



MODEL 988

Pneumatic Control Valve for General and Chemical Service



Model 988
1" – Body Size
CF3M Body – 300# Flanged
Model 55R Actuator
(ATO-FC Action)
"Long Pattern"

The Model 988 is a globe-style, pneumatic control valve designed primarily for general and chemical service. The valve's body/trim materials are available in WCB/316L SST, CF3M/316L SST, or CW-12MW/Hast. C constructions.

Standard trim is metal seated design giving Class IV shutoff. Optional composition seat design gives Class VI shutoff. Available in body sizes 3/4" thru 2" (DN20–DN50). End connections available are NPT, socketweld or flanged.

FEATURES

- All wetted trim components of 316L SST or Hastelloy C.
- Standard non-asbestos construction.
- Dual stem guiding...
 - improved shutoff,
 - increased packing life,
 - maximized stability.
- Standard internally live-loaded V-ring packing.
- Multiple packing designs to meet reduced **fugitive emission** levels.
- Flow-to-open design for increased...
 - rangeability,
 - stability.
- Quick change trim.
- High pressure drop capability, up to 740 psid (51.0 Bard).
- Multiple reduced trim selections.
- Equal percent or linear characterization.
- External corrosion protection.
- Face-to-Face dimensions per ISA S75.20 ("Long Pattern").

APPLICATIONS

Designed primarily for corrosive chemical fluids in throttling services. May also be applied as a general service control valve for utilities services – steam, air, oil, water, industrial gases, etc. The minimum seat/plug/stem material is 316L SST to maximize corrosion resistance. May be applied up to 740 psig (51 Barg) pressure limit, or 450°F (232°C) temperature limit as a standard unit; up to 750°F (400°C) with optional high temperature construction.

STANDARD / GENERAL SPECIFICATIONS

Body Sizes: 3/4", 1", 1-1/2" and 2".
(DN20, 25, 40, and 50).

Body Pressure Temperature Rating: Meets ANSI B16.34 for 150# or 300# Pressure Classes for cast carbon steel (CS), cast stainless steel (SST). See Table 1.

Max. Inlet Pressure: CS – Up to 740 psig (51.0 Barg).
SST – Up to 720 psig (49.6 Barg).
H-C – Up to 740 psig (51.0 Barg).

Working Temperature Range: Standard, all materials: -20°F to +450°F (-29°C to +232°C).
Optional, all materials: -20°F to +750°F (-29°C to +400°C).

End Connections: **Female NPT** – All sizes; CS and SST materials only. F-to-F dimensions per ISA S75.12-1986.
Socket Weld – All sizes; CS and SST body materials only. F-to-F dimensions per ISA S75.12-1986.
Flanged – All sizes and body materials. Separable Type; standard is CS flanges and CS split rings, optional SST.
150# RF and 300# RF: Mating dimensions in accordance with ANSI B16.5. F-to-F dimensions per ISA S75.20-1989. PN16, PN25 and PN40: Standard ANSI raised facing dimensions on body. Mating bolt circle and bolt hole dimensions in accordance with ISO 7005-1. See Figure 9.

Max. Pressure Drop: **Metal Seated** – Up to 600 psid (41.4 Bard) for Full, 1-Step and 2-Step reduced ports. Up to 740 psid (51.0 Bard) for 3-Step, 4-Step, 5-Step and 6-Step reduced ports. **TFE Soft Seated** – Up to 400 psid (27.6 Bard). See Tables 2 thru 5.

Seat Leakage: Meets ANSI/FCI 70-2 (Rev. 1982). Standard – Metal Seated – Class IV. Optional – TFE Soft Seated – Class VI, with metal-to-metal backup.

Flow Direction: Standard: Flow-to-Open (FTO). Minimizes packing sealing pressure level. (Not recommended for Flow-to-Close direction.)

Inherent Flow Characteristic: Equal Percent or Linear; FTO direction only.

Rangeability:

| Body Size inch (mm) | Port Size | | | |
|------------------------|----------------------|--------|--------|------|
| | Reduced | | | FULL |
| | 3, 4, 5, & 6-Step | 2-Step | 1-Step | |
| 3/4" (DN20) | 25:1 | 35:1 | 47.5:1 | 45:1 |
| 1" (DN25) | 25:1 | 35:1 | 50:1 | |
| 1-1/2" (DN40) | – | – | 50:1 | |
| 2" (DN50) | – | – | 50:1 | |

Flow Capacity: Per ISA 75.11 Standard. See Tables 7 and 8.

| Body inch (mm) | Port - Orifice | | Cv Max. | |
|-------------------------|----------------|-------------------|------------|------|
| | Description | Size inch (mm) | =% | Lin. |
| | | | | |
| 3/4" (DN20) | Full | .750 (19.0) | 10.7 | 11.6 |
| | 1-Step Reduced | .562 (14.3) | 6.7 | 7.1 |
| 1" (DN25) | Full | .750" (19.0) | 11.8 | 12.7 |
| | 1-Step Reduced | .562" (14.3) | 7.0 | 7.5 |
| 3/4" & 1" (DN20, 25) | 2-Step Reduced | .562" (14.3) | 4.1 | 4.3 |
| | 3-Step Reduced | .332" (8.4) | 2.5 | 2.6 |
| | 4-Step Reduced | .205" (5.2) | – | 1.1 |
| | 5-Step Reduced | .155" (3.9) | – | 0.58 |
| | 6-Step Reduced | .155" (3.9) | – | 0.27 |
| 1-1/2" (DN40) | Full | 1.250" (31.8) | 26 | 27 |
| | Reduced | .750" (19.0) | 10.4 | 10.8 |
| 2" (DN50) | Full | 1.688" (42.9) | 47 | 50 |
| | Reduced | 1.000" (25.4) | 18.2 | 19.4 |

Actuators: Spring-Diaphragm Type. Select "direct" or "reverse" action; non-field reversible.

| Action | Model | Body Sizes Utilized Upon inch (mm) |
|--|-------|---------------------------------------|
| Direct; ATC-FO (Increase in air "LOAD" extends actuator stem.) | 55D | 3/4", 1", 1-1/2" (DN20, 25, 40) |
| | 75D | 1-1/2", 2" (DN40, 50) |
| | 115D | 2" (DN50) |
| Reverse; ATO-FC (Increase in air "LOAD" retracts actuator stem.) | 55R | 3/4", 1", 1-1/2" (DN20, 25, 40) |
| | 75R | 1-1/2", 2" (DN40, 50) |
| | 115R | 2" (DN50) |

ATC-FO = Air-to-Close, Fail Open;
ATO-FC = Air-to-Open, Fail Close.

See Tables 2 thru 5 for proper selection of required bench setting range spring and Model number.

Painting: Standard – All non SST portions painted with corrosion resistant epoxy paint per Cashco Specification #S-1606 except tubing and fittings.
Optional – 2-coat epoxy coating per Cashco Specification #S-1547.

BODY SUB-ASSEMBLY SPECIFICATIONS

Body/Bonnet Materials: CS – ASTM A216, Gr. WCB.
 SST – ASTM A351, Gr. CF3M (316L).
 H-C – ASTM A494, Gr. CW-12MW (Similar to “Hasteloy C”).

Separable Flange Materials: Standard: All body materials;
 Flanges – CS per ASTM A216, Gr. WCB, or equal;
 Split Rings – CS.
Optional: SST or H-C body materials;
 Flanges – SST per ASTM A351, Gr. CF3M, or equal;
 Split Rings – 316 SST.
Optional: All body materials;
 Flanges – CS per above;
 Split Rings – 316 SST.

Trim: Function of packing design and body material.

| Seat Design | Trim Designation # | Body Materials | Basic Trim Description |
|------------------|----------------------|----------------|------------------------|
| Metal | S1S, S1R, S1SE, S1RE | CS or SST | 316L SST |
| | S40, S40E | CS or SST | NACE |
| | S1HT | CS or SST | High Temp |
| | HC1, HC1E | CS, SST or H-C | H-C |
| Composition Soft | S3S, S3R, S3SE, S3RE | CS or SST | 316L SST/TFE |
| | S40T, S40TE | CS or SST | NACE/TFE |
| | HC3, HC3E | CS, SST or H-C | H-C/TFE |

See Table 6 for complete trim material specifications.

Gaskets: Standard – Non-asbestos, Spiral-Wound Type ;
CS or SST Body – 316L SST with carbon filler,
H-C Body – Hasteloy C with carbon filler.

