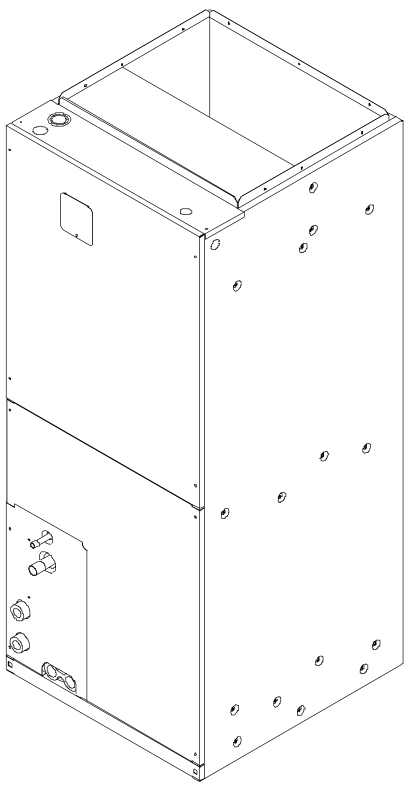
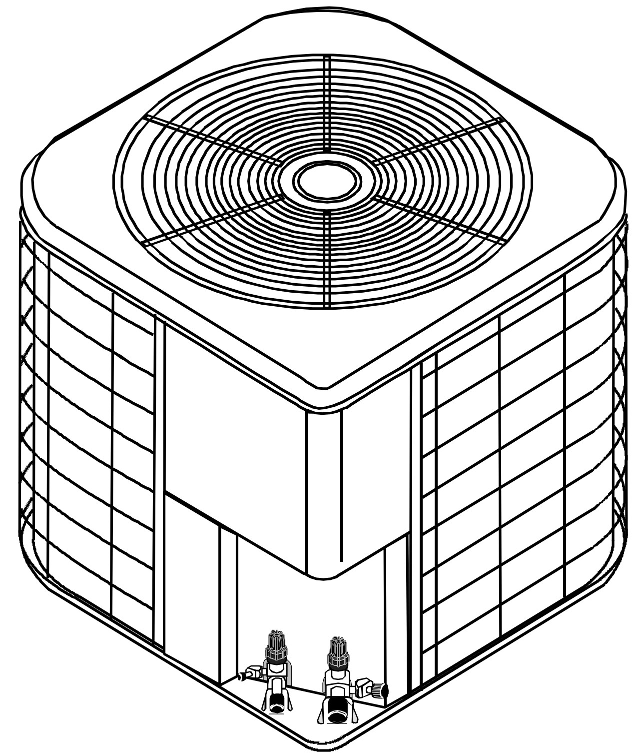
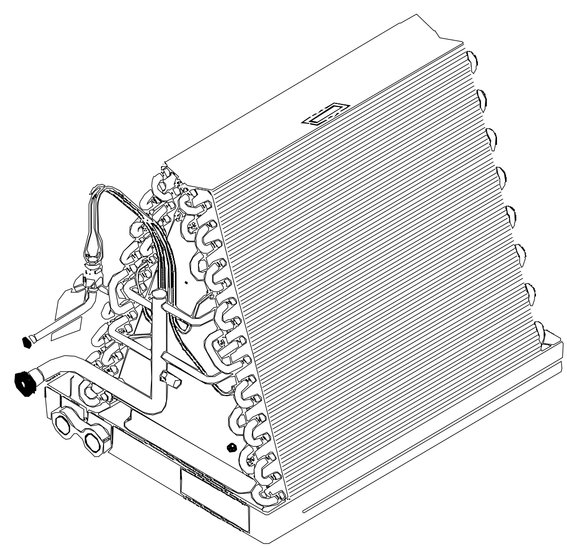
Model and Manufacturing
numbers listed on pages 4 & 5

Service Instructions

RSD Model Remote Coolers with R410A Refrigerant
Blowers, Coils, & Accessories







This manual is to be used by qualified HVAC technicians only. Amana does not assume any responsibility for property damage or personal injury for improper service procedures done by an unqualified person.

Heating & Air Conditioning
Amana®
Comfort. Quality. Trust.

RS6100003
January 2002

Table of Contents

IMPORTANT INFORMATION

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

IMPORTANT NOTICES FOR CONSUMERS AND SERVICERS

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

DANGER

DANGER - Immediate hazards which **WILL** result in severe personal injury or death.

WARNING

WARNING - Hazards or unsafe practices which **COULD** result in severe personal injury or death.

CAUTION

CAUTION - Hazards or unsafe practices which **COULD** result in minor personal injury or product or property damage.

IMPORTANT INFORMATION

⚠ WARNING

IF REPAIRS ARE ATTEMPTED BY UNQUALIFIED PERSONS, DANGEROUS CONDITIONS (SUCH AS EXPOSURE TO ELECTRICAL SHOCK) MAY RESULT. THIS MAY CAUSE SERIOUS INJURY OR DEATH.

⚠ CAUTION

AMANA WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU PERFORM SERVICE ON YOUR OWN PRODUCT, YOU ASSUME RESPONSIBILITY FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE WHICH MAY RESULT.

To locate an authorized servicer, please consult your telephone book or the dealer from whom you purchased this product. For further assistance, please contact:

CONSUMER INFORMATION LINE
AMANA TOLL FREE
1-877-254-4729 (U.S. only)
email us at: hac.consumer.affairs@amanahvac.com
fax us at: (931) 438- 4362
(Not a technical assistance line for dealers.)

Outside the U.S., call 1-931-433-6101.
(Not a technical assistance line for dealers.)
Your telephone company will bill you for the call.

⚠ WARNING

SYSTEM CONTAMINANTS, IMPROPER SERVICE PROCEDURE AND/OR PHYSICAL ABUSE AFFECTING HERMETIC COMPRESSOR ELECTRICAL TERMINALS MAY CAUSE DANGEROUS SYSTEM VENTING.

System contaminants, improper Service Procedure and/or physical abuse affecting hermetic compressor electrical terminals may cause dangerous system venting.

The successful development of hermetically sealed refrigeration compressors has completely sealed the compressor's moving parts and electric motor inside a common housing, minimizing refrigerant leaks and the hazards sometimes associated with moving belts, pulleys, or couplings.

Fundamental to the design of hermetic compressors is a method whereby electrical current is transmitted to the compressor motor through terminal conductors which pass through the compressor housing wall. These terminals are sealed in a dielectric material which insulates them from the housing and maintains the pressure tight integrity of the hermetic compressor. The terminals and their dielectric embedment are strongly constructed, but are vulnerable to careless compressor installation or maintenance procedures and equally vulnerable to internal electrical short circuits caused by excessive system contaminants.

In either of these instances, an electrical short between the terminal and the compressor housing may result in the loss of integrity between the terminal and its dielectric embedment. This loss may cause the terminals to be expelled, thereby venting the vaporous and liquid contents of the compressor housing and system.

A venting compressor terminal normally presents no danger to anyone providing the terminal protective cover is properly in place.

If, however, the terminal protective cover is not properly in place, a venting terminal may discharge a combination of

(a) hot lubricating oil and refrigerant

(b) flammable mixture (if system is contaminated with air)

in a stream of spray which may be dangerous to anyone in the vicinity. Death or serious bodily injury could occur.

Under no circumstances is a hermetic compressor to be electrically energized and/or operated without having the terminal protective cover properly in place.

See Service Section S-17 for proper servicing.

PRODUCT IDENTIFICATION

This section will identify the models that are covered.

Model #	Manufacturing #	Description
RSDA***	P1236801C-P1236806C	**R**emote Cooling (**S**) Alternate Refrigerant (**D**) 13 Seer Outdoor Units. Featuring cubed coil design and low speed fan motors for quieter operation, and R410A refrigerant.
CAF*A**	P1237005C-P1237114C	**C**oil "**A**" style coil design. "**F**" designator indicates flowrator installed. All R410A applications require a R410A rated TXV. Up-flow, counter-flow applications. Cased and uncased models.
CHF*A**	P1237303C-P1237305C	**C**oil "**H**" slab coil design. "**F**" designator indicates flowrator installed. All R410A applications require a R410A rated TXV.
CFF*A**	P1237204C-P1237210C	**C**oil "**F**" dedicated Horizontal A coil design. "**F**" designator indicates flowrator installed. All R410A applications require a R410A rated TXV.
TX410AA**	P1236901C-P1236906C	**T**hermo-e**X**pansion valve Rated for **R410A** (Alternate Refrigerant) installations
GAGE01		Alternate Refrigerant R410A rated manifold gauge set
HOSE01		Alternate Refrigerant R410A rated hose set. These hoses have the 1/2"-20TPI connections to fit the RSD service valves.
ADPT01		Alternate Refrigerant R410A adapter. Will adapt from the Amana 1/2"-20 TPI connection to 1/4" flare connection to allow use of non-Amana R410A rated manifold gauge sets.

PRODUCT DESIGN

This section gives a basic description of cooling unit operation, its various components and their basic operation. Ensure your system is properly sized for heat gain and loss according to methods of the Air Conditioning Contractors Association (ACCA) or equivalent.

CONDENSING UNIT

These units are designed for free air discharge. Condensed air is pulled through the condenser coil by a direct drive propeller fan and then discharged from the cabinet top. The unit requires no additional resistance (i.e. duct work) and should not be added.

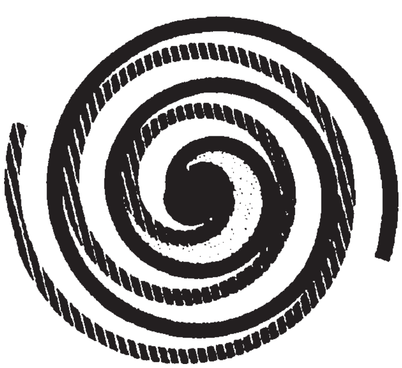
The RSD condensing units are designed for 208-230 dual voltage single phase applications. The units range in size from 2 to 5-ton and have a rating of 13 SEER. The actual system efficiency is dependent upon the unit and its components. Refer to the "Technical Information" manual of the unit you are servicing for further details.

Suction and Liquid Line Connections

The suction and liquid line connections of the unit are set up for field piping with refrigerant-type copper. Back seating valves were factory-installed to accept the field-run copper. The total refrigerant charge needed for a normal installation is also factory-installed. For additional refrigerant line set information, refer to the "Technical Information" manual of the unit you are servicing.

Compressors

Amana RSD outdoor units use Copeland Compliant® ZP series scroll compressors. There are a number of design characteristics which differentiate the scroll compressor from the reciprocating compressor. One is the scroll. A scroll is an involute spiral which, when matched with a mating scroll form, generates a series of crescent-shaped gas pockets between the members (see following illustration). During compression, one scroll remains stationary while the other form orbits. This motion causes the resulting gas pocket to compress and push toward the center of the scrolls. When the center is reached, the gas is discharged out a port located at the compressor center.



COILS AND BLOWER COILS

Amana CA, CH, and CF coils are designed to be installed with a furnace or air handler unit and matched with Amana RSD condensing units to provide high efficiency heating and cooling. R410A rated thermal expansion valves are required on the CA_F, CH_F, and CF_F coils to give accurate refrigerant control and provide reliable operation over a wide range of conditions.

Amana CA coils are designed for upflow and counterflow operation. The CH slab coils, and the CF coils are designed for horizontal applications.

All Amana R410A installations require an R410A rated TXV for proper operation.

BBA and BBC blower cabinets are designed as a two-piece blower coil. Either the BBA or BBC blower section can be attached to a CA**FC*, CH**FC*, or CF*FC* cased evaporator coil. This two piece arrangement allows for a variety of mix-matching possibilities providing greater flexibility.

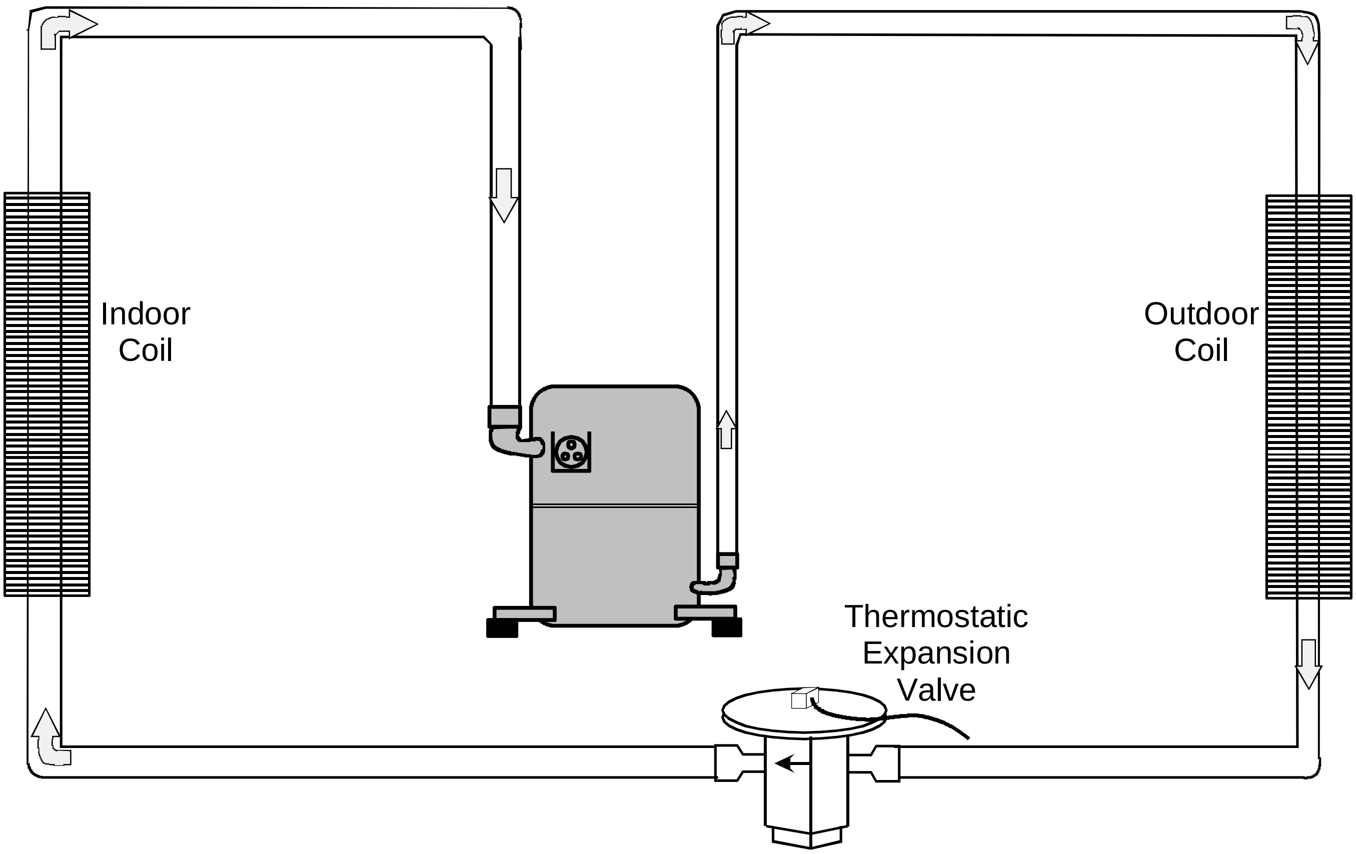
The BBC blower cabinet uses a variable speed motor that maintains a constant airflow despite duct static. It is approved for applications with cooling coils of up to 0.8 inches W.C. external static pressure and includes a feature that allows airflow to be changed by ±15%.

The BBC is intended to be used with a cased evaporator coil and a condensing unit or heat pump. The blower section of the cabinet can also be used as an electric furnace. The electric heating elements are field-installed. Electric heater kits (EHK-B/C/D and ECB_B/C/D) are available as sales accessories for supplemental electric heat.

The BBA and BBC blower cabinets can be positioned for upflow, counterflow, horizontal right or horizontal left operation. All units are constructed with R-4.2 insulation. In areas of extreme humidity (greater than 80% consistently), the installer should insulate the exterior of the blower with insulation having a vapor barrier equivalent to ductwork insulation, providing local codes permit.

SYSTEM OPERATION

COOLING CYCLE



COOLING

The refrigerant used in the system is R410A. It is a clear, colorless, non-toxic, non-irritating, liquid. R410A is a 50:50 blend of R-32 and R-125. The boiling point at atmospheric pressure is **-62.9°**F.

A few of the important principles that make the refrigeration cycle possible are: heat always flows from a warmer to a cooler body, under lower pressure a refrigerant will absorb heat and vaporize at a low temperature, the vapors may be drawn off and condensed at a higher pressure and temperature to be used again.

The indoor evaporator coil functions to cool and dehumidify the air conditioned spaces through the evaporative process taking place within the coil tubes.

NOTE: The pressures and temperatures shown in the refrigerant cycle illustrations on the following pages are for demonstration purposes only. Actual temperatures and pressures are to be obtained from the "Expanded Performance Chart."

