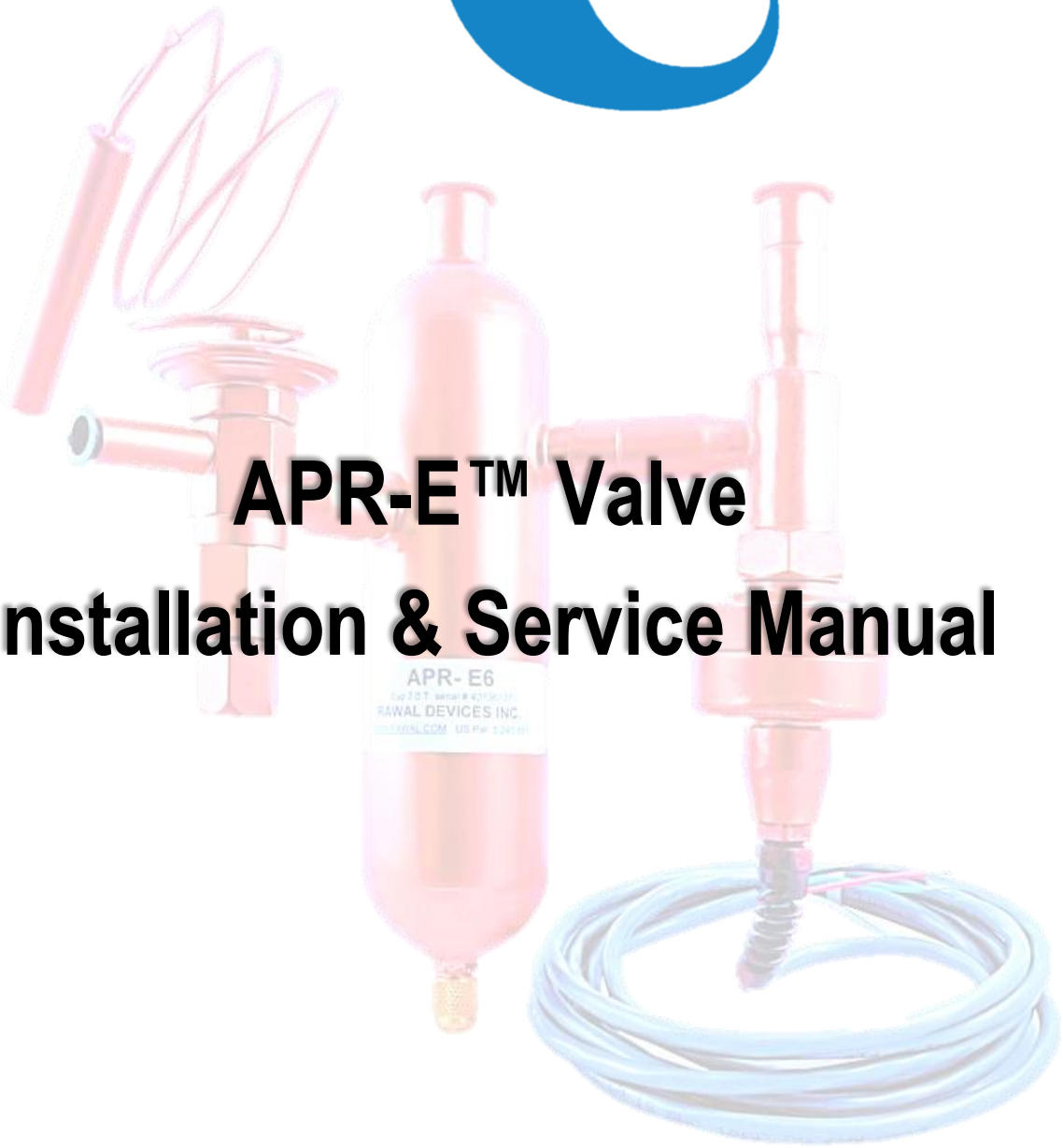
APR-E™ Valve
Installation & Service Manual



Please Read All Instructions Fully Before Installing

For Support Contact:

Rawal Devices, Inc.

Call: (800) 727- 6447

Email: techsupport@rawal.com

What is the APR-E?

The **APR-E™ Valve** is an ***electrically driven, electronically controlled, motorized compressor unloading valve***. It is popularly used as a discharge air controller on DX systems. The APR-E will regulate the amount of refrigerant flow entering the evaporator by diverting the discharge gas into the suction line before the compressor. Thus, modulate the cooling capacity of the evaporator.

