Hill PHOENIX
EXCELLENCE
A DOVER COMPANY

Smart Valve

Operation Manual

SMART VALVE

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INTRODUCTION

Smart Valve is a stand-alone system designed to regulate superheat in a refrigerated fixture. It performs the same basic function as a typical, mechanical thermostatic expansion valve; however, it automatically adjusts superheat to pre-determined target values based on the application (i.e. low- or medium-temperature operation). In addition, Smart Valve does not require periodic adjustments, as it automatically regulates superheat in response to changing ambient conditions, system parameter changes, and case-load changes.

COMPONENTS

The components of Smart Valve include the following: refrigeration valve with stator, control module with power cord, pressure transducer, and temperature sensor (see Fig. 1 below).

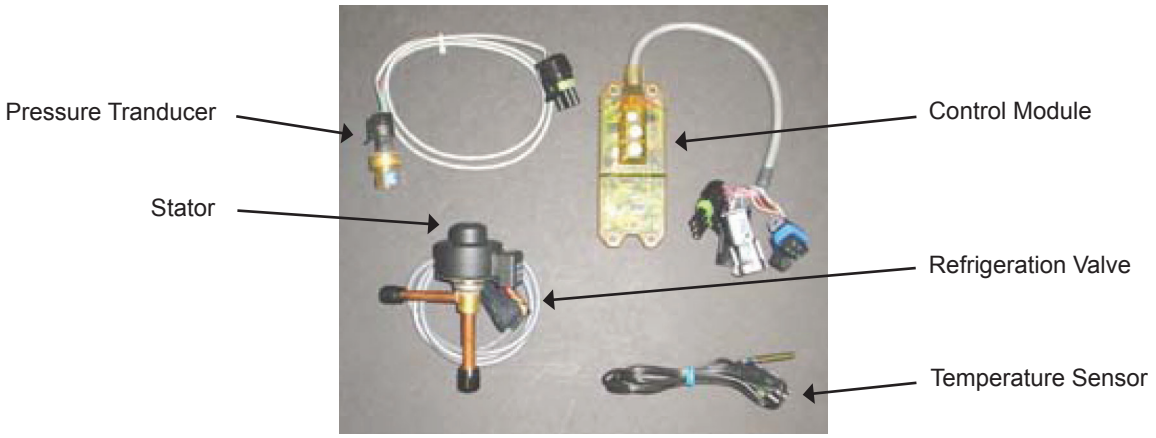


Fig. 1: Smart Valve Components

A 24-volt AC transformer is also required to power the system. A 3-wire power cable is used to connect the transformer to the control module.

INSTALLATION

Refrigeration Valve

- **Note: The refrigeration valve should be oriented and installed with the stator located slightly higher than the outlet of the refrigeration valve to prevent debris from blocking the orifice and needle assembly.**
- The inlet and outlet of the refrigeration valve are depicted in Fig. 2 (see right).

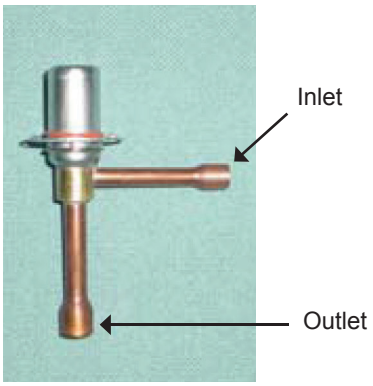


Fig. 2: Refrigeration Valve

Remember

When brazing, the refrigeration valve must be wrapped in a wet cloth to prevent damage to the internal components.

Refrigeration Valve (cont'd)

- There are three refrigeration valves currently in use today: 1.5-, 3-, and 5-ton valves. They are rated based on R22 flow capacities and can be distinguished by an engraving on the top of the valve: "14B" indicates a 1.5-ton valve, "18B" indicates a 3-ton valve, and "24B" indicates a 5-ton valve.
- They can also be distinguished by rings engraved around the bottom housing of the valve (see Fig. 3 below): 1 ring indicates a 3-ton valve and 2 rings indicate a 5-ton valve as shown below (the 14B valve does not contain rings on the housing).

