

# Fisher® Dirty Service Anti-Cavitation Trim (DST)

Fisher Dirty Service Trim (DST) (figure 1) is a patented multi-stage, anti-cavitation control valve trim for use in services where the fluid may have entrained particulate that could plug the passages, or cause erosion damage to conventional anti-cavitation trims. DST is frequently used in high pressure drop applications up to 4200 psid in the chemical, refining, oil and gas production, and power industries.

## Features

- **Cavitation Control**—2-, 3-, 4-, 5-, or 6-stage DST used in a valve properly selected for flow conditions can eliminate cavitation and associated damage and noise.
- **Versatility**—Available in globe and angle valves, flow down (figure 3) or flow up (figure 4), from NPS 1 to 16 having weld-end or flanged-end connections. Can be used in easy-e®, EH, EHA, EW, HP, and HPA valves.
- **Long Trim Life**—This patented trim concept uses a combined axial and radial flow that features large, open flow paths and decreased clearance flow erosion.
- **Flexibility**—In many cases DST can be retrofitted to replace Cav III trims that are currently in service. DST can pass 1/4 to 3/4 inch particles without plugging.
- **Easy Maintenance**—In-line trim removal allows inspection of parts without taking the valve body out of the pipeline.
- **Trim Materials**—Typical trim materials include 17-4PH SST cages, 440C SST valve plug and seat, 316/ENC/alloy 6 cages with 316/alloy 6 valve plug and seat, or S32550/ENC/alloy 6 cages with S32550/alloy 6 valve plug and seat. Other materials are available to satisfy application requirements.



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Figure 1. Fisher Dirty Service Trim

- **Sour Service Capability**—Materials are available for applications handling sour fluids. Please contact your local Emerson Process Management sales office for additional information.
- **Shutoff**—DST also features a protected seat design where the shutoff function of the valve is separate from the throttling areas of the trim.



# Dirty Service Trim

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## Principle of Operation

DST provides cavitation control for applications with entrained particulate that could potentially plug the inlet passages or cause severe erosion damage to conventional anti-cavitation trim. The DST design uses a combined axial and radial flow path that features large openings allowing particulate up to 3/4 inches in diameter to pass through the valve.

Due to the need for tight shutoff, the multi-stage design incorporates a protected seating surface that separates the shutoff and the throttling locations. All significant pressure drops are taken downstream of the seating surface. As a result, the seating surfaces are not worn away by throttling control action, (valve must always be throttled above the min  $C_v$ ) resulting in extended shutoff capabilities.

In conventional staged-trim designs, cavitation usually does not exist until the final stage. Figure 2 illustrates why this happens. As shown, the greater the pressure drop through the final stage, the lower the vena contracta pressure ( $P_{vc}$ ). If  $P_{vc}$  is less than or equal to  $P_v$ , and  $P_2$  is greater than  $P_v$ , then cavitation will result.