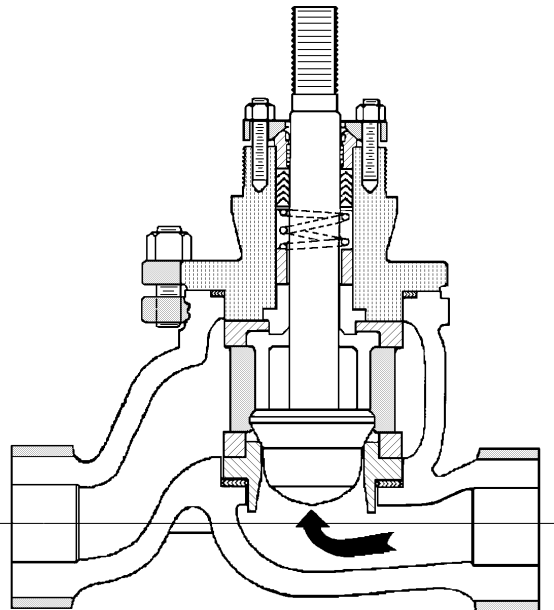


FIGURE 1

Body Sub-Assembly Internal Design – Metal Seated with Internal Live-Loading

Stem Size: 0.625" (15.9mm) diameter, all body sizes.

Plug Travel:

| Body Size inch (mm) | Travel/Stroke inch (mm) |
|-----------------------------------|-------------------------|
| 3/4", 1", & 1-1/2" (DN20, 25, 40) | .750" (19.0) |
| 2" (DN50) | 1.125" (28.6) |

Bonnet Bolting:

Zinc plated alloy steel.
CS Body/Bonnet: All standard and optional constructions.
Studs: ASTM A193, Gr. B7;
Nuts: ASTM A194, Gr. 2H.
SST or H-C Body/Bonnet: Std. construction and Opt-40 (NACE) Construction.
Studs: ASTM A193, Gr. B7;
Nuts: ASTM A194, Gr. 2H.
SST Body/Bonnet: Opt-35 High Temperature Construction (no plating).
Studs: ASTM A193, Gr. B8M, Cl. 2;
Nuts: ASTM A194, Gr. 8M-S1.

Packing Apparatus:

Std – Internal Live-Loaded & Jammed:
 Flange – 316 SST;
 Follower & Upper Guide – per Trim Designation Number.
Optional – External Live-Loaded:
 Retainers – 316 SST;
 Spacer – 316 SST;
 Follower & Upper Guide – per Trim Designation Number;
 Belleville Washers – 17-7PH SST.
All Designs – Bolting:
CS Body – All constructions;
 Studs – 18-8 SST,
 Nuts – 18-8 SST.
SST or H-C Body – All constructions except Opt-35;
 Studs – 18-8 SST,
 Nuts – 18-8 SST.
SST Body – Opt-35 High Temperature Construction;
 Studs – ASTM A193, Gr. B8M, Cl. 2;
 Nuts – ASTM A194, Gr. 8M-S1.

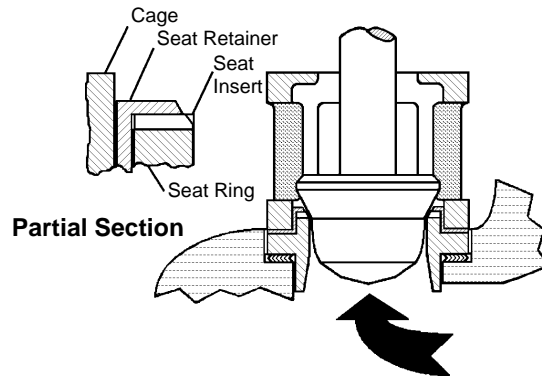


FIGURE 2

Composition Soft Seat Design

Packing:

All packing ring sets are complete with upper and lower non-extrusion adapters.

Live-Loaded (LL): (See Figure 3.)

Standard: Internal LL, virgin TFE V-ring.

Opt-EXT: External LL, virgin TFE V-ring.

Opt-HTE: External LL, carbon graphite rings.

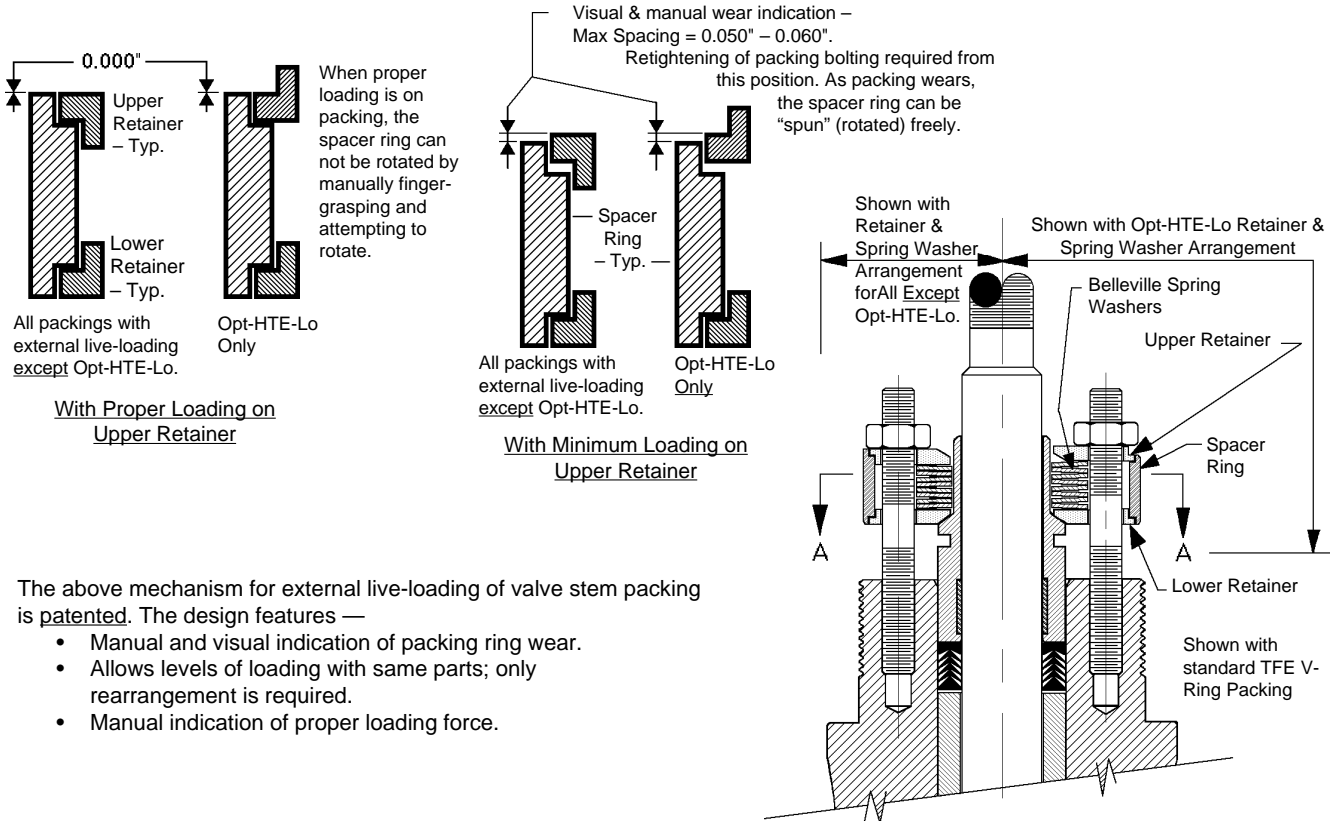
Opt-KRI: Internal LL, DuPont Kalrez/TFE rings with CRCC adapters.

Opt-KRE: Same as 'KRI', except external LL.

Jammed (Non-LL): (See "Option Specifications").

Opt-34: Dual packing, TFE V-ring, lantern ring spacer; 3 variations.

Opt-38J: Virgin TFE V-ring, dead-loaded.



The above mechanism for external live-loading of valve stem packing is patented. The design features —

- Manual and visual indication of packing ring wear.
- Allows levels of loading with same parts; only rearrangement is required.
- Manual indication of proper loading force.

ACTUATOR SUB-ASSEMBLY SPECIFICATIONS

(Continued on page 5)

Size, Stroke & Volumes:

| Basic Actuator Model | Diaphragm Area in ² (cm ²) | Nominal Stroke in (mm) | Volumes | |
|----------------------|--|---------------------------|---|--|
| | | | Clearance in ³ (cm ³) | Displacement in ³ (cm ³) |
| 55D | 50 (325) | .750" (19.0) | 26 (400) | 37 (600) |
| 55R | | | 41 (700) | |
| 75D or 75R | 75 (475) | .750" (19.0) | 75 (1200) | 55 (900) |
| | | 1.125" (28.6) | 75 (1200) | 85 (1400) |
| 115D | 110 (700) | 1.125" (28.6) | 76 (1200) | 131 (2100) |
| 115R | | | 84 (1400) | |

Ambient Temperature: -20° to +180°F (-28° to +83°C).
-20° to +140°F (-29° to +60°C) with electrical accessories.

