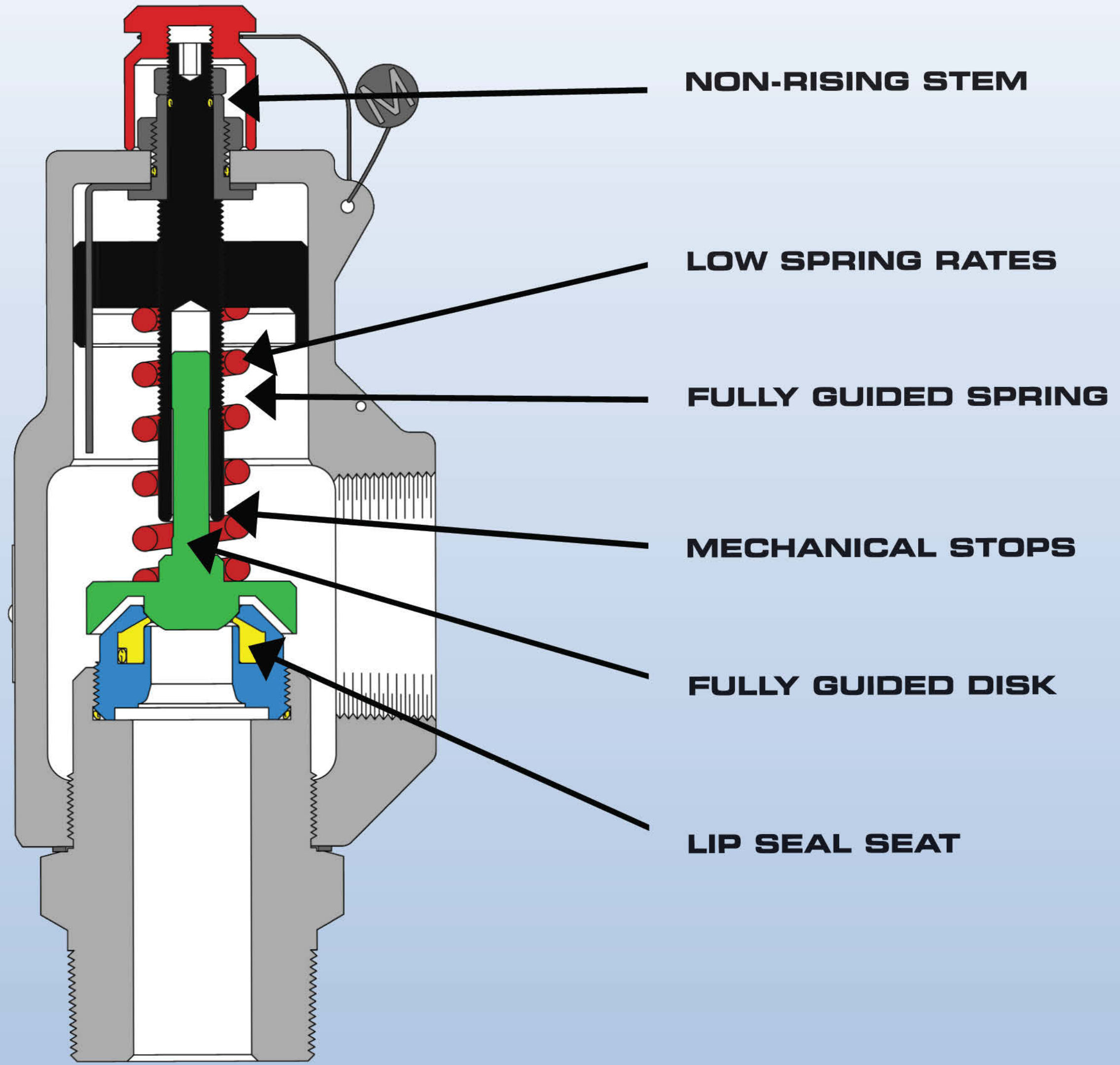
MERCER VALVE CO., INC.®

"AUTO SEAT TECHNOLOGY"®

GENERAL INFORMATION



THINK...MERCER FIRST®

MERCER VALVE

Mercer Valve Company

1980s
Mercer valve was founded by Wesley Taylor with his "Auto Seat Technology"® patent for pressure relief valves.

