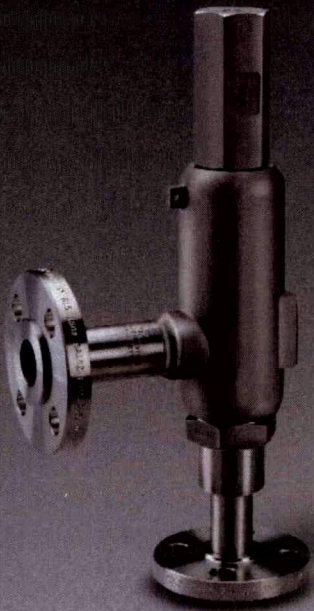


4



Series 2700

Pressure Relief Valves



Flanged



Female NPT Inlet



Sanitary Inlet



Sanitary Inlet and Outlet



Farris Engineering

Division of Curtiss-Wright Flow Control Corporation



Series 2700 Pressure Relief Valves



Designed to provide customers with the widest selection of sizes, orifices and construction materials, Series 2700 meets the exacting demands of the process industry.

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Superior Design

- A single design handles air, steam, vapor and liquid services.
- Maximum interchangeability of parts affords easy maintenance and lower costs.
- Fixed blowdown design simplifies testing and repair. Maximum blowdown of 5% to 15% regardless of service.¹
- A built-in lift stop ensures stable performance.
- Balanced design in "C" and "D" orifices nullifies the effects of back pressure on set point.

ASME Code Certification

- Manufactured in conformance to Section VIII of the ASME Boiler and Pressure Vessel Code for air, steam, and liquid service.
- Capacities certified by The National Board of Boiler and Pressure Vessel Inspectors.

Optional O-Ring Seat Design

- O-ring seat design available for maximum seat tightness.
- Teflon® available at higher pressures to provide the same zero bubbles per minute leakage as elastomer O-ring seats.

Comprehensive Product Line

- Set pressures from 15 psig to 6500 psig with orifice areas from 0.068 to 0.573 sq. in.
- Standard valves have MNPT inlet X FNPT outlet. Optional female thread, flanged, socket weld, welding nipple, and sanitary connections available.

Maximum Selection of Materials

- Standard construction includes 316 stainless steel body, trim and spring, with carbon steel bonnet.
- Optional materials include Monel®, Hastelloy C®, and materials suitable for NACE service.

General Note:

¹Blowdown on liquid service may slightly exceed 15% in certain applications.

Teflon is a registered trademark of the DuPont Company.

Monel is a registered trademark of Inco Alloys International Inc.

Hastelloy and Hastelloy C are registered trademarks of Haynes International Inc.



Numbering System

Selecting and specifying Farris pressure relief valves is simple using the numbering system that follows. Each digit of the part number has a distinct significance. The digits describe the basic valve series, orifice, seat design, inlet temperature range, body, bonnet and spring material, inlet type and pressure rating.

27	D	A	2	3	H	M	2	0	S4
Series Number	Orifice Area	Seat Construction	Inlet Size ¹	Outlet Size ¹	Special Variations	Inlet Connections	Cap Construction	Test Gag	Special Materials
27	C 0.068	A Metal Seat	1 1/2"	3 1"	H High pressure variations of standard types	M MNPT	2 Plain	0 No Gag	S4 Complete 316 St. St.
	D 0.125	C Soft Seat	2 3/4"	4 1 1/2"		F FNPT	4 Packed Lever	1 Test Gag	S7 NACE Trim
	E 0.223	T Teflon Seat	3 1"	5 2"	B Balanced design ³	1 Flanged-150RF	7 Open Lever		M1 Monel Body & Disc
	F 0.350		4 1 1/2"	6 2 1/2"	D Heat transfer fluid standard pressure	2 Flanged-300RF			M2 Monel Trim
	G 0.573				E Heat transfer fluid high pressure	3 Flanged-600RF			M4 Complete Monel
						4 Flanged-900RF			H1 Hastelloy C Body & Disc
						5 Flanged-1500RF			H2 Hastelloy C Trim
						6 Flanged-2500RF			H4 Complete Hastelloy C
						O Special			
						S Socket Weld			
						T Sanitary			
						W Welding Nipple			

Ordering Information

Please specify the following so that we may process your order as quickly as possible.

- Quantity.*
- Inlet and outlet sizes.
- Farris type number.*
- Inlet and outlet connections: MNPT, FNPT, flanged, socket weld, sanitary inlet or weld nipple.
- Materials of construction if other than standard.
- O-ring seat pressure seal material, if required.
- Set pressure.*
- Operating and relieving temperatures.*
- Allowable overpressure.*
- Fluid and fluid state.*
- Backpressure, superimposed constant and/or variable, and built-up.*
- Required capacity.*
- Accessories: open or packed lever if required; test gag.
- Code requirements, if any.

**As a customer service, we verify your selection and sizing. In order to do this, we must have this information.*

General Notes:

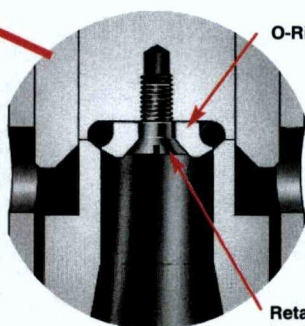
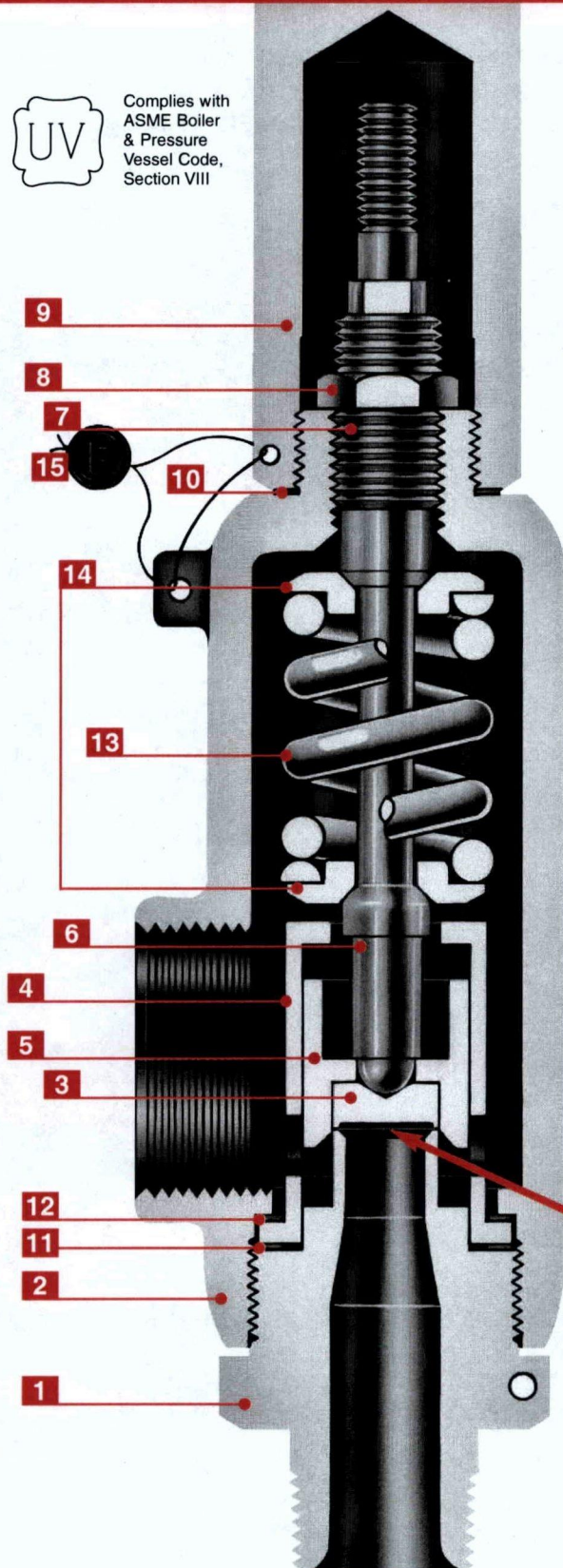
- Not all combinations of inlet and outlet sizes shown are available. Consult the selection tables of pages 6 and 7.
- Test gag option is not available with open lever cap.
- Available in O-ring seat design only. Consult the Farris Factory.

Bill of Materials - Conventional

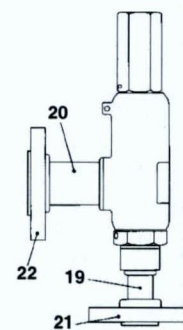
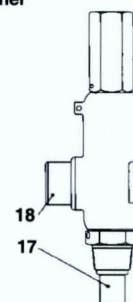


Complies with
ASME Boiler
& Pressure
Vessel Code,
Section VIII

Item No.	Part Name	Standard Material
1	Body	SA-351, Gr. CF8M St. St. or SA-479 Type 316 St. St.
2	Bonnet	SA-216, Gr. WCB, Carb. St.
3	Disc	316 St. St.
4	Guide	316 St. St.
5	Disc Holder	316 St. St.
6	Stem	316 St. St.
7	Spring Adj. Screw	316 St. St.
8	Jam Nut	316 St. St.
9	Cap, Plain Screwed	Carbon Steel
10	Cap Gasket	316 St. St.
11	Body Gasket	316 St. St.
12	Guide Gasket	316 St. St.
13	Spring (-20° to +750°F)	Stainless Steel
14	Spring Buttons	316 St. St.
15	Wire Seal	St. St. Wire / Lead Seal
16	Nameplate (Not Shown)	Stainless Steel
17	Welding Nipple (Inlet)	316 St. St.
18	Welding Nipple (Outlet)	Carbon Steel
19	Lap Joint Stub End (Inlet)	316 St. St.
20	Lap Joint Stub End (Outlet)	Carbon Steel
21	Lap Joint Flange (Inlet)	Carbon Steel
22	Lap Joint Flange (Outlet)	Carbon Steel



O-Ring Design
(Optional)

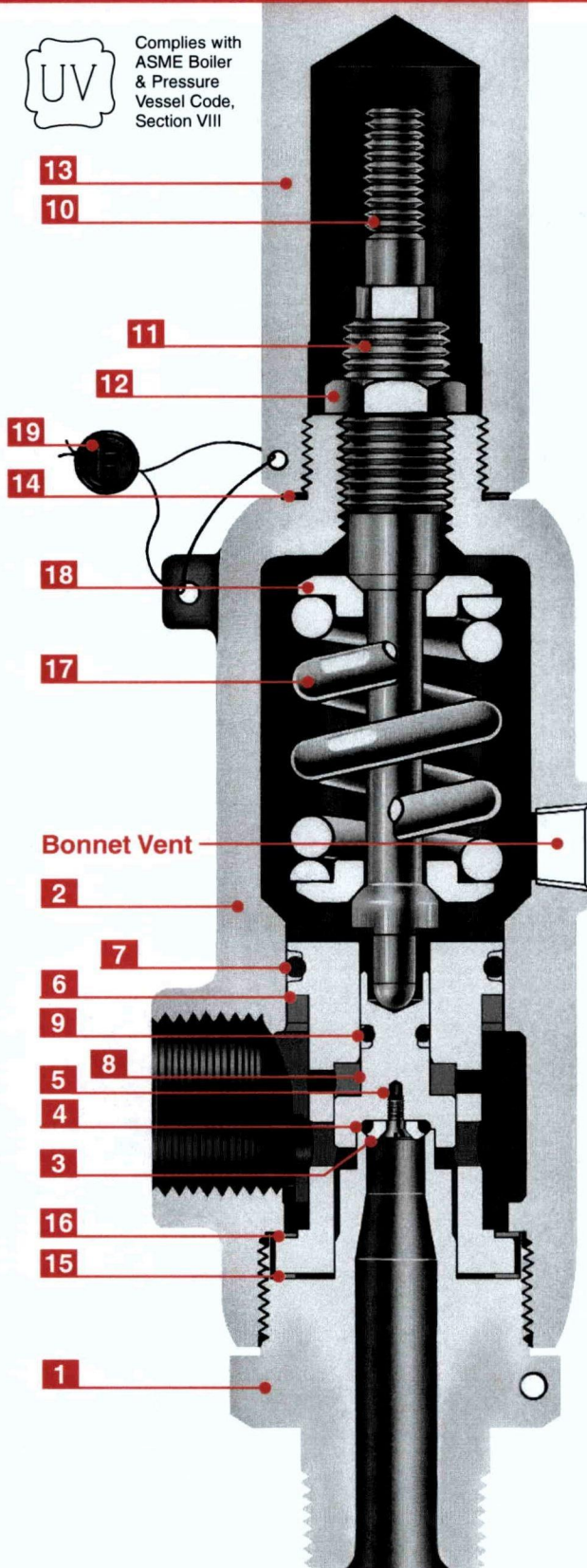




Bill of Materials - Balanced Design



Complies with
ASME Boiler
& Pressure
Vessel Code,
Section VIII



Do you have variable back pressure? Can't use a balanced bellows design? Farris has the solution with the Series 2700 balanced design pressure relief valve. The balanced effect is achieved by isolating the upper valve chamber and eliminating any back pressure build-up in the bonnet effecting valve set pressure.

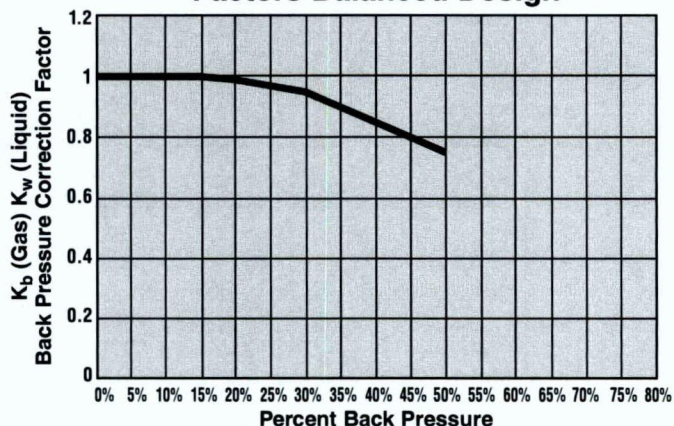
These valves are available in 1/2", 3/4" and 1" inlet sizes with a 1" outlet and two orifice areas. Pressure ranges from 15 to 1480 psig, standard soft seat design. Flanged and welded inlet and outlet connections are available with the same material options as the standard design.

Item No.	Part Name	Standard Material
1	Body	SA-351, Gr. CF8M St. St. or SA-479 Type 316 St. St.
2	Bonnet	SA-216, Gr. WCB, Carb. St.
3	O-ring Retainer	316 St. St.
4	O-ring Seat Seal	Viton®
5	Retainer Lock Screw	304 St. St.
6	Guide	316 St. St.
7	Guide Seal	Viton
8	Disc Holder	316 St. St.
9	Disc Holder Seal	Viton
10	Stem	316 St. St.
11	Spring Adj. Screw	316 St. St.
12	Jam Nut	316 St. St.
13	Cap, Plain Screwed	Carbon Steel
14	Cap Gasket	316 St. St.
15	Body Gasket	316 St. St.
16	Guide Gasket	316 St. St.
17	Spring (-20° to +750°F)	Stainless Steel
18	Spring Buttons	316 St. St.
19	Wire Seal	St. St. Wire/Lead Seal
20	Nameplate (Not Shown)	Stainless Steel

General Notes:

1. Other O-ring materials available. Consult the Factory.
2. Flanged, socket weld, welding nipple and female threaded designs available.

Series 2700 Back Pressure Correction Factors Balanced Design



Viton is a registered trademark of DuPont Dow Elastomers.

O-ring Selection



PRESSURE & TEMPERATURE LIMITS O-RING SEAT VALVE

The 2700 Series is available with an optional O-ring seat which minimizes fugitive emissions and costly product loss. This optional seat construction provides zero bubbles per minute leakage at 90%

of set pressure per API Standard 527. The Tables below list the set pressure and temperature range for both the elastomer and Teflon seat options.

Orifice	Pressure Range, PSIG ¹		Pressure Range, Bar G ²	
	Elastomer Seat	Teflon Seat	Elastomer Seat	Teflon Seat
C High Pressure	15 to 1480 —	800 to 2500 2501 to 5000	1.00 to 102 —	55.1 to 172 172.1 to 345
D High Pressure	15 to 1480 —	800 to 1600 1601 to 5000	1.00 to 102 —	55.1 to 110 110.1 to 345
E	15 to 1480	600 to 2500	1.0 to 102	41.3 to 172
F	15 to 1480	600 to 1600	1.0 to 102	41.3 to 110
G	15 to 1000	200 to 1000	1.0 to 69	14 to 69

MATERIAL AVAILABILITY		
Material	Temperature Range ¹	
	°F	°C
Viton®	-20° to +450°	-29° to +232°
Buna N	-20° to +250°	-29° to +121°
EPR	0° to +350°	-18° to +177°
Silicone	-150° to +450°	-101° to +232°
Kalrez®	-20° to +550°	-29° to +289°
Teflon	-300° to +500°	-184° to +260°

General Notes:

1. Maximum O-ring set pressure limit cannot exceed the pressure limit for a given type number and size as indicated in the metal seat selection tables.
2. Temperature range may vary depending on service fluid.
3. Ethylene propylene is suitable for steam service up to 350°F, Teflon up to 500°F.
4. Consult the Farris Factory for other materials.

Selection Table

U.S. CUSTOMARY UNITS: THREADED CONNECTIONS-MNPT X FNPT

Orifice Area Sq. In.	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, PSIG	Max. Back Pressure PSIG at 100° F	Materials	
			-20° F to 750° F		Body/Bonnet	Spring
0.068	1/2 x 1	27CA13-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CA23-M20	2500			
	3/4 x 1	27CA23H-M20	5000			
	1 x 1	27CA33-M20	2500			
	1 x 1	27CA33H-M20	6500			
0.125	1/2 x 1	27DA13-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DA23-M20	1600			
	3/4 x 1	27DA23H-M20	5000			
	1 x 1	27DA33-M20	1600			
	1 x 1	27DA33H-M20	5000			
0.223	1 x 1 1/2	27EA34-M20	2500	400	316 St. St. / Carb. St.	Stainless Steel
0.350	1 1/2 x 2	27FA45-M20	1600	400	316 St. St. / Carb. St.	Stainless Steel
0.573	1 1/2 x 2 1/2	27GA46-M20	1000	400	316 St. St. / Carb. St.	Stainless Steel

Viton and Kalrez are registered trademarks of DuPont Dow Elastomers.



Selection Tables

U.S. CUSTOMARY UNITS: FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, PSIG			Max. Back Pressure PSIG at 100° F	Materials	
		Inlet RF	Outlet RF		-20° F to 100° F	400° F	750° F		Body / Bonnet	Spring
0.068	1/2 x 1	150#	150#	27CA13-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CA13-220	740	635	505	285		
		600#	150#	27CA13-320	1480	1270	1010	285		
		900#	300#	27CA13-420	2220	1900	1510	400		
		1500#	300#	27CA13H-520	3705	3170	2520	400		
		2500#	300#	27CA13H-620	5000	5000	4200	400		
	3/4 x 1	150#	150#	27CA23-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CA23-220	740	635	505	285		
		600#	150#	27CA23-320	1480	1270	1010	285		
		900#	300#	27CA23-420	2220	1900	1510	400		
		1500#	300#	27CA23H-520	3705	3170	2520	400		
		2500#	300#	27CA23H-620	5000	5000	4200	400		
	1 x 1	150#	150#	27CA33-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CA33-220	740	635	505	285		
		600#	150#	27CA33-320	1480	1270	1010	285		
		900#	300#	27CA33-420	2220	1900	1510	400		
		1500#	300#	27CA33H-520	3705	3170	2520	400		
		2500#	300#	27CA33H-620	6170	5280	4200	400		
0.125	1/2 x 1	150#	150#	27DA13-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA13-220	740	635	505	285		
		600#	150#	27DA13-320	1480	1270	1010	285		
		900#	300#	27DA13H-420	2220	1900	1510	400		
	3/4 x 1	150#	150#	27DA23-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA23-220	740	635	505	285		
		600#	150#	27DA23-320	1480	1270	1010	285		
		900#	300#	27DA23H-420	2220	1900	1510	400		
		1500#	300#	27DA23H-520	3705	3170	2520	400		
		2500#	300#	27DA23H-620	5000	5000	4200	400		
	1 x 1	150#	150#	27DA33-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA33-220	740	635	505	285		
		600#	150#	27DA33-320	1480	1270	1010	285		
		900#	300#	27DA33H-420	2220	1900	1510	400		
		1500#	300#	27DA33H-520	3705	3170	2520	400		
		2500#	300#	27DA33H-620	6170	5280	4200	400		
0.223	1 x 1 1/2	150#	150#	27EA34-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27EA34-220	740	635	505	285		
		600#	150#	27EA34-320	1480	1270	1010	285		
		900#	300#	27EA34-420	2220	1900	1510	400		
0.350	1 1/2 x 2	150#	150#	27FA45-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27FA45-220	740	635	505	285		
		600#	150#	27FA45-320	1480	1270	1010	285		
0.573	1 1/2 x 2 1/2	150#	150#	27GA46-120	285	200	95	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27GA46-220	740	635	505	285		
		600#	150#	27GA46-320	1000	1000	1000	285		

General Notes:

- Available with optional elastomer or Teflon seat design as illustrated. Change the fourth digit of the type number from "A" to "C" for soft seat, "A" to "T" for Teflon. Example: 27DC23-M20 for soft seat, 27DT23-M20 for Teflon. See Selection Table for pressure and temperature limits.
- Above type numbers indicate standard materials of construction. To select corrosive or low temperature materials, add type number suffix as indicated on pages 3 and 9.
- Available in materials suitable for sour gas (H₂S) service to NACE Standard MR0175: add "S7" to the type number. Example: 27DA23-M20/S7.
- For open or packed levers, change the second digit of the type number suffix. Examples: 27FA45-M70 for open lever, 27GA46-M40 for packed lever.
- For socket weld or welding nipple connections, change the first digit of the type number suffix to "S" for socket weld or "W" for welding nipple inlet and outlet. Examples: 27DA33-S20 for socket weld, 27DA33-W20 for welding nipple.
- Female threaded inlet available. Change first digit of type number suffix to "F". Example: 27EA-34-F20.
- For set pressures below 15 psig, consult the Farris Factory.

Selection Tables - Balanced Design



U.S. CUSTOMARY UNITS: THREADED CONNECTIONS-MNPT X FNPT

Orifice Area Sq. In.	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, PSIG	Max. Back Pressure	Materials	
			-20° F to 450° F	PSIG at 100° F	Body/Bonnet	Spring
0.068	1/2 x 1	27CC13B-M20	1480	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CC23B-M20				
	1 x 1	27CC33B-M20				
0.125	1/2 x 1	27DC13B-M20	1480	400	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DC23B-M20				
	1 x 1	27DC33B-M20				

U.S. CUSTOMARY UNITS: FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, PSIG		Max. Back Pressure PSIG at 100° F	Materials	
		Inlet RF	Outlet RF		-20° F to 100° F	400° F		Body / Bonnet	Spring
0.068	1/2 x 1	150#	150#	27CC13B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC13B-220	740	635	285		
		600#	150#	27CC13B-320	1480	1270	285		
		900#	300#	27CC13B-420	1480	1270	400		
	3/4 x 1	150#	150#	27CC23B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC23B-220	740	635	285		
		600#	150#	27CC23B-320	1480	1270	285		
		900#	300#	27CC23B-420	1480	1270	400		
	1 x 1	150#	150#	27CC33B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC33B-220	740	635	285		
		600#	150#	27CC33B-320	1480	1270	285		
		900#	300#	27CC33B-420	1480	1270	400		
0.125	1/2 x 1	150#	150#	27DC13B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC13B-220	740	635	285		
		600#	150#	27DC13B-320	1480	1270	285		
	3/4 x 1	150#	150#	27DC23B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC23B-220	740	635	285		
		600#	150#	27DC23B-320	1480	1270	285		
	1 x 1	150#	150#	27DC33B-120	285	200	285	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC33B-220	740	635	285		
		600#	150#	27DC33B-320	1480	1270	285		



Special Materials

FOR CORROSIVE & LOW TEMPERATURE SERVICE

Part Name	316 St. St.		Monel			Hastelloy C		
	S7 (NACE)	S4	M1	M2	M4	H1	H2	H4
	-20°F to 750°F	-450°F to 750°F ²	-20°F to 750°F			-20°F to 750°F		
Body	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Bonnet	—	SA-351 Gr. CF8M St. St.	—	—	Monel	—	—	Hastelloy C
Disc	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Guide	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Disc Holder	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Stem	—	—	—	—	Monel	—	—	Hastelloy C
Spring Adj. Screw	—	—	—	—	Monel	—	—	Hastelloy C
Jam Nut	—	—	—	—	Monel	—	—	Hastelloy C
Cap, Plain Screwed	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Cap Gasket	—	—	—	—	Monel	—	—	Hastelloy C
Body Gasket	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Guide Gasket	—	—	—	Monel	Monel	—	Hastelloy C	Hastelloy C
Spring	Inconel [®] X-750	316 St. St.	—	Inconel X-750	Inconel X-750	—	Inconel X-750	Hastelloy C
Spring Buttons	—	—	—	—	Monel	—	—	Hastelloy C
O-Ring Retainer (note 5)	—	316 St. St.	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Retainer Lock Screw (note 5)	—	316 St. St.	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
O-Ring Seat Seal (note 5)	—	—	—	—	—	—	—	—
Guide Seal (note 5)	—	—	—	—	—	—	—	—
Disc Holder Seal (note 5)	—	—	—	—	—	—	—	—
Wire Seal	—	—	—	—	—	—	—	—
Nameplate (Not Shown)	—	—	—	—	—	—	—	—
Welding Nipple (Inlet)	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Welding Nipple (Outlet)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Stub End (Inlet)	—	—	Monel	Monel	Monel	Hastelloy C	Hastelloy C	Hastelloy C
Lap Joint Stub End (Outlet)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Flange (Inlet)(note 4)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C
Lap Joint Flange (Outlet)(note 4)	—	316 St. St.	—	—	Monel	—	—	Hastelloy C

General Notes:

- Any part denoted with a dash is standard material.
- For S4 trim, a 17-4 Ph. or 17-7 Ph. spring may be necessary for some pressures and temperatures.
- For open and packed lever materials, see page 16.
- Maximum set pressures for S4, M4, and H4 trim are the same as the carbon steel valves or the 316 St. St., Monel and Hastelloy C flange limits respectively, whichever is lower.
- Temperature for balanced or O-ring seat design is limited by the elastomer selected. For Viton O-rings, the temperature range is -20°F to +450°F. For other materials, consult chart on page 6.
- Hastelloy and Hastelloy C are registered trademarks of Haynes International. Monel, Inconel and Inconel X-750 are registered trademarks of Inco Alloys International. We reserve the right to substitute comparable material from other manufacturers.

AIR

10% OVERPRESSURE
Capacities in Standard Cubic Feet Per Minute at 60° F

Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	35	65	117	183	301
20	41	75	135	212	347
30	52	95	171	268	439
40	64	117	210	330	540
50	76	140	249	392	642
60	88	162	288	454	743
70	100	184	328	515	844
80	112	206	368	577	946
90	124	228	407	639	1047
100	136	250	447	701	1148
150	196	361	644	1011	1655
200	256	471	841	1320	2161
250	316	582	1038	1630	2668
300	376	692	1235	1939	3175
350	436	803	1432	2248	3681
400	497	913	1630	2558	4188
450	557	1024	1827	2867	4695
500	617	1134	2024	3177	5201
550	677	1245	2221	3486	5708
600	737	1355	2418	3796	6215
650	797	1466	2615	4105	6721
700	857	1576	2813	4415	7228
750	917	1687	3010	4724	7735
800	978	1797	3207	5034	8241
850	1038	1908	3404	5343	8748
900	1098	2018	3601	5653	9255
950	1158	2129	3799	5962	9761
1000	1218	2240	3996	6272	10268
1050	1278	2350	4193	6581	—
1100	1338	2461	4390	6891	—
1150	1398	2571	4587	7200	—
1200	1459	2682	4784	7509	—
1250	1519	2792	4982	7819	—
1300	1579	2903	5179	8128	—
1350	1639	3013	5376	8438	—
1400	1699	3124	5573	8747	—
1450	1759	3234	5770	9057	—
1500	1819	3345	5967	9366	—
1550	1879	3455	6165	9676	—
1600	1940	3566	6362	9985	—
1650	2000	3676	6559	—	—
1700	2060	3787	6756	—	—
1750	2120	3897	6953	—	—
1800	2180	4008	7151	—	—
1850	2240	4118	7348	—	—
1900	2300	4229	7545	—	—
2000	2421	4450	7939	—	—
2100	2541	4671	8334	—	—
2200	2661	4892	8728	—	—
2300	2781	5113	9122	—	—
2400	2902	5334	9577	—	—
2500	3022	5555	9911	—	—
2600	3142	5776	—	—	—
2700	3262	5997	—	—	—
2800	3383	6218	—	—	—
2900	3503	6439	—	—	—
3000	3623	6661	—	—	—
3500	4224	7766	—	—	—
4000	4826	8871	—	—	—
4500	5427	9976	—	—	—
5000	6028	11081	—	—	—
5500	6629	—	—	—	—
6000	7231	—	—	—	—
6500	7832	—	—	—	—

Capacity Tables



U.S. CUSTOMARY UNITS:
ASME PRESSURE VESSEL CODE, SECTION VIII
(UV) STAMP

STEAM

10% OVERPRESSURE
Capacities in Pounds Per Hour at Saturation Temperature

Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	100	184	329	516	846
20	115	212	379	595	975
30	146	269	480	754	1234
40	180	331	591	927	1519
50	214	393	702	1101	1803
60	247	455	812	1275	2088
70	281	517	923	1449	2373
80	315	579	1034	1623	2657
90	349	641	1145	1797	2942
100	382	704	1255	1971	3227
150	551	1014	1809	2840	4650
200	720	1325	2363	3710	6073
250	889	1635	2917	4579	7497
300	1058	1946	3471	5448	8920
350	1227	2256	4025	6318	10344
400	1396	2567	4579	7187	11767
450	1565	2877	5133	8057	13190
500	1734	3188	5687	8926	14614
550	1903	3498	6241	9796	16037
600	2072	3809	6795	10665	17461
650	2241	4119	7349	11535	18884
700	2410	4430	7903	12404	20307
750	2578	4740	8457	13273	21731
800	2747	5051	9011	14143	23154
850	2916	5361	9565	15012	24578
900	3085	5672	10119	15882	26001
950	3254	5982	10673	16751	27424
1000	3423	6293	11227	17621	28848
1050	3592	6603	11781	18490	—
1100	3761	6914	12335	19359	—

General Notes:

1. Capacities at 30 PSIG and below are based on 3 PSI overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.

Farris Capacity Tables

**U.S. CUSTOMARY UNITS:
ASME PRESSURE VESSEL CODE,
SECTION VIII (UV) STAMP**

General Notes:

1. Capacities at 30 PSIG and below are based on 3 PSI overpressure.
2. For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.
3. To determine capacity at 25% overpressure, multiply the capacity at 10% by 1.066.

