V146 Series 2-Way Pressure-Actuated Water-Regulating Valves

Product Bulletin

Code No. LIT-121709
Issued May 2018

The V146 Series 2-Way Pressure-Actuated Water-Regulating Valves regulate water flow to control refrigerant head pressure in systems with water-cooled condensers. The V146 valves are ideal for applications with system water pressures of up to 350 psig (24.1 bar), such as high-rise buildings.

V146EK and V146AL valves have an adjustable opening point in a refrigerant pressure range of 70 to 260 psi (4.8 to 17.9 bar). V146EK and V146AL valves are available in a 3/4 in. and 1 in. size. Use these valves with standard, noncorrosive refrigerants.

V146GK1 and V146GL1 valves have an adjustable opening point in a refrigerant pressure range of 200 to 400 psi (13.8 to 27.6 bar). The V146GK1 and V146GL1 valves are available in 3/4 in. and 1 in. size for use with standard, noncorrosive, high-pressure refrigerants.

⚠ WARNING

This product is made of copper alloy, which contains lead. The product is therefore not to be used on drinking water.

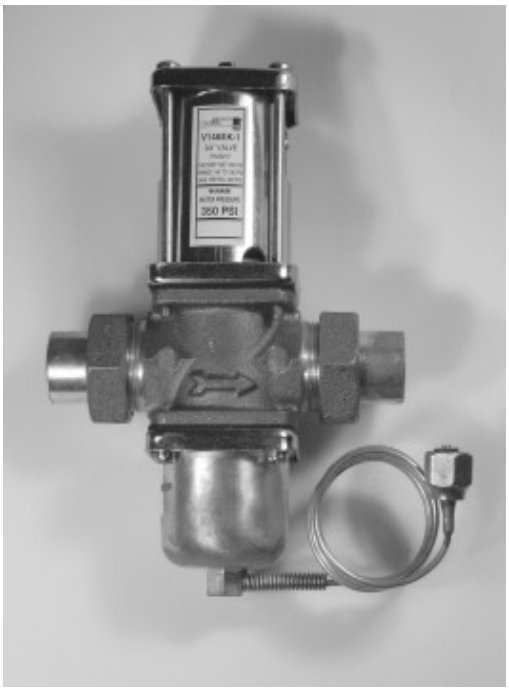

Figure 1: V146 Series Valve

Table 1: Features and Benefits

Features	Benefits
No Close-Fitting or Sliding Parts in Water Passages	Provides control in less-than-ideal water conditions.
High-Pressure Design	Allows use in systems with up to 350 psi (24.1 bar) water pressure.
Pressure-Balanced Design	Resists changes to setpoint caused by gradual or sudden water pressure changes.
Corrosion-Resistant Material for Internal Parts	Promotes long valve life.
Accessible Range Spring	Allows easy manual flushing.
Take-Apart Construction	Allows access to valve interior without removing valve from refrigeration system or pumping down the system.

Application

IMPORTANT: The V146 Series 2-Way Pressure-Actuated Water-Regulating Valve is intended to control water or coolant flow under normal operating conditions. Where failure or malfunction of the V146 valve could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls, intended to warn of or protect against failure or malfunction of the V146 valve.

Operation

The V146 valve controls refrigerant head pressure by sensing the condensing pressure and adjusting water flow to meet cooling demand as the condenser requirements change.

Valve Sizing

Each application is unique and requires specific engineering data to properly size and design a system to fulfill the appropriate requirements. Typically, a valve is replaced with another valve of the same size in a properly sized and engineered system.

To make a rough field estimate of the size of valve for an application, find the valve size by locating a point on a flow chart (see Figure 6 through Figure 9) that satisfies these requirements:

- water flow required by the condenser (**Flow**)
- refrigerant head pressure rise ($\mathbf{P_{RISE}}$)
- available water pressure ($\mathbf{P_{AVAIL}}$)

Follow these steps, and use the information obtained to locate a point on one of the flowcharts (Figure 6 through Figure 9) that satisfies all three steps.

