# Fisher<sup>™</sup> TBX Steam Conditioning Valve

The Fisher TBX Steam Conditioning Valve is designed to handle the most severe applications in today's cycling power plants as well as provide precise pressure and temperature control for process applications. The TBX incorporates over 30 years of steam conditioning experience and product development. The valve body is designed with the latest finite element analysis (FEA) and computational fluid dynamics (CFD) tools to optimize performance and reliability for demanding steam systems.

The TBX valve design provides the ultimate combination of performance and maintainability (see figure 2). The TBX valve incorporates low noise Whisper Trim™ technology. The simplified trim configuration is thermally compensated to handle rapid changes in temperatures, as expected during a turbine trip, without any sticking or binding.

Water atomization and vaporization are key elements in any steam conditioning application. The TBX design incorporates a spraywater manifold of variable geometry AF nozzles that produce an optimized spray pattern over a wide operating range. These nozzles are strategically placed to achieve optimal mixing and quick vaporization at all flowing conditions (see figure 2). Years of research in spray atomization and vaporization were key to optimizing the water injection system. Extensive use of CFD analysis, in addition to field performance feedback, was used to validate spray system enhancements.



W8740-2A

## Whisper Trim and WhisperFlo Cages

To help attenuate aerodynamic noise, Whisper Trim III cages are standard with TBX control valves.

WhisperFlo™ cages (figure 1) are also available to attenuate aerodynamic noise. Contact your <u>Emerson</u> <u>sales office</u> or Local Business Partner for more information.





## Features

- Total Steam Control-- Combines pressure and temperature control in a single valve.
- Full Pressure Drop Capability-- Rugged cage-guided design enables handling of full pressure drop of main steam.
- Noise Attenuation-- Whisper III and WhisperFlo trims help to attenuate the noise by 30 to 40 dBA.
- High Temperature Capability with Available Class V Shutoff-- Use of the Fisher Bore Seal trim gives capability of standard Class V shutoff up to 593°C (1100°F). This unique balanced trim is field-proven. See figure 4.
- Forged Valve Body-- FEA designed valve body can handle the most demanding applications without thermal stress problems.
- Flow Up Angle-- Permits vertical stem orientation for ease of maintenance in most applications.
- Flow Down Angle-- Permits vertical stem orientation for ease of maintenance in most applications.
- Thermally Compensated Trim-- The cage is case-hardened for maximum life and is allowed to grow during thermally induced excursions. The plug is continuously guided and employs cobalt-based overlays for guide bands and tight metal-to-metal shutoff against the seat.
- Easy Maintenance Seat Ring-- Welded design provides Class V shutoff and long life. Deep Alloy 6 overlay can be refinished multiple times to maintain tight shutoff. Bolted seat rings are also available for ease of maintenance.

- Spiral-Wound Gaskets for Excellent Bonnet Sealing Under All Service Conditions-- Premium gaskets provided with N06600 windings and graphite filler material.
- Precise Spraywater Injection-- CFD designed spray manifold determines water injection point and insertion depth to maximize mixing and quick vaporization.
- High Turndown-- Standard trim control rangeability is 50:1. Special construction can provide up to 75:1 turndown.
- Quick Stroking Actuation-- High performance pneumatic piston actuators with FIELDVUE<sup>TM</sup> digital valve controllers can achieve full stroke in less than 2 seconds while still maintaining highly accurate step response. Optimized digital valve controllers and accessory packages are available when high stroke speeds are required. Contact your <u>Emerson</u> <u>sales office</u> or Local Business Partner for assistance.
- Customized Valve Body and Trim-- Valve is designed to meet your exact demanding application needs.
- Performance Diagnostics-- With the self-diagnostic capability, questions can be answered about a valve's performance, without pulling the valve from the line. The present valve/actuator signature (seat load, friction, etc.) can be compared against previously stored signatures to discover performance changes before they cause process control problems.
- More Compact Valve Body and Trim Profile--Creates a lighter valve that requires less support without compromising structural integrity.

# Options

- Blowdown Trim-- Protects the working trim and machined surfaces of the valve body during steam blow.
- Hydro-Plug-- Provides a convenient way to establish hydrotest boundaries associated with using a split pressure class valve.
- Split Functionality-- When piping dictates, the TBX valve can be provided as separate components allowing the pressure control in the valve body and separate temperature reduction downstream in a steam cooler.
- Commissioning Service-- Proper installation of blowdown trim and hydro-plug fixtures, along with reassembly and calibration of turbine bypass valves, is critical for the valves to be ready for service when needed. Let skilled Emerson Automation Solutions technicians take care of this vital commissioning service to protect this very important plant asset.
- Diagnostic Services-- The Emerson Automation Solutions Services Group delivers world class services and innovative technologies for top performance of critical service valves and other production assets.