Liquid refrigerant at condensing pressure and temperatures, (428 psig and 122°F), leaves the outdoor condensing coil through the drier and is metered into the indoor coil through the metering device. As the cool, low pressure, saturated refrigerant enters the tubes of the indoor coil, a portion of the liquid immediately vaporizes. It continues to soak up heat and vaporizes as it proceeds through the coil, cooling the indoor coil down to about 48°F.

Heat is continually being transferred to the cool fins and tubes of the indoor evaporator coil by the warm system air. This warming process causes the refrigerant to boil. The heat removed from the air is carried off by the vapor.

As the vapor passes through the last tubes of the coil, it becomes superheated, that is, it absorbs more heat than is necessary to vaporize it. This is assurance that only dry gas will reach the compressor. Liquid reaching the compressor can weaken or break compressor valves.

The compressor increases the pressure of the gas, thus adding more heat, and discharges hot, high pressure superheated gas into the outdoor condenser coil.

In the condenser coil, the hot refrigerant gas, being warmer than the outdoor air, first loses its superheat by heat transferred from the gas through the tubes and fins of the coil. The refrigerant now becomes saturated, part liquid, part vapor and then continues to give up heat until it condenses to a liquid alone. Once the vapor is fully liquefied, it continues to give up heat which subcools the liquid, and it is ready to repeat the cycle.

SYSTEM OPERATION

BBA Standard Efficiency Blower Section Sequence of Operation

BBA Cooling-Only Operations

The cooling operation is fairly straight forward. With the thermostat in the FAN—AUTO position and a “Y” or “G” call, the blower starts within three seconds. When the “Y” call is satisfied, the blower will stay on until the supply temperature is greater than 65°F or up to a maximum of forty-five seconds, whichever occurs first.

BBA Electric Heat-Only Operations

As in the cooling-only operations, with the thermostat in the FAN—AUTO position and a “W2” or “E” call, the blower starts within three seconds. The board then starts turning-on banks of electric heat, one every ten seconds, until the supply temperature reaches 90°F. If the “W2” or “E” call has not been satisfied within the next five minutes, the board turns-on additional banks of heaters and increases the minimum supply temperature (selectable) from 90°F to 110°F. If an additional five minutes passes and the “W2” or “E” call has not been satisfied, the board will raise the minimum supply temperature to 120°F and once again turns-on additional banks of electric heaters.

Should the temperature at the thermistor go above 150°F, the control logic will start turning off one bank of heaters every ten seconds until the temperature falls below 150°F. If the temperature climbs above 160°F, the control logic turns off all electric heat and keeps the blower on until the temperature falls below 85°F.

BBA Fan Idle Option

The control board has a special option for the BBA models. The blower motor is wired for only one speed for heating and cooling operations. The control has a "Fan Idle" tap that is energized when there is not a call for heating, cooling, or fan operation. Any one motor speed lead can be connected to the “idle” speed tap. With the thermostat in the FAN—AUTO position, the board allows the motor to operate at the “idle” speed during system off cycles for minimum circulation air. When the thermostat is switched to the FAN—ON position, the blower motor will operate at heating/cooling speed.

BBC High Efficiency Blower Section

Sequence of Operation

It is important to note that the operational logic for the control board for the BBC’s is different from the BBA board, hence, they are not interchangeable.

The BBC’s use the variable speed to maintain constant CFM. However, the BBC’s control board logic changes the CFM in response to “over-temperature” and “under-temperature” conditions with help from the discharge air temperature readings from the discharge air thermistor.

BBC Cooling-Only Operations

With the thermostat in the FAN—AUTO position and a “Y” or “G” call, the blower ramps up to speed. After a 3 minute period, if the supply thermistor senses the acceptable cooling operation temperature range of 50 to 75°F, the control maintains the preset CFM setting.

If the supply air temperature is above the acceptable range, 75°F, the control logic decreases the CFM. If the supply temperature is below the acceptable temperature, the control increases the CFM. On the next “Y” or “G” call the CFM will return to the preset level.

BBC Electric Heat-Only Operations

As in the cooling-only operations, with the thermostat in the FAN—AUTO position and a “W2” or “E” call, the first bank of electric heat is energized as the blower ramps up to speed over a 30 second period. The control logic continues turning-on banks of electric heat, one every ten seconds, until the supply temperature reaches a set point of 110°F. The board will then keep all existing banks of electric heaters on until the “W2” or “E” call has been satisfied. The minimum supply air setting has no effect in this mode. If the “W2” or “E” call has not been satisfied within the ten minutes, the board increases the minimum supply temperature to 120°F. If the supply air temperature goes above the upper limit of the acceptable range, 150°F, the control turns off one bank of heaters every 10 seconds until the temperature falls below 150°F. Should the temperature exceed 160°F, the control logic will shut-off all electric heat and runs the fan continuously until the temperature is back below 105°F.

BBC Heat Pump With Back Up Electric Heat Operations

With the thermostat in the FAN—AUTO position and a “W2”, "Y", and "O" signal, after 30 seconds, the control compares the supply air temperature to the minimum supply air setting on the control. If the supply air is at or above the minimum supply air setting, no electric heat is energized. If the supply is below the minimum supply air setting, the control will decrease the blower CFM by 10% and wait 30 seconds to see if the minimum supply air temperature is met. If the minimum supply air temperature is not met, the control will return the blower CFM to the preset CFM, turn on one bank of electric heat, and wait another 30 seconds to see if the supply air is at or above the minimum supply air setting.

The control will repeat this procedure until the supply air is at or above minimum supply air setting. The control will then maintain all existing banks of electric heaters and CFM settings until the thermostat has been satisfied.

If the supply air temperature is above the upper limit of the acceptable range, 150°F, the control turns off one bank of heaters every 10 seconds until the temperature falls below 150°F. Should the temperature exceed 160°F, the control logic will shut-off all electric heat and runs the fan continuously until the temperature is back below 105°F.

BBC Manual Fan Operation

The control board has a special option for the BBC models. When the thermostat is switched to the FAN—ON position, the blower motor will operate at either 50% or 100% of the cooling speed. This is accomplished with the use of the "Low Speed Manual Fan" jumper located just below the indicator light on the control board. With the jumper in place (as shipped) the blower will operate at 50% of the nominal cooling speed selected. With the jumper removed the blower will operate at 100% of the nominal blower speed selected.

Accessories

Model Number	ASC01A	ATK05A	CSB__A	HSK10A	HSK12A	ADPT01	HOSE01	GAGE01	FSK01A	TX410A01A	TX410A03A	TX410A04A	TX410A05A	SPK01A	SPK02A	DSK01A	EHK05B/C/D	EHK07B/C/D	EHK10B/C/D	EHK15B/C/D	EHK20B/C/D	EHK25B/C/D	EHK30B/C/D
Description	Anti Short Cycle Kit	Ambient Temperature Kit	Compressor Sound Blanket	Hard Start Kit	Hard Start Kit	Ultron Adaptor Fittings	R410A Hose Set	R410 Gauge Set	Freeze Protection Kit	Expansion Valve Kit	Expansion Valve Kit	Expansion Valve Kit	Expansion Valve Kit	Single Piont Wiring Kit	Single Piont Wiring Kit	Disconnect Kit	Electric Heat Kit	Electric Heat Kit	Electric Heat Kit	Electric Heat Kit	Electric Heat Kit	Electric Heat Kit	Electric Heat Kit
RSD24A2*	**	x	**	x		x	x	x	x	x													
RSD30A2*	**	x	**	x		x	x	x	x		x												
RDS36A2*	**	x	**	x		x	x	x	x		x												
RSD42A2*	**	x	**	x		x	x	x	x			x											
RSD48A2*	**	x	**		x	x	x	x	x			x											
RSD60A2*	**	x	**		x	x	x	x	x				x										
BBA24A2A														x	x	x	x	x	x	x	x		
BBA36A2A														x	x	x	x	x	x	x	x		
BBA48A2A														x	x	x	x	x	x	x	x	x	x
BBA60A2A														x	x	x	x	x	x	x	x	x	x
BBC36A2A														x	x	x	x	x	x	x	x		
BBC48A2A														x	x	x	x	x	x	x	x	x	x
BBC60A2A														x	x	x	x	x	x	x	x	x	x

x Available for this model ** Factory installed ▢ Not used in this application or not available

SCHEDULED MAINTENANCE

The owner should be made aware of the fact that, as with any mechanical equipment the remote air conditioner requires regularly scheduled maintenance to preserve high performance standards, prolong the service life of the equipment, and lessen the chances of costly failure.

In many instances the owner may be able to perform some of the maintenance, however, the advantage of a service contract, which places all maintenance in the hands of a trained serviceman, should be pointed out to the owner.

WARNING

DISCONNECT POWER SUPPLY BEFORE SERVICING

ONCE A MONTH

1. Inspect the return filters of the evaporator unit and clean or change if necessary. **NOTE:** Depending on operation conditions, it may be necessary to clean the filters more often. If permanent type filters are used, they should be washed with warm water, dried and sprayed with an adhesive according to manufacturers recommendations.
2. When operating on the cooling cycle, inspect the condensate line piping from the evaporator coil. Make sure the piping is clear for proper condensate flow.

ONCE A YEAR

Qualified Service Personnel Only

1. Clean the indoor and outdoor coils.
2. Clean the casing of the outdoor unit inside and out.
3. Motors used on Amana products are considered to be permanently lubricated and do not require lubrication. Most current motors no longer have oil ports on the motors.
4. Manually rotate the outdoor fan and indoor blower to be sure they run freely.
5. Inspect the control panel wiring, compressor connections, and all other component wiring to be sure all connections are tight. Inspect wire insulation to be certain that it is good.
6. Check the contacts of the compressor contactor. If they are burned or pitted, replace the contactor.
7. Using a halide or electronic leak detector, check all piping and etc. for refrigerant leaks.
8. Start the system and run a Cooling Performance Test. If the results of the test are not satisfactory, see the "Service Problem Analysis" Chart for the possible cause.

SERVICING

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regular hand tools.

The following is a must for every service technician and service shop:

1. Thermocouple type temperature meter - measure dry bulb temperature.
2. Sling psychrometer- measure relative humidity and wet bulb temperature.
3. Amprobe - measure amperage and voltage.
4. Refrigeration test cord - check compressors, motors, and continuity testing.
5. Volt-Ohm meter - testing continuity, capacitors, and motor windings.
6. Accurate Leak Detector - testing for refrigerant leaks.
7. High evacuation pump - evacuation.
8. Electric vacuum gauge, manifold, and high vacuum hoses - to measure and obtain proper vacuum.
9. Accurate charging cylinder or electronic scale - measure proper refrigerant charge.
10. Inclined manometer - measure static pressure and pressure drop across coils.

Other recording type instruments can be essential in solving abnormal problems, however, in many instances they may be rented from local sources.

Proper equipment promotes faster, more efficient service, and accurate repairs with less call backs.

COOLING & HEATING PERFORMANCE TEST

Before attempting to diagnose an operating fault, run a Cooling and/or Heating Performance Test and apply the results to the Service Problem Analysis Guide.

SCHEDULED MAINTENANCE

Complaint	No Cooling							Unsatisfactory Cooling					System Operating Pressures					
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE" / SYMPTOM	System will not start	Compressor will not start - fan runs	Compressor and Condenser Fan will not start	Evaporator fan will not start	Condenser fan will not start	Compressor runs - goes off on overload	Compressor cycles on overload	System runs continuously - little cooling	Too cool and then too warm	Not cool enough on warm days	Certain areas too cool others too warm	Compressor is noisy	Low suction pressure	Low head pressure	High suction pressure	High head pressure	Test Method Remedy	See Service Procedure Reference
Power Failure	●																Test Voltage	S-1
Blown Fuse	●		●	●													Impact Fuse Size & Type	S-4
Loose Connection	●			●		●											Inspect Connection - Tighten	S-2
Shorted or Broken Wires	●	●	●	●	●	●											Test Circuits With Ohmmeter	S-3
Open Overload	●	●		●	●												Test Continuity of Overloads	S-17A
Faulty Thermostat	●			●					●								Test continuity of Thermostat & Wiring	S-3
Faulty Transformer	●		●														Check control circuit with voltmeter	S-4
Shorted or Open Capacitor		●			●	●											Test Capacitor	S-15
Internal Overload Open	●																Test Continuity of Overload	S-17A
Shorted or Grounded Compressor		●				●											Test Motor Windings	S-17B
Compressor Stuck	●					●											Use Test Cord	S-17C
Faulty Compressor Contactor	●	●			●	●											Test continuity of Coil & Contacts	S-7, S-8
Faulty Fan Relay				●													Test continuity of Coil And Contacts	S-7
Open Control Circuit				●													Test Control Circuit with Voltmeter	S-4
Low Voltage		●				●	●										Test Voltage	S-1
Faulty Evap. Fan Motor				●									●				Repair or Replace	S-16
Shorted or Grounded Fan Motor					●											●	Test Motor Windings	S-16
Improper Cooling Anticipator						●	●		●								Check resistance of Anticipator	S-3
Shortage of Refrigerant							●	●					●	●			Test For Leaks, Add Refrigerant	S-103
Restricted Liquid Line							●	●					●	●			Replace Restricted Part	S-112
Undersized Liquid Line								●		●			●			●	Replace Line	S-120
Undersized Suction Line													●				Replace Line	S-120
Dirty Air Filter								●		●	●		●				Inspect Filter-Clean or Replace	
Dirty Indoor Coil								●		●	●		●				Inspect Coil - Clean	
Not enough air across Indoor Coil								●		●	●		●				Speed Blower, Check Dust Static Pressure	S-200
Too much air across Indoor Coil															●		Reduce Blower Speed	S-200
Overcharge of Refrigerant						●	●					●			●	●	Recover Part of Charge	S-113
Dirty Outdoor Coil						●	●			●			●			●	Inspect Coil - Clean	
Noncondensibles							●			●						●	Remove Charge, Evacuate, Recharge	S-114
Recirculation of Condensing Air							●			●						●	Remove Obstruction to Air Flow	
Infiltration of Outdoor Air								●		●	●						Check Windows, Doors, Vent Fans, Etc.	
Improperly Located Thermostat						●			●								Relocate Thermostat	
Air Flow Unbalanced									●		●						Readjust Air Volume Dampers	
System Undersized								●		●							Refigure Cooling Load	
Broken Internal Parts												●					Replace Compressor	
Broken Values												●					Test compressor Efficiency	S-104
Inefficient Compressor								●						●	●		Test Compressor Efficiency	S-104
High Pressure Control Open			●														Reset And Test Control	S-12
Wrong Type Expansion Valve						●	●			●							Replace Valve	
Expansion Valve Restricted						●	●	●		●			●	●			Replace Valve	
Oversized Expansion Valve												●			●		Replace Valve	
Undersized Expansion Valve						●	●	●		●			●				Repalce Valve	
Expansion Valve Bulb Loose												●			●		Tighten Bulb Bracket	
Inoperative Expansion Valve						●		●					●				Check Valve Operation	S-110
Loose Hold-down Bolts												●					Tighten Bolts	

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SERVICING

S-1 CHECKING VOLTAGE

WARNING

Disconnect Electrical Power Supply:

1. Remove outer case, control panel cover, etc. from unit being tested.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

2. Using a voltmeter, measure the voltage across terminals L1 and L2 of the contactor for the condensing unit or at the field connections for the air handler or heaters.
3. No reading - indicates open wiring, open fuse(s) no power or etc. from unit to fused disconnect service. Repair as needed.
4. With ample voltage at line voltage connectors, energize the unit.
5. Measure the voltage with the unit starting and operating, and determine the unit Locked Rotor Voltage. **NOTE**: If checking heaters, be sure all heating elements are energized.

   Locked Rotor Voltage is the actual voltage available at the compressor during starting, locked rotor, or a stalled condition. Measured voltage should be above minimum listed in chart below.

   To measure Locked Rotor Voltage attach a voltmeter to the run "R" and common "C" terminals of the compressor, or to the T_1 and T_2 terminals of the contactor. Start the unit and allow the compressor to run for several seconds, then shut down the unit. Immediately attempt to restart the unit while measuring the Locked Rotor Voltage.
6. Lock rotor voltage should read within the voltage tabulation as shown. If the voltage falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company in regard to either low or high voltage.

REMOTE CONDENSING UNITS BLOWER COILS		
VOLTAGE	MIN.	MAX.
208/230	198	253
115	104	127

NOTE: When operating electric heaters on voltages other than 240 volts refer to the System Operation section on electric heaters to calculate temperature rise and air flow. Low voltage may cause insufficient heating.

S-2 CHECKING WIRING

WARNING

Disconnect Electrical Power Supply:

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with comparable gauge and insulation thickness.

