

MIL 77000 - Multi-stage Labyrinth Lo-dB Control Valves





Table of Contents

Introduction	01
Features	02 - 03
Typical Applications	04
Technical Information	05 - 06
<ul style="list-style-type: none"> • Model Decodification • Standard Sizes / Ratings / End Connections • General Data • Seat Leakage Class / Temperature Range • Flow Coefficients (Rated Cv) • Actuator Selection 	
Construction	07 - 08
Dimensions and Weights	09



Introduction

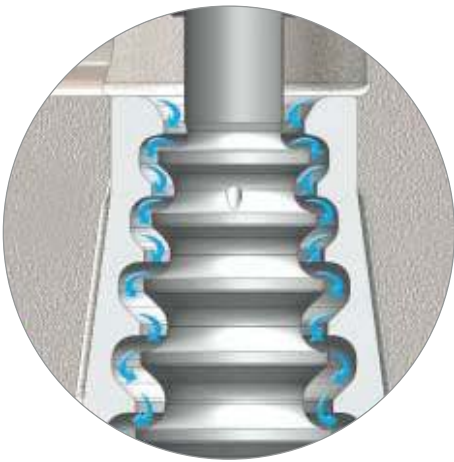
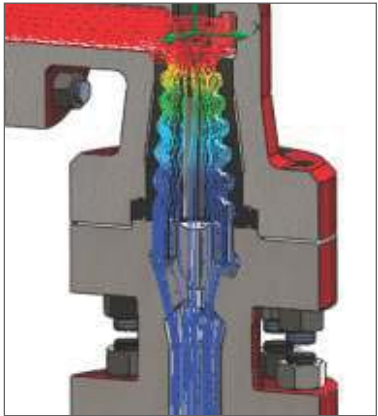
It has always been a challenge for control valve manufacturers to handle high pressure compressible fluids and flashing/multi-phase liquids efficiently, where problems associated with noise, velocity and vibration are much higher due to expansion of the fluid during the throttling process. Multi-stage, multi-path control valves with the tortuous flow path built on stacked metallic plates or concentric cages are effective to an extent for compressible fluids, but it fails to deliver with the presence of foreign material in the fluid stream.

In many cases especially in the oil & gas sector, presence of foreign materials like catalyst fines in refineries or fine sand particles in oil fields can be a process necessity. To provide unmatched performance and ease of maintenance in such high pressure applications, MIL offers its trusted and field proven 77000 series with multiple pressure letdown stages and expanding downstream area. The unique trim design allows safe operation by directing the flow through a series of expanding stages, providing improved service.

Features

Advanced Design Principle

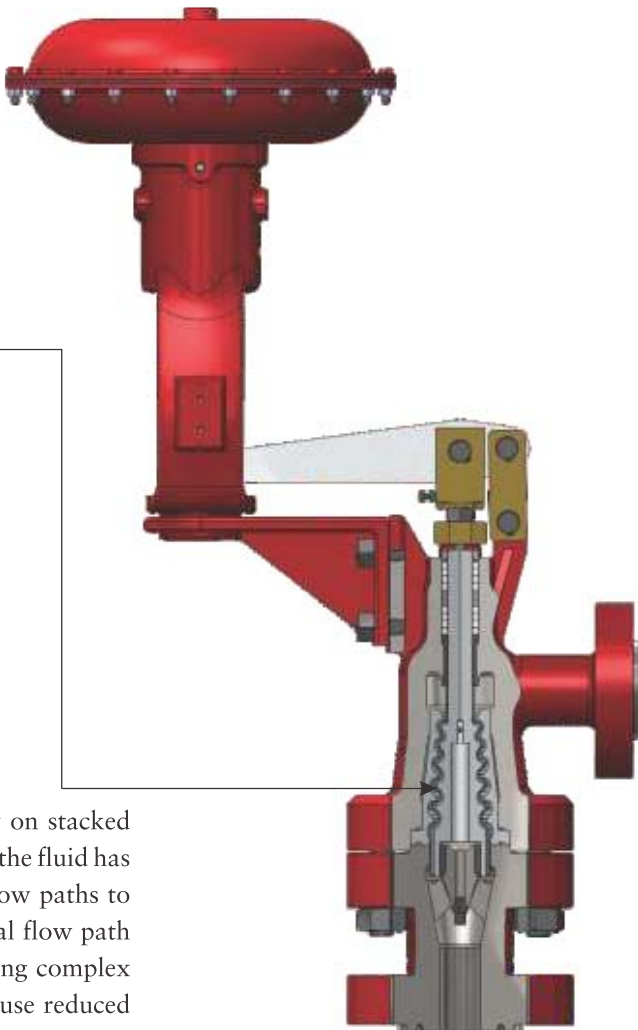
MIL 77000 series valves employ the principle of “Adiabatic Flow with Friction” to reduce pressure similar to the pressure loss occurring in a long pipeline. This effect is produced by causing the fluid to pass through a number of restrictions, created by a labyrinth plug which provides a tortuous flow pattern dissipating energy through high head loss rather than through shock waves. The flow area of the valve trim is gradually increased towards the downstream section. This compensates for expansion of gas with the drop in pressure and ensures a nearly constant fluid velocity throughout the throttling process. Thus the advanced design eliminates the damaging erosive effects caused by high kinetic energy spikes and vibration, particularly in applications that include particulates in the flow.



