Flexi-Hinge® CHECK VALVE

ENGINEERING INFORMATION

Table of Contents

January 2010
Flexi-Hinge® Valve Co., Inc.

Flexi-Hinge® Check Valves

Series Selection Guide

End Connection, Materials, and Pressure Ratings

SERIES	BODY STYLE (1)	INTERNALS MATERIAL (1) (2) (3)	FLANGE CLASS (4)	MAXIMUM PRESSURE PSI
502-M-12**	Male pipe threaded ends (MPT), Carbon Steel	316 SS	N/A	200
502-M-22**	Male pipe threaded ends (MPT), 316 SS	316 SS	N/A	200
502-M-33**	Male pipe threaded ends (MPT), Aluminum	Aluminum	N/A	200
595M-12**	Male pipe threaded ends (MPT) Foot Valve, Carbon Steel	316 SS	N/A	200
595M-22**	Male pipe threaded ends (MPT) Foot Valve, 316 SS	316 SS	N/A	200
503-12**	Flanged style 150#, Carbon Steel	316 SS	150	200
503-22**	Flanged style 150#, 316 SS	316 SS	150	200
595-12**	Flanged style 150# Foot Valve, Carbon Steel	316 SS	150	200
595-22**	Flanged style 150# Foot Valve, 316 SS	316 SS	150	200
513-12**	Grooved ends, Carbon Steel	316 SS	N/A	200
513-22**	Grooved ends, 316 SS	316 SS	N/A	200
513-33**	Grooved ends, Aluminum	Aluminum	N/A	200
514-12**	Plain ends, Carbon Steel	316 SS	N/A	200
514-22**	Plain ends, 316 SS	316 SS	N/A	200
514-33**	Plain ends, Aluminum	Aluminum	N/A	200
517-12**	Flanged Expansion style 150#, Carbon Steel	316 SS	150	200
517-22**	Flanged Expansion style 150#, 316 SS	316 SS	150	200
517M-12**	Male pipe threaded ends (MPT) Expansion Style, Carbon Steel	316 SS	N/A	200
517M-22**	Male pipe threaded ends (MPT) Expansion Style, 316 SS	316 SS	N/A	200
581F-12**	Flanged style 125# - Long Pattern, Carbon Steel	316 SS	125	195
581R-12**	Flanged style 150# - Long Pattern, Carbon Steel	316 SS	150	200

NOTES:
(1) Other materials are available, please consult the factory.
(2) Standard seal material is Buna-N; other materials are available, please consult the factory.
(3) Standard hardware is 316 SS; other materials are available, please consult the factory.
(4) Please consult the factory for flange classes not shown; Metric, British, DIN, JIS, and other international standards are available.

Attention: Sales Department **Sheet ____ of ____**
Response required by: ________________

Customer: ________________________________
Address: ________________________________
____
____

Contact: ______________________
Phone: ______________________
Fax: ______________________
E-mail: ______________________

APPLICATION INFORMATION

System: ____

Flow Media: ____

Service: Liquid Gas **(circle one)**

Nominal Line Size: __________ **(if known)** **Recommended Size** ______________________

Flow Rate: ________________ gpm lpm cfm m^3/min **(circle one)**

System Pressure: min_______ **max**________ psig kg./cm^2 **(circle one)**

Max. Differential Pressure acceptable: __________ psig kg./cm^2 **(circle one)**

System Temperature Range: **min** ____ ^{o} Fahrenheit Centigrade **(circle one)**
max ____

Valve Orientation: horizontal vertical-UP vertical-DOWN **(circle one)**
angled-UP angled-DOWN

Pump / Blower Type: centrifugal positive displacement **(circle one)**
vertical turbine other ______________________________________
Suction side Discharge side **(circle one)**

VALVE INFORMATION

Valve Series: ________________ **(if known)**

Body Style: MTE FTE Grooved Plain Flanged Wafer **(circle one)**
Special Combination _______________ and ___________________

Materials: Body: ____
Internals: ____
Seal: Buna-N EPDM Viton® Silicone **(circle one)**

Spring Required: yes no **(circle one)**

Special Coatings: ____

Testing Required: Hydrostatic Seat Leakage **(circle if needed)**

Screen Size: ______________ **Material:** 316 SS other ________ **(Foot Valves Only)**

Other Special Requirements: ____
____

APPLICATION DIAGRAM: Attach additional sheets as required Note: Indicate nearest upstream and downstream components and distance.

This page has been intentionally left blank.

VALVE APPLICATION INFORMATION

1. GENERAL CONSIDERATIONS

1.1 ORIENTATION / PLACEMENT IN PIPELINE SYSTEMS

Flexi-Hinge® valves must be installed with the center post vertical in horizontal pipelines. Failure to do so will result in uneven loading of closure plates as well as insufficient operation. Installation in vertical up flow does not require any additional considerations. However, vertical down flow will likely require valves with an optional spring to ensure closure of valve plates. For other orientations, such as angled pipelines, please consult the factory with your specific requirements.

When placing Flexi-Hinge® valves in pipelines, a minimum of five pipe diameters should be maintained upstream and downstream from other piping components, such as fittings and other valves. Locating the check valve near other components may directly affect its performance and life. Flow, which is relatively laminar, is required to maintain stable, open valve plates. In the 'check' direction, relatively laminar flow is also required to provide smooth, complete closure of the valve plates.

1.2 TYPES OF SYSTEMS

These check valves are best suited for continuous, positive displacement flow applications. Pulse type, cyclic, or reciprocating operation are **not** recommended and will likely result in inadequate operation and early failure of the hinge/sealing member.

Flexi-Hinge® valves can be successfully used in low pressure gas and liquid applications due to its large flow area and low opening and closing pressure requirements. The normally closed configuration ensures positive closing in low flow, low pressure systems.

1.3 PAINTING AND PLATING

All steel and aluminum valve bodies are provided standard with a durable paint finish on the exterior. Other special finishes are available, please consult the factory for your specific painting requirements.

Custom plating of body and internal components is available to improve resistance to corrosion and/or wear. Please consult the factory with your specific needs.

2. DESIGN CONSIDERATIONS

2.1 MAXIMUM OPERATING PRESSURE AND TEMPERATURE

Maximum operating pressures are given in the valve series data sheets. Generally they are limited by the internal components. Pressures beyond those stated are considered special and the factory should be contacted with your requirements. ANSI flanged units **do not** meet full ANSI ratings as to pressure and temperature, therefore the specific series limitations must be observed for safe operation.

Maximum operating temperatures are generally limited by seal selection. The maximum (intermittent) temperatures for various standard seal materials are as follows:

SEAL MATERIAL	
Material	**Temperature Range °F [°C]**
Buna-N	-60 to 225 [-51 to 107]
EPDM	-40 to 300 [-40 to 149]
Viton ®	-20 to 400 [-29 to 204]
Silicone	-100 to 500 [-73 to 260]

See Appendix A for specific seal properties and resistance comparisons.