- Magnetite Strainer Design-- protects the bore seal and piston ring from magnetite buildup and prevents trim strokage.
- Bolted Seat Ring-- Seat ring is bolted to the valve body for easy removal, replacement, or maintenance.

Figure 1. Magnetite Catcher



#### Physical Specifications

#### **End Connection Sizes and Valve Body Ratings**

VALVE INLET	- INLET PRESSURE RATINGS	
NPS		
4-18	CL150 - CL2500	
20-24	CL150 - CL1500	

VALVE OUTLET	
NPS	OUTLET PRESSURE RATINGS
8-18	CL150 - CL2500
20	CL150 - CL1500
24	CL150 - CL900
30	CL150 - CL600
36	CL150 - CL300

#### **End Connection Types**

- Buttweld (all sizes)
- Raised Face Flanges (all sizes)

#### Configuration

Angle Pattern (Flow Up or Flow Down)

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

Valve with Whisper Trim III Cage:  $0.999 \Delta P/P_1$ maximum for levels A1 through D3

Standard end connection sizes.
 Values given are Inlet versus Outlet. # represents inlet size, less than or equal to the outlet size, per customer requirements.
 Not all valve sizes are available in all pressure ratings.
 Contact your <u>Emerson sales office</u> for special characterized cages.

#### Valve with WhisperFlo Trim (Flow Up Only):

■ Levels X, Y, and Z: 0.999 △P/P<sub>1</sub> maximum

#### Flow Characteristics<sup>(4)</sup>

Whisper Trim III Cages: Linear WhisperFlo: Linear

#### **Flow Direction**

Whisper Trim III Cage: Flow Up or Flow Down WhisperFlo: Flow Up only

#### Port Diameter and Maximum Travel

See table 1 for Whisper Trim III cages See table 3 for WhisperFlo

#### **Bonnet Type**

Bolted

#### Seat Ring Type

- Welded in (standard)
- Bolted in (optional)

#### Shutoff Classifications per ANSI/FCI 70-2 and IEC 60534-4

- Class V (standard) (Whisper Trim III)
- Class V (standard) (WhisperFlo)
- Class IV (available)

		INLET PRESSURE	PORT DIAMETER		MAXIMUM TRAVEL	
SEAT KING TIPE		RATING	mm	Inches	mm	Inches
			120	4.70	197	7.75
			159	6.25	264	10.38
		CL150 - CL2500	194	7.62	321	12.62
	41.62		234	9.20	391	15.38
	AT-C3		285	11.20	473	18.62
		CL150 - CL1500	349	13.75	581	22.88
			424	16.70	606	23.88
		CL150 - CL900	507	19.94	606	23.88
Welded Seat		CL150 - CL2500	87	3.44	165	6.5
	D1-D3		120	4.70	197	7.75
			159	6.25	264	10.38
			194	7.62	321	12.62
		CL150 - CL1500	234	9.20	391	15.38
			285	11.20	473	18.62
		CL150 - CL900 -	349	13.75	571	22.88
			424	16.70	606	23.88
			87	3.44	165	6.5
			120	4.70	197	7.75
		CL150 - CL2500	159	6.25	264	10.38
	A11		194	7.62	321	12.62
boiled Seal	ALL		234	9.20	391	15.38
		CL150 - CL1500	285	11.20	473	18.62
			349	13.75	571	22.88
		CL150 - CL900	424	16.70	606	23.88

### Table 1. Port Diameter and Maximum Travel for Flow Up Whisper Trim III

### Table 2. Port Diameter and Maximum Travel for Flow Down Whisper Trim III

INLET PRESSURE	PORT DIAMETER			MAXIMUM TRAVEL	
RATING	mm	Inches	VVHISPER LEVEL	mm	Inches
	150	4.70	A1,A3,B1,B3	73	2.88
	159	4.70	C1,C3	121	4.75
	104	C 25	A1,A3,B1,B3	92	3.62
CL150 - CL2500	194	0.20	C1,C3	159	6.25
	234	7.62	A1,A3,B1,B3	117	4.62
			C1,C3	213	8.38
	285	9.20	A1,A3,B1,B3	137	5.38
			C1,C3	235	9.25
CL150 - CL1500	349 11.20	11 20	A1,A3,B1,B3	171	6.75
		11.20	C1,C3	311	12.25
	424	13.75	A1,A3,B1,B3	219	8.62
CL150 - CL900	424		C1,C3	397	15.62
	507	16 70	A1,A3,B1,B3	267	10.5
	507 16.70		C1,C3	480	18.88

