

# NGC

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# GALLI & CASSINA

*Plus Valves*

SINCE 1919



# DUAL SEAL D.B&B



# PLUG VALVES



## **GALLI&CASSINA in the World:**

**Our products are being used in the most important Plants and Gas Pipelines all over the world.**

*Galli&Cassina Plug Valves are used in the most important hydrocarbon plants and gas pipelines all over the world.*

*For over 70 years Galli&Cassina has been committed to provide service to the end-users with a full range of products ensuring total customer's satisfaction.*

*Galli&Cassina is represented by sales offices worldwide and you are requested to contact our main office in Italy for more details.*





## Galli&Cassina Profile



**Galli&Cassina** is a prominent Italian Company, leader in Design and manufacturing a complete range of Lubricated Plug valves.

The company is located in Solaro near to Milan (Italy)

**Galli&Cassina** was founded in 1919, and it is one of the oldest Italian companies which today is still in the valve business; in the beginnings G&C business activity was concentrated in the production of valves to serve the domestic growing market.

After the first ten years the company gradually turned its production towards the newly born Chemical Industry.

**G&C** was the first in Italy to produce valves in stainless steel and other special material in light with the demand of the

most important chemical companies. It was not possible to expand further the Milan factory which was built in 1930 and enlarged after the second world war.

Since 1991 **Galli&Cassina** has moved to a new location in Solaro (Milan) with modern building and facilities after 30 years of experience in chemical valves.

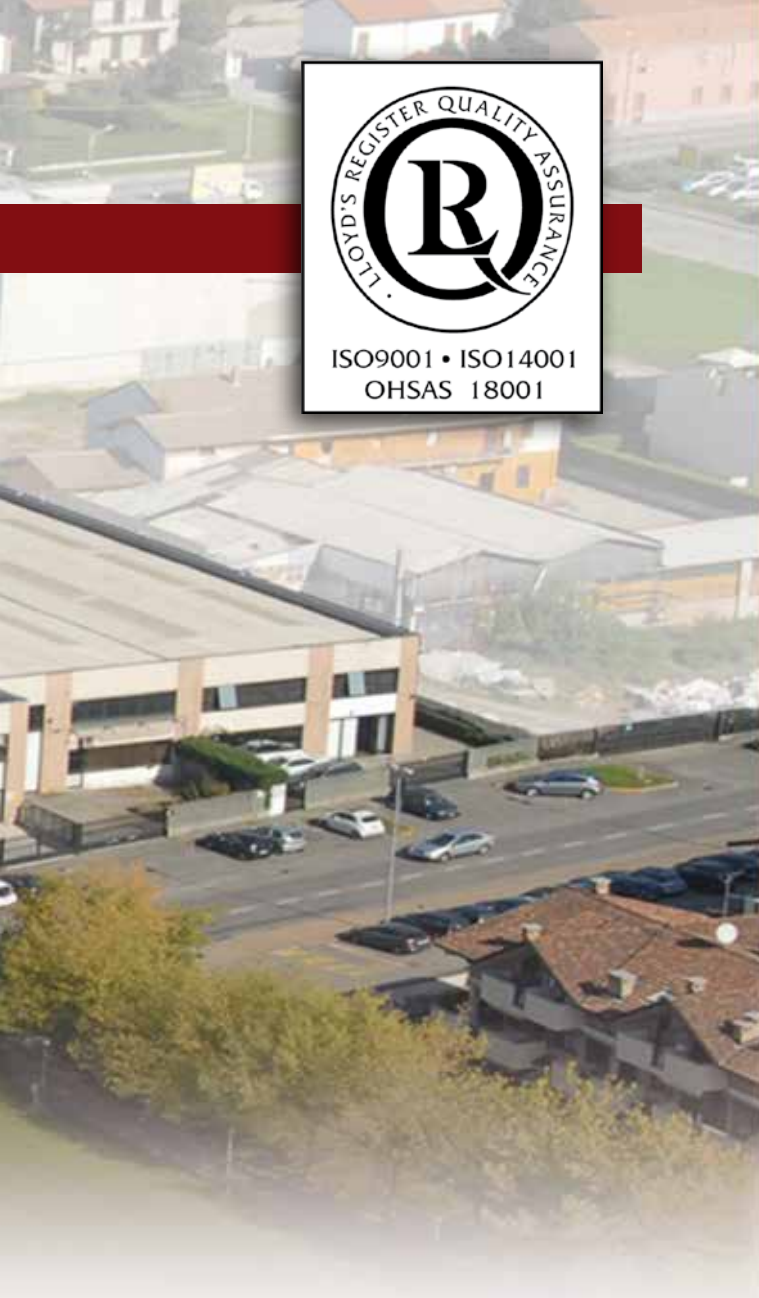
**Galli&Cassina** started the production of Plug Valves to serve the Oil & Gas worldwide market becoming one of the most significant supplier for all International Oil & Gas companies across the world.



with extensive offices and workshop covering 12.000 sq.mt. area including 5000 sq.mt. of covered space.







**1. WORKSHOP & OFFICES.**



**2. WELDING.**



**3. MATERIAL RECEIVING.**



**4. TESTING AND INSPECTION.**



**5. PACKING AND SHIPPING.**



**6. WAREHOUSE.**

**Galli&Cassina** is a world's leading manufacturer of plug valves for Oil & Gas and Chemical application since 1919. The company is located in Solaro near Milan (Italy) with extensive offices and workshop covering a 12.000 sq.mt. area including 5.000 sq.mt. of covered space.

**Galli&Cassina's** Quality Assurance System ISO 9001 has been assessed, approved and certified by Lloyd's Register as well as the Environmental Management System ISO 14001 and Occupational Health & Safety Systems

ISO 18001. Valves design is fully developed by **Galli&Cassina** technical department and it complies to API 6D requirements other than the applicable international standards.

**Galli&Cassina** sales activity covers most of the continents with a leading and growing presence in Europe, Middle East, North & South America and Far East thanks also to an extensive service network with subsidiaries, branch offices and distributors.

**Galli&Cassina** Dual Seal Double Block & Bleed valve has been included in the products range in order to merge **Galli&Cassina** consolidated plug valves know how with the new "Dual Seal" technology to approach a wider range of applications.



# Galli&Cassina Profile





## DBB Technical Descriptions

The Galli&Cassina Dual Seal Double Block & Bleed valve is a single valve that simultaneously blocks both the upstream and downstream flow while allowing the user to verify tightness using a manual or automatic body bleed system. They are designed for applications where positive shut-off, verifiable zero leakage and double block and bleed (DBB) capabilities are required.

The **DBB** feature is ensured by two slips with bonded in seals sliding on the tapered plug to achieve upstream and downstream tight shut-off sealing. During opening operation the plug is pulled up allowing the sliding slips to retract, than the plug starts the 90° rotation taking the slips completely out of the flow. During closing operation, the tapered plug takes the slips back to position, than it is pushed down forcing the slips against the body seats, providing the tight shut off sealing.

### Main Features:

- Easy in line maintenance: Dual Seal Plug Valves have a design which makes simple the maintenance operation. The body slips can be replaced with the valve installed in line (depressurized and drained), just by removing the lower bonnet and replacing the slips with a pair of new ones.

- Long service life and Low Operational Torque: During valve operation the soft seals bonded in the slips are in contact with body seats only at the end of the expanding operation, while during the 90° run they are retracted, therefore they are not affected by friction against body seat.

- Verifiable Positive sealing: Individual seat sealing effectiveness can be easily verified by the operator at completion of every valve operation through body cavity bleed valve.
- Quick opening and closing time: Valve simple design makes very quick the opening and closing operation.

### Main Media Handled:

- Refined Oil Products, such as Diesel, Kerosene, Gasoline, Jet Fuel etc..

### Main Applications :

- Meter Stations.
- Integral Manifolds.
- Loading & Unloading Fuel tank farm.
- Tank Storage Isolations.
- Hydrant Systems Isolations.



### Range Size: Dual Seal Plug valves

**Class:**  
ASME/ANSI  
150 up to Class 1500 Lb  
**Size:**  
DN 2" up to 36"  
Class 150 - 300.

DN 2" up to 24"  
Class 600.

DN 2" up to 10"  
Class 900 - 1500.

**Range Temperature:**  
-29 C° to 220 C°  
(-22 F° to 428 F°)

**Over size available  
upon Customer's  
requested.**



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*Galli&Cassina reserves the right to edit any data within this catalog whenever necessary.*







# Product Identification System

Identification numbers here shown are used to describe essential features of Galli & Cassina valves.

## Example: 100 EPCC01R0001

|             |                                         |                                                                                                                                                                                                                                                                                    |
|-------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>100</b>  | <b>Size</b>                             | <ul style="list-style-type: none"> <li>• 1/2" 015 • 3" 080 • 12" 300 • 22" 550</li> <li>• 3/4" 020 • 4" 100 • 14" 350 • 24" 600</li> <li>• 1" 025 • 6" 150 • 16" 400 • 30" 750</li> <li>• 1 1/2" 040 • 8" 200 • 18" 450 • 36" 900</li> <li>• 2" 050 • 10" 250 • 20" 500</li> </ul> |
| <b>EP</b>   | <b>Valve Type</b>                       | <b>EXPANDING PLUG VALVE</b>                                                                                                                                                                                                                                                        |
| <b>C</b>    | <b>Pattern</b>                          | <ul style="list-style-type: none"> <li>• <b>C</b> Short</li> <li>• <b>R</b> Regular</li> <li>• <b>F</b> ** Full bore</li> </ul>                                                                                                                                                    |
| <b>C</b>    | <b>Valve Operator Type</b>              | <ul style="list-style-type: none"> <li>• <b>C</b> Handwheel</li> <li>• <b>R</b> Gear</li> <li>• <b>E</b> Gear with Electric Motor</li> <li>• <b>A</b> Actuator (Pneumatic or Gas overoil)</li> <li>• <b>B</b> Bare Stem</li> </ul>                                                 |
| <b>01</b>   | <b>Working Pressure Class</b>           | <b>API 6D Valves</b> <ul style="list-style-type: none"> <li>• 150 01 • 300 03</li> <li>• 400 04 • 600 06</li> <li>• 900 09 • 1500 15</li> </ul>                                                                                                                                    |
| <b>R</b>    | <b>Valve End Connection</b>             | <ul style="list-style-type: none"> <li>• <b>R</b> RF Flange</li> <li>• <b>W</b> Butt Weld</li> <li>• <b>B</b> Butt Weld by Flange</li> <li>• <b>J</b> Ring Joint Flange</li> </ul>                                                                                                 |
| <b>P</b>    | <b>Optional Special Features</b>        | <ul style="list-style-type: none"> <li>• <b>T</b> Completely Buried</li> <li>• <b>P</b> Partially Buried</li> <li>• <b>N</b> Pups</li> <li>• <b>J</b> Partially Buried and Pups</li> </ul>                                                                                         |
| <b>0001</b> | <b>Internal Material Identification</b> | According to client's materials requirement                                                                                                                                                                                                                                        |

The Code used as sample above (100 EPCC01 R 0001) identifies a: DN 100 (4") - Expanding plug valve - Short pattern - Handwheel operated - ANSI 150 (PN 20) - Flange ends connection - Standard carbon steel materials suitable for ambient and higher temperature service.

\* See G&C blue catalogue "LUBRICATED PLUG VALVES STANDARD & JACKETED TYPE".

\*\* See G&C green catalogue "LUBRICATED PLUG VALVES PRESSURE BALANCED FULL BORE TYPE".

\*\*\* See G&C silver catalogue "FULL BORE PRESSURE BALANCED TYPE WITH LGC\* LUBRICATION SYSTEM".



# Material Selection Guide for GALLI&CASSINA Valves

**Trim materials are designed according to the service conditions.**

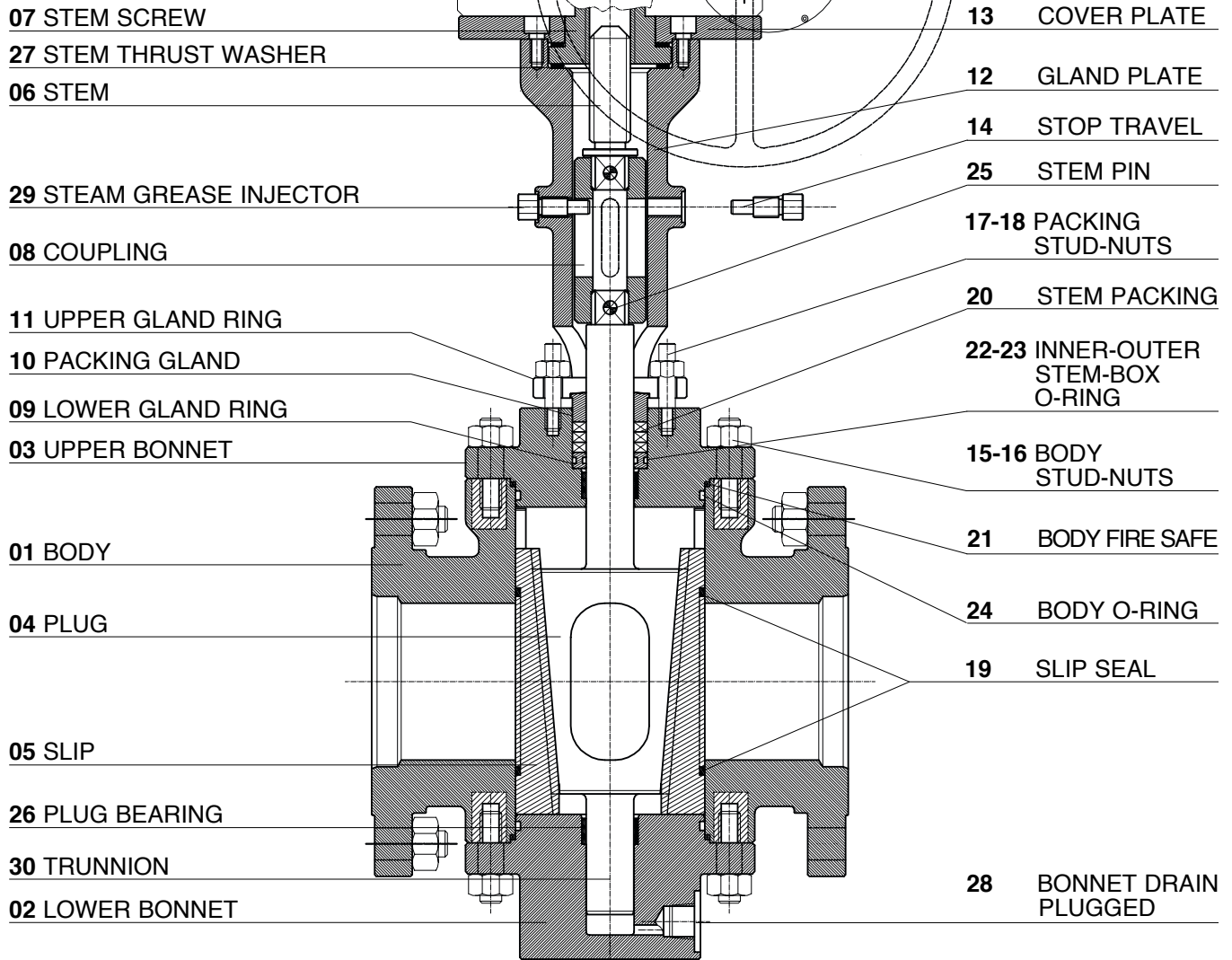
- 1** Standard Carbon Steel Body and Plug. (ASTM-A216 WCB/WCC material) suitable for general services.
- 2** Carbon Steel Body and Plug (A352 LCB/LCC material) suitable for low temperature services.
- 3** Carbon Steel Body and Plug (ASTM A216WCB/WCC material) suitable for "SOUR SERVICE" (H<sub>2</sub>S and CO<sub>2</sub>) according to NACE-MR.01.75/Latest Edition.
- 4** Special Austenitic (6MO) and Ferritic-Austenitic Stainless Steel (Duplex and Superduplex) suitable for sea water and corrosive services.
- 5** Other materials upon request.

## Standard Design Categories (Typical Construction Materials)

| Trim Service                                                                      | Body/Cover                                                    | Plug & Stem                                                   | Slip                                                     | Slip Seal    | Bolting                                     |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------|--------------|---------------------------------------------|
| <b>1</b> Standard service<br>Natural gas<br>Hydrocarbons                          | ASTM A105<br>ASTM A216<br>WCB/WCC<br>Max C 0.25%              | ASTM A105<br>ASTM A216<br>WCB/WCC                             | ASTM A105<br>ASTM A216<br>WCB/WCC                        | VITON<br>NBR | ASTM A193-B7M<br>ASTM A194-2HM              |
| <b>2</b> Low temperature<br>Natural gas<br>Hydrocarbons                           | ASTM A350-LF2<br>ASTM A352<br>LCB/LCC<br>Max C 0.23%          | LCB/LCC<br>ASTM A352<br>ASTM A350-LF2<br>ASTM 182 F6 A        | ASTM A350-LF2<br>ASTM 182 F6 A<br>ASTM A352-<br>LCB/LCC  | VITON        | ASTM A320-L7<br>ASTM A194 Gr.7              |
| <b>3</b> Sour Service<br>(H <sub>2</sub> S and CO <sub>2</sub> )<br>Hydrocarbon s | ASTM A105<br>ASTM A216<br>WCB/WCC<br>Max C.0.23%<br>Max HRC22 | ASTM A105<br>ASTM A216<br>WCB/WCC<br>Max C.0.23%<br>Max HRC22 | ASTM A105<br>PTFE<br>WCB/WCC<br>Max C.0.23%<br>Max HRC22 | VITON        | ASTM A193-B7M<br>ASTM A194-2HM<br>MAX HRC22 |
| <b>4</b> Sea Water                                                                | UNS S31254<br>ASTM A 351<br>CK3MCuN<br>(6MO)                  | UNS S31254<br>ASTM A 351<br>CK3MCuN<br>(6MO)                  | UNS S31254                                               | VITON        | ASTM A453 Gr.660A                           |
|                                                                                   | UNS S31803<br>ASTM A 890<br>J92205<br>(Duplex 22% Cr)         | UNS S31803<br>ASTM A 890<br>J92205<br>(Duplex 22% Cr)         | UNS S31803                                               | VITON        | ASTM A453 Gr.660A<br>UNS S32760             |
|                                                                                   | UNS S32750<br>ASTM A 890<br>J93404<br>(Super duplex 25% Cr)   | UNS S32750<br>ASTM A 890<br>J93404                            | UNS S32750                                               | VITON        | UNS S32760                                  |
|                                                                                   | UNS S32760<br>ASTM A 890<br>J93380<br>(Super duplex 25% Cr)   | UNS S32760<br>ASTM A 890<br>J93380                            | UNS S32760                                               | VITON        | UNS S32760                                  |