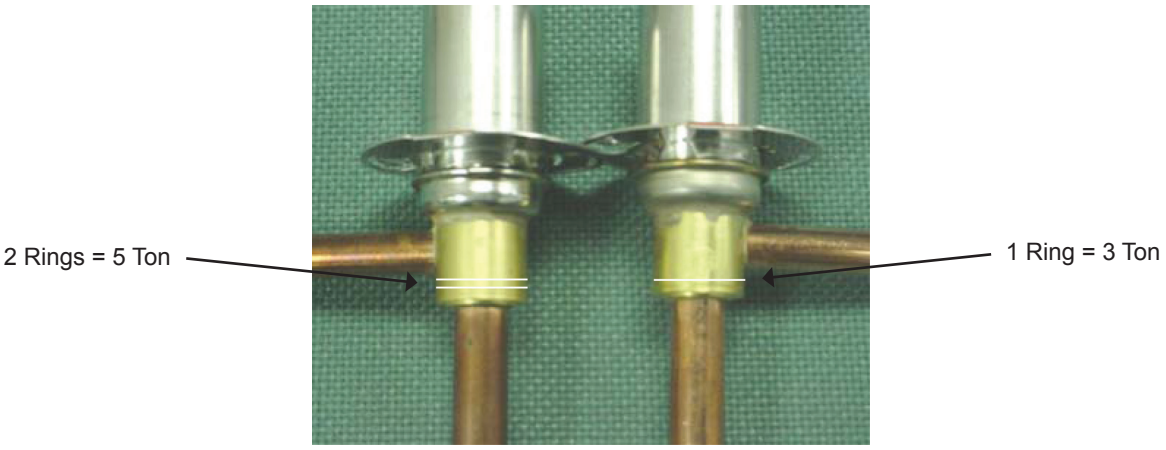


Fig. 3: Ring Engravings

Stator

- The stator is connected to the refrigeration valve by lining up the tabs on the stator with the notches on the valve and then performing a one-quarter turn to lock the stator in place.
- The stator is connected to the control module via the cable provided. The stator cable has been designed to only fit one connector attached to the module.

Control Module with Power Cord

- The control module is an over-molded electronics board with a four-connector pigtail. The mounting holes in the module are utilized to attach the module to a fixed surface (i.e. tank surface, mounting plate, etc.)
- Each of the connectors on the four-connector pigtail are unique and should only be plugged into its matching connector from the temperature sensor, pressure transducer, power input, and stator.

Remember

Do not jump- or cross-wire the connectors to avoid damaging the control module and/or components.

- The power cord is connected to the control module via the matching connector. The pigtail end of the power cord is hardwired to the transformer.
- Each connector should be fastened together until a slight click is heard or visually checked to ensure the locking tab on the side of the connector is engaged.

Remember

Connecting the power cord directly to the pressure transducer may cause damage to the transducer.

Pressure Transducer

- The pressure transducer is connected to the control module via a snap-in cable.
- The transducer cable should never be plugged directly into the power supply as damage to the transducer could result.
- To attach the transducer to the Schraeder fitting on the suction line, clean the flare fitting mating surface with a Scotch Bright® pad prior to transducer installation. Apply a thin layer of oil around the mating surface and install the transducer. The transducer must be torqued to 120 in-lbs.
- The transducer is sensitive to heat and should be removed if brazing or soldering is being done to the suction line within 2 feet of the transducer.
- The transducer can be left installed while a vacuum is applied to the system.

Temperature Sensor

- The temperature sensor is connected to the control module via a connector at the end of the sensor wires.
- The temperature sensor must be attached to the suction line in the same fashion as a capillary tube utilized on a mechanical valve. The sensor should be firmly attached longitudinally along the suction line in the 4 o'clock or 8 o'clock position for $^{7}/_{8}$-inch lines or larger; on the top portion of the pipe between the 3 o'clock and 9 o'clock position for pipe sizes smaller than $^{7}/_{8}$-inches.
- The temperature sensor must be removed if brazing or soldering is being done to the suction line within 2 feet of the sensor.

Transformer

- The required transformer is a 24VAC transformer with a minimum rating of 20 VA. The transformer must also be grounded.
- The ground wire must be utilized with the line voltage.
- The ground wire leading to the control module must be utilized.
- A maximum transformer rating of 50 VA can be utilized to energize Smart Valve.

OPERATION, ERROR CODES & FAILSAFE OPERATION

Smart Valve is equipped with a 3-colored LED light panel that is capable of steady-on or blinking operation. When voltage is applied to the system, the control module will begin its startup and verify LED operation by cycling through all of the panel's lights. The amber light will engage, indicating that the module is working correctly and that all of the sensors have been checked.

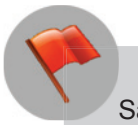
The module will open the refrigeration valve and attempt to reach the superheat target. Upon reaching the target value, the amber light will turn off and the green light will engage to indicate proper superheat has been achieved. If the superheat target can not be achieved, the module will indicate the error.

