

brands you trust.



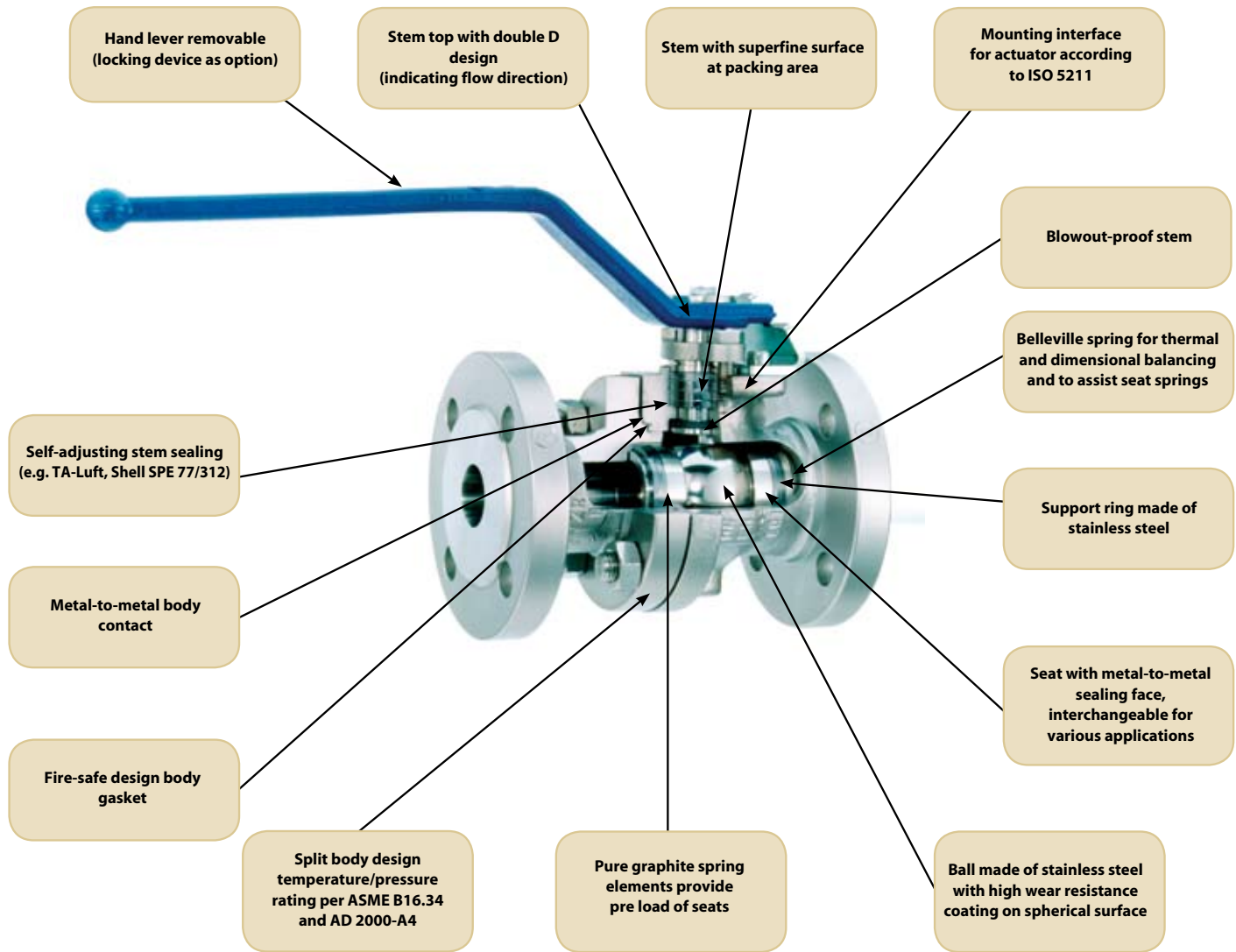
## KROMBACH<sup>®</sup> Metal Seated Ball Valves

**CRANE**<sup>®</sup>

Energy Flow Solutions

[www.craneenergy.com](http://www.craneenergy.com)

# Krombach Metal Seated Ball Design Features and Applications



## Krombach Metal Seated Ball Valve Applications

- Chemical Processing
- Food and Fragrances
- Gases
- Mining
- Oil and Gas
- Pharmaceutical
- Power Generation
- Refining
- Slurries

Krombach® Metal Seated Ball Valve's ball and seat are machined to such precise tolerances that ball and seat lapping does not have to be performed individually for each valve – making both the ball and seat freely interchangeable (if equal in nominal size). Its trunnion-mounted ball design offers a polygon stem-to-ball connection, which reduces stress and ensures optimal torque transmission. An additional feature is its self-cleaning system which removes excess particles, minimizes leakage, and extends product life. Other key options include a fire-safe design body gasket and removable hand lever. To ensure that the Krombach® Metal Seated Ball Valve meets the considerably higher benchmark of leak protection required for Isolation service, it is typically tested for 60 minutes at 300 psig Nitrogen with a permissible leakage rate of level VI (versus the standard test API 598 of 2 minutes at 70 psig under identical conditions).

# Metal Sealing System Design

Our Krombach® Metal Seated Ball Valve's design and production is the culmination of over 25 years of development and manufacturing experience. Innovations offered by this group of products have proven successful in many fields of service application worldwide. Our process-optimized standard series KFO 1136 complies (within respective pressure/temperature ranges) with the ASME B16.34 and AD2000-A4 standards. The Metal Seated Ball Valve's modular sealing system utilizing hard coatings for the ball and seats is just one of the features from which it derives its superior performance. The Krombach® brand is well known for its broad range of special designs for very demanding applications, and supplies many high-profile enterprises globally.

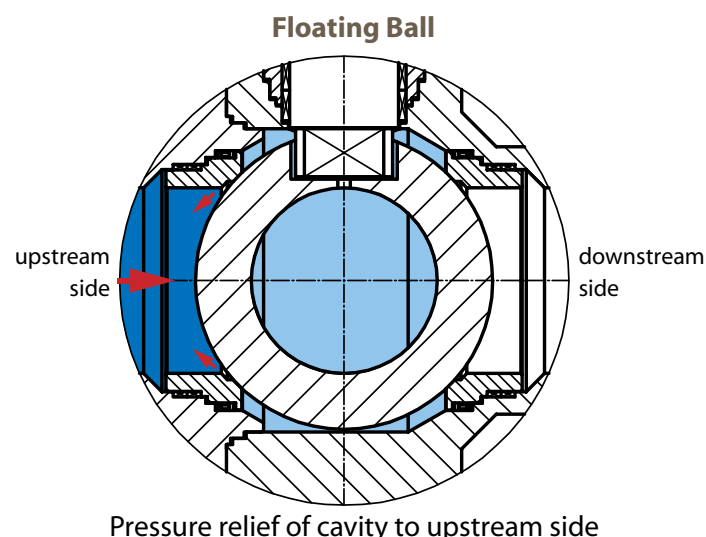
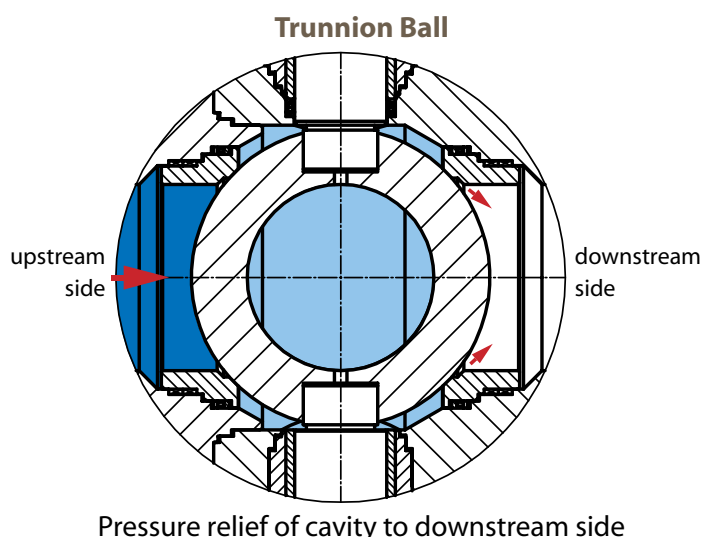
A **self-adjusting seat design** offers leakage protection for a variety of applications utilizing bi-directional flow control. Special flexible graphite spring elements and a cup spring made of high-strength Inconel® deliver the required pre-load of the seats to the ball, creating a tight seal without the need for a separate mechanism to generate differential pressure. The sealing system compensates for thermal balancing, minimizes dimensional tolerances, and extends the service life of the valve.

Its **self-cleaning system** removes adhesive media whenever the valve is cycled. The hardness of the coatings and the special edge treatment of the seats removes sediments from the ball during cycling, prolonging service life.

An automatic **self-relieving seat design** allows for venting of internal cavity pressures without venting the ball.

The ability to freely interchange valve components allows ease of maintenance. Special lapping and surface treatment technology are the primary features that make this possible. The sealing system resists corrosion and wear, which increases the valve's reliability, safety, and operating economy.

Note: The valves can be ordered with a variety of surfaces to accommodate harsh media and other unique internal characteristics of the system being operated with our valves. For critical applications it is recommended that the sealing system is tested under field conditions to ensure that its sealing surface materials offer the desired level of resistance to wear and corrosion or abrasion.



Spring-loaded seats delivering appropriate pre-load (against the ball) and our range of various wear-resistant hard coatings are unique features of the Krombach® sealing system. The selection of the optimal coating to be used in a particular application will be based on several factors (see Table 1: Selection; is based on 4 key parameters).

**Condition phases:** gaseous, vapor, steam, liquid, suspensions, molten, solid particles

Under equal pressure and velocity conditions the abrasive effects of the media increase with the size and quantity of solids in the media. The hardness of the coatings measured in Rockwell C, ranging from 56 to approximately 70 HRC, is what determines the level of resistance to wear (of the ball and seat sealing surfaces). The coating thickness is between 0.0025 and 0.03 inches.

Inconel® is a registered trademark of Special Metal Corporation.

## Acidic or alkaline

Due to the wide range of chemical processes and conditions within a flow-handling system, it is not practical to recommend a single coating surface that will work in all applications. The pH-value of the medium is just one among many considerations in selecting a coating.

Corrosion resistance depends on many factors. The behavior of materials can change substantially in response to small variations in media content, changes in pressure, temperature, flow velocity, and the like. Coatings with a higher content of chrome/cobalt are more effective in acidic applications (pH-value 0-7). Coatings based on nickel are used with alkaline fluids (pH-value 7-14).