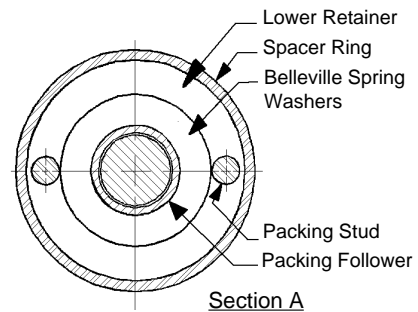


FIGURE 3
External Live-Loaded Packing Details

Bench Set & Max/Normal Pressures:

| Bench Set psig (Barg) | Air Pressures | |
|--------------------------|------------------------------|----------------------------|
| | Normal Supply psig (Barg) | Design Max. psig (Barg) |
| 5-15 (.34-1.03) | 20 | 25 |
| 3-13 (.21-.90) | (1.4) | (1.7) |
| 10-30 (.69-2.07) | 35 (2.4) | 40 (2.8) |
| 6-26 (.41-1.79) | | |
| 7-30 (.48-2.07) | | |
| 6-29 (.41-2.00) | | |
| 8-30 (.55-2.07) | | |
| 6-28 (.41-1.93) | | |
| 9-30 (.62-2.07) | | |
| 6-27 (.41-1.86) | | |
| 6-30 (.41-2.07) | | |

NOTE: No range springs are available for split ranging. A positioner is required for split range input signal.

Materials:

| Part | Material | |
|---|---------------------------------|----------------------------------|
| | Models 55/115 | Model 75 |
| Diaphragm | Neoprene with nylon mesh insert | Neoprene with dacron mesh insert |
| Casings - Upper and Lower | Pressed Carbon Steel | |
| Yoke | Cast Iron | |
| Stem | 416 SST | |
| Diaphragm Plate | Cast Iron | |
| Spring Button | Cast Iron | |
| Spring Adjustor | 18-8 SST | |
| Position Indicator | SST | |
| Bolting-Casings | Plated Steel | |
| Jam Nuts | 18-8 SST | |
| Position Plate, Screws & Unit Nameplate | SST | |
| Bonnet/Yoke Nut | Plated Steel | |

OPTION SPECIFICATIONS

Option -3:

MANUAL HANDWHEEL. Overrides the actuator spring force to allow manual stroking of the valve. Single acting design, top-mounted, enclosed handwheel. For ATO-FC action, handwheel operator “opens” the valve against spring force; may be utilized as a travel stop to prevent full closure. For ATC-FO action, handwheel operator “closes” the valve against spring force; may be utilized as a travel stop to prevent full opening.

Option -15:

STELLITED TRIM. For metal seated 316 SST designs only; limited to use with S1S, S1R, S1SE, S1RE or S1HT trim designation numbers only. Seat ring and plug seating surfaces are covered with Stellite #6 material. Recommended for flashing or partially cavitating liquid service, or where extended time periods of ON-OFF or low flow (less than 10% open) operation occur and good shutoff is required.

Option -26:

LEAK-OFF CONNECTION. 1/4" NPT tapped opening on bonnet. Complete with removeable steel plug for all body materials. Located between primary and secondary packing sets when supplied with Option -34, Dual Packing. See Figure 4.

Option -34:

DUAL PACKING. Two sets of standard TFE V-ring packing separated by a lantern ring of same material as trim material. Use for lethal, toxic, explosive, etc., type fluids, where extra packing sealing protection is desired; also used for vacuum service. *USE TABLE 4 FOR MAX. ALLOWABLE PRESSURE DROP.*

Arrangement A – Pressure inside valve is always greater than ambient pressure; see Figure 5.

Arrangement B – Pressure inside valve is always less than (i.e. vacuum) ambient pressure; see Figure 6.

Arrangement C – Pressure inside valve is alternately greater than or less than (i.e. vacuum) ambient pressure; see Figure 7.

Option -35:

HIGH TEMPERATURE CONSTRUCTION. Apply where temperatures from 450° to 750°F (232° to 400°C) are expected. Includes high strength, high temperature alloy bolting for the bonnet and packing retainer when applied with a SST body. Must select Opt -HTE stem packing design. Limited to use with trim designation S1HT ONLY.

Option -EXT:

TFE V-RING PACKING (External) Standard internal live-loaded (LL) design is replaced by patented external LL design. Includes SST Belleville spring washers enclosed within a SST spacer with SST upper and lower retainers (see Figure 3), and a variation of the standard packing follower. Temperature range: -20 to +450°F (-29 to +232°C).

Option -HTE:

HIGH TEMPERATURE PACKING. Includes patented externally live-loaded design. Packing set includes braided carbon yarn, graphite embedded upper and lower rings; high density graphite formed rings acting as non-extrusion adapters; and compressed carbon graphite ribbon

Option - HTE (Cont): formed into one-piece rings. Special packing follower includes carbon bushing. Temperature range: -20° to +750°F (-29° to +400°C). Opt-HTE is further classified as to max. inlet pressure— Opt-HTE-Lo is for inlet pressures up to 250 psig (17.2 Barg); Opt-HTE-Hi is for inlet pressures greater than 250 psig (17.2 Barg). **NOTE:** If application is for temperatures greater than 450 °F (232 °C), Opt-35 is also required.

Option -KRI: **KALREZ PACKING (Internal)** Standard packing is replaced with DuPont “Kalrez” fluoroelastomer, Series 500 KVSP packing set, consisting of one carbon filled TFE V-ring, two Kalrez V-rings, and upper and lower CRCC non-extrusion adapter rings. Uses standard internal live-loading. Temperature range: -20° to +450°F (-29° to +232°C).

Option -KRE: **KALREZ PACKING (External).** Incorporates external live-loaded features of packing Opt-EXT, and packing rings of packing KRI. Temperature range: -20° to +450°F (-29° to +232°C).

Option -38J: **JAMMED PACKING.** Live loading packing spring is replaced by a fixed spacer of same material as trim material; see Figure 8. **USE TABLES 2 AND 3 FOR MAX ALLOWABLE PRESSURE DROP.**

Option -40: **NACE SERVICE.** Internal wetted portions meet NACE standard MR0175-90 revision, when the exterior of the valve is not directly exposed to a sour gas environment, buried, insulated or otherwise denied direct atmospheric exposure. Apply in sour gas, sour crude, or service with hydrogen sulfide (H₂S) in the flow mixture. Limits effects of sulfide stress corrosion cracking. Use with CS or SST body/bonnet materials, and only with trim designations S40, S40E, S40T, or S40TE. Certificate of compliance supplied on request.

Option -55: **SPECIAL CLEANING.** Cleaned and packaged per Cashco Specification #S-1134. Suitable for oxygen service and other fluids. SST BODIES ONLY.

Option -56: **SPECIAL CLEANING.** Special cleaning procedure per Cashco Specification #S-1542. Suitable for fluids other than oxygen. For all body materials.

Option -95: **EPOXY PAINT.** Special epoxy painting for exterior surfaces. Utilized in harsh atmospheric conditions. Procedures and specs per Cashco Specification #S-1547.

