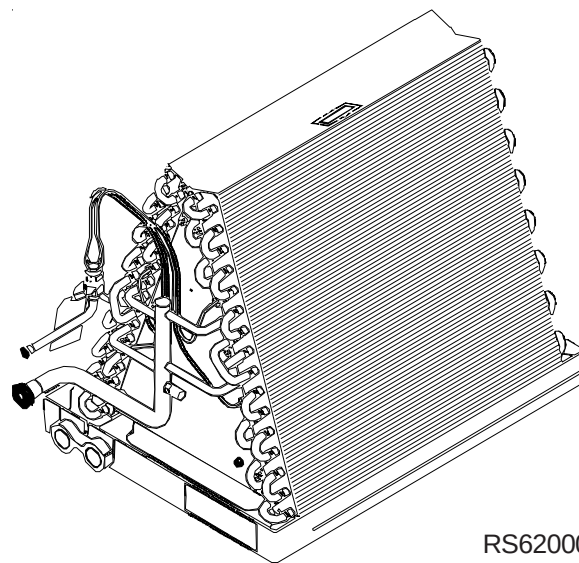
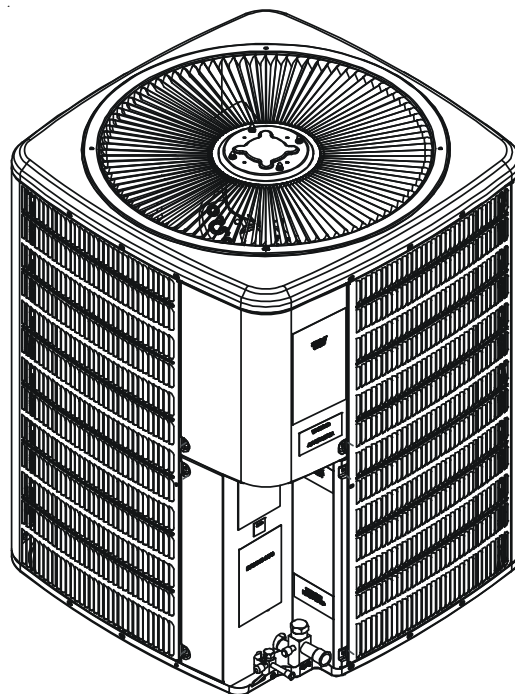
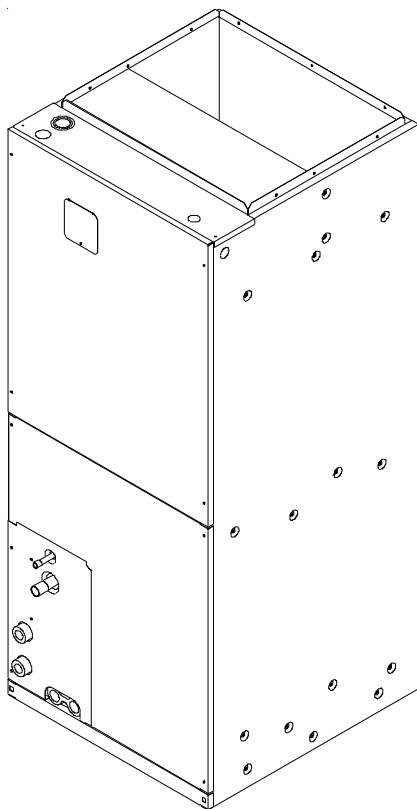


Service Instructions

GSZ13 / GSZ14 / SSZ14 Split System Heat Pumps with R-410A Refrigerant Blowers, Coils, & Accessories



This manual is to be used by qualified, professionally trained HVAC technicians only. Goodman does not assume any responsibility for property damage or personal injury due to improper service procedures or services performed by an unqualified person.

RS6200008r4
August 2016

IMPORTANT INFORMATION

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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

WARNING

THIS UNIT SHOULD NOT BE CONNECTED TO, OR USED IN CONJUNCTION WITH, ANY DEVICES THAT ARE NOT DESIGN CERTIFIED FOR USE WITH THIS UNIT OR HAVE NOT BEEN TESTED AND APPROVED BY THE MANUFACTURER. **SERIOUS PROPERTY DAMAGE OR PERSONAL INJURY, REDUCED UNIT PERFORMANCE AND/OR HAZARDOUS CONDITIONS MAY RESULT FROM THE USE OF DEVICES THAT HAVE NOT BEEN APPROVED OR CERTIFIED BY THE MANUFACTURER.**

WARNING

ONLY PERSONNEL THAT HAVE BEEN TRAINED TO INSTALL, ADJUST, SERVICE OR REPAIR (HEREINAFTER, "SERVICE") THE EQUIPMENT SPECIFIED IN THIS MANUAL SHOULD SERVICE THE EQUIPMENT. THE MANUFACTURER WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU SERVICE THIS UNIT, YOU ASSUME RESPONSIBILITY FOR ANY INJURY OR PROPERTY DAMAGE WHICH MAY RESULT. IN ADDITION, IN JURISDICTIONS THAT REQUIRE ONE OR MORE LICENSES TO SERVICE THE EQUIPMENT SPECIFIED IN THIS MANUAL, ONLY LICENSED PERSONNEL SHOULD SERVICE THE EQUIPMENT. IMPROPER INSTALLATION, ADJUSTMENT, SERVICING OR REPAIR OF THE EQUIPMENT SPECIFIED IN THIS MANUAL, OR ATTEMPTING TO INSTALL, ADJUST, SERVICE OR REPAIR THE EQUIPMENT SPECIFIED IN THIS MANUAL WITHOUT PROPER TRAINING MAY RESULT IN PRODUCT DAMAGE, PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

WARNING

TO PREVENT THE RISK OF PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH, DO NOT STORE COMBUSTIBLE MATERIALS OR USE GASOLINE OR OTHER FLAMMABLE LIQUIDS OR VAPORS IN THE VICINITY OF THIS APPLIANCE.

WARNING

HIGH VOLTAGE

DISCONNECT **ALL** POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



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

GOODMAN® BRAND PRODUCTS **TOLL FREE**

1-877-254-4729 (U.S. only)

email us at: **customerservice@goodmanmfg.com**

fax us at: **(713) 856-1821**

(Not a technical assistance line for dealers.)

AMANA® BRAND PRODUCTS **TOLL FREE**

1-877-254-4729 (U.S. only)

email us at: **customerservice@goodmanmfg.com**

fax us at: **(713) 856-1821**

(Not a technical assistance line for dealers.)

Outside the U.S., call **1-713-861-2500**.

(Not a technical assistance line for dealers.) Your telephone company will bill you for the call.

IMPORTANT INFORMATION

SAFE REFRIGERANT HANDLING

While these items will not cover every conceivable situation, they should serve as a useful guide.



WARNING

REFRIGERANTS ARE HEAVIER THAN AIR. THEY CAN "PUSH OUT" THE OXYGEN IN YOUR LUNGS OR IN ANY ENCLOSED SPACE. TO AVOID POSSIBLE DIFFICULTY IN BREATHING OR DEATH:

- NEVER PURGE REFRIGERANT INTO AN ENCLOSED ROOM OR SPACE. BY LAW, ALL REFRIGERANTS MUST BE RECLAIMED.
- IF AN INDOOR LEAK IS SUSPECTED, THOROUGHLY VENTILATE THE AREA BEFORE BEGINNING WORK.
- LIQUID REFRIGERANT CAN BE VERY COLD. TO AVOID POSSIBLE FROST-BITE OR BLINDNESS, AVOID CONTACT WITH REFRIGERANT AND WEAR GLOVES AND GOGGLES. IF LIQUID REFRIGERANT DOES CONTACT YOUR SKIN OR EYES, SEEK MEDICAL HELP IMMEDIATELY.
- ALWAYS FOLLOW EPA REGULATIONS. NEVER BURN REFRIGERANT, AS POISONOUS GAS WILL BE PRODUCED.



WARNING

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY ("EPA") HAS ISSUED VARIOUS REGULATIONS REGARDING THE INTRODUCTION AND DISPOSAL OF REFRIGERANTS INTRODUCED INTO THIS UNIT. FAILURE TO FOLLOW THESE REGULATIONS MAY HARM THE ENVIRONMENT AND CAN LEAD TO THE IMPOSITION OF SUBSTANTIAL FINES. THESE REGULATIONS MAY VARY BY JURISDICTION. SHOULD QUESTIONS ARISE, CONTACT YOUR LOCAL EPA OFFICE.



WARNING

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.



WARNING

TO AVOID POSSIBLE EXPLOSION:

- NEVER APPLY FLAME OR STEAM TO A REFRIGERANT CYLINDER. IF YOU MUST HEAT A CYLINDER FOR FASTER CHARGING, PARTIALLY IMMERSE IT IN WARM WATER.
- NEVER FILL A CYLINDER MORE THAN 80% FULL OF LIQUID REFRIGERANT.
- NEVER ADD ANYTHING OTHER THAN R-22 TO AN R-22 CYLINDER OR R-410A TO AN R-410A CYLINDER. THE SERVICE EQUIPMENT USED MUST BE LISTED OR CERTIFIED FOR THE TYPE OF REFRIGERANT USED.
- STORE CYLINDERS IN A COOL, DRY PLACE. NEVER USE A CYLINDER AS A PLATFORM OR A ROLLER.



WARNING

TO AVOID POSSIBLE EXPLOSION, USE ONLY RETURNABLE (NOT DISPOSABLE) SERVICE CYLINDERS WHEN REMOVING REFRIGERANT FROM A SYSTEM.

- ENSURE THE CYLINDER IS FREE OF DAMAGE WHICH COULD LEAD TO A LEAK OR EXPLOSION.
- ENSURE THE HYDROSTATIC TEST DATE DOES NOT EXCEED 5 YEARS.
- ENSURE THE PRESSURE RATING MEETS OR EXCEEDS 400 LBS.

WHEN IN DOUBT, DO NOT USE CYLINDER.



WARNING

TO AVOID POSSIBLE INJURY, EXPLOSION OR DEATH, PRACTICE SAFE HANDLING OF REFRIGERANTS.

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

Split System Heat Pumps R410A	
Model #	Description
GSZ130191AA GSZ130251AA GSZ130311AA GSZ130371AA	<u>Goodman Split Z</u> R410A Heat Pump 13 Seer heat pump units. Initial release of 13 SEER models w/new flowrator body/filter dryer outside the liquid line for long line set applications when the outdoor unit is above the indoor unit.
GSZ130191AB GSZ130311AB GSZ130371AB	<u>Goodman Split Z</u> R410A Heat Pump 13 Seer heat pump units. The current four piece louver assembly has changed to a two piece louver plus a corner post on Goodman and value series 26" and 29" chassis.
GSZ130251BA	<u>Goodman Split Z</u> R410A Heat Pump 13 Seer heat pump units. Initial release of 13 SEER models w/new flowrator body/filter dryer outside the liquid line for long line set applications when the outdoor unit is above the indoor unit.
GSZ130251BB	<u>Goodman Split Z</u> R410A Heat Pump 13 Seer heat pump units. The current four piece louver assembly has changed to a two piece louver plus a corner post on Goodman and value series 26" and 29" chassis.
SSZ140191AA SSZ140251AA SSZ140311AA SSZ140371AA	<u>Special High Feature Split Z</u> R410A Heat Pump 14 Seer heat pump units. Initial release of 14 SEER models w/new flowrator body/filter dryer outside the liquid line for long line set applications when the outdoor unit is above the indoor unit..
SSZ140[19-37]1AB	<u>Special High Feature Split Z</u> R410A Heat Pump 14 Seer heat pump units. The current four piece louver assembly has changed to a two piece louver plus a corner post on Goodman and value series 26" and 29" chassis.
SSZ140[19-37]1AC	<u>Special High Feature Split Z</u> R410A Heat Pump 14 Seer heat pump units. Refrigerant quantity change.
SSZ140[19-37]1AD	<u>Special High Feature Split Z</u> R410A Heat Pump 14 Seer heat pump units. Reversing valve vendor change.
GSZ140191A* GSZ140251A*	<u>Goodman Split Z</u> R410A Heat Pump 14 SEER. Initial release.
GSZ140311A* GSZ140371A*	<u>Goodman Split Z</u> R410A Heat Pump 14 SEER. Initial release.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	Description
ARUF172916AA A24-00-2RCA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater Introduction of new Air Handler Models with all aluminum evaporator coils. Conversion includes coils, manifold, hairpin, flowrators, 3/8" return bend to 5/16" aluminum return bends.
ARUF***16AA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater Introduction of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A
ARUF364216AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF486016AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF364216AC	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF***16BA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces all ARUFcoils using wavy fin with louver enhanced fin.
ARUF***1BA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater Introdution of R-22 Only Air Handlers.
ARUF***16CA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces existing air handler copper coils and other associated parts with aluminum components.
ARPF***16AA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater Introdution of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A
ARPF364216AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARPF486016AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARPF***16BA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater. Revision replaces all ARPFcoils using wavy fin with louver enhanced fin.
ARPF***1BA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater. Introdution of R-22 Only Air Handlers.
ARPF***16CA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrater. Revision replaces existing air handler copper coils and other associated parts with aluminum components.
ADPF***16AA	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Introduction of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A.
ADPF364216AB	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF486016AB	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF304216AC	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF***1BA	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater Revision replaces all ARPFcoils using wavy fin with louver enhanced fin.
ADPF182416CA ADPF486016CA	<u>A</u> Single Piece <u>D</u> ownflow PSC Motor <u>Un</u> ainted <u>F</u> lowrater. Revision replaces existing air handler copper coils and other associated parts with aluminum components.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	Description
ASPF313716AA	<u>A</u> Single Piece <u>E</u> Multi-Position Variable-Speed <u>P</u> ainted <u>F</u> lowrator (AEPF) and <u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator (ASPF). Introduction of 3-Ton Air Handler units with 3-row coil.
ASPF****16AA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator. Introduces new ASPF Air Handlers
ASPF****16BA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator. Revision introuces modified ASPF control scheme, to ensure blower operation during and after call for heat on units with heat kits and replacing wavy fin with louver enhanced fin on coil
ASPF****16CA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator. Revision replaces existing air handler copper coils and other associated parts with aluminum components.
ASPF****16DA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator. Revision introduces and replaces Regal-Beliot X-13 motor with Emerson SelecTech motor.
ASPF****16EA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted <u>F</u> lowrator. Revision replaces existing air handler copper coils and other associated parts with aluminum components and replaces Regal-Beliot X-13 motor with Emerson SelecTech motor.
AWUF****1AA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. Introduces 13 SEER Dayton wall mount air handlers
AWUF****16AA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. Introduces 13 SEER Dayton wall mount air handlers. All Models will be suitable for use with R-22 and R-410A
AWUF3005-101AA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. Introduces 13 SEER Dayton wall mount air handlers using a Burr Oak Louvered Fin coil.
AWUF****1BA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. Revision replaces current wavy fin design with new louvered fin design
AWUF370**16AA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted Flowrator. Introduction of AWUF37 Air Handlers for use with R-22 and R410A.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	Description
AWUF****16BA	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Revision has louver fins & replaces copper tube hairpins with aluminum hairpins.
AWUF180316BA AWUF240316BA AWUF300316BA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. AWUF 3KW Heater Introduction. Introduction of 3KW heater in the AWUF air handlers
AWUF310516AA AWUF310816AA AWUF321016AA	<u>A</u> Single Piece Air Handler <u>W</u> all Mount <u>U</u> nainted <u>F</u> lowrator. Introduction of higher 14 SEER AWUF series air-handlers
ACNF****1AA	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Revision release all models of 13 SEER Dayton uncased air handlers.
ACNF****16AA	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Revision release all models of 13 SEER Dayton uncased air handlers.All Models will be suitable for use with R-22 and R-410A
ACNF****1AB	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Drain pan material change.
ACNF****1BA	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Revision replaces current wavey fin design with new louvered fin design
ACNF****16DA	<u>A</u> Single Piece Air Handler <u>C</u> eilings Mount <u>N</u> Uncased <u>F</u> lowrater. Conversion of existing copper coils, manifolds, hairpins, flowrators, 90° flowrator stub to aluminum. Conversion of copper 3/8" return bends to aluminum 5/16" return bends .All Models will be suitable for use with R-22 and R-410A

MBR Air Handlers	
Model #	Description
MBR****AA-1AA	<u>M</u> odular <u>B</u> lower <u>R</u> Multi-Position PSC Motor. Introduces module blower with PSC blower motor.
MBR****AA-1AB	<u>M</u> odular <u>B</u> lower <u>R</u> Multi-Position PSC Motor. Quality improvement to use 0.75" Quiet Flex Insulation.

PRODUCT IDENTIFICATION

SMART FRAME AIR HANDLER

Single Piece Air Handlers	
Model #	Description
ASPT[24/36/48/60]*14	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted TXV. Revision introduces new generation ASPT air handlers.
ASPT36C14AB ASPT[48/60]D14AB ASPT48D14AC	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted TXV. Revision updates 9mm return bend coil changes to the new generation of ASPT air handlers. These revisions cover the ASPT36C, ASPT48D, and ASPT60D models.
ASPT24B14AC ASPT30C14AB ASPT36C14AC	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted TXV. Programmed Broad Ocean Motor. This revision will allow the supplier to program the motor instead of furnace plant, thus eliminating any programming installing issues. The programmed label will be provided by supplier.
ASPT[42-48]C14AA	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted TXV. Introduction with 2+2 coil slab assy. These models are required to meet higher tonnage ratings in Cabinet.
ASPT42D14AB ASPT48D14AD ASPT60D14AC	<u>A</u> Single Piece <u>S</u> Multi-Position EEM motor <u>P</u> ainted TXV. Nidec Pre-programmed Motor. This revision will allow the Nidec motor to be programmed by the supplier instead of programming at the furnace plant, thus eliminating any programming installing issues.
ASUF29B14AA ASUF39C14AA	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. Releases ASUF29B14 and ASUF39C14 to add to the mid efficiency ranges that the product line offers. Incorporates the smart frame chasis with EEM (X-13) style motors and piston type flowrators.
ASUF49C14AA ASUF59D14AA	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. Introduces a mid-range efficiency air handler with X-13 motor & fixed orifice flowrator.
ASUF49C14AB ASUF59D14AB	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. Revision updates the 9mm return bends in the coil tubing assembly on the ASUF air handlers. These revisions cover the ASUF49C14 and ASUF59D14.
ASUF59D14AC	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. This revision creates a four row, piston, 9 mm return bend coil, which will create a new S&R plates and Travel label. It will also reduce poron gasket qty (pt # 0154A00005) from 10 ft to 7 ft similar to all other D chassis air handlers.
ASUF59D14AD	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. Nidec Pre-programmed Motor. This revision will allow the Nidec motor to be programmed by the supplier instead of programming at the furnace plant, thus eliminating any programming installing issues.
ASUF29B14AB ASUF39C14AB ASUF49C14AC	<u>A</u> Single Piece Air Handler <u>S</u> Energy Efficient Motor <u>U</u> nainted <u>F</u> lowrator. Programmed Broad Ocean Motor. This revision will allow the supplier to program the motor instead of furnace plant, thus eliminating any programming installing issues. The programmed label will be provided by supplier.

PRODUCT IDENTIFICATION

SMART FRAME AIR HANDLER

Single Piece Air Handlers	
Model #	Description
ARUF***14AA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>U</u> nainted <u>F</u> lowrator, R-410A only. Initial release of the redesigned air handlers.
ARUF***14AA ARUF***14AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>U</u> nainted <u>F</u> lowrator, R-410A only. Initial release of the redesigned air handlers manufactured at the Houston furnace facility.
ARUF36C14BC ARUF30B14AC ARUF30C14BB ARUF42C14AD ARUF[48-60]D14AC	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>U</u> nainted <u>F</u> lowrator, R-410A only. Revisions are made due to changes made on serial plate.
ARPT***14AA	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrator, TXV, R-410A only. Initial release of the new air handlers.
ARPT***14AB	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrator, TXV, R-410A only. Initial release of the air handlers manufactured at the Houston furnace facility.
ARPT[18-36]B14AC ARPT[36-60]D14AC	<u>A</u> Single Piece <u>R</u> Multi-Position PSC Motor <u>P</u> ainted <u>F</u> lowrator, TXV, R-410A only. Revisions are made due to changes made on serial plate.

Single Piece Air Handlers	
Model #	Description
AVPTC24B14AA AVPTC30C14AA AVPTC36C14AA AVPTC42D14AA AVPTC48D14AA AVPTC60D14AA	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Redesign of the current AVPTC models to new air handler cabinetry incorporating the new 4-way, multi-position painted body utilized on the ARPT/ASPT models.
AVPTC48C14AA	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Minor revision change to S&R labels and Travel labels.
AVPTC[24, 36]*14AB AVPTC42D14AC AVPTC48C14AB AVPTC48D14AC AVPTC60D14AD	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Minor revision updates share data information.
AVPTC42D14AB AVPTC48D14AB AVPTC60D14AB	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Redesign of the current AVPTC models to new air handler cabinetry incorporating the new 4-way, multi-position painted body utilized on the ARPT/ASPT models.
AVPTC60D14AC	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Revisions are made due to changes made on serial plate.
AVPTC24B14AC AVPTC30C14AB	<u>A</u> Single Piece <u>V</u> Multi-Position Variable-Speed <u>P</u> ainted <u>T</u> TXV <u>F</u> lowrator <u>C</u> ommunicating ready w/4-wires. Revisions are made to update Heater kit airflow .