# Metal Sealing Selection

**Selection of Sealing System (Table 1)**

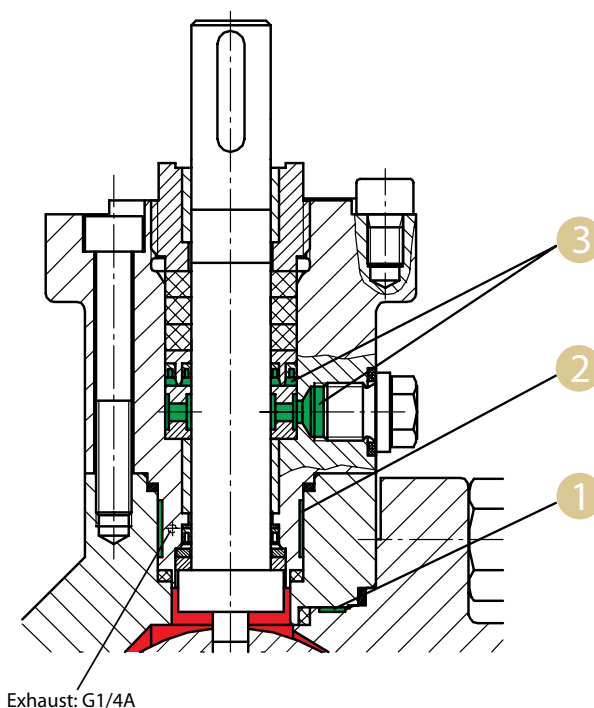
Selection of Sealing System			Code of Sealing System					
			H2	H3	H4	H5	H6	H7
Substance Property	Phase	Slurry, suspensions	+	+	+	+	+	+
		Liquid fluids	+	+	+	+	+	+
		Steam/Vapor	•	+	+	+	+	+
		Gas	•	+	+	+	+	+
		With traces of particles	•	+	+	+	+	+
		With solid parts	-	•	+	+	+	+
	pH Value	0-9	+	-	-	•	+	+
		6-8	+	+	+	+	+	+
		4-14	-	•	•	+	•	-
		7-14	-	+	+	•	-	-
Operating Conditions	Temperature	up to 600°F	+	+	+	+	+	+
		up to 800°F	•	+	+	+	+	•
		up to 1050°F	•	•	+	+	+	-
		up to 1500°F	-	-	-	-	+	-
	Pressure	up to Class 300	+	+	+	+	+	+
		up to Class 600	•	•	+	+	+	+
		up to Class 900	-	•	+	+	+	•
		up to Class 2500	-	•	+	+	•	•

+ suitable  
- not suitable  
• Consult Krombach®

**Characteristic of Coating (Table 2)**

Code	Based On	Coating Procedure	Thickness	Hardness HRC Approx.
H2	Chromium	Electro galvanic	0.003 inch	70
H3	Nickel alloy	Plasma spray and fused	0.032 inch	56-58
H4	Nickel alloy and carbides	Plasma spray and fused	0.032 inch	60-62
H5	Cobalt alloy	Plasma spray and fused	0.032 inch	62-65
H6	Chrom-carbides	High speed spraying	0.012 inch	65-70
H7	Ceramic chromoxide	Spraying	0.012 inch	>70

## Emission Monitoring



We fulfill the mandatory requirements of the TA-Luft / Shell SPE 77/312. Nearly all Krombach® ball valves can be equipped with leak detection / purge ports.

The housing seal is available in a double-gasket configuration. The inner gasket is made of PTFE. The outer gasket is made of pure graphite. These gaskets are linked with the body by way of a connecting bore, ending with a female-threaded bore (e.g., G1/4A). Extremely small leakage rates can be monitored at ports 1 or 2. For monitoring under standard conditions, testing equipment with a measuring range of  $\leq n \times 10E^{-8}$  mbar / L per sec. ( $n = 1-9$ ) is recommended.

Along the stem, the first seal ring on the stem shoulder is loaded by the line pressure. After the guide bushing, the spring-loaded PTFE gasket seals regardless of the line pressure. Any potential leakage along this gasket can be detected at port 3. The spring-loaded PTFE gaskets above the yoke prevent any leakage from reaching the graphite packing rings. The packing rings are preloaded and retain elasticity even in high temperature ranges (resulting in improved fire safety). To enable the plant to carry out a controlled shut-down (as may be needed in certain critical situations), these packing rings are adjustable by quarter turns of the stuffing-box nut (to shutoff).

### Example of test results

An independent laboratory test attend by RWTuV (a technical inspection organization) obtained the following results with a helium pressure test at 3.2 bar (report No. 20 344 294 of 30.7.99.)

#### Leakage rate of body gasket:

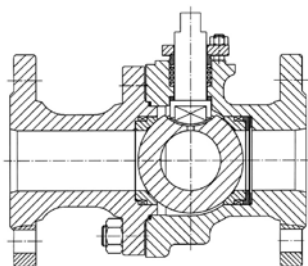
$\leq n \times 10E^{-8}$  mbar / L per sec., ( $n = 1-9$ )

#### After 40.000 cycles:

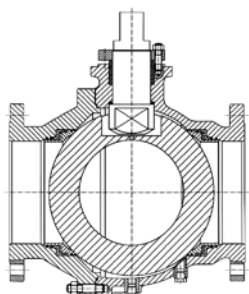
Leakage rate of stem sealing

$\leq n \times 10E^{-6}$  mbar / L per sec., ( $n = 1-9$ )

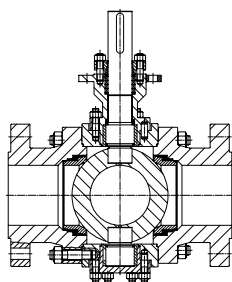
## Product Range



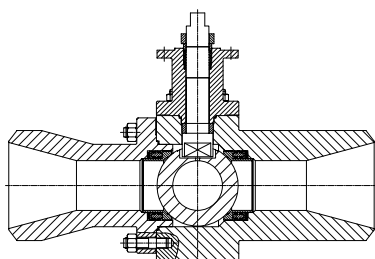
Type KFO 1136  
 Cast body material  
 Class 150 - 300  
 Size ½" - 8"



Type KFO 5136  
 Forged body material  
 Class 150 - 900  
 Size ½" - 16"



Type KFO 7136  
 Trunnion mounted  
 Class 150 - 2500  
 Size 3" - 16"



Type KAO 580  
 Butt-weld end  
 Class 150 - 600  
 Size ½" - 8"

## Manufacturing Locations



Kreuztal – Deutschland/Germany

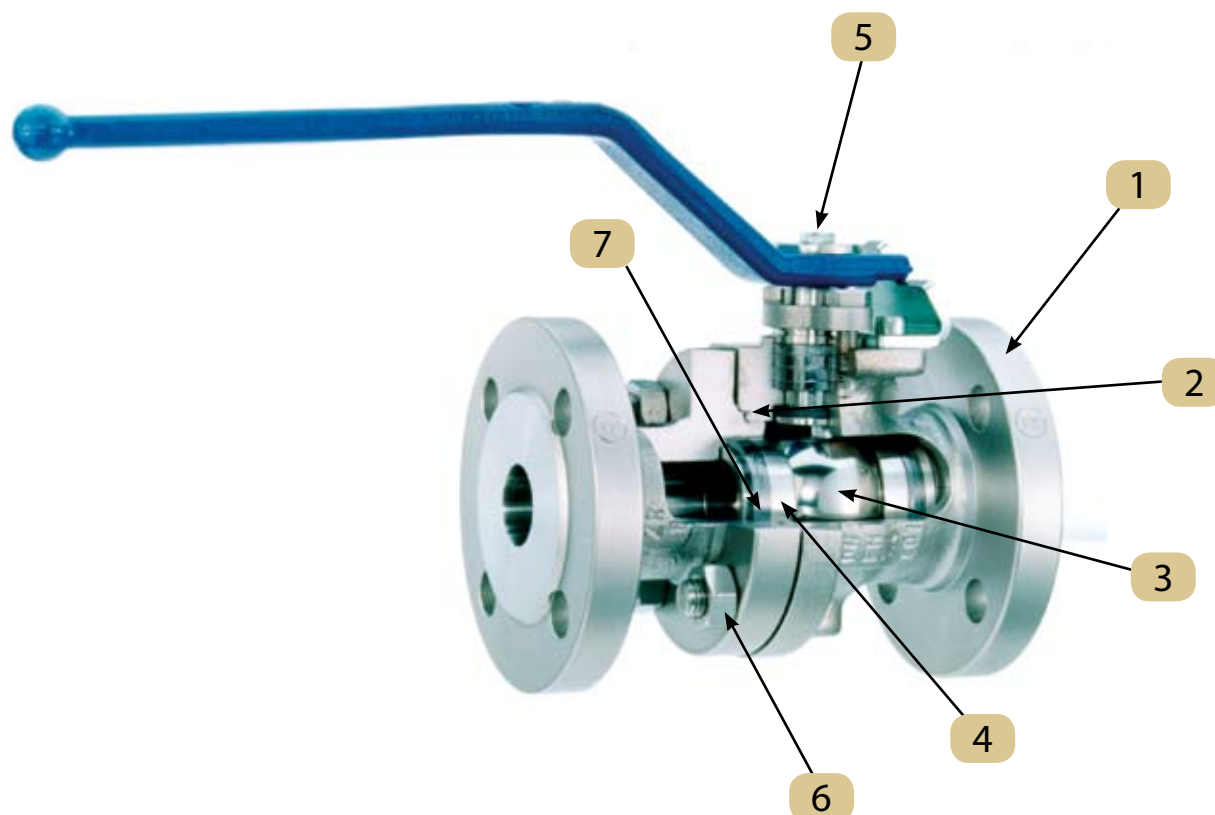


Muta – Slowenien/Slovenia



Ravne – Slowenien/Slovenia

## Materials of Construction



Item	Component	Materials
1	Body	1.0619, 1.4581, 1.4571, 1.0460, Hastelloy® C276; Hastelloy® C2000, all other special materials A216 Gr. WCB; A105; A182 Gr. F316 (1.4301); A182 Gr. F316 Ti (1.4571); Hastelloy® C-276; Hastelloy® C2000, etc.
2	Body Gasket	pure graphite
3	Ball	stainless steel, or other special alloys with coating (see page 4, Table 2)
4	Seat Ring	stainless steel, or other special alloys with coating (see page 4, Table 2)
5	Stem	F316 Ti, A453 Gr. 660 (1.4980), or other special alloys
6	Stud Bolt / Hex. Nut	A4-70, 1.7709 A193 Gr. B8 / A194 Gr. 8M; A193 Gr. B16 / A194 Gr. 7
7	Pressure Ring	A182 F316 Ti (1.4571), or other special alloys

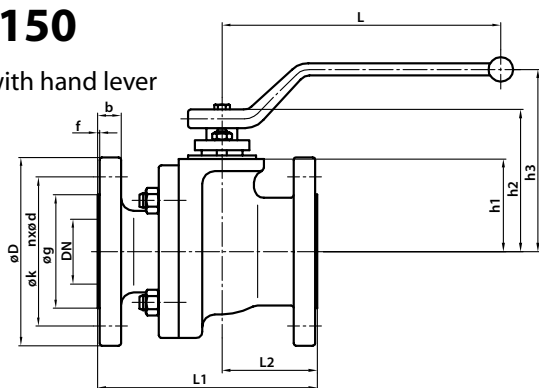
Hastelloy® is a registered trademark of Haynes International, Inc.