S-3 CHECKING THERMOSTAT, WIRING, AND ANTICIPATOR

THERMOSTAT WIRE SIZING CHART	
LENGTH OF RUN	MIN. COPPER WIRE GAUGE (AWG)
25 feet	18
50 feet	16
75 feet	14
100 feet	14
125 feet	12
150 feet	12

S-3A Thermostat and Wiring

WARNING

LINE VOLTAGE NOW PRESENT

With power ON, thermostat calling for cooling

1. Use a voltmeter to check for 24 volts at thermostat wires C and Y in the condensing unit control panel.
2. No voltage indicates trouble in the thermostat, wiring or external transformer source.
3. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Indoor Blower Motor

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

1. Set fan selector switch at thermostat to "ON" position.
2. With voltmeter, check for 24 volts at wires C and G.
3. No voltage, indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Resistance Heaters

1. Set room thermostat to a higher setting than room temperature so both stages call for heat.
2. With voltmeter, check for 24 volts at each heater relay. Note, BBA/BBC heater relays are DC voltage.

3. No voltage, indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

NOTE: Consideration must be given to how the heaters are wired (O.D.T. and etc.). Also safety devices must be checked for continuity.

S-3B Cooling Anticipator

The cooling anticipator is a small heater (resistor) in the thermostat. During the "off" cycle it heats the bimetal element helping the thermostat call for the next cooling cycle. This prevents the room temperature from rising too high before the system is restarted. A properly sized anticipator should maintain room temperature within 1 1/2 to 2 degree range.

The anticipator is supplied in the thermostat and is not to be replaced. If the anticipator should fail for any reason, the thermostat must be changed.

S-3C Heating Anticipator

The heating anticipator is a wire wound adjustable heater which is energized during the "ON" cycle to help prevent overheating of the conditioned space.

The anticipator is a part of the thermostat and if it should fail for any reason, the thermostat must be replaced. See the following tables for recommended heater anticipator setting in accordance to the number of electric heaters installed.

HEATER KIT ANTICIPATOR TABLE

ECB/C/D - EHK__B/C/D	5	7	10	15	20	25	30
HEATER KW	4.8	7.2	9.6	14.4	19.2	24	28.8
FIRST STAGE	0.4	0.4	0.4	0.4	0.4	0.4	0.4
SECOND STAGE	0.4	0.4	0.4	0.4	0.4	0.4	0.4

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

A step-down transformer (208/240 volt primary to 24 volt secondary) is provided with each indoor unit. This allows ample capacity for use with resistance heaters. The outdoor sections do not contain a transformer.

WARNING

Disconnect Electrical Power Supply:

1. Remove control panel cover or etc. to gain access to transformer.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

2. Using a voltmeter, check voltage across secondary voltage side of transformer (R to C).
3. No voltage indicates faulty transformer, bad wiring, or bad splices.
4. Check transformer primary voltage at incoming line voltage connections and/or splices.
5 If line voltage available at primary voltage side of transformer and wiring and splices good, transformer is inoperative. Replace.

S-5 CHECKING CYCLE PROTECTOR

Some models feature a solid state, delay-on make after break time delay relay installed in the low voltage circuit. This control is used to prevent short cycling of the compressor under certain operating conditions.

The component is normally closed (R_1 to Y_1). A power interruption will break circuit (R_1 to Y_1) for approximately three minutes before resetting.

WARNING

Disconnect Electrical Power Supply:

1. Remove wire from Y_1 terminal.
2. Wait for approximately four (4) minutes if machine was running.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

1. Apply 24 VAC to terminals R_1 and R_2.
2. Should read 24 VAC at terminals Y_1 and Y_2.
3. Remove 24 VAC at terminals R_1 and R_2.
4. Should read 0 VAC at Y_1 and Y_2.
5. Reapply 24 VAC to R1 and R2 - within approximately three (3) to four (4) minutes should read 24 VAC at Y_1 and Y_2.

If not as above - replace relay.

S-6 CHECKING TIME DELAY RELAY

Time delay relays are used in some of the blower cabinets to improve efficiency by delaying the blower off time. Time delays are also used in electric heaters to sequence in multiple electric heaters.

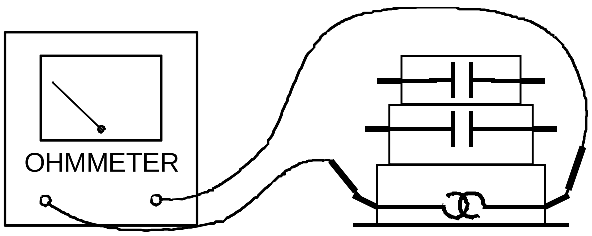
WARNING

Disconnect Electrical Power Supply:

1. Tag and disconnect all wires from male spade connections of relay.
2. Using an ohmmeter, measure the resistance across terminals H1 and H2. Should read approximately 150 ohms.
3. Using an ohmmeter, check for continuity across terminals 3 and 1, and 4 and 5.

4. Apply 24 volts to terminals H1 and H2. Check for continuity across other terminals - should test continuous. If not as above - replace.

NOTE: The time delay for the contacts to make will be approximately 20 to 50 seconds and to open after the coil is de-energized is approximately 40 to 90 seconds.



TESTING COIL CIRCUIT

S-7 CHECKING CONTACTOR AND/OR RELAYS

The compressor contactor and other relay holding coils are wired into the low or line voltage circuits. When the control circuit is energized, the coil pulls in the normally open contacts or opens the normally closed contacts. When the coil is de-energized, springs return the contacts to their normal position.

NOTE: *Most single phase contactors break only one side of the line (L1), leaving 115 volts to ground present at most internal components.*

WARNING

Disconnect Electrical Power Supply:

1. Remove the leads from the holding coil.
2. Using an ohmmeter, test across the coil terminals.

If the coil does not test continuous, replace the relay or contactor.

S-8 CHECKING CONTACTOR CONTACTS

WARNING

Disconnect Electrical Power Supply:

1. Disconnect the wire leads from the terminal (T) side of the contactor.
2. With power ON, energize the contactor.

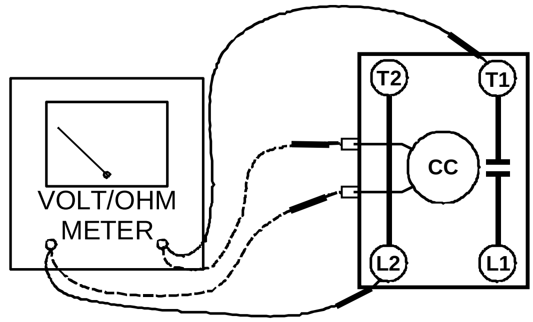
WARNING

LINE VOLTAGE NOW PRESENT

3. Using a voltmeter, test across terminals.

   A. L2 - T1 - No voltage indicates CC1 contacts open.

If a no voltage reading is obtained - replace the contactor.



---- Ohmmeter for testing holding coil
—— Voltmeter for testing contacts

TESTING COMPRESSOR CONTACTOR

S-9 CHECKING FAN RELAY CONTACTS

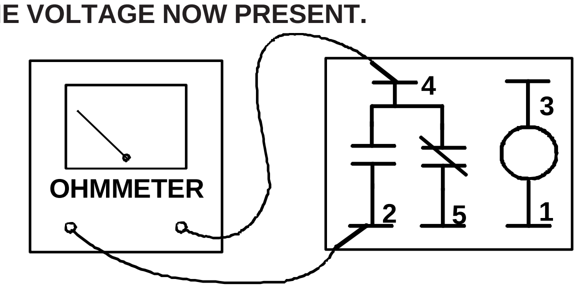
WARNING

Disconnect Electrical Power Supply:

1. Disconnect wires leads from terminals 2 and 4 of Fan Relay Cooling and 2 and 4, 5 and 6 of Fan Relay Heating.
2. Using an ohmmeter, test between 2 and 4 - should read open. Test between 5 and 6 - should read continuous.
3. With power ON, energize the relays.

WARNING

LINE VOLTAGE NOW PRESENT.



TESTING FAN RELAY

4. Using an ohmmeter, test between 2 and 4 - should read continuous . Test between 5 and 6 - should read open.
5. If not as above, replace the relay.

SERVICING

S-12 CHECKING HIGH PRESSURE CONTROL

The high pressure control capillary senses the pressure in the compressor discharge line. If abnormally high condensing pressures develop, the contacts of the control open, breaking the control circuit before the compressor motor overloads. This control is automatically reset.

WARNING

Disconnect Electrical Power Supply:

1. Using an ohmmeter, check across terminals of high pressure control, with wire removed. If not continuous, the contacts are open.

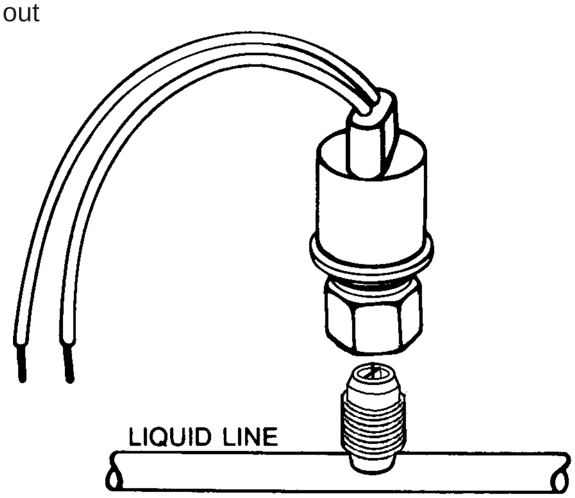
3. Attach a gauge to the dill valve port on the base valve.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

4. Start the system and place a piece of cardboard in front of the condenser coil, raising the condensing pressure.
5. Check pressure at which the high pressure control cuts-out



AUTOMATIC RESET

If it cuts-out at 610 PSIG ± 10 PSIG, it is operating normally (See causes for high head pressure in Service Problem Analysis Guide). If it cuts out below this pressure range, replace the control.

S-13 CHECKING LOW PRESSURE CONTROL

The low pressure control senses the pressure in the suction line and will open its contacts on a drop in pressure. The low pressure control will automatically reset itself with a rise in pressure.

The low pressure control is designed to cut-out (open) at approximately 50 PSIG. It will automatically cut-in (close) at approximately 85 PSIG.

Test for continuity using a VOM and if not as above, replace the control.

S-15 CHECKING CAPACITOR

CAPACITOR, RUN

A run capacitor is wired across the auxiliary and main windings of a single phase permanent split capacitor motor. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor.

The line side of this capacitor is marked with "COM" and is wired to the line side of the circuit.

CAPACITOR, START

SCROLL COMPRESSOR MODELS

In most cases hard start components are not required on Scroll compressor equipped units due to a non-replaceable check valve located in the discharge line of the compressor. However in installations that encounter low lock rotor voltage, a hard start kit can improve starting characteristics and reduce light dimming within the home. Only hard start kits approved by Amana or Copeland should be used. "Kick Start" and/or "Super Boost" kits are not approved start assist devices.

The discharge check valve closes off high side pressure to the compressor after shut down allowing equalization through the scroll flanks. Equalization requires only about ½ second.

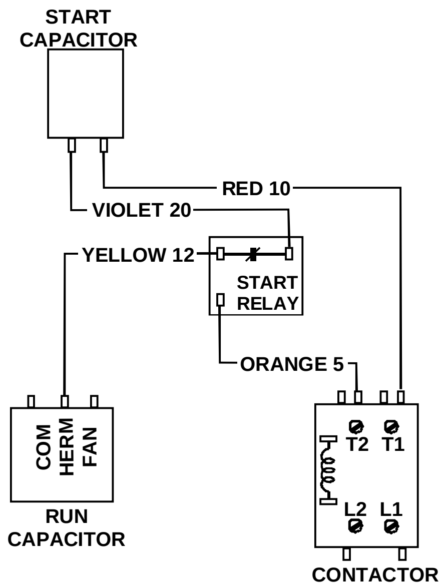
To prevent the compressor from short cycling, a Time Delay Relay (Cycle Protector) has been added to the low voltage circuit.

RELAY, START

A potential or voltage type relay is used to take the start capacitor out of the circuit once the motor comes up to speed. This type of relay is position sensitive. The normally closed contacts are wired in series with the start capacitor and the relay holding coil is wired parallel with the start winding. As the motor starts and comes up to speed, the increase in voltage across the start winding will energize the start relay holding coil and open the contacts to the start capacitor.

SERVICING

Two quick ways to test a capacitor are a resistance and a capacitance check.



HARD START KIT WIRING

S-15A Resistance Check

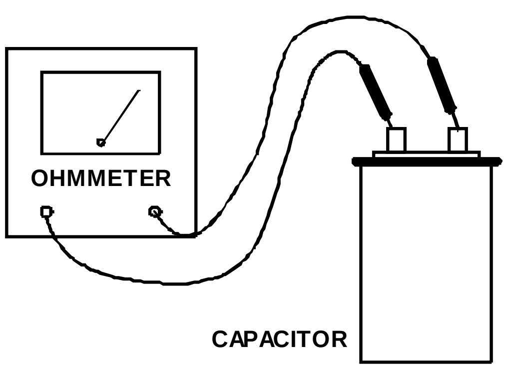
WARNING

Disconnect Electrical Power Supply:

1. Discharge capacitor and remove wire leads.

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.



TESTING CAPACITOR RESISTANCE

2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor -

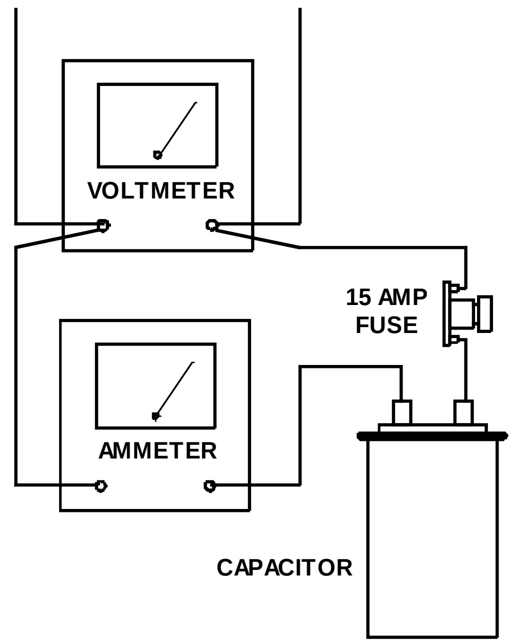
   A. Good Condition - indicator swings to zero and slowly returns to infinity. (Start capacitor with bleed resistor will not return to infinity. It will still read the resistance of the resistor).

   B. Shorted - indicator swings to zero and stops there - replace.

   C. Open - no reading - replace. (Start capacitor would read resistor resistance).

S-15B Capacitance Check

Using a hookup as shown below, take the amperage and voltage readings and use them in the formula:



TESTING CAPACITANCE

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.

$$\text{Capacitance (MFD)} = \frac{2650 \times \text{Amperage}}{\text{Voltage}}$$

S-16A CHECKING FAN AND BLOWER MOTOR WINDINGS (PSC MOTORS)

The auto reset fan motor overload is designed to protect the motor against high temperature and high amperage conditions by breaking the common circuit within the motor, similar to the compressor internal overload. However, heat generated within the motor is faster to dissipate than the compressor, allow at least 45 minutes for the overload to reset, then retest.

WARNING

Disconnect Electrical Power Supply:

1. Remove the motor leads from its respective connection points and capacitor (if applicable).
2. Check the continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

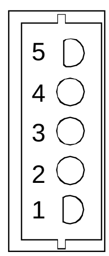
If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

S-16B CHECKING FAN AND BLOWER MOTOR (ECM MOTORS)

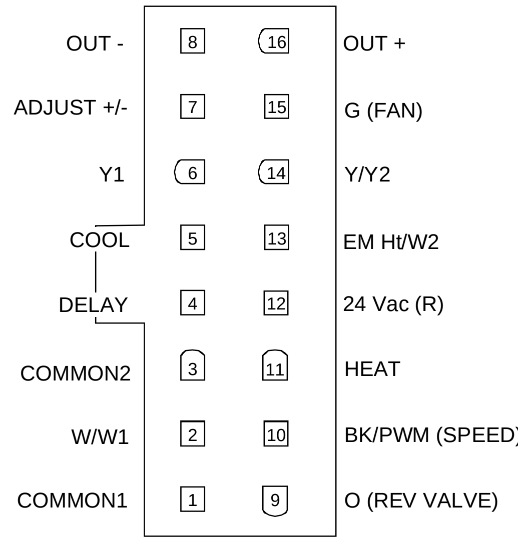
An ECM is an *Electronically Commutated Motor* which offers many significant advantages over PSC motors. The ECM has near zero rotor loss, synchronous machine operation, variable speed, low noise, and programmable air flow. Because of the sophisticated electronics within the ECM motor, some technicans are intimated by the ECM motor; however, these fears are unfounded. GE offers two ECM motor testers, and with a VOM meter, one can easily perform basic troubleshooting on ECM motors. An ECM motor requires power (line voltage) and a signal (24 volts) to operate. The ECM motor stator contains permanent magnet. As a result, the shaft feels "rough" when turned by hand. This is a characteristic of the motor, not an indication of defective bearings.