PRODUCT IDENTIFICATION

Evaporator Coils	
Model #	Description
CAUF*****6AA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow <u>U</u> ncased <u>F</u> lowrator. Introduces 13 SEER CAUF Dayton Upflow/Downflow coils.
CAUF*****6BA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow <u>U</u> ncased <u>F</u> lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production.
CAUF*****6*DA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow [<u>P</u> ainted or <u>U</u> ncased] <u>F</u> lowrator. Revision replaces existing copper coils and other associated parts with aluminum components.
CAUF*****6DB	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow [<u>P</u> ainted or <u>U</u> ncased] <u>F</u> lowrator. Drain pan material change.
CAPF*****6AA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow <u>P</u> ainted <u>F</u> lowrator. Introduces 13 SEER CAPF Dayton Upflow/Downflow coils.
CAPF*****6BA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow <u>P</u> ainted <u>F</u> lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production.
CAPF/CAUF36***CA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow [<u>P</u> ainted or <u>U</u> ncased] <u>F</u> lowrator. Revision redesigns for performance improvement from 2 row to 3 row.
CAPF*****6DA	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow [<u>P</u> ainted or <u>U</u> ncased] <u>F</u> lowrator. Revision replaces existing copper coils and other associated parts with aluminum components.
CAPF*****6DB	<u>C</u> Indoor Coil <u>A</u> Upflow/Downflow [<u>P</u> ainted or <u>U</u> ncased] <u>F</u> lowrator. Drain pan material change.
CHPF*****6AA	<u>C</u> Indoor Coil <u>H</u> orizontal A Coil <u>P</u> ainted <u>F</u> lowrator. Release 13 SEER CHPF horizontal A coil.
CHPF*****6BA	<u>C</u> Indoor Coil <u>H</u> orizontal A Coil <u>P</u> ainted <u>F</u> lowrator. Release 13 SEER CHPF horizontal A coil. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production. The rows change by one, (i.e. 4 row to 3 row; 3 row to 2 row) where applicable.
CHPF1824A6CA CHPF2430B6CA CHPF3636B6CA CHPF3642C6CA CHPF3642D6CA CHPF3743C6BA CHPF3743D6BA CHPF4860D6DA	<u>C</u> Indoor Coil <u>H</u> orizontal A Coil <u>P</u> ainted <u>F</u> lowrator. 13 SEER CHPF horizontal A coil, revision has louver fins & replaces copper tube hairpins with aluminum hairpins.
CHPF1824A6CB CHPF2430B6CB CHPF3636B6CB CHPF3642C6CB CHPF3642D6CB CHPF3743C6BB CHPF3743D6BB CHPF4860D6DB	<u>C</u> Indoor Coil <u>H</u> orizontal A Coil <u>P</u> ainted <u>F</u> lowrator. 13 SEER CHPF horizontal A coil. Drain pan material change.

PRODUCT IDENTIFICATION

Evaporator Coils	
Model #	Description
CSCF****6AA	<u>C</u> Indoor Coil <u>S</u> Horizontal Slab Coil <u>C</u> Upainted <u>F</u> lowrator. Release 13 SEER CSCF slab horizontal coil.
CSCF****6BA	<u>C</u> Indoor Coil <u>S</u> Horizontal Slab Coil <u>C</u> Upainted <u>F</u> lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production. The rows change by one, (i.e. 4 row to 3 row; 3 row to 2 row) where applicable.
CSCF1824N6BB CSCF3036N6BB CSCF3642N6CB CSCF4860N6CB	<u>C</u> Indoor Coil <u>S</u> Horizontal Slab Coil <u>C</u> Upainted <u>F</u> lowrator. Drain pan material change.
CSCF1824N6CA CSCF3036N6CA CSCF3642N6CA CSCF4860N6CA	<u>C</u> Indoor Coil <u>S</u> Horizontal Slab Coil <u>C</u> Upainted <u>F</u> lowrator. Release 13 SEER CSCF slab horizontal coil. Converting copper coils, maifolds, haripins, flowrators, 90° flowrator stub and 3/8" return bends to aluminum.
CTPF****6AA	<u>C</u> Indoor Coil <u>T</u> Coated <u>P</u> ainted <u>F</u> lowrator. Initial release of coated coils.
CTPF1824*6AB CTPF3030*6AB CTPF3131*6AB CTPF3636*6AC CTPF3642*6AB CTPF4860*6AB	<u>C</u> Indoor Coil <u>T</u> Coated <u>P</u> ainted <u>F</u> lowrator. Drain pan material change.
CTUF1824*6AA CTUF3030*6AA CTUF3131*6AA CTUF3636*6AA CTUF3642*6AA CTUF4860*6AA	<u>C</u> Indoor Coil <u>T</u> Coated <u>U</u> nainted <u>F</u> lowrator. Initial release.
CTUF1824*6AB CTUF3030*6AB CTUF3131*6AB CTUF3636*6AC CTUF3642*6AB CTUF4860*6AB	<u>C</u> Indoor Coil <u>T</u> Coated <u>U</u> nainted <u>F</u> lowrator. Initial release.

PRODUCT IDENTIFICATION

	G	S	Z	13	025	1	A	A	
Product Family:									Minor Revision*
G: Goodman® Brand									
Standard Feature Set Models									Major Revision*
A: Amana® Brand									
High Feature Set Models									Electrical
									1: 208/230V
Product Family									1 phase/60 Hz
S: Split System									Nominal Capacity
Product Type:									019: 1.5 Tons
Z: Heat Pump R-410A									025: 2 Tons
									031: 2.5 Tons
SEER									037: 3 Tons
SEER Rating									

SMART FRAME AIR HANDLER

	A	S	U	F	29	B	1	4	A	A	
Product Type:											Minor Revision*
A: Single-Piece Air Handler											
Application:											Major Revision*
C: Ceiling Mount PSC Motor											Refrigerant Charge
D: Downflow PSC Motor											4: R-410A
e: Multi-Position Variable-Speed Motor											
R: Multi-Position PSC Motor											Electrical
S: Multi-Position EEM Motor											1: 208/230V,
W: Wall Mount PSC Motor											1 phase/60 Hz
Cabint Finish:											Cabinet Width
U: Unpainted											B: 17 1/2"
P: Painter											C: 21"
N: Uncased											D: 24 1/2"
Expansion Device:											Nominal Capacity Range
F: Flowrater											29: 2 1/2 Tons
T: TXV (Expansion Valve)											49: 3 1/2 Tons
											39: 3 1/2 Tons
											59: 5 tons

PRODUCT IDENTIFICATION

	A	W	U	F	3642	1	4	A	A	
Product Type:										Minor Revision*
A: Air Handler										
Application:										Major Revision*
C: Ceiling Mount PSC Motor										
D: Downflow PSC Motor										
E: Multi-Position Variable-Speed Motor										Refrigerant Charge
R: Multi-Position PSC Motor										No digit: R-22 Only
S: Multi-Position EEM Motor										6: R-410A or R-22
T: Coated Coils										
W: Wall Mount PSC Motor										Electrical
										1: 208/230V, 1 phase/60 Hz
Cabint Finish:										Nominal Capacity Range @ 13 SEER
U: Unpainted										Dedicated Application - 3636: 3 Tons
P: Painter										
N: Uncased										
Expansion Device:										
F: Flowrater										
T: TXV (Expansion Valve)										

MultiPostion & Downflow Applications

3137: 3 Tons

3642: 3 - 3.5 Tons

1830: 1.5 - 3.5 Tons

@ 10 SEER

(for export systems) 1729: 1.5 - 2.5 Tons

Ceiling Mount & Wall Mount Applications

(Nominal Cooling Capacity/Electric Heat kW)

1803: 1.5 Tons Cooling / 3 kW Electric Heat

1805: 1.5 Tons Cooling / 5 kW Electric Heat

2405: 2 Tons Cooling / 5 kW Electric Heat

3608: 3 Tons Cooling / 8 kW Electric Heat

3105: 1.5 - 2.5 Tons Cooling / 5 kW Electric Heat

3210: 2 - 2.5 Tons Cooling / 10 kW Electric Heat

3705: 3 Tons Cooling / 5 kW Electric Heat

3708: 3 Tons Cooling / 8 kW Electric Heat

3710: 3 Tons Cooling / 10 kW Electric Heat

All Airhandlers use **DIRECT DRIVE MOTORS**. Power supply is AC 208-230v, 60 hz, 1 phase.

PRODUCT IDENTIFICATION

	C	A	P	F	1824	A	6	A	
Product Family									Minor Revision*
C: Indoor Coil									Major Revision*
Application									Nominal Width for Gas Furnace
A: Upflow/Downflow Coil									A: Fits 14" Furnace Cabinet
H: Horizontal A Coil									B: Fits 17.5" Furnace Cabinet
S: Horizontal Slab Coil									C: Fits 21" Furnace Cabinet
T: Coated Coil									D: Fits 24.5" Furnace Cabinet
Cabinet Finish									N: Done Not Apply (Horizontal Slab Coils)
u: Unpainted									Nomimnal Capacity Range @ 13 SEER
P: Painter									1824: 1.5 -2 Tons
N: Unpainted Case									3030: 2.5 Tons
Expansion Device									36365: 3 Tons
F: Flowrater									3642: 3 - 3.5 Tons
									3743: 3 - 3.5 Tons
									4860: 4 & 5 Tons
									4961: 4 & 5 Tons

	MB	R	8	00	A	A	1	
Design Series								Electrical Supply:
MB: Modular Blower								1: 208-230V
Motor Type								1 phase, 60 hZ
R: Constant Speed								Design Series
E: Variable Speed								A: First Series
Airflow Delivered								Circuit Breaker
08: 800 CFM								A: No Circuit Breaker
12: 1200 CFM								B: Circuit Breaker
16: 1600 CFM								
20: 2000 CFM								
Factory Heat								
00: No Heat								

ACCESSORIES

GSZ13

Model	Description	GSZ13019	GSZ13025	GSZ13031	GSZ13037
ABK-20 ¹	Anchor Bracket Kit	X	X	X	X
AFE18-60A	All-Fuel Kit	X	X	X	X
CSB-15	Sound Blanket	---	---	---	---
CSB-16	Sound Blanket	X	X	X	X
CSR-U-1 ⁴	Hard-start Kit	X	X	X	X
CSR-U-2 ⁴	Hard-start Kit	---	---	---	X
CSR-U-3 ⁴	Hard-start Kit	---	---	---	---
FSK01A ²	Freeze Protection Kit	X	X	X	X
LSK02A	Liquid Line Solenoid Kit	X	X	X	X
OT/EHR18-60	Emergency Heat Relay kit	X	X	X	X
OT18-60A ³	Outdoor Thermostat w/ Lockout Stat	X	X	X	X
TX2N4A ⁵	TXV Kit	X	X	---	---
TX3N4 ⁵	TXV Kit	---	---	X	X
TX5N4 ⁵	TXV Kit	---	---	---	---

GSZ14

Model	Description	GSZ140191	GSZ140251	GSZ140311	GSZ140371
ABK-20 ¹	Anchor Bracket Kit	X	X	X	X
AFE18-60A	All-Fuel Kit	X	X	X	X
CSR-U-1 ⁴	Hard-start Kit	X	X	X	X
FSK01A ²	Freeze Protection Kit	X	X	X	X
OT/EHR18-60	Emergency Heat Relat Kit	X	X	X	X
OT18-60A ³	Outdoor Thermostat w/lockout Stat	X	X	X	X
TX2N4A	TXV Kit	X	X	---	---
TX3N4	TXV Kit	---	---	X	X

¹ Contains 20 brackets; four brackets needed to anchor unit to pad

² Installed on indoor coil

³ Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidity.

⁴ Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed expansion valve refrigerant metering device.

⁵ Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refig

ACCESSORIES

SSZ14

Model	Description	SSZ14019	SSZ14025	SSZ14031	SSZ14037
ABK-20 ¹	Anchor Bracket	X	X	X	X
AFE18-60A	All-Fuel Kit	X	X	X	X
CSR-U-1 ⁴	Hard-start Kit	X	X	X	X
CSR-U-2 ⁴	Hard-start Kit	---	---	---	X
CSR-U-3 ⁴	Hard-start Kit	---	---	---	---
FSK01A ²	Freeze Protection Kit	X	X	X	X
LSK02A	Liquid Line Solenoid Kit	X	X	X	X
OT18-60A ³	Outdoor Thermostat	X	X	X	X
OT/EHR18-60	Emergency Heat Relat Kit	X	X	X	X
TX2N4A ⁵	TXV Kit	X	X	---	---
TX3N4 ⁵	TXV Kit	---	---	X	X
TX5N4 ⁵	TXV Kit	---	---	---	---

¹ Contains 20 brackets; four brackets needed to anchor unit to pad

² Installed on indoor coil

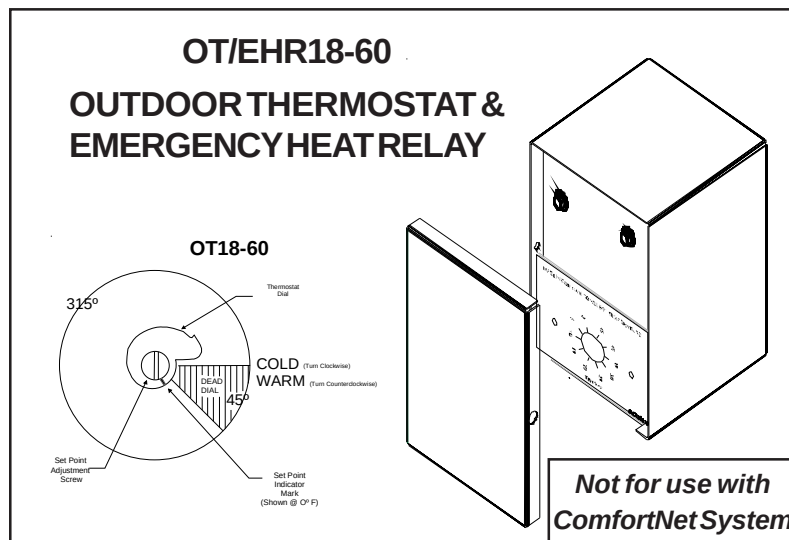
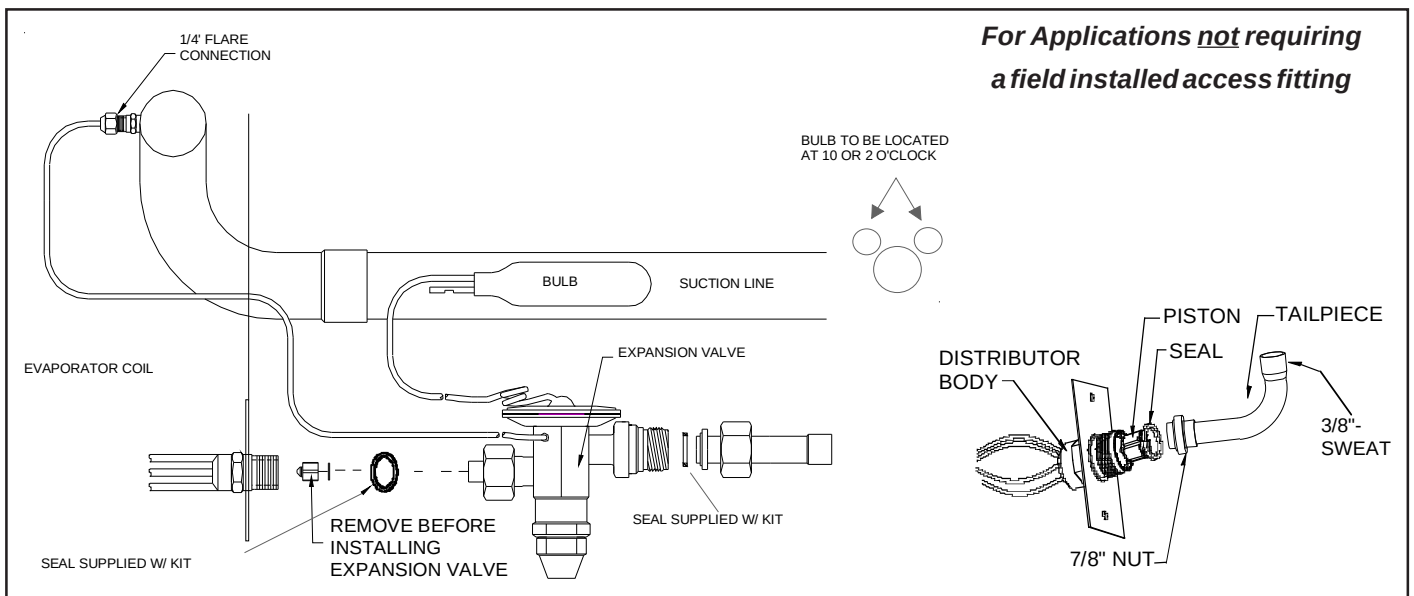
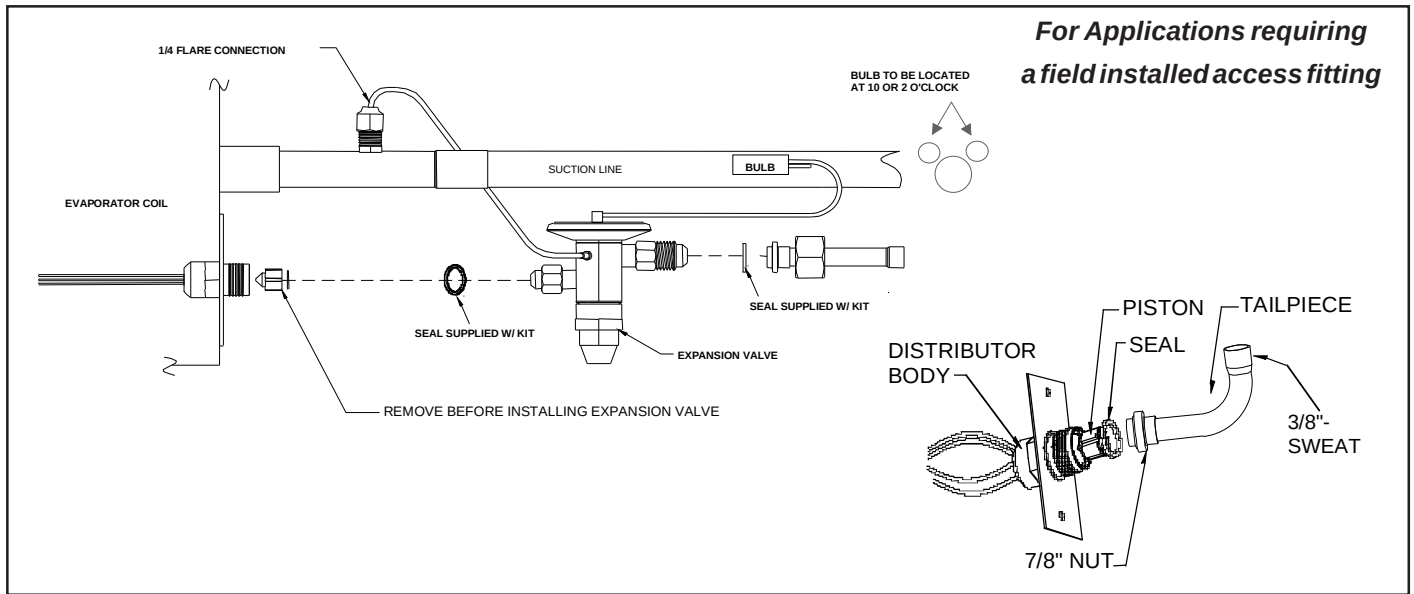
³ Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidity.

⁴ Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed expansion valve refrigerant metering device.