WATER 10% OVERPRESSURE Capacities in U.S. Gallons Per Minute at 70° F³					
Set Pressure (PSIG)	Orifice Area, Sq. In.				
	C	D	E	F	G
	0.068	0.125	0.223	0.350	0.573
15	7.4	13.6	24.3	38.1	62.4
20	8.3	15.3	27.4	43.1	70.5
30	10.0	18.4	32.9	51.6	84.5
40	11.5	21.2	37.9	59.6	97.6
50	12.9	23.8	42.4	66.6	109
60	14.1	26.0	46.5	73.0	119
70	15.3	28.1	50.2	78.8	129
80	16.3	30.1	53.7	84.3	138
90	17.3	31.9	56.9	89.4	146
100	18.3	33.6	60.0	94.2	154
150	22.4	41.2	73.5	115	189
200	25.9	47.6	84.9	133	218
250	28.9	53.2	94.9	149	244
300	31.7	58.3	104	163	267
350	34.2	63.0	112	176	288
400	36.6	67.3	120	188	308
450	38.8	71.4	127	200	327
500	40.9	75.3	134	210	345
550	42.9	78.9	140	221	362
600	44.8	82.4	147	230	378
650	46.7	85.8	153	240	393
700	48.4	89.0	158	249	408
750	50.1	92.2	164	258	422
800	51.8	95.2	169	266	436
850	53.4	98.1	175	274	450
900	54.9	101	180	282	463
950	56.4	103	185	290	475
1000	57.9	106	189	298	488
1050	59.3	109	194	305	—
1100	60.7	111	199	312	—
1150	62.1	114	203	319	—
1200	63.4	116	208	326	—
1250	64.7	119	212	333	—
1300	66.0	121	216	339	—
1350	67.3	123	220	346	—
1400	68.5	126	224	352	—
1450	69.7	128	228	359	—
1500	70.9	130	232	365	—
1550	72.1	132	236	371	—
1600	73.2	134	240	377	—
1650	74.4	136	244	—	—
1700	75.5	138	247	—	—
1750	76.6	140	251	—	—
1800	77.7	142	254	—	—
1850	78.7	144	258	—	—
1900	79.8	146	261	—	—
2000	81.9	150	268	—	—
2100	83.9	154	275	—	—
2200	85.9	157	281	—	—
2300	87.8	161	288	—	—
2400	89.7	164	294	—	—
2500	91.5	168	300	—	—
2600	93.4	171	—	—	—
2700	95.1	174	—	—	—
2800	96.9	178	—	—	—
2900	98.6	181	—	—	—
3000	100	184	—	—	—
3500	108	199	—	—	—
4000	115	212	—	—	—
4500	122	225	—	—	—
5000	129	238	—	—	—
5500	135	—	—	—	—
6000	141	—	—	—	—
6500	147	—	—	—	—

Selection Tables - Metric - Conventional



THREADED CONNECTIONS - MNPT X FNPT

Orifice Area Sq. mm	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, Bar G	Max. Back Pressure Bar G at 37.8° C	Materials	
			-28.9° C to 399° C		Body / Bonnet	Spring
43.87	1/2 x 1	27CA13-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CA23-M20	172			
	3/4 x 1	27CA23H-M20	345			
	1 x 1	27CA33-M20	172			
	1 x 1	27CA33H-M20	448			
80.65	1/2 x 1	27DA13-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DA23-M20	110			
	3/4 x 1	27DA23H-M20	345			
	1 x 1	27DA33-M20	110			
	1 x 1	27DA33H-M20	345			
143.87	1 1/2 x 1 1/2	27EA34-M20	172	28	316 St. St. / Carb. St.	Stainless Steel
225.81	1 1/2 x 2	27FA45-M20	110	28	316 St. St. / Carb. St.	Stainless Steel
369.68	1 1/2 x 2 1/2	27GA46-M20	69	28	316 St. St. / Carb. St.	Stainless Steel

General Notes:

1. Available with optional elastomer or Teflon seat design as illustrated. Change the fourth digit of the type number from "A" to "C" for soft seat, "A" to "T" for Teflon. Examples: 27DC23-M20 for soft seat, 27DT23-M20 for Teflon. For O-ring pressure and temperature limits, see selection table on page 6.
2. Above type numbers indicate the standard materials of construction. To select corrosive or low temperature materials, add type number suffix as indicated on pages 3 and 5. Example: 27FA45-M20/S4.
3. Available in materials suitable for sour gas (H₂S) service to NACE Standard MR0175: add "/S7" to the type number. Example: 27DA23-M20/S7.
4. For open or packed levers, change the second digit of the type number suffix. Examples: 27FA45-M70 for open lever, 27GA46-M40 for packed lever.
5. For socket weld or welding nipple connections, change the first digit of the type number suffix to "S" for socket weld or "W" for welding nipple inlet and outlet. Examples: 27DA33-S20 for socket weld, 27DA33-W20 for welding nipple.



Selection Tables - Metric - Conventional

FLANGED CONNECTIONS

Orifice Area Sq. mm	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, Bar G			Max. Back Pressure Bar G at 37.8° C	Materials	
		Inlet RF	Outlet RF		-28.9° C to 37.8° C	204° C	399° C		Body / Bonnet	Spring
43.87	1/2 x 1	150#	150#	27CA13-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CA13-220	51	44	35	20		
		600#	150#	27CA13-320	102	88	69	20		
		900#	300#	27CA13-420	153	131	104	28		
		1500#	300#	27CA13H-520	255	218	174	28		
		2500#	300#	27CA13H-620	345	345	290	28		
	3/4 x 1	150#	150#	27CA23-120	20	14	6	20	316 St. St./ Carb St.	Stainless Steel
		300#	150#	27CA23-220	51	44	35	20		
		600#	150#	27CA23-320	102	88	69	20		
		900#	300#	27CA23-420	153	131	104	28		
		1500#	300#	27CA23H-520	255	218	174	28		
		2500#	300#	27CA23H-620	345	345	290	28		
	1 x 1	150#	150#	27CA33-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CA33-220	51	44	35	20		
		600#	150#	27CA33-320	102	88	69	20		
		900#	300#	27CA33-420	153	131	104	28		
		1500#	300#	27CA33H-520	255	218	174	28		
		2500#	300#	27CA33H-620	425	364	290	28		
80.65	1/2 x 1	150#	150#	27DA13-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA13-220	51	44	35	20		
		600#	150#	27DA13-320	102	88	69	20		
		900#	300#	27DA13H-420	153	131	104	28		
	3/4 x 1	150#	150#	27DA23-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA23-220	51	44	35	20		
		600#	150#	27DA23-320	102	88	69	20		
		900#	300#	27DA23H-420	153	131	104	28		
		1500#	300#	27DA23H-520	255	218	174	28		
		2500#	300#	27DA23H-620	345	345	290	28		
	1 x 1	150#	150#	27DA33-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DA33-220	51	44	35	20		
		600#	150#	27DA33-320	102	88	69	20		
		900#	300#	27DA33H-420	153	131	104	28		
		1500#	300#	27DA33H-520	255	218	174	28		
		2500#	300#	27DA33H-620	425	364	290	28		
143.87	1 x 1 1/2	150#	150#	27EA34-120	20	14	6	20	316 St. St./ Carb St.	Stainless Steel
		300#	150#	27EA34-220	51	44	35	20		
		600#	150#	27EA34-320	102	88	69	20		
		900#	300#	27EA34-420	153	131	104	28		
225.81	1 1/2 x 2	150#	150#	27FA45-120	20	14	6	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27FA45-220	51	44	35	20		
		600#	150#	27FA45-320	102	88	69	20		
369.68	1 1/2 x 2 1/2	150#	150#	27GA46-120	20	14	6	20	316 St. St./ Carb St.	Stainless Steel
		300#	150#	27GA46-220	51	44	35	20		
		600#	150#	27GA46-320	69	69	69	20		

Selection Tables - Metric - Balanced Design



THREADED CONNECTIONS - MNPT X FNPT

Orifice Area Sq. mm	Valve Size Inlet x Outlet	Type Number	Maximum Set Pressure, Bar G	Max. Back Pressure Bar G at 37.8° C	Materials	
			-28.9° C to 232° C		Body / Bonnet	Spring
43.87	1/2 x 1	27CC13B-M20	102	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27CC23B-M20				
	1 x 1	27CC33B-M20				
80.65	1/2 x 1	27DC13B-M20	102	28	316 St. St. / Carb. St.	Stainless Steel
	3/4 x 1	27DC23B-M20				
	1 x 1	27DC33B-M20				

FLANGED CONNECTIONS

Orifice Area Sq. mm	Valve Size Inlet x Outlet	ANSI Flange Class		Type Number	Maximum Set Pressure, Bar G		Max. Back Pressure Bar G at 37.8° C	Materials	
		Inlet RF	Outlet RF		-28.9° C to 37.8° C	204° C		Body / Bonnet	Spring
43.87	1/2 x 1	150#	150#	27CC13B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC13B-220	51	44	20		
		600#	150#	27CC13B-320	102	88	20		
		900#	300#	27CC13B-420	102	88	28		
	3/4 x 1	150#	150#	27CC23B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC23B-220	51	44	20		
		600#	150#	27CC23B-320	102	88	20		
		900#	300#	27CC23B-420	102	88	28		
	1 x 1	150#	150#	27CC33B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27CC33B-220	51	44	20		
		600#	150#	27CC33B-320	102	88	20		
		900#	300#	27CC33B-420	102	88	28		
80.65	1/2 x 1	150#	150#	27DC13B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC13B-220	51	44	20		
		600#	150#	27DC13B-320	102	88	20		
	3/4 x 1	150#	150#	27DC23B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC23B-220	51	44	20		
		600#	150#	27DC23B-320	102	88	20		
	1 x 1	150#	150#	27DC33B-120	20	14	20	316 St. St./ Carb. St.	Stainless Steel
		300#	150#	27DC33B-220	51	44	20		
		600#	150#	27DC33B-320	102	88	20		



Capacity Tables - Metric Units

ASME PRESSURE VESSEL CODE, SECTION VIII (UV) STAMP

AIR 10% OVERPRESSURE Capacities in Standard Cubic Meters Per Minute at 15.6° C					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	1.0	1.8	3.3	5.1	8.4
2	1.4	2.7	4.7	7.4	12.2
3	1.9	3.6	6.3	10.0	16.3
4	2.4	4.5	8.0	12.5	20.5
5	2.9	5.4	9.6	15.1	24.6
6	3.4	6.3	11.2	17.6	28.8
7	3.9	7.2	12.8	20.1	33.0
8	4.4	8.1	14.5	22.7	37.1
9	4.9	9.0	16.1	25.2	41.3
10	5.4	9.9	17.7	27.8	45.5
12	6.4	11.7	20.9	32.8	53.8
14	7.4	13.5	24.2	37.9	62.1
16	8.4	15.4	27.4	43.0	70.4
18	9.3	17.2	30.6	48.1	78.8
20	10.3	19.0	33.9	53.2	87.1
25	12.8	23.5	42.0	65.9	107.9
30	15.3	28.1	50.1	78.6	128.7
35	17.7	32.6	58.2	91.3	149.5
40	20.2	37.2	66.3	104.0	170.3
45	22.7	41.7	74.4	116.7	191.1
50	25.1	46.2	82.5	129.5	211.9
55	27.6	50.8	90.6	142.2	232.7
60	30.1	55.3	98.7	154.9	253.6
65	32.5	59.9	106.8	167.6	274.4
70	35.0	64.4	114.9	180.3	295.2
75	37.5	68.9	123.0	193.0	—
80	40.0	73.5	131.1	205.7	—
85	42.4	78.0	139.2	218.4	—
90	44.9	82.5	147.3	231.1	—
95	47.4	87.1	155.4	243.9	—
100	49.8	91.6	163.5	256.6	—
105	52.3	96.2	171.6	269.3	—
110	54.8	100.7	179.7	282.0	—
115	57.2	105.2	187.8	—	—
120	59.7	109.8	195.9	—	—
125	62.2	114.3	204.0	—	—
130	64.7	118.9	212.1	—	—
135	67.1	123.4	220.2	—	—
140	69.6	127.9	228.3	—	—
145	72.1	132.5	236.4	—	—
150	74.5	137.0	244.5	—	—
155	77.0	141.6	252.6	—	—
160	79.5	146.1	260.7	—	—
165	81.9	150.6	268.8	—	—
170	84.4	155.2	276.9	—	—
175	86.9	159.7	—	—	—
180	89.3	164.3	—	—	—
185	91.8	168.8	—	—	—
190	94.3	173.3	—	—	—
195	96.8	177.9	—	—	—
200	99.2	182.4	—	—	—
220	109.1	200.6	—	—	—
240	119.0	218.7	—	—	—
260	128.9	236.9	—	—	—
280	138.7	255.1	—	—	—
300	148.6	273.2	—	—	—
320	158.5	291.4	—	—	—
340	168.4	309.5	—	—	—
360	178.2	—	—	—	—
380	188.1	—	—	—	—
400	198.0	—	—	—	—
420	207.9	—	—	—	—
440	217.8	—	—	—	—
448	221.7	—	—	—	—

WATER 10% OVERPRESSURE Capacities in Litres Per Minutes at 21° C					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	27.6	50.8	90.7	142	233
2	37.4	68.7	122	192	315
3	45.7	84.0	150	235	385
4	52.8	97.0	173	271	445
5	59.0	108	193	303	497
6	64.6	118	212	332	545
7	69.8	128	229	359	588
8	74.6	137	244	384	629
9	79.2	145	259	407	667
10	83.5	153	273	429	703
12	91.4	168	300	470	770
14	98.8	181	324	508	832
16	105	194	346	543	890
18	112	205	367	576	944
20	118	217	387	607	995
25	132	242	433	679	1112
30	144	265	474	744	1218
35	156	287	512	804	1316
40	167	307	547	859	1407
45	177	325	580	911	1492
50	186	343	612	961	1573
55	195	360	642	1008	1650
60	204	376	670	1052	1723
65	212	391	698	1095	1794
70	220	406	724	1137	1861
75	228	420	750	1177	—
80	236	434	774	1215	—
85	243	447	798	1253	—
90	250	460	821	1289	—
95	257	473	844	1324	—
100	264	485	866	1359	—
105	270	497	887	1392	—
110	276	509	908	1425	—
115	283	520	928	—	—
120	289	531	948	—	—
125	295	542	968	—	—
130	301	553	987	—	—
135	306	564	1006	—	—
140	312	574	1024	—	—
145	318	584	1042	—	—
150	323	594	1060	—	—
155	328	604	1078	—	—
160	334	614	1095	—	—
165	339	623	1112	—	—
170	344	632	1129	—	—
175	349	642	—	—	—
180	354	651	—	—	—
185	359	660	—	—	—
190	364	669	—	—	—
195	368	677	—	—	—
200	373	686	—	—	—
220	391	720	—	—	—
240	409	752	—	—	—
260	425	782	—	—	—
280	441	812	—	—	—
300	457	840	—	—	—
320	472	868	—	—	—
340	486	895	—	—	—
360	501	—	—	—	—
380	514	—	—	—	—
400	528	—	—	—	—
420	541	—	—	—	—
440	553	—	—	—	—
448	558	—	—	—	—

General Notes:

- Capacities at 2.0 BarG set pressure and below are based on 0.2 Bar overpressure.
- For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.
- To determine water capacity at 25% overpressure, multiply the capacity at 10% by 1.066.

Capacity Tables - Metric Units



ASME PRESSURE VESSEL CODE, SECTION VIII (UV) STAMP

STEAM 10% OVERPRESSURE Capacities in Kilograms Per Hour at Saturation Temperature					
Set Pressure (BarG)	Orifice Area, Sq. mm.				
	C	D	E	F	G
	43.87	80.65	143.87	225.81	369.68
1	44	82	147	231	378
2	65	119	213	335	548
3	87	160	286	448	734
4	109	201	358	563	921
5	132	242	431	677	1109
6	154	283	504	792	1296
7	176	323	577	906	1483
8	198	364	650	1020	1671
9	220	405	723	1135	1858
10	243	446	796	1249	2045
12	287	528	942	1478	2420
14	332	610	1087	1707	2794
16	376	691	1233	1936	3169
18	420	773	1379	2165	3544
20	465	855	1525	2393	3918
25	576	1059	1889	2965	4854
30	687	1263	2253	3537	5791
35	798	1467	2618	4109	6727
40	909	1672	2982	4681	7664
45	1021	1876	3347	5253	8600
50	1132	2080	3711	5825	9537
55	1243	2284	4076	6397	10473
60	1354	2489	4440	6969	11409
65	1465	2693	4805	7541	12346
70	1576	2898	5169	8113	13282
75	1687	3102	5533	8685	14219

General Notes:

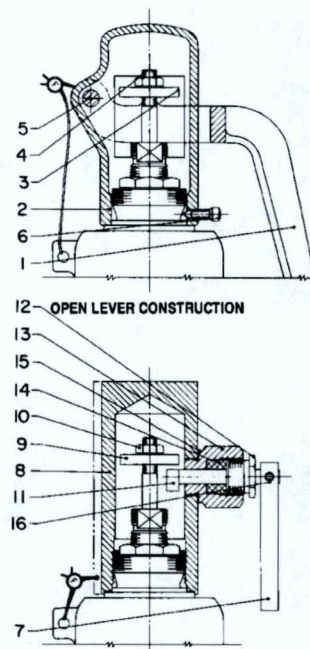
- Capacities at 2.0 BarG set pressure and below are based on 0.2 Bar overpressure.
- For sizing purposes, the coefficients of discharge K are 0.878 for air, gas & steam; 0.676 for liquids.

Cap Constructions

Cap Construction	Item No.	Part Name	Standard Materials	316 St. St.		Monel		Hastelloy C	
				S4	S7	M1 & M2	M4	H1 & H2	H4
M70 Open Lever	1	Test Lever	Iron	—	—	—	—	—	—
	2	Cap, O.L.	Iron	—	—	—	—	—	—
	3	Stem Test Washer	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	4	Stem Jam Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	5	Button Head Rivet	Steel	—	—	—	—	—	—
	6	Set Screw	Steel	—	—	—	—	—	—
M40 Packed Lever	7	Test Lever	Steel	—	—	—	—	—	—
	8	Cap, Packed	Steel	316 St. St.	—	—	Monel	—	Hast. C
	9	Stem Test Washer	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	10	Stem Jam Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	11	Cam	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	12	Gland	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	13	Gland Nut	St. St.	316 St. St.	—	—	Monel	—	Hast. C
	14	Packing Ring	Graphite	—	—	—	—	—	—
	15	Gland Nut Gasket	Flexible Graphite	PTFE, Filled	PTFE, Filled	—	PTFE, Filled	—	PTFE, Filled
	16	Groove Pin	Steel Plt'd	—	—	—	—	—	—

General Notes:

- Any part denoted with a dash is standard material.
- "S4" trim suitable for cryogenic service.





THREADED CONNECTIONS (MNPT X FNPT)

Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	11 1/4	1 3/4	3 9/16	282	45	91	8	3.6
3/4 x 1	11 1/4	1 3/4	3 9/16	286	45	91	8	3.6
3/4 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
1 x 1	11 1/2	1 3/4	3 3/4	292	45	95	8	3.6
1 x 1 H.P.	13 5/8	1 1/2	3 3/4	346	64	95	14	6.3
E Orifice								
1 x 1 1/2	13 5/8	2 1/2	3 1/2	346	64	89	16	7.2
F Orifice								
1 1/2 x 2	14 9/16	3	3 7/8	370	76	98	17	7.7
G Orifice								
1 1/2 x 2 1/2	14 9/16	3	4 1/8	370	76	105	18	8.1

WELDING NIPPLE CONNECTIONS

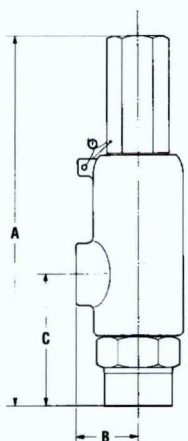
Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	13	3 3/16	5 1/4	330	81	133	9	4
1/2 x 1 H.P.	15 3/16	3 15/16	5 5/16	386	100	135	15	6.8
3/4 x 1	12 15/16	3 3/16	5 3/16	329	81	132	9	4
3/4 x 1 H.P.	15 1/8	3 15/16	5 1/4	384	100	133	15	6.8
1 x 1	12 7/8	3 3/16	5 1/8	327	81	130	9	4
1 x 1 H.P.	15 1/16	3 15/16	5 3/16	383	100	132	15	6.8
E Orifice								
1 x 1 1/2	14 13/16	3 13/16	4 15/16	376	97	125	17	7.7
F Orifice								
1 1/2 x 2	15 7/8	5 3/16	5 3/16	403	132	132	18	8.1
G Orifice								
1 1/2 x 2 1/2	15 7/8	5 3/16	5 7/16	403	132	128	19	8.6

SOCKET WELD & FNPT X FNPT CONNECTIONS

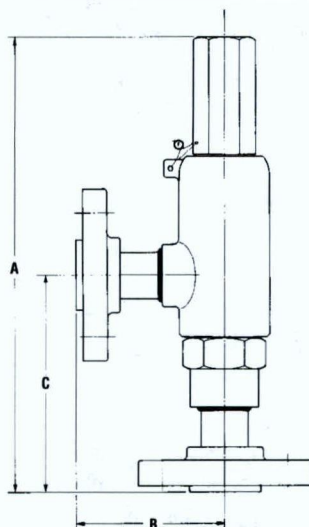
Valve Size	US Customary Units (Inches)			Metric Units (millimeters)			Approximate Weight	
Inlet x Outlet	A Max. All Cap Const.	B	C	A Max. All Cap Const.	B	C	Lbs.	Kgs.
C and D Orifice								
1/2 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
1/2 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
3/4 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
3/4 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
1 x 1	11 7/16	1 3/4	3 11/16	291	45	94	8	3.6
1 x 1 H.P.	13 5/8	2 1/2	3 3/4	346	64	95	14	6.3
E Orifice								
1 x 1 1/2	13 3/8	2 1/2	3 1/2	340	64	89	16	7.2
F Orifice								
1 1/2 x 2	14 9/16	3	3 7/8	370	76	98	17	7.7
G Orifice								
1 1/2 x 2 1/2	14 9/16	3	4 1/8	370	76	105	18	8.1

Note: H.P. designates the high pressure version of a given inlet size.

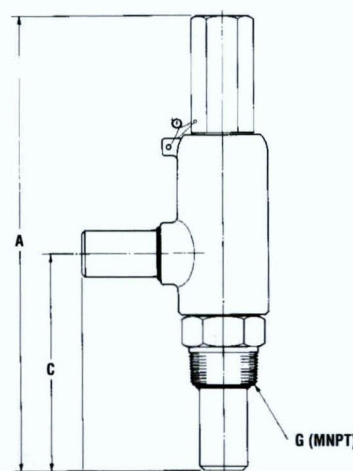
Dimensions & Weights



(MNPT, FNPT, & SW)



(FLANGED)



(WELDING NIPPLE)

FLANGED CONNECTIONS

Orifice Area Sq. In.	Valve Size Inlet x Outlet	ANSI Flange Class		US Customary Units (Inches)				Metric Units (millimeters)			Weight	
		Inlet RF	Outlet RF	A (Max.)	B	C	G' (MNPT)	A (Max.)	B	C	Lbs.	Kgs.
0.068 & 0.125	1/2 x 1	150#	150#	14	5 3/16	6 1/4	1	356	132	159	15	6.8
		300#	150#									
		600#	150#									
		900#	300#									
	3/4 x 1	1500#	300#	16 1/8	5 15/16	6 1/4	1	410	151	159	22	9.9
		2500#	300#									
		150#	150#									
		300#	150#									
	1 x 1	600#	150#	13 15/16	5 3/16	6 3/16	1 1/4	354	132	157	15	6.8
		900#	300#									
		1500#	300#									
		2500#	300#									
0.223	1 x 1/2	150#	150#	16 13/16	5 13/16	6 15/16	1 1/2	427	148	176	26	11.7
		300#	150#									
		600#	150#									
		900#	300#									
0.350	1 1/2 x 2	150#	150#	17 7/8	8 3/16	7 3/16	2	454	208	183	30	13.6
		300#	150#									
		600#	150#									
0.573	1 1/2 x 2 1/2	150#	150#	17 1/8	8 3/16	7 7/16	2	435	208	189	32	14.5
		300#	150#									
		600#	150#									

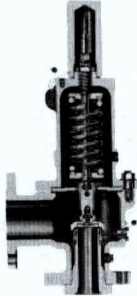
General Note:

1. Same pipe thread connections also used on socket weld models with corresponding inlet sizes.



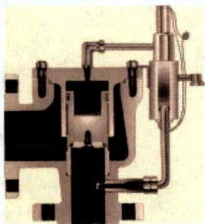
Other Farris Engineering Valves

Process Pressure Relief Valves



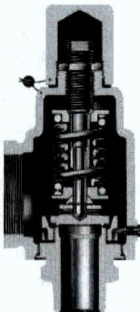
SERIES 2600

- ASME NB Certified: Air, Steam & Water
- Sizes: 1" x 2" to 20" x 24"
- Pressure Range: 15 psig to 6000 psig
- Temperature Range: -450° F to +1500° F
- Materials: Carbon Steel, Stainless, Monel & Hastelloy C
- Options: Balanced Bellows, O-Ring Seat, Open Bonnet



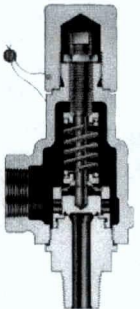
SERIES 3800 Pilot Operated

- ASME NB Certified: Air & Water
- Sizes: 1" x 2" to 12" x 16"
- Pressure Range: 20 psig to 6170 psig
- Temperature Range: -450° F to +500° F
- Materials: Steel Body & Bonnet, Stainless Steel Trim
- Options: Modulating Pilot Control, Complete 316 Stainless Steel Construction



SERIES 2850

- ASME NB Certified: Air & Steam
- Sizes: 3/4" x 1" to 1 1/2" x 2"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +750° F
- Materials: Stainless Steel Body & Trim with Carbon Steel Bonnet



SERIES 1890

- ASME NB Certified: Air, Steam & Water
- Sizes: 1/2" x 1" & 3/4" x 1"
- Pressure Range: 15 psig to 800 psig
- Temperature Range: -450° F to +750° F
- Materials: Stainless Steel Body & Trim with Carbon Steel Bonnet

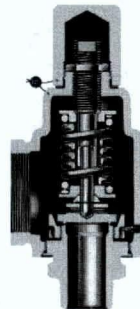
Steam Safety Valves



SERIES 6400/6600

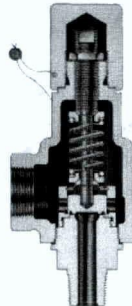
- ASME Section I NB Certified: Steam & Air
- Sizes: 1" x 2" to 4" x 6"
- Pressure Range: 15 psig to 1500 psig
- Temperature Range: -20° F to +1000° F
- Materials: Carbon & Stainless Steel
- Options: Exposed Spring & Closed Bonnet

