselves, it is important to consider and usually eliminate additional resistance imposed by the connecting wires. It is important that only the resistance change of the sensor be measured. To eliminate any change in lead resistance due to ambient changes, either a three or four wire connection should be used.

Most industrial applications are served well by using a three wire system while the four wire is common in laboratory environments.

Diagrams and comments relating to the four commonly used wiring systems are shown below.

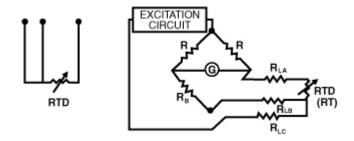
2-Wire System





At balance RB will equal RT + 2RL giving an error equal to the two leads of the sensor connection. Depending on lead length and wire size the error may be negligible or profound.

3-Wire System



Industrial sensors commonly use this three wire connection system. For this system to be effective, all the leads (R_{LA}, B, C) should be very near the same length and of the same gauge.

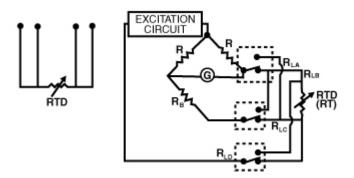
At balance:

$$R_{\scriptscriptstyle B} = R_{\scriptscriptstyle LB} = R_{\scriptscriptstyle T} + R_{\scriptscriptstyle LA}$$

$$R_T = R_B + R_{LB} - R_{LA}$$

Any error would be to the magnitude of the difference in resistance of $R_{\text{\tiny LA}}$ and $R_{\text{\tiny LB}}$ which should be negligible assuming the leads are the same length and gauge.

4-Wire System



This system provides precision measurements. By switching the pairs of leads and averaging, you arrive at a value from which the lead resistance, thermal emf's in the leads and resistance changes in the leads due to ambient variation has been eliminated.

Switch Position a At balance:

$$R_{\scriptscriptstyle B} + R_{\scriptscriptstyle LC} = R_{\scriptscriptstyle T} + R_{\scriptscriptstyle LA}$$

$$R_T = R_B + R_{LC} - R_{LA}$$

Switch Position B At balance:

$$\begin{aligned} R_{\text{B}} + R_{\text{LA}} &= R_{\text{T}} + R_{\text{LC}} \\ R_{\text{T}} &= R_{\text{B}} + R_{\text{LA}} &= R_{\text{LC}} \end{aligned}$$

$$R_T = R_B + R_{LA} = R_{LC}$$

Type *L2* Liquid Level Controller

Snap-Acting or Throttling Control

Vent-Away Case

2-Inch NPT Vessel Connection

NACE Service Ready

Low-Bleed Environmentally Friendly Relay

ASME Class 1500 Pressure Rating

Field-Configurable Vertical or Horizontal Displacer

NOW....ONE PNEUMATIC LIQUID LEVEL CONTROLLER THAT MEETS A WIDE RANGE OF APPLICATIONS

Figure 1. Features







Figure 2. Type L2 Liquid Level Controller

The rugged Type L2 liquid level controller uses a displacer type sensor (see figures 1 and 2) to detect liquid level or the interface of two liquids of different specific gravities. This controller is ideal for controlling level on gas separators and scrubbers. The reliability of the Type L2 design makes it well suited for high pressure liquid level applications in natural gas production, compression, and processing. The device delivers a pneumatic output signal to a control valve. The sensor uses a threaded 2-inch NPT connection to the vessel.

Features

- Snap-Acting or Throttling Control—One standard controller available as either throttling or snap-acting.
- Field-Reversible Output—The controller can be adjusted in the field for direct or reverse action without additional parts. The controller also has adjustable gain sensitivity.
- NACE Service Ready—Standared construction uses materials that comply with the recommendations of NACE MR0175 (National Association of Corrosion Engineers).

- Low-Bleed Environmentally Friendly Relay—Low-bleed relays conserve operating medium and reduce the impact on the environment.
- Vent-Away Case—The ability to pipe away exhaust permits using natural gas as the operating medium.
- ASME Class 1500 Pressure Rating—Sensor assembly is designed and specified for ASME B16.34 Class 1500 service.
- Field-Configurable Vertical or Horizontal Displacer—Displacer may be adjusted in the field for vertical or horizontal operation without additional parts
- Easy Maintenance—Both the controller and the sensor can be easily disassembled to inspect the process seals and for maintenance.
- Vibration Resistant Sensor Dynamics— O-Ring friction and process pressure sensitivity are minimal. Performance stays constant with process pressure changes and controller remains vibration resistant.

Specifications

Available Configurations

Controllers: Snap-acting or throttling. **Sensor:** Displacer-type liquid level sensor for mounting to side of tank. Displacer travel is transmitted to controller by pivotal movement of displacer rod.

Input Signal⁽¹⁾

Type: Liquid level or liquid-to-liquid interface

Level Change Required for Full Change in Output Signal in a 1.0 Specific Gravity Liquid, with 1.4 bar (20 psig) Supply, Direct Action, and Standard 1-7/8 X 12-Inch (48 x 305 mm) Vertical Displacer with Standard Lever Arm Length:

Control Mode	Minimum Proportional Band Level Change, mm (Inches) ⁽²⁾	Maximum Proportional Band Level Change, mm (Inches) ⁽²⁾
Throttling	102 (4)	305 (12)
On-off	127 (5)	305 (12)
Snap-acting	13 (0.5)	20 (0.8)

Minimum Specific Gravity(3)

Throttling Controller: Minimum specific gravity, or specific gravity differential for interface applications, is 0.1 (See note 4).

Snap-Acting Controller: Minimum specific gravity, or specific gravity differential for interface applications, is 0.1

Output Signal⁽¹⁾

Pneumatic ■ on-off or ■ proportional pressure signal

Ranges:

Throttling: ■ 0.2 to 1.0 bar (3 to 15 psig) or ■ 0.4

to 2.0 bar (6 to 30 psig)

On-Off: 0 (off) or full supply pressure (on)

Action: Field-reversible between direct
(increasing level increases output signal) and
reverse (increasing level decreases output signal)

Supply Pressure Requirements

Throttling Controller:

Throttling: 1.4 bar (20 psig) for 0.2 to 1.0 bar (3 to 15 psig) output signal and 2.4 bar (35 psig) for 0.4 to 2.0 bar (6 to 30 psig) output signal On-Off: Any desired pressure between 1.4 and 3.4 bar (20 and 50 psig)

Snap-Acting Controller: Any desired pressure between 1.4 and 5.2 bar (20 and 50 psig) direct, and 1.4 and 2.4 bar (20 and 35 psig) reverse

Do not use supply pressure below 1.4 bar (20 psig).

Steady-State Air Consumption(5)

Throttling Controller: ≤0.03 normal m³/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure

Snap-Acting Controller: \leq 0.03 normal m³/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure or \leq 0.04 normal m³/hr (1.5 scfh) at 2.4 bar (35 psig) supply pressure in tripped condition; air consumption

increases during trip

Standard Displacer Size

48 x 305 mm, 541 cm³ (1-7/8 x 12 inches, 33 in³

Maximum Displacer Working Pressure⁽⁶⁾

258 bar (3750 psig)

Maximum Displacer Insertion Length⁽⁷⁾

Standard lever arm length plus one 6-inch extension, horizontal or vertical

Maximum Sensor Working Pressure⁽⁶⁾

Consistent with Class 1500 pressure temperature ratings per ASME B16.34 up to maximum pressure of 258.5 bar (3750 psig)

Construction Materials

Controller:

Case and Cover: Marine grade aluminum

Relay Body: Thermoplastic Fasteners: Stainless steel Diaphragm: Nitrile

O-Rings: Nitrile

Case and Cover Gasket: Neoprene Sensor Gasket: Composition

Relay Gasket: Nitrile

Throttling Levers: Stainless steel

Sensor:

Pivot Assembly: Stainless steel Sensor Spring: Stainless steel

Sensor Body: LCC

O-Rings: Highly saturated Nitrile⁽⁸⁾ or

fluorelastomer

Displacer: Polyvinylchloride (PVC)

Specifications (continued)

Operative Ambient Temperature Limits⁽¹⁾⁽⁶⁾

Controller: -29 to 71°C (-20 to 160°F)

Sensor Temperature Limits⁽¹⁾⁽⁶⁾

Displacer: -29 to 79°C (-20 to 175°F) **O-Rings:** -40 to 204°C (-40 to 400°F)

Sensor to Vessel Connection

2-inch (51 mm) screwed (NPT)

Controller Connections

Supply: 1/4 in. NPT female located on the bottom

of the case

Output: 1/4 in. NPT female located on the top of

the case

Case Vent: 1/4 in. NPT female with vent screen assembly located on the back of the case

Standard Supply, and Output Pressure Gauge **Indications**

Triple scale gauges in 0 to 60 psig/0 to 0.4 MPa/0

Dimensions

Refer to Figure 3

- This term is defined in ISA Standard 51.1.
- Any deviation from the standard construction described in the input signal specification above requires special sizing considerations. Contact the Fisher sales office for information.

 Minimum specific gravity values apply to both horizontal and vertical displacers with standard lever arm length (see dimension in figure 3).

 Minimum specific gravity differential with standard displacer is 0.4. Minimum specific gravity differential of 0.1 is possible with special displacer. Consult your Fisher sales office for displacer. sizing information.

 5. Normal m³/hr--Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh--Standard cubic feet per hour (60°F and 14.7 psia).

 6. The pressure and temperature limits in this document and any applicable code limitations shold not be exceeded.

- Standard lever arm length. See figure 3.
 Highly saturated Nitrile (H--NBR) has exceptional resistance to swelling in sour applications.

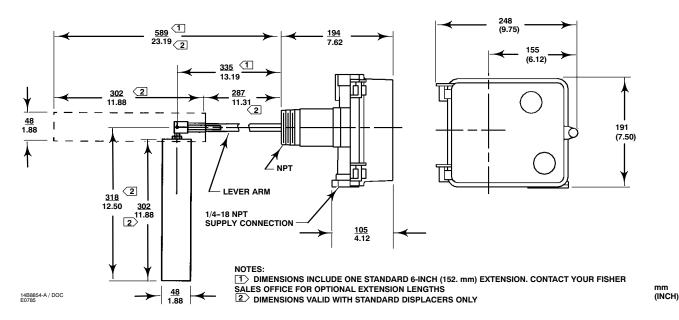


Figure 3. Dimensions

Note

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34.2:L2 July 2002

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Type *D2 FloPro*™ Control Valve

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Introduction

Scope of Manual

This instruction manual provides installation, maintenance, and parts information for the 1-inch Type *D2 FloPro* control valve and actuator.

No person may install, operate, or maintain a Type D2 FloPro control valve without first (1) being fully trained and qualified in valve, actuator, and accessory installation, operation, and maintenance, and (2) carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office before proceeding.

Description

The Type *D2 FloPro* control valve (patents pending) (figures 1 and 2) is a compact, rugged valve designed for on-off control of a variety of fluids at



Figure 1. Type D2 FloPro Control Valve

pressures up to 155 bar (2250 psig). This valve is ideal for use as a dump valve on gas separators and scrubbers. It is also well suited for other high pressure applications in natural gas production, compression, and processing. The Type *D2 FloPro* valve has threaded end connections and is available in a 1-inch globe style body.

Note

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Specifications

Table 1 lists specifications for the Type *D2 FloPro* control valve. Some of the specifications for a given control valve as it originally comes from the factory are stamped on a nameplate located on the upper diaphragm casing flange.





Table 1. Specifications

Valve Assembly Pressure Class

ASME B16.34 Class 900

Maximum Inlet Pressure and Temperature⁽¹⁾

155 bar from -46 to 93°C, and 150 bar at 149°C. (2250 psig from -50 to 200°F, and 2185 psig at 300°F)

Maximum Allowable Pressure Drop(1)

Spring-to-Close - Flow Down⁽²⁾: 155 bar (2250

psig)

Spring-to-Open - Flow Down⁽²⁾: 103 bar (1500

psig)

Spring-to-Close - Flow Up: 103 bar (1500 psig) Spring-to-Open - Flow Up: 103 bar (1500 psig)

Shutoff Classification

ANSI Class IV ANSI/FCI 70-2 and IEC 60534-4

Construction Materials

Valve Body and Bonnet: ASME SA 352 LCC

Stress relieved

Valve Plug and Seat: (R0006) Alloy 6 Valve Stem: (S31600) 316 SST O-Rings: (HNBR) Hydrogenated Nitrile

Packing: PTFE/Carbon PTFE

Packing Springs: (N07718) Inconel 718

Stem Bushing: (Ryton) PPS

Actuator Diaphragm: Nitrile/Polyester Actuator Springs: Zinc-plated steel

Flow Characteristic

FloPro Characterized

Port Diameter

13 mm (1/2 inch)

Maximum Travel

13 mm (1/2 inch)

Approximate Weight

7.7 kg (17 lb)

Material Temperature Capabilities

Valve Body Assembly: -46 to 149°C

(-50 to 300°F)

Actuator Assembly: -46 to 93°C (-50 to 200°F)

Bonnet/Body Connection

Threaded with leakoff bleed

Actuator Configuration

The D2 FloPro actuator is an on-off spring-and-diaphragm. Actuator action is Spring-to-Close from the factory.

For Spring-to-Open actuator action, a Spring-to-Open Spring Kit (10C1998X012) must be used

Maximum Actuator Casing Pressure

2.4 bar (35 psig)

Minimum Required Actuator Casing Pressure

2.1 to 2.4 bar (30 to 35 psig)

Actuator Diaphragm Effective Area

194 cm² (30 square inches)

Actuator Pressure Connections

1/4 inch NPT female

The pressure or temperature limits in the referenced tables and any applicable ASME code limitations should not be exceeded.
 Standard flow direction.

Installation

WARNING

Always wear protective gloves, clothing, and eyewear when performing any installation operations to avoid personal injury.

Personal injury or equipment damage caused by sudden release of pressure may result if the valve assembly is installed where service conditions could exceed the limits given in table 1 or on the appropriate nameplates. To avoid such injury or damage, provide a relief valve for overpressure protection as required by accepted industry or local, state, and Federal codes and good engineering practices.

Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

CAUTION

This valve is intended for a specific range of pressures, temperatures, and other service conditions (see table 1). Applying different pressure, temperature, and other conditions to the valve could result in parts damage, malfunction of the valve, or loss of control of the process. Do not expose this valve to service conditions or variables other than those for which this valve is intended. If you are not sure what these conditions are, you should contact Fisher for more complete specifications. Provide the product serial number (shown on the nameplate) and all other pertinent information.

- 1. Before installing the valve, inspect it to be certain that the valve body cavity is free of foreign material. Clean out all pipelines to remove scale, welding slag, and other foreign materials.
- 2. The control valve assembly may be installed in any orientation unless limited by seismic criteria. However, the normal method is with the actuator vertical above the valve body.

The standard flow direction is indicated by the arrow on the valve body.

- 3. Use accepted piping practices when installing the valve in the pipeline.
- 4. If continuous operation is required during inspection or maintenance, install a three-valve bypass around the control valve assembly.

Note

The 1-inch Type *D2 FloPro* valve is equipped with ENVIRO-SEAL® *D2* packing.

The actuator, as shipped from the factory, is spring-to-close. If spring-to-open action is required, see the Changing Actuator Action section in this manual.

Additionally, the actuator as shipped from the factory, has the *FloPro* flow adjuster set at a 3/8 inch port flow rate position. If some other flow rate is desired, see the Setting Valve Flow Rate section in this manual.

Setting Valve FloPro Flow Adjuster

Spring-to-Close Actuator Action

1. To change the valve flow rate, loosen the flow adjuster socket head cap screws (key 29), and reposition the flow adjuster halves (key 14 and 15) to the desired flow rate position. See figure 4 for flow rate settings.

Spring-to-Open Actuator Action

- 1. Attach a pressure line to the actuator. Supply pressure to the actuator to seat the plug in the seat ring.
- 2. To change the valve flow rate, loosen the flow adjuster socket head cap screws (key 29), and reposition the flow adjuster halves (key 14 and 15) to the desired flow rate position. See figure 4 for flow rate settings.

Changing Actuator Action from (Spring-to-Close) to (Spring-to-Open)

Key numbers are referenced in figures 6 and 7.

Note

The following procedure requires use of Spring Kit 10C1998X012.

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1. Remove the six **short** actuator casing cap screws (key 22) first. Once these have been removed from the actuator assembly, carefully remove the two **long** actuator cap screws (key 30).

Note

Be aware as you loosen and remove the actuator cap screws that the actuator springs are under compression.

- 2. Remove the upper casing (key 21) and the springs (key 27).
- 3. Do not turn the valve stem (key 4) while removing the diaphragm hex nut (key 26). Use an appropriate tool on the machined flats located on the valve stem above the flow adjuster for this procedure. Continue the actuator disassembly by removing the washer (key 24) diaphragm plate (key 25), diaphragm (key 19), and washer (key 24). Inspect the diaphragm for any wear or damage. Replace with a new one if necessary.
- 4. Unscrew the socket head cap screws (key 29), and remove the flow adjuster halves (key 14 and 15). Position the stem (key 4) to its most upward position.
- 5. Place the 3 springs (key 27) from the Spring Kit in their approximate, equally spaced, locations in the bottom casing (key 20). Place the washer (key 24) over the valve stem. Then install the diaphragm plate (key 25) and, using the diaphragm plate, correctly position the actuator springs.
- 6. Place the diaphragm (key 19) over the stem, along with washer (key 24). Position the diaphragm so the holes in the diaphragm align with the holes in the bottom casing.
- 7. Insert a 1/8 inch diameter drift punch, or other suitable device through the 5/32 diameter hole in the valve stem located below the bottom of the previously removed flow adjuster. Install hex nut (key 26) and tighten to 11 N•m (95 lbf•in). Remove the 1/8 inch drift punch or other holding device.
- 8. Attach the upper casing by first installing the two **long** cap screws (key 30) opposite one another. Begin tightening the two long screws evenly until the remaining six shorter cap screws (key 22) can be installed with their hex nuts. Continue tightening the actuator casing cap screws evenly using a cross-tightening procedure. Torque to 14 N•m (10 lbf•ft).
- 9. Connect a pressure line to the top actuator pressure connection, and apply pressure to the

actuator. Stroke the actuator until the valve plug is seated on the seat ring. Install the flow adjuster, positioning it to the desired travel. Tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).

10. Release the actuator pressure, and install the vent plug (key 28) into the bottom casing pressure connection.

Maintenance

Valve parts are subject to normal wear and must be inspected and replaced as necessary. Inspection and maintenance frequency depends on the severity of service conditions. This section includes instructions for packing and trim maintenance, reversing the action, and replacing actuator parts.

All maintenance operations can be performed with the valve in the line.

Note

Whenever a gasket seal or O-ring is disturbed by removing or shifting gasketed parts, a new gasket should be installed upon reassembly. This is necessary to ensure a good gasket seal, since the used gasket or O-ring will not seal properly.

MARNING

Avoid personal injury from sudden release of process pressure. Before performing any maintenance operations:

- Always wear protective gloves, clothing, and eyewear when performing any maintenance operations to avoid personal injury.
- Disconnect any operating lines providing air pressure or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure. Relieve process pressure on both sides of the valve. Drain the process media from both sides of the valve.

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- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- The valve packing box may contain process fluids that are pressurized, even when the valve has been removed from the pipeline. Process fluids may spray out under pressure when removing the packing hardware or packing rings.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Valve Trim Maintenance

Note

The following maintenance procedures apply to both spring-to-close and spring-to-open actuator configurations, except for steps 2 and 8 as noted.

Key numbers are referenced in figures 6 and 7.

- 1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve.
- 2. For spring-to-close actuator action only, apply pressure to the actuator to fully stroke it open. This will raise the plug off its seat so that the valve stem serrations are visible inside the flow adjuster window (see figure 5). Loosen the socket head screws (key 29) and lower the flow adjuster (key 14 and 15) to its lowest position on the valve stem. Retighten the socket head screws (key 29) to 3 N•m (26 lbf•in). Relieve pressure to the actuator, shut off all pressure lines to the actuator, and disconnect. Use lockout procedures to be sure that the above measures stay in effect while you work on the equipment.

Note

The preceding step is intended to prevent damage to the valve plug (key 3) and seat ring (key 5) during the removal of the bonnet and actuator.

3. Unscrew the bonnet from the valve body.

MARNING

Avoid personal injury from sudden release of process pressure. If the process media starts to escape from the safety vent (see figure 4) located in the bonnet neck of the valve body,

STOP DISASSEMBLY IMMEDIATELY!

The escape of process media indicates that the valve has NOT been isolated from the process media, or process pressure is trapped in the valve body.

4. Once the bonnet has been removed from the valve body, inspect the seat ring (key 5) for wear or damage. If the seating surface has been damaged, remove it from the valve body. Also remove the seat ring gasket (key 6). Clean and inspect the valve body gasket surface for damage. Visually inspect the valve body interior below the seat ring for erosion. Replace the valve body if necessary.

To replace the seat ring, first install a new seat ring gasket. Install the new seat ring and tighten to 230 N•m (170 lbf•ft).

Cover the opening in the valve body to prevent foreign material from getting into the valve body cavity.

- 5. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.
- 6. If the valve plug requires replacement, use an appropriate tool on the machined flats located on the valve stem above the flow adjuster and unscrew the valve plug from the valve stem. Replace it with a new valve plug. Screw the valve plug into the valve stem, being careful not to damage the plug seat or plug contour. Tighten to 18 N•m (13 lbf•ft).
- 7. Lubricate a new O-ring (key 13) with Dow Corning 111 compound or equivalent and place it into the valve body as shown in figure 6 or 7. Ensure that no foreign material blocks the safety vent hole. Screw the bonnet into the valve body, and torque to a range of 542.3 to 677.9 N•m (400 to 500 lbf•ft).
- 8. For spring-to-close actuator action only, attach the pressure line to the actuator, and supply pressure to the actuator. Move the flow adjuster to approximately midpoint on the valve stem serration. Release the pressure to the actuator. This allows the plug to find its seated position.
- 9. Set the flow adjuster to the desired travel position (see figure 4), and tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).

Packing and Valve Trim Maintenance

Note

The following maintenance procedures apply to both spring-to-close and spring-to-open actuator configurations, except for steps 2, 23, and 26 as noted.

Key numbers are referenced in figures 6 and 7.

- 1. Isolate the control valve from the line pressure, release pressure from both sides of the valve body, and drain the process media from both sides of the valve.
- 2. For spring-to-close actuator action only, apply pressure to the actuator to fully stroke it open. This will raise the plug off its seat so that the valve stem serrations are visible inside the flow adjuster window (see figure 5). Loosen the socket head screws (key 29) and lower the flow adjuster (key 14 and 15) to its lowest position on the valve stem. Retighten the socket head screws (key 29) to 3 N•m (26 lbf•in). Relieve pressure to the actuator, shut off all pressure lines to actuator, and disconnect. Use lockout procedures to be sure that the above measures stay in effect while you work on the equipment.

Note

The preceding step is intended to prevent damage to the valve plug (key 3) and seat ring (key 5) during the removal of the bonnet and actuator.

3. Unscrew the bonnet from the valve body.

MARNING

Avoid personal injury from sudden release of process pressure. If the process media starts to escape from the safety vent (see figure 4) located in the bonnet neck of the valve body,

STOP DISASSEMBLY IMMEDIATELY!

The escape of process media indicates that the valve has NOT been isolated from the process media, or process pressure is trapped in the valve body.

4. Once the bonnet has been removed from the valve body, inspect the valve seat (key 5) for wear or

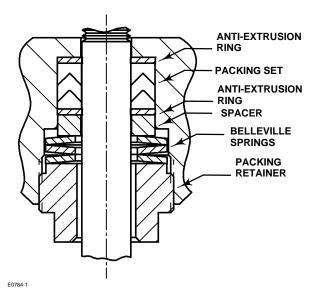


Figure 2. Packing and Belleville Spring Stacking Order

damage. If the seating surface has been damaged, remove it from the valve body. Also remove the seat ring gasket (key 6). Clean and inspect the valve body gasket surface for damage. Visually inspect the valve body interior below the seat ring for erosion. Replace the valve body if necessary.

To replace the seat ring, first install a new seat ring gasket. Install the new seat ring and tighten to 230 N•m (170 lbf•ft).

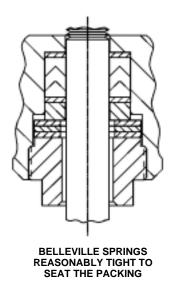
Cover the opening in the valve body to prevent foreign material from getting into the valve body cavity.

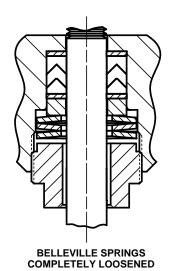
5. Remove the six **short** actuator casing cap screws (key 22) first. Once these have been removed from the actuator assembly, carefully remove the two **long** actuator cap screws (key 30).

Note

Be aware as you loosen and remove the actuator cap screws that the actuator springs are under compression.

- 6. Remove the upper casing (key 21) and the springs (key 27).
- 7. Do not turn the valve stem (key 4) while removing the diaphragm hex nut (key 26). Use an appropriate tool on the machined flats located on the valve stem above the flow adjuster for this procedure. Continue the actuator disassembly by removing the washer (key 24) diaphragm plate (key 25), diaphragm (key 19), and washer (key 24 for spring-to-open or key 36)





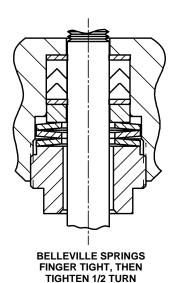


Figure 3. Belleville Spring Procedure

for spring-to-close). Inspect the diaphragm for any wear or damage. Replace with a new one if necessary.

If you wish to inspect/replace the bonnet to actuator casing O-ring (key 16), mark the orientation of the actuator pressure connection to the bonnet for later reference (see figure 5). Unscrew the hex nut (key 18) from the bonnet. Remove the bottom casing (key 20).

- 8. Unscrew the flow adjuster socket head cap screws (key 29), and remove the flow adjuster halves.
- 9. Unscrew the packing retainer (key 7) from the bonnet (key 2). After the packing retainer has been unscrewed from the bonnet, pull the valve stem and plug out of the bonnet.
- 10. Remove the three Belleville springs (key 9), packing spacer (key 10), packing (key 11), and two anti-extrusion rings (key 12) from the bonnet. See figure 2.
- 11. Clean and inspect the packing box wall to ensure that the packing surfaces are not damaged. If the surface condition is damaged, and cannot be improved by light sanding, replace the bonnet by contacting your Fisher sales office.
- 12. Inspect the valve stem for scratches or wear, and valve plug for wear or damage. Replace if necessary.
- 13. If the valve plug requires replacement, use an appropriate tool on the machined flats located on the valve stem above the flow adjuster and unscrew the

- valve plug from the valve stem. Replace it with a new valve plug. Screw the valve plug into the valve stem, being careful not to damage the plug seat or plug contour. Tighten to 18 N•m (13 lbf•ft).
- 14. Inspect the valve stem bushing (key 8) located in the upper end of the bonnet. If damaged, remove and replace it with new bushing (key 8). Replace the valve stem bushing by inserting the bushing, flange end first, into the bore located at the top of the bonnet flow adjuster window. Insert until the flange snaps into the groove provided for it.
- 15. Remove the O-ring (key 17) from the upper end of the bonnet. Replace it with a new one, and lubricate it with Dow Corning 111 compound or equivalent.
- 16. Install new packing according to the packing arrangement shown in figure 2. Slide the valve stem through the packing retainer. Place the Belleville springs over the valve stem, positioned as shown in figure 2. Carefully slide the stem through the packing to a point where the serration extends completely into the flow adjuster window of the bonnet (see figure 5).
- 17. Apply a light film of Dow Corning 111 lubricant or equivalent (key 33) to the threads of the packing retainer (key 7).
- 18. Install the packing retainer into the bonnet and tighten until the Belleville springs (key 9) are reasonably tight to seat the packing. See figure 3.
- 19. Completely loosen the packing retainer to relieve all Belleville spring compression. See figure 3.

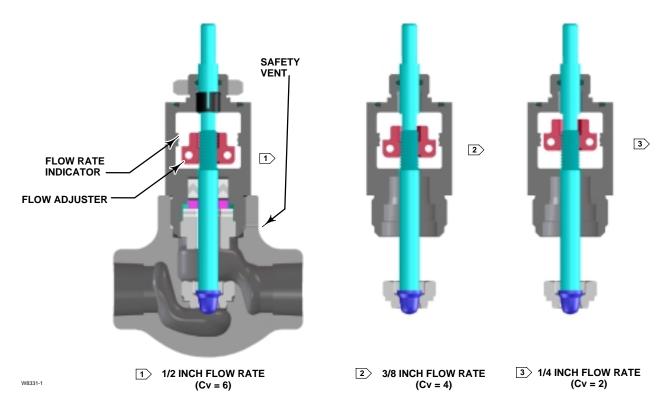


Figure 4. Flow Rate Adjustments

- 20. Retighten the packing retainer with your fingers until the packing retainer contacts the Belleville springs. See figure 3.
- 21. Tighten the packing retainer 1/2 turn clockwise. See figure 3.
- 22. If the bottom casing (key 20) has been removed, place O-ring (key 16) into the groove provided in the top of the bonnet. Place the bottom casing on the bonnet, oriented in the same position as marked in step 7 on page 7. Screw the hex nut (key 18) onto the bonnet, and tighten to 203 N•m (150 lbf•ft).
- 23. For spring-to-close actuator action only, assemble the actuator by first placing the washer (key 24) over the valve stem. Then place the diaphragm (key 19) over the valve stem, and position it so the holes in the diaphragm match the holes in the casing. Place the diaphragm plate (key 25) over the valve stem. Install the washer (key 24), diaphragm hex nut (key 26). Tighten the diaphragm hex nut to 11 N•m (95 lbf•in), while holding the stem by the flats. Install the springs (key 27) and attach the upper casing (key 21) by first installing the two long cap screws (key 30) opposite one another.
- 24. Begin tightening the two long screws evenly until the remaining six shorter cap screws (key 22)

- can be installed with their hex nuts. Continue tightening the actuator casing cap screws evenly using a cross-tightening procedure. Torque to 14 N•m (10 lbf•ft).
- 25. Lubricate a new O-ring (key 13) with Dow Corning 111 compound or equivalent and place it into the valve body as shown in figure 6 or 7. Ensure that no foreign material blocks the safety vent hole. Screw the bonnet into the valve body, and torque to a range of 542 to 678 N•m (400 to 500 lbf•ft).
- 26. For spring-to-close actuator action only, attach the pressure line to the actuator, and supply pressure to the actuator. Move the flow adjuster to approximately midpoint on the valve stem serration. Release the pressure to the actuator. This allows the plug to find its seated position.
- 27. Set the flow adjuster to the desired travel position (see figure 4), and tighten the flow adjuster socket head cap screws to 3 N•m (26 lbf•in).

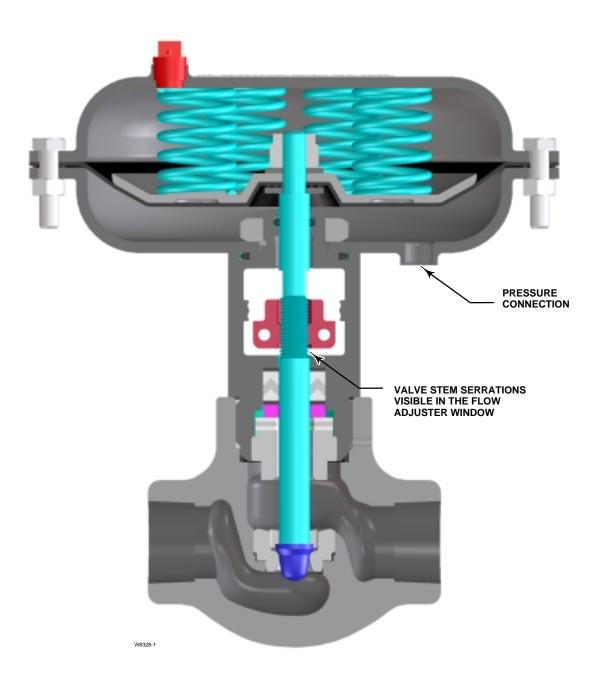


Figure 5. Type D2 FloPro Interior Detail

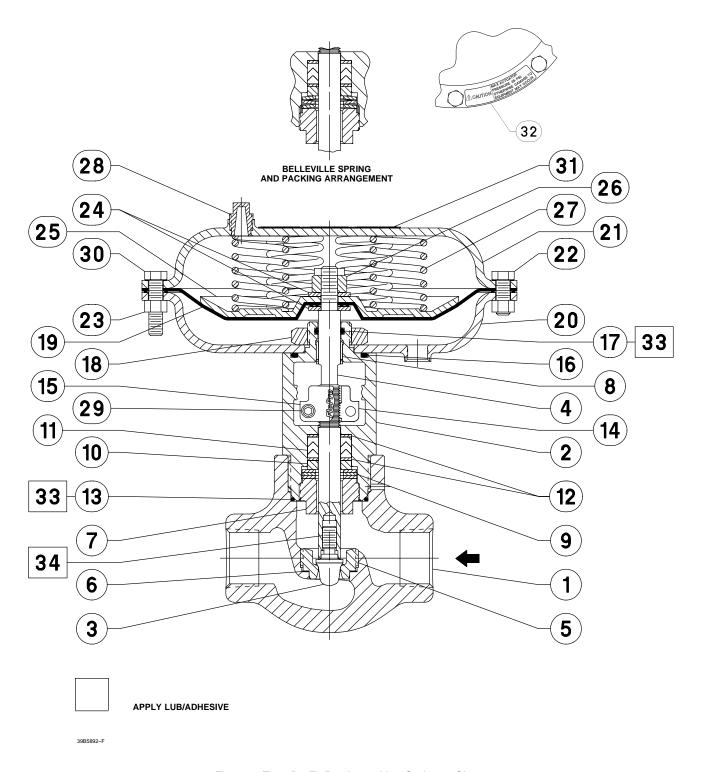


Figure 6. Type D2 FloPro Assembly—Spring-to-Close

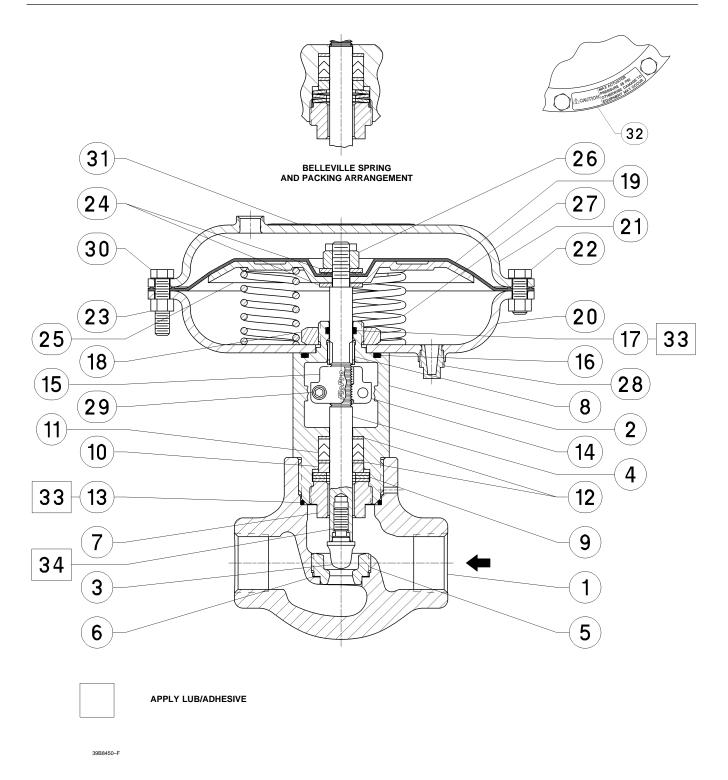


Figure 7. Type D2 FloPro Assembly—Spring-to-Open

39B5914X012

19B5887X012

Parts Ordering

Components that are not manufactured by Fisher should not, under any circumstances, be used in any Fisher valve. The use of parts not manufactured by Fisher may adversely affect the performance of the valve as well as worker and workplace safety.

