Plastic Lined Trunnion Ball Valve

Contents

Introduction

ITT Industries, Engineered Valves Group (EVG) has been an innovator and producer of valves for over fifty years. These valves have gained extensive usage in many industries including power generation, pulp and paper, refineries, chemical process, pharmaceutical/bioprocessing and pollution control. As a recognized leader in the valve business, our heritage stems from diaphragm valves.

Through the years, our product offering has grown extensively. Our corrosion handling expertise has provided the impetus for the design of quarter-turn valve products like our Cam-Line® Ball Valve.

By developing products such as the Cam-Line that address specific problems encountered in industry, we continue to expand our commitment to remain a leader in flow control.

The performance of our products is surpassed only by the care taken in the many facets of manufacturing. Excellence in quality assurance, product reliability, and product safety will always remain paramount.

ITT Industries
Engineered for life

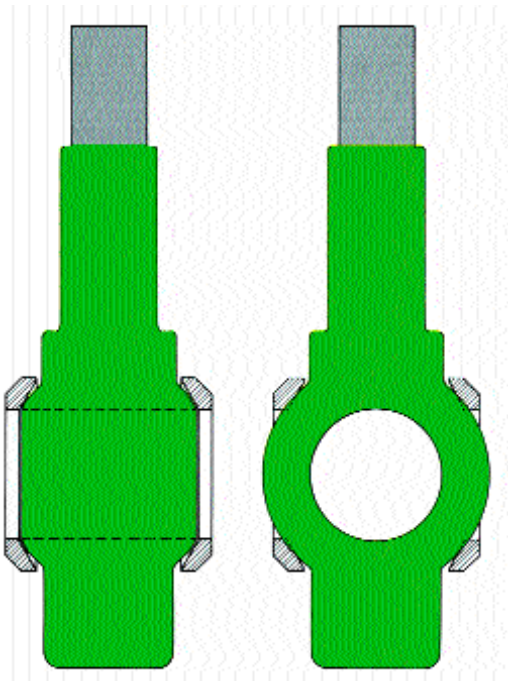
New Generation of Plastic Lined Valve

The Cam-Line trunnion ball valve was designed to overcome problems inherent in conventional lined plug and ball valves. The design objective was to produce a lined quarter-turn valve with positive shut off at high and low pressures, a valve with a stem seal that seals, and a valve that is convenient and safe to operate.

Design innovation has resulted in the valve we proudly call the Cam-Line. The Cam-Line ball valve combines the proven, patented sealing technology of the Cam-Tite ball valve with a trunnion mounting. The result is tight shut off, reliable stem seal performance, and a dramatic torque reduction never before possible in a plastic lined quarter-turn valve.

The sealing mechanism begins as a sphere with a trunnion running through its vertical center. A waterway (port) passes through the center of the sphere. Around the edge of the waterway the spherical surface is cut away, forming a bevel that passes completely around the edge of the waterway. This is a very important feature of the design since it is the difference in the effective distance across the beveled surfaces and the distance across the spherical surface that actually energizes the seat when the valve is closed.

When the valve is open the seats rest against the beveled surfaces. Sealing takes place during closure of the valve when the spherical surface of the ball engages the seats.



Open Closed

Sealing is the result of designed seat compression, not the result of pressure or of crushing components together. The resultant seal is positive at both high and low pressures. And, since load on the seats is minimized when the valve is in the open position, cold flow of the seat material is dramatically reduced, prolonging seat life. With the sealing load on the seats controlled by the geometry of the components (not external adjustments as in lined plug valves), the Cam-Line is a safe and convenient valve to operate. A 6" Cam-Line requires less than 1,250 inch pounds to operate. No gears or cheaters required here!

An important consideration when using plastics in valves is the dimensional stability of the plastic elements. Reliable performance is dependent upon maintaining design dimensions. The objective is to get two or more components to meet each other so that nothing can get by them. Dimensional stability of the lining in the seal area is thus of prime importance. Conventional plug and ball valves place high loads on the plastic linings to get a seal, but often at the expense of valve life and operating ease.

To maximize valve life, the Cam-Line ball valve uses a trunnion not only to support and center the ball, but also as a method to distribute excess hydraulic load into the valve body in non-critical areas, rather than through the seating area. Result? The Cam-Line performs better and longer, even in thermal cycling applications.

The trunnion also aids the stem seal at the top of the valve. The long trunnion shaft reduces the effects of lateral loading found in conventional ball valves and when coupled with the low operating torques, produces a seal that proves a lined valve can have a good stem seal.

Design innovation didn't stop with the basic valve. The choice of plastics and plastic processes has a direct effect on performance. So we engineered those, too. Our unique glass reinforced RTFE seats, along with a high stability TEFZEL® thermoplastic lining, complete the package.

The Cam-Line® is an innovative design that gives:

Positive Shut Off
Reliable Stem Sealing
Low Operating Torque
Convenient and Safe Operation
Long Service Life

And, to make it easy for you to use, the Cam Line® ball valve features ANSI 150# flanges with standard laying lengths and flange pad mounting.

Material Processing for Better Results

All PTFE Seats are not Created Equal

All Cam-Line seats are reinforced PTFE. The finished reinforced seats, when compared to virgin PTFE, exhibit the following performance advantages:

1. Improved dimensional stability
2. More uniform quality
3. Improved sealing characteristics

These properties, obtained through the reinforcing process, result in better sealing and longer seat life. Cam-Line reinforced PTFE seats, combined with the unique beveled edge ball design, result in superior shut-off performance.

Plastic Lining

All wetted parts of the Cam-Line are lined with plastic. Cam-Line linings are injection molded at high pressure. With injection molding we actually "build" a corrosion resistant plastic valve within the strong metal valve body. With injection molding, wall thickness can be varied to suit the mechanical requirements of the various valve sections, while minimum wall thickness is strictly controlled. In fact, all Cam-Line linings have a 3/16" minimum wall thickness. Cam-Line linings are "keyed" to the valve bore for extra stability. The one piece trunnion/ball of the Cam-Line is fully encapsulated with the plastic lining. The metal core is recessed and keyed to lock the lining in place. With the one-piece trunnion/ball design, the joint between the ball and stem as found in conventional lined ball valves is completely eliminated. You can be sure that the ball is in the position indicated by the top of the trunnion.

Experience Counts

Injection molding of plastic linings is not new to Engineered Valves Group (EVG). Initially introduced with its diaphragm valve product line, EVG has been molding plastic lined valves for the past fifty years. This experience and expertise led to the development of the patented "Boteler" method of injection molding valve linings in 1968. Over the years, thousands upon thousands of ball valves and diaphragm valves have been lined using this time proven method.

