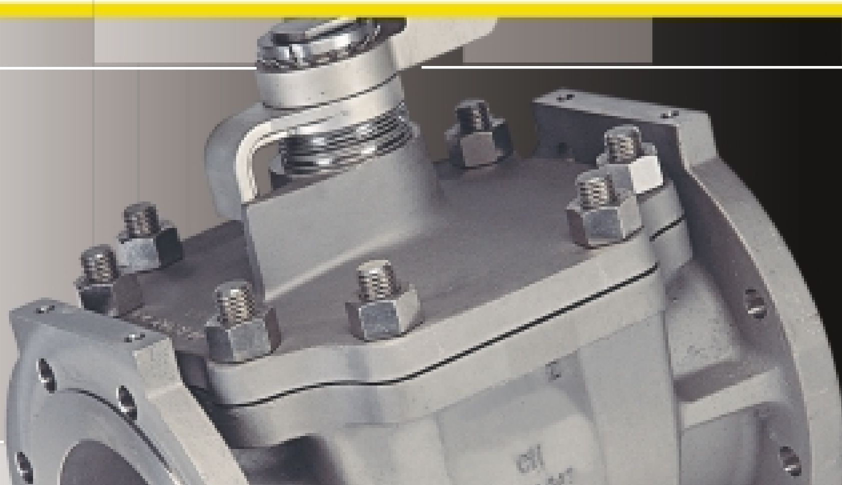
BALL VALVES
AUTOMATION & CONTROLS
BACKFLOW PREVENTERS
BUTTERFLY VALVES
FORGED STEEL VALVES

A COMPLETE SELECTION OF TOP ENTRY BALL VALVES FOR A WIDE RANGE OF SEVERE SERVICES



APOLLO®

SAFETY RELIEF VALVES
STRAINERS
PLUMBING & HEATING PRODUCTS
IN-LINE CHECK VALVES

top entry ball valves

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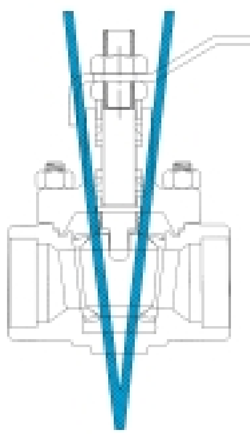
Apollo® Top Entry Ball Valve Features



Top Entry Advantages:

- Self-Adjusting Seats: Compensate for Wear & Temperature Fluctuations
- Spring Loaded Low Pressure Seals
- Pressure Activated Seating
- Built-In Antistatic Feature
- Simplified In-line Service
- Minimal Potential Leak Paths

Standards Compliance

(Most valves within this family of products comply with the requirements of these listed standards.)

ASME B16.5	"Pipe Flanges and Flanged Fittings"
ASME B16.10	"Face to Face Dimensions of Valves" (Except Full Port Valves)
ASME B16.34	"Valves – Flanged, Threaded, and Welding End."
ASME B31.1	"Power Piping"
ASME B31.3	"Chemical Plant and Petroleum Refinery Piping"
ASME B31.8	"Gas Transmission and Distribution Piping Systems"
API 607	"Fire Test – Soft Seated Quarter Turn Valves" (Depending on Seat and Seal Selection)
MSS SP-25	"Standard Marking System for Valves"
MSS SP-61	"Pressure Testing of Steel Valves"
MSS SP-72	"Ball Valves with Flanged of Buttweld Ends"

No Surprises

Apollo's Top Entry Ball Valves offer more. In addition to the three things everyone has come to expect from Conbraco: high quality products, competitive pricing and on time delivery, Apollo Top Entry Valves deliver additional premiums; a broader choice of material for both internal and external components, more optional features to choose from, and selectable seal material combinations all resulting in an expanded serviceable application range.

Fit for Purpose

These premiums can be combined to create a product uniquely tailored to customer specifications and applications. These additional options allow a valve to be selected without compromising critical performance requirements or operating conveniences and without adding unnecessary features and the costs associated with them.

The Correct Design

The special "V" seating design introduced the self-adjusting seat to the floating ball valve. This design does not rely on the built-in interference of conventional floating ball valves. It provides automatic compensation for pressure, temperature and wear. As these changes occur, the ball and seats are continuously snugged down into the "V" resulting in positive leak-tight shutoff when using resilient seats. Maintaining a low pressure seal had been the most difficult condition for floating ball valves, the wedge effect on the ball and seats down the "V" assures continued low pressure sealing for the life of the seat.

All Apollo Top Entry Valves have an "anti-static" feature designed in. All valve configurations also feature blow-out proof stems as standard.

The Right Application

Apollo's Top Entry Valves provide simplified in-line maintenance in the most natural way. The valve body is allowed to act as a permanent part of the piping system. Potential leak paths are eliminated with the one piece body. Only the bonnet seal and stem seals remain to be counted. And with the variety of bonnet gaskets and stem seal arrangements available through the selection of optional features, even these threats can be minimized.

Special Applications

"Fire-Safe" Requirements
Two seat and several seal arrangements are available to address valves in applications where performance during and immediately after a fire are a concern. The #7 (PTFE) and "A" (RPTFE) seat configurations offer "tested" fire-safe performance. Flexible graphite in the form of die-cut, die-formed or spiral wound gaskets are available for bonnet seals. Die-formed Grafoil® in various configurations provide the stem seals.

Abrasive & Erosive Services
"Soft Seated" valves for abrasive services feature seat inserts completely confined by metallic components. Some designs feature inner and outer seat support rings, where the inner ring helps shield the seat insert from abrasives in the service. Other designs feature one piece seatholders which completely confine the seat insert and provide the same function in protecting the soft seat from abrasive particles in the flow stream.

In addition to the seat configuration options, resilient and rigid seat materials are available. The rigid seat choices include carbon-graphite, ceramic, peek, and carbon reinforced peek. The seats and the ball are both produced from ceramic in the one case. Any of these seats provide improved resistance to abrasion and erosion and additionally extend the potential service range to 1000°F.

For steam services, the #5 seat, a RPTFE containing 55% bronze and 5% molybdenum disulfide, is an excellent choice as is the #4 carbon-graphite seat.

Valves for Chlorine Service
Valves intended for service in dry chlorine require specific alloy selections, design features, cleaning and testing procedures. In accordance with the guidelines established by "The Chlorine Institute", Pamphlet 6-13th Edition (April 1993), Hastelloy trimmed carbon steel valves (model numbers starting with "CH") are suggested, and M35-1 trimmed carbon steel valves (model numbers beginning "CM") are the alternative for dry chlorine. All Hastelloy or M35-1 valves are also available, however, stainless steel valves or components are not recommended.

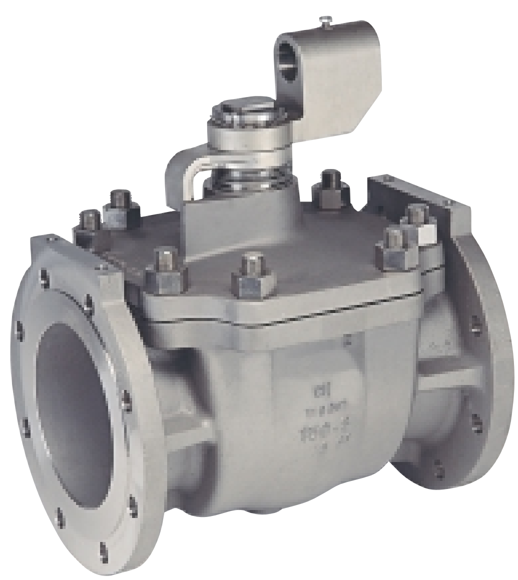
Selecting the required "HO" feature insures a valve that has been vented, cleaned, and tested to comply with the requirements of The Chlorine Institute Pamplet 6.

Oxygen Service Valves
For this application, cleanliness is of utmost importance. Apollo Top Entry Valves specified for oxygen service (option "PO") are subjected to rigorous preparation procedures including special pre-cleaning and inspection followed by ultrasonic cleaning and more intense inspection. All to insure that the finished valve is free of burrs and sharp edges as well as cleaned of hydrocarbon residues and particulate matter. Once valves destined for oxygen service enter Conbraco's clean room for preparation, they do not leave until they have been cleaned, assembled, thoroughly tested, inspected, tagged and bagged to meet customer requirements.

All Apollo Top Entry Valves have "anti-static" features designed in. Valves for oxygen service must also be
fitted with PTFE or RPTFE seats and packing. When planning to insulate valves, consider specifying one of our extended bonnet options.

High Temperature Service
For any applications utilizing metal, graphite, carbon graphite, peek, carbon reinforced peek, or ceramic seats, a ball stop should be incorporated into the valve design (option "RS"). This option is suggested at any temperature but it becomes a necessity above 500°F or when using ceramic or metal seats. The ball stop prevents the ball and seat from sliding down the 7° wedge when expansion caused by the temperature increase widens the wedge. If the ball was permitted to slide down the wedge, the valve would be locked tight when

**Apollo ANSI Class 150 Flanged
8-inch Titanium Top Entry Ball Valve**



How To Specify Apollo® Top Entry Ball Valves

Select the valve model number **0 0 - 0 0 0 - 0 0**

BODY MATERIAL
- A - Alloy 20
- B - CF3M SS (Flanged)
- C - Carbon Steel
- F - Inconel
- H - Hastelloy C
- M - M35-1
- N - Nickel
- S - 316 SS
- T - Titanium

TRIM MATERIAL
- A - Alloy 20
- B - 316L SS
- C - Carbon Steel
- D - Hastelloy C Stem M35-1 Ball
- E - 410 SS
- F - Inconel
- H - Hastelloy C
- M - M35-1 (Monel)
- N - Nickel
- S - 316 SS
- T - Titanium

END CONFIGURATION AND PRESSURE CLASS
- B - 150# Flanged
- C - 300# Flanged
- D - 300# NPT
- E - 150# FP Flange
- F - 300# FP Fange
- G - 300# NPT x Soc. Weld
- H - 600# NPT
- J - 600# Socket Weld
- K - 600# Flanged
- L - 300# FP NPT
- M - 300# FP Soc. Weld
- N - 300# Socket Weld
- P - 300# Buttweld
- Q - 600# NPT x Soc. Weld
- R - 300# FLG x Buttweld
- S - 300# RTJ Flanges
- T - 600# FP Socket Weld
- U - 600# FP Flange
- W- 600# Buttweld
- Y - 300# FP NPT x Socket Weld
- 3 - 300# FP Buttweld
- 4 - 600# FP NPT
- 6 - 600# FP NPT x Socket Weld
- 7 - 600# FP Buttweld
- 9 - 900# Flange

SEAT (FIGURES ON PAGE 15)
- 1 - TFE (Figure 1)
- 2 - RTFE (Figure 1)
- 3 - RTFE Seat (Figure 2)
- 4 - Carbon Graphite -750°F max. (Figure 1)
- 5 - 55% Bronze, 5% Moly, (Figure 2)
- 6 - UHMWPE (Figure 2)
- 7 - API-607 Certified (TFE Seat, TFE O-ring, Grafoil® Seal & Pkgs.)
- 8 - PEEK (Figure 2)
- 9 - Ceramic
- A - API-607 Certified (RTFE Seat, TFE O-ring, Grafoil® Seal & Pkgs.)
- B - 30% Carbon Reinforced PEEK (Figure 2)
- C - PFA (Figure 2)
- D - SRTFE, 60% SS, 40% TFE by weight (50% SS Min) (Figure 2)
- F - CRTFE (Figure 1)
- G - PCTFE (Figure1)
- H - High Temp Graphite-1000°F max. (Figure 1)
- K - Stellite Ball & Seats (Figure 4)
- M - Malcomized 316 SS Ball & Seats (Figure 4)
- U - UHMWPE (Figure 1)