2.2 OPENING AND CLOSING PRESSURE REQUIREMENTS

As an operational guide, Flexi-Hinge® valves begin to open at approximately 0.1 psid (0.007 bar) and are fully open at approximately 0.5 psid (0.035 bar). Valves with optional springs function at approximately double these pressure differentials. Other considerations may effect these values, such as your specific pipeline orientation (flow up, down, or angled), variations in internal materials, and specific size of the valve (large valves may require more or less due to the total surface area or the weight of the valve plates).

2.3 DIFFERENTIAL PRESSURE AND VELOCITY CRITERIA

The maximum recommended pressure drop across the valve is 1.0 psi (0.07 bar) for liquids and 0.1 psi (0.007 bar) for gases. The maximum recommended velocity through the valve is 18 fps (5.5 mps) for liquids and 100 fps (30 mps) for gases.

Specific applications should be checked as outlined in section 2.6 and 2.7 for your flow and pressure requirements. Exceeding these guidelines may result in excessive wear on valve components, poor performance, and excessive pressure loss. Pressure loss charts are provided in Appendix B for liquid and gas service.

2.4 RECOMMENDED LIQUID FLOW RATES

Maximum recommended liquid flow rates are listed below. These rates are limited by the design of the valve (flow area) or by the maximum liquid velocity, which the valve should be subjected to.

Nominal Size (inches)	Nominal Size (mm)	Flexi-Hinge® Check Valves Metal Construction			
		C_v English-Gpm (at 1.0 psid)	C_v Metric-Lpm (at 1.0 psid)	Maximum Flow English – Gpm (at 18 fps)	Maximum Flow Metric – Lpm (at 5.5 mps)
1”	25	37	140	32	121
1-1/4”	32	65	246	57	215
1-1/2”	40	91	345	73	276
2”	50	160	606	137	519
2-1/2”	65	410	1552	217	821
3”	80	620	2347	315	1192
4”	100	965	3653	605	2290
5”	125	1510	5716	953	3607
6”	150	3025	11451	1341	5076
8”	200	5195	19665	2472	9357
10”	250	7345	27803	3838	14528
12”	300	9450	35772	5348	20244
14”	355	13420	50728	7321	27713
16”	400	15910	60226	9572	36234
18”	455	18750	70976	12344	46727
20”	505	29680	112190	14929	56512
24”	610	40950	154791	22124	83748

Shaded columns indicate limiting flow rate.

NOTE: The use of the optional spring configuration will approximately double the pressure drop across the check valve. Care should be exercised when selecting a valve. The desired maximum pressure drop, the flow rate, and the velocity should be considered for final selection of the appropriate valve size.

2.5 CHECK VALVE PARAMETERS – AREA, EQUIVALENT DIAMETERS, AND RESISTANCE COEFFICIENT

Nominal Size (inches)	Nominal Size (mm)	Flexi-Hinge® Check Valves				
		Flow Area (in.^{2})	Equivalent Diameter (inches)	Flow Area (cm^2)	Equivalent Diameter (centimeters)	Resistance Coefficient "K"
1”	25	0.58	0.86	3.74	2.18	0.35
1-1/4”	32	1.01	1.13	6.52	2.88	0.35
1-1/2”	40	1.44	1.35	9.29	3.44	0.35
2”	50	2.59	1.82	16.70	4.61	0.35
2-1/2”	65	4.03	2.26	26.00	5.75	0.12
3”	80	5.76	2.71	37.16	6.88	0.12
4”	100	10.66	3.68	68.77	9.35	0.17
5”	125	16.99	4.65	109.61	11.81	0.17
6”	150	23.76	5.50	153.29	13.97	0.11
8”	200	43.92	7.48	283.35	19.00	0.11
10”	250	68.40	9.33	441.29	23.70	0.11
12”	300	95.34	11.02	615.10	28.00	0.11
14”	355	130.47	12.89	841.74	32.74	0.11
16”	400	170.60	14.74	1100.64	37.43	0.11
18”	455	220.00	16.74	1419.35	42.51	0.11
20”	505	266.07	18.41	1716.58	46.75	0.11
24”	610	394.29	22.41	2543.80	56.91	0.11

2.6 VELOCITY CHECK FOR LIQUID OR GAS APPLICATIONS

LIQUID

ENGLISH

$$\text{VELOCITY (ft./sec.)} = \frac{\text{Flow Rate (gpm)} \times 0.3208}{\text{Flow Area (in.}^2\text{)}}$$

METRIC

$$\text{VELOCITY (mps)} = \frac{\text{Flow Rate (lpm)} \times 0.166}{\text{Flow Area (cm}^2\text{)}}$$

GAS

ENGLISH

$$\text{VELOCITY (ft./sec.)} = \frac{\text{Flow Rate (cfm)} \times 2.4}{\text{Flow Area (in.}^2\text{)}}$$

METRIC

$$\text{VELOCITY (mps)} = \frac{\text{Flow Rate (m}^3\text{/min)} \times 166.7}{\text{Flow Area (cm}^2\text{)}}$$

NOTE: **See valve flow area in square inches or square centimeters on page 7.**
Compare the applications actual velocity to the recommended maximum shown on page 7.

EXAMPLE:

Check the velocity thru a 6” Flexi-Hinge® valve at a liquid flow rate of 900 gpm.

1. The flow area of a 6” valve is 23.76 square inches
2. Performing the calculation for liquid applications:
   900 gpm x 0.3208 / 23.76 in.^{2} = 12 ft./sec.

A velocity of 12 ft./sec. is less than the maximum recommended velocity. A 6” valve would be acceptable with regard to velocity. A further check with respect to the pressure drop should be performed before finalizing the valve selection. See below for pressure drop calculations or see charts in Appendix B.

