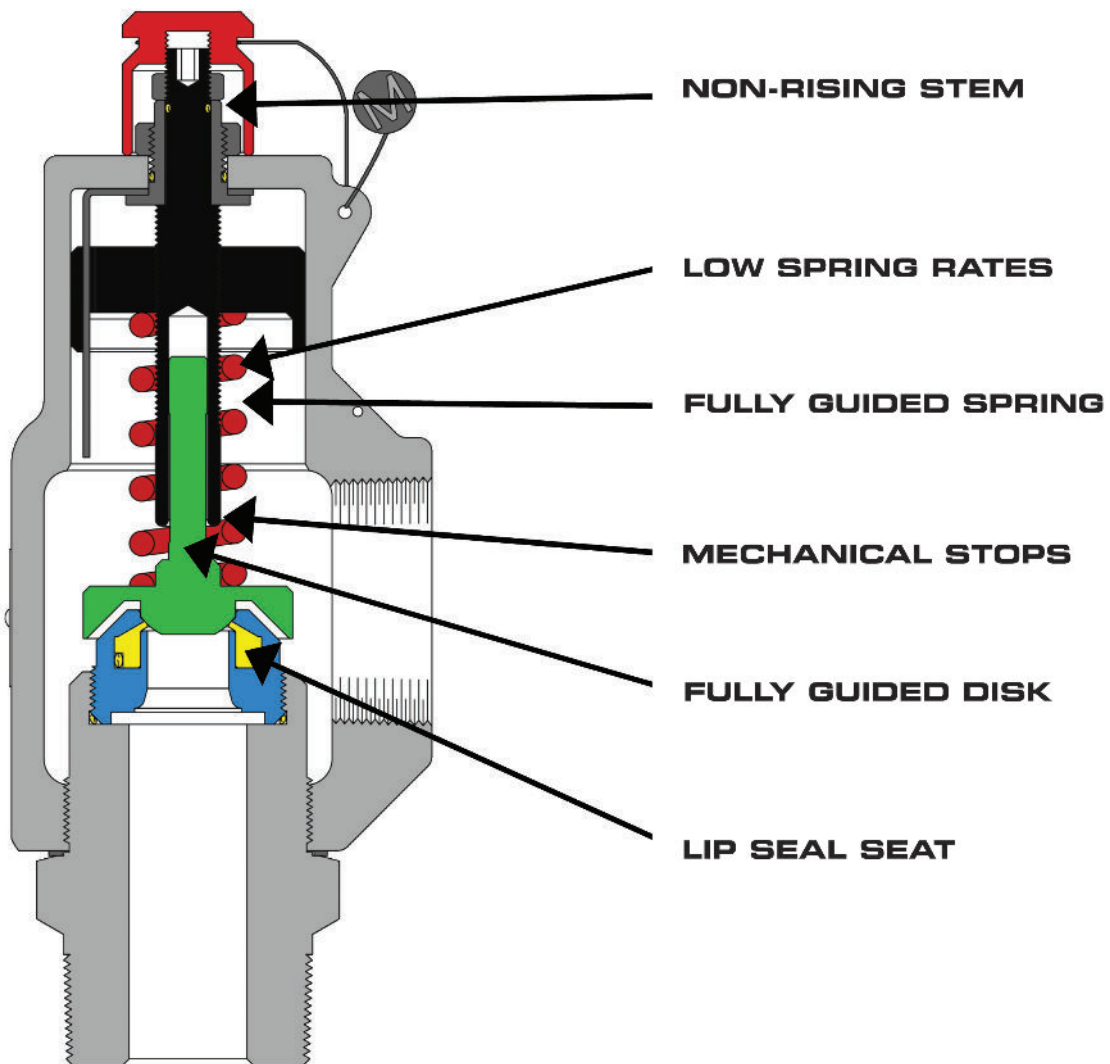




MERCER VALVE CO., INC.®
"AUTO SEAT TECHNOLOGY"®

GENERAL INFORMATION



THINK...MERCER FIRST®

MERCEROER VALVE



Mercer Valve Company

Mercer Valve Company, Inc. was founded by Wesley Taylor with his patented "Auto Seat Technology"® design for pressure relief valves. "Auto Seat Technology"® is incorporated in all of Mercer Valve's designs, allowing the valves to pop and reseal time and time again. Valves designed with "Auto Seat Technology"® have a soft seat with a fully guided disk and spring to increase valve life and performance.

