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

The V146 Series 2-Way Pressure-Actuated Water-Regulating Valves regulate water flow and 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 (2413 kPa), such as high-rise buildings.

Use V146 valves with standard non-corrosive refrigerants. V146 valves have a monel (nickel-copper alloy) seat and disc holder.

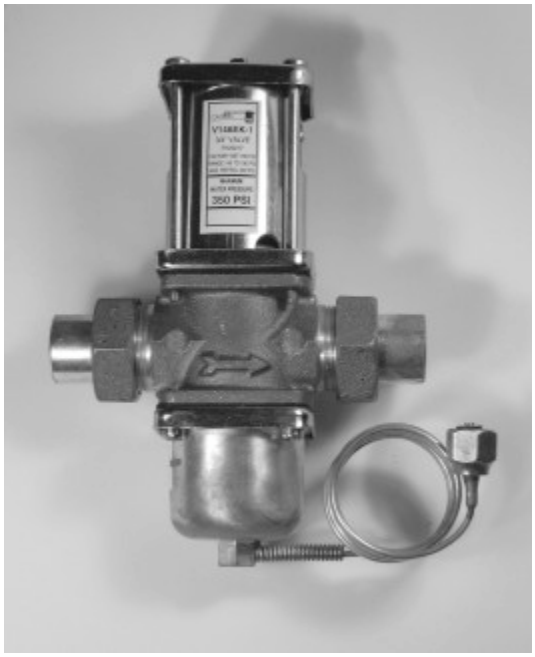

Figure 1: V146 Valve

Features and 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 psig (2413 kPa) 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

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Application

IMPORTANT: The V146 Series 2-Way Pressure-Actuated Water-Regulating Valves are intended to control water flow under normal equipment operating conditions. Where failure or malfunction of a V146 valve could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of, or protect against, failure or malfunction of the V146 valve must be incorporated into and maintained as part of the control system.

V146 valves regulate flow in systems with water pressures up to 350 psig (2413 kPa). The opening point is adjustable within in a refrigerant pressure range of 70-260 psig (483-1793 kPa). See *Setup and Adjustments*.

V146 valves are available in 3/4-in. and 1-in. sizes. Use V146 valves with standard non-corrosive refrigerants. Internal valve parts that are exposed to water are constructed of monel (nickel-copper alloy) and brass to resist corrosion.

Finding the Valve Size Required

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. Contact Johnson Controls/Penn™ Refrigeration Application Engineering at 1-800-275-5676 to obtain specific engineering data.

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 4) that satisfies these requirements:

Maximum Water Flow

Take the **Maximum water flow (Flow)** required by the condenser from information provided by the manufacturer. If the manufacturer's information is unavailable, use the following information to make a rough approximation of maximum water flow in gallons per minute (gpm):

- System Capacity (**Tons of Refrigeration**)
- Outlet Water Temperature (**Temp.** $_{\text{Outlet}}$)
- Inlet Water Temperature (**Temp.** $_{\text{Inlet}}$)

If the outlet temperature is unknown, assume it to be 10F° (5.5C°) above the inlet temperature.

Refrigerant Head Pressure Rise

Approximate the **Refrigerant Head Pressure Rise Above Valve Opening Point (P_H)** with the following information:

- **Refrigerant Condensing Pressure (P_{COND})** is the manufacturer's recommended condensing pressure.
- **Valve Closing Pressure (P_{VC})** is equal to the refrigerant pressure at the highest ambient temperature the refrigeration equipment experiences in the Off cycle. Use a Pressure-Temperature Chart to find this pressure.

Maximum Available Water Pressure Drop

The maximum available water pressure drop through the valve is the water pressure actually available to force water through the valve.

- **Minimum Inlet Pressure** is the water pressure from city water mains, pumps, or other sources.
- **Pressure Drop Through Condenser** is the difference in water pressure between the condenser inlet and the condenser outlet. Obtain this information from the condenser manufacturer.
- **Pressure Drop Through All Associated Piping** is an estimated or calculated value.