Material Specifications	
Body/Bonnet ■ SA105 (Carbon Steel)	<ul> <li>S41000 cage, F22 Nitrided retainer(2.3)</li> <li>SA182 F91 Nitrided<sup>(1,4)</sup></li> </ul>
■ SA182 Grade F22 (2.25Cr-1Mo) up to 566°C (1050°F)	Bolted Seat
■ SA182 Grade F91 (9Cr-1Mo-V)	<ul> <li>F22 with Alloy 6 up to 482°C (900°F)</li> <li>■ N06625 with Alloy 6 above 482°C (900°F)</li> </ul>
Bonnet Bolting	■ F22 Nitrided cage (optional)
■ SA105 Valve Body — SA193 Grade B7 up to 427°C	Welded Seat (standard)
(800°F) ■ SA182 Grade F22 Valve Body — SA193 Grade B16 up to 524°C (975°F), N07718 above 524°C (975°F) to 566°C (1050°F)	<ul> <li>Carbon Steel with Alloy 6 Seating Surface<sup>(3)</sup></li> <li>F22 with Alloy 6 Seating Surface<sup>(3)</sup></li> <li>F91 with Alloy 6 Seating Surface<sup>(4)</sup></li> </ul>
■ SA182 Grade F91 Valve Body — N07718 up to 593°C (1100°F)	<b>Piston Rings</b> Alloy 6 with N07750 Expander
Control Plug	
<ul> <li>F22 with Alloy 6 guiding and seating surfaces<sup>(3)</sup></li> <li>F91 with Alloy 6 guiding and seating surfaces<sup>(4)</sup></li> </ul>	N07718
Stom	Gaskets
= 54470  Type 520010(3)	N07750/Graphite
■ All others use N07718 stems <sup>(4)</sup>	Packing
Cage	Graphite/Flexible Graphite
■ SA182, S910 cage, F91 retainer <sup>(2, 4)</sup> Grade F22 Nitrided <sup>(1)</sup>	Nozzles S41000 SST

## For WhisperFlo constructions. For use with SA105 or F22 valve body. For use with F91 valve body.

## Table 3. Port Diameter and Maximum Travel for Flow Up WhisperFlo Trim

SEAT RING TYPE	INLET PRESSURE	PORT DI	AMETER	MAXIMUM TRAVEL	
	RATING	mm	Inches	mm	Inches
ALL	CL150-CL2500	87	3.44	165	6.5
		109	4.28	241	9.5
		137	5.38	241	9.5
		178	7.00	311	12.25
	CL150-CL1500	203	8.00	384	15.12
		254	10.00	457	18
		279	11.00	527	20.75
		375	14.75	606	23.88
	CL150-CL900	464	18.25	606	23.88

## Figure 2. Fisher TBX Operation - Flow Up







## Coefficients

Table 4. Fisher TBX, Whisper Trim III, Flow Up Through the Port, Linear Characteristic<sup>(1)</sup>

Port Diameter		Inlet Size, NPS	Whisper III Levels	Maximum C <sub>v</sub> Flow	х.
mm	Inches	and Inlet Class	Thispe: In Letters	Coefficient	
			A1 and A3	259	0.65
		4	B1 and B3	259	0.65
		CL600 to 1500	C1 and C3	228	0.65
			D3	228	0.65
			A1 and A3	219	0.65
		4	B1 and B3	209	0.65
		CL2500	C1 and C3	206	0.65
120	4 70		D3	206	0.65
120	4.70	6	A1 and A3	578	0.65
		CL600 to 1500	B1 and B3	397	0.65
		and 8 through 12	C1 and C3	291	0.65
		CL600 to 2500	D3	291	0.65
			A1 and A3	484	0.65
		6	B1 and B3	369	0.65
		CL2500	C1 and C3	278	0.65
			D3	278	0.65
			A1 and A3	722	0.65
		6	B1 and B3	619	0.65
		CL600 to 1500	C1 and C3	456	0.65
			D3	475	0.65
	-	6 CL2500	A1 and A3	488	0.65
			B1 and B3	488	0.65
			C1 and C3	403	0.65
450	6.35		D3	475	0.65
159	6.25	8	A1 and A3	1009	0.65
		CL600 to 1500	B1 and B3	719	0.65
		and 10 through 14	C1 and C3	497	0.65
		CL600 to 2500	D3	475	0.65
			A1 and A3	888	0.65
		8	B1 and B3	675	0.65
		CL2500	C1 and C3	478	0.65
			D3	475	0.65
			A1 and A3	1244	0.65
		8	B1 and B3	978	0.65
		CL600 to 1500	C1 and C3	691	0.65
			D3	691	0.65
			A1 and A3	913	0.65
		8	B1 and B3	844	0.65
		CL2500	C1 and C3	641	0.65
			D3	641	0.65
194	7.62	10	A1 and A3	1481	0.65
		10 CL600 to 1500	B1 and B3	1063	0.65
		and 12 through 16	C1 and C3	725	0.65
		CL600 to 2500		725	0.65
			A1 and A3	1375	0.65
		10	R1 and R3	1025	0.65
		CL2500	C1 and C3	700	0.65
		222500		709	0.05
1 Reduction of standard in	let size may affect capacity. (	onsult your Emerson sales office for	additional information	103	0.00