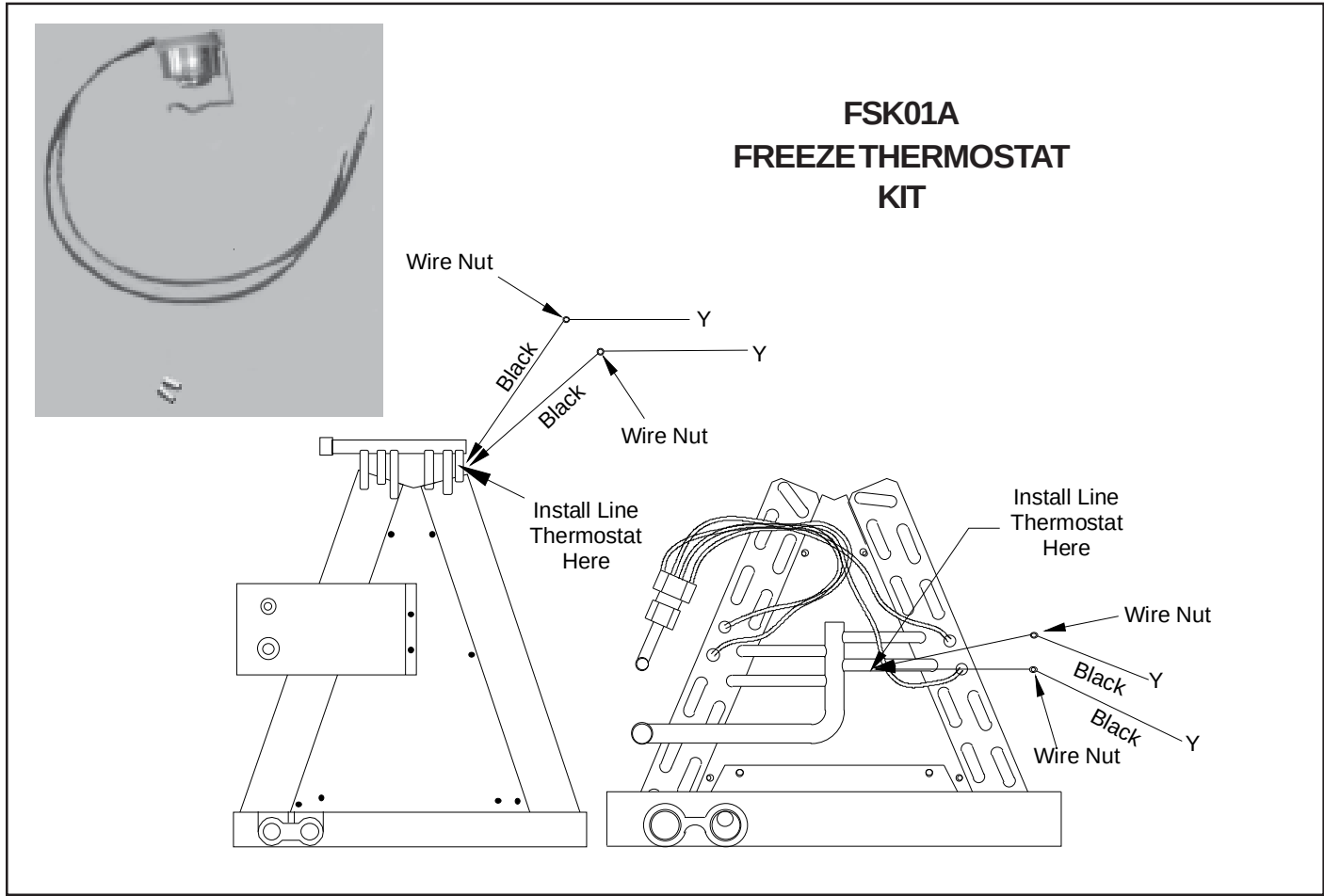
⁵ Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device

ACCESSORIES

EXPANSION VALVE KITS



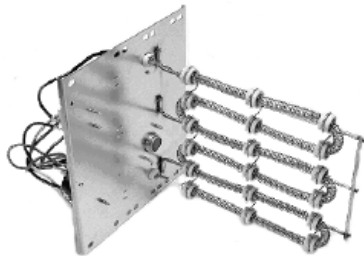
ACCESSORIES



ACCESSORIES

COIL ACCESSORIES

COIL MODEL	TX2N4A TXV KIT	TX3N4 TXV KIT	TX5N4 TXV KIT	FSK01A FREEZE PROTECTION KIT
CA*F18246*	X			X
CA*F30306*		X		X
CA*F31316*				
CA*F36366*				
CA*F36426*		X	X	X
CA*F37436*				
CA*F48606*				
CA*F49616*				
CHPF18246*	X			X
CHPF24306*				
CHPF36366*		X		X
CHPF36426*			X	X
CHPF37436*				
CHPF48606*				
CSCF1824N6*	X			X
CSCF3036N6*		X		X
CSCF3642N6*		X	X	X
CSCF4860N6*				



HKR SERIES ELETRIC HEAT KITS - ELECTRIC HEAT KIT APPLICATIONS - MBR

BLOWER		ELECTRIC HEAT KIT								
	NO HEAT	HKR-03*	HKR05-(C)'	HKR-06*	HKR-08(C)*	HKR-10(C)*	HKA-15(D)*	HKA-20(D)*	^HKR3-15*	^HKR3-20*
MBR0800AA-1AA	-	X	X	X	X	X				
MBR1200AA-1AA	-	X	X	X	X	X	X	X	X	X
MBR1600AA-1AA	-	X	X	X	X	X	X	X	X	X
MBR2000AA-1AA	-	X	X	X	X	X	X	X	X	X

X = Allow able combinations
- = Restricted combinations

^ = Circuit 1: Single Phase for Air Handler Motor
Circuit 2: 3-Phase for HKR3 Heater Kits

* = Revision level that my or may not be designated
C = Circuit Breaker option

ACCESSORIES

ELECTRIC HEAT KIT APPLICATIONS - ARPF

	ARPF1824 1/16	ARPF1931 1/16	ARPF3030 1/16	ARPF3642 1/16	ARPF3743 1/16	ARPF4860 1/16
HKR-03*	X	X	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X	X	X
HKR-06*	X	X	X	X	X	X
HKR-08*, HKR-08C*	X ¹	X ¹	X	X	X	X
HKR-10*, HKR-10C*	X ¹	X ¹	X ¹	X	X	X
HKA-15D*	X ²	X ²	X ²	X ³	X ³	X
HKA-20D*			X ²	X ³	X ³	X
^ HKR3-15*			X ²	X ³	X ³	X
^ HKR3-20*			X ²	X ³	X ³	X

* Revision level that may or may not be designated

C Circuit breaker option

^ Heat kit required three-phase power supply

¹ Air handler must either be on medium or high speed

² Air handler must be on high speed

³ For static pressure of 0.6 or higher, air handler must be on medium or high speed.

ELECTRIC HEAT KIT APPLICATIONS - ARUF

	ARUF1729 1/16	ARUF1824 1/16	ARUF1931 1/16	ARUF3030 1/16	ARUF3642 1/16	ARUF3743 1/16	ARUF4860 1/16
HKR-03*	X	X	X	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X	X	X	X
HKR-06*	X	X	X	X	X	X	X
HKR-08*, HKR-08C*	X ¹	X ¹	X ¹	X	X	X	X
HKR-10*, HKR-10C*	X ¹	X ¹	X ¹	X	X	X	X
HKA-15D*	X ²	X ²	X ²	X ²	X ³	X ³	X
HKA-20D*				X ²	X ³	X ³	X
^ HKR3-15*				X ²	X ³	X ³	X
^ HKR3-20*				X ²	X ³	X ³	X

* Revision level that may or may not be designated

C Circuit breaker option

^ Heat kit required three-phase power supply

¹ Air handler must either be on medium or high speed

² Air handler must be on high speed

³ For static pressure of 0.6 or higher, air handler must be on medium or high speed.

ACCESSORIES

ELECTRIC HEAT KIT APPLICATIONS - ASPF

	ASPF183016	ASPF303616	ASPF313716	ASPF426016
HKR-03*	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X
HKR-06*	X	X	X	X
HRK-08*, HKR-08C*	X ¹	X ¹	X ¹	X
HKR-10*, HKR-10C*	X ¹	X ¹	X ¹	X
HKA-15D*	X ²	X ²	X ²	X ¹
HKA-20D*		X ²	X ²	X ¹
+HKR3-15*	X ²	X ²	X ²	X ¹
+HKR3-20*		X ²	X ²	X ¹

* Revision level that may or may not be designated
 C Circuit Breaker option
 + Heat kit requires 3-phase power supply

¹ Air handler must be on speed tap 2, 3, 4 or 5
² Air handler must be on speed tap 4 or 5
³ Air handler must be on speed tap 3, 4 or 5

ELECTRIC HEAT KIT APPLICATIONS - AVPTC

MODELS	HKR-03*	HKR-05*/-05C*	HKR-06*	HKR-08*/-08C*	HKR-10*/-10C*	HKR-15C*	HKR-20C*	HKR-21C*	HKA-15C*	HKA-20C*
AVPTC183014A*	X	X	X	X ¹	X ¹	---	---	---	---	---
AVPTC313714A*	X	X	X	X ¹	X ¹	X2	---	---	X ²	X
AVPTC426014A*	X	X	X	X	X	X	X3	X3	X	X ³

* Revision level that may or may not be designated.
 C Circuit breaker option.

NOTE:

When 8kW and 10kW heat kits are used with an AVPTC1830 and AVPTC3137, matched with 2-ton outdoor unit, see Note 1 below.

¹ Set Heater Kit dip switches 9, 10 and 11 to 6kW setting (9-ON, 10-OFF, 11-ON) to obtain 840 CFM.

² This heater kit can only be used for '1000 CFM or higher' applications.

³ This heater kit can only be used for '1200 CFM or higher' applications.

ACCESSORIES

SMART FRAME AIR HANDLER

ELECTRIC HEAT KIT APPLICATIONS - ARPT

Heat Kit Applications	ARPT							
Type / model	18B14-A*	24B14-A*	30B14-A*	36C14-A*	36D14-A*	42D14-A*	48D14-A*	60D14-A*
HKSX03XC*	X	X	X	X	X	X	X	X
HKSX05XC*	X	X	X	X	X	X	X	X
HKSX06XC*	X	X	X	X	X	X	X	X
HKSX08XC*	X	X	X	X	X	X	X	X
HKSX10XC*	X	X	X	X	X	X	X	X
HSKX15XF*				X	X	X	X	X
HSKX20XF*				X	X	X	X	X
HKSC05XC*	X	X	X	X	X	X	X	X
HKSC08XC*	X	X	X	X	X	X	X	X
HKSC10XC*	X	X	X	X	X	X	X	X
HKSC15XA*			X	X	X	X	X	X
HKSC15XB*			X	X	X	X	X	X
HKSC15XF*				X	X	X	X	X
HKSC19CA*				X				
HKSC19CB*				X				
HKSC20DA*					X	X	X	X
HKSC20DB*					X	X	X	X
HKSC20XF*				X	X	X	X	X
HKSC25DC*							X	X

* Revision level that may or may not be designated

Refer to the minimum airflow requirements for each of the heat kits.

ELECTRIC HEAT KIT APPLICATIONS - ARUF

Heat Kit Applications	ARUF								
Type / model	18B14-A*	24B14-B*	24B14-C*	30B14-A*	30C14-B*	36C14-B*	42C14-A*	48D14-A*	60D14-A*
HKSX03XC*	X	X	X	X	X	X	X	X	X
HKSX05XC*	X	X	X	X	X	X	X	X	X
HKSX06XC*	X	X	X	X	X	X	X	X	X
HKSX08XC*	X	X	X	X	X	X	X	X	X
HKSX10XC*	X	X	X	X	X	X	X	X	X
HKSX15XF*					X	X	X	X	X
HKSX20XF*					X	X	X	X	X
HKSC05XC*	X	X	X	X	X	X	X	X	X
HKSC08XC*	X	X	X	X	X	X	X	X	X
HKSC10XC*	X	X	X	X	X	X	X	X	X
HKSC15XA*				X	X	X	X	X	X
HKSC15XB*				X	X	X	X	X	X
HKSC15XF*					X	X	X	X	X
HKSC19CA*					X	X	X		
HKSC19CB*					X	X	X		
HKSC20DA*								X	X
HKSC20DB*								X	X
HKSC20XF*					X	X	X	X	X
HKSC25DC*							X	X	X

* Revision level that may or may not be designated

Refer to the minimum airflow requirements for each of the heat kits.

ACCESSORIES

SMART FRAME AIR HANDLER

ELECTRIC HEAT KIT APPLICATIONS - ASPT

Heat Kit Applications	ASPT					
Type / model	24B14-A*	36C14-A*	42C14-A*	48C14-A*	48D14-A*	60D14-A*
HKSX03XC*	X	X	X	X	X	X
HKSX05XC*	X	X	X	X	X	X
HKSX06XC*	X	X	X	X	X	X
HKSX08XC*	X	X	X	X	X	X
HKSX10XC*	X	X	X	X	X	X
HKSX15XF*		X	X	X	X	X
HKSX20XF*		X	X	X	X	X
HKSC05XC*	X	X	X	X	X	X
HKSC08XC*	X	X	X	X	X	X
HKSC10XC*	X	X	X	X	X	X
HKSC15XA*		X	X	X	X	X
HKSC15XB*		X	X	X	X	X
HKSC15XF*		X	X	X	X	X
HKSC19CA*		X	X	X		
HKSC19CB*		X	X	X		
HKSC20DA*					X	X
HKSC20DB*					X	X
HKSC20XF*		X	X	X	X	X
HKSC25DC*					X	X

* Revision level that may or may not be designated.

Refer to the minimum airflow requirements for each of the heat kits.

ACCESSORIES

SMART FRAME AIR HANDLER

ELECTRIC HEAT KIT APPLICATIONS - ASUF

Heat Kit Applications	ASUF			
Type / model	29B14-A*	39C14-A*	49C14-A*	59D14-A*
HKSX03XC*	X	X	X	X
HKSX05XC*	X	X	X	X
HKSX06XC*	X	X	X	X
HKSX08XC*	X	X	X	X
HKSX10XC*	X	X	X	X
HKSX15XF*		X	X	X
HKSX20XF*		X	X	X
HKSC05XC*	X	X	X	X
HKSC08XC*	X	X	X	X
HKSC10XC*	X	X	X	X
HKSC15XA*		X	X	X
HKSC15XB*		X	X	X
HKSC15XF*		X	X	X
HKSC19CA*		X	X	
HKSC19CB*		X	X	
HKSC20DA*				X
HKSC20DB*				X
HKSC20XF*		X	X	X
HKSC25DC*				X

* Revision level that may or may not be designated.

Refer to the minimum airflow requirements for each of the heat kits.

ELECTRIC HEAT KIT APPLICATIONS - AVPTC

Models	HKSX03XC	HKSX05XC	HKSX06XC	HKSX08XC	HKSX10XC	HKSC05XC	HKSC08XC	HKSC10XC	HKSC15XA	HKSC15XB	HKSC15XF	HKSC19CA	HKSC19CB	HKSC20DA	HKSC20DB	HKSC25XF	HKSC25DC
AVPTC24B14A*	X	X	X	X	X	X	X	X									
AVPTC30C14A*	X	X	X	X	X	X	X	X									
AVPTC36C14A*		X	X	X	X	X	X	X	X	X	X	X	X			X	
AVPTC48C14A*		X	X	X	X	X	X	X	X	X	X	X	X			X	
AVPTC42D14A*		X	X	X	X	X	X	X	X	X	X			X	X	X	
AVPTC48D14A*		X	X	X	X	X	X	X	X	X	X			X	X	X	X
AVPTC60D14A*		X	X	X	X	X	X	X	X	X	X			X	X	X	X

PRODUCT OVERVIEW

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

The condenser air is pulled through the condenser coil by a direct drive propeller fan. This condenser air is then discharged out of the top of the cabinet. These units are designed for free air discharge, so no additional resistance, like duct work, shall be attached.

The suction and liquid line connections on present models are of the sweat type for field piping with refrigerant type copper. Front seating valves are factory installed to accept the field run copper. The total refrigerant charge for a normal installation is factory installed in the condensing unit.

GSZ/SSZ models are available in 1 1/2 through 3 ton sizes and use R-410A refrigerant. They are designed for 208/230 volt single phase applications.

GSZ/SSZ model units use the Copeland Scroll "Ultratech" Series compressors which are specifically designed for R-410A refrigerant.

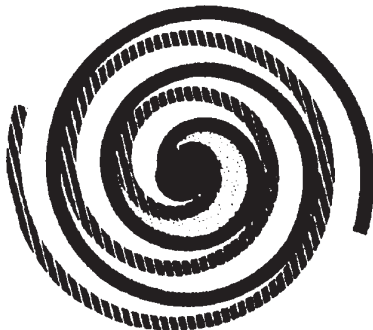
There are a number of design characteristics which are different from the traditional reciprocating and/or scroll compressors.

"Ultratech" Series scroll compressors will not have a discharge thermostat. Some of the early model scroll compressors required discharge thermostat.

"Ultratech" Series scroll compressors use "POE" or polyolester oil which is **NOT** compatible with mineral oil based lubricants like 3GS. "POE" oil must be used if additional oil is required.

A scroll is an involute spiral which, when matched with a mating scroll form as shown, generates a series of crescent shaped gas pockets between the two members.

During compression, one scroll remains stationary (fixed scroll) while the other form (orbiting scroll) is allowed to orbit (but not rotate) around the first form.



As this motion occurs, the pockets between the two forms are slowly pushed to the center of the two scrolls while simultaneously being reduced in volume. When the pocket reaches the center of the scroll form, the gas, which is now at a high pressure, is discharged out of a port located at the center.

During compression, several pockets are being compressed simultaneously, resulting in a very smooth process. Both the suction process (outer portion of the scroll members) and the discharge process (inner portion) are continuous.

Some design characteristics of the Compliant Scroll compressor are:

- Compliant Scroll compressors are 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.

- "Ultratech" Series scroll compressors use "POE" or polyolester oil which is **NOT** compatible with mineral oil based lubricants like 3GS. "POE" oil must be used if additional oil is required.
- Compliant scroll compressors perform "quiet" shutdowns that allow the compressor to restart immediately without the need for a time delay. This compressor will restart even if the system has not equalized.

NOTE: Operating pressures and amp draws may differ from standard reciprocating compressors. This information can be found in the unit's Technical Information Manual.

COILS AND BLOWER COILS

MBR blower cabinets are designed to be used as a two-piece blower and coil combination. MBR blower sections can be attached to cased evaporator coil. This two-piece arrangement allows for a variety of mix-matching possibilities providing greater flexibility.

The MBR blower cabinet uses a PSC motor. It is approved for applications with cooling coils of up to 0.5 inches W.C. external static pressure.

The MBR blower cabinets with proper coil matches 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), insulate the exterior of the blower with insulation having a vapor barrier equivalent to ductwork insulation, providing local codes permit.

The coils are designed for upflow, counterflow or horizontal application, using two-speed direct drive motors on the CACF/CAPF/CHPX models and BPM (Brushless Permanent Magnet).

SYSTEM OPERATION

ARUF, ARPT, ASPT, AWUF, ACNF and ASUF Single Piece Air Handlers

ARPT, ARUF, ASPT, AWUF, ACNF and ASUF air handlers are multi-position, multi-speed with direct drive motors. ARPT and ARUF are available in 1 1/2 to 5 ton sizes with optional 3 kW to 25kW electric heat kits available for field installation. ASPT air handlers are available in 2, 3, 4 and 5 ton sizes with optional 3 kW to 25kW electric heat kits available for field installation.

NOTE: *Factory-sealed to achieve a 2% or less leakage rate at 1.0" water gauge external duct static pressure. Complies with the Factory-sealed Air Handling Credit as listed in the 2001 Florida Building Code, Chapter 13, Section 610.2.A.2.1.*

AVPTC Multi-Position Air Handler

AVPTC is a multi-position, variable-speed air handler used with R-410A and are available in 2 to 5 ton sizes with optional 3 kW to 25kW electric heat kits available for field installation. The AVPTC unit's blower design includes a variable-speed ECM motor and is compatible with heat pumps and variable-capacity cooling applications.

This appliance can be installed in the vertical or left horizontal position without modification. The horizontal right and downflow positions require product modification. This product is designed for zero inches (0 inches) clearance; however, adequate access for service or replacement must be considered without removing permanent structure. This unit can be installed on a platform when deemed necessary.

In an attic installation a secondary drain pan must be provided by the installer and placed under the entire unit with a separate drain line properly sloped and terminated in an area visible to the owner. This secondary drain pan is required in the event that there is a leak or main drain blockage. Closed cell insulation should be applied to the drain lines in unconditioned spaces where sweating may occur.

NOTE: AVPTC air handlers are factory-sealed to achieve a 2% or less leakage rate at 1.0" water gauge external duct static pressure.

SYSTEM OPERATION

COOLING

The refrigerant used in the system is R-410A. It is a clear, colorless, non-toxic and non-irritating liquid. R-410A 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, (270 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.

HEATING

The heating portion of the refrigeration cycle is similar to the cooling cycle. By energizing the reversing valve solenoid coil, the flow of the refrigerant is reversed. The indoor coil now becomes the condenser coil, and the outdoor coil becomes the evaporator coil.

The check valve at the indoor coil will open by the flow of refrigerant letting the now condensed liquid refrigerant bypass the indoor expansion device. The check valve at the outdoor coil will be forced closed by the refrigerant flow, thereby utilizing the outdoor expansion device.

The restrictor orifice used with the CA*F, CHPF and CH**FCB coils will be forced onto a seat when running in the cooling cycle, only allowing liquid refrigerant to pass through the orifice opening. In the heating cycle, it will be forced off the seat allowing liquid to flow around the restrictor. A check valve is not required in this circuit.

HEATING

The heating portion of the refrigeration cycle is similar to the cooling cycle. By energizing the reversing valve solenoid coil, the flow of the refrigerant is reversed. The indoor coil now becomes the condenser coil, and the outdoor coil becomes the evaporator coil.

The check valve at the indoor coil will open by the flow of refrigerant letting the now condensed liquid refrigerant bypass the indoor expansion device. The check valve at the outdoor coil will be forced closed by the refrigerant flow, thereby utilizing the outdoor expansion device.

The restrictor orifice used with the CA*F, CHPF coils and the AR*F air handler will be forced onto a seat when running in the cooling cycle, only allowing liquid refrigerant to pass through the orifice opening. In the heating cycle it will be forced off the seat allowing liquid to flow around the restrictor. A check valve is not required in this circuit.

COOLING CYCLE

When the contacts of the room thermostat close making terminals R to Y & G, the low voltage circuit of the transformer is completed. Current now flows through the magnetic holding coils of the compressor contactor (CC) and fan relay (RFC).

This draws in the normally open contact CC, starting the compressor and condenser fan motors. At the same time contacts RFC close starting the indoor fan motor.