WARNING

LINE VOLTAGE NOW PRESENT



1. Disconnect the 5-pin connector from the motor.
2. Using a volt meter, check for line voltage at terminals #4 & #5 at the power connector. If no voltage is present:
3. Check the unit for incoming power See section S-1.
4. Check the control board, See section S-40.
5. If line voltage is present, reinsert the 5-pin connector and remove the 16-pin connector.
6. Check for signal (24 volts) at the transformer.
7. Check for signal (24 volts) from the thermostat to the "G" terminal at the 16-pin connector.
8. Using an ohmmeter, check for continuity from the #1 & #3 (common pins) to the transformer neutral or "C" thermostat terminal. If you do not have continuity, the motor may function erratically. Trace the common circuits, locate and repair the open neutral.
9. Set the thermostat to "Fan-On". Using a voltmeter check for 24 volts between pin # 15 (G) and common.
10. Disconnect power to compressor. Set thermostat to call for cooling. Using a voltmeter check for 24 volts at pin # 6 and/or #14.
11. Set the thermostat to a call for heating. Using a voltmeter, check for 24 volts at pin #2 and/or #11.



16-PIN ECM HARNESS CONNECTOR

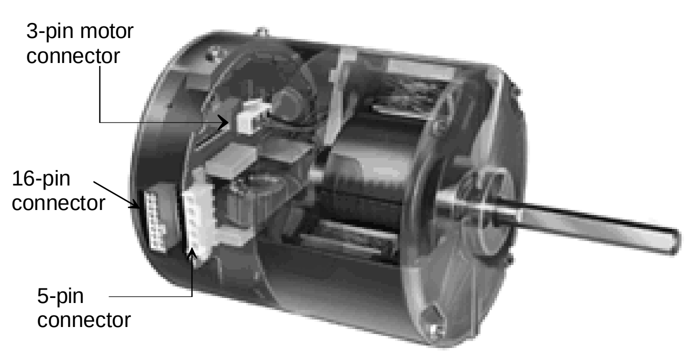
If you do not read voltage and continuity as described, the problem is in the control or interface board, but not the motor. If you register voltage as described , the ECM power head is defective and must be replaced.

S-16C CHECKING ECM MOTOR WINDINGS

WARNING

Disconnect Electrical Power Supply:

1. Disconnect the 5-pin and the 16-pin connectors from the ECM power head.
2. Remove the 2 screws securing the ECM power head and separate it from the motor.
3. Disconnect the 3-pin motor connector from the power head and lay it aside.
4. Using an ohmmeter, check the motor windings for continuity to ground (pins to motor shell). If the ohmmeter indicates continuity to ground, the motor is defective and must be replaced.
5. Using an ohmmeter, check the windings for continuity (pin to pin). If no continuity is indicated, the thermal limit (over load) device may be open. Allow motor to cool and retest.



SERVICING

S-17 CHECKING COMPRESSOR WINDINGS

WARNING

HERMETIC COMPRESSOR ELECTRICAL TERMINAL VENTING CAN BE DANGEROUS. WHEN INSULATING MATERIAL WHICH SUPPORTS A HERMETIC COMPRESSOR ELECTRICAL TERMINAL SUDDENLY DISINTEGRATES DUE TO PHYSICAL ABUSE OR AS A RESULT OF AN ELECTRICAL SHORT BETWEEN THE TERMINAL AND THE COMPRESSOR HOUSING, THE TERMINAL MAY BE EXPELLED, VENTING THE VAPOROUS AND LIQUID CONTENTS OF THE COMPRESSOR HOUSING AND SYSTEM.

If the compressor terminal PROTECTIVE COVER and gasket (if required) are not properly in place and secured, there is a remote possibility if a terminal vents, that the vaporous and liquid discharge can be ignited, spouting flames several feet, causing potentially severe or fatal injury to anyone in its path.

This discharge can be ignited external to the compressor if the terminal cover is not properly in place and if the discharge impinges on a sufficient heat source.

Ignition of the discharge can also occur at the venting terminal or inside the compressor, if there is sufficient contaminant air present in the system and an electrical arc occurs as the terminal vents.

Ignition cannot occur at the venting terminal without the presence of contaminant air, and cannot occur externally from the venting terminal without the presence of an external ignition source.

Therefore, proper evacuation of a hermetic system is essential at the time of manufacture and during servicing.

To reduce the possibility of external ignition, all open flame, electrical power, and other heat sources should be extinguished or turned off prior to servicing a system.

If the following test indicates shorted, grounded or open windings, see procedures S-19 for the next steps to be taken.

S-17A Resistance Test

Each compressor is equipped with an internal overload.

The line break internal overload senses both motor amperage and winding temperature. High motor temperature or amperage heats the disc causing it to open, breaking the common circuit within the compressor on single phase units.

Heat generated within the compressor shell, usually due to recycling of the motor, high amperage or insufficient gas to cool the motor, is slow to dissipate. Allow at least three to four hours for it to cool and reset, then retest.

Fuse, circuit breaker, ground fault protective device, etc. has not tripped -

WARNING

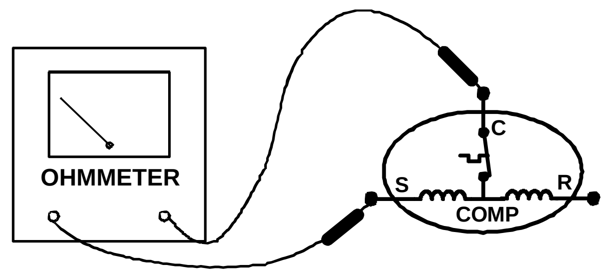
Disconnect Electrical Power Supply:

1. Remove the leads from the compressor terminals.

WARNING

SEE WARNING S-17 PAGE 26 BEFORE REMOVING COMPRESSOR TERMINAL COVER.

2. Using an ohmmeter, test continuity between terminals S-R, C-R, and C-S, on single phase units or terminals T2, T2 and T3, on 3 phase units.



TESTING COMPRESSOR WINDINGS

If either winding does not test continuous, replace the compressor.

NOTE: If an open compressor is indicated allow ample time for the internal overload to reset before replacing compressor.

S-17B Ground Test

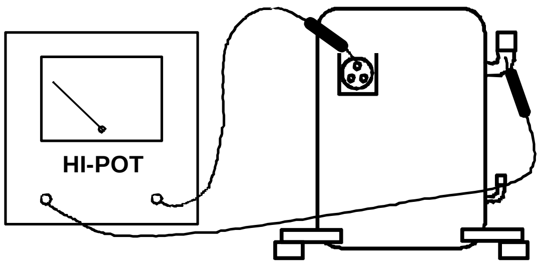
If fuse, circuit breaker, ground fault protective device, etc., has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked, and its maximum rating should coincide with that marked on the equipment nameplate.

With the terminal protective cover in place, it is acceptable to replace the fuse or reset the circuit breaker <u>ONE TIME ONLY</u> to see if it was just a nuisance opening. If it opens again, <u>DO NOT</u> continue to reset.

Disconnect all power to unit, making sure that <u>**all**</u> power legs are open.

1. DO NOT remove protective terminal cover. Disconnect the three leads going to the compressor terminals at the nearest point to the compressor.
2. Identify the leads and using a Megger, Hi-Potential Ground Tester, or other suitable instrument which puts out a voltage between 300 and 1500 volts, check for a ground separately between each of the three leads and ground (such as an unpainted tube on the compressor). Do not use a low voltage output instrument such as a volt-ohmmeter.

SERVICING



COMPRESSOR GROUND TEST

3. If a ground is indicated, then carefully remove the compressor terminal protective cover and inspect for loose leads or insulation breaks in the lead wires.
4. If no visual problems indicated, carefully remove the leads at the compressor terminals.

WARNING

DAMAGE CAN OCCUR TO THE GLASS EMBEDDED TERMINALS IF THE LEADS ARE NOT PROPERLY REMOVED, WHICH CAN RESULT IN THE TERMINAL VENTING AND HOT OIL DISCHARGING.

Carefully retest for ground, directly between compressor terminals and ground.

5. If ground is indicated, replace the compressor.

S-17C Operation Test

If the voltage, capacitor, overload and motor winding test fail to show the cause for failure:

WARNING

Disconnect Electrical Power Supply:

1. Remove unit wiring from disconnect switch and wire a test cord to the disconnect switch.

NOTE: The wire size of the test cord must equal the line wire size and the fuse must be of the proper size and type.

2. With the protective terminal cover in place, use the three leads to the compressor terminals that were disconnected at the nearest point to the compressor and connect the common, start and run clips to the respective leads.
3. Connect good capacitors of the right MFD and voltage rating into the circuit as shown.
4. With power ON, close the switch.

WARNING

LINE VOLTAGE NOW PRESENT

A. If the compressor starts and continues to run, the cause for failure is somewhere else in the system.

B. If the compressor fails to start - replace.

Compressor Serial Number Identification

COPELAND COMPRESSOR

E	:	93	J	123456
Motor	Shift	Year	Month	Serial No

TECUMSEH COMPRESSOR

T:	G	22	93C	123456
	Month	Day	Year	Serial No

BRISTOL COMPRESSOR

291	93	123456
Day of Year	Year	Serial No

S-18 TESTING CRANKCASE HEATER (OPTIONAL ITEM)

The crankcase heater must be energized a minimum of four (4) hours before the condensing unit is operated.

Crankcase heaters are used to prevent migration or accumulation of refrigerant in the compressor crankcase during the off cycles and prevents liquid slugging or oil pumping on start up.

A crankcase heater will not prevent compressor damage due to a floodback or over charge condition.

WARNING

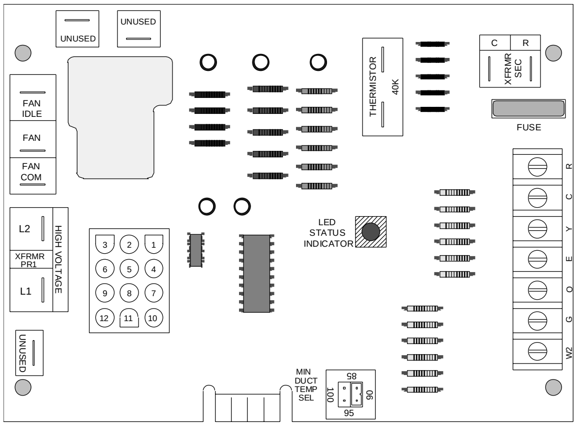
Disconnect Electrical Power Supply:

1. Disconnect the heater lead in wires.
2. Using an ohmmeter, check heater continuity - should test continuous, if not, replace.

NOTE: The positive temperature coefficient crankcase heater is a 40 watt 265 voltage heater. The cool resistance of the heater will be approximately 1800 ohms. The resistance will become greater as the temperature of the compressor shell increases.

SERVICING

S-40 BBA/BBC CONTROL BOARD OPERATION

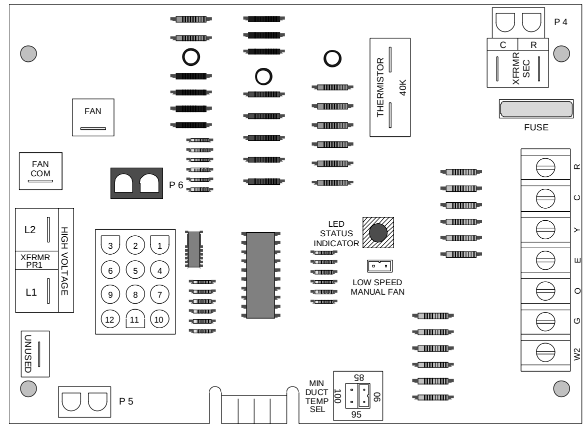


BBA Control Board 11074205

The BBA control board contains a relay that is operated based on inputs from the room thermostat and thermistor. The relay and therefore the blower is controlled per the following table.

Input	Control Board Action
"G" on	Relay energized instantly
"G" off	Relay de-energized instantly
"Y" on	Relay energized instantly
"Y" off while "O" has been on	Relay de-energized after supply air rises above 65°F or 45 seconds, whichever is shorter.
"Y" off no "O"	Relay de-energizes after supply air falls below 85°F or 45 seconds, whichever is shorter.
Thermistor Error	Relay energized until thermistor operation is restored. Blower runs continuously.
Supply Air > 170°	Relay energized until supply air is below 85°F.
"W2" or "E" on	Relay energized instantly
"W2" or "E" off	Relay de-energized instantly

The BBC control board works in conjunction with the BBC interface board to control the blower motor and heaters based on inputs from the room thermostat and thermistor.



BBC Control Board 11074204

Both the BBA and BBC control boards have an LED for indicating operating status. The following table shows the codes that may be displayed by the LED.

MODE	LED SIGNAL	
	ON TIME	OFF TIME
Normal Operation	1/2 second	1/2 second
Thermistor and/or Board Error	2 Flashes	3 seconds
Thermistor Error	4 Flashes	3 seconds
System Error	6 Flashes	3 seconds
Control Board Malfunction	Continuous	None

If the LED indicates a continuous **1/2 second on, 1/2 second off flash code**, then the control is in a normal operating mode and no adjustments need be made.

If the LED indicates **2 flashes** (thermistor and/or board error) then the thermistor connections should be verified first. At 70°F the resistance of the thermistor should be 40 KW (as temperature increases, resistance decreases). The resistance should be checked between the terminations of the thermistor leads at the control board, making sure that the terminals are securely attached insuring a good connection. If the resistance is out of range false signals will be sent to the control board, thus causing improper operation of the unit. In that case, the thermistor must be replaced. If, however, the resistance is correct, then the control board has malfunctioned and must be replaced.

If the LED indicates **4 flashes** (thermistor error) then the resistance should be checked between the terminations of the thermistor leads at the control board, making sure that the terminals are securely attached insuring a good connection. Failures such as opens, shorts across the device, shorts to ground, shorts to power and leakage path to ground shall be sensed. The thermistor (or wire(s)) should be replaced for proper operation.

SERVICING

If the LED indicates **6 flashes** (system error) then the setup and configuration of the system should be checked. This error mode could indicate an abnormal operating condition such as a restricted inlet, blocked outlet, or possibly a leak in the unit or ductwork. The system should be checked for such a condition.

If the LED is in a **continuous on** mode (control board malfunction), then all field and factory connections should be checked. If the error mode still occurs after a power reset, then the control board should be replaced.

NOTE: After an error mode occurs, the system requires a power reset for normal operation after the problem has been corrected.

The control board is programmed with a certain range of acceptable values from the thermistor, depending on the mode of operation. The control board "knows" the mode of operation based on the thermostat inputs, and thus "knows" the acceptable range of resistance readings from the thermistor.

Temp °F	Thermistor Res. Ω	Temp °F	Thermistor Res. Ω
50	79600	90	29610
65	54720	95	26130
75	41800	100	23100
80	36660	105	20470
85	33640	120	14970

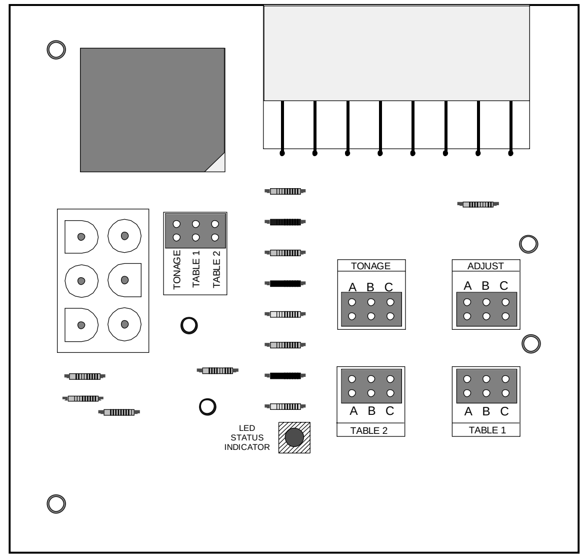
Thermistor Resistance Table

Also included on the BBC model control boards is a two-pin header that allows for either 50% or 100% of nominal airflow during fan only mode. The board is shipped with the connection for 50% airflow during fan only mode.

S-41 BBC INTERFACE BOARD OPERATION

The BBC*A2A model blowers have an interface board incorporated into the control circuitry. This board serves as a selector for the various tonnage selections available (see unit wiring diagram). The unit wiring diagram indicates the appropriate pin-positioning for each available tonnage selection. The board also contains an "adjust" tap, which allows for a ± 15 % variation in airflow. This feature allows for an increase / decrease of the airflow over the entire operating range. See the tables in the "Airflow" section for the available airflow ranges.

There is a LED included on the interface board on the BBC models, in addition to the one found on the main control. The LED serves to indicate the airflow that the motor is delivering, depending upon the positioning of the pin selectors on the interface board. The number of blinks multiplied by 100 yields the programmed CFM. The indicated CFM may vary, depending on the mode of operation and the signals being sent to the control board at the time. The variable speed motor is controlled via a PWM (**P**ulse **W**idth **M**odulated) signal from the control board. Nominal CFM is at an 80% PWM output.