Testing

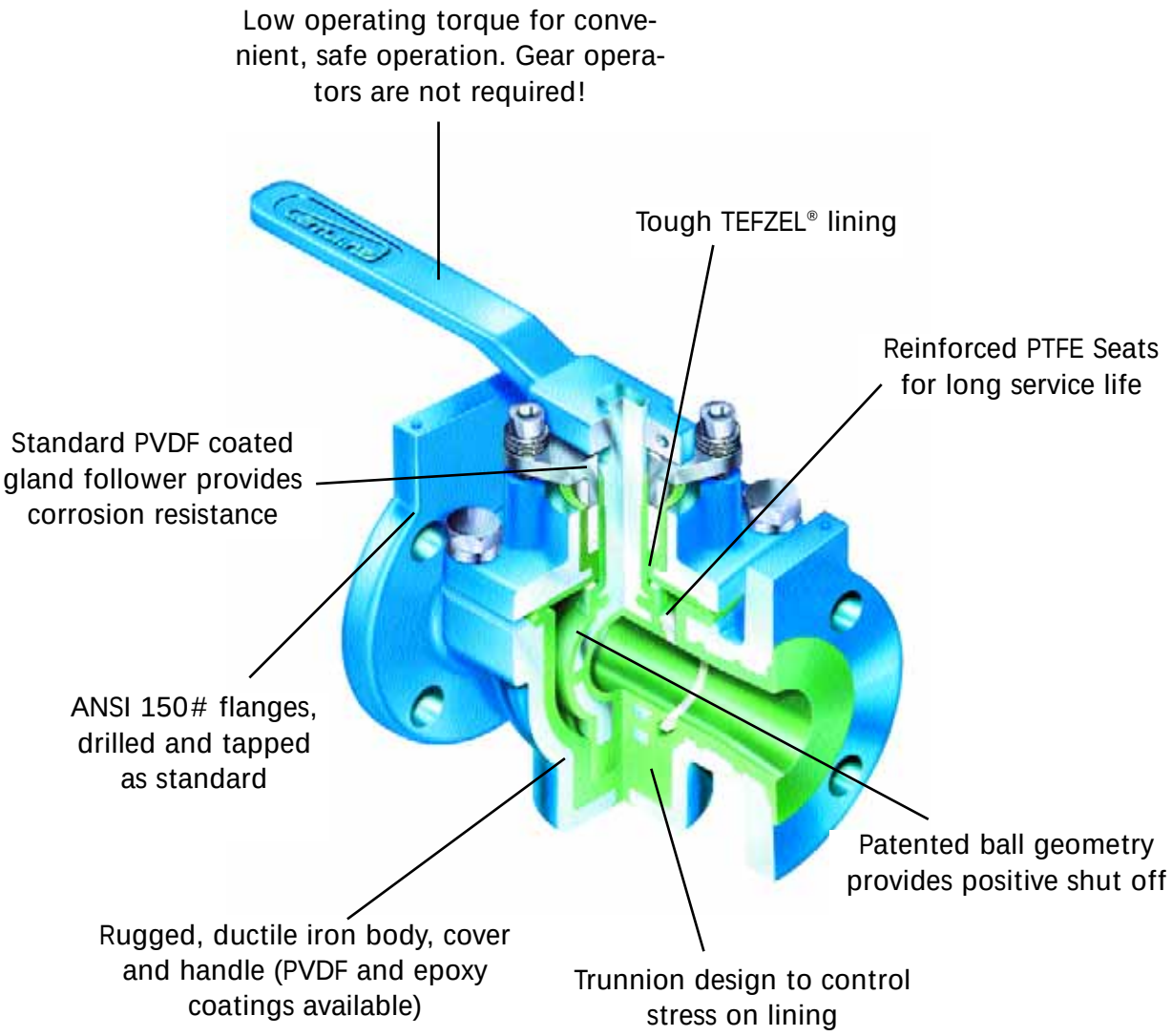
Every valve is tested prior to shipment. Both hydrostatic and seat tests (in accordance with MSS-SP-72) are performed to insure a high integrity, tight sealing valve. In addition, all plastic lined components are 100% spark tested prior to assembly to assure lining integrity.

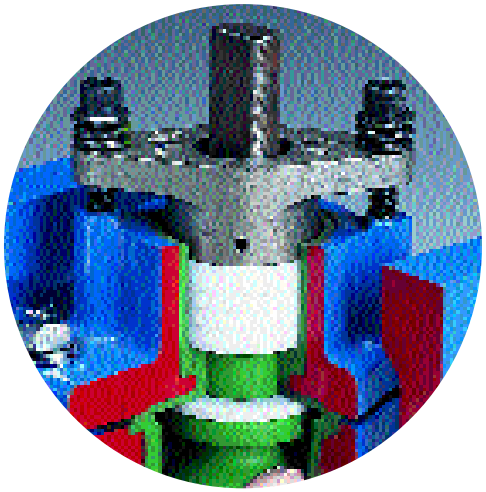
TEFZEL® Lining

TEFZEL® can best be described as a rugged thermoplastic with an outstanding balance of properties. TEFZEL® can perform successfully in applications where other materials are lacking in mechanical toughness, broad thermal capability, and the ability to meet severe environmental conditions.

Chemically, TEFZEL® is a co-polymer of ethylene and tetrafluoroethylene. Mechanically, TEFZEL® is tough, exhibits high tensile strength and hardness, and is more creep resistant than Teflon® PTFE, FEP or PFA fluorocarbon resins. The TEFZEL® used in the Cam-Line is reinforced with glass, yielding a tensile strength approaching 12,000 PSI. TEFZEL® has outstanding resistance to attack by chemicals and solvents that often cause rapid deterioration of other plastic materials. TEFZEL® is inert to strong mineral acids, inorganic bases, halogens, and metal salt solutions. Carboxylic acids, anhydrides, aromatic and aliphatic hydrocarbons, alcohols, aldehydes, ketones, ethers, chlorocarbons, and classic polymer solvents have little effect on the material.

Plastic Lined Trunnion Ball Valve



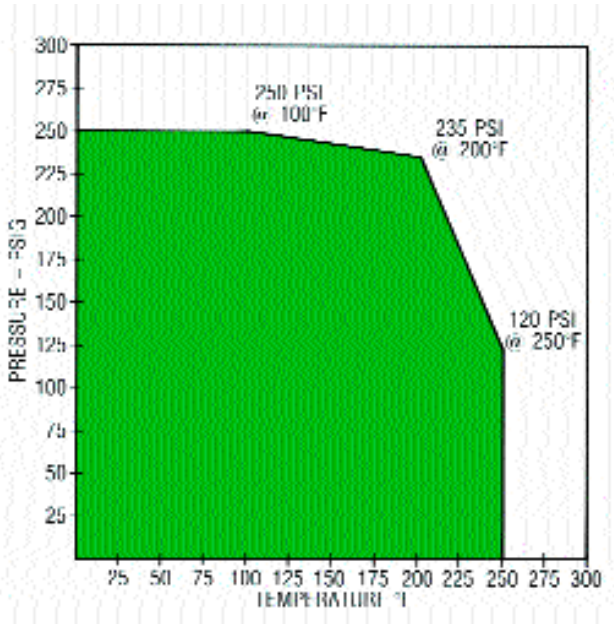


Live loaded multi-ring stem packing

From its inception the Cam-Line ball valve has utilized an emission reduction stem packing design. Multiple V-rings are placed in a deep stuffing box and are loaded via the gland follower using adjustable cap screws. Belleville spring washers are employed to maintain packing compression and to adjust for service variables.

Cam-Line® Technical Data

Pressure/Temperature Curve for Tefzel Lining Reinforced PTFE Seats



Operating Torques/Flow Coefficients (Cv)

The actual amount of torque required to operate a valve is dependent upon many variables, such as line pressure, temperature, type of fluid, frequency of operation, etc. The following tables are based on average breakaway torque requirements for a valve handling a clean, particle free liquid such as water. The torque values listed should be adjusted for special service conditions. For fluids with high solids or abrasive content, consult factory for recommendations.

When sizing an actuator for automatic operation, it is recommended not to exceed the Maximum Stem Torque as noted below. This will avoid permanent damage to the valve stem as a result of a blocked valve and an over-sized operator.

Size	Torque (in lbs.)	Max. Stem Torque (in lbs.)
3/4"-1"	120	709
1 1/2"	130	1870
2"	280	1870
3"	500	3030
4"	800	5740
6"	1250	24500

Flow Coefficients (Cv)	
3/4"-1"	30
1 1/2"	73
2"	160
3"	355
4"	751
6"	800

Based on water flowing at 68°F

Cam-Line® Options

External Protection with Corrosion Resistant PVDF

For ultimate exterior corrosion protection in aggressive chemical environments, Cam-Line ball valves can be externally coated with PVDF. A popular feature of the Dia-Flo® Diaphragm Valve, this optional 6-8 mil coating is applied to all ductile iron components of the Cam-Line prior to the valve being lined. The result is a mechanically tough coating that is resistant to spills, splash, and corrosive atmospheres at temperatures to 200°F. TEFZEL® lined Cam-Line ball valves coated with PVDF are equipped with stainless steel fasteners to enhance total corrosion resistance.