Mercer's first valve line was the 8100 Series introduced in 1985. "Auto Seat Technology"® is incorporated in the valve design, allowing it to pop and reseat time and time again. Unlike the competition, the valve has a soft seat design with a fully guided disk and spring to help the valve have a longer life.

With the introduction of our 8100 Series, Mercer Valve started a VR Certified Valve Repair Division. The repair division repairs all relief valve manufacturers and also has mobile units for on-site repair and testing. In addition to the VR shop, we have added an "ANSI" shop, repairing ball valves, orbit valves, gate valves, as well as many other kind of valves.

The 8700 Series was Mercer Valve's next endeavor. This valve has the same guiding system as the 8100 Series, but incorporates a hard seat. The guiding system increases the repeatability of the valve opening and closing.

1990s
Mercer's 9100 Series, the industrial pressure relief valve, was introduced in 1991. The 9100 Series was developed to handle industrial gases and liquids, while continuing to use the proven design of "Auto Seat Technology"® The 9100 Series also provides more options for the customer including different soft seat and seal materials, threaded and flanged connections, and sizes ranging from 1/2"x 1" to 4" x 6".

In 1995, Mercer Valve added the 9100 Series Model 20 to their product line. This valve line is used for high pressure service up to 8700 psig set pressure.

Mercer Valve entered the pilot operated relief valve market with the 9500 Series. The 9500 Series includes API Orifice Sizes from "D" through "T" and Full Bore Orifices up to 8 inches. Mercer's 9500 Series includes both a snap action pilot and a modulating action pilot. The modulating pilot is unlike any in the industry, having full modulation throughout the over pressure range. Continuing in the Mercer tradition, the 9500 Series has a long life due to the usage of "Auto Seat Technology".®

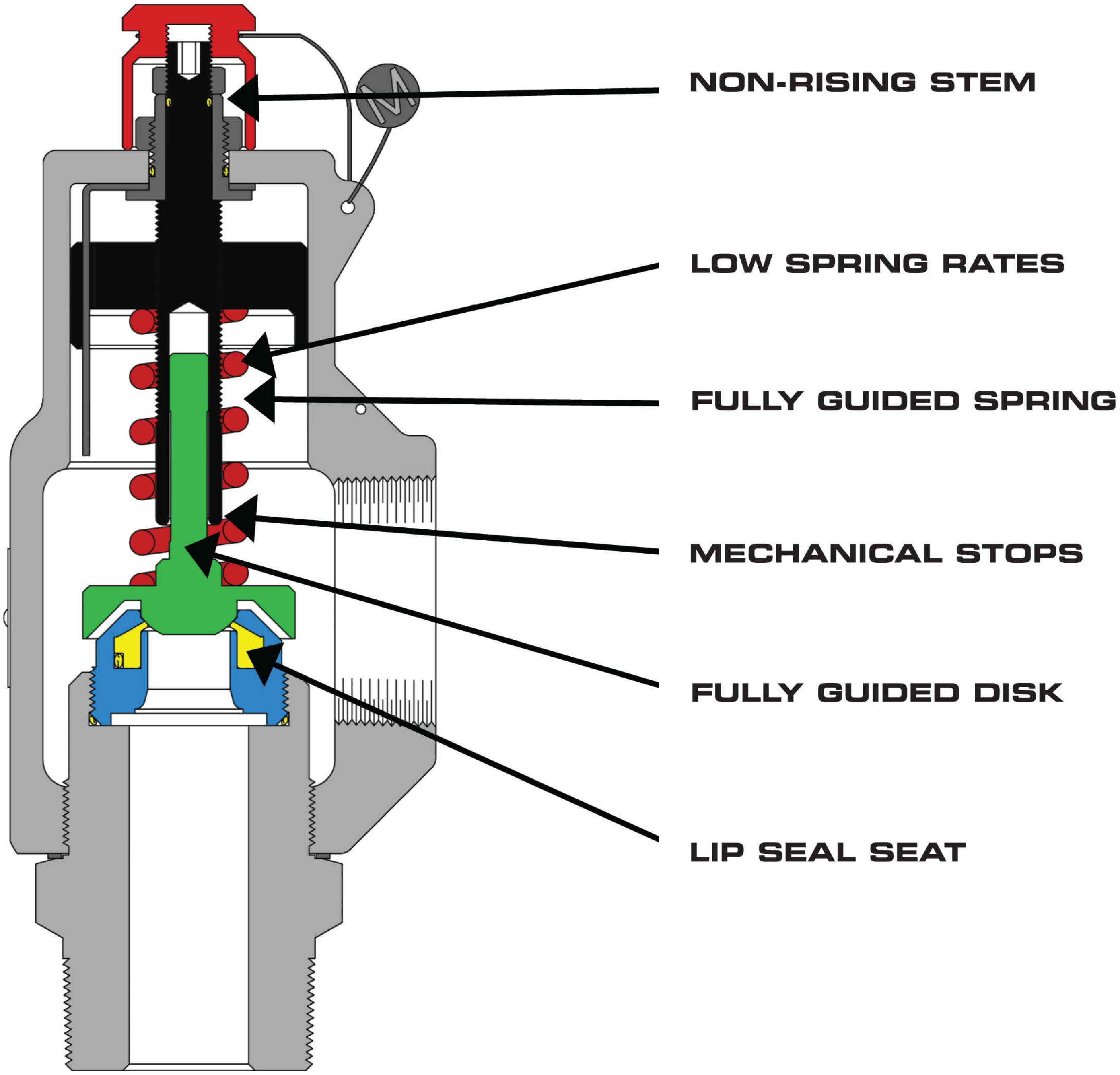
With the growth and success of our valve lines, Mercer Valve moved in a new building. This houses the home office, repair division, and manufacturing department. The facilities also include an expanded fully functioning flow lab. Mercer Valve has always strived to be safe minded and engineer driven. The expanded flow lab has increased testing and enabled further research and development.