Note

Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

Parts Kits

	Description	Part Number
*	Valve Trim Kit	
	Includes key numbers 3, 5, 6, and 13	19B8485X012
*	Valve Packing Kit	
	Includes key numbers 8, 11,	
	12 (2 req'd), 13, 16, and 17	19B8486X012
*	Spring-to-Open Spring Kit	
	Includes key number 27 (3 springs)	10C1998X012

Parts List

Note

Part numbers are shown for recommended spares only. For part numbers not shown, contact your Fisher sales office.

Key	Description	Part Number

- 1 Valve Body
- 2 Bonnet3 Valve Plug
- 4* Valve Stem
- 5 Seat Ring
- 6* Seat Ring Gasket
- 7 Packing Retainer
- 8 Valve Stem Bushing9 Belleville Springs (3 req'd)
- believille Springs (3)
- 10 Packing Spacer
- 11 ENVIRO-SEAL D2 Packing Set
- 12 Anti-Extrusion Ring (2 req'd)
- 13 Valve Body O-ring14 Flow Adjuster Half
- 15 Flow Adjuster Half
- 16 Casing O-ring
- 17 Valve Stem O-ring
- 18 Hex Nut
- 19* Diaphragm 39B3849X012
- 20 Bottom Casing
- 21 Upper Casing
- 22 Short Actuator Casing Cap Screws (6 reg'd)
- 23 Nut
- Washer (2 req'd for spring-to-open, 1 req'd for spring-to-close)
- 25 Diaphragm Plate
- 26 Diaphragm Hex Nut
- 27 Springs
 - Spring-to-Close (6 springs)
 - Spring-to-Open (Spring Kit, 3 springs included)
- 28 Vent Plug
- 29 Flow Adjuster Socket Head Cap Screws (2 req'd)
- 30 Long Actuator Casing Cap Screws (2 req'd)
- 31 Nameplate
- 32 Caution Label
- 33 Lubricant, Dow Corning 111 Compound or equivalent
- 36 Washer (spring-to-close)

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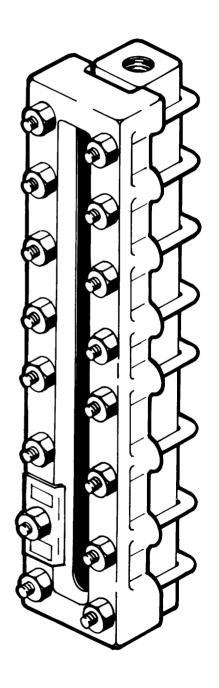


^{*}Recommended spare parts

PENBERTHY®

Section 2000 Instal. Instr. 2950L Issued 9/96 Replaces 6/95

Flat Glass Gages Series L



Installation/Operation/Maintenance Instructions

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PRODUCT WARRANTY

Penberthy Inc., warrants its products as designed and manufactured by Penberthy to be free of defects in material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. Penberthy will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Penberthy and obtain written authorization to return the product. Thereafter, the product shall be returned to Penberthy in Prophetstown, Illinois, with freight prepaid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or altered outside of the Penberthy factory, or if it has been subjected to misuse, neglect or accident.

Penberthy's responsibility hereunder is limited to repairing or replacing the product at its expense. Penberthy shall not be liable for loss, damage, or expenses directly or indirectly related to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that Penberthy is not responsible for damage or injury caused to other products, building, property or persons, by reason of the installation or use of its products.

THIS IS PENBERTHY'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of Penberthy unless modified or made in writing and signed by the President or a Vice President of Penberthy.

1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow *any* instruction could possibly result in a malfunction of the gage or glass breakage with resulting sudden release of pressure, property damage or physical injury to personnel.

SAFETY INSTRUCTIONS

Penberthy does not have any control over the manner in which its liquid level gage is handled, installed or used. Penberthy cannot and will not guarantee that a liquid level gage is suitable or compatible for the user's specific application.



WARNING



Contained fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a liquid level gage. Failure to do so could result in serious physical injury to personnel.

2.0 Introduction

Penberthy liquid level gages are used to allow direct visualization of liquid level in vessels. By peering through the glass, it is possible to monitor color, clarity, and level of a gas/liquid interface. Gages are available in varying lengths and configurations (end connect, side connect, multiple sections, NPT or flange connections, etc.). Visual indication can be enhanced by using reflex glass or illuminators (accessory)

2.1 System Description

Penberthy gages are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the gage. Use the exploded parts view in Section 11 as additional reference material.

<u>Chamber</u> - provides a pressure retaining metallic channel for the liquid to enter and be viewed. Slot(s) are machined into the chamber to provide direct visualization of the process fluid.

<u>Gaskets</u> - seal the gap and prevent leakage between the chamber and the glass. Gaskets are available in a variety of materials for compatibility with the media in the gage.

Glass - glass allows for visual observation of the process fluid in the chamber

<u>Cushion</u> - acts as a protective buffer between the glass and the cover. For proper sealing cushions must be as hard as or harder than the gasket material.

<u>Cover</u> - protects the glass assembly from external hits and provides a flat, rigid surface that is used to evenly compress the gage assembly.

<u>Bolting</u> - compresses the components between the covers (transparent gages) or cover and chamber (reflex gages).

Shield (optional) - used to prevent the process media from contacting the glass.

3.0 Available Models

Penberthy (Series L) low pressure liquid level gages are designed for applications other than steam/water where the physical and mechanical properties of a ductile iron cover are sufficient to meet the pressure and temperature needs of the application.

3.1 Design Ratings at Maximum and Minimum Operating Temperatures

Glass	Model R	L Reflex	
Size	Wetted Parts Material Steel or Stainless Steel w/B7 Bolting		
	-20°F (-29°C) to 100°F (37°C)	600°F (315°C)	
1 1	2400 PSIG (16550 KPa)	1780 PSIG (12275 KPa)	
2	2325 PSIG (16030 KPa)	1720 PSIG (11860 KPa)	
3	2250 PSIG (15515 KPa)	1670 PSIG (11515 KPa)	
4	2175 PSIG (15000 KPa)	1600 PSIG (11030 KPa)	
5	2100 PSIG (14495 KPa)	1550 PSIG (10685 KPa)	
6	2025 PSIG (13960 KPa)	1500 PSIG (10340 KPa)	
7	1950 PSIG (13445 KPa)	1440 PSIG (9930 KPa)	
8	1875 PSIG (12930 KPa)	1390 PSIG (9585 KPa)	
9	1800 PSIG (12410 KPa)	1340 PSIG (9240 KPa)	
1 - 9	2400 PSIG (6205 KPa) at -20	0°F (-29°C) to 500°F(260°C)	
	reference Application Report for gage pressure limitation at specific temperatures		
1 - 9	900 PSIG (6205 KPa) at -20°F (-29°C) to 100°F(37°C)		
	450 PSIG (3105 KP	a) at 500°F (260°C)	
1 - 9	300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F(37°C)		
	225 PSIG (1550 KPa) at 250°F (121°C)		
1 - 9	300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F(37°C)		
		KPa) at 400°F (204°C)	
1 - 9	300 PSIG (2070 KPa) at -20	0°F (-29°C) to 100°F(37°C)	
150 PSIG (2275 KPa) at 500°F (260°C)			
	1 2 3 4 5 6 7 8 9 1 - 9 1 - 9 1 - 9	Size Wetted Parts Material Steel or -20°F (-29°C) to 100°F (37°C) 1 2400 PSIG (16550 KPa) 2 2325 PSIG (16030 KPa) 3 2250 PSIG (15515 KPa) 4 2175 PSIG (15000 KPa) 5 2100 PSIG (14495 KPa) 6 2025 PSIG (13960 KPa) 7 1950 PSIG (13445 KPa) 8 1875 PSIG (12930 KPa) 9 1800 PSIG (6205 KPa) at -20 reference Application Report for gage presence Application	

TABLE 1

Gasket Material	Glass	Model TL Transparent			
	Size	Wetted Parts Material Steel or Stainless Steel w/B7 Bolting			
Grafoil®		-20°F (-29°C) to 100°F (37°C)	600°F (315°C)		
(standard)	1	2000 PSIG (13783 KPa)	1480 PSIG (10200 KPa)		
Or Non-Ashestos	2	1815 PSIG (12508 KPa)	1340 PSIG (9235 KPa)		
Non-Asbestos	3	1630 PSIG (11233 KPa)	1210 PSIG (8339 KPa)		
	4	1440 PSIG (9924 KPa)	1060 PSIG (7305 KPa)		
	5	1250 PSIG (8614 KPa)	920 PSIG (6340 KPa)		
	6	1065 PSIG (7339 KPa)	790 PSIG (5444 KPa)		
	7	875 PSIG (6030 KPa)	645 PSIG (4445 KPa)		
	8	690 PSIG (4755 KPa)	510 PSIG (3514 KPa)		
	9	500 PSIG (3446 KPa)	370 PSIG (2550 KPa)		
PTFE/	1 - 9	2000 PSIG (6205 KPa) at -20°F (-29°C) to 500°F(260°C)			
Top-Chem 2000®		reference Application Report for gage pressure limitation at specific temperatures			
25% glass filled PTFE	1 - 9	900 PSIG (6205 KPa) at -20°F (-29°C) to 100°F(37°C)			
		450 PSIG (3105 KPa) at 500°F (260°C)			
		reference Application Report for gage pres	sure limitation at specific temperatures		
NBR/Buna N®	1 - 9	300 PSIG (2070 KPa) at -20°F (-29°C) to 100°F(37°C)			
		225 PSIG (1550 KPa)			
FKM/Viton®	1 - 9	300 PSIG (2070 KPa) at -20°	F (-29°C) to 100°F(37°C)		
		180 PSIG (1240 KPa)			
PTFE/Teflon®	1-9	300 PSIG (2070 KPa) at -20°	F (-29°C) to 100°F(37°C)		
		150 PSIG (2275 KPa)	` ,		
PCTFE/(Kel-F®) Shields	1 - 9	300 PSIG (2067 KPa) at -20°F (-29°C) to 100°F(37°C)			
0.063" (1.6 mm) thick		180 PSIG (1240 KPa)			

TABLE 2

The pressure and temperature ratings may deviate from the previous tables if the gasketing materials of construction and/or bolting are other than those specified. Higher and/or lower temperature ratings are available with different materials of construction.

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in the tables, the user should refer to Penberthy dimension sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

NOTE: under no circumstances should shields be used in reflex style gages. Installation of shields in reflex style gages will keep the liquid from coming in contact with the refractive prisms, thereby prohibiting visualization of the liquid level in the gage.



DANGER



NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of gage components resulting in death, serious personal injury and property damage.

4.0 Inspection

Upon receipt of a liquid level gage, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

Penberthy's standard 1 section TL gage consists of: (1) chamber, (2) gaskets, (2) borosilicate flat glass, (2) rubber bands, (2) cushions, (2) covers, (1) washer, (1) nameplate, and (6 - 14) bolting sets, depending on the size.

4.1 Glass Inspection

The self stick caution tape was applied at the factory to protect the glass during shipping, handling, and installation. Do not remove the tape from the glass until all installation procedures have been completed, except during receiving inspection to momentarily inspect glass for shipping damage. Glass that is not protected will be vulnerable to dust, grit, tools and any other objects which may scratch, chip, or break the glass.



WARNING



DO NOT use glass that is chipped or even slightly scratched. Glass surface defects weaken the glass which may result in glass breakage and fluid loss under pressure resulting in serious personal and property damage.

4.2 User Rating Inspection

The user should confirm that:

- 1) the Series L liquid level gage model and assembly number stamped on the nameplate conforms to the description on the user's purchase order,
- 2) the operating conditions described in the purchase order agree with the actual operating conditions at the installation site,
- 3) the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above, and
- 4) the materials of construction of the liquid level gage are compatible with both the contained media and surrounding atmosphere in the specific application.

SAFETY INSTRUCTIONS

If the size, model, or performance data of the liquid level gage as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect gage can result in unacceptable performance and potential damage to the gage.

5.0 Installation

Installation should only be undertaken by qualified personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model liquid level gage.

Penberthy recommends that all liquid level gage installations be provided with gage valve sets equipped with ball check shut-off. Gage valve sets are designed to isolate the gages from the pressure vessel when it becomes necessary to drain or service the gages. The ball check shut-off is designed to retard leakage of the contained fluid in the event of gage glass breakage. Ball checks are available for both positive and negative vessel pressures.

The number of different types of gage and valve installations is too great to adequately detail in an installation manual. It is, therefore, the user's responsibility to assure that the knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the installation guidelines that should be employed.

5.1 Piping Strain

The gage should be mounted and connected so that it does not support any piping weight. Piping not properly supported, independent of the gage, may subject the gage to stresses that can cause leaks or glass breakage. Support brackets are available as an accessory.

5.2 Differential Thermal Expansion

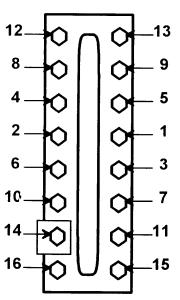
High mechanical loads may be imposed on a gage by expanding and contracting pipes due to hot or cold service. Such mechanical loads on the gage must be minimized by the use of expansion loops in the system. Failure to allow for expansion or contraction can result in leaks or glass breakage.

5.3 Mirror Viewing

For added safety, a system of indirect viewing by means of mirrors should be installed to protect personnel from the hazards of possible gage failure.

5.4 Nut Retorquing (not applicable for gages with Belleville washers) - see Section 5.5

Nut retorque is vital to the operation of a liquid level gage because gaskets take permanent set under initial bolt loading at assembly. Tightening of nuts before installation to values specified in



Nut Tightening Sequence Figure 1

Table 3 is necessary to insure pressure retaining capabilities of liquid level gage to specific design ratings. The user must refer to the liquid level gage model and assembly number and to the purchase order or tag to determine materials of construction.

BOLT TORQUE VALUES

GAGE MODELS and GASKET MATERIAL	ft·lb
RL, TL w/Grafoil® (standard)	25 to 30
RL, TL w/Non-asbestos (optional)	30 to 35
Top-Chem 2000®	25 to 30
25% glass filled PTFE	20
All Models w/Teflon®, Viton® or elastomeric (optional)	10
TL with PCTFE/(Kel-F®) Shields (optional) 0.063"	10

Table 3

Using a torque wrench, tighten nuts in five **ft-lb** increments following the "Z" pattern sequence in Figure 1, until the torque values shown in Table 3 above for the specific liquid level gage are reached. For multiple section gages, torque the center section(s) and progressively work toward the ends of the gage.

If bolting, gasketing or glass on any or repaired section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued as necessary.



WARNING

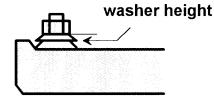


Failure to comply with the proper torquing sequence or force/height value can lead to leakage, gasket blow-out or glass breakage resulting in gage failure, serious injury and/or property damage.

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

5.5 Belleville Washers

Belleville washers are used to reduce or eliminate the need to retorque nuts. This is especially important for gages subject to pressure and/or thermal cycling and also in offshore applications where use of wrenches often cracks or chips the protective coat. The conical washers allow for material expansion and contraction while maintaining axial bolt loading and, therefore, compression on the gasket.



Belleville Washer Height Figure 2

CONICAL SPRING HEIGHT FOR BELLEVILLE WASHERS

GAGE MODELS	No. of Washers per nut	Spring Height (top of cover to bottom of nut) inch (mm)	
RL	3	0.200 (5.1)	
TL	2	0.136 (3.5)	

Table 4

The effective range of a Belleville washer is measured in height (or compression distance) of the washer **NOT TORQUE**. Refer to Figure 2 and Table 4 for proper compression height. Do not tighten nuts until the washers are flat. Belleville washers cannot absorb expansion when flat.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and stack height, if necessary.

6.0 Operation

Before initializing liquid level gage operation, check that all installation procedures have been completed. Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight. Assure that nuts have been retorqued to their

proper values as specified in Table 3. Remove self stick caution tape from the glass and inspect to be sure that glass is clean and free of any damage such as cracks, scratches, pits, and chips.

6.1 Hydrostatic Test



DANGER



Liquid level gage installations should be brought into service slowly to avoid excessive shock or stress on the glass. Rapid pressurization or sudden changes in temperature may cause glass breakage. To avoid excessive thermal shock or mechanical stress on glass, the connecting valves should be opened slightly, and the gage temperature and pressure allowed to slowly equalize. If the valves are equipped with ball checks, the valves must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball checks in the event of failure. Failure to follow the recommended operating procedures can result in death, severe personal injury and/or property damage.

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatically pressure test all installations to at least 100 PSIG but less than design pressure and correct any leakage before proceeding.

7.0 Maintenance



WARNING



Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

The rate at which components degrade is dependent upon a variety of conditions. Pressure, temperature and process media all influence the rate at which gage components deteriorate. Higher temperatures can accelerate the deterioration of gaskets, cushions, glass, and metals. Acids and similar chemicals can break down the integrity of almost any material. Concentration of chemicals can accelerate the corrosion rate. Penberthy cannot create a blanket maintenance schedule for every application.

The end user is the most familiar with the process media and conditions and must be responsible for creating a maintenance schedule. The user must create maintenance schedules, safety manuals, and inspection details for each liquid level gage. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved. These will be based upon the user's own operating experience with their specific application.

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

- 1) glass, for cleanliness and signs of damage or wear,
- 2) shields, if used, for signs of clouding, wear or deterioration,
- 3) gage, for signs of leakage around gaskets or at connections and
- 4) gage, for signs of internal or external corrosion.

If bolting, gasketing or glass on any section of a multi-section gage is disturbed, all sections must be checked for integrity and retorqued or repaired as necessary.

7.1 Maintenance Procedures

GLASS should be given regular and careful attention. Keep glass clean using a commercial glass cleaner and a soft cloth. Inspect the surface of the glass for any clouding, etching or scratching or physical damage such as bruises, checks or corrosion. Glass that is damaged is weakened and may break under pressure. Shining a light at approximately a 45° angle will aid in detecting some of these conditions. Typical damaged areas will glisten more brightly than the surrounding glass because the light is reflected.

Detection of any damage, problem areas or surface wear is sufficient evidence to take the liquid level gage out of service. DO NOT proceed with operation of the liquid level gage until the glass has been replaced with a glass replacement kit following the disassembly - reassembly instructions in Section 8.

SHIELDS showing any signs of clouding, wear, or deterioration are an indication that the gage glass has been exposed, or could soon be exposed to the contained fluid. Immediately take liquid level gage out of service. DO NOT proceed with operation of the liquid level gage until shields and glass have been replaced by following the disassembly-reassembly instructions in Section 8.

GASKET LEAKS must be repaired immediately. DO NOT proceed with operation of a liquid level gage until gaskets have been replaced by following Section 8 disassembly-reassembly instructions.

CONNECTION LEAKS at a flanged or threaded connection should be corrected by tightening the bolting at the connection or by taking the liquid level gage out of service and wrapping the connection threads with Teflon® tape on all male pipe threads.

CORROSION may occur if the user has selected an improper material for the liquid level gage application. It is the responsibility of the user to choose a material of construction compatible with both the contained fluid and the surrounding environment. If internal or external corrosion is present, an investigation must immediately be performed by the user. It may be necessary to contact an authorized Penberthy distributor to better determine the origin of the corrosion.

7.2 Troubleshooting

Problem:

glass becomes prematurely etched or clouded in service

Cause:

fluid being handled is not compatible with the glass or shields

Solution:

replace the glass and install shields which will not be affected by contained

fluid

Problem:

glass continually breaks in service despite careful attention to maintenance

procedures

Cause:

thermal shock, hydraulic shock, mechanical loads, exceeding design ratings or

a combination of these

Solution:

check entire system to determine possible sources of loads. Check application

to determine actual operating conditions and contact an authorized Penberthy

distributor on how to proceed.

8.0 Removal - Disassembly - Reassembly

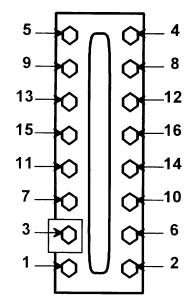


WARNING



Use only qualified, experienced personnel who are familiar with liquid level gage equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the liquid level gage has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

8.1 Disassembly



Nut Loosening Sequence Figure 3

Secure workbench longer than the liquid level gage, and sufficiently wide to lay out parts as they are removed.

- 1) Lay gage on bench so nut side of fastener is up.
- 2) Hold gage firmly, and loosen nuts starting at both ends of each section and then proceeding from both ends to the center of each section as shown in Figure 3.
- 3) Nut Loosening Sequence
- remove nuts, washer, belleville washers (if any) and nameplate
- tap covers with rubber hammer as needed to loosen and remove
- for belleville washer assemblies: to remove covers, studs may need to be removed by laying the assembly on its side and knocking the stud/U-bolts through the cover with a hammer and punch
- remove cushions, glass, shields (if any), and gaskets
- tap liquid chamber or remaining covers as necessary with rubber hammer to break loose, and remove remaining components
- remove, destroy, and dispose of all glass, cushions, gaskets, and shields. Under no circumstances should

these components be re-used or installed on a gage

NOTE: If size of gage is smaller than shown, follow "Z" sequence from the ends until all bolting is loosened.



WARNING



After assembly and proper torquing, cushions, gaskets and shields are permanently deformed by compression and if re-used, may cause leaks and high stress points resulting in glass breakage. Glass may contain hidden damage and internal stresses caused by previous usage. If re-used, the glass may break under pressure causing personal and property damage.

8.2 Inspection of Glass Seating Surfaces

Clean the glass seating surfaces on the liquid chamber and cover with a soft metal scraper (preferably brass) to remove all burrs, rust, and remnants of the previous gaskets and cushions. Exercise extreme care to avoid gouging or scarring gasket and cushion seating surfaces.

Use a known flat piece of metal the same approximate length as the glass or a new piece of glass and a thickness gage to check flatness of each glass seating surface on liquid chamber and under cover. Surface must be flat within 0.002 inch (0.051 mm). If any one surface is found to be beyond a tolerance of 0.002 inch (0.051 mm), the entire gage must be disposed of and replaced. Gasket seating surface must have a final surface finish of 450 to 500 AARH.



WARNING



Flatness of glass seating surfaces outside 0.002 inch tolerance specified is an indication of the gage having been overstressed through repeated exposure to mechanical, thermal, or hydraulic shock during its previous service. Operation of a liquid level gage which has been overstressed will result in abnormal stresses on the glass which may cause glass to break. If surface finish is not in the 450-500 AARH range, gasket may extrude under pressure with resulting sudden release of pressure, leakage of contained fluid, serious personal injury, or property damage.

Glass seating surfaces should NOT be machined to achieve seating tolerance. The chamber and cover are designed for a critical thickness to achieve the pressure/temperature ratings. Machining glass seating surfaces may result in non-compliance to the necessary critical thickness due to material removal.

8.3 Reassembly

If all glass seating surfaces are found to be within the 0.002 inch (0.051mm) tolerance described in the previous section, proceed to obtain new glass, gaskets, cushions and shields (if used) and proceed to reassemble as follows (refer to exploded parts view in Section 11 if needed):

1) clean threads on bolt and nuts to remove all paint, rust, and scale. Apply a light coat of oil to the threads.

- 2) for transparent gages, insert bolts through half the cover and lay out covers along bench, side by side, with the liquid chambers. Use chambers to space covers and line them up with vision slots.
- 3) for reflex style and belleville reflex style gages, lay out covers along bench, side by side, with liquid chambers. Use chambers to space covers and line them up with vision slots.
- 4) for transparent belleville style gages, thread nuts on stud, place two bellevile washers under nut with pointed end toward the nut (see Figure 2), insert stud through each cover and lay out covers along bench, side by side, with liquid chambers. Use chambers to space covers and line them up with vision slots.
- 5) install one cushion inside each cover.



WARNING



Separate installation instructions are supplied with replacement glass. All instructions supplied with the glass must be followed as there are precautions to be taken when handling gage glass. Among the precautions is avoidance of bumping or sliding glass against any surface and inspection of individual pieces. Failure to follow any of the replacement gage glass installation instructions could result in glass breakage with resulting sudden release of pressure, personal or property damage.

- 6) install rubber band around each piece of glass, then place glass centered inside each cover.
- 7) install shields, if used, and gasket on glass being careful to keep components centered.
- 8) place liquid chamber on the gaskets making sure all components are aligned with vision slot.
- 9) for reflex gage, install U-bolts in place by tapping as needed with rubber hammer, being careful not to lose alignment with vision slot.
- 10) for reflex gage, quickly turn over assembly onto back side of U-bolts. Assemble nameplate, washer, and nuts to U-bolts. Tighten nuts with fingers. Using a torque wrench, tighten nuts in five ft-lb increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.

NOTE: Depending on gage size there may be less bolting than shown in Figure 1. Start at the center and follow "Z" pattern outward to the limit of bolting on a specific gage.

- 11) for transparent gage, install gaskets in place, and shields if used.
- 12) install rubber band around each piece of glass, then place glass centered inside each cover. NOTE WARNING ABOVE
- 13) install one cushion on each piece of glass
- 14) install covers in place being careful to maintain components alignment inside.
- 15) install nameplate, washer, and nuts to studs. Tighten nuts with fingers. Using a torque wrench, tighten nuts in five ft·lb increments, following the sequence in Figure 1 until the torque values shown in Table 3 are reached.
- 15A) for transparent belleville style gages: install nameplate and two belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.

NOTE: the following procedure is to be done on only one side of the gage.

- 15B) for reflex belleville style gages: install nameplate and three belleville washers under each nut with pointed end toward the nut (see Figure 2). Finger tighten nuts.
- 16A) Using a torque wrench, tighten nuts in five **ft-lb** increments, following the sequence in Figure 1. Once 20 **ft-lb** is reached, begin measuring stack height. Tighten nuts in five **ft-lb** increments until stack spring height is within 0.008" (0.2 mm) of proper height. Individually tighten each nut until stack height is achieved. (see Table 5) To estimate washer height, add the thickness of the nut to the compressed height requirement and use this value to compare to the measurement from the top of the nut to the face of the cover.

Refer to Section 5 for installation and Section 6 for operation of liquid level gage when returning to service.

9.0 Disposal at End of Useful Life

Penberthy gages are used in a variety of fluid applications. By following the appropriate governmental and industry regulations, the user must determine the extent of preparation and treatment the gage must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metals, glass, and polymers should be recycled whenever possible. Refer to order and Penberthy's Material Specification sheets for materials of construction.

10.0 Telephone Assistance

If you are having difficulty with your liquid level gage, notify your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information as possible when you call:

- Model #
- Name of the company from whom you purchased your liquid level gage
- Invoice # and date
- · Process fluid
- Operating pressures
- · Operating temperatures
- · A brief description of the problem
- Troubleshooting procedures that failed

If attempts to solve your problem fail, you may be requested to return your liquid level gage to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from Penberthy prior to returning anything. Failure to do so will result in the unit being returned to you, without being tested, freight collect. To obtain a R.A. number, the following information (in addition to that above) is needed:

- · Reason for return
- Person to contact at your company
- "Ship To" address

We recommend that you return the entire unit for testing. There is a minimum charge of \$75.00 for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the

cost exceed the minimum charge. If you return a unit that is covered by the warranty, but is not defective, the minimum charge will apply.

Grafoil® is a registered trademark of Union Carbide Corporation

Neoprene®, Viton®, and Teflon® are registered trademarks of E.I. du Pont de Nemours and Company

Top Chem 2000® is a registered trademark of Klinger

Kel-F® is a registered trademark of 3M

11.0 Exploded Parts Drawing

Transparent

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Transparent
(8)
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Recommended Spare Parts			
REF#	ITEM	QTY	
100	Bolt/U-bolt	2/1 per sect.	
4	Nut	2 per sect.	
48	Glass	1	
7	Gasket	2	
8	Cushion	2	
9	Shield (if used)	2	

Reflex

1 - Cover
2 - Chamber
4 - Nut
48 - Glass
7 - Gasket
8 - Cushion
9 - Shield
100 - Bolt/U-bolt
125 - Washer
163 - Nameplate
331 - Band

2

NOTE: size 9 shown - actual gage may be shorter and require fewer bolting components

PENBERTHY

≈ DECLARATION of CONFORMITY

In conformance with ISO/IEC Guide 22 - 96 LLG.DC r C

Penberthy, Incorporated

Manufacturer's Address:

320 Locust Street

Prophetstown, IL 61277-1147 U.S.A.

Product:

Type of Equipment: Pressure Vessel - Liquid Level Gauge Glass Equipment Class: Industrial Instrumentation - Hazardous Area

Model Designations: RL, TL, RM, TM, RH, TH, RMW, TMW, RLC, TLC

The product described above is in conformity with:

92/59/EEC		General product safety	1992
87/404/EEC		Simple pressure vessel	1987
89/392/EEC		Machinery	1989
EN 10213-1:	4	Technical delivery conditions for steel castings	1996
ISO 7-1		Pipe threads where pressure-tight joints are made	1996
BS 10		Flanges and bolting for pipes, valves and fittings	1962
BS 21		Pipe threads for tubes and fittings where pressure-tight	1985
BS 759		Valves, gauges and other safety fittings for application	1984
BS 970 Part	1	Wrought steels for mechanical and allied engineering	1996
BS 970 Part	3	Wrought steel for mechanical and allied engineering	1991
BS 1501 Part		Steels for presure purposes	1990
BS 1502		Steels for fired and unfired pressure vessels	1982
BS 1506		Carbon, low alloy and stainless steel bars and billets	1990
BS 1560		Circular flanges for pipes, valves and fittings	1989
BS 1640 Part	t 1	Steel butt-welding pipe fittings	1962
BS 1640 Part	t 2	Steel butt-welding pipe fittings	1962
BS 1965		Butt-welding pipe fittings	1963
BS 3076		Nickel and nickel alloys: bar	1989
BS 3463		Observation and gauge glasses for pressure vessels	1975
BS 3602 Part		Steel pipes and tubes for pressure purposes	1987
BS 3605		Austenitic stainless steel pipes and tubes	1991
BS 3643		ISO metric screw threads	1981
BS 3799	;	Steel pipe fittings, screwed and socket-welding	1974
BS 4504		Circular flanges for pipes, valves and fittings	1989
ASME B&PV		Rules for construction of pressure vessels	1995
Section VI			
ANSI/ASME		Unified screw inch threads un and unr thread form	1982
ANSI/ASME		Pipe threads, general purpose (inch)	1983
ANSI/ASME		Pipe flanges and flanged fittings	1988
ANSI/ASME		Square and hex nuts and screw inch series	1981
ANSI/ASME		Square and hex nuts	1972
ANSI/ASME	B31.3	Process piping	1996

Date: 30 December 1996 Prophetstown, IL U.S.A. Signature:

Name: Position:

David J./Williams, C.Q.E. Quality 'Assurance Manager

Technical Construction File is available at stated address. Signatory is contact person.

Notes

PENBERTHY

320 Locust St., Prophetstown, Illinois 61277

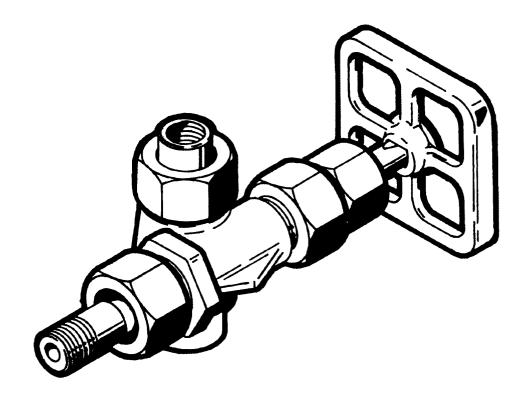
Telephone: 815/537-2311 Fax: 815/537-5764 Printed in U.S.A. Part No. 18R65-009

PENBERTHY®

Section 2000 Instal. Instr. 2960 Issued 8/96 Replaces 2/94

Gage Valves

Series 100, 200, 300 and 400



Installation/Operation/Maintenance Instructions

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PRODUCT WARRANTY

Penberthy Inc., warrants its products as designed and manufactured by Penberthy to be free of defects in material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. Penberthy will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to Penberthy and obtain written authorization to return the product. Thereafter, the product shall be returned to Penberthy in Prophetstown, Illinois, with freight prepaid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or altered outside of the Penberthy factory, or if it has been subjected to misuse, neglect or accident.

Penberthy's responsibility hereunder is limited to repairing or replacing the product at its expense. Penberthy shall not be liable for loss, damage, or expenses directly or indirectly related to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that Penberthy is not responsible for damage or injury caused to other products, building, property or persons, by reason of the installation or use of its product.

THIS IS PENBERTHY'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by on behalf of Penberthy unless modified or made in writing and signed by the President or a Vice President of Penberthy.

1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance. Failure to follow *any* instruction could possibly result in a malfunction of the valve with resulting sudden release of pressure, property damage or physical injury to personnel.

SAFETY INSTRUCTION

Penberthy does not have any control over the manner in which its gage valves are handled, installed, or used. Penberthy cannot and will not guarantee that a gage valve is suitable or compatible for the user's specific application.



CAUTION



Vessel fluids may be pressurized and can unexpectedly exit vessel connections due to apparatus or material failure. Safety glasses should be worn when installing a gage valve. Failure to do so could result in serious physical injury to personnel or property damage.

2.0 Introduction

Penberthy armored gage valves are used to isolate gage glass, magnetic gages or other apparatus from the holding or pressure vessel when it becomes necessary to drain and service the gage. Penberthy Series 100, 200, 300, and 400 gage valve are supplied in pairs (upper and lower) and are available with socketweld, flanged and NPT connections.

These valves are equipped, as a standard feature, with a floating shank union vessel connection, which permits up to 3/8" [9.5mm] variation in center to center distance and with ball check shut-offs to prevent leakage of contained fluid in case of accidental gage glass breakage.

Series 100, 200, 300, and 400 valves for process use should include ball check shut-off feature. Valves without the ball check shut-off feature will not automatically stop leakage of contained fluid in the event of accidental gage glass breakage.

2.1 System Description

Penberthy armored valves are comprised of six basic components. Each component may vary slightly, depending on the desired physical and mechanical properties for the valve. Use the exploded parts view in Section 11.0 as additional reference material.

Body – a pressure retaining structure through which liquid passes to enter a gage glass or other apparatus. Provides a rigid, union, or spherical union connection to the vessel and seating surfaces for most valve components. Series 100 and 200 are straight pattern bodies; Series 300 and 400 are offset pattern bodies.

<u>Ball Checks</u> – sphere installed loosely within the body of the valve that seats to prevent significant leakage when a differential pressure surge occurs (e.g., mechanical failure). Ball checks for ASME steam service incorporate a vertically rising lower and leaky horizontal upper or omit ball checks completely. "Reverse acting" ball checks are available for vacuum service.

<u>Trim</u> – wetted parts that mechanically control the liquid path from the vessel to the gage glass or other apparatus. The ball and stem act to seal and release the liquid. In the event of mechanical failure, the ball will seat to prevent large quantities of the contained fluid from exiting the vessel. Liquid is allowed to exit the vessel into the gage glass or other apparatus when the stem is screwed away from its seated position. The liquid is sealed when the stem is screwed into its seated position.

The stem packing retainer provides a compression surface between the process liquid and the stem packing. A stem packing gland is used to compress the packing against the retainer and around the stem to prevent leakage.

<u>Stem Packing</u> – under compression the stem packing is forced to mold around the stem and prevent leakage of media during operation.

<u>Gage Connection</u> – provides connection between the valve and the gage glass or other apparatus. A union, spherical union or rigid connection may be used. A union connection can move in a plane parallel to the vessel connection.

Handwheel/Lever – rotated to engage threads and provide screw action of stem.

3.0 Available Models

Armored valves standard feature are listed in chart below.