**Notes:** Other slip seal elastomer upon request.

# Typical Valve Assembly



## Bill of Components

| Ref. No | Part Name        | Material                                     | Ref. No | Part Name              | Material          |
|---------|------------------|----------------------------------------------|---------|------------------------|-------------------|
| 01      | Body             | ASTM A216 GR.WBC/WCC                         | 15      | Body Stud              | ASTM A193 GR.B7   |
| 02      | Lower Bonnet     | ASTM A105N                                   | 16      | Body Nuts              | ASTM A194 GR.2H   |
| 03      | Upper Bonnet     | ASTM A105N                                   | 17      | Packing Stud           | ASTM A193 GR.B7   |
| 04      | Plug             | ASTM A105N                                   | 18      | Packing Nuts           | ASTM A194 GR.2H   |
| 05      | Slip             | +Nickel Plating 0,003"<br>AISI 4140+VITON GF | 19      | Slip Seal              | VITON - GF        |
| 06      | Stem             | +Nickel Plating 0,003"<br>AISI 4140          | 20      | Stem Packing           | Graphite          |
| 07      | Stem Crew        | Bronze B148                                  | 21      | Body Fire Safe         | Graphite          |
| 08      | Coupling         | ASTM A182 F6A CL.2                           | 22      | Inner Stem-Box O-Ring  | VITON GF          |
| 09      | Lower Gland Ring | ASTM A182 F316                               | 23      | Outer Stem-Box O-Ring  | VITON GF          |
| 10      | Packing Gland    | ASTM A182 F316                               | 24      | Body O-Ring            | VITON GF          |
| 11      | Upper Gland Ring | AISI 4140                                    | 25      | Stem Pin               | AISI 4140         |
| 12      | Gland Plate      | ASTM A216 GR.WBC/WCC                         | 26      | Plug Bearing           | S.S. du Dry - 316 |
| 13      | Cover Plate      | ASTM A105N                                   | 27      | Stem Thrust Washer     | S.S. du Dry - 316 |
| 14      | Stop Travel      | ASTM A FA CL.2                               | 28      | Bonnet Drain - Plugged | S.S. 304          |
|         |                  |                                              | 29      | Stem Grease Injector   | S.S. 304          |
|         |                  |                                              | 30      | Trunnion               | S.S. 304          |

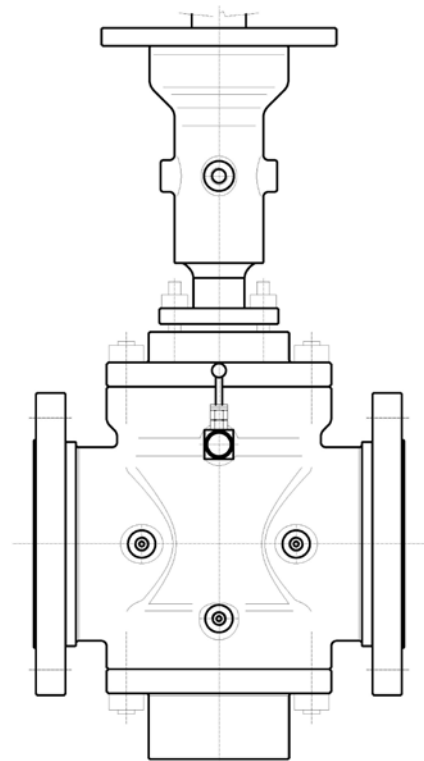


## Pressure Relief System

*The Automatic Body Bleed Valve provides visual, positive assurance that the Dual Seal has sealed completely at each cycling operation and prevents thermal pressure buildups in the body cavity.*

*An automatic bleed valve connected to the body cavity of the main valve is mechanically opened by the valve operator when the Dual Seal is closed. Seal integrity is indicated by viewing the discharge of the bleed valve.*

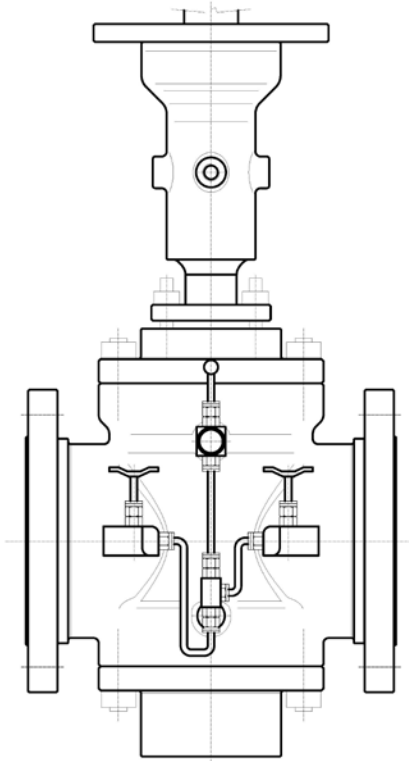
*When the Dual Seal is opened, the bleed valve is automatically closed by the combination of line pressure and the spring in the bleed valve.*



### **Manual Bleed Valve to Atmosphere.\***

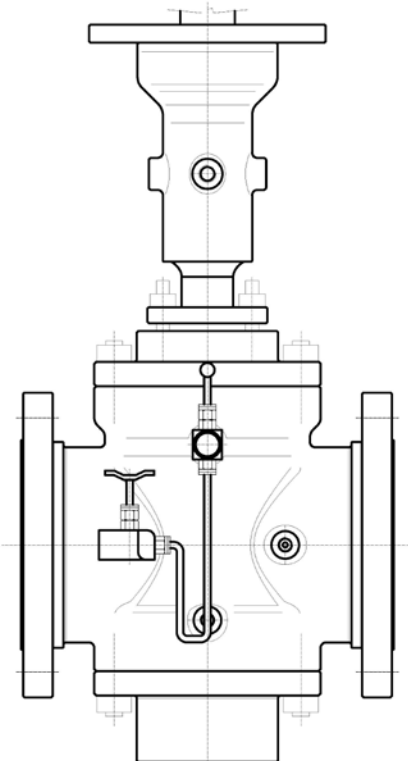
A manual bleed valve is connected to body cavity, it can be opened after the Dual Seal valve is closed, in this way the seal effectiveness can be checked immediately. This bleed valve must be closed before to reopen the Dual Seal valve.

*\*Standard feature on Galli & Cassina Dual Seal Valves.*



### **Manual Relief to Atmosphere with Thermal Relief from Downstream and Body to Upstream.**

This system is designed to relieve the overpressure of valve body cavity and downstream to upstream due temperature floating when the valve is closed. Further to standard manual bleed to atmosphere, this system has the addition of a thermal relief from downstream to upstream. The thermal relief system relieve to upstream when differential pressure exceeds 25 psi. The above system works when the valves part of the thermal relieve system are kept open and the manual body bleed valve to atmosphere is closed.



### **Manual Bleed Valve with Thermal Relief to Upstream.**

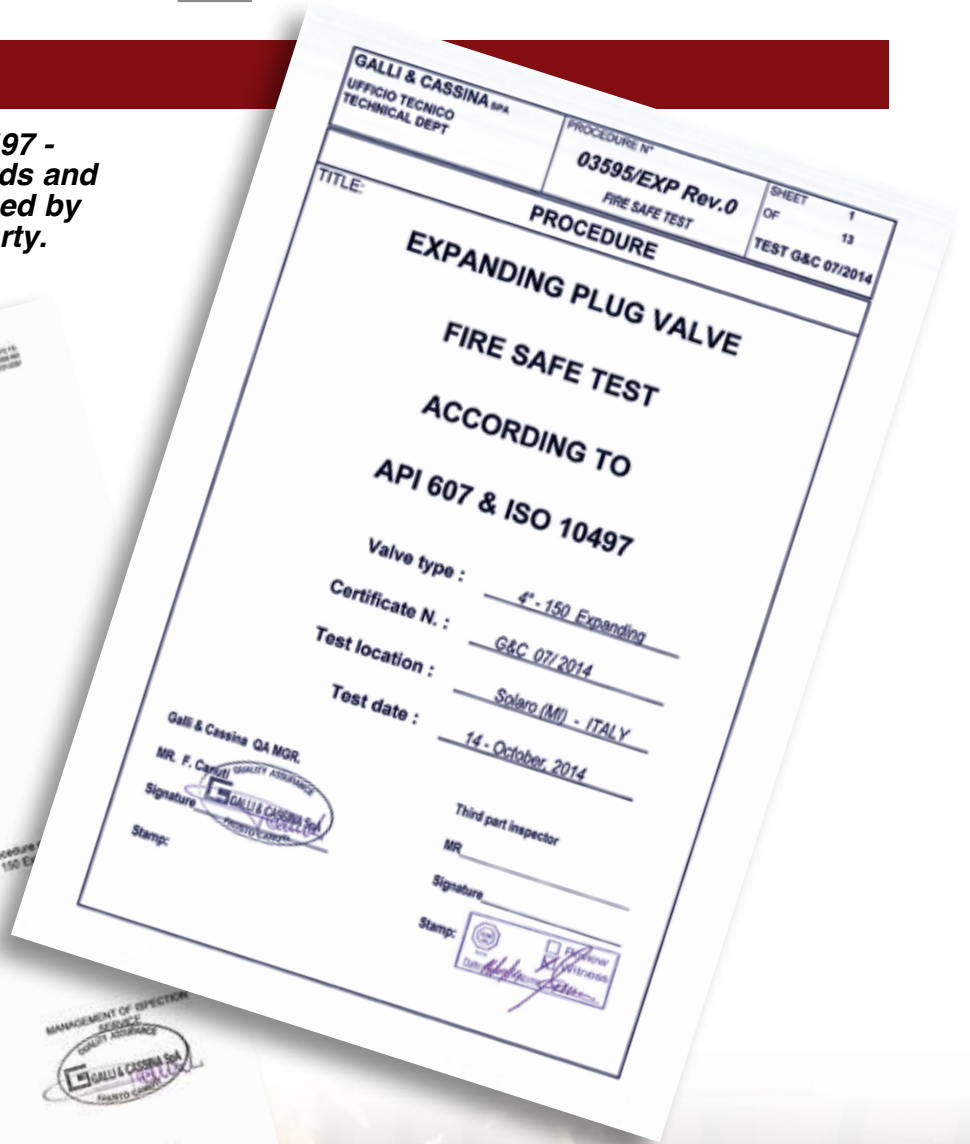
This system is designed to relieve the overpressure of valve body cavity and to upstream due to temperature floating when the valve is closed. Further to standard manual bleed to atmosphere, this system has the addition of a thermal relief from valve body cavity to upstream. The thermal relief system relieve to upstream when differential pressure exceeds 25 psi.



# Fire Safe Test

**Galli&Cassina Dual Seal Plug Valves have been tested against fire resistance, according to API-607 and**

**ISO 10497 - standards and witnessed by third party.**





## Available Tests

| Type of Test                          | Applicable Standards                                                                | Performance                                                         |
|---------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| X AND GAMMA RAYS                      | ANSI B16.34 - Annex-B<br>ASME VIII - Div.1 - MSS - SP 54<br>ASTM E446 - E186 - E280 | 100% all butt welding ends and body.                                |
| DYE PENETRANT                         | ASME V - art.6 and 24 - ASTM E142 100%<br>ANSI B16.34 - Annex-D<br>MSS-SP-93        | All butt welding ends                                               |
| MAGNETIC - PARTICLES<br>(Dry and wet) | ASME V - art.7 and 25<br>ANSI B16.34 - Annex C - MSS - SP 53                        | 100% of all valves                                                  |
| ULTRASONIC                            | ASME V - art.4 and 23<br>ASME VIII - Div.1 - ASTM - A388                            | Upon customer request                                               |
| VISUAL AND DIMENSIONAL                | MSS - SP 55<br>ANSI B16.5 - B16.10<br>API 6D - (Table 4.2)                          | 100% of rough and finished machined components and assembled valves |
| HARDNESS                              | NACE - MR.01.75 Latest Edition                                                      | 100% of wetted components                                           |
| HYDROSTATIC AND PNEUMATIC             | API - 6D - API 598<br>BS 6755 - Part.1 - MSS - SP 61                                | 100% of all valves                                                  |
| OPERATION TORQUE                      | API - 6D                                                                            | Upon customer request                                               |
| HIGH PRESSURE CLOSURE                 | API - 598 - Par. 4-5                                                                | Upon customer request                                               |
| POSITIVE MATERIAL IDENTIFICATION      | ASTM A751                                                                           | 100% of pressure containing components                              |





# Applicable Standard-Specification

**Lubricated Plug Valves are designed to use with most refining services according to API 599 or BS 5353 norms whichever is applicable.**

**API 6D norm aims to standardize the materials as well as instructions to manufacture valves suitable for energy transportation in the pipelines.**

|                   |                                                                                                |                                   |                                                                          |
|-------------------|------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------|
| API 6D            | Specification for Pipeline Valves.                                                             | BS 2080                           | Face to Face - Centre to Face - End to End - Steel Valves.               |
| API 6FA           | Specification for Fire Test for Valves.                                                        | BS 5353                           | Specification for Steel Plug Valves.                                     |
| API RP6F          | Recommended - Practice for Fire Test for Valves.                                               | BS 6755 part 1                    | Testing of Valves (Spec. for Production Pressure Testing Requirements).  |
| API 598           | Valve Inspection and Testing.                                                                  | BS 6755 part 2                    | Testing of valves (Spec. for Fire Safe Testing Requirements).            |
| API 599           | Steel Plug Valves Flanged or Butt Welding Ends.                                                | CSA Z 245. 15                     | Canadian Standard Association.                                           |
| ASME/ANSI B 16.5  | Pipe Flanges and Flanged Fittings.                                                             | MSS-SP6                           | Standard Finish for contact Face of Pipe Flanges.                        |
| ASME/ANSI B 16.10 | Face-to-Face and End-to-End Dimensions of Valves.                                              | MSS-SP25                          | Standard Marking System for Valves.                                      |
| ASME/ANSI B 16.25 | Buttwelding Ends.                                                                              | MSS-SP44                          | Steel Pipe Line Flanges.                                                 |
| ASME/ANSI B 16.34 | Valves-Flanged, threaded and Welding Ends.                                                     | MSS-SP53                          | Quality Standard for Steel Casting-Magnetic Particle Examination Method. |
| ASME/ANSI B 31.3  | Chemical Plant and Petroleum Refinery Piping.                                                  | MSS-SP54                          | Quality Standard for Steel Casting-Radiographic Examination Method.      |
| ASME/ANSI B 31.4  | Liquid Transportation System for Liquid Petroleum Gas.                                         | MSS-SP55                          | Quality Standard for Steel Casting Visual Method.                        |
| ASME/ANSI B 31.8  | Gas Transmission and Distribution Piping System.                                               | MSS-SP61                          | Pressure Testing of Steel Valves.                                        |
| ASME              | Boiler and Pressure Vessel SECTION VIII - DIV.1 & 2                                            | NACE Std. MR 01.75 Latest Edition | National Association of Corrosion Engineers.                             |
| ASME              | Boiler and Pressure Vessel Section V.                                                          | ASTM                              | American Society for Testing and Materials.                              |
| ASNT-TC-1A        | Recommended Practice for Personnel Qualification and Certification in Non destructive Testing. |                                   |                                                                          |





# Pressure Test Tables in Accordance with API 598 & API 6D

## ASME B16.34 Group Material 1.1

(A 105; A 216 WCB; A 350 LF2)

|                         | Working Pressures by Classes, psig (Bar) |           |            |            |            |            |
|-------------------------|------------------------------------------|-----------|------------|------------|------------|------------|
|                         | 150 PN20                                 | 300 PN50  | 600 PN100  | 900 PN150  | 1500 PN250 | 2500 PN420 |
| Working pressure rating | 285 (20)                                 | 740 (51)  | 1480 (102) | 2220 (153) | 3705 (255) | 6170 (425) |
| Hydraulic body test     | 450 (31)                                 | 1125 (78) | 2225 (153) | 3350 (231) | 5575 (384) | 9275 (640) |
| Hydraulic seat test     | 314 (22)                                 | 814 (56)  | 1628 (112) | 2442 (168) | 4076 (281) | 6787 (468) |

## ASME B16.34 Group Material 1.2 and 2.8

(A 350 LF6; A 216 WCC; A 352 LCC; A182 F44/ F51; UNS S31803/S31254/S32750; A 351 Gr. CK3MCuN / CE8MN/ CD4MCu / CD3MWCuN)

|                         | Working Pressures by Classes, psig (Bar) |           |            |            |            |            |
|-------------------------|------------------------------------------|-----------|------------|------------|------------|------------|
|                         | 150 PN20                                 | 300 PN50  | 600 PN100  | 900 PN150  | 1500 PN250 | 2500 PN420 |
| Working pressure rating | 290 (20)                                 | 750 (52)  | 1500 (103) | 2250 (155) | 3750 (259) | 6250 (431) |
| Hydraulic body test     | 450 (31)                                 | 1125 (78) | 2250 (155) | 3375 (233) | 5625 (388) | 9375 (646) |
| Hydraulic seat test     | 319 (22)                                 | 825 (57)  | 1650 (114) | 2475 (171) | 4125 (284) | 6875 (474) |

## ASME B16.34 Group Material 1.3

(A 352 LCB)

|                         | Working Pressures by Classes, psig (Bar) |           |            |            |            |            |
|-------------------------|------------------------------------------|-----------|------------|------------|------------|------------|
|                         | 150 PN20                                 | 300 PN50  | 600 PN100  | 900 PN150  | 1500 PN250 | 2500 PN420 |
| Working pressure rating | 265 (18)                                 | 695 (48)  | 1390 ( 96) | 2085 (144) | 3470 (239) | 5785 (399) |
| Hydraulic body test     | 400 (28)                                 | 1050 (72) | 2100 (145) | 3150 (217) | 5225 (360) | 8700 (600) |
| Hydraulic seat test     | 292 (20)                                 | 765 (53)  | 1529 (105) | 2294 (158) | 3817 (263) | 6364 (439) |

## ASME B16.34 Group Material 2.1 and 2.2

(A 182 F304; A 479 Gr. 304; A 351 CF3; A 351 CF8; A 182 F316; A 479 Gr. 316; A 351 CF3M)

|                         | Working Pressures by Classes, psig (Bar) |           |            |            |            |            |
|-------------------------|------------------------------------------|-----------|------------|------------|------------|------------|
|                         | 150 PN20                                 | 300 PN50  | 600 PN100  | 900 PN150  | 1500 PN250 | 2500 PN420 |
| Working pressure rating | 275 (19)                                 | 720 (50)  | 1440 ( 99) | 2160 (149) | 3600 (248) | 6000 (414) |
| Hydraulic body test     | 425 (29)                                 | 1100 (76) | 2175 (150) | 3250 (224) | 5400 (372) | 9000 (621) |
| Hydraulic seat test     | 303 (21)                                 | 792 (55)  | 1584 (109) | 2376 (164) | 3960 (273) | 6600 (455) |

## ASME B16.34 Group Material 2.3

(A 182 F304/F316L; A 479 Gr. 304/316L)

|                         | Working Pressures by Classes, psig (Bar) |          |            |            |            |            |
|-------------------------|------------------------------------------|----------|------------|------------|------------|------------|
|                         | 150 PN20                                 | 300 PN50 | 600 PN100  | 900 PN150  | 1500 PN250 | 2500 PN420 |
| Working pressure rating | 230 (16)                                 | 600 (41) | 1200 ( 83) | 1800 (124) | 3000 (207) | 5000 (345) |
| Hydraulic body test     | 350 (24)                                 | 900 (62) | 1800 (124) | 2700 (186) | 4500 (310) | 7500 (517) |
| Hydraulic seat test     | 253 (17)                                 | 660 (46) | 1320 ( 91) | 1980 (137) | 3300 (228) | 5500 (379) |