Cam-Line® Options (continued)

Locking Devices

When required, Cam-Line ball valves can be supplied with a locking handle device to provide lockout in both the open and closed positions. These locking devices, designed to meet the requirements of OSHA 1910.147, can be supplied with new valves or can be retrofit to existing valves which have drilled and tapped flange pads. Stainless steel is the standard material of construction for the Cam-Line locking device. Use suffix “LDS” in the configuration number to specify this lockout feature.

Cavity Vents/Chlorine Service

When specified, Cam-Line ball valves can be provided with a vented seat to relieve excess pressure within the body cavity. Such valves are unidirectional and include an external tag with an arrow to indicate the direction of seat tightness. Use suffix “V” in the configuration number to specify a vented cavity only. Use “CLV” to specify a vented valve prepared for chlorine service. Note: As the Cam-Line is an ANSI 150# design, Engineered Valves Group (EVG) only recommends the valve for Class 1 dry chlorine gas service.

Grounding Devices

Upon request Cam-Line ball valves can be equipped with a grounding strap to provide electrical continuity between all metal components. Grounded valves receive a continuity test prior to shipment to assure a resistance reading less than 5 ohms. Use suffix “G” in the configuration number to specify a grounding device.

Oxygen Service

Cam-Line ball valves can be prepared for oxygen service. Oxygen preparation includes special cleaning, assembly, testing, and packaging. Valves prepared for oxygen service are lubricated with Krytox® 206 and are equipped as standard with a grounding strap. Use suffix “OX” in the configuration number to specify oxygen preparation.

Handle Options

The unique low torque design of the Cam-Line allows the use of lever handles throughout the entire size range. In addition to the standard lever handles, the following handle options can be supplied:

- Oval Safety Handwheels (through 2")
- 45° T Handles for chain operation (specify valve in vertical or horizontal position)
- Extended Handles (specify extension length)

For additional information on how to order the above options, see page 16 of the catalog. For additional technical information, contact your Engineered Valves Group (EVG) Technical Sales Representative.

Actuated Valves

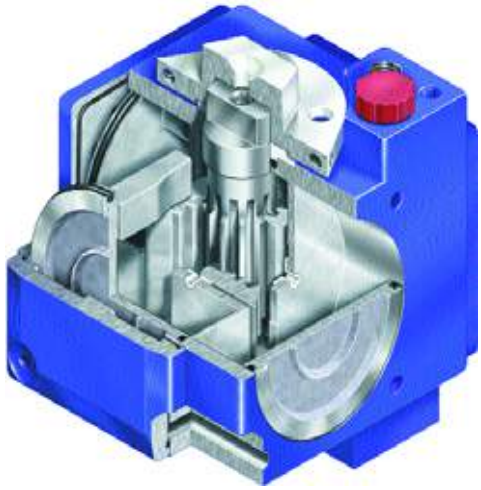
With its simple, 90 degree rotation, the Cam-Line ball valve can be easily supplied with a variety of quarter-turn operators for automated valve service. Utilizing flange pads for actuator mounting, the low torque design of the Cam-Line allows smaller, less costly actuation devices to be employed.

Another advantage of actuating the Cam-Line comes from the camming action of the ball. Since there is virtually no load on the seats when the valve is in the open position, there is no high "breakaway torque" associated with beginning the closing cycle. The actuator is able to start motion from the open position with little resistance. Only when the valve is essentially closed does the actuator see the design torque of the valve. This operation is extremely beneficial for "fail closed" valves in hostile service conditions.

The Cam-Line ball valve can be equipped with a wide range of actuator types (pneumatic and electric) and can be packaged with an assortment of accessory components, such as solenoid valves and limit switches.

Compact Actuator

The Compact quarter-turn pneumatic actuator has been developed to be a simple, reliable, and efficient valve operator by utilizing a patented rack and pinion design. Four separate racks, each driven by its own piston, develop torque around the centrally located pinion. The four rack concept permits operating air pressure to be applied to four pistons simultaneously, increasing torque output and reducing piston diameter and overall actuator size, compared to single and double rack



designs. Symmetrically spaced at 90 degree angles around the central pinion, the Compact's four racks also achieve a more uniform load distribution between the rack and pinion, greatly reducing gear wear at these contact points and curbing stress on the pinion and piston seals. The result is a high cycle actuator design.

A look at the design of the Compact reveals several other important product advantages:

- Minimal air consumption
- Energy efficiency
- Fast response
- Compact, lightweight shape.

The table below shows the Compact actuator sizing for Cam-Line ball valves. This table is based on standard operating torques for a valve handling a clean, particle-free liquid such as water. For dirty fluids or media with high solids or abrasive contents, consult the factory for sizing recommendations.

Compact Actuator Sizing for Cam-Line® Ball Valve

Valve Size	Available Operating Air			
	Double Acting		Spring Return-Fail Close	
	60 PSI	80 PSI	60 PSI	80 PSI
3/4-1"	H20DA	H20DA	H25-2A2B	H25-2C
1-1/2"	H20DA	H20DA	H30-2A2B	H25-2C
2"	H25DA	H25DA	H35-2A2B	H30-2C
3"	H30DA	H25DA	H45-2A2B	H35-2C
4"	H35DA	H30DA	H60-2A2B	H45-2C
6"	H45DA	H35DA	H60-2A2B	H60-2C

Sizing based on 25% safety factor. If application is for gases, viscous or crystallizing liquids, contact factory for actuator sizing.

Torque Chart (In Lb.)

Double Acting

2A – Inner and middle springs

2AB – In opposing pistons:
Inner and middle springs
Inner and outer springs

2C – Middle and outer springs

3 – All three springs

Actuator Size	Air Pressure (PSI)			
	60	80	100	120
20	238	318	398	478
25	480	640	800	960
30	806	1074	1343	1611
35	1412	1882	2353	2824
45	2719	3626	4532	5438
60	6446	8595	10744	12893
75	11295	15060	18825	22590

