Residential Air Conditioners and Heat Pumps Using Puron Advance™ (R-454B) Refrigerant

Application Guideline and Service Manual

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UNIT IDENTIFICATION

Troubleshooting Charts for Air Conditioners and Heat Pumps are provided in the appendix at back of this manual. They enable the service technician to use a systematic approach to locating the cause of a problem and correcting system malfunctions.

This section explains how to obtain the model and serial number from unit rating plate. These numbers are needed to service and repair the Puron Advance™ air conditioner or heat pump. Model and serial numbers can be found on unit rating plate.

Air Conditioner and Heat Pump Model Number Nomenclature

1	2	3	4	5	6	7	8,9	10	11	12
OD Type	Tier & Refrigerant	SEER2	OD Design Type	Major Series	Voltage	Open	Nominal Cooling Capacity (increments of 1,000 BTUH)	Feature	Special Feature	Open
1 = AC **2** = HP	**3** = Legacy R-454B **4** = Preferred R-454B	**4** = 13.4 SEER2 **5** = 14.3 SEER2 **6** = 16.0 SEER2 **7**=17.0 SEER2 **8**=18.0 SEER2	**S** = Single Stage **T** = Two Stage	**A-Z** = Major Iteration	**N** = 208-230-1 or 208/230-1 **P** = 208-230-3 or 208/230-3 **E** = 460-3		**018** = 1-1/2 Tons **024**= 2 Tons **030** = 2-1/2 Tons **036** = 3 Tons **042** = 3-1/2 **048** = 4 **060** = 5	**0** = Standard **C** = Coastal	**0** = Standard 1 = Compressor Electrical Rating Change *2 = Coil Optimization	Not Defined

Builder Model Number Nomenclature

1,2	**3**	**4**	**5**	**6**	**7**	**8,9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
GA	**5**	**S**	**A**	**N**	**5**	**18**	**0**	**0**	**W**	**A**	**A**	**A**	**A**
Series	**SEER2**	**OD Design Type**	**Major Series**	**Voltage**	**Refrigerant**	**Nominal Capacity (Tons)**	**Feature**	**Special Feature**	**Region**	**Eng. Rev.**	**Coil tube Material**	**Parts ID**	**Open**
GA = AC **GH = HP**	**4** = 13.4 **5** = 14.3 **6** = 16.0 **7** = 17.0 **8** =18.0	**S** = Single-Stg **T** = Two-Stg	**A,B** = Puron Advance™	**N** = 208/230-1 **P** = 208/230-3 **E** = 460-3	**5** = R-454B	**18**= 1.5 Tons **24** = 2 Tons **30** = 2.5 Tons **36** = 3 Tons **42** = 3.5Tons **48** = 4 Tons **60** = 5 Tons	**0** = Std **C** = Coastal	**0** = Std **1** = Compressor Electrical Rating Change **2** = Coil Optimization	**A**= Standard HP **E**= Standard SEAC **N**= Std North AC **W**= Std SW AC	**A** - Z=Minor Series	**A**= Aluminum **B**= Copper	**A**= Scroll **B**= Rotary **C**= Other Scroll	**A** = CMX-A **B**=CVL **C**=CMX-C **G**=CMX-G

Serial Number Nomenclature

01 **06** **E** **00001**

- **01** — Week of manufacture
- **06** — Year of manufacture
- **E** — Manufacturing site:
  - E = Collierville, TN
  - X = Monterey Mexico
  - G = CMXG
- **00001** — Serial Number

SAFETY CONSIDERATIONS

Installation, service, and repair of these units should be attempted only by trained service technicians familiar with standard service instruction and training material, including flammable refrigerant training.

All equipment should be installed in accordance with accepted practices and unit Installation Instructions, and in compliance with all national and local codes. Power should be turned off when servicing or repairing electrical components. Extreme caution should be observed when troubleshooting electrical components with power on. Observe all warning notices posted on equipment and in instructions or manuals.

⚠ WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Puron Advance™ (R-454B) systems operate at different and sometimes higher pressures than other refrigerants. Ensure service equipment is rated for Puron Advance™ (R-454B) refrigerant.

Refrigeration systems contain refrigerant under pressure. Extreme caution should be observed when handling refrigerants. Wear safety glasses and gloves to prevent personal injury. During normal system operations, some components are hot and can cause burns. Rotating fan blades can cause personal injury. Appropriate safety considerations are posted throughout this manual where potentially dangerous techniques are addressed.

INTRODUCTION

This document provides required system information necessary to install, service, repair or maintain the family of air conditioners and heat pumps using Puron Advance™ (R-454B) refrigerant.

Refer to the unit Product Data for rating information, electrical data, required clearances, additional component part numbers and related pre-sale data. Installation Instructions are also available per specific models.

INSTALLATION GUIDELINE

Residential New Construction

Specifications for these units in the residential new construction market require the outdoor unit, indoor unit, refrigerant tubing sets, metering device, and filter drier listed in Product Data (PD). DO NOT DEVIATE FROM PD. Consult unit Installation Instructions for detailed information.

Add-On Replacement (Retrofit) - R22 or Puron® (R-410A) to Puron Advance™ (R-454B)

Specifications for these units in the add-on replacement/retrofit market require change-out of outdoor unit, indoor coil or fan coil, and furnace if using furnace coil. Puron Advance™R-454B systems have different expansion devices and require a factory authorized dissipation system that comes with approved fancoil or furnace/furnace coil combinations. There can be no deviation.

1. If system is being replaced due to compressor electrical failure, assume acid is in system. If system is being replaced for any other reason, use approved acid test kit to determine acid level. If even low levels of acid are detected install factory approved, 100 percent activated alumina suction-line filter drier in addition to the factory supplied liquid-line filter drier. Remove the suction line filter drier as soon as possible, with a maximum of 72 hr.
2. Drain oil from low points or traps in suction-line and evaporator if they were not replaced.
3. Change out indoor coil with one that is approved for Puron Advance™ refrigerant. If furnace coil is used be sure furnace used is approved combination in the AHRI directory and has factory approved dissipation board or verify existing coil is listed in the Product Data.
4. Replace outdoor unit with Puron Advance™ (R-454B) outdoor unit.
5. Install factory-supplied liquid-line filter drier.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Never install suction-line filter drier in the liquid-line of a Puron Advance™ (R-454B) system.

6. If suction-line filter drier was installed for system clean up, operate system for 10 hr. Monitor pressure drop across drier. If pressure drop exceeds 3 psig, replace suction-line and liquid-line filter driers. Be sure to purge system with dry nitrogen and evacuate when replacing filter driers. Continue to monitor pressure drop across suction-line filter drier. After 10 hr of runtime, remove suction-line filter drier and replace liquid-line filter drier. Never leave suction-line filter drier in system longer than 72 hr (actual time).
7. Charge system. (See unit information plate.)

If the unit is being installed as an add-on to a furnace, make sure that critical-to-safety wiring connection of the leak detection sensor or leak detection system is installed to the furnace assembly. The wiring for it should be no less than 18AWG with minimum insulation thickness of 1.58mm or protected from damage. The unit should not be installed on furnaces with an inductive electrical greater than Le ,

Le= 5 x (6,7/Su)4 when breaking all phases;

Le= 2,5 x (6,7/Su)4 when breaking two legs of a three phase load, or when breaking one or two legs of a single phase load.

where

Le is the switched inductive electrical load in kilovolt amperes (kVA),

Su is the burning velocity of a refrigerant in centimeters per second (cm/s).

In case of a refrigerant leak, the indoor fan should turn on at the highest speed possible or not less than the minimum ventilation airflow volume (Qmin) as specified by furnace manufacturer. Also for Add-on Heat pumps, the maximum operating temperature must be marked on the unit

Seacoast

Coastal units are available in selected models and sizes of Air Conditioners and Heat Pumps. These units have protection to help resist the corrosive coastal environment. Features include:

- Complete baked-on paint coverage (both sides of external sheet metal)
- Coastal Coated fan guards and, if applicable, inlet grilles.
- Outdoor coils built exclusively with Al tube

Coastal environments are considered to be within 2 miles of the ocean. Salt water can be carried as far away as 2 miles from the coast by means of sea spray, mist or fog. Line-of-sight distance from the ocean, prevailing wind direction, relative humidity, wet/dry time, and coil temperatures will determine the severity of corrosion potential in the coastal environment.

Accessories

Table 1 – Required Field-Installed Accessories for Air Conditioners

ACCESSORY	REQUIRED FOR LOW-AMBIENT COOLING APPLICATIONS (Below 55°F/12.8°C)	REQUIRED FOR LONG LINE APPLICATIONS*	REQUIRED FOR SEA COAST APPLICATIONS (Within 2 miles/3.22 km)
Compressor Start Assist Capacitor and Relay	Yes	Yes	No
Crankcase Heater	Yes †	Yes *	No
Evaporator Freeze Thermostat	Yes	No	No
Liquid Line Solenoid Valve	No	No	No
Motor Master Control or Low-ambient Pressure Switch	Yes‡	No	No
Support Feet	Recommended	No	Recommended
Winter Start Control	Yes	No	No

*. Refer to Residential Piping and Long Line Guideline
†. Standard on some units
‡. Units that utilize Electronically Commutated Motors (ECM) for the outdoor fan cannot use Motor Master Control and must use Low-Ambient Pressure Switch

Table 2 – Required Field-Installed Accessories for Heat Pumps

ACCESSORY	REQUIRED FOR LOW-AMBIENT COOLING APPLICATIONS (Below 55°F / 12.8°C)	REQUIRED FOR LONG LINE APPLICATIONS*	REQUIRED FOR SEA COAST APPLICATIONS (Within 2 miles / 3.22 km)
Compressor Start Assist Capacitor and Relay	Yes	Yes	No
Crankcase Heater	Yes †	Yes †	No
Evaporator Freeze Thermostat	Yes	No	No
Liquid Line Solenoid Valve	No	Yes	No
Motor Master Control or Low Ambient Switch	Yes‡	No	No
Support Feet	Recommended	No	Recommended

*. Refer to Residential Piping and Long Line Guideline
†. Standard on some units
‡. Units that utilize Electronically Commutated Motors (ECM) for the outdoor fan cannot use Motor Master Control and must use Low-Ambient Pressure Switch

ACCESSORY DESCRIPTIONS

Refer to Table 1 for an Accessory Usage Guide for Air Conditioners and Table 2 for Heat Pumps. Refer to the appropriate section below for a description of each accessory and its use.

Standard Accessory Descriptions

1. Compressor Start Assist - Capacitor and Relay

Start capacitor and relay gives a "hard" boost to compressor motor at each start up.

Usage Guideline:

Required for single-phase scroll compressors in the following applications:

Long line

Low ambient cooling

Suggested for all compressors in areas with a history of low voltage problems.

2. Crankcase Heater

An electric resistance heater which mounts to the base of the compressor to keep the lubricant warm during off cycles. Improves compressor lubrication on restart and minimizes the chance of liquid slugging.

Usage Guideline:

Required in low ambient cooling applications.

Required in long line applications.

Suggested in all commercial applications.

3. Evaporator Freeze Thermostat

An SPST temperature-actuated switch that stops unit operation when evaporator reaches freeze-up conditions.

Usage Guideline:

Required when low ambient kit has been added.

4. Liquid Line Solenoid Valve

A liquid line solenoid valve is a normally close two-way valve that is designed to block flow in one direction when power is removed. Solenoid valves separate low and high side pressures which assist in heating performance on heat pumps

Usage Guideline:

Required when factory provided.

Required for long line applications for heat pumps

5. Motor Master Control or Low-Ambient Pressure Switch

A fan-speed control device activated by a temperature sensor, designed to control condenser fan motor speed in response to the saturated condensing temperature during operation in cooling mode only. For outdoor temperatures down to -20°F (-28.9°C), it maintains condensing temperature at 100°F ± 10°F (37.8°C ± 12°C).

Usage Guideline:

A Low Ambient Controller must be used when cooling operation is used at outdoor temperatures below 55°F (12.8°C).

Suggested for all commercial applications.

6. Support Feet

Four or five stick-on plastic feet that raise the unit 4 in. (101.6 mm) above the mounting pad. This allows sand, dirt, and other debris to be flushed from the unit base, minimizing corrosion.

Usage Guideline:

Suggested in the following applications:

Coastal installations.

Windy areas or where debris is normally circulating.

Rooftop installations.

For improved sound ratings.

7. Winter Start Control

This control is designed to alleviate nuisance opening of the low-pressure switch by bypassing it for the first 3 minutes of operation. This control is for AC units operating in low ambient cooling but is not required for Heat Pumps. Heat pumps have a loss of charge switch rather than a low pressure switch and nuisance trips should not be an issue.

Common Accessory Descriptions Not Listed in Table

1. Compressor Sound Shield

A compressor sound shield is a sleeve place over the compressor that dampens the noise of the compressor when running.

Usage Guideline:

Factory installed for mid-tier units.

2. Cycle Protector Kit

The cycle protector is designed to prevent compressor short cycling. This control provides an approximate 5-minute delay after power to the compressor has been interrupted.

Usage Guideline:

Not for use with communicating capable units.

Not for use with communicating or non-communicating heat pumps utilizing R-454B refrigerant.

3. Low Pressure Switch Kit

The low pressure switch shuts off the unit when suction pressure falls below 50 psi.

Usage Guideline:

Not for use on heat pumps

4. High Pressure Switch Kit

The high pressure switch shuts off the unit when liquid pressure exceeds 610 psi.

Usage Guideline:

Required when heat pump is used with a gas furnace (dual fuel) application.

5. Isolator Relay

An SPDT relay which switches the low-ambient controller out of the outdoor fan motor circuit when the heat pump switches to heating mode.

Usage Guideline:

Required in all heat pumps where low ambient kit has been added

6. Time Delay Relay

An SPST delay relay which briefly continues operation of indoor blower motor to provide additional cooling after the compressor cycles off.

NOTE: Most indoor unit controls include this feature. For those that do not, use the guideline below.

Usage Guideline:

Accessory required to meet AHRI rating, where indoor not equipped.

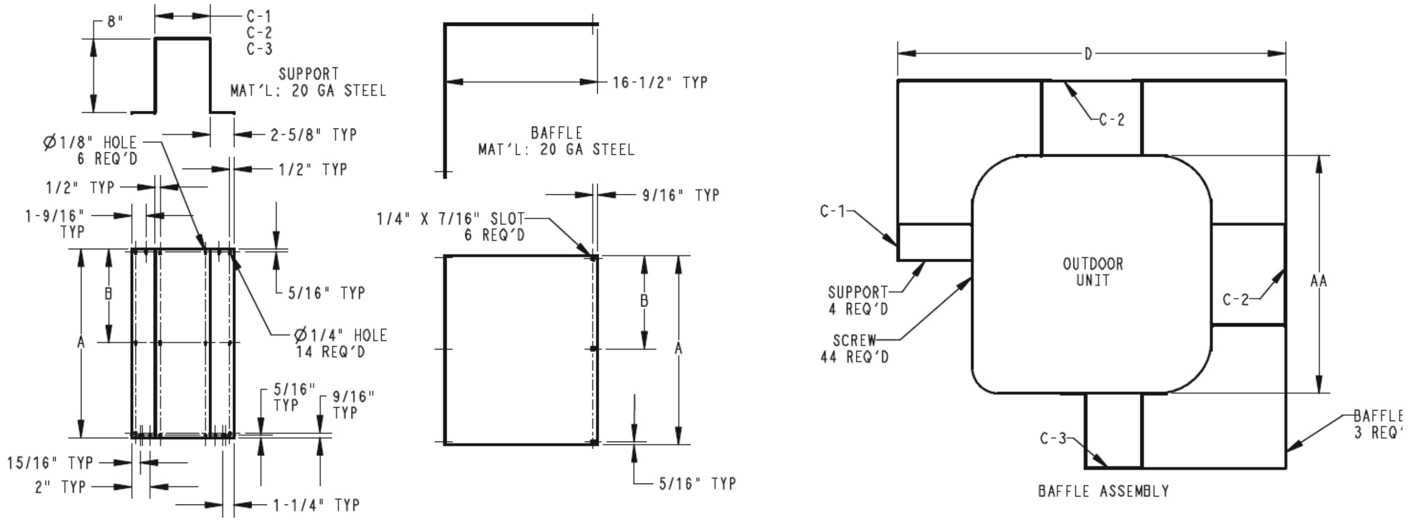
7. Wind Baffle

Use only in installations where high winds are prevalent to prevent cross currents from causing abnormal control operation. For construction, refer to Fig. 1 .

NOTE: When wind baffles are used, raising unit off of mounting pad with 4-in. support feet or unit risers is REQUIRED. This provides better airflow for moderate and high ambient temperatures.

LOW-AMBIENT COOLING GUIDELINE

The minimum operating temperature for these units in cooling mode is 55°F/12.7°C outdoor ambient without additional accessories. This equipment may be operated in cooling mode at ambient temperatures below 55°F/12.7°C when the accessories listed in Table 1 or Table 2 are installed. Wind baffles are required when operating in cooling mode at ambients below 55°F/12.7°C. Refer to Fig. 1 for wind baffle construction details for Base through deluxe models. See most current Product Data for updates.



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Builder, Legacy, and Preferred Units (in.)								
UNIT SIZE	**AA**	**UNIT HEIGHT**	**A**	**B**	**C-1**	**C-2**	**C-3**	**D**
Mini Base	23-1/8	25-5/16	20-3/8	10-1/16	1-5/16	8-1/4	3-1/2	39-1/4
		28-11/16	23-13/16	11-3/4				
		32-1/8	27-3/16	13-1/2				
		35-1/2	30-5/8	15-3/16				
		38-15/16	34	16-7/8				
		42-5/16	37-3/8	18-9/16				
		45-11/16	40-13/16	20-1/4				
Small	25-3/4	25	20-3/8	10-1/16	3-15/16	10-7/8	6-1/8	41-7/8
		28-7/16	23-13/16	11-3/4				
		31-13/16	27-3/16	13-1/2				
		35-1/4	30-5/8	15-3/16				
		38-5/8	34	16-7/8				
		42	37-3/8	18-9/16				
		45-7/16	40-13/16	20-1/4				
Medium	31-1/4	25-1/2	20-3/8	10-1/16	9-3/8	16-5/16	11-9/16	47-3/8
		28-15/16	23-13/16	11-3/4				
		32-5/16	27-3/16	13-1/2				
		35-3/4	30-5/8	15-3/16				
		39-1/8	34	16-7/8				
		42-1/2	37-3/8	18-9/16				
		45-15/16	40-13/16	20-1/4				
Large	35	25-1/2	20-3/8	10-1/16	13-3/16	20-1/8	15-3/8	51-1/8
		28-15/16	23-13/16	11-3/4				
		32-5/16	27-3/16	13-1/2				
		35-3/4	30-5/8	15-3/16				
		39-1/8	34	16-7/8				
		42-1/2	37-3/8	18-9/16				
		45-15/16	40-13/16	20-1/4				

Fig. 1 – Builder, Legacy, and Preferred Baffle Assembly

LONG LINE GUIDELINE

Refer to Residential Piping and Long Line Guideline for Single-Stage and Two-Stage AC/HP Models Using R-454B Refrigerant.

CABINET ASSEMBLY

Basic Cabinet Designs

Certain maintenance routines and repairs require removal of the cabinet panels. There are 3 basic cabinet designs for air conditioning and heat pumps.

Builder

Fig. 2 – Cabinet Designs

Access Compressor Or Other Internal Cabinet Components

NOTE: It is not necessary to remove the top cover to gain access. Removing the top cover may cause grill panels, corner posts, louvers or coils to be damaged. It is recommended to protect the top cover from damage of tools, belt buckles, etc. while servicing from the top.

1. Should the unit height allow components to be accessed from the top of the unit, follow procedures for removing fan motor assembly. Access components through the top cap.
2. Large components may not be removed easily without having access from the top and side. Side access may allow procedures such as brazing, cutting, and removal easier. Follow procedures below:
   a. Follow procedures to remove the fan motor assembly.
   b. Remove the screws from the top of the electrical control panel.
   c. Remove the base pan screws holding the control panel and lift off the unit.

Certain maintenance routines and repairs require removal of cabinet panels.

The appliance should be stored in a way that no mechanical damage occurs.

Remove Top Cover - Preferred

1. Turn off all power to outdoor and indoor units.
2. Remove control box cover.
3. Disconnect fan motor wires and cut wire ties. Remove wires from control box. Refer to unit wiring label.
4. Remove screws holding top cover to louver panels.
5. Lift top cover from unit.
6. Reverse sequence for reassembly.

PreferredRemove Fan Motor Assembly - Preferred

1. Perform items 1 through 6 from above.
2. Remove 4 screws holding wire basket to top cover.
3. Lift wire basket from unit
4. Remove nuts securing fan motor to wire basket.
5. Remove motor and fan blade assembly.
6. Pull wires through wire raceway to change motor.
7. Reverse sequence for reassembly.
8. Prior to applying power, check that fan rotates freely.

Control Box Cover—Legacy and Builder Products

This panel contains much of the same information as the information plate mentioned previously, but is designed only to cover the control box.

Remove Top Cover—Legacy and Builder Products

1. Turn off all power to outdoor an indoor units.
2. Remove screws holding top cover to coil grille and coil tube sheet.
3. Remove 2 screws holding control box cover.
4. Disconnect fan motor wires, cut any wire ties, and move wires out of control box and through tube clamp on back of control box.
5. Lift top cover from unit.
6. Reverse sequence for reassembly.

Remove Fan Motor Assembly—Legacy and Builder Products

1. Perform steps 1, 3, 4, and 5 above. (Note: item 2 is not required.)
2. Remove 4 screws holding wire basket to top cover.
3. Lift wire basket from unit.
4. Remove nuts holding fan motor to wire basket.
5. Remove motor and fan blade assembly.
6. Pull wires through wire raceway to change motor.
7. Reverse sequence for reassembly.
8. Prior to applying power, check that fan rotates freely.