SIZE
- 3 - 1/2"
- 4 - 3/4"
- 5 - 1"
- 7 - 1-1/2"
- 8 - 2"
- 0 - 3"
- A - 4"
- C - 6"
- E - 8"
- G - 10"
- H - 12"

OPTIONAL FEATURES

- **AR** - Actuator Ready
- **BO** - Grafoil® Seals & Packings
- **BN** - TFE Spiralwound Bonnet Gasket
- **BS** - Grafoil® Spiral Wound Bonnet Gasket & Grafoil® Packings
- **CH** - Clamp-On Steam Jacket - Stainless Steel
- **CJ** - Clamp-On Steam Jacket - Carbon Steel
- **CL** - Cam-Lock Handle
- **EB** - Extended Bonnet
- **EO** - Round Handle
- **FC** - Live Loaded Fugitive Emission w/ Double RPTFE Chevron Packings
- **FG** - Fugitive Emission Bonnet with EVSP® 9000 Graphite Stem Packing
- **FL** - Fugitive Emission Bonnet with Double RPTFE Stem Packing
- **FO** - Full Jacketed w/Oversize Flanges
- **FP** - Live Loaded Fugitive Emission w/Double EVSP Packings
- **GO** - 2 1/4" Stem Extension
- **HH** - Vented Body
- **HO** - Vented Body & Cleaned for Chlorine Service
- **HP** - Vented Body & Cleaned for Hydrogen Peroxide Service
- * **MG** - Gear Operator
- **MT** - 2 Position Lock Plate for Standard Bonnet
- **MU** - 2 Position Lock Plate for Extended Bonnet
- **NC** - NACE Certified Trim
- **OL** - Oval Locking Handle
- **OO** - RPTFE Seals & Packings
- **OM** - RPTFE Bonnet Gasket & UHMWPE Packings
- **PJ** - Partial Steam Jacket
- **PO** - Cleaned for Oxygen Service
- **PP** - Cleaned for Industrial Gases
- **RS** - Welded Ball Stop with Safety Cap
- **TP** - Two Position Sliding Latch Lock Lever
- **ZO** - PTFE Seals & Packings

Note: Optional Features may be used alone or in combination (simply added in alphabetical order), however not all combinations are available on all valves. This is a very limited list of the available options. Contact the factory for specific requirements and availability.

* MG Is Generic for Gear Operators. Contact Factory or Price Book For Specific Application and Correct Part Number.

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Shell (External) Material Selection

Material Designation	A	C	H	M	N	S	T
Description	Alloy 20	Carbon Steel	Hastelloy C	M35-1	Nickel (200)	Stainless Steel	Titanium
Body (Flanged ends)	ASTM A351-CN7M	ASTM A216-WCB	ASTM A494-CW12MW	ASTM A494-M35-1	ASTM A494-CZ100	ASTM A351-CF8M	ASTM B367-Gr C3
Body (Buttweld, Socket weld, and screwed ends)	ASTM A351-CN7M	ASTM A216-WCB	ASTM A494-CW12MW	ASTM A494-M35-1	ASTM A494-CZ100	ASTM A351-CF3M	ASTM B367-Gr C3
Bonnet	ASTM A351-CN7M	ASTM A216-WCB	ASTM A494-CW12MW	ASTM A494-M35-1	ASTM A494-CZ100	ASTM A351-CF8M	ASTM B367-Gr C3

Corresponding Hardware Materials

External Designation	A	C	H	M	N	S	T
Seat Ring(s) (from bar, tube or pipe depending on availability)	ASTM B473-CB-3	ASTM A269-316 or ASTM A276-316 or ASTM A312-316	ASTM B574-C276	ASTM B164-400 or ASTM B165-400	ASTM B160-200 ASTM B161- 200	ASTM A269- 316 ASTM A276-316 or ASTM A312-316	ASTM B348-Gr 2
Internal Spring (1 or 2 seats)	Inconel X-750	ASTM A313-Type 316	Inconel X-750	Inconel X-750	Inconel X-750	ASTM A313-Type 316	Ti-6AL-4V
Internal Spring (3, 4, 5, 6, 7, 8, 9, A or Z seats)	Inconel X-750	Inconel X-750	Inconel X-750	Inconel X-750	Inconel X-750	Inconel X-750	Ti-6AL-4V
Packing Gland	316 Stainless Steel						
Packing Jam Nut	18-8 Stainless Steel						
Lever Assembly - (1/2 - 2")	304 Stainless Steel w/Vinyl Grip						
Lever Assembly - (3" - 8")	Stainless Steel Wrench Head and Pipe						
Grounding Spring	18-8 Stainless Steel						
Studs	ASTM A193-B8M						
Nuts	ASTM A194-Gr.8						
Capscrews	ASTM A193-B8	ASTM A193-B7	ASTM A193-B8	ASTM A193-B8	ASTM A193-B8	ASTM A193-B8	ASTM A193-B8

Trim (Internal) Material Selection

Material Designation	A	H	M	N	S	T
Description	Alloy 20	Hastelloy C	M35-1	Nickel (200)	Stainless Steel	Titanium
Ball	ASTM A351-CN7M or ASTM B473-CB-3	ASTM A494-CW12MW or ASTM B574-C276	ASTM A494-M35-1 or ASTM B164-K400	ASTM A494-CZ100 or ASTM B160-200	ASTM A351-CF8M or ASTM A479-316	ASTM B367-Gr C3 or ASTM B348-Gr 4-5
Stem	ASTM B473-CB-3*	ASTM B574-C276	ASTM B164-K400	ASTM B160-200	ASTM A276-316*	ASTM B348-Gr 4-5

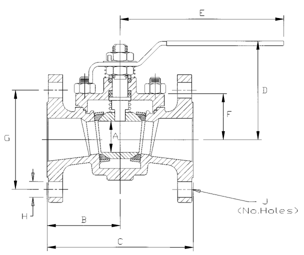
* Denotes Hard Chrome Plated

Seat & Seals Material Selection

Seat Designation	1	2	3	4	5	D	6
Seat	PTFE	RPTFE	RPTFE	Carbon Graphite	55% Bronze, 5% Moly Filled PTFE	60% Stainless Filled PTFE	UHMWPE
Seat O-ring	-	-	-	-	-	-	-
Stem Packing	PTFE	RPTFE	Grafoil®	Grafoil®	Grafoil®	Grafoil®	Grafoil®
Bonnet Gasket	PTFE	RPTFE	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiral Wound Grafoil® (600)
Default Suffix	ZO1 (All Classes)	001 (All Classes)	BO1 (150-300) BS1 (600)	BO1 (150-300) BS1 (600)	BO1 (150-300) BS1 (600)	BO1 (150-300) BS1 (600)	BO1 (150-300) BS1 (600)

Seat Designation	U	7	8	9	A	B	H
Seat	UHMWPE	API 607 - PTFE Fire Seat	Unfilled PEEK	CERAMIC (Seats & Ball)	API 607 RPTFE Fire Seat	Carbon Reinforced PEEK	High Temp. Graphite
Seat O-ring	-	PTFE	-	-	PTFE	-	-
Stem Packing	Grafoil®	Grafoil®	Grafoil®	Grafoil®	Grafoil®	Grafoil®	Grafoil®
Bonnet Gasket	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil®	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil®	Grafoil® (150-300) Spiral Wound Grafoil® (600)	Grafoil® (150-300) Spiralwound Graphoil® (600)
Default Suffix	BO1 (150-300) BS1 (600)	BO1	BO1 (150-300) BSI (600)	BO1 (150-300) BS1 (600)	BO1	BO1 (150-300) BS1 (600)	BO1 (150-300) BS1 (600)

Flanged Series Top Entry Ball Valves



Flanged Valve Dimensions

ANSI 150 Class Flanged Top Entry Valves

Size	A	B	C	D	E	F	G	H	J
1/2"	0.81	2.85	5.69	3.48	5.15	1.70	2.38	0.62	4
3/4"	0.81	2.31	4.62	3.54	5.15	1.76	2.75	0.62	4
1"	0.81	2.50	5.00	3.48	5.15	1.70	3.12	0.62	4
1-1/2"	1.17	3.25	6.50	4.17	5.94	1.96	3.87	0.62	4
2"	1.50	3.50	7.00	4.74	7.87	2.22	4.75	0.75	4
3"	2.25	4.00	8.00	6.41	19.12	2.93	6.00	0.75	4
4"	3.00	4.50	9.00	7.55	19.50	3.32	7.50	0.75	8*
6"**	4.50	7.75	15.50	10.06	36.00	4.97	9.50	0.87	8
8"**	6.00	9.00	18.00	14.39	47.00	6.51	11.75	0.87	8
10"**	7.50	10.50	21.00	15.50	NA	NA	14.25	1.00	12

* Top 2 holes in each flange are tapped 5/8-11 UNC-2B
** Gear Operator or Actuation Recommended.

ANSI 300 Class Flanged Top Entry Valves

Size	A	B	C	D	E	F	G	H	J
1/2"	0.81	2.85	5.69	3.48	5.15	1.70	2.62	0.62	4
3/4"	0.81	3.00	6.00	3.63	5.15	1.86	3.25	0.75	4
1"	0.81	3.25	6.50	3.48	5.15	1.70	3.50	0.75	4
1 1/2"	1.17	3.75	7.50	4.17	5.94	1.96	4.50	0.88	4
2"	1.50	4.25	8.50	4.74	7.87	2.22	5.00	0.75	8
3"	2.25	5.56	11.13	6.41	19.12	2.93	6.63	0.88	8
4"	3.00	6.00	12.00	7.55	19.50	3.32	7.88	0.88	8
6" **	4.50	7.94	15.87	10.06	36.00	4.97	10.63	0.88	12
8" **	6.00	9.87	19.75	14.39	47.00	6.51	13.00	1.00	12
12"**	9.00	12.75	25.50	18.75	NA	NA	17.75	1.25	16*

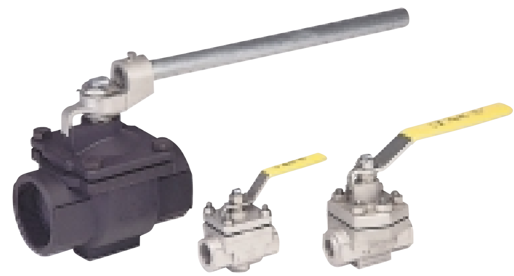
* Top 6 holes in each flange are tapped 1 1/8-8UN-2B.
** Gear Operator or Actuation Recommended.