As the discharge air temperature falls below setpoint, the APR-E can be controlled to open and begin modulating. This action decreases the amount of refrigerant to the evaporator, resulting in a higher discharge air temperature off the coil.

Conversely, as the discharge air temperature rises above setpoint, the APR-E can be controlled to modulate towards the closed position. Now increasing the amount of refrigerant to the evaporator, decreasing the discharge air temperature off the coil.

We offer two control boards for all of our APR-E™ valves:

The first is the external control board. It is a small electronic circuit board drives the APR-E valves' electric motor. The external control board responds to an analog *0-10VDC* or *4-20mA* signal from a separate systems controller.

The second is a stand-alone controller that will modulate the APR-E based on discharge air temperature. Giving you the ability to *"set it and forget it."*

The APR-E is capable of maintaining a +/- 1° deviation from set-point within the modulation range.

APR-E w/ External Control Board Dip Switch Settings

Figure 2

Table 1 - Input Signal
(jumper location)

5	4	3	2	1
4-20mA				0-10V
1200Ω	1000Ω	600Ω	300Ω	

Table 2 – Number of Steps

DIP #	6386	3196	2500	1596	500
1	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	ON	ON	OFF
3	OFF	ON	OFF	ON	OFF

Figure 2a

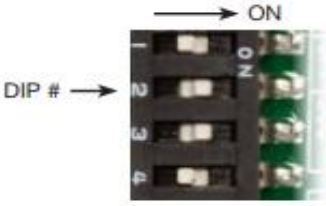


Table 3 – Valve Type/Operation

DIP #	OFF	ON
4	Bipolar	Unipolar
5	Std Direction	Reverse
6	Std Response	Quick
7	200pps	400pps
8	Std Operation	Close Valve

Courtesy of Sporlan Division – Parker Hannifin Corporation

The External Control Board

The external control board is a small electronic circuit board that drives the APR-E valves' step motor. The board needs a 24 VAC, 40 VA, and independent transformer. The external control board shall receive an analog 0-10VDC or 4-20mA signal from a separate systems controller. The signal is then converted to a step motor signal to position the valve. Enhanced features include LED indicators for power and valve position.

Input Signal Settings (Table 1):

The board can be configured to accept 0-10VDC or 4-20mA analog signal. To configure the input signal, place the jumper on the desired setting. The 4-20mA selection offers several impedance choices based on the external controller. If 4-20mA is selected, ensure that the impedance of the control circuit matches that of the external controller requirements. This will ensure that the maximum valve position, at 20mA, is obtained. Where possible, it is recommended to use a constant current design in the external controller to ensure a proper 4-20mA control signal is supplied .

Valve Selection (Table 2): *This is factory set from Rawal Devices - DO NOT ADJUST*

DIP Switch Settings (Table 3):

Bipolar/Unipolar – All Rawal Devices, Inc. electronic valves are Bipolar (dipswitch 4 is off)

STD Direction/REV Direction – This selection allows the valve to operate in reverse direction. STD direction closes the valve based on increasing control signal. To reverse the valve direction, turn the DIP switch #5 to "ON". This selection does not affect the force close direction when the "**CLS**" and "**REF**", "**OPN**" and "**REF**" or forced close DIP switch #8 is turned on.

STD Response/Quick – Strongly recommended that dip switch 6 is off (STD response)

200pps/400pps – Strongly recommended that dipswitch 7 is off(200pps)

STD Operation/Close Valve – This selection allows for the valve to be manually closed via DIP switch #8. By turning this 'ON', the valve will move to the 0%, closed position. This feature can be used for service and troubleshooting. The switch must be turned to 'OFF' to resume normal operation

APR-E w/ External Control Board Testing

THE BOARD CONTINUOUSLY STARTS UP THEN RESETS: Check for reverse polarity across terminals **24V+ and 24V-.** If multiple Boards are used on one power supply, ensure that all the polarities are correct across the boards. Check and ensure ground potentials are the same for the power supplies for both the boards and external controller.

VALVE DOES NOT MOVE WITH CONTROL SIGNAL: Ensure RED status LED is on to indicate the board is powered.

If GREEN LED is solid: Check to ensure terminals 'OPN' and 'REF' are not shorted.

If GREEN LED is blinking: Check valve wiring to ensure proper location on the board. Measure control signal across terminals S+ and S- and ensure it matches the board position established by the 'OPN' LED. For example if the control signal measures 5VDC, ensure the GREEN LED is blinking 4-5 times to denote approximately 50%. Check to ensure DIP switch #4 is set correctly. Check valve for short or open.