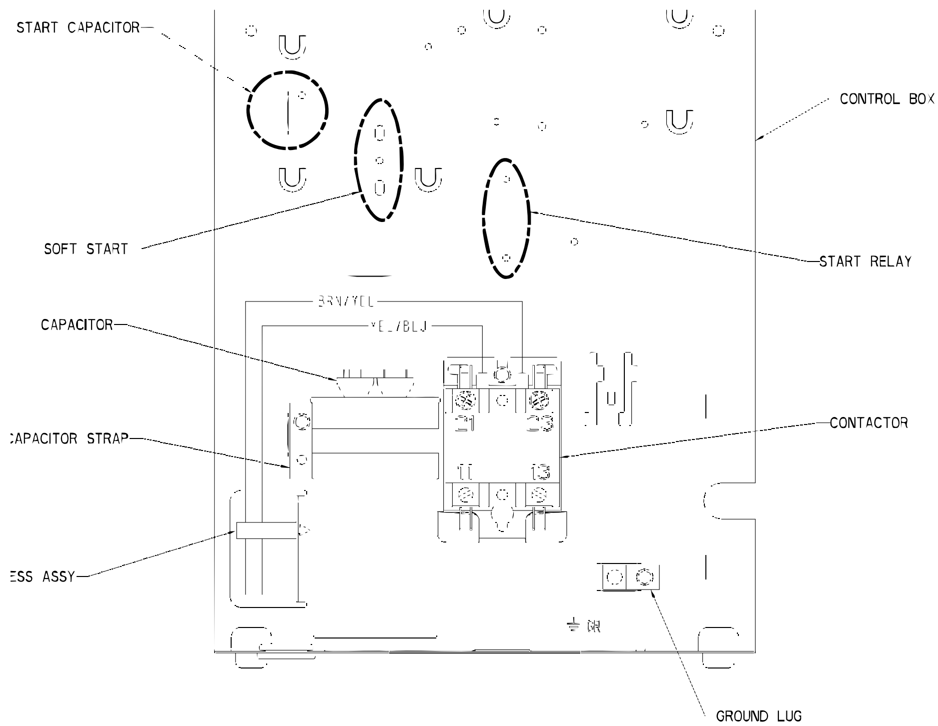
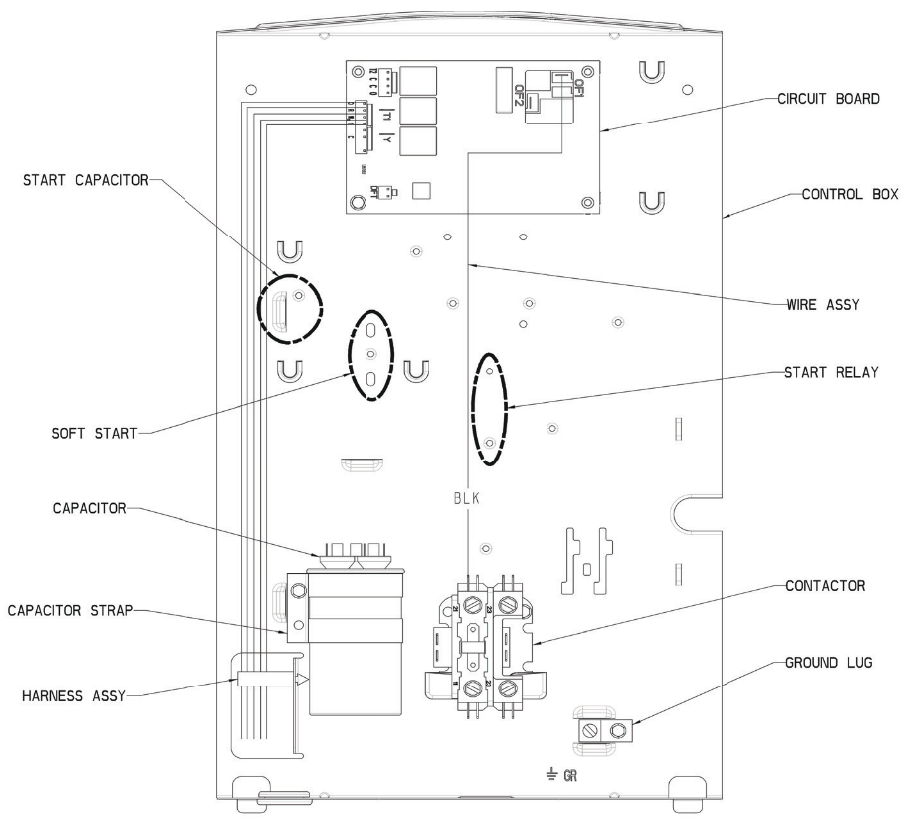


Fig. 3 – Legacy, Builder and Preferred Series AC Control Box



Base and Comfort HP Control Box

Fig. 4 – Legacy, Builder and Preferred Series HP Control Box

Labeling

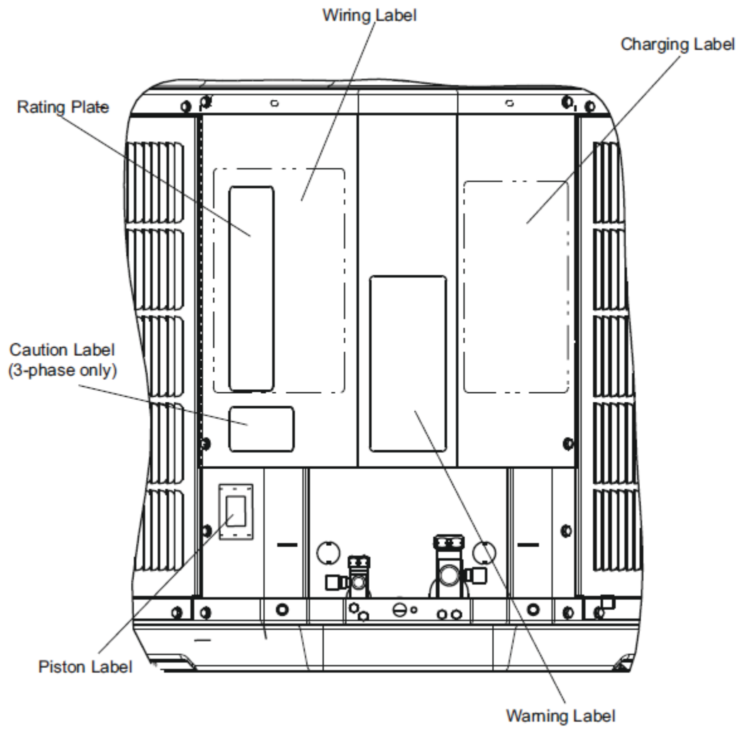


Fig. 5 – Label Locations (Preferred Series)

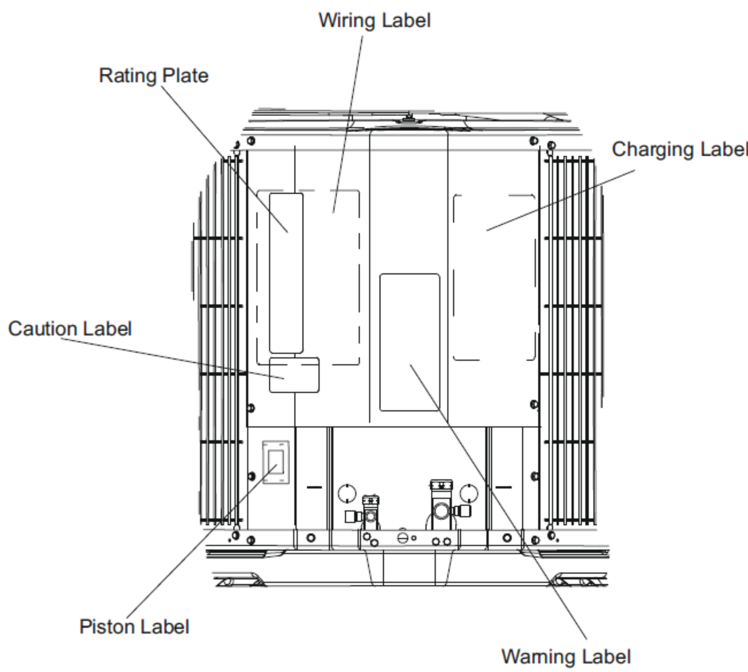


Fig. 6 – Label Locations (Legacy)

ELECTRICAL

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Exercise extreme caution when working on any electrical components. Shut off all power to system prior to troubleshooting. Some troubleshooting techniques require power to remain on. In these instances, exercise extreme caution to avoid danger of electrical shock. ONLY TRAINED SERVICE PERSONNEL SHOULD PERFORM ELECTRICAL TROUBLESHOOTING.

Aluminum Wire

⚠ CAUTION

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Aluminum wire may be used in the branch circuit (such as the circuit between the main and unit disconnect), but only copper wire may be used between the unit disconnect and the unit.

Before starting work on repair and maintenance of electrical components, some inspection procedures and safety checks must be performed such as making sure the capacitors are discharged, continuity of earth bonding is present, no live electrical components and wiring are exposed while charging, recovering or purging the system. If a safety compromising fault exists, then electrical supply should not be connected until it is corrected. A temporary solution can be used if the fault cannot be corrected immediately but the unit requires operation. The owner of the equipment must be informed about it. If the electrical components are to be replaced or changed, make sure the new parts are fit for the purpose and the specifications are correct.

Whenever aluminum wire is used in branch circuit wiring with this unit, adhere to the following recommendations.

Connections must be made in accordance with the National Electrical Code (NEC), using connectors approved for aluminum wire. The connectors must be UL approved (marked Al/Cu with the UL symbol) for the application and wire size. The wire size selected must have a current capacity not less than that of the copper wire specified, and must not create a voltage drop between service panel and unit in excess of 2% of unit rated voltage. To prepare wire before installing connector, all aluminum wire must be “brush-scratched” and coated with a corrosion inhibitor such as Pentrox A. When it is suspected that connection will be exposed to moisture, it is very important to cover entire connection completely to prevent an electrochemical action that will cause connection to fail very quickly. Do not reduce effective size of wire, such as cutting off strands so that wire will fit a connector. Proper size connectors should be used.

Ensure that cabling will not be susceptible to wear and tear from sharp edges, corrosion, excessive pressure, vibration or any serious environmental effects. The effects of aging or continual vibration from compressor and fans should also be taken into account.

Check all factory and field electrical connections for tightness. This should also be done after unit has reached operating temperatures, especially if aluminum conductors are used.

Contactor

The contactor provides a means of applying power to unit using low voltage (24v) from transformer in order to power contactor coil. Depending on unit model, you may encounter single- or double-pole contactors.

Before starting to troubleshoot and repair a sealed electrical component, make sure that the electrical supply is disconnected. In cases where electrical supply is required, place leak detection equipment at the most critical point as warning. While working, make sure that cables or seals are not damaged, excessive number of connections or terminals of incorrect specifications are not installed. This could alter the casing in such a way that safety and protection are affected. Make sure that the equipment is mounted firmly in place.

Exercise extreme caution when troubleshooting as 1 side of line may be electrically energized. The contactor coil is powered by 24vac. If contactor does not operate:

1. With power off, check whether contacts are free to move. Check for severe burning or arcing on contact points.
2. With power off, use ohmmeter to check for continuity of coil. Disconnect leads before checking. A low resistance reading is normal. Do not look for a specific value, as different part numbers will have different resistance values.
3. Reconnect leads and apply low-voltage power to contactor coil. This may be done by leaving high-voltage power to outdoor unit off and turning thermostat to cooling. Check voltage at coil with voltmeter. Reading should be between 20v and 30v. Contactor should pull in if voltage is correct and coil is good. If contactor does not pull in, replace contactor.
4. With high-voltage power off and contacts pulled in, check for continuity across contacts with ohmmeter. A very low or 0 resistance should be read. Higher readings could indicate burned or pitted contacts which may cause future failures.

Capacitor

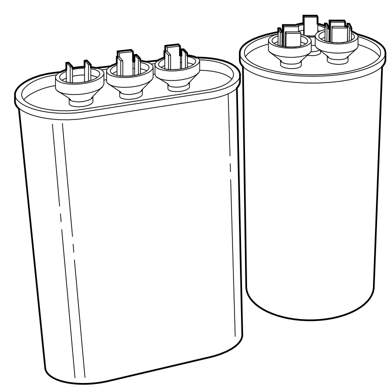


Fig. 7 – Capacitors

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Capacitors can store electrical energy when power is off. Electrical shock can result if you touch the capacitor terminals and discharge the stored energy. Exercise extreme caution when working near capacitors. With power off, discharge stored energy by shorting across the capacitor terminals with a 15,000-ohm, 2-watt resistor.

NOTE: if the bleed resistor is wired across start capacitor, it must be disconnected to avoid erroneous readings when ohmmeter is applied across capacitor.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Always check capacitors with power off. Attempting to troubleshoot a capacitor with power on can be dangerous. Defective capacitors may explode when power is applied. Insulating fluid inside is combustible and may ignite, causing burns.

Intrinsically safe electrical components can be worked on without worrying about flammable atmosphere. Permanent Inductive or capacitance loads should not be applied to the circuit without checking whether the voltage and current exceeds the permissible limit for the equipment in use. Incorrect replacement parts can lead to ignition due to refrigerant leak in the atmosphere.

Capacitors are used as a phase-shifting device to aid in starting certain single-phase motors. Check capacitors as follows:

NOTE: ECM motors do not use capacitors.

1. With power off, discharge capacitors as outlined above. Disconnect capacitor from circuit. Put ohmmeter on R X 10k scale. Using an analog ohmmeter, check each terminal to ground (use capacitor case). Discard any capacitor which measures 1/2 scale deflection or less. Place ohmmeter leads across capacitor and place on R X 10k scale. Meter should jump to a low resistance value and slowly climb to higher value. Failure of meter to do this indicates an open capacitor. If resistance stays at 0 or a low value, capacitor is internally shorted.
2. Capacitance testers are available which will read value of capacitor. If value is not within ±10 percent value stated on capacitor, it should be replaced. If capacitor is not open or shorted, the capacitance value is calculated by measuring voltage across capacitor and current it draws.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Exercise extreme caution when taking readings while power is on.

Use following formula to calculate capacitance:

Capacitance (mfd)= (2650 X amps)/volts

3. Remove any capacitor that shows signs of bulging, dents, or leaking. Do not apply power to a defective capacitor as it may explode.

Sometimes under adverse conditions, a standard run capacitor in a system is inadequate to start compressor. In these instances, a hard start accessory kit, specified in the Product Data, should be used.

Cycle Protector

Bryant thermostats have anti-cycle protection built in to protect the compressor. Should a non-Bryant stat be utilized, it is recommended to add a cycle protector to the system. Solid-state cycle protector protects unit compressor by preventing short cycling. After a system shutdown, cycle protector provides for a 5 ± 2-minute delay before compressor restarts. On normal start-up, a 5-minute delay occurs before thermostat closes. After thermostat closes, cycle protector device provides a 3-sec delay.

Cycle protector is simple to troubleshoot. Only a voltmeter capable of reading 24v is needed. Device is in control circuit, therefore, troubleshooting is safe with control power (24v) on and high-voltage power off.

With high-voltage power off, attach voltmeter leads across T1 and T3, and set thermostat so that Y terminal is energized. Make sure all protective devices in series with Y terminal are closed. Voltmeter should read 24v across T1 and T3. With 24v still applied, move voltmeter leads to T2 and T3. After 5 ± 2 minutes, voltmeter should read 24v, indicating control is functioning normally. If no time delay is encountered or device never times out, change control.

Crankcase Heater

Crankcase heater is a device for keeping compressor oil warm. By keeping oil warm, refrigerant does not migrate to and condense in compressor shell when the compressor is off. This prevents flooded starts which can damage compressor.

On units that have a single-pole contactor, the crankcase heater is wired in parallel with contactor contacts and in series with compressor. (See Fig. 8.) When contacts open, a circuit is completed from line side of contactor, through crankcase heater, through run windings of compressor, and to other side of line. When contacts are closed, there is no circuit through crankcase heater because both leads are connected to same side of line. This allows heater to operate when system is not calling for cooling. The heater does not operate when system is calling for cooling.

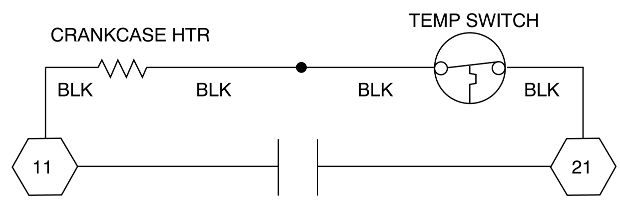


Fig. 8 – Wiring for Single-Pole Contactor

For 460V units, the CCH is controlled by a temperature switch and relay. The relay is controlled by the temperature switch that is wired in series with the low voltage indoor transformer connections, R & C, from the low voltage harness assembly. If the OD ambient is above 85°F (29.4°C), the CCH switch is open and the relay will be de-energized. In this state, the CCH will not be energized. If the OD ambient goes below 65°F (18.3°C) and doesn't rise above 85°F (29.4°C), the CCH switch is closed and the relay will be energized. In this state, the CCH will be energized when the compressor contactor is open. See Fig. 9.

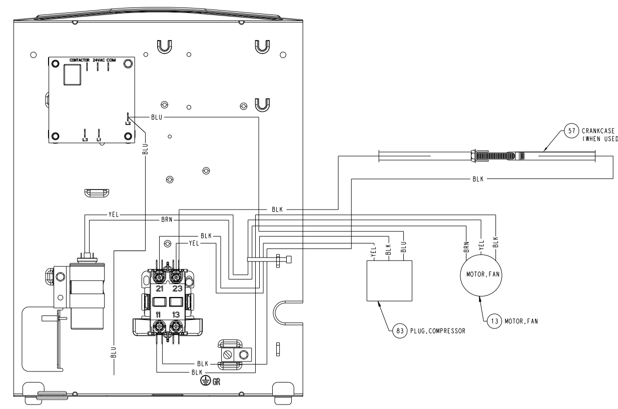


Fig. 9 – Wiring for 460 volt

The crankcase heater is powered by high-voltage power of unit. Use extreme caution troubleshooting this device with power on. The easiest method of troubleshooting is to apply voltmeter across crankcase heater leads to see if heater has power. Do not touch heater. Carefully feel area around crankcase heater. If warm, crankcase heater is probably functioning. Do not rely on this method as absolute evidence heater is functioning. If compressor has been running, the area will still be warm.

With power off and heater leads disconnected, check across leads with ohmmeter. Do not look for a specific resistance reading. Check for resistance or an open circuit. Change heater if an open circuit is detected.

Time-Delay Relay (TDR)

The TDR is a solid-state control, recycle delay timer which keeps indoor blower operating for 30, 60 or 90 seconds after thermostat is satisfied. This delay enables blower to remove residual cooling in coil after compression shutdown, thereby improving efficiency of system. The sequence of operation is that on closure of wall thermostat and at end of a fixed on delay of 1 sec, fan relay is energized. When thermostat is satisfied, an off delay is initiated. When fixed delay of 30, 60 or 90 ± 20 seconds is completed, fan relay is de-energized and fan motor stops. If wall thermostat closes during this delay, TDR is reset and fan relay remains energized. TDR is a 24v device that operates within a range of 15v to 30v and draws about 0.5 amps. If the blower runs continuously instead of cycling off when the fan switch is set to AUTO, the TDR is probably defective and must be replaced.

Pressure Switches

Pressure switches are protective devices wired into control circuit (low voltage). They shut off compressor if abnormally high or low pressures are present in the refrigeration circuit. Puron Advance™ (R-454B) pressure switches are specifically designed to operate with Puron Advance™ (R-454B) systems. R-22 pressure switches must not be used as replacements for the Puron Advance™ (R-454B) air conditioner or heat pump.

Low-Pressure Switch (AC Only)

The low-pressure switch, if installed, is located on the suction line and protects against low suction pressures caused by such events as loss of charge, low airflow across indoor coil, dirty filters, etc. It opens on a pressure drop at about 50 psig for Puron Advance™ (R-454B). If system pressure is above this, switch should be closed. To check switch:

1. Turn off all power to unit.
2. Disconnect leads on switch.
3. Apply ohmmeter leads across switch. You should have continuity on a good switch.

NOTE: Because these switches are attached to refrigeration system under pressure, it is not advisable to remove this device for troubleshooting unless you are reasonably certain that a problem exists. If switch must be removed, remove and recover all system charge so that pressure gauges read 0 psi. Never open system without breaking vacuum with dry nitrogen.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant.

To replace switch:

1. Apply heat with torch to solder joint and remove switch.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses when using torch. Have quenching cloth available. Oil vapor in line may ignite when switch is removed.

2. Braze in 1/4-in. flare fitting and screw on replacement pressure switch.

High-Pressure Switch (AC & HP)

The high-pressure switch, if installed, is located in the liquid line for ACs and in the muffler tube for HPs and protects against excessive condenser coil pressure. It opens around 610 or 670 (+/- 10) psig for Puron Advance™ (R-454B). Switches close at 420 or 470 (+/- 25) psig for Puron Advance™ (R-454B). High pressure may be caused by a dirty condenser coil, failed fan motor, or condenser air re-circulation.

To check switch:

1. Turn off all power to unit.
2. Disconnect leads on switch.
3. Apply ohmmeter leads across switch. You should have continuity on a good switch.

NOTE: Because these switches are attached to refrigeration system under pressure, it is not advisable to remove this device for troubleshooting unless you are reasonably certain that a problem exists. If switch must be removed, remove and recover all system charge so that pressure gauges read 0 psi. Never open system without breaking vacuum with dry nitrogen.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant.

To replace switch:

1. Apply heat with torch to solder joint and remove switch.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses when using torch. Have quenching cloth available. Oil vapor in line may ignite when switch is removed.

2. Braze in 1/4-in. flare fitting and replace pressure switch.

Loss of Charge Switch (HP Only)

Located on liquid line of heat pump only, the liquid line pressure switch functions similar to conventional low-pressure switch.

Because heat pumps experience very low suction pressures during normal system operation, a conventional low-pressure switch cannot be installed on suction line. This switch is installed in liquid line instead and acts as loss-of-charge protector. The liquid-line is the low side of the system in heating mode. It operates identically to low-pressure switch except it opens at 23 (+/- 5) psig and closes at 55 (+/- 5) psig for Puron Advance™ (R-454B). Observe same safety precautions.

Defrost Thermostat

Defrost thermostat signals heat pump that conditions are right for defrost or that conditions have changed to terminate defrost. It is a thermally actuated switch clamped to outdoor coil to sense its temperature. Normal temperature range is closed at 32° ± 3°F and open at 65° ± 5°F. Defrost thermostats are used in Builder, Legacy and Preferred models, a coil temperature thermistor is used in Preferred and Evolution series units. See Fig. 10.