2.7 PRESSURE DROP CHECK FOR LIQUID OR GAS APPLICATIONS

LIQUID - ENGLISH

$$\text{Differential Pressure (psid)} = \left(\frac{Q}{C_v}\right)^2 \frac{P}{62.4}$$

where: Q = Flow Rate in gpm
C_v = Flow Coefficient in gpm (see page 7)
P = Weight Density of the fluid in lbs./ft^3
(water at 60^{o}F P = 62.4 lbs./ft^3)

LIQUID - METRIC

$$\text{Differential Pressure (bar)} = \frac{\left(\frac{Q}{C_v}\right)^2}{14.7} \frac{P}{1000}$$

where: Q = Flow Rate in lpm
C_v = Flow Coefficient in lpm (see page 7)
P = Weight Density of the fluid in Kg/m^3
(water at 16^{o}C P = 1000 Kg/m^3)

2.7 PRESSURE DROP CHECK (CONT'D)

GAS - ENGLISH

$$\text{Differential Pressure (psid)} = \frac{Q^2 \quad K \quad T \quad Sg}{459684 \quad d^4 \quad P}$$

where:
Q= Flow Rate in SCFM
K= Resistance Coefficient (see section 2.5)
T= Temperature, ^{o}Rankine (^{o}F + 460)
Sg= Specific Gravity (air = 1.0)
d= Equivalent dia., inches (see section 2.5)
P= Pressure, psia (14.7 at atmospheric)

GAS - METRIC

$$\text{Differential Pressure (bar)} = \frac{Q^2 \quad K \quad T \quad Sg}{1300 \quad d^4 \quad P}$$

where:
Q= Flow Rate in standard cubic meters/min.
K= Resistance Coefficient (see section 2.5)
T= Temperature, ^{o}Rankine
Sg= Specific Gravity (air = 1.0)
d= Equivalent dia., cm (see section 2.5)
P= Pressure, bars (1.0 at atmospheric)

2.8 ACTUAL TO STANDARD CFM FOR GAS SERVICE

In most systems, the actual flow rate in cubic feet per minute at flowing conditions is known. To use this value will require the conversion to standard flow rate at standard conditions (60^{o}F and 14.7 psi) for use in the various formulas. The suggested method of conversion is given below:

$$\text{SCFM} = \frac{\text{ACFM}}{\left(\frac{14.7}{14.7 + P}\right)\left(\frac{460 + T}{520}\right)}$$

where:
T= Temperature, ^{o}F
P= Pressure, psig
ACFM = Actual ft.^{3} / min.
SCFM = Standard ft.^{3} / min.

3. INSTALLATION CONSIDERATIONS

3.1 FUNCTIONAL CHECK

Before installation, the movement of the valve plates should be checked for free operation. Move the plates manually from fully closed to fully open positions, noting any significant binding or interference. Some “drag” is normal due to the nature of the sealing member. Additionally, the valve plates may appear not to seat tightly, this also is normal, and is due to the stiffness of the sealing member conforming to the body bore. This condition will moderate as the valve cycles during service. If any significant interference is noted, the factory should be contacted for additional information on how this can be corrected.

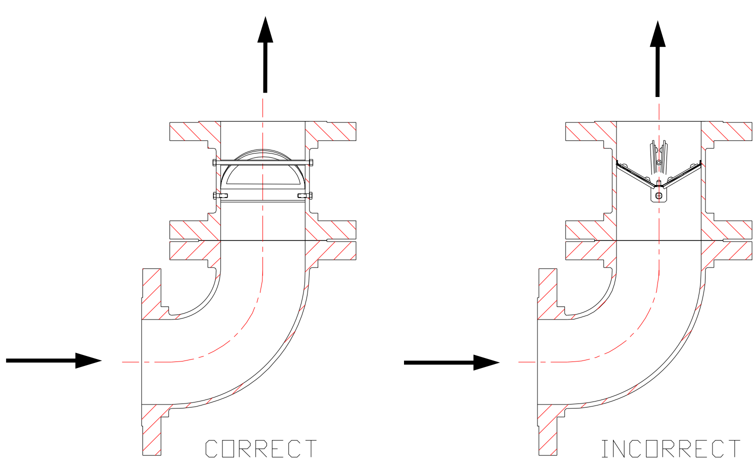
3.2 NAMEPLATE RATING

Prior to installation, check that the rating indicated on the valve nameplate conforms to the system pressure and temperature maximums. **Do not exceed the check valve ratings.**

3.3 LOCATION

A minimum of five pipe diameters between components upstream and downstream of the check valve should be maintained for proper valve operation. Insufficient space between components can result in increased maintenance and early seal failure of the check valve.

Valves installed in horizontal lines must be oriented with the “center post” in the vertical position. This can be determined by observance of the bolts mounting the internal components. Valves installed in vertical flow require no special attention to “center post” orientation. However, in the case where the check valve is positioned less than five pipe diameters downstream of an elbow, the valve must be mounted so that the “center post” is oriented parallel to the centerline of the horizontal pipe (see diagram below). Such positioning will ensure equal loading of the valve plates with respect to the velocity of the gas or liquid through the elbow.



3.4 INSTALLATION

A flow arrow on the nameplate indicates the proper direction of flow for the valve. There are various end connection styles available:

Threaded: A “strap” type pipe wrench should be utilized to install threaded end valves. Standard pipe wrenches may distort body shape and cause valve failure. Normal threaded component installation with Teflon® tape is recommended, however any suitable pipe sealing paste can be used. Thread the components together until hand tight and apply an additional 1 to 1 ½ turns to attain sufficient thread contact.

Grooved: Follow pipe clamp supplier’s recommendations. Grooved valves conform to standard dimensional requirements for “Victaulic®” or other similar style pipe clamps.

Flanged: Flanges conform to ANSI B16.5 dimensions. Suitable fasteners, nuts, and gaskets are required, which conform to system specifications. Tighten bolts in accordance with standard flange bolting sequences (typical ‘star’ type pattern).

Plain: Plain end style valves are intended to be used with compatible style hose and hose clamps rated for the system pressure and temperature.

3.4 MAINTENANCE

No routine maintenance is required. At suitable intervals, in conformance to system requirements, the valve seal should be checked for deterioration or wear. Replacement of seals, as with all valve components, should be scheduled as part of routine maintenance. This procedure does not require any special tools or skills and can be accomplished in the field. Attain required replacement parts and instructions from the factory when necessary. Refer to Appendix C illustration to identify the internal components and descriptions.

3.5 LONG TERM STORAGE

Valves can be stored in their original packaging. Proper care should be taken to keep the packages clean, dry, and protected from damage.

