# Edward
## Forged Steel Valves

*Experience In Motion*

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## Maintenance



## References to Related Brochures

| Brochure | Document Number |
|---|---|
| Forged Steel Valves | EVENCT0001 |
| Cast Steel Valves | EVENCT0002 |
| Nuclear Application Valves | EVENCT0004 |



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# Figure Number Index



*• These valves can be constructed for nuclear service.*

*Note: See "References to Related Brochures" chart in the Table of Contents to locate figures that do not appear in this brochure.*




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# Edward Valves Availability Chart

## Edward Forged Steel, Globe, Angle, and Check Valves

| Description | Pressure Rating[1,2] | Size[2] | Ends | Page |
|---|---|---|---|---|
| **Globe Stop Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 28 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 31 |
| | Series 1500 | ½(15) thru 2(50) | Threaded, Socket, Flanged | 36,37 |
| **Univalve Globe Stop Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 42,48,54 |
| **Hermavalve Globe Stop Valves** | ASME to 1690(290)* | ½(15) thru 2-½(65) | Socket, Buttwelding | 64-67 |
| **Blow Off Stop Valves** | ASME 300(50), 400(68) & 600(110) | 1-½(40) thru 2-½(65) | Socket, Flanged, Buttwelding | 22-25 |
| | ASME 1500(250) & 2500(420) | | Socket, Buttwelding | 26 |
| **Hydraulic Stop Valves** | 5,000 PSI CWP 10,000 PSI CWP | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 57 |
| **Globe Stop-Check Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 29 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 32 |
| | Series 1500 | ½(15) thru 2(50) | Threaded, Socket, Flanged | 38,39 |
| **Univalve Globe Stop-Check Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 43,49,55 |
| **Piston Check Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 30 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 33 |
| | Series 1500 | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 40 |
| **PressurCombo** | ASME 1690*, 2680* & 4500 | ½(15) thru 4(100) | Socket, Buttwelding | 59-62 |
| **Univalve Piston Check Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 44,50,56 |
| **Hydraulic Check Valves** | 5,000 PSI CWP & 10,000 PSI CWP | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 58 |
| **Ball Check Valves** | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 34 |
| | Series 1500 | | | 41 |
| **Strainers** | ASME 800(130) & Series 1500 | ¼(6) thru 2(50) | Threaded, Socket | 63 |
| **Flanged Univalve** | Class 1500(260) | ½(15) thru 2(50) | Flanged | 35 |
| **Univalve Angle Stop, Stop-Check and Check Valves** | ASME 1690(290) | ½(15) thru 4(50) | Socket, Buttwelding | 45-47 |
| | ASME 2680(460) | | | 51-53 |
| **Continuous Blowdown Valves** | ASME 1925 | 1(25) thru 4(100) | Socket, Buttwelding | 27 |
| **Nuclear Valves** | Thru ASME 2500(420)* | to Size 32(800) | Buttwelding | See Nuclear Catalog |

*Note: See "References to Related Brochures" chart in the Table of Contents to locate valves that do not appear in this brochure.*
*1. See 3.2 Pressure Ratings in the Technical Information section of this brochure for definition of various pressure ratings available.*
*2. Metric equivalent values for ratings and sizes are in parentheses.*
**These valves can be constructed and supplied for nuclear service.*



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# Edward Valves Availability Chart

**Edward Cast Steel Gate, Globe, Angle and Check Valves**

**See Edward Cast Steel Valve Catalog for detailed information (EVENCT0002)**

| Description | Pressure Rating[1,2] | Size[2] | Ends | Page |
|---|---|---|---|---|
| **Bolted Bonnet Globe and Angle Valves, Stop and Stop-Check (Non-Return) and Bolted Cover Piston Check** | ASME 300(50) | 2-½(65) thru 12(300) | Buttwelding or Flanged | 26, 28, 30 |
| | ASME 600(110)* | 2-½(65) thru 69(150) | | 35, 38, 41 |
| **Pressure Seal Bonnet Globe and Angle Valves Stop and Stop-Check (Non-Return)** | ASME 600(110)* | 8(200) thru 14(350) | Buttwelding or Flanged | 35, 38 |
| | ASME 900(150)* | 3(80) thru 24(600) | | 46, 47, 50, 51 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 59, 60, 63, 75, 79, 80, 81, 82 |
| **Pressure Seal Cover, Piston Check Valves** | ASME 600(110)* | 8(200) thru 14(350) | Buttwelding or Flanged | 42 |
| | ASME 900(150)* | 8(200) thru 24(600) | | 52 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 65, 66, 81, 82 |
| **Equiwedge® Gate Valves** | ASME 600(110)* & 900(150)* | 2-½(65) thru 32(800) | Buttwelding or Flanged | 37, 38, 48, 49 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 61, 62, 77, 78 |
| | ASME 3600 | 16(400) thru 24(600) | Buttwelding | 88, 89 |
| **Flite-Flow® Globe Valves, Stop and Stop-Check (Non-Return)** | ASME 300(50) | 3(80) thru 16(400) | Buttwelding or Flanged | 27, 29 |
| | ASME 400(68) | 3(80) thru 4(100) | | 32, 33 |
| | ASME 600(110)* | 3(80) thru 32(800) | | 36, 40 |
| | ASME 700(120) | 6(150) thru 32(800) | | 43, 44 |
| | ASME 900(150)* | 6(150) thru 16(400) | | 47, 51 |
| | ASME 1100(190) | 3(80) thru 4(100) | | 55, 56 |
| | ASME 1500(260)* & 2500(420) | 3(80) thru 24(600) | | 60, 64, 76, 80 |
| | ASME 1800(310) & 2900 (490) | 3(80) thru 4(100) | | 69, 70, 84, 85 |
| | ASME 2000(340) | 12(300) thru 14(350) | Buttwelding | 72, 73 |
| | ASME 3600 | 16(400) thru 24(600) | | 87, 90 |
| | Series 4500 | 4(100) thru 10(250) | Buttwelding or Flanged | 92, 93 |
| **Flite-Flow® Piston Check Valves** | ASME 300(50) | 2-½(65) thru 16(400) | Buttwelding or Flanged | 31 |
| | ASME 400(68) | 3(80) thru 4(100) | | 34 |
| | ASME 600(110)* | 3(80) thru 32(800) | | 42 |
| | ASME 700(120) | 3(80) thru 4(100) | | 45 |
| | ASME 900(150)* | 3(80) thru 16(400) | | 54 |
| | ASME 1100(190) | 3(80) thru 4(100) | | 57 |
| | ASME 1500(260)* & 2500(420) | 3(80) thru 24(600) | | 67, 82 |
| | ASME 1800(310) & 2900 (490) | 3(80) thru 4(100) | | 71, 86 |
| | ASME 2000(340) | 12(300) thru 14(350) | | 74 |
| | ASME 3600 | 16(400) thru 24(600 | Buttwelding | 91 |
| | Series 4500 | 4(100) thru 10(250) | Buttwelding or Flanged | 94 |
| **Tilting Disk Check Valves** | ASME 600(110)* | 6(150) thru 20(500) | Buttwelding | 42 |
| | ASME 900(150)*, 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 53, 68, 83 |
| | Class 4500(760) | 6(150) & 8(200) | | 95 |
| **Nuclear Valves** | Thru ASME 2500(420)* | to Size 32(800) | Buttwelding | See Nuclear Catalog |
| **Special Application Valves** | Thru ASME 2500(420) | to Size 18(450) | As Required | 58 |

*Note: "References to Related Brochures" chart in the Table of Contents to locate valves that do not appear in this brochure.*
**These valves can be constructed and supplied for nuclear service.*
*1. See 3.2 Pressure Ratings in the Technical Information section of this brochure for definition of various pressure ratings available.*
*2. Metric equivalent values for ratings and sizes are in parentheses.*

# Edward Description of Figure Number System

## Special Material Suffixes

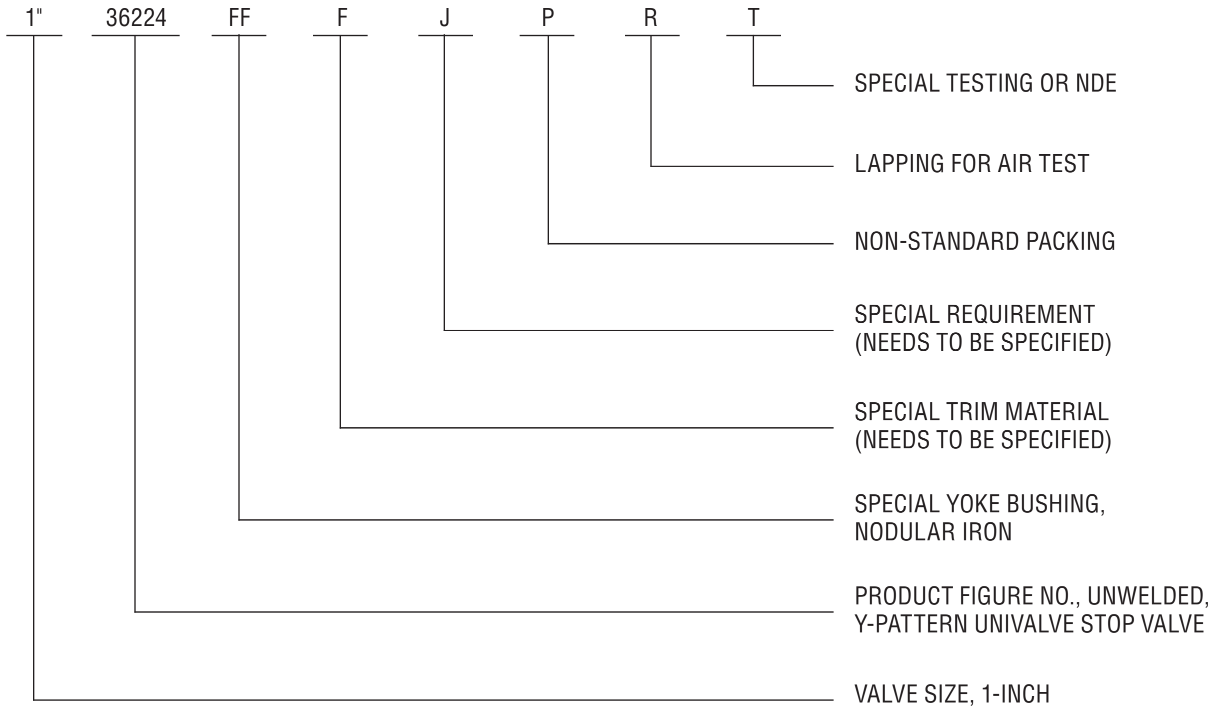
| | |
|---|---|
| **CF8C** | Cast 18-8 stainless steel (type 347) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **CF3M** | Cast 18-8 stainless steel (type 316L) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **CF8M** | Cast 18-8 stainless steel (type 316) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **C5** | Cast chromium molybdenum (5 chromium ½ molybdenum) Grade C5 alloy steel body and bonnet. Trim of equal or higher grad alloy steel. |
| **F11** | Body and bonnet of forged chromium molybdenum (1-¼ chromium, ½ molybdenum) Grade F11 alloy steel. |
| **F22** | Body and bonnet of forged chromium molybdenum (2-¼ chromium, 1 molybdenum) Grade F22 alloy steel. |
| **F91** | Body and bonnet of forged chromium molybdenum (9 chromium, 1 molybdenum) Grade F91 alloy steel. |
| **F316** | Body and bonnet of forged Type 316 stainless steel. |
| **F316L** | Body and bonnet of forged Type 316L stainless steel. |
| **F347** | Body and bonnet of forged Type 347 stainless steel. |
| **F347H** | Body and bonnet of forged Type 347H stainless steel. |
| **LF2** | Forged carbon steel material on which Charpy impact tests have been performed on forging heat to determine low temperature properties. |
| **WC1** | Cast carbon molybdenum Grade WC1 body and bonnet. |
| **WC6** | Cast chromium molybdenum (1-¼ chromium, ½ molybdenum) Grade WC6 alloy steel body and bonnet. |
| **WC9** | Cast chromium molybdenum (2-¼ chromium, 1 molybdenum) Grade WC9 alloy steel body and bonnet. |
| **WCB** | Cast carbon steel Grade WCB body and bonnet. |
| **WCC** | Cast carbon steel Grade WCC body and bonnet. |
| **C12A** | Cast chromium molybdenum (9 chromium, 1 molybdenum) alloy steel body and bonnet. |

## Special Feature Suffixes

| | |
|---|---|
| **A** | Special body only — body pattern alterations not required. Flanges on forged valves not normally supplied with flanges. On socket end forged steel valves the inlet and outlet ends are different. |
| **B** | Venturi pattern body. |
| **C** | Locking devices consisting of padlock and chain. |
| **CD** | Locking devices, indicator type. |
| **DD** | Equalizer external. |
| **DDI** | Equalizer internal. |
| **E** | Permanent drain, hole in disk or groove in disk face. |
| **F** | Special trim material: used to designate special disk material, special stem material, or inconel spring in check valves. |
| **FF** | Special yoke bushing material, such as Austenitic Nodular Iron. |
| **G** | Bypasses on all types of cast steel valves |
| **H** | Spur gear operation. |
| **HH** | Bevel gear operation. |
| **HHL** | Valveless bevel gear actuator but with actuator mounting equipment. |
| **J** | Any unclassified special. |
| **K** | Throttle disk or skirted disk. |
| **L** | Impactor operated. Used now only to indicate impactor handwheel or handle on valves not regularly furnished with impactor. |
| **LD** | Impactorgear or Impactodrive. |
| **M** | Motor actuated. |
| **ML** | Valve less actuator but with motor actuator mounting equipment. |
| **MM** | Cylinder/diaphragm actuated. Either hydraulic or pneumatic. |
| **MML** | Valve less cylinder/diaphragm actuator but with actuator mounting equipment. |
| **N** | Body drilled and tapped or socketed for drains, with or without nipple, with or without drain valves. |
| **P** | Non-standard packing of all types. |
| **PL** | Plastic lined. |
| **Q** | Non-standard bonnet gaskets or gasket plating. |
| **R** | Special lapping and honing and gas testing (recommended for valves on high pressure gas service). |
| **S** | Smooth finish on contact faces of end flanges |
| **T** | Critical service requiring special testing and/or NDE. |
| **UF** | Unfinished ends |
| **W** | Stellited seat and disk. Suffix not used for valves that are cataloged as having stellited seat and disk as standard. |
| **X** | Ring joint facing on body end flanges. |
| **Y** | All welding ends either socket or butt. Suffix not used for valves where figure number designates welding ends as standard, such as Fig. 36224 and 66228 for example. |
| **T1** | ASME Section III Class 1 compliance. |
| **T2** | ASME Section III Class 2 compliance. |
| **T3** | ASME Section III Class 3 compliance. |
| **T4** | ASME Section III compliance without “N” stamp. |
| **T5** | Nuclear safety related-10CFR21 invoked. |

# Edward Description of Figure Number System

## Example




**XX**
1 Alpha Digit Prefix Indicates Design Revision if Applicable.

2 Alpha Digits Indicates Style of Pressure Combo Valve.

**XXXXX**
3-5 Digits Figure Number

**(XXX)**
3-4 Digits Body Material Designation

**XXXXXXX**
1 or more Digits As Required Suffixes (See List)

*Unless otherwise specified when ordering Edward valves, the standard material of construction for Forged products is A105 Carbon Steel, and for Cast products is A216 Grade WCB Carbon Steel.*

See the Edward Description of Figure Number System on page 8 for the letter suffixes used to indicate variations from standard construction, or special features (Ex. 618K, 7506 [WC6]Y, and 847 AH.)

When two or more suffixes follow a figure number a definite suffix sequence is to be used.

The sequence is:

1) Special material (if applicable)

2) All other applicable feature suffixes in alphabetical order. Except T1-T5 which are listed last.

# High Performance for Critical Service

Temperatures that can exceed 1000°F. Pressures surpassing 10,000 psi. In critical service conditions, you can't take chances. You don't just meet standards, you exceed them. That's how Flowserve Edward forged and cast steel valves have become the specified choice for power plants, process facilities, and other high-temperature, high-pressure services.

### Conservative Design

Flowserve Edward Valves takes a conservative approach to valve design. We meet all applicable codes and standards, but we go beyond that...with finite element stress analysis of critical areas and rigorous proof testing. Edward valves are built to take punishment!

And our extensive testing has also allowed us to develop extremely high flow efficiencies in all our valves.

You'll find other unique design advantages on our various product lines, such as our Equiwedge gate valves, with a two-piece wedge gate assembly that adjusts automatically to any angular distortion of the body seats. And many other design features, now considered industry "standards," started on the drawing boards at Flowserve.

### Precision Manufacturing

Edward Valves also exceeds industry standards on the factory floor. Our forged valves are produced on a fully automated line, with CNC machining centers providing precise process control. And we maximize cast steel quality by producing our valve body castings using a directional solidification process from patterns designed by our own technicians. This process assures high strength void free castings for uncompromised quality.

Even with the most advanced equipment, we feel our people make the real difference at Flowserve. Our production personnel have an average 20 years in the industry, and 15 years with Flowserve! This exceptional experience level allows us to achieve an extra degree of precision that can make a very real difference in the field.

Finally, it's our people, along with our procedures for quality assurance and lot-traceability, that have earned Flowserve Edward Valves the ASME N stamp, certifying our Raleigh, North Carolina manufacturing facility for nuclear-service valve production.

### Lower Total Costs

Those tough standards have carried over into every valve we manufacture. Whether it is for nuclear service or not, we design and build our valves to last at least 40 years. That means not only are they tough, but they are designed with easy maintenance in mind.

Considering the cost of valve failure, Flowserve Edward Valves quality is clearly worth specifying. That's been true since 1904, when the first Edward valve was made.

Today, as industrial companies become increasingly aware that operating expenses are part of total cost, the choice becomes both more clear and more critical than ever.

## *Designed With an Eye on Your Bottom Line*

In-house computer-aided design and finite-element method capabilities give our engineering staff powerful tools to develop reliable valves for critical service applications. CAD generated graphic models undergo FEM analysis to determine that stresses are within acceptable limits. Dynamic simulation of valve operation also helps assure reliability of Edward valve performance.

Prototyping is just as important, and rigorous proof testing is a mainstay of Edward valve design. Before we approve a valve for production, we put it through hundreds, even thousands, of cycles to demonstrate that performance and sealing integrity will be maintained in service. Transducers relay data from test assemblies to computers for further analysis.

Laboratory simulation of critical services includes a steam generator and superheater, designed for 2700 psi and 1050°F. This flexible system allows testing of prototype valves under both low pressure and high pressure conditions. In addition to prototype testing, this system has been used for applications such as: friction and wear tests of valve trim materials in hot water and steam environments; qualification tests of new or redesigned valves; and proof testing of new valve gaskets and valve stem packings.

Before we make the first production unit, that valve has already been through a rigorous program to assure long life, simple maintenance, and dependable performance for the lowest cost over the life of the valve. Again, people play important roles in design. The Flowserve product engineering department pools well over 200 years of valve experience.

## Testing Beyond Code Requirements

At Flowserve Edward Valves, quality assurance starts with meeting code requirements. Valves are manufactured to ANSI B16.34 (Standard, Limited and Special Classes), including standards for:

- Minimum wall thickness of valve body.
- Body, bonnet and body-bonnet bolting to specified ASTM material standards.
- Hydrostatic shell testing at 1.5 times the 100°F rating of the valve.

From there, Flowserve Edward Valves goes on to exceed the code, with higher test standards and an additional battery of tests performed on every type of valve we make, using in-house test facilities and personnel to assure expert quality control. Edward Valves' quality assurance program includes:

### Non-Destructive Examination

- All NDE personnel are qualified in accordance with ASNT-TC-1A guidelines.
- All castings are visually examined per MSS SP-55.
- The first five body castings from every pattern are 100% radiographed to verify casting quality.

### Hydrostatic Testing

- The seat-leakage criteria — no visible leakage for forged steel and 2ml/hour/inch of nominal valve size for cast steel — are stricter than the allowed leakage rate of MSS SP-61, which is 10ml/hour/inch of nominal valve size.
- Seat-leakage test is performed at 110% of 100°F rating.

### Statistical Process Control

Requirements are clearly stated and measurements are taken to determine conformance to those requirements. "Quality" equals conformance to requirements.

### Welding

All personnel and procedures are qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX.

### Additional Standard Tests for Specific Valves

Includes heavy-wall examination on large body castings.

We have only listed a few of the Flowserve Edward Valves standard tests that exceed industry requirements. Also, Edward Valves has the facilities and the expertise to meet additional quality-assurance standards, as required for the application.



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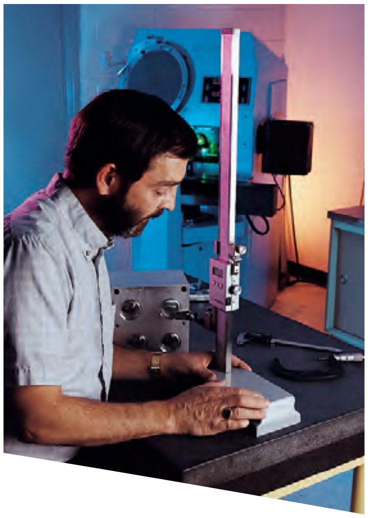


# A History of Firsts

| Feature | Benefit |
|---|---|
| Body-guided disks on globe and angle valves | Minimize wear and ensure alignment for tight sealing. |
| Integral Stellite hardfaced seats in globe and angle valves | Permit compact design and resist erosion. |
| Hermetically sealed globe valves with seal-welded diaphragms | Prevent stem leakage in critical nuclear plant applications. |
| Equalizers for large check and stop-check valves | Ensure full lift at moderate flow rates, and prevent damage due to instability. |
| Compact pressure-seal bonnet joints | Eliminate massive bolted flanges on large, high-pressure valves. |
| Qualified stored-energy actuators | Allow quick-closing valves in safety-related nuclear plant applications. |
| Qualified valve-actuator combinations | Used in main steam and feed-water service throughout the world. |
| Stainless steel spacer rings on gate valves, fitted between wedge halves | Simplify service. Damaged valve seats can be restored to factory fit by in-line replacement with slightly thicker ring. |
| Unique two-piece, flexible wedges on gate valves | Automatically adjust to any angular distortion of body seats. Shape provides greater flexibility. Assure dependable sealing and prevent sticking. |
| Impactor handwheels and handles | Allow workers to generate several thousand foot-pounds of torque, thus ensuring tight shutoff of manually operated globe and angle valves. |
| Inclined-bonnet globe valves with streamlined flow passages | Minimize pressure drop due to flow. |
| Globe valves available with both vertical and inclined stems | Provide stem designs suited to any installation. |
| Live-loaded pressure energized PressurSeat® for globe valves | Globe valve design for high pressure drain and vent service. |

# Miscellaneous Technical Data

## Edward Technical Articles

| Number | Title |
|---|---|
| EVAWP3000 | A Hermetically Sealed Valve for Nuclear Power Plant Service |
| EVAWP3001 | Development of the Edward Equiwedge Gate Valve |
| EVAWP3003 | Nuclear Containment of Postulated Feedwater Linebreak |
| EVAWP3004 | Quick-Closing Isolation Valves – The Equiwedge Alternative |
| EVAWP3005 | Valve Clamp Ring Stress Analysis |
| EVAWP3006 | Univalve Evolution – Another Advance |
| EVAWP3007 | The Type A Stored Energy Actuator – Development and Qualification |
| EVAWP3008 | Model for Check Valve/Feedwater System Waterhammer Analysis |
| EVAWP3009 | Minimizing Use of Cobalt and Strategic Materials in Valves |
| EVAWP3010 | Asbestos-Free Stem Packing for High Temperature Valves |
| EVAWP3011 | Quick-Closing Equiwedge Isolation Valves Global Qualification |
| EVAWP3012 | Avoiding Aluminum Nitride Embrittlement in Steel Castings for Valve Components |
| EVAWP3013 | Quick Closing Equiwedge Isolation Valves Global Qualification |
| EVAWP3014 | Tests of Asbestos-Free Stem Packings for Valves for Elevated Temperature Service |
| EVAWP3015 | Design Basis Qualification of Equiwedge Gate Valves for Safety-Related MOV Applications |
| EVAWP3016 | Flow Performance, Stability and Sealability of Piston Lift and Tilting Disk Check Valves |
| EVAWP3017 | Edward Cast Steel, Pressure-Seal Valves: Research and Development |
| EVAWP3018 | Pressure Locking and Overpressurization of Double Seated Valves |
| EVAWP3019 | Check and Stop-Check Valves for High Turndown Applications |
| EVAWP3020 | PressurCombo |
| EVAWP3021 | Hermavalve-A Zero Emissions Valve |

*Copies of the above Technical Articles are available upon request, or at www.flowserve.com.*

## Sources for Additional Information

For further guidance on selection, shipping and storage, installation, operation, and maintenance of valves, readers are referred to the following documents:

MSS Valve User Guide
MSS SP-92

Available from:

Manufacturers Standardization Society of
the Valve and Fittings Industry, Inc.
127 Park Street N.E.
Vienna, Virginia 22180

Aging and Service Wear of Check Valves
Used in Engineering Safety-Feature
Systems of Nuclear PowerPlants

Nureg/CR-4302

Ornl-6193/V1

Operating Experience and Failure Identification

Available from:

Superintendent of Documents
U.S. Government Printing Office
P.O. Box 37082
Washington, D.C. 20013-7982

And from:

National Technical Information Service
Springfield, Virginia 22161
EPRI Report No. NP 5479

Application Guidelines for Check Valves
in Nuclear Power Plants

Available from:

Electric Power Research Institute
Research Reports Center
P.O. Box 50490
Palo Alto, CA 94303

# Special Application Valves

## NACE VALVES

(NATIONAL ASSOCIATION OF CORROSION ENGINEERS)
Flowserve Edward Valves can provide valves constructed of materials that meet NACE standards MR-01-75 and MR-01-03 for sour service.

This standard entitled "Sulfide Stress Cracking Resistant Metallic Materials For Oil Field Equipment" covers material requirements for production, drilling, gathering and flow line equipment used in hydrogen sulfide bearing hydrocarbon service.

## SPECIAL TRIM

Flowserve Edward Valves provides a standard valve trim that is compatible with the valve body chemistry, pressure class, operating temperature, and fluid. However, on application special trim materials to meet specific customer needs can be provided. Edward also can provide cobalt-free trim for nuclear applications.

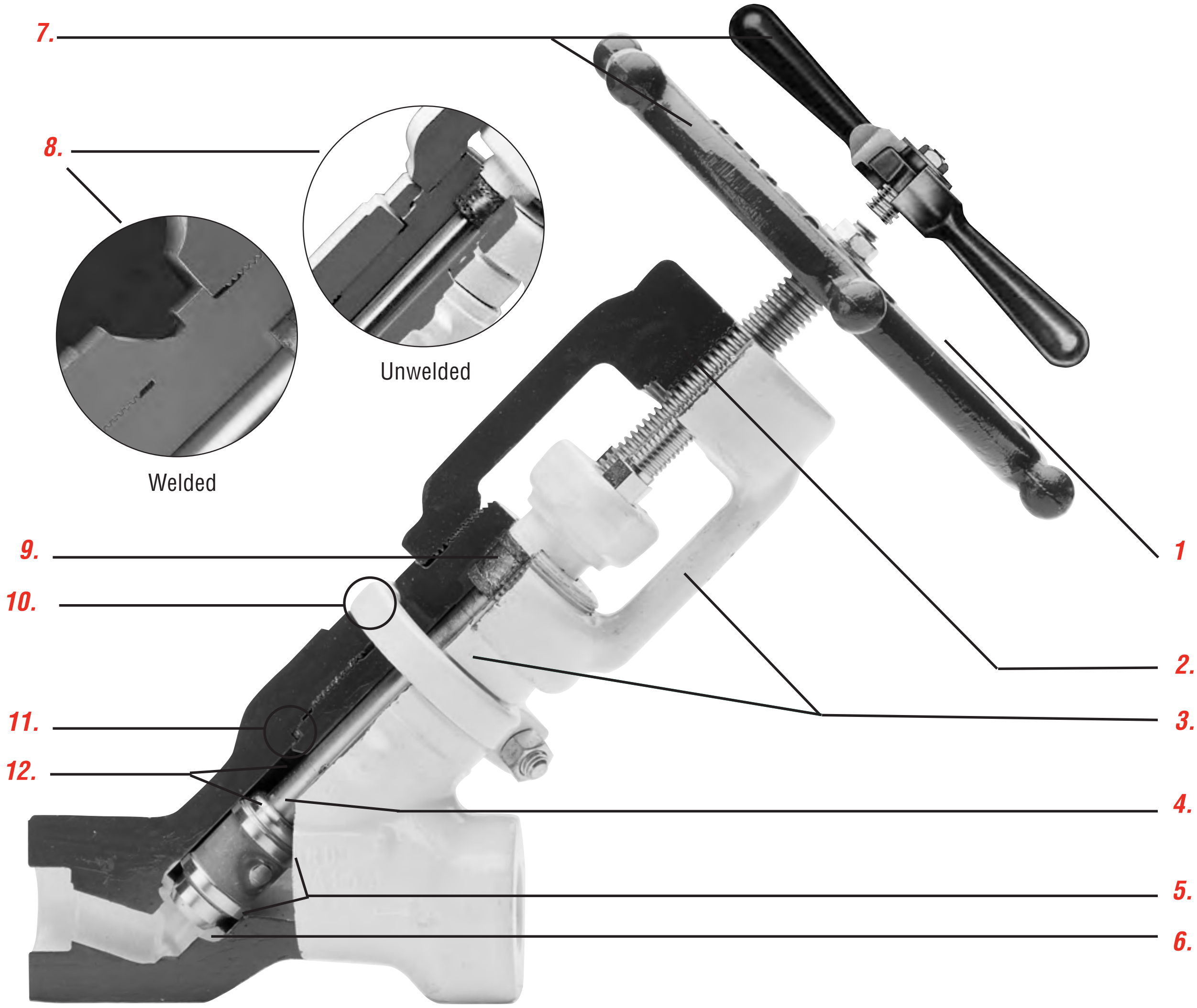
- Cobalt Based Alloy 6
- Cobalt Based Alloy 21
- Iron Based Alloy
- Nickel Based Alloy
- Austenitic stainless steel
- Martensitic stainless steel
- Precipitation hardened stainless steel
- Super alloy steel

## NON-STANDARD ENDS

Most Edward forged and cast steel valves can be provided with welding ends or flanged ends (small forged valves with threaded or socket weld ends also). On special order non-standard ends can be furnished to meet specific customer requirements. A partial list of available options include:

- GRAYLOC® hubs.
- Special flange facings.
- Non-standard end-to-end lengths — most Edward valves are manufactured to ANSI B16.10 criteria; however, non-standard ends are available as a special order.
- Venturi ends.
- Flanged by buttweld.
- Blank ends.
- Others as required.

# Features and Description of Edward Univalve® Globe Valves




**1. Stem** has ACME threads, is ground to a fine finish and is hardened to resist wear.

**2. Yoke bushing** material has low coefficient of friction which substantially reduces torque and stem wear and eliminates galling. Mechanical upset locks yoke bushing to yoke.

**3. Yoke-bonnet assembly** is two piece to facilitate disassembly for faster in-line internal repairs.

**4. Inclined stem** construction and optimum flow shape minimizes flow direction changes and reduces pressure drop.

**5. Body-guided disk** utilizes anti-thrust rings to eliminate misalignment, galling and stem bending.

**6. Integral hardsurfaced seat** provides positive shutoff and long seat life.

**7. Handwheel** on smaller size valves is rugged and knobbed to provide sure grip even when wearing gloves. Impactor handle or handwheel on larger, higher pressure valves provides many times the closing force of an ordinary handwheel for positive seating.

**8. Threaded bonnet** has ACME threads for resistance to galling and ease of disassembly. Unwelded models utilize a graphitic gasket for dependable sealing. Welded models employ a fillet weld (canopy weld on stainless steel valves) for absolute protection from body-bonnet leakage.

**9. Stem packing system** utilizes flexible graphite packing material with carbon fiber anti-extrusion rings for optimum sealability and life.

**10. Bonnet locking collar** (unwelded valves only)

**11. Bonnet seal ring** is die formed flexible graphite gasket seated to a prescribed bonnet torque to provide reliable bonnet seal.

**12. Integral backseat** provides a secondary stem seal back up for positive shutoff and leak protection.



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# *Part Specification List for Edward Univalve®*

This is not a complete list. Construction and materials will vary between sizes and pressure classes and may be changed without notice. For a complete, accurate, and itemized description of a particular valve, contact your Flowserve Edward Valves sales representative.

| Description | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. |
|---|---|---|---|---|---|
| **Body** | A-105<br>— | A-182<br>Grade F-22 | A-182<br>Grade F-316/F-347* | A-182<br>Grade F91 | A-182<br>Grade F92 |
| **Bonnet** | A-105 | A-739<br>Grade B-22 | A-479<br>T-316/347 | A-182<br>Grade F91 | A-182<br>Grade F92 |
| **Stem** | A-479<br>T-410CL3 | A-479<br>T-410CL3 | A-638<br>Grade 660 | A-638<br>Grade 660 | A-638<br>Grade 660 |
| **Disk** | A-732<br>Grade 21 | A-732<br>Grade 21 | A-732<br>Grade 21 | A-732<br>Grade 21 | A-732<br>Grade 21 |
| **Body Seat** | Stellite 21 | Stellite 21 | Stellite 21 | Stellite 21 | Stellite 21 |
| **Junk Ring** | — | — | A-732<br>Grade 21 | — | — |
| **Packing Rings** | Flexible Graphite System | Flexible Graphite System | Flexible Graphite System | Flexible Graphite System | Flexible Graphite System |
| **Gland** | A-668<br>Grade 4140 | A-668<br>Grade 4140 | A-182<br>Grade F6a | A-668<br>Grade 4140 | A-668<br>Grade 4140 |
| **Gland Adjusting Screw** | A-582<br>T-416 | A-582<br>T-416 | A-582<br>T-416 | A-582<br>T-416 | A-582<br>T-416 |
| **Yoke** | A-181<br>Class 70 | A-181<br>Class 70 | A-181<br>Class 70 | A-181<br>Class 70 | A-181<br>Class 70 |
| **Yoke Bushing** | B150 Alloy C61900 or C62300 | B150 Alloy C61900 or C62300 | B150 Alloy C61900 or C62300 | B150 Alloy C61900 or C62300 | B150 Alloy C61900 or C62300 |
| **Yoke Bolt** | A-307<br>Grade A | A-307<br>Grade A | A-307<br>Grade A | A-307<br>Grade A | A-307<br>Grade A |
| **Yoke Nut** | A-563 Grade A | A-563 Grade A | A-563 Grade A | A-563 Grade A | A-563 Grade A |
| **Handwheel/ Impactor Handle Adapter** | Malleable or Ductile Iron | Malleable or Ductile Iron | Malleable or Ductile Iron | Malleable or Ductile Iron | Malleable or Ductile Iron |
| **Stem Nut/Washer** | Mild Steel Plated | Mild Steel Plated | Mild Steel Plated | Mild Steel Plated | Mild Steel Plated |
| **Bonnet Seal Ring**** | Flexible Graphite | Flexible Graphite | Flexible Graphite | Flexible Graphite | Flexible Graphite |
| **Bonnet Insert†** | A-582<br>T-416 | A-582<br>T-416 | A-479<br>T-316 | A-582<br>T-416 | A-582<br>T-416 |
| **Locking Collar†††** | Carbon Steel | Carbon Steel | Carbon Steel | Carbon Steel | Carbon Steel |
| **Spring††** | A-313<br>T-302 | A-313<br>T-302 | A-313<br>T-302 | INCONEL<br>X-750 | INCONEL<br>X-750 |

*Parts shown above are not applicable to all Univalve® valves. * Other Stainless grades available on application. ** Used in unwelded and Class 4500 welded design only. † Class 4500 welded design only. †† Check valves only. ††† Unwelded valves only.*



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# Edward Forged Steel Valves Feature Body-Guided Disks

## Body Guided Disks Prevent Side-Thrust and Eliminate — 1. Stem galling & binding 2. Disk-seat misalignment and damage 3. High operating torque

Valve disks are guided by rings that fit snugly within the body bore and ensure perfect disk-and-seat alignment despite the side thrust of modern high velocities and high pressure-differentials. This protects the stem and its contact points; eliminates galling, scoring, bending and the high operating torque resulting from these abuses. Because they eliminate disk wobble and ensure alignment of disk with seat, they also provide more dependable closing and longer disk, seat and body life.

**Double Duty for Lower Bearing -** The lower ring not only serves as a highly efficient anti-side thrust bearing but serves too, as a "flow director." Its snug fit within the bonnet bore reduces by 90% the amount of flow that can get into the bonnet cavity and exert thrust forces against the side of the disk. In short, the anti-thrust ring design diverts 90% of the line forces into controllable channels.

**Machining is Important, Too -** To ensure concentric alignment essential to tight seating, the body bore and the stellite seat are both machined in a single operation. The disk's anti-thrust rings and conical stellite seat face are also faced in a single operation.

**Streamlined Flow Passages for Highest $C_V$ Values -** The inclined bonnet globe stop valves (and check and stop-check valves) continue the Flowserve reputation for the ultimate in flow passage streamlining. Inclined bonnet construction minimizes flow directional changes and minimizes wear caused by excessive turbulence.

Whether it's pounds per hour of steam or gallons per minute of liquid, the inclined bonnet valves give you better flow capacity.

**Flow Under or Over Disk -** Normal practice is to install globe valves with flow entering from below the disk. However, piping designers may confidently install Edward globe stop valves with flow entering over the disk when space problems or other considerations suggest this procedure. Our valves operate equally well with flow in either direction; however, with flow over the disk, packing is under pressure when the valve is closed and there is a slight penality in $C_V$ value.

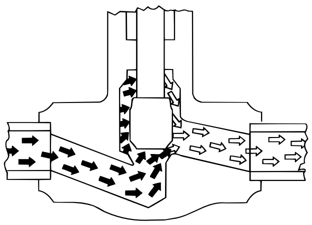

**Figure 1**
Ordinary Vertical Stem Globe Valves are subject to side-thrust under high pressure drop conditions. Illustration shows how upstream pressure can slip past stem-guided disk and impart a thrust toward the downstream side of the valve. Tests have proven that this thrust causes disk-seat misalignment plus galling and scoring.

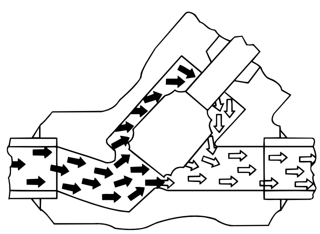

**Figure 2**
Inclined Stem Globe Valves of the stem-guided type are also subject to side-thrust under the same conditions. This illustration shows path pressure through the valve.

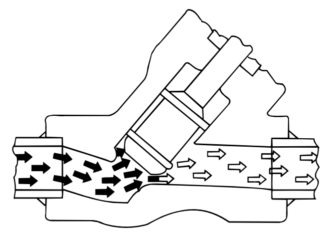

**Figure 3**
This illustration shows the Edward body-guided disk with anti-thrust rings. Lower guide eliminates 90% of the flow upward and behind the disk. Both guide rings maintain perfect alignment. This effectively eliminates all side-thrust problems.

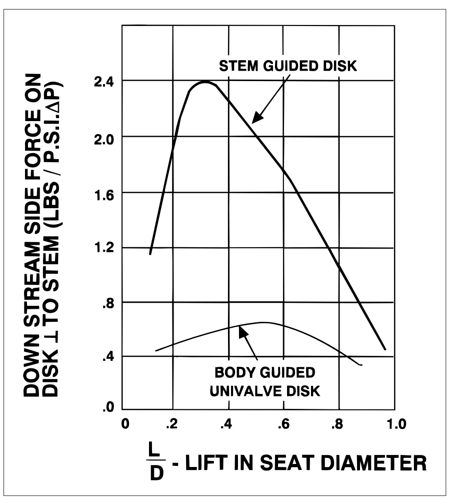


**Figure 4**
Graph illustrates relationship of side-thrust in conventional stem-guided Globe Valve and in Edward Univalve with body-guided disk.

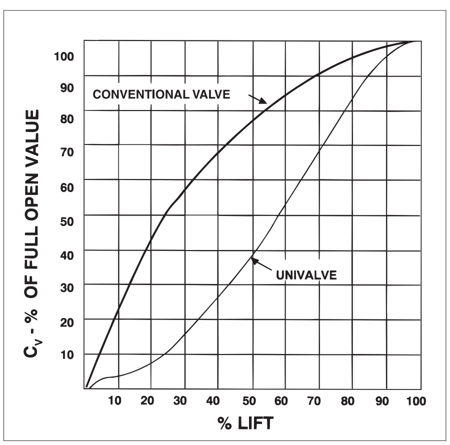


**Figure 5**
Graph illustrates typical throttling curves for conventional stem-guided Globe Valve and Univalve. Note, the Univalve Curve illustrates that finest control is obtained at low lifts, when it is needed. Contrast this with conventional valve curve which shows rapid flow increase as disk lifts off seat.



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# Here's How the Unique Stem-Disk Assembly is Made...

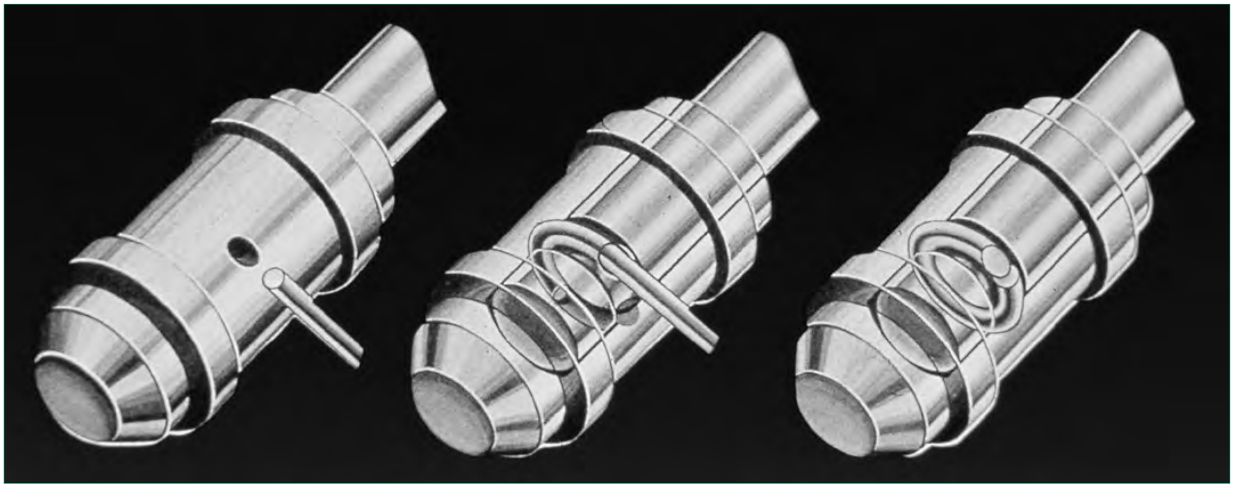

**Figure 1**
First, a Stellite wire is inserted into a hole in a Univalve body guided disk.

**Figure 2**
Next, the Stellite wire is fed around circular grooves, adjacent to one another, on the inside bore of the disk and outside diameter of the stem.

**Figure 3**
Finally the hole through which the wire was fed is welded closed.



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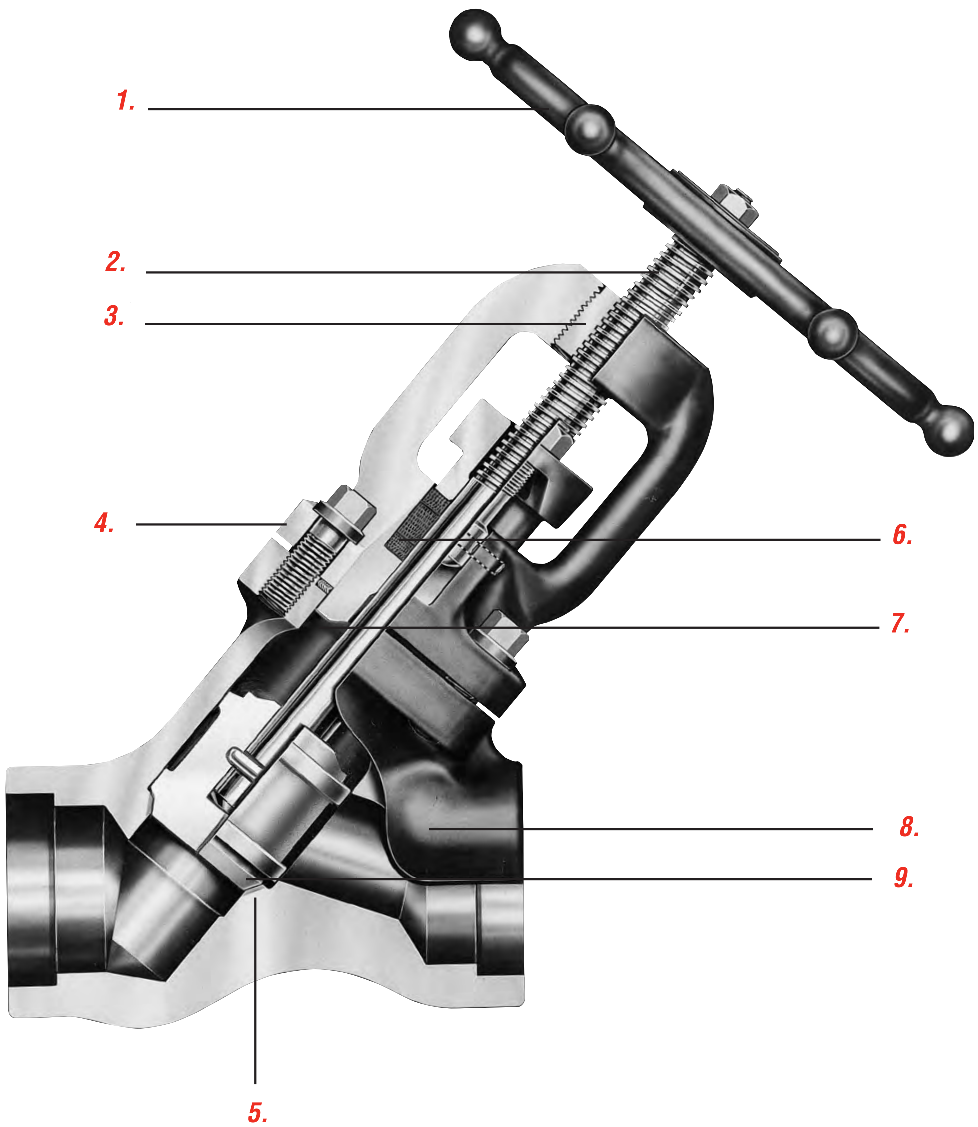
# Features and Description of Edward Bolted Bonnet Globe Valves




1. **Handwheel** is rugged and knobbed to provide sure grip even when wearing gloves.
2. **Stem** has ACME threads, is ground to a fine finish and is hardened to resist wear.
3. **Yoke bushing material** has low coefficient of friction which substantially reduces torque and stem wear and eliminates galling. Mechanical upset locks yoke bushing to yoke.
4. **Bolted Bonnet joint** utilizes a spiral wound gasket for positive sealing and four-bolt design for ease of assembly. Bonnet has pilot extension to ensure proper alignment and positive metal to metal stop to prevent over-compression of gasket.
5. **Integral hardsurfaced seat** provides positive shutoff and long seat life.
6. **Stem packing system** utilizes flexible graphite packing material with anti-extrusion rings for optimum sealability and life.
7. **Integral backseat** provides a secondary stem seal backup for positive shutoff and leak protection.
8. **Body** utilizes optimized flow passages to minimize flow direction changes and reduce pressure drop.
9. **Body-guided disk** utilizes anti-thrust rings to eliminate misalignment, galling and stem bending.

# Part Specification List for Edward Bolted Bonnet Globe Valves

This is not a complete list. Construction and materials will vary between sizes and pressure classes and may be changed without notice. For a complete, accurate, and itemized description of a particular valve, contact your Edward Valves sales representative.

| Description | Bolted Bonnet | |
|---|---|---|
| | ASTM No. | ASTM No. |
| Body/Bonnet | A-105<br>— | A-182<br>Grade F11 |
| Disk | AISI 615<br>Stainless Steel | AISI 615<br>Stainless Steel |
| Body Seat | Stellite 21 | Stellite 21 |
| Stem | A-582<br>T-416 | A-582<br>T-416 |
| Cap Screws | A-193<br>Grade B-7 | A-193<br>Grade B-7 |
| Gasket | Spiral Wound<br>Non Asbestos | Spiral Wound<br>Non-Asbestos |
| Packing | Flexible Graphite System | Flexible Graphite System |
| Gland | A-536<br>GR. 80-55-06 | A-536<br>GR. 80-55-06 |
| Yoke Bushing | B-150 C61900 or C62300 | B-150 C61900 or C62300 |
| Handwheel/Handle | Malleable or<br>Ductile Iron | Malleable or<br>Ductile Iron |
| Stem Nut | Mild Steel-Plated | Mild Steel-Plated |
| Eye Bolt | A-582<br>T-416 | A-582<br>T-416 |
| Eye Bolt Nut | A-563<br>Grade A | A-563<br>Grade A |
| Eye Bolt Pin | AISI<br>Grade 4140 | AISI<br>Grade 4140 |
| Spring** | A-313<br>T302 | A-313<br>T302 |
| Ball** | A-276<br>T440 C | A-276<br>T440 C |

***Check valves only*

*NOTES: Parts shown above are not applicable to all Bolted Bonnet valves. Consult your Flowserve sales representative for special applications.*



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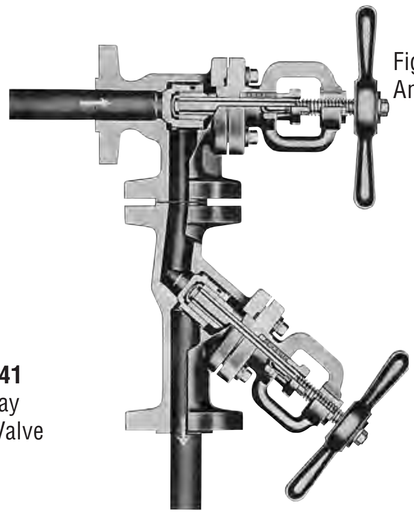
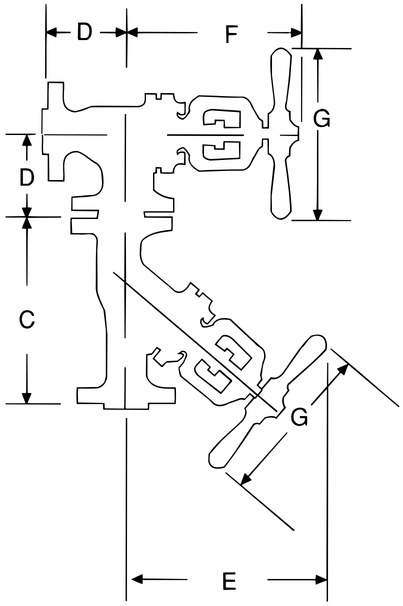
# Blow-Off Valves, Class 300




**1443/1441**

## Standard Features

- Size 11/2 and 2 bodies & bonnets are forged steel (A105).
- Size 21/2 bodies and bonnets are cast steel (WCB).
- Bolted bonnet, OS & Y.
- Straightway and angle design.
- Size 11/2 and 2 have hardened stainless steel disk.
- Size 21/2 has Stellite faced disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free spiral wound bonnet gasket.
- Impactor handle.

## Standards

Edward valves sold for blow-off service are designed and manufactured to comply with all Boiler Code criteria for valves used in these applications.

## Pressure Class 300 (PN 50)

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1441 | Globe | Flanged | 1½ (40) thru 2½ (65) |
| 1441Y | Globe | Socket Welding | 1½ (40) & 2 (50) |
| 1441Y | Globe | Buttwelding | 2½ (65) |
| 1443 | Angle | Flanged | 1½ (40) thru 2½ (65) |
| 1443Y | Angle | Socket Welding | 1½ (40) & 2 (50) |
| 1443Y | Angle | Buttwelding | 2½ (65) |

## Pressure Ratings (B16.34 Standard Class)

| Flanged or Welding Ends | Class 300 Primary Service |
|---|---|
| Maximum Boiler Drum Pressure* | 490 PSI (33.8 BAR) |
| Maximum Non-Shock | 740 PSI @ 100°F (51.1 BAR) |

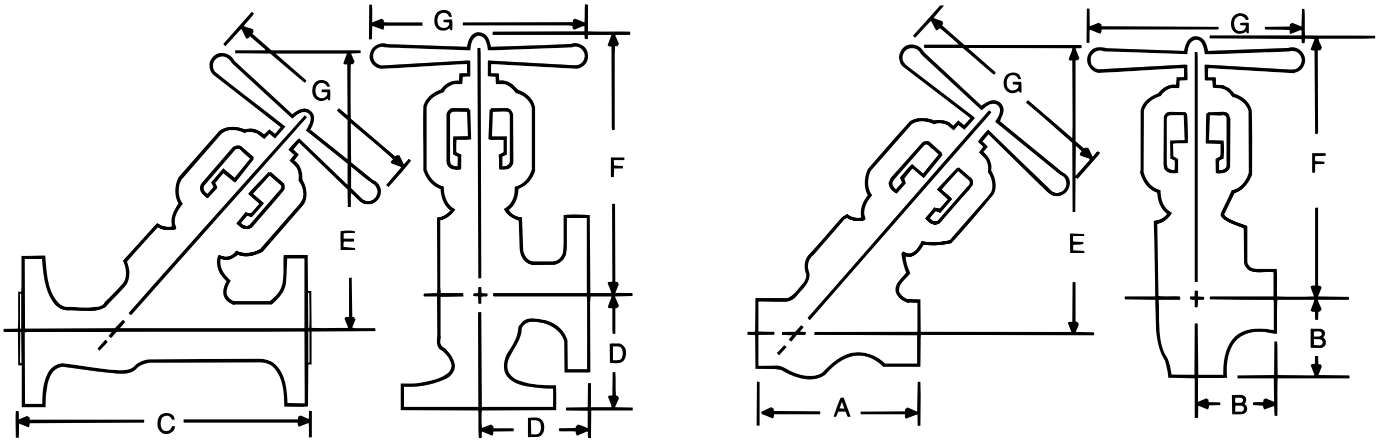
**This adjusted pressure rating represents the maximum allowable working pressure for this Class valve in boiler feed and blow-off line service.*

***Note:*** *For Tandem Blow-off valve operation:*

*Opening - Open upstream valve completely, then slowly open the downstream valve.*

*Closing - Close the downstream valve completely and tightly seat, then close and tightly seat the upstream valve.*

# Blow-Off Valves, Class 300

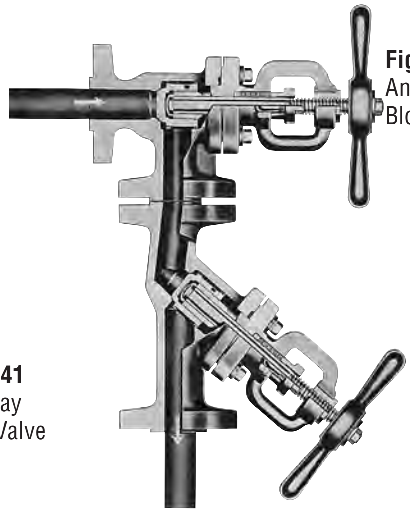


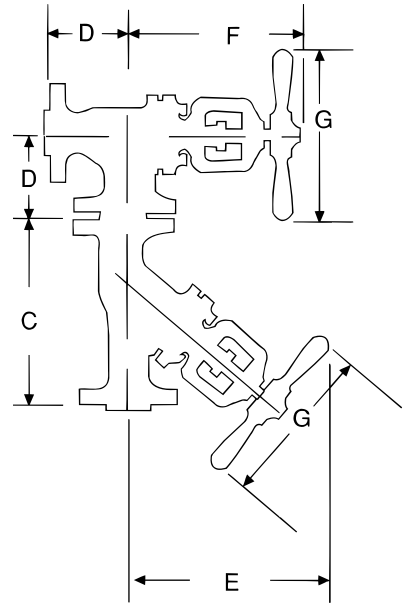

## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1441/1441Y, 1443/1443Y | | | | |
|---|---|---|---|---|
| | NPS | 1½ | 2 | 2½ |
| | DN | 40 | 50 | 65 |
| A - End to End, Globe (Welding) | | 6.8 | 8 | 11.5 |
| | | 173 | 203 | 292 |
| B - Center to End, Angle (Welding) | | 3.4 | 3.8 | 5.8 |
| | | 86 | 97 | 147 |
| C - Face to Face, Globe (Flanged) | | 12 | 12.8 | 14 |
| | | 305 | 325 | 356 |
| D - Center to Face, Angle (Flanged) | | 4.5 | 5.3 | 5.8 |
| | | 114 | 135 | 147 |
| E - Center to Top, Globe (Open) | | 13.4 | 15.3 | 15.9 |
| | | 340 | 389 | 404 |
| F - Center to Top, Angle (Open) | | 12.3 | 13.9 | 14.3 |
| | | 312 | 353 | 363 |
| G - Handwheel/Handle Diameter | | 11 | 11 | 11 |
| | | 279 | 279 | 279 |
| Weight, Globe (Flanged) | | 42 | 60 | 92 |
| | | 18.9 | 27 | 41.7 |
| Weight, Globe (Welding) | | 27 | 38 | 60 |
| | | 12.2 | 17.1 | 27 |
| Weight, Angle (Flanged) | | 39 | 53 | 82 |
| | | 17.6 | 23.9 | 37.2 |
| Weight, Angle (Welding) | | 25 | 36 | 54 |
| | | 11.3 | 16.2 | 24.3 |

# Blow-Off Valves, Class 400 & 600




**1643/1641**
Angle Globe

## Standard Features

- Size 11/2 and 2 bodies & bonnets are forged steel (A105).
- Size 21/2 bodies and bonnets are cast steel (WCB).
- Bolted bonnet, OS & Y.
- Straightway and angle design.
- Size 11/2 and 2 have hardened stainless steel disk.
- Size 21/2 has Stellite faced disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free spiral wound bonnet gasket.
- Impactor handle.

## Standards

Edward valves sold for blow-off service are designed and manufactured to comply with all Boiler Code criteria for valves used in these applications.

## Pressure Class 400 (PN 68) & 600 (PN 110)

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1641 | Globe | Flanged | 1½ (40) thru 2½ (65) |
| 1641Y | Globe | Socket Welding | 1½ (40) & 2 (50) |
| 1641Y | Globe | Buttwelding | 2½ (65) |
| 1643 | Angle | Flanged | 1½ (40) thru 2½ (65) |
| 1643Y | Angle | Socket Welding | 1½ (40) & 2 (50) |
| 1643Y | Angle | Buttwelding | 2½ (65) |

## Pressure Ratings (B16.34 Standard Class)

| Flanged or Welding Ends | Class 600 Primary Service |
|---|---|
| Maximum Boiler Drum Pressure* | 935 PSI (64.5 BAR) |
| Maximum Non-Shock | 1480 PSI @ 100°F (102.1 BAR) |

**This adjusted pressure rating represents the maximum allowable working pressure for this Class valve in boiler feed and blow-off line service.*

*Note: For Tandem Blow-off valve operation:*
*Opening - Open upstream valve completely, then slowly open the downstream valve.*
*Closing - Close the downstream valve completely and tightly seat then close and tightly seat the upstream valve.*



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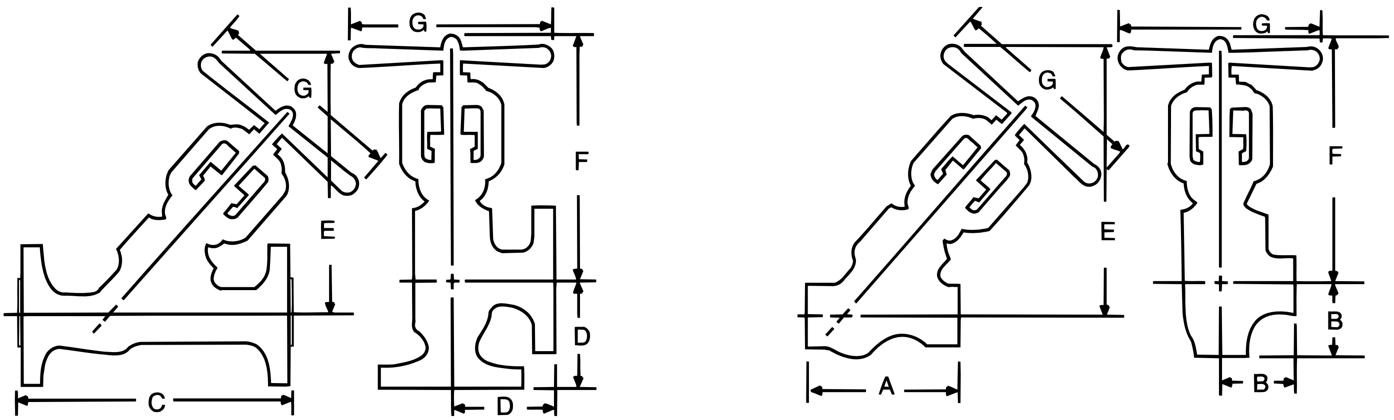
# Blow-Off Valves, Class 400 & 600




## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1641/1641Y, 1643/1643Y | | | | |
|---|---|---|---|---|
| | NPS | 1½ | 2 | 2½ |
| | DN | 40 | 50 | 65 |
| A - End to End, Globe (Welding) | | 6.8 | 8 | 11.5 |
| | | 173 | 203 | 292 |
| B - Center to End, Angle (Welding) | | 3.4 | 3.8 | 5.8 |
| | | 86 | 97 | 147 |
| C - End to End, Globe (Flanged) | | 12.4 | 13.1 | 14.4 |
| | | 315 | 333 | 366 |
| D - Center to End, Angle (Flanged) | | 4.8 | 5.8 | 6.5 |
| | | 122 | 147 | 165 |
| E - Center to Top, Globe (Open) | | 13.4 | 15.3 | 15.9 |
| | | 340 | 389 | 404 |
| F - Center to Top, Angle (Open) | | 12.4 | 13.9 | 14.3 |
| | | 315 | 353 | 363 |
| G - Handwheel/Handle Diameter | | 11 | 11 | 11 |
| | | 279 | 279 | 279 |
| Weight, Globe (Flanged) | | 44 | 62 | 95 |
| | | 19.8 | 27.9 | 43.1 |
| Weight, Globe (Welding) | | 27 | 38 | 76 |
| | | 12.2 | 17.1 | 34.2 |
| Weight, Angle (Flanged) | | 41 | 55 | 85 |
| | | 18.5 | 24.8 | 38.5 |
| Weight, Angle (Welding) | | 25 | 36 | 66 |
| | | 11.3 | 16.2 | 29.7 |



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# Blow-Off Valves, Class 1500 & 2500

Standard construction Flowserve Edward Class 1690 and Class 2680 carbon steel Univalves are supplied for Class 1500 and Class 2500 Blow-Off valve applications.

Although these Univalves are manufactured and tagged to ANSI B16.34 Limited Class ratings, these valves meet and exceed all Boiler Code criteria for boiler feed and blow-off line service.

## Standard Features

- Body Material is A105 carbon steel.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern and Angle Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Asbestos-free graphitic packing.
- Impactor Handle/Impactor Handwheel.

**Refer to pages 42, 45, 48 and 51 – Univalve Stop Valve, Class 1690 and 2680 for dimensions, etc.**

## Pressure Class 1500 (PN 260) & 2500 (PN 420)

| FIG. NO. | | | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|---|---|
| WELDED | | UNWELD | | | | |
| 1500 | 2500 | 1500 | 2500 | | | |
| 36124 | 66124 | 36224 | 66224 | Globe | Socket Welding | 1½ (40) thru 2 (50) |
| 36128 | 66128 | 36228 | 66228 | Globe | Buttwelding | 2½ (65) |

| FIG. NO. | | | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|---|---|
| WELDED | | UNWELD | | | | |
| 1500 | 2500 | 1500 | 2500 | | | |
| 36125 | 66125 | 36225 | 66225 | Angle | Socket Welding | 1½ (40) thru 2 (50) |
| 36129 | 66129 | 36229 | 66228 | Angle | Buttwelding | 2½ (65) |

## Pressure Ratings (B16.34 Standard Class)

| Socket or Welding Ends | Class 1500 Primary Service | Class 2500 Primary Service |
|---|---|---|
| Maximum Boiler Drum Pressure* | 2455 PSI | 3206 PSI# |
| | (169.3 BAR) | (221.1 BAR) |
| Maximum Non-Shock | 3705 PSI @ 100°F | 6170 PSI @ 100°F |
| | (255.3 BAR) | (425.5 BAR) |

** This adjusted pressure rating represents the maximum allowable working pressure for this Class valve in boiler feed and blow-off line service.*
*# Rating exceeds critical pressure of water.*

*Note: For Tandem Blow-off valve operation:*
*Opening - Open upstream valve completely, then slowly open the downstream valve.*
*Closing - Close the downstream valve completely and tightly seat, then close and tightly seat the upstream valve.*



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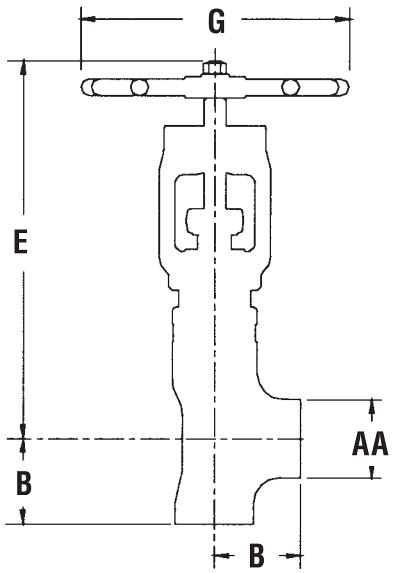
FLOWSERVE

# Continuous Blowdown Valves, Class 1925, 4,815 PSI @ 100°F (331.8 BAR @ 38°C)

## Standard Features

- Available Body Materials
  - A105 carbon steel.
  - F22 alloy steel.
  - Other materials on application.
- Unwelded (graphitic seal) or Welded Bonnet.
- OS & Y.
- Angle Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.
- Stellited flow passage.
- Position indicator




## Pressure Class 1925

<table>
<tr><th rowspan="2">Size</th><th colspan="2">Figure No.</th><th rowspan="2">Ends</th><th rowspan="2">Orifice Number[1]</th><th rowspan="2">Orifice Size</th></tr>
<tr><th>Welded Bonnet</th><th>Unwelded Bonnet</th></tr>
<tr><td rowspan="2">NPS 1 thru 1½<br>DN 25 thru 40</td><td>35125</td><td>35225</td><td>Socket Welding</td><td rowspan="3">-2<br>-3<br>-4<br>-5<br>-6<br>-7<br>-8<br>-10</td><td rowspan="3">0.12 (3)<br>0.18 (5)<br>0.25 (6)<br>0.31 (8)<br>0.38 (10)<br>0.44 (11)<br>0.50 (13)<br>0.62 (16)</td></tr>
<tr><td>35129</td><td>35229</td><td>Butt Welding[4]</td></tr>
<tr><td>NPS 2 thru 2½<br>DN 50 thru 65</td><td>35129</td><td>35229</td><td>Butt Welding</td></tr>
<tr><td rowspan="2">NPS 1¼ thru 3[2]<br>DN 40 thru 80</td><td>35125</td><td>35225</td><td>Socket Welding[3]</td><td rowspan="2">-12<br>-14<br>-16</td><td rowspan="2">0.75 (19)<br>0.88 (22)<br>1.00 (25)</td></tr>
<tr><td>35129</td><td>35229</td><td>Butt Welding</td></tr>
<tr><td>NPS 2½[5] thru 4[2]<br>DN 65 thru 100</td><td>35129</td><td>35229</td><td>Butt Welding</td><td>-18<br>-20</td><td>1.12 (29)<br>1.25 (32)</td></tr>
</table>

*1. Orifice number is added to Figure Numbers shown to form complete figure number (ie: 35125-7).*
*2. Valve sizes 2½ and smaller are ANSI B16.34 Limited Class. Size 3&4 valves are Special Class.*
*5. NPS 2½, socket welding only (35225)*
*3. Socket Welding ends are not available in Size 3 valves.*
*4. NPS 1 through 1½, butt weld valves, minimum bore is 0.875".*

## Dimensions

| Orifice Number | Valve Sizes | AA Hub Diameter | B Center to Face | E Center to Top (open) | G Handwheel/ Handle Diameter | W Weight |
|---|---|---|---|---|---|---|
| -2 thru -10 | 1 thru 2½ | 3.0<br>76 | 2.6<br>67 | 11.1<br>282 | 8.5<br>216 | 25<br>11 |
| -12 thru -16 | 1¼ thru 3 | 3.8<br>97 | 3.6<br>91 | 14.7<br>373 | 11*<br>279 | 45<br>20 |
| -18 thru -20 | 2½ thru 4 | 4.8<br>122 | 5.3<br>135 | 19.7<br>500 | 16**<br>406 | 130<br>59 |

** Impactor Handle* *** Impactor Handwheel*



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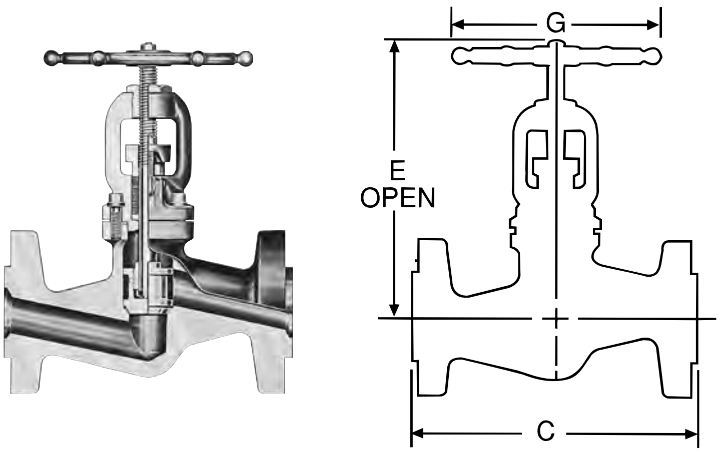
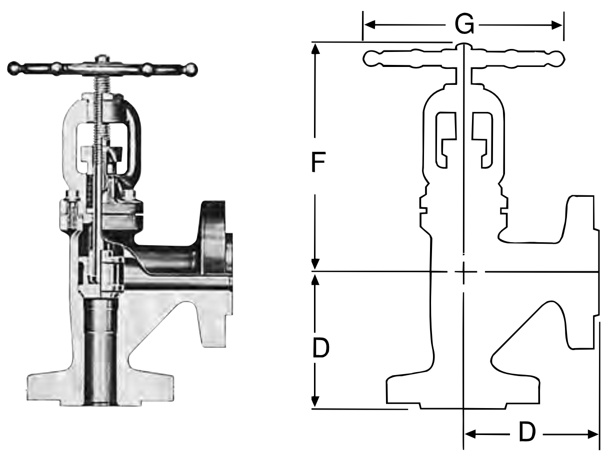
# Stop Valves, Class 600, 1480 PSI @ 100°F (102.1 BAR @ 38°C)




828




829

## Standard Features

- Bodies and bonnets are of forged steel (A105).
- Bolted bonnet, OS&Y.
- Globe & angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.

## Pressure Class 600 (PN 110)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 828 | Globe | Flanged | ½ (15) thru 2 (50) |
| 829 | Angle | Flanged | |

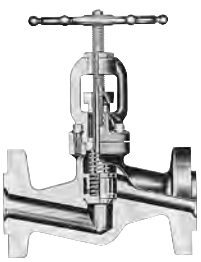
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.

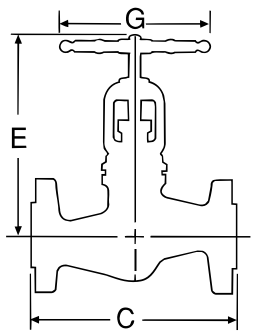
## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

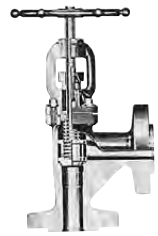
| Figure No. 828, 829 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face, Globe (Flanged) | | 6.5 | 7.5 | 8.5 | 9.5 | 9.5 | 11.5 |
| | | 165 | 191 | 216 | 241 | 241 | 292 |
| D - Center to Face, Angle (Flanged) | | 3.3 | 3.8 | 4.3 | 4.8 | 4.8 | 5.8 |
| | | 84 | 97 | 109 | 122 | 122 | 147 |
| E - Center to Top, Globe (Open) | | 6.1 | 6.9 | 7.7 | 11.1 | 11.1 | 12.1 |
| | | 155 | 175 | 196 | 282 | 282 | 307 |
| F - Center to Top, Angle (Open) | | 5.7 | 6.4 | 7.1 | 10.2 | 10.2 | 11.0 |
| | | 145 | 163 | 180 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 109 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 7.5 | 12 | 16 | 27 | 32 | 38 |
| | | 3.4 | 5.4 | 7.2 | 12.2 | 14.4 | 17.1 |
| Weight, Angle | | 7 | 11 | 15 | 26 | 31 | 36 |
| | | 3.2 | 5 | 6.8 | 11.7 | 14 | 16.2 |

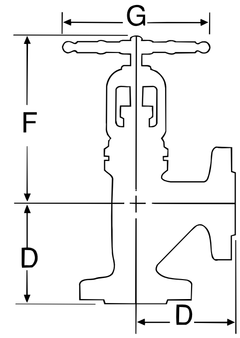
# Stop-Check Valves, Class 600, 1480 PSI @ 100°F (102.1 BAR @ 38°C)






846






847

## Standard Features

- Bodies and bonnets are of forged steel (A105).
- Bolted bonnet, OS & Y.
- Globe & angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.
- Stainless steel spring.

## Pressure Class 600 (PN 110)

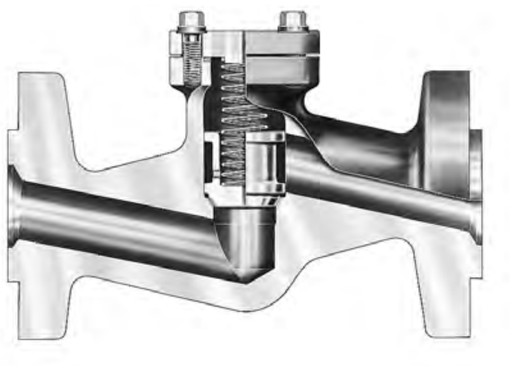
| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 846 | Globe | Flanged | ½ (15) thru 2 (50) |
| 847 | Angle | Flanged | |

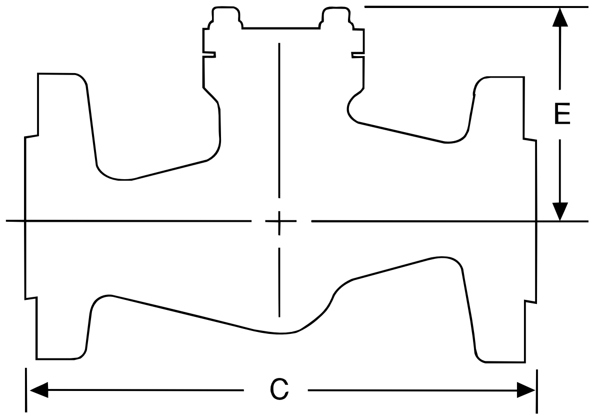
## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 846, 847 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face, Globe (Flanged) | | 6.5 | 7.5 | 8.5 | 9.5 | 9.5 | 11.5 |
| | | 165 | 191 | 216 | 241 | 241 | 292 |
| D - Center to Face, Angle (Flanged) | | 3.3 | 3.8 | 4.3 | 4.8 | 4.8 | 5.8 |
| | | 84 | 97 | 109 | 122 | 122 | 147 |
| E - Center to Top, Globe (Open) | | 6.1 | 6.9 | 7.7 | 11.1 | 11.1 | 12.1 |
| | | 155 | 175 | 196 | 282 | 282 | 307 |
| F - Center to Top, Angle (Open) | | 5.7 | 6.4 | 7.1 | 10.2 | 10.2 | 11.0 |
| | | 145 | 163 | 180 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 109 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 7.5 | 12 | 16 | 27 | 32 | 38 |
| | | 3.4 | 5.4 | 7.2 | 12.2 | 14.4 | 17.1 |
| Weight, Angle | | 7 | 11 | 15 | 26 | 31 | 36 |
| | | 3.2 | 5 | 6.8 | 11.7 | 14 | 16.2 |

# Piston Check Valves, Class 600, 1480 PSI @ 100°F (102.1 BAR @ 38°C)






858

## Standard Features

- Bodies and covers are of forged steel (A105).
- Bolted cover.
- Globe design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Asbestos-free spiral wound cover gasket.
- Stainless steel spring.

## Pressure Class 600 (PN 110)

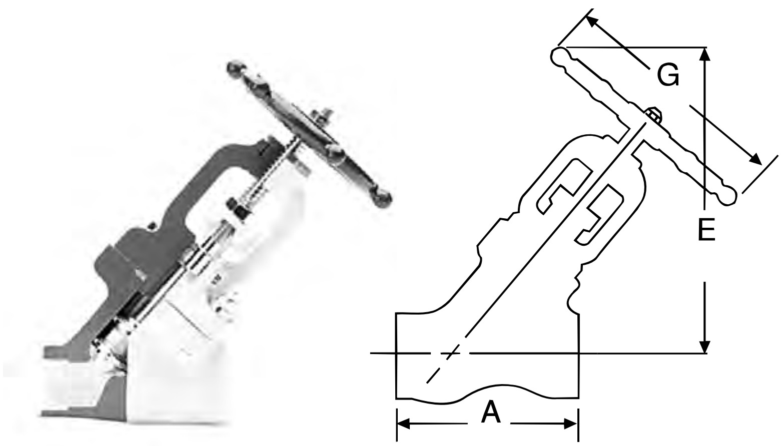
| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 858 | Globe | Flanged | ½ (15) thru 2 (50) |

## Dimensions – Globe & Angle

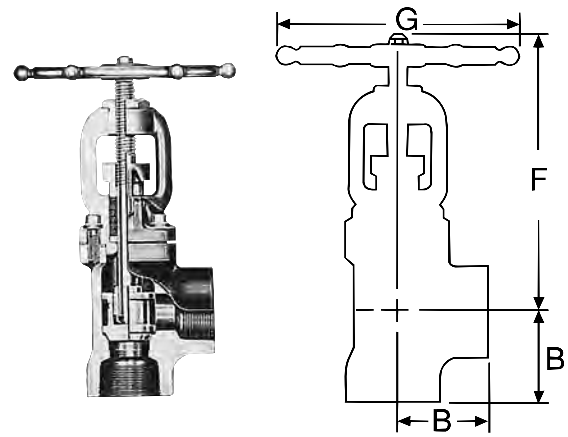
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 858 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face, Globe (Flanged) | | 6.5 | 7.5 | 8.5 | 9.5 | 9.5 | 11.5 |
| | | 165 | 191 | 216 | 241 | 241 | 292 |
| E - Center to Top | | 2.3 | 2.7 | 3.1 | 4.2 | 4.2 | 4.7 |
| | | 58 | 69 | 79 | 107 | 107 | 119 |
| Weight | | 6.5 | 11 | 13 | 21 | 26 | 29 |
| | | 2.9 | 5 | 5.9 | 9.5 | 11.7 | 13.1 |

# Stop Valves, Class 800, 2000 PSI @ 100°F (137.9 BAR @ 38°C)




848Y




849

## Standard Features

- Bodies and bonnets are of forged steel (A105 or F11).
- Bolted bonnet, OS & Y.
- Y-Pattern or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.

## Pressure Class 800 (PN 130)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 848 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 848Y | Y-Pattern | Socket Welding | |
| 849 | Angle | Threaded | |
| 849Y | Angle | Socket Welding | |

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 848/848Y, 849/849Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End, Globe | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| B - Center to End, Angle | | 1.5 | 1.5 | 1.5 | 1.8 | 2 | 2.9 | 2.9 | 3.3 |
| | | 38 | 38 | 38 | 46 | 51 | 74 | 74 | 84 |
| E - Center to Top, Globe (Open) | | 6 | 6 | 6 | 6.8 | 7.6 | 10.9 | 10.9 | 12.1 |
| | | 152 | 152 | 152 | 173 | 193 | 277 | 277 | 307 |
| F - Center to Top, Angle (Open) | | 5.7 | 5.7 | 5.7 | 6.4 | 7.1 | 10.2 | 10.2 | 11 |
| | | 145 | 145 | 145 | 163 | 180 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 3.8 | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 97 | 97 | 109 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 4 | 4 | 4 | 5.5 | 7.5 | 16 | 16 | 23 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.4 | 7.2 | 7.2 | 10.4 |
| Weight, Angle | | 4 | 4 | 4 | 5.5 | 7 | 17 | 17 | 24 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.2 | 7.7 | 7.7 | 10.8 |



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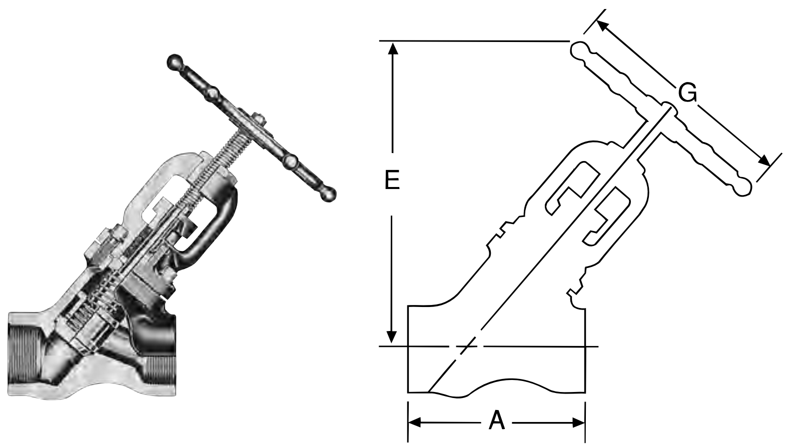
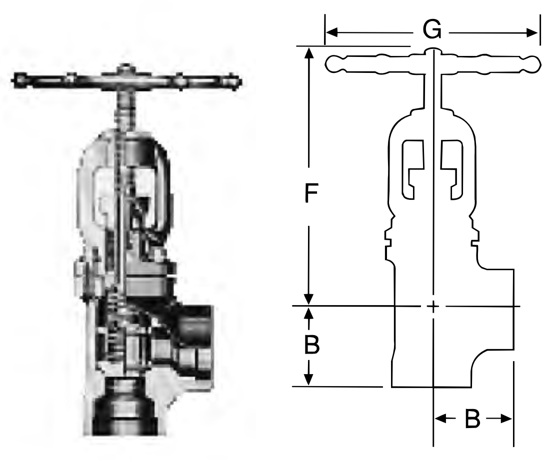
# Stop-Check Valves, Class 800, 2000 PSI @ 100°F (137.9 BAR @ 38°C)




868




869Y

## Standard Features

- Bodies and bonnets are of forged steel (A105 or F11).
- Bolted bonnet, OS & Y.
- Y-Pattern or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.

## Pressure Class 800 (PN 130)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 868 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 868Y | Y-Pattern | Socket Welding | |
| 869 | Angle | Threaded | |
| 869Y | Angle | Socket Welding | |

- Knobbed handwheel.
- Stainless steel spring

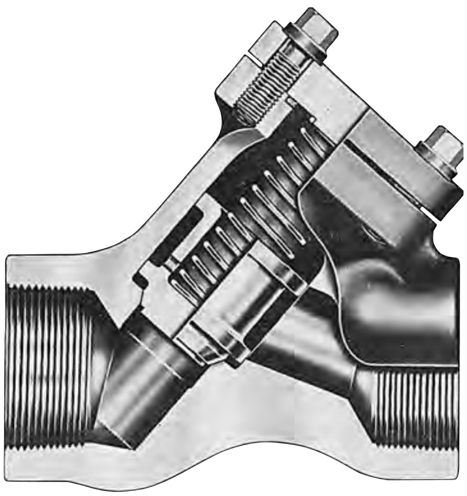
## Dimensions – Globe & Angle

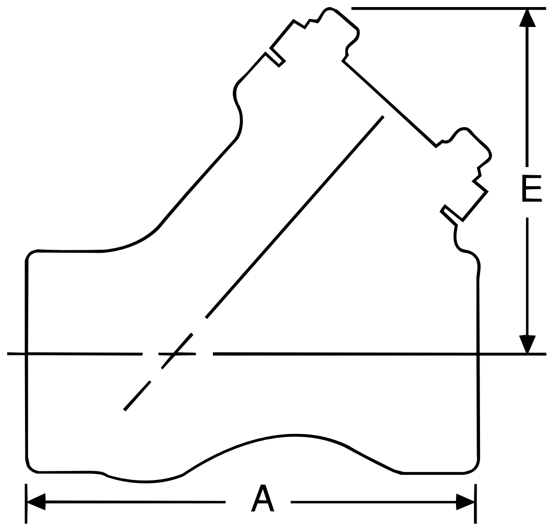
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 868/868Y, 869/869Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End, Globe | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| B - Center to End, Angle | | 1.5 | 1.5 | 1.5 | 1.8 | 2 | 2.9 | 2.9 | 3.3 |
| | | 38 | 38 | 38 | 46 | 51 | 74 | 74 | 84 |
| E - Center to Top, Globe (Open) | | 6 | 6 | 6 | 6.8 | 7.6 | 10.9 | 10.9 | 12.1 |
| | | 152 | 152 | 152 | 173 | 193 | 277 | 277 | 307 |
| F - Center to Top, Angle (Open) | | 5.7 | 5.7 | 5.7 | 6.4 | 7.1 | 10.2 | 10.2 | 11 |
| | | 145 | 145 | 145 | 163 | 180 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 3.8 | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 97 | 97 | 109 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 4 | 4 | 4 | 5.5 | 7.5 | 16 | 16 | 23 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.4 | 7.2 | 7.2 | 10.4 |
| Weight, Angle | | 4 | 4 | 4 | 5.5 | 7 | 17 | 17 | 24 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.2 | 7.7 | 7.7 | 10.8 |

FLOWSERVE

# Piston Check Valves, Class 800, 2000 PSI @ 100°F (137.9 BAR @ 38°C)






838

## Standard Features

- Bodies and covers are of forged steel (A105 or F11).
- Bolted cover.
- Y-Pattern.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Asbestos-free spiral wound cover gasket.
- Stainless steel spring. (Optional without springs, see Technical Information section, 1.3 Check and Stop-Check Valve Installation Guidelines.)

## Pressure Class 800 (PN 130)

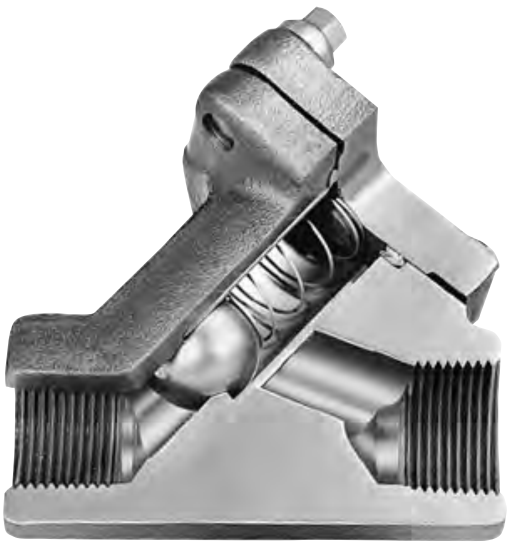
| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 838 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 838Y | Y-Pattern | Socket Welding | |

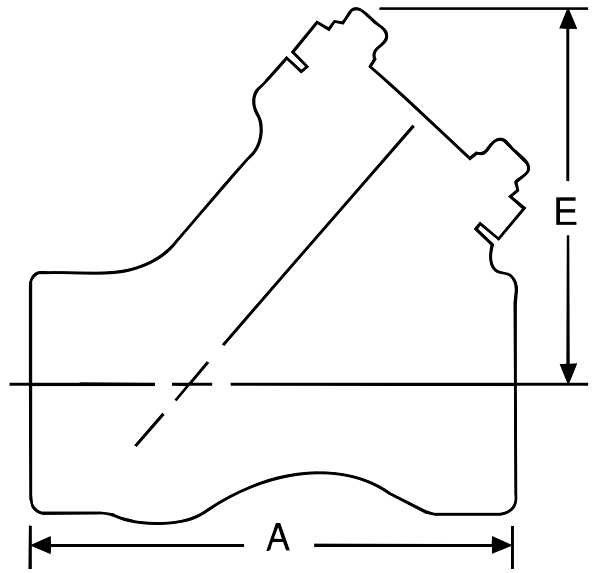
## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 838/838Y | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| E - Center to Top | | 2.8 | 2.8 | 2.8 | 3.3 | 3.8 | 4.6 | 4.6 | 5.1 |
| | | 71 | 71 | 71 | 84 | 97 | 117 | 117 | 130 |
| Weight | | 2 | 2 | 2 | 3.5 | 5 | 11 | 10 | 14 |
| | | .9 | .9 | .9 | 1.6 | 2.3 | 5 | 4.5 | 6.3 |

# Ball Check Valves, Class 800, 2000 PSI @ 100°F (137.9 BAR @ 38°C)






832

## Standard Features

- Bodies and covers are of forged steel (A105 or F11).
- Bolted cover.
- Y-Pattern.
- Integral Stellite seat.
- Asbestos-free spiral wound cover gasket.
- Stainless steel spring.
- Stainless steel ball.

## Pressure Class 800 (PN 130)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 832 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 832Y | Y-Pattern | Socket Welding | |

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 832/832Y | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| E - Center to Top | | 2.8 | 2.8 | 2.8 | 3.3 | 3.8 | 4.6 | 4.6 | 5.1 |
| | | 71 | 71 | 71 | 84 | 97 | 117 | 117 | 130 |
| Weight | | 2 | 2 | 2 | 3.5 | 5 | 11 | 10 | 14 |
| | | .9 | .9 | .9 | 1.6 | 2.3 | 5 | 4.5 | 6.4 |



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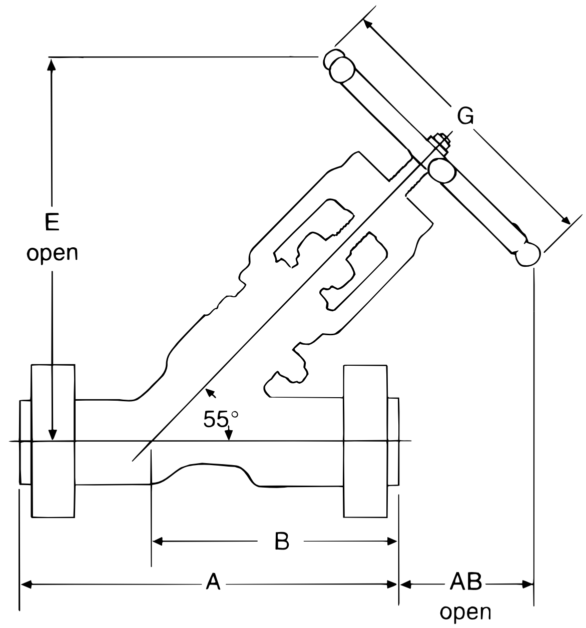
# *Univalve® Stop Valves, Class 1500, 3705 PSI @ 100°F (255.3 BAR @ 38°C)*




## *Standard Features*

- Available Body Materials
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316 stainless steel.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.

## *Pressure Class 1500 (PN 260)*

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| WELDED | UNWELD. | | | |
| 36122 | 36222 | Y-Pattern | Flanged | ½ (15) thru 2 (50) |

- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

## *Dimensions - Globe*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36122, 36222 | | ½ | ¾ | 1 | 1½ | 2 |
|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1½ | 2 |
| | DN | 15 | 20 | 25 | 40 | 50 |
| A - End to End | | 10.0 | 10.0 | 10.0 | 12.0 | 14.5 |
| | | 25.4 | 254 | 254 | 305 | 368 |
| AB - Handwheel Clearance (Open) | | 3.0 | 3.0 | 3.0 | 5.3 | 4.9 |
| | | 76.2 | 76.2 | 76.2 | 135 | 125 |
| B - Center to End | | 6.9 | 6.9 | 6.9 | 8.3 | 10.0 |
| | | 175 | 175 | 175 | 211 | 254 |
| E - Center to Top (Open) | | 11.6 | 11.6 | 11.6 | 16.3 | 18.5 |
| | | 295 | 295 | 295 | 414 | 470 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 14.3* | 14.3* |
| | | 216 | 216 | 216 | 363* | 363* |
| Weight, Welded & Unwelded | | 31 | 34 | 36 | 75 | 120 |
| | | 14.1 | 15.5 | 16.4 | 34 | 55 |

** Impactor Handle*



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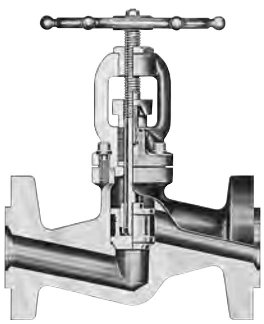
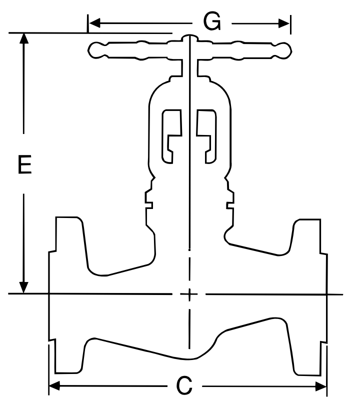
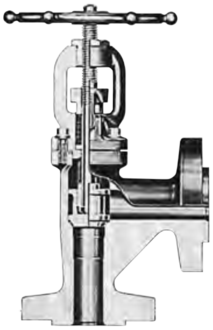
# Stop Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

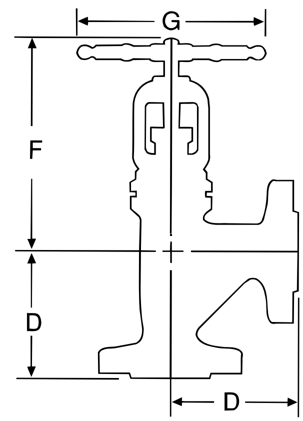
These Series 1500 valves are designed and rated to Flowserve Edward Valve standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.






1028






1029

## Standard Features

- Bodies and bonnets are of forged steel (F11).
- Bolted bonnet, OS & Y.
- Globe or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.

## Series 1500

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1028 | Globe | Flanged | ½ (15) thru 2 (50) |
| 1029 | Angle | Flanged | |

- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.

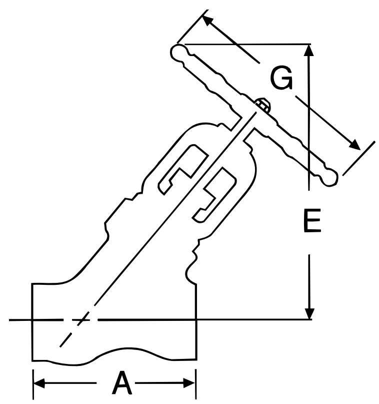
## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

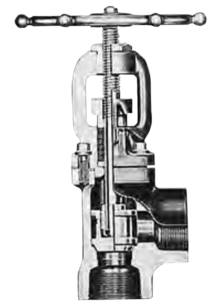
| Figure No. 1028, 1029 | | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face, Globe (Flanged) | | 8.5 | 9 | 10 | 12 | 12 | 14.5 |
| | | 216 | 229 | 254 | 305 | 305 | 368 |
| D - Center to Face, Angle (Flanged) | | 4.3 | 4.5 | 5 | 6 | 6 | 7.3 |
| | | 109 | 114 | 127 | 152 | 152 | 185 |
| E - Center to Top, Globe (Open) | | 7 | 7.7 | 7.7 | 11.1 | 11.1 | 12 |
| | | 178 | 196 | 196 | 282 | 282 | 305 |
| F - Center to Top, Angle (Open) | | 6.6 | 7.1 | 7.1 | 10.2 | 10.2 | 11.1 |
| | | 168 | 180 | 180 | 259 | 259 | 282 |
| G - Handwheel Diameter | | 4.3 | 4.8 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 109 | 122 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 15 | 19 | 26 | 38 | 47 | 77 |
| | | 6.8 | 8.6 | 11.7 | 17.1 | 21.2 | 34.7 |
| Weight, Angle | | 15 | 20 | 26 | 41 | 49 | 80 |
| | | 6.8 | 9 | 11.7 | 18.5 | 22.1 | 36 |

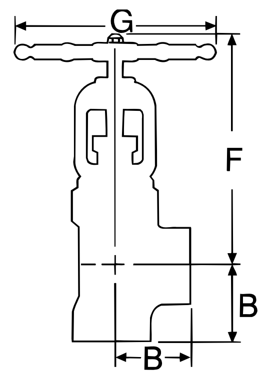
# Stop Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

These Series 1500 valves are designed and rated to Flowserve Edward Valve standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.




1048Y






1049

## Standard Features

- Bodies and bonnets are of forged steel (A105 or F11).
- Bolted bonnet, OS & Y.
- Y-Pattern or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.

## Series 1500

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1048 | Y-Pattern | Threaded | ¼ (6) thru 2 (50) |
| 1048Y | Y-Pattern | Socket Welding | |
| 1049 | Angle | Threaded | |
| 1049Y | Angle | Socket Welding | |

## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1048/1048Y, 1049/1049Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End, Globe | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| B - Center to End, Angle | | 1.5 | 1.5 | 1.5 | 1.8 | 2 | 2.9 | 2.9 | 3.3 |
| | | 38 | 38 | 38 | 46 | 51 | 74 | 74 | 84 |
| E - Center to Top, Globe (Open) | | 6.1 | 6.1 | 6.1 | 6.9 | 7.6 | 10.9 | 10.9 | 12.1 |
| | | 155 | 155 | 155 | 175 | 197 | 277 | 277 | 307 |
| F - Center to Top, Angle (Open) | | 5.8 | 5.8 | 5.8 | 6.6 | 7.1 | 10.2 | 10.2 | 11 |
| | | 147 | 147 | 147 | 168 | 183 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 3.8 | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 97 | 97 | 109 | 122 | 183 | 183 | 216 |
| Weight, Globe | | 4 | 4 | 4 | 5.5 | 8 | 17 | 17 | 24 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.6 | 7.7 | 7.7 | 10.8 |
| Weight, Angle | | 4 | 4 | 4 | 5.5 | 7.5 | 17 | 17 | 25 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.4 | 7.7 | 7.7 | 11.3 |



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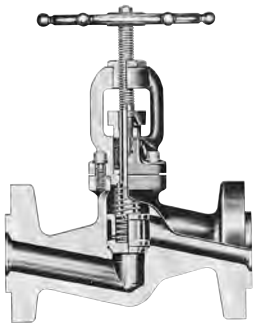
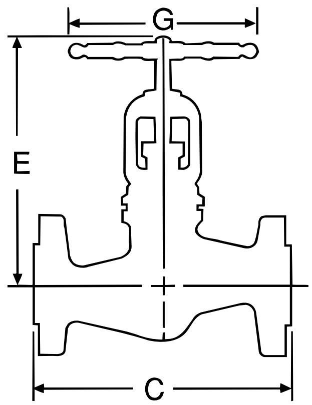
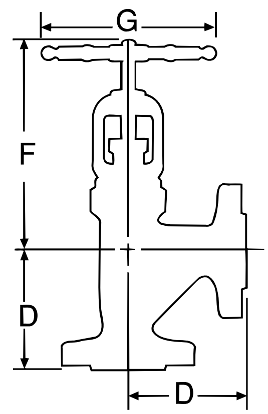
# Stop-Check Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

These Series 1500 valves are designed and rated to Flowserve Edward Valve standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.






1046




1047

## Standard Features

- Bodies and bonnets are of forged steel (F11).
- Bolted bonnet, OS & Y.
- Globe or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.
- Knobbed handwheel.
- Stainless steel spring.

## Series 1500

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1046 | Globe | Flanged | ½ (15) thru 2 (50) |
| 1047 | Angle | Flanged | |

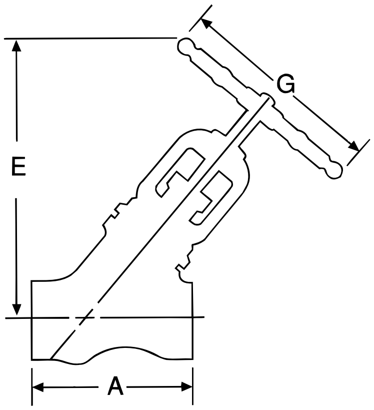
## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

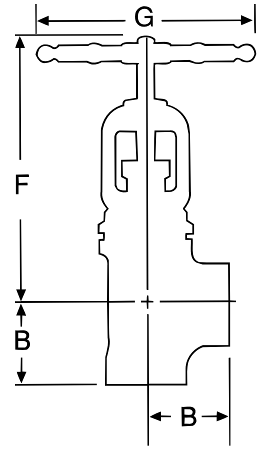
| Figure No. 1046, 1047 | | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face, Globe (Flanged) | | 8.5 | 9 | 10 | 12 | 12 | 14.5 |
| | | 216 | 229 | 254 | 305 | 305 | 368 |
| D - Center to Face, Angle (Flanged) | | 4.3 | 4.5 | 5 | 6 | 6 | 7.3 |
| | | 109 | 114 | 127 | 152 | 152 | 185 |
| E - Center to Top, Globe (Open) | | 7 | 7.7 | 7.7 | 11.1 | 11.1 | 12 |
| | | 178 | 196 | 196 | 282 | 282 | 305 |
| F - Center to Top, Angle (Open) | | 6.6 | 7.1 | 7.1 | 10.2 | 10.2 | 11.1 |
| | | 168 | 180 | 180 | 259 | 259 | 282 |
| G - Handwheel Diameter | | 4.3 | 4.8 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 109 | 122 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 15 | 19 | 26 | 38 | 47 | 77 |
| | | 6.8 | 8.6 | 11.7 | 17.1 | 21.2 | 34.7 |
| Weight, Angle | | 15 | 20 | 26 | 41 | 49 | 80 |
| | | 6.8 | 9 | 11.7 | 18.5 | 22.1 | 36 |

# Stop-Check Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

These Series 1500 valves are designed and rated to Flowserve Edward Valves standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.




1068Y




1069

## Standard Features

- Bodies and bonnets are of forged steel (A105 or F11).
- Bolted bonnet, OS & Y.
- Y-Pattern or angle design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Integral backseat.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound bonnet gasket.

## Series 1500

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1068 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 1068Y | Y-Pattern | Socket Welding | |
| 1069 | Angle | Threaded | |
| 1069Y | Angle | Socket Welding | |

- Knobbed handwheel.
- Stainless steel spring.

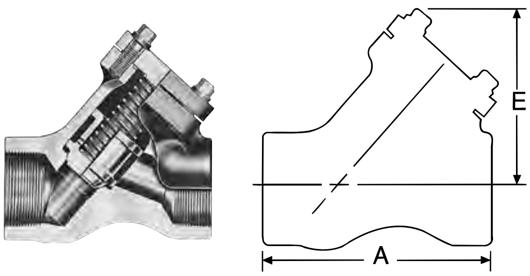
## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

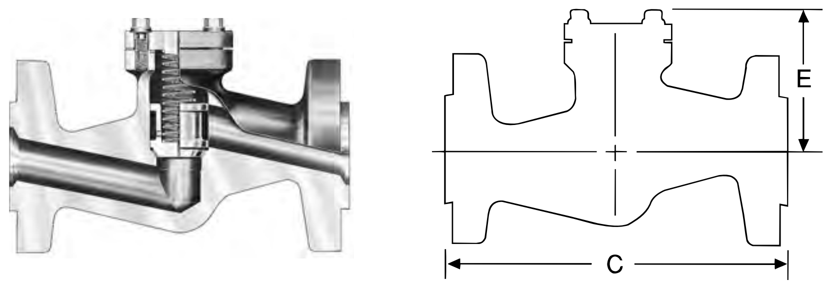
| Figure No. 1068/1068Y, 1069/1069Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End, Globe | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| B - Center to End, Angle | | 1.5 | 1.5 | 1.5 | 1.8 | 2 | 2.9 | 2.9 | 3.3 |
| | | 38 | 38 | 38 | 46 | 51 | 74 | 74 | 84 |
| E - Center to Top, Globe (Open) | | 6.1 | 6.1 | 6.1 | 6.9 | 7.6 | 10.9 | 10.9 | 12.1 |
| | | 155 | 155 | 155 | 175 | 193 | 277 | 277 | 307 |
| F - Center to Top, Angle (Open) | | 5.8 | 5.8 | 5.8 | 6.6 | 7.1 | 10.2 | 10.2 | 11 |
| | | 147 | 147 | 147 | 168 | 180 | 259 | 259 | 279 |
| G - Handwheel Diameter | | 3.8 | 3.8 | 3.8 | 4.3 | 4.8 | 7.1 | 7.1 | 8.5 |
| | | 97 | 97 | 97 | 109 | 122 | 180 | 180 | 216 |
| Weight, Globe | | 4 | 4 | 4 | 5.5 | 8 | 16 | 16 | 23 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.6 | 7.3 | 7.3 | 10.4 |
| Weight, Angle | | 4 | 4 | 4 | 5.5 | 7.5 | 16 | 16 | 24 |
| | | 1.8 | 1.8 | 1.8 | 2.5 | 3.4 | 7.3 | 7.3 | 10.9 |

# Piston Check Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

These Series 1500 valves are designed and rated to Flowserve Edward Valves standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.




1038




1058

## Standard Features

- Bodies and covers are of forged steel (A105 or F11).
- Bolted cover.
- Y-Pattern or globe design.
- Body-guided hardened stainless steel disk.
- Integral Stellite seat.
- Asbestos-free spiral wound cover gasket.
- Stainless steel spring.

## Series 1500

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1038 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 1038Y | Y-Pattern | Socket Welding | |
| 1058 (F11) | Globe | Flanged | ½ (15) thru 2 (50) |

## Dimensions - Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1038/1038Y | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| E - Center to Top | | 2.8 | 2.8 | 2.8 | 3.3 | 3.8 | 4.6 | 4.6 | 5.1 |
| | | 71 | 71 | 71 | 84 | 97 | 117 | 117 | 130 |
| Weight | | 2.5 | 2.5 | 2.5 | 3.5 | 5.5 | 11 | 11 | 15 |
| | | 1.1 | 1.1 | 1.1 | 1.6 | 2.5 | 5 | 5 | 6.8 |

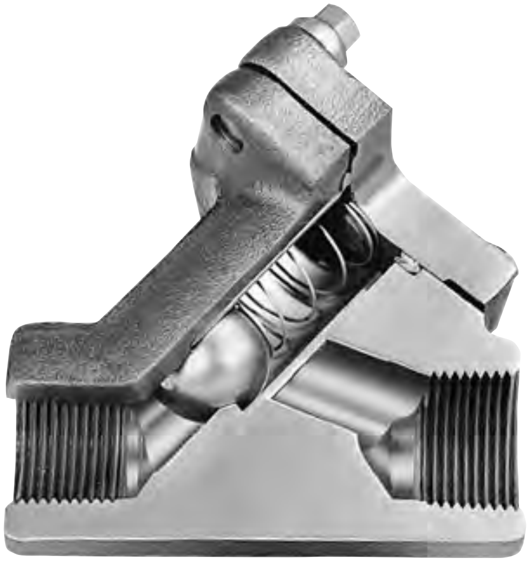
## Dimensions - Globe

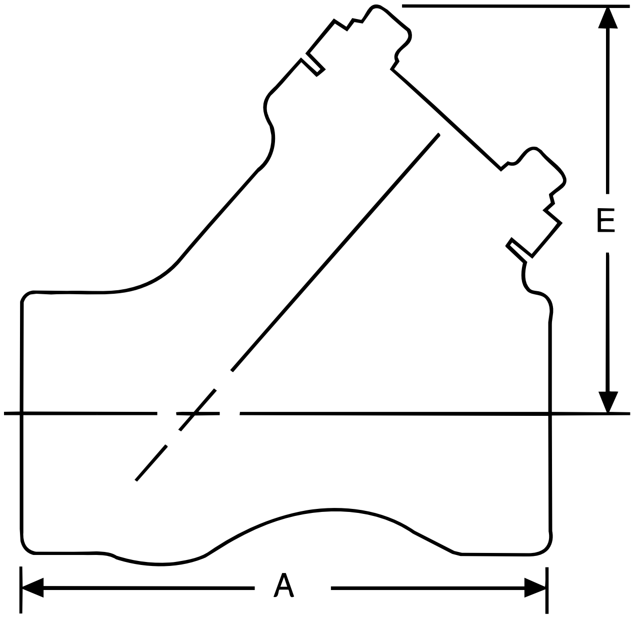
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1058 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 |
| C - Face to Face (Flanged) | | 8.5 | 9 | 10 | 12 | 12 | 14.5 |
| | | 216 | 229 | 254 | 305 | 305 | 368 |
| E - Center to Top | | 2.7 | 3.1 | 3.1 | 4.2 | 4.2 | 4.7 |
| | | 69 | 79 | 79 | 197 | 107 | 119 |
| Weight | | 14 | 17 | 24 | 32 | 41 | 69 |
| | | 6.3 | 7.7 | 10.8 | 14.4 | 18.5 | 31.1 |

# Ball Check Valves, Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

These Series 1500 Valves are designed and rated to Flowserve Edward Valves standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.






1032

## Standard Features

- Bodies and covers are of forged steel (A105 or F11).
- Bolted cover.
- Y-Pattern.
- Integral Stellite seat.
- Asbestos-free spiral wound bonnet gasket.
- Stainless steel spring.
- Stainless steel ball.

## Series 1500

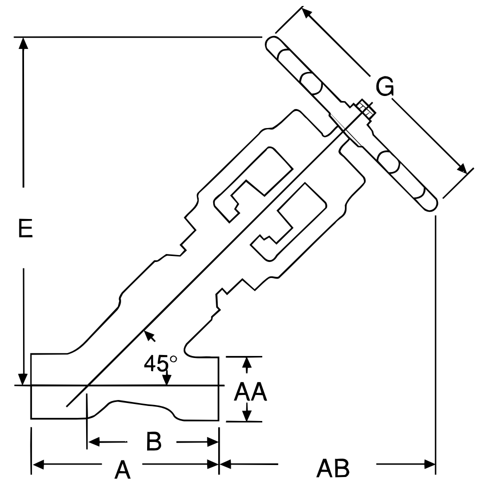
| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1032 | Y-Pattern | Threaded | ¼ (8) thru 2 (50) |
| 1032Y | Y-Pattern | Socket Welding | |

## Dimensions - Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1032/1032Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| E - Center to Top | | 2.8 | 2.8 | 2.8 | 3.3 | 3.8 | 4.6 | 4.6 | 5.1 |
| | | 71 | 71 | 71 | 84 | 97 | 117 | 117 | 130 |
| Weight | | 2.5 | 2.5 | 2.5 | 3.5 | 5.5 | 11 | 11 | 15 |
| | | 1.1 | 1.1 | 1.1 | 1.6 | 2.5 | 5 | 5 | 6.8 |

# Univalve® Stop Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)




36124

## Standard Features

- Available Body Materials
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 1690 (PN 290)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 36120 | 36220 | Y-Pattern | Threaded | ½ (15) thru 1 (25) |
| 36124 | 36224 | Y-Pattern | Socket Welding | ½ (15) thru 2½ (65) |
| 36128 | 36228 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

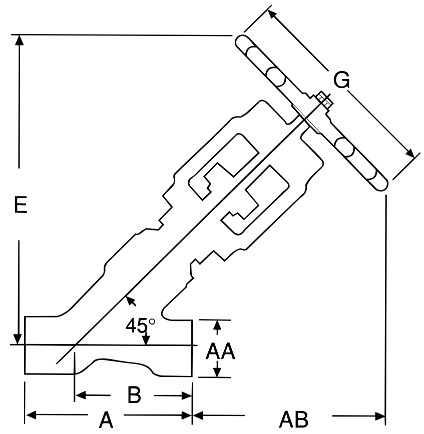
## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36120, 36124, 36128, 36220,36224,36228 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 8.2 | 10.7 | 10.7 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 208 | 272 | 272 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 3.64 | 4.00 | 4.00 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 92 | 102 | 102 | 122 |
| AB - Handwheel Clearance (Open) | | 7.5 | 7.5 | 7.5 | 11.0 | 11.0 | 11.6 | 12.5 | 12.5 | 11.2 |
| | | 191 | 191 | 191 | 279 | 279 | 295 | 318 | 318 | 284 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 6.1 | 7.1 | 7.1 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 155 | 180 | 180 | 224 |
| E - Center to Top (Open) | | 11.5 | 11.5 | 11.5 | 15.9 | 15.9 | 17.7 | 19.6 | 19.6 | 20.0 |
| | | 292 | 292 | 292 | 404 | 404 | 450 | 498 | 498 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 14.3* | 14.3* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 363* | 363* | 363* | 406** | 406** | 406** |
| Weight, Welded | | 19 | 19 | 19 | 36 | 36 | 57 | 100 | 100 | 138 |
| | | 9 | 9 | 9 | 16 | 16 | 26 | 46 | 46 | 63 |
| Weight, Unwelded | | 20 | 20 | 20 | 38 | 38 | 59 | 104 | 104 | 142 |
| | | 9 | 9 | 9 | 17 | 17 | 27 | 47 | 47 | 64 |

** Impactor Handle **Impactor Handwheel*

# Univalve® Stop-Check Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)




36164

## Standard Features

- Available Body Materials
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 1690 (PN 290)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 36160 | 36260 | Y-Pattern | Threaded | ½ (15) thru 1 (25) |
| 36164 | 36264 | Y-Pattern | Socket Welding | ½ (15) thru 2½ (65) |
| 36168 | 36268 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

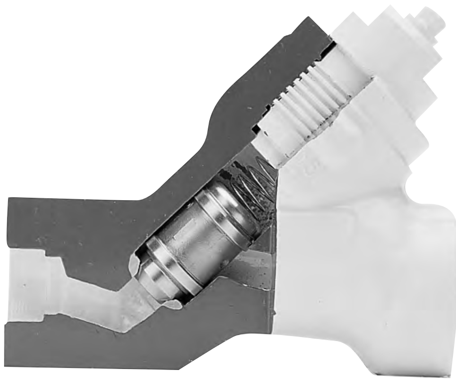
## Dimensions – Globe

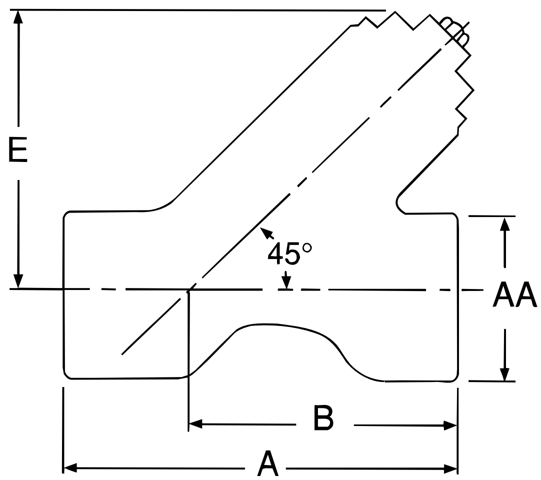
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36160, 36164, 36168, 36260, 36264, 36268 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 8.2 | 10.7 | 10.7 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 208 | 272 | 272 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 3.64 | 4.00 | 4.00 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 92 | 102 | 102 | 122 |
| AB - Handwheel Clearance (Open) | | 7.5 | 7.5 | 7.5 | 11.0 | 11.0 | 11.6 | 12.5 | 12.5 | 11.2 |
| | | 191 | 191 | 191 | 279 | 279 | 295 | 318 | 318 | 284 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 6.1 | 7.1 | 7.1 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 155 | 180 | 180 | 224 |
| E - Center to Top (Open) | | 11.5 | 11.5 | 11.5 | 15.9 | 15.9 | 17.7 | 19.6 | 19.6 | 20.0 |
| | | 292 | 292 | 292 | 404 | 404 | 450 | 498 | 498 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 14.3* | 14.3* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 363* | 363* | 363* | 406** | 406** | 406** |
| Weight, Welded | | 19 | 19 | 19 | 36 | 36 | 57 | 100 | 100 | 138 |
| | | 9 | 9 | 9 | 16 | 16 | 26 | 46 | 46 | 63 |
| Weight, Unwelded | | 20 | 20 | 20 | 38 | 38 | 59 | 104 | 104 | 142 |
| | | 9 | 9 | 9 | 17 | 17 | 27 | 47 | 47 | 64 |

** Impactor Handle  ** Impactor Handwheel*

# Univalve® Piston Check Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)






36174

## Standard Features

- Available Body Materials
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded cover.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.

## Pressure Class 1690 (PN 290)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 36170 | 36270 | Y-Pattern | Threaded | ½ (15) thru 1 (25) |
| 36174 | 36274 | Y-Pattern | Socket Welding | ½ (15) thru 2-½ (65) |
| 36178 | 36278 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

- Stainless steel spring. (Optional without springs, see page Technical Information section, 1.3 Check and Stop-Check Valve Installation Guidelines. Spring is not available on F91 Fig. No. 36170, 36174, and 36178 valves.)

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36170, 36174, 36178, 36270, 36274, 36278 | | ½ | ¾ | 1 | 1-¼ | 1-½ | 2 | 2-½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1-¼ | 1-½ | 2 | 2-½ | 3 | 4 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 8.2 | 10.7 | 10.7 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 208 | 272 | 272 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 3.64 | 4.00 | 4.00 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 92 | 102 | 102 | 122 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 6.1 | 7.1 | 7.1 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 155 | 180 | 180 | 224 |
| E - Center to Top | | 3.9 | 3.9 | 3.9 | 5.0 | 5.0 | 5.8 | 7.2 | 7.2 | 7.8 |
| | | 99 | 99 | 99 | 127 | 127 | 147 | 183 | 183 | 198 |
| Weight | | 14 | 14 | 14 | 22 | 22 | 31 | 44 | 44 | 86 |
| | | 6 | 6 | 6 | 10 | 10 | 14 | 20 | 20 | 39 |



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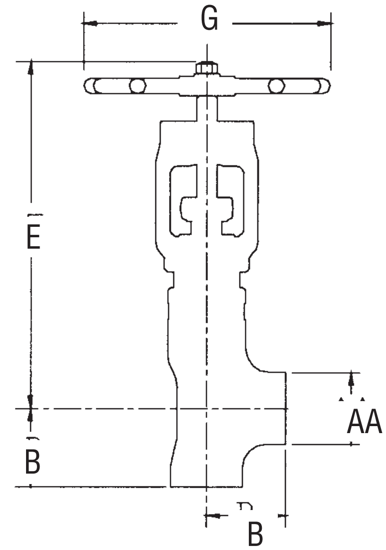
# Univalve® Angle Stop Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)




## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or Welded Bonnet.
- OS&Y.
- Angle Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 1690 (PN 290)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 36125 | 36225 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 36129 | 36229 | Angle | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral Backseat.
- Asbestos-free graphitic packing.

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36125, 36129, 36225, 36229 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 3.6 | 4.0 | 4.0 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 91 | 102 | 102 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.1 | 4.5 | 4.5 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 104 | 114 | 114 | 135 |
| E - Center to Top (Open) | | 11.7 | 11.7 | 11.7 | 14.9 | 14.9 | 17.3 | 19.1 | 19.1 | 19.7 |
| | | 297 | 297 | 297 | 378 | 378 | 439 | 485 | 485 | 500 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 14.3* | 14.3* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 363 | 363 | 363 | 406 | 406 | 406 |
| Weight, Welded | | 18 | 18 | 18 | 40 | 40 | 60 | 103 | 103 | 139 |
| | | 8.2 | 8.2 | 8.2 | 18.1 | 18.1 | 27.2 | 46.7 | 46.7 | 63.0 |
| Weight, Unwelded | | 19 | 19 | 19 | 42 | 42 | 62 | 107 | 107 | 143 |
| | | 8.6 | 8.6 | 8.6 | 19.1 | 19.1 | 28.1 | 48.5 | 48.5 | 64.9 |

** Impactor Handle **Impactor Handwheel*



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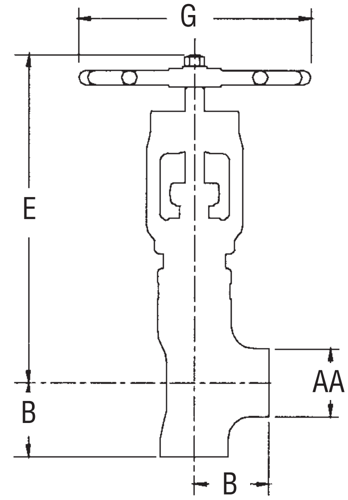
# Univalve® Angle Stop-Check Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)




## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or Welded Bonnet.
- OS&Y.
- Angle Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 1690 (PN 290)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 36165 | 36265 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 36169 | 36269 | Angle | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral Backseat.
- Asbestos-free graphitic packing.

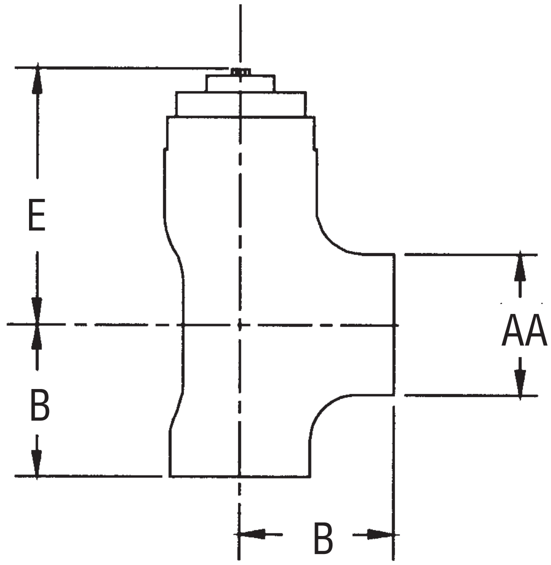
## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36165, 36169, 36265, 36269 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 3.6 | 4.0 | 4.0 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 91 | 102 | 102 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.1 | 4.5 | 4.5 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 104 | 114 | 114 | 135 |
| E - Center to Top (Open) | | 11.7 | 11.7 | 11.7 | 14.9 | 14.9 | 17.3 | 19.1 | 19.1 | 19.7 |
| | | 297 | 297 | 297 | 378 | 378 | 439 | 485 | 485 | 500 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 14.3* | 14.3* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 363 | 363 | 363 | 406 | 406 | 406 |
| Weight, Welded | | 18 | 18 | 18 | 40 | 40 | 60 | 103 | 103 | 139 |
| | | 8.2 | 8.2 | 8.2 | 18.1 | 18.1 | 27.2 | 46.7 | 46.7 | 63.0 |
| Weight, Unwelded | | 19 | 19 | 19 | 42 | 42 | 62 | 107 | 107 | 143 |
| | | 8.6 | 8.6 | 8.6 | 19.1 | 19.1 | 28.1 | 48.5 | 48.5 | 64.9 |

** Impactor Handle    **Impactor Handwheel*

# *Univalve® Angle Check Valves, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)*




## *Standard Features*

- Available Body Material
  – A105 carbon steel.
  – F22 alloy steel.
  – F91 alloy steel.
  – F316, F347 stainless steel.
  – Other material on application.
- Unwelded (graphitic seal) or Welded Cover.
- Angle Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Stainless steel spring. (Optional without spring, see page G14.Stainless steel spring. Spring is not available on F91 Fig. No. 36175 and 36179 valves.)

## *Pressure Class 1690 (PN 290)*

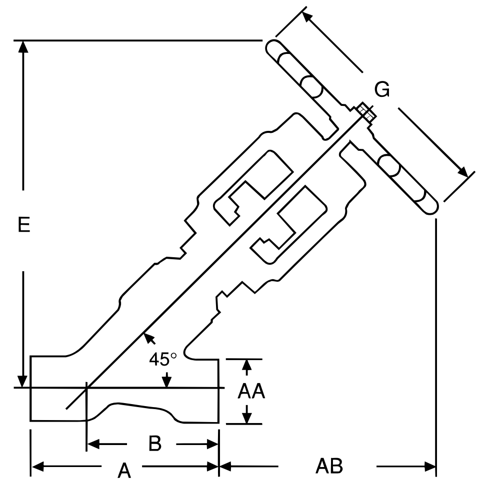
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| **Welded** | **Unweld.** | | | |
| 36175 | 36275 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 36179 | 36279 | Angle | Buttwelding | ½ (15) thru 4 (100) |

## *Dimensions - Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 36175, 36179, 36275, 36279 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 3.6 | 4.0 | 4.0 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 91 | 102 | 102 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.1 | 4.5 | 4.5 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 104 | 114 | 114 | 135 |
| E - Center to Top | | 4.6 | 4.6 | 4.6 | 5.7 | 5.7 | 6.2 | 7.2 | 7.2 | 7.8 |
| | | 117 | 117 | 117 | 145 | 145 | 157 | 183 | 183 | 198 |
| Weight | | 8 | 8 | 8 | 21 | 21 | 30 | 41 | 41 | 76 |
| | | 3.6 | 3.6 | 3.6 | 9.5 | 9.5 | 13.6 | 18.6 | 18.6 | 34.5 |

# Univalve® Stop Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)




66124

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Integral backseat.
- Asbestos free graphitic packing.

## Pressure Class 2680 (PN 460)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 66120 | 66220 | Y-Pattern | Threaded* | ½ (15) thru 1 (25) |
| 66124 | 66224 | Y-Pattern | Socket Welding | ½ (15) thru 2-½ (65) |
| 66128 | 66228 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

** Threaded end valves are limited to Pressure Class 2500.*

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 66120, 66124, 66128, 66220, 66224, 66228 | NPS | ½ | ¾ | 1 | 1-¼ | 1-½ | 2 | 2-½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 10.7 | 12.8 | 12.8 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 272 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 4.00 | 4.80 | 4.80 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 102 | 122 | 122 | 122 |
| AB - Handwheel Clearance, (Open) | | 7.5 | 7.5 | 7.5 | 9.8 | 9.8 | 11.6 | 11.2 | 11.2 | 11.2 |
| | | 191 | 191 | 191 | 249 | 249 | 296 | 284 | 284 | 284 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 7.1 | 8.8 | 8.8 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 180 | 224 | 224 | 224 |
| E - Center to Top, (Open) | | 11.5 | 11.5 | 11.5 | 14.6 | 14.6 | 18.6 | 20.0 | 20.0 | 20.0 |
| | | 292 | 292 | 292 | 371 | 371 | 472 | 508 | 508 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 11.0* | 11.0* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 279* | 279* | 363* | 406** | 406** | 406** |
| Weight, Welded | | 19 | 19 | 19 | 34 | 34 | 79 | 142 | 142 | 142 |
| | | 9 | 9 | 9 | 16 | 16 | 36 | 65 | 65 | 65 |
| Weight, Unwelded | | 20 | 20 | 20 | 36 | 36 | 83 | 146 | 146 | 146 |
| | | 9 | 9 | 9 | 17 | 17 | 38 | 66 | 66 | 66 |

** Impactor Handle    ** Impactor Handwheel*



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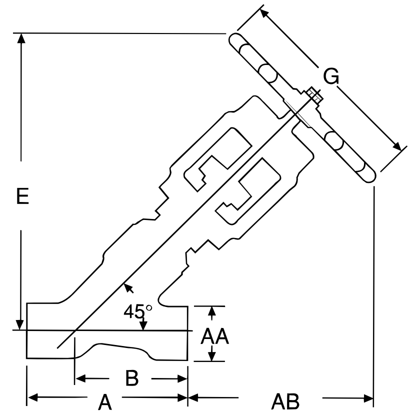
# Univalve® Stop-Check Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)




66164

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 2680 (PN 460)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 66160 | 66260 | Y-Pattern | Threaded* | ½ (15) thru 1 (25) |
| 66164 | 66264 | Y-Pattern | Socket Welding | ½ (15) thru 2½ (65) |
| 66168 | 66268 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

**Threaded end valves are limited to Pressure Class 2500*

- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 66160, 66164, 66168, 66260, 66264, 66268 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 10.7 | 12.8 | 12.8 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 272 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 4.00 | 4.80 | 4.80 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 102 | 122 | 122 | 122 |
| AB - Handwheel Clearance (Open) | | 7.5 | 7.5 | 7.5 | 9.8 | 9.8 | 11.6 | 11.2 | 11.2 | 11.2 |
| | | 191 | 191 | 191 | 249 | 249 | 295 | 284 | 284 | 284 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 7.1 | 8.8 | 8.8 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 180 | 224 | 224 | 224 |
| E - Center to Top (Open) | | 11.5 | 11.5 | 11.5 | 14.6 | 14.6 | 18.6 | 20.0 | 20.0 | 20.0 |
| | | 292 | 292 | 292 | 371 | 371 | 472 | 508 | 508 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 11.0* | 11.0* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 279* | 279* | 363* | 406** | 406** | 406** |
| Weight, Welded | | 19 | 19 | 19 | 34 | 34 | 79 | 142 | 142 | 142 |
| | | 9 | 9 | 9 | 16 | 16 | 36 | 65 | 65 | 65 |
| Weight, Unwelded | | 20 | 20 | 20 | 36 | 36 | 83 | 146 | 146 | 146 |
| | | 9 | 9 | 9 | 17 | 17 | 38 | 66 | 66 | 66 |

** Impactor Handle    **Impactor Handwheel*



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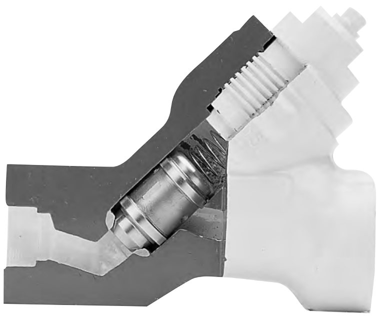
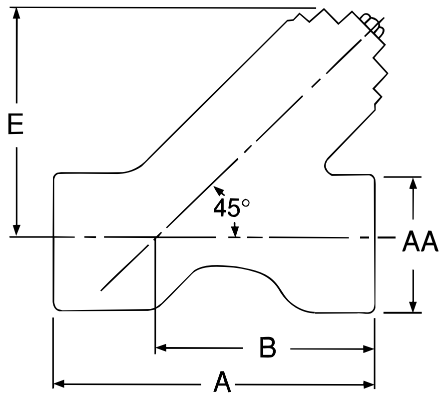
# Univalve® Piston Check Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)






66174

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded cover.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Stainless steel spring. (Optional without springs, See Technical Information section, 1.3 Check and Stop-Check Valve Installation Guidelines. Spring is not available on F91 Fig. No. 66170, 66174, and 66178 valves.)

## Pressure Class 2680 (PN 460)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 66170 | 66270 | Y-Pattern | Threaded* | ½ (15) thru 1 (25) |
| 66174 | 66274 | Y-Pattern | Socket Welding | ½ (15) thru 2½ (65) |
| 66178 | 66278 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

** Threaded end valves are limited to Pressure Class 2500.*

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 66170, 66174, 66178, 66270, 66274, 66278 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6.0 | 6.0 | 6.0 | 6.7 | 6.7 | 10.7 | 12.8 | 12.8 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 272 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 2.30 | 2.30 | 2.30 | 3.20 | 3.20 | 4.00 | 4.80 | 4.80 | 4.80 |
| | | 58 | 58 | 58 | 81 | 81 | 102 | 122 | 122 | 122 |
| B - Center to End | | 4.0 | 4.0 | 4.0 | 4.8 | 4.8 | 7.1 | 8.8 | 8.8 | 8.8 |
| | | 102 | 102 | 102 | 122 | 122 | 180 | 224 | 224 | 224 |
| E - Center to Top (Open) | | 3.9 | 3.9 | 3.9 | 5.0 | 5.0 | 7.0 | 7.8 | 7.8 | 7.8 |
| | | 99 | 99 | 99 | 127 | 127 | 178 | 198 | 198 | 198 |
| Weight | | 14 | 14 | 14 | 22 | 22 | 52 | 86 | 86 | 86 |
| | | 6 | 6 | 6 | 10 | 10 | 24 | 39 | 39 | 39 |



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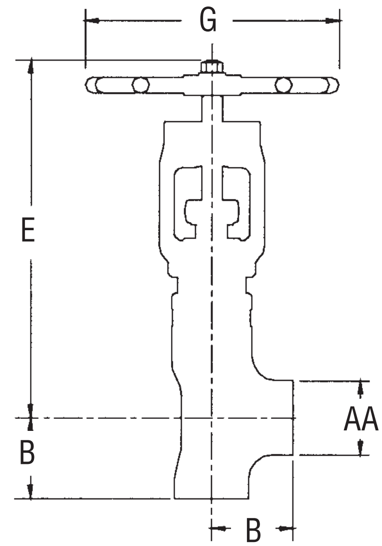
# *Univalve® Angle Stop Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)*




## *Standard Features*

- Available Body Material
  - – A105 carbon steel.
  - – F22 alloy steel.
  - – F91 alloy steel.
  - – F316, F347 stainless steel.
  - – Other material on application.
- Unwelded (graphitic seal) or Welded Bonnet.
- OS&Y.
- Angle Pattern.
- Body-guided investment cast Stellite disk.

## *Pressure Class 2680 (PN 460)*

| Fig. No. Welded | Fig. No. Unweld. | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| 66125 | 66225 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 66129 | 66229 | Angle | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral Backseat.
- Asbestos-free graphitic packing.

## *Dimensions – Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 66125, 66129, 66225, 66229 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 4.0 | 4.8 | 4.8 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 102 | 122 | 122 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.5 | 5.3 | 5.3 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 114 | 135 | 135 | 135 |
| E - Center to Top (Open) | | 11.7 | 11.7 | 11.7 | 14.9 | 14.9 | 18.2 | 19.7 | 19.7 | 19.7 |
| | | 297 | 297 | 297 | 378 | 378 | 462 | 500 | 500 | 500 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 11.0* | 11.0* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 279 | 279 | 363 | 406 | 406 | 406 |
| Weight, Welded | | 18 | 18 | 18 | 38 | 38 | 76 | 139 | 139 | 139 |
| | | 8.2 | 8.2 | 8.2 | 17.2 | 17.2 | 34.5 | 63.0 | 63.0 | 63.0 |
| Weight, Unwelded | | 19 | 19 | 19 | 40 | 40 | 80 | 143 | 143 | 143 |
| | | 8.6 | 8.6 | 8.6 | 18.1 | 18.1 | 36.3 | 64.9 | 64.9 | 64.9 |

** Impactor Handle    **Impactor Handwheel*



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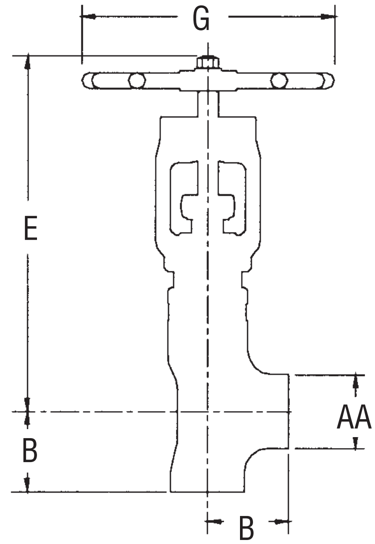
# Univalve® Angle Stop-Check Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)




## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or Welded Bonnet.
- OS&Y.
- Angle Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Integral Backseat.
- Asbestos-free graphitic packing

## Pressure Class 2680 (PN 460)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 66165 | 66265 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 66169 | 66269 | Angle | Buttwelding | ½ (15) thru 4 (100) |

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 66165, 66169, 66265, 66269 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 4.0 | 4.8 | 4.8 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 102 | 122 | 122 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.5 | 5.3 | 5.3 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 114 | 135 | 135 | 135 |
| E - Center to Top (Open) | | 11.7 | 11.7 | 11.7 | 14.9 | 14.9 | 18.2 | 19.7 | 19.7 | 19.7 |
| | | 297 | 297 | 297 | 378 | 378 | 462 | 500 | 500 | 500 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 11.0* | 11.0* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 279 | 279 | 363 | 406 | 406 | 406 |
| Weight, Welded | | 18 | 18 | 18 | 38 | 38 | 76 | 139 | 139 | 139 |
| | | 8.2 | 8.2 | 8.2 | 17.2 | 17.2 | 34.5 | 63.0 | 63.0 | 63.0 |
| Weight, Unwelded | | 19 | 19 | 19 | 40 | 40 | 80 | 143 | 143 | 143 |
| | | 8.6 | 8.6 | 8.6 | 18.1 | 18.1 | 36.3 | 64.9 | 64.9 | 64.9 |

** Impactor Handle   **Impactor Handwheel*



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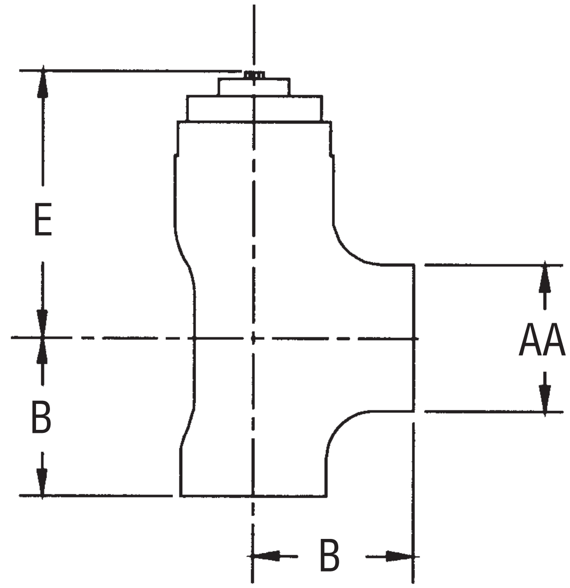
# *Univalve® Angle Check Valves, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)*




## *Standard Features*

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or Welded Cover.
- Angle Pattern.
- Body-guided investment cast Stellite disk.

## *Pressure Class 2680 (PN 460)*

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| **Welded** | **Unweld.** | | | |
| 66175 | 66275 | Angle | Socket Welding | ½ (15) thru 2½ (65) |
| 66179 | 66279 | Angle | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Stainless steel spring. (Optional without spring, see page G14. Spring is not available on F91 Fig. No. 66175 and 66179 valves.)

