Control Valves for Severe Service Applications

DFT® HI-100® Control Valve Features an
In-Line Straight-Thru Venturi Flow Design

DFT designs products using the latest CAD, FEA, and CFD design technology software and manufactures in Exton, PA.

DFT®

Control Valves for Severe Service Applications

DFT® Model HI-100® Severe Service Parameters

- Pressure differential > 1000 psi (69 bar)
- Temperatures > 800°F (427°C)
- Highly erosive and/or corrosive service
- Service with entrained water droplets such as wet steam and mixed phase applications
- Light slurry service
- Buffeting or pulsating fluid

Valve Design

The **HI-100® Control Valve** features an in-line straight-thru venturi flow design. The control element, a spherical ball, is contained by a cage that positions the ball relative to the downstream seat by means of linear stem travel.

There are no close clearances between the moving parts (i.e. cage, ball and seat). These features enable the valve to operate smoothly and efficiently at high or low temperatures and/or in fluids carrying suspended particles such as slurries. FCI 70 Class V shutoff is standard.

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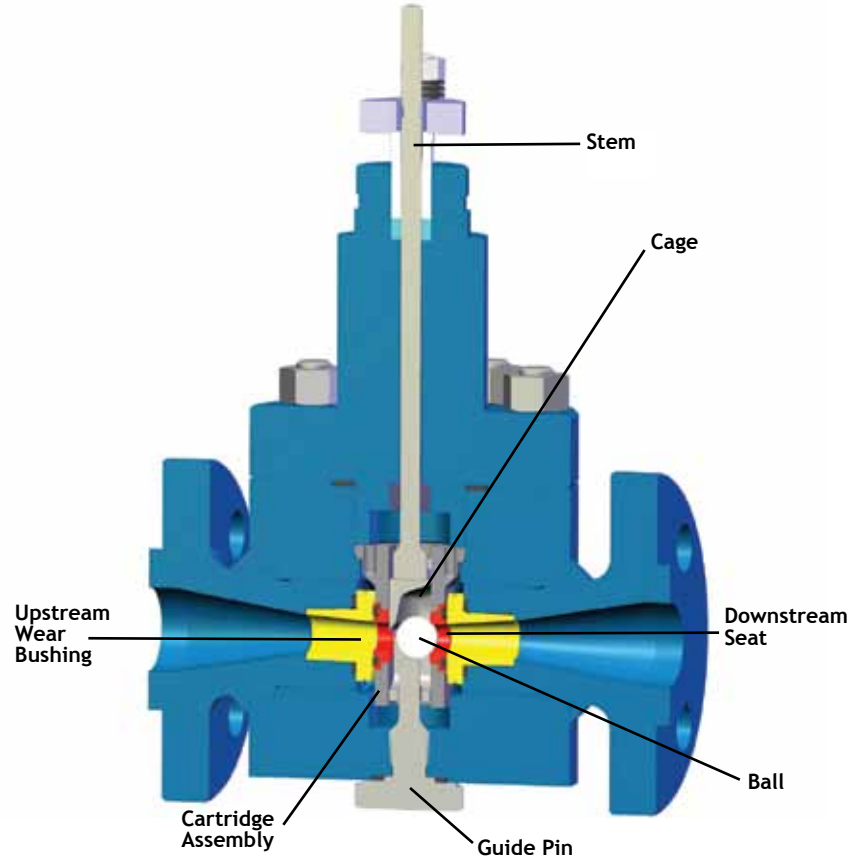

HI-100® Product Line

- Valve Body Sizes: 1" to 12"*
- Trim Sizes: ¼" to 8"
- Pressure Class: ASME 150 to 4500
- Standard Body Materials: Carbon Steel, Stainless Steel and Chrome-moly
- End Connections: Weld End and Flanged
- Stem Seal: Live-loading Packing
- Top or Bottom Entry to Internal Trim
- Flow Characteristics: Linear or Equal Percentage

* Larger sizes, consult factory.