Port Di	ameter	Inlet Size, NPS and Inlet	Whisper III Levels	Maximum C <sub>v</sub> Flow	<b>x</b> .
mm	Inches	Class	Whisper in Levels	Coefficient	At .
			A1 and A3	1913	0.65
		10	B1 and B3	1441	0.65
		CL600 to 1500	C1 and C3	1044	0.65
			D3	1044	0.65
			A1 and A3	1466	0.65
		10	B1 and B3	1284	0.65
		CL2500	C1 and C3	975	0.65
234	9.20		D3	975	0.65
234	5.20	12	A1 and A3	2181	0.65
		CL600 to 1500	B1 and B3	1528	0.65
		and 14 through 18	C1 and C3	1081	0.65
		CL600 to 2500	D3	1081	0.65
			A1 and A3	1994	0.65
		12	B1 and B3	1466	0.65
		CL2500	C1 and C3	1053	0.65
			D3	1053	0.65
			A1 and A3	2791	0.65
		12	B1 and B3	2128	0.65
		CL600 to 1500	C1 and C3	1503	0.65
295	11 70		D3	1503	0.65
285	11.20		A1 and A3	3181	0.65
		14 through 20 CL600 to 1500	B1 and B3	2269	0.65
			C1 and C3	1556	0.65
			D3	1556	0.65
			A1 and A3	4300	0.65
		16	B1 and B3	3225	0.65
	40.75	CL600 to 1500	C1 and C3	2291	0.65
240			D3	2291	0.65
349	13.75		A1 and A3	4781	0.65
		18 through 24	B1 and B3	3394	0.65
		CL600 to 1500	C1 and C3	2359	0.65
			D3	2359	0.65
			A1 and A3	5359	0.65
		18	B1 and B3	4088	0.65
		CL600 to 900	C1 and C3	2866	0.65
			D3	2866	0.65
			A1 and A3	5891	0.65
12.1	46.70	20	B1 and B3	4300	0.65
424	16.70	CL600 to 900	C1 and C3	2953	0.65
			D3	2953	0.65
			A1 and A3	6153	0.65
		22 through 24	B1 and B3	4406	0.65
		CL600 to 900	C1 and C3	2997	0.65
			D3	2997	0.65
			A1 and A3	7131	0.65
		22	B1 and B3	5119	0.65
	10.51	CL600 to 900	C1 and C3	3503	0.65
507	19.94		A1 and A3	7875	0.65
		24	B1 and B3	5406	0.65
		CL600 to 900	C1 and C3	3581	0.65
1. Reduction of standard inle	t size may affect capacity. Consu	It your <u>Emerson sales office</u> for add	ditional information.		1