When the thermostat is satisfied, it opens its contacts, breaking the low voltage circuit, causing the compressor contactor and indoor fan relay to open, shutting down the system.

If the room thermostat fan selector switch should be set on the "on" position, then the indoor blower would run continuous rather than cycling with the compressor.

Heat pumps energize the reversing valve thorough the "O" circuit in the room thermostat. Therefore the reversing valve remains energized as long as the thermostat subbase is in the cooling position. The only exception to this is during defrost.

SYSTEM OPERATION

DEFROST CYCLE

The defrosting of the outdoor coil is jointly controlled by the defrost control board and the defrost thermostat.

Solid State Defrost Control

During operation the power to the circuit board is controlled by a temperature sensor, which is clamped to a return bend (3/8" coils) or a feeder tube (5 mm coils) entering the outdoor coil. Defrost timing periods of 30, 60, or 90 minutes may be selected by connecting the circuit board jumper to 30, 60, or 90 respectively. Accumulation of time for the timing period selected starts when the sensor closes (approximately 31° F), and when the room thermostat calls for heat. At the end of the timing period, the unit's defrost cycle will be initiated provided the sensor remains closed. When the sensor opens (approximately 75° F), the defrost cycle is terminated and the timing period is reset. If the defrost cycle is not terminated due to the sensor temperature, a ten minute override interrupts the unit's defrost period. The new upgraded defrost control has a 12 minute override interrupt.

HEATING CYCLE

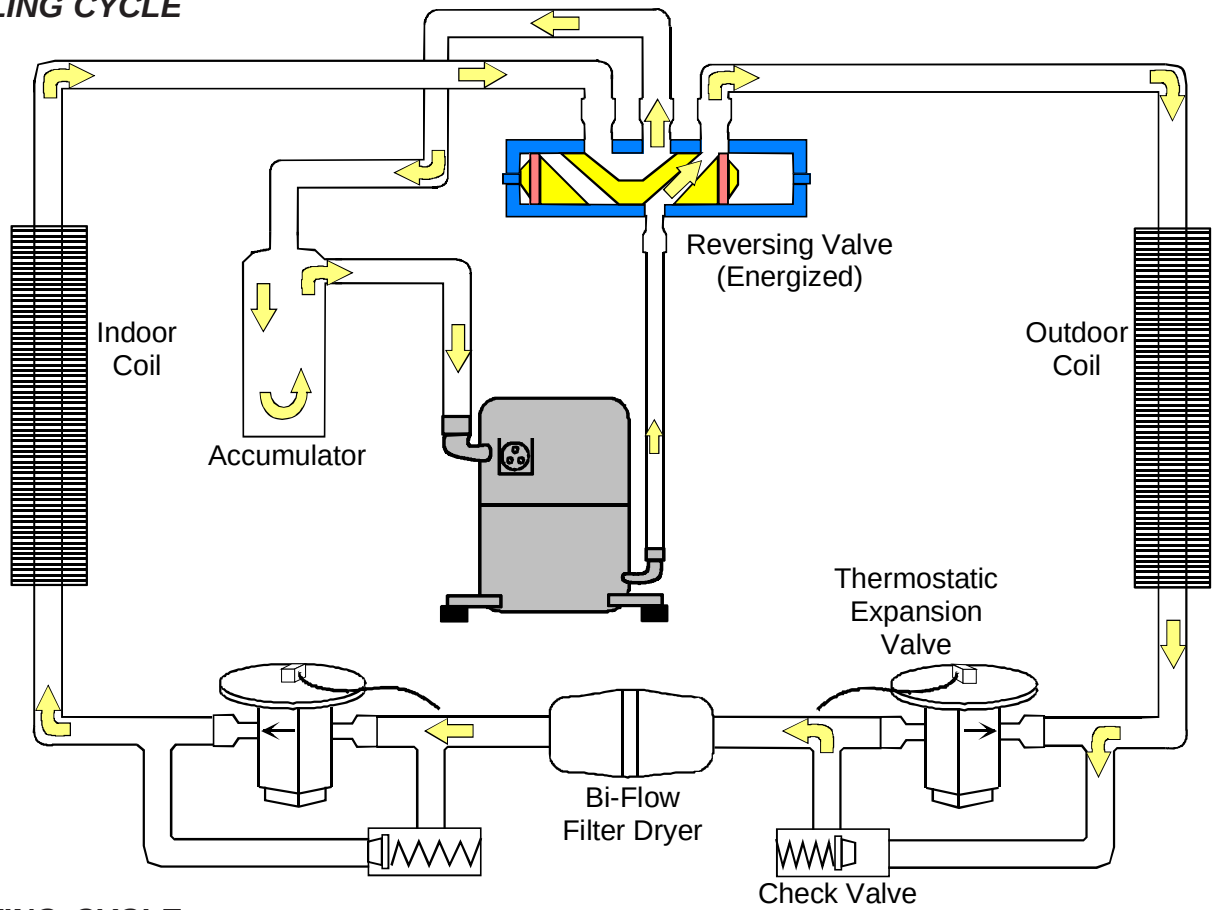
The reversing valve on the GSZ/SSZ models is energized in the cooling cycle through the "O" terminal on the room thermostat.

These models have a 24 volt reversing valve coil. When the thermostat selector switch is set in the cooling position, the "O" terminal on the thermostat is energized all the time.

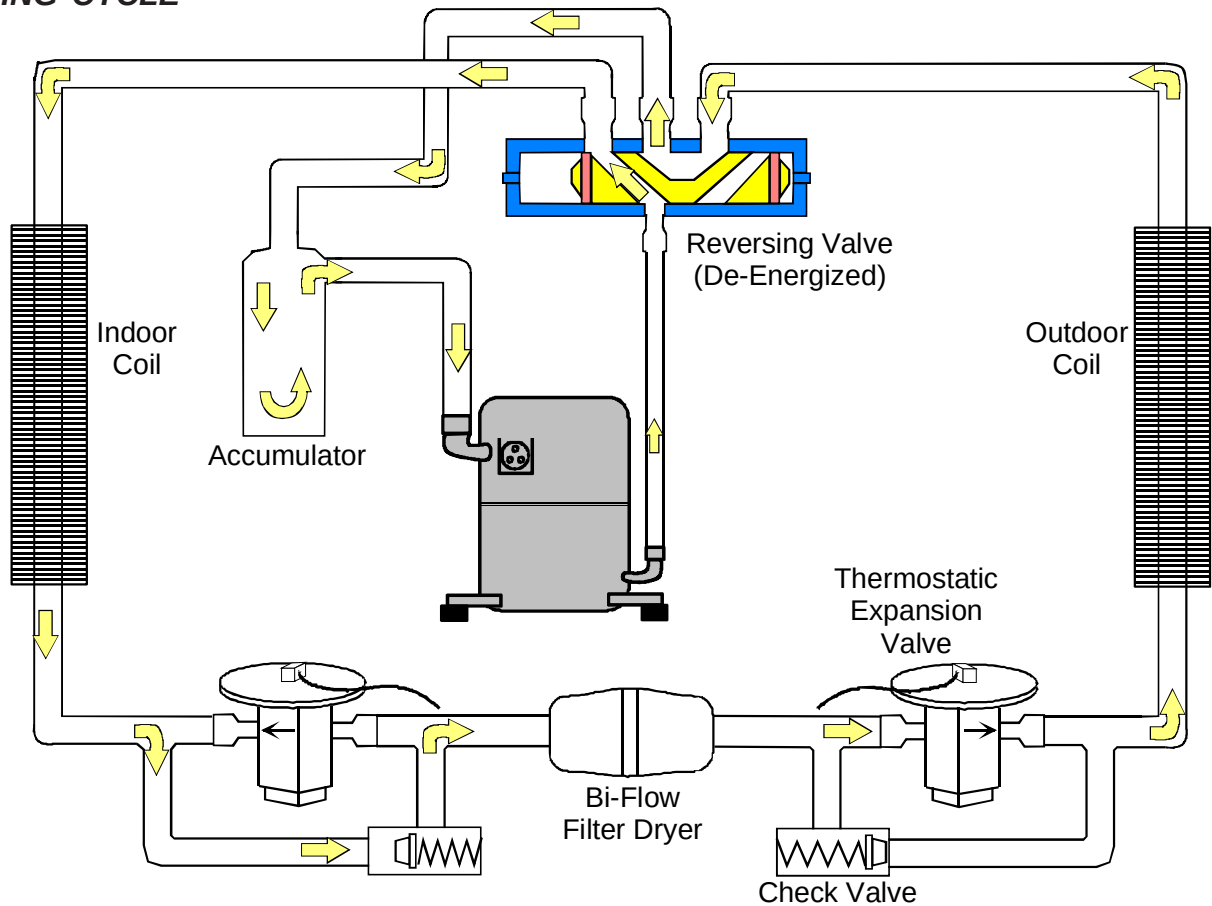
Care must be taken when selecting a room thermostat. Refer to the installation instructions shipped with the product for approved thermostats.

SYSTEM OPERATION

COOLING CYCLE

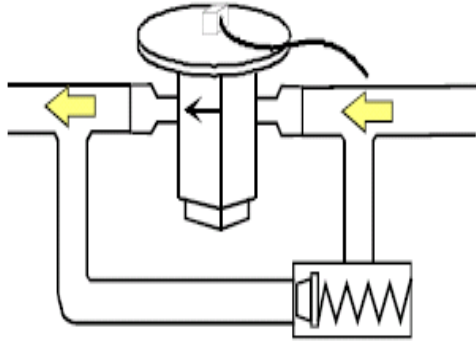


HEATING CYCLE

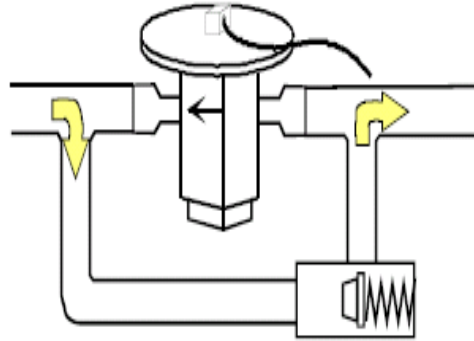


SYSTEM OPERATION

EXPANSION VALVE/CHECK VALVE ASSEMBLY
IN COOLING OPERATION



EXPANSION VALVE/CHECK VALVE ASSEMBLY
IN HEATING OPERATION



Most expansion valves used in current Goodman® Brand Heat Pump products use an internally checked expansion valve. This type of expansion valve does not require an external check valve as shown above. However, the principle of operation is the same.

SYSTEM OPERATION

When the thermostat is satisfied, appropriate commands are sent to the UC control. The compressor relay and outdoor fan relay is de-energized. The compressor high stage solenoid is de-energized if it was energized. The UC control sends an appropriate command to the indoor unit to de-energize the indoor blower motor.

AFE18-60A CONTROL BOARD

DESCRIPTION

The AFE18 control is designed for use in heat pump applications where the indoor coil is located above/downstream of a gas or fossil fuel furnace. It will operate with single and two stage heat pumps and single and two stage furnaces. The AFE18 control will turn the heat pump unit off when the furnace is turned on. An anti-short cycle feature is also incorporated which initiates a 3 minute timed off delay when the compressor goes off. On initial power up or loss and restoration of power, this 3 minute timed off delay will be initiated. The compressor won't be allowed to restart until the 3 minute off delay has expired. Also included is a 5 second de-bounce feature on the "Y, E, W1 and O" thermostat inputs. These thermostat inputs must be present for 5 seconds before the AFE18 control will respond to it.

An optional outdoor thermostat, OT18-60A, can be used with the AFE18 to switch from heat pump operation to furnace

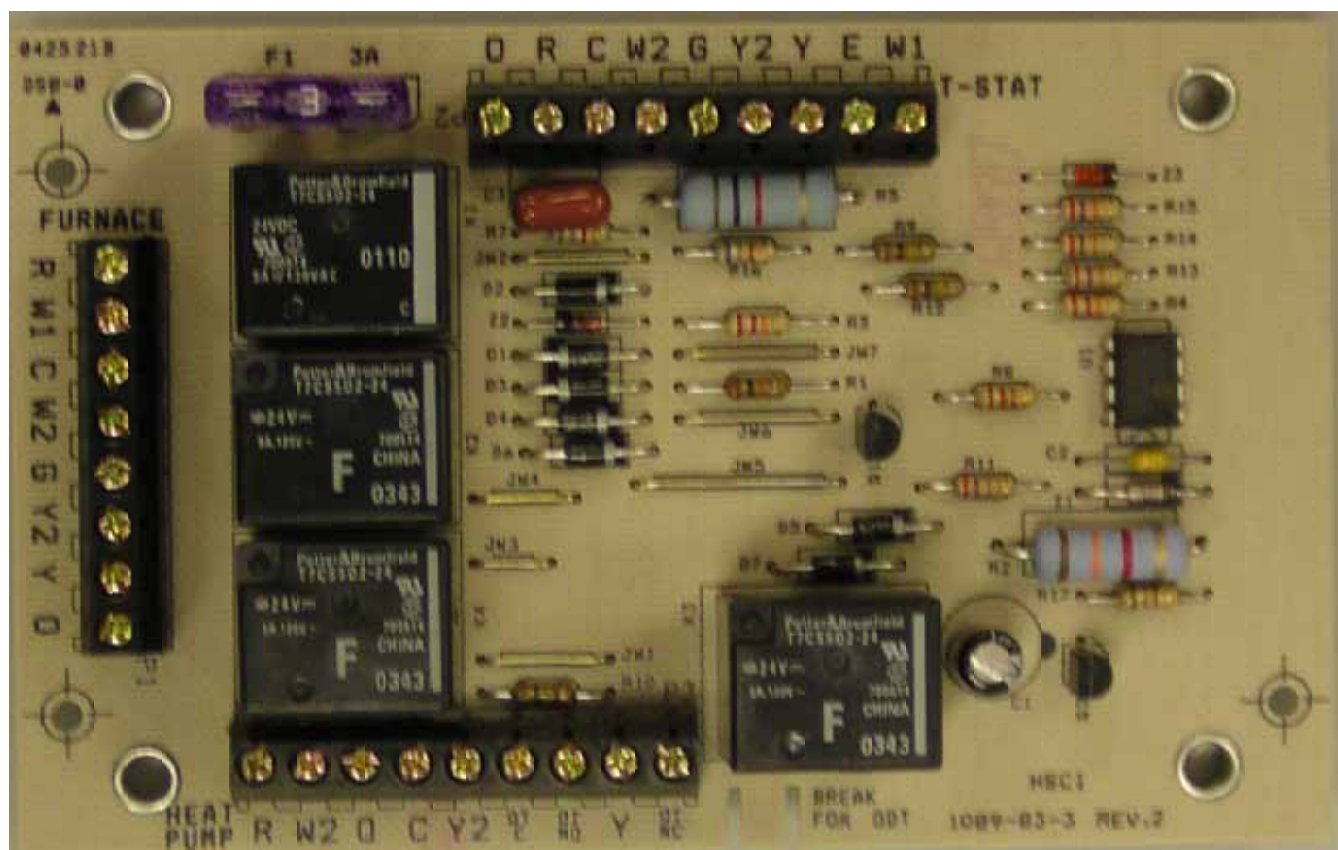
operation below a specific ambient temperature setting, i.e. break even temperature during heating. When used in this manner, the "Y" heat demand is switched to the "W1" input to the furnace by the outdoor thermostat and the furnace is used to satisfy the first stage "Y" heat demand. On some controls, if the outdoor thermostat fails closed in this position during the heating season, it will turn on the furnace during the cooling season on a "Y" cooling demand. In this situation, the furnace produces heat and increases the indoor temperature thereby never satisfying the cooling demand. The furnace will continue to operate and can only be stopped by switching the thermostat to the off position or removing power to the unit and then replacing the outdoor thermostat. **When the AFE18 receives a "Y" and "O" input from the indoor thermostat**, it recognizes this as a cooling demand in the cooling mode. If the outdoor thermostat is stuck in the closed position switching the "Y" demand to the "W1" furnace input during the cooling mode as described above, the AFE18 won't allow the furnace to operate. The outdoor thermostat will have to be replaced to restore the unit to normal operation.



WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



TROUBLESHOOTING CHART

COOLING/HP ANALYSIS CHART

Complaint	No Cooling							Unsatisfactory Cooling/Heating							System Operating Pressures				Test Method Remedy	See Service Procedure Ref.		
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE"	SYMPTOM	System will not start	Compressor will not start - fan runs	Comp. and Cond. 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/htg	Too cool and then too warm	Not cool enough on warm days	Certain areas too cool, others too warm	Compressor is noisy	System runs - blows cold air in heating	Unit will not terminate defrost	Unit will not defrost	Low suction pressure	Low head pressure			High suction pressure	High head pressure
Power Failure	•																				Test Voltage	S-1
Blown Fuse	•		•	•																	Inspect Fuse Size & Type	S-1
Unbalanced Power, 3PH		•					•	•													Test Voltage	S-1
Loose Connection	•				•		•														Inspect Connection - Tighten	S-2, S-3
Shorted or Broken Wires	•	•	•	•	•	•	•														Test Circuits With Ohmmeter	S-2, S-3
Open Fan Overload					•	•															Test Continuity of Overload	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 Compressor Overload Open		•												♦							Test Continuity of Overload	S-17A
Shorted or Grounded Compressor		•					•														Test Motor Windings	S-17B
Compressor Stuck		•					•	•						♦							Use Test Cord	S-17D
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-3B
Shortage of Refrigerant								•	•					♦			•	•			Test For Leaks, Add Refrigerant	S-101,103
Restricted Liquid Line								•	•								•	•		•	Remove Restriction, Replace Restricted Part	S-112
Open Element or Limit on Elec. Heater									♦					♦							Test Heater Element and Controls	S-26,S-27
Dirty Air Filter									•		•	•					•			♦	Inspect Filter-Clean or Replace	
Dirty Indoor Coil									•		•	•					•			♦	Inspect Coil - Clean	
Not enough air across Indoor Coil									•		•	•					•			♦	Check Blower Speed, Duct Static Press, Filter	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								•			•			♦							Recover 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	S-115
Broken Valves														•					•	•	Test Compressor Efficiency	S-104
Inefficient Compressor									•						♦				•	•	Test Compressor Efficiency	S-104
Wrong Type Expansion Valve						•	•	•		•							•	•		♦	Replace Valve	S-110
Expansion Device Restricted						•	•	•		•							•	•			Remove Restriction or Replace Expansion Device	S-110
Oversized Expansion Valve								•													Replace Valve	
Undersized Expansion Valve						•	•	•		•							•				Replace Valve	
Expansion Valve Bulb Loose														•					•		Tighten Bulb Bracket	S-105
Inoperative Expansion Valve						•			•								•				Check Valve Operation	S-110
Loose Hold-down Bolts														•							Tighten Bolts	
Faulty Reversing Valve							•							♦	♦	♦		♦	♦	♦	Replace Valve or Solenoid	S-21, 122
Faulty Defrost Control					•										♦	♦	♦	♦	♦	♦	Test Control	S-24
Faulty Defrost Thermostat															♦	♦	♦	♦	♦	♦	Test Defrost Thermostat	S-25
Flow rator Not Seating Properly									•									•	•		Check Flow rator & Seat or Replace Flow rator	S-111

• Cooling or Heating Cycle (Heat Pump)

♦ Heating Cycle Only (Heat Pump)

SERVICING

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WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



SERVICING

S-1 CHECKING VOLTAGE

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 T₁ and T₂ 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. Locked 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.

UNIT SUPPLY VOLTAGE		
VOLTAGE	MIN.	MAX.
460	437	506
208/230	198	253

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**
HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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

Low voltage wiring must be copper conductors. A minimum of 18AWG must be used for installations up to 100 feet. Low voltage wiring must be connected through the top of the cabinet or either side. See the "Thermostat Wiring" section of this manual for typical low voltage wiring connections.

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.

SERVICING

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.
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.

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT



WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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 (see note below).



WARNING

Disconnect ALL power before servicing.

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-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.



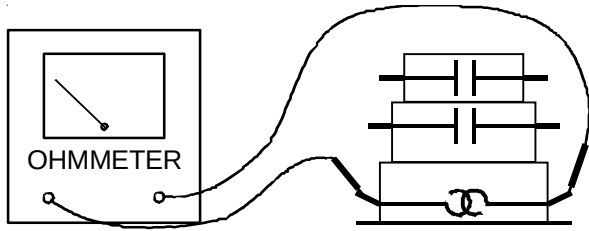
WARNING

Disconnect ALL power before servicing.

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.

SERVICING



TESTING COIL CIRCUIT

S-7 CHECKING CONTACTOR AND/OR RELAYS



WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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.

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 ALL power before servicing.

SINGLE PHASE:

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



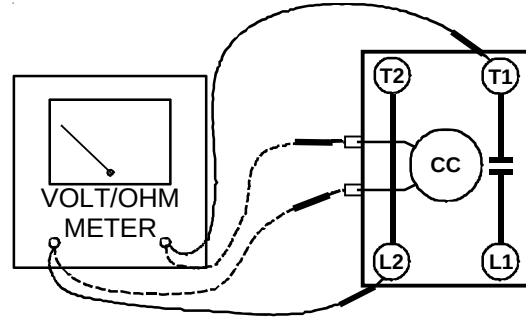
WARNING

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

(Single Phase)

S-9 CHECKING FAN RELAY CONTACTS



WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

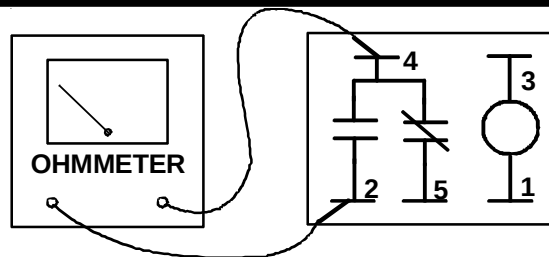


1. Disconnect wire leads from terminals 2 and 4 of Fan Relay Cooling and 2 and 4, 5 and 6 of Fan Relay Heating.
2. Using an ohmmeter, test between 2 and 4 - should read open. Test between 5 and 6 - should read continuous.
3. With power ON, energize the relays.