Mercer Valve offers a complete line of both conventional and pilot operated pressure relief valves. Our 8100 Series and 9100 Series conventional valves are rated for air, gas and liquid service. Sizes range from ½" to 4" inlets in orifice sizes C through P. Mercer's 9500 Series includes both snap and modulating pilot operated valves for air, gas and liquid. Valve body sizes 1" to 8" inlets are available in API orifice sizes of D through T and Full Bore sizes.

Mercer Valve is an ISO 9001 company. All Mercer valves are ASME Section VIII, Division 1 certified for either air/gas or liquid. Additional certifications such as CE, CRN, etc. are available. Additionally, all Mercer valves are made in the USA. Mercer Valve's corporate headquarters and manufacturing facility is located in Oklahoma City, OK. Mercer operates certified valve repair divisions and has several assembly shops throughout the USA and abroad. For a complete list of Mercer owned assembly and certified VR locations, please visit our website at www.mercervalve.net.

Quality Policy:

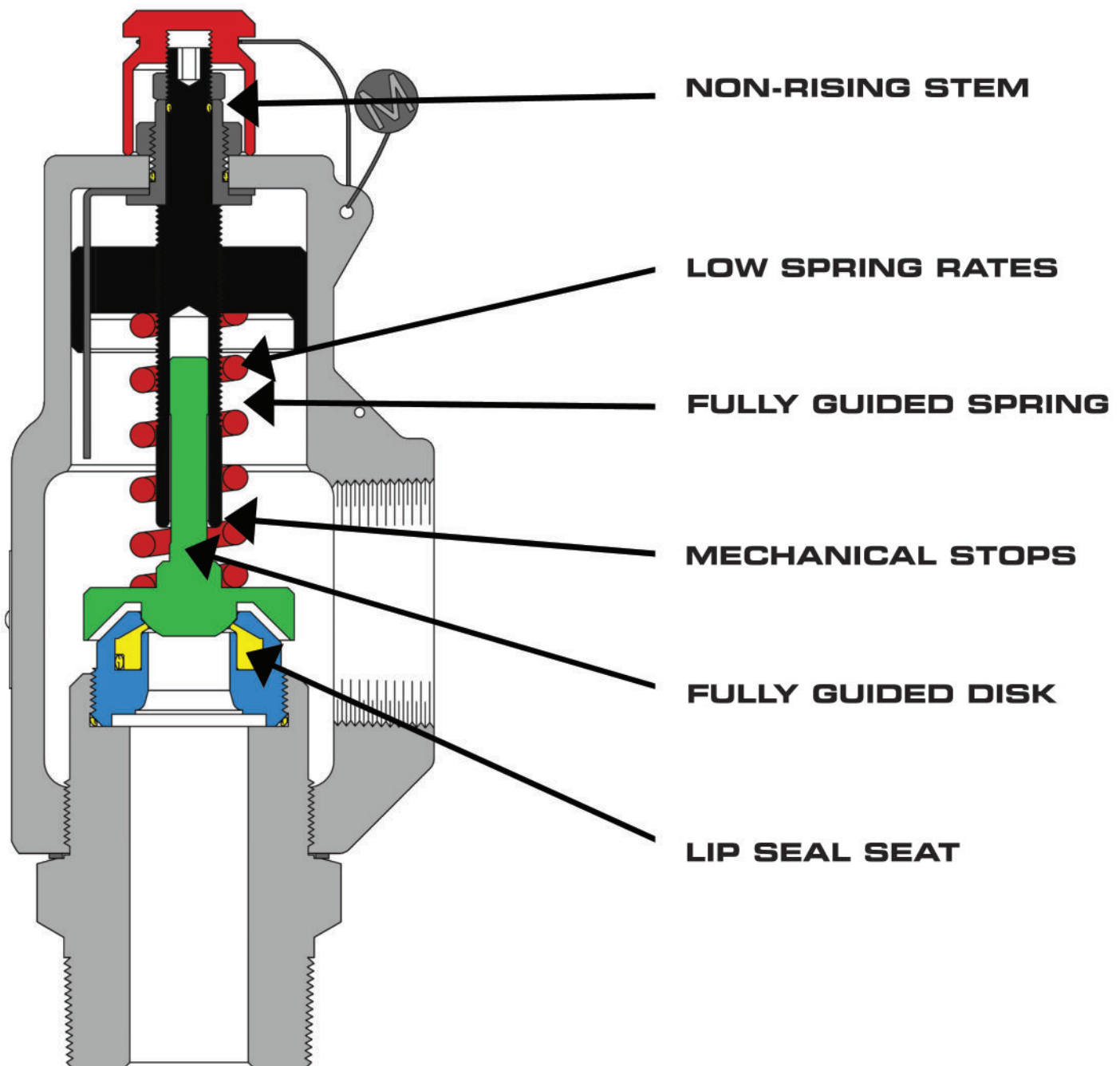
Mercer Valve Co., Inc.® is committed to safely providing the highest quality pressure relief valve featuring our patented Auto Seat Technology"® at a competitive price, delivered on time, and serviced by our trained professionals. We continue to improve our products and services, while meeting industry standards to satisfy our customer's expectations.