Special Purpose Pressure Relief Valves



SERIES 2856

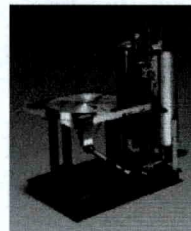
- ASME NB Certified: Air & Steam
- Sizes: 3/4" x 1 1/4" to 2" x 3"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +400° F
- Materials: Brass Body & Trim, Bronze Bonnet



SERIES 1896M

- ASME NB Certified: Air, Steam & Water
- Sizes: 1/2" x 3/4" & 3/4" x 3/4"
- Pressure Range: 15 psig to 300 psig
- Temperature Range: -450° F to +400° F
- Materials: Brass Body & Trim, Bronze Bonnet

Test Stands



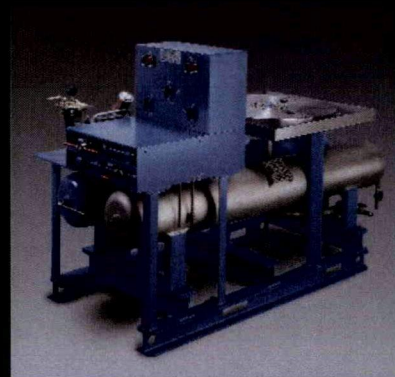
MODELS T1500 & T6000

- Air & Water Testing
- Maximum Pressures of 1500 psig and 6000 psig
- Test Valves to 8" Inlet Size
- Stainless Steel Test Drum & Test Table
- Digital Test Gauge

Also from Farris Engineering



Pressure Relief Valves



Universal Test Stand T6000



Universal Test Stand T1500



Farris Engineering

Division of Curtiss-Wright Flow Control Corporation

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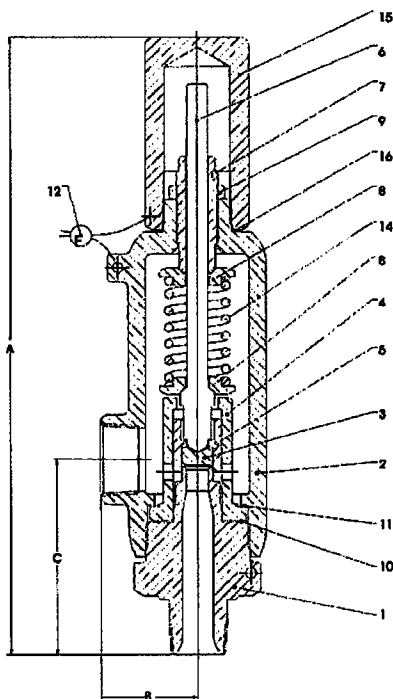
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R3 10M 02/03

Pressure Relief Valve Reference Drawing

Date Prepared: 2005-12-21 11:49

PSV Identification

Customer	Requisition #	Job #	Job Description	
		PG122105	WATERFLOOD	
Tag #	Tag Description	P / ID		NACE
Gas Reg Set 50psi				No
ASME Code	Fluid State	Resolved ASME Area	Resolved API Area	Rupture Disk Coeff.
ASME Sec. VIII	Gas (Volume)	0.26389 in²	0.2375 in²	No Rupture Disk, 1
Operating Pressure	Set Pressure	Constant Back P.	Variable Back P.	Cold Diff. Test P.
40 PSIG	50 PSIG	0 PSIG	0 PSIG	50 PSIG
Operating Temp.	Relief Temp.	Operating to Set %	Over Pressure	Percent Over P.
70 °F	70 °F	80 %	5 PSIG	10 %



Farris 27FA45-M20

API Letter	API Area	ASME Area
		0.350 in²

	Size	Rating	Facing
Inlet:	1.50 in		MNPT
Outlet:	2.00 in		FNPT

Valve Design	Cap Constrn	Test Gag
Conventional	Plain	No
Max. Rel. Cap.	React. Force	Noise
464.22 CFM	16.555 lbs	96.909 dBa

Materials

Body (1)	Bonnet (2)
316 ss	Carbon Steel
Nozzle (1)	Disc (3)
316 ss	316 ss
Guide (4)	Spring (13)
316 ss	316 ss

Dimensions

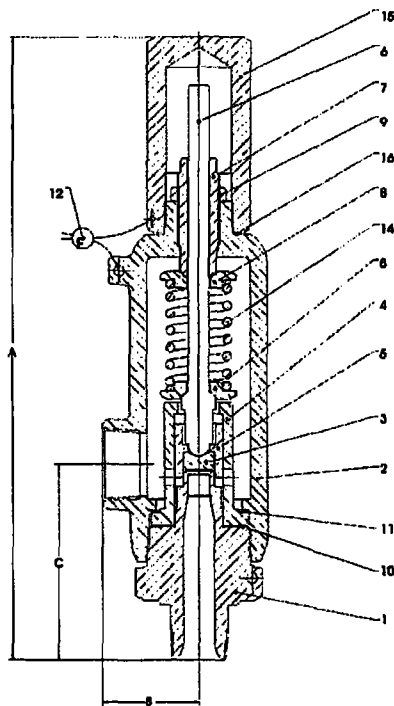
Weight	Dimension A	Dimension B
17 lb	14 8/16 in	3 in
Dimension C		
3 7/8 in		

Pressure Relief Valve Reference Drawing

Date Prepared: 2005-12-21 11:49

PSV Identification

Customer	Requisition #	Job #	Job Description	
		PG122105	WATERFLOOD	
Tag #	Tag Description	P / ID	NACE	
Gas Reg set 75psi			No	
ASME Code	Fluid State	Resolved ASME Area	Resolved API Area	Rupture Disk Coeff.
ASME Sec. VIII	Gas (Volume)	0.097315 in ²	0.087584 in ²	No Rupture Disk, 1
Operating Pressure	Set Pressure	Constant Back P.	Variable Back P.	Cold Diff. Test P.
50 PSIG	75 PSIG	0 PSIG	0 PSIG	75 PSIG
Operating Temp.	Relief Temp.	Operating to Set %	Over Pressure	Percent Over P.
70 °F	70 °F	66.667 %	7.5 PSIG	10 %



Dimensions

Weight	Dimension A	Dimension B
8 lb	11 1/2 in	1 3/4 in
Dimension C		
3 3/4 in		

Farris 27DA33-M20

API Letter	API Area	ASME Area
		0.125 in ²

	Size	Rating	Facing
Inlet:	1.00 in		MNPT
Outlet:	1.00 in		FNPT

Valve Design	Cap Constrn	Test Gag
Conventional	Plain	No
Max. Rel. Cap.	React. Force	Noise
231.21 CFM	8.2453 lbs	94.692 dBa

Materials

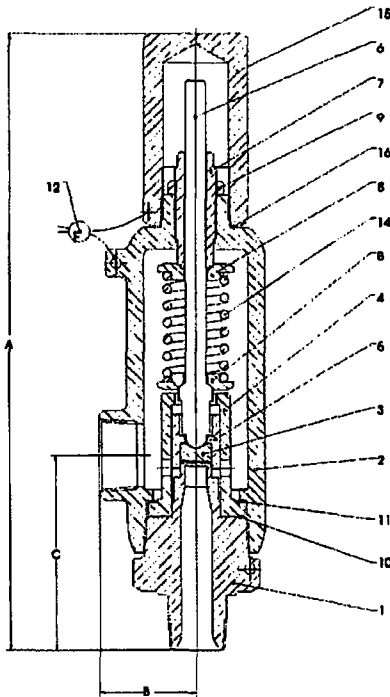
Body (1)	Bonnet (2)
316 ss	Carbon Steel
Nozzle (1)	Disc (3)
316 ss	316 ss
Guide (4)	Spring (13)
316 ss	316 ss

Pressure Relief Valve Reference Drawing

Date Prepared: 2005-12-21 11:49

PSV Identification

Customer	Requisition #	Job #	Job Description	
		PG122105	WATERFLOOD	
Tag #	Tag Description		P / ID	NACE
Gas Reg set at 325psi				No
ASME Code	Fluid State	Resolved ASME Area	Resolved API Area	Rupture Disk Coeff.
ASME Sec. VIII	Gas (Volume)	0.09177 in ²	0.082593 in ²	No Rupture Disk, 1
Operating Pressure	Set Pressure	Constant Back P.	Variable Back P.	Cold Diff. Test P.
280 PSIG	325 PSIG	0 PSIG	0 PSIG	325 PSIG
Operating Temp.	Relief Temp.	Operating to Set %	Over Pressure	Percent Over P.
70 °F	70 °F	86.154 %	32.5 PSIG	10 %



Farris 27DA33-M20

API Letter	API Area	ASME Area
		0.125 in ²

	Size	Rating	Facing
Inlet:	1.00 in		MNPT
Outlet:	1.00 in		FNPT

Valve Design	Cap Constrn	Test Gag
Conventional	Plain	No
Max. Rel. Cap.	React. Force	Noise
885.36 CFM	50.79 lbs	101.42 dBA

Materials

Body (1)	Bonnet (2)
316 ss	Carbon Steel
Nozzle (1)	Disc (3)
316 ss	316 ss
Guide (4)	Spring (13)
316 ss	316 ss

Dimensions

Weight	Dimension A	Dimension B
8 lb	11 1/2 in	1 3/4 in
Dimension C		
3 3/4 in		

Type L2 Liquid Level Controller

Snap-Acting or Throttling Control

Vent-Away Case

Field-Reversible Output

2-Inch NPT Vessel Connection

NACE Service Ready

Low-Bleed Environmentally Friendly Relay

ASME Class 1500 Pressure Rating

Field-Configurable Vertical or Horizontal Displacer

W8335

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

Figure 1. Features



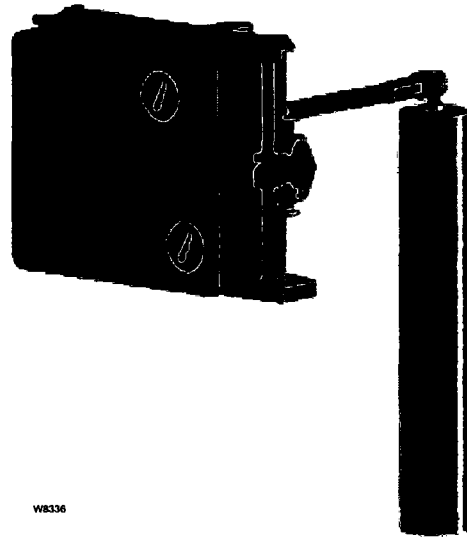


Figure 2. Type L2 Liquid Level Controller

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**—Standard 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: ≤0.03 normal m³/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure or ≤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)

-Continued-

Product Bulletin

34.2:L2
July 2002

L2 Liquid Level Controller

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.

L2 Liquid Level Controller

Product Bulletin

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July 2002

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Type L2 Liquid Level Controllers

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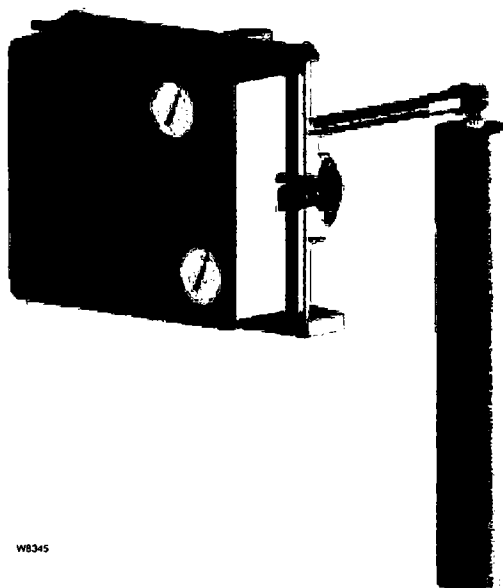


Figure 1. Type L2 Liquid Level Controller

No person may install, operate or maintain a Type L2 Liquid Level Controller without first • being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance, and • carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Fisher sales office.

Note

Neither Emerson, Emerson Process Management, nor Fisher assume responsibility for the selection, use, or maintenance of any product. Responsibility for the selection, use, and maintenance of any Fisher product remains with the purchaser and end-user.

Introduction

Scope of Manual

This instruction manual includes installation, adjustment, maintenance, and parts ordering information for Type L2 liquid level controllers.



Table 1. 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 1.0 Specific Gravity Liquid, with 1.4 Bar (20 Psig) Supply, Direct Action, and Standard 48 x 305 mm (1-7/8 X 12-Inch) Vertical Displacer with Standard Lever Arm Length:

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

Minimum Specific Gravity⁽²⁾

Throttling and On/Off Controllers: Minimum specific gravity, or specific gravity differential for interface applications, is 0.1 (see note 3)

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

Declaration of SEP

Fisher Controls International LLC declares this product to be in compliance with Article 3 paragraph 3 of the Pressure Equipment Directive (PED) 97 / 23 / EC. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.

However, the product *may* bear the CE marking to indicate compliance with *other* applicable EC Directives.

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 and On/Off Controller

Throttling: 1.4 bar for 0.2 to 1.0 bar output signal (20 psig for 3 to 15 psig output signal) and 2.4 bar for 0.4 to 2.0 bar output signal (35 psig for 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 bar 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: ≤0.03 normal m³/hr (1.0 scfh) at 1.4 bar (20 psig) supply pressure or ≤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⁽⁴⁾

258 bar (3750 psig)

Maximum Displacer Insertion Length

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

Sensor to Vessel Connection

51 mm (2-inch) screwed (NPT)

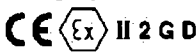
Maximum Sensor Working Pressure⁽⁴⁾

Consistent with Class 1500 pressure temperature ratings per ASME B16.34 up to maximum pressure of 258 bar (3750 psig)

For PED (97/23/EC) maximum pressure limited to 200 bar (2900 psig)

- Continued -

Table 1. Specifications (continued)

<p>Operative Ambient Temperature Limits^(1,4) Controller: -29 to 71°C (-20 to 160°F)</p> <p>Sensor Temperature Limits^(1,4) Displacer: -29 to 79°C (-20 to 175°F) O-Rings: -40 to 204°C (-40 to 400°F)</p> <p>Hazardous Area Classification Complies with the requirements of ATEX Group II Category 2 Gas and Dust </p>	<p>Standard Supply, and Output Pressure Gauge Indications Triple scale gauges in 0 to 60 psig/0 to 0.4 MPa/0 to 4.0 bar</p> <p>Controller Connections Supply: 1/4 inch NPT female located on the bottom of the case Output: 1/4 inch NPT female located on the top of the case Case Vent: 1/4 inch NPT female with vent screen assembly located on the back of the case</p>
---	--

1. This term is defined in ISA Standard S51.1.

2. Depends on float rod/displacer orientation and length. Contact your Fisher sales office for further information.

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.

4. The pressure and temperature limits in this document and any applicable code limitations should not be exceeded.

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).

Description

The rugged Type L2 liquid level controllers use a displacer type sensor (see figure 1) to detect liquid level or the interface of two liquids of different specific gravities.

These low-bleed controllers use a single four-mode relay to provide the applicable control and action. The device delivers a pneumatic output signal to a control valve.

Specifications

Specifications for the controller and sensor are listed in table 1.

Educational Services

For information on available courses for Type L2 Liquid Level Controllers, as well as a variety of other products, contact:

Emerson Process Management
Educational Services, Registration
P.O. Box 190; 301 S. 1st Ave.
Marshalltown, IA 50158-2823
Phone: 800-338-8158 or
Phone: 641-754-3771
FAX: 641-754-3431
e-mail: education@emersonprocess.com

Installation



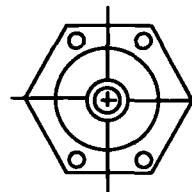
WARNING

- Always wear protective clothing and eyewear when performing any installation operations to avoid personal injury.
- To avoid personal injury or property damage caused by the sudden release of process fluid, be certain the service conditions do not exceed the sensor pressure limits. Use pressure-limiting or pressure-relieving devices to prevent service conditions from exceeding these limits.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.
- If installing this into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section of this instruction manual.

CAUTION

If the Type L2 level controller is installed on a vessel that is to be shipped to a different location (e.g. skid mounted units), remove the displacer and displacer rod extensions before shipment. Failure to do so could result in damage to the displacer rod due to vibration and impact loading during shipment. After the vessel is installed at its final location, reassemble the displacer and displacer rod extension.

1. Be sure there are no obstructions inside the tank that will interfere with displacer installation or operation.
2. Provide the appropriate connection in the tank wall to match the sensor connection. Locate the tank wall connection such that the displacer will be at the desired control level.



**CORRECT CONTROLLER MOUNTING
HOLE ORIENTATION WHEN
MOUNTED ON VESSEL**

A6539 / L

Figure 2. Sensor Orientation

Attaching a Vertical Displacer

Refer to figure 7 for part locations.

1. Thread jam nut (key 68) all the way onto the threaded portion of the universal joint assembly (key 69).
2. Thread the displacer (key 81) all the way onto the threaded portion of the universal joint assembly.
3. Tighten the jam nut (key 63) against the displacer (key 81).

Attaching a Horizontal Displacer

Refer to figure 7 for part locations.

1. Thread the displacer (key 81) all the way onto the displacer rod (key 64) or extension (key 82).
2. Tighten the jam nut (key 63) against the displacer (key 81).

Attaching the Sensor to the Vessel

Insert the displacer end of the controller-sensor assembly into the tank connection, and screw the sensor threads into the tank connection. Tighten sufficiently to seal the threads. If necessary, loosen or tighten slightly to obtain the orientation shown in figure 2. Make sure that the controller case is level.

CAUTION

Do not pick up the controller/sensor by lifting the displacer rod (key 64). This action could place excessive stress on the displacer rod and cause the unit to malfunction.

Pressure Connections



WARNING

Personal injury or property damage may occur from an uncontrolled process if the supply medium is not clean, dry, oil-free air, or non-corrosive gas. While use and regular maintenance of a filter that removes particles larger than 40 microns in diameter will suffice in most applications, check with a Fisher Field office and Industry Instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.

1. Provide a source of clean, dry air that meets the requirements of ISA Standard S7.3 as the operating medium. Refer to table 1 to determine supply pressure.
2. Connect the supply pressure to the 1/4-inch NPT female connection on the bottom of the controller case.
3. Connect the output signal line to the equipment being operated and to the 1/4-inch NPT output connection on the top of the controller case.

Vent



WARNING

If a flammable or hazardous gas is to be used as the supply pressure medium, personal injury or property damage could result from fire or explosion of accumulated gas or from contact with hazardous gas. The controller/actuator assembly does not form a gas-tight seal, and when the

assembly is enclosed, a remote vent line, adequate ventilation, and necessary safety measures should be used. A remote vent pipe alone cannot be relied upon to remove all hazardous gas. Vent line piping should comply with local and regional codes and should be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

The vent opening or the end of the remote vent pipe, if one is required, must be protected against the entrance of all foreign matter that could plug the vent. Use 13 mm (1/2-inch) diameter pipe for the remote vent pipe. Check the vent periodically to be certain it is free of any obstructions.

Changing Controller Action or Mode



WARNING

To avoid personal injury caused by a sudden release of pressure, shut off the supply pressure and bleed pressure from the supply lines before performing any procedure in this section.

Throttling and On/Off Controller

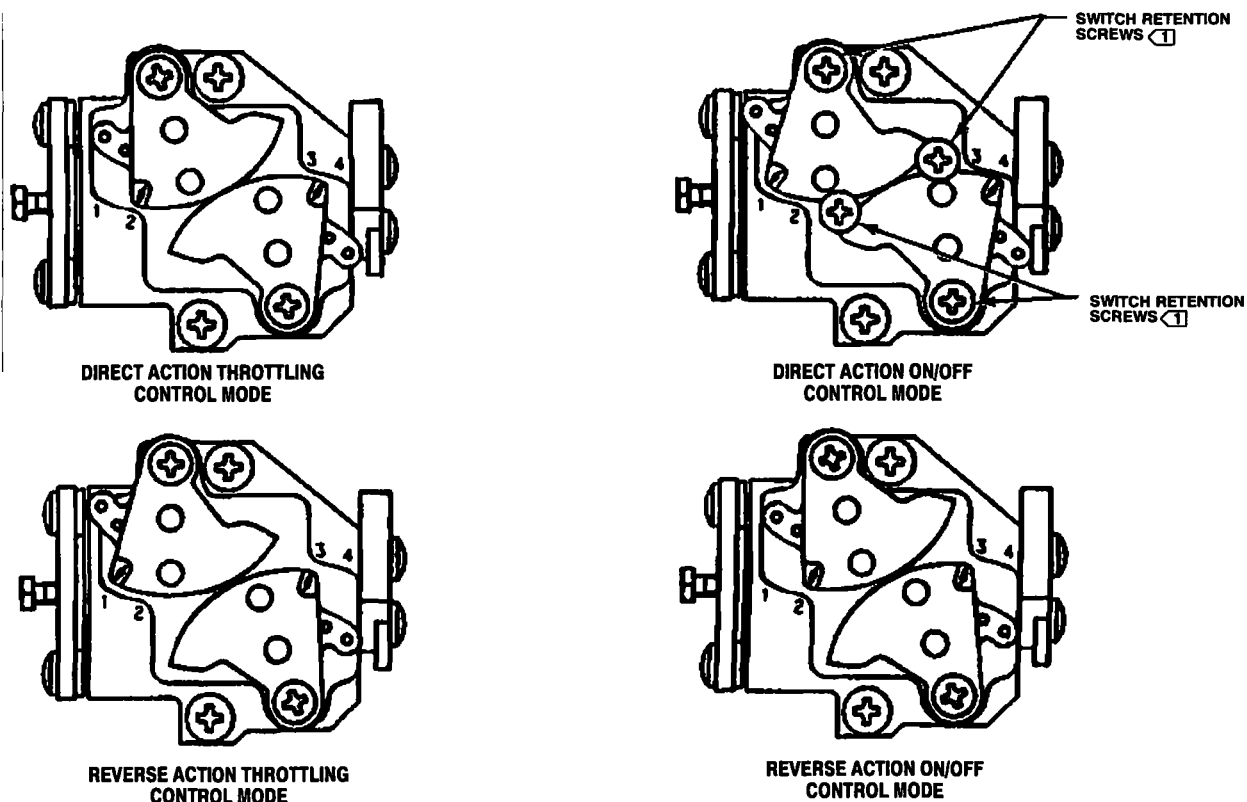
The action of a throttling and on/off controller may be changed between either direct or reverse, and the control mode may be changed between either on/off or throttling.

Refer to figure 3. Loosen the four switch retention screws on the relay. Move the switches to the control action and control mode required by the application. Tighten the four switch retention screws.

Snap-Acting Controller

The action of a snap-acting controller may be changed between either direct or reverse. The control mode is always snap acting.

Refer to figure 4. Loosen the four switch retention screws on the relay. Move the switches to the control action required by the application. Tighten the four switch retention screws.

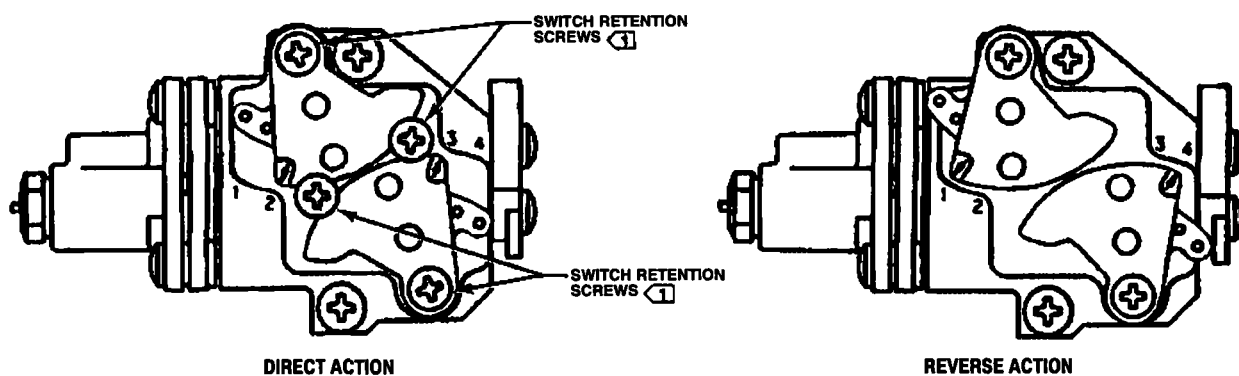


NOTE:

- 1 ALL FOUR SWITCH RETENTION SCREWS SHOWN ONLY ON THIS VIEW. OTHER VIEWS SHOW ONLY TWO SWITCH RETENTION SCREWS IN ORDER TO ILLUSTRATE THE SWITCH CONFIGURATION.

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Figure 3. Type L2 Throttling and On/Off Controller Switch Positions for Changing Action and Control Mode

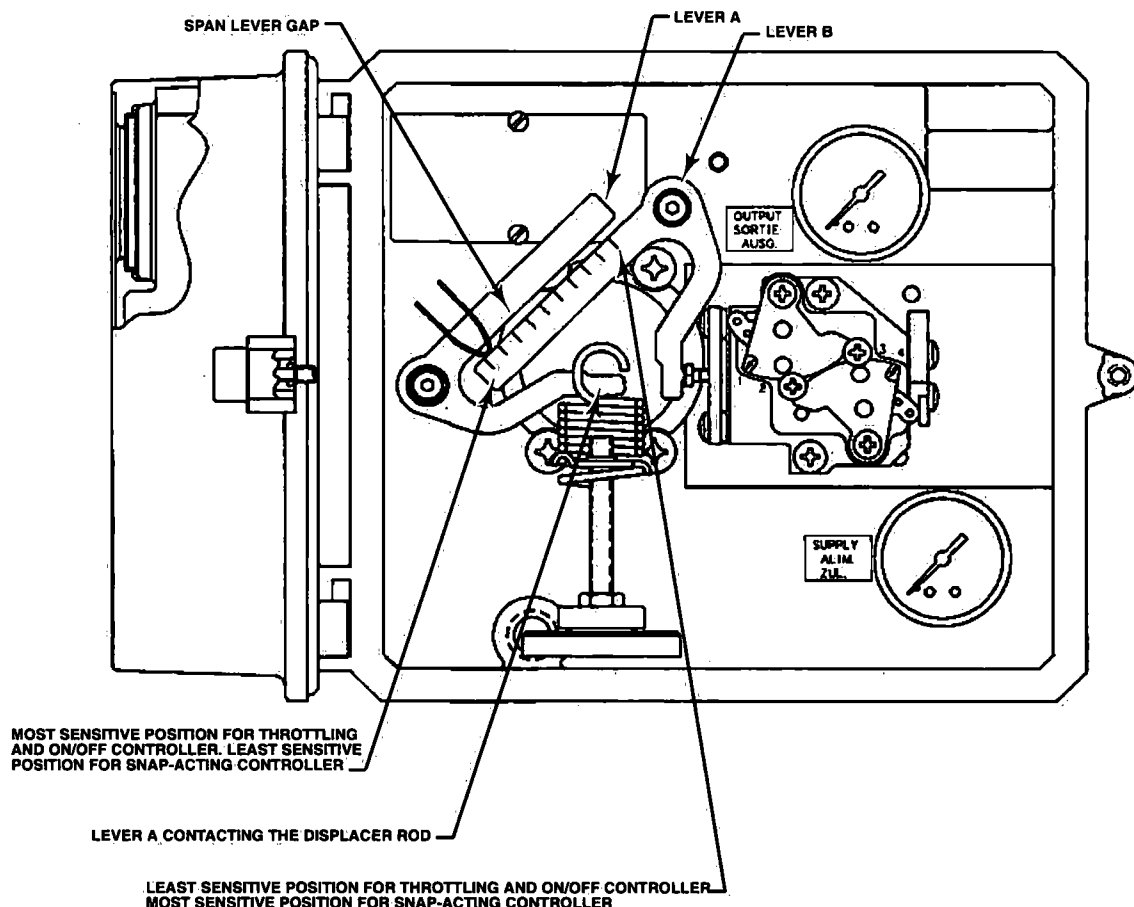


NOTE:

- 1 ALL FOUR SWITCH RETENTION SCREWS SHOWN ONLY ON THIS VIEW. OTHER VIEWS SHOW ONLY TWO SWITCH RETENTION SCREWS IN ORDER TO ILLUSTRATE THE SWITCH CONFIGURATION.

B2340 / IL

Figure 4. Type L2 Snap-Acting Controller Switch Positions for Changing Action



GB0137-2
E0787

Figure 5. Proportional Band Adjustments

Proportional Band Adjustment

Except where indicated, key numbers referenced in the following procedures are shown in figure 8. The span levers and other proportional band information are shown in figure 5.

Preliminary Checks

1. Check the supply pressure gauge (key 10) to be certain that the supply pressure is at the desired value. Adjust the supply pressure as required.
2. Adjust the displacer rod to the horizontal position with the spring adjustment (key 4).
3. Bounce the end of the displacer rod (key 64, figure 7) up and down to check that the sensor is operating freely.
4. Place the span adjuster (key 9) at the desired position (see figure 5).

5. Check figures 3 and 4 for correct control action and control mode.

6. Adjust the relay adjustment screw (key 49, throttling controller) or the valve assembly (key 51, snap-acting controller) so that the gap between the span levers (see figure 5) is equal when lever A is contacting the displacer rod.