	Model No.							
Features	120	130	220	230	320	330	420	430
Straight Pattern	X	Х	Х	Χ				
Offset Pattern					. X	X	X	X
Integral Bonnet	X	X			Х	X		
Union Bonnet			Χ	Х			Х	X
Union Gage Connection	X		X		Х		X	
Rigid Gage Connection		Х		Х		X		Х
Screwed in Seat			Х	X			X	X

3.1 Design Ratings at Maximum and Minimum Operating Temperatures

To determine the maximum allowable working pressure for a specific temperature within the design limits stated below, the user must refer to Penberthy Dimension Sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

DESIGN RATINGS FOR THREADED OR WELDED CONNECTIONS

Valve	Material of	Maximum Allowable Working Pressure				
Series	Construction	Teflon® packing	Grafoil® packing			
	Carbon Steel	4000 psig [27579 kPa] @ -20°F to +100°F	4000 psig [27579 kPa] @ -20°F to +100°F			
100 200 300 400		[-29°C to +38°C]	[-29°C to +38°C]			
		3525 psig [24304kPa] @ 500°F [260°C]	2620 psig [18064 kPa] @ 750°F [399°C]			
	316 STS Construction	4000 psig [27579 kPa] @ -300°F to+100°F	4000 psig [27579 kPa] @ -300°F to			
		[-184°C to +38°C]	+100°F [-184°C to +38°C]			
		3525 psig [24304kPa] @ 500°F [260°C]	2755 psig [18995 kPa] @ 750°F [399°C]			
	For other materials or connections consult factory					

TABLE 1



WARNING



NEVER exceed these design ratings or application data. Exceeding design ratings or application data may result in mechanical failure of valve components resulting in serious personal injury and/or property damage.

3.2 Steam Application

Penberthy series 100, 200, 300 and 400 valves are designed for process conditions. In low pressure steam/water applications (≤ 350 psig [2413 kPa] @ 431°F [221°C], Penberthy allows the use of 300 and 400 series valves because the potential mechanical stress imposed on the valve assembly by the thermodynamic steam environment is relatively small. Request Penberthy Application Reports for more detailed information.

4.0 Inspection

Upon receipt of a gage valve set, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection. Refer to exploded view drawing in Section 11.0 to inventory parts.

4.1 User Rating Inspection

The user should confirm that:

- 1) The gage valve set model number and pressure/temperature rating stamped on nameplate (163) conforms to the description on the user's purchase order
- 2) The operating conditions described in the purchase order agree with the actual operating conditions at the installation site
- 3) The actual operating conditions at the installation site are within the applications data shown on the Penberthy Technical Data Bulletin or product proposal referred to previously.

4) The materials of construction of the gage valve set are compatible with both the contained fluid and the surrounding atmosphere in the specific application.

SAFETY INSTRUCTIONS

If the size, model or performance data of the gage valve set as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for assistance. The incorrect valve can result in unacceptable performance and potential damage to the gage.

5.0 Installation

Installation should only be undertaken by qualified personnel who are familiar with this equipment. They should have read and understood all of the instructions in this manual. The user should refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for specific size and model gage valve.

Penberthy recommendations on gage valve installations are not necessarily related to the installation of flat glass liquid level gages. The number of different types of gage and valve installations is too great to adequately explain in an installation manual. Therefore, it is the user's responsibility to assure that knowledgeable installation personnel plan and carry out the installation in a safe manner. The following procedures are some of the guidelines that should be employed.

5.1 Piping Strain

The gage valve should be mounted and connected so that it can support the gage without binding. Torsional stresses can make it difficult or impossible to seal tailpipes. Although union connections will allow marginal errors in piping alignment, misalignment can still create unusual strain on connectors. Gages not properly supported by brackets may subject the gage valve to stresses that can cause leaks or mechanical failure.

5.2 Differential Thermal Expansion

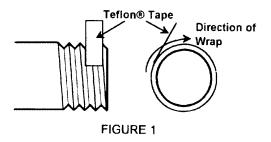
High mechanical loading may be imposed on a gage valve by expanding and contracting gages due to hot or cold service. Such mechanical loads on the valve must be minimized by controlling process conditions in the system.

5.3 Mounting

1) Prior to installation, turn the handwheel of each valve clockwise until the stem closes against the seat

2) Remove union vessel connections from valves, where applicable, and apply heavy grease (where allowable) to tailpipe seat. (the grease minimizes galling of the seat surfaces when tightening the coupling nuts.)

3) Wrench tighten tailpipes of upper and lower valves to the vessel using Teflon® tape, or equivalent, on all male tapered pipe thread connections as shown in Figure 1. If the valve is flanged or weld mount, use proper industry standard procedures.



- 4) If installing with a flat glass gage, follow all installation instructions for the specific liquid level gage as there are many points to consider on gage installation; among them, piping strain, differential thermal expansion, weight and bolt torque.
- 5) Install gage tailpipes to union gage connections, where applicable, making sure that coupling nuts are in place.

6.0 Operation

Before initializing gage valve operation, check that all installation procedures have been completed. Use only qualified, experienced personnel who are familiar with valve equipment and thoroughly understand the implications of the tables and all the instructions. Check to determine that all connections are pressure tight.



DANGER



Valve installations should be brought into service slowly. Valves should be opened slightly, and the valve assembly temperature and pressure allowed to slowly equalize. If the valves are equipped with ball checks, the valves must be opened all the way after the pressure and temperature have equalized to permit operation of the automatic ball check in the event of failure. Failure to follow the recommended operating procedures can result in severe personal injury and property damage.

6.1 Hydrostatic Test

Take all precautions necessary to handle the possibility of leakage during the test. Hydrostatic pressure test all installations to 100 psig [689 kPa] and correct any leakage before proceeding.

7.0 Maintenance



WARNING



Use only qualified, experienced personnel who are familiar with valve equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the valve assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

The user must create maintenance schedules, safety manuals, and inspection details for each gage valve. These will be based upon the users own operating experience with their specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situations involved.

During system shutdown, the valves should be left open to permit the gage to lose pressure and cool with the rest of the system. Failure to leave the valve open during system shutdown may trap high pressure fluid in the gage.

7.1 Preventive Maintenance

On all installations the following items should be regularly evaluated by the user for purposes of maintenance:

- 1) Leakage around stem area
- 2) Internal stem leak
- 3) Leakage around union connections
- 4) Internal or external corrosion

The user must determine upon evaluation of his or her own operating experience an appropriate maintenance schedule necessary for his or her own specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

7.2 Ball Check Shut-Off

SAFETY INSTRUCTION

Ball checks, when installed, may fail to seat due to corrosion of the ball or seat, foreign material in ball chamber or viscous material in the ball chamber. A routine operational test of the ball check can prevent significant seepage of liquid in the event of glass breakage.

An operational check can be performed on the valve ball checks by closing both the upper and lower valve stems completely. Drain contents from and relieve pressure on liquid gage to an appropriate safe container/area. NOTE: some loss of process fluid to the drain line is expected with this test procedure.



WARNING



Use only qualified, experienced personnel who are familiar with valve equipment and thoroughly understand the implications of the tables and all the instructions. DO NOT proceed with any maintenance unless the valve assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

With drain line still in place, open <u>BOTTOM</u> valve as rapidly as possible. Listen for "click" sound which will indicate that the ball has seated. If possible, observe the quantity of flow from the drain line. Flow should either stop completely or be no greater than single drips (no solid stream). Close lower valve. Repeat above procedure for <u>UPPER</u> valve. There must be a pressure differential of at least 5 psi [34.5 kPa] for the above procedure to work properly.

If the above procedure is not successful, the only alternative is to isolate the gage and valve assembly from the vessel or to shut the process down completely. Disassemble the valve as outlined in Section 8.1 using the exploded parts drawing in Section 11.0 as reference. Visibly inspect ball check and ball seats in the valve body. Remove any foreign matter and/or replace with new ball checks if inspection indicates this is required. If the ball seat is damaged, consider replacing the valve or the seat (if it is removable). Reassemble valves as outlined in Section 8.2

7.3 Troubleshooting

STEM PACKING LEAKAGE can often be stopped by tightening the stem packing nut. If leak persists, the stem packing should be replaced by following steps 1) through 5) of the Disassembly and 1) through 6) of the Reassembly instructions

INTERNAL SEAT LEAKAGE is an indication of a worn or damaged stem or seat. To replace the stem follow steps 1) through 5) of the Disassembly and 1) through 7) of the Reassembly instructions. To renew the seat surface, follow steps 1) and 2) of the Disassembly instructions. Renew the seats by using a fine lapping compound and a mandrel the same size, shape and seat angle as the stem. Flush the valve body clean and reassemble by following steps 4) and 5) of the Reassembly instructions.

Renewable Threaded Seats (Series 200 and 400). Remove the seat by inserting a $\frac{1}{4}$ " [6.4mm] square driver in the seat and turning it counterclockwise. Replace the new seat by turning it clockwise using the square driver, making sure that the ball check, if used, is replaced in the body. Tighten the seat in place. Follow steps 4) and 5) of the Reassembly instructions.

LEAKAGE AROUND UNION connections can often be stopped by tightening union coupling nut or remake connection using Teflon® tape, or equivalent, on all male pipe threads as shown in Figure 1

INTERNAL OR EXTERNAL CORROSION could be an indication of a misapplication. An investigation should immediately be carried out to determine the cause of the problem. It is the user's responsibility to choose a material of construction compatible with both the contained fluid and the surrounding atmosphere.

8.0 Removal – Disassembly – Reassembly



WARNING



Use only qualified, experienced personnel who are familiar with valve equipment and thoroughly understand the implications of the tables and all the instructions.

DO NOT proceed with any maintenance unless the valve assembly has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature, and has been drained or purged of all fluids. Failure to do so can cause serious personal injury and property damage.

8.1 Disassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the valves.

- 1) Remove handwheel nut (30), nameplate (163) and handwheel (28) or lever from stem.
- 2) Loosen and remove stem packing nut (26).
- 3) Remove stem by turning counterclockwise, along with stem packing gland, stem packing, and stem packing retainer.
- 4) Slip the stem packing gland, stem packing and stem packing retainer off stem.
- 5) On Series 200 and 400 valves, remove bonnet nut and bonnet.
- 6) To replace seat on Series 200 and 400 valves, follow instructions as described in maintenance procedures.

8.2 Reassembly

Refer to the exploded parts drawing in Section 11.0 for additional reference during disassembly and reassembly of the valves.

- 1) Prepare for installation of new packing by cleaning all packing chambers and glands of upper and lower valves.
- 2) On Series 200 and 400 valves, replace bonnet (20), and bonnet nut (21) and tighten securely in place.
- 3) Slip packing retainer (18) on stem (17)
- 4) Install new stem packing (25) and stem packing gland (19)
- 5) Thread stem assembly into valve by turning clockwise until stem seats and then back off one turn (1/8 turn with quick close stem).
- 6) Assemble stem packing nut (26) and tighten in place.
- 7) Assemble handwheel (28) or lever (261), nameplate (163) and handwheel nut (30) on stem and tighten securely in place.
- 8) Close both valves by turning handwheel or lever clockwise until stem seats.

Refer to Section 6.0 for operation of the gage valve when returned to service.

9.0 Disposal at End of Useful Life

Penberthy valves are used in a variety of fluid applications. By following the appropriate governmental and industry regulations, the user must determine the extent of preparation and treatment the valve must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metals and polymers should be recycled whenever possible. Refer to order and Penberthy's Material Specification sheets for materials of construction.

10.0 Telephone Assistance

If you are having difficulty with your armored gage valve, notify your local Penberthy distributor. You may also contact the factory direct at (815) 537-2311 and ask for an applications engineer. So that we may assist you more effectively, please have as much of the following information as possible when you call:

- Model #
- Name of the company from whom you purchased your valve
- Invoice # and date
- Process fluid
- Operating pressures
- · Operating temperature
- A brief description of the problem
- Troubleshooting procedures that failed

If attempts to solve your problem fail, you may be requested to return your valve to the factory for intensive testing. You must obtain a Return Authorization (RA) number from Penberthy prior to returning anything. Failure to do so will result in the unit being returned to you, without being tested, freight collect. To obtain a R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- · Person to contact at your company
- "Ship To" address
- MSDS sheet if in harmful service

We recommend that you return the entire valve set for testing. There is a minimum charge of \$50.00 for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit that is covered by the warranty, but is not defective, the minimum charge will apply.

Grafoil® is a registered trademark of Union Carbide Corporation Teflon® is a registered trademark of E.I. duPont de Nemours and Company

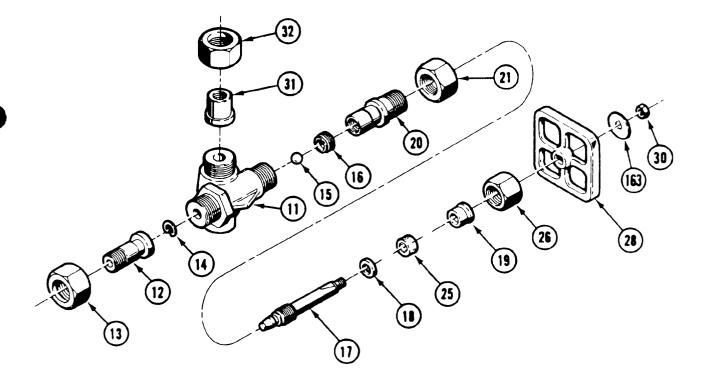
11.0 Exploded Parts Drawing

- 11 Body
- 12 Tailpipe, Vessel
- 13 Nut, Vessel Coupling
- 15 Ball
- 16 Seat
- 17 Stem
- 18 Retainer, Stem Packing
- 19 Gland, Stem Packing
- 20 Bonnet
- 21 Nut, Bonnet
- 25 Packing, Stem
- 26 Nut, Stem Packing
- 30 Nut, Handwheel
- 31 Tailpipe, Gage
- 32 Nut, Gage Coupling
- 163 Nameplate
- 261 Lever

SPARE PARTS

Ref. No.	Item	Min. Qty.
18	Retainer, Stem Packing	1
19	Gland, Stem Packing	1
25	Packing, Stem	1
30	Nut, Handwheel	1

RECOMMENDED MAXIMUM QUANTITIES SHOULD PROVIDE SPARE PARTS FOR 10% OF THE VALVES IN SERVICE



Note: Seat (16), Bonnet (20) and Nut (21) to be used on Series 200 and 400 valves only.

PENBERTHY

DECLARATION of CONFORMITY

In conformance with ISO/IEC Guide 22 – 96 VLV.DC r C

Manufacturer's Name:

Penberthy, Incorporated

Manufacturer's Address:

320 Locust Street

Prophetstown, IL 61277-1147 U.S.A

Product:

Type of Equipment: Equipment Class:

Pressure Vessel – Armored and Tubular Gauge Glass Valves

Industrial Instrumentation - Hazardous Area

Model Designations:

100, 200, 300, 400, 500, 600, 700 series N2, K2, K3, N6, N7, A5

The product described above is in conformity with:

92/59/EEC	General product safety	1992
87/404/EEC	Simple pressure vessels	1987
89/392/EEC	Machinery	1989
EN 10213-1:4	Technical delivery conditions for steel castings	1996
ISO 7 – 1	Pipe threads where pressure-tight joints are made	1994
BS 10	Flanges and bolting for pipes, valves and fittings	1962
BS 21	Pipe threads for tubes and fittings where pressure tight	1985
BS759	Valves, gauges and other safety fittings for application	1984
BS 970 Part 1	Wrought steels for mechanical and allied engineering	1996
BS 970 Part 3	Wrought steel for mechanical and allied engineering	1991
BS 970 Part 4	Wrought steels in the form of blooms, billets, bars	1970
BS 1502	Steels for fired and unfired pressure vessel	1982
BS 1506	Carbon, low alloy and stainless steel bars and billets	1990
BS 1560	Circular flanges for pipes, valves and fittings	1989
BS 1640 Part 1	Steel butt-welding pipe fittings	1962
BS 1640 Part 2	Steel butt-welding pipe fittings	1962
BS 1965	Butt-welding pipe fittings	1963
BS 3076	Nickel and nickel alloys: bar	1989
BS 3463	Observation and gauge glasses for pressure vessels	1975
BS Part 1	Steel pipes and tubes for pressure purposes	1987
BS 3605	Austenitic stainless steel pipes and tubes	1991
BS 3643	ISO metric screw threads	1981
BS 3799	Steel pipe fittings, screwed and socket-welding	1974
BS 4504	Circular flanges for pipes, valves and fittings	1989
ASME B&PV Code, Section VIII	Rules for construction of pressure vessels	1995
ANSI/ASME B1.1	Unified screw inch threads un and unr thread form	1982
ANSI/ASME B1.20.1	Pipe threads, general purpose (inch)	1983
ANSI/ASME B16.5	Pipe flanges and flanged fittings	1988
ANSI/ASME B18.2.1	Square and hex bolts and screw inch series	1981
ANSI/ASME B18.2.2	Square and hex nuts	1972
ANSI/ASME B18.3	Socket cap shoulder and set screws inch series	1982
ANSI/ASME B31.3	Process piping	1996

Date: 30 December 1996 Prophetstown, IL U.S.A.

Signature:

Name: David J Williams, C.Q.E.

Position:

Quality Assurance Manager

Technical Construction File is available at stated address. Signatory is contact person.

NOTES

PENBERTHY

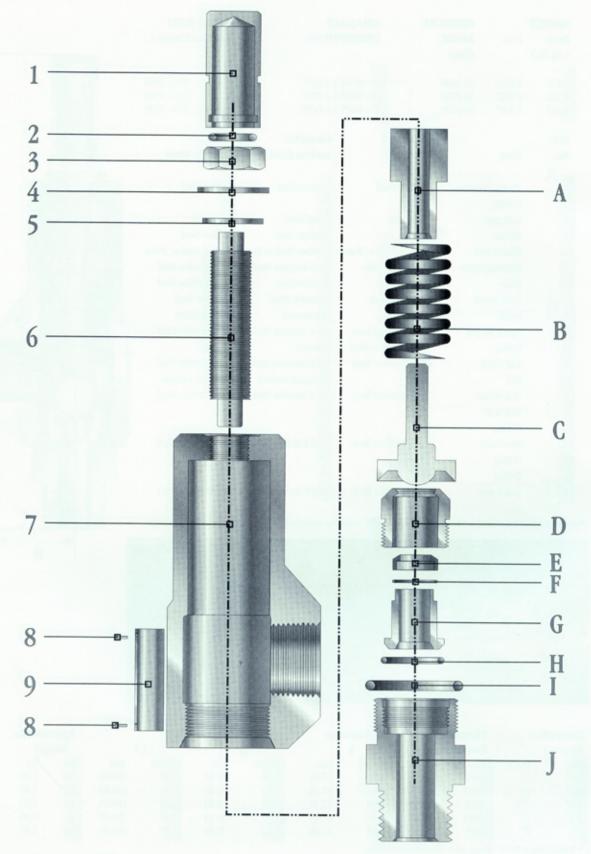
320 Locust St., Prophetstown, Illinois 61277

Telephone: (815) 537-2311 Fax No: (815) 537-5764

e-mail: www.pcc-penberthy.com

Printed in U.S.A Part No. 14912-009 TAYLOR VALVE TECHNOLOGY, INC.

EXPLODED VIEW OF A INCH ASAFETY RELIEF VALVE



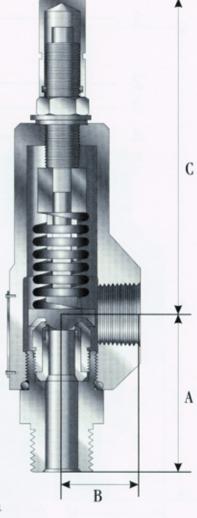
exploded View of

SRV-98

BILL OF MATERIALS 1 INCH SAFETY RELIEF VALVE

ORIFIC Area (sq. In.	Dia.	PRESSUI RANGE (psig)		NNECTIONS	(Smalle	E SIZES st/Largest)
0.128	D	15-4000	1/2 -	MNPT x 1 FNPT	1/2 - 150	1 1/2 - 1500
0.128	D	15-4000	3/4-	MNPT x 1 FNPT	3/4 - 150	1 1/2 - 1500
0.128	D	15-4000	1 -	MNPT x 1 FNPT	1 - 150	1 1/2 - 900
0.212	E	15-2500	1/2 -	MNPT x 1FNPT	1/2 - 150	1 1/2 - 900
0.212	E	15-2500	3/4-	MNPT x 1- FNPT	3/4 - 150	1 1/2 - 900
0.212	E	15-2500	1 -	MNPT x 1- FNPT	1 - 150	1 1/2 - 900
0.357	F	1500-2000	3/4-	FNPT x 1- FNPT	3/4 - 150	1 1/2 - 600
0.357	F	1500-2000	1 -	FNPT x 1- FNPT	1 - 150	1 ½ - 600
Ref.			Standard	Corrosive	NACE	
No.	Part		Service	Carbon Steel	Stainles	s Steel
1.	Thread I	Protector	Carbon Steel	Carbon Steel	Carbon S	Steel

Ref.		Standard	Corrosive	NACE
No.	Part	Service	Carbon Steel	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/ Bun
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 fluorcarbon compound.

Connec	tion	Thread	ed	Dimens	ions					Appr	oximate
Size		Connect	tions	A		В		C	rite and the state of the state	Wei	ight
Inlet	Outlet	Inlet	Outlet	inches	mm	inches	mm	inches	mm	Ibs	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

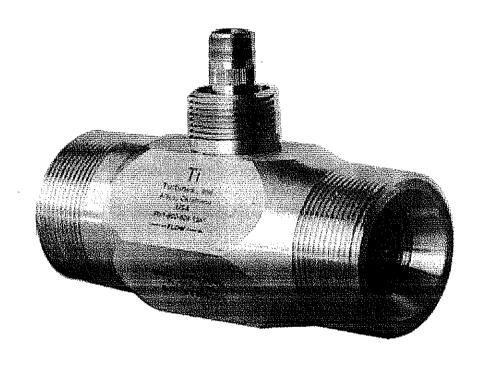


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INSTALLATION & OPERATION MANUAL

This document contains the recommended installation, operation and maintenance regimen authorized and approved by Turbines, Inc., the manufacturer of the referenced equipment. No substitutions of specified components, improper handling or installation procedures, or use that is abusive or outside the specified range or capability specifications of the referenced equipment is permitted hereunder, and may, if evident or present, serve to void any warranties that might otherwise be operative or effective.

In the event installers or end users require additional assistance and/or clarification in any respect, contact the manufacturer at the address below indicated. Technical questions must be accompanied by proper product model number and serial number of subject equipment.



Equipment Covered in This Document:

Liquid In-Line Turbine Flow Meters
Liquid Wafer Style Turbine Flow Meters
Gas In-Line Turbine Flow Meters
Gas Wafer Style Turbine Flow Meters
Insertion Type Turbine Flow Meters



DOCUMENT NUMBER: TI-2000 REV-00



Introduction

Turbines, Inc. is proud to manufacture and support one of the finest American made precision turbine flow meters available anywhere in the world. Tens of thousands of Turbines, Inc. turbines flow meters are in use throughout the USA, Canada, as far away as Mainland China, and almost everywhere in between. Applications range from oil and gas production to industrial and commercial flow metering, monitoring, batching and control installations for gas and liquid line fluids. Thank you for selecting our equipment.

This document is the Installation, Operation and Maintenance Manual pertaining to gas and liquid turbine flow meters, including, inline style, wafer style or insertion style. This manual will provide all the information necessary to secure a successful metering installation. Please follow the instructions contained in this manual carefully, since achieving the proper result depends on correct installation and maintenance of this equipment.

WARNING: Gas and liquid turbine flow meters are not interchangeable. NEVER use air in a liquid turbine flow meter. NEVER use a gas turbine for a liquid line fluid application. SEVERE DAMAGE TO THE **EQUIPMENT MAY RESULT.**

Users unfamiliar with this equipment are strongly recommended to thoroughly familiarize themselves with the contents of this manual. Experts may require some specific, discrete information therefore the table of contents provided will assist in locating individual subjects quickly.

Please do not hesitate to contact an applications specialist at Turbines. Inc. should further information or clarification be necessary. Be sure to have the model and serial number of the subject equipment ready when you call or contact us via e-mail.

Thank you for choosing Turbines, Inc. for your equipment needs.

Table of Contents

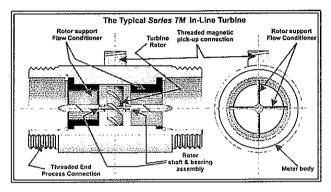
TOPIC	<u>PAGE NUMBER</u>
Introduction	Page 1
Description of the Equipment	Page 1
Installation of the Equipment	Page 2
Operation	Page 3
Equipment Specifications	Page 4
Operating Limitation Notes	Page 5
Maintenance	Page 6
Disassembly of the Equipment	Page 6
Assembly of the Equipment	Page 6

Description of the Equipment

The Turbines, Inc. turbine flow meter is a rugged, high quality instrument designed to handle a broad range of line fluids. The line fluid specific to a given application must be identified in order to assure that the proper turbine flow meter has been obtained for that particular line fluid. Generally, the standard product line offered by Turbines, Inc. is divided into two sections, one being meters suitable for liquid flows, the second consisting of meters suitable for gas flows. The meters in these two sections are not interchangeable. Using the a meter for the wrong line fluid may damage the equipment, and will yield inaccurate, unreliable and inconsistent results.

BASIC TURBINE METER PRINCIPLE OF OPERATION

The turbine flow meter consists of a rugged body housing a rotor that is freely suspended and positioned axially in the flow stream. The motion of the line fluid causes the rotor to spin. The rotational speed of the rotor is directly proportional to velocity of the line fluid, and a true representation, of the volume of line fluid traveling through the meter. The rotor material is magnetic in nature and the housing (body) is nonmagnetic. The magnetic pick-up which is positioned as close as possible to the rotor without piercing the meter body is able to sense the electrical pulses generated by the spinning rotor. Each pulse represents a discrete volume of fluid. The frequency rate of the output represents



The Turbines, Inc. turbine flow meter can be configured with a variety of end arrangements including threaded, flanged, grooved or any other means specified by the customer. The basic operating principles governing the installation, operation and maintenance remain essentially the same.

CALIBRATION AND K-FACTOR

Unlike some competitor's models, every turbine flow meter manufactured by Turbines, Inc. is calibrated at te factory in order to provide a unique K-factor pertaining to that specific meter. This is essential because the K-factor provided with each meter is the reference to which monitors are adjusted in order to assure that the specified accuracy is actually obtained in service.

The K-factor, unique to each individual turbine flow meter is an expression of the number of output pulses recorded by the flow meter per engineering unit of volume flow passing through the meter.

Although any Turbines, Inc. turbine flow meter can be utilized in combination with compatible flow monitors available elsewhere, when a Turbines, Inc. flow monitor is purchased in conjunction with a lurbine flow meter, the necessary settings correlating the K-factor of the turbine flow meter with the monitor are preset at the factory.

For more information concerning the installation, operation and maintenance of flow monitors, please consult the original equipment



urbines Inc

Installation of the Equipment

Various elements that must be considered in order to obtain a proper turbine flow meter installation are provided in this section.

PRE-INSTALLATION INSPECTION

The Turbines, Inc. turbine flow meter is a high quality measuring instrument capable of providing high precision metering performance over an extended period of time. It should be treated with care and not subjected to rough or abusive handling.

Unpack the turbine flow meter from the packaging carefully, verify the information on the packing list for Model number and Serial number. Remove the end-fitting protectors from the turbine meter housing. The turbine meter should be inspected to verify that no damage, either external or concealed has been sustained during transit. Insure that the internal parts are clean and completely free of any packing materials, debris or foreign matter. The rotor should spin freely.

DO NOT USE HIGH PRESSURE AIR TO CLEAN OR TEST ROTOR FOR ROTATION. THIS MAY DAMAGE THE FLOW METER.

Immediately report any visible damage to the seller. Do not discard the packaging materials in the event damage claim and/or product return is indicated.

Upon confirming that the turbine meter is in good condition and free of any damage, replace the end-fitting protectors and return the meter to its original packing, if the intention is to the store the unit until subsequent installation.\

METER RUN ARRANGEMENT

Turbines, Inc. recommends the following standard flow metering run piping configuration to obtain optimum metering performance. Components must be arranged in order beginning upstream (where the flow is originating,) a block valve followed by a strainer, ten straight pipe diameters including flow straightener, the turbine flow meter, 5 straight pipe diameters, then a flow control and/or blocking valve.

The strainer should use an 80 mesh screen for 1.0" line size flow meters and smaller, while a 40 mesh screen is appropriate for meters larger than 1.0" line size.

Flow straighteners should conform to ANSI/ISA representative 31.1.

Pulsating flow should be minimized as it may cause the meter to overregister.

All Lines should be purged prior to installation of the turbine meter, making certain that any debris, foreign particles or other detritus is absent.

It is recommended that the meter be installed in such a way that it remains full of line fluid even when no flow occurs. If a meter is left in a line that is partially or fully drained, severe bearing corrosion may occur. If it is feasible, the turbine meter should be removed, cleaned and properly stored when out of service for any length of time.

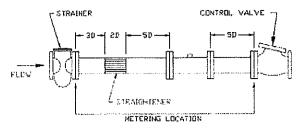
The top meter run depicted in figure 2 incorporates a flow straightener to reduce any swirl effects and condition the stream. This configuration requires only 10 straight upstream pipe diameters.

The bottom meter run in figure 2 demonstrates a configuration not using a flow straightener. In this case, 20 upstream pipe diameters are necessary to accomplish the same function.

DOCUMENT NUMBER: TI-2000 REV-00



Two Typical Metering Runs



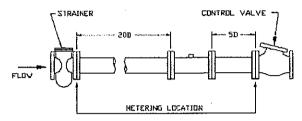


Figure 2

Figure 2 also illustrates the arrangement of the basket strainer upstream of the meter along with a control valve downstream. The purpose of the strainer is to protect the turbine flow meter from rotor damage by large foreign objects in the line fluid.

The control valve will permit the adjustment of flow rate as well as apply the proper amount of back pressure for the turbine meter. The recommended arrangement of piping indicates minimum lengths and are expressed in figure 2 as nominal pipe diameters.

METER INSTALLATION

Meter Position- The turbine flow meter is calibrated horizontally. The best correlation of the meter calibration to installed conditions, therefore, is to install the turbine meter in the identical(horizontal) position. Meters may, however, be operated in any position.

Flow Direction- All Turbines, Inc. turbine flow meters are designed to operate in one direction only. Please make sure that the flow directional arrow inscribed on the body of the meter coincides with the direction of flow of the line fluid. Bi-directional flow meters are available separately and are distinct from the standard liquid or gas turbine flow meters covered in this manual.

Meter Location- When intermittent flow conditions are anticipated, the turbine flow meter should not be mounted at the lowest point of the piping system since sedimentary deposits of foreign matter and/or solids are most likely to settle, or susceptible line fluids may congeal at that point. The consequences may include degraded meter performance or damage to the meter internal components.

Tolerance to Electrical Interference-In order to obtain optimum electrical signal output, consideration must be given to the isolation of the turbine flow meter from source of ambient electrical interference such as nearby motors, transformers, or high voltage power transmission lines.

Maximum Operating Pressure- The safe working pressure of the turbine flow meter is determined by the size and type of the connecting end fittings.

System Pressure- A minimum operating pressure should be maintained to preclude a deviation from the calibrated K-factor. A minimum operating pressure is a function of the line fluid vapor pressure and the TURBINES, INC. INSTALLATION & OPERATION MANUAL --- PAGE 2 OF XX

TUPBINES INC.,
Highway 283 North Altus, OK U.S.A. 73522
Ph; 580-477-3067 Fax: 580-477-3071
http://www.turbinesinc.com

METER INSTALLATION(continued)

System Pressure(continued)prevent cavitation and fluid separation.

Calculation of the required back pressure for liquid line fluid applications is calculated as follows:

BP = (meter P x 2) + (VP x 1.25)

where

BP = Back pressure.

P = Flow meter pressure drop at maximum flow,

and

VP = Line fluid Vapor Pressure at maximum temperature(psig)

PICK-UP COIL INSTALLATION

Pick-up coils should be inserted into the threaded hub of the turbine flow meter, with the electronic connector end of the pick-up coil facing out. This component should be finger tightened to approximately 4in-lb torque.

The magnetic pick-up coil produces a low level sine wave output that requires an amplifier to convert the signal to 0 to 10 volt peak to peak pulse signal suitable for process instrumentation.

The *modulated carrier (RF)* pick-up has the required amplifier built into the pick-up. This also produces a 0 to 10 volt peak to peak pulse.

The following must be observed to obtain proper operating performance:

<u>Use a twisted and</u> shielded cable (Belden 8761 or equivalent) to carry the signal.

The shield should only be connected at one end! This will prevent a ground loop.

<u>Do not mount the</u> meter/pick-up close to electrical noise generating equipment (motors, relays, etc.)

The conduit for the pick-up cable must not be shared with other service(s).

GENERAL PIPING CONSIDERATIONS

As explained in earlier section(s), the line fluid moving through the flow meter causes the rotor to rotate. Thus the rotational velocity of the rotor is a function of the line fluid velocity and the blade angle engagement. Swirl present in the line fluid stream can effectively change the angle of engagement between the fluid stream and the rotor blades and therefore result in a deviation from the calibrated mk-factor supplied with the turbine meter (since the calibration is performed under controlled flow conditions.)

Proper installation as described elsewhere herein, minimizes the harmful effects of fluid swiri.

Meter By-Pass - Where possible, it is advisable to include a valved bypass around the "metering location". This foresight will allow the turbine flow meter to be removed without interrupting the operation of the line.

Line Purge - In a new or revised piping system, the line should be PAGE 3 OF XX --- TURBINES, INC. INSTALLATION & OPERATION MANUAL

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ELECTRICAL CONNECTIONS

Turbines, Inc. pick-up coits are designed to mate with a two pin MS3106A-10SL-4S connector, for liquid turbine flow meters and a three pin MS3106-10SL-3S connector for gas turbine flow meters. A two or three wire (respectively) shielded cable should be used to lead from the connector to the electronic instrument. The cable shield is connected to the ground contained inside the electronic instrument to prevent any ground-loop interference.

The connection should be located away from power lines whenever possible.

Precautions should be adequate when installing or removing the [pickup coil from the turbine flow meter. Turbines, Inc. warranty does not cover physical damage to the coil.

Operation of the Equipment

Proper performance of the equipment is dependent upon correct installation and proper operating procedures being in effect. If the foregoing has been properly executed, then the installation should be good. While not complex, the operating procedure(s) described below are most necessary and must be carefully observed.

OVER RANGE

The greatest hazard to any turbine flow meter is OVER RANGING of the meter. This means that if the flow rate present in the meter is greater than the flow range for which the meter is rated, the meter is said to be "over ranged."

In case this happens, the performance of the turbine meter will, generally, remain linear, however, the pressure drop (head loss) will increase and the radial velocity of the rotor will exceed its design limits, quite likely resulting in permanent damage due to overspeeding of the bearings,

In liquid applications, over speed usually occurs during startup when air is present in the metering line. Air should be bled from meter line prior to a startup operation.

UNDER RANGE

As suggested by the nomenclature, under ranging is defined as operating the turbine flow meter below the flow rate minimum for which the meter is rated. While this will not cause physical damage to the equipment, operating beneath the minimum rated range limit of a turbine flow meter will cause the accuracy to become non-linear and the repeatability will become poor due to increased proportional effect of the bearing friction.

LIQUID FLOW CHARACTERISTICS

WHEN measuring liquids, a turbine flow meter output is related to an absolute standard because the volume of the liquid is considered to be incompressible.

Each turbine flow meter has its own unique k-factor, as derived by calibration wherein a known volume of liquid is passed through the meter in a known span of time.

The turbine meter's linearity is expressed as the variation in the k-factor over its flow range. The k-factor changes slightly over the flow range of the turbine meter, therefore the linearity is the change(deviation) of the actual k-factor from the nominal k-factor.

