ANDERSON GREENWOOD SERIES 90/9000 PILOT OPERATED PRESSURE RELIEF VALVES

Maximize operating pressure and minimize emissions with the Series 90/9000 pilot operated relief valve; a high performance alternative to weight loaded relief devices

FEATURES

- Pilot control keeps high seat forces all the way to set pressure point, helping eliminate product losses.
- Snap action opening permits full opening at set pressure, allowing higher settings and overcoming freezing or sticking problems.
- Choice of rapid snap opening and proportional modulating action pilots to suit the process.
- Extensive selection of resilient seat and diaphragm materials to meet most conditions and provide long maintenance free operation.
- Balanced against back pressure enabling connection to closed header systems without loss of valve lift or set pressure fluctuations.
- Remote sensing option allows accurate pressure sensing regardless of inlet piping pressure losses.
- Field test connection enables valve function verification in place without removal to a test bench or raising process pressures.
- Manual blowdown enables manual or remote actuation to depressurize a system.
- ASME UV Code Stamp for set pressures above 15 psig.

GENERAL APPLICATION

A wide range of both pressure and vacuum relief valves, primarily designed for protecting low pressure storage vessels, tanks and low pressure piping systems.

TECHNICAL DATA

Sizes:	2" x 3" to 14" x 18" (DN 50 x 80 to DN 350 x 450)
Orifices:	2.29 to 113.0 in^2 (14.77 to 729.03 cm^2)
Temperature range:	-320°F to + 400°F (-196°C to +205°C)
Set pressures:	3" wc to 150 psig (7.5 mbarg to 10.34 barg)
Vacuum range:	-2" wc to -5 psig (-5.0 mbarg to -0.345 barg)
Codes:	ASME VIII; API 2000

CONTENTS

HOW TO SELECT A VALVE

Three steps make it easy to select, size and order the valve.

Step 1: Preliminary valve selection: helps you determine the type of valve that best suits your application.

Step 2: Sizing: provides the information you need to choose the correct valve orifice area.

Step 3: Ordering: explains how to finalize valve selection and order the specific model number, after you have chosen the appropriate valve type and size.

SELECTING A VALVE TYPE

To determine which pilot operated pressure relief valve type is most appropriate for your application, use the Application Guide to note which valve types seem most appropriate, refer to the technical and model selection data. Using the formulas in Sizing section (pages 28 -44), determine the required orifice area for your service conditions and select the orifice area that suits your application.

If you have been able to determine a pilot operated valve type and orifice area that suits your application, refer to the Ordering section (pages 52 -53), to select and order a specific model number. If you were not able to find a valve type to meet your application needs, please contact your local representative for assistance.

NOTE

The application of the 90 and 9000 Series flowing style pilot operated pressure relief valves in condensable gas service (ie: n-Butane, Isobutane or Butadiene) with operating fluid saturation temperatures that fall within the expected ambient temperature extremes require special consideration to ensure the valve temperature remains above the operating fluid saturation temperature. Please contact your sales representative to review all applications which fall within this category.

SUGGESTED APPLICATION GUIDE

	Series 90	Series 9000
General pressure	✓	✓
Vacuum only	96A	✓
Pressure and vacuum	1	✓
Cryogenic		✓
Marine service	95	9300
Severe chloride service		9300
Marine vapor recovery systems	93	9300

NOTE

1. Type 96A in combination with other models.

Type 93

Introduced in 1968, the Type 93 is a pilot operated pressure relief valve designed with elastomer seats and seals and in a variety of materials to satisfy the majority of gas piping and chemical tank applications and is also suitable for use on marine vapor recovery systems.

Sizes:	2" x 3" to 12" x 16" (DN 50 to 300)
Orifices:	2.29 to 84.0 in^2 (14.77 to 541.93 cm^2)
Temperature range:	-260 to + 300°F (-162 to +149°C)
Set pressures:	3" wc to 50 psig (7.5 mbarg to 3.45 barg)
Code:	ASME VIII; API 2000

Type 95

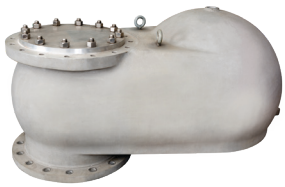
Type 95 is a unique protection valve that utilizes a piston in the main valve for ruggedness and high performance elastomers for pressures up to 150 psig (10.34 barg). This valve is ideal for special applications in marine LPG service, satisfying IMO and other marine regulations.

Sizes:	2" x 3" to 6" x 8" (DN 50 to 150)
Orifices:	2.93 to 22.15 in^2 (18.90 to 142.90 cm^2)
Temperature range:	-160 to + 400°F (-107 to +205°C)
Set pressures:	5 to 150 psig (0.345 barg to 10.34 barg)
Code:	ASME VIII; API 2000

Type 96A

The Type 96A is a weight-loaded vacuum breaker designed for vacuum only service or to complement the Series 90 pilot operated pressure relief valves in applications with high positive operating pressures.

Sizes:	4", 6", 8", 12", 16" (DN 100, 150, 200, 300, 400)
Vacuum setting:	½ oz/in^2 (2.2 mbarg) standard
	1½ oz /in^2 (6.6 mbarg) optional
Max. allowable positive pressure:	50 psig (3.45 barg)
Temperature range:	-320°F to 300°F (-196°C to 149°C)



Types 9200 and 9300

Type 9200 and 9300 are pressure and/or vacuum relief valves with a studded inlet connection and large orifice areas to provide high flow capacities. Featuring a pressurized PTFE seat and protected FEP diaphragms, these valves can be used for pilot operated pressure relief and simultaneously provide vacuum relief, either via weight loads of the internals or with a specific pilot control of the vacuum opening. They are particularly suited for liquified gas services.

Type 9200 vents directly to atmosphere and is suitable for cryogenic applications. The Type 9300 is designed to pipe away the discharge if necessary and is suitable for cryogenic, marine and severe chloride services or for marine vapor recovery systems.

Sizes:	2" x 3" to 14" x 18" (DN 50 x 80 to DN 350 x 450)
Orifices:	3.35 to 113.0 in^2 (21.61 to 729.03 cm^2)
Temperature range:	-320 to + 200°F (-196 to +93°C)
Set pressures:	4" wc to 50 psig (10 mbarg to 3.45 barg)
Vacuum range:	-1oz (-4.3 mbarg) full open weight loaded
	-2" wc to -5 psig (-5 mbarg to -0.345 barg) pilot operated
Code:	ASME VIII; API 2000

FUNCTION - LOW PRESSURE POPRV

Low pressure systems can be protected from overpressure by spring-operated valves, weight-loaded valves or pilot operated valves.

DISADVANTAGES OF SPRING-OPERATED OR WEIGHT-LOADED VALVES

- Begin opening when forces are in equilibrium leading to significant simmer or leakage
- Susceptible to freeze-up in cryogenic applications
- Sticky fluids can prevent opening
- Weight-loaded valves require significant overpressure to achieve rated capacities (see Figure 1)
- Limited flexibility for problem applications
- Decreasing sealing forces to set pressure leads to significant leakage
- Directly affected by back pressure (see Figure 2, weight loaded valve)
- Unsuited for use in closed header systems

ADVANTAGES OF SERIES 90/9000 VALVES

Full open at set pressure
A pilot controls pressure over a large unbalanced member in the main valve, such as a diaphragm or piston (see Figure 3), which means a much larger force on top of the seat compared to process forces pushing up on it. At set pressure, the pilot relieves the pressure quickly, permitting the main valve seat to open rapidly. The Series 90 designs can provide full opening without any overpressure and this is the same in the Series 9000 for vacuum as for pressure relief.

Snap or modulating action opening
These valves can be adjusted to open with a rapid 'snap' or modulating action with a simple adjustment of the external blowdown screw. Snap action will suit most applications, with full opening at set pressure and full reseating after a short blowdown. For systems best served by proportional opening, whereby the valve opens just enough to satisfy small upsets and maintain constant system pressure, the valve still has the capability to reach full capacity within 10% overpressure.

Leak-free operation
The greater the system pressure, the higher the seating force, until set point is reached and the valve opens. This provides superior leak-free operation, minimizing product loss. Figure 4 illustrates the relative seating forces of the valve types.

Balanced against back pressure
Series 90/9000 valves are inherently balanced against back pressures and so will not increase in set pressure or lose lift.

FIGURE 2

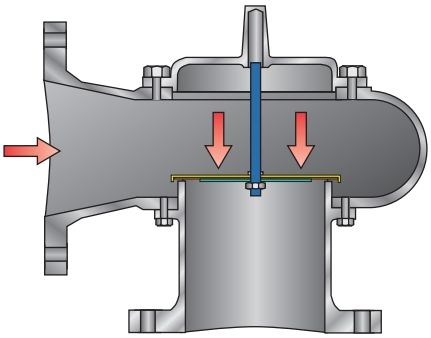


FIGURE 3

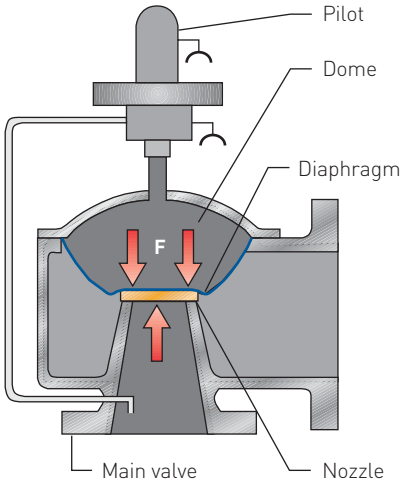


FIGURE 1

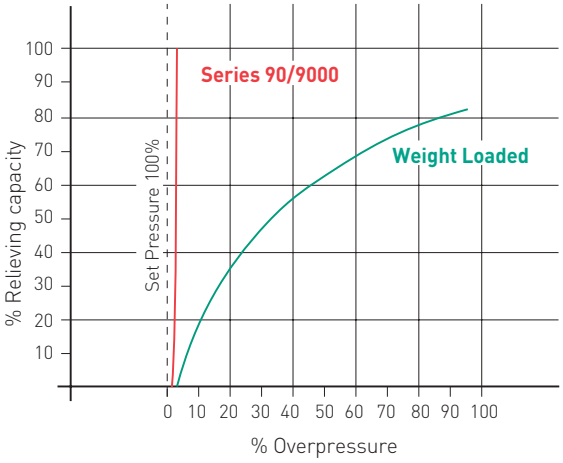


FIGURE 4

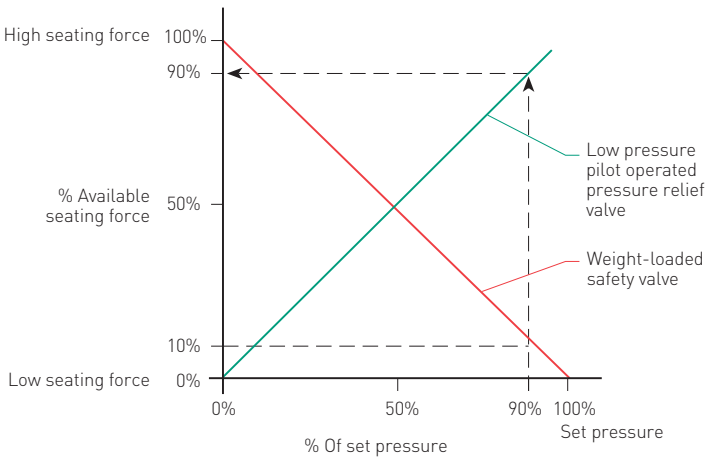
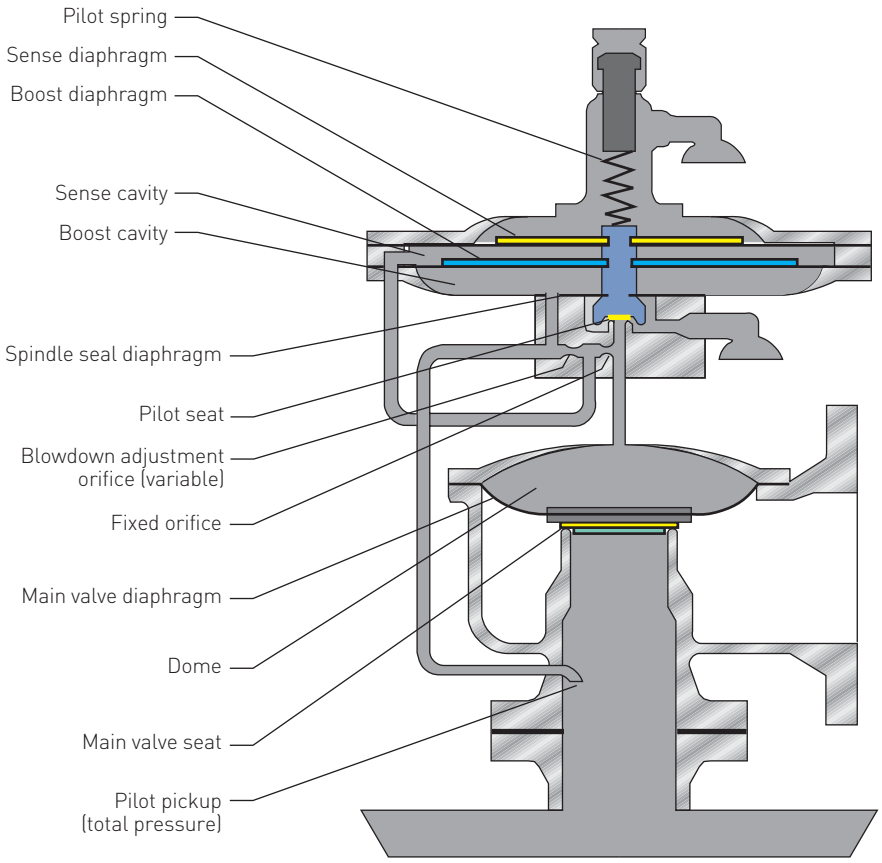


FIGURE 5



FULL OPEN AT SET PRESSURE

A pilot controls pressure over a large unbalanced diaphragm in the main valve, which means a much larger force on top of the seat compared to process forces pushing up on it. At set pressure, the pilot relieves the pressure quickly, permitting the main valve seat to open rapidly. The Type 93 design can provide full opening without any overpressure.

SNAP OR MODULATING ACTION OPENING

This valve can be adjusted to open with a rapid 'snap' or modulating action with a simple adjustment of the external blowdown screw. Snap action will suit most applications, with full opening at set pressure and full reseating after a short blowdown. For systems best served by proportional opening, whereby the valve opens just enough to satisfy small upsets and maintain constant system pressure, the valve still has the capability to reach full capacity within 10% overpressure.

LEAK-FREE OPERATION

The greater the system pressure, the higher the seating force, until set point is reached and the valve opens. This provides superior leak-free operation, minimizing product loss.

BALANCED AGAINST BACK PRESSURE

The Type 93 valve is inherently balanced against back pressures and so will not increase in set pressure or lose lift.

OPTIONAL ACCESSORIES

- Field test connection
- Backflow preventer
- Pilot supply filter
- Remote pressure sense connection
- Auxiliary setters
- Manual or remote blowdown
- Pilot exhaust tubed to main valve
- Pilot gag
- Pilot lift lever

FIGURE 6

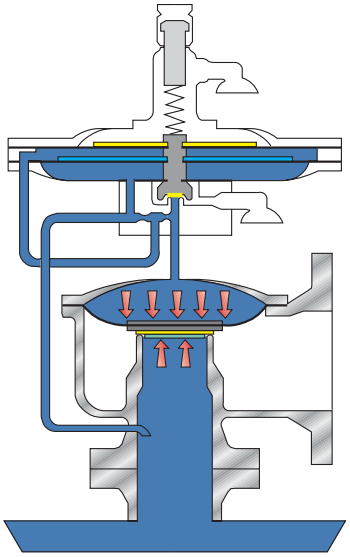


FIGURE 7

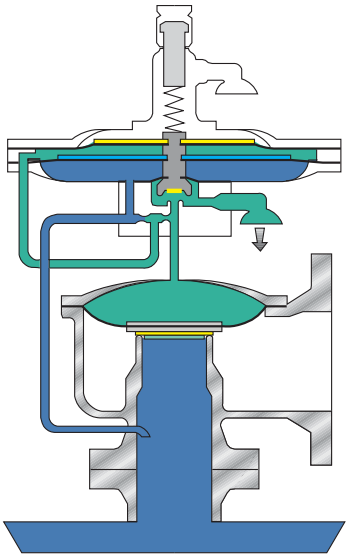
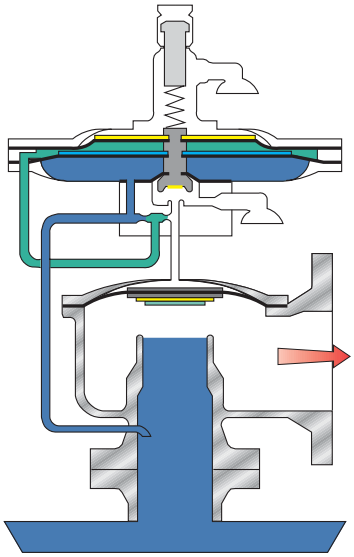


FIGURE 8



Intermediate pressure

Exhaust pressure

System pressure

Figure 6 (closed)
Under normal operating conditions, system pressure acts on the bottom of the main valve seat, on top of the main valve diaphragm and on the pilot diaphragms. The main valve seat is held closed tightly by a large force equal to the system pressure times the unbalanced area of the main valve diaphragm. System pressure is also applied to the boost cavity and the sense cavity downstream of the variable orifice. The soft pilot seat is held closed as the pilot spring load is greater than the upward forces acting on the sense diaphragm.

Figure 7 (pilot open)
When process pressure increases to the point where the upward force on the sense diaphragm exceeds the spring load, the pilot seat lifts slightly, setting up a small flow in the pilot sense line. This small flow across the blowdown adjustment orifice causes a reduction in pressure downstream of the orifice and in the sense cavity. Although only a small reduction in pressure, this creates a large net upward force which snaps the pilot full open.

Figure 8 (open and flowing)
With the pilot fully open, a large reduction in pressure on top of the main valve diaphragm occurs, resulting in full lift of the main valve seat.
Flow through the main valve continues until system pressure has been reduced to the point where the pilot spring is able to overcome the lifting forces on the boost diaphragm. As the pilot begins to close, the flow and pressure drop across the blowdown adjustment and orifice decreases. The sense cavity pressure now increases to assist in an accelerated closing rate.
With the pilot closed, full line pressure again loads the dome area and the main valve seat closes.

NOTE
The point at which the pilot spring overcomes the net lifting forces on the boost diaphragm may be varied by changing the pressure drop across the variable blowdown adjustment orifice: a smaller adjustment makes the valve close at a lower system pressure (longer blowdown); a larger adjustment makes it open and close in a proportional/ modulating mode.