Lights Display G Y R	Error Description
■	Superheat within target range
■	Controller functioning, superheat not within target range
■ ■	Superheat too high for over 2 hours
■ ■ ■	Superheat too low for over 2 hours
B ■ B	Valve Connection Problem
■ B	Transducer Connection Problem
B ■	Temperature Probe - Connection Problem
■	Solid
B	Blinking

Fig. 4: Error Codes

If an error code is displayed, the control module will default to "safe mode" operation, which is based on historical data collected by Smart Valve during normal case operation. The average valve capacity over a 24-hour period is collected and stored under a signature value that is specific to the case and application.

When Smart Valve operates in safe mode, the signature value is utilized to provide a safe level of refrigeration until maintenance can be completed. The system will continue to operate in this mode until the condition is corrected and then will return to normal operation.



Remember

Safe mode operation is based on historical performance. To ensure optimal case function, maintenance to the unit should be completed as soon as possible.

If a sensor failure is detected, a corresponding error code will be displayed via the panel lights (see Fig. 4 on the next page). The first response should be to check all connections and wiring points, as well as to visually inspect sensors for cracks in the wiring, excessive heat, etc. If the problem still persists, the sensor should be replaced and the power-cycled to reset the control module.

In the event of errors related to the superheat target not being achieved (not sensor failures), the system will default to its safe mode and attempt to reach its target superheat every 45 minutes. If superheat is not reached within 15 minutes, the system will default back to safe mode.

In some rare instances, 15 minutes may not be long enough for the system to reach the target superheat; in this event, it may be necessary to cycle the power to reset the system immediately and provide an additional 15 minutes to reach superheat. Also, if the system has been turned on without refrigeration, it may be necessary to cycle the power to the unit several times to achieve proper performance.

If superheat can not be achieved and accurately maintained, Smart Valve will continue to default to safe mode. Further troubleshooting measures should be undertaken as soon as possible, such as ensuring a full column of liquid refrigerant is at the refrigeration valve, determining that the system is performing adequately, and affirming that all sensors are attached correctly and reading accurately.

COMMUNICATION

Smart Valve can communicate externally via infrared (IR) technology. The control module has an onboard emitter and receiver (see Fig. 5 below).

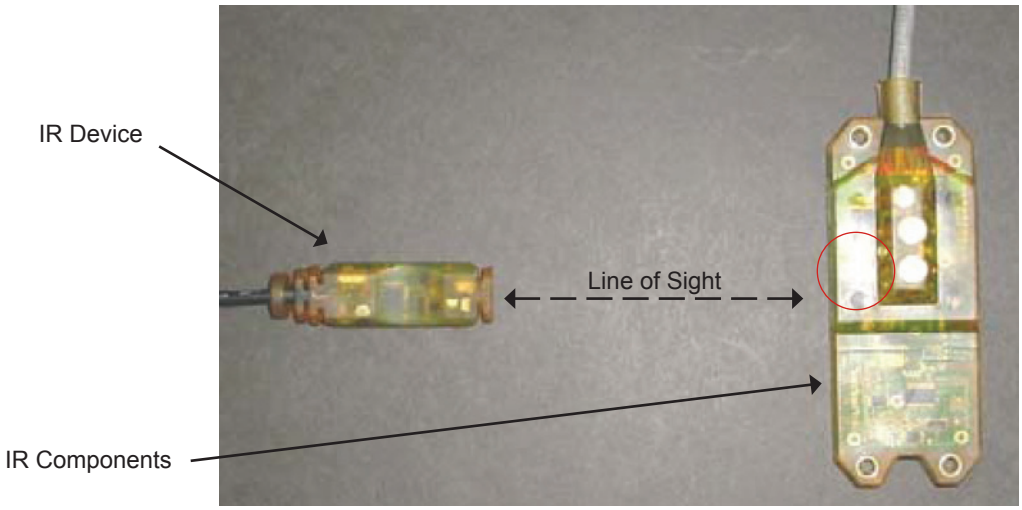


Fig. 5: Infrared (IR) Devices

An IR device (above) is required to connect the control module to a PC using a USB port. IR technology requires that the module and the IR device be in line-of-sight of one another and somewhere between 3-inches to 2-feet apart. The illustration above also demonstrates the correct orientation of the components for communication. The Smart Valve software, as well as the drivers for the IR device, must be installed on the PC.

REFRIGERANT SELECTION

Smart Valve is capable of handling a wide variety of refrigerants and has the ability to select or change the refrigerant through an IR device and a PC. Upon installing and launching the Smart Valve software, a Quick Start interface screen will appear (see Fig 6. below).

Select the circle adjacent to the desired refrigerant and click the "Send Settings to Controller" button. The software will monitor the change in parameters and display whether or not the change was successful (see Fig. 7 below).