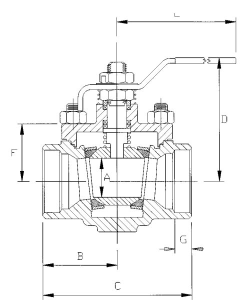
ANSI 600 Class Flanged Top Entry Valves

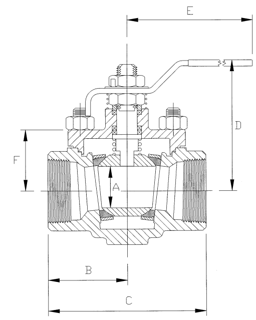
Size	A	B	C	D	E	F	G	H	J
1/2"	0.81	3.25	6.50	4.93	8.50	1.92	2.62	.62	4
3/4"	0.81	3.75	7.50	5.17	8.50	2.18	3.25	0.75	4
1"	0.81	4.25	8.50	5.23	8.50	2.21	3.50	0.75	4
1-1/2"	1.17	4.75	9.50	6.00	12.50	2.36	4.50	0.88	4
2"	1.50	5.75	11.50	7.02	14.75	2.97	5.00	0.75	8
3"	2.25	7.00	14.00	8.64	19.12	3.47	6.63	0.88	8
4" **	3.00	8.50	17.00	9.95	19.12	4.15	8.50	1.00	8
6" **	4.50	11.00	22.00	NA	NA	5.78	11.50	1.12	12

** Gear Operator or Actuation Recommended.

Socket Weld & NPT Series Top Entry Valves







Socket Weld Valve Dimensions

ANSI 300 Class Socket Weld Top Entry Valves

Size	A	B	C	D	E	F	G
1/2"	0.81	2.15	4.29	3.48	5.15	1.70	0.38
3/4"	0.81	1.96	3.91	3.48	5.15	1.70	0.56
1"	0.81	1.96	3.91	3.48	5.15	1.70	0.50
1-1/2"	1.17	2.49	4.98	4.17	5.94	1.96	0.55
2"	1.50	2.86	5.72	4.74	7.87	2.22	0.62
3"	2.25	4.15	8.29	6.41	19.12	2.93	1.00

ANSI 600 Class Socket Weld Top Entry Valves

Size	A	B	C	D	E	F	G
1/2"	0.81	2.37	4.73	4.93	8.50	1.92	0.38
3/4"	0.81	2.18	4.35	4.93	8.50	1.92	0.56
1"	0.81	2.18	4.35	4.93	8.50	1.92	0.50
1-1/2"	1.17	2.62	5.23	5.77	12.50	2.14	0.55
2"	1.50	2.99	5.98	6.59	14.75	2.54	0.62

NPT Valve Dimensions

ANSI 300 Class NPT Top Entry Valves

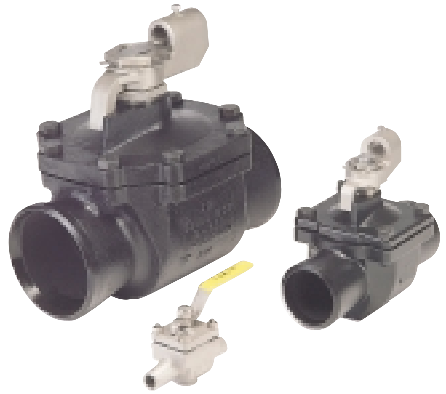
Size	A	B	C	D	E	F
1/2"	0.81	2.15	4.29	3.48	5.15	1.70
3/4"	0.81	1.96	3.91	3.48	5.15	1.70
1"	0.81	1.96	3.91	3.48	5.15	1.70
1-1/2"	1.17	2.49	4.98	4.17	5.94	1.96
2"	1.50	2.86	5.72	4.74	7.87	2.22
3"	2.25	4.15	8.29	6.41	19.12	2.93

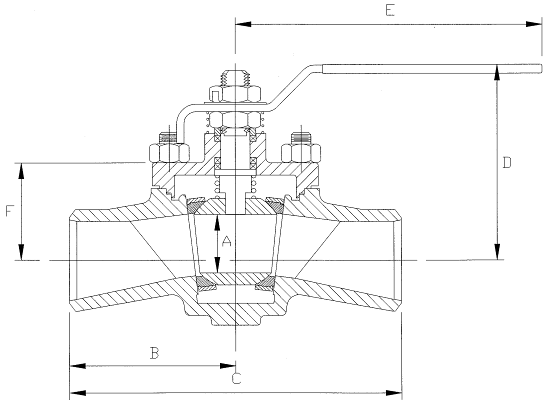
ANSI 600 Class NPT Top Entry Valves

Size	A	B	C	D	E	F
1/2"	0.81	2.37	4.73	4.93	8.50	1.92
3/4"	0.81	2.18	4.35	4.93	8.50	1.92
1"	0.81	2.18	4.35	4.93	8.50	1.92
1-1/2"	1.17	2.62	5.23	5.77	12.50	2.14
2"	1.50	2.99	5.98	6.65	14.75	2.54

Buttweld Series Top Entry Ball Valves

Buttweld Valve Dimensions





ANSI 300 Class Buttweld* Top Entry Valves

Size	A	B	C	D	E	F
1/2"	0.81	2.75	5.50	3.48	5.15	1.70
3/4"	0.81	3.00	6.00	3.48	5.15	1.70
1"	0.81	3.25	6.50	3.66	5.15	1.88
1-1/2"	1.17	3.75	7.50	4.22	5.94	2.01
2"	1.50	4.25	8.50	5.02	7.87	2.50
3"	2.25	5.56	11.13	6.41	19.12	2.93
4"	3.00	6.00	12.00	7.55	19.50	3.32
6"**	4.50	7.94	15.88	10.06	36.00	4.97
8"**	6.00	10.25	20.50	14.39	47.00	6.51

* Available in Schedule 10, 40 and 80 where appropriate.
** Gear Operator or Actuation Recommended.

ANSI 600 Class Buttweld* Top Entry Valves

Size	A	B	C	D	E	F
1/2"	0.81	2.75	5.50	4.93	8.50	1.92
3/4"	0.81	3.75	7.50	5.17	8.50	2.16
1"	0.81	4.25	8.50	5.23	8.50	2.22
1 1/2"	1.17	4.75	9.50	6.01	12.50	2.38
2"	1.50	5.75	11.50	7.11	14.75	3.00
3"	2.25	7.00	14.00	9.34	19.50	NA
4" **	3.00	8.50	17.00	10.98	36.00	NA
6" **	4.50	11.00	22.00	NA	NA	NA

* Available in Schedule 40 and 80 where appropriate.
** Gear Operator or Actuation Recommended.

Bonnet Dimensions For Actuator Mounting

NOTE: Valves are shown In the Closed Position

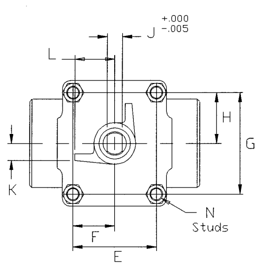


Fig.1

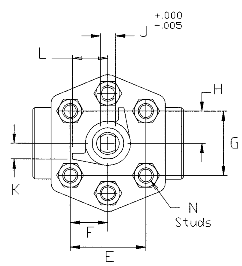


Fig.2

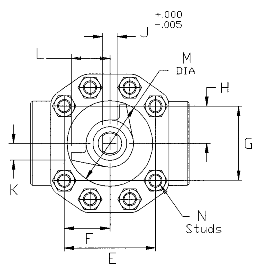
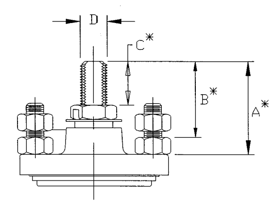


Fig.3

* Stem rises as the packing is adjusted. Allow sufficient clearances.



STANDARD BONNET

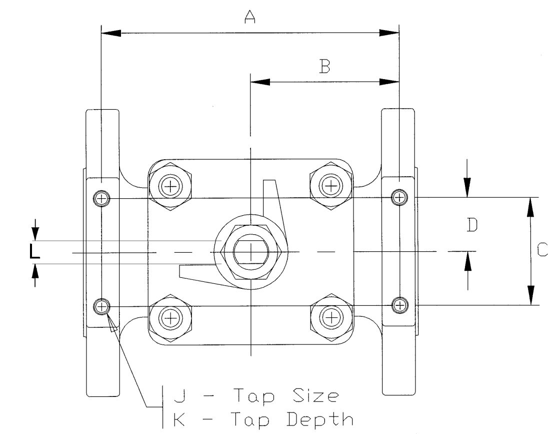
ANSI 150/300 Class Socket Weld, NPT & Buttweld Valves

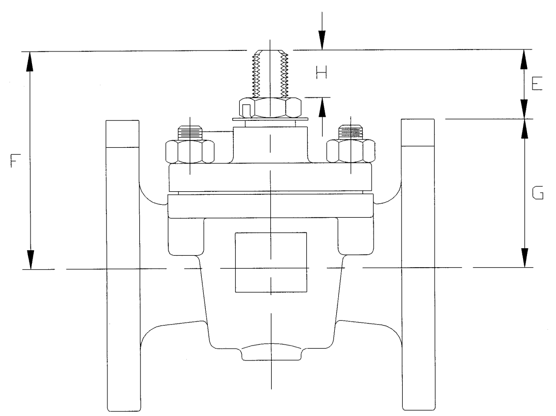
Size	Fig. No.	A	B	C	D	E	F	G	H	J	K	L	M	N
1/2”	1	1.30	1.00	.77	.500	2.125	1.062	1.812	.906	.292	.36	1.00	NA	5/16-18
3/4”	1	1.30	1.00	.77	.500	2.125	1.062	1.812	.906	.292	.36	1.00	NA	5/16-18
1”	1	1.30	1.00	.77	.500	2.125	1.062	1.812	.906	.292	.36	1.00	NA	5/16-18
1-1/2”	1	2.04	1.68	.99	.625	2.812	1.406	2.250	1.125	.417	.36	1.25	NA	3/8-16
2”	1	2.39	1.91	1.06	.750	3.375	1.687	2.750	1.375	.482	.52	1.50	NA	1/2-13
3”	1	3.27	2.66	1.55	1.125	4.000	2.000	4.875	2.437	.730	.72	2.00	NA	5/8-11
4”	3	4.66	4.11	2.24	1.500	6.375	3.188	3.750	1.875	.970	NA	NA	6.00	9/16-12
6”	3	4.88	4.15	1.96	2.000	9.750	4.875	4.500	2.250	1.380	NA	NA	NA	3/4-10
8”	3	5.77	4.79	2.56	2.36	12.06	6.031	7.375	3.688	1.755	NA	NA	7.94	1-8

ANSI 600 Class Socket Weld, NPT, & Buttweld Valves

Size	Fig. No.	A	B	C	D	E	F	G	H	J	K	L	M	N
1/2”	2	2.48	2.06	.76	.625	2.125	1.062	1.816	.908	.412	.36	1.00	NA	7/16-18
3/4”	2	2.48	2.06	.76	.625	2.125	1.062	1.816	.908	.412	.36	1.00	NA	7/16-18
1”	2	2.48	2.06	.76	.625	2.125	1.062	1.816	.908	.412	.36	1.00	NA	7/16-18
1-1/2”	3	3.48	3.06	1.03	.750	2.814	1.407	2.250	1.125	.475	.36	1.25	NA	7/16-14
2”	3	3.95	3.47	1.03	.875	3.370	1.685	2.750	1.375	.535	.52	1.50	NA	1/2-13