APPENDIX A

SEAL PROPERTIES AND RESISTANCE COMPARISON

ANSI/ASTM D 1418-77	NBR	EPDM	FKM	SI
Common Name	Nitrile/Buna-N	EPDM	Viton®	Silicone
Chemical Name Definition	Butadiene Acrylonitrile	Ethylene Propylene Polymer	Fluorinated Hydrocarbon	Polysiloxane
Hardness Range, Duro A	70-75	70-75	70-75	70-75
Reinforcement Material	Nylon or Dacron	Nylon or Dacron	Nylon or Dacron	Fiberglass
Service Temp.[1] °F [°C] Min. Max.	-60 [-51] 225 [107]	-40 [-40] 300 [149]	-20 [-29] 400 [204]	-100 [-73] 500 [260]
RESISTANCE COMPARISON				
Concentrated Acid	Good	Excellent	Excellent	Fair
Dilute Acid	Good	Excellent	Excellent	Excellent
Hydrocarbons-Aromatic	Good	Poor	Excellent	Poor
Hydrocarbons-Oxygenated	Good	Good to Very Good	Poor	Fair
Water	Fair to Good	Excellent	Fair to Good	Fair
Oil, Animal, and Vegetable	Very Good	Good	Excellent	Good to Excellent
Oil and Gasoline	Excellent	Poor	Excellent	Fair
Solvents, Lacquer	Fair	Poor to Fair	Poor to Fair	Poor
Steam	Fair to Good	Excellent	Fair to Good	Fair
PROPERTIES COMPARISON				
Heat	Good	Excellent	Outstanding	Outstanding
Heat Aging	Good	Excellent	Outstanding	Outstanding
Impermeability	Low	Fairly Low	Very Low	Fairly Low
Rebound Cold Hot	Good Good	Very Good Very Good	Fair to Good Good	Excellent Excellent
Swelling in Oil	Very Good	Poor	Excellent	Fair
Water Absorption	Good	Very Good to Excellent	Very Good	Excellent
Tensile Strength	Good to Excellent	Good to Excellent	Good to Excellent	Good
Generally Resistant To:	Most Hydrocarbons, Fats, Oils, Greases, Hydraulic fluids, Chemicals, and Solvents	Vegetable and Animal Fats, Oils, and Ozone. Many Strong and Oxidizing Chemicals, Keytones, and Alcohols	All Aromatic, Aliphatic, and Halogenated Hydrocarbons. Many Acids, Animal, and Vegetable Oils.	Moderate or Oxidizing Chemicals. Ozone and Concentrated Sodium Hydroxide.
Generally Affected or Attacked By:	**Not for**: Ozone, Ketones, Esters, Aldehydes, Nitro and Chlorinated Hydrocarbons, Polar Solvents, and MEK.	**Not for**: Mineral Oils, Solvents, and Aromatic Hydrocarbons	**Not for:** Ketones, Esters, and Nitro Containing Compounds.	**Not for**: Many Solvents, Oils, Concentrated Acids, and Sulfurs.

[1] Maximum temperature indicated is for intermittent duty only, not for continuous service.
[2] Seals in Flexi-Hinge® valves are constructed with elastomer materials reinforced with fibers for added strength.

APPENDIX B

Pressure Loss Charts
(English and Metric)

How to use the charts:

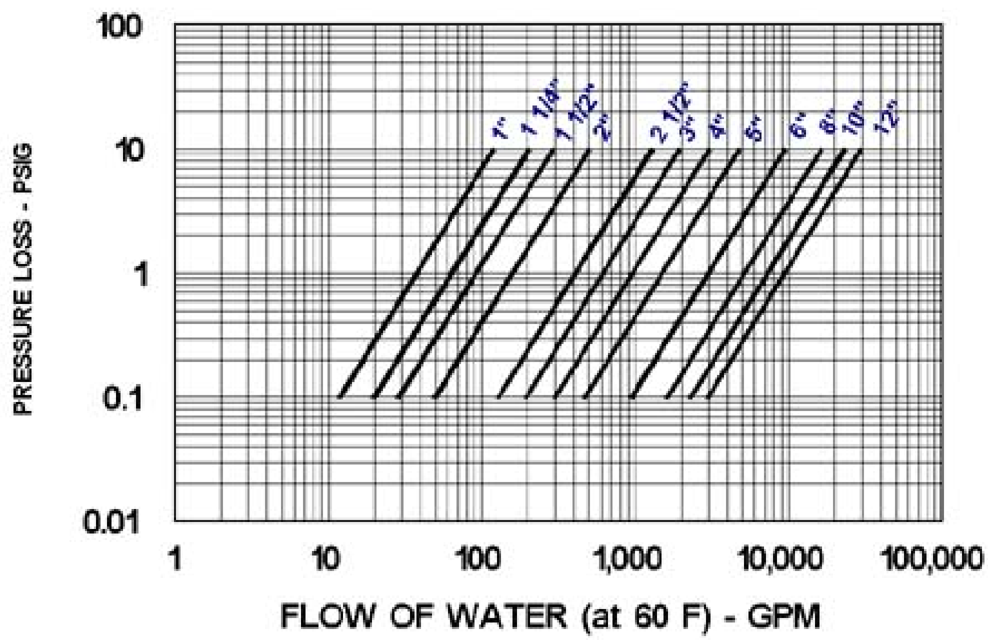
Pressure Loss Basis: Enter the chart on left-hand side at the desired pressure loss maximum, follow the pressure line to the right intersecting size lines, and read the rated flow for the given pressure loss at the bottom of chart.

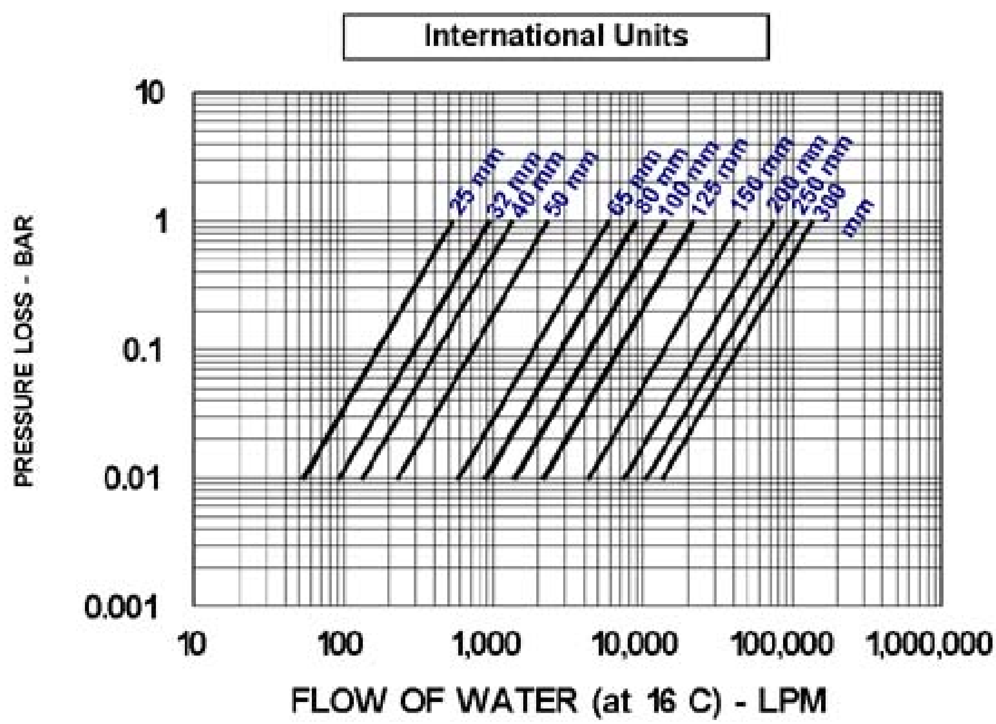
Flow Basis: Enter the chart at the bottom for the desired flow rate, follow the flow line up to the size lines, and read the pressure loss at the given sizes.