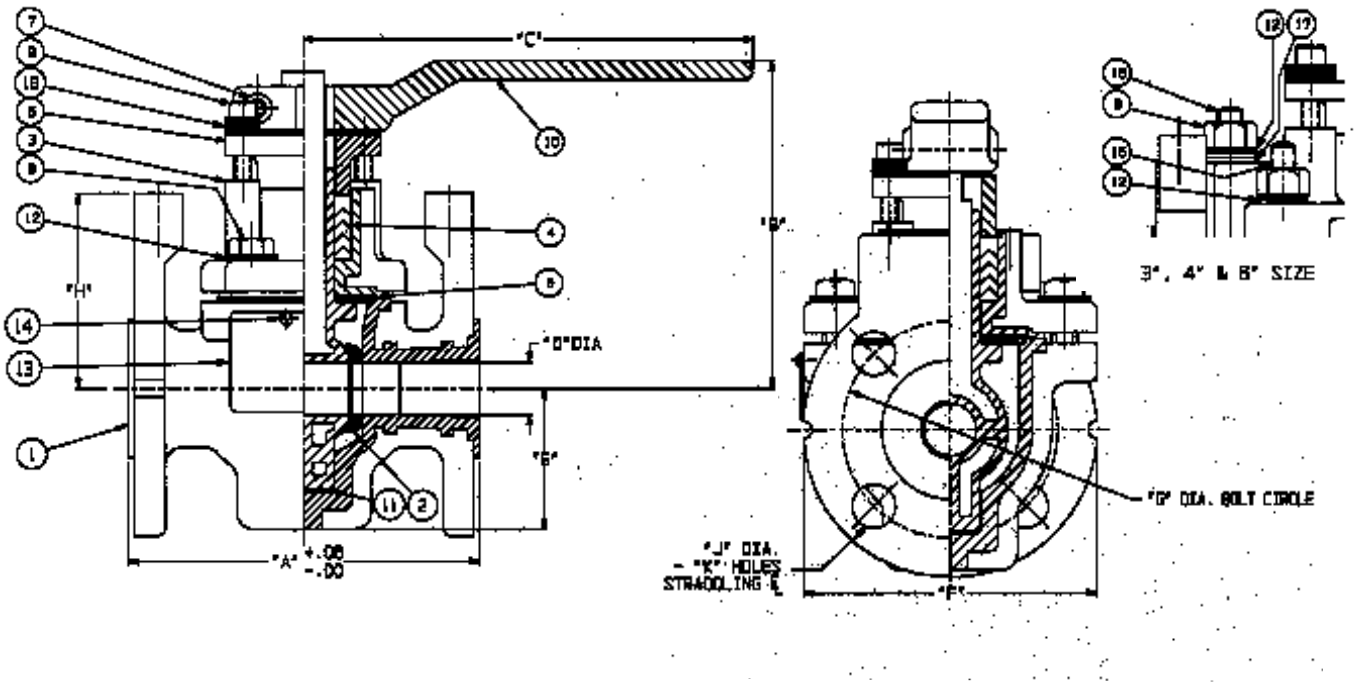
Torque values are in in/lbs

Spring Return

Actuator Size	No. of Springs	Air Pressure (PSI)								Spring Torque Maximum	
		60		80		100		120			
		AIR START	AIR END	AIR START	AIR END	AIR START	AIR END	AIR START	AIR END	SPRG START	SPRG END
20	2A	158	104							115	68
	2A2B	145	79	231	162					140	81
	2C			191	97	269	173	358	249	205	121
	3			165	60	243	136	331	212	242	147
25	2A	331	200							242	128
	2A2B	310	162	481	328					280	146
	2C			419	207	576	359	733	511	401	208
	3			371	116	528	268	685	420	492	256
30	2A	556	351							391	210
	2A2B	521	286	808	564					456	245
	2C			703	369	966	625	1229	879	651	350
	3			634	239	897	495	1160	749	781	419
35	2A	962	538							761	379
	2A2B	916	441	1419	929					859	425
	2C			1212	520	1674	967	2135	1415	1268	632
	3			1068	266	1548	713	2009	1161	1522	758
45	2A	1828	985							1516	755
	2A2B	1733	794	2702	1737					1708	850
	2C			2295	919	3183	1779	4071	2640	2526	1258
	3			2043	414	2931	1274	3819	2135	3031	1510
60	2A	4431	2499							3431	1693
	2A2B	4222	2062	6521	4297					3868	1902
	2C			5602	2447	7708	4489	9814	6530	5718	2821
	3			5040	1303	7146	3345	9252	5386	6862	3383
75	2A	7332	4538							5853	3059
	2A2B	6948	3798	11316	7714					6593	3443
	2C			9661	4552	13351	8129	17040	11706	9755	5098
	3			8642	2600	12332	6177	16021	9754	11707	6117

Torque values are in in/lbs

Dimensions for Manual Valves, Materials of Construction



Inches

Valve Size	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	Weight-Lbs
3/4"	5.00	4.72	6.50	0.75	2.03	4.25	2.75	2.81	*	4	8.7
1"							3.12		0.62		9.5
1-1/2"	6.50	5.06	8.50	1.12	2.59	5.00	3.88	3.00	0.62		17.5
2"	7.00	5.38		1.50	3.03	6.00	4.75	3.12	0.75		24.0
3"	8.00	6.47	13.50	2.25	3.91	7.50	6.00	4.31	*0.75		49.5
4"	9.00	7.38		3.00	4.72	9.00	7.50	4.88	*0.75	8	71.0
6"	10.50	9.06	16.56	4.00	6.21	11.00	9.50	6.12	*0.88		148.0

MM

Valve Size	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	Weight-Kgs
3/4"	127.0	119.9	165.1	19.1	51.6	108.0	70.0	71.4	*	4	3.9
1"							79.2		15.7		4.3
1-1/2"	165.1	128.5	215.9	28.4	65.8	127.0	98.6	76.2	15.7		7.9
2"	177.8	136.7		38.1	77.0	152.4	120.7	79.2	19.1		10.8
3"	203.2	164.3	342.9	57.2	99.3	190.5	152.4	109.5	*19.1		22.3
4"	228.6	187.5		76.2	119.9	228.6	190.5	124.0	*19.1	8	32.0
6"	266.7	230.1	420.6	101.6	157.7	279.4	241.3	155.4	*22.4		66.6

* 3/4" 150 Lb. class flanged bolt holes are tapped 1/2"-13 UNC class 2B.

Top two flanged bolt holes on 3" & 4" 150 Lb. class valves are drilled and tapped 5/8"-11 UNC class 2B

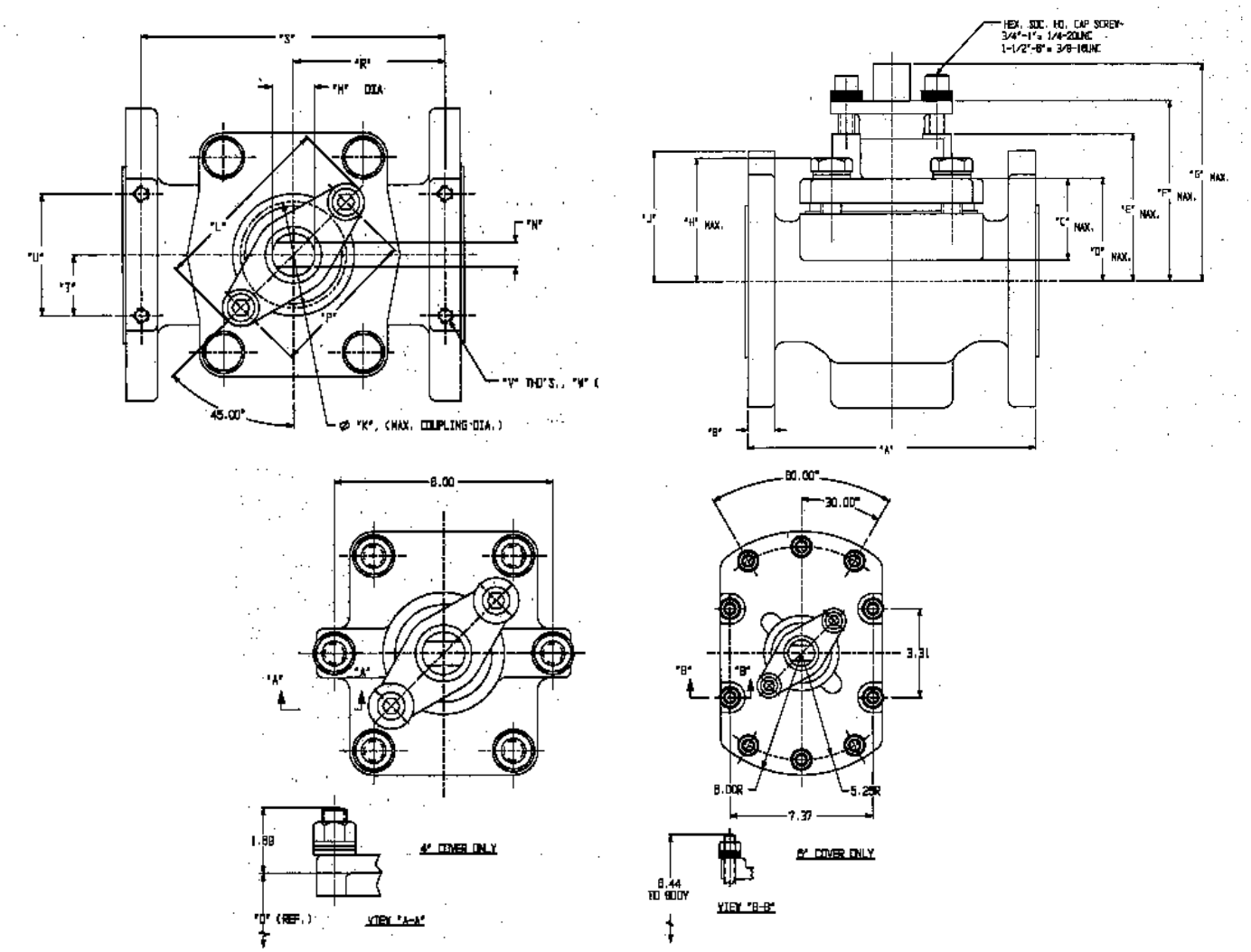
Top four flanged bolt holes on a 6" 150 Lb. class valve are drilled and tapped 3/4"-10 UNC class 2B.