## *Dimensions – Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| **Figure No. 66175, 66179, 66275, 66279** | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| AA - Hub Diameter | | 2.3 | 2.3 | 2.3 | 3.8 | 3.8 | 4.0 | 4.8 | 4.8 | 4.8 |
| | | 58 | 58 | 58 | 97 | 97 | 102 | 122 | 122 | 122 |
| B - Center to End | | 2.5 | 2.5 | 2.5 | 3.6 | 3.6 | 4.5 | 5.3 | 5.3 | 5.3 |
| | | 64 | 64 | 64 | 91 | 91 | 114 | 135 | 135 | 135 |
| E - Center to Top | | 4.6 | 4.6 | 4.6 | 5.7 | 5.7 | 7.2 | 7.8 | 7.8 | 7.8 |
| | | 117 | 117 | 117 | 145 | 145 | 183 | 198 | 198 | 198 |
| Weight | | 8 | 8 | 8 | 23 | 23 | 46 | 76 | 76 | 76 |
| | | 3.6 | 3.6 | 3.6 | 10.4 | 10.4 | 20.9 | 34.5 | 34.5 | 34.5 |



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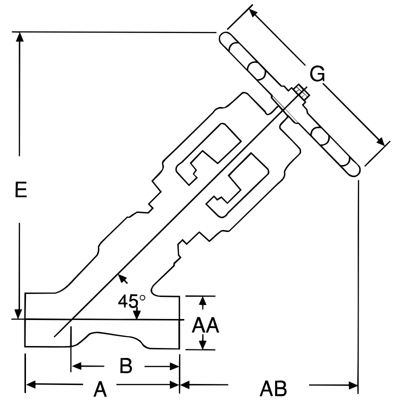
# Univalve® Stop Valves, Class 4500 11,250 PSI @ 100°F (775.7 BAR @ 38°C)




96124

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.

## Pressure Class 4500 (PN 760)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 96124 | 96224 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| 96128 | 96228 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 96124, 96128, 96224, 96228 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 12.8 | 12.8 | 12.8 | 12.8 |
| | | 208 | 208 | 208 | 208 | 208 | 325 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 3.64 | 3.64 | 3.64 | 3.64 | 3.64 | 4.80 | 4.80 | 4.80 | 4.80 |
| | | 92 | 92 | 92 | 92 | 92 | 122 | 122 | 122 | 122 |
| AB - Handwheel Clearance (Open) | | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 11.2 | 11.2 | 11.2 | 11.2 |
| | | 185 | 185 | 185 | 185 | 185 | 284 | 284 | 284 | 284 |
| B - Center to End | | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 8.8 | 8.8 | 8.8 | 8.8 |
| | | 155 | 155 | 155 | 155 | 155 | 224 | 224 | 224 | 224 |
| E - Center to Top (Open) | | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 20.0 | 20.0 | 20.0 | 20.0 |
| | | 340 | 340 | 340 | 340 | 340 | 508 | 508 | 508 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 16.0** | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 216 | 216 | 406** | 406** | 406** | 406** |
| Weight, Welded | | 43 | 43 | 43 | 43 | 43 | 158 | 158 | 158 | 158 |
| | | 20 | 20 | 20 | 20 | 20 | 72 | 72 | 72 | 72 |
| Weight, Unwelded | | 45 | 45 | 45 | 45 | 45 | 162 | 162 | 162 | 162 |
| | | 21 | 21 | 21 | 21 | 21 | 74 | 74 | 74 | 74 |

*** Impactor Handwheel*



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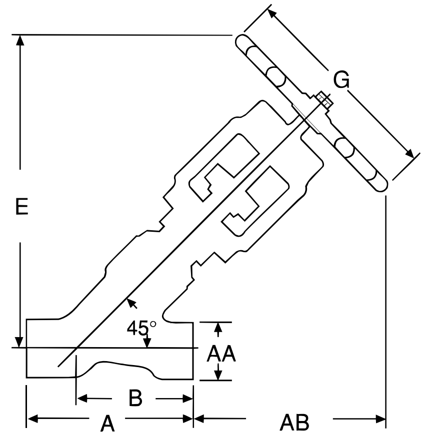
# Univalve® Stop-Check Valves, Class 4500, 11,250 PSI @ 100°F (775.7 BAR @ 38°C)




## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.

## Pressure Class 4500 (PN 760)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 96164 | 96264 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| 96168 | 96268 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Integral backseat.
- Asbestos-free graphitic packing.

## Dimensions – Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 96164, 96168, 96264, 96268 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 12.8 | 12.8 | 12.8 | 12.8 |
| | | 208 | 208 | 208 | 208 | 208 | 325 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 3.64 | 3.64 | 3.64 | 3.64 | 3.64 | 4.80 | 4.80 | 4.80 | 4.80 |
| | | 92 | 92 | 92 | 92 | 92 | 122 | 122 | 122 | 122 |
| AB - Handwheel Clearance (Open) | | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 11.2 | 11.2 | 11.2 | 11.2 |
| | | 185 | 185 | 185 | 185 | 185 | 284 | 284 | 284 | 284 |
| B - Center to End | | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 8.8 | 8.8 | 8.8 | 8.8 |
| | | 155 | 155 | 155 | 155 | 155 | 224 | 224 | 224 | 224 |
| E - Center to Top (Open) | | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 20.0 | 20.0 | 20.0 | 20.0 |
| | | 340 | 340 | 340 | 340 | 340 | 508 | 508 | 508 | 508 |
| G - Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 16.0** | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 216 | 216 | 406** | 406** | 406** | 406** |
| Weight, Welded | | 43 | 43 | 43 | 43 | 43 | 158 | 158 | 158 | 158 |
| | | 20 | 20 | 20 | 20 | 20 | 72 | 72 | 72 | 72 |
| Weight, Unwelded | | 45 | 45 | 45 | 45 | 45 | 162 | 162 | 162 | 162 |
| | | 21 | 21 | 21 | 21 | 21 | 74 | 74 | 74 | 74 |

*** Impactor Handwheel*



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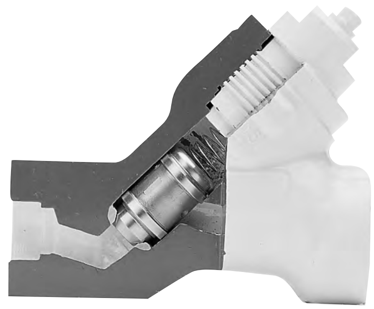
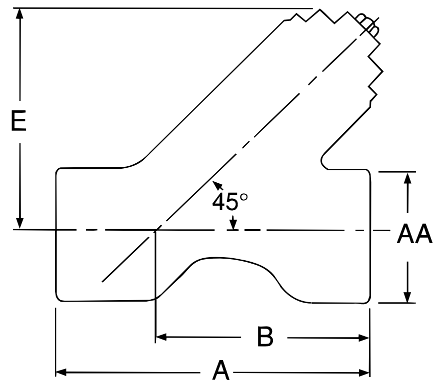
# Univalve® Piston Check Valves, Class 4500, 11,250 PSI @ 100°F (775.7 BAR @ 38°C)






96174

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
  - F316, F347 stainless steel.
  - Other material on application.
- Unwelded (graphitic seal) or welded cover.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Integral Stellite seat.
- Stainless steel spring. (Optional without springs, see page G14. Spring is not available on F91 Fig. No. 96174 and 96178 valves.)

## Pressure Class 4500 (PN 760)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| Welded | Unweld. | | | |
| 96174 | 96274 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| 96178 | 96278 | Y-Pattern | Buttwelding | ½ (15) thru 4 (100) |

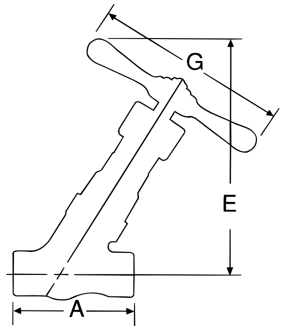
## Dimensions – Globe

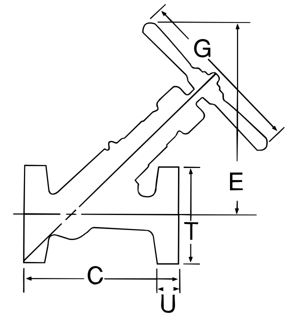
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 96174, 96178, 96274, 96278 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 12.8 | 12.8 | 12.8 | 12.8 |
| | | 208 | 208 | 208 | 208 | 208 | 325 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 3.64 | 3.64 | 3.64 | 3.64 | 3.64 | 4.80 | 4.80 | 4.80 | 4.80 |
| | | 92 | 92 | 92 | 92 | 92 | 122 | 122 | 122 | 122 |
| B - Center to End | | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 8.8 | 8.8 | 8.8 | 8.8 |
| | | 155 | 155 | 155 | 155 | 155 | 224 | 224 | 224 | 224 |
| E - Center to Top | | 5.4 | 5.4 | 5.4 | 5.4 | 5.4 | 7.9 | 7.9 | 7.9 | 7.9 |
| | | 137 | 137 | 137 | 137 | 137 | 201 | 201 | 201 | 201 |
| Weight | | 35 | 35 | 35 | 35 | 35 | 92 | 92 | 92 | 92 |
| | | 16 | 16 | 16 | 16 | 16 | 42 | 42 | 42 | 42 |

Hydraulic Stop Valves 5,000 & 10,000 PSI (345 & 690 BAR) CWP

These hydraulic valves are designed and rated to Flowserve Edward Valves standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.




*158*

## Standard Features

- Body is of forged alloy steel grade F-11.
- Bonnet is zinc coated for corrosion resistance.
- 13% chromium stainless steel replaceable seat.
- 13% chromium stainless steel stem and swivel needle disk.
- Hardfaced seat and disk standard on Figure 5158 & 9158 valves only.
- Impactor handle, size 1 and larger.
- Buna-N "O" rings at body-bonnet and body seat joints for leak-tight connection.
- Asbestos-free packing.

## 5,000 & 10,000 PSI CWP

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| 5,000 | 10,000 | | | |
| | 158 | Globe | Threaded | ¼ (6) thru 2 (50) |
| | 158Y | Globe | Socket Welding | |
| 5158 | | Globe | Flanged† Series 1500 | 2 (50) |
| | 9158 | Globe | Flanged† Series 6BX | 2-1/16 (52.4) only |

*For Pressure up to 10,000 PSI (690 BAR) - Edward high pressure forged steel hydraulic stop valves are used in applications involving high pressures and with temperatures to 300°F (149°C). They provide fast, certain shut-off or accurate pressure control, give long life, reduce replacement costs and lower maintenance time.*

## Dimensions

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 158/158Y, 5158, 9158 | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2 (5158) | 2-1/16† |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 8 | 10 | 15 | 20 | 25 | 40 | 40 | 50 | 50 | 52.4 |
| A - End to End, Globe | | 3.8 | 3.8 | 3.8 | 4.5 | 5.1 | 7.5 | 7.5 | 9 | — | — |
| | | 97 | 97 | 97 | 114 | 130 | 191 | 191 | 229 | — | — |
| C - Contact Face to Contact Face | | — | — | — | — | — | — | — | — | 13.4 | 13.3 |
| | | — | — | — | — | — | — | — | — | 340 | 338 |
| E - Center to Top, (Open) | | 8.4 | 8.4 | 8.4 | 9.6 | 12 | 14.1 | 14.1 | 18 | 17.9 | 17.9 |
| | | 213 | 213 | 213 | 244 | 305 | 358 | 358 | 457 | 455 | 455 |
| G - Handwheel/Handle Diameter | | 5.4 | 5.4 | 5.4 | 6.4 | 11* | 11* | 11* | 14* | 14* | 14* |
| | | 134 | 137 | 137 | 163 | 279 | 279 | 279 | 356 | 356 | 356 |
| T - Flange Diameter | | — | — | — | — | — | — | — | — | 8.5 | 7.9 |
| | | — | — | — | — | — | — | — | — | 216 | 201 |
| U - Flange Thickness | | — | — | — | — | — | — | — | — | 1.8 | 1.7 |
| | | — | — | — | — | — | — | — | — | 46 | 43 |
| Diameter of Ring Groove & Groove Number | | — | — | — | — | — | — | — | — | 3¾-#24 | BX-152 |
| | | — | — | — | — | — | — | — | — | — | — |
| Diameter of Bolt Circle | | — | — | — | — | — | — | — | — | 6.5 | 6.25 |
| | | — | — | — | — | — | — | — | — | 165 | 160 |
| Bolts | | — | — | — | — | — | — | — | — | (8)-7/8 | (8)-¾ |
| | | — | — | — | — | — | — | — | — | — | — |
| Weight | | 5.1 | 5.1 | 5.1 | 6.8 | 12.5 | 32 | 32 | 53 | 120 | 124 |
| | | 2.3 | 2.3 | 2.3 | 3.1 | 5.6 | 14.4 | 14.4 | 23.9 | 54 | 55.8 |

*† Flanges, Ring Joint Facings and Drilling according to A.P.I. standards. Size depicts flange size only and not port size. * Impactor Handle.*



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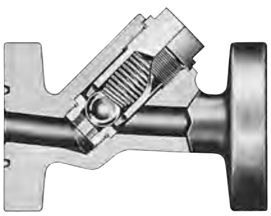
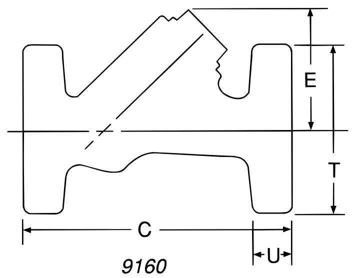
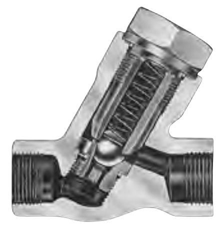
# Hydraulic Check Valves, 5,000 & 10,000 PSI (345 & 690 BAR) CWP

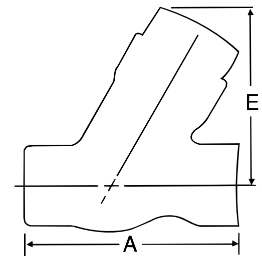
These hydraulic valves are designed and rated to Flowserve Edward Valve standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.






9160






160

## Standard Features

- Body is of forged alloy steel grade F-11.
- Carbon steel cover has a long guide for accurate ball disk seating.
- Seat and ball are 13% chromium stainless steel.
- Hardfaced seat standard on figure 5160 and 9169 only.
- Ball is precision ground for tight seating.
- Stainless steel spring capable of seating the ball disk in viscous fluids.
- Body-cover and body-seat joints have Buna-N "O" rings for leak tight connections.

## 5,000 & 10,000 PSI CWP

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| 5,000 | 10,000 | | | |
| | 160 | Globe | Threaded | ¼ (6) thru 2 (50) |
| | 160Y | Globe | Socket Welding | |
| 5160 | | Globe | Flanged* Series 1500 | 2 (50) |
| | 9160 | Globe | Flanged* Series 6BX | 2-1⁄16 (52.4) only |

*Recommended for use with high viscosity fluids only.*
*For pressure up to 10,000 PSI (690 BAR) - Edward high pressure forged steel hydraulic check valves are used in applications involving high pressures and with temperatures to 300°F (149°C).*

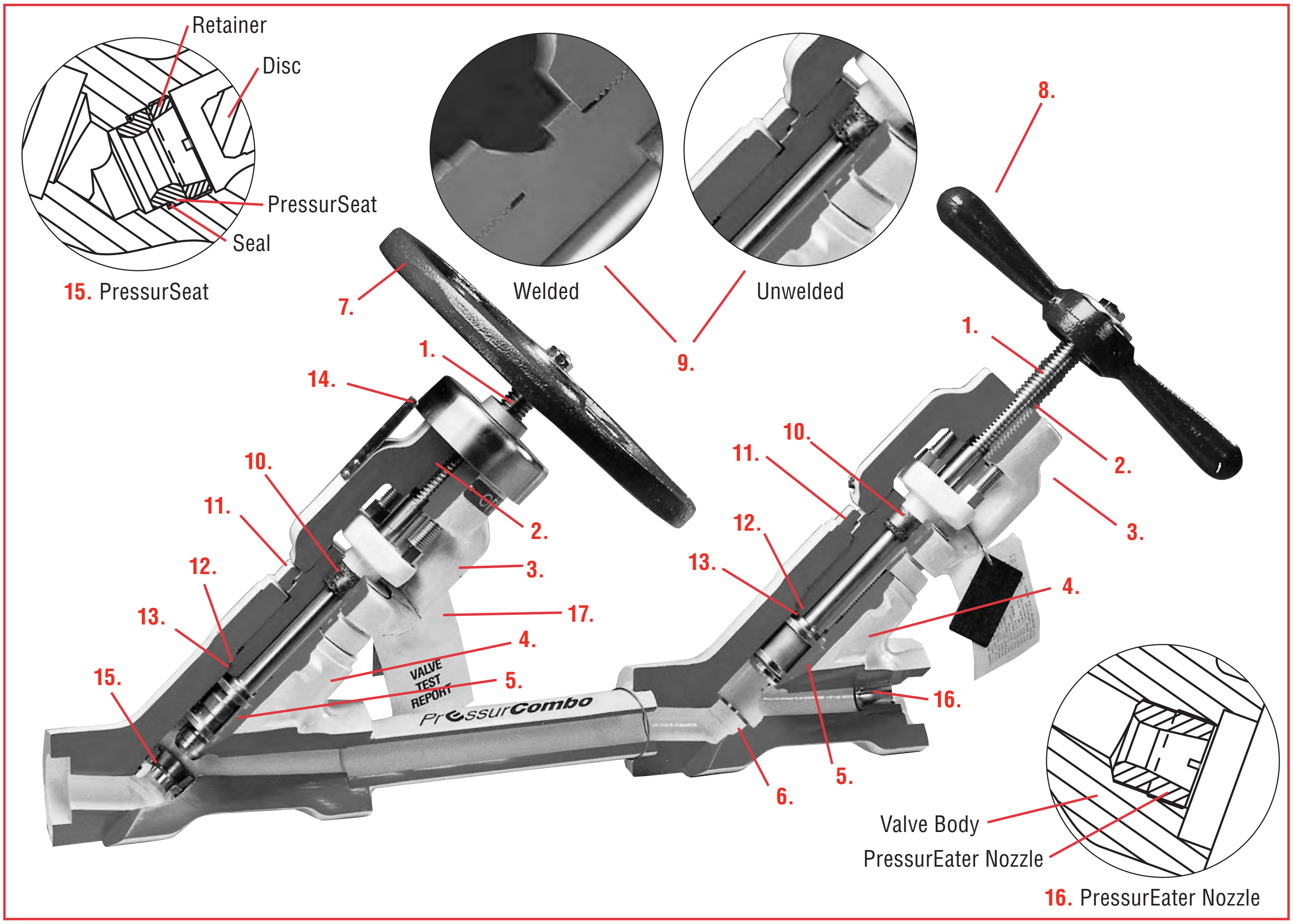
## Dimensions

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 160/160Y, 5160, 9160 | NPS | ¼ | ⅜ | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2 (5150) | 2-1⁄16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 8 | 10 | 15 | 20 | 25 | 40 | 40 | 50 | 50 | 52.4 |
| A - End to End | | 3.8 | 3.8 | 3.8 | 4.5 | 5.1 | 7.5 | 7.5 | 9 | — | — |
| | | 97 | 97 | 97 | 114 | 130 | 191 | 191 | 229 | — | — |
| C - Contact Face to Contact Face | | — | — | — | — | — | — | — | — | 13.4 | 13.3 |
| | | — | — | — | — | — | — | — | — | 340 | 338 |
| E - Center to Top | | 3 | 3 | 3 | 3.3 | 4.4 | 5.2 | 5.2 | 7.3 | 6.1 | 6.1 |
| | | 76 | 76 | 76 | 84 | 112 | 132 | 132 | 185 | 155 | 155 |
| T - Flange Diameter | | — | — | — | — | — | — | — | — | 8.5 | 7.9 |
| | | — | — | — | — | — | — | — | — | 216 | 201 |
| U - Flange Thickness | | — | — | — | — | — | — | — | — | 1.8 | 1.7 |
| | | — | — | — | — | — | — | — | — | 46 | 43 |
| Diameter of Ring Groove & Groove Number | | — | — | — | — | — | — | — | — | 3¾-#24 | BX-152 |
| | | — | — | — | — | — | — | — | — | 95 | — |
| Diameter of Bolt Circle | | — | — | — | — | — | — | — | — | 6.5 | 6.25 |
| | | — | — | — | — | — | — | — | — | 165 | 159 |
| Bolts | | — | — | — | — | — | — | — | — | (8)-7/8 | (8)-¾ |
| | | — | — | — | — | — | — | — | — | — | — |
| Weight | | 2.6 | 2.6 | 2.6 | 4 | 7 | 19 | 19 | 34 | 101 | 105 |
| | | 1.2 | 1.2 | 1.2 | 1.8 | 3.2 | 8.6 | 8.6 | 15.3 | 45.5 | 47.3 |

** Flanges, Ring Joint Facings and Drilling according to A.P.I. standards. Size depicts flange size only and not port size.*

# Features and Description of Edward PressurCombo Valves




*Note: Also available as a single valve.*

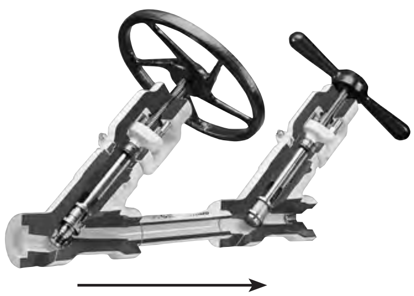
1. **Stem** has ACME threads, is ground to a fine finish and is hardened to resist wear.
2. **Yoke** bushing material has low coefficient of friction which substantially reduces torque and stem wear and eliminates galling. Mechanical upset locks bushing to yoke.
3. **Yoke-bonnet** assembly is two-piece to facilitate disassembly for faster in-line internal repairs.
4. **Inclined stem** construction and optimum flow shape minimizes flow direction changes and reduces pressure drop.
5. **Body-guided disk** utilizes anti-thrust rings to eliminate misalignment, galling and stem bending.
6. **Integral hardsurfaced seat** provides positive shutoff and long seat life.
7. **Handwheel** is rugged and knobbed to provide sure grip even when wearing gloves.
8. **Impactor handle** provides many times the closing force of an ordinary handwheel for positive seating.
9. **Threaded bonnet** has ACME threads for resistance to galling and ease of disassembly.
10. **Stem packing** system utilizes flexible graphite packing material with carbon fiber anti-extrusion rings for optimum sealability and life.
11. **Bonnet locking collar.**
12. **Bonnet seal ring** is die formed flexible graphite seated to a prescribed bonnet torque to provide reliable bonnet seal.
13. **Integral backseat** provides a secondary stem seal backup for positive shutoff and leak protection.
14. **Position indicator** provides positive indication of closed valve.
15. **PressurSeat** features live-loaded, pressure-energized Stellite seat, providing tight shut-off under varying pressures and temperatures.
16. **PressurEater nozzle** prevents excess wear on valve seat.
17. **Valve test report** is an actual report of the individual valve hydrostatic test.
18. **Nameplate** contains all relevant data for operational and maintenance records.

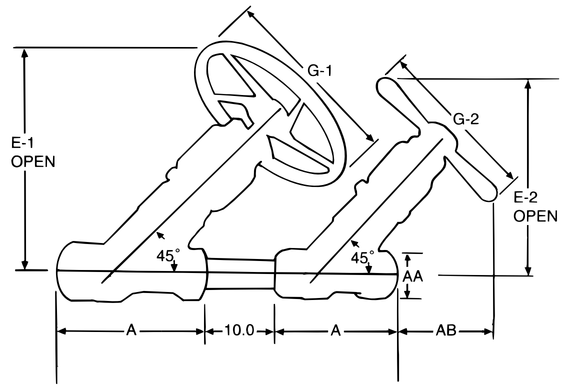
# PressurCombo, Class 1690, 4225 PSI @ 100°F (291.3 BAR @ 38°C)

Maximum Recommended Differential Pressure = 4200 Psi (289.7 Bar)

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
- Available as tandem assembly or individual valves.**
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Investment cast Stellite seat in PressurSeat and PressurCombo.
- Integral Stellite seat in PressurEater.
- PressurEater & PressurCombo have outlet choke/nozzles.
- Integral Stellite backseat.
- Asbestos-free graphitic packing.
- PressurSeat and PressurCombo have position indicators.




## Pressure Class 1690 (PN 290)

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| WELDED | UNWELD. | | | |
| **36124 | **36224 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| **36128 | **36228 | Y-Pattern | Buttwelding | 2½ (65) thru 4 (100) |

*** DS36xxx PressurSeat — Inv. cast Stellite seat*
*DE36xxx PressurEater — Integral Stellite seat, choke*
*DC36xxx PressurCombo — Inv. cast Stellite seat, choke*

## Dimensions - Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. **36124, **36128, **36224, **36228 | | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 6 | 6 | 6 | 6.7 | 6.7 | 8.2 | 10.7 | 10.7 | 12.8 |
| | | 152 | 152 | 152 | 170 | 170 | 208 | 272 | 272 | 325 |
| AA - End Hub Diameter | | 3.20 | 3.20 | 3.20 | 3.20 | 3.20 | 3.64 | 4.00 | 4.00 | 4.8 |
| | | 81 | 81 | 81 | 81 | 81 | 92 | 102 | 102 | 122 |
| AB - Handwheel Clearance, (Open) | | 7.8 | 7.8 | 7.8 | 9.8 | 9.8 | 11.6 | 12.5 | 12.5 | 11.2 |
| | | 198 | 198 | 198 | 249 | 249 | 295 | 318 | 318 | 284 |
| E - 1 Center to Top, (Open) | | 12.2 | 12.2 | 12.2 | 13.7 | 13.7 | 17.1 | 20.3 | 20.3 | 20.7 |
| | | 310 | 310 | 310 | 348 | 348 | 434 | 516 | 516 | 526 |
| E - 2 Center to Top (Open) | | 12.1 | 12.1 | 12.1 | 14.6 | 14.6 | 17.7 | 19.6 | 19.6 | 20.0 |
| | | 307 | 307 | 307 | 371 | 371 | 450 | 498 | 498 | 508 |
| G - 1 Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 14.0 | 18.0 | 18.0 | 18.0 |
| | | 216 | 216 | 216 | 216 | 216 | 356 | 457 | 457 | 457 |
| G - 2 Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 11.0* | 11.0* | 14.3* | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 279 | 279 | 363* | 406** | 406** | 406** |
| Weight, Welded (Tandem DS/DE) | | 51 | 51 | 51 | 79 | 79 | 124 | 210 | 210 | 286 |
| | | 23 | 23 | 23 | 36 | 36 | 56 | 95 | 95 | 130 |
| Weight, Unwelded (Tandem DS/DE) | | 53 | 53 | 53 | 83 | 83 | 128 | 218 | 218 | 294 |
| | | 24 | 24 | 24 | 38 | 38 | 58 | 99 | 99 | 133 |

** Impactor Handle    ** Impactor Handwheel*

*Flow coefficients are listed on page G32.*

FLOWSERVE

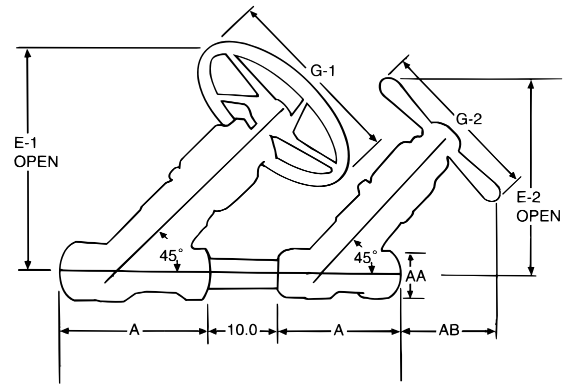
# PressurCombo, Class 2680, 6700 PSI @ 100°F (461.9 BAR @ 38°C)

Maximum Recommended Differential Pressure = 4500 psi (310.3 bar)

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
- Available as tandem assembly or individual valves.**
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Investment cast Stellite seat in PressurSeat and PressurCombo.
- Integral Stellite seat in PressurEater.
- PressurEater & PressurCombo have outlet choke/nozzles.
- Integral Stellite backseat.
- Asbestos-free graphitic packing.
- PressurSeat and PressurCombo have position indicators.v

Flow, DP




## Pressure Class 2680 (PN 460)

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| WELDED | UNWELD. | | | |
| **66124 | **66224 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| **66128 | **66228 | Y-Pattern | Buttwelding | 2½ (65) thru 4 (100) |

***DS66xxx PressurSeat — Inv. cast Stellite seat*
*DE66xxx PressurEater — Integral Stellite seat, choke*
*DC66xxx PressurCombo — Inv. cast Stellite seat, choke*

## Dimensions - Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. **66124, **66128, **66224, **66228, | NPS / DN | ½ / 15 | ¾ / 20 | 1 / 25 | 1¼ / 32 | 1½ / 40 | 2 / 50 | 2½ / 65 | 3 / 80 | 4 / 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| A - End to End | in | 6 | 6 | 6 | 6.7 | 6.7 | 10.7 | 12.8 | 12.8 | 12.8 |
| | mm | 152 | 152 | 152 | 170 | 170 | 272 | 325 | 325 | 325 |
| AA - End Hub Diameter | in | 3.20 | 3.20 | 3.20 | 3.20 | 3.20 | 4.00 | 4.80 | 4.80 | 4.80 |
| | mm | 81 | 81 | 81 | 81 | 81 | 102 | 122 | 122 | 122 |
| AB - Handwheel Clearance (Open) | in | 7.8 | 7.8 | 7.8 | 9.8 | 9.8 | 11.6 | 11.2 | 11.2 | 11.2 |
| | mm | 198 | 198 | 198 | 249 | 249 | 295 | 285 | 285 | 285 |
| E - 1 Center to Top (Open) | in | 12.2 | 12.2 | 12.2 | 13.7 | 13.7 | 18.5 | 20.7 | 20.7 | 20.7 |
| | mm | 310 | 310 | 310 | 348 | 348 | 470 | 526 | 526 | 526 |
| E - 2 Center to Top (Open) | in | 12.1 | 12.1 | 12.1 | 14.6 | 14.6 | 18.6 | 20.0 | 20.0 | 20.0 |
| | mm | 307 | 307 | 307 | 371 | 371 | 472 | 508 | 508 | 508 |
| G - 1 Handwheel/Handle Diameter | in | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 14 | 18 | 18 | 18 |
| | mm | 216 | 216 | 216 | 216 | 216 | 356 | 457 | 457 | 457 |
| G - 2 Handwheel/Handle Diameter | in | 8.5 | 8.5 | 8.5 | 11* | 11* | 14.3* | 16** | 16** | 16** |
| | mm | 216 | 216 | 216 | 279* | 279* | 363* | 406** | 406** | 406** |
| Weight, Welded (Tandem DS/DE) | lb | 51 | 51 | 51 | 79 | 79 | 167 | 298 | 298 | 298 |
| | kg | 23 | 23 | 23 | 36 | 36 | 76 | 135 | 135 | 135 |
| Weight, Unwelded (Tandem DS/DE) | lb | 53 | 53 | 53 | 83 | 83 | 169 | 306 | 306 | 306 |
| | kg | 24 | 24 | 24 | 38 | 38 | 77 | 139 | 139 | 139 |

** Impactor Handle* *** Impactor Handwheel*

*Weights are listed for tandem assembly combo. Flow coefficients are listed on page G32.*



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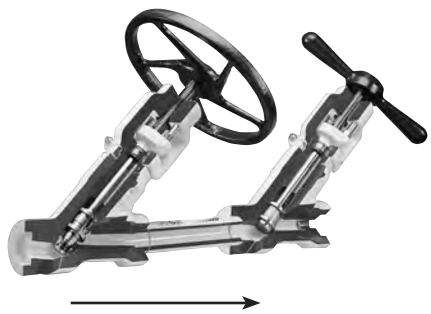
# PressurCombo, Class 4500, 11,250 PSI @ 100°F (775.7 BAR @ 38°C)

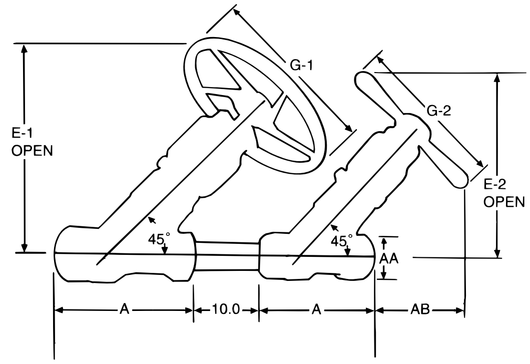
Maximum Recommended Differential Pressure = 5000 psi (344.8 bar)

## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F91 alloy steel.
- Available as tandem assembly or individual valves.**
- Unwelded (graphitic seal) or welded bonnet.
- OS & Y.
- Y-Pattern.
- Body-guided investment cast Stellite disk.
- Investment cast Stellite seat in PressurSeat and PressurCombo.
- Integral Stellite seat in PressurEater.
- PressurEater & PressurCombo have outlet choke/nozzles.
- Integral Stellite backseat.
- Asbestos-free graphitic packing.
- PressurSeat and PressurCombo have position indicators.



Flow, DP




## Pressure Class 4500 (PN 760)

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| WELDED | UNWELD. | | | |
| **96124 | **96224 | Y-Pattern | Socket Welding | ½ (15) thru 2 (50) |
| **96128 | **96228 | Y-Pattern | Buttwelding | 2½ (65) thru 4 (100) |

***DS96xxx PressurSeat — Inv. cast Stellite seat*
*DE96xxx PressurEater — Integral Stellite seat, choke*
*DC696xxx PressurCombo — Inv. cast Stellite seat, choke*

## Dimensions - Globe

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

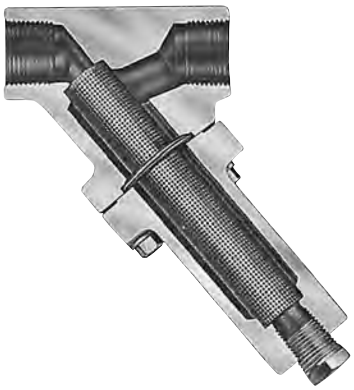
| Figure No. **96124, **96128, **96224, **96228 | NPS | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
| A - End to End | | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 12.8 | 12.8 | 12.8 | 12.8 |
| | | 208 | 208 | 208 | 208 | 208 | 325 | 325 | 325 | 325 |
| AA - End Hub Diameter | | 3.64 | 3.64 | 3.64 | 3.64 | 3.64 | 4.80 | 4.80 | 4.80 | 4.80 |
| | | 92 | 92 | 92 | 92 | 92 | 122 | 122 | 122 | 122 |
| AB - Handwheel Clearance (Open) | | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 11.2 | 11.2 | 11.2 | 11.2 |
| | | 185 | 185 | 185 | 185 | 185 | 284 | 284 | 284 | 284 |
| E - 1 Center to Top (Open) | | 13.1 | 13.1 | 13.1 | 13.1 | 13.1 | 19.1 | 19.1 | 19.1 | 19.1 |
| | | 333 | 333 | 333 | 333 | 333 | 485 | 485 | 485 | 485 |
| E - 2 Center to Top (Open) | | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 20.0 | 20.0 | 20.0 | 20.0 |
| | | 340 | 340 | 340 | 340 | 340 | 508 | 508 | 508 | 508 |
| G - 1 Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 14.0 | 14.0 | 14.0 | 14.0 |
| | | 216 | 216 | 216 | 216 | 216 | 356 | 356 | 356 | 356 |
| G - 2 Handwheel/Handle Diameter | | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 16.0** | 16.0** | 16.0** | 16.0** |
| | | 216 | 216 | 216 | 216 | 216 | 406** | 406** | 406** | 406** |
| Weight, Welded (Tandem DS/DE) | | 90 | 90 | 90 | 90 | 90 | 320 | 320 | 320 | 320 |
| | | 41 | 41 | 41 | 41 | 41 | 145 | 145 | 145 | 145 |
| Weight, Unwelded (Tandem DS/DE) | | 94 | 94 | 94 | 94 | 94 | 328 | 328 | 328 | 328 |
| | | 43 | 43 | 43 | 43 | 43 | 149 | 149 | 149 | 149 |

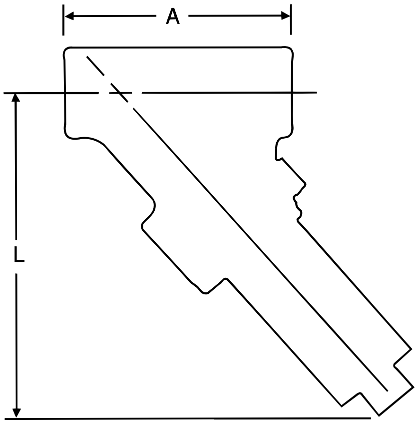
*** Impactor Handwheel*

*Flow coefficients are listed on page G32.*

# Strainers, Class 800, 2000 PSI @ 100°F (137.9 BAR @ 38°C)
# Series 1500, 3600 PSI @ 100°F (248.3 BAR @ 38°C)

The Class 800 Strainers are rated in accordance with ASME/ANSI B16.34 criteria. The Series 1500 Strainers are designed and rated to Flowserve Edward Valves standards. See 3.2 Pressure Ratings in the Technical Information section for additional information.






238/338

## Standard Features

- Bodies and covers are of forged carbon steel.
- Screen is stainless steel.
- Screen specification (400, .027 dia. holes per square inch).
- Removable drain plug for easy cleaning.

## Pressure Class 800 (PN 130) and Series 1500

| FIG. NO. | | ENDS | NPS (DN) |
|---|---|---|---|
| 800 | 1500 | | |
| 238 | 338 | Threaded | ¼ (8) thru 2 (50) |
| 238Y | 338Y | Socket Welding | |

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 238/238Y, 338/338Y | | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 |
| | DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 |
| A - End to End | | 3 | 3 | 3 | 3.6 | 4.3 | 5.8 | 5.8 | 6.5 |
| | | 76 | 76 | 76 | 91 | 109 | 147 | 147 | 165 |
| L - Center to Bottom | | 3.4 | 3.4 | 3.4 | 4.8 | 6.1 | 10.4 | 10.4 | 12.1 |
| | | 86 | 86 | 86 | 122 | 155 | 264 | 264 | 307 |
| Plug Size (NPT) | | ¼ | ¼ | ¼ | ¼ | ½ | ½ | ½ | ½ |
| | | 6 | 6 | 6 | 6 | 13 | 13 | 13 | 13 |
| Weight | | 2 | 2 | 2 | 4 | 6 | 13 | 13 | 20 |
| | | .9 | .9 | .9 | 1.8 | 2.7 | 5.9 | 5.9 | 9 |

*Special interior surface preparation for corrosive and erosive water services available on size 1 (DN 25) only.*



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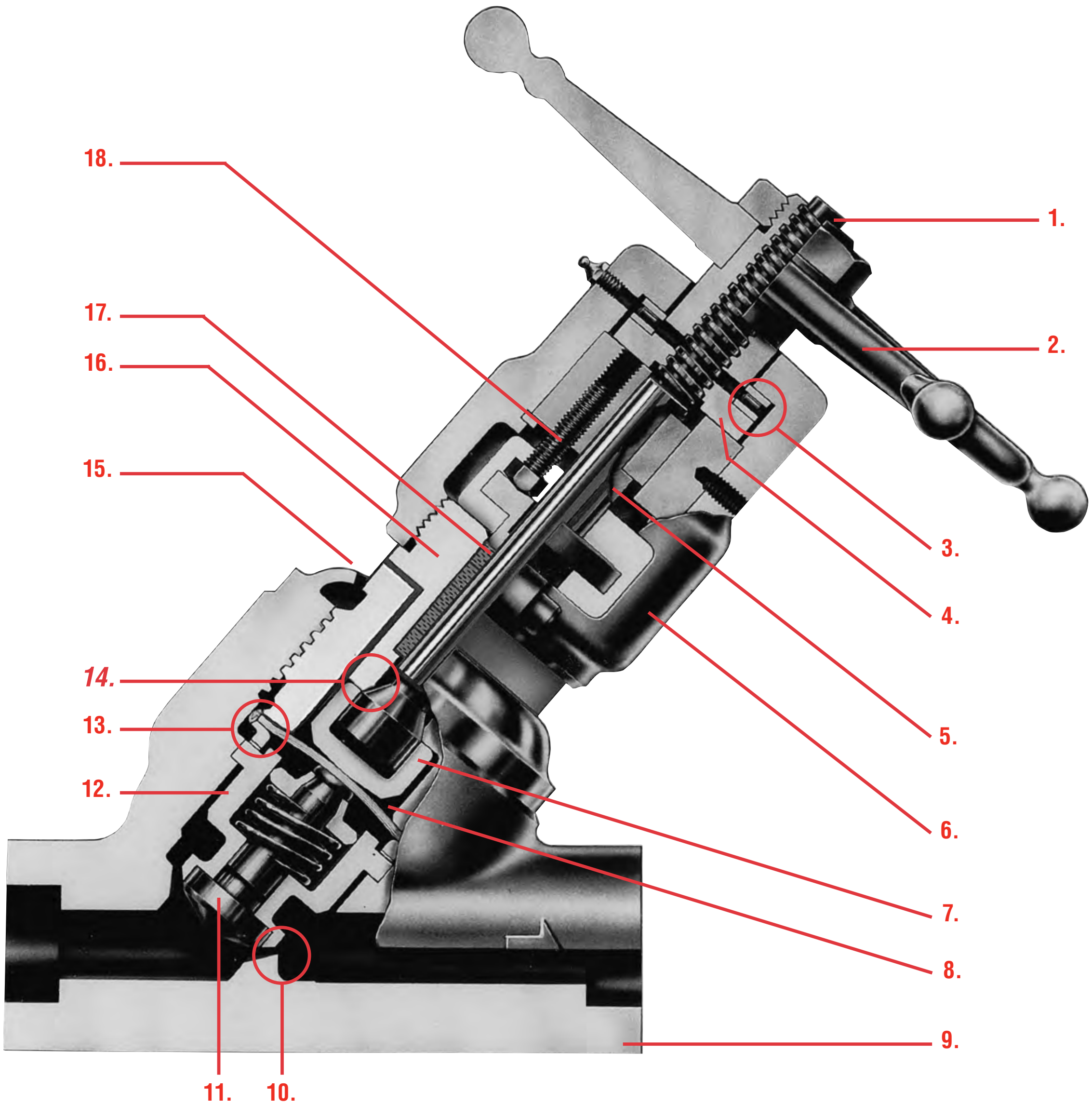
# Features and Descriptions of Edward Hermavalve® Hermetically-Sealed Valves



# Features and Descriptions of Edward Hermavalve® Hermetically-Sealed Valves

1. **Position indicator** shows whether the valve is open or closed.
2. **Handwheel** is rugged and knobbed to permit sure grip even when wearing gloves.
3. **Needle thrust bearings** minimize torque. Their upper yoke location protects from heat and allows lubrication.
4. **Yoke bushing.** Revolving bushing of aluminum bronze material has low coefficient of friction, substantially reduces torque, stem wear and eliminates galling.
5. **Non-revolving stem** is stainless steel. It is ground to a fine finish and keyed to the yoke to prevent rotation and torsional stress on the diaphragm.
6. **Yoke** of carbon steel.
7. **Diaphragm disk** is a unique shape which maximizes diaphragm life.
8. **Diaphragm** of multi-ply flexible metal provides a reliable primary stem seal.
9. **Body** with inclined stem construction and unique flow shape minimizes flow directional changes and cuts pressure drop.
10. **Integral hardfaced seat** of hard, heat resistant hardfacing material is integrally welded to the body.
11. **Solid Stellite disk** assures maximum seating life.
12. **Disk guide assembly** assures disk/seat alignment. Its completely encapsulated spring assures full disk life.
13. **Diaphragm seal weld** is a unique seal weld which makes the diaphragm an integral part of the bonnet and eliminates a potential leak path past the stem.
14. **Backseat** provides a secondary stem seal backup.
15. **Body-bonnet seal** features leak-proof seal-welded construction. The weld is for seal only; the threaded section carries the pressure load. Canopy weld in stainless steel; fillet weld in carbon steel.
16. **Bonnet** is barstock steel with gall-resistant Acme threads to ensure easy disassembly from body.
17. **Backup packing** with O.S. & Y. design allows for inspection or addition of packing without disassembling valve.
18. **Adjustable gland screws** with O.S. & Y. design allow for easy access to packing adjustment if necessary.

**What is a Hermavalve?** A Hermavalve is a hermetically sealed valve that cannot leak to the environment. The Edward Hermavalve cannot leak because it is double seal welded:

1. The multi-ply flexible metal diaphragm is seal welded to the bonnet.
2. The body-to-bonnet joint is also seal welded.

This unique construction eliminates any potential leakage through a mechanical joint. It is more than just packless, it is hermetically sealed.

**Zero leakage to environment** — Welded, heretic design and dependable metal diaphragm help to ensure zero leakage for the life of the valve. In approved services the valve is warranted against leakage to the environment.

**High efficiency flow-shape** — Unique flow shape assures high $C_v$ comparable to or greater than conventionally packed valves — proven by extensive flow testing.

**Non-revolving stem design** — Assures lowest possible operating torque and is the only absolute method of avoiding diaphragm damage caused by rotational forces from a revolving stem.

**Two backup stem seals** — 1) Packing and 2) backseat provide redundancy in backup seals.



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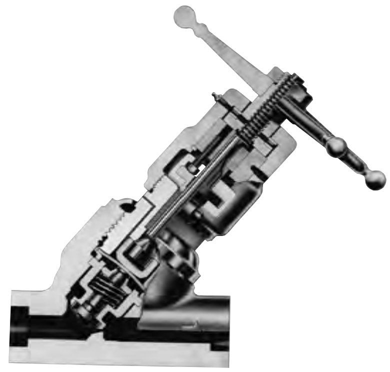
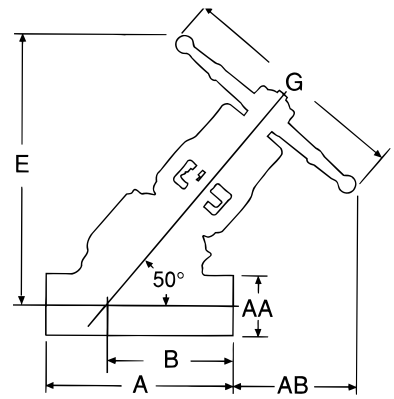
# Part Specification List For Edward Hermavalve®

| DESCRIPTION | ASTM NO. | ASTM NO. | ASTM NO. |
|---|---|---|---|
| Body | A-105 | A-182 Grade F22 | A-182 Grade F316 |
| Disk | A-565 Grade 615 | A-565 Grade 615 | A-732 Grade 21 |
| Body Seat | Stellite 21 | Stellite 21 | Stellite 21 |
| Stem | A-479 T410 Class 3 | A-479 T410 Class 3 | A-479 T410 Class 3 |
| Junk Ring | A-582 T416 | A-582 T416 | A-582 T416 |
| Bonnet | A-105 | A-739 Grade B22 | A-479 T316 |
| Yoke Bolt | A-307 Grade A | A-307 Grade A | A-307 Grade A |
| Packing | Flexible Graphite System | Flexible Graphite System | Flexible Graphite System |
| Gland | A-696 Grade C | A-696 Grade C | A-696 Grade C |
| Retaining Ring | Nickel Plated Steel | Nickel Plated Steel | Nickel Plated Steel |
| Gland Adjusting Screw | A-193 Grade B6 | A-193 Grade B6 | A-194 Grade B6 |
| Stem Guide Bushing | A-696 Grade C Nickel Plated | A-696 Grade C Nickel Plated | A-696 Grade C Nickel Plated |
| Yoke Bolt Nut | A-563 Grade A | A-563 Grade A | A-563 Grade A |
| Yoke | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| Yoke Bushing | B-150 Alloy C61900 or C62300 | B-150 Alloy C61900 or C62300 | B-150 Alloy C61900 or C62300 |
| Drive Pin | Alloy Steel | Alloy Steel | Alloy Steel |
| Key | A-331 Grade 4140 | A-331 Grade 4140 | A-331 Grade 4140 |
| Spring Housing | A-582 T416 | A-582 T416 | A-479 T316 |
| Diaphragm Ring | A-696 Grade C | A-739 Grade B22 | A-479 T316 |
| Diaphragm Assembly | B-670 Alloy 718 (Inconel) | B-670 Alloy 718 (Inconel) | B-670 Alloy 718 (Inconel) |
| Diaphragm Disk | A-732 Grade 21 | A-732 Grade 21 | A-732 Grade 21 |
| Shims | A-167 T316 | A-167 T316 | A-167 T316 |
| Disk Collar | A-565 Grade 615 | A-565 Grade 615 | A-479 T316 |
| Spring | Inconel X-750 | Inconel X-750 | Inconel X-750 |
| Handwheel | Malleable or Ductile Iron | Malleable or Ductile Iron | Malleable or Ductile Iron |
| Handwheel Nut | Steel | Steel | Steel |
| Indicator | A-479 T316 | A-479 T316 | A-479 T316 |
| Thrust Bearing | Steel | Steel | Steel |
| Lube Fitting | Steel | Steel | Steel |

# Hermavalve® Hermetically-Sealed Valves






## Standard Features

- Available Body Material
  - A105 carbon steel.
  - F22 alloy steel.
  - F316 stainless steel.
- Seal welded diaphragm and seal welded body/bonnet joint.
- OS & Y.
- Y-Pattern.
- Non-revolving stem with position indicator.
- Back-up asbestos-free graphitic packing and secondary stem backseat.
- Integral backseat.
- Knobbed handwheel.

## Pressure Class 1690 (PN 290)

| FIG. NO. | TYPE | ENDS | PORT | NPS (DN) |
|---|---|---|---|---|
| 16004 | Y-Pattern | Socket Welding | Regular | ½ (15) thru 2 (50) |
| 16008 | Y-Pattern | Buttwelding | Regular | |
| 16014 | Y-Pattern | Socket Welding | Reduced | 1 (25) thru 2½ (40) |
| 16018 | Y-Pattern | Buttwelding | Reduced | |

## Dimensions

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 16004, 16008, 16014, 16018 | NPS | ½ | ¾ | 1 | 1½ | 2 | 1 | 1½* | 2 | 2½ |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 15 | 20 | 25 | 40 | 50 | 25 | 40 | 50 | 65 |
| A - End to End | | 5.5 | 5.5 | 6.62 | 8.7 | 10 | 5.5 | 6.62 | 8.7 | 10 |
| | | 140 | 140 | 168 | 220 | 254 | 140 | 168 | 220 | 254 |
| AA - End Hub Diameter | | 2.06 | 2.06 | 2.12 | 3.4 | 3.4 | 2.06 | 2.12 | 3.4 | 3.4 |
| | | 52 | 52 | 54 | 86 | 86 | 52 | 54 | 86 | 86 |
| AB - Handwheel Clearance (Open) | | 4.62 | 4.62 | 5.69 | 9.06 | 10.88 | 4.62 | 5.69 | 9.06 | 10.88 |
| | | 117 | 117 | 145 | 230 | 276 | 117 | 145 | 230 | 276 |
| E - Center to Top | | 9.12 | 9.12 | 11.19 | 16 | 18.5 | 9.12 | 11.19 | 16 | 18.5 |
| | | 232 | 232 | 284 | 406 | 470 | 232 | 284 | 406 | 470 |
| B - Center to End | | 3.8 | 3.8 | 4.62 | 6 | 6.86 | 3.8 | 4.62 | 6 | 6.86 |
| | | 97 | 97 | 117 | 152 | 174 | 97 | 117 | 152 | 174 |
| G - Handwheel Diameter | | 7.12 | 7.12 | 8.5 | 11.5 | 15 | 7.12 | 8.5 | 11.5 | 15 |
| | | 181 | 181 | 216 | 292 | 381 | 181 | 216 | 292 | 381 |
| Weight | | 18 | 18 | 30 | 73 | 106 | 18 | 30 | 73 | 106 |
| | | 8 | 8 | 14 | 33 | 48 | 8 | 14 | 33 | 48 |

*Available in buttweld only.



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# Accessories – Forged Steel

The following "accessories" or "options" are available for Edward Forged Steel Valves. Consult your Flowserve sales representative for specific details.

## Custom Paint

Unless otherwise specified Edward Cast and Forged (carbon or alloy) Steel Valves are painted with a high temperature aluminum lacquer paint. Upon special order Edward Valves can be provided with customer specified paints or coatings.

## Locking Devices

Edward Valves can be provided with padlock & chain or other locking devices as specified.

## Position Indicators & Limit Switches

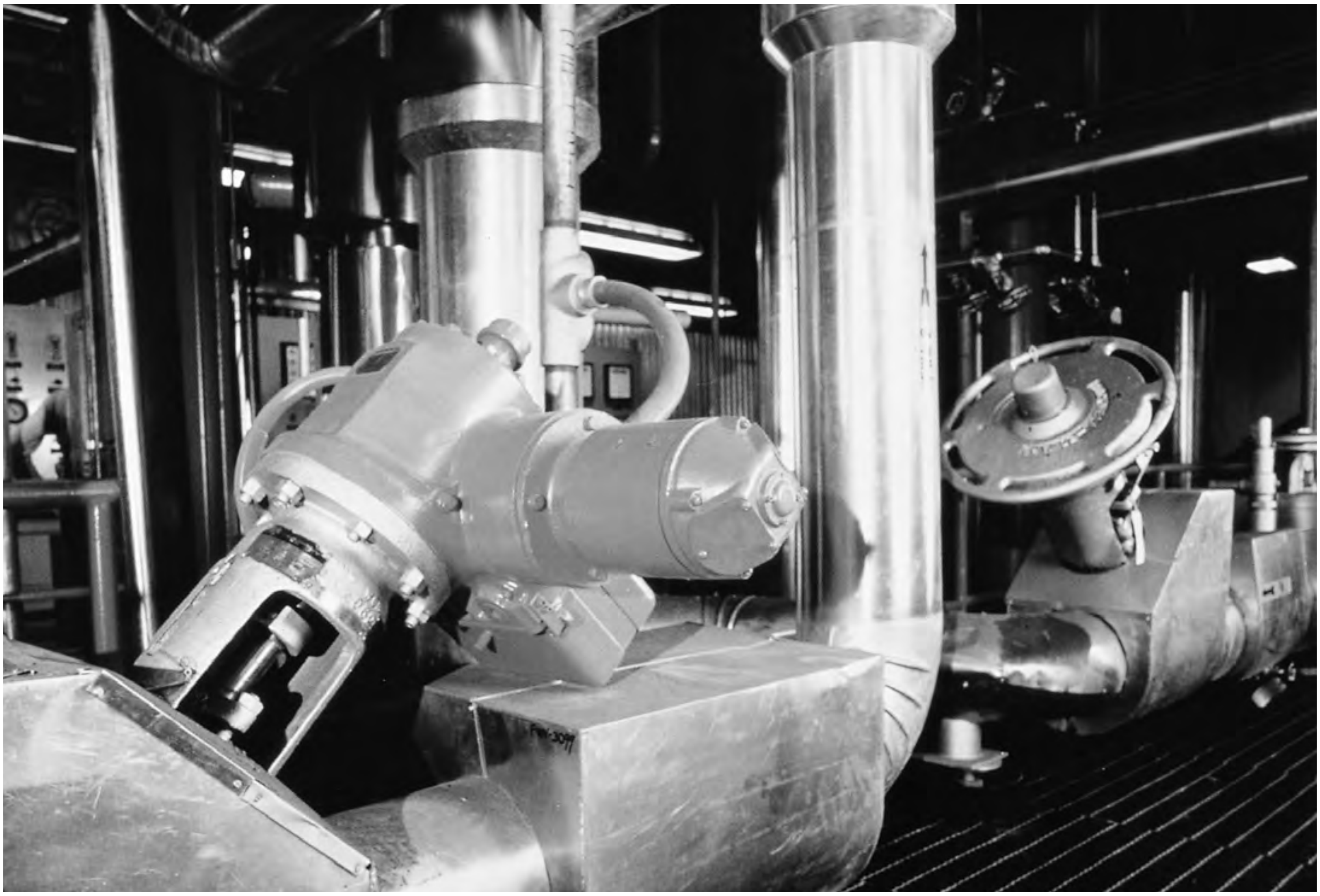
If required, Edward Valves can be fitted with a variety of position indicators and/or limit switches for remote indication.

## Soft Seats

This option is available for both Forged and Cast Steel Globe and Check Valves on a limited basis.

The disk face can be fitted with a soft seat or insert when drop tight sealing is a must. However, some limitations (temperature, differential pressure, radiation) may apply. Consult your Flowserve Edward Valves representative for more information.

# Actuators – Forged Steel



Flowserve Edward Valves supplies actuators for Edward forged and cast steel valves when alternate sources of power are required to open, close or maintain an intermediate position in the valve.

The most commonly used actuators are: electric, pneumatic, hydraulic, manual gear, or a stored energy gas hydraulic used in nuclear applications. Most Edward valves can be equipped with an actuator, if required. Where specific or special customer requirements are needed, Flowserve engineering and expertise with all types of actuators can be applied and adapted to meet the most rigid codes.

The following information on page 70 will allow Flowserve engineers to correctly size and select the proper motor actuator for your application.



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# Required Information for Motor Actuators

**1. OPERATING PRESSURES:**

A) PRESSURE UNDER SEAT = ______________________________ psig
B) PRESSURE OVER SEAT = ______________________________ psig
C) PRESSURE DIFFERENTIAL = ______________________________ psig

**2. MOTOR POWER SUPPLY*:**

A) AC = ______________ V. _______________ HZ. _______________ PH. _________________
B) DC = ______________ V.

*STANDARD VOLTAGE VARIANCE ± 10%, IF OTHERWISE, PLEASE INDICATE

**3. LIMIT SWITCH, TOTAL QUANTITY OF CONTACTS =** ____________________________________________

**4. DOUBLE TORQUE SWITCH IS STANDARD.**

**5. CONTROL POWER SUPPLY TO SWITCH COMPARTMENT =** _______________________________________

**6. CLOSING TIME:**

A) STANDARD (GLOBE VALVES APPROX. 4 IN./MIN., GATE VALVES APPROX. 12 IN./MIN. STEM SPEED.)
B) SPECIAL ________________ INDICATE REQUIRED CLOSING TIME:______________________

**7. OPTIONAL EQUIPMENT: (PLEASE INDICATE REQUIRED OPTIONS)**

A) MECHANICAL DIAL POSITION INDICATOR
B) EXTRA TERMINALS
C) REVERSING MOTOR CONTROLLER: _______________ INTEGRAL OR _______________ NON-INTEGRAL.
D) PUSH-BUTTON STATION: ______________________ INTEGRAL OR _______________ NON-INTEGRAL.
E) POSITION TRANSMITTER, INDICATE TYPE _______________________________________________
F) POSITION RECEIVER ____________________________________________________________
H) OTHERS ______________________________________________________________________
______________________________________________________________________________

**8. AMBIENT CONDITIONS:** ______________________________________________________________

**9. NEMA RATING:** *STANDARD IS NEMA 4 (WEATHERPROOF), IF OTHERWISE, PLEASE LIST*
______________________________________________________________________________

**10. STEM POSITION OF INSTALLED VALVE:**

A) VERTICAL UP-RIGHT ___________________________________
B) VERTICAL UP-SIDE DOWN_______________________________
C) HORIZONTAL _________________________________________

*Data in the Table above represents the minimum information that should be provided when ordering a valve equipped with a motor operator.*

# Material Chemical Analysis (ASTM) for Edward Valves

| MATERIAL | ELEMENTS | PERCENTAGE* | |
|---|---|---|---|
| | | CAST | FORGED |
| **Carbon Steel (Body)**<br>**Cast - ASTM A216 Grade WCB**<br>**Forged - ASTM A105** | Carbon<br>Manganese<br>Phosphorus<br>Sulfur<br>Silicon | 0.30 max.<br>1.00 max.<br>0.04 max.<br>0.045 max.<br>0.60 max. | 0.22 max.<br>.60 to 1.05<br>0.04 max.<br>0.05 max.<br>0.35 max. |

**Continued on next page**

FLOWSERVE

Continued from previous page

| MATERIAL | ELEMENTS | PERCENTAGE* CAST | FORGED | |
|---|---|---|---|---|
| **Carbon Steel (Body)** | Carbon | 0.25 max. | | |
| **Cast - ASTM A216-WCC** | Manganese | 1.20 max. | | |
| | Phosphorus | 0.04 max. | | |
| | Sulfur | 0.045 max. | | |
| | Silicon | 0.60 max. | | |
| **1¼ Chromium-Molybdenum Steel (Body)** | Carbon | 0.20 max. | 0.10 to 0.15 | |
| **Cast - ASTM A217 Grade WC6** | Manganese | 0.50 to 0.80 | 0.30 to 0.80 | |
| **Forged - ASTM A182 Grade F11** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Sulfur | 0.045 max. | 0.04 max. | |
| | Silicon | 0.60 max. | 0.50 to 1.00 | |
| | Chromium | 1.00 to 1.50 | 1.00 to 1.50 | |
| | Molybdenum | 0.45 to 0.65 | 0.44 to 0.65 | |
| **2¼ Chromium-Molybdenum Steel (Body)** | Carbon | 0.18 max. | 0.15 max. | |
| **Cast - ASTM A217 Grade WC9** | Manganese | 0.40 to 0.70 | 0.30 to 0.60 | |
| **Forged - ASTM A182 Grade F22** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Sulfur | 0.045 max. | 0.04 max. | |
| | Silicon | 0.60 max. | 0.50 max. | |
| | Chromium | 2.00 to 2.75 | 2.00 to 2.50 | |
| | Molybdenum | 0.90 to 1.20 | 0.87 to 1.13 | |
| **9 Chromium, 1 Molybdenum Steel Body** | Carbon | 0.12 max. | 0.08-0.12 max. | |
| **Cast - ASTM A-217 Grade C12A** | Manganese | 0.30-0.60 max. | 0.30-0.60 max. | |
| **Forged - ASTM A-182 Grade F91** | Phosphorus | 0.02 max. | 0.02 max. | |
| | Sulfur | 0.018 max. | 0.01 max. | |
| | Silicon | 0.20-0.50 | 0.20-0.50 max. | |
| | Chromium | 8.0-9.5 | 8.00-9.50 | |
| | Molybdenum | 0.85-1.05 | 0.85-1.05 | |
| | Columbium | 0.060-0.10 | 0.060-0.10 | |
| | Venadium | 0.18-0.25 | 0.18-0.25 | |
| | Nitrogen | 0.030-0.070 | 0.030-0.070 | |
| | Nickel | 0.40 max. | 0.40 max. | |
| **9 Chromium, 1.8 Tungsten, 0.2 Vanadium** | Carbon | | 0.07 - 0.13 | |
| **Forged - ASTM A182 Grade F92** | Manganese | | 0.30 - 0.60 | |
| | Phosphorus | | 0.02 max. | |
| | Sulfur | | 0.01 max. | |
| | Silicon | | 0.50 max. | |
| | Chromium | | 8.50 - 9.50 | |
| | Molybdenum | | 0.30 - 0.60 | |
| | Nickel | | 0.40 max. | |
| **Austenitic Stainless Steel (Body)** | Carbon | 0.03 max. | 0.08 max. | |
| **Cast - ASTM A-351 Grade CF8M** | Manganese | 1.50 max. | 2.00 max. | |
| **Forged - ASTM A-182 Grade F316** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Nickel | 9.00 to 13.00 | 10.00 to 14.00 | |
| | Sulfur | 0.04 max. | 0.03 max. | |
| | Silicon | 1.50 max. | 1.00 max. | |
| | Chromium | 17.00 to 21.00 | 16.00 to 18.00 | |
| | Molybdenum | 2.00 to 3.00 | 2.00 to 3.00 | |
| **Martensitic Stainless Steel (Stems)** | Carbon | 0.15 max. | 0.15 max. | |
| **Bolted Bonnet T416** | Manganese | 1.00 max. | 1.25 max. | |
| **Cast Valves - ASTM A182 Grade F6a** | Phosphorus | 0.04 max. | 0.06 max. | |
| **Univalves - A-479 T-410 Cl 3** | Sulfur | 0.03 max. | 0.15 min. | |
| | Silicon | 1.00 max. | 1.00 max | |
| | Nickel | 0.50 max. | — | |
| | Chromium | 11.50 to 13.50 | 12.00 to 14.00 | |
| | Molybdenum | — | 0.60 max. | |
| **Aluminum Bronze (Yoke Bushings)** | | | 61900 | 62300 |
| **Cast Valves - ASTM B 148 Alloy 95400** | Copper | remainder | remainder | remainder |
| **Forged Valves - ASTM B150 Alloy 61900-62300** | Aluminum | 10.00 to 11.50 | 8.50 to 10.00 | 8.50 to 11.00 |
| | Iron | 3.00 to 5.00 | 3.00 to 4.50 | 2.00 to 4.00 |
| | Tin | — | 0.60 max. | 0.60 max. |
| | Lead | — | 0.80 max. | — |
| | Manganese | 0.50 max. | — | 0.50 max. |
| | Zinc | — | 0.02 max. | — |
| | Silicon | — | — | 0.25 max. |
| | Nickel & Cobalt | 1.50 max. | — | 1.00 max. |
| **Chromium-Molybenum (Bolting)** | Carbon | 0.37 to 0.49 | | |
| **ASTM A193 Grade B7** | Manganese | 0.65 to 1.10 | | |
| **Forged - ASTM A105** | Phosphorus | 0.035 max. | | |
| | Sulfur | 0.04 max. | | |
| | Silicon | 0.15 to 0.35 | | |
| | Chromium | 0.75 to 1.20 | | |
| | Molybdenum | 0.15 to 0.25 | | |
| **Hard Surfacing for Seats and Disks** | Chromium | 25.00 to 29.00 | | |
| **A732 Grade 21 & Stellite 21®** | Manganese | 1.00 max. | | |
| | Molybdenum | 5.00 to 6.00 | | |
| | Nickel | 1.75 to 3.75 | | |
| | Iron | 3.00 | | |
| | Boron | .007 max. | | |
| | Carbon | 0.20 to 0.30 | | |
| | Silicon | 1.00 | | |

**The equivalent Edward valve material specification for valve bodies meets all of the requirements of the referenced ASTM Specification; additionally Flowserve restricts certain elements (i.e. carbon, manganese) to tighter allowable ranges to enhance weldability.*

This ASTM specification data is provided for customer information. The data was based on information available at time of printing and may not reflect the latest ASTM revision. Flowserve suggests referring to the applicable specification for complete information or contacting your Edward Valves sales representative.



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# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings

## Forged Steel Univalves

| MATERIAL | TEMP (°F) | PRESSURE (PSIG) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A105/ A216 WCB (4) (6) | -20 to 100 | 3705 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3395 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 300 | 3270 | 4170 | 4170 | 4750 | 4750 | 6170 | 6615 | 6615 | 11105 | 11105 |
| | 400 | 3170 | 4130 | 4130 | 4700 | 4700 | 6105 | 6545 | 6545 | 10995 | 10995 |
| | 500 | 3015 | 4130 | 4130 | 4700 | 4700 | 6105 | 6545 | 6545 | 10995 | 10995 |
| | 600 | 2840 | 4130 | 4130 | 4700 | 4700 | 6105 | 6545 | 6545 | 10995 | 10995 |
| | 650 | 2745 | 4030 | 4030 | 4590 | 4590 | 5960 | 6390 | 6390 | 10730 | 10730 |
| | 700 | 2665 | 3895 | 3895 | 4435 | 4435 | 5760 | 6175 | 6175 | 10365 | 10365 |
| | 750 | 2535 | 3570 | 3570 | 4070 | 4070 | 5285 | 5665 | 5665 | 9515 | 9515 |
| | 800 | 2055 | 2895 | 2895 | 3300 | 3300 | 4285 | 4595 | 4595 | 7715 | 7715 |
| | 850 | 1595 | 2245 | 2245 | 2560 | 2560 | 3320 | 3560 | 3560 | 5980 | 5980 |
| | 900 | 1150 | 1615 | 1615 | 1845 | 1845 | 2395 | 2565 | 2565 | 4305 | 4305 |
| | 950 | 685 | 990 | 965 | 1130 | 1100 | 1485 | 1595 | 1535 | 2745 | 2570 |
| | 1000 | 430 | 650 | 605 | 750 | 690 | 1000 | 1085 | 960 | 1990 | 1605 |
| A 182 F22 (5) (6) | -20 to 100 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 300 | 3640 | 4165 | 4165 | 4745 | 4745 | 6160 | 6605 | 6605 | 11090 | 11090 |
| | 400 | 3530 | 4100 | 4100 | 4670 | 4670 | 6065 | 6500 | 6500 | 10915 | 10915 |
| | 500 | 3325 | 4080 | 4080 | 4645 | 4645 | 6035 | 6470 | 6470 | 10865 | 10865 |
| | 600 | 3025 | 4060 | 4060 | 4625 | 4625 | 6010 | 6440 | 6440 | 10815 | 10815 |
| | 650 | 2940 | 4035 | 4035 | 4595 | 4595 | 5965 | 6395 | 6395 | 10735 | 10735 |
| | 700 | 2840 | 3985 | 3985 | 4540 | 4540 | 5895 | 6320 | 6320 | 10605 | 10605 |
| | 750 | 2660 | 3985 | 3985 | 4540 | 4540 | 5895 | 6320 | 6320 | 10605 | 10605 |
| | 800 | 2540 | 3985 | 3985 | 4540 | 4540 | 5895 | 6320 | 6320 | 10605 | 10605 |
| | 850 | 2435 | 3815 | 3815 | 4345 | 4345 | 5645 | 6050 | 6050 | 10160 | 10160 |
| | 900 | 2245 | 3380 | 3380 | 3850 | 3850 | 5000 | 5360 | 5360 | 9000 | 9000 |
| | 950 | 1930 | 2725 | 2660 | 3115 | 3025 | 4075 | 4380 | 4215 | 7555 | 7070 |
| | 1000 | 1335 | 2030 | 1880 | 2335 | 2145 | 3120 | 3375 | 2985 | 6215 | 5015 |
| | 1050 | 875 | 1330 | 1235 | 1530 | 1405 | 2040 | 2205 | 1950 | 4065 | 3280 |
| | 1100 | 550 | 835 | 770 | 960 | 880 | 1280 | 1385 | 1225 | 2545 | 2055 |
| | 1150 | 345 | 520 | 485 | 600 | 550 | 800 | 865 | 765 | 1590 | 1285 |
| | 1200 | 205 | 310 | 290 | 360 | 330 | 480 | 520 | 460 | 955 | 770 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES:* 
1. *Standard Class, Flanged Ends only.*
2. *Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
   *Limited Class Threaded ends limited to Size 1 and smaller, 1000°F maximum and Class 2500 maximum.*
3. *Special Class, Sizes 3 and 4, Butt-weld ends only.*
4. *Permissible but not recommended for prolonged usage above approx. 800°F.*
5. *Permissible but not recommended for use above 1100°F.*
6. *Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

## Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings (metric)

### Forged Steel Univalves

1 bar = 100 kPa = 14.50 psi

| MATERIAL | TEMP (°C) | PRESSURE (BAR) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A105/ A216 WCB (4) (6) | -29 to 38 | 255.3 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 250.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 100 | 233.0 | 290.9 | 290.9 | 331.3 | 331.3 | 430.3 | 461.3 | 461.3 | 774.5 | 774.5 |
| | 150 | 225.4 | 287.5 | 287.5 | 327.5 | 327.5 | 425.3 | 455.9 | 455.9 | 765.5 | 765.5 |
| | 200 | 219.0 | 284.9 | 284.9 | 324.5 | 324.5 | 421.4 | 451.7 | 451.7 | 758.6 | 758.6 |
| | 250 | 209.7 | 284.6 | 284.6 | 324.2 | 324.2 | 421.1 | 451.4 | 451.4 | 757.9 | 757.9 |
| | 300 | 199.1 | 284.6 | 284.6 | 324.2 | 324.2 | 421.1 | 451.4 | 451.4 | 757.9 | 757.9 |
| | 325 | 193.6 | 282.3 | 282.3 | 321.6 | 321.6 | 417.6 | 447.7 | 447.7 | 751.7 | 751.7 |
| | 350 | 187.8 | 275.6 | 275.6 | 313.9 | 313.9 | 407.6 | 436.9 | 436.9 | 733.7 | 733.7 |
| | 375 | 181.8 | 265.3 | 265.3 | 302.2 | 302.2 | 392.5 | 420.8 | 420.8 | 706.5 | 706.5 |
| | 400 | 173.6 | 244.5 | 244.5 | 278.5 | 278.5 | 361.7 | 387.7 | 387.7 | 651.0 | 651.0 |
| | 425 | 143.8 | 202.6 | 202.6 | 230.7 | 230.7 | 299.6 | 321.2 | 321.2 | 539.3 | 539.3 |
| | 450 | 115.0 | 162.0 | 162.0 | 184.5 | 184.5 | 239.6 | 256.9 | 256.9 | 431.4 | 431.4 |
| | 475 | 87.2 | 122.8 | 122.8 | 139.9 | 139.9 | 181.6 | 194.7 | 194.7 | 326.9 | 326.9 |
| | 500 | 58.8 | 84.1 | 82.8 | 96.0 | 94.3 | 122.4 | 134.7 | 131.2 | 230.3 | 220.4 |
| | 538 | 29.5 | 44.8 | 41.6 | 51.7 | 47.4 | 69.0 | 74.6 | 66.0 | 137.3 | 110.8 |
| A 182 F22 (5) (6) | -29 to 38 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 100 | 257.6 | 290.8 | 290.8 | 331.2 | 331.2 | 430.2 | 461.2 | 461.2 | 774.3 | 774.3 |
| | 150 | 250.8 | 287.1 | 287.1 | 327.0 | 327.0 | 424.6 | 455.2 | 455.2 | 764.3 | 764.3 |
| | 200 | 243.4 | 282.9 | 282.9 | 322.2 | 322.2 | 418.5 | 448.6 | 448.6 | 753.4 | 753.4 |
| | 250 | 231.8 | 281.6 | 281.6 | 320.7 | 320.7 | 416.5 | 446.5 | 446.5 | 749.7 | 749.7 |
| | 300 | 214.4 | 280.4 | 280.4 | 319.4 | 319.4 | 414.8 | 444.7 | 444.7 | 746.7 | 746.7 |
| | 325 | 206.6 | 279.4 | 279.4 | 318.3 | 318.3 | 413.3 | 443.1 | 443.1 | 743.9 | 743.9 |
| | 350 | 201.1 | 277.2 | 277.2 | 315.7 | 315.7 | 410.0 | 439.5 | 439.5 | 738.1 | 738.1 |
| | 375 | 194.1 | 274.7 | 274.7 | 312.9 | 312.9 | 406.3 | 435.5 | 435.6 | 731.3 | 731.3 |
| | 400 | 183.1 | 274.7 | 274.7 | 312.9 | 312.9 | 406.3 | 435.5 | 435.6 | 731.3 | 731.3 |
| | 425 | 175.1 | 274.7 | 274.7 | 312.9 | 312.9 | 406.3 | 435.5 | 435.6 | 731.3 | 731.3 |
| | 450 | 169.0 | 265.7 | 265.7 | 302.7 | 302.7 | 393.1 | 421.4 | 421.4 | 707.6 | 707.6 |
| | 475 | 158.2 | 240.8 | 240.8 | 274.3 | 274.3 | 356.3 | 382.0 | 382.0 | 641.3 | 641.3 |
| | 500 | 140.9 | 204.5 | 201.2 | 233.4 | 229.1 | 304.8 | 327.3 | 318.9 | 559.4 | 535.4 |
| | 538 | 92.2 | 139.9 | 129.8 | 162.2 | 147.9 | 215.2 | 232.6 | 205.9 | 428.3 | 345.7 |
| | 550 | 78.2 | 118.7 | 110.1 | 136.6 | 125.4 | 182.3 | 197.2 | 174.5 | 363.1 | 293.1 |
| | 575 | 52.6 | 79.9 | 74.1 | 92.1 | 84.5 | 122.9 | 132.9 | 117.6 | 244.6 | 197.4 |
| | 600 | 34.4 | 52.5 | 48.5 | 60.2 | 55.2 | 80.3 | 86.8 | 76.9 | 159.9 | 129.1 |
| | 625 | 22.3 | 33.9 | 31.4 | 39.0 | 35.8 | 52.1 | 56.3 | 49.8 | 103.7 | 83.7 |
| | 650 | 14.2 | 21.5 | 19.9 | 24.8 | 22.7 | 33.0 | 35.7 | 31.6 | 65.9 | 53.2 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*

*2.. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*

*Limited Class Threaded ends limited to Size 1 and smaller, 538°C maximum and Class 2500 maximum.*

*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*

*4. Permissible but not recommended for prolonged usage above approx. 425°C.*

*5. Permissible but not recommended for use above 595°C.*

*6. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings

## Forged Steel Univalves

| MATERIAL | TEMP (°F) | PRESSURE (PSIG) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A182 F91 | -20 to 100 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 300 | 3640 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 400 | 3530 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 500 | 3325 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 600 | 3025 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 650 | 2940 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 700 | 2840 | 4130 | 4130 | 4705 | 4705 | 6110 | 6550 | 6550 | 10995 | 10995 |
| | 750 | 2660 | 4105 | 4105 | 4675 | 4675 | 6070 | 6505 | 6505 | 10930 | 10930 |
| | 800 | 2540 | 4055 | 4055 | 4620 | 4620 | 6000 | 6430 | 6430 | 10800 | 10800 |
| | 850 | 2435 | 3815 | 3815 | 4345 | 4345 | 5645 | 6050 | 6050 | 10160 | 10160 |
| | 900 | 2245 | 3380 | 3380 | 3850 | 3850 | 5000 | 5360 | 5360 | 9000 | 9000 |
| | 950 | 1930 | 2725 | 2660 | 3115 | 3025 | 4075 | 4380 | 4215 | 7555 | 7070 |
| | 1000 | 1820 | 2555 | 2370 | 2945 | 2700 | 3925 | 4245 | 3755 | 7555 | 6310 |
| | 1050 | 1800 | 2555 | 2370 | 2945 | 2700 | 3925 | 4245 | 3755 | 7555 | 6310 |
| | 1100 | 1510 | 2290 | 2125 | 2640 | 2420 | 3520 | 3810 | 3370 | 7005 | 5655 |
| | 1150 | 1115 | 1695 | 1570 | 1950 | 1790 | 2600 | 2810 | 2485 | 5180 | 4180 |
| | 1200 | 720 | 1095 | 1015 | 1260 | 1155 | 1680 | 1815 | 1610 | 3345 | 2700 |
| A 182 F92 | -20 to 100 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3750 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 300 | 3640 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 400 | 3530 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 500 | 3325 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 600 | 3025 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 650 | 2940 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 700 | 2840 | 4130 | 4130 | 4705 | 4705 | 6110 | 6550 | 6550 | 10995 | 10995 |
| | 750 | 2660 | 4105 | 4105 | 4675 | 4675 | 6070 | 6505 | 6505 | 10930 | 10930 |
| | 800 | 2540 | 4055 | 4055 | 4620 | 4620 | 6000 | 6430 | 6430 | 10800 | 10800 |
| | 850 | 2435 | 3815 | 3815 | 4345 | 4345 | 5645 | 6050 | 6050 | 10160 | 10160 |
| | 900 | 2245 | 3380 | 3380 | 3850 | 3850 | 5000 | 5360 | 5360 | 9000 | 9000 |
| | 950 | 1930 | 2725 | 2660 | 3115 | 3025 | 4075 | 4380 | 4215 | 7555 | 7070 |
| | 1000 | 1820 | 2555 | 2370 | 2945 | 2700 | 3925 | 4245 | 3755 | 7555 | 6310 |
| | 1050 | 1800 | 2555 | 2370 | 2945 | 2700 | 3925 | 4245 | 3755 | 7555 | 6310 |
| | 1100 | 1610 | 2450 | 2270 | 2820 | 2585 | 3765 | 4070 | 3600 | 7490 | 6045 |
| | 1150 | 1370 | 2085 | 1935 | 2400 | 2200 | 3205 | 3465 | 3065 | 6375 | 5145 |
| | 1200 | 960 | 1460 | 1350 | 1680 | 1540 | 2240 | 2420 | 2145 | 4460 | 3600 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*

*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 1000°F maximum and Class 2500 maximum.*

*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*



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# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings (metric)

## Forged Steel Univalves

1 bar = 100 kPa = 14.50 psi

| MATERIAL | TEMP (°C) | PRESSURE (BAR) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A 182 F91 | -29 to 38 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 100 | 257.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 150 | 250.8 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 200 | 243.4 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 250 | 231.8 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 300 | 214.4 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 325 | 206.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 350 | 201.1 | 289.7 | 289.7 | 330.0 | 330.0 | 428.6 | 459.5 | 459.5 | 771.4 | 771.4 |
| | 375 | 194.1 | 284.5 | 284.5 | 324.1 | 324.1 | 420.9 | 451.2 | 451.2 | 757.4 | 757.4 |
| | 400 | 183.1 | 282.9 | 282.9 | 322.2 | 322.2 | 418.3 | 448.4 | 448.4 | 753.2 | 753.2 |
| | 425 | 175.1 | 279.6 | 279.6 | 318.5 | 318.5 | 413.7 | 443.5 | 443.5 | 744.6 | 744.6 |
| | 450 | 169.0 | 265.7 | 265.7 | 302.7 | 302.7 | 393.1 | 421.4 | 421.4 | 707.6 | 707.6 |
| | 475 | 158.2 | 240.8 | 240.8 | 274.3 | 274.3 | 356.3 | 382.0 | 381.9 | 641.3 | 641.3 |
| | 500 | 140.9 | 204.5 | 201.2 | 233.4 | 229.1 | 297.5 | 327.3 | 318.9 | 559.4 | 535.4 |
| | 538 | 125.5 | 176.2 | 163.5 | 202.9 | 186.2 | 270.7 | 292.7 | 259.1 | 539.1 | 435.1 |
| | 550 | 124.9 | 176.2 | 163.5 | 202.9 | 186.2 | 270.7 | 292.7 | 259.1 | 539.1 | 435.1 |
| | 575 | 119.7 | 173.7 | 161.1 | 200.0 | 183.5 | 266.9 | 288.6 | 255.4 | 531.3 | 428.8 |
| | 600 | 97.5 | 148.8 | 137.3 | 170.5 | 156.4 | 227.5 | 246.0 | 217.7 | 453.0 | 365.6 |
| | 625 | 73.0 | 110.9 | 102.9 | 127.7 | 117.1 | 170.4 | 184.2 | 163.1 | 339.2 | 273.8 |
| | 650 | 49.6 | 75.4 | 69.9 | 86.8 | 79.7 | 115.8 | 125.2 | 110.9 | 230.7 | 186.2 |
| A 182 F92 | -29 to 38 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 258.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 100 | 257.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 150 | 250.8 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 200 | 243.4 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 250 | 231.8 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 300 | 214.4 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 325 | 206.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 350 | 201.1 | 289.7 | 289.7 | 330.0 | 330.0 | 428.6 | 459.5 | 459.5 | 771.4 | 771.4 |
| | 375 | 194.1 | 284.5 | 284.5 | 324.1 | 324.1 | 420.9 | 451.2 | 451.2 | 757.4 | 757.4 |
| | 400 | 183.1 | 282.9 | 282.9 | 322.2 | 322.2 | 418.3 | 448.4 | 448.4 | 753.2 | 753.2 |
| | 425 | 175.1 | 279.6 | 279.6 | 318.5 | 318.5 | 413.7 | 443.5 | 443.5 | 744.6 | 744.6 |
| | 450 | 169.0 | 265.7 | 265.7 | 302.7 | 302.7 | 393.1 | 421.4 | 421.4 | 707.6 | 707.6 |
| | 475 | 158.2 | 240.8 | 240.8 | 274.3 | 274.3 | 356.3 | 382.0 | 381.9 | 641.3 | 641.3 |
| | 500 | 140.9 | 204.5 | 201.2 | 233.4 | 229.1 | 304.8 | 327.3 | 318.9 | 559.4 | 535.4 |
| | 538 | 125.5 | 176.2 | 163.5 | 202.9 | 186.2 | 270.7 | 292.7 | 259.1 | 539.1 | 435.1 |
| | 550 | 124.9 | 176.2 | 163.5 | 202.9 | 186.2 | 270.7 | 292.7 | 259.1 | 539.1 | 435.1 |
| | 575 | 119.7 | 173.7 | 161.1 | 200.0 | 183.5 | 266.9 | 288.6 | 255.4 | 531.3 | 428.8 |
| | 600 | 107.0 | 162.8 | 151.0 | 187.5 | 172.0 | 250.2 | 270.5 | 239.5 | 497.9 | 401.9 |
| | 625 | 91.2 | 138.9 | 128.8 | 159.9 | 146.7 | 213.5 | 230.8 | 204.3 | 424.7 | 342.8 |
| | 650 | 66.2 | 100.5 | 93.2 | 115.7 | 106.2 | 154.4 | 167.0 | 147.8 | 307.5 | 248.2 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*
*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 1000°F maximum and Class 2500 maximum.*
*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*

# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings

## Forged Steel Univalves

| MATERIAL | TEMP (°F) | PRESSURE (PSIG) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A182 F316 (4) | -20 to 100 | 3600 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3095 | 3895 | 3895 | 4435 | 4435 | 5760 | 6175 | 6175 | 10365 | 10365 |
| | 300 | 2795 | 3515 | 3515 | 4005 | 4005 | 5200 | 5575 | 5575 | 9360 | 9360 |
| | 400 | 2570 | 3230 | 3230 | 3675 | 3675 | 4775 | 5120 | 5120 | 8600 | 8600 |
| | 500 | 2390 | 3000 | 3000 | 3420 | 3420 | 4440 | 4760 | 4760 | 7995 | 7995 |
| | 600 | 2255 | 2840 | 2840 | 3230 | 3230 | 4195 | 4495 | 4495 | 7555 | 7555 |
| | 650 | 2210 | 2775 | 2775 | 3160 | 3160 | 4105 | 4400 | 4400 | 7395 | 7395 |
| | 700 | 2170 | 2730 | 2730 | 3110 | 3110 | 4040 | 4330 | 4330 | 7270 | 7270 |
| | 750 | 2135 | 2685 | 2685 | 3060 | 3060 | 3975 | 4260 | 4260 | 7150 | 7150 |
| | 800 | 2110 | 2655 | 2655 | 3025 | 3025 | 3930 | 4215 | 4215 | 7070 | 7070 |
| | 850 | 2090 | 2625 | 2625 | 2990 | 2990 | 3885 | 4165 | 4165 | 6990 | 6990 |
| | 900 | 2075 | 2610 | 2610 | 2970 | 2970 | 3860 | 4140 | 4140 | 6950 | 6950 |
| | 950 | 1930 | 2580 | 2580 | 2940 | 2940 | 3815 | 4090 | 4090 | 6870 | 6870 |
| | 1000 | 1820 | 2370 | 2370 | 2700 | 2700 | 3505 | 3755 | 3755 | 6310 | 6310 |
| | 1050 | 1800 | 2370 | 2370 | 2700 | 2700 | - | 3755 | 3755 | 6310 | 6310 |
| | 1100 | 1525 | 2200 | 2145 | 2515 | 2445 | - | 3545 | 3410 | 6115 | 5720 |
| | 1150 | 1185 | 1799 | 1665 | 2070 | 1900 | - | 2985 | 2640 | 5495 | 4435 |
| | 1200 | 925 | 1405 | 1300 | 1620 | 1485 | - | 2335 | 2070 | 4300 | 3470 |
| | 1250 | 735 | 1120 | 1035 | 1290 | 1180 | - | 1860 | 1645 | 3425 | 2765 |
| | 1300 | 585 | 885 | 820 | 1020 | 935 | - | 1470 | 1300 | 2705 | 2185 |
| | 1350 | 480 | 730 | 675 | 840 | 770 | - | 1210 | 1070 | 2230 | 1800 |
| | 1400 | 380 | 570 | 530 | 660 | 605 | - | 950 | 840 | 1755 | 1415 |
| | 1450 | 290 | 445 | 410 | 510 | 465 | - | 735 | 650 | 1355 | 1095 |
| | 1500 | 205 | 315 | 290 | 360 | 330 | - | 520 | 460 | 955 | 770 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*

*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 1000°F maximum and Class 2500 maximum.*

*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*

*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

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# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings (metric)

## Forged Steel Univalves

1 bar = 100kPa = 14.50 psi

| MATERIAL | TEMP (°C) | PRESSURE (BAR) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A182 F316 (4) | -29 to 38 | 248.2 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 240.6 | 286.3 | 286.3 | 326.1 | 326.1 | 423.5 | 454.0 | 454.0 | 762.3 | 762.3 |
| | 100 | 211.0 | 265.3 | 265.3 | 302.2 | 302.2 | 392.4 | 420.7 | 420.7 | 706.4 | 706.4 |
| | 150 | 192.5 | 242.0 | 242.0 | 275.7 | 275.7 | 358 | 383.8 | 383.8 | 644.4 | 644.4 |
| | 200 | 178.3 | 224.2 | 224.2 | 255.4 | 255.4 | 331.7 | 355.6 | 355.6 | 597.0 | 597.0 |
| | 250 | 166.9 | 209.9 | 209.9 | 239.0 | 239.0 | 310.4 | 332.8 | 332.8 | 558.8 | 558.8 |
| | 300 | 158.1 | 198.8 | 198.8 | 226.4 | 226.4 | 294.1 | 315.3 | 315.3 | 529.3 | 529.3 |
| | 325 | 154.4 | 194.1 | 194.1 | 221.1 | 221.1 | 287.2 | 307.9 | 307.9 | 517.0 | 517.0 |
| | 350 | 151.6 | 190.7 | 190.7 | 217.2 | 217.2 | 282.1 | 302.4 | 302.4 | 507.7 | 507.7 |
| | 375 | 149.4 | 187.8 | 187.8 | 214.0 | 214.0 | 277.9 | 297.9 | 297.9 | 500.2 | 500.2 |
| | 400 | 147.2 | 185.1 | 185.1 | 210.8 | 210.8 | 273.8 | 293.5 | 293.5 | 492.9 | 492.9 |
| | 425 | 145.7 | 183.2 | 183.2 | 208.7 | 208.7 | 271.1 | 290.6 | 290.6 | 487.9 | 487.9 |
| | 450 | 144.2 | 181.4 | 181.4 | 206.6 | 206.6 | 268.3 | 287.6 | 287.6 | 482.9 | 482.9 |
| | 475 | 143.4 | 180.3 | 180.3 | 205.3 | 205.3 | 266.6 | 285.8 | 285.8 | 480.0 | 480.0 |
| | 500 | 140.9 | 178.7 | 178.7 | 203.5 | 203.5 | 264.3 | 283.3 | 283.3 | 475.7 | 475.7 |
| | 538 | 125.5 | 163.5 | 163.5 | 186.2 | 186.2 | 241.7 | 259.1 | 259.1 | 435.1 | 435.1 |
| | 550 | 124.9 | 163.5 | 163.5 | 186.2 | 186.2 | - | 259.1 | 259.1 | 435.1 | 435.1 |
| | 575 | 119.7 | 162.4 | 161.1 | 185.2 | 183.5 | - | 258.7 | 255.4 | 435.1 | 428.8 |
| | 600 | 99.5 | 145.1 | 140.2 | 166.0 | 159.6 | - | 234.8 | 222.2 | 410.1 | 373.2 |
| | 625 | 79.1 | 120.0 | 111.3 | 138.2 | 126.8 | - | 199.5 | 176.6 | 367.3 | 296.5 |
| | 650 | 63.3 | 96.1 | 89.1 | 110.7 | 101.5 | - | 159.7 | 141.4 | 294.1 | 237.4 |
| | 675 | 51.6 | 78.3 | 72.7 | 90.2 | 82.8 | - | 130.2 | 115.2 | 239.7 | 193.5 |
| | 700 | 41.9 | 69.4 | 64.3 | 79.9 | 73.3 | - | 115.3 | 102.0 | 212.2 | 171.3 |
| | 725 | 34.9 | 57.9 | 53.7 | 66.7 | 61.2 | - | 96.3 | 85.2 | 177.2 | 143 |
| | 750 | 29.3 | 44.6 | 41.4 | 51.3 | 47.1 | - | 74.1 | 65.6 | 136.7 | 110.3 |
| | 775 | 22.8 | 34.6 | 32.1 | 39.9 | 36.6 | - | 57.6 | 51.0 | 106.1 | 85.6 |
| | 800 | 17.4 | 26.7 | 24.8 | 30.7 | 28.2 | - | 44.3 | 39.2 | 81.3 | 65.6 |
| | 816 | 14.1 | 21.7 | 20.1 | 24.9 | 22.9 | - | 35.8 | 31.7 | 65.8 | 53.1 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*
*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 538°C maximum and Class 2500 maximum.*
*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*
*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*



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# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings

## Forged Steel Univalves

| MATERIAL | TEMP (°F) | PRESSURE (PSIG) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CLASS 1500 | CLASS 1690 | | CLASS 1925 | | CLASS 2500 | CLASS 2680 | | CLASS 4500 | |
| | | SIZES ½ to 2 ½ (1) STANDARD | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 1 (2) LIMITED | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL | SIZES ½ to 2 ½ (2) LIMITED | SIZES 3 & 4 (3) SPECIAL |
| A182 F347/ F347H (4) (5) | -20 to 100 | 3600 | 4225 | 4225 | 4815 | 4815 | 6250 | 6700 | 6700 | 11250 | 11250 |
| | 200 | 3310 | 4165 | 4165 | 4745 | 4745 | 6160 | 6605 | 6605 | 11090 | 11090 |
| | 300 | 3085 | 3875 | 3875 | 4415 | 4415 | 5735 | 6150 | 6150 | 10325 | 10325 |
| | 400 | 2880 | 3620 | 3620 | 4125 | 4125 | 5355 | 5740 | 5740 | 9645 | 9645 |
| | 500 | 2710 | 3410 | 3410 | 3885 | 3885 | 5045 | 5410 | 5410 | 9080 | 9080 |
| | 600 | 2580 | 3245 | 3245 | 3695 | 3695 | 4800 | 5145 | 5145 | 8640 | 8640 |
| | 650 | 2530 | 3185 | 3185 | 3625 | 3625 | 4710 | 5050 | 5050 | 8480 | 8480 |
| | 700 | 2485 | 3120 | 3120 | 3555 | 3555 | 4620 | 4955 | 4955 | 8315 | 8315 |
| | 750 | 2460 | 3095 | 3095 | 3525 | 3525 | 4575 | 4905 | 4905 | 8235 | 8235 |
| | 800 | 2435 | 3065 | 3065 | 3490 | 3490 | 4530 | 4855 | 4855 | 8155 | 8155 |
| | 850 | 2425 | 3050 | 3050 | 3470 | 3470 | 4510 | 4835 | 4835 | 8115 | 8115 |
| | 900 | 2245 | 3050 | 3050 | 3470 | 3470 | 4510 | 4835 | 4835 | 8115 | 8115 |
| | 950 | 1930 | 2660 | 2660 | 3025 | 3025 | 3930 | 4215 | 4215 | 7070 | 7070 |
| | 1000 | 1820 | 2370 | 2370 | 2700 | 2700 | 3505 | 3755 | 3755 | 6310 | 6310 |
| | 1050 | 1800 | 2370 | 2370 | 2700 | 2700 | - | 3755 | 3755 | 6310 | 6310 |
| | 1100 | 1610 | 2325 | 2270 | 2660 | 2585 | - | 3745 | 3600 | 6310 | 6045 |
| | 1150 | 1370 | 2085 | 1935 | 2400 | 2200 | - | 3465 | 3065 | 6310 | 5145 |
| | 1200 | 1030 | 1560 | 1450 | 1800 | 1650 | - | 2600 | 2300 | 4780 | 3860 |
| | 1250 | 910 | 1380 | 1280 | 1590 | 1460 | - | 2295 | 2030 | 4225 | 3410 |
| | 1300 | 685 | 1045 | 970 | 1200 | 1100 | - | 1730 | 1535 | 3185 | 2570 |
| | 1350 | 515 | 780 | 725 | 900 | 825 | - | 1295 | 1145 | 2390 | 1930 |
| | 1400 | 380 | 570 | 530 | 660 | 605 | - | 950 | 840 | 1755 | 1415 |
| | 1450 | 290 | 445 | 410 | 510 | 470 | - | 740 | 655 | 1355 | 1095 |
| | 1500 | 205 | 315 | 290 | 360 | 330 | - | 520 | 460 | 955 | 770 |
| A182 F316L | -20 to 100 | 3000 | 4070 | 3775 | 4685 | 4300 | 6250 | 6760 | 5980 | 12445 | 10045 |
| | 200 | 2555 | 3215 | 3215 | 3665 | 3665 | 4755 | 5095 | 5095 | 8560 | 8560 |
| | 300 | 2280 | 2865 | 2865 | 3265 | 3265 | 4240 | 4545 | 4545 | 7635 | 7635 |
| | 400 | 2100 | 2640 | 2640 | 3010 | 3010 | 3905 | 4185 | 4185 | 7030 | 7030 |
| | 500 | 1970 | 2475 | 2475 | 2820 | 2820 | 3660 | 3925 | 3925 | 6590 | 6590 |
| | 600 | 1860 | 2340 | 2340 | 2665 | 2665 | 3460 | 3710 | 3710 | 6230 | 6230 |
| | 650 | 1825 | 2295 | 2295 | 2615 | 2615 | 3395 | 3640 | 3640 | 6105 | 6105 |
| | 700 | 1800 | 2265 | 2265 | 2580 | 2580 | 3350 | 3590 | 3590 | 6025 | 6025 |
| | 750 | 1765 | 2220 | 2220 | 2525 | 2525 | 3280 | 3515 | 3515 | 5905 | 5905 |
| | 800 | 1730 | 2175 | 2175 | 2475 | 2475 | 3215 | 3445 | 3445 | 5785 | 5785 |
| | 850 | 1690 | 2130 | 2130 | 2425 | 2425 | 3145 | 3370 | 3370 | 5665 | 5665 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*

*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 1000°F maximum and Class 2500 maximum.*

*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*

*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

*5. A182 F347 material is not to be used over 1000°F.*

FLOWSERVE

# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings (metric)

## Forged Steel Univalves

1 bar = 100kPa = 14.50 psi

| MATERIAL | TEMP (°C) | PRESSURE (BAR) CLASS 1500 SIZES ½ to 2 ½ (1) STANDARD | CLASS 1690 SIZES ½ to 2 ½ (2) LIMITED | CLASS 1690 SIZES 3 & 4 (3) SPECIAL | CLASS 1925 SIZES ½ to 2 ½ (2) LIMITED | CLASS 1925 SIZES 3 & 4 (3) SPECIAL | CLASS 2500 SIZES ½ to 1 (2) LIMITED | CLASS 2680 SIZES ½ to 2 ½ (2) LIMITED | CLASS 2680 SIZES 3 & 4 (3) SPECIAL | CLASS 4500 SIZES ½ to 2 ½ (2) LIMITED | CLASS 4500 SIZES 3 & 4 (3) SPECIAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A182 F347/ F347H (4) (5) | -29 to 38 | 248.2 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 50 | 240.6 | 291.3 | 291.3 | 331.8 | 331.8 | 430.9 | 461.9 | 461.9 | 775.7 | 775.7 |
| | 100 | 211.0 | 284.8 | 284.8 | 324.4 | 324.4 | 421.3 | 451.6 | 451.6 | 758.3 | 758.3 |
| | 150 | 192.5 | 267.0 | 267.0 | 304.1 | 304.1 | 395.0 | 423.4 | 423.4 | 711.0 | 711.0 |
| | 200 | 178.3 | 251.1 | 251.1 | 286.1 | 286.1 | 371.5 | 398.2 | 398.2 | 668.6 | 668.6 |
| | 250 | 166.9 | 237.7 | 237.7 | 270.8 | 270.8 | 351.7 | 377.0 | 377.0 | 633.0 | 633.0 |
| | 300 | 158.1 | 226.9 | 226.9 | 258.4 | 258.4 | 335.6 | 359.8 | 359.8 | 604.1 | 604.1 |
| | 325 | 154.4 | 222.3 | 222.3 | 253.2 | 253.2 | 328.8 | 352.5 | 352.5 | 591.8 | 591.8 |
| | 350 | 151.6 | 218.6 | 218.6 | 249.0 | 249.0 | 323.3 | 346.6 | 346.6 | 581.9 | 581.9 |
| | 375 | 149.4 | 215.1 | 215.1 | 245.0 | 245.0 | 318.1 | 341.0 | 341.0 | 572.7 | 572.7 |
| | 400 | 147.2 | 213.2 | 213.2 | 242.8 | 242.8 | 315.4 | 338.1 | 338.1 | 567.7 | 567.7 |
| | 425 | 145.7 | 211.4 | 211.4 | 240.7 | 240.7 | 312.6 | 335.1 | 335.1 | 562.7 | 562.7 |
| | 450 | 144.2 | 210.3 | 210.3 | 239.6 | 239.6 | 311.1 | 333.5 | 333.5 | 560.0 | 560.0 |
| | 475 | 143.4 | 210.1 | 210.1 | 239.4 | 239.4 | 310.9 | 333.3 | 333.3 | 559.6 | 559.6 |
| | 500 | 140.9 | 201.2 | 201.2 | 229.1 | 229.1 | 297.5 | 318.9 | 318.9 | 535.4 | 535.4 |
| | 538 | 125.5 | 163.5 | 163.5 | 186.2 | 186.2 | 241.7 | 259.1 | 259.1 | 435.1 | 435.1 |
| | 550 | 124.9 | 163.5 | 163.5 | 186.2 | 186.2 | - | 259.1 | 259.1 | 435.1 | 435.1 |
| | 575 | 119.7 | 162.4 | 161.1 | 185.2 | 183.5 | - | 258.7 | 255.4 | 435.1 | 428.8 |
| | 600 | 99.5 | 156.3 | 151.0 | 178.9 | 172.0 | - | 253.0 | 239.5 | 435.1 | 401.9 |
| | 625 | 79.1 | 138.9 | 128.8 | 159.9 | 146.7 | - | 230.8 | 204.3 | 424.7 | 342.8 |
| | 650 | 63.3 | 107.7 | 99.9 | 124.0 | 113.8 | - | 179.1 | 158.5 | 329.7 | 266.1 |
| | 675 | 51.6 | 95.9 | 88.9 | 110.5 | 101.3 | - | 159.5 | 141.2 | 293.6 | 237.0 |
| | 700 | 41.9 | 75.6 | 70.2 | 87.1 | 79.9 | - | 125.6 | 111.2 | 231.1 | 186.5 |
| | 725 | 34.9 | 58.6 | 54.4 | 67.4 | 61.9 | - | 97.1 | 86.0 | 179.0 | 144.5 |
| | 750 | 29.3 | 44.6 | 41.4 | 51.3 | 47.1 | - | 74.1 | 65.6 | 136.7 | 110.3 |
| | 775 | 22.8 | 34.6 | 32.1 | 39.9 | 36.6 | - | 57.6 | 51.0 | 106.1 | 85.6 |
| | 800 | 17.4 | 26.7 | 24.8 | 30.7 | 28.2 | - | 44.3 | 39.2 | 81.3 | 65.6 |
| | 816 | 14.1 | 21.7 | 20.1 | 24.9 | 22.9 | - | 35.8 | 31.7 | 65.8 | 53.1 |
| A182 F316L | -29 to 38 | 206.8 | 260.1 | 260.1 | 296.3 | 296.3 | 384.8 | 412.5 | 412.5 | 692.6 | 692.6 |
| | 50 | 200.1 | 251.6 | 251.6 | 286.6 | 286.6 | 372.2 | 399.0 | 399.0 | 670.0 | 670.0 |
| | 100 | 173.9 | 218.7 | 218.7 | 249.1 | 249.1 | 323.6 | 346.9 | 346.9 | 582.4 | 582.4 |
| | 150 | 157.0 | 197.4 | 197.4 | 224.8 | 224.8 | 291.9 | 312.9 | 312.9 | 525.5 | 525.5 |
| | 200 | 145.8 | 183.3 | 183.3 | 208.8 | 208.8 | 271.2 | 290.7 | 290.7 | 488.1 | 488.1 |
| | 250 | 137.3 | 172.7 | 172.7 | 196.7 | 196.7 | 255.4 | 273.8 | 273.8 | 459.8 | 459.8 |
| | 300 | 130.3 | 163.9 | 163.9 | 186.7 | 186.7 | 242.4 | 259.9 | 259.9 | 436.4 | 436.4 |
| | 325 | 127.4 | 160.2 | 160.2 | 182.5 | 182.5 | 237.0 | 254.1 | 254.1 | 426.6 | 426.6 |
| | 350 | 125.4 | 157.6 | 157.6 | 179.6 | 179.6 | 233.2 | 250.0 | 250.0 | 419.7 | 419.7 |
| | 375 | 123.8 | 155.6 | 155.6 | 177.2 | 177.2 | 230.2 | 246.8 | 246.8 | 414.4 | 414.4 |
| | 400 | 121.5 | 152.8 | 152.8 | 174.0 | 174.0 | 226.0 | 242.3 | 242.3 | 406.9 | 406.9 |
| | 425 | 119.3 | 150.0 | 150.0 | 170.8 | 170.8 | 221.9 | 237.9 | 237.9 | 399.4 | 399.4 |
| | 450 | 117.1 | 147.1 | 147.1 | 167.6 | 167.6 | 217.7 | 233.4 | 233.4 | 391.9 | 391.9 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*
*2. Limited Class, Sizes 2 ½ and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 1 and smaller, 538°C maximum and Class 2500 maximum.*
*3. Special Class, Sizes 3 and 4, Butt-weld ends only.*
*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*
*5. A182 F347 material is not to be used over 538°C.*



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# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings

## Forged Steel, Bolted Bonnet

| MATERIAL | TEMP (°F) | PRESSURE (PSIG) | | | |
|---|---|---|---|---|---|
| | | CLASS 300 | CLASS 400 | CLASS 600 | CLASS 800 |
| | | STANDARD (1) (4) | STANDARD (1) (4) | STANDARD (1) (4) | LIMITED (2) (4) |
| A105 / A216 WCB (3) | -20 to 100 | 740 | 985 | 1480 | 2000 |
| | 200 | 680 | 905 | 1360 | 2000 |
| | 300 | 655 | 875 | 1310 | 1975 |
| | 400 | 635 | 845 | 1265 | 1955 |
| | 500 | 605 | 805 | 1205 | 1955 |
| | 600 | 570 | 760 | 1135 | 1955 |
| | 650 | 550 | 735 | 1100 | 1905 |
| | 700 | 530 | 705 | 1060 | 1845 |
| | 750 | 505 | 675 | 1015 | 1695 |
| | 800 | 410 | 550 | 825 | 1375 |
| | 850 | 320 | 425 | 640 | 1060 |
| | 900 | 230 | 305 | 460 | 765 |
| | 950 | 135 | 180 | 275 | 465 |
| | 1000 | 85 | 115 | 170 | 295 |
| A182 F11 | -20 to 100 | - | - | 1500 | 2000 |
| | 200 | - | - | 1500 | 2000 |
| | 300 | - | - | 1445 | 2000 |
| | 400 | - | - | 1385 | 2000 |
| | 500 | - | - | 1330 | 2000 |
| | 600 | - | - | 1210 | 2000 |
| | 650 | - | - | 1175 | 2000 |
| | 700 | - | - | 1135 | 1955 |
| | 750 | - | - | 1065 | 1945 |
| | 800 | - | - | 1015 | 1920 |
| | 850 | - | - | 975 | 1805 |
| | 900 | - | - | 900 | 1565 |
| | 950 | - | - | 640 | 1075 |
| | 1000 | - | - | 430 | 745 |
| | 1050 | - | - | 290 | 495 |
| | 1100 | - | - | 190 | 330 |
| | 1150 | - | - | 130 | 225 |
| | 1200 | - | - | 80 | 145 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*

*2. Limited Class, Sizes 2 and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 2 and smaller, 1000°F maximum and Class 2500 maximum.*

*3. Permissible but not recommended for prolonged usage above approx. 800°F*

*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

# Reference: ASME B16.34 – 2009 Pressure/Temperature Ratings (metric)

## Forged Steel, Bolted Bonnet

| MATERIAL | TEMP (°F) | PRESSURE (BAR) | | | |
|---|---|---|---|---|---|
| | | CLASS 300 | CLASS 400 | CLASS 600 | CLASS 800 |
| | | STANDARD (1) (4) | STANDARD (1) (4) | STANDARD (1) (4) | LIMITED (2) (4) |
| A105 / A216 WCB (3) | -29 to 38 | 51.1 | 68.1 | 102.1 | 137.9 |
| | 50 | 50.1 | 66.8 | 100.2 | 137.9 |
| | 100 | 46.6 | 62.1 | 93.2 | 137.7 |
| | 150 | 45.1 | 60.1 | 90.2 | 136.1 |
| | 200 | 43.8 | 58.4 | 87.6 | 134.8 |
| | 250 | 41.9 | 55.9 | 83.9 | 134.8 |
| | 300 | 39.8 | 53.1 | 79.6 | 134.8 |
| | 325 | 38.7 | 51.6 | 77.4 | 133.6 |
| | 350 | 37.6 | 50.1 | 75.1 | 130.4 |
| | 375 | 36.4 | 48.5 | 72.7 | 125.6 |
| | 400 | 34.7 | 46.3 | 69.4 | 115.7 |
| | 425 | 28.8 | 38.4 | 57.5 | 95.9 |
| | 450 | 23.0 | 30.7 | 46.0 | 76.7 |
| | 475 | 17.4 | 23.2 | 34.9 | 58.1 |
| | 500 | 11.8 | 15.7 | 23.5 | 39.5 |
| | 538 | 5.9 | 7.9 | 11.8 | 20.4 |
| A182 F11 | -29 to 38 | - | - | 103.4 | 137.9 |
| | 50 | - | - | 103.4 | 137.9 |
| | 100 | - | - | 103.0 | 137.9 |
| | 150 | - | - | 99.5 | 137.9 |
| | 200 | - | - | 95.9 | 137.9 |
| | 250 | - | - | 92.7 | 137.9 |
| | 300 | - | - | 85.7 | 137.9 |
| | 325 | - | - | 82.6 | 137.9 |
| | 350 | - | - | 80.4 | 137.1 |
| | 375 | - | - | 77.6 | 134.7 |
| | 400 | - | - | 73.3 | 133.9 |
| | 425 | - | - | 70.0 | 132.4 |
| | 450 | - | - | 67.7 | 125.7 |
| | 475 | - | - | 63.4 | 114.0 |
| | 500 | - | - | 51.5 | 85.8 |
| | 538 | | | 29.8 | 51.4 |
| | 550 | | | 25.4 | 43.9 |
| | 575 | | | 17.6 | 30.4 |
| | 600 | | | 12.2 | 21.1 |
| | 625 | | | 8.5 | 14.7 |
| | 650 | - | - | 5.7 | 9.8 |

**MPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*NOTES: 1. Standard Class, Flanged Ends only.*
*2. Limited Class, Sizes 2 and smaller, butt weld and socket weld ends.*
*Limited Class Threaded ends limited to Size 2 and smaller, 538°C maximum and Class 2500 maximum.*
*3. Permissible but not recommended for prolonged usage above approx. 800°F*
*4. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*



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# Reference: Series 1500 Pressure/Temperature Ratings

## Forged Steel, Bolted Bonnet

| VALVE TYPE | TEMPERATURE °F | PRESSURE (PSIG) | |
|---|---|---|---|
| | | A-105 (1) | F-11 |
| SOCKET WELDING, THREADED AND FLANGED END VALVES SERIES 1500 (2) (3) MANUFACTURER'S RATING ASME B31.1 PARA. 107.1B | -20 to 100 | 3600 | 3600 |
| | 200 | 3375 | 3510 |
| | 300 | 3280 | 3365 |
| | 400 | 3170 | 3290 |
| | 500 | 2995 | 3130 |
| | 600 | 2735 | 2770 |
| | 650 | 2560 | 2595 |
| | 700 | 2350 | 2420 |
| | 750 | 2130 | 2255 |
| | 800 | 1830 | 2085 |
| | 850 | 1500 | 1920 |
| | 900 | — | 1750 |
| | 950 | — | 1585 |
| | 975 | — | 1500 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Permissible but not recommended for prolonged use at temperatures above approx. 800°F.*

*2. Series 1500 components are designed and rated to Edward Valves standards. Series 1500 components do not meet ANSI BI6.34 requirements. See 3.2 Pressure Ratings from the Technical Information section for additional information.*

*3. Shaded ratings exceed those of Edward Valves. Consult your Flowserve sales representative for applications in these ranges.*

# Reference: Series 1500 Pressure/Temperature Ratings (metric)

## Forged Steel, Bolted Bonnet

1 bar = 100 kPa = 14.50 psi

| VALVE TYPE | TEMPERATURE °C | PRESSURE (BAR) | |
|---|---|---|---|
| | | A-105 (1) | F-11 |
| SOCKET WELDING, THREADED AND FLANGED END VALVES SERIES 1500 (2) (3) MANUFACTURER'S RATING ASME B31.1 PARA. 107.1B | -29 to 38 | 248.3 | 248.3 |
| | 50 | 244.9 | 246.9 |
| | 100 | 232.0 | 240.9 |
| | 150 | 226.1 | 232.0 |
| | 200 | 219.2 | 227.3 |
| | 250 | 208.7 | 217.8 |
| | 300 | 193.6 | 198.0 |
| | 350 | 173.1 | 176.1 |
| | 375 | 159.9 | 165.3 |
| | 400 | 146.1 | 155.0 |
| | 425 | 127.4 | 144.5 |
| | 454/450 | 103.4 | 134.2 |
| | 475 | — | 123.7 |
| | 500 | — | 113.4 |
| | 524 | — | 103.4 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Permissible but not recommended for prolonged use at temperatures above approx. 427°C.*

*2. Series 1500 components are designed and rated to Edward Valves standards. Series 1500 components do not meet ANSI B16.34 requirements. See 3.2 Pressure Ratings from the Technical Information section for additional information.*

*3. Shaded ratings exceed those of Edward Valves. Consult your Flowserve sales representative for applications in these ranges.*



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# 1. Stop and Check Valve Applications Guide

## 1.1 Stop Valve Applications

**Foreword**
Edward stop valves are used primarily as isolation valves in medium and high pressure piping systems. They are offered in a broad range of sizes, pressure ratings, and types, and they are used in an immense array of diverse applications. Only a few are listed for illustration:

- Normally open valves in main steam lines; used only for equipment isolation, e.g. during maintenance.
- Normally open valves to provide for emergency shutoff due to failure of downstream piping or other equipment; closed periodically for verification of operability.
- Normally open valves that are throttled to varying degrees during start-up or shutdown of plants or systems.
- Frequently cycled valves that are opened and closed for control of batch processes or for start-up and shutdown of equipment (e.g., equipment that is on-stream daily but shut-down at night).
- Normally closed valves; used only for filling or draining systems during outages.

Stop valves are sometimes referred to as "on-off valves." They should not normally be considered as "control valves," but they are suitable for moderate or infrequent flow-control functions. Valves that must open and close under high differential pressure and flow conditions (such as "blowdown" service) inherently function as flow-control devices while they are stroking.

Considering the diversity of stop valve applications, it is not surprising that there is no universal valve type that is best for all services. Users' experience with specific applications is a valuable basis for selecting the best valves.

The goal of this guide is to supplement users' experience with information based on decades of Flowserve Edward Valves' laboratory tests and field experience.

**Introduction**
While many other types of valves (ball, plug, butterfly) are used as stop valves where service conditions permit, emphasis in this guide is on selection and application of Edward valves with forged- and cast-steel bodies and bonnets. Comparisons are presented with other similar valves where appropriate.

Edward stop valves are typically of metal-seated construction and, where necessary, use gaskets and stem seals designed for severe high-pressure, high-temperature service. While special designs with "soft seats" and O-ring seals are supplied for unique specific applications, the standard products are designed to stand up to tough service conditions with minimum requirements for maintenance or parts replacement.

Edward stop valves fall into two basic categories – **globe valves** and **gate valves**. The following sections of this guide will address the principal features of each type and the design variations within the types.

Globe valves are offered in stop, stop-check, and check versions. Stop-check valves can also be used for isolation in unidirectional flow applications. These valves are discussed in the Check Valves Applications section (1.2).

The FLOW PERFORMANCE section of this catalog provides equations and coefficients for the calculation of pressure drop across any of these valves. This information can be used to evaluate the effects of different valve sizes and types of system energy efficiency.

### 1.1.1 Stop Valve Types and Typical Uses

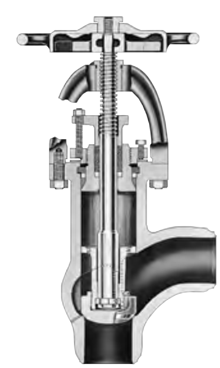
Brief notes on the advantages, disadvantages, applications and limitations of the various types of Edward stop valves are presented in the Stop Valve Applications Chart (section 1.1.4). Some additional highlights of the features of these valves and some comparisons with similar valves are presented in the following paragraphs.

**Globe Valves**
A globe valve employs a poppet or disk that opens and closes by moving linearly along the seat axis. There are many types of globe valve bodies, seats and methods of guiding the disk to and from the seat.

• **Bodies** – Edward stop, stop-check and check type globe valves are offered with three basic body styles:

**Conventional or 90°-bonnet globe valves** are usually the most compact, and the stem and yoke position allow easy handwheel or actuator access and convenience for maintenance. Relatively short stem travel allows fast actuation. Multiple direction changes in the flow stream result in higher pressure drop than with other types, but streamlined flow passages in Flowserve Edward valves generally yield lower pressure drop than competitive valves of this type.

**Angle valves** are otherwise similar to conventional globe valves, but the less tortuous flow path yields lower pressure drop. Angle valves are particularly economical in piping layouts where use of this configuration eliminates an elbow and associated flanged or welded joints.



**Inclined bonnet or "Y type" valves**, such as Univalves® and Flite-Flow® valves, yield lower pressure drop than other styles, because they permit a more nearly straight-through flow path. Typically, they require a longer stem travel. In large sizes, this body shape is heavier and requires a greater end-to-end length than conventional globe valves.

• **Seats** – Industrial globe valves are available from various manufacturers with a broad variety of seat designs — flat or tapered, and integral or inserted (threaded or welded).

All Edward globe valves employ tapered seats with "area contact" under load to seal over minor imperfections. Many similar valves use "line-contact" seats that seal with less load when new but degrade rapidly if damaged at the seating line.

Except for hydraulic stop valves, all Edward globe valves employ integral (hardfaced) body seats to permit compact design and assure that there can be no leakage "behind" the seat.

• **Disk Guiding** – Globe valve disks may be guided by either the stem or the body. When opened or closed under very high differential pressure, side load due to flow pushes a stem-guided disk eccentric to the seat and makes it difficult to obtain a seal. Under extreme conditions, the stem may bend.

All Edward globe valves employ body guided disks which are held closely concentric with the body seat. Guiding is provided at both the top and bottom of the disk to form a fully body-guided disk piston. The bottom guide ring on the disk, a Flowserve Edward Valves innovation, minimizes flow behind the disk and minimizes the side load. These features make Edward globe valves well suited to "blowdown" applications in which there is a high differential pressure across the valve when it is partially open.

Since globe valves are not symmetrical with respect to flow, consideration must be given to the direction of flow and differential pressure. It should be noted that the direction of flow when open and differential pressure when closed may not be the same in all applications (e.g., a block valve on a feed line may involve flow into a system when open but may need to prevent leakage out of the system when closed). Users should consider both factors when deciding on the installation direction for a globe valve.

In most globe valve applications, pressure is under the seat when the valve is closed, and the flow is from under to over the seat (termed "flow to open" or "underseat flow"). In installations where the downstream pressure is zero or very low, this arrangement minimizes packing leakage problems. However, handwheel or actuator effort to close the valve is high, because the stem must supply enough load to both overcome the differential pressure load across the seat area and ensure sufficient sealing load on the metal seat-contact surfaces. Since this flow direction is the most common for globe valves, the flow coefficients given in the Flow Performance section of this catalog are for underseat flow.

Globe valves can also be used with overseat flow and pressure ("flow to close"), but such applications require careful consideration. In systems with dirty line fluids, this arrangement could lead to trapping foreign material in locations where it would interfere with opening. With overseat pressure, the effort to close the valve is low, because closure and sealing are pressure-assisted. However, the effort to open the valve at high differential pressure is high, because the stem must overcome the pressure force to lift the disk (in small valves, the stem diameters approaching the seat diameter, this may not be a problem, because the pressure helps to lift the stem). Also, since the flow coefficients given in this catalog are for underseat flow, pressure-drop predictions may not be as accurate (pressure drop may be up to 10% higher with overseat flow).

While not designed as control valves and not recommended for continuous modulation, Edward globe valves are often used successfully for manual or automatic control during limited periods of system operation (start-up, shutdown, etc.). Some manual valves are also used for continuous throttling or "trimming." Inclined-bonnet valves, (e.g., Univalves® and Flite-Flow® valves) have an approximately linear flow characteristic ($C_V$ versus % open).

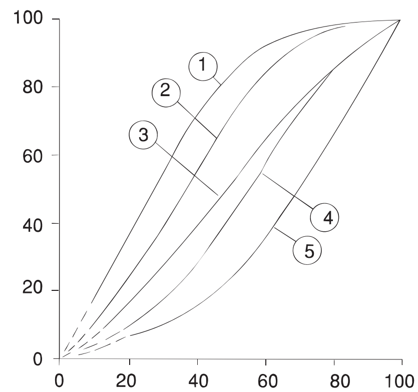
The Flow Performance section of this catalog covers only flow coefficients for fully open valves, but consult Flowserve concerning applications involving flow control. It should be understood that severe throttling at high pressure drops involves high energy dissipation, and serious problems (e.g., noise, vibration, cavitation, erosion) can develop if not carefully considered when a system is designed.

### 1.1.2 Throttling Characteristics of Edward Stop Valves

As noted in the previous section, Edward stop valves are not normally recommended for continuous modulation, and Edward Valves should be consulted concerning applications involving flow control. This section is intended only to provide general guidelines on flow-control characteristics of typical Edward stop valves. These guidelines may be used for preliminary studies relating to applications involving throttling, but they should not be considered as a substitute for a complete evaluation of the acceptability of a valve for a critical application.

Figure A

**Inherent Flow Characteristics**




**Valve Opening – Percent**
1 - Conventional 90° bonnet globe valve
2 - Angle valve
3 - Flite-Flow
4 - Univalve
5 - Equiwedge Gate valve

Figure A provides typical **inherent flow-characteristic** curves (percent of full-open flow coefficient versus percent opening) of the most common types of Edward stop valves. It should be understood that these curves are approximate, because there are variations due to size and pressure class that cannot be represented accurately by a single curve for each valve type. Nevertheless, these typical curves can provide some guidance relating to control capabilities of the various valve types.

Note the following subtle differences between the curves in Figure A:

• The conventional 90°-bonnet globe valve provides a relatively steep slope at small openings approaching a "quick-opening" characteristic. While the body-guided disk in Edward globe valves moderates this effect, it makes the flow coefficient very sensitive to small changes in stem position, so it may prove difficult to control low flow rates.

- The angle valve has a characteristic similar to that of a globe valve, but it is slightly closer to linear due to its normally higher full-open flow coefficient. An angle valve has about the same control characteristics as a globe valve of the same size at small openings.
- The cast-steel Flite-Flow® Y-type valve provides a characteristic that is nearly linear over most of its stem-travel range. For control of flow over a broad range, the high flow efficiency of this type of valve may permit use of a smaller valve size for a given allowable pressure drop. The smaller size, combined with the linear characteristic, can give improved control of low flow rates when the valve is throttled.
- The forged-steel Y-type Univalve® provides even better control at very small openings because of its "double throttling" characteristic as the lower disk-guide ring opens the machined port in the body. Other forged-steel valves have this characteristic to some degree.
- The Equiwedge gate valve has an excellent inherent flow characteristic ("concave upward"), approaching that of an **equal-percentage** control valve. However, this is somewhat misleading. When installed in pipe of the same nominal size as the valve, the pressure drop of a gate valve is so low at large openings (e.g., over 70%) that piping flow resistance usually overshadows that of the valve. The gate valve would provide little control over flow in that range.

While not normally recommended for throttling for the reasons cited in the previous section, the gate valve flow-characteristic curve is attractive from a standpoint of controlling low flow rates without excessive sensitivity. Use of a gate valve for throttling may be considered for some applications.

### 1.1.3 Stop Valve Actuators and Accessories

Most Edward stop and stop-check valves illustrated in this catalog are shown with handwheels, and the majority of valves are furnished for applications where manual actuation is acceptable. Most larger and higher-pressure globe valves are furnished with standard Impactor handles or handwheels, which provide up to twelve times the stem force of an ordinary handwheel, to provide for adequate seating thrust. Impacto-gear assemblies on the largest globe valves permit operation using an air wrench. These Flowserve Edward Valves innovations permit practical manual operation of many valves that would otherwise require gearing or power actuators.

**Manual Gear Actuators**
When specified, many Edward valves can be supplied with manual actuators with gear reduction in lieu of a handwheel. Such actuators reduce the required rim-pull effort and often permit operation by one person in cases where several people would be required to seat the valve with a handwheel. While manual gear actuators slow down operation, they are often an attractive option for valves that are not operated frequently. Operating pressure and differential pressure should be specified.

*Note: Users sometimes specify that valves be operable at maximum differential pressure with very low rim-pull forces. This may require selection of gearing that may cause two problems: (1) literally thousands of handwheel turns for full-stroke valve operation and/or (2) capability to damage the valve easily with rim-pull forces that are readily applied by many operating personnel. Manual gear actuators with high ratios provide relatively little "feel" to the operator, and it is difficult to tell when a valve is fully open or closed. Good judgment should be exercised in specifying practical rim-pull force requirements.*

**Power Actuators**
Where valves are inaccessible for manual operation or where relatively fast opening or closing is required, most Edward valves can be furnished with power actuators. The most commonly used actuators are electric actuators with torque- and position-control fea-



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tures. Users frequently have individual preferences on actuator brand names and type, so Edward valves can be furnished with Flowserve actuators or other brand actuators to satisfy customer requirements.

Flowserve establishes actuator sizes and switch setting based on specific valve-application requirements, using a computer program that matches the valve and actuator operating characteristics to the service-pressure conditions. Flowserve can help make this selection since we best know the requirements of our valve. However, we must also know the requirements of your application. As a minimum, requests for quotation should specify:

- Operating pressures – under-and over-seat and differential
- Maximum valve operating temperature
- Ambient conditions – temperature, humidity, radiation
- Motor power supply – AC voltage, frequency, and phase or DC voltage (including variance)
- NEMA rating
- Closing/opening time – if important. If not specified, standard nominal stem speed will be 4 inches/minute (100 mm/min) for globe valves and 12 inches/min (305 mm/min) for gate valves.
- Valve-stem plane – vertical (stem up or down) or horizontal
- Special accessories – position indicator, etc.

Any other special requirements should be clearly specified. If there are non-standard manual-override requirements, see the note above relative to rim-pull forces for manual gear actuators.

## 1.2 Check Valve Applications Guide

**Foreword**

Check valves are used in fluid circuits in applications similar to those in which diodes are used in electrical circuits. Reduced to simplest terms, the duty of most check valves is to allow flow in one direction and to prevent flow in the reverse direction. The ideal check would have zero resistance to flow in the normal flow direction and infinite resistance to flow (leakage) in the reverse direction. Of course, the ideal check valve should also be perfectly reliable and should require no maintenance.

There are many different types of check valves, and most do their duty well, giving long, trouble-free service. However, in the real world, no single type of check valve achieves the ideal performance characteristics users sometimes expect. In a very few cases, mismatching of check valves to the needs of fluid circuits has produced serious problems (noise, vibration, severe pressure surges and check-element failures with attendant gross leakage and consequential damage to other equipment). While it is not necessary for every application to be ideal, knowledge of the characteristics of each type of check valve should help system designers and valve users to select the best type

### 1.1.4 Stop Valve Application Chart (For Large Valves, See Cast Steel Catalog)

| Type | Advantages | Disadvantages | Applications | Limitations |
|---|---|---|---|---|
| **Globe 90° Bonnet** | • Compact<br>• Easy access to handwheel or actuator<br>• Fast response | • High pressure drop<br>• High torque<br>• Heavy in large sizes | • Class 300-2500 steam and water<br>• Other gasses and liquids<br>• Usable for throttling | • Not for stem-down installations<br>• Sizes ¼ through **24** |
| **Angle** | • Same as globe<br>• Replaces an elbow<br>• Lower pressure drop than globe | • High torque<br>• Heavy in large sizes | • Same as globe | • Same as globe |
| **Globe Inclined Bonnet** | • Lower pressure drop than globe or angle<br>• May permit smaller size than globe | • Same as angle<br>• Longest end-to-end length<br>• Handwheel or actuator on an angle<br>• Long stem travel slows response | • Class 600-4500 through size 4<br>• Class 300-2500 through size 24<br>• Otherwise, same as globe | • Same as globe |
| **Equiwedge® Gate** | • Lowest pressure drop<br>• Lowest torque<br>• May permit smallest size | • Not recommended for throttling<br>• Long stem travel slows response with manual actuation | • Class 600-2500 steam and water<br>• Other gasses and liquids<br>• Main steam isolation | • Possibility of pressure binding<br>• Sizes **2½** through **32** |

and size intelligently. This knowledge should also help in assuring that serious problems are avoided.

Most check valves seem deceptively simple, with only one moving part — a poppet or flapper that appears capable of allowing flow in only one direction. However, this single mechanical part cannot be expected to take the place of a sophisticated control system that senses flow (direction, quantity, rate of change) and provides output to (1) open the valve fully when flow is in one direction and yet (2) close the valve to prevent flow and leakage in the reverse direction. Each type of check valve has features that enable it to perform one or more of its duties well, but each type also has weaknesses. The relative importance of these strengths and weaknesses is highly dependent on the requirements of individual applications.

The goal of this guide is to provide application engineers and users with practical advice on check valve selection and sizing, location in piping systems, preventive maintenance and repairs. Emphasis will be on Flowserve Edward Valves products, but comparisons will be provided in some cases with other types of check valves.

This guide is based on extensive testing of Edward check valves in sizes from NPS ½ through 18 as well as a reasonable sampling of other types. Since complete performance testing of every valve type, size and pressure class is not practical, predictions of the performance of some valves are based on mathematical models. However, the models are based on substantial test data and are believed to be reasonably accurate or conservative. The laboratory test files cover over forty years. Perhaps even more important, the files include feedback from substantial field experience — in fossil and nuclear-fueled power plants, refineries, chemical plants, oil fields and in countless other applications. It is hoped that this test and field experience will help others avoid problems and pitfalls in the application and use of check valves.

**Introduction**
This guide has been prepared to aid fluid-system designers in sizing and selecting check valves for industrial and power-piping systems. Guidance is also provided on valve orientation (inclination from horizontal, etc.) and on location of check valves with respect to other flow disturbances. In addition, this guide should aid users in planning preventive maintenance programs, performing maintenance and repairs when necessary, and in evaluating and correcting problems.

Emphasis in this guide is on selection and application of forged- and cast-steel Edward Valves products, but comparisons with other types of check valves are given where this can be done based on valid information.

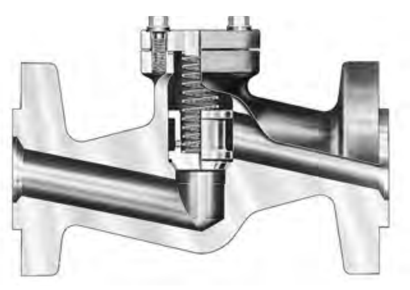
The Flow Performance section of this catalog provides equations and coefficients for the calculation of pressure drop and the flow required to assure full valve opening. In addition, that section provides most of the necessary supplemental data required for routine calculations, such as water and steam density.

This guide also provides caution notes relative to system-related problems to be avoided (such as piping vibration, flow instability, waterhammer). Some of these guidelines are qualitative and could involve further analysis. However, attention to these notes should help to avoid problems.

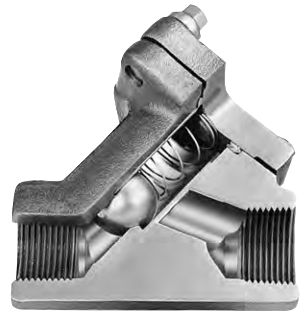
Finally, this guide addresses check valve maintenance. History indicates that preventive maintenance of check valves is often neglected, and this can lead to serious valve failures which may damage other equipment. The guidelines provided on periodic inspection and preventive maintenance should pay off in terms of reduced overall plant maintenance and repair costs.

## 1.2.1 Check Valve Types and Typical Uses

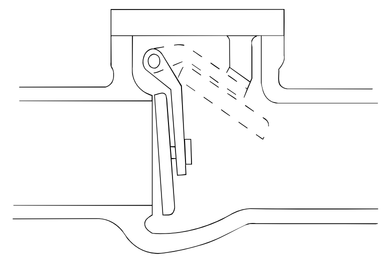
While other types are sometimes encountered in power hydraulics and other specialized applications, four basic types of check valves are commonly used in industrial and power piping applications.



**1-Lift Check Valves**
The closure element is a poppet or disk that is lifted open by flow and which seats, usually on a mating conical surface in the valve body, under no-flow conditions.



**2-Ball Check Valves**
A lift check valve in which the closure element is a ball.



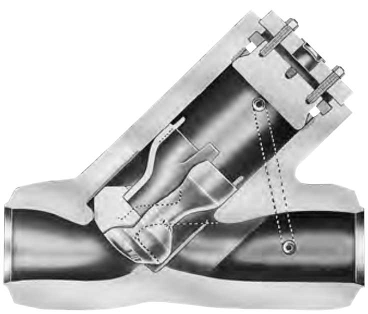
**3-Swing Check Valves**
The closure element is a pivoted flapper which is swung open by flow and which seats, generally against a mating flat surface in the valve body, under no-flow conditions.


**4-Tilting-Disk Check Valve**
The closure element is a pivoted disk or flapper, somewhat like that in a swing check valve but with a pivot axis close to the center of the flow stream. It is swung open by flow and seats against a mating conical surface in the valve body under no-flow conditions.

There are many variations among these four basic types of check valves. For example, springs may be included to assist closure and counteract gravitational forces, and accessories may be provided for exercising or position indication. All Edward lift check valves employ body-guided disks with a piston-like extension to provide good guidance and resistance to wear. Accordingly, they are referred to in this guide as piston-lift check valves. In addition, Flowserve manufactures Edward stop-check valves which are piston-lift check valves that allow positive closure for isolation, just like globe stop valves.

Illustrations of the Edward valve types manufactured by Flowserve are provided in this catalog, and brief notes on advantages, disadvantages, applications, and limitations are provided in the Check Valve Applications Chart (section 1.2.2). Some further highlights of the features of these valves are provided in the following paragraphs.

**Edward Piston-Lift Check Valves**
In both small forged-steel and large cast-steel Edward lines, three distinctly different valve body styles appear in the illustrations – inclined-bonnet globe valve style, angle valve style, and 90°-bonnet globe valve style.



With respect to check valve function, these valves are all similar, with only slightly different orientation limits as discussed in the Valve-Installation Guidelines section (1.3). The main difference between these systems is in flow performance:

• Inclined-bonnet piston-lift check valves produce low pressure drop due to flow when fully open. They have flow coefficients comparable to those of tilting-disk check valves and only slightly lower than provided by many swing check valves.

• In most cases, angle piston-lift check valves have lower flow coefficients and thus produce more pressure drop than inclined-bonnet valves, but they are superior to 90°-bonnet valves. Where a piping system requires a bend and a valve, use of an angle piston-lift check valve eliminates the cost and pressure drop of an elbow and the cost of associated piping welds or flanged connections.

• 90°-bonnet piston-lift check valves have the lowest flow coefficients and produce pressure drops comparable to 90°-bonnet globe valves. They are sometimes preferred in systems where pressure drop is not critical or where space requirements dictate a minimum size and easy access to a handwheel or actuator (on a stop-check valve).

Piston-lift check valves are generally the most practical type for small sizes, and they generally provide the best seat tightness. Small forged-steel piston-lift check valves normally include a disk-return spring, but may be ordered without springs. The Flow Performance section of this catalog and section 1.3 below address such valves, both with and without springs. Cast-steel piston-lift check valves have equalizer tubes which connect the volume above the piston with a relatively low-pressure region near the valve outlet. This feature allows a much larger valve opening (and higher flow coefficient) than would be possible otherwise, and it allows the valve to open fully at a relatively low flow.

The body-guided feature of Edward piston-lift check valves is an advantage in most services, because it assures good alignment of the disk with the valve seat and minimizes lateral vibration and wear. However, this feature may lead to sticking problems due to foreign-material entrapment in unusually dirty systems. Another inherent characteristic is that large piston-lift check valves may not respond rapidly to flow reversals and may cause water-hammer problems in systems where the flow reverses quickly [see the Pressure Surge and Waterhammer section (1.4.2)]. Since smaller valves display inherently faster response, historic files have shown no water-hammer problems with small forged-steel check valves.

**Edward Stop-Check Valves**
Stop-check valves offer the same tight sealing performance as a globe stop valve and at the same time give piston-lift check valve protection in the event of backflow. A stop-check valve is nearly identical to a stop valve, but the valve stem is not connected to the disk. When the stem is in the "open" position, the disk is free to open and close in response to flow, just as in a piston-lift check valve. When serving as a check valve, stop-check valves display the same advantages and disadvantages as discussed above for piston-lift check valves. Small forged-steel stop-check valves, except the Univalve® stop-check valves, employ a disk-return spring, and cast-steel stop-check valves have equalizer tubes that function in the same manner as those on comparable piston-lift check valves.

The stem in the stop-check valve may be driven either by a handwheel or an actuator, and it may be used either to (1) prevent flow in the normal direction when necessary for isolation or (2) supplement line pressure to enhance seat tightness in applications with pressure from the downstream side. Some users automate stop-check valves to give extra system protection against reverse flow and leakage. For example, an actuator may be signaled to close the valve when a pump is shut off; the disk closes quickly by normal check valve action, and the stem follows to seat the valve firmly a short time later.

**Edward Ball Check Valves**
Ball check valves are offered only in small forged-steel configurations (size 2 and smaller) with inclined-bonnet bodies and ball-return springs. These valves are recommended over piston check valves, for service with viscous fluids or where there is scale or sediment in the system. The bolted-bonnet versions offer flow performance that is generally similar to that of equivalent piston-lift check valves, and they are the preferred ball check valves for most industrial and power-piping applications.