If YELLOW LED is solid: Check to ensure terminals 'CLS' and 'REF' are not shorted. Check to ensure DIP switch #8 is set to OFF. Note: A short across terminals 'OPN' and 'REF' will position the valve at 100%. Note: DIP switch #8 can be placed in 'ON' position to manually position the valve to 0%.

VALVE DOES NOT OPEN TO 100% If GREEN LED is solid: This denotes that the board has electronically positioned the valve at 100%. Check to ensure valve stroke is set correctly based on DIP switches 1-3; see Table 2. Check to ensure DIP switch #4 is set correctly. Check valve for short or open.

If GREEN LED is off or blinking: Check signal across terminals S+ and S-. The signal should be 10VDC or 20mA depending on jumper selection found in Table 1.If using 4-20mA control signal, ensure proper selection of impedance to match requirement of external controller. Check to ensure DIP switch #5 is set correctly. Check to ensure DIP switch #8 is set to OFF. Check to ensure there is not a short across terminals 'CLS' and 'REF'. Note: A short across terminals 'OPN' and 'REF' will position the valve at 100%.

VALVE DOES NOT CLOSE TO 0% If YELLOW LED is solid: This denotes that the board has electronically positioned the valve at 0%. Check to ensure valve stroke is set correctly based on DIP switches 1-3; see Table 2. Check to ensure DIP switch #4 is set correctly. Check valve for short or open. ***If YELLOW LED is off:*** Check signal across terminals S+ and S-. The signal should be 0VDC or 4mA depending on jumper selection found in Table 1. Check to ensure there is not a short across terminals 'OPN' and 'REF'. Check to ensure DIP switch #5 is set correctly. Note: DIP switch #8 can be placed in 'ON' position to manually position the valve to 0%.

VALVE MOVES THE WRONG WAY: Check valve wiring to ensure lead wires match color code on the board terminals. Check DIP switch #5; this reverses direction of the valve.

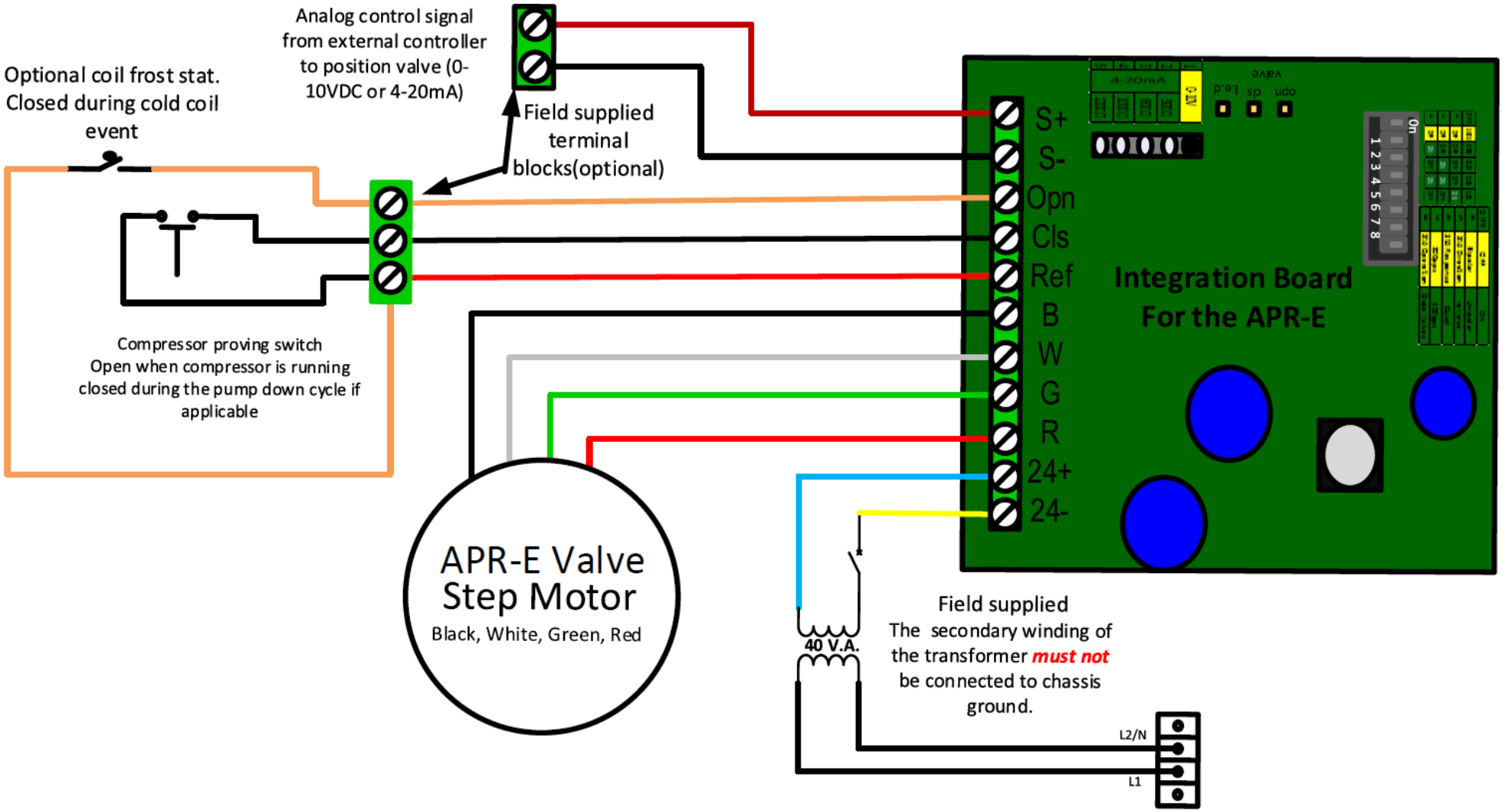
GREEN LED IS BLINKING: **This denotes normal operation**. The blinking indicates how far the valve is open. For example 2 blinks is approximately 20% open. *ALL LEDS ARE BLINKING*: This denotes that the DIP switches are positioned in an invalid configuration. Check DIP switches, Table 3, to ensure the board is set up correctly