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DFT® HI-100®

Materials of Construction* and Application Guide

BODY				
Body / Bonnet *(normally matches pipe)*	A105		F22 or F11	A479-316
Cage: 1/4" to 2"	Cast Stellite® #6			
Cage: 2-1/2" & Larger	WC6 w/Stellite® #6 Hardfacing			CF8M/Stellite® #6
Cartridge	A351 CF8M			
Guide Pin	A193 B7			A193 B8M
Gland/ Follower	303 SS			
TRIM STYLE				
Trim Code	(A)	(B)	(C)	(D)
Stem Trim	17-4 PH		A286	A286
Ball: 1/4" to 4"	PSZ Ceramic	440C	Stellite®	Stellite®
Ball: 6" and Larger	Stellite® #6			
Seat: 1/4" to 2"	440C		Stellite® #6	Stellite® #6
Seat: 2-1/2" & Larger	440C		316 SS/Stellite®	316 SS/Stellite®
Wear Bushing	440C			Stellite® #6

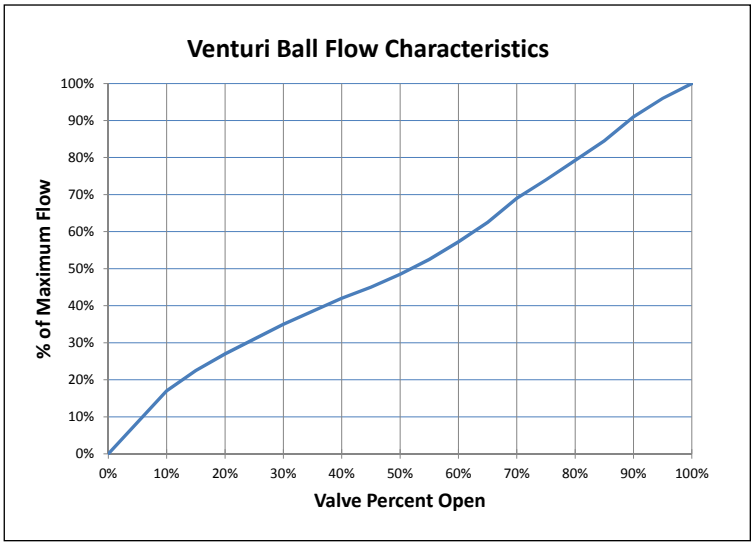
APPLICATION	TRIM CODE	APPLICATION	TRIM CODE
Boiler Feed Pump Bypass	A	Drum Level Control	B
Auxiliary Steam Control	C	Attemperator Spray Control	C
Sootblower Control (Hi-Temp)	D	Turbine Bypass	C
Feed Water Control	B	Turbine and Boiler Drain	B

*Standard materials of construction are shown. These materials can be modified for special applications. Contact the factory for more information.

Flow Characteristics

HI-100®/MSV-100®/Ultra-Trol® Flow Characteristics

The classic DFT design has a linear flow characteristic. This characteristic gives the best flow control over the widest range. DFT's venturi-ball design is the only design that actually works with the physics of the fluid flow. Incoming flow enters through the nozzle to the control area. The smoothly converging nozzle lowers turbulence as the flow moves around the curved control path. Note that only rounded surfaces and cones are used for the control function. As the flow exits the valve, the diverging nozzle controls expansion and recovery so that no turbulence is added to the flow stream. This design provides a superior, smooth flow control. The preferred operating range of the valve is between 15% and 90% open.



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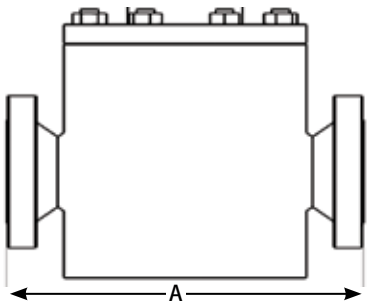
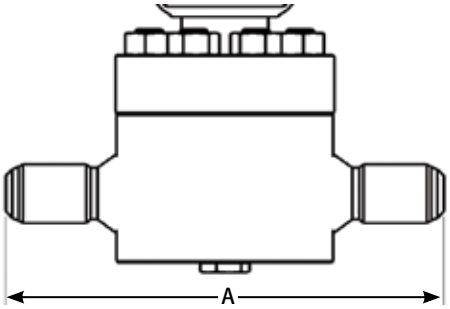
DFT® HI-100®