WARNING

Line Voltage now present.



SERVICING

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.

S-12 CHECKING HIGH PRESSURE CONTROL

WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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.

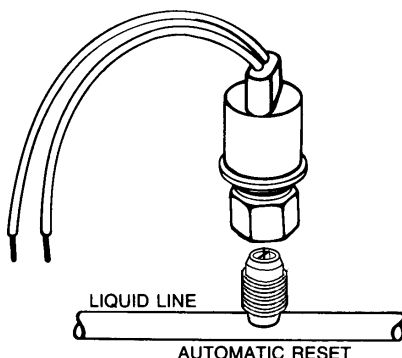
1. Using an ohmmeter, check across terminals of high pressure control, with wire removed. If not continuous, the contacts are open.
3. Attach a gauge to the dill valve port on the base valve.

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. If it cuts-out at 610 PSIG $\pm$ 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 21 PSIG for heat pumps and 55 PSIG for air conditioners. It will automatically cut-in (close) at approximately 50 PSIG for heat pumps and 95 PSIG for air conditioners.

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® brand 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.

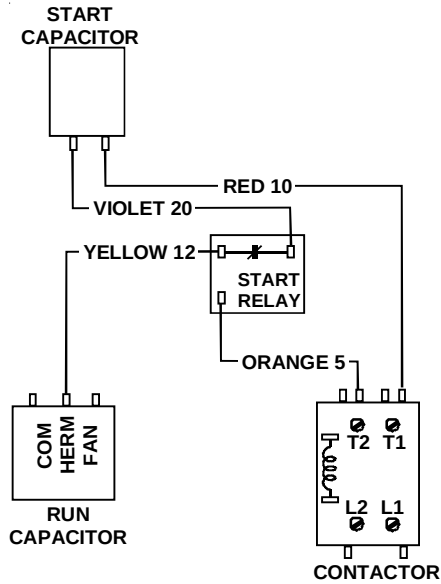
To prevent the compressor from short cycling, a Time Delay Relay (Cycle Protector) has been added to the low voltage circuit.

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 contracts to the start capacitor.

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

SERVICING



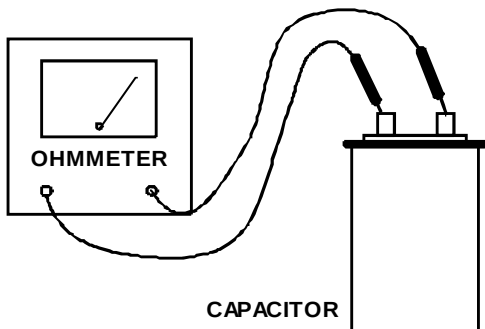
HARD START KIT WIRING

S-15A RESISTANCE CHECK

WARNING
HIGH VOLTAGE!
 Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

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).

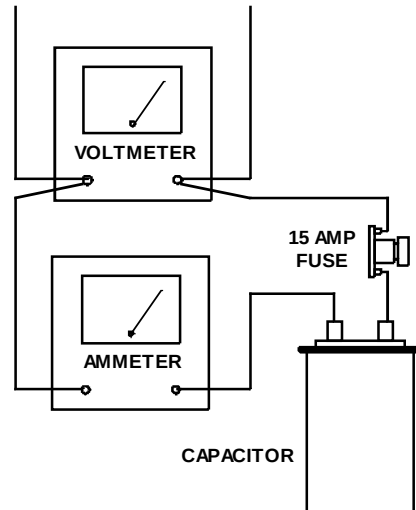
- B. Shorted - indicator swings to zero and stops there - replace.
- C. Open - no reading - replace. (Start capacitor would read resistor resistance.)

S-15B CAPACITANCE CHECK

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

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

WARNING
 Discharge capacitor through a 20 to 30 OHM resistor before handling.



TESTING CAPACITANCE

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.

SERVICING

**WARNING**
HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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.

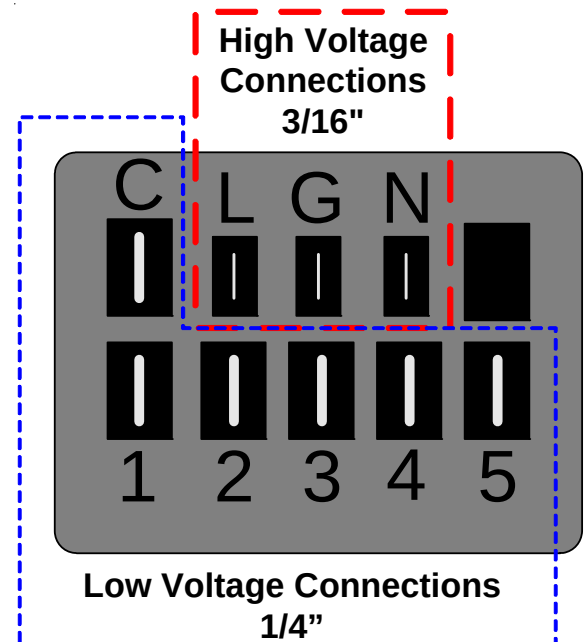
If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

S-16F CHECKING HIGH EFFICIENCY MOTORS

The motor is a one piece, fully encapsulated, 3 phase brushless DC (single phase AC input) motor with ball bearing construction.

1. Using a voltmeter, check for 230 volts to the motor connections L and N. If 230 volts is present, proceed to step 2. If 230 volts is not present, check the line voltage circuit to the motor.
2. Using a voltmeter, check for 24 volts from terminal C to either terminal 1, 2, 3, 4, or 5, depending on which tap is being used, at the motor. If voltage present, proceed to step 3. If no voltage, check 24 volt circuit to motor.
3. If voltage was present in steps 1 and 2, the motor has failed and will need to be replaced.

Note: When replacing motor, ensure the belly band is between the vents on the motor and the wiring has the proper drip loop to prevent condensate from entering the motor.



MOTOR CONNECTIONS

S-17 CHECKING COMPRESSOR

**WARNING**
Hermetic compressor electrical terminal venting can be dangerous. When insulating material which supports a hermetic compressor or 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 vapor 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.

SERVICING

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 -

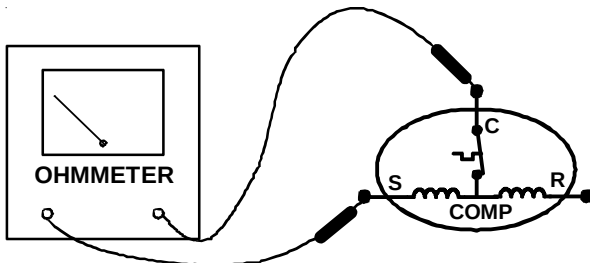
**WARNING**
HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Remove the leads from the compressor terminals.

**WARNING**
See warnings S-17 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.

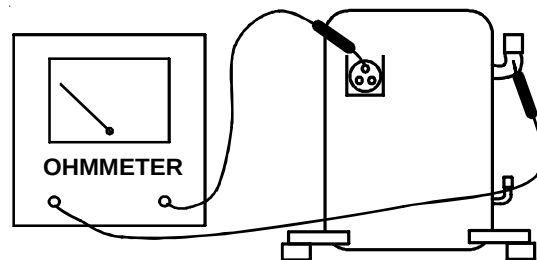
S-17B GROUND TEST

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 ONE TIME ONLY to see if it was just a nuisance opening. If it opens again, DO NOT continue to reset.

Disconnect all power to unit, making sure that **all** 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 an ohmmeter on the R x 10,000 scale or the highest resistance scale on your ohmmeter check the resistance between each of the three leads separately to ground (such as an unpainted tube on the compressor).
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.
5. Carefully retest for ground, directly between compressor terminals and ground.
6. If ground is indicated, replace the compressor. The resistance reading should be infinity. If there is any reading on meter, there is some continuity to ground and compressor should be considered defective.



**WARNING**
Damage can occur to the glass embedded terminals if the leads are not properly removed. This can result in terminal and hot oil discharging.

S-17D OPERATION TEST

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

SERVICING



WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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.

COPELAND COMPRESSOR

03	A	12345	L
YEAR	MONTH	SERIAL NUMBER	PLANT

S-17E CHECKING 3-PHASE SCROLL COMPRESSOR ROTATION

Verify the proper rotation of Copeland scroll compressors as follows:

NOTE: The compressor may run backwards (noisy operation) for 1 or 2 seconds at shutdown. This is normal and does not harm the compressor.

1. Install gauges and verify that the suction pressure drops while the discharge pressure increases.
2. Listen for normal compressor sound levels. Reverse rotation results in elevated or unusual sound levels.
3. Reverse rotation will result in substantially reduced amp draw from tabulated values.

To correct improper rotation, switch any two power supply leads at the outdoor unit contactor.

The 3-phase scroll compressors are direction of rotation sensitive. They will rotate in either direction depending on the phasing of the power. There is no negative impact on durability caused by operating 3-phase compressors in reversed rotation. The compressor's internal protector will trip, de-energizing the compressor. Continued operation of 3-phase scroll compressors with the rotation reversed will contribute to compressor failure. All 3-phase scroll compressors should be checked for correct phase rotation.

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 ALL power before servicing.

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.

S-21 CHECKING REVERSING VALVE AND SOLENOID

Occasionally the reversing valve may stick in the heating or cooling position or in the mid-position.

When stuck in the mid-position, part of the discharge gas from the compressor is directed back to the suction side, resulting in excessively high suction pressure. An increase in the suction line temperature through the reversing valve can also be measured. Check operation of the valve by starting the system and switching the operation from COOLING to HEATING cycle.

If the valve fails to change its position, test the voltage (24V) at the valve coil terminals, while the system is on the COOLING cycle.

If no voltage is registered at the coil terminals, check the operation of the thermostat and the continuity of the connecting wiring from the "O" terminal of the thermostat to the unit.

If voltage is registered at the coil, tap the valve body lightly while switching the system from HEATING to COOLING, etc. If this fails to cause the valve to switch positions, remove the coil connector cap and test the continuity of the reversing valve solenoid coil. If the coil does not test continuous - replace it.

SERVICING

If the coil test continuous and 24 volts is present at the coil terminals, the valve is inoperative - replace it.

S-24 TESTING DEFROST CONTROL

To check the defrost control for proper sequencing, proceed as follows: With power ON; unit not running.

1. Jumper defrost thermostat by placing a jumper wire across the terminals "DFT" and "R"/"R-DFT" at defrost control board.
2. Connect jumper across test pins on defrost control board.
3. Set thermostat to call for heating. System should go into defrost within 21 seconds.
4. Immediately remove jumper from test pins.
5. Using VOM check for voltage across terminals "C & O". Meter should read 24 volts.
6. Using VOM check for voltage across fan terminals DF1 and DF2 on the board. You should read line voltage (208-230 VAC) indicating the relay is open in the defrost mode.
7. Using VOM check for voltage across "W"/"W2" & "C" terminals on the board. You should read 24 volts.
8. If not as above, replace control board.
9. Set thermostat to off position and disconnect power before removing any jumpers or wires.

NOTE: Remove jumper across defrost thermostat before returning system to service.

S-25 TESTING DEFROST THERMOSTAT

1. Install a thermocouple type temperature test lead on the tube adjacent to the defrost control. Insulate the lead point of contact.
2. Check the temperature at which the control closes its contacts by lowering the temperature of the control. Part # 0130M00009P which is used on 2 and 2.5 ton units should close at $34^{\circ}\text{F} \pm 5^{\circ}\text{F}$. Part # 0130M00001P or B1370803 which is used on 3 thru 5 ton units should close at $31^{\circ}\text{F} \pm 3^{\circ}\text{F}$.
3. Check the temperature at which the control closes its contacts by lowering the temperature of the control. Part # 0130M00085, which is used on units with 5 mm coils, should close at $30^{\circ}\text{F} \pm 5^{\circ}\text{F}$.
4. Check the temperature at which the control opens its contacts by raising the temperature of the control. Part # 0130M00009P which is used on 2 and 2.5 ton units should open at $60^{\circ}\text{F} \pm 5^{\circ}\text{F}$. Part # 0130M00001P or B1370803 which is used on 3 thru 5 ton units should open at $75^{\circ}\text{F} \pm 6^{\circ}\text{F}$.
5. Check the temperature at which the control opens its contacts by raising the temperature of the control. Part # 0130M00085, which is used on units with 5 mm coils, should open at $60^{\circ}\text{F} \pm 5^{\circ}\text{F}$.
6. If not as above, replace control.

S-40 MBR/AR*F ELECTRONIC BLOWER

TIME DELAY RELAY

The MBR/AR*F contains an Electronic Blower Time Delay Relay board, B1370735. This board provides on/off time delays for the blower motor in cooling and heat pump heating demands when "G" is energized.

During a cooling or heat pump heating demand, 24Vac is supplied to terminal "G" of the EBTDR to turn on the blower motor. The EBTDR initiates a 7 second delay on and then energizes it's onboard relay. The relay on the EBTDR board closes it's normally open contacts and supplies power to the blower motor. When the "G" input is removed, the EBTDR initiates a 65 second delay off. When the 65 seconds delay expires the onboard relay is de-energized and it's contacts open and remove power from the blower motor.

During an electric heat only demand, "W1" is energized but "G" is not. The blower motor is connected to the normally closed contacts of the relay on the EBTDR board. The other side of this set of contacts is connected to the heat sequencer on the heater assembly that provides power to the first heater element. When "W1" is energized, the sequencer will close it's contacts within 10 to 20 seconds to supply power to the first heater element and to the blower motor through the normally closed contacts on the relay on the EBTDR. When the "W1" demand is removed, the sequencer opens it contacts within 30 to 70 seconds and removes power from the heater element and the blower motor.

The EBTDR also contains a speedup terminal to reduce the delays during troubleshooting of the unit. When this terminal is shorted to the common terminal, "C", on the EBTDR board, the delay ON time is reduced to 3 seconds and the delay OFF time is reduced to 5 second.

Two additional terminals, M1 and M2, are on the EBTDR board. These terminals are used to connect the unused leads from the blower motor and have no affect on the board's operation.

SEQUENCE OF OPERATION

MBR/AR*F WITH SINGLE STAGE HEAT PUMPS

1.0 Cooling Operation

On heat pump units, when the room thermostat set to the cooling mode, 24Vac is supplied to "O" which energizes the reversing valve. As long as the thermostat is set for cooling, the reversing valve will be in the energized position for cooling.

1.1 On a demand for cooling, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "Y" at the heat pump and the "G" terminal on the EBTDR board.

1.2 The heat pump turned on in the cooling mode and after a 7 second on delay, the relay on the EBTDR board is energized and the blower motor starts.

1.3 When the cooling demand is satisfied, the room thermostat removes the 24Vac from "G" and "Y".

1.4 The heat pump is turned off and after a 65 second delay

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off, the relay on the EBTDR board is de-energized and the blower motor is turned off.

2.0 Heating Operation

On heat pump units, when the room thermostat set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle. Some installations may use one or more outdoor thermostats to restrict the amount of electric heat that is available above a preset ambient temperature. Use of optional controls such as these can change the operation of the electric heaters during the heating mode. This sequence of operation does not cover those applications.

2.1 On a demand for first stage heat with heat pump units, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "Y" at the heat pump unit and the "G" terminal on the EBTDR board. The heat pump is turned on in the heating mode and the blower motor starts after a 7 second on delay.

2.2 If the first stage heat demand cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize terminal "W2" for second stage heat and 24Vac will be supplied to heat sequencer HR1 on the heater assembly.

2.3 HR1 contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close and turn on heater element #2. The blower motor is already on as a result of terminal "G" on the EBTDR board being energized for the first stage heat demand.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. If the second stage heat demand, "W2" cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W3" and 24Vac will be supplied to HR2 on the heater assembly. When the "W3" demand is satisfied, the room thermostat will remove the 24Vac from HR2. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off. **On most digital/electronic thermostats, "W3" will remain energized until the first stage heat demand "Y" is satisfied and then the "G", "Y", "W2" and "W3" demands will be removed.**

2.4 As the temperature indoors increase, it will reach a point where the second stage heat demand, "W2", is satisfied. When this happens, the room thermostat will remove the 24Vac from the coil of HR1. The contacts on HR1 will open between 30 to 70 seconds and turn off both heater element(s). The heat pump remains on along with the blower motor because the "Y" demand for first stage heat will still be present.

2.5 When the first stage heat demand "Y" is satisfied, the room thermostat will remove the 24Vac from "G" and "Y".

The heat pump is turned off and the blower motor turns off after a 65 second off delay.

3.0 Defrost Operation

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle.

3.1 The heat pump will be on and operating in the heating mode as described the Heating Operation in section 4.

3.2 The defrost control in the heat pump unit checks to see if a defrost is needed every 30, 60 or 90 minutes of heat pump operation depending on the selectable setting by monitoring the state of the defrost thermostat attached to the outdoor coil.

3.3 If the temperature of the outdoor coil is low enough to cause the defrost thermostat to be closed when the defrost board checks it, the board will initiate a defrost cycle.

3.4 When a defrost cycle is initiated, the contacts of the HVDR relay on the defrost board open and turns off the outdoor fan. The contacts of the LVDR relay on the defrost board closes and supplies 24Vac to "O" and "W2". The reversing valve is energized and the contactson HR1 close and turns on the electric heater(s). The unit will continue to run in this mode until the defrost cycle is completed.

a. For models with defrost control PCBDM133 or PCBDM160, a 30 second compressor delay at defrost initiation/termination is optional. As shipped from the factory, the control is set for the delay ("DLY"), which will turn the compressor off for 30 seconds while the reversing valve shifts to/from the cooling mode position. To bypass the delay, which typically reduces sound levels during defrost mode, change the pin settings from "DLY" to "NORM".

3.5 When the temperature of the outdoor coil rises high enough to causes the defrost thermostat to open, the defrost cycle will be terminated. If at the end of the programmed 10 minute override time the defrost thermostat is still closed, the defrost board will automatically terminate the defrost cycle.

3.6 When the defrost cycle is terminated, the contacts of the HVDR relay will close to start the outdoor fan and the contacts of the LVDR relay will open and turn off the reversing valve and electric heater(s). The unit will now be back in a normal heating mode with a heat pump demand for heating as described in the Heating Operation in section 4. See section 5.4a.

SEQUENCE OF OPERATION

AVPTC/MBVC with Single Stage Condensers (24VAC Legacy Wired Systems)

1.0 Cooling Operation

1.1 On a demand for single stage cooling operation, the thermostat closes the "G" and "Y" contacts providing 24VAC to the "G", "Y1", and "Y2" terminals at the

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integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variable speed ECM motor at the demanded airflow.

- 1.2 The compressor and condensor fan motor is energized by the closing of the thermostat "Y" contacts.
- 1.3 The system operates at single stage cooling.
- 1.4 Upon satisfying the thermostat, the "G" and "Y" thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor and condensor fan motor are both de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

- 2.1 On a demand for auxiliary heat operation, the thermostat closes the "W1" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variable speed ECM motor at the demanded airflow.
- 2.2 The system operates at low stage auxiliary heat.
- 2.3 If the thermostat demand cannot be met on low stage auxiliary heat, the thermostat will close the "W2" contacts, providing 24VAC to the "W2" terminal at the integrated AH control. Thermostat "W1" contacts remain closed.
- 2.4 Upon receiving the high stage auxiliary heat demand, the control operates the ECM blower motor at the demanded airflow.
- 2.5 The system operates at high stage auxiliary heat as demanded by the thermostat.
- 2.6 Upon satisfying the thermostat, the "W1" thermostat contacts (or "W1" and "W2" contacts) open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

- 3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variable speed ECM motor at 30% of the air handler's maximum airflow capability.
- 3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

AVPTC/MBVC with Single Stage Heat Pumps (24VAC Legacy Wired Systems)

1.0 Cooling Operation

- 1.1 On a demand for single stage cooling operation, the thermostat closes the "G", "O", and "Y" contacts providing 24VAC to the "G", "O", "Y1", and "Y2" terminals at the integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variable speed ECM motor at the demanded airflow.
- 1.2 The compressor and condensor fan motor is energized by the closing of the thermostat "Y" contacts. The reversing valve is energized by the closing of the thermostat "O" contacts.
- 1.3 The system operates at single stage cooling.
- 1.4 Upon satisfying the thermostat, the "G", "O", and "Y" thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor, condensor fan motor, and reversing valve are de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

- 2.1 On a demand for heat pump heating, the room thermostat closes the "G" and "Y" contacts, providing 24VAC to the "G" and "Y" terminals at the integrated air handler control. The integrated AH control initiates the heat pump heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variable speed ECM motor at the demanded airflow.
- 2.2 The compressor and condensor fan motor are energized by the closing of the thermostat "Y" contacts.
- 2.3 The system operates at single stage heat pump heat.
- 2.4 If the thermostat demand cannot be met with heat pump heating, the thermostat will close the "W1/W2" contacts, providing 24VAC to the "W1" or "W1" and "W2" terminals at the integrated AH control. Thermostat "G" and "Y" contacts remain closed.
- 2.5 Upon receiving a demand for auxiliary heat, the control determines the appropriate airflow demand for heat pump + auxiliary heat operation and operates the ECM blower motor at that airflow demand. The control determines which airflow demand is greatest and applies that demand when operating the ECM blower motor.
- 2.6 The system operates at single stage heat pump heating plus auxiliary heat.
- 2.5 Upon satisfying the thermostat, the "G" and "Y" thermostat contacts (or "G", "Y" and "W1/W2" contacts) open, removing 24VAC from the integrated air handler control.