Dimensions For Actuator Pad Style Mounting





Class 150 Flanged Valves

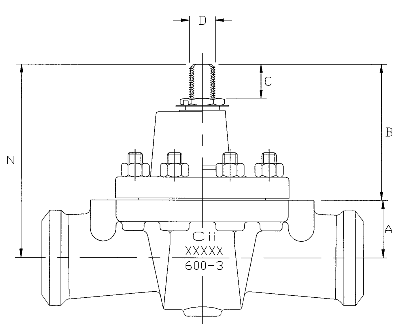
	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"	10"
A	4.06	4.43	5.75	6.24	7.18	8.19	14.25	16.75	19.75
B	2.03	2.21	2.88	3.12	3.59	4.09	7.13	8.38	9.88
C	1.75	1.75	1.75	2.25	3.50	4.00	4.00	5.00	7.00
D	0.88	0.88	0.88	1.13	1.75	2.00	2.00	2.50	3.50
E	0.70	0.62	1.37	1.48	2.32	3.33	4.22	5.28	6.50
F	3.06	3.00	4.00	4.61	6.20	7.98	9.85	12.28	15.50
G	2.36	2.38	2.63	3.13	3.88	4.63	5.63	7.00	9.00
H	0.77	0.77	0.99	1.06	1.55	2.24	1.96	2.56	2.90
J	5/16-18	5/16-18	5/16-18	5/16-18	3/8-16	7/16-14	7/16-14	1/2-13	3/4-10
K	0.48	0.48	0.47	0.47	0.56	0.66	0.50	0.66	1.25
L	0.292	0.292	0.417	0.482	0.730	0.970	1.380	1.755	2.030

Class 300 Flanged Valves

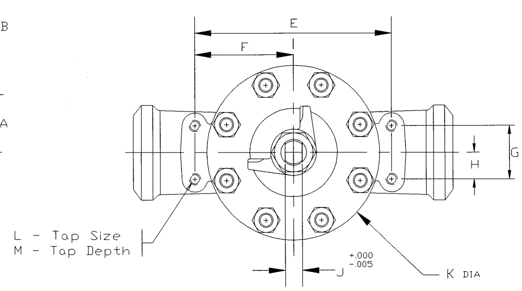
	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"
A	5.31	5.75	6.63	7.56	9.88	10.69	14.31	18.06
B	2.66	2.88	3.31	3.78	4.94	5.34	7.15	9.03
C	1.75	1.75	1.75	2.25	3.50	4.00	4.00	5.00
D	0.88	0.88	0.88	1.13	1.75	2.00	2.00	2.50
E	0.70	0.62	0.81	1.23	1.95	2.83	3.47	4.53
F	3.15	3.00	4.00	4.61	6.20	7.98	9.85	12.28
G	2.45	2.38	3.19	3.38	4.25	5.13	6.38	7.75
H	0.77	0.77	0.99	1.06	1.55	2.24	1.96	2.56
J	5/16-18	5/16-18	5/16-18	5/16-18	3/8-16	7/16-14	7/16-14	1/2-13
K	0.48	0.48	0.47	0.47	0.56	0.66	0.50	0.66
L	0.292	0.292	0.417	0.482	0.730	0.970	1.380	1.755

Class 600 Flanged Valves

	3/4"	1"	1-1/2"	2"	3"	4"	6"
A	6.32	7.25	8.06	9.94	12.25	15.00	19.62
B	3.16	3.63	4.03	4.97	6.13	7.50	9.81
C	2.38	2.38	2.75	3.50	4.75	5.50	7.00
D	1.19	1.19	1.38	1.75	2.38	2.75	3.50
E	2.21	2.15	2.83	3.54	4.18	4.88	4.97
F	4.65	4.71	6.08	6.92	8.43	10.38	12.09
G	2.44	2.56	3.25	3.38	4.25	5.50	7.12
H	0.76	0.76	1.27	1.03	1.54	2.25	1.34
J	3/8-16	3/8-16	1/2-13	1/2-13	1/2-13	1/2-13	3/4-10
K	0.47	0.47	0.66	0.66	0.66	0.75	1.00
L	0.412	0.412	0.475	0.535	0.730	0.970	1.380



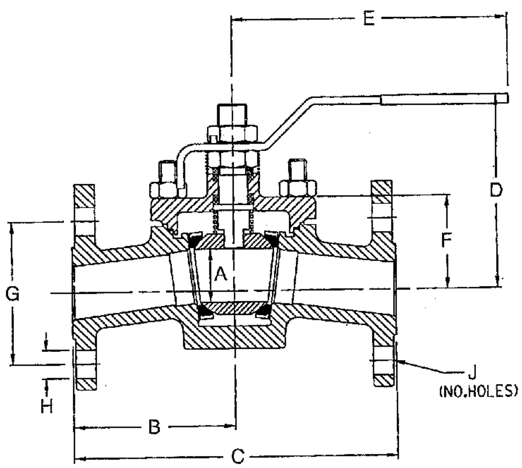
NOTE: Valves shown in the closed position.



Class 600 Buttweld

	3"	4"	6"
A	2.50	2.90	4.19
B	5.96	7.36	7.91
C	1.54	2.25	1.34
D	1.125	1.500	2.000
E	8.620	11.000	15.000
F	4.310	5.500	7.500
G	2.330	2.800	4.160
H	1.150	1.400	2.130
J	0.730	0.970	1.380
K	7.56	9.38	12.88
L	1/2-13	1/2-13	3/4-10
M	0.61	0.75	1.00
N	8.45	10.25	12.10

Flanged Series Top Entry Full Port Ball Valve Dimensional Data



ANSI 150 Class Full Port Flanged Top Entry Valves

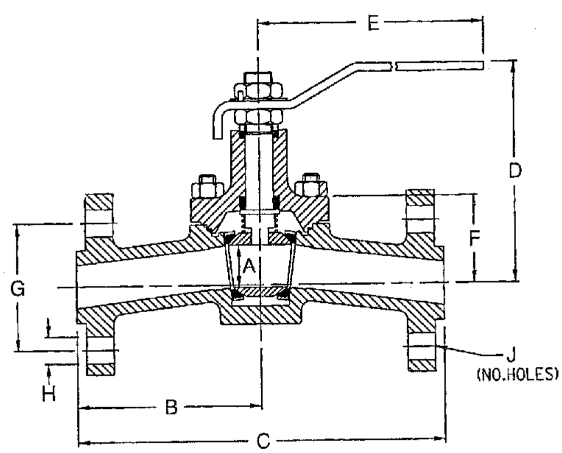
Size	A	B	C	D	E	F	G	H	J
1"	1.17	3.50	7.00	4.27	5.94	2.05	3.12	.62	4
1-1/2"	1.50	4.37	8.75	5.05	7.87	2.51	3.87	.62	4
2"	2.25	5.25	10.50	7.61	19.12	3.23	4.75	.62	4
3"	3.00	6.75	13.50	9.33	19.50	3.80	6.00	.75	4
4"	4.50	8.50	17.00	12.32	36.00	5.39	7.50	.75	8
6"	6.00	10.75	21.50	15.57	43.00	6.67	9.50	.87	8
8"	8.00	12.25	24.50	18.32	NA	9.39	11.75	.87	8*

• Top 2 Holes in each flange are tapped 3/4-10 UNC-2B

ANSI 300 Class Full Port Flanged Top Entry Valves

Size	A	B	C	D	E	F	G	H	J
1"	1.17	3.75	7.50	4.27	5.94	2.08	3.50	.75	4
1-1/2"	1.50	4.75	9.50	5.05	7.87	2.55	4.50	.87	4
2"	2.25	5.56	11.13	7.61	19.12	3.27	5.00	.75	8
3"	3.00	7.62	15.25	9.33	19.50	3.91	6.63	.87	8
4"	4.50	9.00	18.00	12.32	36.00	5.45	7.88	.87	8
6"	6.00	11.00	22.00	15.57	43.00	6.70	10.63	.87	12
8"	8.00	13.50	27.00	18.32	NA	9.54	13.00	1.00	12*

• Top 2 Holes in each flange are tapped 7/8-9 UNC-2B

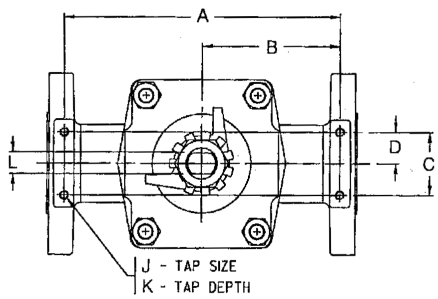


ANSI 600 Class Full Port Flanged Top Entry Valves

Size	A	B	C	D	E	F	G	H	J
1"	1.17	5.00	10.00	6.06	12.50	2.40	3.50	.75	4
1-1/2"	1.50	6.25	12.50	7.15	14.75	3.06	4.50	.87	4
2"	2.25	6.50	13.00	9.76	19.12	3.70	5.00	.75	8
3"	3.00	8.75	17.50	11.45	19.50	4.48	6.63	.87	8
4"	4.50	10.00	20.00	12.44	NA	6.13	8.50	1.00	8
6"	6.00	13.00	26.00	15.28	NA	7.50	11.50	1.12	12
8"	8.00	15.62	31.25	18.58	NA	11.42	13.75	1.25	12*

• Top 2 Holes in each flange are tapped 1-1/8 UN-2B

Flanged Series Top Entry
Full Port Ball Valves
Actuator Mounting Data



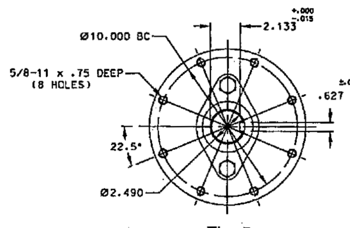


Fig. 2

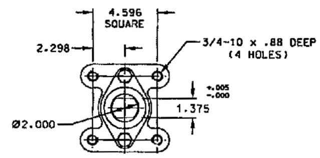
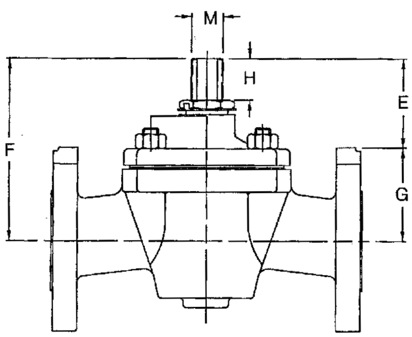
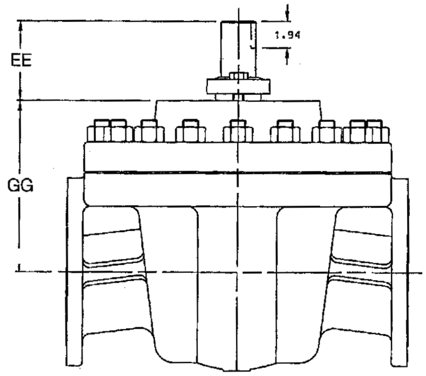


Fig. 1





Dimensions For Actuator Pad Style Mounting

ANSI 150 Class Full Port Flanged Top Entry Valves

Size	A	B	C	D	E	EE	F	G	GG	H	J	K	L	M
1"	6.44	3.22	1.75	.88	1.71	NA	4.09	2.38	NA	.99	5/16-18	.48	.417	.625
1-1/2"	8.06	4.03	1.75	.88	2.27	NA	4.90	2.63	NA	1.06	5/16-18	.47	.482	.750
2"	9.68	4.84	2.25	1.13	3.37	NA	6.50	3.13	NA	1.55	5/16-18	.47	.730	1.125
3"	12.48	6.24	3.50	1.75	4.58	NA	8.46	3.88	NA	2.24	3/8-16	.56	.970	1.500
4"	15.81	7.91	4.00	2.00	5.23	NA	10.27	5.04	NA	1.96	7/16-14	.66	1.380	2.000
6"	20.25	10.13	4.00	2.00	6.13	2.73	12.29	6.16	9.56	1.00	7/16-14	.66	Fig. 1	Fig. 1
8"	NA	NA	NA	NA	NA	5.77	NA	NA	12.37	NA	NA	NA	Fig 2	Fig. 2
10"	19.75	8.88	7.00	3.50	6.50	NA	15.50	9.00	NA	2.90	3/4-10	1.25	2.030	2.933