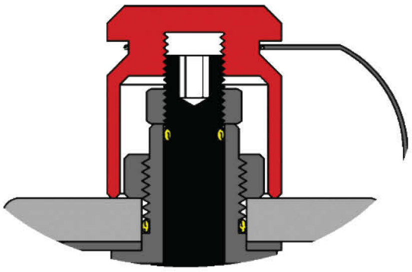
2000s
In 2000, Mercer opened a Houston Branch to help service our Houston customers more efficiently. The Houston Branch assembles valves keeping lead times at a minimum. The Houston Branch is also a VR Certified repair shop.

A few years later, Mercer opened a location in Calgary, AB, Canada to support our Canadian customers. Mercer Valve also opened a new repair center in Oklahoma City to accommodate the increasing repair business. The new repair center offers a larger area for the repair of other oilfield equipment including glycol pumps, chemical pumps, ball valves, gate valves, orbit valves, etc.

"Auto Seat Technology"®

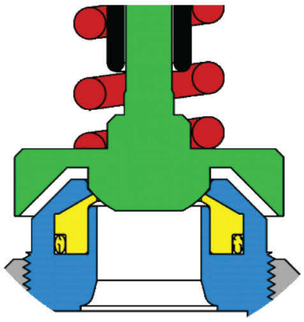
"Auto Seat Technology"® is Mercer Valve's patented soft seat relief valve design. "Auto Seat Technology"® increases seat life, reduces repairs, and gives the valve a consistent set pressure. "Auto Seat Technology"® is a non-rising stem design that uses low rated springs to achieve a consistent set pressure. 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.





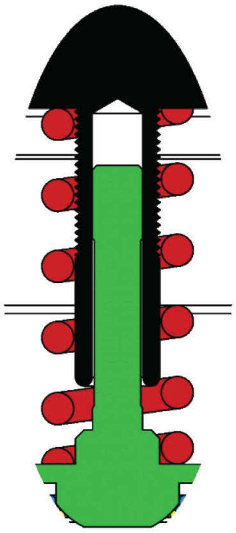
NON-RISING STEM

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 of the valve.