MIL 77000 Flow Path

Rugged, Anti-clog Design

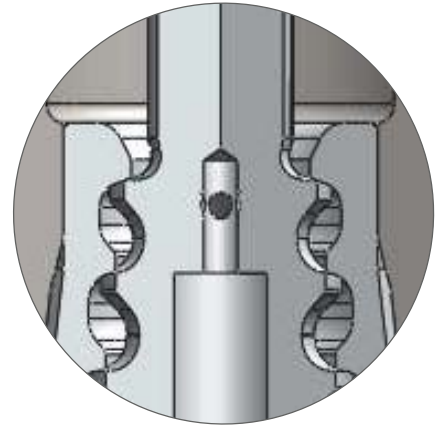
Valve designs employing multi-stage, multi-path technology on stacked discs or cages have an increased tendency to get clogged when the fluid has particulate presence. MIL 77000 series valves have larger flow paths to allow the passage of entrained particulates. The smooth axial flow path allows particles to move through the valve without navigating complex trim geometry preventing clogging of the trim which can cause reduced capacity or valve failure.





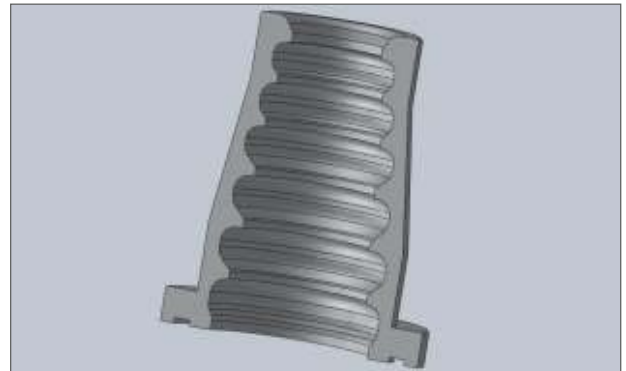
Seat Protection

Seat protection in a high pressure valve design is critical to prevent premature seat wear leading to unwanted and undetected leakage. A damaged valve seat can lead to wire drawing and eventually to rapid trim damage from cavitation or flashing when the valve is closed. Seat damage effects are minimized in MIL 77000 series by locating the seat on the upstream section of the trim. This design feature ensures that the seat is isolated from the most severe and potentially damaging pressure reduction stages which are located in the downstream section of the trim.



Unbalanced, Flow-to-open Design

MIL 77000 series has an unbalanced plug design that does not require seal rings. This eliminates any secondary leak paths that could compromise the seat leak tightness of the valve.



Unbalanced Plug and Seat Construction

Force Multiplication Actuator

The comparatively higher actuator thrust requirements due to the unbalanced design is efficiently managed by an offset actuator where loading forces are multiplied by the actuator lever arm. Flow-to-open direction is also ideal for dynamic stability and for applications requiring a reliable fail safe mode.