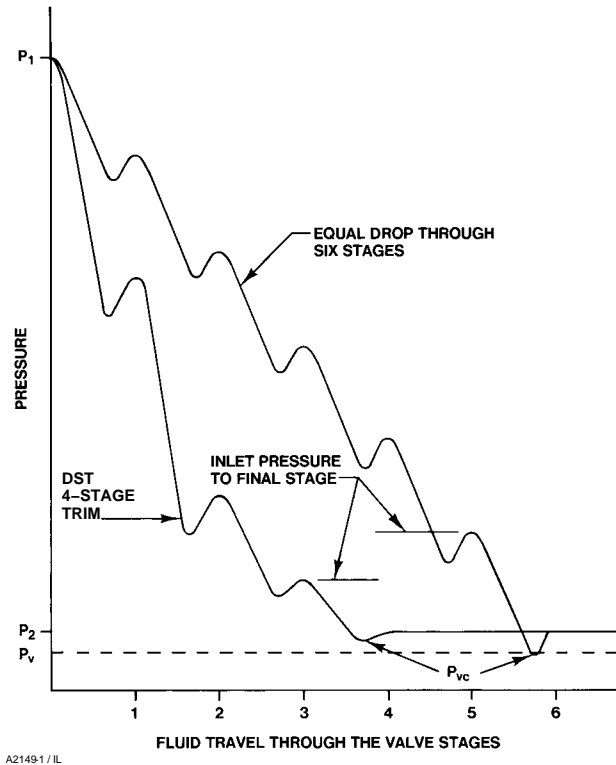


Figure 2. Staged Pressure Drop Patterns

The DST valve avoids this by means of its unique expanding flow area design. Each of the stages has a successively larger flow area. The result is a very efficient operation because more than 90 percent of the overall pressure drop is taken in the stages prior to the final stage where there is little danger of bubble formation. Consequently, a relatively low inlet pressure to the final stage is achieved. Figure 2 also compares the pressure drop pattern through the four stages in the expanding area DST design with a pattern representing a six-stage trim design with each stage taking an equal portion of the total pressure drop. As can be seen, the inlet pressure to the last stage of DST trim is always less than the inlet pressure to the sixth stage of an equal-drop cage. Therefore the  $P_{vc}$  of the DST cage remains higher than the  $P_{vc}$  of an equal-drop cage. If the pressure drops were all equivalent to that of the last stage in DST trim, 11 stages would be required in the equal-drop trim.

## Availability

DST trim is available in numerous body designs and pressure classes. Table 1 shows the pressure drop limits for each design relative to the number of stages used.

Table 2 shows the different valve constructions that DST can be used in. It also shows typical min and max  $C_v$  values each valve can achieve. Any deviation from the sizes listed in table 2, or temperatures in table 3, will result in different  $C_v$  limitations. Please contact your Emerson Process Management sales office for any requests that do not fall within these ranges.

## Trim Selection Guidelines

The standard trim materials are listed below, and in table 3. Other materials such as superaustenitic SST, 347 SST, Solid Alloy 6, N08800, and tungsten carbide trim are available upon request. Contact your Emerson Process Management sales office for more information.

- **Trim A:** Trim A is the typical trim used with carbon steel and alloy steel valve bodies. It can generally be used in severe service applications up to 316°C (600°F). Higher temperature can be achieved with alternate trim parts. Contact your Emerson Process Management sales office for higher temperature requirements. Typical

applications for Trim A include boiler feedwater, water, non-sour hydrocarbons, and other non-sour liquids.

- **Trim B:** Trim B is the typical trim used with stainless steel valve bodies. It can generally be used in severe service applications up to 316°C (600°F). Higher temperatures can be achieved with alternate trim parts. Contact your Emerson Process Management sales office for higher temperature requirements. Typical applications for Trim B include produced water, water, sour hydrocarbons, and other sour liquids. Not for use with boiler feedwater.

- **Trim C:** Trim C can commonly be seen in carbon steel and Duplex SST valve bodies. This trim is most commonly used in sea water applications, produced water, and other offshore crude oil applications.

Please contact your Emerson Process Management sales office for more information on DST trim.

## Characteristics

The DST trim is designed to have a linear flow characteristic. It is also designed to have no significant flow for the first 10-15% travel. Special characterizations may be possible, including special low minimum  $C_v$  designs. Please contact your Emerson Process Management sales office for assistance.

Table 1. Allowable Pressure Drop Limits

PRESSURE DROP LIMITS				
Number of Stages	Flowing Pressure Drop Limit (bar)	Flowing Pressure Drop Limit (psi)	FI	Kc
2	52	750	0.95	1.0
3	103	1500	0.97	1.0
4	207	3000	0.99	1.0
5	241	3500	0.99	1.0
6	289	4200	0.99	1.0

## Valve Sizing Guidelines

Sizing procedures from Catalog 12 or Fisher Specification Manager can be used to size DST control valves. Noise calculations are best performed by using Fisher Specification Manager. The multi-stage configuration of the DST design reduces valve trim noise significantly. Select CAV III 2-Stage as the valve type in Fisher Specification Manager to perform the noise prediction calculation.