If the application line fluid differs from water (the calibration medium,) the k-factor provided with the turbine flow meter may not accurately

Liquid Flow Characteristics (continued)

actual performance that will obtain. In order to achieve high accuracy in connection with given non-water liquid installation, it is recommended that the turbine meter be proved in place.

Repeatability of a turbine flow meter is defined as the ability to reproduce a k-factor under identical conditions, including flow rate, temperature, pressure, viscosity and other fluid parameters.

GAS FLOW CHARACTERISTICS

In order to measure gas, first confirm and verify that the turbine you are seeking to use is specified as a gas turbine flow meter. USING A LIQUID TURBINE FLOW METER FOR GAS MEASUREMENT WILL DAMAGE THE TURBINE FLOW METER AND NOT YIELD CONSISTENT OR ACCURATE PERFORMANCE.

The measurement of gas with the proper turbine flow meter requires that the volume flow be given a useful technical meaning. It is, therefore necessary that the actual measured volume per minute (ACFM) be compared against its equivalent standard volume per minute (SCFM.) The turbine flow meter can only measure actual volume of line fluid flowing.

The standard conditions of pressure and temperature that are used under this convention are:

Pressure: 14.69 pounds per square inch absolute (psia)

Temperature: 520 degrees Rankin (60 degrees Fahrenheit.)

In order to properly facilitate conversion, an absolute temperature scale must be used.

To convert from ACFM to SCFM it is assumed that the gas follows the Perfect Gas Law. The following equation applies when converting the actual measured volume flow rate to an equivalent standard condition of SCFM:

where:

Qs = gas flow rate in SCFM

Qa = gas flow rate in ACFM

Pa = measured gas pressure in the flow meter in psia

Ps = Standard pressure = 14.69 psia

Ta = actual gas flowing temperature degrees Rankin

Ts = standard temperature = 520 degrees Rankin

The short form of the foregoing equation becomes:

The actual pressure and temperature measurements for conversion purposes must be obtained as close as possible to the meter (preferably adjacent to the upstream side.)

DOCUMENT NUMBER: TI-2000 REV-00



Equipment Specifications

END CONNECTIONS AND FLOW RANGES-In-Line Turbine Flow Meters

The following table provides typical end connections and flow range specification for the Turbines, Inc. standard line of Turbine Flow Meters.

Meter	E	Mete nd Arrang			Rated Flow Range		
Size	Threaded	Flanged	Wafer	Grooved	GPM	ACFM	
3/8"	1.0"	1.0"	1.0"	N/A	0.3 - 3.0	N/A	
1/2"	1.0"	1.0"	1.0"	N/A	0.75 - 7.5	N/A	
3/4"	1.0"	1.0"	1.0"	N/A	2.0 - 15.0	N/A	
7/8"	1.0"	1.0"	1.0"	N/A	3.0 - 30.0	N/A	
1.0"	1.0"	1.0"	1.0"	N/A	5.0 - 50.0	N/A	
1.0"	N/A	N/A	2.0*	N/A	5.0 - 50.0	N/A	
1-1/2"	1-1/2"	1-1/2"	2.0*	N/A	15 - 180	N/A	
1-1/2"	2.0"	N/A	N/A	N/A	15 - 180	N/A	
2.0"	2.0° female	2.0"	2.0	N/A	40 - 400	N/A	
3.0"	N/A	3,0"	3.0*	3.0"	60 - 600	N/A	
4.0"	N/A	4.0"	4.0"	4.0"	120 - 1200	N/A	
6.0"	N/A	6.0"	6.0"	6.0"	200 - 2000	N/A	
8.0"	N/A	8.0"	8.0"	8.0"	350 - 3500	N/A	
10.0"	N/A	10.0"	10.0"	10.0"	500 - 5000	N/A	
12.0"	N/A	12.0"	12.0"	12.0"	750 - 7500	N/A	

Note: Other sizes, non-standard materials and configurations are available upon request.

FLOW RANGE - Insertion Turbine Flow Meter Head

The turbine heads for the Turbines, Inc. insertion flow meter line are fully replaceable and cover the flow ranges indicated below:

For Liquid Line Fluids:

1 - 10 ft/sec

2 - 20 ft/sec

3 - 30 ft/sec

For Gas Line Fluids:

6 - 60 ft/sec

10 - 100 t/sec

20 - 200 ft/sec

For more extensive information regarding the insert turbine flow meter line, please contact Turbines, Inc.

STANDARD CALIBRATION PROTOCOL

Turbines, Inc. offers the following calibration options for standard turbine flow meters. The option selection must be specified at the time of order placement.

Turbines, Inc. also offers re-certification and calibration of turbine type and other flow meters. Contact the company for additional information or instructions on how to obtain calibration services.

Standard Calibration:

A standard calibration consists of 3 data points covering the rated flow range at low, mid and high points, this calibration being performed using water as the line fluid. All Turbines, Inc. turbine flow meters are factory calibrated based on this standard calibration protocol in order to determine the applicable k-factor.

Non-Standard Calibration:

At additional charge, Turbines, Inc. offers 5 point, 10 point and 20 point calibrations, upon request. Also, other line fluids may be substituted for water, as an additional option offered at additional charge.

TURBINES, INC. INSTALLATION & OPERATION MANUAL --- PAGE 4 OF XX

Turbines inc.

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MATERIALS OF CONSTRUCTION

Turbines, Inc. offers the standard turbine flow meter product line with material configuration as follows:

Meter Body: 316 stainless steel Bearing Support: 316 stainless steel

Rotor: 416 stainless steel Shaft & Bearing

(Liquid): tungsten carbide

Shaft & Bearing

(Gas): 316 stainless steel shaft

440C stainless steel Ball Bearings

Other materials such as Hastelloy, Monel, various plastics and so forth, are available by special request.

PICK-UP COILS

The following pick-up coils are available:

Magnetic pick-up coil to +225 deg. F. Magnetic pick-up coil to +450 deg. F. Magnetic pick-upcoil to +850 deg. F.

Modulated carrier (RF) with preamplifier Magnetic pick-up coil with preamplifier

FLOW MONITORS-TOTALIZERS

Turbines, Inc. offers several proprietary monitor/totalizer units as well as a number of OEM units. Operation and Maintenance of these pieces of equipment are separately provided.

Generally, however, monitor/totalizers offer Nema 4X enclosures with LED read-out calibrated to units of measure suitable to the user's application. Such units can be configured to either direct mount onto the hub of the turbine flow meter, or alternatively, to be remote mounted using additional cable set. As well, local indication can be augmented by the addition of 4 - 20 mA output features.

These units can be of explosion proof and intrinsically safe design, as well as certified to various industry standards, depending upon application requirements.

Gas turbine flow measurement requires monitor/totalizer equipment capable of integrating line pressure and temperature data in order to compensate for the compressibility of gases.

Depending upon application specifications, monitor/totalizer equipment can be expanded to handle batching, control, reporting and other functions. Consult factory for further information and applications

Operating Limitations Notes

INSTALLATION

The flow directional arrow prominently displayed on the body of the turbine flow meter must coincide with the direction of flow of the process line fluid.

TEMPERATURE

Do not subject the meter electronics (i. e. monitors/totalizers, etc.) to temperatures in excess of 160 degrees F.

Don not subject the meter (or electronics) to temperatures below the PAGE 5 OF XX---TURBINES, INC. INSTALLATION & OPERATION MANUAL

Turbines Inc. Highway 283 North Attus, OK U.S.A. 73522 Ph: \$80-477-3071 http://www.turbinesinc.com

TEMPERATURE(continued)

Unless a high temperature pick-up coil is selected and secondary electronics are remotely mounted, temperatures exceeding the rated maximum may cause irreparable damage.

Lower temperatures will limit the rotation of the rotor and cause the electronic display(s) to cease functioning until acceptable temperature is restored.

PRESSURE

Never exceed the pressure rating of the turbine meter. Excessive pressure may cause inaccurate registration of the turbine flow meter, or may result in the rupture or explosion of the flow element.

When pressurizing an empty line, gradually increase pressure incrementally until full required line pressure that is compliant with rated pressure of the flow element(s) is achieved. Do not quickly approach full pressurization.

Damage to the turbine flow meter consistent with failure to comply with the foregoing shall immediately void any warranty otherwise operative.

WARNING: DO NOT REMOVE METER FROM A PRESSURIZED LINE.

CORROSION

The standard design for Turbines, Inc. turbine flow meters consists of stainless steel and tungsten carbide internals. It is essential that the user confirms that these materials are compatible with the process line fluid. Incompatible process line fluids may cause premature deterioration of meter components, and lead to inaccurate meter registration and eventual failure.

If the compatibility of an intended process line fluid is questioned, contact the factory for application assistance. Alternate and/or non-standard materials selection can be facilitated resulting in the production of flow elements that will be fully compatible.

PULSATING FLOW ISSUES

Severe pulsation of flow will affect the accuracy of the turbine flow meter, and shorten the useful service life of the equipment.

VIBRATION AND SHOCK

Severe mechanical shock and/or vibration may decrease the useful service life of the meter. Excessive mechanical shock and/or vibration may cause structural failure of connections between meter and secondary (monitor/totalizer.

CONTROL OR THROTTLING VALVE(S)

Throttling valves should be installed downstream of the turbine flow meter only.

FILTRATION

A strainer should be installed upstream of the turbine flow meter, suspended particles and/or foreign matter may damage rotor and/or other internal components.

LINE FLUID-FLOW CONDITIONS

Never introduce air or gaseous substances or flow into a liquid turbine

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LINE FLUID-FLOW CONDITIONS (continued)

The turbines flow meter should be operated within the specified rated range of the meter. Don not run below the minimum limit of the flow range as it will result in inaccuracies.

Do not exceed the maximum imit of the flow range as this may damage the turbine flow meter.

Equipment Maintenance

By observing proper maintenance procedures the useful service life of the turbine flow meter can be prolonged and with the exception of replaceable parts, the meter can be expected to perform for an extended period of time.

PERIODIC MAINTENANCE

Maintenance for Turbines, Inc. turbine flow meters consists of periodic inspection of the internal components, namely rotor supports, rotor and bearings. Excessive wear, physical damage, or clogging must be identified promptly. Should evidence of such conditions be present, it is recommended that the meter be returned to the factory to be rebuilt.

Complete sets of calibrated internal retro-fit its are available in the event field retro-fitting and/or replacement is desired. Consult with factory for assistance.

INSPECTION AND CLEANING

In order to inspect or clean the turbine flow meter, the retaining ring must be removed. At that point, the rotor support and rotor can be removed.

Particularly if the meter has been out of service for a period of time, it is recommended that it be dipped in light machine oil.

One of the primary sources of turbine meter failure is the bearing wear caused by foreign material build-up. A large number of process line fluids will leave residue that severely degrades the free motion of the rotor

It is recommended that the meter be flushed with Stoddard solvent whenever possible.

Disassembly and Assembly Notes

In order to perform regular maintenance and occasional field retro-fit the need will arise to disassemble and assemble the turbine flow meter. The pertinent procedures for standard Turbines, Inc. turbine flow meters are offered in the following sections.

Each type of turbine flow meter is listed with the appropriate procedure steps listed. There follows a series of illustrations in figure 3 that relate to these procedures, and provide general typical drawings for the various meter styles. Additional assistance, if required, may be obtained by contacting the factory.

STANDARD IN-LINE THREADED, FLANGED OR GROOVED TURBINE FLOW METER

Disassembly

Step 1

Prior to removing any flow element from the process line, MAKE SURE THAT ALL PRESSURE HAS BEEN RELIEVED FROM THE LINE, and that no line fluid is flowing.

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STANDARD IN-LINE THREADED, FLANGED OR GROOVED TURBINE FLOW METER(continued)

Step 2

Make sure that all power to any connected secondary device(s) has been disconnected. Remove any connections to the pick-up coil.

Step 3

Remove retaining rings from both ends of the meter body.

Step 4

Remove forward rotor support assembly, rotor, and rear rotor support assembly carefully.

Step 5

Thoroughly inspect all internal components for evidence of wear, degradation, corrosion, foreign debris entanglement, and physical damage. Nicks, dents, misalignment of blades, or encrustation on the rotor assembly can cause the turbine flow meter to register incorrectly.

Step 6

Any component parts constituting the internals that demonstrate evidence described in #5 above should be replaced with authorized replacement components available by calling the factory.

Step 7

Clean all parts thoroughly and immerse in light machine oil prior to reassembly.

Re-assembly

Step 1

Internal components must be reassembled exactly as they were previously removed.

Step 2

Insert rear rotor support making sure to firmly seat this part in grooves provided to prevent rotor support from turning.

Step 3

Insert rotor, then front rotor support.

Step 4

Install retaining rings in machined body groove. Make sure they seat firmly into the groove.

Step 5

Verify that the rotor support(s) do not rotate within the body housing.

Step 6

Examine and verify that the rotor assembly spins freely without any disruption, bias or binding.

Consult Figure 3a following for detailed typical drawing.

STANDARD WAFER STYLE TURBINE FLOW METER

Disassembly

Step 1

Prior to removing any flow element from the process line, MAKE SURE THAT ALL PRESSURE HAS BEEN RELIEVED FROM THE LINE, and that no line fluid is flowing.

Step 2

Make sure that all power to any connected secondary device(s) has

TURBINES, INC. INSTALLATION & OPERATION MANUAL --- PAGE 6 OF XX



STANDARD WAFER STYLE TURBINE FLOW METER

Disassembly (continued)

Step 3

Remove button head screws from rear and front of wafer style turbine flow meter body (three from each side.)

Step 4

Remove forward rotor support assembly, rotor, and rear rotor support assembly carefully.

Step 5

Thoroughly inspect all internal components for evidence of wear, degradation, corrosion, foreign debris entanglement, and physical damage. Nicks, dents, misalignment of blades, or encrustation on the rotor assembly can cause the turbine flow meter to register incorrectly.

Step 6

Any component parts constituting the internals that demonstrate evidence described in #5 above should be replaced with authorized replacement components available by calling the factory.

Step 7

Clean all parts thoroughly and immerse in light machine oil prior to reassembly.

Re-assembly

Step 1

Internal components must be reassembled exactly as they were previously removed.

Step 2

Insert rear rotor support and replace three button head screws.

Step 3

Insert rotor, then front rotor support, replacing remaining three button head screws.

Step 4

Install retaining rings in machined body groove. Make sure they seat firmly into the groove.

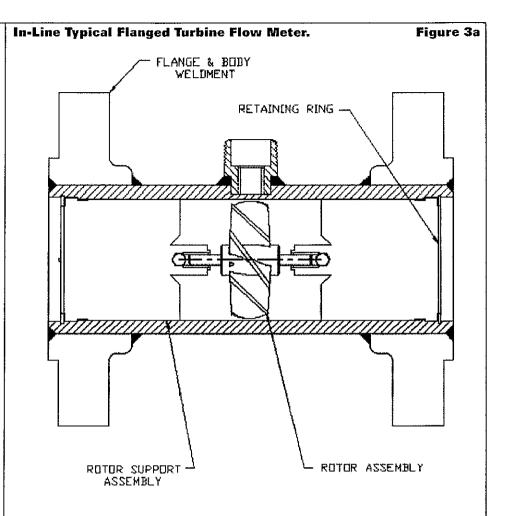
Step 5

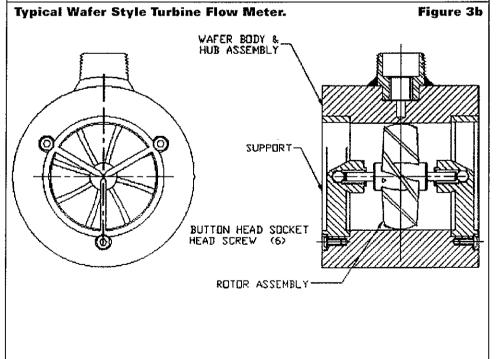
Verify that the rotor support(s) do not rotate within the body housing.

Step 6

Examine and verify that the rotor assembly spins freely without any disruption, bias or binding.

Consult Figure 3b following for detailed typical drawing.



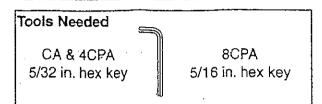


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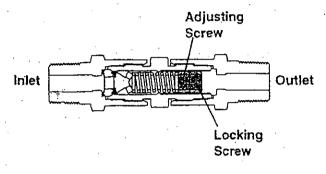
DOCUMENT NUMBER: TI-2000 REV-00 0 2000 TURBINES, INC.

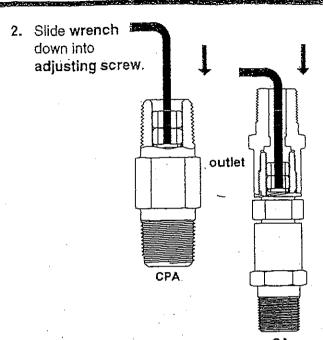
Swageloke

CA & CPA Series Check Valve Cracking Pressure Adjustment



CA Series



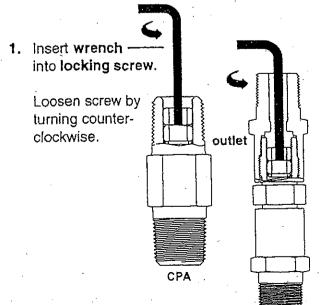


Adjusting Screw

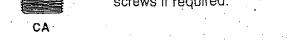
Inlet

Locking Screw

 Turn both screws to reach desired cracking pressure. (Turn clockwise to increase cracking pressure, counter clockwise to decrease cracking pressure)

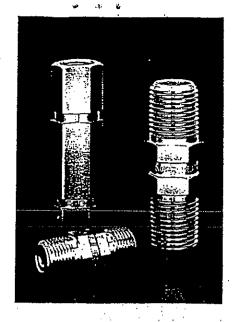


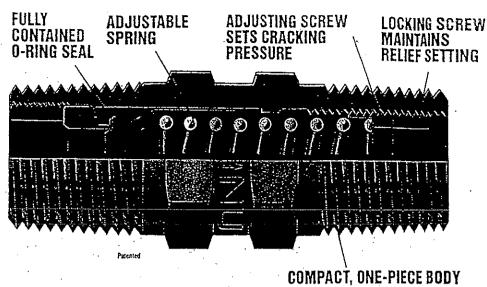
- Slide wrench back up into locking screw and turn clockwise to lock.
- Verify cracking pressure and adjust screws if required.



CPA" Series One-Piece, Pipe Ended Adjustable Relief Valves

N-189-5 August, 1990





FEATURES

- working pressure to 3000 psig (206 bar)
- I temperatures to 375°F (191°C) with Viton seal
- lour different springs with adjustable cracking pressures from 3 to 600 psig (0.2 to 41 bar)
- variety of NPT and ISO pipe end connections and sizes
- variety of materials: 316 staigless steel, brass, alloy R-405, and carbon steel
- 100% tested for crack and reseal performance

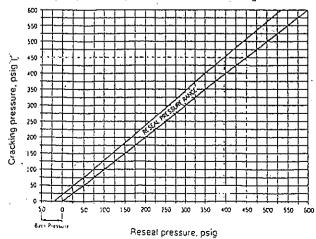
TECHNICAL DATA

Cracking Pressure Range	3 to 50 psig (0.2 to 3.4 bar) 50 to 150 psig (3.4 to 10.3 bar) 150 to 350 psig (10.3 to 24 bar) 350 to 600 psig (24 to 41 bar)
Maximum Working Pressure @ 70°F (21°C) (316 SS)*	3000 psig (206 bar)
Maximum Back Pressure @ 70°F (21°C) (316 SS)*	3000 psig (206 bar)
Flow Coefficient (Cv)	*4CPA*: 0.35 *8CPA*: 1.2 (See Flow Curves)
Temperature Rating	Vilon: -10°F to 375°F (-23°C to 191°C) Buna N: -10°F to 250°F (-23°C to 121°C)

^{*}For complete pressure-temperature ratings, relet to Technical Bulletin No. 4.

CRACKING PRESSURE¹ vs. RESEAL PRESSURE²

NUPRO "CPA" Series Valves, set to crack at 20 psig (1.3 bar) or lower, may require back pressure to reseal bubble-tight.



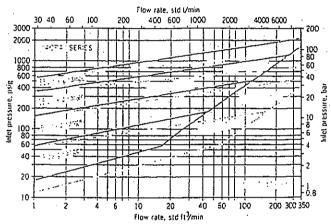
1 - noutle street to Green. For a valve set to crack at 450 psig, the - minimum reseal pressure would be 390 psig.

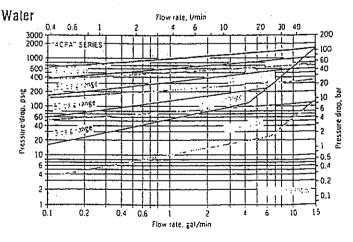
1 Cracking Pressure - The pressure at which the first indication of flow occurs,

Valves that are not actuated for a period of time may initially crack at higher than subsequent cracking pressures.

FLOW CURVES

Αir





TESTING

Every valve is factory tested for crack and reseal performance.

CLEANING

All valves are cleaned and packaged to SWAGELOK Specification SC-10. Optional special cleaning and packaging to SWAGELOK Specification SC-11 is also available. Consult your Authorized Sales & Service Representative.

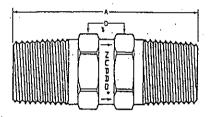


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100	A	Vi	ilye Body Maleri	als 20 feet to the	1167630
4,016	31688	Bi	in Wat	S Alloy R-405	
	13.5. 1000	"4CPA"		(ACPA" Only)	Carbon Steel
	En-Ham.			allon zas	
1 Insert Lock Screw ¹	316S/A276	Brass 485/B21	Brass 360/816	Alloy R-405/8164	316S/A276
2 Insert	or A479	1000 100041	or B345	7000 N-403/0104	or A479 .
3 O-Ring ¹	Viton	Bu	na N	Viton	Buna N
4 Poppet	316SS/A276 or A479	Brass 485/821	Brass 360/816	Alloy R-405/B164	316SS/A276 .or A479
5 Spring	302SS/A313	3028	S/A313	Alloy 400/8164	302SS/A313
6 Body	316SS/A276 or A479	. Brass	360/816	Alloy R-405/8164	12L14/A108 ³
7 Adjusting Screw	3155S/A276 ²	316SS/A276	Brass 360/B16*	Alloy R-405/8164 ²	316SS/A276 ²
8 Locking Screw	or A479	or A479		,	or A479

^{*}Adjusting Screw in B-8CPA2-150 or 350 is 316SS/A276.

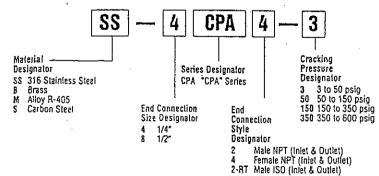
TABLE OF DIMENSIONS



Basic Ordering Number	Connection/Size (Inlet & Outlet)	A	D Hex	
-4CPA2-	1/4 Male NPT	1.62	9/16	
-4CPA2-RT*	1/4 Male ISO	1.02	716	
-4CPA4-	1/4 Female NPT	2.98	3/4	
-8CPA2-	1/2 Male NPT	2.56	7/8	
-8CPA2-RT*	1/2 Male ISO	2.56	7∕8	

For a complete Ordering Number, see Ordering Information below.
 All dimensions are in inches – for reference only, subject to change.
 Valves with RT end connections conform to ISO7/1, DIN-2999, BS21 and JIS BO203.

ORDERING INFORMATION - Typical Ordering Number



Your Local Authorized Sales & Service Representative:

OPTIONS

The following options are available factory assembled. To order these same options as separate items, refer to NUPRO Check & Relief Valve Maintenance Kits Data Sheet N-189-6.

Elastomer Seals

Optional elastomer seals are available in the materials shown in the chart below. To order, insert the desired elastomer designator into the valve Ordering Number.

Example: SS-4CPA2-KZ-50.

Elasiomer Material	Designator	Temperature Rating
Viton	-VI	-10°F to 375°F (-23°C to 191°C)
Buna Ņ	–BU	-10°F to 250°F (-23°C to 121°C)
Ethylene Propylene	–EP	-50°F to 300°F (-46°C to 149°C)
Neoprene	-NE	-40°F to 250°F (-40°C to 121°C)
Kalrez	-KZ	-10°F to 375°F (-23°C to 191°C)
TFE*	-TR	-50°F to 350°F (-46°C to 177°C)

^{&#}x27;TFE will not seal leak-tight except when high back pressure is applied, therefore it is not recommended for use with leak-light sealing is required.

Springs

Optional springs with TFE coating are available.
To order, insert the desired designator from the chart below into the valve Ordering Number. Example: M-4CPA2-TA-150

Yalve Material	Spring Cracking Pressure (Min. psig)	- Spring Material	TFE Coated Spring Designator
316 Stainless Steel, Brass and Carbon Steel	3, 50, 150, 350	30288	-TS
Alloy D 405	3, 50	Alloy 400	
Alloy R-405	150, 350	302SS	-TA

Deflector Cap

A polyethylene Deflector Cap deflects the flow from direct contact with personnel and prevents atmospheric contaminants from entering the valve. The Deflector Cap easily screws onto the male NPT outlet end of the valve. To order, insert -DG for a green cap or -DR for a red cap into the valve Ordering Number.

Example: SS-8CPA2-DR-150



Special Alloy Material

Optional aluminum body material is available for the "4CPA". Series only. Consult your Authorized Sales & Service Representative for more information.

SAFE VALVE SELECTION

When selecting a valve, the total system design must be considered to ensure safe, trouble-free performance. Valve function, materials compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibility of the system designer and user.

Viton, Xaintz - TM GuPon

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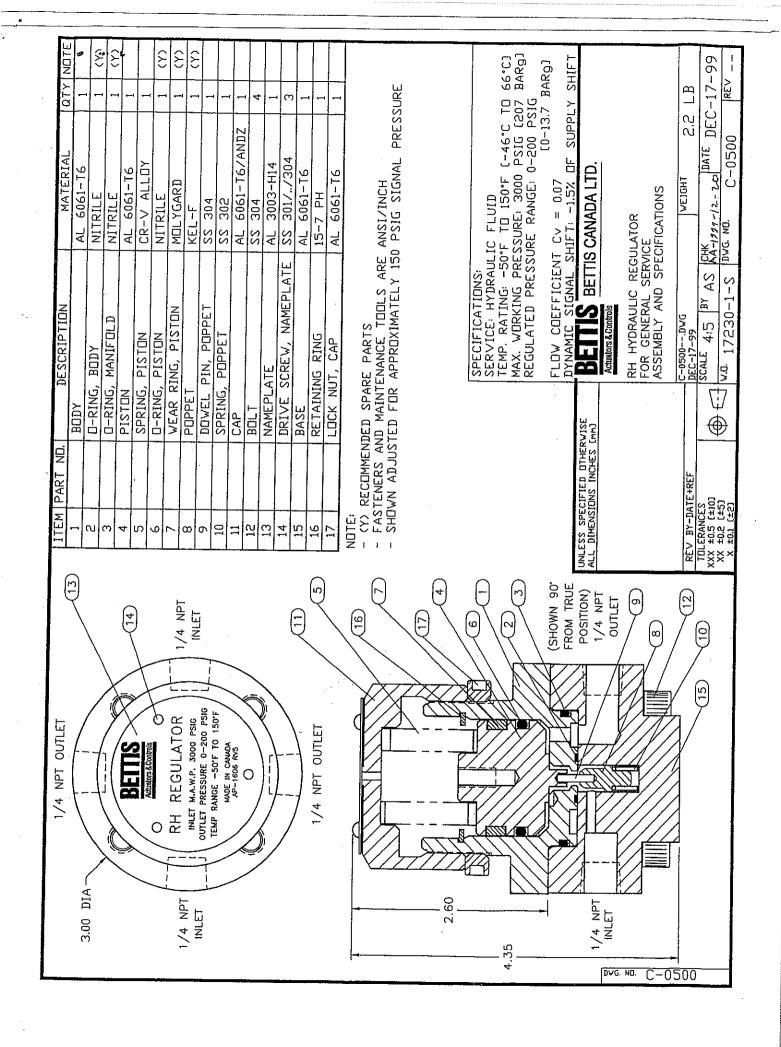




Silicone base lubricant.

¹Molybdenum disulfide base dry film lubricant.

Silver mist chrome plated.





Dyna-Flo 4000 Pressure Controllers Operation, Parts and Instruction Manuals

Figure 1 Dyna-flo 4000 Controllers Mounted on a Dyna-Flo Control Valve Assembly



Dyna-Flo 4000Operation, Parts and Instruction Manual

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Dyna-Flo 4000 Pressure Controllers Operation, Parts and Instruction Manuals



!Notice!

These instructions are meant to be used with the Dyna-Flo 4000 Series Technical Bulletin as they refer to Figures and Tables therein. If you not have the Technical Bulletin, contact Dyna-Flo immediately, or visit www.dynaflo.com

Each controller is factory checked. Check the calibration for the specific application, before a controller is put into service.

Calibration F ocedure | Initial Set-up

The 4020 Differential Gap Instructions are at the end of this section.

It is recommended to calibrate the controller in the position in which it will be operated

Determine supply pressure requirement by checking controller output signal range:

- a) An output signal range of 6-30 psi (40-200 KPa) would require 35 psi (240 KPa) supply pressure
- b) An output signal range of 3-15 psi (20-100 KPa) would require 20 psi (140 KPa) supply pressure

Connect a supply pressure line at the required setting, to the SUPPLY connection at the back of the case as shown 12.in figure 5.

- Install 1/4" NPT pipe plug at the OUTPUT connection at the back of the case as sho12. in figure 5. The controller output pressure change is measured by the output pressure gauge.
- Locate a pressure supply (of compressed air or nitrogen) equivalent to the bourdon tube rating.

With the block valve closed, connect the pressure supply through a block valve and regulator to the CONTROL pressure block.

Note

There are 2 possible connections to the control press block:

- a) the CONTROL connection in the back of the case
- b) the connection at the left side of the case

Plug the unused connection.

Verify that the calibration adjuster scr 5 s (figure 10 key 44) are at mid-point in the calibration adj. 5 er (figure 10

8)

Inspect the following for leaks (using leak detection solution or soapy water):

4000 / 4020 Controller

Relay and relay base

All tubing and connections (relay & compensator) Bellows, bellows frame and bellows screws Proportional band

4010 Controller

Relay and relay base All tubing and connections (relay & compensator) Bellows, bellows frame and bellows screws Proportional band Reset restrictor valve Reset and compensator tubing

Set PRESSURE SETTING 1410b (figure 9) at 0 (zero) setting

Adjust the no:5le (figure 7 key 50), until the output pressure is between 8 and 10 psi.

4000 Controller

t at zero

Rotate prospition ti) on all band knob and set at zero (closed position).

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Calibration Procedure Initial Set-up (cont'd)

4000 Controller (cont'd)

The output pressure gauge should indicate full supply pressure.

Check that for a direct acting unit the bellows movement is downward, and upward for a reverse acting controller.

B)

Rotate proportional band knob and set at 10 (open position).

The output pressure gauge should indicate 0 – 5 psi pressure.

Check that for a direct acting unit the bellows movement is downward, and upward for a reverse acting controller.

tata propor

Rotate proportional band knob and set at 1.5 (15% proportional band).

The output pressure gauge should indicate 8-10 psi pressure.

4010 Controller

Refer to Figure 6.

Rotate Reset Restrictor Valve and set at MAX.

Note

If the 4010 is to be left at the maximum Reset setting, the 4010 controller will perform as a 4000 (proportional band) controller. It is recommended that the reset bellows tubing be removed and retubed as shown in Figure 7 for a 4000 (proportional band) controller.

Range

4000 Controller

Verify that the proportional band is set at 1.5.

4010 Controller

Additionally, verify that the reset valve is set at 0.01 minutes per repeat.

A)

Apply input pressure equal to the bourdon tube maximum rating.

R)

Rotate pressure setting knob (figure 4) to the maximum value which is equal to the bourdon tube rating.

C)

Output gauge reading should be between 8 and 10 psi. If not, adjust controller span by loosening one of the two calibration adjuster screws (figure 5 key 44) and move the calibration adjuster (figure 5 key 8) a small distance as explained below and illustrated in figure 5.

For direct-acting controller

- a) If output is below 8 to 10 psi, move calibration adjuster to the left
- b) If output is above 8 to 10 psi, move calibration adjuster to the right

For reverse-acting controller

- a) If output is below 8 to 10 psi, move calibration adjuster to the right
- b) If output is above 8 to 10 psi, move calibration adjuster to the left
- D)

Repeat calibration adjuster movements until output gauge reads between 8 and 10 psi on both zero and maximum value. (Maximum value is bourdon tube upper limit.)

E)

Isolate the controller from process, control, and supply pressure.

F

Vent any trapped pressure from the controller.

4020 Controller

A)

Temporarily set-up the 4020 (differential gap) controller as a 4000 (proportional band) controller, by changing the proportional band tubing connection to the bellows frame. The reversing block IS NOT inverted at this time.

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Calibration Procedure I Initial Set-up (cont'd)

4020 Controller (cont'd)

B)

Calibrate as a 4000 (proportional band) controller

C

After calibration, restore the proportional band tubing to it's original connection on the bellows frame.

D)

Due to physical differences in the bellows, there may be a slight shift in the output pressure. This will be adjusted out through nozzle adjustments described below.

E)

Set the proportional band knob for the required differential gap (See adjustment section for differential gap details)

F)

Set the process pressure:

Direct Acting Controller

- 1) Move the pressure setting to the upper switch point value at which the output pressure will go from zero, to full supply pressure, with rising process pressure
- 2) Apply input pressure to the bourdon tube, as you observe the output gauge. When the upper switch point value is reached, while increasing input pressure, the controller output should switch from zero pressure, to full supply pressure.
- 3) Adjust the nozzle to correct any upper switch point error, and retest until the switch point and input pressure values agree.

Reverse Acting Controller

The controller output described above will be reversed.

G)

Check controller operation by running the input pressure from zero to above the upper switch point, and observing the switching points. Set a new differential gap, vary the input pressure, and then repeat with the calibration settings

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Adjustments

Manual Set Point (4000 / 4010 / 4020)

Adjust the pressure setting by turning the pressure setting 4nob (figure 9) to the desired pressure. This represents the upper switch point for a direct acting 4020.

Proportional Band (4000 and 4010)

To adjust the proportional band, rotate the proportional band I4iob (figure 9) to the desired value (between 3 to 100%). This represents 3-100% of the sensing element range, and controls the percentage of sensed pressure change required to cause full output of the controller

Differential Gap (4020)

Adjust the proportional band \(\frac{1}{2}\) do (figure 9) to set the width of the differential gap about the switch point. Use Table 4 as a guide. Calculate the Differential Gap as follows:

(Upper Switch Point – Lower Switch Point) x 100 Bourdon Tube Range

Proportional Band Setting	Differential Gap (% Of Element Range)
1.2	10
1.8	20
2.5	30
3.1	40
3.8	50
4.4	60
5.1	70
5.7	80
6.4	90
7	100

Table 4 - Differential Gap Setting Guide

Reset (4010 only)

To adjust the reset action, rotate the reset | 6 ob (figure 11) counter-clockwise to increase the speed. The minutes per repeat indicate the time required for the reset bellows pressure to equal the proportional bellows pressure.

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! Warning!

The following maintenance procedures require taking the controller out of service. To avoid personnel injury, only qualified technician should perform the following procedures. Always ensure the controller is fully released of pressure or process fluid before starting maintenance.

Controller Maintenance

Regular Maintenance

Δ)

If the installation includes a supply regulator, periodically open the drain on the filter regulator to drain accumulated moisture.

B)

Push the cleaner wire on the relay orifice (key 83, figure 3) to release moisture or particulate.

C)

Inspect, and if necessary, clean the opening of the vent assembly (key 71, figure 4) or the opening of the remote vent pipe, if one is used.

Replacing Gauges

Refer to figure 4.

A)

Quantity 2 gauges (key 31) are used, one for output, and one for supply pressure.

R)

Always ensure to check the range of the controller before ordering replacement gauges (0-30 psi gauges WILL NOT work on a 6-30 psi controller).