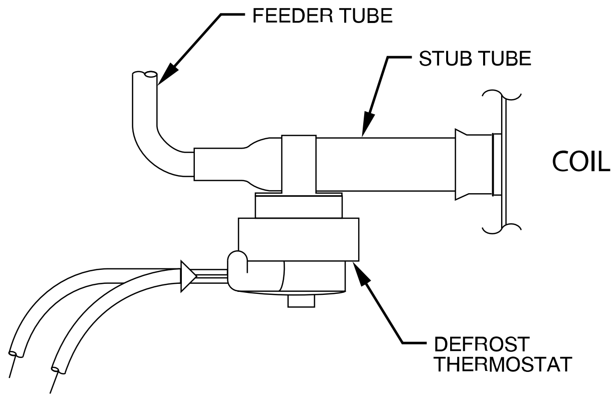


Fig. 10 – Defrost Thermostat Location

Check Defrost Thermostat

There is a liquid header with a distributor and feeder tube going into outdoor coil. At the end of 1 of the feeder tubes, there is a 3/8-in. OD stub tube approximately 2 in. (50.8 mm) long. (See Fig. 10.) The defrost thermostat should be located on stub tube. Note that there is only 1 stub tube used with a liquid header, and on most units it is the bottom circuit.

NOTE: The defrost thermostat must be located on the liquid side of the outdoor coil on the bottom circuit and as close to the coil as possible. For a copper stub tube, the DFT will have a copper cup. For an aluminum stub tube, the DFT will have an aluminum cup. Don't interchange material types.

Defrost Control Boards

Troubleshooting defrost control involves a series of simple steps that indicate whether or not board is defective.

NOTE: This procedure allows the service technician to check control board and defrost thermostat for defects. First, troubleshoot to make sure unit operates properly in heating and cooling modes. This ensures operational problems are not attributed to the defrost control board.

⚠ WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

To accelerate the defrosting process or to clean, only use means that are recommended by the manufacturer.

The appliance should not be stored in a room with continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater).

Do not pierce or burn.

Be aware that refrigerants may not contain an odor.

HK32EA012 DEFROST CONTROL

The HK32EA012 defrost control is used in most Preferred Series heat pumps with Puron Advance™ (R-454B) refrigerant. Its features include selectable defrost intervals of 30, 60, 90, & 120 minutes, Quiet Shift, compressor time delay, defrost speed up capability. This section describes the sequence of operation and trouble shooting methods for this control.

Five-Minute Compressor Delay (HK32EA012)

This control features a 5-minute time delay to protect the compressor from short cycling. The delay begins counting when the low voltage is interrupted, and at the end of heating or cooling cycle.

System function and Sequence of operation (HK32EA012)

On power-up (24 volts between R-C) the 5 minute cycle timer begins counting down. The compressor will not be energized until this timer is elapsed.

Cooling

On a call for cooling, thermostat makes R-O, R-Y, and R-G. Circuit R-O energizes reversing valve switching it to cooling position. Circuit R-Y sends low voltage through the safeties and energizes the T1 terminal on the circuit board. If the compressor has been off for 5 minutes, or power has not been cycled for 5 minutes, the OF2 relay and T2 terminal will energize. This will close the contactor, start the outdoor fan motor and compressor.

When the cycle is complete, R-Y is turned off and compressor and outdoor fan should stop. When using Bryant thermostats, the reversing valve remains energized in the cooling mode until the thermostat is switched to heat, or the mode it turned off. The 5-minute time guard begins counting. Compressor will not come on again until this time delay expires. In the event of a power interruption, the time guard will not allow another cycle for 5 minutes.

Heating

On a call for heating, thermostat makes R-Y, and R-G. Circuit R-Y sends low voltage through the safeties and energizes the T1 terminal on the circuit board. T1 energizes the defrost logic circuit. If the compressor has been off for 5 minutes, or power has not been cycled for 5 minutes, the OF2 relay and T2 terminal will energize. This will close the contactor, start the outdoor fan motor and compressor.

When the cycle is complete, R-Y is turned off and the compressor and outdoor fan should stop. The 5 minute time guard begins counting. Compressor will not come on again until this time delay expires. In the event of a power interruption, the time guard will not allow another cycle for 5 minutes.

Defrost Sequence

The defrost control is a Demand Defrost Control that has field selectable settings of 30, 60, 90 and 120 minutes. These represent the amount of time that must pass after closure of the defrost thermostat before the defrost sequence begins.

Demand defrost control will use the previous defrost time and adjust the next defrost interval. After the initial period the defrost interval will adjust. When a defrost cycle completes quickly (1-3 minutes), the next defrost interval will be increased. When a defrost cycle takes a long time to complete (7-10 minutes), the next time defrost interval will be decreased. Dip switch settings for defrost interval apply only to the initial defrost interval.

Turning ON quiet shift (dip switch 3) will turn OFF demand defrost and the system will revert to a time/temperature control that has field selectable settings of 30, 60, 90, and 120 minutes.

Forcing a defrost will reset the defrost interval to the DIP switch setting before resuming variable length intervals based on defrost cycle length.

The defrost thermostat senses coil temperature throughout the heating cycle. When the coil temperature reaches the defrost thermostat setting of approximately 32 degrees F, it will close, which energizes the DFT terminal and begins the defrost timing sequence. When the DTF has been energized for the selected time, the defrost cycle begins. If the defrost thermostat opens before the timer expires, the timing sequence is reset.

Defrost cycle is terminated when defrost thermostat opens (~65 degrees) or automatically after 10 minutes.

Defrost Speedup

To initiate a force defrost, speedup pins (J1) must be shorted with a flat head screwdriver for 5 seconds and RELEASED. If the defrost thermostat is open, a short defrost cycle will be observed (actual length depends on Quiet Shift switch position). When Quiet Shift is off, only a short 30 second defrost cycle is observed. With Quiet Shift ON, the speed up sequence is one minute; 30 second compressor off period followed by 30 seconds of defrost with compressor operation. When returning to heating mode, the compressor will turn off for an additional 30 seconds and the fan for 40 seconds.

If the defrost thermostat is closed, a complete defrost cycle is initiated. If the Quiet Shift switch is turned on, the compressor will be turned off for two 30 second intervals as explained previously.

Troubleshooting (HK32EA012/HK32EA014)

If outdoor unit will not run:

1. Does the Y input have 24 volts from thermostat? If not, check thermostat or wire. If yes proceed to #2
2. The Y spade terminal should have 24 volts if Y input is energized. This output goes through the pressure switches and back to the T1 input to energize the time delay and defrost timing circuit. If the contactor is not closed, the time delay may still be active. Defeat time delay by shorting speed up pins for 1 second. Be sure not to short more than 1 second.
3. Once time delay has elapsed voltage on T2 should energize contactor with 24v. Check voltage on contactor coil. If no voltage is present, check for opened pressure switch.
4. If voltage is present and contactor is open, contactor may be defective. Replace contactor
5. If contactor is closed and unit will still not run, check capacitor and compressor.

If unit will not defrost:

1. Perform the speedup function as described above to test the defrost function of the circuit board.
2. If the unit will go into defrost with the speed up, but will not on its own, the defrost thermostat may not be functioning properly. Perform the below full defrost thermostat and board troubleshooting.
3. Turn thermostat to OFF. Shut off all power to outdoor unit.
4. Remove control box cover for access to electrical components and defrost control board.
5. Disconnect defrost thermostat leads from control board, and connect to ohmmeter. Thermostat leads are black, insulated wires connected to DFT and R terminals on control board. Resistance reading may be zero (indicating closed defrost thermostat), depending on outdoor temperature.
6. Jumper between DFT and R terminals on control board as shown in Fig. 12 .
7. Disconnect outdoor fan motor lead from OF2. Tape lead to prevent grounding.
8. Turn on power to outdoor unit.
9. Restart unit in heating mode, allowing frost to accumulate on outdoor coil.
10. After a few minutes in heating mode, liquid line temperature at defrost thermostat should drop below closing set point of defrost thermostat of approximately 32°F. Check resistance across defrost thermostat leads using ohmmeter. Resistance of zero indicates defrost thermostat is closed and operating properly.
11. Short between the speed-up terminals using a thermostat screwdriver. This reduces the timing sequence to 1/256 of original time.
12. Unit is now operating in defrost mode. Check between C and W2 using voltmeter. Reading on voltmeter should indicate 24v. This step ensures defrost relay contacts have closed, energizing supplemental heat (W2) and reversing valve solenoid (O).
13. Unit should remain in defrost no longer than 10 minutes. Actual time in defrost depends on how quickly speed-up jumper is removed. If it takes 2 sec to remove speed-up jumper after unit has switched to defrost, the unit will switch back to heat mode.
14. After a few minutes, in defrost (cooling) operation, liquid line should be warm enough to have caused defrost thermostat contacts to open. Check resistance across defrost thermostat. Ohmmeter should read infinite resistance, indicating defrost thermostat has opened at approximately 65°F.
15. Shut off unit power and reconnect fan lead.
16. If unit will still not run defrost, remove thermostat pigtail harness for the board and perform checks directly on input pins with jumper wires. The pigtail may have a bad connection or be mis-wired.

Quiet Shift-2 (non-communicating)

Quiet shift-2 is a field selectable defrost mode (factory set to OFF), which will reduce the occasional noise that could be heard at the start of defrost cycle and restarting of heating cycle. It is selected by placing DIP switch 3 on defrost board in the ON position.

When Quiet Shift-2 switch is placed in ON position, and defrost is initiated, the following sequence of operation will occur: The compressor will be de-energized for approximately 1 minute, then the reversing valve will be energized. A few seconds later, the compressor will be re-energized and the normal defrost cycle starts. Once defrost termination conditions have been met, the following sequence will occur: The compressor will be de-energized for approximately 1 minute, then the reversing valve will be de-energized. A few seconds later, the compressor will be re-energized and the normal heating cycle starts.

HK32EA014 DEFROST CONTROL

The HK32EA014 is used in place of the HK32EA012 boards when an outdoor ECM motor is being used. The functionality of these controls are identical except the HK32EA014 uses 24v to turn the outdoor motor on/off at the ODF terminal. The 24v signal is internal to the board and usually originates from the indoor transformer. The other side (common) of the ECM motor is connected directly to the 24v common side of the contactor.

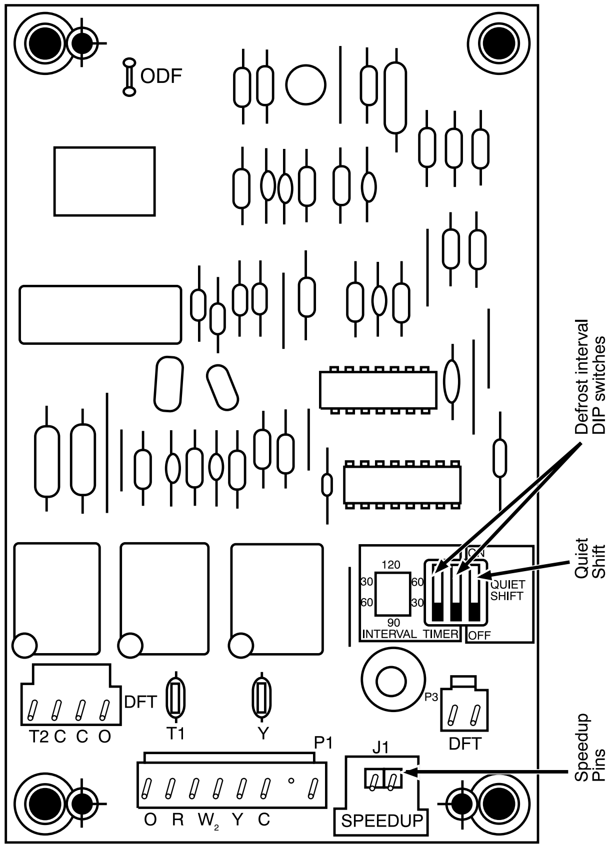


Fig. 11 – Defrost Control HK32EA014

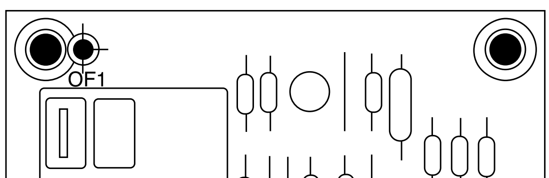


Fig. 12 – Defrost Control HK32EA012

InteliSense™ Technology

Preferred units are InteliSense™ capable when used with a capable smart thermostat with InteliSense™ technology.

InteliSense™ technology allows for the collection of performance data to be sent to the cloud. Utilizing Bryant's digital tools, dealers can gather system settings and equipment data, with homeowner opt-in, to provide quicker and more efficient service. The unit comes with the following sensors installed on the control board (see Fig. 13):

- Liquid Service Valve Pressure (LSVP)
- Liquid Service Valve Temperature (LSVT)
- Outside Air Temperature (OAT)
- Vapor Service Valve Pressure (VSVP)
- Vapor Service Valve Temperature (VSVT)

The amber LED is illuminated solid when there is power to the product. The green LED is illuminated solid when there is communication between the control board and the InteliSense™-enabled thermostat.

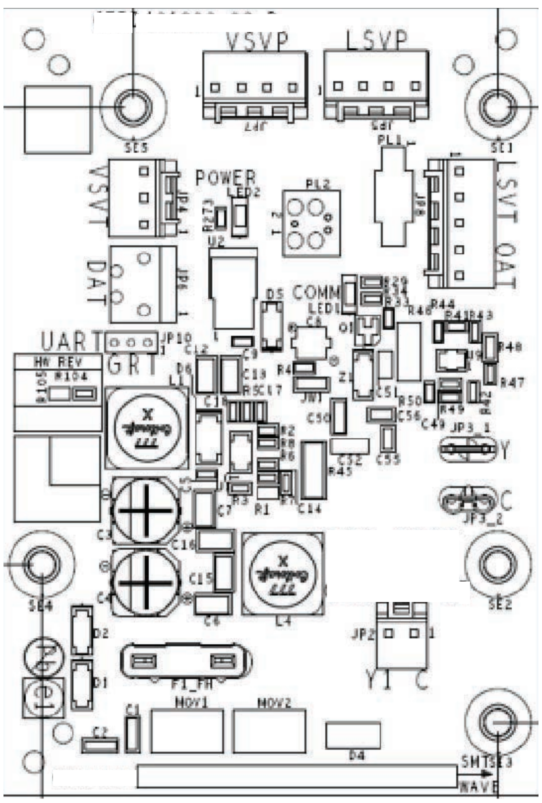


Fig. 13 – InteliSense™ Control Board HK32EA013

For more information, refer to the thermostat advanced installation and configuration instructions found at:
Bryant.HVACPartners.com/InteliSense™

Or, by scanning this QR Code:

NOTE: A new thermostat will show up in connected portal 24 hours after field installation so field gauges are needed for install.

NOTE: The outdoor temperature sensor does not show up on this new thermostat display so it should not be used for troubleshooting or charging.

NOTE: HP units with InteliSense™ technology do not come with factory installed high pressure switch. Only loss of charge pressure switch is factory installed.

HK32EA013 SENSOR COMMUNICATION MODULE

The HK32EA013 InteliSense™ AC/HP Sensor Communication Module provides AC and HP sensor data and fault code information to the InteliSense enabled thermostat. The InteliSense™ data bus uses the Y1 and C conductors typically found in a thermostat wiring bundle. The sensor data provided will come from the two pressure transducers and three temperature thermistors routed directly to the control board. This section describes the sensors and troubleshooting methods for this control.

InteliSense™ Sensors (HK32EA013)

Liquid Service Valve Pressure (LSVP)

LSVP is the refrigerant pressure at the liquid service valve. LSVP is placed after the liquid service valve and before the distributor, so it is necessary to note that this transducer is measuring pressure in the two-phase region after piston expansion in heating mode. LSVP in conjunction with the LSVT thermistor reading can be used to calculate the level that the refrigerant is being subcooled by the condenser. This calculation, when measured at normal cooling conditions, serves as a method to evaluate the amount of charge in the refrigeration system.

Liquid Service Valve Temperature (LSVT)

LSVT is a relatively slowly changing parameter indicating the temperature of the refrigerant line at the liquid service valve. LSVT is placed after the service valve and before the distributor, so it is necessary to note that this thermistor is measuring temperature in the two-phase region after piston expansion in heating mode.

Vapor Service Valve Pressure (VSVP)

VSVP is the refrigerant pressure at the vapor service valve. On heat pumps in heating mode, this sensor is measuring the pressure of the refrigerant after compression. In cooling mode and on air conditioners, this sensor measures the pressure of the refrigerant entering the compressor. VSVP and VSVT can be used in conjunction to ensure superheated vapor is entering the compressor in cooling mode. This sensor is placed in a location such that it would reflect the pressure a gauge set would measure when placed on the vapor service valve.

Vapor Service Valve Temperature (VSVT)

VSVT is a relatively quickly changing parameter that indicates the temperature of the refrigerant line at the vapor service valve. On heat pumps in heating mode, this sensor measures the temperature of the refrigerant after compression. In cooling mode and on air conditioners, this sensor measures the temperature of the refrigerant entering the compressor.

Outdoor Air Temperature (OAT)

Outside Air Temperature is a slowly changing parameter indicating the ambient air temperature in the environment around the equipment. This is a measurement of the air entering the coil.

Troubleshooting (HK32EA013)

If the thermostat or cloud is not receiving Intelisense data from the outdoor unit:

1. Check if the 1A fuse blown on the board.
2. Check if Y1 approximately 24VAC when energized.
3. Verify all connections are secure.
4. If only one sensor isn't reporting correctly, replace sensor.

Outdoor Fan Motors

Ball bearing fan motors are standard factory installed for all outdoor units. Ball bearing fan motors utilize ball bearings which permit speed reduction while maintaining bearing lubrication.

ECM Fan Motor

Some outdoor units will be equipped with ECM fan motors. For suspected ECM motor electrical failures, first check for loose or faulty electrical connections. ECM motors are not wired to the capacitor. A reference for the wires is listed in the Table 3:

Table 3 – ECM Fan Motor Wires

TERMINAL	DESCRIPTION	COLOR
1/4” Non insulated Q.C.	Speed, Common (low Voltage)	BRN/YEL
1/4” Insulated Q.C.	AC line (high voltage)	YEL
1/4” Non insulated Q.C.	Speed (low voltage)	BLU/YEL
#8 Non insulated ring	Ground	GRN/YEL
1/4” Insulated Q.C.	AC line (high voltage)	BLK

The low voltage wires should see 24VAC when the contactor is engaged. The high voltage wires should see 230VAC as long as 230VAC is being supplied to the field side of the contactor. The ECM motor will not operate unless both 24VAC and 230VAC are being supplied. Refer to the wiring diagram to determine where each wire should be connected to the contactor. If connections are secure, the motor is wired properly, proper voltages are present, and the ECM motor is still not operational, replace the ECM motor.

If utilizing Motor Master,, the ECM motor will not function properly. The ECM motor will need to be replaced with a PSC fan motor and fan blade specified in the accessory lists for the unit and wired per the wiring diagram.

PSC Fan Motor

The fan motor rotates the fan blade that draws air through the outdoor coil to exchange heat between the refrigerant and the air. Motors are totally enclosed to increase reliability. This eliminates the need for a rain shield. For the correct position of fan blade assembly, the fan hub should be flush with the motor shaft. Replacement motors and blades may vary slightly.

! WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Turn off all power before servicing or replacing fan motor. Be sure unit main power switch is turned off.

The bearings are permanently lubricated, therefore, no oil ports are provided.

For suspected electrical failures, check for loose or faulty electrical connections, or defective fan motor capacitor. Fan motor is equipped with thermal overload device in motor windings which may open under adverse operating conditions. Allow time for motor to cool so device can reset. Further checking of motor can be done with an ohmmeter. Set scale on R X 1 position, and check for continuity between 3 leads. Replace motors that show an open circuit in any of the windings. Place 1 lead of ohmmeter on each motor lead. At same time, place other ohmmeter lead on motor case (ground). Replace any motor that shows resistance to ground, arcing, burning, or overheating.

Compressor Plug

The compressor electrical plug provides a quick-tight connection to compressor terminals. The plug completely covers the compressor terminals and the mating female terminals are completely encapsulated in plug. Therefore, terminals are isolated from any moisture so corrosion and resultant pitted or discolored terminals are reduced. The plug is oriented to relief slot in terminal box so cover cannot be secured if wires are not positioned in slot, assuring correct electrical connection at the compressor. The plug can be removed by simultaneously pulling while “rocking“ plug. However, these plugs can be used only on specific compressors. The configuration around the fusite terminals is outlined on the terminal covers. The slot through which wires of plug are routed is oriented on the bottom and slightly to the left. The correct plug can be connected easily to compressor terminals and plug wires can easily be routed through slot terminal cover.

It is strongly recommended to replace the compressor plug should a compressor fail due to a suspected electrical failure. At a minimum, inspect plug for proper connection and good condition on any compressor replacement.

Low-Voltage Terminals

The low-voltage terminal designations, and their description and function, are used on all split-system condensers.

W—Energizes first-stage supplemental heat through defrost relay (wht).

R—Energizes 24-v power from transformer (red).

Y—Energizes contactor for first-stage cooling or first-stage heating for heat pumps (yel).

O—Energizes reversing valve on heat pumps (orn).

C—Common side of transformer (blk).

COPELAND SCROLL COMPRESSOR

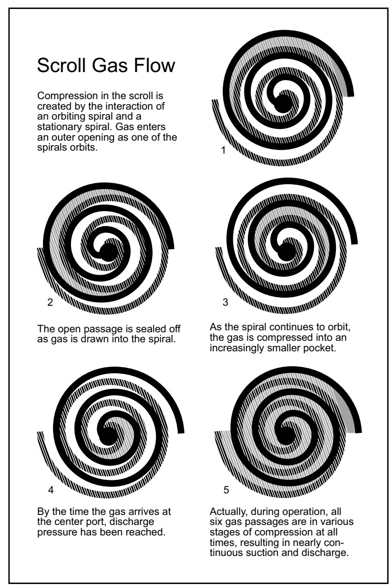


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Fig. 14 – Scroll Compressor Refrigerant Flow

The compressors used in these products are specifically designed to operate with designated refrigerant and cannot be interchanged. The compressor is an electrical (as well as mechanical) device. Exercise extreme caution when working near compressors. Power should be shut off, if possible, for most troubleshooting techniques. Refrigerants present additional safety hazards.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant.