BBC Interface Board 11106901

S-60 ELECTRIC HEATER (OPTIONAL ITEM)

Optional electric heaters may be added, in the quantities shown in the specifications section to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

The low voltage circuit in the air handler is factory wired and terminates at the location provided for the electric heater(s). A minimum of field wiring is required to complete the installation.

Other components such as a Heating/Cooling Thermostat and Outdoor Thermostats are available to complete the installation.

The system CFM can be determined by measuring the static pressure external to the unit. The installation manual supplied with the blower coil, or the blower performance table in the service manual shows the CFM for the static measured.

Alternately, the system CFM can be determined by operating the electric heaters and indoor blower WITHOUT having the compressor in operation. Measure the temperature rise as close to the blower inlet and outlet as possible.

If other than a 240V power supply is used, refer to the **BTUH CAPACITY CORRECTION FACTOR** chart below.

BTUH CAPACITY CORRECTION FACTOR				
SUPPLY VOLTAGE	250	230	220	208
MULTIPLICATION FACTOR	1.08	.92	.84	.75

EXAMPLE: Five (5) heaters provide 24.0 KW at the rated 240V. Our actual measured voltage is 220V, and our measured temperature rise is 42°F. Find the actual CFM:

Answer: 24.0KW, 42°F Rise, 240 V = 1800 CFM from the **TEMPERATURE RISE** chart on the right.

Heating output at 220 V = 24.0KW x 3.413 x .84 = 68.8 MBH.

Actual CFM = 1800 x .84 Corr. Factor = 1400 CFM.

SERVICING

NOTE: The temperature rise table is for sea level installations. The temperature rise at a particular KW and CFM will be greater at high altitudes, while the external static pressure at a particular CFM will be less.

TEMPERATURE RISE (F°) @ 240V							
CFM	4.8 KW	7.2 KW	9.6 KW	14.4 KW	19.2 KW	24.0 KW	28.8 KW
600	25	38	51	-	-	-	-
700	22	33	43	-	-	-	-
800	19	29	38	57	-	-	-
900	17	26	34	51	-	-	-
1000	15	23	30	46	-	-	-
1100	14	21	27	41	55	-	-
1200	13	19	25	38	50	-	-
1300	12	18	23	35	46	-	-
1400	11	16	22	32	43	54	65
1500	10	15	20	30	40	50	60
1600	9	14	19	28	38	47	57
1700	9	14	18	27	36	44	53
1800	8	13	17	25	34	42	50
1900	8	12	16	24	32	40	48
2000	8	12	15	23	30	38	45
2100	7	11	14	22	29	36	43
2200	7	11	14	21	27	34	41
2300	7	10	13	20	26	33	39

ELECTRIC HEATER CAPACITY BTUH							
HTR KW	4.8 KW	7.2 KW	9.6 KW	14.4 KW	19.2 KW	24.0 KW	28.8 KW
BTUH	16380	24915	32765	49150	65530	81915	98295

FORMULAS:

Heating Output = KW x 3413 x Corr. Factor

Actual CFM = CFM (from table) x Corr. Factor

BTUH = KW x 3413

BTUH = CFM x 1.08 x Temperature Rise (ΔT)

$$\text{CFM} = \frac{\text{KW x 3413}}{1.08 \times \Delta T}$$

$$\Delta T = \frac{\text{BTUH}}{\text{CFM} \times 1.08}$$

S-61A CHECKING HEATER LIMIT CONTROL(S)

Each individual heater element is protected with a limit control device connected in series with each element to prevent overheating of components in case of low airflow. This limit control will open its circuit at approximately 150°F.

WARNING

Disconnect Electrical Power Supply:

1. Remove the wiring from the control terminals.
2. Using an ohmmeter test for continuity across the normally closed contacts. No reading indicates the control is open - replace if necessary.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

S-61B CHECKING HEATER FUSE LINK (OPTIONAL ELECTRIC HEATERS)

Each individual heater element is protected with a one time fuse link which is connected in series with the element. The fuse link will open at approximately 333°.

WARNING

Disconnect Electrical Power Supply:

1. Remove heater element assembly so as to expose fuse link.
2. Using an ohmmeter, test across the fuse link for continuity - no reading indicates the link is open. Replace as necessary.

NOTE: The link is designed to open at approximately 333°F. DO NOT WIRE AROUND - determine reason for failure.

S-62 CHECKING HEATER ELEMENTS

WARNING

Disconnect Electrical Power Supply:

1. Disassemble and remove the heating element.
2. Visually inspect the heater assembly for any breaks in the wire or broken insulators.
3. Using an ohmmeter, test the element for continuity - no reading indicates the element is open. Replace as necessary.

S-100 REFRIGERATION REPAIR PRACTICE

DANGER

ALWAYS REMOVE THE REFRIGERANT CHARGE IN A PROPER MANNER BEFORE APPLYING HEAT TO THE SYSTEM.

When repairing the refrigeration system:

WARNING

Disconnect Electrical Power Supply:

1. Never open a system that is under vacuum. Air and moisture will be drawn in.

2. Plug or cap all openings.
3. Remove all burrs and clean the brazing surfaces of the tubing with sand cloth or paper. Brazing materials do not flow well on oxidized or oily surfaces.
4. Clean the inside of all new tubing to remove oils and pipe chips.
5. When brazing, sweep the tubing with dry nitrogen to prevent the formation of oxides on the inside surfaces.
6. Complete any repair by replacing the liquid line drier in the system, evacuate and charge.

BRAZING MATERIALS

Copper to Copper Joints - Sil-Fos used without flux (alloy of 15% silver, 80% copper, and 5% phosphorous). Recommended heat 1400°F.

Copper to Steel Joints - Silver Solder used without a flux (alloy of 30% silver, 38% copper, 32% zinc). Recommended heat - 1200°F.

S-101 LEAK TESTING

Refrigerant leaks are best detected with an electronic leak detector rated for use with HFC refrigerants.

For a system that contains a refrigerant charge and is suspected of having a leak, stop the operation and hold the exploring tube of the detector as close to the tube as possible, check all piping and fittings. If a leak is detected, do not attempt to apply more brazing to the joint. Remove and capture the charge, unbraze the joint, clean and rebraze.

For a system that has been newly repaired and does not contain a charge, connect a cylinder of refrigerant through a gauge manifold to the service ports.

NOTE: Refrigerant hoses must be rated for use with R410A refrigerant and equipped with dill valve depressors. Open the valve on the cylinder and manifold and allow the pressure to build up within the system. Test for leaks as described above. After the test has been completed, remove and capture the leak test refrigerant.

S-102 EVACUATION

This is the most important part of the entire service procedure. The life and efficiency of the equipment is dependent upon the thoroughness exercised by the serviceman when evacuating air (non-condensables) and moisture from the system.

Air in a system causes high condensing temperature and pressure resulting in increased power input and reduced performance.

Moisture chemically reacts with the refrigerant oil to form corrosive acids. These acids attack motor windings and parts, causing breakdown.

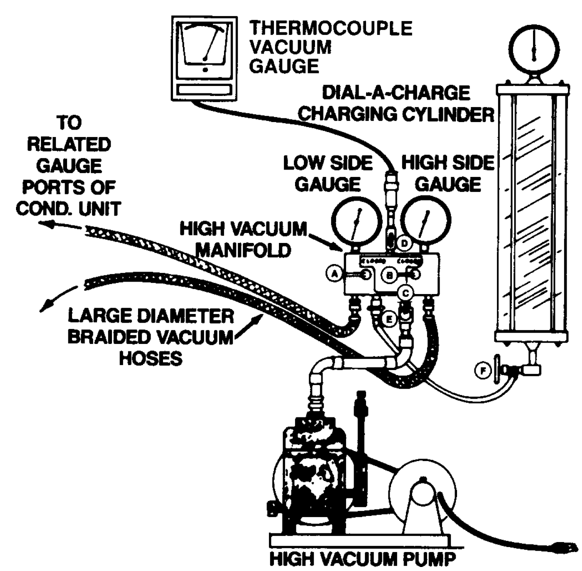
The equipment required to thoroughly evacuate the system is a high vacuum pump, capable of producing a vacuum equivalent to 25 microns absolute and a thermocouple vacuum gauge to give a true reading of the vacuum in the system

NOTE: Never use the system compressor as a vacuum pump or run when under a high vacuum. Motor damage could occur.

WARNING

DO NOT FRONT SEAT THE SERVICE VALVE(S) WITH THE COMPRESSOR OPERATING IN AN ATTEMPT TO SAVE REFRIGERANT. WITH THE SUCTION LINE OF THE COMPRESSOR CLOSED OR SEVERELY RESTRICTED.

1. Connect the vacuum pump, vacuum tight manifold set with high vacuum hoses, thermocouple vacuum gauge and charging cylinder as shown.
2. Start the vacuum pump and open the shut off valve to the high vacuum gauge manifold only. After the compound gauge (low side) has dropped to approximately 29 inches of vacuum, open the valve to the vacuum thermocouple gauge. See that the vacuum pump will blank-off to a maximum of 25 microns. A high vacuum pump can only produce a good vacuum if its oil is non-contaminated.



EVACUATION

3. If the vacuum pump is working properly, close the valve to the vacuum thermocouple gauge and open the high and low side valves to the high vacuum manifold set. With the valve on the charging cylinder closed, open the manifold valve to the cylinder.
4. Evacuate the system to at least 29 inches gauge before opening valve to thermocouple vacuum gauge.

5. Continue to evacuate to a maximum of 250 microns. Close valve to vacuum pump and watch rate of rise. If vacuum does not rise above 1500 microns in three to five minutes, system can be considered properly evacuated.
6. If thermocouple vacuum gauge continues to rise and levels off at about 5000 microns, moisture and non-condensables are still prevent. If gauge continues to rise a leak is present. Repair and re-evacuate.
7. Close valve to thermocouple vacuum gauge and vacuum pump. Shut off pump and prepare to charge.

S-103 CHARGING

Charge the system with the exact amount of refrigerant.

Refer to the specification section or check the unit name-plates for the correct refrigerant charge.

An inaccurately charged system will cause future problems.

1. When using an ambient compensated calibrated charging cylinder, allow liquid refrigerant only to enter the high side.
2. After the system will take all it will take, close the valve on the high side of the charging manifold.
3. Start the system and charge the balance of the refrigerant through the low side.

NOTE: R410A should be drawn out of the storage container or drum in liquid form due to its fractionation properties, but should be "Flashed" to it's gas state before entering the system. There are commercially available restriction devices that fit into the system charging hose set to accomplish this. **DO NOT** charge liquid R410A into the compressor.

4. With the system still running, close the valve on the charging cylinder. At this time, you may still have some liquid refrigerant in the charging cylinder hose and will definitely have liquid in the liquid hose. Reseat the liquid line core. Slowly open the high side manifold valve and transfer the liquid refrigerant from the liquid line hose and charging cylinder hose into the suction service valve port. CAREFUL: Watch so that liquid refrigerant does not enter the compressor.
5. With the system still running, back-seat the valves, remove hose and reinstall both valve caps.
6. Check system for leaks.

Do not charge a remote condensing unit with a non-matching evaporator coil, or a system where the charge quantity is unknown. Do not install or charge R410A condensers matched with coils having capillary tubes or flow control restrictors. ARI rated Coil combinations with thermostatic expansion valves (TEV's) should be charged by subcooling. See "Checking Subcooling and Superheat" sections in this manual. Subcooling values for "Ultron" system are found in the Technical Information manuals for "Ultron" outdoor units.

Due to their design Scroll compressors are inherently more tolerant of liquid refrigerant.

NOTE: *Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.*

S-104 CHECKING COMPRESSOR EFFICIENCY

The reason for compressor inefficiency is broken or damaged scroll flanks on Scroll compressors, reducing the ability of the compressor to pump refrigerant vapor.

The condition of the scroll flanks is checked in the following manner.

1. Attach gauges to the high and low side of the system.
2. Start the system and run a "Cooling Performance Test.

If the test shows:

a. Below normal high side pressure.

b. Above normal low side pressure.

c. Low temperature difference across coil.

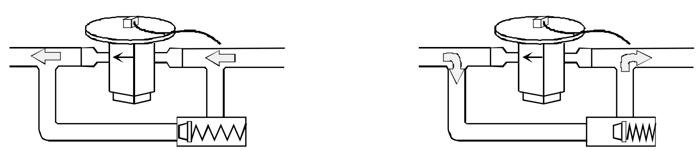
d. Low amp draw at compressor.

And the charge is correct. The compressor is faulty - replace the compressor.

S-105 THERMOSTATIC EXPANSION VALVE

The expansion valve is designed to control the rate of liquid refrigerant flow into an evaporator coil in exact proportion to the rate of evaporation of the refrigerant in the coil. The amount of refrigerant entering the coil is regulated since the valve responds to temperature of the refrigerant gas leaving the coil (feeler bulb contact) and the pressure of the refrigerant in the coil. This regulation of the flow prevents the return of liquid refrigerant to the compressor.

The illustration below shows typical heatpump TXV/check valve operation in the heating and cooling modes.



COOLING HEATING

TXV VALVES

Some TXV valves contain an internal check valve thus eliminating the need for an external check valve and bypass loop. The three forces which govern the operation of the valve are: (1) the pressure created in the power assembly by the feeler bulb, (2) evaporator pressure, and (3) the equivalent pressure of the superheat spring in the valve.

0% bleed type expansion valves are used on indoor and outdoor coils. The 0% bleed valve will not allow the system pressures (High and Low side) to equalize during the shut down period. The valve will shut off completely at approximately 100 PSIG.

30% bleed valves used on some other models will continue to allow some equalization even though the valve has shut-off completely because of the bleed holes within the valve. This type of valve should not be used as a replacement for a 0% bleed valve, due to the resulting drop in performance.

The bulb must be securely fastened with two straps to a clean straight section of the suction line. Application of the bulb to a horizontal run of line is preferred. If a vertical installation cannot be avoided, the bulb must be mounted so that the capillary tubing comes out at the top.

THE VALVES PROVIDED BY AMANA ARE DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. DO NOT USE SUBSTITUTES.

S-106 OVERFEEDING

Overfeeding by the expansion valve results in high suction pressure, cold suction line, and possible liquid slugging of the compressor.

If these symptoms are observed:

1. Check for an overcharged unit by referring to the cooling performance charts in the servicing section.
2. Check the operation of the power element in the valve as explained in S-26 Checking Expansion Valve Operation.
3. Check for restricted or plugged equalizer tube.

S-107 UNDERFEEDING

Underfeeding by the expansion valve results in low system capacity and low suction pressures.

If these symptoms are observed:

1. Check for a restricted liquid line or drier. A restriction will be indicated by a temperature drop across the drier.
2. Check the operation of the power element of the valve as described in S-26 Checking Expansion Valve Operation.

S-108 SUPERHEAT

The expansion valves are factory adjusted to maintain 8 to 12 degrees superheat of the suction gas. Before checking the superheat or replacing the valve, perform all the procedures outlined under Air Flow, Refrigerant Charge, Expansion Valve - Overfeeding, Underfeeding. These are the most common causes for evaporator malfunction.

CHECKING SUPERHEAT

Refrigerant gas is considered superheated when its temperature is higher than the saturation temperature corresponding to its pressure. The degree of superheat equals the degrees of temperature increase above the saturation temperature at existing pressure. See Temperature - Pressure Chart (next collum).

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the suction line near the suction line service valve.
2. Install a low side pressure gauge on the suction line service valve at the outdoor unit.
3. Record the gauge pressure and the temperature of the line.
4. Convert the suction pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
5. The difference between the thermometer reading and pressure to temperature conversion is the amount of superheat.

EXAMPLE:

a. Suction Pressure = 143
b. Corresponding Temp. °F. = 50
c. Thermometer on Suction Line = 61°F.

To obtain the degrees temperature of superheat subtract 50.0 from 61.0°F.

The difference is 11° Superheat. The 11° Superheat would fall in the ± range of allowable superheat.

SUPERHEAT ADJUSTMENT

The expansion valves used on Amana coils are factory set and are not field adjustable. If the superheat setting becomes disturbed, replace the valve.

S-109 CHECKING SUBCOOLING

Refrigerant liquid is considered subcooled when its temperature is lower than the saturation temperature corresponding to its pressure. The degree of subcooling equals the degrees of temperature decrease below the saturation temperature at the existing pressure.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the liquid line as it leaves the condensing unit.
2. Install a high side pressure gauge on the high side (liquid) service valve at the front of the unit.
3. Record the gauge pressure and the temperature of the line.
4. Review the technical information manual or specfication sheet for the model being serviced to obtain the design subcooling and hi-pressure values.
5. Compare the hi-pressure reading to the "Required Liquid Line Temperature" chart (left). Find the hi-pressure value on the left column, follow that line right to the collum under the design subcooling value, where the two intersect is the required liquid line temperature.

   Alternantly you can convert the liquid line pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
6. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.