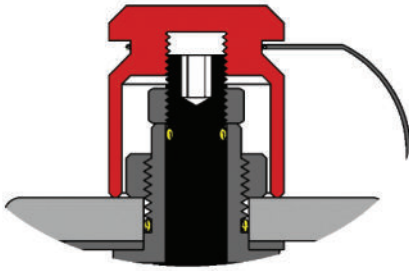
THINK...MERCER FIRST®
"Your Business Needs - Our Company Focus"



"Auto Seat Technology"®

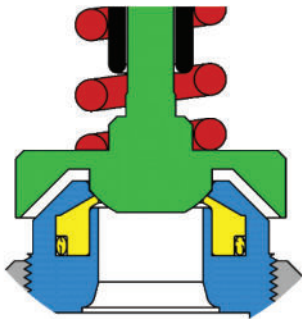
"Auto Seat Technology"® is Mercer Valve's patented soft seat relief valve design. "Auto Seat Technology"® increases seat life, reduces repairs, and gives the valve a consistent set pressure. "Auto Seat Technology"® is a non-rising stem design that uses low rated springs to achieve a consistent set pressure. A fully guided disk and spring give the valve accurate set pressures and help with reseating after each pop. The lip seal seat creates a tighter seal up to set pressure allowing for less leakage. Mechanical stops allow the disk to open to the same point every pop, allowing for the same flow rate and limiting spring stress. "Auto Seat Technology"® reduces the need for repair while giving an accurate set pressure and tight seal.





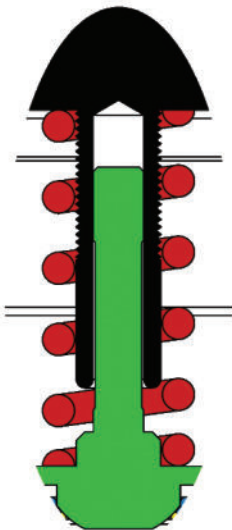
NON-RISING STEM

The adjustment screw in the Mercer valve is a non-rising stem, meaning that, when adjusting the set pressure, the adjustment screw does not move up or down. When the adjustment screw is turned, it moves the adjustment bushing straight up and down increasing and decreasing the tension in the spring. The adjustment bushing never turns. Because the adjustment bushing never turns, it does not transmit a torque into the disk and seat when adjusting the set pressure. This helps extend the seat life.



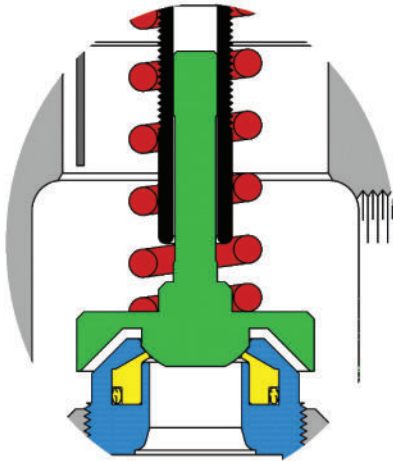
MECHANICAL STOPS

Due to Mercer valve having an on-rising stem design, the adjustment screw never moves up and down. Because the adjustment screw is always in the same place, it can be used as a mechanical stop for the disk. This allows the disk to open the same amount each time the valve opens. This gives the valve the same capacity every pop. The mechanical stop is positioned so that the disk is always held up by the flow of the valve until the pressure drops low enough to reclose the valve. The mechanical top also does not allow the spring to be over compressed, reducing stress on the spring.