## Ordering Information

When ordering, specify:

### Application Information

1. Process Liquid: State particle size and type of entrained impurities, if any.
2. Specific gravity of liquid
3. Temperature and vapor pressure of liquid
4. Critical pressure
5. Range of flowing inlet pressures
6. Pressure drops
  - a. Range of flowing pressure drops
  - b. Maximum at shutoff
7. Flow rates
  - a. Minimum controlled flow
  - b. Normal flow
  - c. Maximum flow
8. Required Cv
9. Line size and schedule

Table 2. Fisher DST Flow Down Availability<sup>(4)</sup>

VALVE DESIGN	PRESSURE RATING	VALVE SIZE	PORT SIZE	TRAVEL	UNBALANCED AREA	MINIMUM AND MAXIMUM CAPACITIES <sup>(3)</sup>							
						2-Stage		3-Stage		4-Stage		6-Stage	
						Min	Max	Min	Max	Min	Max	Min	Max
easy-e Globe	CL600	1 <sup>(5)</sup>	0.875	0.63	0.610	(1)		0.15	4.4	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		1.5 <sup>(5)</sup>	1.125	0.75	0.800	(1)		0.22	8.9	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		2	1.75	0.75	0.029	0.3	23.1	0.22	18.5	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		2.5	2.188	0.75	0.061	0.5	30.5	0.4	23.4	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		3	2.50	0.75	0.041	0.8	46	0.8	36	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		4	3.438	1.25	0.118	1.7	81	1.5	64	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		6	4.375	1.50	0.154	2.8	174	2.8	128	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		8	5.375	2.00	0.206	5.5	253	5	185	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
easy-e Angle	CL600	2 <sup>(5)</sup>	1.125	0.75	0.800	(1)		0.22	8.9	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		3	2.188	0.75	0.061	0.5	30.5	0.4	23.4	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		4	2.50	0.75	0.041	0.8	46	0.8	36	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		6	3.438	1.25	0.118	1.7	81	1.5	64	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
EH	CL1500	2	1.50	0.75	0.051	NA <sup>(2)</sup>		(1)		0.3	7.5	(1)	
		3	1.875	1.00	0.031	NA <sup>(2)</sup>		(1)		0.58	23	(1)	
		4	2.875	1.50	0.047	NA <sup>(2)</sup>		1.4	54	1	44	(1)	
		6	3.625	1.75	0.118	NA <sup>(2)</sup>		1.2	106	1	88.5	(1)	
		8	5.375	1.50	0.142	NA <sup>(2)</sup>		4	147	3	115	(1)	
		10	5.375	1.50	0.142	NA <sup>(2)</sup>		4	147	3	115	(1)	
		12	8.00	2.00	0.350	NA <sup>(2)</sup>		(1)		10	298	(1)	
	14	8.00	2.00	0.350	NA <sup>(2)</sup>		(1)		10	298	(1)		
	CL2500	3 <sup>(5)</sup>	1.50	0.75	0.780	NA <sup>(2)</sup>		NA <sup>(2)</sup>		(1)		0.4	9.4
		4 <sup>(5)</sup>	1.875	0.75	1.534	NA <sup>(2)</sup>		NA <sup>(2)</sup>		0.5	16	0.5	13.7
EHA	CL1500	4	1.875	1.00	0.031	NA <sup>(2)</sup>		(1)		0.45	19.2	(1)	
		6	2.875	1.50	0.047	NA <sup>(2)</sup>		1.4	54	1	44	(1)	
		8	3.625	1.75	0.118	NA <sup>(2)</sup>		1.2	105	1	88.5	(1)	
	CL2500	4 <sup>(6)</sup>	3.625	1.75	0.118	NA <sup>(2)</sup>		NA <sup>(2)</sup>		1	86	(1)	
		6 <sup>(6)</sup>	2.875	1.50	0.047	NA <sup>(2)</sup>		NA <sup>(2)</sup>		1	46	1	28
EU	CL600	12	8.00	1.50	0.350	10	382	10	292	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		16	11.00	4.00	0.490	(1)		10	617	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
EW	CL600	4X2	1.75	0.75	0.029	(1)		0.22	18.5	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		6X4	3.438	1.25	0.118	1.7	81	1.5	64	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		8X6	4.375	1.75	0.154	2.8	187	2.8	150	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
		12X8	5.375	2.00	0.142	5.5	253	5	185	NA <sup>(2)</sup>		NA <sup>(2)</sup>	
HP & HPA	CL1500	1 <sup>(5)</sup>	0.875	0.63	0.589	NA <sup>(2)</sup>		(1)		0.09	3.2	(1)	
		2 <sup>(5)</sup>	1.25	0.75	0.785	NA <sup>(2)</sup>		0.2	8.3	0.28	7.1	(1)	
		3	1.875	1.00	0.031	NA <sup>(2)</sup>		0.65	24.8	0.45	19.4	(1)	
		4	2.875	1.00	0.047	NA <sup>(2)</sup>		1	39.5	1	34.6	(1)	
		6	3.625	1.50	0.118	NA <sup>(2)</sup>		1.2	89.3	1	71	(1)	
	CL2500	1 <sup>(5)</sup>	0.875	0.63	0.589	NA <sup>(2)</sup>		NA <sup>(2)</sup>		(1)		(1)	
		2 <sup>(5)</sup>	1.00	0.75	0.785	NA <sup>(2)</sup>		NA <sup>(2)</sup>		(1)		0.3	4.3