# Hydraulic Pressure Test Duration In accordance with API 6D and API 598

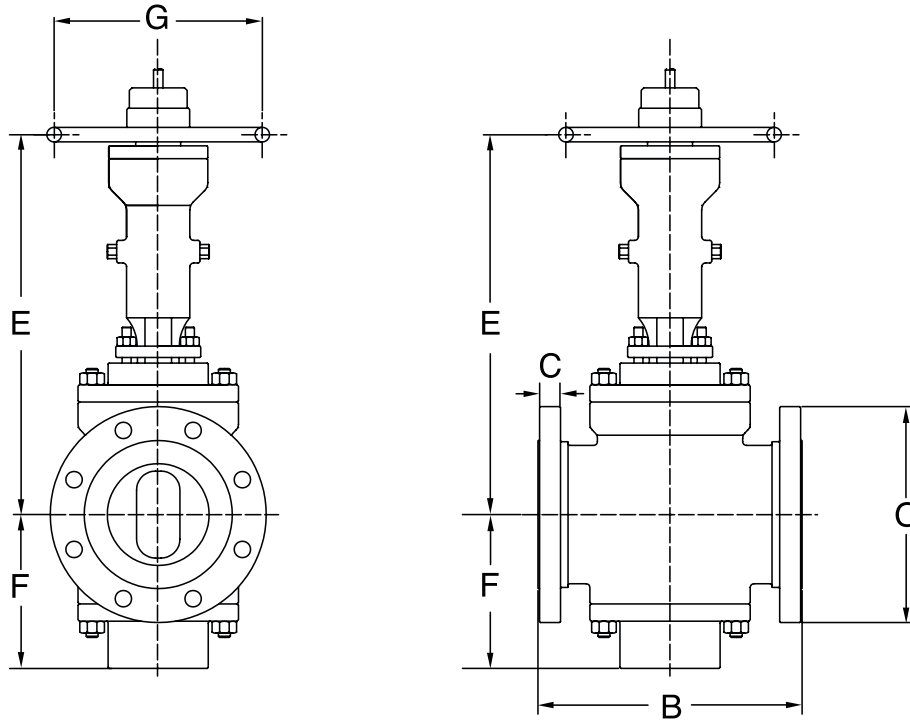
| Valve Size                |              | Test Duration |          | Valve Size   |              | Test Duration |          |
|---------------------------|--------------|---------------|----------|--------------|--------------|---------------|----------|
| DN (mm)                   | NPS (Inches) | Shell         | Seat (1) | DN (mm)      | NPS (Inches) | Shell         | Seat (1) |
| <b>API 598</b>            |              |               |          |              |              |               |          |
| 15 - 50                   | 1/2 - 2      | 15 sec.       | 15 sec.  | 15 - 100     | 1/2 - 4      | 2 min.        | 2 min.   |
| 65 - 150                  | 2 1/2 - 6    | 60 sec.       | 60 sec.  | 150 - 250    | 6 - 10       | 5 min.        | 5 min.   |
| 200 - 300                 | 8 - 12       | 120 sec.      | 120 sec. | 300 - 450    | 12 - 18      | 15 min.       | 5 min.   |
| 350 and over              | 14 and over  | 300 sec.      | 120 sec. | 500 and over | 20 and over  | 30 min.       | 5 min.   |
| <b>API 6D / ISO 14313</b> |              |               |          |              |              |               |          |

(1) Duration applicable also for the pneumatic seat test (5.5 bar/80 psi).





# ANSI Class 150 (PN 20)



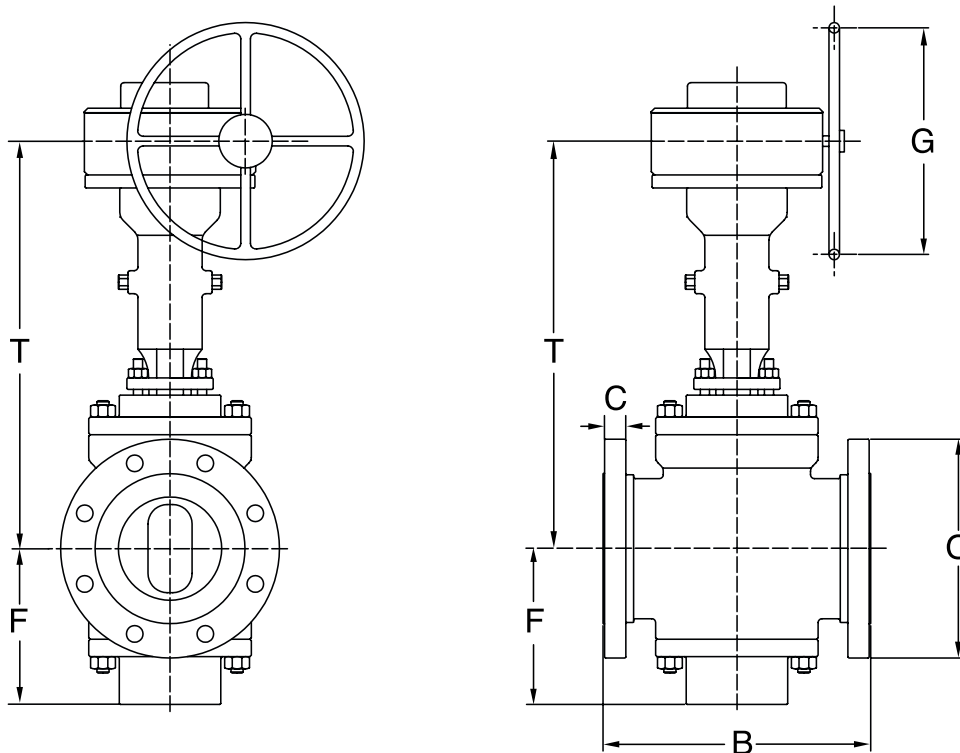
## Handwheel Operated

| Size                                        | NPS<br>DN | 2"  | 3"  | 4"  | 6"  | 8"  |
|---------------------------------------------|-----------|-----|-----|-----|-----|-----|
| <b>Face To Face</b>                         |           |     |     |     |     |     |
| RF                                          | <b>B</b>  | 178 | 203 | 229 | 267 | 292 |
| RTJ                                         | <b>B</b>  | 191 | 216 | 241 | 279 | 305 |
| BW                                          | <b>B</b>  | 267 | 330 | 356 | 457 | 521 |
| Flange Diameter                             | <b>O</b>  | 152 | 191 | 229 | 279 | 343 |
| Flange Thickness                            | <b>C</b>  | 16  | 19  | 24  | 26  | 29  |
| Top of Handwheel<br>to center Line of valve | <b>E</b>  | 306 | 350 | 390 | 450 | 595 |
| Body Cap to Center<br>Line of valve         | <b>F</b>  | 130 | 150 | 170 | 225 | 25  |
| Handwheel Diameter                          | <b>G</b>  | 270 | 270 | 270 | 350 | 500 |
| Weight RF/RTJ                               | <b>Kg</b> | 30  | 37  | 45  | 91  | 182 |
| Weight BW                                   | <b>Kg</b> | 27  | 32  | 38  | 80  | 150 |
| Minimum space required<br>to remove Slips.  | <b>H</b>  | 80  | 85  | 120 | 210 | 260 |

**NOTES:** Face to Face in accordance with API6D or ASME B16.10  
 Handwheel Dimension (G) are indicative only.  
 The weights are indicative only.



# ANSI Class 150 (PN 20)



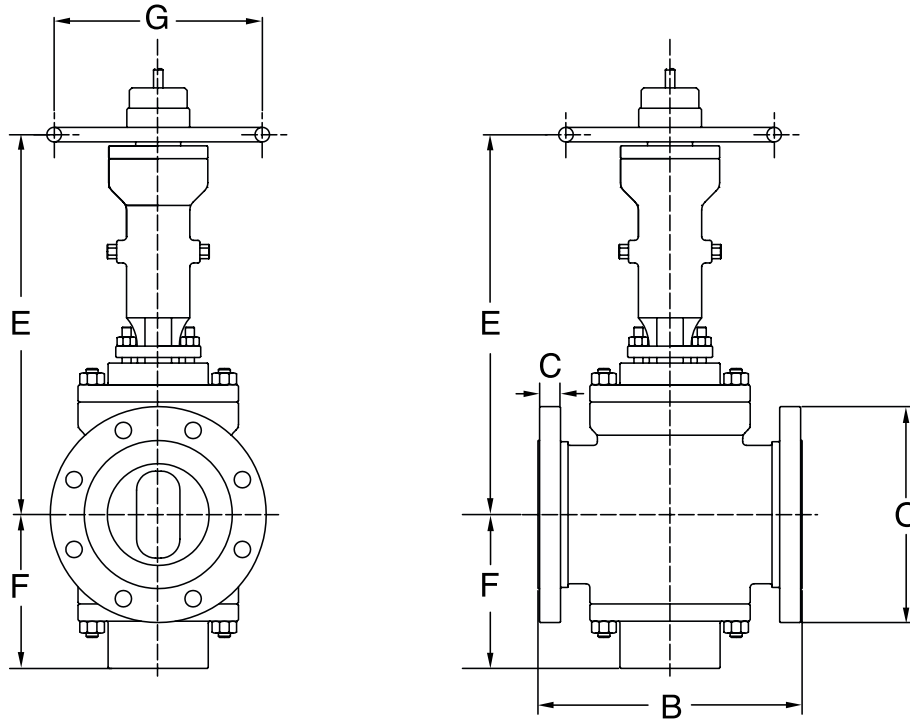
## Gear Operated

| Size                                               | NPS<br>DN | 10" | 12" | 14" | 16" | 18" | 20"  | 24"  | 28"  | 30"  | 36"  |
|----------------------------------------------------|-----------|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>Face To Face</b>                                |           |     |     |     |     |     |      |      |      |      |      |
| RF                                                 | <b>B</b>  | 533 | 610 | 686 | 762 | 864 | 914  | 1067 | 1244 | 1295 | 1600 |
| RTJ                                                | <b>B</b>  | 546 | 622 | 699 | 775 | 876 | 927  | 1080 | 1257 | 1308 | 1537 |
| BW                                                 | <b>B</b>  | 559 | 635 | 686 | 762 | 864 | 914  | 1067 | 1244 | 1295 | 1600 |
| Flange Diameter                                    | <b>O</b>  | 406 | 483 | 533 | 597 | 635 | 699  | 813  | 927  | 984  | 1168 |
| Flange Thickness                                   | <b>C</b>  | 30  | 32  | 35  | 37  | 40  | 43   | 48   | 52   | 54   | 60   |
| Center line of valve<br>To center line of hanwheel | <b>T</b>  | 290 | 345 | 380 | 420 | 460 | 530  | 570  | 720  | 830  | 870  |
| Body Cap to Center Line                            | <b>F</b>  | 650 | 820 | 850 | 990 | 990 | 1020 | 1100 | 1550 | 1650 | 1960 |
| Handwheel Diameter                                 | <b>G</b>  | 500 | 500 | 500 | 500 | 500 | 500  | 700  | 700  | 700  | 800  |
| Weight RF/RTJ                                      | <b>Kg</b> | 240 | 370 | 460 | 620 | 700 | 1250 | 1800 | 5900 | 6400 | 7500 |
| Weight BW                                          | <b>Kg</b> | 220 | 330 | 405 | 550 | 616 | 1100 | 1600 | 5200 | 5600 | 6600 |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 385 | 470 | 490 | 550 | 590 | 650  | 730  | 840  | 1050 | 1510 |

**NOTES:** Face to Face according to API 6D/ASME B16.10 ( DN 28" according to API 6D ASME/ANSI 300 )  
 Flange Dimensions of NPS DN 28" 30 "36" are in accordance with ASME B16.47  
 Handwheel Dimension (G) is indicative only.  
 The weights indicated are indicative only.



# ANSI Class 300 (PN 50)



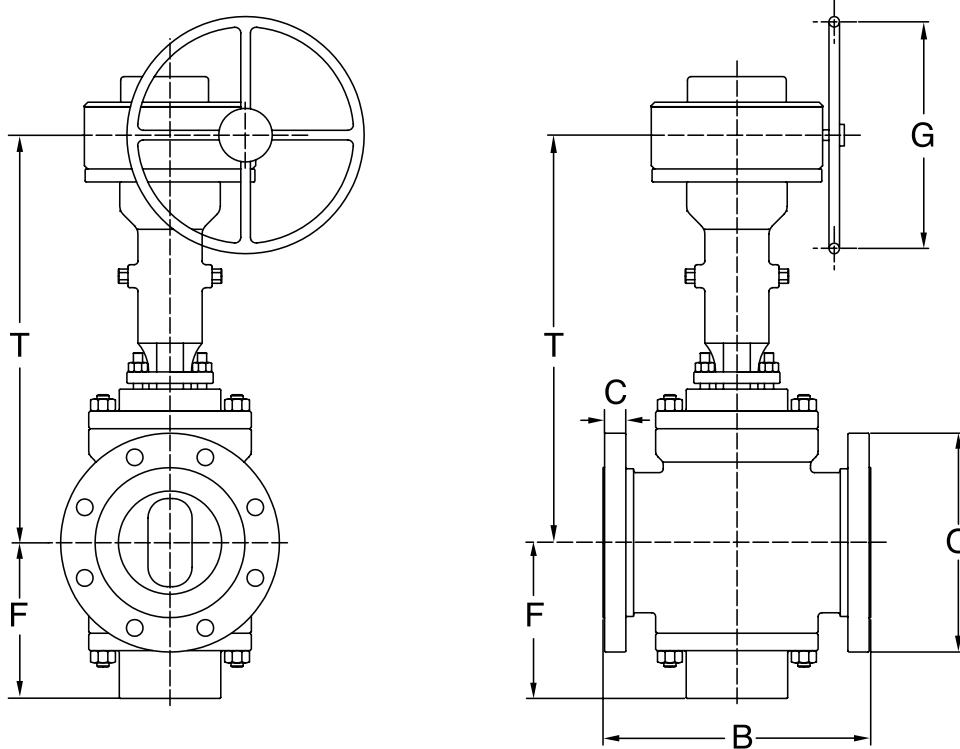
## Handwheel Operated

| Size                                               | NPS<br>DN | 2"  | 3"  | 4"  | 6"  |
|----------------------------------------------------|-----------|-----|-----|-----|-----|
| <b>Face To Face</b>                                |           |     |     |     |     |
| RF                                                 | <b>B</b>  | 216 | 283 | 305 | 403 |
| RTJ                                                | <b>B</b>  | 232 | 298 | 321 | 419 |
| BW                                                 | <b>B</b>  | 267 | 330 | 356 | 457 |
| Flange Diameter                                    | <b>O</b>  | 165 | 210 | 254 | 318 |
| Flange Thickness                                   | <b>C</b>  | 22  | 29  | 32  | 37  |
| Center line of valve<br>To center line of hanwheel | <b>E</b>  | 310 | 330 | 390 | 550 |
| Body Cap to Center Line of valve                   | <b>F</b>  | 130 | 150 | 170 | 225 |
| Handwheel Diameter                                 | <b>G</b>  | 270 | 270 | 350 | 350 |
| Weight RF/RTJ                                      | <b>Kg</b> | 32  | 44  | 70  | 100 |
| Weight BW                                          | <b>Kg</b> | 28  | 39  | 62  | 80  |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 80  | 85  | 120 | 210 |

**NOTES:** Face to Face in accordance with API6D/ASME B16.10  
Handwheel Dimension (G) are indicative only.  
The weights are indicative only.



# ANSI Class 300 (PN 50)



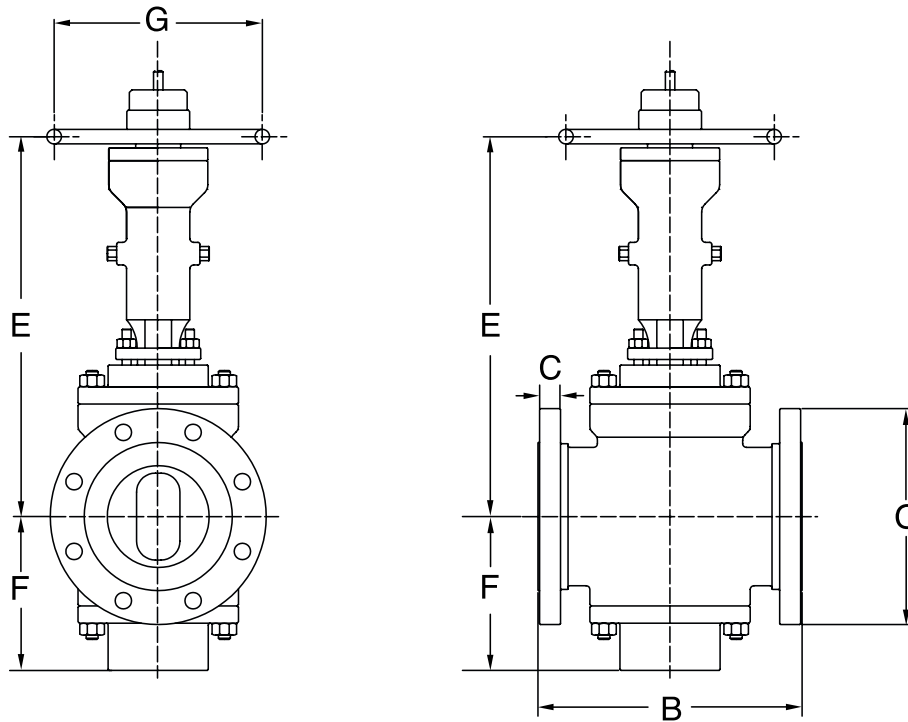
## Gear Operated

| Size                                               | NPS<br>DN | 6"  | 8"  | 10" | 12" | 14" | 16"  | 18"  | 20"  | 24"  | 28"  | 30"  | 36"   |
|----------------------------------------------------|-----------|-----|-----|-----|-----|-----|------|------|------|------|------|------|-------|
| <b>Face To Face</b>                                |           |     |     |     |     |     |      |      |      |      |      |      |       |
| RF                                                 | <b>B</b>  | 403 | 419 | 457 | 502 | 762 | 838  | 914  | 991  | 1143 | 1346 | 1397 | 1727  |
| RTJ                                                | <b>B</b>  | 419 | 435 | 584 | 518 | 778 | 854  | 930  | 1010 | 1165 | 1372 | 1422 | 1756  |
| BW                                                 | <b>B</b>  | 457 | 521 | 559 | 635 | 762 | 838  | 914  | 991  | 1321 | 1346 | 1397 | 1727  |
| Flange Diameter                                    | <b>O</b>  | 318 | 381 | 445 | 520 | 585 | 650  | 710  | 775  | 915  | 1035 | 1090 | 1270  |
| Flange Thickness                                   | <b>C</b>  | 37  | 42  | 48  | 51  | 54  | 58   | 61   | 64   | 70   | 86   | 95   | 111   |
| Center line of valve<br>To center line of hanwheel | <b>T</b>  | 550 | 691 | 750 | 940 | 940 | 940  | 1040 | 1240 | 1302 | 1805 | 1805 | 2320  |
| Body Cap to Center<br>Line of valve                | <b>F</b>  | 220 | 240 | 320 | 380 | 400 | 425  | 530  | 650  | 670  | 750  | 830  | 880   |
| Handwheel Diameter                                 | <b>G</b>  | 350 | 500 | 500 | 500 | 500 | 500  | 500  | 500  | 700  | 700  | 700  | 800   |
| Weight RF/RTJ                                      | <b>Kg</b> | 120 | 180 | 430 | 670 | 950 | 1300 | 1650 | 1930 | 3730 | 5850 | 6720 | 10750 |
| Weight BW                                          | <b>Kg</b> | 80  | 165 | 240 | 590 | 840 | 1145 | 1450 | 1698 | 3290 | 5150 | 5920 | 9470  |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 260 | 360 | 385 | 470 | 490 | 550  | 590  | 650  | 730  | 840  | 1050 | 1510  |

**NOTES:** Face to Face in accordance with API6D/ASME B16.10  
 Flange Dimensions of NPS DN 28"/30"/36" in accordance with ASME B16.47  
 Handwheel Dimensions (G) are indicative only.  
 The weights are indicative only.