The threaded-bonnet hydraulic ball check valves are used primarily in very high pressure, low-flow applications with viscous fluids. They have lower flow coefficients that have proven acceptable for those services. These valves sometimes exhibit chattering tendencies when handling water, so they are not recommended for low-viscosity fluids.

A unique feature of the ball check valve is that the ball closure element is free to rotate during operation, allowing the ball and seat to wear

relatively evenly. This feature, combined with the standard return spring, helps to promote positive seating even with heavy, viscous fluids.

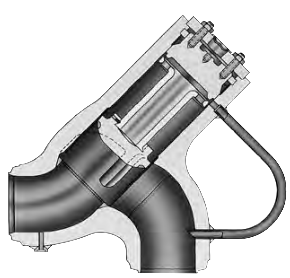
**Edward Tilting-Disk Check Valves**
Tilting-disk check valves are particularly well-suited to applications where rapid response and freedom from sticking are essential. Fully open valves of this type also exhibit low pressure drop. They have flow coefficients comparable to those of Edward inclined-bonnet piston-lift (Flite-Flow[www]) check valves and only slightly lower than provided by many swing check valves.


Tilting-disk check valves provide rapid response, because the center of mass of the disk is close to the pivot axis. Just as in a pendulum, this characteristic promotes rapid motion of the disk toward its natural (closed) position whenever the force holding it open is removed. This response can be valuable in applications where relatively rapid flow reversals may occur, such as in pump-discharge service where multiple pumps discharge into a common manifold. In such cases, the flow may reverse quickly, and the rapid response of the tilting-disk check valve minimizes the magnitude of the reverse velocity and the resulting waterhammer pressure surge. This characteristic also minimizes impact stresses on the disk and body seats. However, an extremely rapid flow reversal, as might be produced by an upstream pipe rupture, could cause a problem. See the Pressure Surge and Water Hammer section (1.4.2) for further discussion.

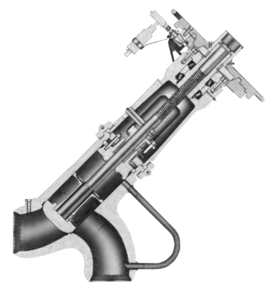
Size-6 and larger tilting-disk check valves have totally enclosed torsion springs in their hinge pins to help initiate the closing motion, but the disk is counterweighted to fully close without the springs. With the free pivoting action of the disk, this type of valve is highly immune to sticking due to debris in the system.

Tilting-disk check valve are superficially similar to swing check valves in that both operate on a pivoting-disk principle. However, the pivot axis in a swing check valve is much farther from the disk's center of mass, and this increases the "pendulum period" and hence the time required for closure in services with flow reversal. In addition, the one-piece disk in the tilting-disk check valve avoids the necessity of internal fasteners and locking devices, which are required to secure disks to pivot arms in most swing check valves. However, like swing check valves, tilting-disk check valves have hinge pins and bearings that are subject to wear due to disk flutter if the valve is not fully open and/or there are flow disturbances or instabilities. Such wear may product eccentricity of the disk and seat when the valve closes, leading to a degradation of seat tightness (particularly at low differential pressures). Applications involving severely unstable flow or prolonged service without preventive maintenance can lead to failures in which the disk separates completely from the hinge pins and will not close. Other sections of this guide address the flow conditions which may lead to problems as well as maintenance recommendations.

**Edward Elbow-Down Check and Stop-Check Valves**



Elbow-down piston-lift check and stop-check valves are similar to Flite-Flow valves except that the valve outlet is in the form of an elbow to direct the flow downward. These valves were designed specifically for applications in controlled-circulation power plants, and they have special clearances and other design features. Because of these special features, the sizing and pressure-drop calculation methods given in the Flow Performance section of this catalog do not apply. However, special elbow-down valves can be furnished with conventional check valve design features for applications where this valve-body geometry is desirable.



**Edward Combinations of Check and Stop-Check Valves**
As noted in the Foreword to this section (1.2), no single type of check valve achieves ideal performance characteristics. The advantages and disadvantages noted in the Check Valve Applications Chart (section 1.2.2) and other information in this catalog should assist in selection of the best valve size and type for any specific application. However, the selection of any single valve may require undesirable compromises.

Some system designers and users specify two check valves in series for critical applications, and this does give some insurance that at least one valve will close even if the other valve fails. However, if two identical valves are used, a system characteristic that is troublesome to one valve could produce problems with both. In such cases, use of two valves does not assure double safety or double life. Sometimes it is worth considering the selection of two different types of check valve, each with advantages to offset disadvantages of the other.

One specific check valve combination has been used in applications of Flowserve Edward valves to provide advantages that no single valve can offer. A tilting-disk check valve in series with a piston-lift check valve offers minimum waterhammer and freedom from sticking (from the tilting-disk) and good seat tightness (from the piston-lift check). The disadvantage is added pressure drop and cost, but the pressure-drop penalty is minor if the Flite-Flow inclined-bonnet piston-lift check valve is used. Even the cost penalty may be offset if a stop-check valve is used, because it may be able to take the place of a stop valve that would be required otherwise for isolation.

### 1.2.2 Check Valve Applications Chart (For Large Valves, See Cast Steel Catalog)

| Type | Advantages | Disadvantages | Applications | Limitations |
|---|---|---|---|---|
| **Piston Lift Check** | • Very low pressure drop in inclined bonnet valves<br>• Relatively low pressure drop in angle valves<br>• Larger valves incorporate an external equalizer<br>• Minimum chatter due to flow disturbances<br>• Good seat tightness<br>• Forged steel valves with spring can be mounted in any orientation | • Relatively high pressure drop in 90° bonnet valves<br>• Subject to “sticking” in very dirty systems | • Class 300-4500 service<br>• High temperature steam and water<br>• Refining, petrochmical, chemical, etc.<br>• Oilfield production<br>• Can be used in series with Tilting Disk Check to provide maximum line protection (advantages of both types). | • Sizes ¼ through **24**<br>• For orientation limits see valve installation guidelines<br>• For flow limits see Flow Performance section of this catalog |
| **Ball Check** | • Wear on body seat and check element evenly distributed<br>• Long service life<br>• Forged steel valves with spring can be mounted in any orientation<br>• Available with either integral or threaded seat for hydraulic valve<br>• Low cost | • High pressure drop<br>• Available only in small sizes | • Class 600 and Series 1500 service<br>• Water, steam, refining, petro-chemical, chemical, etc.<br>• Service where scale and sediment exist<br>• Viscous fluids | • Sizes ¼ through **2**<br>• For orientation limits see valve installation guidelines<br>• Not recommended for gas service at low flow rates<br>• For flow limits see Flow Performance section of this catalog |
| **Tilting Disk Check** | • Very low pressure drop<br>• Straight through body design<br>• Very fast closing<br>• Minimizes disk slamming and waterhammer pressure surges<br>• Will not “stick” in dirty systems | • Not recommended for service with rapidly fluctu-ating flow<br>• Seat tightness may dete-riorate at low differential pressure | • Class 600-4500 service<br>• High temperature steam and water<br>• Refining, petrochemical, chemical, etc.<br>• Oilfield production<br>• Can be used in series with Piston Lift check or Stop-Check to provide maximum line protection (advantages of both types) | • Sizes 2½ through **24**<br>• For orientation limits see valve installation guidelines<br>• For flow limits see Flow Performance section of this catalog |
| **Stop Check** | • See Piston Lift Check above<br>• Can be used for Stop valve service<br>• Stem can be lowered onto disk to prevent chatter at low flow<br>• Stem force can overcome “sticking” | • See Piston Lift Check valve above | • See Piston Lift Check above | • See Piston Lift Check above |

## 1.3 Check and Stop-Check Valve Installation Guidelines

Unlike stop valves, which can be installed in any position with little or no effect on performance, most check and stop-check valves have limitations as to their installed orientation. Although the normal installation is in a horizontal or vertical line (depending on valve type), check and stop-check valves can be installed in other orientations. It should be noted, however, that valves installed in other than the normal positions may exhibit a degradation of performance, service life and resistance to sticking, depending on the flow conditions and cleanliness of the line fluid. For maximum reliability, it is recommended that piston-lift check valves and stop-check valves be installed with flow axis horizontal (vertical inlet and horizontal outlet for angle valves) with the bonnet above the valve in a vertical plane. Following are maximum out-of-position orientations that may be used for less critical applications and which should never be exceeded.

• All Edward forged-steel check and stop-check valves (except Univalve® stop-check valves) are normally furnished with spring-loaded disks and may be installed in any position. The spring-loaded disk enables positive closure regardless of valve position. However, installed positions in which dirt or scale can accumulate in the valve neck should be avoided. An example of this would be an inclined-bonnet valve installed in a vertical pipeline with downward flow. If forged-steel valves are ordered without springs, the limitations below should be observed.

• Edward cast-steel Flite-Flow®, forged-steel Univalve, and inclined-bonnet check and stop-check valves without springs, when installed in vertical or near vertical lines, should be oriented such that the fluid flow is upward and the angle of incline of the line is not more than 5° past the vertical in the direction of the bonnet. When installed in horizontal or near horizontal lines, the valve bonnet should be up and the angle of incline of the line should be not more than 5° below the horizontal. See Figure 1A. Also, the roll angle of the valve bonnet should not be more than 20° from side to side for either vertical or horizontal installations. See Figures 1B and 1C. Consult your Flowserve Edward Valves representative concerning installation limits of bolted-bonnet forged-steel check valves without springs.

**Figure 1**
**45° Inclined Bonnet Piston Lift Check Valves**
**Maximum Check Valve Orientation Limits**

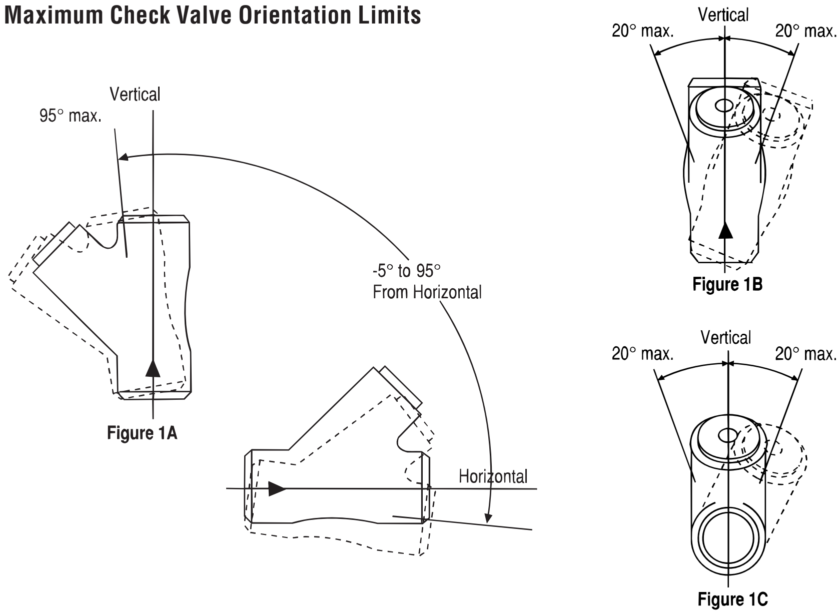
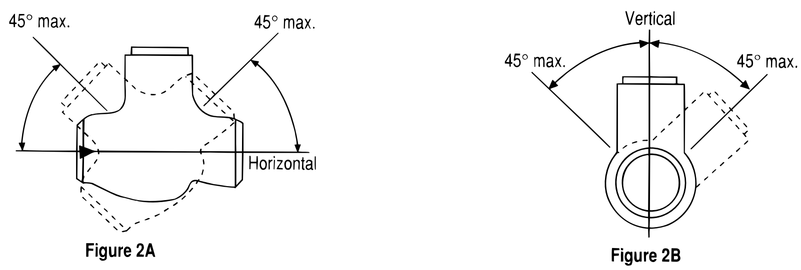



**Figure 2**
**90° Bonnet Piston Lift Check Valves**
**Maximum Valve Orientation Limits**




*Note: For piston lift check valves, any installation resulting in combined out of position orientation, such as a valve in an inclined line with a rollover angle as well, should limit the angle of the bonnet to the following:*

• 45° from vertical for angle and 90°bonnet valves.

• 50° from vertical for inclined bonnet valves.

• Edward cast-steel and forge-steel 90°-bonnet check and stop-check valves without springs should be installed with the bonnet up, and the angle of incline of the line should not be more than 45° form the horizontal. Also, the roll angle of the valve bonnet should not be more than 45° from side to side. See Figures 2A and 2B.

• Edward cast-steel and forged-steel angle check and stop-check valves without springs should be oriented such that the incoming flow is upward, and the angle of incline of the line should not be more than 45° in either direction. See Figure 3A and 3B.

• Edward tilting-disk check valves may be installed in horizontal lines and vertical lines and at any incline angle in between. When the incline angle is not horizontal, flow should always be up. The roll angle of the valve should not be more than 30° from side to side. See Figures 4A and 4B. Also, when installed in other than vertical lines, the bonnet should always be oriented up.

**Figure 3**
**Angle Piston Lift Check Valves Orientation Limits**

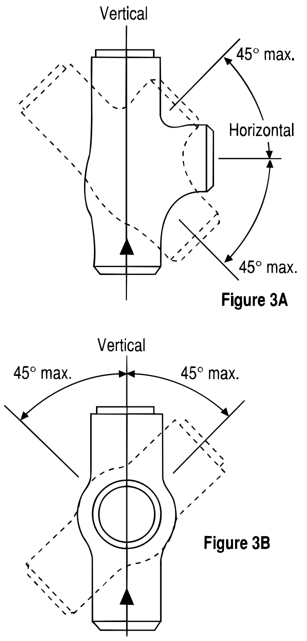
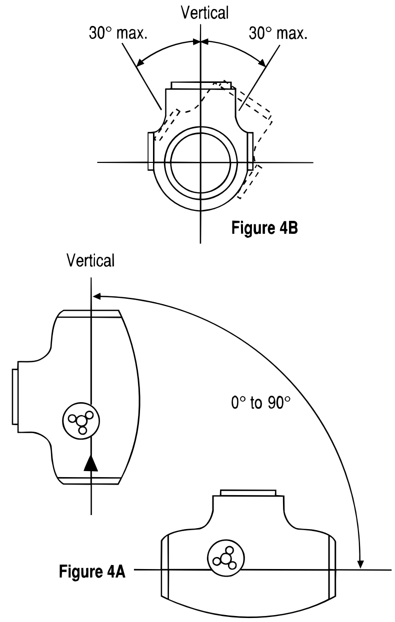



**Figure 4**
**Tilting Disk Check Valves Orientation Limits**




In each case described above, the limitations given for line inclination and bonnet roll angle should not be combined.

It should be understood that the information given in the section of this catalog entitled Flow Performance is based on traditional horizontal orientations. For other orientations, the pressure drop and flow required for full lift may be affected. In addition, seat tightness, particularly at low differential pressures, may be adversely affected.

Orientation restrictions may also exist for power-actuated stop-check valves. Most linear valve actuators are designed to be mounted upright and nearly vertical, although they can usually be modified for mounting in any position. When selecting a stop-check valve and power actuator, be sure to specify the mounting position desired if not vertical and upright.

### 1.3.1 Adjacent Flow Disturbances

Check valves, like other valve types, are generally tested for performance and flow capacity in long, straight-pipe runs. Flow coefficients obtained from these tests are then used to predict the flow rate or pressure drop that will be experienced in actual applications. The ideal installation of a check valve in a plant would be in a long run of straight pipe so that performance would correspond to the test conditions. Since space limitations involved with many installations preclude such ideal straight-pipe runs, the effects of adjacent pipe fittings, control valves, pumps and other flow disturbances must be considered.

**Figure 5**
**Pipe fittings near valves may produce instability because of velocity profile distortion**

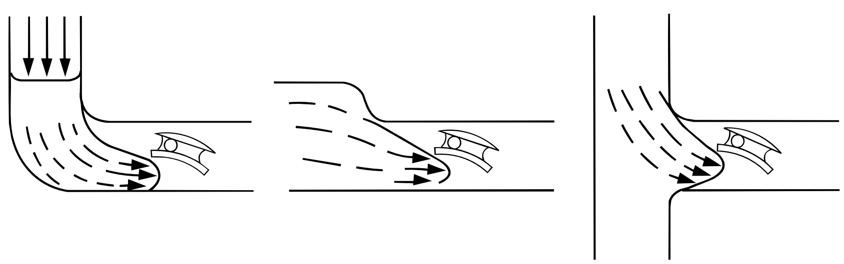
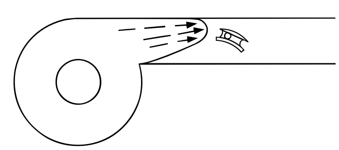
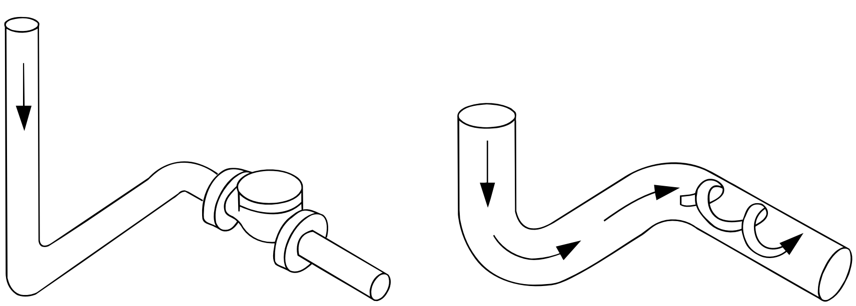


**Figure 6**
**Non-uniform velocity profile at blower or pump discharge can affect stability.**



Previously published data have indicated that flow disturbances, particularly upstream disturbances, may significantly affect check valve performance. It has been reported that valve flow capacity may be significantly reduced as compared to that measured in straight-pipe tests, and there have been strong suggestions that such disturbances aggravate check valve flutter and vibration. Since these conditions could degrade valve performance and contribute to rapid wear and premature valve failure, they

**Figure 7**
**Elbows in two places cause swirl which can promote instability.**



are important factors in evaluating check valve applications. Figure 5 illustrates how upstream pipe fittings may alter the flow profile entering a check valve, crowding it to one side or the other. A similar distortion occurs in a valve located near the discharge of a centrifugal pump or blower, as shown in Figure 6. Elbows in two planes cause a flow stream to swirl, which might produce unusual effects on a check valve installed as shown in Figure 7.

Since there was no known way to predict the effects of flow disturbances on check valves by mathematical models, Flowserve conducted extensive testing of size 2, 4, 8 and 10 check valves in straight-pipe runs and in piping with upstream flow disturbances. Figures 8 and 9 illustrate typical flow-test setups.

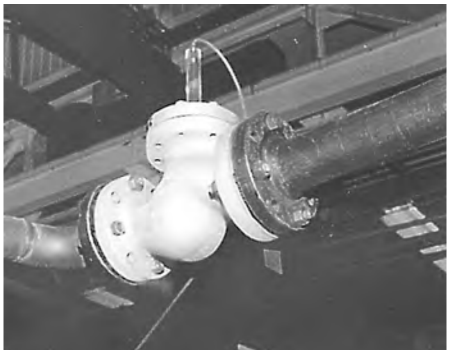


**Figure 8**
Size 4 Class 600 90° bonnet piston lift check valve with two upstream elbows (out of plane). This arrangement produces swirl as shown in Figure 7.

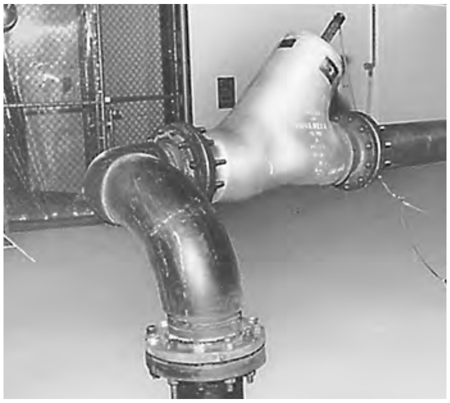


**Figure 9**
Size 10 Class 1500 Flite-Flow® inclined bonnet piston lift check valve with two upstream elbows. Test loop capacity permitted tests with line velocity over 20 ft/s (6 m/s).

In most tests, room temperature water was the flow medium, but limited straight-pipe testing was performed with air. The valves tested included Edward piston-lift check (inclined-bonnet, angle and 90°-bonnet), tilting-disk check valves and a size-4 swing check valve manufactured by another company. The tests were designed to evaluate the effects of flow disturbances on (1) valve stability, particularly when partially open; (2) flow rate required to open the valve fully; and (3) the flow coefficient ($C_V$) of the valve. The flow disturbances evaluated included single and double (out of plane) 90° elbows in various orientations immediately upstream of the check valves. In addition, the effects of a throttled, upstream control valve were simulated with an offset-disk butterfly valve (at various throttle positions) mounted immediately upstream, as well as at five and eleven pipe diameters upstream, of the check valves.

With few exceptions, tests with ten or more diameters of straight pipe upstream of check valves produced little cause for concern. In water flow tests, visual position indicators usually showed only minor disk "wobble" or very small open-close flutter (e.g. less than 1° total rotation of a tilting disk), even at very low flows and small valve openings. The only conditions that produced severe instability were those involving air flow at very low pressures (below 50 psi or 3.4 bar) and valve openings less than 20%. Such conditions produced significant cyclic motion, with disks bouncing on and off the body seats. In view or the many uncertainties in applying laboratory test results to service conditions, it is considered prudent to avoid operating conditions which produce check valve openings of less than 25%, even in ideal straight-pipe applications.

Highlights of the results of the Flowserve tests with flow disturbances are given in Table A on page 95. The test program clearly showed that upstream flow disturbances do affect check valve performance, but the effect is not always predictable. The magnitude of the effect can vary, depending on the type and even the size of the valve. In some cases, even the direction of the effect (improvement or degradation) varies from valve to valve. Nevertheless, some general observations on the results of these tests are:

• Single and double upstream elbows produced less severe effects on check valve performance than had been expected, and some valves displayed no discernible effects. For example, Edward angle piston-lift check valves exhibited the same stability, lift and flow coefficients ($C_V$) with upstream elbows as with straight pipe. In tests of other types of valves, upstream elbows produced both beneficial and adverse effect to various degrees.

• In each case where a check valve was tested with a throttled butterfly valve immediately upstream, there were significant effects on performance. The effects included increased disk flutter and reduced valve opening at a given flow, as compared to straight-pipe performance. In some cases, full check valve opening could not be achieved at any flow within the capabilities of the test loop.

Even where full opening was obtained, some valves continued to flutter on and off their stops. These effects were worst when the butterfly valve was most severely throttled (smallest opening and highest pressure drop). In the worst cases, the butterfly valve exhibited audible cavitation, but it is not clear whether the adverse effects resulted from simple flow distortion or the two-phase flow stream from the cavitating butterfly valve.

In similar tests with the butterfly valve moved 5 diameters upstream of the check valve (but with similar throttling), the adverse performance effects were decreased significantly but not eliminated. When the butterfly valve was moved 11 diameters upstream of the check valve, normal check valve performance was restored.

The results of these tests were enlightening, but they must be combined with observations based on field experience. For example, while upstream elbows produced less severe effects than expected, there were still adverse effects on some valves. It is difficult to extrapolate a laboratory test to years of service in a plant installation, but Flowserve service files include an interesting and relevant incident. Two size-12 tilting-disk check valves in one plant had hinge-pin failures over a time period of several months after 25 years of service. While this incident might best be cited as a case for more inspection and preventive maintenance, the details of the installation were investigated. It was determined that the flow rates were in a range that should have assured full disk opening, but the valves were installed close to upstream elbows.

Users of this catalog may wish to refer to EPRI Report No. NP 5479 (see the Sources for Additional Information section of this catalog) for further data on the performance of swing check valves in tests similar to those conducted by Flowserve. The size-4 swing check valve used in the Flowserve test program had a stop positioned to restrict the disk-opening angle to about 38°. This valve opened fully at a relatively low flow and exhibited reasonably stable performance. The tests sponsored by EPRI showed that other swing check valves (with less restrictive stops) exhibited larger amplitudes of flutter than were observed in comparable Flowserve tests.

The following guidelines are based on Flowserve tests and field experience, combined with other published information:

• If possible, check valves near flow disturbances should be sized to be fully open, preferably by a good margin, even at the lowest sustained flow rate anticipated for each application. The Flow Performance section of this catalog provides methods for sizing Edward check valves for new installations or for evaluating existing applications. When flow-induced forces load a valve closure element firmly against a stop, it is less likely to flutter and suffer from rapid wear.

Full opening does not guarantee freedom from problems if the margin is not sufficient to provide a firm load against the stop. Equalizers on Edward cast-steel piston-lift check and stop-check valves enhance this margin and provide good stop loading, but flow disturbances may cause other valve disks to bounce on and off their stops. This “tapping” phenomenon may cause faster wear than flutter about a partially open position. For this reason, the minimum sustained flow rate through a tilting-disk check valve near flow disturbances should be about 20% greater than the flow rate required to just achieve full opening.

If it is not possible to ensure full opening of a check valve at minimum flow conditions, at least 25% opening should be ensured. Valves operating at partial opening for significant periods of time should be monitored regularly to determine if there is instability or wear.

• In view of uncertainties associated with long-term effects of flow disturbances, it is recommended that a minimum of 10 diameters of straight pipe be provided between the inlet of a check valve and any upstream flow disturbance (fittings, pumps, control valves, etc.), particularly if calculations indicate that the check valve will not be fully open for a substantial portion of the valve service life. There should be a minimum of 1 to 2 diameters of pipe between the check valve and the nearest downstream flow disturbance.

• In the specific case of upstream elbows, reasonably successful performance should be attainable with 5 diameters of straight pipe between an upstream elbow and a check valve if the valve will not be partially open for a significant portion of its service life. Tests described in EPRI Report No. NP 5479 indicate that elbows installed 5 diameters or more upstream had a negligible effect on swing check valves, and this is expected to be true for other check valve types. Even less straight pipe may be satisfactory, but such close spacing should be reserved for applications with very tight space constraints. More frequent inspection and preventive maintenance should be planned for valves in such installations.

**Table A – Effects of Upstream Flow Disturbances on Check Valve Performance**

| Valve Size and Type | Single Elbow at Valve Inlet[1] | Double Elbows (Out of Plane) at Valve Inlet | Throttled Butterfly Valve | | |
|---|---|---|---|---|---|
| | | | At Valve Inlet | 5 Diam. Upstream | 11 Diam. Upstream |
| Size 2, Inclined-Bonnet, Piston-Lift Check | Higher Lift for Same Flow; Disk Flutter at Lower Lifts[2] | Higher Lift for Same Flow | NA | NA | NA |
| Size 4, Angle, Piston-Lift Check | No Effect | No Effect | NA | NA | NA |
| Size 4, 90°-Bonnet, Piston-Lift Check | Same, Lower or Higher Flow for Full Lift | No Effect | Disk Flutter and Chatter: Failure to Achieve Full Open | NA | NA |
| Size 4, Swing Check | Smaller Opening for Same Flow | Smaller Opening for Same Flow | Larger Opening for Same Flow; Disk Flutter | NA | NA |
| Size 8, Angle, Piston-Lift Check | No Effect | NA | NA | NA | NA |
| Size 8, 90°-Bonnet, Piston-Lift Check | Disk Flutter at Partial Lift | NA | NA | NA | NA |
| Size 10, Inclined-Bonnet, Piston-Lift Check | Same or Lower Lift for Same Flow; Slight Disk Wobble | No Effect | Failure to Achieve Full Open; Disk Flutter and Chatter | Failure to Achieve Full Open | No Effect |
| Size 10, Tilting-Disk Check | No Effect | Minor Flutter | Same, Lower or Higher Lift for Same Flow; Disk Flutter and Chatter | Minor Flutter | No Effect |

*1: Tests were conducted with single 90° elbows in the horizontal plane and in the vertical plane (with flow both from above and below).*
*2: One size-2 valve exhibited flutter at lower lifts; another was stable.*

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• In the specific case of throttled upstream control valves, the minimum requirement of 10 upstream pipe diameters should be adhered to rigidly. Calculations indicating full valve opening based on straight-pipe tests cannot be trusted to prevent problems, because severe flow disturbances may prevent full opening. Even greater lengths of straight pipe should be considered if the control valve operates with very high pressure drop or significant cavitation.

• Users with existing check valve installations that do not meet these guidelines should plan more frequent inspection and preventive maintenance for such valves. If a check valve is installed close to an upstream control valve that operates with a high pressure drop, considerations should be given to a change in piping or valve arrangements.

### 1.3.2 Other Problem Sources

In addition to the fundamentals of check valve selection, sizing and installation, several other potential sources of check valve problems should be considered in applications engineering or, if necessary, in solving problems with existing installations:

**• Piping-System Vibration**
In other sections of this guide, it has been noted that check valve damage or performance problems may result from flow-induced flutter or vibration of the closure element. Very similar damage may result from piping-system vibration. Such vibration may originate at pumps, cavitating control valves or other equipment. Check and stop-check valves are susceptible to vibration damage, because the check element is "free floating" when partially open, with only the forces due to fluid flow to balance the moving weight. Impact damage and internal wear may result if the valve body vibrates while internal parts attempt to remain stationary. This condition may be avoided by adequately supporting the piping system near the check valve or by damping vibration at its source. Of course, it is helpful to assure that the check element opens fully, because flow forces at the disk-stop help to inhibit relative motion.

**• Debris in Line Fluid**
Debris in the flow stream can cause damage and performance problems in check and stop-check valves. Debris entrapped between the disk and seat may prevent full closure and lead directly to seat leakage. If hard particles or chips are in the debris, they may damage the seating surfaces and contribute to seat leakage even after they are flushed away. Debris caught between the disk and the body bore of a piston-lift check valve can cause the disk to jam and prevent full opening or closing. To ensure best check valve performance and seat tightness, line fluids should be kept as clean as practical. As noted before, tilting-disk check valves are particularly resistant to sticking or jamming, but they are no more resistant to seat damage than other types.

**• Unsteady (Pulsating) Flow**
An unsteady flow rate can lead to rapid check valve damage, particularly if the minimum flow during a cycle is not sufficient to hold the valve fully open. The valve may be damaged just because it does what a check valve is designed to do – open and close in response to changes in flow. As an example, a check valve installed too close to the outlet of a positive displacement pump may attempt to respond to the discharge of each cylinder. If the mean flow during a cycle is low, the disk may bounce off the seat repeatedly in a chattering action. If the mean flow is higher, the disk may bounce on and off the full-open stop. Such pulsating flows may be difficult to predict. For example, a steam leak past the seat of an upstream stop valve may produce a "percolating" action in a line filled with condensate and cause a check valve to cycle. Such problems may only be discovered by preventive maintenance inspections.

**• Vapor Pockets in Liquid Piping Systems**
Unusual phenomena are sometimes observed in piping systems containing hot water that partially vaporizes downstream of a closed check valve. Vapor pockets at high points may collapse suddenly when the check valve opens (due to the start-up of a pump, for example). This collapse may be remote from the check valve and have no effect on the check valve performance. However, if a vapor pocket exists in the upper part of a piston-lift check or stop-check valve body (above the disk), the collapse may generate unbalanced forces in the direction of disk opening. Since the vapor offers little fluid resistance, rapid acceleration of the disk toward the fully open position may occur. In extreme cases, the disk or bonnet stops may be damaged due to impact. Such thermodynamic quirks are difficult to anticipate when designing a piping system and are sometimes as difficult to diagnose if they occur in an existing installation. Changes in piping arrangements or operating procedures may be necessary if severe problems occur. It is possible that similar problems may occur during low-pressure start-up operations in unvented liquid-piping systems.

## *1.4 Check Valve Performance*

### 1.4.1 Check Valve Seat Tightness

Edward check valves are factory-tested with water in accordance with MSS SP-61 (Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.) at an overseat pressure of 1.1 times the pressure ratings of the valve. While check valves are allowed leakage rates up to 40 ml/hr per unit of nominal valve size by MSS SP-61, Flowserve allows no more than 5% of this leakage for cast-steel valves and no visible leakage for forged-steel valves. Tilting-disk and forged-steel check valves are then tested again at a reduced pressure with allowable leakage rates which are less than the MSS SP-61 requirements.

Closed check valve closure elements (disk, ball, flapper, etc.) are acted on by a combination of forces produced by gravity, springs (where applicable) and reversed differential pressure. While gravity and spring forces help to position the closure element into the substantially closed position, metal-to-metal seating check valves typically rely on pressure forces to produce the seating loads necessary for good seat tightness.

Some metal-seated check valves do not produce good seat tightness at low differential pressures, particularly when the pressure increases from zero. A threshold level of differential pressure is required to produce uniform metal-to-metal contact and restrict leakage to a reasonable rate. An even higher level is required to ensure that a valve meets leakage-rate criteria like those in MSS SP-61. Unfortunately, these levels of differential pressure are difficult to predict; they vary with valve type, condition and orientation (and with cleanliness of line fluid).

Tests of new valves in horizontal lines show that cast-steel inclined-bonnet and 90°-bonnet piston-lift check and tilting-disk check valves seal off reasonably well at under 50 psi (3.4 bar) when differential pressure increases from zero. Small forged-steel ball and piston-lift check valves are less consistent, sometimes seating at less than 50 psi (3.4 bar) and sometimes requiring 250 psi (17 bar) or more. This "seating" action often occurs suddenly when the pressure forces shift the closure element into good metal-to-metal contact with the body seat, and leakage generally continues to decrease as the pressure is increased. Once seated, most valves seal well if pressure is reduced below the threshold required for initial seating, but the seat tightness with reducing pressure is also difficult to predict.

Some of the Edward check valves described in this catalog have been manufactured with "soft seats" to provide improved seat tightness at low differential pressures. This design feature includes an elastomeric or plastic sealing member on the valve closure element to supplement the basic metal-to-metal seating function. Since the design and material selection for these sealing members are very sensitive to pressure, temperature and compatibility with the line fluid, there are no standard, general-purpose, soft-seated valves. Consult Flowserve for further information about specific applications.

Foreign material in the flow medium is a major source of leakage problems in many valves. Because of the limited seating forces in check valves, dirt has a far greater effect on the tightness of these valves than other types. Attention to cleanliness of the fluid is necessary where good check valve seat tightness is desired.

Incorrect sizing or misapplication of a check valve can also lead to leakage problems. Chattering of the closure element on its seat due to insufficient flow or pressure can cause damage to the seat or closure element and result in leakage.

In applications where check valve leakage is a problem, a stop-check valve may offer the solution. Stem load from a handwheel or actuator can provide the necessary seating force independent of pressure. Of course, the stem must be returned to the "open" position to allow flow in the normal direction. Consult Flowserve about applications that are usually sensitive to leakage.

A complete treatment of the subject of pressure surge and waterhammer is beyond the scope of this catalog, but some discussion is provided so that application engineers may appreciate the significance of the problem as it relates to check valves.

### 1.4.2 Pressure Surge and Waterhammer

One part of the problem is that the terminology or jargon is not consistently used. For example, "waterhammer" or "steam hammer" is sometimes used to describe the implosion which occurs when water enters a hot, low pressure region and causes a steam void to collapse. This has occurred in systems with a failed check valve, where the water came back from a large reverse flow through the check valve. However, the more common "waterhammer" problem associated with check valves occurs as a result of the check valve closing and suddenly terminating a significant reversed flow velocity. This problem is generally associated with valves handling water or other liquids. A similar pressure surge phenomenon may be encountered with steam or gas, but it is generally much less serious with a compressible flow medium.

Waterhammer is a pressure surge produced by the deceleration of a liquid column, and it involves pressure waves that travel at close to the velocity of sound through the fluid. It is commonly illustrated in texts by an example involving rapid closure or a valve in a long pipe. For such a case, it can be shown that instantaneous closure of a valve in a room-temperature water line will produce an increase in pressure of about 50 psi (3.4 bar) above the steady-state pressure for every 1 ft/sec (0.30 m/sec) decrease in water velocity. Even if the valve does not close instantaneously, the same pressure increase would develop if the upstream pipe is long enough to prevent reflected pressure waves from reaching the valve before it closes. The waves of increasing pressure that are generated by the closing valve "reflect" from a constant-pressure reservoir or vessel, if present in the system, and return to the valve as inverted waves that decrease pressure. A solution to the "textbook problem" is to slow down the valve closure so that the reflected pressure waves attenuate the surge. However, this is not necessarily the best approach in the case of a check valve.

In a check valve, the fluid velocity is forward before the valve starts to close, but it reduces due to some system action (e.g., a pump is shut off). If the velocity reverses before the valve closes, a waterhammer surge will be produced by a conventional check valve that is nearly proportional to the magnitude of the maximum reversed velocity. Figure 10 provides curves illustrating flow transients associated with different types of systems and flow interruptions. The graphs illustrate velocity in the pipe, forward and reverse, versus time on arbitrary scales. The following discussions describe each of the curves:

- **Curve A** illustrates flow coast-down in a simple circulating loop, such as a cooling system, following switch-off of pump power. The momentum of the pump impeller and the fluid keeps the fluid going forward until it is decelerated and finally stopped by friction. There would be no need for a check valve to prevent reverse flow in this system, but one might be included to permit pump maintenance without draining other equipment. In normal operation of this system, the check valve could produce no waterhammer.

- **Curve B** illustrates an application with a pump feeding a high-pressure system with a fairly large volume. It might represent a boiler feed system of a pump feeding a high reservoir. In this case, assuming similar momentum in the pump and fluid, forward flow continues for a while after the pump is switched off, but the downstream pressure decelerates the flow more rapidly and then reverses its direction. Without a check valve, the reverse flow would increase and stabilize at some value, unless the downstream system pressure declined. In the illustration, the magnitude of the maximum reverse velocity is drawn less than the initial forward velocity, but it might be higher in some systems.

- **Curve C** illustrates what would happen in the system described for Curve B with a fast-response check valve (e.g., a tilting-disk type) installed. As discussed in the Foreword to this guide, an "ideal" check valve would allow no reverse flow and would close exactly at the time the velocity curve passes through zero; there would be no waterhammer. A "real" check valve starts closing while the flow is still forward, but it lags the velocity curve. With fast response, it closes before a high reverse velocity develops, thus minimizing the waterhammer surge.

- **Curve D** illustrates the same system with a check valve that responds just a bit slower. It shows that just a small increase in check valve lag may allow a large increase in reverse velocity (and a corresponding increase in waterhammer surge pressure).

- **Curve E** illustrates an accidental situation that might develop with a severely worn valve or a dirty system. If a check valve in the system described above should stick open, it might allow the reverse velocity to build up so as to approach that which would occur without a check valve. If the reverse flow forces should then overcome the forces that caused the sticking, the resulting valve stem could cause a damaging waterhammer surge.

- **Curve F** illustrates what might happen in the system described for Curve B if there were a major pipe rupture just upstream of the check valve. With free discharge through the open

**Figure 10 - Flow Reversal Transients**

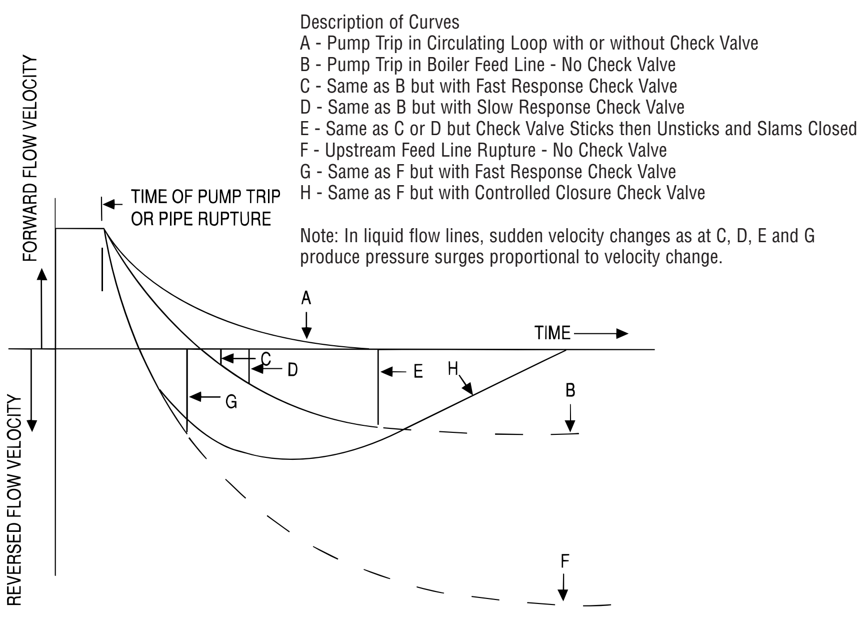
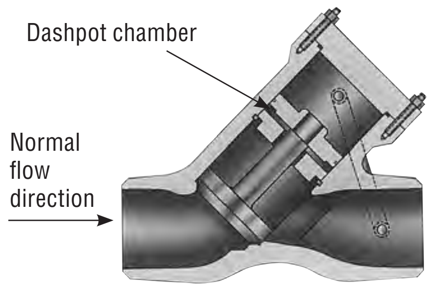



**Figure 11 - Controlled Closure Check Valve (CCCV)**




end, the flow would decelerate much more rapidly and, without a check valve, reach a much higher reverse velocity.

• **Curve G** shows the response of the system in Curve F if even a fast-response conventional check valve were to be used. With a flow deceleration this rapid, even a small lag may result in a very high reverse velocity to be arrested and a correspondingly high waterhammer surge.

Fortunately, it is not necessary to design every piping system with a check valve to cope with a pipe rupture. However, this requirement has emerged in some power-plant feedwater piping systems. Flowserve analyses and tests have shown that even the most rapid-responding conventional check valve could produce unacceptable waterhammer surges. This led to the development of the special controlled-closure check valve (CCCV–see Figure 11). Since high reverse velocities are inevitable, the CCCV solves the problem the way the "textbook problem" discussed above is solved–by closing slowly. The CCCV is a piston-lift check valve, but it has an internal dashpot which slows the closing speed of the valve. Closing speed depends on the rate at which water is squeezed out of the dashpot chamber, through flow paths that are sized for each application.

• **Curve H** illustrates the velocity variation in the pipe-rupture situation described for Curve F, but with a CCCV in the line. In this case, the maximum reverse velocity might even be higher than in Curve G, but it is decelerated back to zero slowly, allowing reflected reducing-pressure waves to minimize the resulting waterhammer surge. Figure 12 provides a comparison between a conventional check valve and a CCCV for a specific pipe-rupture situation. Note that the conventional check valve closes in 0.07 seconds as compared to 1.0 seconds for CCCV. As a result, the conventional check valve produced a surge of 3000 psi (207 bar) while the CCCV limits the surge to 600 psi (41 bar). These characteristics have been demonstrated in tests and can be duplicated in computer-based dynamic analysis simulations of specific valves and systems.

While the CCCV solves a special problem, even this sophisticated product does not fulfill the definition of an ideal check valve. By closing slowly, it allows significant reverse blow before it seats. This characteristic might be undesirable in common pump-discharge applications, because the reverse flow might have adverse effects on pumps or other equipment. Studies of systems designs sometimes show that fast-response check valves, such as the tilting-disk type, should be retained at pump discharge points where an upstream pipe rupture is unlikely, with CCCVs applied at locations where an upstream pipe rupture could cause serious consequences (e.g., in feedwater lines inside the containment vessel of a nuclear power plant).

In Curves C, D, E, and G of Figure 10, it may be noted that the final terminations of reverse velocity are shown as substantially vertical lines. This does not imply that the valve closes instantaneously. However, tests of conventional check valves show that the reverse velocity in the pipe containing the valve does terminate almost instantaneously. This apparent contradiction may be understood by referring to Figure 13, which illustrates a check valve approaching the closed position with reverse flow (while the illustration depicts a swing check valve, the flow condition discussed here would be much the same with a poppet or disk in a conventional lift check or piston-lift check valve).

The key observation from Figure 13 is that a column of fluid follows the closure element at roughly the same velocity that the closure element has as it approaches its seating surface in the valve body. While the valve may start to close while the flow velocity is still forward (see Figure 10), an undamped check valve has little effect on pipe flow during closure, and the disk velocity is about the same as the reverse flow velocity in the pipe at the instant just before closure. Since the disk is stopped substantially instantaneously when it makes metal-to-metal contact with the body seat, the reverse flow velocity in the pipe must also be arrested instantaneously. Because of this characteristic, the surge produced by the slam of a conventional check valve cannot be attenuated significantly by reflected reducing-pressure waves, and the surge tends to be relatively insensitive to system pipe lengths.

**Figure 12 - Example Comparison of Closure Time and Surge Pressure Conventional vs Controlled Closure Check Valves**

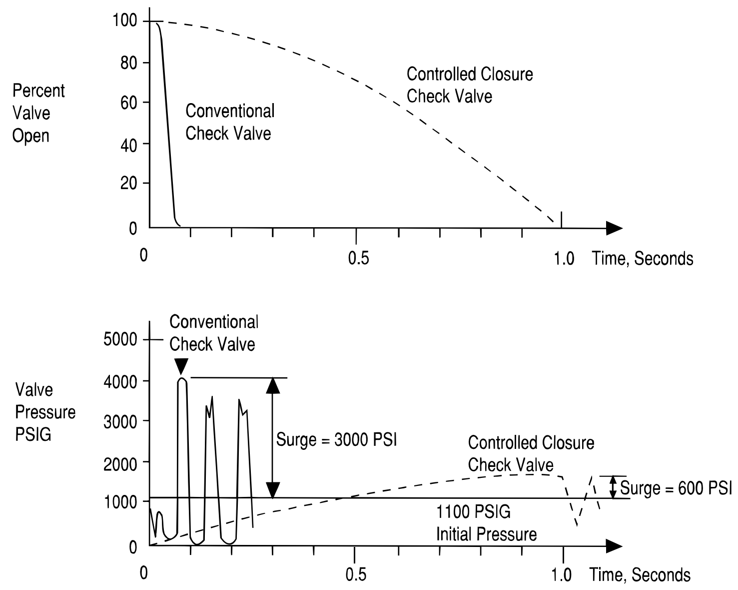
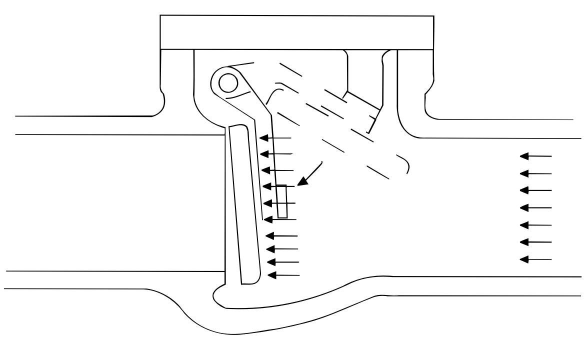



**Figure 13 - Reverse Flow in Conventional Swing Check Valve - Just Before Closing**



In some check valve applications, problems have been observed due to a phenomenon that is related to waterhammer but not as widely recognized. When a high-pressure wave is produced on the downstream side of a check valve at closure, a reverse low-pressure wave is produced on the upstream side. If this low-pressure wave reduces the fluid pressure to below the saturation pressure of the fluid, a vapor pocket can form. This can be compared to a tensile failure of the flow stream, and it is sometimes referred to as column separation or column rupture. This vapor pocket is unstable and will collapse quickly, with an implosion that produces a high-pressure "spike." It is possible for this pressure surge to exceed the one initially produced on the downstream of the check valve. Instrumented laboratory tests have shown that the upstream pressure spike sometimes causes the disk to reopen slightly and "bounce" off its seat once or twice. In very rare occasions, sometimes involving systems with multiple check valves, this characteristic has been known to amplify, leading to damaging pipe vibrations.

In summary, waterhammer can produce complex problems in check valve applications. Numerical solutions to these problems require sophisticated computer-based dynamic analyses of both the check valve and the fluid in the piping system. This catalog does not provide the methods for making such analyses; instead, the information in this section is intended to assist fluid-system designers in avoiding the problem.

Users who already have check valves in liquid flow lines that emit loud "slams" when they close should be aware that the noise is probably associated with pressure surges that could lead to fatigue problems in the valve, piping or other components. Where the existing check valve is a piston-lift check or stop-check valve, the solution could be to add a tilting-disk check valve in series with the existing check valve to gain the advantages of both valve types. Where the existing valve is a swing check valve, replacement by a tilting-disk check valve might be considered. See the section of this catalog entitled Check Valve Types and Typical Uses (1.2.1) for a discussion of the strengths and weaknesses of the various valve types.

### 1.4.3 Check Valve Accessories and Special Features

Edward Check valves can be provided with various accessories which are used to induce check-element motion (exercise) or indicate check-element position. Some of the features available are as follows:

- Visual disk-position indicator for tilting-disk check valve
- Electrical open/close position indicator for tilting-disk or cast-steel piston-lift check valve
- Manual or pneumatic actuator to partially open tilting-disk check valve under zero differential pressure
- CCCVs can be furnished with an injection port which allows the valve disk to be exercised by injecting water into the dashpot chamber when the valve is under a zero differential pressure.

### 1.4.4 Check/Stop-Check Valve Periodic Inspection and Preventive Maintenance

Periodic inspection and preventive maintenance of check and stop-check valves should be performed to ensure that the valves are operating properly. Bonnet-joint leakage and packing leakage on stop-check valves are easy to detect. Seat leakage of a check or stop-check valve might be indicated by one of the following: a definite pressure loss on the high-pressure side of the valve; continued flow through an inspection drain on the low-pressure side; or, in hot water or steam lines, a downstream pipe that remains hot beyond the usual length of time after valve closure. Leakage of steam through a valve which is badly steam-cut has a whistling or sonorous sound. If the valve is only slightly steam-cut, however, leakage is identified by subdued gurgling or weak popping sounds. These sounds can often be heard through a stethoscope.

Excessive vibration, noise or humming coming from within a piston-lift check or stop-check valve indicates the possibility that the disk-piston assembly is wedged inside the body. Such sticking may be caused by uneven body-guide rib wear on the downstream side. Sticking rarely occurs with tilting-disk check valves.

"Tapping," "thumping" or "rattling" noises detected from or near a check valve may indicate disk instability or cavitation. Instability could lead to rapid wear and possible valve failure. Audible cavitation is also detrimental. It may produce damage to the valve or the downstream piping. While the noise symptoms may be transmitted through the pipe from other equipment, prompt investigation is required if the check valve's performance is critical to plant reliability.

No specific inspection/preventive maintenance schedule can be given to cover all check valves. It is suggested that small valves be sampled by size and type (there may be hundreds in a large installation). Schedules for audit of larger valves should consider the criticality of the valve service. It is wise to open some critical valves for internal inspection at intervals even if no suspicious noises are detected.

Where check valves are installed close to pumps, control valves, pipe fittings or other flow disturbances, they should have more frequent inspection [see the section of this catalog entitled Adjacent Flow Disturbances (1.3.1)]. In addition, attention should be given to valves in installations with significant pipe vibration.

Users of this guide may wish to consider non-intrusive check valve monitoring methods as a supplement to periodic visual inspection and measurement of check valve internals. Noise and vibration, acoustic emission, ultrasonic and radiographic methods have been studied and demonstrated. EPRI Report No. NP 5479 provides an evaluation of the state of the art, but users are advised to obtain the most current information available on these emerging technologies.

If problems are found through any of the inspections discussed above, refer to section J: Maintenance.

# 2. Flow Performance

## 2.1 Choose the Best Valve Size for Your Service Conditions

The most economical valve is the valve correctly sized for the service flow conditions. Too small a valve will have a high pressure drop and will incur expensive energy costs in service. Too large a valve wastes money at the time of purchase, and it may require excessive effort or an excessively large and expensive actuator for operation.

Piping-system designers sometimes optimize the size of valves and piping systems to minimize the sum of investment costs and the present value of pumping power costs. While this may not be practical for selection of every valve, it is a goal that should be kept in mind. This catalog provides information necessary to evaluate the various types and sizes of Edward valves for stop (isolation), stop-check and check valve applications.

In the case of stop-check and check valves, another consideration is that an oversized valve may not open completely. Obviously, if a valve is not fully open, the pressure drop will be increased. Also, if the disk operates too close to the seat, unsteady flow may cause flutter that may damage valve seats, disks or guides.

System designers should also address "turndown" if service conditions involve a broad range of flow rates (e.g., high flow in normal operation but low flow during start-up and standby conditions). For these reasons, selection of check valves requires extra steps and care in calculations.

This section includes equations for the calculation of pressure drop, required flow coefficient, flow rate or inlet flow velocity. Procedures are also provided to check and correct for cavitation and flow choking. The equations in this section assume that the fluid is a liquid, a gas or steam. Two-component flow (e.g. slurries, oil-gas mixtures) is not covered by the equations. Consult Flowserve for assistance in evaluating such applications.

Tables in this section contain performance data for all Edward stop, stop-check and check valves. Flow coefficients and cavitation/choked-flow coefficients are given for all fully open Edward valves. In addition, for check and stop-check valves, the tables provide minimum pressure drop for full lift, crack-open pressure drop, and a novel "sizing parameter" that is helpful in selecting the proper valve size for each application.

***Caution:*** *Pressure drop, flow rate and check valve lift estimates provided by Edward calculation methods are "best estimate" valves. Calculations are based on standard equations of the Instrument Society of America (ISA), flow rate and fluid data provided by the user, and valve flow coefficients provided by Flowserve.*

*Flow rate and fluid data are often design or best-estimate values. Actual values may differ from original estimates. Flow and check valve lift coefficients are based on laboratory testing. Valves of each specific type are tested, and results are extended to sizes not tested using model theory. This approach is fundamentally correct, but there is some uncertainty because of geometric variations between valves.*

*These uncertainties prevent a guarantee with respect to valve pressure drop, flow rate and lift performance, but we expect results of calculations using Flowserve methods to be at least as accurate as comparable calculations involving flow and pressure drop of other piping system components.*

### 2.1.1 Pressure Drop, Sizing and Flow Rate Calculations – Fully Open Valves – All Types

This section is divided into two parts. The Basic Calculations section (2.2) covers most applications where pressure drops are not excessive. This is generally the case in most Edward valve applications, and the simple equations in this section are usually sufficient for most problems.

When the pressure drop across a valve is large compared to the inlet pressure, refer to the Corrections Required with Large Pressure Drops section (2.3). Various fluid effects must be considered to avoid errors due to choked flow of steam or gas – or flashing or cavitation of liquids. While use of these more detailed calculations is not usually required, it is recommended that the simple checks in that section always be made to determine if correction of the results of the Basic Calculations is necessary. With experience, these checks can often be made at a glance.

***Note:*** *In preliminary calculations using the following equations, a piping geometry factor, $F_p$ = 1.0, may be used, assuming that the valve size is the same as the nominal pipe size. However, if an application involves installing a valve in a larger-sized piping system (or piping with a lower pressure rating than the valve, which will have a larger inside diameter), determine $F_p$ from the Pipe Reducer Coefficients section when final calculations are made.*

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## 2.2 Basic Calculations

The following equations apply to FULLY OPEN gate and globe valves of all types. They also apply to stop-check and check valves if the flow is sufficient to open the disk completely. The Check Valve Sizing section (2.4) must be used to determine if a check valve is fully open and to make corrections if it is not.

The following simple methods may be used to calculate pressure drop, required flow coefficient, flow rate or inlet flow velocity for fully open Edward valves in the majority of applications. Always check Basic Calculations against the $\Delta P/p_1$ criteria in Figure 14 to see if corrections are required. This check is automatically made when using the Proprietary Edward Valves Sizing Computer Program.

### 2.2.1 Pressure Drop

**KNOWN:**
Flow rate (w or q)
Fluid specific gravity (G) or
Density (ρ)
For water, steam or air, see Figures 22-24

**FIND:** Valve flow coefficient ($C_V$) from appropriate table

**CALCULATE:** Pressure drop (ΔP)

When flow rate and fluid properties are known, determine required coefficients for a specific valve and calculate the pressure drop from the appropriate equation (see Nomenclature table for definition of terms and symbols):

**Equation 1a (U.S.)**

$$\Delta P = G\left(\frac{q}{F_P C_V}\right)^2$$

**Equation 1b (metric)**

$$\Delta P = G\left(\frac{q}{0.865 F_P C_V}\right)^2$$

**Equation 1c (U.S.)**

$$\Delta P = \frac{1}{\rho}\left(\frac{w}{63.3 F_P C_V}\right)^2$$

**Equation 1d (metric)**

$$\Delta P = \frac{1}{\rho}\left(\frac{w}{27.3 F_P C_V}\right)^2$$

If the resulting pressure drop is higher than desired, try a larger valve or a different type with a higher $C_V$. If the pressure drop is lower than necessary for the application, a smaller and more economical valve may be tried.

### 2.2.2 Required Flow Coefficient

**KNOWN:**
Flow rate (w or q)
Allowable pressure drop (ΔP)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 22-24

**CALCULATE:** Minimum required valve flow coefficient ($C_V$)

When the flow, fluid properties and an allowable pressure drop are known, calculate the required valve flow coefficient from the appropriate equation:

**Equation 2a (metric)**

$$C_V = \frac{q}{F_p}\sqrt{\frac{G}{\Delta P}}$$

**Equation 2b (metric)**

$$C_V = \frac{q}{0.865 F_p}\sqrt{\frac{G}{\Delta P}}$$

**Equation 2c (U.S.)**

$$C_V = \frac{w}{63.3 F_P \sqrt{\Delta P \rho}}$$

**Equation 2d (metric)**

$$C_V = \frac{w}{27.3 F_P \sqrt{\Delta P \rho}}$$

Results of these calculations may be used to select a valve with a valve flow coefficient that meets the required flow and pressure-drop criteria. Of course, valve selection also required prior determination of the right valve type and pressure class, using other sections of this catalog. The tabulated $C_V$ of the selected valve should then be used in the appropriate pressure drop or flow-rate equation to evaluate actual valve performance. At this stage, the checks described in section

**Nomenclature (metric units in parentheses)**

| | |
|---|---|
| $C_V$ | Valve flow coefficient |
| d | Valve inlet diameter, inches (mm) |
| $F_L$ | Liquid pressure recovery coefficient, dimensionless |
| $F_p$ | Piping geometry factor, dimensionless |
| G | Liquid specific gravity, dimensionless |
| $G_V$ | Gas compressibility coefficient, dimensionless |
| k | Ratio of specific heats, dimensionless |
| $K_i$ | Incipient cavitation coefficient, dimensionless |
| ΔP | Valve pressure drop, psi (bar) |
| $\Delta P_{CO}$ | Valve crack-open pressure drop, psi (bar) |
| $\Delta P_{FL}$ | Minimum valve pressure drop for full lift-psi (bar) |
| $p_1$ | Valve inlet pressure, psia (bar, abs) |
| $p_V$ | Liquid vapor pressure at valve inlet temperature-psia (bar, abs) |
| q | Volumetric flow rate, U.S. gpm ($m^3$/hr) |

| | |
|---|---|
| $R_F$ | Ratio of sizing parameter to sizing parameter for full lift |
| $R_p$ | Ratio of valve pressure drop to minimum pressure drop for full lift |
| $R_1$ | Pressure drop ratio (gas or steam) |
| $R_2$ | Pressure drop ratio (liquids) |
| SP | Valve sizing parameter |
| $SP_{FL}$ | Valve sizing parameter for full lift |
| V | Fluid velocity at valve inlet, ft/sec (m/sec) |
| w | Weight flow rate-lb/hr (kg/hr) |
| $x_T$ | Terminal value of $\Delta P/p_1$ for choked gas or steam flow, dimensionless |
| Y | Gas expansion factor, dimensionless |
| ρ | Weight density of fluid at valve inlet conditions, lb/$ft^3$ (kg/$m^3$) |
| Conversion factors are provided in the Conversion Factors section at the end of this catalog. | |

2.2 should be made to correct for effects of large pressure drops if required.

As discussed below under flow-rate calculations, the flow-coefficient equations assume that the allowable pressure drop is available for the valve. Piping pressure drop should be addressed separately.

***Caution:*** *In applications of stop-check or check valves, the results of these equations will apply only if the valve is fully open. Always use the methods given in the Check Valve Sizing section (2.3) to ensure that the valve will be fully open or to make appropriate corrections.*

### 2.2.3 Flow Rate

**KNOWN:**
Pressure drop (ΔP)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 22-24

**FIND:** Valve flow coefficient ($C_V$) from appropriate table

**CALCULATE:** Flow rate (w or q)

When the fluid properties and an allowable pressure drop are known, determine required coefficients for a specific valve and calculate the flow rate from the appropriate equation:

**Equation 3a (U.S.)**

$$q = F_P C_V \sqrt{\frac{\Delta P}{G}}$$

**Equation 3b (metric)**

$$q = 0.865 F_P C_V \sqrt{\frac{\Delta P}{G}}$$

**Equation 3c (U.S.)**

$$w = 63.3 F_P C_V \sqrt{\Delta P \rho}$$

**Equation 3d (metric)**

$$w = 27.3 F_P C_V \sqrt{\Delta P \rho}$$

### 2.2.4 Inlet Flow Velocity

**KNOWN:**
Flow rate (w or q)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 22-24

**FIND:** Valve inlet diameter (d) from appropriate table

**CALCULATE:** Fluid velocity at valve inlet (V)

While not normally required for valve sizing and selection, the fluid velocity at the valve inlet may be calculated from the appropriate equation:

**Equation 4a (U.S.)**

$$V = \frac{0.409q}{d^2}$$

**Equation 4b (metric)**

$$V = \frac{354q}{d^2}$$

**Equation 4c (U.S.)**

$$V = \frac{0.0509w}{\rho d^2}$$

**Equation 4d (metric)**

$$V = \frac{354w}{\rho d^2}$$

These valve flow-rate calculations are used less frequently than pressure drop and flow-coefficient calculations, but they are useful in some cases.

***Caution:*** *These equations assume that the pressure drop used for the calculation is available for the valve. In many piping systems with Edward Valves, flow is limited by pressure drop in pipe and fittings, so these equations should not be used as a substitute for piping calculations.*

Use of these flow-rate equations for stop-check and check valves is not recommended unless the allowable pressure drop is relatively high (e.g., over about 10 psi or 0.7 bar). At lower values of ΔP, two or more different flow rates might exist, depending on whether or not the disk is fully open. Flow would vary depending on whether the pressure drop increased or decreased to reach the specified value.

*Note: If a specific pipe inside diameter is known, that diameter may be used as the "d" value in the equation above to calculate the fluid velocity in the upstream pipe.*

## *2.3 Corrections Required with Large Pressure Drops*

While most Edward valves are used in relatively high-pressure systems and are usually sized to produce low pressure drop at normal flow rates, care is necessary to avoid errors (which may be serious in some cases) due to flow "choking" (or near-choking). Problems arise most often at off-design flow conditions that exist only during plant start-up, shutdown, or standby operation.

Since steam and gas are compressible fluids, choking (or near-choking) may occur due to fluid expansion which causes the fluid velocity to approach or reach the speed of sound in reduced-area regions. While liquids are normally considered to be incompressible fluids, choking may also occur with liquid flow due to cavitation or flashing. In each case, simple calculations can be made to determine if a problem exists. Relatively simple calculations are required to correct for these effects. In some cases, these calculations may require a change in the size of type of valve required for a specific application.

The flow parameters $K_i$, $F_L$ and $x_T$ in the valve data tables assume that the valve is installed in pipe of the same nominal size. This is a fairly good assumption for preliminary calculations, but refer to the Pipe Reducer Coefficients section if there is a mismatch between valve and pipe diameters (also see instructions relative to $F_p$ calculations in section 2.1) and make the appropriate corrections when final calculations are made.

*Note: Because large pressure drop problems are not encountered frequently, equations are presented in terms of weight flow rate (w) and density (ρ) only. See the Conversion of Measurement Units section for converting other units of flow rate to weight flow rate.*

### 2.3.1 Gas and Steam Flow

**2.3.1.1 Pressure Drop**
To determine if corrections are needed for compressible flow effects, use the data from the Basic Calculations to determine the ratio of the calculated pressure drop to the absolute upstream pressure:

**Equation 5**

$$R_1 = \frac{\Delta P}{p_1}$$

If the ratio $R_1$ is less than the values in Figure 14, the results of the Basic Calculations will usually be sufficiently accurate, and further calculations are unnecessary.

**Figure 14 – Maximum ΔP/$P_1$ for use of Basic Calculations Without Correction**

| Valve Type | Max. ΔP/P1 |
|---|---|
| Gate | 0.01 |
| Inclined Bonnet Globe<br>Angle<br>Tilting-Disk Check | 0.02 |
| 90° Bonnet Globe | 0.05 |

If the pressure-drop ratio $R_1$ exceeds that tabulated for the valve type under evaluation, the procedure described below should be used to check and correct for possible flow choking or near-choking.

**(1)** Calculate the gas compressibility coefficient:

**Equation 6 (U.S. or metric)**

$$G_y = \frac{0.467}{kX_T}\left(\frac{\Delta P}{p_1}\right)$$

*Note: The ΔP in this equation is the uncorrected value from the Basic Calculations. Values of $x_T$ are given in valve data tables, and values of k are given in Figure 21.*

**(2)** The next step depends on the value of $G_y$ determined in equation 6:

• If $G_y < 0.148$, *the flow is not fully choked.* Read the value of Y from Figure 15 and calculate the corrected pressure drop:

**Equation 7 (U.S. or metric)**

$$\Delta P_C = \frac{\Delta P}{Y^2}$$

• If $G_y \geq 0.148$, the *flow is choked*. The desired flow cannot be achieved at the specified upstream pressure and will be limited to the choked flow rate given by:

**Equation 8a (U.S.)**

$$w_{choked} = 35.67 F_P C_V \sqrt{k x_T p_1 \rho}$$

**Equation 8b (metric)**

$$w_{choked} = 15.4 F_P C_V \sqrt{k x_T p_1 \rho}$$

• When flow is choked, the actual pressure drop cannot be calculated using valve flow calculations alone. It can be any valve greater than the following minimum value for choked flow:

**Equation 9 (U.S. or metric)**

$$\Delta P_{min.\,choked} \geq 0.714 k x_T p_1$$

• The only way to determine the pressure downstream of a valve with choked flow is to calculate the pressure required to force the choked flow rate through the downstream piping. This may be done with piping calculations (not covered by this catalog).

**2.3.1.2 Flow Rate**

When calculating the flow rate through a valve, the actual pressure drop is known, but the flow may be reduced by choking or near-choking.

To check for high pressure-drop effects, calculate $R_1$, the ratio of pressure drop to absolute upstream pressure (see equation 5 above) noting that the pressure drop in this case is the known value.

**(1)** Flow rates determined using the Basic Calculations are sufficiently accurate if $R_1$ is less than about twice the value tabulated in Figure 14 for the applicable valve type (higher because actual pressure drop is used in the ratio). In this case, no correction is necessary.

**(2)** When corrections for higher values of R1 are required, calculate the gas expansion factor directly from:

**Equation 10 (U.S. or metric)**

$$Y = 1 - 0.467\left(\frac{\Delta P/p_1}{kx_T}\right)$$

**(3)** The calculation method to determine the flow rate depends on the calculated value of Y from equation (10):

• If Y is greater than 0.667 (but less that 1), the flow is not fully choked. Calculate the corrected flow rate as follows:

**Equation 11 (U.S. or metric)**

$$w_c = Yw$$

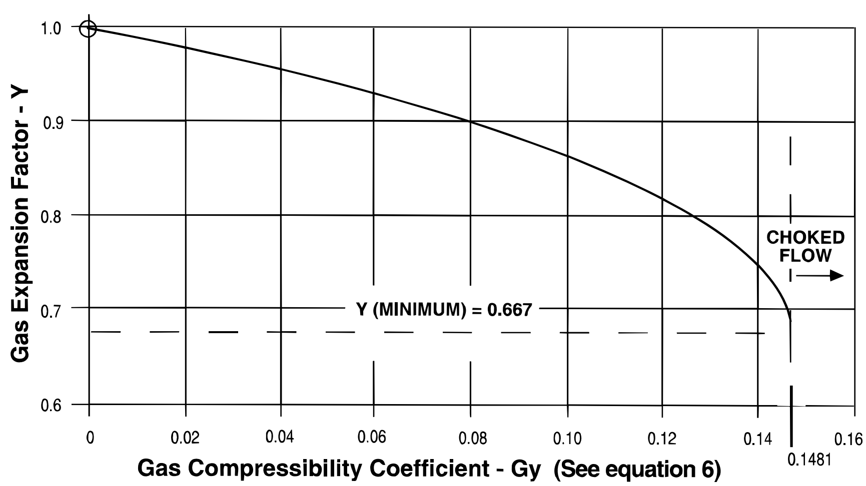
• If Y is equal to or less than 0.667, the valve flow is choked, and the results of the Basic Calculations are invalid. The actual flow rate may be calculated from the equation for $w_{choked}$ [(8a) or (8b)] above.

***Caution:*** *Choked or near-choked flow conditions may produce significant flow-induced noise and vibration. Prolonged operation with flow rates in this region may also cause erosion damage within a valve or in downstream piping, particularly if the flow condition involve "wet" steam. Edward valves tolerate these conditions well in services involving limited time periods during plant start-up, shutdown, etc., but consult Flowserve about applications involving long exposure to such conditions.*

## 2.3.2 Liquid Flow – Cavitation and Flashing

The fluid pressure in high-velocity regions within a valve may be much lower than either

**Figure 15**



the upstream pressure or the downstream pressure. If the pressure within a valve falls below the vapor pressure ($p_v$) of the liquid, vapor bubbles or cavities may form in the flow stream. Cavitation, flashing and choking may occur. Use the equations and procedures in this section to evaluate these phenomena.

Cavitation and flashing are closely related, and they may be evaluated by calculating a pressure-drop ratio that is slightly different from that used for gas or steam:

**Equation 12**

$$R_1 = \frac{\Delta P}{(p_1 - p_V)}$$

To evaluate a particular valve and application, find values of $K_i$ and $F_L$ from the appropriate valve-data table, find $P_V$ values for common liquids given in Figure 21, calculate $R_2$, and perform the following checks:

**(1) Cavitation** – the sudden and sometimes violent coalescence of the cavities back to the liquid state – occurs when the downstream pressure (within the valve or in the downstream pipe) recovers to above the vapor pressure.

• If $R_2 < K_i$, there should be no significant cavitation or effect on flow or pressure drop. Results of the Basic Calculations require no correction.

• If $R_2 > K_i$, cavitation begins. If the ratio is only slightly greater than $K_i$, it may be detected as an intermittent "ticking" noise near the valve outlet, although pipe insulation may muffle this sound. This stage of cavitation is usually related to tiny vapor cavities that form near the center of vortices in the flow stream, and it generally produces neither damage nor effects on flow characteristics. However, as the pressure drop ratio $R_2$ increases, the noise progresses to a "shh," then a "roar."

• If $R_2 > (K_i + FL_2)/2$, approximately, larger vapor cavities develop and the risk of cavitation damage (pitting) in the valve or downstream pipe may be a concern if this flow condition is sustained for significant periods of time. Noise may also pose a problem. Still, at this stage, there is usually no significant effect on valve flow characteristics. Results of the Basic Calculations require no correction.

As the pressure-drop ration increases beyond this point, some valves suffer slight reductions in their $C_V$ values, but there is no practical way of correcting pressure drop or flow calculations for this effect. Vibration and noise increase, ultimately sounding like "rocks and gravel" bouncing in the pipe at about the point where flow becomes choked.

**(2) Flashing** – the persistence of vapor cavities downstream of the valve — occurs when the pressure downstream of the valve remains below the vapor pressure.

• If $R_2 > 1$, flashing occurs, and the flow is choked due to vapor cavities in the flow stream.

**(3) Liquid choking** – A slightly different ratio may be used to predict the minimum pressure drop at choked flow conditions. Choking occurs due to vapor cavities near the minimum-area region in the flow stream when:

**Equation 13**

$$\frac{\Delta P}{(p_1 - 0.7p_V)} \geq F_L^2$$

Thus, the minimum pressure drop which will produce choked liquid flow is given by:

**Equation 14**

$$\Delta P \geq F_L^2 (p_1 - 0.7p_V)$$

Note that flow may be choked by either sever cavitation or flashing.

#### 2.3.2.1 Predicting Choked Flow Rate

If the result of a Basic Calculation to determine pressure drop exceeds the value determined from equation (13), the Basic Calculation is invalid. the flow used for input cannot be obtained at the specified upstream pressure and temperature. In such a case, of if it is necessary to calculate liquid flow rate through a valve with high pressure drop, the choked flow rate at specified conditions may be calculated from:

**Equation 15a (U.S.)**

$$W_{choked} = 63.3 F_P C_V F_L \sqrt{\rho(p_1 - 0.7p_V)}$$

**Equation 15b (metric)**

$$W_{choked} = 27.3 F_P C_V F_L \sqrt{\rho(p_1 - 0.7p_V)}$$

When flow is choked due to either cavitating or flashing flow, the actual pressure drop cannot be determined from valve calculations. It may be any value greater than the minimum value for choked flow [equation (14)]. As in the case of choked gas or steam flow, the pressure downstream of a valve must be determined by calculating the pressure required to force the choked flow through the downstream piping. This may be done with piping calculations (not covered by this catalog).

• If the pressure drop from a Basic Calculation was used to determine flow rate, and the pressure drop exceeds the pressure drop of choked flow, the result is invalid. The corrected flow rate may be calculated from equation (15a) or (15b) above.

## 2.4 Check Valve Sizing

The most important difference between check (including stop-check) valves and stop valves, from a flow performance standpoint, is that the check valve disk is opened only by dynamic forces due to fluid flow. The preceding calculation methods for flow and pressure drop are valid only if it can be shown that the valve is fully open.

The primary purpose of this section is to provide methods to predict check valve disk opening and to make corrections to pressure-drop calculations if the valve is not fully open. These methods are particularly applicable to sizing valves for new installations, but they are also useful for evaluation of performance of existing valves.

In selecting a stop-check or check valve for a new installation, the first steps require selecting a proper type and pressure class. The Stop and Check Valve Applications Guide section of this catalog should be reviewed carefully when the type is selected, noting advantages and disadvantages of each type and considering how they relate to the requirements of the installation. Other sections of this catalog provide pressure ratings to permit selection of the required pressure class.

### 2.4.1 Sizing Parameter

The first step in evaluating a stop-check or check valve application is to determine the Sizing Parameter based on the system flow rate and fluid properties:

**Equation 16 (U.S. or metric)**

$$SP = \frac{W}{\sqrt{\rho}}$$

Tables in this section provide a Sizing Parameter for full lift ($SP_{FL}$) for each Edward stop-check and check valve. The amount of opening of any check valve and its effect on pressure drop can be checked simply as follows:

• If $SP_{FL} < SP$, the valve is fully open. Pressure drop may be calculated using the equations given previously for fully open valves (including corrections for large pressure drops if required).

• IF $SP_{FL} > SP$, the valve is not fully open. A smaller size valve or another type should be selected if possible to ensure full opening. If that is not feasible, three additional steps are required to evaluate the opening and pressure drop of the valve under the specified service conditions.

*Note: EPRI Report No. NP 5479 (Application Guideline 2.1) uses a "C" factor to calculate the minimum flow velocity required to fully open a check valve. The sizing procedures in this catalog do not employ the "C" factor, but values are given in the valve data tables for readers who prefer to use the EPRI methods. Since the EPRI methods are based on velocity, a flow area is required as a basis. Valve Inlet Diameters presented in data tables are the basis for correlation between flow rate and velocity.*

### 2.4.2 Calculations for Check Valves Less Than Fully Open

If the preceding evaluation revealed an incompletely open check valve, perform the following additional calculations:

**Calculate the flow-rate ratio:**

**Equation 17 (U.S. or metric)**

$$R_F = \frac{SP}{SP_{FL}}$$

**Determine the disk operating position:**
Using the $R_F$ value calculated above, determine the valve operating position from Figure 16. Performance curve numbers for individual cast-steel stop-check and check valves are given in the tabulations with other coefficients. Evaluate the acceptability of the operating position based on recommendations in the Check Valve Applications Guide and in the specific sizing guidelines below.

**Calculate the pressure drop:**
Again using the $R_F$ value calculated above, determine the pressure drop ratio $R_P$ from Figure 16, and calculate the valve pressure drop at the partially open position:

**Equation 18 (U.S. or metric)**

$$\Delta P = R_P \Delta P_{FL}$$

Values for $\Delta P_{FL}$ for all stop-check and check valves are given in Valve Tables 1 to 5 and 9 with other coefficients.

*Note: The values of the various valve coefficients given in the tabulations are based on testing of a substantial number of valves. Most are applicable to any line fluid, but those involving check valve lift are influenced by buoyancy. Tabulated values are based on reference test conditions with room-temperature water. $SP_{FL}$ and $\Delta P_{FL}$ are slightly higher in applications involving lower-density line fluids. Considering the expected accuracy of these calculations, the following corrections may be considered:*

• For water at any temperature and other common liquids – No correction required.

• For steam, air and other common gases at normal operating pressures and temperatures – Increase $SP_{FL}$ by 7% and increase $\Delta P_{FL}$ by 14%.

### 2.4.3 Sizing Guidelines

Considering the recommendations in the Check Valve Applications Guide section of this catalog and the calculation methods described above, the following specific steps are recommended for sizing check valves for optimum performance and service life (it is assumed that the check valve type and pressure class have already been selected before starting this procedure):

**(1) Constant flow rate** – If the application involves a substantially constant flow rate during all operating conditions, the check valve should be sized to be fully open. This may be accomplished by the following procedure:

• Calculate the check valve sizing parameter (SP) for the application from equation (15). Values of density for water, steam, and air are available in Figures 18-20.

If the flow rate is not given in lb/hr (or kg/hr), refer to the Conversion of Measurement Units section of this catalog to make the necessary calculation.

• Select the valve size with the next smaller $SP_{FL}$ value from valve data tables (Tables 1-5 for forged-steel valves). Make note of the $C_V$, $\Delta P_{CO}$, $\Delta P_{FL}$, $K_i$, $F_L$ and $x_T$ values for use in later calculations.

*Note: Preferably, there should be a good margin between SP and $SP_{FL}$ to be sure the valve will be fully open. In the specific case of tilting-disk check valves, it is recommended that $SP_{FL}$ be less than 0.83 (SP) to be sure that the disk is fully loaded against its stop (particularly if it is close to a flow disturbance).*

• Calculate the pressure drop using the Basic Calculation method in equation (1) and the Cxx value of the valve size selected above. Make the simple checks described above in section 2.2 (Corrections Required With Large Pressure Drops), and make appropriate corrections in necessary (this is rarely needed for a valve sized for constant flow rate, but the check is desirable).

• Evaluate the pressure drop. If it is too high, a larger size or another check valve type should be tried. If it is lower than necessary for the application, a smaller and more economical valve (with a lower $SP_{FL}$) may be evaluated with assurance that it would also be fully open.

• Evaluate the crack-open pressure drop ($\Delta P_{CO}$) to be certain that the system head available at the initiation of flow will initiate valve opening. Note that, for some valves, the crack-open pressure drop exceeds the pressure drop for full lift. Preceding calculations might indicate no problem, but it is possible that a valve might not open at all in a low-head application (e.g., gravity flow).

**(2) Variable flow rate** – If the application involves check valve operation over a range of flow rates, additional calculations are necessary to ensure satisfactory, stable performance at the lowest flow rate without causing excessive pressure drop at the maximum flow condition. This required careful evaluation of specific system operating conditions (e.g., are the minimum and maximum flow rates normal operating conditions or infrequent conditions that occur only during start-up or emergency conditions?).

The following options should be considered in selecting the best stop-check or check valve size for variable flow applications:

• The best method, if practical, is to size the valve to be fully open at the minimum flow condition. This may be done by following the first two steps listed above for the constant flow-rate case, but using the minimum flow rate in the sizing parameter (SP) calculation.

The only difference is that the pressure-drop calculations and evaluations in the third and fourth steps must be repeated at normal and maximum flow rates. If the selected valve size is fully open at the minimum flow rate and has an acceptable pressure drop at the maximum flow condition, it should give good overall performance.

• Sometimes a change in valve type provides the best cost-effective solution for variable-flow applications (e.g. use a smaller Flite-Flow® stop-check or check valve instead of a 90°-bonnet type to provide full lift at the minimum flow condition, but a high $C_V$ for low pressure drop at maximum flow).

• Operation at less than full lift may have to be considered.

**(3) Operation at less than full lift** – "High Turndown" applications sometimes exist on boilers and other process systems that must swing through periodic flow changes from start-up, to standby, to maximum, and back again. In such cases, calculations may not reveal any single valve that will offer a satisfactory compromise assuring full lift and an acceptable pressure drop at both minimum and maximum flow conditions.

It may be acceptable to permit a check valve to operate at less than fully open at the minimum flow condition if such operation is infrequent or not expected to be sustained continuously for long periods. A valve may be sized by following the methods above using the lowest expected normal sustained flow rate in the sizing parameter (SP) calculation. Pressure drop at normal and maximum flow rates should then be calculated and evaluated.

The acceptability of valve operation at the minimum flow condition should be evaluated as follows:

• Calculate the sizing parameter (SP) at the minimum flow rate and the flow-rate ratio $R_F$ from equation (17). The valve operating position (% open) should be determined from the proper performance curve (Figure 16).

***Caution:*** *Check valve operation at less than 25% opening is not recommended. Any check valve that operates for sustained periods at partial openings should be monitored or inspected periodically for evidence of instability or wear.*

• If the minimum operating position is considered satisfactory, the pressure drop at the minimum flow condition may be calculated from equation (18), using the pressure-drop ratio ($R_p$) determined from the proper performance curve.

**(4) Alternatives for high turndown applications** – If the preceding steps show that the range of flow rates is too large for any single standard check valve, consult Flowserve. Several alternatives may be considered:

• Either 90°-bonnet or angle-type stop-check or piston-lift check valves may be furnished with a special disk with an extended "skirt" as illustrated in Figure 15A. This skirt increases flow resistance at low flow rates, producing additional lifting force to help prevent operation at small openings.

Of course, the skirt also reduces the $C_V$ of the valve somewhat when it is fully open and increases pressure drop at maximum flow. Nevertheless, a special disk sometimes solves difficult high turndown problems. A special disk also permits solution of some problems with existing valves that are "oversized."

• A stop-check valve may be used with the stem lifted just enough to provide a positive stop for the disk at very low flows (e.g., short-term start-up conditions). The stem should be lifted with increasing flow rate to maintain the disk-stopping action while preventing excessive pressure drop. At normal flow rates, the stem can be lifted to its fully open position, permitting normal check valve function. The stem may be actuated manually for infrequent start-up operations, or a motor actuator may be furnished for convenience if large flow rate variations are expected to be frequent.

***Caution:*** *This arrangement could produce cavitation or flow-choking problems if the flow rate is increased substantially without lifting the valve stem to compensate.*

• A small check or stop-check valve may be installed in parallel with a larger stop-check valve. The smaller valve may be sized for the minimum flow condition, and the larger stop-check may be held closed with the stem until the flow is sufficient to ensurev adequate lift. If necessary, the stem on the larger valve may be opened gradually with increasing flow to maintain disk-stopping action as in the example above. The smaller valve may be allowed to remain open at higher flow rates or, if a stop-check type is used, it may be closed if preferred. Either or both valves may be manually actuated or furnished with a motor actuator for convenience.

## 2.5 Pipe Reducer Coefficient

The equations in the Flow Performance section of this catalog use a piping geometry factor, $F_p$, to account for the effect of pipe reducers attached directly to the valve. This permits the valve and pipe reducers to be treated as an assembly, i.e., $F_pC_V$ is the flow coefficient of the valve/pipe reducer combination. Then, the pressure drop in the flow equations is the pressure drop of the assembly.

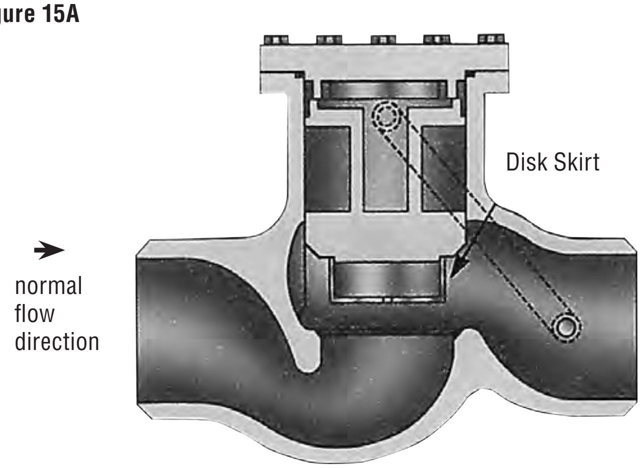
This method is also applicable when valves are furnished with oversized ends to fit larger diameter pipe. It should also be used to evaluate line-size valves used in pipe with a lower pressure rating than the valve, because such pipe may have less wall thickness and a larger inside diameter than the valve inlet diameter given in the valve data tabulations.

This section provides equations for calculation of the piping geometry factor, $F_p$, which should be used even in Basic Calculations when there is a significant difference between the pipe diameter and valve inlet diameter (d).

In addition, other coefficients ($K_1$, $F_L$, $x_T$) are affected by the presence of pipe reducers. Equations are also provided for correction of these terms, which are required only when evaluating significant valve-to-pipe diameter mismatch.

*Note: These equations apply only where the valve diameter is less than the connecting pipe diameter.*

**Figure 15A**



### 2.5.1 Pipe Geometry Factor

Calculate upstream loss coefficient:

**Equation 1-1 (U.S. or metric)**

$$K_1 = 0.5\left[1 - \left(\frac{d}{D_1}\right)^2\right]^2$$

Calculate downstream loss coefficient:

**Equation 1-2 (U.S. or metric)**

$$K_2 = \left[1 - \left(\frac{d}{D_2}\right)^2\right]^2$$

Summation:

**Equation 1-3 (U.S. or metric)**

$$\sum K = K_1 + K_2$$

**Equation 1-4a (U.S.)**

$$F_P = \sqrt{\frac{1}{1 + \frac{\sum K}{890}\left(\frac{C_y}{d^2}\right)^2}}$$

**Equation 1-4b (metric)**

$$F_P = \sqrt{\frac{1}{1 + 486\sum K\left(\frac{C_y}{d^2}\right)^2}}$$

*Note: If $D_1$ and $D_2$ are not the same, use of $F_P$ calculated in this manner accounts for energy losses associated with flow contraction and expansion, and the pressure drop calculated using this factor represents energy loss. Bernoulli effects may cuase a different static pressure change between upstream and downstream pipes.*

### 2.5.2 Other Coefficients

Correction of values of $K_1$, $F_L$ and $x_T$ requires an initial calculation of a Bernoulli coefficient to account for static pressure change in the inlet reducer:

**Equation 1-5 (U.S. or metric)**

$$K_{B1} = 1 - \left(\frac{d}{D_1}\right)^4$$

Then, corrected values of each coefficient may be calculated, using the corresponding value from valve data tables as input:

**Equation 1-6a (U.S.)**

$$K_{ii} = \frac{1}{F_P^2\left[\frac{1}{K_i} + \left(\frac{K_1 + K_{B1}}{890}\right)\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-6b (metric)**

$$K_{ii} = \frac{1}{F_P^2\left[\frac{1}{K_i} + 468(K_1 + K_{B1})\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-7a (U.S.)**

$$F_{LL} = \frac{1}{F_P\sqrt{\frac{1}{F_L^2} + \left(\frac{K_1 + K_{B1}}{890}\right)\left(\frac{C_V}{d^2}\right)^2}}$$

**Equation 1-7b (metric)**

$$F_{LL} = \frac{1}{F_P\sqrt{\frac{1}{F_L^2} + 468(K_1 + K_{B1})\left(\frac{C_V}{d^2}\right)^2}}$$

**Equation 1-8a (U.S.)**

$$x_{TT} = \frac{x_T}{F_P^2\left[1 + \frac{x_T\,(K_1 + K_{B1})}{1000}\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-8b (metric)**

$$x_{TT} = \frac{x_T}{F_P^2\left[1 + 416x_T(K_1 + K_{B1})\left(\frac{C_V}{d^2}\right)^2\right]}$$

where: $K_i$, $F_L$ and $x_T$ are values from valve data tables; $K_{ii}$, $F_{LL}$ and $x_{TT}$ are corrected values for valve/reducer assembly.

### Nomenclature

| | |
|---|---|
| $C_V$ | valve flow coefficient. See Valve Reference Data. |
| d | valve-end inside diameter, inches, (mm). See Valve Reference Data. |
| $D_1$ | inside diameter of upstream pipe, inches, (mm). See Pipe Data Section. |
| $D_2$ | inside diameter of downstream pipe, inches, (mm). See Pipe Data Section. |
| $F_L$ | liquid-pressure recovery coefficient, dimensionless* |
| $F_p$ | piping-geometry factor, dimensionless |
| $K_1$ | pressure-loss coefficient for inlet reducer, dimensionless |
| $K_2$ | pressure-loss coefficient for outlet reducer, dimensionless |
| $K_{B1}$ | pressure change (Bernoulli) coefficient for inlet reducer, dimensionless |
| $\sum K$ | $K_1 + K_2$, dimensionless |
| $K_i$ | incipient-cavitation coefficient, dimensionless* |
| $x_T$ | terminal value of $\Delta P/p_1$ for choked gas or steam flow, dimensionless |

**Double subscripts (e.g. $K_{ii}$) represent values corrected for effects of pipe reducers.*



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## *Table 1 – Forged Steel Angle Univalve® Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valves* with Springs (Std.) | | | | | Check Valves* without Springs | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | $\Delta P_{FL}$ | | $SP_{FL}$ | | C |
| **Class 1690 (PN 290)** *All Stop valves, all Stop-Check valves, all Piston Check valves* | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 10.5 | 0.80 | 0.41 | 0.16 | 0.68 | 17.3 | 6.0 | 0.41 | 887 | 101 | 179 | 1.5 | 0.103 | 468 | 53 | 165 |
| 0.75 | 20 | 10.5 | | | | 0.68 | 17.3 | | | 1522 | 172 | 179 | | | 804 | 91 | 165 |
| 1.00 | 25 | 10.5 | | | | 0.68 | 17.3 | | | 1522 | 172 | 179 | | | 804 | 91 | 165 |
| 1.25 | 32 | 31 | | | | 1.19 | 30.2 | | | 5326 | 604 | 179 | | | 2810 | 318 | 164 |
| 1.50 | 40 | 31 | | | | 1.19 | 30.2 | | | 5066 | 574 | 179 | | | 2670 | 303 | 164 |
| 2.00 | 50 | 50 | | | | 1.50 | 38.1 | | | 8620 | 977 | 180 | | | 4550 | 516 | 166 |
| 2.50 | 65 | 90 | | | | 2.00 | 50.8 | | | 13,916 | 1580 | 179 | | | 7360 | 834 | 165 |
| 3.00 | 80 | 90 | | | | 2.00 | 50.8 | | | 12,715 | 1440 | 179 | | | 6690 | 758 | 165 |
| **Class 2680 (PN 460)** *All Stop valves, all Stop-Check valves, all Piston Check valves* | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 10.5 | 0.80 | 0.41 | 0.16 | 0.68 | 17.3 | 6.0 | 0.41 | 729 | 83 | 179 | 1.5 | 0.103 | 385 | 44 | 165 |
| 0.75 | 20 | 10.5 | | | | 0.68 | 17.3 | | | 625 | 71 | 179 | | | 330 | 37 | 165 |
| 1.00 | 25 | 10.5 | | | | 0.68 | 17.3 | | | 1140 | 129 | 179 | | | 604 | 68 | 165 |
| 1.25 | 32 | 19 | | | | 0.94 | 23.9 | | | 3120 | 354 | 177 | | | 1650 | 187 | 163 |
| 1.50 | 40 | 19 | | | | 0.94 | 23.9 | | | 2910 | 330 | 177 | | | 1540 | 175 | 163 |
| 2.00 | 50 | 50 | | | | 1.50 | 38.1 | | | 7290 | 826 | 180 | | | 3850 | 436 | 166 |
| 2.50 | 65 | 89 | | | | 2.00 | 50.8 | | | 10,400 | 1180 | 179 | | | 5490 | 622 | 165 |
| 3.00 | 80 | 89 | | | | 2.00 | 50.8 | | | 10,400 | 1180 | 179 | | | 5490 | 622 | 165 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See notes following paragraph 2.4.1, page 106, for discussion of C factor.*
** Stop-check valves are only furnished without springs.*

## Table 1A – Forged Steel Univalve®
## Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

**Class 1690 (PN 290)** *All Stop valves, all Stop-Check valves, all Piston Check valves*

| Size NPS | Size DN | All Stop and Check Valves $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | d | Check Valves* with Springs (Std.) $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C | Check Valves* without Springs $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.50 | 15 | 7.0 | | | | 0.464 | 11.8 | | | 886 | 100 | 210 | | | 443 | 50.2 | 105 |
| 0.75 | 20 | 12 | | | | 0.612 | 15.5 | | | 1520 | 172 | 207 | | | 760 | 86.0 | 103 |
| 1.00 | 25 | 12 | | | | 0.815 | 20.7 | | | 1520 | 172 | 117 | | | 760 | 86.0 | 58 |
| 1.25 | 32 | 42 | | | | 1.160 | 29.5 | | | 5320 | 602 | 201 | | | 2660 | 301 | 101 |
| 1.50 | 40 | 40 | 0.66 | 0.27 | 0.16 | 1.338 | 34.0 | 4.0 | 0.28 | 5060 | 574 | 144 | 1.0 | 0.069 | 2530 | 287 | 72 |
| 2.00 | 50 | 68 | | | | 1.687 | 42.8 | | | 8610 | 975 | 154 | | | 4300 | 488 | 77 |
| 2.50 | 65 | 110 | | | | 2.125 | 54.0 | | | 13,900 | 1580 | 157 | | | 6960 | 789 | 79 |
| 3.00 | 80 | 100 | | | | 2.624 | 66.6 | | | 12,700 | 1430 | 94 | | | 6330 | 717 | 47 |
| 4.00 | 100 | 85 | | | | 3.438 | 87.3 | | | 10,800 | 1220 | 46 | | | 5380 | 609 | 23 |

**Class 2680 (PN 460)** *All Stop valves, all Stop-Check valves, all Piston Check valves*

| Size NPS | Size DN | All Stop and Check Valves $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | d | Check Valves* with Springs (Std.) $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C | Check Valves* without Springs $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.50 | 15 | 7.0 | | | | 0.464 | 11.8 | | | 886 | 100 | 210 | | | 443 | 50.2 | 105 |
| 0.75 | 20 | 12 | | | | 0.612 | 15.5 | | | 760 | 86.0 | 103 | | | 380 | 43.0 | 52 |
| 1.00 | 25 | 11 | | | | 0.599 | 15.2 | | | 1390 | 158 | 198 | | | 696 | 78.9 | 99 |
| 1.25 | 32 | 30 | | | | 0.896 | 22.8 | | | 3800 | 430 | 241 | | | 1900 | 215 | 121 |
| 1.50 | 40 | 28 | 0.63 | 0.24 | 0.15 | 1.100 | 28.0 | 4.0 | 0.28 | 3540 | 401 | 149 | 1.0 | 0.069 | 1770 | 201 | 75 |
| 2.00 | 50 | 70 | | | | 1.503 | 38.2 | | | 8860 | 1000 | 200 | | | 4430 | 502 | 100 |
| 2.50 | 65 | 100 | | | | 1.771 | 45.0 | | | 12,700 | 1430 | 206 | | | 6330 | 717 | 103 |
| 3.00 | 80 | 100 | | | | 2.300 | 58.4 | | | 12,700 | 1430 | 122 | | | 6330 | 717 | 61 |
| 4.00 | 100 | 90 | | | | 3.152 | 80.1 | | | 11,400 | 1290 | 58 | | | 5700 | 645 | 29 |

**Class 4500 (PN760)** *All Stop valves, all Stop-Check valves, all Piston Check valves*

| Size NPS | Size DN | All Stop and Check Valves $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | d | Check Valves* with Springs (Std.) $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C | Check Valves* without Springs $\Delta P_{FL}$ | $\Delta P_{FL}$ | $SP_{FL}$ | $SP_{FL}$ | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.50 | 15 | 2.0 | | | | 0.252 | 6.4 | | | 253 | 28.7 | 203 | | | 127 | 14.3 | 102 |
| 0.75 | 20 | 6.0 | | | | 0.434 | 11.0 | | | 760 | 86.0 | 205 | | | 380 | 43.0 | 103 |
| 1.00 | 25 | 12 | | | | 0.599 | 15.2 | | | 1520 | 172 | 216 | | | 760 | 86.0 | 108 |
| 1.25 | 32 | 12 | | | | 0.808 | 20.5 | | | 1520 | 172 | 117 | | | 760 | 86.0 | 59 |
| 1.50 | 40 | 11 | 0.64 | 0.25 | 0.15 | 0.926 | 23.5 | 4.0 | 0.28 | 1390 | 158 | 82 | 1.0 | 0.069 | 696 | 78.9 | 41 |
| 2.00 | 50 | 48 | | | | 1.156 | 29.4 | | | 6080 | 688 | 230 | | | 3040 | 344 | 115 |
| 2.50 | 65 | 62 | | | | 1.400 | 35.6 | | | 7850 | 889 | 202 | | | 3920 | 444 | 101 |
| 3.00 | 80 | 60 | | | | 1.700 | 43.2 | | | 7600 | 860 | 132 | | | 3800 | 430 | 66 |
| 4.00 | 100 | 55 | | | | 2.200 | 55.9 | | | 6960 | 789 | 76 | | | 3480 | 394 | 37 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See notes following paragraph 2.4.1, page 106, for discussion of C factor.*
** Stop-check valves are only furnished without springs.*

## *Table 1B – Forged Steel PressurCombo Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | Pressurseat (DS) | | | | | | Pressureater (DE) | | | | | | PressurCombo (DC) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | | $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | | $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | |
| **Class 1690** **(PN 290)** *36124, 36128, 36224, 36228* | | | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 5.0 | | | | 0.464 | 11.8 | 5.0 | | | | 0.464 | 11.8 | 4.1 | | | | 0.464 | 11.8 |
| 0.75 | 20 | 6.1 | | | | 0.612 | 15.5 | 5.9 | | | | 0.612 | 15.5 | 4.5 | | | | 0.612 | 15.5 |
| 1.00 | 25 | 6.1 | | | | 0.815 | 20.7 | 5.6 | | | | 0.815 | 20.7 | 4.4 | | | | 0.815 | 20.7 |
| 1.25 | 32 | 12 | | | | 1.160 | 29.55 | 11 | | | | 1.160 | 29.5 | 8.0 | | | | 1.160 | 29.5 |
| 1.50 | 40 | 12 | .85 | .50 | .27 | 1.338 | 34.0 | 11 | .80 | .45 | .24 | 1.338 | 34.0 | 8.0 | .80 | .45 | .24 | 1.338 | 34.0 |
| 2.00 | 50 | 30 | | | | 1.687 | 42.3 | 28 | | | | 1.687 | 42.8 | 22 | | | | 1.687 | 42.8 |
| 2.50 | 65 | 53 | | | | 2.125 | 54.0 | 51 | | | | 2.125 | 54.0 | 39 | | | | 2.125 | 54.0 |
| 3.00 | 80 | 51 | | | | 2.624 | 66.6 | 47 | | | | 2.624 | 66.6 | 37 | | | | 2.624 | 66.6 |
| 4.00 | 100 | 49 | | | | 3.438 | 87.3 | 43 | | | | 3.438 | 87.3 | 35 | | | | 3.438 | 87.3 |
| **Class 2680** **(PN 460)** *66124, 66128, 66224, 66228* | | | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 5.0 | | | | 0.464 | 11.8 | 5.0 | | | | 0.464 | 5.0 | 4.1 | | | | 0.464 | 11.8 |
| 0.75 | 20 | 4.6 | | | | 0.612 | 15.5 | 4.5 | | | | 0.612 | 4.5 | 3.8 | | | | 0.612 | 15.5 |
| 1.00 | 25 | 6.0 | | | | 0.599 | 15.2 | 5.7 | | | | 0.599 | 5.7 | 4.5 | | | | 0.599 | 15.2 |
| 1.25 | 32 | 12 | | | | 0.896 | 22.8 | 12 | | | | 0.896 | 12 | 8.9 | | | | 0.896 | 22.8 |
| 1.50 | 40 | 12 | .85 | .50 | .27 | 1.100 | 28.0 | 11 | .80 | .45 | .24 | 1.100 | 11 | 8.3 | .80 | .45 | .24 | 1.100 | 27.9 |
| 2.00 | 50 | 31 | | | | 1.502 | 38.2 | 30 | | | | 1.502 | 30 | 23 | | | | 1.502 | 38.2 |
| 2.50 | 65 | 52 | | | | 1.771 | 45.0 | 56 | | | | 1.771 | 56 | 41 | | | | 1.771 | 45.0 |
| 3.00 | 80 | 52 | | | | 2.300 | 58.4 | 48 | | | | 2.300 | 48 | 38 | | | | 2.300 | 58.4 |
| 4.00 | 100 | 50 | | | | 3.152 | 80.1 | 44 | | | | 3.152 | 44 | 36 | | | | 3.152 | 80.1 |
| **Class 4500** **(PN 760)** *96124, 96128, 96224, 96228* | | | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 1.9 | | | | 0.252 | 6.4 | 1.5 | | | | 0.252 | 6.4 | 1.4 | | | | 0.252 | 6.4 |
| 0.75 | 20 | 4.6 | | | | 0.434 | 11.0 | 4.4 | | | | 0.434 | 11.0 | 3.8 | | | | 0.434 | 11.0 |
| 1.00 | 25 | 6.1 | | | | 0.599 | 15.2 | 5.8 | | | | 0.599 | 15.2 | 4.5 | | | | 0.599 | 15.2 |
| 1.25 | 32 | 6.1 | | | | 0.808 | 20.5 | 5.6 | | | | 0.808 | 20.5 | 4.4 | | | | 0.808 | 20.5 |
| 1.50 | 40 | 5.9 | .85 | .50 | .27 | 0.926 | 23.5 | 5.3 | .80 | .45 | .24 | 0.926 | 23.5 | 4.3 | .80 | .45 | .24 | 0.926 | 23.5 |
| 2.00 | 50 | 28 | | | | 1.156 | 29.4 | 29 | | | | 1.156 | 29.4 | 22 | | | | 1.158 | 29.4 |
| 2.50 | 65 | 30 | | | | 1.400 | 35.6 | 30 | | | | 1.400 | 35.6 | 23 | | | | 1.400 | 35.6 |
| 3.00 | 80 | 30 | | | | 1.700 | 43.2 | 28 | | | | 1.700 | 43.2 | 22 | | | | 1.700 | 43.2 |
| 4.00 | 100 | 29 | | | | 2.200 | 55.9 | 25 | | | | 2.200 | 55.9 | 21 | | | | 2.200 | 55.9 |

## Table 2 – Forged Steel Inclined Bonnet, Bolted Bonnet Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valves* with Springs (Std.) | | | | | Check Valves* without Springs | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | $\Delta P_{FL}$ | | $SP_{FL}$ | | C |
| **Class 800 (PN 130)** *Figure No. 848/848Y Stop valve, 868/868Y Stop-Check valve, 838/838Y Piston Check valve* | | | | | | | | | | | | | | | | | |
| 0.25 | 8 | 1.4 | 0.72 | 0.30 | 0.20 | 0.364 | 9.2 | 5.0 | 0.34 | 198 | 22.4 | 76 | 0.6 | 0.041 | 68.6 | 7.77 | 26 |
| 0.38 | 10 | 3.3 | | | | 0.493 | 12.5 | | | 467 | 52.9 | 98 | | | 162 | 18.3 | 34 |
| 0.50 | 15 | 3.3 | | | | 0.546 | 13.9 | | | 467 | 52.9 | 80 | | | 162 | 18.3 | 28 |
| 0.75 | 20 | 5.7 | | | | 0.742 | 18.8 | | | 722 | 81.8 | 67 | | | 250 | 28.3 | 23 |
| 1.00 | 25 | 13.5 | | | | 0.957 | 24.3 | | | 1910 | 216 | 106 | | | 662 | 75.0 | 37 |
| 1.25 | 32 | 23.5 | | | | 1.278 | 32.5 | | | 3330 | 377 | 104 | | | 1150 | 131 | 36 |
| 1.50 | 40 | 37.5 | | | | 1.500 | 38.1 | | | 5290 | 600 | 120 | | | 1830 | 208 | 42 |
| 2.00 | 50 | 48.5 | | | | 1.939 | 49.3 | | | 6860 | 778 | 93 | | | 2380 | 269 | 32 |
| **Series 1500 Figure No. 1048/1048Y Stop valve, 1068/1068Y Stop-Check valve, 1038/1038Y Piston Check valve** | | | | | | | | | | | | | | | | | |
| 0.25 | 8 | 1.7 | 0.75 | 0.34 | 0.20 | 0.302 | 7.7 | 5.0 | 0.34 | 241 | 27.3 | 134 | 0.6 | 0.041 | 83.4 | 9.45 | 47 |
| 0.38 | 10 | 3.9 | | | | 0.423 | 10.7 | | | 552 | 62.5 | 157 | | | 191 | 21.7 | 54 |
| 0.50 | 15 | 3.8 | | | | 0.464 | 11.8 | | | 538 | 60.9 | 127 | | | 186 | 21.1 | 44 |
| 0.75 | 20 | 6.8 | | | | 0.612 | 15.5 | | | 963 | 109 | 131 | | | 333 | 37.8 | 45 |
| 1.00 | 25 | 10.5 | | | | 0.815 | 20.7 | | | 1490 | 168 | 114 | | | 515 | 58.3 | 39 |
| 1.25 | 32 | 28 | | | | 1.160 | 29.5 | | | 3960 | 449 | 150 | | | 1370 | 155 | 52 |
| 1.50 | 40 | 26.5 | | | | 1.338 | 34.0 | | | 3750 | 425 | 107 | | | 1300 | 147 | 37 |
| 2.00 | 50 | 41.5 | | | | 1.687 | 42.8 | | | 5870 | 665 | 105 | | | 2030 | 230 | 36 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See note following paragraph 2.4.1, page 106, for discussion of C factor.*



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## Table 3 – Forged Steel Angle, Bolted Bonnet Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valves* with Springs (Std.) | | | | | Check Valves* without Springs | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | $\Delta P_{FL}$ | | $SP_{FL}$ | | C |
| **Class 600 (PN 110)** *Figure No. 829 Stop valves, 847 Stop-Check valves* | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 3.3 | 0.55 | 0.19 | 0.11 | 0.546 | 13.9 | 6.0 | 0.41 | 512 | 58.0 | 87 | 0.8 | 0.055 | 187 | 21.2 | 32 |
| 0.75 | 20 | 5.7 | | | | 0.742 | 18.8 | | | 884 | 100 | 82 | | | 323 | 36.5 | 30 |
| 1.00 | 25 | 17.5 | | | | 0.957 | 24.3 | | | 2710 | 307 | 151 | | | 991 | 112 | 55 |
| 1.25 | 32 | 36 | | | | 1.278 | 32.5 | | | 5580 | 632 | 174 | | | 2040 | 231 | 64 |
| 1.50 | 40 | 35 | | | | 1.500 | 38.1 | | | 5430 | 615 | 123 | | | 1980 | 224 | 45 |
| 2.00 | 50 | 45.5 | | | | 1.939 | 49.3 | | | 7050 | 799 | 96 | | | 2580 | 292 | 35 |
| **Class 800 (PN 130)** *Figure No. 849/849Y Stop valves, 869/869Y Stop-Check valves* | | | | | | | | | | | | | | | | | |
| 0.25 | 8 | 2.6 | 0.64 | 0.25 | 0.16 | 0.364 | 9.2 | 6.0 | 0.41 | 403 | 45.7 | 155 | 0.8 | 0.055 | 147 | 16.7 | 57 |
| 0.38 | 10 | 2.9 | | | | 0.493 | 12.5 | | | 450 | 50.9 | 94 | | | 164 | 18.6 | 34 |
| 0.50 | 15 | 2.8 | | | | 0.546 | 13.9 | | | 434 | 49.2 | 74 | | | 159 | 18.0 | 27 |
| 0.75 | 20 | 4.8 | | | | 0.742 | 18.8 | | | 744 | 84.3 | 69 | | | 272 | 30.8 | 25 |
| 1.00 | 25 | 10.5 | | | | 0.957 | 24.3 | | | 1630 | 184 | 91 | | | 595 | 67.3 | 33 |
| 1.25 | 32 | 31 | | | | 1.278 | 32.5 | | | 4810 | 544 | 150 | | | 1760 | 199 | 55 |
| 1.50 | 40 | 30 | | | | 1.500 | 38.1 | | | 4650 | 527 | 105 | | | 1700 | 192 | 38 |
| 2.00 | 50 | 38.5 | | | | 1.939 | 49.3 | | | 5970 | 676 | 81 | | | 2180 | 247 | 30 |
| **Series 1500 Figure No. 1049/1049Y Stop valves, 1069/1069Y Stop-Check valves** | | | | | | | | | | | | | | | | | |
| 0.25 | 8 | 1.9 | 0.61 | 0.22 | 0.14 | 0.302 | 7.7 | 6.0 | 0.41 | 295 | 33.4 | 165 | 0.8 | 0.055 | 108 | 12.2 | 60 |
| 0.38 | 10 | 2.9 | | | | 0.423 | 10.7 | | | 450 | 50.9 | 128 | | | 164 | 18.6 | 47 |
| 0.50 | 15 | 2.9 | | | | 0.464 | 11.8 | | | 450 | 50.9 | 106 | | | 164 | 18.6 | 39 |
| 0.75 | 20 | 5.0 | | | | 0.612 | 15.5 | | | 775 | 87.8 | 105 | | | 283 | 32.1 | 39 |
| 1.00 | 25 | 7.7 | | | | 0.815 | 20.7 | | | 1190 | 135 | 92 | | | 436 | 49.4 | 33 |
| 1.25 | 32 | 20 | | | | 1.160 | 29.5 | | | 3100 | 351 | 117 | | | 1130 | 128 | 43 |
| 1.50 | 40 | 20 | | | | 1.338 | 34.0 | | | 3100 | 351 | 88 | | | 1130 | 128 | 32 |
| 2.00 | 50 | 33.5 | | | | 1.687 | 42.8 | | | 5190 | 588 | 93 | | | 1900 | 215 | 34 |
| **Series 1500 Figure No. 1029 Stop valves, 1047 Stop-Check valves** | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 2.7 | 0.65 | 0.24 | 0.16 | 0.464 | 11.8 | 6.0 | 0.41 | 419 | 47.4 | 99 | 0.8 | 0.055 | 153 | 17.3 | 36 |
| 0.75 | 20 | 4.7 | | | | 0.612 | 15.5 | | | 729 | 82.5 | 99 | | | 266 | 30.1 | 36 |
| 1.00 | 25 | 7.5 | | | | 0.815 | 20.7 | | | 1160 | 132 | 89 | | | 425 | 48.1 | 33 |
| 1.25 | 32 | 21 | | | | 1.160 | 29.5 | | | 3260 | 369 | 123 | | | 1190 | 135 | 45 |
| 1.50 | 40 | 21 | | | | 1.338 | 34.0 | | | 3260 | 369 | 93 | | | 1190 | 135 | 34 |
| 2.00 | 50 | 31.5 | | | | 1.687 | 42.8 | | | 4920 | 557 | 88 | | | 1790 | 203 | 32 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See note following paragraph 2.4.1, page 106, for discussion of C factor. See Table 10 page 120 for Hermavalves.*

## *Table 4 – Edward Forged Steel Vertical Stem, Bolted Bonnet Globe Valve and 90° Bonnet Piston Check Valve Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valves with Springs (Std.) | | | | | Check Valves without Springs | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | $\Delta P_{FL}$ | | $SP_{FL}$ | | C |
| **Series 600 (PN 110)** *Figure No. 828 Stop valve, 846 Stop-Check valve, 858 Piston Check valve* | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 2.4 | 0.63 | 0.29 | 0.15 | 0.546 | 13.9 | 8.0 | 0.55 | 430 | 48.7 | 73 | 1.2 | 0.083 | 166 | 18.8 | 28 |
| 0.75 | 20 | 4.2 | | | | 0.742 | 18.8 | | | 752 | 85.2 | 70 | | | 291 | 33.0 | 27 |
| 1.00 | 25 | 13.5 | | | | 0.957 | 24.3 | | | 2400 | 272 | 133 | | | 929 | 105 | 52 |
| 1.25 | 32 | 27.5 | | | | 1.278 | 32.5 | | | 4920 | 558 | 154 | | | 1910 | 216 | 59 |
| 1.50 | 40 | 27 | | | | 1.500 | 38.1 | | | 4830 | 548 | 109 | | | 1870 | 212 | 42 |
| 2.00 | 50 | 35.5 | | | | 1.939 | 49.3 | | | 6360 | 720 | 86 | | | 2460 | 279 | 33 |
| **Series 1500 Figure No. 1028 Stop valve, 1046 Stop-Check valve, 1058 Piston Check valve** | | | | | | | | | | | | | | | | | |
| 0.50 | 15 | 3.6 | 0.68 | 0.27 | 0.17 | 0.464 | 11.8 | 8.0 | 0.55 | 645 | 73.0 | 153 | 1.2 | 0.083 | 250 | 28.3 | 59 |
| 0.75 | 20 | 6.2 | | | | 0.612 | 15.5 | | | 1110 | 126 | 151 | | | 430 | 48.7 | 58 |
| 1.00 | 25 | 6.2 | | | | 0.815 | 20.7 | | | 1110 | 126 | 85 | | | 430 | 48.7 | 33 |
| 1.25 | 32 | 18 | | | | 1.160 | 29.5 | | | 3220 | 365 | 122 | | | 1250 | 141 | 47 |
| 1.50 | 40 | 17.5 | | | | 1.338 | 34.0 | | | 3130 | 355 | 89 | | | 1210 | 137 | 35 |
| 2.00 | 50 | 24.5 | | | | 1.687 | 42.8 | | | 4390 | 497 | 79 | | | 1700 | 192 | 30 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See note following paragraph 2.4.1, page 106, for discussion of C factor.*

## Table 5 – Forged Steel Ball Check Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | Check Valve Flow Coefficients | | | | | | Check Valves with Springs (Std.) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C |
| **Class 800 (PN 130)** *Figure No. 832/832Y Ball Check valve* | | | | | | | | | | | | |
| 0.25 | 8 | 1.5 | 0.53 | 0.16 | 0.11 | 0.364 | 9.2 | 6.0 | 0.41 | 233 | 26.3 | 89 |
| 0.38 | 10 | 3.5 | | | | 0.493 | 12.5 | | | 543 | 61.5 | 114 |
| 0.50 | 15 | 3.5 | | | | 0.546 | 13.9 | | | 543 | 61.5 | 93 |
| 0.75 | 20 | 6.1 | | | | 0.742 | 18.8 | | | 946 | 107 | 88 |
| 1.00 | 25 | 14 | | | | 0.957 | 24.3 | | | 2170 | 246 | 121 |
| 1.25 | 32 | 25 | | | | 1.278 | 32.5 | | | 3880 | 439 | 121 |
| 1.50 | 40 | 39.5 | | | | 1.500 | 38.1 | | | 6120 | 694 | 139 |
| 2.00 | 50 | 51.5 | | | | 1.939 | 49.3 | | | 7990 | 904 | 108 |
| **Series 1500 Figure No. 1032/1032Y Ball Check valve** | | | | | | | | | | | | |
| 0.25 | 8 | 1.1 | 0.77 | 0.37 | 0.16 | 0.302 | 7.7 | 6.0 | 0.41 | 171 | 19.3 | 95 |
| 0.38 | 10 | 2.5 | | | | 0.423 | 10.7 | | | 388 | 43.9 | 110 |
| 0.50 | 15 | 2.4 | | | | 0.464 | 11.8 | | | 372 | 42.1 | 88 |
| 0.75 | 20 | 4.3 | | | | 0.612 | 15.5 | | | 667 | 75.5 | 91 |
| 1.00 | 25 | 6.6 | | | | 0.815 | 20.7 | | | 1020 | 116 | 79 |
| 1.25 | 32 | 17.5 | | | | 1.160 | 29.5 | | | 2710 | 307 | 103 |
| 1.50 | 40 | 17 | | | | 1.338 | 34.0 | | | 2640 | 299 | 75 |
| 2.00 | 50 | 26.5 | | | | 1.687 | 42.8 | | | 4110 | 465 | 74 |
| **5000 CWP (345 Bar)** *Figure No. 5160 Hydraulic Check valve* | | | | | | | | | | | | |
| 2.00 | 50 | 14 | 0.96 | 0.57 | 0.24 | 1.502 | 38.2 | 20 | 1.4 | 3960 | 449 | 89 |
| **10000 CWP (690 Bar)** *Figure No. 160/160Y Hydraulic Check valve, 9160 Hydraulic Check valve* | | | | | | | | | | | | |
| 0.25 | 8 | 0.40 | 0.96 | 0.57 | 0.24 | 0.133 | 3.4 | 20.0 | 1.4 | 113 | 12.8 | 326 |
| 0.38 | 10 | 0.80 | | | | 0.205 | 5.2 | | | 227 | 25.7 | 275 |
| 0.50 | 15 | 1.3 | | | | 0.252 | 6.4 | | | 368 | 41.7 | 295 |
| 0.75 | 20 | 3.5 | | | | 0.434 | 11.0 | | | 991 | 112 | 268 |
| 1.00 | 25 | 2.9 | | | | 0.599 | 15.2 | | | 821 | 93.0 | 117 |
| 1.25 | 32 | 3.5 | | | | 0.808 | 20.5 | | | 991 | 112 | 77 |
| 1.50 | 40 | 3.5 | | | | 0.926 | 23.5 | | | 991 | 112 | 58 |
| 2.00 | 50 | 14 | | | | 1.156 | 29.4 | | | 3960 | 449 | 150 |

*NOTES: See Table 9 for $\Delta P_{CO}$. See note following paragraph 2.4.1, page 106, for discussion of C factor.*

## Table 6 – Hydraulic Stop Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop Valves | | | | | | Check Valves with Springs (Std.) | | | Check Valves without Springs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | $SP_{FL}$ | C | $\Delta P_{FL}$ | $SP_{FL}$ | C |
| **5,000 PSI CWP (345 BAR)** *Figure No. 5158 Hydraulic Stop Valves* | | | | | | | | | | | | | |
| **10,000 PSI CWP (690 BAR)** *Figure No. 158/158Y, 9158 Hydraulic Stop Valves* | | | | | | | | | | | | | |
| 0.25 | 8 | 1.6 | | | | 0.133 | 3.4 | | | | | | |
| 0.38 | 10 | 1.6 | | | | 0.205 | 5.2 | | | | | | |
| 0.50 | 15 | 1.6 | | | | 0.252 | 6.4 | | | | | | |
| 0.75 | 20 | 3.6 | 0.48 | 0.30 | .024 | 0.434 | 11.0 | N/A | | | | | |
| 1.00 | 25 | 5.7 | | | | 0.599 | 15.2 | | | | | | |
| 1.25 | 32 | 9.1 | | | | 0.808 | 20.5 | | | | | | |
| 1.50 | 40 | 19 | | | | 0.926 | 23.5 | | | | | | |
| 2.00 | 50 | 33 | | | | 1.156 | 29.4 | | | | | | |

## Table 7 – Inclined Bonnet Blow-Off Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop Valves | | | | | | Check Valves with Springs (Std.) | | | Check Valves without Springs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | $SP_{FL}$ | C | $\Delta P_{FL}$ | $SP_{FL}$ | C |
| **Class 300 (PN 50)** *Figure No. 1441/1441Y* | | | | | | | | | | | | | |
| 1.50 | 40 | 44 | 0.49 | 0.32 | | 1.610 | 40.9 | | | | | | |
| 2.00 | 50 | 67 | 0.69 | 0.44 | 0.20 | 2.067 | 52.5 | N/A | | | | | |
| 2.50 | 65 | 100 | 0.53 | 0.34 | | 2.469 | 62.7 | | | | | | |
| **Class 600 (PN 110)** *Figure No. 1641/1641Y* | | | | | | | | | | | | | |
| 1.50 | 40 | 43 | 0.55 | 0.35 | | 1.500 | 38.1 | | | | | | |
| 2.00 | 50 | 68 | 0.71 | 0.44 | 0.20 | 1.939 | 49.3 | N/A | | | | | |
| 2.50 | 65 | 110 | 0.56 | 0.35 | | 2.323 | 59.0 | | | | | | |

## Table 8 – Angle Blow-Off Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop Valves | | | | | | Check Valves with Springs (Std.) | | | Check Valves without Springs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | $SP_{FL}$ | C | $\Delta P_{FL}$ | $SP_{FL}$ | C |
| **Class 300 (PN 50)** *Figure No. 1443/1443Y* | | | | | | | | | | | | | |
| 1.50 | 40 | 45 | 0.48 | 0.31 | 0.15 | 1.610 | 40.9 | N/A | | | | | |
| 2.00 | 50 | 80 | 0.48 | 0.31 | | 2.067 | 52.5 | | | | | | |
| 2.50 | 65 | 110 | 0.53 | 0.34 | | 2.469 | 62.7 | | | | | | |
| **Class 600 (PN 110)** *Figure No. 1643/1643Y* | | | | | | | | | | | | | |
| 1.50 | 40 | 41 | 0.60 | 0.38 | 0.15 | 1.500 | 38.1 | N/A | | | | | |
| 2.00 | 50 | 81 | 0.50 | 0.31 | | 1.939 | 49.3 | | | | | | |
| 2.50 | 65 | 110 | 0.56 | 0.35 | | 2.323 | 59.0 | | | | | | |



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## Table 9 – Crack-Open ΔP for Edward Forged Steel Check Valves, $\Delta P_{CO}$ – PSI (BAR)

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Valve Type | Installation Orientation | | Valves with Springs (Std.) | | Valves without Springs | |
|---|---|---|---|---|---|---|
| Inclined, Bolted Bonnet, Piston Lift | Horizontal | Bonnet up | 0.7 – 0.9 | 0.05 – 0.06 | 0.1 – 0.5 | 0.007 – 0.03 |
| | | Bonnet sideways* | 0.3 – 0.8 | 0.02 – 0.06 | — | — |
| | | Bonnet down* | 0.05 – 0.7 | 0.003 – 0.05 | — | — |
| | Vertical | Bonnet up | 0.7 – 1.0 | 0.05 – 0.07 | 0.1 – 0.3 | 0.007 – 0.02 |
| | | Bonnet down* | 0.05 – 0.7 | 0.003 – 0.05 | — | — |
| 90°, Bolted Bonnet, Piston Lift | Horizontal | Bonnet up | 0.8 – 1.0 | 0.06 – 0.07 | 0.1 – 0.6 | 0.007 – 0.04 |
| | | Bonnet sideways* | 0.4 – 0.8 | 0.03 – 0.06 | — | — |
| | | Bonnet down* | 0.05 – 0.6 | 0.003 – 0.04 | — | — |
| | Vertical | | 0.4 – 0.8 | 0.03 – 0.06 | — | — |
| Inclined, Univalve®, Piston Lift | Horizontal | Bonnet up | 1.0 – 1.5 | 0.07 – 0.10 | 0.4 – 0.8 | 0.03 – 0.06 |
| | | Bonnet sideways* | 0.5 – 1.2 | 0.03 – 0.08 | — | — |
| | | Bonnet down* | 0.05 – 1.1 | 0.003 – 0.08 | — | — |
| | Vertical | Bonnet up | 1.0 – 1.5 | 0.07 – 0.10 | 0.4 – 0.8 | 0.03 – 0.06 |
| | | Bonnet down* | 0.05 – 1.1 | 0.003 – 0.08 | — | — |
| Inclined, Ball Lift | Horizontal | Bonnet up | 0.9 – 1.7 | 0.06 – 0.10 | — | — |
| | | Bonnet sideways* | 0.7 – 1.4 | 0.05 – 0.10 | — | — |
| | | Bonnet down* | 0.5 – 1.2 | 0.03 – 0.08 | — | — |
| | Vertical | Bonnet up | 0.9 – 1.7 | 0.06 – 0.10 | — | — |
| | | Bonnet down* | 0.5 – 1.2 | 0.03 – 0.08 | — | — |

** Not recommended because of possible accumulation of debris in valve neck.*

## Figure 16 – Edward Forged Steel Check Valve Flow Performance Curves

**Figure 16A**

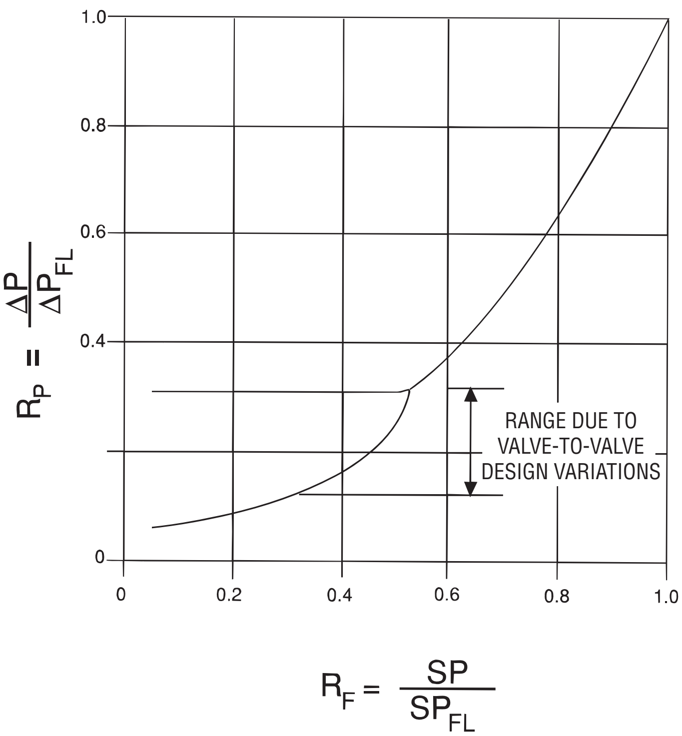
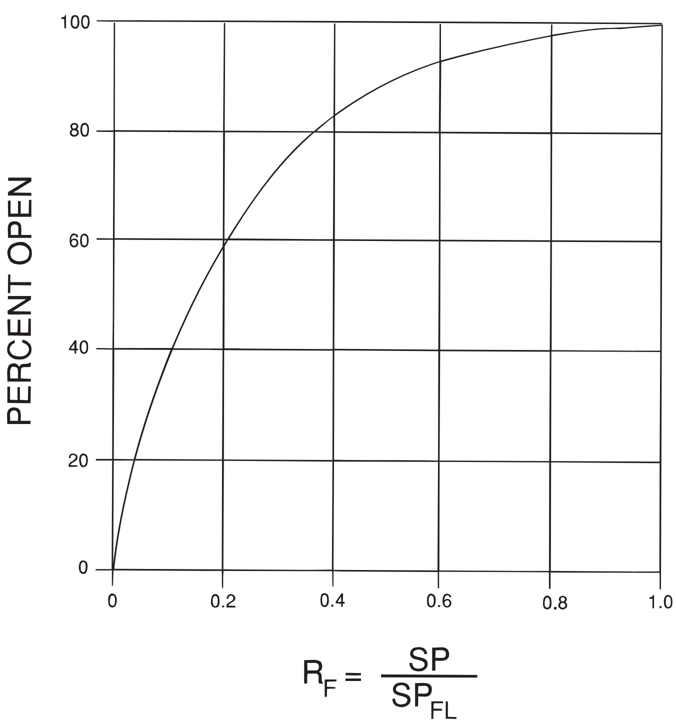



**Figure 16B**



## Table 10 – Edward Forged Steel Hermavalve® Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| NPS | DN | Regular Port Hermavalves Fig. No. 15004/15104, 15008/15108, 16004, 16008 | | | | Reduced Port Hermavalves Fig. No. 15014/15114, 15018/15118, 16014, 16018 | | | | d | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $C_V$ | $F_L$ | $X_T$ | $K_i$ | $C_V$ | $F_L$ | $X_T$ | $K_i$ | | |
| 0.05 | 15 | 4.9 | 0.46 | 0.31 | 0.07 | — | — | — | — | 0.464 | 11.8 |
| 0.75 | 20 | 6.1 | 0.52 | 0.36 | 0.09 | — | — | — | — | 0.612 | 15.5 |
| 1.00 | 25 | 11 | 0.55 | 0.38 | 0.10 | 6.1 | 0.51 | 0.36 | 0.09 | 0.815 | 20.7 |
| 1.50 | 40 | 32 | 0.62 | 0.39 | 0.13 | 11 | 0.53 | 0.37 | 0.09 | 1.338 | 34.0 |
| 2.00 | 50 | 50 | 0.68 | 0.40 | 0.15 | 32 | 0.57 | 0.37 | 0.11 | 1.687 | 42.8 |
| 2.50 | 65 | — | — | — | — | 50 | 0.59 | 0.37 | 0.12 | 2.125 | 54.0 |

## Figure 17 – Ratio of Specific heats (k) for some gasses

| | | | | | |
|---|---|---|---|---|---|
| k = 1.3 | Ammonia | Carbon Dioxide | Dry Steam | Methane | Natural Gas |
| k = 1.4 | Air | Carbon Monoxide | Hydrogen | Nitrogen | Oxygen |

## Figure 18A – Saturated Water - Temperature, Pressure & Density (U.S. Units)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp. °F | 32 | 70 | 100 | 200 | 300 | 400 | 500 | 550 | 600 | 650 | 700 | 705 |
| Vapor Pressure, $p_v$ | 0.09 | 0.36 | 0.95 | 11.5 | 67 | 247 | 681 | 1045 | 1543 | 2208 | 3094 | 3206 |
| Water Density, ρ | 62.4 | 62.3 | 62.0 | 60.1 | 57.3 | 53.7 | 49.0 | 46.0 | 42.3 | 37.4 | 27.3 | 19.7 |

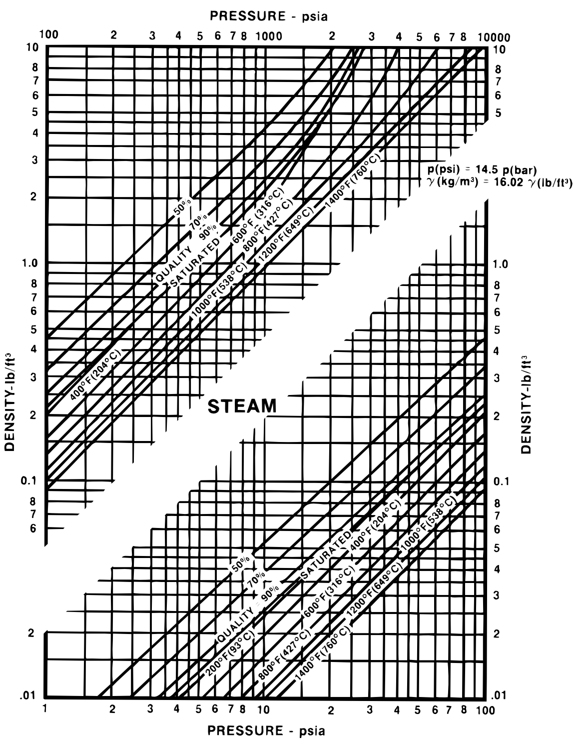
*P = Pressure in psia, ρ = Density in lb./ft³*

## Figure 18B – Saturated Water - Temperature, Pressure & Density (Metric)

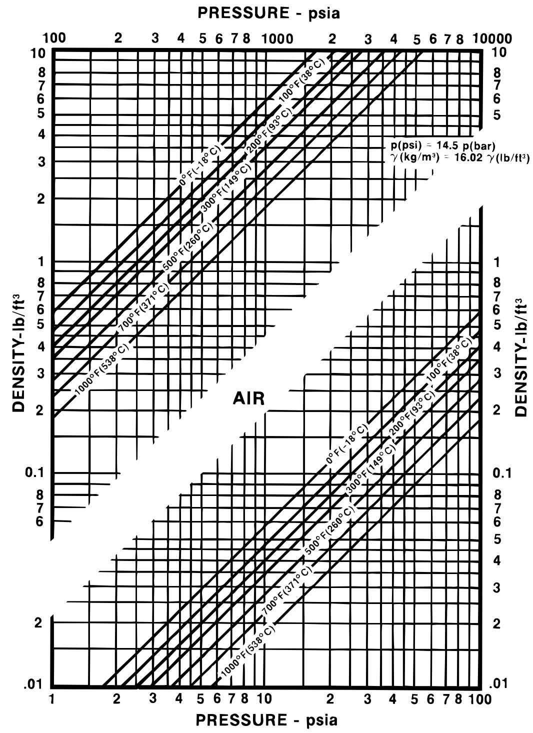
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp. °C | 0 | 25 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 370 | 374 |
| Vapor Pressure, $p_v$ | .006 | .032 | .123 | 1.01 | 4.76 | 15.6 | 39.8 | 85.9 | 165.4 | 211 | 221 |
| Water Density, ρ | 1000 | 997 | 988 | 958 | 917 | 865 | 799 | 712 | 574 | 452 | 315 |

*P = Pressure in Bar Absolute, ρ = Density in Kg/m³*

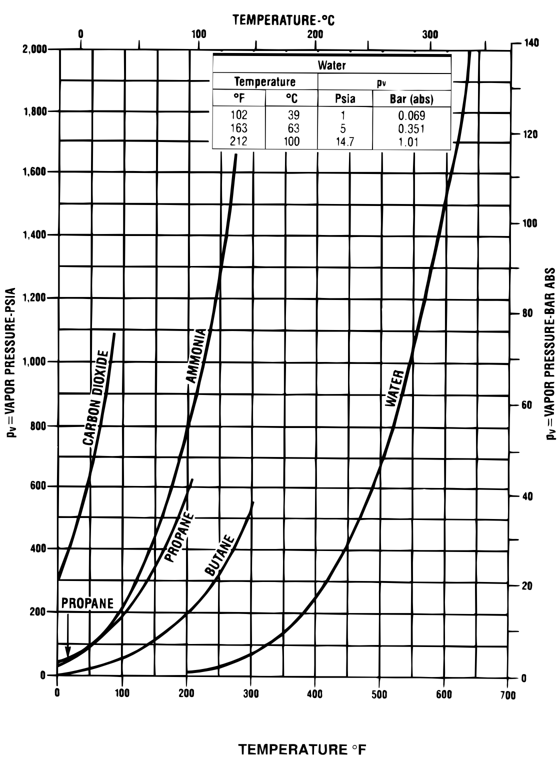
## Figure 19 – Density of Steam




## Figure 20 – Density of Air




## Figure 21 – Vapor Pressure of Liquid



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# Conversion of Measurement Units

### Length

| | |
|---|---|
| 1 in. = 25.4 mm | 1 mile = 5280 ft |
| 1 in. = 2.54 cm | 1 mile = 1.609 km |
| 1 in. = 0.0254 m | 1 km = 3281 ft |
| 1 ft = 0.3048 m | 1 m = 39.37 in. |

### Area

| | |
|---|---|
| 1 in.$^2$ = 645.2 mm$^2$ | 1 m$^2$ = 10.76 ft$^2$ |
| 1 in.$^2$ = 6.452 cm$^2$ | 1 m$^2$ = 1550 in.$^2$ |
| 1 ft$^2$ = 144 in.$^2$ | |

### Volume

| | |
|---|---|
| 1 in.$^3$ = 16.39 cm$^3$ | 1 m$^3$ = 35.31 ft$^3$ |
| 1 ft$^3$ = 1728 in.$^3$ | 1 m$^3$ = 264.2 U.S. gal. |
| 1 U.S. gal. = 231 in.$^3$ | 1 m$^3$ = 220 Imp. gal. |
| 1 U.S. gal. = 0.1337 ft$^3$ | 1 m$^3$ = 1000 liters |
| 1 U.S. gal. = 0.8327 Imp. gal. | 1 liter = 61.02 in.$^3$ |
| 1 U.S. gal. = 3.7854 liters | 1 liter = 1000 cm$^3$ |
| 1 ft$^3$ = 28.32 liters | 1 ml = 1 cm$^3$ |

### Density

1 lb/ft$^3$ = 16.02 kg/m$^3$
1 lb/ft$^3$ = 0.01602 g/cm$^3$
1 lb/in$^3$ = 1728 lb/ft$^3$
density = specific gravity x reference density
density = 1/specific volume

### Specific Volume

specific volume = 1/density

### Temperature

T(°C) = T(°F -32) / 1.8
T(°F) = 1.8 T(°C) + 32
T(°R) = T(°F) + 460
T(°K) = T(°C) + 273
T(°R) = 1.8 T(°K)

where:
°C = degrees Celsius
°F = degrees Fahrenheit
°K = degrees Kelvin (absolute temperature)
°R = degrees Rankine (absolute temperature)

### Specific Gravity – Liquids

$$G_l = \frac{\text{density of liquid}}{\text{density of water at reference condition}}$$

Commonly used relations are:

$$G_l = \frac{\text{density ofl iquid}}{\text{density of water at 60°F and atmospheric pressure}}$$

$$G_l = \frac{\rho\,(\text{lb/ft}^3)}{62.38\,(\text{lb/ft}^3)}$$

$$G_l = \frac{\text{density of liquid}}{\text{density of water at 4°C and atmospheric pressure}}$$

$$G_l = \frac{\rho\,(\text{kg/m}^3)}{1000\,(\text{kg/m}^3)}$$

For practical purposes, these specific gravities may be used interchangeably, as the reference densities are nearly equivalent.

Specific gravities are sometimes given with two temperatures indicated, e.g.,

$$G_l\,\frac{60°F}{60°F},\ G_l\,\frac{15.5°C}{4°C},\ G_l\,60°F/60°$$

The upper temperature is that of the liquid whose specific gravity is given, and the lower value indicates the water temperature of the reference density. If no temperatures are shown, assume that the commonly used relations apply.

For petroleum liquids having an "API degrees" specification:

$$G_l\,60°F/60° = \frac{141.5}{131.5 + \text{API degrees}}$$

### Pressure

| | |
|---|---|
| 1 Mpa = 145 psi | 1 psi = 6895 Pa |
| 1 pond = 1 gf | 1 psi = 6895 N/m$^2$ |
| 1 std atm = 14.696 psi | 1 Pa = 1 N/m$^2$ |
| 1 std atm = 1.0133 bar | 1 bar = 14.50 psi |
| 1 std atm = 1.0133 x 10$^5$ N/m$^2$ | 1 bar = 100,000 N/m$^2$ |

1 kgf/cm2 = 14.22 psi
1 std atm =
760 torr absolute pressure =
gage pressure + atmospheric pressure

### Specific Gravity – Gases

$$G_g = \frac{\text{density of gas (at pressure and temperature of interest)}}{\text{density of air (at same pressure and temperature)}}$$

Because the relation between density, pressure and temperature does not always behave in an ideal way (i.e., ideally, density is proportional to pressure divided by temperature, in absolute units), use of the above relation requires that the pressure and temperature of interest be specified. This means that the specific gravity of a gas as defined may vary with pressure and temperature (due to "compressibility" effects).