Direct-Acting Throttling Controllers

1. Make certain the Preliminary Checks procedure at the start of this section has been completed.
2. Lower the liquid level so that it is below the bottom of the displacer or at the lowest desired operating point on the displacer. For interface applications, completely cover the displacer with the fluid with the lower specific gravity. The heavier fluid should be below the bottom of the displacer or at the lowest desired operating point on the displacer.

L2 Controllers

3. Adjust the spring adjustment (key 4) until the output pressure is 1 to 2 psig for a 3 to 15 psig output range, or 2 to 4 psig for a 6 to 30 psig output range.

Reverse-Acting Throttling Controllers

1. Make certain the Preliminary Checks procedure at the start of this section has been completed.
2. Lower the liquid level so that it is below the bottom of the displacer or at the lowest desired operating point on the displacer. For interface applications, completely cover the displacer with the fluid with the lower specific gravity. The heavier fluid should be below the bottom of the displacer or at the lowest desired operating point on the displacer.
3. Adjust the spring adjustment (key 4) until the output is 16 to 17 psig for a 3 to 15 psig output range, or 31 to 34 psig for a 6 to 30 psig output range.

Direct-Acting On/Off and Snap-Acting Controllers

1. Make certain the Preliminary Checks procedure at the start of this section has been completed.
2. Lower the liquid level so that it is below the bottom of the displacer or at the lowest desired operating point on the displacer. For interface applications, completely cover the displacer with the fluid with the lower specific gravity. The heavier fluid should be below the bottom of the displacer or at the lowest desired operating point on the displacer.
3. Adjust the spring adjustment (key 4) until the output pressure is at full supply pressure.
4. Readjust the spring adjustment (key 4) until the output pressure goes to zero psig.

Reverse-Acting On/Off and Snap-Acting Controllers

1. Make certain the Preliminary Checks procedure at the start of this section has been completed.
2. Lower the liquid level so that it is below the bottom of the displacer or at the lowest desired operating point on the displacer. For interface applications, completely cover the displacer with the fluid with the lower specific gravity. The heavier fluid should be below the bottom of the displacer or at the lowest desired operating point on the displacer.

3. Adjust the spring adjustment (key 4) until the output pressure goes to zero psig.

4. Readjust the spring adjustment (key 4) until the output pressure goes to full supply pressure.

Principle of Operation

The operation of Type L2 controllers in combination with the sensor is based on Archimedes Principle, which states that a body immersed in a liquid will be buoyed up by a force equal to the weight of the liquid displaced. The buoyant force and resultant movement of the displacer in the liquid is transmitted to the controller which delivers a pneumatic signal to a control valve.

Figure 6 shows a simple schematic of the controller and sensor. In its normal position, the counterclockwise moment due to the weight of the displacer about pivot point O is balanced by the clockwise zero spring moment and the counterclockwise relay zero force moment applied through lever A to the displacer rod. The weight of the displacer decreases when the liquid level increases and the subsequent buoyant force increases causing a force imbalance between the zero spring, relay, and displacer forces. This force imbalance is transmitted to the relay by levers A and B. The relay compensates for the force imbalance by converting it to a pressure output to a control valve and bringing the forces back into equilibrium.

For throttling control, the relay pressure output will be proportional to the buoyant force. For on/off control, the relay pressure output will be either zero or equal to the supply pressure over the range of liquid level change. The liquid level change required to fully operate the relay is adjusted by sliding the proportional band adjustment along lever A to vary the lever ratio between levers A and B.

With reverse-acting proportional control, the principle of operation remains the same as that for direct action; however, the controller delivers an increasing pneumatic signal to the control valve when the liquid level falls.

Maintenance

Parts are subject to normal wear and must be inspected periodically and replaced as necessary. The frequency of parts inspection and replacement depends upon the severity of service conditions.

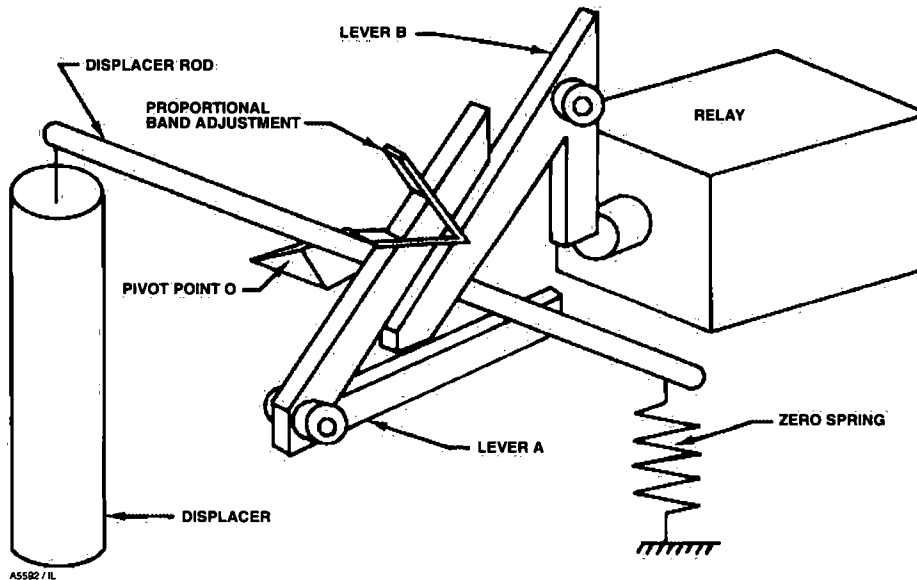


Figure 6. Operational Schematic

When inspection or repairs are required, disassemble only those parts necessary to accomplish the task.



WARNING

Always wear protective clothing and eyewear when performing any maintenance operations to avoid personal injury.

To avoid personal injury or property damage caused by the release of pressure or process fluid, observe the following before starting maintenance:

- Provide some temporary means of control for the process before taking the controller out of service.
- Provide a means of containing the process fluid before removing any measurement devices from the process.
- Vent any trapped process pressure.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

Removing the Controller From the Sensor



WARNING

Refer to the **WARNING** at the beginning of this section.

1. Disconnect the supply and output pressure lines.
2. Slide the hook end of the zero spring (key 5, figure 8) over and off the controller end of the displacer rod (key 64, figure 7).
3. Remove the four controller mounting screws (key 11, figure 8), and pull the controller straight away from the sensor.

Replacing the Sensor O-Rings



WARNING

Refer to the **WARNING** at the beginning of this section.

Refer to figure 7 for key number locations unless otherwise indicated.

Disassembly

1. Remove the controller from the sensor by following the procedure outlined in the previous section.

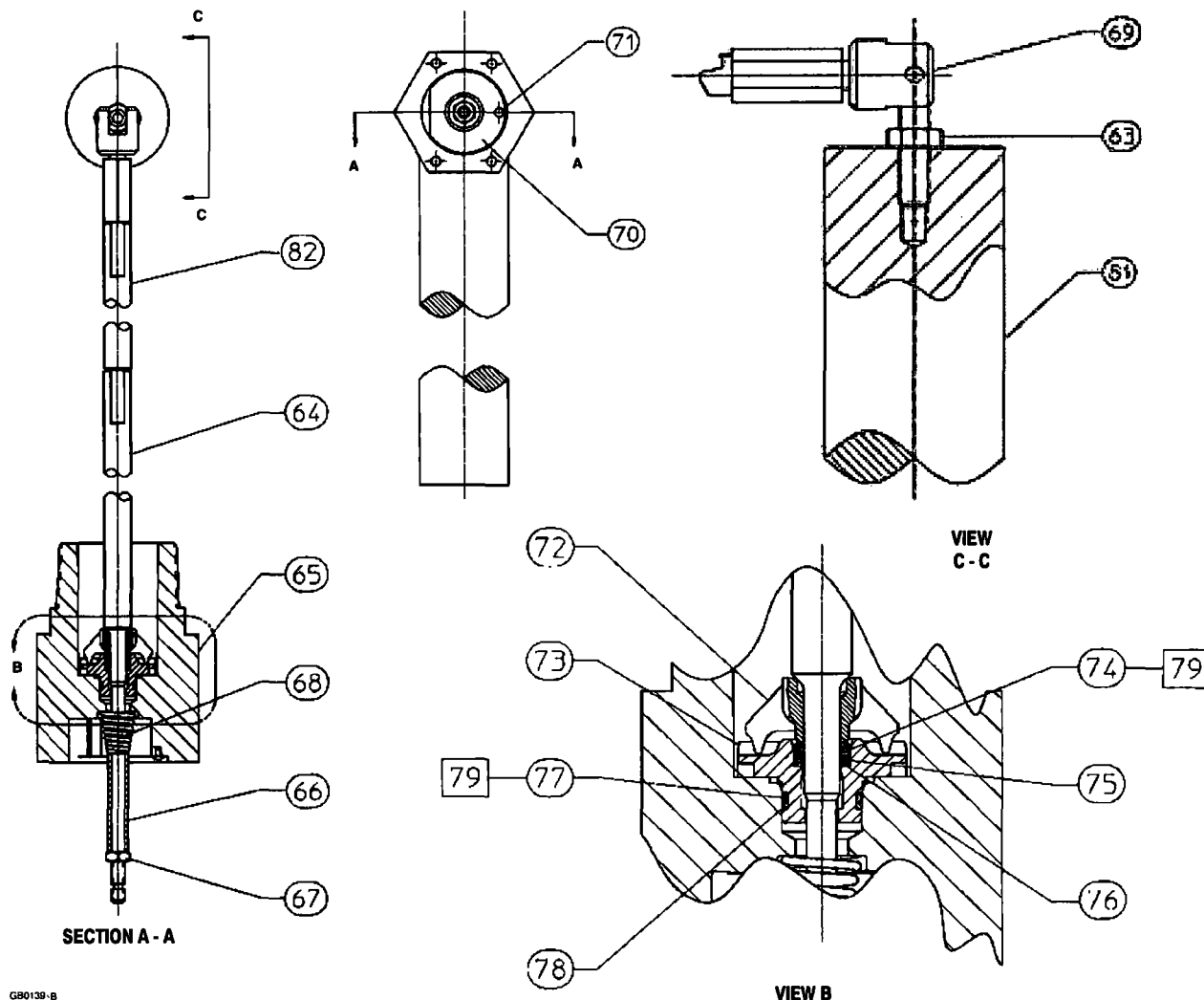


Figure 7. Sensor

2. Remove the sensor from the tank.

3. Unscrew the hex nut (key 67) and remove the spacer (key 66) and spring (key 68). After removing the spring, replace the spacer (key 66) and hex nut (key 67) on the displacer rod.

From the displacer end, pull the displacer rod away from the sensor connection (key 65) to pull the pivot base (key 73) loose from the sensor connection. Remove the hex nut (key 67) to permit removing the displacer rod, pivot base, pivot body, and spacer from the sensor connection.

4. Slide the pivot base (key 73), retaining ring (key 76), anti-extrusion ring (key 75), and O-ring (key 74) off the displacer rod. Remove the O-ring (key 77) and backup ring (key 78) from the pivot base.

Assembly



WARNING

Improper assembly of the O-rings, anti-extrusion ring, and backup ring could result in O-ring extrusion and

permit leakage of process fluids. To avoid personal injury or property damage from leaking process fluid, be sure the O-rings, anti-extrusion ring and backup ring are assembled in the order shown in figure 7.

1. Place the pivot body (key 72) on the displacer rod (key 64) so that it is positioned as shown in figure 7.
2. Slide the O-ring (key 74), anti-extrusion ring (key 75) and retaining ring (key 76) onto the displacer rod assembly (key 64). Be sure the O-ring, anti-extrusion ring, and retaining ring are in the order shown in figure 7. Slide the pivot base onto the displacer rod so that the points of the pivot body (key 72) will engage the slots in the pivot base (key 73).
3. Install the O-ring (key 77) and backup ring (key 78) into the groove on the pivot base (key 73). Be sure the backup ring is on the downstream pressure side of the O-ring as shown in figure 7.
4. Insert the displacer rod (key 64) into the vessel side of the sensor connection (key 65).
5. The pivot base must seat in the slots cast in the sensor connection. These slots will be horizontal when the sensor connection (key 65) is oriented as shown in figure 2.
6. To reduce the possibility of nicking the O-ring (key 77) on the pivot base, keep the displacer rod centered in the sensor connection as much as possible while pushing the pivot base into the sensor connection. Be sure the pivot base seats in the slots cast in the sensor connection.
7. Slide the spring (key 68) and spacer (key 66) onto the displacer rod and secure with the hex nut (key 67). Fully tighten the hex nut (key 67).
8. View the sensor connection from the vessel side. Ensure that the pivot body arms remain aligned with the pivot base arms (the two pivot body points are seated in the pivot base slots).
9. Install the sensor on the tank.

Replacing the Controller Relay



WARNING

Refer to the WARNING at the beginning of this section.

Refer to figure 8 for key number locations unless otherwise indicated.

1. Disconnect the supply and output pressure lines.
2. Remove the two relay mounting screws (key 33), and pull the relay away from the controller base (key 1).
3. Install the new relay using two relay mounting screws (key 33). Make certain that the relay mounting O-rings (keys 43 and 44, not shown) are completely in their mounting bosses before installing the relay. Make certain span lever B (see figure 5) is in line with and pushing in on the end of either the relay adjustment screw (key 49, throttling controller) or the pilot valve plug of the valve assembly (key 51, snap-acting controller).

Replacing the Controller Supply Filter



WARNING

Refer to the WARNING at the beginning of this section.

Refer to figure 8 for key number locations unless otherwise indicated.

1. Disconnect the supply and output pressure lines.
2. Loosen the filter cap screws (key 17), and rotate the filter cap (key 14) to the side to uncover the supply filter (key 15).
3. Remove the old filter (key 15), and remove any debris from the filter boss.
4. Install a new supply filter. Reinstall the filter cap (key 14), and tighten the filter cap screws (key 17).

L2 Controllers

Parts Ordering

When corresponding with your Fisher sales office about this equipment, always mention the serial number of the controller. The serial number can be found on the nameplate (key 55, figure 8). When ordering replacement parts, also specify the complete 11-character part number of each part required as found in the following parts list.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Fisher should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Fisher will void your warranty, might adversely affect the performance of the valve, and might jeopardize worker and workplace safety.

Note

Neither Emerson, Emerson Process Management, nor Fisher 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.

Parts Kits

Key	Description	Part Number
	Controller	
	Repair kit includes O-rings (keys 13 and 16) and gaskets (keys 18, 21, and 23)	RL2CNTRX012
	Relay	
	Repair kits include relay assembly, relay mounting screws (key 33), and O-rings (keys 33, 43, and 44)	
	Throttling and On/Off Controller	GB0138X0012
	Snap-Acting Controller	GB0138X0022
	Sensor	
	Repair kit includes keys 74, 75, 77, and 78 (fluoroelastomer O-rings, anti-extrusion ring, and fluoroelastomer backup ring)	RL2SENSX012

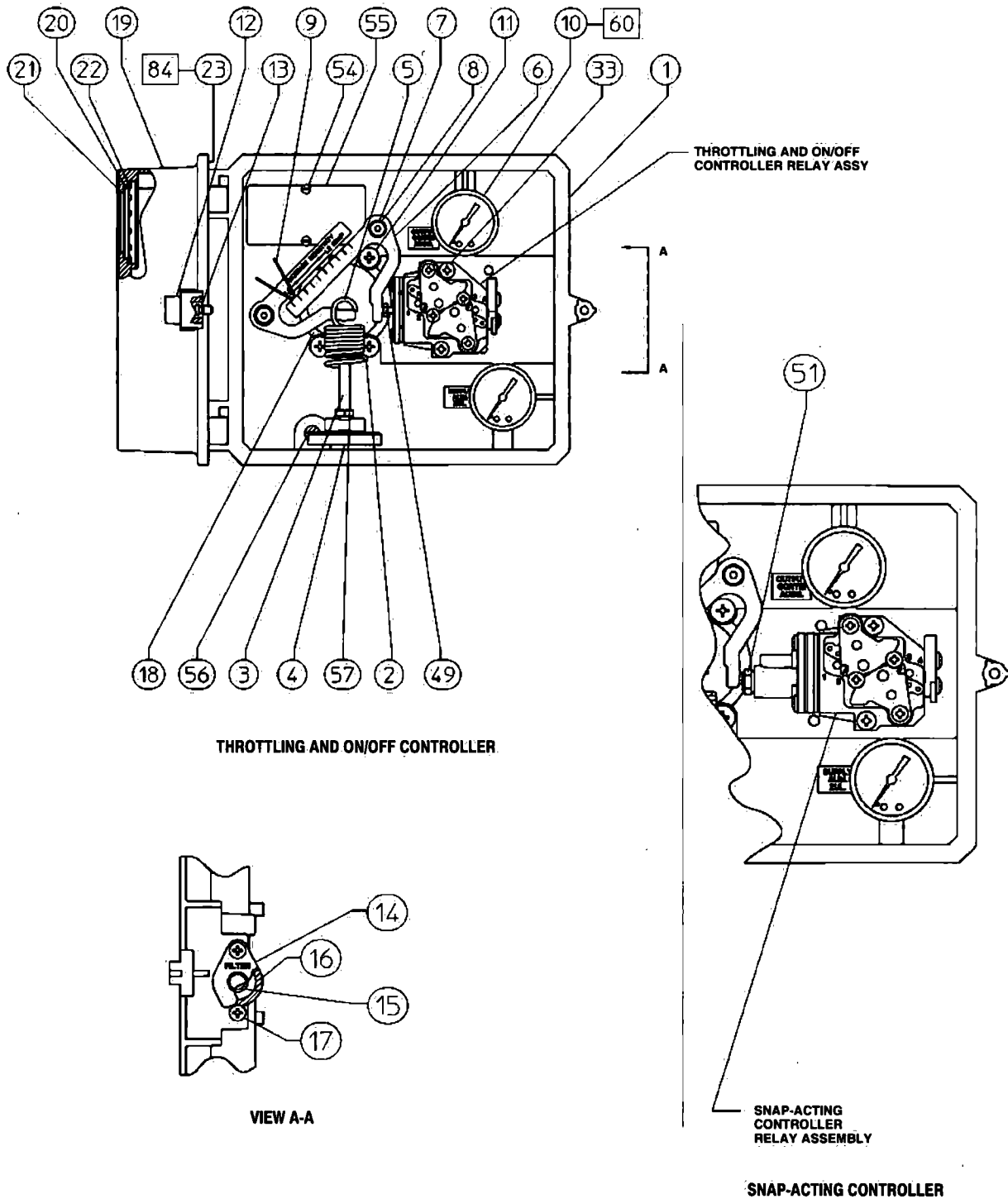
Parts List

Note

For part numbers not shown, contact your Fisher sales office.

Controller

Key	Description	Part Number
1	Controller Base, marine grade aluminum	
2	Zero Spring Seat, 316 SST	
3	Zero Adjustment Bolt, stainless steel	
4	Spring Adjustment, 316 SST	
5	Zero Spring, 17-7PH SST	
6	Span Lever Assembly, stainless steel	
7	Shoulder Screw, stainless steel (2 req'd)	
8	Flanged Bearing, nylon (4 req'd)	
9	Span Adjustor, stainless steel	
10	Pressure Gauge (2 req'd)	
11	Mounting Screw, stainless steel (4 req'd)	
12	Cover Screw, stainless steel	
13*	O-Ring, nitrile	
14	Filter Cap, reinforced plexiglass	
15	Filter	11B2307X012
16*	O-Ring, nitrile	
17	Machine Screw, stainless steel (2 req'd)	
18*	Sensor Gasket, composition	
19	Cover, marine grade aluminum	
20	Cover Lens, plexiglass (2 req'd)	
21*	Gasket, neoprene (2 req'd)	
22	Retaining Ring, steel (2 req'd)	
23*	Cover Gasket, nitrile	
33	Relay Mounting Screw, stainless steel (2 req'd)	
43*	Relay Mounting O-Ring, nitrile (not shown)	
44*	Relay Mounting O-Ring, nitrile (not shown)	
49	Relay Adjustment Screw	
51	Valve Assembly	
52	Valve Assembly O-Ring	
53	Label, setup and calibration	
54	Self-Tapping Screw, stainless steel (2 req'd)	
55	Nameplate	
56	Screen, stainless steel	
57	Hex Nut, stainless steel	
60	Sealant Zinc-plate No. 770 (not furnished with controller)	
61	Lubricant, Dow Corning 111 (not furnished with controller)	
62	Sealant, Loctite No. 222 (not furnished with controller)	
84	Adhesive, Loctite 416	



□ APPLY LUB/SEALANT
GB0137-B

Figure 8. Type L2 Liquid Level Controllers

L2 Controllers

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Key	Description	Part Number	Key	Description	Part Number
Sensor			71	Drive Screw, stainless steel	
81	Displacer, PVC 1-7/8x12-inches	12B2936X032	72	Pivot Body, CB7CU-1 (17-4PH SST)	
63	Hex Nut, 316 SST		73	Pivot Base, CF8M (316 SST)	
64	Displacer Rod, 17-4 SST (17-4PH SST)		74*	O-Ring, fluoroelastomer	
65	Sensor Connection		75*	Anti-Extrusion Ring, PTFE	
66	Spacer, 304 SST (304 SST)		76	Retaining Ring, 304 SST	
67	Hex Nut, 316 SST		77*	O-Ring, fluoroelastomer	
68	Conical Spring, 316 SST		78*	Backup Ring, fluoroelastomer	
69	Universal Joint, 316 SST (vert displ only)		79	Lubricant, Lubriplate Mag-1 (not furnished with sensor)	
70	Nameplate		80	Instruction Tag	
			82	Extension, S31600	12B2953X022

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L2 Controllers

L2 Controllers

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www.Fisher.com



4150K and 4160K Series Pressure Controllers and Transmitters

Wizard® II controllers and transmitters are used wherever durable, dependable, and simply constructed pressure-sensing instrumentation is required. The use of this line in all kinds of demanding applications, including those in the chemical process, gas, and oil production industries, demonstrates its versatility.

The 4150K and 4160K Series controllers, shown in figure 1, compare a sensed process pressure (or differential pressure) with an operator-adjusted set point, and send a pneumatic signal to an adjacent control element that maintains the process pressure at or near the set point value. The 4150K Series transmitters sense process pressure and send out a pneumatic signal, usually to an indicating or recording device that directly indicates the process pressure.

Unless otherwise noted, all NACE references are to NACE MR0175-2002.

Features

- **Wide Range of Sensing Elements**—A Bourdon tube is available for high pressures or bellows for vacuum and low pressures. Either kind of sensing element can be installed in the case with the controller or transmitter. Two interchangeable ranges of output bellows and gauges also are available.

- **Sour Service Capability**—Materials are available for applications handling sour process fluids. These constructions comply with the metallurgical requirements of NACE MR0175-2002. Environmental restrictions may apply.

- **Mounting Versatility**—Install the case on a panel, wall or pipestand, as well as directly on the control valve actuator.

- **Reduced Maintenance Costs**—A spring-out cleaning wire, shown in figure 5, provides for in-service cleaning of the relay orifice.

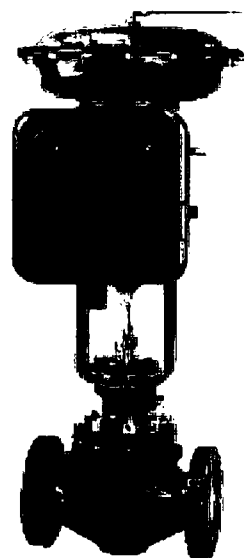


Figure 1. Wizard® II Controller Yoke-Mounted on Control Valve Actuator

- **Easy Conversion to Another Mode**—Add reset action to a proportional controller by adding only one valve and three pieces of tubing, as shown in figure 6. The original case may be used in either instance.

- **Easy Reversibility**—Switch action from direct to reverse or vice versa without additional parts. As illustrated in figure 7, simply transfer the reversing block to the opposite side of the flapper and change the feedback bellows frame tubing connections.

- **Easy, Accurate Adjustments**—Make pressure setting, proportional band, and reset changes with simple dial-knob controls that help to assure positive settings.

- **Sensitive Response**—Area ratio of large relay diaphragm to small relay diaphragm permits small nozzle pressure changes to induce much greater output pressure changes.



4150K/4160K Controllers and Transmitters

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Specifications

Available Configurations

See table 1

Input Signal⁽¹⁾

Type: ■ Gauge pressure, ■ vacuum, ■ compound pressure, or ■ differential pressure of a liquid or gas
Limits: See table 2 or 3

Output Signal⁽¹⁾

Proportional or Proportional-Plus-Reset Controllers and Transmitters: ■ 0.2 to 1.0 bar (3 to 15 psig) or ■ 0.4 to 2.0 bar (6 to 30 psig) pneumatic pressure signal
Differential Gap Controllers: ■ 0 and 1.4 bar (0 and 20 psig) or ■ 0 and 2.4 bar (0 and 35 psig) pneumatic pressure signal
Action: Control action is field reversible between ■ direct (increasing sensed pressure produces increasing output signal) and ■ reverse (increasing sensed pressure produces decreasing output signal). The suffix R is added to the type number of a construction specified for reverse action.

Supply Pressure Requirements⁽³⁾

See table 4

Supply Pressure Medium

Air or Natural Gas⁽⁴⁾

Steady-State Air Consumption⁽¹⁾

See figure 2

Supply and Output Connections

1/4- inch NPT female

Supply and Output Pressure Gauge Ranges

See table 5

Proportional Band⁽¹⁾ Adjustment

For Proportional and Proportional-Plus-Reset Controllers:

0.2 to 1.0 bar (3 to 15 psig) Output: Full output pressure change adjustable from 3 to 100% of the sensing element range.

0.4 to 2.0 bar (6 to 30 psig) Output: Full output pressure change adjustable from 6 to 100% of the sensing element range.

Differential Gap Adjustment

For Differential Gap Controllers: Full output pressure change adjustable from 15% to 100% of sensing element range

Reset⁽¹⁾ Adjustment

For Proportional-Plus-Reset Controllers: Adjustable from 0.01 to 74 minutes per repeat (100 to 0.01 repeats per minute)

Zero⁽¹⁾ Adjustment (Transmitters Only)

Continuously adjustable to position span of less than 100% anywhere within the sensing element range

Span⁽¹⁾ Adjustment (Transmitters Only)

Full output pressure change adjustable from 6 to 100% of process sensing element range

Performance

Repeatability⁽¹⁾: 0.5% of sensing element range

Dead Band⁽¹⁾ (Except Differential Gap Controllers⁽²⁾): 0.1% of output span

Typical Frequency Response at 100% Proportional Band.

Output to Actuator: 0.7 Hz and 110 degree phase shift with 1850 cm³ (113 inches³) volume actuator at mid-stroke

Output to Positioner Bellows: 9 Hz and 130 degree phase shift with 0.2 to 1.0 bar (3 to 15 psig) output to 33 cm³ (2 inches³) bellows

Ambient Operating Temperature Limits⁽³⁾

■ **Standard Construction:** -40 to 93°C (-40 to 200°F)

■ **4160KF (w/Reset Relief):** -40 to 71°C (-40 to 160°F)

- Continued -

Specifications (continued)

Typical Ambient Temperature Operating Influence

Proportional Control only: Output pressure changes $\pm 3.0\%$ of sensing element rating for each 28°C (50°F) change in temperature between -40 and 71°C (-40 and 160°F) for a controller set at 100% proportional band

Reset Control only: Output pressure changes $\pm 2.0\%$ of sensing element rating for each 28°C (50°F) change in temperature between -40 and 71°C (-40 and 160°F) for a controller set at 100% proportional band

Transmitters only: Output pressure changes $\pm 3.0\%$ of sensing element rating for each 28°C

(50°F) change in temperature between -40 and 71°C (-40 and 160°F) for a transmitter set at 100% span

Hazardous Area Classification

Complies with the requirements of ATEX Group II Category 2 Gas and Dust:

CE Ξ II 2 G D

Construction Materials

See tables 2, 3, and 6

Approximate Weight

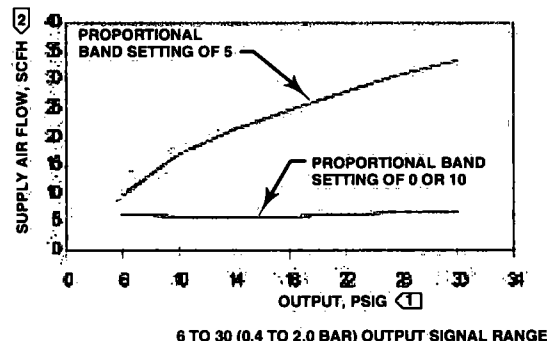
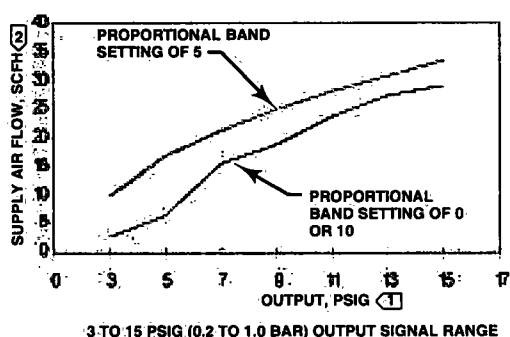
8.2 kg (18 pounds)

1. This term is defined in ISA Standard S51.1.
2. An adjustable differential gap (differential gap controllers) is equivalent to an adjustable deadband.
3. The pressure and temperature limits in this document, and any applicable standard or code limitation should not be exceeded.
4. This product can be used with natural gas. Natural gas to contain no more than 20 ppm of hydrogen sulphide.