ANSI 300 Class Full Port Flanged Top Entry Valves

Size	A	B	C	D	E	EE	F	G	GG	H	J	K	L	M
1"	6.69	3.35	1.75	.88	1.74	NA	4.12	2.38	NA	.99	5/16-18	.48	.417	.625
1-1/2"	8.63	4.31	1.75	.88	1.75	NA	4.94	3.19	NA	1.06	5/16-18	.47	.482	.750
2"	9.90	4.95	2.25	1.13	3.16	NA	6.54	3.38	NA	1.55	5/16-18	.47	.730	1.125
3"	13.68	6.84	3.50	1.75	4.32	NA	8.57	4.25	NA	2.24	3/8-16	.56	.970	1.500
4"	16.50	8.25	4.00	2.00	5.20	NA	10.33	5.13	NA	1.96	7/16-14	.66	1.380	2.000
6"	20.38	10.19	4.00	2.00	5.41	2.73	12.32	6.91	9.59	1.00	7/16-14	.66	Fig. 1	Fig. 1
8"	NA	NA	NA	NA	NA	5.77	NA	NA	12.52	NA	NA	NA	Fig. 2	Fig. 2

ANSI 600 Class Full Port Flanged Top Entry Valves

Size	A	B	C	D	E	EE	F	G	GG	H	J	K	L	M
1"	8.75	4.38	2.38	1.19	3.56	NA	6.12	2.56	NA	1.27	3/8-16	.47	.475	.750
1-1/2"	11.06	5.53	2.75	1.38	3.75	NA	7.00	3.25	NA	1.03	1/2-13	.66	.535	.875
2"	11.38	5.69	3.50	1.75	5.20	NA	8.66	3.46	NA	1.54	1/2-13	.66	.730	1.125
3"	15.56	7.78	4.75	2.38	6.45	NA	10.70	4.25	NA	2.25	1/2-13	.66	.970	1.500
4"	17.75	8.88	5.50	2.75	6.94	NA	12.44	5.50	NA	1.34	1/2-13	.75	1.380	2.000
6"	23.44	11.72	7.00	3.50	8.21	NA	15.33	7.12	NA	2.56	3/4-10	1.00	1.380	2.360
8"	NA	NA	NA	NA	NA	5.77	NA	NA	12.78	NA	NA	NA	Fig. 2	Fig. 2

Apollo® Top Entry Valve Operating Torques

Torque Constants for Apollo® Top Entry Ball Valves****

Seat Options	Valve Size	Differential Pressures (psig) 100	285	500	740	1480
*1 *7	1/2 thru 1"	85	110	140	180	290
	1-1/2"	205	260	330	415	660
2 A	2"	350	430	550	735	1,200
3 C	3"	950	1,250	1,650	2,000	3,200
	4"	2,000	2,500	3,300	4,100	6,500
5 D	6"**	5,300	6,700	8,200	11,400	18,000
6 Z	8"**	11,000	14,000	18,500	25,000	36,000
	10"**	18,500	22,000	30,000	40,000	62,000

Seat Options	Valve Size	Differential Pressures (psig) 100	285	500	740	1480
	1/2 thru 1"	115	160	210	260	450
4	1-1/2"	270	370	480	590	1,000
8	2"	475	650	860	1,050	1,750
***9	3"	1,250	1,850	2,400	2,950	4,900
	4"**	2,700	3,700	4,900	5,900	10,000
B	6"**	7,410	10,100	13,400	16,400	25,300
	8"**	15,000	20,000	26,000	34,500	56,000
	10"**	25,000	32,000	45,000	60,000	96,000

*Reduce torque by 30% for PTFE seats
**Gear operator or actuation recommended
***Increase torque by 10% for Ceramic seats
****For full port figures, use one valve size larger

Torque Adjustment Factors

Provision	Condition	Additional Factor
Type of Operation	ON/OFF Service	0
	Modulating	0.25
Process Media	Liquid, Clean Particle Free	0
	Liquid, Dirty, Slurry, Raw Water	0.3 to 0.8
	Liquid, Black Liquor, Lime Slurry	0.8
	Liquid, Oil, Lubricating	-0.3
	Liquid, Viscous, Molasses	0.3
	Gas, Clean & Wet, Saturated Steam	0
	Gas, Dry, Superheated Steam	0.3 to 0.5
	Gas, Dirty, Air Slurry, Natural Gas	0.5 to 1
	Oxygen, Chlorine	0.5
Frequency of Operation	Once per Day or More	0
	Once per Day to Once per Week	0.2
	Once per Week to Once per Month	0.5
	Once per Month or Less	1

Example:

Selected Valve: 3" 150 w/#6 seat (Model: CS-C60-BO1)

Torque Constant: 1250 in-lbs

Service Factors:

ON/OFF Service 0.0
Clean Dry Air 0.3
Weekly Operation 0.2
Net Service Factor 0.5

"In Service" Valve Torque: 1250 x (1 + 0.5) = 1875 in-lbs
This is the valve torque used to select an actuator.

There are several elements involved in developing an appropriate "in-service" valve operating torque. Selection of the basic valve torque constant, shown at the left establishes the nominal valve torque based on the valve size, specified valve seat and the approximate working pressure.

Armed with the nominal valve operating torque, adjustments are now made to account for individual service conditions. These factors are selected from the table at the lower left. They are additive, or combined in series and used to arrive at the "in-service" torque.

Extended Bonnets

Features:

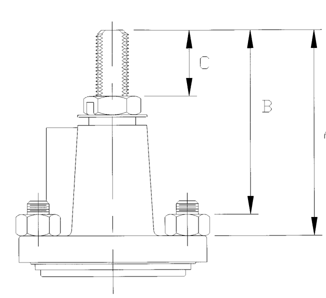
- Extended bonnets for Apollo® Top Entry Ball Valves are available for sizes 1/2" through 8" in classes 150 and 300. Extended bonnets are standard for all class 600 valves.
- These bonnets provide excellent performance in high temperature or semi cryogenic applications.
- This bonnet design places the stem seals further away from the process flow thereby maintaining temperatures closer to ambient.
- Insulation can be applied to the bonnet reducing the chance of disturbance as would be caused by a stem extension. If and when stem leakage occurs it can be immediately observed and corrective action taken without insulation removal.
- A valuable feature of the Extended Bonnet is that it is field retrofitable. In addition to being able to order valves with several bonnet styles direct from the factory, kits are available that are pre-assembled with the stem, bonnet, packings, glands and jam nut installed and properly torqued for dependable performance. Contact the factory for kit part numbers for any specific valve or application.

Materials of Construction:

Extended bonnets are available in the same broad selection of materials of construction as those illustrated on page 5 for the bonnet, stem, stem packings, packing gland, nuts and body seals.

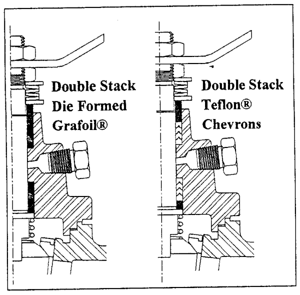
Class 150 & 300 Extended Bonnets

Size	A	B	C
3/4"	2.55	2.25	0.77
1"	2.55	2.25	0.77
1-1/2"	3.54	3.18	0.99
2"	4.14	3.66	1.06
3"	5.27	4.66	1.55
4"	6.66	6.11	2.24
6"	6.88	6.15	1.96
8"	7.77	6.79	2.56



Fugitive Emissions Stem Seals

Following a detailed testing program it has been found that the double stack of RPTFE Chevron style packings clearly outperformed the other contenders evaluated. In applications where this material is acceptable, it would be the hands-down choice. However, when resistance to high temperatures is a must, such as in a valve requiring fire-safe performance, then the Grafoil® packings must be considered.



With any of the styles of grafoil packings tested it is reasonable to expect that over the anticipated life of the packing (100,000 cycles) two (2) packing adjustments will be required. From the testing, the first adjustment could be anticipated around the 20,000 cycle point and the second some time after the 60,000 cycle mark. The primary offering in Grafoil® fugitive emissions style packings for Apollo® Top Entry Ball Valves will be the double stack arrangement provided by Garlock® under the trade name EVSP.

The results are presented here in 5000 cycle increments. Measurements were taken more frequently and those other data points showed no evidence of any trends in the growth of a leak from a minor status to one requiring adjustment. Through process monitoring, statistical data can be used to establish preventive maintenance schedules showing packing adjustment intervals.

Leakage Rate in PPM Methane

Cycle Count	Double Stack RPTFE Chevrons	Double Stack Grafoil®
5000	0	0
10,000	0	0
15,000	0	0
20,000	4	1
25,000	3	42*
30,000	4	0
35,000	18	0
40,000	14	0
45,000	13	2
50,000	3	3
55,000	4	3
60,000	8	3
65,000	14	4
70,000	30	92*
75,000	24	0
80,000	24	0
85,000	23	2
90,000	52*	11
95,000	0	0
100,000	0	0

*Indicates a packing adjustment was made.
Grafoil® is a registered trademark of Union Carbide.
Garlock® is a registered trademark of Coltec Industries.

Fugitive Emisions Bonnet Dimension

Features:

- Two types of the Fugitive Emissions Bonnet are available. The first type intended for manual operation is not live loaded. Testing has shown that live loading only becomes necessary in high cycle applications. This leads to the second type, the live loaded version. This second type not only is more appropriate for unattended automated operations and high cycle applications, it is also well suited for applications involving thermal cycling.
- Two styles of packings are available for the Fugitive Emissions bonnet. The primary offering is a double stack of RPTFE Chevrons. The second option is a specially contoured double stack of “Die Formed” graphoil rings.
- The lower, primary packing stack is pressure activated as well as mechanically loaded. The upper packing stack acts as back-up seals in the case of primary seal failure. A purge port is available between the two stacks for the purpose of detecting primary seal leakage.
- One of the most valuable features of the Fugitive Emissions Bonnet is that it is field retrofitable to existing installations. In addition to being able to order Top Entry valves with any of three bonnet styles direct from the factory, kits are available that are pre-assembled with the stem, bonnet, packings, glands and jam nut installed and properly torqued for dependable performance. In the case where the service or regulations change and a design upgrade is required, the Top Entry Ball valve is designed to accomodate these changes. Contact the factory for kit part numbers for any specific valve or application.

Materials of Construction:

Extended bonnets are available in the same materials of construction as those illustrated on page 5 for the bonnet, stem, stem packings, packing gland, nuts and body seals.