Materials			
Item	Description	Material	Qty
1	Body (Lined)	DI ASTM A395 GR. 60-40-18	1
2	Seat	Reinforced PTFE	2
3	Cover (Lined)	DI ASTM A395 GR. 60-40-18	1
4	Packing, "V"-Ring (Complete Set)	PTFE	1
5	Follower, Gland-PVDF Coated	DI ASTM A536 GR. 65-45-12	1
6*	Washer, Thrust	PTFE	1
6**	O-Ring		
7	Screw, Hex Soc. Hd. Cap	CS	1
8	Screw, Hex Hd. Cap	CS ASTM A193-B7	4
8+	Nut, Hvy. Hex	CS ASTM A-194-2H	4
8#			6
8##			10
9	Screw, Hex Soc. Hd. Cap	CS	2
10	Handle	DI ASTM A536 GR. 65-45-12	1
11	Ball/Stem (Lined)	DI ASTM A536 GR. 65-45-12	1
12	Washer, Belleville	SS	8
12#			12
12##			20
13	Plate, Identification	SS	1
14	Screw, Drive	CS	2
15	Stud	CS ASTM A-193-B7	4
15##			6
16#	Stud		2
16##			4
17#	Flat Washer	SS	2
17##			4
18	Washer, Belleville	SS	12
	Lubricant	Dupont KRYTOX® GPL-206	

\+ 3" only # 4" only ## 6" only

* 3/4" only ** 4" and 6" only

Dimensions for Actuator Mounting



Inches

Valve Size	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	"N"	"P"	"R"	"S"	"T"	"U"	"V"	"W"
3/4" & 1"	4.88	.46	1.19	1.88	3.06	3.72	4.56	2.20	2.81	1.84	2.98	.62	.367/.363	2.469	2.10	4.19	.87	1.75	5/16-18UNC	.62
1-1/2"	6.38	.58	1.44	2.06	3.25	4.06	4.88	2.54	3.00	2.16	3.83	.88	.492/.488	3.062	2.81	5.62	.87	1.75	5/16-18UNC	.62
2"	6.88	.64	2.03	2.53	3.59	4.53	5.22	3.04	3.12	2.16	3.83	.88	.492/.488	3.062	3.10	6.19	1.12	2.25	5/16-18UNC	.62
3"	7.88	.78	1.94	3.12	4.31	5.25	6.16	4.06	4.31	2.81	5.07	1.00	.617/.613	4.062	3.56	7.12	1.75	3.50	3/8-16UNC	.75
4"	8.88	.97	2.19	3.62	5.09	5.97	7.09	4.38	4.88	2.69	5.07	1.25	.742/.738	4.062	4.00	8.00	2.00	4.00	7/16-14UNC	1.00
6"	10.38	1.03	2.41	5.03	6.44	7.69	8.82	5.88	6.12	3.81	6.19	2.00	1.242/1.238	5.188	4.66	9.31	2.56	5.12	7/16-14UNC	1.00

MM

Valve Size	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	"N"	"P"	"R"	"S"	"T"	"U"	"V"	"W"
3/4" & 1"	124.0	11.7	30.2	47.8	77.7	94.5	115.8	55.9	71.4	46.7	75.7	15.8	9.32/9.22	62.7	53.3	106.4	22.1	44.4	5/16-18UNC	15.8
1-1/2"	162.1	14.7	36.6	52.3	82.6	103.1	124.0	64.5	76.2	54.9	97.3	22.4	12.50/12.40	77.8	71.4	142.8	22.1	44.4	5/16-18UNC	15.8
2"	174.8	16.3	51.6	64.3	91.2	115.1	132.6	77.2	79.2	54.9	97.3	22.4	12.50/12.40	77.8	78.7	157.2	28.4	57.2	5/16-18UNC	15.8
3"	200.2	19.8	49.3	79.2	109.5	133.4	156.5	103.1	109.5	71.4	128.8	25.4	15.67/15.57	103.2	90.4	180.8	44.4	88.9	3/8-16UNC	19.0
4"	225.6	24.6	55.6	91.9	129.3	151.6	180.1	111.2	124.0	68.3	128.8	31.8	18.85/18.75	103.2	101.6	203.2	50.8	101.6	7/16-14UNC	25.4
6"	263.7	26.2	61.2	127.8	163.6	195.3	224.0	149.4	155.4	96.8	157.2	50.8	31.55/31.45	131.8	118.4	236.5	65.0	130.0	7/16-14UNC	25.4

Service Guide

Data, recommendations, and suggestions contained herein are based on experiences in actual field applications as well as common corrosion data. However, because of so many possible variances in practices from plant to plant, these recommendations are intended for use only as a guide and should not be interpreted as a guarantee.

Selections in the following pages have been made with safety and serviceability as the foremost considerations.

Many variables enter into the question of serviceability. Factors such as concentration, temperature, pressure, velocity, percent solids, temperature cycling, vacuum, cleaning practices, etc. are all important in determining whether or not a particular material will give satisfactory service.

Of the endless number of chemical compounds many are insoluble in water and would consequently cause no corrosion problems when in water. However, some of these simple services can become difficult when it is necessary to make such materials soluble through use of some other solvent. For example, sulfuric acid is commonly used as a solvent for silver chloride. Then the recommendation must take into account both silver chloride and sulfuric acid. As a general rule, it is recommended that pipeline or tank material be used for the valve body whenever possible.

		Max Use Temp.	
	Chemical	°F	°C
A	Acetaldehyde	200	95
	Acetamide	250	120
	Acetic Acid (50%)	250	120
	Acetic Acid (Glacial)	230	110
	Acetic Anhydride	300	150
	Acetone	150	65
	Acetone (50% H_20)	150	65
	Acetonitrile	150	65
	Acetophenone	300	150
	Acetylchloride	150	65
	Acetylene	250	120
	Acetylene Tetrabromide	300	150
	Acetylene Tetrachloride	300	150
	Acrylonitrile	150	65
	Adipic Acid	275	135
	Air	300	150
	Allyl Alcohol	212	100
	Allyl Chloride	212	100
	Aluminum Ammonium Sulfate	300	150
	Aluminum Chloride	300	150
	Aluminum Fluoride	300	150
	Aluminum Hydroxide	300	150
	Aluminum Nitrate	300	150
	Aluminum Oxychloride	300	150
	Aluminum Potassium Sulfate	300	150
	Amino Acids (H_20)	212	100
	Ammonia (Anhydrous)	300	150
	Ammonia (Aqueous 30%)	230	110
	Ammonium Bifluoride	300	150
	Ammonium Bromide (50%)	275	135
	Ammonium Carbonate	300	150
	Ammonium Chloride	300	150
	Ammonium Dichromate	275	135
	Ammonium Dichromate	275	135
	Ammonium Fluoride	300	150
	Ammonium Hydroxide	300	150
	Ammonium Nitrate (Conc.)	230	110

		Max Use Temp.	
	Chemical	°F	°C
	Ammonium Perchlorate	275	135
	Ammonium Persulfate	150	65
	Ammonium Phosphate	300	150
	Ammonium Sulfate	300	150
	Ammonium Sulfide	300	150
	Ammonium Thiocyanate	300	150
	Amyl Acetate	250	120
	Amyl Alcohol	300	150
	Amyl Chloride	300	150
	Aniline	230	110
	Aniline Hydrochloride (10%)	150	65
	Anthraquinone	275	135
	Anthraquinone-Sulfonic Acid	275	135
	Antimony Trichloride	212	100
	Aqua Regia	212	100
	Arsenic Acid	300	150
B	Barium Carbonate	300	150
	Barium Chloride	300	150
	Barium Hydroxide	300	150
	Barium Sulfate	300	150
	Barium Sulfide	300	150
	Battery Acid	250	120
	Benzaldehyde	212	100
	Benzene	212	100
	Benzene Sulfonic Acid	212	100
	Benzoic Acid	275	135
	Benzoyl Chloride	150	65
	Benzyl Alcohol	300	150
	Barium Sulfate	300	150
	Barium Sulfide	300	150
	Battery Acid	250	120
	Benzaldehyde	212	100
	Benzene	212	100
	Benzene Sulfonic Acid	212	100
	Benzoic Acid	275	135
	Benzoyl Chloride	150	65
	Benzyl Alcohol	300	150