Test the Motor:

The resistance of the motor winding may be tested without opening the system.

1. ***Remove*** power from the external controller and the board
2. ***Remove*** valve leads from the board
3. Measure the resistance between black and white leads of the valve. The resistance should be 75Ω ±10% at 71°F (21.7°C). (For the APR -E-7,APR-e-12,and the APR-E-25, the resistance should be 100Ω ±10% at 71°F (21.7°C).)
4. Measure the resistance between the green and red leads. This value should be within ±5% of The resistance between the black and white leads recorded in step 3.
5. 5. Measure the resistance from any lead to the valve body. Resistance should be infinite (open).

APR-E w/ External Control Board Wiring



Control Strategy for Discharge Air Control

(Sequence of Operations Based on Rawal Devices Installation Diagram)

(Do not deviate unless consulted by RAWAL DEVICES technical support team.)

1) Upon power-up the board will go through a calibration process (about 30 seconds)

2) Optional frost stat and/or low-pressure switch must be enabled (open input function on board) for the input signal (from the BAS) to be recognized.

3) As the discharge air temperature increases above set point, a call for cooling shall enable the first compressor (***assuming all conditions are met for enabling compressor***)

4) Once the lead compressor is on and proven, the programmer can modulate the control signal (*0-10vdc or 4-20ma)* based on deviation from set point of the discharge air. (The discharge air set point can be determined from any control strategy that is required from engineer or building needs)

5) As the discharge air temperature decreases below set point, the APR-E should modulate towards the ***open*** position to provide capacity control modulation. (Decreasing cooling capacity)

6) As the discharge air temperature increases above the discharge air set point, the APR-E shall modulate towards the ***closed*** position to decrease the amount of modulation.(Increasing cooling capacity)

7) As the discharge air temperature increases ***AND*** the APR-E is at 100% ***closed THEN*** an additional stage of compressor should be added (this sequence for all stages over the first stage).

8) As the discharge air temperature is drops below set point ***AND*** the APR-E is 100% ***open*** (full capacity control) ***THEN*** remove a stage of compressor.

9) A time delay before compressor staging (adding or removing) should be utilized to ensure stability of system. Around 5 minutes should be acceptable for most applications. However, each system is unique and the systems control should be “tuned” to each system for optimal performance.

10) When the lead compressor is off, the APR-E will drive to the closed position regardless of the BAS input signal due to the input function of the compressor proven switch.

11) If the low-pressure switch or the frost stat are in the closed position (indicating a less than ideal operating condition) the APR-E will drive to the ***open*** position (fully modulated) regardless of BAS input signal. This option should be utilized as a ***pre-failure preventative measure and not as a system safety.*** This should not be utilized as a repetitive cycling function.