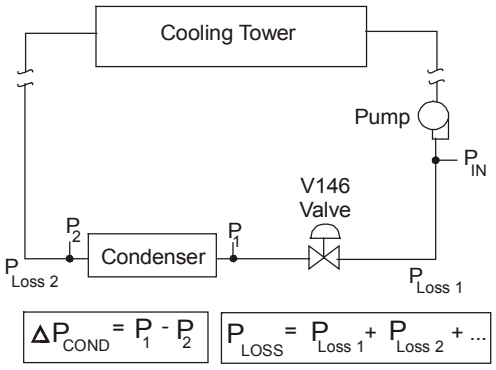

Figure 2: Maximum Available Water Pressure Drop

Equations

Maximum Water Flow

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

Refrigerant Head Pressure Rise

$$P_H = P_{COND} - (P_{VC} + 7 \text{ psi})$$

Maximum Available Water Pressure Drop

$$P_{AVAIL} = P_{IN} - \Delta P_{COND} - P_{LOSS}$$

Metric Conversions

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

1 dm^3/s = 3.6 m^3/h = 15.8 U.S. gal. /min. = 13.2 U.K. gal. /min.

1 bar = 100 kPa = 0.1 MPa ≈ 1.02 kp/cm^2 = 1.02 atm at ≈ 14.5 psig

Valve Sizing Example

Maximum Water Flow

According to the manufacturer's information, the maximum required water flow for the system is 35 gpm.

Maximum water flow is 35 gpm.

Refrigerant Head Pressure Rise

- The system uses refrigerant R-22.
- Maximum ambient temperature during the Off cycle is estimated at 95°F, which gives a refrigerant pressure of 180 psig. ($\mathbf{P_{VC}}$ = 180)
- The manufacturer's recommended condensing temperature is 110°F, so the Condensing Pressure is 226 psig. ($\mathbf{P_{COND}}$ = 226)
- $\mathbf{P_H = P_{COND} – (P_{VC} + 7 \text{ psig})}$ = 226 - (180 + 7) = 39 psi

Note: Refrigerant Head Pressure Rise is 39 psi.

Maximum Available Water Pressure Drop

- City water pressure (minimum inlet pressure) is 40 psig. ($\mathbf{P_{IN}}$ = 40 psig)
- The manufacturer's table gives a pressure drop through the condenser and the accompanying piping and valves at 15 psi. ($\mathbf{\Delta P_{COND}}$ = 15 psi)
- Water pressure drop through the installed piping is approximately 5 psi. ($\mathbf{\Delta P_{Loss}}$ = 5 psi)
- $\mathbf{P_{AVAIL} = P_{IN} - \Delta P_{COND} - \Delta P_{LOSS}}$ = 40 - 15 - 5 = 20 psi

Maximum Available Water Pressure Drop is 20 psi.

Using a flow of 35 gpm, a head pressure rise of 39 psi, and a pressure drop across the valve of 20 psi, the 1 in. valve meets these criteria. See the 1 in. V146 valve flow chart.

V146 Flowcharts

Note: The maximum differential water pressure across a valve is 60 psig (414 kPa).