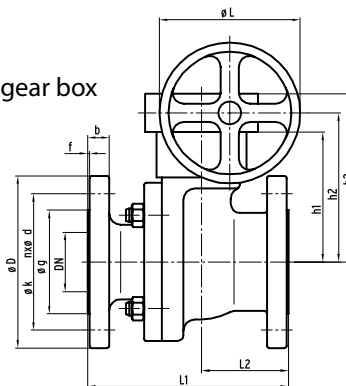
# Dimensions and Weights

## Class 150

Ball valve with hand lever  
½" – 3"



Ball valve with gear box  
4" – 16"



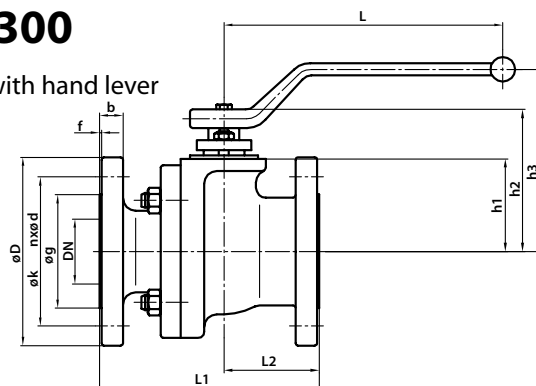
Valve Port Size, Full Bore	Class	Dimensions						Flange Dimensions						Weights
		L1	L2	L	h1	h2	h3	øD	øk	nxød	øg	f	b	lb / kg
inch ½ mm 15	150	4.25 108	2.00 51	10.20 260	1.38 35	2.44 62	4.24 108	3.50 88.9	2.38 60.5	4x0.62 4x15.7	1.38 35.1	0.06 1.6	0.44 11.2	9.7 4.4
inch ¾ mm 20	150	4.60 117	2.10 53	10.20 260	1.38 35	2.44 62	4.25 108	3.88 98.6	2.75 69.9	4x0.62 4x15.7	1.69 42.9	0.06 1.6	0.50 12.7	13.2 6.0
inch 1 mm 25	150	5.00 127	2.40 60	10.20 260	1.93 49	3.03 77	4.84 123	4.25 108.0	3.12 79.2	4x0.62 4x15.7	2.00 50.8	0.06 1.6	0.56 14.2	14.1 6.4
inch 1 ½ mm 40	150	6.50 165	2.70 68	13.10 330	2.56 65	4.13 105	6.10 155	5.00 127.0	3.88 98.6	4x0.62 4x15.7	2.88 73.1	0.06 1.6	0.69 17.5	22.0 10.0
inch 2 mm 50	150	7.00 178	3.00 77	13.10 330	2.95 75	4.53 115	6.50 165	6.00 152.4	4.75 120.7	4x0.75 4x19.0	3.62 91.9	0.06 1.6	0.75 19.1	30.9 14.0
inch 3 mm 80	150	8.00 203	3.50 89	16.00 405	4.21 107	6.46 164	8.15 207	7.50 190.5	6.00 152.4	4x0.75 4x19.0	5.00 127.0	0.06 1.6	0.94 23.9	52.9 24.0
inch 4 mm 100	150	9.00 229	4.20 107	11.81 300	8.27 210	9.65 245	11.02 280	9.00 228.6	7.50 190.5	8x0.75 8x19.0	6.19 157.2	0.06 1.6	0.94 23.9	83.8 38.0
inch 6 mm 150	150	15.50 394	7.10 180	13.78 350	12.10 307	14.05 357	15.75 400	11.00 279.4	9.50 241.3	8x0.88 8x22.4	8.50 215.9	0.06 1.6	1.00 25.4	185.2 84.0
inch 8 mm 200	150	18.00 457	8.66 220	18.00 457	14.33 364	16.30 414	18.50 470	13.50 342.9	11.75 298.5	8x0.88 8x22.4	10.62 269.7	0.06 1.6	1.12 28.4	313.1 142.0
inch 10 mm 250	150	21.00 533	9.45 240	18.00 457	22.83 580	24.80 630	27.80 706	16.00 406.4	14.25 326.0	12x1.00 12x25.4	12.75 323.9	0.06 1.6	1.19 30.2	705.0 320.0
inch 12 mm 300	150	24.00 609	12.00 305	18.00 457	24.80 630	27.36 695	31.10 790	19.00 482.6	17.00 431.8	12x1.00 12x25.4	15.00 381.0	0.06 1.6	1.25 31.8	1100.0 500.0
inch 14 mm 350	150	27.00 686	13.50 343	18.00 457	25.60 650	28.15 715	31.89 80	21.00 533.4	18.75 476.3	12x1.12 12x28.4	16.25 412.8	0.06 1.6	1.38 35.1	1320.0 600.0
inch 16 mm 400	150	30.00 762	15.00 381	18.00 457	26.77 680	29.33 745	33.07 840	23.50 596.9	21.25 539.8	16x1.12 16x28.4	18.50 469.9	0.06 1.6	1.44 36.6	1870.0 850.0



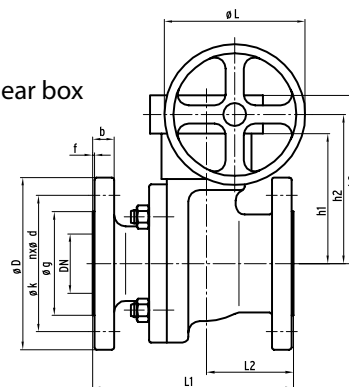
# Dimensions and Weights

## Class 300

Ball valve with hand lever  
1/2" – 3"



Ball valve with gear box  
4" – 16"

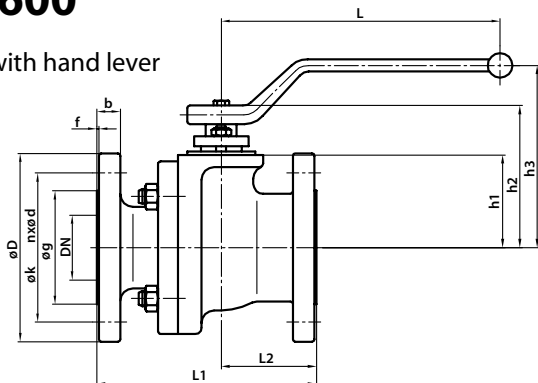


Valve Port Size, Full Bore	Class	Dimensions						Flange Dimensions						Weights lb / kg
		L1	L2	L	h1	h2	h3	øD	øk	nxød	øg	f	b	
inch 1/2 mm 15	300	5.50 140	2.20 56	10.20 260	1.38 35	2.44 62	4.25 108	3.75 95.2	2.62 66.5	4x0.62 4x15.7	1.38 35.1	0.06 1.6	0.56 14.2	11.9 5.4
inch 3/4 mm 20	300	6.00 152	2.40 61	10.20 260	1.38 35	2.44 62	4.25 108	4.62 117.3	3.25 82.5	4x0.75 4x19.0	1.69 42.9	0.06 1.6	0.62 15.7	15.4 7.0
inch 1 mm 25	300	6.50 165	2.40 60	10.20 260	1.93 49	3.03 77	4.84 123	4.88 123.9	3.50 88.9	4x0.75 4x19.0	2.00 50.8	0.06 1.6	0.69 17.5	16.5 7.5
inch 1 1/2 mm 40	300	7.50 190	2.83 72	13.10 330	2.56 65	4.13 105	6.10 155	6.12 155.4	4.50 114.3	4x0.88 4x22.3	2.88 73.1	0.06 1.6	0.81 20.6	26.5 12.0
inch 2 mm 50	300	8.50 216	3.54 90	13.10 330	2.95 75	4.53 115	6.50 165	6.50 165.1	5.00 127.0	4x0.75 4x19.0	3.62 91.9	0.06 1.6	0.88 22.3	39.7 18.0
inch 3 mm 80	300	11.12 283	4.13 105	16.00 405	4.21 107	6.46 164	8.15 207	8.25 209.5	6.62 168.1	8x0.88 8x22.3	5.00 127.0	0.06 1.6	1.12 28.4	72.7 33.0
inch 4 mm 100	300	12.00 305	4.92 125	11.81 300	8.27 210	9.65 245	11.02 280	10.00 254.0	7.88 200.1	8x0.88 8x22.3	6.19 157.2	0.06 1.6	1.25 31.7	119.0 54.0
inch 6 mm 150	300	15.88 403	6.61 168	13.78 350	12.10 307	14.05 357	15.75 400	12.50 317.5	10.62 269.7	12x0.88 12x22.3	8.50 215.9	0.06 1.6	1.44 36.5	242.5 110.0
inch 8 mm 200	300	19.75 502	8.66 220	18.00 457	14.33 364	16.30 414	18.50 470	15.00 381.0	13.00 330.2	12x1.00 12x25.4	10.62 269.7	0.06 1.6	1.62 41.1	429.9 195.0
inch 10 mm 250	300	22.38 568	10.00 254	18.00 457	22.83 580	24.80 630	27.80 706	17.50 444.5	15.25 387.3	16x1.12 16x28.4	12.75 323.9	0.06 1.6	1.88 47.7	880.0 400.0
inch 12 mm 300	300	25.50 648	12.75 324	18.00 457	24.80 630	27.36 695	31.10 790	20.50 520.7	17.75 480.8	16x1.25 16x31.7	15.00 381.0	0.06 1.6	2.00 50.8	1320.0 600.0
inch 14 mm 350	300	30.00 762	15.00 381	18.00 457	25.60 650	28.15 715	31.89 810	23.00 584.2	20.25 514.3	20x1.25 20x31.7	16.25 412.8	0.06 1.6	2.12 53.8	1600.0 725.0
inch 16 mm 400	300	33.00 838	16.50 419	18.00 457	26.77 680	29.33 745	33.07 840	25.50 647.7	22.50 571.5	20x1.38 20x35.0	18.50 469.9	0.06 1.6	2.25 57.1	2200.0 1000.0

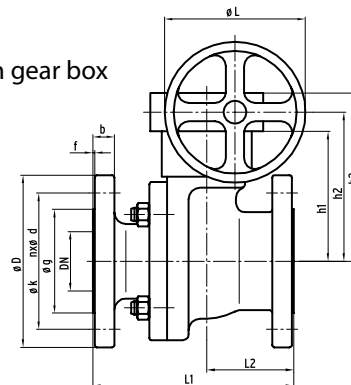
# Dimensions and Weights

## Class 600

Ball valve with hand lever  
1/2" – 3"