# ANSI Class 600 (PN 100)



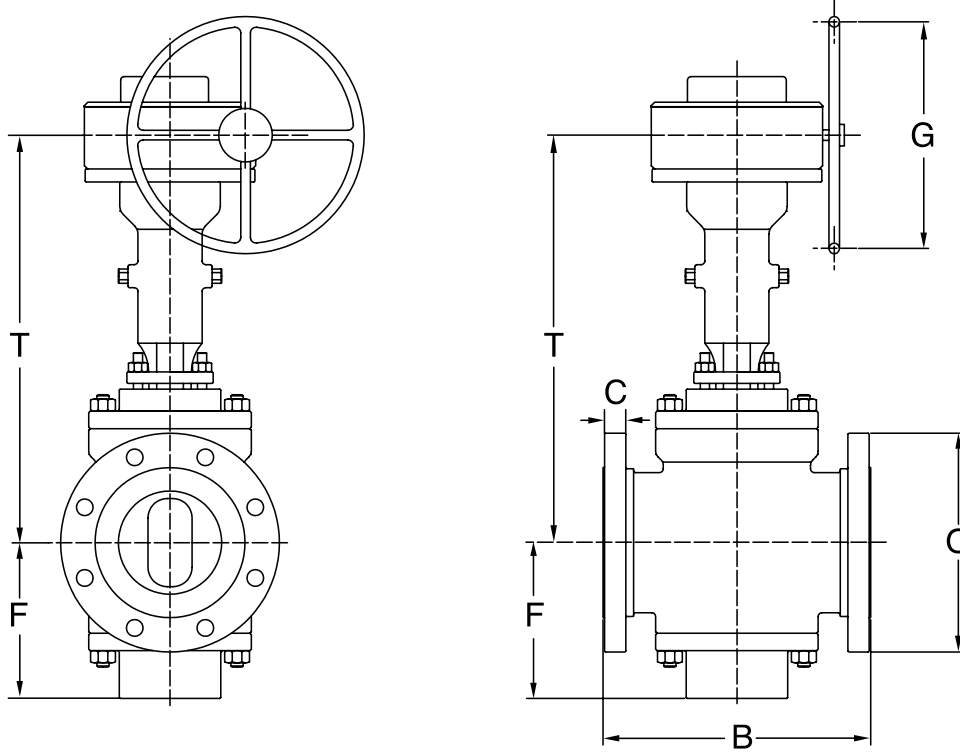
## Handwheel Operated

| Size                                               | NPS<br>DN | 2"  | 3"  | 4"  |
|----------------------------------------------------|-----------|-----|-----|-----|
| <b>Face To Face</b>                                |           |     |     |     |
| RF                                                 | <b>B</b>  | 292 | 356 | 432 |
| RTJ                                                | <b>B</b>  | 295 | 359 | 435 |
| BW                                                 | <b>B</b>  | 292 | 356 | 432 |
| Flange Diameter                                    | <b>O</b>  | 165 | 210 | 273 |
| Flange Thickness                                   | <b>C</b>  | 26  | 32  | 38  |
| Center line of valve<br>To center line of hanwheel | <b>E</b>  | 306 | 350 | 390 |
| Body Cap to Center<br>Line of valve                | <b>F</b>  | 130 | 150 | 170 |
| Handwheel Diameter                                 | <b>G</b>  | 270 | 270 | 270 |
| Weight RF/RTJ                                      | <b>Kg</b> | 54  | 65  | 115 |
| Weight BW                                          | <b>Kg</b> | 42  | 53  | 80  |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 80  | 85  | 120 |

**NOTES:** Face to Face according to API 6D  
Handwheel Dimension (G) is indicative only.  
The weights indicated are indicative only.



# ANSI Class 600 (PN 100)



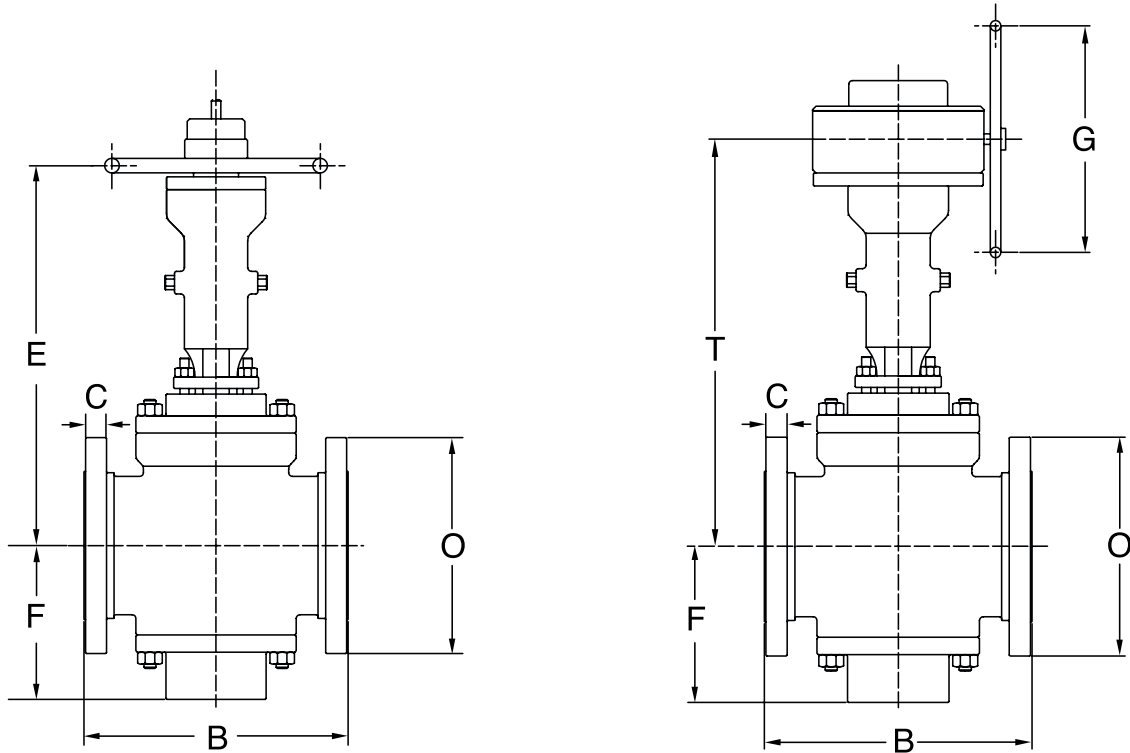
## Gear Operated

| Size                                               | NPS<br>DN | 2"  | 3"  | 4"  | 6"  | 8"  | 10" | 12"  | 14"  | 16"  | 18"  | 20"  | 24"  |
|----------------------------------------------------|-----------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| <b>Face To Face</b>                                |           |     |     |     |     |     |     |      |      |      |      |      |      |
| RF                                                 | <b>B</b>  | 292 | 356 | 432 | 559 | 660 | 787 | 838  | 889  | 991  | 1092 | 1194 | 1397 |
| RTJ                                                | <b>B</b>  | 295 | 359 | 435 | 562 | 664 | 791 | 841  | 892  | 994  | 1095 | 1200 | 1407 |
| BW                                                 | <b>B</b>  | 292 | 356 | 432 | 559 | 660 | 787 | 838  | 889  | 991  | 1092 | 1194 | 1397 |
| Flange Diameter                                    | <b>O</b>  | 165 | 210 | 273 | 356 | 419 | 508 | 559  | 603  | 686  | 743  | 813  | 940  |
| Flange Thickness                                   | <b>C</b>  | 26  | 32  | 38  | 48  | 56  | 64  | 67   | 70   | 77   | 83   | 89   | 102  |
| Center line of valve<br>To center line of hanwheel | <b>T</b>  | 395 | 395 | 510 | 665 | 695 | 950 | 985  | 1205 | 1205 | 1630 | 1690 | 1860 |
| Body Cap to Center<br>Line of valve                | <b>F</b>  | 145 | 145 | 195 | 240 | 290 | 415 | 450  | 510  | 510  | 575  | 610  | 685  |
| Handwheel Diameter                                 | <b>G</b>  | 260 | 260 | 360 | 550 | 550 | 550 | 550  | 800  | 800  | 800  | 800  | 800  |
| Weight RF/RTJ                                      | <b>Kg</b> | 56  | 68  | 125 | 320 | 510 | 910 | 1160 | 1880 | 1970 | 2960 | 3750 | 6010 |
| Weight BW                                          | <b>Kg</b> | 44  | 55  | 85  | 221 | 373 | 746 | 940  | 1492 | 1672 | 2520 | 3050 | 4840 |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 80  | 85  | 120 | 210 | 360 | 385 | 470  | 490  | 550  | 590  | 650  | 730  |

**NOTES:** Face to Face according to API 6D  
Handwheel Dimension (G) is indicative only.  
The weights indicated are indicative only.



# ANSI Class 900 (PN 150)

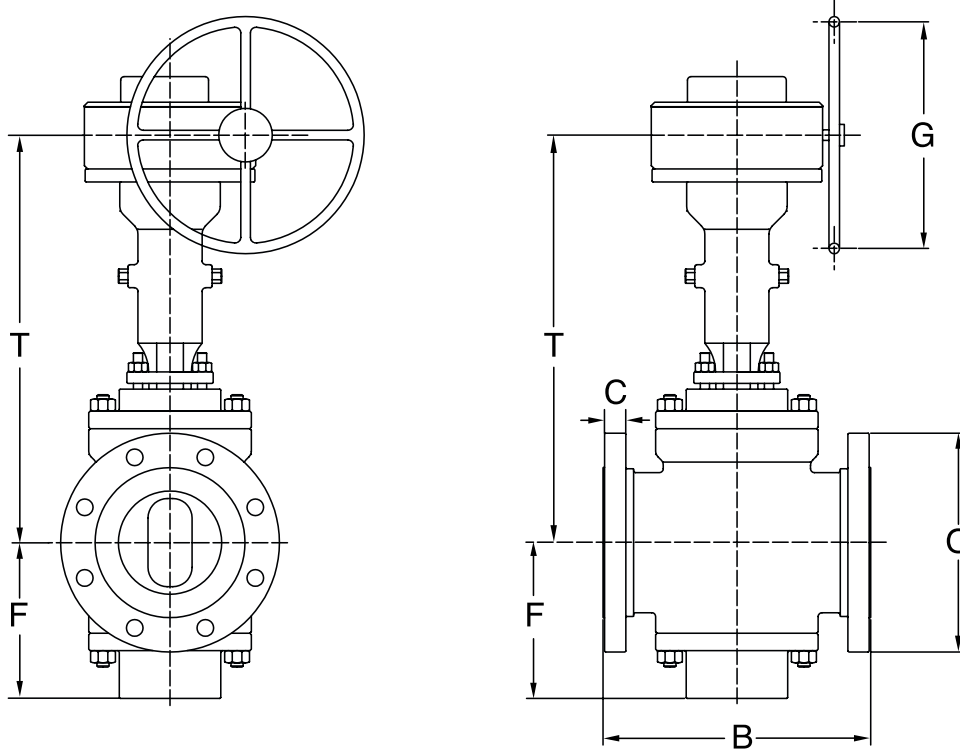


| Size                                               | NPS<br>DN | Handwheel Operated |     |     | Gear Operated |     |      |
|----------------------------------------------------|-----------|--------------------|-----|-----|---------------|-----|------|
|                                                    |           | 2"                 | 3"  | 4"  | 6"            | 8"  | 10"  |
| <b>Face To Face</b>                                |           |                    |     |     |               |     |      |
| RF                                                 | <b>B</b>  | 368                | 381 | 457 | 610           | 737 | 838  |
| RTJ                                                | <b>B</b>  | 371                | 384 | 460 | 613           | 740 | 841  |
| BW                                                 | <b>B</b>  | 368                | 381 | 457 | 610           | 737 | 838  |
| Flange Diameter                                    | <b>O</b>  | 216                | 242 | 292 | 381           | 470 | 546  |
| Flange Thickness                                   | <b>C</b>  | 38                 | 38  | 45  | 56            | 64  | 70   |
| Center line of valve<br>To center line of hanwheel | <b>T</b>  | 493                | 493 | 510 | 670           | 950 | 1315 |
| Body Cap to Center Line                            | <b>F</b>  | 185                | 215 | 270 | 305           | 430 | 560  |
| Handwheel Diameter                                 | <b>G</b>  | 350                | 350 | 550 | 550           | 800 | 800  |
| Weight RF/RTJ                                      | <b>Kg</b> | 85                 | 135 | 185 | 455           | 660 | 1650 |
| Weight BW                                          | <b>Kg</b> | 62                 | 95  | 163 | 370           | 515 | 1285 |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 80                 | 85  | 120 | 210           | 360 | 385  |

**NOTES:** The weights indicated are indicative only.  
Handwheel Dimension (G) are indicative only.



# ANSI Class 1500 (PN 250)



| Size                                               | NPS<br>DN | Handwheel Operated |     |     | Gear Operated |      |      |
|----------------------------------------------------|-----------|--------------------|-----|-----|---------------|------|------|
|                                                    |           | 2"                 | 3"  | 4"  | 6"            | 8"   | 10"  |
| <b>Face To Face</b>                                |           |                    |     |     |               |      |      |
| RF                                                 | <b>B</b>  | 368                | 470 | 546 | 705           | 832  | 991  |
| RTJ                                                | <b>B</b>  | 371                | 473 | 549 | 711           | 841  | 1000 |
| BW                                                 | <b>B</b>  | 368                | 470 | 546 | 705           | 832  | 991  |
| Flange Diameter                                    | <b>O</b>  | 216                | 267 | 311 | 394           | 483  | 584  |
| Flange Thickness                                   | <b>C</b>  | 38                 | 48  | 54  | 83            | 92   | 108  |
| Center line of valve<br>To center line of hanwheel | <b>T</b>  | 860                | 890 | 935 | 985           | 1035 | 1220 |
| Body Cap to Center Line                            | <b>F</b>  | 185                | 200 | 297 | 325           | 390  | 480  |
| Handwheel Diameter                                 | <b>G</b>  | 350                | 350 | 550 | 550           | 800  | 800  |
| Weight RF/RTJ                                      | <b>Kg</b> | 85                 | 135 | 220 | 395           | 760  | 1230 |
| Weight BW                                          | <b>Kg</b> | 62                 | 95  | 194 | 321           | 592  | 960  |
| Minimum space required<br>to remove Slips.         | <b>H</b>  | 80                 | 85  | 120 | 210           | 360  | 385  |

**NOTES:** The weights indicated are indicative only.  
Handwheel Dimension (G) are indicative only.



# Quality Assurance Programme

## CERTIFICATE OF APPROVAL

This is to certify that the Occupational Health & Safety Management System of:

**Galli & Cassina S.p.A.**  
Via Drizza, 30/32  
20020 Solaro (Milano) - Italy

has been approved by Lloyd's Register Quality Assurance to the following standard:

**OHSAS 18001:2007**

The Occupational Health & Safety Management System is applicable to:

**Design & manufacturing of plug valves of the after sales services, in carbon steel and exotic special alloys with DN from 6 to DN 900, up to class ANSI 2500 (PN 42) and with DN from 1" 3/16 to 11" up to class API 10000 P and flow indicators and gear operators.**

Approval Certificate  
No: LRC 6017612/OHS/U/EN



## CERTIFICATE OF APPROVAL

This is to certify that the Environmental Management System of:

**Galli & Cassina S.p.A.**  
Via Drizza, 30/32  
20020 Solaro (Milano) - Italia

has been approved by Lloyd's Register Quality Assurance to the following Environmental Management System Standard:

**ISO 14001:2004**

The Environmental Management System is applicable to:

**Design & manufacturing of plug valves, including the after sales services, in carbon steel, alloy steel and exotic special alloys with DN from 1/4" up to 36" (i.e. from DN 6 to DN 900), up to class ANSI 2500 (PN 42) and with DN from 1" 3/16 to 11" up to class API 10000 P and flow indicators and gear operators.**

Original Approval: 18<sup>th</sup> March 2014

Approval Certificate  
No: LRC 6017612/EMS/U/EN

## Certificate of Authority to use the Official API Monogram

License Number: 6A-0520

The American Petroleum Institute hereby grants to:

**GALLI & CASSINA S.P.A.**  
Via Drizza, 30/32  
Solaro, Milan  
Italy

the right to use the Official API Monogram on manufactured products under the conditions in the official publications of the American Petroleum Institute entitled API Spec Q1<sup>st</sup> and API Spec 6A and in accordance with the provisions of the License Agreement.

In all cases where the Official API Monogram is applied, the API Monogram should be used in conjunction with this certificate number: 6A-0520.

The American Petroleum Institute reserves the right to revoke this authorization to use the Official API Monogram for any reason satisfactory to the Board of Directors of the American Petroleum Institute.

The scope of this license includes the following product: Plug Valves at PSL 1 through 4

QMS Exclusions: No Exclusions Identified as Applicable

American Petroleum Institute  
*John Madala*  
Director of Training and Certification Programs





## Quality Assurance System

After 95 years of manufacturing experience and latest technology, **Galli&Cassina** Quality Assurance System has been assessed, approved and certified against the following quality assurance standards: ISO 9001-and API Q1.

Rigorous procedures and internal audits ensure that the Quality System is implemented at all stages: incoming materials, production, inspection, assembly, final test, packing and shipping. Every product is designed and

manufactured to comply with the latest applicable standards.



## Quality Assurance Development

**Galli&Cassina's** Quality Assurance System ISO 9001-2008 - HSE ISO 14001 & ISO 18001 have been assessed, approved and certified by Lloyd's Register, while the API 6D and API 6A monograms have been certified by API (American Petroleum Institute): all the certificates are the result of **Galli&Cassina's** dedication towards the aim of good reputation in the world-wide valve market, since 95 years.

In addition **Galli&Cassina** Plug Valves are in compliance with CE Pressure Equipment Directive PED N. 97/23/EC and ATEX (N. 94/9/EC) for products intended for use in potentially explosive atmospheres.