The scroll compressor pumps refrigerant through the system by the interaction of a stationary and an orbiting scroll. (See Fig. 14.) The scroll compressor has no dynamic suction or discharge valves, and it is more tolerant of stresses caused by debris, liquid slugging, and flooded starts. The compressor is equipped with an internal pressure relief port. The pressure relief port is a safety device, designed to protect against extreme high pressure. The relief port has an operating range between 550 to 625 psi differential pressure for Puron Advance™ (R-454B). Scrolls have a variety of shut down solutions, depending on model, to prevent backward rotation and eliminate the need for cycle protection.

LG SCROLL COMPRESSOR

The compressors used in these products are specifically designed to operate with designated refrigerants and cannot be interchanged.

LG produced scroll compressors are designed to operate and function as the typical orbiting scroll on a fixed scroll design. Refrigerant flow and compression is basically the same.

Characteristics of the LG Scroll Compressor:

Internal Motor Overload Protection (OLP): This is an inherent protection system sensing both motor winding temperature and motor current. This is designed to open the common wire on single phase units and stop the motor operation if motor high temperature or over current conditions exist. Trip of the OLP opens the common line.

Vacuum protection device: If the suction side of the compressor is blocked or limited, an extremely low vacuum situation is formed by the optimum efficiency of the scrolls. The high vacuum pressure causes the arc at the internal power terminal and cause tripping of the internal overload or breaker or damage to the compressor. This compressor is equipped with internal protection that opens if this high vacuum condition exists and bypasses high pressure gas to the low pressure and the internal overload may trip. In the case of refrigerant pump down, the unit can operate with pump down but this protection may not allow the refrigerant to be pumped down completely.

Internal Pressure Relief (IPR): The internal pressure relief is located between the high and low pressure of the compressor and is designed to open when the difference of the suction and discharge pressure is (55-550 psid (35.1-38.7 kg/cm2). When the IPR valve opens, the high temperature gas bypasses into the motor area and will trip the motor OLP.

Quiet Shut Down Device: The LG scroll has a shut down device to efficiently minimize the shut down sound. The reversing sound is minimized by a check valve located in the discharge port of the scroll sets. This slows the equalization of the high side to low side upon shut down to prevent the scrolls from operating backwards.

COMPRESSOR TROUBLESHOOTING

Compressor Failures

Compressor failures are classified in 2 broad failure categories; mechanical and electrical. Both types are discussed below.

Mechanical Failures

A compressor is a mechanical pump driven by an electric motor contained in a welded or hermetic shell. In a mechanical failure, motor or electrical circuit appears normal, but compressor does not function normally.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Do not supply power to unit with compressor terminal box cover removed.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Exercise extreme caution when reading compressor currents when high-voltage power is on. Correct any of the problems described below before installing and running a replacement compressor.

Locked Rotor

In this type of failure, the compressor motor and all starting components are normal. When the compressor attempts to start, it draws locked rotor current and cycles off on internal protection. Locked rotor current is measured by applying a clamp-on ammeter around the common (blk) lead of the compressor. Current drawn when it attempts to start is then measured. Locked rotor amp (LRA) value is stamped on the compressor nameplate.

If the compressor draws locked rotor amps and all other external sources of problems have been eliminated, the compressor must be replaced. Because the compressor is a sealed unit, it is impossible to determine the exact mechanical failure. However, the complete system should be checked for abnormalities such as incorrect refrigerant charge, restrictions, insufficient airflow across indoor or outdoor coil, etc., which could be contributing to the failure.

Runs, Does Not Pump

In this type of failure, the compressor motor runs and turns the compressor, but the compressor does not pump refrigerant. A clamp-on ampmeter on the common leg shows a very low current draw, much lower than the rated load amp (RLA) value stamped on the compressor nameplate. Because no refrigerant is being pumped, there is no return gas to cool the compressor motor. It eventually overheats and shuts off on its internal protection.

Noisy Compressor

Noise may be caused by a variety of internal and external factors. Careful attention to the “type” of noise may help identify the source. The following are some examples of abnormal conditions that may create objectionable noise:

1. A gurgling sound may indicate a liquid refrigerant floodback during operation. This could be confirmed if there is no compressor superheat. A compressor superheat of “0” degrees would indicate liquid refrigerant returning to the compressor. Most common reasons for floodback are: loss of evaporator blower, dirty coils, and improper airflow.
2. A rattling noise may indicate loose hardware. Inspect all unit hardware including the compressor grommets.
3. A straining (hard start) or vibration occurring at start up but clears quickly after could indicate an off cycle refrigerant migration issue. Refrigerant migration can occur when a compressor is off and refrigerant vapor transfers from other areas of the system, settles into the compressor as it is attracted to the oil, and then condenses into the oil. Upon start up, the compressor draws suction from within itself first and lowers the boiling point of the refrigerant that is entrained in the oil. This can cause the liquid refrigerant and oil to boil into the compression area or liquid refrigerant to wipe off oil films that are critical for proper lubrication. Migration is worsened by greater temperature differentials and/or extra refrigerant in the system. Prevention of migration can be reduced by various options but some of the more common remedies is to verify proper charge and add a crankcase heater where this situation is suspected.
4. Operational vibration could indicate a charge issue. Verify charge and ensure proper piping and structural penetration insulation. Tubing that is too rigid to building rafters without proper insulation could transfer noise throughout the structure. On some occasions a sound dampener or mass weight (RC part no. 328209-751) placed on the vibrating tubing has been known to reduce this noise. Utilizing compressor split post grommets (see Fig. 15) may also reduce this vibration if piping cannot be remedied.
5. An operational high pitch frequency or “waa waa” sound that appears to resonate through the suction line could indicate a need to add more flex or muffling in the lines. This has been occasional in scroll compressor applications and is usually remedied by adding a field-fabricated suction line loop (see Fig. 16). Reciprocating compressors may have a noticeable discharge pulsation that could be remedied with a field installed discharge muffler. Recommend loop by continuous tubing with no more than 12 inches vertical and 6 inch horizontal loop.
6. An internal “thunking”, “thumping”, “grinding” or “rattling” noise could indicate compressor internal failures and may be verified by comparing the compressor amperage to what the compressor should be drawing according to a manufacturer’s performance data.
7. A whistling or squealing noise during operation may indicate a partial blockage of the refrigerant charge.
8. A whistle on shut down could indicate a partial leak path as refrigerant is equalizing from high to low side. On occasion, an in-line discharge check valve has prevented this sound.
9. If a compressor hums but won’t start it could indicate either a voltage or amperage issue. Verify adequate voltage and operational start components if installed. If it is drawing excessive amperage and voltage doesn’t appear to be the problem it may be assumed a locked condition. Ensure refrigerant has had ample time to equalize and boil out of the compressor before condemning.
10. When a heat pump switches into and out of defrost, a ”swooshing” noise is expected due to the rapid pressure change within the system. However customers sometimes complain that the noise is excessive, or it is sometimes accompanied by a ”groaning, or howling” noise. When receiving these complaints, Quiet Shift-2 (if available) may improve the noise, but will probably not eliminate it totally. Check that the defrost thermostat or thermistor is operating properly. Insulating the defrost sensing device may also help. If the howling or groaning noise is intermittent, replacing the reversing valve may or may not help.
11. Rattling that occurs during a shift into or out of defrost on a heat pump could indicate a pressure differential issue. This is usually a brief occurrence (under 60 seconds) and can be remedied by incorporating Quiet Shift-2, if available. This is a device that shuts down the compressor during the defrost shift for approximately 1 minute allowing the pressures to equalize. It is enabled by either a dip switch setting on the defrost board, or in the User Interface on communicating systems. Verify proper system charge as well.

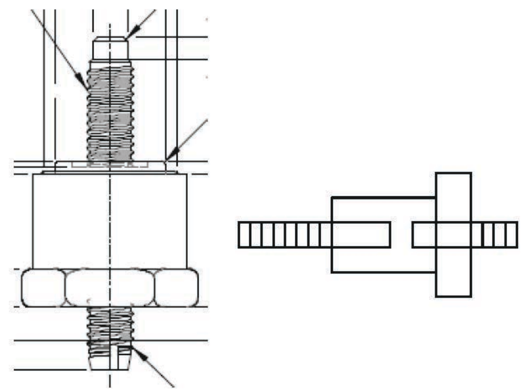
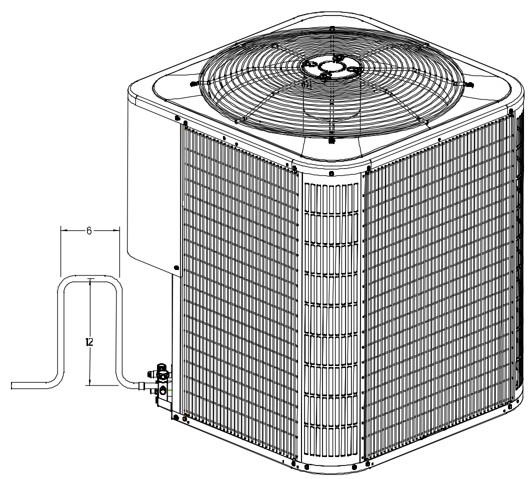


Fig. 15 – Split Post Grommet part number: 344660-401



Note : Long radius elbows recommended

Fig. 16 – Suction Line Loop

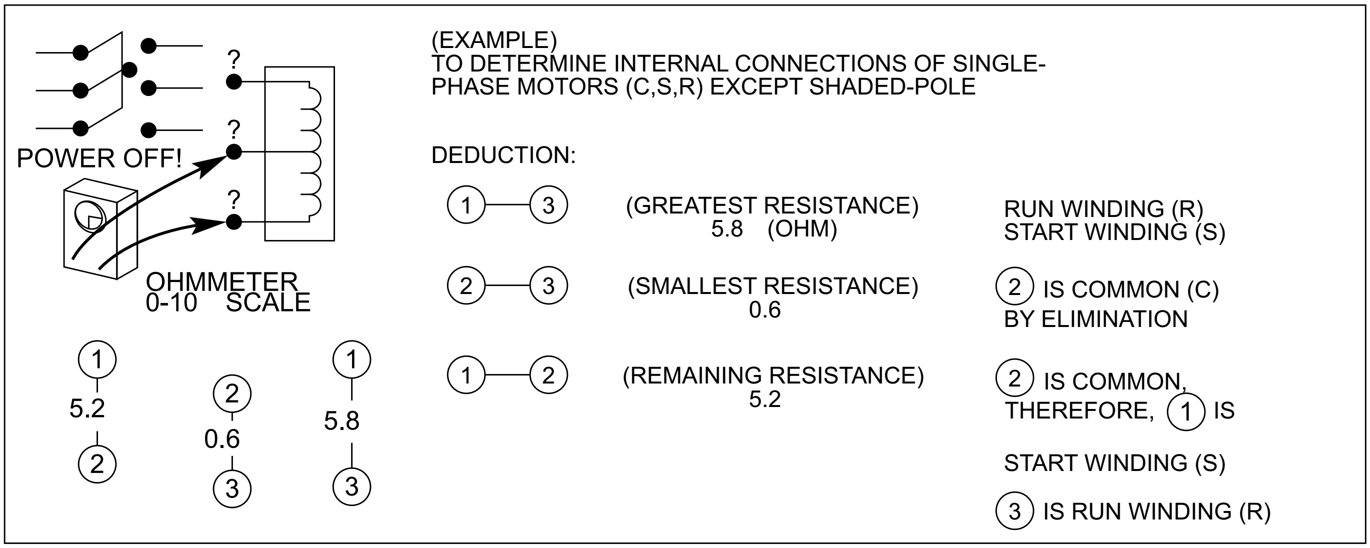


Fig. 17 – Identifying Compressor Terminals

Electrical Failures

The compressor mechanical pump is driven by an electric motor within its hermetic shell. In electrical failures, compressor does not run although external electrical and mechanical systems appear normal. Compressor must be checked electrically for abnormalities.

Before troubleshooting compressor motor, review this description of compressor motor terminal identification.

Single-Phase Motors

To identify terminals C, S, and R:

1. Turn off all unit power.
2. Discharge run and start capacitors to prevent shock.
3. Remove all wires from motor terminals.
4. Read resistance between all pairs of terminals using an ohmmeter on 0-10 ohm scale.
5. Determine 2 terminals that provide greatest resistance reading.

Through elimination, remaining terminal must be common (C). Greatest resistance between common (C) and another terminal indicates the start winding because it has more turns. This terminal is the start (S). The remaining terminal will be run winding (R).

NOTE: If compressor is hot, allow time to cool and internal line break to reset. There is an internal line break protector which must be closed.

All compressors are equipped with internal motor protection. If motor becomes hot for any reason, protector opens. Compressor should always be allowed to cool and protector to close before troubleshooting. Always turn off all power to unit and disconnect leads at compressor terminals before taking readings.

Most common motor failures are due to either an open, grounded, or short circuit. When a compressor fails to start or run, 3 tests can help determine the problem. First, all possible external causes should be eliminated, such as overloads, improper voltage, pressure equalization, defective capacitor(s), relays, wiring, etc. Compressor has internal line break overload, so be certain it is closed.

Open Circuit

! WARNING

UNIT PERSONAL INJURY HAZARD

Failure to follow this warning could result in personal injury.

Use caution when working near compressor terminals. Damaged terminals have the potential to cause personal injury. Never put face or body directly in line with terminals.

To determine if any winding has a break in the internal wires and current is unable to pass through, follow these steps:

1. Be sure all power is off.
2. Discharge all capacitors.
3. Remove wires from terminals C, S, and R.
4. Check resistance from C-R, C-S, and R-S using an ohmmeter on 0-1000 ohm scale.

Because winding resistances are usually less than 10 ohms, each reading appears to be approximately 0 ohm. If resistance remains at 1000 ohms, an open or break exists and compressor should be replaced.

! CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Be sure internal line break overload is not temporarily open.

Ground Circuit

To determine if a wire has broken or come in direct contact with shell, causing a direct short to ground, follow these steps:

1. Allow crankcase heaters to remain on for several hours before checking motor to ensure windings are not saturated with refrigerant.
2. Using an ohmmeter on R X 10,000 ohm scale or megohmmeter (follow manufacturer's instructions).
3. Be sure all power is off.
4. Discharge all capacitors.
5. Remove wires from terminals C, S, and R.
6. Place one meter probe on ground or on compressor shell. Make a good metal-to-metal contact. Place other probe on terminals C, S, and R in sequence.
7. Note meter scale.
8. If reading of 0 or low resistance is obtained, motor is grounded. Replace compressor.

Compressor resistance to ground should not be less than 1000 ohms per volt of operating voltage.

Example:

230 volts X 1000 ohms/volt = 230,000 ohms minimum.

Short Circuit

To determine if any wires within windings have broken through their insulation and made contact with other wires, thereby shorting all or part of the winding(s), be sure the following conditions are met.

1. Correct motor winding resistances must be known before testing, either from previous readings or from manufacturer's specifications.
2. Temperature of windings must be as specified, usually about 70°F.
3. Resistance measuring instrument must have an accuracy within ± 5-10 percent. This requires an accurate ohmmeter such as a Wheatstone bridge or null balance-type instrument.
4. Motor must be dry or free from direct contact with liquid refrigerant.

Make This Critical Test

(Not advisable unless above conditions are met)

1. Be sure all power is off.
2. Discharge all capacitors.
3. Remove wires from terminals C, S, and R.
4. Place instrument probes together and determine probe and lead wire resistance.
5. Check resistance readings from C-R, C-S, and R-S.
6. Subtract instrument probe and lead resistance from each reading.

If any reading is within ±20 percent of known resistance, motor is probably normal. Usually a considerable difference in reading is noted if a turn-to-turn short is present.

REFRIGERATION SYSTEM

Refrigerant

! WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Puron™ Advance (R-454B) refrigerant runs at different pressures than other refrigerants and is often higher. No other refrigerant may be used in this system. Gauge set, hoses, and recovery system must be designed to handle Puron™ Advance (R-454B). If you are unsure consult the equipment manufacturer.

Before starting work on systems containing flammable refrigerants, safety checks are required to make sure that ignition risks are minimized

! CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

The compressor in a Puron™ Advance (R-454B) system uses a polyol ester (POE) oil. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oils can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

In an air conditioning and heat pump system, refrigerant transfers heat from one place to another. The condenser is the outdoor coil in the cooling mode and the evaporator is the indoor coil.

In a heat pump, the condenser is the indoor coil in the heating mode and the evaporator is the outdoor coil.

In the typical air conditioning mode, compressed hot gas leaves the compressor and enters the condensing coil. As gas passes through the condenser coil, it rejects heat and condenses into liquid. The liquid leaves condensing unit through liquid line and enters metering device at evaporator coil. As it passes through metering device, it becomes a gas-liquid mixture. As it passes through indoor coil, it absorbs heat and the refrigerant moves to the compressor and is again compressed to hot gas, and cycle repeats.

Servicing Systems on Roofs With Synthetic Materials

POE (polyol ester) compressor lubricants are known to cause long term damage to some synthetic roofing materials. Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service which may risk exposure of compressor oil to the roof, take appropriate precautions to protect roofing. Procedures which risk oil leakage include but are not limited to compressor replacement, repairing refrigerants leaks, replacing refrigerant components such as filter drier, pressure switch, metering device, coil, accumulator, or reversing valve.

Synthetic Roof Precautionary Procedure

1. Cover extended roof working area with an impermeable polyethylene (plastic) drop cloth or tarp. Cover an approximate 10 x 10 ft area.
2. Cover area in front of the unit service panel with a terry cloth shop towel to absorb lubricant spills and prevent run-offs, and protect drop cloth from tears caused by tools or components.

3. Place terry cloth shop towel inside unit immediately under component(s) to be serviced and prevent lubricant run-offs through the louvered openings in the base pan.
4. Perform required service.
5. Remove and dispose of any oil contaminated material per local codes.

When working on refrigeration equipment that uses flammable refrigerant, the following safety checks are required:

1. Ensure that the refrigerant pipe or components are not installed in a position where they may corrode due to exposure to other substances. Not required if the component is made of non corrosive material or sufficiently protected from corrosion
2. Ensure that all markings and signs on the equipment are corrected if they are not visible or legible and that all ventilation machinery/outlets are working correctly without any obstruction.
3. Ensure that the actual refrigerant charge is in accordance with the room size where the refrigeration equipment is installed. If an indirect refrigerating circuit is used, the secondary circuit must be checked for refrigerant presence.

Brazing

This section on brazing is not intended to teach a technician how to braze. There are books and classes which teach and refine brazing techniques. The basic points below are listed only as a reminder.

Definition: The joining and sealing of metals using a nonferrous metal having a melting point over 800°F/426.6°C.

Flux: A cleaning solution applied to tubing or wire before it is brazed. Flux improves the strength of the brazed connection.

When brazing is required in the refrigeration system, certain basics should be remembered. The following are a few of the basic rules.

1. Clean joints make the best joints. To clean:
   – Remove all oxidation from surfaces to a shiny finish before brazing.
   – Remove all flux residue with brush and water while material is still hot.
2. Silver brazing alloy is used on copper-to-brass, copper-to-steel, or copper-to-copper. Flux is required when using silver brazing alloy. Do not use low temperature solder.
3. Fluxes should be used carefully. Avoid excessive application and do not allow fluxes to enter into the system.
4. Brazing temperature of copper is proper when it is heated to a minimum temperature of 800°F and it is a dull red color in appearance.

Aluminum Brazing

This field repair procedure is intended for aluminum coil product group that have acquired mechanical damage. This procedure is limited to repairing self-tapping screw holes and punctures, not to exceed 0.182” along its largest axis if non circular, and 0.182” diameter if circular. Brazing kit p/n 337748-751 is available from RC.

Coil replacement is needed if at least one of the following is present:

- Corrosion cracks and burst cracks
- A singular tube with more than 2 holes
- Holes that exceed .182” largest axis if non circular and .182” dia. If circular.

The key to brazing aluminum is watching the flame change in color. Any fuel gas/oxygen flame in the neutral state will produce a flame that is a shade of blue. As the aluminum heats up to temperature, you will see the flame change in color to red/orange.

The change in color indicates the base metal is at temperature ready for braze material. Continuing to apply heat will not change the color and will melt the base metal.

The braze alloys should not have direct contact with the flame. In cored wire filler metals, you will notice that the filler metal will melt away exposing the flux. The flux change in state is from white liquid, to dry white, to clear liquid. The change in state of flux coincides with the flame change in color. The addition of flux will minimize the flame change in color. The alloy is ready to apply when the flux is in the clear state.

Most aluminum alloys melt at 1200°F, and the braze materials melt between 905°F and 1080°F. The zinc alloys (ZA-1) melt at a lower temperature while alloys which have more aluminum content melt at a higher temperature.

Materials:

1. 78/22 braze alloy Channel Flux ZA-1, Harris AlGroove900 cored wire
2. Flux CX-60 Omni / Lucas product
3. Stainless steel wire brushes small handle / rotary brush
4. Turbo-Torch equipment

Aluminum Brazing Instructions:

1. Clean area to be brazed
   a. Joint must be free of oil, grease, rust, corrosion, and refrigerant.
2. Wire brush to remove oxides from area
3. Flux area if required with the CX-60 flux. Cored wire alloys will not need fluxing.
   a. Additional flux with cored filler will aid in dirty conditions
4. Depending on thickness of material, select an appropriate torch tip size.
   a. Turbo torch standard nozzles work well for aluminum repair
   NOTE: It is important to size the torch tip to the thickness of material. Example: too large a torch tip will melt the aluminum base metal before you are able to repair it.
5. Heat area until flux turns clear or you see flame change in color.
6. Continue to heat the joint and test by wiping the braze rod across the joint.
7. Once the alloy melts on the parent metal add alloy to repair the area. Maintain joint temperature until repair is complete. Do not over heat. (withdraw torch as required)
8. It is best to repair the area the first time. Reheating can cause failure to repair the area.
9. If reheating is necessary, let joint cool, wire brush, reapply flux. Reheat joint so flux melts and reapply braze material.

Service Valves and Pumpdown

⚠ WARNING

PERSONAL INJURY AND UNIT DAMAGE HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Never attempt to make repairs to existing service valves. Unit operates under high pressure. Damaged seats and o-rings should not be replaced. Replacement of entire service valve is required. Service valve must be replaced by properly trained service technician.

Service valves provide a means for holding original factory charge in outdoor unit prior to hookup to indoor coil. They also contain gauge ports for measuring system pressures and provide shutoff convenience for certain types of repairs. (See Fig. 18 .)