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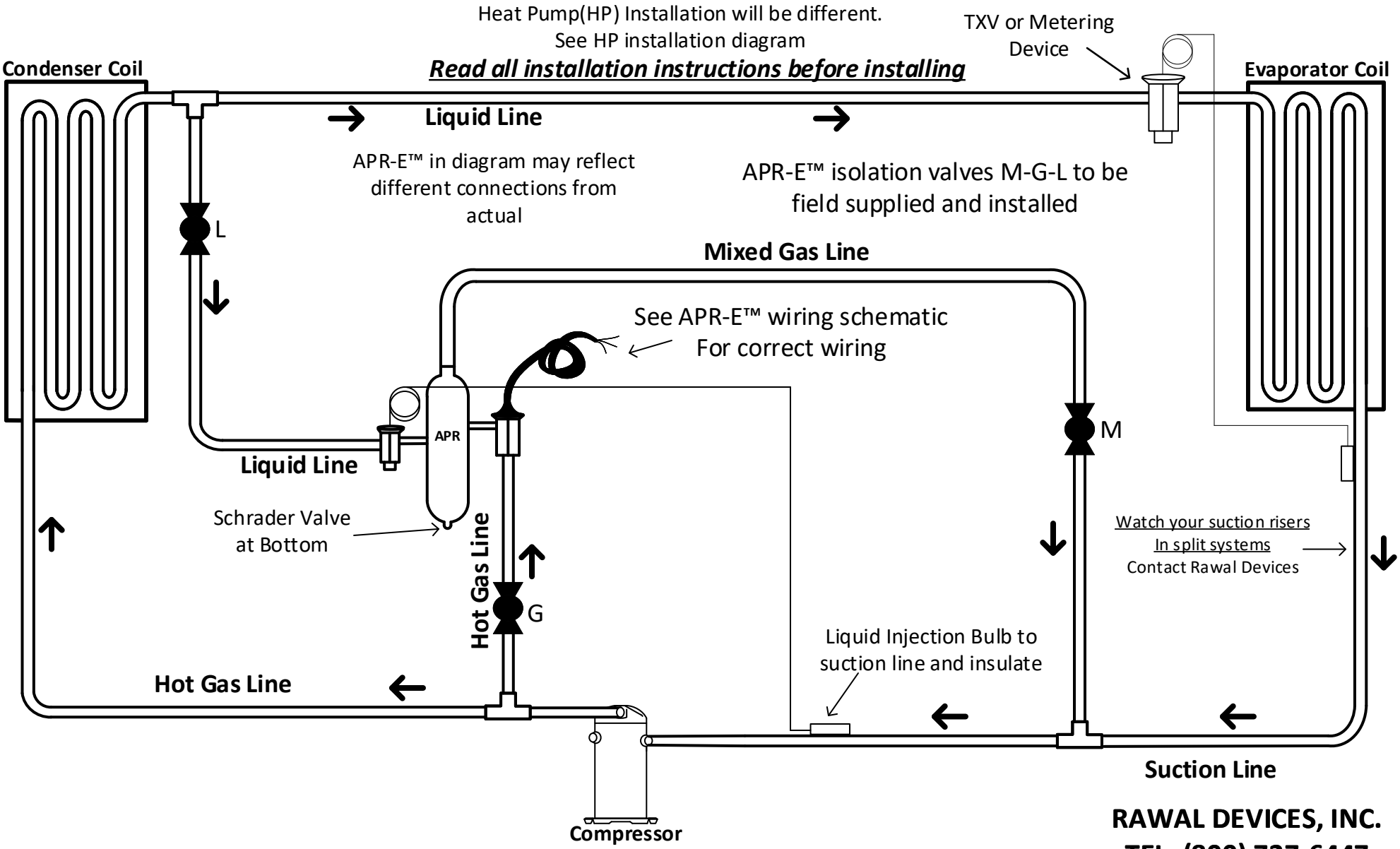
FREE 20-MINUTE ONLINE PRE-INSTALLATION TRAINING AVAILABLE

APR-E™ IN SINGLE EVAPORATOR MODE



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APR-E™ VALVE - SPEC. & DIMENSION SHEET (R-410A & R-22)