	Max Use Temp.	
Chemical	°F	°C
Benzyl Chloride	300	150
Bismuth Carbonate	300	150
Black Liquor	300	150
Bleach (12.5% Cl_2)	212	100
Borax	300	150
Boric Acid	300	150
Brine	300	150
Bromic Acid	250	120
Bromine (Dry)	150	65
Bromine Water (10%)	230	110
mono-Bromobenzene	212	100
Bromoform	212	100
m-Bromotoluene	212	100
Butadiene	250	120
Butane	300	150
Butanediol	275	135
Butyl Acetate	230	110
Butyl Acrylate	230	110
n-Butyl Alcohol	300	150
sec-Butyl Alcohol	300	150
tert-Butyl Alcohol	300	150
n-Butylamine	120	50
sec-Butylamine	120	50
tert-Butylamine	120	50
di-n-Butyl Amine	230	110
tri-n-Butyl Amine	230	110
Butylene	300	150
Butyl Bromide	300	150
Butyl Chloride	300	150
n-Butyl Mercaptan	300	150
Butyl Phenol	230	110
Butyl Phthalate	150	65
Butyraldehyde	212	100
Butyric Acid	250	120
Calcium Bisulfate	300	150
Calcium Bisulfide	300	150
Calcium Carbonate	300	150
Calcium Chlorate	300	150
Calcium Chloride	300	150
Calcium Hydroxide	300	150
Calcium Hypochlorite	300	150
Calcium Nitrate	300	150
Calcium Oxide	275	135
Calcium Sulfate	300	150
Calcium Sulfide	250	120
Caprylic Acid	212	100
Carbon Dioxide (Dry)	300	150
Carbon Dioxide (Wet)	300	150
Carbon Disulfide	150	65
Carbon Monoxide	300	150
Carbon Tetrachloride	150	65
Carbonic Acid	300	150

	Max Use Temp.	
Chemical	°F	°C
Castor Oil	300	150
Caustic Potash (10 and 50%)	212	100
Caustic Soda (10 and 50%)	212	100
Cellosolve®	300	150
Chloral Hydrate	212	100
Chlorinated Brine	250	120
Chlorinated Phenol	212	100
Chlorine (Dry)	212	100
Chlorine (Wet)	250	120
Chlorine Dioxide	250	120
Chloroacetic Acid (50% H_20)	230	110
Chlorobenzene	212	100
Chlorobenzyl Chloride	150	65
Chloroform	212	100
Chlorohydrin (Liquid)	150	65
Chlorosulphonic Acid	75	25
Chromic Acid (50%)	150	65
Chromic Chloride	212	100
Chromyl Chloride	212	100
Clorox Bleach Solution (5-1/2% Cl_2)	212	100
Coal Gas	212	100
Copper Chloride	300	150
Copper Cyanide	300	150
Copper Fluoride	300	150
Copper Nitrate	300	150
Copper Sulfate	300	150
Cresol	275	135
Cresylic Acid	275	135
Croton aldehyde	212	100
Crude Oil	300	150
Cyclohexane	300	150
Cyclohexanol	250	120
Cyclohexanone	300	150
DDT	212	100
Decalin	250	120
Decane	300	150
Dextrin	300	150
Diacetone Alcohol	212	100
1,2-Dibromopropane	200	95
Dibutyl Phthalate	150	65
Dichloroacetic Acid	150	65
o-Dichlorobenzene	150	65
Dichloroethylene	150	65
Dichloropropionic Acid	150	65
Diesel Fuels	300	150
Diethyl Benzene	275	135
Diethyl Cellosolve	300	150
Diethyl Ether	212	100
Diethylamine	230	110
Diglycolic Acid	212	100
Diisobutyl Ketone	230	110
Diisobutylene	275	135

	Max Use Temp.	
Chemical	°F	°C
Dimethyl Formamide	250	120
Dimethyl Phthalate	212	100
Dimethyl Sulfate	150	65
Dimethyl Sulfoxide	212	100
Dimethylamine	120	50
Dimethylaniline	275	135
Dioctyl Phthalate	150	65
p-Dioxane	150	65
Diphenyl Ether	175	80
Divinyl Benzene	175	80
E Epichlorhydrin	150	65
Ethyl Acetate	150	65
Ethyl Acrylate	212	100
Ethyl Alcohol	300	150
Ethyl Chloride	300	150
Ethyl Chloroacetate	212	100
Ethyl Cyanoacetate	212	100
Ethylacetoacetate	150	65
Ethylamine	100	40
Ethylene Bromide	300	150
Ethylene Chloride	300	150
Ethylene Chlorohydrin	150	65
Ethylene Diamine	120	50
Ethylene Glycol	300	150
Ethylene Oxide	230	110
F Fatty Acids	300	150
Ferric Chloride (50% in H_20)	300	150
Ferric Hydroxide	300	150
Ferric Nitrate	300	150
Ferric Sulfate	300	150
Ferrous Chloride	300	150
Ferrous Hydroxide	300	150
Ferrous Nitrate	300	150
Ferrous Sulfate	300	150
Fluorine (Gaseous)	100	40
Fluoroboric Acid	275	135
Fluosilicic Acid	275	135
Formaldehyde (37% in H_20)	230	110
Formic Acid	275	135
FREON® 11	230	110
FREON® 12	230	110
FREON® 22	230	110
Fuel Oil	300	150
Fumaric Acid	200	95
Furane	150	65
Furfural	212	100
G Gallic Acid	212	100
Gas-Manufactured	300	150
Gas-Natural	300	150
Gasoline-Leaded	300	150
Gasoline-Sour	300	150
Gasoline-Unleaded	300	150

	Max Use Temp.	
Chemical	°F	°C
Glycerol	300	150
Glycol	275	135
Glycolic Acid	250	120
H Heptane	300	150
Hexane	300	150
Hydrazine	100	40
Hydrazine Dihydrochloride	125	50
Hydriodic Acid	300	150
Hydrobromic Acid (50%)	300	150
Hydrochloric Acid (20%)	300	150
Hydrochloric Acid (Conc.)	300	150
Hydrochloric Acid (Gas)	300	150
Hydrocyanic Acid	300	150
Hydrofluoric Acid (35%)	275	135
Hydrofluoric Acid (70%)	250	120
Hydrofluoric Acid (100%)	230	110
Hydrofluorosilicic Acid	300	150
Hydrogen	300	150
Hydrogen Cyanide	300	150
Hydrogen Peroxide (30%)	250	120
Hydrogen Peroxide (90%)	150	65
Hydrogen Phosphide	150	65
Hydrogen Sulfide (Dry)	300	150
Hydrogen Sulfide (Wet)	300	150
Hydroquinone	250	120
Hypochlorous Acid	300	150
I Inert Gases	300	150
Iodine (Dry)	230	110
Iodine (Wet)	230	110
Iodoform	230	110
Isobutyl Alcohol	275	135
Isopropylamine	120	50
J Jet Fuel-JP4	230	110
Jet Fuel-JP5	230	110
L Lactic Acid	250	120
Lard Oil	300	150
Lauric Acid	250	120
Lauryl Chloride	275	135
Lauryl Sulfate	250	120
Lead Acetate	300	150
Linoleic Acid	275	135
Linseed Oil	300	150
Lithium Bromide (Saturated)	250	120
Lithium Hydroxide	300	150
Lubricating Oil	300	150
M Magnesium Carbonate	300	150
Magnesium Chloride	300	150
Magnesium Hydroxide	300	150
Magnesium Nitrate	300	150
Magnesium Sulfate	300	150
Maleic Acid	275	135
Maleic Anhydride	200	95