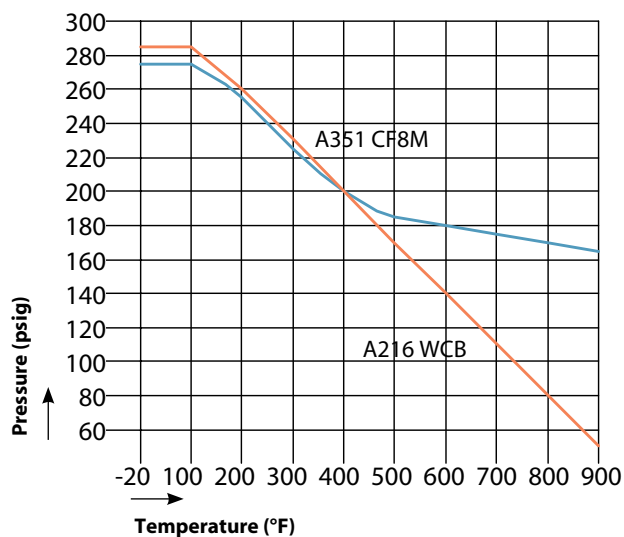
Ball valve with gear box  
4" – 16"



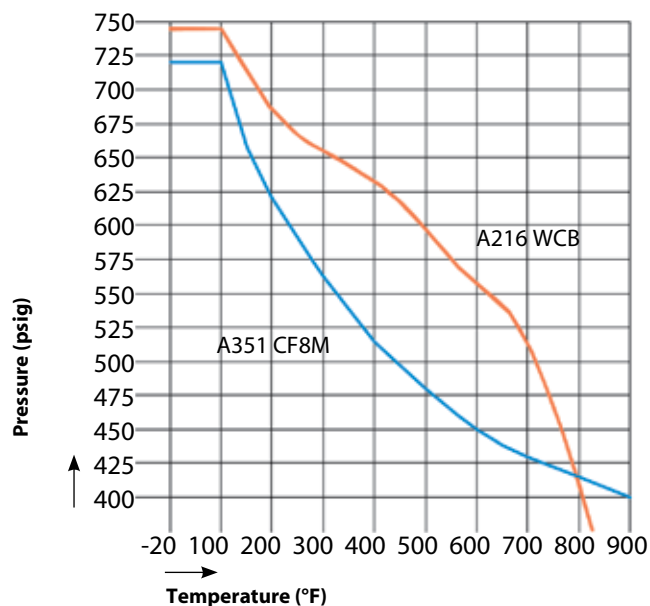
Valve Port Size, Full Bore	Class	Dimensions						Flange Dimensions						Weights lb / kg
		L1	L2	L	h1	h2	h3	øD	øk	nxød	øg	f	b	
inch 1/2 mm 15	600	6.50 165	2.91 74	10.20 260	1.38 35	2.44 62	4.25 108	3.75 95.2	2.62 66.5	4x0.62 4x15.7	1.38 35.1	0.06 1.6	0.56 14.2	13.2 6
inch 3/4 mm 20	600	7.50 190	3.35 85	10.20 260	1.38 35	2.44 62	4.25 108	4.62 117.3	3.25 82.5	4x0.75 4x19.0	1.69 42.9	0.06 1.6	0.62 15.7	18.87 8.5
inch 1 mm 25	600	8.50 216	3.74 95	10.20 260	1.93 49	3.03 77	4.84 123	4.88 123.9	3.50 88.9	4x0.75 4x19.0	2.00 50.8	0.06 1.6	0.69 17.5	24.2 11.0
inch 1 1/2 mm 40	600	9.50 241	4.25 108	13.10 330	2.56 65	4.13 105	6.10 155	6.12 155.4	4.50 114.3	4x0.88 4x22.3	2.88 73.1	0.06 1.6	0.88 22.4	44.0 20.0
inch 2 mm 50	600	11.50 292	5.16 131	13.10 330	2.95 75	4.53 115	6.50 165	6.50 165.1	5.00 127.0	4x0.75 4x19.0	3.62 91.9	0.06 1.6	1.00 25.4	61.7 28.0
inch 3 mm 80	600	14.00 356	6.30 160	16.00 405	4.21 107	6.46 166.4	8.15 207	8.25 209.5	6.62 168.1	8x0.88 8x22.3	5.00 127.0	0.06 1.6	1.25 31.8	143.0 65
inch 4 mm 100	600	17.00 432	7.64 194	11.81 300	8.27 210	9.65 245	11.02 280	10.75 273.1	8.50 215.9	8x1.00 8x25.4	6.19 157.2	0.06 1.6	1.50 38.1	220.0 100.0
inch 6 mm 150	600	22.00 559	9.88 251	13.78 350	12.10 307	14.05 357	15.75 400	14.00 355.6	11.50 292.1	12x1.12 12x28.4	8.50 215.9	0.06 1.6	1.88 47.8	440.0 200.0
inch 8 mm 200	600	26.00 660	11.42 290	18.00 457	14.33 364	16.30 414	18.50 470	16.50 419.1	13.75 349.3	12x1.25 12x31.8	10.62 269.7	0.06 1.6	2.19 55.6	695.0 315.0
inch 10 mm 250	600	31.00 787	13.75 349	18.00 457	22.83 580	24.80 630	27.80 706	20.00 508.0	17.00 431.8	16x1.38 16x35.1	12.75 323.9	0.06 1.6	2.50 63.5	992.0 450.0
inch 12 mm 300	600	33.00 838	16.50 419	18.00 457	24.80 630	27.36 695	31.10 790	22.00 558.8	19.25 489.0	20x1.38 20x35.1	15.00 381.0	0.06 1.6	2.62 66.5	1587.0 720.0
inch 14 mm 350	600	35.00 889	17.50 444	18.00 457	25.60 650	28.15 715	31.89 810	23.75 603.3	20.75 527.1	20x1.50 20x38.1	16.25 412.8	0.06 1.6	2.75 69.9	1948.0 870.0
inch 16 mm 400	600	39.00 990	19.50 495	18.00 457	26.77 680	29.33 745	33.07 840	27.00 685.8	23.75 603.3	20x1.62 20x41.1	18.50 469.9	0.06 1.6	3.00 76.2	2755.0 1250.0

## Pressure and Temperature Ratings

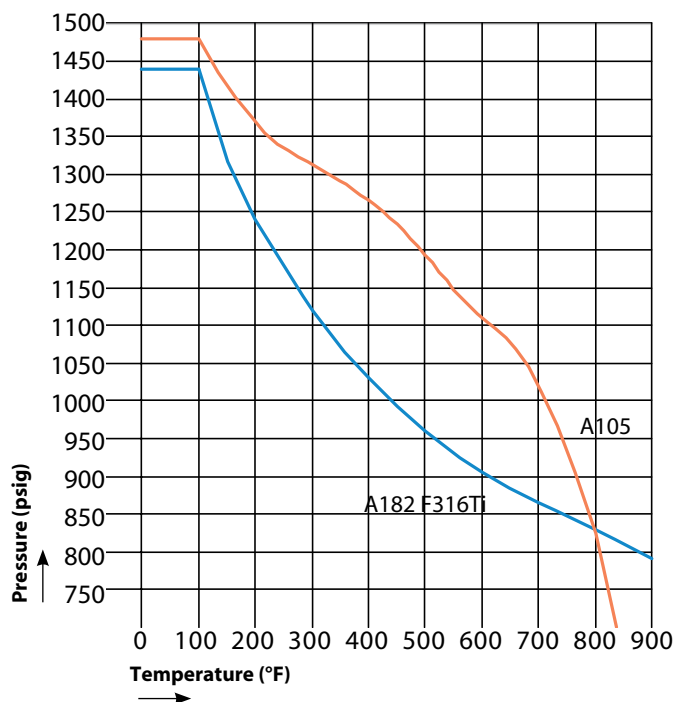
**Class 150 - A351 CF8M and A216 WCB**



**Class 300 - A351 CF8M and A216 WCB**

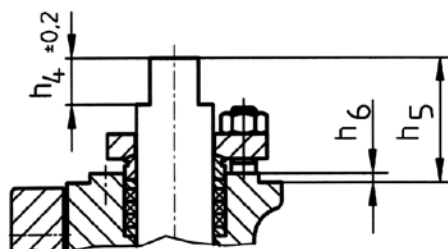
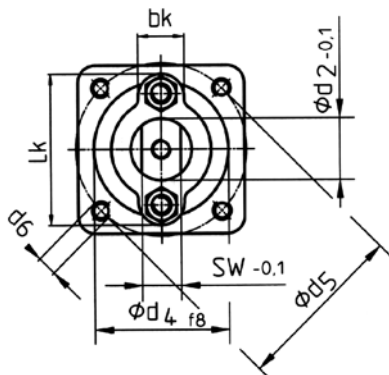