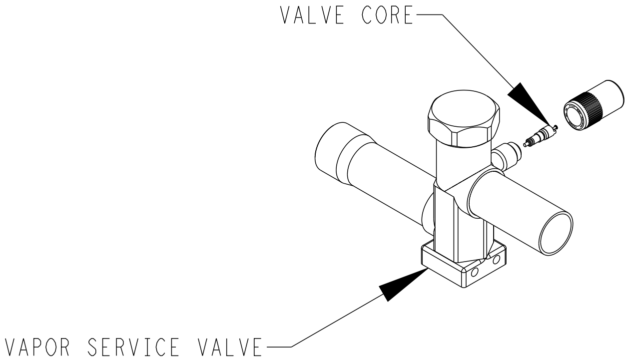


Fig. 18 – Vapor Service Valve (Front Seating)
Used in Legacy, Builder and Preferred **ACs and HPs**

Front-seating service valves are used in outdoor residential equipment. This valve has a service port that contains a Schrader fitting. The service port is always pressurized after the valve is moved off the front-seat position.

The service valves used in the outdoor units come from the factory front-seated. This means that the refrigerant charge is isolated from the line-set connection ports. All heat pumps that are equipped with an AccuRater piston heating metering device are shipped with an adapter stub tube. This tube must be installed on the liquid service valve. After connecting the stub tube to the liquid service valve of a heat pump, the valves are ready for brazing. The interconnecting tubing (line set) can be connected to the service valves using field supplied mechanical connections or brazed using industry accepted methods.

Before making connections, the tube ends of the service valves must be cleaned. To prevent damage to the valve and/or cap "O" ring, use a wet cloth or other acceptable heat-sinking material on the valve before brazing. To prevent damage to the unit, use a metal barrier between brazing area and unit.

After the brazing operation and the refrigerant tubing and evaporator coil have been evacuated, the valve stem can be turned counterclockwise until back-seats, which releases refrigerant into tubing and evaporator coil. The system can now be operated.

Back-seating service valves must be back-seated (turned counterclockwise until seated) before the service-port caps can be removed and hoses of gauge manifold connected. In this position, refrigerant has access from and through outdoor and indoor unit.

The service valve-stem cap is tightened to 20 ± 2 ft/lb torque and the service-port caps to 9 ± 2 ft/lb torque. The seating surface of the valve stem has a knife-set edge against which the caps are tightened to attain a metal-to-metal seal. If accessory pressure switches are used, the service valve must be cracked. Then, the knife-set stem cap becomes the primary seal.

The service valve cannot be field repaired; therefore, only a complete valve or valve stem and service-port caps are available for replacement.

If the service valve is to be replaced, a metal barrier must be inserted between the valve and the unit to prevent damaging the unit exterior from the heat of the brazing operations.

! CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant.

Pumpdown Procedure

Service valves provide a convenient shutoff valve useful for certain refrigeration-system repairs. System may be pumped down to make repairs on low side without losing complete refrigerant charge.

1. Attach pressure gauge to suction service-valve gauge port.
2. Front seat liquid-line valve.
3. Start unit in cooling mode. Run until suction pressure reaches 5 psig (35kPa). Do not allow compressor to pump to a vacuum.
4. Shut unit off. Front seat suction valve.

NOTE: All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant, such as in long-line applications, may cause unit to relieve pressure through internal pressure-relief valve (indicated by sudden rise of suction pressure) before suction pressure reaches 5 psig (35kPa). If this occurs, shut unit off immediately, front seat suction valve, and recover remaining pressure.

Heating Piston (AccuRater®) - Heat Pumps Only

AccuRater pistons are used to meter refrigerant for heat pump heating mode only. All indoor coils are supplied with a bi-flow TXV for metering in the cooling mode. AccuRater piston has a refrigerant metering hole through it. The piston seats against the piston body in heating mode and meters the refrigerant in heating mode and allows refrigerant to flow around it in cooling mode.

There are 2 types of liquid line connections used.

1. Shut off power to unit.
2. Pump unit down using pumpdown procedure described in this service manual.
3. Loosen nut and remove liquid line adapter connection from AccuRater.
4. Slide piston out by inserting a small soft wire with small kinks through metering hole. Do not damage metering hole, sealing surface around piston cones, or fluted portion of piston.
5. Clean piston refrigerant metering hole.
6. Install a new retainer O-ring, retainer assembly, or Teflon washer before reassembling AccuRater.

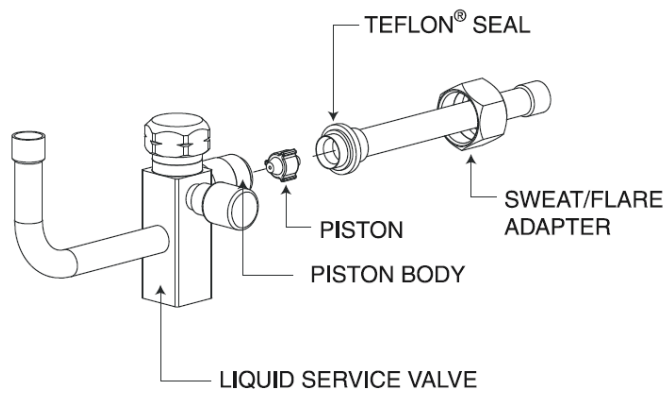


Fig. 19 – Front Seating Service Valve with Chatleff Connection Used in Legacy, Builder and Preferred Puron Advance™ (R-454B) Heat Pumps.

Reversing Valve

In heat pumps, changeover between heating and cooling modes is accomplished with a valve that reverses flow of refrigerant between the two coils. This reversing valve device is easy to troubleshoot and replace. The reversing valve solenoid can be checked with power off with an ohmmeter. Check for continuity and shorting to ground. With control circuit (24v) power on, check for correct voltage at solenoid coil. Check for overheated solenoid.

With unit operating, other items can be checked, such as frost or condensate water on refrigerant lines.

The sound made by a reversing valve as it begins or ends defrost is a “whooshing” sound, as the valve reverses and pressures in system equalize. An experienced service technician detects this sound and uses it as a valuable troubleshooting tool.

Using a remote measuring device, check inlet and outlet line temperatures. DO NOT touch lines. If reversing valve is operating normally, inlet and outlet temperatures on appropriate lines should be close to each other. Any difference would be due to heat loss or gain across valve body. Temperatures are best checked with a remote reading electronic-type thermometer with multiple probes. Route thermocouple leads to inside of coil area through service valve mounting plate area underneath coil. Fig. 20 and Fig. 21 show test points (TP) on reversing valve for recording temperatures. Insulate points for more accurate reading.

If valve is defective:

1. Shut off all power to unit and remove charge from system.
2. Remove solenoid coil from valve body. Remove valve by cutting it from system with tubing cutter. Repair person should cut in such a way that stubs can be easily re-brazed back into system. Do not use hacksaw. This introduces chips into system that cause failure. After defective valve is removed, wrap it in wet rag and carefully unbraze stubs. Save stubs for future use. Because defective valve is not overheated, it can be analyzed for cause of failure when it is returned.
3. Braze new valve onto used stubs. Keep stubs oriented correctly. Scratch corresponding matching marks on old valve and stubs and on new valve body to aid in lining up new valve properly. When brazing stubs into valve, protect valve body with wet rag to prevent overheating.
4. Use slip couplings to install new valve with stubs back into system. Even if stubs are long, wrap valve with a wet rag to prevent overheating.
5. After valve is brazed in, check for leaks. Evacuate and charge system. Operate system in both modes several times to be sure valve functions properly.

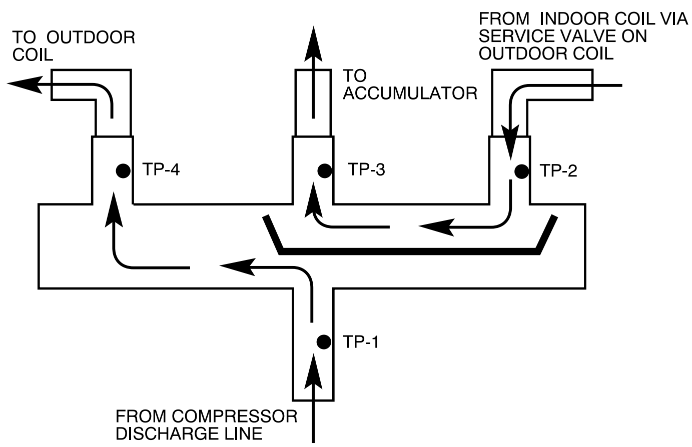


Fig. 20 – Reversing Valve (Cooling Mode or Defrost Mode, Solenoid Energized)

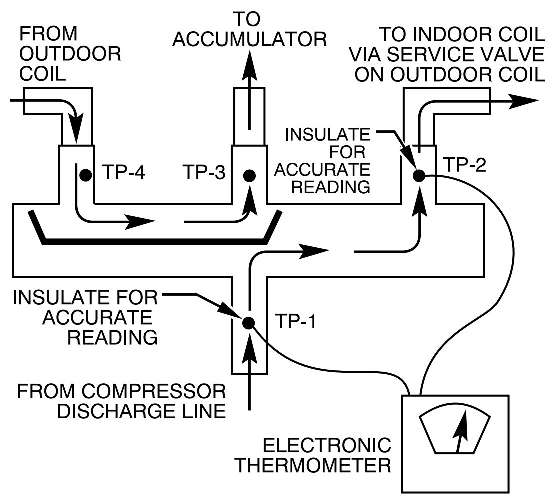


Fig. 21 – Reversing Valve (Heating Mode, Solenoid De-Energized)

Liquid Line Filter Drier

Filter driers are specifically designed for EvolutionPuron Advance™ (R-454B) refrigerant. Only operate with the appropriate drier using factory authorized components.

It is recommended that the liquid line drier be installed at the indoor unit. Placing the drier near the TXV allows additional protection to the TXV as the liquid line drier also acts as a strainer.

Install Liquid-line Filter Drier Indoor - AC

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

To avoid performance loss and compressor failure, installation of filter drier in liquid line is required.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

To avoid filter drier damage while brazing, filter drier must be wrapped in a heat-sinking material such as a wet cloth.

Refer to Fig. 22 and install filter drier as follows:

1. Braze 5-in. liquid tube to the indoor coil.
2. Wrap filter drier with damp cloth.
3. Braze filter drier to above 5” liquid tube. Flow arrow must point towards indoor coil.
4. Connect and braze liquid refrigerant tube to the filter drier.

Install Liquid-line Filter Drier Indoor - HP

Refer to Fig. 23 and install filter drier as follows:

1. Braze 5 in. liquid tube to the indoor coil.
2. Wrap filter drier with damp cloth.
3. Braze filter drier to 5 in. long liquid tube from step 1.
4. Connect and braze liquid refrigerant tube to the filter drier.

Suction Line Filter Drier

The suction line drier is specifically designed to operate with Puron, use only factory authorized components. Suction line filter drier is used in cases where acid might occur, such as burnout. Heat pump units must have the drier installed between the compressor and the accumulator only. Remove after 10 hours of operation. Never leave suction line filter drier in a system longer than 72 hours (actual time).

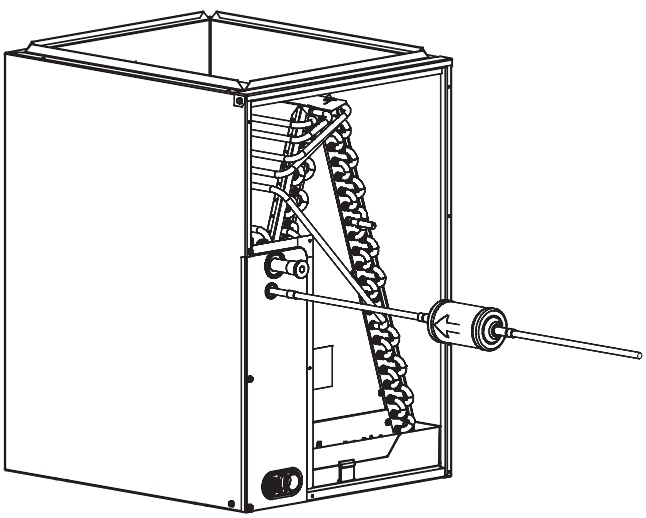


Fig. 22 – Liquid Line Filter Drier - AC

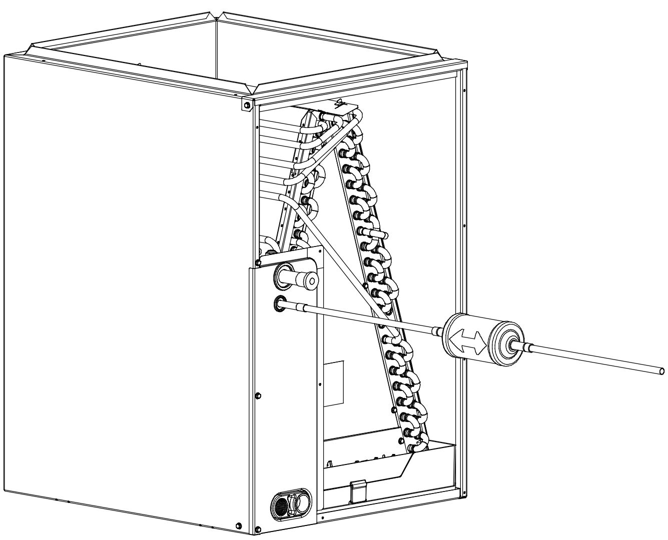


Fig. 23 – Liquid Line Filter Drier - HP

Solenoid Valve

Normally closed solenoid valves are designed to block flow when power is removed from the OD unit. Solenoid valves separate low and high side pressures which assist in heating performance on heat pumps. Solenoid valves may be factory provided with the unit or, when required for long-line applications, can be purchased separately as an accessory kit.

The solenoid valve must be installed at the outdoor unit. Placing the solenoid valve within 3.5" of the liquid service valve ensures it provides adequate performance enhancement in heating mode.

Install Liquid Line Solenoid Valve

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

To avoid performance loss, installation of solenoid valve is required.

To avoid solenoid valve damage while brazing, solenoid valve must be wrapped in a heat-sinking material such as a wet cloth.

To avoid trapped refrigerant during unit operation, no more than one solenoid valve may be installed.

Refer to Fig. 24 and install filter drier as follows:

1. Wrap solenoid valve with damp cloth.
2. Braze solenoid valve to adapter tube connected to liquid service valve. Flow arrow must point towards outdoor coil. Solenoid stem must not point downwards.
3. Connect and braze liquid refrigerant tube to solenoid valve.

NOTE: When solenoid valve is de-energized (closed), refrigerant flow will be stopped only in the direction of the flow arrow on the valve body.

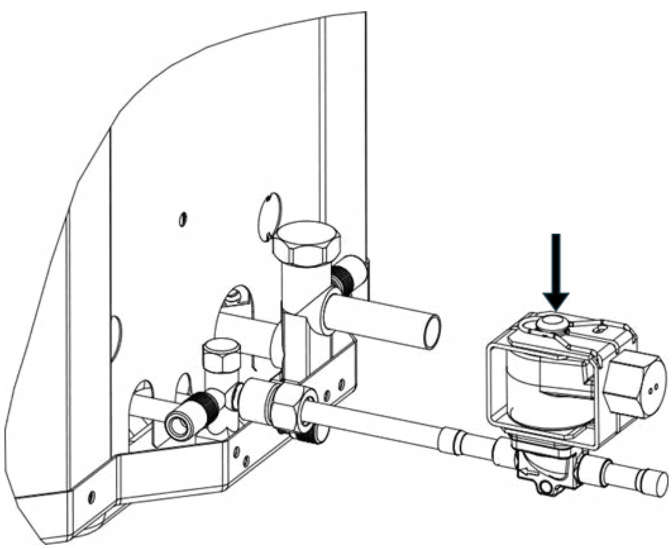


Fig. 24 – Liquid Line Service Valve

Pump Down with Liquid Line Solenoid Valve Installed

⚠ WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

Failure to follow this warning could result in personal injury or death.

Relieve pressure and recover all refrigerant before system repair or final unit disposal.

Federal regulations require that refrigerant is not vented into the atmosphere. Recover during system repair or final unit disposal.

When a liquid line solenoid valve is installed, it will block refrigerant flow when the unit is off. This can lead to trapped refrigerant in the unit or line set. Refrigerant must be vacuumed through vapor service valve to ensure no refrigerant remains trapped within the unit.

Alternatively, a strong magnet can be placed on top of the solenoid coil (indicated by the arrow in Fig. 24). This will open valve so refrigerant can flow freely through the valve in both directions.

Accumulator

Accumulators are standard factory installed for all heat pumps that operate with Puron Advance™ (R-454B) refrigerant.

The accumulator is specifically designed to operate with Puron Advance™ (R-454B) so use only factory-authorized components. Under some light load conditions on indoor coils, liquid refrigerant is present in suction gas returning to compressor. The accumulator stores liquid and allows it to boil off into a vapor so it can be safely returned to compressor. Since a compressor is designed to pump refrigerant in its gaseous state, introduction of liquid into it could cause severe damage or total failure of compressor.

The accumulator is a passive device which seldom needs replacing. Occasionally its internal oil return orifice or bleed hole may become plugged. Some oil is contained in refrigerant returning to compressor. It cannot boil off in accumulator with liquid refrigerant. The bleed hole allows a small amount of oil and refrigerant to enter the return line where velocity of refrigerant returns it to compressor. if the bleed hole plugs, oil is trapped in accumulator, and compressor will eventually fail from lack of lubrication. if the bleed hole is plugged, accumulator must be changed. The accumulator has a fusible element located in the bottom end bell. (See Fig. 25.) This fusible element will melt at 430°F/221°C and vent the refrigerant if this temperature is reached either internal or external to the system. If fuse melts, the accumulator must be replaced.

To change accumulator:

1. Shut off all power to unit.
2. Recover all refrigerant from system.
3. Break vacuum with dry nitrogen. Do not exceed 5 psig.

NOTE: Coil may be removed for access to accumulator. Refer to appropriate sections of Service Manual for instructions.

⚠ CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant.

4. Remove accumulator from system with tubing cutter.
5. Tape ends of open tubing.
6. Scratch matching marks on tubing studs and old accumulator. Scratch matching marks on new accumulator. Unbraze stubs from old accumulator and braze into new accumulator.
7. Thoroughly rinse any flux residue from joints and paint with corrosion-resistant coating such as zinc-rich paint.
8. Install factory authorized accumulator into system with copper slip couplings.
9. Evacuate and charge system.

Pour and measure oil quantity (if any) from old accumulator. If more than 20 percent of oil charge is trapped in accumulator, add new POE oil to compressor to make up for this loss.

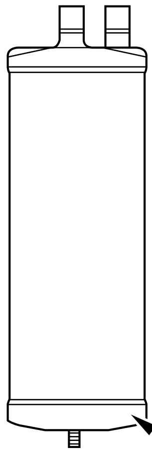


Fig. 25 – Accumulator

Thermostatic Expansion Valve (TXV)

All (post-2006) furnace coils, most fan coils and a few heat pumps have a factory installed thermostatic expansion valve (TXV). The TXV will be a bi-flow, hard-shutoff with an external equalizer and a balance port pin. A hard shut-off TXV does not have a bleed port. Therefore, minimal equalization takes place after shutdown. TXVs are specifically designed to operate with EvolutionPuron Advance™ (R-454B) refrigerant, use only factory authorized TXV's. Do not interchange EvolutionPuron Advance™ (R-454B) TXVs with any other refrigerant.

TXV Operation

The TXV is a metering device that is used in air conditioning and heat pump systems to adjust to changing load conditions by maintaining a preset superheat temperature at the outlet of the evaporator coil. The volume of refrigerant metered through the valve seat is dependent upon the following:

1. Superheat temperature is sensed by cap tube sensing bulb on suction tube at outlet of evaporator coil. This temperature is converted into pressure by refrigerant in the bulb pushing downward on the diaphragm which opens the valve via the pushrod(s).
2. The suction pressure at the outlet of the evaporator coil is transferred via the external equalizer tube to the underside of the diaphragm. This is needed to account for the indoor coil pressure drop. Residential coils typically have a high pressure drop, which requires this valve feature.
3. The pin is spring loaded, which exerts pressure on the underside of the diaphragm. Therefore, the bulb pressure works against the spring pressure and evaporator suction pressure to open the valve. If the load increases, the temperature increases at the bulb, which increases the pressure on the top side of the diaphragm. This opens the valve and increases the flow of refrigerant. The increased refrigerant flow causes the leaving evaporator temperature to decrease. This lowers the pressure on the diaphragm and closes the pin. The refrigerant flow is effectively stabilized to the load demand with negligible change in superheat.

Install TXV

The thermostatic expansion valve is specifically designed to operate with a refrigerant type. Use only TXVs labeled for Puron Advance™ (R-454B).

⚠ CAUTION

UNIT OPERATION HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Al indoor coil units must be installed with a hard shut off Puron TXV metering device.

IMPORTANT: The TXV should be mounted as close to the indoor coil as possible and in a vertical, upright position. Avoid mounting the inlet tube vertically down. The valve is more susceptible to malfunction due to debris if inlet tube is facing down. A factory-approved filter drier must be installed in the liquid line at the indoor unit.

Replacing TXV on Indoor Coil

1. Pump system down to 2 psig and recover refrigerant.
2. Remove coil access panel and fitting panel from front of cabinet.
3. Remove TXV using a backup wrench on connections to prevent damage to tubing.
4. Remove equalizer tube from suction line of coil. Note: Some coils may have a mechanical connection. If coil has a braze connection, use file or tubing cutter to cut brazed equalizer line approximately 2 inches above suction tube.
5. Remove bulb from vapor tube inside cabinet.
6. Install the new TXV using a wrench and backup wrench to avoid damage to tubing or valve to attach TXV to distributor.
7. Attach equalizer tube to suction line. If coil has mechanical connection, then use wrench and back up wrench to attach. If coil has brazed connection, use file or tubing cutters to remove mechanical flare nut from equalizer line. Then use coupling to braze the equalizer line to stub (previous equalizer line) in suction line.
8. Attach TXV bulb to vapor tube inside cabinet, in same location as original was when removed, using supplied bulb clamps (nylon or copper). See Fig. 26 for correct positioning of sensing bulb.
9. Route equalizer tube through suction connection opening (large hole) in fitting panel and install fitting panel in place.
10. Sweat inlet of TXV, marked "IN" to liquid line. Avoid excessive heat which could damage valve.
11. Proceed with remainder of unit installation.