FIGURE 9
Closed

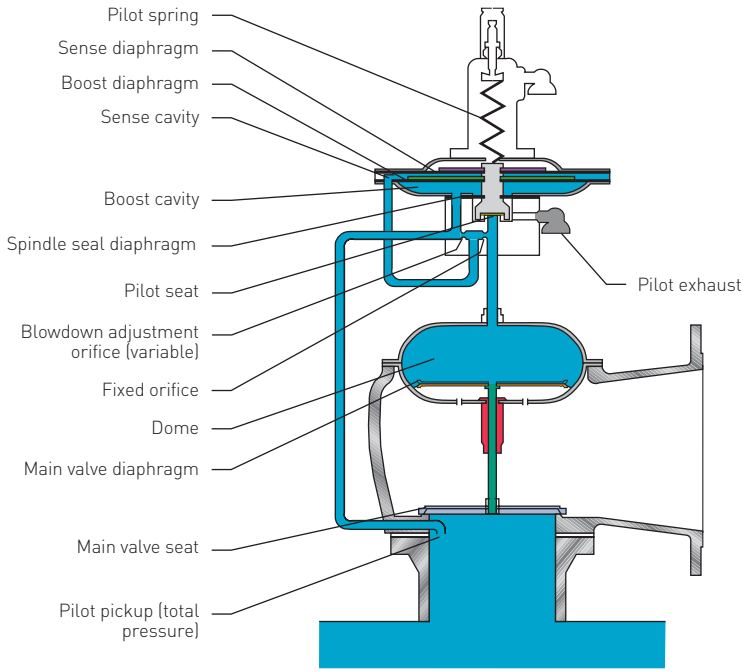


Figure 9 Positive pressure relief[2]
The Type 9200 uses the proven Series 90 pilot in both 'snap' and 'modulating' actions. The main valve diaphragms are fully supported by the surrounding cases and diaphragm plates, providing high pressure ranges to the PTFE diaphragms and permitting vacuum operations. The main valve seat is a high performance PTFE film seat which is extended from the main valve diaphragms to a low profile nozzle, which permits high flow capacities at set pressure.

Figure 10 Positive pressure relief
When process pressure increases to the point at which the upward force on the sense diaphragm exceeds the pilot spring load, the pilot seat lifts and begins the flow through the pilot. The flow across the blowdown adjustment orifice can be set to reduce the main valve dome pressure rapidly for a 'snap' action, or slowly for a 'modulating' action.

FIGURE 10
Pilot open

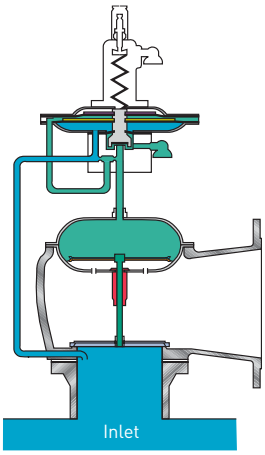
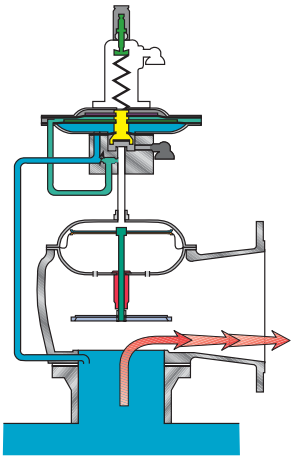


FIGURE 11
Open and flowing



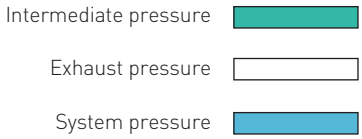


Figure 11 Positive pressure relief
- With the pilot open, the dome pressure is reduced sufficiently to enable the forces under the main valve seat to lift the seat plate and begin to relieve system pressure.
- Flow through the main valve continues until system pressure has been reduced enough so the pilot spring is again able to overcome the lifting forces on the boost diaphragm.
- As the pilot begins to close, the flow and pressure drop across the blowdown adjustment orifice decrease.
- The sense cavity pressure then increases to assist in an accelerated closing rate.
- With the pilot closed, full line pressure again loads the dome area and the main valve seat closes. Pressures return to those shown in Figure 9.

VACUUM RELIEF[2][3]

FIGURE 12
Closed

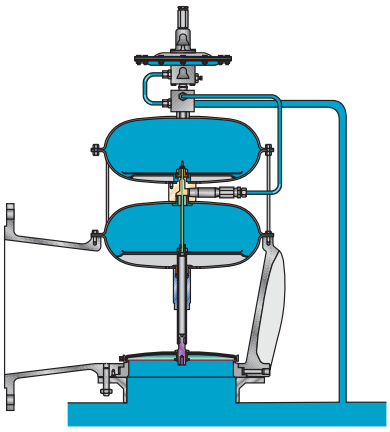


FIGURE 13
Open and flowing

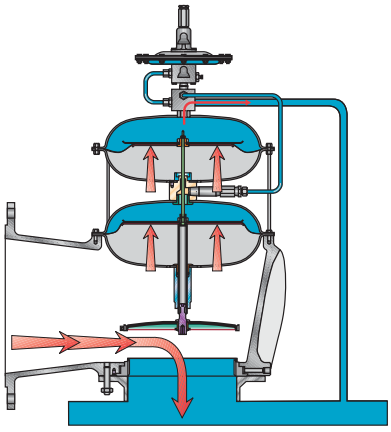


FIGURE 14
Closed

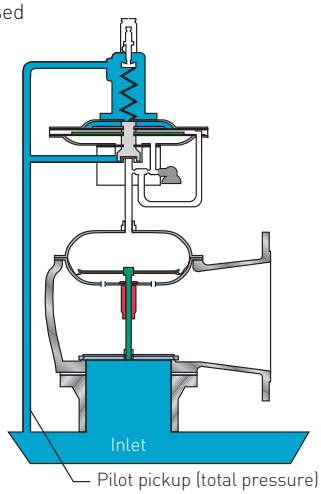


Figure 12 Weight loaded vacuum relief
Weight loaded vacuum relief provides economical vacuum protection in combination with a pilot operated pressure relief valve.

- The same valve which is held tightly closed on positive pressure opens on vacuum, based on the weight of internal components.

Figure 13 Weight loaded vacuum relief

- Vacuum in the protected vessel pulls up on one or two dome areas while external atmosphere pushes upwards on the diaphragms to lift the seat plates.
- Vacuum opening pressures depend on valve internals and the number of diaphragm chambers used.

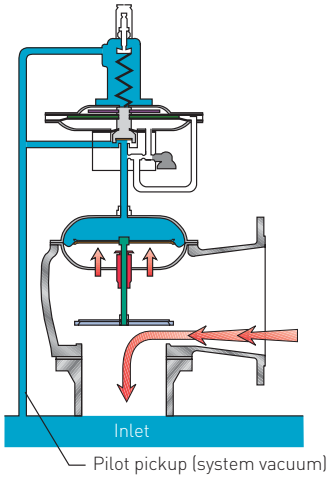
Figure 14 Pilot operated vacuum relief
Pilot operated vacuum relief operation is basically the same as for positive pressure relief:

- A seating force is established by loading the large dome area with a pressure greater than the inlet pressure under the seat.
- In the closed condition, there is atmospheric pressure in the dome area of the main valve and a vacuum at the inlet. This causes a net force that closes the seat and maintains tightness up to set point.
- At set point, the vacuum pulls against the spring force and the pilot valve opens, evacuating the dome pressure through the supply tube into the inlet vacuum.

Figure 15 Pilot operated vacuum relief

- With a partial vacuum established in the dome, atmospheric pressure forces the diaphragm and seat to open and establishes air flow into the valve. This relieves the system vacuum.
- When the pilot reseats, the supply line is closed by the pilot seat.
- Atmospheric pressure again fills the dome through the blowdown adjustment and fixed orifice, which closes the main valve.

FIGURE 15
Open and flowing

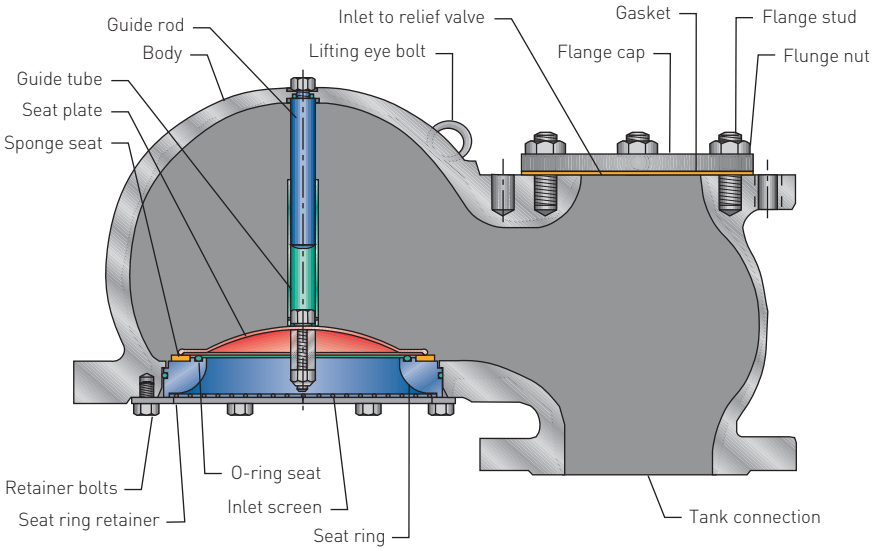


Intermediate pressure
Exhaust pressure
System pressure

NOTES

1. The point at which the pilot spring overcomes the net lifting forces on the boost diaphragm can be varied by changing the pressure drop across the variable blowdown adjustment orifice. A smaller orifice adjustment makes the valve close at a lower system pressure (longer blowdown).
2. With either pressure or vacuum configuration alone, the valve will open and flow when the weight-loaded pressure or vacuum for the opposite condition is exceeded unless a backflow preventer is installed.
3. Remote pressure sense required.

FIGURE 16



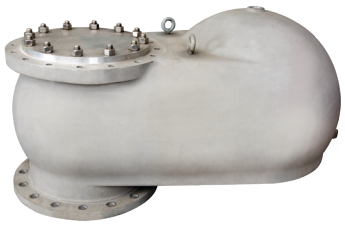
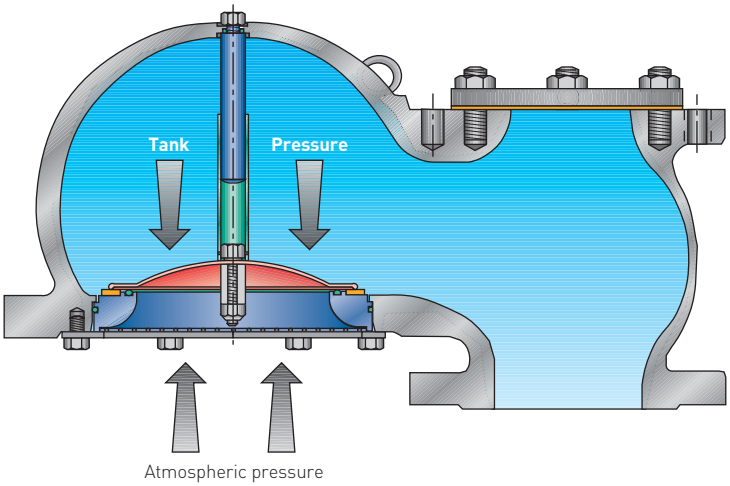
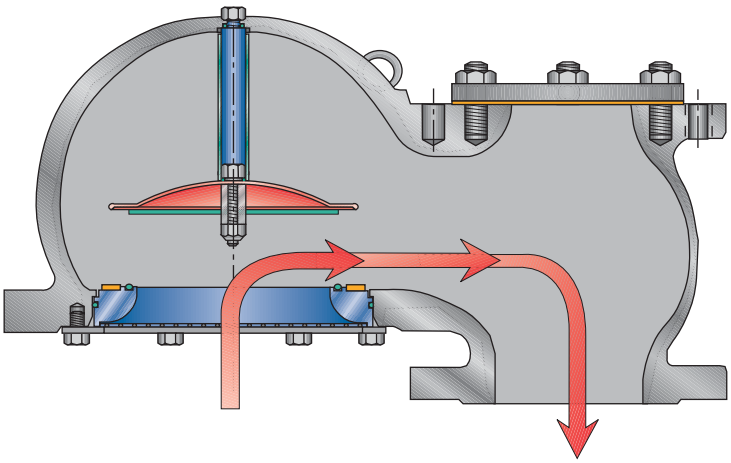


FIGURE 17



VALVE CLOSED
The weight of the pallet and any positive internal tank pressure holds the valve closed.

FIGURE 18



VALVE OPEN AND FLOWING
The tank vacuum creates a pressure differential great enough to overcome the weight of the pallet and the pallet is lifted to the open position.

GENERAL TECHNICAL DATA - REFER TO MODEL SELECTION TABLES FOR SPECIFIC PRESSURE LIMITATION

SERIES 90[1]

Valve type	Materials	Main valve soft goods	Pilot soft goods	Set pressure range	Process temperature
Pressure Relief Valves					
Type 93	AL, CS[6], SS	Elastomer or PTFE diaphragm, rubber seat and seals	Elastomer or PTFE diaphragm, elastomer soft goods	3¨ wc to 50 psig (7.5 mbarg to 3.45 barg)	-260°F to 300°F[2] (-162°C to 149°C)
Type 95	SS	Kalrez® seat PTFE seals	Hastelloy® PTFE Kalrez® soft goods	5 psig to 150 psig (.345 barg to 10.34 barg)	-160°F to 400°F (-107°C to 205°C)
Vacuum Breaker					
Type 96A	AL, CS[6], SS	Elastomer seat and seals	N/A	½ oz. or 1½ oz. vacuum (-2.2 to -6.6 mbarg)	-320°F to 300°F[2] (-196°C to 149°C)

SERIES 9000[1][7]

Valve type	Materials	Main valve soft goods	Pilot soft goods	Set pressure range	Vacuum range	Process temperature
Pressure relief valves						
Type 9200	AL or SS	PTFE diaphragm seat and seals	Elastomer or all PTFE soft goods	4¨ wc to 5 psig (9.9 mbarg to 0.345 barg)	-1.73¨ wc to -5 psig (-4.3 mbarg to -0.345 barg)	-320°F to 200°F[2] (-196°C to 93°C)
Type 9300	AL, CS[6], SS	PTFE diaphragm seat and seals	Elastomer or all PTFE soft goods	4¨ wc to 50 psig (9.9 mbarg to 3.45 barg)	-1.73¨ wc to -5 psig (-4.3 mbarg to -0.35 barg)	-320°F to 200°F[2] (-196°C to 93°C)

SERIES 90 TEMPERATURE RATINGS

NBR[3]	-65°F to 250°F (-54°C to 121°C)
FKM	-65°F to 300°F (-54°C to 149°C)
EPR	-65°F to 250°F (-54°C to 121°C)

NOTES

1. Not all valve sizes are available for service at extreme limits of both temperature and pressure simultaneously. Please consult your sales representative when 'at limits' to confirm suitability of selected valve.
2. Maximum temperature ratings for Series 90 soft goods: this is only a guide since pressure and fluid compatibility will also affect valve selection. See Series 90 temperature ratings table. For ASME code requirements, the maximum temperature for aluminum is 250°F (121°C).
3. NBR O-ring main valve seat is rated to -260°F (-162°C) in conjunction with PTFE diaphragm.
4. Kalrez® is a registered trademark of E.I. duPont de Nemours Company.
5. Hastelloy® is a registered trademark of Haynes International.
6. Minimum temperature for CS is -20°F (-29°C).
7. Contact your sales representative for 90 or 9000 Series product recommendations when the boiling point of the lading fluid is in between the minimum and maximum expected ambient temperatures.

MODEL SELECTION

MODEL SELECTION OVERVIEW

Valve size	Orifice area		
Inlet x outlet in (DN)	Type 93 in² (cm²)	Type 95 in² (cm²)	Types 9200 and 9300 in² (cm²)
2 x 3 (50 x 80)	2.29 (14.77)	2.93 (18.90)	3.35 (21.61)
3 x 4 (80 x 100)	5.16 (33.29)	6.25 (40.32)	7.39 (47.68)
4 x 6 (100 x 150)	8.74 (56.39)	10.32 (66.58)	12.73 (82.13)
6 x 8 (150 x 200)	19.56 (126.19)	22.15 (142.90)	28.89 (186.39)
8 x 10 (200 x 250)	36.40 (234.84)		50.00 (322.58)
10 x 12 (250 x 300)	51.00 (329.03)		78.85 (508.71)
12 x 16 (300 x 400)	84.00 (541.93)		113.00 (729.03)
14 x 18 (350 x 450)			140.60 (907.09)

TYPE 93

Main valve size				Sponge seat[4]	
Inlet x outlet in (DN)	Orifice area in² (cm²)	Valve body material[2][3]	Minimum[1] set pressure in wc (mbarg)	O-ring seat psig (mbarg)	Maximum[1] set pressure psig (barg)
2 x 3 (50 x 80)	2.29 (14.77)	AL	2 (5.0)	2.5 (170)	50.0 (3.45)
		CS	2 (5.0)	2.5 (170)	50.0 (3.45)
		SS	2 (5.0)	2.5 (170)	50.0 (3.45)
3 x 4 (80 x 100)	5.16 (33.29)	AL	2 (5.0)	1.5 (103)	50.0 (3.45)
		CS	2 (5.0)	1.5 (103)	50.0 (3.45)
		SS	2 (5.0)	1.5 (103)	50.0 (3.45)
4 x 6 (100 x 150)	8.74 (56.39)	AL	2 (5.0)	1.0 (69)	50.0 (3.45)
		CS	2 (5.0)	1.0 (69)	50.0 (3.45)
		SS	2 (5.0)	1.0 (69)	50.0 (3.45)
6 x 8 (150 x 200)	19.56 (126.19)	AL	2 (5.0)	1.0 (69)	50.0 (3.45)
		CS	2 (5.0)	1.0 (69)	50.0 (3.45)
		SS	2 (5.0)	1.0 (69)	50.0 (3.45)
8 x 10 (200 x 250)	36.40 (234.84)	AL	2 (5.0)	1.0 (69)	50.0 (3.45)
		CS	2 (5.0)	1.0 (69)	50.0 (3.45)
		SS	2 (5.0)	1.0 (69)	50.0 (3.45)
10 x 12 (250 x 300)	51.00 (329.03)	AL	2 (5.0)	1.0 (69)	30.0 (2.07)
		CS	2 (5.0)	1.0 (69)	30.0 (2.07)
		SS	2 (5.0)	1.0 (69)	30.0 (2.07)
12 x 16 (300 x 400)	84.00 (541.93)	AL	2 (5.0)	1.0 (69)	30.0 (2.07)
		CS	2 (5.0)	1.0 (69)	30.0 (2.07)
		SS	2 (5.0)	1.0 (69)	30.0 (2.07)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations. Minimum set pressure with accessories is 5 inches wc (12.4 mbarg) or minimum stated above, whichever is greater. Consult with sales office for verification.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. Standard aluminum valves are manufactured with flat faced flange finish in accordance with commercial practice. The flanges are designated as Class 150 FF, with drilling equal to ANSI Class 150. Standard CS and SS valves are manufactured with ANSI Class 150 RF (spiral serrated, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request.
4. At this pressure and below, a sponge-design seat is utilized in the main valve. Above this pressure, an O-ring design seat is utilized.