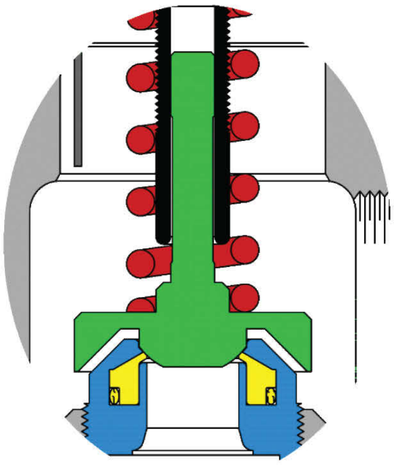
MECHANICAL STOPS

Due to Mercer Valve having a non-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 stop also does not allow the spring to be over compressed, reducing stress on the spring.



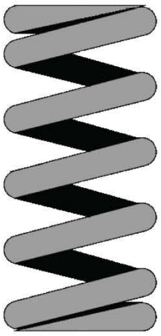
FULLY GUIDED SPRING

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.



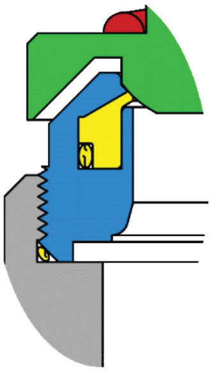
FULLY GUIDED DISK

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 3psi, which ever 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 II, Appendix M

American Petroleum Institute
Recommended Practices 520 part I, 520 part II, and 521 & Standards 526, 527, and 2000

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 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 (in^2)

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

μ = Viscosity at flowing temperature (cP)

SG = Specific Gravity

Unit Conversion

Multiply	By	To Obtain
psi	6.895	kPa
psi	0.068	atm
psi	0.0689	bar
psi	0.0703	kg / cm2
psi	2.036	in Hg
psi	51.715	mm Hg
psi	27.679	in H2O
kPa	0.009869	atm
kPa	0.01	bar
kPa	0.0102	kg / cm2
kPa	0.2953	in Hg
kPa	7.5006	mm Hg
kPa	4.0146	in H2O
atm	1.01325	bar
atm	1.0332	kg / cm2
atm	29.92126	in Hg
atm	759.999	mm Hg
atm	406.7825	in H2O
bar	1.0197	kg / cm2
bar	29.52999	in Hg
bar	750.0616	mm Hg
bar	401.4631	in H2O
kg / cm2	28.959	in Hg

Multiply	By	To Obtain
kg / cm2	735.5591	mm Hg
kg / cm2	393.7008	in H2O
in Hg	25.4	mm Hg
in Hg	13.595	in H2O
mm Hg	0.5352	in H2O
in	0.08333	ft
in	25.4	mm
in	2.54	cm
in	0.0254	m
ft	304.8	mm
ft	30.48	cm
ft	0.3048	m
mm	0.1	cm
mm	0.001	m
cm	0.01	m
in^2	0.006944	ft^2
in^2	645.16	mm^2
in^2	6.4516	cm^2
in^2	0.000645	m^2
ft^2	92903.04	mm^2
ft^2	929.0304	cm^2
ft^2	0.092903	m^2
mm^2	0.01	cm^2

Multiply	By	To Obtain
mm^2	0.000001	m^2
cm^2	0.0001	m^2
in^3	0.000579	ft^3
in^3	16387.064	mm^3
in^3	16.387064	cm^3
in^3	0.000016	m^3
ft^3	28316846.59	mm^3
ft^3	28316.8466	cm^3
ft^3	0.028317	m^3
mm^3	0.001	cm^3
mm^3	0.000000001	m^3
cm^3	0.000001	m^3
ounce	0.02835	kg
slug	14.5939	kg
slug	514.785	ounce
lb	0.031081	slug
lb	0.453592	kg
lb	16	ounce
cfm	1.699	m^3 / hr
GPM	34.2857	BPD
GPM	227.1247	LPH
BPD	6.624471	LPH
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
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
8700 Series	.854*	---	1.91	---	.975	---
9500 Series API Orifice Letters	.870	.731	---	---	.975	.650
9500 Series Full Bores	.820	---	---	---	.975	---

* = 8100 Series and 8700 Series are certified under the slope method. The discharge coefficients for these orifices have been calculated from the slopes and Flow Factors.

GENERAL INFORMATION

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Please visit our website to learn about our *NEW* branch locations!

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