SERVICING

Pressure vs. Temperature Chart

R-410A

PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
12	-37.7	114.0	37.8	216.0	74.3	318.0	100.2	420.0	120.7	522.0	137.6
14	-34.7	116.0	38.7	218.0	74.9	320.0	100.7	422.0	121.0	524.0	137.9
16	-32.0	118.0	39.5	220.0	75.5	322.0	101.1	424.0	121.4	526.0	138.3
18	-29.4	120.0	40.5	222.0	76.1	324.0	101.6	426.0	121.7	528.0	138.6
20	-36.9	122.0	41.3	224.0	76.7	326.0	102.0	428.0	122.1	530.0	138.9
22	-24.5	124.0	42.2	226.0	77.2	328.0	102.4	430.0	122.5	532.0	139.2
24	-22.2	126.0	43.0	228.0	77.8	330.0	102.9	432.0	122.8	534.0	139.5
26	-20.0	128.0	43.8	230.0	78.4	332.0	103.3	434.0	123.2	536.0	139.8
28	-17.9	130.0	44.7	232.0	78.9	334.0	103.7	436.0	123.5	538.0	140.1
30	-15.8	132.0	45.5	234.0	79.5	336.0	104.2	438.0	123.9	540.0	140.4
32	-13.8	134.0	46.3	236.0	80.0	338.0	104.6	440.0	124.2	544.0	141.0
34	-11.9	136.0	47.1	238.0	80.6	340.0	105.1	442.0	124.6	548.0	141.6
36	-10.1	138.0	47.9	240.0	81.1	342.0	105.4	444.0	124.9	552.0	142.1
38	-8.3	140.0	48.7	242.0	81.6	344.0	105.8	446.0	125.3	556.0	142.7
40	-6.5	142.0	49.5	244.0	82.2	346.0	106.3	448.0	125.6	560.0	143.3
42	-4.5	144.0	50.3	246.0	82.7	348.0	106.6	450.0	126.0	564.0	143.9
44	-3.2	146.0	51.1	248.0	83.3	350.0	107.1	452.0	126.3	568.0	144.5
46	-1.6	148.0	51.8	250.0	83.8	352.0	107.5	454.0	126.6	572.0	145.0
48	0.0	150.0	52.5	252.0	84.3	354.0	107.9	456.0	127.0	576.0	145.6
50	1.5	152.0	53.3	254.0	84.8	356.0	108.3	458.0	127.3	580.0	146.2
52	3.0	154.0	54.0	256.0	85.4	358.0	108.8	460.0	127.7	584.0	146.7
54	4.5	156.0	54.8	258.0	85.9	360.0	109.2	462.0	128.0	588.0	147.3
56	5.9	158.0	55.5	260.0	86.4	362.0	109.6	464.0	128.3	592.0	147.9
58	7.3	160.0	56.2	262.0	86.9	364.0	110.0	466.0	128.7	596.0	148.4
60	8.6	162.0	57.0	264.0	87.4	366.0	110.4	468.0	129.0	600.0	149.0
62	10.0	164.0	57.7	266.0	87.9	368.0	110.8	470.0	129.3	604.0	149.5
64	11.3	166.0	58.4	268.0	88.4	370.0	111.2	472.0	129.7	608.0	150.1
66	12.6	168.0	59.0	270.0	88.9	372.0	111.6	474.0	130.0	612.0	150.6
68	13.8	170.0	59.8	272.0	89.4	374.0	112.0	476.0	130.3	616.0	151.2
70	15.1	172.0	60.5	274.0	89.9	376.0	112.4	478.0	130.7	620.0	151.7
72	16.3	174.0	61.1	276.0	90.4	378.0	112.6	480.0	131.0	624.0	152.3
74	17.5	176.0	61.8	278.0	90.9	380.0	113.1	482.0	131.3	628.0	152.8
76	18.7	178.0	62.5	280.0	91.4	382.0	113.5	484.0	131.6	632.0	153.4
78	19.8	180.0	63.1	282.0	91.9	384.0	113.9	486.0	132.0	636.0	153.9
80	21.0	182.0	63.8	284.0	92.4	386.0	114.3	488.0	132.3	640.0	154.5
82	22.1	184.0	64.5	286.0	92.8	388.0	114.7	490.0	132.6	644.0	155.0
84	23.2	186.0	65.1	288.0	93.3	390.0	115.0	492.0	132.9	648.0	155.5
86	24.3	188.0	65.8	290.0	93.8	392.0	115.5	494.0	133.3	652.0	156.1
88	25.4	190.0	66.4	292.0	94.3	394.0	115.8	496.0	133.6	656.0	156.6
90	26.4	192.0	67.0	294.0	94.8	396.0	116.2	498.0	133.9	660.0	157.1
92	27.4	194.0	67.7	296.0	95.2	398.0	116.6	500.0	134.0	664.0	157.7
94	28.5	196.0	68.3	298.0	95.7	400.0	117.0	502.0	134.5	668.0	158.2
96	29.5	198.0	68.9	300.0	96.2	402.0	117.3	504.0	134.8	672.0	158.7
98	30.5	200.0	69.5	302.0	96.6	404.0	117.7	506.0	135.2	676.0	159.2
100	31.2	202.0	70.1	304.0	97.1	406.0	118.1	508.0	135.5	680.0	159.8
102	32.2	204.0	70.7	306.0	97.5	408.0	118.5	510.0	135.8	684.0	160.3
104	33.2	206.0	71.4	308.0	98.0	410.0	118.8	512.0	136.1	688.0	160.8
106	34.1	208.0	72.0	310.0	98.4	412.0	119.2	514.0	136.4	692.0	161.3
108	35.1	210.0	72.6	312.0	98.9	414.0	119.6	516.0	136.7	696.0	161.8
110	35.5	212.0	73.2	314.0	99.3	416.0	119.9	518.0	137.0		
112	36.9	214.0	73.8	316.0	99.7	418.0	120.3	520.0	137.3		

*Based on ALLIED SIGNAL Data

REQUIRED LIQUID LINE TEMPERATURE						
LIQUID PRESSURE AT SERVICE VALVE (PSIG)	REQUIRED SUBCOOLING TEMPERATURE (°F)					
	8	10	12	14	16	18
189	58	56	54	52	50	48
195	60	58	56	54	52	50
202	62	60	58	56	54	52
208	64	62	60	58	56	54
215	66	64	62	60	58	56
222	68	66	64	62	60	58
229	70	68	66	64	62	60
236	72	70	68	66	64	62
243	74	72	70	68	66	64
251	76	74	72	70	68	66
259	78	76	74	72	70	68
266	80	78	76	74	72	70
274	82	80	78	76	74	72
283	84	82	80	78	76	74
291	86	84	82	80	78	76
299	88	86	84	82	80	78
308	90	88	86	84	82	80
317	92	90	88	86	84	82
326	94	92	90	88	86	84
335	96	94	92	90	88	86
345	98	96	94	92	90	88
354	100	98	96	94	92	90
364	102	100	98	96	94	92
374	104	102	100	98	96	94
384	106	104	102	100	98	96
395	108	106	104	102	100	98
406	110	108	106	104	102	100
416	112	110	108	106	104	102
427	114	112	110	108	106	104
439	116	114	112	110	108	106
450	118	116	114	112	110	108
462	120	118	116	114	112	110
474	122	120	118	116	114	112
486	124	122	120	118	116	114
499	126	124	122	120	118	116
511	128	126	124	122	120	118

EXAMPLE:

a. Liquid Line Pressure = 417
b. Corresponding Temp. °F. = 120°
c. Thermometer on Liquid line = 109°F.

To obtain the amount of subcooling subtract 109°F from 120°F.

The difference is 11° subcooling. See the specification sheet or technical information manual for the design subcooling range for your unit.

S-110 CHECKING EXPANSION VALVE OPERATION

1. Remove the remote bulb of the expansion valve from the suction line.
2. Start the system and cool the bulb in a container of ice water, closing the valve. As you cool the bulb the suction pressure should fall and the suction temperature will rise.
3. Next warm the bulb in your hand. As you warm the bulb the suction pressure should rise and the suction temperature will fall.
4. If a temperature or pressure change is noticed, the expansion valve is operating. If no change is noticed, the valve is restricted, the power element is faulty, or the equalizer tube is plugged.
5. Capture the charge, replace the valve and drier, evacuate and recharge.

S-113 CHECKING RESTRICTED LIQUID LINE

When the system is operating, the liquid line is warm to the touch. If the liquid line is restricted, a definite temperature drop will be noticed at the point of restriction. In severe cases, frost will form at the restriction and extend down the line in the direction of the flow.

Discharge and suction pressures will be low, giving the appearance of an undercharged unit. However, the unit will have normal to high subcooling.

Located the restriction, replace the restricted part, replace drier, evacuate and recharge.

S-114 OVERCHARGE OF REFRIGERANT

An overcharge of refrigerant is normally indicated by an excessively high head pressure.

An evaporator coil, using an expansion valve metering device, will basically modulate and control a flooded evaporator and prevent liquid return to the compressor.

An evaporator coil, using a capillary tube metering device, could allow refrigerant to return to the compressor under extreme overcharge conditions. Also with a capillary tube metering device, extreme cases of insufficient indoor air can cause icing of the indoor coil and liquid return to the compressor, but the head pressure would be lower.

There are other causes for high head pressure which may be found in the "Service Problem Analysis Guide."

If other causes check out normal, an overcharge or a system containing non-condensables would be indicated.

If this system is observed:

1. Start the system.
2. Remove and capture small quantities of gas from the suction line dill valve until the head pressure is reduced to normal.
3. Observe the system while running a cooling performance test, if a shortage of refrigerant is indicated, then the system contains non-condensables.

S-115 NON-CONDENSABLES

If non-condensables are suspected shut down the system and allow the pressures to equalize. Wait at least 15 minutes. Compare the pressure to the temperature of the coldest coil sense this is where most of the refrigerant will be. If the pressure indicates a higher temperature than that of the coil temperature, non-condensables are present.

Non-condensables are removed from the system by first removing the refrigerant charge, replacing and/or installing liquid line drier, evacuating and recharging.

S-116 COMPRESSOR BURNOUT

When a compressor burns out, high temperature develops causing the refrigerant, oil and motor insulation to decompose forming acids and sludge.

If a compressor is suspected of being burned-out, attach a refrigerant hose to the liquid line dill valve and properly remove and dispose of the refrigerant.

Now determine if a burn out has actually occurred. Confirm by analyzing an oil sample using a Sporlan Acid Test Kit, AK-3 or its equivalent.

Remove the compressor and obtain an oil sample from the suction stub. If the oil is not acidic, either a burnout has not occurred or the burnout is so mild that a complete clean-up is not necessary.

If acid level is unacceptable, the system must be cleaned by using the clean-up drier method.

CAUTION

DO NOT ALLOW THE SLUDGE OR OIL TO CONTACT THE SKIN, SEVERE BURNS MAY RESULT.

NOTE: The Flushing Method using R-11 refrigerant is no longer approved by Amana Heating-Cooling.

Suction Line Drier Clean-Up Method

The POE oils used with R410A refrigerant is an excellent solvent. In the case of a burnout, the POE oils will remove any burnout residue left in the system. If not captured by the refrigerant filter, they will collect in the compressor or other system components causing a failure of the replacement compressor and/or spread contaminants throughout the system damaging additional components.

Use AMANA part number RF000127 suction line filter drier kit. This drier should be installed as close to the compressor suction fitting as possible. The filter must be accessible and be rechecked for a pressure drop after the system has operated for a time. It may be necessary to use new tubing and form as required.

NOTE: At least twelve (12) inches of the suction line immediately out of the compressor stub must be discarded due to burned residue and contaminates.

1. Remove compressor discharge line strainer.
2. Remove the liquid line drier and expansion valve.
3 Purge all remaining components with dry nitrogen or carbon dioxide until clean.
4. Install new components **<u>including</u>** liquid line drier.
5. Braze all joints, leak test, evacuate, and recharge system.
6. Start up the unit and record the pressure drop across the drier.
7. Continue to run the system for a minimum of twelve (12) hours and recheck the pressure drop across the drier. Pressure drop should not exceed 6 PSIG.
8. Continue to run the system for several days repeatedly checking pressure drop across the suction line drier. If the pressure drop never exceeds the 6PSIG, the drier has trapped the contaminants. Remove the suction line drier from the system.

9. If the pressure drop becomes greater, then it must be replaced and steps 5 through 9 repeated until it does not exceed 6 PSIG.

NOTICE: Regardless, the cause for burnout must be determined and corrected before the new compressor is started.

S-120 REFRIGERANT PIPING

The piping of a refrigeration system is very important in relation to system capacity, proper oil return to compressor, pumping rate of compressor and cooling performance of the evaporator.

POE oils maintain a consistent viscosity over a large temperature range which aids in the oil return to the compressor; however, there will be some installations which require oil return traps. These installations should be avoided whenever possible as adding oil traps to the refrigerant lines also increases the opportunity for debris and moisture to be introduced into the system.

The maximum length of tubing to be used with a remote Condenser system is 175 feet.

1. All horizontal suction line runs must be pitched towards the compressor (one inch per ten feet). This aids the return of the oil to the compressor.
2. Avoid long running traps in horizontal suction line.
3. The liquid line must not be attached to an uninsulated suction line.
4. If the liquid line is routed through an area which has an ambient higher than 120°F., then that portion of the liquid line must be insulated.
5. Suction line sizes should allow for sufficient internal line velocity to return oil to the compressor. An oil trap by the indoor coil may be necessary to aid in oil return when the outdoor unit is located above the indoor coil.
6. In sizing refrigeration piping determine the number of 90° and 45° elbows required and add their equivalent lengths to the length of straight pipe. Find the equivalent length of fittings in the following table:

EQUIVALENT LENGTH IN FEET

SUCTION LINE ELBOWS

Fitting Size I.D. Inches Sweat, Copper	3/8	1/2	5/8	3/4	7/8	1-1/8
90° Short Radius	1.2	1.4	1.5	1.7	2.0	2.3
90° Long Radius	0.8	0.9	1.0	1.5	1.7	1.6
45°	0.4	0.5	0.6	0.7	0.8	1.0

EXAMPLE: One 7/8" 90° short radius copper sweat ell is equal to the resistance of two foot of 7/8" O.D. straight pipe.

To obtain the total equivalent length, add length of straight pipe to equivalent length of fittings.

NOTE: The outdoor unit's refrigerant holding charge is for the matched indoor coil plus 25 feet of liquid line. If the piping run is longer than 25 feet, additional refrigerant may be needed depending on the indoor coil that is used. The following charge correction chart

REFRIGERANT LINES IN EXCESS OF 50 FEET

It is always best to keep refrigerant lines to 30 feet or less, however this is not always possible. The following information should be used to size refrigerant lines in excess of 50 feet.

1. Sketch the system and determine the number of traps required. Traps are required only if the condensing unit is above the evaporator coil. Traps are only necessary in the suction line.

Oil Trap guide lines:

Gas velocity = 500 to 1999 Ft/Min. oil trap every 10 ft.

Gas velocity = 2000 to 2999 Ft/Min. oil trap every 20 ft.

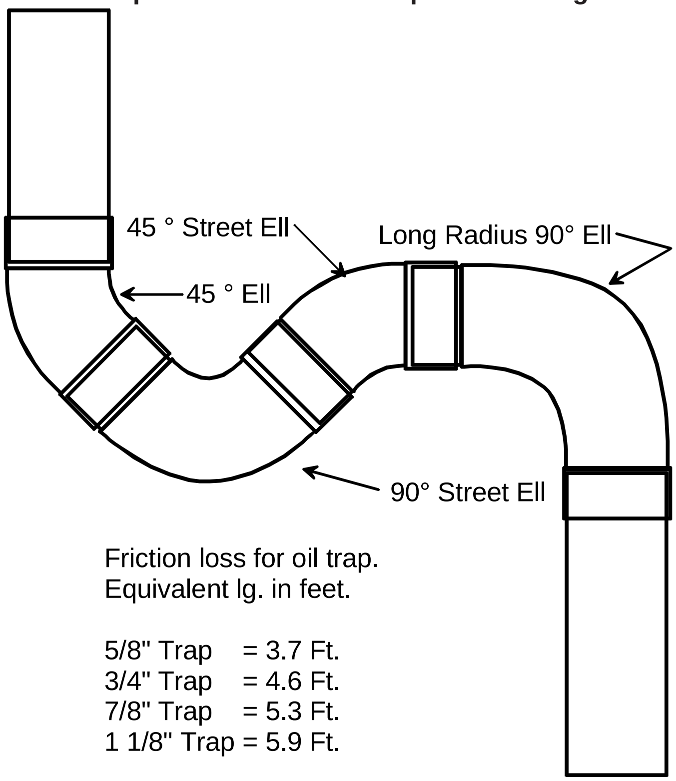
Gas velocity = 3000 Ft/Min. or greater, oil trap every 30 ft.