Frequently, specific gravity is defined using:

$$G_g = \frac{\text{molecular weight of gas}}{\text{molecular weight of air}} = \frac{M_w}{28.96}$$

If this relation is used to calculate density, one must be careful to consider "compressibility" effects.

When the pressure and temperature of interest are at or near "standard" conditions (14.73 psia, 60°F) or "normal" conditions (1.0135 bar abs, 0°C), specific gravities calculated from either of the above relations are essentially equal.

### Pressure Head

1 foot of water at 60°F = 0.4332 psi

$$p\,(\text{psi}) = \frac{\rho\,(\text{lb/ft}^3) \times h\,(\text{feet of liquid})}{144}$$

$$p\,(\text{N/m}^2) = \frac{\rho\,(\text{kg/m}^3) \times h\,(\text{meters of liquid})}{0.1020}$$

$$p\,(\text{bar}) = \frac{\rho\,(\text{kg/m}^3) \times h\,(\text{meters of liquid})}{10200}$$

1 meter of water at 20°C = 9.790 kN/m2
1 meter of water at 20°C = 97.90 mbar
1 meter of water at 20°C = 1.420 psi

### Flow Rate

• mass units
1 lb/hr = 0.4536 kg/hr
1 metric tonne/hr = 2205 lb/hr

• liquid volume units
1 U.S. gpm = 34.28 BOPD
BOPD = barrels oil per day
1 U.S. gpm = 0.8327 Imp. gpm
1 U.S. gpm = 0.2273 m$^3$/hr
1 U.S. gpm = 3.785 liters/min
1 m$^3$/hr = 16.68 liters/min
1 ft$^3$/s = 448.8 U.S. gpm

• mixed units
w(lb/hr) = 8.021 q(U.S. gpm) x ρ(lb/ft$^3$)
w(lb/hr) = 500 q(U.S. gpm of water at 70°F or less)

In the following:
STP (standard conditions) refers to 60°F, 14.73 psia
NTP (normal conditions) refers to 0°C, 1.0135 bar abs

$$G_g = \frac{\text{molecular weight of gas}}{\text{molecular weight of air}} = \frac{M_w}{28.96}$$

w(lb/hr) = 60 q(scfm of gas) x ρ(lb/ft$^3$) at STP
w(lb/hr) = q(scfh of gas) x ρ(lb/ft$^3$) at STP
w(lb/hr) = 4.588 q(scfm of gas) x $G_g$
w(lb/hr) = 0.07646 q(scfh of gas) x $G_g$
w(lb/hr) = 3186 q(MMscfd of gas) x $G_g$
Mmscfd = millions of standard cubic feet per day
w(kg/hr) = q(normal m$^3$/hr of gas) x ρ(kg/m$^3$ at NTP)
w(kg/hr) = 1.294 q(normal m$^3$/hr of gas) x $G_g$



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# 3. Edward Valve Design Standards and Features

Engineering and research efforts – both analytical and experimental – have contributed to innovative leadership by Flowserve Edward Valves through the introduction or practical development of some major industrial valving features:

- Integral hardfaced seats in globe and angle valves to permit compact valve designs and to resist erosion and wear.
- Impactor handwheels and handles to permit tight shutoff of manually operated globe and angle valves.
- Body-guided globe and angle valve disks to minimize wear and ensure alignment with seats for tight sealing.
- Inclined-bonnet globe valves with streamlined flow passages to minimize pressure drop due to flow.
- Equalizers for large check and stop-check valves to ensure full lift at moderate flow rates and to prevent damage due to instability.
- Compact pressure-seal bonnet joints to eliminate massive bolted flanges on large, high-pressure valves:

  – First with wedge-shaped metal gaskets with soft coatings, optimized over more than four decades to provide tight sealing in most services.

  – Now, for the severest services, with composite gaskets using flexible graphite and special anti-extrusion rings to ensure tight sealing, even with severe temperature transients – overcomes need for field re-tightening and eases disassembly for maintenance.
- Optimized stem-packing chambers and packing-material combinations to ensure tight stem sealing:

  – First with asbestos-based materials and then with asbestos-free materials.
- Hermetically sealed globe valves with seal-welded diaphragm stem seals to prevent stem leakage in critical applications, including nuclear.
- Gate valves with flexible double-wedge construction to ensure tight sealing at both low and high pressures and to prevent sticking difficulties when opening.
- Qualified stored-energy actuators for quick-closing valves in safety-related nuclear-plant applications – and qualified valve-actuator combinations that are used in main-steam isolation service throughout the world.

Flowserve valve expertise, acquired over more than 85 years, is shared with national and international codes-and-standards committees and other technical societies and groups whose activities influence industrial valves. This cooperation has included participation in the development of every issue of ASME/ANSI B16.34 as well as most issues of ASME/ANSI B16.5 (Pipe Flanges and Flanged Fittings), which applied to steel valves before ASME/ANSI B16.34 was first issued in 1973. Flowserve representatives have also been active in preparation of ISO (International Standards Organization) standards. In addition, Flowserve representatives have participated where appropriate with trade organizations such as EPRI, INPO and various nuclear power-plant owners' groups in addressing valve issues.

## 3.1 Codes and Standards

Flowserve Edward valves are designed, rated, manufactured and tested in accordance with the following standards where applicable:

- ASME B16.34-2004 – Valves: flanged, threaded and welding end.
- ASME/ANSI B16.10-2000– Face-to-face and end-to-end dimensions of valves.
- ASME B16.11 – Forged Fittings, Socket-welding and Threaded.
- ASME Boiler and Pressure-Vessel Code – Applicable sections including Nuclear Section III.
- ASME and ASTM Material Specifications – Applicable sections.
- MSS Standard Practices – Where appropriate: Edward sealability acceptance criteria are equal to or better than those in MSS SP-61.

Users should note that ASME/ANSI B16.34-2004 has a much broader scope than the previous editions. While this standard previously covered only flanged-end and butt welding-end valves, the 1988 edition covered socket welding-end and threaded-end valves as well. With this revision, the standard now addresses practically all types, materials and end configurations of valves commonly used in pressure-piping systems. All Edward valves in this catalog with a listed class number (e.g. Class 1500) comply with ASME B16.34.

In addition to the standards listed, special requirements such as those of API and NACE are considered on application.

## 3.2 Pressure Ratings

Flowserve Edward valve-pressure ratings are tabulated in pressure-versus-temperature format. The temperatures range from -20°F (-29°C) to the maximum temperature permitted for each specific design and pressure-boundary material. Typically, pressure ratings decrease with increasing temperature, approximately in proportion to decreases in material strength.

Valves in this catalog with a listed class number are rated in accordance with ASME B16.34-2004. This standard establishes allowable working pressure ratings for each class number and material. These ratings also vary with class definitions as described below.

**Standard Class** (Ref: Paragraph 2.1.2 of ASME B16.34-2004) – These lowest ratings apply to all flanged-end valves as well as any threaded-end or welding-end valves that do not meet the requirements for other classes. Typically, ratings for these valves are consistent with ratings listed for flanges and flanged fittings of similar materials in ASME/ANSI B16.5-2003.

**Special Class** (Ref: Paragraph 2.1.3 of ASME B16.34-2004) – These ratings apply to threaded-end or welding-end valves which meet all requirements for a Standard Class rating and in addition meet special nondestructive examination (NDE) requirements. Valve bodies and bonnets are examined by volumetric and surface examination methods and upgraded as required. Pressure ratings for Special Class valves are higher than those for Standard Class valves (particularly at elevated temperatures) because of the improved assurance of soundness of pressure boundaries and because they are not subject to the limitations of flanged and gasketed end joints.

**Limited Class** (Ref: Paragraph 2.1.3 of ASME B16.34-2004) – These ratings apply only to threaded-end or welding-end valves in sizes 2-½ and smaller, with generally cylindrical, internal-wetted pressure boundaries. Limited Class valves meet all requirements for Standard Class valves, and body designs must also satisfy special reinforcement rules to compensate for irregularities in shape. Typically, the regions of minimum wall thickness in these valves are very localized, so minor plasticity in such regions at high temperature will not adversely affect valve geometry. Pressure ratings for Limited Class valves are the same as those for Special Class valves at lower temperatures, but Limited Class ratings are higher at very high temperatures [above 900°F (482°C) for ferritic steels and above 1050°F (565°C) for austenitic steels].

It should be understood that flanged-end valves can be supplied only as Standard Class valves with numerically even pressure-class designations (300, 600, 900, 1500, 2500), for consistency with mating flanges in piping systems. Threaded-end or welding-end valves can be supplied with the same designations or as Class 4500 (for which there is no standard for flanged-end connections). In addition, threaded-end or welding-end valves can be furnished with intermediate ratings or class designations (ref: paragraph 2.1.4 of ASME B16.34-2004), up to Class 2500 for threaded ends and up to Class 4500 for welding-ends. For example, Class 2680 welding-end Univalves, can be applied in superheater-drain applications that could not be satisfied with a Class 2500 valve rating.

**Series or CWP**

A few valves in this catalog with "Series" or "CWP" designations are designed, rated, manufactured and tested to Flowserve Edward Valves proprietary standards. These valve designs, qualified by decades of successful field performance, will provide safe and reliable service in applications where an ASME/ANSI rating is not required by a piping code or other specifications.

These valve designs and ratings are generally, but not completely, in conformance with recognized national standards (e.g., some employ high-strength materials not listed in standards). These valves have a history of excellent performance and safety, and they may be applied with confidence in applications where ASME/ANSI ratings are not required.

**Notes:**

1. While Edward cast-steel valves described in this catalog have even listed ratings (e.g., 1500), many designs provide more wall thickness than required in critical areas. Accordingly, welding-end valves can often be offered with intermediate ratings (ref: Paragraph 6.1.4 of ASME B16.34-2004) moderately higher than the nominal class ratings. With appropriate revisions to testing procedures, this can allow somewhat higher pressure ratings than those listed in the tabulations. Consult Edward Valves and provide information on specific required design pressure and temperature conditions.

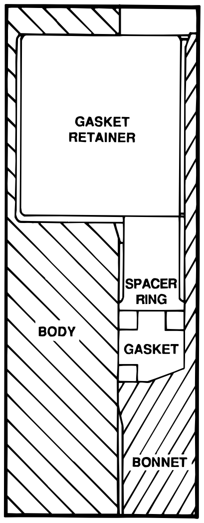
2. Pressure ratings for carbon steel (A105 and A216 WCB) valves are tabulated for temperatures through 1000°F (538°C), which is consistent with ASME B16.34-2004. As noted in that standard, these materials are permissible but not recommended for prolonged usage at above about 800°F (427°C). This precaution is related to the possibility that carbides in carbon steel may be converted to graphite.

3. Other codes or standards applicable to piping systems may be more restrictive than ASME B16.34-2004 in limiting allowable pressures for valves. For example, ASME B31.1-1995 (Power Piping) does not permit use of carbon steel (A105 and A216 WCB) at design temperatures above 800°F (427°C). Users must consider all codes or regulations applicable to their systems in selecting Edward Valves.

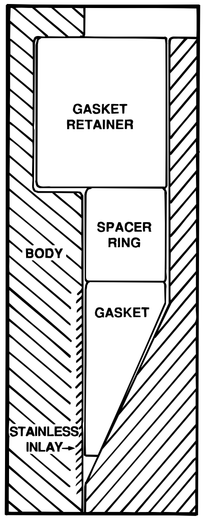
4. The maximum tabulated temperatures at which pressure ratings are given for Edward valves are in some cases less than the maximum temperatures given in ASME B16.34-2004 for valves of the same material. The maximum tabulated temperatures in this catalog may reflect limitations of materials used for other valve parts (e.g., stems). Use of Edward valves at temperatures above the maximum tabulated values may result in degradation and is not recommended.

## 3.3 Pressure-Seal Construction

The time-proven Edward pressure-seal bonnet seals more effectively as pressure increases, because the pressure forces the sealing elements into closer contact. Metal pressure-seal gaskets with soft plating employ optimum contact angles and materials for each applicable valve type, size and pressure-class rating. The gaskets yield initially



Composite Pressure-Seal Construction



Typical Pressure-Seal Construction



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under bolting load and then under pressure, to provide excellent sealing contact.

New designs for highest pressure/temperature services employ improved composite pressure-seal gaskets with flexible graphite rings. Flowserve leadership in proof-testing of Edward Valves flexible graphite stem packings clearly showed the superior sealing characteristics of this material, and continued research led to the development of a test-proven bonnet closure that provides highest sealing integrity. The composite pressure-seal provides excellent sealing at low and high pressures, even under severe pressure/temperature transients. It provides easier disassembly for maintenance, seals over minor scratches and does not depend on retightening under pressure after reassembly.

## 3.4 Hardfacing

Integrity of seating surfaces on bodies, wedges and disks in gate, globe, and check valves is essential for tight shutoff. Valve body seats must be hardfaced, and wedges and disks must either be hardfaced or made from an equivalent base material.

The standard seating material for most Edward valves is cobalt-based Stellite 21®, which has excellent mechanical properties and an exceptional performance history. As compared to Stellite 6®, which was used in many early Edward valves and is still used in many competitive valves, Stellite 21® is more ductile and impact resistant. These properties provide superior resistance to cracking of valve seating surfaces in service.

Stellite 21 is used either as a complete part made from a casting (as in Univalve® disks and small Equiwedge® gate valve wedges) or as a welded hardsurfacing deposit. Depending on valve size and type, hardsurfacing material is applied by a process that assures highest integrity (PTA, MIG, etc.).

While the as-deposited (or as-cast) hardness of Stellite 21 is somewhat lower than that of Stellite 6, Stellite 21 has a work-hardening coefficient that is five times that of Stellite 6. This provides essentially equivalent hardness after machining, grinding, and exposure to initial seating stresses. In addition, low friction coefficients attainable with Stellite 21 provide valuable margins in assuring valve operation with reasonable effort or actuator sizing.

The properties of Stellite 21 also provide an advantage to the user long after a valve leaves the Edward plant. If a large valve seat is severely damaged in a localized area, as may occur due to closing on foreign objects, the seat may be repaired locally and refinished, in such cases, where a valve cannot be adequately preheated before welding, a Stellite 6 seat may crack during the repair process – requiring either removal of the valve from the line or in situ removal replacement of the complete seat.

Some Edward valves have used solid disks made of hardened ASTM A-565 Grade 616 or 615 stainless steel. This corrosion-resistant alloy has been proven in seating and erosion tests and in service. This material can be furnished in certain valves for nuclear-plant services where reduced cobalt is desirable. Similar iron-base trim materials are used in production of certain standard valves. Extensive research on other cobalt-free valve trim materials has also identified other alloys which provide good performance under many service conditions. Consult Flowserve about any special trim requirements.

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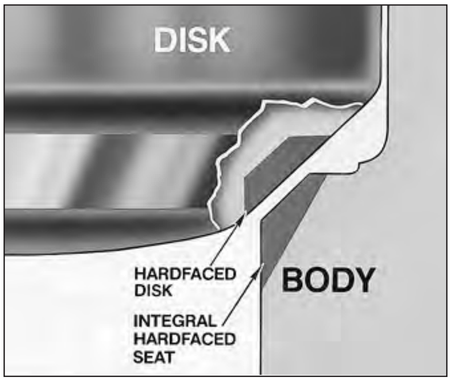
## 3.5 Valve-Stem Packing

Stem sealing is an extremely important valve performance feature, since seal leakage can represent energy loss, a loss of product and a potential environmental or safety hazard. Consequently, Edward stop and stop-check valves employ stem packings that have been qualified by extensive testing.

The search for improved sealing performance was a primary reason for seeking out new stem-packing materials to replace asbestos-based packings. The demand of many valve users to discontinue use of asbestos due to health risks was an important secondary reason. Since there are no simple laboratory tests that will predict sealing performance based on measurable properties of packing materials, hundreds of tests have been necessary with various packings in valves or valve mockups.

Some packings required frequent adjustments due to wear, extrusion or breakdown, and some could not be made to seal at all after relatively brief testing. All standard Edward stop and stop-check valves now employ flexible graphite packing which provides excellent stem sealing. However, the key to its success involves retaining the graphitic material with special, braided end rings to prevent extrusion. Various end rings are used, depending on the valve pressure class and expected service-temperature range. All Edward valves assembled since January 1986 have been asbestos-free.

See V-REP 86-2 for more information.



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# Maintenance

## FLOWSERVE EDWARD VALVES ON-SITE FIELD SERVICE REPAIR CAPABILITIES

Flowserve is totally committed to customer service satisfaction. Our entire manufacturing operation guarantees we will stand behind all field service repair work to maximize customer support.

## OUR FACILITY OFFERS

- Mobile machine shop trailer for on-site repairs
- After-hours plant-based service team for around-the-clock coverage
- Expertly trained field service personnel capable of handling any size field service job
- Special equipment for seat refinishing, body boring, welding and stress relieving
- In-house valve repair and return remanufacturing to original specifications with new valve warranty
- Experience in turnkey jobs to help the customer with one-stop shopping
- 180,000-sq.-ft. manufacturing facility with state-of-the-art machining and engineering capability and ISO 9001 certification
- Flowserve Raleigh is ISO 9001 certified
- Flowserve Raleigh is authorized by ASME to use the “NR” symbol

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**365 Days a Year**
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## STAYING ON-LINE WITH FLOWSERVE

We design and manufacture all our valves for 40 years' life in the field. That means not just building a reliable product, but one that is easy to maintain and service. It also means providing a team of experienced, dedicated professionals to keep your Flowserve valves operating at peak performance.

### Highly Experienced Technicians

Flowserve brings unmatched experience to the field. Our service technicians have an average 20 years in the industry, and 15 years with Flowserve. Each has special skills, such as welding and machining, that we can target for the needs of the individual job.

### Comprehensive Record-Keeping

Our files include original specifications for every Flowserve valve sold since 1908. All valves are coded for easy identification. On new and replacement orders, Flowserve stands ready to provide the complete lot-traceability required for nuclear and other critical services.

### In-Line Service

We are dedicated to on-site service whenever possible. To this end, we not only provide highly experienced, expert personnel — we also support those technicians with field equipment, including portable boring, lapping, welding, and weld-cutting machines. Major parts, such as disks or bonnets, can be air-shipped back to the factory for service and repaired while service personnel perform other tasks.

### Parts Replacement

Our comprehensive record-keeping system also facilitates replacement of parts. Our computer database can quickly tell us if we have the part in stock or on order, or how we can best coordinate raw materials and factory resources for the quickest possible turnaround time.

### New 90-day Warranty

On all valves repaired to Flowserve's standards, we will issue a new 90-day warranty.

### Factory Repair & Upgrading

Our After-Hours Coverage Team (AHCT) specialists are on-call around the clock, seven days a week, to deliver on our commitment to provide immediate response to our customers' requirements. Whether your requirements are for a planned outage, preventive maintenance or an emergency demand, Flowserve will remanufacture or upgrade valves to the original or most current specification. Our in-house engineering and quality assurance support is committed to meet the required turn-around time.

### Planned & Emergency Outages

Our service managers will coordinate scheduled maintenance, and also get technical assistance to your facility quickly for emergency needs.



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# Edward Valves
# Catalog and Application Manual Appendix

## End Configurations

### American Steel Flange Standards ASME B16.5

Dimensions in Inches

| Class | Nominal Pipe Size | O Outside Diameter of Flange | R Outside Diameter of Raised Face | C* Minimum Thickness of Flange | A Diameter of Bolt Circle | Number of Bolt Studs | Diameter of Bolt Studs | Diameter of Bolt Stud Holes |
|---|---|---|---|---|---|---|---|---|
| CLASS 600 VALVE FLANGES | ½ | 3.75 | 1.38 | 0.56 | 2.62 | 4 | ½ | 0.62 |
| | ¾ | 4.62 | 1.69 | 0.62 | 3.25 | 4 | 5/8 | 0.75 |
| | 1 | 4.88 | 2.00 | 0.69 | 3.50 | 4 | 5/8 | 0.75 |
| | 1¼ | 5.25 | 2.50 | 0.75 | 3.88 | 4 | 5/8 | 0.75 |
| | 1½ | 6.12 | 2.88 | 0.81 | 4.50 | 4 | ¾ | 0.88 |
| | 2 | 6.50 | 3.62 | 0.88 | 5.00 | 8 | 5/8 | 0.75 |
| | 2½ | 7.50 | 4.12 | 1.00 | 5.88 | 8 | ¾ | 0.88 |
| | 3 | 8.25 | 5.00 | 1.12 | 6.62 | 8 | ¾ | 0.88 |
| | 4 | 10.00 | 6.19 | 1.25 | 7.88 | 8 | ¾ | 0.88 |
| | 5 | 11.00 | 7.31 | 1.38 | 9.25 | 8 | ¾ | 0.88 |
| | 6 | 12.50 | 8.50 | 1.44 | 10.62 | 12 | ¾ | 0.88 |
| | 8 | 15.00 | 10.62 | 1.62 | 13.00 | 12 | 7/8 | 1.00 |
| | 10 | 17.50 | 12.75 | 1.88 | 15.25 | 16 | 1 | 1.12 |
| | 12 | 20.50 | 15.00 | 2.00 | 17.75 | 16 | 1-1/8 | 1.25 |
| | 14 | 23.00 | 16.25 | 2.12 | 20.25 | 20 | 1-1/8 | 1.25 |
| CLASS 600 VALVE FLANGES | ½ | 3.75 | 1.38 | 0.56 | 2.62 | 4 | ½ | 0.62 |
| | ¾ | 4.62 | 1.69 | 0.62 | 3.25 | 4 | 5/8 | 0.75 |
| | 1 | 4.88 | 2.00 | 0.69 | 3.50 | 4 | 5/8 | 0.75 |
| | 1¼ | 5.25 | 2.50 | 0.81 | 3.88 | 4 | 5/8 | 0.75 |
| | 1½ | 6.12 | 2.88 | 0.88 | 4.50 | 4 | ¾ | 0.88 |
| | 2 | 6.50 | 3.62 | 1.00 | 5.00 | 8 | 5/8 | 0.75 |
| | 2½ | 7.50 | 4.12 | 1.12 | 5.88 | 8 | ¾ | 0.88 |
| | 3 | 8.25 | 5.00 | 1.25 | 6.62 | 8 | ¾ | 0.88 |
| | 4 | 10.75 | 6.19 | 1.50 | 8.50 | 8 | 7/8 | 1.00 |
| | 5 | 13.00 | 7.31 | 1.75 | 10.50 | 8 | 1 | 1.12 |
| | 6 | 14.00 | 8.50 | 1.88 | 11.50 | 12 | 1 | 1.12 |
| | 8 | 16.50 | 10.62 | 2.19 | 13.75 | 12 | 1-1/8 | 1.25 |
| | 10 | 20.00 | 12.75 | 2.50 | 17.00 | 16 | 1¼ | 1.38 |
| | 12 | 22.00 | 15.00 | 2.62 | 19.25 | 20 | 1¼ | 1.38 |
| | 14 | 23.75 | 16.25 | 2.75 | 20.75 | 20 | 1-3/8 | 1.50 |
| CLASS 900 VALVE FLANGES** | 2½ | 9.62 | 4.12 | 1.62 | 7.50 | 8 | 1 | 1.12 |
| | 3 | 9.50 | 5.00 | 1.50 | 7.50 | 8 | 7/8 | 1.00 |
| | 4 | 11.50 | 6.19 | 1.75 | 9.25 | 8 | 1-1/8 | 1.25 |
| | 5 | 13.75 | 7.31 | 2.00 | 11.00 | 8 | 1¼ | 1.38 |
| | 6 | 15.00 | 8.50 | 2.19 | 12.50 | 12 | 1-1/8 | 1.25 |
| | 8 | 18.50 | 10.62 | 2.50 | 15.50 | 12 | 1-3/8 | 1.50 |
| | 10 | 21.50 | 12.75 | 2.75 | 18.50 | 16 | 1-3/8 | 1.50 |
| | 12 | 24.00 | 15.00 | 3.12 | 21.00 | 20 | 1-3/8 | 1.50 |
| | 14 | 25.25 | 16.25 | 3.38 | 22.00 | 20 | 1½ | 1.62 |
| CLASS 1500 VALVE FLANGES | ½ | 4.75 | 1.38 | 0.88 | 3.25 | 4 | ¾ | 0.88 |
| | ¾ | 5.12 | 1.69 | 1.00 | 3.50 | 4 | ¾ | 0.88 |
| | 1 | 5.88 | 2.00 | 1.12 | 4.00 | 4 | 7/8 | 1.00 |
| | 1¼ | 6.25 | 2.50 | 1.12 | 4.38 | 4 | 7/8 | 1.00 |
| | 1½ | 7.00 | 2.88 | 1.25 | 4.88 | 4 | 1 | 1.12 |
| | 2 | 8.50 | 3.62 | 1.50 | 6.50 | 8 | 7/8 | 1.00 |
| | 2½ | 9.62 | 4.12 | 1.62 | 7.50 | 8 | 1 | 1.12 |
| | 3 | 10.50 | 5.00 | 1.88 | 8.00 | 8 | 1-1/8 | 1.25 |
| | 4 | 12.25 | 6.19 | 2.12 | 9.50 | 8 | 1¼ | 1.38 |
| | 5 | 14.75 | 7.31 | 2.88 | 11.50 | 8 | 1½ | 1.62 |
| | 6 | 15.50 | 8.50 | 3.25 | 12.50 | 12 | 1-3/8 | 1.50 |
| | 8 | 19.00 | 10.62 | 3.62 | 15.50 | 12 | 1-5/8 | 1.75 |
| | 10 | 23.00 | 12.75 | 4.25 | 19.00 | 12 | 1-7/8 | 2.00 |
| | 12 | 26.50 | 15.00 | 4.88 | 22.50 | 16 | 2 | 2.12 |
| | 14 | 29.50 | 16.25 | 5.25 | 25.00 | 16 | 2¼ | 2.38 |
| CLASS 2500 VALVE FLANGES | ½ | 5.25 | 1.38 | 1.19 | 3.50 | 4 | ¾ | 0.88 |
| | ¾ | 5.50 | 1.69 | 1.25 | 3.75 | 4 | ¾ | 0.88 |
| | 1 | 6.25 | 2.00 | 1.38 | 4.25 | 4 | 7/8 | 1.00 |
| | 1¼ | 7.25 | 2.50 | 1.50 | 5.12 | 4 | 1 | 1.12 |
| | 1½ | 8.00 | 2.88 | 1.75 | 5.75 | 4 | 1-1/8 | 1.25 |
| | 2 | 9.25 | 3.62 | 2.00 | 6.75 | 8 | 1 | 1.12 |
| | 2½ | 10.50 | 4.12 | 2.25 | 7.75 | 8 | 1-1/8 | 1.25 |
| | 3 | 12.00 | 5.00 | 2.62 | 9.00 | 8 | 1¼ | 1.38 |
| | 4 | 14.00 | 6.19 | 3.00 | 10.75 | 8 | 1½ | 1.62 |
| | 5 | 16.50 | 7.31 | 3.62 | 12.75 | 8 | 1¾ | 1.88 |
| | 6 | 19.00 | 8.50 | 4.25 | 14.50 | 8 | 2 | 2.12 |
| | 8 | 21.75 | 10.62 | 5.00 | 17.25 | 12 | 2 | 2.12 |
| | 10 | 26.50 | 12.75 | 6.50 | 21.25 | 12 | 2½ | 2.62 |
| | 12 | 30.00 | 15.00 | 7.25 | 24.38 | 12 | 2¾ | 2.88 |

**C dimensions include raised face in Class 300 values.*

***Class 900 and 1500 standards are identical in all sizes below 2½.*

# End Configurations (cont'd)

## Socket Welding Ends ASME B16.11

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ |
|---|---|---|---|---|---|---|---|---|---|
| DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 | 65 |
| A Socket Diameter - min | 0.56 | 0.69 | 0.86 | 1.07 | 1.33 | 1.68 | 1.92 | 2.41 | 2.91 |
| | 14 | 18 | 22 | 27 | 34 | 43 | 49 | 61 | 74 |
| B Depth of Socket - min | 0.38 | 0.38 | 0.38 | 0.50 | 0.50 | 0.50 | 0.50 | 0.62 | 0.62 |
| | 10 | 10 | 10 | 13 | 13 | 13 | 13 | 16 | 16 |

## Standard Flange Facings & Extras

All Class 300 flanged valves are regularly furnished with 1/16-in. raised face with phonograph finish.

All Class 600, 900, 1500 and 2500 flanged valves are regularly furnished with ¼-in. raised face with phonograph finish.

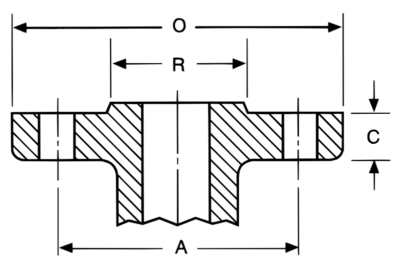
An extra charge will be made for facings other than regularly furnished as above.

No deductions for valves ordered with flange faces only.

Flowserve will furnish valves with patented flange facings with the understanding that the purchaser must obtain from the patent owners a license to use these joints.

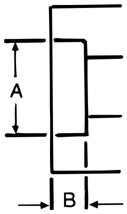
** C dimensions include raised face in Class 300 valves.*

*** Class 900 and 1500 standards are identical in all sizes below size 2½.*




## Socket Welding Ends

Conforming to requirements of ASME/ANSI B16.11

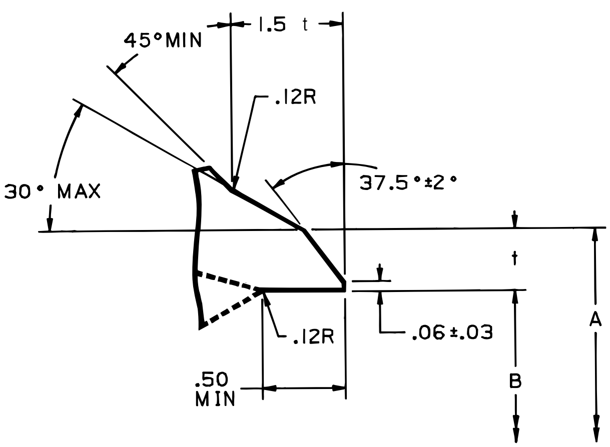



## Threaded Ends

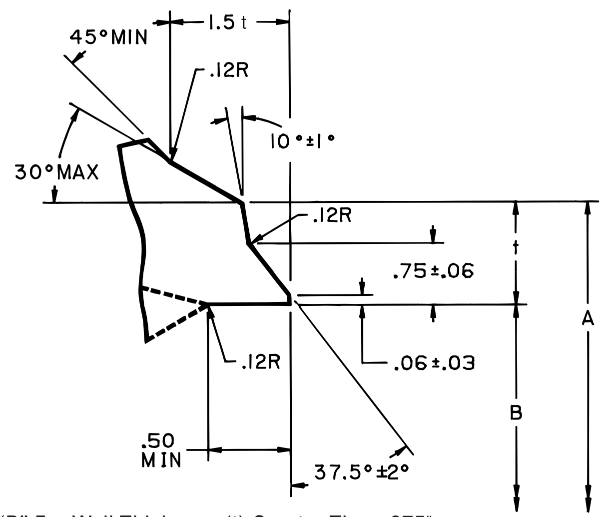
Threaded ends are provided with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1

# End Preparations

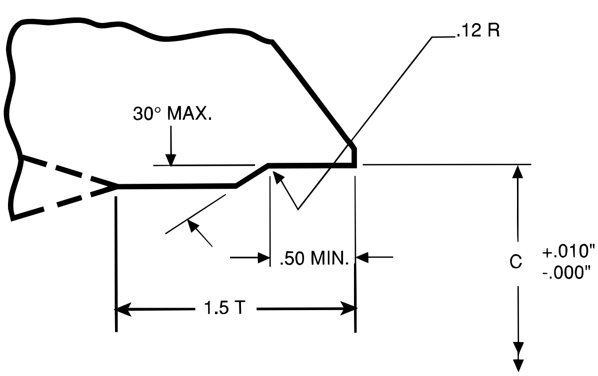
## Buttwelding Ends



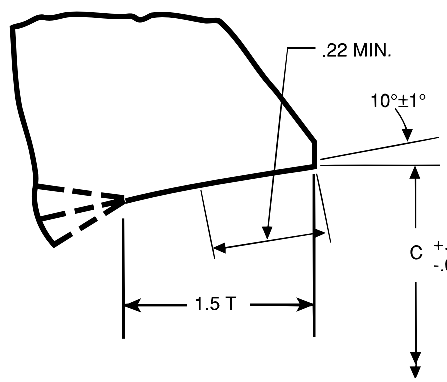

"**A**" For Wall Thickness (t) .1875" to .875" inclusive (ASME B 16.25 - Fig. 2A, 2B or 4)




"**B**" For Wall Thickness (t) Greater Than .875" (ASME B16.25 - Fig. 3A, 3B)




"**C**" Inside Contour for Use With Rectangular Backing Ring (ASME B16.25 - Fig. 2C, 3C)




"**D**" Inside Contour for Use With Taper Backing Ring (ASME B16.25 - Fig. 2D, 3D)

**A – Nominal outside diameter of pipe**

**B – Nominal inside diameter of pipe**

**C – A - 0.031" - 1.75t - 0.010"**

**t – Nominal wall thickness of pipe**

**IMPORTANT:**
When ordering buttwelding end valves, indicate type of weld prep desired from this page and give pipe schedule to be used from pages A4, A5, A6 or provide other complete instructions.

**WARNING!**
If weld prep information is not received at time of order placement, scheduled ship dates cannot be guaranteed.

Inside and outside of welding ends of both cast and forged steel valves to be finish machined and carefully inspected where the thickness of these ends is less than 1.15 t.

Flowserve standard practice is to machine the outside of the casting as shown to avoid sharp re-entrant angles and abrupt changes in slope. Runout of machined surface diameter of valve to have no abrupt change in section. Inside diameter of valve may be either larger or smaller than pipe inside diameter.

# End Preparation for Forged Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | FEATURES ARE PER ANSI B16.25 A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
|---|---|---|---|---|---|---|---|---|---|
| | | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| ½ 15 | 40 | 0.840 | 21 | 0.622 | 15.8 | 0.608 | 15.4 | 0.109 | 2.8 |
| | 80 | | | 0.546 | 13.9 | 0.542 | 13.8 | 0.147 | 3.7 |
| | 160 | | | 0.464 | 11.8 | 0.470 | 11.9 | 0.188 | 4.8 |
| | XXS | | | 0.252 | 6.4 | 0.285 | 7.2 | 0.294 | 7.5 |
| ¾ 20 | 40 | 1.050 | 27 | 0.824 | 20.9 | 0.811 | 20.6 | 0.113 | 2.9 |
| | 80 | | | 0.742 | 18.8 | 0.740 | 18.8 | 0.154 | 3.9 |
| | 160 | | | 0.612 | 15.6 | 0.626 | 15.9 | 0.219 | 5.6 |
| | XXS | | | 0.434 | 11.0 | 0.470 | 11.9 | 0.308 | 7.8 |
| 1 25 | 40 | 1.315 | 33 | 1.049 | 26.6 | 1.041 | 26.4 | 0.133 | 3.4 |
| | 80 | | | 0.957 | 24.3 | 0.961 | 24.4 | 0.179 | 4.5 |
| | 160 | | | 0.815 | 20.7 | 0.837 | 21.3 | 0.250 | 6.4 |
| | XXS | | | 0.599 | 15.2 | 0.648 | 16.5 | 0.358 | 9.1 |
| 1¼ 32 | 40 | 1.660 | 42 | 1.380 | 35.1 | 1.374 | 34.9 | 0.140 | 3.6 |
| | 80 | | | 1.278 | 32.5 | 1.285 | 32.6 | 0.191 | 4.9 |
| | 160 | | | 1.160 | 29.5 | 1.181 | 30.0 | 0.250 | 6.4 |
| | XXS | | | 0.896 | 22.8 | 0.951 | 24.2 | 0.382 | 9.7 |
| 1½ 40 | 40 | 1.900 | 48 | 1.610 | 40.9 | 1.605 | 40.8 | 0.145 | 3.7 |
| | 80 | | | 1.500 | 38.1 | 1.509 | 38.3 | 0.200 | 5.1 |
| | 160 | | | 1.338 | 34.0 | 1.367 | 34.7 | 0.281 | 7.1 |
| | XXS | | | 1.100 | 27.9 | 1.159 | 29.4 | 0.400 | 10.2 |
| 2 50 | 40 | 2.375 | 60 | 2.067 | 52.5 | 2.065 | 52.5 | 0.154 | 3.9 |
| | 80 | | | 1.939 | 49.3 | 1.953 | 49.6 | 0.218 | 5.5 |
| | 160 | | | 1.687 | 42.9 | 1.734 | 44.0 | 0.344 | 8.7 |
| | XXS | | | 1.503 | 38.2 | 1.571 | 39.9 | 0.436 | 11.1 |
| 2½ 65 | 40 | 2.875 | 73 | 2.469 | 63 | 2.479 | 62.95 | 0.203 | 5.15 |
| | 80 | | | 2.323 | 59 | 2.351 | 59.7 | 0.276 | 7 |
| | 160 | | | 2.125 | 54 | 2.178 | 55.3 | 0.375 | 9.55 |
| | XXS | | | 1.771 | 45 | 1.868 | 47.45 | 0.552 | 14 |
| 3 80 | 40 | 3.500 | 89 | 3.068 | 78 | 3.081 | 78.25 | 0.216 | 5.5 |
| | 80 | | | 2.900 | 74 | 2.934 | 74.5 | 0.300 | 7.6 |
| | 160 | | | 2.624 | 67 | 2.692 | 68.4 | 0.438 | 11.15 |
| | XXS | | | 2.300 | 58 | 2.409 | 61.2 | 0.600 | 15.25 |
| 4 100 | 40 | 4.500 | 114 | 4.026 | 102 | 4.044 | 102.7 | 0.237 | 6 |
| | 80 | | | 3.826 | 97 | 3.869 | 98.25 | 0.337 | 8.55 |
| | 120 | | | 3.624 | 92 | 3.692 | 93.8 | 0.438 | 11.15 |
| | 160 | | | 3.438 | 87 | 3.530 | 89.65 | 0.531 | 13.5 |
| | XXS | | | 3.152 | 80 | 3.279 | 83.3 | 0.674 | 17.1 |

*XXS – Double extra-strong wall thickness.*
*1 – Designations per ANSI B36.10.*

FLOWSERVE

# End Preparations for Cast Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | VALVE[2] PRESSURE CLASS | | | | | FEATURES ARE PER ANSI B16.25 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
| | | 300 | 600 | 900 | 1500 | 2500 | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| 2½ 65 | 40 | X | X | | | | 2.875 | 73 | 2.469 | 63 | 2.479 | 62.95 | 0.203 | 5.15 |
| | 80 | X | X | X | X | | | | 2.323 | 59 | 2.351 | 59.7 | 0.276 | 7 |
| | 160 | | | X | X | X | | | 2.125 | 54 | 2.178 | 55.3 | 0.375 | 9.55 |
| | XXS | | | | | X | | | 1.771 | 45 | 1.868 | 47.45 | 0.552 | 14 |
| 3 80 | 40 | X | X | | | | 3.500 | 89 | 3.068 | 78 | 3.081 | 78.25 | 0.216 | 5.5 |
| | 80 | | X | X | X | | | | 2.900 | 74 | 2.934 | 74.5 | 0.300 | 7.6 |
| | 160 | | | X | X | X | | | 2.624 | 67 | 2.692 | 68.4 | 0.438 | 11.15 |
| | XXS | | | | | X | | | 2.300 | 58 | 2.409 | 61.2 | 0.600 | 15.25 |
| 4 100 | 40 | X | X | | | | 4.500 | 114 | 4.026 | 102 | 4.044 | 102.7 | 0.237 | 6 |
| | 80 | | X | X | X | | | | 3.826 | 97 | 3.869 | 98.25 | 0.337 | 8.55 |
| | 120 | | | X | X | | | | 3.624 | 92 | 3.692 | 93.8 | 0.438 | 11.15 |
| | 160 | | | | X | X | | | 3.438 | 87 | 3.530 | 89.65 | 0.531 | 13.5 |
| | XXS | | | | | X | | | 3.152 | 80 | 3.279 | 83.3 | 0.674 | 17.1 |
| 5 125 | 40 | X | X | | | | 5.563 | 141 | 5.047 | 128 | 5.070 | 128.8 | 0.258 | 6.55 |
| | 80 | | X | X | X | | | | 4.813 | 122 | 4.866 | 123.6 | 0.375 | 9.55 |
| | 120 | | | X | X | | | | 4.563 | 116 | 4.647 | 118.05 | 0.500 | 12.7 |
| | 160 | | | | X | X | | | 4.313 | 110 | 4.428 | 112.45 | 10.625 | 15.9 |
| | XXS | | | | | X | | | 4.063 | 103 | 4.209 | 106.9 | 0.750 | 19.05 |
| 6 150 | 40 | X | X | | | | 6.625 | 168 | 6.065 | 154 | 6.094 | 154.8 | 0.280 | 7.1 |
| | 80 | | X | X | X | | | | 5.761 | 146 | 5.828 | 148.05 | 0.432 | 10.95 |
| | 120 | | | X | X | | | | 5.501 | 140 | 5.600 | 142.25 | 0.562 | 14.25 |
| | 160 | | | | X | X | | | 5.187 | 132 | 5.326 | 135.3 | 0.719 | 18.25 |
| | XXS | | | | X | X | | | 4.897 | 124 | 5.072 | 128.85 | 0.864 | 21.95 |
| 8 200 | 40 | X | X | | | | 8.625 | 219 | 7.981 | 203 | 8.020 | 203.7 | 0.322 | 8.2 |
| | 60 | | X | | | | | | 7.813 | 198 | 7.873 | 199.95 | 0.406 | 10.3 |
| | 80 | | X | X | X | | | | 7.625 | 194 | 7.709 | 195.8 | 0.500 | 12.7 |
| | 100 | | X | X | X | | | | 7.437 | 189 | 7.544 | 191.6 | 0.594 | 15.1 |
| | 120 | | | X | X | | | | 7.187 | 183 | 7.326 | 186.1 | 0.719 | 18.25 |
| | 140 | | | | X | | | | 7.001 | 178 | 7.163 | 181.95 | 0.812 | 20.6 |
| | XXS | | | | X | X | | | 6.875 | 175 | 7.053 | 179.15 | 0.875 | 22.25 |
| | 160 | | | | X | X | | | 6.813 | 173 | 6.998 | 177.75 | 0.906 | 23 |
| 10 250 | 40 | X | X | | | | 10.750 | 273 | 10.02 | 255 | 10.070 | 255.8 | 0.365 | 9.25 |
| | 60 | | X | | | | | | 9.750 | 248 | 9.834 | 249.8 | 0.500 | 12.7 |
| | 80 | | X | X | X | | | | 9.562 | 243 | 9.670 | 245.6 | 0.594 | 15.1 |
| | 100 | | X | X | X | | | | 9.312 | 237 | 9.451 | 240.05 | 0.719 | 18.25 |
| | 120 | | | X | X | | | | 9.062 | 230 | 9.232 | 234.5 | 0.844 | 21.45 |
| | 140 | | | | X | | | | 8.750 | 222 | 8.959 | 227.55 | 1.000 | 25.4 |
| | 160 | | | | X | X | | | 8.500 | 216 | 8.740 | 222 | 1.125 | 28.6 |
| 12 300 | STD | X | X | | | | 12.750 | 324 | 12.000 | 305 | 12.053 | 306.15 | 0.375 | 9.55 |
| | 40 | X | X | | | | | | 11.938 | 303 | 11.999 | 304.75 | 0.406 | 10.3 |
| | XS | X | X | | | | | | 11.750 | 298 | 11.834 | 300.6 | 0.500 | 12.7 |
| | 60 | | X | | | | | | 11.625 | 298 | 11.725 | 297.8 | 0.562 | 14.25 |
| | 80 | | X | X | X | | | | 11.374 | 289 | 11.505 | 292.25 | 0.688 | 17.5 |
| | 100 | | X | X | X | | | | 11.062 | 281 | 11.232 | 285.3 | 0.844 | 21.45 |
| | 120 | | | X | X | | | | 10.750 | 273 | 10.959 | 278.35 | 1.000 | 25.4 |
| | 140 | | | | X | | | | 10.500 | 267 | 10.740 | 272.8 | 1.125 | 28.6 |
| | 160 | | | | X | X | | | 10.126 | 257 | 10.413 | 264.5 | 1.312 | 33.3 |

*STD – Standard wall thickness.*
*XS – Extra-strong wall thickness.*
*XXS – Double extra-strong wall thickness.*

*1 – Designations per ANSI B36.10. 2 – The welding ends of valve bodies do not contain enough extra material to match the wall thickness of all pipe schedules. The "X" marks show the schedules that can be supplied for each size and pressure class of valve bodies. Many Class 1500 and 2500 valves can be machined to accommodate special high-pressure pipe with greater wall thickness and smaller inside diameter than schedule 160; consult your Edward Valves sales representative concerning such cases.*

# End Preparations for Cast Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | VALVE[2] PRESSURE CLASS | | | | | FEATURES ARE PER ANSI B16.25 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
| | | 300 | 600 | 900 | 1500 | 2500 | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| 14 / 350 | STD | X | | | | | 14.000 | 356 | 13.25 | 337 | 13.303 | 337.9 | 0.375 | 9.55 |
| | 40 | | X | | | | | | 13.124 | 333 | 13.192 | 335.1 | 0.438 | 11.15 |
| | XS | | X | | | | | | 13 | 330 | 13.084 | 332.35 | 0.5 | 12.7 |
| | 60 | | X | | | | | | 12.812 | 325 | 12.92 | 328.15 | 0.594 | 15.1 |
| | 80 | | X | X | X | | | | 12.5 | 318 | 12.646 | 321.2 | 0.75 | 19.05 |
| | 100 | | X | X | X | | | | 12.124 | 308 | 12.318 | 312.9 | 0.938 | 23.85 |
| | 120 | | | X | X | | | | 11.812 | 300 | 12.044 | 305.9 | 1.094 | 27.8 |
| | 140 | | | | X | | | | 11.5 | 292 | 11.771 | 299 | 1.25 | 31.75 |
| | 160 | | | | X | X | | | 11.188 | 284 | 11.498 | 292.05 | 1.406 | 35.7 |
| 16 / 400 | STD | | X | | | | 16.000 | 406 | 15.25 | 387 | 15.303 | 388.7 | 0.375 | 9.55 |
| | 40 | | X | | | | | | 15 | 381 | 15.084 | 383.15 | 0.5 | 12.7 |
| | 60 | | X | | | | | | 14.688 | 373 | 14.811 | 376.2 | 0.656 | 16.65 |
| | 80 | | X | X | X | | | | 14.312 | 364 | 14.482 | 367.85 | 0.844 | 21.45 |
| | 100 | | X | X | X | | | | 13.938 | 354 | 14.155 | 359.55 | 1.031 | 26.2 |
| | 120 | | | X | X | | | | 13.562 | 344 | 13.826 | 351.2 | 1.219 | 30.95 |
| | 140 | | | | X | | | | 13.124 | 333 | 13.442 | 341.45 | 1.438 | 36.55 |
| | 160 | | | | X | X | | | 12.812 | 325 | 13.17 | 334.5 | 1.594 | 40.5 |
| 18 / 450 | 40 | | X | | | | 18.000 | 457 | 16.876 | 429 | 16.975 | 431.15 | 0.562 | 14.25 |
| | 60 | | X | | | | | | 16.500 | 419 | 16.646 | 422.8 | 0.75 | 19.05 |
| | 80 | | X | X | | | | | 16.124 | 410 | 16.318 | 414.5 | 0.938 | 23.85 |
| | 100 | | X | X | X | | | | 15.688 | 398 | 15.936 | 404.75 | 1.156 | 29.35 |
| | 120 | | | X | X | X | | | 15.250 | 387 | 15.553 | 395.05 | 1.375 | 34.95 |
| | 140 | | | X | X | X | | | 14.876 | 378 | 15.225 | 386.7 | 1.562 | 39.65 |
| | 160 | | | | X | X | | | 14.438 | 367 | 14.842 | 377 | 1.781 | 45.25 |
| 20 / 500 | 40 | | X | | | | 20.000 | 508 | 18.812 | 478 | 18.92 | 480.55 | 0.594 | 15.1 |
| | 60 | | X | | | | | | 18.376 | 467 | 18.538 | 470.85 | 0.812 | 20.6 |
| | 80 | | X | X | | | | | 17.938 | 456 | 18.155 | 461.15 | 1.031 | 26.2 |
| | 100 | | X | X | X | | | | 17.438 | 443 | 17.717 | 450 | 1.281 | 32.55 |
| | 120 | | | X | X | X | | | 17 | 432 | 17.334 | 440.3 | 1.5 | 38.1 |
| | 140 | | | X | X | X | | | 16.5 | 419 | 16.896 | 429.15 | 1.75 | 44.45 |
| | 160 | | | | X | X | | | 16.062 | 408 | 16.513 | 419.45 | 1.969 | 50 |
| 22 / 550 | STD | | X | | | | 22.000 | 559 | 21.25 | 540 | 21.303 | 541.1 | 0.375 | 9.55 |
| | XS | | X | | | | | | 21 | 533 | 21.084 | 535.55 | 0.5 | 12.7 |
| | 60 | | X | X | | | | | 20.25 | 514 | 20.428 | 518.85 | 0.875 | 22.25 |
| | 80 | | X | X | | | | | 19.75 | 502 | 19.99 | 507.75 | 1.125 | 28.6 |
| | 100 | | | X | X | X | | | 19.25 | 489 | 19.553 | 496.65 | 1.375 | 34.95 |
| | 120 | | | X | X | X | | | 18.75 | 476 | 19.115 | 485.5 | 1.625 | 41.3 |
| | 140 | | | | X | X | | | 18.25 | 464 | 18.678 | 474.4 | 1.875 | 47.65 |
| | 160 | | | | | | | | 17.75 | 451 | 18.24 | 463.3 | 2.125 | 54 |
| 24 / 600 | STD | | | | | | 24.000 | 610 | 23.25 | 591 | 23.303 | 591.9 | 0.375 | 9.55 |
| | XS | | | | | | | | 23 | 584 | 23.084 | 586.35 | 0.5 | 12.7 |
| | 30 | | X | | | | | | 22.876 | 581 | 22.975 | 583.55 | 0.562 | 14.25 |
| | 40 | | X | X | | | | | 22.624 | 575 | 22.755 | 578 | 0.688 | 17.5 |
| | 60 | | X | X | | | | | 22.062 | 560 | 22.263 | 565.5 | 0.969 | 24.6 |
| | 80 | | X | X | X | | | | 21.562 | 548 | 21.826 | 554.4 | 1.219 | 30.95 |
| | 100 | | X | X | X | | | | 20.938 | 532 | 21.28 | 540.5 | 1.531 | 38.9 |
| | 120 | | | X | X | X | | | 20.376 | 518 | 20.788 | 528 | 1.812 | 46 |
| | 140 | | | X | X | X | | | 19.876 | 505 | 20.35 | 516.9 | 2.062 | 52.35 |
| | 160 | | | | X | X | | | 19.312 | 491 | 19.857 | 504.35 | 2.344 | 59.55 |

*STD – Standard wall thickness.*
*XS – Extra-strong wall thickness.*
*XXS – Double extra-strong wall thickness.*

*1 – Designations per ANSI B36.10.*
*2 – The welding ends of valve bodies do not contain enough extra material to match the wall thickness of all pipe schedules. The "X" marks show the schedules that can be supplied for each size and pressure class of valve bodies. Many Class 1500 and 2500 valves can be machined to accommodate special high-pressure pipe with greater wall thickness and smaller inside diameter than schedule 160; consult your Edward Valves sales representative concerning such cases.*

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***To find your local Flowserve representative***
or for more information about Flowserve Corporation,
visit www.flowserve.com or call USA 1 800 225 6989

# Edward
## Cast Steel Valves

*Experience In Motion*

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Flowserve Edward Valves • 1900 South Saunders Street, Raleigh, North Carolina 27603 • 1-800-225-6989 • 1-919-832-0525 • Fax 1-919-831-3369

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## Technical Information



## Maintenance



## References to Related Brochures

| Brochure | Document Number |
|---|---|
| Forged Steel Valves | EVENCT0001 |
| Cast Steel Valves | EVENCT0002 |
| Nuclear Application Valves | EVENCT0004 |



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| 338 | 63 | | |
| 338Y | 63 | | |
| 391 | | 30 | |
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| 604Y | | 39 | 78 |
| 605 | | 39 | 78 |
| 605Y | | 39 | 78 |
| 606 | | 39 | 78 |
| 606Y | | 39 | 78 |
| 607 | | 39 | 78 |
| • 607Y | | 39 | 78 |
| • 614 | | 36 | 77 |
| • 614Y | | 36,43 | 77 |
| 616 | | 35 | 76 |
| 616Y | | 35 | 76 |
| 617 | | 35 | 76 |
| • 617Y | | 35 | 76 |
| 618 | | 35 | 76 |
| 618Y | | 35 | 76 |
| 619 | | 35 | 76 |
| 619Y | | 35 | 76 |
| • 670Y | | 41,42 | 115,116 |
| 690 | | 41 | 115 |
| 690Y | | 41 | 115 |
| 691 | | 41 | 115 |
| 691Y | | 41 | 115 |
| • 692 | | 41,42 | 115,116 |
| • 692Y | | 41,42,45 | 115,116 |
| 694 | | 41 | 115 |
| 694Y | | 41 | 115 |
| 695 | | 41 | 115 |
| 695Y | | 41 | 115 |
| • 702Y | | 40,44 | 79 |
| 706Y | | 39 | 78 |
| 707Y | | 39 | 78 |
| • 714Y | | 36,43 | 77 |
| 716Y | | 35 | 76 |
| 717Y | | 35 | 76 |
| • 770Y | | 41,42 | 115,116 |
| • 792Y | | 41,42,45 | 115,116 |
| 794Y | | 41 | 115 |
| 795Y | | 41 | 115 |
| • 828 | 28 | | |
| • 829 | 28 | | |
| 832 | 34 | | |
| 832Y | 34 | | |
| • 838 | 33 | | 108 |
| • 838Y | 33 | | 108 |
| • 846 | 29 | | |
| • 847 | 29 | | |
| • 848 | 31 | | |
| • 848Y | 31 | | 60 |
| • 849 | 31 | | |
| • 849Y | 31 | | 60 |
| • 858 | 30 | | |
| • 868 | 32 | | |
| • 868Y | 32 | | 61 |
| • 869 | 32 | | |
| • 869Y | 32 | | 61 |
| • 970Y | | 52,53 | 117,119 |

| Figure | Forged | Cast | Nuclear |
|---|---|---|---|
| 1028 | 36 | | |
| 1029 | 36 | | |
| 1032 | 41 | | |
| 1032Y | 41 | | |
| 1038 | 40 | | |
| 1038Y | 40 | | |
| 1046 | 38 | | |
| 1047 | 38 | | |
| 1048 | 37 | | |
| 1048Y | 37 | | |
| 1049 | 37 | | |
| 1049Y | 37 | | |
| 1058 | 40 | | |
| 1068 | 39 | | |
| 1068Y | 39 | | |
| 1069 | 39 | | |
| 1069Y | 39 | | |
| • 1302 | | 29 | |
| • 1302Y | | 29,33 | |
| • 1314 | | 27 | |
| • 1314Y | | 27,32 | |
| 1324 | | 27 | |
| 1324Y | | 27 | |
| 1390 | | 31 | |
| 1390Y | | 31 | |
| 1392 | | 31 | |
| 1392Y | | 31,34 | |
| 1441 | 22,23 | | |
| 1441Y | 22,23 | | |
| 1443 | 22,23 | | |
| 1443Y | 22,23 | | |
| • 1570Y | | 68 | 123 |
| • 1611 | | 37,38 | 29,30 |
| • 1611BY | | 37,38 | 29,30 |
| • 1611Y | | 37,38 | 29,30 |
| 1641 | 24,25 | | |
| 1641Y | 24,25 | | |
| 1643 | 24,25 | | |
| 1643Y | 24,25 | | |
| • 1711BY | | 37,38 | 29,30 |
| • 1711Y | | 37,38 | 29,30 |
| • 1911 | | 48,49 | 31,32 |
| • 1911BY | | 48,49 | 31,32 |
| • 1911Y | | 48,49 | 31,32 |
| • 2002Y | | 63,64,70 | 86,87 |
| • 2006Y | | 63,64 | 86 |
| • 2007Y | | 63,64 | 86,87 |
| • 2014Y | | 59,60,69 | 84,87 |
| • 2016Y | | 59 | 84 |
| • 2017Y | | 59,60 | 87,88 |
| • 2070Y | | 68 | 123 |
| • 2092Y | | 65,67,71 | 120,122 |
| • 2094Y | | 65,66 | 120,121 |
| • 2095Y | | 65,66 | 120,121 |
| • 2214Y | | 72 | |
| • 2202Y | | 73 | |
| • 2292Y | | 74 | |
| • 2570Y | | 81,81 | |
| 3602Y | | 90,91 | |
| • 3902Y | | 79,80,85 | |
| • 3906 | | 79 | |
| • 3906Y | | 79 | |
| • 3907 | | 79,80 | |
| • 3907Y | | 79,80 | |
| • 3914Y | | 75,76,84 | |
| • 3916 | | 75 | |
| • 3916Y | | 75 | |
| • 3917 | | 75,76 | |
| • 3917Y | | 75,76 | |
| • 3992Y | | 81,82,86 | |
| • 3994 | | 81 | |
| • 3994Y | | 81 | |
| • 3995 | | 81,82 | |
| • 3995Y | | 81,82 | |
| • 4002 | | 50,51 | 82,83 |
| • 4002Y | | 50,51,56 | 82,83 |
| • 4006 | | 50 | 82 |
| • 4006Y | | 50 | 82 |
| • 4007 | | 50,51 | 82,83 |
| • 4007Y | | 50,51 | 82,83 |
| • 4014 | | 46,47 | 80,81 |
| • 4014Y | | 46,47,55 | 80,81 |
| • 4016 | | 46 | 80 |

| Figure | Forged | Cast | Nuclear |
|---|---|---|---|
| • 4016Y | | 46 | 80 |
| • 4017 | | 46,47 | 80,81 |
| • 4017Y | | 46,47 | 80,81 |
| • 4092 | | 52,54 | 117,118 |
| • 4092Y | | 52,54,57 | 117,118 |
| • 4094 | | 52 | 117 |
| • 4094Y | | 52 | 117 |
| • 4095 | | 52,53 | 117,118 |
| • 4095Y | | 52,53 | 117,118 |
| • 4302Y | | 50,51,56 | 82,83 |
| • 4306Y | | 50 | 82 |
| • 4307Y | | 50,51 | 82,83 |
| • 4314Y | | 46,47,55 | 80,81 |
| • 4316Y | | 46 | 80 |
| • 4317Y | | 46,47 | 80,81 |
| • 4370Y | | 52,53 | 117,119 |
| • 4392Y | | 52,54,57 | 117,118 |
| • 4394Y | | 52 | 117 |
| • 4395Y | | 52,53 | 117,119 |
| • 4402Y | | 79,80,85 | |
| • 4406Y | | 79 | |
| • 4407Y | | 79,80 | |
| • 4414Y | | 75,76,84 | |
| • 4416Y | | 75 | |
| • 4417Y | | 75,76 | |
| 4448Y | | 58 | |
| • 4470Y | | 81,83 | |
| • 4492Y | | 81,82,86 | |
| • 4494Y | | 81 | |
| • 4495Y | | 81,82 | |
| 4498Y | | 58 | |
| 4502Y | | 93 | |
| 4514Y | | 92 | |
| 4570Y | | 95 | |
| 4592Y | | 94 | |
| 5002Y | | 93 | |
| 5014Y | | 92 | |
| 5070Y | | 95 | |
| 5092Y | | 94 | |
| 5158 | 57 | | |
| 5160 | 58 | | |
| • 7502Y | | 63,64,70 | 86,87 |
| • 7506 | | 63 | 86 |
| • 7506Y | | 63 | 86 |
| • 7507 | | 63,64 | 86,87 |
| • 7507Y | | 63,64 | 86,87 |
| • 7514Y | | 59,60,69 | 84,85 |
| • 7516 | | 59 | 84 |
| • 7516Y | | 59 | 84 |
| • 7517 | | 59,60 | 84,85 |
| • 7517Y | | 59,60 | 84,85 |
| 7548Y | | 58 | |
| • 7592Y | | 65,67,71 | 120,122 |
| • 7594 | | 65,66 | 120,121 |
| • 7594Y | | 65,66 | 120,121 |
| • 7595 | | 65,66 | 120,121 |
| • 7595Y | | 65,66 | 120,121 |
| 7598Y | | 58 | |
| 9158 | 57 | | |
| 9160 | 58 | | |
| • 11511 | | 61,62 | 33 |
| • 11511Y | | 61,62 | 33,34 |
| • 11511BY | | 61,62 | 33,34 |
| • 12011Y | | 61,62 | 33,34 |
| • 12011BY | | 61,62 | 33,34 |
| • 12511 | | 77 | |
| • 12511Y | | 77 | |
| • 12511BY | | 77,78 | |
| • 14311Y | | 48,49 | 32,32 |
| • 14311BY | | 48,49 | 31,32 |
| • 14411BY | | 77,78 | |
| • 14411Y | | 77 | |
| • 15004 | | | 71 |
| • 15008 | | | 71 |
| • 15014 | | | 71 |
| • 15018 | | | 71 |
| • 15104 | | | 71 |
| • 15108 | | | 71 |
| • 15114 | | | 71 |
| • 15118 | | | 71 |
| 16004 | 67 | | |
| 16008 | 67 | | |
| 16014 | 67 | | |

| Figure | Forged | Cast | Nuclear |
|---|---|---|---|
| 16018 | 67 | | |
| 35125 | 27 | | |
| 35129 | 27 | | |
| 35225 | 27 | | |
| 35229 | 27 | | |
| • 36120 | 42 | | |
| • 36122 | 35 | | |
| • 36124 | 26,42,60 | | 64 |
| 36125 | 45 | | |
| • 36128 | 26,42,60 | | 64 |
| 36129 | 45 | | |
| • 36160 | 43 | | |
| • 36164 | 43 | | 65 |
| 36165 | 46 | | |
| • 36168 | 43 | | 65 |
| 36169 | 46 | | |
| • 36170 | 44 | | |
| • 36174 | 44 | | 109 |
| 36175 | 47 | | |
| • 36178 | 44 | | 109 |
| 36179 | 47 | | |
| • 36220 | 42 | | |
| • 36222 | 35 | | |
| • 36224 | 26,42,60 | | 64 |
| 36225 | 45 | | |
| • 36228 | 26,42,60 | | 64 |
| 36229 | 45 | | |
| • 36260 | 43 | | |
| • 36264 | 43 | | 65 |
| 36265 | 46 | | |
| • 36268 | 43 | | 65 |
| 36269 | 46 | | |
| • 36270 | 44 | | |
| • 36274 | 44 | | 109 |
| 36275 | 47 | | |
| • 36278 | 44 | | 109 |
| 36279 | 47 | | |
| • 66120 | 48 | | |
| • 66124 | 26,48,61 | | 66 |
| 66125 | 51 | | |
| • 66128 | 26,48,61 | | 66 |
| 66129 | 51 | | |
| • 66160 | 49 | | |
| • 66164 | 49 | | 67 |
| 66165 | 52 | | |
| • 66168 | 49 | | 67 |
| 66169 | 52 | | |
| • 66170 | 50 | | |
| • 66174 | 50 | | 110 |
| 66175 | 53 | | |
| • 66178 | 50 | | 110 |
| 66179 | 53 | | |
| • 66220 | 48 | | |
| • 66224 | 26,48,61 | | 66 |
| 66225 | 51 | | |
| • 66228 | 26,48,61 | | 66 |
| 66229 | 51 | | |
| • 66260 | 49 | | |
| • 66264 | 49 | | 67 |
| 66265 | 52 | | |
| • 66268 | 49 | | 67 |
| 66269 | 52 | | |
| • 66270 | 50 | | |
| • 66274 | 50 | | 110 |
| 66275 | 53 | | |
| • 66278 | 50 | | 110 |
| 66279 | 53 | | |
| 96124 | 54,62 | | |
| 96128 | 54,62 | | |
| 96164 | 55 | | |
| 96168 | 55 | | |
| 96174 | 56 | | |
| 96178 | 56 | | |
| 96224 | 54,62 | | |
| 96228 | 54,62 | | |
| 96264 | 55 | | |
| 96268 | 55 | | |
| 96274 | 56 | | |
| 96278 | 56 | | |
| DSXXXX | 60,61,62 | | |
| DEXXXX | 60,61,62 | | |
| DCXXXX | 60,61,62 | | |



*• These valves can be constructed for nuclear service.*
*Note: See "References to Related Brochures" chart in the Table of Contents to locate figures that do not appear in this brochure.*

# Edward Valves Availability Chart

## Edward Cast Steel Gate, Globe, Angle and Check Valves

| Description | Pressure Rating[1,2] | Size[2] | Ends | Page |
|---|---|---|---|---|
| **Bolted Bonnet Globe and Angle Valves, Stop and Stop-Check (Non-Return) and Bolted Cover Piston Check** | ASME 300(50) | 2-½(65) thru 12(300) | Buttwelding or Flanged | 26, 28, 30 |
| | ASME 600(110)* | 2-½(65) thru 69(150) | | 35, 38, 41 |
| **Pressure Seal Bonnet Globe and Angle Valves Stop and Stop-Check (Non-Return)** | ASME 600(110)* | 8(200) thru 14(350) | Buttwelding or Flanged | 35, 38 |
| | ASME 900(150)* | 3(80) thru 24(600) | | 46, 47, 50, 51 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 59, 60, 63, 75, 79, 80, 81, 82 |
| **Pressure Seal Cover, Piston Check Valves** | ASME 600(110)* | 8(200) thru 14(350) | Buttwelding or Flanged | 42 |
| | ASME 900(150)* | 8(200) thru 24(600) | | 52 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 65, 66, 81, 82 |
| **Equiwedge® Gate Valves** | ASME 600(110)* & 900(150)* | 2-½(65) thru 32(800) | Buttwelding or Flanged | 37, 38, 48, 49 |
| | ASME 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 61, 62, 77, 78 |
| | ASME 3600 | 16(400) thru 24(600) | Buttwelding | 88, 89 |
| **Flite-Flow® Globe Valves, Stop and Stop-Check (Non-Return)** | ASME 300(50) | 3(80) thru 16(400) | Buttwelding or Flanged | 27, 29 |
| | ASME 400(68) | 3(80) thru 4(100) | | 32, 33 |
| | ASME 600(110)* | 3(80) thru 32(800) | | 36, 40 |
| | ASME 700(120) | 6(150) thru 32(800) | | 43, 44 |
| | ASME 900(150)* | 6(150) thru 16(400) | | 47, 51 |
| | ASME 1100(190) | 3(80) thru 4(100) | | 55, 56 |
| | ASME 1500(260)* & 2500(420) | 3(80) thru 24(600) | | 60, 64, 76, 80 |
| | ASME 1800(310) & 2900 (490) | 3(80) thru 4(100) | | 69, 70, 84, 85 |
| | ASME 2000(340) | 12(300) thru 14(350) | Buttwelding | 72, 73 |
| | ASME 3600 | 16(400) thru 24(600) | | 87, 90 |
| | Series 4500 | 4(100) thru 10(250) | Buttwelding or Flanged | 92, 93 |
| **Flite-Flow® Piston Check Valves** | ASME 300(50) | 2-½(65) thru 16(400) | Buttwelding or Flanged | 31 |
| | ASME 400(68) | 3(80) thru 4(100) | | 34 |
| | ASME 600(110)* | 3(80) thru 32(800) | | 42 |
| | ASME 700(120) | 3(80) thru 4(100) | | 45 |
| | ASME 900(150)* | 3(80) thru 16(400) | | 54 |
| | ASME 1100(190) | 3(80) thru 4(100) | | 57 |
| | ASME 1500(260)* & 2500(420) | 3(80) thru 24(600) | | 67, 82 |
| | ASME 1800(310) & 2900 (490) | 3(80) thru 4(100) | | 71, 86 |
| | ASME 2000(340) | 12(300) thru 14(350) | | 74 |
| | ASME 3600 | 16(400) thru 24(600 | Buttwelding | 91 |
| | Series 4500 | 4(100) thru 10(250) | Buttwelding or Flanged | 94 |
| **Tilting Disk Check Valves** | ASME 600(110)* | 6(150) thru 20(500) | Buttwelding | 42 |
| | ASME 900(150)*, 1500(260)* & 2500(420) | 2-½(65) thru 24(600) | | 53, 68, 83 |
| | Class 4500(760) | 6(150) & 8(200) | | 95 |
| **Nuclear Valves** | Thru ASME 2500(420)* | to Size 32(800) | Buttwelding | See Nuclear Catalog |
| **Special Application Valves** | Thru ASME 2500(420) | to Size 18(450) | As Required | 58 |

*Note: "References to Related Brochures" chart in the Table of Contents to locate valves that do not appear in this brochure.*
**These valves can be constructed and supplied for nuclear service.*
*1. See 3.2 Pressure Ratings in the Technical Information section of this brochure for definition of various pressure ratings available.*
*2. Metric equivalent values for ratings and sizes are in parentheses.*



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# Edward Valves Availability Chart

### Edward Forged Steel, Globe, Angle, and Check Valves

**See Edward Forged Steel Valve Catalog for detailed information (EVENCT0001)**

| Description | Pressure Rating[1,2] | Size[2] | Ends | Page |
|---|---|---|---|---|
| **Globe Stop Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 28 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 31 |
| | Series 1500 | ½(15) thru 2(50) | Threaded, Socket, Flanged | 36,37 |
| **Univalve Globe Stop Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 42,48,54 |
| **Hermavalve Globe Stop Valves** | ASME to 1690(290)* | ½(15) thru 2-½(65) | Socket, Buttwelding | 64-67 |
| **Blow Off Stop Valves** | ASME 300(50), 400(68) & 600(110) | 1-½(40) thru 2-½(65) | Socket, Flanged, Buttwelding | 22-25 |
| | ASME 1500(250) & 2500(420) | | Socket, Buttwelding | 26 |
| **Hydraulic Stop Valves** | 5,000 PSI CWP 10,000 PSI CWP | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 57 |
| **Globe Stop-Check Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 29 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 32 |
| | Series 1500 | ½(15) thru 2(50) | Threaded, Socket, Flanged | 38,39 |
| **Univalve Globe Stop-Check Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 43,49,55 |
| **Piston Check Valves** | ASME 600(110)* | ½(15) thru 2(50) | Flanged | 30 |
| | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 33 |
| | Series 1500 | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 40 |
| **PressurCombo** | ASME 1690*, 2680* & 4500 | ½(15) thru 4(100) | Socket, Buttwelding | 59-62 |
| **Univalve Piston Check Valves** | ASME 1690(290)*<br>ASME 2680(460)*<br>ASME 4500(760) | ½(15) thru 4(100) | Threaded, Socket, Buttwelding | 44,50,56 |
| **Hydraulic Check Valves** | 5,000 PSI CWP & 10,000 PSI CWP | ¼(6) thru 2(50) | Threaded, Socket, Flanged | 58 |
| **Ball Check Valves** | ASME 800(130) | ¼(6) thru 2(50) | Threaded, Socket | 34 |
| | Series 1500 | | | 41 |
| **Strainers** | ASME 800(130) & Series 1500 | ¼(6) thru 2(50) | Threaded, Socket | 63 |
| **Flanged Univalve** | Class 1500(260) | ½(15) thru 2(50) | Flanged | 35 |
| **Univalve Angle Stop, Stop-Check and Check Valves** | ASME 1690(290) | ½(15) thru 4(50) | Socket, Buttwelding | 45-47 |
| | ASME 2680(460) | | | 51-53 |
| **Continuous Blowdown Valves** | ASME 1925 | 1(25) thru 4(100) | Socket, Buttwelding | 27 |
| **Nuclear Valves** | Thru ASME 2500(420)* | to Size 32(800) | Buttwelding | See Nuclear Catalog |

*Note: See "References to Related Brochures" chart in the Table of Contents to locate valves that do not appear in this brochure.*
*1. See 3.2 Pressure Ratings in the Technical Information section of this brochure for definition of various pressure ratings available.*
*2. Metric equivalent values for ratings and sizes are in parentheses.*
**These valves can be constructed and supplied for nuclear service.*



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# Edward Description of Figure Number System

## Special Material Suffixes

| | |
|---|---|
| **CF8C** | Cast 18-8 stainless steel (type 347) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **CF3M** | Cast 18-8 stainless steel (type 316L) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **CF8M** | Cast 18-8 stainless steel (type 316) body and bonnet. Parts in contact with line fluid either cast or forged 18-8 stainless steel or equivalent. |
| **C5** | Cast chromium molybdenum (5 chromium ½ molybdenum) Grade C5 alloy steel body and bonnet. Trim of equal or higher grad alloy steel. |
| **F11** | Body and bonnet of forged chromium molybdenum (1-¼ chromium, ½ molybdenum) Grade F11 alloy steel. |
| **F22** | Body and bonnet of forged chromium molybdenum (2-¼ chromium, 1 molybdenum) Grade F22 alloy steel. |
| **F91** | Body and bonnet of forged chromium molybdenum (9 chromium, 1 molybdenum) Grade F91 alloy steel. |
| **F316** | Body and bonnet of forged Type 316 stainless steel. |
| **F316L** | Body and bonnet of forged Type 316L stainless steel. |
| **F347** | Body and bonnet of forged Type 347 stainless steel. |
| **F347H** | Body and bonnet of forged Type 347H stainless steel. |
| **LF2** | Forged carbon steel material on which Charpy impact tests have been performed on forging heat to determine low temperature properties. |
| **WC1** | Cast carbon molybdenum Grade WC1 body and bonnet. |
| **WC6** | Cast chromium molybdenum (1-¼ chromium, ½ molybdenum) Grade WC6 alloy steel body and bonnet. |
| **WC9** | Cast chromium molybdenum (2-¼ chromium, 1 molybdenum) Grade WC9 alloy steel body and bonnet. |
| **WCB** | Cast carbon steel Grade WCB body and bonnet. |
| **WCC** | Cast carbon steel Grade WCC body and bonnet. |
| **C12A** | Cast chromium molybdenum (9 chromium, 1 molybdenum) alloy steel body and bonnet. |

## Special Feature Suffixes

| | |
|---|---|
| **A** | Special body only — body pattern alterations not required. Flanges on forged valves not normally supplied with flanges. On socket end forged steel valves the inlet and outlet ends are different. |
| **B** | Venturi pattern body. |
| **C** | Locking devices consisting of padlock and chain. |
| **CD** | Locking devices, indicator type. |
| **DD** | Equalizer external. |
| **DDI** | Equalizer internal. |
| **E** | Permanent drain, hole in disk or groove in disk face. |
| **F** | Special trim material: used to designate special disk material, special stem material, or inconel spring in check valves. |
| **FF** | Special yoke bushing material, such as Austenitic Nodular Iron. |
| **G** | Bypasses on all types of cast steel valves |
| **H** | Spur gear operation. |
| **HH** | Bevel gear operation. |
| **HHL** | Valveless bevel gear actuator but with actuator mounting equipment. |
| **J** | Any unclassified special. |
| **K** | Throttle disk or skirted disk. |
| **L** | Impactor operated. Used now only to indicate impactor handwheel or handle on valves not regularly furnished with impactor. |
| **LD** | Impactorgear or Impactodrive. |
| **M** | Motor actuated. |
| **ML** | Valveless actuator but with motor actuator mounting equipment. |
| **MM** | Cylinder/diaphragm actuated. Either hydraulic or pneumatic. |
| **MML** | Valve less cylinder/diaphragm actuator but with actuator mounting equipment. |
| **N** | Body drilled and tapped or socketed for drains, with or without nipple, with or without drain valves. |
| **P** | Non-standard packing of all types. |
| **PL** | Plastic lined. |
| **Q** | Non-standard bonnet gaskets or gasket plating. |
| **R** | Special lapping and honing and gas testing (recommended for valves on high pressure gas service). |
| **S** | Smooth finish on contact faces of end flanges. |
| **T** | Critical service requiring special testing and/or NDE. |
| **UF** | Unfinished ends. |
| **W** | Stellited seat and disk. Suffix not used for valves that are cataloged as having stellited seat and disk as standard. |
| **X** | Ring joint facing on body end flanges. |
| **Y** | All welding ends either socket or butt. Suffix not used for valves where figure number designates welding ends as standard, such as Fig. 36224 and 66228 for example. |
| **T1** | ASME Section III Class 1 compliance. |
| **T2** | ASME Section III Class 2 compliance. |
| **T3** | ASME Section III Class 3 compliance. |
| **T4** | ASME Section III compliance without "N" stamp. |
| **T5** | Nuclear safety-related 10CFR21 invoked. |



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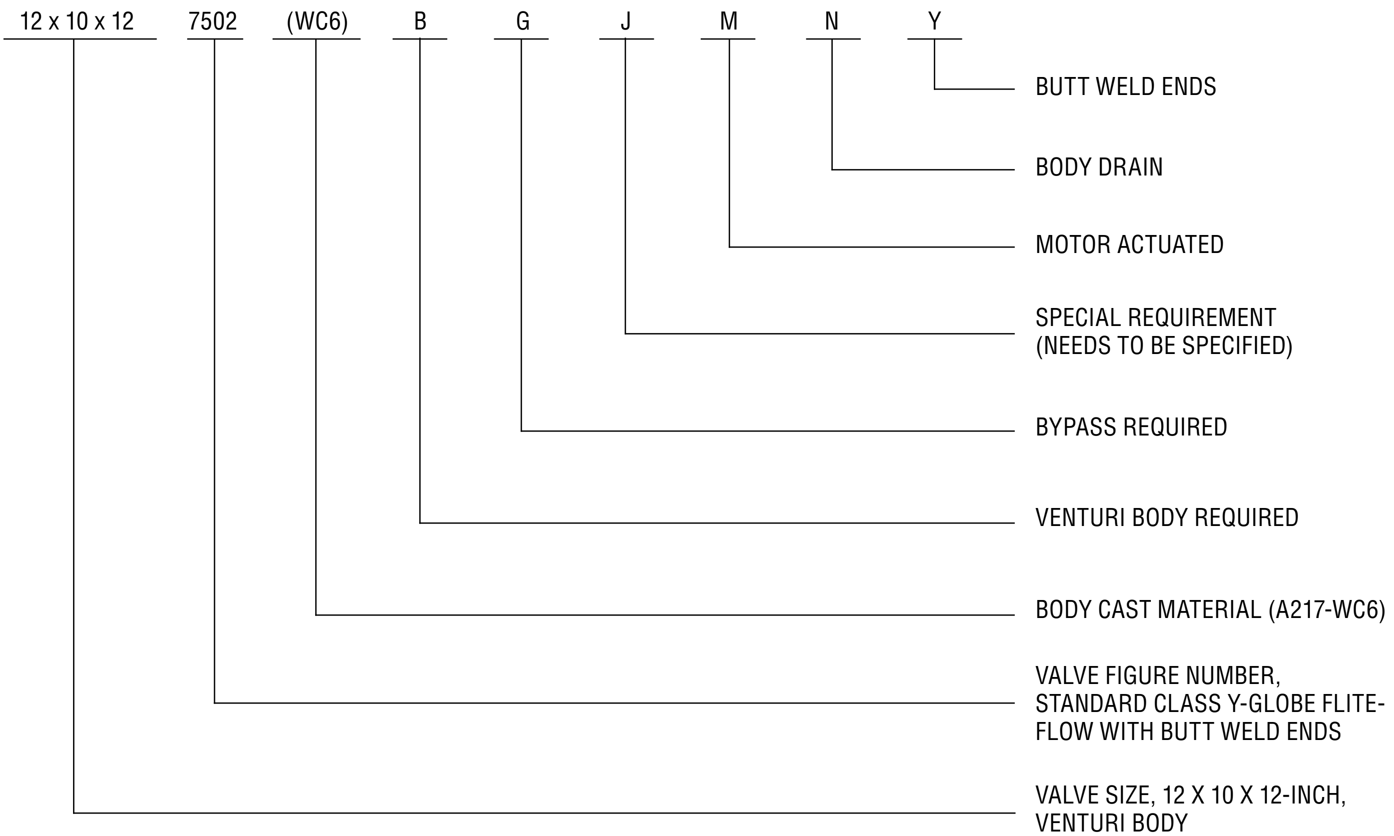
# Edward Description of Figure Number System

## Example




**XX**
1 Alpha Digit Prefix Indicates Design Revision, if applicable.

2 Alpha Digits Indicates Style of Pressure Combo valve.

**XXXXX**
3-5 Digits Figure Number

**(XXX)**
3-4 Digits Body Material Designation

**XXXXXXX**
1 or more Digits as Required Suffixes (See List)

*Unless otherwise specified when ordering Edward valves, the standard material of construction for Forged products is A105 Carbon Steel, and for Cast products is A216 Grade WCB Carbon Steel.*

See the Edward Description of Figure Number System on page 8 for the letter suffixes used to indicate variations from standard construction or special features (Ex. 618K, 7506 [WC6]Y, and 847 AH).

A definite suffix sequence is to be used when two or more suffixes follow a figure number.

The sequence is:

1) Special material (if applicable).

2) All other applicable feature suffixes in alphabetical order, except T1-T5 which are listed last.



Flowserve Edward Valves • 1900 South Saunders Street, Raleigh, North Carolina 27603 • 1-800-225-6989 • 1-919-832-0525 • Fax 1-919-831-3369

# High Performance for Critical Service

In critical service conditions, where temperatures and pressures can exceed 1000°F and 10,000 psi. respectively, you can't take chances. You don't just meet standards, you exceed them. That's how Flowserve Edward forged and cast steel valves have become the specified choice for power plants, process facilities, and other high-temperature, high-pressure services.

### Conservative Design

Flowserve Edward valves takes a conservative approach to valve design. We meet all applicable codes and standards, but we go beyond that...with finite element stress analysis of critical areas and rigorous proof testing. Edward valves are built to take punishment!

And our extensive testing has also allowed us to develop extremely high flow efficiencies in all our valves.

You'll find other unique design advantages on our various product lines, such as our Equiwedge gate valves, with a two-piece wedge gate assembly that adjusts automatically to any angular distortion of the body seats. And many other design features, now considered industry "standards," started on the drawing boards at Flowserve.

### Precision Manufacturing

Edward valves also exceeds industry standards on the factory floor. Our forged valves are produced on a fully automated line, with CNC machining centers providing precise process control. And we maximize cast steel quality by producing our valve body castings using a directional solidification process from patterns designed by our own technicians. This process assures high strength void-free castings for uncompromised quality.

Even with the most advanced equipment, we feel our people make the real difference at Flowserve. Our production personnel have an average of 20 years in the industry and 15 years with Flowserve! This exceptional experience level allows us to achieve an extra degree of precision that can make a very real difference in the field.

Finally, it's our people, along with our procedures for quality assurance and lot-traceability, that have earned Flowserve Edward valves the ASME N stamp, certifying our Raleigh, North Carolina manufacturing facility for nuclear-service valve production.

### Lower Total Costs

Those tough standards have carried over into every valve we manufacture. Whether or not for nuclear service, we design and build our valves to last at least 40 years. That means not only are they tough, but they are designed with easy maintenance in mind.

Considering the cost of valve failure, the quality of Flowserve Edward valves is clearly worth specifying. That's been true since 1904, when the first Edward valve was made.

Today, as industrial companies become increasingly aware that operating expenses are part of total cost, the choice becomes both clearer and more critical than ever.

## Designed With an Eye on Your Bottom Line

In-house computer-aided design and finite-element method capabilities give our engineering staff powerful tools to develop reliable valves for critical service applications. CAD generated graphic models undergo FEM analysis to determine that stresses are within acceptable limits. Dynamic simulation of valve operation also helps assure reliability of Edward valve performance.

Prototyping is just as important, and rigorous proof testing is a mainstay of Edward valve design. Before we approve a valve for production, we put it through hundreds, even thousands, of cycles to demonstrate that performance and sealing integrity will be maintained in service. Transducers relay data from test assemblies to computers for further analysis.

Laboratory simulation of critical services includes a steam generator and superheater designed for 2700 psi and 1050°F. This flexible system allows testing of prototype valves under both low pressure and high pressure conditions. In addition to prototype testing, this system has been used for applications such as: friction and wear tests of valve trim materials in hot water and steam environments; qualification tests of new or redesigned valves; and proof testing of new valve gaskets and valve stem packings.

Before we make the first production unit, that valve has already been through a rigorous program to assure long life, simple maintenance, and dependable performance for the lowest cost over the life of the valve. Again, people play important roles in design. The Flowserve product engineering department pools well over 200 years of valve experience.

## *Testing Beyond Code Requirements*

At Flowserve Edward valves, quality assurance starts with meeting code requirements. valves are manufactured to ASME B16.34 (Standard, Limited and Special Classes), including standards for:

- Minimum wall thickness of valve body.
- Body, bonnet and body-bonnet bolting to specified ASTM material standards.
- Hydrostatic shell testing at 1.5 times the 100°F rating of the valve.

From there, Flowserve Edward valves goes on to exceed the code, with higher test standards and an additional battery of tests performed on every type of valve we make, using in-house test facilities and personnel to assure expert quality control. Edward valves' quality assurance program includes:

### Non-Destructive Examination

- All NDE personnel are qualified in accordance with ASNT-TC-1A guidelines.
- All castings are visually examined per MSS SP-55.
- The first five body castings from every pattern are 100% radiographed to verify casting quality.

### Hydrostatic Testing

- The seat-leakage criteria — no visible leakage for forged steel and 2ml/hour/inch of nominal valve size for cast steel — are stricter than the allowed leakage rate of MSS SP-61, which is 10ml/hour/inch of nominal valve size.
- Seat-leakage test is performed at 110% of 100°F rating.

### Statistical Process Control

Requirements are clearly stated and measurements are taken to determine conformance to those requirements. "Quality" equals conformance to requirements.

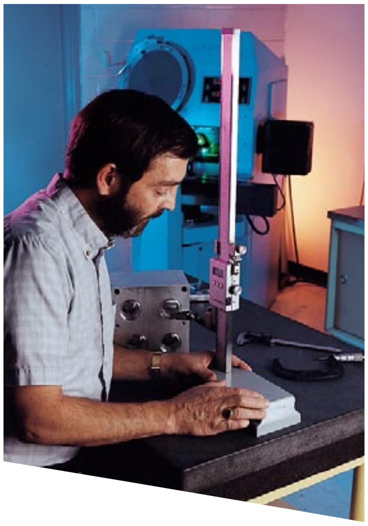
### Welding

All personnel and procedures are qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX.

### Additional Standard Tests for Specific valves

Includes heavy-wall examination on large body castings.

We have only listed a few of the Flowserve Edward valves standard tests that exceed industry requirements. Also, Edward valves has the facilities and the expertise to meet additional quality-assurance standards, as required for the application.



## A History of Firsts

| Feature | Benefit |
|---|---|
| Body-guided disks on globe and angle valves | Minimize wear and ensure alignment for tight sealing. |
| Integral Stellite hardfaced seats in globe and angle valves | Permit compact design and resist erosion. |
| Hermetically sealed globe valves with seal-welded diaphragms | Prevent stem leakage in critical nuclear plant applications. |
| Equalizers for large check and stop-check valves | Ensure full lift at moderate flow rates, and prevent damage due to instability. |
| Compact pressure seal bonnet joints | Eliminate massive bolted flanges on large, high-pressure valves. |
| Qualified stored-energy actuators | Allow quick-closing valves in safety-related nuclear plant applications. |
| Qualified valve-actuator combinations | Used in main steam and feed-water service throughout the world. |
| Stainless steel spacer rings on gate valves, fitted between wedge halves | Simplify service. Damaged valve seats can be restored to factory fit by in-line replacement with slightly thicker ring. |
| Unique two-piece, flexible wedges on gate valves | Automatically adjust to any angular distortion of body seats. Shape provides greater flexibility. Assure dependable sealing and prevent sticking. |
| Impactor handwheels and handles | Allow workers to generate several thousand foot-pounds of torque, thus ensuring tight shutoff of manually operated globe and angle valves. |
| Inclined-bonnet globe valves with streamlined flow passages | Minimize pressure drop due to flow. |
| Globe valves available with both vertical and inclined stems | Provide stem designs suited to any installation. |
| Live-loaded pressure energized PressurSeat® for globe valves | Globe valve design for high pressure drain and vent service. |

# Miscellaneous Technical Data

## Edward Technical Articles

| Number | Title |
|---|---|
| EVAWP3000 | A Hermetically Sealed valve for Nuclear Power Plant Service |
| EVAWP3001 | Development of the Edward Equiwedge Gate valve |
| EVAWP3003 | Nuclear Containment of Postulated Feedwater Linebreak |
| EVAWP3004 | Quick-Closing Isolation valves – The Equiwedge Alternative |
| EVAWP3005 | Valve Clamp Ring Stress Analysis |
| EVAWP3006 | Univalve Evolution – Another Advance |
| EVAWP3007 | The Type A Stored Energy Actuator – Development and Qualification |
| EVAWP3008 | Model for Check valve/Feedwater System Water-hammer Analysis |
| EVAWP3009 | Minimizing Use of Cobalt and Strategic Materials in valves |
| EVAWP3010 | Asbestos-Free Stem Packing for High Temperature valves |
| EVAWP3011 | Quick-Closing Equiwedge Isolation valves Global Qualification |
| EVAWP3012 | Avoiding Aluminum Nitride Embrittlement in Steel Castings for valve Components |
| EVAWP3013 | Quick Closing Equiwedge Isolation valves Global Qualification |
| EVAWP3014 | Tests of Asbestos-Free Stem Packings for valves for Elevated Temperature Service |
| EVAWP3015 | Design Basis Qualification of Equiwedge Gate valves for Safety-Related MOV Applications |
| EVAWP3016 | Flow Performance, Stability and Sealability of Piston Lift and Tilting Disk Check valves |
| EVAWP3017 | Edward Cast Steel, Pressure Seal valves: Research and Development |
| EVAWP3018 | Pressure Locking and Overpressurization of Double Seated valves |
| EVAWP3019 | Check and Stop-Check valves for High Turndown Applications |
| EVAWP3020 | PressurCombo |
| EVAWP3021 | Hermavalve-A Zero Emissions valve |

*Copies of the above Technical Articles are available upon request., or at www.flowserve.com*

## Sources for Additional Information

For further guidance on selection, shipping and storage, installation, operation, and maintenance of valves, readers are referred to the following documents:

MSS valve User Guide
MSS SP-92

Available from:

Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
127 Park Street N.E.
Vienna, VA 22180

Aging and Service Wear of Check Valves Used in Engineering Safety-Feature Systems of Nuclear PowerPlants

Nureg/CR-4302

Ornl-6193/V1

Operating Experience and Failure Identification

Available from:

Superintendent of Documents
U.S. Government Printing Office
P.O. Box 37082
Washington, D.C. 20013-7982

And from:

National Technical Information Service
Springfield, VA 22161
EPRI Report No. NP 5479

Application Guidelines for Check Valves in Nuclear Power Plants

Available from:

Electric Power Research Institute
Research Reports Center
P.O. Box 50490
Palo Alto, CA 94303

# Special Application Valves

## NACE VALVES

(NATIONAL ASSOCIATION OF CORROSION ENGINEERS)
Flowserve Edward valves can provide valves constructed of materials that meet NACE standard MR-01-75 for sour service.

This standard entitled "Sulfide Stress Cracking Resistant Metallic Materials For Oil Field Equipment" covers material requirements for production, drilling, gathering and flow line equipment used in hydrogen sulfide bearing hydrocarbon service.

## SPECIAL TRIM

Flowserve Edward valves provides a standard valve trim that is compatible with the valve body chemistry, pressure class, operating temperature, and fluid. However, on application special trim materials to meet specific customer needs can be provided. Edward also can provide cobalt-free trim for nuclear applications.

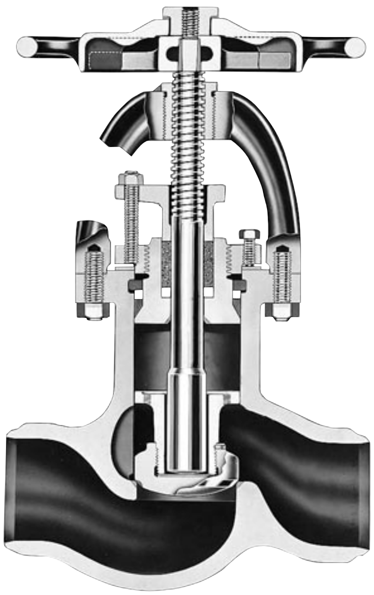
- Cobalt Based Alloy 6
- Cobalt Based Alloy 21
- Iron Based Alloy
- Nickel Based Alloy
- Austenitic stainless steel
- Martensitic stainless steel
- Precipitation hardened stainless steel
- Super alloy steel

## NON-STANDARD ENDS

Most Edward forged and cast steel valves can be provided with welding ends or flanged ends (small forged valves with threaded or socket weld ends also). On special order non-standard ends can be furnished to meet specific customer requirements. A partial list of available options includes:

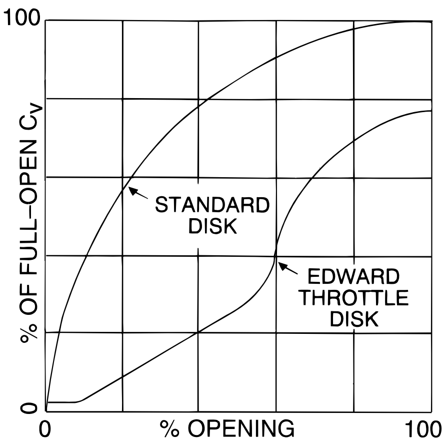
- GRAYLOC® hubs
- Special flange facings
- Non-standard end-to-end lengths — most Edward valves are manufactured to ANSI B16.10 criteria; however, non-standard ends are available as a special order
- Venturi ends
- Flanged by buttweld
- Blank ends
- Others as required

# Special Application Valves



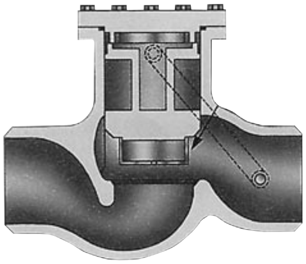
## Edward Throttle Valves

Edward standard cast steel valves with the body-guided feature have excellent ability to handle flow at high pressure differentials. However, for improved accuracy, cast globe and angle stop valves can be equipped with a special throttle disk. Disk shape provides good regulation over wide ranges of flow. When required, valves equipped with a throttle disk may also be ordered with a motor operator. Edward cast stop valves equipped with a throttle disk are identified by adding the suffix "K" to the standard valve figure number.




**Comparison Curves of Typical Standard Disk With Throttle Disk**

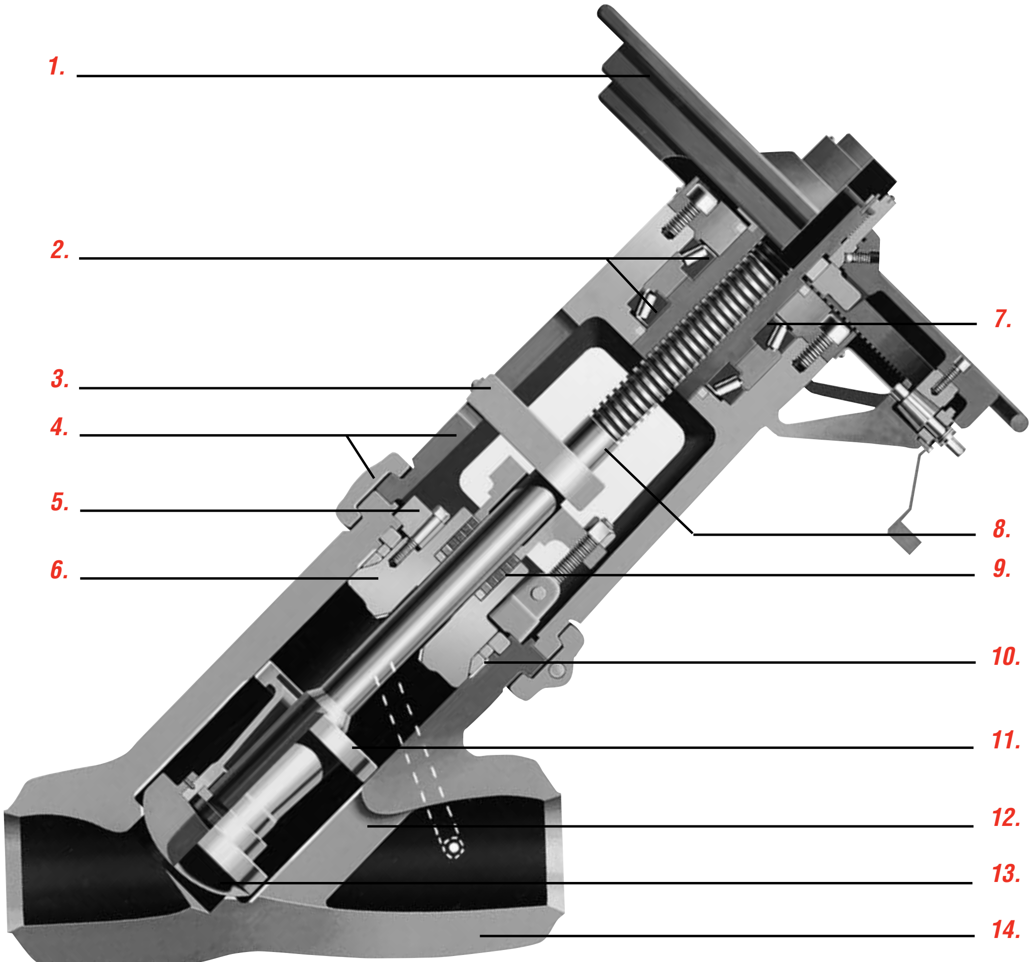
The standard stop valve disk gives rapid increases in flow for each increment of lift at low lifts and small increases in flow at higher lifts. This is not desirable in many applications where the valve is used for controlling flow rate. The conical projection on the throttle disk gives straight line control at the lower lifts, as long as it remains in the seat. Once the cone lifts entirely out of the seat, it permits high capacity at high lifts with only moderate pressure drop penalty.



## Edward Skirted Check Valves

For check or stop-check applications with a broad range of flow conditions, a "skirted" disk, identified by adding the suffix "K" to the valve figure number, may provide the required minimum lift at low flow while providing acceptable pressure drop at maximum flow. Specifically, the illustrated disk with a Mini-Skirt provides good low-flow performance while reducing $C_v$ by only 10%. See the Flowserve Edward valves Technical Article EVAWP3019 for assistance on high turndown applications.

# Features and Description of Edward Flite-Flow® Globe Valves




*For high pressure/high temperature installation, the Flite-Flow valve is capable of handling millions of pounds per hour of fluid flow - without sacrificing low pressure drop or piping flexibility.*

1. **Impactor handwheel** - provides many times the closing force of an ordinary handwheel for positive seating. Impactogear, available on larger sizes, allows cycling by one man utilizing the air wrench adaptor.
2. **Thrust bearings** - minimize torque requirements and eliminate side loading due to out-of-position orientation. Smoother operation and longer valve life are possible.
3. **Stem guide collar** - prevents stem rotation and provides valve position indication.
4. **Yoke/Yoke lock ring** - the yoke is designed for ready access to the packing chamber and the lock ring allows quick disassembly for maintenance.
5. **Bonnet retainer** - provides loading to effect a seal at the pressure seal gasket.
6. **Bonnet** - is precision machined, retains packing and provides an integral hardfaced stem backseat.
7. **Yoke bushing material** - has low coefficient of friction which substantially reduces torque and thread wear and eliminates galling.
8. **Stem** - has ACME threads, is machined to a fine finish and is heat treated for improved strength and hardness to resist wear.
9. **Stem packing system** - utilizes flexible graphite packing material with anti-extrusion rings for optimum sealability and life.
10. **Composite pressure seal gasket** - is a preloaded, pressure energized design for long reliable service.
11. **Disk piston** - is body guided to eliminate misalignment, galling and stem bending.
12. **Guide ribs** - hardfaced on Flite-Flow and some angle patterns, provide body guiding for disk/piston assemblies.
13. **Integral hardsurfaced seats** - both body and disk provide shutoff and long seat life.
14. **Body** - utilizes optimized flow passages to minimize flow direction changes and reduce pressure drop.

# Parts Specification List for Globe Valves: Stop, Stop-Check & Piston Lift Check

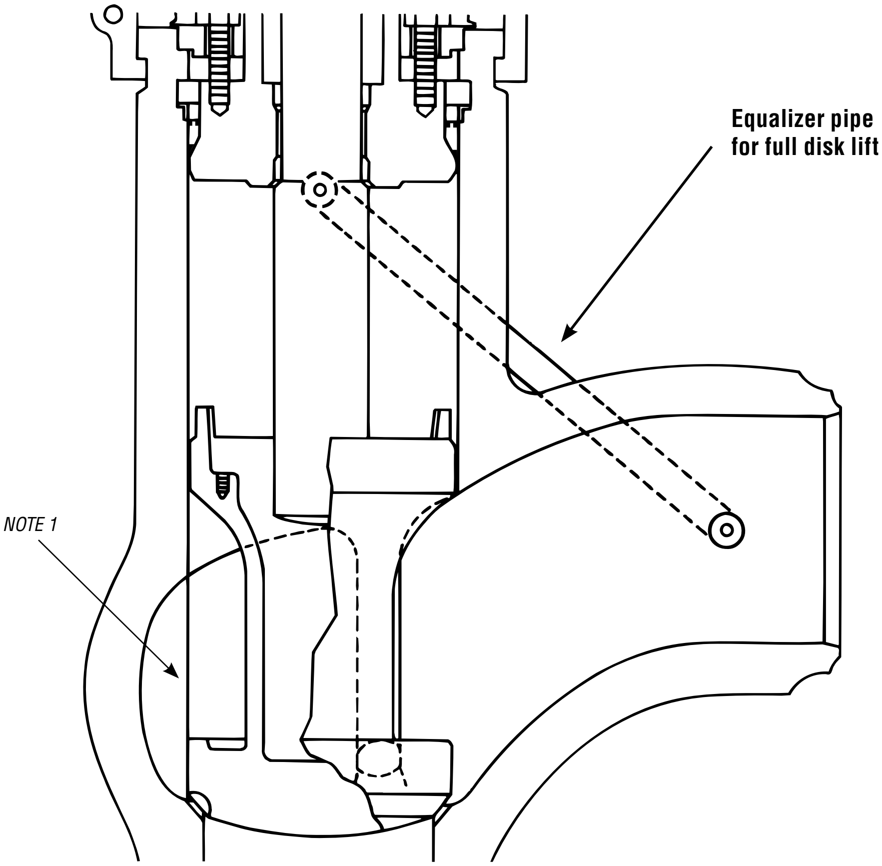
This is not a complete list. Construction and materials will vary between sizes and pressure classes and may be changed without notice. For a complete, accurate, and itemized description of a particular valve, contact your Flowserve Edward valves sales representative.

| Description(1) | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. |
|---|---|---|---|---|---|---|
| **Body/Bonnet*** | A-216 Grade WCB | A-216 Grade WCC | A-217 Grade WC6 | A-217 Grade WC9 | A-217 Grade C12A | A-351 Grade CF8M |
| **Disk** | A-105 — | A-105 — | A-182 Grade F11 | A-182 Grade F22 | A-182 Grade F91 | A-182 Grade F316 |
| **Body-Guided Disk Nut** | A-216 Grade WCB | A-216 Grade WCB | A-217 Grade WC6 | A-217 Grade WC9 | A-217 Grade C12A | A-182 Grade F316 |
| **Stem** | A-182 Grade F6a | A-182 Grade F6a | A-182 Grade F6a | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 T2 |
| **Yoke Bushing** | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 |
| **Packing Rings** | Flexible Graphite inner rings and suitable anti-extrusion rings. | | | | | |
| **Junk Rings** | A-108 Grade 1018-20 $MnPO_4$ Plated | A-108 Grade 1018-20 $MnPO_4$ Plated | A-108 Grade 1018-20 $MnPO_4$ Plated | A-108 Grade 1018-20 $MnPO_4$ Plated | A-108 Grade 1018-20 $MnPO_4$ Plated | A-182 Grade F316/Stellite I.D. |
| **Pressure Seal Gasket** | Composite Pressure Seal Gasket. | | | | | |
| **Spacer Ring** | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-182 Grade F6 CL4 |
| **Gasket Retainer** | A-182 Grade F6 CL4 | SA-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 T2 |
| **Bonnet Retainer** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Bonnet Retainer Studs** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 |
| **Bonnet Retainer Nuts** | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H |
| **Gland** | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60/Chrome Plated |
| **Eye Bolt** | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated |
| **Eye Bolt Nuts** | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated |
| **Eye Bolt Pins** | A-182 Grade F6a Class 4 | A-182 Grade F6a Class 4 | A-182 Grade F6a Class 4 | A-182 Grade F6a Class 4 | A-182 Grade F6a Class 4 | A-182 Grade F6a Class 4 |
| **Stem Guide Collar** | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 |
| **Stem Guide Key** | A-331 Grade 4140 HT | A-331 Grade 4140 HT | A-331 Grade 4140 HT | A-331 Grade 4140 HT | A-331 Grade 4140 HT | A-331 Grade 4140 HT |
| **Yoke** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Yoke Lock Ring** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Yoke Lock Ring Studs** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 |
| **Yoke Lock Ring Nuts** | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H |
| **Impactor Handwheel** | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A |
| **Crossarm, Handwheel** | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 |
| **Handwheel Bearing Nut** | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 | A-536 Grade 65-45-12 |
| **Stem Collar** | A-182 Grade F6a | A-182 Grade F6a | A-182 Grade F6a | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 T2 |

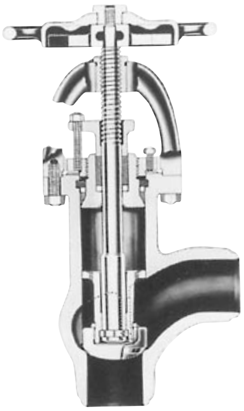
*(1) Through Class 2500, for Series 4500 valves, some construction differences exist. Contact your Edward valves sales representative for more information. * Other material grades available on application.*

# Features and Description of Edward Stop-Check (Non-Return) Valves

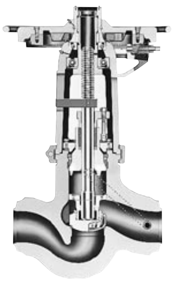
Edward stop-check (non-return) valves offer the same tight-sealing performance as Edward stop valves and, at the same time, give check valve protection in the event of fluid back flow. Edward stop-check valves are commonly used to prevent back flow from a header fed from two or more sources when there is a loss of pressure in one of the sources — for example, the boiler outlet to a common header or at the feedwater heater outlets.




Flite-Flow®



Angle



Globe

## Equalizer

All Edward cast steel stop-check valves are equipped with an Equalizer pipe. Acting as an external pressure balancing pipeline, the Equalizer connects the zone above the disk with the lower pressure area in the valve outlet (See drawing above.) This reduces pressure above the disk and, as a result, causes the higher pressure below the disk to raise the disk to full lift. The Equalizer helps reduce pressure drop and disk-piston movement and wear.

**All other features are the same as those defined on page 17 for stop valves.**

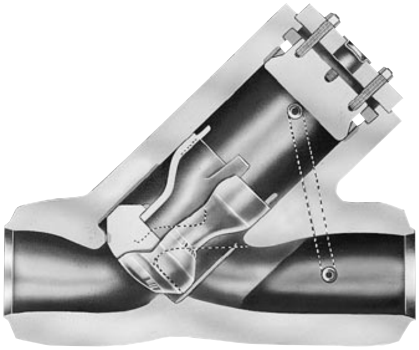
*NOTE 1: Guide ribs are hardfaced on Flite-Flow and some angle pattern valves.*

Elbow Down

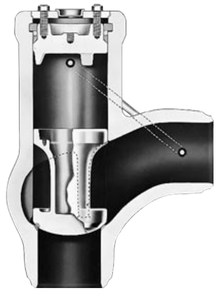
# Features and Description of Edward Check Valves

Over 75 years of valve field experience coupled with ongoing research and development programs have led to Flowserve Edward valves reputation as a leader in supplying horizontal, angle, Flite-Flow and Elbow Down piston lift check valves.

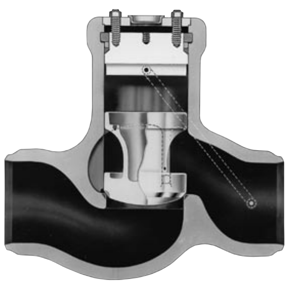
These check valves all incorporate time proven design features such as: equalizers for full lift at lower flows; body guided disk-piston assemblies for seat alignment and stable operation; integral Stellite seating surfaces for long life and tight sealing; and streamlined flow shapes for low pressure drop. Flowserve Edward valves maintains a reputation for the "Preferred" valve in critical high-pressure, high-temperature applications.



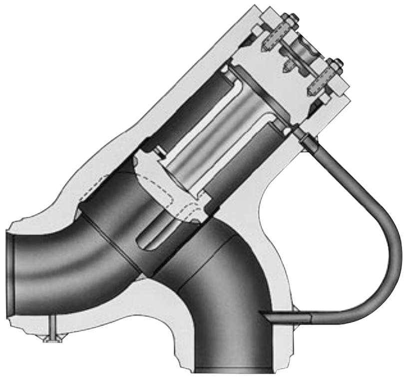
**Flite-Flow®**



**Angle**



**Globe**



**Elbow Down**



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# Features and Descriptions of Edward One-Piece Tilting Disk Check Valves

The Edward tilting disk check valve is designed to close as quickly as possible. It minimizes loud, damaging slamming and vibration noises caused when high velocity reverse flow is allowed to build up before the completion of closing.

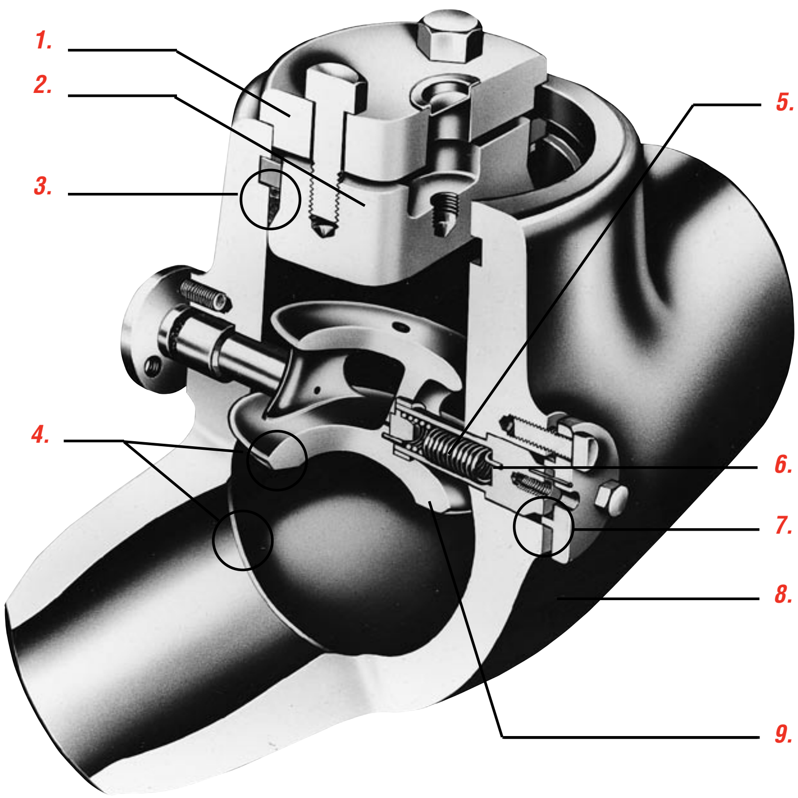
### Quick Closing

Quick closing is achieved through a combination of several design construction features. The disk is dome shaped to avoid hesitation of disk motion or closing, common to conventional flat disks. For minimum pendulum period — an important factor in assuring quick closing — the disk pivot is located close to the center of gravity of the disk.

All disk surfaces are open to line fluid, so that no dashpot action can delay closing. The disk pivots on pin supports having chrome-plated bearings for minimum friction. Totally enclosed torsion springs in the pivot pins help speed the closing action, although the disk is counter weighted sufficiently to close automatically without aid from the springs whether the valve is in a vertical or horizontal position. Since the springs are fully enclosed in the pins, they are not subject to possible erosive effects of line fluids and foreign matter cannot get in. There is no bolting in the flow stream.

### Adjustable Hinge Pins

Available factory installed or as a conversion kit, Edward valve's unique adjustable hinge pin replaces the usual concentric hinge pins with double offset eccentric hinge pins, making core alignment a matter of simply dialing in the fit.




1. Cover retainer provides loading through the cover retainer and bolting to initiate a seal at the pressure seal gasket.
2. Cover is precision machined to retain pressure integrity and critical gasket seating surfaces.
3. Composite pressure seal gasket is a pre-loaded pressure energized flexible graphite composite for long reliable service.
4. Integral hardsurfaced seats, both body and disk, provide positive shutoff and long seat life.
5. Springs ensure quick closing of the disk by providing a positive seating force to speed closing.
6. Hinge pin provides a disk pivot point close to its center of gravity for fast response to flow reversals which, minimizes water-hammer effects.
7. Hinge pin gasket is spiral wound, coated steel, or flexible graphite for long, reliable service.
8. Body features a straight through compact design for low pressure drop.
9. Disk assembly is dome shaped and counterweighted for fast response to flow reversals.

# Parts Specification List for Edward One-Piece Tilting Disk Check

This is not a complete list. Construction and materials will vary between sizes and pressure classes and may be changed without notice. For a complete, accurate, and itemized description of a particular valve, contact your Flowserve Edward valves sales representative.

| Description(1) | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. |
|---|---|---|---|---|---|---|
| **Body Cover*** | A-216 Grade WCB | A-216 Grade WCC | A-217 Grade WC6 | A-217 Grade WC9 | A-217 Grade C12A | A-351 Grade CF8M |
| **Disk††** | A-105 — | A-105 — | A-182 Grade F11 | A-182 Grade F22 | A-182 Grade F91 | A-182 Grade F316 |
| **Pressure Seal Gasket*** | Composite Pressure Seal Gasket | | | | | |
| **Spacer Ring** | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | A-668 Grade 4140 $MnPO_4$ Plated | Grade 182 Grade F6 CL4 |
| **Gasket Retainer** | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 T2 |
| **Cover Retainer** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Cover Retainer Capscrews or Studs** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 |
| **Cover Retainer Nuts** | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H |
| **Hinge Pin Gasket Size 2½, 3, 4** | Spiral Wound Gasket (Asb. Free) | Spiral Wound Gasket (Asb. Free) | Spiral Wound Gasket (Asb. Free) | Spiral Wound Gasket (Asb. Free) | Spiral Wound Gasket (Asb. Free) | Spiral Wound Gasket (Asb. Free) |
| **Hinge Pin Gasket Size 6 & Larger** | Graphite Gasket | | | | | |
| **Hinge Pin** | A-182 Grade F6aCL4 | A-182 Grade F6aCL4 | A-182 Grade F6aCL4 | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 Type 2 |
| **Hinge Pin Bolts** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B16 | A-193 Grade B16 | A-453 Grade 660B | A-453 Grade 660B |
| **Hinge Pin Retainer** | A-105 — | A-105 — | A-182 Grade F11 | A-182 Grade F22 | A-182 Grade F91 | A-182 Grade F316 |
| **Hinge Pin Springs†** | A-313 | A-313 | A-313 | A-313 | A-313 | A-313 |

**Other material grades available on application.*
***All ANSI Class 600 valves utilize an asbestos-free spiral wound bonnet gasket.*
*†Hinge Pin Torsion Springs required in size 6 and larger valves only.*
*††Sizes 2½, 3 and 4, Pressure Classes 900, 1500 and 2500 – disk material is A732-GR21*

# Features and Description of Edward Equiwedge® Gate Valves

For detailed description of the two-piece flexible wedge, see page 25.


1. **Yoke bushing** – material has low coefficient of friction, which substantially reduces torque and thread wear and eliminates galling.
2. **Weather/Grease seals** – are provided to protect against environmental conditions.
3. **Yoke** – the yoke is designed for ready access to the packing chamber.
4. **Packing and junk ring** – utilizes flexible graphite packing material with anti-extrusion rings for optimum sealability and life.
5. **Extended bonnet design** – further separates the packing chamber from fluid flow area for longer packing life. Also provides accessible area for leakoff connections, if required.
6. **Composite pressure seal gasket** – preloaded, pressure energized design, for long reliable service.
7. **Body guiding system** – holds the wedge halves together and absorbs thrust loads due to line flow. Integral hardfaced guide system components reduce friction and prevent galling for longer valve life.
8. **Conical stem backseat** – Cone-on-cone design provides a reliable sealing geometry that operates over many valve cycles without leakage.
9. **Body** – rugged cast steel body provides maximum flow efficiency. Information on alternate materials can be obtained through your Flowserve representative.
10. **Handwheel** – spoke design provides more efficient transfer of load with minimum weight.
11. **Tapered roller bearings** – on larger valves, tapered roller bearings reduce torque, carry the stem thrust and provide additional radial support for side loads imposed by handwheel or power actuator. Smaller size valves have needle roller bearings.
12. **Stem** – has ACME threads, is machined to a fine finish and is heat treated for improved strength and hardness to resist wear.
13. **Packing gland** – made of alloy steel and retained against the stuffing box pressure by an easy-to-maintain stud and heavy-hex nut assembly.
14. **Bonnet retaining ring** – assures an effective, tight seal by pulling the bonnet and gasket together at the pressure seal.
15. **Yoke lock ring** – permits easier field maintenance of upper structure without disturbing pressure containing parts. Valves in smaller sizes utilize a wishbone yoke design. Class 600 valves utilize a bolted pressure seal bonnet.
16. **Bonnet backseat** – especially hard faced to assure long-term sealability.
17. **Hemispherical-type bonnet** – reduces valve body height and provides weight savings. Hemispherical-type design results in better pressure distribution across the bonnet area.
18. **Two-piece wedge assembly** – allows each wedge half to flex and adjust independently to compensate for body distortions caused by thermal changes or pipe bending stresses. (See pg. 25)
19. **Welded-in seat ring with hardfaced seat** – assures better wear and longer valve life. Seat ring is welded into the valve body to prevent leakage.

# *Parts Specification List for Gate Valves*

This is not a complete list. Construction and materials will vary between sizes and pressure classes and may be changed without notice. For a complete, accurate, and itemized description of a particular valve, contact your Flowserve Edward valves sales representative.

| Description | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. | ASTM No. |
|---|---|---|---|---|---|---|
| **Body/Bonnet*** | A-216 Grade WCB | A-216 Grade WCC | A-217 Grade WC6 | A-217 Grade WC9 | A-217 Grade C12A | A-351 Grade CF8M |
| **Gate 2½-6** | A-732 Grade 21 | A-732 Grade 21 | A-732 Grade 21 | A-732 Grade 21 | A-732 Grade 21 | A-732 Grade 21 |
| **Gate 8 and up*** | A-216 Grade WCB | A-216 Grade WCB | A-217 Grade WC6 | A-217 Grade WC9 | A-217 Grade C12A | A-351 Grade CF8M |
| **Stem** | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-565 Grade 616 HT | *** A-565 Grade 616 HT | A-638 Grade 660 T2 |
| **Yoke Bushing** | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 | B-148 Alloy 95400 |
| **Packing Rings** | Flexible Graphite inner rings and suitable anti-extrusion rings. | | | | | |
| **Junk Rings** | AISI 1117 Cad. Plated | AISI 1117 Cad. Plated | AISI 1117 Cad. Plated | AISI 1117 Cad. Plated | AISI 1117 Cad. Plated | A-182 Grade F316/Stellite I.D. |
| **Pressure Seal Gasket**** | Composite Pressure Seal Gasket. | | | | | |
| **Spacer Ring** | — A-668 Grade 4140 $MnPO_4$ Plated | — A-668 Grade 4140 $MnPO_4$ Plated | — A-668 Grade 4140 $MnPO_4$ Plated | — A-668 Grade 4140 $MnPO_4$ Plated | — A-668 Grade 4140 $MnPO_4$ Plated | — A-182 Grade F6 CL4 |
| **Gasket Retainer** | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-182 Grade F6 CL4 | A-565 Grade 616 HT | A-565 Grade 616 HT | A-638 Grade 660 T2 |
| **Bonnet Retainer** | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 | A-515 Grade 70 |
| **Bonnet Retainer Studs** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 |
| **Bonnet Retainer Nuts** | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H |
| **Gland** | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60 | A-148 Grade 90-60/ Chrome Plated |
| **Gland Studs** | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated | A-193 Grade B7/Cad. Plated |
| **Gland Nuts** | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated | A-194 Grade 2H/Cad. Plated |
| **Yoke** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Yoke Lock Ring** | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB | A-216 Grade WCB |
| **Yoke Lock Ring Studs** | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 | A-193 Grade B7 |
| **Yoke Lock Ring Nuts** | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H | A-194 Grade 2H |
| **Handwheel** | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A | A-126 Class A |

** Hardfaced wedge guide rails and seating surfaces.*
*** Size 2½ thru 6, Class 600 & Size 2½ thru 4, Class 900 also available with bolted bonnet/flat gasket.*
**** Use A-368 Grade 660 T2 for applications over 1100°F*

# Features and Description of Edward Equiwedge® Gate Valves

### Unique Two-Piece Flexible Wedge

Wedging action provides tight seat sealing, even at low differential pressures. Wedge guiding by grooves in body minimizes seat wear and damage, since seating surfaces of wedge and body are in contact over less than 5% of total travel. Two separate flexible wedge halves are free to align with seats even when they are tilted or rotated due to thermal effects or piping loads. Resistance to thermal binding assures opening with a torque or load less than design closing load.

Wedge guide area and strength provide capability to support high differential pressures with valve partially open, so Equiwedge gate valves can be opened or closed under “blowdown” conditions. Bypasses are not required if full differential is specified for actuator sizing.

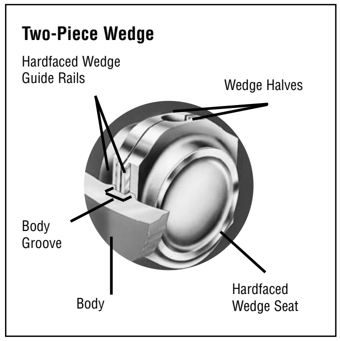



**Figure 1**

The outstanding design feature of the Equiwedge gate valve is unique two-piece wedge that permits maximum independence and flexibility for good sealability and freedom from sticking.

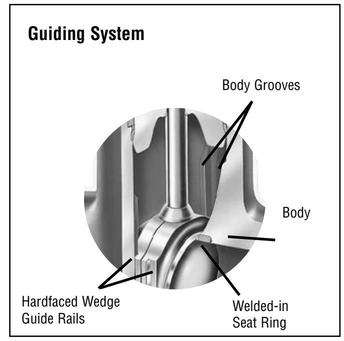



**Figure 2**

The body groove extends high in the body neck region, so that in the open position the wedge assembly is both trapped and fully guided. Body grooves are hardfaced for critical service valves.

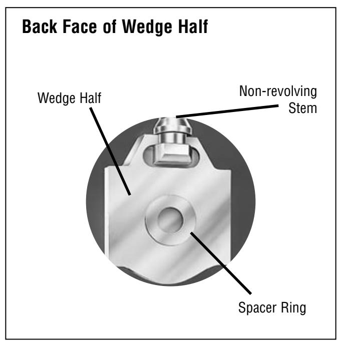



**Figure 3**

Wedge halves are separated the proper amount by a spacer ring that provides controlled deflection from stem loading. Use of a space and weight-saving “captured stem” (shown here and in Figure 4) is possible because of the two-piece wedge design.

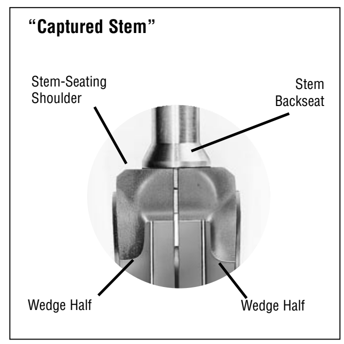



**Figure 4**

The Equiwedge two-piece wedge design allows the use of a space and weight-saving “captured stem.”

## Center Cavity Overpressurization

Some valve designs are capable of sealing simultaneously against a pressure differential between an internal cavity of the valve and the adjacent pipe in both directions. All double-seated gate valves, including Equiwedge, are examples of such a design. In fact, seat joint integrity for these valves is tested in the factory by pressurizing the center cavity and simultaneously examining each seat. However, if a fluid is entrapped in such a valve while closed, and then subsequently heated, a dangerous rise in pressure can result, thus leading to pressure boundary failure.

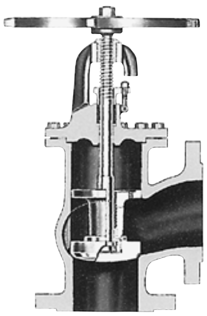
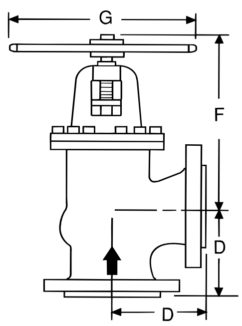
Both ASME B16.34 (Valves - Flanged, Threaded and Welding End), para. 2.3.3 and ASME B31.1 (Pressure Piping Code), para. 107.1(c), recognize this situation and require that the Purchaser shall provide means in design, installation and/or operation to assure that the pressure in the valve shall not exceed the rated pressure for the attained temperature. Therefore, if deemed necessary by the Purchaser, and so specified in the purchase order, Flowserve Edward Valves can provide an equalizer system (internal or external) that will relieve this trapped fluid to the upstream piping or a relief valve that will exhaust excessive pressure to some other specified area. It should be understood that an internal or external equalizer will change a basically by-directional gate valve to a design with fully effective seat sealing in only one direction. The equalizer bypasses the upstream seat and allows leakage by that seat if the pressure is reversed. The “downstream” seat would become the “upstream” seat with pressure reversed; the wedging action provided by stem load provides good upstream seat sealing at low-to-moderate pressures, but leakage could be excessive at high pressures.

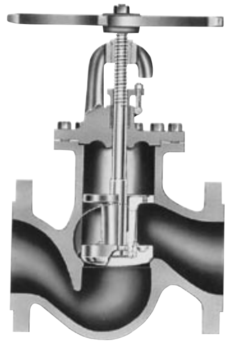
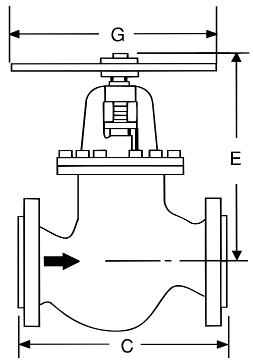
Excessive pressure trapped in the center cavity of a gate valve can also produce “pressure locking” — a condition that can make opening difficult or impossible. Either an internal or an external equalizer will prevent pressure locking. However, a relief valve may allow the center cavity pressure to be higher than either the upstream or downstream pressure, and this can allow pressure locking to occur. The Flowserve Edward valves unique ACCEV (Automation Center Cavity Equalizing Valve) can alleviate this problem. Refer to page 98 for additional information.



Flowserve Edward Valves • 1900 South Saunders Street, Raleigh, North Carolina 27603 • 1-800-225-6989 • 1-919-832-0525 • Fax 1-919-831-3369

# Stop Valves
# Class 300  740 PSI @ 100°F (51.1 BAR @ 38°C)

319




## Standard Features

- Bodies and bonnets are cast steel (WCB & WC6).
- Bolted Bonnet, OS & Y.
- Globe & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Long Terne# steel gasket.

## Pressure Class 300 (PN 50)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 318 | Globe | Flanged | 3 (80) thru 12 (300) |
| 318Y | Globe | Buttwelding | |
| 319 | Angle | Flanged | 2½ (65) thru 12 (300) |
| 319Y | Angle | Buttwelding | |
| 329 | Angle | Threaded | 2½ (65) |
| 329Y | Angle | Socket Welding | |

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

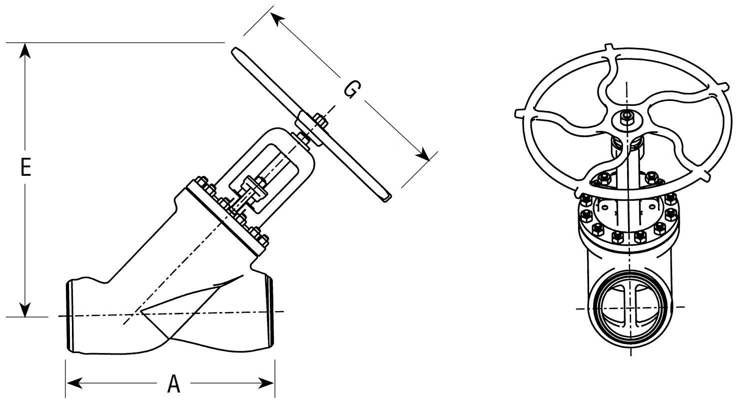
| Figure No. 318/318Y, 319/319Y, 329/329Y | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 |
| C - Face to Face, Globe (Flanged)• | | — | 12.5 | 14 | 15.76 | 17.5 | 22 | 24.5 | 28 |
| | | | 318 | 356 | 400 | 445 | 559 | 622 | 711 |
| D - Center to Face, Angle (Flanged)• | | 5.75 | 6.25 | 7 | 7.88 | 8.75 | 11 | 12.25 | 14 |
| | | 146 | 159 | 178 | 200 | 222 | 279 | 310 | 356 |
| E - Center to Top, Globe (Open) | | — | 16.2 | 16.7 | 20.1 | 24.8 | 28.4 | 34.3 | 39.7 |
| | | | 411 | 424 | 510 | 630 | 721 | 871 | 1008 |
| F - Center to Top, Angle (Open) | | 13.6 | 14.4 | 14.6 | 17.7 | 21.4 | 24.2 | 28.8 | 32.9 |
| | | 345 | 366 | 371 | 450 | 544 | 615 | 731 | 836 |
| G - Handwheel/Handle Diameter* | | 11 | 11.5 | 11.5 | 15 | 18 | 22 | 22 | 26 |
| | | 279 | 292 | 292 | 381 | 457 | 559 | 559 | 660 |
| Weight, Globe (Flanged) | | — | 100 | 193 | 226 | 370 | 525 | 895 | 1520 |
| | | | 45 | 88 | 103 | 168 | 238 | 406 | 689 |
| Weight, Globe (Welding) | | — | 80 | 95 | 172 | 295 | 400 | 720 | 1270 |
| | | | 36 | 43 | 78 | 134 | 181 | 327 | 576 |
| Weight, Angle (Flanged) | | 65 | 94 | 126 | 210 | 300 | 425 | 710 | 1250 |
| | | 29 | 43 | 57 | 95 | 136 | 193 | 322 | 561 |
| Weight, Angle (Welding) | | 55 | 70 | 85 | 152 | 225 | 325 | 530 | 970 |
| | | 25 | 32 | 39 | 69 | 102 | 147 | 240 | 440 |

** Regular handwheel standard on all sizes except size 12 has an impactor handwheel and size 2½ has an impactor handle.*

*• Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

# Stop Valves
# Class 300 740 PSI @ 100°F (51.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6).
- Bolted or OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Gasket:
  - Size 2½ – 6 – asbestos-free, spiral wound.
  - All others – Long Terne# steel.

## Pressure Class 300 (PN 50)*

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 1314 | Flite-Flow | Flanged | 2½ (65) thru 16 (400) |
| 1314Y | Flite-Flow | Buttwelding | |
| 1324 | Flite-Flow | Threaded | 2½ (65) |
| 1324Y | Flite-Flow | Socket Welding | |

** Size 3&4 Buttweld valves are Class 400. See page 32.*

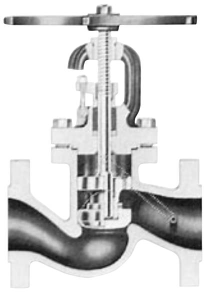
## Dimensions – Flite-Flow®

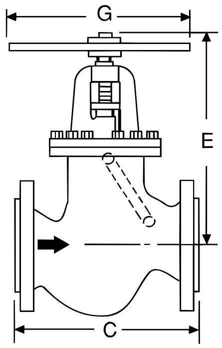
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1314/1314Y 1324/1324Y | | 2 ½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2 ½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| $A_1$- End to End (Welding) | | 11.5 | 13 | 15.5 | 20 | 26.5 | 31 | 40 | 40 | 42 |
| | | 292 | 330 | 394 | 508 | 673 | 787 | 1016 | 1016 | 1067 |
| $A_2$- Face to Face (Flanged) | | 11.5 | 16 | 20.25 | 23.75 | 29 | 34.75 | 43 | 43.25 | 44 |
| | | 292 | 406 | 514 | 603 | 737 | 883 | 1092 | 1099 | 1118 |
| E - Center to Top (Open) | | 16 | 17.2 | 22 | 29 | 35 | 41 | 47.8 | 47.8 | 47.8 |
| | | 406 | 437 | 559 | 737 | 889 | 1041 | 1213 | 1213 | 1213 |
| G - Handwheel Diameter** | | 11 | 11.5 | 15 | 22 | 22 | 26 | 30 | 30 | 30 |
| | | 279 | 292 | 381 | 559 | 559 | 660 | 762 | 762 | 762 |
| Weight (Welding) | | 56 | 100 | 150 | 300 | 575 | 1030 | 1500 | 1525 | 1575 |
| | | 25 | 45 | 68 | 136 | 261 | 468 | 682 | 693 | 716 |
| Weight (Flanged) | | 70 | 130 | 200 | 380 | 700 | 1200 | 1750 | 1850 | 1950 |
| | | 32 | 59 | 91 | 173 | 318 | 545 | 795 | 841 | 886 |

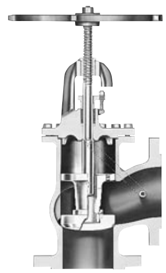
*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*
*** Impactor handwheel standard on 10" and larger Flite-Flow valves. Impactor handle standard on 2½" valve.*

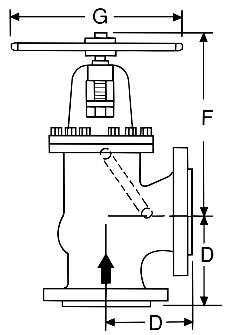
# Stop-Check (Non-Return) Valves
# Class 300 740 PSI @ 100°F (51.1 BAR @ 38°C)



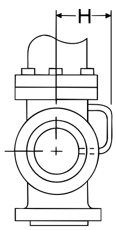



304






303




## Standard Features

- Bodies and bonnets are cast steel (WCB & WC6).
- Bolted Bonnet, OS & Y.
- Globe & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Gasket:
  - Size 2½ – asbestos-free, spiral wound.
  - All others – Long Terne# steel.
- Equipped with equalizer.

## Pressure Class 300 (PN 50)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 304 | Globe | Flanged | 3 (80) thru 12 (300) |
| 304Y | Globe | Buttwelding | |
| 303 | Angle | Flanged | 2½ (65) thru 12 (300) |
| 303Y | Angle | Buttwelding | |

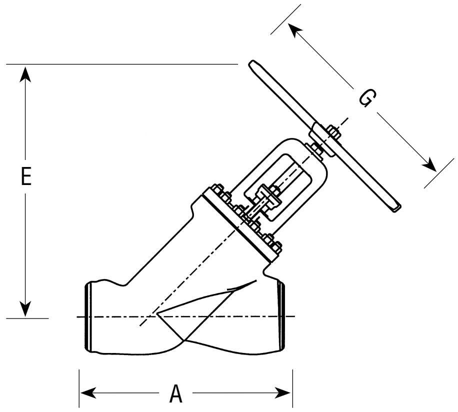
## Dimensions – Globe & Angle

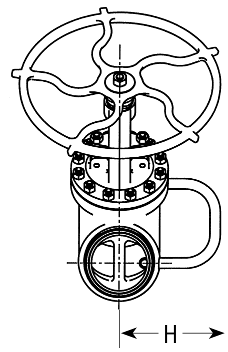
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 303/303Y, 304/304Y | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 125 | 150 | 250 | 250 | 300 |
| C - Face to Face, Globe• | | — | 12.5 | 14 | 15.76 | 17.5 | 22 | 24.5 | 28 |
| | | | 318 | 356 | 400 | 445 | 559 | 622 | 711 |
| D - Center to Face, Angle• | | 5.75 | 6.25 | 7 | 7.88 | 8.75 | 11 | 12.25 | 14 |
| | | 146 | 159 | 178 | 200 | 222 | 279 | 310 | 356 |
| E - Center to Top, Globe | | — | 16.2 | 16.7 | 20.1 | 24.8 | 28.4 | 34.3 | 39.7 |
| | | | 411 | 424 | 510 | 630 | 721 | 871 | 1008 |
| F - Center to Top, Angle | | 13.6 | 14.4 | 14.6 | 17.7 | 21.4 | 24.2 | 28.8 | 32.9 |
| | | 345 | 366 | 371 | 450 | 544 | 615 | 731 | 836 |
| G - Handwheel/Handle Diameter* | | 11 | 11.5 | 11.5 | 15 | 18 | 22 | 22 | 26 |
| | | 279 | 292 | 292 | 381 | 457 | 559 | 559 | 660 |
| H - Equalizer Clearance | | 5.9 | 8.7 | 8.5 | 10 | 9.6 | 11 | 13.7 | 15 |
| | | 150 | 221 | 216 | 254 | 244 | 279 | 348 | 381 |
| Weight, Globe (Flanged) | | — | 100 | 110 | 230 | 370 | 525 | 920 | 1525 |
| | | | 45 | 50 | 104 | 168 | 238 | 417 | 692 |
| Weight, Globe (Welding) | | — | 75 | 95 | 175 | 295 | 400 | 765 | 1365 |
| | | | 34 | 43 | 79 | 134 | 181 | 327 | 619 |
| Weight, Angle (Flanged) | | 66 | 100 | 130 | 200 | 300 | 450 | 700 | 1250 |
| | | 29 | 45 | 59 | 91 | 136 | 204 | 318 | 567 |
| Weight, Angle (Welding) | | 51 | 70 | 90 | 152 | 215 | 325 | 560 | 970 |
| | | 23 | 32 | 41 | 69 | 98 | 147 | 254 | 440 |

** Regular handwheel standard on all sizes except size 12 has an impactor handwheel and size 2½ has an impactor handle.*
*• Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*
*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

# Stop-Check (Non-Return) Valves
# Class 300    740 PSI @ 100°F (51.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6).
- Bolted bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Gasket:
  - Size 2½ – 6 – asbestos-free, spiral wound.
  - All others – Long Terne# steel.
- Equipped with equalizer.