Typical Applications

MIL 77000 series valves are widely employed in the oil & gas sector, both upstream and downstream. The compact design is ideal for high pressure, erosive choke applications in wellheads. In the downstream refining area, during the processes of hydrocracking, hydrotreating, resid-hydrocracking and catalytic dewaxing, the control valves are required to exhibit a combination of high pressure letdown with cavitation protection, allow the passing of fine entrained particles and the handling of multi-phase flows.

MIL 77000 series has proven its reliability in these environments for over 30 years, and is endorsed by many worldwide process technology owners and licensors. It is common to see the design mentioned by name in technical specifications for industry leading processes that include hot high pressure separator and delayed coker letdown in refineries. MIL 77000 series valves are also successfully used for steam/water injection in oil fields where high pressure injection steam/water contains particulates like sand, which can clog conventional multi-stage, multi-path control valves.



In the energy sector, the common applications are startup bypass valves in super critical power plants, where the conditions can be extremely severe as the process fluid undergoes transition from liquid phase to super critical steam phase. The valve offers exceptional service in both continuous and intermittent boiler blow down applications.

HYDROCARBON PROCESSING

- High Pressure Hot-Separator Letdown of Flashing Liquid Hydrocarbons
- Delayed Coker Letdown

OIL & NATURAL GAS PRODUCTION

- Gas Pressure Reduction
- Choke Application
- Steam / Water Injection

HIGH PRESSURE SUPERHEATED STEAM

- Turbine Bypass
- Steam Vent
- Boiler Blowdown



Technical Information

Model Decodification

1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
		7	7	—	—	—
ACTUATOR TYPE		BODY SERIES		PLUG TYPE	TRIM CHARACTERISTICS	TRIM TYPE
37. Direct Spring Diaphragm 38. Reverse Spring Diaphragm 67. Direct Piston Cylinder 68. Reverse Piston Cylinder		77. Multi-stage Labyrinth Lo-dB Control Valve		0. Undefined 7. Labyrinth Lo-dB	0. Undefined 7. Mod. Linear	0. Undefined 7A. Reduced Area 7B. Full Area 7C. High Capacity Single Step

Standard Sizes / Ratings / End connections

NOMINAL VALVE SIZE (inch)	INLET		OUTLET	
	SIZE (inch)	RATING (ASME Class)	SIZE (inch)	RATING (ASME Class)
2	2	1500# & 2500#	3	2500#
			4 ⁽¹⁾	900#
3	3	1500# & 2500#	4	2500#
			6 ⁽¹⁾	600#
4	4	1500# & 2500#	6	2500#
			8 ⁽¹⁾	600#
6	6	1500# & 2500#	8	2500#

* 77000 Series valves are available only with flanged ends. For weld end, please consult MIL

⁽¹⁾ : Not available with Trim '7C'

General Data

BODY		
Type	:	Angle castings with integral bonnet and bolted outlet flange
Recommended flow direction	:	Flow to open (Side inlet - Bottom outlet)

BONNET		
Type	:	Integral to body
Temperature range	:	-27°C to 566°C

GLAND SEAL		
Type	:	Adjustable double sealed packing box with PTFE or Graphite moulded split rings
Option	:	Eco lock (Varying density for low emission, PTFE or Graphite) or PTFE V rings
Temperature range	:	≤ 180 °C PTFE, > 180 °C Graphite

TRIM		
Plug type	:	Unbalanced
Options	:	<ul style="list-style-type: none"> • Multistage, expanding labyrinth • High capacity single step (In trim 7C)
Seat type	:	Clamped (quick change) with metal seat
Guiding	:	Top & Bottom guiding
Rangeability	:	100 : 1
Characteristic	:	Mod. linear

Seat Leakage Class / Temperature Range

NOMINAL VALVE SIZE (inch)	TEMPERATURE RANGE (°C)		SEAT LEAKAGE CLASS (FCI 70.2)	
	MIN.	MAX.	STANDARD	OPTIONAL
2 - 6	-27	566	Class IV	Class V

Flow Coefficients (Rated Cv)

NOMINAL VALVE SIZE (inch)	TRIM 7A		TRIM 7B		TRIM 7C
	AREA RATIO	Cv ⁽²⁾	AREA RATIO	Cv ⁽²⁾	Cv ⁽³⁾
2	4.2	15	1.9	25	45
3	3.4	35	1.8	50	110
4	4.0	60	2.4	80	185
6	3.5	85	2.0	125	260