MODEL SELECTION

TYPE 95

Main valve size				
Inlet x outlet in (DN)	Orifice area in² (cm²)	Valve body material[1][2]	Minimum set pressure psig (barg)	Maximum set pressure psig (barg)
2 x 3 (50 x 80)	2.93 (18.90)	SS	10.00 (0.690)	150 (10.3)
3 x 4 (80 x 100)	6.25 (40.32)	SS	5.00 (0.345)	150 (10.3)
4 x 6 (100 x 150)	10.32 (66.58)	SS	5.00 (0.345)	150 (10.3)
6 x 8 (150 x 200)	22.15 (142.90)	SS	5.00 (0.345)	150 (10.3)

NOTES

1. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
2. SS valves are standard with ANSI Class 150 RF (spiral serrated, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request.

TYPE 9200, PRESSURE ONLY - PILOT OPERATED (SINGLE CHAMBER)

Main valve size				
Inlet in (DN)	Orifice area in² (cm²)	Valve trim material[2][3]	Minimum[1] set pressure in wc (mbarg)	Maximum[1] set pressure psig (barg)
2 Vent (50)	3.35 (21.61)	AL	6 (14.9)	5 (0.35)
		SS	6 (14.9)	5 (0.35)
3 Vent (80)	7.39 (47.68)	AL	4 (10.0)	5 (0.35)
		SS	4 (10.0)	5 (0.35)
4 Vent (100)	12.73 (82.13)	AL	3 (7.5)	5 (0.35)
		SS	5 (12.4)	5 (0.35)
6 Vent (150)	28.89 (186.39)	AL	3 (7.5)	5 (0.35)
		SS	5 (12.4)	5 (0.35)
8 Vent (200)	50.00 (322.58)	AL	4 (10.0)	5 (0.35)
		SS	7 (17.4)	5 (0.35)
10 Vent (250)	78.85 (508.71)	AL	4 (10.0)	5 (0.35)
		SS	6 (14.9)	2 (0.14)
12 Vent (300)	113.00 (729.03)	AL	4 (10.0)	5 (0.35)
		SS	10 (24.9)	2 (0.14)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations. Minimum set pressure with accessories is 5 inches wc (12.4 mbarg) or minimum stated above, whichever is greater. Consult with sales office for verification.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. All standard Type 9200 valves are manufactured with ANSI Class 150 RF inlet flanges (smooth, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request.

MODEL SELECTION

TYPE 9300, PRESSURE ONLY - PILOT OPERATED (SINGLE CHAMBER)

Main valve size				
Inlet x outlet in (DN)	Orifice area in² (cm²)	Valve trim material[2][3][6]	Minimum[1] set pressure in wc (mbarg)	Maximum[1] set pressure psig (barg)
2 x 3 (50 x 80)	3.35 (21.61)	AL	6 (14.9)	5 (0.35)
		SS	6 (14.9)	5 (0.35)
		SS	19 (47.3)	50 (3.45)
3 x 4 (80 x 100)	7.39 (47.68)	AL	4 (10.0)	5 (0.35)
		SS	4 (10.0)	5 (0.35)
		SS	11 (27.4)	50 (3.45)
4 x 6 (100 x 150)	12.73 (82.13)	AL	3 (7.5)	5 (0.35)
		SS	5 (12.4)	5 (0.35)
		SS	8 (19.9)	44[4] (3.03)
6 x 8 (150 x 200)	28.89 (186.39)	AL	3 (7.5)	5 (0.35)
		SS	5 (12.4)	5 (0.35)
		SS	6 (14.9)	25[4] (1.72)
8 x 10 (200 x 250)	50.00 (322.58)	AL	4 (10.0)	5 (0.35)
		SS	7 (17.4)	5 (0.35)
		SS	10 (24.9)	23[4] (1.59)
10 x 12 (250 x 300)	78.85 (508.71)	AL	4 (10.0)	5 (0.35)
		SS	6 (14.9)	2 (0.14)
		SS	11 (27.4)	14[5] (0.97)
12 x 16 (300 x 400)	113.00 (729.03)	AL	4 (10.0)	5 (0.35)
		SS	10 (24.9)	2 (0.14)
		SS	17 (42.3)	14[5] (0.97)
14 x 18 (350 x 450)	140.60 (907.09)	SS	9 (22.5)	10[7] (0.68)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations. Minimum set pressure with accessories is 5 inches wc (12.4 mbarg) or minimum stated above, whichever is greater. Consult with sales office for verification.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. Standard Aluminum valves are manufactured with flat faced outlet flange finish in accordance with commercial practice. The flanges are designated as Class 150 FF, with drilling equal to ANSI Class 150. Standard CS and SS valves are manufactured with ANSI Class 150 RF (smooth, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request. All inlet flanges must be raised face.
4. 50 psig (3.45 barg) with SS cap.
5. 30 psig (2.07 barg) with SS cap.
6. Valve body available in AL, CS or SS, for sizes 2-inch through 12-inch. 14 x 18 is available only in SS. Consult factory for other valve body materials.
7. This limit is further restricted by absolute pressure ratio (P_2/P_1) - P_2/P_1 to fall within 0.8 to 1.0. Refer page 28 for further details.

MODEL SELECTION

TYPE 9200, VACUUM ONLY - PILOT OPERATED[5][6] (SINGLE CHAMBER)

Main valve size				
Inlet in (DN)	Orifice area in² (cm²)	Valve trim material[2][3]	Minimum[1][4] set vacuum in wc (mbarg)	Maximum[1] set vacuum psig (barg)
2 Vent (50)	3.35 (21.61)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
3 Vent (80)	7.39 (47.68)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
4 Vent (100)	12.73 (82.13)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
6 Vent (150)	28.89 (186.39)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
8 Vent (200)	50.00 (322.58)	AL	-4 (-10.0)	-5 (-0.35)
		SS	-4 (-10.0)	-5 (-0.35)
10 Vent (250)	78.85 (508.71)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-2 (-0.14)
12 Vent (300)	113.00 (729.03)	AL	-3 (-7.6)	-5 (-0.35)
		SS	-5 (-12.7)	-2 (-0.14)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. All standard Type 9200 valves are manufactured with ANSI Class 150 RF (smooth, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request.
4. Weight loaded vacuum openings are available from -1 oz (-4.3 mbarg) full open. Dual chambers may be required.
5. Valve will open on positive pressure unless equipped with positive pressure block accessory. Minimum vacuum set with this accessory is limited to -5" wc (-12.4 mbarg). Positive pressure is limited. Please consult your sales representative.
6. Remote pressure sense connection is required for all vacuum configurations.

MODEL SELECTION

TYPE 9300, VACUUM ONLY - PILOT OPERATED[6][7] (SINGLE CHAMBER)

Main valve size				
Inlet x outlet in (DN)	Orifice area in² (cm²)	Valve trim material[2][3][4]	Minimum[1][5] set vacuum in wc (mbarg)	Maximum[1] set vacuum psig (barg)
2 x 3 (50 x 80)	3.35 (21.61)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
3 x 4 (80 x 100)	7.39 (47.68)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
4 x 6 (100 x 150)	12.73 (82.13)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
6 x 8 (150 x 200)	28.89 (186.39)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
8 x 10 (200 x 250)	50.00 (322.58)	AL	-4 (-10.0)	-5 (-0.35)
		SS	-4 (-10.0)	-5 (-0.35)
10 x 12 (250 x 300)	78.85 (508.71)	AL	-2 (-5.0)	-5 (-0.35)
		SS	-2 (-5.0)	-5 (-0.35)
12 x 16 (300 x 400)	113.00 (729.03)	AL	-3 (-7.6)	-5 (-0.35)
		SS	-5 (-12.7)	-5 (-0.35)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. Standard aluminum valves are manufactured with flat faced outlet flange finish in accordance with commercial practice. The flanges are designated as Class 150 FF, with drilling equal to ANSI Class 150. Standard CS and SS valves are manufactured with ANSI Class 150 RF (smooth, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request. All inlet flanges must be raised face.
4. Valve body available in AL, CS or SS.
5. Weight loaded vacuum openings are available from -1 oz (-4.3 mbarg) full open. Dual chambers may be required.
6. Valve will open on positive pressure unless equipped with positive pressure block accessory. Minimum vacuum set with this accessory is limited to -5" wc (-12.4 mbarg). Positive pressure is limited. Please consult your sales representative.
7. Remote pressure sense connection is required for all vacuum configurations.

MODEL SELECTION

TYPE 9200, PRESSURE PILOT WEIGHT LOADED VACUUM COMBINATION[4][5] (DUAL CHAMBER)

Main valve size			
Inlet in (DN)	Orifice area in² (cm²)	Valve trim material[2][3]	Pressure[1] pilot range
2 (50)	3.35 (21.61)	AL	6" wc - 5 psig (14.9 mbarg - 0.35 barg)
2 (50)	3.36 (21.68)	SS	6" wc - 5 psig (14.9 mbarg - 0.35 barg)
3 (80)	7.39 (47.68)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
3 (80)	7.39 (47.68)	SS	4" wc - 5 psig (10 mbarg - 0.35 barg)
4 (100)	12.73 (82.13)	AL	3" wc - 5 psig (7.5 mbarg - 0.35 barg)
4 (100)	12.73 (82.13)	SS	5" wc - 5 psig (12.4 mbarg - 0.35 barg)
6 (150)	28.89 (186.39)	AL	3" wc - 5 psig (7.5 mbarg - 0.35 barg)
6 (150)	28.89 (186.39)	SS	5" wc - 5 psig (12.4 mbarg - 0.35 barg)
8 (200)	50.00 (322.58)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
8 (200)	50.00 (322.58)	SS	7" wc - 5 psig (17.4 mbarg - 0.35 barg)
10 (250)	78.85 (508.71)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
10 (250)	78.85 (508.71)	SS	6" wc - 2 psig (14.9 mbarg - 0.14 barg)
12 (300)	113.00 (729.03)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
12 (300)	113.00 (729.03)	SS	10" wc - 2 psig (24.9 mbarg - 0.14 barg)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations. Consult with sales representative for verification.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. Aluminum and SS valves are manufactured with raised faced inlet flange finish in accordance with commercial practice. The flanges are designated as Class 150 RF.
4. With dual diaphragm chambers, valve reaches rated capacity at -1 oz (-4.3 mbarg). Note that 2-inch valve only requires single diaphragm chamber. Pilot operated control of vacuum setting is available. Please consult your sales representative.
5. Remote pressure sense connection is required for all vacuum configurations.

MODEL SELECTION

TYPE 9300, PRESSURE PILOT WEIGHT LOADED VACUUM COMBINATION[7][8] (DUAL CHAMBER)

Main valve size			
Inlet in (DN)	Orifice area in² (cm²)	Valve internals material[2][3][6]	Pressure[1] pilot range
2 x 3 (50 x 80)	3.35 (21.61)	AL	6" wc - 5 psig (14.9 mbarg - 0.35 barg)
2 x 3 (50 x 80)	3.36 (21.68)	SS	6" wc - 5 psig (14.9 mbarg - 0.35 barg)
	3.36 (21.68)		20" wc - 50 psig (48.8 mbarg - 3.45 barg)
3 x 4 (80 x 100)	7.39 (47.68)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
3 x 4 (80 x 100)	7.39 (47.68)	SS	4" wc - 5 psig (10 mbarg - 0.35 barg)
	7.39 (47.68)		12" wc - 50 psig (29.9 mbarg - 3.45 barg)
4 x 6 (100 x 150)	12.73 (82.13)	AL	3" wc - 5 psig (7.5 mbarg - 0.35 barg)
4 x 6 (100 x 150)	12.73 (82.13)	SS	5" wc - 5 psig (12.4 mbarg - 0.35 barg)
	12.73 (82.13)		9" wc - 44 psig[4] (22.4 mbarg - 3.03 barg)
6 x 8 (150 x 200)	28.89 (186.39)	AL	3" wc - 5 psig (7.5 mbarg - 0.35 barg)
6 x 8 (150 x 200)	28.89 (186.39)	SS	5" wc - 5 psig (12.4 mbarg - 0.35 barg)
	28.89 (186.39)		7" wc - 25 psig[4] (17.4 mbarg - 1.72 barg)
8 x 10 (200 x 250)	50.00 (322.58)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
8 x 10 (200 x 250)	50.00 (322.58)	SS	7" wc - 5 psig (17.4 mbarg - 0.35 barg)
	50.00 (322.58)		11" wc - 23 psig[4] (27.4 mbarg - 1.59 barg)
10 x 12 (250 x 300)	78.85 (508.71)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
10 x 12 (250 x 300)	78.85 (508.71)	SS	6" wc - 2 psig (14.9 mbarg - 0.14 barg)
	78.85 (508.71)		12" wc - 14 psig[5] (29.9 mbarg - 0.97 barg)
12 x 16 (300 x 400)	113.00 (729.03)	AL	4" wc - 5 psig (10 mbarg - 0.35 barg)
12 x 16 (300 x 400)	113.00 (729.03)	SS	10" wc - 2 psig (24.9 mbarg - 0.14 barg)
	113.00 (729.03)		19" wc - 14 psig[5] (47.3 mbarg - 0.97 barg)

NOTES

1. Listed minimum and maximum set pressure may not be available for some material and service temperature combinations. Consult with your sales representative for verification.
2. Refer to material sections of this catalog for balance of standard materials for the valve model shown.
3. Standard aluminum valves are manufactured with flat faced outlet flange finish in accordance with commercial practice. The flanges are designated as Class 150 FF, with drilling equal to ANSI Class 150. Standard CS and SS valves are manufactured with ANSI Class 150 RF (smooth, raised face, unless otherwise specified). Special facings, drilling and surface finishes are available upon request.
4. 50 psig (3.45 barg) with SS cap.
5. 30 psig (2.07 barg) with SS cap.
6. Valve body available in AL, CS or SS.
7. With dual diaphragm chambers, valve reaches rated capacity at -1 oz (-4.3 mbarg). Note that 2-inch valve only requires single diaphragm chamber. Pilot operated control of vacuum setting is available. Please consult your sales representative.
8. Remote pressure sense connection is required for all vacuum configurations.

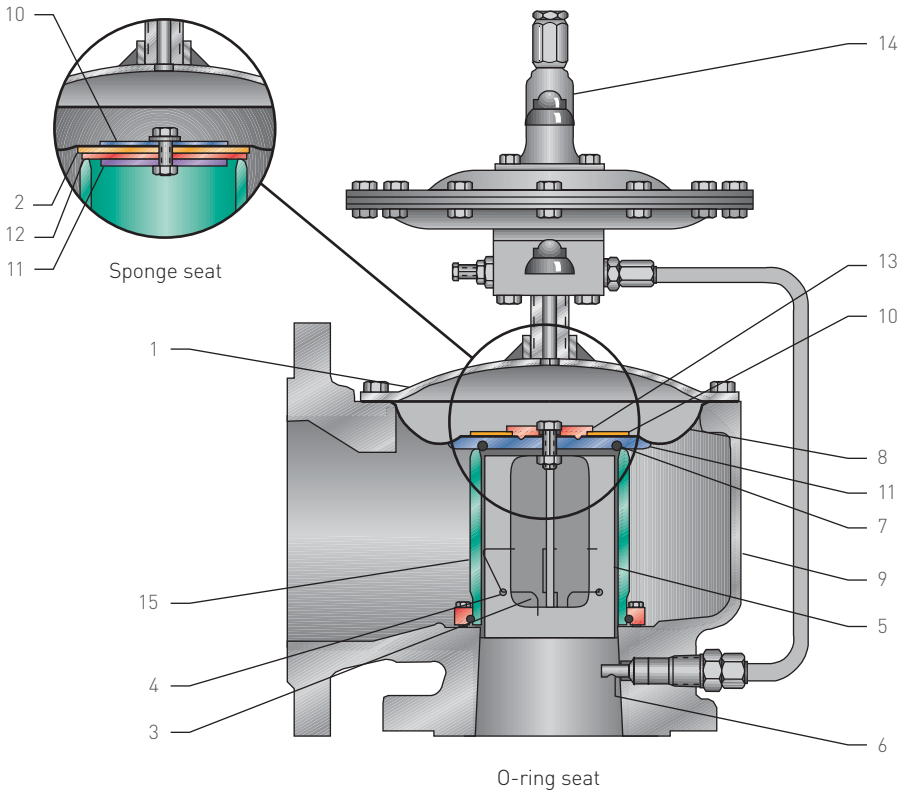
MODEL SELECTION

TYPE 96A VACUUM BREAKER[1]

Tank connection			Safety valve connection			
Valve size in (DN)	ANSI flange Class[2]	Valve body material	Valve size in (DN)	ANSI flange Class[2]	Maximum positive pressure	Valve model number[3][4]
4 (100)	150 FF	AL	Capped	150 FF	50 psig (3.45 barg)	96A04FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A04RS
4 (100)	150 FF	AL	4 (100)	150 FF	50 psig (3.45 barg)	96A0404FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A0404RS
4 (100)	150 FF	AL	3 (80)	150 FF	50 psig (3.45 barg)	96A0403FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A0403RS
6 (150)	150 FF	AL	Capped	150 FF	30 psig (2.07 barg)	96A06FA
	150 RF	SS		150 FF	30 psig (2.07 barg)	96A06RS
6 (150)	150 FF	AL	6 (150)	150 FF	30 psig (2.07 barg)	96A0606FA
	150 RF	SS		150 FF	30 psig (2.07 barg)	96A0606RS
6 (150)	150 FF	AL	4 (100)	150 FF	30 psig (2.07 barg)	96A0604FA
	150 RF	SS		150 FF	30 psig (2.07 barg)	96A0604RS
8 (200)	150 FF	AL	Capped	150 FF	50 psig (3.45 barg)	96A08FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A08RS
8 (200)	150 FF	AL	8 (200)	150 FF	50 psig (3.45 barg)	96A0808FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A0808RS
8 (200)	150 FF	AL	6 (150)	150 FF	50 psig (3.45 barg)	96A0806FA
	150 RF	SS		150 FF	50 psig (3.45 barg)	96A0806RS
12 (300)	150 FF	AL	Capped	150 FF	20 psig (1.38 barg)	96A12FA
	150 RF	SS		150 FF	20 psig (1.38 barg)	96A12RS
12 (300)	150 FF	AL	12 (300)	150 FF	20 psig (1.38 barg)	96A1212FA
	150 RF	SS		150 FF	20 psig (1.38 barg)	96A1212RS
12 (300)	150 FF	AL	10 (250)	150 FF	20 psig (1.38 barg)	96A1210FA
	150 RF	SS		150 FF	20 psig (1.38 barg)	96A1210RS
16 (400)	150 FF	AL	Capped	150 FF	20 psig (1.38 barg)	96A16FA
	150 FF	AL	16 (400)	150 FF	20 psig (1.38 barg)	96A1616FA
	150 FF	AL	12 (300)	150 FF	20 psig (1.38 barg)	96A1612FA

NOTES

1. All model numbers shown are standard. Some alternative flange facing or drilling is available upon request.
2. The pressure relief valve connection is drilled to meet the size and number of bolts for ANSI Class 150 flanges.
3. Standard settings: -½ oz (-2.2 mbarg)
   -1½ oz (-6.6 mbarg)
   Full open at double this setting.
4. Seat and seals available in NBR, FKM and EPR.