Flexi-Hinge® Check Valves

FLOW vs. PRESSURE LOSS

[for other liquids see technical section 2.7]

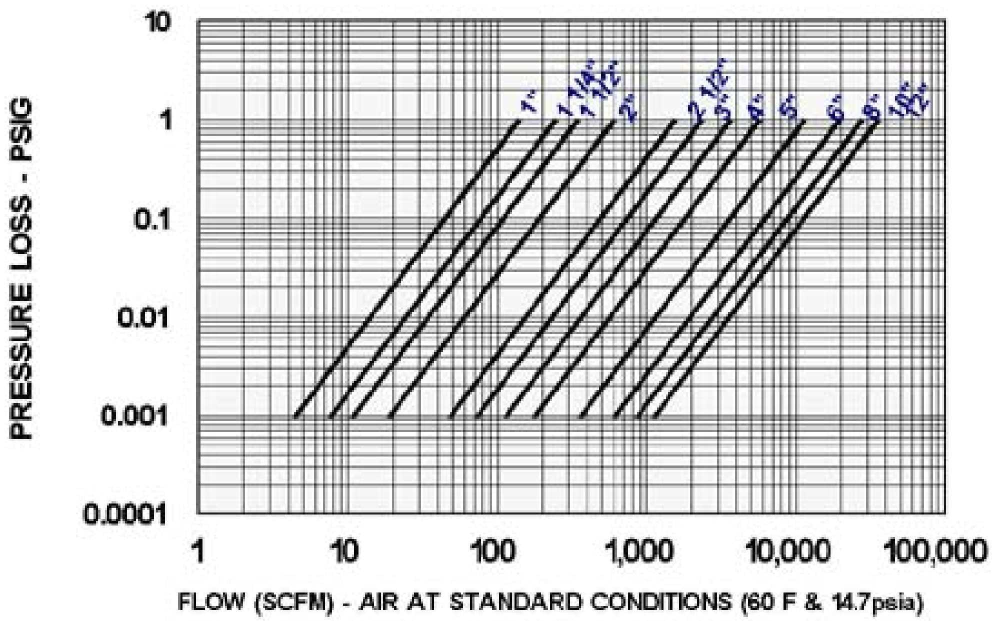


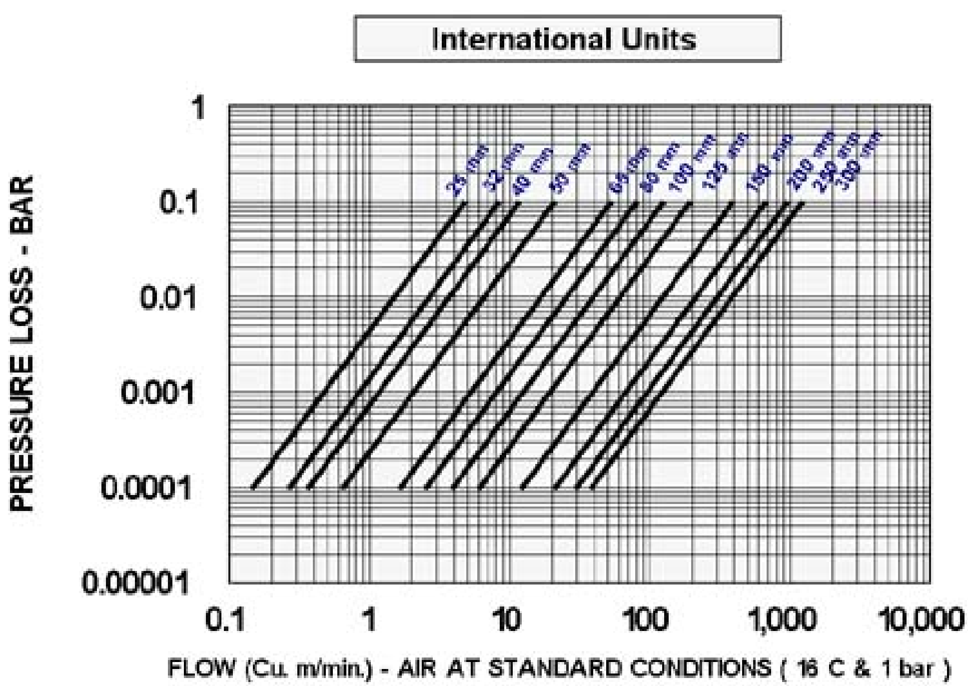


Flexi-Hinge® Check Valves

AIR FLOW vs. PRESSURE LOSS

[for other gases see technical section 2.7]