**Class 600 - A182 F316Ti and A105**



# Actuation

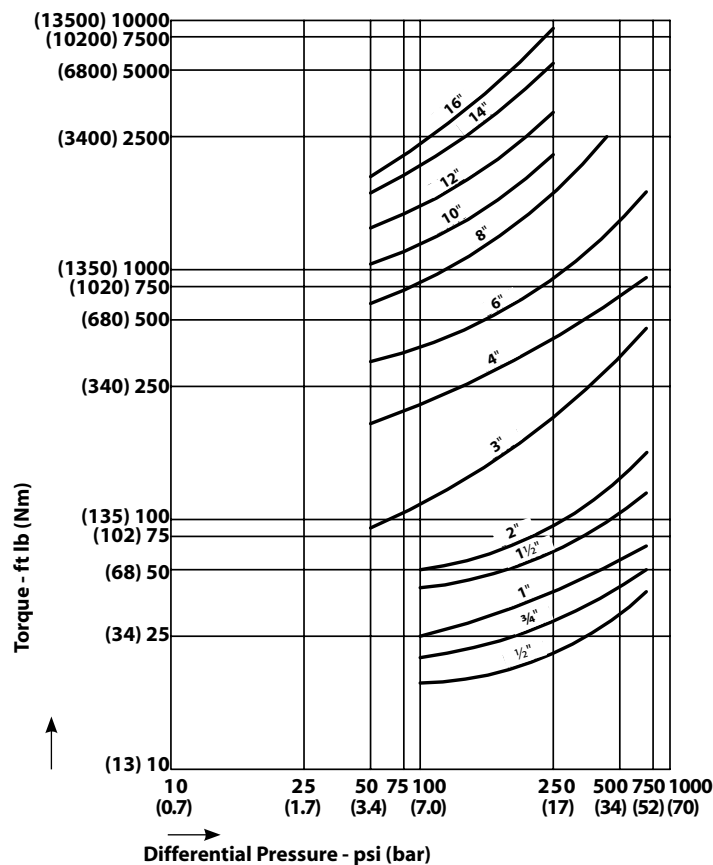
According to ISO 5211



Valve Port Size, Full Bore	ISO 5211	ød2	ød4	ød5	d6	h4	h5	h6	LK	BK	SW
inch ½ mm 15	F04	0.67 17	1.18 30	1.65 42	4xM5	0.35 9	1.06 27	0.12 3	2.05 52	0.55 14	0.47 12
inch ¾ mm 20	F04	0.67 17	1.18 30	1.65 42	4xM5	0.35 9	1.06 27	0.12 3	2.05 52	0.55 14	0.47 12
inch 1 mm 25	F05	0.79 20	1.38 35	1.97 50	4xM6	0.35 9	1.10 28	0.12 3	2.44 62	0.71 18	0.55 14
inch 1 ½ mm 40	F07	0.98 25	2.16 55	2.76 70	4xM8	0.59 15	1.57 40	0.12 3	2.26 60	0.79 20	0.63 16
inch 2 mm 50	F07	0.98 25	2.16 55	2.76 70	4xM8	0.59 15	1.57 40	0.12 3	2.26 60	0.79 20	0.63 16
inch 3 mm 80	F10	1.38 35	2.76 70	4.02 102	4xM10	0.79 20	2.24 57	0.12 3	3.15 80	0.87 22	0.87 22
inch 4 mm 100	F12	1.57 40	3.35 85	4.92 125	4xM12	1.18 30	2.60 66	0.12 3	- -	- -	1.06 27
inch 6 mm 150	F16	2.16 55	5.12 130	6.50 165	4xM20	1.77 45	3.90 99	0.20 5	- -	- -	1.42 26
inch 8 mm 200	F16	2.76 70	5.12 130	6.50 165	4xM20	2.16 55	4.13 105	0.20 5	- -	- -	1.81 46
inch 10 mm 250	F25	2.76 70	7.87 200	10.00 254	8x ø 0.71 ø 18	2.68 68	5.51 140	0.20 5	- -	- -	1.97 50
inch 12 mm 300	F25	3.94 100	5.12 200	10.00 254	8x ø 0.71 ø 18	3.15 80	5.71 145	0.20 5	- -	- -	2.76 70
inch 14 mm 350	F25	3.94 100	5.12 200	10.00 254	8x ø 0.71 ø 18	3.15 80	5.71 145	0.20 5	- -	- -	2.76 70
inch 16 mm 400	F25	3.94 100	5.12 200	10.00 254	8x ø 0.71 ø 18	3.15 80	5.71 145	0.20 5	- -	- -	2.76 70

## Break Away Torques Floating Ball Design

### Basic Torque vs Differential Pressure



Break away torque depends on the combination of differential pressure, media, and cycle frequency. It can be determined as follows:

Basic torque x safety factor x cycle frequency factor

### Media Factor

Media	Safety Factor
Pure oil	1.0
Thermal oil	1.3
Other HC-fluids	1.5
Water	1.5
Suspension, slurry	2.6
Steam, vapor	2.6
Gas	2.6
Solid particles	3.0

### Cycle Frequency Factor

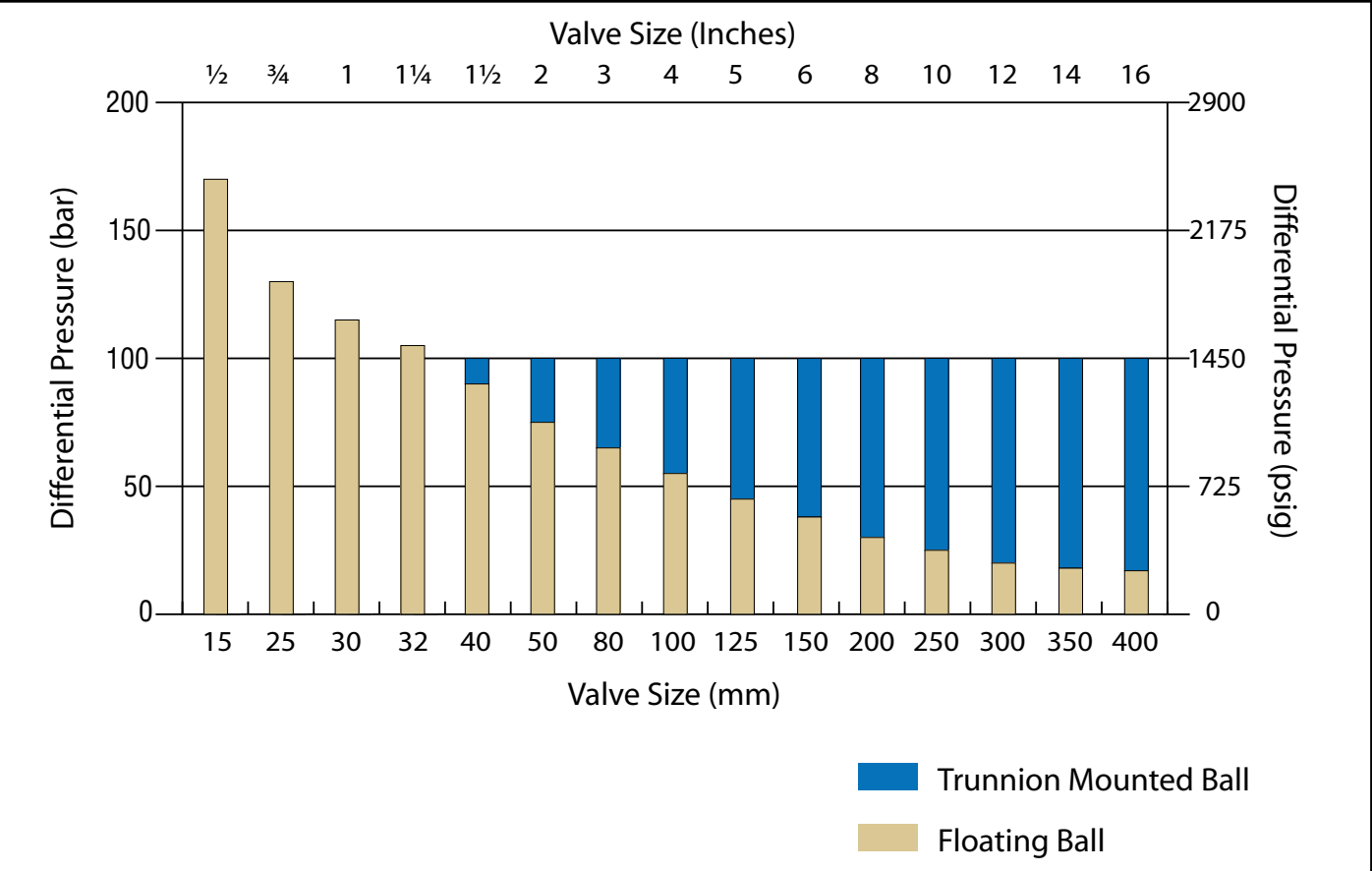
If a Valve is Cycled Once Per	Cycle Frequency Factor
Day or more	1.25
Week or more	1.28
Month or more	1.30
Every four month	1.41
Every eight month	1.45

# Maximum Operating Torques Floating Ball Design

## Maximum Allowable Torques of Stem: A453 Gr. 660 (e.g., 1.4980)

Valve Port Size, Full Bore		Up to 70°F		Up to 220°F		Up to 400°F		Up to 580°F		Up to 750°F	
mm	inch	Nm	ft lb(f)	Nm	ft lb(f)	Nm	ft lb(f)	Nm	ft lb(f)	Nm	ft lb(f)
15	½	81	60	69	51	63	46	57	42	54	40
20	¾	81	60	69	51	63	46	57	42	54	40
25	1	140	103	117	86	105	77	93	69	86	63
32	1 ¼	450	332	378	279	340	250	300	221	283	209
40	1 ½	450	332	378	279	340	250	300	221	283	209
50	2	450	332	378	279	340	250	300	221	283	209
65	2 ½	1420	1074	1375	1014	1235	911	1085	800	1025	756
80	3	1420	1074	1375	1014	1235	911	1085	800	1025	756
100	4	2260	1667	1870	1379	1680	1239	1490	1099	1375	1014
150	6	5900	4352	5650	4167	5075	3743	4500	3319	4215	3109
200	8	12200	8998	10120	7464	9000	6638	8000	5900	7570	5510
250	10	14000	10320	11500	8480	10800	7960	9300	6850	8500	6270
300	12	40000	29500	32500	23970	30000	22120	26000	19170	24000	17700
350	14	40000	29500	32500	23970	30000	22120	26000	19170	24000	17700
400	16	40000	29500	32500	23970	30000	22120	26000	19170	24000	17700

## Selection Guide for Floating/Trunnion Ball Valve Design



- NOTES:**
- For operation conditions and sizes not found on this chart, please contact Krombach® Customer Service.
  - All size nominations indicate ball with full bore.

## Design Features Trunnion Mounted Ball Design

**Special Lapping Procedure  
Ensures Precise Roundness**



**Interchangeable Ball and Seats**

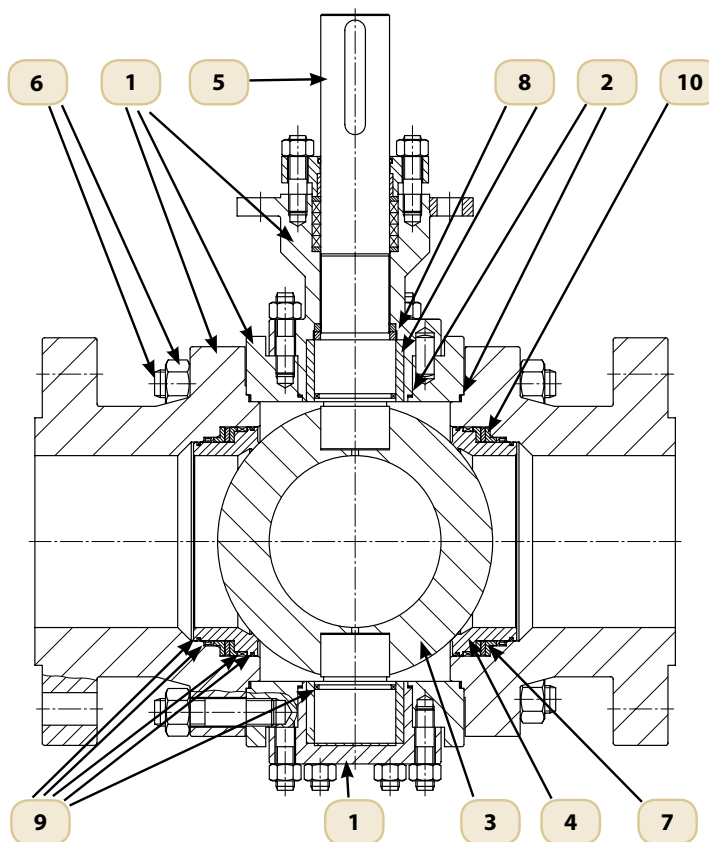


**FK-Polygon Profile  
Ensures Most Effective  
Torque Transmission**





## Materials of Construction Trunnion Mounted Ball Design



Item	Part	Materials
1	Body	1.4571, 1.0460, Hastelloy® C276; Hastelloy® C2000, all other special materials A216 Gr. WCB; A105; A182 Gr. F316 (1.4301); A182 Gr. F316 Ti (1.4571); Hastelloy® C-276; Hastelloy® C2000, etc.
2	Body Gasket	pure graphite
3	Ball	stainless steel, or other special alloys with coating (see page 4, Table 2)
4	Seat Ring	stainless steel, or other special alloys with coating (see page 4, Table 2)
5	Stem	F316 Ti, A453 Gr. 660 (1.4980), or other special alloys
6	Stud Bolt / Hex. Nut	A4-70, 1.7709 A193 Gr. B8 / A194 Gr. 8M; A193 Gr. B16 / A194 Gr. 7
7	Pressure Ring	A182 F316 Ti (1.4571), or other special alloys
8	Bearing	stainless steel; or other special alloys with coating (see page 4, Table 2)
9	Secondary Gaskets	Graphite, Viton®, PTFE, Kalrez, depending on temperature, pressure and medium
10	Belleville Washer	Inconel® 718

Hastelloy® is a registered trademark of Haynes International, Inc.  
Inconel® is a registered trademark of Special Metal Corporation.  
Viton® is a registered trademark of Dupont Performance Elastomers L.L.C.