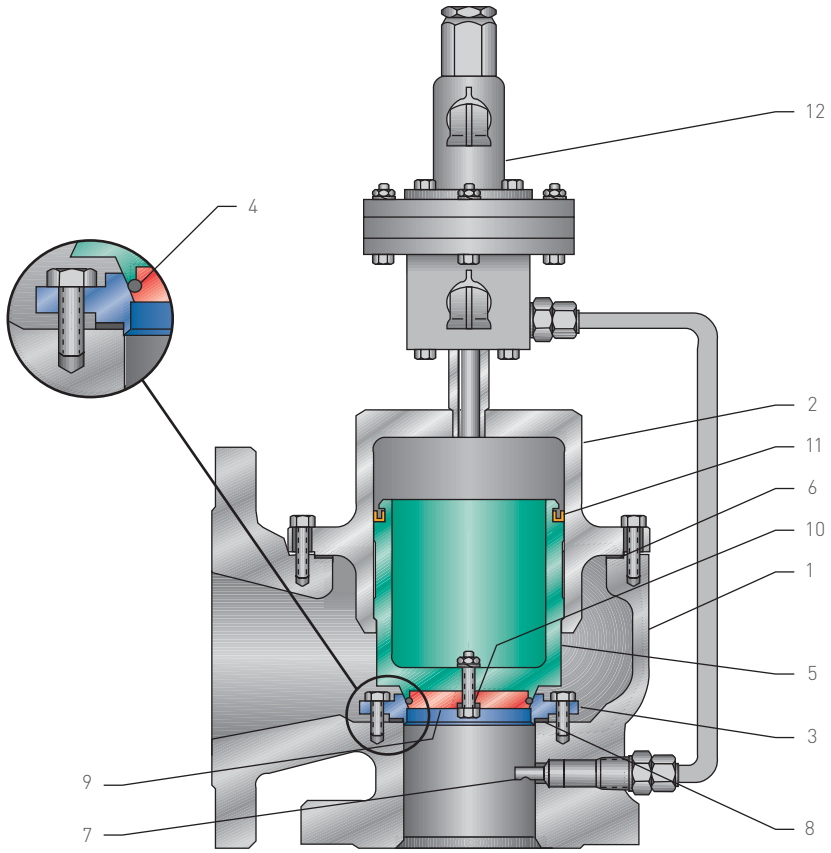
- ASME UV code stamp, NB certified capacity 15 psig and above
- Elastomer or PTFE diaphragms
- Replaceable nozzles
- Elastomer seat and seals
- Pressure range 2-inch wc to 50 psig (5.0 mbarg to 3.45 barg)
- Sizes 2 to 12-inch (DN 50 to 300)
- Orifices 2.29 to 84.0 in^2 (14.78 to 541.97 cm^2)

MATERIALS OF CONSTRUCTION

		Material		
Part #	**Description**	**AL**	**CS**	**SS**
1	Cap	CS[1] SA516-70[1]	CS SA516-70[1]	SS A240-316
2	Retainer plate	AL 6061-T651[1]	AL 6061-T651[1]	SS A240-304
3	Guide spring[6]	316 SS	316 SS	316 SS
4	Spring pin[2]	302 SS	302 SS	302 SS
5	Guide[6]	AL 6061-T6[1]	AL 6061-T6[1]	[7]
6	Dipper tube	17-4 SS	17-4 SS	17-4 SS
7	Seat O-ring	[3]	[3]	[3]
8	Diaphragm	[4]	[4]	[4]
9	Body	AL SB26 356-T6	CS A216-WCB	SS A351-CF8M
10	Diaphragm retainer	AL 6061-T6[1]	AL 6061-T6[1]	SS A240-304
11	Seat retainer	AL 6061-T6[1]	AL 6061-T6[1]	SS A240-304
12	Sponge seat	[3]	[3]	[3]
13	Top plate[8]	AL 6061-T6[1]	AL 6061-T6[1]	SS A240-304
14	Pilot valve	AL[1]	CS[1]	SS
15	Nozzle	SS 479-316 or A351-CF8M	CS[1][5] A108-1213 or A513-1026	SS 479-316 or A351-CF8M
–	Nuts/bolts/tubing	18-8 SS	18-8 SS	18-8 SS

NOTES

1. SS optional.
2. Used on 6-inch (DN 150) and larger valves only.
3. NBR standard, FKM or EPR optional.
4. NBR, Dacron reinforced standard; FKM, EPR, Dacron reinforced optional; non-reinforced PTFE optional.
5. Electroless nickel plated.
6. Not required in lowest pressure.
7. 2- to 6-inch (DN 50 to 150):
   A747-CB7CU1H1150.
   8- to 12-inch (DN 200 to 300):
   A240-304/A276-304/A312-304W.
8. Used on 6-inch (DN 150) and smaller valves.

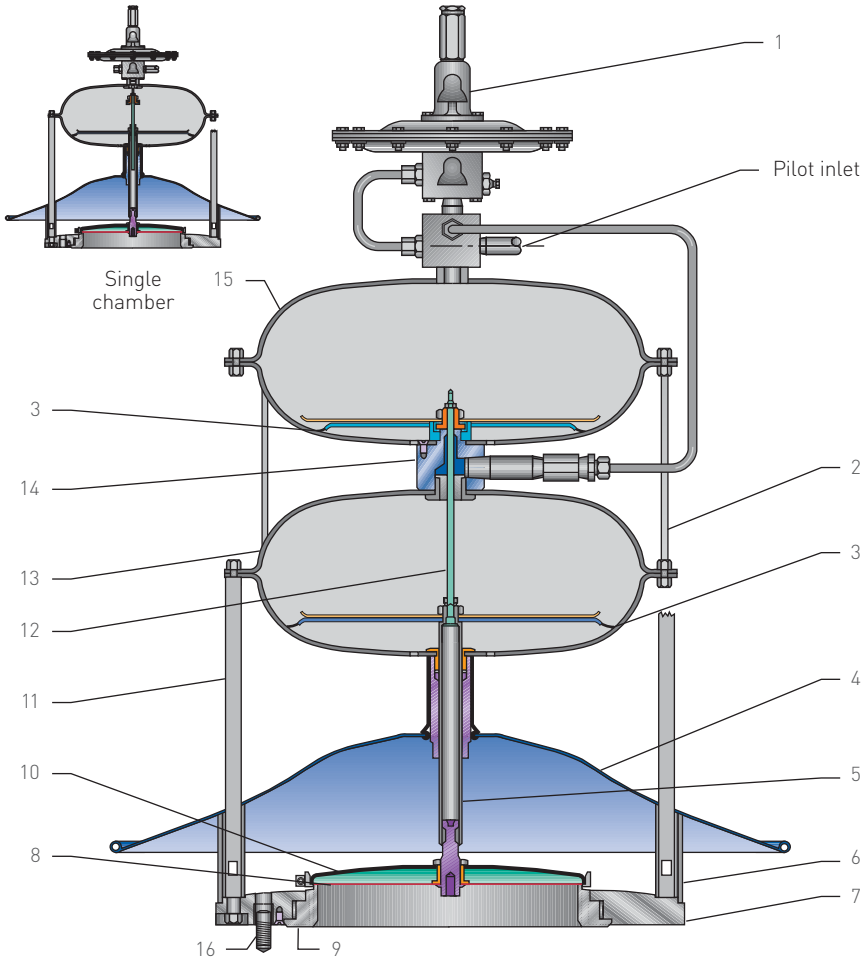


MATERIALS OF CONSTRUCTION

Part #	Description	Material SS
1	Body	SS A351-CF8M
2	Cap/liner	SS A479-316[1]
3	Nozzle	SS A479-316
4	Seat	Kalrez®[2]
5	Piston	SS A479-316[3]
6	Cap gasket	PTFE
7	Dipper tube	17-7 SS
8	Nozzle gasket	PTFE
9	Seat retainer	SS A582-303[4]
10	Seat retainer seal	PTFE
11	Piston seal	PTFE
12	Pilot valve	SS
–	Nuts/bolts/tubing	18-8 SS

NOTES

1. Optional SS A351-CF8M.
2. duPont Co. Perfluoroelastomer.
3. 4- and 6-inch (DN 100 and 150): A351-CF8M.
4. 4- and 6-inch (DN 100 and 150): A240-316.



OPTIONAL ACCESSORIES

- Field test connection
- Backflow preventer
- Pilot supply filter
- Remote pressure sense connection
- Auxiliary setters
- Manual or remote blowdown
- Pilot gag
- Pilot lift lever

MATERIALS OF CONSTRUCTION

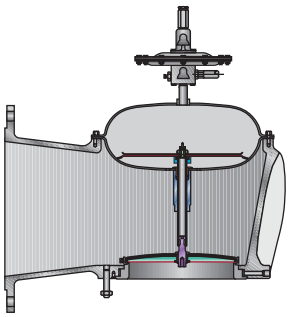
		Material	
Part #	**Description**	**AL**	**SS**
1	Pilot	AL	SS
2	Auxiliary actuator support	SS 316	SS 316
3	Diaphragms	FEP	FEP
4	Shield	AL B209-6061-0	SS A240-304
5	Shaft	AL B211-6061-T6	SS 316
6	Screen	SS 304	SS 304
7	Base flange	AL B209-6061-T6	SS A351-CF8M
8	Film seat	FEP	FEP
9	Nozzle	SS A351-CF8M	SS A351-CF8M
10	Seat plate	AL B209-6061-T62	SS A240-316
11	Support column	SS A479-304	SS A479-304
12	Auxiliary rod	SS A276-316	SS A276-316
13	Primary actuator case	AL SB209-6061-T4	SS A240-304/316
14	Adaptor[1]	SS 17-4	SS 17-4
15	Auxiliary actuator case[1]	AL SB209-6061-T4	SS A240-304/316
16	Inlet studs	CS A193-B7	SS A193-B8M

NOTES

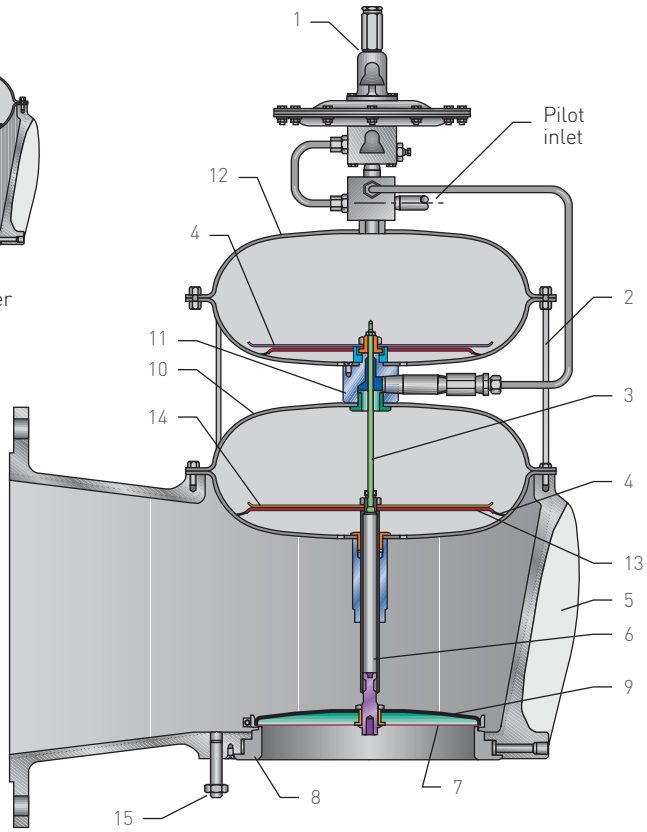
1. Only supplied for certain vacuum conditions.
2. Also available in SS.

ANDERSON GREENWOOD SERIES 90/9000 PILOT OPERATED PRESSURE RELIEF VALVES

PRODUCT DETAIL - TYPE 9300



Single chamber



Dual chamber

- ASME UV code stamp, NB certified capacity 15 psig and above
- Protected FEP PTFE Diaphragms
- Film type main valve seat
- Elastomer or PTFE pilot seat and seals available
- Full body valve. Piped away to discharge or to atmosphere.
- Balanced against back pressure
- Pressure range 4-inch wc to 50 psig (10.0 mbarg to 3.45 barg)
- Vacuum range
  -1 oz (-4.3 mbarg) full open weight loaded
  -2-inch wc to -5 psig pilot operated
  (-5.0 mbarg to -0.345 barg)
- Sizes 2 to 14-inch (DN 50 to 350)
- Orifices 3.35 to 140.60 in^2 (21.61 to 907.09 cm^2)

OPTIONAL ACCESSORIES

- Field test connection
- Backflow preventer
- Pilot supply filter
- Remote pressure sense connection
- Auxiliary setters
- Manual or remote blowdown
- Pilot exhaust tubed to main valve
- Pilot gag
- Pilot lift lever

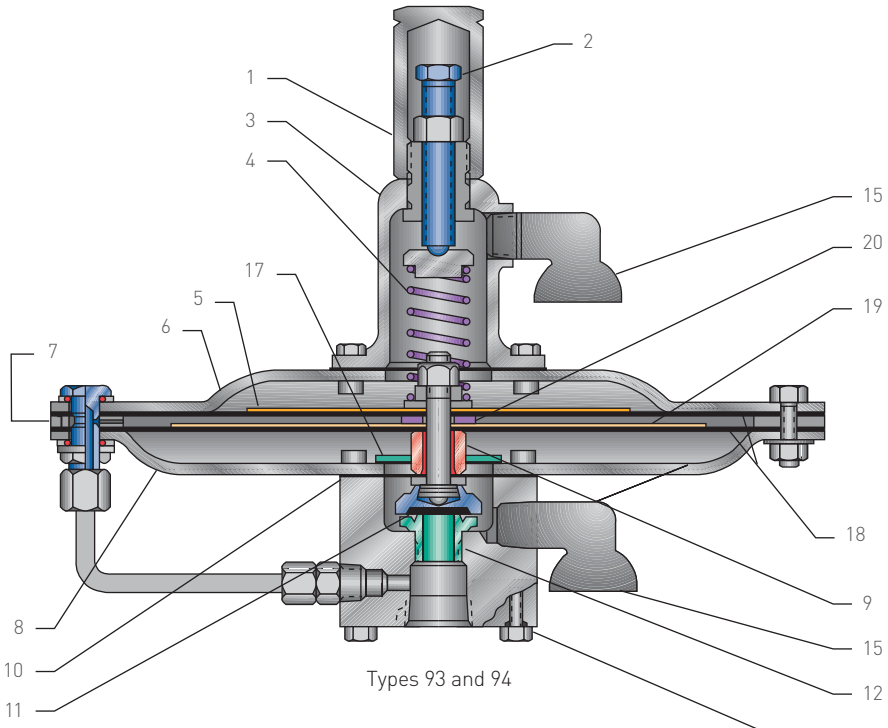
MATERIALS OF CONSTRUCTION

		Material		
Part nr.	**Description**	**AL**	**CS**	**SS**
1	Pilot	AL	CS	SS
2	Auxiliary actuator support	SS 316	SS 316	SS 316
3	Auxiliary rod	SS A276-316	SS A276-316	SS A276-316
4	Diaphragms	FEP	FEP	FEP
5	Body	AL SB26 356-T6	CS SA216-WCB	SS SA351-CF8M
6	Shaft	AL B211-6061-T6	SS 316	SS 316
7	Film seat	FEP	FEP	FEP
8	Nozzle	SS A351-CF8M	SS A351-CF8M	SS A351-CF8M
9	Seat plate	AL B209-6061-T6[2]	SS A240-316	SS A240-316
10	Primary actuator case	AL SB209-6061-T4/T451	CS SA516-70	SS A240-304/316
11	Adapter[1]	SS 17-4	SS 17-4	SS 17-4
12	Auxiliary actuator case[1]	AL SB209-6061-T4/T451	CS SA516-70	SS A240-304/316
13	Pressure support plate	AL B209-6061-T6[2]	SS A240-304	SS A240-304
14	Vacuum support plate	AL B209-6061-T6[2]	SS A240-304	SS A240-304
15	Inlet stud	CS A193-B7	CS A193-B7	SS A193-B8M