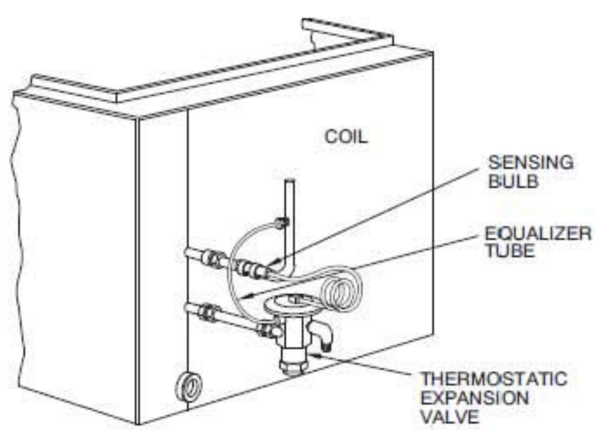


Fig. 26 – Typical TXV Installation

Make Piping Connections

Before starting work on piping connections, make sure that the pipe work, including piping material, pipe routing and installation is protected from physical damage during operation and service..

Once the field piping is complete, the pipe work should be pressure tested with an inert gas. The minimum test pressure of the low side of the system should be the low side design pressure and the minimum test pressure for the high side of the system should be the high side pressure. If there is no way to separate the low side and high side of the system, then the minimum test pressure for the entire system should be low side design pressure. It is then vacuum tested before refrigerant charging . The field-made refrigerant joints must be tightness tested. The testing method should have a sensitivity of 5g of refrigerant per year or better under a pressure of at least 0.25 times the maximum allowable pressure and no leaks should be detected. Once the joints are inspected, only then should they be covered or enclosed.

WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

Failure to follow this warning could result in personal injury or death.

Relieve pressure and recover all refrigerant before system repair or final unit disposal.

Use all service ports and open all flow-control devices, including solenoid valves.

CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Do not leave system open to atmosphere any longer than minimum required for installation. POE oil in compressor is extremely susceptible to moisture absorption. Always keep ends of tubing sealed during installation.

CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

If ANY refrigerant tubing is buried, provide a 6 in. vertical rise at service valve. Refrigerant tubing lengths up to 36 in. may be buried without further special consideration. Do not bury lines longer than 36 in.

REFRIGERATION SYSTEM REPAIR

Repair work should be started under a controlled procedure in an open area or an area that is sufficiently ventilated throughout the work period and all persons in the vicinity must be informed about the nature of work being performed.

A dry powder or CO_2 Fire extinguisher must be present adjacent to the charging area and anyone working on exposed pipework must not use any sources of ignition in a manner that might lead to the risk of fire and explosion. The site of installation, repair, removal or disposal must be inspected to ensure no flammable hazard or ignition risks are present and all possible ignition sources including Cigarette smoking must be kept far away. NO SMOKING signs shall be displayed.

Leak Detection

New installations should be checked for leaks prior to complete charging. If a system has lost all or most of its charge, system must be pressurized again to approximately 150 psi minimum and 375 psi maximum. This can be done by pressurizing system with nitrogen. Nitrogen leaks faster than refrigerants. Nitrogen cannot, however, be detected by an electronic leak detector. (See Fig. 27.)

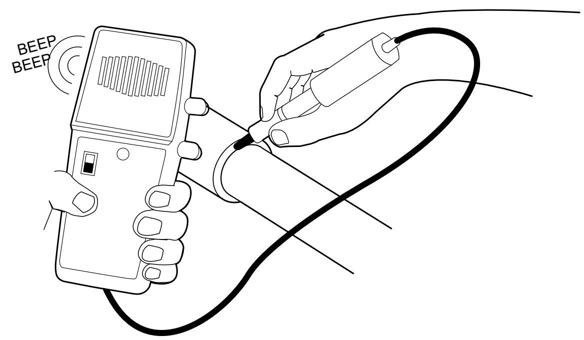


Fig. 27 – Electronic Leak Detection

WARNING

PERSONAL INJURY AND UNIT DAMAGE HAZARD

Failure to follow this warning could result in personal injury or death.

Due to the high pressure of nitrogen, it should never be used without a pressure regulator on the tank.

WARNING

PERSONAL INJURY AND/OR FIRE HAZARD

Failure to follow this warning could result in personal injury and/or fire.

For searching and detecting refrigerant leaks, possible sources of ignition such as halide torch or any other detector with a naked flame should not be used under any circumstance.

Assuming that a system is pressurized with either all refrigerant or a mixture of nitrogen and refrigerant, leaks in the system can be found with an electronic leak detector that is capable of detecting specific refrigerants.

For flammable refrigerant, the electronic leak detector may not be accurate or it might need re-calibration in a refrigerant free area. The leak detector should be set at a percentage of the refrigerant's Lower Flammability Limit (LFL).

If system has been operating for some time, first check for a leak visually. Since refrigerant carries a small quantity of oil, traces of oil at any joint or connection is an indication that refrigerant is leaking at that point.

A simple and inexpensive method of testing for leaks is to use soap bubbles or detergent but do not use detergents containing chlorine as the chlorine might react with the flammable refrigerant and corrode the copper pipe-work (See Fig. 28). Any solution of water and soap may be used. Soap solution is applied to all joints and connections in system. A small pinhole leak is located by tracing bubbles in soap solution around leak. If the leak is very small, several minutes may pass before a bubble will form. Popular commercial leak detection solutions give better, longer-lasting bubbles and more accurate results than plain soapy water. The bubble solution must be removed from the tubing and fittings after checking for leaks as some solutions may corrode the metal.

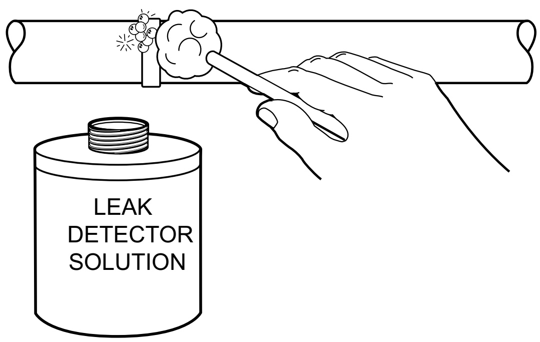


Fig. 28 – Bubble Leak Detection

You may use an electronic leak detector designed for specific refrigerant to check for leaks (See Fig. 27). This unquestionably is the most efficient and easiest method for checking leaks. There are various types of electronic leak detectors. Check with manufacturer of equipment for suitability. Generally speaking, they are portable, lightweight, and consist of a box with several switches and a probe or sniffer. Detector is turned on and probe is passed around all fittings and connections in system. Leak is detected by either the movement of a pointer on detector dial, a buzzing sound, or a light.

In all instances when a leak is found, system charge must be recovered or isolated using shut-off valves and leak repaired before final charging and operation.

The Following procedures should be followed for flammable refrigerants

1. The refrigerant must be safely removed and recovered into correct cylinders. Do not vent refrigerant.
2. The system is purged a couple of times to make it safe for flammable refrigerants.
   Purging happens by:
   – Breaking the vacuum in the system with oxygen free nitrogen
   – Continuing to fill it up until working pressure is achieved, followed by venting to atmosphere,
   – Pulling down to a vacuum.
   – Repeat the process until all the refrigerant has left the system
   – Finally, vent down the system to atmospheric pressure before starting the work.

NOTE: This entire purging process is not optional for A2L.

3. Open the circuit for repair. Make sure the vacuum pump used is not close to any ignition sources and proper ventilation is provided.

After leak testing or leak is repaired, replace liquid line filter drier, evacuate system, and recharge with correct refrigerant quantity.

The cylinder used for recovery should be labeled (special cylinders) and must have a pressure-relief valve and associated shut-off valves.

Empty recovery cylinders must be evacuated and if possible cooled before recovery again. The recovery equipment must be suitable for flammable refrigerants. The equipment operating instructions must be at hand. The manufacturer should be consulted if you have any doubts about equipment operation. A set of calibrated weighing scales and hoses with leak free disconnect coupling are also needed.

The recovery equipment and all other components must be in good working condition. Make sure the refrigerant recovered is processed per local laws and waste transfer note arranged.

Ensure different refrigerants are not mixed together in recovery units and especially in cylinders

Coil Removal

Coils are easy to remove if required for compressor removal, or to replace coil.

Before the compressor or compressor oil is removed, make sure that the flammable refrigerant is evacuated to a level where there is no refrigerant left in the lubricant. The compressor body should not be heated with an open flame or other ignition sources to speed up this evacuation process. The oil drain from the system must be carried out safely

1. Shut off all power to unit.
2. Recover refrigerant from system through service valves.
3. Break vacuum with nitrogen.
4. Remove top cover. (See Remove Top Cover in Cabinet section of the manual.)
5. Remove screws in base pan to coil grille.
6. Remove coil grille from unit.
7. Remove screws on corner post holding coil tube sheet.

⚠ WARNING

FIRE HAZARD

Failure to follow this warning could result in personal injury or equipment damage.

Cut tubing to reduce possibility of personal injury and fire.

8. Use a small tubing cutter to cut the liquid and vapor lines at both side of the coil. Cut in convenient location for easy reassembly with copper slip couplings.
9. Lift coil vertically from basepan and carefully place aside.
10. Reverse procedure to reinstall coil.
11. Replace filter drier, evacuate system, recharge, and check for normal systems operation.

Aluminum Coil Removal

For all aluminum coils, the coil has two or four (depending on size of unit) fin isolators on the top of the coil as shown in Fig. 29. These must be reinstalled onto replacement coil.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in premature corrosion failure of aluminum coil

During coil replacement, when brazing the new coil into the unit, a guard is needed so copper-to-copper joint braze splatter does not reach any aluminum parts. This can cause pitting and premature failure due to corrosion.

Fabricate a metal braze shield of approximately 8” X 8” to protect aluminum components when brazing (see Fig. 30).

The orientation of the fin isolator is shown in Fig. 31. There is a threaded mechanical fitting on the liquid distributor. This connection is not field serviceable and should not be disturbed.

The copper stub tube connection to the liquid service valve needs to be un-brazed for coil removal. (See Fig. 32.)

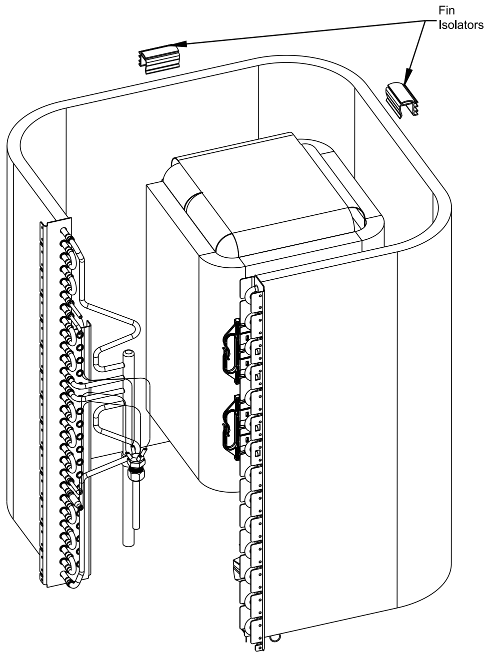


Fig. 29 – Fin Isolator Location

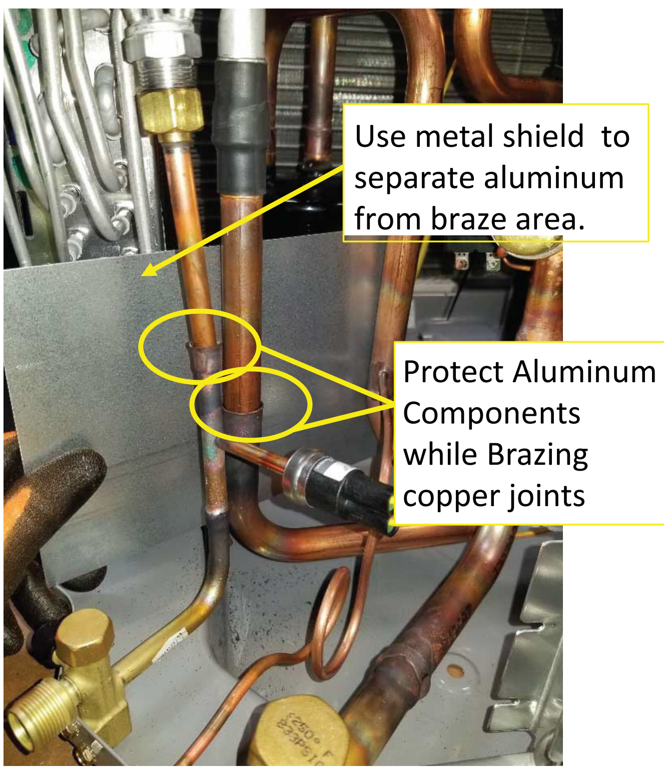


Fig. 30 – Use Braze Shield to Protect Aluminum

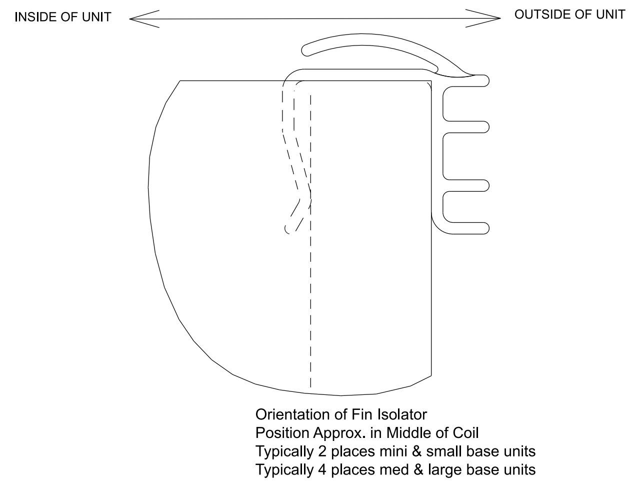


Fig. 31 – Fin Isolator Orientation

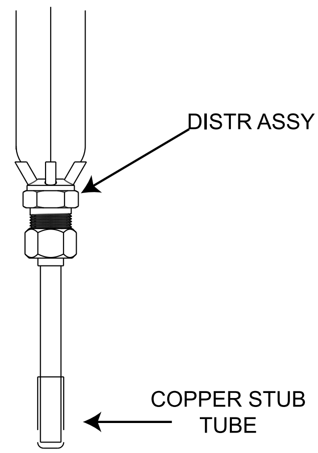


Fig. 32 – Copper Stub Tube Connection

Compressor Removal and Replacement

Once it is determined that compressor has failed and the reason established, compressor must be replaced.

⚠ CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Turn off all power to unit before proceeding. Wear safety glasses, protective clothing, and gloves when handling refrigerant. Acids formed as a result of motor burnout can cause burns.

⚠ CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

Wear safety glasses, protective clothing, and gloves when handling refrigerant and when using brazing torch..

1. Shut off all power to unit.
2. Remove and recover all refrigerant from system until pressure gauges read 0 psi. Use all service ports. Never open a system under a vacuum to atmosphere. Break vacuum with dry nitrogen holding charge first. Do not exceed 5 psig.
3. Disconnect electrical leads from compressor. Disconnect or remove crankcase heater and remove compressor hold-down bolts.

4. Cut compressor from system with tubing cutter. Do not use brazing torch for compressor removal. Oil vapor may ignite when compressor is disconnected.
5. Scratch matching marks on stubs in old compressor. Make corresponding marks on replacement compressor.
6. Use torch to remove stubs from old compressor and to reinstall them in replacement compressor.
7. Use copper couplings to tie compressor back into system.
8. Replace filter drier, evacuate system, recharge, and check for normal system operation.

CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Do not leave system open to atmosphere. Compressor oil is highly susceptible to moisture absorption.

System Clean-Up After Burnout

Some compressor electrical failures can cause motor to burn. When this occurs, by-products of burn, which include sludge, carbon, and acids, contaminate system. Test the oil for acidity using POE oil acid test to determine burnout severity. If burnout is severe enough, system must be cleaned before replacement compressor is installed. The 2 types of motor burnout are classified as mild or severe.

In mild burnout, there is little or no detectable odor. Compressor oil is clear or slightly discolored. An acid test of compressor oil will be negative. This type of failure is treated the same as mechanical failure. Liquid-line strainer should be removed and liquid-line filter drier replaced.

In a severe burnout, there is a strong, pungent, rotten egg odor. Compressor oil is very dark. Evidence of burning may be present in tubing connected to compressor. An acid test of compressor oil will be positive. Follow these additional steps:

1. TXV must be cleaned or replaced.
2. Drain any trapped oil from accumulator if used.
3. Remove and discard liquid-line strainer and filter drier.
4. After system is reassembled, install liquid and suction-line, replace with Puron Advance™ (R-454B) filter driers.

NOTE: On heat pumps, install suction line drier between compressor and accumulator.

5. Operate system for 10 hr. Monitor pressure drop across drier. If pressure drop exceeds 3 psig replace suction-line and liquid-line filter driers. Be sure to purge system with dry nitrogen when replacing filter driers. If suction line driers must be replaced, retest pressure drop after additional 10 hours (run time). Continue to monitor pressure drop across suction line filter drier. After 10 hr of run time, remove suction-line filter drier and replace liquid-line filter drier. Never leave suction-line filter drier in system longer than 72 hr (run time).
6. Charge system. (See unit information plate.)

CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Only suction line filter driers should be used for refrigerant and oil clean up. Use of non-approved products could limit system life and void unit warranty.

Evacuation

Proper evacuation of the system will remove non-condensibles and assure a tight, dry system before charging. The two methods used to evacuate a system are the deep vacuum method and the triple evacuation method.

Deep Vacuum Method

The deep vacuum method requires a vacuum pump capable of pulling a vacuum of 500 microns and a vacuum gauge capable of accurately measuring this vacuum depth. The deep vacuum method is the most positive way of assuring a system is free of air and moisture. (See Fig. 33.)

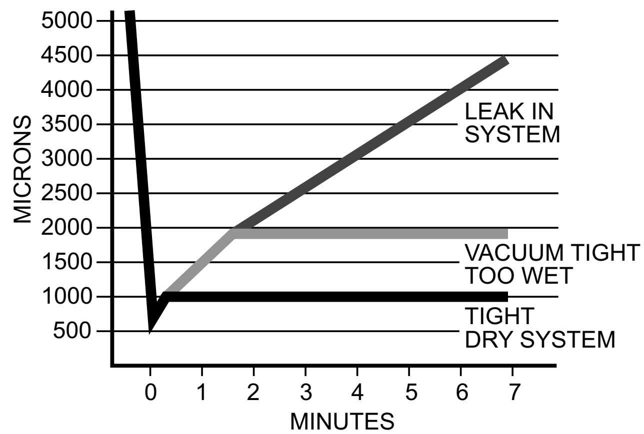


Fig. 33 – Deep Vacuum Graph

Triple Evacuation Method

The triple evacuation method should be used when vacuum pump is only capable of pumping down to 28 in. of mercury vacuum and system does not contain any liquid water. Refer to Fig. 34 and proceed as follows:

1. Pump system down to 28 in. of mercury and allow pump to continue operating for an additional 15 minutes.
2. Close service valves and shut off vacuum pump.
3. Connect a nitrogen cylinder and regulator to system and open until system pressure is 2 psig.
4. Close service valve and allow system to stand for 1 hr. During this time, dry nitrogen will be able to diffuse throughout the system absorbing moisture.
5. Repeat this procedure as indicated in Fig. 34. System will then be free of any contaminants and water vapor.

EVACUATE
▼
BREAK VACUUM WITH DRY NITROGEN
▼
WAIT
▼
EVACUATE
▼
BREAK VACUUM WITH DRY NITROGEN
▼
WAIT
▼
EVACUATE
▼
CHECK FOR TIGHT, DRY SYSTEM
(IF IT HOLDS DEEP VACUUM)
▼
CHARGE SYSTEM

Fig. 34 – Triple Evacuation Method

Check Charge

Factory charge amount and desired subcooling are shown on unit rating plate. Charging method is shown on information plate inside unit. To properly check or adjust charge, conditions must be favorable for subcooling charging.

For flammable refrigerants, the following additional charging procedures are required

1. Ensure there is no contamination of other refrigerants when charging equipment is used and the hoses/lines should be as short as possible to minimize the charge present in them.
2. Ensure the cylinder used for charging is in proper position as per instructions and the refrigerant system is earthed before charging.
3. Care should be taken that the refrigeration system is not overfilled with charge and make sure to label the system after charging if it wasn't done earlier.
4. If the system is being recharged, it must be pressure tested with purging gas. The system must be leak tested after charging but before commissioning and a follow-up leak test must be done before it leaves the site.

Favorable conditions exist when the outdoor temperature is between 70°F/21.11°C and 100°F/37.78°C, and the indoor temperature is between 70°F/21.11°C and 80°F/26.67°C.

When additional charge is required as per installation instructions, a label is provided to note down the final refrigerant charge. The interconnected refrigerant piping length and diameter should also be considered

Follow the procedure below:

Unit is factory charged for 15ft (4.57 m) of lineset. Adjust charge by adding or removing 0.6 oz/ft of 3/8 liquid line above or below 15ft (4.57 m) respectively.

For standard refrigerant line lengths, allow system to operate in cooling mode at least 15 minutes. If conditions are favorable, check system charge by subcooling method. If any adjustment is necessary, adjust charge slowly and allow system to operate for 15 minutes to stabilize before declaring a properly charged system.

If the indoor temperature is above 80°F /26.67°C, and the outdoor temperature is in the favorable range, adjust system charge by weight based on line length and allow the indoor temperature to drop to 80°F (26.67°C) before attempting to check system charge by subcooling method as described above.

If the indoor temperature is below 70°F / 21.11°C, or the outdoor temperature is not in the favorable range, adjust charge for line set length above or below 15ft (4.57 m) only. Charge level should then be appropriate for the system to achieve rated capacity. The charge level could then be checked at another time when the both indoor and outdoor temperatures are in a more favorable range.

NOTE: Special charging requirements exist for Long Line applications. See Residential Piping and Long Line Guideline to determine if an application is considered Long Line.