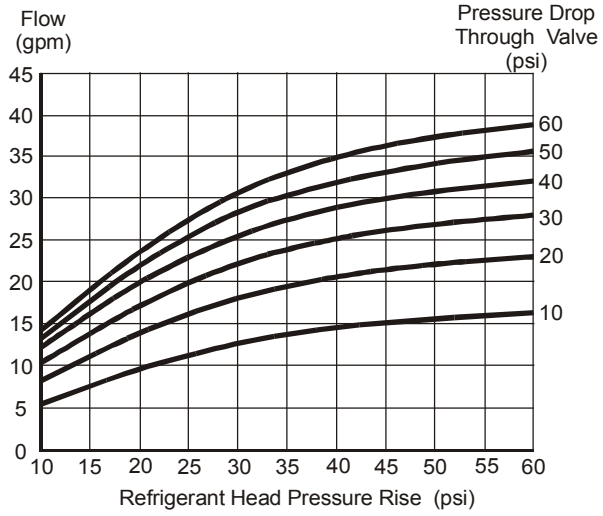

Figure 3: 3/4 in. V146 Valve

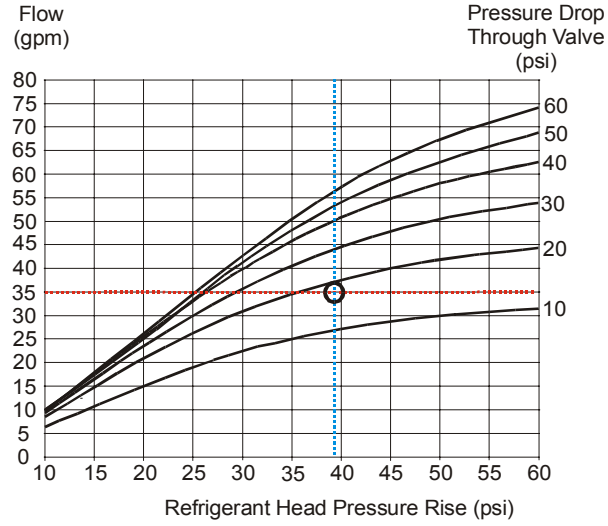

Figure 4: 1 in. V146 Valve

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.

Installation

IMPORTANT: If these valves are installed on equipment that contains hazardous or regulated materials, such as refrigerants or lubricants, observe all regulations governing the handling and containment of those materials.

IMPORTANT: Apply a non-hardening, pliable sealant (Loctite 567 or equivalent) to the face of the copper tailpiece to compensate for slight piping misalignments and surface imperfections on union ends.

IMPORTANT: After installing the valve, evacuate bellows and pressure connection lines, in accordance with EPA and other regulations, to remove air, moisture and other contaminants.

Dimensions

See Table 1, Figure 5 and Figure 6 for dimensions of V146 valves.

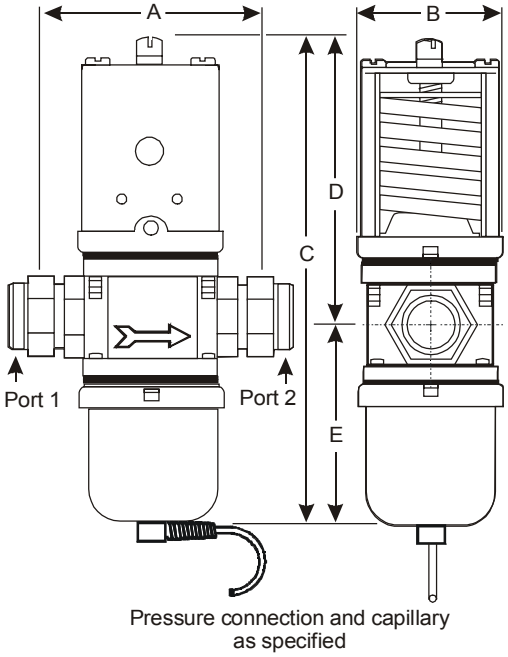

Figure 5: V146 Valve Dimensions for 1 in. Valves

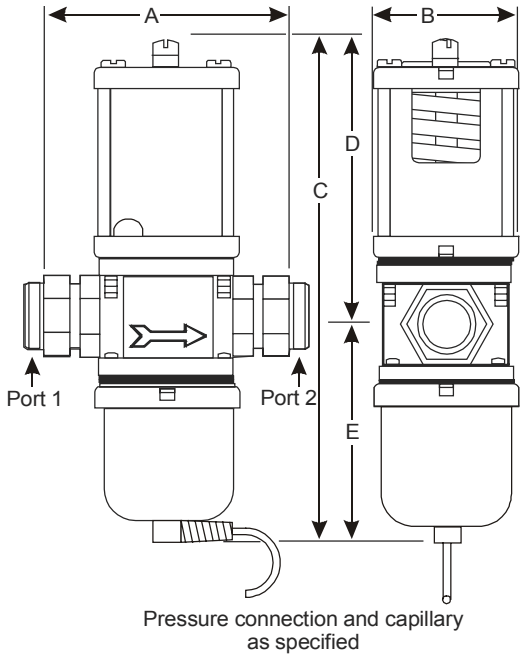

Figure 6: V146 Valve Dimensions for 3/4 in. Valves

Table 1: 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)
V146AL-1C	1 in.	4-3/4 (121)	2-15/16 (75)	10 (254)	5-15/16 (151)	4-1/16 (103)

Table 2: Dimensions, Shipping Weight

Product Code Number	Nominal Valve Size	Shipping Weight
V146EK-1C	3/4 in.	4.3 lb (2.0 kg)
V146AL-1C	1 in.	9.3 lb (4.0 kg)

Manually Flushing the Valve

Manually flush the valve and fluid piping before and after installing, repairing, or replacing a valve to remove filings, chips, or other foreign matter. Insert screwdrivers under both sides of the valve spring guide and lift upward to flush the valve. (See Figure 7 and Figure 8.) Manual flushing does not affect valve adjustment.