1. Take the water flow required by the condenser **(Flow)** from information provided by the manufacturer of the condensing unit. If the manufacturer's information is unavailable, use the following information and Figure 2 to make a rough approximation of maximum water flow in gallons per minute (gpm) (cubic meters per hour [m^3/hr]):
   - System Capacity (**Tons of Refrigeration**)
   - Outlet Water Temperature (**Temp. $_{\mathbf{Outlet}}$**)
   - Inlet Water Temperature (**Temp. $_{\mathbf{Inlet}}$**)

   Calculate the flow using the following formula:

$$\text{Flow} = \frac{\text{Tons of Refrigeration x 30}}{(\text{Temp.}_{\text{Outlet}} - \text{Temp.}_{\text{Inlet}})}$$

FIG:flw_eqn

Figure 2: Flow Required

   Note: If the outlet temperature is unknown, assume it to be 10F° (5.6C°) above the inlet temperature.

2. Determine refrigerant head pressure rise above the valve opening point ($\mathbf{P_{RISE}}$) using the following steps:
   a. The **Valve Closing Pressure** ($\mathbf{P_{CLOSE}}$) is equal to the refrigerant pressure at the highest ambient temperature the refrigeration equipment experiences in the Off cycle. Use a Pressure-Temperature Chart for the refrigerant selected to find this pressure.
   b. To approximate the **Valve Opening Pressure** ($\mathbf{P_{OPEN}}$), add about 7 psi (0.5 bar) for EK and AL models or 10 psi (0.7 bar) for GL1 or GK1 models to the Valve Closing Pressure. See Figure 3.

$$P_{OPEN} = P_{CLOSE} + 7 \text{ psi (0.5 bar)}$$

$$P_{OPEN} = P_{CLOSE} + 10 \text{ psi (0.7 bar)}$$

FIG:V14x_eqn_opn_prssr

Figure 3: Valve Opening Pressure, EK and AL Models (Top) or GK1 and GL1 Models (Bottom)

   c. From the Pressure-Temperature Chart for the refrigerant selected, read the **Refrigerant Condensing Pressure** ($\mathbf{P_{COND}}$) (operating head pressure) corresponding to the selected condensing temperature.
   d. Subtract the Valve Opening Pressure from the Refrigerant Condensing Pressure. This gives the head pressure rise. See Figure 4.

$$P_{RISE} = P_{COND} - P_{OPEN}$$

FIG:eqn_hd_prssr_rs

Figure 4: Refrigerant Head Pressure Rise

3. Determine the available water pressure to the valve ($\mathbf{P_{AVAIL}}$) using the following steps and Figure 5. This is the actual water pressure available to force water through the valve.

   a. Determine the minimum inlet pressure ($\mathbf{P_{IN}}$). This is the water pressure from city water mains, pumps, or other sources.

   b. Pressure drop through condenser ($\Delta\mathbf{P_{COND}}$) is the difference in water pressure between the condenser inlet and the condenser outlet. Obtain this information from the condenser manufacturer.

   c. Estimate or calculate the pressure drop through all associated piping **($\mathbf{P_{LOSS}}$)**.

   d. Subtract the $\Delta\mathbf{P_{COND}}$ and $\mathbf{P_{LOSS}}$ from $\mathbf{P_{IN}}$. The result is $\mathbf{P_{AVAIL}}$.

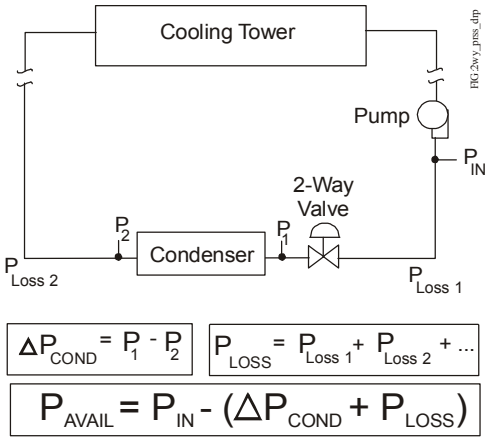

Figure 5: Available Water Pressure

4. Select the proper valve size from the flowcharts by locating a point on a chart that satisfles the flow, the head pressure rise above opening point, and the pressure drop across the valve.