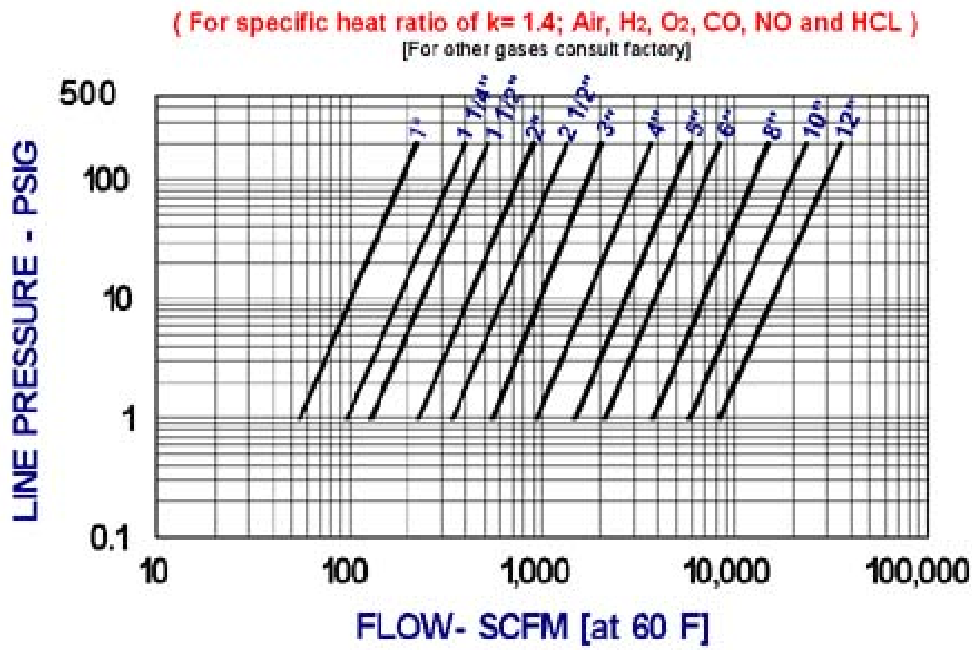


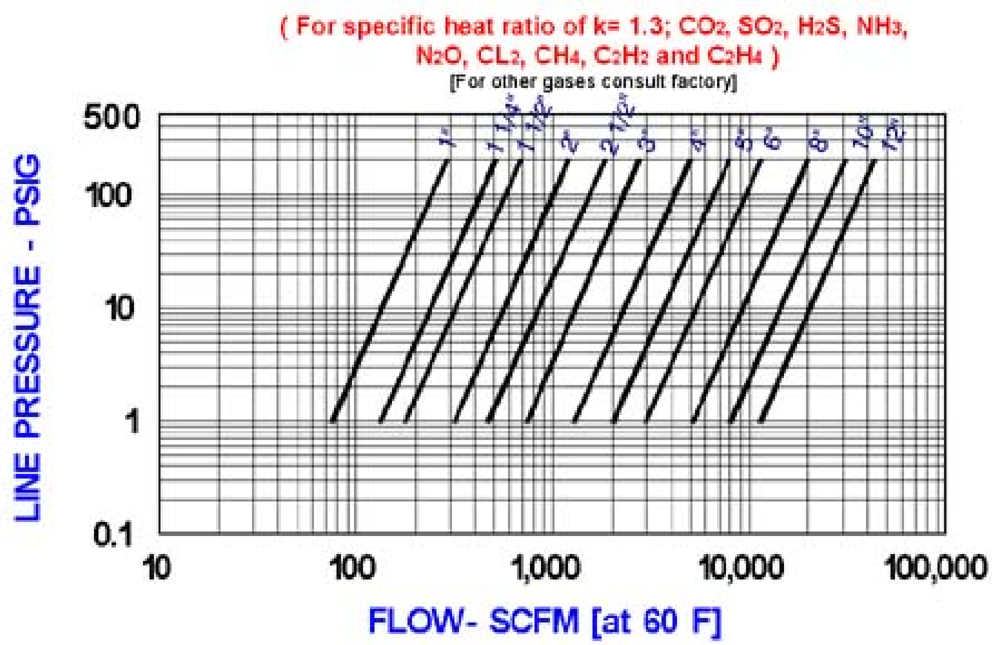


Flexi-Hinge® Check Valves

GAS FLOW vs. LINE PRESSURE

[at recommended maximum 0.10 psid]





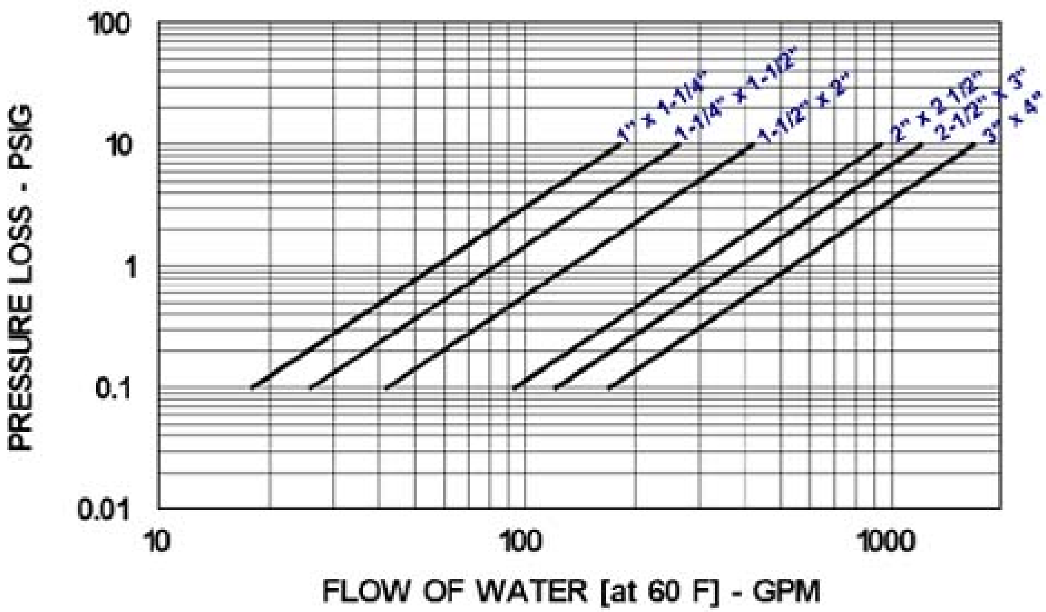
Valve Sizing:

1. Enter chart on 'Y' axis at desired system line pressure [psig].
2. From 'X' axis locate desired flow, read up to intersection with system pressure.
3. Choose any valve size that falls to the right of this point.
4. For actual pressure drop at system conditions refer to technical section for calculating or contact factory for assistance.

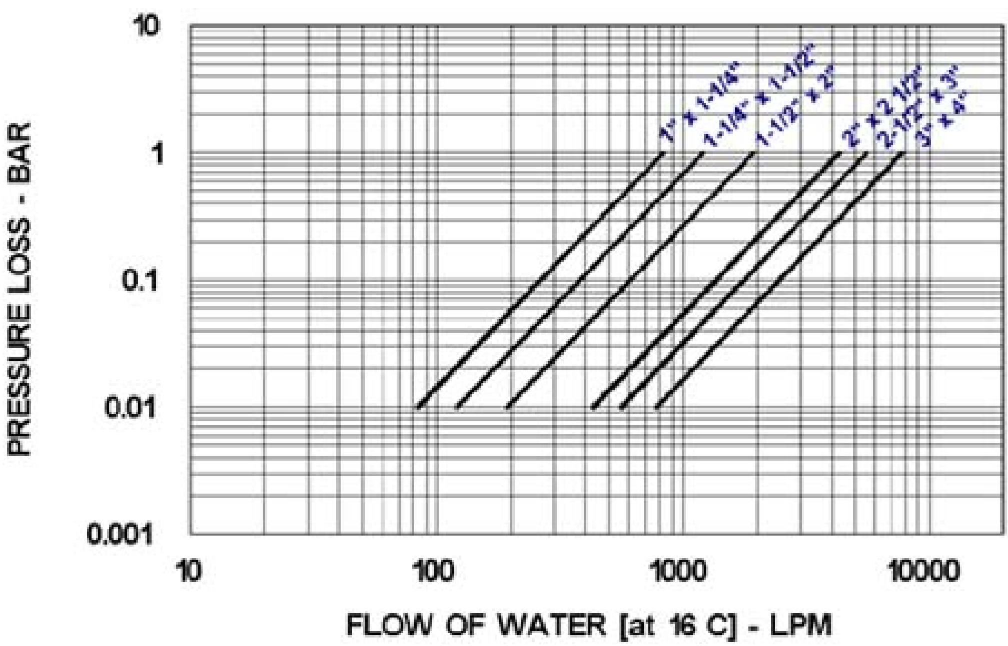
Flexi-Hinge® Series 517M Expansion Check Valves