1. Consult your Emerson Process Management sales office.  
 2. Construction not available.  
 3. 5-stage DST is available upon request.  
 4. For flow up constructions consult your Emerson Process Management sales office.  
 5. Unbalanced constructions.  
 6. These valves are from block forged angle valve bodies. Cast valve bodies are available and may change these values.

# Dirty Service Trim

Table 3. Trim Combinations for Fisher DST<sup>(1)</sup>

TRIM DESIGNATION	VALVE BODY MATERIAL	VALVE PLUG	CAGE	SEAT RING	MAXIMUM TEMPERATURE LIMIT	
					°C	°F
A	WCC	440C	17-4PH	17-4PH or 440C	316	600
B	WCC	316/CoCr-A	316/CoCr-A/ENC	316/CoCr-A/ENC	204	400
	SST				316	600
C	WCC	S32550/CoCr-A	S32550/CoCr-A/ENC	S32550/CoCr-A/ENC	316	600
	SST				204	400

1. Contact your Emerson Process Management sales office for higher temperature capabilities.

Table 4. Typical Applications

<b>POWER/COGENERATION</b>	Boiler feed pump recirculation
	Desuperheater spray water control
	Feedwater start-up regulators
	Condensate pump recirculation
	Superheater bypass
<b>OIL AND GAS PRODUCTION</b>	Water injection pump recirculation
	Produced/waste water injection well control
	Separator letdown
	Chemical injection pump bypass
<b>NATURAL GAS PROCESSING</b>	Contactora (rich amine) letdown
	Rich and lean amine pump spillback
<b>REFINING</b>	Contactora letdown
	Rich and lean amine pump spillback
	Pump spillback/recirculation
	Various high pressure and low pressure separator letdown