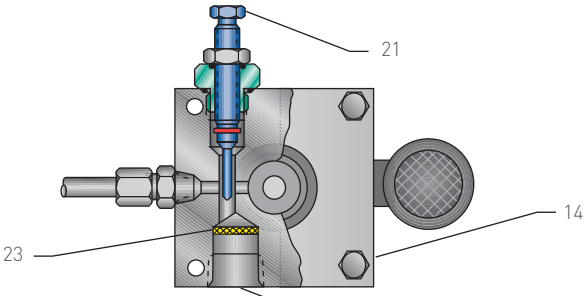
NOTES

1. Only supplied for certain vacuum conditions.
2. Also available in SS.
3. 14-inch available in SS only.

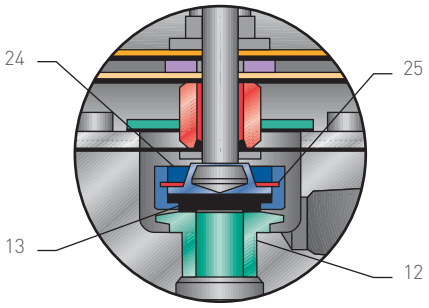
SERIES 90 PILOT CONSTRUCTION



Types 93 and 94



View A - A



Types 91 and 93T seat PTFE

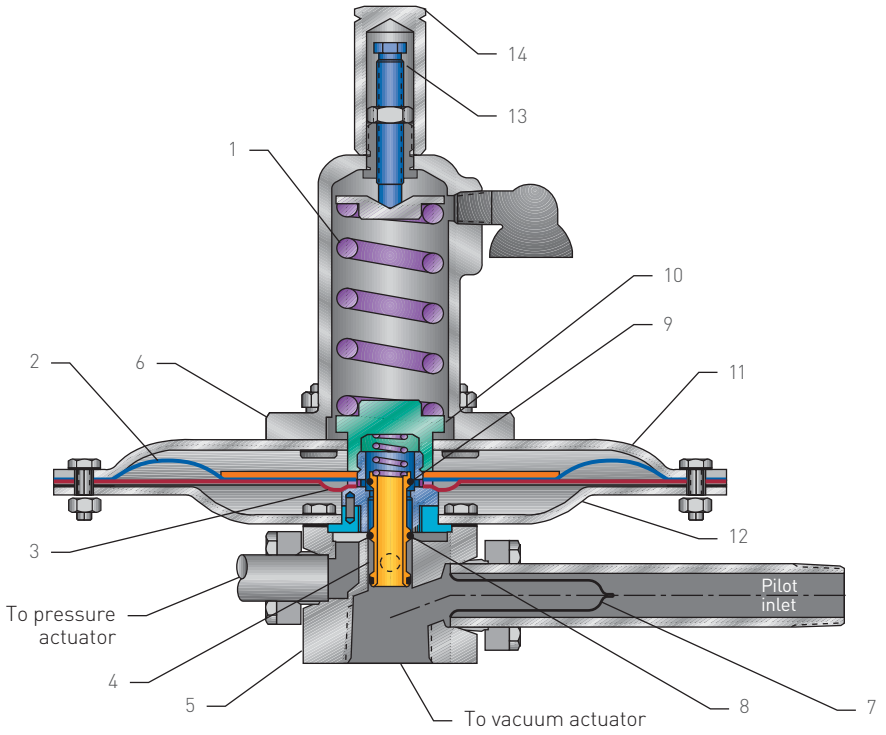
MATERIALS OF CONSTRUCTION

		Material		
Part #	**Description**	**AL**	**CS**	**SS**
1	Cap	CS AX/ZN/CO	CS AX/ZN/CO	SS A582-303
2	Pressure adjustment bolt	SS A276-316	SS A276-316	SS A276-316
3	Bonnet	SS A351-CF8M	SS A351-CF8M	SS A351-CF8M
4	Spring	316 SS	316 SS	316 SS
5	Sense plate	AL 6061-T6	CS 1010 ZN/CO	304 SS
6	Upper case	CS A36[7]	CS A36[7]	304 SS
7	Spacer ring	CS A36[7]	CS A36[7]	304 SS
8	Lower case	CS A36[7]	CS A36[7]	304 SS
9	Boost spacer	AL 2617-T451	304 SS	304 SS
10	Spindle diaphragm	[1]	[1]	[1]
11	Seat (types 93 and 94)	[2]	[2]	[2]
12	Nozzle	SS A351-CF8M	SS A351-CF8M	SS A351-CF8M
13	Seat (type 91)	PTFE	PTFE	PTFE
14	Body	AL 6061-T651	CS 1117 Ni Pl	SS A479-316/316L
15	Vent	Zytel	Zytel	Zytel
16	Seat (type 95)	Kalrez®[3]	Kalrez®[3]	Kalrez®[3]
17	Check plate	304 SS[5]	304 SS[5]	304 SS[5]
18	Diaphragms	[6]	[6]	[6]
19	Boost plate	AL 6061-T6	CS 1010 ZN/CO	304 SS
20	Sense spacer	316 SS	316 SS	316 SS
21	Blowdown needle	SS A276-316	SS A276-316	SS A276-316
22	Body bolt seal	[4]	[4]	[4]
23	Filter screen	316 SS	316 SS	316 SS
24	Seat retainer	SS SA479-304	SS SA479-304	SS SA479-304
25	Retainer ring	SS PH15-7M0	SS PH15-7M0	SS PH15-7M0
–	Nuts/bolts/tubing	18-8 SS	18-8 SS	18-8 SS

NOTES

1. NBR standard; FKM, EPR or PTFE optional.
2. NBR standard; FKM or EPR optional.
3. duPont Co. Perfluoroelastomer.
4. NBR standard; FKM or EPR optional.
5. NBR standard; FKM or EPR optional.
6. NBR standard; FKM, EPR, or PTFE optional.
7. SS optional.

SERIES 400 NO-FLOW MODULATING PILOT

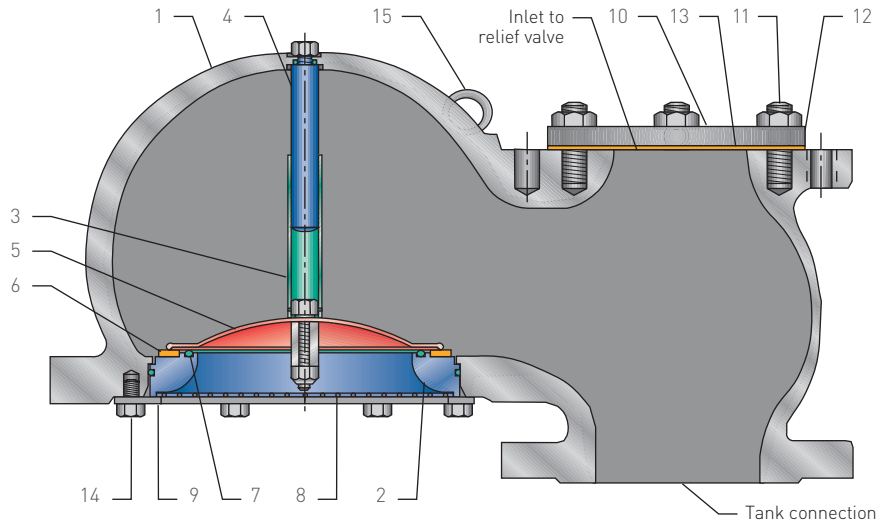


MATERIALS OF CONSTRUCTION

Part #	Description	Material
1	Spring	316 SS
2	Sensing diaphragm	FEP
3	Feedback diaphragm	FEP
4	Spool	SS A479-316
5	Body	SS A479-316
6	Bonnet assembly	SS A351-CF8M
7	Inlet screen	316 SS
8	Outlet seat	[1]
9	Inlet seat	[1]
10	Spindle assembly	SS A276-316
11	Upper diaphragm case	304 SS
12	Lower diaphragm case	304 SS
13	Pressure adjusting screw	SS A276-316
14	Bonnet cap	SS A582-303

NOTE

1. NBR standard; FKM or EPR optional.



MATERIALS OF CONSTRUCTION

		Material		
Part #	**Description**	**AL**	**CS**	**SS[3]**
1	Body	AL ASTM-B26 356-T6	CS SA216-WCB	SS A351-CF8M
2	Seat ring	AL 6061-T6	SS A240-316	SS A240-316
3	Guide tube	SS A269-316W/D	SS A269-316W/D	SS A269-316W/D
4	Guide rod	303 SS PTFE Coated	303 SS PTFE Coated	303 SS PTFE Coated
5	Seat plate	SS A240-316	SS A240-316	SS A240-316
6	Sponge seat	[1]	[1]	[1]
7	O-ring seat	[1]	[1]	[1]
8	Inlet screen	304 SS, 1" mesh 0.08-inch wire diameter	304 SS, 1" mesh 0.08-inch wire diameter	304 SS, 1" mesh 0.08-inch wire diameter
9	Seat ring retainer	SS A240-316	SS A240-316	SS A240-316
10	Flange cap	AL 6061-T6[2]	SS A240-316[2]	SS A240-316[2]
11	Flange stud	316 SS[2]	316 SS[2]	316 SS[2]
12	Flange nut	18-8 SS[2]	18-8 SS[2]	18-8 SS[2]
13	Gasket	PTFE[2]	PTFE[2]	PTFE[2]
14	Retainer bolts	SS 18-8	SS 18-8	SS 18-8
15	Lifting eye bolt	CS A307	CS A307	CS A307

Tank connection size inch (mm)	**Maximum allowable positive pressure psig (barg)**
4 (100)	50 (3.45)
6 (150)	30 (2.07)
8 (200)	50 (3.45)
12 (300)	20 (1.38)
16 (400)	20 (1.38)

NOTES

1. NBR standard; FKM, EPR optional.
2. Furnished on vacuum breakers without relief valve connection.
3. SS not available for 16" size.

Vacuum breakers and pressure relief valves can be mounted together.

VALVE SIZING[1] - SUBSONIC FLOW

Pilot operated PRV Types 93, 95, 9200 and 9300
(Set pressure < 15 psig (1.03 barg))

U.S. weight flow (lb/h)
Formula 1

$$A_{(in^2)} = \frac{W\sqrt{TZ}}{735\,K_d\,P_1F\sqrt{M}}$$

Metric weight flow (kg/h)
Formula 1M

$$A_{(cm^2)} = \frac{W\sqrt{TZ}}{560\,K_d\,P_1F\sqrt{M}}$$

U.S. volumetric flow (SCFM)
Formula 11

$$A_{(in^2)} = \frac{V\sqrt{MTZ}}{4645\,K_d\,P_1F}$$

Metric volumetric flow (Nm^3/h)
Formula 11M

$$A_{(cm^2)} = \frac{V\sqrt{MTZ}}{12510\,K_d\,P_1F}$$

where

$$F = \sqrt{\frac{k}{k-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k+1}{k}}\right]}$$

(Refer to page 31)

NOTE

1. A computer sizing program is available. Consult your sales representative.
2. Refer model selection overview on page 12 for available sizes.

SUBSONIC COEFFICIENT OF DISCHARGE - K_d

Valve type	Sizes	Relief	Coefficient of discharge	Units	Reference
95	All	Pressure	$K_d = 0.678\ (P_2/P_1)^{-0.285}$	all	Figure 22, page 33
93	All	Pressure	$K_d = 0.700\ (P_2/P_1)^{-0.265}$	all	Figure 23, page 33
9200	All	Pressure	$K_d = 0.756\ (P_1\text{-}P_A)^{0.0517}$	in/lb	Figure 20, page 32
9200	All	Pressure	$K_d = 0.756\ ((P_1\text{-}1.013) \times P_A)^{0.0517}$	metric	Figure 20, page 32
9200	All	Vacuum	$K_d = 0.667$	all	None
9300	2"-12"	Pressure	$K_d = 0.650\ (P_2/P_1)^{-0.349}$	all	Figure 21(a), page 32
9300	2"-12"	Vacuum	$K_d = 0.55$	all	None
9300	14"	Pressure	$K_d = 0.8085\ (P_2/P_1)^{-0.199}$ where $(0.80 \leq P_2/P_1 \leq 1.00)$	all	Figure 21(b), page 32

VALVE SIZING[1] - SONIC FLOW EQUATIONS

ASME VIII gas flow (set pressure ≥ 15 psig (1.03 barg))

U.S. weight flow (lb/h)
Formula 3

$$A_{(in^2)} = \frac{W}{CK\ P_1}\sqrt{\frac{TZ}{M}}$$

Metric weight flow (kg/h)
Formula 3M

$$A_{(cm^2)} = \frac{1.316\ W}{CK\ P_1}\sqrt{\frac{TZ}{M}}$$

U.S. volumetric flow (SCFM)
Formula 4

$$A_{(in^2)} = \frac{V\sqrt{MTZ}}{6.32\ CK\ P_1}$$

Metric volumetric flow (Nm^3/h)
Formula 4M

$$A_{(cm^2)} = \frac{V\sqrt{MTZ}}{17.02\ CK\ P_1}$$

where

SONIC COEFFICIENT OF DISCHARGE - K

Valve type	ASME derated coefficient
95	0.852
93	0.845
9300	0.629

Sizing Information ASME Section VIII

After system capacity has been determined, a properly sized pressure relief valve is determined by the following method.

A. From the formulas in this section, calculate required orifice area as a function of capacity.
B. Identify the required orifice size. Always choose an orifice which is equal to, or greater than the required orifice area.
C. Specifications exceeding standard catalog descriptions should be referred to our sales department.

NOTE

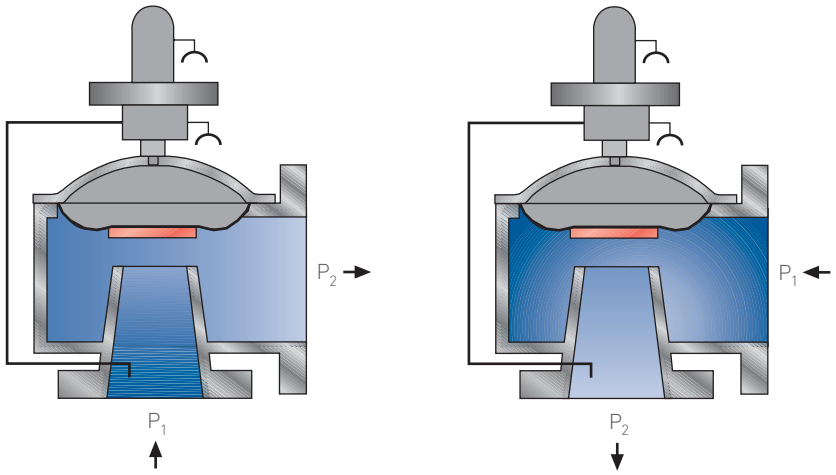
1. A computer sizing program is available. Consult your sales representative.

VALVE SIZING - NOMENCLATURE

GAS FLOW

Symbol	Description	Inch pounds	Metric units
A	Orifice area or equivalent flow area.	square inch (in^2)	square centimeter (cm^2)
C	The gas constant, based on the specific heat ratio, k. If C is unknown, use C = 315, a conservative value. Refer also to Table 1, page 34.	-	-
F	Subsonic flow factor, based on the ratio of specific heats and pressure drop(differential) across the valve.	-	-
k	Ratio of specific heats of gas, where $k = C_p/C_v$. When the value of k is unknown, use k = 1.001, a conservative value. Refer also to Table 1, page 34.	-	-
K	ASME derated valve coefficient, used where set pressure is 15 psig (1.03 barg) and greater, and the requirements of Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code apply.	-	-
K_d	Subsonic valve coefficient to be used where set pressure is less than 15 psig.	-	-
M	Molecular weight of the flowing gas. Refer to Physical properties of selected gases, or other resources, for listing of M.	-	-
Z	Compressibility Factor (Z=1)	-	-

VALVE SIZING - NOMENCLATURE



GAS FLOW

Symbol	Description	Inch pounds	Metric units
P_1	Pressure at valve inlet during flow Pressure relief, P_1 = set pressure (psig) + overpressure + P_A Vacuum relief, $P_1 = P_A$	lb/in^2 absolute (psia)	Bar absolute (bara)
P_2	Pressure at valve outlet during flow Pressure relief, P_2 = back pressure (psig) + P_A Vacuum relief, P_2 = vacuum set (psig) = overpressure + P_A	lb/in^2 absolute (psia)	Bar absolute (bara)
P_A	Atmospheric pressure - sea level or local atmospheric pressure	Sea level 14.7 psia	Sea level 1.013 bara
T	Absolute relieving temperature	Degrees Rankin (°R = °F + 460)	Degrees Kelvin (°K = °C +273)
V	Gas flow capacity expressed in volumetric units per time unit at standard conditions SCFM (14.7 psia and 60°F) Nm^3/h (1.013 bara and 0°C)	Standard cubic feet per minute (SCFM)	Normal cubic meters per hour (Nm^3/h)
W	Gas flow capacity expressed in weight units per time unit. Refer to Gas flow conversions for other units of measure	Pounds per hour (lb/h)	Kilograms per hour (kg/h)

SIZING - SERIES 90 AND 9000

FIGURE 19
Flow correction factor F (for use in subsonic sizing page 28)