Face to Face Dimensions

RAISED FACE



BUTT WELD END



Nominal Valve Size		HI-100 Face to Face Dimensions*											
		ASME Class 150		ASME Class 300		ASME Class 600		ASME Class 900		ASME Class 1500		ASME Class 2500	
NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
1/4	8	4.00	102										
3/8	10	4.00	102										
1/2	15	4.25	108	6.00	152	6.50	165	8.50	216	8.50	216	10.38	264
3/4	20	4.62	117	7.00	178	7.50	190	9.00	229	9.00	229	10.75	273
1	25	5.00	127	8.00	203	8.50	216	10.00	254	10.00	254	12.12	308
1 1/4	32	5.50	140	8.50	216	9.00	229	11.00	279	11.00	279	13.75	349
1 1/2	40	6.50	165	9.00	229	9.50	241	12.00	305	12.00	305	15.12	384
2	50	8.00	203	10.50	267	11.50	292	14.50	368	14.50	368	17.75	451
2 1/2	65	8.50	216	11.50	292	13.00	330	16.50	419	16.50	419	20.00	508
3	80	9.50	241	12.50	318	14.00	356	15.00	381	18.50	470	22.75	578
4	100	11.50	292	14.00	356	17.00	432	18.00	457	21.50	546	26.50	673
6	150	16.00	406	17.50	445	22.00	559	24.00	610	27.75	705	36.00	914
8	200	19.50	495	22.00	559	26.00	660	29.00	737	32.75	832	40.25	1022

* Dimensions per ASME B16.10. Valves can be supplied to meet end user requirements.
Class 4500 and higher pressure valves are supplied to meet end user requirements.

HI-100 Maximum Valve Flow Coefficient							
Size NPS	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2
SizeDN	8	10	15	20	25	32	40
Cv (Kv)	1 (0.9)	2.5 (2.2)	4.5 (3.9)	10 (8.6)	20 (17)	31 (27)	45 (39)
Size NPS	2	2 1/2	3	4	6	8	
SizeDN	50	65	80	100	150	200	
Cv (Kv)	80 (69)	125 (108)	180 (155)	320 (275)	720 (621)	1280 (1103)	

* Larger sizes consult factory.

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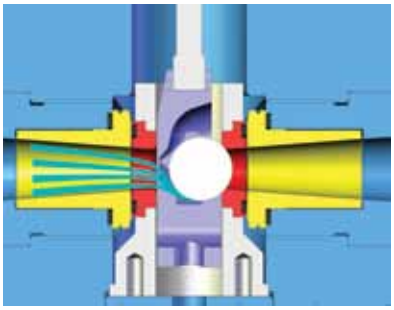
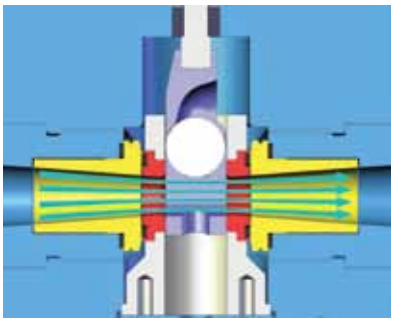
DFT® Control Valve Operation



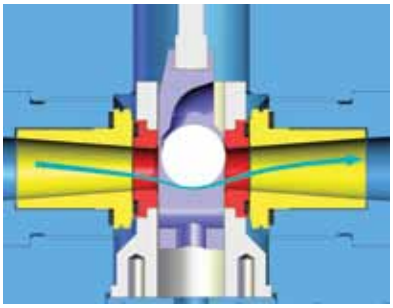
Closed Position

In the closed position, pressure moves the ball into the conical seating surface and holds it in place. Line contact between the ball and the seat results in high surface loads between the seat and the ball producing tight closure. As pressure increases, the seat load increases improving the seal. During each valve stroke, the ball rotates and repositions itself presenting a new sealing surface to the seat, prolonging the tight shutoff capability. Temperature changes do not affect the tight shutoff since there is freedom of movement between the ball and the seat. The ball cannot become wedged into the seat. The guide pin is used to set the valve position. During normal operation, it has no function.



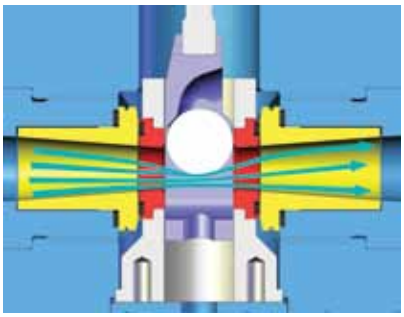
Full Open Position

In the full open position a straight-thru flowpath exists and the valve operates with the inherently high flow capacity of a venturi. The ball is firmly held out of the flow stream by four inclined pads on the cage which oppose the pressure differential force. The Bernoulli pressure differential moves the suspended particles towards the center of the fluid stream, preventing them from settling out into the body. This keeps the valve clean and free of material deposits in all positions during the valve stroke.