Table 1. Available Configurations

DESCRIPTION ⁽¹⁾		TYPE NUMBER ⁽²⁾	
		Bourdon Tube Sensing Element (Gauge Pressure Only)	Bellows Sensing Element
			Gauge Pressure Differential Pressure
Proportional controller		4150K	4152K 4154K
Proportional-plus-reset controller	Without anti-reset windup	4160K	4162K 4164K
	With anti-reset windup	4160KF	4162KF - - -
Differential-gap controller		4150KS	4152KS - - -
Transmitter		4157K	4158K 4155K

1. See figures 5 and 6 for construction details.
2. The suffix R is added to the type number of a construction specified for reverse action.



NOTES

- ① TO CONVERT PSIG TO BAR, MULTIPLY BY 0.06895.
② SCFH—STANDARD CUBIC FEET PER HOUR (60°F AND 14.7 PSIA).
TO CONVERT TO NORMAL M³/HR—NORMAL CUBIC METERS PER HOUR (0°C AND 1.01325 BAR, ABSOLUTE), MULTIPLY BY 0.0268

A7242 / IL

Figure 2. Steady-State Air Consumption

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Table 2. Bourdon Tube Pressure Ranges and Materials

PRESSURE RANGES ⁽¹⁾		MAXIMUM ALLOWABLE STATIC PRESSURE ⁽²⁾ LIMITS ⁽³⁾				MATERIAL
		Standard		With Optional Travel Stop ⁽⁴⁾		
Bar	Psig	Bar	Psig	Bar	Psig	316 stainless steel
0 to 2.0	0 to 30	2.0	30	3.3	48	
0 to 4.0	0 to 60	4.0	60	6.6	96	
0 to 7.0	0 to 100	7.0	100	11	160	
0 to 14	0 to 200	14	200	19	280	
0 to 20	0 to 300	20	300	29	420	
0 to 40	0 to 600 ⁽⁵⁾	40	600	50	720	
0 to 70	0 to 1000 ⁽⁵⁾	70	1000	83	1200	
0 to 100	0 to 1500 ⁽⁵⁾	100	1500	115	1650	
0 to 200	0 to 3000	200	3000	230	3300	
0 to 350	0 to 5000	350	5000	380	5500	
0 to 550	0 to 8000	550	8000	550	8000	
0 to 700	0 to 10,000	700	10,000	700	10,000	

1. Range marked on Bourdon tube may be in kPa (1 bar = 100 kPa).

2. This term is defined in ISA Standard S51.1.

3. Bourdon tube may be pressured to limit shown without permanent zero shift.

4. With travel stop set at 110% of the range.

5. These Bourdon tubes are also available in N05500 nickel alloy for sour service.

Table 3. Bellows Pressure Ranges and Materials

PRESSURE RANGES			MAXIMUM ALLOWABLE STATIC PRESSURE ⁽¹⁾ LIMITS ⁽²⁾			
			Brass Construction		Stainless Steel Construction	
			Bar	Psig	Bar	Psig
Gauge pressure	Vacuum	0 to 150 mbar (0 to 60 inch wc)	1.4	20	---	---
		0 to 340 mbar (0 to 10 inch Hg)	2.8	40	---	---
		0 to 1.0 bar (0 to 30 inch Hg)	2.8	40	6.9	100
	Compound pressure	75 mbar vac. to 75 mbar (30 inch wc vac. to 30 inch wc)	1.4	20	6.9	100
		500 mbar vac. to 500 mbar (15 inch Hg vac. to 7.5 psig)	2.8	40	6.9	100
		1.0 bar vac. to 1.0 bar (30 inch Hg vac. to 15 psig)	2.8	40	---	---
Gauge pressure	Positive pressure	0 to 150 mbar (0 to 60 inch wc)	1.4	20	---	---
		0 to 250 mbar ⁽³⁾ (0 to 100 inch wc)	1.4	20	---	---
		0 to 350 mbar ⁽⁴⁾ (0 to 140 inch wc)	2.8	40	---	---
		0 to 0.35 bar (0 to 5 psig)	2.8	40	---	---
		0 to 0.5 bar (0 to 7.5 psig)	2.8	40	---	---
		0 to 0.7 bar (0 to 10 psig)	2.8	40	---	---
		0 to 1.0 bar (0 to 15 psig)	2.8	40	6.9	100
		0 to 1.4 bar (0 to 20 psig)	2.8	40	---	---
Differential pressure ⁽⁵⁾		0 to 200 mbar (0 to 80 inch wc)	1.4	20	---	---
		0 to 0.7 bar (0 to 10 psi)	2.8	40	---	---
		0 to 1.4 bar (0 to 20 psi)	2.8	40	---	---
		0 to 2.0 bar (0 to 30 psi)	---	---	6.9	100

1. This term is defined in ISA Standard S51.1.
2. Bellows may be pressured to limit shown without permanent zero shift.
3. Type 4158K transmitter only.
4. Except Type 4158K transmitter.
5. The overrange limit for these sensing elements is a differential pressure equal to the maximum allowable static pressure limit.

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4150K/4160K Controllers and Transmitters*Table 4. Supply Pressure Data*

OUTPUT SIGNAL		NORMAL OPERATING SUPPLY PRESSURE ⁽¹⁾		MAXIMUM ALLOWABLE SUPPLY PRESSURE TO PREVENT INTERNAL PART DAMAGE	
Bar	Psig	Bar	Psig	Bar	Psig
0.2 to 1.0 or 0 and 1.4	3 to 15 or 0 and 20	1.4	20	3.4	50
0.4 to 2.0 or 0 and 2.4	6 to 30 or 0 and 35	2.4	35	3.4	50

1. If this pressure is exceeded, control may be impaired.

Table 5. Supply and Output Pressure Gauge Ranges

Gauge Scale	0.2 to 1.0 Bar (3 to 15 Psig) or 0 and 1.4 Bar (0 and 20 Psig) Output	0.4 to 2.0 Bar (6 to 30 Psig) or 0 and 2.4 Bar (0 and 35 Psig) Output
Single	0 to 30 psig 0 to 2 kg/cm ² 0 to 200 kPa	0 to 60 psig 0 to 4 kg/cm ² 0 to 400 kPa
Dual	0 to 30 psig/0 to 200 kPa	0 to 60 psig/0 to 400 kPa
Triple	0 to 30 psig/0 to 2 kg/cm ² /0 to 2 bar	0 to 60 psig/0 to 4 kg/cm ² /0 to 4 bar

Table 6. Construction Materials

	Part	Material
In contact with process	Bourdon tube	Stainless steel, or N05500 nickel alloy
	Sensing bellows	Brass or stainless steel
	Pressure block	Stainless steel
	Control tubing (from pressure block to sensing element and to optional process pressure gauge)	Stainless steel
In contact with operating medium	All other interior tubing	Stainless steel
	Exterior tubing	Copper (with or without PVC plastic lining), stainless steel, or synthetic rubber
	Exterior fittings	Brass or stainless steel
	Nozzle and reversing block	Zinc/stainless steel
	Relay springs and spring plate	Steel
	Relay diaphragms	Nitrile/nylon (standard) or polyacrylate/nylon (high-temperature)
	Other metal relay parts, proportional bellows, and exhaust/reset bellows	Zinc/brass or zinc/stainless steel
	Proportional valve assembly	Brass/plated steel or stainless steel
	Reset valve assembly and differential relief valve if used (4160K Series controllers only)	Aluminum/steel/ceramic
	O-rings	Nitrile (standard) or fluoroelastomer (high-temperature)
Other	Gaskets	Chloroprene (standard) or silicone (high-temperature)
	Case and adjustment dial	Aluminum
	Cover	Aluminum, except glass for gauge windows
	Flapper	K93602 nickel alloy
	Control link	N04400 nickel alloy and/or stainless steel
	Flexure and pressure setting adjustment assemblies	Aluminum/steel/stainless steel/plastic
	Calibration adjuster and proportional adjustment assembly	Zinc
	O-rings	Nitrile

4150K/4160K Controllers and Transmitters

Principle of Operation

The key to Wizard II controller operation is the pressure-balanced relay with its yoked double-diaphragm assembly, shown in figure 3 or 4. The relay is connected so that supply pressure bleeds through the fixed orifice before escaping through the nozzle. The nozzle pressure registers on the large relay diaphragm, and loading pressure (controller output) on the small relay diaphragm.

Steady-state sensed process pressure holds the Bourdon tube steady in relation to the nozzle. This allows pressure to escape between the nozzle and beam-flapper assembly at the same rate it bleeds through the orifice.

A change in the process pressure moves the beam and flapper with respect to the nozzle by either expanding or contracting the Bourdon tube arc. An increasing process pressure with direct action (or decreasing pressure with reverse action) produces a nozzle-flapper restriction that increases the loading on the large relay diaphragm. This causes the relay valve to close at the exhaust end and to open at the inlet end. Additional supply pressure flows through the relay chamber to increase the loading pressure on the control valve actuator. A decreasing process pressure with direct action (or increasing pressure with reverse action) produces a nozzle-flapper opening that bleeds off pressure on the large relay diaphragm. This causes the relay valve inlet to close and the exhaust to open, thus exhausting loading pressure from the actuator.

Proportional-Only Controllers

The controller output pressure change feeds back to the proportional bellows, countering the pressure change in the nozzle and equalizing the relay diaphragm pressure differential. The relay valve maintains a new loading pressure according to the change in sensed pressure.

If the proportional valve is wide open (maximum dial setting), all of the controller output pressure change feeds back to the proportional bellows. The more the proportional valve is closed, the more the controller output pressure change bleeds out through the proportional valve exhaust and the less there is to feed back to the proportional bellows. A fully open proportional valve results in a proportional band of 100 percent; closing the proportional valve reduces the proportional band.

Proportional-Plus-Reset Controllers

Additionally, all 4160K Series controllers have a two-way reset restriction valve that channels proportional pressure into a reset bellows to oppose the proportional bellows action. The action of this reset pressure occurs on a delayed basis, and the reset valve can be adjusted to vary the time of delay.

Anti-Reset Windup

The Type 4160KF and 4162KF controllers have an adjustable and reversible differential relief valve to provide anti-reset windup. As shown in figure 4, the proportional pressure registers rapidly on the spring side of the relief valve diaphragm as well as in the proportional bellows. Reset pressure registers slowly on the opposite side of the relief valve diaphragm. As long as controller output pressure changes are slow enough for normal proportional and reset action, the relief valve spring keeps the relief valve diaphragm from opening. However, a large or rapid decrease in controller output pressure causes the relay to rapidly exhaust loading pressure from the control element, and also from the proportional system and spring side of the relief diaphragm. If this decrease on the spring side of the diaphragm is greater than the relief valve spring setting, the diaphragm will move off the relief valve orifice and permit the reset pressure on the opposite side of the relief valve diaphragm to bleed rapidly into the proportional system. The anti-reset windup action also can be reversed to relieve with an increasing proportional pressure.

Construction Features

Rugged Service Capability

The case and cover are made of weather resistant, die-cast aluminum. Stainless steel tubing and fitting materials provide the capability for operation in ammonia and similar corrosive service conditions. Optional materials for relay diaphragms and other soft parts permit operation at ambient temperatures up to 93°C (200°F).

Low-Pressure Precision

Bellows sensing constructions provide accuracy in low-pressure, vacuum, or compound ranges. Two sensing bellows are used where an important variable is the difference between two sensed pressures.

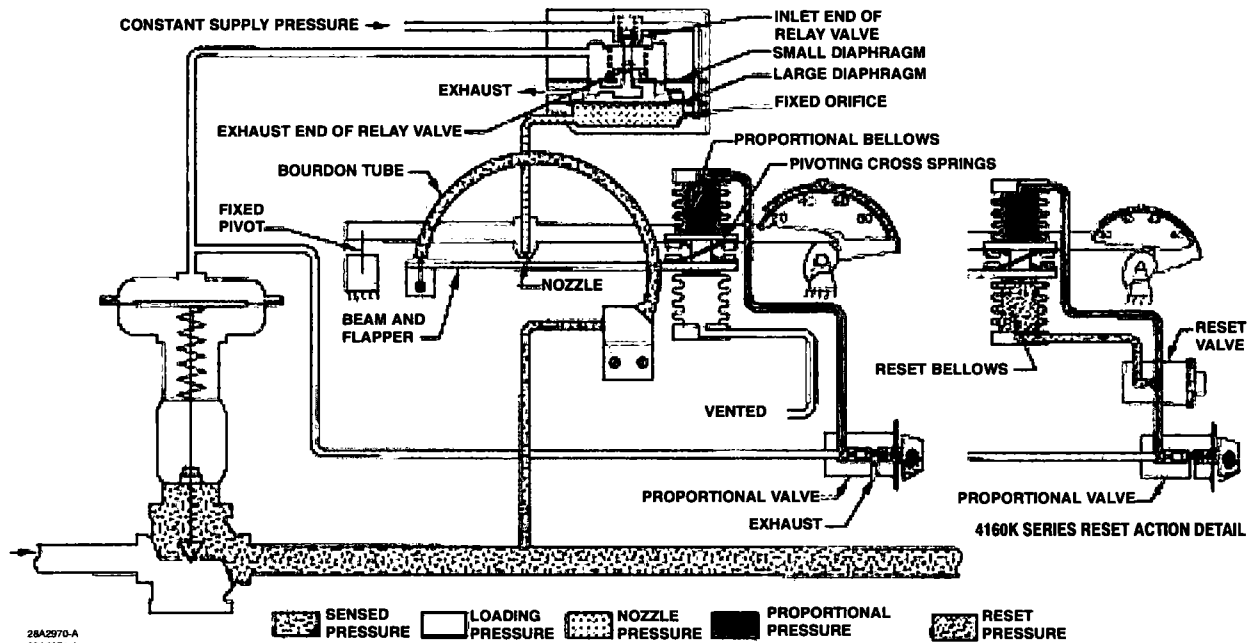


Figure 3. Operational Schematic of Direct-Acting Bourdon Tube Controller on Pipeline Pressure Service

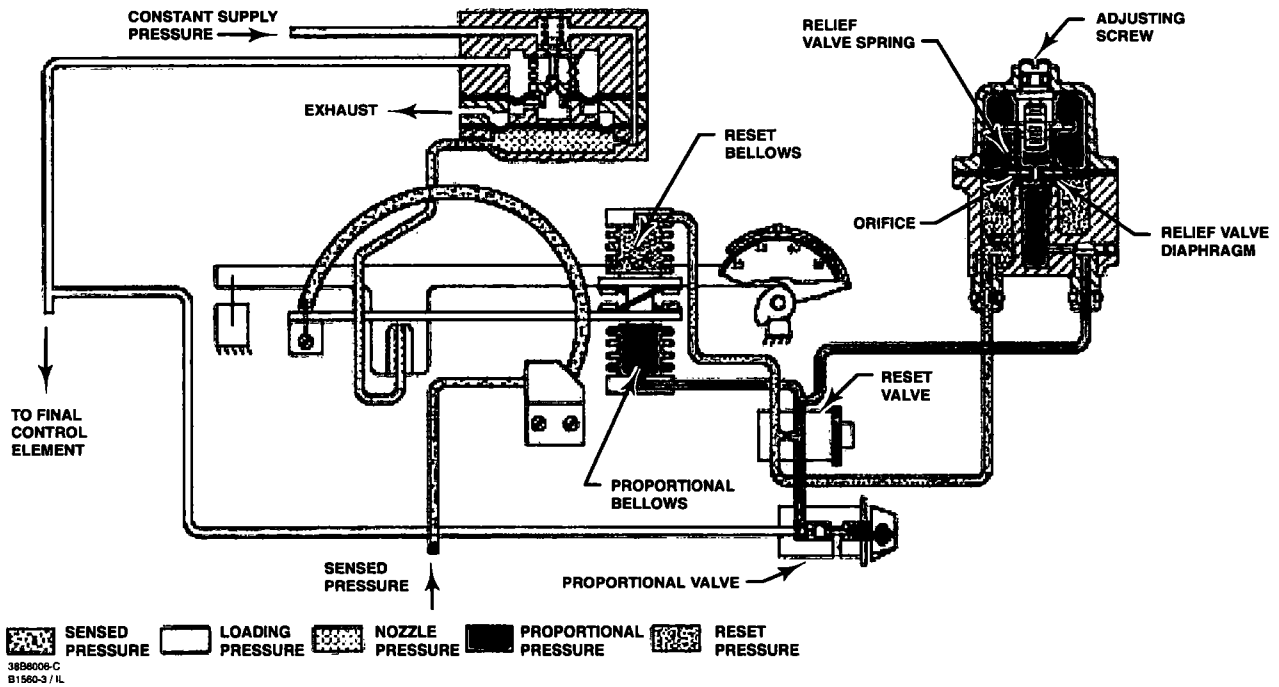


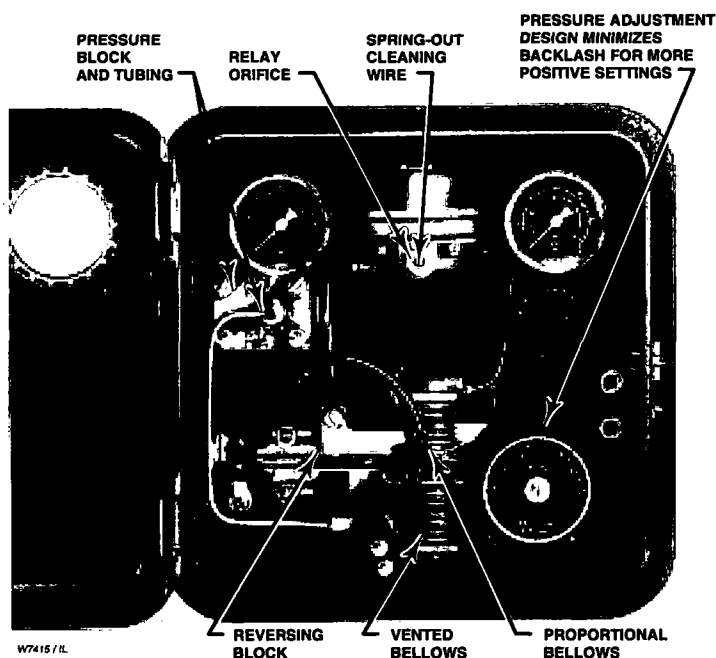
Figure 4. Operational Schematic of Type 4160KFR Controller

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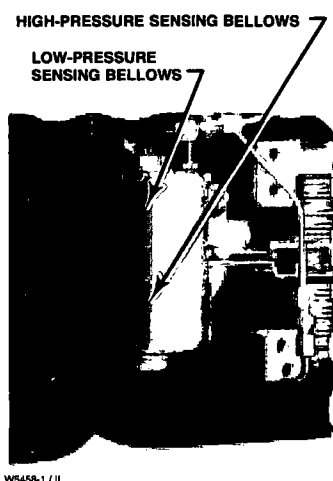
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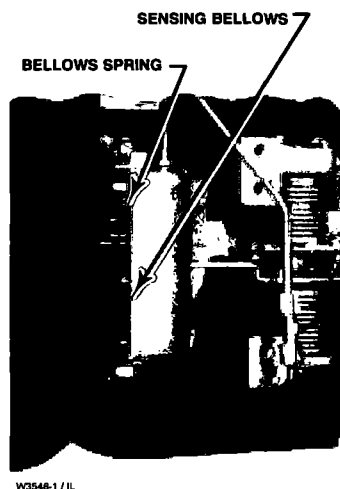
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DIRECT-ACTING TYPE 4150K CONTROLLER (ALSO REPRESENTATIVE OF TYPE 4150KS AND 4157K BOURDON TUBE CONSTRUCTIONS)



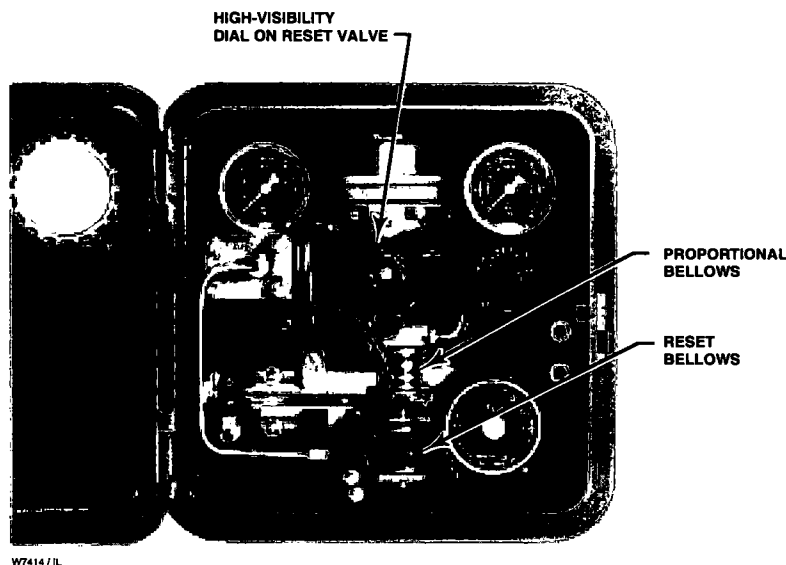
TYPE 4154K AND 4155K DIFFERENTIAL BELLOWS DETAILS



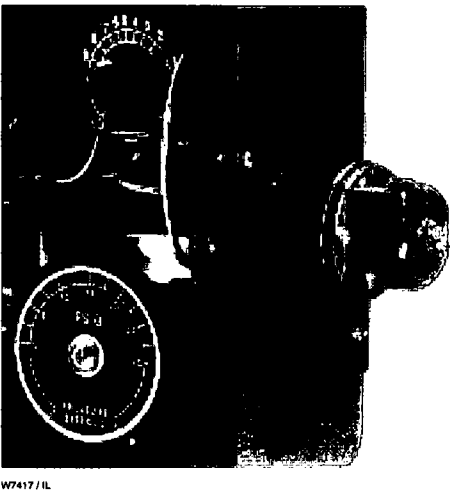
TYPE 4152K, 4152KS AND 4158K BELLOWS DETAILS

Figure 5. 4150K Series Constructions

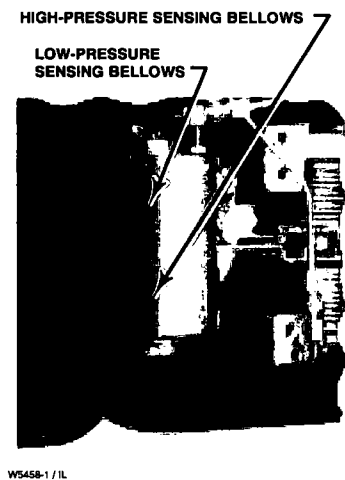
4150K/4160K Controllers and Transmitters



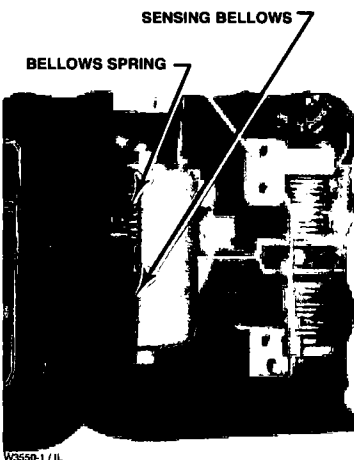
DIRECT-ACTING TYPE 4160K CONTROLLER



TYPE 4160KF AND 4162KF DIFFERENTIAL
RELIEF VALVE DETAIL



TYPE 4164K DIFFERENTIAL
BELLOWS DETAILS



TYPE 4162K BELLOWS DETAILS

Figure 6. 4160K Series Constructions

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Table 7. Optional Process Pressure Gauges

Sensing Element	Gauge Range ⁽¹⁾	
Bourdon tube	Positive pressure	0 to 30 psig ⁽²⁾
		0 to 60 psig
		0 to 160 psig
	Positive pressure	0 to 300 psig ⁽²⁾
		0 to 600 psig
		0 to 1000 psig
Bellows	Positive pressure	0 to 30 psig ⁽²⁾

1. Consult your Emerson Process Management™ sales office for gauges in other units.
2. Also available in stainless steel trim.

Easy Conversion From Proportional To On-Off Control

The Type 4150KS controller provides on-off rather than proportional control. This construction has the same parts as the comparable Type 4150K controller. However, the proportional bellows is connected so that feedback pressure pushes the beam and flapper in the same direction as caused by the sensed pressure change. This reinforcement completely opens the relay valve either to full supply pressure or to full exhaust, allowing no in-between throttling.

To change from a proportional to on-off controller, or vice versa, just reverse the tubing connection at the bellows frame on top of the beam and flapper as shown in figure 7.

Anti-Reset Windup

The anti-reset windup capability of the Type 4160KF and 4162KF controllers provides quick equalization of reset and proportional pressures. This capability reduces overshoot and the time required for a system to return to the pressure setting after large changes in sensed pressure. This feature is useful when slow reset and broad proportional band settings are used.

The differential relief valve has a range of 0.14 to 0.4 bar (2 to 7 psig) and, unless ordered otherwise, is set by the factory to relieve at a 0.3 bar (5 psi) difference between proportional and reset pressures.

Manual Backup

As shown in figure 8, a 670 or 671 Series panel-mounted loading regulator with changeover valve permits switching to an alternate loading

pressure, if a Wizard II controller experiences supply pressure failure or other malfunction.

Continuous Indication of Process Pressure

Replacing the supply pressure gauge on a controller or transmitter by a process pressure gauge permits indicating process pressure in one of the ranges shown in table 7. To obtain a supply pressure indication, install a gauge on the supply regulator. The process pressure gauge must be specially ordered and comes with brass trim standard in all ranges and stainless steel trim optional in some ranges. Adding a process pressure gauge in the field also requires a special control pressure block. A process pressure gauge can not be added to controllers or transmitters that use a differential bellows for sensing process pressure.

Bourdon Tube Protection

All Bourdon tube constructions are available with one or both of the following protective devices:

- **Barrier Protector for Corrosive or Clogging Process Fluids**—A sealed and fluid-filled barrier (described in a separate bulletin) may be installed between the process and the Bourdon tube. The barrier fluid transmits sensed pressure on a one-to-one basis into the Bourdon tube.

- **Travel Stop for Bourdon Tube**—The stop limits Bourdon tube overtravel when momentary surges in the sensed pressure exceed the Bourdon tube rating. Although it does not permit accurate control or transmission of a pressure higher than the upper range limit listed in table 2, this stop does permit Bourdon tube overpressuring to the maximum static pressure shown in table 2 without damage.

Installation

A Wizard II controller or transmitter normally comes installed on a final control element or indicating device or equipped for separate surface or pipestand mounting. Usually, a control valve with just a controller or transmitter and one supply regulator has the controller/transmitter and regulator yoke-mounted on opposite sides of the actuator as shown in figure 9. Nipple mounting of the supply regulator (if desired) is available. Specify such mounting if the opposite yoke boss of an actuator will be occupied by a positioner.

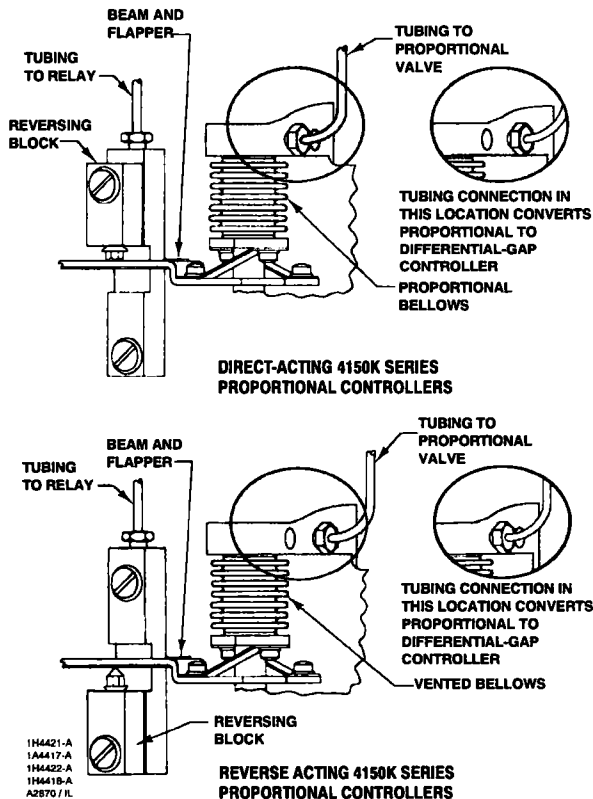


Figure 7. Conversion from Direct to Reverse Action or Proportional to On-Off Control

Install the controller or transmitter so that the vent points down. Figure 10 illustrates the vent location, the location of all case connections, dimensions, and mounting information.