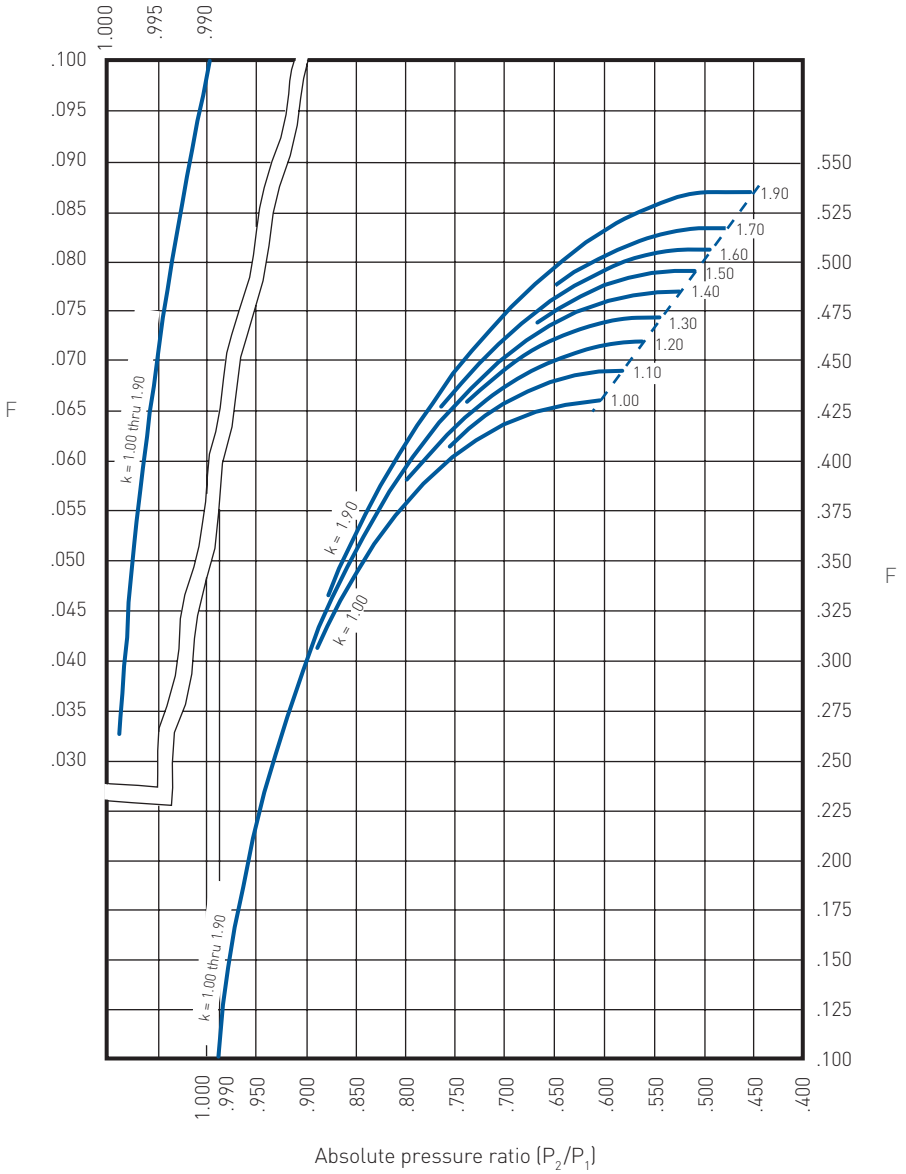


FIGURE 20
Type 9200 subsonic valve coefficient (Kd) vs. relief pressure

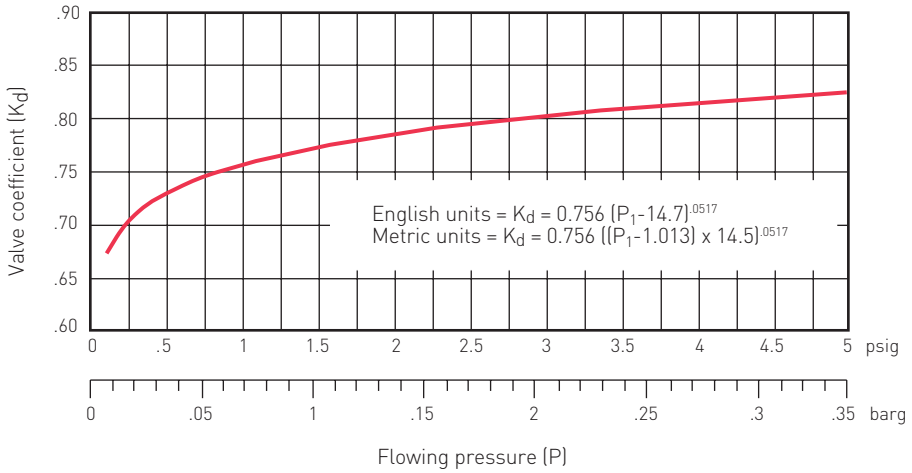
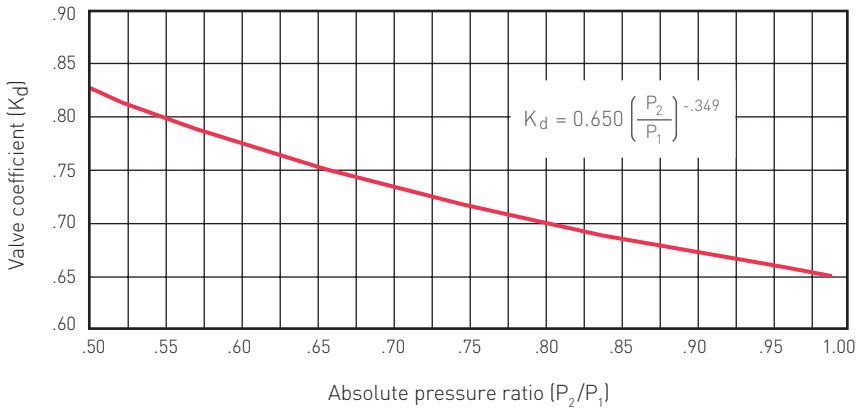
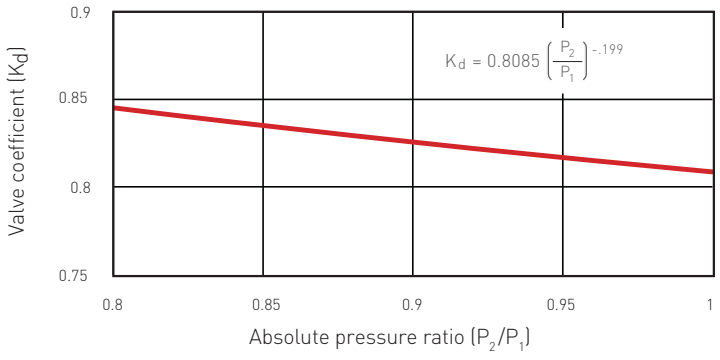


FIGURE 21
Type 9300 subsonic valve coefficient (Kd) vs. absolute pressure ratio

(a) sizes 2"-12" - 9300



(b) size 14" - 9300



For larger capacities, please consult your sales representative. Anderson Greenwood has two Models of the 9300 with increased discharge coefficients for large storage tanks.

FIGURE 22
Type 95 subsonic valve coefficient (Kd) vs. absolute pressure ratio

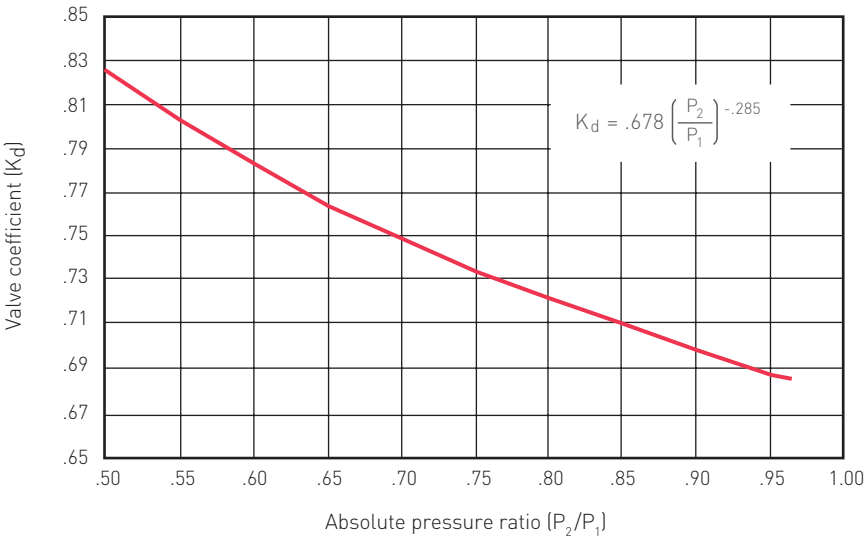


FIGURE 23
Type 93 subsonic valve coefficient (Kd) vs. absolute pressure ratio

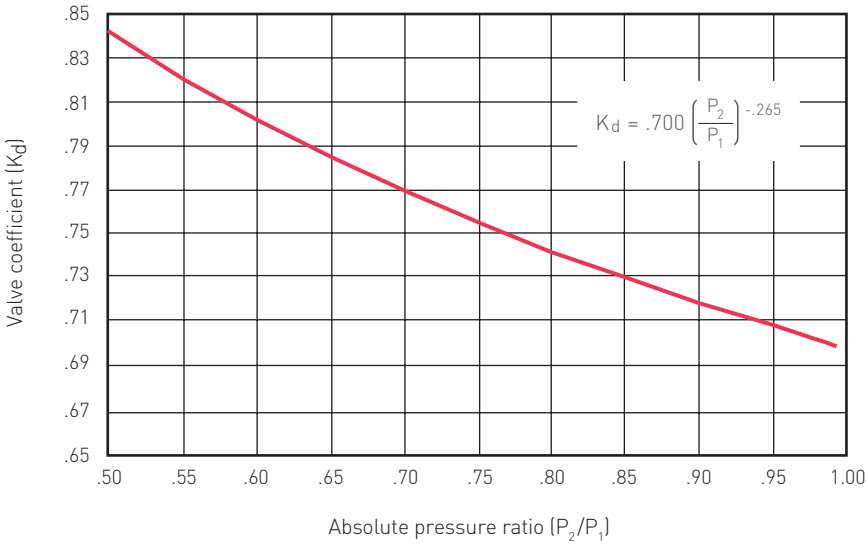


TABLE 1 - VALUES OF M, k FOR REPRESENTATIVE GASES AND VAPORS

Gas or vapor	M Molecular weight	k Spec. heat ratio	C Gas constant	Boiling point[1] (atm pressure)
Air	29.0	1.40	356	-318°F (-194°C)
Ammonia (NH_3)	17.0	1.31	348	-28°F (-33°C)
Benzene (C_6H_6)	78.0	1.12	329	176°F (80°C)
Butadiene (C_4H_6)	54.0	1.12	329	24°F (-4°C)
Carbon dioxide (CO_2)	44.0	1.28	345	-109°F (-78°C)
Ethane (C_2H_6)	30.0	1.19	336	-127°F (-88°C)
Ethylene (C_2H_4)	28.0	1.24	341	-155°F (-104°C)
Helium (He)	4.0	1.66	377	-454°F (-270°C)
Hexane (C_6H_{14})	86.0	1.06	322	156°F (69°C)
Hydrogen (H_2)	2.0	1.41	357	-423°F (-253°C)
Hydrogen sulphide (H_2S)	34.0	1.32	349	-77°F (-61°C)
Methane (CH_4)	16.0	1.31	348	-259°F (-162°C)
Methyl mercaptan (CH_4S)	48.1	1.20	337	43°F (6°C)
n-Butane (C_4H_{10})	58.0	1.09	326	31°F (-1°C)
Natural gas (SG = 0.60)	17.4	1.27	344	-260°F (-162°C)
Nitrogen (N_2)	28.0	1.40	356	-320°F (-196°C)
Oxygen (O_2)	32.0	1.40	356	-297°F (-183°C)
Pentane (C_4H_{12})	72.0	1.07	323	97°F (36°C)
Propane (C_3H_8)	44.0	1.13	330	-44°F (-42°C)
Propylene (C_3H_6)	42.0	1.15	332	-54°F (-48°C)
Propylene oxide (C_3H_5O)	58.1	1.21	338	94°F (34°C)

NOTE

1. Contact your sales representative for 90 or 9000 Series product recommendations when the boiling point of the lading fluid is in between the minimum and maximum expected ambient temperatures.

SIZING - TYPE 93 CAPACITIES

National Board certified, 15 psig and greater

AIR CAPACITIES (SCFM, 10 PERCENT OVERPRESSURE, 60°F, Z = 1.00)

	Valve size, in						
	2	3	4	6	8	10	12
	Orifice area, in²						
Set pressure	**2.29**	**5.16**	**8.74**	**19.56**	**36.40**	**51.00**	**84.00**
3.0 wc	80	181	307	687	1280	1720	2950
5.0 wc	104	234	397	888	1650	2310	3810
10.0 wc	147	332	563	1260	2340	3280	5410
15.0 wc	181	408	691	1550	2880	4030	6640
20.0 wc	210	473	801	1790	3330	4670	7690
25.0 wc	235	530	898	2010	3740	5240	8630
1.0 psig	248	559	946	2120	3940	5520	9100
1.5 psig	306	690	1170	2610	4860	6820	11300
2.5 psig	401	903	1530	3420	6370	8930	14700
5.0 psig	586	1320	2230	5000	9310	13000	21500
8.0 psig	765	1720	2920	6530	12200	17000	28100
10.0 psig	872	1960	3330	7440	13800	19400	32000
14.0 psig	1060	2400	4070	9100	16933	23700	39100
15.0 psig	1160	2600	4430	9910	18400	25800	42500
20.0 psig	1340	3010	5100	11400	21300	29900	49000
25.0 psig	1510	3410	5780	12900	24100	33700	55600
30.0 psig	1690	3810	6460	14400	26900	37700	62100
35.0 psig	1890	4250	7200	16100	30000	-	-
40.0 psig	2080	4690	7950	17800	33100	-	-
45.0 psig	2280	5130	8690	19400	36200	-	-
50.0 psig	2470	5570	9440	21100	39300	-	-

NOTE

1. Capacities are de-rated per ASME at 15 psig and greater.

SIZING - TYPE 93 CAPACITIES

AIR CAPACITIES - METRIC (Nm^3/h, 10 PERCENT OVERPRESSURE, 0°C, Z = 1.00)

	Metric valve size, DN						
	50	80	100	150	200	250	300
	Orifice area, cm^2						
Set pressure	**14.77**	**33.29**	**56.39**	**126.19**	**234.84**	**329.03**	**541.93**
7.5 mbarg	133	300	509	1140	2120	2970	4890
10.0 mbarg	154	347	588	1310	2450	3430	5640
15.0 mbarg	189	425	721	1610	3000	4200	6930
20.0 mbarg	218	492	833	1860	3500	4860	8010
50.0 mbarg	348	783	1330	2970	5530	7740	12700
100.0 mbarg	497	1120	1900	4250	7900	11100	18200
250.0 mbarg	810	1830	3090	6920	12900	18000	29700
0.400 barg	1050	2370	4020	8990	16700	23400	38600
0.600 barg	1330	2990	5070	11300	21100	29600	48700
0.800 barg	1570	3550	6010	13400	25000	35000	57700
1.000 barg	1800	4050	6870	15400	28600	40100	66000
1.200 barg	2060	4640	7860	17600	32800	45800	75500
1.400 barg	2230	5020	8510	19000	35400	49600	81800
1.600 barg	2400	5400	9160	20500	38100	53400	88000
1.800 barg	2570	5790	9810	21900	40800	57200	94200
2.000 barg	2740	6170	10400	23400	43500	61000	100000
2.500 barg	3200	7210	12200	27300	50900	-	-
3.000 barg	3670	8270	14000	31300	58300	-	-
3.448 barg	4090	9210	15600	34900	65000	-	-

NOTE

1. Capacities are de-rated per ASME at 1.03 barg and greater.

SIZING - TYPE 93 CAPACITIES

National Board certified, 15 psig and greater

NATURAL GAS CAPACITIES (SCFM, 10 PERCENT OVERPRESSURE, 60°F, Z = 1.00 SG = 0.60)

	Valve size, in						
	2	3	4	6	8	10	12
	Orifice area, in^2						
Set pressure	**2.29**	**5.16**	**8.74**	**19.56**	**36.40**	**51.00**	**84.00**
3.0 wc	104	234	396	886	1650	2310	3800
5.0 wc	134	302	511	1140	2130	2890	4920
10.0 wc	190	428	725	1620	3020	4230	6970
15.0 wc	233	525	890	1990	3710	5190	8550
20.0 wc	270	608	1030	2300	4290	6010	9900
25.0 wc	302	681	1150	2580	4810	6730	11100
1.0 psig	319	718	1220	2720	5070	7100	11700
1.5 psig	393	885	1500	3350	6240	8740	14400
2.5 psig	513	1150	1960	4380	8150	11400	18800
5.0 psig	742	1670	2830	6340	11800	16500	27200
8.0 psig	962	2170	3670	8220	15300	21400	35300
10.0 psig	1090	2460	4160	9310	17300	24300	40000
14.0 psig	1320	3000	5040	11300	21000	29400	48500
15.0 psig	1450	3300	5520	12400	22300	32200	53100
20.0 psig	1670	3760	6370	14200	26500	37100	61200
25.0 psig	1890	4260	7210	16100	30000	42100	69300
30.0 psig	2110	4750	8050	18000	33500	47000	77400
35.0 psig	2350	5300	9000	20000	37400	-	-
40.0 psig	2600	5850	9910	22200	41300	-	-
45.0 psig	2840	6400	10800	24300	45100	-	-
50.0 psig	3080	6950	11800	26300	49000	-	-

NOTE

1. Capacities are de-rated per ASME at 15 psig and greater.

SIZING - TYPE 93 CAPACITIES

NATURAL GAS CAPACITIES - METRIC (Nm^3/h, 10 PERCENT OVERPRESSURE, 0°C, Z = 1.00)

	Metric valve size, DN						
	50	80	100	150	200	250	300
	Orifice area, cm^2						
Set pressure	**14.77**	**33.29**	**56.39**	**126.19**	**234.84**	**329.03**	**541.93**
7.5 mbarg	172	387	656	1470	2730	3830	6300
10.0 mbarg	198	447	758	1700	3160	4420	7280
15.0 mbarg	243	548	929	2080	3870	5420	8930
20.0 mbarg	281	634	1070	2400	4470	6264	10300
50.0 mbarg	447	1010	1710	3820	7110	9960	16400
100.0 mbarg	638	1440	2430	5450	10100	14200	23400
250.0 mbarg	1030	2320	3940	8810	16400	23000	37800
0.400 barg	1330	3000	5080	11400	21200	29600	48800
0.600 barg	1670	3760	6360	14200	26500	37100	61100
0.800 barg	1960	4420	7490	16700	31200	43700	71944
1.000 barg	2230	5020	8510	19000	35400	49400	81700
1.200 barg	2570	5780	9800	21900	40800	57200	94200
1.400 barg	2780	6260	10600	23700	44200	61900	102000
1.600 barg	2990	6740	11400	25500	47500	66600	110000
1.800 barg	3200	7220	12200	27400	50900	71300	117000
2.000 barg	3400	7700	13000	29200	54300	76100	125000
2.500 barg	3990	9000	15200	34100	63500	-	-
3.000 barg	4570	10300	17500	39100	72700	-	-
3.448 barg	5100	11500	19500	43500	81000	-	-

NOTE

1. Capacities are de-rated per ASME at 1.03 barg and greater.

SIZING - TYPE 95 CAPACITIES

National Board certified, 15 psig and greater

AIR CAPACITIES (SCFM, 10 PERCENT OVERPRESSURE, 60°F, Z = 1.00)

	Valve size, in			
	2	3	4	6
	Orifice area, in²			
Set pressure	**2.93**	**6.25**	**10.32**	**22.15**
5.0 psig	-	1560	2570	5520
10.0 psig	1090	2330	3850	8260
15.0 psig	1500	3190	5270	11300
20.0 psig	1720	3680	6080	13000
40.0 psig	2690	5730	9460	20300
60.0 psig	3690	7880	13000	27900
80.0 psig	4700	10000	16500	35500
100.0 psig	5710	12300	20100	43100
120.0 psig	6710	14300	23600	50700
140.0 psig	7720	16500	27200	58400
150.0 psig	8220	17500	29000	62200

AIR CAPACITIES - METRIC (Nm^3/h, 10 PERCENT OVERPRESSURE, 0°C, Z = 1.00)

	Metric valve size, DN			
	50	80	100	150
	Orifice area, cm²			
Set pressure	**18.90**	**40.32**	**66.58**	**142.90**
0.250 barg	-	2150	3550	7630
0.400 barg	-	2800	4630	9930
0.600 barg	-	3550	5860	12600
0.800 barg	1970	4210	6960	14900
1.000 barg	2260	4830	7970	17100
1.500 barg	2980	6370	10500	22600
2.000 barg	3520	7520	12400	26700
2.500 barg	4130	8810	14500	31200
3.000 barg	4730	10100	16700	35800
4.000 barg	5940	12700	20900	44900
5.000 barg	7150	15200	25200	54000
7.000 barg	9560	20400	33700	72300
10.000 barg	13200	28100	46400	99600

NOTE

1. Capacities are de-rated per ASME at 15 psig and greater (1.03 barg and greater).

SIZING - TYPE 9200 CAPACITIES

AIR CAPACITY (SCFM, 10 PERCENT OVERPRESSURE AT 60°F)

	Valve size, in						
	2	3	4	6	8	10	12
	Orifice area, in²						
Set pressure	**3.35**	**7.39**	**12.73**	**28.89**	**50.00**	**78.85**	**113.00**
4 wc	133	294	506	1150	1990	3130	4490
6 wc	167	367	632	1430	2490	3920	5620
8 wc	196	430	741	1680	2910	4590	6580
10 wc	221	486	838	1900	3290	5190	7440
15 wc	277	608	1050	2380	4120	6490	9310
20 wc	324	712	1230	2780	4820	7600	10900
25 wc	366	805	1390	3150	5450	8590	12300
1.0 psig	387	852	1470	3330	5770	9090	13000
1.5 psig	484	1060	1830	4160	7200	11400	16300
2.0 psig	566	1250	2150	4870	8430	13300	19100
2.5 psig	640	1410	2420	5500	9530	15000	21500
3.0 psig	706	1550	2680	6070	10500	16600	23800
4.0 psig	826	1820	3130	7100	12300	19400	27800
5.0 psig	932	2050	3530	8010	13900	21900	31400