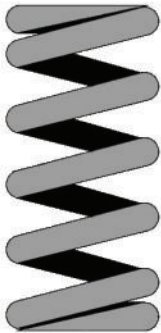
FULLY GUIDED SPRING

The spring in the Mercer valve is guided from top to bottom. With a fully guided spring, the spring is only compressed vertically so the spring keeps consistent tension from one pop to the next.



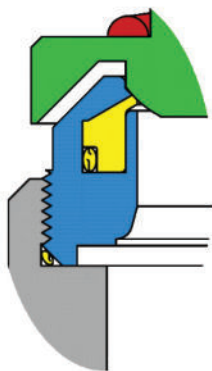
FULLY GUIDED DISK

The disk is aligned on the top through the adjustment screw and at the bottom of the disk by the radius on the disk. When a relief valve begins to vent, the flow of the valve pulls everything toward the outlet. Guiding the disk allows the disk to only move up and down and not to the sides. This keeps the disk from being pulled toward the outlet. With the disk only rising up and down, the disk has a consistent opening and reseating. The radius on the bottom of the disk also helps insure that the valve reseats after each pop. If the disk is not centered on the nozzle at reclose, the radius on the bottom of the disk helps to realign the disk. The spring force will push the disk down and the radius will allow the disk to roll back into place.



LOW SPRING RATES

A spring rate is the amount of force the spring exerts for how much it is compressed. Mercer Valve uses low rated springs to help keep stresses out of the spring. The more force that the spring is exerting, the higher the stresses in the spring. When a spring is over stressed, the properties of the spring are changed affecting the set pressure of the valve.



LIP SEAL SEAT

Mercer uses a lip seal soft seat. On reclose, the seat flexes allowing the brute impact of the disk reclosing to be taken by the hard nozzle while still providing the soft seat seal. Also, before the valve reaches set pressure, the pressure is applied underneath the lip seal pushing the seat against the disk. This gives a tight seal up to the set pressure and extends the seat life.



General Terms

Set Pressure is the point at which the pressure relief valve is set to open.

Over Pressure is the amount of pressure above the set pressure that is allowed for the valve to go to full lift and achieve full flow. For most applications, this is typically 10% or 3 psi, whichever is greater.

Conventional Pressure Relief Valve is a direct spring operated valve. The spring tension controls the opening and closing of the valve. The set pressure is affected by back pressure on this type of valve.

Pilot Operated Pressure Relief Valve is a valve where the opening and closing of the main valve is controlled by an auxiliary pressure relief valve called a pilot. The main valve is the primary relief device.

Back Pressure is pressure on the outlet side of the valve. There are 2 types of back pressure, superimposed and built-up. Some types of back pressure can affect the flow rate and/or the set pressure.

Built-Up Back Pressure is pressure in the outlet of the valve caused by the flow of the valve after the valve opens. This type of back pressure does not affect the set pressure.

Superimposed Back Pressure is the pressure on the outlet of the valve at the time the valve opens. This back pressure is caused by other sources and will affect the set pressure of a conventional pressure relief valve. Superimposed back pressure can be variable or constant.

Blowdown is the difference between when a valve opens (set pressure) and when the valve closes. Typically, blowdown is expressed as a percentage of the set pressure.

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Common Codes and Standards

American Society of Mechanical Engineers

Boiler and Pressure Vessel Code, Section VIII, Division 1 UG-125-136, Appendix 11, Appendix M

American Petroleum Institute

Recommended Practice 576, Standards 520 Part 1, 520 Part 2, 521, 526, 527, and 598

US Department of Transportation

CFR Title 49, Chapter 1

Compressed Gas Association

S-1.1, S-1.2, and S-1.3



Sizing Overview

There are multiple ways of sizing a pressure relief valve depending on the type of system the valve is installed. In some cases, multiple scenarios may be present and all cases should be considered. Pressure relief valves are sized to relieve a specified flow at the particular conditions of the system the valve is installed. The flow rate used in sizing the pressure relief valves is based on the amount needed to be relieved to prevent further overpressure of the system. The result of the pressure relief sizing gives a minimum required area to produce the required flow rate. The minimum required area is then used to select the proper orifice area for the valve.