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The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heat pump heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

- 3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variable speed ECM motor at 30% of the air handler's maximum airflow capability.
- 3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

4.0 Defrost Operation

- 4.1 The control in the outdoor unit determines when a defrost cycle is needed. Upon determining that a defrost cycle is needed, the outdoor control de-energizes the condensor fan motor and energizes the reversing valve. A "W1" signal is sent from the outdoor unit control to the integrated air handler control.
- 4.2 The air handler control energizes the electric heat sequencer output to turn on the electric heaters. The appropriate airflow demand is provided to the motor (greater of heat pump or auxiliary heat).
- 4.3 At the conclusion of the defrost cycle, the outdoor unit control removes the "W1" output to the integrated air handler control, de-energizes the reversing valve and re-energizes the condensor fan motor.

5.0 Emergency Heat Operation

- 5.1 On a demand for emergency heat operation, the thermostat closes the "W1/W2" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variable speed ECM motor at the demanded airflow.
- 5.2 The system operates at emergency heat.
- 5.3 Upon satisfying the thermostat emergency heat demand, the "W1" thermostat contacts open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized.

S-50 CHECKING HEATER LIMIT CONTROL(S) (OPTIONAL ELECTRIC HEATERS)

Each individual heater element is protected with an automatic reset limit control 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. to 160°F and close at approximately 110°F.



WARNING

Disconnect ALL power before servicing.

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. Make sure the limits are cool before testing.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

S-52 CHECKING HEATER ELEMENTS

Optional electric heaters may be added, in the quantities shown in the spec sheet for each model unit, to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.



WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Disassemble and remove the heating element(s).
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-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.

SERVICING

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 following **BTUH CAPACITY CORRECTION FACTOR** chart.

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.

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	3.0 kW	4.8 kW	7.2 kW	9.6 kW	14.4 kW	19.2 kW	24.0 kW	28.8 kW
600	16	25	38	51	-	-	-	-
700	14	22	33	43	-	-	-	-
800	12	19	29	38	57	-	-	-
900	11	17	26	34	51	-	-	-
1000	10	15	23	30	46	-	-	-
1100	9	14	21	27	41	55	-	-
1200	8	13	19	25	38	50	-	-
1300	7	12	18	23	35	46	-	-
1400	7	11	16	22	32	43	54	65
1500	6	10	15	20	30	40	50	60
1600	6	9	14	19	28	38	47	57
1700	6	9	14	18	27	36	44	53
1800	5	8	13	17	25	34	42	50
1900	5	8	12	16	24	32	40	48
2000	5	8	12	15	23	30	38	45
2100	5	7	11	14	22	29	36	43
2200	4	7	11	14	21	27	34	41
2300	4	7	10	13	20	26	33	39

ELECTRIC HEATER CAPACITY BTUH								
HTR KW	3.0 KW	4.7 KW	6.0 KW	7.0 KW	9.5 KW	14.2 KW	19.5 KW	21.0 KW
BTUH	10200	16200	20400	23800	32400	48600	66500	71600

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 (T)

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

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

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

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

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°.

SERVICING



WARNING

Disconnect ALL power before servicing.

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 ALL power before servicing.

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

HIGH VOLTAGE!

Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



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

IMPORTANT NOTE: Torch heat required to braze tubes of various sizes is proportional to the size of the tube. Tubes of smaller size require less heat to bring the tube to brazing temperature before adding brazing alloy. Applying too much heat to any tube can melt the tube. Service personnel must use the appropriate heat level for the size of the tube being brazed.

NOTE: The use of a heat shield when brazing is recommended to avoid burning the serial plate or the finish on the unit. Heat trap or wet rags should be used to protect heat sensitive components such as service valves and TXV valves.

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 (NITROGEN OR NITROGEN-TRACED)



WARNING

To avoid the risk of fire or explosion, never use oxygen, high pressure air or flammable gases for leak testing of a refrigeration system.



WARNING

To avoid possible explosion, the line from the nitrogen cylinder must include a pressure regulator and a pressure relief valve. The pressure relief valve must be set to open at no more than 150 psig.

Pressure test the system using dry nitrogen and soapy water to locate leaks. If you wish to use a leak detector, charge the system to 10 psi using the appropriate refrigerant then use nitrogen to finish charging the system to working pressure, then apply the detector to suspect areas. If leaks are found, repair them. After repair, repeat the pressure test. If no leaks exist, proceed to system evacuation.

SERVICING

S-102 EVACUATION



WARNING

REFRIGERANT UNDER PRESSURE!

Failure to follow proper procedures may cause property damage, personal injury or death.

IMPORTANT NOTE: Because of the potential damage to compressors, do not allow suction pressure at service valve to drop below 20 PSIG when pumping unit system down for repair. Outdoor section, depending on line set length and amount of charge in system, may not be able to hold the entire system charge.

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 250 microns absolute and a thermocouple vacuum gauge to give a true reading of the vacuum in the system

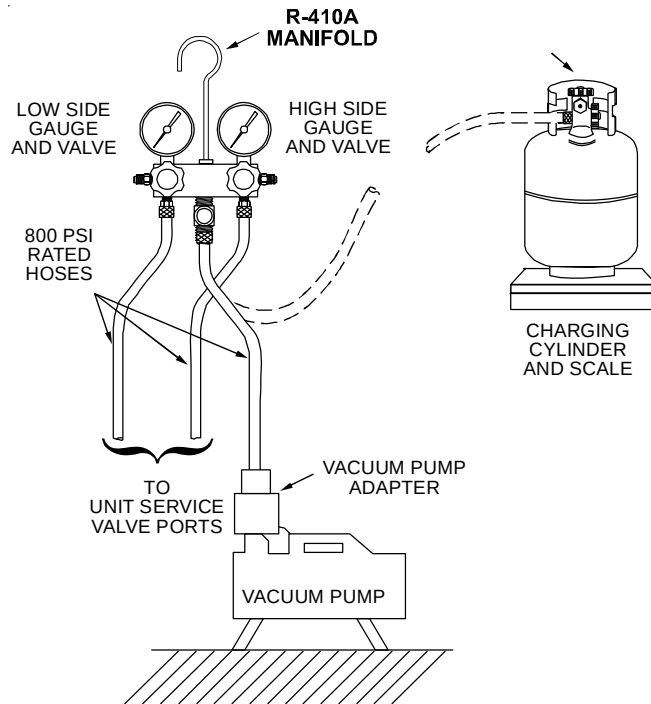
NOTE: Never use the system compressor as a vacuum pump or run when under a high vacuum. Motor damage could occur.



WARNING

Do not front seat the service valve(s) with the compressor open, 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 250 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 present. 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



WARNING

REFRIGERANT UNDER PRESSURE!

- * Do not overcharge system with refrigerant.
- * Do not operate unit in a vacuum or at negative pressure.

Failure to follow proper procedures may cause property damage, personal injury or death.

SERVICING



CAUTION

Use refrigerant certified to AHRI standards. Used refrigerant may cause compressor damage and is not covered under the warranty. Most portable machines Cannot clean used refrigerant to meet AHRI standards.



CAUTION

Damage to the unit caused by operating the compressor with the suction valve closed is not covered under the warranty and may cause serious compressor damage.

Charge the system with the exact amount of refrigerant.

Refer to the specification section or check the unit nameplates 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 its 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.

Final Charge Adjustment

The outdoor temperature must be 60°F or higher. Set the room thermostat to COOL, fan switch to AUTO, and set the temperature control well below room temperature.

After system has stabilized per startup instructions, compare the operating pressures and outdoor unit amp draw to the numbers listed on the performance label on the outdoor unit. If pressures and amp draw are too low, add charge. If pressures and amp draw are too high, remove charge. Check subcooling and superheat as detailed in the following section.

5. With the system still running, 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. AHRI 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.

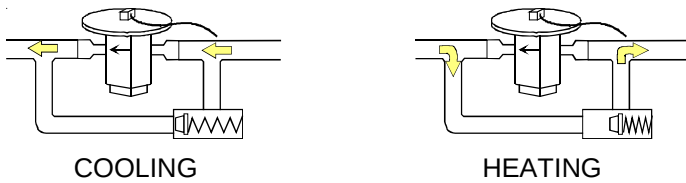
And the charge is correct. The compressor is faulty - replace the compressor.

S-105B 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.

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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 GOODMAN 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-110 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-110 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 on following pages.



CAUTION

To prevent personal injury, carefully connect and disconnect manifold gauge hoses. Escaping liquid refrigerant can cause burns. Do not vent refrigerant to atmosphere. Recover during system repair or final unit disposal.

1. Run system at least 10 minutes to allow pressure to stabilize.
2. For best results, temporarily install a thermometer on the liquid line at the liquid line service valve and 4-6" from the compressor on the suction line. Ensure the thermometer makes adequate contact and is insulated for best possible readings. Use liquid line temperature to determine sub-cooling and vapor temperature to determine superheat.
3. Refer to the superheat table provided for proper system superheat. Add charge to lower superheat or recover charge to raise superheat.

Superheat Formula = Suct. Line Temp. - Sat. Suct. Temp.

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 AND SUBCOOLING ADJUSTMENT ON TXV APPLICATIONS

1. Run system at least 10 minutes to allow pressure to stabilize.

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2. For best results, temporarily install a thermometer on the liquid line at the liquid line service valve and 4-6" from the compressor on the suction line. Ensure the thermometer makes adequate contact and is insulated for best possible readings. Use liquid line temperature to determine sub-cooling and vapor temperature to determine superheat.

NOTE: An optional method is to locate the thermometer at the suction line service valve. Ensure the thermometer makes adequate contact and is insulated for best possible readings.

3. Check subcooling and superheat. Systems with TXV application should have a subcooling and superheat of $7 \pm 2^\circ\text{F}$.
 - a. If subcooling and superheat are low, **adjust** TXV to $7 - 9^\circ\text{F}$ then check subcooling.
 - b. If subcooling is low and superheat is high, **add** charge to raise subcooling to $7 \pm 2^\circ\text{F}$ then check superheat.
 - c. If subcooling and superheat are high, **adjust** TXV valve to $7 \pm 9^\circ\text{F}$ then check subcooling.
 - d. If subcooling is high and superheat is low, **adjust** TXV valve to 7 to 9°F superheat and **remove** charge to lower the subcooling to $7 \pm 2^\circ\text{F}$.

The TXV should **NOT** be adjusted at light load conditions 55° to 60°F , under such conditions only the subcooling can be evaluated. This is because suction pressure is dependent on the indoor coil match, indoor airflow, and wet bulb temperature. **NOTE:** Do **NOT** adjust charge based on suction pressure unless there is a gross undercharge.

4. Disconnect manifold set. Installation is complete.

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 specification sheet for the model being serviced to obtain the design subcooling.
5. Compare the hi-pressure reading to the "Required Liquid Line Temperature" chart (page 108). Find the hi-pressure

value on the left column. Follow that line right to the column under the design subcooling value. Where the two intersect is the required liquid line temperature.

Alternately 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 $^\circ\text{F}$. Column.

6. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.

Add charge to raise subcooling. Recover charge to lower subcooling.

Subcooling Formula = Sat. Liquid Temp. - Liquid Line Temp.

EXAMPLE:

- a. Liquid Line Pressure = 417
- b. Corresponding Temp. $^\circ\text{F}$. = 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-112 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.

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

S-113 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-114 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 since 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-115 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.

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® Brand 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.

Install a field supplied suction line drier. 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 **including** 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 6 PSIG, the drier has



NOTICE

Violation of EPA regulations may result in fines or other penalties.

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

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Pressure vs. Temperature Chart													
R-410A													
PSIG	°F	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

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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

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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. Avoid long running traps in horizontal suction line.

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Long Line Set Application R-410A

This long line set application guideline applies to all AHRI listed R-410A heat pump split system matches of nominal capacity 18,000 to 60,000 Btuh. This guideline will cover installation requirements and additional accessories needed for split system installations where the line set exceeds 80 feet in actual length. The long line sets in this manual are configured for the when outdoor unit is above the Indoor unit.

This guideline is meant to provide installation instructions based on most common long line set applications. Installation variables may affect the system operation.

Contact Goodman® Technical Services for variations or applications outside those outlined in this document.

SECTION 1. GENERAL REQUIREMENTS FOR ALL LONG LINE SET APPLICATIONS

1. Equivalent length must be used to determine acceptability of any long line set application. See Section 3 for equivalent length calculations.
 - A long line application when the linear length of interconnecting tubing **exceeds 80 ft.**
 - Vertical separation between Indoor and Outdoor units **exceeds 20 ft.**
2. For any residential split system installed with a long line set, **3/8" liquid line size** must be used. Limiting the liquid line size to 3/8" is critical because an increased refrigerant charge level from having a larger liquid line could possibly shorten a compressor's life span. See table 3-3 for allowable suction line diameters for single-stage systems.
3. Most refrigerant tubing kits are supplied with 3/8" thick insulation on the suction line. For long line installations over 80 feet, 1/2" thick suction line insulation is required to reduce loss of capacity if the line set passes through a high ambient temperature zone. The liquid line must be insulated if more than 50 feet of liquid line will pass through an area that might reach temperature of 30°F or higher than outdoor ambient. Never attach a liquid line to any uninsulated portion of the suction line.
4. A **crankcase heater** must be installed on *any* compressor (if crankcase heater is not already factory installed).
5. Hard start assist kit is required.
6. Use of a thermostatic expansion valve (**TXV**) is required in all long line set applications. Unit must be charged to 6° ± 1°F subcooling at the indoor unit.
7. Maximum of line set is:
 - a. Maximum equivalent length of line is **250 feet** for single stage units with scroll compressors.
 - b. Maximum linear/actual length is **200 feet.**
 - c. Maximum vertical separation of outdoor unit above indoor unit is **200 feet** (Figure 1-6).
8. **Low voltage wiring.** Verify low voltage wire gauge is adequate for the length used due to increased line set application.
9. **Vibration and Noise:** In long line applications, refrigerant tubing is highly prone to transmit noise and vibration to the adjoining structure. When mounting line set to structural members, use adequate vibration-isolating hardware. For examples of proper mounting, see Figures 1-1, 1-2 and 1-3.

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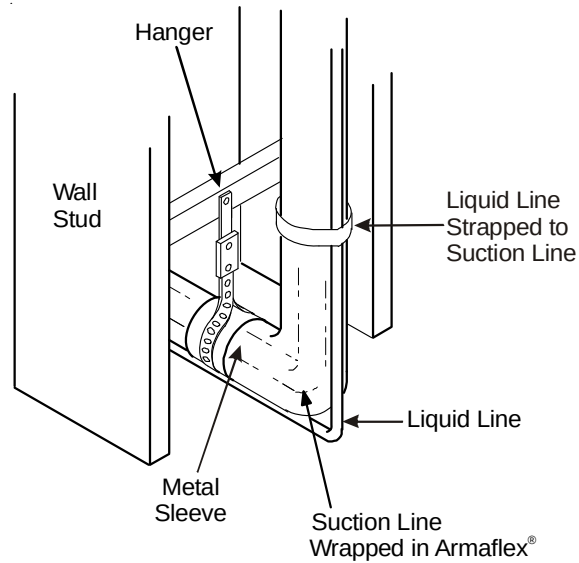


Figure 1-1.
Installation of Refrigeration Piping From Vertical to Horizontal

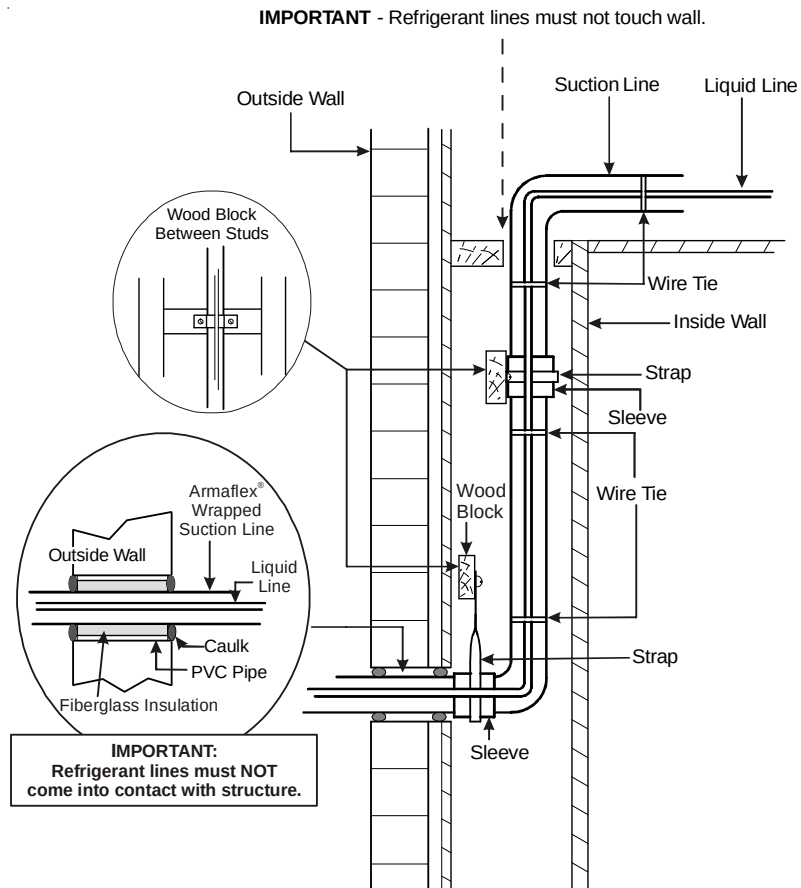


Figure 1-2. Installation of Refrigerant Piping (Vertical)
New construction shown

NOTE: If line set is installed on the exterior of an outside wall, similar installation practices are to be used.

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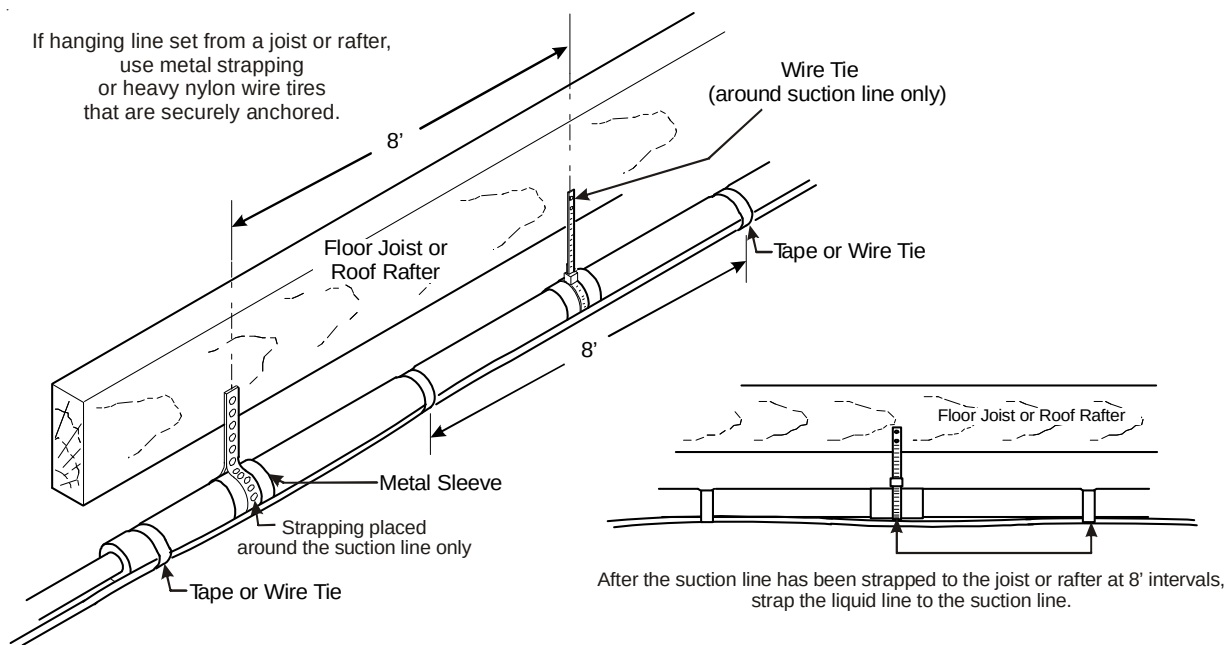


Figure 1-3. Installation of Refrigerant Piping (Horizontal)

10. **Heat Pump Application Only.** Liquid line solenoid must be installed less than 2 feet from the outdoor unit following the solenoid supplier information for installation.
11. Braze the flowrator body/filter dryer kit to the outdoor unit liquid service valve with the arrow on the flowrator body **pointing towards the indoor unit**.
NOTE: Heat trap or wet rags should be used to protect heat sensitive components in flowrator body and filter dryer.
12. **Heat Pump Application Only.** Heating piston change is required. Refer to Table 1.