### Table 5. Fisher TBX, Whisper Trim III, Flow Up Through the Port, Linear Characteristic<sup>(1)</sup>

nmindexindex internal controlindex120indexindex0.811204.7index0.79indexindex0.79indexindex0.752indexindex0.752indexindex0.752indexindex0.752indexindex0.752indexindex0.752indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.811indexindex0.813indexindex0.813indexindex0.751indexindexindexindexindex0.761indexindex0.761indexindex0.761indexindex0.761indexindex0.761indexindex0.761indexindex0.761indexindex0.761 <t< th=""><th>Port Di</th><th>ameter</th><th>Whisper III Level</th><th>Max Cy Flow Coefficient</th><th>¥t</th></t<>	Port Di	ameter	Whisper III Level	Max Cy Flow Coefficient	¥t	
A1178.40.81A3170.70.881169.40.79981169.40.79983173.70.80263140.70.75263140.70.75263140.20.75264301.20.812781301.20.81276.656.7640.76461245.60.7646261245.60.76463235.80.8147.6281475.80.8147.6281475.80.81463645.50.810.753763375.10.75876361.60.75876361.70.80276361.70.80276361.70.80276361.70.80276361.70.80276361.70.80276361.70.80276361.70.80276361.70.80276361.60.798861.11008.20.81276361.60.798861.60.7980.8166360.60.8110.76676381.250.75676381.250.75676311.870.7978631075.10.807<	mm	Inch	Whisper in Level		Λι	
120A3170.70.8120A7B1170.70.802C1140.70.7520.802C1140.70.7520.802C3140.20.752A1301.20.812A3287.70.801B1293.90.811B3235.60.764C3235.80.764C3235.80.764C3235.80.764C3235.80.764C3235.80.764C3235.80.814A1475.80.814C47.62B1475.8B1475.80.814C1379.60.759C3378.10.759C461378.1A35960.794C4610.798B3601.60.798B3601.60.798C1484.20.746C3810.746C4484.30.746C5630.812B31007.30.809C4631018.20.812B31007.30.809C4631018.20.756C3812.50.756C411801518.70.307C5631111280.90.756C41280.90.7560.31C5631280.40.756C41280.90.7560.307			A1	178.4	0.81	
120         4.7         81         109.4         0.799           0.1         137.7         0.802           0.1         140.7         0.752           0.3         140.2         0.752           0.3         140.2         0.752           0.3         140.2         0.812           0.43         287.7         0.801           0.43         293.6         0.806           0.1         293.6         0.806           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         293.6         0.753           0.1         215.8         0.814           0.1         215.8         0.814           0.1         215.8         0.814           0.1         217.8         0.814           0.1         217.8         0.814           0.1         217.8         0.814           0.			A3	170.7	0.8	
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C1140.70.752C3140.20.752A1301.20.812A3287.70.801B3293.60.806C1245.60.764C1245.60.764C1245.60.764C1253.80.753A1475.30.814A3247.60.781B3447.60.798A1475.30.814A3447.60.798B1468.50.81C1379.60.759C1379.60.759C1379.60.759C1379.60.758A1619.80.805C34810.768C4611.70.802B3601.60.798C1484.20.747C34810.766C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C31518.70.807C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.40.756C3280.4 </td <td>120</td> <td>ч.7</td> <td>B3</td> <td>173.7</td> <td>0.802</td>	120	ч.7	B3	173.7	0.802	
C3140.20.752A1301.20.812A3287.70.801B1293.60.806C1245.60.764C3235.80.753C4C1245.60.814C3255.80.753A1475.30.814A3447.60.798B1475.80.814C1379.60.759C1379.60.759C1379.60.759C3378.10.758A35960.794B1611.70.802C1484.20.747C3481.00.746C1484.20.747C3481.50.781A11003.80.81C1484.20.747C3481.50.756C483601.6C183.40.766C1484.20.778B11018.20.81C183.40.766C1814.50.756C3812.50.756C41590.70.809A31518.70.797S5013.756.83A31518.70.797A411590.70.807C41280.90.756C31280.90.756C42345.70.799S613.70.807A31280.40.756C41280.40.756C			C1	140.7	0.752	
A1301.20.812A3287.70.801A3287.70.801B1299.90.811C1245.60.764C3235.60.753A1475.30.814A3245.60.753A1475.30.814A3447.60.798B1475.80.814C1378.60.814C1378.60.814C1378.60.814C1378.60.759C3378.10.758C3378.10.758A1619.80.805C3378.10.758A35960.794B3601.60.798C1484.20.747C3481.20.746C3481.20.746C3481.50.756C3814.50.756C3814.50.756C3814.50.756C3814.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.50.756C3812.70.709A30.7560.807C4137.60.807C50.3110.756C31280.40.756C31280.40.756C40.7			C3	140.2	0.752	
A3         287.7         0.801           B1         299.9         0.811           B1         293.6         0.0806           C1         245.6         0.764           C3         235.8         0.753           A1         475.3         0.814           A3         447.6         0.798           B1         475.8         0.814           A3         447.6         0.798           B1         475.8         0.814           C1         379.6         0.759           C3         378.1         0.759           C1         379.6         0.759           C3         378.1         0.758           A1         61.7         0.802           B3         601.6         0.798           C1         484.2         0.747           C1         81         0.166           C1         81         0.1676           C1         81         0.176			A1	301.2	0.812	
1606.2581299.90.81183235.80.0764C3235.80.753762A1475.30.814762B1475.80.814762B1475.80.814762B1475.80.814762B1475.80.814763378.10.75976461379.60.75976563378.10.75876661379.60.759767635060.7947686161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.8027696161.70.802760611018.20.736761611018.20.8127626161.70.80776361107.60.807764631518.70.796764631518.70.75676376631280.40.75676376631280.40.756764631280.40.756631 <td></td> <td></td> <td>A3</td> <td>287.7</td> <td>0.801</td>			A3	287.7	0.801	
1000.23B3293.60.806C1245.60.764C1235.80.753C3235.80.753A1475.30.814A3447.60.798B1475.80.81C1379.60.759C1379.60.759C3378.10.758A1619.80.805A35960.794B1611.70.802B3601.60.798C1484.20.747C34810.746C1484.20.747C34810.746C1484.20.747C3605.90.798A11009.80.81A3966.590.798C181.30.756C381.250.756C40.7560.756C381.250.756C41007.30.809A31518.70.756C3158.70.756C41280.90.756C31280.40.756C31280.40.756C41280.90.756C31280.40.756C41280.90.756C41280.90.756C31280.40.811A450.7560.811C42356.60.811C42356.60.811C4C40.756C4C40.756 </td <td>160</td> <td>6.25</td> <td>B1</td> <td>299.9</td> <td>0.811</td>	160	6.25	B1	299.9	0.811	