C)

Always use approved thread sealant on the threaded connections.

Replacing Bourdon Tube

Refer to figures 4 & 5.

! WARNING!

Isolate the process sensing line prior to disconnecting the bourdon tube from the control tubing (key 14) Be aware of potential hazards from disconnecting process connections. A)

Disconnect the control tubing (figure 4 key 14) at the bourdon tube end.

B)

Remove the screw (key 11) that connects the link (key 12) to the beam (key 1).

C)

Unscrew two screws (key 38) and washers (key 35), and remove the bourdon tube (key 7).

D)

Remove the screw (key 11) that retains the link (key 12) and link bearing (key 34) to the bourdon tube (key 7).

! Note! Be careful! – Bearings are easy to loose.

F)

Attach the link and bearing to the replacement bourdon tube.

F)

Attach the bourdon tube (key 7) with two machine screws (keys 38) and washers (key 35).

G)

Connect the link and bearing to the beam (key 1).

H)

Check to be sure that the beam is reasonably parallel with the bottom of the case. The link (key 12) should be in tension. If the beam is not parallel with the case, loosen the machine screws (key 38), reposition the bourdon tube to get the beam parallel, and retighten the screws.

! Note!

If a bourdon tube with a different range was installed, install a new dial having an adjustment range corresponding to the range of the bourdon tube. Remove the machine screw and washer (keys 19 and 72) and dial (key 20).

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! Warning!

The following maintenance procedures require taking the controller out of service. To avoid personnel injury, only qualified technician should perform the following procedures. Always ensure the controller is fully released of pressure or process fluid before starting maintenance.

Controller Maintenance (cont'd)

Check all tubing connections and the bourdon tube machine screws for leaks, tighten as necessary.

Perform the calibration procedure.

Changing Proportional Valve

Disconnect the tubing and remove the proportional band valve assembly (figure 4 key 55) from the case by turning it counter-clockwise

Install the desired replacement assembly – **Do not over** torque

C)

Use a proper thread sealant when reinstalling the tubing

D)

Check for leaks

Changing Reset Valve

Disconnect the tubing and remove the reset restriction valve assembly (figure 6) by removing a retaining screw (not shown) on the back of the controller

Install the desired replacement assembly.

Use a proper thread sealant when reinstalling the tubing

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D)

Connect the tubing

Check all connections for leaks

F)

Perform the calibration procedure.

Changing Controller Action

Isolate the controller from process, control, and supply pressure. Vent any trapped pressure from the controller before proceeding.

Refer to figure 2

Direct to Reverse Action

Direct action

Increasing sensed pressure produces increasing output pressure)

Reverse action

Increasing sensed pressure produces decreasing output pressure

A)

Refer to figure 2, and locate the new tubing and reversing block positions for the action desired.

B)

Changing the action is accomplished by reversing the positions of 2 components:

- 1) the reversing block
- 2) the bellows tubing

In the controller, locate the two bellows and the reversing block (key 63, figure 2)

For a 4000 (proportional-only) controller

Disconnect the proportional tubing (key 10) from the bellows frame and reconnect it in the opposite hole.

For a 4010 (proportional-plus-reset) controller

Disconnect the proportional tubing (key 10) and reset tubing from the bellows frame, and reconnect them in the opposite hole.

For both Models of Controllers

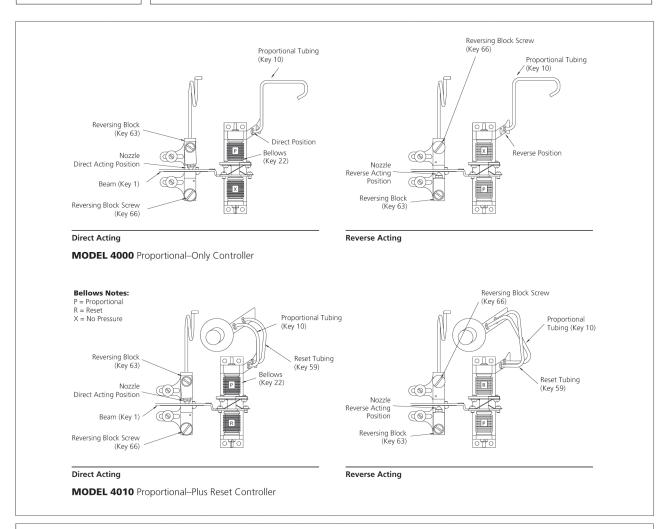
Remove the reversing block screw (key 66, figure 2) and reversing block assembly (key 63).

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▲ Figure 2 Tubing Connections

For both Models of Controllers (cont'd)

B)

Inspect the o-rings (key 53) located in the recessed area under the reversing block screw head and between the reversing block assembly and the calibration adjuster (key 8, figure 5). Replace these o-rings, if necessary.

C)

Position the reversing block assembly, with o-ring, on the calibration adjuster so that the nozzle is on the opposite side of the beam (key 1, figure 2) from which it was removed. Properly position the reversing block assembly so that the alignment pin engages the hole in the calibration adjuster. Install the reversing block screw (key 66) with o-ring (key 53).

D)

Install the sealing screw with o-ring in the hole previously covered by the reversing block assembly.

E)

Install the relay tubing (key 58) in the reversing block (key 62).

F)

Check all the connections for leaks with leak detector solution.

G)

Perform the calibration procedure.

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Model

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Relay

Replacement

Refer to figure 4

Δ)

Always shut down the supply, control and process pressure line to the controller.

B)

Disconnect the relay tubing (key 58) from the relay (key 56).

C

Remove the relay (key 56) from the case by unscrewing the 2 retaining screws (key 39– not shown) on the back of the case.

D)

Remove the relay gasket (key 57, not shown).

F)

Replace the relay gasket, and hold it place by inserting the retaining crews from the back of the case.

F)

Attach the replacement relay.

G)

Connect the tubing, and check all connections for leaks.

H)

Perform the calibration procedure.

Relay Reconditioning

Refer to figure 3.

Disassembly

A)

Complete Steps 1 through 4 of relay replacement.

B)

Unscrew the orifice assembly (key 83). Remove the O-rings (key 79) from the orifice assembly.

 \subset)

Place the relay on the work surface with the casing screws facing up. Remove the casing screws (key 78), in a crisscross pattern.

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D)

Remove and separate the lower casing (key 76), bottom diaphragm (key 86), spacer ring (key 84), diaphragm assembly (key 75), and relay spring (key 82) from the relay body (key 81).

E)

Remove the screws (key 77), spring plate (key 85), spring plate gasket (key 80), spring (key 88), and valve plug (key 87).

F)

Inspect the valve seats (under a good light) for roughness due to corrosion. One seat is located in the diaphragm assembly (key 75), and the other seat is located in the relay body (key 81). Replace the diaphragm assembly or relay body if seats are damaged or worn.

G

Inspect the diaphragms and gaskets, and replace them if necessary.

H)

Replace the spring and valve plug if they show signs of corrosion.

1)

The lower diaphragm is part of the diaphragm assembly and must be replaced as an assembly.

J)

Clean all parts thoroughly before re-assembling.

Re-assembly

A)

With the relay body opening facing up, place the relay spring in the relay body, and set aside.

B)

Place, in order, the top diaphragm, spacer ring, and diaphragm assembly on the lower casing so that the flow passage holes are lined up.

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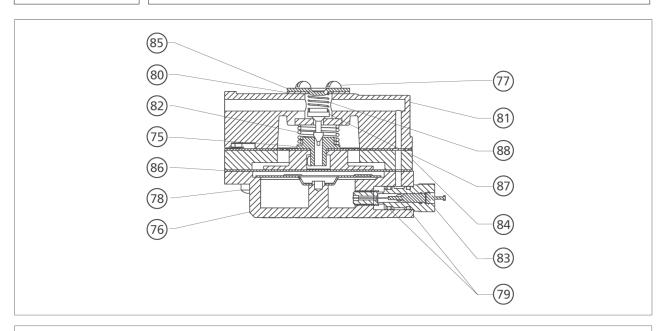


Figure 3 Relay Cross-section

Relay (cont'd)

Re-assembly (cont'd)

Put the assembly just built on the relay body and spring assembly, taking care to maintain the alignment of the flow passages. A second check is to align the grooves on the casing and spacer ring, with the tab on the relay body.

Install the casing screws, but do not tighten them.

Tighten the casing screws (key 78) evenly, in a criss-cross pattern.

- Install the valve plug, spring, gasket, and cover plate (keys 80, 86, 87, and 88). Secure with the machine screws (key 77).
- Install the o-ring (key 79) on the orifice assembly (key 83), and install the orifice assembly into the relay casing.
- Replace the relay gasket (key 57), and hold it place by inserting the retaining crews from the back of the case.

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Attach the reconditioned relay.

Connect the tubing, and check all connections for leaks.

Perform the calibration procedure.

Changing Output Signal Range

From 3 to 15 psig (20 to 100 kpag) to a 6 to 30 psig (40 to 200 psig) output signal range or vice versa.

- Always shut down the supply, control and process pressure line to the controller.
- Refer to the parts list to make sure you have the bellows in appropriate range and material. Quantity 2 are required.
- C) Disconnect the tubing (key 58) from the relay (key 56) to the reversing block (figure 2, key 63), at the relay end.

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Changing Output Signal Range (cont'd)

D)

Disconnect the tubing from the bellows frame (figure 5, key 2) to the proportional band assembly, at the bellows frame end. (Bending of the tubing will be reduced if you loosen the fitting at the proportional valve end as well).

E)

Disconnect the tubing (figure 4 key 14) from the CONTROL pressure block (figure 4 key 13) to the bourdon tube (key 7), at the CONTROL pressure block end.

F)

Remove the 4 machine screws (key 40, figure 4), and lift the controller subassembly from the case.

(G)

Remove the screw (key 11, figure 5) that connects the link (key 12) to the beam (key 1).

H)

Unscrew two screws (key 38) and washers (key 35), and remove the bourdon tube (key 7).

1)

Remove the screw (key 11) that retains the link (key 12) and bearing (key 34) to the bourdon tube.

! Note! Be careful! – Bearings are easy to loose.

J)

Unscrew the bellows screws (key 4) from each end of the bellows frame (key 2).

K)

Compress the feedback bellows so that the end of the bellows and beam can be removed from the end of the bellows frame (key 2).

Ľ

While firmly holding the bottom feedback bellows (key 22) in your hand, turn the upper bellows counter clockwise with your other hand to separate the bellows from the beam assembly.

M)

Remove the bellows connecting stud (not shown) for re-use with the new bellows.

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N)

With the stud that connects the two bellows in place in the spacer (key 69), screw the new bellows onto the stud. Install new gaskets (key 3) on each bellows.

0

Compress the feedback bellows, and install them into the bellows frame (key 2).

P)

With the beam parallel with the mounting base, secure the feedback bellows with the bellows screws (key 4).

 \bigcirc

When tightening the bellows screws, make sure that the nozzle (key 50) is centered on the flapper (key 23).

R)

Install the bourdon tube if it was removed – Refer to the Replacing Bourdon Tube section.

S)

Replace the subassembly in the case and secure with the machine screws (key 40, figure 4).

T)

Reconnect all tubing. Take care to get the proportional tubing back in the right connection on the proportional valve (Refer to Figure 2).

U)

Unscrew the supply and output gauges (key 31, figure 4) and install new gauges with correct ranges.

V)

Check all tubing connections and the bellows screws (key 4) for leaks. Tighten as necessary.

W)

Perform the calibration procedure.

Note: Use Proper Thread Sealant on all tubing connections.

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Start-Up & Tuning Guidelines

4000

1)
Check that controller is calibrated.

2) Check that supply regulator set point matches the controller output range.

3)
Set the pressure setting knob at the required pressure.

4)
Based on your process (fast, or slow) set the proportional band:

a) for a fast (liquid) system, use a setting of 10 (100 percent)

b) for slow (gas) system uses a calculated proportional band setting, from the expression:

20 X <u>Allowable Error</u> Output Pressure Range (X 10 for percent value)

Example:

- 3 psig Allowable Error - 30 psig output Range

 $20 \times 3 / 30 = setting of 2 (20\% PB)$

- 5)
 Check the proportional action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Lower the proportional band setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then double proportional band setting for a reasonable starting point.
- 6) Minimize proportional band effect on set point by turning the nozzle (Key 50) until the process pressure matches the controller pressure setting.
- 7)
 Check the proportional band setting for stable operation by making a change in the process and watching for cycling.

4010

T)
Check that controller is calibrated.

2)

Check that supply regulator set point matches the controller output range.

- 3)
 Set the pressure setting knob at the required pressure.
- 4)
 Based on your process (fast, or slow) set the reset:
 - a) for a fast (liquid) system use 0.05 minutes per repeat
 - b) for a slow system (gas) use 0.5 minutes per repeat
- 5)
 Based on your process (fast, or slow) set the proportional band:
 - a) for a fast (liquid) system, use a setting of 10 (100 percent)
 - b) for slow (gas) system uses a calculated proportional band setting, from the expression:

20 X <u>Allowable Error</u>
Output Pressure Range
(X 10 for percent value)

Example:

- 3 psig Allowable Error - 30 psig output Range 20 X 3 / 30 = setting of 2 (20% PB)

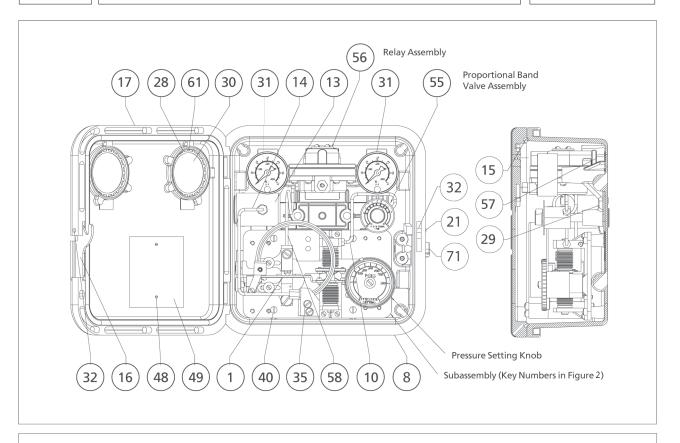
- 6)
 Check the proportional action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Lower the proportional band setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then double proportional band setting for a reasonable starting point.
- 7) Check the reset action by either making a small set point change, or bumping the flapper lightly, and watching for the output to cycle. Increase the reset setting if the system does not cycle, and check again. Repeat this process until the controller output does cycle, and then triple that reset setting for a reasonable starting point.
- Check the reset setting for stable operation by making a change in the process and watching for cycling.

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Model

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▲ Figure 4 Dyna-Flo Model 4000 General Detail

Parts Ordering

Whenever corresponding with Dyna-Flo about a 4000 series pressure controller, refer to the nameplate (key 48, figure 4) for the serial number of the unit. Please order by the complete part number (as given in the following parts list) of each part required.

Parts Kits

Relay Replacement Kit Part Number
Kit contains key 58 and 3C and RRELAYX0L2D
the replacement relay

Controller Repair kit R4150X00L1D Kit contains keys 3C, 12, 19, 26, 29, 34, 37, 50, 51, 52, 53, 55,

62, 63, 66, and 68

Relay Repair Kit Kit contains keys 58, 76, 77, 80, 81, 83, 84, 88, and 89 RRELAYXOL1D

Assemblies

Assemblies Part
Proportional Band Valve Assembly
Relay Assembly
Reset Restriction Valve Assembly

Number 10A9122X03D 22B0463X01D 19A4361X01D

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C ey	Description	Part Number			
l	Beam, steel	1H26682507D		0-3000 psig	16A7662X09
2	Bellows Frame, aluminum	2H26530801D		0-5000 psig	16A7662X10
3*	Bellows Gasket, neoprene (2 req'd)	1D39700301D		0-8000 psig	16A7662X11
1	Bellows Screw (2 req'd)	1D39761402D		0-10000 psig	16A7662X12
5	Bellows Stud, SST (not shown)	1H2658X001D	21	Door Latch Pin, steel pl (2 req'd)	PC00000003
5	Bourdon Tube Bracket	PC00000025D	22	Feedback Bellows	
7*	Bourdon Tube, sst			Brass	
	0-30 psig	10B2892X01D		3-15 psig (20-100 kpag) (2 req'd)	14A5726X01
	0-60 psig	10B2892X02D		6-30 psig (40-200 kpag) (2 req'd)	14A5726X03
	0-100 psig	10B2892X03D		Stainless Steel	
	0-200 psig	10B2892X04D		3-15 psig (20-100 kpag) (2 req'd)	14A5726X02
	0-300 psig	10B2892X05D		6-30 psig (40-200 kpag) (2 req'd)	14A5726X04
	0-600 psig	10B2892X06D	23	Flapper, sst	1H26694113
	0-1000 psig	10B2892X07D	24	Flexure Strip Base, steel	1C89772508
	0-1500 psig	10B2892X08D	25	Flexure Strip Washer, steel pl (2 req'd)	16A7671X01
	0-3000 psig	10B2892X09D	26	Flexure Strip, sst	1C89783601
	0-5000 psig	10B2892X10D	27*	Gasket, Bellows Frame (not shown), neoprene	1H26540301
	0-8000 psig	10B2892X11D	28*	Gasket, gauge Glass, neoprene (2 req'd)	0T01910408
	0-10000 psig	10B2892X12D	29*	Gasket, Pressure Block, neoprene (not shown)	C32860301D
3	Calibration Adjuster, steel pl	2H26624401D	30	Gauge Glass (2 req'd)	PC00000039
)	Case, aluminum	PC0000010D	31	Gauge, Supply and Output Pressure (2 req'd)	
0	Proportional Tubing Assembly, sst			0-30 psig	PC00000037
	4000	1H6864000AD		0-60 psig	PC00000038
	4010	1H6870000AD	32	Latch Roll Pin, steel pl	PC00000003
1	Connecting Link Screw, steel pl (2 req'd)	1B28562898D	33	Knob Spring, steel pl (not shown)	1C22152702
2	Connecting Link, sst	1L37964101D	34	Link Bearing, sst (2 req'd)	1L37954620
3	Control Pressure Block, steel pl	PC00000024D	35	Lockwasher, Bourdon Tube, steel pl (2 req'd)	1H26722898
4	Control Tubing Assembly	PC00000023D	36	Lockwasher, steel pl (2 req'd)	1H26712898
5	Cover Gasket, nitrile	1J40750643D	37	Machine Screw, Flapper, steel pl	1B27512899
6	Cover Latch, steel pl	1H28862898D	38	Machine Screw, Bourdon Tube, steel pl (2 req'd)	1H26772898
7	Cover, aluminum	PC00000011D	39	Machine Screw, steel pl, Relay (2 req'd)	1H52712898
8	Cross Spring, sst (2 req'd)	1H26603703D		(not shown)	
9	Dial Screw, steel pl	1J84152898D	40	Machine Screw, steel pl (4 req'd)	1A33212898
0.	Dial, sst		41	Machine Screw, steel pl (4 req'd)	14B4995X01
	0-30 psig	16A7662X01D	42	Machine Screw, steel pl (4 req'd)	1V74352898
	0-60 psig	16A7662X02D	43	Machine Screw, steel pl, pressure block (4 req'd)	PC00000026
	0-100 psig	16A7662X03D		(not shown)	
	0-200 psig	16A7662X04D	44	Machine Screw, steel pl (9 req'd)	1A5733X001
	0-300 psig	16A7662X05D	45	Mounting Base, aluminum	2H26512501
	0-600 psig	16A7662X06D	46	Mounting Screw for reset valve (not shown)	1H52702898
	0-1000 psig	16A7662X07D	47	Nameplate Screw, steel pl	1C94192898

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Parts (cont'd)

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Par	(cont d)				
Key	Description	Part Number	83	Reset Plug and Wire Assembly	12B0468X01D
48	Nameplate, sst	PC0000013D	84	Spacer Ring, aluminum	38A3778X01D
49*	Nozzle O-ring, nitrile	1E22260699D	85	Spring Plate, steel pl	1H26972507D
50	Nozzle, Reversing Block, sst	1U63913513D	86	Top Diaphragm	1L55560204D
51*	O-ring, nitrile)	1D68750699D	87	Valve Plug, sst	0Y0617X002D
	-under reversing block screw (key 62)		88	Valve Spring, sst	0X08363702D
	-under reversing block (key 63)				
	-under sealing screw (key 66)		Мо	unting (See Figure 7 & 8)	
53	Pipe Plug, steel (not shown)	1A76752466D			
54	Pressure Set Arm, steel pl	PC0000012D	Key	Description	Part Number
55	Proportional Band Valve Assembly	10A9122X03D	89	Cap Screw, steel pl (4 req'd) for wall or	1B84802405D
56	Relay Assembly	22B0463X01D		Panel Mounting	
57*	Relay Gasket, neoprene	1C89740301D	90	Cap Screw, steel pl (specify qty req'd)	
58	Relay Tubing Assembly, sst	1H6861000AD		-5/16 UNC x 1 inch	1A35262405D
59	Reset Tubing Ass'y, sst	1H6866000AD		-5/16 UNC x 3/4 inch	1A38162405D
	4010		91	Cap Screw, steel pl (4 req'd)	1C33332898D
60	Reset Valve Ass'y	10A9129X0AD	92	Hex Nut, steel pl (4 req'd)	1C33282898D
	4010		93	Lockwasher, steel pl (2 req'd)	1C22572898D
61	Retaining Ring, Gauge Glass, sst (2 req'd)	PC00000006D	94	Machine Screw, steel pl (2 req'd)	1C63922898D
62	Reversing Block Screw, sst	24A5720X01D	95	Mounting Bracket, actuator casing, steel pl	1F40122507D
63	Reversing Block, steel pl	26A0975X01D		(not shown)	
64	Roll Pin, Door Hinge, sst (2 req'd)	1H28882899D	96	Mounting Bracket, actuator yoke, steel pl	1C22182502D
65	Rotary Spring, sst	1J42343702D		(not shown)	
66	Sealing Screw, sst	14A5721X01D		-Dyna-Flo Model DFC, DFR, and Others	

PC0000001D

16A0976X01D 1H26594401D

PC00000004D

1R98202507D

1E87302899D

Y602-12D

Relay (See Figure 3)

Washer, Dial, steel pl

Washer, Cal. Adjuuster, steel (2 req'd)

Spacer, aluminum Spring Washer, steel pl

Sleeve, Delrin

Vent Assembly

Set Point Adjustment Post, alum (not shown)

Key	Description	Part Number
75	Diaphragm Assembly	18A2451X01D
76	Diaphragm Casing Ass'y, aluminum/steel	12B0460X04D
77	Machine Screw, steel pl (4 req'd)	1A8664X00AD
78	Machine Screw, steel pl (6 req'd)	1C89692898D
79	O-ring, nitrile (2 req'd)	1D68750699D
80	Plate Gasket, neoprene	1H26960301D
81	Relay Body, aluminum/sst	48A3776X03D
82	Relay Spring, steel pl	1C89612701D

Commonly Replaced Part

Mounting Bracket, Panel or Wall, steel pl

Mounting Spacer, steel pl (specify qty req'd)

Mounting Bracket, pipestand

100 Pipe Mounting Clamp, steel (2 req'd)

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1H2892000AD

3N97572509D

1F90672409D

1P42702898D

14

67

69

70 71



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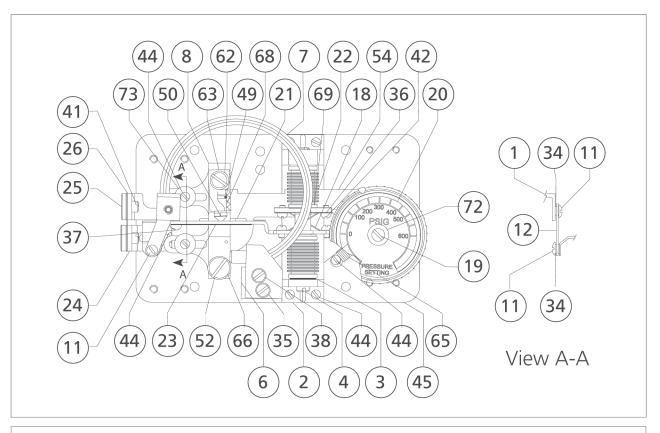
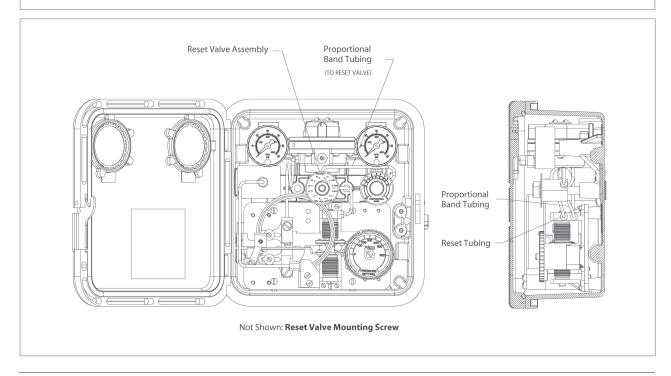


Figure 5 Sub-Assembly Detail

Figure 6 4010 Controller General Arrangement



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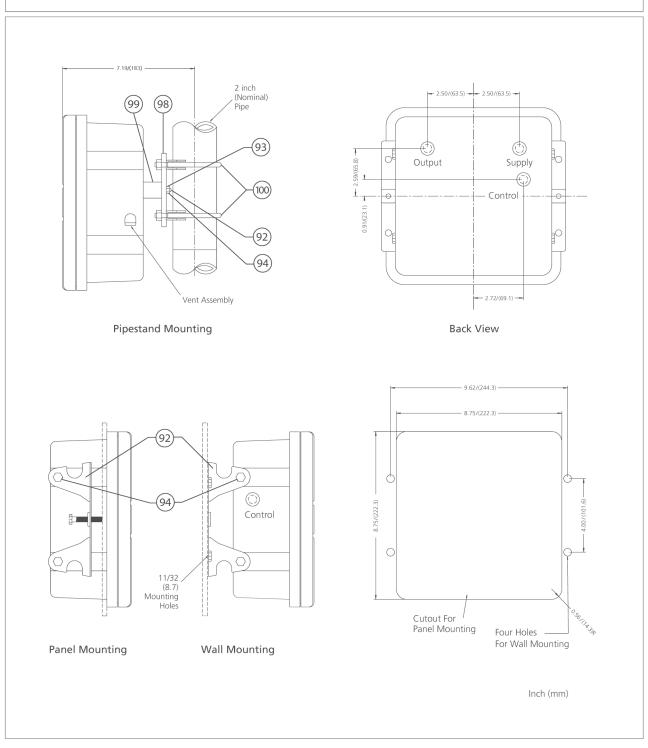
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Model

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7 Figure 12 Model 4000 Mounting Details, Pipestand, Surface, Panel

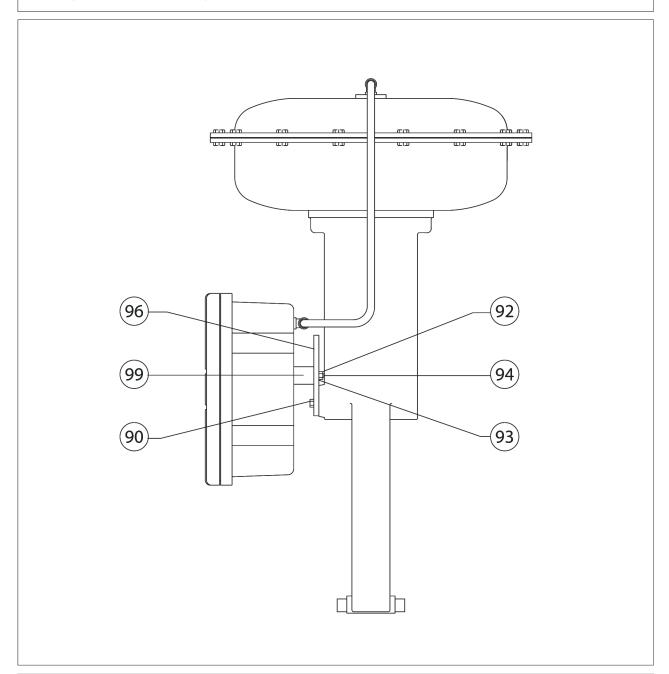


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▼ Figure 8 Model 4000 Mounting Details, Actuator yoke



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Instruction Manual

CVS 7970 High-Low Pressure Sensor

Introduction

This instruction manual includes the following information for CVS 7970 High-Low Pressure Pilot:

- 1. Description
- 2. Piston Arrangement Changeover Instructions
- 3. Parts Information

Only persons qualified through training or experience should install, operate and service this equipment. If you have any questions regarding this product or this manual, please contact your CVS Controls Sales Representative before proceeding.

Description

The CVS 7970 is a versatile sensor that can be programmed to detect and react to either increasing pressure or decreasing pressure with an adjustable range of 10 to 10,000 PSI (.689 to 689.5 Bar).

When used within standard safety systems, a pressure sensor monitors a specific media or process pressure source for changes to the normal operating range. Loss of pressure within the control circuit will begin a shutdown sequence or trigger an alarm, and pressure sensors can also indirectly operate on/off flow



Figure 1: CVS 7970 High/Low Pressure Sensor

control valves or pneumatic driven pumps. The CVS 7970 is a two position, three-way pilot with universal port (H, O, L), automatic reset (spring return) and pressure balance spool.

Each CVS 7970 is a self-contained unit containing necessary components for four different piston arrangements. Changeover instructions and drawings are included in this manual. Parts which are not installed in your current piston arrangement are kept in an enclosed storage tube. Machined within the piston housing of the CVS 7970 is a convenient 1/8"–27 NPT Female process connection and 1/2" NPT Male process connection.

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CVS

Controls Ltd.

Website: www.cvs-controls.com E-Mail: info@cvs-controls.com

205, 2323 – 32 Avenue NE Calgary, Alberta, Canada

T2E 6Z3

Office: (403) 250-1416 Fax: (403) 291-9487

Table 1: CVS 7970 Specifications

Dimensions		1.750" diameter x 8.0" length	
Working	Process Pressure Inlet	10,000 PSI Maximum (689.5 Bar)	
Pressure	Control Parts	125 PSI Maximum (8.62 Bar)	
Connections	Process Pressure Inlet	1/2"-14 NPT M and 1/8"-27 NPT F	
Connections	Control Ports	1/4"-18 NPT F	
Weight		3.5 lbs / 1.6 kg	
Panel Hole Cutout Size		1 5/8" (39.81 mm)	

One particular advantage of the CVS 7970 is its adjustment range capability. Because of the complete supplied components, there is no need to purchase and store additional sets of matching piston and spring components. The installation or reorientation of the existing piston components allows for an adjustment range capability of 10 to 10,000 PSI. This is especially convenient for remote facilities which require changes to pressure settings to match changes in process conditions.

Piston Arrangement Changeover Instructions

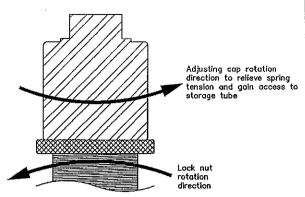
When your CVS 7970 High/Low Pressure Sensor is shipped, it is set with your specified piston arrangement and pressure setting. When it becomes necessary to adjust pressure setting to that which is out of range of the current piston arrangement, make use of the additional components stored in a tube within the piston housing.

The information in this manual, including the parts listings and piston detail drawings, will assist you in completing the Piston Arrangement Changeover.

Caution: Consult and follow the established safety procedures of your facility prior to beginning disassembly of any CVS Controls product. Ensure that all pressure is exhausted from the system prior to performing any service work. Failure to remove the pressure from the system can result in serious personal injury.

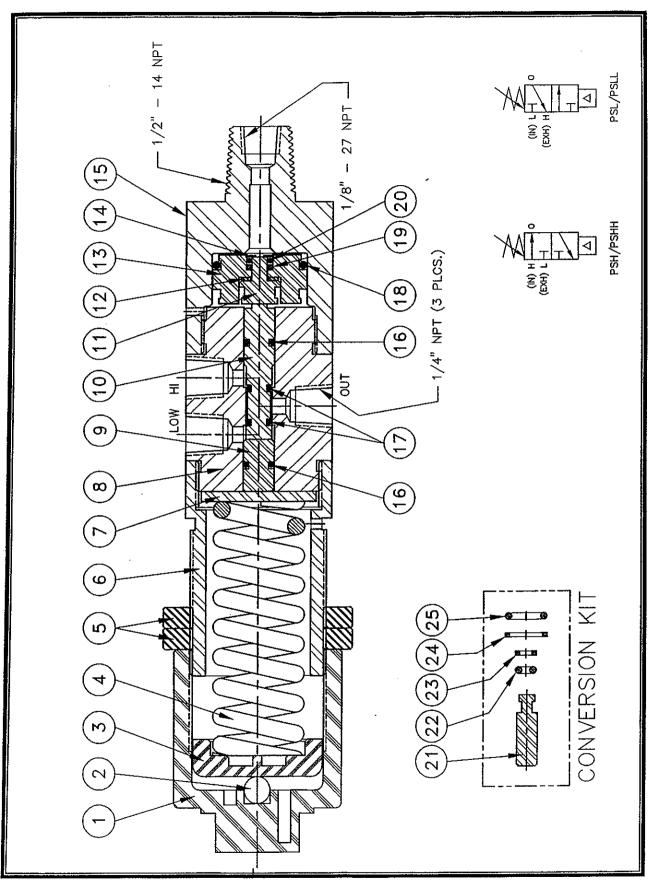
- 1. Isolate and depressurize the control system.
- Disconnect the control circuit instrumentation tubing from control valve, as well as the monitored process connection from the piston housing.
- Where possible, remove the CVS 7970 from the service location to perform the changeover in a clean work environment.
- 4. Loosen the lock nut and remove from the adjusting cap. (See figure 2)
- Gently relieve all spring tension by fully unscrewing the adjusting cap. This allows access to the storage tube.
- 6. Unscrew the piston housing from the valve body.
- 7. Turn the piston housing upside down and tap it gently on a flat, clean surface to remove the piston arrangement. The pistons should slide out easily.
- Thoroughly clean the piston components, including the piston housing and internal bores, using warm water and a liquid detergent. Do not use abrasive tools or acidic cleansers. Dry all components with a cloth or paper towel.
- Lightly lubricate all components and seals, and assemble the piston arrangement as desired according to the enclosed detail drawing.
- 10. When inserting the new piston arrangement into the piston housing, apply even pressure. Press evenly using both thumbs on the piston's outer edges for the insertion of the 1-1/8", 1/2" and 3/16" piston arrangements.
- 11. For the 1/4" piston insertion, install the 1/4" piston first, using a needle-nosed pliers. Then press the other piston components into place.

- Lightly lubricate the threads of the piston housing, body and spring housing. Be sure to use a grease or medium appropriate for stainless steel.
- 13. Reassemble the pressure sensor.
- 14. Adjust the pressure setting to the required amount, and function test the pressure sensor. When the desired setting is achieved, tighten the lock nut securely against the adjusting cap.
- 15. Connect the instrumentation tubing and the pressure connection to the monitored process.
- Introduce pressure to the pressure sensor's control circuit and monitored process inlet. Resume normal operation.