Different standards and organizations have developed sizing methods and calculations. Two of the most common methods for blocked flow sizing are from American Society of Mechanical Engineers (ASME) and The American Petroleum Institute (API). The calculations are similar for both methods. The Main Difference between the two methods is the discharge coefficient and orifice areas used. API uses generic values for both the discharge coefficient and orifice areas, while ASME uses the actual orifice area for the particular valve series and the measured discharge coefficient.



Sizing Formula

Gas/Vapor Mass Flow Sizing Coefficient Method

$$W = C \times K \times P \times A \times \sqrt{\frac{M}{T \times Z}}$$

Gas/Vapor Volumetric Flow Sizing Coefficient Method

$$Q = \frac{6.323 \times C \times K \times P \times A}{\sqrt{T \times Z \times M}}$$

Liquid Volumetric Flow Sizing Coefficient Method

$$Q_{GPM} = 38 \times K \times K_v \times A \times \sqrt{\frac{P - P_D}{SG}}$$

Viscosity Correction Factor

$$K_v = \left(.9935 + \frac{2.878}{R^{0.5}} + \frac{342.75}{R^{1.5}} \right)^{-1.0}$$

Reynold's Number

$$R = \frac{Q_{GPM} \times 2800 \times SG}{\mu \times \sqrt{A}}$$

Gas/Vapor Volumetric Flow Sizing Slope Method

$$Q = Slope \times P$$

Liquid Volumetric Flow Sizing Flow Factor Method

$$Q_{GPM} = F \times \sqrt{P - P_D}$$



Equation Variable Definitions

W = Mass Flow rate (lbs/hr)

Q = Gas Volumetric Flow Rate (scfm)

Q_{GPM} = Liquid Flow Rate (GPM)

C = Gas Constant

K = Discharge Coefficient

P = Flowing Pressure, Set Pressure + Over Pressure + Atmospheric Pressure (psia)

P_D = Pressure at the Discharge (psia)

A = Flow Area (in²)

M = Gas Molecular Weight

T = Temperature (°R=°F + 460)

Z = Gas Compressibility Factor

K_v = Viscosity Correction Factor

F = ASME Flow Factor, (GPM/ √(P-PD))

R = Reynold's Number

U = Viscosity at flowing temperature (cP)

SG = Specific Gravity



Unit Conversion

Multiply	By	To Obtain	Multiply	By	To Obtain	Multiply	By	To Obtain
psi	6.895	kPa	kg / cm2	735.5591	mm Hg	mm ²	0.000001	m ²
psi	0.068	atm	kg / cm2	393.7008	in H2O	cm ²	0.0001	m ²
psi	0.0689	bar	in Hg	25.4	mm Hg	in ³	0.000579	ft ³
psi	0.0703	kg / cm2	in Hg	13.595	in H2O	in ³	16387.064	mm ³
psi	2.036	in Hg	mm Hg	0.5352	in H2O	in ³	16.387064	cm ³
psi	51.715	mm Hg	in	0.08333	ft	in ³	0.000016	m ³
psi	27.679	in H2O	in	25.4	mm	ft ³	28316846.59	mm ³
kPa	0.009869	atm	in	2.54	cm	ft ³	28316.8466	cm ³
kPa	0.01	bar	in	0.0254	m	ft ³	0.028317	m ³
kPa	0.0102	kg / cm2	ft	304.8	mm	mm ³	0.001	cm ³
kPa	0.2953	in Hg	ft	30.48	cm	mm ³	0.000000001	m ³
kPa	7.5006	mm Hg	ft	0.3048	m	cm ³	0.000001	m ³
kPa	4.0146	in H2O	mm	0.1	cm	ounce	0.02835	kg
atm	1.01325	bar	mm	0.001	m	slug	14.5939	kg
atm	1.0332	kg / cm2	cm	0.01	m	slug	514.785	ounce
atm	29.92126	in Hg	in ²	0.006944	ft ²	lb	0.031081	slug
atm	759.999	mm Hg	in ²	645.16	mm ²	lb	0.453592	kg
atm	406.7825	in H2O	in ²	6.4516	cm ²	lb	16	ounce
bar	1.0197	kg / cm2	in ²	0.000645	m ²	cfm	1.699	m ³ / hr
bar	29.52999	in Hg	ft ²	92903.04	mm ²	GPM	34.2857	BPD
bar	750.0616	mm Hg	ft ²	929.0304	cm ²	GPM	227.1247	LPH
bar	401.4631	in H2O	ft ²	0.092903	m ²	BPD	6.624471	LPH
kg / cm2	28.959	in Hg	mm ²	0.01	cm ²	lb / hr	0.453592	kg / hr