Close Throttling Position

As the valve opens, it operates in the close throttling position. In this position, the ball is supported by the two forward inclined pads on the cage and the seat surface which oppose the pressure differential force caused by the Bernoulli effect. The ball is supported and stable throughout the valve stroke and does not pinwheel or chatter.



Intermediate Throttling Position

In the intermediate throttling position, the ball rests on the four cage pads and is opposed by the same differential pressure force. The stable suspension of the ball throughout the valve stroke permits extremely close and repeatable control throughout the entire valve stroke.

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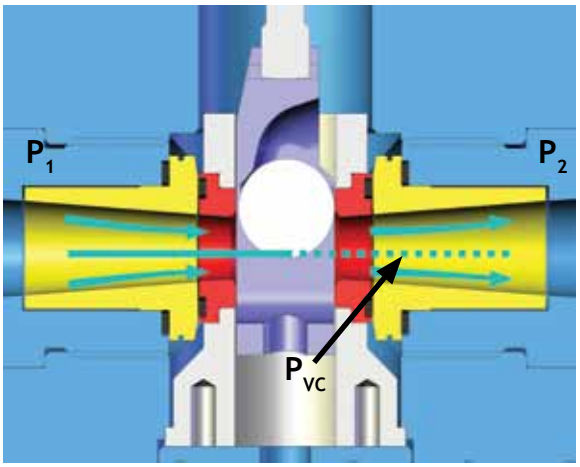
Cavitation Control

Using the illustration below, at P_1 the fluid stream is all liquid. Liquid flashes at the valve port when the pressure at the vena contracta (P_{VC}) drops below the liquid vapor pressure. As the velocity decreases in the exit nozzle, the pressure increases (or recovers) to P_2 and the vapor bubbles collapse. This is known as the potentially damaging phenomena called cavitation. Unlike tortuous path valves, our control valves manage cavitation. Bubbles form at the lowest pressure (highest velocity) which is at the center of the fluid stream. The subsequent collapse is within the hydraulic barrier, not on metal surfaces. Our nozzle design provides a smooth recovery prior to the fluid exiting the valve.



Bernoulli

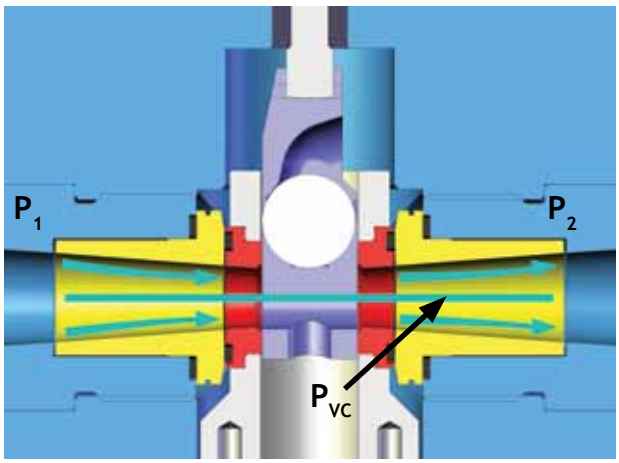
The Bernoulli Principle

Energy per unit volume at inlet = Energy per unit volume at outlet

$$P_1 + 1/2\,\rho v_1^2 + \rho g h_1 = P_2 + 1/2\,\rho v_2^2 + \rho g h_2$$

Where: P = Pressure Energy; $1/2\,\rho v^2$ = Kinetic Energy; $\rho g h_1$ = Potential Energy

The best example of the Bernoulli Principle is often called the "Bernoulli Effect" which states that fluid pressure decreases as fluid velocity increases.



The illustration shows the typical change in pressure as the fluid moves through the valve. At inlet, the pressure is P_1. Velocity increases through the valve to a maximum as it moves through the valve port. At the valve port, the pressure drops to P_{VC} (pressure at the vena contracta), which is the lowest pressure in the valve. As the fluid exits the valve, pressure recovers to P_2 which is lower than P_1.