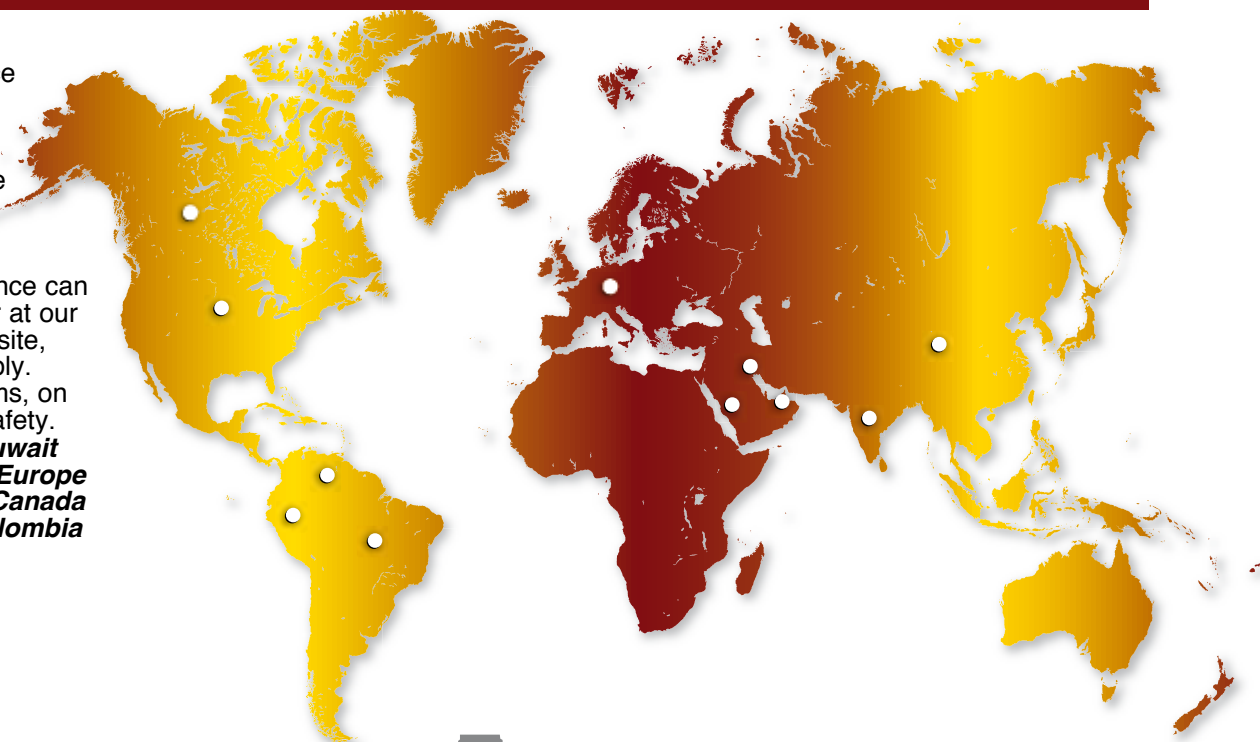


## Customer Service

**Galli&Cassina's** Customer Service is always willing to assist the customer with a prompt response to "service" requests.

Full after sales services assistance can be offered either at our workshop or on site, spare parts supply. Training programs, on operation and safety.

**Cina - UAE - Kuwait  
Saudi Arabia - Europe  
India - U.S.A - Canada  
Venezuela - Colombia  
Brasil.**





# Conversion Tables

| To Convert | Into                       | Multipl y |
|------------|----------------------------|-----------|
| <b>A</b>   |                            |           |
| Atmosphere | bar                        | 1.01325   |
| Atmosphere | cms. of mercury            | 76.0      |
| Atmosphere | ft. of water (at 4°C)      | 33.90     |
| Atmosphere | in. of mercury (at 0°C)    | 29.92     |
| Atmosphere | kgs./sq. cm.               | 1.0333    |
| Atmosphere | pounds/sq. in.             | 14.70     |
| Atmosphere | pascal (N/m <sup>2</sup> ) | 98070     |

|                      |                 |              |
|----------------------|-----------------|--------------|
| <b>B</b>             |                 |              |
| Bar                  | atmosphere      | 1.0197       |
| Bar                  | psi             | 14.505       |
| Bar                  | pascal          | 105          |
| Barrels(U.S.,liquid) | gallons         | 31.5         |
| Barrels (oil)        | gallons (oil)   | 42.0         |
| Barrels (42 gal.)    | cubic. meter    | 0.159        |
| Barrels/hr           | liter/second    | 0.044        |
| Btu                  | foot-lbs.       | 778.3        |
| Btu                  | gram-calories   | 252.0        |
| Btu                  | horsepower-hrs. | 3.931 x 10-4 |
| Btu/hr               | kilowatt-hrs    | 2.928 x 10-4 |
| Btu/hr               | horsepower      | 3.931 x 10-4 |
| Btu                  | Watts           | 0.2931       |

|                        |                     |               |
|------------------------|---------------------|---------------|
| <b>C</b>               |                     |               |
| Calories, gram (mean)  | B.T.U. (mean)       | 3.9685 x 10-3 |
| Centigrade             | Fahrenheit          | (C° 9/5)+32   |
| Centimeters            | feet                | 3.281 x 10-2  |
| Centimeters            | inches              | 0.3937        |
| Centimeters            | mils                | 393.7         |
| Centimeters of mercury | atmospheres         | 0.01316       |
| Centimeters of mercury | feet of water       | 0.4461        |
| Centimeters of mercury | pounds/sq. in.      | 0.1934        |
| Circumference          | radians             | 6.283         |
| Cubic centimeters      | cu. feet            | 3.531 x 10-5  |
| Cubic centimeters      | cu. inches          | 0.06102       |
| Cubic centimeters      | gallons (U.S. liq.) | 2.642 x 10-4  |
| Cubic feet             | cu. cms.            | 28.320.0      |
| Cubic feet             | cu. inches          | 1.728.0       |
| Cubic feet             | gallons (U.S. liq.) | 7.481         |
| Cubic feet             | liters              | 28.32         |
| Cubic feet/hour        | cubic meters/hour   | 0.02832       |
| Cubic feet/min.        | gallons/sec.        | 0.1247        |
| Cubic feet/min.        | cubic meters/hour   | 1.6990        |
| Cubic inches           | cu. cms.            | 16.39         |
| Cubic inches           | gallons             | 4.329 x 10-3  |
| Cubic inches           | quarts (U.S. liq.)  | 0.01732       |
| Cubic meters           | cu. feet            | 35.31         |
| Cubic meters           | gallons (U.S. liq.) | 264.2         |
| Cubic meters/hour      | cu. feet/min        | 0.5886        |
| Cubic meters/hour      | cu. feet/hour       | 35.315        |
| Cubic meters/hour      | gallons /hour       | 264.17        |

|                         |                      |         |
|-------------------------|----------------------|---------|
| <b>D</b>                |                      |         |
| Degres (angle)          | radians              | 0.01745 |
| Drams                   |                      |         |
| (apothecaries' or troy) | ounces (avoirdupois) | 0.13714 |
| Drams                   |                      |         |
| (apothecaries' or troy) | ounces (troy)        | 0.125   |
| Drams                   |                      |         |
| (U.S., fluid or apoth)  | cubic cm.            | 3.6967  |
| Drams                   | grams                | 1.772   |
| Drams                   | grains               | 27.3437 |
| Drams                   | ounces               | 0.0625  |

|               |                |              |
|---------------|----------------|--------------|
| <b>F</b>      |                |              |
| Fahrenheit    | centigrade     | (F 32°) 5/9  |
| Feet          | centimeters    | 30.48        |
| Feet          | kilometers     | 3.048 x 10-4 |
| Feet          | meters         | 0.3048       |
| Feet          | miles (naut.)  | 1.645 x 10-4 |
| Feet          | miles (stat.)  | 1.894 x 10-4 |
| Feet of water | atmospheres    | 0.02950      |
| Feet of water | in. of mercury | 0.8826       |
| Feet of water | kgs./sq. cm.   | 0.03045      |
| Feet of water | kgs./sq. meter | 304.8        |
| Feet of water | pounds/sq.ft.  | 62.43        |
| Feet of water | pounds/sq.in   | 0.4335       |
| Foot-pounds   | Btu            | 1.286 x 10-3 |
| Foot-pounds   | gram-calories  | 0.3238       |

| To Convert        | Into          | Multipl y    |
|-------------------|---------------|--------------|
| <b>F</b>          |               |              |
| Foot-pounds       | hp.-hrs.      | 5.050 x 10-7 |
| Foot-pounds       | kilowatt-hrs. | 3.766 x 10-7 |
| Foot-pounds/min.  | Btu/min.      | 1.286 x 10-3 |
| Foot-pounds/min.  | horsepower    | 3.030 x 10-5 |
| Foot-pounds/sec.  | Btu/hr.       | 4.6263       |
| Foot/square       | Foot/meter    | 0.093        |
| Foot/cubic/minute | liter/second  | 0.471        |
| Furlongs          | miles (U.S.)  | 0.125        |
| Furlongs          | feet          | 660.0        |

|                        |                     |               |
|------------------------|---------------------|---------------|
| <b>G</b>               |                     |               |
| Gallons                | cu.cms              | 3.785.0       |
| Gallons                | cu.feet             | 0.1337        |
| Gallons                | cu.inches           | 231.0         |
| Gallons                | cu.meters           | 3.785 x 10-3  |
| Gallons                | cu.yards            | 4.951 x 10-3  |
| Gallons                | liters              | 3.785         |
| Gallons (liq. Br Imp.) | gallons (U.S. liq.) | 1.20095       |
| Gallons (U.S.)         | gallons (Imp.)      | 0.83267       |
| Gallons of water       | pounds of water     | 8.3453        |
| Gallons/min.           | cu.ft./sec.         | 2.228 x 10-3  |
| Gallons/min.           | liters/sec.         | 0.06308       |
| Gallons/min.           | cu.ft./hr.          | 8.0208        |
| Grains (troy)          | grain (avdp.)       | 1.0           |
| Grains (troy)          | grams               | 0.06480       |
| Grains (troy)          | ounces (avdp.)      | 2.286 x 10-3  |
| Grains (troy)          | pennyweight (troy)  | 0.04167       |
| Grains /U.S. gal.      | parts/million       | 17.118        |
| Grains /U.S. gal.      | pounds/million gal. | 142.86        |
| Grains /Imp. gal.      | parts/million gal.  | 14.286        |
| Grams                  | grains              | 15.43         |
| Grams                  | ounces (avdp.)      | 0.03527       |
| Grams                  | ounces (troy)       | 0.03215       |
| Grams                  | poundals            | 0.07093       |
| Grams                  | pounds              | 2.205 x 10-3  |
| Gram/liter             | parts/million       | 1.000.0       |
| Gram-calories          | Btu                 | 3.9683 x 10-3 |
| Gram-calories          | foot-pounds         | 3.0880        |
| Gram-calories          | kilowatt-hrs.       | 1.1630 x 10-6 |
| Gram-calories          | watt-hrs.           | 1.1630 x 10-3 |

|                     |                     |                        |
|---------------------|---------------------|------------------------|
| <b>H</b>            |                     |                        |
| Horsepower          | Btu/min.            | 42.40                  |
| Horsepower          | foot-lbs./min.      | 33.000                 |
| Horsepower          | foot-lbs./sec.      | 550.0                  |
| Horsepower (metric) | horsepower          | 0.9863                 |
| 542.5 ft. lb/sec.)  | (550.5 ft. lb/sec.) |                        |
| Horsepower          | horsepower (metric) | 1.014                  |
| (550.5 ft. lb/sec.) | (542.5 ft. lb/sec.) |                        |
| Horsepower          | kilowatts           | 0.7457                 |
| Horsepower          | watts               | 745.7                  |
| Horsepower (boiler) | Btu/hr              | 33.520                 |
| Horsepower (boiler) | kilowatts           | 9.803                  |
| Horsepower-hrs.     | Btu                 | 2.547                  |
| Horsepower-hrs.     | foot-lbs.           | 1.98 x 10 <sup>6</sup> |
| Horsepower-hrs.     | kilowatts-hrs.      | 0.7457                 |

|                          |                   |              |
|--------------------------|-------------------|--------------|
| <b>I</b>                 |                   |              |
| Inches                   | pounds            | 0.113        |
| Inches                   | centimeters       | 2.540        |
| Inches                   | meters            | 2.540 x 10-2 |
| Inches                   | millimeters       | 25.40        |
| Inches of mercury        | kilopascal        | 3.376        |
| Inches of mercury        | atmospheres       | 0.03342      |
| Inches of mercury        | feet of water     | 1.133        |
| Inches of mercury        | kgs./sq. cm.      | 0.03453      |
| Inches of mercury        | kgs./sq. meter    | 345.3        |
| Inches of mercury        | pounds/sq. ft.    | 70.73        |
| Inches of mercury        | pounds/sq. in.    | 0.4912       |
| Inches of water (at 4°C) | kilopascal        | 0.248        |
| Inches of water (at 4°C) | atmospheres       | 2.458 x 10-3 |
| Inches of water (at 4°C) | inches of mercury | 0.07355      |
| Inches of water (at 4°C) | kgs./sq. cm.      | 2.538 x 10-3 |
| Inches of water (at 4°C) | pounds/sq. ft.    | 5.204        |
| Inches of water (at 4°C) | pounds/sq. in.    | 0.03613      |

|          |     |              |
|----------|-----|--------------|
| <b>J</b> |     |              |
| Joules   | Btu | 9.480 x 10-4 |



# Conversion Tables

| To Convert          | Into              | Multipli by              |
|---------------------|-------------------|--------------------------|
| <b>K</b>            |                   |                          |
| Kilograms           | grams             | 1.000.0                  |
| Kilograms           | pounds            | 2.205                    |
| Kilograms/cu. meter | pounds/cu. ft.    | 0.06243                  |
| Kilograms/cu. meter | pounds/cu. in.    | 3.613 x 10 <sup>-5</sup> |
| Kilograms/sq. cm    | atmosphere        | 0.9678                   |
| Kilograms/sq. cm    | feet of water     | 32.84                    |
| Kilograms/sq. cm    | inches of mercury | 28.96                    |
| Kilograms/sq. cm.   | pounds/sq. ft.    | 2.048                    |
| Kilograms/sq. cm.   | pounds/sq. in.    | 14.22                    |
| Kilograms/sq. meter | atmosphere        | 9.678 x 10 <sup>-5</sup> |
| Kilograms/sq. meter | feet of water     | 3.281 x 10 <sup>-3</sup> |
| Kilograms/sq. meter | inches of mercury | 2.896 x 10 <sup>-3</sup> |
| Kilograms/sq. meter | pounds/sq. ft.    | 0.2048                   |
| Kilograms/sq. meter | pounds/sq. in.    | 1.422 x 10 <sup>-3</sup> |
| Kilograms/sq. mm.   | kgs./sq. meter    | 106                      |
| Kilograms-calories  | Btu               | 3.968                    |
| Kilograms-calories  | foot-pounds       | 3.088                    |
| Kilograms-calories  | hp-hrs            | 1.560 x 10 <sup>-3</sup> |
| Kilograms-calories  | kilowatt-hrs      | 1.163 x 10 <sup>-3</sup> |
| Kilograms meters    | Btu               | 9.294 x 10 <sup>-3</sup> |
| Kilometers          | centimeters       | 105                      |
| Kilometers          | feet              | 3.281                    |
| Kilometers          | miles             | 0.6214                   |
| kilowatts           | Btu/min.          | 56.87                    |
| kilowatts           | foot-lbs./min.    | 4.426 x 10 <sup>4</sup>  |
| kilopascal          | Bar               | 0.01                     |
| kilopascal          | Pounds/sq.in      | 0.145                    |
| kilowatts           | horsepower        | 1.341                    |
| kilowatts-hrs.      | Btu               | 3.413                    |
| kilowatts-hrs.      | foot-lbs.         | 2.655 x 10 <sup>6</sup>  |
| kilowatts-hrs.      | horsepower-hrs.   | 1.341                    |
| knots               | statute miles/hr. | 1.151                    |

| To Convert | Into                | Multipli by |
|------------|---------------------|-------------|
| <b>L</b>   |                     |             |
| Liters     | cu. cm.             | 1.000.0     |
| Liters     | cu. feet            | 0.03531     |
| Liters     | cu. inches          | 61.02       |
| Liters     | gallons (U.S. liq.) | 0.2642      |

| To Convert      | Into               | Multipli by              |
|-----------------|--------------------|--------------------------|
| <b>M</b>        |                    |                          |
| MMSCFD          | cubic meter/second | 0.328                    |
| Meters          | centimeters        | 100.0                    |
| Meters          | feet               | 3.281                    |
| Meters          | inches             | 39.37                    |
| Meters          | millimeters        | 1.000.0                  |
| Meters          | yards              | 1.094                    |
| Microns         | inches             | 39.37 x 10 <sup>-6</sup> |
| Microns         | meters             | 1 x 10 <sup>-6</sup>     |
| Miles (statute) | feet               | 5.280                    |
| Miles (statute) | kilometers         | 1.609                    |
| Miles/hr.       | cms./sec.          | 44.70                    |
| Miles/hr.       | feet/min.          | 88.0                     |
| Miils           | inches             | 0.001                    |
| Miils           | yards              | 2.778 x 10 <sup>-5</sup> |

| To Convert | Into     | Multipli by |
|------------|----------|-------------|
| <b>N</b>   |          |             |
| Nepers     | decibels | 8.686       |

| To Convert           | Into           | Multipli by      |
|----------------------|----------------|------------------|
| <b>O</b>             |                |                  |
| Ohms                 | megohms        | 10 <sup>-6</sup> |
| Ohms                 | microhms       | 10 <sup>6</sup>  |
| Ounces (avoirdupois) | drams          | 16.0             |
| Ounces (avoirdupois) | grains         | 437.5            |
| Ounces (avoirdupois) | grams          | 28.35            |
| Ounces (avoirdupois) | pounds         | 0.0625           |
| Ounces (avoirdupois) | ounces (troy)  | 0.9115           |
| Ounces (troy)        | grains         | 480.0            |
| Ounces (troy)        | grams          | 31.10            |
| Ounces (troy)        | ounces (avdp.) | 1.09714          |
| Ounces (troy)        | pounds (troy)  | 0.08333          |

| To Convert                 | Into           | Multipli by      |
|----------------------------|----------------|------------------|
| <b>P</b>                   |                |                  |
| Pound/sq in.               | kilopascal     | 6.894            |
| Pound/sq in.               | bar            | 0.06894          |
| Pound/sq in.               | pascal         | 6894.14          |
| Pound/sq in.               | pounds/sq foot | 144              |
| Pascal (N/m <sup>2</sup> ) | bar            | 10 <sup>-5</sup> |