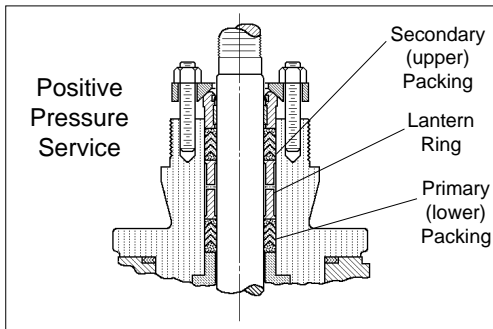


FIGURE 5
Dual Packing – Arr. “A”
Option-34A

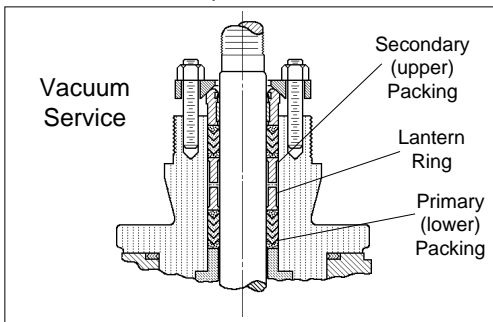


FIGURE 6
Dual Packing – Arr. “B”
Option-34B

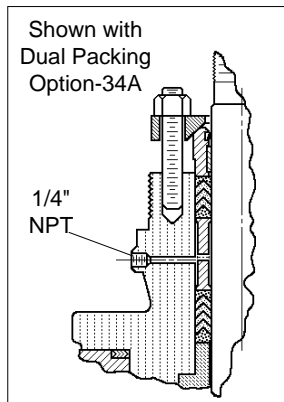


FIGURE 4
Leak-Off Conn.
Option-26

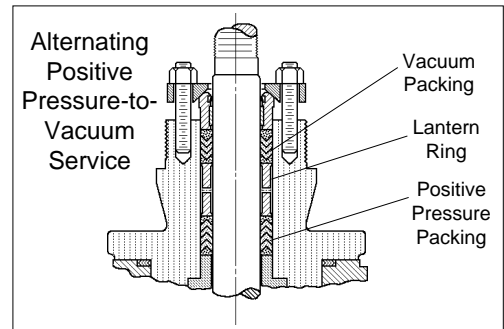


FIGURE 7
Dual Packing – Arr. “C”
Option-34C

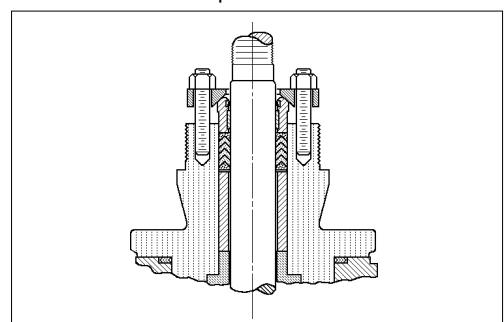


FIGURE 8
Jammed Packing
Option-38

MOUNTED ACCESSORY SPECIFICATIONS

| | | |
|------------------------|---|---|
| Positioners: | <p><u>General.</u> Yoke mounted to unit. All feedback linkage exposed to elements of SST materials. Aluminum housing with corrosion resistant polyurethane paint. Standard with 2-gauge cluster. Pneumatic output load as required by actuator bench range. Adjustable zero, stroke, gain and damping settings. Field reversible action. Dedicated airset recommended.</p> <p><u>P/P Pneumatic.</u> Model 9540L. Accepts 3-15 psig (0.2-1.0 Barg); 2-way split ranges 3-9 or 9-15 psig (0.2-0.6 or 0.6-1.0 Barg) input signals. Plastic cover with see-thru panel to view internal gauges.</p> <p><u>I/P Electro-Pneumatic.</u> Model 9520L. Accepts 4-20 mA; 2-way split ranges 4-12 or 12-20 mA input signals. NEMA 3 enclosure, intrinsically safe. FM approved. Gauges mounted on external gauge block.</p> <p><u>Mounting Bracket.</u> P/P – Pneumatic uses a SST bracket. I/P – Electro Pneumatic uses a die cast aluminum bracket.</p> | <p>NEMA 4 & 7 explosion-proof model. Brass body, 1/4" female NPT connections. Nipple mounted or bracket mounted to actuator casing. 120 VAC, 60 Hz power supply. Class F coil, continuous duty. 0.125" (3 mm) orifice, 50 psid (3.4 Bard) maximum pressure drop.</p> <p><u>Gen. Purpose:</u> ASCO #8320G176. <u>X-Proof:</u> ASCO #EF8320G176. <u>Alternate SST:</u> Similar to standard unit, <u>except</u> with .094" (2.38 mm) orifice, 40 psid (2.75 Bard) maximum differential pressure, and 303 SST body. <u>Gen. Purpose:</u> ASCO #8320G201. <u>X-Proof:</u> ASCO #EF8320G201.</p> <p>Standard installation vents actuator and drives valve to failsafe position upon loss of electrical power.</p> |
| Air Tubing: | <p>Standard instrument air tubing is Imperial-Eastman "Impolene" thermo-plastic tubing with brass fittings.</p> <p>Optional copper tubing with brass fittings, or SST tube and fittings.</p> | <p><u>Standard:</u> Yoke mounted, rotary trip switch; contains 1-SPDT switch. Switch rating is 15A @ 125 or 250 VAC. UL/CSA rating L96. Up to two switch units may be mounted per valve.</p> <p><u>Gen. Purpose:</u> Microswitch #OP-AR. NEMA 4 enclosure. <u>X-Proof:</u> Microswitch #EX-AR. For "hazardous locations" NEMA 7, Class 1, Groups C & D; NEMA 9, Class II, Groups E, F & G. <u>Alternate:</u> Proximity Controls Model #12ALO, 2-SPDT switches. Switch rating is 15A @ 125 or 250 VAC; proximity-type. UL listed for Class I, Groups A, B, C, D; Class II, Groups E, F, G; Div. 1 and 2. CSA, BASEEFA and CENELEC listed. Enclosure per NEMA 1, 2, 3, 3R, 3S, 4, 4X, 6, 7, 9, 12 and 13.</p> |
| Airset: | <p>Model 5100P instrument air supply regulator. Use with positioners. Bracket mounted to actuator casing.</p> | |
| Solenoid Valve: | <p><u>Standard Brass:</u> Available in standard NEMA 3, 4 and 6 weatherproof model, or</p> | |
| | Position Indicating Switches: | |

APPLICATION AND SELECTION

The following procedure will help determine a suitable selection for an application. Consult Cashco area Representative for assistance in sizing.

| | | | |
|---------|--|---------|---|
| STEP 1. | <p><u>FIVE KNOWNNS.</u> The following minimal parameters/information must be available before a selection procedure can begin:</p> <ol style="list-style-type: none"> a. Service Fluid – What is it? Liquid or gas? SG (std. cond.). b. Inlet Pressure – P_1 (upstream pressure). c. Outlet Pressure - P_2 (downstream pressure). d. Desired capacity – Cv, GPM, SCFH; minimum, maximum and normal. e. Fluid temperature – T_1, SG (actual). | STEP 2. | <p><u>CHARACTER and RESERVE.</u> Decide whether the inherent characteristic of the valve should be <u>equal percent</u> or <u>linear</u>. Also, decide the amount of <u>over-capacity</u> in the selection; i.e. =% character with 20% reserve capacity. (NOTE: A linear character gives "constant gain" throughout the full stroke. An equal percent character gives a "low gain" up to near 50% of full signal, a "medium gain" up to about 75% of full signal, and a "high gain" the last 25% of full signal.)</p> |
|---------|--|---------|---|

STEP 3. **CAPACITY.** Using the knowns from Step 1, calculate the maximum and minimum Cv required.

Example: Max Cv Req'd = 7.5 Cv
Min Cv Req'd = 0.8 Cv
=% Character
20% reserve capacity

Max Cv Available
 $7.5 \div 0.80 = 9.4 \text{ Cv}$

Select the body/orifice sizes that are near the 9.4 Cv Available level. Table 7 should be used as the character is =%.

Example: Preliminary selections –

- a. 1" @ 11.8 Cv Max, full port.
- b. 1-1/2" @ 10.4 Cv Max, reduced port.

STEP 4. **RANGEABILITY.** Check the Min Cv Available from Table 7 for the selection of Step 3.

- a. 0.24 Cv @ Min. Cv.
- b. 0.21 Cv @ Min Cv

As the Min Cv Req'd is greater than any of the previous Min Cv Available, all of the selections are acceptable at minimum flow level.

STEP 5. **FAILURE ACTION.** Consider the process related safety conditions to determine if the valve should "fail open" or "fail close" upon:

- a. loss of air supply pressure.
 - b. loss of electric power. *
 - c. loss of both supply air and electric power. *
- * Requires 3-way solenoid valve.

STEP 6. **P vs. T BODY RATINGS.** For the desired body material assure that the actual design inlet temperature/pressure limits established in Table 1 are not exceeded.

STEP 7. **PRESSURE DROP & ACTUATOR SIZE.** Maximum pressure drop (ΔP) is normally experienced at shutoff flow. Knowing the maximum ΔP required, the desired action/failsafe position (ATO-FC or ATC-FO), the seat design (metal or composition soft), and the packing type, go to the correct table of Tables 2 thru 5 to assure the valve's capability.

Example: ΔP shutoff = 320 psid (22.1 Bard). Valve selected – 1-1/2" (DN40) @ 10.4 Cv Max, reduced port, TFE seat, TFE packing, ATO-FC action.

Selection: Use Table 3. Only acceptable actuator is Model 55R-10 with a 5-15 psig (.34-1.03 Barg) bench set range spring.

Note: *If a bench set had been selected such as a 10-30 psig (.69-2.07 Barg), i.e. other than a nominal 3-15 psig (.21-1.03 Barg); a positioner would have been required.)*

STEP 8. **MATERIALS.** Review Table 9. Select the desired trim from Table 6. Consider the use of Option -15, stellite seating surfaces. Consider leakage rate.