## Pressure Class 300 (PN 50)*

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 1302 | Flite-Flow | Flanged | 2½ (65) thru 16 (400) |
| 1302Y | Flite-Flow | Buttwelding | |

*Size 3&4 Buttweld End valves are Class 400. See page 32.*

## Dimensions – Flite-Flow®

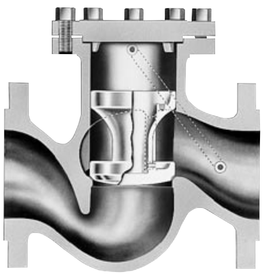
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

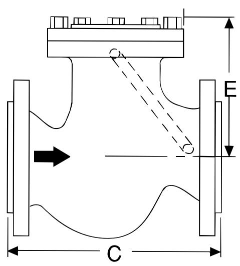
| Figure No. 1302/1302Y | | 2½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| $A_1$- End to End (Welding) | | 11.5 | 13 | 15.5 | 20 | 26.5 | 31 | 40 | 40 | 42 |
| | | 292 | 330 | 394 | 508 | 673 | 787 | 1016 | 1016 | 1067 |
| $A_2$- Face to Face (Flanged) | | 11.5 | 16 | 20.25 | 23.75 | 29 | 34.75 | 43 | 43.25 | 44 |
| | | 292 | 406 | 514 | 603 | 737 | 885 | 1092 | 1099 | 1118 |
| E - Center to Top (Open) | | 16 | 17.2 | 22 | 29 | 35 | 41 | 47.8 | 47.8 | 47.8 |
| | | 406 | 437 | 559 | 737 | 889 | 1041 | 1213 | 1213 | 1213 |
| G - Handwheel Diameter** | | 11 | 11.5 | 15 | 22 | 22 | 26 | 30 | 30 | 30 |
| | | 279 | 292 | 381 | 559 | 559 | 660 | 762 | 762 | 762 |
| H - Equalizer Clearance | | 5.9 | 8.0 | 9.5 | 10.1 | 13.0 | 14.4 | 15.5 | 20.3 | 15.5 |
| | | 150 | 203 | 241 | 257 | 330 | 366 | 394 | 514 | 394 |
| Weight (Welding) | | 56 | 100 | 150 | 300 | 575 | 1030 | 1500 | 1525 | 1575 |
| | | 25 | 45 | 68 | 136 | 261 | 468 | 682 | 693 | 716 |
| Weight (Flanged) | | 70 | 130 | 200 | 380 | 700 | 1200 | 1750 | 1850 | 1950 |
| | | 32 | 59 | 91 | 173 | 318 | 545 | 795 | 841 | 886 |

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*
*** Impactor handwheel standard on 10 NPS & larger Flite-Flow valves. 2½ NPS has impactor handle.*

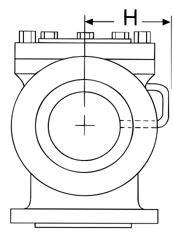
FLOWSERVE

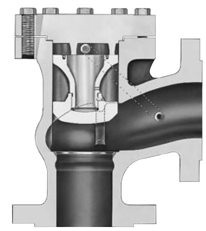
# *Check Valves*
# *Class 300 740 PSI @ 100°F (51.1 BAR @ 38°C)*

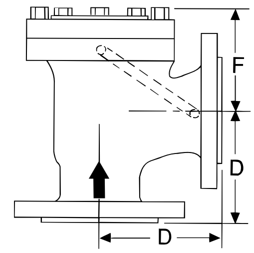





394






393

## *Standard Features*

- Bodies and covers are cast steel (WCB & WC6).
- Bolted cover.
- Globe & angle design.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Gasket:
  - Size 2½ – asbestos-free, spiral wound.
  - All others – Long Terne# steel.
- Equipped with equalizer.

## *Pressure Class 300 (PN 50)*

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 391 | Angle | Threaded | 2½ (65) |
| 391Y | Angle | Socket Welding | |
| 394 | Globe | Flanged | 3 (80) thru 12 (300) |
| 394Y | Globe | Buttwelding | |
| 393 | Angle | Flanged | 2½ (65) thru 12 (300) |
| 393Y | Angle | Buttwelding | |

## *Dimensions – Globe & Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 391/391Y, 394/394Y, 393/393Y | | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 |
| C - Face to Face, Globe• | | — | 12.5 | 14 | 15.76 | 17.5 | 22 | 24.5 | 28 |
| | | | 318 | 356 | 400 | 445 | 559 | 622 | 711 |
| D - Center to Face, Angle• | | 5.75 | 6.25 | 7 | 7.88 | 8.75 | 11 | 12.25 | 14 |
| | | 146 | 159 | 178 | 200 | 222 | 279 | 310 | 356 |
| E - Center to Top, Globe | | — | 6.58 | 7.08 | 8.88 | 11.4 | 13.1 | 15.9 | 18.5 |
| | | | 167 | 180 | 226 | 290 | 333 | 405 | 470 |
| F - Center to Top, Angle | | 3.88 | 4.82 | 4.96 | 6.44 | 8.04 | 8.9 | 10.5 | 11.7 |
| | | 99 | 122 | 126 | 164 | 204 | 226 | 267 | 297 |
| H - Equalizer Clearance | | 5.9 | 8.7 | 8.5 | 10 | 9.6 | 11 | 13.7 | 15 |
| | | 150 | 221 | 216 | 254 | 244 | 279 | 348 | 381 |
| Weight, Globe (Flanged) | | — | 85 | 120 | 195 | 320 | 470 | 835 | 1280 |
| | | | 39 | 54 | 88 | 145 | 213 | 379 | 581 |
| Weight, Globe (Welding) | | — | 60 | 85 | 141 | 250 | 350 | 620 | 1050 |
| | | | 27 | 39 | 64 | 113 | 159 | 281 | 476 |
| Weight, Angle (Flanged) | | 49 | 78 | 108 | 175 | 250 | 375 | 600 | 980 |
| | | 22 | 35 | 49 | 79 | 113 | 170 | 272 | 445 |
| Weight, Angle (Welding) | | 35 | 53 | 70 | 121 | 260 | 250 | 430 | 820 |
| | | 16 | 24 | 32 | 55 | 118 | 113 | 195 | 372 |

*• Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*



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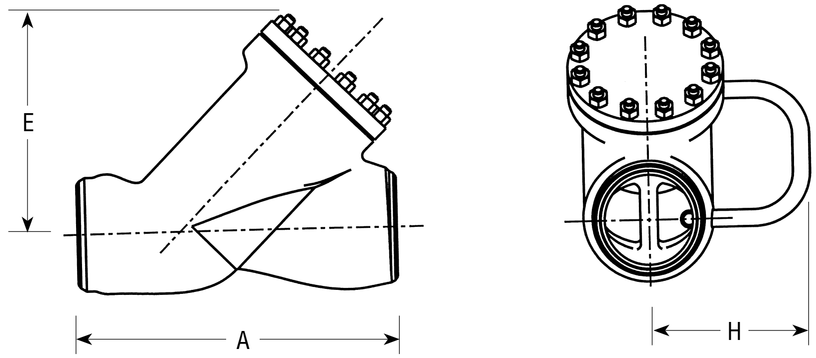
# Check Valves
# Class 300 740 PSI @ 100°F (51.1 BAR @ 38°C)




## Standard Features

- Bodies and covers are cast steel (WCB & WC6).
- Bolted cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Gasket:
  - Size 21/2 – 6 – asbestos-free, spiral wound.
  - All others – Long Terne# steel.
- Equipped with equalizer.

## Pressure Class 300 (PN 50)*

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1392 | Flite-Flow | Flanged | 2½ (65) |
| 1392Y | Flite-Flow | Buttwelding | 16 (400) |
| 1390 | Flite-Flow | Threaded | 2½ (65) |
| 1390Y | Flite-Flow | Socket Welding | |

** Size 3&4 Buttweld valves are Class 400. See page 32.*

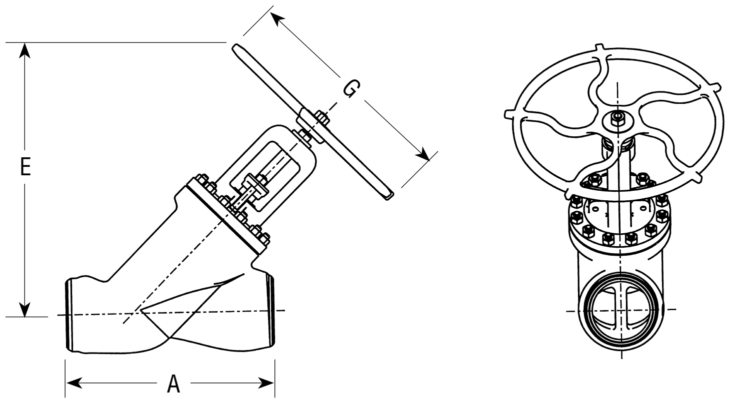
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1392/1392Y | | 2½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| A1- End to End (Welding) | | 11.5 | 13 | 15.5 | 20 | 26.5 | 31 | 40 | 40 | 42 |
| | | 292 | 330 | 394 | 508 | 673 | 787 | 1016 | 1016 | 1067 |
| A2- Face to Face (Flanged) | | 11.5 | 16 | 20.25 | 23.75 | 29 | 34.75 | 43 | 43.25 | 44 |
| | | 292 | 406 | 514 | 603 | 737 | 883 | 1092 | 1099 | 1118 |
| E - Center to Top/Check Valve | | 7 | 8 | 11 | 13.5 | 17 | 20 | 25.5 | 25.5 | 25.5 |
| | | 178 | 203 | 279 | 343 | 432 | 508 | 648 | 648 | 648 |
| H - Equalizer Clearance | | 5.9 | 8.0 | 9.5 | 10.1 | 13.0 | 14.4 | 15.5 | 20.3 | 15.5 |
| | | 150 | 203 | 241 | 257 | 330 | 366 | 394 | 514 | 394 |
| Weight (Welding) | | 40 | 70 | 105 | 210 | 400 | 700 | 1050 | 1075 | 1125 |
| | | 18 | 32 | 48 | 95 | 182 | 318 | 477 | 489 | 511 |
| Weight (Flanged) | | 54 | 100 | 150 | 290 | 520 | 875 | 1300 | 1400 | 1500 |
| | | 25 | 45 | 68 | 132 | 236 | 398 | 591 | 636 | 682 |

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

# Stop Valves
# Class 400 985 PSI @ 100°F (68.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6).
- Bolted bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound gasket.

## Pressure Class 400 (PN 68)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 1314Y | Flite-Flow | Buttwelding | 3 (80) thru 4 (100) |

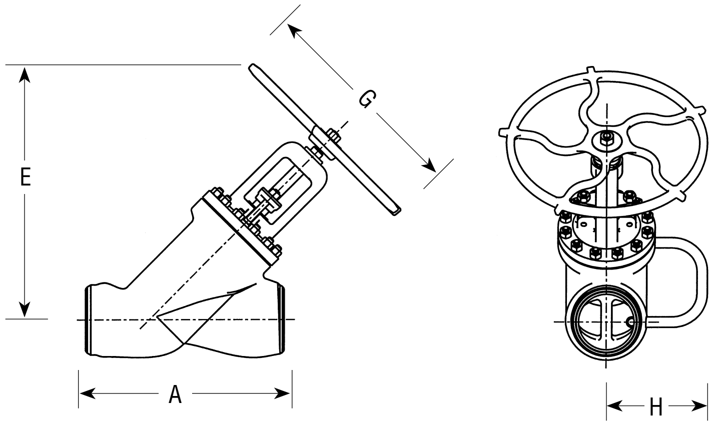
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1314Y | | 3 | 4 |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| $A_1$- End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top (Open) | | 16 | 22 |
| | | 406 | 559 |
| G - Handwheel Diameter | | 11.5 | 16 |
| | | 292 | 406 |
| Weight (Welding) | | 100 | 150 |
| | | 45 | 68 |

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

# Stop-Check (Non-Return) Valves
# Class 400 985 PSI @ 100°F (68.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6).
- Bolted or Pressure Seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound gasket.
- Equipped with equalizer.

## Pressure Class 400 (PN 68)

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 1302Y | Flite-Flow | Buttwelding | 3 (80) thru 4 (100) |

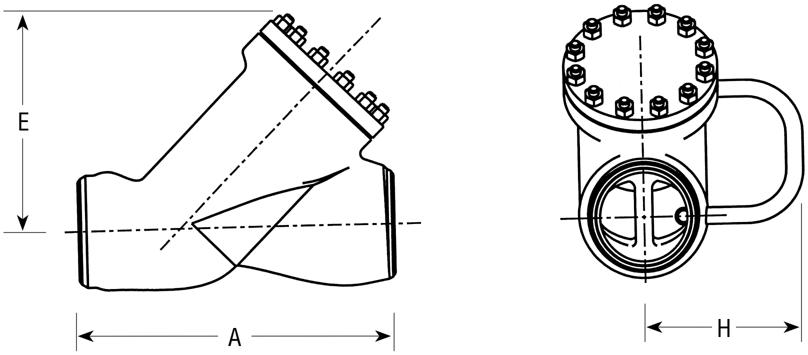
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1302Y | | 3 | 4 |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top (Open) | | 16 | 22 |
| | | 406 | 559 |
| G - Handwheel Diameter | | 11.5 | 16 |
| | | 292 | 406 |
| H - Equalizer Clearance | | 8.0 | 9.5 |
| | | 203 | 241 |
| Weight (Welding) | | 100 | 150 |
| | | 45 | 68 |

*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

# Check Valves
# Class 400 985 PSI @ 100°F (68.1 BAR @ 38°C)




## Standard Features

- Bodies and covers are cast steel (WCB, WC6).
- Bolted cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Asbestos-free spiral wound gasket.
- Equipped with equalizer.

## Pressure Class 400 (PN 68)

| Fig. No. | Type | Ends | NPS (DN) |
|---|---|---|---|
| 1392Y | Flite-Flow | Buttwelding | 3 (80) thru 4 (100) |

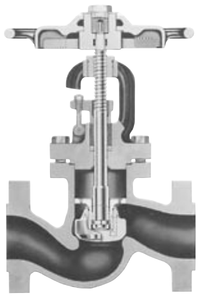
## Dimensions – Flite-Flow®

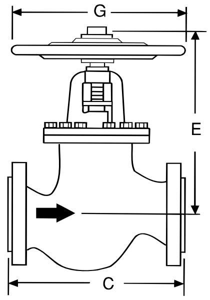
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1392Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top/Check Valve | | 8 | 11 |
| | | 203 | 279 |
| H - Equalizer Clearance | | 8.0 | 9.5 |
| | | 203 | 241 |
| Weight (Welding) | | 70 | 105 |
| | | 32 | 48 |

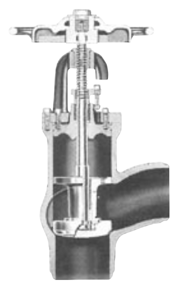
*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*

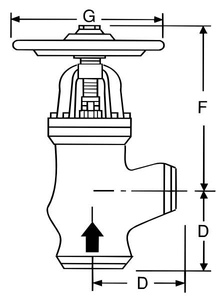
# Stop Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)






618






617Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Bolted or pressure seal bonnet, OS & Y.
- Globe or angle.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Long Terne# steel or composite pressure seal gasket.

## Pressure Class 600 (PN 110)

| FIG. NO. | | TYPE | ENDS | BONNET | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 616 | — | Globe | Flanged | Bolted Pressure Seal | 8 (200) thru 14 (350) |
| 616Y | 716Y | Globe | Buttwelding | Bolted Pressure Seal | |
| 617 | — | Angle | Flanged | Bolted Pressure Seal | 8 (200) thru 14 (350), 24 (600), 28 (700) & 30 (750) |
| 617Y | 717Y | Angle | Buttwelding | Bolted Pressure Seal | |
| 618 | — | Globe | Flanged | Bolted | 2½ (65) thru 6 (150) |
| 618Y | — | Globe | Buttwelding | Bolted | |
| 619 | — | Angle | Flanged | Bolted | |
| 619Y | — | Angle | Buttwelding | Bolted | |

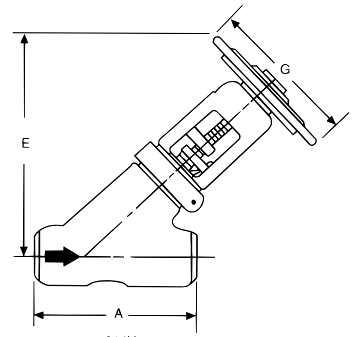
## Dimensions – Globe & Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 616/616Y, 617/617Y, 618/618Y, 619/619Y, 716Y, 717Y | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| C - Face to Face, Globe • | | 13 | 14 | 17 | 20 | 22 | 26 | 31 | 33 | 35 |
| | | 330 | 356 | 432 | 508 | 559 | 660 | 787 | 838 | 889 |
| D - Center to Face, Angle • | | 6.5 | 7 | 8.5 | 10 | 11 | 13 | 15.5 | 16.5 | 17.5 |
| | | 165 | 178 | 216 | 254 | 279 | 330 | 394 | 419 | 445 |
| E - Center to Top, Globe | | 16.2 | 16.7 | 20.1 | 24.8 | 28.4 | 34.3 | 39.7 | 43.6 | 47 |
| | | 411 | 424 | 511 | 630 | 721 | 871 | 1008 | 1107 | 1194 |
| F - Center to Top, Angle | | 14.4 | 14.6 | 17.7 | 21.4 | 24.2 | 28.8 | 32.9 | 36.1 | 38.8 |
| | | 366 | 371 | 450 | 544 | 615 | 731 | 836 | 917 | 986 |
| G - Handwheel/Handle Diameter** | | 12 | 12 | 14 | 16 | 16 | 20 | 26 | 30 | 30 |
| | | 305 | 305 | 356 | 406 | 406 | 508 | 660 | 762 | 762 |
| Weight, Globe (Flanged) | | 110 | 135 | 245 | 425 | 525 | 900 | 1550 | 2200 | 2640 |
| | | 50 | 61 | 111 | 193 | 238 | 408 | 703 | 998 | 1198 |
| Weight, Globe (Welding) | | 90 | 110 | 180 | 315 | 400 | 750 | 1200 | 1850 | 2250 |
| | | 41 | 50 | 82 | 143 | 181 | 340 | 544 | 839 | 1021 |
| Weight, Angle (Flanged) | | 100 | 122 | 228 | 355 | 460 | 730 | 1230 | 1790 | 2120 |
| | | 45 | 55 | 103 | 161 | 209 | 331 | 558 | 812 | 962 |
| Weight, Angle (Welding) | | 100 | 125 | 170 | 245 | 350 | 540 | 950 | 1450 | 1760 |
| | | 45 | 57 | 77 | 111 | 159 | 245 | 431 | 658 | 798 |

** Angle valves only, are also available in Sizes 24, 28, and 30. Dimensions available upon request.*
*** Impactor handwheel is standard on all size valves.*
*• Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*

# Stop Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)




*614Y*

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphite packing.
- Spiral wound or composite pressure seal gasket.

## Pressure Class 600 (PN 110)*

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 614*** | — | Flite-Flow | Flanged | *Pressure Seal | 3 (80) thru 32 (800) |
| 614Y | 714Y | Flite-Flow | Buttwelding | *Pressure Seal | |

** 3&4 Bolted bonnet with asbestos-free spiral wound gasket.*
** Size 3&4 Buttweld valves are Class 700. See page 43.*

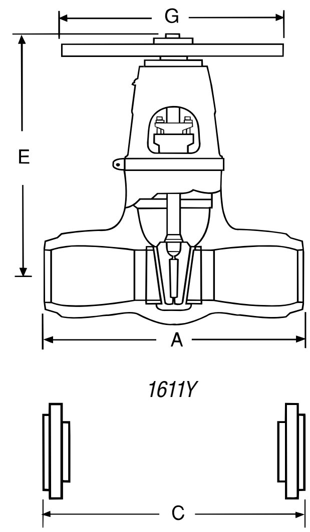
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 614Y/714Y, 614*** | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 26 | 28 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 250 | 400 | 500 | 600 | 650 | 700 | 800 |
| $A_1$ - End to End, (Welding) | | 13 | 15.5 | 20 | 26 | 31 | 38 | 38 | 41 | 60 | 66 | 70 | 81.5 | 90 |
| | | 330 | 394 | 508 | 660 | 788 | 965 | 965 | 1041 | 1524 | 1676 | 1778 | 2070 | 2286 |
| $A_2$ - Face to Face, (Flanged) | | 16.75 | 21.25 | 29 | 33 | 39 | 45 | 45 | 52 | * | * | * | * | * |
| | | 425 | 540 | 737 | 838 | 991 | 1143 | 1143 | 1321 | | | | | |
| E - Center to Top, (Open) | | 17.5 | 21.5 | 28.5 | 34 | 42 | 49 | 49 | 74 | 71 | * | * | * | * |
| | | 445 | 546 | 724 | 864 | 1067 | 1245 | 1245 | 1880 | 1803 | | | | |
| G - Handwheel Diameter | | 12 | 14 | 16 | 20 | 26 | 30 | 30 | 48 | 48 | * | * | * | * |
| | | 305 | 356 | 406 | 508 | 660 | 762 | 762 | 1219 | 1219 | | | | |
| Weight, (Welding) | | 110 | 150 | 450 | 850 | 1400 | 2050 | 2050 | 5500 | 9200 | * | * | * | * |
| | | 50 | 68 | 204 | 385 | 635 | 930 | 930 | 2495 | 4173 | | | | |
| Weight, (Flanged) | | 150 | 240 | 570 | 1000 | 1800 | 2450 | 2550 | 6500 | * | * | * | * | * |
| | | 68 | 109 | 259 | 454 | 816 | 1111 | 1157 | 2948 | | | | | |

** Dimensions and information supplied upon request.*
*** Impactor handwheel standard on all Flite-Flow valves.*
**** Flanged valves are available in sizes 3 through 16.*

# Stop Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Pressure seal bonnet OS & Y.
- Integral Stellite seats and backseat.
- Two-piece body-guided wedge.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Composite pressure seal gasket.
- Available in standard or venturi pattern.
- Yoke bushing thrust bearings.

## Pressure Class 600 (PN 110)

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 1611* | — | Equiwedge Gate | Flanged | Pressure Seal | 2½ (65) thru 28 (700) |
| 1611Y | 1711Y | Equiwedge Gate | Buttwelding | Pressure Seal | |
| 1611BY | 1711BY | Venturi Pattern / Equiwedge Gate | Buttwelding | Pressure Seal | 8 (200) thru 32 (800) |

** Flanges to size 24 only.*

## Dimensions – Equiwedge Gate

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1611/1611Y, 1711Y, A1611/A1611Y | NPS | 2½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 10 | 10 | 12 | 18 | 23 | 28 | 32 | 35 |
| | | 254 | 254 | 305 | 457 | 584 | 711 | 813 | 889 |
| C - Face to Face (Flanged) | | 13 | 14 | 17 | 22 | 26 | 31 | 33 | 35 |
| | | 330 | 356 | 432 | 559 | 660 | 787 | 838 | 889 |
| E - Center to Top (Open) | | 22.25 | 22.25 | 25.5 | 31.75 | 39.75 | 48 | 54 | 58.5 |
| | | 565 | 565 | 648 | 806 | 1010 | 1219 | 1372 | 1486 |
| G - Handwheel Diameter | | 14 | 14 | 14 | 24 | 24 | 30 | 30 | 36 |
| | | 356 | 356 | 356 | 610 | 610 | 762 | 762 | 914 |
| Weight (Welding) | | 81 | 81 | 175 | 372 | 667 | 1050 | 1623 | 2345 |
| | | 37 | 37 | 79 | 169 | 303 | 476 | 738 | 1066 |

** E, G, and other dimensions and information supplied upon request.*

# Stop Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)

## Dimensions – Equiwedge Gate (continued)

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1611/1611Y, 1711Y | | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
|---|---|---|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| | DN | 400 | 450 | 500 | 550 | 600 | 650 | 700 |
| A - End to End (Welding) | | 39 | 43 | 47 | 51 | 55 | 57 | 61 |
| | | 991 | 1092 | 1194 | 1295 | 1397 | 1448 | 1549 |
| C - Face to Face (Flanged) | | 39 | 43 | 47 | 51 | 55 | 57 | 61 |
| | | 991 | 1092 | 1194 | 1295 | 1397 | 1448 | 1549 |
| E - Center to Top (Open) | | 67 | 76 | 82.75 | 89 | 96 | 101 | 110.5 |
| | | 1702 | 1930 | 2102 | 2261 | 2438 | 2565 | 2807 |
| G - Handwheel Diameter | | 36 | 36 | 36 | 48 | 48 | 48 | 48 |
| | | 914 | 914 | 914 | 1219 | 1219 | 1219 | 1219 |
| Weight (Welding) | | 2950 | 3600 | 5000 | 5700 | 6500 | 8000 | 10,000 |
| | | 1338 | 1633 | 2268 | 2585 | 2948 | 3628 | 4535 |

## Dimensions – Equiwedge Gate Venturi Pattern

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1611BY, 1711BY | NPS | 8x6x8 | 10x8x10 | 12x10x12 | 14x12x14 | 16x14x16 | 18x16x18 |
|---|---|---|---|---|---|---|---|
| | DN | 200 | 250 | 300 | 350 | 400 | 450 |
| A - End to End (Welding) | | 18 | 23 | 28 | 32 | 35 | 39 |
| | | 457 | 584 | 711 | 813 | 889 | 991 |
| E - Center to Top (Open) | | 31.75 | 39.75 | 48 | 54 | 58.5 | 67 |
| | | 806 | 1010 | 1219 | 1372 | 1486 | 1702 |
| G - Handwheel Diameter | | 24 | 24 | 30 | 30 | 36 | 36 |
| | | 610 | 610 | 762 | 762 | 914 | 914 |
| Weight (Welding) | | 372 | 610 | 1114 | 1623 | 2345 | 2950 |
| | | 169 | 277 | 506 | 738 | 1066 | 1338 |

| Figure No. 1611BY, 1711BY | NPS | 20x18x20 | 22x20x22 | 24x20x24 | 26x22x26 | 28x24x28 | 30x26x30 | 32x28x32 |
|---|---|---|---|---|---|---|---|---|
| | DN | 500 | 550 | 600 | 650 | 700 | 750 | 800 |
| A - End to End (Welding) | | 43 | 47 | 47 | 51 | 55 | 57 | 61 |
| | | 1092 | 1194 | 1194 | 1295 | 1397 | 1448 | 1549 |
| E - Center to Top (Open) | | 76 | 82.75 | 82.75 | 89 | 96 | 101 | 110.5 |
| | | 1930 | 2102 | 2102 | 2261 | 2438 | 2565 | 2807 |
| G - Handwheel Diameter | | 36 | 36 | 48 | 48 | 48 | 48 | 48 |
| | | 914 | 914 | 1219 | 1219 | 1219 | 1219 | 1219 |
| Weight (Welding) | | 3600 | 5000 | 5700 | 6500 | 7000 | 8500 | 10,500 |
| | | 1633 | 2268 | 2585 | 2948 | 3175 | 3855 | 4762 |



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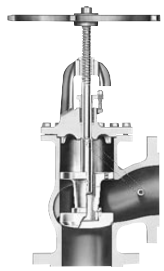
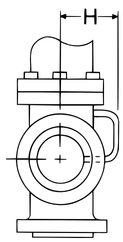
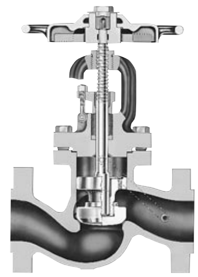
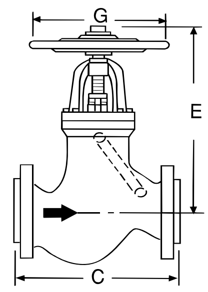
# Stop-Check (Non-Return) Valves
# Class 600    1480 PSI @ 100°F (102.1 BAR @ 38°C)

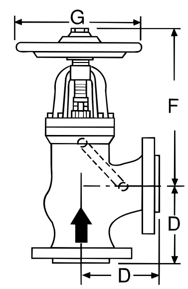






604



605

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Bolted or pressure seal bonnet OS & Y.
- Globe or angle.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Long terne# steel or composite pressure seal gasket.
- Equipped with equalizer.

## Pressure Class 600 (PN 110)

| FIG. NO. | | TYPE | ENDS | BONNET | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 604 | — | Globe | Flanged | Bolted | 2½ (65) thru 6 (150) |
| 604Y | — | Globe | Buttwelding | Bolted | |
| 605 | — | Angle | Flanged | Bolted | |
| 605Y | — | Angle | Buttwelding | Bolted | |
| 606 | — | Globe | Flanged | Pressure Seal | 8 (200) thru 14 (350) |
| 606Y | 706Y | Globe | Buttwelding | Pressure Seal | |
| 607 | — | Angle | Flanged | Pressure Seal | 8 (200) thru 14 (350), 24 (600), 28 (700) & 30 (750) |
| 607Y | 707Y | Angle | Buttwelding | Pressure Seal | |

## Dimensions – Globe & Angle*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 604/604Y, 605/605Y, 606/606Y, 607/607Y, 706Y, 707Y | | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| C - Face to Face, Globe** | | 13 | 14 | 17 | 20 | 22 | 26 | 31 | 33 | 35 |
| | | 330 | 356 | 432 | 508 | 559 | 660 | 787 | 838 | 889 |
| D - Center to Face, Angle** | | 6.5 | 7 | 8.5 | 10 | 11 | 13 | 15.5 | 16.5 | 17.5 |
| | | 165 | 178 | 216 | 254 | 279 | 330 | 394 | 419 | 445 |
| E - Center to Top, Globe | | 16.2 | 16.7 | 20.1 | 24.8 | 28.4 | 34.3 | 39.7 | 43.6 | 47 |
| | | 411 | 424 | 511 | 630 | 721 | 871 | 1008 | 1107 | 1194 |
| F - Center to Top, Angle | | 14.4 | 14.6 | 17.7 | 21.4 | 24.2 | 28.8 | 32.9 | 36.1 | 38.8 |
| | | 366 | 371 | 450 | 544 | 615 | 731 | 836 | 917 | 986 |
| G - Handwheel Diameter# | | 12 | 12 | 14 | 16 | 16 | 20 | 26 | 30 | 30 |
| | | 305 | 305 | 356 | 406 | 406 | 508 | 660 | 762 | 762 |
| H - Equalizer Clearance | | 8.7 | 8.5 | 10 | 9.6 | 11 | 11.8 | 13 | 13.7 | 15.7 |
| | | 221 | 216 | 254 | 244 | 279 | 300 | 330 | 348 | 399 |
| Weight, Globe (Flanged) | | 110 | 135 | 220 | 425 | 540 | 960 | 1540 | 2200 | 2680 |
| | | 50 | 61 | 112 | 193 | 245 | 435 | 699 | 998 | 1216 |
| Weight, Globe (Welding) | | 84 | 110 | 185 | 335 | 410 | 750 | 1270 | 1850 | 2250 |
| | | 38 | 50 | 84 | 152 | 186 | 340 | 596 | 839 | 1021 |
| Weight, Angle (Flanged) | | 105 | 125 | 225 | 325 | 460 | 750 | 1200 | 1790 | 2150 |
| | | 48 | 57 | 102 | 147 | 209 | 340 | 544 | 812 | 975 |
| Weight, Angle (Welding) | | 80 | 90 | 168 | 245 | 350 | 560 | 950 | 1450 | 1760 |
| | | 36 | 41 | 76 | 111 | 159 | 254 | 431 | 667 | 798 |

** Angle valves only, are also available in Sizes 24, 28, and 30. Dimensions available upon request.*
*** Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*
*# Impactor handwheel is standard on all size valves.*



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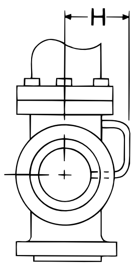
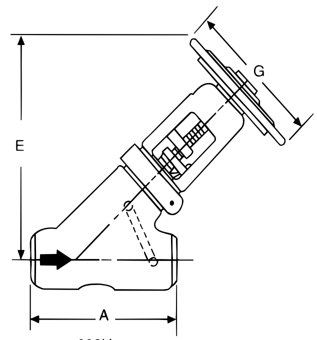
# Stop-Check (Non-Return) Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)




602Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Bolted or pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Spiral wound or composite pressure seal gasket.
- Equipped with equalizer.

## Pressure Class 600 (PN 110)*

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| ***602 | — | Flite-Flow | Flanged | Pressure Seal* | 3 (80) thru 32 (800) |
| 602Y | 702Y | Flite-Flow | Buttwelding | Pressure Seal* | |

** Size 3 & 4 - Bolted bonnet with asbestos-free spiral wound gasket.*
** Size 3 & 4 Buttweld valves are Class 700. See page 44.*

## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 602Y/702Y, ***602 | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 26 | 28 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 250 | 400 | 500 | 600 | 650 | 700 | 800 |
| A1 - End to End (Welding) | | 13 | 15.5 | 20 | 26 | 31 | 38 | 38 | 41 | 60 | 66 | 70 | 81.5 | 90 |
| | | 330 | 394 | 508 | 660 | 787 | 965 | 965 | 1041 | 1524 | 1676 | 1778 | 2070 | 2286 |
| A2 - Face to Face (Flanged) | | 16.75 | 21.25 | 29 | 33 | 39 | 45 | 45 | 52 | * | * | * | * | * |
| | | 425 | 540 | 737 | 838 | 991 | 1143 | 1143 | 1321 | | | | | |
| E - Center to Top (Open) | | 17.5 | 21.5 | 28.5 | 34 | 42 | 49 | 49 | 74 | 71 | * | * | * | * |
| | | 445 | 546 | 724 | 864 | 1067 | 1245 | 1245 | 1880 | 1803 | | | | |
| G - Handwheel Diameter | | 12 | 14 | 16 | 20 | 26 | 30 | 30 | 48 | 48 | * | * | * | * |
| | | 305 | 356 | 406 | 508 | 660 | 762 | 762 | 1219 | 1219 | | | | |
| H - Equalizer Clearance | | 7 | 9 | 10 | 12 | 13 | 14 | 14 | 22 | 24 | * | * | * | * |
| | | 178 | 229 | 254 | 305 | 330 | 356 | 356 | 559 | 610 | | | | |
| Weight (Welding) | | 110 | 150 | 450 | 850 | 1400 | 2050 | 2050 | 5500 | 9200 | * | * | * | * |
| | | 50 | 68 | 204 | 385 | 635 | 930 | 930 | 2495 | 4173 | | | | |
| Weight (Flanged) | | 150 | 240 | 570 | 1000 | 1800 | 2850 | 3100 | 6500 | * | * | * | * | * |
| | | 68 | 109 | 259 | 454 | 816 | 1293 | 1406 | 2948 | | | | | |

** E, G, and other dimensions and information supplied upon request.*
*** Impactor handwheel standard on all Flite-Flow valves.*
**** Flanged valves available in sizes 3 through 16.*



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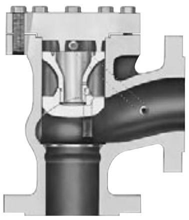
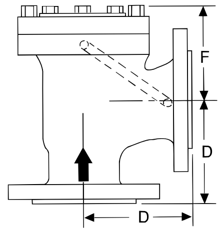
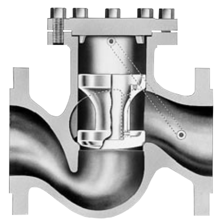
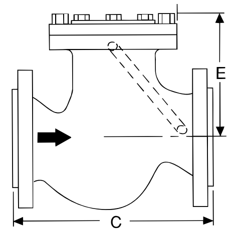
# Check Valves
# Class 600 1480 PSI @ 100°F (102.1 BAR @ 38°C)






691






690

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A).
- Bolted or pressure seal cover.
- Y-Pattern, globe, angle, or tilting disk.
- Integral Stellite seats.
- Body-guided disk piston, globe, angle & Flite-Flow.
- Long Terne# steel or pressure seal gasket.
- Equipped with equalizer, globe, angle & Flite-Flow.

## Pressure Class 600 (PN 110)*

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 670Y | 770Y | Tilting Disk | Buttwelding | Bolted | 6 (150) thru 20 (500) |
| 690 | — | Globe | Flanged | Bolted | 2½ (65) thru 6 (150) |
| 690Y | — | Globe | Buttwelding | Bolted | |
| 691 | — | Angle | Flanged | Bolted | |
| 691Y | — | Angle | Buttwelding | Bolted | |
| ***692 | — | Flite-Flow | Flanged | *Pressure Seal | 3 (80) thru 32 (800) |
| 692Y | 792Y | Flite-Flow | Buttwelding | *Pressure Seal | |
| 694 | — | Globe | Flanged | Pressure Seal | 8 (200) thru 14 (350) |
| 694Y | 794Y | Globe | Buttwelding | Pressure Seal | |
| 695 | — | Angle | Flanged | Pressure Seal | |
| 695Y | 795Y | Angle | Buttwelding | Pressure Seal | |

** Size 3&4 - Bolted bonnet with asbestos-free spiral wound gasket.*
** Size 3&4 Buttweld Flite-Flow valves are Class 700. See page 45.*

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 690/690Y, 691/691Y, 694/694Y, 695/695Y, 794Y, 795Y | | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| C - Face to Face, Globe (Flanged)• | | 13 | 14 | 17 | 20 | 22 | 26 | 31 | 33 | 35 |
| | | 330 | 356 | 432 | 508 | 559 | 660 | 787 | 838 | 889 |
| D - Center to Face, Angle (Flanged)• | | 6.5 | 7 | 8.5 | 10 | 11 | 13 | 15.5 | 16.5 | 17.5 |
| | | 165 | 178 | 216 | 254 | 279 | 330 | 394 | 419 | 445 |
| E - Center to Top, Globe | | 6.6 | 7.1 | 8.9 | 11.4 | 13.1 | 17.3 | 20.2 | 23.2 | 25.1 |
| | | 168 | 180 | 226 | 290 | 333 | 439 | 513 | 589 | 638 |
| F - Center to Top, Angle | | 4.8 | 5.0 | 6.4 | 8.0 | 8.9 | 11.9 | 13.4 | 15.5 | 16.6 |
| | | 122 | 127 | 163 | 203 | 226 | 302 | 340 | 394 | 422 |
| H - Equalizer Clearance | | 8.7 | 8.5 | 10 | 9.6 | 11 | 11.8 | 13 | 13.7 | 15.7 |
| | | 221 | 216 | 254 | 244 | 279 | 300 | 330 | 348 | 399 |
| Weight, Globe (Flanged) | | 80 | 110 | 210 | 360 | 460 | 815 | 1290 | 1870 | 2320 |
| | | 36 | 50 | 95 | 163 | 209 | 370 | 585 | 848 | 1052 |
| Weight, Globe (Welding) | | 60 | 80 | 140 | 250 | 325 | 620 | 1040 | 1550 | 1930 |
| | | 27 | 36 | 64 | 113 | 147 | 281 | 472 | 703 | 875 |
| Weight, Angle (Flanged) | | 72 | 95 | 184 | 290 | 380 | 590 | 990 | 1490 | 1830 |
| | | 33 | 43 | 84 | 132 | 172 | 268 | 449 | 676 | 830 |
| Weight, Angle (Welding) | | 50 | 70 | 124 | 180 | 250 | 400 | 710 | 1170 | 1440 |
| | | 23 | 32 | 56 | 82 | 113 | 181 | 322 | 531 | 653 |

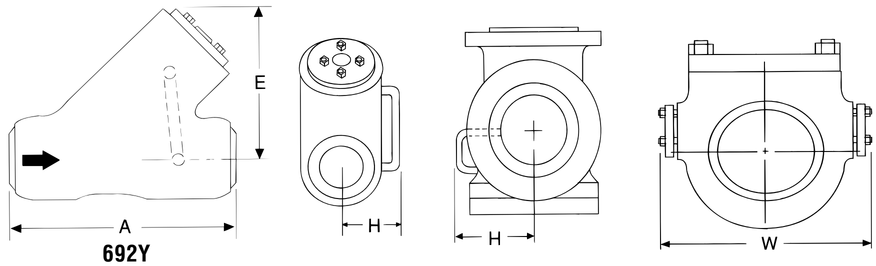
*• Center-to-end or end-to-end dimensions for welding end valves same as center-to-contact face or contact-face to contact-face dimensions for flanged end valves.*
*# Long Terne Steel is a product coated by immersion in molten terne metal. Terne Metal is an alloy of lead and a small amount (about 3%) of tin.*
**** Flanged valves available in sizes 3 through 16.*

FLOWSERVE

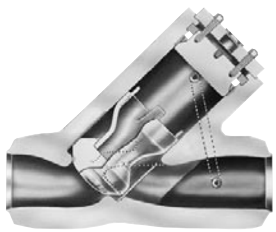
# *Check Valves*
# *Class 600    1480 PSI @ 100°F (102.1 BAR @ 38°C)*

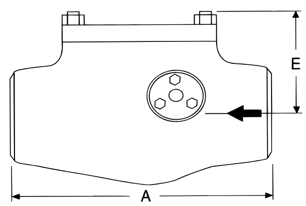
## *Standard Features*

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A).
- Bolted or pressure seal cover.
- Y-Pattern, globe, angle, or tilting disk.
- Integral Stellite seats.
- Body-guided disk piston, globe, angle & Flite-Flow.
- Gasket: Sizes 3 & 4 asbestos-free, spiral wound. All others: composite pressure seal.
- Equipped with equalizer, globe, angle & Flite-Flow.




**692Y**






*670Y*

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

## *Dimensions – Flite-Flow*

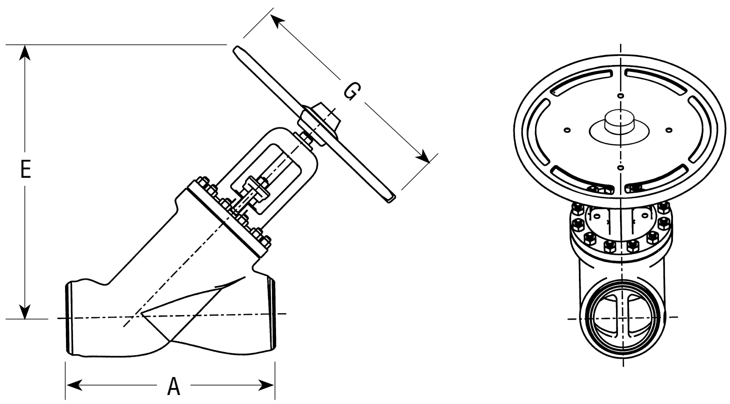
| **Figure No.692Y/792Y** ***692 | | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 26 | 28 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 26 | 28 | 32 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 250 | 400 | 500 | 600 | 650 | 700 | 800 |
| A - End to End (Welding) | | 13 | 15.5 | 20 | 26 | 31 | 38 | 38 | 41 | 60 | 66 | 70 | 81.5 | 90 |
| | | 330 | 394 | 508 | 660 | 787 | 965 | 965 | 1041 | 1524 | 1676 | 1778 | 2070 | 2286 |
| $A_2$ - Face to Face (Flanged) | | 16.75 | 21.5 | 29 | 33 | 39 | 45 | 45 | 52 | * | * | * | * | * |
| | | 425 | 540 | 737 | 838 | 991 | 1143 | 1143 | 1321 | * | * | * | – | – |
| E - Center to Top | | 7 | 11 | 15.75 | 17.75 | 21.25 | 25.25 | 25.25 | 31.5 | 36.0 | * | * | * | * |
| | | 178 | 279 | 400 | 451 | 540 | 641 | 641 | 800 | 914 | | | | |
| H - Equalizer Clearance | | 7 | 9 | 10 | 12 | 13 | 14 | 14 | 22 | 24 | * | * | * | * |
| | | 178 | 229 | 254 | 305 | 330 | 356 | 356 | 559 | 610 | * | * | * | * |
| Weight (Welding) | | 80 | 125 | 375 | 575 | 1000 | 1450 | 1450 | 3300 | * | * | * | * | * |
| | | 35 | 55 | 170 | 261 | 454 | 658 | 658 | 1497 | | | | | |
| Weight (Flanged) | | 120 | 200 | 520 | 750 | 1250 | 1900 | 2150 | 4300 | * | * | – | – | – |
| | | 54 | 90 | 236 | 340 | 567 | 862 | 975 | 1950 | | | | | |

*  *E, H and other dimensions and information supplied upon request.*
**** Flanged valves available in sizes 3 through 16.*
*Note: Size 3&4 Buttweld Class 600 Flite-Flow valves are Class 700. See page 45.*

## *Dimensions – Tilting Disk*

| **Figure No. 670Y/770Y** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| | DN | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
| A - End to End (Welding) | | 19.5 | 22 | 28.5 | 34.5 | 34.5 | 43.25 | 48.25 | 53.5 |
| | | 495 | 559 | 724 | 876 | 876 | 1099 | 1226 | 1359 |
| E - Center to Top | | 9.5 | 10.5 | 13.5 | 15.5 | 15.5 | 20.5 | 22.5 | 23.75 |
| | | 241 | 267 | 343 | 394 | 394 | 521 | 572 | 603 |
| W - Width | | 15.25 | 17.5 | 21 | 25 | 25 | 32.25 | 34 | 38.5 |
| | | 387 | 445 | 533 | 635 | 635 | 819 | 864 | 978 |
| Weight (Welding) | | 300 | 500 | 950 | 1450 | 1550 | 2550 | 3550 | 5650 |
| | | 136 | 225 | 428 | 653 | 698 | 1148 | 1598 | 2543 |

# Stop Valves
# Class 700 1725 PSI @ 100°F (119.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Bolted bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound gasket.

## Pressure Class 700 (PN 120)

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 614Y | 714Y | Flite-Flow | Buttwelding | Bolted | 3 (80) and 4 (100) |

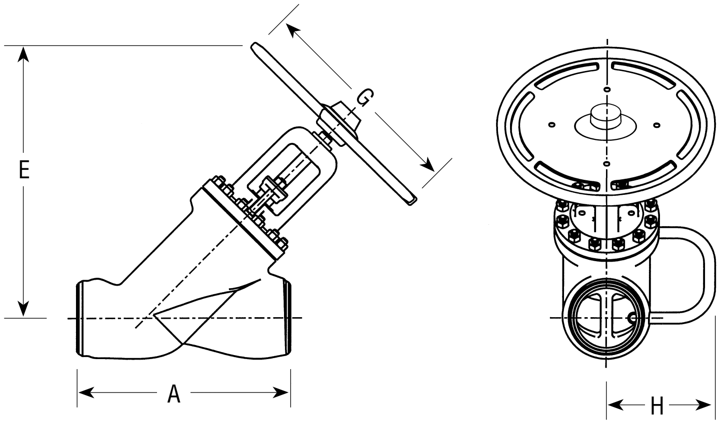
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No.614Y**, 714Y** | | 3 | 4 |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top (Open) | | 16 | 21.5 |
| | | 406 | 546 |
| G - Handwheel Diameter | | 12 | 14 |
| | | 305 | 356 |
| Weight (Welding) | | 110 | 150 |
| | | 50 | 68 |

*** Impactor handwheel standard on all Flite-Flow valves.*

# Stop-Check (Non-Return) Valves
# Class 700 1725 PSI @ 100°F (119.1 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A).
- Bolted bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Asbestos-free spiral wound gasket.
- Equipped with equalizer.

## Pressure Class 700 (PN 120)

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 602Y | 702Y | Flite-Flow | Buttwelding | Bolted | 3 (80) and 4 (100) |

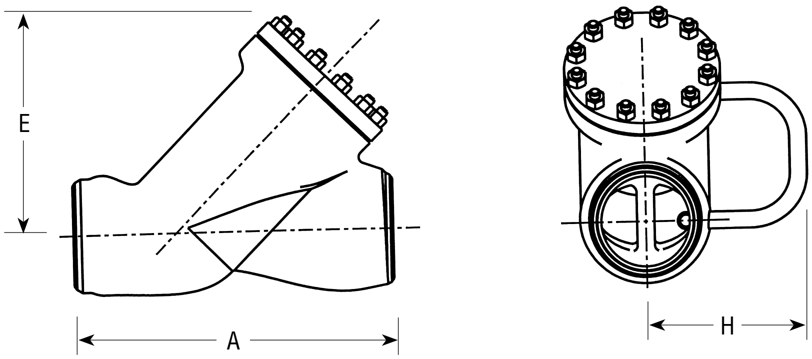
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No.602Y/702Y | | 3 | 4 |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top (Open) | | 16 | 21.5 |
| | | 406 | 546 |
| G - Handwheel Diameter** | | 12 | 14 |
| | | 305 | 356 |
| H - Equalizer Clearance | | 7 | 9 |
| | | 178 | 229 |
| Weight (Welding) | | 110 | 150 |
| | | 50 | 68 |

*** Impactor handwheel standard on Flite-Flow valves.*

# Check Valves
# Class 700    1725 PSI @ 100°F (119.1 BAR @ 38°C)




## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A).
- Bolted cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Asbestos-free spiral wound gasket.
- Equipped with equalizer.

## Pressure Class 700 (PN 120)

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 692Y | 792Y | Flite-Flow | Buttwelding | Bolted | 3 (80) & 4 (100) |

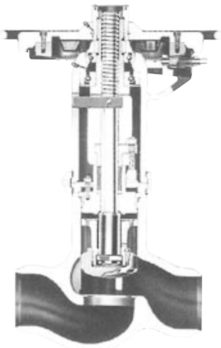
## Dimensions – Flite-Flow®

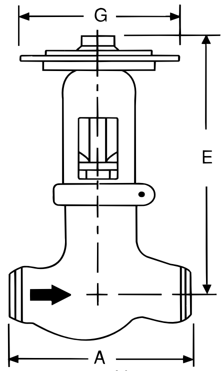
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No.692Y/792Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 13 | 15.5 |
| | | 330 | 394 |
| E - Center to Top | | 8 | 11 |
| | | 203 | 279 |
| H - Equalizer Clearance | | 7 | 9 |
| | | 178 | 229 |
| Weight (Welding) | | 80 | 125 |
| | | 36 | 55 |

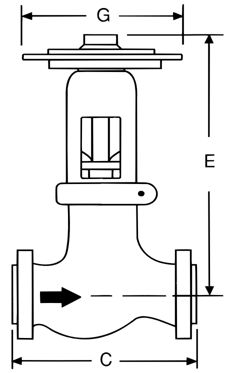
FLOWSERVE

# Stop Valves
# Class 900    2220 PSI @ 100°F (153.2 BAR @ 38°C)






*4016Y*




*4016*

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M, or CF8C).
- Pressure seal Bonnet, OS & Y.
- Y-Pattern, globe & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Yoke bushing thrust bearings size 5 and larger.

## Pressure Class 900 (PN 150)*

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4016 | — | Globe | Flanged | 3 (80) thru 14 (350) |
| 4016Y | 4316Y | Globe | Buttwelding | |
| 4017 | — | Angle | Flanged | 3 (80) thru 24 (600) |
| 4017Y | 4317Y | Angle | Buttwelding | |
| 4014 | | Flite-Flow | Flanged | 3 (80) thru 16 (400) |
| 4014Y | 4314Y | Flite-Flow | Buttwelding* | |

*Size 3 & 4 Buttweld Flite-Flow valves are class 1100 - see page 55.*

## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4016/4016Y, 4017/4017Y, 4316Y, 4317Y | | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
| | DN | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| B - Center to Face (Welding) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 19 |
| | | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 483 |
| C - Face to Face (Flanged) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| D - Center to Face (Flanged) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 21.75 |
| | | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 552 |
| E - Center to Top, Globe (Open) | | 22.5 | 26.25 | 30.6 | 37 | 46 | 54.75 | 64.75 | 71.25 |
| | | 572 | 667 | 777 | 940 | 1168 | 1391 | 1645 | 1810 |
| F - Center to Top, Angle (Open) | | 20.4 | 23.75 | 28.25 | 34.25 | 43.4 | 49.25 | 60 | 60 |
| | | 518 | 603 | 718 | 870 | 1102 | 1251 | 1524 | 1524 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 20 | 28 | 28 | 36 | 36 |
| | | 406 | 406 | 508 | 508 | 711 | 711 | 914 | 914 |
| Weight, Globe (Flanged) | | 210 | 310 | 610 | 800 | 1570 | 2410 | 3700 | 4600 |
| | | 95 | 141 | 277 | 363 | 712 | 1093 | 1665 | 2086 |
| Weight, Globe (Welding) | | 175 | 235 | 500 | 620 | 1390 | 2300 | 3100 | 3850 |
| | | 79 | 107 | 227 | 281 | 630 | 1043 | 1395 | 1746 |
| Weight, Angle (Flanged) | | 206 | 284 | 540 | 710 | 1360 | 2103 | 3010 | 3060 |
| | | 93 | 129 | 245 | 322 | 612 | 946 | 1365 | 1388 |
| Weight, Angle (Welding) | | 150 | 210 | 410 | 552 | 1035 | 1690 | 2555 | 2580 |
| | | 68 | 95 | 185 | 250 | 466 | 761 | 1159 | 1170 |

** Impactor handwheel is standard on all valves.*



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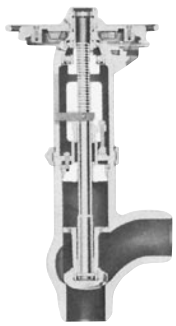
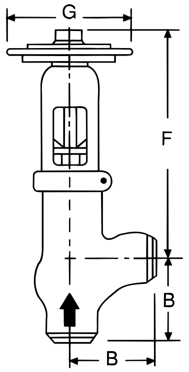
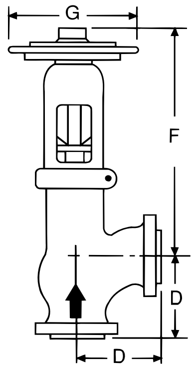
# Stop Valves
# Class 900  2220 PSI @ 100°F (153.2 BAR @ 38°C)

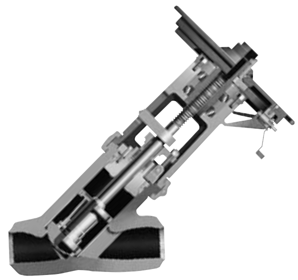


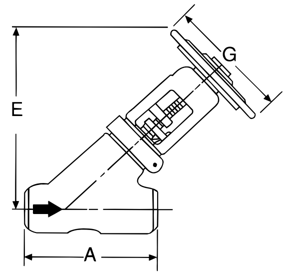



4017 Y




4017






4014 Y

## Dimensions - Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4017/4017Y, 4317Y | NPS | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| | DN | 400 | 450 | 500 | 600 |
| B - Center to End (Welding) | | 26 | ** | 32.5 | 39 |
| | | 660 | | 825 | 991 |
| F - Center to Top, Angle | | 78.5 | ** | 95 | 102 |
| | | 1994 | | 2413 | 2591 |
| G - Handwheel Diameter* | | 48 | ** | 72 | 72 |
| | | 1219 | | 1829 | 1829 |
| Weight, Angle (Welding) | | 4440 | ** | 8150 | 13,750 |
| | | 2014 | | 3697 | 6237 |

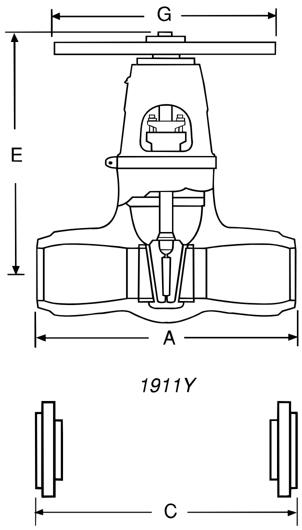
*** Size 18 angle - available upon request.*

## Dimensions - Flite-Flow®

| Figure No. 4014/4014Y, 4314Y | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| $A_1$ - End to End (Welding) | | 17 | 18.5 | 20 | 26 | 31 | 38 | 38 | 44.5 |
| | | 432 | 479 | 508 | 660 | 787 | 965 | 965 | 1130 |
| $A_2$ - Face to Face (Flanged) | | 22.25 | 23.75 | 30 | 38 | 44 | 50 | 51 | 58 |
| | | 565 | 603 | 762 | 965 | 1118 | 1270 | 1295 | 1473 |
| E - Center to Top (Open) | | 20 | 25 | 35 | 44 | 51 | 60 | 60 | 73 |
| | | 508 | 635 | 889 | 1118 | 1295 | 1524 | 1524 | 1854 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 28 | 28 | 36 | 36 | 48 |
| | | 406 | 406 | 508 | 711 | 711 | 914 | 914 | 1219 |
| Weight (Welding) | | 190 | 275 | 550 | 1150 | 2100 | 3400 | 3400 | 5550 |
| | | 86 | 125 | 249 | 522 | 953 | 1542 | 1542 | 2517 |
| Weight (Flanged) | | 250 | 370 | 775 | 1550 | 2650 | 4150 | 4550 | 6950 |
| | | 113 | 168 | 352 | 703 | 1202 | 1882 | 2064 | 3152 |

** Impactor handwheel is standard on all valves.*
*Note: Size 3&4 Buttweld Class 900 Flite-Flow valves are Class 1100. See page 55.*

# Stop Valves
# Class 900 2220 PSI @ 100°F (153.2 BAR @ 38°C)




1911Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Integral Stellite seat, disk and backseat.
- Two-piece body-guided wedge.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Available in standard or venturi pattern.
- Yoke bushing thrust bearings.
- Composite pressure seal gasket.

## Pressure Class 900 (PN 150)

| Fig. No. | | Type | Ends | Bonnet | NPS (DN) |
|---|---|---|---|---|---|
| STD CL | SPL CL | | | | |
| 1911 | — | Equiwedge Gate | Flanged* | Pressure Seal | 2½ (65) thru 28 (700) |
| 1911Y | 14311Y | Equiwedge Gate | Buttwelding | Pressure Seal | |
| 1911BY | 14311BY | Venturi Pattern Equiwedge Gate | Buttwelding | Pressure Seal | 8 (200) thru 32 (800) |

## Dimensions – Equiwedge Gate

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1911/1911Y, 14311Y | NPS | 2½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 12 | 12 | 14 | 20 | 26 | 31 | 36 | 39 |
| | | 305 | 305 | 356 | 508 | 660 | 787 | 914 | 991 |
| C - Face to Face (Flanged) | | 16.5 | 15 | 18 | 24 | 29 | 33 | 38 | 40.5 |
| | | 419 | 381 | 457 | 610 | 737 | 838 | 965 | 1029 |
| E - Center to Top (Open) | | 21.25 | 21.25 | 24.5 | 33.5 | 40 | 46.75 | 54.5 | 59 |
| | | 540 | 540 | 622 | 851 | 1016 | 1187 | 1384 | 1499 |
| G - Handwheel Diameter | | 14 | 14 | 18 | 24 | 24 | 36 | 36 | 36 |
| | | 356 | 356 | 457 | 610 | 610 | 914 | 914 | 914 |
| Weight (Welding) | | 95 | 125 | 165 | 380 | 690 | 1523 | 2118 | 2805 |
| | | 43 | 57 | 75 | 172 | 313 | 692 | 963 | 1275 |



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# Stop Valves
# Class 900 2220 PSI @ 100°F (153.2 BAR @ 38°C)

## Dimensions – Equiwedge Gate (continued)

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1911/1911Y, 14311Y | | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
|---|---|---|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| | DN | 400 | 450 | 500 | 550 | 600 | 650 | 700 |
| A - End to End (Welding) | | 43 | 48 | 52 | 57 | 61 | 64 | 68 |
| | | 1092 | 1291 | 1321 | 1448 | 1549 | 1626 | 1727 |
| C - Face to Face (Flanged) | | 44.5 | 48 | 52 | 57 | 61 | Available Upon Request | |
| | | 1130 | 1291 | 1321 | 1448 | 1549 | | |
| E - Center to Top (Open) | | 68 | 73.75 | 82 | 89.25 | 95 | 102 | 109 |
| | | 1727 | 1873 | 2083 | 2267 | 2413 | 2591 | 2769 |
| G - Handwheel Diameter | | 36 | 36 | 48 | 48 | 48 | 60 | 60 |
| | | 914 | 914 | 1219 | 1219 | 1219 | 1524 | 1524 |
| Weight (Welding) | | 4150 | 4300 | 5800 | 7500 | 9600 | 12,000 | |
| | | 1882 | 1950 | 2631 | 3402 | 4355 | 5443 | |

## Dimensions - Equiwedge Gate Venturi Pattern

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

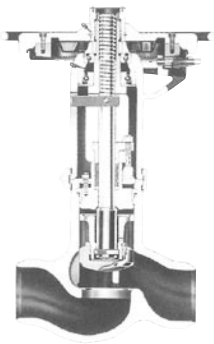
| Figure No. 1911BY, 14311BY | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 8x6x8 | 10x8x10 | 12x10x12 | 14x12x14 | 16x14x16 | 18x16x18 |
| | DN | 200 | 250 | 300 | 350 | 400 | 450 |
| A - End to End (Welding) | | 20 | 26 | 31 | 36 | 39 | 43 |
| | | 508 | 660 | 787 | 914 | 991 | 1092 |
| E - Center to Top (Open) | | 33.5 | 40 | 46.75 | 54.5 | 59 | 68 |
| | | 851 | 1016 | 1187 | 1384 | 1499 | 1727 |
| G - Handwheel Diameter | | 24 | 24 | 36 | 36 | 36 | 36 |
| | | 610 | 610 | 914 | 914 | 914 | 914 |
| Weight (Welding) | | 530 | 891 | 1523 | 2118 | 2805 | 4150 |
| | | 241 | 405 | 692 | 963 | 1275 | 1882 |

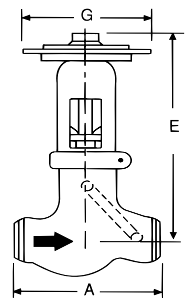
| Figure No. 1911BY, 14311BY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | NPS | 20x18x20 | 22x20x22 | 24x20x24 | 26x22x26 | 28x24x28 | 30x26x30 | 32x28x32 |
| | DN | 500 | 550 | 600 | 650 | 700 | 750 | 800 |
| A - End to End (Welding) | | 48 | 52 | 52 | 57 | 61 | 64 | 68 |
| | | 1219 | 1321 | 1321 | 1448 | 1549 | 1626 | 1727 |
| E - Center to Top (Open) | | 73.75 | 82 | 82 | 89.25 | 95 | 102 | 109 |
| | | 1873 | 2083 | 2083 | 2267 | 2413 | 2591 | 2769 |
| G - Handwheel Diameter | | 36 | 48 | 48 | 48 | 48 | 60 | 60 |
| | | 914 | 1219 | 1219 | 1219 | 1219 | 1524 | 1524 |
| Weight (Welding) | | 4500 | 6970 | 7200 | 8000 | 10,000 | 12,500 | 15,000 |
| | | 2041 | 3162 | 3266 | 3629 | 4536 | 5670 | 6804 |

# Stop-Check (Non-Return) Valves
# Class 900 2220 PSI @ 100°F (153.2 BAR @ 38°C)

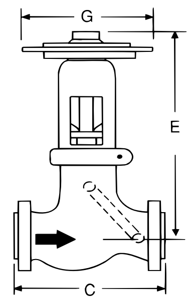
## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal Bonnet, OS & Y.
- Y-Pattern, globe & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.
- Yoke bushing thrust bearings.





4006Y



4006

## Pressure Class 900 (PN 150)*

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4006 | — | Globe | Flanged | 3 (80) thru 14 (350) |
| 4006Y | 4306Y | Globe | Buttwelding | |
| 4007 | — | Angle | Flanged | 3 (80) thru 24 (600) |
| 4007Y | 4307Y | Angle | Buttwelding | |
| 4002 | — | Flite-Flow | Flanged | 3 (80) thru 16 (400) |
| 4002Y | 4302Y | Flite-Flow | Buttwelding* | |

** Size 3&4 Buttweld Flite-Flow valves are Class 1100 - see page 56.*

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4006/4006Y, 4007/4007Y, 4306Y, 4307Y | | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
| | DN | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| B - Center to End (Welding) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 19 |
| | | 190 | 22 | 279 | 305 | 368 | 419 | 483 | 483 |
| C - Face to Face (Flanged) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| D - Center to Face (Flanged) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 21.75 |
| | | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 552 |
| E - Center to Top, Globe (Open) | | 22.5 | 26.25 | 30.63 | 37 | 46 | 54.75 | 64.75 | 71.25 |
| | | 572 | 667 | 778 | 940 | 1168 | 1391 | 1645 | 1810 |
| F - Center to Top, Angle (Open) | | 20.38 | 23.75 | 28.25 | 34.25 | 43.38 | 49.25 | 60 | 62.75 |
| | | 518 | 603 | 718 | 870 | 1102 | 1251 | 1524 | 1594 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 20 | 28 | 28 | 36 | 36 |
| | | 406 | 406 | 508 | 508 | 711 | 711 | 914 | 914 |
| H - Clearance for Equalizer | | 7.5 | 7.63 | 9.75 | 10.75 | 12.5 | 12.88 | 14.75 | 17.38 |
| | | 190 | 194 | 248 | 273 | 318 | 327 | 375 | 441 |
| Weight, Globe (Flanged) | | 220 | 314 | 615 | 800 | 1570 | 2425 | 3700 | 4600 |
| | | 100 | 142 | 279 | 363 | 712 | 1100 | 1665 | 2087 |
| Weight, Globe (Welding) | | 175 | 245 | 500 | 642 | 1400 | 2300 | 3100 | 4750 |
| | | 79 | 111 | 227 | 291 | 635 | 1043 | 1406 | 2155 |
| Weight, Angle (Flanged) | | 206 | 284 | 540 | 690 | 1360 | 2103 | 3010 | 3060 |
| | | 93 | 129 | 245 | 313 | 617 | 954 | 1365 | 1388 |
| Weight, Angle (Welding) | | 150 | 215 | 410 | 552 | 1035 | 1600 | 2555 | 2580 |
| | | 68 | 98 | 186 | 250 | 469 | 725 | 1159 | 1170 |

** Impactor handwheel is standard on all valves.*



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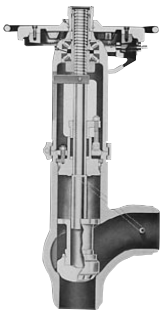
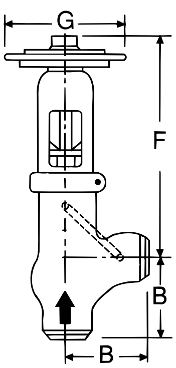
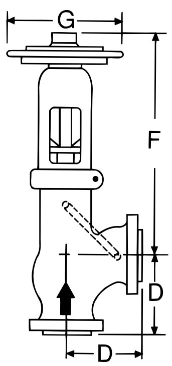
# Stop-Check (Non-Return) Valves
# Class 900    2220 PSI @ 100°F (153.2 BAR @ 38°C)

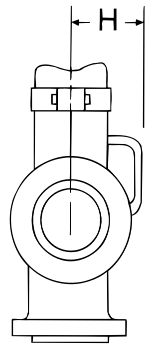


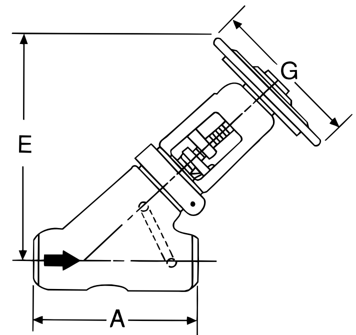



4007 Y




4007




4002 Y

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4007/4007Y, 4307Y | | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 24 |
| | DN | 400 | 450 | 500 | 600 |
| B - Center to End (Welding) | | 26 | ** | 32.5 | 39 |
| | | 660 | | 825 | 991 |
| F - Center to Top, Angle | | 78.5 | ** | 95 | 102 |
| | | 1994 | | 2413 | 2591 |
| G - Handwheel Diameter* | | 48 | ** | 72 | 72 |
| | | 1219 | | 1829 | 1829 |
| H - Clearance for Equalizer | | 20 | ** | 21.5 | 30 |
| | | 50.8 | | 546 | 762 |
| Weight, Angle (Welding) | | 4960 | ** | 8150 | 13,750 |
| | | 2250 | | 3697 | 6237 |

*** Size 18" Angle - Available Upon Request.*

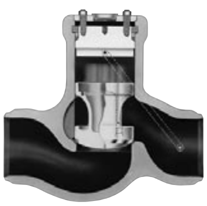
## Dimensions – Flite-Flow

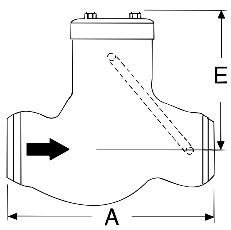
| Figure No. 4002/4002Y, 4302Y | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| $A_1$ - End to End (Welding) | | 17 | 18.5 | 20 | 26 | 31 | 38 | 38 | 44.5 |
| | | 432 | 470 | 508 | 660 | 787 | 965 | 965 | 1130 |
| $A_2$ - Face to Face (Flanged) | | 22.25 | 23.75 | 30 | 38 | 44 | 50 | 51 | 58 |
| | | 565 | 603 | 762 | 965 | 1118 | 1270 | 1295 | 1473 |
| E - Center to Top (Open) | | 20 | 25 | 35 | 44 | 51 | 60 | 60 | 73 |
| | | 508 | 635 | 889 | 1118 | 1295 | 1524 | 1524 | 1854 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 28 | 28 | 36 | 36 | 48 |
| | | 406 | 406 | 508 | 711 | 711 | 914 | 914 | 1219 |
| H - Equalizer Clearance | | 9 | 9.3 | 10 | 12.5 | 16 | 15 | 15 | 25.75 |
| | | 229 | 236 | 254 | 318 | 406 | 381 | 381 | 654 |
| Weight (Welding) | | 190 | 275 | 555 | 1150 | 2100 | 3400 | 3400 | 5550 |
| | | 86 | 125 | 252 | 522 | 953 | 1542 | 1542 | 2517 |
| Weight (Flanged) | | 250 | 370 | 775 | 1550 | 2650 | 4150 | 4550 | 6950 |
| | | 113 | 168 | 352 | 703 | 1202 | 1882 | 2064 | 3153 |

** Impactor handwheel is standard on all valves.*
*Note: Size 3&4 Buttweld Class 900 Flite-Flow valves are Class 1100. See page 56.*

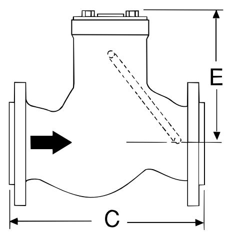
FLOWSERVE

# *Check Valves*
# *Class 900 2220 PSI @ 100°F (153.2 BAR @ 38°C)*

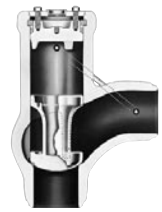


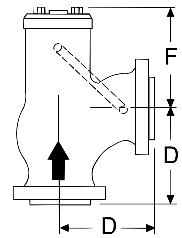


*4094Y*

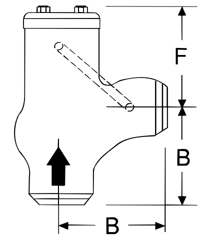


*4094*

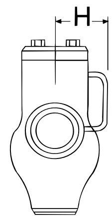




*4095*



*4095Y*




## *Standard Features*

- Bodies and Covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal Cover.
- Globe, angle & tilting disk design.
- Integral Stellite seats.
- Body-guided disk piston. (Globe & Angle)
- Equipped with equalizer. (Globe & Angle)

## *Pressure Class 900 (PN 150)**

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 970Y | 4370Y | Tilting Disk | Buttwelding | 2½ (65) thru 24 (600) |
| 4094 | — | Globe | Flanged | 3 (80) thru 14 (350) |
| 4094Y | 4394Y | Globe | Buttwelding | |
| 4095 | — | Angle | Flanged | 3 (80) thru 24 (600) |
| 4095Y | 4395Y | Angle | Buttwelding | |
| 4092 | — | Flite-Flow | Flanged | 3 (80) thru 16 (400) |
| 4092Y | 4392Y | Flite-Flow | Buttwelding* | |

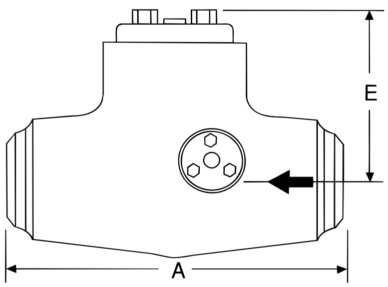
**Size 3&4 Buttweld Flite-Flow valves are Class 1100 - see page 57.*

## *Dimensions – Globe & Angle*

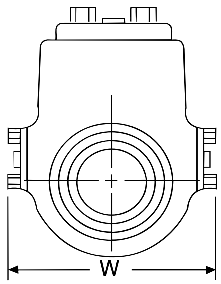
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

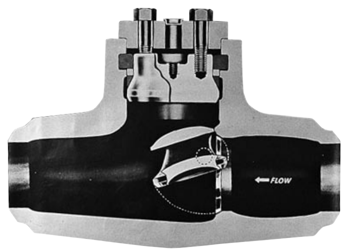
| Figure No. 4094/4094Y, 4095/4095Y, 4394Y, 4395Y | NPS | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| B - Center to End (Welding) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 20.25 |
| | | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 514 |
| C - Face to Face (Flanged) | | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| D - Center to Face (Flanged) | | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 20.25 |
| | | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 514 |
| E - Center to Top, Globe | | 11 | 12 | 13.75 | 15.63 | 18.5 | 22.25 | 26.25 | 28.75 |
| | | 279 | 305 | 349 | 397 | 470 | 565 | 667 | 730 |
| F - Center to Top, Angle | | 9.25 | 10.25 | 11.25 | 12.5 | 16 | 16.75 | 21.5 | 21.5 |
| | | 235 | 260 | 286 | 318 | 406 | 425 | 546 | 546 |
| H - Clearance for Equalizer | | 7.5 | 7.63 | 9.75 | 10.75 | 12.5 | 12.88 | 14.75 | 17.38 |
| | | 190 | 194 | 248 | 273 | 318 | 327 | 275 | 441 |
| Weight, Globe (Flanged) | | 140 | 246 | 426 | 550 | 1188 | 1310 | 2710 | 3820 |
| | | 64 | 112 | 193 | 249 | 539 | 594 | 1229 | 1733 |
| Weight, Globe (Welding) | | 108 | 160 | 272 | 400 | 840 | 1090 | 2110 | 3070 |
| | | 49 | 73 | 123 | 181 | 381 | 494 | 957 | 1393 |
| Weight, Angle (Flanged) | | 134 | 217 | 356 | 485 | 898 | 1080 | 2165 | 2345 |
| | | 61 | 98 | 161 | 220 | 407 | 490 | 982 | 1064 |
| Weight, Angle (Welding) | | 115 | 131 | 202 | 290 | 510 | 860 | 1565 | 1860 |
| | | 52 | 59 | 92 | 132 | 231 | 390 | 710 | 844 |

# Check Valves
# Class 900 2220 PSI @ 100°F (153.2 BAR @ 38°C)




970Y




## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4095/4095Y, 4395Y | | | | | |
|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 24 |
| | DN | 400 | 450 | 500 | 600 |
| B - Center to End (Welding) | | 26 | 29 | 32.5 | 39 |
| | | 660 | 737 | 825 | 991 |
| F - Center to Top Angle (Open) | | 29 | 32 | 32 | 36 |
| | | 737 | 813 | 813 | 914 |
| G - Handwheel Diameter | | 20 | 21 | 21.5 | 30 |
| | | 508 | 533 | 546 | 762 |
| Weight, Angle (Welding) | | 2675 | 3710 | 4930 | 8190 |
| | | 1213 | 1682 | 2636 | 3714 |

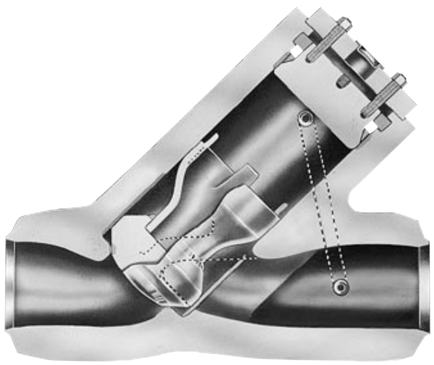
## Dimensions – Tilting Disk

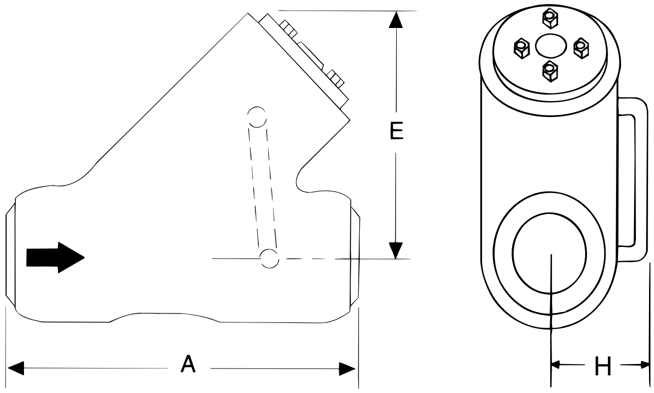
| Figure No. 970Y, 4370Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 2½* | 3* | 4* | 6 | 8 | 10 |
| | DN | 65 | 80 | 100 | 150 | 200 | 250 |
| A - End to End (Welding) | | 12 | 12 | 12 | 22 | 28 | 34 |
| | | 305 | 305 | 305 | 559 | 711 | 864 |
| E - Center to Top | | 7.25 | 7.25 | 7.25 | 9.25 | 11 | 13 |
| | | 184 | 184 | 184 | 235 | 279 | 330 |
| W - Width | | 10.5 | 10.5 | 10.5 | 16.5 | 16 | 20.5 |
| | | 267 | 267 | 267 | 419 | 406 | 521 |
| Weight (Welding) | | 95 | 95 | 120 | 535 | 600 | 1010 |
| | | 43 | 43 | 54 | 243 | 272 | 458 |

** Spiral wound hinge pin gaskets; hinge pin torsion spring not required.*

| Figure No. 970Y, 4370Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 42 | 40.5 | 47 | 53 | 51.5 | 78 |
| | | 1067 | 1029 | 1194 | 1346 | 1308 | 1981 |
| E - Center to Top | | 15.75 | 15.75 | 18.75 | 18.75 | 23 | 36 |
| | | 400 | 400 | 476 | 476 | 584 | 914 |
| W - Width | | 26.5 | 26.5 | 29 | 29 | 37.5 | 55 |
| | | 673 | 673 | 737 | 737 | 953 | 1397 |
| Weight (Welding) | | 2090 | 2090 | 3260 | 3300 | 4510 | 10,200 |
| | | 948 | 948 | 1479 | 1497 | 2046 | 4627 |

# Check Valves
# Class 900    2200 PSI @ 100°F (153.2 BAR @ 38°C)






4092Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with equalizer.

## Dimensions – Flite-Flow

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

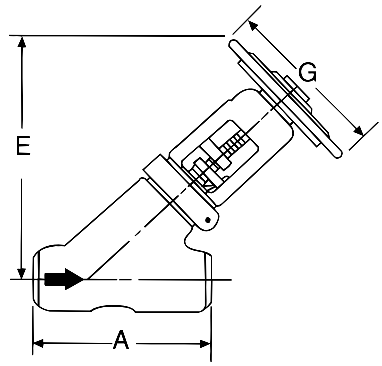
| Figure No. 4092/4092Y, 4392Y | | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| $A_1$ - End to End (Welding) | | 17 | 18.5 | 20 | 26 | 31 | 38 | 38 | 44.5 |
| | | 432 | 470 | 508 | 660 | 787 | 914 | 914 | 1092 |
| $A_2$ - Face to Face (Flanged) | | 22.25 | 23.75 | 30 | 38 | 44 | 50 | 51 | 58 |
| | | 565 | 603 | 762 | 965 | 1118 | 1270 | 1295 | 1473 |
| E - Center to Top | | 10 | 11 | 13.5 | 17.25 | 20.25 | 24 | 24 | 30 |
| | | 254 | 279 | 343 | 438 | 514 | 610 | 610 | 762 |
| H - Equalizer Clearance | | 9 | 9.3 | 10 | 12.5 | 16 | 15 | 15 | 25.75 |
| | | 229 | 236 | 254 | 318 | 406 | 381 | 381 | 654 |
| Weight (Welding) | | 130 | 175 | 300 | 710 | 1300 | 2050 | 2050 | 3900 |
| | | 59 | 79 | 136 | 322 | 590 | 930 | 930 | 1769 |
| Weight (Flanged) | | 190 | 250 | 520 | 1100 | 1850 | 2800 | 3200 | 5300 |
| | | 86 | 113 | 236 | 499 | 839 | 1270 | 1452 | 2404 |

** Impactor handwheel is standard on all valves.*
*Note: Size 3&4 Buttweld Class 900 Flite-Flow valves are Class 1100. See page 57.*



Flowserve Edward Valves • 1900 South Saunders Street, Raleigh, North Carolina 27603 • 1-800-225-6989 • 1-919-832-0525 • Fax 1-919-831-3369

# Stop Valves
# Class 1100 2715 PSI @ 100°F (187.2 BAR @ 38°C)




*4014 Y*

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.

## Pressure Class 1100 (PN 190)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4014Y | 4314Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

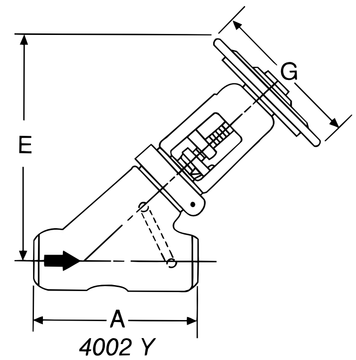
## Dimensions – Flite-Flow®

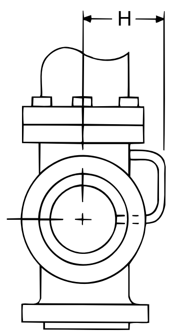
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4014Y, 4314Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter* | | 16 | 16 |
| | | 406 | 406 |
| Weight (Welding) | | 190 | 275 |
| | | 86 | 125 |

** Impactor handwheel is standard on all valves.*

# Stop-Check (Non-Return) Valves
# Class 1100   2715 PSI @ 100°F (187.2 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.

## Pressure Class 1100 (PN 190)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4002Y | 4302Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

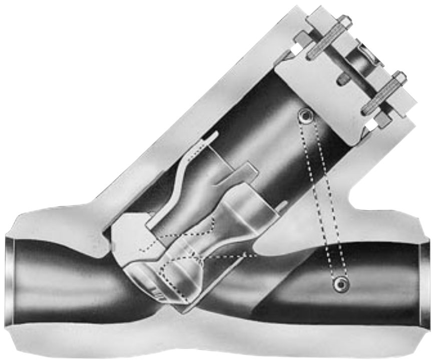
## Dimensions – Flite-Flow®

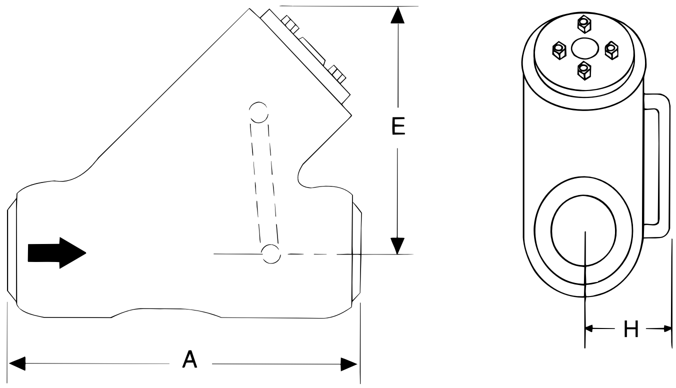
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4002Y, 4302Y | NPS | 3 | 4 |
|---|---|---|---|
| | DN | 80 | 100 |
| A - End to End (Welding) | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter* | | 16 | 16 |
| | | 406 | 406 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight (Welding) | | 190 | 275 |
| | | 86 | 125 |

** Impactor handwheel is standard on all valves.*

# Check Valves
# Class 1100 2715 PSI @ 100°F (187.2 BAR @ 38°C)






4092Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M, or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Equipped with equalizer.

## Pressure Class 1100 (PN 190)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4092Y | 4392Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

## Dimensions – Flite-Flow®

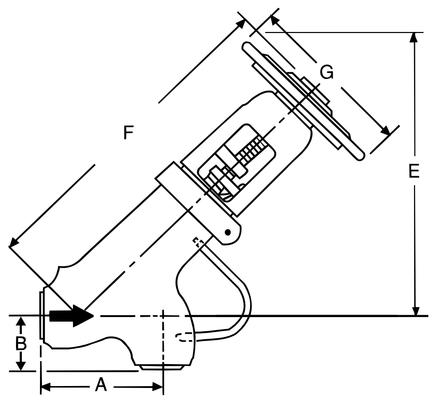
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4092Y, 4392Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End (Welding) | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top | | 10 | 11 |
| | | 254 | 279 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight (Welding) | | 130 | 175 |
| | | 59 | 79 |

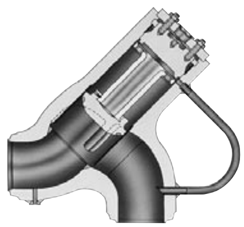
# Stop-Check & Check Valves Elbow Down

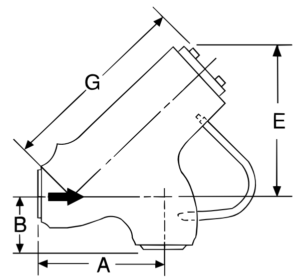
Flowserve Edward Elbow Down stop-check valves are available for special service requirements. Consult the Flowserve sales representative for application and design details.

Because they eliminate the need for a piping elbow, and at the same time offer tight shutoff with minimum pressure drop, they are commonly used at discharge of circulating pumps on controlled circulation boilers.




4448Y/7548Y






4498Y/7598Y

## Standard Features

- Bodies and bonnets/covers are cast steel (WCB or WC6).
- Pressure seal bonnet/cover.
- Integral Stellite seat, disk seating & backseat.
- Disk body guided.
- Impactor handwheel/impactogear.
- Equipped with equalizer.
- Buttwelding ends.
- Asbestos-free packing.

## Elbow Down*

| FIG. NO. | TYPE | ENDS | NPS (DN) |
|---|---|---|---|
| 4448Y | Stop Check | Buttwelding | 10 (250) |
| 4498Y | Check | Buttwelding | thru 16 (400) |
| 7548Y | Stop Check | Buttwelding | 10 (250) |
| 7598Y | Check | Buttwelding | thru 18 (450) |

** Pressure temperature ratings available on request.*

## Dimensions

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4448Y, 4498Y | NPS | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|
| | DN | 250 | 300 | 350 | 400 |
| A - Center to End (Inlet) | | 23 | 27.56 | 35.06 | 34 |
| | | 584 | 700 | 891 | 864 |
| B - Center to End (Outlet) | | 12.25 | 14.56 | 18.94 | 18.56 |
| | | 311 | 370 | 481 | 471 |

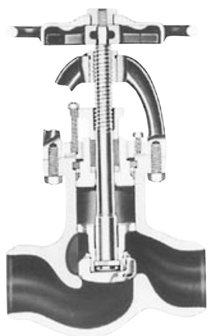
*E, F & G upon request.*

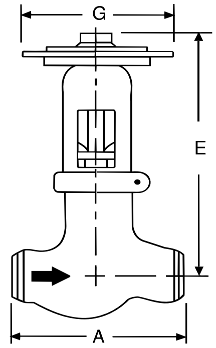
## Dimensions

| Figure No. 7548Y, 7598Y | NPS | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|---|
| | DN | 250 | 300 | 350 | 400 | 450 |
| A - Center to End (Inlet) | | 23 | 27 | 29 | 36 | 39.25 |
| | | 584 | 675 | 737 | 914 | 997 |
| B - Center to End (Outlet) | | 13 | 14 | 15 | 17 | 21.25 |
| | | 330 | 356 | 381 | 432 | 540 |

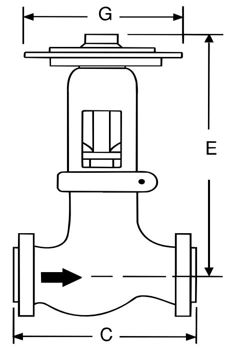
*E, F & G upon request.*

# Stop Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)





*7516Y*



*7516*

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern, globe & angle design.
- Integral Stellite seats and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Yoke bushing thrust bearings size 5 and larger.

## Pressure Class 1500 (PN 260)*

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7514Y | 2014Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |
| 7516 | — | Globe | Flanged | 2½ (65) thru 14 (350) |
| 7516Y | 2016Y | Globe | Buttwelding | |
| 7517 | — | Angle | Flanged | 2½ (65) thru 24 (600) |
| 7517Y | 2017Y | Angle | Buttwelding | |

**Size 3&4 Buttweld Flite-Flow valves are Class 1800. See page 69.*

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 7516/7516Y, 2016Y 7517/7517Y, 2017Y | | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 20.25 |
| | | 165 | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 514 |
| C - End to End (Flanged) | | 16.5 | 18.5 | 21.5 | 26.5 | 27.75 | 32.75 | 39 | 44.5 | 49.5 |
| | | 419 | 470 | 546 | 673 | 705 | 832 | 991 | 1130 | 1257 |
| D - Center to End (Flanged) | | 8.25 | 9.25 | 10.75 | 13.25 | 13.88 | 16.38 | 19.5 | 22.25 | 24.75 |
| | | 210 | 235 | 273 | 337 | 353 | 416 | 495 | 565 | 629 |
| E - Center to Top, Globe (Open) | | 19.25 | 22.5 | 26.25 | 30.63 | 36.5 | 48.75 | 59.5 | 70 | 70 |
| | | 489 | 572 | 667 | 778 | 927 | 1238 | 1511 | 1778 | 1778 |
| F - Center to Top, Angle (Open) | | 18 | 20.4 | 23.75 | 28.25 | 34.75 | 45.75 | 56 | 66.3 | 66.75 |
| | | 457 | 518 | 603 | 718 | 883 | 1162 | 1422 | 1684 | 1695 |
| G - Handwheel Diameter* | | 14 | 16 | 16 | 20 | 20 | 28 | 36 | 36 | 48 |
| | | 356 | 406 | 406 | 508 | 508 | 711 | 914 | 914 | 1219 |
| Weight, Globe (Flanged) | | 167 | 260 | 385 | 760 | 960 | 1800 | 3150 | 4910 | 5900 |
| | | 76 | 118 | 175 | 345 | 435 | 816 | 1429 | 2227 | 2676 |
| Weight, Globe (Welding) | | 90 | 175 | 270 | 525 | 700 | 1620 | 2600 | 3710 | 4850 |
| | | 41 | 79 | 122 | 238 | 317 | 735 | 1179 | 1683 | 2200 |
| Weight, Angle (Flanged) | | 153 | 230 | 330 | 730 | 865 | 1580 | 2780 | 4100 | 4850 |
| | | 69 | 104 | 150 | 331 | 392 | 717 | 1261 | 1860 | 2200 |
| Weight, Angle (Welding) | | 80 | 150 | 255 | 510 | 670 | 1250 | 2200 | 2900 | 3800 |
| | | 36 | 68 | 116 | 231 | 304 | 567 | 998 | 1315 | 1724 |

**Impactor handle is standard on size 2½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe and Angle valves and all Flite-Flow valves.*
**Impactogear is available on size 8 and larger Globe, Angle and Flite-Flow valves.*



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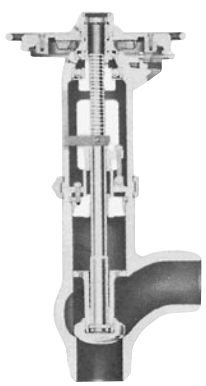
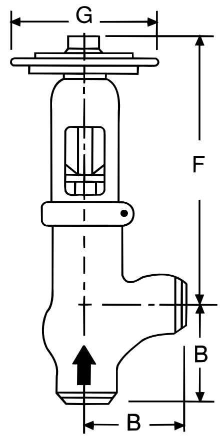
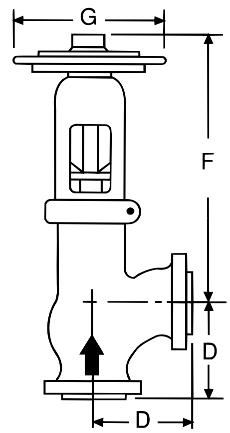
# Stop Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)

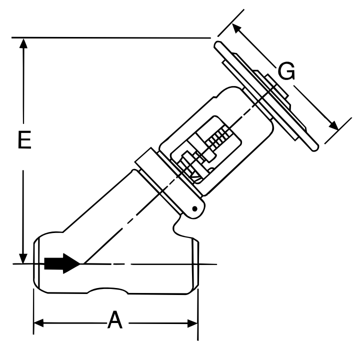





7517Y




7517




7514Y

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

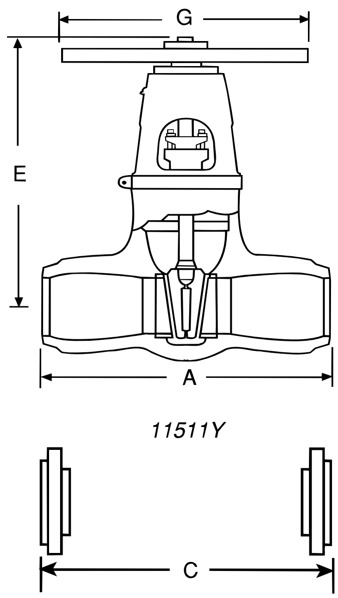
| Figure No. 7517/7517Y, 2017Y | | | | | |
|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 24 |
| | DN | 400 | 450 | 500 | 600 |
| B - Center to End (Welding) | | 23.5 | 23.5 | 28.5 | 35.5 |
| | | 597 | 597 | 724 | 902 |
| F - Center to Top, Angle | | 77.5 | 77.5 | 84 | 103 |
| | | 1969 | 1969 | 2134 | 2616 |
| G - Handwheel Diameter* | | 48 | 48 | 72 | 72 |
| | | 1219 | 1219 | 1829 | 1829 |
| Weight, Angle (Welding) | | 6600 | 6800 | 9500 | 16,200 |
| | | 2994 | 3084 | 4309 | 7348 |

## Dimensions – Flite-Flow®

| Figure No. 7514Y/2014Y | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 17 | 18.5 | 27.75 | 30 | 36.25 | 43 | 41 | 54 | 63 | 54.5 | 59.5 |
| | | 432 | 470 | 705 | 762 | 921 | 1092 | 1041 | 1372 | 1600 | 1384 | 1511 |
| E - Center to Top (Open) | | 20 | 25 | 34.25 | 45 | 53.5 | 60.75 | 60.75 | 78.5 | 78.5 | 96 | 96 |
| | | 508 | 635 | 870 | 1143 | 1359 | 1543 | 1543 | 1994 | 1994 | 2438 | 2438 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 28 | 36 | 36 | 36 | 48 | 48 | 72 | 72 |
| | | 406 | 406 | 508 | 711 | 914 | 914 | 914 | 1219 | 1219 | 1829 | 1829 |
| Weight (Welding) | | 210 | 300 | 700 | 1550 | 2725 | 4220 | 4300 | 7650 | 8390 | 10,500 | 16,800 |
| | | 95 | 136 | 318 | 702 | 1236 | 1914 | 1950 | 3470 | 3806 | 4763 | 7620 |

**Impactor handle is standard on size 2½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe and Angle valves and all Flite-Flow valves.*
**Impactogear is available on size 8 and larger Globe, Angle and Flite-Flow valves.*
*Note: Size 3&4 Buttweld Class 1500 Flite-Flow valves are Class 1800. See page 69.*

# Stop Valves
# Class 1500 3705 PSI @ 100°F (255.3 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Integral Stellite seats and backseat.
- Two-piece body-guided wedge.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Available in standard or venturi pattern.
- Yoke bushing thrust bearings.

## Pressure Class 1500 (PN 260)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 11511 | — | Equiwedge Gate | Flanged* | 2½ (65) thru 24 (600) |
| 11511Y | 12011Y | Equiwedge Gate | Buttwelding | |
| 11511BY | 12011BY | Venturi Pattern Equiwedge Gate | Buttwelding | 8 (200) thru 28 (700) |

** Optional weld-on flanges.*

## Dimensions – Equiwedge Gate

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 11511/11511Y, 12011Y | | 2½ | 3 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 6 | 8 | 10 | 12 |
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 |
| A - End to End (Welding) | | 12 | 12 | 16 | 22 | 28 | 34 | 39 |
| | | 305 | 305 | 406 | 559 | 711 | 864 | 991 |
| C - Face to Face (Flanged) | | 16.5 | 18.5 | 21.5 | 27.75 | 32.75 | 39 | 44.5 |
| | | 419 | 470 | 546 | 705 | 832 | 991 | 1130 |
| E - Center to Top (Open) | | 21.25 | 21.25 | 24.25 | 31.5 | 40 | 48.25 | 55.25 |
| | | 540 | 540 | 616 | 800 | 1016 | 1226 | 1403 |
| G - Handwheel Diameter | | 14 | 14 | 18 | 24 | 36 | 36 | 36 |
| | | 356 | 356 | 457 | 610 | 914 | 914 | 914 |
| Weight (Welding) | | 125 | 125 | 190 | 490 | 675 | 1730 | 2725 |
| | | 57 | 57 | 86 | 222 | 306 | 785 | 1236 |



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# Stop Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)

## Dimensions – Equiwedge Gate (continued)

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 11511/11511Y, 12011Y | | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|
| | NPS | 14 | 16 | 18 | 20 | 22 | 24 |
| | DN | 350 | 400 | 450 | 500 | 550 | 600 |
| A - End to End (Welding) | | 42 | 47 | 53 | 58 | 67 | 76.5 |
| | | 1067 | 1194 | 1346 | 1473 | 1702 | 1943 |
| C - Face to Face (Flanged) | | 49.5 | 54.5 | 60.5 | 65.5 | 71 | 76.5 |
| | | 1257 | 1384 | 1537 | 1664 | 1803 | 1943 |
| E - Center to Top (Open) | | 61 | 68.75 | 73.75 | 80 | 86.75 | 93.5 |
| | | 1549 | 1746 | 1873 | 2032 | 2203 | 2375 |
| G - Handwheel Diameter | | 48 | 48 | 48 | 60 | 60 | 60 |
| | | 1219 | 1219 | 1219 | 1524 | 1524 | 1524 |
| Weight (Welding) | | 3660 | 4450 | 6000 | 8000 | 10,500 | 13,000 |
| | | 1660 | 2019 | 2722 | 3629 | 4763 | 5897 |

## Dimensions – Equiwedge Gate Venturi Pattern

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 11511BY, 12011BY | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 8x6x8 | 10x8x10 | 12x10x12 | 14x12x14 | 16x14x16 | 18x16x18 |
| | DN | 200 | 250 | 300 | 350 | 400 | 450 |
| A - End to End (Welding) | | 22 | 28 | 34 | 39 | 42 | 47 |
| | | 559 | 711 | 864 | 991 | 1067 | 1194 |
| E - Center to Top (Open) | | 31.5 | 40 | 48.25 | 55.25 | 61 | 68.75 |
| | | 800 | 1016 | 1226 | 1403 | 1549 | 1746 |
| G - Handwheel Diameter | | 24 | 36 | 36 | 36 | 48 | 48 |
| | | 610 | 914 | 914 | 914 | 1219 | 1219 |
| Weight (Welding) | | 490 | 1082 | 1690 | 2725 | 3600 | 4600 |
| | | 222 | 491 | 767 | 1236 | 1633 | 2087 |

| Figure No. 11511BY, 12011BY | | | | | | |
|---|---|---|---|---|---|---|
| | NPS | 20x18x20 | 22x20x22 | 24x20x24 | 26x22x26 | 28x24x28 |
| | DN | 500 | 550 | 600 | 650 | 700 |
| A - End to End (Welding) | | 53 | 58 | 58 | 67 | 76.5 |
| | | 1346 | 1473 | 1473 | 1702 | 1943 |
| E - Center to Top (Open) | | 73.75 | 80 | 80 | 86.75 | 93.5 |
| | | 1873 | 2032 | 2032 | 2203 | 2375 |
| G - Handwheel Diameter | | 48 | 60 | 60 | 60 | 60 |
| | | 1219 | 1524 | 1524 | 1524 | 1524 |
| Weight (Welding) | | 6200 | 8200 | 8,500 | 11,000 | 13,500 |
| | | 2812 | 3720 | 3855 | 4990 | 6124 |



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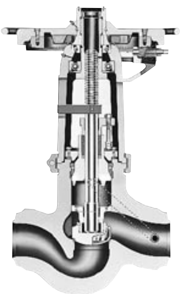
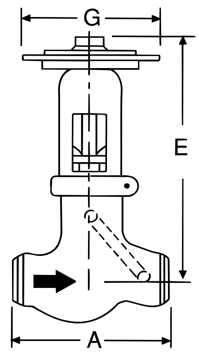
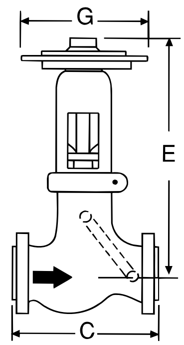
# Stop-Check (Non-Return) Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)

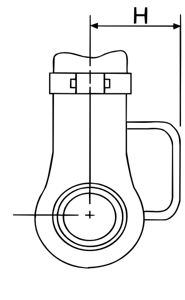




7506Y



7506




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern, globe or angle design.
- Integral Stellite seats and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.
- Yoke bushing thrust bearings size 5 and larger.

## Pressure Class 1500 (PN 260)*

| FIG. NO. | | TYPE | ENDS | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7502Y | 2002Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |
| 7506 | — | Globe | Flanged | 2½ (65) thru 14 (350) |
| 7506Y | 2006Y | Globe | Buttwelding | |
| 7507 | — | Angle | Flanged | 2½ (65) thru 24 (600) |
| 7507Y | 2007Y | Angle | Buttwelding | |

** Size 3 & 4 Buttweld Flite-Flow valves are Class 1800. See page 70.*

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 7506/7506Y, 7507/7507Y, 2006Y, 2007Y | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 | 350 |
| A - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 | 38 | 40.5 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 | 965 | 1029 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 | 20.25 |
| | | 165 | 190 | 229 | 279 | 305 | 368 | 419 | 483 | 514 |
| C - Face to Face (Flanged) | | 16.5 | 18.5 | 21.5 | 26.5 | 27.75 | 32.75 | 39 | 44.5 | 49.5 |
| | | 419 | 470 | 546 | 673 | 705 | 832 | 991 | 1130 | 1257 |
| D - Center to Face (Flanged) | | 8.25 | 9.25 | 10.75 | 13.25 | 13.88 | 16.38 | 19.5 | 22.25 | 24.75 |
| | | 210 | 235 | 273 | 337 | 353 | 416 | 495 | 565 | 628 |
| E - Center to Top, Globe | | 19.25 | 22.5 | 26.25 | 30.63 | 36.5 | 48.75 | 59.5 | 70 | 70 |
| | | 489 | 572 | 667 | 778 | 927 | 1238 | 1511 | 1778 | 1778 |
| F - Center to Top, Angle | | 18 | 20.38 | 23.75 | 28.25 | 34.75 | 45.75 | 56 | 66.3 | 66.75 |
| | | 457 | 518 | 603 | 718 | 883 | 1162 | 1422 | 1684 | 1695 |
| G - Handwheel Diameter* | | 14 | 16 | 16 | 20 | 20 | 28 | 36 | 36 | 48 |
| | | 356 | 406 | 406 | 508 | 508 | 711 | 914 | 914 | 1219 |
| H - Clearance for Equalizer | | 6.75 | 7.75 | 7.75 | 10 | 10.75 | 12.75 | 14 | 15 | 17.38 |
| | | 171 | 197 | 197 | 254 | 273 | 324 | 356 | 381 | 441 |
| Weight, Globe (Flanged) | | 167 | 270 | 385 | 770 | 960 | 1800 | 3150 | 4910 | 5900 |
| | | 76 | 122 | 175 | 349 | 435 | 816 | 1429 | 2227 | 2676 |
| Weight, Globe (Welding) | | 90 | 180 | 270 | 570 | 710 | 1470 | 2600 | 3710 | 4850 |
| | | 41 | 82 | 122 | 258 | 322 | 667 | 1179 | 1683 | 2200 |
| Weight, Angle (Flanged) | | 153 | 230 | 330 | 730 | 865 | 1580 | 2780 | 4100 | 4850 |
| | | 69 | 104 | 149 | 331 | 392 | 717 | 1261 | 1860 | 2200 |
| Weight, Angle (Welding) | | 77 | 160 | 255 | 510 | 585 | 1250 | 2200 | 2900 | 3800 |
| | | 35 | 73 | 116 | 231 | 265 | 567 | 998 | 1315 | 1724 |

**Impactor handle is standard on size 2½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe and Angle valves and all Flite-Flow valves.*
**Impactogear is available on size 8 and larger Globe, Angle and Flite-Flow valves.*



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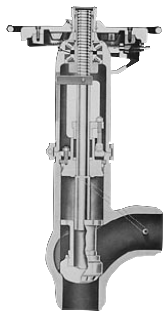
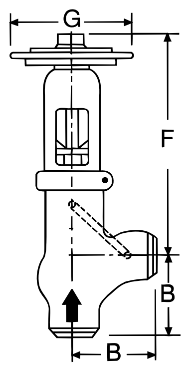
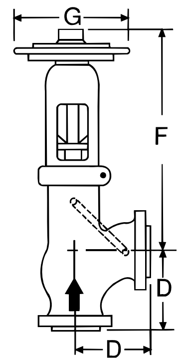
# Stop-Check (Non-Return) Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)

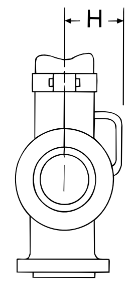


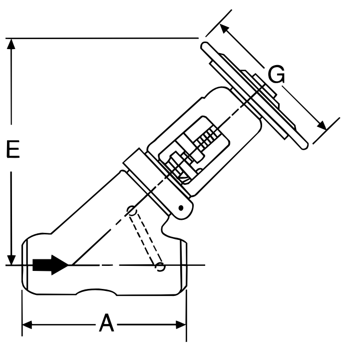



7507Y




7507




7502Y

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

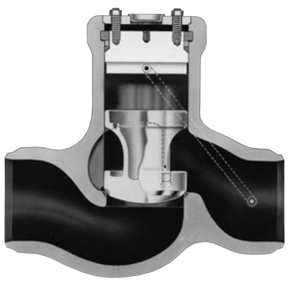
| Figure No. 7507/7507Y, 2007Y | | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| | NPS | 16 | 18 | 20 | 24 |
| | DN | 400 | 450 | 500 | 600 |
| B - Center to End (Welding) | | 23.5 | 23.5 | 28.5 | 35.5 |
| | | 597 | 597 | 724 | 902 |
| F - Center to Top, Angle | | 77.5 | 77.5 | 84 | 103 |
| | | 1969 | 1969 | 2134 | 2616 |
| G - Handwheel Diameter* | | 48 | 48 | 72 | 72 |
| | | 1219 | 1219 | 1829 | 1829 |
| H - Clearance for Equalizer | | 19.5 | 19.5 | 23 | 28.5 |
| | | 495 | 495 | 584 | 724 |
| Weight, Angle (Welding) | | 6600 | 6800 | 9500 | 16,200 |
| | | 2994 | 3084 | 4309 | 7348 |

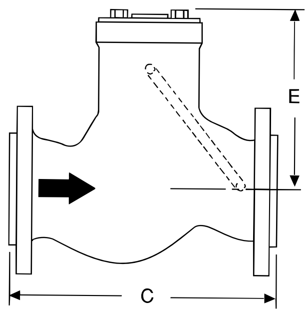
## Dimensions – Flite-Flow

| Figure No. 7502Y, 2002Y | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 17 | 18.5 | 27.75 | 30 | 36.25 | 43 | 41 | 54 | 63 | 54.5 | 59.5 |
| | | 432 | 470 | 705 | 762 | 921 | 1092 | 1041 | 1372 | 1600 | 1384 | 1511 |
| E - Center to Top | | 20 | 25 | 34.25 | 45 | 53.5 | 60.75 | 60.75 | 78.5 | 78.5 | 96 | 96 |
| | | 508 | 635 | 870 | 1143 | 1359 | 1543 | 1543 | 1994 | 1994 | 2438 | 2438 |
| G - Handwheel Diameter* | | 16 | 16 | 20 | 28 | 36 | 36 | 36 | 48 | 48 | 72 | 72 |
| | | 406 | 406 | 508 | 711 | 914 | 914 | 914 | 1219 | 1219 | 1829 | 1829 |
| H - Equalizer Clearance | | 9 | 10 | 10.75 | 12.75 | 15.75 | 16.5 | 16.5 | 19.5 | 19.5 | 28 | 28 |
| | | 229 | 254 | 273 | 324 | 400 | 419 | 419 | 495 | 495 | 711 | 711 |
| Weight (Welding) | | 210 | 300 | 720 | 1600 | 2820 | 4260 | 4280 | 8450 | 8400 | 10,500 | 11,500 |
| | | 95 | 136 | 327 | 726 | 1279 | 1932 | 1941 | 3833 | 3810 | 4763 | 5216 |

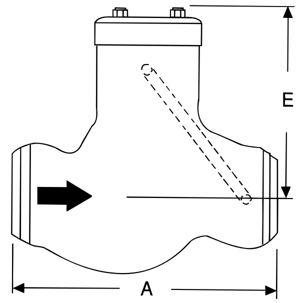
*Impactor handle is standard on size 2½ Globe and Angle valves.
*Impactor handwheel is standard on all other size Globe and Angle valves and all Flite-Flow valves.
*Impactogear is available on size 8 and larger Globe, Angle and Flite-Flow valves.
Note: Size 3&4 Buttweld Class 1500 Flite-Flow valves are Class 1800. See page 70.

# Check Valves
# Class 1500 3705 PSI @ 100°F (255.3 BAR @ 38°C)






7594




7594Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover OS & Y.
- Globe or angle design.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with equalizer.

## Pressure Class 1500 (PN 260)*

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7594 | — | Globe | Flanged | 2½ (65) thru 14 (350) |
| 7594Y | 2094Y | Globe | Buttwelding | |
| 7595 | — | Angle | Flanged | 2½ (65) thru 24 (600) |
| 7595Y | 2095Y | Angle | Buttwelding | |
| 7592Y | 2092Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |

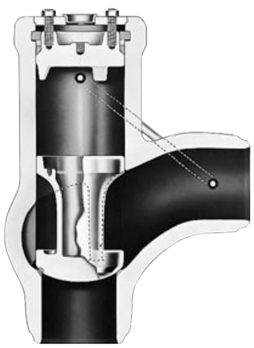
*Size 3&4 Buttweld Flite-Flow valves are Class 1800. See page 71.*

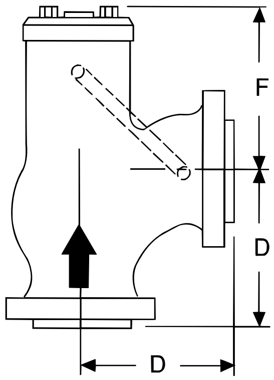
## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

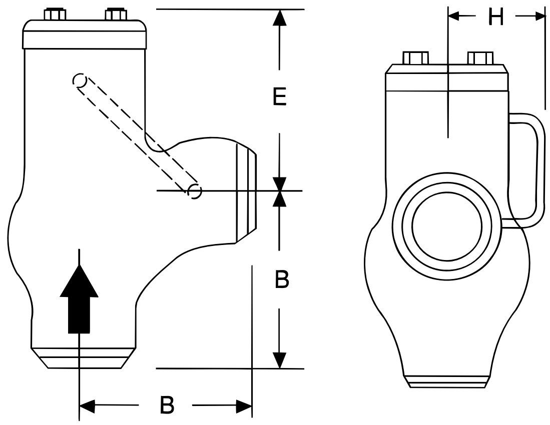
| Figure No. 2094Y, 2095Y, 7594/7594Y, 7595/7595Y | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 |
|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 |
| A - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 |
| | | 165 | 190 | 229 | 279 | 305 | 368 | 419 |
| C - Face to Face (Flanged) | | 16.5 | 18.5 | 21.5 | 26.5 | 27.75 | 32.75 | 39 |
| | | 419 | 470 | 546 | 673 | 705 | 832 | 991 |
| D - Center to Face (Flanged) | | 8.25 | 9.25 | 10.75 | 13.25 | 13.88 | 16.38 | 19.5 |
| | | 210 | 235 | 273 | 337 | 353 | 416 | 495 |
| E - Center to top, Globe | | 9.25 | 11 | 12 | 13.75 | 15 | 18.75 | 20.75 |
| | | 235 | 279 | 305 | 349 | 381 | 476 | 527 |
| F - Center to Top, Angle | | 8.25 | 9.25 | 10.25 | 11.25 | 13 | 15.75 | 17.25 |
| | | 210 | 235 | 260 | 286 | 330 | 400 | 438 |
| H - Clearance for Equalizer | | 6.75 | 7.75 | 7.75 | 10 | 10.75 | 12.75 | 14 |
| | | 171 | 197 | 197 | 254 | 273 | 324 | 356 |
| Weight, Globe (Flanged) | | 125 | 195 | 320 | 534 | 684 | 1390 | 2360 |
| | | 57 | 88 | 145 | 242 | 310 | 631 | 1070 |
| Weight, Globe (Welding) | | 65 | 115 | 180 | 308 | 470 | 960 | 1530 |
| | | 29 | 52 | 82 | 140 | 213 | 435 | 694 |
| Weight, Angle (Flanged) | | 107 | 186 | 290 | 350 | 470 | 1070 | 1060 |
| | | 49 | 84 | 132 | 159 | 213 | 485 | 481 |
| Weight, Angle (Welding) | | 57 | 94 | 152 | 260 | 340 | 680 | 1230 |
| | | 26 | 43 | 69 | 118 | 154 | 308 | 558 |

# Check Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)






7595




7595Y

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 2094Y, 2095Y, 7594/7594Y, 7595/7595Y | NPS | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|
| | DN | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 38 | 40.5 | Valve Not Available | | | |
| | | 965 | 1029 | | | | |
| B - Center to End (Welding) | | 19 | 20.25 | 23.5 | 23.5 | 28.5 | 35.5 |
| | | 483 | 514 | 597 | 597 | 724 | 902 |
| C - Face to Face (Flanged) | | 44.5 | 49.5 | Valve Not Available | | | |
| | | 1130 | 1257 | | | | |
| D - Center to Face (Flanged) | | 22.25 | 24.75 | Available Upon Request | | | |
| | | 565 | 629 | | | | |
| E - Center to Top, Globe | | 24.25 | 30 | Valve Not Available | | | |
| | | 616 | 762 | | | | |
| F - Center to Top, Angle | | 20.5 | 25 | 24.5 | 24.5 | 42 | 51 |
| | | 521 | 635 | 622 | 622 | 1067 | 1295 |
| H - Clearance for Equalizer | | 15 | 17.38 | 19.5 | 19.5 | 23 | 28.5 |
| | | 381 | 441 | 495 | 495 | 584 | 724 |
| Weight, Globe (Flanged) | | 3100 | 4400 | Valve Not Available | | | |
| | | 1406 | 1995 | | | | |
| Weight, Globe (Welding) | | 2310 | 3300 | Available Upon Request | | | |
| | | 1040 | 1497 | | | | |
| Weight, Angle (Flanged) | | 2320 | 3900 | Valve Not Available | | | |
| | | 1044 | 1769 | | | | |
| Weight, Angle (Welding) | | 1530 | 2060 | 4700 | 4880 | 6820 | 11,600 |
| | | 686 | 927 | 2131 | 2213 | 3093 | 5261 |



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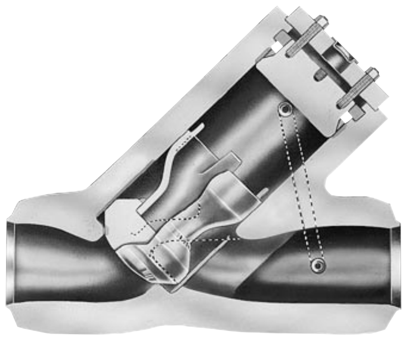
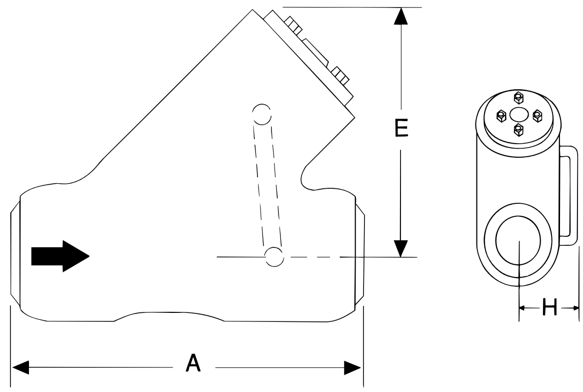
# Check Valves
# Class 1500   3705 PSI @ 100°F (255.3 BAR @ 38°C)






7592Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M  or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with equalizer.

## Dimensions – Flite-Flow

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 2092Y, 7592Y | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End | | 17 | 18.5 | 27.75 | 30 | 36.25 | 43 | 41 | 54 | 63 | 54.5 | 58 |
| | | 432 | 470 | 705 | 762 | 921 | 1092 | 1041 | 1372 | 1600 | 1384 | 1478 |
| E - Center to Top | | 10 | 11 | 16 | 20.75 | 25.5 | 29.25 | 29.25 | 34 | 34 | 43 | 43 |
| | | 254 | 279 | 406 | 527 | 648 | 743 | 743 | 864 | 864 | 1092 | 1092 |
| H - Equalizer Clearance | | 9 | 10 | 10.75 | 12.75 | 15.75 | 16.5 | 16.5 | 19.5 | 19.5 | 28 | 28 |
| | | 229 | 254 | 273 | 324 | 400 | 419 | 419 | 495 | 495 | 711 | 711 |
| Weight | | 140 | 200 | 480 | 900 | 1750 | 2525 | 2525 | 5550 | 5850 | 6700 | 11,200 |
| | | 64 | 91 | 218 | 408 | 794 | 1145 | 1145 | 2517 | 2654 | 3039 | 5080 |

*Note: Size 3&4 Buttweld Class 1500 Flite-Flow valves are Class 1800. See page 71.*



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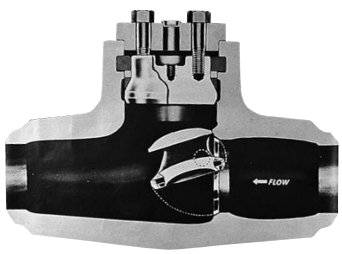
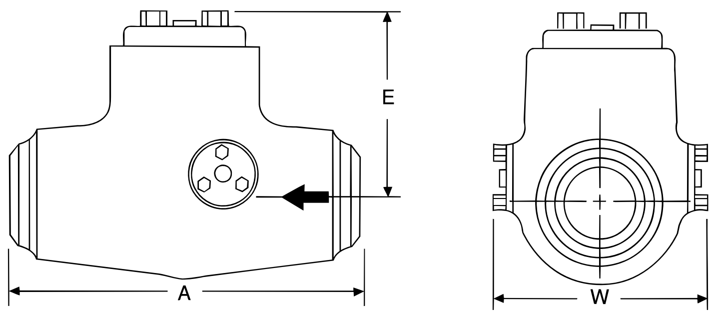
# Check Valves
# Class 1500 3705 PSI @ 100°F (255.3 BAR @ 38°C)






1570Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seats.
- Body-guided disk piston.

## Pressure Class 1500 (PN 260)

| Fig. No. STD CL | Fig. No. SPL CL | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| 1570Y | 2070Y | Tilting Disk | Buttwelding | 2½ (65) thru 24 (600) |

## Dimensions – Tilting Disk

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 1570Y, 2070Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 2½* | 3* | 4* | 6 | 8 | 10 |
| | DN | 65 | 80 | 100 | 150 | 200 | 250 |
| A - End to End (Welding) | | 12 | 12 | 12 | 22 | 28 | 34 |
| | | 305 | 305 | 305 | 559 | 711 | 864 |
| E - Center to Top | | 7.25 | 7.25 | 7.25 | 9.25 | 11 | 13 |
| | | 184 | 184 | 184 | 235 | 279 | 330 |
| W - Width | | 10.5 | 10.5 | 10.5 | 16.5 | 16.75 | 20.5 |
| | | 267 | 267 | 267 | 419 | 425 | 521 |
| Weight (Welding) | | 90 | 90 | 95 | 460 | 600 | 1005 |
| | | 41 | 41 | 43 | 209 | 272 | 456 |

** Spiral wound hinge pin gaskets; hinge pin torsion spring not required.*

| Figure No. 1570Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 42 | 40.5 | 47 | 53 | 51.5 | 58 |
| | | 1067 | 1029 | 1194 | 1346 | 1308 | 1473 |
| E - Center to Top | | 15.75 | 15.75 | 18.75 | 18.75 | 23 | 36 |
| | | 400 | 400 | 476 | 476 | 584 | 914 |
| W - Width | | 26.5 | 26.5 | 29 | 29 | 37.5 | 55 |
| | | 673 | 673 | 737 | 737 | 953 | 1397 |
| Weight (Welding) | | 1520 | 1550 | 3280 | 3590 | 4600 | 10,300 |
| | | 689 | 703 | 1487 | 1628 | 2087 | 4672 |



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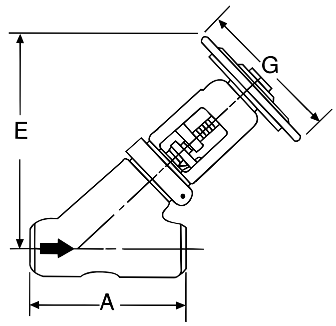
# Stop Valves
# Class 1800  4445 PSI @ 100°F (306.4 BAR @ 38°C)




7514Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover, OS & Y.
- Y-Pattern.
- Integral Stellite seats.
- Body-guided disk piston.
- 13% chromium stainless steel stem.

## Pressure Class 1800 (PN 310)

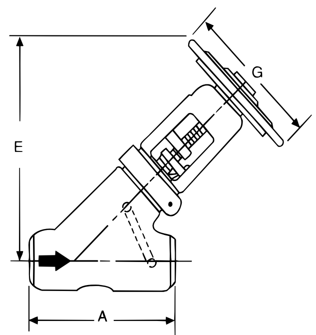
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7514Y | 2014Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

## Dimensions – Flite-Flow®

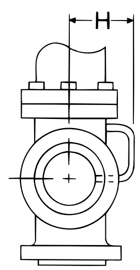
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 7514Y, 2014Y | NPS | 3 | 4 |
|---|---|---|---|
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter* | | 16 | 16 |
| | | 406 | 406 |
| Weight (Welding) | | 210 | 300 |
| | | 95 | 136 |

# Stop-Check (Non-Return) Valves
# Class 1800  4445 PSI @ 100°F (306.4 BAR @ 38°C)




7502Y




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS&Y.
- Y-Pattern.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with equalizer.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.

## Pressure Class 1800 (PN 310)

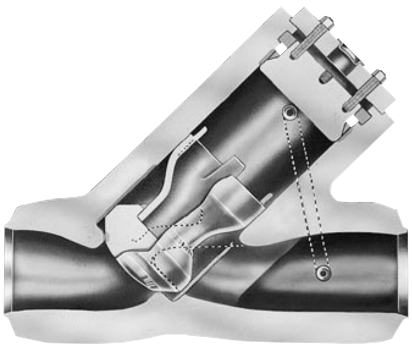
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7502Y | 2002Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

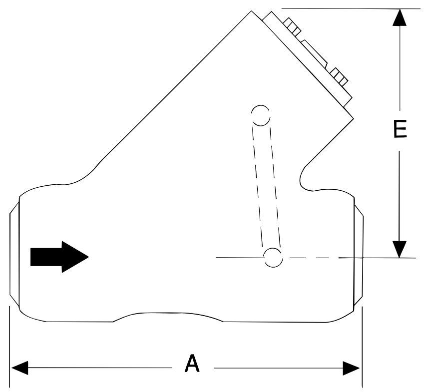
## Dimensions – Flite-Flow®

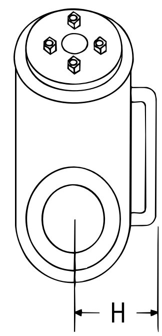
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 7502Y, 2002Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter* | | 16 | 16 |
| | | 406 | 406 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight (Welding) | | 210 | 300 |
| | | 95 | 136 |

# Check Valves
# Class 1800  4445 PSI @ 100°F (306.4 BAR @ 38°C)






7592Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Equipped with equalizer.

## Pressure Class 1800 (PN 310)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 7592Y | 2092Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

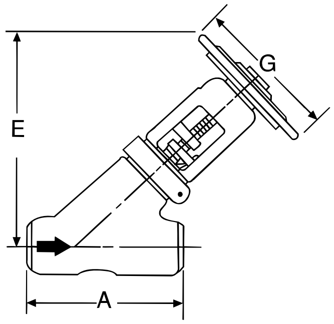
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 7592Y, 2092Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 10 | 11 |
| | | 254 | 279 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight (Welding) | | 140 | 200 |
| | | 64 | 91 |

# Stop Valves
# Class 2000 4940 PSI @ 100°F (340.4 BAR @ 38°C)

2214Y




2214Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.

## Pressure Class 2000 (PN 340)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 2214Y | 3214Y | Flite-Flow | Buttwelding | 12 (300) and 14 (350) |

## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 2214Y, 3214Y | | 12 | 14 |
|---|---|---|---|
| | NPS | 12 | 14 |
| | DN | 300 | 350 |
| A - End to End | | 39 | 39 |
| | | 991 | 991 |
| E - Center to Top (Open) | | 58 | 58 |
| | | 1473 | 1473 |
| G - Handwheel Diameter* | | 48 | 48 |
| | | 1219 | 1219 |
| Weight (Welding) | | 4300 | 4300 |
| | | 1950 | 1950 |



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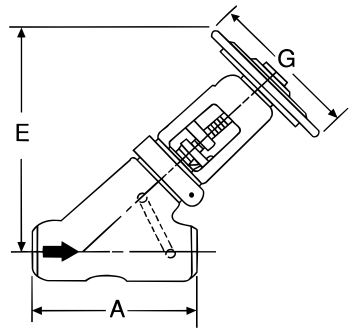
# Stop-Check (Non-Return) Valves
# Class 2000  4940 PSI @ 100°F (340.4 BAR @ 38°C)

2202Y




2202Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.

## Pressure Class 2000 (PN 340)

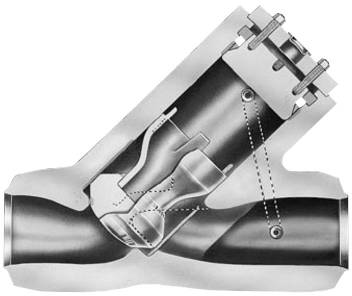
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 2202Y | 3202Y | Flite-Flow | Buttwelding | 12 (300) and 14 (350) |

## Dimensions – Flite-Flow®

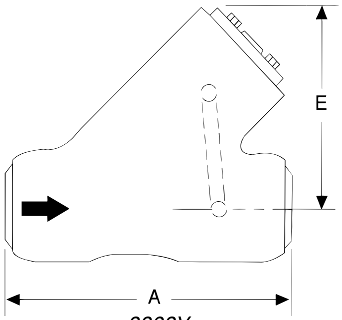
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 2202Y, 3202Y | | | |
|---|---|---|---|
| | NPS | 12 | 14 |
| | DN | 300 | 350 |
| A - End to End | | 39 | 39 |
| | | 991 | 991 |
| E - Center to Top (Open) | | 58 | 58 |
| | | 1473 | 1473 |
| G - Handwheel Diameter* | | 48 | 48 |
| | | 1219 | 1219 |
| H - Equalizer Clearance | | 18 | 18 |
| | | 457 | 457 |
| Weight | | 4300 | 4300 |
| | | 1950 | 1950 |

# Check Valves
# Class 2000 4940 PSI @ 100°F (340.4 BAR @ 38°C)



2292Y




2292Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Equipped with equalizer.

## Pressure Class 2000 (PN 340)

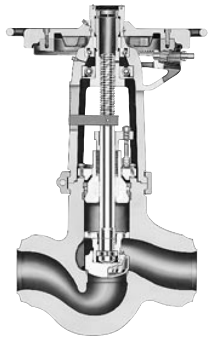
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 2292Y | 3292Y | Flite-Flow | Buttwelding | 12 (300) and 14 (350) |

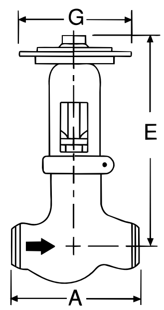
## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

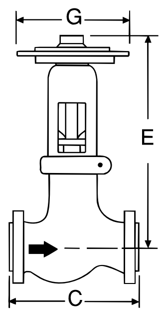
| Figure No. 2292Y, 3292Y | | | |
|---|---|---|---|
| | NPS | 12 | 14 |
| | DN | 300 | 350 |
| A - End to End | | 39 | 39 |
| | | 991 | 991 |
| E - Center to Top | | 24 | 24 |
| | | 610 | 610 |
| H - Equalizer Clearance | | 18 | 18 |
| | | 457 | 457 |
| Weight | | 2900 | 2900 |
| | | 1315 | 1315 |

# Stop Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)






3916Y




3916

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Vertical, Y-Pattern & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Yoke bushing thrust bearings size 5 and larger.

## Pressure Class 2500 (PN 420)*

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 3914Y | 4414Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |
| 3916 | — | Globe | Flanged | 2½ (65) thru 12 (300) |
| 3916Y | 4416Y | Globe | Buttwelding | |
| 3917 | — | Angle | Flanged* | 2½ (65) thru 24 (600) |
| 3917Y | 4417Y | Angle | Buttwelding | |

** Flanges to size 12 only.*
** Size 3 & 4 Buttweld Flite-Flow valves are Class 2900. See page 84.*

## Dimensions - Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3916/3916Y, 3917/3917Y, 4416Y/4417Y | | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 |
| A1 - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 | 38 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 | 965 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 |
| | | 165 | 190 | 228 | 279 | 305 | 368 | 419 | 483 |
| C - Face to Face (Flanged) | | 20 | 22.75 | 26.5 | 31.25 | 36 | 40.25 | 50 | 56 |
| | | 508 | 578 | 673 | 794 | 914 | 1022 | 1270 | 1422 |
| D - Center to Face, Flanged | | 10 | 11.38 | 13.25 | 15.63 | 18 | 20.13 | 25 | 28 |
| | | 254 | 289 | 337 | 397 | 457 | 511 | 635 | 711 |
| E - Center to Top, Globe (Open) | | 19.63 | 22.38 | 25.25 | 28.25 | 37.63 | 47.25 | 55.25 | 72.5 |
| | | 499 | 568 | 572 | 718 | 955 | 1200 | 1403 | 1842 |
| F - Center to Top, Angle (Open) | | 18 | 20 | 22.5 | 25 | 33.75 | 42.25 | 48.75 | 69.5 |
| | | 457 | 508 | 641 | 635 | 857 | 1073 | 1238 | 1765 |
| G - Handwheel/Handle Diameter* | | 14 | 16 | 16 | 20 | 28 | 28 | 36 | 48 |
| | | 356 | 406 | 406 | 508 | 711 | 711 | 914 | 1219 |
| Weight, Globe (Flanged) | | 158 | 330 | 442 | 890 | 1586 | 2370 | 3160 | 5050 |
| | | 72 | 150 | 200 | 404 | 719 | 1075 | 1433 | 2290 |
| Weight, Globe (Welding) | | 95 | 165 | 255 | 560 | 900 | 1610 | 2440 | 3400 |
| | | 43 | 75 | 115 | 254 | 408 | 730 | 1107 | 1542 |
| Weight, Angle (Flanged) | | 150 | 255 | 490 | 830 | 1466 | 2120 | 3320 | 4650 |
| | | 68 | 115 | 222 | 376 | 665 | 961 | 1505 | 2109 |
| Weight, Angle (Welding) | | 82 | 148 | 220 | 465 | 780 | 1450 | 2110 | 3000 |
| | | 37 | 67 | 100 | 211 | 354 | 657 | 957 | 1360 |

**Impactor handle is standard on size 2½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe, Angle and all Flite-Flow valves.*
**Impactogear is available on size 6 and larger valves.*



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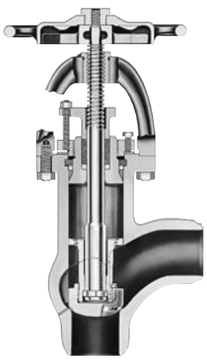
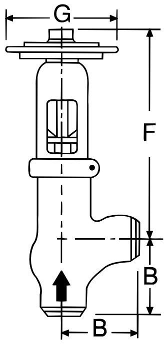
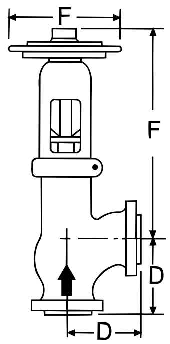
# Stop Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)

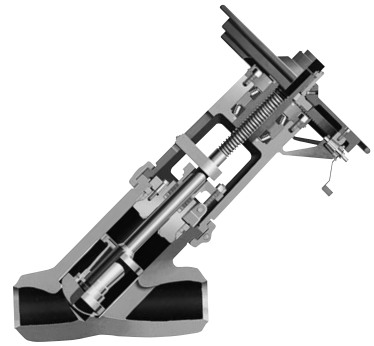


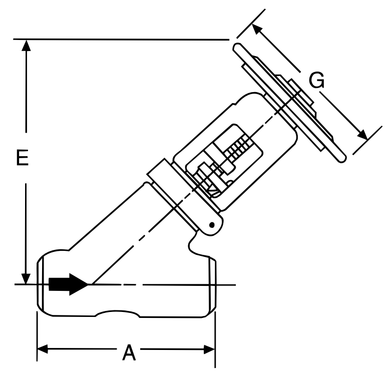



3917Y




3917






3914Y

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

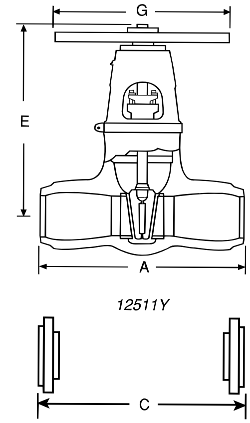
| Figure No. 3917/3917Y, 4417Y | NPS | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|
| | DN | 350 | 400 | 450 | 500 | 550 | 600 |
| B - Center to End (Welding) | | 20.25 | 20.25 | 23.5 | 23.5 | 26 | 28.5 |
| | | 514 | 514 | 597 | 597 | 660 | 724 |
| F - Center to Top, Angle (Open) | | 67 | 67 | 92 | 92 | 89.5 | 96 |
| | | 1701 | 1701 | 2300 | 2300 | 2238 | 2438 |
| G - Handwheel Diameter* | | 48 | 48 | 72 | 72 | 72 | 72 |
| | | 1219 | 1219 | 1829 | 1829 | 1829 | 1829 |
| Weight, Angle (Welding) | | 5350 | 5410 | 10,460 | 10,540 | 14,350 | 18,200 |
| | | 2427 | 2454 | 4745 | 4781 | 6509 | 8255 |

## Dimensions – Flite-Flow

| Figure No. 3914Y, 4414Y | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 17 | 18.5 | 24 | 30 | 36 | 41 | 48.75 | 48.75 | 58 | 58 | 68 |
| | | 432 | 470 | 610 | 762 | 914 | 1041 | 1238 | 1238 | 1473 | 1473 | 1727 |
| E - Center to Top (Open) | | 20 | 25 | 37.5 | 41.75 | 50 | 65 | 69 | 69 | 93.8 | 93.8 | 113 |
| | | 508 | 635 | 953 | 1060 | 1270 | 1651 | 1753 | 1753 | 2382 | 2382 | 2870 |
| G - Handwheel Diameter* | | 16 | 16 | 28 | 28 | 36 | 48 | 48 | 48 | 72 | 72 | 72 |
| | | 406 | 406 | 711 | 711 | 914 | 1219 | 1219 | 1219 | 1829 | 1829 | 1829 |
| Weight (Welding) | | 230 | 325 | 875 | 1610 | 2750 | 4600 | 6990 | 7010 | 12,700 | 12,790 | 16,570 |
| | | 104 | 147 | 397 | 730 | 1247 | 2087 | 3171 | 3180 | 5761 | 5802 | 7516 |

**Impactor handle is standard on size 2-½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe, Angle and all Flite-Flow valves.*
**Impactogear is available on size 6 and larger valves.*
*Note: Size 3&4 Buttweld Class 2500 Flite-Flow valves are Class 2900. See page 84.*

# Stop Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Integral Stellite seat and backseat.
- Two-piece body-guided wedge.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Available in standard or venturi pattern.
- Yoke bushing thrust bearings.