# Dimensions and Weights

## Class 150, 300, 600

Fig. A

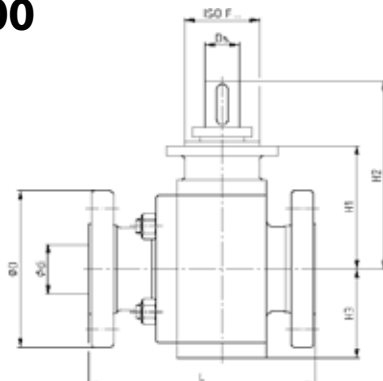
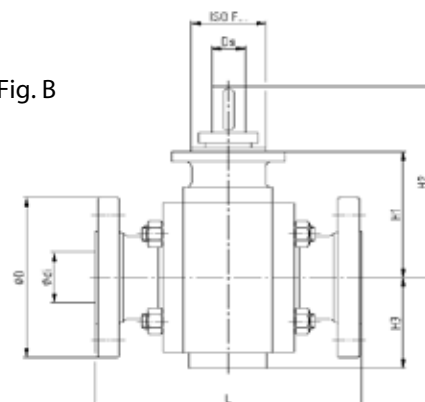


Fig. B



### Trunnion Ball Design Class 150

Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 8	13.50	8.00	18.00	13.75	17.71	8.66	2.36	F16	A	771
mm 200	342	203	457	350	450	220	60			350
inch 10	16.00	10.00	21.00	16.14	20.50	11.00	3.15	F25	A	881
mm 250	406	254	533	410	520	280	80			400
inch 12	19.00	12.00	24.00	18.11	23.62	12.60	3.93	F25	A	1653
mm 300	482	304	610	460	600	320	100			750
inch 14	21.00	13.25	27.00	19.29	26.37	14.17	3.93	F25	A	2094
mm 350	533	336	686	490	670	360	100			950
inch 16	23.50	15.25	30.00	21.25	28.34	15.00	3.93	F25	A	2425
mm 400	596	387	762	540	720	380	100			1100

### Trunnion Ball Design Class 300

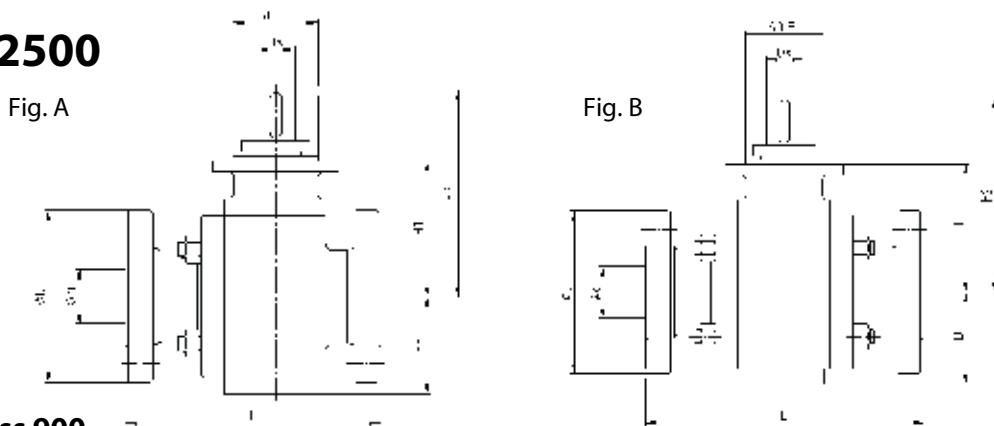
Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 8	15.00	8.00	19.76	13.75	17.71	8.66	2.36	F16	A	837
mm 200	381	203	502	350	450	220	60			380
inch 10	17.50	10.00	22.36	16.14	20.50	11.00	3.15	F25	A/B	992
mm 250	444	254	568	410	520	280	80			450
inch 12	20.50	12.00	25.57	18.11	23.62	12.60	3.93	F25	A/B	1873
mm 300	520	304	648	460	600	320	100			850
inch 14	23.00	13.25	30.00	19.29	26.37	14.17	3.93	F25	A/B	2094
mm 350	584	336	762	490	670	360	100			950
inch 16	25.50	15.25	33.00	21.25	28.34	15.00	3.93	F25	A/B	2645
mm 400	647	387	838	540	720	380	100			1200

### Trunnion Ball Design Class 600

Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 4	10.75	4.00	17.00	9.85	14.17	5.90	1.96	F16	A/B	286
mm 100	273	101	432	250	360	150	50			130
inch 6	14.00	6.00	22.00	11.81	18.11	7.87	2.36	F25	B	595
mm 150	355	152	559	300	460	200	60			270
inch 8	16.50	7.87	26.00	13.75	20.47	9.84	2.75	F25	B	1212
mm 200	419	199	660	350	520	250	70			550
inch 10	20.00	9.75	31.00	16.92	24.00	11.81	3.15	F25	B	1653
mm 250	508	247	787	430	610	300	80			750
inch 12	22.00	11.75	33.00	19.68	29.50	13.77	3.93	F25	B	2535
mm 300	558	298	838	500	750	350	100			1150
inch 14	23.75	12.85	35.00	20.47	30.31	14.76	3.93	F25	B	3086
mm 350	603	326	889	520	770	375	100			1400
inch 16	27.00	14.75	39.00	21.65	31.50	16.53	3.93	F30	B	3637
mm 400	685	374	991	550	800	420	100			1650

## Dimensions and Weights

### Class 900, 1500, 2500



#### Trunnion Ball Design Class 900

Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 4 mm 100	11.50 292	3.85 98	18.00 457	9.84 250	14.17 360	5.90 150	1.96 50	F16	A/B	352 160
inch 6 mm 150	15.00 381	5.75 146	24.00 610	11.81 300	18.11 460	7.87 200	2.36 60	F25	A/B	661 300
inch 8 mm 200	18.50 469	7.50 190	29.00 737	14.56 370	21.25 540	10.23 260	2.75 70	F25	B	1499 680
inch 10 mm 250	21.50 546	9.37 238	34.00 838	17.32 440	24.80 630	11.81 300	3.15 80	F25	B	2425 1100
inch 12 mm 300	24.00 609	11.10 282	38.00 965	20.50 520	30.31 770	14.17 360	3.93 100	F25	B	3527 1600
inch 14 mm 350	25.25 641	12.25 311	40.50 1029	21.65 550	32.28 820	15.35 390	4.72 120	F30	B	4188 1900
inch 16 mm 400	27.75 704	14.00 355	44.50 1130	22.44 570	33.07 840	16.92 430	4.72 120	F30	B	4850 2200

#### Trunnion Ball Design Class 1500

Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 4 mm 100	24.25 311	3.58 91	21.50 546	11.41 290	18.89 480	7.08 180	2.36 60	F25	B	551 250
inch 6 mm 150	15.5 393	5.35 136	27.75 705	15.00 380	20.50 520	8.66 220	2.95 75	F25	B	1146 520
inch 8 mm 200	19.00 482	7.00 177	32.75 832	21.00 530	28.34 720	13.38 340	4.33 110	F30	B	2204 1000
inch 10 mm 250	23.00 584	8.75 222	39.00 991	22.00 560	30.70 780	15.74 400	4.72 120	F30	B	3527 1600
inch 12 mm 300	26.5 673	10.35 263	44.50 1130	23.22 590	33.50 850	16.53 420	4.72 120	F35	B	5291 2400
inch 14 mm 350	30.50 749	11.35 288	49.50 1257	25.19 640	35.45 900	17.71 450	5.11 130	F35	B	6613 3000
inch 16 mm 400	32.50 825	13.00 330	54.50 1384	26.75 680	37.80 960	18.89 480	5.90 150	F40	B	9700 4400

#### Trunnion Ball Design Class 2500

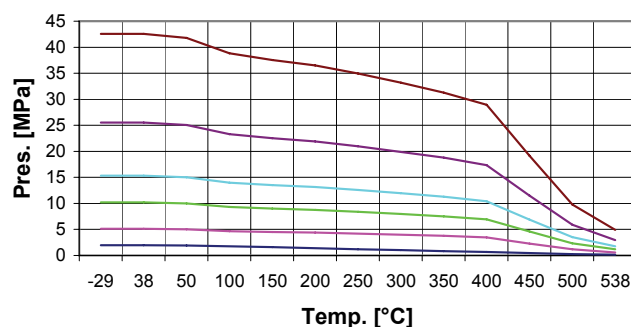
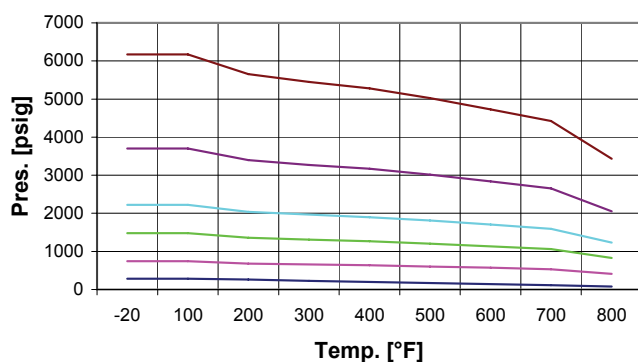
Size	ØD	Ødi	L	H1	H2	H3	Ds	ISO F	Fig.	Weight/kg
inch 4 mm 100	14.00 355	2.87 72	26.50 673	11.81 300	19.68 500	7.87 200	2.36 60	F25	B	859 390
inch 6 mm 150	19.00 482	4.37 111	36.00 914	15.00 380	24.40 620	9.50 240	3.15 80	F25	B	1984 900
inch 8 mm 200	21.75 552	5.75 146	40.25 1022	21.65 550	31.50 800	14.17 360	4.72 120	F35	B	3306 1500
inch 10 mm 250	26.50 673	7.25 184	50.00 1270	23.62 600	35.50 900	16.50 420	5.90 150	F40	B	4960 2250
inch 12 mm 300	30.00 762	8.62 218	56.00 1422	29.50 750	43.34 1100	16.50 450	7.08 180	F48	B	7826 3550

# Pressure and Temperature Ratings

## Group 1.1 Material ASTM A105, A350 LF2 According to ASME B16.34

Temp.	Cl.150 Pres.	Cl.300 Pres.	Cl.600 Pres.	Cl.900 Pres.	Cl.1500 P res.	Class 2500
°F	psig	psig	psig	psig	psig	psig
-20	285	740	1480	2220	3705	6170
100	285	740	1480	2220	3705	6170
200	260	680	1360	2035	3395	5655
300	230	655	1310	1965	3270	5450
400	200	635	1265	1900	3170	5280
500	170	605	1205	1810	3015	5025
600	140	570	1135	1705	2840	4730
700	110	530	1060	1590	2655	4425
800	80	410	825	1235	2055	3430