Metric Conversions

Use these equations to convert between U.S. and S.I. units.

- 1 dm^3/s = 3.6 m^3/h = 15.9 U.S. gal. /min. = 13.2 U.K. gal. /min.
- 1 bar = 100 kPa = 0.1 MPa = 1.02 kg/cm^2 = 0.987 atm = 14.5 psi

Valve Sizing Example

A 12-ton capacity R410A system has an inlet water temperature of 85°F (29°C) and an outlet water temperature of 95°F (35°C).

The manufacturer's recommended condensing temperature is 105°F (41°C), and the corresponding condensing pressure is 340 psi (23.4 bar). The maximum ambient temperature is estimated at 90°F (32°C).

City water pressure is 40 psi (2.8 bar) and the manufacturer's table gives a pressure drop through the condenser at 15 psi (1 bar). Drop through the installed piping is approximately 4 psi (0.3 bar).

Use the valve sizing process to find the correctly sized valve for this application:

1. Find or calculate the water flow required by the condenser. See Figure 2.
   - **Flow**: According to the data provided, the required flow is 36 GPM (8.2 m^3/h).
2. Determine refrigerant head pressure rise above the valve opening point. See Figure 3 and Figure 4.
   - $\mathbf{P_{CLOSE}}$: Closing point is pressure of refrigerant corresponding to 90°F (32°C). Using a refrigerant pressure-temperature chart for the refrigerant (R410A), the pressure is 274 psi (18.9 bar).
   - $\mathbf{P_{OPEN}}$: Opening point = 274 psi + 10 psi = 284 psi (18.9 bar + 0.7 bar = 19.6 bar)
   - $\mathbf{P_{COND}}$: Condensing pressure = 340 psi (23.4 bar)
   - $\mathbf{P_{RISE}}$: Head pressure rise = 340 psi -284 psi = 56 psi (23.4 bar - 19.6 bar = 3.9 bar)

3. Determine the available water pressure to the valve. See Figure 5.
   - **P_{IN}**: Inlet water pressure = 40 psi (2.8 bar)
   - **ΔP_{COND}**: Pressure drop through the condenser = 15 psi (1 bar)
   - **P_{LOSS}**: Combined piping pressure loss = 4 psi (0.3 bar)
   - **P_{AVAIL}**: Available water pressure to the valve = 40 psi - (15 psi + 4 psi) = 21 psi (2.8 bar - [1 bar + 0.3 bar] = 1.4 bar)
4. Using the following data and the flowcharts, the only valve that comes close to meeting all the criteria (without being oversized) is the V146GL1 valve (see Figure 9):
   - **Flow** = 36 GPM (8.2 m^3/h)
   - **P_{RISE}** = a head pressure rise of 56 psi (3.9 bar)
   - **P_{AVAIL}** = available water pressure to the valve is 21 psi (1.4 bar)

Note: In this example, you must use the V146GL1 valve instead of the V146AL valve because of the application's pressure range.

V146 Flowcharts

The maximum recommended differential water pressure across a valve is 60 psi (4.1 bar).