## Pressure Class 2500 (PN 420)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 12511 | — | Equiwedge Gate | Flanged | 2-½ (65) thru 24 (600) |
| 12511Y | 14411Y | Equiwedge Gate | Buttwelding | |
| 12511BY | 14411BY | Venturi Pattern Equiwedge Gate | Buttwelding | 8 (200) thru 28 (700) |

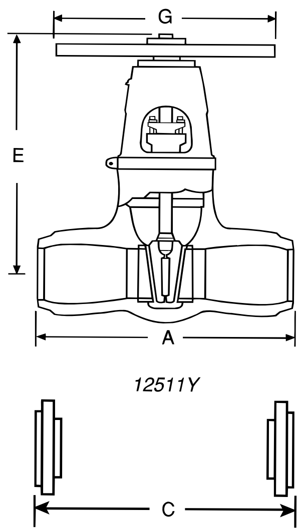
## Dimensions – Equiwedge Gate

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 12511/12511Y, 14411Y | NPS | 2-½ | 3 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|
| | DN | 65 | 80 | 100 | 150 | 200 | 250 | 300 |
| A - End to End (Welding) | | 13 | 14.5 | 18 | 24 | 30 | 36 | 41 |
| | | 330 | 368 | 457 | 610 | 762 | 914 | 1041 |
| C - Face to Face (Flanged) | | 20 | 22.75 | 26.5 | 36 | 40.25 | 50 | 56 |
| | | 508 | 578 | 673 | 914 | 1022 | 1270 | 1422 |
| E - Center to Top (Open) | | 21.5 | 21.5 | 22 | 31.75 | 36.75 | 49.25 | 56 |
| | | 546 | 546 | 559 | 806 | 933 | 1251 | 1422 |
| G - Handwheel/Handle Diameter | | 24 | 24 | 24 | 30 | 36 | 36 | 48 |
| | | 610 | 610 | 610 | 762 | 914 | 914 | 1219 |
| Weight (Welding) | | 126 | 126 | 318 | 715 | 1245 | 2130 | 3557 |
| | | 57 | 57 | 144 | 324 | 565 | 966 | 1613 |

| Figure No. 12511/12511Y, 14411Y | NPS | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|
| | DN | 350 | 400 | 450 | 500 | 550 | 600 |
| A - End to End (Welding) | | 44 | 49 | 55 | 62 | 64 | 66 |
| | | 1118 | 1245 | 1397 | 1575 | 1626 | 1676 |
| C - Face to Face (Flanged) | | N/A | | | | | |
| E - Center to Top (Open) | | 56.75 | 66 | 71 | 75.5 | 87.25 | 88.75 |
| | | 1441 | 1676 | 1803 | 1918 | 2116 | 2254 |
| G - Handwheel Diameter | | 48 | 48 | 60 | 60 | 72 | 72 |
| | | 1219 | 1219 | 1524 | 1524 | 1829 | 1829 |
| Weight (Welding) | | 5167 | 6600 | 8600 | 11,400 | 13,000 | 15,000 |
| | | 2349 | 2994 | 3901 | 5171 | 5897 | 6804 |

# Stop Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)




## Dimensions – Equiwedge Gate
## Venturi Pattern

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 12511BY/14411BY | | 8x6x8 | 10x8x10 | 12x10x12 | 14x12x14 | 16x14x16 |
|---|---|---|---|---|---|---|
| | NPS | 8x6x8 | 10x8x10 | 12x10x12 | 14x12x14 | 16x14x16 |
| | DN | 200 | 250 | 300 | 350 | 400 |
| A - End to End (Welding) | | 24 | 30 | 36 | 41 | 44 |
| | | 610 | 762 | 914 | 1041 | 1118 |
| E - Center to Top (Open) | | 31.75 | 36.75 | 49.25 | 56 | 56.75 |
| | | 806 | 933 | 1251 | 1422 | 1441 |
| G - Handwheel Diameter | | 30 | 36 | 36 | 48 | 48 |
| | | 762 | 914 | 914 | 1219 | 1219 |
| Weight (Welding) | | 715 | 1245 | 2165 | 3557 | 5167 |
| | | 325 | 566 | 984 | 1617 | 2349 |

| Figure No. 12511BY/14411BY | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 18x16x18 | 20x18x20 | 22x20x22 | 24x20x24 | 26x22x26 | 28x24x28 |
| | DN | 450 | 500 | 550 | 600 | 650 | 700 |
| A - End to End (Welding) | | 49 | 55 | 62 | 62 | 64 | 66 |
| | | 1245 | 1397 | 1575 | 1575 | 1626 | 1676 |
| E - Center to Top (Open) | | 66 | 71 | 75.5 | 75.5 | 87.25 | 88.75 |
| | | 1676 | 1803 | 1918 | 1918 | 2116 | 2254 |
| G - Handwheel Diameter | | 48 | 60 | 60 | 60 | 72 | 72 |
| | | 1219 | 1524 | 1524 | 1524 | 1829 | 1829 |
| Weight (Welding) | | 6600 | 8600 | 11,400 | 13,000 | 15,000 | 15,000 |
| | | 2994 | 3901 | 5171 | 5900 | 6800 | 6800 |



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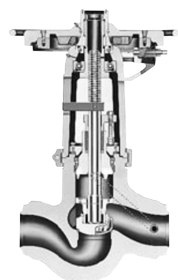
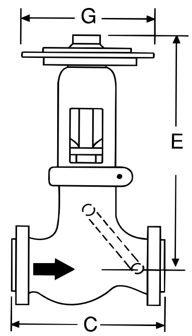
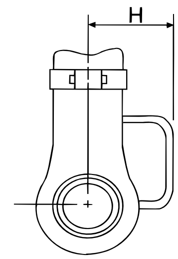
# Stop-Check (Non-Return) Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)

## Standard Features

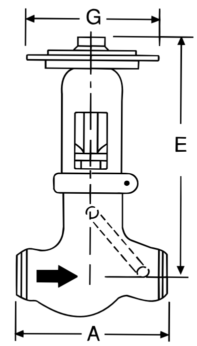
- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern, globe & angle design.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.
- Yoke bushing thrust bearings size 5 and larger.






3906




3906Y

## Pressure Class 2500 (PN 420)*

| Fig. No. STD CL | Fig. No. SPL CL | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| 3902Y | 4402Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |
| 3906 | — | Globe | Flanged | 2-½ (65) thru 12 (300) |
| 3906Y | 4406Y | Globe | Buttwelding | |
| 3907 | — | Angle | Flanged* | 2-½ (65) thru 24 (600) |
| 3907Y | 4407Y | Angle | Buttwelding | |

** Flanges to size 12 only.*
** Size 3 & 4 Buttweld Flite-Flow valves are Class 2900. See page 85.*

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3906/3906Y, 3907/3907Y, 4406Y, 4407Y | | 2-½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2-½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 |
| A - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 | 38 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 | 965 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 |
| | | 165 | 190 | 229 | 279 | 305 | 368 | 419 | 483 |
| C - Face to Face (Flanged) | | 20 | 22.75 | 26.5 | 31.25 | 36 | 40.25 | 50 | 56 |
| | | 508 | 578 | 673 | 794 | 914 | 1022 | 1270 | 1422 |
| D - Center to Face (Flanged) | | 10 | 11.38 | 13.25 | 15.63 | 18 | 20.13 | 25 | 28 |
| | | 254 | 289 | 337 | 397 | 457 | 511 | 635 | 711 |
| E - Center to Top Globe | | 19.63 | 22.38 | 25.25 | 28.25 | 37.63 | 47.25 | 55.25 | 72.5 |
| | | 499 | 568 | 641 | 718 | 956 | 1200 | 1403 | 1842 |
| F - Center to Top, Angle | | 18 | 20 | 22.5 | 25 | 33.75 | 42.25 | 48.75 | 69.5 |
| | | 457 | 508 | 572 | 635 | 857 | 1073 | 1238 | 1765 |
| G - Handwheel/Handle Diameter* | | 14 | 16 | 16 | 20 | 28 | 28 | 36 | 48 |
| | | 356 | 406 | 406 | 508 | 711 | 711 | 914 | 1219 |
| H - Clearance for Equalizer | | 7.25 | 8 | 8.5 | 8.5 | 11 | 11.5 | 14 | 16 |
| | | 184 | 203 | 216 | 216 | 279 | 292 | 356 | 406 |
| Weight, Globe (Flanged) | | 160 | 350 | 520 | 900 | 1600 | 2400 | 3200 | 5100 |
| | | 73 | 159 | 236 | 408 | 726 | 1089 | 1452 | 2313 |
| Weight, Globe (Welding) | | 95 | 169 | 263 | 570 | 915 | 1730 | 2480 | 3450 |
| | | 43 | 77 | 119 | 259 | 415 | 785 | 1125 | 1565 |
| Weight, Angle (Flanged) | | 152 | 260 | 420 | 840 | 1480 | 2150 | 3360 | 4700 |
| | | 69 | 118 | 191 | 381 | 671 | 975 | 1524 | 2132 |
| Weight, Angle (Welding) | | 84 | 150 | 228 | 475 | 795 | 1480 | 2140 | 3050 |
| | | 38 | 68 | 103 | 215 | 361 | 671 | 971 | 1383 |

**Impactor handle is standard on size 2-½ Globe and Angle valves.*
**Impactor handwheel is standard on all other size Globe, Angle and all Flite-Flow valves.*
**Impactogear is available on size 6 and larger valves.*



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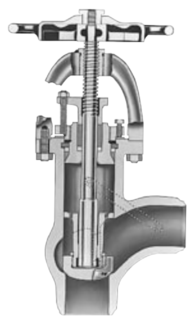
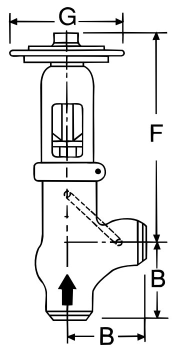
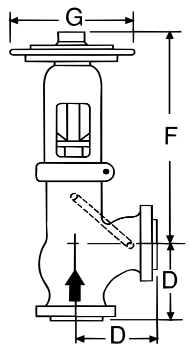
# Stop-Check (Non-Return) Valves
# Class 2500   6170 PSI @ 100°F (425.5 BAR @ 38°C)

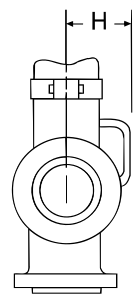


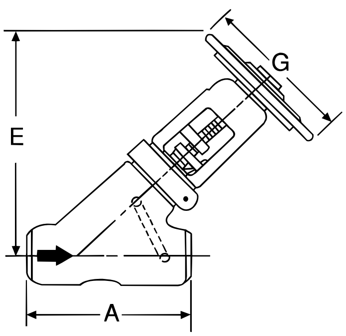


3907Y



3907



3902Y

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

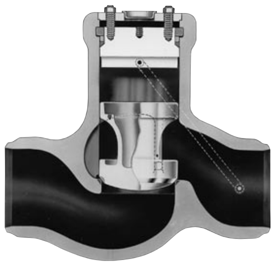
| Figure No. 3907/3907Y, 4407Y | | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|
| | NPS | 14 | 16 | 18 | 20 | 22 | 24 |
| | DN | 350 | 400 | 450 | 500 | 550 | 600 |
| B - Center to End (Welding) | | 20.25 | 20.25 | 23.5 | 23.5 | 26 | 28.5 |
| | | 514 | 514 | 597 | 597 | 660 | 724 |
| F - Center to Top, Angle | | 67 | 67 | 92 | 92 | 89.5 | 96 |
| | | 1702 | 1702 | 2337 | 2337 | 2273 | 2438 |
| G - Handwheel Diameter* | | 48 | 48 | 72 | 72 | 72 | 72 |
| | | 1219 | 1219 | 1829 | 1829 | 1829 | 1829 |
| H - Clearance for Equalizer | | 18.5 | 18.5 | 22 | 22 | 23 | 24 |
| | | 470 | 470 | 559 | 559 | 584 | 610 |
| Weight, Angle (Welding) | | 5390 | 5450 | 10,540 | 10,620 | 14,470 | 18,340 |
| | | 2445 | 2472 | 4781 | 4817 | 6564 | 8319 |

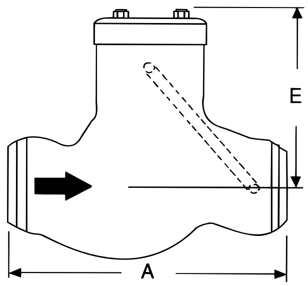
## Dimensions – Flite-Flow

| Figure No. 3902Y, 4402Y | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 17 | 18.5 | 24 | 30 | 36 | 41 | 48.75 | 48.75 | 58 | 58 | 68 |
| | | 432 | 470 | 610 | 762 | 914 | 1041 | 1238 | 1238 | 1473 | 1473 | 1727 |
| E - Center to Top | | 20 | 25 | 37.5 | 41.75 | 50 | 65 | 69 | 69 | 93.8 | 93.8 | 113 |
| | | 508 | 635 | 953 | 1060 | 1290 | 1651 | 1753 | 1753 | 2383 | 2383 | 2870 |
| G - Handwheel Diameter* | | 16 | 16 | 28 | 28 | 36 | 48 | 48 | 48 | 72 | 72 | 72 |
| | | 408 | 406 | 711 | 711 | 914 | 1219 | 1219 | 1219 | 1829 | 1829 | 1829 |
| H - Equalizer Clearance | | 9 | 10 | 11 | 11.5 | 15.75 | 17.5 | 20.25 | 20.25 | 23.5 | 23.5 | 32 |
| | | 229 | 254 | 279 | 292 | 400 | 445 | 514 | 514 | 591 | 591 | 813 |
| Weight (Welding) | | 230 | 325 | 890 | 1610 | 2750 | 4600 | 6990 | 7010 | 12,700 | 12,790 | 16,570 |
| | | 104 | 147 | 404 | 730 | 1247 | 2087 | 3170 | 3179 | 5760 | 5802 | 7516 |

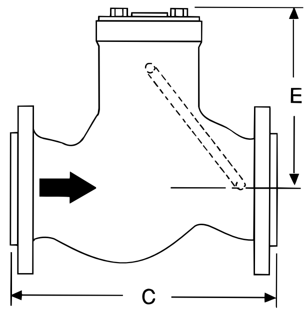
** Impactor handwheel is standard on all valves.*
** Impactogear is available on size 6 and larger valves.*
*Note: Size 3&4 Buttweld Class 2500 Flite-Flow valves are Class 2900. See page 85.*

# Check Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)





3994Y



3994

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with equalizer.

## Pressure Class 2500 (PN 420)*

| Fig. No. STD CL | Fig. No. SPL CL | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| 3992Y | 4492Y | Flite-Flow | Buttwelding* | 3 (80) thru 24 (600) |
| 3994 | — | Globe | Flanged | 2-½ (65) thru 12 (300) |
| 3994Y | 4494Y | Globe | Buttwelding | |
| 3995 | — | Angle | Flanged* | 2-½ (65) thru 24 (600) |
| 3995Y | 4495Y | Angle | Buttwelding | |
| 2570Y | 4470Y | Tilting Disk | Buttwelding | 2-½ (65) thru 24 (600) |

*Flanges to size 12 only.
*Size 3&4 Buttweld Flite-Flow valves are Class 2900. See page 86.

## Dimensions – Globe & Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3994/3994Y, 3995/3995Y, 4494Y,4495Y | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NPS | 2-½ | 3 | 4 | 5 | 6 | 8 | 10 | 12 |
| | DN | 65 | 80 | 100 | 125 | 150 | 200 | 250 | 300 |
| A - End to End (Welding) | | 13 | 15 | 18 | 22 | 24 | 29 | 33 | 38 |
| | | 330 | 381 | 457 | 559 | 610 | 737 | 838 | 965 |
| B - Center to End (Welding) | | 6.5 | 7.5 | 9 | 11 | 12 | 14.5 | 16.5 | 19 |
| | | 165 | 190 | 229 | 279 | 305 | 368 | 419 | 483 |
| C - Face to Face (Flanged) | | 20 | 22.75 | 26.5 | 31.25 | 36 | 40.5 | 50 | 56 |
| | | 508 | 578 | 673 | 794 | 914 | 1022 | 1270 | 1422 |
| D - Center to Face (Flanged) | | 10 | 11.38 | 13.25 | 15.63 | 18 | 20.13 | 25 | 28 |
| | | 254 | 289 | 337 | 397 | 457 | 511 | 635 | 711 |
| E - Center to Top, Globe | | 9.25 | 10.38 | 11.25 | 12.25 | 14 | 17 | 19.25 | 23 |
| | | 235 | 264 | 286 | 311 | 356 | 432 | 489 | 584 |
| F - Center to Top, Angle | | 7.63 | 8.38 | 8.5 | 9 | 10.25 | 12 | 12.75 | 20 |
| | | 194 | 213 | 216 | 229 | 260 | 305 | 324 | 508 |
| H - Clearance for Equalizer | | 7.25 | 8 | 8.5 | 8.5 | 11 | 11.5 | 14 | 16 |
| | | 184 | 203 | 216 | 216 | 279 | 292 | 356 | 406 |
| Weight, Globe (Flanged) | | 120 | 200 | 290 | 670 | 900 | 1760 | 2920 | 4070 |
| | | 54 | 91 | 131 | 304 | 408 | 798 | 1324 | 1846 |
| Weight, Globe (Welding) | | 65 | 108 | 185 | 318 | 490 | 1010 | 1690 | 2420 |
| | | 29 | 49 | 84 | 144 | 222 | 458 | 766 | 1098 |
| Weight, Angle (Flanged) | | 112 | 185 | 275 | 610 | 820 | 1610 | 2520 | 3860 |
| | | 51 | 84 | 124 | 277 | 372 | 730 | 1143 | 1751 |
| Weight, Angle (Welding) | | 57 | 92 | 155 | 263 | 372 | 827 | 1284 | 2210 |
| | | 26 | 42 | 70 | 119 | 169 | 375 | 582 | 1002 |



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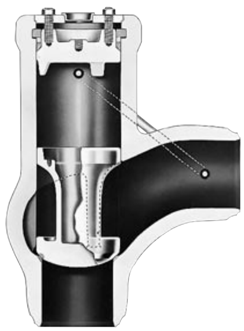
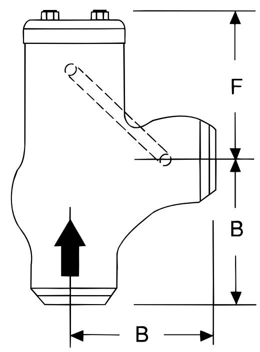
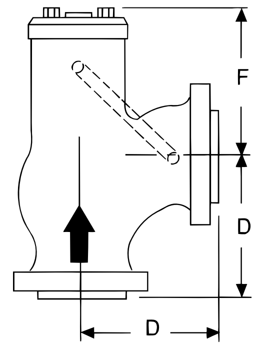
# Check Valves
# Class 2500 6170 PSI @ 100°F (425.5 BAR @ 38°C)

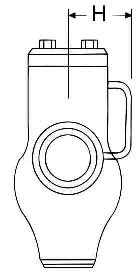


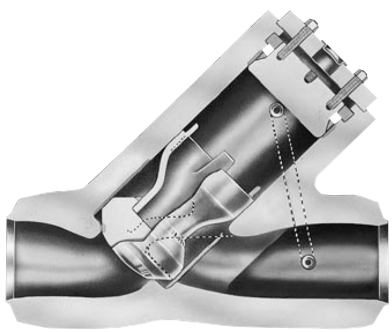


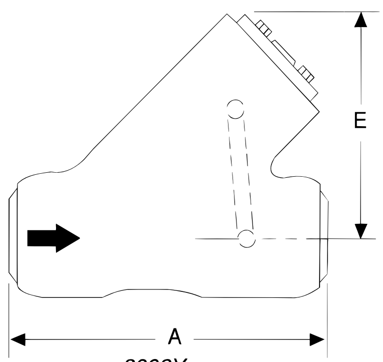

3995Y




3995






3992Y

## Dimensions – Angle

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

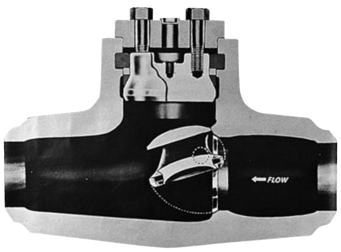
| Figure No. 3995/3995Y, 4495Y | | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|
| | NPS | 14 | 16 | 18 | 20 | 22 | 24 |
| | DN | 350 | 400 | 450 | 500 | 550 | 600 |
| B - Center to End (Welding) | | 20.25 | 20.25 | 23.5 | 23.5 | 26 | 28.5 |
| | | 514 | 514 | 597 | 597 | 660 | 724 |
| F - Center to Top, Angle | | 21.75 | 21.75 | 26.5 | 26.5 | 30.5 | 33 |
| | | 552 | 552 | 673 | 673 | 775 | 838 |
| H - Clearance for Equalizer | | 18.5 | 18.5 | 22 | 22 | 23 | 24 |
| | | 470 | 470 | 559 | 559 | 584 | 610 |
| Weight, Angle (Welding) | | 3210 | 3270 | 5570 | 5650 | 8100 | 10,550 |
| | | 1456 | 1483 | 2527 | 2562 | 3674 | 4785 |

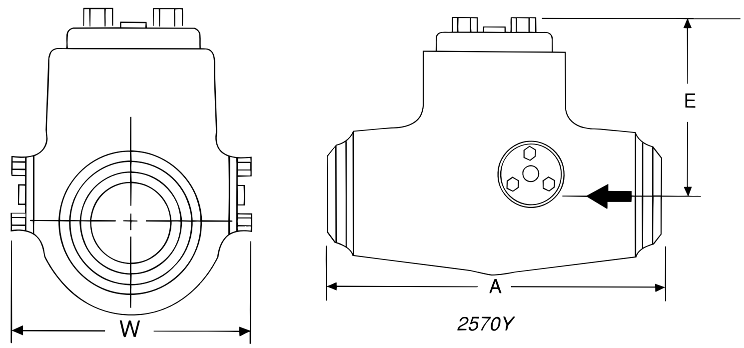
## Dimensions – Flite-Flow

| Figure No. 3992Y, 4492Y | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NPS | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 17 | 18.5 | 24 | 30 | 36 | 41 | 48.75 | 48.75 | 58 | 58 | 68 |
| | | 432 | 470 | 610 | 762 | 914 | 1041 | 1238 | 1238 | 1473 | 1473 | 1727 |
| E - Center to Top | | 10 | 11 | 14.25 | 18.75 | 22.25 | 26.75 | 28.5 | 28.5 | 36.5 | 36.5 | 54 |
| | | 254 | 279 | 362 | 476 | 565 | 679 | 724 | 724 | 927 | 927 | 1372 |
| H - Equalizer Clearance | | 9 | 10 | 11 | 11.5 | 15.75 | 17.5 | 20.25 | 20.25 | 23.5 | 23.5 | 32 |
| | | 229 | 254 | 279 | 292 | 400 | 445 | 514 | 514 | 591 | 591 | 813 |
| Weight (Welding) | | 150 | 225 | 510 | 950 | 1950 | 2730 | 4300 | 4300 | 8100 | 8190 | 12,620 |
| | | 68 | 102 | 230 | 431 | 884 | 1238 | 1950 | 1950 | 3674 | 3715 | 5724 |

*Note: Size 3&4 Buttweld Class 2500 Flite-Flow valves are Class 2900. See page 86.*

# Check Valves
# Class 2500  6170 PSI @ 100°F (425.5 BAR @ 38°C)




2570Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Integral Stellite seats.

## Dimensions – Tilting Disk

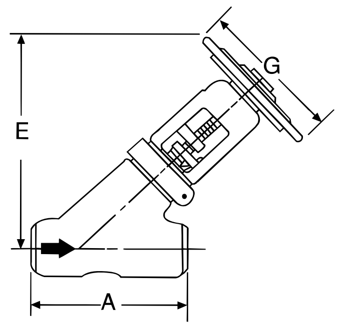
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| **Figure No. 2570Y, 4470Y** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 2-½* | 3* | 4* | 6 | 8 | 10 |
| | DN | 65 | 80 | 100 | 150 | 200 | 250 |
| A - End to End (Welding) | | 12 | 12 | 12 | 24 | 30 | 36 |
| | | 305 | 305 | 305 | 610 | 762 | 914 |
| E - Center to Top | | 7.25 | 7.25 | 7.25 | 9.5 | 10.5 | 12.5 |
| | | 184 | 184 | 184 | 241 | 267 | 318 |
| W - Width | | 10.5 | 10.5 | 10.5 | 15 | 18 | 20 |
| | | 267 | 267 | 267 | 381 | 457 | 508 |
| Weight (Welding) | | 95 | 95 | 95 | 435 | 800 | 1180 |
| | | 43 | 43 | 43 | 197 | 363 | 535 |

**Spiral wound hinge pin gaskets; hinge pin torsion spring not required.*

| **Figure No. 2570Y, 4470Y** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | NPS | 12 | 14 | 16 | 18 | 20 | 24 |
| | DN | 300 | 350 | 400 | 450 | 500 | 600 |
| A - End to End (Welding) | | 41 | 44 | 44 | 55 | 55 | 63 |
| | | 1041 | 1118 | 1118 | 1397 | 1397 | 1600 |
| E - Center to Top | | 15.75 | 17.75 | 17.75 | 23.75 | 23.75 | 31 |
| | | 400 | 451 | 451 | 603 | 603 | 787 |
| W - Width | | 24.25 | 28.5 | 28.5 | 35 | 35 | 45 |
| | | 616 | 724 | 724 | 889 | 889 | 1143 |
| Weight (Welding) | | 2250 | 3200 | 3200 | 5580 | 5690 | 13,200 |
| | | 1021 | 1452 | 1452 | 2531 | 2581 | 5988 |

# Stop Valves
# Class 2900 7160 PSI @ 100°F (493.6 BAR @ 38°C)




3914Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.

## Pressure Class 2900 (PN 490)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 3914Y | 4414Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3914Y, 4414Y | | 3 | 4 |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter | | 16 | 16 |
| | | 406 | 406 |
| Weight | | 230 | 325 |
| | | 104 | 147 |



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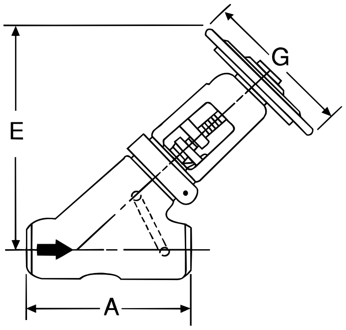
# Stop-Check (Non-Return) Valves
# Class 2900  7160 PSI @ 100°F (493.6 BAR @ 38°C)



3902Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seat, disk and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.

## Pressure Class 2900 (PN 490)

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 3902Y | 4402Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

## Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3902Y, 4402Y | | | |
|---|---|---|---|
| | NPS | 3 | 4 |
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top (Open) | | 20 | 25 |
| | | 508 | 635 |
| G - Handwheel Diameter* | | 16 | 16 |
| | | 406 | 406 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight | | 230 | 325 |
| | | 104 | 147 |

** Impactor handwheel is standard on all valves*



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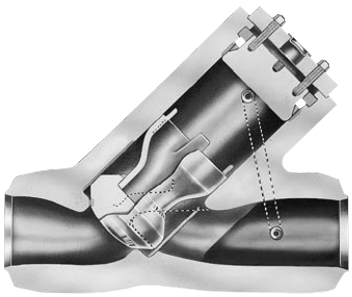
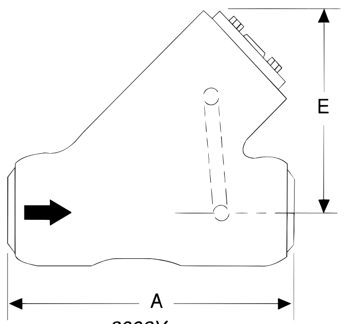
## Check Valves
## Class 2900 7160 PSI @ 100°F (493.6 BAR @ 38°C)






3992Y

### Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern.
- Integral Stellite seat and disk.
- Body-guided disk piston.
- Equipped with equalizer.

### Pressure Class 2900 (PN 490)

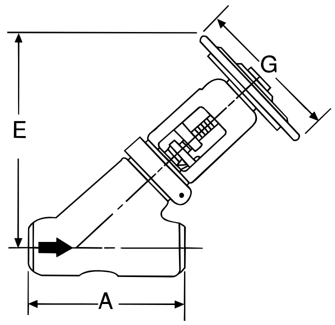
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 3992Y | 4492Y | Flite-Flow | Buttwelding | 3 (80) and 4 (100) |

### Dimensions – Flite-Flow®

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3992Y, 4492Y | NPS | 3 | 4 |
|---|---|---|---|
| | DN | 80 | 100 |
| A - End to End | | 17 | 18.5 |
| | | 432 | 470 |
| E - Center to Top | | 10 | 11 |
| | | 254 | 279 |
| H - Equalizer Clearance | | 9 | 10 |
| | | 229 | 254 |
| Weight | | 150 | 225 |
| | | 68 | 102 |

# Stop Valves
# Class 3600 8885 PSI @ 100°F (612.7 BAR @ 38°C)




3614Y/3014Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seats and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Yoke bushing thrust bearings.

## Dimensions – Flite-Flow**

| Figure No.** | NPS | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| A - End to End (Welding) | | | | | |
| E - Center to Top | | | | | |
| G - Handwheel Diameter* | | | | | |
| Weight (Welding) | | | | | |

** Impactor handwheel is standard on all valves.*
** Impactogear is available on size 6 and larger valves.*
*** Consult Flowserve sales representative for figure numbers and applicable dimensions.*

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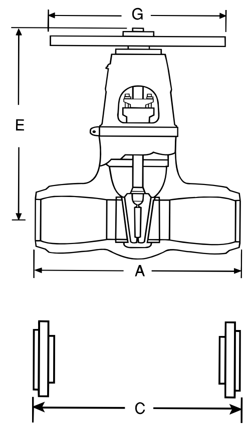
# Stop Valves
# Class 3600   8885 PSI @ 100°F (612.7 BAR @ 38°C)




## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Integral Stellite seat and backseat.
- Two-piece body-guided wedge.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Available in standard or venturi pattern.
- Yoke bushing thrust bearings.

## Pressure Class 3600

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 13611Y | 13011Y | Equiwedge Gate | Buttwelding | 16 (400) thru 24 (600) |
| 13611BY | 13011BY | Venturi Pattern Equiwedge Gate | Buttwelding | 18 (450) thru 28 (700) |

## Dimensions – Equiwedge Gate*

| Figure No.* | NPS | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|
| A - End to End (Welding) | | | | | | |
| E - Center to Top (Open) | | | | | | |
| G - Handwheel Diameter | | | | | | |
| Weight (Welding) | | | | | | |

** Consult Flowserve sales representative for applicable dimensions.*



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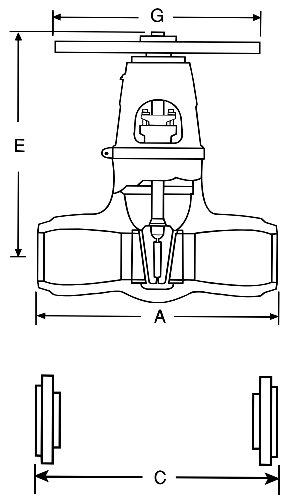
# Stop Valves
# Class 3600   8885 PSI @ 100°F (612.7 BAR @ 38°C)




## Dimensions – Equiwedge Gate*
## Venturi Pattern

| Figure No.* | NPS | 18x16x18 | 20x18x20 | 22x20x22 | 24x20x24 | 26x22x26 | 28x24x28 |
|---|---|---|---|---|---|---|---|
| A - End to End (Welding) | | | | | | | |
| E - Center to Top (Open) | | | | | | | |
| G - Handwheel Diameter | | | | | | | |
| Weight (Welding) | | | | | | | |

** Consult Flowserve sales representative for figure numbers and applicable dimensions.*

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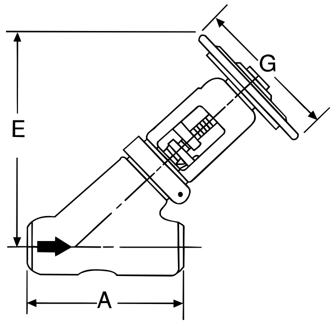
# Stop-Check (Non-Return) Valves
# Class 3600 8885 PSI @ 100°F (612.7 BAR @ 38°C)




3602Y/3002Y

## Standard Features

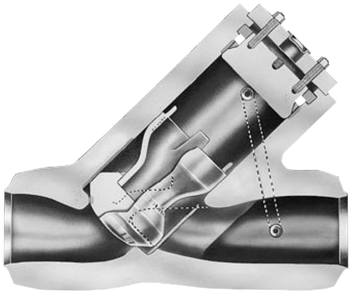
- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seats and backseats.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.
- Yoke bushing thrust bearings.

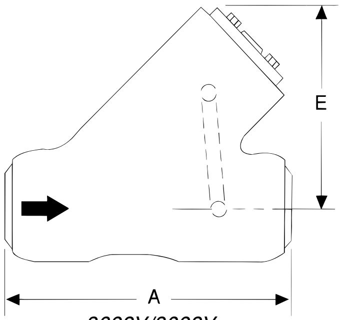
## Dimensions – Flite-Flow**

| Figure No.** | NPS | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| A - End to End (Welding) | | | | | |
| E - Center to Top | | | | | |
| G - Handwheel Diameter* | | | | | |
| H - Equalizer Clearance | | | | | |
| Weight (Welding) | | | | | |

*Impactor handwheel is standard on all valves.*
*Impactogear is available on size 6 and larger valves.*
*** Consult Flowserve sales representative for figure numbers and applicable dimensions.*

# Check Valves
# Class 3600 8885 PSI @ 100°F (612.7 BAR @ 38°C)






3692Y/3092Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern design.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with Equalizer.

## Dimensions – Flite-Flow® **

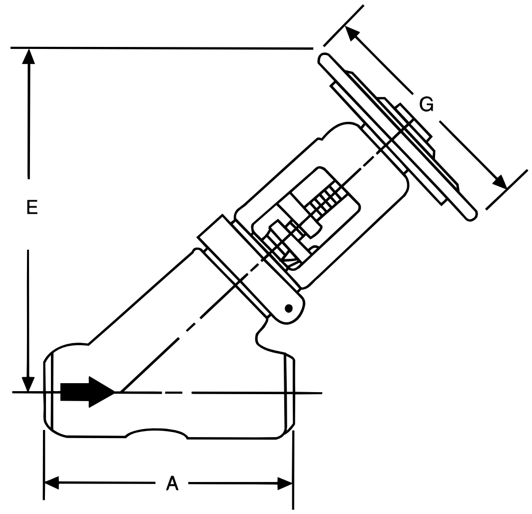
Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 3602Y | NPS | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|
| A - End to End | | | | | |
| | | | | | |
| E - Center to Top | | | | | |
| | | | | | |
| H - Equalizer Clearance | | | | | |
| | | | | | |
| Weight | | | | | |
| | | | | | |

*** Consult Flowserve sales representative for figure numbers and applicable dimensions.*

# Stop Valves
# Series 4500

These Series 4500 valves are designed and rated to Edward valve standards. See section 3.2 for additional information.




*4514Y*

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seats and backseat.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Yoke bushing thrust bearings.

## Series 4500

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD Series | SPL Series | | | |
| 4514Y | 5014Y | Flite-Flow | Buttwelding | 4 (100) thru 10 (250) |

## Dimensions – Flite-Flow

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4514Y, 5014Y | | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| | NPS | 4 | 6 | 8 | 10 |
| | DN | 100 | 150 | 200 | 250 |
| A - End to End | | 28 | 31 | 31 | 39.75 |
| | | 711 | 787 | 787 | 1010 |
| E - Center to Top (Open) | | 27.4 | 35 | 48.25 | 52.75 |
| | | 696 | 889 | 1226 | 1340 |
| G - Handwheel Diameter* | | 20 | 28 | 36 | 36 |
| | | 508 | 711 | 914 | 914 |
| Weight | | 625 | 1360 | 2510 | 4020 |
| | | 284 | 617 | 1139 | 1823 |

* *Impactor handwheel is standard on size 4 & larger. Impactogear is available on size 6 and larger.*



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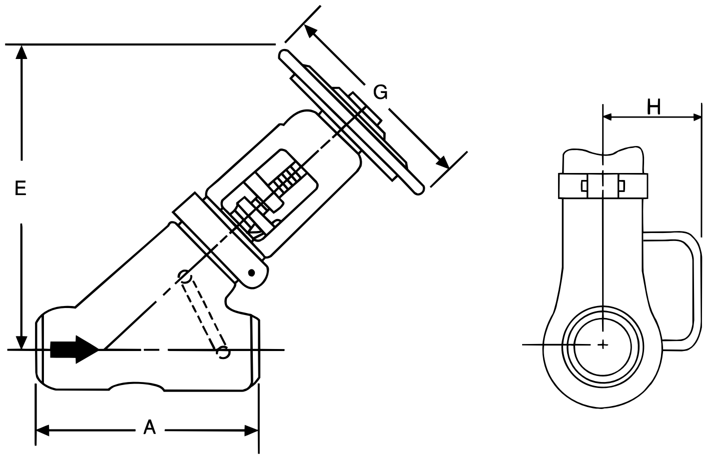
# Stop Check (Non-Return) Valves
# Series 4500

These Series 4500 valves are designed and rated to Edward valve standards. See section 3.2 for additional information.




4502Y

## Standard Features

- Bodies and bonnets are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal bonnet, OS & Y.
- Y-Pattern.
- Integral Stellite seats and backseats.
- Body-guided disk piston.
- 13% chromium stainless steel stem.
- Asbestos-free graphitic packing.
- Equipped with equalizer.
- Yoke bushing thrust bearings.

## Series 4500

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD Series | SPL Series | | | |
| 4502Y | 5002Y | Flite-Flow | Buttwelding | 4 (100) thru 10 (250) |

## Dimensions – Flite Flow

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4502Y/5002Y | | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| | NPS | 4 | 6 | 8 | 10 |
| | DN | 100 | 150 | 200 | 250 |
| A - End to End | | 28 | 31 | 31 | 39.75 |
| | | 711 | 787 | 787 | 1010 |
| E - Center to Top | | 27.4 | 35 | 48.25 | 52.75 |
| | | 695 | 889 | 1226 | 1340 |
| G - Handwheel Diameter* | | 20 | 28 | 36 | 36 |
| | | 508 | 711 | 914 | 914 |
| H - Equalizer Clearance | | 9.75 | 10.6 | 14.5 | 18.5 |
| | | 248 | 270 | 368 | 470 |
| Weight | | 625 | 1360 | 2510 | 4020 |
| | | 284 | 617 | 1139 | 1823 |

**Impactor handwheel is standard on size 4 & larger. Impactogear is available on size 6 and larger.*



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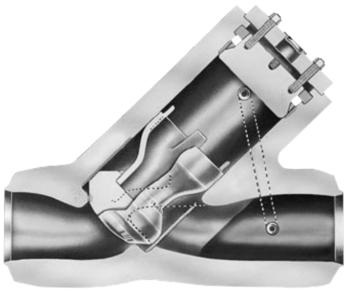
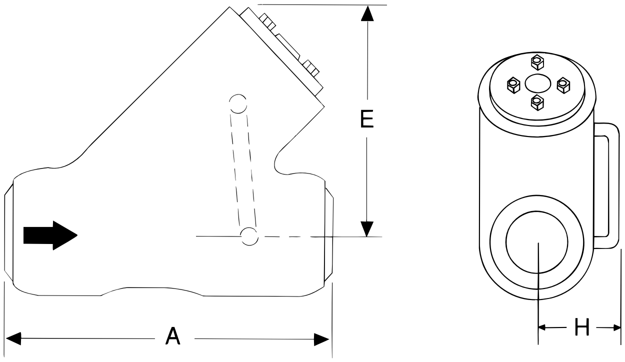
# Check Valves
# Series 4500

These Series 4500 valves are designed and rated to Edward valve standards. See 3.2 Pressure Ratings in the Technical Information Section for additional information.






4592Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Y-Pattern design.
- Integral Stellite seats.
- Body-guided disk piston.
- Equipped with Equalizer.

## Series 4500

| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD Series | SPL Series | | | |
| 4592Y | 5092Y | Flite-Flow | Buttwelding | 4 (100) thru 10 (250) |

## Dimensions – Flite Flow

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4592Y/5092Y | | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| | NPS | 4 | 6 | 8 | 10 |
| | DN | 100 | 150 | 200 | 250 |
| A - End to End | | 28 | 31 | 31 | 39.75 |
| | | 711 | 787 | 787 | 1010 |
| E - Center to Top | | 14 | 18 | 20 | 26 |
| | | 356 | 457 | 508 | 660 |
| H - Equalizer Clearance | | 9.75 | 10.6 | 14.5 | 18.5 |
| | | 248 | 269 | 368 | 470 |
| Weight | | 415 | 800 | 1500 | 2300 |
| | | 188 | 360 | 675 | 1035 |



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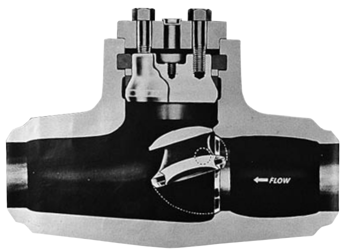
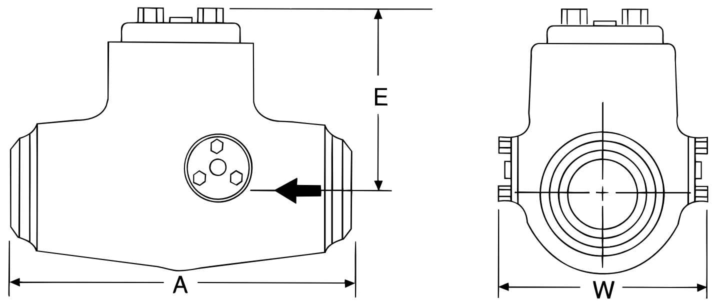
# Check Valves
# Class 4500 11,110 PSI @ 100°F (765.9 BAR @ 38°C)






4570Y

## Standard Features

- Bodies and covers are cast steel (WCB, WC6, WC9, C12A, CF8M or CF8C).
- Pressure seal cover.
- Tilting Disk design.
- Integral Stellite seats.

## Class 4500 (PN 760)

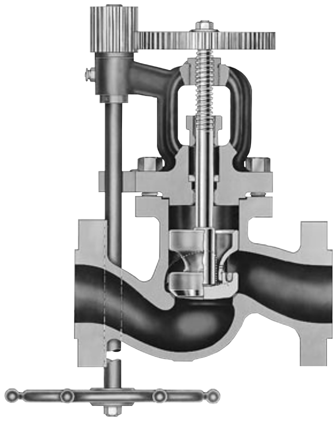
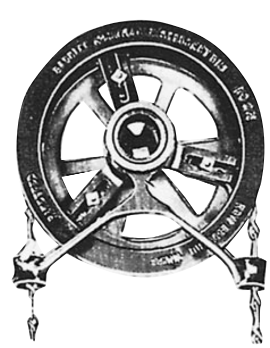
| Fig. No. | | Type | Ends | NPS (DN) |
|---|---|---|---|---|
| STD CL | SPL CL | | | |
| 4570Y | 5070Y | Tilting Disk | Buttwelding | 6 (150) and 8 (200) |

## Dimensions – Tilting Disk

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| Figure No. 4570Y/5070Y | | | |
|---|---|---|---|
| | NPS | 6 | 8 |
| | DN | 150 | 200 |
| A - End to End | | 20 | 24 |
| | | 508 | 610 |
| E - Center to Top | | 10.25 | 11.375 |
| | | 260 | 289 |
| W - Width | | 17.5 | 19 |
| | | 445 | 483 |
| Weight | | 520 | 1330 |
| | | 234 | 599 |

# Accessories


## Globe, Angle, Gate

By-Passes for Larger Cast Steel valves (See Pg. 118)

Edward by-pass valves conform to the latest edition of MSS-SP45 of the Manufacturers Standardization Society of the Valve and Fittings Industry.

Unless otherwise specified when globe and angle valves are ordered with by-pass attached, the by-pass is attached to the left hand side of the valve when viewed from the overseat end.

### Edward Forged Steel Valves for use as by-passes

| Socket Welding Ends Only | | Class 600 | Class 900 | Class 1500 | Class 2500 | Series 4500 |
|---|---|---|---|---|---|---|
| For use on main stop valve | Globe style, By-pass | Fig. A848Y* | Fig. D36224 | Fig. D36224 | Fig. D66224 | Fig. D96224 |
| For use on main stop-check valve | Globe style, By-pass | Fig. A868Y** | Fig. D36264 | Fig. D36264 | Fig. D66264 | Fig. D96264 |

** ALL MOTOR ACTUATED BY-PASS VALVES WILL BE FURNISHED WITH FIG. D36224.*
*** ALL MOTOR ACTUATED BY-PASS VALVES WILL BE FURNISHED WITH FIG. D36264.*

### Standard sizes of by-pass valves*

| | | | | | |
|---|---|---|---|---|---|
| Main valve size (all pressures) | 4 | 5 | 6 | 8 | 10 to 24 |
| By-Pass size | ½ | ¾ | ¾ | ¾ | 1 |

** By-passes are provided only when specified. Standard sizes of by-pass valves are in accordance with the table above. Larger size by-pass valves will be furnished on special order.*

### Floor Stands

Edward floor stands are cast iron or fabricated steel, and are designed and machined for accurate alignment. They are regularly furnished painted and are faced on bottom and drilled. Two heights, 20 and 32 inches, are available and can be furnished in indicating or non-indicating types. Spur and motor control floor stands can be furnished to meet special conditions.

### Chain Wheels

A simple and efficient means of valve operation from a lower level is provided by the use of chain wheels. They are fitted to the regular valve handwheels and are furnished complete with chain wheel and chain guide.

### Valve Extension

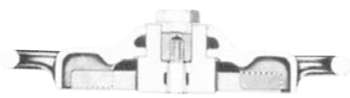
Illustration shows spur geared valve with extension stem for operation from below. Valves can also be furnished for extension operation above the valve. Larger size valves are also available with bevel gearing.

# Accessories – Cast Steel

The following “accessories” or “options” are available for Edward Forged and Cast Steel valves. Consult your Edward valves sales representative for specific details.

## Impactor Handwheel

Larger size Edward valves (except gate valves) feature an Impactor handwheel that permits one or two men to develop several thousand foot-pounds of torque for final valve closure — up to 12 times the force of an ordinary handwheel.

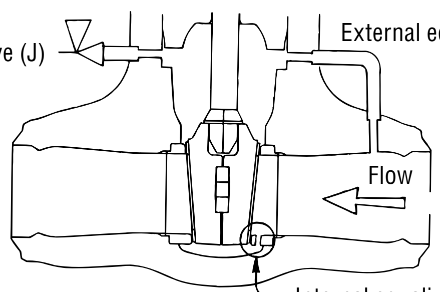


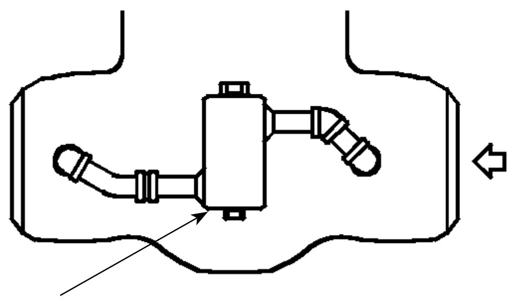
## Impactogear®

The Edward Impactogear makes cycling of larger, high pressure valves a one man operation. Impactogear is an exclusive Edward ring gear and pinion assembly that is fastened to an Impactor handwheel and yoke. Using the mechanical advantage of gearing reduction, the assembly permits large valves to be cycled between full open and full closed with an air wrench operating off a nominal air supply. The Impactogear wrench connection is equipped with a safety wrench guard.

## Custom Paint

Unless otherwise specified Edward Cast and Forged (carbon or alloy) Steel valves are painted with a high temperature aluminum lacquer paint. Upon special order Edward valves can be provided with customer specified paints or coatings.




## Drain or Vent

All Edward Cast Steel valves can be supplied with drains and/or vents. A standard drain or vent pipe, six inches long, is socket welded to the valve body, or as specified by the customer.

## External Equalizer

A pipe that connects the bonnet cavity of the Equiwedge Gate valve to the upstream side of the valve. See drawing and page 19 for additional information.

## Internal Equalizer

A hole drilled in the upstream seat ring of the Equiwedge Gate valve for pressure equalization. See drawing for additional information.

## Relief Valve

A pressure relief valve can be attached to the bonnet of the Equiwedge Gate valve to protect against overpressurization, but not prevent pressure locking. See drawing and page 25 for additional information.

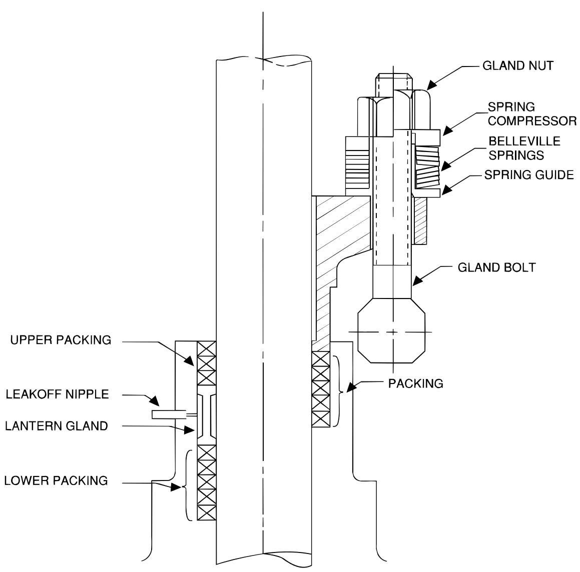
## Automatic Center Cavity Equalizing Valve

A fully automatic bonnet relief device that allows bi-directional seating, even at low pressure differential. See drawing and page 98 for details.

# Accessories – Cast Steel

**Examples of a Typical Packing Leakoff (left) and Live Load Packing Gland (right)**

Packing Chamber with Leakoff | Typical Live Loading Arrangement




The following "accessories" or "options" are available for Flowserve Edward Forged and Cast Steel valves. Consult your Flowserve Edward valves sales representative for specific details.

## Leakoff

The left half of the schematic to the left depicts a typical Leakoff arrangement, including lantern gland and upper and lower packing sets. This double packing arrangement provides added protection against packing leaks.

## Live-Loading

The right half of the schematic to the left depicts a typical live-loaded packing assembly. The Belleville springs provide a constant packing load to compensate for packing consolidation and thermal effects.

## Locking Devices

Edward valves can be provided with padlock and chain or other locking devices as specified.

## Position Indicators and Limit Switches

If required, Edward valves can be fitted with a variety of position indicators and/or limit switches for remote indication.

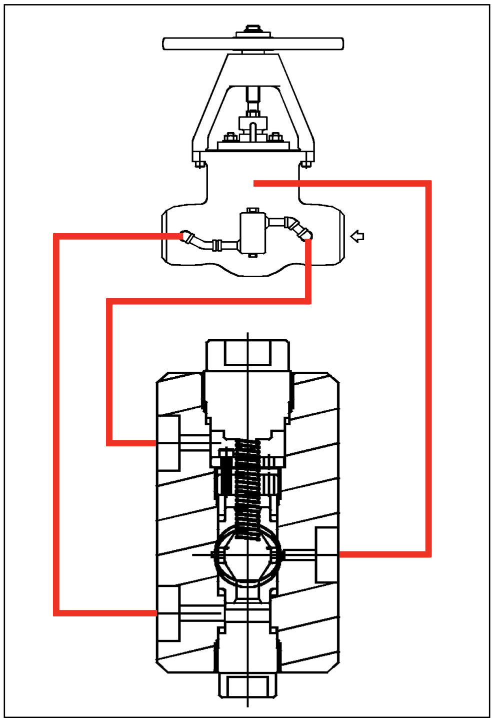
## Soft Seats

This option is available for both Forged and Cast Steel Globe and Check valves on a limited basis.

The disk face can be fitted with a soft seat or insert when drop tight sealing is a must. However, some limitations (temperature, differential pressure, radiation) may apply. Consult your Flowserve Edward valves representative for more information.

## Washout Connections

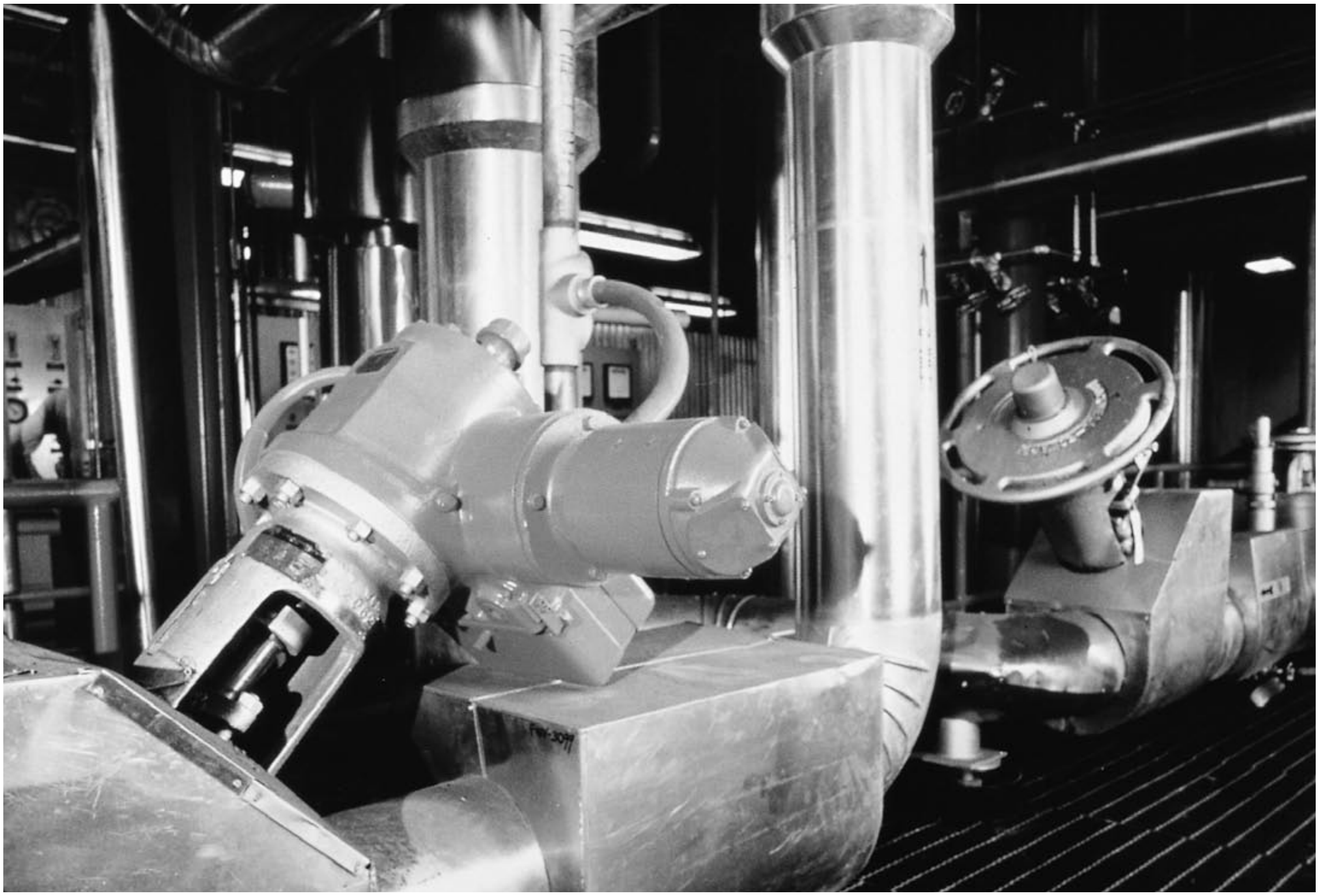
Edward Cast Steel valves can be fitted with special covers that incorporate a pipe nipple to be used as a washout connection to introduce cleaning solutions, etc. for pipeline flushing.



## Automatic Center Cavity Equalizing Valve (ACCEV)

The Flowserve Edward ACCEV automatically relieves increasing center cavity pressure to the higher pressure end of the valve, while preventing leakage to the lower pressure end, solving pressure locking and bonnet over-pressurization problems that can occur in double-seated valves. The internal spring gives preferential connection to the designated upstream end of the valve. When system conditions result in the downstream pressure being higher than the upstream, the ball shifts so that the center cavity connects with the downstream end of the valve. The Edward ACCEV meets or exceeds MSS SP-61 for tight shutoff in both directions. When furnished on an Edward Equiwedge gate valve, all of the necessary connections are made to the host valve and hydro tested in our factory. No piping connections or testing are required by the user. The Edward ACCEV is available as a kit with necessary piping to be field installed on any existing Edward or other manufacturer's valve and can be readily dissassembled and repaired in-line in the event any maintenance is required. The Edward ACCEV is available in a commercial B16.34 version for general service and also in an ASME Section III N-Stamp version for nuclear applications.

# Actuators – Cast Steel



Flowserve Edward valves supplies actuators for Edward forged and cast steel valves when alternate sources of power are required to open, close or maintain an intermediate position in the valve.

The most commonly used actuators are: electric, pneumatic, hydraulic, manual gear, or a stored energy gas hydraulic used in nuclear applications. Most Edward valves can be equipped with an actuator, if required. Where specific or special customer requirements are needed, Flowserve engineering and expertise with all types of actuators can be applied and adapted to meet the most rigid codes.

The following information on page 100 will allow Flowserve engineers to correctly size and select the proper motor actuator for your application.

# Required Information for Motor Actuators

**1. OPERATING PRESSURES:**

A) PRESSURE UNDER SEAT = ________________________________ psig
B) PRESSURE OVER SEAT = ________________________________ psig
C) PRESSURE DIFFERENTIAL = ______________________________ psig

**2. MOTOR POWER SUPPLY*:**

A) AC = ______________ V. ________________ HZ. ________________ PH. __________________
B) DC = ______________ V.

*STANDARD VOLTAGE VARIANCE ± 10%. IF OTHERWISE, PLEASE INDICATE

**3. LIMIT SWITCH, TOTAL QUANTITY OF CONTACTS** = _______________________________________________

**4. DOUBLE TORQUE SWITCH IS STANDARD.**

**5. CONTROL POWER SUPPLY TO SWITCH COMPARTMENT** = ____________________________________________

**6. CLOSING TIME:**

A) STANDARD (GLOBE VALVES APPROX. 4 IN./MIN.; GATE VALVES APPROX. 12 IN./MIN. STEM SPEED.)
B) SPECIAL: _________________ INDICATE REQUIRED CLOSING TIME: ___________________

**7. OPTIONAL EQUIPMENT (PLEASE INDICATE REQUIRED OPTIONS):**

A) MECHANICAL DIAL POSITION INDICATOR
B) EXTRA TERMINALS
C) REVERSING MOTOR CONTROLLER: ________________ INTEGRAL OR ________________ NON-INTEGRAL.
D) PUSH-BUTTON STATION: ________________________ INTEGRAL OR ________________ NON-INTEGRAL.
E) POSITION TRANSMITTER, INDICATE TYPE: ________________________________________________
F) POSITION RECEIVER: ________________________________________________________________
H) OTHERS: _______________________________________________________________________
_____________________________________________________________________________________

**8. AMBIENT CONDITIONS:** __________________________________________________________________

**9. NEMA RATING:** *STANDARD IS NEMA 4 (WEATHERPROOF), IF OTHERWISE, PLEASE LIST*
_____________________________________________________________________________________

**10. STEM POSITION OF INSTALLED VALVE:**

A) VERTICAL UP-RIGHT: ___________________________________
B) VERTICAL UP-SIDE DOWN: _______________________________
C) HORIZONTAL: _________________________________________

*Data in the Table above represents the minimum information that should be provided when ordering a valve equipped with a motor operator.*

# Material Chemical Analysis (ASTM) for Edward Valves

| MATERIAL | ELEMENTS | PERCENTAGE* CAST | PERCENTAGE* FORGED | |
|---|---|---|---|---|
| **Carbon Steel (Body)** | Carbon | 0.30 max. | 0.22 max. | |
| **Cast - ASTM A216 Grade WCB** | Manganese | 1.00 max. | .60 to 1.05 | |
| **Forged - ASTM A105** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Sulfur | 0.045 max. | 0.05 max. | |
| | Silicon | 0.60 max. | 0.35 max. | |
| **Carbon Steel (Body)** | Carbon | 0.25 max. | | |
| **Cast - ASTM A216-WCC** | Manganese | 1.20 max. | | |
| | Phosphorus | 0.04 max. | | |
| | Sulfur | 0.045 max. | | |
| | Silicon | 0.60 max. | | |
| **1¼ Chromium-Molybdenum Steel (Body)** | Carbon | 0.20 max. | 0.10 to 0.15 | |
| **Cast - ASTM A217 Grade WC6** | Manganese | 0.50 to 0.80 | 0.30 to 0.80 | |
| **Forged - ASTM A182 Grade F11** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Sulfur | 0.045 max. | 0.04 max. | |
| | Silicon | 0.60 max. | 0.50 to 1.00 | |
| | Chromium | 1.00 to 1.50 | 1.00 to 1.50 | |
| | Molybdenum | 0.45 to 0.65 | 0.44 to 0.65 | |
| **2¼ Chromium-Molybdenum Steel (Body)** | Carbon | 0.18 max. | 0.15 max. | |
| **Cast - ASTM A217 Grade WC9** | Manganese | 0.40 to 0.70 | 0.30 to 0.60 | |
| **Forged - ASTM A182 Grade F22** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Sulfur | 0.045 max. | 0.04 max. | |
| | Silicon | 0.60 max. | 0.50 max. | |
| | Chromium | 2.00 to 2.75 | 2.00 to 2.50 | |
| | Molybdenum | 0.90 to 1.20 | 0.87 to 1.13 | |
| **9 Chromium, 1 Molybdenum Steel Body** | Carbon | 0.12 max. | 0.08-0.12 max. | |
| **Cast - ASTM A-217 Grade C12A** | Manganese | 0.30-0.60 max. | 0.30-0.60 max. | |
| **Forged - ASTM A-182 Grade F91** | Phosphorus | 0.02 max. | 0.02 max. | |
| | Sulfur | 0.018 max. | 0.01 max. | |
| | Silicon | 0.20-0.50 | 0.20-0.50 max. | |
| | Chromium | 8.0-9.5 | 8.00-9.50 | |
| | Molybdenum | 0.85-1.05 | 0.85-1.05 | |
| | Columbium | 0.060-0.10 | 0.060-0.10 | |
| | Venadium | 0.18-0.25 | 0.18-0.25 | |
| | Nitrogen | 0.030-0.070 | 0.030-0.070 | |
| | Nickel | 0.40 max. | 0.40 max. | |
| **Austenitic Stainless Steel (Body)** | Carbon | 0.03 max. | 0.08 max. | |
| **Cast - ASTM A-351 Grade CF8M** | Manganese | 1.50 max. | 2.00 max. | |
| **Forged - ASTM A-182 Grade F316** | Phosphorus | 0.04 max. | 0.04 max. | |
| | Nickel | 9.00 to 13.00 | 10.00 to 14.00 | |
| | Sulfur | 0.04 max. | 0.03 max. | |
| | Silicon | 1.50 max. | 1.00 max. | |
| | Chromium | 17.00 to 21.00 | 16.00 to 18.00 | |
| | Molybdenum | 2.00 to 3.00 | 2.00 to 3.00 | |
| **Martensitic Stainless Steel (Stems)** | Carbon | 0.15 max. | 0.15 max. | |
| **Bolted Bonnet T416** | Manganese | 1.00 max. | 1.25 max. | |
| **Cast valves - ASTM A182 Grade F6a** | Phosphorus | 0.04 max. | 0.06 max. | |
| **Univalves - A-479 T-410 Cl 3** | Sulfur | 0.03 max. | 0.15 min. | |
| | Silicon | 1.00 max. | 1.00 max | |
| | Nickel | 0.50 max. | — | |
| | Chromium | 11.50 to 13.50 | 12.00 to 14.00 | |
| | Molybdenum | — | 0.60 max. | |
| **Aluminum Bronze (Yoke Bushings)** | | | 61900 | 62300 |
| **Cast valves - ASTM B 148 Alloy 95400** | Copper | remainder | remainder | remainder |
| **Forged valves - ASTM B150 Alloy 61900-62300** | Aluminum | 10.00 to 11.50 | 8.50 to 10.00 | 8.50 to 11.00 |
| | Iron | 3.00 to 5.00 | 3.00 to 4.50 | 2.00 to 4.00 |
| | Tin | — | 0.60 max. | 0.60 max. |
| | Lead | — | 0.80 max. | — |
| | Manganese | 0.50 max. | — | 0.50 max. |
| | Zinc | — | 0.02 max. | — |
| | Silicon | — | — | 0.25 max. |
| | Nickel & Cobalt | 1.50 max. | — | 1.00 max. |
| **Chromium-Molybenum (Bolting)** | Carbon | 0.37 to 0.49 | | |
| **ASTM A193 Grade B7** | Manganese | 0.65 to 1.10 | | |
| **Forged - ASTM A105** | Phosphorus | 0.035 max. | | |
| | Sulfur | 0.04 max. | | |
| | Silicon | 0.15 to 0.35 | | |
| | Chromium | 0.75 to 1.20 | | |
| | Molybdenum | 0.15 to 0.25 | | |
| **Hard Surfacing for Seats and Disks** | Chromium | 25.00 to 29.00 | | |
| **A732 Grade 21 & Stellite 21®** | Manganese | 1.00 max. | | |
| | Molybdenum | 5.00 to 6.00 | | |
| | Nickel | 1.75 to 3.75 | | |
| | Iron | 3.00 | | |
| | Boron | .007 max. | | |
| | Carbon | 0.20 to 0.30 | | |
| | Silicon | 1.00 | | |

**The equivalent Edward valve material specification for valve bodies meets all of the requirements of the referenced ASTM Specification; additionally Flowserve restricts certain elements (i.e. carbon, manganese) to tighter allowable ranges to enhance weldability.*

This ASTM specification data is provided for customer information. The data was based on information available at time of printing and may not reflect the latest ASTM revision. Flowserve suggests referring to the applicable specification for complete information or contacting your Edward valves sales representative.

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A216-WCB STANDARD CLASS (1) (2) | -20 to 100 | 740 | 985 | 1480 | 1725 | 2220 | 2715 | 3705 | 4445 | 4940 | 6170 | 7160 | 8885 | 11110 |
| | 200 | 680 | 905 | 1360 | 1585 | 2035 | 2490 | 3395 | 4075 | 4525 | 5655 | 6560 | 8145 | 10185 |
| | 300 | 655 | 875 | 1310 | 1530 | 1965 | 2400 | 3270 | 3925 | 4360 | 5450 | 6325 | 7850 | 9815 |
| | 400 | 635 | 845 | 1265 | 1475 | 1900 | 2325 | 3170 | 3805 | 4225 | 5280 | 6125 | 7605 | 9505 |
| | 500 | 605 | 805 | 1205 | 1405 | 1810 | 2210 | 3015 | 3620 | 4020 | 5025 | 5830 | 7235 | 9040 |
| | 600 | 570 | 760 | 1135 | 1325 | 1705 | 2085 | 2840 | 3405 | 3785 | 4730 | 5485 | 6810 | 8515 |
| | 650 | 550 | 735 | 1100 | 1285 | 1650 | 2015 | 2745 | 3295 | 3660 | 4575 | 5310 | 6590 | 8240 |
| | 700 | 530 | 705 | 1060 | 1235 | 1590 | 1950 | 2665 | 3195 | 3545 | 4425 | 5130 | 6370 | 7960 |
| | 750 | 505 | 675 | 1015 | 1185 | 1520 | 1860 | 2535 | 3045 | 3385 | 4230 | 4905 | 6090 | 7610 |
| | 800 | 410 | 550 | 825 | 960 | 1235 | 1510 | 2055 | 2470 | 2745 | 3430 | 3980 | 4935 | 6170 |
| | 850 | 320 | 425 | 640 | 745 | 955 | 1170 | 1595 | 1915 | 2125 | 2655 | 3080 | 3825 | 4785 |
| | 900 | 230 | 305 | 460 | 535 | 690 | 845 | 1150 | 1380 | 1535 | 1915 | 2225 | 2760 | 3455 |
| | 950 | 135 | 180 | 275 | 320 | 410 | 500 | 685 | 825 | 915 | 1145 | 1325 | 1645 | 2055 |
| | 1000 | 85 | 115 | 170 | 200 | 255 | 315 | 430 | 515 | 575 | 715 | 830 | 1030 | 1285 |
| ASTM A216-WCB SPECIAL CLASS (1) (2) | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 740 | 985 | 1480 | 1725 | 2220 | 2715 | 3700 | 4440 | 4935 | 6170 | 7155 | 8885 | 11105 |
| | 400 | 735 | 980 | 1465 | 1710 | 2200 | 2690 | 3665 | 4395 | 4885 | 6105 | 7085 | 8795 | 10995 |
| | 500 | 735 | 980 | 1465 | 1710 | 2200 | 2690 | 3665 | 4395 | 4885 | 6105 | 7085 | 8795 | 10995 |
| | 600 | 735 | 980 | 1465 | 1710 | 2200 | 2690 | 3665 | 4395 | 4885 | 6105 | 7085 | 8795 | 10995 |
| | 650 | 715 | 955 | 1430 | 1670 | 2145 | 2620 | 3575 | 4290 | 4770 | 5960 | 6915 | 8585 | 10730 |
| | 700 | 690 | 920 | 1380 | 1610 | 2075 | 2535 | 3455 | 4145 | 4610 | 5760 | 6680 | 8295 | 10365 |
| | 750 | 635 | 845 | 1270 | 1480 | 1905 | 2325 | 3170 | 3805 | 4230 | 5285 | 6130 | 7610 | 9515 |
| | 800 | 515 | 685 | 1030 | 1200 | 1545 | 1885 | 2570 | 3085 | 3430 | 4285 | 4970 | 6170 | 7715 |
| | 850 | 400 | 530 | 795 | 930 | 1195 | 1460 | 1995 | 2395 | 2660 | 3320 | 3850 | 4785 | 5980 |
| | 900 | 285 | 380 | 575 | 670 | 860 | 1050 | 1435 | 1725 | 1915 | 2395 | 2775 | 3445 | 4305 |
| | 950 | 170 | 230 | 345 | 400 | 515 | 630 | 855 | 1030 | 1145 | 1430 | 1660 | 2055 | 2570 |
| | 1000 | 105 | 140 | 215 | 250 | 320 | 390 | 535 | 645 | 715 | 895 | 1035 | 1285 | 1605 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Note: Flanged End valve ratings are limited to standard class only.*

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 800°F.*

*2. Shaded ratings exceed those of standard Edward valves. Consult your Edward valves sales representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 "valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*



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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A216-WCB STANDARD CLASS (1) (2) | -29 to 38 | 51.1 | 68.1 | 102.1 | 119.1 | 153.2 | 187.2 | 255.3 | 306.4 | 340.4 | 425.5 | 493.6 | 612.7 | 765.9 |
| | 50 | 50.1 | 66.8 | 100.2 | 116.9 | 150.4 | 183.8 | 250.6 | 300.7 | 334.2 | 417.7 | 484.5 | 601.5 | 751.9 |
| | 100 | 46.6 | 62.1 | 93.2 | 108.7 | 139.8 | 170.9 | 233.0 | 279.6 | 310.7 | 388.3 | 450.4 | 559.2 | 699.0 |
| | 150 | 45.1 | 60.1 | 90.2 | 105.2 | 135.2 | 165.3 | 225.4 | 270.5 | 300.5 | 375.6 | 435.7 | 540.9 | 676.1 |
| | 200 | 43.8 | 58.4 | 87.6 | 102.2 | 131.4 | 160.6 | 219.0 | 262.8 | 292.0 | 365.0 | 423.4 | 525.6 | 657.0 |
| | 250 | 41.9 | 55.9 | 83.9 | 97.9 | 125.8 | 153.8 | 209.7 | 251.6 | 279.6 | 349.5 | 405.4 | 503.3 | 629.1 |
| | 300 | 39.8 | 53.1 | 79.6 | 92.9 | 119.5 | 146.0 | 199.1 | 238.9 | 265.5 | 331.8 | 384.9 | 477.8 | 597.3 |
| | 325 | 38.7 | 51.6 | 77.4 | 90.3 | 116.1 | 141.9 | 193.6 | 232.3 | 258.1 | 322.6 | 374.2 | 464.6 | 580.7 |
| | 350 | 37.6 | 50.1 | 75.1 | 87.6 | 112.7 | 137.7 | 187.8 | 225.4 | 250.4 | 313.0 | 363.1 | 450.8 | 563.5 |
| | 375 | 36.4 | 48.5 | 72.7 | 84.8 | 109.1 | 133.3 | 181.8 | 218.2 | 242.5 | 303.1 | 351.6 | 436.4 | 545.5 |
| | 400 | 34.7 | 46.3 | 69.4 | 81.0 | 104.2 | 127.3 | 173.6 | 208.3 | 231.5 | 289.3 | 335.6 | 416.6 | 520.8 |
| | 425 | 28.8 | 38.4 | 57.5 | 67.1 | 86.3 | 105.5 | 143.8 | 172.6 | 191.8 | 239.7 | 278.1 | 345.2 | 431.5 |
| | 450 | 23.0 | 30.7 | 46.0 | 53.7 | 69.0 | 84.3 | 115.0 | 138.0 | 153.4 | 191.7 | 222.4 | 276.1 | 345.1 |
| | 475 | 17.4 | 23.2 | 34.9 | 40.7 | 52.3 | 63.9 | 87.2 | 104.6 | 116.3 | 145.3 | 168.5 | 209.2 | 261.5 |
| | 500 | 11.8 | 15.7 | 23.5 | 27.4 | 35.3 | 43.1 | 58.8 | 70.5 | 78.4 | 97.9 | 113.6 | 141.0 | 176.3 |
| | 538 | 5.9 | 7.9 | 11.8 | 13.8 | 17.7 | 21.6 | 29.5 | 35.4 | 39.4 | 49.2 | 57.1 | 70.9 | 88.6 |
| ASTM A216-WCB SPECIAL CLASS (1) (2) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.6 | 68.8 | 103.3 | 120.5 | 154.9 | 189.3 | 258.2 | 309.8 | 344.3 | 430.3 | 499.1 | 619.6 | 774.5 |
| | 150 | 51.0 | 68.0 | 102.1 | 119.1 | 153.1 | 187.1 | 255.2 | 306.2 | 340.3 | 425.3 | 493.3 | 612.4 | 765.5 |
| | 200 | 50.6 | 67.4 | 101.1 | 118.0 | 151.7 | 185.4 | 252.9 | 303.5 | 337.2 | 421.4 | 488.8 | 606.9 | 758.6 |
| | 250 | 50.5 | 67.4 | 101.1 | 117.9 | 151.6 | 185.3 | 252.6 | 303.2 | 336.9 | 421.1 | 488.5 | 606.3 | 757.9 |
| | 300 | 50.5 | 67.4 | 101.1 | 117.9 | 151.6 | 185.3 | 252.6 | 303.2 | 336.9 | 421.1 | 488.5 | 606.3 | 757.9 |
| | 325 | 50.1 | 66.8 | 100.2 | 116.9 | 150.3 | 183.7 | 250.6 | 300.7 | 334.1 | 417.6 | 484.4 | 601.4 | 751.7 |
| | 350 | 48.9 | 65.2 | 97.8 | 114.1 | 146.7 | 179.3 | 244.6 | 293.5 | 326.1 | 407.6 | 472.8 | 587.0 | 733.7 |
| | 375 | 47.1 | 62.8 | 94.2 | 109.9 | 141.3 | 172.7 | 235.5 | 282.6 | 314.0 | 392.5 | 455.3 | 565.2 | 706.5 |
| | 400 | 43.4 | 57.9 | 86.8 | 101.3 | 130.2 | 159.1 | 217.0 | 260.4 | 289.4 | 361.7 | 419.6 | 520.8 | 651.0 |
| | 425 | 36.0 | 48.0 | 71.9 | 83.9 | 107.9 | 131.9 | 179.8 | 215.7 | 239.7 | 299.6 | 347.5 | 431.4 | 539.3 |
| | 450 | 28.8 | 38.4 | 57.5 | 67.1 | 86.3 | 105.5 | 143.8 | 172.5 | 191.7 | 239.6 | 278.0 | 345.1 | 431.4 |
| | 475 | 21.8 | 29.1 | 43.6 | 50.9 | 65.4 | 79.9 | 109.0 | 130.8 | 145.3 | 181.6 | 210.7 | 261.5 | 326.9 |
| | 500 | 14.7 | 19.6 | 29.4 | 34.3 | 44.1 | 53.9 | 73.5 | 88.2 | 98.0 | 122.4 | 142.0 | 176.3 | 220.4 |
| | 538 | 7.4 | 9.9 | 14.8 | 17.3 | 22.2 | 27.1 | 36.9 | 44.3 | 49.3 | 61.6 | 71.4 | 88.7 | 110.8 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 427°C.*

*2. Shaded ratings exceed those of standard Edward valves. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

FLOWSERVE

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| A216-WCC GROUP 1.2 STANDARD CLASS (1) (2) | 100 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 200 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 300 | 730 | 970 | 1,455 | 1,700 | 2,185 | 2,670 | 3,640 | 4,370 | 4,855 | 6,070 | 7,040 | 8,740 | 10,925 |
| | 400 | 705 | 940 | 1,405 | 1,640 | 2,110 | 2,580 | 3,520 | 4,225 | 4,695 | 5,865 | 6,805 | 8,445 | 10,555 |
| | 500 | 665 | 890 | 1,330 | 1,550 | 1,995 | 2,440 | 3,325 | 3,990 | 4,435 | 5,540 | 6,425 | 7,975 | 9,965 |
| | 600 | 605 | 810 | 1,210 | 1,410 | 1,815 | 2,220 | 3,025 | 3,630 | 4,035 | 5,040 | 5,845 | 7,260 | 9,070 |
| | 650 | 590 | 785 | 1,175 | 1,370 | 1,765 | 2,160 | 2,940 | 3,530 | 3,925 | 4,905 | 5,690 | 7,060 | 8,825 |
| | 700 | 555 | 740 | 1,110 | 1,295 | 1,665 | 2,035 | 2,775 | 3,330 | 3,705 | 4,630 | 5,370 | 6,665 | 8,330 |
| | 750 | 505 | 675 | 1,015 | 1,180 | 1,520 | 1,860 | 2,535 | 3,045 | 3,385 | 4,230 | 4,905 | 6,090 | 7,610 |
| | 800 | 410 | 550 | 825 | 960 | 1,235 | 1,510 | 2,055 | 2,470 | 2,745 | 3,430 | 3,980 | 4,940 | 6,170 |
| | 850 | 320 | 430 | 640 | 745 | 955 | 1,170 | 1,595 | 1,915 | 2,125 | 2,655 | 3,080 | 3,830 | 4,785 |
| | 900 | 225 | 300 | 445 | 520 | 670 | 820 | 1,115 | 1,340 | 1,485 | 1,855 | 2,155 | 2,675 | 3,345 |
| | 950 | 135 | 180 | 275 | 320 | 410 | 500 | 685 | 825 | 915 | 1,145 | 1,330 | 1,645 | 2,055 |
| | 1000 | 85 | 115 | 170 | 200 | 255 | 315 | 430 | 515 | 575 | 715 | 830 | 1,030 | 1,285 |
| A216-WCC GROUP 1.2 SPECIAL CLASS (1) (2) | 100 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 200 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 300 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 400 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 500 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 600 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 650 | 750 | 1,000 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 700 | 715 | 950 | 1,425 | 1,660 | 2,140 | 2,615 | 3,565 | 4,280 | 4,755 | 5,940 | 6,890 | 8,550 | 10,690 |
| | 750 | 635 | 850 | 1,270 | 1,480 | 1,905 | 2,330 | 3,170 | 3,805 | 4,230 | 5,285 | 6,130 | 7,610 | 9,515 |
| | 800 | 515 | 690 | 1,030 | 1,200 | 1,545 | 1,890 | 2,570 | 3,085 | 3,430 | 4,285 | 4,970 | 6,170 | 7,715 |
| | 850 | 400 | 530 | 795 | 930 | 1,195 | 1,460 | 1,995 | 2,395 | 2,660 | 3,320 | 3,850 | 4,780 | 5,980 |
| | 900 | 280 | 370 | 555 | 650 | 835 | 1,020 | 1,395 | 1,675 | 1,860 | 2,320 | 2,690 | 3,340 | 4,180 |
| | 950 | 170 | 230 | 345 | 400 | 515 | 630 | 855 | 1,030 | 1,140 | 1,430 | 1,660 | 2,060 | 2,570 |
| | 1000 | 105 | 140 | 215 | 250 | 320 | 390 | 535 | 645 | 715 | 895 | 1,040 | 1,285 | 1,605 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Note: Flanged End valve ratings are limited to standard class only and terminate at 1000°F.*

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 800°F.*

*2. Shaded ratings may require special trim and packing. Consult your Edward valves sales representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*



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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| A216-WCC GROUP 1.2 SPEICAL CLASS (1) (2) | 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.5 | 68.7 | 103.0 | 120.2 | 154.6 | 188.9 | 257.6 | 309.1 | 343.5 | 429.4 | 498.1 | 618.4 | 773.0 |
| | 150 | 50.2 | 66.9 | 100.3 | 117.0 | 150.5 | 183.9 | 250.8 | 301.0 | 334.5 | 418.1 | 485.0 | 602.1 | 752.6 |
| | 200 | 48.6 | 64.8 | 97.2 | 113.4 | 145.8 | 178.3 | 243.2 | 291.9 | 324.3 | 405.4 | 470.3 | 583.8 | 729.7 |
| | 250 | 46.3 | 61.6 | 92.2 | 107.8 | 139.0 | 169.9 | 231.8 | 278.1 | 309.0 | 386.2 | 447.9 | 555.9 | 694.8 |
| | 300 | 42.9 | 57.2 | 85.7 | 100.0 | 128.6 | 157.2 | 214.4 | 257.2 | 285.8 | 357.1 | 414.2 | 514.1 | 642.6 |
| | 325 | 41.4 | 55.1 | 82.6 | 96.4 | 124.0 | 151.5 | 206.6 | 247.9 | 275.5 | 344.3 | 399.4 | 495.7 | 619.6 |
| | 350 | 40.0 | 53.3 | 80.0 | 93.4 | 120.1 | 146.8 | 200.1 | 240.1 | 266.8 | 333.5 | 386.9 | 480.2 | 600.3 |
| | 375 | 37.8 | 50.4 | 75.7 | 88.3 | 113.5 | 138.7 | 189.2 | 227.0 | 252.3 | 315.3 | 365.7 | 454.0 | 567.5 |
| | 400 | 34.7 | 46.3 | 69.4 | 81.0 | 104.2 | 127.3 | 173.6 | 208.3 | 231.5 | 289.3 | 335.6 | 416.6 | 520.8 |
| | 425 | 28.8 | 38.4 | 57.5 | 67.1 | 86.3 | 105.5 | 143.8 | 172.6 | 191.8 | 239.7 | 278.1 | 345.2 | 431.5 |
| | 450 | 23.0 | 30.7 | 46.0 | 53.7 | 69.0 | 84.3 | 115.0 | 138.0 | 153.4 | 191.7 | 222.4 | 276.1 | 345.1 |
| | 475 | 17.1 | 22.8 | 34.2 | 39.9 | 51.3 | 62.7 | 85.4 | 102.5 | 113.9 | 142.4 | 165.2 | 205.0 | 256.3 |
| | 500 | 11.6 | 15.5 | 23.2 | 27.0 | 34.7 | 42.4 | 57.9 | 69.5 | 77.2 | 96.5 | 111.9 | 139.0 | 173.7 |
| | 538 | 5.9 | 7.9 | 11.8 | 13.8 | 17.7 | 21.6 | 29.5 | 35.4 | 39.4 | 49.2 | 57.1 | 70.9 | 88.6 |
| A216-WCC GROUP 1.2 SPECIAL CLASS (1) (2) | 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 150 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 200 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 250 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 300 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 325 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 350 | 51.1 | 68.1 | 102.2 | 119.2 | 153.3 | 187.4 | 255.5 | 306.6 | 340.7 | 425.8 | 493.9 | 613.1 | 766.4 |
| | 375 | 48.4 | 64.5 | 96.7 | 112.8 | 145.1 | 177.4 | 241.9 | 290.3 | 322.5 | 403.1 | 467.6 | 580.5 | 725.6 |
| | 400 | 43.4 | 57.9 | 86.8 | 101.3 | 130.2 | 159.1 | 217.0 | 260.4 | 289.4 | 361.7 | 419.6 | 520.8 | 651.0 |
| | 425 | 36.0 | 48.0 | 71.9 | 83.9 | 107.9 | 131.9 | 179.8 | 215.7 | 239.7 | 299.6 | 347.5 | 431.4 | 539.3 |
| | 450 | 28.8 | 38.4 | 57.5 | 67.1 | 86.3 | 105.5 | 143.8 | 172.5 | 191.7 | 239.6 | 278.0 | 345.1 | 431.4 |
| | 475 | 24.4 | 30.5 | 42.7 | 49.8 | 64.1 | 78.3 | 106.8 | 128.2 | 142.4 | 178.0 | 206.5 | 256.3 | 320.4 |
| | 500 | 14.5 | 19.3 | 29.0 | 33.8 | 43.4 | 53.1 | 72.4 | 86.9 | 96.6 | 120.7 | 140.0 | 173.8 | 217.2 |
| | 538 | 7.4 | 9.9 | 14.8 | 17.3 | 22.2 | 27.1 | 36.9 | 44.3 | 49.3 | 61.6 | 71.4 | 88.7 | 110.8 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 427°C.*

*2. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*



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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A-217-WC6 STANDARD CLASS (1) | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 720 | 960 | 1445 | 1685 | 2165 | 2645 | 3610 | 4330 | 4815 | 6015 | 6980 | 8665 | 10830 |
| | 400 | 695 | 925 | 1385 | 1615 | 2080 | 2540 | 3465 | 4160 | 4620 | 5775 | 6700 | 8320 | 10400 |
| | 500 | 665 | 885 | 1330 | 1550 | 1995 | 2440 | 3325 | 3990 | 4435 | 5540 | 6425 | 7975 | 9965 |
| | 600 | 605 | 805 | 1210 | 1410 | 1815 | 2220 | 3025 | 3630 | 4035 | 5040 | 5845 | 7255 | 9070 |
| | 650 | 590 | 785 | 1175 | 1370 | 1765 | 2155 | 2940 | 3530 | 3925 | 4905 | 5690 | 7060 | 8825 |
| | 700 | 570 | 760 | 1135 | 1325 | 1705 | 2085 | 2840 | 3405 | 3785 | 4730 | 5485 | 6810 | 8515 |
| | 750 | 530 | 710 | 1065 | 1240 | 1595 | 1950 | 2660 | 3190 | 3545 | 4430 | 5140 | 6375 | 7970 |
| | 800 | 510 | 680 | 1015 | 1185 | 1525 | 1865 | 2540 | 3045 | 3385 | 4230 | 4905 | 6090 | 7610 |
| | 850 | 485 | 650 | 975 | 1135 | 1460 | 1785 | 2435 | 2925 | 3250 | 4060 | 4710 | 5845 | 7305 |
| | 900 | 450 | 600 | 900 | 1050 | 1350 | 1650 | 2245 | 2695 | 2995 | 3745 | 4345 | 5390 | 6740 |
| | 950 | 320 | 425 | 640 | 745 | 955 | 1170 | 1595 | 1915 | 2125 | 2655 | 3080 | 3825 | 4785 |
| | 1000 | 215 | 285 | 430 | 505 | 650 | 795 | 1080 | 1295 | 1440 | 1800 | 2090 | 2590 | 3240 |
| | 1050 | 145 | 195 | 290 | 335 | 430 | 525 | 720 | 865 | 960 | 1200 | 1390 | 1730 | 2160 |
| | 1100 | 95 | 125 | 190 | 225 | 290 | 355 | 480 | 575 | 640 | 800 | 930 | 1150 | 1440 |
| ASTM A-217-WC6 SPECIAL CLASS (1) | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 400 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 500 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 600 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 650 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 700 | 735 | 980 | 1465 | 1710 | 2200 | 2690 | 3665 | 4400 | 4890 | 6110 | 7085 | 8795 | 10995 |
| | 750 | 730 | 975 | 1460 | 1700 | 2185 | 2670 | 3645 | 4375 | 4860 | 6070 | 7040 | 8745 | 10930 |
| | 800 | 720 | 960 | 1440 | 1680 | 2160 | 2640 | 3600 | 4320 | 4800 | 6000 | 6960 | 8640 | 10800 |
| | 850 | 680 | 905 | 1355 | 1580 | 2030 | 2480 | 3385 | 4065 | 4515 | 5645 | 6550 | 8130 | 10160 |
| | 900 | 585 | 780 | 1175 | 1370 | 1760 | 2150 | 2935 | 3525 | 3915 | 4895 | 5675 | 7045 | 8805 |
| | 950 | 400 | 530 | 795 | 930 | 1195 | 1460 | 1995 | 2395 | 2660 | 3320 | 3850 | 4785 | 5980 |
| | 1000 | 270 | 360 | 540 | 630 | 810 | 990 | 1350 | 1620 | 1800 | 2250 | 2610 | 3240 | 4050 |
| | 1050 | 180 | 240 | 360 | 420 | 540 | 660 | 900 | 1080 | 1200 | 1500 | 1740 | 2160 | 2700 |
| | 1100 | 120 | 160 | 240 | 280 | 360 | 440 | 600 | 720 | 800 | 1000 | 1160 | 1440 | 1800 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Note: Flanged End valve ratings are limited to standard class only and terminate at 1000°F.*

*1. Shaded ratings may require special trim and packing. Consult your Edward valves sales representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A-217-WC6 STANDARD CLASS (1) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.5 | 68.7 | 103.0 | 120.1 | 154.4 | 188.7 | 257.4 | 308.9 | 343.2 | 429.0 | 497.6 | 617.8 | 772.2 |
| | 150 | 49.7 | 66.3 | 99.5 | 116.1 | 149.2 | 182.4 | 248.7 | 298.4 | 331.6 | 414.5 | 480.8 | 596.9 | 746.2 |
| | 200 | 48.0 | 64.0 | 95.9 | 111.9 | 143.9 | 175.9 | 239.8 | 287.7 | 319.7 | 399.6 | 463.6 | 575.5 | 719.4 |
| | 250 | 46.3 | 61.8 | 92.7 | 108.1 | 139.0 | 169.9 | 231.8 | 278.1 | 309.0 | 386.2 | 447.9 | 555.9 | 694.8 |
| | 300 | 42.9 | 57.2 | 85.7 | 100.0 | 128.6 | 157.2 | 214.4 | 257.2 | 285.8 | 357.1 | 414.2 | 514.1 | 642.6 |
| | 325 | 41.4 | 55.1 | 82.6 | 96.4 | 124.0 | 151.5 | 206.6 | 247.9 | 275.5 | 344.3 | 399.4 | 495.7 | 619.6 |
| | 350 | 40.3 | 53.7 | 80.4 | 93.8 | 120.7 | 147.5 | 201.1 | 241.4 | 268.2 | 335.3 | 388.9 | 482.7 | 603.3 |
| | 375 | 38.9 | 51.8 | 77.6 | 90.6 | 116.5 | 142.4 | 194.1 | 232.8 | 258.7 | 323.2 | 374.9 | 465.4 | 581.8 |
| | 400 | 36.5 | 48.8 | 73.3 | 85.5 | 109.8 | 134.2 | 183.1 | 219.6 | 244.0 | 304.9 | 353.6 | 438.9 | 548.5 |
| | 425 | 35.2 | 46.8 | 70.0 | 81.7 | 105.1 | 128.4 | 175.1 | 210.1 | 233.4 | 291.6 | 338.2 | 419.8 | 524.7 |
| | 450 | 33.7 | 45.0 | 67.7 | 78.9 | 101.4 | 123.9 | 169.0 | 202.8 | 225.4 | 281.8 | 326.8 | 405.7 | 507.0 |
| | 475 | 31.7 | 42.3 | 63.4 | 74.0 | 95.1 | 116.1 | 158.2 | 189.9 | 211.1 | 263.9 | 306.1 | 379.9 | 474.8 |
| | 500 | 25.7 | 34.3 | 51.5 | 60.1 | 77.2 | 94.3 | 128.6 | 154.3 | 171.5 | 214.4 | 248.7 | 308.7 | 385.9 |
| | 538 | 14.9 | 19.9 | 29.8 | 34.8 | 44.7 | 54.6 | 74.5 | 89.4 | 99.3 | 124.1 | 144.0 | 178.7 | 223.4 |
| | 550 | 12.7 | 16.9 | 25.4 | 29.6 | 38.1 | 46.6 | 63.5 | 76.2 | 84.7 | 105.9 | 122.8 | 152.5 | 190.6 |
| | 575 | 8.8 | 11.7 | 17.6 | 20.5 | 26.4 | 32.3 | 44.0 | 52.8 | 58.7 | 73.4 | 85.1 | 105.6 | 132.0 |
| | 595 | 6.6 | 8.9 | 13.3 | 15.5 | 19.9 | 24.3 | 33.2 | 39.9 | 44.3 | 55.4 | 64.3 | 79.8 | 99.7 |
| ASTM A-217-WC6 SPECIAL CLASS (1) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 150 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 200 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 250 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 300 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 325 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 350 | 51.5 | 68.6 | 102.8 | 120.0 | 154.3 | 188.6 | 257.1 | 308.6 | 342.9 | 428.6 | 497.2 | 617.1 | 771.4 |
| | 375 | 50.6 | 67.4 | 101.0 | 117.8 | 151.5 | 185.2 | 252.5 | 303.0 | 336.7 | 420.9 | 488.2 | 606.0 | 757.4 |
| | 400 | 50.3 | 67.1 | 100.6 | 117.3 | 150.6 | 184.1 | 251.2 | 301.3 | 334.8 | 418.3 | 485.3 | 602.5 | 753.2 |
| | 425 | 49.6 | 66.2 | 99.3 | 115.8 | 148.9 | 182.0 | 248.2 | 297.9 | 331.0 | 413.7 | 479.9 | 595.7 | 744.6 |
| | 450 | 47.3 | 63.0 | 94.4 | 110.1 | 141.4 | 172.9 | 235.8 | 283.0 | 314.5 | 393.1 | 456.0 | 566.1 | 707.6 |
| | 475 | 42.8 | 57.0 | 85.5 | 99.7 | 128.2 | 156.7 | 213.7 | 256.5 | 285.0 | 356.3 | 413.3 | 513.1 | 641.3 |
| | 500 | 32.2 | 42.9 | 64.3 | 75.0 | 96.5 | 117.9 | 160.8 | 193.0 | 214.4 | 268.0 | 310.9 | 385.9 | 482.4 |
| | 538 | 18.6 | 24.8 | 37.2 | 43.4 | 55.8 | 68.2 | 93.1 | 111.7 | 124.1 | 155.1 | 179.9 | 223.4 | 279.2 |
| | 550 | 15.9 | 21.2 | 31.8 | 37.1 | 47.7 | 58.3 | 79.4 | 95.3 | 105.9 | 132.4 | 153.6 | 190.6 | 238.3 |
| | 575 | 11.0 | 14.7 | 22.0 | 25.7 | 33.0 | 40.3 | 55.0 | 66.0 | 73.4 | 91.7 | 106.4 | 132.1 | 165.1 |
| | 595 | 8.3 | 11.1 | 16.6 | 19.4 | 24.9 | 30.5 | 41.6 | 49.9 | 55.4 | 69.2 | 80.3 | 99.7 | 124.6 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A217-WC9 STANDARD CLASS | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 730 | 970 | 1455 | 1700 | 2185 | 2670 | 3640 | 4370 | 4855 | 6070 | 7040 | 8740 | 10925 |
| | 400 | 705 | 940 | 1410 | 1645 | 2115 | 2585 | 3530 | 4235 | 4705 | 5880 | 6820 | 8470 | 10585 |
| | 500 | 665 | 885 | 1330 | 1550 | 1995 | 2440 | 3325 | 3990 | 4435 | 5540 | 6425 | 7975 | 9965 |
| | 600 | 605 | 805 | 1210 | 1410 | 1815 | 2220 | 3025 | 3630 | 4035 | 5040 | 5845 | 7255 | 9070 |
| | 650 | 590 | 785 | 1175 | 1370 | 1765 | 2155 | 2940 | 3530 | 3925 | 4905 | 5690 | 7060 | 8825 |
| | 700 | 570 | 760 | 1135 | 1325 | 1705 | 2085 | 2840 | 3405 | 3785 | 4730 | 5485 | 6810 | 8515 |
| | 750 | 530 | 710 | 1065 | 1240 | 1595 | 1950 | 2660 | 3190 | 3545 | 4430 | 5140 | 6375 | 7970 |
| | 800 | 510 | 680 | 1015 | 1185 | 1525 | 1865 | 2540 | 3045 | 3385 | 4230 | 4905 | 6090 | 7610 |
| | 850 | 485 | 650 | 975 | 1135 | 1460 | 1785 | 2435 | 2925 | 3250 | 4060 | 4710 | 5845 | 7305 |
| | 900 | 450 | 600 | 900 | 1050 | 1350 | 1650 | 2245 | 2695 | 2995 | 3745 | 4345 | 5390 | 6740 |
| | 950 | 385 | 510 | 755 | 890 | 1160 | 1415 | 1930 | 2315 | 2575 | 3220 | 3735 | 4635 | 5795 |
| | 1000 | 265 | 355 | 535 | 625 | 800 | 980 | 1335 | 1605 | 1785 | 2230 | 2585 | 3210 | 4010 |
| | 1050 | 175 | 235 | 350 | 410 | 525 | 640 | 875 | 1050 | 1165 | 1455 | 1690 | 2100 | 2625 |
| | 1100 | 110 | 145 | 220 | 255 | 330 | 405 | 550 | 660 | 735 | 915 | 1060 | 1315 | 1645 |
| ASTM A217-WC9 SPECIAL CLASS | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 740 | 985 | 1480 | 1725 | 2220 | 2710 | 3695 | 4435 | 4930 | 6160 | 7145 | 8870 | 11090 |
| | 400 | 730 | 970 | 1455 | 1700 | 2185 | 2670 | 3640 | 4370 | 4855 | 6065 | 7035 | 8735 | 10915 |
| | 500 | 725 | 965 | 1450 | 1690 | 2175 | 2655 | 3620 | 4345 | 4830 | 6035 | 7000 | 8690 | 10865 |
| | 600 | 720 | 960 | 1440 | 1680 | 2165 | 2645 | 3605 | 4325 | 4810 | 6010 | 6970 | 8655 | 10815 |
| | 650 | 715 | 955 | 1430 | 1670 | 2145 | 2625 | 3580 | 4295 | 4775 | 5965 | 6920 | 8590 | 10735 |
| | 700 | 705 | 940 | 1415 | 1650 | 2120 | 2590 | 3535 | 4245 | 4715 | 5895 | 6835 | 8485 | 10605 |
| | 750 | 705 | 940 | 1415 | 1650 | 2120 | 2590 | 3535 | 4245 | 4715 | 5895 | 6835 | 8485 | 10605 |
| | 800 | 705 | 940 | 1415 | 1650 | 2120 | 2590 | 3535 | 4245 | 4715 | 5895 | 6835 | 8485 | 10605 |
| | 850 | 680 | 905 | 1355 | 1580 | 2030 | 2480 | 3385 | 4065 | 4515 | 5645 | 6550 | 8130 | 10160 |
| | 900 | 600 | 800 | 1200 | 1400 | 1800 | 2200 | 3000 | 3600 | 4000 | 5000 | 5800 | 7200 | 9000 |
| | 950 | 470 | 630 | 945 | 1100 | 1415 | 1730 | 2360 | 2830 | 3145 | 3930 | 4560 | 5655 | 7070 |
| | 1000 | 335 | 445 | 670 | 780 | 1005 | 1225 | 1670 | 2005 | 2230 | 2785 | 3230 | 4010 | 5015 |
| | 1050 | 220 | 290 | 435 | 510 | 655 | 800 | 1095 | 1315 | 1460 | 1820 | 2110 | 2625 | 3280 |
| | 1100 | 135 | 180 | 275 | 320 | 410 | 500 | 685 | 825 | 915 | 1145 | 1325 | 1645 | 2055 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

** Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A-217-WC9 STANDARD CLASS (1) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.5 | 68.7 | 103.0 | 120.2 | 154.6 | 188.9 | 257.6 | 309.1 | 343.5 | 429.4 | 498.1 | 618.4 | 773.0 |
| | 150 | 50.3 | 67.0 | 100.3 | 117.1 | 150.6 | 184.0 | 250.8 | 301.0 | 334.5 | 418.2 | 485.1 | 602.2 | 752.8 |
| | 200 | 48.6 | 64.8 | 97.2 | 113.4 | 145.8 | 178.3 | 243.4 | 292.0 | 324.4 | 405.4 | 470.3 | 583.8 | 729.8 |
| | 250 | 46.3 | 61.8 | 92.7 | 108.1 | 139.0 | 169.9 | 231.8 | 278.1 | 309.0 | 386.2 | 447.9 | 555.9 | 694.8 |
| | 300 | 42.9 | 57.2 | 85.7 | 100.0 | 128.6 | 157.2 | 214.4 | 257.2 | 285.8 | 357.1 | 414.2 | 514.1 | 642.6 |
| | 325 | 41.4 | 55.1 | 82.6 | 96.4 | 124.0 | 151.5 | 206.6 | 247.9 | 275.5 | 344.3 | 399.4 | 495.7 | 619.6 |
| | 350 | 40.3 | 53.7 | 80.4 | 93.8 | 120.7 | 147.5 | 201.1 | 241.4 | 268.2 | 335.3 | 388.9 | 482.7 | 603.3 |
| | 375 | 38.9 | 51.8 | 77.6 | 90.6 | 116.5 | 142.4 | 194.1 | 232.8 | 258.7 | 323.2 | 374.9 | 465.4 | 581.8 |
| | 400 | 36.5 | 48.8 | 73.3 | 85.5 | 109.8 | 134.2 | 183.1 | 219.6 | 244.0 | 304.9 | 353.6 | 438.9 | 548.5 |
| | 425 | 35.2 | 46.8 | 70.0 | 81.7 | 105.1 | 128.4 | 175.1 | 210.1 | 233.4 | 291.6 | 338.2 | 419.8 | 524.7 |
| | 450 | 33.7 | 45.0 | 67.7 | 78.9 | 101.4 | 123.9 | 169.0 | 202.8 | 225.4 | 281.8 | 326.8 | 405.7 | 507.0 |
| | 475 | 31.7 | 42.3 | 63.4 | 74.0 | 95.1 | 116.1 | 158.2 | 189.9 | 211.1 | 263.9 | 306.1 | 379.9 | 474.8 |
| | 500 | 28.2 | 37.6 | 56.5 | 65.9 | 84.7 | 103.4 | 140.9 | 169.1 | 188.0 | 235.0 | 272.6 | 338.4 | 423.0 |
| | 538 | 18.4 | 24.6 | 36.9 | 43.0 | 55.3 | 67.6 | 92.2 | 110.7 | 123.0 | 153.7 | 178.3 | 221.3 | 276.6 |
| | 550 | 15.6 | 20.8 | 31.3 | 36.5 | 46.9 | 57.3 | 78.2 | 93.8 | 104.3 | 130.3 | 151.1 | 187.6 | 234.5 |
| | 575 | 10.5 | 14.0 | 21.1 | 24.6 | 31.6 | 38.6 | 52.6 | 63.1 | 70.2 | 87.7 | 101.7 | 126.3 | 157.9 |
| | 595 | 7.6 | 10.2 | 15.3 | 17.8 | 22.9 | 27.9 | 38.0 | 45.7 | 50.8 | 63.5 | 73.6 | 91.4 | 114.2 |
| ASTM A-217-WC9 SPECIAL CLASS (1) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.6 | 68.8 | 103.2 | 120.4 | 154.9 | 189.3 | 258.1 | 309.7 | 344.2 | 430.2 | 499.0 | 619.5 | 774.3 |
| | 150 | 51.0 | 68.0 | 101.9 | 118.9 | 152.9 | 186.9 | 254.8 | 305.7 | 339.7 | 424.6 | 492.5 | 611.4 | 764.3 |
| | 200 | 50.2 | 66.9 | 100.4 | 117.2 | 150.7 | 184.2 | 251.1 | 301.3 | 334.8 | 418.5 | 485.5 | 602.7 | 753.4 |
| | 250 | 50.0 | 66.7 | 100.0 | 116.6 | 149.9 | 183.2 | 249.9 | 299.9 | 333.2 | 416.5 | 483.1 | 599.8 | 749.7 |
| | 300 | 49.8 | 66.4 | 99.6 | 116.2 | 149.3 | 182.5 | 248.9 | 298.7 | 331.9 | 414.8 | 481.2 | 597.3 | 746.7 |
| | 325 | 49.6 | 66.1 | 99.2 | 115.7 | 148.8 | 181.9 | 248.0 | 297.6 | 330.7 | 413.3 | 479.4 | 595.1 | 743.9 |
| | 350 | 49.2 | 65.6 | 98.4 | 114.8 | 147.6 | 180.4 | 246.0 | 295.2 | 328.0 | 410.0 | 475.6 | 590.5 | 738.1 |
| | 375 | 48.8 | 65.0 | 97.5 | 113.8 | 146.3 | 178.8 | 243.8 | 292.6 | 325.1 | 406.3 | 471.3 | 585.1 | 731.3 |
| | 400 | 48.8 | 65.0 | 97.5 | 113.8 | 146.3 | 178.8 | 243.8 | 292.6 | 325.1 | 406.3 | 471.3 | 585.1 | 731.3 |
| | 425 | 48.8 | 65.0 | 97.5 | 113.8 | 146.3 | 178.8 | 243.8 | 292.6 | 325.1 | 406.3 | 471.3 | 585.1 | 731.3 |
| | 450 | 47.3 | 63.0 | 94.4 | 110.1 | 141.4 | 172.9 | 235.8 | 283.0 | 314.5 | 393.1 | 456.0 | 566.1 | 707.6 |
| | 475 | 42.8 | 57.0 | 85.5 | 99.7 | 128.2 | 156.7 | 213.7 | 256.5 | 285.0 | 356.3 | 413.3 | 513.1 | 641.3 |
| | 500 | 35.6 | 47.6 | 71.5 | 83.4 | 107.1 | 130.9 | 178.6 | 214.3 | 238.1 | 297.5 | 345.1 | 428.3 | 535.4 |
| | 538 | 23.0 | 30.7 | 46.1 | 53.8 | 69.1 | 84.5 | 115.2 | 138.3 | 153.7 | 192.1 | 222.8 | 276.6 | 345.7 |
| | 550 | 19.5 | 26.0 | 39.1 | 45.6 | 58.6 | 71.6 | 97.7 | 117.2 | 130.3 | 162.8 | 188.9 | 234.5 | 293.1 |
| | 575 | 13.2 | 17.6 | 26.3 | 30.7 | 39.5 | 48.3 | 65.8 | 79.0 | 87.8 | 109.7 | 127.2 | 157.9 | 197.4 |
| | 595 | 9.5 | 12.7 | 19.0 | 22.2 | 28.5 | 34.9 | 47.6 | 57.1 | 63.4 | 79.3 | 92.0 | 114.2 | 142.8 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

FLOWSERVE

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A217-C12A STANDARD CLASS | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 730 | 970 | 1455 | 1700 | 2185 | 2670 | 3640 | 4370 | 4855 | 6070 | 7040 | 8740 | 10925 |
| | 400 | 705 | 940 | 1410 | 1645 | 2115 | 2585 | 3530 | 4235 | 4705 | 5880 | 6820 | 8470 | 10585 |
| | 500 | 665 | 885 | 1330 | 1550 | 1995 | 2440 | 3325 | 3990 | 4435 | 5540 | 6425 | 7975 | 9965 |
| | 600 | 605 | 805 | 1210 | 1410 | 1815 | 2220 | 3025 | 3630 | 4035 | 5040 | 5845 | 7255 | 9070 |
| | 650 | 590 | 785 | 1175 | 1370 | 1765 | 2155 | 2940 | 3530 | 3925 | 4905 | 5690 | 7060 | 8825 |
| | 700 | 570 | 760 | 1135 | 1325 | 1705 | 2085 | 2840 | 3405 | 3785 | 4730 | 5485 | 6810 | 8515 |
| | 750 | 530 | 710 | 1065 | 1240 | 1595 | 1950 | 2660 | 3190 | 3545 | 4430 | 5140 | 6375 | 7970 |
| | 800 | 510 | 680 | 1015 | 1185 | 1525 | 1865 | 2540 | 3045 | 3385 | 4230 | 4905 | 6090 | 7610 |
| | 850 | 485 | 650 | 975 | 1135 | 1460 | 1785 | 2435 | 2925 | 3250 | 4060 | 4710 | 5845 | 7305 |
| | 900 | 450 | 600 | 900 | 1050 | 1350 | 1650 | 2245 | 2695 | 2995 | 3745 | 4345 | 5390 | 6740 |
| | 950 | 385 | 515 | 775 | 905 | 1160 | 1415 | 1930 | 2315 | 2575 | 3220 | 3735 | 4635 | 5795 |
| | 1000 | 365 | 485 | 725 | 845 | 1090 | 1335 | 1820 | 2185 | 2425 | 3030 | 3515 | 4360 | 5450 |
| | 1050 | 360 | 480 | 720 | 840 | 1080 | 1320 | 1800 | 2160 | 2400 | 3000 | 3480 | 4320 | 5400 |
| | 1100 | 300 | 400 | 605 | 705 | 905 | 1105 | 1510 | 1810 | 2015 | 2515 | 2915 | 3620 | 4525 |
| | 1150 | 225 | 300 | 445 | 520 | 670 | 820 | 1115 | 1335 | 1485 | 1855 | 2155 | 2675 | 3345 |
| | 1200 | 145 | 195 | 290 | 335 | 430 | 525 | 720 | 865 | 960 | 1200 | 1390 | 1730 | 2160 |
| ASTM A217-C12A SPECIAL CLASS | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 300 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 400 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 500 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 600 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 650 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 700 | 735 | 980 | 1465 | 1710 | 2200 | 2690 | 3665 | 4400 | 4890 | 6110 | 7085 | 8795 | 10995 |
| | 750 | 730 | 975 | 1460 | 1700 | 2185 | 2670 | 3645 | 4375 | 4860 | 6070 | 7040 | 8745 | 10930 |
| | 800 | 720 | 960 | 1440 | 1680 | 2160 | 2640 | 3600 | 4320 | 4800 | 6000 | 6960 | 8640 | 10800 |
| | 850 | 680 | 905 | 1355 | 1580 | 2030 | 2480 | 3385 | 4065 | 4515 | 5645 | 6550 | 8130 | 10160 |
| | 900 | 600 | 800 | 1200 | 1400 | 1800 | 2200 | 3000 | 3600 | 4000 | 5000 | 5800 | 7200 | 9000 |
| | 950 | 470 | 630 | 945 | 1100 | 1415 | 1730 | 2360 | 2830 | 3145 | 3930 | 4560 | 5655 | 7070 |
| | 1000 | 420 | 560 | 840 | 980 | 1260 | 1540 | 2105 | 2525 | 2805 | 3505 | 4065 | 5050 | 6310 |
| | 1050 | 420 | 560 | 840 | 980 | 1260 | 1540 | 2105 | 2525 | 2805 | 3505 | 4065 | 5050 | 6310 |
| | 1100 | 375 | 500 | 755 | 880 | 1130 | 1380 | 1885 | 2265 | 2515 | 3145 | 3645 | 4525 | 5655 |
| | 1150 | 280 | 370 | 555 | 650 | 835 | 1020 | 1395 | 1675 | 1860 | 2320 | 2690 | 3345 | 4180 |
| | 1200 | 180 | 240 | 360 | 420 | 540 | 660 | 900 | 1080 | 1200 | 1500 | 1740 | 2160 | 2700 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Shaded ratings may require special trim or packing. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends."*
*Consult your Edward valves sales representative for pressure temperature ratings of materials not included in this catalog.*

***Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 ps

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A-217-C12A STANDARD CLASS | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.5 | 68.7 | 103.0 | 120.2 | 154.6 | 188.9 | 257.6 | 309.1 | 343.5 | 429.4 | 498.1 | 618.4 | 773.0 |
| | 150 | 50.3 | 67.0 | 100.3 | 117.1 | 150.6 | 184.0 | 250.8 | 301.0 | 334.5 | 418.2 | 485.1 | 602.2 | 752.8 |
| | 200 | 48.6 | 64.8 | 97.2 | 113.4 | 145.8 | 178.3 | 243.4 | 292.0 | 324.4 | 405.4 | 470.3 | 583.8 | 729.8 |
| | 250 | 46.3 | 61.8 | 92.7 | 108.1 | 139.0 | 169.9 | 231.8 | 278.1 | 309.0 | 386.2 | 447.9 | 555.9 | 694.8 |
| | 300 | 42.9 | 57.2 | 85.7 | 100.0 | 128.6 | 157.2 | 214.4 | 257.2 | 285.8 | 357.1 | 414.2 | 514.1 | 642.6 |
| | 325 | 41.4 | 55.1 | 82.6 | 96.4 | 124.0 | 151.5 | 206.6 | 247.9 | 275.5 | 344.3 | 399.4 | 495.7 | 619.6 |
| | 350 | 40.3 | 53.7 | 80.4 | 93.8 | 120.7 | 147.5 | 201.1 | 241.4 | 268.2 | 335.3 | 388.9 | 482.7 | 603.3 |
| | 375 | 38.9 | 51.8 | 77.6 | 90.6 | 116.5 | 142.4 | 194.1 | 232.8 | 258.7 | 323.2 | 374.9 | 465.4 | 581.8 |
| | 400 | 36.5 | 48.8 | 73.3 | 85.5 | 109.8 | 134.2 | 183.1 | 219.6 | 244.0 | 304.9 | 353.6 | 438.9 | 548.5 |
| | 425 | 35.2 | 46.8 | 70.0 | 81.7 | 105.1 | 128.4 | 175.1 | 210.1 | 233.4 | 291.6 | 338.2 | 419.8 | 524.7 |
| | 450 | 33.7 | 45.0 | 67.7 | 78.9 | 101.4 | 123.9 | 169.0 | 202.8 | 225.4 | 281.8 | 326.8 | 405.7 | 507.0 |
| | 475 | 31.7 | 42.3 | 63.4 | 74.0 | 95.1 | 116.1 | 158.2 | 189.9 | 211.1 | 263.9 | 306.1 | 379.9 | 474.8 |
| | 500 | 28.2 | 37.6 | 56.5 | 65.9 | 84.7 | 103.4 | 140.9 | 169.1 | 188.0 | 235.0 | 272.6 | 338.4 | 423.0 |
| | 538 | 25.2 | 33.5 | 50.0 | 58.4 | 75.2 | 92.0 | 125.5 | 150.5 | 167.2 | 208.9 | 242.3 | 300.7 | 375.8 |
| | 550 | 25.0 | 33.3 | 49.8 | 58.1 | 74.8 | 91.5 | 124.9 | 149.8 | 166.5 | 208.0 | 241.2 | 299.4 | 374.2 |
| | 575 | 24.0 | 32.0 | 47.9 | 55.9 | 71.8 | 87.8 | 119.7 | 143.6 | 159.6 | 199.5 | 231.4 | 287.3 | 359.1 |
| | 600 | 19.5 | 26.0 | 39.0 | 45.5 | 58.5 | 71.5 | 97.5 | 117.0 | 130.0 | 162.5 | 188.5 | 234.0 | 292.5 |
| | 625 | 14.6 | 19.5 | 29.2 | 34.1 | 43.8 | 53.5 | 73.0 | 87.6 | 97.4 | 121.7 | 141.2 | 175.3 | 219.1 |
| | 650 | 9.9 | 13.2 | 19.9 | 23.2 | 29.8 | 36.4 | 49.6 | 59.5 | 66.2 | 82.7 | 95.9 | 119.1 | 148.9 |
| ASTM A-217-C12A SPECIAL CLASS | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 100 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 150 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 200 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 250 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 300 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 325 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 350 | 51.5 | 68.6 | 102.8 | 120.0 | 154.3 | 188.6 | 257.1 | 308.6 | 342.9 | 428.6 | 497.2 | 617.1 | 771.4 |
| | 375 | 50.6 | 67.4 | 101.0 | 117.8 | 151.5 | 185.2 | 252.5 | 303.0 | 336.7 | 420.9 | 488.2 | 606.0 | 757.4 |
| | 400 | 50.3 | 67.1 | 100.6 | 117.3 | 150.6 | 184.1 | 251.2 | 301.3 | 334.8 | 418.3 | 485.3 | 602.5 | 753.2 |
| | 425 | 49.6 | 66.2 | 99.3 | 115.8 | 148.9 | 182.0 | 248.2 | 297.9 | 331.0 | 413.7 | 479.9 | 595.7 | 744.6 |
| | 450 | 47.3 | 63.0 | 94.4 | 110.1 | 141.4 | 172.9 | 235.8 | 283.0 | 314.5 | 393.1 | 456.0 | 566.1 | 707.6 |
| | 475 | 42.8 | 57.0 | 85.5 | 99.7 | 128.2 | 156.7 | 213.7 | 256.5 | 285.0 | 356.3 | 413.3 | 513.1 | 641.3 |
| | 500 | 35.6 | 47.6 | 71.5 | 83.4 | 107.1 | 130.9 | 178.6 | 214.3 | 238.1 | 297.5 | 345.1 | 428.3 | 535.4 |
| | 538 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 550 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 575 | 28.6 | 38.1 | 57.1 | 66.6 | 85.7 | 104.8 | 143.0 | 171.6 | 190.7 | 238.3 | 276.4 | 343.1 | 428.8 |
| | 600 | 24.4 | 32.5 | 48.7 | 56.8 | 73.1 | 89.4 | 121.9 | 146.3 | 162.5 | 203.1 | 235.6 | 292.5 | 365.6 |
| | 625 | 18.3 | 24.4 | 36.5 | 42.6 | 54.8 | 67.0 | 91.3 | 109.5 | 121.7 | 152.1 | 176.4 | 219.0 | 273.8 |
| | 650 | 12.4 | 16.5 | 24.8 | 28.9 | 37.2 | 45.5 | 62.1 | 74.5 | 82.8 | 103.4 | 120.0 | 148.9 | 186.2 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Shaded ratings may require special trim or packing. Consult your Flowserve sales representative for applications in these ranges.*

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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM A351-CF8M STANDARD CLASS (1) | -20 to 100 | 720 | 960 | 1440 | 1680 | 2160 | 2640 | 3600 | 4320 | 4800 | 6000 | 6960 | 8640 | 10800 |
| | 200 | 620 | 825 | 1240 | 1445 | 1860 | 2270 | 3095 | 3715 | 4130 | 5160 | 5985 | 7430 | 9290 |
| | 300 | 560 | 745 | 1120 | 1305 | 1680 | 2050 | 2795 | 3355 | 3730 | 4660 | 5405 | 6710 | 8390 |
| | 400 | 515 | 685 | 1025 | 1195 | 1540 | 1885 | 2570 | 3085 | 3425 | 4280 | 4965 | 6165 | 7705 |
| | 500 | 480 | 640 | 955 | 1115 | 1435 | 1755 | 2390 | 2865 | 3185 | 3980 | 4615 | 5730 | 7165 |
| | 600 | 450 | 600 | 900 | 1050 | 1355 | 1655 | 2255 | 2705 | 3010 | 3760 | 4360 | 5415 | 6770 |
| | 650 | 440 | 590 | 885 | 1030 | 1325 | 1620 | 2210 | 2650 | 2945 | 3680 | 4270 | 5300 | 6625 |
| | 700 | 435 | 580 | 870 | 1015 | 1305 | 1595 | 2170 | 2605 | 2895 | 3620 | 4200 | 5210 | 6515 |
| | 750 | 425 | 570 | 855 | 995 | 1280 | 1565 | 2135 | 2565 | 2850 | 3560 | 4130 | 5130 | 6410 |
| | 800 | 420 | 560 | 845 | 985 | 1265 | 1545 | 2110 | 2535 | 2815 | 3520 | 4085 | 5070 | 6335 |
| | 850 | 420 | 560 | 835 | 975 | 1255 | 1535 | 2090 | 2505 | 2785 | 3480 | 4035 | 5010 | 6265 |
| | 900 | 415 | 555 | 830 | 970 | 1245 | 1520 | 2075 | 2490 | 2770 | 3460 | 4015 | 4985 | 6230 |
| | 950 | 385 | 515 | 775 | 905 | 1160 | 1415 | 1930 | 2315 | 2575 | 3220 | 3735 | 4635 | 5795 |
| | 1000 | 365 | 485 | 725 | 845 | 1090 | 1335 | 1820 | 2185 | 2425 | 3030 | 3515 | 4360 | 5450 |
| | 1050 | 360 | 480 | 720 | 840 | 1080 | 1320 | 1800 | 2160 | 2400 | 3000 | 3480 | 4320 | 5400 |
| | 1100 | 305 | 405 | 610 | 710 | 915 | 1120 | 1525 | 1830 | 2035 | 2545 | 2950 | 3660 | 4575 |
| | 1150 | 235 | 315 | 475 | 555 | 710 | 870 | 1185 | 1420 | 1580 | 1970 | 2285 | 2840 | 3550 |
| | 1200 | 185 | 245 | 370 | 430 | 555 | 680 | 925 | 1110 | 1235 | 1545 | 1790 | 2220 | 2775 |
| | 1250 | 145 | 195 | 295 | 345 | 440 | 540 | 735 | 885 | 985 | 1230 | 1425 | 1770 | 2210 |
| | 1300 | 115 | 155 | 235 | 275 | 350 | 430 | 585 | 700 | 780 | 970 | 1125 | 1400 | 1750 |
| | 1350 | 95 | 125 | 190 | 225 | 290 | 355 | 480 | 575 | 640 | 800 | 930 | 1150 | 1440 |
| | 1400 | 75 | 100 | 150 | 175 | 225 | 275 | 380 | 455 | 505 | 630 | 730 | 905 | 1130 |
| | 1450 | 60 | 80 | 115 | 135 | 175 | 215 | 290 | 350 | 390 | 485 | 565 | 700 | 875 |
| | 1500 | 40 | 55 | 85 | 100 | 125 | 150 | 205 | 245 | 275 | 345 | 400 | 495 | 620 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends."*
*Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

***Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A351-CF8M SPECIAL CLASS (1) | -20 to 100 | 750 | 1000 | 1500 | 1750 | 2250 | 2750 | 3750 | 4500 | 5000 | 6250 | 7250 | 9000 | 11250 |
| | 200 | 690 | 920 | 1380 | 1610 | 2075 | 2535 | 3455 | 4145 | 4610 | 5760 | 6680 | 8295 | 10365 |
| | 300 | 625 | 835 | 1250 | 1455 | 1870 | 2285 | 3120 | 3745 | 4160 | 5200 | 6030 | 7490 | 9360 |
| | 400 | 575 | 765 | 1145 | 1335 | 1720 | 2100 | 2865 | 3440 | 3820 | 4775 | 5540 | 6880 | 8600 |
| | 500 | 535 | 710 | 1065 | 1245 | 1600 | 1955 | 2665 | 3200 | 3555 | 4440 | 5150 | 6395 | 7995 |
| | 600 | 505 | 670 | 1005 | 1175 | 1510 | 1845 | 2520 | 3025 | 3360 | 4195 | 4865 | 6045 | 7555 |
| | 650 | 495 | 660 | 985 | 1150 | 1480 | 1810 | 2465 | 2955 | 3285 | 4105 | 4765 | 5915 | 7395 |
| | 700 | 485 | 645 | 970 | 1130 | 1455 | 1780 | 2425 | 2910 | 3235 | 4040 | 4685 | 5815 | 7270 |
| | 750 | 475 | 635 | 955 | 1115 | 1430 | 1750 | 2385 | 2860 | 3180 | 3975 | 4610 | 5720 | 7150 |
| | 800 | 470 | 630 | 945 | 1100 | 1415 | 1730 | 2355 | 2830 | 3145 | 3930 | 4560 | 5655 | 7070 |
| | 850 | 465 | 620 | 930 | 1085 | 1400 | 1710 | 2330 | 2795 | 3110 | 3885 | 4505 | 5595 | 6990 |
| | 900 | 465 | 620 | 925 | 1080 | 1390 | 1700 | 2315 | 2780 | 3090 | 3860 | 4480 | 5560 | 6950 |
| | 950 | 460 | 610 | 915 | 1070 | 1375 | 1680 | 2290 | 2750 | 3055 | 3815 | 4425 | 5495 | 6870 |
| | 1000 | 420 | 560 | 840 | 980 | 1260 | 1540 | 2105 | 2525 | 2805 | 3505 | 4065 | 5050 | 6310 |
| | 1050 | 420 | 560 | 840 | 980 | 1260 | 1540 | 2105 | 2525 | 2805 | 3505 | 4065 | 5050 | 6310 |
| | 1100 | 380 | 510 | 765 | 890 | 1145 | 1400 | 1905 | 2290 | 2545 | 3180 | 3690 | 4575 | 5720 |
| | 1150 | 295 | 395 | 590 | 690 | 885 | 1085 | 1480 | 1775 | 1975 | 2465 | 2860 | 3550 | 4435 |
| | 1200 | 230 | 310 | 465 | 540 | 695 | 850 | 1155 | 1390 | 1545 | 1930 | 2240 | 2775 | 3470 |
| | 1250 | 185 | 245 | 370 | 430 | 555 | 675 | 920 | 1105 | 1230 | 1535 | 1780 | 2210 | 2765 |
| | 1300 | 145 | 195 | 290 | 340 | 435 | 535 | 730 | 875 | 975 | 1215 | 1410 | 1750 | 2185 |
| | 1350 | 120 | 160 | 240 | 280 | 360 | 440 | 600 | 720 | 800 | 1000 | 1160 | 1440 | 1800 |
| | 1400 | 95 | 125 | 190 | 220 | 285 | 345 | 470 | 565 | 630 | 785 | 910 | 1130 | 1415 |
| | 1450 | 75 | 100 | 145 | 170 | 220 | 270 | 365 | 435 | 485 | 605 | 705 | 875 | 1095 |
| | 1500 | 50 | 70 | 105 | 120 | 155 | 190 | 260 | 310 | 345 | 430 | 500 | 615 | 770 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 “Valves, Flanged, Threaded and Welding Ends.” Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*



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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A351-CF8M STANDARD CLASS (1) | -29 to 38 | 49.6 | 66.2 | 99.3 | 115.8 | 148.9 | 182.0 | 248.2 | 297.9 | 331.0 | 413.7 | 479.9 | 595.7 | 744.6 |
| | 50 | 48.1 | 64.1 | 96.2 | 112.2 | 144.3 | 176.4 | 240.6 | 288.7 | 320.8 | 400.9 | 465.1 | 577.3 | 721.7 |
| | 100 | 42.2 | 56.3 | 84.4 | 98.5 | 126.6 | 154.7 | 211.0 | 253.2 | 281.3 | 351.6 | 407.9 | 506.3 | 632.9 |
| | 150 | 38.5 | 51.3 | 77.0 | 89.8 | 115.5 | 141.2 | 192.5 | 231.0 | 256.7 | 320.8 | 372.1 | 461.9 | 577.4 |
| | 200 | 35.7 | 47.6 | 71.3 | 83.2 | 107.0 | 130.8 | 178.3 | 214.0 | 237.8 | 297.2 | 344.7 | 427.9 | 534.9 |
| | 250 | 33.4 | 44.5 | 66.8 | 77.9 | 100.1 | 122.4 | 166.9 | 200.3 | 222.5 | 278.1 | 322.6 | 400.5 | 500.6 |
| | 300 | 31.6 | 42.1 | 63.2 | 73.8 | 94.9 | 116.0 | 158.1 | 189.7 | 210.8 | 263.5 | 305.7 | 379.4 | 474.3 |
| | 325 | 30.9 | 41.2 | 61.8 | 72.1 | 92.7 | 113.3 | 154.4 | 185.3 | 205.9 | 257.4 | 298.6 | 370.6 | 463.3 |
| | 350 | 30.3 | 40.4 | 60.7 | 70.8 | 91.0 | 111.2 | 151.6 | 181.9 | 202.2 | 252.7 | 293.1 | 363.9 | 454.9 |
| | 375 | 29.9 | 39.9 | 59.8 | 69.7 | 89.6 | 109.5 | 149.4 | 179.3 | 199.2 | 249.0 | 288.8 | 358.6 | 448.2 |
| | 400 | 29.4 | 39.2 | 58.9 | 68.7 | 88.3 | 107.9 | 147.2 | 176.6 | 196.3 | 245.3 | 284.6 | 353.3 | 441.6 |
| | 425 | 29.1 | 38.8 | 58.3 | 68.0 | 87.4 | 106.8 | 145.7 | 174.9 | 194.3 | 242.9 | 281.7 | 349.7 | 437.1 |
| | 450 | 28.8 | 38.4 | 57.7 | 67.3 | 86.5 | 105.7 | 144.2 | 173.1 | 192.3 | 240.4 | 278.9 | 346.2 | 432.7 |
| | 475 | 28.7 | 38.2 | 57.3 | 66.9 | 86.0 | 105.1 | 143.4 | 172.1 | 191.2 | 238.9 | 277.1 | 344.1 | 430.1 |
| | 500 | 28.2 | 37.6 | 56.5 | 65.9 | 84.7 | 103.4 | 140.9 | 169.1 | 188.0 | 235.0 | 272.6 | 338.4 | 423.0 |
| | 538 | 25.2 | 33.5 | 50.0 | 58.4 | 75.2 | 92.0 | 125.5 | 150.5 | 167.2 | 208.9 | 242.3 | 300.7 | 375.8 |
| | 550 | 25.0 | 33.3 | 49.8 | 58.1 | 74.8 | 91.5 | 124.9 | 149.8 | 166.5 | 208.0 | 241.2 | 299.4 | 374.2 |
| | 575 | 24.0 | 32.0 | 47.9 | 55.9 | 71.8 | 87.8 | 119.7 | 143.6 | 159.6 | 199.5 | 231.4 | 287.3 | 359.1 |
| | 600 | 19.9 | 26.5 | 39.8 | 46.4 | 59.7 | 73.0 | 99.5 | 119.4 | 132.7 | 165.9 | 192.4 | 238.9 | 298.6 |
| | 625 | 15.8 | 21.1 | 31.6 | 36.9 | 47.4 | 58.0 | 79.1 | 94.9 | 105.5 | 131.8 | 152.9 | 189.8 | 237.2 |
| | 650 | 12.7 | 16.9 | 25.3 | 29.5 | 38.0 | 46.4 | 63.3 | 76.0 | 84.4 | 105.5 | 122.4 | 151.9 | 189.9 |
| | 675 | 10.3 | 13.7 | 20.6 | 24.1 | 31.0 | 37.9 | 51.6 | 61.9 | 68.8 | 86.0 | 99.8 | 123.8 | 154.8 |
| | 700 | 8.4 | 11.2 | 16.8 | 19.6 | 25.1 | 30.7 | 41.9 | 50.3 | 55.9 | 69.8 | 81.0 | 100.5 | 125.7 |
| | 725 | 7.0 | 9.3 | 14.0 | 16.3 | 21.0 | 25.6 | 34.9 | 41.9 | 46.6 | 58.2 | 67.5 | 83.8 | 104.8 |
| | 750 | 5.9 | 7.8 | 11.7 | 13.7 | 17.6 | 21.5 | 29.3 | 35.2 | 39.1 | 48.9 | 56.7 | 70.4 | 87.9 |
| | 775 | 4.6 | 6.1 | 9.0 | 10.6 | 13.7 | 16.7 | 22.8 | 27.4 | 30.4 | 38.0 | 44.1 | 54.7 | 68.4 |
| | 800 | 3.5 | 4.7 | 7.0 | 8.2 | 10.5 | 12.8 | 17.4 | 20.9 | 23.3 | 29.2 | 33.9 | 42.1 | 52.6 |
| | 816 | 2.8 | 3.8 | 5.9 | 6.8 | 8.6 | 10.4 | 14.1 | 17.0 | 19.0 | 23.8 | 27.6 | 34.2 | 42.7 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends."*

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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| ASTM A351-CF8M SPECIAL CLASS (1) | -29 to 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 50.8 | 67.7 | 101.6 | 118.6 | 152.5 | 186.4 | 254.1 | 304.9 | 338.8 | 423.5 | 491.3 | 609.8 | 762.3 |
| | 100 | 47.1 | 62.8 | 94.2 | 109.9 | 141.3 | 172.7 | 235.5 | 282.6 | 314.0 | 392.4 | 455.2 | 565.1 | 706.4 |
| | 150 | 43.0 | 57.3 | 85.9 | 100.2 | 128.9 | 157.5 | 214.8 | 257.8 | 286.4 | 358.0 | 415.3 | 515.5 | 644.4 |
| | 200 | 39.8 | 53.1 | 79.6 | 92.9 | 119.4 | 145.9 | 199.0 | 238.8 | 265.4 | 331.7 | 384.8 | 477.6 | 597.0 |
| | 250 | 37.3 | 49.7 | 74.5 | 86.9 | 111.8 | 136.6 | 186.3 | 223.5 | 248.4 | 310.4 | 360.1 | 447.0 | 558.8 |
| | 300 | 35.3 | 47.1 | 70.6 | 82.4 | 105.9 | 129.4 | 176.4 | 211.7 | 235.3 | 294.1 | 341.1 | 423.5 | 529.3 |
| | 325 | 34.5 | 46.0 | 68.9 | 80.4 | 103.4 | 126.4 | 172.3 | 206.8 | 229.8 | 287.2 | 333.2 | 413.6 | 517.0 |
| | 350 | 33.8 | 45.1 | 67.7 | 79.0 | 101.5 | 124.1 | 169.2 | 203.1 | 225.7 | 282.1 | 327.2 | 406.2 | 507.7 |
| | 375 | 33.3 | 44.4 | 66.7 | 77.8 | 100.0 | 122.2 | 166.7 | 200.1 | 222.3 | 277.9 | 322.4 | 400.2 | 500.2 |
| | 400 | 32.9 | 43.8 | 65.7 | 76.7 | 98.6 | 120.5 | 164.3 | 197.2 | 219.1 | 273.8 | 317.6 | 394.3 | 492.9 |
| | 425 | 32.5 | 43.4 | 65.1 | 75.9 | 97.6 | 119.3 | 162.6 | 195.2 | 216.9 | 271.1 | 314.5 | 390.3 | 487.9 |
| | 450 | 32.2 | 42.9 | 64.4 | 75.1 | 96.6 | 118.1 | 161.0 | 193.2 | 214.7 | 268.3 | 311.2 | 386.3 | 482.9 |
| | 475 | 32.0 | 42.7 | 64.0 | 74.7 | 96.0 | 117.3 | 160.0 | 192.0 | 213.3 | 266.6 | 309.3 | 384.0 | 480.0 |
| | 500 | 31.7 | 42.3 | 63.4 | 74.0 | 95.1 | 116.3 | 158.6 | 190.3 | 211.5 | 264.3 | 306.6 | 380.6 | 475.7 |
| | 538 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 550 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 575 | 28.6 | 38.1 | 57.1 | 66.6 | 85.7 | 104.8 | 143.0 | 171.6 | 190.7 | 238.3 | 276.4 | 343.1 | 428.8 |
| | 600 | 24.9 | 33.2 | 49.8 | 58.1 | 74.6 | 91.2 | 124.4 | 149.3 | 165.9 | 207.3 | 240.5 | 298.5 | 373.2 |
| | 625 | 19.8 | 26.4 | 39.5 | 46.1 | 59.3 | 72.5 | 98.8 | 118.6 | 131.8 | 164.7 | 191.1 | 237.2 | 296.5 |
| | 650 | 15.8 | 21.1 | 31.7 | 37.0 | 47.5 | 58.0 | 79.1 | 94.9 | 105.5 | 131.9 | 153.0 | 189.9 | 237.4 |
| | 675 | 12.9 | 17.2 | 25.8 | 30.1 | 38.7 | 47.3 | 64.5 | 77.4 | 86.0 | 107.5 | 124.7 | 154.8 | 193.5 |
| | 700 | 11.4 | 15.2 | 22.8 | 26.6 | 34.3 | 41.9 | 57.1 | 68.5 | 76.2 | 95.2 | 110.4 | 137.1 | 171.3 |
| | 725 | 9.5 | 12.7 | 19.1 | 22.3 | 28.6 | 35.0 | 47.7 | 57.2 | 63.6 | 79.5 | 92.2 | 114.4 | 143.0 |
| | 750 | 7.4 | 9.9 | 14.8 | 17.2 | 22.1 | 27.0 | 36.7 | 44.1 | 49.0 | 61.2 | 71.0 | 88.2 | 110.3 |
| | 775 | 5.8 | 7.7 | 11.4 | 13.3 | 17.2 | 21.0 | 28.5 | 34.2 | 38.1 | 47.6 | 55.2 | 68.5 | 85.6 |
| | 800 | 4.4 | 5.9 | 8.8 | 10.3 | 13.2 | 16.1 | 22.0 | 26.4 | 29.3 | 36.6 | 42.4 | 52.6 | 65.6 |
| | 816 | 3.4 | 4.7 | 7.2 | 8.4 | 10.7 | 13.1 | 17.9 | 21.4 | 23.8 | 29.6 | 34.3 | 42.5 | 53.1 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Shaded ratings may require special trim and packing. Consult your Flowserve representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends."*
*Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

FLOWSERVE

# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings

## Cast Steel* (Gate, Globe & Check Valves)

| RATING | TEMP. °F | PRESSURE (PSIG) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| A 351 Gr. CF8C GROUP 2.11 STANDARD CLASS (1) (2) | 100 | 275 | 660 | 1,440 | 1,680 | 2,160 | 2,640 | 3,600 | 4,320 | 4,800 | 6,000 | 6,960 | 8,640 | 10,800 |
| | 200 | 255 | 610 | 1,325 | 1,545 | 1,985 | 2,430 | 3,310 | 3,975 | 4,415 | 5,520 | 6,400 | 7,950 | 9,935 |
| | 300 | 230 | 565 | 1,235 | 1,440 | 1,850 | 2,260 | 3,085 | 3,700 | 4,115 | 5,140 | 5,900 | 7,400 | 9,250 |
| | 400 | 200 | 520 | 1,150 | 1,340 | 1,730 | 2,115 | 2,880 | 3,455 | 3,840 | 4,800 | 5,570 | 6,910 | 8,640 |
| | 500 | 170 | 475 | 1,085 | 1,265 | 1,625 | 1,990 | 2,710 | 3,250 | 3,615 | 4,520 | 5,240 | 6,510 | 8,135 |
| | 600 | 140 | 440 | 1,030 | 1,200 | 1,550 | 1,895 | 2,580 | 3,095 | 3,440 | 4,300 | 4,990 | 6,190 | 7,740 |
| | 650 | 125 | 420 | 1,015 | 1,180 | 1,520 | 1,860 | 2,530 | 3,040 | 3,375 | 4,220 | 4,895 | 6,075 | 7,595 |
| | 700 | 110 | 405 | 995 | 1,160 | 1,490 | 1,820 | 2,485 | 2,980 | 3,315 | 4,140 | 4,800 | 5,960 | 7,450 |
| | 750 | 95 | 390 | 985 | 1,150 | 1,475 | 1,800 | 2,460 | 2,950 | 3,280 | 4,100 | 4,755 | 5,905 | 7,380 |
| | 800 | 80 | 380 | 975 | 1,140 | 1,460 | 1,785 | 2,435 | 2,925 | 3,250 | 4,060 | 4,710 | 5,850 | 7,310 |
| | 850 | 65 | 370 | 970 | 1,130 | 1,455 | 1,780 | 2,425 | 2,910 | 3,235 | 4,040 | 4,685 | 5,820 | 7,270 |
| | 900 | 50 | 330 | 900 | 1,050 | 1,350 | 1,650 | 2,245 | 2,695 | 2,995 | 3,745 | 4,345 | 5,390 | 6,740 |
| | 950 | 35 | 280 | 775 | 900 | 1,160 | 1,420 | 1,930 | 2,320 | 2,575 | 3,220 | 3,735 | 4,635 | 5,795 |
| | 1000 | 20 | 255 | 725 | 850 | 1,090 | 1,335 | 1,820 | 2,180 | 2,425 | 3,030 | 3,515 | 4,360 | 5,450 |
| | 1050 | 20 | 250 | 720 | 840 | 1,080 | 1,320 | 1,800 | 2,160 | 2,400 | 3,000 | 3,480 | 4,320 | 5,400 |
| | 1100 | 20 | 220 | 625 | 730 | 935 | 1,145 | 1,560 | 1,870 | 2,080 | 2,600 | 3,015 | 3,745 | 4,680 |
| | 1150 | 20 | 150 | 420 | 490 | 625 | 765 | 1,045 | 1,255 | 1,395 | 1,745 | 2,025 | 2,510 | 3,135 |
| | 1200 | 20 | 115 | 300 | 350 | 455 | 555 | 755 | 905 | 1,005 | 1,255 | 1,560 | 1,810 | 2,265 |
| | 1250 | 20 | 90 | 225 | 265 | 340 | 415 | 565 | 380 | 755 | 945 | 1,095 | 1,360 | 1,695 |
| | 1300 | 20 | 60 | 150 | 175 | 225 | 275 | 375 | 450 | 500 | 630 | 730 | 905 | 1,130 |
| | 1350 | 20 | 50 | 105 | 120 | 155 | 190 | 255 | 310 | 345 | 430 | 500 | 620 | 770 |
| | 1400 | 15 | 40 | 80 | 95 | 125 | 150 | 205 | 250 | 275 | 345 | 400 | 495 | 615 |
| | 1450 | 10 | 30 | 60 | 70 | 95 | 115 | 155 | 185 | 205 | 255 | 300 | 370 | 465 |
| | 1500 | 10 | 25 | 55 | 65 | 80 | 100 | 135 | 165 | 185 | 230 | 265 | 330 | 410 |
| A 351 Gr. CF8C GROUP 2.11 SPECIAL CLASS (1) (2) | 100 | 290 | 695 | 1,500 | 1,750 | 2,250 | 2,750 | 3,750 | 4,500 | 5,000 | 6,250 | 7,250 | 9,000 | 11,250 |
| | 200 | 275 | 660 | 1,435 | 1,675 | 2,150 | 2,630 | 3,585 | 4,300 | 4,780 | 5,975 | 6,930 | 8,600 | 10,750 |
| | 300 | 255 | 610 | 1,320 | 1,540 | 1,975 | 2,415 | 3,295 | 3,955 | 4,395 | 5,490 | 6,370 | 7,910 | 9,885 |
| | 400 | 240 | 575 | 1,245 | 1,450 | 1,865 | 2,280 | 3,105 | 3,730 | 4,145 | 5,180 | 6,010 | 7,460 | 9,320 |
| | 500 | 230 | 550 | 1,200 | 1,400 | 1,800 | 2,200 | 3,000 | 3,600 | 4,000 | 5,000 | 5,800 | 7,200 | 9,000 |
| | 600 | 220 | 530 | 1,150 | 1,340 | 1,730 | 2,115 | 2,880 | 3,455 | 3,840 | 4,800 | 5,570 | 6,910 | 8,640 |
| | 650 | 215 | 520 | 1,130 | 1,320 | 1,695 | 2,070 | 2,825 | 3,390 | 3,770 | 4,710 | 5,465 | 6,785 | 8,480 |
| | 700 | 215 | 515 | 1,110 | 1,295 | 1,665 | 2,030 | 2,770 | 3,325 | 3,695 | 4,620 | 5,360 | 6,650 | 8,315 |
| | 750 | 210 | 510 | 1,100 | 1,280 | 1,645 | 2,010 | 2,745 | 3,295 | 3,660 | 4,575 | 5,310 | 6,590 | 8,235 |
| | 800 | 210 | 505 | 1,090 | 1,270 | 1,630 | 1,995 | 2,720 | 3,265 | 3,625 | 4,530 | 5,255 | 6,525 | 8,155 |
| | 850 | 205 | 500 | 1,080 | 1,260 | 1,625 | 1,985 | 2,705 | 3,250 | 3,610 | 4,510 | 5,230 | 6,495 | 8,115 |
| | 900 | 205 | 500 | 1,080 | 1,260 | 1,625 | 1,985 | 2,705 | 3,250 | 3,610 | 4,510 | 5,230 | 6,490 | 8,115 |
| | 950 | 180 | 435 | 945 | 1,100 | 1,415 | 1,730 | 2,360 | 2,830 | 3,145 | 3,930 | 4,560 | 5,660 | 7,070 |
| | 1000 | 160 | 390 | 840 | 980 | 1,260 | 1,540 | 2,105 | 2,525 | 2,805 | 3,505 | 4,065 | 5,050 | 6,310 |
| | 1050 | 160 | 390 | 840 | 980 | 1,260 | 1,540 | 2,105 | 2,525 | 2,805 | 3,505 | 4,065 | 5,048 | 6,310 |
| | 1100 | 150 | 360 | 780 | 910 | 1,170 | 1,430 | 1,950 | 2,340 | 2,600 | 3,250 | 3,770 | 4,680 | 5,850 |
| | 1150 | 100 | 240 | 525 | 610 | 785 | 960 | 1,305 | 1,570 | 1,745 | 2,180 | 2,530 | 3,137 | 3,920 |
| | 1200 | 70 | 170 | 375 | 440 | 565 | 690 | 945 | 1,135 | 1,260 | 1,570 | 1,820 | 2,263 | 2,830 |
| | 1250 | 55 | 130 | 285 | 330 | 425 | 520 | 705 | 850 | 945 | 1,180 | 1,370 | 1,697 | 2,120 |
| | 1300 | 35 | 90 | 190 | 220 | 285 | 350 | 470 | 565 | 630 | 785 | 910 | 1,132 | 1,415 |
| | 1350 | 25 | 60 | 130 | 150 | 195 | 240 | 320 | 385 | 430 | 535 | 620 | 772 | 965 |
| | 1400 | 20 | 50 | 105 | 120 | 155 | 190 | 255 | 310 | 345 | 430 | 500 | 617 | 770 |
| | 1450 | 15 | 35 | 75 | 90 | 115 | 140 | 195 | 230 | 260 | 320 | 370 | 463 | 580 |
| | 1500 | 15 | 35 | 70 | 80 | 105 | 130 | 170 | 205 | 230 | 285 | 330 | 412 | 515 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*Note: Flanged End valve ratings are limited to standard class only and terminate at 1000°F.*

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 800°F.*

*2. Shaded ratings may require special trim and packing. Consult your Edward valves sales representative for applications in these ranges.*

** Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*

*** Series 4500 rated Cast Steel valves do not comply with ASME Class 4500 ratings. Consult your Flowserve sales representative for pressure temperature ratings of these valves. See 3.2 Pressure Ratings in the Technical Information section for additional information.*



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# Reference: ASME B16.34 – 2004 Pressure/Temperature Ratings (metric)

## Cast Steel* (Gate, Globe & Check Valves)

1 bar = 100 kPa = 14.50 psi

| RATING | TEMP. °C | PRESSURE (BAR) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 400 | 600 | 700 | 900 | 1100 | 1500 | 1800 | 2000 | 2500 | 2900 | 3600 | 4500 |
| A 351 Gr. CF8C GROUP 2.11 STANDARD CLASS (1) (2) | 38 | 49.6 | 66.2 | 99.3 | 115.8 | 148.9 | 182.0 | 248.2 | 297.9 | 331.0 | 413.7 | 479.9 | 595.7 | 744.6 |
| | 50 | 48.8 | 65.0 | 97.5 | 113.8 | 146.3 | 178.8 | 243.8 | 292.6 | 325.1 | 406.4 | 471.4 | 585.2 | 731.5 |
| | 100 | 45.3 | 60.4 | 90.6 | 105.7 | 135.9 | 166.1 | 226.5 | 259.8 | 282.0 | 337.4 | 405.8 | 525.5 | 679.4 |
| | 150 | 42.5 | 53.3 | 74.8 | 92.3 | 127.4 | 155.7 | 212.4 | 254.9 | 283.2 | 353.9 | 410.5 | 509.7 | 637.1 |
| | 200 | 39.9 | 53.2 | 79.9 | 93.2 | 119.8 | 146.4 | 199.7 | 239.6 | 266.3 | 332.8 | 386.1 | 479.3 | 599.1 |
| | 250 | 37.8 | 50.4 | 75.6 | 88.2 | 113.4 | 138.6 | 189.1 | 226.9 | 252.1 | 315.1 | 365.5 | 453.8 | 567.2 |
| | 300 | 36.1 | 48.1 | 72.2 | 84.2 | 108.3 | 132.3 | 180.4 | 216.5 | 240.6 | 300.7 | 348.8 | 433.0 | 541.3 |
| | 325 | 35.4 | 47.2 | 70.7 | 82.5 | 106.1 | 129.7 | 176.8 | 212.1 | 235.7 | 294.6 | 341.7 | 424.2 | 530.3 |
| | 350 | 34.8 | 46.4 | 69.5 | 81.1 | 104.3 | 127.5 | 173.8 | 208.5 | 231.7 | 289.6 | 335.9 | 417.0 | 521.3 |
| | 375 | 34.2 | 45.6 | 68.4 | 79.8 | 102.6 | 125.4 | 171.0 | 205.2 | 228.1 | 285.1 | 330.7 | 410.5 | 513.1 |
| | 400 | 33.9 | 45.2 | 67.8 | 79.1 | 101.7 | 124.3 | 169.5 | 203.4 | 226.1 | 282.6 | 327.8 | 406.9 | 508.6 |
| | 425 | 33.6 | 44.8 | 67.2 | 78.4 | 100.8 | 123.2 | 168.1 | 201.7 | 224.1 | 280.1 | 324.9 | 403.4 | 504.2 |
| | 450 | 33.5 | 44.6 | 66.9 | 78.1 | 100.4 | 122.7 | 167.3 | 200.8 | 223.1 | 278.8 | 323.4 | 401.5 | 501.8 |
| | 475 | 31.7 | 42.2 | 63.2 | 73.8 | 95.1 | 116.1 | 158.2 | 189.9 | 211.1 | 263.9 | 306.1 | 379.9 | 474.8 |
| | 500 | 28.2 | 37.6 | 56.5 | 65.9 | 84.7 | 103.4 | 140.9 | 169.1 | 188.0 | 235.0 | 272.6 | 338.4 | 423.0 |
| | 538 | 25.2 | 33.5 | 50.0 | 58.4 | 75.2 | 92.0 | 125.5 | 150.5 | 167.2 | 208.9 | 242.3 | 300.7 | 375.8 |
| | 550 | 25.0 | 33.3 | 49.8 | 58.1 | 74.8 | 91.5 | 124.9 | 149.8 | 166.5 | 208.0 | 241.2 | 299.4 | 374.2 |
| | 575 | 24.0 | 32.0 | 47.9 | 55.9 | 71.8 | 87.8 | 119.7 | 143.6 | 159.6 | 199.5 | 231.4 | 287.3 | 359.1 |
| | 600 | 19.8 | 26.4 | 39.6 | 46.2 | 59.4 | 72.6 | 99.0 | 118.8 | 132.1 | 165.1 | 191.5 | 237.7 | 297.1 |
| | 625 | 13.9 | 18.5 | 27.7 | 32.3 | 41.6 | 50.8 | 69.3 | 83.2 | 92.4 | 115.5 | 134.0 | 166.3 | 207.9 |
| | 650 | 10.3 | 13.7 | 20.6 | 24.0 | 30.9 | 37.8 | 51.5 | 61.8 | 68.7 | 85.8 | 99.5 | 123.6 | 154.5 |
| | 675 | 8.0 | 10.6 | 15.9 | 18.6 | 23.9 | 29.2 | 39.8 | 47.8 | 53.1 | 66.3 | 76.9 | 95.5 | 119.4 |
| | 700 | 5.6 | 7.5 | 11.2 | 13.1 | 16.8 | 20.6 | 28.1 | 33.7 | 37.5 | 46.8 | 54.3 | 67.4 | 84.2 |
| | 725 | 4.0 | 5.3 | 8.0 | 9.3 | 11.9 | 14.6 | 19.9 | 23.9 | 26.5 | 33.1 | 38.4 | 47.7 | 59.6 |
| | 750 | 3.1 | 4.1 | 6.2 | 7.2 | 9.3 | 11.4 | 15.5 | 18.6 | 20.7 | 25.8 | 29.9 | 37.1 | 46.4 |
| | 775 | 2.5 | 3.3 | 4.9 | 5.7 | 7.4 | 9.0 | 12.3 | 14.7 | 16.4 | 20.4 | 23.7 | 29.4 | 36.8 |
| | 800 | 2.0 | 2.7 | 4.0 | 4.7 | 6.1 | 7.4 | 10.1 | 12.1 | 13.5 | 16.9 | 19.6 | 24.3 | 30.4 |
| | 816 | 1.9 | 2.5 | 3.8 | 4.4 | 5.7 | 7.0 | 9.5 | 11.4 | 12.7 | 15.8 | 18.3 | 22.7 | 28.4 |
| A 351 Gr. CF8C GROUP 2.11 SPECIAL CLASS (1) (2) | 38 | 51.7 | 68.9 | 103.4 | 120.6 | 155.1 | 189.6 | 258.6 | 310.3 | 344.8 | 430.9 | 499.9 | 620.5 | 775.7 |
| | 50 | 51.2 | 68.3 | 102.4 | 119.5 | 153.6 | 187.7 | 256.0 | 307.2 | 341.4 | 426.7 | 495.0 | 614.5 | 768.1 |
| | 100 | 48.9 | 65.2 | 97.9 | 114.2 | 146.8 | 179.4 | 244.7 | 293.6 | 326.3 | 407.8 | 473.1 | 587.3 | 734.1 |
| | 150 | 45.4 | 60.5 | 90.8 | 105.9 | 136.1 | 166.4 | 226.9 | 272.3 | 302.6 | 378.2 | 438.7 | 544.6 | 680.7 |
| | 200 | 43.1 | 57.4 | 86.1 | 100.5 | 129.2 | 157.9 | 215.3 | 258.4 | 287.1 | 358.8 | 416.2 | 516.7 | 645.8 |
| | 250 | 41.6 | 55.5 | 83.3 | 97.2 | 124.9 | 152.7 | 208.2 | 249.8 | 277.6 | 347.0 | 402.5 | 499.6 | 624.5 |
| | 300 | 40.2 | 53.6 | 80.3 | 93.7 | 120.5 | 147.3 | 200.9 | 241.1 | 267.9 | 334.8 | 388.4 | 482.1 | 602.6 |
| | 325 | 39.5 | 52.6 | 78.9 | 92.1 | 118.4 | 144.7 | 197.3 | 236.8 | 263.1 | 328.8 | 381.4 | 473.5 | 591.8 |
| | 350 | 38.8 | 51.7 | 77.6 | 90.5 | 116.4 | 142.3 | 194.0 | 232.8 | 258.7 | 323.3 | 375.0 | 465.5 | 581.9 |
| | 375 | 38.2 | 50.9 | 76.4 | 89.1 | 114.5 | 140.0 | 190.9 | 229.1 | 254.5 | 318.1 | 369.0 | 458.1 | 572.7 |
| | 400 | 37.8 | 50.4 | 75.7 | 88.3 | 113.5 | 138.7 | 189.2 | 227.1 | 252.3 | 315.4 | 365.9 | 454.2 | 567.7 |
| | 425 | 37.5 | 50.0 | 75.0 | 87.5 | 112.5 | 137.5 | 187.6 | 225.1 | 250.1 | 312.6 | 362.6 | 450.2 | 562.7 |
| | 450 | 37.3 | 49.8 | 74.7 | 87.1 | 112.0 | 136.9 | 186.7 | 224.0 | 248.9 | 311.1 | 360.9 | 448.0 | 560.0 |
| | 475 | 37.3 | 49.7 | 74.6 | 87.0 | 111.9 | 136.8 | 186.5 | 223.8 | 248.7 | 310.9 | 360.6 | 447.7 | 559.6 |
| | 500 | 35.6 | 47.6 | 71.5 | 83.4 | 107.1 | 130.9 | 178.6 | 214.3 | 238.1 | 297.5 | 345.1 | 428.3 | 535.4 |
| | 538 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 550 | 29.0 | 38.6 | 57.9 | 67.6 | 86.9 | 106.3 | 145.1 | 174.1 | 193.4 | 241.7 | 280.4 | 348.1 | 435.1 |
| | 575 | 28.6 | 38.1 | 57.1 | 66.6 | 85.7 | 104.8 | 143.0 | 171.6 | 190.7 | 238.3 | 276.4 | 343.1 | 428.8 |
| | 600 | 24.8 | 33.0 | 49.5 | 57.8 | 74.3 | 90.8 | 123.8 | 148.6 | 165.1 | 206.4 | 239.4 | 297.2 | 371.4 |
| | 625 | 17.3 | 23.1 | 34.6 | 40.4 | 52.0 | 63.5 | 86.6 | 103.9 | 115.5 | 144.3 | 167.4 | 207.8 | 259.8 |
| | 650 | 12.9 | 17.2 | 25.7 | 30.0 | 38.6 | 47.2 | 64.4 | 77.3 | 85.9 | 107.3 | 124.5 | 154.5 | 193.1 |
| | 675 | 9.9 | 13.2 | 19.9 | 23.2 | 29.8 | 36.4 | 49.7 | 59.7 | 66.3 | 82.9 | 96.2 | 119.4 | 149.2 |
| | 700 | 8.2 | 10.9 | 16.4 | 19.1 | 24.5 | 30.0 | 40.9 | 49.1 | 54.6 | 68.2 | 79.1 | 98.2 | 122.7 |
| | 725 | 5.9 | 7.9 | 11.8 | 13.8 | 17.7 | 21.6 | 29.5 | 35.4 | 39.4 | 49.2 | 57.1 | 70.8 | 88.5 |
| | 750 | 4.1 | 5.5 | 8.2 | 9.5 | 12.2 | 14.9 | 20.4 | 24.5 | 27.2 | 34.0 | 39.4 | 49.0 | 61.2 |
| | 775 | 3.1 | 4.1 | 6.2 | 7.2 | 9.3 | 11.4 | 15.5 | 19.5 | 22.2 | 28.8 | 32.3 | 38.5 | 46.4 |
| | 800 | 2.7 | 3.6 | 5.3 | 6.2 | 8.0 | 9.8 | 13.3 | 16.0 | 17.8 | 22.2 | 25.8 | 32.0 | 40.0 |
| | 816 | 2.4 | 3.2 | 4.7 | 5.5 | 7.1 | 8.7 | 11.8 | 14.2 | 15.8 | 19.7 | 22.9 | 28.4 | 35.5 |

**IMPORTANT: The above ratings are only for reference. Refer to ASME B16.34 for pressure/temperature ratings.**

*1. Permissible, but not recommended for prolonged use at temperatures above approx. 427°C.*

*2. Shaded ratings may require special trim and packing. Consult your Flowserve sales representative for applications in these ranges.*

**Pressure temperature ratings are from ASME B16.34 "Valves, Flanged, Threaded and Welding Ends." Consult your Flowserve sales representative for pressure temperature ratings of materials not included in this catalog.*



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# 1. Stop and Check Valve Applications Guide

## 1.1 Stop Valve Applications

**Foreword**
Edward stop valves are used primarily as isolation valves in medium and high pressure piping systems. They are offered in a broad range of sizes, pressure ratings, and types, and they are used in an immense array of diverse applications. Only a few are listed for illustration:

- Normally open valves in main steam lines; used only for equipment isolation, e.g. during maintenance.
- Normally open valves to provide for emergency shutoff due to failure of downstream piping or other equipment; closed periodically for verification of operability.
- Normally open valves that are throttled to varying degrees during start-up or shutdown of plants or systems.
- Frequently cycled valves that are opened and closed for control of batch processes or for start-up and shutdown of equipment (e.g., equipment that is on stream daily but shutdown at night).
- Normally closed valves; used only for filling or draining systems during outages.