Class 150 & 300 Valves LIVE LOADED FUGITIVE EMISSIONS BONNET

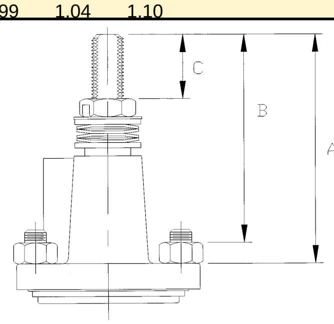
	3/4"	1"	1-1/2"	2"	3"	4"	6"
A	3.41	3.41	3.90	5.20	6.31	7.37	8.03
B	3.11	3.11	3.54	4.72	5.70	6.80	7.30
C	0.98	0.98	0.85	1.35	1.47	2.27	1.30

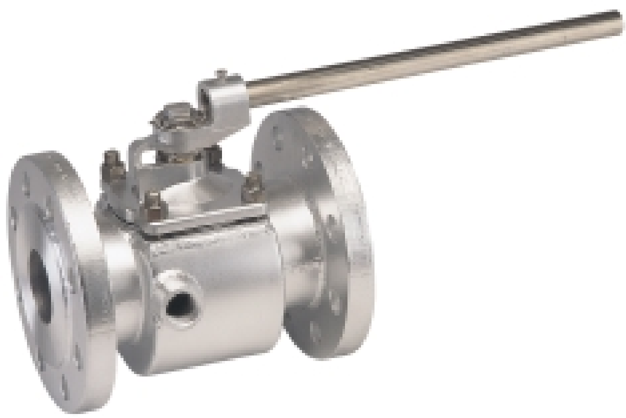
Class 150 & 300 Valves FUGITIVE EMISSIONS BONNET

	3/4"	1"	1-1/2"	2"	3"	4"	6"
A	2.55	2.55	3.54	4.14	5.27	6.66	6.88
B	2.25	2.25	3.18	3.66	4.66	6.11	6.15
C	0.77	0.77	0.99	1.06	1.55	2.24	1.96

Class 600 Valves LIVE LOADED FUGITIVE EMISSIONS BONNET

	3/4"	1"	1-1/2"	2"
A	3.27	3.27	4.54	5.03
B	2.85	2.85	4.12	4.55
C	0.99	0.99	1.04	1.10





Steam Jacketed Apollo® Top Entry Ball Valves

Conbraco's Apollo® Top Entry Ball Valves are ideally suited for jacketed applications. The top entry concept allows for continued access to stem packings and valve internals for ease of maintenance without disturbing the jacket itself or removing the valve from the pipeline.

Partial jacketing (Option "PJ") may be used on standard valves. Partial jacketing is applied just to the center section of the valve and does not incorporate the neck area or flanges of the valve. It is generally specified to allow the use of standard flanges and retain conventional flange bolting. Fully jacketed, standard flange valves have modified flanges with blind tapped stud holes in place of the ordinary through holes.

Welded full jacketing may be applied to valves with standard flanges (Option "FS") or oversize flanges (Option "FO"). Valves and jacketing can be supplied in a variety of materials. Common materials are stainless valves with stainless jackets, but exotic combinations such as Alloy 20 valves with carbon steel flanges and carbon steel jacketing have been supplied to meet the performance and cost requirements for specific applications.

Clamp-on jacketing (Option "CJ") offers flexibility not available in the other configurations. Clamp-on jacketing can be applied to valves already in service, or can be removed and reinstalled on a replacement valve or another similar valve in another application. Clamp-on jackets can be supplied as a weldment or in cast aluminum. A heat transfer compound can be applied between the clamp-on jacket and valve to improve its efficiency.

Combining these jacketed valves with extended bonnets for safe convenient operation, and adding carbon graphite seats or ceramic balls and seats enables the valve to handle a broad range of viscous materials.

Seat Performance Data

#1 (PTFE)
General application seat material, exhibiting lowest operating torque and excellent resistance to chemical attack. **(Figure 1)** Reference chart 1

#2 (RPTFE)
Most commonly specified seat material, and used as the basis for published torque values. Maintains the excellent chemical resistance of unfilled Teflon® (PTFE) with increased resistance to wear and abrasion resulting in longer life. **(Figure 1)** Reference Chart 2

#3 (RPTFE w/Inner Ring)
Features a metallic inner ring to improve abrasion resistance particularly in high solids or throttling applications. Maintains the other features of the #2 seat. **(Figure 2)** Reference Chart 2

#7 (API 607 Cert. PTFE) to 500°F
This seat design has been successfully tested to the requirements of API 607, fourth edition. The PTFE seat is fully confined by a metallic seat holder which provides a secondary seal in the event of the loss of the primary PTFE seal due to a fire. As the seat seal material is PTFE, chemical and torque characteristics will be the same as in the #1 seats. **(Figure 3)** Reference Chart 1

#A (API 607 Cert. RPTFE) to 550°F
This seat design has been successfully tested to the requirements of API 607, fourth edition. The RPTFE seat is fully confined by a metallic seat holder which provides a secondary seal in the event of the loss of the primary PTFE seal due to a fire. The seat holder can perform the same function as the inner ring found in the #3 and #5 seats making this design appropriate for abrasive and throttling applications. As the seat seal material is RPTFE, chemical and torque characteristics will be the same as in the #2 and #3 seats. **(Figure 3)** Reference Chart 2

#5 (55%Bronze/5%Moly BRTFE)
Specifically intended for steam applications. Also applicable to abrasive and throttling applications because of the heavy loading of reinforcing materials and the presence of the inner ring. However, chemical compatibility may be a limiting factor in the application of this seat. **(Figure 2)** Reference Chart 3

"D" (60% Stainless Steel SRTFE)
Intended for abrasive and throttling applications because of the heavy loading of reinforcing materials and the completely confined seat. **(Figure 2)** Reference Chart 2

#6 (UHMWPE)
Ultra High Molecular Weight Polyethylene offers good abrasion resistance making it suitable for use in high solids or slurry applications. These seats are completely confined by a metallic seatholder enhancing their performance in abrasive services. This seat is frequently specified in services where fluorine off-gasing in even the slightest amounts is objectionable. Examples of these services are food, tobacco processing, and nuclear services.
(Figure 2) Reference Chart 4

® Teflon is a registered trademark of DuPont

"U" (UHMWPE)
Exhibits the same characteristics as the #6 seat with the exception that it utilizes the inner seat ring to enhance performance in abrasive services. UHMWPE should be used with caution in the presence of solvents, and the operating torque can be expected to be 30% higher than that of the teflon based seat materials. **(Figure 1)** Reference Chart 4

#8 (PEEK)
PEEK (PolyEtherEtherKetone) offers a high strength alternative to RPTFE, resistant to creep and cold flow. This seat offers good abrasion resistance. Higher in cost, this material offers similar chemical resistance to PTFE but should be checked on application. Operating torque tend to be 40% higher than RPTFE. Ball stop recommended. **(Figure 2)** Reference Chart 5

#B (Carbon Reinforced, PEEK)
Carbon Reinforced PEEK provides improved abrasion resistance when compared to the unfilled variety. Higher in cost, this material offers a broader temperature range than RPTFE with similar chemical resistance but should be checked on application. Operating torque tends to be 40% higher than RPTFE. Ball stop recommended. **(Figure 2)** Reference Chart 5

#4 (Carbon Graphite)
Designed for high temperature applications. A ball stop is required in applications above 500°F. Maximum service temperature is limited to 750°F in oxidizing applications. This seat like all rigid seat materials does not necessarily provide "bubble tight" shut-off. Most test standards have allowable leakage rates or list "classes" of shut-off for this type of seat. Be aware of the system design requirements when specifing this or any rigid seat. Ball stop recommended. **(Figure 1)** Reference Chart 6

#H (High Temperature Graphite)
Designed for very high temperature applications. A ball stop is required in applications above 500°F. Maximum service temperature is limited to 1000°F. This seat like other rigid seat materials does not provide "bubble tight" shut-off. This seat is not as abrasion resistant as the #4 version. Be aware of the system design requirements when specifing this or any rigid seat. Ball stop
recommended. **(Figure 1)** Reference Chart 6

#9 (Ceramic)
Working in conjunction with a ceramic ball, this seat outperforms all other materials in throttling and abrasive applications. It possesses excellent chemical resistance. Cost is very high, and unless experience dictates its use, other alternatives should be evaluated first. A ball stop is recommended for all applications. This seat like all rigid seat materials does not necessarily provide "bubble tight" shut-off. Most test standards have allowable leakage rates or list "classes" of shut-off for this type of seat. Be aware of the system design requirements when specifing this or any rigid seat. **(Figure 4)** Reference Chart 7

Figure 1

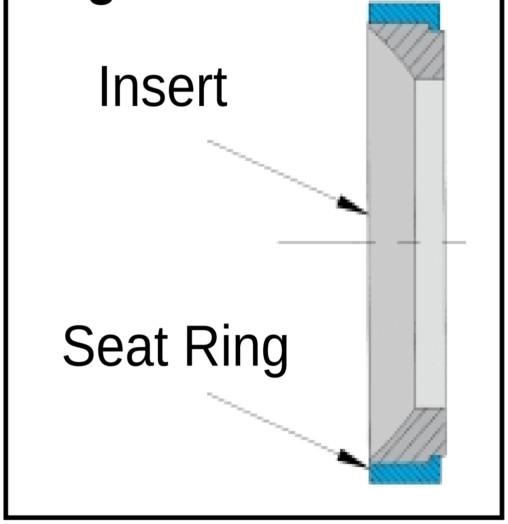


Figure 2

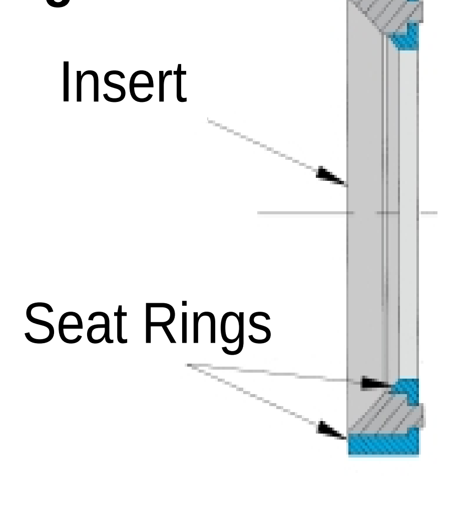


Figure 3

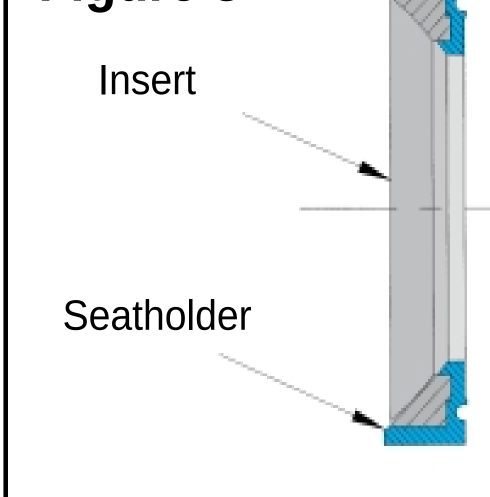
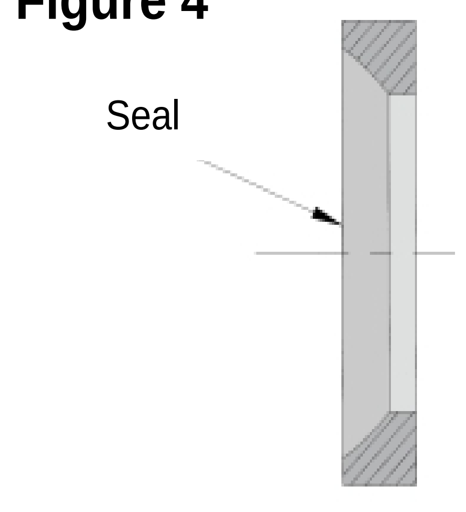
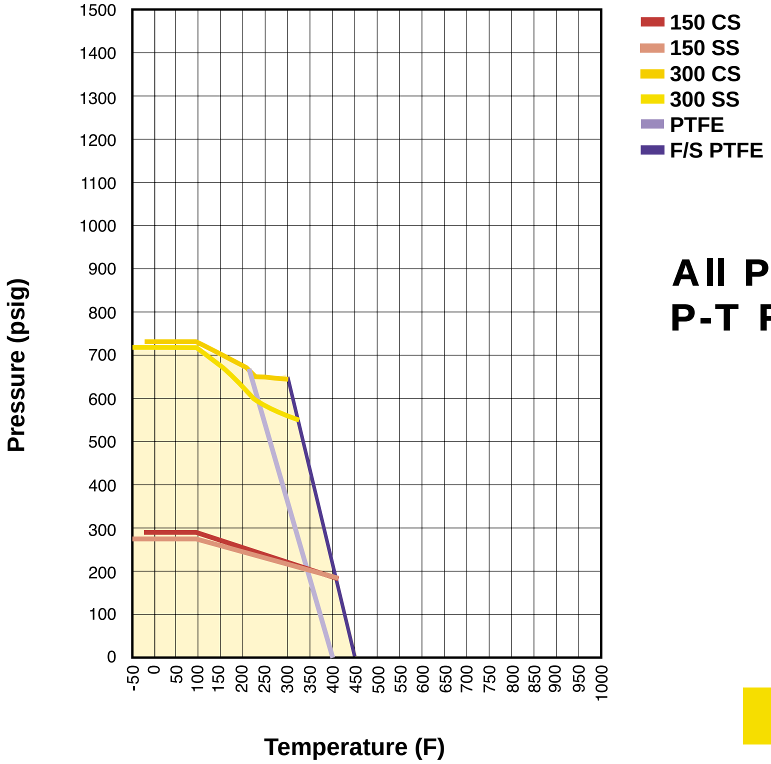