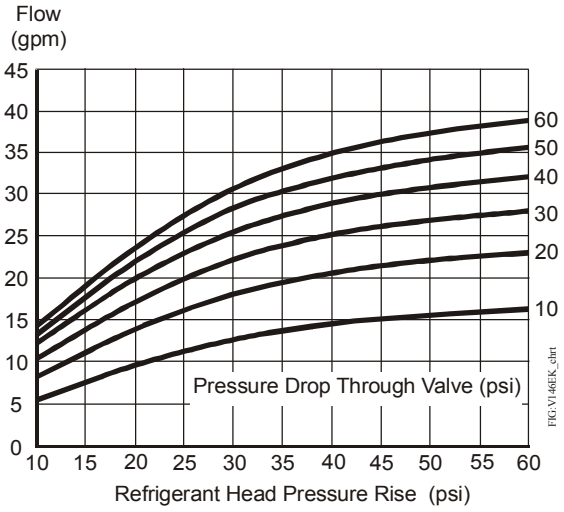

Figure 6: 3/4 in. V146EK Valve

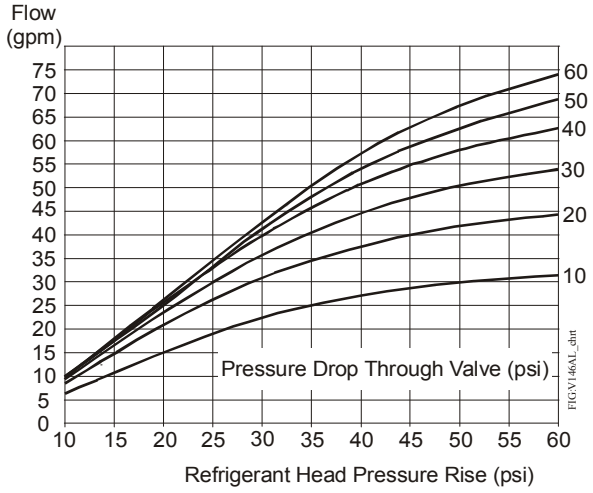

Figure 7: 1 in. V146AL Valve

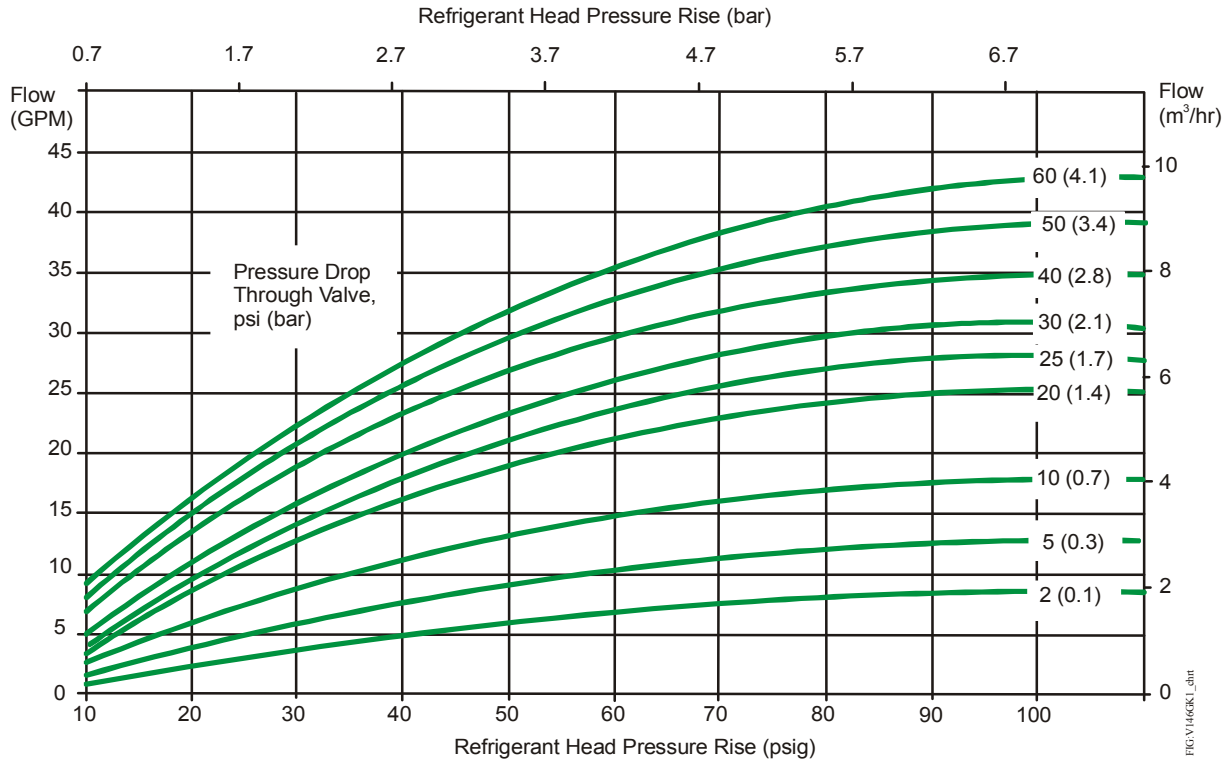

Figure 8: High Refrigerant Pressure 3/4 in. V146GK1 Valves

