

Diagnosing a System with an APR Control

Before trouble-shooting the APR Control, it's important to know that the APR has an extremely low failure rate compared to all of the other components of a HVAC system. Chances are, when you are trying to diagnose a system issue with an APR Control installed, the problem is not the APR Control! It is extremely rare to have the APR Control be the cause, which often leads to misdiagnosis of the APR.

- *While active, the APR can mask many system limitations in an air conditioning/ refrigeration circuit including, but not limited to:*
 - Low airflow (VAV/VVT)
 - Low Entering Air Temperature
- *While active, the APR can conceal potential contributors to system failures from, but not limited to:*
 - System Undercharge
 - System Overcharge
 - Low Suction Pressure due to outside air temperature without low ambient kit
 - Bad metering device/TXV

Verifying Proper System Operation with the APR Control INACTIVE

Testing and adjusting the APR Control is nearly impossible without confirmation that the rest of the system is operating correctly! The first step to troubleshooting the APR Control is to verify the unit's operation with the APR Control isolated by the ball valves and "out of system/circuit." If there are no isolation ball valves installed, please install them! If unable to do so, call Rawal Devices for further consultation.

- Step 1: Isolate the APR Control from the system
 - Close ball valve between *discharge line* and ***Compression Ratio Reduction Valve (CRR)***
 - Close ball valve between *liquid line* and ***Liquid Injection Valve***
 - Close ball valve between ***De-Superheating Chamber*** and *suction line*
- Step 2: Verify Correct Charge
 - Compare system superheat to manufacturer's recommendations
 - Compare system sub-cooling to manufacturer's recommendations

NOTE: When APR Control is *active*, super-heat at the compressor can range anywhere between 12° to 20° & sub cooling can range up to 30°+. This is considered normal operation with the APR active. The system needs to be performing per manufacturer's recommendations *prior* to troubleshooting the APR.

Adjusting the APR Control

The standard APR Control for R-410a comes set from the factory to maintain a suction pressure of 118 psi. This set-point of 118 psi is approximately equivalent to a 40° S.S.T. (saturated suction temperature). Rawal Devices has found that a 118 psi suction pressure set-point is effective for the vast majority of applications. However, *this does not mean 118 psi set-point is suitable for your specific application!* This is why the APR Control's **Compression Ratio Reduction Valve (CRR)** (connected to the discharge line) is field adjustable. This will require the technician to determine their specific system's needs as there are many system applications with different operating parameters out in the field. The "ideal adjustment" on any DX system should strive for the most modulation of the APR Control *before* termination of the compressor. Please call Rawal Devices with any questions regarding set-point.

- *If system/space is experiencing high humidity...*
 - A higher suction pressure set point *may* be recommended to extend run-time of compressor to keep the evaporator coil active for extended dehumidification
- *In VAV or MUA (make up air) applications...*
 - A lower suction pressure set point *may* be desired to prevent coil freezing or liquid flood back
- Adjustments should be made **ONLY** on the **CRR Valve** (discharge side)
- **NEVER** adjust the **Liquid Injection Valve**
 - Factory set to open at 20° Superheat to not exceed 65° suction line temperature entering compressor
 - *Adjusting the Liquid Injection Valve WILL void the warranty*

The adjustment procedure for the **Compression Ratio Reduction Valve (CRR)** varies with each different model number of the APR Control. However, all APR Controls have a cap over the adjustment screw that will have to be removed in order to make adjustments. While making adjustments, be sure that the gauges are connected to the system so you can verify the suction pressure set-point. Most applications will only need a single turn (in either direction) to tune the APR to the system's needs. In order for the adjustment procedure to be valuable, the suction pressure of the system will have to be lower than the APR Control's suction pressure set-point when the APR Control is *isolated* from the system. If there is a rare need to adjust more than one turn, please give Rawal Devices a call to discuss the application.