	Modulation Capacity (Tons)		Unit Dimensions				Connection Dimensions (OD)			
Model #	**R-22**	**R-410A**	**X**	**Y**	**Z**		**L**	**M**	**G**	**Application Notes**
APR-E1	**0.65 tons**	**1 ton**	7.5"	12"	3.5"		3/8"	5/8"	3/8"	
APR-E2	**1.8 tons**	**2.9 tons**	8.5"	13"	4.5"		3/8"	5/8"	1/2"	
APR-E4	**3.7 tons**	**5.9 tons**	8.5"	13"	4.5"		3/8"	5/8"	1/2"	
APR-E5	**5.1 tons**	**8 tons**	8.5"	13"	4.5"		3/8"	5/8"	5/8"	
APR-E7	**6.9 tons**	**11.3 tons**	10"	14"	5"		3/8"	5/8"	5/8"	
APR-E12	**12.5 tons**	**20.3 tons**	10”	14”	5”		3/8”	5/8”	5/8”	

- **MUST SUPPLY BALL SHUT-OFF VALVES FOR ALL CONNECTIONS**
- **MUST SUPPLY TEE FOR SUCTION LINE CONNECTION**
- **MUST SUPPLY TEE FOR HOT-GAS CONNECTION**
- **MUST SUPPLY TEE FOR LIQUID LINE CONNECTION**

WHEN REQUIRED, MUST SUPPLY TEE FOR EE CONNECTIONS
EXTERNAL EQUILIZERS - EE - HAVE 1/4" SWEAT CONNECTION TEE
EE CONNECTIONS INTO SUCTION LINE

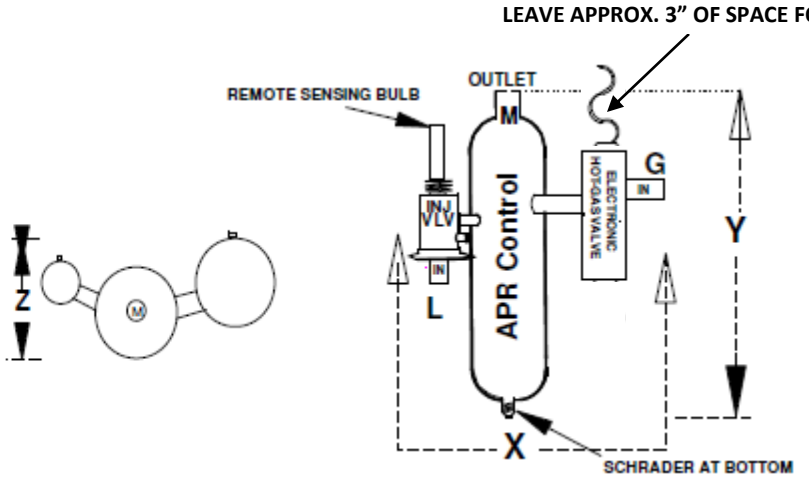
SENSING BULB ON LIQ INJ VALVE MUST BE ATTACHED AND INSULATED TO SUCTION LINE BETWEEN TEE TO APR CONTROL DISCHARGE COMING FROM TOP OF THE CHAMBER AND COMPRESSOR

APR Control Selection:

System or Stage size is reduced by the Modulation Capacity listed above

Oil entrainment in suction line must be addressed

Please refer to Rawal Devices Fast Selection Chart or Consult with Rawal Devices Engineers