	Max Use Temp.	
Chemical	°F	°C
Malic Acid	275	135
Mercuric Chloride	275	135
Mercuric Cyanide	275	135
Mercuric Nitrate	275	135
Mercury	275	135
Methacrylic Acid	200	95
Methane	250	120
Methane Sulfonic Acid (50%)	230	110
Methyl Alcohol	300	150
n-Methylaniline	250	120
Methyl Benzoate	250	120
Methyl Bromide	300	150
Methyl Cellosolve®	300	150
Methyl Chloride	200	95
Methyl Chloroform	150	65
Methyl Chloromethyl Ether	175	80
Methyl Cyanoacetate	175	80
Methyl Ethyl Ketone	230	110
Methyl Isobutyl Ketone	230	110
Methyl Methacrylate	175	80
Methyl Salicylate	200	95
Methyl Sulfuric Acid	212	100
Methyl Trichlorosilane	200	95
Methylene Bromide	212	100
Methylene Chloride	212	100
Methylene Iodide	212	100
Mineral Oil	300	150
Monochlorobenzene	230	110
Monoethanolamine	150	65
Morpholine	150	65
N Naphtha	300	150
Naphthalene	300	150
Nickel Chloride	300	150
Nickel Nitrate	300	150
Nickel Sulfate	300	150
Nicotine	212	100
Nicotinic Acid	250	120
Nitric Acid (50%)	150	65
Nitric Acid (Conc. 70%)	75	25
Nitric Acid-Sulfuric Acid (50/50)	212	100
Nitrobenzene	300	150
Nitrogen Dioxide	212	100
Nitrogen Gas	300	150
Nitromethane	212	100
Nitrous Acid	212	100
O Octane	300	150
Octene	300	150
Oleic Acid	275	135
Oleum	120	50
Oxalic Acid	230	110
Oxygen	300	150
Ozone (<1% in Air)	212	100

	Max Use Temp.	
Chemical	°F	°C
P Palmitic Acid	275	135
Perchlorethylene	275	135
Perchloric Acid (10%)	230	110
Perchloric Acid (72%)	150	65
Petrolatum	300	150
Petroleum	300	150
Petroleum Ether	212	100
Phenol (10%)	230	110
Phenol (100%)	212	100
Phenolsulfonic Acid	212	100
Phenylhydrazine	212	100
Phenylhydrazine Hydrochloride	212	100
o-Phenylphenol	212	100
Phosgene	212	100
Phosphoric Acid (30%)	300	150
Phosphoric Acid (85%)	275	135
Phosphorus Oxychloride	221	100
Phosphorus Pentachloride	212	100
Phosphorus Pentoxide	230	110
Phosphorus Trichloride	250	120
Phthalic Acid	212	100
Phthalic Anhydride	212	100
Picric Acid	125	50
Polyvinyl Acetate	300	150
Polyvinyl Alcohol	300	150
Potassium Aluminum Chloride	300	150
Potassium Aluminum Sulfate (50%)	300	150
Potassium Bicarbonate	300	150
Potassium Borate	300	150
Potassium Bromate	300	150
Potassium Bromide	300	150
Potassium Carbonate	300	150
Potassium Chlorate	300	150
Potassium Chloride	300	150
Potassium Chromate	300	150
Potassium Cyanide	300	150
Potassium Dichromate	300	150
Potassium Ferrocyanide	300	150
Potassium Fluoride	300	150
Potassium Hydroxide (50%)	212	100
Potassium Hypochlorite	275	135
Potassium Nitrate	300	150
Potassium Perborate	275	135
Potassium Perchlorate	212	100
Potassium Permanganate	300	150
Potassium Persulfate	150	65
Potassium Sulfate	300	150
Potassium Sulfide	300	150
Propane	275	135
Propionic Acid	212	100
Propyl Alcohol	300	150
Propylene Dibromide	212	100

	Max Use Temp.	
Chemical	°F	°C
Propylene Dichloride	212	100
Propylene Glycol Methyl Ether	212	100
Propylene Oxide	150	65
Pyridine	150	65
Pyrogallol	150	65
S Salicylaldehyde	212	100
Salicylic Acid	250	120
Salt Brine	300	150
Sea Water	300	150
Silicon Tetrachloride	250	120
Silver Chloride	300	150
Silver Cyanide	300	150
Silver Nitrate	300	150
Sodium Acetate	300	150
Sodium Benzene-Sulfonate	300	150
Sodium Benzoate	300	150
Sodium Bicarbonate	300	150
Sodium Bisulfate	300	150
Sodium Bisulfite	300	150
Sodium Borate	212	100
Sodium Bromide	300	150
Sodium Carbonate	300	150
Sodium Chlorate	300	150
Sodium Chloride	300	150
Sodium Chromate	300	150
Sodium Cyanide	300	150
Sodium Dichromate (Alkaline)	212	100
Sodium Ferricyanide	300	150
Sodium Ferrocyanide	300	150
Sodium Fluoride	300	150
Sodium Glutamate	275	135
Sodium Hydroxide (10%)	230	110
Sodium Hydroxide (50%)	230	110
Sodium Hypochlorite	300	150
Sodium Hyposulfite	300	150
Sodium Iodide	300	150
Sodium Lignosulfonate	300	150
Sodium Metasilicate	300	150
Sodium Nitrate	300	150
Sodium Nitrite	300	150
Sodium Perborate	212	100
Sodium Perchlorate	150	65
Sodium Peroxide	300	150
Sodium Persulfate	175	80
Sodium Phosphate	300	150
Sodium Silicate	300	150
Sodium Silicofluoride	300	150
Sodium Sulfate	300	150
Sodium Sulfide	300	150
Sodium Sulfite	300	150
Sodium Thiosulfate	300	150
Sorbic Acid	275	135

	Max Use Temp.	
Chemical	°F	°C
Sour Crude Oil	300	150
Stannic Chloride	300	150
Stannous Chloride	300	150
Stannous Fluoride	250	120
Stearic Acid	300	150
Stoddard's Solvent	275	135
Styrene Monomer	212	100
Succinic Acid	275	135
Sulfamic Acid	212	100
Sulfur (Molten)	250	120
Sulfur Dioxide	230	110
Sulfur Trioxide (Liquid)	75	25
Sulfuric Acid (60%)	300	150
Sulfuric Acid (Conc.)	300	150
Sulfuric Acid (Fuming-Oleum)	120	50
Sulfurous Acid	230	110
T Tall Oil	300	150
Tannic Acid	275	135
Tartaric Acid	275	135
2,3,4,6-Tetrachlorophenol	212	100
Tetraethyl Lead	300	150
Tetrahydrofuran	212	100
Tetramethyl Ammonium Hydroxide (50%)	212	100
Thionyl Chloride	212	100
Tin Tetrachloride	230	110
Titanium Dioxide	300	150
Titanium Tetrachloride	212	100
Toluene	250	120
Tributyl Phosphate	150	65
Trichloracetic Acid	212	100
Trichloroethylene	275	135
Trichloromethane	212	100
2,4,5-Trichlorophenol	212	100
Triethylamine	230	110
Trisodium Phosphate	275	135
Turpentine	275	135
U UDMH-Hydrazine (50/50)	120	50
Urea (50% H_20)	275	135
V Varsol	275	135
Vinyl Acetate	275	135
Vinyl Chloride (Monomer)	150	65
W Water	300	150
Water Sewage	275	135
Wax	300	150
X Xylene	250	120
Z Zinc Acetate	250	120
Zinc Chloride	300	150
Zinc Hydrosulfite (10%)	250	120
Zinc Nitrate	300	150
Zinc Sulfate	300	150
Zinc Sulfide	300	150