| To Convert                 | Into              | Multipli by               |
|----------------------------|-------------------|---------------------------|
| <b>P</b>                   |                   |                           |
| Pascal (N/m <sup>2</sup> ) | pound/sq in.      | 0.145 x 10 <sup>-3</sup>  |
| Pascal (N/m <sup>2</sup> ) | atmosphere        | 1.0197 x 10 <sup>-5</sup> |
| Pounds (avoirdupois)       | drams             | 256.                      |
| Pounds (avoirdupois)       | grains            | 7.000                     |
| Pounds (avoirdupois)       | grams             | 28.35                     |
| Pounds (avoirdupois)       | kilograms         | 0.02835                   |
| Pounds (avoirdupois)       | ounces            | 16.0                      |
| Pounds/gallon              | kg/liter          | 0.119                     |
| Pounds of water            | cu. feet          | 0.01602                   |
| Pounds of water            | cu. inches        | 27.68                     |
| Pounds of water            | gallons           | 0.1198                    |
| Pounds of water/min.       | cu. ft./sec.      | 2.670 x 10 <sup>-4</sup>  |
| Pounds/cu. ft.             | grams/cu. cm.     | 0.01602                   |
| Pounds/cu. ft.             | kgs./cu. meter    | 16.02                     |
| Pounds/cu. ft.             | pounds/cu. in.    | 5.787 x 10 <sup>-4</sup>  |
| Pounds/cu. in.             | pounds/cu. ft.    | 1.728                     |
| Pounds/sq. ft.             | atmospheres       | 4.725 x 10 <sup>-4</sup>  |
| Pounds/sq. ft.             | feet of water     | 0.01602                   |
| Pounds/sq. ft.             | inches of mercury | 0.014414                  |
| Pounds/hr.                 | kg/hr             | 0.453                     |
| Pounds/sq. in.             | atmospheres       | 0.06804                   |
| Pounds/sq. in.             | feet of water     | 2.307                     |
| Pounds/sq. in.             | inches of mercury | 2.036                     |
| Pounds/sq. in.             | kgs./sq. meter    | 703.1                     |
| Pounds/sq. in.             | pounds/sq. ft.    | 144.0                     |

| To Convert      | Into         | Multipli by |
|-----------------|--------------|-------------|
| <b>R</b>        |              |             |
| Radians         | degrees      | 57.30       |
| Revolution/min. | degrees/sec. | 6.0         |
| Revolution/min. | radians/sec. | 0.1047      |
| Revolution/min. | rev./sec.    | 0.01667     |

| To Convert         | Into            | Multipli by              |
|--------------------|-----------------|--------------------------|
| <b>S</b>           |                 |                          |
| Square centimeters | sq. feet        | 1.076 x 10 <sup>-3</sup> |
| Square centimeters | sq. inches      | 0.1550                   |
| Square centimeters | sq. meters      | 0.0001                   |
| Square centimeters | sq. millimeters | 100.0                    |
| Square feet        | acres           | 2.296 x 10 <sup>-5</sup> |
| Square feet        | sq. cms.        | 929.0                    |
| Square feet        | sq. inches      | 144.0                    |
| Square feet        | sq. miles       | 3.587 x 10 <sup>-8</sup> |
| Square inches      | sq. cms.        | 6.452                    |
| Square inches      | sq. feet        | 6.944 x 10 <sup>-3</sup> |
| Square inches      | sq. yards       | 7.716 x 10 <sup>-4</sup> |
| Square meters      | sq. feet        | 10.76                    |
| Square meters      | sq. inches      | 1.550                    |
| Square meters      | sq. millimeters | 106                      |
| Square meters      | sq. yards       | 1.196                    |
| Square millimeters | sq. inches      | 1.550 x 10 <sup>-3</sup> |
| Square yards       | sq. feet        | 9.0                      |
| Square yards       | sq. inches      | 1.296                    |
| Square yards       | sq. meters      | 0.8361                   |

| To Convert               | Into                      | Multipli by |
|--------------------------|---------------------------|-------------|
| <b>T</b>                 |                           |             |
| Temperature (°C) + 273   | absolute temperature (°C) | 1.0         |
| Temperature (°C) + 17.78 | temperature (°F)          | 1.8         |
| Temperature (°F) + 460   | absolute temperature (°F) | 1.0         |
| Temperature (°F) - 32°   | temperature (°C)          | 5/9         |
| Tons (metric)            | kilograms                 | 1000        |
| Tons (metric)            | pounds                    | 2.205       |
| Tons of water/24hrs      | pounds of water           | 83.333      |
| Tons of water/24hrs      | gallons/min.              | 0.16643     |
| Tons of water/24hrs      | cu. ft./hr.               | 1.3349      |

| To Convert | Into                | Multipli by              |
|------------|---------------------|--------------------------|
| <b>W</b>   |                     |                          |
| Watts      | Btu/hr.             | 3.4129                   |
| Watts      | Btu/min.            | 0.05688                  |
| Watts      | horsepower          | 1.341 x 10 <sup>-3</sup> |
| Watts      | horsepower (metric) | 1.360 x 10 <sup>-3</sup> |
| Watts      | kilowatts           | 0.001                    |
| Watts      | B.T.U. (mean)/min.  | 0.056884                 |
| Watts      | Btu                 | 3.413                    |
| Watts      | horsepower-hrs.     | 1.341 x 10 <sup>-3</sup> |

| To Convert | Into        | Multipli by              |
|------------|-------------|--------------------------|
| <b>Y</b>   |             |                          |
| Yards      | centimeters | 91.44                    |
| Yards      | kilometers  | 9.144 x 10 <sup>-4</sup> |
| Yards      | meters      | 0.9144                   |



# Temperature Conversion Table

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$$

| $^{\circ}\text{C}$ |        | $^{\circ}\text{F}$ | $^{\circ}\text{C}$ |      | $^{\circ}\text{F}$ |
|--------------------|--------|--------------------|--------------------|------|--------------------|
| -273.0             | -459.4 |                    | 43.3               | 110  | 230.0              |
| -268.0             | -450   |                    | 46.1               | 115  | 239.0              |
| -240.0             | -400   |                    | 48.9               | 120  | 248.0              |
| -212.0             | -350   |                    | 54.4               | 130  | 266.0              |
| -184.0             | -300   |                    | 60.0               | 140  | 284.0              |
| -157.0             | -250   | -418.0             | 65.6               | 150  | 302.0              |
| -129.0             | -200   | -328.0             | 71.1               | 160  | 320.0              |
| -101.0             | -150   | -238.0             | 76.7               | 170  | 338.0              |
| - 73.0             | -100   | -148.0             | 82.2               | 180  | 356.0              |
| - 45.6             | - 50   | - 58.0             | 87.8               | 190  | 374.0              |
| - 42.8             | - 45   | - 49.0             | 93.3               | 200  | 392.0              |
| - 40.0             | - 40   | - 40.0             | 98.9               | 210  | 410.0              |
| - 37.2             | - 35   | - 31.0             | 104.4              | 220  | 428.0              |
| - 34.4             | - 30   | 22.0               | 110.0              | 230  | 446.0              |
| - 31.7             | - 25   | - 13.0             | 115.6              | 240  | 464.0              |
| - 28.9             | - 20   | - 4.0              | 121.0              | 250  | 482.0              |
| - 26.1             | - 15   | 5.0                | 149.0              | 300  | 572.0              |
| - 23.2             | - 10   | 14.0               | 177.0              | 350  | 662.0              |
| - 20.6             | - 5    | 23.0               | 204.0              | 400  | 752.0              |
| - 17.8             | 0      | 32.0               | 232.0              | 450  | 842.0              |
| - 15.0             | 5      | 41.0               | 260.0              | 500  | 932.0              |
| - 12.2             | 10     | 50.0               | 288.0              | 550  | 1022.0             |
| - 9.4              | 15     | 59.0               | 316.0              | 600  | 1112.0             |
| - 6.7              | 20     | 68.0               | 343.0              | 650  | 1202.0             |
| - 3.9              | 25     | 77.0               | 371.0              | 700  | 1292.0             |
| - 1.1              | 30     | 86.0               | 399.0              | 750  | 1382.0             |
| 0                  | 32     | 89.6               | 427.0              | 800  | 1472.0             |
| 7.7                | 35     | 95.0               | 454.0              | 850  | 1562.0             |
| 4.4                | 40     | 104.0              | 482.0              | 900  | 1652.0             |
| 7.2                | 45     | 113.0              | 510.0              | 950  | 1742.0             |
| 10.0               | 50     | 122.0              | 538.0              | 1000 | 1832.0             |
| 12.8               | 55     | 131.0              | 566.0              | 1050 | 1922.0             |
| 15.6               | 60     | 140.0              | 593.0              | 1100 | 2012.0             |
| 18.3               | 65     | 149.0              | 621.0              | 1150 | 2102.0             |
| 21.1               | 70     | 158.0              | 649.0              | 1200 | 2192.0             |
| 23.9               | 75     | 167.0              | 677.0              | 1250 | 2282.0             |
| 26.7               | 80     | 176.0              | 704.0              | 1300 | 2372.0             |
| 29.4               | 85     | 185.0              | 732.0              | 1350 | 2462.0             |
| 32.2               | 90     | 194.0              | 762.0              | 1400 | 2552.0             |
| 35.0               | 95     | 203.0              | 788.0              | 1450 | 2642.0             |
| 37.8               | 100    | 212.0              | 816.0              | 1500 | 2732.0             |
| 40.6               | 105    | 221.0              |                    |      |                    |

**NOTES:** The temperature to be converted is the figure in the yellow column.  
To obtain a reading in  $^{\circ}\text{C}$  use left column; for conversion to  $^{\circ}\text{F}$  use the right column.



# Pressure/Temperature Rating According to ASME B16.34-2013

## Material: ASTM A 105, ASTM A 216 Gr. WCB, ASTM A 350 Gr. LF2 (Table 2-1.1)

| Temperature           | Working Pressures by Classes, psig (Bar) |          |             |             |             |             |
|-----------------------|------------------------------------------|----------|-------------|-------------|-------------|-------------|
| °F (°C)               | 150                                      | 300      | 600         | 900         | 1500        | 2500        |
| -20 to 10 (-29 to 38) | 285 (20)                                 | 740 (51) | 1.480 (102) | 2.220 (153) | 3.705 (255) | 6.170 (425) |
| 200 ( 93)             | 260 (18)                                 | 680 (47) | 1.360 ( 94) | 2.035 (140) | 3.395 (234) | 5.655 (390) |
| 300 (149)             | 230 (16)                                 | 655 (45) | 1.310 ( 90) | 1.965 (135) | 3.270 (225) | 5.450 (376) |
| 400 (204)             | 200 (14)                                 | 635 (44) | 1.265 ( 87) | 1.900 (131) | 3.170 (219) | 5.280 (364) |
| 500 (260)             | 170 (12)                                 | 605 (42) | 1.205 ( 83) | 1.810 (125) | 3.015 (208) | 5.025 (346) |
| 600 (316)             | 140 (10)                                 | 570 (39) | 1.135 ( 78) | 1.705 (118) | 2.840 (196) | 4.730 (326) |
| 650 (343)             | 125 ( 9)                                 | 550 (38) | 1.100 ( 76) | 1.650 (114) | 2.745 (189) | 4.575 (315) |
| 700 (371)             | 110 ( 8)                                 | 530 (36) | 1.060 ( 73) | 1.590 (110) | 2.665 (184) | 4.425 (305) |

## Material: ASTM A 216 Gr. WCC, ASTM A 352 Gr. LCC/LC2/LC3 (Table 2-1.2)

| Temperature           | Working Pressures by Classes, psig (Bar) |          |             |             |             |             |
|-----------------------|------------------------------------------|----------|-------------|-------------|-------------|-------------|
| °F (°C)               | 150                                      | 300      | 600         | 900         | 1500        | 2500        |
| -20 to 10 (-29 to 38) | 290 (20)                                 | 750 (52) | 1.500 (103) | 2.250 (155) | 3.750 (259) | 6.250 (431) |
| 200 ( 93)             | 260 (18)                                 | 750 (52) | 1.500 (103) | 2.250 (155) | 3.750 (259) | 6.250 (431) |
| 300 (149)             | 230 (16)                                 | 730 (50) | 1.455 (100) | 2.185 (151) | 3.640 (251) | 6.070 (419) |
| 400 (204)             | 200 (14)                                 | 705 (49) | 1.405 ( 97) | 2.110 (145) | 3.520 (243) | 5.865 (404) |
| 500 (260)             | 170 (12)                                 | 665 (46) | 1.330 ( 92) | 1.995 (137) | 3.325 (229) | 5.540 (382) |
| 600 (316)             | 140 (10)                                 | 605 (42) | 1.210 ( 83) | 1.815 (125) | 3.025 (209) | 5.040 (348) |
| 650 (343)             | 125 ( 9)                                 | 590 (41) | 1.175 ( 81) | 1.765 (122) | 2.940 (203) | 4.905 (338) |
| 700 (371)             | 110 ( 8)                                 | 555 (38) | 1.110 ( 76) | 1.665 (115) | 2.775 (191) | 4.630 (319) |

## Material: ASTM A 352 Gr. LCB (Table 2-1.3)

| Temperature           | Working Pressures by Classes, psig (Bar) |          |            |             |             |             |
|-----------------------|------------------------------------------|----------|------------|-------------|-------------|-------------|
| °F (°C)               | 150                                      | 300      | 600        | 900         | 1500        | 2500        |
| -20 to 10 (-29 to 38) | 265 (18)                                 | 695 (48) | 1.395 (96) | 2.090 (144) | 3.480 (240) | 5.805 (400) |
| 200 ( 93)             | 255 (17)                                 | 660 (45) | 1.320 (91) | 1.980 (136) | 3.300 (227) | 5.505 (379) |
| 300 (149)             | 230 (16)                                 | 640 (44) | 1.275 (88) | 1.915 (132) | 3.190 (220) | 5.315 (366) |
| 400 (204)             | 200 (14)                                 | 615 (42) | 1.230 (85) | 1.845 (127) | 3.075 (212) | 5.125 (353) |
| 500 (260)             | 170 (12)                                 | 585 (40) | 1.175 (81) | 1.760 (121) | 2.930 (202) | 4.885 (337) |
| 600 (316)             | 140 (10)                                 | 550 (38) | 1.105 (76) | 1.655 (114) | 2.755 (190) | 4.595 (317) |
| 650 (343)             | 125 ( 9)                                 | 535 (37) | 1.065 (73) | 1.600 (110) | 2.665 (184) | 4.440 (306) |
| 700 (371)             | 110 ( 8)                                 | 510 (35) | 1.025 (71) | 1.535 (106) | 2.560 (176) | 4.270 (294) |

## Material: ASTM A 182 Gr. F316/F316H, ASTM A 479 Gr. 316/316H, ASTM A 351Gr. CF3M/CF8M (Table 2-2.2)

| Temperature           | Working Pressures by Classes, psig (Bar) |          |            |             |             |             |
|-----------------------|------------------------------------------|----------|------------|-------------|-------------|-------------|
| °F (°C)               | 150                                      | 300      | 600        | 900         | 1500        | 2500        |
| -20 to 10 (-29 to 38) | 275 (19)                                 | 720 (50) | 1.440 (99) | 2.160 (149) | 3.600 (248) | 6.000 (414) |
| 200 ( 93)             | 235 (16)                                 | 620 (43) | 1.240 (85) | 1.860 (128) | 3.095 (213) | 5.160 (356) |
| 300 (149)             | 215 (15)                                 | 560 (39) | 1.120 (77) | 1.680 (116) | 2.795 (193) | 4.660 (321) |
| 400 (204)             | 195 (13)                                 | 515 (36) | 1.025 (71) | 1.540 (106) | 2.570 (177) | 4.280 (295) |
| 500 (260)             | 170 (12)                                 | 480 (33) | 955 (66)   | 1.435 ( 99) | 2.390 (165) | 3.980 (274) |
| 600 (316)             | 140 (10)                                 | 450 (31) | 900 (62)   | 1.355 ( 93) | 2.255 (155) | 3.760 (259) |
| 650 (343)             | 125 ( 9)                                 | 440 (30) | 885 (61)   | 1.325 ( 91) | 2.210 (152) | 3.680 (254) |
| 700 (371)             | 110 ( 8)                                 | 435 (30) | 870 (60)   | 1.305 ( 90) | 2.170 (150) | 3.620 (250) |



# Chemical and Mechanical Requirements - Forged / bar

| Composition % (Maximum Percent Unless Range is Given) |                                    |                        |                     |           |            |         |           |           |      |
|-------------------------------------------------------|------------------------------------|------------------------|---------------------|-----------|------------|---------|-----------|-----------|------|
|                                                       | ASTM Standard<br>(UNS designation) | Nominal<br>Composition | C                   | Mn        | P          | S       | Si        |           |      |
| Carbon Steel                                          | A 105 (1) (2) (3)                  |                        | 0,35                | 0,60-1,05 | 0,035      | 0,040   | 0,10-0,35 |           |      |
|                                                       | A 350 LF1 (2) (3)                  |                        | 0,30                | 0,60-1,35 | 0,035      | 0,040   | 0,15-0,30 |           |      |
|                                                       | A 350 LF2 (2) (3)                  |                        | 0,30                | 0,60-1,35 | 0,035      | 0,040   | 0,15-0,30 |           |      |
| Low Alloy                                             | A 350 LF3 (3)                      |                        | 0,20                | 0,90      | 0,035      | 0,040   | 0,20-0,35 |           |      |
|                                                       | A 29 Gr.4140                       |                        | 0,38-0,43           | 0,75-1,00 | 0,035      | 0,040   | 0,15-0,35 |           |      |
|                                                       | A 29 Gr.4340                       |                        | 0,38-0,43           | 0,60-0,80 | 0,035      | 0,040   | 0,15-0,35 |           |      |
|                                                       | A 182 F1                           | (UNS K12822)           | C-Mo                | 0,28      | 0,60-0,90  | 0,045   | 0,045     | 0,15-0,35 |      |
|                                                       | A 182 F2                           | (UNS K12122)           | 0,5Cr-0,5Mo         | 0,05-0,21 | 0,30-0,80  | 0,040   | 0,040     | 0,10-0,60 |      |
|                                                       | A 182 F5a                          | (UNS K42544)           | 5Cr                 | 0,25      | 0,60       | 0,040   | 0,030     | 0,50      |      |
|                                                       | A 182 F9                           | (UNS K90941)           | 9Cr                 | 0,15      | 0,30-0,60  | 0,030   | 0,030     | 0,50-1,00 |      |
|                                                       | A 182 F11 CL.3                     | (UNS K11572)           | 1,25Cr-0,5Mo        | 0,10-0,20 | 0,30-0,80  | 0,040   | 0,040     | 0,50-1,00 |      |
|                                                       | A 182 F12 CL.2                     | (UNS K11564)           | 1Cr-0,5Mo           | 0,10-0,20 | 0,30-0,80  | 0,040   | 0,040     | 0,10-0,60 |      |
|                                                       | A 182 F22 CL.3                     | (UNS K21590)           | Cr-Mo               | 0,05-0,15 | 0,30-0,60  | 0,040   | 0,040     | 0,50      |      |
|                                                       | Martensitic                        | A182 F6a CL.2          | (UNS S41000)        | 13Cr      | 0,15       | 1,00    | 0,040     | 0,030     | 1,00 |
| A 182 F6NM                                            |                                    | (UNS S41500)           | 13Cr-4Ni            | 0,05      | 0,5-1,0    | 0,030   | 0,030     | 0,60      |      |
| Austenitic Stainless Steel                            | A 182 F304 (4)                     | (UNS S30400)           | 18Cr-8Ni            | 0,08      | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F304H (4)                    | (UNS S30409)           | 18Cr-8Ni            | 0,04-0,10 | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F304L (4)                    | (UNS S30403)           | 18Cr-8Ni            | 0,035     | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F316 (4)                     | (UNS S31600)           | 18Cr-10Ni-Mo        | 0,08      | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F316H (4)                    | (UNS S31609)           | 18Cr-10Ni-Mo        | 0,04-0,10 | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F316L (4)                    | (UNS S31603)           | 18Cr-10Ni-Mo        | 0,030     | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F310                         | (UNS S31000)           | 25Cr-20Ni           | 0,25      | 2,00       | 0,045   | 0,030     | 1,00      |      |
|                                                       | A 182 F44                          | (UNS S31254)           | 20Cr-18Ni-6Mo       | 0,020     | 1,00       | 0,030   | 0,010     | 0,80      |      |
|                                                       | B 462- UNS N08020                  | (ALLOY 20)             | 29Ni-20Ni-3Cu-2Mo   | 0,07      | 2,00       | 0,045   | 0,035     | 1,00      |      |
| Austenitic Ferritic Stainless Steel                   | A 182 F51                          | (UNS S31803)           | 22Cr-5Ni            | 0,030     | 2,00       | 0,030   | 0,020     | 1,00      |      |
|                                                       | A 182 F53                          | (UNS S32750)           | 25Cr-7Ni-4Mo        | 0,030     | 1,20       | 0,035   | 0,020     | 0,80      |      |
|                                                       | A 182 F55                          | (UNS S32760) (5)       | 25Cr-7Ni-3,5Mo      | 0,030     | 1,00       | 0,030   | 0,010     | 1,00      |      |
| Age hardened SS                                       | A 564 Gr 630 H900                  | (UNS S17400)           | 16Cr-4Ni-4Cu        | 0,07      | 1,00       | 0,040   | 0,030     | 1,00      |      |
|                                                       | A 564 Gr 630 H1150M                | (UNS S17400)           | 16Cr-4Ni-4Cu        | 0,07      | 1,00       | 0,040   | 0,030     | 1,00      |      |
| Titanium                                              | B 348 Gr.3                         | (Unalloyed Titanium)   | Ti                  | 0,08      | Ti=Balance | H=0,015 | Fe=0,30   | O=0,35    |      |
|                                                       | B 348 Gr.5                         | (Titanium Alloy)       | 6Al-4V              | 0,08      | Ti=Balance | H=0,015 | Fe=0,40   | O=0,20    |      |
| Nickel Alloy                                          | B 564-UNS N06625                   | (INCONEL 625)          | 60Ni-22Cr-9Mo-3,5Cb | 0,10      | 0,5        | 0,015   | 0,015     | 0,5       |      |
|                                                       | B 564-UNS N08825                   | (INCONEL 825)          |                     | 0,05      | 1,0        |         | 0,03      | 0,5       |      |