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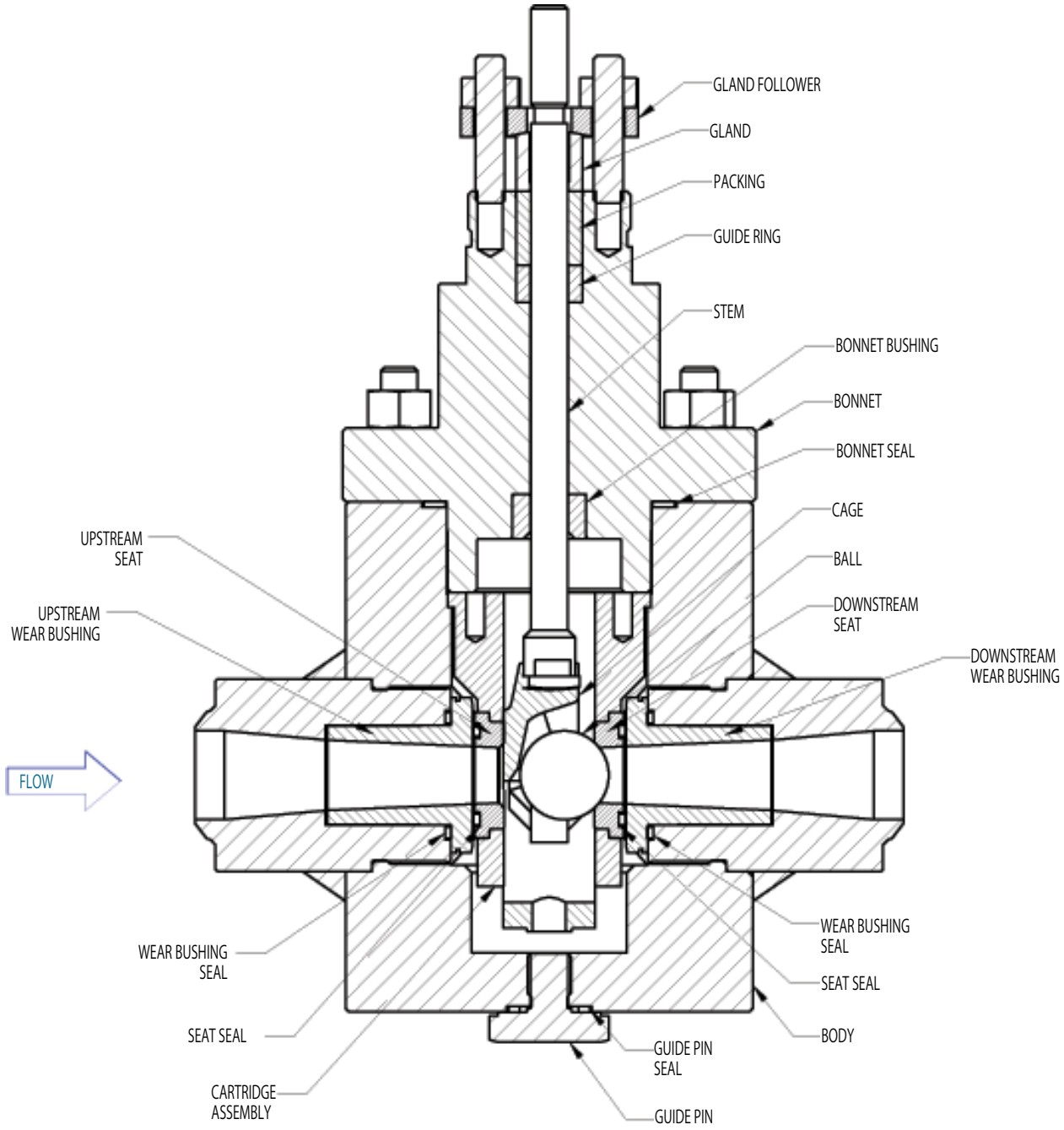
Nomenclature

HI-100® Control Valve



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Our Unique Venturi-Cage Valve

• Straight-thru Design- solves your performance problems

1. Eliminates Damage: Our unique nozzle design smoothes turbulence which eliminates body, trim and piping damage caused by high velocity fluid impingement in your system.
2. Handles Greater Flow: Since we have no tortuous path through our valve, our valves have a higher Cv than that of the same size valve made by competitors, often saving you money.
3. Precision Modulation & Control: Our 200:1 turndown ratio and linear flow characteristic gives you precise control over the entire operating range.