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°C	Mpa	Mpa	Mpa	Mpa	Mpa	Mpa
-29	1.96	5.11	10.21	15.32	25.53	42.55
38	1.96	5.11	10.21	15.32	25.53	42.55
50	1.92	5.01	10.02	15.04	25.06	41.77
100	1.77	4.66	9.32	13.98	23.30	38.83
150	1.58	4.51	9.02	13.52	22.54	37.56
200	1.38	4.38	8.76	13.14	21.90	36.50
250	1.21	4.19	8.39	12.58	20.97	34.95
300	1.02	3.98	7.96	11.95	19.91	33.18
350	0.84	3.76	7.51	11.27	18.78	31.30
400	0.65	3.47	6.94	10.42	17.36	28.93
450	0.46	2.30	4.60	6.90	11.50	19.17
500	0.28	1.18	2.35	3.53	5.88	9.79
538	0.14	0.59	1.18	1.77	2.95	4.92



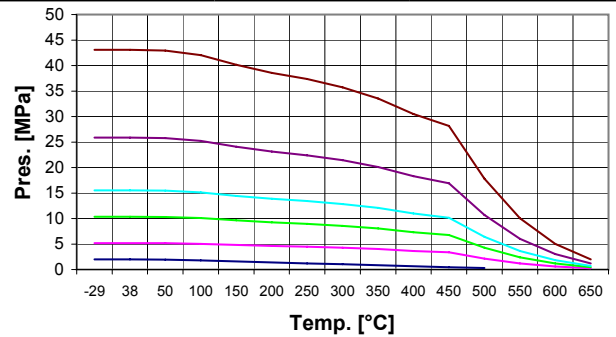
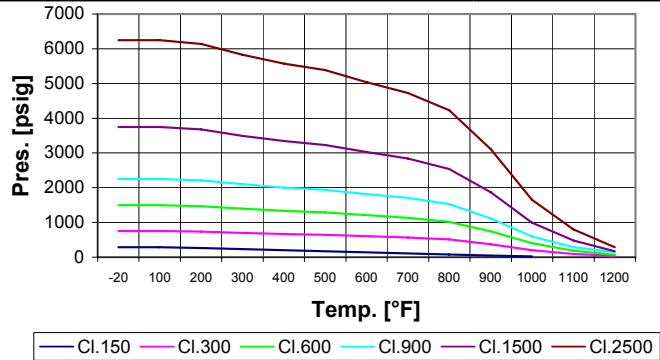
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 — Cl.600   
 — Cl.900   
 — Cl.1500   
 — Cl.2500

# Pressure and Temperature Ratings

## Group 1.17 Material ASTM A182 F5 According to ASME B16.34

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°F	psig	psig	psig	psig	psig	psig
-20	290	750	1500	2250	3750	6250
100	290	750	1500	2250	3750	6250
200	260	735	1470	2210	3680	6135
300	230	700	1400	2100	3495	5830
400	200	670	1335	2005	3345	5570
500	170	645	1290	1940	3230	5385
600	140	605	1210	1815	3025	5040
700	110	570	1135	1705	2840	4730
800	80	510	1015	1525	2540	4230
900	50	375	745	1120	1870	3115
1000	20	200	400	595	995	1655
1100		95	190	290	480	800
1200		35	70	150	170	285

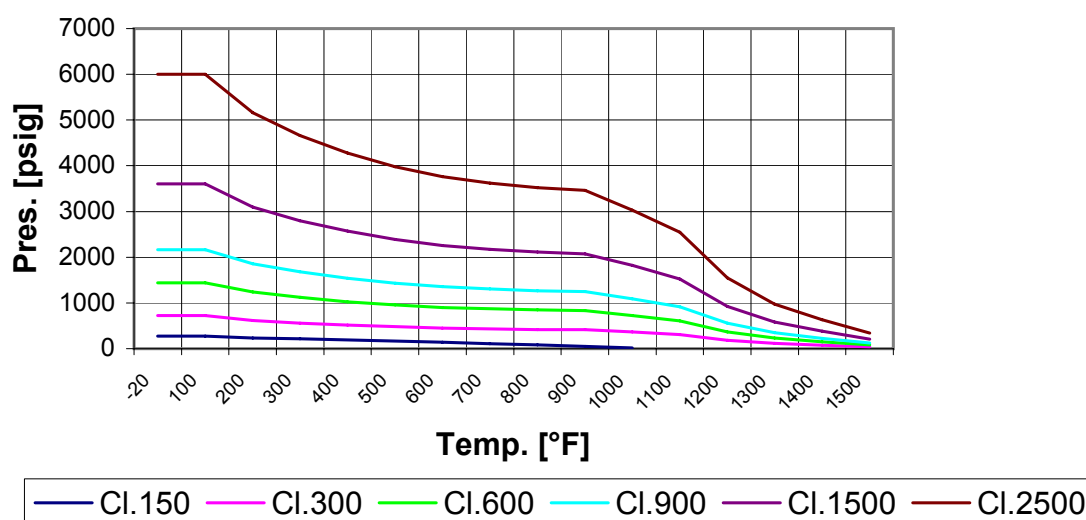
Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°C	Mpa	Mpa	Mpa	Mpa	Mpa	Mpa
-29	1.98	5.17	10.34	15.51	25.86	43.09
38	1.98	5.17	10.34	15.51	25.86	43.09
50	1.95	5.15	10.30	15.45	25.75	42.92
100	1.77	5.04	10.09	15.13	25.22	42.04
150	1.58	4.82	9.64	14.45	24.09	40.15
200	1.38	4.63	9.25	13.88	23.13	38.56
250	1.21	4.48	8.96	13.45	22.41	37.35
300	1.02	4.29	8.57	12.86	21.44	35.71
350	0.84	4.03	8.04	12.07	20.11	33.53
400	0.65	3.65	7.33	10.98	18.31	30.49
450	0.46	3.37	6.77	10.14	16.90	28.18
500	0.28	2.14	4.28	6.41	10.69	17.82
550		1.20	2.41	3.61	6.02	10.04
600		0.61	1.21	1.82	3.03	5.04
650		0.24	0.47	0.71	1.18	1.97



## Pressure and Temperature Ratings

### Group 2.2 Material ASTM A 182 F316 According to ASME B16.34

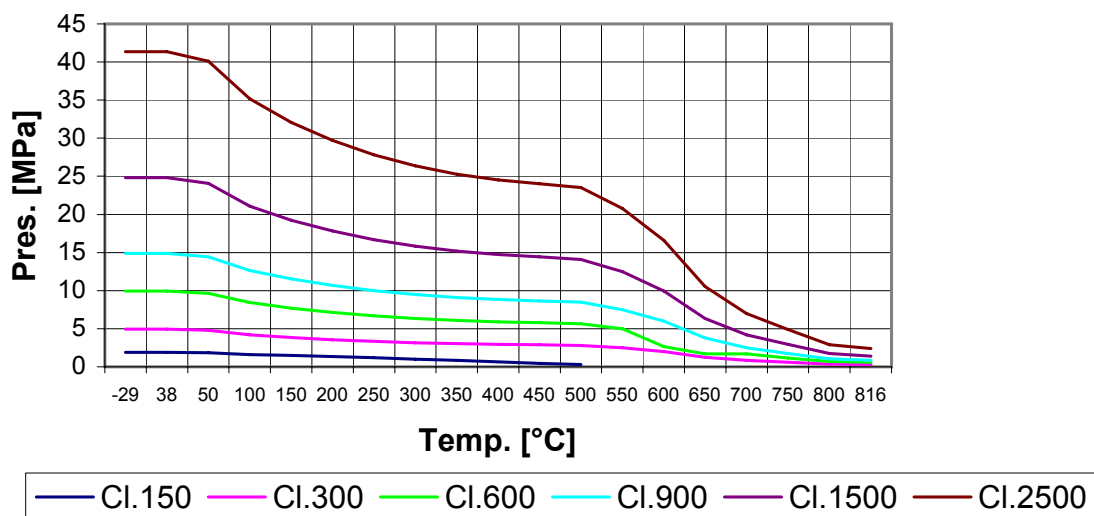
Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°F	psig	psig	psig	psig	psig	psig
-20	275	720	1440	2160	3600	6000
100	275	720	1440	2160	3600	6000
200	235	620	1240	1860	3095	5160
300	215	560	1120	1680	2795	4660
400	195	515	1025	1540	2570	4280
500	170	480	955	1435	2390	3980
600	140	450	900	1355	2255	3760
700	110	435	870	1305	2170	3620
800	80	420	845	1265	2110	3520
900	50	415	830	1245	2075	3460
1000	20	365	725	1090	1820	3030
1100	-	305	610	915	1525	2545
1200	-	185	370	555	925	1545
1300	-	115	235	350	585	970
1400	-	75	150	225	380	630
1500	-	40	85	125	205	345



## Pressure and Temperature Ratings

### Group 2.2 Material ASTM A 182 F316 According to ASME B16.34

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°C	Mpa	Mpa	Mpa	Mpa	Mpa	Mpa
-29	1.90	4.96	9.93	14.89	24.82	41.37
38	1.90	4.96	9.93	14.89	24.82	41.37
50	1.84	4.81	9.62	14.43	24.06	40.09
100	1.62	4.22	8.44	12.66	21.10	35.16
150	1.48	3.85	7.70	11.55	19.25	32.08
200	1.37	3.57	7.13	10.70	17.83	29.72
250	1.21	3.34	6.68	10.01	16.69	27.81
300	1.02	3.16	6.32	9.49	15.81	26.35
350	0.84	3.03	6.07	9.10	15.16	25.27
400	0.65	2.94	5.89	8.83	14.72	24.53
450	0.46	2.88	5.77	8.65	14.42	24.04
500	0.28	2.82	5.65	8.47	14.09	23.50
550	-	2.50	4.98	7.48	12.49	20.80
600	-	1.99	2.65	5.97	9.95	16.59
650	-	1.27	1.69	3.80	6.33	10.55
700	-	0.84	1.68	2.51	4.19	6.98
750	-	0.59	1.17	1.76	2.93	4.89
800	-	0.35	0.70	1.05	1.74	2.92
816	-	0.28	0.59	0.86	1.41	2.38