Heat Pump Outdoor Piston Change - Outdoor Unit ABOVE Indoor Unit

Btuh	Vertical Separation (ft) - Outdoor Above Indoor Unit							
	20-25	26-50	51-75	76-100	101-125	126-150	151-175	176-200
18,000	+1	+1	+2	+3	+3	+4	+5	+6
24,000	+1	+1	+2	+3	+4	+5	+6	+7
30,000	+1	+2	+2	+4	+5	+6	+8	+9
36,000	+1	+2	+2	+4	+5	+6	+8	+9
42,000	+1	+2	+3	+4	+5	+7	+8	+10
48,000	+1	+2	+3	+4	+5	+7	+9	+10
60,000	+1	+2	+3	+5	+6	+8	+10	+12

Table 1.

13. Use the following instructions to replace the piston size based on Table 1, depending on vertical separation between outdoor and indoor unit. See Figures 1-4 and 1-5.

EXAMPLE: A 2-ton unit (24,000 Btuh) has a factory installed piston of 0.043. Vertical separation is 100 feet. The new piston size to be used on the flowrator body is $0.043 + 3 = 0.046$.

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SECTION 3. OUTDOOR UNIT IS ABOVE THE INDOOR UNIT

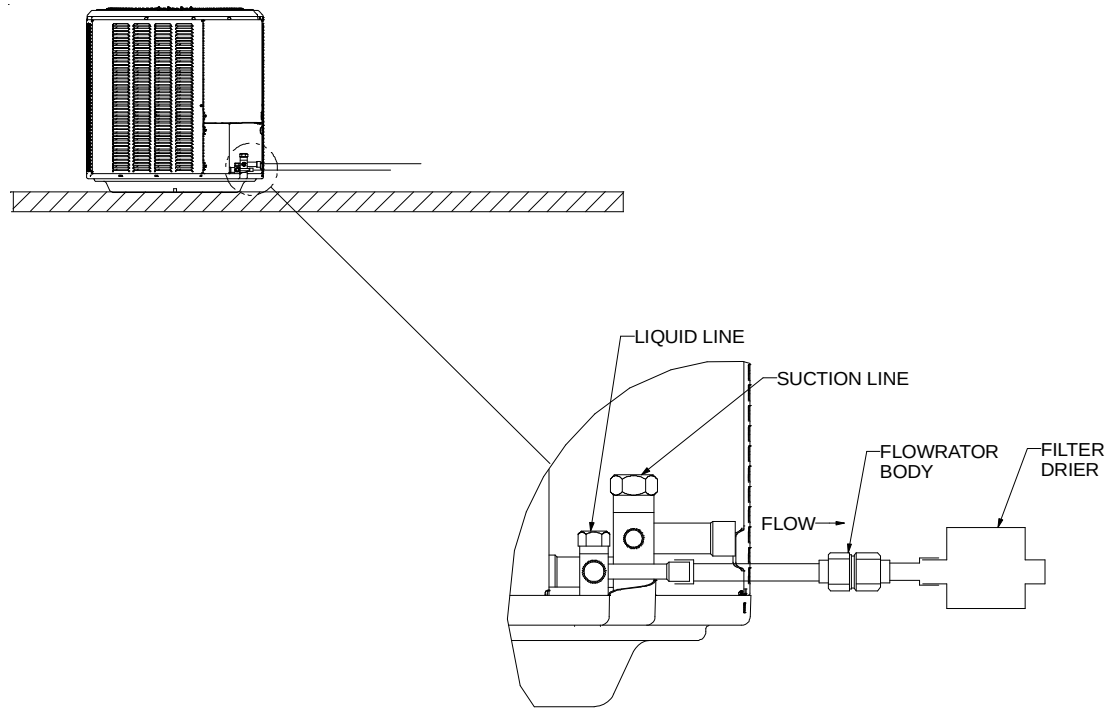


Figure 1-4. Replacing the Piston

1. Remove the Piston.
Replace piston as shown,
with the Teflon seal down.
*Piston number is on the
piston body.*
2. Replace Teflon Ring on
the ring seat.
DO NOT REUSE
ORIGINAL TEFLON RING.
3. Torque 10-30 Ft. Lbs
Optimum torque is 20 Ft. Lbs.

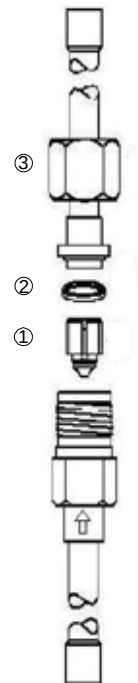


Figure 1-5. Piston Components

SERVICING

14. **Final Charge Adjustment.** All units must have refrigerant charge verified by proper adjustment of subcooling at the indoor unit after initial charge adjustment per Section 3. Proper adjustment means pressure and temperature of the liquid line at the indoor unit must be measured to calculate subcooling at the indoor unit. If subcooling at the indoor unit is less than 5°F, then additional refrigerant must be added until this subcooling level is achieved. If subcooling at the indoor unit is more than 7°F, then refrigerant must be removed until this subcooling level is achieved.

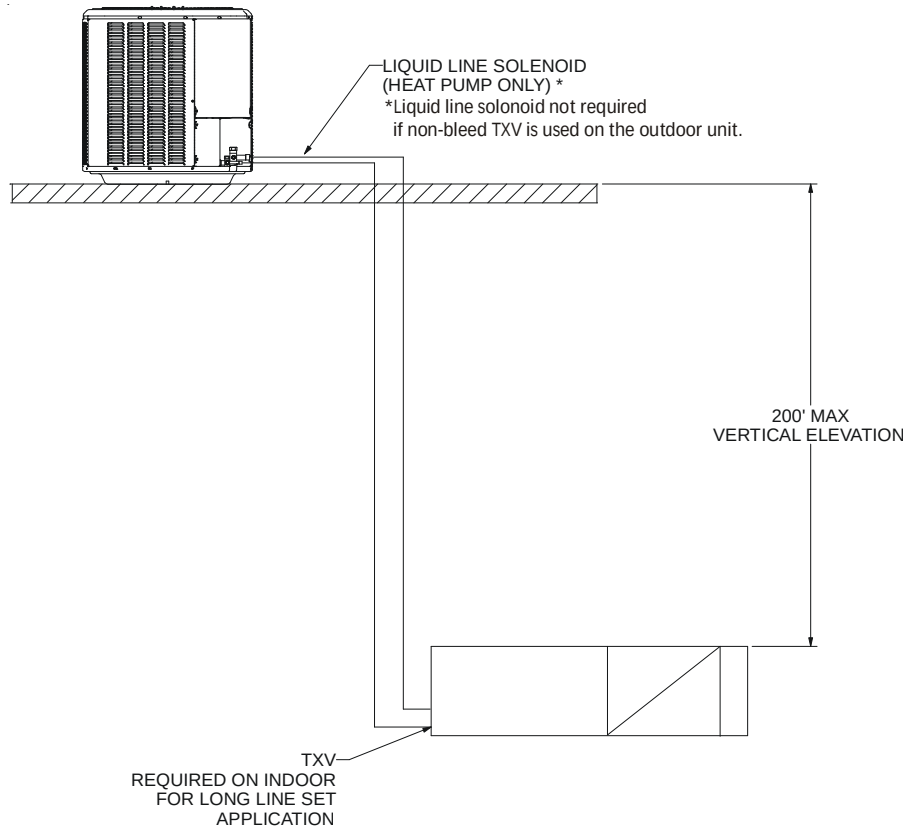


Figure 1-6. Elevation Between Outdoor and Indoor Units

SECTION 2. OUTDOOR UNIT IS ABOVE THE INDOOR UNIT

Accessory	Air Conditioner (AC)	Heat Pump (HP)
Crankcase Heater (40 watts minimum)	Yes	Yes
Hard Start Assist	Yes (See manual for each product)	Yes (See manual for each product)
TXV (Indoor)	Yes	Yes
Liquid Line Solenoid at Outdoor	No	Yes*
Inverted Refrigerant Trap at Indoor	No	No
Oil Trap at Indoor	Yes**	Yes**

** An oil trap at the indoor unit is required if the elevation difference exceeds 80'. The trap can be constructed of standard refrigerant fitting (See Figure 2-1).

* Liquid line solenoid not required if non-bleed TXV is used on the outdoor unit.

SERVICING

1. Suction line must be sloped continuously towards the indoor unit.
2. The maximum elevation (vertical) difference between the outdoor unit and indoor unit is 200 ft. for single stage heat pump (Figure 1.6).
3. Inverted suction loop is not required at either unit.
4. An accumulator is not required for air conditioners (accumulators are factory installed on heat pumps).

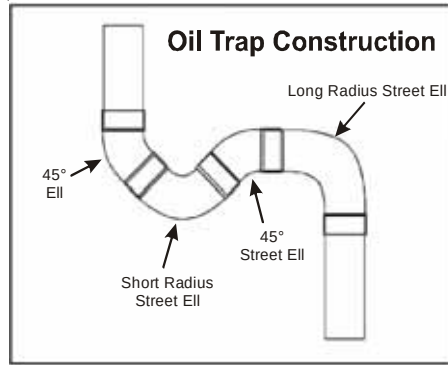


Figure 2-1. Oil Trap

SECTION 3. CALCULATIONS - TUBING EQUIVALENT LENGTH, TUBE SIZE AND REFRIGERANT

1. In long line applications the “equivalent line length” is the sum of the straight length portions of the suction line plus losses (in equivalent length) from 45 and 90 degree bends. Add the total straight (lineal) length of tubing to the equivalent length of elbows and bends to get total equivalent length.

$$\text{Equivalent length} = \text{Length}_{\text{Horizontal}} + \text{Length}_{\text{Vertical}} + \text{Losses from bends (see Table 3-1)}$$

2. Table 3-1 lists the equivalent length gained from adding bends to the suction line. Properly size the suction line to minimize capacity loss.

Type of Elbow Fitting	Inside Diameter (inches)		
	3/4	7/8	1 1/8
90° short radius	1.7	2	2.3
90° long radius	1.5	1.7	1.6
45°	0.7	0.8	1

Table 3-1. Losses from Suction Line Elbows (equivalent length, ft.)

EXAMPLE: 3/4” suction line using 3/4” elbows

$$150 \text{ feet of straight tubing} + (\text{four short radius elbows} \times 1.7) + (2 \text{ long radius elbows} \times 1.5) = 150 + 3.4 + 3 = 156.4 \text{ equivalent feet}$$

3. Table 3-2 lists multiplier values to recalculate system cooling capacity as a function of a system’s equivalent line length (as calculated from the suction line) and the selected suction tube size.

NOTE: Select the proper suction tube size based on equivalent length of the suction line (see Tables 3-1 and 3-2) and recalculated system capacity.

SERVICING

Table 3-2. Capacity Multipliers

Unit (Btu)	Suction Dia. (in)	Capacity Multiplier for Given Length (ft) ¹									
		25	50	75	100	125	150	175	200	225	250
18000	1/2	0.99	0.97	0.96	0.94	0.94	0.93	0.93	0.92	0.91	0.89
	5/8	1.00	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.97	0.97
	3/4	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99
24000	5/8	0.99	0.99	0.98	0.98	0.97	0.97	0.97	0.96	0.95	0.95
	3/4	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.97	0.97
	7/8	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99
30000	5/8	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.94	0.93	0.92
	3/4	1.00	1.00	0.99	0.99	0.99	0.98	0.88	0.98	0.98	0.97
	7/8	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99
36000	5/8	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.88
	3/4	1.00	1.00	0.99	0.99	0.98	0.98	0.97	0.97	0.96	0.96
	7/8	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.98	0.98
42000	3/4	1.00	0.99	0.99	0.98	0.97	0.97	0.96	0.96	0.95	0.94
	7/8	1.00	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.97
	1 1/8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
48000	3/4	0.99	0.99	0.98	0.97	0.96	0.96	0.95	0.95	0.94	0.93
	7/8	1.00	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.97	0.97
	1 1/8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99
60000	3/4	0.99	0.98	0.97	0.96	0.94	0.93	0.93	0.91	0.90	0.89
	7/8	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.94	0.95	0.95
	1 1/8	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99

TABLE 3-2. Capacity Multipliers

¹ Equivalent length is to be used for capacity multiplier reduction

4. **Refrigerant Quantity Adjustment.** All residential R-410A outdoor units are factory charged for 15 feet of line set. To calculate the initial amount of extra refrigerant (in ounces):
- Subtract 15 feet from the total linear (not equivalent) length of actual line set
 - Multiply that value by 0.6 (oz. per foot) of R-410A refrigerant
 - This will be the initial amount of R-410A refrigerant that must be added prior to final charge adjustment.

All systems must have final charge adjustment performed as required in Section 1. In most residential applications a minimal amount of additional refrigerant will be needed to account for the volume in the suction line. For some applications using 1 1/8" suction line and/or over 150 feet of lineal length, approximately 3 pounds of additional refrigerant may be needed to account for the suction line.

For a more precise calculation of refrigerant needs use Table 3-3. The additional refrigerant for given line lengths can be found in Table 3-4.

$$R_A (\text{oz.}) = (L_A - 15) \text{ ft.} \times 0.6 \text{ oz./ft.}$$

Where:

R_A = Initial additional refrigerant needed

L_A = Actual lineal line set length

SERVICING

Line set sizes	Additional Refrigerant (oz. per lineal foot)
3/8" liquid only	0.60
3/8" liquid and 5/8" suction	0.63
3/8" liquid and 3/4" suction	0.67
3/8" liquid and 7/8" suction	0.74
3/8" liquid and 1 1/8" suction	0.78

Table 3-3. Additional Refrigerant Per Foot.

	Additional lineal line length over 15 feet						
	25	50	75	100	125	150	175
	Initial refrigerant addition (oz.)						
3/8" liquid line only	15	30	45	60	75	90	105
3/8" liquid line & 5/8" suction line	16	32	47	63	79	95	110
3/8" liquid line & 3/4" suction line	17	34	50	67	84	101	117
3/8" liquid line & 7/8" suction line	18	35	53	70	88	105	123
3/8" liquid line & 1-1/8" suction line	20	39	59	78	98	117	137

Table 3-4. Initial Refrigerant for Given Line Length

S-202 DUCT STATIC PRESSURES AND/OR STATIC PRESSURE DROP ACROSS COILS

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-203 SINGLE PIECE AIR HANDLER EXTERNAL STATIC

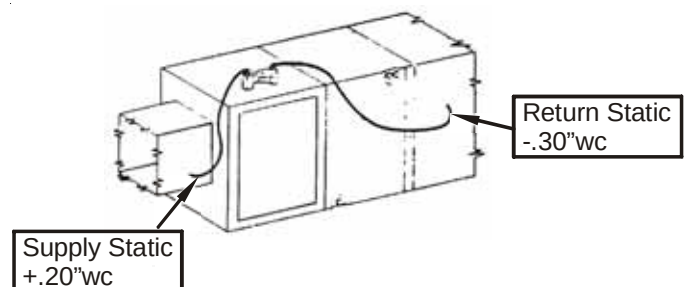
To determine proper airflow, proceed as follows:

1. Using a Inclined Manometer or Magnehelic gauge , measure the static pressure of the return duct at the inlet of the air handler, this will be a negative pressure (for example-.30"wc)
2. Measure the static pressure of the supply duct at the outlet of the air handler, this should be a positive pressure (for example .20"wc).

3. Add the two readings together (for example -.30"wc + .20"wc = .50"wc total external static pressure.

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

4. Consult proper air handler airflow chart for quantity of air (CFM) at the measured external static pressure.



TOTAL EXTERNAL STATIC

SERVICING

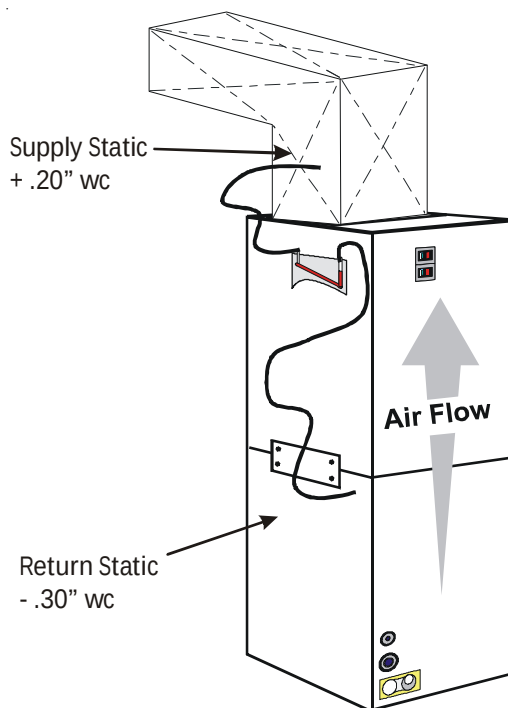
S-203A TWO PIECE AIR HANDLER EXTERNAL STATIC PRESSURE

To determine proper airflow, proceed as follows:

1. Using a Inclined Manometer or Magnehelic gauge, measure the static pressure between the outlet of the evaporator coil and the inlet of the air handler, this will be a negative pressure (for example $-.30''\text{wc}$)
2. Measure the static pressure of the supply duct at the outlet of the unit, this should be a positive pressure (for example $.20''\text{wc}$).
3. Add the two readings together (for example $-.30''\text{wc} + .20''\text{wc} = .50''\text{wc}$ total static pressure.

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

4. Consult proper air handler airflow chart for quantity of air (CFM) at the measured external static pressure.



TOTAL EXTERNAL STATIC

ACCESSORIES WIRING DIAGRAMS

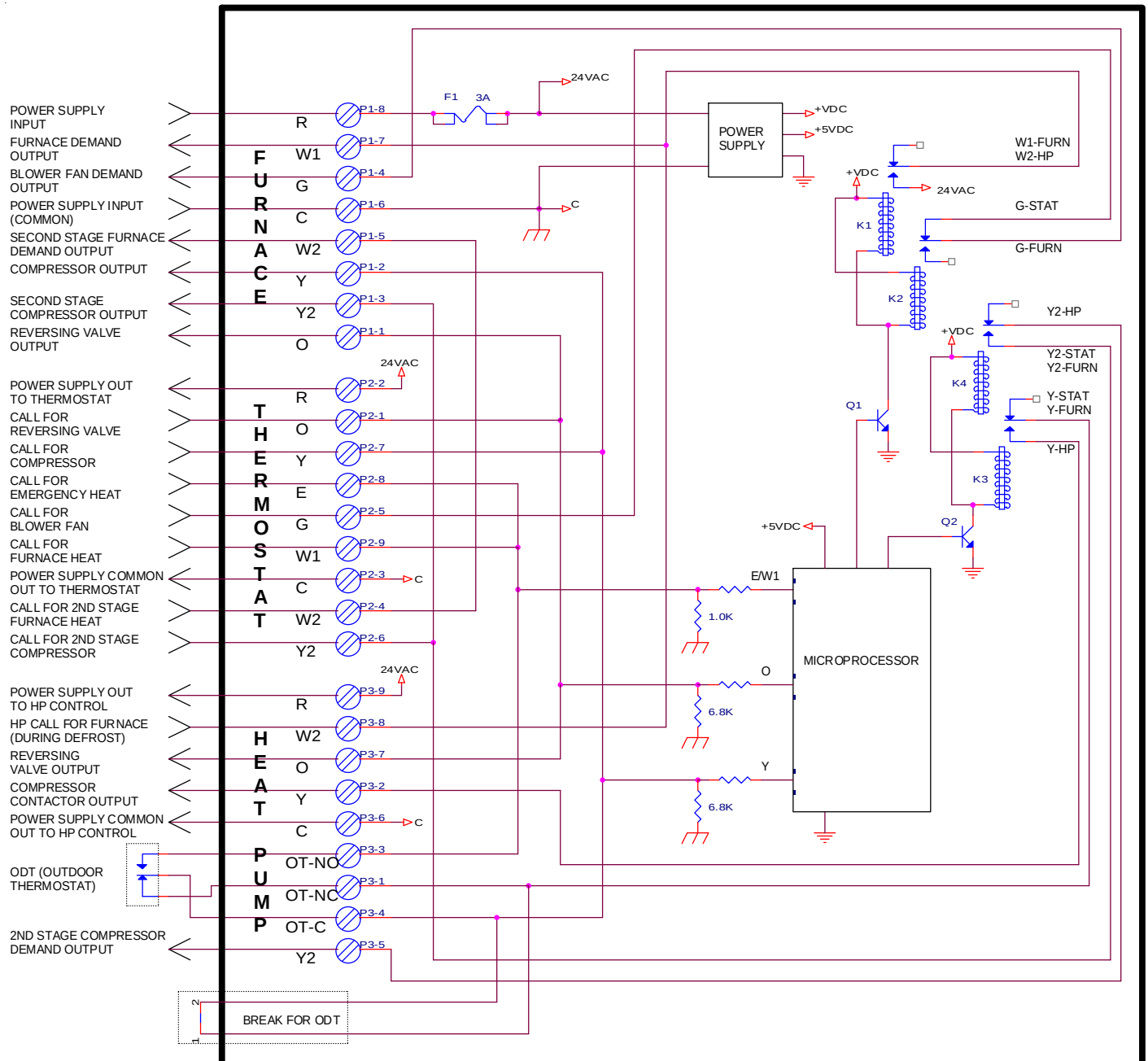


WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



ALL FUEL SYSTEM AFE18-60A CONTROL BOARD



ALL FUEL CONTROL BOARD - AFE18-60A

This wiring diagram is for reference only. Not all wiring is as shown above.