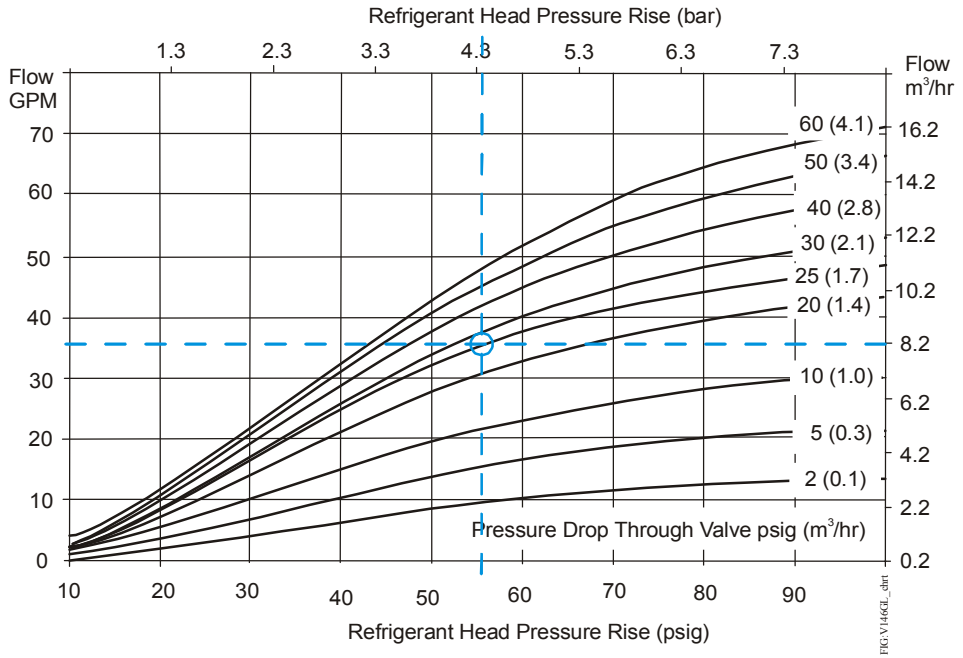

Figure 9: High Refrigerant Pressure 1 in. V146GL1 Valves

Dimensions

See Figure 10, Figure 11, Figure 12, Figure 13, and Table 2 for dimensions of V146 valves.