Reference materials vs. fluid corrosion tables for suitability of body and trim materials.

STEP 9. **ACCESSORIES.** Consider use of various valve installed accessories:

- a. P/P positioner
- b. I/P positioner
- c. Position limit switches
- d. Manual handwheel
- e. Solenoid valve
- f. Airset

TECHNICAL SPECIFICATIONS

**TABLE 1
MATERIAL PRESSURE / TEMPERATURE RATINGS**

| Body/Bonnet Materials | | Option Nos. | End Connection | English Units | | Metric Units | |
|----------------------------|---------------------------------|---------------|----------------------------------|---------------|----------------|---------------|----------------|
| General | ASTM Spec. | | | Pressure psig | Temperature °F | Pressure Barg | Temperature °C |
| Cast Carbon Steel (CS) | A216, Grade WCB | None | 150# Flanged | 285 | -20 to +100 | 19.6 | -29 to +38 |
| | | | | 260 | 200 | 17.9 | 94 |
| | | | | 230 | 300 | 15.9 | 149 |
| | | | | 200 | 400 | 13.8 | 205 |
| | | | | 185 | 450 | 12.7 | 232 |
| | | | | 155 | 550 | 10.7 | 288 |
| | | | | 125 | 650 | 8.6 | 344 |
| | | 95 | 750 | 6.5 | 400 | | |
| | | -35 (T>450°F) | NPT, SW or 300# Flanged (Note 1) | 740 | -20 to +100 | 51.0 | -29 to +38 |
| | | | | 675 | 200 | 46.5 | 94 |
| | | | | 655 | 300 | 45.2 | 149 |
| | | | | 635 | 400 | 43.8 | 205 |
| | | | | 615 | 450 | 42.4 | 232 |
| | | | | 575 | 550 | 39.6 | 288 |
| 535 | 650 | | | 36.9 | 344 | | |
| 505 | 750 | 34.8 | 400 | | | | |
| Cast Stainless Steel (SST) | A351 Grade CF3M | None | 150# Flanged | 275 | -20 to +100 | 18.9 | -29 to +38 |
| | | | | 235 | 200 | 16.2 | 94 |
| | | | | 215 | 300 | 14.8 | 149 |
| | | | | 195 | 400 | 13.4 | 205 |
| | | | | 180 | 450 | 12.4 | 232 |
| | | | | 155 | 550 | 10.7 | 288 |
| | | | | 125 | 650 | 8.6 | 344 |
| | | 95 | 750 | 6.5 | 400 | | |
| | | -35 (T>450°F) | NPT, SW or 300# Flanged (Note 2) | 720 | -20 to +100 | 49.6 | -29 to +38 |
| | | | | 620 | 200 | 42.7 | 94 |
| | | | | 560 | 300 | 38.6 | 149 |
| | | | | 515 | 400 | 35.5 | 205 |
| | | | | 495 | 450 | 34.1 | 232 |
| | | | | 465 | 550 | 32.1 | 288 |
| 445 | 650 | | | 30.7 | 344 | | |
| 425 | 750 | 29.3 | 400 | | | | |
| Cast Ni-Mo-Cr (H-C) | A494, Gr. CW-12MW (Note 3) | None | 150# Flanged (with CS flanges) | 230 | -20 to +100 | 15.8 | -29 to +38 |
| | | | | 205 | 200 | 14.1 | 94 |
| | | | | 195 | 300 | 13.4 | 149 |
| | | | | 185 | 400 | 12.7 | 205 |
| | | | | 175 | 450 | 12.0 | 232 |
| | | | | 155 | 550 | 10.7 | 288 |
| | | None | 150# Flanged (with SST flanges) | 230 | -20 to +100 | 15.8 | -29 to +38 |
| | | | | 205 | 200 | 14.1 | 94 |
| | | | | 195 | 300 | 13.4 | 149 |
| | | | | 185 | 400 | 12.7 | 205 |
| | | | | 175 | 450 | 12.0 | 232 |
| | | | | 155 | 550 | 10.7 | 288 |
| | | None | 300# Flanged (with CS flanges) | 600 | -20 to +100 | 41.3 | -29 to +38 |
| | | | | 540 | 200 | 37.2 | 94 |
| | | | | 505 | 300 | 34.8 | 149 |
| | | | | 480 | 400 | 33.1 | 205 |
| | | | | 465 | 450 | 32.0 | 232 |
| | | | | 425 | 750 | 29.3 | 400 |
| None | 300# Flanged (with SST flanges) | 600 | -20 to +100 | 41.3 | -29 to +38 | | |
| | | 540 | 200 | 37.2 | 94 | | |
| | | 505 | 300 | 34.8 | 149 | | |
| | | 480 | 400 | 33.1 | 205 | | |
| | | 465 | 450 | 32.0 | 232 | | |
| | | 425 | 750 | 29.3 | 400 | | |

NOTE 1: CS separable flanges with CS bodies. NOTE 2: CS or SST separable flanges with SST or H-C bodies.
NOTE 3: H-C material is now recognized by ASME in Sec. VIII of BPVC. It is not covered by ANSI B16.34.

TABLE 2
MAXIMUM PRESSURE DROP – psid (Bard)
METAL SEATED
PACKING DESIGNS – STD, EXT, KRI, KRE, 38J

| Actuator Action | Body Size Inch (mm) | Port-Orifice | | Maximum Operating Pressure Drop psid (Bard) | Actuator | | Air Supply Pressure psig (Barg) |
|---------------------|-------------------------|----------------|-------------------|--|----------------------------------|--------------|--|
| | | Description | Size inch (mm) | | Bench Settings psig (Barg) | Model No. | |
| ATO-FC (Reverse) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 320 (22) | 5-15 (.34-1.03) | 55R-10 | 20 (1.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | | | | |
| | 6-Step Reduced | | | | | | |
| | 1-1/2" (DN40) | Full | .750" (19.0) | 600 (41) | 10-30 (.69-2.07) | 55R-11 | 35 (2.4) |
| | | Full | 1.250" (31.8) | 65 (4.5) | 5-15 (.34-1.03) | 55R-10 | 20 (1.4) |
| | | Reduced | .750" (19.0) | 320 (22) | | | |
| | | Full | 1.250" (31.8) | 255 (17) | 10-30 (.69-2.07) | 55R-11 | 35 (2.4) |
| | | Reduced | .750" (19.0) | 600 (41) | | | |
| | | Full | 1.250" (31.8) | 175 (12) | 5-15 (.34-1.03) | 75R-10 | 20 (1.4) |
| | 2" (DN50) | Full | 1.688" (42.9) | 75 (5.2) | 10-30 (.69-2.07) | 75R-11 | 35 (2.4) |
| | | Reduced | 1.000" (25.4) | 400 (27) | 5-15 (.34-1.03) | 75R-12 | 20 (1.4) |
| | | Full | 1.688" (42.9) | 315 (21) | | | |
| | | Reduced | 1.000" (25.4) | 240 (16) | 10-30 (.69-2.07) | 75R-13 | 35 (2.4) |
| | | Full | 1.688" (42.9) | 400 (27) | | | |
| Reduced | | 1.000" (25.4) | 150 (10) | 5-15 (.34-1.03) | 115R-10 | 20 (1.4) | |
| ATC-FO (Direct) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 530 (36) | 3-13 (.21-.90) | 55D-10 | 20 (1.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | | | | |
| | 6-Step Reduced | | | | | | |
| | 1-1/2" (DN40) | Full | .750" (19.0) | 600 (41) | 6-26 (.41-1.79) | 55D-11 | 35 (2.4) |
| | | Full | 1.250" (31.8) | 140 (9.6) | 3-13 (.21-.90) | 55D-10 | 20 (1.4) |
| | | Reduced | .750" (19.0) | 530 (36) | | | |
| | | Full | 1.250" (31.8) | 215 (15) | 6-26 (.41-1.79) | 55D-11 | 35 (2.4) |
| | | Reduced | .750" (19.0) | 600 (41) | | | |
| | | Full | 1.250" (31.8) | 300 (20) | 3-13 (.21-.90) | 75D-10 | 20 (1.4) |
| | 2" (DN50) | Full | 1.688" (42.9) | 400 (27) | 6-26 (.41-1.79) | 75D-11 | 35 (2.4) |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | |
| | | Full | 1.688" (42.9) | 140 (9.6) | 3-13 (.21-.90) | 75D-12 | 20 (1.4) |
| | | Reduced | 1.000" (25.4) | 210 (14) | 6-26 (.41-1.79) | 75D-13 | 35 (2.4) |
| | | Full | 1.688" (42.9) | 400 (27) | | | |
| Reduced | | 1.000" (25.4) | 250 (17) | 3-13 (.21-.90) | 115D-10 | 20 (1.4) | |
| 2" (DN50) | Full | 1.688" (42.9) | 400 (27) | 6-26 (.41-1.79) | 115D-11 | 35 (2.4) | |
| | Full | 1.688" (42.9) | 400 (27) | | | | |

NOTE: All above pressure drop values are based on Flow-to-Open (FTO) direction. Consult factory before applying in FTC direction.