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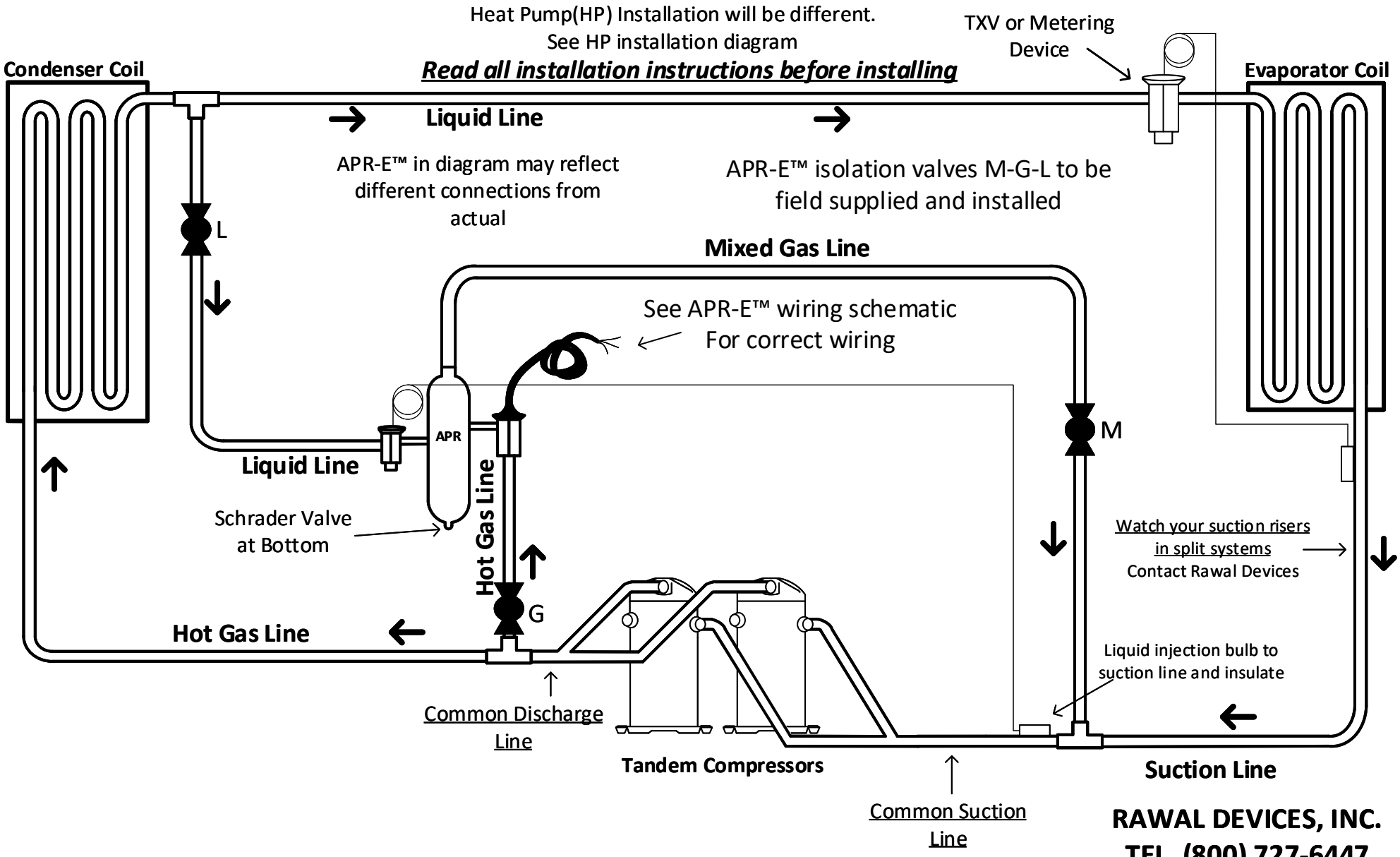
APR-E™ IN TANDEM COMPRESSOR CONFIGURATION



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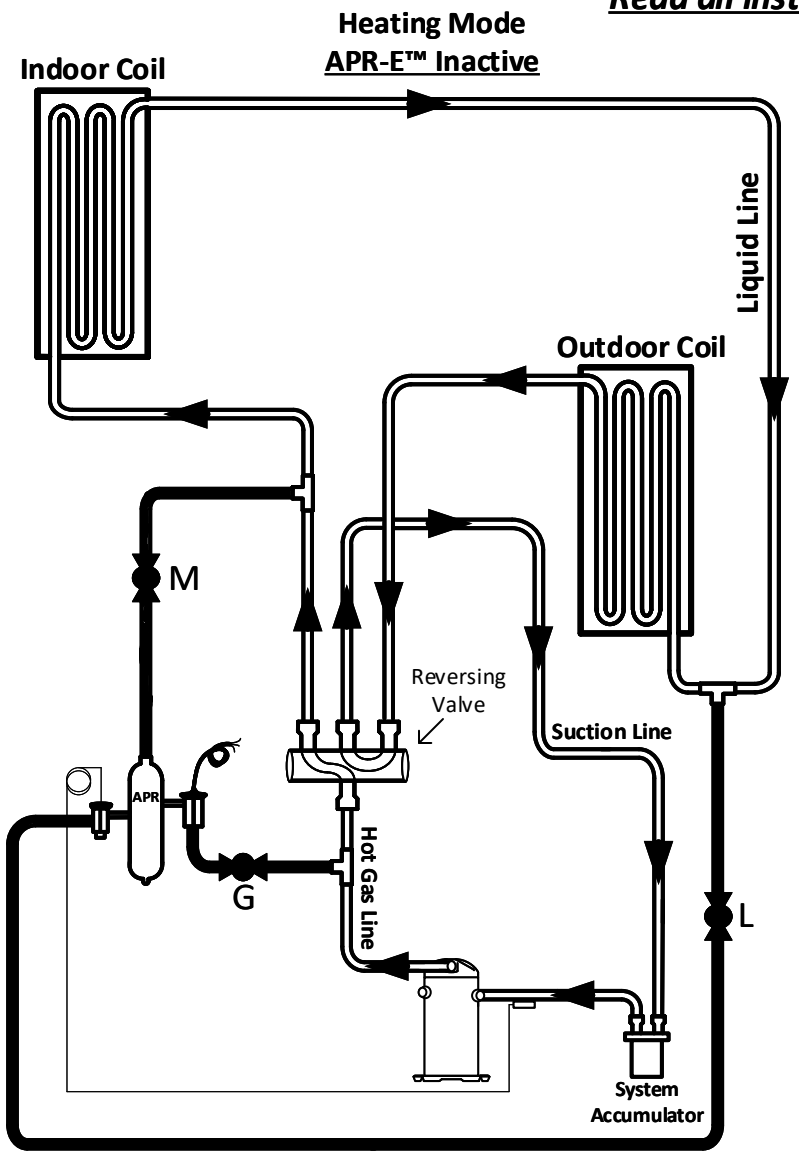
APR-E™ IN A HEAT PUMP SYSTEM