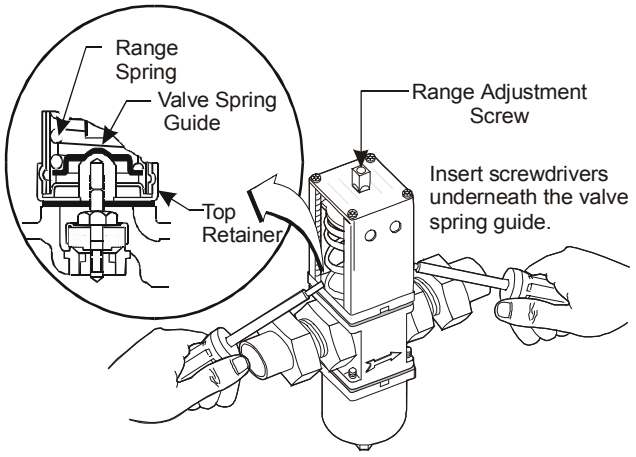

Figure 7: Manual Flushing for 1 in. Valves

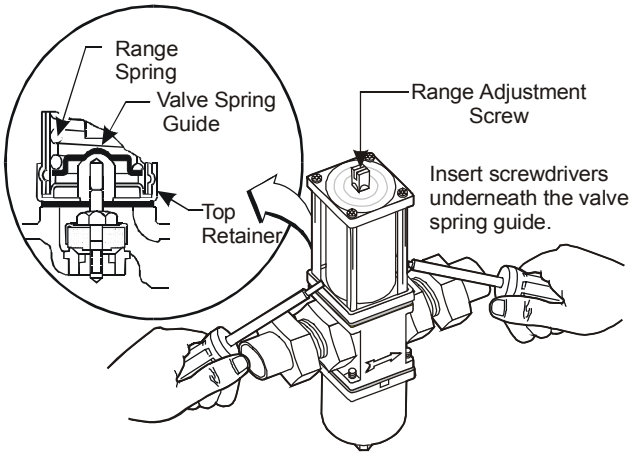

Figure 8: Manual Flushing for 3/4 in. Valves

Mounting

Install the valve vertically with the range adjustment screw on the top and the bellows and pressure connection line on the bottom to allow drainage of oil and refrigerant away from valve bellows.

Do not mount the valve in any position other than vertical unless specified by the manufacturer of the equipment on which the valve is installed. Follow the manufacturer's installation instructions.

Location Considerations

Install the valve on the inlet side of the condenser. If it is necessary to keep the condenser flooded with water, install the valve on the outlet side of the condenser.

If the system is located in an area with high ambient temperatures, refrigerant head pressures may remain high enough during off cycles to prevent the valve from closing completely. In such instances, raise the opening point of the valve just enough to cause the valve to stop flow to the condenser during compressor standby periods.

Pressure Connections

WARNING: Risk of Personal Injury.
Contents of liquid lines could be under pressure. Avoid possible personal injury by shutting off the liquid supply and relieving the pressure before servicing the valve.

Connect the refrigerant-side flare connector to the appropriate high-side pressure tap point. If additional capillary tubing is necessary, use 1/4-in. copper tubing.

Follow the guidelines below when making pressure connections:

- ***Use Pressure Tap Points Located on the Top Side of the Refrigerant Lines.***

  This reduces the possibility of oil, liquids, or sediment accumulating in the pressure connection line or valve bellows, which could cause valve malfunction.

- ***Avoid Sharp Bends in the Capillary Tubes.***

  Sharp bends can weaken or kink capillary tubes, which may result in refrigerant leaks or restrictions.

- ***Allow for Slack in the Capillary Tubes to Dampen Vibration.***

  Mechanical vibration can weaken or damage the capillary tubes.