TABLE 3
MAXIMUM PRESSURE DROP – psid (Bard)
COMPOSITION SOFT SEAT
PACKING DESIGNS – STD, EXT, KRI, KRE, 38J

| Actuator Action | Body Size Inch (mm) | Port-Orifice | | Maximum Operating Pressure Drop psid (Bard) | Actuator | | Air Supply Pressure psig (Barg) | | | |
|---------------------|-------------------------|----------------|-------------------|---|----------------------------------|--------------|---------------------------------------|------------------|---------|----------|
| | | Description | Size inch (mm) | | Bench Settings psig (Barg) | Model No. | | | | |
| ATO-FC (Reverse) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 400 (27) | 5-15 (.34-1.03) | 55R-10 | 20 (1.4) | | | |
| | | 1-Step Reduced | .562" (14.3) | | | | | | | |
| | | 2-Step Reduced | | | | | | | | |
| | | 3-Step Reduced | .332" (8.4) | | | | | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 110 (7.6) | 5-15 (.34-1.03) | 55R-10 | 20 (1.4) | | | |
| | | Reduced | .750" (19.0) | 400 (27) | | | | | | |
| | | Full | 1.250" (31.8) | 300 (20) | | | | 10-30 (.69-2.07) | 55R-11 | 35 (2.4) |
| | | | | 225 (15) | | | | 5-15 (.34-1.03) | 75R-10 | 20 (1.4) |
| | | | | 400 (27) | | | | 10-30 (.69-2.07) | 75R-11 | 35 (2.4) |
| | 2" (DN50) | Full | 1.688" (42.9) | 110 (7.6) | 5-15 (.34-1.03) | 75R-12 | 20 (1.4) | | | |
| | | Reduced | 1.000" (25.4) | 375 (25) | | | | | | |
| | | Full | 1.688" (42.9) | 275 (19) | | | | 10-30 (.69-2.07) | 75R-13 | 35 (2.4) |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | | | | |
| | | Full | 1.688" (42.9) | 185 (12) | | | | 5-15 (.34-1.03) | 115R-10 | 20 (1.4) |
| | | | | 400 (27) | | | | 10-30 (.69-2.07) | 115R-11 | 35 (2.4) |
| ATC-FO (Direct) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 400 (27) | 3-13 (.21-.90) | 55D-10 | 20 (1.4) | | | |
| | | 1-Step Reduced | .562" (14.3) | | | | | | | |
| | | 2-Step Reduced | | | | | | | | |
| | | 3-Step Reduced | .332" (8.4) | | | | | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 190 (13) | 3-13 (.21-.90) | 55D-10 | 20 (1.4) | | | |
| | | Reduced | .750" (19.0) | 400 (27) | | | | | | |
| | | Full | 1.250" (31.8) | 265 (18) | | | | 6-26 (.41-1.79) | 55D-11 | 35 (2.4) |
| | | | | 350 (24) | | | | 3-13 (.21-.90) | 75D-10 | 20 (1.4) |
| | | | | 400 (27) | | | | 6-26 (.41-1.79) | 75D-11 | 35 (2.4) |
| | 2" (DN50) | Full | 1.688" (42.9) | 175 (12) | 3-13 (.21-.90) | 75D-12 | 20 (1.4) | | | |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | | | | |
| | | Full | 1.688" (42.9) | 240 (16) | | | | 6-26 (.41-1.79) | 75D-13 | 35 (2.4) |
| | | | | 285 (19) | | | | 3-13 (.21-.90) | 115D-10 | 20 (1.4) |
| | | | | 400 (27) | | | | 6-26 (.41-1.79) | 115D-11 | 35 (2.4) |
| | | | | | | | | | | |

NOTE: All above pressure drop values are based on Flow-to-Open (FTO) direction. Consult factory before applying in FTC direction.

**TABLE 4
MAXIMUM PRESSURE DROP – psid (Bard)
METAL OR COMPOSITION SOFT SEATED with OPT-34A/B/C DUAL PACKING**

| Actuator Action | Body Size Inch (mm) | Port-Orifice | | Maximum Operating Pressure Drop psid (Bard) | Actuator | | Air Supply Pressure psig (Barg) |
|------------------|----------------------|----------------|----------------|---|----------------------------|-----------|---------------------------------|
| | | Description | Size inch (mm) | | Bench Settings psig (Barg) | Model No. | |
| ATO-FC (Reverse) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 530 * (36) | 7-30 (.48-2.07) | 55R-11 | 35 (2.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 * (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 * (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | 740 ** (51) | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 100 (6.9) | 7-30 (.48-2.07) | 55R-11 | |
| | | Reduced | .750" (19.0) | 400 (27) | | | |
| | | Full | 1.250" (31.8) | 360 (25) | 8-30 (.55-2.07) | 75R-11 | |
| | 2" (DN50) | Full | 1.688" (42.9) | 175 (12) | 8-30 (.55-2.07) | 75R-13 | |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | |
| | | Full | 1.688" (42.9) | 350 (24) | 9-30 (.62-2.07) | 115R-11 | |
| ATC-FO (Direct) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 425 * (29) | 6-29 (.41-2.00) | 55D-11 | 35 (2.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 * (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 * (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | 740 ** (51) | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 140 (9.6) | 6-29 (.41-2.00) | 55D-11 | |
| | | Reduced | .750" (19.0) | 400 (27) | | | |
| | | Full | 1.250" (31.8) | 300 (20) | 6-28 (.41-1.93) | 75D-11 | |
| | 2" (DN50) | Full | 1.688" (42.9) | 140 (9.6) | 6-28 (.41-1.93) | 75D-13 | |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | |
| | | Full | 1.688" (42.9) | 300 (20) | 6-27 (.41-1.86) | 115D-11 | |

NOTE: All above pressure drop values are based on Flow-to-Open (FTO) direction. Consult factory before applying in FTC direction.

* Maximum pressure drop with composition soft seat is 400 psid (27 Bard); value given is metal seat only.

** Metal seat only.

**TABLE 5
 MAXIMUM PRESSURE DROP – psid (Bard)
 METAL SEAT – HIGH TEMP. PACKING, OPT-HTE**

| Actuator Action | Body Size Inch (mm) | Port-Orifice | | Maximum Operating Pressure Drop psid (Bard) | Actuator | | Air Supply Pressure psig (Barg) |
|---------------------|-------------------------|----------------|-------------------|---|----------------------------------|--------------|---------------------------------------|
| | | Description | Size inch (mm) | | Bench Settings psig (Barg) | Model No. | |
| ATO-FC (Reverse) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 425 (29) | 6-30 (.41-2.07) | 55R-11 | 35 (2.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | | | | |
| | 6-Step Reduced | | | | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 100 (6.9) | 6-30 (.41-2.07) | 55R-11 | |
| | | Reduced | .750" (19.0) | 400 (27) | | | |
| | | Full | 1.250" (31.8) | 300 (20) | 7-30 (.48-2.07) | 75R-11 | |
| | 2" (DN50) | Full | 1.688" (42.9) | 140 (9.6) | 7-30 (.48-2.07) | 75R-13 | |
| | | Reduced | 1.000" (25.4) | 400 (27) | | | |
| Full | | 1.688" (42.9) | 300 (20) | 8-30 (.55-2.07) | 115R-11 | | |
| ATC-FO (Direct) | 3/4" & 1" (DN20, 25) | Full | .750" (19.0) | 320 (22) | 6-30 (.41-2.07) | 55D-11 | 35 (2.4) |
| | | 1-Step Reduced | .562" (14.3) | 600 (41) | | | |
| | | 2-Step Reduced | | | | | |
| | | 3-Step Reduced | .332" (8.4) | 740 (51) | | | |
| | | 4-Step Reduced | .205" (5.2) | | | | |
| | | 5-Step Reduced | .155" (3.9) | | | | |
| | 6-Step Reduced | | | | | | |
| | 1-1/2" (DN40) | Full | 1.250" (31.8) | 65 (4.5) | 6-30 (.41-2.07) | 55D-11 | |
| | | Reduced | .750" (19.0) | 320 (22) | | | |
| | | Full | 1.250" (31.8) | 240 (16) | 6-29 (.41-2.00) | 75D-11 | |
| | | Reduced | .750" (19.0) | 400 (27) | | | |
| | 2" (DN50) | Full | 1.688" (42.9) | 105 (7.2) | 6-29 (.41-2.00) | 75D-13 | |
| | | Reduced | 1.00" (25.4) | 400 (27) | | | |
| | | Full | 1.688" (42.9) | 250 (17) | 6-28 (.41-1.93) | 115D-11 | |

NOTE: All above pressure drop values are based on Flow-to-Open (FTO) direction. Consult factory before applying in FTC direction.