Figure 4

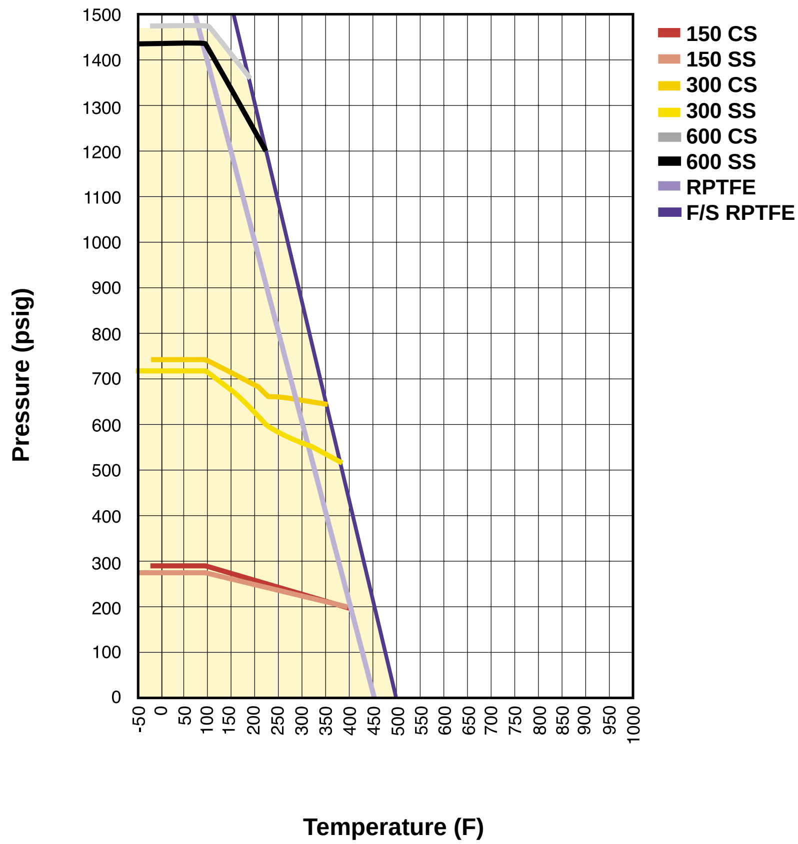


Reference Chart 1



All PTFE Seats P-T Ratings

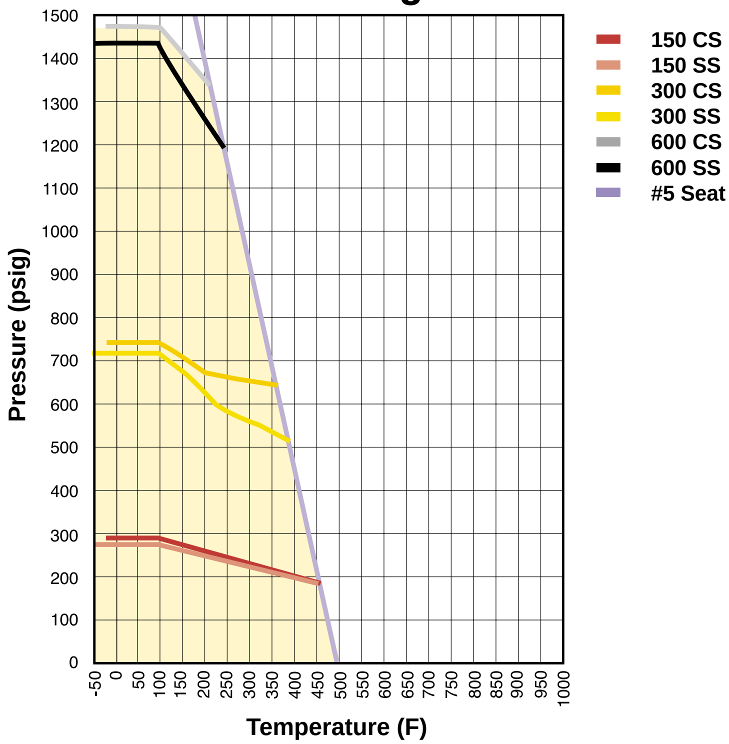
Reference Chart 2



RPTFE Seats P-T Ratings

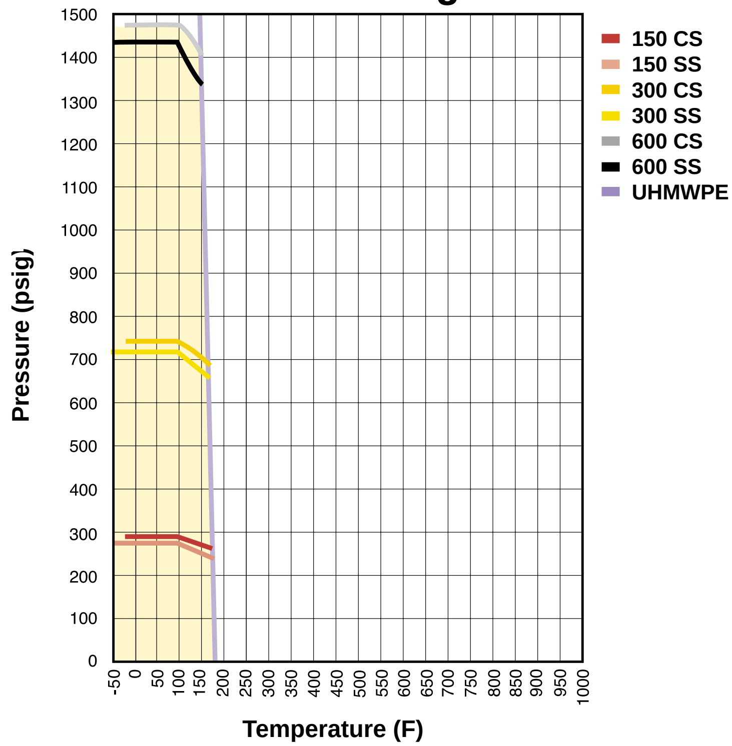
Reference Chart 3

#5 Seat P-T Ratings



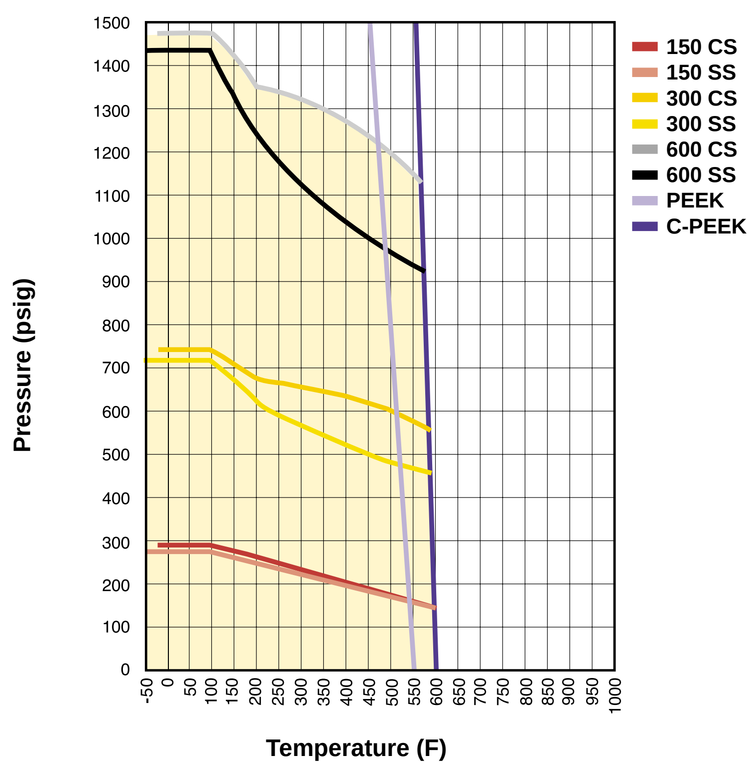
Reference Chart 4

UHMWPE Seats P-T Ratings



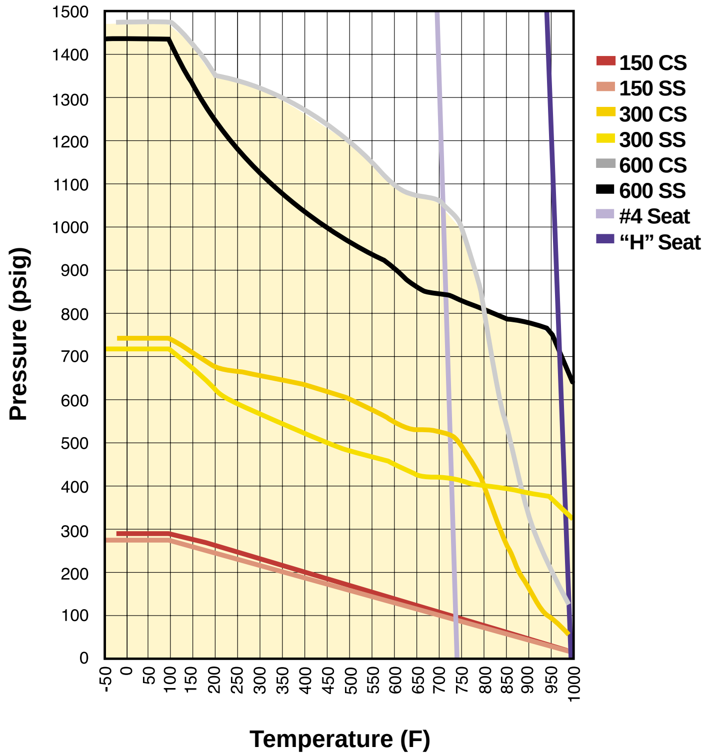
Reference Chart 5

All Peek Seats P-T Ratings



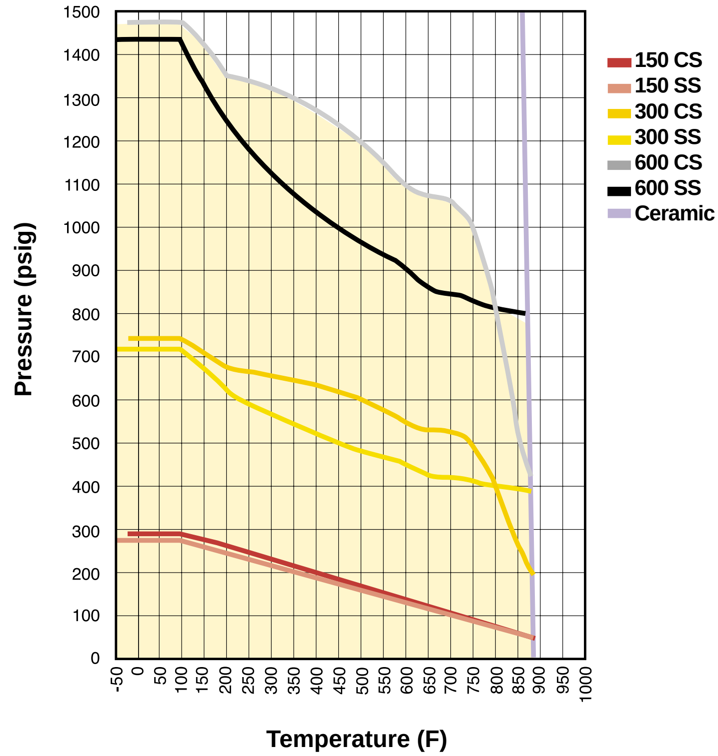
Reference Chart 6

All Carbon-Graphite Seats P-T Ratings



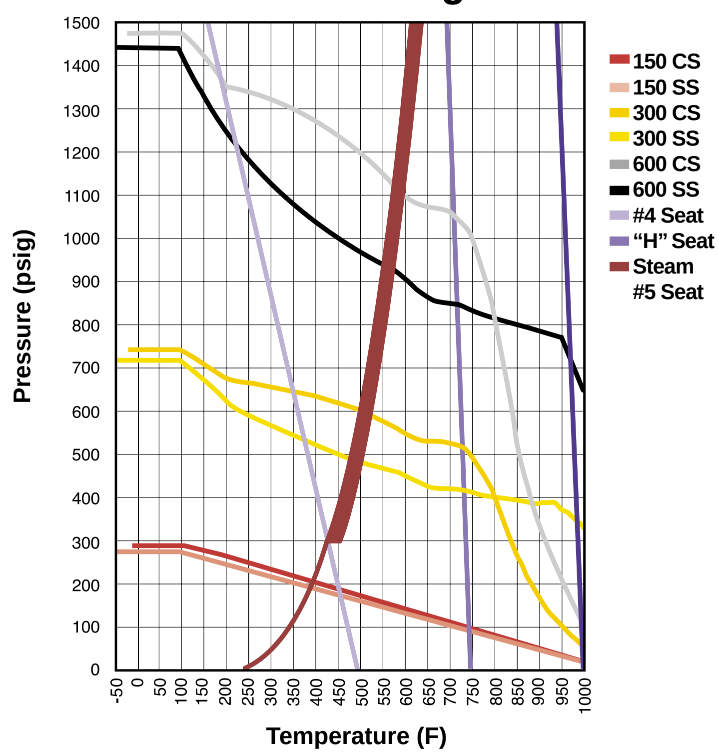
Reference Chart 7

Ceramic Seats P-T Ratings



Reference Chart 8

Steam Rated Seats P-T Ratings



Apollo® Top Entry Full Port Valve Flow Coefficients

Valve Size	150 Class Flanged	300 Class Flanged	600 Class Flanged
1"	95	90	85
1-1/2"	230	225	200
2"	435	420	400
3"	1050	1000	950
4"	1950	1900	1800
6"	4800	4300	4300
8"	9100	8700	8000

Apollo® Top Entry Valve Flow Coefficients

Valve Size	150 Class Flanged End	300 Class Flanged End	300 Class Buttweld End	300 Class Socket Weld	300 Class NPT	600 Class Flanged End	600 Class Buttweld End	600 Class Socket Weld	600 Class NPT
1/2"				20	20			20	20
3/4"	50	50	50	30	30	50	50	30	30
1"	60	60	60	40	40	60	60	40	40
1-1/2"	100	100	100	70	70	100	100	70	70
2"	180	180	180	120	120	190	190	120	120
3"	330	400	400	260	260	410	410	260	260
4"	600	720	720				780	780	
6"	1,500	1,500	1,500				1,700	1,700	
8"	2,500	2,500					3,100		
10"	3,800	3,800					4,900		

The table above presents the Flow Coefficients (Cv) for Apollo® Top Entry Ball Valves. This number represents the flow (in gallons per minute of water) required to produce a 1 psig pressure drop across the valve. The data shown is for a valve in the full open position. Data for various degrees of open are available upon request. The values shown represent the average for several tests which highlighted the variability of Flow Coefficients. It is not unreasonable to expect a 10% to 20% deviation for a specific valve from the nominal figures shown.

Knowing specific system characteristics; such as line size, flow rate, temperature and pressure and knowing specific fluid characteristics; such as specific gravity, density, or compressibility factor allows the verification of the pressure drop across a known valve. Or conversely, in the absence of a valve size and knowing an acceptable pressure drop under the described flow conditions it is possible to select an appropriately sized valve.

Flow of Liquids

$$Q = C_V\sqrt{\frac{P_D}{S_G}} \quad \text{or} \quad P_D = \frac{Q^2(S_G)}{(C_V)^2}$$

Where:
- Q = Flow in US GPM
- P_D = Pressure Drop (PSI)
- S_G = Specific Gravity at flow conditions
- C_V = Valve Flow Coefficient

Flow of Gases

$$P_D = \frac{5.4(10^{-7})Q^2(T)(S_G)}{[(C_V)^2(P_2)]}$$

$$Q = 1360(C_V)\sqrt{\frac{[(P_D)(P_2)]}{[(S_G)(T)]}}$$

Where:
- Q = Flow in SCFM
- P_D = Pressure Drop (PSI)
- P_2 = Outlet Pressure PSIA
- T = Temp.(°R) or (°F + 460)
- S_G = Specific Gravity at flow conditions
- C_V = Valve Flow Coefficient

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Southeast Region	**Five Star Sales**	Florida except Panhandle	fss5star@yahoo.com	941-574-1050	941-574-4214
	Valves & Fittings, Inc.	Georgia/Alabama/Florida Panhandle/Tennessee-East	sales@valves-fittings.com	770-483-3057	770-483-3110
	Pro Marketing, Inc.	North Carolina/South Carolina	sales@promarketinginc.net	864-578-4334	864-578-4889