Heating Check Chart Procedure

To check system operation during heating cycle, refer to the Heating Check Chart on outdoor unit. This chart indicates whether a correct relationship exists between system operating pressure and air temperature entering indoor and outdoor units. If pressure and temperature do not match on chart, system refrigerant charge may not be correct. Do not use chart to adjust refrigerant charge.

TROUBLESHOOTING with SUPERHEAT

This troubleshooting routine was developed to diagnose cooling problems using superheat in TXV systems. It is effective on heat pumps in cooling mode as well as air conditioners. The system must utilize a TXV as the expansion device in cooling mode.

Basic Diagnostics

NOTE: When checking refrigerant charge and troubleshooting operating systems, the indoor airflow has significant effect on the determination. If you are at this stage, it is assumed you have already checked the subcooling once and believe the charge is correct. From this point, the airflow must be verified prior to proceeding, hence step 1 below.

1. Check or verify proper indoor airflow
   - Indoor air filter
   - Duct dampers and supply registers are open
   - Indoor coil for debris
2. Check subcooling at OD unit liquid service valve
   - Outdoor airflow (debris on coil, etc.)
   - Set the subcooling at value listed on rating plate if standard lineset
   - Set the subcooling at the maximum of 10°F or value listed on rating plate if a long line application
3. Check superheat at OD unit vapor service valve.
   - If low (< 2°F), proceed to Low SuperHeat section.
   - If between 2 and 20°F/11°C valve is probably operating properly.
   - If greater than 20°F/11°C, perform Pseudo Evaporator SuperHeat Instructions check as follows:
     - Check refrigerant pressure at vapor service valve and refrigerant temperature at outlet of evaporator.
     - Use suction line geometry (diameter and equivalent length), unit capacity and Table 5 to determine suction pressure drop.
     - •For standard lineset diameters (vapor service valve diameters and larger) and lengths less than the defined long line applications in the Residential Piping and Long Line Guideline, generally no pressure adjustment is required.
     - •For longer linesets (as defined in the Residential Piping and Long Line Guideline), correct pressure (add to gauge pressure reading).

- If Pseudo Superheat is greater than 15, proceed to High SuperHeat section.
- If Pseudo Evaporator Superheat is between 2 and 15, TXV appears to be functioning properly.
- If operation erratic (hunting), proceed to Hunting Superheat °F Superheat in repetition section.

NOTE: Hunting is when the valve superheat swings more than 10°.

Low Superheat with Normal or Low Suction Pressure

NOTE: Normal or low suction pressure is considered for Puron Advance™ (R-454B): < 135 psig

1. Re-check airflow and then check sensing bulb tightness, orientation on vapor tube and is properly wrapped. If OK proceed to Step 2
2. Check superheat at vapor service valve and Pseudo Evaporator Superheat.

- If both are less than 2°F, TXV likely not controlling properly, i.e. stuck open -> REPLACE VALVE
- If superheat is higher than 15°F, proceed to Step 3

3. Perform TXV function check.

- With system running, place sensing bulb in ice bath for ~1 minute -> superheat should increase.
  – If no response, Replace Valve
  – If OK proceed to Step 4

4. Check for even temperature distribution at outlet of each circuit of evaporator

- If greater than 15°F between circuits, distributor or coil has a restriction.
- If OK proceed to Step 5

Low Superheat with High Suction Pressure

NOTE: High suction pressure is considered for Puron Advance™ (R-454B): > ~135 psig. An application issue or other system component failure typically causes this condition.

5. Check that proper valve for proper refrigerant is used

- If OK proceed to Step 6

6. Check airflow, sensing bulb tightness, orientation on vapor tube and ensure bulb is properly wrapped.

- If OK proceed to Step 7

7. Check that compressor is pumping properly

NOTE: Loose Rules of Thumb: Is discharge saturated ~20°F higher than ambient temperature? Is discharge superheat between 15 and 50?

- If OK proceed to Step 8

8. Recheck Airflow and Subcooling.

- If OK proceed to Replace Valve

High Superheat with Normal or Low Pressure

NOTE: Normal or low suction pressure is considered: Puron Advance™ (R-454B) < 135 psig.

9. Check for restriction in liquid line (kinked line, filter drier restricted, etc.)

- If OK proceed to Step 10

10. Check for restriction in suction line (kink, restricted suction filter drier etc.))

- If OK proceed to Step 11

11. Check power element cap tube is not broken

- If OK proceed to Step 12

12. Check that equalizer tube is not kinked or plugged

- If OK proceed to Step 13

13. Replace Valve

High Superheat with Normal or High Suction Pressure

NOTE: Normal to High suction pressure is considered for Puron Advance™ (R-454B): > ~110 psig. An application issue or other system component failure typically causes this condition.

14. Check airflow, sensing bulb tightness, orientation on vapor tube and ensure bulb is properly wrapped.

- If OK proceed to Step 16

15. Make sure proper valve is used for proper refrigerant

- If OK proceed to Step 17

16. Check for even temperature distribution at outlet of each circuit of evaporator

- If OK proceed to Step 18

17. Check for high evaporator load: Return Air Leaks, high indoor wet bulb and/or dry bulb temp, undersized system, etc.

- If OK proceed to Step 19

18. Check that compressor is pumping properly

- Loose Rule of Thumb: Is discharge saturated ~20°F higher than ambient temperature? Is discharge superheat between 15°F and 50°F?

Hunting Superheat

NOTE: Hunting is when the valve superheat swings more than 10°F Superheat in repetition. This is typically an application issue.

19. Check for obvious kinked or pinched distributor (capillary) tubes causing imbalance to the circuiting.
- If OK proceed to Step 21
20. Check that proper size valve is used per Product Literature.
- If OK proceed to Step 22
21. Check airflow, sensing bulb tightness, orientation on vapor tube and ensure bulb is properly wrapped.
- If OK proceed to Step 23
22. Check for even temperature distribution (15 degree range between circuits) at outlet of each circuit of evaporator and for even air distribution over all evaporator slabs
- If OK proceed to Step 24.
23. Move sensing bulb further down suction line.
- If problem not corrected, replace valve

Pseudo Evaporator Superheat Instructions

The Pseudo Evaporator Superheat calculates the superheat at the outlet of the evaporator with known and available information. Because there generally is not a pressure port on the vapor line at the indoor coil, this procedure allows the service personnel to evaluate the evaporator superheat with the vapor pressure port at the outdoor unit.

The method requires the following information:

- Suction line temperature at the outlet of the evaporator (°F).
- Suction line pressure at the outdoor unit (psig).
- Outdoor nominal unit size (btuh).
- Suction line equivalent line length (ft).
- Suction line pressure drop from tables.
- Pressure-Temperature relationship for refrigerant used (P-T Chart).

If system uses a vapor line the same size as vapor service valve fitting or larger AND the line set equivalent length is less than the defined long line applications in the Residential Piping and Long Line Guideline, the pressure drop in vapor line of line set can be ignored.

1. Take suction line temperature at outlet of evaporator at indoor unit.
2. Take suction service valve pressure at OD unit.
3. Determine lineset vapor line equivalent length and tube diameter.
4. Determine suction line pressure drop from Table 5 .
5. Calculate Pseudo Evaporator Superheat.
- Add the suction line pressure drop to the pressure reading obtained at suction service valve.

NOTE: For nominal and larger diameter vapor lines with standard length linesets (vapor line same size as service valve fitting size and larger with equivalent length less than the defined long line applications in the Residential Piping and Long Line Guideline). the pressure drop can be ignored – use vapor service valve pressure and evaporator outlet temperature to calculate superheat

- Determine saturated evaporator temperature from a refrigerant pressure temperature relationship chart (PT chart).
- Subtract saturated evaporator from evaporator suction line temperature to obtain evaporator superheat.

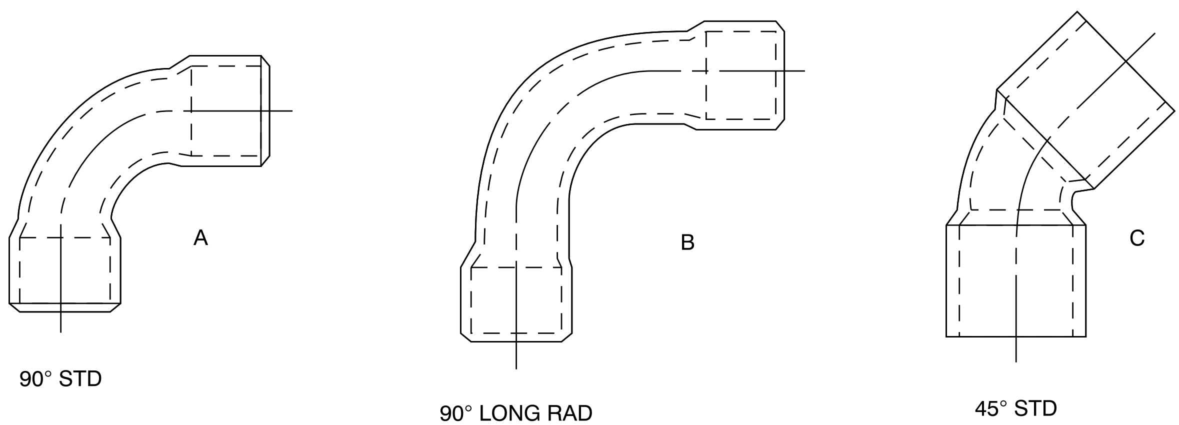


Fig. 35 – Tube Fitting Geometry

Table 4 – Fitting Losses in Equivalent Feet

TUBE SIZE OD (IN.)	90° STD (A)	90° LONG RAD (B)	45° STD (C)
1/2	1.2	0.8	0.6
5/8	1.6	1.0	0.8
3/4	1.8	1.2	0.9
7/8	2.0	1.4	1.0
1-1/8	2.6	1.7	1.3

Table 5 – Puron Advance (R-454B) System Suction Pressure Drop

Nominal Size (Btuh)	Suction Line OD (in.)	Pressure Drop (psi/100 ft)	Suction Velocity fpm	R-454B Suction Line Pressure Drop (psig) Total Equivalent Line Length (ft)									
				20	50	80	100	125	150	175	200	225	250
18000	1/2	13.0	1651	3	7	11	13	16	18	21	23	25	27
	5/8	4.2	1044	1	2	3	4	5	6	7	8	9	10
	3/4	1.6	706	0	1	1	2	2	2	3	3	3	4
24000	1/2	21.0	2157	5	12	17	21	25	29	32	35	38	41
	5/8	7.1	1405	2	4	6	7	9	10	12	13	15	16
	3/4	2.8	959	1	1	2	3	3	4	5	5	6	7
	7/8	1.4	725	0	1	1	1	2	2	2	3	3	3
30000	5/8	9.2	1636	2	5	7	9	11	13	15	17	18	20
	3/4	3.6	1125	1	2	3	4	4	5	6	7	8	8
	7/8	1.9	853	0	1	1	2	2	3	3	4	4	4
36000	5/8	12.8	1981	3	7	11	13	16	18	20	23	25	27
	3/4	5.2	1380	1	3	4	5	6	8	9	10	11	12
	7/8	2.7	1051	1	1	2	3	3	4	5	5	6	6
42000	5/8	17.5	2294	4	10	14	17	21	24	27	30	33	35
	3/4	7.3	1622	2	4	6	7	9	10	12	13	15	16
	7/8	3.8	1242	1	2	3	4	5	6	6	7	8	9
	1 1/8	1.1	740	0	1	1	1	1	2	2	2	2	3
48000	3/4	8.9	1825	2	5	7	9	11	13	15	16	18	19
	7/8	4.6	1403	1	2	4	5	6	7	8	9	10	11
	1 1/8	1.3	838	0	1	1	1	2	2	2	3	3	3
60000	3/4	12.5	2169	3	7	10	13	15	18	20	22	25	27
	7/8	6.6	1679	1	3	5	7	8	10	11	12	14	15
	1 1/8	1.9	1009	0	1	2	2	2	3	3	4	4	5
	= Line set application not recommended												

Example 1

While on a service call, after checking for proper indoor and outdoor airflow, Tom finds the following pressures and temperatures at the service valves of a **Puron Advance™ (R-454B)** air conditioner:

- Liquid line pressure = 340 psig
- Liquid line temperature = 100°F
- Suction line pressure = 118 psig
- Suction line temperature = 60°F

Using a Puron Advance™ (R-454B) PT chart, the subcooling is determined to be 8°F, which is within ±3 of the 10°F listed on the rating plate. Tom believes the charge is correct. He calculates the superheat to be approximately 17°F superheat. The apparently high superheat has Tom concerned.

Tom uses the Pseudo Evaporator Superheat method to check the TXV performance. The system is a 3-ton Puron Advance air conditioner with 75 feet equivalent length of 3/4" suction line. Based on Table 5, the system has approximately 4-psig pressure drop in the vapor line. Per the instructions, he takes the suction line temperature at the outlet of the evaporator and finds it to be 53°F. Tom adds 4 psig to the 118-psig suction pressure at the outdoor unit to get 122 psig evaporator pressure. The saturated pressure of 122 equates to 46°F. Tom calculates the evaporator superheat to be (53°F - 46°F =) 7°F. The TXV appears to be operating properly.

NOTE: The additional superheat at the compressor is due principally to heat gain in the 75 feet of suction line with a minor contribution by the pressure drop. Because the suction line of the lineset was the same size as the vapor service valve fitting and less than 80 feet, Tom could have ignored the pressure drop in the suction line and obtained the evaporator superheat by using the vapor service valve pressure of 118 psig (saturated temperature = 45°F) and the evaporator outlet temperature of 53°F. The evaporator superheat is calculated to be (53°F - 45°F =) 8°F.

Table 6 – Puron Advance™ (R-454B) Refrigerant Pressure Temperature Chart

PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
12	-33.6	118	44.8	224	80.8	330	107.8	436	129.1	542	145.2
14	-31.2	120	45.6	226	81.3	332	108.3	438	129.4	544	145.5
16	-28.9	122	46.5	228	81.9	334	108.7	440	129.8	546	145.8
18	-26.6	124	47.4	230	82.4	336	109.2	442	130.1	548	146.1
20	-24.4	126	48.2	232	83.0	338	109.7	444	130.5	550	146.4
22	-22.2	128	49.0	234	83.5	340	110.1	446	130.8	554	147.0
24	-20.1	130	49.9	236	84.1	342	110.6	448	131.1	558	147.6
26	-18.0	132	50.7	238	84.6	344	111.0	450	131.4	560	147.8
28	-15.9	134	51.5	240	85.2	346	111.4	452	131.8	564	148.4
30	-13.9	136	52.3	242	85.7	348	111.9	454	132.1	568	149.0
32	-11.9	138	53.1	244	86.3	350	112.3	456	132.4	570	149.3
34	-10.0	140	53.8	246	86.8	352	112.8	458	132.7	574	149.9
36	-8.1	142	54.6	248	87.3	354	113.2	460	133.1	578	150.5
38	-6.3	144	55.3	250	87.9	356	113.6	462	133.4	580	150.8
40	-4.5	146	56.1	252	88.4	358	114.1	464	133.7	584	151.4
42	-2.7	148	56.8	254	88.9	360	114.5	466	134.0	588	151.9
44	-0.9	150	57.6	256	89.5	362	114.9	468	134.3	590	152.2
46	0.8	152	58.3	258	90.0	364	115.4	470	134.6	594	152.8
48	2.4	154	59.0	260	90.5	366	115.8	472	135.0	598	153.4
50	4.1	156	59.7	262	91.1	368	116.2	474	135.3	600	153.7
52	5.7	158	60.4	264	91.6	370	116.6	476	135.6	604	154.3
54	7.2	160	61.1	268	92.6	372	117.0	478	135.9	606	154.6
56	8.8	162	61.8	268	92.6	374	117.4	480	136.2	608	154.9
58	10.3	164	62.5	270	93.1	376	117.9	482	136.5	610	155.3
60	11.8	166	63.1	272	93.7	378	118.3	484	136.8	612	155.6
62	13.2	168	63.8	274	94.2	380	118.7	486	137.1	614	155.9
64	14.6	170	64.5	278	95.2	382	119.1	488	137.4	616	156.2
66	16.0	172	65.1	278	95.2	384	119.5	490	137.7	618	156.5
68	17.4	174	65.8	280	95.7	386	119.9	492	138.0	620	156.8
70	18.7	176	66.4	282	96.2	388	120.3	494	138.3	624	157.4
72	20.1	178	67.1	284	96.7	390	120.7	496	138.6	626	157.7
74	21.4	180	67.7	286	97.2	392	121.1	498	138.9	628	158.0
76	22.6	182	68.3	288	97.7	394	121.4	500	139.2	630	158.3
78	23.9	184	69.0	290	98.2	396	121.8	502	139.5	634	158.9
80	25.1	186	69.6	292	98.7	398	122.2	504	139.8	636	159.2
82	26.3	188	70.2	294	99.2	400	122.6	506	140.1	638	159.5
84	27.5	190	70.8	296	99.7	402	123.0	508	140.3	640	159.8
86	28.6	192	71.4	298	100.2	404	123.4	510	140.6	644	160.5
88	29.8	194	72.0	300	100.7	406	123.7	512	140.9	646	160.8
90	30.9	196	72.6	302	101.2	408	124.1	514	141.2	648	161.1
92	32.0	198	73.2	304	101.7	410	124.5	516	141.5	650	161.4
94	33.1	200	73.8	306	102.2	412	124.8	518	141.8	654	162.0
96	34.1	202	74.4	308	102.6	414	125.2	520	142.1	656	162.3
98	35.2	204	75.0	310	103.1	416	125.6	522	142.4	658	162.6
100	36.2	206	75.6	312	103.6	418	125.9	524	142.7	660	162.9
102	37.2	208	76.2	314	104.1	420	126.3	526	143.0	664	163.4
104	38.2	210	76.8	316	104.6	422	126.7	528	143.2	666	163.7
106	39.2	212	77.4	318	105.0	424	127.0	530	143.5	668	164.0
108	40.2	214	77.9	320	105.5	426	127.4	532	143.8	670	164.3
110	41.1	216	78.5	322	106.0	428	127.7	534	144.1	574	164.9
112	42.0	218	79.1	324	106.4	430	128.1	536	144.4	676	165.2
114	43.0	220	79.6	326	106.9	432	128.4	536	144.4	**Critical Point**	
116	43.9	222	80.2	328	107.4	434	128.8	540	145.0	722	173

Table 7 – Puron Advance (R-454B) Subcooling Chart

Liquid Line Temperature (°F)											
Liq Press PSIG	**P-T (°F)**	**Subcooling (°F)**									
		2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
200	74	72	70	68	66	64	62	60	58	56	54
210	77	75	73	71	69	67	65	63	61	59	57
220	79	77	75	73	71	69	67	65	63	61	59
230	82	80	78	76	74	72	70	68	66	64	62
240	85	83	81	79	77	75	73	71	69	67	65
250	87	85	83	81	79	77	75	73	71	69	67
260	90	88	86	84	82	80	78	76	74	72	70
270	92	90	88	86	84	82	80	78	76	74	72
280	95	93	91	89	87	85	83	81	79	77	75
290	97	95	93	91	89	87	85	83	81	79	77
300	99	97	95	93	91	89	87	85	83	81	79
310	102	100	98	96	94	92	90	88	86	84	82
320	104	102	100	98	96	94	92	90	88	86	84
330	106	104	102	100	98	96	94	92	90	88	86
340	108	106	104	102	100	98	96	94	92	90	88
350	111	109	107	105	103	101	99	97	95	93	91
360	113	111	109	107	105	103	101	99	97	95	93
370	115	113	111	109	107	105	103	101	99	97	95
380	117	115	113	111	109	107	105	103	101	99	97
390	119	117	115	113	111	109	107	105	103	101	99
400	121	119	117	115	113	111	109	107	105	103	101
410	123	121	119	117	115	113	111	109	107	105	103
420	125	123	121	119	117	115	113	111	109	107	105
430	127	125	123	121	119	117	115	113	111	109	107
440	128	126	124	122	120	118	116	114	112	110	108
450	130	128	126	124	122	120	118	116	114	112	110
460	132	130	128	126	124	122	120	118	116	114	112
470	134	132	130	128	126	124	122	120	118	116	114
480	135	133	131	129	127	125	123	121	119	117	115
490	137	135	133	131	129	127	125	123	121	119	117
500	139	137	135	133	131	129	127	125	123	121	119
510	140	138	136	134	132	130	128	126	124	122	120
520	142	140	138	136	134	132	130	128	126	124	122
530	143	141	139	137	135	133	131	129	127	125	123
540	145	143	141	139	137	135	133	131	129	127	125
550	146	144	142	140	138	136	134	132	130	128	126
560	147	145	143	141	139	137	135	133	131	129	127
570	149	147	145	143	141	139	137	135	133	131	129
580	150	148	146	144	142	140	138	136	134	132	130
590	151	149	147	145	143	141	139	137	135	133	131
600	153	151	149	147	145	143	141	139	137	135	133
610	154	152	150	148	146	144	142	140	138	136	134

Table 8 – Puron Advance (R-454B) Superheat Chart

Vap Press PSIG	P-T (°F)	Vapor Line Temperature (°F)														
		Superheat (°F)														
		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
80	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54
82	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55
84	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56
86	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57
88	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58
90	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59
92	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
94	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61
96	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62
98	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63
100	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64
102	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65
104	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66
106	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67
108	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68
110	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69
112	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
114	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71
116	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
118	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73
120	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74
122	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74
124	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75
126	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76
128	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77
130	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78
132	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79
134	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
136	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
138	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81
140	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
142	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83
144	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84
146	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84
148	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85
150	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86
152	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87
154	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87
156	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88
158	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89
160	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
162	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90

Two Stage Non-Communicating

These units are a 2-stage option that is non-communicating utilizing 2 stage scroll technology. These units require furnaces or fan coils capable of two stages of airflow. Other furnaces or fan coils will NOT be rated with the new two stage units as they are not capable of meeting the air flow requirements necessary for rating. These are designed to operate with basic 24 volt thermostat inputs.

Operating Ambient

The minimum outdoor operating ambient in cooling mode is 55_F / 12.78_C, and the maximum outdoor operating ambient in cooling mode is 125_F / 51.67_C when operating voltage is 230v.