How to Order: *Cam-Line*® Valves

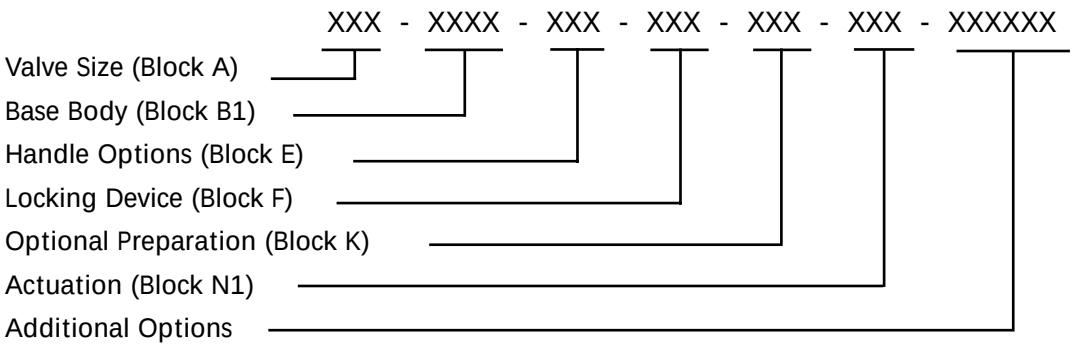


Figure Numbers:

Flanged Ends - Lined Cam-Line Ball Valves (Block B1)

Code	Lining Material
DUCTILE IRON - 150#	
1059	Tefzel
1159	Tefzel Lined (PVDF Coated)

Extended Stem (Block D2)

Code	Extension Length
CAST STEEL	
EXTSP	Stem Extension w/out Bracket
EXTSPBR	Stem Extionsion with Bracket

Exterior Trim (Block D3)

Code	Material
ET1	Stainless Steel
ET2	Carbon Steel

Handle Options (Block E)

Code	Description
OVAL HANDWHEEL	
HD2	Carbon Steel
HD3	Stainless Steel
HD4	None Provided
CHAINWHEEL	
HD5	Carbon Steel Horizontal Line
HD6	Carbon Steel Vertical Line
HD7	Stainless Steel Horizontal Line
HD8	Stainless Steel Vertical Line

Locking Device (Block F)

Code	Material
LDS	Stainless Steel

Grounding Strap (Block F1)

Code	Description
G	Grounding Strap

Optional Coatings (Block G)

Code	Coating
C1	White Epoxy
C2	Sherwin Williams Polane Blue
CSpec	Special Coating

Optional Preparation (Block K)

Code	Preparation
OX	Oxygen Preparation
CL	Halogen Service w/o Venting
CLV	Dry Chlorine Gas w/ Vented Seats
V	Vented Seats

Compact Actuator (Block N1)

Code	Actuator Model
H15	H15
H20	H20
H25	H25
H30	H30
H35	H35
H45	H45
H60	H60
H75	H75

Compact Actuator Mode (Block N2)

Code	Actuator Model
DA	Double Acting
SR	Spring Return
GR	Gear/Manual or Electric

Compact Actuator Springs (Block N3)

Code	Actuator Springs
2A	2A
2A2B	2A2B
2C	2C
3	3

Compact Actuator Failure Position (Block N4)

Code	Failure Position
FO	Fail Open
FC	Fail Closed

Solenoid Valve (Block N5)

Code	Description
SV1	Asco 8320G184
SV2	Asco EF8320G184
SV3	Asco 8345G1
SV4	Asco EF8345G1
SV5	Asco EF8320G194
SV6	Asco EFHT8320G184

Actuator Limit Switches (Block N7)

Code	Description
LS1	Westlock 1065
LS2	Westlock 1040
LS3	Westlock 2004BY
LS4	Westlock 2007XBY
LS5	Posiflex F30A-A-A
LS7	Posiflex F30A-C-A
LS9	Westlock 3030BY
LS10	Westlock 9479BY
LS11	GO 41-2U000-000
LS12	Westlock 360-BY-M6
LS13	Westlock E360-BY-M6

Filter Regulator (Block N1R)

Code	Description
RF1	Fischer 67CFR
RF2	Conoflow GFH60XTKEX3G

Speed Control (Block N1C)

Code	Description
SC	Schrader 337-1001

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1. **CONTROLLING PROVISIONS**: These terms and conditions shall control with respect to any purchase order or sale of Seller's products. No waiver, alteration or modification of these terms and conditions whether on Buyer's purchase order or otherwise shall be valid unless the waiver, alteration or modification is specifically accepted in writing and signed by an authorized representative of Seller.
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4. **U.S. EXPORT CONTROLS**: If applicable, Seller shall file for a U.S. export license only after appropriate documentation for the license application has been provided by Buyer. Buyer shall furnish such documentation within a reasonable time after order acceptance. Any delay in obtaining such license shall suspend delivery dates of EQUIPMENT without liability to either party. If export license is not granted or is revoked by the appropriate authorities, the ORDER may be cancelled by Seller in accordance with the Seller's cancellation policy. Seller will ship the ORDER in accordance with the United States Department of Commerce's Export Administration Regulations. Export or re-export of the ORDER contrary to U.S. law is prohibited.
5. **SELLER'S LIABILITY**: Seller will not be liable for any loss, damage, cost of repairs, incidental or consequential damages of any kind, whether based upon warranty (except for the obligation accepted by Seller under "Warranty" above), contract or negligence, arising in connection with the design, manufacture, sale, use or repair of the products or of the engineering designs supplies to Buyer.
6. **RETURNS**: Seller cannot accept return of any products unless its written permission has been first obtained, in which case same will be credited subject to the following: (a) All material returned must, on its arrival at Seller's plant, be found to be in first-class condition; if not, cost of putting in saleable condition will be deducted from credit memoranda; (b) A handling charge will be made from all credit memoranda issued for material returned; (c) Transportation charges, if not prepaid, will be deducted from credit-memoranda.
7. **SHIPMENTS**: All products sent out will be carefully examined, counted and packed. The cost of any special packing or special handling caused by Buyer's requirements of requests shall be added to the amount of the order. No claim for shortages will be allowed unless made in writing within ten (10) days of receipt of a shipment. Claims for products damaged or lost in transit should be made on the carrier, as Seller's responsibility ceases, and title passes, on delivery to the carrier.
8. **SPECIAL PRODUCTS**: Orders covering special or non-standard products are not subject to cancellation except on such terms as Seller may specify on application.
9. **PRICES AND DESIGNS**: Prices and designs are subject to change without notice. All prices are F.O.B. Point of Shipment, unless otherwise stated.
10. **TAXES**: The amount of any sales, excise or other taxes, if any, applicable to the products covered by this order, shall be added to the purchase price and shall be paid by Buyer unless Buyer provides Seller with an exemption certificate acceptable to the taxing authorities.
11. **MINIMUM INVOICE**: $200.00 plus transportation on complete valve assemblies. $100.00 plus transportation on replacement parts.
12. **TERMS**: Cash, net 30 days unless otherwise specified.

WARNING

Engineered Process Solutions Group Valves are designed and manufactured using good workmanship and materials, and they meet all applicable industry standards. These valves are manufactured with various materials, and they should be used only in services recommended by a company engineer.

Misapplication of the product may result in injuries or property damage. A selection of valve components of the proper material and consistent with the particular performance requirement is important for proper application.

Examples of the misapplication or misuse of any Engineered Process Solutions Group products include use in an application in which the pressure/temperature rating is exceeded or failure to maintain valve as recommended and use of products to handle caustic and/or hazardous substances when not designed for that purpose.

If the valve exhibits any indication or leakage, do not operate. Isolate valve and either repair or replace.

For additional information on the products as referenced,
call 1-800-2itt-ftc (1-800-248-8382), or contact the nearest regional office listed below.

Or visit us on the Web at www.engvalves.com

CAM-TITE®
Metal Ball Valves

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For Corrosive Services

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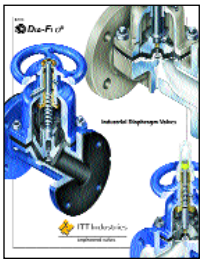

DIA-FLO®
Diaphragm Valves

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