CVS 7970 High-Low Pressure Sensor

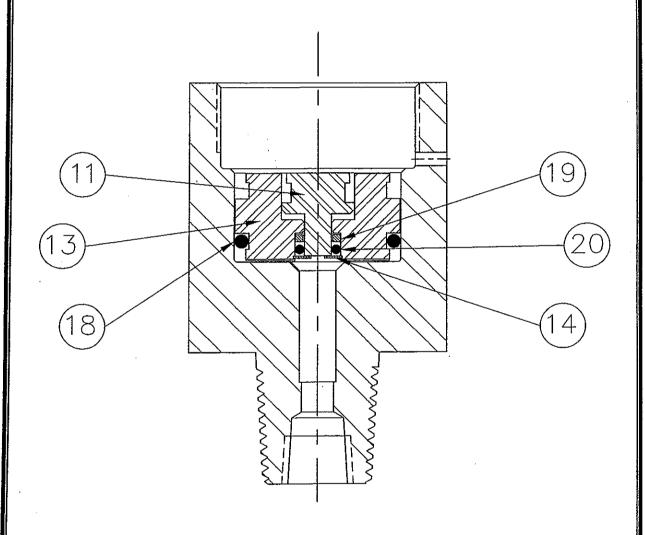
1	CVS79710A	1	Adjusting Cap	Black Delrin
		5/16" Ball Bearing	Stainless Steel	
3 CVS7911A		1	Spring Guide	Black Delrin
4	CVS7970A	11	Spring	302 Stainless Steel
5	CVS79712A	2	Lock Nut	Black Delrin
6	CVS79709A	1	Spring Housing	316 Stainless Steel
7	CVS79708	1	Stop Plate	316 Stainless Steel
8	CVS79704A	11	Body Housing	316 Stainless Steel
9	CVS79707A	1	Upper Stem	316 Stainless Steel
10	CVS79706A	1	Lower Stem	316 Stainless Steel
11	CVS79703A	1	Small Piston	316 Stainless Steel
12	CVS79705	1	Stop Washer	316 Stainless Steel
13	CS79702	1	Large Piston	316 Stainless Steel
14	CVS797014	1	Snap Ring	304 Stainless Steel
15	CVS79701A	1	Piston Housing	316 Stainless Steel
16	V-75-010	2	O-Ring	Viton
17	V-75-008	2	O-Ring	Viton
18	V-75-119	1	O-Ring	Viton
19	TFE-008	1	Back-Up Ring	Teflon
20	V-75-008	1	O-Ring	Viton
21	CVS79713A	1	1/4" Piston	316 Stainless Steel
22	V-75-006	1	O-Ring	Viton
23	TFE-006	1	Back-Up Ring	Teflon
24	TFE-012	1	Back-Up Ring	Teflon
25	V-75-012	1	O-Ring	Viton
O-Ri	ng Kits			
	70-BKK	1	Piston O-Ring Kit (Body Housing)	
V-75-0		1	O-Ring	Viton
V-75-0		1	O-Ring	Viton
CVS7970-Pkk		- 	Piston O-Ring Kit (Body Housing)	
V-75-006		1	O-Ring	Viton
V-75-0		1 1	O-Ring	Viton
		 i	O-Ring	Viton
V-75-1		+ +	O-Ring	Viton
TFE-00		1 1	Back-Up-Ring	Teflon
TFE-00		1	Back-Up Ring	Teflon
TFE-0		1 1	Back-Up Ring	Teflon



3/16 Piston Arrangement

Enlarged Detail Drawing

For pressures from 5900 to 10,000 PSI (406.8 to 689.5 Bar)

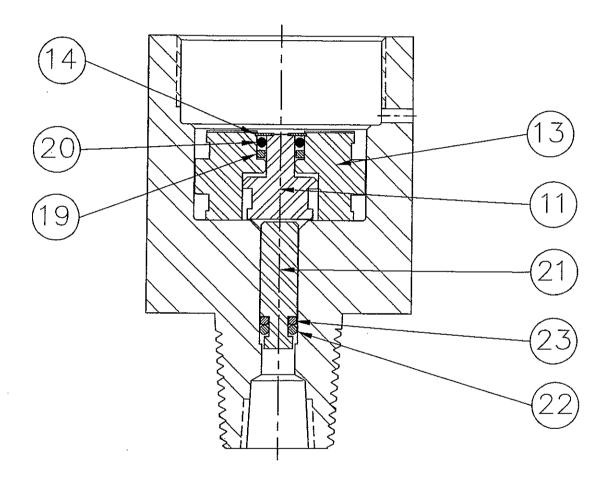


1	CVS79703A	1	Small Piston	316 Stainfess Steel
13	CS79702	1	Large Piston	316 Stainless Steel
13 14	CVS797014	1	Snap Ring	304 Stainless Steel
	V-75-119	1	O-Ring	Viton
19	TFE-008	1	Back-Up Ring	Teflon
18 19 20	V-75-008	1	O-Ring	Viton

1/4" Piston Arrangement

Enlarged Detail Drawing

For pressures from 1440 to 5900 PSI (99.28 to 406.8 Bar)

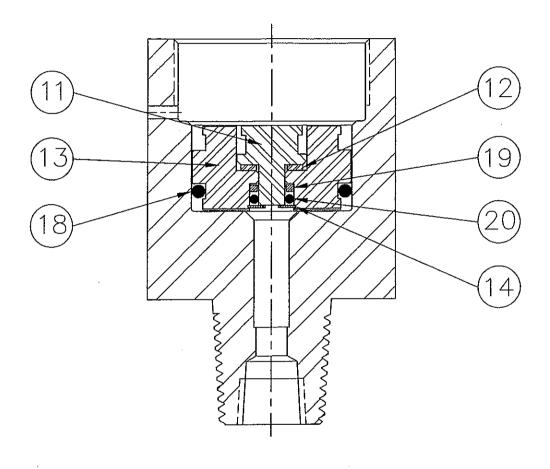


	Park State Day			
11	CVS79703A	1	Small Piston	316 Stainless Steel
13	CS79702	1	Large Piston	316 Stainless Steel
14	CVS797014	1	Snap Ring	304 Stainless Steel
19	TFE-008	1	Back-Up Ring	Teflon
20 21	V-75-008	1	O-Ring	Viton
21	CVS79713A	1	1/4" Piston	316 Stainless Steel
22	V-75-006	1	O-Ring	Viton
23	TFE-006	1	Back-Up Ring	Teflon

1-1/8" Piston Arrangement

Enlarged Detail Drawing

For pressures from 10 to 290 PSI (.689 to 20 Bar)

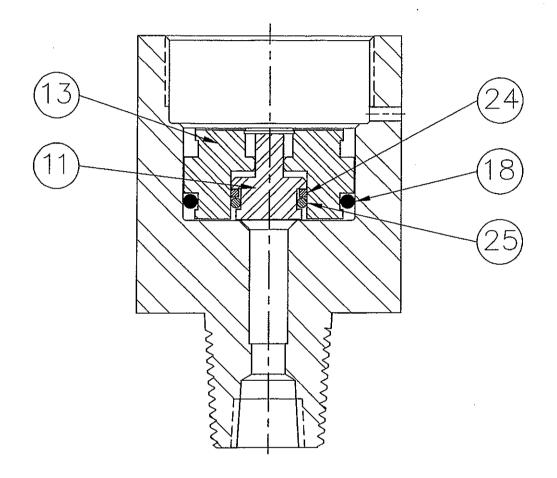


	医动脉 医阴道性皮肤			
11	CVS79703A	1	Small Piston	316 Stainless Steet
12	CVS79705	1	Stop Washer	316 Stainless Steel
13	CS79702	1	Large Piston	316 Stainless Steel
14	CVS797014	1	Snap Ring	304 Stainless Steel
18	V-75-119	1	O-Ring	Viton
19	TFE-008	1	Back-Up Ring	Teflon
20	V-75-008	1	O-Ring	Viton

1/2" Piston Arrangement

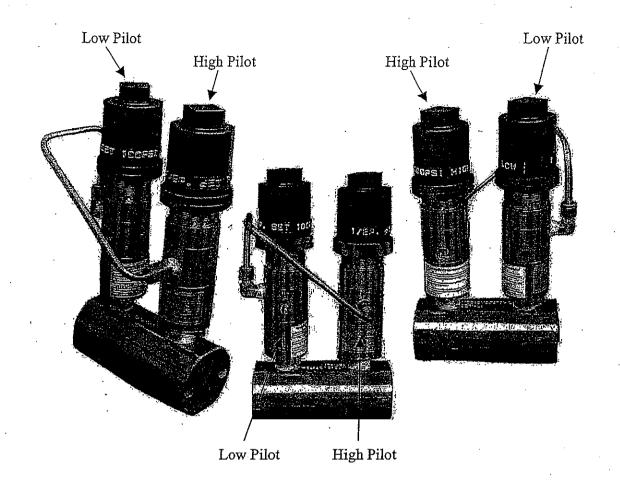
Enlarged Detail Drawing

For pressures from 290 to 1440 PSI (20 to 99.28 Bar)



11	CVS79703A	1	Small Piston	316 Stainless Steel
13	CS79702	1	Large Piston	316 Stainless Steel
18	V-75-119	1	O-Ring	Viton
24	TFE-012	1 1	Back-Up Ring	Teflon
24 25	V-75-012	1	O-Ring	Viton

Printed in Canada



7970 Hi and Lo Pilot Pressure Switch

Low Pressure Valve:

*Out Port ----

To Valve

*Hi Port

→ To Vent

High Pressure Valve:

*Hi Port

→

To (air/gas) Supply (Max Supply Pressure 125 psi)

*Lo Port

__ To Vent

Manifold:

*Either port for process

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April 2003

Type 4660 High-Low Pressure Pilot

The Type 4660 pneumatic high-low pressure pilot (figure 1) activates safety shutdown systems for flowlines, production vessels, and compressors. This pilot is available with either single or dual set point capability, using patented switch points, to maintain full output pressure when the process pressure is within the set point range. If the process pressure is outside this range, the pilot switches from full output pressure to zero output pressure.

The primary switching mechanism in this pilot is a block-and-bleed relay assembly. This construction can be used in both block-and-bleed and bleed-only systems.

Features

- Superior Performance—Repeatability meets the U.S. Minerals Management Service test tolerances referenced in Outer Continental Shelf (OCS) Order No. 5 and defined in the American Petroleum Institute (API) RP14C standard.
- Easy Maintenance—Simple modular construction plus a line of prepackaged parts kits makes pilot maintenance fast and easy.
- Reliable Operation—The pilot uses a field-proven Bourdon tube process pressure sensing element that reduces maintenance by eliminating the need for wetted dynamic O-rings.
- Environmental Packaging—Construction materials have been selected to protect the pilot from corrosive environments such as the salt spray atmosphere of offshore platforms.
- Vibration Resistance—The rugged Bourdon tube sensing element and shock-absorbing switch points dampen the effects of vibration while maintaining performance.



FRONT VIEW



LEFT SIDE WITH CASE COVER OFF

Figure 1. Type 4660 High-Low Pressure Pilot with Block and Bleed Relay

• Set Point Accuracy—Standard high-resolution set point adjustments are easy to set, non-interactive, and can be locked in place to maintain the desired set point. The optional set point indication assemblies on the front panel are easy to read and let you simply dial in the desired set point.





Table 1. Additional Specifications, Bar

BOURDON TUBE RATING(1)	SET RANGE(1)	SET POINT ∆P _I ALLOWABLE BETWEEN HIGH AN	TRIP-TO-RESET ZONE	
KATINGO		Single High-Low Unit	High-Only/ Low-Only Pair	
7	0.3 to 6.6	0.7	0.2	≤0.1
17	0.6 to 16.6	1.7	0.5	0.3
35	1.1 to 33.4	3.5	1.0	0.5
70	2.1 to 67.9	6.9	2.1	1.0
100	3.2 to 100.2	10.3	3.1	1.6
170	5.2 to 167.2	17.2	5.2	2.6
350	10.4 to 334.4	51.7	10.3	5.2
500	15.6 to 501.5	70.7	15.5	7.8
700 ⁽²⁾	20.7 to 668.8	103.4	20.7	10.3

Table 2. Additional Specifications, Psig

BOURDON TUBE RATING	SET RANGE	SET POINT AF ALLOWABLE BETWEEN HIGH AI	TRIP-TO-RESET ZONE	
RATING		Single High-Low Unit	High-Only/ Low-Only Pair	
100	3 to 97	10	3.0	≤1.5
250	8 to 242	25	7.5	3.8
500	5 to 485	50	15	7.5
1000	30 to 970	100	30	15
1500	45 to 1455	150	45	23
2500	75 to 2425	250	75	38
5000	150 to 4850	750	150	75
7500	225 to 7275	1025	225	113
10,000 ⁽¹⁾	300 to 9700	1500	300	150
1. Available in N05500 (K-Monel) or	nly, for NACE	-	ı	

- Cost-Effective Design—One pilot provides either a high-low function or a single switch point, whichever the application requires.
- Installation Versatility—Panel, rack, pipestand, or actuator mounting is available to meet field requirements.
- Operational Indications—A supply pressure test function is provided. The optional output indicator lets you check at a glance whether the pilot output pressure is at full output or zero output pressure.
- NACE Conformance—A K-Monel Bourdon tube is available for those applications where the pilot must meet the requirements of NACE Standard MR0175.

Specifications

Available Configurations

■ High-low, ■ low-only, or ■ high-only set point capability

Input Signal(1)

Type: Process pressure sensed with a Bourdon

tube

Bourdon Tube Ratings: See table 1 or 2 **Overpressure Protection:** Maximum allowable emergency process pressures and maximum allowable process pressures to ensure set point readjustability are shown in table 3

Output Signal⁽¹⁾

■ Zero pressure or ■ full supply pressure (automatically resets)

Supply Pressure(1),(3)

Normal Operating Pressure: 1.4 to 4.4 bar (20

to 65 psig)

Medium: Air or natural gas

Quality: Should be dry with solid particles

removed

Steady-State Air Consumption⁽²⁾

Output Signal at 0 psig: ≤0.134 normal m³/hr

(≤5 Scfh)

Output Signal at Full Supply Pressure:

 \leq 0.00134 normal m³/hr (\leq 0.05 Scfh)

Set Point Adjustments

Continuously adjustable between 3 and 97% of Bourdon tube rating; see table 1 or 2 for ranges

Performance in Percentage of Bourdon Tube Rating

Repeatability⁽¹⁾: ≤0.25%

Set Point ΔP_{min} . (See table 1 or 2)

Single High-Low Unit: 10% for up to 170 bar (2500 psig) Bourdon tubes; 15% for 350, 500, and 700 (NACE) bar (5000, 7500, and 10,000 (NACE) psig) Bourdon tubes

Low-Only and High-Only Pair: 3%

Trip-to-Reset Zone: ≤1.5% (see table 1 or 2)

Exhaust Capacity

C_a ≥15

Construction Materials

Case and Cover: Polyester

Front Cover: Tinted Lexan with scratch-resistant

coating

Base: Hard-anodized nickel-sealed aluminum

allov

Bourdon Tube: ■ 316 stainless steel, or

■ N05500 (K-Monel)

Relay Body, Relay Flange, Nozzle/Flapper Assembly Orifice Block, and Switch Point.

Housings: Glass-filled Ryton

Relay Diaphragm: ■ Nitrile/Polyester or ■ Fluorosilicone/Polyester (low temperature version), or ■ Fluoroelastomer/Polyester Relay Disks: ■ Nitrile, ■ Fluorosilicone (low

temperature version), or ■ Fluoroelastomer/Polyester

Process Pressure Block, Tubing, Front Plate, Flapper, Linkages, and Other Major Metal

Parts: Stainless steel

Gaskets: Neoprene and nitrile

O-Rings.

Relay: ■ Nitrile or ■ Fluoroelastomer

Switchpoint Assembly: Nitrile impregnated with

molybdenum disulphide Base/Case: Nitrile

Operating Conditions^{(1),(3)}

Condition	Normal Operating Limits	Nominal Reference
	Nitrile Elastomers: -40 to 60°C (-40 to 140°F)	
Ambient temperature	Fluoroelastomer Elastomers: -7 to 71°C (-20 to 160°F	21°C (70°F)
	Fluorosilicone Elastomers: (Low Temperature Version) -75 °F (-59°C)	
Process temperature	-29 to 93°C (-20 to 200°F)	21°C (70°F)

(continued)

Specifications (continued)

Operating Influences⁽¹⁾ on Switch Point Sensitivity

Supply Pressure: ≤0.05% of Bourdon tube rating

for a 10% change in supply pressure

Ambient Temperature: ■ ≤1.5% (standard construction) or ■ ≤2.5% (low temperature version) of Bourdon tube rating throughout normal

operating limits with nominal reference

Time: ≤1% of Bourdon tube rating over 30 days at ambient temperature nominal reference Process Pressure: Range shift or set point drift can occur if process pressure exceeds the

Bourdon tube rating

Pressure Connections

1/4 inch NPT female

Mounting

■ Panel, ■ rack, ■ pipestand, or ■ actuator

Approximate Weight

2.3 kg (5 pounds)

Options

■ Visual output indication, ■ fluoroelastomers in relay, ■ low-temperature version to -59°C-(75°F) ■ 316 stainless steel panel mounting flange, ■ set point indication, ■ tamper-resistant front cover, or ■ 1/2 inch NPT male pressure connections

Table 3. Maximum Allowable Process Pressure⁽¹⁾

BOURDON	TUBE RATING	MAXIMU	M ALLOWABLE EME	RGENCY PROCESS F	PRESSURE
Bar ⁽²⁾ Psig		Stainless Steel Bourdon Tubes		N05500 (K-Monel) Bourdon Tubes (NACE)	
	3	Bar ⁽²⁾	Psig	Bar ⁽²⁾	Psig
6.9	100	13.8	200	13.8	200
17.2	250	34.2	500	34.2	500
34.5	500	69.0	1000	69.0	1000
69.0	1000	138.0	2000	138.0	2000
103.4	1500	206.8	3000	206.8	3000
172.4	2500	344.8	5000	258.6	3750
344.8	5000	517.2	7500	430.9	6250
517.2	7500	646.3	9375	568.8	8250
689.5	10,000	N/A	N/A	758.5	11,000
	Maximum Allow	able Process Pressu	re to Ensure Set Poi	nt Readjustability ⁽³⁾	
6.9	100	13.8	200	13.8	200
17.2	250	34.8	500	22.3	325
34.5	500	51.7	750	53.4	775
69.0	1000	103.5	1500	89.7	1300
103.4	1500	155.1	2250	124.0	1800
172.4	2500	172.4	2500	227.5	3300
344.8	5000	517.2	7500	344.8	5000
517.2	7500	646.3	9375	517.2	7500
689.5	10,000	N/A	N/A	689.5	10,000

This term is defined in ISA Standard S51.1.
 Normal m³/h--Normal cubic meters per hour at 0°C and 1.01325 bar, absolute. Scfh--Standard cubic feet per hour at 60°F and 14.7 psia.
 The pressure/temperature limits in this bulletin and any applicable standard or code limitation for valve should not be exceeded.

Normal operating process pressures should not exceed the Bourdon tube rating.
 Ratings indicated on Bourdon tube are in psig and kPa (1 bar = 100 kPa).
 Values listed for the N05500 Bourdon tubes are for a 2% deviation from set point due to overpressure.

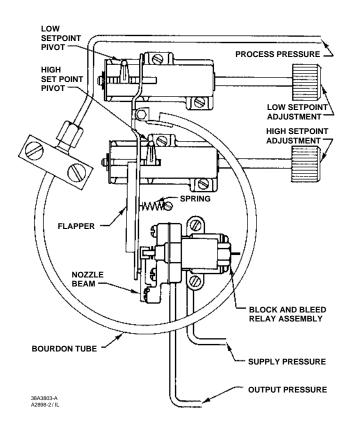


Figure 2. Principle of Operation Schematic

Principle of Operation

Refer to figure 2.

Process pressure is connected to the Bourdon tube sensing element. While the process pressure remains in the adjusted set ranges (between the low set point and the high set point), the flapper does not contact either set point pivot. This keeps the nozzle capped and maintains full output pressure.

As the process pressure decreases below the low set point value, the radius of arc of the Bourdon tube contracts. This causes the flapper to contact the low set point pivot and uncap the nozzle, which blocks supply pressure and vents (bleeds) output pressure. As the process pressure increases above the high set point value, the radius of arc of the Bourdon tube extends. This causes the flapper to contact the high set point pivot, also uncapping the nozzle and providing block-and-bleed action. When the process pressure returns to the set range, the nozzle is again capped, switching the relay back to maintain full output pressure.

Performance

The performance characteristics shown in figure 3 and table 4 illustrate several important functional parameters.

 S_L represents the low set point and S_H represents the high set point. The set range capability is 3 to 97 percent of the Bourdon tube rating. However, with a single high-low unit or a high-only/low-only pair, there is a limit on how close to each other the set points can be adjusted. This limit is defined as set point ΔP_{MIN} and is shown as S_L and S_H .

Trip-to-reset is the combined effect of pilot deadband and hysteresis. After the pilot has tripped, it automatically resets when the process pressure returns to the set range. However, full output pressure is not instantaneous. The difference between the set point and reset to full output pressure is the trip-to-reset zone. This parameter is also a function of the Bourdon tube rating as shown in figure 3 and table 4.

Repeatability is the switch point deviation around the set point as a percentage of the Bourdon tube rating.

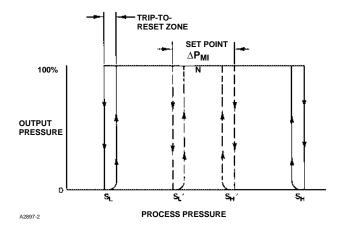


Figure 3. Performance Characteristics (also see table 4).

Table 4. Performance Characteristics

	PERCENT OF BOURDON TUBE RATING				
CONSTRUCTION	SET POINT ΔP_{MIN}	TRIP-TO-RESET ZONE	REPEATABILITY		
Single High-Low Unit	10 ⁽¹⁾	1.5	0.25		
High-Only/Low -Only Pair	3				
1. 5000 and 7500 P	sig Bourdon tube	s are 15 percent of Bou	rdon tube rating.		

Applications

Figure 4 shows some of the many ways in which the Type 4660 high-low pressure pilot may be connected to accommodate requirements for single and dual outputs as well as single and dual process pressure lines. Examples A and D in figure 4 show how a pair of high-only and low-only pilots are connected to obtain closer set points as specified by the set point ΔP_{MIN} values in tables 1 and 2. Example B or C shows connections for a two-segment flow line configuration that adheres to API Specification RP14C. Example E shows a typical connection to an electrical pressure switch.

Installation

Normal installation is with the pilot mounted vertically and the connections for process pressure, supply pressure, and output pressure facing down. The supply medium should be regulated dry air or natural gas with solid particles removed.

Figures 5 and 6 illustrate the mounting dimensions and the location of the pressure connections.

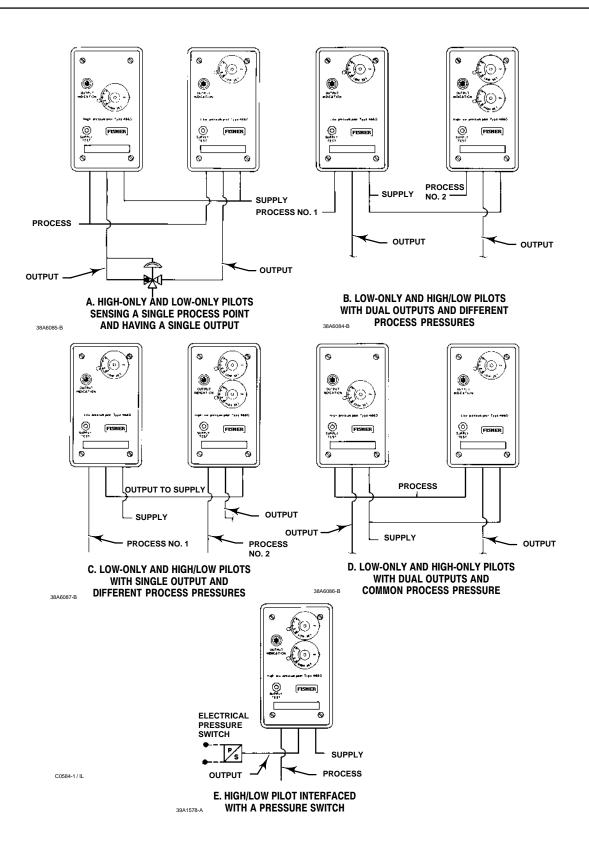
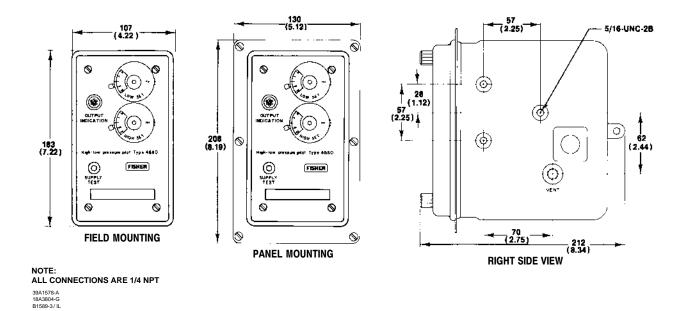


Figure 4. Typical Connection Schematics



186 (7.31) (0.19) (0.19) (0.19) (0.19) REAR REMOVAL

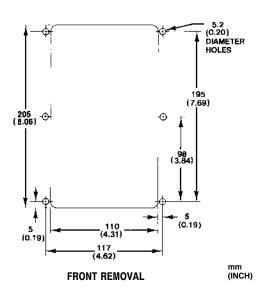


Figure 5. Panel Mounting Dimensions

18A3804-F A3299-1 / IL

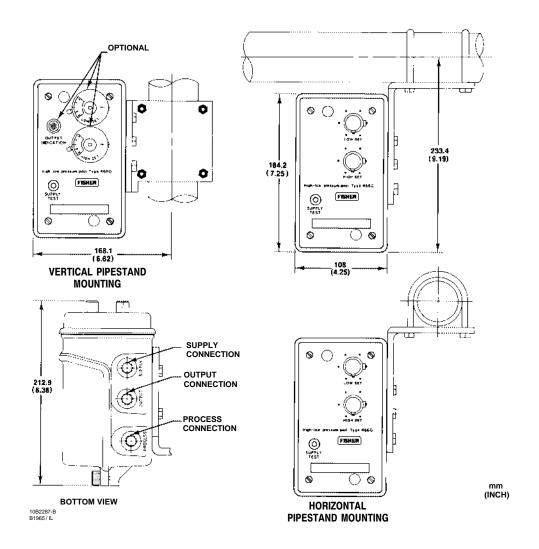


Figure 6. Pipestand Mounting Dimensions

4660 Pressure Pilot

Ordering Information

Note: Fisher does not assume responsibility for the selection, use, or maintenance of any product. Responsibility for the proper selection, use, and maintenance of any Fisher product remains solely with the purchaser and end-user.

When ordering, specify:

Application

Bourdon tube rating and material

- Composition, pressure, and temperature of the process fluid
 - Ambient temperature range
 - Description of application

Construction

Refer to the Specifications table. Review the information under each specification and in the referenced tables; specify the desired selection whenever there is a choice to be made.

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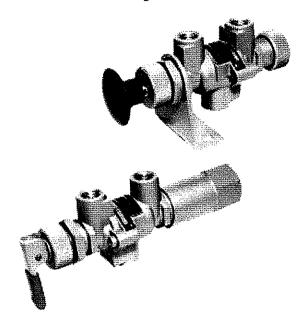
www.Fisher.com



AMOT CONTROLS

Model 4057/4457

3-Way Valves



FEATURES

- BALANCED FORCE DESIGN-PRESSURE CAN BE APPLIED TO ANY PORT
- **CENTER DEAD SPOT-STD.**
- **PORT OVERLAP-OPTIONAL**
- ARRANGED FOR PANEL OR BRACKET MOUNTING
- AVAILABLE IN ALUMINUM OR 316 STAINLESS STEEL

APPLICATIONS

- **HYDRAULIC FLUID CONTROL**
- ACTUATOR CONTROL
- **PNEUMATIC PANEL SYSTEMS**
- SAFETY CONTROL SYSTEMS

AMOT Model 4057 or 4457 Valves were developed for use in manual and automatic hydraulic or pneumatic control systems. They offer versatility in operating requirements and allowable pressure limits. For a 1/4" size control valve, they offer exceptional flow capacity.

These valves are suitable for use on clean air, natural gas, L.P. gases, petroleum-base lubricants and hydraulic oils as well as many other fluids.

Each valve is carefully assembled, tested, and inspected to ensure that high quality standards are met. Valves are made from precision cast and machined aluminum or stainless steel parts. The unique porting arrangement eliminates seal ring cutting, and permits pressure inlet at any port without danger of seal "blow out". Standard construction permits valve pressures to 125 psi.

Certain of these valves are completely unique in the industry. For example, the 4057 or 4457 Type CP has a manual reset latch which automatically will drop out on introduction of pilot pressure, and permits return stroke on loss of pilot pressure.

These valves make use of AMOT's patented "Tad-Pole" seal which provides for lower friction and longer cycle life than conventional O-rings. (U.S. Pat. No. 3,926, 444).

INSTALLATION

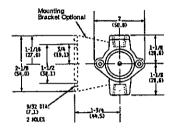
All connections on 4057 and 4457 Valves are made with 1/4" pipe thread fittings. Apply a quality thread sealant such as Loctite Pipe Sealant to pipe thread connections but do not permit it to enter the valve passages. Teflon thread sealing tape may be used but must be applied so that shreds of the tape do not enter the valve.

Avoid overtightening fittings on the valve port bosses as they may be cracked, especially when Teflon thread sealing tape is used.

All valves may be bracket mounted; most are also suitable for panel mounting. A Satin Chrome Nut, Part No. 3496L001, is available as an option for most types. It substitutes for standard Nut (8) to improve the appearance for front of panel mountings. A red Knob, Part No. 681L001, is available for Types CA, CB, CD or CE if desired as a substitute for standard black Knob (11).

DIMENSIONS

Dimensions in Inches Millimeters in ()

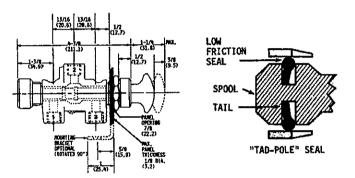


SPECIFICATIONS

Body Material4057; precision cast aluminum 4457; stainless steel
Standard Spool Materialglass reinforced Ryton
Standard Seal MaterialViton
Maximum Temperature
Flow Coefficient (equivalent to 9/32 dia. port) C =1.2
Maximum Pressure at Ports 1, 2 or 3 *125 psi (860 kPa)
Maximum Pressure at Ports A or B 150 psi (1034 kPa)
Maximum Pressure at Port C (Types CT & SB)
**125 psi (860 kPa)
Net Weight
4457; 1.7 to 5.7 lbs (0.8 to 2.6 kg)

* 150 psi (1034 kPa) if a slight increase in operating force and pressure acceptable.

** 350 psi (2411 kPa) if a suitable orifice is used to prevent damage to valve components from sudden application of pressure.

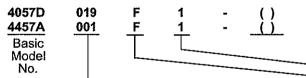


OPERATION

AMOT Model 4057 and 4457 3-Way Valves feature modular construction and incorporate a sliding spool. The standard spool has a small center dead spot position and no valve port overlap. With the spool fully to the left (rest position) as shown in the diagrams, Port 2 is open to Port 3 and Port 1 is closed. With the spool moved to the right (actuated

position), Port 2 is open to Port 1 and Port 3 is closed. The valves are available with a variety of manual and pressure operators and with manual, pressure or spring returns. See the Valve Type Description Table for the standard variations which are available.

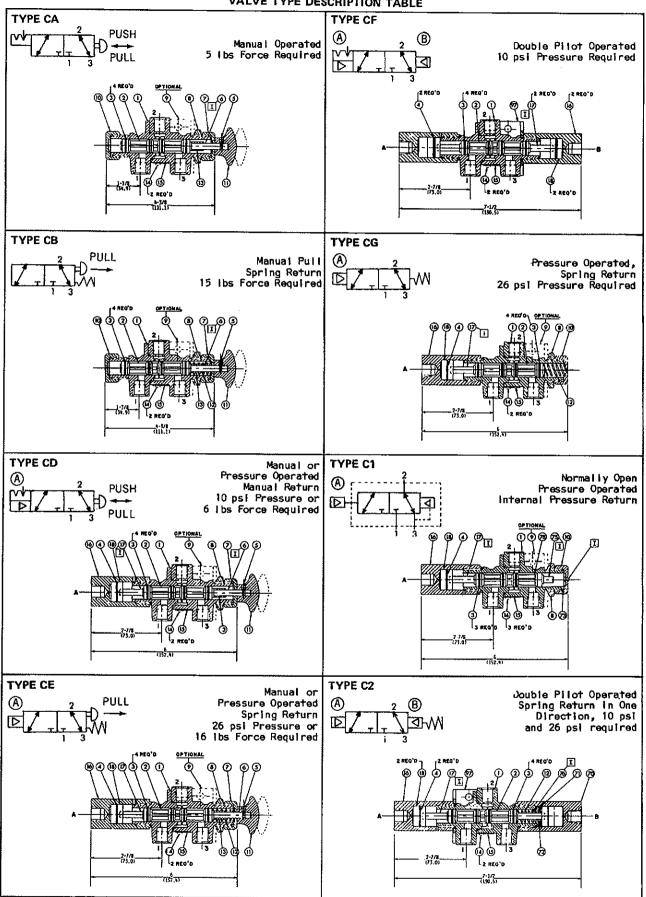
MODEL CODE SYSTEM



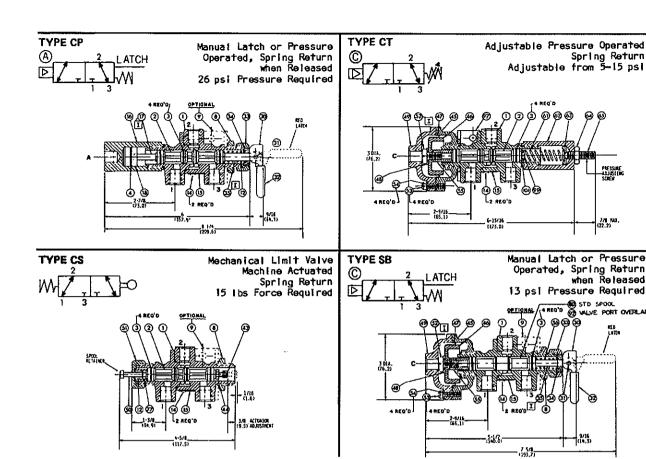
Note: Letters or numbers in the MTO space, other than nothing, A1 or AA, indicate the unit is built to special requirements and some of the other code numbers may not be valid Check with the factory for full specification of such models.

	Onerster	Table	Table B		ole C		
Valve Type	Stainless Steel NPT	Gulf- Proofed NPT	thread Code Stainless Steel *BSP (PL)	Gulf- Proofed *BSP (PL)	Seal Material Code No. Viton	Stan- dard	Valve Port Overlap
CA CB CD CE CP SB CT CG CF	001 002 004 005 007 013 014	019 020 022 023 025 027 029 031 032 035	073 074 076 077 079 085 086	091 092 094 095 097 099 101 103 104	FEHHHKKHJJ	1 1 1 1 1 5 1 1	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

- * Available from U.K. Factory Only
- - Not Available



Note: The symbol $\[\]$ does not designate a detent, but indicates that the valve has a memory and that the piston will remain in position until moved.



MAINTENANCE

AMOT 4057 and 4457 Valves make use of AMOT's "Tad Pole" rubber seals to provide low operating forces and high cycle life. Wear can be observed by checking for leakage which will increase as there is more wear.

To check the seal rings, the valve spool can be removed. This is done on most versions by simply removing the end cap and pulling out the spool. Spools on panel mounted valves can be removed from in front of the panel without disconnecting any piping.

To replace seal rings, remove the spool, take off the old rings, thoroughly clean the grooves, and coat the grooves with Dow Corning No. 33 grease (AMOT Part No. 911L001). Lightly coat the new rings with grease and install them, first inserting the thin tail section of the ring into one side of the groove. Work around the ring until it is uniformly positioned. Remove excess grease and reinstall the piston.

When these valves are used in safety control systems, it is recommended that the system be checked monthly for proper functioning.

When communicating with AMOT regarding operation of a control, always give the Model No. and Serial No. If ordering service parts, also include the Description, Part No., and quantity desired. If any parts are ordered by Reference No. only, please include the Form No., Revision No., and date of the brochure.