Model #	Pressure Range (psi)	PSI Change per turn	Factory Setting
APR-410-1	96-142	5.0 # per turn Counter Clockwise Raises Setpoint	118
APR-410-2	96-137	5.0 # per turn Counter Clockwise Raises Setpoint	118
APR-410-3	90-130	5.0 # per turn Counter Clockwise Raises Setpoint	118
APR-410-5	95-115	2.5 # per turn <i>Clockwise*</i> Raises Setpoint	110
APR-410-6	96-142	5.0 # per turn Counter Clockwise Raises Setpoint	118
APR-410-10	96-132	5.0 # per turn Counter Clockwise Raises Setpoint	118
APR-0.7	0-100	16 # per turn Clockwise Raises Setpoint	50
APR-0.9		3.5 # per turn Counterclockwise Raises Setpoint	65
APR-1R	0-80	9.8 # per turn Clockwise Raises Setpoint	50
APR-1D	3-85	6.0 # per turn Clockwise Raises Setpoint	60
APR-1	0-80	4.0 # per turn Clockwise Raises Setpoint	50
APR-2	3-85	6.0 # per turn Clockwise Raises Setpoint	60
APR-2.5	3-85	6.0 # per turn Clockwise Raises Setpoint	60
APR-3	0-80	7.5 # per turn Clockwise Raises Setpoint	60

Mechanical Testing of APR Control

The APR Control has few moving parts and **this test is to verify that they are moving and free from obstruction**. *Mechanical testing should be performed only after system verification has been completed.* In order for this test to be valid, the suction pressure of the system will have to be lower than the APR Control's suction pressure set-point when the APR Control is *isolated* from the system.

1. With the system running, close the **Liquid Injection ball valve** and insert the bulb attached to the **Compression Ratio Reduction Valve (CRR)** into a cup of ice water. This will open the **CRR Valve** (the one piped to the discharge line) within roughly 10 seconds and will cause a rise in suction pressure. The amount of rise will depend on the amount of modulation taking place (percentage of total system tonnage). Most likely, the suction pressure will be above 118 psi, but not in all applications (technician MAY notice the sound of the refrigerant flow modulating through valve). If the pressure does not rise, a possible failure has occurred and replacement of the APR Control may be needed. *Please call Rawal Devices to verify.*
2. Insert the bulb attached to the **CRR Valve** into a warm water bath (not to exceed 100°F). This should drop the suction pressure to normal system pressure (as with the APR inactive). If a return to normal operation does not occur, a possible failure has happened and replacement of the APR Control may be needed. *Please call Rawal Devices to verify.*
3. Next, open the isolation ball valve for the **Liquid Injection Valve** and close the isolation ball valve for the **CRR Valve**. Insert the bulb attached to the **Liquid Injection Valve** into a warm water bath (not to exceed 100°F). This will cause a drop in temperature for the suction line and mixed gas line (the amount of the temperature drop will vary depending on the conditions of each individual system). If the temperature did not drop, a possible failure has occurred and replacement of the APR Control may be needed. *Please call Rawal Devices to verify.*
4. Insert the bulb attached to the **Liquid Injection Valve** into cold-water bath. The suction and mixed gas line temperature and pressure should return to normal. If not, a possible failure has occurred. Replacement of the APR Control may be needed. *Please call Rawal Devices to verify.*

Keep in mind, the APR Control is a capacity reduction device, not a capacity eliminator. An APR Control enhanced system will still need a thermostat to cycle the compressor. If you have gone through all the checks and testing, and the suction pressure is still low with all the components operational, the issue is likely *the lack of heat load* on the evaporator. There could be a situation where there is just not enough heat content in the air to maintain the suction pressure at the desired set-point, **even with the APR Control operating properly and at its full capacity**. This would mean that the load on the evaporator is below the APR's modulation range. In situations like this or any question that may arise, **please call Rawal Devices for assistance as our team is available for live support!**

Note: Always be sure to contact Rawal Devices Technical Team regarding any pump-down/pump-out systems!