Stop valves are sometimes referred to as "on-off valves." They should not normally be considered as "control valves," but they are suitable for moderate or infrequent flow-control functions. Valves that must open and close under high differential pressure and flow conditions (such as "blowdown" service) inherently function as flow-control devices while they are stroking.

Considering the diversity of stop valve applications, it is not surprising that there is no universal valve type that is best for all services. Users' experience with specific applications is a valuable basis for selecting the best valves.

The goal of this guide is to supplement users' experience with information based on decades of Flowserve Edward valves' laboratory tests and field experience.

**Introduction**
While many other types of valves (ball, plug, butterfly) are used as stop valves where service conditions permit, emphasis in this guide is on selection and application of Edward valves with forged- and cast-steel bodies and bonnets. Comparisons are presented with other similar valves where appropriate.

Edward stop valves are typically of metal-seated construction and, where necessary, use gaskets and stem seals designed for severe high-pressure, high-temperature service. While special designs with "soft seats" and O-ring seals are supplied for unique, specific applications, the standard products are designed to stand up to tough service conditions with minimum requirements for maintenance or parts replacement.

Edward stop valves fall into two basic categories – **globe valves** and **gate valves**. The following sections of this guide will address the principal features of each type and the design variations within the types.

Globe valves are offered in stop, stop-check, and check versions. Stop-check valves can also be used for isolation in unidirectional flow applications. These valves are discussed in the Check Valves Applications section (1.2).

The FLOW PERFORMANCE section of this catalog provides equations and coefficients for the calculation of pressure drop across any of these valves. This information can be used to evaluate the effects of different valve sizes and types of system energy efficiency.

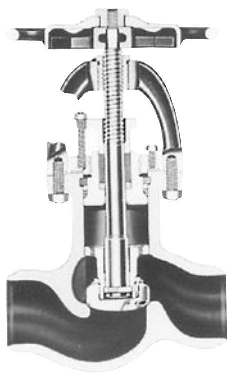
### 1.1.1 Stop Valve Types and Typical Uses

Brief notes on the advantages, disadvantages, applications and limitations of the various types of Edward stop valves are presented in the Stop Valve Applications Chart (section 1.1.4). Some additional highlights of the features of these valves and some comparisons with similar valves are presented in the following paragraphs.

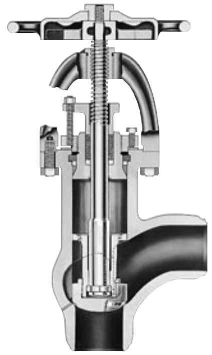
**Globe Valves**
A globe valve employs a poppet or disk that opens and closes by moving linearly along the seat axis. There are many types of globe valve bodies, seats and methods of guiding the disk to and from the seat.

• **Bodies** – Edward stop, stop-check and check type globe valves are offered with three basic body styles:

**Conventional or 90°-bonnet globe valves** are usually the most compact, and the stem and yoke position allow easy handwheel or actuator access and convenience for maintenance. Relatively short stem travel allows fast actuation. Multiple direction changes in the flow stream result in higher pressure drop than with other types, but streamlined flow passages in Flowserve Edward valves generally yield lower pressure drop than competitive valves of this type.



**Angle valves** are otherwise similar to conventional globe valves, but the less tortuous flow path yields lower pressure drop. Angle valves are particularly economical in piping layouts where use of this configuration eliminates an elbow and associated flanged or welded joints.



**Inclined bonnet or "Y type" valves**, such as Univalves® and Flite-Flow® valves, yield lower pressure drop than other styles, because they permit a more nearly straight-through flow path. Typically, they require a longer stem travel. In large sizes, this body shape is heavier and requires a greater end-to-end length than conventional globe valves.



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• **Seats** – Industrial globe valves are available from various manufacturers with a broad variety of seat designs — flat or tapered and integral or inserted (threaded or welded).

All Edward globe valves employ tapered seats with "area contact" under load to seal over minor imperfections. Many similar valves use "line-contact" seats that seal with less load when new, but degrade rapidly if damaged at the seating line.

Except for hydraulic stop valves, all Edward globe valves employ integral (hardfaced) body seats to permit compact design and assure that there can be no leakage "behind" the seat.

• **Disk Guiding** – Globe valve disks may be guided by either the stem or the body. When opened or closed under very high differential pressure, side load due to flow pushes a stem-guided disk eccentric to the seat and makes it difficult to obtain a seal. Under extreme conditions, the stem may bend.

All Edward globe valves employ body-guided disks that are held closely concentric with the body seat. Guiding is provided at both the top and bottom of the disk to form a fully body-guided disk piston. The bottom guide ring on the disk, a Flowserve Edward valves innovation, minimizes flow behind the disk and minimizes the side load. These features make Edward globe valves well suited to "blowdown" applications in which there is a high differential pressure across the valve when it is partially open.

Since globe valves are not symmetrical with respect to flow, consideration must be given to the direction of flow and differential pressure. It should be noted that the direction of flow when open and differential pressure when closed may not be the same in all applications (e.g., a block valve on a feed line may involve flow into a system when open, but may need to prevent leakage out of the system when closed). Users should consider both factors when deciding on the installation direction for a globe valve.

In most globe valve applications, pressure is under the seat when the valve is closed, and the flow is from under to over the seat (termed "flow to open" or "underseat flow"). In installations where the downstream pressure is zero or very low, this arrangement minimizes packing leakage problems. However, handwheel or actuator effort to close the valve is high, because the stem must supply enough load to both overcome the differential pressure load across the seat area and ensure sufficient sealing load on the metal seat-contact surfaces. Since this flow direction is the most common for globe valves, the flow coefficients given in the Flow Performance section of this catalog are for underseat flow.

Globe valves can also be used with overseat flow and pressure ("flow to close"), but such applications require careful consideration. In systems with dirty line fluids, this arrangement could lead to trapping foreign material in locations where it would interfere with opening. With overseat pressure, the effort to close the valve is low, because closure and sealing are pressure assisted. However, the effort to open the valve at high differential pressure is high, because the stem must overcome the pressure force to lift the disk (In small valves, the stem diameters approaching the seat diameter. This may not be a problem, because the pressure helps to lift the stem). Also, since the flow coefficients given in this catalog are for underseat flow, pressure-drop predictions may not be as accurate (pressure drop may be up to 10% higher with overseat flow).

While not designed as control valves and not recommended for continuous modulation, Edward globe valves are often used successfully for manual or automatic control during limited periods of system operation (start-up, shutdown, etc.). Some manual valves are also used for continuous throttling or "trimming." Inclined-bonnet valves, (e.g., Univalves® and Flite-Flow® valves) have an approximately linear flow characteristic ($C_V$ versus % open).

The Flow Performance section of this catalog covers only flow coefficients for fully open valves, but consult Flowserve concerning applications involving flow control. It should be understood that severe throttling at high pressure drops involves high energy dissipation and serious problems (e.g., noise, vibration, cavitation, erosion) can develop if not carefully considered when a system is designed.

**Gate Valves**

A gate valve employs a closure member (or assembly) that opens and closes by moving perpendicular to the flow stream to engage two seats in the body. There are two basically different types of gate valves – parallel-side and wedge gate – in common use in pressure-piping systems, but there are many variations in design within each type.

As compared to glove valves, all gate valves offer straight-through flow paths which tend to produce less pressure drop than typical globe valves of the same nominal size. A Venturi gate valve with a smaller port than a Regular gate valve may offer a lower first cost as well as a size and weight saving if a minimized pressure drop is not required.

The Flow Performance section of this catalog gives comparable flow coefficients for Edward Equiwedge® gate valves and all Edward globe stop valves. Evaluation of many valve applications has shown that inclined-bonnet globe valves are often competitive with gate valves when all factors are considered.

The stem in a gate valve does not have to overcome the full differential pressure load across the valve seat area to open or close the valve. Instead, it just has to overcome the friction force due to that load. Consequently, for operation at similar differential pressures, a gate valve generally requires less effort for actuation than a globe valve and can employ a smaller actuator when powered operation is required. However, a gate valve requires considerably greater stem travel than a conventional globe or angle valve (slightly greater than an inclined-bonnet globe valve), so a somewhat longer time may be required for action.

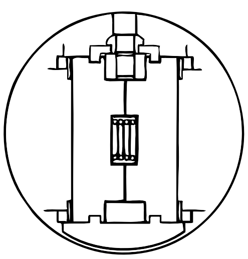
The two body seats – the common feature in all ordinary gate valves – can be both an advantage and a disadvantage. Most gate valves are primarily "downstream-sealing," because the closure member is pressure-energized in that direction. However, the upstream seating surfaces may help by limiting leakage, if the downstream seat is damaged. Simultaneous sealing at both seats can be hazardous, if the center cavity of a closed valve is filled or partially filled with liquid and then subjected to an increase in temperature, causing a corresponding increase in pressure. In moderate cases, this may cause "pressure binding" which can impede or prevent valve opening; in extreme cases, it may cause pressure-boundary failure (e.g., the bonnet could blow off).

*Note: ASME/ANSI B16.34-2004 (paragraph 2.3.3) places the responsibility of the purchaser to assure that the pressure in the valve will not exceed that allowed by the standard. Special operating procedures, such as partially opening a valve during warm-up, may be considered. Special internal design features or external bypass arrangements are required in many applications. Consult Flowserve regarding Edward Equiwedge® gate valve applications that may be subject to possible center-cavity over-pressurization.*

Some highlights of the various types of gate valves, including the Edward Equiwedge, are discussed below:

**• Parallel-Slide Gate Valves**

Flowserve Edward valves does not offer parallel-slide valves. In these valves, the two seats in the body are in parallel planes, and a gate assembly (including 2 disks with parallel seating faces) moves into or out of engagement with the body seats. The gates are urged into contact with the opposing seats in the closed position by either a spring (or a set of springs) or an internal wedge mechanism.



**Parallel Slide Gate**

Since the two gates are relatively independent, the downstream gate is free to align with the downstream seat; and new valves usually seal well as long as the differential pressure across the valve is sufficient to provide adequate seating load. Leakage may be a problem with these valves at low differential pressures (e.g. when filling a system or during low-pressure start-up operation).

In typical parallel-slide valves, there is continuous sliding contact between the sealing surfaces of the gates and body seats throughout the full stem stroke. Wearing or scoring is possible, particularly when operating with high differential pressures, and this may cause seat sealing to be degraded. However, this shearing action may be helpful in cleaning loose debris from the seats.

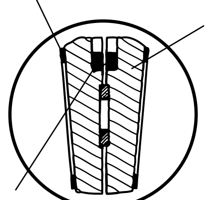
**• Wedge Gate Valves**

A wedge gate valve uses one of the oldest engineering principles to provide mechanical advantage to convert stem load to seat-sealing load. This is particularly important in low-pressure applications where differential pressure alone may not provide sufficient loading on the downstream seat.

Early wedge gate valves for low pressure employed solid wedges, and these are still used in many small high-pressure gate valves. However, as industrial valve requirements moved toward larger sizes and higher pressures and temperatures, a solid wedge designed to provide sufficient strength became too rigid to accommodate the flexibility of the valve body. The seat planes deflect significantly in large, high-pressure valve bodies due to thermal effects and the loads from connecting piping, and a rigid wedge may either leak or bind in the closed position.

Many gate valves have been designed with "flexible" one-piece wedges that have overcome these problems to some degree, but the two halves of the wedge are not truly independent and free to align with the two opposing body seats. It is particularly difficult to provide torsional flexibility in the wedge to accommodate twist in the valve body.

Consequently, the Edward Equiwedge valve was designed with two independent, flexible wedge halves that permit relative rotation and can tilt to accommodate changes in the body-seat angles. The thickness of the wedges was minimized, while maintaining acceptable stresses, to allow deflection to accommodate out-of-flatness in the seat plane. In prototype tests, acceptable sealing was maintained with seats intentionally misaligned 1° in angle and up to 2° in rotation.




**Double Wedge Design**

The result is a valve that has high-pressure sealing performance comparable to that of a parallel-slide valve but that can also seal exceptionally well at low differential pressures. The independent, flexible wedge halves in Edward Equiwedge gate valves also have commendable resistance to sticking or binding in the closed position. In prototype tests, the valve always opened with a torque less than the design closing torque when exposed to extreme pipe-bending moments and severe thermal transients (heat-up and cool-down).

All wedge gate valves have body guides that must support the wedges when they are not in the fully closed position. The seating surfaces of the wedges and seats are in sliding contact only through a small portion of the opening and closing travel, thus minimizing wear that may degrade seat sealing. Outside that range, the side loads are transferred from the seats to the body guides. Wear or scoring of the body guides does not affect sealing.

In Edward Equiwedge gate valves, the body guides are vertical machined grooves at each side of the valve body which engage tongues on each side of the wedge halves. Precision machining allows transfer of side load from the seats to the body guides within 3% to 5% of valve travel. Testing has proven that this guiding system is rugged and supports the gate assembly effectively, even in "blowdown" services where high differential pressure loads act across the gates when the valve is partially open.

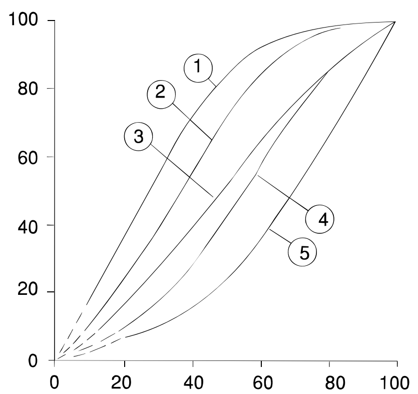
Gate valves of any type are usually not recommended for throttling or modulating flow-control service. The seating surfaces of the gates are subject to impingement when partially open, and some gate valves reportedly exhibit instability (internal vibration) when throttled. Nevertheless, high-velocity flow tests of a prototype Edward Equiwedge gate valve produced no flow-induced vibration, and there are cases where these valves have been used successfully for limited flow-control functions. Consult Flowserve concerning any proposed throttling or control applications.

### 1.1.2 Throttling Characteristics of Edward Stop Valves

As noted in the previous section, Edward stop valves are not normally recommended for continuous modulation, and Edward valves should be consulted concerning applications involving flow control. This section is intended only to provide general guidelines on flow-control characteristics of typical Edward stop valves. These guidelines may be used for preliminary studies relating to applications involving throttling, but they should not be considered as a substitute for a complete evaluation of the acceptability of a valve for a critical application.

Figure A

**Inherent Flow Characteristics**




**Valve Opening – Percent**
1 - Conventional 90° bonnet globe valve
2 - Angle valve
3 - Flite-Flow
4 - Univalve
5 - Equiwedge Gate valve

Figure A provides typical **inherent flow-characteristic** curves (percent of full-open flow coefficient versus percent opening) of the most common types of Edward stop valves. It should be understood that these curves are approximate, because there are variations due to size and pressure class that cannot be represented accurately by a single curve for each valve type. Nevertheless, these typical curves can provide some guidance relating to control capabilities of the various valve types.

Note the following subtle differences between the curves in Figure A:

- The conventional 90°-bonnet globe valve provides a relatively steep slope at small openings approaching a "quick-opening" characteristic. While the body-guided disk in Edward globe valves moderates this effect, it makes the flow coefficient very sensitive to small changes in stem position, so it may prove difficult to control low flow rates.
- The angle valve has a characteristic similar to that of a globe valve, but it is slightly closer to linear due to its normally higher full-open flow coefficient. An angle valve has about the same control characteristics as a globe valve of the same size at small openings.
- The cast-steel Flite-Flow® Y-type valve provides a characteristic that is nearly linear over most of its stem-travel range. For control of flow over a broad range, the high flow efficiency of this type of valve may permit use of a smaller valve size for a given allowable pressure drop. The smaller size, combined with the linear characteristic, can give improved control of low flow rates when the valve is throttled.
- The forged-steel Y-type Univalve® provides even better control at very small openings, because of its "double throttling" characteristic as the lower disk-guide ring opens the machined port in the body. Other forged-steel valves have this characteristic to some degree.
- The Equiwedge gate valve has an excellent inherent flow characteristic ("concave upward"), approaching that of an **equal-percentage** control valve. However, this is somewhat misleading. When installed in pipe of the same nominal size as the valve, the pressure drop of a gate valve is so low at large openings (e.g., over 70%) that piping flow resistance usually overshadows that of the valve. The gate valve would provide little control over flow in that range.

  While not normally recommended for throttling for the reasons cited in the previous section, the gate valve flow-characteristic curve is attractive from a standpoint of controlling low flow rates without excessive sensitivity. Use of a gate valve for throttling may be considered for some applications.

### 1.1.3 Stop Valve Actuators and Accessories

Most Edward stop and stop-check valves illustrated in this catalog are shown with handwheels, and the majority of valves are furnished for applications where manual actuation is acceptable. Most larger and higher-pressure globe valves are furnished with standard Impactor handles or handwheels, which provide up to 12 times the stem force of an ordinary handwheel, to provide for adequate seating thrust. Impactogear assemblies on the largest globe valves permit operation using an air wrench. These Flowserve Edward valves innovations permit practical manual operation of many valves that would otherwise require gearing or power actuators.

**Manual Gear Actuators**

When specified, many Edward valves can be supplied with manual actuators with gear reduction in lieu of a handwheel. Such actuators reduce the required rim-pull effort and often permit operation by one person in cases where several people would be required to seat the valve with a handwheel. While manual gear actuators slow down operation, they are often an attractive option for valves that are not operated frequently. Operating pressure and differential pressure should be specified.

*Note: Users sometimes specify that valves be operable at maximum differential pressure with very low rim-pull forces. This may require selection of gearing that may cause two problems: (1) literally thousands of handwheel turns for full-stroke valve operation and/or (2) capability to damage the valve easily with rim-pull forces that are readily applied by many operating personnel. Manual gear actuators with high ratios provide relatively little "feel" to the operator, and it is difficult to tell when a valve is fully opened or closed. Good judgment should be exercised in specifying practical rim-pull force requirements.*

**Power Actuators**

Where valves are inaccessible for manual operation, or where relatively fast opening or closing is required, most Edward valves can be furnished with power actuators. The most commonly used actuators are electric actuators with torque- and position-control features. Users frequently have individual preferences on actuator brand names and type; therefore, so Edward valves can be furnished with Flowserve actuators or other brand actuators to satisfy customer requirements.

Flowserve establishes actuator sizes and switch setting based on specific valve-application requirements, using a computer program that matches the valve and actuator operating characteristics to the service-pressure conditions. Flowserve can help make this selection, since we best know the requirements of our valve. However, we must also know the requirements of your application. As a minimum, requests for quotation should specify:

- Operating pressures – under-seat and over-seat and differential
- Maximum valve operating temperature
- Ambient conditions – temperature, humidity, radiation
- Motor power supply – AC voltage, frequency, and phase or DC voltage (including variance)

- NEMA rating
- Closing/opening time – if important. If not specified, standard nominal stem speed will be 4 inches/minute (100 mm/min) for globe valves and 12 inches/min (305 mm/min) for gate valves.
- Valve-stem plane – vertical (stem up or down) or horizontal
- Special accessories – position indicator, etc.

Any other special requirements should be clearly specified. If there are non-standard manual-override requirements, see the note above relative to rim-pull forces for manual gear actuators.

### 1.1.4 By-Passes and Drains

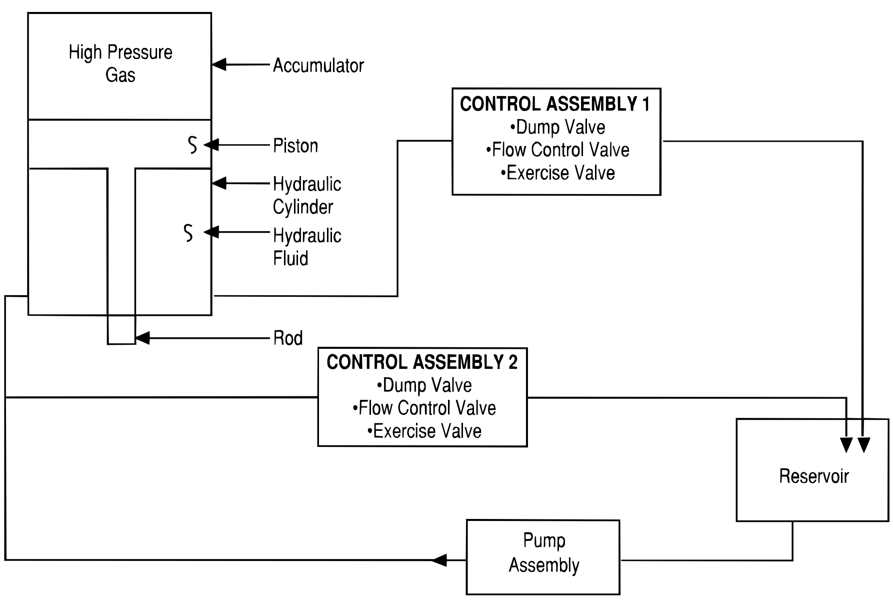
When specified, larger Edward cast-steel valves are furnished with valved by-passes and drains in accordance with ASME-ANSI B16.34 and MSS SP-45. Cast-steel stop valves employ forged-steel Edward globe stop valves, and cast-steel stop-check valves use forged steel Edward stop-check valves as by-pass valves. Sizes and by-pass valve figure numbers are as shown on page 96.

Drain valves for all main valves are the same as the by-pass valves listed for stop valves. When drains are specified without valves, the standard drain for classes 300 and 600 valves is a NPT tapped hole in the valve body, fitted with a pipe plug. For class 900 and higher-pressure valves, the standard drain is a pipe nipple, six inches (152 mm) long, socket-welded to the valve body.

Drain sizes are the same as by-passes. By-pass valves are particularly useful when opened before the main valve to permit controlled warming of the valve and downstream line in services involving steam or other hot fluids. By-passes also can be used to partially or fully balance the differential pressure across the main valve before opening where the downstream line or system is of limited volume. This facilitates opening of a gate valve or a glove valve with overseat pressure.

Large-volume systems may require larger by-passes for balancing in a reasonable time. If this is the case, a special by-pass size should be specified by the purchaser. It should be noted that actuated Edward Equiwedge gate valves do not require by-passes to permit opening if the full differential pressure is specified for actuator sizing. See page 96 for tables of standard sizes and pressure classes for most applications.

**General schematic of stored energy gas / hydraulic actuator.**



### 1.1.5 Stop Valve Application Chart

| Type | Advantages | Disadvantages | Applications | Limitations |
|---|---|---|---|---|
| **Globe 90° Bonnet** | • Compact<br>• Easy access to handwheel or actuator<br>• Fast response | • High pressure drop<br>• High torque<br>• Heavy in large sizes | • Class 300-2500 steam and water<br>• Other gasses and liquids<br>• Usable for throttling | • Not for stem-down installations<br>• Sizes ¼ through **24** |
| **Angle** | • Same as globe<br>• Replaces an elbow<br>• Lower pressure drop than globe | • High torque<br>• Heavy in large sizes | • Same as globe | • Same as globe |
| **Globe Inclined Bonnet** | • Lower pressure drop than globe or angle<br>• May permit smaller size than globe | • Same as angle<br>• Longest end-to-end length<br>• Handwheel or actuator on an angle<br>• Long stem travel slows response | • Class 600-4500 through size 4<br>• Class 300-2500 through size 24<br>• Otherwise, same as globe | • Same as globe |
| **Equiwedge® Gate** | • Lowest pressure drop<br>• Lowest torque<br>• May permit smallest size | • Not recommended for throttling<br>• Long stem travel slows response with manual actuation | • Class 600-2500 steam and water<br>• Other gasses and liquids<br>• Main steam isolation | • Possibility of pressure binding<br>• Sizes 2½ through **32** |



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## 1.2 Check Valve Applications Guide

**Foreword**
Check valves are used in fluid circuits in applications similar to those in which diodes are used in electrical circuits. Reduced to simplest terms, the duty of most check valves is to allow flow in one direction and to prevent flow in the reverse direction. The ideal check would have zero resistance to flow in the normal flow direction and infinite resistance to flow (leakage) in the reverse direction. Of course, the ideal check valve should also be perfectly reliable and should require no maintenance.

There are many different types of check valves, and most do their duty well, giving long, trouble-free service. However, in the real world, no single type of check valve achieves the ideal performance characteristics users sometimes expect. In a very few cases, mismatching of check valves to the needs of fluid circuits has produced serious problems (noise, vibration, severe pressure surges and check-element failures with attendant gross leakage and consequential damage to other equipment). While it is not necessary for every application to be ideal, knowledge of the characteristics of each type of check valve should help system designers and valve users to select the best type and size intelligently. This knowledge should also help in assuring that serious problems are avoided.

Most check valves seem deceptively simple, with only one moving part — a poppet or flapper that appears capable of allowing flow in only one direction. However, this single mechanical part cannot be expected to take the place of a sophisticated control system that senses flow (direction, quantity, rate of change) and provides output to (1) open the valve fully when flow is in one direction and yet (2) close the valve to prevent flow and leakage in the reverse direction. Each type of check valve has features that enable it to perform one or more of its duties well, but each type also has weaknesses. The relative importance of these strengths and weaknesses is highly dependent on the requirements of individual applications.

The goal of this guide is to provide application engineers and users with practical advice on check valve selection and sizing, location in piping systems, preventive maintenance and repairs. Emphasis will be on Flowserve Edward valves products, but comparisons will be provided in some cases with other types of check valves.

This guide is based on extensive testing of Edward check valves in sizes from NPS ½ through 18, as well as a reasonable sampling of other types. Since complete performance testing of every valve type, size and pressure class is not practical, predictions of the performance of some valves are based on mathematical models. However, the models are based on substantial test data and are believed to be reasonably accurate or conservative. The laboratory test files cover over 40 years. Perhaps even more important, the files include feedback from substantial field experience — in fossil - and nuclear-fueled power plants, refineries, chemical plants, oil fields and in countless other applications. It is hoped that this test and field experience will help others avoid problems and pitfalls in the application and use of check valves.

**Introduction**
This guide has been prepared to aid fluid-system designers in sizing and selecting check valves for industrial and power-piping systems. Guidance is also provided on valve orientation (inclination from horizontal, etc.) and on location of check valves with respect to other flow disturbances. In addition, this guide should aid users in planning preventive maintenance programs, performing maintenance and repairs when necessary, and in evaluating and correcting problems.

Emphasis in this guide is on selection and application of forged- and cast-steel Edward valves products, but comparisons with other types of check valves are given where this can be done based on valid information.

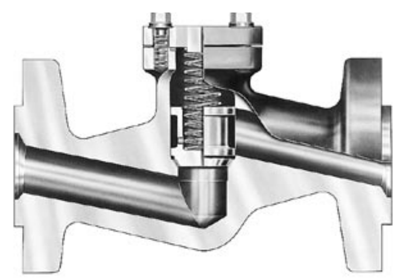
The Flow Performance section of this catalog provides equations and coefficients for the calculation of pressure drop and the flow required to assure full valve opening. In addition, that section provides most of the necessary supplemental data required for routine calculations, such as water and steam density.

This guide also provides caution notes relative to system-related problems to be avoided (such as piping vibration, flow instability, water-hammer). Some of these guidelines are qualitative and could involve further analysis. However, attention to these notes should help to avoid problems.

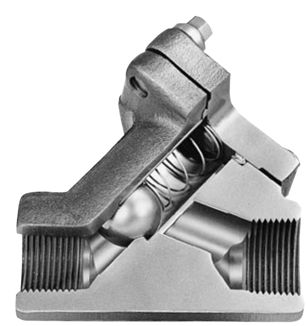
Finally, this guide addresses check valve maintenance. History indicates that preventive maintenance of check valves is often neglected, and this can lead to serious valve failures that may damage other equipment. The guidelines provided on periodic inspection and preventive maintenance should pay off in terms of reduced overall plant maintenance and repair costs.

### 1.2.1 Check Valve Types and Typical Uses

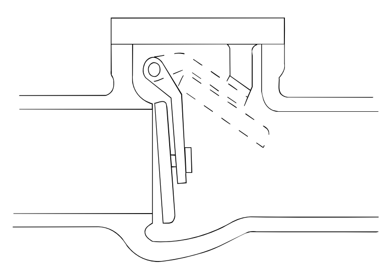
While other types are sometimes encountered in power hydraulics and other specialized applications, four basic types of check valves are commonly used in industrial and power piping applications.



**1-Lift Check Valves**
The closure element is a poppet or disk that is lifted open by flow and which seats, usually on a mating conical surface in the valve body, under no-flow conditions.



**2-Ball Check Valves**
A lift check valve in which the closure element is a ball.





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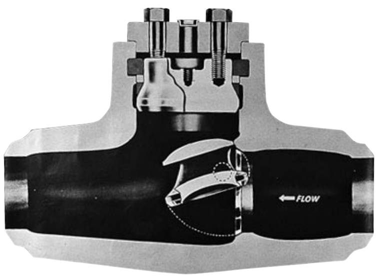
**3-Swing Check Valves**
The closure element is a pivoted flapper, which is swung open by flow and which seats, generally against a mating flat surface in the valve body, under no-flow conditions.

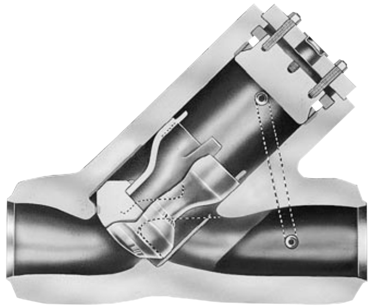



**4-Tilting-Disk Check Valve**
The closure element is a pivoted disk or flapper, somewhat like that in a swing check valve but with a pivot axis close to the center of the flow stream. It is swung open by flow and seats against a mating conical surface in the valve body under no-flow conditions.

There are many variations among these four basic types of check valves. For example, springs may be included to assist closure and counteract gravitational forces, and accessories may be provided for exercising or position indication. All Edward lift check valves employ body-guided disks with a piston-like extension to provide good guidance and resistance to wear. Accordingly, they are referred to in this guide as piston-lift check valves. In addition, Flowserve manufactures Edward stop-check valves, which are piston-lift check valves that allow positive closure for isolation, just like globe stop valves.

Illustrations of the Edward valve types manufactured by Flowserve are provided in this catalog, and brief notes on advantages, disadvantages, applications, and limitations are provided in the Check Valve Applications Chart (section 1.2.2). Some further highlights of the features of these valves are provided in the following paragraphs.

**Edward Piston-Lift Check Valves**
In both small forged-steel and large cast-steel Edward lines, three distinctly different valve body styles appear in the illustrations – inclined-bonnet globe valve style, angle valve style, and 90°-bonnet globe valve style.



With respect to check valve function, these valves are all similar, with only slightly different orientation limits, as discussed in the Valve-Installation Guidelines section (1.3). The main difference between these systems is in flow performance:

• Inclined-bonnet piston-lift check valves produce low pressure drop due to flow, when fully open. They have flow coefficients comparable to those of tilting-disk check valves and only slightly lower than provided by many swing check valves.

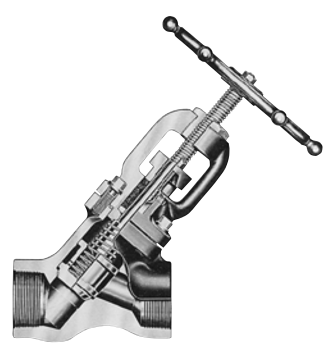
• In most cases, angle piston-lift check valves have lower flow coefficients and, thus, produce more pressure drop than inclined-bonnet valves, but they are superior to 90°-bonnet valves. Where a piping system requires a bend and a valve, use of an angle piston-lift check valve eliminates the cost and pressure drop of an elbow and the cost of associated piping welds or flanged connections.

• 90°-bonnet piston-lift check valves have the lowest flow coefficients and produce pressure drops comparable to 90°-bonnet globe valves. They are sometimes preferred in systems where pressure drop is not critical or where space requirements dictate a minimum size and easy access to a handwheel or actuator (on a stop-check valve).

Piston-lift check valves are generally the most practical type for small sizes, and they generally provide the best seat tightness. Small forged-steel piston-lift check valves normally include a disk-return spring, but may be ordered without springs. The Flow Performance section of this catalog and section 1.3 below address such valves, both with and without springs. Cast-steel piston-lift check valves have equalizer tubes which connect the volume above the piston with a relatively low-pressure region near the valve outlet. This feature allows a much larger valve opening (and higher flow coefficient) than would be possible otherwise, and it allows the valve to open fully at a relatively low flow.

The body-guided feature of Edward piston-lift check valves is an advantage in most services, because it assures good alignment of the disk with the valve seat and minimizes lateral vibration and wear. However, this feature may lead to sticking problems due to foreign-material entrapment in unusually dirty systems. Another inherent characteristic is that large piston-lift check valves may not respond rapidly to flow reversals and may cause water-hammer problems in systems where the flow reverses quickly. [See the Pressure Surge and Water-hammer section (1.4.2)]. Since smaller valves display inherently faster responses, historic files have shown no water-hammer problems with small forged-steel check valves.

**Edward Stop-Check Valves**
Stop-check valves offer the same tight sealing performance as a globe stop valve and at the same time give piston-lift check valve protection in the event of backflow. A stop-check valve is nearly identical to a stop valve, but the valve stem is not connected to the disk. When the stem is in the “open” position, the disk is free to open and close in response to flow, just as in a piston-lift check valve. When serving as a check valve, stop-check valves display the same advantages and disadvantages as discussed above for piston-lift check valves. Small forged-steel stop-check valves, except the Univalve® stop-check valves, employ a disk-return spring, and cast-steel stop-check valves have equalizer tubes that function in the same manner as those on comparable piston-lift check valves.



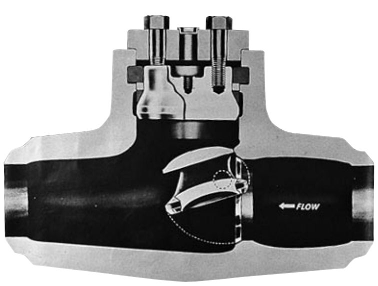
The stem in the stop-check valve may be driven either by a handwheel or an actuator, and it may be used either to (1) prevent flow in the normal direction when necessary for isolation or (2) supplement line pressure to enhance seat tightness in applications with pressure from the downstream side. Some users automate stop-check valves to give extra system protection against reverse flow and leakage. For example, an actuator may be signaled to close the valve when a pump is shut off; the disk closes quickly by normal check valve action, and the stem follows to seat the valve firmly a short time later.

**Edward Ball Check Valves**
Ball check valves are offered only in small forged-steel configurations (size 2 and smaller) with inclined-bonnet bodies and ball-return springs. These valves are recommended over piston check valves, for service with viscous fluids or where there is scale or sediment in the system. The bolted-bonnet versions offer flow performance that is generally similar to that of equivalent piston-lift check valves, and they are the preferred ball check valves for most industrial and power-piping applications.

The threaded-bonnet hydraulic ball check valves are used primarily in very high pressure, low-flow applications with viscous fluids. They have lower flow coefficients that have proven acceptable for those services. These valves sometimes exhibit chattering tendencies when handling water, so they are not recommended for low-viscosity fluids.

A unique feature of the ball check valve is that the ball closure element is free to rotate during operation, allowing the ball and seat to wear relatively evenly. This feature, combined with the standard return spring, helps to promote positive seating even with heavy, viscous fluids.

**Edward Tilting-Disk Check Valves**
Tilting-disk check valves are particularly well suited to applications where rapid response and freedom from sticking are essential. Fully open valves of this type also exhibit low pressure drop. They have flow coefficients comparable to those of Edward inclined-bonnet piston-lift (Flite-Flowwww) check valves and only slightly lower than provided by many swing check valves.

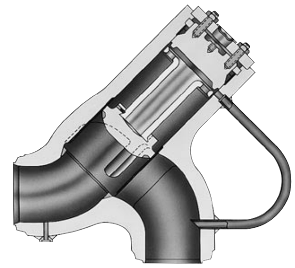



Tilting-disk check valves provide rapid response, because the center of mass of the disk is close to the pivot axis. Just as in a pendulum, this characteristic promotes rapid motion of the disk toward its natural (closed) position whenever the force holding it open is removed. This response can be valuable in applications where relatively rapid flow reversals may occur, such as in pump-discharge service, where multiple pumps discharge into a common manifold. In such cases, the flow may reverse quickly, and the rapid response of the tilting-disk check valve minimizes the magnitude of the reverse velocity and the resulting water-hammer pressure surge. This characteristic also minimizes impact stresses on the disk and body seats. However, an extremely rapid flow reversal, as might be produced by an upstream pipe rupture, could cause a problem. See the Pressure Surge and Water-Hammer section (1.4.2) for further discussion.

Size 6 and larger tilting-disk check valves have totally enclosed torsion springs in their hinge pins to help initiate the closing motion, but the disk is counterweighted to fully close without the springs. With the free pivoting action of the disk, this type of valve is highly immune to sticking due to debris in the system.

Tilting-disk check valves are superficially similar to swing check valves in that both operate on a pivoting-disk principle. However, the pivot axis in a swing check valve is much farther from the disk's center of mass, and this increases the "pendulum period" and, hence, the time required for closure in services with flow reversal. In addition, the one-piece disk in the tilting-disk check valve avoids the necessity of internal fasteners and locking devices, which are required to secure disks to pivot arms in most swing check valves. However, like swing check valves, tilting-disk check valves have hinge pins and bearings that are subject to wear due to disk flutter, if the valve is not fully open and/ or there are flow disturbances or instabilities. Such wear may produce eccentricity of the disk and seat when the valve closes, leading to a degradation of seat tightness (particularly at low differential pressures). Applications involving severely unstable flow or prolonged service without preventive maintenance can lead to failures in which the disk separates completely from the hinge pins and will not close. Other sections of this guide address the flow conditions that may lead to problems, as well as maintenance recommendations.

**Edward Elbow-Down Check and Stop-Check Valves**



Elbow-down piston-lift check and stop-check valves are similar to Flite-Flow valves, except that the valve outlet is in the form of an elbow to direct the flow downward. These valves were designed specifically for applications in controlled-circulation power plants, and they have special clearances and other design features. Because of these special features, the sizing and pressure-drop calculation methods given in the Flow Performance section of this catalog do not apply. However, special elbow-down valves can be furnished with conventional check valve design features for applications where this valve-body geometry is desirable.

**Edward Combinations of Check and Stop-Check Valves**
As noted in the Foreword to this section (1.2), no single type of check valve achieves ideal performance characteristics. The advantages and disadvantages noted in the Check Valve Applications Chart (section 1.2.2) and other information in this catalog should assist in selection of the best valve size and type for any specific application. However, the selection of any single valve may require undesirable compromises.

Some system designers and users specify two check valves in series for critical applications, and this does give some insurance

### 1.2.2 Check Valve Applications Chart

| Type | Advantages | Disadvantages | Applications | Limitations |
|---|---|---|---|---|
| **Piston Lift Check** | • Very low pressure drop in inclined bonnet valves<br>• Relatively low pressure drop in angle valves<br>• Larger valves incorporate an external equalizer<br>• Minimum chatter due to flow disturbances<br>• Good seat tightness<br>• Forged steel valves with spring can be mounted in any orientation | • Relatively high pressure drop in 90° bonnet valves<br>• Subject to “sticking” in very dirty systems | • Class 300-4500 service<br>• High temperature steam and water<br>• Refining, petrochemical, chemical, etc.<br>• Oilfield production<br>• Can be used in series with Tilting Disk Check to provide maximum line protection (advantages of both types). | • Sizes ¼ through **24**<br>• For orientation limits see valve installation guidelines<br>• For flow limits see Flow Performance section of this catalog |
| **Ball Check** | • Wear on body seat and check element evenly distributed<br>• Long service life<br>• Forged steel valves with spring can be mounted in any orientation<br>• Available with either integral or threaded seat for hydraulic valve<br>• Low cost | • High pressure drop<br>• Available only in small sizes | • Class 600 and Series 1500 service<br>• Water, steam, refining, petrochemical, chemical, etc.<br>• Service where scale and sediment exist<br>• Viscous fluids | • Sizes ¼ through **2**<br>• For orientation limits see valve installation guidelines<br>• Not recommended for gas service at low flow rates<br>• For flow limits see Flow Performance section of this catalog |
| **Tilting Disk Check** | • Very low pressure drop<br>• Straight through body design<br>• Very fast closing<br>• Minimizes disk slamming and water-hammer pressure surges<br>• Will not “stick” in dirty systems | • Not recommended for service with rapidly fluctu-ating flow<br>• Seat tightness may dete-riorate at low differential pressure | • Class 600-4500 service<br>• High temperature steam and water<br>• Refining, petrochemical, chemical, etc.<br>• Oilfield production<br>• Can be used in series with Piston Lift check or Stop-Check to provide maximum line protection (advantages of both types) | • Sizes **2½** through **24**<br>• For orientation limits see valve installation guidelines<br>• For flow limits see Flow Performance section of this catalog |
| **Stop Check** | • See Piston Lift Check above<br>• Can be used for Stop valve service<br>• Stem can be lowered onto disk to prevent chatter at low flow<br>• Stem force can overcome “sticking” | • See Piston Lift Check valve above | • See Piston Lift Check valve above | • See Piston Lift Check valve above |



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that at least one valve will close even if the other valve fails. However, if two identical valves are used, a system characteristic that is troublesome to one valve could produce problems with both. In such cases, use of two valves does not assure double safety or double life. Sometimes it is worth considering the selection of two different types of check valves, each with advantages to offset disadvantages of the other.

One specific check valve combination has been used in applications of Flowserve Edward valves to provide advantages that no single valve can offer. A tilting-disk check valve in series with a piston-lift check valve offers minimum water-hammer and freedom from sticking (from the tilting disk) and good seat tightness (from the piston-lift check). The disadvantage is added pressure drop and cost, but the pressure-drop penalty is minor if the Flite-Flow inclined-bonnet piston-lift check valve is used. Even the cost penalty may be offset if a stop-check valve is used, because it may be able to take the place of a stop valve that would be required otherwise for isolation.

## 1.3 Check and Stop-Check Valve Installation Guidelines

Unlike stop valves, which can be installed in any position with little or no effect on performance, most check and stop-check valves have limitations as to their installed orientation. Although the normal installation is in a horizontal or vertical line (depending on valve type), check and stop-check valves can be installed in other orientations. It should be noted, however, that valves installed in other than the normal positions may exhibit a degradation of performance, service life and resistance to sticking, depending on the flow conditions and cleanliness of the line fluid. For maximum reliability, it is recommended that piston-lift check valves and stop-check valves be installed with flow axis horizontal (vertical inlet and horizontal outlet for angle valves) with the bonnet above the valve in a vertical plane. Following are maximum out-of-position orientations that may be used for less critical applications and should never be exceeded.

• All Edward forged-steel check and stop-check valves (except Univalve® stop-check valves) are normally furnished with spring-loaded disks and may be installed in any position. The spring-loaded disk enables positive closure, regardless of valve position.

**Figure 1**
**45° Inclined Bonnet Piston Lift Check Valves**
**Maximum Check Valve Orientation Limits**

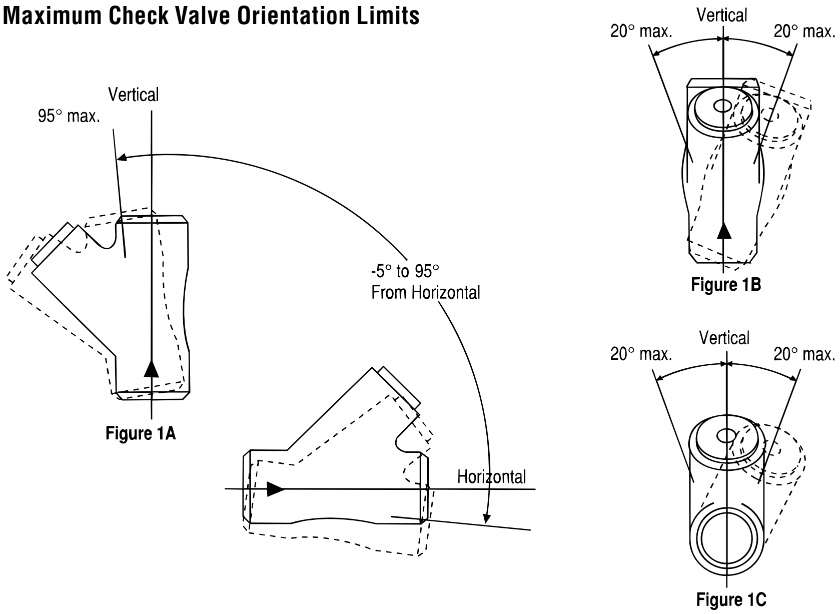
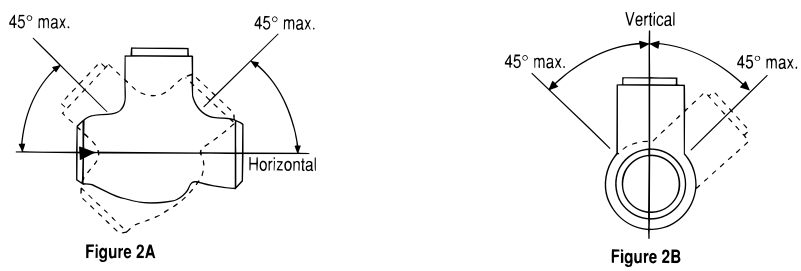



**Figure 2**
**90° Bonnet Piston Lift Check Valves**
**Maximum Valve Orientation Limits**




*Note: For piston lift check valves, any installation resulting in combined out-of-position orientation, such as a valve in an inclined line with a rollover angle as well, should limit the angle of the bonnet to the following:*

• 45° from vertical for angle and 90°bonnet valves.

• 50° from vertical for inclined bonnet valves.

However, installed positions in which dirt or scale can accumulate in the valve neck should be avoided. An example of this would be an inclined-bonnet valve installed in a vertical pipeline with downward flow. If forged-steel valves are ordered without springs, the limitations below should be observed.

• Edward cast-steel Flite-Flow®, forged-steel Univalve, and inclined-bonnet check and stop-check valves without springs, when installed in vertical or near vertical lines, should be oriented such that the fluid flow is upward and the angle of incline of the line is not more than 5° past the vertical in the direction of the bonnet. When installed in horizontal or near horizontal lines, the valve bonnet should be up and the angle of incline of the line should be no more than 5° below the horizontal. See Figure 1A. Also, the roll angle of the valve bonnet should not be more than 20° from side to side for either vertical or horizontal installations. See Figures

**Figure 3**
**Angle Piston Lift Check Valves Orientation Limits**

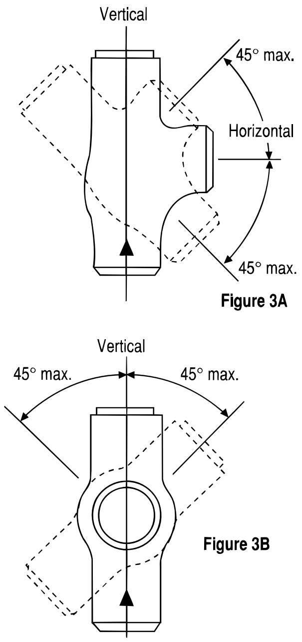
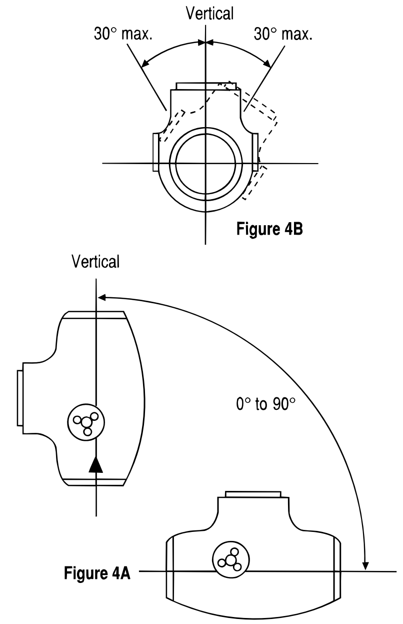



**Figure 4**
**Tilting Disk Check Valves Orientation Limits**




1B and 1C. Consult your Flowserve Edward valves representative concerning installation limits of bolted-bonnet forged-steel check valves without springs.

- Edward cast-steel and forge-steel 90°-bonnet check and stop-check valves without springs should be installed with the bonnet up, and the angle of incline of the line should not be more than 45° form the horizontal. Also, the roll angle of the valve bonnet should not be more than 45° from side to side. See Figures 2A and 2B.
- Edward cast-steel and forged-steel angle check and stop-check valves without springs should be oriented such that the incoming flow is upward, and the angle of incline of the line should not be more than 45° in either direction. See Figure 3A and 3B.
- Edward tilting-disk check valves may be installed in horizontal lines and vertical lines and at any incline angle in between. When the incline angle is not horizontal, flow should always be up. The roll angle of the valve should not be more than 30° from side to side. See Figures 4A and 4B. Also, when installed in other than vertical lines, the bonnet should always be oriented up.

**Figure 5**
**Pipe fittings near valves may produce instability because of velocity profile distortion**

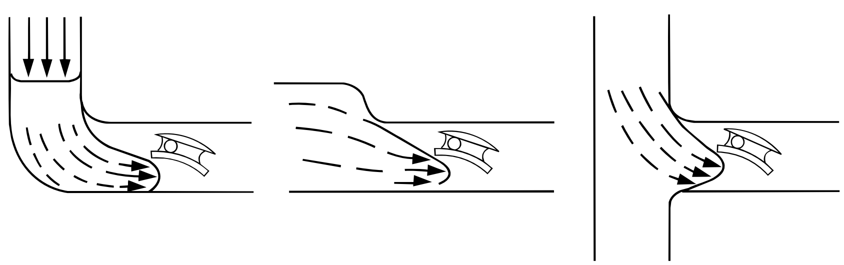
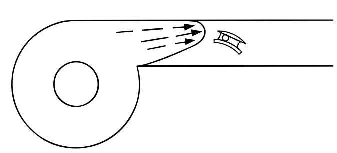


**Figure 6**
**Non-uniform velocity profile at blower or pump discharge can affect stability.**

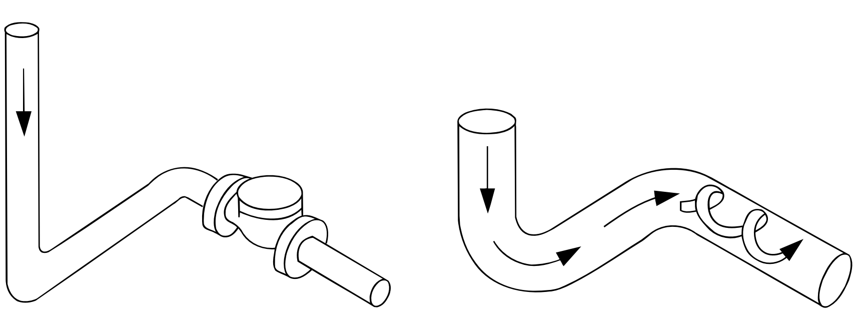


In each case described above, the limitations given for line inclination and bonnet roll angle should not be combined.

It should be understood that the information given in the section of this catalog entitled Flow Performance is based on traditional horizontal orientations. For other orientations, the pressure drop and flow required for full lift may be affected. In addition, seat tightness, particularly at low differential pressures, may be adversely affected.

Orientation restrictions may also exist for power-actuated stop-check valves. Most linear valve actuators are designed to be mounted upright and nearly vertical, although they can usually be modified for mounting in any position. When selecting a stop-check valve and power actuator, be sure to specify the mounting position desired if not vertical and upright.

**Figure 7**
**Elbows in two places cause swirl that can promote instability.**



### 1.3.1 Adjacent Flow Disturbances

Check valves, like other valve types, are generally tested for performance and flow capacity in long, straight-pipe runs. Flow coefficients obtained from these tests are then used to predict the flow rate or pressure drop that will be experienced in actual applications. The ideal installation of a check valve in a plant would be in a long run of straight pipe, so that performance would correspond to the test conditions. Since space limitations involved with many installations preclude such ideal straight-pipe runs, the effects of adjacent pipe fittings, control valves, pumps and other flow disturbances must be considered.

Previously published data have indicated that flow disturbances, particularly upstream disturbances, may significantly affect check valve performance. It has been reported that valve flow capacity may be significantly reduced as compared to that measured in straight-pipe tests; and there have been strong suggestions that such disturbances aggravate check valve flutter and vibration. Since these conditions could degrade valve performance and contribute to rapid wear and premature valve failure, they are important factors in evaluating check valve applications. Figure 5 illustrates how upstream pipe fittings may alter the flow profile entering a check valve, crowding it to one side or the other. A similar distortion occurs in a valve located near the discharge of a centrifugal pump or blower, as shown in Figure 6. Elbows in two planes cause a flow stream to swirl, which might produce unusual effects on a check valve installed, as shown in Figure 7.

Since there was no known way to predict the effects of flow disturbances on check valves by mathematical models, Flowserve conducted extensive testing of sizes 2, 4, 8 and 10 check valves in straight-pipe runs and in piping with upstream flow disturbances. Figures 8 and 9 illustrate typical flow-test setups.

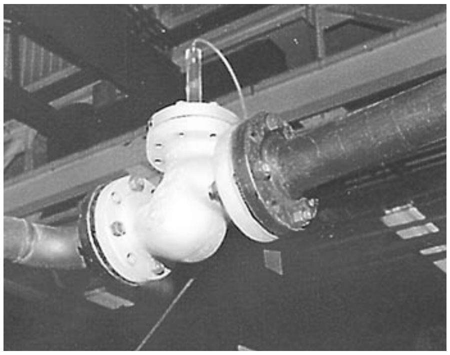


**Figure 8**
Size 4 Class 600 90°-bonnet piston-lift check valve with two upstream elbows (out of plane). This arrangement produces swirl, as shown in Figure 7.

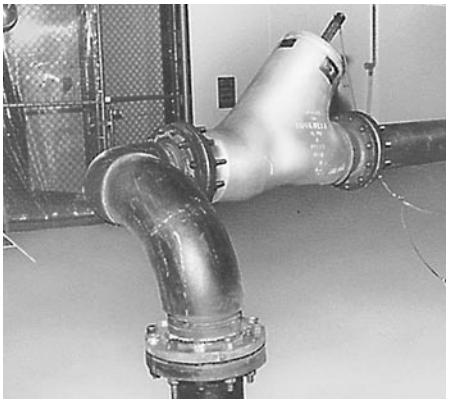


**Figure 9**
Size 10 Class 1500 Flite-Flow® inclined bonnet piston lift check valve with two upstream elbows. Test loop capacity permitted tests with line velocity over 20 ft/s (6 m/s).

In most tests, room temperature water was the flow medium, but limited straight-pipe testing was performed with air. The valves tested included Edward piston-lift check valves (inclined-bonnet, angle and 90°-bonnet), tilting-disk check valves and a size-4 swing check valve manufactured by another company. The tests were designed to evaluate the effects of flow disturbances on (1) valve stability, particularly when partially open; (2) flow rate required to open the valve fully; and (3) the flow coefficient ($C_V$) of the valve. The flow disturbances evaluated included single and double (out of plane) 90° elbows in various orientations immediately upstream of the check valves. In addition, the effects of a throttled, upstream control valve were simulated with an offset-disk butterfly valve (at various throttle positions) mounted immediately upstream, as well as at 5 and 11 pipe diameters upstream of the check valves.

With few exceptions, tests with 10 or more diameters of straight pipe upstream of check valves produced little cause for concern. In water-flow tests, visual position indicators usually showed only minor disk "wobble" or very small open-close flutter (e.g. less than 1° total rotation of a tilting disk), even at very low flows and small valve openings. The only conditions that produced severe instability were those involving air flow at very low pressures (below 50 psi or 3.4 bar) and valve openings less than 20%. Such conditions produced significant cyclic motion, with disks bouncing on and off the body seats. In view or the many uncertainties in applying laboratory test results to service conditions, it is considered prudent to avoid operating conditions which produce check valve openings of less than 25%, even in ideal straight-pipe applications.

Highlights of the results of the Flowserve tests with flow disturbances are given in Table A on page 131. The test program clearly showed that upstream flow disturbances do affect check valve performance, but the effect is not always predictable. The magnitude of the effect can vary, depending on the type and even the size of the valve. In some cases, even the direction of the effect (improvement or degradation) varies from valve to valve. Nevertheless, some general observations on the results of these tests are:

- Single and double upstream elbows produced less severe effects on check valve performance than had been expected, and some valves displayed no discernible effects. For example, Edward angle piston-lift check valves exhibited the same stability, lift and flow coefficients ($C_V$) with upstream elbows as with straight pipe. In tests of other types of valves, upstream elbows produced both beneficial and adverse effects to various degrees.

- In each case where a check valve was tested with a throttled butterfly valve immediately upstream, there were significant effects on performance. The effects included increased disk flutter and reduced valve opening at a given flow, as compared to straight-pipe performance. In some cases, full check valve opening could not be achieved at any flow within the capabilities of the test loop.

Even where full opening was obtained, some valves continued to flutter on and off their stops. These effects were worst when the butterfly valve was most severely throttled (smallest opening and highest pressure drop). In the worst cases, the butterfly valve exhibited audible cavitation, but it is not clear whether the adverse effects resulted from simple flow distortion or the two-phase flow stream from the cavitating butterfly valve.

In similar tests with the butterfly valve moved 5 diameters upstream of the check valve (but with similar throttling), the adverse performance effects were decreased significantly but not eliminated. When the butterfly valve was moved 11 diameters upstream of the check valve, normal check valve performance was restored.

The results of these tests were enlightening, but they must be combined with observations based on field experience. For example, while upstream elbows produced less severe effects than expected, there were still adverse effects on some valves. It is difficult to extrapolate a laboratory test to years of service in a plant installation, but Flowserve service files include an interesting and relevant incident. Two size-12 tilting-disk check valves in one plant had hinge-pin failures over a time period of several months after 25 years of service. While this incident might best be cited as a case for more inspection and preventive maintenance, the details of the installation were investigated. It was determined that the flow rates were in a range that should have assured full disk opening, but the valves were installed close to upstream elbows.

Users of this catalog may wish to refer to EPRI Report No. NP 5479 for further data on the performance of swing check valves in tests similar to those conducted by Flowserve. (See the Sources for Additional Information section of this catalog). The size-4 swing check valve used in the Flowserve test program had a stop positioned to restrict the disk-opening angle to about 38°. This valve opened fully at a relatively low flow and exhibited reasonably stable performance. The tests sponsored by EPRI showed that other swing check valves (with less restrictive stops) exhibited larger amplitudes of flutter than were observed in comparable Flowserve tests.

The following guidelines are based on Flowserve tests and field experience, combined with other published information:

• If possible, check valves near flow disturbances should be sized to be fully open, preferably by a good margin, even at the lowest sustained flow rate anticipated for each application. The Flow Performance section of this catalog provides methods for sizing Edward check valves for new installations or for evaluating existing applications. When flow-induced forces load a valve closure element firmly against a stop, it is less likely to flutter and suffer from rapid wear.

Full opening does not guarantee freedom from problems, if the margin is not sufficient to provide a firm load against the stop. Equalizers on Edward cast-steel piston-lift check and stop-check valves enhance this margin and provide good stop loading, but flow disturbances may cause other valve disks to bounce on and off their stops. This “tapping” phenomenon may cause faster wear than flutter about a partially open position. For this reason, the minimum sustained flow rate through a tilting-disk check valve near flow disturbances should be about 20% greater than the flow rate required to merely achieve full opening.

If it is not possible to ensure full opening of a check valve at minimum flow conditions,

**Table A – Effects of Upstream Flow Disturbances on Check Valve Performance**

| Valve Size and Type | Single Elbow at Valve Inlet[1] | Double Elbows (Out of Plane) at Valve Inlet | Throttled Butterfly Valve | | |
|---|---|---|---|---|---|
| | | | At Valve Inlet | 5 Diam. Upstream | 11 Diam. Upstream |
| Size 2, Inclined-Bonnet, Piston-Lift Check | Higher Lift for Same Flow; Disk Flutter at Lower Lifts[2] | Higher Lift for Same Flow | NA | NA | NA |
| Size 4, Angle, Piston-Lift Check | No Effect | No Effect | NA | NA | NA |
| Size 4, 90°-Bonnet, Piston-Lift Check | Same, Lower or Higher Flow for Full Lift | No Effect | Disk Flutter and Chatter: Failure to Achieve Full Open | NA | NA |
| Size 4, Swing Check | Smaller Opening for Same Flow | Smaller Opening for Same Flow | Larger Opening for Same Flow; Disk Flutter | NA | NA |
| Size 8, Angle, Piston-Lift Check | No Effect | NA | NA | NA | NA |
| Size 8, 90°-Bonnet, Piston-Lift Check | Disk Flutter at Partial Lift | NA | NA | NA | NA |
| Size 10, Inclined-Bonnet, Piston-Lift Check | Same or Lower Lift for Same Flow; Slight Disk Wobble | No Effect | Failure to Achieve Full Open; Disk Flutter and Chatter | Failure to Achieve Full Open | No Effect |
| Size 10, Tilting-Disk Check | No Effect | Minor Flutter | Same, Lower or Higher Lift for Same Flow; Disk Flutter and Chatter | Minor Flutter | No Effect |

*1: Tests were conducted with single, 90° elbows in the horizontal plane and in the vertical plane (with flow both from above and below).*
*2: One size-2 valve exhibited flutter at lower lifts; another was stable.*

at least 25% opening should be ensured. Valves operating at partial opening for significant periods of time should be monitored regularly to determine if there is instability or wear.

• In view of uncertainties associated with long-term effects of flow disturbances, it is recommended that a minimum of 10 diameters of straight pipe be provided between the inlet of a check valve and any upstream flow disturbance (fittings, pumps, control valves, etc.), particularly if calculations indicate that the check valve will not be fully open for a substantial portion of the valve service life. There should be a minimum of 1 to 2 diameters of pipe between the check valve and the nearest downstream flow disturbance.

• In the specific case of upstream elbows, reasonably successful performance should be attainable with 5 diameters of straight pipe between an upstream elbow and a check valve, if the valve will not be partially open for a significant portion of its service life. Tests described in EPRI Report No. NP 5479 indicate that elbows installed 5 diameters or more upstream had a negligible effect on swing check valves, and this is expected to be true for other check valve types. Even less straight pipe may be satisfactory, but such close spacing should be reserved for applications with very tight space constraints. More frequent inspection and preventive maintenance should be planned for valves in such installations.

• In the specific case of throttled upstream control valves, the minimum requirement of 10 upstream pipe diameters should be adhered to rigidly. Calculations indicating full valve opening based on straight-pipe tests cannot be trusted to prevent problems, because severe flow disturbances may prevent full opening. Even greater lengths of straight pipe should be considered if the control valve operates with very high pressure drop or significant cavitation.

• Users with existing check valve installations that do not meet these guidelines should plan more frequent inspection and preventive maintenance for such valves. If a check valve is installed close to an upstream control valve that operates with a high pressure drop, considerations should be given to a change in piping or valve arrangements.

### 1.3.2 Other Problem Sources

In addition to the fundamentals of check valve selection, sizing and installation, several other potential sources of check valve problems should be considered in applications engineering or, if necessary, in solving problems with existing installations:

**• Piping-System Vibration**
In other sections of this guide, it has been noted that check valve damage or performance problems may result from flow-induced flutter or vibration of the closure element. Very similar damage may result from piping-system vibration. Such vibration may originate at pumps, cavitating control valves or other equipment. Check and stop-check valves are susceptible to vibration damage, because the check element is "free floating" when partially open, with only the forces due to fluid flow to balance the moving weight. Impact damage and internal wear may result if the valve body vibrates while internal parts attempt to remain stationary. This condition may be avoided by adequately supporting the piping system near the check valve or by damping vibration at its source. Of course, it is helpful to assure that the check element opens fully, because flow forces at the disk-stop help to inhibit relative motion.

**• Debris in Line Fluid**
Debris in the flow stream can cause damage and performance problems in check and stop-check valves. Debris entrapped between the disk and seat may prevent full closure and lead directly to seat leakage. If hard particles or chips are in the debris, they may damage the seating surfaces and contribute to seat leakage even after they are flushed away. Debris caught between the disk and the body bore of a piston-lift check valve can cause the disk to jam and prevent full opening or closing. To ensure best check valve performance and seat tightness, line fluids should be kept as clean as practical. As noted before, tilting-disk check valves are particularly resistant to sticking or jamming, but they are no more resistant to seat damage than other types.

**• Unsteady (Pulsating) Flow**
An unsteady flow rate can lead to rapid check valve damage, particularly if the minimum flow during a cycle is not sufficient to hold the valve fully open. The valve may be damaged just because it does what a check valve is designed to do – open and close in response to changes in flow. As an example, a check valve installed too close to the outlet of a positive displacement pump may attempt to respond to the discharge of each cylinder. If the mean flow during a cycle is low, the disk may bounce off the seat repeatedly in a chattering action. If the mean flow is higher, the disk may bounce on and off the full-open stop. Such pulsating flows may be difficult to predict. For example, a steam leak past the seat of an upstream stop valve may produce a "percolating" action in a line filled with condensate and cause a check valve to cycle. Such problems may only be discovered by preventive maintenance inspections.

**• Vapor Pockets in Liquid Piping Systems**
Unusual phenomena are sometimes observed in piping systems containing hot water that partially vaporizes downstream of a closed check valve. Vapor pockets at high points may collapse suddenly when the check valve opens (due to the start-up of a pump, for example). This collapse may be remote from the check valve and have no effect on the check valve performance. However, if a vapor pocket exists in the upper part of a piston-lift check or stop-check valve body (above the disk), the collapse may generate unbalanced forces in the direction of disk opening. Since the vapor offers little fluid resistance, rapid acceleration of the disk toward the fully open position may occur. In extreme cases, the disk or bonnet stops may be damaged due to impact. Such thermodynamic quirks are difficult to anticipate when designing a piping system and are sometimes as difficult to diagnose if they occur in an existing installation. Changes in piping arrangements or operating procedures may be necessary if severe problems occur. It is possible that similar problems may occur during low-pressure start-up operations in unvented liquid-piping systems.

## *1.4 Check Valve Performance*

### 1.4.1 Check Valve Seat Tightness

Edward check valves are factory-tested with water in accordance with MSS SP-61 (Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.) at an overseat pressure of 1.1 times the pressure ratings of the valve. While check valves are allowed leakage rates up to 40 ml/hr per unit of nominal valve size by MSS SP-61, Flowserve allows no more than 5% of this leakage for cast-steel valves and no visible leakage for forged-steel valves. Tilting-disk and forged-steel check valves are then tested again at a reduced pressure with allowable leakage rates that are less than the MSS SP-61 requirements.

Closed check valve closure elements (disk, ball, flapper, etc.) are acted on by a combination of forces produced by gravity, springs (where applicable) and reversed differential pressure. While gravity and spring forces help to position the closure element into the substantially closed position, metal-to-metal seating check valves typically rely on pressure forces to produce the seating loads necessary for good seat tightness.

Some metal-seated check valves do not produce good seat tightness at low differential pressures, particularly when the pressure increases from zero. A threshold level of differential pressure is required to produce uniform metal-to-metal contact and restrict leakage to a reasonable rate. An even higher level is required to ensure that a valve meets leakage-rate criteria like those in MSS SP-61. Unfortunately, these levels of differential pressure are difficult to predict; they vary with valve type, condition and orientation (and with cleanliness of line fluid).

Tests of new valves in horizontal lines show that cast-steel inclined-bonnet and 90°-bonnet piston-lift check and tilting-disk check valves seal off reasonably well at under 50 psi (3.4 bar) when differential pressure increases from zero. Small forged-steel ball and piston-lift check valves are less consistent, sometimes seating at less than 50 psi (3.4 bar) and sometimes requiring 250 psi (17 bar) or more. This "seating" action often occurs suddenly when the pressure forces shift the closure element into good metal-to-metal contact with the body seat, and leakage generally continues to decrease as the pressure is increased. Once seated, most valves seal well if pressure is reduced below the threshold required for initial seating, but the seat tightness with reducing pressure is also difficult to predict.

Some of the Edward check valves described in this catalog have been manufactured with "soft seats" to provide improved seat tightness at low differential pressures. This design feature includes an elastomeric or plastic sealing member on the valve closure element to supplement the basic metal-to-metal seating function. Since the design and material selection for these sealing members are very sensitive to pressure, temperature and compatibility with the line fluid, there are no standard, general-purpose, soft-seated valves. Consult Flowserve for further information about specific applications.

Foreign material in the flow medium is a major source of leakage problems in many valves. Because of the limited seating forces in check valves, dirt has a far greater effect on the tightness of these valves than other types. Attention to cleanliness of the fluid is necessary where good check valve seat tightness is desired.

Incorrect sizing or misapplication of a check valve can also lead to leakage problems. Chattering of the closure element on its seat, due to insufficient flow or pressure, can cause damage to the seat or closure element and result in leakage.

In applications where check valve leakage is a problem, a stop-check valve may offer the solution. Stem load from a handwheel or actuator can provide the necessary seating force independent of pressure. Of course, the stem must be returned to the "open" position to allow flow in the normal direction. Consult Flowserve about applications that are usually sensitive to leakage.

A complete treatment of the subject of pressure surge and water-hammer is beyond the scope of this catalog, but some discussion is provided so that application engineers may appreciate the significance of the problem, as it relates to check valves.

### 1.4.2 Pressure Surge and Water-hammer

One part of the problem is that the terminology or jargon is not consistent. For example, "water-hammer" or "steam hammer" is sometimes used to describe the implosion which occurs when water enters a hot, low pressure region and causes a steam void to collapse. This has occurred in systems with a failed check valve, where the water came back from a large reverse flow through the check valve. However, the more common "water-hammer" problem associated with check valves occurs as a result of the check valve closing and suddenly terminating a significant reversed-flow velocity. This problem is generally associated with valves handling water or other liquids. A similar pressure-surge phenomenon may be encountered with steam or gas, but it is generally much less serious with a compressible flow medium.

Water-hammer is a pressure surge produced by the deceleration of a liquid column, and it involves pressure waves that travel at close to the velocity of sound through the fluid. It is commonly illustrated in texts by an example involving rapid closure or a valve in a long pipe. For such a case, it can be shown that instantaneous closure of a valve in a room-temperature water line will produce an increase in pressure of about 50 psi (3.4 bar) above the steady-state pressure for every 1 ft/sec (0.30 m/sec) decrease in water velocity. Even if the valve does not close instantaneously, the same pressure increase would develop if the upstream pipe is long enough to prevent reflected pressure waves from reaching the valve before it closes. The waves of increasing pressure that are generated by the closing valve "reflect" from a constant-pressure reservoir or vessel, if present in the system, and return to the valve as inverted waves that decrease pressure. A solution to the "textbook problem" is to slow down the valve closure, so that the reflected pressure waves attenuate the surge. However, this is not necessarily the best approach in the case of a check valve.

In a check valve, the fluid velocity is forward before the valve starts to close, but it reduces due to some system action (e.g., a pump is shut off). If the velocity reverses before the valve closes, a water-hammer surge will be produced by a conventional check valve that is nearly proportional to the magnitude of the maximum reversed velocity. Figure 10 provides curves illustrating flow transients associated with different types of systems and flow interruptions. The graphs illustrate velocity in the pipe, forward and reverse, versus time on arbitrary scales. The following discussions describe each of the curves:

- **Curve A** illustrates flow coast down in a simple circulating loop, such as a cooling system, following switch-off of pump power. The momentum of the pump impeller and the fluid keeps the fluid going forward until it is decelerated and finally stopped by friction. There would be no need for a check valve to prevent reverse flow in this system, but one might be included to permit pump maintenance without draining other equipment. During normal operation of this system, the check valve could produce no water-hammer.

- **Curve B** illustrates an application with a pump feeding a high-pressure system with a fairly large volume. It might represent a boiler feed system of a pump feeding a high reservoir. In this case, assuming similar momentum in the pump and fluid, forward flow continues for a while after the pump is switched off, but the downstream pressure decelerates the flow more rapidly and then reverses its direction. Without a check valve, the reverse flow would increase and stabilize at some value, unless the downstream system pressure declined. In the illustration, the magnitude of the maximum reverse velocity is drawn less than the initial forward velocity, but it might be higher in some systems.

**Figure 10 - Flow Reversal Transients**

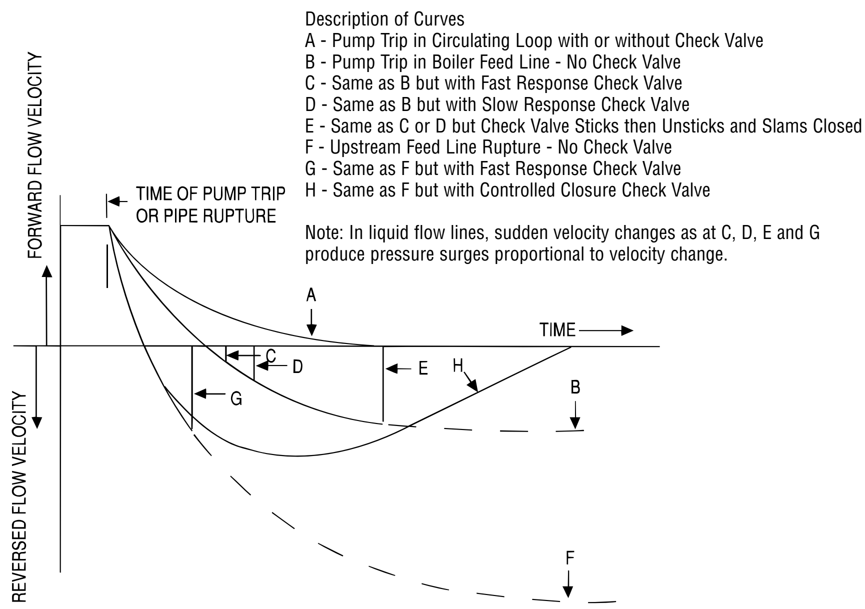
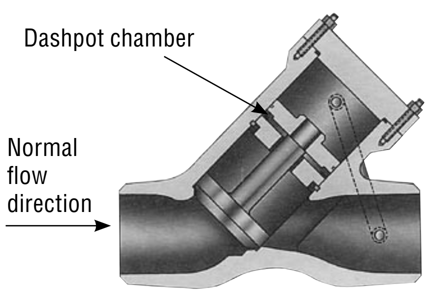



**Figure 11 - Controlled Closure Check Valve (CCCV)**




• **Curve C** illustrates what would happen in the system described for Curve B with a fast-response check valve (e.g., a tilting-disk type) installed. As discussed in the Foreword to this guide, an “ideal” check valve would allow no reverse flow and would close exactly at the time the velocity curve passes through zero; there would be no water-hammer. A “real” check valve starts closing while the flow is still forward, but it lags the velocity curve. With fast response, it closes before a high reverse velocity develops, thus minimizing the water-hammer surge.

• **Curve D** illustrates the same system with a check valve that responds just a bit slower. It shows that even a small increase in check valve lag may allow a large increase in reverse velocity (and a corresponding increase in water-hammer surge pressure).

• **Curve E** illustrates an accidental situation that might develop with a severely worn valve or a dirty system. If a check valve in the system described above should stick open, it might allow the reverse velocity to build up to approach that which would occur without a check valve. If the reverse flow forces should then overcome the forces that caused the sticking, the resulting valve stem could cause a damaging water-hammer surge.

• **Curve F** illustrates what might happen in the system described for Curve B, if there were a major pipe rupture just upstream of the check valve. With free discharge through the open end, the flow would decelerate much more rapidly and, without a check valve, reach a much higher reverse velocity.

• **Curve G** shows the response of the system in Curve F if even a fast-response conventional check valve were to be used. With a flow deceleration this rapid, even a small lag may result in a very high reverse velocity to be arrested and a correspondingly high water-hammer surge.

Fortunately, it is not necessary to design every piping system with a check valve to cope with a pipe rupture. However, this requirement has emerged in some power-plant feedwater piping systems. Flowserve analyses and tests have shown that even the most rapidly-responding conventional check valve could produce unacceptable water-hammer surges. This led to the development of the special controlled-closure check valve (CCCV–see Figure 11). Since high reverse velocities are inevitable, the CCCV solves the problem the way the “textbook problem” discussed above is solved–by closing slowly. The CCCV is a piston-lift check valve, but it has an internal dashpot which slows the closing speed of the valve. Closing speed depends on the rate at which water is squeezed out of the dashpot chamber, through flow paths that are sized for each application.

• **Curve H** illustrates the velocity variation in the pipe-rupture situation described for Curve F, but with a CCCV in the line. In this case, the maximum reverse velocity might even be higher than in Curve G, but it is decelerated back to zero slowly, allowing reflected reducing-pressure waves to minimize the resulting water-hammer surge. Figure 12 provides a comparison between a conventional check valve and a CCCV for a specific pipe-rupture situation. Note that the conventional check valve closes in 0.07 seconds, as compared to 1.0 seconds for CCCV. As a result, the conventional check valve produced a surge of 3000 psi (207 bar), while the CCCV limits the surge to 600 psi (41 bar). These characteristics have been demonstrated in tests and can be duplicated in computer-based dynamic analysis simulations of specific valves and systems.

While the CCCV solves a special problem, even this sophisticated product does not fulfill the definition of an ideal check valve. By closing slowly, it allows significant reverse blow before it seats. This characteristic might be undesirable in common pump-discharge applications, because the reverse flow might have adverse effects on pumps or other equipment. Studies of systems designs sometimes show that fast-response check valves, such as the tilting-disk type, should be retained at pump discharge points where an upstream pipe rupture is unlikely, with CCCVs applied at locations where an upstream pipe rupture could cause serious consequences (e.g., in feedwater lines inside the containment vessel of a nuclear power plant).

In Curves C, D, E and G of Figure 10, it may be noted that the final terminations of reverse velocity are shown as substantially vertical lines. This does not imply that the valve closes instantaneously. However, tests of

**Figure 12 - Example Comparison of Closure Time and Surge Pressure Conventional vs. Controlled Closure Check Valves**

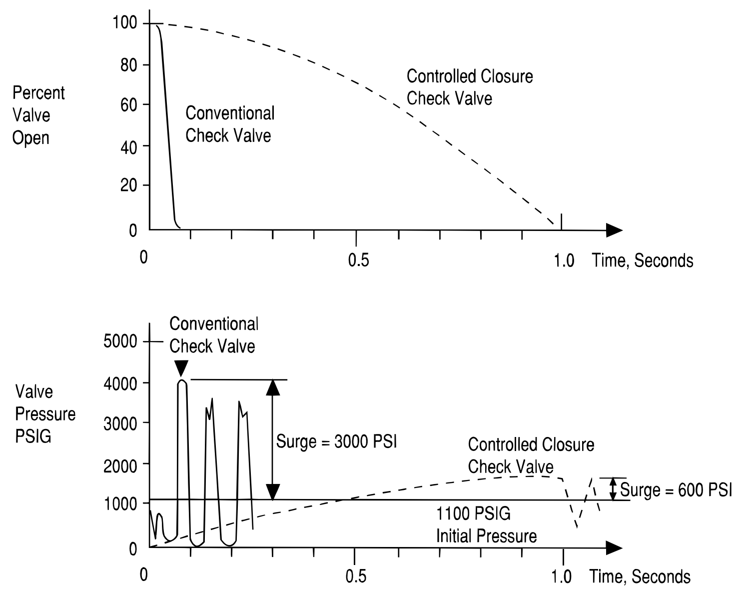
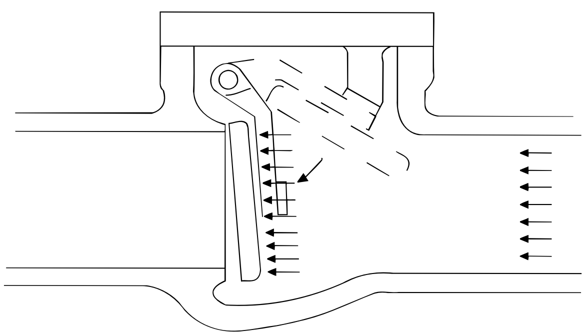



**Figure 13 - Reverse Flow in Conventional Swing Check Valve - Just Before Closing**



conventional check valves show that the reverse velocity in the pipe containing the valve does terminate almost instantaneously. This apparent contradiction may be understood by referring to Figure 13, which illustrates a check valve approaching the closed position with reverse flow (while the illustration depicts a swing check valve, the flow condition discussed here would be much the same with a poppet or disk in a conventional lift check or piston-lift check valve).

The key observation from Figure 13 is that a column of fluid follows the closure element at roughly the same velocity that the closure element has as it approaches its seating surface in the valve body. While the valve may start to close while the flow velocity is still forward (see Figure 10), an undamped check valve has little effect on pipe flow during closure, and the disk velocity is about the same as the reverse flow velocity in the pipe at the instant just before closure. Since the disk is stopped substantially instantaneously when it makes metal-to-metal contact with the body seat, the reverse flow velocity in the pipe must also be arrested instantaneously. Because of this characteristic, the surge produced by the slam of a conventional check valve cannot be attenuated significantly by reflected reducing-pressure waves, and the surge tends to be relatively insensitive to system pipe lengths.

In some check valve applications, problems have been observed due to a phenomenon that is related to water-hammer, but not as widely recognized. When a high-pressure wave is produced on the downstream side of a check valve at closure, a reverse low-pressure wave is produced on the upstream side. If this low-pressure wave reduces the fluid pressure below the saturation pressure of the fluid, a vapor pocket can form. This can be compared to a tensile failure of the flow stream, and it is sometimes referred to as column separation or column rupture. This vapor pocket is unstable and will collapse quickly, with an implosion that produces a high-pressure “spike.” It is possible for this pressure surge to exceed the one initially produced on the downstream of the check valve. Instrumented laboratory tests have shown that the upstream pressure spike sometimes causes the disk to reopen slightly and “bounce” off its seat once or twice. In very rare occasions, sometimes involving systems with multiple check valves, this characteristic has been known to amplify, leading to damaging pipe vibrations.

In summary, water-hammer can produce complex problems in check valve applications. Numerical solutions to these problems require sophisticated computer-based dynamic analyses of both the check valve and the fluid in the piping system. This catalog does not provide the methods for making such analyses; instead, the information in this section is intended to assist fluid-system designers in avoiding the problem.

Users, who already have check valves in liquid flow lines that emit loud “slams” when they close, should be aware that the noise is probably associated with pressure surges that could lead to fatigue problems in the valve, piping or other components. Where the existing check valve is a piston-lift check or stop-check valve, the solution could be to add a tilting-disk check valve in series with the existing check valve to gain the advantages of both valve types. Where the existing valve is a swing check valve, replacement by a tilting-disk check valve might be considered. See the section of this catalog entitled Check Valve Types and Typical Uses (1.2.1) for a discussion of the strengths and weaknesses of the various valve types.

### 1.4.3 Check Valve Accessories and Special Features

Edward Check valves can be provided with various accessories which are used to induce check-element motion (exercise) or indicate check-element position. Some of the features available are as follows:

- Visual disk-position indicator for tilting-disk check valve
- Electrical open/close position indicator for tilting-disk or cast-steel piston-lift check valve
- Manual or pneumatic actuator to partially open tilting-disk check valve under zero differential pressure
- CCCVs can be furnished with an injection port which allows the valve disk to be exercised by injecting water into the dashpot chamber when the valve is under a zero differential pressure.

### 1.4.4 Check/Stop-Check Valve Periodic Inspection and Preventive Maintenance

Periodic inspection and preventive maintenance of check and stop-check valves should be performed to ensure that the valves are operating properly. Bonnet-joint leakage and packing leakage on stop-check valves are easy to detect. Seat leakage of a check or stop-check valve might be indicated by one of the following: a definite pressure loss on the high-pressure side of the valve; continued flow through an inspection drain on the low-pressure side; or, in hot water or steam lines, a downstream pipe that remains hot beyond the usual length of time after valve closure. Leakage of steam through a valve which is badly steam cut has a whistling or sonorous sound. If the valve is only slightly steam cut, however, leakage is identified by subdued gurgling or weak popping sounds. These sounds can often be heard through a stethoscope.

Excessive vibration, noise or humming coming from within a piston-lift check or stop-check valve indicates the possibility that the disk-piston assembly is wedged inside the body. Such sticking may be caused by uneven body-guide rib wear on the downstream side. Sticking rarely occurs with tilting-disk check valves.

“Tapping,” “thumping” or “rattling” noises detected from or near a check valve may indicate disk instability or cavitation. Instability could lead to rapid wear and possible valve failure. Audible cavitation is also detrimental. It may produce damage to the valve or the downstream piping. While the noise symptoms may be transmitted through the pipe from other equipment, prompt investigation is required if the check valve’s performance is critical to plant reliability.

No specific inspection/preventive maintenance schedule can be given to cover all check valves. It is suggested that small valves be sampled by size and type (there may be hundreds in a large installation). Schedules for audit of larger valves should consider the criticality of the valve service. It is wise to open some critical valves for internal inspection at intervals, even if no suspicious noises are detected.

Where check valves are installed close to pumps, control valves, pipe fittings or other flow disturbances, they should have more frequent inspection. [See the section of this catalog entitled Adjacent Flow Disturbances (1.3.1)]. In addition, attention should be given to valves in installations with significant pipe vibration.

Users of this guide may wish to consider non-intrusive check valve monitoring methods as a supplement to periodic visual inspection and measurement of check valve internals. Noise and vibration, acoustic emission, ultrasonic and radiographic methods have been studied and demonstrated. EPRI Report No. NP 5479 provides an evaluation of the state of the art, but users are advised to obtain the most current information available on these emerging technologies.

If problems are found through any of the inspections discussed above, refer to section J: Maintenance.



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# 2. Flow Performance

## 2.1 Choose the Best Valve Size for Your Service Conditions

The most economical valve is the valve correctly sized for the service flow conditions. Too small a valve will have a high pressure drop and will incur expensive energy costs in service. Too large a valve wastes money at the time of purchase, and it may require excessive effort or an excessively large and expensive actuator for operation.

Piping-system designers sometimes optimize the size of valves and piping systems to minimize the sum of investment costs and the present value of pumping power costs. While this may not be practical for selection of every valve, it is a goal that should be kept in mind. This catalog provides information necessary to evaluate the various types and sizes of Edward valves for stop (isolation), stop-check and check valve applications.

In the case of stop-check and check valves, another consideration is that an oversized valve may not open completely. Obviously, if a valve is not fully open, the pressure drop will be increased. Also, if the disk operates too close to the seat, unsteady flow may cause flutter that may damage valve seats, disks or guides.

System designers should also address "turndown" if service conditions involve a broad range of flow rates (e.g., high flow in normal operation, but low flow during start-up and standby conditions). For these reasons, selection of check valves requires extra steps and care in calculations.

This section includes equations for the calculation of pressure drop, required flow coefficient, flow rate or inlet flow velocity. Procedures are also provided to check and correct for cavitation and flow choking. The equations in this section assume that the fluid is a liquid, a gas or steam. Two-component flow (e.g. slurries, oil-gas mixtures) is not covered by the equations. Consult Flowserve for assistance in evaluating such applications.

Tables in this section contain performance data for all Edward stop, stop-check and check valves. Flow coefficients and cavitation/choked-flow coefficients are given for all fully open Edward valves. In addition, for check and stop-check valves, the tables provide minimum pressure drop for full lift, crack-open pressure drop, and a novel "sizing parameter" that is helpful in selecting the proper valve size for each application.

***Caution:*** *Pressure drop, flow rate and check valve lift estimates provided by Edward calculation methods are "best estimate" valves. Calculations are based on standard equations of the Instrument Society of America (ISA), flow rate and fluid data provided by the user, and valve flow coefficients provided by Flowserve.*

*Flow rate and fluid data are often design or best-estimate values. Actual values may differ from original estimates. Flow and check valve lift coefficients are based on laboratory testing. Valves of each specific type are tested, and results are extended to sizes not tested using model theory. This approach is fundamentally correct, but there is some uncertainty because of geometric variations between valves.*

*These uncertainties prevent a guarantee with respect to valve pressure drop, flow rate and lift performance, but we expect results of calculations using Flowserve methods to be at least as accurate as comparable calculations involving flow and pressure drop of other piping system components.*

### 2.1.1 Pressure Drop, Sizing and Flow Rate Calculations – Fully Open Valves – All Types

This section is divided into two parts. The Basic Calculations section (2.2) covers most applications where pressure drops are not excessive. This is generally the case in most Edward valve applications, and the simple equations in this section are usually sufficient for most problems.

When the pressure drop across a valve is large compared to the inlet pressure, refer to the Corrections Required with Large Pressure Drops section (2.3). Various fluid effects must be considered to avoid errors due to choked flow of steam or gas – or flashing or cavitation of liquids. While use of these more detailed calculations is not usually required, it is recommended that the simple checks in that section always be made to determine if correction of the results of the Basic Calculations is necessary. With experience, these checks can often be made at a glance.

***Note:*** *In preliminary calculations using the following equations, a piping geometry factor, $F_p = 1.0$, may be used, assuming that the valve size is the same as the nominal pipe size. However, if an application involves installing a valve in a larger-sized piping system (or piping with a lower pressure rating than the valve, which will have a larger inside diameter), determine $F_p$ from the Pipe Reducer Coefficients section when final calculations are made.*

## 2.2 Basic Calculations

The following equations apply to FULLY OPEN gate and globe valves of all types. They also apply to stop-check and check valves, if the flow is sufficient to open the disk completely. The Check Valve Sizing section (2.4) must be used to determine if a check valve is fully open and to make corrections if it is not.

The following simple methods may be used to calculate pressure drop, required flow coefficient, flow rate or inlet flow velocity for fully open Edward valves in the majority of applications. Always check Basic Calculations against the $\Delta P/p_1$ criteria in Figure 14 to see if corrections are required. This check is automatically made when using the Proprietary Edward valves Sizing Computer Program.

### 2.2.1 Pressure Drop

**KNOWN:**
Flow rate (w or q)
Fluid specific gravity (G) or
Density (ρ)
For water, steam or air, see Figures 21-23

**FIND:** Valve flow coefficient ($C_V$) from appropriate table

**CALCULATE:** Pressure drop (ΔP)

When flow rate and fluid properties are known, determine required coefficients for a specific valve and calculate the pressure drop from the appropriate equation. (See Nomenclature table for definition of terms and symbols):

**Equation 1a (U.S.)**

$$\Delta P = G\left(\frac{q}{F_P C_V}\right)^2$$

**Equation 1b (metric)**

$$\Delta P = G\left(\frac{q}{0.865 F_P C_V}\right)^2$$

**Equation 1c (U.S.)**

$$\Delta P = \frac{1}{\rho}\left(\frac{w}{63.3 F_P C_V}\right)^2$$

**Equation 1d (metric)**

$$\Delta P = \frac{1}{\rho}\left(\frac{w}{27.3 F_P C_V}\right)^2$$

If the resulting pressure drop is higher than desired, try a larger valve or a different type with a higher $C_V$. If the pressure drop is lower than necessary for the application, a smaller and more economical valve may be tried.

### 2.2.2 Required Flow Coefficient

**KNOWN:**
Flow rate (w or q)
Allowable pressure drop (ΔP)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 21-23

**CALCULATE:** Minimum required valve flow coefficient ($C_V$)

When the flow, fluid properties and an allowable pressure drop are known, calculate the required valve flow coefficient from the appropriate equation:

**Equation 2a (metric)**

$$C_V = \frac{q}{F_p}\sqrt{\frac{G}{\Delta P}}$$

**Equation 2b (metric)**

$$C_V = \frac{q}{0.865 F_p}\sqrt{\frac{G}{\Delta P}}$$

**Equation 2c (U.S.)**

$$C_V = \frac{w}{63.3 F_P \sqrt{\Delta P \rho}}$$

**Equation 2d (metric)**

$$C_V = \frac{w}{27.3 F_P \sqrt{\Delta P \rho}}$$

Results of these calculations may be used to select a valve with a valve flow coefficient that meets the required flow and pressure-drop criteria. Of course, valve selection also required prior determination of the right valve type and pressure class, using other sections of this catalog. The tabulated $C_V$ of the selected valve should then be used in the appropriate pressure drop or flow-rate equation to evaluate actual valve performance. At this stage, the checks described in section

**Nomenclature (metric units in parentheses)**

| | |
|---|---|
| $C_V$ | Valve flow coefficient |
| d | Valve inlet diameter, inches (mm) |
| $F_L$ | Liquid pressure recovery coefficient, dimensionless |
| $F_p$ | Piping geometry factor, dimensionless |
| G | Liquid specific gravity, dimensionless |
| $G_V$ | Gas compressibility coefficient, dimensionless |
| k | Ratio of specific heats, dimensionless |
| $K_i$ | Incipient cavitation coefficient, dimensionless |
| ΔP | Valve pressure drop, psi (bar) |
| $\Delta P_{CO}$ | Valve crack-open pressure drop, psi (bar) |
| $\Delta P_{FL}$ | Minimum valve pressure drop for full lift-psi (bar) |
| $p_1$ | Valve inlet pressure, psia (bar, abs) |
| $p_V$ | Liquid vapor pressure at valve inlet temperature-psia (bar, abs) |
| q | Volumetric flow rate, U.S. gpm (m³/hr) |

| | |
|---|---|
| $R_F$ | Ratio of sizing parameter to sizing parameter for full lift |
| $R_p$ | Ratio of valve pressure drop to minimum pressure drop for full lift |
| $R_1$ | Pressure drop ratio (gas or steam) |
| $R_2$ | Pressure drop ratio (liquids) |
| SP | Valve sizing parameter |
| $SP_{FL}$ | Valve sizing parameter for full lift |
| V | Fluid velocity at valve inlet, ft/sec (m/sec) |
| w | Weight flow rate-lb/hr (kg/hr) |
| $x_T$ | Terminal value of $\Delta P/p_1$ for choked gas or steam flow, dimensionless |
| Y | Gas expansion factor, dimensionless |
| ρ | Weight density of fluid at valve inlet conditions, lb/ft³ (kg/m³) |
| Conversion factors are provided in the Conversion Factors section at the end of this catalog. | |



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2.2 should be made to correct for effects of large pressure drops, if required.

As discussed below under flow-rate calculations, the flow-coefficient equations assume that the allowable pressure drop is available for the valve. Piping pressure drop should be addressed separately.

***Caution:*** *In applications of stop-check or check valves, the results of these equations will apply only if the valve is fully open. Always use the methods given in the Check Valve Sizing section (2.3) to ensure that the valve will be fully open or to make appropriate corrections.*

### 2.2.3 Flow Rate

**KNOWN:**
Pressure drop (ΔP)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 21-23

**FIND:** Valve flow coefficient ($C_V$) from appropriate table

**CALCULATE:** Flow rate (w or q)

When the fluid properties and an allowable pressure drop are known, determine required coefficients for a specific valve and calculate the flow rate from the appropriate equation:

**Equation 3a (U.S.)**

$$q = F_P C_V \sqrt{\frac{\Delta P}{G}}$$

**Equation 3b (metric)**

$$q = 0.865 F_P C_V \sqrt{\frac{\Delta P}{G}}$$

**Equation 3c (U.S.)**

$$w = 63.3 F_P C_V \sqrt{\Delta P \rho}$$

**Equation 3d (metric)**

$$w = 27.3 F_P C_V \sqrt{\Delta P \rho}$$

### 2.2.4 Inlet Flow Velocity

**KNOWN:**
Flow rate (w or q)
Fluid specific gravity (G) or density (ρ)
For water, steam or air, see Figures 21-23

**FIND:** Valve inlet diameter (d) from appropriate table

**CALCULATE:** Fluid velocity at valve inlet (V)

While not normally required for valve sizing and selection, the fluid velocity at the valve inlet may be calculated from the appropriate equation:

**Equation 4a (U.S.)**

$$V = \frac{0.409q}{d^2}$$

**Equation 4b (metric)**

$$V = \frac{354q}{d^2}$$

**Equation 4c (U.S.)**

$$V = \frac{0.0509w}{\rho d^2}$$

**Equation 4d (metric)**

$$V = \frac{354w}{\rho d^2}$$

These valve flow-rate calculations are used less frequently than pressure drop and flow-coefficient calculations, but they are useful in some cases.

***Caution:*** *These equations assume that the pressure drop used for the calculation is available for the valve. In many piping systems with Edward valves, flow is limited by pressure drop in pipe and fittings, so these equations should not be used as a substitute for piping calculations.*

Use of these flow-rate equations for stop-check and check valves is not recommended unless the allowable pressure drop is relatively high (e.g., over about 10 psi or 0.7 bar). At lower values of ΔP, two or more different flow rates might exist, depending on whether or not the disk is fully open. Flow would vary depending on whether the pressure drop increased or decreased to reach the specified value.

*Note: If a specific pipe inside diameter is known, that diameter may be used as the "d" value in the equation above to calculate the fluid velocity in the upstream pipe.*

## 2.3 Corrections Required with Large Pressure Drops

While most Edward valves are used in relatively high-pressure systems and are usually sized to produce low pressure drop at normal flow rates, care is necessary to avoid errors (which may be serious in some cases) due to flow "choking" (or near choking). Problems arise most often at off-design flow conditions that exist only during plant start-up, shutdown, or standby operation.

Since steam and gas are compressible fluids, choking (or near choking) may occur due to fluid expansion which causes the fluid velocity to approach or reach the speed of sound in reduced-area regions. While liquids are normally considered to be incompressible fluids, choking may also occur with liquid flow due to cavitation or flashing. In each case, simple calculations can be made to determine if a problem exists. Relatively simple calculations are required to correct for these effects. In some cases, these calculations may require a change in the size of type of valve required for a specific application.

The flow parameters $K_i$, $F_L$ and $x_T$ in the valve data tables assume that the valve is installed in pipe of the same nominal size. This is a fairly good assumption for preliminary calculations, but refer to the Pipe Reducer Coefficients section if there is a mismatch between valve and pipe diameters and make the appropriate corrections when final calculations are made. (Also see instructions relative to $F_p$ calculations in section 2.1).

*Note: Because large pressure drop problems are not encountered frequently, equations are presented in terms of weight flow rate (w) and density (ρ) only. See the Conversion of Measurement Units section for converting other units of flow rate to weight flow rate.*

### 2.3.1 Gas and Steam Flow

**2.3.1.1 Pressure Drop**
To determine if corrections are needed for compressible flow effects, use the data from the Basic Calculations to determine the ratio of the calculated pressure drop to the absolute upstream pressure:

**Equation 5**

$$R_1 = \frac{\Delta P}{p_1}$$

If the ratio $R_1$ is less than the values in Figure 14, the results of the Basic Calculations will usually be sufficiently accurate, and further calculations are unnecessary.

**Figure 14 – Maximum ΔP/P$_1$ for use of Basic Calculations Without Correction**

| Valve Type | Max. ΔP/P1 |
|---|---|
| Gate | 0.01 |
| Inclined Bonnet Globe<br>Angle<br>Tilting-Disk Check | 0.02 |
| 90° Bonnet Globe | 0.05 |

If the pressure-drop ratio $R_1$ exceeds that tabulated for the valve type under evaluation, the procedure described below should be used to check and correct for possible flow choking or near choking.

**(1)** Calculate the gas compressibility coefficient:

**Equation 6 (U.S. or metric)**

$$G_y = \frac{0.467}{kX_T}\left(\frac{\Delta P}{p_1}\right)$$

*Note: The ΔP in this equation is the uncorrected value from the Basic Calculations. Values of $x_T$ are given in valve data tables, and values of k are given in Figure 20.*

**(2)** The next step depends on the value of $G_y$ determined in equation 6:

• If $G_y < 0.148$, *the flow is not fully choked.* Read the value of Y from Figure 15 and calculate the corrected pressure drop:

**Equation 7 (U.S. or metric)**

$$\Delta P_C = \frac{\Delta P}{Y^2}$$

• If $G_y \geq 0.148$, the *flow is choked*. The desired flow cannot be achieved at the specified upstream pressure and will be limited to the choked flow rate given by:

**Equation 8a (U.S.)**

$$w_{choked} = 35.67 F_P C_V \sqrt{k x_T p_1 \rho}$$

**Equation 8b (metric)**

$$w_{choked} = 15.4 F_P C_V \sqrt{k x_T p_1 \rho}$$

• When flow is choked, the actual pressure drop cannot be calculated using valve flow calculations alone. It can be any valve greater than the following minimum value for choked flow:

**Equation 9 (U.S. or metric)**

$$\Delta P_{min.\,choked} \geq 0.714 k x_T p_1$$

• The only way to determine the pressure downstream of a valve with choked flow is to calculate the pressure required to force the choked flow rate through the downstream piping. This may be done with piping calculations (not covered by this catalog).

### 2.3.1.2 Flow Rate

When calculating the flow rate through a valve, the actual pressure drop is known, but the flow may be reduced by choking or near choking.

To check for high pressure-drop effects, calculate $R_1$, the ratio of pressure drop to absolute upstream pressure (see equation 5 above) noting that the pressure drop in this case is the known value.

**(1)** Flow rates determined using the Basic Calculations are sufficiently accurate if $R_1$ is less than about twice the value tabulated in Figure 14 for the applicable valve type (higher because actual pressure drop is used in the ratio). In this case, no correction is necessary.

**(2)** When corrections for higher values of R1 are required, calculate the gas expansion factor directly from:

**Equation 10 (U.S. or metric)**

$$Y = 1 - 0.467\left(\frac{\Delta P/p_1}{kx_T}\right)$$

**(3)** The calculation method to determine the flow rate depends on the calculated value of Y from equation (10):

• If Y is greater than 0.667 (but less than 1), the flow is not fully choked. Calculate the corrected flow rate as follows:

**Equation 11 (U.S. or metric)**

$$w_c = Yw$$

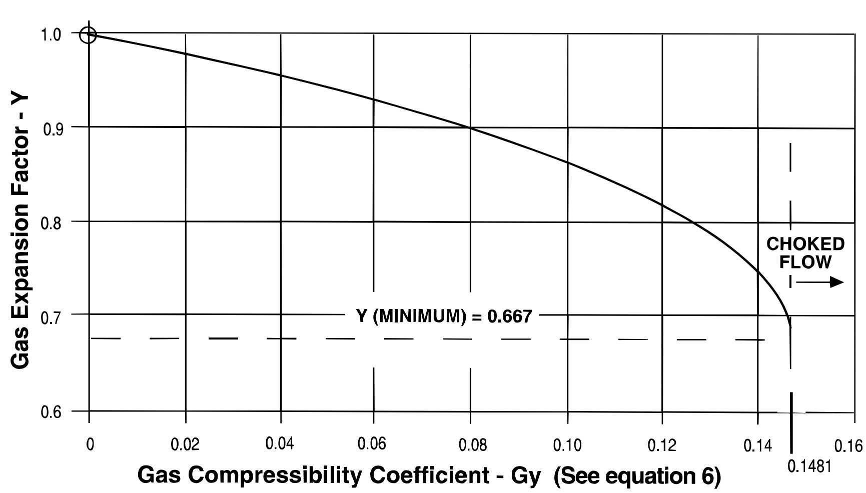
• If Y is equal to or less than 0.667, the valve flow is choked, and the results of the Basic Calculations are invalid. The actual flow rate may be calculated from the equation for $w_{choked}$ [(8a) or (8b)] above.

***Caution:** Choked or near-choked flow conditions may produce significant flow-induced noise and vibration. Prolonged operation with flow rates in this region may also cause erosion damage within a valve or in downstream piping, particularly if the flow conditions involve "wet" steam. Edward valves tolerate these conditions well in services involving limited time periods during plant start-up, shutdown, etc., but consult Flowserve about applications involving long exposure to such conditions.*

## 2.3.2 Liquid Flow – Cavitation and Flashing

The fluid pressure in high-velocity regions within a valve may be much lower than either

**Figure 15**



the upstream pressure or the downstream pressure. If the pressure within a valve falls below the vapor pressure ($p_v$) of the liquid, vapor bubbles or cavities may form in the flow stream. Cavitation, flashing and choking may occur. Use the equations and procedures in this section to evaluate these phenomena.

Cavitation and flashing are closely related, and they may be evaluated by calculating a pressure-drop ratio that is slightly different from that used for gas or steam:

**Equation 12**

$$R_1 = \frac{\Delta P}{(p_1 - p_V)}$$

To evaluate a particular valve and application, find values of $K_i$ and $F_L$ from the appropriate valve-data table, find $P_V$ values for common liquids given in Figure 24, calculate $R_2$, and perform the following checks:

**(1) Cavitation** – the sudden and sometimes violent coalescence of the cavities back to the liquid state – occurs when the downstream pressure (within the valve or in the downstream pipe) recovers to above the vapor pressure.

• If $R_2 < K_i$, there should be no significant cavitation or effect on flow or pressure drop. Results of the Basic Calculations require no correction.

• If $R_2 > K_i$, cavitation begins. If the ratio is only slightly greater than $K_i$, it may be detected as an intermittent "ticking" noise near the valve outlet, although pipe insulation may muffle this sound. This stage of cavitation is usually related to tiny vapor cavities that form near the center of vortices in the flow stream, and it generally produces neither damage nor effects on flow characteristics. However, as the pressure-drop ratio $R_2$ increases, the noise progresses to a "shh," then a "roar."

• If $R_2 > (K_i + FL_2)/2$, approximately, larger vapor cavities develop, and the risk of cavitation damage (pitting) in the valve or downstream pipe may be a concern if this flow condition is sustained for significant periods of time. Noise may also pose a problem. Still, at this stage, there is usually no significant effect on valve flow characteristics. Results of the Basic Calculations require no correction.

As the pressure-drop ratio increases beyond this point, some valves suffer slight reductions in their $C_V$ values, but there is no practical way of correcting pressure drop or flow calculations for this effect. Vibration and noise increase, ultimately sounding like "rocks and gravel" bouncing in the pipe at about the point where flow becomes choked.

**(2) Flashing** – the persistence of vapor cavities downstream of the valve — occurs when the pressure downstream of the valve remains below the vapor pressure.

• If $R_2 > 1$, flashing occurs, and the flow is choked due to vapor cavities in the flow stream.

**(3) Liquid choking** – A slightly different ratio may be used to predict the minimum pressure drop at choked flow conditions. Choking occurs due to vapor cavities near the minimum-area region in the flow stream when:

**Equation 13**

$$\frac{\Delta P}{(p_1 - 0.7p_V)} \geq F_L^2$$

Thus, the minimum pressure drop, which will produce choked liquid flow is given by:

**Equation 14**

$$\Delta P \geq F_L^2 (p_1 - 0.7p_V)$$

Note that flow may be choked by either sever cavitation or flashing.

#### 2.3.2.1 Predicting Choked Flow Rate

If the result of a Basic Calculation to determine pressure drop exceeds the value determined from equation (13), the Basic Calculation is invalid. The flow used for input cannot be obtained at the specified upstream pressure and temperature. In such a case, of if it is necessary to calculate liquid flow rate through a valve with high pressure drop, the choked flow rate at specified conditions may be calculated from:

**Equation 15a (U.S.)**

$$w_{choked} = 63.3 F_P C_V F_L \sqrt{\rho(p_1 - 0.7p_V)}$$

**Equation 15b (metric)**

$$w_{choked} = 27.3 F_P C_V F_L \sqrt{\rho(p_1 - 0.7p_V)}$$

When flow is choked due to either cavitating or flashing flow, the actual pressure drop cannot be determined from valve calculations. It may be any value greater than the minimum value for choked flow [equation (14)]. As in the case of choked gas or steam flow, the pressure downstream of a valve must be determined by calculating the pressure required to force the choked flow through the downstream piping. This may be done with piping calculations (not covered by this catalog).

• If the pressure drop from a Basic Calculation was used to determine flow rate, and the pressure drop exceeds the pressure drop of choked flow, the result is invalid. The corrected flow rate may be calculated from equation (15a) or (15b) above.

## 2.4 Check Valve Sizing

The most important difference between check (including stop-check) valves and stop valves, from a flow performance standpoint, is that the check valve disk is opened only by dynamic forces due to fluid flow. The preceding calculation methods for flow and pressure drop are valid only if it can be shown that the valve is fully open.

The primary purpose of this section is to provide methods to predict check valve disk opening and to make corrections to pressure-drop calculations, if the valve is not fully open. These methods are particularly applicable to sizing valves for new installations, but they are also useful for evaluation of performance of existing valves.

In selecting a stop-check or check valve for a new installation, the first steps require selecting a proper type and pressure class. The Stop and Check Valve Applications Guide section of this catalog should be reviewed carefully when the type is selected, noting advantages and disadvantages of each type and considering how they relate to the requirements of the installation. Other sections of this catalog provide pressure ratings to permit selection of the required pressure class.

### 2.4.1 Sizing Parameter

The first step in evaluating a stop-check or check valve application is to determine the Sizing Parameter based on the system flow rate and fluid properties:

**Equation 16 (U.S. or metric)**

$$SP = \frac{w}{\sqrt{\rho}}$$

Tables in this section provide a Sizing Parameter for full lift ($SP_{FL}$) for each Edward stop-check and check valve. The amount of opening of any check valve and its effect on pressure drop can be checked simply, as follows:

• If $SP_{FL} < SP$, the valve is fully open. Pressure drop may be calculated using the equations given previously for fully open valves (including corrections for large pressure drops, if required).

• IF $SP_{FL} > SP$, the valve is not fully open. A smaller size valve or another type should be selected, if possible, to ensure full opening. If that is not feasible, three additional steps are required to evaluate the opening and pressure drop of the valve under the specified service conditions.

*Note: EPRI Report No. NP 5479 (Application Guideline 2.1) uses a "C" factor to calculate the minimum flow velocity required to fully open a check valve. The sizing procedures in this catalog do not employ the "C" factor, but values are given in the valve data tables for readers who prefer to use the EPRI methods. Since the EPRI methods are based on velocity, a flow area is required as a basis. Valve Inlet Diameters presented in data tables are the basis for correlation between flow rate and velocity.*

### 2.4.2 Calculations for Check Valves Less Than Fully Open

If the preceding evaluation revealed an incompletely open check valve, perform the following additional calculations:

**Calculate the flow-rate ratio:**

**Equation 17 (U.S. or metric)**

$$R_F = \frac{SP}{SP_{FL}}$$

**Determine the disk operating position:**
Using the $R_F$ value calculated above, determine the valve operating position from Figures 16-19 (cast-steel valves). Performance curve numbers for individual cast-steel stop-check and check valves are given in the tabulations with other coefficients. Evaluate the acceptability of the operating position based on recommendations in the Check Valve Applications Guide and in the specific sizing guidelines below.

**Calculate the pressure drop:**
Again using the $R_F$ value calculated above, determine the pressure drop ratio $R_P$ from Figures 16-19, and calculate the valve pressure drop at the partially open position:

**Equation 18 (U.S. or metric)**

$$\Delta P = R_P \Delta P_{FL}$$

Values for $\Delta P_{FL}$ for all stop-check and check valves are given in Valve Tables 1 to 5 and 10 to 15 with other coefficients.

*Note: The values of the various valve coefficients given in the tabulations are based on testing of a substantial number of valves. Most are applicable to any line fluid, but those involving check valve lift are influenced by buoyancy. Tabulated values are based on reference test conditions with room-temperature water. $SP_{FL}$ and $\Delta P_{FL}$ are slightly higher in applications involving lower-density line fluids. Considering the expected accuracy of these calculations, the following corrections may be considered:*

• For water at any temperature and other common liquids – No correction required.

• For steam, air and other common gases at normal operating pressures and temperatures – Increase $SP_{FL}$ by 7% and increase $\Delta P_{FL}$ by 14%.

### 2.4.3 Sizing Guidelines

Considering the recommendations in the Check Valve Applications Guide section of this catalog and the calculation methods described above, the following specific steps are recommended for sizing check valves for optimum performance and service life (It is assumed that the check valve type and pressure class have already been selected before starting this procedure):

**(1) Constant flow rate** – If the application involves a substantially constant flow rate during all operating conditions, the check valve should be sized to be fully open. This may be accomplished by the following procedure:

• Calculate the check valve sizing parameter (SP) for the application from equation (15). Values of density for water, steam and air are available in Figures 21-23.

If the flow rate is not given in lb/hr (or kg/hr), refer to the Conversion of Measurement Units section of this catalog to make the necessary calculation.

• Select the valve size with the next smaller $SP_{FL}$ value from valve data tables (Tables 1-5 for cast-steel valves). Make note of the $C_V$, $\Delta P_{CO}$, $\Delta P_{FL}$, $K_i$, $F_L$ and $x_T$ values for use in later calculations.

*Note: Preferably, there should be a good margin between SP and $SP_{FL}$ to be sure the valve will be fully open. In the specific case of tilting-disk check valves, it is recommended that $SP_{FL}$ be less than 0.83 (SP) to be sure that the disk is fully loaded against its stop (particularly if it is close to a flow disturbance).*

• Calculate the pressure drop using the Basic Calculation method in equation (1) and the Cxx value of the valve size selected above. Make the simple checks described above in section 2.2 (Corrections Required With Large Pressure Drops), and make appropriate corrections if necessary (this is rarely needed for a valve sized for constant flow rate, but the check is desirable).

• Evaluate the pressure drop. If it is too high, a larger size or another check valve type should be tried. If it is lower than necessary for the application, a smaller and more economical valve (with a lower $SP_{FL}$) may be evaluated with assurance that it would also be fully open.

• Evaluate the crack-open pressure drop ($\Delta P_{CO}$) to be certain that the system head available at the initiation of flow will initiate valve opening. Note that, for some valves, the crack-open pressure drop exceeds the pressure drop for full lift. Preceding calculations might indicate no problem, but it is possible that a valve might not open at all in a low-head application (e.g., gravity flow).

**(2) Variable flow rate** – If the application involves check valve operation over a range of flow rates, additional calculations are necessary to ensure satisfactory, stable performance at the lowest flow rate without causing excessive pressure drop at the maximum flow condition. This required careful evaluation of specific system operating conditions (e.g., are the minimum and maximum flow rates normal operating conditions or infrequent conditions that occur only during start-up or emergency conditions?).

The following options should be considered in selecting the best stop-check or check valve size for variable flow applications:

• The best method, if practical, is to size the valve to be fully open at the minimum flow condition. This may be done by following the first two steps listed above for the constant flow-rate case, but using the minimum flow rate in the sizing parameter (SP) calculation.

The only difference is that the pressure-drop calculations and evaluations in the third and fourth steps must be repeated at normal and maximum flow rates. If the selected valve size is fully open at the minimum flow rate and has an acceptable pressure drop at the maximum flow condition, it should give good overall performance.

• Sometimes a change in valve type provides the best cost-effective solution for variable-flow applications (e.g. use a smaller Flite-Flow® stop-check or check valve instead of a 90°-bonnet type to provide full lift at the minimum flow condition, but a high $C_V$ for low pressure drop at maximum flow).

• Operation at less than full lift may have to be considered.

**(3) Operation at less than full lift** – "High Turndown" applications sometimes exist on boilers and other process systems that must swing through periodic flow changes from start-up, to standby, to maximum and back again. In such cases, calculations may not reveal any single valve that will offer a satisfactory compromise assuring full lift and an acceptable pressure drop at both minimum and maximum flow conditions.

It may be acceptable to permit a check valve to operate at less than fully open, at the minimum-flow condition if such operation is infrequent or not expected to be sustained continuously for long periods. A valve may be sized by following the methods above using the lowest expected normal sustained flow rate in the sizing parameter (SP) calculation. Pressure drop at normal and maximum flow rates should then be calculated and evaluated.

The acceptability of valve operation at the minimum flow condition should be evaluated as follows:

• Calculate the sizing parameter (SP) at the minimum flow rate and the flow-rate ratio $R_F$ from equation (17). The valve operating position (% open) should be determined from the proper performance curve (Figures 16-19).

***Caution:*** *Check valve operation at less than 25% opening is not recommended. Any check valve that operates for sustained periods at partial openings should be monitored or inspected periodically for evidence of instability or wear.*

• If the minimum-operating position is considered satisfactory, the pressure drop at the minimum-flow condition may be calculated from equation (18), using the pressure-drop ratio ($R_p$) determined from the proper performance curve.

**(4) Alternatives for high turndown applications** – If the preceding steps show that the range of flow rates is too large for any single standard check valve, consult Flowserve. Several alternatives may be considered:

• Either 90°-bonnet or angle-type stop-check or piston-lift check valves may be furnished with a special disk with an extended "skirt" as illustrated in Figure 15A. This skirt increases flow resistance at low flow rates, producing additional lifting force to help prevent operation at small openings. Of course, the skirt also reduces the $C_V$ of the valve somewhat when it is fully open and increases pressure drop at maximum flow. Nevertheless, a special disk sometimes solves difficult high turndown problems. A special disk also permits solution of some problems with existing valves that are "oversized."

• A stop-check valve may be used with the stem lifted just enough to provide a positive stop for the disk at very low flows (e.g., short-term start-up conditions). The stem should be lifted with increasing flow rate to maintain the disk-stopping action, while preventing excessive pressure drop. At normal flow rates, the stem can be lifted to its fully open position, permitting normal check valve function. The stem may be actuated manually for infrequent start-up operations, or a motor actuator may be furnished for convenience, if large flow rate variations are expected to be frequent.

***Caution:*** *This arrangement could produce cavitation or flow-choking problems, if the flow rate is increased substantially without lifting the valve stem to compensate.*

• A small check or stop-check valve may be installed in parallel with a larger stop-check valve. The smaller valve may be sized for the minimum flow condition, and the larger stop-check valve may be held closed with the stem until the flow is sufficient to ensure adequate lift. If necessary, the stem on the larger valve may be opened gradually with increasing flow to maintain disk-stopping action, as in the example above. The smaller valve may be allowed to remain open at higher flow rates or, if a stop-check type is used, it may be closed, if preferred. Either or both valves may be manually actuated or furnished with a motor actuator for convenience.

## 2.5 Pipe Reducer Coefficient

The equations in the Flow Performance section of this catalog use a piping geometry factor, $F_p$, to account for the effect of pipe reducers attached directly to the valve. This permits the valve and pipe reducers to be treated as an assembly, i.e., $F_pC_V$ is the flow coefficient of the valve/pipe reducer combination. Then, the pressure drop in the flow equations is the pressure drop of the assembly.