C1245.60.754C3235.80.753A1475.30.814A3447.60.798B1475.80.814C1379.60.759C3378.10.759C1379.60.759C3378.10.758A1619.80.805A35960.794B1611.70.802A35960.747C1484.20.747C34810.746C1484.20.747C34810.746C18140.746C34810.746C4811018.2A3596.590.798A41009.80.812B11018.20.812B31007.30.809C1814.50.756C3812.50.756C4159.70.807A31518.70.797A41590.70.807C41280.90.756C31280.40.756C41280.90.756C31280.40.756C41280.90.756C31280.40.756C41280.90.756C31280.40.756C41236.60.811C423460.811C423460.811C41917.80.806C11917.80.806C119	100	0.25	B3	293.6	0.806	
C3235.80.753A1475.30.814A3447.60.798B1475.80.814C1379.60.759C3378.10.758C1379.60.759C3378.10.758A1619.80.805B1611.70.802B1611.70.802B3601.60.798C1484.20.747B1611.70.802B3601.60.798C1484.20.747C34810.746C483007.3B11018.20.81C1814.50.756C3481.50.756C4831007.3A31518.70.797B11576.70.807C11280.90.756C31280.40.756C42356.60.811A32245.70.799A45A32245.7A50631280.4C11280.90.756C31280.40.756C40.812346C50.811C42356.60.811A500.2300.806C11280.90.756C318600.753			C1	245.6	0.764	
194A1475.30.814194A3447.60.798194B1475.80.814194B1475.80.814194C1379.60.7591011379.60.759102C1378.10.758103619.80.805104619.80.805105611.70.80210583601.60.79810561.60.7981061018.20.747107484.20.74710861.60.79810961.60.79811.26111009.811.26111009.811.2831007.311.2831007.311.2831007.311.36110.79711.41590.70.80911.5610.80711.7811518.711.7610.80711.7611280.911.7610.80711.7631280.411.7631280.411.7631280.411.7636311.8632245.711.7636311.7636311.7636311.7636311.8636311.8636311.8636312.8636313.9			C3	235.8	0.753	
194A3447.60.7981940.620.810.8119410.760.7940.75919410.10379.60.75919510.10378.10.75819410.120.810.80519510.13101.80.80519510.170.8020.79419610.170.8020.79419710.11101.70.802198101.10.1740.80219910.111009.80.74619910.111009.80.8119911.2101.80.74619911.2101.80.81219911.2101.80.8119911.2101.80.80919911.211.20.81219911.211.211.219911.211.20.81219911.211.20.81219911.211.20.80919911.211.20.80719911.211.20.80719911.37511.370.80719911.37511.3750.80719911.37511.3750.80719911.37511.3750.80719911.37511.3750.30719911.37511.3750.30719911.37511.3750.30719911.37511.3750.75619911.375 <t< td=""><td></td><td></td><td>A1</td><td>475.3</td><td>0.814</td></t<>			A1	475.3	0.814	
P4B1475.80.814B3468.50.81C1379.60.759C3378.10.758A1619.80.805A35960.794B1611.70.802C1484.20.747C1484.20.747C1484.20.747C1484.20.746C1484.20.746C1484.20.746C1484.20.746C160.980.81A3966.590.798A11009.80.81C1814.50.756B11018.20.809C1814.50.756C3812.50.797A31518.70.807A31518.70.807A31576.10.807C11280.90.756C31280.40.756C4C11280.9A32245.70.799A32309.70.806C11917.80.761C318600.811C4C32309.7A32309.70.806C11917.80.761			A3	447.6	0.798	
194         1.62         B3         468.5         0.81           C1         379.6         0.759           C3         378.1         0.758           C3         378.1         0.758           C3         378.1         0.704           C3         596         0.794           A3         596         0.794           B1         611.7         0.802           B3         601.6         0.798           C1         484.2         0.747           C3         481         0.746           C3         481         0.746           C4         0.03         0.81           A3         966.59         0.798           B1         1018.2         0.81           C1         81         0.076           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C3         1518.7         0.807           A3         1518.7         0.807           C1         1280.9	104	7.02	B1	475.8	0.814	
C1         379.6         0.759           C3         378.1         0.758           A1         619.8         0.805           A3         596         0.794           B1         611.7         0.802           B3         601.6         0.798           C1         484.2         0.747           C3         481         0.746           C1         484.2         0.747           C3         481         0.746           C3         481         0.746           C4         1009.8         0.81           C3         481         0.746           C4         1009.8         0.81           C5         C3         481         0.746           C4         1009.8         0.81           C5         C3         81.5         0.756           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C4         1590.7         0.807           6         C1         1280.9         0.756           C3	194	7.62	B3	468.5	0.81	
C3378.10.758A1619.80.805A35960.794B1611.70.802B3601.60.798C1484.20.747C34810.746C1484.20.747C34810.746C183966.59C1811019.8A3966.590.798B11018.20.812B31007.30.809C1814.50.756C3812.50.756C3812.50.756C3812.50.756C31518.70.797B11590.70.80735013.7563A31518.70.797C11280.90.756C31280.40.756C42356.60.811A32245.70.79942561812346C318600.753			C1	379.6	0.759	
A1         619.8         0.805           A3         596         0.794           B1         611.7         0.802           B3         601.6         0.798           C1         484.2         0.747           C3         481         0.746           C1         484.2         0.747           C3         481         0.746           C1         484.2         0.748           6         1009.8         0.81           C3         481         0.766           C3         81.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C3         1518.7         0.797           83         1576.1         0.807           63         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C3         1280.4         0.6807			C3	378.1	0.758	
A35960.794B1611.70.802B3601.60.798C1484.20.747C34810.746C34810.746A11009.80.81B11018.20.812B31007.30.809C1814.50.756C3812.50.756C3812.50.756C3812.50.756C31518.70.797B11576.70.807B31576.10.807C11280.90.756C3128.40.756C3128.40.756C32245.70.79942561332309.7A123460.811C11917.80.76C318600.753		8.5	A1	619.8	0.805	
2158.581611.70.802B3601.60.798C1484.20.747C34810.746C34810.746A11009.80.81A3966.590.798B11018.20.812B31007.30.809C1814.50.756C3812.50.756C3812.50.756C3812.50.797B11576.70.807B11576.70.807B11576.70.807C11280.90.756C31280.40.756C31280.40.756C31280.40.756C31280.40.756C31280.40.756C412356.60.811A32245.70.799B123460.811A32309.70.806C11917.80.76C318600.753			A3	596	0.794	
215         8.5         B3         601.6         0.798           C1         484.2         0.747           C3         481         0.746           C3         481         0.746           C4         1009.8         0.81           A3         966.59         0.798           B1         1018.2         0.812           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.798           A1         1590.7         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.797           B1         1590.7         0.807           C1         813         1576.1         0.807           C1         1280.9         0.756         0.756           C3         1280.4         0.756         0.759           C1         1280.9         0.756         0.811           C4         2356.6         0.811         0.76           C3         1280.4         0.759         0.759	215		B1	611.7	0.802	