Ordering Information

Application

When ordering, specify:

1. Type of service, such as pressure reduction or pressure relief, throttling or on-off.
2. Composition, pressure, and temperature of measured variable(s).
3. Type number, orientation, and other applicable descriptions of control or indicating device(s).

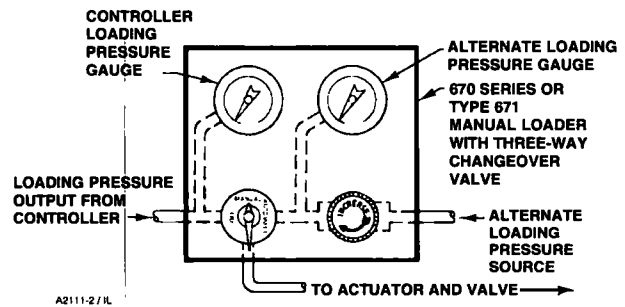


Figure 8. Schematic of Manual Backup Changeover Hookup for Wizard® II Controller

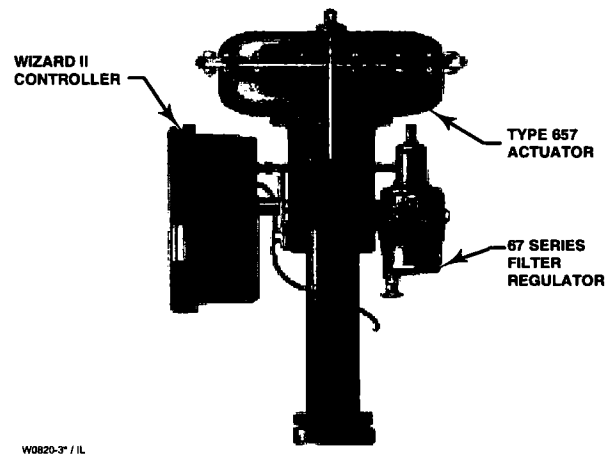


Figure 9. Typical Yoke Mounting

Construction

Refer to the Specifications and the Construction Features sections. Review the description for each specification, construction feature, and in the referenced tables. Specify the desired selection whenever there is a choice.

Always specify the complete type number (including the R suffix for reverse action) of the Wizard II controller or transmitter, supply pressure regulator, and other desired equipment. On controllers with anti-reset windup, specify whether the differential relief valve is to relieve with falling or rising output.

4150K/4160K Controllers and Transmitters

Product Bulletin

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December 2005

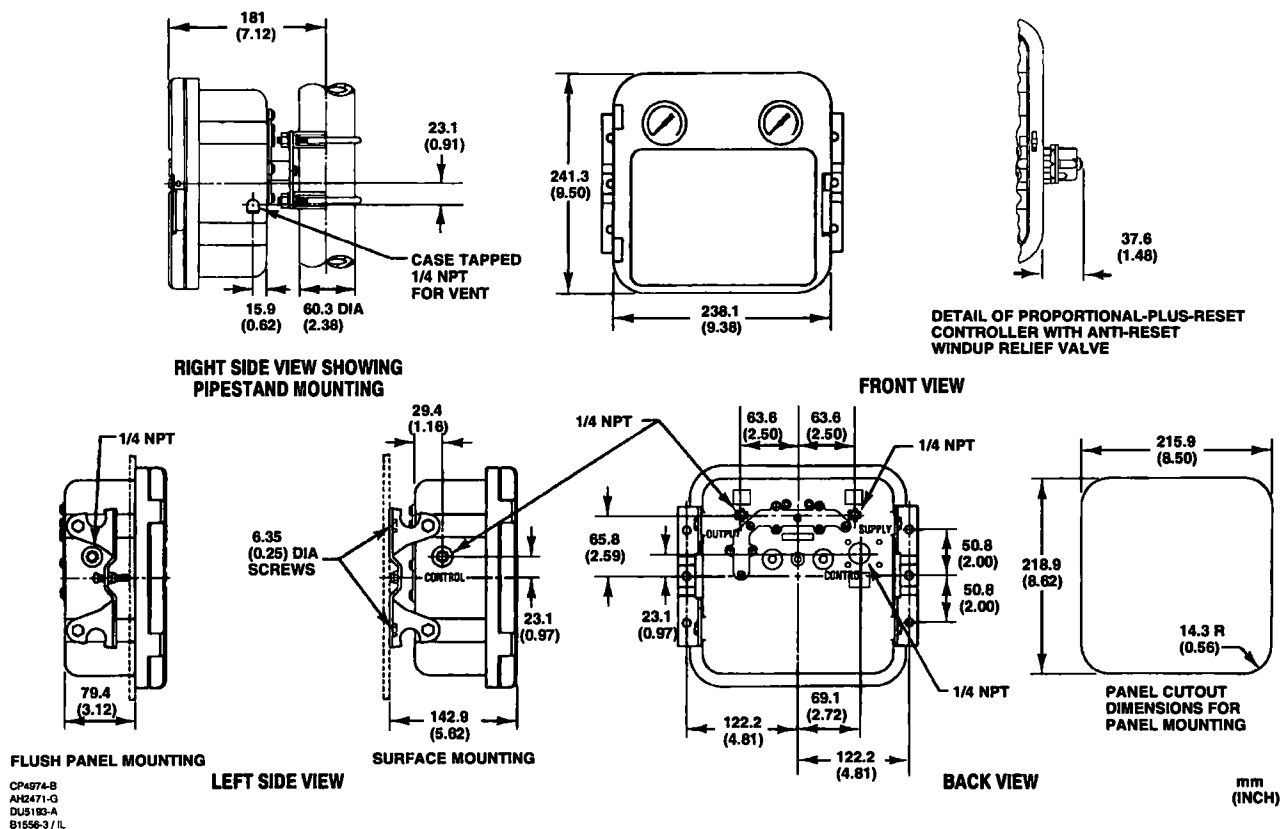


Figure 10. Dimensions

Note

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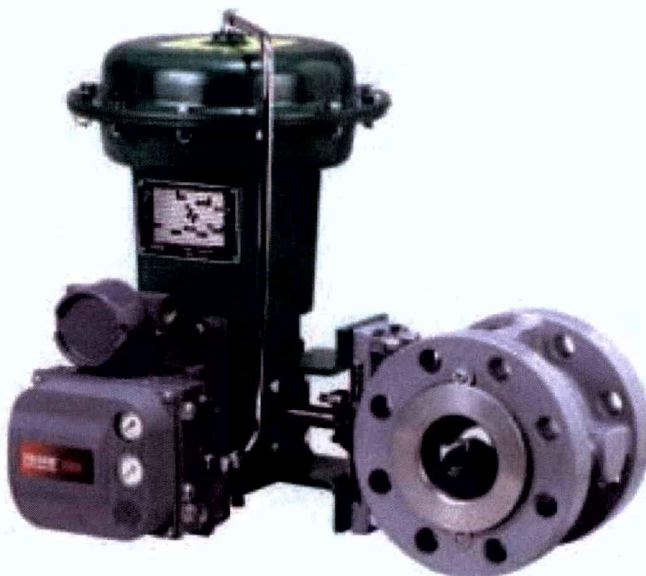
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Process Management

Type Vee-Ball® Designs V150, V200 and V300 Rotary Control Valves

This bulletin covers the 1- through 2-inch, 3- through 12-inch Series B, and the 14- through 20-inch Designs V150, V200 and V300 Vee-Ball® control valves (shown in figure 1). The Type Vee-Ball valve combines globe valve ruggedness with the efficiency of a rotary valve. A shearing action between the V-notch ball and the ball seal (figure 2) promotes smooth, nonclogging operation. The unrestricted straight-through flow design provides high capacity for gas, steam, liquids, and fibrous slurries.

The Designs V150, V200 and V300 mate with a variety of ANSI raised face flanges, as well as with DIN flanges (see Specifications).

To meet specific application requirements, a variety of metal and soft ball seal materials are available. A splined drive shaft combines with a variety of power operated and manual actuators to provide reliable, high-performance throttling or on-off operation for many different applications in the process industries.



WB172-1

Figure 1. Design V150 Vee-Ball Valve with Type 1052 Actuator and Type DVC Positioner



Specifications

Valve Sizes and End Connection Styles

Design V150: ■ 1, ■ 1-1/2, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, ■ 10, ■ 12-inch, flanged valves that mate with ANSI Class 150 raised-face flanges (see table 1). Also, sizes 3 through 12-inch mate with DIN PN classes (see table 1)

Design V150: ■ 14, ■ 16 and ■ 20-Inch: Flanged raised-face valves. 14 and 16-inch valves are available in ASME B16.10 Short, face-to-face dimensions only (see table 1 and figure 9)

Design V200: ■ 1, ■ 1-1/2, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, or ■ 10-inch flangeless valves that mate with ANSI Class ■ 150, ■ 300, or ■ 600 raised-face flanges depending on size (see table 1)

Design V300: ■ 1, ■ 1-1/2, ■ 2, ■ 3, ■ 4, ■ 6, ■ 8, ■ 10, ■ 12, ■ 14, and ■ 16-inch valve sizes mate with ANSI Class 300 raised-face flanges. Also some sizes mate with DIN PN classes (see table 1)

Maximum Inlet Pressures⁽¹⁾

Design V150 or V300 Steel, CF3M (316L Stainless Steel) or CG8M (317 Stainless Steel) Valves: Consistent with Class 150 for V150, or Class 300 for V300, pressure-temperature ratings per ASME B16.34 or with DIN pressure-temperature ratings shown in table 1 but do not exceed the material temperature capabilities shown below or the pressure drop limitations. CF3M is available in all areas and is the standard material offering from Fisher in Europe.

Design V200 Steel and CG8M (317 Stainless Steel) Valves: Consistent with applicable pressure-temperature ratings in table 1 per ASME B16.34, but do not exceed the material temperature capabilities shown below and the pressure drop limitations.

CW2M (Hastelloy C) Valves: Consistent with applicable pressure-temperature ratings shown in table 6, but do not exceed the material temperature capabilities shown below and the pressure drop limitations.

Maximum Shutoff Pressure/Temperature Ratings⁽¹⁾

Composition (Fisher TCM Plus or TCM Ultra), Flat Metal (3- through 12-inch valves only), HD

and High Temperature HD Metal Ball Seals and Flow Ring: See table 8.

Shutoff Classification⁽¹⁾

Fisher TCM Plus or Ultra Ball Seal (Forward Flow): Class VI per ANSI/FCI 70-2 and per IEC 60534-4,

Flat Metal Ball Seal for 3 through 12-inch valves only (Forward Flow): Class IV per ANSI/FCI 70-2 and per IEC 60534-4,

HD (Heavy Duty) Metal Ball Seal (Bidirectional Flow): 0.01% of valve capacity; Class IV per ANSI/FCI 70-2 and IEC 60534-4; Maximum allowable pressure drop in reverse flow is 6.9 bar (100 psi);

High Temperature HD (Heavy Duty) Metal Seal (Bidirectional Flow): Class III per ANSI/FCI 70-2 and IEC 60534-4

Flow Ring Construction (Bidirectional Flow): 5% of valve capacity at full travel

Construction Materials

See tables 3, 4 and 5

Temperature Capabilities^(1,2)

Composition Seals (Fisher TCM Plus or TCM Ultra): -46 to 232°C (-50 to 450°F)

HD Metal Seals: -46 to 288°C (-50 to 550°F)

High Temperature HD Metal Seal: 288 to 427°C (550 to 800°F). Contact your Fisher sales office if higher temperatures are required.

Ceramic Micro-Notch Ball: -46 to 93°C (-50 to 200°F)⁽⁴⁾.

Flow Ring or Flat Metal Seal : -198 to 425°C (-325 to 800°F)

PEEK/PTFE Bearings: -198 to 260°C (-325 to 500°F)

Packing Constructions

PTFE V-ring: -198 to 232°C (-325 to 450°F)

Graphite: -198 to 538°C (-325 to 1000°F)

ENVIRO-SEAL® Single PTFE V-ring: -46 to 232°C (-50 to 450°F)

ENVIRO-SEAL Graphite: -7 to 316°C (20 to 600°F)

Flow Characteristic

Modified equal percentage

Dimensions

See figures 6, 7, and 8 for dimensions

(continued)

Specifications (continued)

Optional Face-to-Face Dimensions

■ ASME B16.10 short face-to-face dimensions are available as an option for 1- through 12-inch valves. Note that ASME B16.10 short dimensions are actually longer than ISA S75.04. See figure 9 for dimensions.

Standard Flow Direction

Forward (into the convex face of the V-notch ball)

Flow Coefficients

See Catalog 12

Flow Coefficient Ratio⁽³⁾

See Catalog 12

Noise Levels

See Catalog 12

Maximum Ball Rotation

90 degrees

Actuator Mounting

Standard valve construction is for right-hand

mounting, as viewed from upstream end of valve. Left-hand (optional) mounting is available upon request.

Valve/Actuator Action

With diaphragm or piston rotary actuator, the valve is field-reversible between PDTC or PDT0:
■ push-down-to-close (extending actuator rod closes valve) and ■ push-down-to-open (extending actuator rod opens valve)

Approximate Weight

See table 2

Options

■ Pipe plug at end of follower shaft for all sizes,
■ Line flange bolting, ■ Materials that comply with National Association of Corrosion Engineers (NACE) standard MR0175 for sour-gas service (see table 5), ■ Alloy construction materials,
■ ENVIRO-SEAL packing system: See figure 5 and Bulletin 59.3:041, ENVIRO-SEAL Packing Systems for Rotary Valves for more information,
■ Micro-Notch™ construction for 1-inch valves (see Micro-Notch Construction section), ■ Avesta (CK3MCUN) trim material

1. The pressure/temperature limits in this bulletin, and any applicable code or standard limitation, should not be exceeded.

2. Additional limits are shown in tables 6, 7 and 8.

3. Ratio of maximum flow coefficients to minimum usable flow coefficient can also be called rangeability.

4. For the CG8M and alloy 6 Micro-Notch constructions, pressure and temperature capabilities are the same as for standard constructions.

Features

● **Trim Versatility**—Trim components are interchangeable between Design V150, V200, and V300 valves. This feature allows you to reduce your spare parts inventory and maintenance procedures. The seal assembly can be changed without removing the actuator or without removing the ball from the valve body.

● **Easy Installation**—Flanged body design of the V150 and V300 eliminates exposed line flange bolting, reduces alignment and installation time, and promotes secure valve installations and piping integrity.

● **Application Versatility**—The valves are available with ISA S75.04 and IEC 534-3-2 face-to-face dimensions as a standard construction, and optional ASME B16.10 short face-to-face

dimensions: IEC 534.3.2 face-to-face dimensions are equivalent to S75.04 face-to-face dimensions.

● **Longer Service Life**—The solid HD metal seal (figures 2 and 3) construction provides longer service life in demanding applications. The constant wiping action of the seal across the ball's sealing surface prevents scale and sludge buildup, and provides superior service on steam, gases, slurries, and various liquid applications.

● **Smooth Valve Operation**—Precision machined parts and pressure balanced seal designs allow smooth, precise movement of the ball.

● **Excellent Flow Control**—Precise contouring of the Vee-Ball provides a modified equal percentage flow characteristic. For very precise control of low flow rates, the Micro-Notch option is available on the 1-inch size valve. See the Micro-Notch Construction section of this bulletin for more information.

Vee-Ball Valves

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Table 1. Valve Body Materials, End Connections, and Ratings

VALVE DESIGN	VALVE BODY MATERIAL	SIZE	RATINGS	SIZE	RATINGS
		Inch	ANSI	DIN	PN
V150	CF3M	1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	Class 150	---	---
	DIN STL 1.0619, DIN SST 1.4581, or DIN SST 1.4408 ⁽¹⁾	---	---	DN 25, 40, 50, 80, 100, 150, 200, 250	PN 10/16
		---	---	DN 300	PN 16
		WCC or CW2M	1, 1/2, 2, 3, 4, 6, 8, 10	Class 150	DN 25, 40, 50, 80, 100, 150, 200, 250
	12, 16, 20		Class 150	DN 300	PN 16
	14		Class 150	---	---
	CG8M	1, 1-1/2, 2, 3, 4, 6, 8, 10, 12 and 14	Class 150	---	---
CK3MCUN (Avesta)	1, 1-1/2, 2, 3, 4, 6, 8, 10 and 12	Class 150	---	---	
V200	CF3M	1, 1-1/2, 2	Class 150/300/600 raised-face	Not Available	Not Available
	WCC, CG8M, or CW2M	3, 4	Class 150 and Class 300/600 raised-face		
		6, 8	Class 150/300 and 600 raised-face		
		10	Class 150 raised-face		
	M35-1 (Monel)	1, 1-1/2, 2, 3, 4, 6, 8	Class 150, 300 and 600		
	CK3MCUN (Avesta)	1, 1-1/2, 2, 3, 4, 6, 8	Class 150, 300 and 600		
		10	Class 150		
V300	CF3M	1, 1-1/2, 2, 3, 4, 6, 8, 10, 12	Class 300	---	---
	WCC or CW2M	1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16	Class 300	---	---
	DIN STL 1.0619, DIN SST 1.4581, or DIN SST 1.4408 ⁽¹⁾	---	---	DN 25, 40, 50, 80, and 100	PN 25/40
	CG8M	1, 1-1/2, 2, 3, 4, 6, 8, 10, 12, 14, 16	Class 300	---	---
	M35-1 (Monel)	1, 1-1/2, 2, 3, 4, 6, 8	Class 300	---	---

1. 216 WCC and DIN Stl 1.0619 are dual certified. CF3M and DIN SST 1.4408 are dual certified.

1. 216 WCC and DIN STL 1.0619 are dual certified. CF3M and DIN SST 1.4408 are dual certified.

• **Sour Gas Service Capability**—Optional trim and bolting materials are available for applications handling sour fluids and gases. These constructions comply with the recommendations of the National Association of Corrosion Engineers (NACE) MRO175. Because of the care exercised by Fisher in procurement and manufacturing, **additional testing and documentation to assure compliance with the NACE standard is not required in most cases.**

• **Quick and Easy Maintenance**—Ball seal inspection and replacement is done at the valve body inlet without removing the actuator or

disassembling the valve. Valve maintenance requires no special tools.

• **Structural Integrity**—One-piece valve body improves structural integrity of the pressure boundary by eliminating leak paths that could be caused by the gaskets in two-piece, bolted valve designs.

• **Improved Environmental Capabilities**—The optional ENVIRO-SEAL packing systems are designed with very smooth shaft surfaces and live loading to provide improved sealing. The seal of the ENVIRO-SEAL system can restrict emissions to less than the EPA (Environmental Protection Agency) limit of 500 ppm (parts per million).

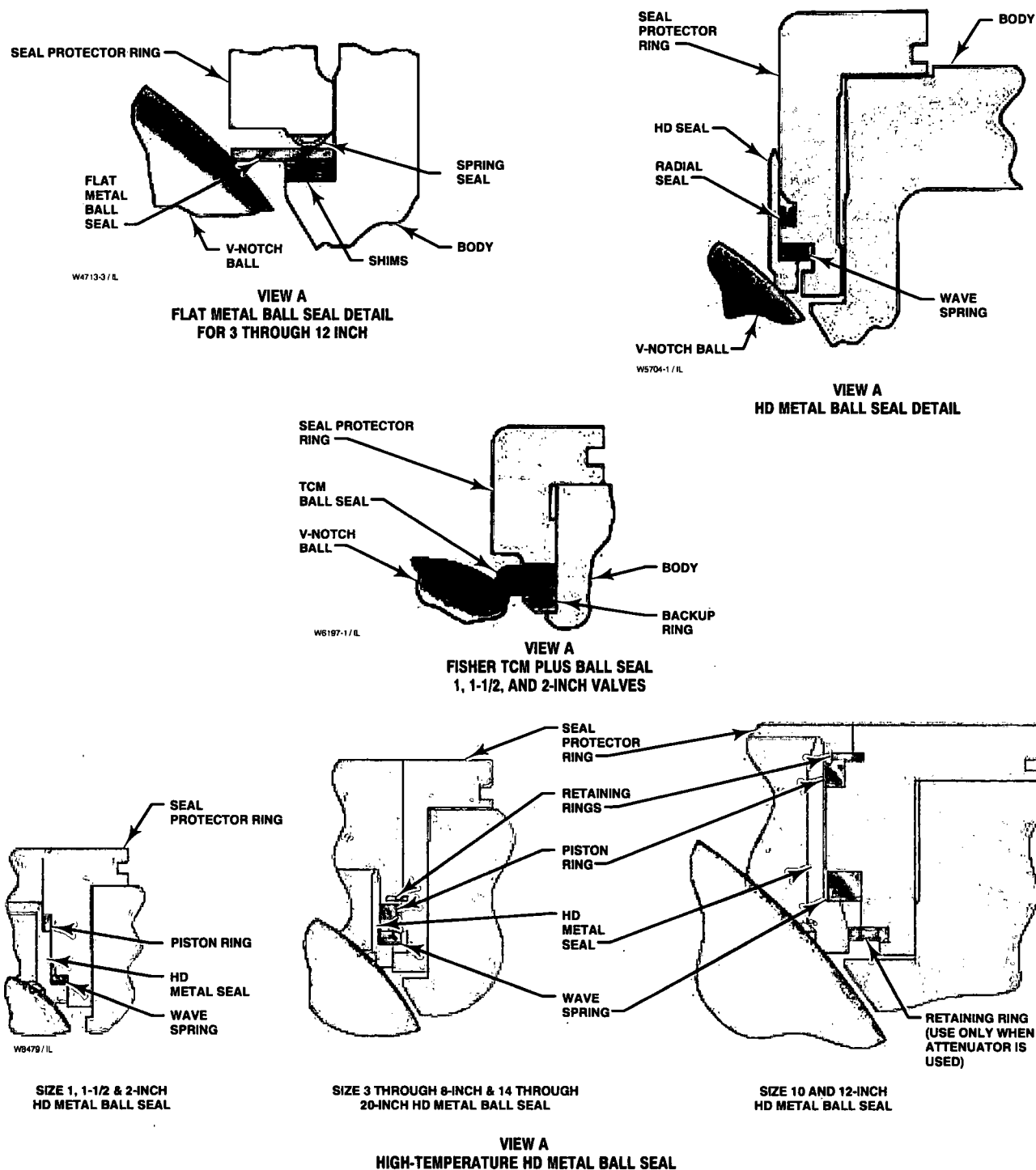
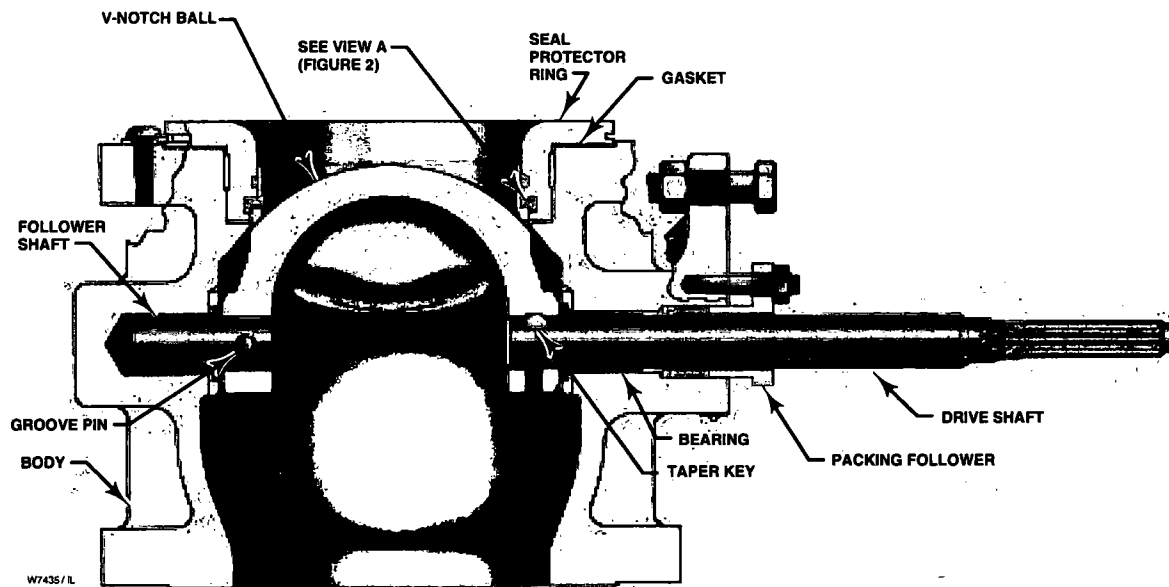
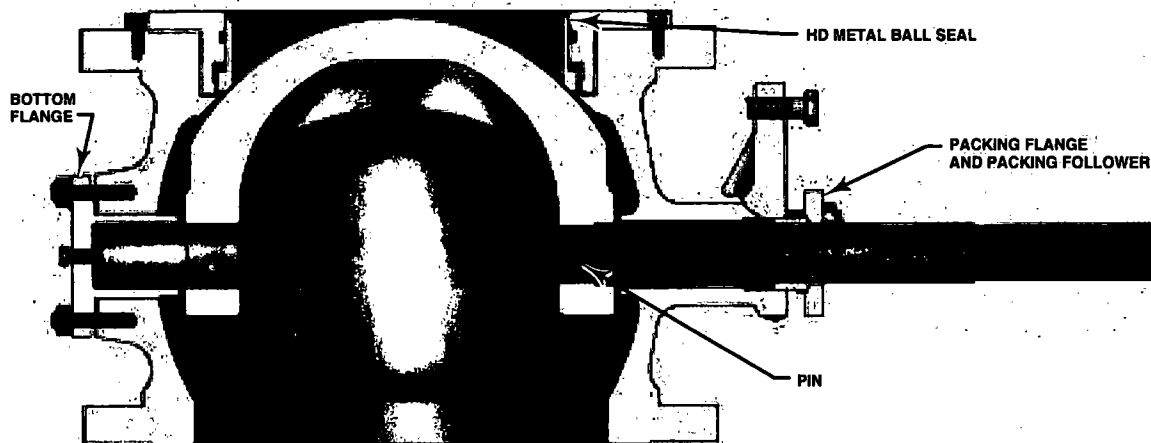


Figure 2. Vee-Ball Construction Features, Seals (Design V150 Shown)



**3 THROUGH 12-INCH VALVES
(HD BALL SEAL SHOWN)**



**14, 16, AND 20-INCH VALVES
(HD METAL BALL SEAL)**

Figure 3. Vee-Ball Construction Features (Design V150 Shown)

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Table 2. Valve Weights, Approximate

VALVE SIZE, INCH	V150		V200		V300	
	kg	lbs	kg	lbs	kg	lbs
1	5.6	13	4.5	10	8	17
1-1/2	8.2	19	6.4	14	12	27
2	9.1	21	10	23	17	38
3	13	43	15	34	28	61
4	26	57	22	48	37	81
6	42	93	36	80	60	133
8	72	158	62	136	103	226
10	107	235	114	252	200	440
12	157	347	---	---	293	645
14	247	545	---	---	374	825
16	333	735	---	---	510	1125
20	524	1155	---	---	---	---

Series B

The 3- through 12-inch sizes have been changed to reduce parts and to improve control performance. The V-notch Ball now resembles the 14- through 20-inch size V-notch Ball. The pressed-in bushings have been eliminated, as well as the thrust washer.

Micro-Notch Construction

For very precise control of low flow rates, the Micro-Notch construction (see figure 4) is available on 1-inch valves. Three Micro-Notch ball materials are available: chrome-plated CG8M (317 stainless steel), solid alloy 6, and solid VTC ceramic. A VTC ceramic HD seal is standard with the VTC ceramic ball. For the CG8M and alloy 6 constructions, pressure and temperature capabilities are the same as for standard constructions. For the ceramic construction, maximum temperature is 93°C (200°F).

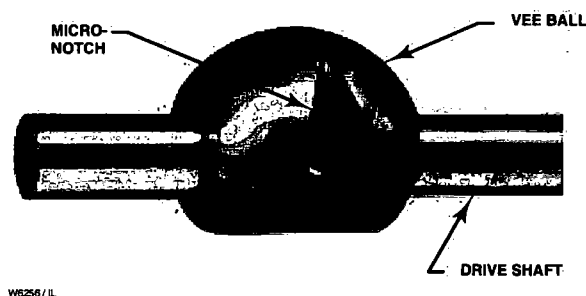


Figure 4. Typical Micro-Notch Ball and Shaft

For further information, please refer to Type Vee-Ball Designs V150, V200 and V300 Rotary Control Valves Sizes 1- through 12-inch instruction manual.