FLOW vs. PRESSURE LOSS

[for other liquids see technical section 2.7]



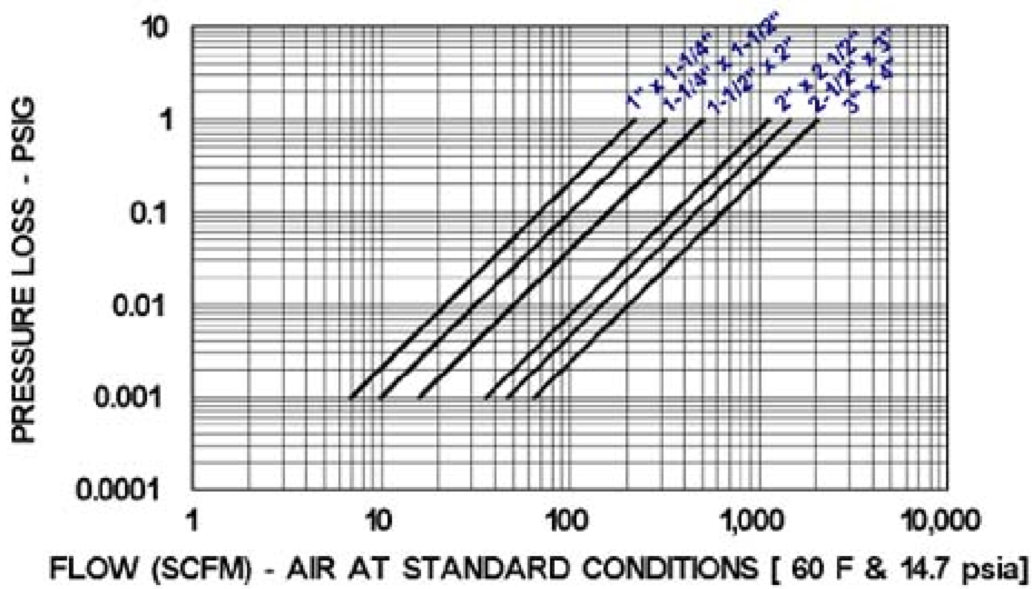
International Units



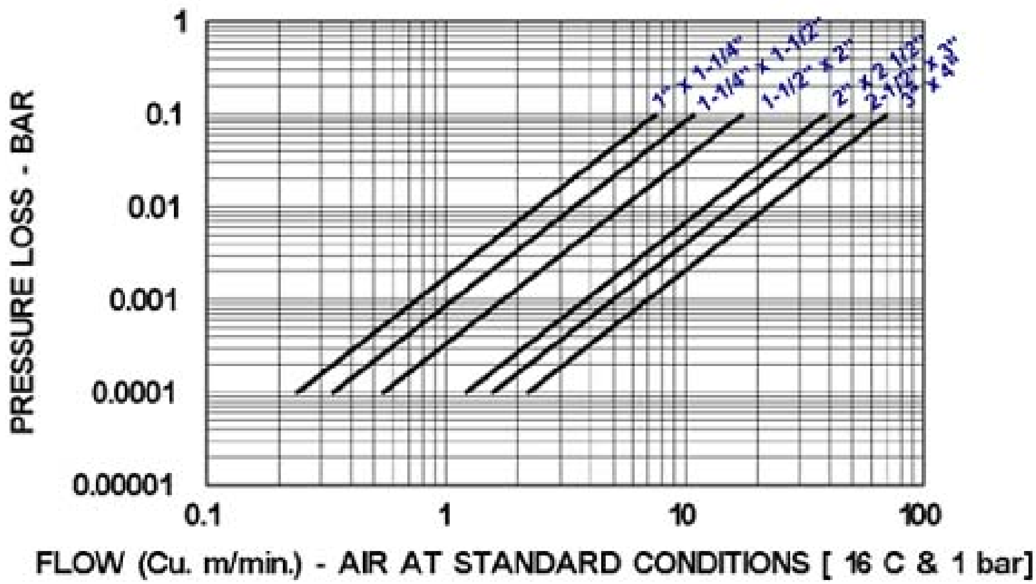
Flexi-Hinge® Series 517M Expansion Check Valves

AIR FLOW vs. PRESSURE LOSS

[for other gases and pressure see technical section 2.7]