	Mid South Marketing	Virginia/Maryland/Washington, D.C./WV-East	midsouth7@aol.com	804-749-8712	804-749-8717
Southern Region	**Southern Marketing Group**	MS/TN-West/AR/Bowie Cty.-TX	SMG49@bellsouth.net	901-547-0042	901-547-0035
	Advanced Valves & Controls	Oklahoma/Texas-North	valvesales@avalve.com	817-649-2229	817-649-2225
	Knox & Associates, Inc.	Texas-South/Louisiana	knox1@pdq.net	713-462-7766	713-690-6228
Midwestern Region	**HEBCO, Inc.**	Kansas/Missouri-West	chuckHEBCO@aol.com	913-491-0797	913-491-5126
	New Tech Marketing, Inc.	IL/WI-East/IN-North/MI-Upper Peninsula/IA-River Counties	ntm12@ameritech.net	630-378-4300	630-378-0343
	New Tech Marketing, Inc.	Eastern Missouri/Southern Illinois	ntm112@aol.com	618-394-0329	618-394-0427
	L.J. Whitfill & Associates, Inc.	Kentucky/Indiana-South/Ohio-South	ljwhitfill@aol.com	502-459-4545	502-459-9944
	V.E. Sales Co., Inc.	Michigan (Except Upper Peninsula)	tomv@vesalesinc.com	586-774-7760	586-774-1490
	Northstar Valve & Fitting, Inc.	Minnesota/North & South Dakota/Wisconsin-West	nsvalve@aol.com	952-937-0108	952-937-0803
	Willco, Inc.	Nebraska/Iowa (Except River Counties)	willcoinc@att.net	402-573-7000	402-573-7371
	Morrissey Associates, Inc.	Ohio-North/Pennsylvania-West/West Virginia-West	sales@morrisseyassoc.com	330-538-0406	330-538-0410
Western Region	**Specified Process Equipment Co.**	California-North	john@specifiedprocess.com	707-747-3466	707-747-4957
	SoCal Controls, Inc.	California-South	sales@socalcontrols.com	714-935-9533	714-935-9503
	Marshall-Rodeno Associated	CO/WY/MT/ID-SE/UT/NV-NE/NM/El Paso-TX	trodeno@marshall-rodeno.com	303-575-6701	303-575-6706
	J.P. Harris & Associates, Inc.	Washington/Oregon/Idaho-North West/Alaska	jim@jpharrisassoc.com	360-944-8457	360-944-8459
	Layden Valve Sales & Solutions	Hawaii	will@laydenvalve.com	808-456-3331	808-455-1064
	Southwestern Mechnical Sales Co.	Arizona/Nevada-SW	sales@swmech.com	480-813-1313	480-813-2286
Northeast Region	**Urell, Inc.**	Massachusetts/New England States	doug@urell.com	617-923-9500	617-926-9414
	Pence & Associates	New York-Upstate/New York-West	penceassociates@aol.com	315-423-0066	315-423-0290
	Continuous Sales Corporation	New York-East/New Jersey-North	csc07@aol.com	516-248-5177	516-248-5187
	J.A. Layden Co.	Pennsylvania-East/Delaware/New Jersey-South	sales@jalayden.com	610-353-2311	610-359-1299
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	M.A. Stewart & Sons, Ltd.	British Columbia, Alberta,Ontario,Quebec	surrey@mastewart.com	604-594-8431	604-594-4335
	Mechanical Systems 2000, Inc.	Alberta-South	hoth20@telusplanet.net	403-291-1244	403-219-0686
	Dynamic Agencies, Ltd.	Saskatchewan	doug.dynamicage@sk.sympatico.ca	306-343-1901	306-343-1901
	Tom Beggs Agencies Ltd.	Manitoba/NW Ontario	TBA@MB.SYMPATICO.CA	204-953-1900	204-774-6915
	Task Controls, Inc.	Ontario	taskcontrols@on.aibn.com	416-291-3004	416-754-3481
	Agences J. Pierre Sylvain, Inc.	Quebec	agencespsylvain@videotron.ca	450-655-9588	450-641-2737
	Kern Industries, Ltd.	Alberta-North	kernind@telusplanet.net	780-451-2056	780-454-6687
	J. Levandier Sales, Inc.	Nova Scotia, New Brunswick, Prince Edward Island	jlssales@istar.ca	506-858-1615	506-858-1084
	Smith Agencies	Newfoundland	smithagencies@roadrunner.nf.net	709-364-8856	709-747-9414
	Key to the North Sales Agency, Inc.	Ontario-North	keytothenorthsales@sympatico.ca	705-524-6714	705-566-0148
	Pelco Sales	Eastern-Ontario/Ottawa	pelco@cyberus.ca	613-839-0114	613-839-0115
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