C1484.20.747C34810.746C34810.746C34810.746A11009.80.81A3966.590.798B11018.20.812B31007.30.809C1814.50.756C3812.50.756C3812.50.797B11590.70.809A31518.70.797B11576.10.807C11280.90.756C31280.40.756C42356.60.811A32245.70.799B123460.811B123460.811C11917.80.76C318600.753	215		B3	601.6	0.798	
C3         481         0.746           A1         1009.8         0.81           A3         966.59         0.798           B1         1018.2         0.812           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C3         1280.4         0.756           C3         1280.4         0.811           A3         2245.7         0.799           425         B1         2346         0.811           A3         2309.7			C1	484.2	0.747	
A1         1009.8         0.81           A3         966.59         0.798           B1         1018.2         0.812           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         1518.7         0.797           B1         1576.7         0.809           A3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C4         0.3         2245.7         0.799           81         2346         0.811           A3         2245.7         0.799           81         2346         0.811           C3         1860			C3	481	0.746	
A3         966.59         0.798           B1         1018.2         0.812           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.756           C3         812.5         0.756           A3         1590.7         0.809           A41         1590.7         0.809           A3         1518.7         0.797           B1         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           A3         2245.7         0.799           81         2346         0.811           A3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753			A1	1009.8	0.81	
285         11.2         B1         1018.2         0.812           B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.756           A1         1590.7         0.809           A3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C1         1280.9         0.756           C3         1280.4         0.756           C4         0.756         0.811           A3         2245.7         0.799           16.7         B1         2346         0.811           C1         1917.8         0.76         0.76           C1         1917.8         0.76         0.76			A3	966.59	0.798	
285         11.2         B3         1007.3         0.809           C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.797           A1         1590.7         0.809           A3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753	205		B1	1018.2	0.812	
C1         814.5         0.756           C3         812.5         0.756           C3         812.5         0.756           A1         1590.7         0.809           A3         1518.7         0.797           B1         1576.7         0.807           C1         1280.9         0.756           C1         1280.9         0.756           C3         1280.4         0.756           C4         2356.6         0.811           A3         2245.7         0.799           B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76	285	11.2	B3	1007.3	0.809	
C3         812.5         0.756           A1         1590.7         0.809           A3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C4         2356.6         0.811           A3         2245.7         0.799           16.7         B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753			C1	814.5	0.756	
A1         1590.7         0.809           350         A3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C3         1280.4         0.797           425         16.7         B1         2346           60.811         60.811         0.807           C1         1917.8         0.799			C3	812.5	0.756	
350         A3         1518.7         0.797           B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           A1         2356.6         0.811           A3         2245.7         0.799           16.7         B3         2309.7         0.806           C1         1917.8         0.76			A1	1590.7	0.809	
350         B1         1576.7         0.807           B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           A1         2356.6         0.811           425         16.7         B3         2309.7         0.806           C1         1917.8         0.76         0.753			A3	1518.7	0.797	
350         13.75         B3         1576.1         0.807           C1         1280.9         0.756           C3         1280.4         0.756           C3         2356.6         0.811           425         16.7         B1         2346         0.811           B3         2309.7         0.806         0.76           C1         1917.8         0.76	250	10.75	B1	1576.7	0.807	
C1         1280.9         0.756           C3         1280.4         0.756           A1         2356.6         0.811           A3         2245.7         0.799           B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753	350	13.75	B3	1576.1	0.807	
C3         1280.4         0.756           A1         2356.6         0.811           A3         2245.7         0.799           B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753			C1	1280.9	0.756	
425         A1         2356.6         0.811           16.7         A3         2245.7         0.799           B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753			C3	1280.4	0.756	
A3         2245.7         0.799           425         B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753			A1	2356.6	0.811	
425         B1         2346         0.811           B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753		ļ	A3	2245.7	0.799	
425         16.7         B3         2309.7         0.806           C1         1917.8         0.76           C3         1860         0.753		4.6-	B1	2346	0.811	
C11917.80.76C318600.753	425	16.7	B3	2309.7	0.806	
C3 1860 0.753			C1	1917.8	0.76	
			C3	1860	0.753	