- (1) For each reduction of 0,01% below the specified maximum carbon content, an increase of 0,06% Mn above the specified maximum will be permitted up to a maximum of 1,35%.
- (2)  $Cu + Ni + Cr + Mo \leq 1,00\%$



# Materials for Body, Plug, Cover and Stem Components

|             |           |             |                 |             |                 | Mechanical Properties           |                               |                 |                        |
|-------------|-----------|-------------|-----------------|-------------|-----------------|---------------------------------|-------------------------------|-----------------|------------------------|
| Cr          | Mo        | Ni          | Cu              | V           | Others Elements | Tensile Strength min, ksi (MPa) | Yield Strength min, ksi (MPa) | Elongation min% | Reduction of area min% |
| 0,30        | 0,12      | 0,40        | 0,40            | 0,08        | Cb = 0,02       | 70 (485)                        | 36 (250)                      | 22              | 30                     |
| 0,30        | 0,12      | 0,40        | 0,40            | 0,08        | Cb=0,02         | 60 (415)                        | 30 (205)                      | 25              | 38                     |
| 0,30        | 0,12      | 0,40        | 0,40            | 0,08        | Cb=0,02         | 70 (485)                        | 36 (250)                      | 22              | 30                     |
| 0,30        | 0,12      | 3,3-3,7     | 0,40            | 0,03        | Cb=0,02         | 70 (485)                        | 37,5 (260)                    | 22              | 35                     |
| 0,80-1,10   | 0,15-0,25 | -           | -               | -           | -               | 100 (690)                       | 75 (520)                      | 20              | 50                     |
| 0,70-0,90   | 0,20-0,30 | 1,65-2,00   | -               | -           | -               | 115 (790)                       | 96 (660)                      | 16              | 45                     |
| -           | 0,44-0,65 | -           | -               | -           | -               | 70 (485)                        | 40 (275)                      | 20              | 30                     |
| 0,50-0,81   | 0,44-0,65 | -           | -               | -           | -               | 70 (485)                        | 40 (275)                      | 20              | 30                     |
| 4,0-6,0     | 0,44-0,65 | 0,50        | -               | -           | -               | 90 (620)                        | 65 (450)                      | 22              | 50                     |
| 8,0-10,0    | 0,90-1,10 | -           | -               | -           | -               | 85 (585)                        | 55 (380)                      | 20              | 40                     |
| 1,00-1,50   | 0,44-0,65 | -           | -               | -           | -               | 75 (515)                        | 45 (310)                      | 20              | 30                     |
| 0,80-1,25   | 0,44-0,65 | -           | -               | -           | -               | 70 (485)                        | 40 (275)                      | 20              | 30                     |
| 2,00-2,50   | 0,87-1,13 | -           | -               | -           | -               | 75 (515)                        | 45 (310)                      | 20              | 30                     |
| 11,5-13,5   | -         | 0,50        | -               | -           | -               | 85 (585)                        | 55 (380)                      | 18              | 35                     |
| 11,5-14,0   | 0,5-1,0   | 3,5-5,5     | -               | -           | -               | 115 (790)                       | 90 (620)                      | 15              | 45                     |
| 18,0-20,0   | -         | 8,0-11,0    | -               | -           | -               | 75 (515)                        | 30 (205)                      | 30              | 50                     |
| 18,0-20,0   | -         | 8,0-11,0    | -               | -           | -               | 75 (515)                        | 30 (205)                      | 30              | 50                     |
| 18,0-20,0   | -         | 8,0-13,0    | -               | -           | -               | 70 (485)                        | 25 (170)                      | 30              | 50                     |
| 16,0-18,0   | 2,00-3,00 | 10,0-14,0   | -               | -           | -               | 75 (515)                        | 30 (205)                      | 30              | 50                     |
| 16,0-18,0   | 2,00-3,00 | 10,0-14,0   | -               | -           | -               | 75 (515)                        | 30 (205)                      | 30              | 50                     |
| 16,0-18,0   | 2,00-3,00 | 10,0-15,0   | -               | -           | -               | 70 (485)                        | 25 (170)                      | 30              | 50                     |
| 19,0-22,0   | -         | 24,0-26,0   | -               | -           | -               | 75 (515)                        | 30 (205)                      | 30              | 50                     |
| 19,5-20,5   | 6,0-6,5   | 17,5-18,5   | 0,5-1,0         | -           | N=0,18-0,22     | 94 (650)                        | 44 (300)                      | 35              | 50                     |
| 19,00-21,00 | 2,00-3,00 | 32,00-38,00 | 3,00-4,00       | -           | -               | 80 (551)                        | 35 (241)                      | 30              | 50                     |
| 21,0-23,0   | 2,5-3,5   | 4,5-6,5     | -               | -           | N=0,08-0,20     | 90 (620)                        | 65 (450)                      | 25              | 45                     |
| 24,0-26,0   | 3,0-5,0   | 6,0-8,0     | 0,5             | -           | N=0,24-0,32     | 116 (800)                       | 80 (550)                      | 15              | -                      |
| 24,0-26,0   | 3,0-4,0   | 6,0-8,0     | 0,50-1,00       | N=0,20-0,30 | W=0,50-1,00     | 109 (750)                       | 80 (550)                      | 25              | 45                     |
| 15,0-17,5   | -         | 3,00-5,00   | 3,00-5,00       | -           | -               | 190 (1.310)                     | 170 (1.170)                   | 10              | 40                     |
| 15,0-17,5   | -         | 3,00-5,00   | 3,00-5,00       | -           | -               | 115 (795)                       | 75 (515)                      | 18              | 55                     |
| -           | -         | -           | -               | -           | N=0,05          | 65 (450)                        | 55 (380)                      | 18              | 30                     |
| Al=5,5-6,75 | -         | -           | -               | 3,5-4,5     | N=0,05          | 130 (895)                       | 120 (828)                     | 10              | 25                     |
| 20,0-23,0   | 8,0-10,0  | 58,0Min     | Ta+Cb=3,15-4,15 | Ti=0,4      | Fe=5,0Al=0,4    | 110 (758)                       | 50 (345)                      | 25              | -                      |
| 19,5-23,5   | 2,5-3,5   | 38,0-46,0   | 1,5-3,0         | Ti=0,6-1,2  | Fe=22,0Al=0,2   | 85 (586)                        | 35 (241)                      | 30              | -                      |

(3)  $Cr + Mo \leq 0,32\%$

(4) Maximum nitrogen content of 0,10%

(5) Pitting Resistance Equivalent Number (PREN) =  $Cr + 3,3Mo + 16N \leq 40$ .





## Chemical and Mechanical Requirements - Cast Materials

Composition % (Maximum Percent Unless Range is Given)

|                                                         | ASTM Standard<br>(UNS designation) | Nominal<br>Composition | C         | Mn        | P     | S     | Si   |
|---------------------------------------------------------|------------------------------------|------------------------|-----------|-----------|-------|-------|------|
| Carbon<br>Steel                                         | A 216 WCB (2)                      |                        | 0,30      | 1,00      | 0,035 | 0,035 | 0,60 |
|                                                         | A 216 WCC (2)                      |                        | 0,25      | 1,20      | 0,035 | 0,035 | 0,60 |
|                                                         | A 352 LCB (UNS J03003) (2)         |                        | 0,30      | 1,00      | 0,040 | 0,045 | 0,60 |
|                                                         | A 352 LCC (UNS J02505) (2)         |                        | 0,25      | 1,20      | 0,040 | 0,045 | 0,60 |
|                                                         | A 352 LC3 (UNS J31550)             | 3,5Ni                  | 0,15      | 0,50-0,80 | 0,040 | 0,045 | 0,60 |
|                                                         | A 487 Gr4Q 4-C                     | Ni-Cr-Mo               | 0,030     | 1,00      | 0,040 | 0,045 | 0,80 |
| Low Alloy                                               | A 217 WC1                          | C-Mo                   | 0,25      | 0,50-0,80 | 0,040 | 0,045 | 0,60 |
|                                                         | A 217 WC6                          | Cr-Mo                  | 0,05-0,20 | 0,50-0,80 | 0,035 | 0,035 | 0,60 |
|                                                         | A 217 WC9                          | Cr-Mo                  | 0,05-0,18 | 0,40-0,70 | 0,035 | 0,035 | 0,60 |
|                                                         | A 217 C5                           | Cr-Mo                  | 0,20      | 0,40-0,70 | 0,040 | 0,045 | 0,75 |
|                                                         | A 217 C12                          | Cr-Mo                  | 0,20      | 0,35-0,65 | 0,035 | 0,035 | 1,00 |
| Martensitic                                             | A 217 CA15 (UNS J91150)            | 13Cr                   | 0,15      | 1,00      | 0,040 | 0,025 | 1,50 |
|                                                         | A 487 CA6NM (UNS J91540)           | 13Cr-4Ni               | 0,06      | 1,00      | 0,040 | 0,030 | 1,00 |
| Austenitic<br>Stainless<br>Steel                        | A 351 CF3 (UNS J92500)             | 18Cr-8Ni               | 0,03      | 1,50      | 0,040 | 0,040 | 2,00 |
|                                                         | A 351 CF3M (UNS J92800)            | 16Cr-12Ni-2Mo          | 0,03      | 1,50      | 0,040 | 0,040 | 1,50 |
|                                                         | A 351 CF8 (UNS J92600)             | 18Cr-8Ni               | 0,08      | 1,50      | 0,040 | 0,040 | 2,00 |
|                                                         | A 351 CF8C (UNS 92710) (1)         | 18Cr-10Ni-2Co          | 0,08      | 1,50      | 0,040 | 0,040 | 2,00 |
|                                                         | A 351 CF8M (UNS J92900)            | 16Cr-12Ni-2Mo          | 0,08      | 1,50      | 0,040 | 0,040 | 1,50 |
|                                                         | A 351 CN7M (UNS N08007)            | 29Ni-20Cr-3Cu-2Mo      | 0,07      | 1,50      | 0,040 | 0,040 | 1,50 |
|                                                         | A 351 CK3MCuN (UNS J93254) (3)     | 20Cr-18Ni-6Mo-N        | 0,025     | 1,20      | 0,045 | 0,010 | 1,00 |
| Cast Austenitic<br>Ferritic (Duplex)<br>Stainless Steel | A 890 CD3MN (UNS J92205)           | 22Cr-5Ni-Mo-N          | 0,03      | 1,50      | 0,040 | 0,020 | 1,00 |
|                                                         | A 890 CE3MN (UNS J93404) (3)       | 25Cr-7Ni-Mo-N          | 0,03      | 1,50      | 0,040 | 0,040 | 1,00 |
|                                                         | A 890 CD3MWCuN (UNS J93380)(3)     | 25Cr-7Ni-Mo-N          | 0,03      | 1,00      | 0,030 | 0,025 | 1,00 |

## Chemical and Mechanical Requirements Bolting Materials

|      |                      |               |           |           |       |       |           |
|------|----------------------|---------------|-----------|-----------|-------|-------|-----------|
| Stud | A 193 B7 and B7M (5) | Cr-Mo         | 0,38-0,48 | 0,75-1,00 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 193 B16            | Cr-Mo-V       | 0,36-0,47 | 0,45-0,70 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 193 B8M CL.2       | 18Cr-10Ni-2Mo | 0,08      | 2,00      | 0,045 | 0,030 | 1,00      |
|      | A 320 L43            | Ni-Cr-Mo      | 0,38-0,43 | 0,60-0,85 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 320 L7 and L7M (5) | Cr-Mo         | 0,38-0,48 | 0,75-1,00 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 453 Gr 660A        |               | 0,08      | 2,00      | 0,040 | 0,030 | 1,00      |
| Nut  | A 194 2H/2HM         | C             | min 0,40  | 1,00      | 0,040 | 0,050 | 0,40      |
|      | A 194 4              | C-Mo          | 0,40-0,50 | 0,70-0,90 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 194 7/7M           | Cr-Mo         | 0,38-0,48 | 0,75-1,00 | 0,035 | 0,040 | 0,15-0,35 |
|      | A 194 8M             | 18Cr-10Ni-2Mo | 0,08      | 2,00      | 0,045 | 0,030 | 1,00      |

- (1) Grade CF8C shall have a columbium content of not less than 8 times the carbon content but not over 1,00%  
 (2) For each reduction of 0,01% below the specified maximum carbon content, and increase of 0,04% Mn above the specified maximum will be permitted up to a maximum of: 1,28% for WCB and LCB; 1,40% for WCC and LCC.



# for Body, Plug and Cover Components

|             |           |            |           |      |             | Mechanical Properties              |                                  |                    |                              |
|-------------|-----------|------------|-----------|------|-------------|------------------------------------|----------------------------------|--------------------|------------------------------|
| Cr          | Mo        | Ni         | Cu        | V    | W           | Tensile Strength<br>min, ksi (MPa) | Yield Strength<br>min, ksi (MPa) | Elongation<br>min% | Reduction<br>of area<br>min% |
| 0,50        | 0,20      | 0,50       | 0,30      | 0,03 | -           | 70 (485)                           | 36 (250)                         | 22                 | 35                           |
| 0,50        | 0,20      | 0,50       | 0,30      | 0,03 | -           | 70 (485)                           | 40 (275)                         | 22                 | 35                           |
| 0,50        | 0,20      | 0,50       | 0,30      | 0,03 | -           | 65 (450)                           | 35 (240)                         | 24                 | 35                           |
| 0,50        | 0,20      | 0,50       | -         | 0,03 | -           | 70 (485)                           | 40 (275)                         | 22                 | 35                           |
|             | -         | 3,00-4,00  | -         | -    | -           | 70 (485)                           | 40 (275)                         | 24                 | 35                           |
| 0,40-0,80   | 0,15-0,30 | 0,4-0,80   | 0,50      | 0,03 | 0,10        | 90 (620)                           | 60 (415)                         | 18                 | 35                           |
| 0,35        | 0,45-0,65 | -          | 0,50      | -    | 0,10        | 65 (450)                           | 35 (240)                         | 24                 | 35                           |
| 1,00-1,50   | 0,45-0,65 | 0,50       | 0,50      | -    | 0,10        | 70 (485)                           | 40 (275)                         | 20                 | 35                           |
| 2,00-2,75   | 0,90-1,20 | 0,50       | 0,50      | -    | 0,10        | 70 (485)                           | 40 (275)                         | 20                 | 35                           |
| 4,00-6,50   | 0,45-0,65 | 0,50       | 0,50      | -    | 0,10        | 90 (620)                           | 60 (415)                         | 18                 | 35                           |
| 8,00-10,00  | 0,90-1,20 | 0,50       | 0,50      | -    | 0,10        | 90 (620)                           | 60 (415)                         | 18                 | 35                           |
| 11,50-14,00 | 0,50      | 1,00       | -         | -    | -           | 90 (620)                           | 65 (450)                         | 18                 | 30                           |
| 11,5-14,0   | 0,4-1,0   | 3,5-4,5    | 0,50      | 0,05 | 0,10        | 100 (690)                          | 75 (515)                         | 17                 | 35                           |
| 17,00-21,00 | 0,50      | 8,00-12,00 | -         | -    | -           | 70 (485)                           | 30 (206)                         | 35                 | -                            |
| 17,00-21,00 | 2,00-3,00 | 9,00-13,00 | -         | -    | -           | 70 (485)                           | 30 (206)                         | 30                 | -                            |
| 18,00-21,00 | 0,50      | 8,00-11,00 | -         | -    | -           | 70 (485)                           | 30 (206)                         | 35                 | -                            |
| 18,00-21,00 | 0,50      | 9,00-12,00 | -         | -    | -           | 70 (485)                           | 30 (206)                         | 30                 | -                            |
| 18,00-21,00 | 2,00-3,00 | 9,00-12,00 | -         | -    | -           | 70 (485)                           | 30 (206)                         | 30                 | -                            |
| 19,0-22,0   | 2,0-3,0   | 27,5-30,5  | 3,0-4,0   | -    | -           | 62 (425)                           | 25 (170)                         | 35                 | -                            |
| 19,5-20,5   | 6,0-7,0   | 17,5-19,5  | 0,50-1,00 | -    | N=0,18-0,24 | 80 (550)                           | 38 (260)                         | 35                 | -                            |
| 21,0-23,5   | 2,5-3,5   | 4,5-6,5    | 1,00      | -    | N=0,10-0,30 | 90 (620)                           | 60 (415)                         | 25                 | -                            |
| 24,0-26,0   | 4,0-5,0   | 6,0-8,0    | -         | -    | N=0,10-0,30 | 100 (690)                          | 75 (515)                         | 18                 | -                            |
| 24,0-26,0   | 3,0-4,0   | 6,5-8,5    | 0,5-1,0   | -    | N=0,20-0,30 | 100 (690)                          | 65 (450)                         | 25                 | -                            |

## (Body / Plug)

|           |           |           |   |           |                              |                   |                  |       |    |
|-----------|-----------|-----------|---|-----------|------------------------------|-------------------|------------------|-------|----|
| 0,75-1,20 | 0,15-0,25 | -         | - | -         | -                            | 125/100 (860/690) | 105/80 (720/550) | 16/18 | 50 |
| 0,80-1,15 | 0,50-0,65 | -         | - | 0,25-0,35 | Al=0,015                     | 125 (860)         | 105 (725)        | 18    | 50 |
| 16,0-18,0 | 2,00-3,00 | 10,0-14,0 | - | -         | -                            | 110 (760)         | 95 (655)         | 15    | 45 |
| 0,70-0,90 | 0,20-0,30 | 1,65-2,00 | - | -         | -                            | 125 (860)         | 105 (725)        | 16    | 50 |
| 0,80-1,10 | 0,15-0,25 | -         | - | -         | -                            | 125/100 (860/690) | 105/80 (725/550) | 16/18 | 50 |
| 13,5-16,0 | 1,00-1,50 | 24,0-27,0 | - | 0,10-0,50 | B=0,001-0,01<br>Ti=1,90-2,35 | 130 (895)         | 85 (585)         | 15    | 18 |
| -         | -         | -         | - | -         | -                            | --                | --               | -     | -  |
| -         | 0,20-0,30 | -         | - | -         | -                            | --                | --               | -     | -  |
| 0,8-1,10  | 0,15-0,25 | -         | - | -         | -                            | --                | --               | -     | -  |
| 16,0-18,0 | 2,00-3,00 | 10,0-14,0 | - | -         | -                            | --                | --               | -     | -  |

(3) Pitting Resistance Equivalent Number (PREN) = Cr + 3,3Mo + 16N ≤ 40.