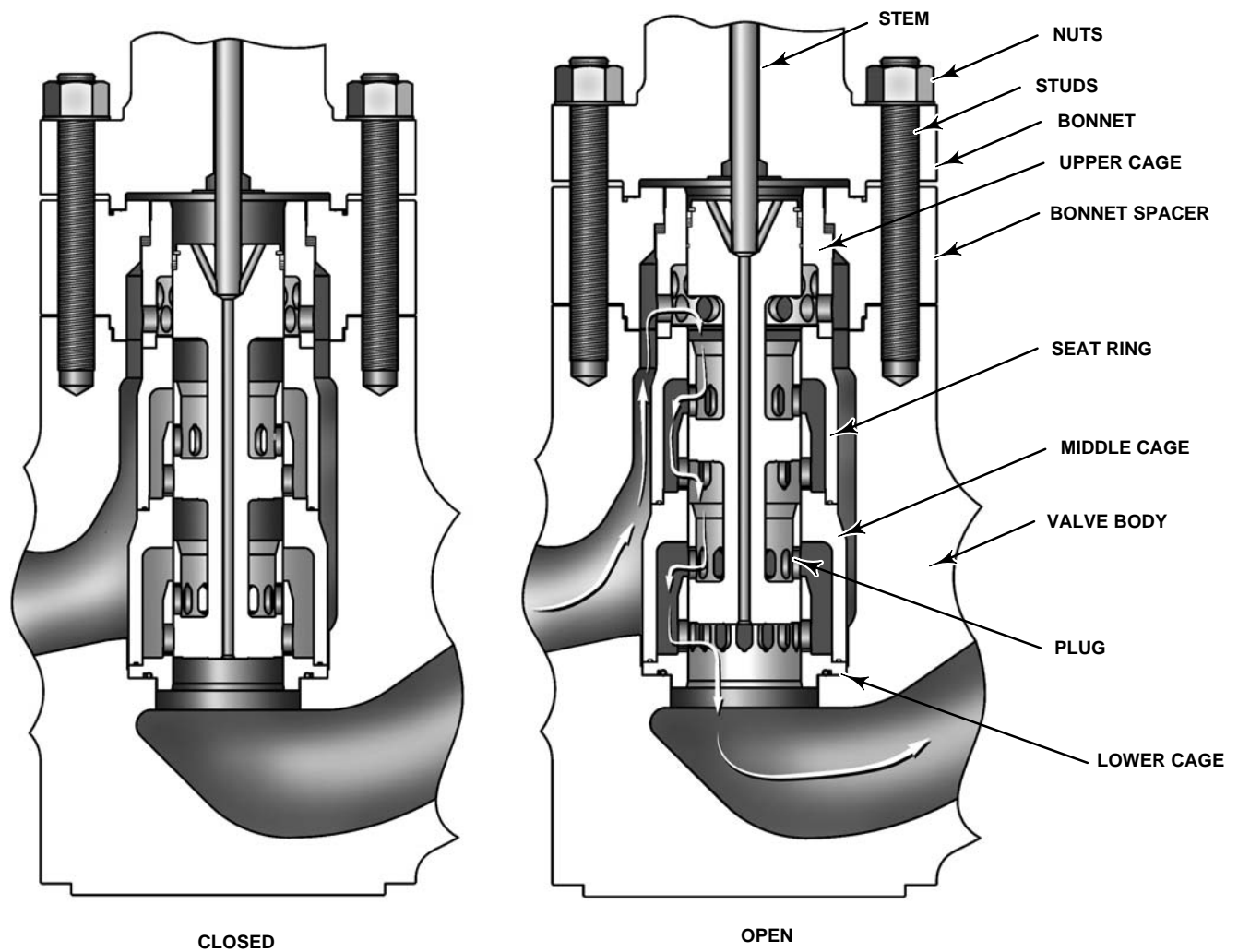


Figure 3. 4-Stage Fisher DST Flow Down Trim

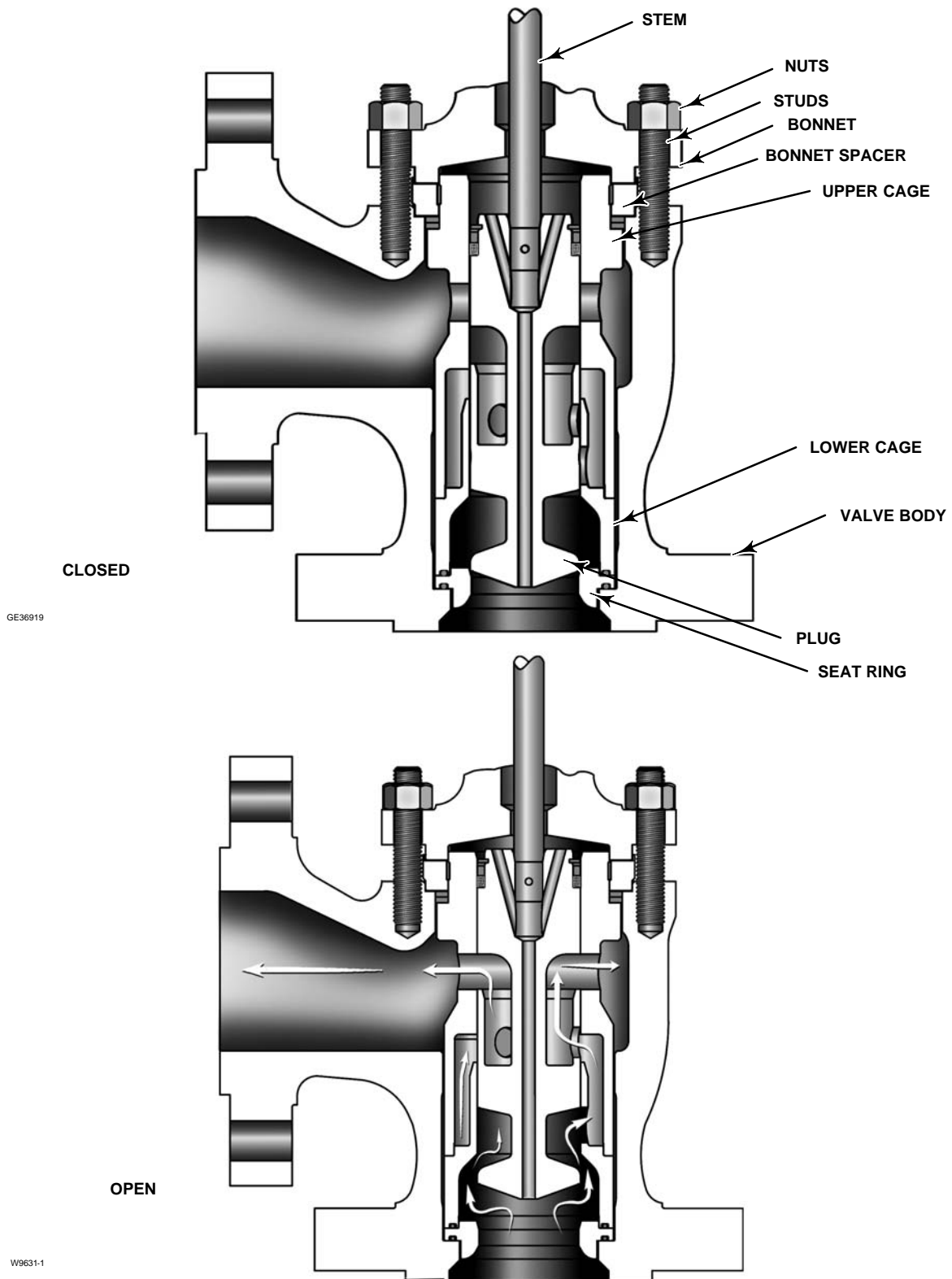


Figure 4. 3-Stage Fisher DST Flow Up Trim

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## Specifications

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### Available Valves

easy-e, EH, EHA, EU, EW, HP, and HPA.  
See table 2

### End Connection Styles

Refer to appropriate valve bulletin

### Valve Body Dimensions and Weights

Valve type, pressure class, and number of stages will result in changes to these values. Please consult your Emerson Process Management sales office for more information on finished dimensions and weights

### Shutoff Classifications

Class V per ANSI/FCS 70-2 and IEC 60534-4

### Maximum Inlet Pressures and Temperatures<sup>(1)</sup>

Consistent with applicable CL600, CL900, CL1500, and CL2500 pressure/temperature ratings according to ASME B16.34 ratings unless limited by individual temperature and pressure limits shown in tables 1 and 3

### Maximum Pressure Drop<sup>(1)</sup>

See table 1

### Construction Materials

**Trim Parts:** 17-4PH SST cages, 440C SST valve plug and seat or 316/ENC/alloy 6 cages with 316/Alloy 6 valve plug and seat. S32550/ENC/alloy 6 cages, S32550/alloy 6 valve plug and seat. Trim can be made from several other bar stock alloys. Consult your Emerson Process Management sales office for your specific application

### Temperature Capabilities

**Valve Body/Trim Combinations:** See table 3  
**All Other Parts:** Consult your Emerson Process Management sales office

### Flow Coefficients

See table 2

### Flow Characteristic

Linear

### Flow Direction

Flow down (typical) or Flow up (available)

### Valve Cavitation Coefficient

$K_C = 1.0$  for all valves when trim is used within applicable pressure drop limits.

### Maximum Valve Plug Travel

Typical plug travels are 0.75 inch through 2 inch. Contact your Emerson Process Management sales office for your specific application

### Minimum Seating Force

Use Class V seat load requirements

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

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