**TABLE 6
TRIM MATERIALS VS. DESIGNATION NOS.**

| Part Description | METAL SEAT – Trim Designation Nos. | | | | | | | | |
|---------------------|------------------------------------|---------------------|---------------------------|------------------------|--------------------------------|-------------|------------|------------|------------|
| | S1S * | S1R * | S40 ** | HC1 | √ S1HT * | S1SE * | S1RE * | S40E ** | HC1E |
| Plug/Stem Assy. | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Seat Ring | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Cage | CF3M | CF3M | CF3M | CW-12MW | CF3M | CF3M | CF3M | CF3M | CW-12MW |
| Upper Stem Guide | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape | Carbon | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape |
| Lower Guide | | 316L SST | 316L SST | Hast C-22 | | | 316L SST | 316L SST | Hast C-22 |
| Bushing | Stellite #6 | Rulon | Rulon | Rulon | Stellite #6 | Stellite #6 | Rulon | Rulon | Rulon |
| Packing Load Spring | Cold Worked 316 SST | Cold Worked 316 SST | Cold Worked Inconel X-750 | Cold Worked Hast C-276 | None | None | None | None | None |
| Packing Follower | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Wiper Ring | *** | *** | *** | *** | None | None | None | None | None |
| Spacer | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Packing Design | Internal Live-Loaded | | | | External Live-Loaded or jammed | | | | |

| Part Description | COMPOSITION / SOFT SEAT – Trim Designation Nos. | | | | | | | |
|---------------------|---|---------------------|---------------------------|------------------------|--------------------------------|------------|------------|------------|
| | S3S | S3R | S40T ** | HC3 | S3SE | S3RE | S40TE ** | HC3E |
| Plug/Stem Assy. | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Seat Ring | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Cage | CF3M | CF3M | CF3M | CW-12MW | CF3M | CF3M | CF3M | CW-12MW |
| Upper Stem Guide | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape | Rulon Tape |
| Lower Guide | | 316L SST | 316L SST | Hast C-22 | | 316L SST | 316L SST | Hast C-22 |
| Bushing | Stellite #6 | Rulon | Rulon | Rulon | Stellite #6 | Rulon | Rulon | Rulon |
| Packing Load Spring | Cold Worked 316 SST | Cold Worked 316 SST | Cold Worked Inconel X-750 | Cold Worked Hast C-276 | None | None | None | None |
| Packing Follower | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Wiper Ring | *** | *** | *** | *** | None | None | None | None |
| Spacer | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Seat Retainer | 316L SST | 316L SST | 316L SST | Hast C-22 | 316L SST | 316L SST | 316L SST | Hast C-22 |
| Seat Insert | TFE | TFE | TFE | TFE | TFE | TFE | TFE | TFE |
| Packing Design | Internal Live-Loaded | | | | External Live-Loaded or Jammed | | | |

√ Only trim recommended for temperatures greater than 450°F (232°C), and up to 750°F (400°C).

* Use these trim designation numbers for Option -15 Stellite Seating surfaces.

** Use these trims when application is required for NACE service.

*** Polyurethane / Molybdenum

| Material | Material Specifications |
|----------------|--|
| 316L SST | ASTM A479, S31603; Wrought Barstock, Annealed |
| CF3M | ASTM A351, Gr. CF3M; Cast 316L SST |
| Hastelloy C-22 | ASTM B574, Alloy N06022; Wrought Barstock, Annealed |
| CW-12MW | ASTM A494, Gr. CW-12MW; Cast Ni-Mo-Cr, similar to "Hastelloy C". |

TABLE 7
FLOW CAPACITY – Cv
EQUAL PERCENT (=%) CHARACTER
Cv @ 10% TRAVEL INCREMENTS
FL @ 10%; FL @ 100%
METAL or COMPOSITION SOFT SEAT

| Body Size inch/(mm) | Port Size | FL @ 10% Travel | Minimum Flow | Percent of Travel - % | | | | | | | | | | FL @ 100% Travel |
|--------------------------|----------------|-----------------------|-----------------|-----------------------|-----|-----|-----|------|------|------|------|------|-------------|------------------------|
| | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | |
| 3/4" (DN20) | Full | .90 | .24 | .4 | .7 | 1.2 | 1.9 | 2.6 | 3.6 | 5.3 | 7.6 | 9.6 | 10.7 | .90 |
| | 1-Step Reduced | .90 | .14 | .3 | .6 | .9 | 1.2 | 1.6 | 2.2 | 3.0 | 4.1 | 5.5 | 6.7 | |
| 3/4" & 1" (DN20 & 25) | 2-Step Reduced | .90 | .12 | .2 | .4 | .6 | .8 | 1.0 | 1.3 | 1.7 | 2.3 | 3.0 | 4.1 | .90 |
| | 3-Step Reduced | .90 | .10 | .14 | .2 | .3 | .4 | .5 | .7 | .9 | 1.3 | 1.8 | 2.5 | |
| 1" (DN25) | Full | .90 | .24 | .4 | .7 | 1.2 | 1.9 | 2.6 | 3.6 | 5.3 | 7.6 | 10.2 | 11.8 | .90 |
| | 1-Step Reduced | .90 | .14 | .3 | .6 | .9 | 1.2 | 1.6 | 2.2 | 3.1 | 4.3 | 5.7 | 7.0 | |
| 1-1/2" (DN40) | Full | .90 | .52 | 1.2 | 2.3 | 3.4 | 4.5 | 6.3 | 8.8 | 13.7 | 18.5 | 22.8 | 26 | .90 |
| | Reduced | .90 | .21 | .6 | .9 | 1.3 | 1.9 | 2.5 | 3.4 | 4.7 | 6.2 | 8.2 | 10.4 | |
| 2" (DN50) | Full | .90 | .94 | 2.8 | 4.9 | 7.1 | 9.7 | 12.9 | 17.1 | 24 | 32 | 41 | 47 | .90 |
| | Reduced | .90 | .36 | 1.0 | 1.8 | 2.6 | 3.4 | 4.8 | 6.3 | 8.2 | 10.8 | 14.4 | 18.2 | |

TABLE 8
FLOW CAPACITY – Cv
LINEAR (Lin) CHARACTER
Cv @ 10% TRAVEL INCREMENTS
FL @ 10%; FL @ 100%
METAL or COMPOSITION SOFT SEAT

| Body Size inch/(mm) | Port Size | FL @ 10% Travel | Minimum Flow | Percent of Travel - % | | | | | | | | | | FL @ 100% Travel |
|-------------------------|----------------|-----------------------|-----------------|-----------------------|------|------|------|------|------|------|------|------|--------------|------------------------|
| | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | |
| 3/4" (DN20) | Full | .90 | .25 | 1.2 | 2.5 | 3.9 | 5.2 | 6.4 | 7.5 | 8.7 | 9.7 | 10.7 | 11.6 | .90 |
| | 1-Step reduced | .90 | .15 | .8 | 1.5 | 2.2 | 3.0 | 3.7 | 4.5 | 5.2 | 5.9 | 6.5 | 7.1 | |
| 3/4" & 1" (DN20, 25) | 2-Step Reduced | .90 | .14 | .4 | .8 | 1.2 | 1.7 | 2.1 | 2.5 | 3.0 | 3.4 | 3.8 | 4.3 | .90 |
| | 3-Step Reduced | .90 | .08 | .3 | .6 | .8 | 1.1 | 1.4 | 1.7 | 2.0 | 2.3 | 2.5 | 2.6 | |
| | 4-Step Reduced | .90 | .03 | .1 | .2 | .3 | .4 | .5 | .7 | .8 | .9 | 1.0 | 1.1 * | |
| | 5-Step Reduced | .90 | .02 | .06 | .12 | .18 | .24 | .29 | .35 | .41 | .46 | .52 | .58 * | |
| 1" (DN25) | 6-Step Reduced | .90 | .01 | .03 | .06 | .08 | .11 | .14 | .16 | .19 | .22 | .24 | .27 * | .90 |
| | Full | .90 | .25 | 1.2 | 2.5 | 3.9 | 5.2 | 6.5 | 7.8 | 9.2 | 10.5 | 11.7 | 12.7 | |
| 1-1/2" (DN40) | 1-Step Reduced | .90 | .15 | .8 | 1.5 | 2.2 | 3.1 | 3.8 | 4.6 | 5.4 | 6.2 | 6.9 | 7.5 | .90 |
| | Full | .90 | .54 | 2.6 | 5.0 | 7.4 | 10.0 | 12.6 | 15.2 | 18.2 | 21 | 24 | 27 | |
| 2" (DN50) | Reduced | .90 | .22 | .9 | 1.8 | 2.7 | 3.7 | 4.6 | 5.7 | 6.8 | 8.0 | 9.4 | 10.8 | .90 |
| | Full | .90 | 1.0 | 4.2 | 10.0 | 15.3 | 19.8 | 23 | 27 | 35 | 41 | 46 | 50 | |
| 2" (DN50) | Reduced | .90 | .39 | 1.9 | 4.0 | 6.1 | 8.0 | 10.0 | 12.0 | 13.9 | 15.8 | 17.9 | 19.4 | .90 |
| | Full | .90 | .94 | 2.8 | 4.9 | 7.1 | 9.7 | 12.9 | 17.1 | 24 | 32 | 41 | 47 | |