Airflow Selections (ECM Furnaces)

The ECM Furnaces provide blower operation to match the capacities of the compressor during high and low stage cooling operation. Tap selections on the furnace control board enable the installing technician to select the proper airflows for each stage of cooling. Below is a brief summary of the furnace airflow configurations

1. The Y2 call for high stage cooling energizes the “Cool” tap on the control board. The grey wire from cool tap is connected to tap 5 on the motor. Refer to the furnace Product Data to find the corresponding airflow. If the airflow setting for high cooling needs to be switched from tap 5 to a different tap, jumper a connection from the cool tap to the desired tap so that the Y2 signal is communicated via the cool tap to the desired speed tap.
2. The Y1 call for low stage cooling energizes the “Fan” tap on the control board. The red wire from the fan tap is connected to tap 1 on the motor. Refer to the furnace Product Data to find the corresponding airflow. If the airflow setting for low cooling needs to be switched from tap 1 to a different tap, jumper a connection from the Fan tap to the desired tap so that the Y1 signal is communicated via the Fan tap to the desired speed tap. The Y1 setting will also govern the continuous fan airflow for the furnace. Refer to the literature for the furnace for further details.

Airflow Selection for Variable Speed Furnaces (non-communicating)

The variable speed furnaces provide blower operation to match the capacities of the compressor during high and low stage cooling operation. The furnace control board allows the installing technician to select the proper airflows for each stage of cooling. Below is a summary of required adjustments. See furnace installation instructions for more details:

1. Turn SW1-5 ON for 400 CFM/ton airflow or OFF for 350 CFM/ton airflow. Factory default is OFF.
2. The A/C DIP switch setting determines airflow during high stage cooling operation. Select the A/C DIP switch setting corresponding to the available airflow shown in the furnace Installation Instructions that most closely matches the required airflow shown in the air conditioning Product Data for HIGH speed.
3. The CF DIP switch setting determines airflow during low stage cooling operation. Select the CF DIP switch setting corresponding to the available airflow shown in the furnace installation instructions that most closely matches the required airflow shown in the air conditioning Product Data for LOW speed. If a higher or lower continuous fan speed is desired, the continuous fan speed can be changed using the fan switch on the thermostat. Refer to the furnace Installation Instructions for details of how to use this feature.

System function and Sequence Of Two-Stage Operation

NOTE: Defrost control board is equipped with 5 minute lockout timer that is initiated upon any interruption of power.

Turn on power to indoor and outdoor units. Transformer is energized.

These models utilize a 2-stage indoor thermostat. With a call for first (low) stage cooling or heating, the outdoor fan and low-stage compressor are energized. If low-stage cannot satisfy cooling or heating demand, high-stage is energized by the second (high) stage of the indoor thermostat. After the second stage is satisfied, the unit returns to low-stage operation until second stage is required again. When both, first and second stage cooling or heating are satisfied, the compressor will shut off.

Cooling

With first stage cooling, Y and O are powered on; and with second stage cooling, Y2, Y and O are powered on. The O energizes the reversing valve, switching it to cooling position. The Y signal sends low voltage through the safeties and energizes the T1 terminal on the circuit board. If the compressor has been off for 5 minutes, or power has not been cycled for 5 minutes, the OF2 relay and T2 terminal will energize. This will close the contactor and start the outdoor fan motor and compressor. When the cycle is complete, Y is turned off, stopping the compressor and outdoor fan. The 5 minute time guard begins counting. Compressor will not come on until this delay expires. In the event of a power interruption, the time guard will not allow another cycle for 5 minutes.

Heating

With first stage heating, Y is powered on; with second stage heating, Y2 and Y are powered on. The Y signal sends low voltage through the safeties and energizes the T1 terminal on the circuit board. If the compressor has been off for 5 minutes or power has not been cycled for 5 minutes, the OF2 relay and T2 terminal will energize. This will close the contactor and start the outdoor fan motor and compressor.

When the cycle is complete, Y is turned off, stopping the compressor nd outdoor fan. The 5 minute time guard begins counting. Compressor will not come on until this delay expires. In the event of a power interruption, the time guard will not allow another cycle for 5 minutes.

Compressor Operation

The basic scroll design has been modified with the addition of an internal unloading mechanism that opens a by-pass port in the first compression pocket, effectively reducing the displacement of the scroll. The opening and closing of the by-pass port is controlled by an internal electrically operated solenoid. The modulated scroll uses a single step of unloading to go from full capacity to approximately 67% capacity.

A single speed, high efficiency motor continues to run while the scroll modulates between the two capacity steps. Modulation is achieved by venting a portion of the gas in the first suction pocket back to the low side of the compressor, thereby reducing the effective displacement of the compressor.

Full capacity is achieved by blocking these ports, thus increasing the displacement to 100%. A DC solenoid in the compressor controlled by a rectified 24 volt AC signal in the external solenoid plug moves the slider ring that covers and uncovers these ports.

The port covers are arranged in such a manner that the compressor operates at approximately 67% capacity when the solenoid is not energized and 100% capacity when the solenoid is energized. The loading and unloading of the two step scroll is done ”on the fly” without shutting off the motor between steps.

NOTE: 67% compressor capacity translates to approximately 75% cooling or heating capacity at the indoor coil.

The compressor will always start unloaded and stay unloaded for five seconds even when the thermostat is calling for high stage capacity.

Verify units for proper switching between low & high stages

Check the suction pressures at the service valves. Suction pressure should be reduced by 3-10% when switching from low to high capacity.

Compressor current should increase 20-45% when switching from low to high stage. The compressor solenoid when energized in high stage, should measure 24vac.

When the compressor is operating in low stage the 24v DC compressor solenoid coil is de-energized. When the compressor is operating in high stage, the 24v DC solenoid coil is energized. The solenoid plug harness that is connected to the compressor has an internal rectifier that converts the 24v AC signal to 24v DC. **DO NOT INSTALL A PLUG WITHOUT AN INTERNAL RECTIFIER.**

Unloader Test Procedure

The unloader is the compressor internal mechanism, controlled by the DC solenoid, that modulates between high and low stage. If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at 30 second plus intervals at the thermostat (from low to high stage and back to low stage). Wait 5 seconds after staging to high before taking a reading. The compressor amperage should go up or down at least 20 percent.
2. If the expected result is not achieved, remove the solenoid plug from the compressor and with the unit running and the thermostat calling for high stage, test the voltage output at the plug with a DC voltmeter. The reading should be 24 volts DC.
3. If the correct DC voltage is at the control circuit molded plug, measure the compressor unloader coil resistance. The resistance should be approximately 330 or 1640 ohms depending on unloader coil supplier. If the coil resistance is infinite or is grounded, the compressor must be replaced.

CARE AND MAINTENANCE

To assure high performance and minimize possible equipment malfunction, it is essential that maintenance be performed periodically on this equipment. The frequency with which maintenance is performed is dependent on such factors as hours of operation, geographic location, and local environmental conditions.

⚠ WARNING

ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Disconnect all electrical power to unit before performing any maintenance or service on outdoor unit. Remember to disconnect power supply to air handler as this unit supplies low-voltage power to the outdoor unit.

The minimum maintenance that should be performed on this equipment is as follows:

1. Check outdoor coil for cleanliness each heating and cooling season and clean as necessary.
2. Check fan motor and blade for cleanliness each month during cooling season and clean as necessary.
3. Check electrical connections for tightness and controls for proper operation each cooling season and service as necessary.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Because of possible damage to the equipment or personal injury, maintenance should be performed by qualified personnel only.

Desert and Seacoast Locations

Special consideration must be given to installation and maintenance of condensing units installed in coastal or desert locations. This is because salt and alkali content of sand adheres to aluminum fins of coil and can cause premature coil failure due to corrosion.

Preventive measures can be taken during installations, such as:

1. Locate unit on side of structure opposite prevailing winds.
2. Elevate unit to height where drifting sand cannot pile up against coil. Mounting feet, 4 in. high, are available as accessories and can be used to elevate unit.
3. Addition of coastal filter (See Product Data for accessory listing).

Maintenance in desert and seacoast locations:

1. Frequent inspection of coil and basepan especially after storms and/or high winds.
2. Clean coil by flushing out sand from between coil fins and out of basepan as frequently as inspection determines necessary.
3. In off season, cover with covering that allows air to circulate through but prevents sand from sifting in (such as canvas material). Do not use plastic as plastic will hold moisture possibly causing corrosion.

Cleaning Coil

1. Remove top cover. (See Remove Top Cover in Cabinet section of this manual.)
2. Remove coil grilles or louvers (as applicable) to gain full access to coils for cleaning.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in equipment damage or improper operation.

Coil fin damage can result in higher operating costs or compressor damage. Do not use flame, high-pressure water, steam, volatile or corrosive cleaners on fins or tubing.

3. Clean coil using vacuum cleaner and its crevice tool. Move crevice tool vertically, close to area being cleaned, making sure tool touches only dirt on fins and not fins. to prevent fin damage, do not scrub fins with tool or move tool horizontally against fins.
4. If oil deposits are present, spray coil with ordinary household detergent. Wait 10 minutes, and proceed to next step.
5. Using garden hose, spray coil vertically downward with constant stream of water at moderate pressure. Keep nozzle at a 15- to 20_ angle, about 3 in. from coil face and 18 in. from tube. Spray so debris is washed out of coil and basepan.
6. Reinstall top cover and position blade.
7. Reconnect electrical power and check for proper operation.

Cleaning Outdoor Fan Motor and Blade

1. Remove fan motor and blade. Be careful not to bend or dent fan blade.
2. Clean motor and blade with soft brush or cloth. Be careful not to disturb balance weights on fan blade.
3. Check fan blade setscrew for tightness.
4. Reinstall fan motor and blade to top cover and check for alignment.
5. Reinstall top cover and position blade.
6. Reconnect electrical power and check for proper operation.

Electrical Controls and Wiring

1. Disconnect power to both outdoor and indoor units.
2. Check all electrical connections for tightness. Tighten all screws on electrical connections. If any connections appear to be burned or smoky, disassemble the connection, clean all parts and stripped wires, and reassemble. Use a new connector if old one is burned or corroded, and crimp tightly.
3. Reconnect electrical power to indoor and outdoor units and observe unit through 1 complete operating cycle.
4. If there are any discrepancies in operating cycle, troubleshoot to find cause and correct.

Refrigerant Circuit

1. Check refrigerant charge using the superheat method, and if low on charge, check unit for leaks using an electronic leak detector.
2. If any leaks are found, remove and reclaim or isolate charge (pumpdown) if applicable. Make necessary repairs.
3. Evacuate, recharge, and observe unit through 1 complete operating cycle.

Final Check-Out

After the unit has been operating, the following items should be checked.

1. Check that unit operational noise is not excessive due to vibration of component, tubing, panels, etc. If present, isolate problem and correct.
2. Check to be sure caps are installed on service valves and are tight.
3. Check to be sure tools, loose parts, and debris are removed from unit.
4. Check to be sure all panels and screws are in place and tight.

AIR CONDITIONER TROUBLESHOOTING CHART

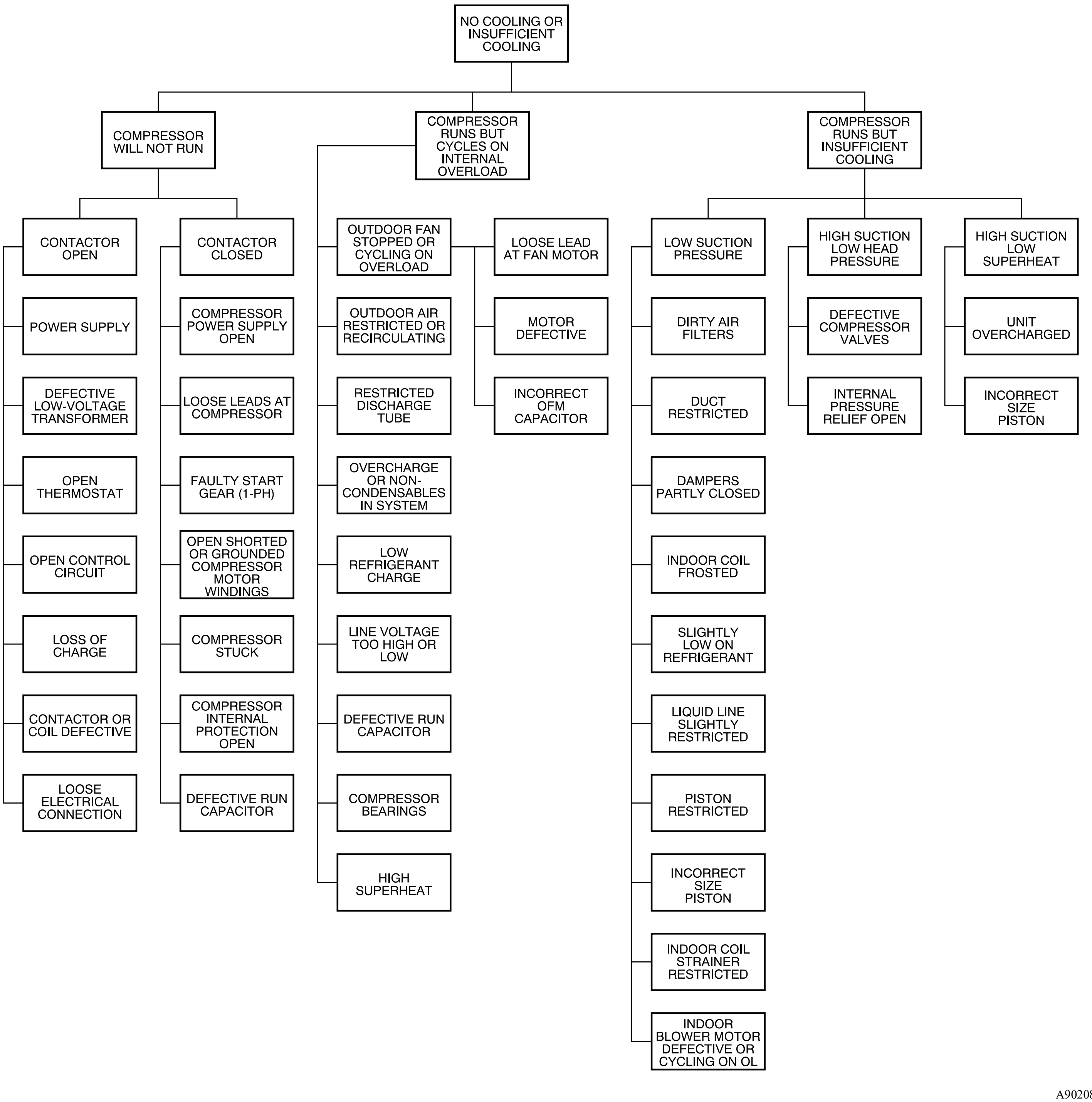


Fig. 36 – Air Conditioner Troubleshooting Chart

HEAT PUMP
TROUBLESHOOTING HEATING CYCLE

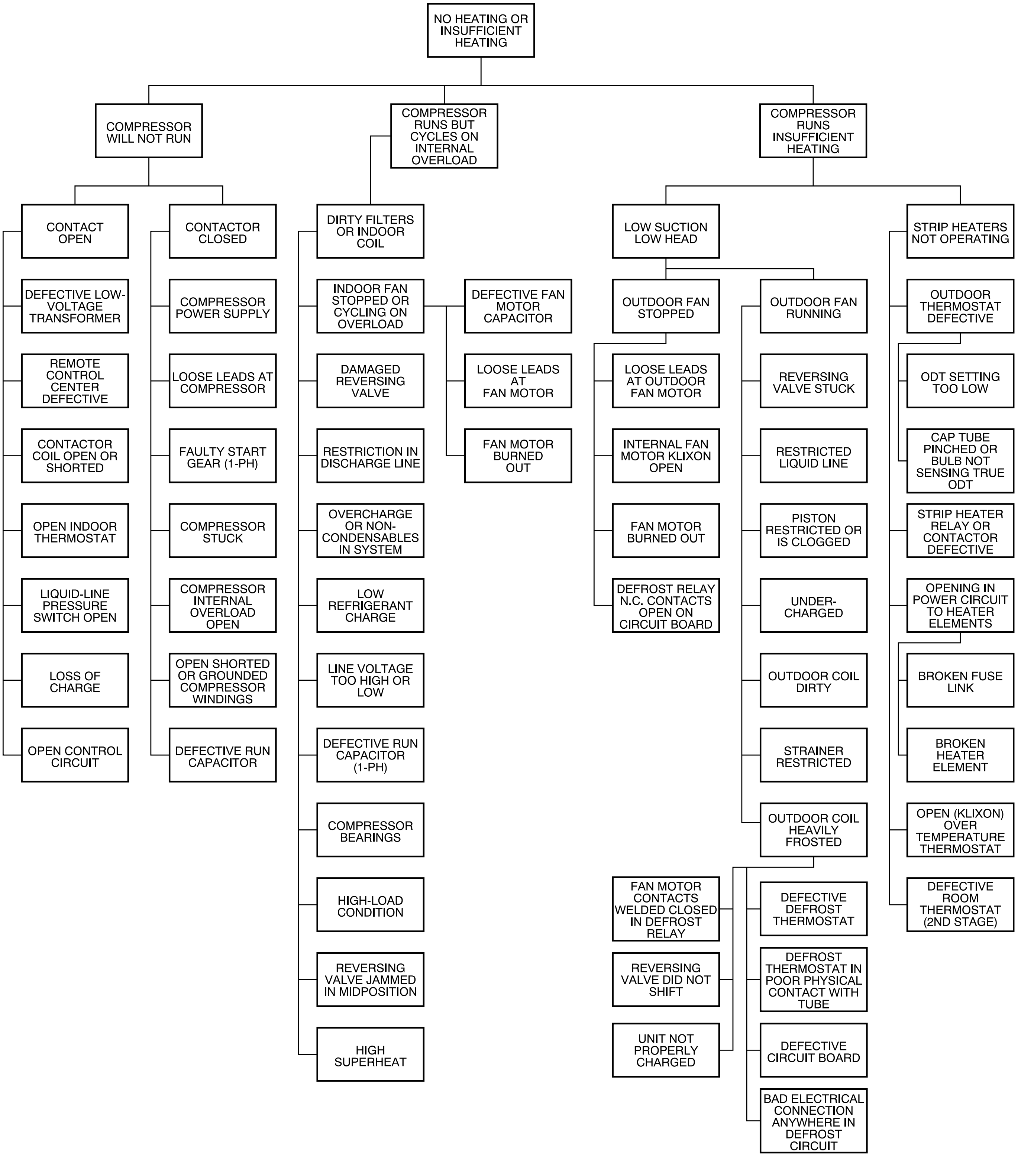


Fig. 37 – Heat Pump Troubleshooting - Heating Cycle

HEAT PUMP
TROUBLESHOOTING COOLING CYCLE

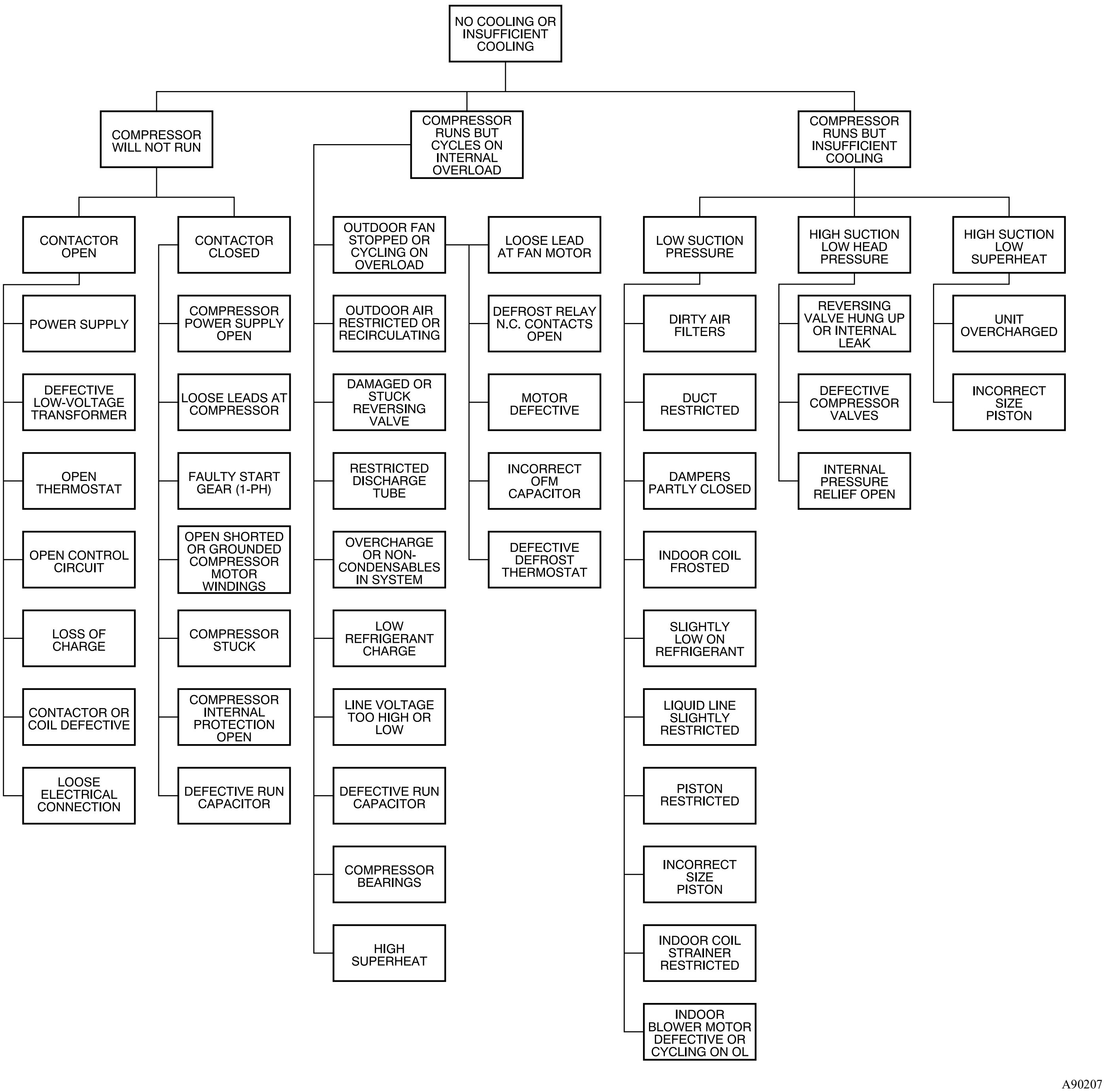


Fig. 38 – Heat Pump Troubleshooting - Cooling Cycle

Training

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