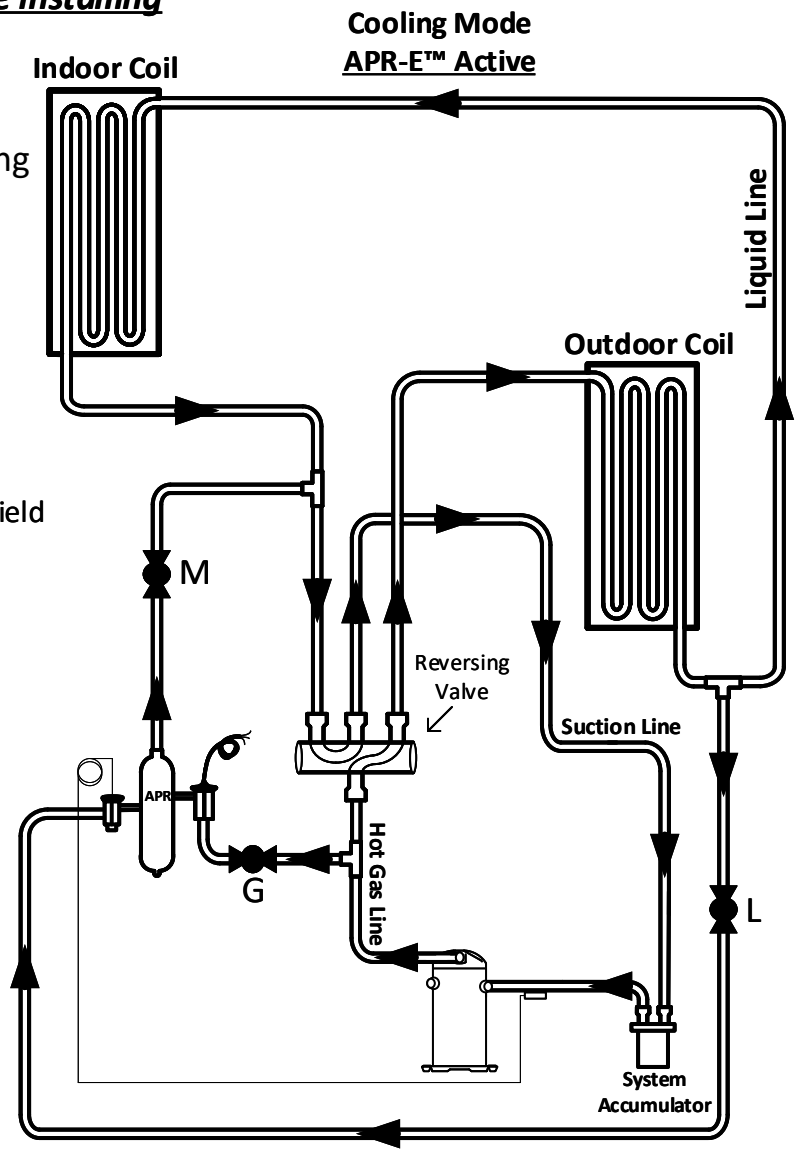
Read all installation instructions before installing



See APR-E™ wiring schematic for correct wiring

Isolation valves M-G-L to be field supplied and installed

APR-E™ active in cooling mode only



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