(4) For 3/4" (M20) and under: 110/(760), 95/(655) 15; over 3/4" (M20) up to 1" (M24): 100/(690), 80/(550), 20 over 1" M24 up to 1.25" (M30) 95/(655), 65/(450), 25 over 1.25" (M30) up to 1.5" (M36): 90/(620), 50/(345), 30.

(5) For B7M and L7M grades, a minimum carbon content of 0,28% is permitted, provided that the required tensile properties are met in the section size involved.



# Plug Valve Dimensions According to API Std. 6D/ISO14313

Face to Face (A) and End to End (B - C) dimensions in mm.

| NPS (DN)                 | Short Welding End |             |            | Reduced (Regular) Welding End |             |            | Venturi Welding End |             |            | Round-Port, Full Bore Ring Joint |             |            |
|--------------------------|-------------------|-------------|------------|-------------------------------|-------------|------------|---------------------|-------------|------------|----------------------------------|-------------|------------|
|                          | Raised Face       | Welding End | Ring Joint | Raised Face                   | Welding End | Ring Joint | Raised Face         | Welding End | Ring Joint | Raised Face                      | Welding End | Ring Joint |
| 1<br>Inch/mm             | 2<br>A            | 3<br>B      | 4<br>C     | 5<br>A                        | 6<br>B      | 7<br>C     | 8<br>A              | 9<br>B      | 10<br>C    | 11<br>A                          | 12<br>B     | 13<br>C    |
| <b>CLASS 150 (PN 20)</b> |                   |             |            |                               |             |            |                     |             |            |                                  |             |            |
| 2 ( 50)                  | 178               | 267         | 191        | -                             | -           | -          | -                   | -           | -          | 267                              | -           | 279        |
| 2 1/2 ( 65)              | 191               | 305         | 203        | -                             | -           | -          | -                   | -           | -          | 298                              | -           | 311        |
| 3 ( 80)                  | 203               | 330         | 216        | -                             | -           | -          | -                   | -           | -          | 343                              | -           | 356        |
| 4 (100)                  | 229               | 356         | 241        | -                             | -           | -          | -                   | -           | -          | 432                              | -           | 445        |
| 6 (150)                  | 267               | 457         | 279        | 394                           | -           | 406        | -                   | -           | -          | 546                              | -           | 559        |
| 8 (200)                  | 292               | 521         | 305        | 457                           | -           | 470        | -                   | -           | -          | 622                              | -           | 635        |
| 10 (250)                 | 330               | 559         | 343        | 533                           | -           | 546        | 533                 | 559         | 546        | 660                              | -           | 673        |
| 12 (300)                 | 356               | 635         | 368        | 610                           | -           | 622        | 610                 | 635         | 622        | 762                              | -           | 775        |
| 14 (350)                 | -                 | -           | -          | -                             | -           | -          | 686                 | 686         | 699        | -                                | -           | -          |
| 16 (400)                 | -                 | -           | -          | -                             | -           | -          | 762                 | 762         | 775        | -                                | -           | -          |
| 18 (450)                 | -                 | -           | -          | -                             | -           | -          | 864                 | 864         | 876        | -                                | -           | -          |
| 20 (500)                 | -                 | -           | -          | -                             | -           | -          | 914                 | 914         | 927        | -                                | -           | -          |
| 24 (600)                 | -                 | -           | -          | -                             | -           | -          | 1067                | 1067        | 1080       | -                                | -           | -          |
| <b>CLASS 300 (PN50)</b>  |                   |             |            |                               |             |            |                     |             |            |                                  |             |            |
| 2 ( 50)                  | 216               | 267         | 232        | -                             | -           | -          | -                   | -           | -          | 283                              | 283         | 298        |
| 2 1/2 ( 65)              | 241               | 305         | 257        | -                             | -           | -          | -                   | -           | -          | 330                              | 330         | 346        |
| 3 ( 80)                  | 283               | 330         | 298        | -                             | -           | -          | -                   | -           | -          | 387                              | 387         | 403        |
| 4 (100)                  | 305               | 356         | 321        | -                             | -           | -          | -                   | -           | -          | 457                              | 457         | 473        |
| 6 (150)                  | 403               | 457         | 419        | 403                           | -           | 419        | 403                 | 457         | 419        | 559                              | 559         | 575        |
| 8 (200)                  | 419               | 521         | 435        | 502                           | -           | 518        | 419                 | 521         | 435        | 686                              | 686         | 702        |
| 10 (250)                 | 457               | 559         | 473        | 568                           | -           | 584        | 457                 | 559         | 473        | 826                              | 826         | 841        |
| 12 (300)                 | 502               | 635         | 518        | -                             | -           | -          | 502                 | 635         | 518        | 965                              | 965         | 981        |
| 14 (350)                 | -                 | -           | -          | -                             | -           | -          | 762                 | 762         | 778        | -                                | -           | -          |
| 16 (400)                 | -                 | -           | -          | -                             | -           | -          | 838                 | 838         | 854        | -                                | -           | -          |
| 18 (450)                 | -                 | -           | -          | 914                           | -           | 930        | 914                 | 914         | 930        | -                                | -           | -          |
| 20 (500)                 | -                 | -           | -          | 991                           | -           | 1010       | 991                 | 991         | 1010       | -                                | -           | -          |
| 22 (550)                 | -                 | -           | -          | 1092                          | -           | 1114       | 1092                | 1092        | 1114       | -                                | -           | -          |
| 24 (600)                 | -                 | -           | -          | 1143                          | -           | 1165       | 1143                | 1143        | 1165       | -                                | -           | -          |
| 26 (650)                 | -                 | -           | -          | 1245                          | -           | 1270       | 1245                | 1245        | 1270       | -                                | -           | -          |
| 28 (700)                 | -                 | -           | -          | 1346                          | -           | 1372       | 1346                | 1346        | 1372       | -                                | -           | -          |
| 30 (750)                 | -                 | -           | -          | 1397                          | -           | 1422       | 1397                | 1397        | 1422       | -                                | -           | -          |
| 32 (800)                 | -                 | -           | -          | 1524                          | -           | 1553       | 1524                | 1524        | 1553       | -                                | -           | -          |
| 34 (850)                 | -                 | -           | -          | 1626                          | -           | 1654       | 1626                | 1626        | 1654       | -                                | -           | -          |
| 36 (900)                 | -                 | -           | -          | 1727                          | -           | 1756       | 1727                | 1727        | 1756       | -                                | -           | -          |
| <b>CLASS 400 (PN 64)</b> |                   |             |            |                               |             |            |                     |             |            |                                  |             |            |
| 2 ( 50)                  | -                 | -           | -          | 292                           | 292         | 295        | -                   | -           | -          | 330                              | -           | 333        |
| 2 1/2 ( 65)              | -                 | -           | -          | 330                           | 330         | 333        | -                   | -           | -          | 381                              | -           | 384        |
| 3 ( 80)                  | -                 | -           | -          | 356                           | 356         | 359        | -                   | -           | -          | 445                              | -           | 448        |
| 4 (100)                  | -                 | -           | -          | 406                           | 406         | 410        | -                   | -           | -          | 483                              | 559         | 486        |
| 6 (200)                  | -                 | -           | -          | 495                           | 495         | 498        | 495                 | 495         | 498        | 610                              | 711         | 613        |
| 8 (200)                  | -                 | -           | -          | 597                           | 597         | 600        | 597                 | 597         | 600        | 737                              | 845         | 740        |
| 10 (250)                 | -                 | -           | -          | 673                           | 673         | 676        | 673                 | 673         | 676        | 889                              | 889         | 892        |
| 12 (300)                 | -                 | -           | -          | 762                           | 762         | 765        | 762                 | 762         | 765        | 1016                             | 1016        | 1019       |
| 14 (350)                 | -                 | -           | -          | -                             | -           | -          | 826                 | 826         | 829        | -                                | -           | -          |
| 16 (400)                 | -                 | -           | -          | -                             | -           | -          | 902                 | 902         | 905        | -                                | -           | -          |
| 18 (450)                 | -                 | -           | -          | -                             | -           | -          | 978                 | 978         | 981        | -                                | -           | -          |
| 20 (500)                 | -                 | -           | -          | -                             | -           | -          | 1054                | 1054        | 1060       | -                                | -           | -          |
| 22 (550)                 | -                 | -           | -          | -                             | -           | -          | 1143                | 1143        | 1153       | -                                | -           | -          |
| 24 (600)                 | -                 | -           | -          | -                             | -           | -          | 1232                | 1232        | 1241       | -                                | -           | -          |
| 26 (650)                 | -                 | -           | -          | -                             | -           | -          | 1308                | 1308        | 1321       | -                                | -           | -          |
| 28 (700)                 | -                 | -           | -          | -                             | -           | -          | 1397                | 1397        | 1410       | -                                | -           | -          |
| 30 (750)                 | -                 | -           | -          | -                             | -           | -          | 1524                | 1524        | 1537       | -                                | -           | -          |
| 32 (800)                 | -                 | -           | -          | -                             | -           | -          | 1651                | 1651        | 1667       | -                                | -           | -          |
| 34 (850)                 | -                 | -           | -          | -                             | -           | -          | 1778                | 1778        | 1794       | -                                | -           | -          |
| 36 (900)                 | -                 | -           | -          | -                             | -           | -          | 1880                | 1880        | 1895       | -                                | -           | -          |

**Tolerance:** +/-2 mm. on sizes 10 in. (DN250) and smaller. +/-3 mm on sizes 12 in. (DN300) and larger.



# Plug Valve Dimensions According to API Std. 6D/ISO14313

Face to Face (A) and End to End dimensions in mm.

| NPS (DN)                   | Reduced (Regular) |             |            | Venturi     |             |            | Round-Port , Full Bore |             |            |
|----------------------------|-------------------|-------------|------------|-------------|-------------|------------|------------------------|-------------|------------|
|                            | Raised Face       | Welding End | Ring Joint | Raised Face | Welding End | Ring Joint | Raised Face            | Welding End | Ring Joint |
| 1<br>Inch/mm               | 2<br>A            | 3<br>B      | 4<br>C     | 5<br>A      | 6<br>B      | 7<br>C     | 8<br>A                 | 9<br>B      | 10<br>C    |
| <b>CLASS 600 (PN 100)</b>  |                   |             |            |             |             |            |                        |             |            |
| 2 ( 50)                    | 292               | 292         | 295        | -           | -           | -          | 330                    | -           | 333        |
| 2½ ( 65)                   | 330               | 330         | 333        | -           | -           | -          | 381                    | -           | 384        |
| 3 ( 80)                    | 356               | 356         | 359        | -           | -           | -          | 445                    | -           | 448        |
| 4 (100)                    | 432               | 432         | 435        | -           | -           | -          | 508                    | 559         | 511        |
| 6 (150)                    | 559               | 559         | 562        | 559         | 559         | 562        | 660                    | 711         | 664        |
| 8 (200)                    | 660               | 660         | 664        | 660         | 660         | 664        | 794                    | 845         | 797        |
| 10 (250)                   | 787               | 787         | 791        | 787         | 787         | 791        | 940                    | 1016        | 943        |
| 12 (300)                   | -                 | -           | -          | 838         | 838         | 841        | 1067                   | 1067        | 1070       |
| 14 (350)                   | -                 | -           | -          | 889         | 889         | 892        | -                      | -           | -          |
| 16 (400)                   | -                 | -           | -          | 991         | 991         | 994        | -                      | -           | -          |
| 18 (450)                   | -                 | -           | -          | 1092        | 1092        | 1095       | -                      | -           | -          |
| 20 (500)                   | -                 | -           | -          | 1194        | 1194        | 1200       | -                      | -           | -          |
| 22 (550)                   | -                 | -           | -          | 1295        | 1295        | 1305       | -                      | -           | -          |
| 24 (600)                   | -                 | -           | -          | 1397        | 1397        | 1407       | -                      | -           | -          |
| 26 (650)                   | -                 | -           | -          | 1448        | 1448        | 1461       | -                      | -           | -          |
| 30 (750)                   | -                 | -           | -          | 1651        | 1651        | 1664       | -                      | -           | -          |
| 32 (800)                   | -                 | -           | -          | 1778        | 1778        | 1794       | -                      | -           | -          |
| 34 (850)                   | -                 | -           | -          | 1930        | 1930        | 1946       | -                      | -           | -          |
| 36 (900)                   | -                 | -           | -          | 2083        | 2083        | 2099       | -                      | -           | -          |
| <b>CLASS 900 (PN 150)</b>  |                   |             |            |             |             |            |                        |             |            |
| 2 ( 50)                    | 368               | -           | 371        | -           | -           | -          | 381                    | -           | 384        |
| 2½ ( 65)                   | 419               | -           | 422        | -           | -           | -          | 432                    | -           | 435        |
| 3 ( 80)                    | 381               | 381         | 384        | -           | -           | -          | 470                    | -           | 473        |
| 4 (100)                    | 457               | 457         | 460        | -           | -           | -          | 559                    | -           | 562        |
| 6 (150)                    | 610               | 610         | 613        | 610         | 610         | 613        | 737                    | -           | 740        |
| 8 (200)                    | 737               | 737         | 740        | 737         | 737         | 740        | 813                    | -           | 816        |
| 10 (250)                   | 838               | 838         | 841        | 838         | 838         | 841        | 965                    | -           | 968        |
| 12 (300)                   | -                 | -           | -          | 965         | 965         | 968        | 1118                   | -           | 1121       |
| 16 (400)                   | -                 | -           | -          | 1130        | 1130        | 1140       | -                      | -           | -          |
| <b>CLASS 1500 (PN 250)</b> |                   |             |            |             |             |            |                        |             |            |
| 2 ( 50)                    | 368               | -           | 371        | -           | -           | -          | 391                    | -           | 394        |
| 2½ ( 65)                   | 419               | -           | 422        | -           | -           | -          | 454                    | -           | 457        |
| 3 ( 80)                    | 470               | 470         | 473        | -           | -           | -          | 524                    | -           | 527        |
| 4 (100)                    | 546               | 546         | 549        | -           | -           | -          | 625                    | -           | 629        |
| 6 (150)                    | 705               | 705         | 711        | 705         | 705         | 711        | 787                    | -           | 794        |
| 8 (200)                    | 832               | 832         | 841        | 832         | 832         | 841        | 889                    | -           | 899        |
| 10 (250)                   | 991               | 991         | 1000       | 991         | 991         | 1000       | 1067                   | -           | 1076       |
| 12 (300)                   | 1130              | 1130        | 1146       | 1130        | 1130        | 1146       | 1219                   | -           | 1235       |
| <b>CLASS 2500 (PN 420)</b> |                   |             |            |             |             |            |                        |             |            |
| 2 ( 50)                    | 451               | -           | 454        | -           | -           | -          | -                      | -           | -          |
| 2½ ( 65)                   | 508               | -           | 514        | -           | -           | -          | -                      | -           | -          |
| 3 ( 80)                    | 578               | -           | 584        | -           | -           | -          | -                      | -           | -          |
| 4 (100)                    | 673               | -           | 683        | -           | -           | -          | -                      | -           | -          |
| 6 (150)                    | 914               | -           | 927        | -           | -           | -          | -                      | -           | -          |
| 8 (200)                    | 1022              | -           | 1038       | -           | -           | -          | -                      | -           | -          |
| 10 (250)                   | 1270              | -           | 1292       | -           | -           | -          | -                      | -           | -          |
| 12 (300)                   | 1422              | -           | 1445       | -           | -           | -          | -                      | -           | -          |



## Application

### Pipeline Isolation

Line Isolation is the most important point when the valve must shut-off the line, in process where sensitive fluid is critical for environmental and process safety. Dual seal plug valve is suitable to guarantee «0» leakage in both ends, (inlet/outlet), therefore it is the ideal solution as an isolation valve.

### Flow Meter Calibration

One of the main applications of DBB expanding plug valve is for calibration of flow meter instrument on line, where «0» leakage allows the operator to set-up the instrument (flow-meter) without any risk of error in the measurement system of flow rate from wellheads through flow lines, gathering lines and high pressure transmission system in gas pipeline or in petrochemical plants or other processing.

### Manifolds

Another application of DBB expanding plug valve is in Refineries at the manifolds loop, where there are different products (e.g. gasoline-diesel-jet fuel) without any contamination or risk to mix them up. Two, three or four way valves can be supplied.

### Terminals-Oil Depots

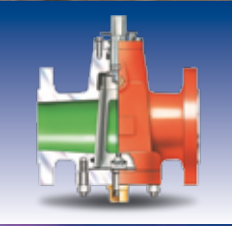
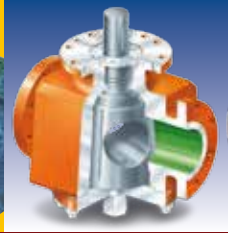
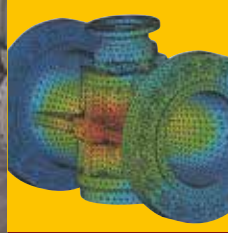
The application of DBB expanding plug valves for loading and unloading tankers, requires the guarantee of a positive shut-off of the valves in order to avoid any environmental damage due to spillage.

### Aviation Fuel Operation

Aviation fuel operation is commonly used in Airports. The DBB valves must guarantee a quickly close and reliable seal integrity. In case of emergency, the DBB valve can be dismantled very quickly and repaired by the replacement of the slips without any other adjustment, and put in operation very fast.

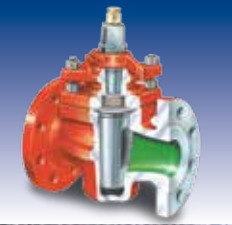
## Actuators





AdverTime-MI

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