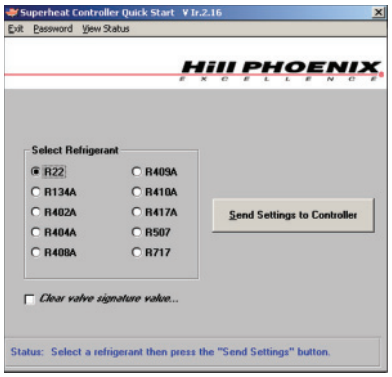


Fig. 6: Quick Start Interface

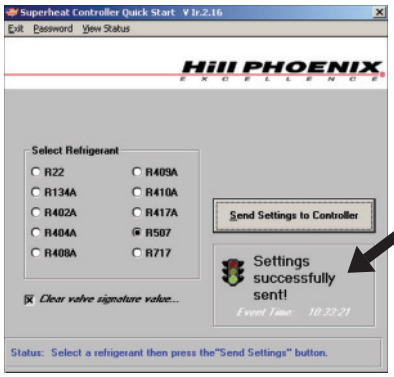


Fig. 7: Selecting Refrigerant

If the settings were not successfully sent, the connection to the IR device should be checked and the orientation of the IR device and control module should be examined to ensure there is nothing blocking the line of sight between the IR device and the module.

The signature value of the controller can also be reset by checking the box next to "Clear valve signature value", selecting the desired refrigerant, and clicking the "Send Settings to Controller" button. For example, it may be necessary to reset this value if switching a controller to a different case or if a refrigerant change is made.

DIAGNOSTICS/ VIEW STATUS

The Smart Valve software is also capable of displaying in-depth information about the performance of the system. Normal operation does not warrant the use of these functions but could aid in diagnosing system performance issues.

To utilize this functionality, the IR device needs to be utilized as detailed above in the refrigerant selection section. When the software is initialized and the Quick Start screen is displayed, the "View Status" heading at the top of the screen must be selected (see Fig. 8 to the right).

Fig. 8: View Status

When the status screen is displayed, click on the "Connect to Controller" button. The buttons marked Rx and Tx should blink from green-to-red, and a status summary will be displayed at the bottom of the screen. The software should indicate that the connection was successful, and the current settings and readings of the sensors will be displayed in real time. A graph will record the readings as measured by the software and display them.

The control module does not store data, so data cannot be pulled from the module. The graph can be started and then viewed later to look at system performance. Values to be displayed in the graph are listed on the right. Checked boxes indicate the values that are to be displayed (see Fig. 9 below).

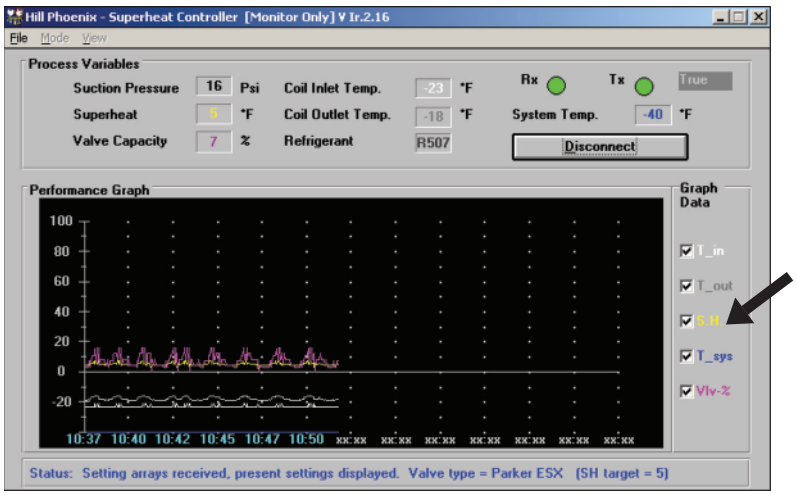


Fig. 9: Control Module

The following is a list of readings and parameters that are available for display:

- Suction Pressure – Displays the suction pressure as recorded by the pressure transducer.
- Coil Inlet Temp. – Displays the saturated suction temperature converted from the pressure recorded by the transducer and based on the refrigerant selected.
- Superheat – Displays the calculated superheat based on the temperature sensor and the coil inlet temperature.
- Coil Outlet Temp. – Displays the coil outlet temperature as recorded by the temperature sensor.
- Refrigeration Valve Capacity – Displays the percentage of full capacity the valve is currently operating at.
- Refrigerant – Displays refrigerant selected in the software.
- System Temp – Not used at this time.

QUESTIONS?

If you have any questions or concerns, please contact Hill PHOENIX at 1-800-283-1109 (select extension "2444").