Common Gas Properties at 77°F and 1 atm

Gas	Molecular Weight	Ratio of Specific Heats (k)	Gas Constant (C)
Acetylene	26.038	1.231	340
Air	28.97	1.4	356
Ammonia	17.031	1.297	347
Argon	39.948	1.667	378
Butane	58.124	1.091	326
Carbon Dioxide	44.01	1.289	346
Carbon Monoxide	28.01	1.399	356
Ethane	30.07	1.186	336
Ethylene	28.054	1.237	341
Helium	4.003	1.667	378
Hydrogen	2.016	1.409	357
Methane	16.043	1.299	347

Gas	Molecular Weight	Ratio of Specific Heats (k)	Gas Constant (C)
Natural Gas	17.4	1.27	344
Neon	20.183	1.667	378
Nitric Oxide	30.006	1.387	355
Nitrogen	28.013	1.4	356
Nitrous Oxide	44.013	1.274	345
Oxygen	31.999	1.393	355
Propane	44.094	1.126	330
R-12	120.914	1.126	330
R-22	86.469	1.171	334
R-134a	102.03	1.106	327
Sulfur Dioxide	64.059	1.263	343

Common Liquid Properties at 77°F and 1 atm

Liquid	Specific Gravity	Density (lb/ft ³)	Viscosity (cP)
Ammonia	0.606	37.7	0.21
Benzene	0.883	54.9	0.595
Butane	0.558	34.7	0.164
CO2	0.683	42.5	0.071
Engine Oil	0.887	55.2	489.605
Ethanol	0.786	48.9	1.042
Gasoline	0.752	46.8	0.521
Glycerine	1.265	78.7	800.63
Kerosine	0.818	50.9	1.488

Liquid	Specific Gravity	Density (lb/ft ³)	Viscosity (cP)
Mercury	13.633	848	1.518
Methanol	0.789	49.1	0.551
n-octane	0.695	43.2	0.506
Propane	0.511	31.8	0.091
R-12	1.315	81.8	0.25
R-22	1.195	74.3	0.199
R-134a	1.211	75.3	0.199
Water	1	62.2	0.893



Discharge Coefficients

Valve Series	ASME Gas/Vapor Discharge Coefficient	ASME Liquid Discharge Coefficient	ASME Gas/Vapor Slope	ASME Liquid Flow Factor	API Gas/Vapor Discharge Coefficient	API Liquid Discharge Coefficient
8100 Series 1/2" Diameter Orifice	.798*	.639*	3.10	5.15	.975	.650
8100 Series 3/4" Diameter Orifice	.833*	.711*	7.21	12.77	.975	.650
9100 Series	.818	.707	---	---	.975	.650
9100 Series Model 20	.818	.707	---	---	.975	.650
1400 Series	.794*	---	.291	---	---	---
9500 Series API Orifice Letter	.870	.731	---	---	.975	.650
9500 Series Full Bores	.820	---	---	---	.975	---

* = 8100 Series and 1400 Series are certified under the slope method. The discharge coefficients for these orifices have been calculated from the slopes and Flow Factors.



CORPORATE HEADQUARTERS

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Please visit our website to learn about our branch locations!

WWW.MERCERVALVE.NET

Mercer Valve Company, Inc.[®] manufactures pressure relief valves for uses with many different products. Your choice of a valve requires that you, as buyer, determine the valve material is compatible with the intended use of the valve. You are responsible to insure that the correct pressure relief valve is installed for your application and your order of a valve confirms the material compatibility choices.