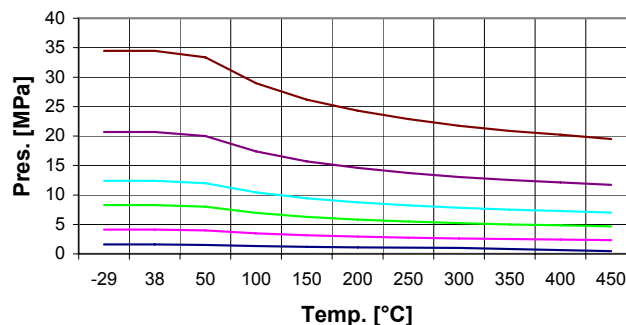
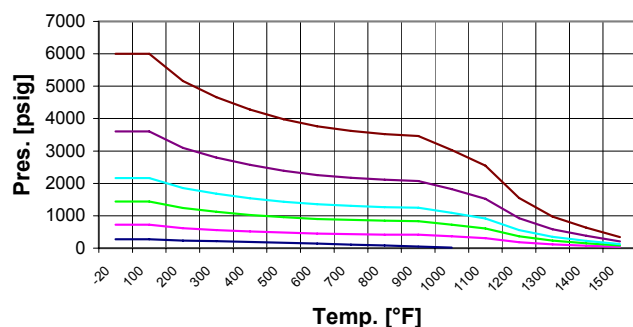


# Pressure and Temperature Ratings

## Group 2.3 Material ASTM A 182 F316L According to ASME B16.34

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°F	psig	psig	psig	psig	psig	psig
-20	230	600	1200	1800	3000	5000
100	230	600	1200	1800	3000	5000
200	195	510	1020	1535	2555	4260
300	175	455	910	1370	2280	3800
400	160	420	840	1260	2100	3500
500	150	395	785	1180	1970	3280
600	140	370	745	1115	1860	3100
700	110	360	720	1080	1800	3000
800	80	345	690	1035	1730	2880
850	65	340	675	1015	1690	2820

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°C	Mpa	Mpa	Mpa	Mpa	Mpa	Mpa
-29	1.59	4.14	8.27	12.41	20.68	34.47
38	1.59	4.14	8.27	12.41	20.68	34.47
50	1.53	4.00	8.00	12.01	20.01	33.35
100	1.33	3.48	6.96	10.44	17.39	28.99
150	1.20	3.14	6.28	9.42	15.70	26.16
200	1.12	2.92	5.83	8.75	14.58	24.30
250	1.05	2.75	5.49	8.24	13.73	22.89
300	1.00	2.61	5.21	7.82	13.03	21.72
350	0.84	2.51	5.01	7.52	12.54	20.89
400	0.65	2.43	4.86	7.29	12.15	20.25
450	0.46	2.34	4.68	7.02	11.71	19.51



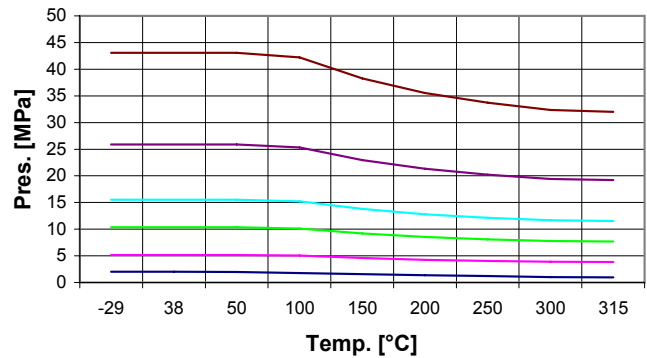
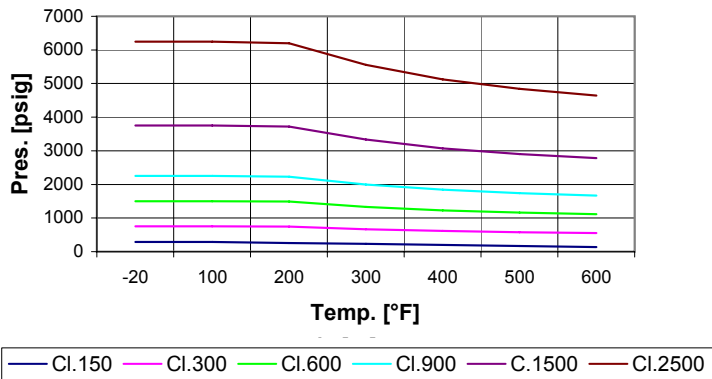
— Cl.150 — Cl.300 — Cl.600 — Cl.900 — Cl.1500 — Cl.2500

## Pressure and Temperature Ratings

### Group 2.8 Material ASTM A 182 F51 According to ASME B16.34

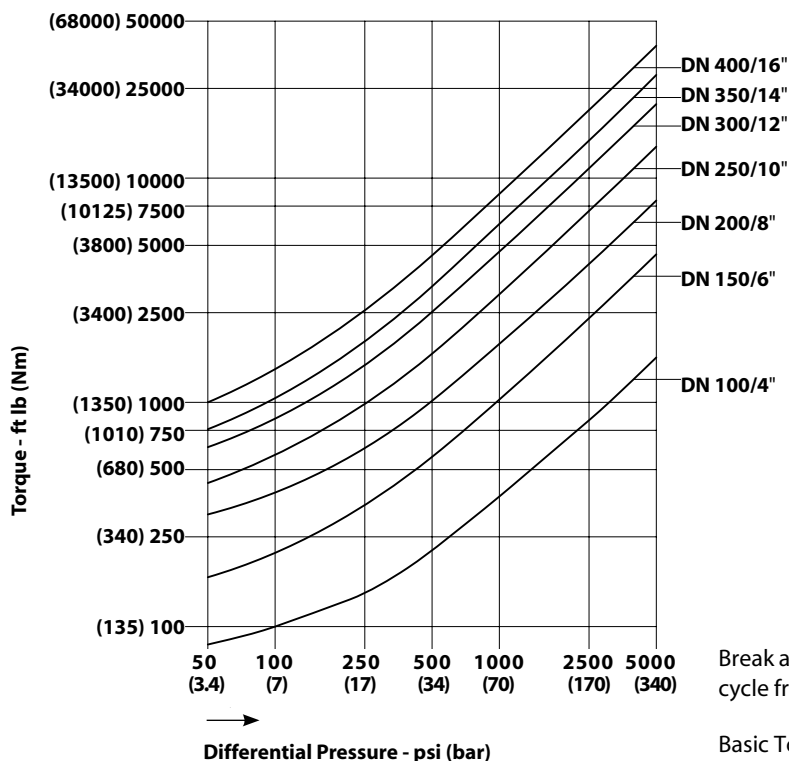
Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°F	psig	psig	psig	psig	psig	psig
-20	290	750	1500	2250	3750	6250
100	290	750	1500	2250	3750	6250
200	260	745	1490	2230	3720	6200
300	230	665	1335	2000	3335	5560
400	200	615	1230	1845	3070	5120
500	170	580	1160	1740	2905	4840
600	140	555	1115	1670	2785	4640

Temp.	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
°C	Mpa	Mpa	Mpa	Mpa	Mpa	Mpa
-29	2.00	5.17	10.34	15.51	25.86	43.09
38	2.00	5.17	10.34	15.51	25.86	43.09
50	1.95	5.17	10.34	15.51	25.86	43.09
100	1.77	5.07	10.13	15.20	25.33	42.22
150	1.58	4.59	9.19	13.78	22.96	38.27
200	1.38	4.27	8.53	12.80	21.33	35.54
250	1.21	4.05	8.09	12.14	20.23	33.72
300	1.02	3.89	7.77	11.66	19.43	32.38
350	0.84	3.76	7.53	11.29	18.82	31.37
400	0.65	3.65	7.33	10.98	18.31	30.49



# Break Away Torques - Trunnion Mounted Ball Design

## Basic Torque vs Differential Pressure



Break away torque is determined by differential pressure, media, and cycle frequency. It can be determined as follows:

Basic Torque x safety factor x cycle frequency factor

## Media Factor

Media	Safety Factor
Pure oil	1.0
Thermal oil	1.3
Other HC-fluids	1.5
Water	1.5
Suspension, slurry	2.6
Steam, vapors	2.6
Gas	2.6
Solid particles	3.0

## Cycle Frequency Factor

If a Valve is Cycled Once Per	Cycle Frequency Factor
Day or more	1.25
Week or more	1.28
Month or more	1.30
Four months	1.41
Eight months	1.45

# Trunnion Mounted Ball Valve Design

## Maximum Allowable Torques of Stem: A182 Gr. 316Ti

Size Full Bore	Class												
	150		300		600		900		1500		2500		Temp.
	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	°C/ °F
100 4"	On request				3510	2589	3510	2589	6060	4469	6060	4469	20/68
					2950	2176	2950	2176	5100	3761	5100	3761	100/212
					2660	1962	2660	1962	4600	3393	4600	3393	200/392
					2310	1704	2310	1704	4000	2950	4000	2950	300/572
150 6"					6060	4469	6060	4469	11850	8739	14370	10598	20/68
					5100	3761	5100	3761	9960	7346	12080	8909	100/212
					4600	3393	4600	3393	8990	6630	10910	8046	200/392
					4000	2950	4000	2950	7810	5760	9470	6984	300/572
200 8"	6060	4469	6060	4469	9630	7102	9630	7102	37370	27560	48520	35784	20/68
	5100	3761	5100	3761	8100	5974	8100	5974	31430	23180	40800	30090	100/212
	4600	3393	4600	3393	7310	5391	7310	5391	28370	20923	36830	27162	200/392
	4000	2950	4000	2950	6350	4683	6350	4683	24630	18165	31980	23585	300/572
250 10"	14370	10598	14370	10598	14370	10598	14370	10598	48520	35784	94770	69893	20/68
	12080	8909	12080	8909	12080	8909	12080	8909	40800	30090	79690	58771	100/212
	10910	8046	10910	8046	10910	8046	10910	8046	36830	27162	71930	53048	200/392
	9470	6984	9470	6984	9470	6984	9470	6984	31980	23585	62460	46064	300/572
300 12"	28100	20724	28100	20724	28100	20724	28100	20724	48520	35784	163750	120766	20/68
	23600	17405	23600	17405	23600	17405	23600	17405	40800	30090	137700	101554	100/212
	21300	15709	21300	15709	21300	15709	21300	15709	36830	27162	124300	91671	200/392
	18500	13644	18500	13644	18500	13644	18500	13644	31980	23585	107930	79598	300/572
350 14"	28100	20724	28100	20724	28100	20724	48520	35784	61690	45496	On request		20/68
	23600	17405	23600	17405	23600	17405	40800	30090	51870	38254			100/212
	21300	15709	21300	15709	21300	15709	36830	27162	46830	34537			200/392
	18500	13644	18500	13644	18500	13644	31980	23585	40660	29987			300/572
400 16"	28100	20724	28100	20724	28100	20724	48520	35784	94770	69893			20/68
	23600	17405	23600	17405	23600	17405	40800	30090	79690	58771			100/212
	21300	15709	21300	15709	21300	15709	36830	27162	71930	53048			200/392
	18500	13644	18500	13644	18500	13644	31980	23585	62460	46064			300/572

## Stem Material Conversion Factor

ASTM	DIN	20°C 68°F	100°C 212°F	200°C 392°F	300°C 572°F
A182 Gr. 316 Ti	1.4571	1	1	1	1
A182 Gr. F51	1.4462	2	2	2	2
A286 Gr. 660	1.4980	2.7	3.1	3.3	3.7

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**Ball valves with bottom drain discharge**



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**Ball valves with stem extensions**



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