* Metal Seat ONLY

**TABLE 9
APPLICATION RECOMMENDATIONS**

| Fluid | | Temperature Range | | | Options | Trim Designation Nos. |
|-------------------|--|----------------------|--------------------------------|--------------------------------|--|--|
| | | T<250°F (T<121°C) | 250°<T<450°F (121°<T<232°C) | 450°<T<750°F (232°<T<400°C) | | |
| GASES | Inert Industrial (N ₂ , He, Ar) | √ | √ | — | None, -EXT | S3S, S3R, S3SE, S3RE, S1S, S1R, S1SE, S1RE |
| | | — | — | √ | -35, HTE | S1HT |
| | Oxygen | √ | √ | CF | -55, -EXT | S3S, S3R, S3SE, S3RE, S1S, S1R, S1SE, S1RE |
| | | √ | √ | — | None, -EXT | All |
| | Hydrocarbons - Clean | — | — | √ | -15, -35, -HTE | S1HT |
| | | √ | √ | — | -15, -34 | S1S, S1R, S1SE, S1RE |
| | Hydrocarbons - Dirty | — | — | √ | -15, -35, -HTE | S1HT |
| √ | | √ | CF | -34, -EXT, -KRI, -KRE | S3R, S40T, HC3, S3RE, S40TE, HC3E, S1R, S40, HC1, S1RE, HC1E | |
| Corrosive - Dirty | √ | √ | CF | -15, -34, -EXT -KRI, -KRE | S1S, S1R, S40, S1SE, S1RE, S40, S40E, HC1, HC1E | |
| Cryogenic | — | — | — | — | N/R | |
| LIQUIDS | Clean, Non-Cavitating, Non-Flashing | √ | √ | — | None, -EXT | S3S, S3R, S3SE, S3RE, S1S, S1R, S1SE, S1RE |
| | | — | — | √ | -15, -35, -HTE | S1HT |
| | Clean, Cavitating, Flashing | N/R | N/R | N/R | — | Recommend Applying Ranger QCT |
| | NACE (H ₂ S + HC's) | √ | √ | CF | -40, -KRI, -KRE, -EXT | S40, S40E, S40T, S40TE |
| | Corrosive | √ | √ | CF | -34, -EXT, -KRI, -KRE | S3R, S40T, HC3, S3RE, S40TE, HC3E, S1R, S40, HC1, S1RE, HC1E |
| Abrasive | N/R | N/R | N/R | — | Recommend Applying Ranger QCT | |
| STEAM | P1 < 150 psig (10.3 Barg) | Saturated | | | None, -EXT | S1S, S1R, S1SE, S1RE, S3S, S3R, S3SE, S3RE |
| | 150 psig < P1 < 400 psig (10.3 Barg < P1 < 27.6 Barg) | Saturated | | | -15 | S1S, S1R, S1SE, S1RE |
| | Superheated | √ | √ | — | -15, -EXT | S1S, S1HT, S1SE |
| | | — | — | √ | -15, -35, -HTE | S1HT |

CF = Consult Factory
N/R = Not Recommended

DIMENSIONS & WEIGHTS
ENGLISH UNITS – Inch & Lbs.

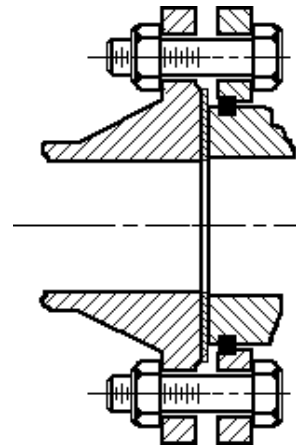
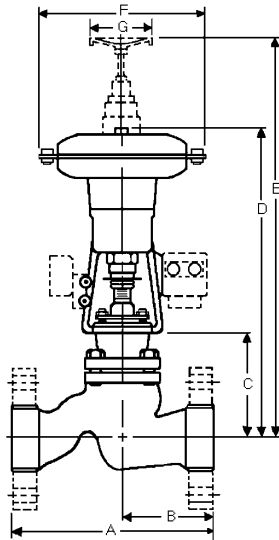
| End Conn. | Dimensions | Body Size | | | | | | | | | |
|-----------|-------------------|--------------------------|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| | | 3/4" and 1" | | 1-1/2" | | | | 2" | | | |
| | | Basic Actuator Model No. | | | | | | | | | |
| | | 55D | 55R | 55D | 55R | 75D | 75R | 75D | 75R | 115D | 115R |
| NPT or SW | A | 8.25 | | 9.25 | | | | 11.25 | | | |
| | B | 3.68 | | 4.00 | | | | 5.00 | | | |
| FLGD | A * | 8.50 | | 9.50 | | | | 11.50 | | | |
| | B | 3.81 | | 4.13 | | | | 5.12 | | | |
| ALL | C | 5.03 | | 5.40 | | | | 6.16 | | | |
| | D | 18.63 | 20.82 | 19.00 | 21.19 | 23.40 | 26.37 | 24.16 | 27.13 | 25.22 | 27.94 |
| | E | 25.76 | 30.13 | 26.13 | 30.50 | 31.34 | 35.59 | 32.10 | 36.75 | 32.40 | 35.12 |
| | F | 10.50 | | 10.50 | | 13.81 | | 13.81 | | 15.50 | |
| | G | 4.00 | | 4.00 | | 8.00 | | 8.00 | | | |
| NPT or SW | SHIP WT. - LBS ** | 46 | 52 | 52 | 58 | 72 | 82 | 89 | 99 | 118 | 152 |
| FLGD. | | 52 | 58 | 64 | 70 | 84 | 94 | 103 | 113 | 132 | 166 |

METRIC UNITS – mm & kg

| End Conn. | Dimensions | Body Size | | | | | | | | | |
|-----------|------------------|--------------------------|-----|------|-----|-----|-----|------|-----|------|------|
| | | DN20 and DN25 | | DN40 | | | | DN50 | | | |
| | | Basic Actuator Model No. | | | | | | | | | |
| | | 55D | 55R | 55D | 55R | 75D | 75R | 75D | 75R | 115D | 115R |
| NPT or SW | A | 210 | | 235 | | | | 286 | | | |
| | B | 94 | | 102 | | | | 127 | | | |
| FLGD | A * | 216 | | 241 | | | | 292 | | | |
| | B | 97 | | 105 | | | | 130 | | | |
| ALL | C | 128 | | 137 | | | | 156 | | | |
| | D | 473 | 529 | 482 | 538 | 594 | 670 | 613 | 689 | 640 | 709 |
| | E | 655 | 766 | 664 | 775 | 796 | 904 | 815 | 933 | 822 | 892 |
| | F | 267 | | 267 | | 351 | | 351 | | 394 | |
| | G | 102 | | 102 | | 203 | | 203 | | | |
| NPT or SW | SHIP WT. - Kg ** | 21 | 24 | 24 | 26 | 33 | 37 | 40 | 45 | 54 | 69 |
| FLGD. | | 24 | 26 | 29 | 32 | 38 | 43 | 47 | 51 | 60 | 75 |

* Face-to-face dimensions per ISA S75.20-1989.

** Basic valve with actuator, no accessories or manual handwheel operator. Add for: positioner @ 4# (1.8 kg); limit switch @ 3# (1.4 kg); manual handwheel operator @ 8# (3.6 kg).



988 body with flange bolt holes drilled to mate to DIN flange

FIGURE 9
DIN Flange

NOTES

NOTES