SERVICE KITS

Ref No.	Part No.	Qty	Description	
For all Types except CT & SB (Viton) Kit 9113X001				
3	7896L002	4	Seal Ring, Viton	
4	7898L002	2	Seal Ring, Viton	

Service Kit 9113X002 may contain extra parts when used with some valve types.

For Types CT & SB (Viton)			Kit 9128X001
3	7896L002	4	Seal Ring, Viton
47	2254L002	1	Diaphragm, Viton
48	7898L002	1	Thread Seal

SERVICE PARTS

Ref No.	Part No.	Qty	Description
1101110.	i ait ivo.	Gry	Bescription
3	7986L002		Seal Ring, Viton
4	7898L002		Seal Ring, Viton
47	2254L002		Diaphragm, Viton, for Types CT & SB
48	714L004		Seal Ring, Viton

These Parts Lists effective with Valve Serial No. C761.

AMOT Controls Corporation
401 First Street
Richmond, CA 94801
Tel: (510) 236-8300
Fax: (510) 234-9950

AMOT Controls Ltd.
Western Way
Bury St. Edmunds IP33 3SZ
Suffolk England
Tel: (01284) 762222
Fax: (01284) 760256

AMOT Controls Corporation 230 Orchard Road # 09-230 Faber House Singapore 238854 Tel: (65) 235-8187 Fax: (65) 235-8869

Installation & Maintenance Instructions

3-WAY DIRECT-ACTING SOLENOID VALVES UNIVERSAL OPERATION — 1/4" NPT — 1/16" ORIFICE **BRASS OR STAINLESS STEEL CONSTRUCTION** AIR OR INERT GAS SERVICE

SERIES 8314

Form No.V6855R1

IMPORTANT: See separate solenoid installation and maintenance instructions for information on: Solenoid Temperature, Causes of Improper Operation, Coil or Solenoid Replacement.

DESCRIPTION

Series 8314 valves are 3-way direct-acting solenoid valves designed for air or inert gas service. Valve bodies are made of rugged brass or stainless steel. The valves may be provided with a low power or intrinsically safe solenoid.

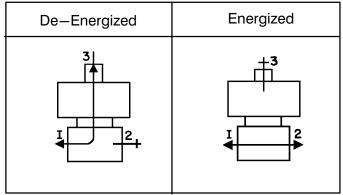
OPERATION

Universal (Pressure at any orifice)

Solenoid De-energized: Flow is from I to 3 or from 3 to I. Port 2 is closed.

Solenoid Energized: Flow is from I to 2 or from 2 to I. Port 3 is closed.

Flow Diagrams



INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Temperature Limitations

Fluid and ambient temperature range: -40° F to $+140^{\circ}$ F.

Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

Positioning

Valve may be mounted in any position.

Mounting

Refer to Figure 1 for mounting brass valve with mounting bracket or directly to valve body. Refer to Figure 2 for mounting stainless steel valve with mounting bracket.

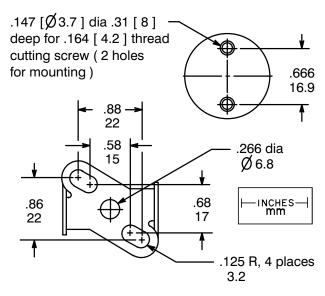


Figure 1. Dimensions for direct mounting to valve body or mounting bracket for brass valve construction.

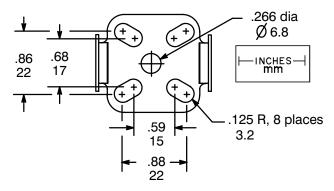


Figure 2. Mounting bracket dimensions for stainless steel valve.

Piping

Connect piping or tubing to valve according to markings on valve body. Refer to flow diagrams in *OPERATION* section.

To avoid damage or accidental **A** CAUTION: disengagement of cartridge assembly from valve body, hold cartridge assembly securely by wrenching flats when installing or removing piping at Port 3.

Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve ands cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

Page 1 of 2 Automatic Switch Co. MCMXCIII All Rights Reserved. Printed in U.S.A.

IMPORTANT: These solenoid valves are intended for use on clean dry air or inert gas, filtered to 50 micrometres or better. The dew point of the media should be at least 10° C (18° F) below the minimum temperature to which any portion of the clean air/inert gas system could be exposed to prevent freezing. If lubricated air is used, the lubricants must be compatible with Buna N elastomers. Diester oils may cause operational problems. Instrument air in compliance with ANSI/ISA Standard S7.3-1975 (R1981) exceeds the above requirements and is, therefore, an acceptable media for these valves.

MAINTENANCE

A WARNING: To prevent the possibility of personal injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before servicing the valve.

NOTE: It is not necessary to remove the valve body from the pipeline for repairs. However, piping or tubing must be removed from Port 3 connection.

Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to shift. Clean strainer or filter when cleaning the valve.

Preventive Maintenance

- Keep the medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service condition, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Causes of Improper Operation

- **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
- Disassemble valve and install a **Excessive Leakage:** complete ASCO Rebuild Kit.

Valve Disassembly

- 1. Disassemble valve in an orderly fashion using exploded view for identification and placement of parts.
- 2. Remove solenoid, see separate instructions.
- 3. Unscrew cartridge assembly from valve body. remove cartridge gasket and orifice gasket.
- 4. Clean valve and install a complete ASCO Rebuild Kit.

Valve Reassembly

- 1. Lubricate all gaskets with DOW CORNING® 111 Compound lubricant or an equivalent high-grade silicone
- 2. Position cartridge gasket in valve body.
- 3. Install orifice gasket in recess in base of cartridge assembly.
- Thread cartridge assembly with orifice gasket into valve body. Then torque cartridge assembly to 175 ± 25 in—lbs $[19.8 \pm 2.8 \text{ Nm}].$
- 5. Install solenoid see separate instructions. Then make up piping and electrical connection to solenoid.

A WARNING: To prevent the possibility of personal injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.

- 6. Restore line pressure and electrical power supply to valve.
- 7. After maintenance is completed, operate the valve a few times to be sure of proper operation.

ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk (*) in the exploded view are supplied in Rebuild Kits. When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

Torque Chart

Part Name	Torque Value In-lbs	Torque Value Nm
Cartridge Assembly	175 ± 25	19,8 ± 2,8

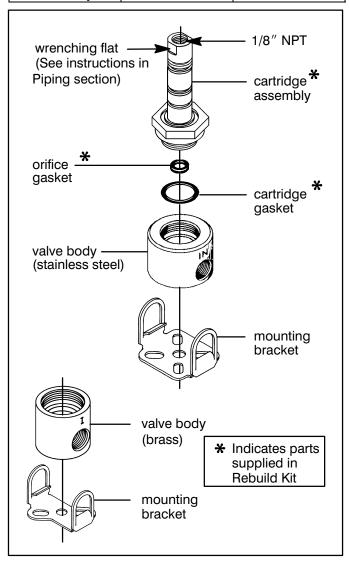


Figure 3. Series 8314 without solenoid.

Form No.V6855R1 Page 2 of 2

CATA-DYNE™ HEATER

STANDARD HEATER APPLICATIONS

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.





INSTALLATION & OPERATION INSTRUCTIONS

The Cata-Dyne[™] heater can be used in all industrial indoor locations where a source of infrared radiant heat is required, providing adequate ventilation is available.

CERTIFICATION

Model WX (Series X) Cata-Dyne[™] Explosion-proof, flameless infrared catalytic gas heaters are certified by the Canadian Standards Association (CSA) for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations and Factory Mutual Global (FM), for use in Class I, Division 1, Group D hazardous (classified) locations, temperature code T2C at an ambient temperature of 40°C (104°F).

The Model BX (Series G) Cata-Dyne[™] heater is certified by CSA and FM for use in general industrial non-hazardous locations. The MKII model (Series X) Explosion-proof, flameless infrared catalytic gas heater is certified by CSA for use in Class I, Divisions 1 and 2, Group D hazardous (classified) locations. Models listed are certified for industrial use only, for either natural gas or propane gas. CSA approved models are equipped for high altitudes: 0 - 4,500 ft. (0-1,370 m) above sea level.

INSTALLATION

To ensure maximum efficiency of your Cata-Dyne[™] heater, it should be installed with the heating surface positioned plus or minus 45° from the vertical plane at a height of no more than 8 ft.(2.44 m). All heaters must be installed in accordance with the latest revisions of the *Canadian Electrical Code*, CAN/CGA-B149.1, the *Natural Gas Installation Code* and/or CAN/CGA-B149.2, the

Cata-Dyne™ Heater - Models Available							
	WX Model (Series X)						
Approved for	or use in Class I, Divis	sion 1 and 2, Group D	hazardous (clas	sified) locations by b	oth FM and CSA		
Model Number	For Both Natural and Probabe Gas		Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas			
Nullibei	Max. Btu/hr	Max. kW	Nullibei	Max. Btu/hr	Max. kW		
WX 6 x 6	1,000 Btu/hr	0.293 kW	WX 18 x 24	12.000 Btu/hr	3.514 kW		
WX 6 x 12	2,000 Btu/hr	0.586 kW	WX 18 x 30	15,000 Btu/hr	4.393 kW		
WX 6 x 24	4,000 Btu/hr	1.171 kW	WX 18 x 36	18,000 Btu/hr	5.272 kW		
WX 6 x 60	10,000 Btu/hr	2.929 kW	WX 18 x 48	24,000 Btu/hr	7.029 kW		
WX 8 x 8	1,778 Btu/hr	0.521 kW	WX 18 x 60	30,000 Btu/hr	8.786 kW		
WX 10 x 12	3,333 Btu/hr	0.976 kW	WX 18 x 72	36,000 Btu/hr	10.543 kW		
WX 12 x 12	4,000 Btu/hr	1.171 kW	WX 24 x 24	16,000 Btu/hr	4.686 kW		
WX 12 x 24	8,000 Btu/hr	2.343 kW	WX 24 x 30	20,000 Btu/hr	5.857 kW		
WX 12 x 36	12,000 Btu/hr	3.514 kW	WX 24 x 36	24,000 Btu/hr	7.029 kW		
WX 12 x 48	16,000 Btu/hr	4.686 kW	WX 24 x 48	32,000 Btu/hr	9.372 kW		
WX 12 x 60	20,000 Btu/hr	5.857 kW	WX 24 x 60	40,000 Btu/hr	11.715 kW		
WX 12 x 72	24,000 Btu/hr	7.029 kW	WX 24 x 72	48,000 Btu/hr	14.058 kW		
	Approved for use in g		(Series G) -hazardous local	ions by both FM and	CSA		
Model Number		u/hr Input Ratings) and Propane Gas	Model Number		u/hr Input Ratings) and Propane Gas		
Nullibei	Max. Btu/hr	Max. kW	Mailinei	Max. Btu/hr	Max. kW		
BX 6 x 6	1,500 Btu/hr	0.4 kW	BX 18 x 24	18,000 Btu/hr	5.3 kW		
BX 6 x 12	3,000 Btu/hr	0.9 kW	BX 18 x 30	22,500 Btu/hr	6.6 kW		
BX 6 x 24	6,000 Btu/hr	1.8 kW	BX 18 x 36	27,000 Btu/hr	7.9 kW		
BX 8 x 8	3,500 Btu/hr	1.0 kW	BX 18 x 48	36,000 Btu/hr	10.5 kW		
BX 10 x 12	5,000 Btu/hr	1.5 kW	BX 18 x 60	45,000 Btu/hr	13.2kW		
BX 12 x 12	6,000 Btu/hr	1.8 kW	BX 18 x 72	54,000 Btu/hr	15.8 kW		
BX 12 x 24	12,000 Btu/hr	3.5 kW	BX 24 x 24	24,000 Btu/hr	7.0 kW		
BX 12 x 36	18,000 Btu/hr	5.3 kW	BX 24 x 30	30,000 Btu/hr	8.8 kW		

Approved for use in Class I, Division 1 and 2, Group D hazardous (classified) locations by CSA

BX 24 x 36

BX 24 x 48

BX 24 x 60

BX 24 x 72

36,000 Btu/hr

48,000 Btu/hr

60.000 Btu/hr

72.000 Btu/hr

10.5 kW

14.1 kW

17.5 kW

21.0 kW

Model Number	Specifications (Btu/hr Input Ratings) For Both Natural and Propane Gas				
Number	Max. Btu/hr Max. kW				
MKII 12 x 12	4,000 Btu/hr	1.171 kW			
MKII 12 x 24	8,000 Btu/hr	2.343 kW			
MKII 24 x 24	16,000 Btu/hr	4.686 kW			

MKII Model (Series X)

7.0 kW

8.8 kW

10.5 kW

BX 12 x 48

BX 12 x 60

BX 12 x 72

24.000 Btu/hr

30,000 Btu/hr

36.000 Btu/hr

Model WX Series Heaters are certified for use in Class I, Division 1 and 2, Group D hazardous locations by both FM and CSA/CGA

The WX Series Cata-Dyne™ features an improved efficiency catalyst pad that requires 1/3 less fuel to generate the same heat value as our BX Series Cata-Dyne™ heater.



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Propane Installation Code and/or any local codes and regulations. Before installing the heater, all information on the heater nameplate must be carefully reviewed. The nameplate lists all the fuel and electrical requirements for the heater.

SPECIFICATIONS

Clearances

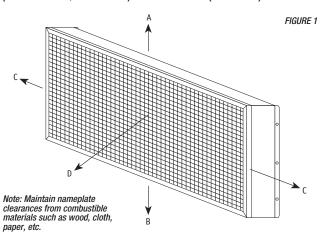
Appropriate clearances from the heating surface must be observed during the installation of the Cata-Dyne[™] heaters (See Figure 1). Maintain nameplate clearances from combustible materials such as wood, cloth, paper, etc.

Fuels

The Cata-Dyne $^{\text{TM}}$ flameless gas heater is designed to operate on clean, dry natural or propane gas as specified on the heater nameplate.

Natural Gas – these heaters are designed to use natural gas (1000 Btu/ft³, 37 MJ/m³) at 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa).

Propane – these heaters are designed to use propane gas (2500 Btu/ft³, 88 MJ/m³) at 11 in. w.c. (2.72 kPa).

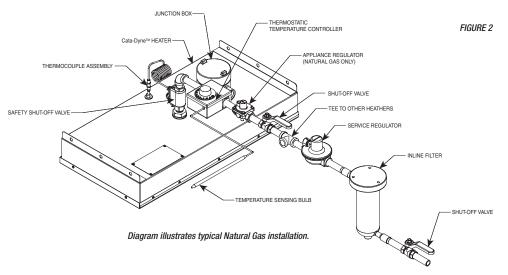


HEATER CLEARANCE										
	Radiant Surface			Sides	Тор		Bottom			
Radiant Surface Position	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr	All Heaters Up To 72,000 Btu/hr	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr	Heaters Up To 12,000 Btu/hr	Over 12,000 Up To 48,000 Btu/hr	Over 48,000 Up To 72,000 Btu/hr
Vertical (0°)	28 in.	42 in.	60 in.	12 in.	18 in.	18 in.	42 in.	7 in.	12 in.	18 in.
0-45° up	28 in.	42 in.	60 in.	12 in.	18 in.	32 in.	54 in.	0 in.	12 in.	18 in.
0-45° down	28 in.	42 in.	60 in.	12 in.	18 in.	18 in.	18 in.	22 in.	24 in.	42 in.

Piping

- 1. A main shut-off valve must be installed upstream of all auxiliary heater controls.
- 2. The 100% safety shut-off valve and appliance regulator (natural gas heaters only) must be installed in the upright position.
- 3. The thermostatic temperature controller should be installed with the dial shaft in the horizontal position.
- 4. The maximum inlet pressure to the 100% safety shut-off valve, thermostatic temperature controller and appliance regulator is 1/2 psi (3.4 kPa). If the inlet pressure is higher than this, a low-pressure service regulator must be installed upstream of these components.

- 5. The maximum inlet pressure to the low-pressure service regulator is 250 psi (1.7 MPa). If the inlet pressure is higher than this, a high-pressure regulator must be installed upstream.
- All components should be installed as indicated in Figure 2 (WX and BX models only) or Figure 3 (MKII model only).



Electrical

- All wiring is to be installed in accordance with the latest revisions of the Canadian Electrical Code (CEC) and/or any applicable local codes.
- 2. It is desirable to install an indicating light on all starting systems. This will reduce the possibility of the power being left on once the heater is started, which can severely reduce the lifespan of the heater.
- 3. Ground connections for 120 V and above heaters are required as indicated in Figures 4 and 5.
- 4. The number of terminals in the junction box can be two or four depending on the number of elements used in the fabrication of the heater. All MKII models incorporate a single element and therefore have only two terminals. The connection procedure for the different combinations is as described in Figures 4 and 5:

Ventilation

The catalytic reaction in Cata-Dyne[™] heaters occurs when natural gas or propane reacts with oxygen to produce water vapor, carbon dioxide and infrared energy. Ventilation must be provided to allow an adequate supply of oxygen for the reaction.

For every 1.0 ft² (0.093 m²) of heater surface, 40 ft³/hr (1.13 m³/hr) of air supply is required. For example, a WX 24 x 24 heater (16,000 Btu/hr / 4.686 kW) would require 160 ft³/hr (4.53 m³) of air to ensure proper operation of the Cata-Dyne TM heater.

To reduce the carbon dioxide and water vapor concentrations in the building, a vent hood assembly can be installed to provide positive ventilation from the heater (See Figure 6).

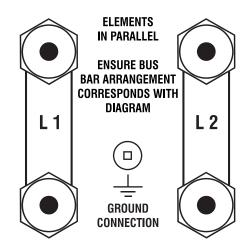
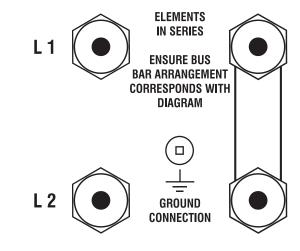
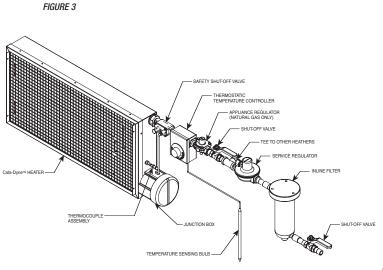


FIGURE 5

FIGURE 4





Tin. approx.

Vent hood

Wall mounting bracket

Dependant upon application

3 in. Snow cap

3 in. Snow cap

Wall mounting bracket

Diagram illustrates typical Natural Gas installation.

OPERATION

All Cata-Dyne[™] heaters are supplied with a Safety Shut-Off Valve (SSOV)/Thermocouple assembly to ensure the safe operation of the heater. Under no circumstances should the reset button be held or locked into the depressed position by use of a mechanical restraint. A tamper resistant model SSO V is available if desired.

Start-up

- 1. Ensure the heater has been installed according to all instructions and relevant codes.
- 2. Turn on the main gas supply to the system.
- 3. If the heater is equipped with a thermostatic temperature controller, rotate the dial completely clockwise to the fully open position.
- 4. Turn on the power to the electrical elements.
- 5. After 15 minutes, depress the reset button on the top of the 100% safety shut-off valve. The button should return to the original position and internally open the valve and allow gas to flow to the heater. If the valve does not stay open when the reset button is released, it may be necessary to wait an additional few minutes and then depress the reset button again. This will allow the electrical elements additional time to warm up.
- 6. When the catalytic reaction is well established, turn off the electrical power to the elements.
- If the heater is equipped with a thermostatic temperature controller, it can be set to the desired setting after the catalytic reaction has been established for at least one hour.

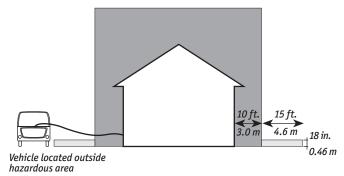
Shut down

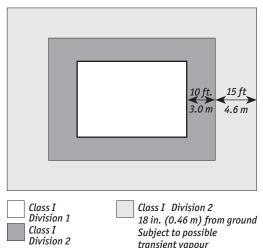
Turn off the gas supply to the heater.

Multi-heater start-up

Cata-Dyne $^{\text{TM}}$ heaters can also be purchased/installed in multi-heater assemblies. If these assemblies are 12 V, each heater must be started individually. This ensures the correct voltage and current will be reaching the heater from the power supply.

12 V HAZARDOUS ELECTRICAL INSTALLATIONS

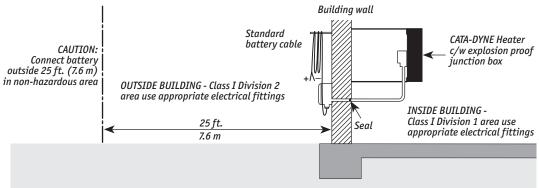




Most oil and gas production buildings have an area classification as follows:

- 1. Class I, Division 1, within the building.
- 2. Class I, Division 2, outside the building for a distance of 10 ft.(3.0 m) from the building at all elevations.
- 3. Class I, Division 2, outside the building for a distance of 25 ft.(4.5 m) from the building at an elevation of 18 in. (0.45 m) from the ground.

All electrical apparatus and wiring within this area must conform to the appropriate codes. Connection to the power supply must be outside of the Class I, Division 2 location.



SPOT HEATING

There are several factors to consider when Cata-Dyne[™] heaters are utilized for spot heating.

Infrared energy travels in straight lines from the face of the Cata-Dyne[™] heater covering approximately 160° of arc and is inversely proportional to the square of the distance. The heater should therefore be mounted as close as practical (min. of 8 in. (20 cm)) to the object requiring heat for maximum temperature rise.

Match the shape of the object requiring heat with the appropriate Cata-DyneTM heater, e.g. WX/BX 6 x 24 for long narrow objects or WX/BX 12 x 12 for a square object.

Objects requiring heat should be painted dull, dark colors for maximum infrared absorption and objects not requiring heat should be painted light or reflective colors.

Insulate and protect plastic, rubber and similar materials from direct intense infrared heat.

SPACE HEATING

A separate heat load calculation should be done for each building in which a Cata-DyneTM heater will be installed for space heating purposes.

The heat load calculation determines the building heat losses through the structure and allows for air infiltration (refer to the sample Heat Load Calculation in the Cata-Dyne TM catalogue).

Cata-Dyne[™] heaters produce low intensity infrared heat that is absorbed by objects within the range of the heat source. The closer the object is to the source of heat, the more heat the object will absorb. Cata-Dyne[™] heaters should be placed close to the floor level within the building to heat objects close to the floor.

Ideally, Cata-Dyne[™] heaters should be mounted 1-3 ft.(0.3-1 m) from the floor and equally spaced around the building perimeter for space heating applications.

If low mounting is not practical, then overhead mounting may be utilized. Overhead mounted heaters should be sloped face down to a maximum 45° angle to direct the infrared energy towards the floor. Overhead mounting should be restricted to heaters of 30,000 Btu/hr (8.8 kW) capacity and larger.

If the building requires only one heater, place the Cata-Dyne $^{\text{TM}}$ heater as close as possible to the center of the longest wall.

For multiple heater installations, space the Cata-Dyne $^{\text{TM}}$ heaters as evenly as possible around the perimeter of the building.

Make sure the piping is large enough to handle the gas load (refer to the sample Piping Calculation in the Cata-DyneTM catalogue for sizing information).

Make sure the electrical starting system has sufficient current carrying capacity and conforms to all applicable electrical codes.

It is advisable to install an indicator light in the electrical circuit to reduce the possibility of the power being left on once the heater is started.

PERSONAL SAFETY

The Cata-Dyne[™] flameless infrared catalytic gas heater does not produce harmful carbon monoxide gas when used with natural gas or propane. Adequate ventilation must be incorporated in any building design to ensure oxygen replenishment and removal of any carbon dioxide. Protective grills should be used on any installation where personnel may come in contact with the face of the heater.

ORDERING INFORMATION

You can order any of CCI Thermal's products by telephone, fax, mail or e-mail. To assist us in processing your order as quickly and efficiently as possible, please provide us with the following information:

- Cata-Dyne[™] product name
- Cata-Dyne[™] model number
- Fuel gas natural gas or propane
- Starting voltage 12, 24, 120, 208, 240, 480, or 600 V
- Accessories required:
 - Protection Grill
 - Wall Mount Brackets
 - Thermostat
 - Regulator
 - Start Up Leads (12 V system only)
 - Vent Hood
 - Other
- Company name and contact
- Billing address, phone number, fax or e-mail
- Shipping address and phone number
- Shipping instructions
- Special tagging instructions
- Date required
- Method of payment:
 - on account P.O. number required
 - credit card Visa or Mastercard number
 - cash or cheque

GUARANTEE

CCI Thermal warrants all Cata-Dyne[™] flameless infrared heaters sold to be free from defects in material or workmanship under normal use and service. The company agrees to repair or replace any Cata-Dyne[™] heater which, upon its examination, reveals it to have been defective due to faulty workmanship or material, if returned to our factory, transportation PREPAID, within one (1) year from date of purchase. The company does not assume responsibility for misuse or misapplication of its heaters.

Warranty is void if Cata-Dyne[™] heaters are used with sour, dirty or wet gas, or where sulphur content is greater than allowable for utility gas specifications. Warranty is void if, upon our inspection, the heater has been tampered with. Neither CCI Thermal nor the selling dealer shall be held responsible for loss of time, inconvenience, commercial loss or consequential damages relating to the use of Cata-Dyne[™] heaters.

RETURN GOODS POLICY

Prior written approval must be obtained from CCI Thermal for the return of any Cata-DyneTM product(s). A restocking charge of 15% will apply. All returns must be shipped to our factory in Edmonton, freight prepaid. Final acceptance will be contingent on inspection at our factory.

REPAIRS

Cata-Dyne[™] heaters may require periodic maintenance or repair. Our factory is staffed with technicians who are qualified to perform any required repairs. The procedure to follow to have a heater repaired is as follows.

Send the heater to our factory in Edmonton. Include the following information with the heater:

- Company name and address
- Contact name
- Telephone number/fax number/e-mail
- P.O. number
- Advise if an estimate is required prior to starting the repair
- Details on the repair or conversion required
- Return shipping instructions

NOTE: Under the terms of our certification, all repairs must be performed at our factory in Edmonton.

TROUBLE SHOOTING

- 1. Ensure that the fuel matches that listed on the nameplate.
- 2. Ensure that the voltage matches that listed on the nameplate.
- Check for any physical damage. All signs of physical damage to the catalyst pad such as holes, tears or a general deterioration of the catalyst bed signal that it is time to have the heater repaired.
- 4. Check the gas supply pressure at the heater 7 in. w.c. (1.73 kPa), 4.5 in. w.c. (1.12 kPa), or 3.5 in. w.c. (0.86 kPa) for natural gas and 11 in. w.c. (2.72 kPa) for propane.
- 5. Check the gas orifice for obstructions or dirt and ensure the size matches that listed on the nameplate. It may be necessary to install a filter upstream of the heater or regulator if the gas supply is dirty. If the fuel supply is constantly dirty and/or wet it would be advisable to use bottled propane fuel.
- Check the mounting position of the heater. The face of the heater should be preferably in the vertical position and should not vary more than 45° from the vertical position for maximum efficiency.
- 7. Check for saturation of the catalyst face caused by condensation or rain running down the face of the heater. If the heater has been exposed to water, it is advisable to place the unit in a warm area for a period of a few hours or longer if required. Once the moisture is removed, the heater can be re-installed and re-started.
- 8. Check the jumper cable size to ensure that the resistance of the cable is not reducing the current to the heater. This would not allow sufficient power to the electrical element to preheat the catalyst to the activity temperature. It is recommended to run the service vehicle at fast idle while starting the heater.
- 9. Cata-Dyne[™] heaters are designed to use clean fuel and to be used in non-contaminated atmospheres. Sulphur compounds in the fuel or atmosphere will poison the catalyst bed over a period of time and render the heater inoperative. If the heater has been exposed to sulphur compounds, it should be sent to the factory for service.
- 10. Avoid spraying the face of the heater with high-pressure air, steam or water because this can damage the catalyst bed. If physical damage is visible, return the heater to the factory for servicing.
- 11. Ensure that the temperature controller is correct for the model size, fuel, and pressure specifications for the heater it is fitted to. If the temperature controller is too low, the heater will not have sufficient fuel rating to operate and will stop.



Thermal
Systems Division
Cata-Dyne™ Infrared Ovens
QuikCat™ Infrared Ovens
DriQuik™ Electric Infrared

Safety Thermal
Products Division
Cata-Dyne™ Explosion-Proof
Infrared Gas Heaters
• Sure Seal Pipeline Systems™

SAFETY NOTICE 120/240 Volt Cata-DyneTM Heaters

Cata-Dyne[™] heaters using 120/240 volt electrical starting elements should have ground fault circuit interrupters (G.F.I.) installed in the electrical circuits to minimize the risk of damage caused by electrical element failure. The G.F.I. must be installed outside of the hazardous location.

Electrical element failures are rare and in most cases are caused by failure to turn off the electrical power to the Cata-DyneTM heater once it is started. Other potential causes for failure include corrosion and contamination. Installation of a G.F.I. should confine the damage caused by a short circuit within the electrical element to the interior of the element.

In all cases, electrical power must be turned off to Cata-DyneTM heaters once the heater is started. Failure to do so will cause damage to the heater and will create a potentially hazardous condition.

Cata-Dyne™ Technical Bulletin - Flo-Dri Gas Scrubbers

Ensuring the Efficient Operation of your Cata-Dyne™ Heater

Cata-Dyne[™] heaters, as with all other gas appliances, are designed to work on clean natural gas or propane. For optimal performance the operating fuel should have a calorific value of 1,000 Btu/Ft³ (37 MJ/m³) for natural gas or 2,500

Btu/Ft³ (93 MJ/m³) for propane.

The heat generated from a gas-fired catalytic heater is provided by a proprietary catalyst. Contamination in the fuel

source may deactivate this catalyst, allowing gas to pass through the heater's catalyst pad uncombusted. Other compo-

nents of the heater, including the thermocouple, safety shut-off valve (SSOV), thermostat, gas regulators, and insulation

will also be adversely affected by fuel contaminants. The most common contaminants of natural gas in the field, such as

may be supplied from a natural gas well, are moisture, minerals dissolved in moisture, hydrogen sulphide (H₂S), oil and

other liquids.

The Flo-Dri Gas Scrubber, available from CCI Thermal, is designed to remove these contaminants. The Flo-Dri units

contain a desiccant-based filter cartridge. Different filter cartridges are available depending upon the contaminants pres-

ent in the fuel source. Maximum working pressures of the units are 150 psig (G-10 Model only) and 250 psig (G-25,

G-60, G-100, and G-150).

How the Flo-Dri Gas Scrubber Works

The filtration process occurs in three stages:

1. Impaction: As gas enters the lower chamber it expands and impacts moisture droplets against the diffuser. As gas

passes through the filter, droplets coalesce forming larger drops that collect at the bottom of the scrubber. These can

be drained.

2. Adsorption: Gas flows through the desiccant and the filter media adsorbs the contaminants. Flo-Dri has a patented

spring-loaded cartridge that prevents channelling, particularly between the sidewalls and the fixed bed of desiccant.

As an additional feature, the filter design does not require a steady flow of gas.

3. Entrapment: The gas leaves through a special filter that traps any remaining particles. The outlet of larger Flo-Dri fil-

ters is furnished with a screen that is designed to remove particles from 0.5 microns and up.



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Why Clean Fuel is Important

The Cata-Dyne[™] heater will be less reliable if it is operated with contaminated fuel. The presence of moisture, minerals or hydrogen sulphide in the fuel supply speeds up the following processes:

- > Internal corrosion of the safety shut off valves (SSOV), regulators and thermostats.
- External corrosion of brass and copper components such as the thermocouple particularly in the presence of hydrogen sulphide.
- Sedimentation of minerals inside the SSOV's, regulators and thermostats, causing their malfunction. Mineral deposits inside the SSOV and/or external corrosion to the thermocouple will result in a weaker electromagnetic connection between the thermocouple and SSOV, causing the heater to shut down.
- Hydrogen sulphide is oxidised to elemental sulphur which is deposited on the surface of the catalytic pad and inhibits air diffusion to the pad.
- > Over time, hydrogen sulphide deactivates the catalyst, making it less efficient, eventually allowing greater amounts of uncombusted gas to pass through the catalytic pad into the surrounding area, creating a potentially dangerous situation.

Suggestions to Improve Performance

- ➤ The XX (H₂S) cartridge will only work on dry gas. If there is moisture in the fuel supply, the H₂S will not be adsorbed. Two filters may be required; the first to remove moisture and the second to remove H₂S.
- Filters used in conjunction with the Cata-Dyne[™] WX Series explosion-proof heater will last longer than filters used with the same size model of the discontinued BX Series explosion-proof heater; e.g., the XX cartridge filter in a G-10 gas scrubber used with a WX 12x24 heater will need to be changed every 87 days, while for a BX 12x24 heater the filter would need to be changed every 58 days, when the H₂S concentration is 10 ppm.
- Make sure you know the concentration of your contaminants. Use the tables shown to determine how often you will need to change your desiccant filter.
- Many customers ask if there is an allowable minimum concentration of fuel contaminants under which the Cata-Dyne[™] heater will operate efficiently. All gas appliances are designed to operate on clean gas; using the Flo-Dri filtration system ensures a pure gas supply. A comparison can be made to a car; it functions best with clean gasoline rather than a mixture of gasoline and impurities.

Table 1 - Recommended Frequency of Changeouts: XX Cartridge Filter

- > The XX cartridge filter is used for hydrogen sulphide (The gas must be dry. Otherwise the moisture will be adsorbed).
- > Filter change schedule is in days for natural gas containing 10 ppm of hydrogen sulphide.

WX Series	Rating Btu/hr	G10 Days	G25 Days	G60 Days	G100 Days	G150 Days
6" x 6"	1,000	696	936	1,680	2,848	11,152
6" x 12"	2,000	348	468	840	1,424	5,576
6" x 24"	4,000	174	234	420	712	2,788
8" x 8"	2,333	298	401	720	1,221	4,780
10" x 12"	3,333	209	281	504	854	3,346
12" x 12"	4,000	174	234	420	712	2,788
12" x 24"	8,000	87	117	210	356	1,394
12" x 36"	12,000	58	78	140	237	929
12" x 48"	16,000	44	59	105	178	697
12" x 60"	20,000	35	47	84	142	558
12" x 72"	24,000	29	39	70	119	465
18" x 24"	12,000	58	78	140	237	929
18" x 30"	15,000	46	62	112	190	743
18" x 36"	18,000	39	52	93	158	620
18" x 48"	24,000	29	39	70	119	465
18" x 60"	30,000	23	31	56	95	372
18" x 72"	36,000	19	26	47	79	310
24" x 24"	16,000	44	59	105	178	697
24" x 30"	20,000	35	47	84	142	558
24" x 36"	24,000	29	39	70	119	465
24" x 48"	32,000	22	29	53	89	349
24" x 60"	40,000	17	23	42	71	279
24" x 72"	48,000	15	20	35	59	232

The table shows cartridge changeout frequencies in days for each model heater and gas scrubber for H₂S concentrations of 10 ppm in natural gas. To determine the cartridge changeout frequency in days for other H₂S concentrations, use the formula given in the following example:

- ➤ Your installation has a Cata-DyneTM heater, model WX12x24, 8,000 Btu/hr natural gas using a model G10 Flo-Dri gas scrubber.
- \succ The concentration of H₂S in your gas supply is 25 ppm.
- > The changeout frequency for 10 ppm is 87 days (derived from the table above).
- > 87 days X 10 ppm / 25 ppm = 34.8 days.
- > The filter should be changed approximately every 35 days for the example above.

Table 2 - Recommended Frequency of Changeouts: AA and MS Cartridge Filters

- > AA and MS cartridge filters are used for moisture and minerals dissolved in moisture.
- > Filter change schedule in days for natural gas containing 50 ppm moisture.