R410A Refrigerant Flow Rates

R410A Refrigerant Flow Rates				
Model	Ft/Min 5/8" Tube	Ft/Min 3/4" Tube	Ft/Min 7/8" Tube	Ft/Min 1 1/8" Tube
RSD24	1,470	941	NR	NR
RSD30	1,608	1,029	715	NR
RSD36	1,960	1,255	871	NR
RSD42	NR	1,450	1,007	NR
RSD48	NR	1,648	1,144	NR
RSD60	NR	2,182	1,515	1,113

2. The first trap goes at the outlet of the evaporator coil. The remaining traps go halfway up the riser (2 traps total), or 1/3 and 2/3 the way up the riser (3 traps total).
3. Estimate the effective length of pipe. Remember, each trap will have a substantial equivalent length. The suction line effective length could therefore be considerably greater than the liquid line effective length.

Oil Trap Construction and Equivalent Lengths



Friction loss for oil trap.
Equivalent lg. in feet.

5/8" Trap = 3.7 Ft.
3/4" Trap = 4.6 Ft.
7/8" Trap = 5.3 Ft.
1 1/8" Trap = 5.9 Ft.

4. Size the suction line per the Suction Line Sizing Chart. Remember, you want to balance the size selection; A smaller line size will improve oil return, but reduce capacity. A larger line size will minimize capacity loss, but oil return may be an issue.

SUCTION LINE SIZING

Cooling capacity loss with long line sets (percentage of total capacity loss)

Tonnage	Vapor Line OD (in)	line equiv length (feet)						
		25	50	75	100	125	150	175
2	5/8	1.0%	2.3%	4.0%	4.7%	5.8%	6.9%	7.9%
	3/4	0.0%	1.0%	2.0%	3.0%	3.8%	4.5%	5.0%
2.5	5/8	1.4%	2.8%	4.4%	5.6%	6.7%	7.9%	9.1%
	3/4	0.0%	1.0%	1.9%	2.7%	3.5%	4.1%	4.8%
	7/8	0.0%	0.0%	1.1%	2.0%	2.8%	3.4%	3.9%
3	5/8	1.9%	4.1%	6.0%	7.6%	9.3%	10.9%	12.4%
	3/4	0.0%	1.4%	2.6%	3.6%	4.5%	5.6%	6.4%
	7/8	0.0%	1.0%	2.0%	2.7%	3.3%	3.8%	4.5%
3.5	3/4	0.7%	1.9%	3.2%	4.3%	5.3%	6.2%	7.1%
	7/8	0.0%	1.0%	1.7%	2.1%	2.4%	2.7%	2.9%
4	3/4	0.5%	2.0%	3.5%	5.0%	6.3%	7.4%	8.5%
	7/8	0.0%	1.0%	2.0%	3.0%	3.8%	4.4%	5.3%
5	3/4	1.5%	3.3%	5.4%	7.1%	8.9%	10.2%	11.8%
	7/8	0.0%	1.2%	2.4%	3.6%	4.9%	5.8%	6.9%
	1 1/8	0.0%	0.0%	1.0%	1.5%	1.8%	2.3%	2.8%

5. Size the liquid line per the Liquid Line Sizing charts. If the evaporator coil is above the condensing unit, you must add the subcooling loss for the vertical rise to the liquid line friction loss. If the evaporator coil is below the condenser, you may subtract the subcooling increase from the friction line loss. The subcooling loss (or gain) is 1°F. for every 10 feet of change in vertical height. In any application, the subcooling loss (+2°F) cannot exceed the system design subcooling.

LIQUID LINE SIZING

Liquid line subcooling loss for R410a due to Pressure Drop (degree F)

Tonnage	Liquid Line OD (in)	line equiv length (feet)						
		25	50	75	100	125	150	175
2	1/4	2.7	6.0	9.6	NR	NR	NR	NR
	5/16	0.0	0.7	1.6	2.4	3.3	4.2	5.1
	3/8	0.0	0.0	0.0	0.0	0.3	0.6	0.9
2.5	1/4	4.1	8.4	NR	NR	NR	NR	NR
	5/16	0.4	1.5	2.6	3.8	4.9	6.1	NR
	3/8	0.0	0.0	0.3	0.6	1.0	1.4	1.8
3	1/4	6.3	NR	NR	NR	NR	NR	NR
	5/16	1.3	2.9	4.4	6.1	NR	NR	NR
	3/8	0.1	0.6	1.1	1.6	2.2	2.7	3.2
3.5	5/16	2.9	5.0	7.1	NR	NR	NR	NR
	3/8	1.3	2.0	2.7	3.3	4.0	4.7	5.4
4	5/16	2.7	5.3	8.0	NR	NR	NR	NR
	3/8	0.7	1.5	2.4	3.3	4.1	5.0	5.9
5	5/16	5.2	NR	NR	NR	NR	NR	NR
	3/8	2	3.3	4.6	6	7.3	8.7	10.1

6. Determine the amount of additional refrigerant the system will require using the Refrigerant Correction Chart.

REFRIGERANT CORRECTION CHART

Liquid Line size OD	Oz. Refrig/ft. liquid line.
1/4”	0.20
5/16”	0.36
3/8”	0.55
1/2”	1.07

7. An accumulator is not normally required in R410A systems.

SERVICING

REFRIGERANT LINE SIZING

Known Factors:

1. RSD48A2A and CA48TCC coil/TX41004A expansion valve. Evaporator above Condenser.
2. Liquid Line 65 linear feet w/ 8 long radius elbows, and 30 ft. vertical lift.
3. Suction Line 65 linear feet w/ 8 long radius elbows.

Determine Suction and Liquid Line sizes:

Procedures:

A. Measure length of suction line. (65 ft.)

B. Count the number of suction line elbows. (8 long radius)

C. Calculate the equivalent length of fittings using the Fitting Losses in Equivalent Feet Chart. (Calculate using the recommended suction line size for each unit, and long radius elbows.) 8 x 2.0 = 16 equivalent feet.

D. Add suction line length (A) and equivalent feet of fittings (C). 65 + 16 = 81 effective feet.

E. The total effective length of Suction Line is 81 feet. Refer to the Suction Line Sizing Chart to determine the actual suction line required. A 7/8" suction line would be recommended in this installation. No oil return traps are needed as the coil is above the condenser.

F. Measure liquid line length. (65 ft.)

G. Count the number of liquid line elbows. (8 short radius)

H. Calculate the equivalent length of fittings using the Suction Line Elbow chart. (Calculate using the recommended liquid line size for each unit.)

   8 x 1.2 = 9.6 equivalent feet.

I. Add liquid line length (F), equivalent feet of fittings (H). 65 + 9.6 = 74.6 effective feet.

J. The total effective length of liquid line is 74.6 ft. Refer to the Liquid Line Sizing Chart to determine the subcooling loss, add the additional 3°F subcooling loss for the vertical rise. Using 3/8" liquid line the subcooling loss is 5.4°F, which is within an acceptable range, so 3/8" liquid line will be used.

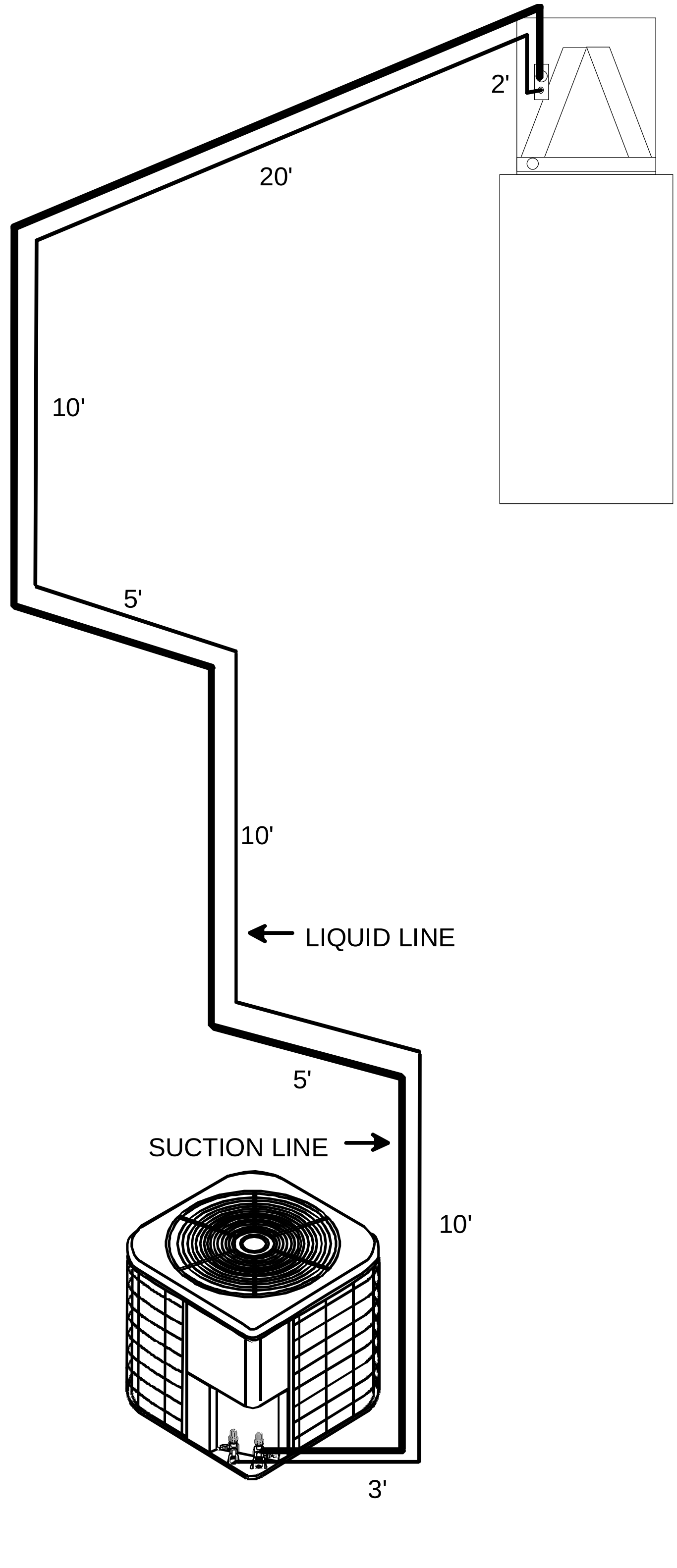
K. To determine the additional charge required, multiply the linear feet of liquid line to the refrigerant correction factor, and subtract the factory charge for the line set.

   65 x 0.55 = 35.75

   25 x 0.55 = <u>13.75</u>

   = 22 oz. additional charge

L. To determine the subcooling value for this application, refer to spec sheet or technical information manual. The design subcooling for RSD48 is 10.5°F. Add the subcooling loss for the liquid line length (5.4°F), less 2°F equals 13.9°F subcooling at the liquid line service valve.



SERVICING

REFRIGERANT LINE SIZING

Known Factors:

1. RSD36A2A and matching "A" coil. Condenser above Evaporator.
2. Liquid Line 72 linear feet w/ 6 long radius elbows
3. Suction Line 72 linear feet, and 43 ft. vertical lift.

Determine Suction and Liquid Line sizes:

Procedures:

A. Measure length of suction line. (72 ft.)

B. Measure the vertical lift of the suction line (43'). Using the Suction Line Traps Chart determine the number of traps required in the suction line (3). Count the number of suction line elbows. (6 long radius)

C. Calculate the equivalent length of fittings using the appropriate charts. (Calculate using the recommended suction line size for each unit.) 6 x 1.7 = 10.2 + Traps 3 x 4.6 = 13.8 (10.2 + 13.8) = 24 equivalent feet.

D. Add suction line length (A) and equivalent feet of fittings (C). 72 + 24 = 96 effective feet.

E. The total equivalent length of Suction Line is 96 feet. Refer to the Suction Line Sizing Chart to determine the actual suction line required. (Since 96' is greater than 75' but less than 100', use the 100' column). A 3/4" Suction line will be adequate with a 3.6% capacity loss.

F. Measure liquid line length. (72 ft.)

G. Count the number of liquid line elbows. (6 long radius)

H. Calculate the equivalent length of fittings using the Fitting Losses in Equivalent Feet Chart. (Calculate using the recommended liquid line size for each unit.)

6 x .8 = 4.8 equivalent feet.

I. Add liquid line length (F) equivalent feet of fittings (H). 72 + 4.8 = 76.8 effective feet.

J. The total effective length of liquid line is 76.8 ft. Refer to the Liquid Line Sizing Chart to determine the liquid line subcooling loss. 76.8 effective feet of 5/16 tubing will have 4.4°F subcooling loss, less the subcooling gain due to the vertical drop (43 ft.) = 4.3°F for a net 0.1°F subcooling loss. 5/16" Tubing would be the appropriate size.

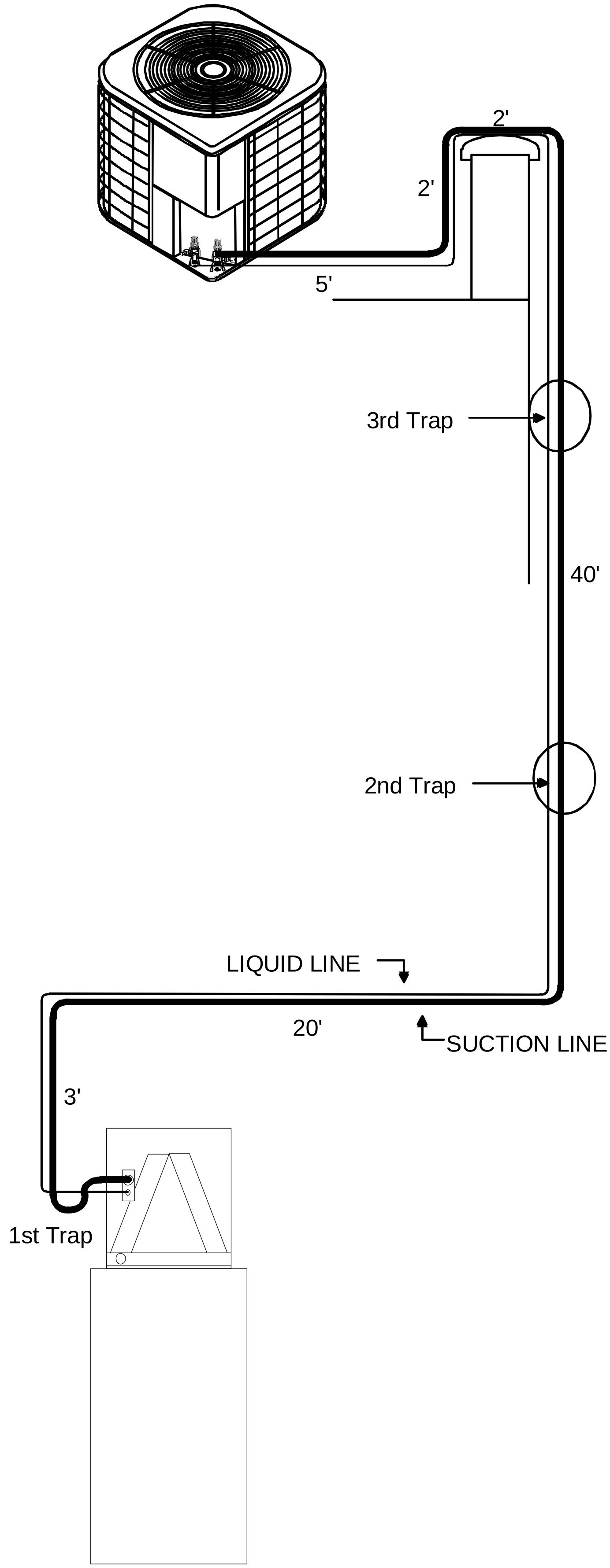
K. To determine the additional charge required, multiply the linear feet of liquid line to the refrigerant correction factor, and subtract the factory charge for the line set.

72 x .36 = 27.36

25 x .55 = 13.75

= 13.6 oz. additional charge

L. To calculated the correct subcooling for this application, Refer to spec sheet or technical service manual for the design subcooling value. RSD36 design subcooling is 9°F. Add 4.4°F for the liquid line friction loss, subtract 4.3°F for the elevation change, less 2°F equals 7.1. the design subcooling for this installation is 7.1°F at the liquid line service valve.



SERVICING

7. Make the final charge adjustment. Refer to the Unit specification sheet or technical information manual for the correct subcooling. The subcooling reading must be adjusted for any elevation differences between the condenser and evaporator. The super-heat at the indoor coil should also be measured to verify proper operation of the TXV. Adjust charge as explained in section **S-103 CHARGING.**

S-200 DUCT STATIC PRESSURES AND/OR STATIC PRESSURE DROP ACROSS COIL

This minimum and maximum allowable duct static pressure for the indoor sections are found in the specifications section.