Vee-Ball Valves

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Table 3. Standard Construction Materials for 1 through 12-Inch Valves

PART		MATERIAL
Valve Body and Seal Protector Ring or Flow Ring		WCC steel (NACE), WCC steel (DIN 1.0619), CG8M (317 SST, NACE), CF3M ⁽¹⁾ (316L SST DIN 1.4408 or optional DIN 1.4581), CW2M (Hastelloy C) (CW2M valve available with Fisher TCM Plus seal only), M35-1 (Monel) or CK3MCuN (Avesta)
Backup Ring (1, 1-1/2 and 2-inch only)		CG8M (NACE), CF3M ⁽¹⁾ (NACE) or CW2M
V-Notch Ball		CG8M (NACE), CF3M, CW2M, chromium-plated CF3M, chromium-plated CG8M(NACE) and chromium-plated CG8M1/2 CF3M with alloy 6 notch (NACE), M35-1 (Monel) or CK3MCuN (Avesta)
Seal	Fisher TCM	Fisher TCM Plus and Fisher TCM Ultra
	Flat Metal Seal, Shims, and Spring Seal ⁽⁷⁾	Spring Tempered S31600 (316 stainless steel) or Spring Tempered S30200 (302 stainless steel) for 12-inch valves only
	HD (Heavy-Duty) Metal	CF10SMnN ⁽²⁾ (Nitronic 60), CD7MCuN ⁽³⁾ (alloy 255 duplex stainless steel) or R30006 (Alloy 6, NACE)
	High Temperature HD Metal Seal	R30006 (Alloy 6)
Wave Spring (use with HD seal)		N07750 (Inconel X750)
HD Seal Radial Seal		Graphite reinforced PTFE
High Temp HD Seal Piston Ring		Graphite FMS 17F39
Bearings		PEEK ⁽⁴⁾ /Carbon-filled liner (NACE), S31600L Nitride, R30006 (alloy 6, NACE), silver-plated R30006, carbon-filled PTFE with N10276 (Hastelloy C) sleeve, or glass-filled PTFE with N10276 sleeve
Seal Retainer Gasket		Laminated graphite
Packing		PTFE V-ring with one carbon-filled PTFE ring ⁽⁵⁾ , PTFE V-ring, or graphite ribbon. Packing is available with or without live loading.
Shafts		S20910 (Nitronic 50, NACE), S17400 (17-4PH stainless steel), N10276 (Hastelloy C276), M35-1 (Monel) or CK3MCuN (Avesta)
Groove Pin		S31600 (NACE) or N10276
Taper Key		R30006 ⁽⁶⁾ , S20910, or N10276
Taper Pin (1, 1-1/2, and 2-inch only)		S20910 (NACE) or N10276
Pipe Plug (Optional)		S31600 (NACE) N10276, or S31603 (316L stainless steel, NACE)
Seal Retainer Screws and Washers		Stainless steel
Packing Follower and Packing Box Ring		CF8M (316 stainless steel, NACE), N10276, S312254 (Avesta), or N10276 with separate S31600 packing box flange (NACE)
Actuator Mounting Bolts and Nuts		Grade 5 steel or strain-hardened B8M stainless steel
Spacer and Bushing		S31700 (NACE), N10276, or S31603
Packing Follower Bolting and Optional Line Bolting		SA-193-B7, SA-193-B7M, or strain-hardened SA-193-B8M

1. CF3M is available in all areas as a special order and is the standard material offered for Fisher in Europe.

2. Recommended for lubricated and non-lubricated service and where corrosion properties similar to 304 stainless steel are acceptable.

3. Recommended for lubricated service and where corrosion properties equal to or better than 317 stainless steel are required.

4. PEEK is poly-ether-ether-ketone.

5. The carbon-filled PTFE ring is used for grounding.

6. Standard material offered in North America.

7. Offered for lubricated service only.

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Table 4. Standard Construction Materials for 14-, 16- and 20-Inch Valves

Part		Material
Valve Body, Seal Protector Ring, and Flow Ring		WCC steel or CG8M (317 stainless steel)
V-Notch Ball		Chromium-plated CG8M, CG8M, Chromium-plated CG8M with alloy 6 notch
Ball Seal	Fisher TCM	Fisher TCM Plus and Fisher TCM Ultra
	HD (Heavy-Duty Metal)	CF10SMnN ⁽¹⁾ (Nitronic 60), CD7MCuM ⁽²⁾ (alloy 225 duplex stainless steel) or R30006 (alloy 6)
Wave Spring (use with HD seal)		N07750 (Inconel X750)
Radial Seal (use with HD seal)		PTFE with N10276 (Hastelloy 276C) spring
Bearings		PEEK/PTFE ⁽³⁾ , S44004 (440C stainless steel—use with S17400 [17-4PH stainless steel] shafts, alloy 6B, and silver plated alloy 6B
Thrust Washer (use with metal bearings)		Alloy 6B
Seal Retainer Gasket		Laminated Graphite
Packing		PTFE V-ring with one conductive V-ring ⁽⁴⁾ , PTFE V-ring, or graphite ribbon
Shafts		S17400 (17-4 stainless steel) or S20910 (Nitronic 50)
Pins		S20910
Pipe Plug		S31700 (317 stainless steel)
Packing Follower Bolting		B7M steel or strain-hardened B8M stainless steel
Retainer Screw		B8M stainless steel
Packing Follower and Packing Box ring		S31600 (316 stainless steel)
Packing Flange		Steel or S31600
Actuator Mounting Bolts and Nuts		Grade 5 steel or strain-hardened B8M stainless steel
Gasket (used with bottom flange)		S31603 (316L stainless steel) spiral wound
Stud and Hex Nut (used with bottom flange)		B7 steel or strain-hardened B8M stainless steel

1. Recommended where corrosion properties similar to 304 stainless steel are acceptable.
2. Recommended for lubricated service and where corrosion properties equal to or better than S31700 stainless steel.
3. PEEK (Poly-ether-ether-ketone) w/PTFE liner.
4. A carbon-filled PTFE ring is used for grounding.

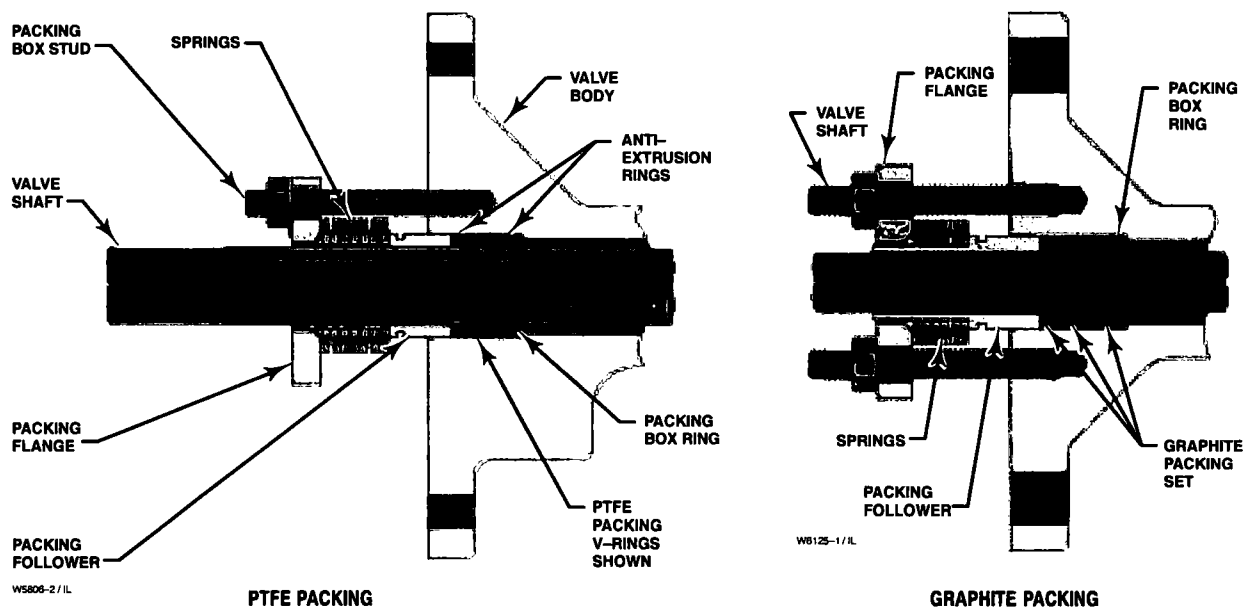


Figure 5. Typical ENVIRO-SEAL Packing Arrangements

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Table 5. Construction Materials for Compliance with NACE MR0175

Part		Material
Valve Body and Seal Protector Ring or Flow Ring		WCC steel ⁽¹⁾ , CG8M (317 stainless steel), CF3M ⁽²⁾ (316L stainless steel) or CW2M (Hastelloy C), M35-1 (Monel) or 254SMO (Avesta)
Backup Ring (1, 1-1/2, and 2-inch)		CG8M, CF3M ⁽²⁾ or CW2M
V-Notch Ball		Chrome-plated CG8M, CW2M, CF3M, chrome-plated CG8M with alloy 6 notch, chrome-plated CF3M, and chrome-plated CF3M with alloy 6 notch, M35-1 (Monel) or CK3MCuN (Avesta)
Seal	Fisher TCM	Fisher TCM Plus and Fisher TCM Ultra
	HD (Heavy-Duty) Metal	R30006 (alloy 6)
HD Seal Wave Spring		N07750 (Inconel X750)
HD Seal Radial Seal		PTFE
High Temp HD Seal Piston Ring		Graphite FMS 17F39
Bearings		PEEK/PTFE ⁽³⁾ , 316L Nitride, alloy 6B, silver-plated alloy 6B, carbon-filled PTFE with N10276 sleeve, or glass-filled PTFE with N10276 sleeve
Thrust Washer (1, 1-1/2, and 2-inch only)		S31600 or N10276
Seal Retainer Gasket		Laminated graphite
Packing		PTFE V-ring with one carbon-filled PTFE conductive packing ring ⁽⁴⁾ , or ENVIRO-SEAL packing
Shafts		S20910 (Nitronic 50), N10276, M35-1 (Monel) or S31254 (Avesta)
Groove Pin (1- through 12-inch only)		S31600 (316 stainless steel)
Taper Key (1- through 12-inch) or Pins (14- through 20-inch)		(1- through 12-inch) R30006, (14- through 20-inch) S20910
Taper Pin (1, 1-1/2, and 2-inch)		S20910
Pipe Plug (optional 1 through 12-inch)		S31700 (317 stainless steel) 14, 16 and 20-inch, S31600 (316 stainless steel 1- through 12-inch)
Seal Retainer Screws and Clips		Stainless steel
Packing Follower and Packing Box Ring		CF8M (316 stainless steel) or S312254 (Avesta)
Spacer and Bushing (3- through 12-inch sizes)		S31700
Packing Follower Bolting and Optional Line Bolting		Grade B7 or B7M steel studs, 2H, 2HM, or B8M nuts

1. Includes stress relief of body, seal protector ring or flow ring.
2. CF3M is available in all areas and is the standard material offering from Fisher in Europe (not available for 14- through 20-inch sizes).
3. PEEK (Poly-ether-ether-ketone) w/PTFE liner.
4. Carbon-filled PTFE ring is used for grounding.

Table 6. Maximum Allowable Inlet Pressure for CW2M (Hastelloy C) and CG8M (317 Stainless Steel) Valves, Class 150⁽¹⁾

TEMPERATURE	CW2M	CG8M	TEMPERATURE	CW2M	CG8M
°C	Bar		°F	Psig	Psig
-29 to 38	20.0	19.0	-20 to 100	290	275
93	17.9	16.2	200	260	235
149	15.9	14.8	300	230	215
204	13.8	13.4	400	200	195
232	12.8	12.6	450	185	183
260	---	11.7	500	---	170
316	---	9.6	600	---	140
343	---	8.6	650	---	125
371	---	7.6	700	---	110
399	---	6.5	750	---	95
427	---	5.5	800	---	80

1. These materials are not listed in ASME B16.34. The designation 150 is used only to indicate relative pressure-retaining capabilities and is not an ANSI pressure-temperature rating class designation.

Pressure Drops

Pressure drop limits of any given valve are based on valve body, and trim material limits. To find the appropriate pressure drop limitation, choose the desired valve size and temperature range. Then search table 7 for body limitations and table 8 for trim limitations. Information on limits for Avesta, Hastelloy, Monel and other alloy constructions can be found in PS Sheet 59.1:021(C). The lowest number from the tables is the appropriate limit. **The tables for both trim and body limits must be consulted.**

Note

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Table 7: Maximum Allowable Shutoff Pressure Drops (Body Ratings) based on Carbon Steel and Stainless Steel Valve Body Types. The tables for both trim and body limits must be consulted.

TEMPERATURE RANGE	ANSI PRESSURE CLASS								
	WCC CL 150	316L SST CL 150	317 SST CL 150	WCC CL 300	316L SST CL 300	317 SST CL 300	WCC CL 600	316L SST CL 600	317 SST CL 600
°C	Bar								
-46 to -29	---	15.9	19.0	---	41.4	49.6	---	82.7	99.3
-29 to 38	20.0	15.9	19.0	51.7	41.4	49.6	103	82.7	99.3
93	17.9	13.4	16.2	51.7	34.8	42.7	103	70.0	85.5
149	15.9	12.1	14.8	50.3	31.4	38.6	100	62.7	77.2
204	13.8	11.0	13.4	48.6	28.6	35.5	97.2	56.9	70.6
232	12.8	10.7	12.8	47.2	27.9	34.5	94.5	54.8	68.6
260	11.7	10.0	11.7	45.9	26.2	33.1	91.7	52.7	65.8
316	10.7	9.9	10.7	43.8	25.5	32.1	87.6	51.0	64.1
343	9.65	9.7	8.62	41.7	23.8	31.0	83.4	49.6	62.4
371	8.62	8.6	7.58	40.7	23.8	30.7	81.0	48.3	60.0
399	6.55	6.6	6.55	34.8	23.1	29.3	69.6	46.2	58.9
427	5.52	5.5	5.52	28.3	22.8	29.0	56.9	45.5	58.3
°F	Psi								
-50 to -20	---	230	275	---	600	720	---	1200	1440
-20 to 100	290	230	275	750	600	720	1500	1200	1440
200	260	195	235	750	505	620	1500	1015	1240
300	230	175	215	730	455	560	1455	910	1120
400	200	160	195	705	415	515	1410	825	1025
450	185	155	185	685	405	500	1370	795	995
500	170	145	170	665	380	480	1330	765	955
550	155	143	155	635	370	465	1270	740	930
600	140	140	140	605	360	450	1210	720	905
650	125	125	125	590	350	445	1175	700	890
700	110	110	110	570	345	430	1135	685	870
750	95	95	95	505	335	425	1010	670	855
800	80	80	80	410	330	420	825	660	845

Vee-Ball Valves

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Table 8. Maximum Allowable Shutoff Pressure Drops based on Trim (Bearing and Seal).

Note: Do not exceed the DIN or ANSI pressure/temperature rating of the valve or mating flanges.

BEARING MATERIAL	BALL SEAL	TEMPERATURE RANGE, °C	VALVE SIZE, INCHES											
			1	1-1/2	2	3	4	6	8	10	12	14	16	20
			Bar											
PEEK/PTFE	Fisher TCM Plus or Ultra	-46 to 38	51.7	51.7	51.7	51.7	51.7	51.7	51.7	40.2	37.6	31.0	23.8	31.0
		93	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.6	31.0	23.8	31.0
		149	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	23.8	24.1
		204	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
		232	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
	HD Metal ⁽¹⁾	-46 to 260	51.7	51.7	51.7	51.7	51.7	51.7	51.7	40.9	38.1	40.3	26.5	40.3
	Flat Metal ⁽²⁾	-73 to 260	---	---	---	20.7	20.7	20.7	20.7	10.3	10.3	---	---	---
R30006	Flow Ring	260	103.4	103.4	103.4	103.4	72.4	75.2	73.8	40.5	37.7	40.5	35.0	44.7
	HD Metal ⁽¹⁾	-46 to 288	51.7	50.0	25.7	17.5	11.0	10.9	11.2	6.14	5.72	6.14	7.52	6.83
	High Temp HD Metal ⁽¹⁾	228 to 427	38.3 ⁽³⁾	37.5 ⁽³⁾	19.3 ⁽³⁾	13.2 ⁽³⁾	8.3 ⁽³⁾	8.2 ⁽³⁾	8.4 ⁽³⁾	4.6 ⁽³⁾	4.3 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-73 to 427	---	---	---	17.0	10.1	10.7	10.6	5.86	5.52	---	---	---
R30006 Silver Plated	Flow Ring	427	74.5	49.6	26.8	18.8	10.9	11.2	11.1	6.07	5.65	6.07	7.31	6.69
	HD Metal ⁽¹⁾	-46 to 288	51.7	51.7	51.7	35.0	22.1	21.8	22.5	12.3	11.4	12.3	13.2	13.7
	High Temp HD Metal ⁽¹⁾	228 to 427	38.3 ⁽³⁾	38.3 ⁽³⁾	38.3 ⁽³⁾	26.3 ⁽³⁾	16.5 ⁽³⁾	16.3 ⁽³⁾	16.9 ⁽³⁾	9.2 ⁽³⁾	8.6 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-73 to 427	---	---	---	20.7	20.1	20.7	20.7	10.3	10.3	---	---	---
S31600L Nitride	Flow Ring	427	103.4	103.4	53.5	37.6	21.8	22.5	22.2	12.1	11.3	12.1	14.6	13.4
	HD Metal ⁽¹⁾	-46 to 288	51.0	51.0	51.0	51.7	36.7	36.3	37.4	20.5	19.1	---	---	---
	High Temp HD Metal ⁽¹⁾	228 to 427	---	---	---	38.3 ⁽³⁾	27.6 ⁽³⁾	27.2 ⁽³⁾	28.1 ⁽³⁾	15.4 ⁽³⁾	14.3 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-73 to 427	---	---	---	20.7	20.7	20.7	20.7	10.3	10.3	---	---	---
S31600L Nitride	Flow Ring	427	99.3	99.3	88.9	62.7	36.3	37.4	37.0	20.2	18.8	---	---	---
BEARING MATERIAL	BALL SEAL	TEMPERATURE RANGE, °F	Psi											
PEEK/PTFE	Fisher TCM Plus or Ultra	-50 to 100	750	750	750	750	750	750	750	583	545	450	345	450
		200	550	550	550	550	550	550	550	550	545	450	345	450
		300	350	350	350	350	350	350	350	350	350	350	345	350
		400	150	150	150	150	150	150	150	150	150	150	150	150
		450	50	50	50	50	50	50	50	50	50	50	50	50
	HD Metal ⁽¹⁾	-50 to 500	750	750	750	750	750	750	750	593	553	450	384	444
	Flat Metal ⁽²⁾	-100 to 500	---	---	---	300	300	300	300	150	150	---	---	---
R30006	Flow Ring	500	1500	1500	1500	1500	1050	1090	1070	587	547	587	508	648
	HD Metal ⁽¹⁾	-50 to 550	750	725	373	254	160	158	163	89	83	89	109	99
	High Temp HD Metal ⁽¹⁾	550 to 800	555 ⁽³⁾	544 ⁽³⁾	280 ⁽³⁾	191 ⁽³⁾	120 ⁽³⁾	119 ⁽³⁾	122 ⁽³⁾	67 ⁽³⁾	62 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-100 to 800	---	---	---	246	146	155	154	85	80	---	---	---
R30006 Silver Plated	Flow Ring	800	1080	720	388	273	158	163	161	88	82	88	106	97
	HD Metal ⁽¹⁾	-50 to 550	750	750	750	508	320	316	326	178	166	178	192	198
	High Temp HD Metal ⁽¹⁾	550 to 800	555 ⁽³⁾	555 ⁽³⁾	555 ⁽³⁾	381 ⁽³⁾	240 ⁽³⁾	237 ⁽³⁾	245 ⁽³⁾	134 ⁽³⁾	125 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-100 to 800	---	---	---	300	292	300	300	150	150	---	---	---
S31600L Nitride	Flow Ring	800	1500	1500	776	546	316	326	322	176	164	176	212	194
	HD Metal ⁽¹⁾	-50 to 550	740	740	740	750	533	527	543	297	277	---	---	---
	High Temp HD Metal ⁽¹⁾	550 to 800	---	---	---	555 ⁽³⁾	400 ⁽³⁾	395 ⁽³⁾	407 ⁽³⁾	223 ⁽³⁾	208 ⁽³⁾	---	---	---
	Flat Metal ⁽²⁾	-100 to 800	---	---	---	300	300	300	300	150	150	---	---	---
S31600L Nitride	Flow Ring	800	1440	1440	1290	910	527	543	537	293	273	---	---	---

1. Pressure drops shown for HD metal seals are for forward flow only. For reverse flow with HD metal seal, limit pressure drop to 6.9 bar (100 psig).

2. Lubricated service only.

3. Consult your Fisher sales office if higher pressure drops are required.

Table 9. Design V150 Dimensions

VALVE SIZE	DESIGN V150 DIMENSIONS (ISA S75.04) ⁽¹⁾										
	A	B	D	G	K	M ⁽³⁾	N ⁽³⁾	S Diameter	T	U	W
DN	mm										
25	102	56		83	95	78	71	13			
40	114	62	188	90	121	90	78	15.9 and 15.9 x 12.7	117	---	14.2
50	124	67		87	127	104	92	15.9 and 15.9 x 12.7			
80	165	79		100	130	104	98	19.1			14.2
100	194	101	214	133	141	117	98	19.1	152	31.8	14.2
150	229	109		151	164	124	112	25.4			17.5
200	243	124		184	232	131	124	31.8			
250	297	147	208	222	260	145	132	31.8	235	46.0	17.5
300	338	174		268	303	151	132	38.1			
Inch	Inch										
1	4.00	2.21		3.19	3.75	3.06	2.81	1/2			
1-1/2	4.50	2.46	7.38	3.38	4.75	3.56	3.06	5/8 and 5/8 x 1/2	4.62	---	0.56
2	4.88	2.63		4.19	5.00	4.11	3.61	5/8 and 5/8 x 1/2			
3	6.50	3.10		4.62	5.12	4.11	3.86	3/4			0.56
4	7.62	3.99	8.44	5.25	5.56	4.61	3.86	3/4	6.00	1.25	0.56
6	9.00	4.29		5.94	6.44	4.90	4.40	1			0.69
8	9.56	4.88		7.69	9.12	5.15	4.90	1-1/4			
10	11.69	5.77	8.19	8.75	10.25	5.69	5.19	1-1/4	9.25	1.81	0.69
12	13.31	6.87		10.56	11.94	5.94	5.19	1-1/2			
14 ⁽²⁾	15.00	8.12		11.62	13.50	6.00	5.25	1-3/4	10.75	2.00	0.75
16 ⁽²⁾	16.00	9.00	14.00	13.00	14.38	6.00	5.25	2-1/8	10.75	2.00	0.75
20	20.00	9.25		16.00	18.00	7.00	6.25	2-1/2	13.25	3.00	0.88

1. Inlet flange stud bolt length is longer than the standard length specified in ANSI B16.5. See dimension M below.
2. 14- and 16-inch valves are available in ASME B16.10 short, only. See dimension A for ASME B16.10 short shown in figure 9.
3. Clearance necessary to remove flange bolts.

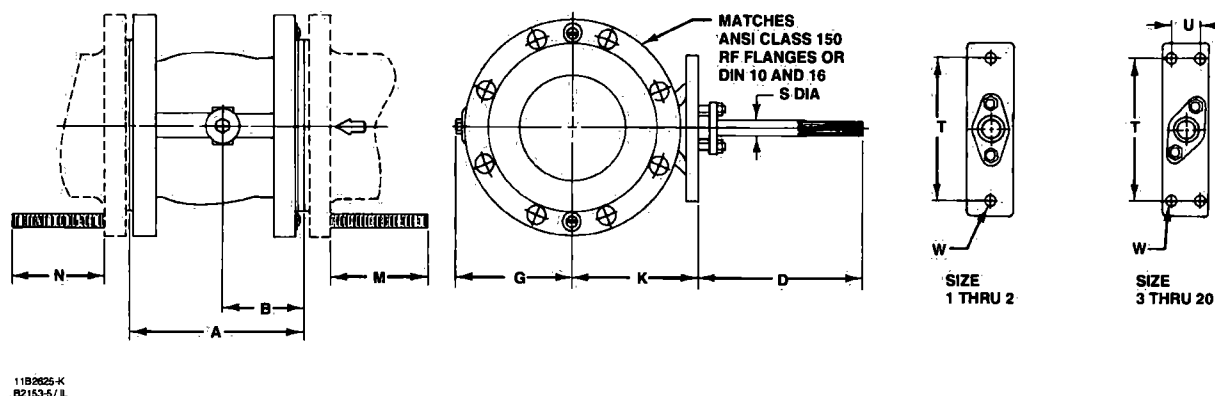


Figure 6. Design V150 Dimensions (also see table 9)

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Table 10. Design V200 Dimensions

VALVE SIZE, INCH	DESIGN V200 DIMENSIONS (ISA S75.04)														ANSI B16.5 RF FLANGES
	A	B	D	G	K	M			R	R1	S	T	U	W	
						Class 150	Class 300	Class 600							
mm															
1	102	56	188	81	95	176	202	202	51	102	12.7	117	---	14.2	ANSI Class 150, 300, and 600
1-1/2	114	62		89	121	189	224	224	73	119	15.7 and 15.7 x 12.7				
2	124	67	106	127	211	236	236	92	137	15.7 and 15.7 x 12.7					
3	165	79	214	117	130	254	279	286	127	167	19.1	152	32	14.2	
4	194	101		133	141	286	305	343	157	197	19.1				
6	229	109		159	164 ⁽¹⁾	343	362	413	216	260	25.4				
8	243	124	208	195	232	343	387	426	270	314	31.8	235	46	17.5	Class 150
10	297	147		222	260	419	----	----	324	368					
Inch															
1	4.00	2.21	7.38	3.19	3.75	6.94	7.94	7.94	2	4.00	1/2	4.62	---	0.56	ANSI Class 150 and 300
1-1/2	4.50	2.46		3.50	4.75	7.44	8.81	8.81	2.88	4.68	5/8 and 5/8 x 1/2				
2	4.88	2.63	4.19	5.00	8.31	9.31	9.31	3.63	5.38	5/8 and 5/8 x 1/2					
3	6.50	3.10	8.44	4.62	5.12	10.00	11.00	11.25	5.00	6.56	3/4	6.00	1.25	0.56	
4	7.62	3.99		5.25	5.56	11.25	12.00	13.50	6.19	7.76	3/4				
6	9.00	4.29		6.25	6.44 ⁽¹⁾	13.50	14.25	16.25	8.50	10.24	1				
8	9.56	4.88	8.19	7.69	9.12	13.50	15.25	16.75	10.63	12.38	1-1/4	9.25	1.81	0.69	Class 150
10	11.69	5.77		8.75	10.25	16.50	----	----	12.75	14.50					
1. 179 mm (7.06 inches) for 6 inch, ANSI Class 600 valves only.															

1. 179 mm (7.06 inches) for 6 inch, ANSI Class 600 valves only.

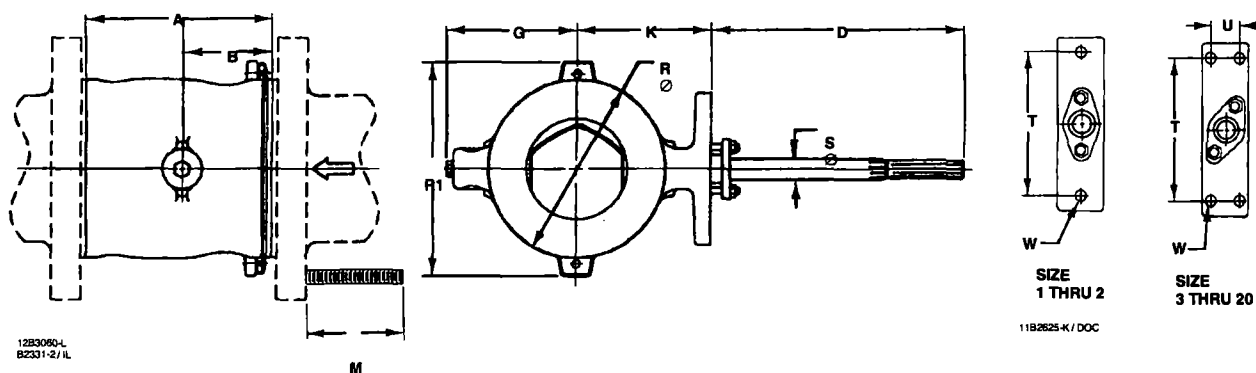


Figure 7. V200 Dimensions (also see table 10)

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Vee-Ball Valves

Table 11. Design V300 Dimensions

VALVE SIZE, DN ⁽¹⁾	DESIGN V300 DIMENSIONS (ISA S75.04)										
	A	B	D	G	K	M ⁽²⁾	N ⁽²⁾	S Diameter	T	U	W
	mm										
25	102	56		81	95	98	85	13			
40	114	62	188	89	121	112	99	16 and 16 X 13	117	---	
50	124	67		106	127	104	98	16 and 16 X 13			14.2
80	165	79		117	130	131	118	19			
100	194	101	214	133	141	137	124	19	152	32	
150	229	109		159	164	150	137	25			
200	243	124		195	232	164	151	32			
250	297	147	208	222	260	184	172	32	235	46	17.5
300	338	174		268	303	197	184	38			
356 mm (14-in.)	381	206	356	295	343	197	178	44.5	273	50.8	19.5
406 mm (16-in.)	406	228	356	338	356	210	191	53.8	273	50.8	19.5
	Inch										
1	4.00	2.21		3.19	3.75	3.86	3.36	1/2			
1-1/2	4.50	2.46	7.38	3.50	4.75	4.40	3.90	5/8 and 5/8 X 1/2	4.62	---	
2	4.88	2.63		4.19	5.00	4.11	3.86	5/8 and 5/8 X 1/2			0.56
3	6.50	3.10		4.62	5.12	5.15	4.65	3/4			
4	7.62	3.99	8.44	5.25	5.56	5.40	4.90	3/4	6.00	1.25	
6	9.00	4.29		6.25	6.44	5.90	5.40	1			
8	9.56	4.88		7.69	9.12	6.44	5.94	1-1/4			
10	11.69	5.77	8.19	8.75	10.25	7.25	6.75	1-1/4	9.25	1.81	0.69
12	13.31	6.87		10.56	11.94	7.75	7.25	1-1/2			
14	15.00	8.12	14.00	11.62	13.50	7.75	7.00	1-3/4	10.75	2.00	0.75
16	16.00	9.00	14.00	13.31	14.38	8.25	7.50	2-1/8			

1. DN25, 40, 50, 80, and 100 are the only sizes offered in Design V300 for Europe.
2. Clearance necessary to remove flange bolts.