## Table 6. Fisher TBX Whisper III flow down through the Port, Linear Characteristic

Port Diameter		WhisperFlo Level	Max Cy Flow Coofficient	Vt.
mm	Inch	- Whisperrio Level		AL .
		Х	288	0.575
3.43	7.75	Y	213	0.575
		Z	133	0.525
		Х	446	0.575
4.28	9.5	Y	352	0.575
		Z	234	0.525
		Х	703	0.575
5.375	9.5	Y	508	0.575
		Z	312	0.525
		Х	1171	0.532
7	12.625	Y	808	0.532
		Z	505	0.525
	15.375	Х	1558	0.532
8		Y	1247	0.532
		Z	748	0.532
	18.625	Х	2435	0.532
10		Y	1635	0.532
		Z	1040	0.532
	22.875	Х	2814	0.532
11		Y	2314	0.532
		Z	1286	0.532
		Х	5297	0.532
14.75	22.875	Y	3947	0.532
		Z	2368	0.532
		Х	7105	0.532
18.25	22.875	Y	4342	0.532
		Z	2763	0.532

### Table 7. Fisher TBX, WhisperFlo Trim, Flow Up Through the Port, Linear Characteristic



Figure 4. Fisher TBX Bore Seal Trim in Closed Position

## System Noise Level

Today's power plants must comply with strict noise limitations, especially those that are located close to residential areas. Satisfying a low fence line noise requirement requires a complete understanding of the system and how individual components can affect the total noise transmitted to the plant boundary.

Extensive steam conditioning noise research has been conducted at the Marshalltown research facility, resulting in a new understanding of the impact of sparger installations in turbine exhaust ducts. Testing has revealed critical spatial relationships of multiple spargers that must be maintained to prevent noise generation.

This knowledge, together with the application of low noise technology trims and pressure reducing devices, allows the Emerson Automation Solutions research facility to accurately predict the system noise level.

## **Bore Seal Trim**

TBX valves provide Class V leakage as a standard. The design employs a variation of the proven C-seal trim with enhancements for use with the TBX hung cage. The sealing design is called Bore Seal trim (figure 4).

In the Bore Seal trim, the primary plug-to-seat interface is a metal-to-metal line contact while the secondary metallic seal engages a controlled bore region in the cage when the plug is seated.

During modulation, the secondary seal does not contact the upper cage wall and the controlled bore region remains protected, which extends the shutoff life of the valve.

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Emerson Automation Solutions Marshalltown, Iowa 50158 USA Sorocaba, 18087 Brazil Cernay, 68700 France Dubai, United Arab Emirates Singapore 128461 Singapore

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