⁽²⁾ : Critical flow factor C_f or $F_L = 0.99$

⁽³⁾ : Critical flow factor C_f or $F_L = 0.9$

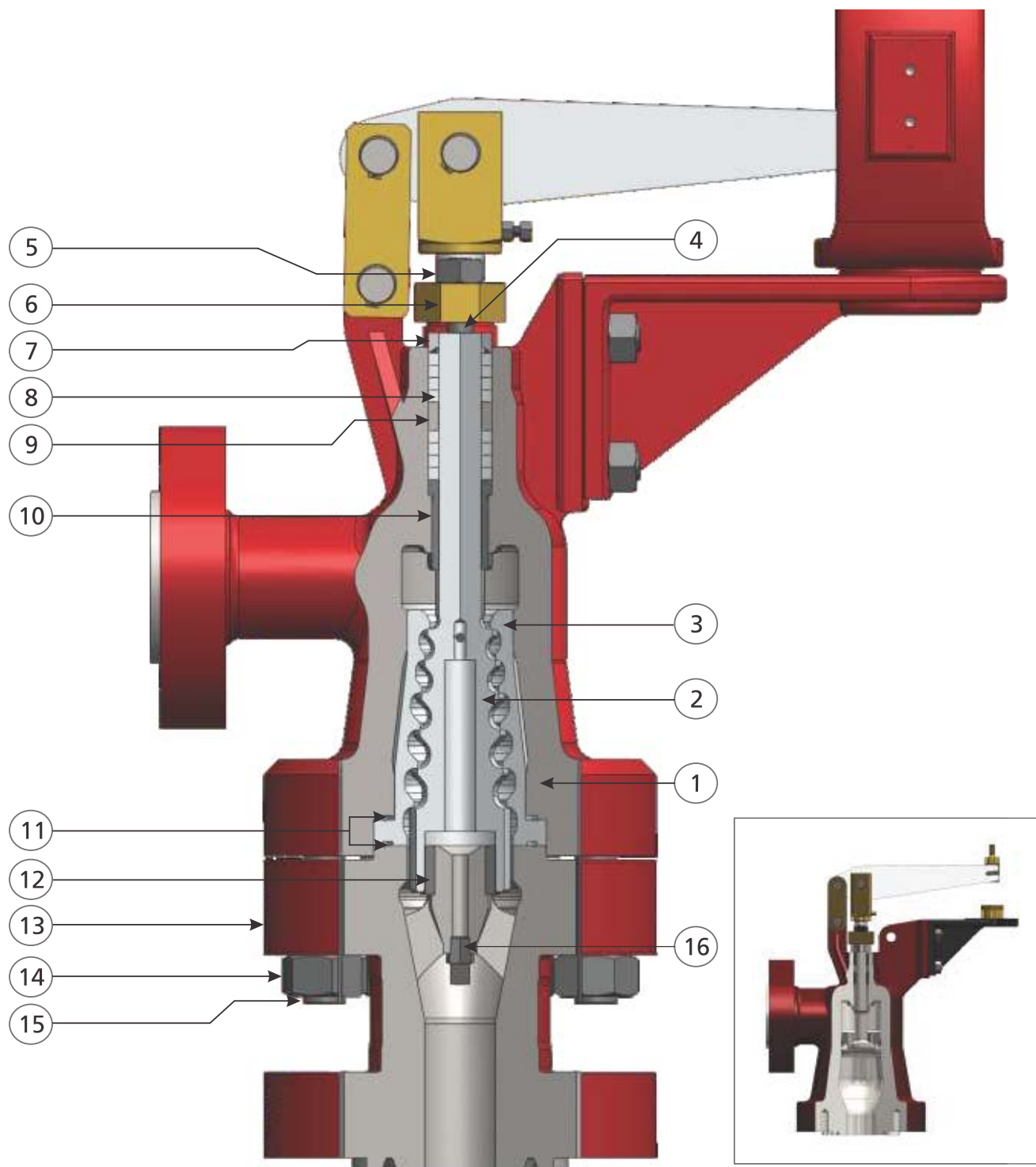
Actuator Selection (Spring Diaphragm Actuator)