• Unique Trim Design – lowers your cost of ownership

1. In-Line Repair: All styles can be repaired in-line without the need for expensive special tools saving you time and money.
2. Long Life: Our trim design uses wear components at the critical places along the flow path maximizing design life for the application.
3. Low Replacement Costs: Our unique ball, cage and wear bushing design allows you the flexibility to replace only the worn parts, lowering your cost of repair significantly when compared to our competition.

• Wide Application Range- can be used in nearly any service

1. ANSI 150 to 4500: Handles all ANSI applications, pressures up to 16,000psi and temperatures from -425°F to 1900°F.
2. Liquid, Gas, Steam, Slurry: Our non-tortuous path design handles liquids, gases, steam (including mixed phase flow), abrasives and many slurry applications.
3. Materials: Standard body materials are Carbon, Alloy and Stainless Steel. High nickel and exotic alloys are also available – any weldable alloy that is available as a forged material can be used.

• Venturi Nozzle Design – reduces turbulence in your piping system

1. Cavitation Control: Our nozzle design controls cavitation and reduces the associated noise and vibration.
2. Particulate and Mixed Phase Flow: Our nozzle design moves particles and water droplets to the middle of the flowstream avoiding costly damage.
3. Prevents Erosion: Our nozzle design smoothes the flow and reduces the potential for valve body and pipe erosion.

• Class V Shutoff

• Actuation

The actuator (Linear: pneumatic, hydraulic, electric etc.) and accessories (positioners, limit switches, manual over-rides, etc.) of your choice can be mounted on the valve.

Applications

Aerospace
- Air
- Fuel Oil
- Gas
- High Pressure Water with fines
- Methane Vapor

Chemical
- Abrasive Slurry Control
- Hot Hydrogen Gas
- Pitch Blend Control
- Powerhouse Applications
- Super Critical Water Oxidation

Government/Military Test
- Air
- Cryogenic
- Nitrogen Gas
- Steam
- High Pressure Water

Pulp & Paper
- Powerhouse
- Steam Control

Power
- Bottom Ash
- Condensate Drain
- Drum Emergency Blowdown
- Drum Level Control
- Feedwater Control
- Feedwater Recirculation
- Fuel Oil Control
- Geothermal Water Injection
- Power Operated Relief
- Soot Blower Control
- Spray Control (Attemperator, Reheat/Superheat)
- Steam PRV
- Thermal Drain
- Turbine Bypass
- Turbine Steam Extraction

Steel
- Powerhouse

Refinery
- Abrasive Slurry Control
- Amine Service
- Butadiene
- DEA
- Desulphurization Sour Water
- H2S, NH3, Hydrocarbon
- Hydrocarbon Sluicing
- Level Control
- Pitch Blending Control
- Platinum Catalyst Slurry
- Quench Water to Coker
- Sour Water
- Sulfur Recovery Throttling Valve

Pipeline
- Gas Plant Pigging
- Pipeline Control

Petrochemical
- Heavy Oil Upgrading

Codes & Standards

ASME B16.5 – Pipe Flanges & Flanged Fittings

ASME B16.10 – Face to Face & End to End Dimensions of Valves

ASME B16.34 – Valves – Flanged, Threaded & Welding Ends

ANSI/FCI 70-2 – Control Valve Seat Leakage – HI-100® & Ultra-Trol® seat test

ANSI/ISA 75.01 – Flow Equations for Sizing Control Valves

ANSI/ISA 75.08.01 Face-to-Face Dimensions for Flanged Globe-Style Control Valve Bodies - LSV-100®

API 598 – Valve Inspection & Testing – Uniflo® seat test

MSS-SP 25 – Standard Marking System for Valves, Fittings, Flanges & Unions

Sizing DFT® Control Valves

DFT® Control Valves are sized using standard ISA sizing formulae for liquid, gas and steam applications.

Please complete the Application Data Sheet on page 10 so that we can specify the proper valve for your application. Additional information concerning any valve that is being replaced by our valve such as the Cv of that valve and the original data sheet can be used to effectively specify the proper valve as well.