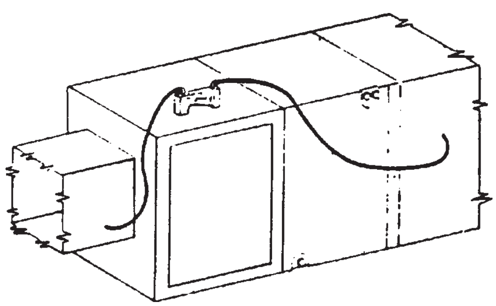
Tables are also provided for each coil, listing quantity of air (CFM) versus static pressure drop across the coil.

Too great an external static pressure will result in insufficient air that can cause icing of the coil. Too much air can cause poor humidity control and condensate to be pulled off the evaporator coil causing condensate leakage. Too much air can also cause motor overloading and in many cases this constitutes a poorly designed system.

S-201 AIR HANDLER EXTERNAL STATIC

To determine proper air movement, proceed as follows:

1. Using a draft gauge (inclined manometer) measure the static pressure of the return duct at the inlet of the unit, (Negative Pressure).
2. Measure the static pressure of the supply duct, (Positive Pressure).
3. Add the two readings together.

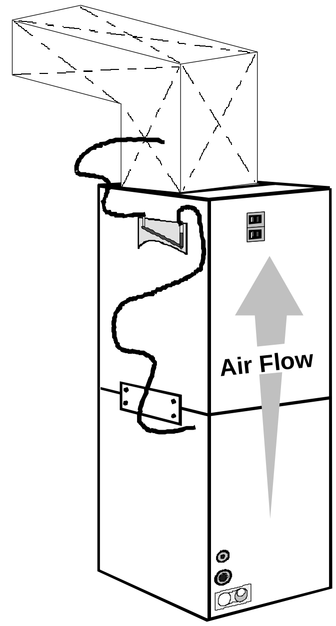


TOTAL EXTERNAL STATIC

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired.

4. Consult proper table for quantity of air.

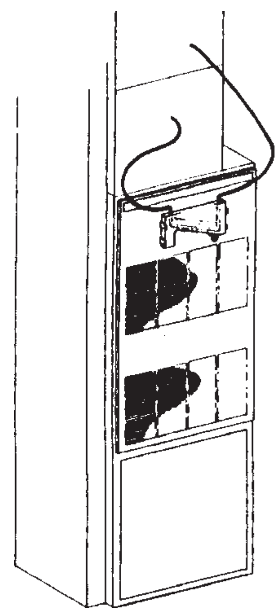
If external static pressure is being measured on a furnace to determine airflow, supply static must be taken between the "A" coil and the furnace.



TOTAL EXTERNAL STATIC

S-202 COIL STATIC PRESSURE DROP

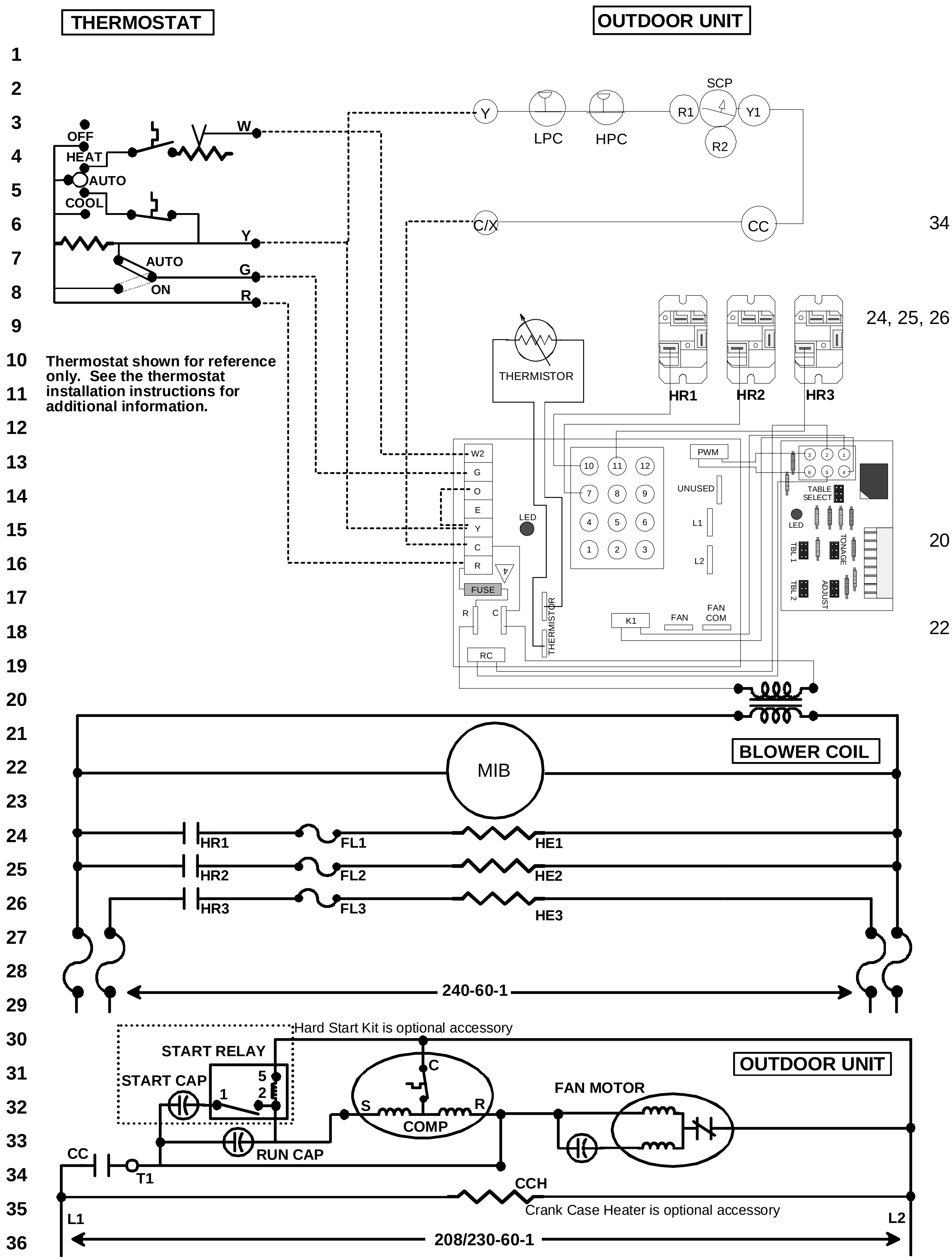
1. Using a draft gauge (inclined manometer), connect the positive probe underneath the coil and the negative probe above the coil.
2. A direct reading can be taken of the static pressure drop across the coil.
3. Consult proper table for quantity of air.



STATIC PRESSURE DROP

If the total external static pressure and/or static pressure drop exceeds the maximum or minimum allowable statics, check for closed dampers, dirty filters, undersized or poorly laid out duct work.

SCHEMATICS

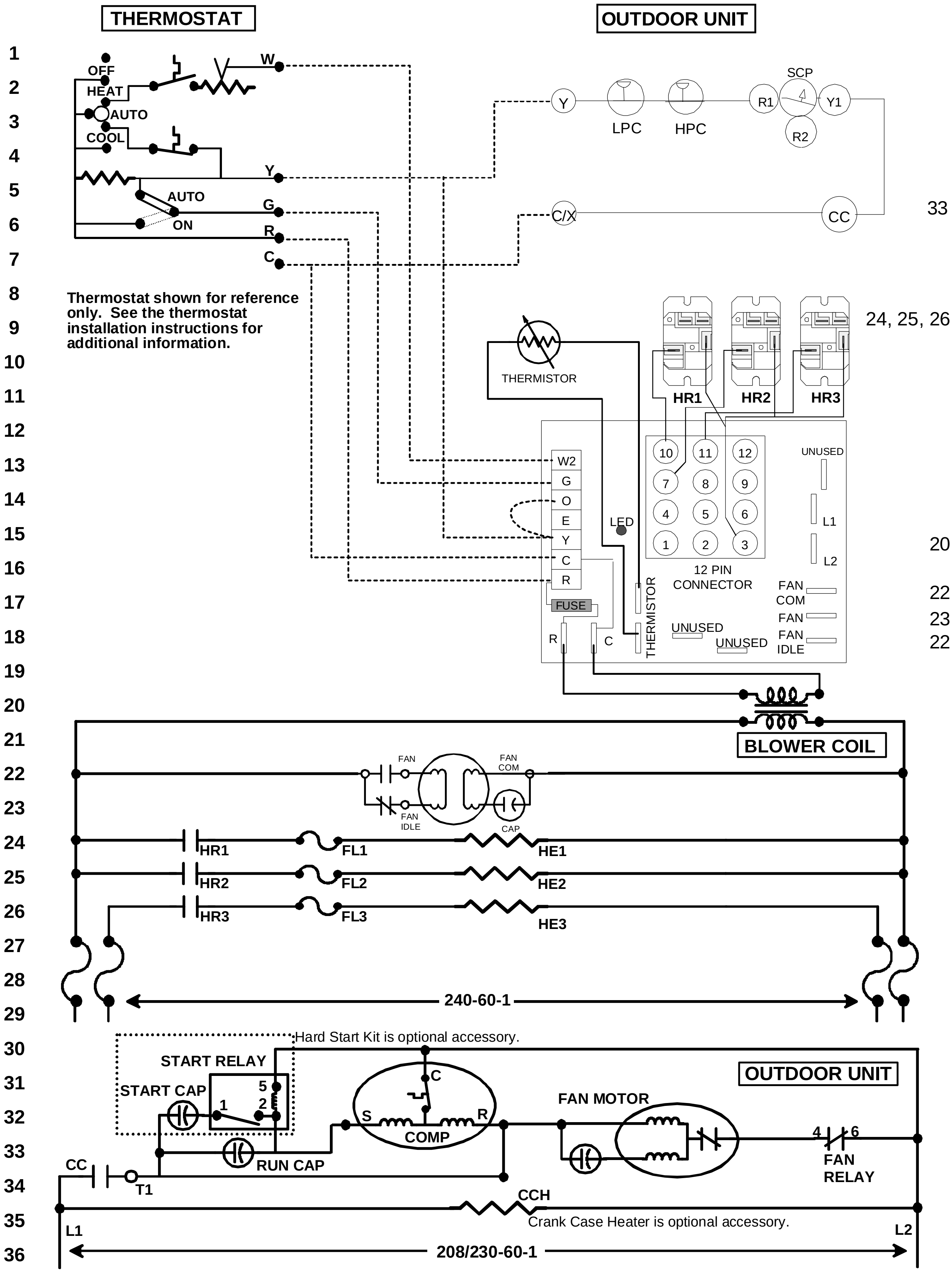


WARNING

TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.

Typical Wiring Schematic RSDA2* with BBC**A2A blower**

SCHEMATICS



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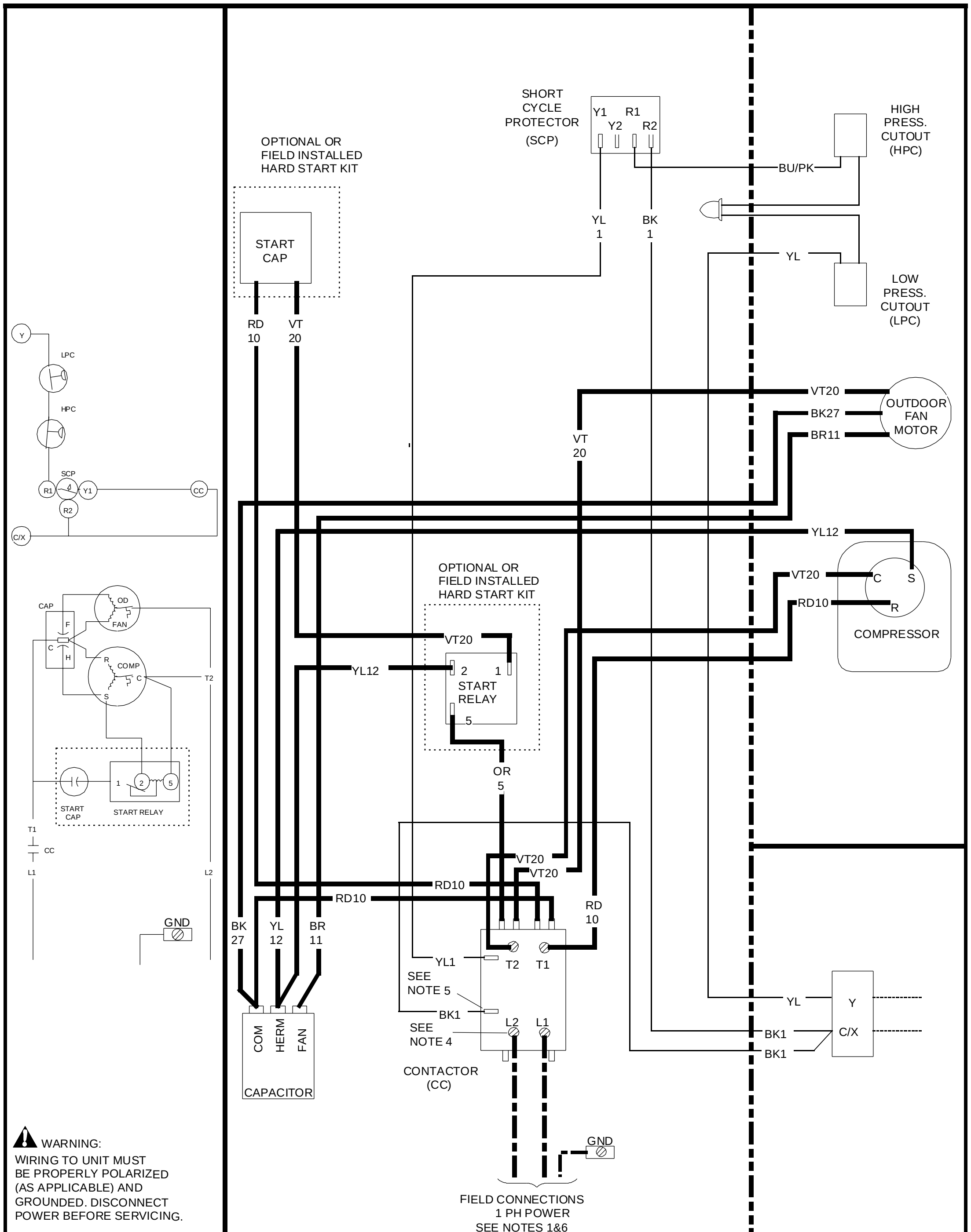
Typical Wiring Schematic RSDA2* with BBA**A2A blower**



ACCESSORIES:
OPTIONAL OR FIELD INSTALLED HARD START KIT

⚠ WARNING:
WIRING TO UNIT MUST BE PROPERLY POLARIZED (AS APPLICABLE) AND GROUNDED. DISCONNECT POWER BEFORE SERVICING.

NOTES
1. SEE ELECTRICAL INFORMATION ON UNIT NAMEPLATE. FIELD CONNECTIONS FOR 1ø UNITS ARE TO BE MADE AT CONTACTOR & EQUIPMENT GROUND SCREW.
2. FOR FIELD CONNECTIONS SEE INSTALLATION INSTRUCTIONS.
3. TRANSFORMER N.E.C. CLASS 2, 24VAC OUTPUT, 20VA MINIMUM.

CANADIAN REQUIREMENTS:
4. NEUTRAL, IF INPUT POWER DERIVED FROM 240/416 SOURCE.
5. CONTROL CIRCUIT GROUND.
6. 120/240 VAC 3 WIRE

FACTORY SUPPLIED WIRING
- LOW VOLTAGE
- HIGH VOLTAGE

FIELD SUPPLIED WIRING
- LOW VOLTAGE
- HIGH VOLTAGE

NOTE: READ THE FOLLOWING NOTES BEFORE OPERATING OR SERVICING THIS UNIT.
1. AMANA APPROVED REPLACEMENT PARTS MUST BE USED WHEN SERVICING.
2. TOTAL SYSTEM CHARGE IS MARKED ON CONDENSER NAMEPLATE WHICH INCLUDES INDOOR SECTION AND 25 FEET OF INTERCONNECTING LIQUID LINE, IF DIFFERENT LIQUID LINE LENGTH IS USED ADJUST PER FOLLOWING CHART.

.250 LIQUID LINE	.20 OZ. PER FOOT
.312 LIQUID LINE	.36 OZ. PER FOOT
.375 LIQUID LINE	.55 OZ. PER FOOT
.500 LIQUID LINE	1.07 OZ. PER FOOT

TOTAL CHARGE BLOCK MUST BE STAMPED BY THE DEALER WHO INSTALLS THE UNIT.
FOR MORE COMPLETE INSTRUCTIONS SEE INSTALLATION INSTRUCTIONS.

COLOR CODE & LEGEND
1ST GROUP-COLOR
2ND GROUP-NUMBER

OR-ORANGE	BK-BLACK
YL-YELLOW	BU-BLUE
VT-VIOLET	RD-RED
BR-BROWN	TN-TAN
GN-GREEN	GY-GRAY
PK-PINK	WN-WIRE NUT

20324801 REV 0

⚠ WARNING

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