NOMINAL VALVE SIZE (inch)	STROKE (inch)	ACTUATOR SIZE	ACTUATOR TYPE : 37 DIRECT* (ACTION : AIR TO OPEN)			ACTUATOR TYPE : 38 REVERSE* (ACTION : AIR TO CLOSE)		
			SPRING RANGE (psig)	SUPPLY PRESSURE (psig)	SHUT OFF PRESSURE (kg/cm ² g)	SPRING RANGE (psig)	SUPPLY PRESSURE (psig)	SHUT OFF PRESSURE (kg/cm ² g)
2	1.5	15	11-30	35	351	3-15	35	351
3	2.5	18	12-30	35	281	3-15	35	421
4	3.5	24	9-30	35	210	3-15	35	351
6	3.5	24	19-46	50	281	3-15	50	281

* In MIL 77000 series, direct actuator provides 'Air To Open' action and reverse actuator provides 'Air To Close' action.



Construction



Trim 7C

MIL 77000 Valve (Trim 7A and 7B)



MIL 77000

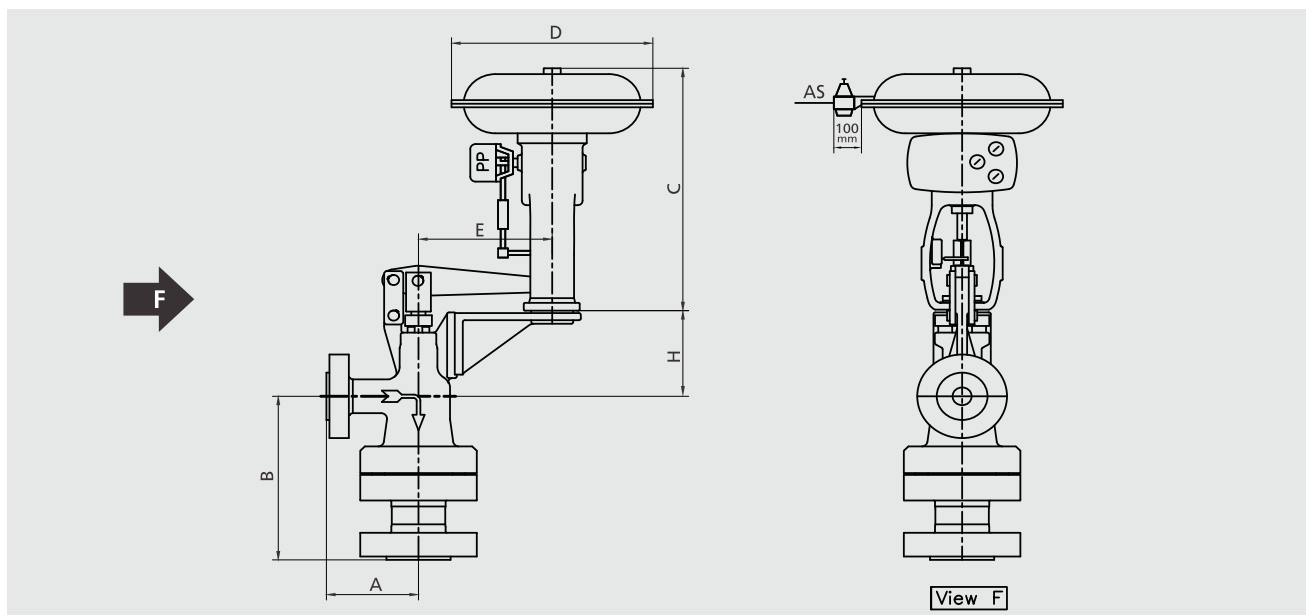
Material of Construction

DRAWING REF. NO.	PART NAME	STANDARD MATERIAL *	
1	Valve Body	Carbon Steel : ASTM A 216 Gr. WCC	
		Alloy Steel : ASTM A 217 Gr. WC6 / WC9 / C5	
		Stainless Steel : ASTM A 351 Gr. CF8 / CF8M / CF3M	
2	Valve Plug & Stem	17-4 PH SST H1075	<343 °C
		316 SST Stellited	<565 °C
3	Seat Ring	316 SST Stellited	
4	Packing Flange Stud	ASTM A 193 Gr. B8	
5	Packing Flange Nut	ASTM A 194 Gr. 8	
6	Packing Flange	EN 8 Zn Passivated	
7	Packing Follower	304 SST	
8	Packing	PTFE ≤180 °C / Graphite >180 °C	
9	Packing Spacer / Lantern Ring	304 SST	
10	Upper Guide Bush	440 C SST Heat Treated	<427 °C
		316 SST Stellited	<565 °C
11	Helicoflex Gasket	Nickel + Nimonic	
12	Lower Guide Bush	440 C SST Heat Treated	<427 °C
		316 SST Stellited	<565 °C
13	Bottom Flange	Same as Body Material	
14	Body Nut	ASTM A 194 Gr. 2H	
15	Body Stud	ASTM A 193 Gr. B7	
16	Pipe Plug	304 SST	