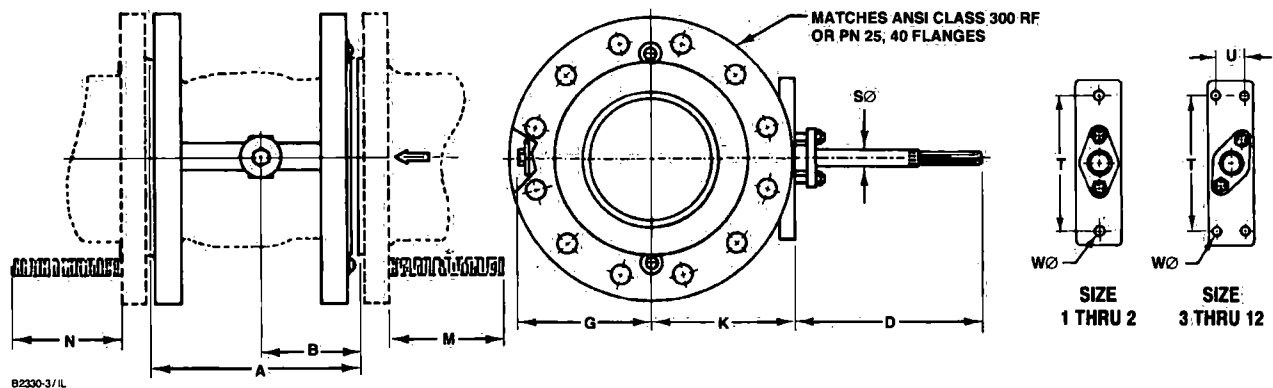


Figure 8. Design V300 Dimensions (also see table 11)

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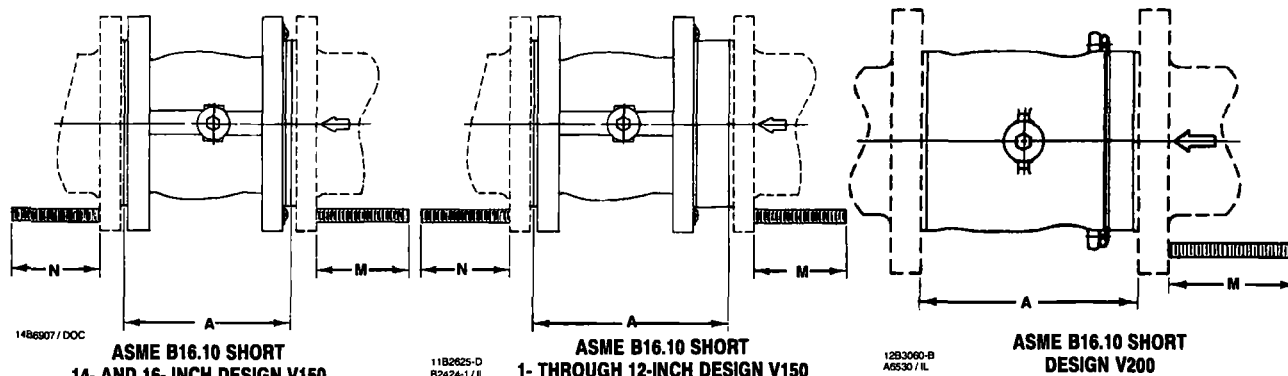
Table 12. Design V150 Optional Dimensions

DESIGN V150 OPTIONAL DIMENSIONS FOR 1- THROUGH 12-INCH SIZES (ASME B16.10 SHORT)						
VALVE SIZE, INCH	A		M		N	
	mm	Inches	mm	Inches	mm	Inches
1	127	5.00	103	4.06	71	2.81
1-1/2	165	6.50	135	5.31	78	3.06
2	178	7.00	155	6.11	92	3.61
3	203	8.00	142	5.61	98	3.86
4	229	9.00	155	6.11	98	3.86
6	267	10.50	163	6.40	112	4.40
8	292	11.50	182	7.15	124	4.90
10	330	13.00	176	6.94	132	5.19
12	356	14.00	170	6.69	132	5.19

Table 13. Design V200 Optional Dimensions

DESIGN V200 OPTIONAL DIMENSIONS (ASME B16.10 SHORT) ^(1,2)		
VALVE SIZE, INCH	A	M
	mm	
1	127	202
1-1/2	165	240
2	178	268
3	203	286
4	229	321
6	267	381
8	292	394
10	330	451
	Inch	
1	5.00	7.94
1-1/2	6.50	9.44
2	7.00	10.56
3	8.00	11.25
4	9.00	12.62
6	10.50	15.00
8	11.50	15.50
10	13.00	17.75

1. Available for Class 150 valves only.
2. ASME B16.10 short dimensions are actually longer than ISA S75.04 dimensions.



NOTES:

1- THROUGH 12-INCH VALVES ARE AVAILABLE WITH EITHER ISA S75.04 FACE- TO-FACE DIMENSIONS OR ASME B16.10 SHORT FACE-TO-FACE DIMENSIONS. 1-THROUGH 12-INCH VALVES WILL BE SUPPLIED IN ISA S75.04 UNLESS YOU SPECIFY OTHERWISE. NOTE THAT ASME B16.10 SHORT DIMENSIONS ARE ACTUALLY LONGER THAN ISA S75.04.

14- AND 16-INCH VALVES ARE AVAILABLE ONLY WITH ASME B16.10 SHORT FACE-TO-FACE DIMENSIONS.

20-INCH VALVES ARE AVAILABLE ONLY WITH A 508 MM (20-INCH) FACE-TO-FACE DIMENSION.

M AND N DIMENSIONS SHOWN FOR DESIGN V150 ARE CLEARANCE NECESSARY TO REMOVE FLANGE BOLTS.

Figure 9. Design V150 and V200 Optional Dimensions (also see tables 12 and 13)

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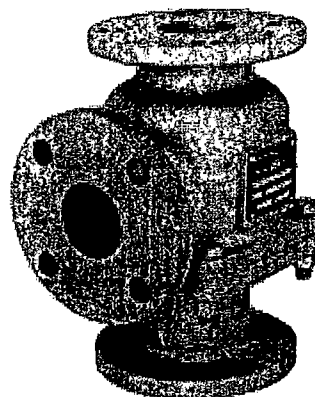
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AMOT CONTROLS

Model B

Thermostatic Valves



FEATURES

- FLOW RATES OF 68 - 1200 USGPM
- TAMPER-PROOF TEMPERATURE SETTINGS OF 55°F - 240°F
- COMPLETELY SELF-CONTAINED
- POSITIVE 3-WAY VALVE ACTION
- AVAILABLE IN CAST IRON, DUCTILE IRON, BRONZE, STEEL, AND STAINLESS STEEL
- 1-1/2" - 6" PIPE SIZES: FLANGED, AND THREADED CONNECTION

APPLICATIONS

- ENGINE & COMPRESSOR COOLING SYSTEM
- LUBE OIL SYSTEMS
- COGENERATION HEAT RECOVERY LOOPS
- PROCESS CONTROL
- TEMPERATURE MIXING OR DIVERTING

AMOT Model B Thermostatic Valves are fully automatic, 3-way fluid temperature control valves for diverting or mixing applications. They provide reliable control of fluid temperatures in engine jacket water and lubrication oil cooling systems. These valves are suitable for process control and industrial applications where fluids must be mixed or diverted depending on their temperatures. They may also be applied to cogeneration systems to control temperatures in the heat recovery loop assuring proper engine cooling and maximizing heat recovery.

TAMPER-PROOF

As with other AMOT thermostatic valve the Model B utilizes fully enclosed, factory-set temperature element assemblies which provide tamper-proof operation. To change a valve setting it is necessary to exchange the temperature element assemblies inside the valve.

HIGH RESISTANCE TO SHOCK

Model B thermostatic valves display excellent reliability even under extreme shocks or vibration and many models have been qualified to MIL-S-901 and MIL-V-19772.

MANUAL OVERRIDE

If desired, AMOT Model B thermostatic valves can be supplied with a manual override which allows the user to direct flows through Ports A and C. On valves equipped with the manual override option, there is one manual override device for each of the temperature element assemblies. To engage the manual override function, flip the lever(s) 180° from "Auto" to "Manual" position.

FORM 936

OPERATION

The valve is supplied with the temperature element assemblies factory-set to the nominal temperature setting. Temperature is sensed at Port A which remains open to Port B (bypass) until the fluid temperature reaches a point 5 - 10°F below the nominal setting. As the temperature continues to rise, the sliding valve moves to close off Port B and open Port C (connected to the cooler or heat exchanger) Port B is fully closed 8 - 10°F above the nominal setting. The valve continually modulates the fluid flow to maintain the nominal temperature. For optimum control, the system should be sized so about 1/2 the total fluid flow is passing through the cooler at full load.

For long life, AMOT Model B valves should not be exposed to continuous temperatures exceeding 25°F above their nominal temperature setting. For occasional short periods (1/2 hour or less), they can be exposed to temperatures of 50°F above their nominal temperature setting, but not to exceed 250°F maximum.

For higher over-temperatures, reduced stroke element assemblies (5566X) are available. They will withstand continuous temperatures of 60°F above their nominal temperature setting but add 30% to the valve pressure drop. Reduced stroke elements are not available in all temperatures.

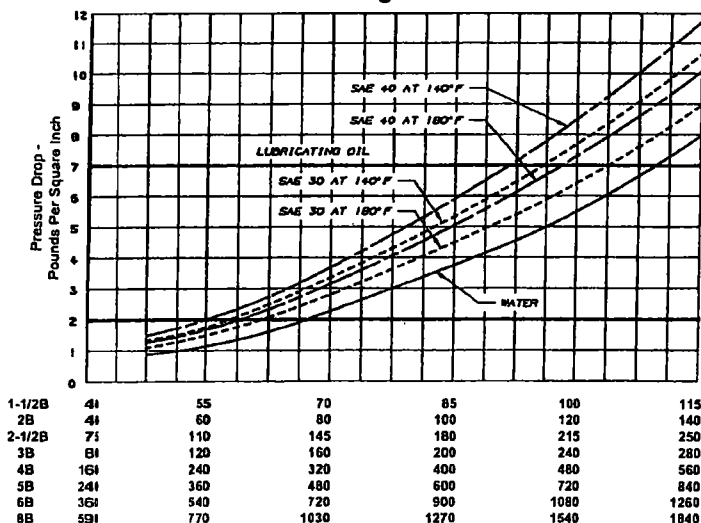
INSTALLATION

AMOT thermostatic valves operate in any position and may be oriented at the convenience of the system designer. In the smaller sizes, the valve may be supported by the connecting pipe but should not be subjected to excessive bending. Line up the piping before tightening the connecting bolts. Larger sizes should not be used to support long and heavy lengths of pipe nor used to draw up lengths of pipe which have been fabricated too short.

If the valve is mounted at the high point of the system, the system should be properly vented to prevent trapping air at the temperature element assemblies.

For piping diagrams regarding specific applications, refer to Form 913, AMOT Thermostatic Valves General Information.

Figure 1



Flow in U.S. Gallons Per Minute
Recommended pressure drop is 2 to 7 psi.

SELECTION

AMOT thermostatic valves are selected by the anticipated flow rate through the valve. Refer to Fig. 1. Pressure drop across the valve is usually limited to approximately 2 psi to 7 psi to maintain good temperature regulation.

Threaded end connections are available on 1 1/2 and 2 inch sizes. Models with cast iron, ductile iron, or bronze housings have ANSI 125 lb flat face flanges. Steel or Stainless Steel housings feature ANSI Class 150 or 300 raised face flanges. Metric connections also available.

Models with steel housings have ANSI 150 lb/300 lb Class compatible raised face flanges.

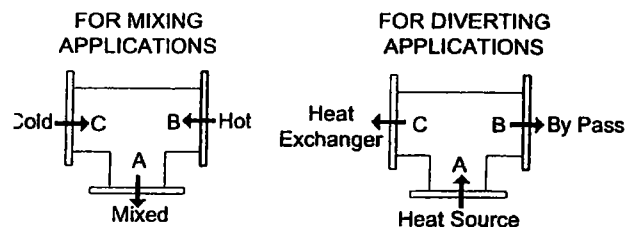
Versions available from USA factory.

Cast Iron	Ductile Iron	Bronze	Steel
1-1/2BOCT	2BMDF	1-1/2BOBT	2BCSJ
1-1/2BHCT	2BDF	2BOBT	2BCSH
2BOCT	2-1/2BMDF	2BCBF	2BMSJ
2BHCT	3BODF	2BFBF	2BMSH
2BMCF	4BEDF	2-1/2BMBF	2-1/2BOSJ
2BCCF	4BODF	3BOBF	2-1/2BMSJ
2BFCF	4BODF	3BMBF	3BOSJ
2-1/2BOCF	5BODF	4BEBF	3BMSJ
2-1/2BMCF	5BMDF	4BOBF	3BOSH
3BOCF	6BODF	4BMBF	
3BMCF	6BMDF	5BOBF	
4BECF		5BMBF	
4BOCF		6BOBF	
4BMCF		6BMBF	
5BOCF			
5BMCF			
6BOCF			
6BMCF			

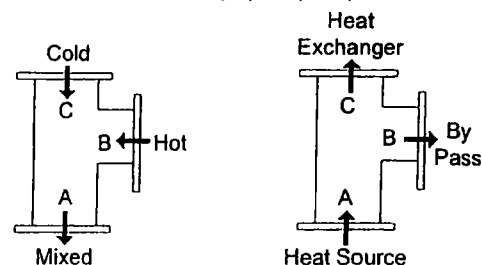
Indicates Non-Standard

PIPING DIAGRAMS

MODELS BO, BC, BM



MODEL 1-1/2, 2, BO, BH, BF



SPECIFICATIONS

Internal Trim Materials	Bronze and Stainless Steel
Standard Seal Material	Buna N
Max. Pressure Drop Across Valve	20 psi (1.4 Bar)
Valve Pressure Ratings at 250°F	
Cast Iron, Ductile Iron, Bronze	150 psi (10 Bar)
Cast Iron, Model BH	340 psi (23 Bar)
Steel, Class 150,	245 psi (17 Bar)
Steel, Class 300,	665 psi (46 Bar)
Stainless Steel Class 150,	228 psi (15 Bar)
Stainless Steel Class 300,	590 psi (41 Bar)

Shipping Weights:	Cast Iron	Ductile Iron	Bronze	Steel
1-1/2BO/2BO	25	--	--	--
1-1/2BH/2BH	32	--	--	--
1-1/2BM	--	--	25	--
2BC, BM	30	30	35	45
2BF	35	35	40	--
2-1/2B	55	55	75	75
3B	60	60	80	80
4B	135	135	150	--
5B	200	200	240	--
6B	270	270	300	--

HOW TO ORDER

(Refer to Model Code System Below.)

When ordering please specify the following:

1. Valve size connection (see Table A).
2. Valve Type (see Table B).
3. Housing material (see Table C).
4. Type of End Connection (see Table D).
5. Nominal temperature setting (see Table E).
6. Any of the following special features if required:
 - a) Viton or neoprene seals (instead of Buna N).
 - b) Electroless Nickel plated temperature element assembly.
 - c) Element leak hole (see Table G).
 - d) Reduced stroke element assembly for high over-temperature.

This product may be ordered using the full description as shown above or by constructing a Model No. using the Model Code System below. For special requirements, contact the AMOT factory or your local representative.

MODEL CODE SYSTEM

3 BO C F 160 01 - - ()

Special Requirements, (MTO) Made-To-Order

Element Assembly Leak Hole, See Table G

Element Assembly Type, See Table F

Temperature Setting, See Table E

TABLE A Valve Size Inches (mm)
1-1/2 (40)
2 (50)
2-1/2 (65)
3 (80)
4 (100)
5 (125)
6 (150)
8 (200)

TABLE B Valve Type Code No.
BO Standard
BM Manual Override
BC Tee config, Flanged
3 (80) 1-1/2, 2" only
BF Flanged, 2" only
BH 1-1/2, 2" only
BR Manual override (UK)

TABLE C Body Material Code No. Material
C Cast Iron
S Steel
B Bronze
D Ductile Iron
F Stainless Steel

TABLE D*	
Connections	
Code No.	End Type
F	ANSI B16.1 Class 125 FF Flange
J	ANSI B16.5 Class 150 RF Flange
H	ANSI B16.34 Class 300 RF Flange
A	ND6 (Metric) Flange
B	ND10 (Metric) Flange
C	ND16 (Metric) Flange
N	Navy Flange
P	JIS 5K Flange
T	NPT Threaded
V	BSP-TR / JIS Threaded
W	SAB Threaded (straight thread / O-ring seal)

TABLE E Temperature Setting Code No.	Nominal Temp °F	(°C)
*055	55	(13)
*075	75	(24)
*090	90	(32)
*095	95	(35)
*100	100	(38)
*105	105	(41)
*110	110	(43)
*115	115	(46)
120	120	(49)
*130	130	(54)
135	135	(57)
140	140	(60)
145	145	(63)
*150	150	(66)
155	155	(69)

TABLE E (Continued) Temperature Setting Code No.	Nominal Temp °F	(°C)
160	160	(71)
165	165	(74)
170	170	(77)
175	175	(79)
180	180	(83)
185	185	(85)
195	195	(91)
205	205	(96)
215	215	(102)
225	225	(107)
230	230	(110)
235	235	(113)
240	240	(116)
Temperatures apply only to 1096 and 2433 Element Assemblies.		

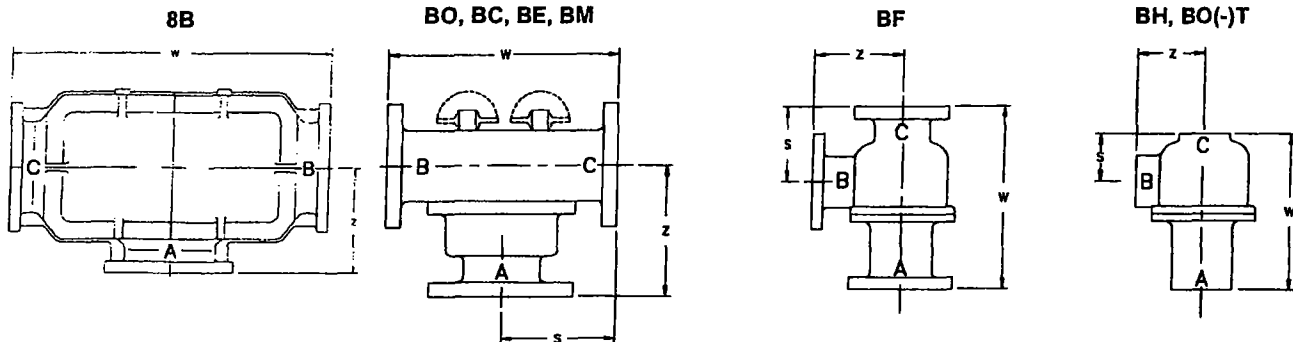
TABLE F Element Assembly Code No.	Element	Assembly Type
01	1096X	Standard
02	1096P	Plated with Viton
03	1096X	with Viton seals
07	2433X	Manual Override
11	5566X	Reduced stroke
05	6836S	Seawater
44	1096X	with Neoprene
45	1096P	with Neoprene
20	5566X	with Viton
12	5566P	Plated
53	2433X	with Viton
50	6836K	Electroless Nickel with Neoprene

TABLE G Element Assembly Leak Hole Code No.	Size Inches (mm)
none	(standard)
A	1/2" (12.5)
B	1/2" (6.4)
C	3/8" (9.5)
D	1/8" (3.2)
E	1/16" (1.6)
F	3/32" (2.4)
G	3/16" (4.8)
H	5/16" (7.9)

* = Also avail. as reduced stroke. Contact factory for other temps.

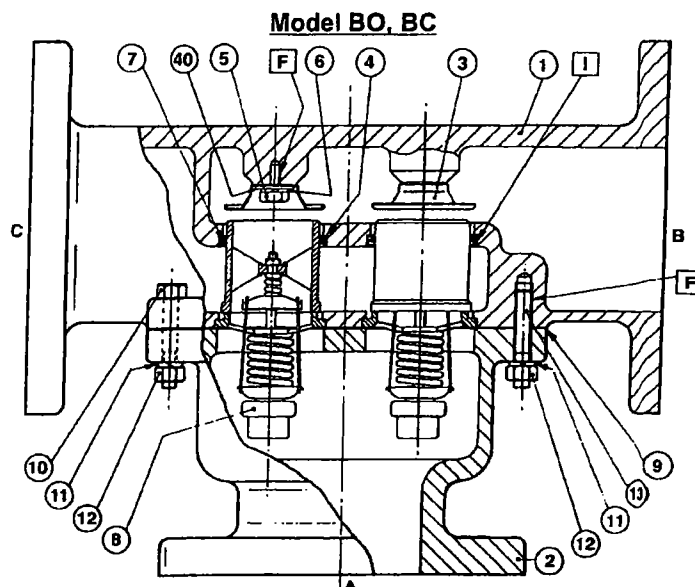
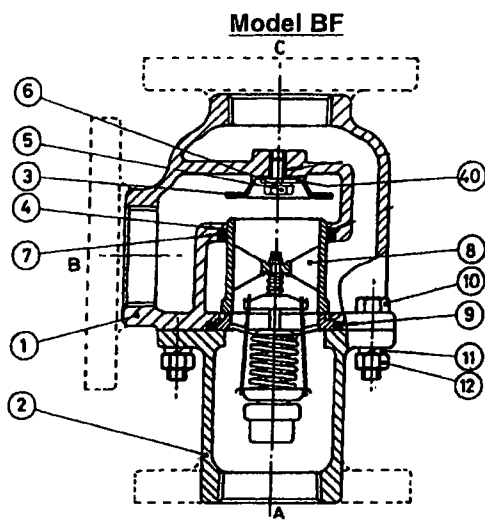
Indicates Non-Standard, MTO

DIMENSIONS



Model No.	Nominal Pipe Size	Principal Dimensions			Width in the Other Plane	Flange Drilling			No. of Element Assemblies
		"S"	"W"	"Z"		No. of Holes	Dia. of Holes	Bolt Circle	
1-1/2BO(-)T	1-1/2 (40)	3-13/16 (97)	9-11/16 (246)	3-9/16 (90)	5-1/2 (140)	—	—	—	1
1-1/2BHCT	1-1/2 (40)	4-1/16 (103)	10-11/16 (271)	4 (102)	5-3/4 (146)	—	—	—	1
2BC(-)F 2BM(-)F	2 (50)	4-7/16 (113)	8-7/8 (225)	5-7/8 (149)	6 (152)	4	3/4 (19)	4-3/4 (121)	1
2BF(-)F	2 (50)	4-3/4 (121)	10-5/8 (270)	4-7/16 (113)	6 (152)	4	3/4 (19)	4-3/4 (121)	1
2BCSJ 2BMSJ	2 (50)	4-7/16 (112)	8-7/8 (225)	5-7/8 (149)	6 (152)	4	3/4 (19)	4-3/4 (121)	1
2BCSH 2BMSH	2 (50)	4-7/16 (112)	8-7/8 (225)	5-7/8 (149)	6 (152)	8	3/4 (19)	5 (127)	1
2BO(-)T	2 (50)	3-13/16 (97)	9-11/16 (246)	3-9/16 (90)	5-1/2 (140)	—	—	—	1
2BHCT	2 (50)	4-1/16 (103)	10-11/16 (271)	4 (102)	5-3/4 (146)	—	—	—	1
2-1/2BO(-)F 2-1/2BM(-)F	2-1/2 (65)	5 (127)	10 (254)	6-1/2 (165)	8-1/4 (210)	4	3/4 (19)	5-1/2 (140)	2
2-1/2BOSJ 2-1/2BMSJ	2-1/2 (65)	5 (127)	10 (254)	6-1/2 (165)	8-1/4 (210)	4	3/4 (19)	5-1/2 (140)	2
3BO(-)F 3BM(-)F	3 (80)	5-1/4 (133)	10-1/2 (267)	6-3/4 (172)	8-1/4 (210)	4	3/4 (19)	6 (152)	2
3BOSJ 3BMSJ	3 (80)	5-1/4 (133)	10-1/2 (267)	6-3/4 (172)	8-1/4 (210)	4	3/4 (19)	6 (152)	2
3BOSH 3BMSH	3 (80)	5-1/4 (133)	10-1/2 (267)	6-3/4 (172)	8-1/4 (210)	8	3/4 (19)	6-5/8 (168)	2
4BO(-)F 4BM(-)F	4 (100)	7-15/16 (201)	15-7/8 (403)	8-9/16 (218)	12-1/8 (308)	8	3/4 (19)	7-1/2 (190)	4
5BO(-)F 5BM(-)F	5 (125)	9-5/8 (249)	19-1/4 (489)	9-1/2 (241)	13-3/4 (349)	8	7/8 (22)	8-1/2 (216)	6
6BO(-)F 6BM(-)F	6 (150)	9-5/8 (244)	19-1/4 (489)	10 (254)	19 (483)	8	7/8 (22)	9-1/2 (241)	9
8BO(-)F 8BR(-)F	8 (200)	16-1/2 (420)	33 (840)	11 (280)	19-11/16(500) 26-3/4(680)	8	7/8 (22)	11-3/4 (298)	18

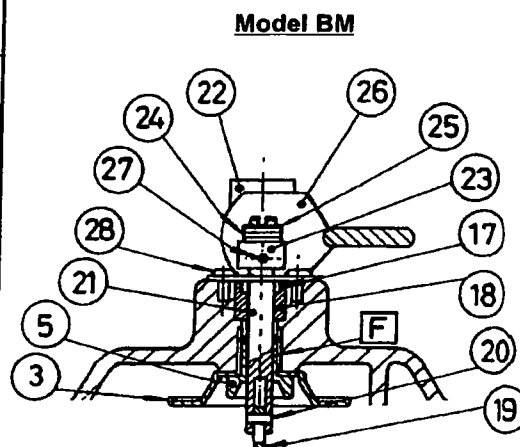
Dimensions in inches. Millimeters in ().



SERVICE PARTS FOR MODELS BO, BC, BF, BH, BM

Ref No.	Part No.	Description
3	9585L001	Seat, Bolted-In (Except BM)
3	9585L002	Seat (BM only)
4	1182	Sleeve
5	11132L050	Capscrew
6	11133	Lockwasher
7	1183	Element O-ring, Buna N (Standard)
7	1183L002	Element O-ring Seal, Viton
8	1096X(temp)	Element Assembly (Standard)
8	1096P(temp)	Element Assembly, plated
8	2433X(temp)	Element Assembly, manual override
9	761	O-ring 1-1/2 - 3B, Buna N
9	761L001	O-ring 1-1/2 - 3B, Viton
9	1094	Gasket 2-1/2 B, 3B, (Old Versions)
9	1123	Gasket 4B
9	1117	Gasket 5B
9	1149	Gasket 6B
17	358	O-ring, Buna N (BM only)
17	358L001	O-ring, Viton (BM only)

This Parts List effective with Valve Serial No. B941.



MAINTENANCE

Properly applied and installed, AMOT Thermostatic Valves require practically no maintenance.

If necessary, temperature element assemblies may be easily replaced. Remove Nuts (12) or Bolts (6) and separate the Upper (1) and Lower (2) Housing. Remove Element Assembly (8) and Element O-ring Seal (7). Remove Housing O-ring (9) or Gasket and clean any foreign material from sealing surfaces. Lubricate new Element O-ring Seal (7) with a good grade of petroleum grease and re-insert in the groove in Upper Housing (1). Insert Element Assembly (8) through Element O-ring Seal (7) with a twisting motion. Install Housing O-ring (9) or Gasket around the Element Assembly Flange and bolt on Lower Housing (2).

AMOT designs and tests all its products to ensure that high quality standards are met. For good product life, carefully follow AMOT's installation and maintenance instruction; failure to do so could result in damage to the equipment being protected or controlled.

When communicating with AMOT regarding operation of a control, always give the Model No. and Serial No. If ordering service parts, also include 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 this brochure.

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