- ***Avoid Contact Between the Capillary Tubing and Sharp or Abrasive Objects.***

  Vibration or rubbing of sharp or abrasive objects in contact with capillary tubes can cause leaks.

- ***Coil and Secure Excess Capillary Tubing Away from Contact with Sharp or Abrasive Objects or Surfaces***

  Carefully loop any excess capillary tube into smooth, circular coils (minimum 2 in. [5 cm] diameter). Securely fasten the coiled capillary tube.

- ***Do Not Overtighten Flare Nuts on Pressure Connection Line Fittings.***

  Overtightening flare connections may damage the threads on the flare nuts or flare connectors and result in refrigerant leaks. Do not exceed 9 lb·ft (12 N·m) of torque when tightening brass flare connections.

- ***Avoid Severe Pressure Pulsation at Pressure Tap Points.***

  Install pressure connection lines to pressure tap points away from the compressor discharge, to minimize the effects of pressure pulsation from reciprocating compressors.

Table 3: Refrigerant Pressure Specifications

Product Code Number	Nominal Valve Size	Maximum Refrigerant Pressure at Bellows	Opening Point Adjustment Range	Factory-Set Opening Point
V146EK-1C	3/4 in.	370 psig (2551 kPa)	70-260 psig (483-1793 kPa)	165 psig (1138 kPa)
V146AL-1C	1 in.	320 psig (2206 kPa)		

Setup and Adjustments

The V146 valves are factory adjusted for the settings shown in Table 3.

The **opening point pressure** is the refrigerant pressure (at the valve's bellows) necessary to just lift the valve disc off the valve seat and allow water to flow through the valve body. Turning the range adjustment screw changes the opening point pressure.

Use a standard service valve wrench or screwdriver to adjust the opening point pressure.

- Turn the range adjustment screw **counterclockwise to raise the opening point pressure.**
- Turn the range adjustment screw **clockwise to lower the opening point pressure.**

Use a refrigerant pressure gauge to adjust the opening point pressure. Operate the system at normal load conditions and adjust the valve's opening point to the desired pressure. See Table 3 for refrigerant pressure specifications.

Repair and Replacement

Replacement of the sensing element, internal parts, and the rubber diaphragm can be made.

For a replacement valve or replacement parts kit, contact the nearest Johnson Controls/PENN distributor. For replacement kit part numbers, refer to Table 4.

For replacement kit instructions and details, refer to the following bulletins:

- *V146 Series Valves Repair and Replacement Kits Installation Instructions (Part No. 24-7664-2071)*
- *V146 and V148 Series Valves Sensing Element Replacement Kits Installation Instructions (Part No. 24-7664-2101)*

Table 4: Repair and Replacement Kits

Valve Product Code Number	Nominal Valve Size	Seat Repair Kit Product Code Number	Diaphragm Replacement Kit Product Code Number	Sensing Element Replacement Kit Product Code Number
V146EK-1C	3/4 in.	STT146075-600R	DPM14A075-600R	SEP14A075-603R
V146AL-1C	1 in.	STT146100-600R	DPM14A100-600R	SEP14A100-603R

Ordering Information

Table 5: Ordering Information

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)
V146AL-1C	1 in.			9.3 lb (4.0 kg)

* See Figure 9.

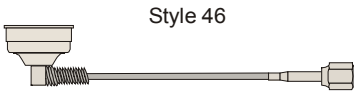

Figure 9: Pressure Connection Styles

Technical Specifications

Product		V146 Series 2-Way Pressure-Actuated Water-Regulating Valves
Refrigerant Pressure Range		See Table 3.
Water Supply		350 psig (2413 kPa) Maximum, 40°F (4°C) Minimum, 170°F (77°C) Maximum
Material	**Body**	3/4 in. - Cast Brass 1 in. - Cast Iron with Corrosion-Resistant Finish
	Disc Stud, Valve Stem	Brass
	Disc Cup, Valve Seat	Monel (Nickel-Copper Alloy)
	Valve Disc	Buna-N
	Sensing Element	Brass and Phosphor Bronze Bellow in Brass Cup
	Diaphragm	Nylon-Reinforced Buna-N
Dimensions (H x W x D)		See Figure 5, Figure 6 and Table 1.
Shipping Weight		See Table 2.

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, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

JOHNSON CONTROLS

Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

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