AIR CAPACITY - METRIC (Nm^3/h, 10 PERCENT OVERPRESSURE AT 0°C)

	Metric valve size, DN						
	50	80	100	150	200	250	300
	Orifice area, cm²						
Set pressure	**21.61**	**47.68**	**82.13**	**186.39**	**322.58**	**508.71**	**729.03**
10 mbarg	221	487	838	1900	3290	5190	7450
15 mbarg	277	608	1050	2380	4120	6490	9310
20 mbarg	324	713	1230	2790	4830	7610	10911
25 mbarg	367	806	1390	3150	5460	8600	12300
40 mbarg	475	1040	1800	4080	7070	11100	16000
50 mbarg	537	1180	2030	4610	7990	12600	18100
60 mbarg	593	1300	2250	5100	8830	13900	20000
70 mbarg	646	1420	2450	5550	9610	15100	21700
0.1 barg	785	1730	2970	6750	11700	18400	26400
0.15 barg	980	2160	3710	8430	14600	23000	33000
0.2 barg	1150	2520	4340	9860	17100	26900	38600
0.3 barg	1430	3140	5410	12300	21300	33500	48100
0.35 barg	1550	3410	5880	13300	23100	36400	52300

SIZING - TYPE 9300 CAPACITIES

National Board certified, 15 psig and greater

AIR CAPACITY (SCFM, 10 PERCENT OVERPRESSURE AT 60°F)

	Valve size, in							
	2	3	4	6	8	10	12	14
	Orifice area, in²							
Set pressure	**3.35**	**7.39**	**12.73**	**28.89**	**50.00**	**78.85**	**113.00**	**140.60**
4 wc	126	279	480	1090	1890	2970	4260	-
6 wc	155	342	589	1340	2310	3650	5230	-
8 wc	179	395	681	1550	2680	4220	6050	-
10 wc	201	443	763	1730	3000	4730	6770	10400
15 wc	247	545	938	2130	3680	5811	8330	12800
20 wc	286	631	1090	2470	4270	6740	9600	14800
25 wc	321	709	1220	2770	4790	7560	10800	16600
1.0 psig	339	748	1290	2920	5060	7980	11400	17500
2.0 psig	489	1080	1860	4220	7300	11500	16500	25000
3.0 psig	611	1350	2320	5270	9120	14400	20600	30900
4.0 psig	718	1580	2730	6200	10700	16900	24200	-
5.0 psig	817	1800	3100	7050	12200	19200	27600	-
6.0 psig	909	2000	3450	7840	13600	21400	30700	-
8.0 psig	1080	2380	4110	9320	16100	25400	36500	-
10.0 psig	1240	2740	4720	10700	18500	29200	41900	-
12.0 psig	1390	3070	5290	12000	20800	32800	47000	-
14.0 psig	1540	3390	5840	13200	22900	36200	51800	-
15.0 psig	1260	2790	4800	10900	18800	29700	42600	-
17.0 psig	1340	2960	5090	11600	20000	31500	45200	-
20.0 psig	1460	3210	5530	12600	21700	34300	49100	-
22.0 psig	1530	3380	5830	13200	22900	36100	51700	-
25.0 psig	1650	3640	6270	14200	24600	38800	55600	-
27.0 psig	1730	3810	6560	14900	25600	40600	58200	-
30.0 psig	1840	4060	7000	15900	27500	43400	62100	-
35.0 psig	2050	4530	7810	17700	30700	-	-	-
40.0 psig	2270	5000	8620	19500	33800	-	-	-
45.0 psig	2480	5470	9420	21400	37000	-	-	-
50.0 psig	2690	5940	10200	23200	40200	-	-	-

NOTE

1. Capacities are de-rated per ASME at 15 psig and greater.

SIZING - TYPE 9300 CAPACITIES

AIR CAPACITY - METRIC (Nm^3/h, 10 PERCENT OVERPRESSURE AT 0°C)

	Metric valve, DN							
	50	80	100	150	200	250	300	350
	Orifice area, cm^2							
Set pressure	**21.61**	**47.68**	**82.13**	**186.39**	**322.58**	**508.71**	**729.03**	**907.09**
10.0 mbarg	209	462	796	1810	3130	4930	7060	-
15.0 mbarg	257	567	976	2220	3830	6050	8670	-
20.0 mbarg	297	656	1130	2560	4430	6990	10000	-
25.0 mbarg	333	734	1260	2870	4970	7830	11200	17200
40.0 mbarg	423	933	1610	3650	6310	9960	14300	21900
50.0 mbarg	474	1050	1800	4090	7080	11200	16000	24500
60.0 mbarg	521	1150	1980	4490	7780	12300	17600	26900
70.0 mbarg	565	1250	2150	4870	8430	13300	19000	29100
0.1 barg	681	1500	2590	5870	10200	16000	23000	35000
0.2 barg	991	2190	3770	8550	14800	23300	33400	50200
0.3 barg	1250	2750	4740	10700	18600	29300	42000	-
0.5 barg	1680	3710	6400	14500	25100	39600	56800	-
1.0 barg	2600	5730	9880	22400	38800	61200	87700	-
1.200 barg	2200	4940	8520	19300	33400	52800	75600	-
1.400 barg	2430	5350	9220	20900	36200	57100	81900	-
1.600 barg	2610	5760	9930	22500	39000	61500	88100	-
1.800 barg	2800	6170	10600	24100	41700	65800	94300	-
2.000 barg	2980	6580	11300	25700	44500	70200	101000	-
2.200 barg	3170	6990	12000	27300	47300	-	-	-
2.400 barg	3350	7400	12700	28900	50000	-	-	-
2.600 barg	3540	7810	13400	30500	52800	-	-	-
2.800 barg	3790	8360	14400	32700	56600	-	-	-
3.000 barg	3990	8810	15200	34400	59600	-	-	-
3.200 barg	4200	9260	16000	36200	62700	-	-	-
3.400 barg	4400	9710	16700	38000	65700	-	-	-
3.448 barg	4450	9820	16900	38400	66400	-	-	-

NOTE

1. Capacities are de-rated per ASME at 1.03 barg and greater.

SIZING - TYPE 96A VACUUM CAPACITIES

AIR CAPACITIES (SCFH, 60°F, Z = 1.00)

Full open[1] vacuum relief	Valve size, in				
	4	6	8	12	16
	Orifice area, in²				
(oz/in²)	12.73	28.89	50.03	113.10	182.65
1.0	18900	46200	85300	199000	333000
3.0	32700	79700	147000	342000	574000

AIR CAPACITIES - METRIC (NM³/H, 0°C, Z = 1.00)

Full open[1] vacuum relief	Metric valve size, DN				
	100	150	200	300	400
	Orifice area, cm²				
(mbarg)	82.13	186.39	322.77	729.68	1178.38
4.3	506	1240	2290	5330	8920
12.9	876	2140	3940	9160	15380

SIZING - TYPE 9200/9300 VACUUM CAPACITIES

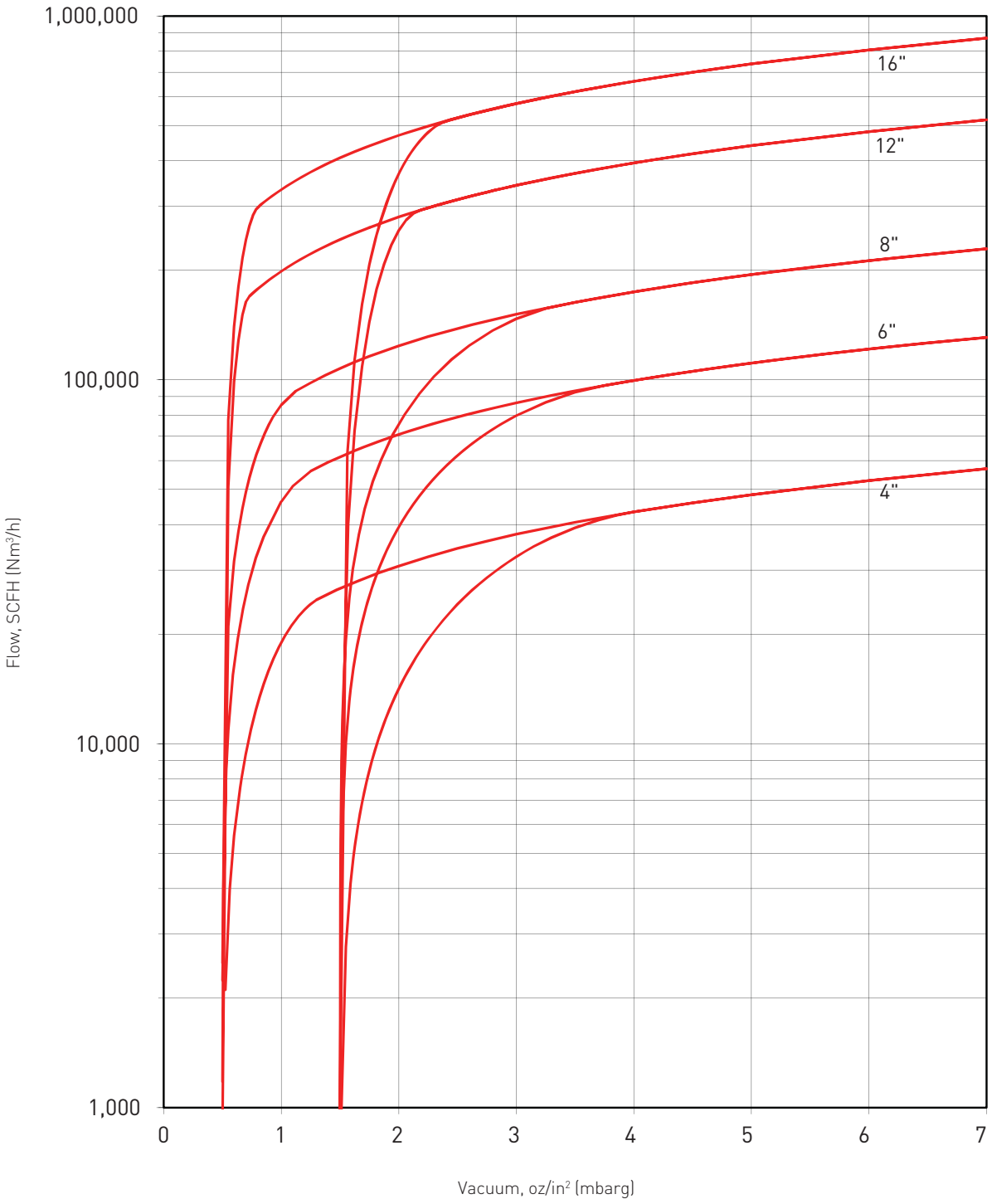
VACUUM CAPACITY - AT 1 oz. in² (4.3 mb) - SCFH , 60°F (Nm³/h, 0°C)[1][2]

Valve size in (DN)	9200	9300
2 (50)	4850 (134)	4000 (110)
3 (80)	10700 (295)	8830 (243)
4 (100)	18400 (508)	15200 (419)
6 (150)	41800 (1150)	34500 (951)
8 (200)	72400 (2000)	59700 (1650)
10 (250)	114000 (3150)	94200 (2600)
12 (300)	164000 (4510)	135000 (3720)

NOTES

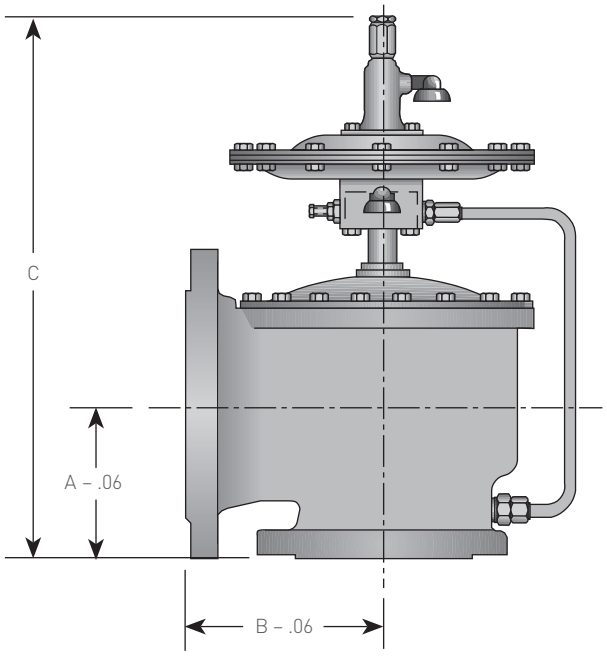
1. Nameplate vacuum setting ½ full open vacuum. Capacities based on flow testing.
2. Remote pressure sense connection is required for all vacuum configurations.

TYPE 96A FLOW TEST RESULTS



NOTE
Sizing program not applicable for Type 96A.

TYPES 93 AND 95



DIMENSIONS AND WEIGHTS

Valve size	Dimensions, in (mm)			Weight max., lb (kg)[2]	
Inlet x outlet	A	B	C max.[1]	AL	CS and SS
2 x 3	3.75	5.00	16.7	27	81
(50 x 80)	(95)	(127)	(424)	(12.3)	(36.7)
3 x 4	4.50	5.75	18.0	35	105
(80 x 100)	(114)	(146)	(457)	(15.9)	(47.6)
4 x 6	5.50	7.00	20.3	49	147
(100 x 150)	(140)	(178)	(516)	(22.2)	(66.7)
6 x 8	6.75	9.31	22.9	76	228
(150 x 200)	(172)	(237)	(582)	(34.5)	(103.4)
8 x 10	8.00	11.00	25.0	105	315
(200 x 250)	(203)	(279)	(635)	(47.6)	(142.9)
10 x 12	9.50	12.50	31.0	142	426
(250 x 300)	(241)	(318)	(784)	(64.4)	(193.2)
12 x 16	11.75	14.25	34.5	230	690
(300 x 400)	(299)	(362)	(876)	(104.3)	(313.0)

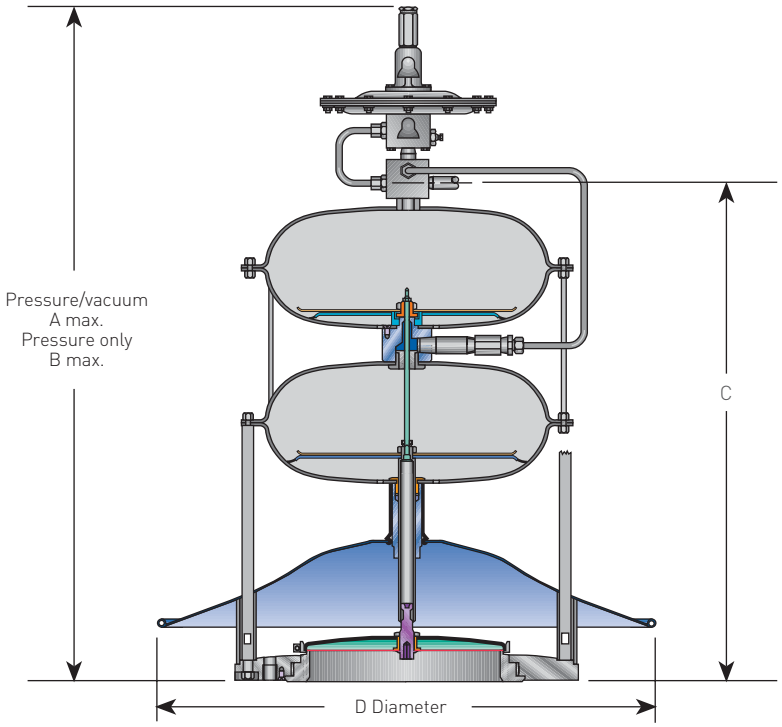
NOTES

1. Will vary with accessories.
2. Weight will vary with accessories.
3. Certified data will be furnished upon request when valves are ordered.

DIMENSIONS AND WEIGHTS - TYPES 9200 AND 9300

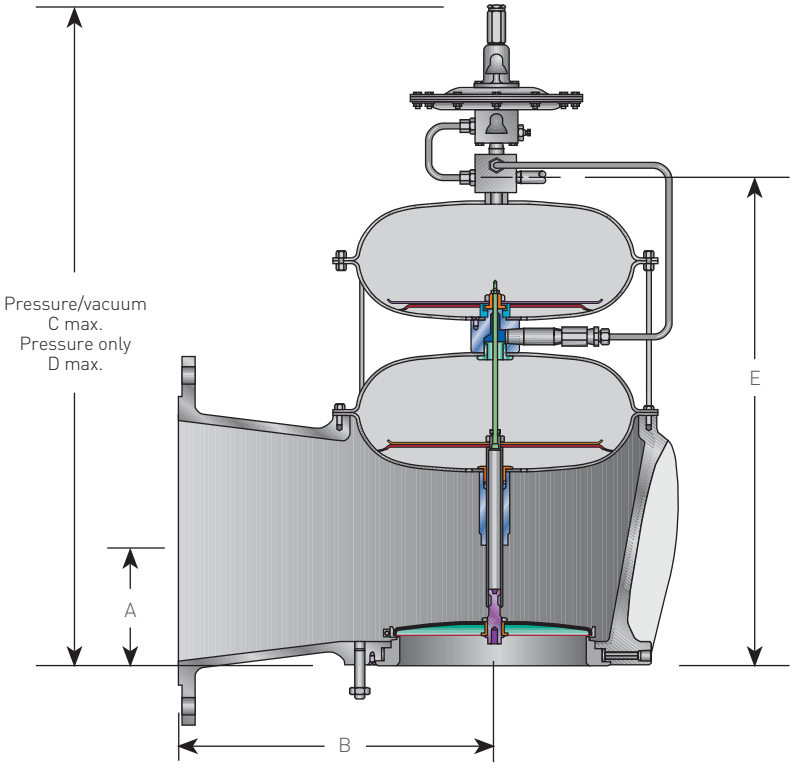
DIMENSIONS, in (mm)

Inlet size	A	B	C[1]	D
2	18.5	18.5	12.9	12.0
(50)	(470)	(470)	(328)	(305)
3	24.8	18.5	12.9	12.0
(80)	(630)	(470)	(328)	(305)
4	27.0	20.4	15.1	14.5
(100)	(686)	(518)	(384)	(368)
6	30.2	22.8	18.3	20.0
(150)	(767)	(579)	(465)	(508)
8	35.4	26.4	24.4	22.0
(200)	(899)	(671)	(620)	(559)
10	39.8	29.1	28.8	31.0
(250)	(1011)	(739)	(732)	(787)
12	42.4	31.7	31.4	31.0
(300)	(1077)	(805)	(798)	(787)



DIMENSIONS, in (mm)