Accessories

The following accessories are available for the DFT® Control Valves			
ACTUATORS	**ACTUATOR ACCESSORIES**	**PACKING**	**SPECIAL TRIM**
Pneumatic Diaphragm	Air Filter Regulator	Graphite	Feedwater
Pneumatic Piston	Air Set	Teflon® (CVH)	Steam
Electric	Limit Switches	Live Loaded	Catalyst
Electro-Hydraulic	Manual Override	Emission Compliant	Slurry
Hydraulic	Positioner		
Manual	Solenoid		
	Transducer		

DFT® INC.

FAX OR SCAN AND EMAIL THIS COMPLETED FORM TO THE FACTORY

SEVERE SERVICE CONTROL VALVES
APPLICATION DATA SHEET

DFT Rep:		DFT Quote #:	

Highlighted items are required information

CUSTOMER:		CUSTOMER REFERENCE #:	
ADDRESS:		RESPONSE DUE DATE	
		REQUIRED DELIVERY:	
CONTACT:		PHONE:	
EMAIL:		FAX:	

General

1	End User		
2	Application		
3	Tag Number		
4	Inlet Pipe		Size/schedule
5	Outlet Pipe		Size/schedule
6	Pipe Material		

	Valve Type		Choose From:
7	Style		Hi-100®, Ultra-Trol®, UniFlo®
8	Material		A105,F22,316, * other
9	End Connections		RF, RTJ, BW, SW, * other
10	Pressure Class		
11	Entry		Top or Bottom
12	Orientation		Horizontal, Vertical, * other
12.1	Flow Direction		Right-Left; Left-Right

	Trim		Choose From:
13	Type		Std, Steam, Feedwater, *other
14	Packing		Teflon®, Graphite, *other
			Live Load, Emission Compliant
15	Seals		Spiral Wound; O-ring; *other

Process Data

18	Fluid (water/steam etc)				
		Operating Conditions			
		Min	Normal	Max	Units
19	Inlet Pressure				
20	Outlet Pressure				
21	Flow Rate				
22	Temperature				
	Fluid properties (if known)				Units
23	Specific Volume				
24	Specific Gravity				
25	Density				
26	Vapor Pressure				
27	Viscosity				

	Valve Design Conditions		Units
28	Pressure		
29	Temperature		
30	Max Differential Press.		

Process Notes

31	Service Type		Modulating; On/Off
32	Cycles per day		

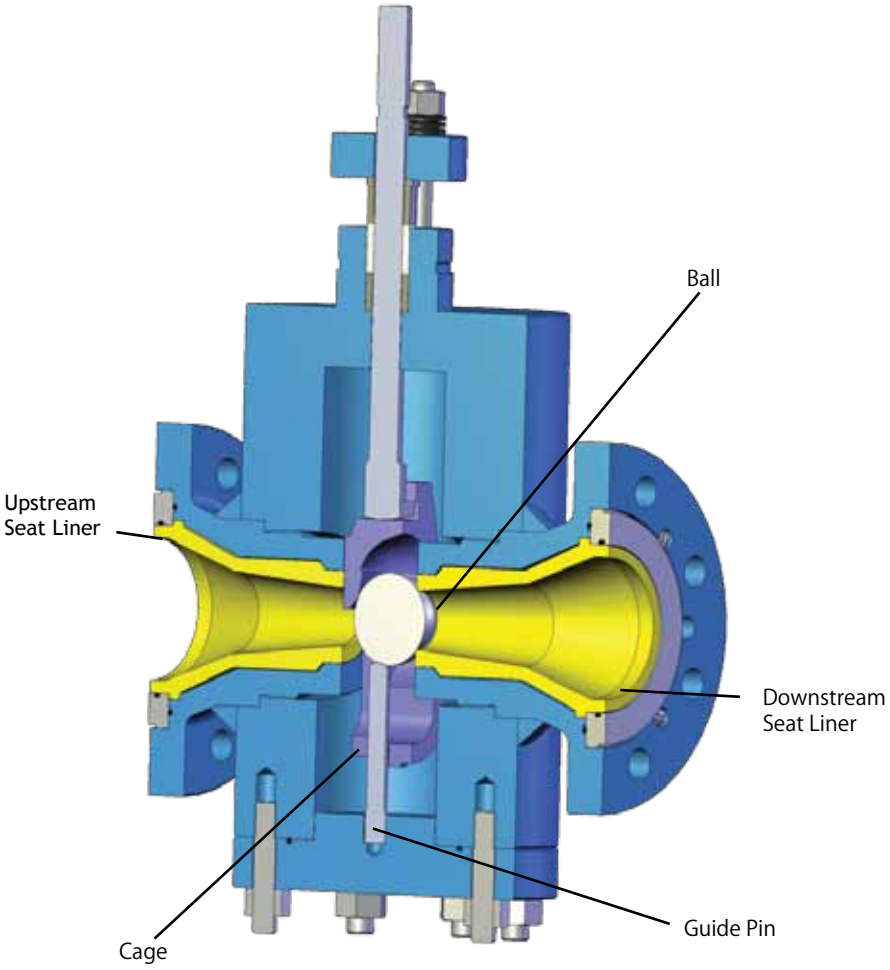
	Actuator		
16	Choose Type		Model Required
16.1	Air		
	Min psig avail.		
16.2	Electric		
	Volts AC/DC		
16.3	Hydraulic		
	psig		
	Capacity (gpm)		
16.4	Manual		
17	Failure Mode		Open/Close/In Place