WX Series	Rating Btu/hr	G10 Days	G25 Days	G60 Days	GIOO Days
6" x 6"	1,000	552	752	1,352	2,328
6" x 12"	2,000	276	376	676	1,164
6" x 24"	4,000	138	188	338	582
8" x 8"	2,333	237	322	580	998
10" x 12"	3,333	166	226	406	698
12" x 12"	4,000	138	188	338	582
12" x 24"	8,000	69	94	169	291
12" x 36"	12,000	46	63	113	194
12" x 48"	16,000	35	47	85	146
12" x 60"	20,000	28	38	68	116
12" x 72"	24,000	23	31	56	97
18" x 24"	12,000	46	63	113	194
18" x 30"	15,000	37	50	90	155
18" x 36"	18,000	31	42	75	129
18" x 48"	24,000	23	31	56	97
18" x 60"	30,000	18	25	45	78
18" x 72"	36,000	15	21	38	65
24" x 24"	16,000	35	47	85	146
24" x 30"	20,000	28	38	68	116
24" x 36"	24,000	23	31	56	97
24" x 48"	32,000	17	24	42	73
24" x 60"	40,000	14	19	34	58
24" x 72"	48,000	12	16	28	49

The table shows cartridge changeout frequencies in days for each model heater and gas scrubber for moisture concentrations of 50 ppm in natural gas. To determine the cartridge changeout frequency in days for other moisture concentrations, use the formula given in the following example:

- ➤ Your installation has a Cata-DyneTM heater, model WX12x24, 8,000 Btu/hr natural gas using a model G10 Flo-Dri gas scrubber.
- > The concentration of moisture in your gas supply is 25 ppm.
- > The changeout frequency for 50 ppm is 69 days (derived from the table above).
- ➤ 69 days X 50 ppm / 25 ppm = 138 days.
- > The filter should be changed approximately every 138 days for the example above.

DYNA-FLO

CONTROL VALVE SERVICES LTD.

Technical Bulletin:

DFC AND DFO VALVE ACTUATOR



Figure 1 Valve on left: DFC 2156 mounted on DF2000 Valve on right: DFO 2156 mounted on DF2000

The Model DFC and DFO series linear output spring and diaphragm actuator is used in all kinds of demanding applications. The large area of the diaphragm allows low-pressure operation, and the spring provides fail safe positioning of a control valve on loss of the pneumatic supply. The actuator stem extends in the fail safe mode of the Model DFC design, and the actuator stem retracts in the fail safe mode of the Model DFO design. Both model DFC and DFO are used to automate control valves in both throttling and on/off control of liquids or gases.

When combined with a Dyna-Flo Model DF2000 or 360 valve, the DFC or DFO is part of a rugged control valve assembly, to which a wide variety of controllers and instruments can be attached.

Dyna-Flo's high level of quality specifications used in the manufacture of the Model DFC and DFO series linear pneumatic actuators ensures superior performance and customer satisfaction.

Toll Free: 1-(866)-396-2356

Website: www.dynaflo.com

FEATURES

Reliable Design

Low pressure diaphragm and fail safe spring, with split clamp stem connector for accurate and safe operation.

Rugged Long Lasting Construction

Steel and thick section cast iron are used for structural components for a high factor of safety. The rigid structure is also a stable base for accurate and repeatable performance.

Specialized Diaphragm

The carefully contoured diaphragm provides minimal area change through its travel, which results in maximum accuracy and thrust.

Instrumentation Flexibility

The DFC and DFO actuators feature an open yoke – meaning the valve stem is open. This allows for a wide variety of instruments including positioners and limit switches to be mounted on the actuator.



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Technical Bulletin: **DFC AND DFO VALVE ACTUATOR**

Activo				Maximum Ca	sing Pressure	
Active Diaphragm	Thrust	Travel	D	FC	DI	FO
Area	Limit	Maximum	Sizing	Safety	Sizing	Safety
in2(cm2)	lb(N)	in.(mm)	psig (kPag)	psig (kPag)	psig (kPag)	psig (kPag)
46 (297)	2300 (10,200)	0.75 (19)	55 (380)	110 (760)	125 (860)	140 (960)
69 (445)	2300 (10,200)	0.75 (19)	70 (480)	90 (620)	65 (450)	75 (520)
69 (445)	2700 (12,000)	1.5 (38)	70 (480)	90 (620)	65 (450)	75 (520)
105 (677)	5600 (25,100)	2.0 (51)	65 (450)	75 (520)	50 (340)	60 (410)
156 (1006)	7500 (33,500)	2.0 (51)	55 (350)	65(450)	40 (280)	50 (340)
105 (677)	5600 (25,100)	2.0 (51)	65 (450)	75 (520)	50 (340)	60 (410)
156 (1006)	6800 (30,200)	2.0 (51)	55 (350)	65 (450)	40 (280)	50 (340)
220 (1420)	8800 (39,100)	4.0 (102)	50 (340)	60 (410)	55 (350)	65 (450)

Table 1 Maximum Travel, thrust and casing pressure for a given diaphragm area.

SPECIFICATIONS

Material Temperature Capabilities

 Standard: -40 to 180 degrees F (-40 to
 3156
 122 (55)
 116 (53)

 82 degrees C)
 3220
 254 (115)
 235 (107)

Construction Materials

See table 3 for construction details Contact your Dyna-Flo sales office for more informa-

tion and other options

Valve Stem Compatibility, inches (mm)

 1046, 1069
 3/8 (9.5)

 2069, 2105, 2156
 1/2 (12.7)

 3105, 3156, 3220
 3/4 (19)

Valve Mounting Connection Sizes, inches (mm)

1046, 1069 2-1/8 (54) 2069, 2105, 2156 2-13/16 (71) 3105, 3156, 3220 3-9/16 (90)

Actuator Weights, lb (kg)

	DFC	DFO
1046	34 (15)	36 (16)
1069	48 (22)	40 (22)
2069	50 (23)	51 (23)
2105	90 (41)	82 (37)
2156	121 (55)	107 (49)

Tubing Connection Size

All sizes, 1/4 inch FNPT, other sizes available

94 (43)

92 (42)

Actuator Mounting

3105

Vertical on valve yoke 360° rotatable for optimum accessory orientation

Actuator Dimensions

See figure 3 for actuator diagram
See table 2 for actuator dimensions

Options

Increased size tubing connection

Stem connections Mechanical Travel stops Manual overrides

Reduced travel output

Corrosion resistant materials

For more information and other options contact your Dyna-Flo sales office.

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CONTROL VALVE SERVICES LTD.

Technical Bulletin: DFC AND DFO VALVE ACTUATOR

10) will force the actuator stem (key 8) to retract, putting the valve in it's failsafe position.

Using a push down to close action valve with a Model DFO will result in a fail open valve assembly.

OPERATION

The Model DFC spring return diaphragm actuator employs time proven reliable technology. As the instrument signal to the sealed lower actuator casing (Key 3) is increased, the force generated by that pressure on the diaphragm (Key 12), and diaphragm plate (Key 10), force the diaphragm plate and actuator stem (Key 20) up, compressing the spring (key 2). The lifting action is transferred to the valve stem through a secure split and bolted stem connector (key 23). On a decrease, or complete loss of pneumatic signal, the actuator spring (Key 2) will force the actuator stem (key 20) to extend, putting the valve in it's failsafe position.

Using a push down to close action valve with a Model DFC will result in a fail closed valve assembly.

The Model DFO spring return diaphragm actuator is also time proven. Refer to Figure 4. As the instrument signal to the sealed upper actuator casing (Key 1) is increased, the force generated by that pressure on the diaphragm (Key 2), and diaphragm plate (Key 3), force the diaphragm plate and actuator stem (Key 8) down, compressing the spring (key 10). The extension action is transferred to the valve stem through a secure split and bolted stem connector (key 13). On a decrease, or complete loss of pneumatic signal, the actuator spring (Key

Handwheels

There are 2 types of manual override available for the DFC and DFO. The simple, cost effective option is the top mounted handwheel, and the more convenient option is the side-mounted handwheel.

The top mounted handwheel is a good choice for emergency only positioning of a valve, and it is commonly used as a travel stop. It is available for all sizes of DFC and DFO.

The side-mounted handwheel is the right selection for an application that requires frequent manual positioning. The flexibility of the side-mounted handwheel allows it to limit operation in either direction, but only one direction at a time. It is available for sizes 1069 and larger.

External Travel Stops

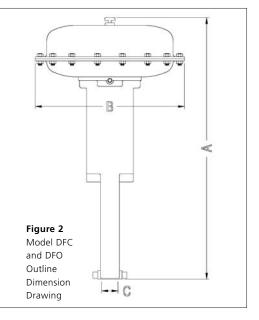
Top mounted handwheel based travel stops are available to restrict valve opening or closing. Configurations are available with caps to reduce tampering.

DFC ACTUATOR	DIMENSION REFERENCE					
Size	inch	(mm)	inch (mm)			
	A	A	В			
	DFC	DFO				
1046	18.8 (478)	17.3 (439)	11.4 (289)			
1069	22.6 (574)	19.6 (498)	13.1 (333)			
2069	23.4 (594)	21.6 (549)	13.1 (333)			
2105	30.3 (770)	25.9 (658)	16.0 (406)			
2156	29.4 (747)	25.8 (655)	18.6 (473)			
3105	30.9 (785)	28.4 (721)	16.0 (406)			
3156	30.9 (785)	28.4 (721)	18.6 (473)			
3220	36.8 (935)	33.1 (841)	21.1 (536)			

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Table 2 Model DFC and DFO Outline Dimensions in. (mm)



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Fax: (780)-469-4035

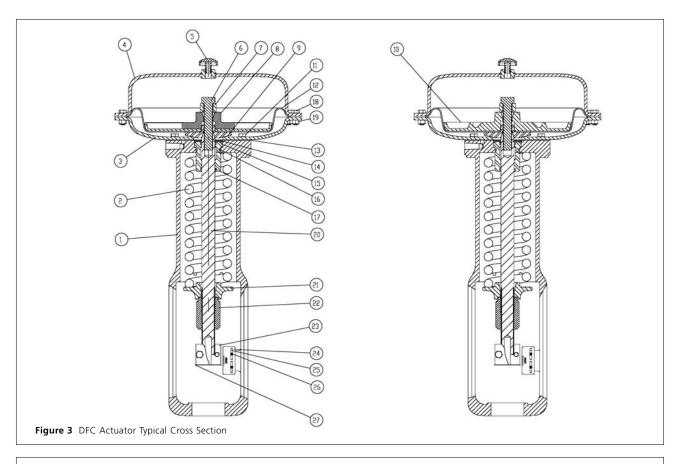
Technical Sales Bulletin | January 2004

DYNA-FLO

Technical Bulletin:

DFC AND DFO VALVE ACTUATOR

CONTROL VALVE SERVICES LTD.



KEY	DESCRIPTION	MATERIAL	KEY	DESCRIPTION	MATERIAL
1	Yoke	Cast Iron	15	Bushing	Brass
2	Spring	Steel	16	O-Ring	Buna
3	Lower Casing	Steel	17	O-Ring	Buna
4	Upper Casing	Steel	teel 18 Hex Head Bolt		ST. ZI. PL.
5	Vent	Plastic	19	Nut	ST. ZI. PL.
6	Hex Head Bolt	ST. ZI. PL.	ZI. PL. 20 Stem		STL.CHR.PL
7	Travel Stop	Steel	21	Spring Seat	Steel
8	Diaphragm Plate Ass'y*	ST. ZI. PL.	22	Spring Adjuster	Steel
9	Lwr Diaphragm Plate	Steel	23	Stem Connector Assembly	Steel
10	Diaphragm Plate*	Cast Iron	24	Travel Scale	SST
11	Hex Head Bolt	ST. ZI. PL.	25	Speed Nut	SST
12	Diaphragm	Nitrile	26	Screw	SST
13	Gasket	Comp.	27	Travel Disc	SST
14	Snap Ring	SST			

^{*} DFC actuators have either a diaphragm plate assembly (key 8) or a diaphragm plate (key 10) depending on date of manufacture and model. See instruction manual for details.

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Table 3 Model DFC Construction Materials

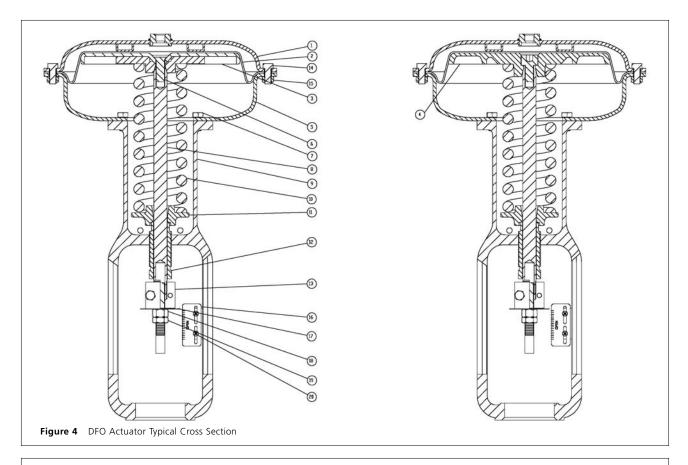
Phone: (780)-469-4000 Fax: (780)-469-4035



Technical Bulletin:

DFC AND DFO VALVE ACTUATOR

CONTROL VALVE SERVICES LTD.



KEY	DESCRIPTION	MATERIAL	KEY	DESCRIPTION	MATERIAL
1	Upper Casing	Steel	12	Spring Adjuster	Steel-Plated
2	Diaphragm	Nitrile / Nylon	13	Stem Connector Ass'y	Steel-Plated
3	Diaphragm Plate Ass'y*	Steel	14	Hex Head Bolt	Steel-Plated
4	Diaphragm Plate*	Cast Iron	15	Nut	Steel-Plated
5	Lower Casing	Steel	16	Travel Scale	SST
6	CTS Socket Cap Screw	Steel	17	Travel Disc	SST
7	Hex Head Bolt	Steel-Plated	18	Stem Nut	Steel-Plated
8	Stem	Steel Chrome Plated	19	Jam Nut	Steel-Plated
9	Yoke	Cast Iron	20	Machine Screw	Steel-Plated
10	Spring	Steel	21	Speed Nut	SST
11	Lower Spring Seat	Steel-Plated			

^{*} DFO actuators have either a diaphragm plate assembly (key 3) or a diaphragm plate (key 4) depending on date of manufacture and model. See instruction manual for details.

Table 4 Model DFO Construction Materials

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Actuator Travel Bench			Range - psig	(kPag)	Bench	ch Range - psig (kPag)		
Size	inches	3-15	3-11	3-9	6-30	6-26	6-22	
	(mm)	(21-103)	(21-76)	(21-62)	(41-207)	(41-179)	(41-152)	
1046	3/4 (19)	138 (614)	322 (1432)	414 (1842)	138 (614)	322 (1432)	506 (2251)	
1069 ^A	3/4 (19)							
and	to	207 (921)	483 (2148)	621 (2762)	207 (921)	483 (2148)	759 (3376) ^B	
2069	1-1/2 (38)							
2105	3/4 (19)							
and	to	315 (1401)	630 (2802)	945 (4204)	315 (1401)	735 (3269)	1155 (5138)	
3105	2 (51)			, ,				
2156	3/4 (19)							
and	to	468 (2082)	1092 (4857)	1404 (6245)	468 (2082)	1092 (4857)	1716 (7633)	
3156	2 (51)							
2220	3/4 (19)	880 (3914) ^A	1320 (5872) ^p	1980 (8807)	2640(11743) ^E	3520(15658) ^F	Consult Dyna-Flo	
3220	1-1/2 (38)							
	to	660 (2936)	1220 /5072\D	1000 (0007)	880 (3914) ^G	1E // /60E/\H	2640/11742\E	
	2 (51)	000 (2930)	1320 (3672)	1900 (0007)	000 (3914)-	1340 (0630)	2040(11743)-	
B – Consu C – 3-14	" (29 mm) MA) ult Dyna-Flo on osig (21-97 kP osig (21-83 kP	2069 thrust value ag)	F - 6- G - 6-	21 psig (41-145 k 17 psig (41-117 k 19 psig (41-131 k 200 lb-f, 6-23 psig	Pag)	1/2" travel		

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DEC VIID	DEO	\/ \/\	ACTUATOR
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Actuator	Travel	Bench	Range - psig	(kPag)	Bench	Range - psig	(kPag)
Size	inches	3-15	6-15	8-15	6-30	10-30	14-30
	(mm)	(21-104)	(41-104)	(55-104)	(41-207)	(69-207)	(97-207)
1046	3/4 (19)	138 (614)	276 (1228)	368 (1637)	276 (1228)	460 (2046)	644 (2845)
1069	3/4 (19)						
and	to	207 (921)	414 (1842)	552 (2455)	414 (1842)	690 (3069)	966 (4297)
2069	1-1/2 (38)						
2105	3/4 (19)						
and	to	315 (1401)	630 (2802)	966 (4297)	630 (2802)	1050 (4671)	1470 (6530)
3105	2 (51)						
2156	3/4 (19)						
and		468 (2082)	936 (4164)	1248 (5551)	936 (4164)	1560 (6939)	2184 (9715)
3156	2 (51)						
	3/4 (19)						
3220	to	660 (2936)	1320 (5872)	1760 (7829)	1320 (5872)	2200 (9786)	3080 (13700)
	2 (51)						

 Table 6
 Model DFC Actuator Stem Thrust Available by Bench Range force-pounds (Newtons)

Our Commitment to Quality

Dyna-Flo is committed to continuous improvement. All efforts have been made to maximize the accuracy of this information. Without notification, product specifications and designs may be modified at any time. The issue of this document is for information only and does not imply suitability, a warranty, or guarantee for a specific service.

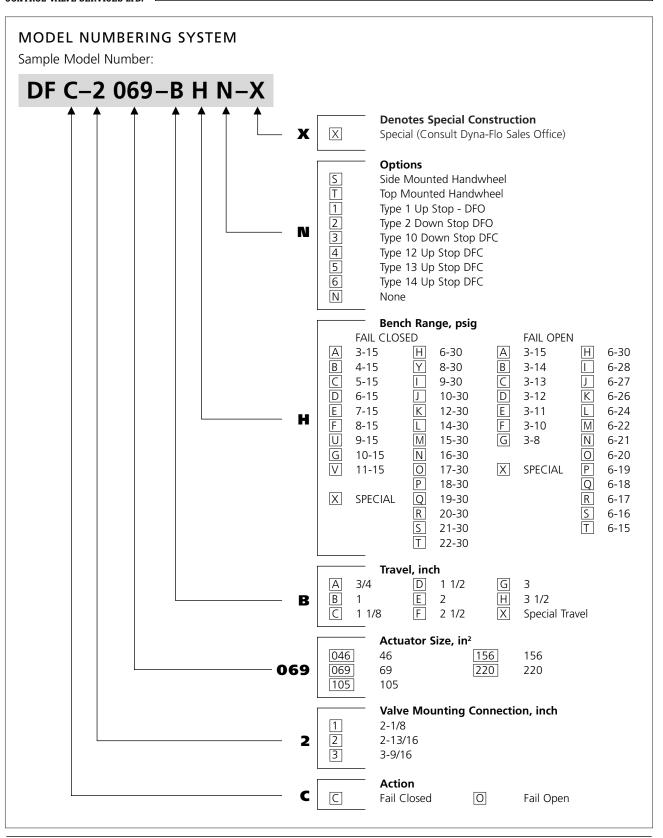
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DFC AND DFO VALVE ACTUATOR

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P627 HIGH FLOW GAS REGULATORS

The P627 is a spring loaded, direct-operated regulator for both low and high pressure applications in the oil and gas industries. These regulators provide durability, from the powder-coated epoxy exterior finish, as well as installation versatility, from the multi-position body and spring case configurations. These regulators are also available in an external pressure registration model (P627M), and NACE construction.

APPLICATIONS

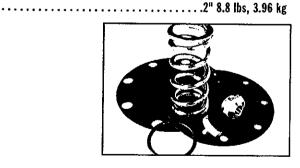
- Farm Tap Regulation
- Monitoring Regulators
- Gate Regulators

MATERIALS OF CONSTRUCTION

Body, Bonnet, Diaphragm Case Steel Body, Bonnet & Diaphragm Case
OR Cast Ductile Iron Body/Aluminum Bonnet & Diaphragm Case
OR Steel Body/Aluminum Bonnet & Diaphragm Case (NACE only)
Diaphragm Nitrile (low pressure) or Neoprene (high pressure)
Seat Nitrile or Nylon
Orifice Aluminum

SPECIFICATIONS

Maximum Inlet:	
Nylon Seat2000 psig (steel);	1000 psig (ductile iron)
Nitrile Seat1000 psig (steel);	1000 psig (ductile iron)
Outlet	
Port Sizes	
Orifice Sizes	1/8", 1/16", 1/11, 1/2", 1/2"
Outlet Range	Flow Range
520 psig	300-43,000
15—40 psig	
35—80 psig	
70—150 psig	2,500-172,000
140-250 psig	
240-500 psig	4,500—140,000
(SCFH of 0.6 S.G. Natural Gas)	•



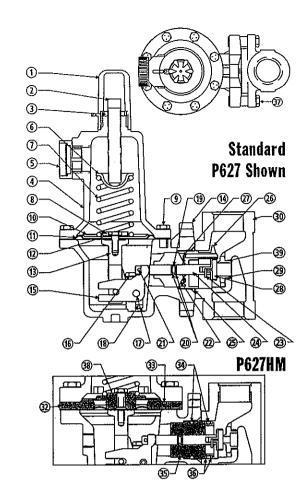
REGULATOR REBUILD KITS

	KIT INCLUDES	PART NUMBER
627 Low Pressure	Nitrile diaphragms (2), Nitrile valve disk, Oʻrings, back-up rings, and retaining pin.	971-627-000
627 Low Pressure	Nitrile diaphragms (2), Nylon valve disk, O'rings, back-up rings, and retaining pin.	971-627-001
627 figh Pressure	Neoprene diaphragm, Nitrile valve disk, O'rings, back-up rings, and retaining pin.	971-627-002
627	Neoprene diaphragm, Nylon valve disk, O'rings, back-up rings, and retaining pin.	971-627-003



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		(1)	
SPRING RANGE			i
psi	BAR		
5-20	0.34-14	020	
15-40	1-2.8	040	
35-80	24-5.5	080	
70-150	4.8-10.3	150	Nitrile Seat is recommend-
140-250	9.7-17.2	250	ed for 5-20 psi, and Nylon
240-500 °	16.5-34.5	500	Seat is recommended for
Steel Casin	/Steel Body Only		psi above 140.
NEPRIE MAST		9.5235	
		31	
A Company	ANG RESIDEN		·
		(2) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	
VERSIONS	·		
Standard		0	
NACE .		N	
* Available as Aluminum/Ste	al aniv		
olija (divisa dili)	- Only		
(15) S.		7277	
		7	
76.7			
71050			
SEAT MATERIAL			
Nitrile (Buna-N)		0	
Nylon		1	
(ASIRIGATURA)		786 X H	
dimension.	A Park State		
ALVERTAGE CONTRACTOR	Ale foli		

1TEM	DESCRIPTION	PART NUMBER
ITEM		610-053-000
1	Cover Adj. Screw	648-465-000
2	Adjustment Screw	634-154-000
3	Locknut	604-210-000
4	Bonnet, P627 - aluminum Bonnet, P627M, P627H & P627HM - Steel	604-211-000
5	Vent Assembly	836-005-000
6	Spring Guide, Upper	626-079-000
7	Range Spring 5-20 psig Yellow 15-40 psig Green 35-80 psig Blue 70-150 psig Red 140-250 psig Red 240-500 psig Red	655-661-000 655-661-001 655-661-002 655-661-003 655-661-002 655-661-003
8	Spring Guide, Lower (P627 or P627M only)	637-306-000
9	Build Screw, Spring Case (8 required) P627 - Aluminum P627 or P627M - Steel P627H or P627HM	648-466-000 648-467-003 648-467-002
10	Diaphragm Piston (P627 or P627M only)	643-191-000
11	Diaphragm P627 & P627M Aluminum/fron Case Steel Case Diaphragm P627H & P627HM Steel Case	618-069-000 618-070-000 618-070-001
12	Screw, Diaphragm P627 & P627M Screw, Diaphragm P627H & P627HM	648-466-002 648-467-000
13	Post, Pusher P627 & P627M Assy Post, Pusher P627H & P627HM Assy Post, Pusher P627 & P627M, NACE Post, Pusher P627H & P627HM, NACE	827-005-000 827-005-001 827-008-000 827-008-001
14	Diaphragm Case P627 - aluminum w/o gauge tap Diaphragm Case P627 & P627H - steel Diaphragm Case P627M & P627HM- steel Diaphragm Case, aluminum/steel	629-202-000 629-203-000 629-204-000 629-215-000
15	Lever Lever, NACE	703-004-000 703-005-000
16	Lever Screw (2 required) Lever Screw, NACE (2 required)	648-466-002 648-474-000
17	Pin, Lever Pin, Lever, NACE	635-053-000 635-057-000
18	Lever Retainer Lever Retainer, NACE	643-192-000 643-194-000
19	Stem O'Ring, nitrile	649-000-003
20	Stem Backup Ring, TFE (2 required)	644-047-000
21	Pin, Groove Pin, Groove NACE	635-054-000 635-058-000
22	Stem Guide	626-083-000
23	Pin Clip Pin Clip NACE	635-055-000 635-056-000
24	Stem, 316SS	689-005-000
25	Diaphragm Case O'Ring, nitrile (P627 & P627H)	649-280-000
26	Boost Body P627 or P627H	686-003-000
27	Stabilizer, nitrile P627 or P627H	649-278-000
28	Seat assembly – aluminum holder/nitrile disk Seat assembly – aluminum/nylon Seat assembly – 316SS holder/nitrile (NACE only) Seat assembly – 316SS/nylon (NACE only	822-019-000 822-019-001 822-020-000 822-020-001
29	Orifice - Aluminum '/" '/" '/" '/" '/"	688-013-004 688-013-003 688-013-002



* For 648-466-003 only, orde 662-000-023 lock washer.

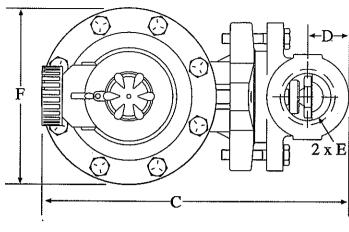
662-000	1-023 lock wasner.
DESCRIPTION	PART NUMBE
⅓ ^u	688-013-001
1/2 ¹¹	688-013-000
Orifice - 316SS (NACE units)	
% "	688-014-004
3/s"	688-014-003
<u> </u>	688-014-002
	688-014-001 688-014-000
	000-014-000

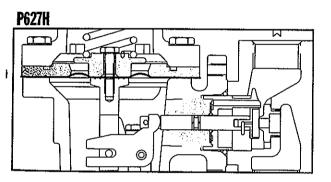
	664-280-000
	664-280-001
	664-282-000
BODY - Steel	664-281-000
1" UDT	664-281-001
7" NDT	664-283-000
	632-474-000
Diaphragm Spacer (P627H or P627HM only)	654-167-000
O'Ring, Spacer (P627H or P627HM only)	649-279-000
O'Ring, Throat Block (2 required)	649-281-000
Throat Block (P627M or P627HM only)	626-081-000
Backup Ring, Throat Block (2 required)	644-048-000
Build Screw, ¼" & 1" aluminum unit	648-466-001
Build Screw, all steel bodies	648-467-001
Build Screw 2" aluminum unit (2 required)	648-466-003
Spring Guide, Lower (P627H & P627HM only)	637-307-000
Thread Locker	consult factor
	DESCRIPTION '/" '/" '/" '/" '/" '/" '/" '/

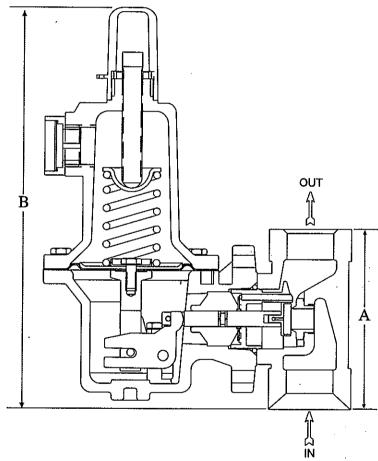
DIMENSIONS: Aluminum/Cast Ductile Iron Units

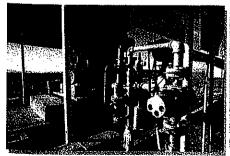
TYPE	BODY SIZE		A	В	C	D	E	F"
	3/4"	mm inches	104 4.08	243 9.54	190 7.46	26 1.0	½" NPT	108 4.25
627 & 627M	1"	mm inches	104 4.08	243 9.54	190 7.46	26 1.0	1" NPT	108 4.25
	2"	mm inches	127 5.0	256 10.06	218 8.56	43 1.69	2" NPT	108 4.25
627H & 627HM	Λ,	mm inches	104 4.08	250 9.82	194 7.62	26 1.0	パ" NPT	120 4.70
	1"	mm inches	104 4.08	250 9.82	194 7.62	26 1.0	1" NPT	120 4.70
	2"	inches inmi	127 5.0	265 10.44	224 8.80	43 1.69	2" NPT	120 4.70

^{&#}x27;F Dimensions for steel P627 and P627M - 120mm/4.7 inches

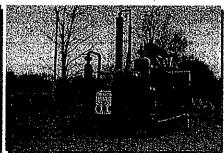














7400 Snaptrol / LLC, Liquid Level Control, Low Pressure No-Bleed

Application

For use in low-pressure vessels or tanks, this versatile and multioptional device can be used as a level control or as a component of
Hi-Lo level alarm systems. The 1" NPTM unit may be mounted into
a 1" coupling when the float is accessible from inside the vessel. If
float is not accessible, a 2" or larger connection must be provided to
allow passage of the float through the connection. The pneumatic 3way 2-port no-bleed pilot valve makes this unit an excellent choice
for the control of liquid level in oil and gas production equipment such
as separators, dehydrators, treaters, as well as in manufacturing
plants, hazardous waste disposal, food processing, petro-chemical
facilities, or wherever fluid levels need to be monitored or controlled.

Features

- No-Bleed
- Cost Effective
- Pneumatic or Electric
- 1" and 2" Threaded or 4" Union
- Other Connections Available on Request
- Choices of Float Size and Float Arm Extension Length

Specifications

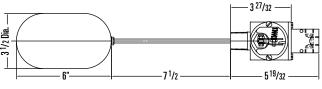
· '	411-1			
Size	1" Threaded	2" Threaded	4" Union	
Body Working Pressure	!	500 psi		
Float				
Size	*2" x 6"	3" x 6"	**31/2" x 6"	
Working Pressure	500 psi	500 psi	500 psi	
Collapse Pressure	720 psi	850 psi	800 psi	
Operating Temperature	50°F to	+212°F (availa	able to 400°F)	
Supply Pressure		75 psi (100	psi available)	
3-Way Pilot Connections				
Material	1" Threaded	2" Threaded	4" Union	
Body	836 Bronze	A216 WCB	A216 WCB	
Float	Stainless Steel			
Float Arm	Stainless Steel			
Seals	Buna-N Standard (others available)			
Bushing (Retainer)	360 Brass (S.S. available)			
Electric Switch		E	xplosion Proof	
Electric Switch, Single Pole / Double Throw, UL and CSA listed:				
"L96" 15 amps, 125, 250, or 480 VAC; 1/2 HP-125 VAC,				
1/4 HP-250 VAC, 1/2 amp-125 VDC, 1/4 amp-250 VDC				
*0. 1 1 011				

^{*}Standard on 2"





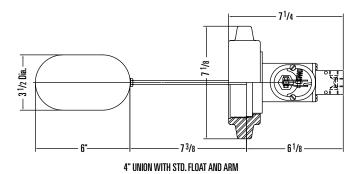
Dimensional Data



1" NPT THREAD WITH STD. FLOAT AND ARM



2" NPT THREAD WITH STD. FLOAT AND ARM

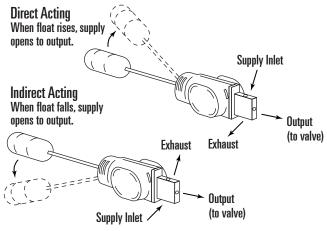


^{**}Standard on 1" Threaded & 4" Union



7400 Snaptrol / LLC, Liquid Level Control, Low Pressure No-Bleed

Plumbing Schematic



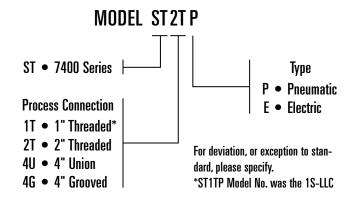
Parts List

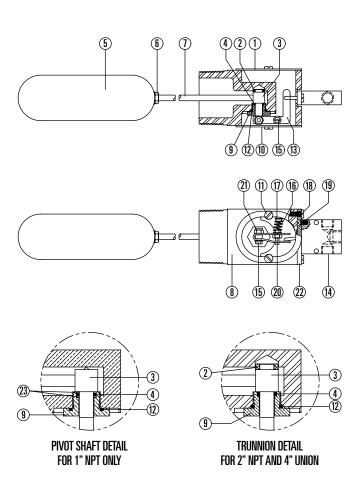
Item	Description	Oty.	Part No.
1*	NAME PLATE, ALUMINUM	1	10068
2*	BEARING SLEEVE, DELRIN	1	20031
3*	TRUNNION, STAINLESS STEEL	1	20030
3**	PIVOT SHAFT, STAINLESS STEEL	1	05010-1773
4	O-RING, BUNA-N ●	1	05000-0041
	FLOAT 2"X6",STAINLESS STEEL	1	10051
5	FLOAT 3"X6",STAINLESS STEEL	1	10266
	FLOAT 3 1/2"X6", STAINLESS STEEL	1	10128
6	JAM NUT, STAINLESS STEEL	1	10007
7	FLOAT ARM, STAINLESS STEEL, 10" STD.		20028
	BODY, 1" NPT PNEUMATIC, 836 BRONZE		05010-1625
	BODY, 2" NPT PNEUMATIC, STEEL WCB	1	40016
8	BODY, 2" NPT ELECTRIC, STEEL WCB	1	40067
	BODY, 4" UNION, PNEUMATIC, STEEL WCB	1	40041
	BODY, 4" UNION, ELECTRIC, STEEL WCB	1	40043
9*	BUSHING, 360 BRASS	1	20029
9**	RETAINER, 360 BRASS	1	05010-1757
10*	COVER PLATE, LEXAN		10050
10**	COVER PLATE, ALUMINUM	2	05010-2128
11	COVER SCREW, STL. PLATED	4	10046
12*	O-RING, BUNA-N ●	1	10133
12**	O-RING, BUNA-N ●	1	05000-0058
13	ACTUATOR, STAINLESS STEEL	1	10049
14	3-WAY VALVE, PNEUMATIC ONLY •	1	06000-0577
14	ELECTRIC SWITCH, ELECTRIC ONLY	1	10219
15	SCREW, STL. PLATED	2	10041
16	SPRING, STAINLESS STEEL	1	10045
17	SPRING KEEPER, BRASS	1	20033
18	SCREW, STL. PLATED	2	10043
19	SCREW, STL. PLATED	2	10047
20	JAM NUT, STAINLESS STEEL	1	10060
21	LOCK NUT, STL. PLATED	1	10044
22 N	MOUNTING PLATE, ALUM. PNEUMATIC	1	20032
	MOUNTING PLATE 1, ELECTRIC	1	20185
	MOUNTING PLATE 2, ELECTRIC	1	20186
23**	BACK UP RING, TEFLON® ●	2	05011-3612
24***	HAMMER UNION, STD. V THREAD, WCB	1	05012-6705
24	HAMMER UNION, ACME THREAD, WCB	1	05012-3702
25***	O-RING, BUNA-N FOR SCH.80 WN ◆	1	05000-5446
	O-RING, BUNA-N FOR SCH.160 WN •	1	05000-0561

*For 2" NPT and 4" Union only.

Determining the Model Number

Example given: Standard Model ST2TP - Series 7400, 2" Threaded Process Connection, Pneumatic Type Control.





^{**}For 1" NPT only.

^{***}For 4" Union only.

Recommended Spare Part