Size	A	B	C[1]	D	E
2 x 3	2.82	6.00	18.9	18.9	13.2
(50 x 80)	(72)	(152)	(480)	(480)	(335)
3 x 4	2.53	8.00	24.8	18.5	13.3
(80 x 100)	(64)	(203)	(630)	(470)	(338)
4 x 6	3.50	10.00	27.0	20.4	15.5
(100 x 150)	(89)	(254)	(686)	(518)	(394)
6 x 8	4.32	12.00	30.2	22.8	18.2
(150 x 200)	(110)	(305)	(767)	(579)	(462)
8 x 10	5.36	14.00	35.4	26.4	24.6
(200 x 250)	(136)	(356)	(899)	(671)	(625)
10 x 12	6.64	18.00	39.8	29.1	29.1
(250 x 300)	(169)	(457)	(1011)	(739)	(739)
12 x 16	8.01	20.00	42.4	31.7	31.7
(300 x 400)	(203)	(508)	(1077)	(805)	(805)
14 x 18	12.81	21.11		43.75	34.86
(350 x 450)	(325)	(536)		(1112)	(885)



NOTES

1. Will vary with accessories.
2. Inlet flange drilling conforms to ANSI 16.5, Class 150.

DIMENSIONS AND WEIGHTS - TYPES 9200 AND 9300

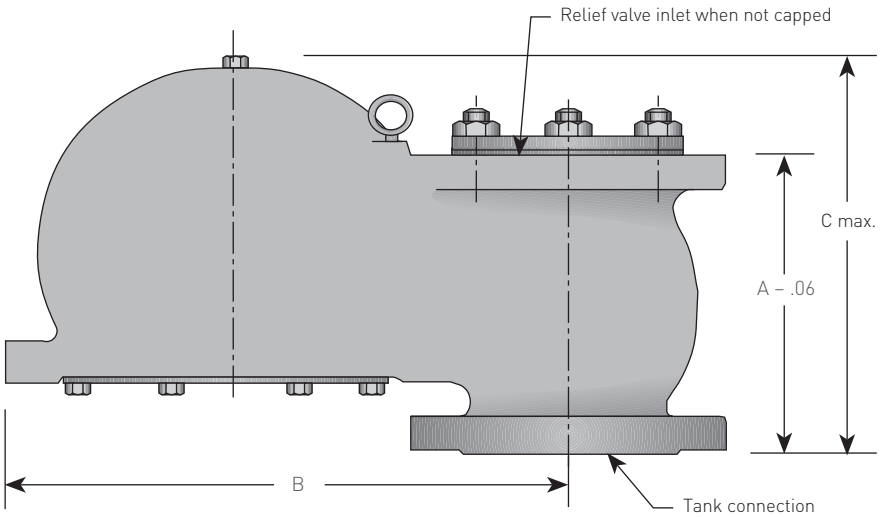
WEIGHTS[1], lb (kg)

Size in (DN)	9200 AL	9200 SS	9300 AL	9300 SS
2 (50)	27 (12.3)	72 (32.7)	33 (15.0)	79 (35.9)
3 (80)	29 (13.2)	78 (35.5)	34 (15.5)	86 (39.0)
4 (100)	35 (15.9)	96 (43.6)	38 (17.3)	110 (50.0)
6 (150)	57 (25.9)	162 (73.6)	85 (38.6)	246 (111.8)
8 (200)	77 (35.0)	213 (96.8)	105 (47.7)	306 (139.1)
10 (250)	119 (54.1)	348 (158.2)	177 (80.5)	522 (237.3)
12 (300)	123 (55.9)	370 (168.2)	225 (102.3)	675 (306.8)
14 (350)	-	-	-	1670 (759.0)

NOTE

1. Weights will vary with accessories.

DIMENSIONS AND WEIGHTS - TYPE 96A



DIMENSIONS AND WEIGHTS

Tank connection size in (DN)	Relief valve connection dimensions, in (mm) A 3 (80)	4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	16 (400)	B max.	C max.	Weight, max. lb (kg) AL	SS
4 (100)	8.56 (217)	8.56 (217)	-	-	-	-		16.5 (419)	11.7 (297)	47 (21.4)	133 (60.5)
6 (150)	-	11.12 (283)	11.12 (283)	-	-	-		20.7 (526)	14.3 (363)	64 (29.1)	182 (82.7)
8 (200)	-	-	11.95 (304)	11.95 (304)	-	-		24.8 (630)	17.2 (437)	120 (54.5)	339 (154.1)
12 (300)	-	-	-	-	16.33 (415)	16.33 (415)		35.0 (889)	21.0 (533)	253 (115.0)	734 (333.6)
16 (400)	-	-	-	-	-	22.53 (572)	22.53 (572)	46.2 (1174)	29.2 (742)	495 (224.6)	-

ACCESSORIES AND OPTIONS

A variety of accessories and options is available to provide additional functions. Some simplify the process of periodic testing, an important safety requirement; others assist in the successful operation of the safety valve under adverse or special applications.

The standard options and accessories available are detailed in the table below. Other options such as position indicators, purge connections, multiple pilots, differential pressure sensing etc., are available for some models for special situations, on request.

A. Field test connection

- In-service verification of set pressure.
- Simplifies the periodic testing of safety valves.

With this option, which is available on most models, valves may be tested easily for verification of set pressure during normal system operation. It requires a pressure source plus a test gauge and metering valve.

When test pressure is admitted slowly through a metering valve, the pilot and the main valve dome are pressurized, simulating an increased system pressure. When set pressure is reached, the pilot will actuate and this actuation pressure can be compared with the nameplate value.

Depending on the current system pressure, the main valve may also open and close briefly, or partially open and close, providing verification that the main valve will operate successfully.

Special provisions are available to prevent the main valve opening temporarily during this test.

The standard field test connection is shown in Figure A1. With this style, any overpressure condition during testing will override the test pressure and open the valve.

A three-way ball valve, shown in Figure A2, must be used for the field test connection when any vacuum opening is required of the valves, as the check valve would prevent a vacuum signal from reaching the pilot. This style of field test connection must also be used with the Type 400 non-flowing modulating pilot.

- A field test connection is recommended when a backflow preventer is specified, to provide a means to evacuate trapped dome pressure before disassembly.

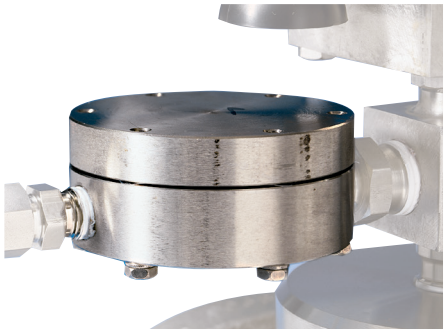
A1. FIELD TEST CONNECTION

A2. FIELD TEST CONNECTION

OPTIONS MATRIX

	FTC	BFP	Pilot filter	Aux. setters	Manual or remote blowdown	PEMVO	Remote sense	Pilot gag	Lift lever
93	✓	✓	✓	✓	✓	✓	✓	✓	✓
95	✓	✓	✓	✓	✓	✓	✓	✓	✓
96A									
9200	✓	✓	✓	✓	✓		✓	✓	✓
9300	✓	✓	✓	✓	✓	✓	✓	✓	✓

B. BACKFLOW PREVENTER



B. Backflow preventer

- Prevents accidental reverse flow through safety valve.

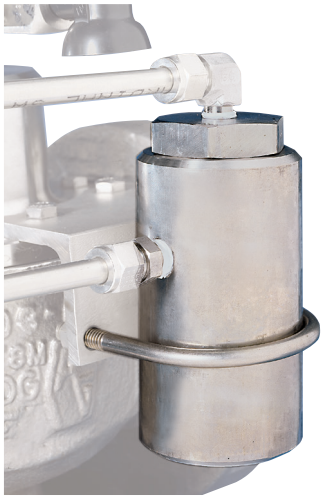
This option, sometimes called a 'vacuum block', prevents reverse flow, when sufficient vacuum is present at the inlet flange or when the pressure at the outlet flange (superimposed back pressure) is greater than the current system pressure. Reverse flow will occur with any standard type or design of pilot operated safety valve when sufficient reverse differential pressure exists.

The backflow preventer operates by permitting the introduction of outlet pressure into the main valve dome, holding the piston firmly onto the nozzle and overcoming the effect of a reverse differential pressure across the safety valve. The option also includes a built-in provision to prevent reverse flow through the pilot that would otherwise pass through the pilot supply line, back into the system.

A backflow preventer should be specified whenever:

- A vacuum may be present at the inlet connection due to unusual operating conditions or when a temporary vacuum may occur under start-up conditions.
- The discharge of the pressure relief valve is connected to a downstream pressure vessel, where pressure may vary occasionally in excess of the pressure in the upstream system.
- The discharge of multiple safety valves is combined into a single manifold or vent system, creating superimposed back pressures in excess of the current upstream system pressure.
- A pilot operated vacuum valve is specified and the valve must remain closed on positive pressure.

C. PILOT SUPPLY FILTER

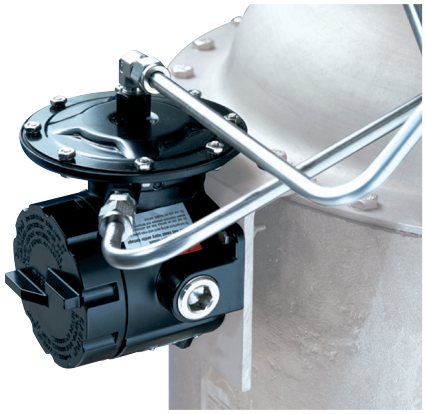


C. Pilot supply filter

- Protects pilot from excessive particulate matter in flow stream.

This is a mechanical filter available for applications where there is a possibility of large amounts of particulate matter in the fluid stream. It is mounted to the main valve cap. A filter drain valve is available as an option.

D. REMOTE VALVE LIFT INDICATOR



D. Remote valve lift indicator

- Provides remote signal to inform the plant operator when a pressure relief valve has opened.

This is a differential pressure switch, which is actuated when the main valve has been operated. It is adjusted to sense the difference between the system pressure and the main valve dome pressure, providing electrical indication to a remote location.

Supply full particulars on electrical power available; switch contact style and rating, enclosure type and hazard rating. The switch will be mounted mechanically to the main valve cap.

Please note that this method of indication is indirect, as it indicates only that pilot actuation has occurred and the necessary dome pressure reduction has taken place. Direct mechanical position indication is not available.

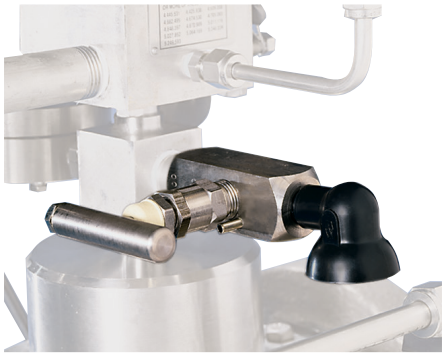
E. AUXILIARY SETTERS

E. Auxiliary setters

- Allows the primary pilot to be set easily to a second or third set pressure.

This system is widely used aboard ships where it is desirable to have different set pressures when under different jurisdictions or when a ship is in port. It consists of additional springs which are fitted to the primary pilot.

F. MANUAL UNLOADER



F. Manual unloader

- Permits the pressure relief valve to be opened at pressures below the nameplate setting.
- Acts as manual override to normal pressure setting, but has no effect on the sealed pressure setting.

A manual unloader is a small hand valve connected to the dome line of the main valve. Opening the valve vents the dome pressure faster than it can be recharged by the pilot supply. Sufficient dome pressure reduction results in opening of the main valve, due to unbalanced forces, simulating a pilot actuation. This option is used to allow the pressure relief valve to be used, along with other valves, for the emergency reduction of system pressure due to potential safety hazards. Venting is to the atmosphere through a weather fitting, unless specified otherwise.

G. Remote unloader

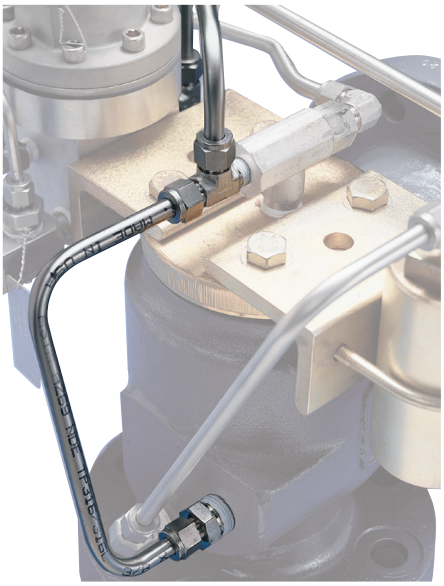
- Permits the safety valve to be opened remotely to depressurize the system.

Similar to the manual unloader but with the valve operated remotely, either by solenoid or pneumatic actuator. The remote unloader is mounted mechanically to the safety valve with the pressure connection to the main valve's dome line. Venting is to the atmosphere through a weather fitting.

Please furnish full particulars of the type of unloader electro valve to be supplied and the desired valve action: normally open or closed. For pneumatic operation, indicate the fluid media and available pressure range; for solenoid operation, specify the voltage and current (AC or DC) and the frequency in Hertz for alternating current.

The type of enclosure, such as explosion proof, splash proof, corrosion resistant, etc., must also be specified for electric operators. No separate wiring enclosure is supplied unless specified.

H. PILOT DISCHARGE TUBED TO MAIN VALVE OUTLET



H. Pilot exhaust tubed to main valve outlet (PEMVO)

- Eliminates any local venting of fluid media from pilot.

This option is desirable when the pressure relief valve is within a closed environment and even the small amount of gas discharged from the pilot is to be avoided. In the majority of applications there will be no measurable effect on the set pressure of the pressure relief valve. However, the following considerations should be taken into account:

- The effect of superimposed back pressure on the Series 90 pilot valve will be to slightly reduce the nameplate set pressure. This represents a safe condition, i.e., the pilot is slightly overbalanced to the effect of back pressure. Rarely is readjustment of pilot set pressure necessary (see below).
- For the larger diaphragm of Type 93 pilots, the set pressure will be reduced by 0.0034 psig for each 1 psig (0.034 mbarg for each 1.0 mbarg) of back pressure.
- For the small diaphragm of Type 93 or 95 pilots, the set pressure will be reduced by 0.233 psig for each 1 psig (0.233 mbarg for each 1.0 mbarg) of back pressure.
- When this accessory is used and there is a constant superimposed back pressure of relative significance, no upward adjustment to the factory pilot pressure setting is made, unless requested.

Please consult with your representative for additional assistance.

I. REMOTE PRESSURE SENSE CONNECTION

I. Remote pressure sense connection

- Pressure relief valve will respond to actual system pressure conditions.
- Eliminates undesirable cycling due to excessive inlet pressure losses.
- Improves safety under adverse operating conditions.

This option permits the pilot to sense system pressure at a location that most accurately reflects the actual operating pressure of the protected system. It eliminates the false reading of system pressure that will occur during relieving conditions due to pressure losses in the inlet piping and is required for any vacuum setting.

Most applicable codes recommend that the inlet piping system is designed for a maximum anticipated pressure loss of 3% of set pressure. The remote pressure sense connection should be specified if this is not possible. Inlet pressure loss can occur during relieving conditions, when one or more of the following conditions is present:

- The length of the inlet piping is substantial, contributing to an excessive pressure loss under flowing conditions.
- There is one or more directional changes in the inlet piping, such as elbows, tees, etc.
- The geometry of the connection between the pressure vessel and the inlet piping creates an excessive pressure loss.
- Block or isolation valves between the system and the pressure relief valve are overly restrictive to flow.

Please note that the addition of a remote pilot sense line allows the pilot to sense system pressure correctly and to keep the valve from rapid cycling. However, the relieving capacity will be reduced proportionately whenever there is inlet pressure loss to the pressure relief valve. In arriving at the required orifice area, the sizing calculation should take inlet loss into consideration.

The amount of anticipated inlet loss under actual relieving conditions should be reviewed with your representative, as high loss may affect valve performance during a relief cycle.

The installation of a remote pilot sense line may also reduce the ingestion of particulate matter from 'dirty' systems, whether or not excessive inlet pressure loss is present during the relief cycle.

Pilot operated pressure relief valves supplied originally for remote pilot sense may be converted to integral sense, as the pressure pickup (dipper tube) is installed at the factory in all instances and then closed off with a removable threaded pipe plug.

SELECTION GUIDE - SERIES 90

Example:		93	03	04	F	A
Valve type						
93, 95, 96A						
Inlet size						
02	2-inch (DN 50)	**08**	8-inch (DN 200)			
03	3-inch (DN 80)	**10**	10-inch (DN 250)			
04	4-inch (DN 100)	**12**	12-inch (DN 300)			
06	6-inch (DN 150)	**16**	16-inch (DN 400)(96A only)			
Outlet size						
03	3-inch (DN 80)	**10**	10-inch (DN 250)			
04	4-inch (DN 100)	**12**	12-inch (DN 300)			
06	6-inch (DN 150)	**16**	16-inch (DN 400)			
08	8-inch (DN 200)	**Blank**	for capped 96A			
Flange facing						
R	Raised					
F	Flat					
Main valve material						
A	Aluminum					
C	Carbon steel					
S	Stainless steel					

NOTE

When ordering or inquiring about the Anderson Greenwood Series 90 and 9000, please include the following:

- Model number
- Set pressure
- Accessories
- Required capacity
- Maximum inlet temperature
- Service (specific gravity or molecular weight)
- Detail of any special requirements, including inspection and testing
- Connections

SELECTION GUIDE - SERIES 9000

Example:	9	2	9	0	C	03	SS	B	A

Basic series

Main valve type

2	Vent (bodyless)
3	Valve

Pressure pilot

0	None
4	Series 400
9	Series 90

Vacuum pilot

0	None
4	Series 400
9	Series 90

Configurations

P	Pressure
V	Vacuum[1]
C	Combined pressure and vacuum[1]

Flange inlet size

02	2-inch (DN 50)	**08**	8-inch (DN 200)
03	3-inch (DN 80)	**10**	10-inch (DN 250)
04	4-inch (DN 100)	**12**	12-inch (DN 300)
06	6-inch (DN 150)	**14**	14-inch (DN 350)[2] (Type 9300 only)

Material code

AL	Aluminum
CS	CS
SS	SS

Pilot soft goods code

B	NBR
V	FKM
E	EPR
T	PTFE

Accessory code

A	Field test connection
B	Manual blowdown
C	Remote pressure sense (for pressure only units) (vacuum and combination units are remote sense by default)
D	Auxiliary filter (Series 90 pilots only)
E	Remote blowdown
F	Pilot exhaust to main valve outlet (Type 9300 only)
G	Back flow preventer

NOTE

1. Configurations 'V' and 'C' require accessory code 'C' (remote pressure sense).
2. Size 14-inch available only as 'P' configuration with material code 'SS' and requires accessory code 'C'.