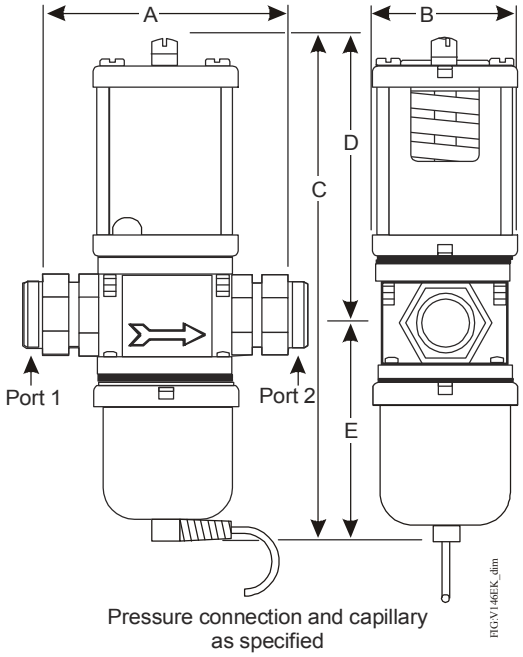

Figure 10: 3/4 in. V146EK Valves

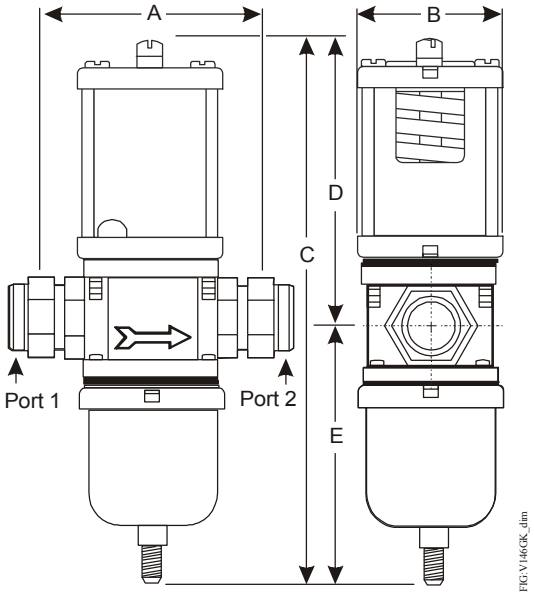

Figure 11: High Refrigerant Pressure 3/4 in. V146GK1 Valves

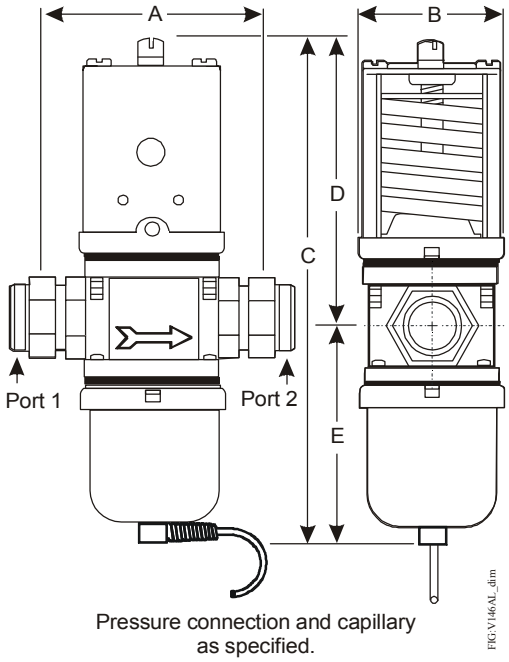

Figure 12: 1 in. V146AL Valves

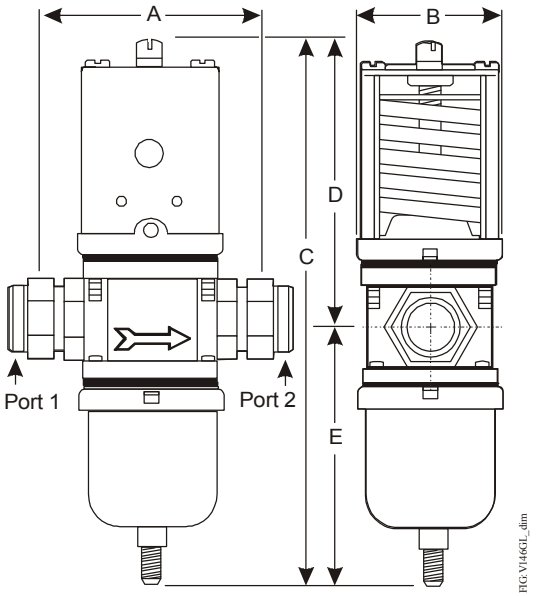

Figure 13: High Refrigerant Pressure 1 in. V146GL1 Valves

Table 2: Valve Dimensions, Inches (Millimeters)