*Material indicated above are for reference only. MIL reserves the right to supply alternate material due to constant product upgradation. Other specific material are available on request.



Dimensions and Weights



VALVE INLET SIZE (inch)	VALVE OUTLET SIZE (inch)	DIMENSIONS (mm)					UNPACKED WEIGHT (kg)
		A	B		H	E	
			TRIM 7A & 7B	TRIM 7C			
2	3	241	460	215	240	352	220
	4			-			
3	4	292	570	300	270	430	350
	6			-			
4	6	368	730	395	360	475	650
	8			-			
6	8	406	954	508	420	560	1200

ACTUATOR SIZE	ACTUATOR TYPE : 37 DIRECT			ACTUATOR TYPE : 38 REVERSE		
	DIMENSIONS (mm)		UNPACKED WEIGHT (kg)	DIMENSIONS (mm)		UNPACKED WEIGHT (kg)
	C	D		C	D	
11	421	330	21	617	330	25
13	516	381	32	782	381	40
15	654	445	55	943	445	75
18	848*	527	82	1360*	527	178
24	870*	686	170	1505*	686	210

*Actuator height varies with spring range / stroke. Maximum height is indicated. Contact MIL for exact height.



MIL 77000

Product Highlights

Intelligent Design Principle

- Unbalanced plug design without seal rings
- Employs adiabatic flow with friction
- Labyrinth plug which provides a tortuous flow pattern
- Advanced design that eliminates the damaging erosive effects

Rugged, Anti Clog Design

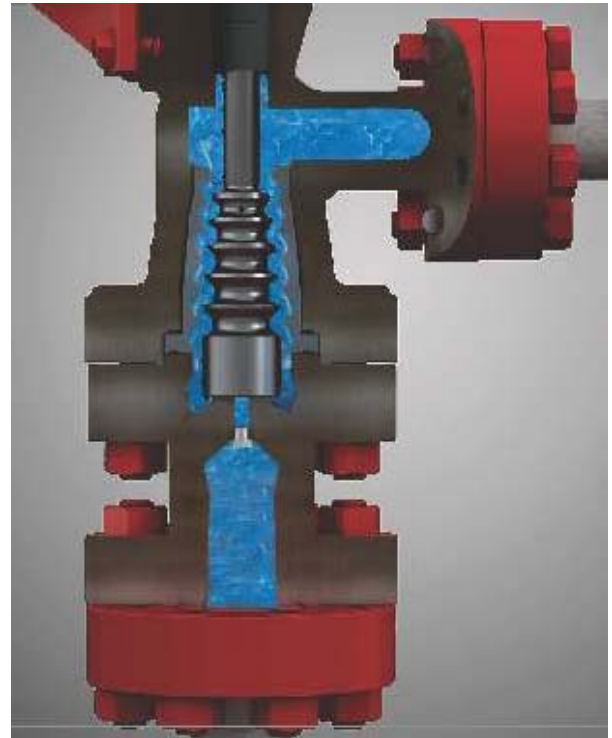
- Larger flow paths
- Smooth axial flow path allowing movement of particles

Seat Protection

- Prevents premature seat wear, avoiding unwanted and undetected leakage
- Minimized seat damage effects
- Isolation of seat from the most severe and potentially damaging pressure reduction stages

Force Multiplication Actuator

- Offset actuator to meet the higher actuator thrust requirement
- Flow-to-open direction gives dynamic stability



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