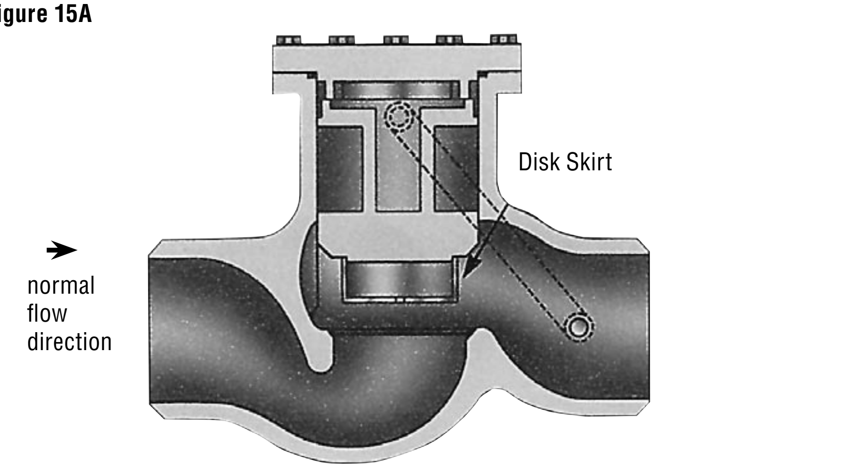
This method is also applicable when valves are furnished with oversized ends to fit larger diameter pipe. It should also be used to evaluate line-size valves used in pipe with a lower pressure rating than the valve, because such pipe may have less wall thickness and a larger inside diameter than the valve inlet diameter given in the valve data tabulations.

This section provides equations for calculation of the piping geometry factor, $F_p$, which should be used even in Basic Calculations when there is a significant difference between the pipe diameter and valve inlet diameter (d).

In addition, other coefficients ($K_1$, $F_L$, $x_T$) are affected by the presence of pipe reducers. Equations are also provided for correction of these terms, which are required only when evaluating significant valve-to-pipe diameter mismatch.

*Note: These equations apply only where the valve diameter is less than the connecting pipe diameter.*

**Figure 15A**



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### 2.5.1 Pipe Geometry Factor

Calculate upstream loss coefficient:

**Equation 1-1 (U.S. or metric)**

$$K_1 = 0.5\left[1-\left(\frac{d}{D_1}\right)^2\right]^2$$

Calculate downstream loss coefficient:

**Equation 1-2 (U.S. or metric)**

$$K_2 = \left[1-\left(\frac{d}{D_2}\right)^2\right]^2$$

Summation:

**Equation 1-3 (U.S. or metric)**

$$\sum K = K_1 + K_2$$

**Equation 1-4a (U.S.)**

$$F_P = \sqrt{\frac{1}{1+\frac{\sum K}{890}\left(\frac{C_y}{d^2}\right)^2}}$$

**Equation 1-4b (metric)**

$$F_P = \sqrt{\frac{1}{1+486\sum K\left(\frac{C_y}{d^2}\right)^2}}$$

*Note: If $D_1$ and $D_2$ are not the same, use of $F_P$ calculated in this manner accounts for energy losses associated with flow contraction and expansion, and the pressure drop calculated using this factor represents energy loss. Bernoulli effects may cause a different static pressure change between upstream and downstream pipes.*

### 2.5.2 Other Coefficients

Correction of values of $K_i$, $F_L$ and $x_T$ requires an initial calculation of a Bernoulli coefficient to account for static pressure change in the inlet reducer:

**Equation 1-5 (U.S. or metric)**

$$K_{B1} = 1-\left(\frac{d}{D_1}\right)^4$$

Then, corrected values of each coefficient may be calculated, using the corresponding value from valve data tables as input:

**Equation 1-6a (U.S.)**

$$K_{ii} = \frac{1}{F_P^2\left[\frac{1}{K_i}+\left(\frac{K_1+K_{B1}}{890}\right)\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-6b (metric)**

$$K_{ii} = \frac{1}{F_P^2\left[\frac{1}{K_i}+468(K_1+K_{B1})\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-7a (U.S.)**

$$F_{LL} = \frac{1}{F_P\sqrt{\frac{1}{F_L^2}+\left(\frac{K_1+K_{B1}}{890}\right)\left(\frac{C_V}{d^2}\right)^2}}$$

**Equation 1-7b (metric)**

$$F_{LL} = \frac{1}{F_P\sqrt{\frac{1}{F_L^2}+468(K_1+K_{B1})\left(\frac{C_V}{d^2}\right)^2}}$$

**Equation 1-8a (U.S.)**

$$x_{TT} = \frac{x_T}{F_P^2\left[1+\frac{x_T(K_1+K_{B1})}{1000}\left(\frac{C_V}{d^2}\right)^2\right]}$$

**Equation 1-8b (metric)**

$$x_{TT} = \frac{x_T}{F_P^2\left[1+416x_T(K_1+K_{B1})\left(\frac{C_V}{d^2}\right)^2\right]}$$

where: $K_i$, $F_L$ and $x_T$ are values from valve data tables; $K_{ii}$, $F_{LL}$ and $x_{TT}$ are corrected values for valve/reducer assembly.

### Nomenclature

| | |
|---|---|
| $C_V$ | valve flow coefficient. See Valve Reference Data. |
| d | valve-end inside diameter, inches, (mm). See Valve Reference Data. |
| $D_1$ | inside diameter of upstream pipe, inches, (mm). See Pipe Data Section. |
| $D_2$ | inside diameter of downstream pipe, inches, (mm). See Pipe Data Section. |
| $F_L$ | liquid-pressure recovery coefficient, dimensionless* |
| $F_p$ | piping-geometry factor, dimensionless |
| $K_1$ | pressure-loss coefficient for inlet reducer, dimensionless |
| $K_2$ | pressure-loss coefficient for outlet reducer, dimensionless |
| $K_{B1}$ | pressure change (Bernoulli) coefficient for inlet reducer, dimensionless |
| $\sum K$ | $K_1 + K_2$, dimensionless |
| $K_i$ | incipient-cavitation coefficient, dimensionless* |
| $x_T$ | terminal value of $\Delta P/p_1$ for choked gas or steam flow, dimensionless |

**Double subscripts (e.g. $K_{ii}$) represent values corrected for effects of pipe reducers.*

## Table 1 – Edward Cast Steel Globe Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 300 (PN 50)** *Figure No. 318/318Y Stop valves, 304/304Y Stop-Check valves, 394/394Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 110 | 0.53 | 0.34 | 0.20 | 2.50 | 63.5 | 0.58 | 0.040 | 0.31 | 0.021 | 5630 | 637 | 46 | 4 |
| 3 | 80 | 84 | 0.80 | 0.43 | | 3.00 | 76.2 | 0.79 | 0.054 | 1.3 | 0.088 | 5990 | 679 | 34 | 4 |
| 4 | 100 | 120 | 0.79 | 0.43 | | 4.00 | 102 | 0.80 | 0.055 | 1.4 | 0.095 | 8980 | 1020 | 29 | 4 |
| 5 | 125 | 215 | 0.79 | 0.43 | | 5.00 | 127 | 0.97 | 0.067 | 1.8 | 0.12 | 18,100 | 2050 | 37 | 4 |
| 6 | 150 | 335 | 0.80 | 0.44 | 0.06 | 6.00 | 152 | 1.2 | 0.084 | 2.3 | 0.16 | 31,900 | 3610 | 45 | 1 |
| 8 | 200 | 580 | 0.76 | 0.39 | | 8.00 | 203 | 1.2 | 0.086 | 1.2 | 0.085 | 40,800 | 4620 | 33 | 1 |
| 10 | 250 | 1000 | 0.77 | 0.40 | | 10.00 | 254 | 1.2 | 0.081 | 1.1 | 0.079 | 67,600 | 7660 | 34 | 1 |
| 12 | 300 | 1550 | 0.77 | 0.40 | | 12.00 | 305 | 1.3 | 0.092 | 1.2 | 0.084 | 107,000 | 12,100 | 38 | 1 |
| **Class 600 (PN 110)** *Figure No. 616/616Y, 618/618Y, 716Y Stop valves, 604/604Y, 606/606Y, 706Y Stop-Check valves, 694/694Y, 690/690Y, 794Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 84 | 0.97 | 0.61 | | 2.50 | 63.5 | 0.79 | 0.054 | 1.3 | 0.088 | 5990 | 679 | 49 | 4 |
| 3 | 80 | 120 | 0.97 | 0.61 | 0.10 | 3.00 | 76.2 | 0.80 | 0.055 | 1.4 | 0.095 | 8980 | 1020 | 51 | 4 |
| 4 | 100 | 215 | 0.97 | 0.60 | | 4.00 | 102 | 0.97 | 0.067 | 1.8 | 0.12 | 18,100 | 2050 | 58 | 4 |
| 5 | 125 | 335 | 0.97 | 0.61 | | 5.00 | 127 | 1.2 | 0.084 | 2.3 | 0.16 | 31,900 | 3610 | 65 | 4 |
| 6 | 150 | 580 | 0.81 | 0.42 | | 6.00 | 152 | 1.2 | 0.086 | 1.2 | 0.085 | 40,800 | 4620 | 58 | 1 |
| 8 | 200 | 1000 | 0.81 | 0.42 | | 7.87 | 200 | 1.2 | 0.081 | 1.1 | 0.079 | 67,600 | 7660 | 56 | 1 |
| 10 | 250 | 1550 | 0.81 | 0.42 | 0.07 | 9.75 | 248 | 1.3 | 0.092 | 1.2 | 0.084 | 107,000 | 12,100 | 57 | 1 |
| 12 | 300 | 2200 | 0.81 | 0.42 | | 11.75 | 298 | 1.5 | 0.10 | 1.4 | 0.099 | 169,000 | 19,100 | 62 | 1 |
| 14 | 350 | 2650 | 0.81 | 0.42 | | 12.87 | 327 | 1.6 | 0.11 | 1.5 | 0.10 | 205,000 | 23,200 | 63 | 1 |
| **Class 900 (PN 150)** *Figure No. 4016/4016Y, 4316Y Stop valves, 4006/4006Y, 4306Y Stop-Check valves, 4094/4094Y, 4394Y Check valves* | | | | | | | | | | | | | | | |
| 3 | 80 | 110 | 0.96 | 0.60 | | 2.87 | 72.9 | 0.92 | 0.063 | 1.5 | 0.10 | 8510 | 964 | 53 | 4 |
| 4 | 100 | 200 | 0.97 | 0.60 | 0.10 | 3.87 | 98.2 | 1.3 | 0.090 | 2.3 | 0.16 | 19,500 | 2210 | 66 | 5 |
| 5 | 125 | 305 | 0.97 | 0.61 | | 4.75 | 121 | 1.3 | 0.092 | 2.5 | 0.18 | 30,600 | 3470 | 69 | 4 |
| 6 | 150 | 530 | 0.81 | 0.42 | | 5.75 | 146 | 1.2 | 0.085 | 1.5 | 0.10 | 41,500 | 4700 | 64 | 3 |
| 8 | 200 | 910 | 0.81 | 0.42 | | 7.50 | 191 | 1.3 | 0.093 | 1.5 | 0.10 | 69,500 | 7870 | 63 | 2 |
| 10 | 250 | 1400 | 0.81 | 0.42 | 0.07 | 9.37 | 238 | 1.6 | 0.11 | 1.8 | 0.12 | 119,000 | 13,500 | 69 | 1 |
| 12 | 300 | 2000 | 0.81 | 0.42 | | 11.12 | 282 | 1.8 | 0.12 | 2.1 | 0.14 | 182,000 | 20,600 | 75 | 2 |
| 14 | 350 | 2400 | 0.81 | 0.42 | | 12.25 | 311 | 1.6 | 0.11 | 1.9 | 0.13 | 211,000 | 23,900 | 72 | 2 |

*See note following section 2.4.1 for discussion of C factor.*



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## *Table 1 – Edward Cast Steel Globe Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 1500 (PN 260)** *Figure No. 2016, 7516/7516Y Stop valves, 2006Y, 7506/7506Y Stop-Check valves, 2094Y, 7594/7594Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 72 | 0.92 | 0.54 | 0.08 | 2.25 | 57.2 | 0.76 | 0.052 | 1.3 | 0.091 | 5230 | 592 | 53 | 5 |
| 3 | 80 | 110 | 0.89 | 0.51 | | 2.75 | 69.9 | 0.92 | 0.063 | 1.5 | 0.10 | 8510 | 964 | 57 | 4 |
| 4 | 100 | 200 | 0.85 | 0.47 | | 3.62 | 91.9 | 1.3 | 0.088 | 2.3 | 0.16 | 19,300 | 2190 | 75 | 5 |
| 5 | 125 | 300 | 0.83 | 0.44 | 0.07 | 4.37 | 111 | 1.2 | 0.080 | 2.2 | 0.15 | 28,600 | 3240 | 76 | 4 |
| 6 | 150 | 465 | 0.80 | 0.42 | | 5.37 | 136 | 1.4 | 0.094 | 1.4 | 0.096 | 35,000 | 3960 | 62 | 2 |
| 8 | 200 | 790 | 0.81 | 0.42 | | 7.00 | 178 | 1.6 | 0.11 | 1.4 | 0.097 | 59,300 | 6720 | 62 | 1 |
| 10 | 250 | 1250 | 0.81 | 0.42 | | 8.75 | 222 | 1.5 | 0.10 | 1.4 | 0.100 | 93,900 | 10,600 | 63 | 1 |
| 12 | 300 | 1750 | 0.81 | 0.42 | | 10.37 | 263 | 1.5 | 0.11 | 1.8 | 0.12 | 147,000 | 16,600 | 70 | 3 |
| 14 | 350 | 2100 | 0.81 | 0.42 | | 11.37 | 289 | 1.7 | 0.12 | 2.1 | 0.14 | 190,000 | 21,500 | 75 | 3 |
| **Class 2500 (PN 420)** *Figure No. 3916/3916Y, 4416Y Stop valves, 3906/3906Y, 4406Y Stop-Check valves, 3994/3994Y, 4494Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 47 | 0.97 | 0.60 | 0.10 | 1.87 | 47.5 | 1.1 | 0.075 | 1.3 | 0.088 | 3370 | 382 | 49 | 6 |
| 3 | 80 | 68 | 0.97 | 0.61 | | 2.25 | 57.2 | 1.4 | 0.093 | 1.6 | 0.11 | 5480 | 620 | 55 | 6 |
| 4 | 100 | 110 | 0.96 | 0.60 | | 2.87 | 72.9 | 0.96 | 0.066 | 1.4 | 0.095 | 8280 | 938 | 51 | 5 |
| 5 | 125 | 175 | 0.97 | 0.60 | | 3.62 | 91.9 | 1.4 | 0.097 | 2.2 | 0.15 | 16,600 | 1880 | 65 | 5 |
| 6 | 150 | 310 | 0.81 | 0.42 | 0.07 | 4.37 | 111 | 1.5 | 0.11 | 1.6 | 0.11 | 24,600 | 2790 | 66 | 3 |
| 8 | 200 | 530 | 0.81 | 0.42 | | 5.75 | 146 | 2.2 | 0.15 | 2.2 | 0.15 | 49,800 | 5640 | 77 | 2 |
| 10 | 250 | 845 | 0.81 | 0.42 | | 7.25 | 184 | 1.5 | 0.10 | 1.5 | 0.11 | 66,600 | 7540 | 65 | 2 |
| 12 | 300 | 1200 | 0.81 | 0.42 | | 8.62 | 219 | 1.6 | 0.11 | 1.7 | 0.11 | 97,700 | 11,100 | 67 | 3 |

*See note following section 2.4.1 for discussion of C factor.*

## Figure 16 – Edward Cast Steel Globe Piston-Lift Check Valve Performance Curves

**Figure 16A**

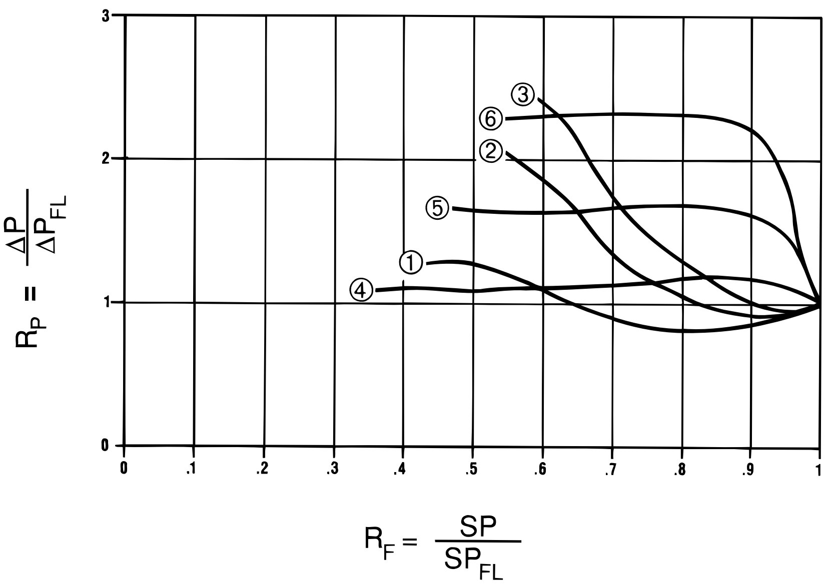
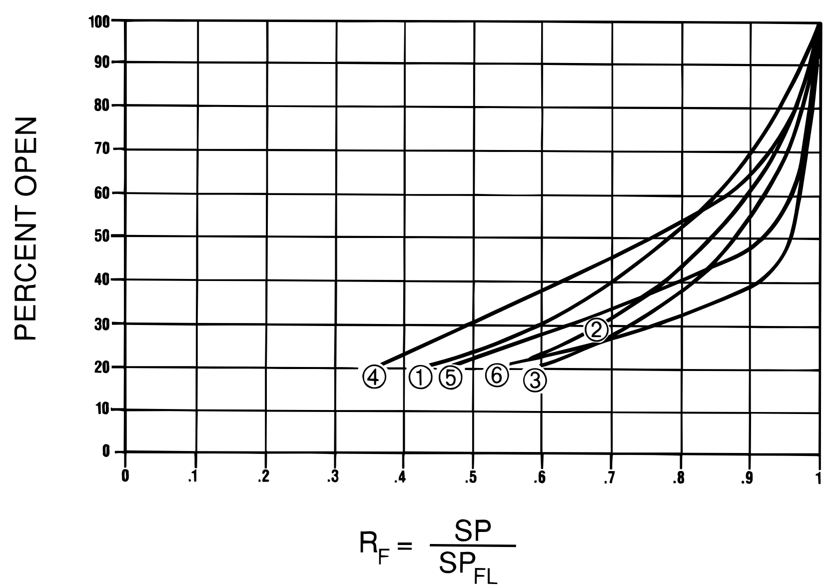



**Figure 16B**



## Table 2 – Edward Cast Steel Angle Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficient | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_I$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 300 (PN 50)** *Figure No. 319/319Y/329/329Y, Stop valves, 303/303Y, Stop-Check valves, 391/391Y/393/393Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 110 | 0.53 | 0.34 | 0.15 | 2.50 | 63.5 | 0.63 | 0.043 | 0.46 | 0.032 | 4940 | 559 | 40 | 5 |
| 3 | 80 | 135 | 0.59 | 0.24 | 0.07 | 3.00 | 76.2 | 0.79 | 0.054 | 0.55 | 0.038 | 6300 | 714 | 36 | 5 |
| 4 | 100 | 195 | 0.58 | 0.23 | | 4.00 | 102 | 0.80 | 0.055 | 0.59 | 0.041 | 9460 | 1070 | 30 | 5 |
| 5 | 125 | 345 | 0.59 | 0.23 | | 5.00 | 127 | 0.97 | 0.067 | 0.75 | 0.052 | 18,900 | 2140 | 39 | 4 |
| 6 | 150 | 535 | 0.59 | 0.24 | | 6.00 | 152 | 1.2 | 0.084 | 0.96 | 0.066 | 33,200 | 3760 | 47 | 1 |
| 8 | 200 | 860 | 0.59 | 0.23 | | 8.00 | 203 | 1.2 | 0.086 | 0.75 | 0.052 | 47,200 | 5340 | 38 | 1 |
| 10 | 250 | 1500 | 0.59 | 0.23 | | 10.00 | 254 | 1.2 | 0.081 | 0.70 | 0.048 | 78,200 | 8860 | 40 | 1 |
| 12 | 300 | 2250 | 0.59 | 0.23 | | 12.00 | 305 | 1.3 | 0.092 | 0.74 | 0.051 | 124,000 | 14,000 | 44 | 1 |
| **Class 600 (PN 110)** *Figure No. 617/617Y, 619/619Y, 717Y Stop valves, 605/605Y, 607/607, 707Y Stop-Check valves, 691/691Y, 695/695Y, 795Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 135 | 0.62 | 0.25 | 0.08 | 2.50 | 63.5 | 0.79 | 0.054 | 0.55 | 0.038 | 6300 | 714 | 51 | 5 |
| 3 | 80 | 195 | 0.62 | 0.25 | | 3.00 | 76.2 | 0.80 | 0.055 | 0.59 | 0.041 | 9460 | 1070 | 54 | 5 |
| 4 | 100 | 345 | 0.62 | 0.25 | | 4.00 | 102 | 0.97 | 0.067 | 0.75 | 0.051 | 18,800 | 2130 | 60 | 4 |
| 5 | 125 | 535 | 0.62 | 0.25 | | 5.00 | 127 | 1.2 | 0.084 | 0.96 | 0.066 | 32,200 | 3760 | 68 | 4 |
| 6 | 150 | 860 | 0.64 | 0.25 | | 6.00 | 152 | 1.2 | 0.086 | 0.75 | 0.052 | 47,200 | 5340 | 67 | 1 |
| 8 | 200 | 1500 | 0.63 | 0.25 | | 7.87 | 200 | 1.2 | 0.081 | 0.70 | 0.048 | 78,200 | 8860 | 64 | 1 |
| 10 | 250 | 2250 | 0.63 | 0.25 | | 9.75 | 248 | 1.3 | 0.092 | 0.74 | 0.051 | 124,000 | 14,000 | 66 | 1 |
| 12 | 300 | 3300 | 0.63 | 0.25 | | 11.75 | 298 | 1.5 | 0.10 | 0.88 | 0.061 | 196,000 | 22,200 | 72 | 1 |
| 14 | 350 | 3950 | 0.63 | 0.25 | | 12.87 | 327 | 1.6 | 0.11 | 0.90 | 0.062 | 237,000 | 26,900 | 73 | 1 |
| **Class 900 (PN 150)** *Figure No. 4017/4017Y, 4317Y Stop valves, 4007/4007Y, 4307Y Stop-Check valves, 4095/4095Y, 4395Y Check valves* | | | | | | | | | | | | | | | |
| 3 | 80 | 180 | 0.62 | 0.24 | 0.08 | 2.87 | 72.9 | 0.92 | 0.063 | 0.64 | 0.044 | 8980 | 1020 | 56 | 5 |
| 4 | 100 | 325 | 0.62 | 0.25 | | 3.87 | 98.2 | 1.5 | 0.10 | 1.2 | 0.081 | 22,200 | 2510 | 75 | 5 |
| 5 | 125 | 485 | 0.63 | 0.25 | | 4.75 | 121 | 1.2 | 0.083 | 1.0 | 0.072 | 31,200 | 3530 | 70 | 5 |
| 6 | 150 | 790 | 0.63 | 0.25 | | 5.75 | 146 | 1.3 | 0.092 | 1.0 | 0.071 | 50,900 | 5770 | 78 | 3 |
| 8 | 200 | 1350 | 0.63 | 0.25 | | 7.50 | 190 | 1.4 | 0.099 | 1.0 | 0.071 | 86,600 | 9810 | 78 | 3 |
| 10 | 250 | 2100 | 0.63 | 0.25 | | 9.37 | 238 | 1.7 | 0.12 | 1.3 | 0.090 | 152,000 | 17,200 | 88 | 3 |
| 12 | 300 | 2950 | 0.63 | 0.25 | | 11.12 | 282 | 1.8 | 0.13 | 1.4 | 0.093 | 218,000 | 24,700 | 90 | 2 |
| 14 | 350 | 3600 | 0.63 | 0.25 | | 12.25 | 311 | 1.5 | 0.10 | 1.3 | 0.091 | 261,000 | 29,600 | 89 | 2 |
| 16 | 400 | 6450 | 0.56 | 0.19 | 0.06 | 14.00 | 356 | 1.9 | 0.13 | 0.74 | 0.051 | 350,000 | 39,700 | 91 | 2 |
| 18 | 450 | * | * | * | | 15.75 | 400 | * | * | * | * | * | * | * | * |
| 20 | 500 | 10,000 | 0.56 | 0.19 | | 17.50 | 444 | 1.7 | 0.11 | 0.76 | 0.052 | 553,000 | 62,600 | 92 | 3 |
| 24 | 600 | 14,500 | 0.56 | 0.19 | | 21.00 | 533 | 2.6 | 0.18 | 1.1 | 0.073 | 940,000 | 106,000 | 109 | 3 |

*See note following section 2.4.1 for discussion of C factor.*



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## Table 2 (continued) – Edward Cast Steel Angle Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 1500 (PN 260)** *Figure No. 2017Y, 7517/7517Y Stop valves, 2007Y, 7507/7507Y Stop-Check valves, 2095Y, 7595/7595Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 115 | 0.59 | 0.22 | 0.06 | 2.25 | 57.2 | 0.75 | 0.052 | 0.58 | 0.040 | 5560 | 630 | 56 | 6 |
| 3 | 80 | 180 | 0.57 | 0.21 | | 2.75 | 69.9 | 0.92 | 0.063 | 0.64 | 0.044 | 8980 | 1020 | 60 | 5 |
| 4 | 100 | 320 | 0.55 | 0.19 | | 3.62 | 91.9 | 1.50 | 0.10 | 1.20 | 0.081 | 22,000 | 2490 | 86 | 5 |
| 5 | 125 | 475 | 0.54 | 0.18 | | 4.37 | 111 | 1.30 | 0.093 | 1.20 | 0.083 | 33,000 | 3740 | 88 | 5 |
| 6 | 150 | 690 | 0.63 | 0.25 | 0.08 | 5.37 | 136 | 1.50 | 0.10 | 1.00 | 0.069 | 43,800 | 4970 | 77 | 3 |
| 8 | 200 | 1150 | 0.63 | 0.25 | | 7.00 | 178 | 1.60 | 0.11 | 0.99 | 0.068 | 73,900 | 8370 | 77 | 3 |
| 10 | 250 | 1850 | 0.63 | 0.25 | | 8.75 | 222 | 1.60 | 0.11 | 1.20 | 0.083 | 127,000 | 14,400 | 85 | 3 |
| 12 | 300 | 2550 | 0.63 | 0.25 | | 10.37 | 263 | 1.80 | 0.13 | 1.40 | 0.094 | 190,000 | 21,500 | 90 | 3 |
| 14 | 350 | 3100 | 0.63 | 0.25 | | 11.37 | 289 | 1.70 | 0.12 | 1.30 | 0.091 | 225,000 | 25,500 | 89 | 3 |
| 16 | 400 | 5550 | 0.56 | 0.19 | 0.06 | 13.00 | 330 | 2.00 | 0.14 | 0.79 | 0.055 | 313,000 | 35,400 | 94 | 3 |
| 18 | 450 | 5350 | 0.54 | 0.19 | | 14.62 | 371 | 2.00 | 0.14 | 0.86 | 0.059 | 313,000 | 35,400 | 75 | 3 |
| 20 | 500 | * | * | * | * | 16.37 | 416 | * | * | * | * | * | * | * | * |
| 24 | 600 | * | * | * | * | 19.62 | 498 | * | * | * | * | * | * | * | * |
| **Class 2500 (PN 420)** *Fig. No. 3917/3917Y, 4417Y Stop valves, 3907/3907Y, 4407Y Stop-Check valves, 3995/3995Y, 4495Y Check valves* | | | | | | | | | | | | | | | |
| 2.5 | 65 | 75.5 | 0.62 | 0.24 | 0.08 | 1.87 | 47.5 | 1.1 | 0.075 | 0.57 | 0.039 | 3610 | 409 | 53 | 6 |
| 3 | 80 | 110 | 0.62 | 0.24 | | 2.25 | 57.2 | 1.3 | 0.091 | 0.69 | 0.048 | 5770 | 653 | 58 | 6 |
| 4 | 100 | 180 | 0.62 | 0.24 | | 2.87 | 72.9 | 0.96 | 0.066 | 0.61 | 0.042 | 8810 | 998 | 55 | 6 |
| 5 | 125 | 280 | 0.62 | 0.25 | | 3.62 | 91.9 | 1.4 | 0.097 | 0.97 | 0.067 | 17,600 | 1990 | 68 | 5 |
| 6 | 150 | 455 | 0.63 | 0.25 | | 4.37 | 111 | 1.5 | 0.11 | 0.96 | 0.066 | 28,300 | 3210 | 76 | 2 |
| 8 | 200 | 790 | 0.63 | 0.25 | | 5.75 | 146 | 2.3 | 0.16 | 1.4 | 0.096 | 59,000 | 6680 | 91 | 2 |
| 10 | 250 | 1250 | 0.64 | 0.25 | | 7.25 | 184 | 1.5 | 0.10 | 0.93 | 0.064 | 76,500 | 8660 | 74 | 2 |
| 12 | 300 | 1750 | 0.63 | 0.25 | | 8.62 | 219 | 1.8 | 0.13 | 1.3 | 0.088 | 127,000 | 14,400 | 87 | 3 |
| 14 | 350 | 3400 | 0.40 | 0.10 | 0.05 | 9.50 | 241 | 2.1 | 0.14 | 0.89 | 0.061 | 204,000 | 23,100 | 115 | 3 |
| 16 | 400 | 3500 | 0.54 | 0.18 | | 10.87 | 276 | 2.1 | 0.14 | 0.85 | 0.058 | 204,000 | 23,100 | 88 | 3 |
| 18 | 450 | 5450 | 0.50 | 0.15 | | 12.25 | 311 | 2.5 | 0.17 | 1.00 | 0.069 | 347,000 | 39,300 | 118 | 3 |
| 20 | 500 | 5500 | 0.55 | 0.18 | | 13.50 | 343 | 2.5 | 0.17 | 1.00 | 0.070 | 351,000 | 39,800 | 98 | 3 |
| 22 | 550 | 6900 | 0.55 | 0.18 | | 14.87 | 378 | 2.5 | 0.17 | 0.97 | 0.067 | 429,000 | 48,600 | 99 | 3 |
| 24 | 600 | * | * | * | * | * | * | * | * | * | * | * | * | * | * |

*See note following section 2.4.1 for discussion of C factor.*
** Consult Flowserve Edward valves Sales Representative*

# Figure 17 – Edward Cast Steel Angle Piston-Lift Check Valve Performance Curves

**Figure 17A**

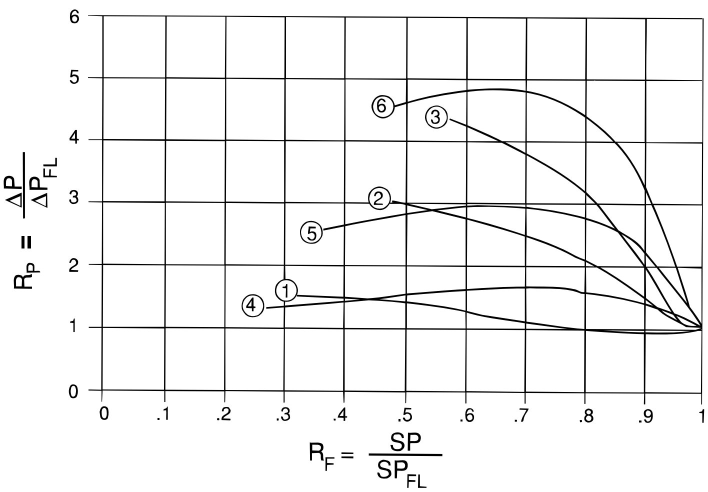
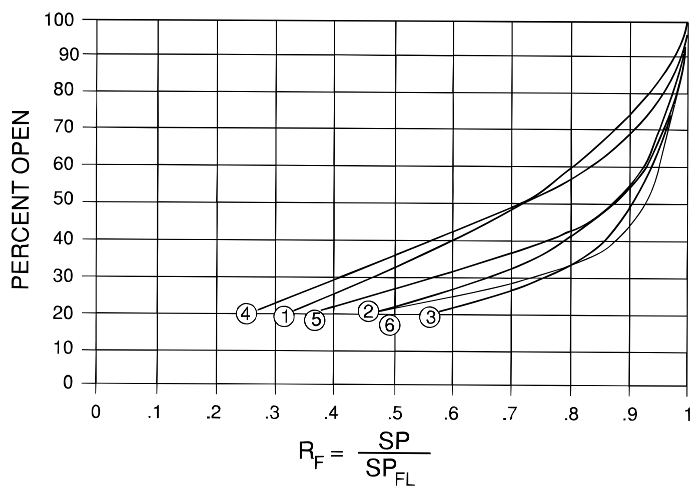



**Figure 17B**



## *Table 3 – Edward Cast Steel Flite-Flow® Stop and Stop-Check Valve Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 300/400 (PN 50/68)** *Figure No. 1314, 1314Y, 1329, 1329Y Stop valves; 1302, 1302Y Stop-Check valves; 1390, 1390Y, 1392, 1392Y Piston Lift Check valves* | | | | | | | | | | | | | | | |
| 2-½ | 65 | 110 | 0.53 | 0.34 | 0.02 | 2.50 | 64 | 0.9 | 0.06 | 0.91 | 0.063 | 6,750 | 765 | 55 | 1, 2 |
| 3 | 80 | 295 | 0.52 | 0.20 | 0.08 | 3.00 | 76 | 0.8 | 0.06 | 0.64 | 0.044 | 15,000 | 1,680 | 85 | 4, 4 |
| 4 | 100 | 525 | 0.52 | 0.20 | 0.08 | 4.00 | 102 | 0.8 | 0.06 | 0.66 | 0.046 | 27,000 | 3,070 | 86 | 4, 4 |
| 6 | 150 | 1,200 | 0.52 | 0.20 | 0.08 | 6.00 | 152 | 0.7 | 0.05 | 0.71 | 0.049 | 63,000 | 7,120 | 89 | 4, 4 |
| 8 | 200 | 2,100 | 0.52 | 0.20 | 0.08 | 8.00 | 200 | 0.9 | 0.06 | 0.67 | 0.046 | 109,000 | 12,400 | 87 | 4, 4 |
| 10 | 250 | 3,300 | 0.52 | 0.20 | 0.08 | 10.00 | 248 | 1.0 | 0.07 | 0.76 | 0.052 | 181,000 | 20,500 | 92 | 4, 4 |
| 12 | 300 | 4,750 | 0.52 | 0.20 | 0.08 | 12.00 | 305 | 1.1 | 0.08 | 0.87 | 0.060 | 279,000 | 31,500 | 99 | 4, 4 |
| 14 | 350 | 4,750 | 0.52 | 0.20 | 0.08 | 12.00 | 305 | 1.1 | 0.08 | 0.87 | 0.060 | 279,000 | 31,500 | 99 | 4, 4 |
| 16 | 400 | 4,750 | 0.53 | 0.22 | 0.09 | 12.00 | 305 | 1.5 | 0.10 | 0.87 | 0.060 | 279,000 | 31,500 | 99 | 4, 4 |
| **Class 600/700 (PN 110/120)** *Figure No. 614, 614Y, 714Y Stop valves; 602, 602Y, 702Y Stop-Check valves; 692, 692Y, 792Y Piston Lift Check valves* | | | | | | | | | | | | | | | |
| 3 | 80 | 295 | 0.52 | 0.20 | 0.08 | 3.00 | 76.2 | 0.8 | 0.06 | 0.44 | 0.030 | 12,400 | 1,400 | 70 | 4, 4 |
| 4 | 100 | 525 | 0.52 | 0.20 | 0.08 | 4.00 | 102 | 0.8 | 0.06 | 0.47 | 0.032 | 22,900 | 2,590 | 73 | 4, 4 |
| 6 | 150 | 1,200 | 0.52 | 0.20 | 0.08 | 6.00 | 152 | 0.7 | 0.05 | 0.53 | 0.037 | 54,500 | 6,170 | 77 | 4, 4 |
| 8 | 200 | 2,050 | 0.52 | 0.20 | 0.08 | 7.87 | 200 | 0.9 | 0.06 | 0.68 | 0.047 | 106,000 | 12,000 | 87 | 4, 4 |
| 10 | 250 | 3,100 | 0.52 | 0.20 | 0.08 | 9.75 | 248 | 1.0 | 0.07 | 0.85 | 0.059 | 182,000 | 20,600 | 98 | 4, 4 |
| 12 | 300 | 4,550 | 0.52 | 0.20 | 0.08 | 11.75 | 298 | 1.1 | 0.08 | 0.96 | 0.066 | 281,000 | 31,800 | 104 | 4, 4 |
| 14 | 350 | 4,550 | 0.52 | 0.20 | 0.08 | 11.75 | 298 | 1.1 | 0.08 | 0.96 | 0.066 | 281,000 | 31,800 | 104 | 4, 4 |
| 16 | 400 | 7,150 | 0.56 | 0.19 | 0.04 | 14.75 | 375 | 1.5 | 0.10 | 1.05 | 0.072 | 463,000 | 52,400 | 108 | 4, 4 |
| 20 | 500 | 11,000 | 0.52 | 0.20 | 0.08 | 18.25 | 484 | 1.4 | 0.10 | 0.96 | 0.066 | 677,000 | 76,700 | 104 | 1, 1 |
| 24 | 600 | 16,000 | 0.56 | 0.19 | 0.04 | 22.00 | 558 | 1.2 | 0.08 | 0.86 | 0.076 | 935,000 | 106,000 | 98 | 1, 2 |
| **Class 900/1100 (PN 150/190)** *Figure No. 4014, 4014Y, 4314Y Stop valves; 4002, 4002Y, 4302Y Stop-Check valves; 4092, 4092Y, 4392Y Piston Lift Check valves* | | | | | | | | | | | | | | | |
| 3 | 80 | 270 | 0.52 | 0.02 | 0.08 | 2.87 | 72.9 | 0.9 | 0.06 | 0.52 | 0.036 | 12,400 | 1,400 | 77 | 4, 4 |
| 4 | 100 | 490 | 0.52 | 0.02 | 0.08 | 3.87 | 98.2 | 0.9 | 0.06 | 0.53 | 0.037 | 22,600 | 2,550 | 77 | 4, 4 |
| 6 | 150 | 1,100 | 0.52 | 0.02 | 0.08 | 5.75 | 146 | 0.7 | 0.05 | 0.50 | 0.034 | 48,500 | 5,490 | 75 | 4, 4 |
| 8 | 200 | 1,850 | 0.52 | 0.02 | 0.08 | 7.50 | 191 | 0.8 | 0.06 | 0.65 | 0.045 | 94,200 | 10,700 | 85 | 4, 4 |
| 10 | 250 | 2,900 | 0.52 | 0.02 | 0.08 | 9.37 | 238 | 1.0 | 0.07 | 0.84 | 0.058 | 167,000 | 18,900 | 97 | 4, 4 |
| 12 | 300 | 4,050 | 0.52 | 0.02 | 0.08 | 11.12 | 282 | 1.1 | 0.08 | 0.93 | 0.064 | 248,000 | 28,100 | 102 | 4, 4 |
| 14 | 350 | 4,050 | 0.52 | 0.02 | 0.08 | 11.12 | 282 | 1.1 | 0.08 | 0.93 | 0.064 | 248,000 | 28,100 | 102 | 4, 4 |
| 16 | 400 | 6,450 | 0.52 | 0.02 | 0.08 | 14.00 | 356 | 1.3 | 0.09 | 1.09 | 0.075 | 426,000 | 48,200 | 111 | 4, 4 |

*See note following section 2.4.1 for discussion of C factor.*
** Consult Flowserve Edward valves Sales Representative*

## *Table 3 (continued) – Edward Cast Steel Flite-Flow® Stop and Stop-Check Valve Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

**Class 1500/1800 (PN 260/310)** *Figure No. 2014Y, 7514Y Stop valves; 2002Y, 7502Y Stop-Check valves; 2092Y, 7592Y Check valves*

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| 3 | 80 | 270 | 0.52 | 0.20 | 0.08 | 2.87 | 72.9 | 1.0 | 0.07 | 0.51 | 0.035 | 12,200 | 1,380 | 75 | 4, 4 |
| 4 | 100 | 425 | 0.52 | 0.20 | | 3.62 | 91.9 | 1.0 | 0.07 | 0.62 | 0.043 | 21,200 | 2,400 | 82 | 4, 4 |
| 6 | 150 | 950 | 0.61 | 0.23 | 0.05 | 5.37 | 136 | 1.3 | 0.09 | 0.73 | 0.050 | 51,200 | 5,800 | 90 | 1, 3 |
| 8 | 200 | 1,600 | 0.61 | 0.23 | | 7.00 | 178 | 1.5 | 0.10 | 0.74 | 0.051 | 87,800 | 9,940 | 91 | 1, 2 |
| 10 | 250 | 2,500 | 0.61 | 0.23 | | 8.75 | 222 | 1.5 | 0.10 | 0.89 | 0.061 | 150,000 | 17,000 | 100 | 1, 2 |
| 12 | 300 | 3,550 | 0.61 | 0.23 | | 10.37 | 263 | 1.7 | 0.12 | 1.01 | 0.070 | 225,000 | 25,500 | 107 | 1, 2 |
| 14 | 350 | 3,550 | 0.59 | 0.22 | | 10.37 | 263 | 1.7 | 0.12 | 1.01 | 0.070 | 225,000 | 25,500 | 106 | 1, 2 |
| 16 | 400 | 5,550 | 0.61 | 0.23 | | 13.00 | 330 | 1.8 | 0.12 | 1.09 | 0.075 | 366,000 | 41,500 | 110 | 1, 2 |
| 18 | 450 | 5,550 | 0.59 | 0.22 | | 13.00 | 330 | 1.8 | 0.12 | 1.09 | 0.075 | 366,000 | 41,500 | 110 | 1, 2 |
| 20 | 500 | 8,800 | 0.61 | 0.23 | | 16.37 | 416 | 2.2 | 0.15 | 1.46 | 0.101 | 673,000 | 76,200 | 128 | 1, 2 |
| 24 | 600 | 8,800 | 0.59 | 0.23 | 0.06 | 16.37 | 416 | 2.3 | 0.16 | * | * | * | * | * | * |

**Class 2500/2900 (PN 460/490)** *Figure No. 3914Y, 4414Y Stop valves, 3902Y, 4402Y Stop-Check valves, 3992Y, 4492Y Check valves*
**Class 2900 (PN 490)** *Size 3 and 4 only with figure numbers the same as Class 2500 valves.*

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| 3 | 80 | 165 | 0.52 | 0.20 | 0.08 | 2.25 | 57.2 | 1.1 | 0.08 | 0.71 | 0.049 | 8,850 | 1,000 | 89 | 4, 4 |
| 4 | 100 | 270 | 0.52 | 0.20 | | 2.87 | 72.9 | 0.9 | 0.06 | 0.70 | 0.048 | 14,300 | 1,620 | 88 | 4, 4 |
| 6 | 150 | 625 | 0.61 | 0.23 | 0.05 | 4.37 | 111 | 1.5 | 0.11 | 0.84 | 0.058 | 36,300 | 4,110 | 97 | 1, 2 |
| 8 | 200 | 1,100 | 0.61 | 0.23 | | 5.75 | 146 | 2.1 | 0.15 | 1.13 | 0.078 | 73,000 | 8,270 | 112 | 1, 2 |
| 10 | 250 | 1,750 | 0.61 | 0.22 | | 7.25 | 184 | 1.5 | 0.10 | 0.80 | 0.055 | 97,600 | 11,100 | 95 | 1, 2 |
| 12 | 300 | 2,450 | 0.61 | 0.22 | | 8.62 | 219 | 1.7 | 0.12 | 0.96 | 0.066 | 151,000 | 17,100 | 103 | 1, 3 |
| 14 | 350 | 3,550 | 0.53 | 0.17 | | 10.37 | 263 | 1.9 | 0.13 | 1.17 | 0.081 | 242,000 | 27,400 | 115 | 1, 2 |
| 16 | 400 | 3,550 | 0.60 | 0.22 | | 10.37 | 263 | 1.9 | 0.13 | 1.17 | 0.081 | 242,000 | 27,400 | 115 | 1, 2 |
| 18 | 450 | 5,550 | 0.55 | 0.18 | | 13.00 | 330 | 2.3 | 0.16 | 1.38 | 0.095 | 412,000 | 46,700 | 124 | 1, 2 |
| 20 | 500 | 5,550 | 0.54 | 0.18 | | 13.00 | 330 | 2.3 | 0.16 | 1.38 | 0.095 | 412,000 | 46,700 | 124 | 1, 2 |
| 24 | 600 | 8,100 | 0.60 | 0.22 | | 15.69 | 399 | 2.4 | 0.17 | 1.61 | 0.111 | 648,000 | 73,400 | 134 | 1, 2 |

**Series 4500 Figure No. 4514Y, 5014Y Stop valves, 4502Y, 5002Y Stop-Check valves, 4592Y, 5092Y Check valves**

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| 4 | 100 | 135 | 0.66 | 0.26 | 0.06 | 2.37 | 60.2 | 1.2 | 0.08 | 0.97 | 0.067 | 8,290 | 939 | 75 | 1, 2 |
| 6 | 150 | 305 | 0.64 | 0.24 | | 3.37 | 85.6 | 1.5 | 0.10 | 1.75 | 0.121 | 25,300 | 2,870 | 113 | 1, 2 |
| 8 | 200 | 740 | 0.48 | 0.14 | 0.3 | 4.75 | 121 | 2.3 | 0.16 | 0.83 | 0.057 | 42,800 | 4,840 | 97 | 1, 2 |
| 10 | 250 | 1,100 | 0.51 | 0.16 | | 5.75 | 146 | 1.7 | 0.12 | 0.86 | 0.059 | 63,600 | 7,200 | 98 | 1, 3 |

*See note following section 2.4.1 for discussion of C factor.*
** Consult Flowserve Edward Valves Sales Representative.*

## Table 3 (continued) – Edward Cast Steel Flite-Flow® Stop and Stop-Check Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | All Stop and Check Valves | | | | | | Check Valve Coefficients | | | | | | | Perf. Curves Fig. 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{CO}$ | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 2000 (PN 340)** *Figure No. 2214Y, 3214Y Stop valves; 2002Y, 3202Y Stop-Check valves; 2292Y, 3292Y Check valves* | | | | | | | | | | | | | | | |
| 12 | 300 | 2950 | 0.52 | 0.20 | 0.08 | 9.50 | 241 | 1.7 | 0.12 | 0.85 | 0.059 | 172,600 | 19,500 | 97 | 4, 4 |
| 14 | 350 | 2950 | 0.52 | 0.20 | | 9.50 | 241 | 1.7 | 0.12 | 0.85 | 0.059 | 172,600 | 19,500 | 97 | 4, 4 |

## Figure 18 – Cast Steel Flite-Flow® Piston-Lift Check Valve Performance Curves

**Figure 18A**

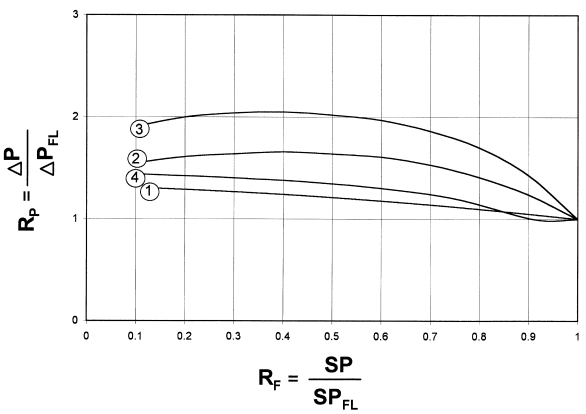
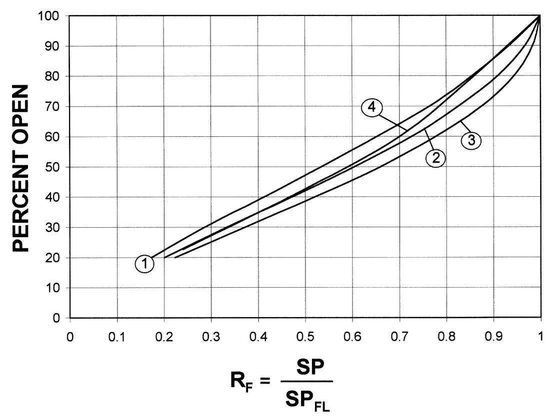



**Figure 18B**



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## *Table 4 – Edward Cast Steel Tilting Disk Check Valve Flow Coefficients*[1]

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | Check Valve Flow Coefficients | | | | | | Check Valve Coefficients | | | | | Perf. Curves Fig. 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 600 (PN 110)** *Figure No. 670Y, 770Y* | | | | | | | | | | | | | |
| 6 | 150 | 1110 | 0.57 | 0.20 | | 6.00 | 152 | 0.80 | 0.055 | 62,300 | 7,060 | 88 | 1 |
| 8 | 200 | 1850 | 0.57 | 0.20 | | 7.87 | 200 | 1.0 | 0.069 | 115,000 | 13,000 | 95 | 1 |
| 10 | 250 | 2850 | 0.57 | 0.20 | | 9.75 | 248 | 1.1 | 0.076 | 187,000 | 21,200 | 100 | 1 |
| 12 | 300 | 4100 | 0.57 | 0.20 | 0.05 | 11.75 | 298 | 1.2 | 0.083 | 285,000 | 32,300 | 105 | 1 |
| 14 | 350 | 4050 | 0.56 | 0.20 | | 12.87 | 327 | 1.2 | 0.083 | 285,000 | 32,300 | 88 | 1 |
| 16 | 400 | 6500 | 0.57 | 0.20 | | 14.75 | 375 | 1.4 | 0.097 | 481,000 | 54,500 | 113 | 1 |
| 18 | 450 | 8100 | 0.57 | 0.20 | | 16.50 | 419 | 1.5 | 0.10 | 622,000 | 70,500 | 116 | 1 |
| 20 | 500 | 9950 | 0.57 | 0.20 | | 18.25 | 464 | 1.6 | 0.11 | 786,000 | 89,000 | 120 | 1 |
| **Class 900 (PN 150)** *Figure No. 970Y, 4370Y* | | | | | | | | | | | | | |
| 2.5 | 65 | 195 | 0.44 | 0.12 | 0.02 | 2.25 | 57.2 | 1.0 | 0.069 | 12,200 | 1,380 | 123 | 1 |
| 3 | 80 | 245 | 0.57 | 0.20 | | 2.87 | 72.9 | 0.60 | 0.041 | 12,200 | 1,380 | 75 | 1 |
| 4 | 100 | 215 | 0.59 | 0.23 | | 3.87 | 98.2 | 0.80 | 0.055 | 12,200 | 1,380 | 41 | 1 |
| 6 | 150 | 990 | 0.57 | 0.20 | | 5.75 | 146 | 0.80 | 0.055 | 56,800 | 6,430 | 87 | 1 |
| 8 | 200 | 1700 | 0.57 | 0.20 | | 7.50 | 190 | 0.80 | 0.055 | 97,000 | 11,000 | 88 | 2 |
| 10 | 250 | 2400 | 0.56 | 0.20 | 0.05 | 9.37 | 238 | 0.90 | 0.062 | 145,000 | 16,400 | 84 | 2 |
| 12 | 300 | 3450 | 0.56 | 0.20 | | 11.12 | 282 | 1.1 | 0.076 | 233,000 | 26,400 | 96 | 1 |
| 14 | 350 | 3300 | 0.56 | 0.20 | | 12.25 | 311 | 1.3 | 0.090 | 233,000 | 26,400 | 79 | 1 |
| 16 | 400 | 4950 | 0.56 | 0.20 | | 14.00 | 356 | 1.3 | 0.090 | 360,000 | 40,800 | 94 | 1 |
| 18 | 450 | 4700 | 0.57 | 0.21 | | 15.75 | 400 | 1.5 | 0.10 | 360,000 | 40,800 | 74 | 1 |
| 20 | 500 | 9150 | 0.57 | 0.20 | | 17.50 | 444 | 1.2 | 0.083 | 713,000 | 80,800 | 119 | 1 |
| **Class 1500 (PN 260)** *Figure No. 1570Y, 2070Y* | | | | | | | | | | | | | |
| 2.5 | 65 | 195 | 0.44 | 0.12 | 0.02 | 2.25 | 57.2 | 1.0 | 0.069 | 12,200 | 1,380 | 123 | 1 |
| 3 | 80 | 245 | 0.52 | 0.17 | | 2.75 | 69.9 | 0.60 | 0.041 | 12,200 | 1,380 | 82 | 1 |
| 4 | 100 | 225 | 0.57 | 0.22 | | 3.62 | 91.9 | 0.70 | 0.048 | 12,200 | 1,380 | 47 | 1 |
| 6 | 150 | 970 | 0.51 | 0.16 | | 5.37 | 136 | 0.90 | 0.062 | 56,800 | 6,430 | 100 | 1 |
| 8 | 200 | 1650 | 0.51 | 0.16 | | 7.00 | 178 | 0.90 | 0.062 | 97,000 | 11,000 | 101 | 2 |
| 10 | 250 | 2400 | 0.54 | 0.18 | 0.05 | 8.75 | 222 | 0.90 | 0.062 | 145,000 | 16,400 | 96 | 2 |
| 12 | 300 | 3450 | 0.53 | 0.17 | | 10.37 | 263 | 1.1 | 0.076 | 233,000 | 26,400 | 110 | 1 |
| 14 | 350 | 3400 | 0.56 | 0.20 | | 11.37 | 289 | 1.2 | 0.083 | 233,000 | 26,400 | 92 | 1 |
| 16 | 400 | 5050 | 0.57 | 0.20 | | 13.00 | 330 | 1.3 | 0.090 | 360,000 | 40,800 | 108 | 1 |
| 18 | 450 | 4900 | 0.56 | 0.20 | | 14.62 | 371 | 1.4 | 0.097 | 360,000 | 40,800 | 86 | 1 |
| 24 | 600 | 10,500 | 0.56 | 0.20 | | 19.62 | 498 | 1.5 | 0.10 | 824,000 | 93,400 | 109 | 1 |

*See note following section 2.4.1 for discussion of C factor.*

*[1] Crack open pressure drop $\Delta P_{CO}$ values are generally less than 0.25 psi (0.01 bar).*

## Table 4 (continued) – Edward Cast Steel Tilting Disk Check Valve Flow Coefficients[1]

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Size | | Check Valve Flow Coefficients | | | | | | Check Valve Coefficients | | | | | Perf. Curves Fig. 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPS | DN | $C_V$ | $F_L$ | $x_T$ | $K_i$ | d | | $\Delta P_{FL}$ | | $SP_{FL}$ | | C | |
| **Class 2500 (PN 420)** *Figure No. 2570Y, 4470Y* | | | | | | | | | | | | | |
| 2.5 | 65 | 125 | 0.47 | 0.13 | 0.01 | 1.87 | 47.5 | 2.4 | 0.17 | 12,200 | 1,380 | 178 | 1 |
| 3 | 80 | 195 | 0.44 | 0.12 | | 2.25 | 57.2 | 1.0 | 0.069 | 12,200 | 1,380 | 123 | 1 |
| 4 | 100 | 245 | 0.57 | 0.20 | 0.05 | 2.87 | 72.9 | 0.60 | 0.041 | 12,200 | 1,380 | 75 | 1 |
| 6 | 150 | 655 | 0.50 | 0.15 | | 4.37 | 111 | 0.40 | 0.028 | 26,500 | 3,000 | 71 | 1 |
| 8 | 200 | 990 | 0.57 | 0.20 | | 5.75 | 146 | 0.80 | 0.055 | 56,700 | 6,420 | 87 | 2 |
| 10 | 250 | 1650 | 0.54 | 0.18 | | 7.25 | 184 | 0.90 | 0.062 | 97,000 | 11,000 | 94 | 2 |
| 12 | 300 | 2400 | 0.53 | 0.17 | | 8.62 | 219 | 0.50 | 0.034 | 156,000 | 17,700 | 107 | 1 |
| 14 | 350 | 3250 | 0.47 | 0.14 | | 9.50 | 241 | 1.3 | 0.090 | 233,000 | 26,400 | 131 | 1 |
| 16 | 400 | 3450 | 0.57 | 0.20 | | 10.87 | 276 | 1.1 | 0.076 | 233,000 | 26,400 | 100 | 1 |
| 18 | 450 | 5050 | 0.51 | 0.16 | | 12.25 | 311 | 1.3 | 0.090 | 360,000 | 40,800 | 122 | 1 |
| 20 | 500 | 5000 | 0.56 | 0.20 | | 13.50 | 343 | 1.3 | 0.090 | 360,000 | 40,800 | 101 | 1 |
| **Class 4500 (PN 760)** *Figure No. 4570Y, 5070Y Check valves* | | | | | | | | | | | | | |
| 6 | 150 | 420 | 0.43 | 0.11 | .03 | 3.76 | 95.5 | 0.70 | 0.048 | 21,900 | 2480 | 79 | 1 |
| 8 | 200 | 675 | 0.45 | 0.12 | | 4.75 | 121 | 0.8 | 0.055 | 37,000 | 4190 | 84 | 1 |

*See note following section 2.4.1 for discussion of C factor.*

[1] *Crack open pressure drop $\Delta P_{CO}$ values are generally less than 0.25 psi (0.01 bar).*

## Figure 19 – Tilting Disk Check Valve Performance Curves

**Figure 19A**

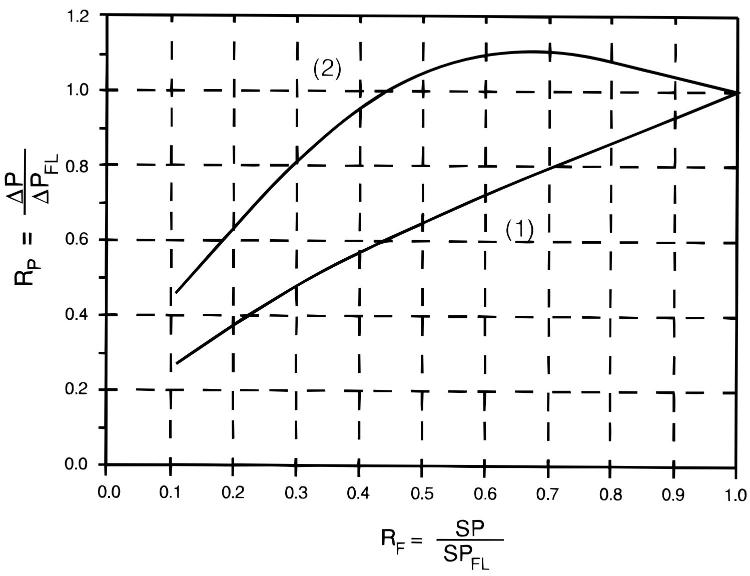
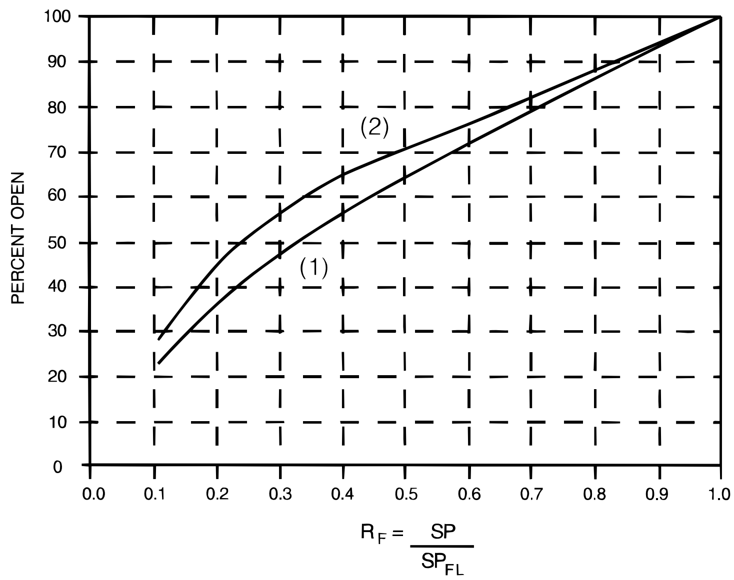



**Figure 19B**



## Table 5 – Edward Cast Steel Equiwedge® Gate Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

**Regular Port Gate Valves**

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| **Class 600 (PN 110)** *Figure No. A1611 Stop valves* | | | | | | | |
| 2.5 | 65 | 395 | 0.74 | 0.23 | 0.02 | 2.50 | 63.5 |
| 3.0 | 80 | 325 | 0.57 | 0.19 | 0.02 | 3.00 | 76.2 |
| 4.0 | 100 | 545 | 0.58 | 0.20 | 0.03 | 4.00 | 102 |
| 6.0 | 150 | 2350 | 0.38 | 0.08 | 0.02 | 6.00 | 152 |
| **Class 900 (PN 150)** *Figure No. A1911, Stop valves* | | | | | | | |
| 2.5 | 65 | 270 | 0.88 | 0.33 | 0.02 | 2.25 | 57.2 |
| 3.0 | 80 | 340 | 0.60 | 0.20 | 0.03 | 2.87 | 72.9 |
| 4.0 | 100 | 570 | 0.40 | 0.18 | 0.02 | 3.87 | 98.2 |

**Regular Port Gate Valves**

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| **Class 600 (PN 110)** *Figure No. A1611Y Stop valves* | | | | | | | |
| 2.5 | 65 | 385 | 0.76 | 0.25 | 0.02 | 2.50 | 63.5 |
| 3.0 | 80 | 365 | 0.55 | 0.16 | 0.02 | 2.90 | 73.7 |
| 4.0 | 100 | 625 | 0.53 | 0.16 | 0.03 | 3.83 | 97.3 |
| 6.0 | 150 | 2350 | 0.41 | 0.09 | 0.02 | 5.75 | 146 |
| **Class 900 (PN 150)** *Figure No. A1911Y Stop valves* | | | | | | | |
| 2.5 | 65 | 280 | 0.75 | 0.24 | 0.02 | 2.12 | 53.8 |
| 3.0 | 80 | 400 | 0.61 | 0.18 | 0.03 | 2.62 | 66.5 |
| 4.0 | 100 | 670 | 0.54 | 0.15 | 0.02 | 3.62 | 91.9 |

**Regular Port Gate Valves**

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| **Class 600 (PN 110)** *Figure No. 1611/ 1611Y, 1711Y Stop valves* | | | | | | | |
| 2.5 | 65 | 380 | 0.77 | 0.25 | 0.02 | 2.50 | 63.5 |
| 3.0 | 80 | 610 | 0.44 | 0.10 | 0.02 | 3.00 | 76.2 |
| 4.0 | 100 | 1250 | 0.41 | 0.08 | 0.03 | 4.00 | 102 |
| 6.0 | 150 | 3250 | 0.40 | 0.07 | 0.02 | 6.00 | 152 |
| 8.0 | 200 | 5300 | 0.35 | 0.06 | 0.02 | 7.87 | 200 |
| 10.0 | 250 | 8550 | 0.34 | 0.06 | 0.01 | 9.75 | 248 |
| 12.0 | 300 | 12,000 | 0.31 | 0.05 | 0.01 | 11.75 | 298 |
| 14.0 | 350 | 14,000 | 0.32 | 0.05 | 0.01 | 12.87 | 327 |
| 16.0 | 400 | 18,500 | 0.32 | 0.05 | 0.01 | 14.75 | 375 |
| 18.0 | 450 | 25,500 | 0.30 | 0.05 | 0.01 | 16.50 | 419 |
| 20.0 | 500 | 30,500 | 0.31 | 0.05 | 0.01 | 18.25 | 464 |
| 22.0 | 550 | 36,500 | 0.30 | 0.05 | 0.01 | 20.12 | 511 |
| 24.0 | 600 | 46,500 | 0.30 | 0.05 | 0.01 | 22.00 | 559 |
| 26.0 | 650 | 53,500 | 0.30 | 0.05 | 0.01 | 23.75 | 603 |
| 28.0 | 700 | 62,500 | 0.29 | 0.04 | 0.01 | 25.50 | 648 |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |

**Venturi Port Gate Valves**

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| **Class 600 (PN 110)** *Figure No. 1611BY, 1711BY Stop valves* | | | | | | | |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 8x6x8 | 200x150x200 | 2650 | 0.33 | 0.07 | 0.03 | 7.87 | 200 |
| 10x8x10 | 250x200x250 | 4500 | 0.32 | 0.07 | 0.02 | 9.75 | 248 |
| 12x10x12 | 300x250x300 | 7100 | 0.32 | 0.06 | 0.02 | 11.75 | 298 |
| 14x12x14 | 350x300x350 | 9900 | 0.32 | 0.06 | 0.02 | 12.87 | 327 |
| 16x14x16 | 400x350x400 | 12,000 | 0.31 | 0.06 | 0.02 | 14.75 | 375 |
| 18x16x18 | 450x400x450 | 17,500 | 0.29 | 0.05 | 0.01 | 16.50 | 419 |
| 20x18x20 | 500x450x500 | 22,000 | 0.30 | 0.06 | 0.02 | 18.25 | 464 |
| 22x20x22 | 550x500x550 | 29,000 | 0.28 | 0.05 | 0.01 | 20.12 | 511 |
| 24x20x24 | 600x500x600 | 24,500 | 0.30 | 0.06 | 0.02 | 22.00 | 559 |
| 26x22x26 | 650x550x650 | 30,000 | 0.30 | 0.06 | 0.02 | 23.75 | 603 |
| 28x24x28 | 700x600x700 | 40,500 | 0.29 | 0.05 | 0.01 | 25.50 | 648 |
| 30x26x30 | 750x650x750 | 46,500 | 0.29 | 0.05 | 0.01 | 27.37 | 695 |
| 32x28x32 | 800x700x800 | 52,000 | 0.30 | 0.05 | 0.01 | 29.25 | 743 |

## *Table 5 (continued) – Edward Cast Steel Equiwedge® Gate Valve Flow Coefficients*

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

### Regular Port Gate Valves

**Class 900 (PN 150)** *Figure No. 1911/ 1911Y, 14311Y Stop valves*

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| 2.5 | 65 | 380 | 0.63 | 0.17 | 0.02 | 2.25 | 57.2 |
| 3.0 | 80 | 455 | 0.44 | 0.11 | 0.03 | 2.87 | 72.9 |
| 4.0 | 100 | 990 | 0.42 | 0.09 | 0.02 | 3.87 | 98.2 |
| 6.0 | 150 | 2350 | 0.41 | 0.09 | 0.02 | 5.75 | 146 |
| 8.0 | 200 | 4200 | 0.37 | 0.07 | 0.02 | 7.50 | 190 |
| 10.0 | 250 | 6250 | 0.40 | 0.08 | 0.02 | 9.37 | 238 |
| 12.0 | 300 | 9500 | 0.36 | 0.07 | 0.02 | 11.12 | 282 |
| 14.0 | 350 | 12,000 | 0.35 | 0.06 | 0.02 | 12.25 | 311 |
| 16.0 | 400 | 15,000 | 0.35 | 0.06 | 0.02 | 14.00 | 356 |
| 18.0 | 450 | 19,500 | 0.33 | 0.06 | 0.02 | 15.75 | 400 |
| 20.0 | 500 | 26,000 | 0.35 | 0.06 | 0.02 | 17.50 | 444 |
| 22.0 | 550 | 28,000 | 0.38 | 0.07 | 0.02 | 19.25 | 489 |
| 24.0 | 600 | 38,000 | 0.32 | 0.05 | 0.01 | 21.00 | 533 |
| 26.0 | 650 | 45,000 | 0.32 | 0.05 | 0.01 | 22.75 | 578 |
| 28.0 | 700 | 52,500 | 0.31 | 0.05 | 0.01 | 24.50 | 622 |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |

**Class 1500 (PN 260)** *Figure No. 11511/11511Y, 12011Y Stop valves*

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| 2.5 | 65 | 305 | 0.78 | 0.26 | 0.02 | 2.25 | 57.2 |
| 3.0 | 80 | 420 | 0.52 | 0.14 | 0.03 | 2.75 | 69.9 |
| 4.0 | 100 | 760 | 0.47 | 0.12 | 0.03 | 3.62 | 91.9 |
| 6.0 | 150 | 1650 | 0.54 | 0.15 | 0.04 | 5.37 | 136 |
| 8.0 | 200 | 3150 | 0.48 | 0.12 | 0.03 | 7.00 | 178 |
| 10.0 | 250 | 5500 | 0.40 | 0.08 | 0.02 | 8.75 | 222 |
| 12.0 | 300 | 6850 | 0.42 | 0.09 | 0.02 | 10.37 | 263 |
| 14.0 | 350 | 9700 | 0.40 | 0.08 | 0.02 | 11.37 | 289 |
| 16.0 | 400 | 12,000 | 0.39 | 0.08 | 0.02 | 13.00 | 330 |
| 18.0 | 450 | 15,000 | 0.37 | 0.07 | 0.02 | 14.62 | 371 |
| 20.0 | 500 | 18,500 | 0.37 | 0.07 | 0.02 | 16.37 | 416 |
| 22.0 | 550 | 23,000 | 0.37 | 0.07 | 0.02 | 18.00 | 457 |
| 24.0 | 600 | 27,000 | 0.37 | 0.08 | 0.02 | 19.62 | 498 |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |

### Venturi Port Gate Valves

**Class 900 (PN 150)** *Figure No. 1911BY, 14311BY Stop valves*

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 8x6x8 | 200x150x200 | 2000 | 0.37 | 0.09 | 0.03 | 7.50 | 190 |
| 10x8x10 | 250x200x250 | 3500 | 0.35 | 0.08 | 0.02 | 9.37 | 238 |
| 12x10x12 | 300x250x300 | 5950 | 0.35 | 0.08 | 0.02 | 11.12 | 282 |
| 14x12x14 | 350x300x350 | 7700 | 0.39 | 0.09 | 0.03 | 12.25 | 311 |
| 16x14x16 | 400x350x400 | 10,000 | 0.35 | 0.07 | 0.02 | 14.00 | 356 |
| 18x16x18 | 450x400x450 | 14,000 | 0.32 | 0.06 | 0.02 | 15.75 | 400 |
| 20x18x20 | 500x450x500 | 18,000 | 0.32 | 0.06 | 0.02 | 17.50 | 444 |
| 22x20x22 | 550x500x550 | 25,000 | 0.31 | 0.06 | 0.02 | 19.25 | 489 |
| 24x20x24 | 600x500x600 | 23,000 | 0.31 | 0.06 | 0.02 | 21.00 | 533 |
| 26x22x26 | 650x550x650 | 28,000 | 0.31 | 0.06 | 0.02 | 22.75 | 578 |
| 28x24x28 | 700x600x700 | 33,500 | 0.31 | 0.06 | 0.02 | 24.50 | 622 |
| 30x26x30 | 750x650x750 | 38,000 | 0.32 | 0.06 | 0.02 | 26.25 | 667 |
| 32x28x32 | 800x700x800 | 48,000 | 0.29 | 0.05 | 0.01 | 28.00 | 711 |

**Class 1500 (PN 260)** *Figure No. 11511BY, 12011BY Stop valves*

| Size NPS | Size DN | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | d (mm) |
|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 8x6x8 | 200x150x200 | 1650 | 0.43 | 0.12 | 0.04 | 7.00 | 178 |
| 10x8x10 | 250x200x250 | 2950 | 0.41 | 0.11 | 0.03 | 8.75 | 222 |
| 12x10x12 | 300x250x300 | 4500 | 0.40 | 0.10 | 0.03 | 10.37 | 263 |
| 14x12x14 | 350x300x350 | 7050 | 0.37 | 0.08 | 0.02 | 11.37 | 289 |
| 16x14x16 | 400x350x400 | 8700 | 0.37 | 0.08 | 0.02 | 13.00 | 330 |
| 18x16x18 | 450x400x450 | 11,000 | 0.37 | 0.08 | 0.02 | 14.62 | 371 |
| 20x18x20 | 500x450x500 | 13,500 | 0.36 | 0.08 | 0.02 | 16.37 | 416 |
| 22x20x22 | 550x500x550 | 18,000 | 0.34 | 0.07 | 0.02 | 18.00 | 457 |
| 24x20x24 | 600x500x600 | 17,000 | 0.35 | 0.07 | 0.02 | 19.62 | 498 |
| 26x22x26 | 650x550x650 | 20,500 | 0.35 | 0.07 | 0.02 | 21.25 | 540 |
| 28x24x28 | 700x600x700 | 24,000 | 0.36 | 0.08 | 0.02 | 23.00 | 584 |

## Table 5 (continued) – Edward Cast Steel Equiwedge® Gate Valve Flow Coefficients

Black numerals are in U.S. customary units or dimensionless
Colored numerals are in metric units

| Regular Port Gate Valves | | | | | | | |
|---|---|---|---|---|---|---|---|
| Size | | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | |
| NPS | DN | | | | | | |
| **Class 2500 (PN 420)** *Figure No. 12511/ 12511Y, 14411Y Stop valves* | | | | | | | |
| 2.5 | 65 | 150 | 0.78 | 0.50 | 0.02 | 1.87 | 47.5 |
| 3.0 | 80 | 230 | 0.58 | 0.18 | 0.04 | 2.25 | 57.2 |
| 4.0 | 100 | 340 | 0.59 | 0.19 | 0.04 | 2.87 | 72.9 |
| 6.0 | 150 | 910 | 0.61 | 0.19 | 0.05 | 4.37 | 111 |
| 8.0 | 200 | 1850 | 0.51 | 0.14 | 0.04 | 5.75 | 146 |
| 10.0 | 250 | 2950 | 0.48 | 0.12 | 0.03 | 7.25 | 184 |
| 12.0 | 300 | 4350 | 0.46 | 0.11 | 0.03 | 8.62 | 219 |
| 14.0 | 350 | 5150 | 0.47 | 0.12 | 0.03 | 9.50 | 241 |
| 16.0 | 400 | 7050 | 0.46 | 0.11 | 0.03 | 10.87 | 276 |
| 18.0 | 450 | 8950 | 0.46 | 0.11 | 0.03 | 12.25 | 311 |
| 20.0 | 500 | 11,500 | 0.45 | 0.11 | 0.03 | 13.50 | 343 |
| 22.0 | 550 | 14,000 | 0.45 | 0.11 | 0.03 | 14.87 | 378 |
| 24.0 | 600 | 17,500 | 0.43 | 0.10 | 0.03 | 16.25 | 413 |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |

| Venturi Port Gate Valves | | | | | | | |
|---|---|---|---|---|---|---|---|
| Size | | $C_V$ | $F_L$ | $X_T$ | $K_i$ | d | |
| NPS | DN | | | | | | |
| **Class 2500 (PN 420)** *Figure No. 12511B/ 12511BY, 14411BY Stop valves* | | | | | | | |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 8x6x8 | 200x150x200 | 1000 | 0.44 | 0.12 | 0.04 | 5.75 | 146 |
| 10x8x10 | 250x200x250 | 1650 | 0.46 | 0.14 | 0.04 | 7.25 | 184 |
| 12x10x12 | 300x250x300 | 2750 | 0.43 | 0.11 | 0.03 | 8.62 | 219 |
| 14x12x14 | 350x300x350 | 3900 | 0.46 | 0.13 | 0.03 | 9.50 | 241 |
| 16x14x16 | 400x350x400 | 4850 | 0.44 | 0.12 | 0.03 | 10.87 | 276 |
| 18x16x18 | 450x400x450 | 6450 | 0.43 | 0.11 | 0.03 | 12.25 | 311 |
| 20x18x20 | 500x450x500 | 8200 | 0.44 | 0.12 | 0.03 | 13.50 | 343 |
| 22x20x22 | 550x500x550 | 11,500 | 0.39 | 0.10 | 0.03 | 14.87 | 378 |
| 24x20x24 | 600x500x600 | 10,500 | 0.39 | 0.10 | 0.03 | 16.25 | 413 |
| 26x22x26 | 650x550x650 | 13,000 | 0.39 | 0.09 | 0.02 | 17.62 | 448 |
| 28x24x28 | 700x600x700 | 16,000 | 0.39 | 0.09 | 0.03 | 19.00 | 483 |

## Figure 21 – Ratio of Specific heats (k) for some gasses

| | | | | | |
|---|---|---|---|---|---|
| k = 1.3 | Ammonia | Carbon Dioxide | Dry Steam | Methane | Natural Gas |
| k = 1.4 | Air | Carbon Monoxide | Hydrogen | Nitrogen | Oxygen |

## Figure 22A – Saturated Water - Temperature, Pressure & Density (U.S. Units)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp. °F | 32 | 70 | 100 | 200 | 300 | 400 | 500 | 550 | 600 | 650 | 700 | 705 |
| Vapor Pressure, $p_V$ | 0.09 | 0.36 | 0.95 | 11.5 | 67 | 247 | 681 | 1045 | 1543 | 2208 | 3094 | 3206 |
| Water Density, ρ | 62.4 | 62.3 | 62.0 | 60.1 | 57.3 | 53.7 | 49.0 | 46.0 | 42.3 | 37.4 | 27.3 | 19.7 |

*P = Pressure in psia, ρ = Density in lb/ft³*

## Figure 22B – Saturated Water - Temperature, Pressure & Density (Metric)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Temp. °C | 0 | 25 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 370 | 374 |
| Vapor Pressure, $p_V$ | .006 | .032 | .123 | 1.01 | 4.76 | 15.6 | 39.8 | 85.9 | 165.4 | 211 | 221 |
| Water Density, ρ | 1000 | 997 | 988 | 958 | 917 | 865 | 799 | 712 | 574 | 452 | 315 |

*P = Pressure in Bar Absolute, ρ = Density in kg/m³*

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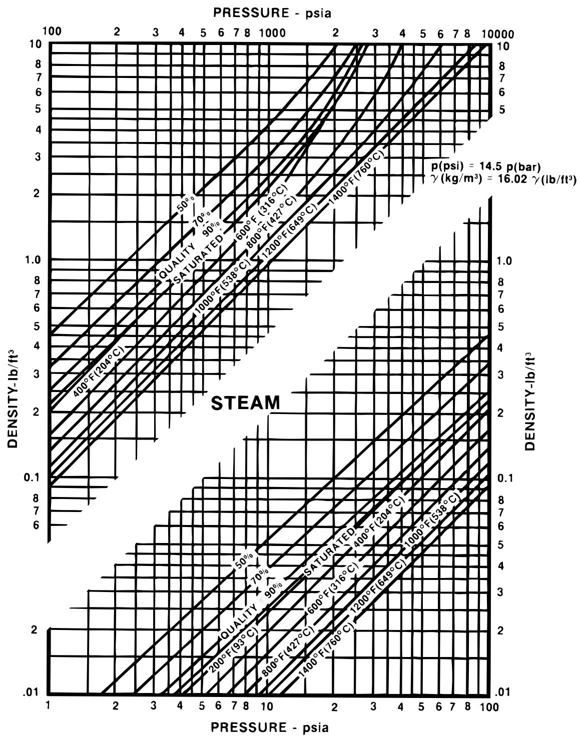
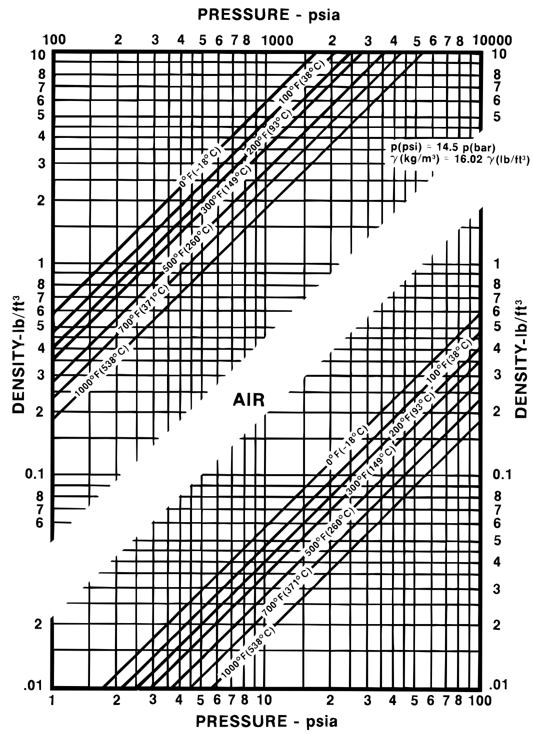
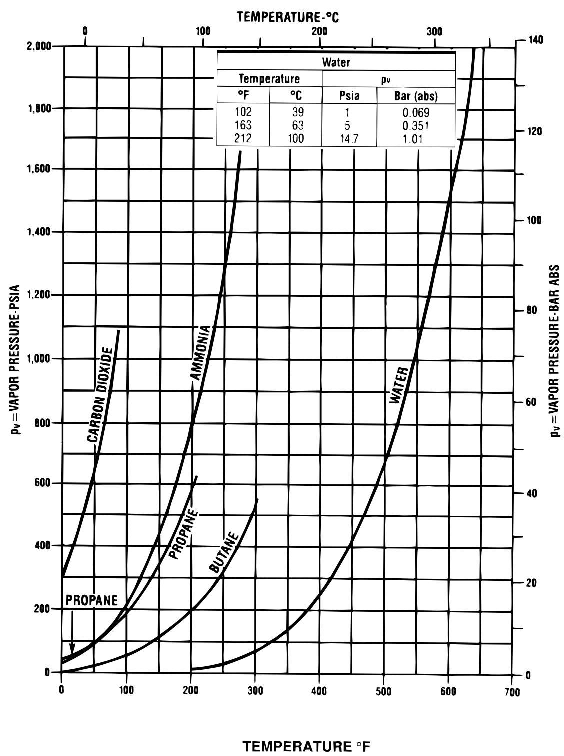
## Figure 22 – Density of Steam




## Figure 23 – Density of Air




## Figure 24 – Vapor Pressure of Liquid



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# Conversion of Measurement Units

**Length**

1 in. = 25.4 mm — 1 mile = 5280 ft
1 in. = 2.54 cm — 1 mile = 1.609 km
1 in. = 0.0254 m — 1 km = 3281 ft
1 ft = 0.3048 m — 1 m = 39.37 in.

**Area**

1 in.$^2$ = 645.2 mm$^2$ — 1 m$^2$ = 10.76 ft$^2$
1 in.$^2$ = 6.452 cm$^2$ — 1 m$^2$ = 1550 in.$^2$
1 ft$^2$ = 144 in.$^2$

**Volume**

1 in.$^3$ = 16.39 cm$^3$ — 1 m$^3$ = 35.31 ft$^3$
1 ft$^3$ = 1728 in.$^3$ — 1 m$^3$ = 264.2 U.S. gal.
1 U.S. gal. = 231 in.$^3$ — 1 m$^3$ = 220 Imp. gal.
1 U.S. gal. = 0.1337 ft$^3$ — 1 m$^3$ = 1000 liters
1 U.S. gal. = 0.8327 Imp. gal. — 1 liter = 61.02 in.$^3$
1 U.S. gal. = 3.7854 liters — 1 liter = 1000 cm$^3$
1 ft$^3$ = 28.32 liters — 1 ml = 1 cm$^3$

**Density**

1 lb/ft$^3$ = 16.02 kg/m$^3$
1 lb/ft$^3$ = 0.01602 g/cm$^3$
1 lb/in$^3$ = 1728 lb/ft$^3$
density = specific gravity x reference density
density = 1/specific volume

**Specific Volume**

specific volume = 1/density

**Temperature**

T(°C) = T(°F -32) / 1.8
T(°F) = 1.8 T(°C) + 32
T(°R) = T(°F) + 460
T(°K) = T(°C) + 273
T(°R) = 1.8 T(°K)

where:
°C = degrees Celsius
°F = degrees Fahrenheit
°K = degrees Kelvin (absolute temperature)
°R = degrees Rankine (absolute temperature)

**Specific Gravity – Liquids**

$$G_l = \frac{\text{density of liquid}}{\text{density of water at reference condition}}$$

Commonly used relations are:

$$G_l = \frac{\text{density of liquid}}{\text{density of water at 60°F and atmospheric pressure}}$$

$$G_l = \frac{\rho\,(\text{lb/ft}^3)}{62.38\,(\text{lb/ft}^3)}$$

$$G_l = \frac{\text{density of liquid}}{\text{density of water at 4°C and atmospheric pressure}}$$

$$G_l = \frac{\rho\,(\text{kg/m}^3)}{1000\,(\text{kg/m}^3)}$$

For practical purposes, these specific gravities may be used interchangeably, as the reference densities are nearly equivalent.

Specific gravities are sometimes given with two temperatures indicated, e.g.,

$$G_l\,\frac{60°F}{60°F},\ G_l\,\frac{15.5°C}{4°C},\ G_l\,60°F/60°$$

The upper temperature is that of the liquid whose specific gravity is given, and the lower value indicates the water temperature of the reference density. If no temperatures are shown, assume that the commonly used relations apply.

For petroleum liquids having an "API degrees" specification:

$$G_l\,60°F/60° = \frac{141.5}{131.5 + \text{API degrees}}$$

**Pressure**

1 Mpa = 145 psi — 1 psi = 6895 Pa
1 pond = 1 gf — 1 psi = 6895 N/m$^2$
1 std atm = 14.696 psi — 1 Pa = 1 N/m$^2$
1 std atm = 1.0133 bar — 1 bar = 14.50 psi
1 std atm = 1.0133 x $10^5$ N/m$^2$ — 1 bar = 100,000 N/m$^2$
1 kgf/cm2 = 14.22 psi
1 std atm =
760 torr absolute pressure =
gage pressure + atmospheric pressure

**Specific Gravity – Gases**

$$G_g = \frac{\text{density of gas (at pressure and temperature of interest)}}{\text{density of air (at same pressure and temperature)}}$$

Because the relation between density, pressure and temperature does not always behave in an ideal way (i.e., ideally, density is proportional to pressure divided by temperature, in absolute units), use of the above relation requires that the pressure and temperature of interest be specified. This means that the specific gravity of a gas as defined may vary with pressure and temperature (due to "compressibility" effects).

Frequently, specific gravity is defined using:

$$G_g = \frac{\text{molecular weight of gas}}{\text{molecular weight of air}} = \frac{M_w}{28.96}$$

If this relation is used to calculate density, one must be careful to consider "compressibility" effects.

When the pressure and temperature of interest are at or near "standard" conditions (14.73 psia, 60°F) or "normal" conditions (1.0135 bar abs, 0°C), specific gravities calculated from either of the above relations are essentially equal.

**Pressure Head**

1 foot of water at 60°F = 0.4332 psi

$$p\,(\text{psi}) = \frac{\rho\,(\text{lb/ft}^3) \times h\,(\text{feet of liquid})}{144}$$

$$p\,(\text{N/m}^2) = \frac{\rho\,(\text{kg/m}^3) \times h\,(\text{meters of liquid})}{0.1020}$$

$$p\,(\text{bar}) = \frac{\rho\,(\text{kg/m}^3) \times h\,(\text{meters of liquid})}{10200}$$

1 meter of water at 20°C = 9.790 kN/m2
1 meter of water at 20°C = 97.90 mbar
1 meter of water at 20°C = 1.420 psi

**Flow Rate**

- mass units

1 lb/hr = 0.4536 kg/hr
1 metric tonne/hr = 2205 lb/hr

- liquid volume units

1 U.S. gpm = 34.28 BOPD
BOPD = barrels oil per day
1 U.S. gpm = 0.8327 Imp. gpm
1 U.S. gpm = 0.2273 m$^3$/hr
1 U.S. gpm = 3.785 liters/min
1 m$^3$/hr = 16.68 liters/min
1 ft$^3$/s = 448.8 U.S. gpm

- mixed units

w(lb/hr) = 8.021 q(U.S. gpm) x $\rho$(lb/ft$^3$)
w(lb/hr) = 500 q(U.S. gpm of water at 70°F or less)

In the following:
STP (standard conditions) refers to 60°F, 14.73 psia
NTP (normal conditions) refers to 0°C, 1.0135 bar abs

$$G_g = \frac{\text{molecular weight of gas}}{\text{molecular weight of air}} = \frac{M_w}{28.96}$$

w(lb/hr) = 60 q(scfm of gas) x $\rho$(lb/ft$^3$) at STP
w(lb/hr) = q(scfh of gas) x $\rho$(lb/ft$^3$) at STP
w(lb/hr) = 4.588 q(scfm of gas) x $G_g$
w(lb/hr) = 0.07646 q(scfh of gas) x $G_g$
w(lb/hr) = 3186 q(MMscfd of gas) x $G_g$
Mmscfd = millions of standard cubic feet per day
w(kg/hr) = q(normal m$^3$/hr of gas) x $\rho$(kg/m$^3$ at NTP)
w(kg/hr) = 1.294 q(normal m$^3$/hr of gas) x $G_g$



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# 3. Edward Valve Design Standards and Features

Engineering and research efforts – both analytical and experimental – have contributed to innovative leadership by Flowserve Edward valves through the introduction or practical development of some major industrial valving features:

- Integral hardfaced seats in globe and angle valves to permit compact valve designs and to resist erosion and wear.
- Impactor handwheels and handles to permit tight shutoff of manually operated globe and angle valves.
- Body-guided globe and angle valve disks to minimize wear and ensure alignment with seats for tight sealing.
- Inclined-bonnet globe valves with streamlined flow passages to minimize pressure drop due to flow.
- Equalizers for large check and stop-check valves to ensure full lift at moderate flow rates and to prevent damage due to instability.
- Compact pressure seal bonnet joints to eliminate massive bolted flanges on large, high-pressure valves:

  – First with wedge-shaped metal gaskets with soft coatings, optimized over more than four decades to provide tight sealing in most services.

  – Now, for the severest services, with composite gaskets using flexible graphite and special anti-extrusion rings to ensure tight sealing, even with severe temperature transients – overcomes need for field re-tightening and eases disassembly for maintenance.
- Optimized stem-packing chambers and packing-material combinations to ensure tight stem sealing:

  – First with asbestos-based materials and then with asbestos-free materials.
- Hermetically sealed globe valves with seal-welded diaphragm stem seals to prevent stem leakage in critical applications, including nuclear.
- Gate valves with flexible double-wedge construction to ensure tight sealing at both low and high pressures and to prevent sticking difficulties when opening.
- Qualified stored-energy actuators for quick-closing valves in safety-related nuclear-plant applications – and qualified valve-actuator combinations that are used in main-steam isolation service throughout the world.

Flowserve valve expertise, acquired over more than 85 years, is shared with national and international codes-and-standards committees and other technical societies and groups whose activities influence industrial valves. This cooperation has included participation in the development of every issue of ASME/ANSI B16.34, as well as most issues of ASME/ANSI B16.5 (Pipe Flanges and Flanged Fittings), which applied to steel valves before ASME/ANSI B16.34 was first issued in 1973. Flowserve representatives have also been active in preparation of ISO (International Standards Organization) standards. In addition, Flowserve representatives have participated, where appropriate, with trade organizations such as EPRI, INPO and various nuclear power plant owners' groups in addressing valve issues.

## 3.1 Codes and Standards

Flowserve Edward valves are designed, rated, manufactured and tested in accordance with the following standards, where applicable:

- ASME B16.34-2004 – Valves: flanged, threaded and welding end.
- ASME/ANSI B16.10-2000 – Face-to-face and end-to-end dimensions of valves.
- ASME B16.11 – Forged Fittings, Socket-welding and Threaded.
- ASME Boiler and Pressure-Vessel Code – Applicable sections including Nuclear Section III.
- ASME and ASTM Material Specifications – Applicable sections.
- MSS Standard Practices – Where appropriate: Edward sealability acceptance criteria are equal to or better than those in MSS SP-61.

Users should note that ASME/ANSI B16.34-2004 has a much broader scope than the previous editions. While this standard previously covered only flanged-end and butt welding-end valves, the 1988 edition covered socket welding-end and threaded-end valves as well. With this revision, the standard now addresses practically all types, materials and end configurations of valves commonly used in pressure-piping systems. All Edward valves in this catalog with a listed class number (e.g. Class 1500) comply with ASME B16.34.

In addition to the standards listed, special requirements, such as those of API and NACE, are considered on application.

## 3.2 Pressure Ratings

Flowserve Edward valve-pressure ratings are tabulated in pressure-versus-temperature format. The temperatures range from -20°F (-29°C) to the maximum temperature permitted for each specific design and pressure-boundary material. Typically, pressure ratings decrease with increasing temperature, approximately in proportion to decreases in material strength.

Valves in this catalog with a listed class number are rated in accordance with ASME B16.34-2004. This standard establishes allowable working pressure ratings for each class number and material. These ratings also vary with class definitions, as described below.

**Standard Class** (Ref: Paragraph 2.1.2 of ASME B16.34-2004) – These lowest ratings apply to all flanged-end valves, as well as any threaded-end or welding-end valves that do not meet the requirements for other classes. Typically, ratings for these valves are consistent with ratings listed for flanges and flanged fittings of similar materials in ASME/ANSI B16.5-2003.

**Special Class** (Ref: Paragraph 2.1.3 of ASME B16.34-2004) – These ratings apply to threaded-end or welding-end valves which meet all requirements for a Standard Class rating and in addition meet special nondestructive examination (NDE) requirements. Valve bodies and bonnets are examined by volumetric and surface examination methods and upgraded as required. Pressure ratings for Special Class valves are higher than those for Standard Class valves (particularly at elevated temperatures) because of the improved assurance of soundness of pressure boundaries and because they are not subject to the limitations of flanged and gasketed end joints.

**Limited Class** (Ref: paragraph 2.1.3 of ASME B16.34-2004) – These ratings apply only to threaded-end or welding-end valves in sizes 2-½ and smaller, with generally cylindrical, internal-wetted pressure boundaries. Limited Class valves meet all requirements for Standard Class valves, and body designs must also satisfy special reinforcement rules to compensate for irregularities in shape. Typically, the regions of minimum wall thickness in these valves are very localized, so minor plasticity in such regions at high temperature will not adversely affect valve geometry. Pressure ratings for Limited Class valves are the same as those for Special Class valves at lower temperatures, but Limited Class ratings are higher at very high temperatures [above 900°F (482°C) for ferritic steels and above 1050°F (565°C) for austenitic steels].

It should be understood that flanged-end valves can be supplied only as Standard Class valves with numerically even pressure-class designations (300, 600, 900, 1500, 2500), for consistency with mating flanges in piping systems. Threaded-end or welding-end valves can be supplied with the same designations or as Class 4500 (for which there is no standard for flanged-end connections). In addition, threaded-end or welding-end valves can be furnished with intermediate ratings or class designations (ref: paragraph 2.1.4 of ASME B16.34-2004), up to Class 2500 for threaded ends and up to Class 4500 for welding-ends. For example, Class 2680 welding-end Univalves can be applied in superheater-drain applications that could not be satisfied with a Class 2500 valve rating.

**Series or CWP**

A few valves in this catalog with "Series" or "CWP" designations are designed, rated, manufactured, and tested to Flowserve Edward valves proprietary standards. These valve designs, qualified by decades of successful field performance, will provide safe and reliable service in applications where an ASME/ANSI rating is not required by a piping code or other specifications.

These valve designs and ratings are generally, but not completely, in conformance with recognized national standards (e.g., some employ high-strength materials not listed in standards). These valves have a history of excellent performance and safety, and they may be applied with confidence in applications where ASME/ANSI ratings are not required.

**Notes:**

1. While Edward cast-steel valves described in this catalog have even-listed ratings (e.g., 1500), many designs provide more wall thickness than required in critical areas. Accordingly, welding-end valves can often be offered with intermediate ratings (ref: paragraph 6.1.4 of ASME B16.34-2004) moderately higher than the nominal class ratings. With appropriate revisions to testing procedures, this can allow somewhat higher pressure ratings than those listed in the tabulations. Consult Edward valves and provide information on specific required design pressure and temperature conditions.

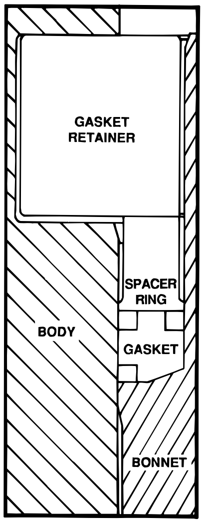
2. Pressure ratings for carbon steel (A105 and A216 WCB) valves are tabulated for temperatures through 1000°F (538°C), which is consistent with ASME B16.34-2004. As noted in that standard, these materials are permissible but, not recommended for prolonged usage at above about 800°F (427°C). This precaution is related to the possibility that carbides in carbon steel may be converted to graphite.

3. Other codes or standards applicable to piping systems may be more restrictive than ASME B16.34-2004 in limiting allowable pressures for valves. For example, ASME B31.1-1995 (Power Piping) does not permit use of carbon steel (A105 and A216 WCB) at design temperatures above 800°F (427°C). Users must consider all codes or regulations applicable to their systems in selecting Edward valves.

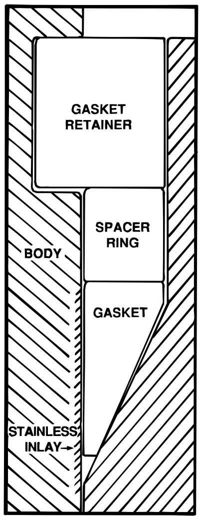
4. The maximum tabulated temperatures at which pressure ratings are given for Edward valves are in some cases less than the maximum temperatures given in ASME B16.34-2004 for valves of the same material. The maximum tabulated temperatures in this catalog may reflect limitations of materials used for other valve parts (e.g., stems). Use of Edward valves at temperatures above the maximum tabulated values may result in degradation and is not recommended.

## 3.3 Pressure Seal Construction

The time-proven Edward pressure seal bonnet seals more effectively as pressure increases, because the pressure forces the sealing elements into closer contact. Metal pressure seal gaskets with soft plating employ optimum contact angles and materials for each applicable valve type, size and pressure-class rating. The gaskets yield initially



Composite Pressure Seal Construction



Typical Pressure Seal Construction



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under bolting load and then under pressure, to provide excellent sealing contact.

New designs for highest pressure/temperature services employ improved composite pressure seal gaskets with flexible graphite rings. Flowserve leadership in proof testing of Edward valves, flexible graphite stem packings clearly showed the superior sealing characteristics of this material, and continued research led to the development of a test-proven bonnet closure that provides highest sealing integrity. The composite pressure seal provides excellent sealing at low and high pressures, even under severe pressure/temperature transients. It provides easier disassembly for maintenance, seals over minor scratches and does not depend on retightening under pressure after reassembly.

## 3.4 Hardfacing

Integrity of seating surfaces on bodies, wedges and disks in gate, globe and check valves is essential for tight shutoff. Valve body seats must be hardfaced, and wedges and disks must either be hardfaced or made from an equivalent base material.

The standard seating material for most Edward valves is cobalt-based Stellite 21®, which has excellent mechanical properties and an exceptional performance history. As compared to Stellite 6®, which was used in many early Edward valves and is still used in many competitive valves, Stellite 21® is more ductile and impact resistant. These properties provide superior resistance to cracking of valve seating surfaces in service.

Stellite 21 is used either as a complete part made from a casting (as in Univalve® disks and small Equiwedge® gate valve wedges) or as a welded hardsurfacing deposit. Depending on valve size and type, hardsurfacing material is applied by a process that assures highest integrity (PTA, MIG, etc.).

While the as-deposited (or as-cast) hardness of Stellite 21 is somewhat lower than that of Stellite 6, Stellite 21 has a work-hardening coefficient that is five times that of Stellite 6. This provides essentially equivalent hardness after machining, grinding and exposure to initial seating stresses. In addition, low friction coefficients attainable with Stellite 21 provide valuable margins in assuring valve operation with reasonable effort or actuator sizing.

The properties of Stellite 21 also provide an advantage to the user long after a valve leaves the Edward plant. If a large valve seat is severely damaged in a localized area, as may occur due to closing on foreign objects, the seat may be repaired locally and refinished. In such cases, where a valve cannot be adequately preheated before welding, a Stellite 6 seat may crack during the repair process – requiring either removal of the valve from the line or in situ, removal replacement of the complete seat.

Some Edward valves have used solid disks made of hardened ASTM A-565 Grade 616 or 615 stainless steel. This corrosion-resistant alloy has been proven in seating and erosion tests and in service. This material can be furnished in certain valves for nuclear plant services where reduced cobalt is desirable. Similar iron-base trim materials are used in production of certain standard valves. Extensive research on other cobalt-free valve trim materials has also identified other alloys that provide good performance under many service conditions. Consult Flowserve about any special trim requirements.

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## 3.5 Valve Stem Packing

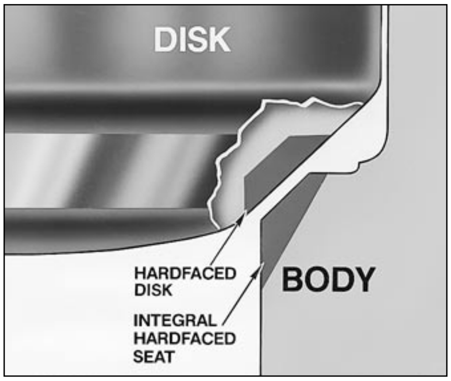
Stem sealing is an extremely important valve performance feature, since seal leakage can represent energy loss, a loss of product and a potential environmental or safety hazard. Consequently, Edward stop and stop-check valves employ stem packings that have been qualified by extensive testing.

The search for improved sealing performance was a primary reason for seeking new stem-packing materials to replace asbestos-based packings. The demand of many valve users to discontinue use of asbestos due to health risks was an important secondary reason. Since there are no simple laboratory tests that will predict sealing performance based on measurable properties of packing materials, hundreds of tests have been necessary with various packings in valves or valve mock-ups.

Some packings required frequent adjustments due to wear, extrusion or breakdown, and some could not be made to seal at all after relatively brief testing. All standard Edward stop and stop-check valves now employ flexible graphite packing, which provides excellent stem sealing. However, the key to its success involves retaining the graphitic material with special, braided end rings to prevent extrusion. Various end rings are used, depending on the valve pressure class and expected service-temperature range.

All Edward valves assembled since January 1986 have been asbestos-free.

See V-REP 86-2 for more information.




# Maintenance

## FLOWSERVE EDWARD VALVES ON-SITE FIELD SERVICE REPAIR CAPABILITIES

Flowserve is totally committed to customer service satisfaction. Our entire manufacturing operation guarantees we will stand behind all field service repair work to maximize customer support.

## OUR FACILITY OFFERS

- Mobile machine shop trailer for on-site repairs
- After hours plant-based service team for around the clock coverage
- Expertly trained field service personnel capable of handling any size field service job
- Special equipment for seat refinishing, body boring, welding and stress relieving
- In-house valve repair and return remanufacturing to original specifications with new valve warranty
- Experience in turnkey jobs to help the customer with one-stop shopping
- 180,000 Sq. Ft. manufacturing facility with state of the art machining and engineering capabilities and ISO 9001 certification
- Flowserve Raleigh is ISO 9001 certified.
- Flowserve Raleigh is authorized by the National Board of Boiler and Pressure Vessel Inspectors to use the “R” and “NR” symbols.

**Phone Toll Free**
**24 Hours a Day**
**365 Days a Year**
**(Day) 1-800-225-6989**
**(Night) 1-800-543-3927**


## STAYING ON-LINE WITH FLOWSERVE

We design and manufacture all our valves for 40 years' life in the field. That means not just building a reliable product, but one that is easy to maintain and service. It also means providing a team of experienced, dedicated professionals to keep your Flowserve valves operating at peak performance.

### Highly Experienced Technicians

Flowserve brings unmatched experience to the field. Our service technicians have an average 20 years in the industry, and 15 years with Flowserve. Each has special skills, such as welding and machining, that we can target for the needs of the individual job.

### Comprehensive Record Keeping

Our files include original specifications for every Flowserve valve sold since 1908. All valves are coded for easy identification. On new and replacement orders, Flowserve stands ready to provide the complete lot traceability required for nuclear and other critical services.

### In-Line Service

We are dedicated to on-site service whenever possible. To this end, we not only provide highly experienced, expert personnel — we also support those technicians with field equipment, including portable boring, lapping, welding and weld-cutting machines. Major parts, such as disks or bonnets, can be air-shipped back to the factory for service and repaired while service personnel perform other tasks.

### Parts Replacement

Our comprehensive record-keeping system also facilitates replacement of parts. Our computer database can quickly tell us if we have the part in stock or on order, or how we can best coordinate raw materials and factory resources for the quickest possible turnaround time.

### New 90-day Warranty

On all valves repaired to Flowserve's standards, we will issue a new 90-day warranty.

### Factory Repair & Upgrading

Our After-Hours Coverage Team (AHCT) specialists are on-call around the clock, seven days a week, to deliver on our commitment to provide immediate response to our customers' requirements. Whether your requirements are for a planned outage, preventive maintenance or an emergency demand, Flowserve will remanufacture or upgrade valves to the original or most current specification. Our in-house engineering and quality assurance support is committed to meet the required turn around time.

### Planned & Emergency Outages

Our service managers will coordinate scheduled maintenance, as well as provide technical assistance to your facility—quickly—for emergency needs.

# Edward Valves
# Catalog and Application Manual Appendix

## End Configurations

### American Steel Flange Standards ASME B16.5

Dimensions in Inches

| Class | Nominal Pipe Size | O Outside Diameter of Flange | R Outside Diameter of Raised Face | C* Minimum Thickness of Flange | A Diameter of Bolt Circle | Number of Bolt Studs | Diameter of Bolt Studs | Diameter of Bolt Stud Holes |
|---|---|---|---|---|---|---|---|---|
| CLASS 600 VALVE FLANGES | ½ | 3.75 | 1.38 | 0.56 | 2.62 | 4 | ½ | 0.62 |
| | ¾ | 4.62 | 1.69 | 0.62 | 3.25 | 4 | 5/8 | 0.75 |
| | 1 | 4.88 | 2.00 | 0.69 | 3.50 | 4 | 5/8 | 0.75 |
| | 1¼ | 5.25 | 2.50 | 0.75 | 3.88 | 4 | 5/8 | 0.75 |
| | 1½ | 6.12 | 2.88 | 0.81 | 4.50 | 4 | ¾ | 0.88 |
| | 2 | 6.50 | 3.62 | 0.88 | 5.00 | 8 | 5/8 | 0.75 |
| | 2½ | 7.50 | 4.12 | 1.00 | 5.88 | 8 | ¾ | 0.88 |
| | 3 | 8.25 | 5.00 | 1.12 | 6.62 | 8 | ¾ | 0.88 |
| | 4 | 10.00 | 6.19 | 1.25 | 7.88 | 8 | ¾ | 0.88 |
| | 5 | 11.00 | 7.31 | 1.38 | 9.25 | 8 | ¾ | 0.88 |
| | 6 | 12.50 | 8.50 | 1.44 | 10.62 | 12 | ¾ | 0.88 |
| | 8 | 15.00 | 10.62 | 1.62 | 13.00 | 12 | 7/8 | 1.00 |
| | 10 | 17.50 | 12.75 | 1.88 | 15.25 | 16 | 1 | 1.12 |
| | 12 | 20.50 | 15.00 | 2.00 | 17.75 | 16 | 1-1/8 | 1.25 |
| | 14 | 23.00 | 16.25 | 2.12 | 20.25 | 20 | 1-1/8 | 1.25 |
| CLASS 600 VALVE FLANGES | ½ | 3.75 | 1.38 | 0.56 | 2.62 | 4 | ½ | 0.62 |
| | ¾ | 4.62 | 1.69 | 0.62 | 3.25 | 4 | 5/8 | 0.75 |
| | 1 | 4.88 | 2.00 | 0.69 | 3.50 | 4 | 5/8 | 0.75 |
| | 1¼ | 5.25 | 2.50 | 0.81 | 3.88 | 4 | 5/8 | 0.75 |
| | 1½ | 6.12 | 2.88 | 0.88 | 4.50 | 4 | ¾ | 0.88 |
| | 2 | 6.50 | 3.62 | 1.00 | 5.00 | 8 | 5/8 | 0.75 |
| | 2½ | 7.50 | 4.12 | 1.12 | 5.88 | 8 | ¾ | 0.88 |
| | 3 | 8.25 | 5.00 | 1.25 | 6.62 | 8 | ¾ | 0.88 |
| | 4 | 10.75 | 6.19 | 1.50 | 8.50 | 8 | 7/8 | 1.00 |
| | 5 | 13.00 | 7.31 | 1.75 | 10.50 | 8 | 1 | 1.12 |
| | 6 | 14.00 | 8.50 | 1.88 | 11.50 | 12 | 1 | 1.12 |
| | 8 | 16.50 | 10.62 | 2.19 | 13.75 | 12 | 1-1/8 | 1.25 |
| | 10 | 20.00 | 12.75 | 2.50 | 17.00 | 16 | 1¼ | 1.38 |
| | 12 | 22.00 | 15.00 | 2.62 | 19.25 | 20 | 1¼ | 1.38 |
| | 14 | 23.75 | 16.25 | 2.75 | 20.75 | 20 | 1-3/8 | 1.50 |
| CLASS 900 VALVE FLANGES** | 2½ | 9.62 | 4.12 | 1.62 | 7.50 | 8 | 1 | 1.12 |
| | 3 | 9.50 | 5.00 | 1.50 | 7.50 | 8 | 7/8 | 1.00 |
| | 4 | 11.50 | 6.19 | 1.75 | 9.25 | 8 | 1-1/8 | 1.25 |
| | 5 | 13.75 | 7.31 | 2.00 | 11.00 | 8 | 1¼ | 1.38 |
| | 6 | 15.00 | 8.50 | 2.19 | 12.50 | 12 | 1-1/8 | 1.25 |
| | 8 | 18.50 | 10.62 | 2.50 | 15.50 | 12 | 1-3/8 | 1.50 |
| | 10 | 21.50 | 12.75 | 2.75 | 18.50 | 16 | 1-3/8 | 1.50 |
| | 12 | 24.00 | 15.00 | 3.12 | 21.00 | 20 | 1-3/8 | 1.50 |
| | 14 | 25.25 | 16.25 | 3.38 | 22.00 | 20 | 1½ | 1.62 |
| CLASS 1500 VALVE FLANGES | ½ | 4.75 | 1.38 | 0.88 | 3.25 | 4 | ¾ | 0.88 |
| | ¾ | 5.12 | 1.69 | 1.00 | 3.50 | 4 | ¾ | 0.88 |
| | 1 | 5.88 | 2.00 | 1.12 | 4.00 | 4 | 7/8 | 1.00 |
| | 1¼ | 6.25 | 2.50 | 1.12 | 4.38 | 4 | 7/8 | 1.00 |
| | 1½ | 7.00 | 2.88 | 1.25 | 4.88 | 4 | 1 | 1.12 |
| | 2 | 8.50 | 3.62 | 1.50 | 6.50 | 8 | 7/8 | 1.00 |
| | 2½ | 9.62 | 4.12 | 1.62 | 7.50 | 8 | 1 | 1.12 |
| | 3 | 10.50 | 5.00 | 1.88 | 8.00 | 8 | 1-1/8 | 1.25 |
| | 4 | 12.25 | 6.19 | 2.12 | 9.50 | 8 | 1¼ | 1.38 |
| | 5 | 14.75 | 7.31 | 2.88 | 11.50 | 8 | 1½ | 1.62 |
| | 6 | 15.50 | 8.50 | 3.25 | 12.50 | 12 | 1-3/8 | 1.50 |
| | 8 | 19.00 | 10.62 | 3.62 | 15.50 | 12 | 1-5/8 | 1.75 |
| | 10 | 23.00 | 12.75 | 4.25 | 19.00 | 12 | 1-7/8 | 2.00 |
| | 12 | 26.50 | 15.00 | 4.88 | 22.50 | 16 | 2 | 2.12 |
| | 14 | 29.50 | 16.25 | 5.25 | 25.00 | 16 | 2¼ | 2.38 |
| CLASS 2500 VALVE FLANGES | ½ | 5.25 | 1.38 | 1.19 | 3.50 | 4 | ¾ | 0.88 |
| | ¾ | 5.50 | 1.69 | 1.25 | 3.75 | 4 | ¾ | 0.88 |
| | 1 | 6.25 | 2.00 | 1.38 | 4.25 | 4 | 7/8 | 1.00 |
| | 1¼ | 7.25 | 2.50 | 1.50 | 5.12 | 4 | 1 | 1.12 |
| | 1½ | 8.00 | 2.88 | 1.75 | 5.75 | 4 | 1-1/8 | 1.25 |
| | 2 | 9.25 | 3.62 | 2.00 | 6.75 | 8 | 1 | 1.12 |
| | 2½ | 10.50 | 4.12 | 2.25 | 7.75 | 8 | 1-1/8 | 1.25 |
| | 3 | 12.00 | 5.00 | 2.62 | 9.00 | 8 | 1¼ | 1.38 |
| | 4 | 14.00 | 6.19 | 3.00 | 10.75 | 8 | 1½ | 1.62 |
| | 5 | 16.50 | 7.31 | 3.62 | 12.75 | 8 | 1¾ | 1.88 |
| | 6 | 19.00 | 8.50 | 4.25 | 14.50 | 8 | 2 | 2.12 |
| | 8 | 21.75 | 10.62 | 5.00 | 17.25 | 12 | 2 | 2.12 |
| | 10 | 26.50 | 12.75 | 6.50 | 21.25 | 12 | 2½ | 2.62 |
| | 12 | 30.00 | 15.00 | 7.25 | 24.38 | 12 | 2¾ | 2.88 |

*C dimensions include raised face in Class 300 values.

**Class 900 and 1500 standards are identical in all sizes below 2½.

# End Configurations (cont'd)

## Socket Welding Ends ASME B16.11

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NPS | ¼ | 3/8 | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ |
|---|---|---|---|---|---|---|---|---|---|
| DN | 8 | 10 | 15 | 20 | 25 | 32 | 40 | 50 | 65 |
| A Socket Diameter - min | 0.56 | 0.69 | 0.86 | 1.07 | 1.33 | 1.68 | 1.92 | 2.41 | 2.91 |
| | 14 | 18 | 22 | 27 | 34 | 43 | 49 | 61 | 74 |
| B Depth of Socket - min | 0.38 | 0.38 | 0.38 | 0.50 | 0.50 | 0.50 | 0.50 | 0.62 | 0.62 |
| | 10 | 10 | 10 | 13 | 13 | 13 | 13 | 16 | 16 |

## Standard Flange Facings & Extras

All Class 300 flanged valves are regularly furnished with 1/16-in. raised face with phonograph finish.

All Class 600, 900, 1500 and 2500 flanged valves are regularly furnished with ¼-in. raised face with phonograph finish.

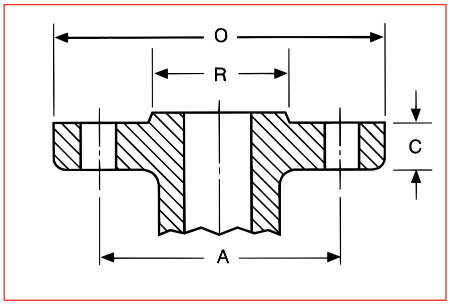
An extra charge will be made for facings other than regularly furnished as above.

No deductions for valves ordered with flange faces only.

Flowserve will furnish valves with patented flange facings with the understanding that the purchaser must obtain from the patent owners a license to use these joints.

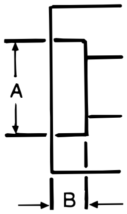
** C dimensions include raised face in Class 300 valves.*

*** Class 900 and 1500 standards are identical in all sizes below size 2½.*




## Socket Welding Ends

Conforming to requirements of ASME/ANSI B16.11




## Threaded Ends

Threaded ends are provided with American National Standard Taper Pipe Threads per ANSI/ASME B1.20.1



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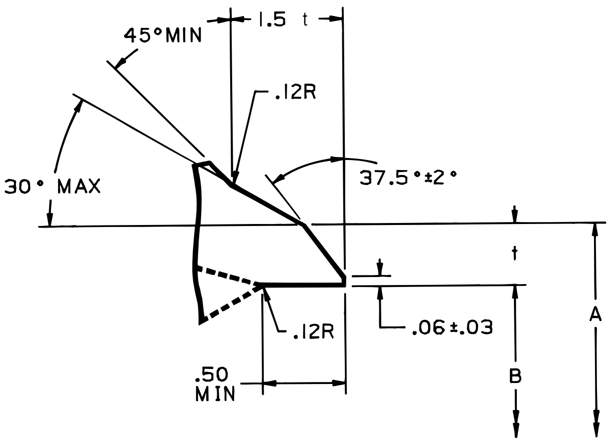
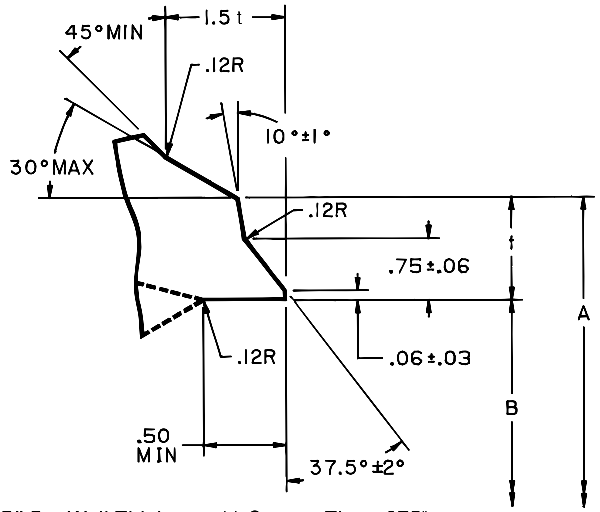
# End Preparations

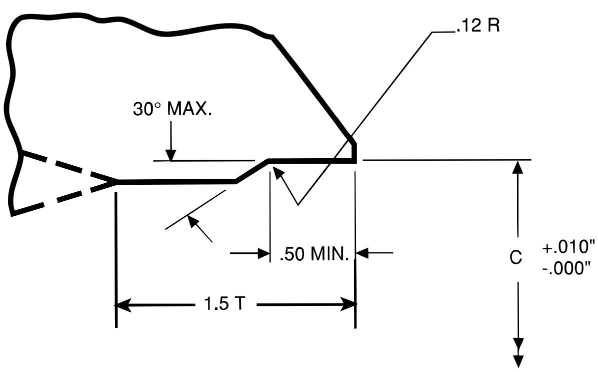
## Buttwelding Ends



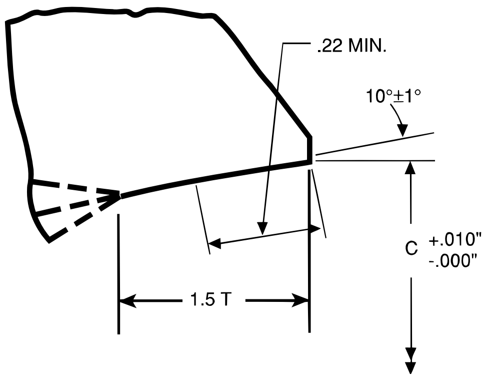

"**A**" For Wall Thickness (t) .1875" to .875" inclusive (ASME B 16.25 - Fig. 2A, 2B or 4)




"**B**" For Wall Thickness (t) Greater Than .875" (ASME B16.25 - Fig. 3A, 3B)




"**C**" Inside Contour for Use With Rectangular Backing Ring (ASME B16.25 - Fig. 2C, 3C)




"**D**" Inside Contour for Use With Taper Backing Ring (ASME B16.25 - Fig. 2D, 3D)

**A – Nominal outside diameter of pipe**
**B – Nominal inside diameter of pipe**
**C – A - 0.031" - 1.75t - 0.010"**
**t – Nominal wall thickness of pipe**

**IMPORTANT:**
When ordering buttwelding end valves, indicate type of weld prep desired from this page and give pipe schedule to be used from pages A4, A5, A6 or provide other complete instructions.

**WARNING!**
If weld prep information is not received at time of order placement, scheduled ship dates cannot be guaranteed.

Inside and outside of welding ends of both cast and forged steel valves to be finish machined and carefully inspected where the thickness of these ends is less than 1.15 t.

Flowserve standard practice is to machine the outside of the casting as shown to avoid sharp re-entrant angles and abrupt changes in slope. Runout of machined surface diameter of valve to have no abrupt change in section. Inside diameter of valve may be either larger or smaller than pipe inside diameter.

# End Preparation for Forged Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | FEATURES ARE PER ANSI B16.25 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
| | | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| ½ 15 | 40 | 0.840 | 21 | 0.622 | 15.8 | 0.608 | 15.4 | 0.109 | 2.8 |
| | 80 | | | 0.546 | 13.9 | 0.542 | 13.8 | 0.147 | 3.7 |
| | 160 | | | 0.464 | 11.8 | 0.470 | 11.9 | 0.188 | 4.8 |
| | XXS | | | 0.252 | 6.4 | 0.285 | 7.2 | 0.294 | 7.5 |
| ¾ 20 | 40 | 1.050 | 27 | 0.824 | 20.9 | 0.811 | 20.6 | 0.113 | 2.9 |
| | 80 | | | 0.742 | 18.8 | 0.740 | 18.8 | 0.154 | 3.9 |
| | 160 | | | 0.612 | 15.6 | 0.626 | 15.9 | 0.219 | 5.6 |
| | XXS | | | 0.434 | 11.0 | 0.470 | 11.9 | 0.308 | 7.8 |
| 1 25 | 40 | 1.315 | 33 | 1.049 | 26.6 | 1.041 | 26.4 | 0.133 | 3.4 |
| | 80 | | | 0.957 | 24.3 | 0.961 | 24.4 | 0.179 | 4.5 |
| | 160 | | | 0.815 | 20.7 | 0.837 | 21.3 | 0.250 | 6.4 |
| | XXS | | | 0.599 | 15.2 | 0.648 | 16.5 | 0.358 | 9.1 |
| 1¼ 32 | 40 | 1.660 | 42 | 1.380 | 35.1 | 1.374 | 34.9 | 0.140 | 3.6 |
| | 80 | | | 1.278 | 32.5 | 1.285 | 32.6 | 0.191 | 4.9 |
| | 160 | | | 1.160 | 29.5 | 1.181 | 30.0 | 0.250 | 6.4 |
| | XXS | | | 0.896 | 22.8 | 0.951 | 24.2 | 0.382 | 9.7 |
| 1½ 40 | 40 | 1.900 | 48 | 1.610 | 40.9 | 1.605 | 40.8 | 0.145 | 3.7 |
| | 80 | | | 1.500 | 38.1 | 1.509 | 38.3 | 0.200 | 5.1 |
| | 160 | | | 1.338 | 34.0 | 1.367 | 34.7 | 0.281 | 7.1 |
| | XXS | | | 1.100 | 27.9 | 1.159 | 29.4 | 0.400 | 10.2 |
| 2 50 | 40 | 2.375 | 60 | 2.067 | 52.5 | 2.065 | 52.5 | 0.154 | 3.9 |
| | 80 | | | 1.939 | 49.3 | 1.953 | 49.6 | 0.218 | 5.5 |
| | 160 | | | 1.687 | 42.9 | 1.734 | 44.0 | 0.344 | 8.7 |
| | XXS | | | 1.503 | 38.2 | 1.571 | 39.9 | 0.436 | 11.1 |
| 2½ 65 | 40 | 2.875 | 73 | 2.469 | 63 | 2.479 | 62.95 | 0.203 | 5.15 |
| | 80 | | | 2.323 | 59 | 2.351 | 59.7 | 0.276 | 7 |
| | 160 | | | 2.125 | 54 | 2.178 | 55.3 | 0.375 | 9.55 |
| | XXS | | | 1.771 | 45 | 1.868 | 47.45 | 0.552 | 14 |
| 3 80 | 40 | 3.500 | 89 | 3.068 | 78 | 3.081 | 78.25 | 0.216 | 5.5 |
| | 80 | | | 2.900 | 74 | 2.934 | 74.5 | 0.300 | 7.6 |
| | 160 | | | 2.624 | 67 | 2.692 | 68.4 | 0.438 | 11.15 |
| | XXS | | | 2.300 | 58 | 2.409 | 61.2 | 0.600 | 15.25 |
| 4 100 | 40 | 4.500 | 114 | 4.026 | 102 | 4.044 | 102.7 | 0.237 | 6 |
| | 80 | | | 3.826 | 97 | 3.869 | 98.25 | 0.337 | 8.55 |
| | 120 | | | 3.624 | 92 | 3.692 | 93.8 | 0.438 | 11.15 |
| | 160 | | | 3.438 | 87 | 3.530 | 89.65 | 0.531 | 13.5 |
| | XXS | | | 3.152 | 80 | 3.279 | 83.3 | 0.674 | 17.1 |

*XXS – Double extra-strong wall thickness.*
*1 – Designations per ANSI B36.10.*

# End Preparations for Cast Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | VALVE[2] PRESSURE CLASS | | | | | FEATURES ARE PER ANSI B16.25 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300 | 600 | 900 | 1500 | 2500 | A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
| | | | | | | | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| 2½<br>65 | 40 | X | X | | | | 2.875 | 73 | 2.469 | 63 | 2.479 | 62.95 | 0.203 | 5.15 |
| | 80 | X | X | X | X | | | | 2.323 | 59 | 2.351 | 59.7 | 0.276 | 7 |
| | 160 | | | X | X | X | | | 2.125 | 54 | 2.178 | 55.3 | 0.375 | 9.55 |
| | XXS | | | | | X | | | 1.771 | 45 | 1.868 | 47.45 | 0.552 | 14 |
| 3<br>80 | 40 | X | X | | | | 3.500 | 89 | 3.068 | 78 | 3.081 | 78.25 | 0.216 | 5.5 |
| | 80 | | X | X | X | | | | 2.900 | 74 | 2.934 | 74.5 | 0.300 | 7.6 |
| | 160 | | | X | X | X | | | 2.624 | 67 | 2.692 | 68.4 | 0.438 | 11.15 |
| | XXS | | | | | X | | | 2.300 | 58 | 2.409 | 61.2 | 0.600 | 15.25 |
| 4<br>100 | 40 | X | X | | | | 4.500 | 114 | 4.026 | 102 | 4.044 | 102.7 | 0.237 | 6 |
| | 80 | | X | X | X | | | | 3.826 | 97 | 3.869 | 98.25 | 0.337 | 8.55 |
| | 120 | | | X | X | | | | 3.624 | 92 | 3.692 | 93.8 | 0.438 | 11.15 |
| | 160 | | | | X | X | | | 3.438 | 87 | 3.530 | 89.65 | 0.531 | 13.5 |
| | XXS | | | | | X | | | 3.152 | 80 | 3.279 | 83.3 | 0.674 | 17.1 |
| 5<br>125 | 40 | X | X | | | | 5.563 | 141 | 5.047 | 128 | 5.070 | 128.8 | 0.258 | 6.55 |
| | 80 | | X | X | X | | | | 4.813 | 122 | 4.866 | 123.6 | 0.375 | 9.55 |
| | 120 | | | X | X | | | | 4.563 | 116 | 4.647 | 118.05 | 0.500 | 12.7 |
| | 160 | | | | X | X | | | 4.313 | 110 | 4.428 | 112.45 | 10.625 | 15.9 |
| | XXS | | | | | X | | | 4.063 | 103 | 4.209 | 106.9 | 0.750 | 19.05 |
| 6<br>150 | 40 | X | X | | | | 6.625 | 168 | 6.065 | 154 | 6.094 | 154.8 | 0.280 | 7.1 |
| | 80 | | X | X | X | | | | 5.761 | 146 | 5.828 | 148.05 | 0.432 | 10.95 |
| | 120 | | | X | X | | | | 5.501 | 140 | 5.600 | 142.25 | 0.562 | 14.25 |
| | 160 | | | | X | X | | | 5.187 | 132 | 5.326 | 135.3 | 0.719 | 18.25 |
| | XXS | | | | X | X | | | 4.897 | 124 | 5.072 | 128.85 | 0.864 | 21.95 |
| 8<br>200 | 40 | X | X | | | | 8.625 | 219 | 7.981 | 203 | 8.020 | 203.7 | 0.322 | 8.2 |
| | 60 | | X | | | | | | 7.813 | 198 | 7.873 | 199.95 | 0.406 | 10.3 |
| | 80 | | X | X | X | | | | 7.625 | 194 | 7.709 | 195.8 | 0.500 | 12.7 |
| | 100 | | X | X | X | | | | 7.437 | 189 | 7.544 | 191.6 | 0.594 | 15.1 |
| | 120 | | | X | X | | | | 7.187 | 183 | 7.326 | 186.1 | 0.719 | 18.25 |
| | 140 | | | | X | | | | 7.001 | 178 | 7.163 | 181.95 | 0.812 | 20.6 |
| | XXS | | | | X | X | | | 6.875 | 175 | 7.053 | 179.15 | 0.875 | 22.25 |
| | 160 | | | | X | X | | | 6.813 | 173 | 6.998 | 177.75 | 0.906 | 23 |
| 10<br>250 | 40 | X | X | | | | 10.750 | 273 | 10.02 | 255 | 10.070 | 255.8 | 0.365 | 9.25 |
| | 60 | | X | | | | | | 9.750 | 248 | 9.834 | 249.8 | 0.500 | 12.7 |
| | 80 | | X | X | X | | | | 9.562 | 243 | 9.670 | 245.6 | 0.594 | 15.1 |
| | 100 | | X | X | X | | | | 9.312 | 237 | 9.451 | 240.05 | 0.719 | 18.25 |
| | 120 | | | X | X | | | | 9.062 | 230 | 9.232 | 234.5 | 0.844 | 21.45 |
| | 140 | | | | X | | | | 8.750 | 222 | 8.959 | 227.55 | 1.000 | 25.4 |
| | 160 | | | | X | X | | | 8.500 | 216 | 8.740 | 222 | 1.125 | 28.6 |
| 12<br>300 | STD | X | X | | | | 12.750 | 324 | 12.000 | 305 | 12.053 | 306.15 | 0.375 | 9.55 |
| | 40 | X | X | | | | | | 11.938 | 303 | 11.999 | 304.75 | 0.406 | 10.3 |
| | XS | X | X | | | | | | 11.750 | 298 | 11.834 | 300.6 | 0.500 | 12.7 |
| | 60 | | X | | | | | | 11.625 | 298 | 11.725 | 297.8 | 0.562 | 14.25 |
| | 80 | | X | X | X | | | | 11.374 | 289 | 11.505 | 292.25 | 0.688 | 17.5 |
| | 100 | | X | X | X | | | | 11.062 | 281 | 11.232 | 285.3 | 0.844 | 21.45 |
| | 120 | | | X | X | | | | 10.750 | 273 | 10.959 | 278.35 | 1.000 | 25.4 |
| | 140 | | | | X | | | | 10.500 | 267 | 10.740 | 272.8 | 1.125 | 28.6 |
| | 160 | | | | X | X | | | 10.126 | 257 | 10.413 | 264.5 | 1.312 | 33.3 |

*STD – Standard wall thickness.*
*XS – Extra-strong wall thickness.*
*XXS – Double extra-strong wall thickness.*

*1 – Designations per ANSI B36.10. 2 – The welding ends of valve bodies do not contain enough extra material to match the wall thickness of all pipe schedules. The "X" marks show the schedules that can be supplied for each size and pressure class of valve bodies. Many Class 1500 and 2500 valves can be machined to accommodate special high-pressure pipe with greater wall thickness and smaller inside diameter than schedule 160; consult your Edward Valves sales representative concerning such cases.*

# End Preparations for Cast Steel Valves

## Buttwelding Ends

Black numerals are in inches and pounds
Colored numerals are in millimeters and kilograms

| NOMINAL PIPE SIZE | PIPE[1] SCH. NO. | VALVE[2] PRESSURE CLASS | | | | | FEATURES ARE PER ANSI B16.25 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A OUTSIDE DIAMETER | | B INSIDE DIAMETER | | C BORE OF WELDING LIP | | t WALL THICKNESS | |
| | | 300 | 600 | 900 | 1500 | 2500 | INCHES | MM | INCHES | MM | INCHES | MM | INCHES | MM |
| 14<br>350 | STD | X | | | | | 14.000 | 356 | 13.25 | 337 | 13.303 | 337.9 | 0.375 | 9.55 |
| | 40 | | X | | | | | | 13.124 | 333 | 13.192 | 335.1 | 0.438 | 11.15 |
| | XS | | X | | | | | | 13 | 330 | 13.084 | 332.35 | 0.5 | 12.7 |
| | 60 | | X | | | | | | 12.812 | 325 | 12.92 | 328.15 | 0.594 | 15.1 |
| | 80 | | X | X | X | | | | 12.5 | 318 | 12.646 | 321.2 | 0.75 | 19.05 |
| | 100 | | X | X | X | | | | 12.124 | 308 | 12.318 | 312.9 | 0.938 | 23.85 |
| | 120 | | | X | X | | | | 11.812 | 300 | 12.044 | 305.9 | 1.094 | 27.8 |
| | 140 | | | | X | | | | 11.5 | 292 | 11.771 | 299 | 1.25 | 31.75 |
| | 160 | | | | X | X | | | 11.188 | 284 | 11.498 | 292.05 | 1.406 | 35.7 |
| 16<br>400 | STD | | X | | | | 16.000 | 406 | 15.25 | 387 | 15.303 | 388.7 | 0.375 | 9.55 |
| | 40 | | X | | | | | | 15 | 381 | 15.084 | 383.15 | 0.5 | 12.7 |
| | 60 | | X | | | | | | 14.688 | 373 | 14.811 | 376.2 | 0.656 | 16.65 |
| | 80 | | X | X | X | | | | 14.312 | 364 | 14.482 | 367.85 | 0.844 | 21.45 |
| | 100 | | X | X | X | | | | 13.938 | 354 | 14.155 | 359.55 | 1.031 | 26.2 |
| | 120 | | | X | X | | | | 13.562 | 344 | 13.826 | 351.2 | 1.219 | 30.95 |
| | 140 | | | | X | | | | 13.124 | 333 | 13.442 | 341.45 | 1.438 | 36.55 |
| | 160 | | | | X | X | | | 12.812 | 325 | 13.17 | 334.5 | 1.594 | 40.5 |
| 18<br>450 | 40 | | X | | | | 18.000 | 457 | 16.876 | 429 | 16.975 | 431.15 | 0.562 | 14.25 |
| | 60 | | X | | | | | | 16.500 | 419 | 16.646 | 422.8 | 0.75 | 19.05 |
| | 80 | | X | X | | | | | 16.124 | 410 | 16.318 | 414.5 | 0.938 | 23.85 |
| | 100 | | X | X | X | | | | 15.688 | 398 | 15.936 | 404.75 | 1.156 | 29.35 |
| | 120 | | | X | X | X | | | 15.250 | 387 | 15.553 | 395.05 | 1.375 | 34.95 |
| | 140 | | | X | X | X | | | 14.876 | 378 | 15.225 | 386.7 | 1.562 | 39.65 |
| | 160 | | | | X | X | | | 14.438 | 367 | 14.842 | 377 | 1.781 | 45.25 |
| 20<br>500 | 40 | | X | | | | 20.000 | 508 | 18.812 | 478 | 18.92 | 480.55 | 0.594 | 15.1 |
| | 60 | | X | | | | | | 18.376 | 467 | 18.538 | 470.85 | 0.812 | 20.6 |
| | 80 | | X | X | | | | | 17.938 | 456 | 18.155 | 461.15 | 1.031 | 26.2 |
| | 100 | | X | X | X | | | | 17.438 | 443 | 17.717 | 450 | 1.281 | 32.55 |
| | 120 | | | X | X | X | | | 17 | 432 | 17.334 | 440.3 | 1.5 | 38.1 |
| | 140 | | | X | X | X | | | 16.5 | 419 | 16.896 | 429.15 | 1.75 | 44.45 |
| | 160 | | | | X | X | | | 16.062 | 408 | 16.513 | 419.45 | 1.969 | 50 |
| 22<br>550 | STD | | X | | | | 22.000 | 559 | 21.25 | 540 | 21.303 | 541.1 | 0.375 | 9.55 |
| | XS | | X | | | | | | 21 | 533 | 21.084 | 535.55 | 0.5 | 12.7 |
| | 60 | | X | X | | | | | 20.25 | 514 | 20.428 | 518.85 | 0.875 | 22.25 |
| | 80 | | X | X | | | | | 19.75 | 502 | 19.99 | 507.75 | 1.125 | 28.6 |
| | 100 | | | X | X | X | | | 19.25 | 489 | 19.553 | 496.65 | 1.375 | 34.95 |
| | 120 | | | X | X | X | | | 18.75 | 476 | 19.115 | 485.5 | 1.625 | 41.3 |
| | 140 | | | | X | X | | | 18.25 | 464 | 18.678 | 474.4 | 1.875 | 47.65 |
| | 160 | | | | | | | | 17.75 | 451 | 18.24 | 463.3 | 2.125 | 54 |
| 24<br>600 | STD | | | | | | 24.000 | 610 | 23.25 | 591 | 23.303 | 591.9 | 0.375 | 9.55 |
| | XS | | | | | | | | 23 | 584 | 23.084 | 586.35 | 0.5 | 12.7 |
| | 30 | | X | | | | | | 22.876 | 581 | 22.975 | 583.55 | 0.562 | 14.25 |
| | 40 | | X | X | | | | | 22.624 | 575 | 22.755 | 578 | 0.688 | 17.5 |
| | 60 | | X | X | | | | | 22.062 | 560 | 22.263 | 565.5 | 0.969 | 24.6 |
| | 80 | | X | X | X | | | | 21.562 | 548 | 21.826 | 554.4 | 1.219 | 30.95 |
| | 100 | | X | X | X | | | | 20.938 | 532 | 21.28 | 540.5 | 1.531 | 38.9 |
| | 120 | | | X | X | X | | | 20.376 | 518 | 20.788 | 528 | 1.812 | 46 |
| | 140 | | | X | X | X | | | 19.876 | 505 | 20.35 | 516.9 | 2.062 | 52.35 |
| | 160 | | | | X | X | | | 19.312 | 491 | 19.857 | 504.35 | 2.344 | 59.55 |

*STD – Standard wall thickness.*
*XS – Extra-strong wall thickness.*
*XXS – Double extra-strong wall thickness.*

*1 – Designations per ANSI B36.10.*
*2 – The welding ends of valve bodies do not contain enough extra material to match the wall thickness of all pipe schedules. The "X" marks show the schedules that can be supplied for each size and pressure class of valve bodies. Many Class 1500 and 2500 valves can be machined to accommodate special high-pressure pipe with greater wall thickness and smaller inside diameter than schedule 160; consult your Edward Valves sales representative concerning such cases.*



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