	Actuator Accessories		
33	Manual Override		Top; Side; * special
34	Positioner		Digital/EP/Type
	Signal		3-15 psig; 4-20 mA
35	Solenoid		Type/Model/Voltage
36	Limitswitch		Quantity/Location
	*Notes		Type/Model/Voltage
37	Air Filter Regulator		
38	Gages		
39	Special		Add to notes

	Notes

DFT® ULTRA-TROL®

The DFT ULTRA-TROL® Control Valve features hardened sleeves for slurry applications. This style valve is designed for flanged end applications and bench replacement of the seat insert. The internal design is the same in-line venturi flow design used for the HI-100®. The control element, a spherical ball, is contained by a cage which positions it relative to the downstream seat. Stem travel is linear and operating thrusts are low. The result is excellent control in tough environments. The ball, cage and stem can be replaced in-line through the bottom cover.



FEATURES:

- Straight-thru design
- 1/2" to 6"
- Carbon Steel, Alloy Steel Stainless and High Alloys
- ANSI RF, RTJ or DIN Ends
- Linear Characteristic
- Hardened Sleeves
- Temperatures: -425° F to 1000° F
- Bench Repair
- Manual, Pneumatic, or Electric
- Low Operating Thrust
- Bottom Entry

Ultra-Trol Maximum Flow Coefficient										
Size NPS	1/2	3/4	1	1 1/4	1 1/2	2	2.5	3	4	6
Size DN	15	20	25	32	40	50	65	80	100	150
Cv (Kv)	4.5(3.9)	10(8.6)	20(17)	31(27)	45(39)	80(69)	125(108)	180(155)	320(275)	720(621)

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Benefits of DFT® Control Valves

Compact Size & Straight-thru Design

- Easier to install
- Design provides smooth flow transitions through valve because fluid does not have multiple right angle turns.
- A straight through flow path is less turbulent and it will not clog from solid particles. It also leads to non-turbulent pressure recovery.

Modulating Control

- Design offers better modulating control than any other control valve on the market today.

High Flow Capacity and Larger Cv's

- 2-3 times the flow capacity of nominal size control valves.

Low Leakage and Tight Metal-to-Metal Sealing

- Per API 598 and/or FCI 70-2 Class V

Low Cost of Spare Parts and Quick Change Trim

- The DFT HI-100 is serviceable in-line without special tools. A 1" valve can be serviced in less than 2 hours.

Low Actuator Cost

- DFT HI-100 is position-seated design. Globe valves are force seated. Therefore, less actuator forces are required to operate valve and therefore allows the use of smaller, less expensive actuator packages.

Prevents sediment build-up with Self-purging Design

- Due to the venturi flow path and resulting increase in velocity, the body cavities are purged preventing sediment build up within valve body. This occurs due to a vacuuming effect.

Warranty

Each DFT®Inc. product is warranted against defects in material and workmanship for a period of one year after being placed in service, but not exceeding 18 months after shipment, when these products are properly installed, maintained and used within the service and temperature and pressure ranges for which they were designed and manufactured, and provided they have not been subject to accident, negligence, alteration, abuse, misuse or the like. This warranty extends to the first purchaser only. All defective material must be returned to the person from whom you purchased the product, transportation prepaid, free of any liens or encumbrances and if found to be defective will be repaired free of charge or replaced, at the warrantor's or DFT's option.

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