Product Code Number	Nominal Valve Size	A	B	C	D	E
V146EK-1C	3/4 in.	3-3/8 (86)	2-3/16 (55)	7-3/16 (183)	4-3/16 (106)	3 (76)
V146GK1-001C	3/4 in.	3-3/8 (86)	2-3/16 (55)	8 (204)	4-3/16 (106)	3-13/16 (98)
V146AL-1C	1 in.	4-3/4 (121)	2-13/16 (72)	10 (254)	5-15/16 (151)	4-1/16 (103)
V146GL1-001C	1 in.	4-3/4 (121)	2-13/16 (72)	10-1/2 (267)	5-15/16 (151)	4-9/16 (116)

Selection

Use Figure 14 and Table 3 to select valves.

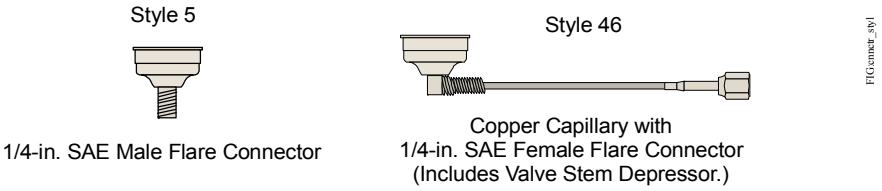

Figure 14: Pressure Connection Styles

Table 3: Selection Chart

Product Code Number	Nominal Valve Size	Inlet and Outlet Ports	Pressure Connection Style	Shipping Weight
V146EK-1C	3/4 in.	Union (Sweat)	46	4.3 lb (2.0 kg)
V146GK1-001C	3/4 in.	Union (Sweat)	5	4.3 lb (2.0 kg)
V146AL-1C	1 in.	Union (Sweat)	46	9.3 lb (4.0 kg)
V146GL1-001C	1 in.	Union (Sweat)	5	9.3 lb (4.0 kg)

Repair Information

Repairs can be made. Replacement sensing elements, internal parts and diaphragms are available. For replacement parts kit product code numbers, see Table 4. To obtain replacement parts, contact your local Johnson Controls/PENN® Distributor.

IMPORTANT: When servicing these valves, use only the replacement kits listed in Table 4. Use of an improper replacement kit may lead to premature failure and setpoint shift.

Table 4: Replacement Kits

Valve Product Code Number	Nominal Valve Size	Seat Replacement Kit Product Code Number	Diaphragm Replacement Kit Product Code Number	Sensing Element Replacement Kit Product Code Number
V146EK-1C	3/4 in.	STT16A-622R	DPM16A-622R	SEP38A-600R
V146GK1-001C	3/4 in.			SEP38A-601R
V146AL-1C	1 in.	STT17A-622R	DPM17A-622R	SEP38A-602R
V146GL1-001C	1 in.			SEP38A-603R

Technical Specifications

V146 Series 2-Way Pressure-Actuated Water-Regulating Valves

Maximum Refrigerant Pressure	V146EK: 370 psi (25.5 bar) V146AL: 320 psi (22.1 bar)
Maximum Working Pressure	V146GK1, V146GL1: 630 psi (43.4 bar)
Opening Point Adjustment Range	V146EK, V146AL: 70 to 260 psi (4.8 to 17.9 bar) V146GK1, V146GL1: 200 to 400 psi (13.8 to 27.6 bar)
Factory-Set Opening Point	V146EK, V146AL: 165 psi (11.4 bar) V146GK1, V146GL1: 275 psi (19.0 bar)
Media	350 psi (24.1 bar) Maximum, -4°F to 170°F (-20°C to 77°C) glycol/water or liquids with low freezing points that are compatible with valve materials

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Johnson Controls/PENN Refrigeration Application Engineering at 1-800-275-5676. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.

www.penncontrols.com