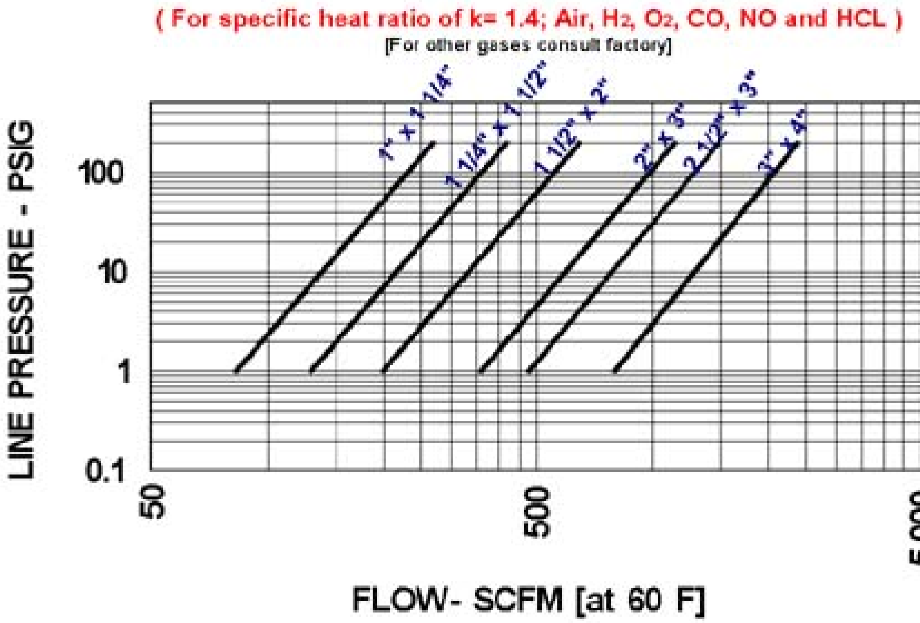
International Units

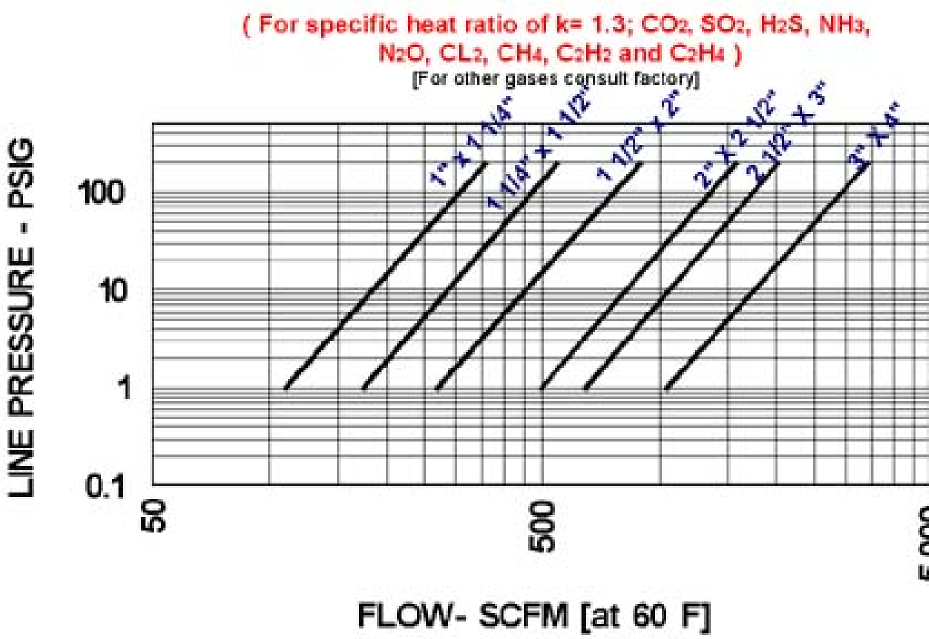


Flexi-Hinge® Series 517M Expansion Check Valves

GAS FLOW vs. LINE PRESSURE

[at recommended maximum 0.10 psid]





Valve Sizing:

1. Enter chart on 'Y' axis at desired system line pressure [psig].
2. From 'X' axis locate desired flow, read up to intersection with system pressure.
3. Choose any valve size that falls to the right of this point.
4. For actual pressure drop at system conditions refer to technical section for calculating or contact factory for assistance.

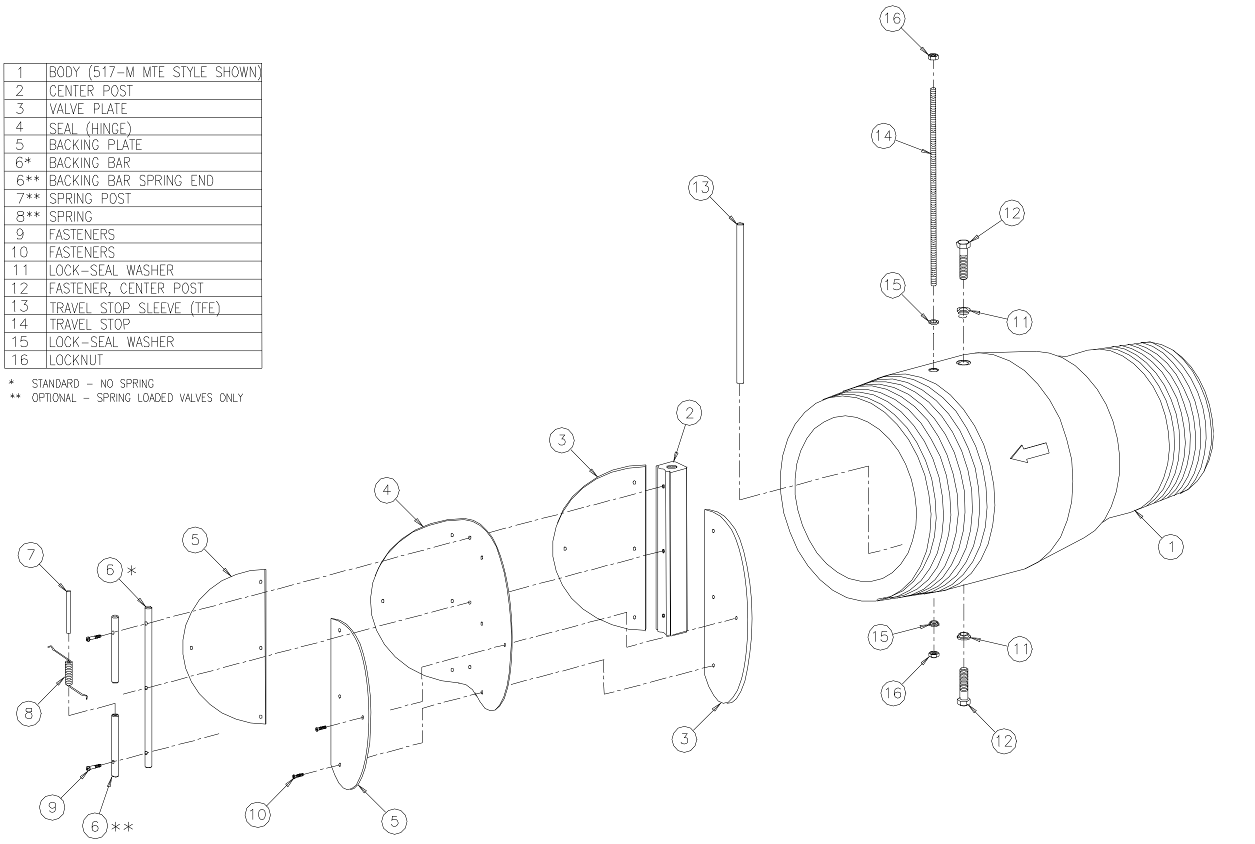
APPENDIX C

VALVE COMPONENTS, PARTS, AND DESCRIPTIONS

1	BODY (517-M MTE STYLE SHOWN)
2	CENTER POST
3	VALVE PLATE
4	SEAL (HINGE)
5	BACKING PLATE
6*	BACKING BAR
6**	BACKING BAR SPRING END
7**	SPRING POST
8**	SPRING
9	FASTENERS
10	FASTENERS
11	LOCK-SEAL WASHER
12	FASTENER, CENTER POST
13	TRAVEL STOP SLEEVE (TFE)
14	TRAVEL STOP
15	LOCK-SEAL WASHER
16	LOCKNUT

* STANDARD – NO SPRING

** OPTIONAL – SPRING LOADED VALVES ONLY



Note: Item 1, the body, will vary with series configuration. All other parts remain the same.