Refer to the appropriate wiring diagram for the unit being serviced.

(For use with Heat Pumps in conjunction with 80% or 90% Single-Stage or Two-Stage Furnaces)

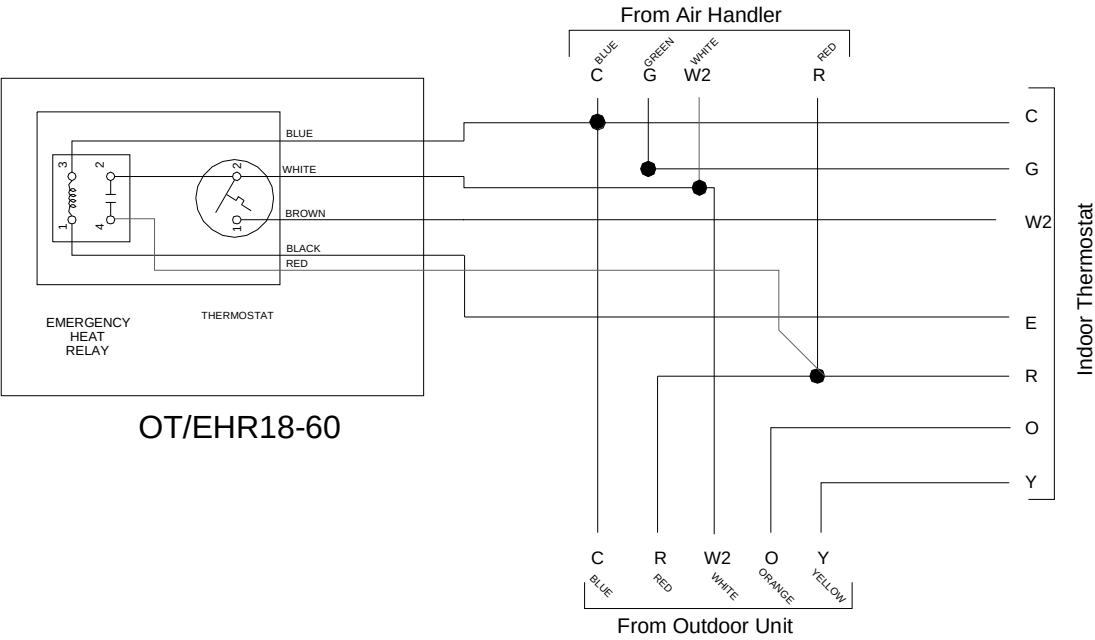
ACCESSORIES WIRING DIAGRAMS

**WARNING**

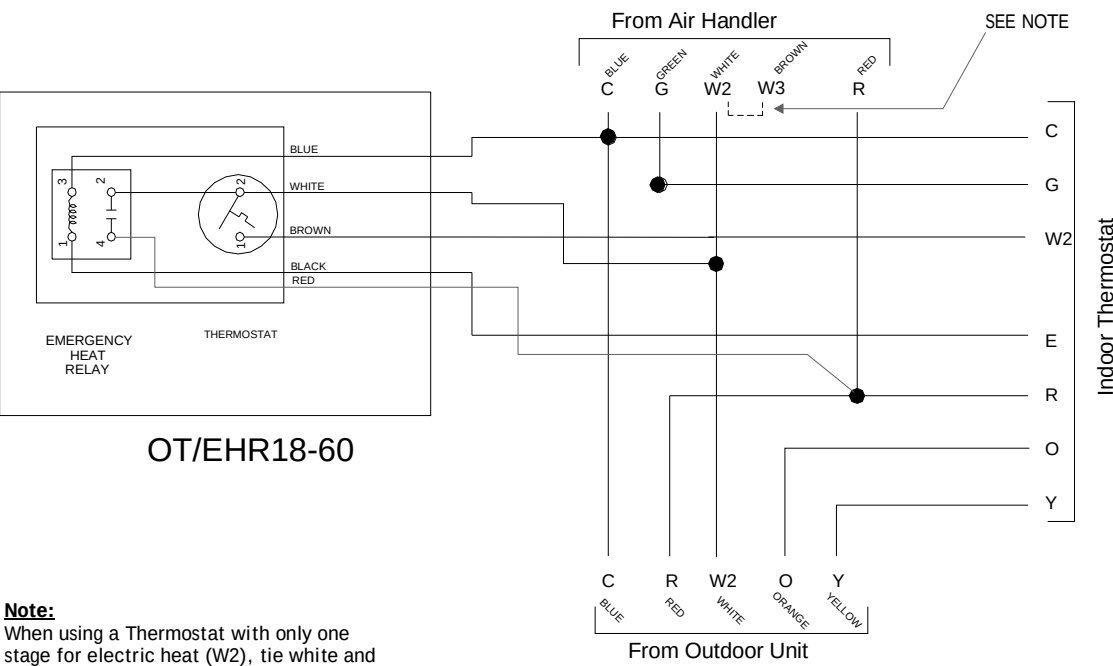
HIGH VOLTAGE!
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10kw and Below, One Stage Electric Heat



15kw and Above, Two Stage Electric Heat



Note:
When using a Thermostat with only one stage for electric heat (W2), tie white and brown wires from air handler together.

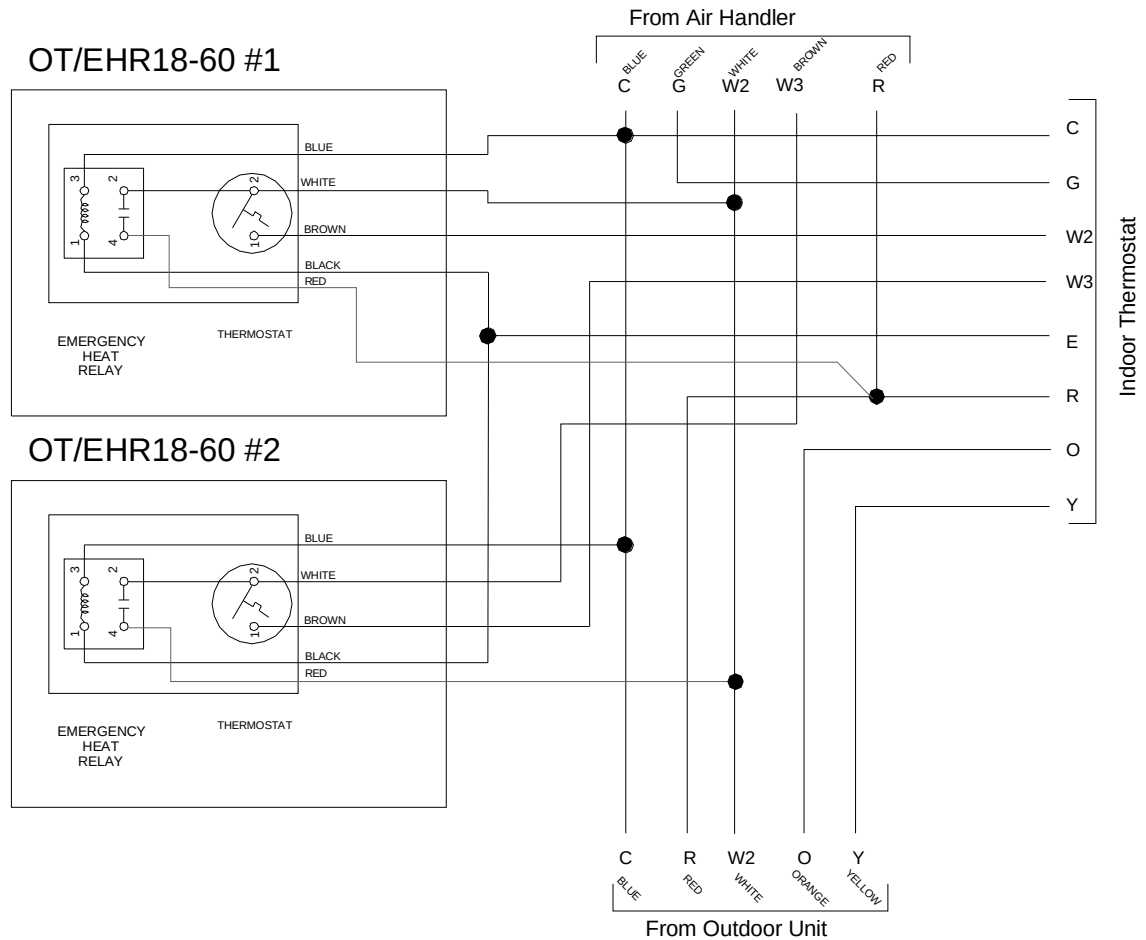
Typical Wiring Schematics for OT/EHR18-60 (Outdoor Thermostat & Emergency Heat Relay).
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

ACCESSORIES WIRING DIAGRAMS

WARNING

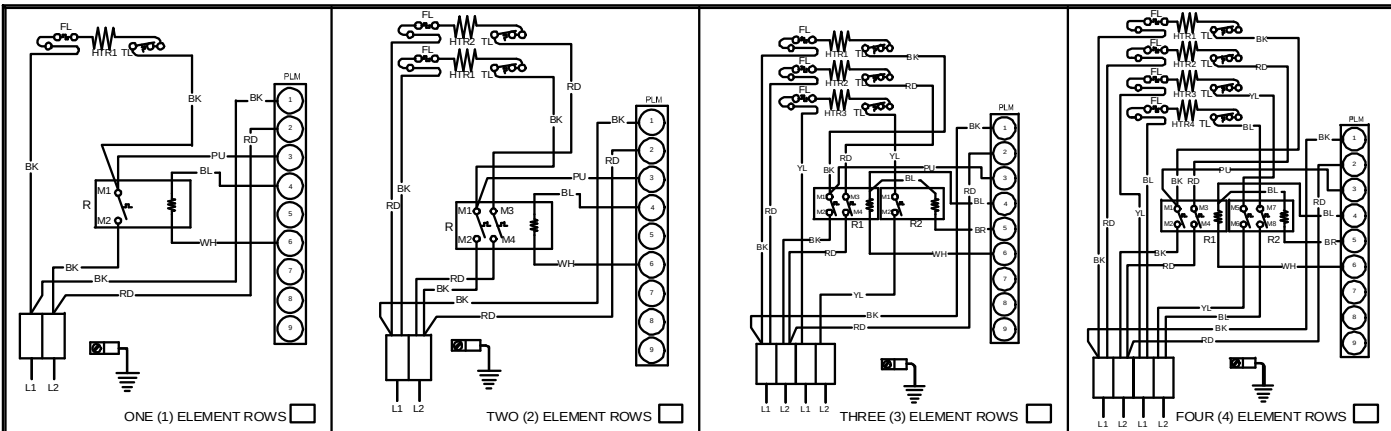
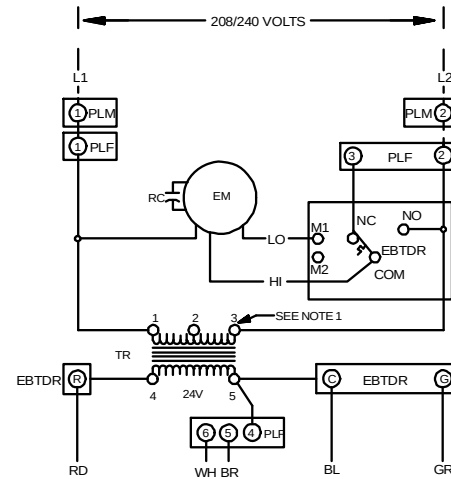
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15kw and Above with Two OT/EHR18-60's, Two Stage Electric Heat and Two Stage Thermostat



Typical Wiring Schematics for OT/EHR18-60 (Outdoor Thermostat & Emergency Heat Relay).
 This wiring diagram is for reference only. Not all wiring is as shown above.
 Refer to the appropriate wiring diagram for the unit being serviced.

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[illegible]

<u>COLOR CODE</u>		<u>WIRING CODE</u>
BK _ BLACK	GR _ GREEN	FACTORY WIRING
RD _ RED	PU _ PURPLE	HIGH VOLTAGE _____
YL _ YELLOW	BR _ BROWN	LOW VOLTAGE _____
BL _ BLUE	WH _ WHITE	FIFI D WIRING

COMPONENT CODE	LOW VOLTAGE	NOTE 2
EM	EVAPORATOR MOTOR	TR TRANSFORMER
RC	RUN CAPACITOR	PLF FEMALE PLUG CONNECTOR
SR	STRAIN RELIEF	PLM MALE PLUG CONNECTOR
R	RELAY	FL FUSE LINK
TDR	ELECTRONIC BLOWER TIME	TL THERMAL LIMIT
	DELAY RELAY	HTR HEAT ELEMENTS

Notes:

- 1) Red wires to be on transformer terminal "3" for 240 volts and on terminal "2" for 208 volts
- 2) See composite wiring diagrams in installation instructions for proper low voltage wiring connections.
- 3) Confirm speed tap selected is appropriate for application. If speed tap needs to be changed, connect appropriate motor wire (Red for low, Blue for medium, and Black for high speed) on "COM" connection of the EBTDR.
- 4) Inactive motor wires should be connected to "M1 or M2" on EBTDR.
- 5) Brown and white wires are used with Heat Kits only.
- 6) EBTDR has a 7 second on delay when "G" is energized and a 65 second off delay when "G" is de-energized.

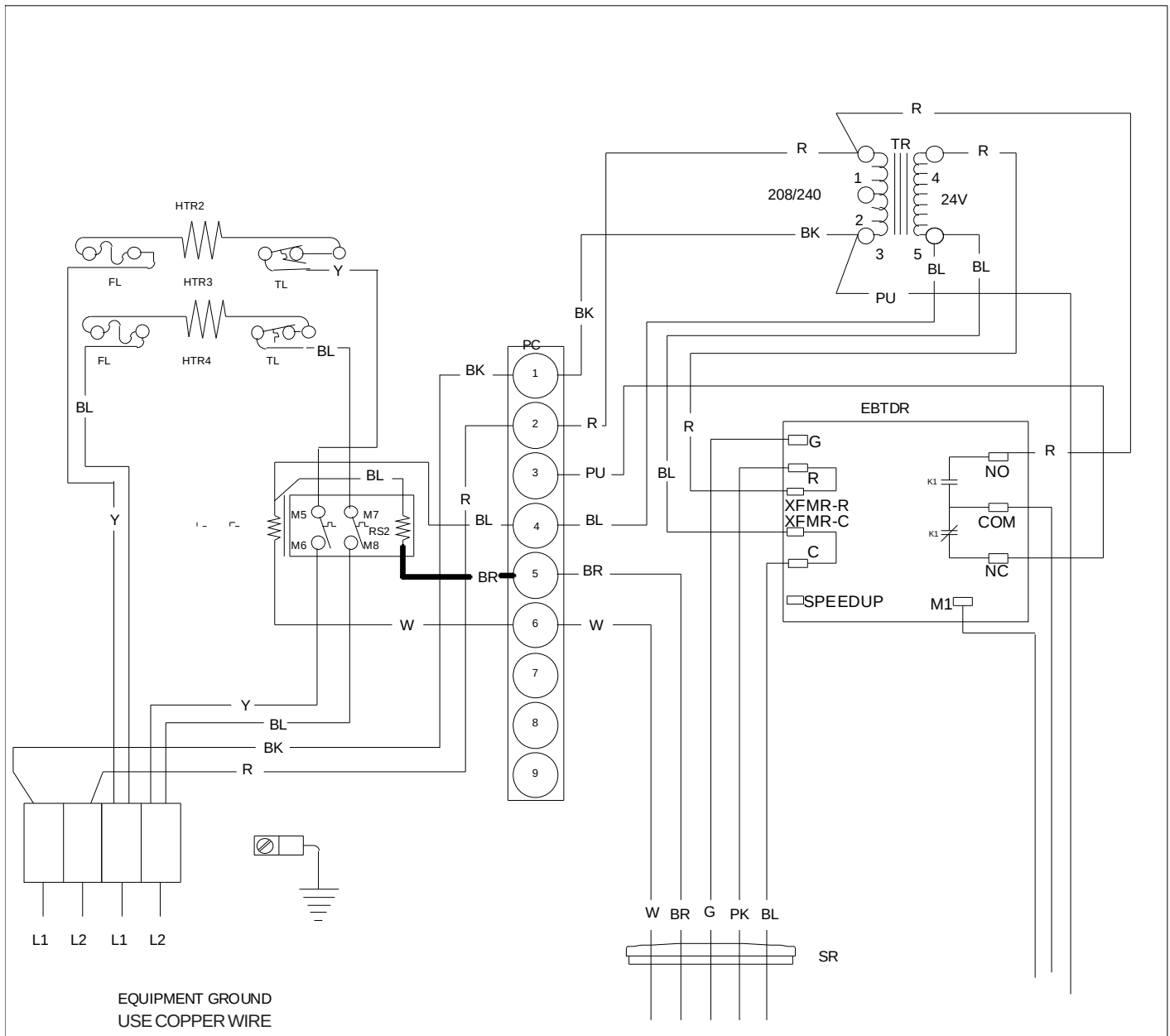
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ACCESSORIES WIRING DIAGRAMS

WARNING

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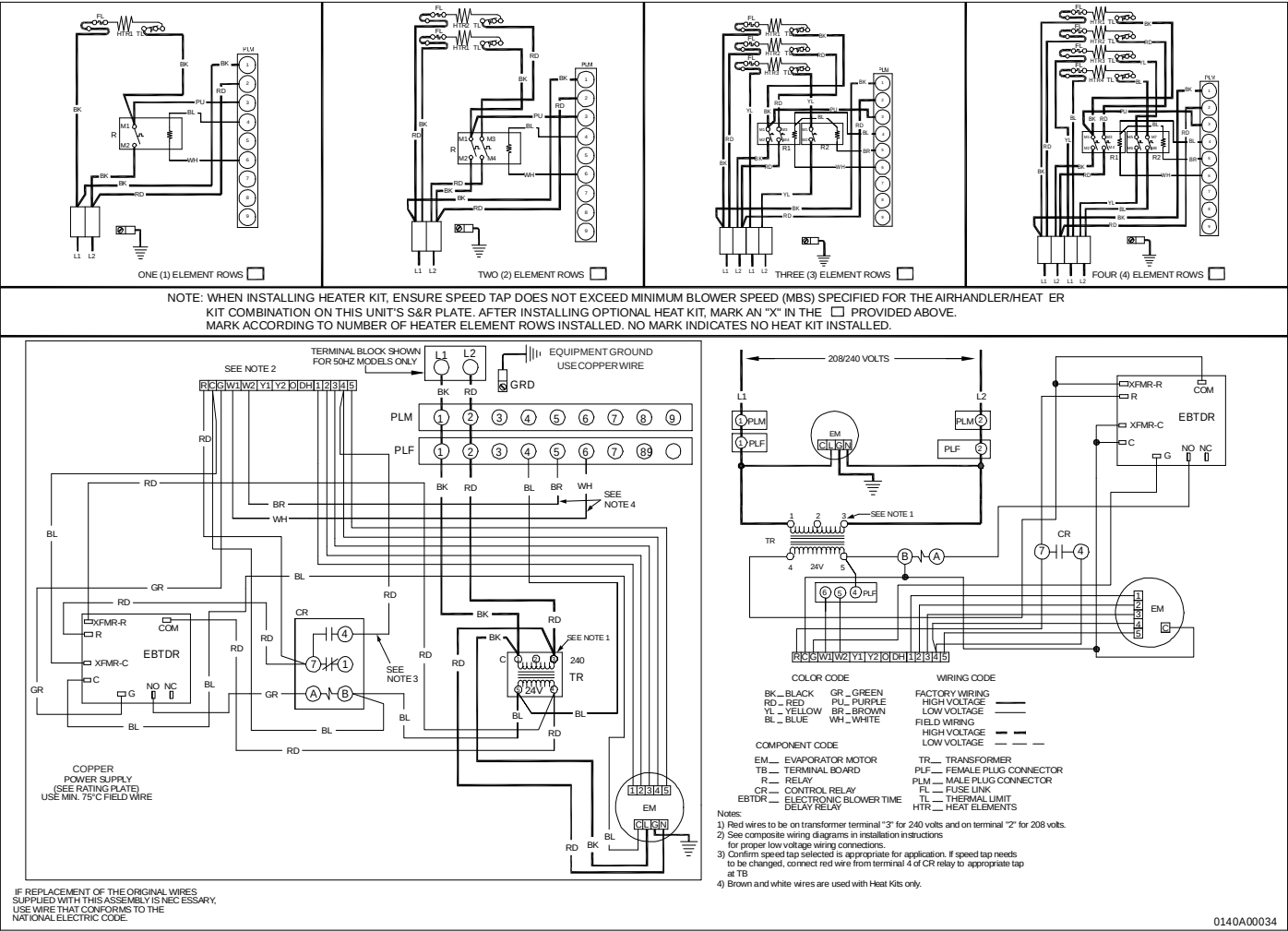


Typical Wiring Schematic MBR Blower with Electric Heat.
 This wiring diagram is for reference only. Not all wiring is as shown above.
 Refer to the appropriate wiring diagram for the unit being serviced.

ACCESSORIES WIRING DIAGRAMS

**WARNING**

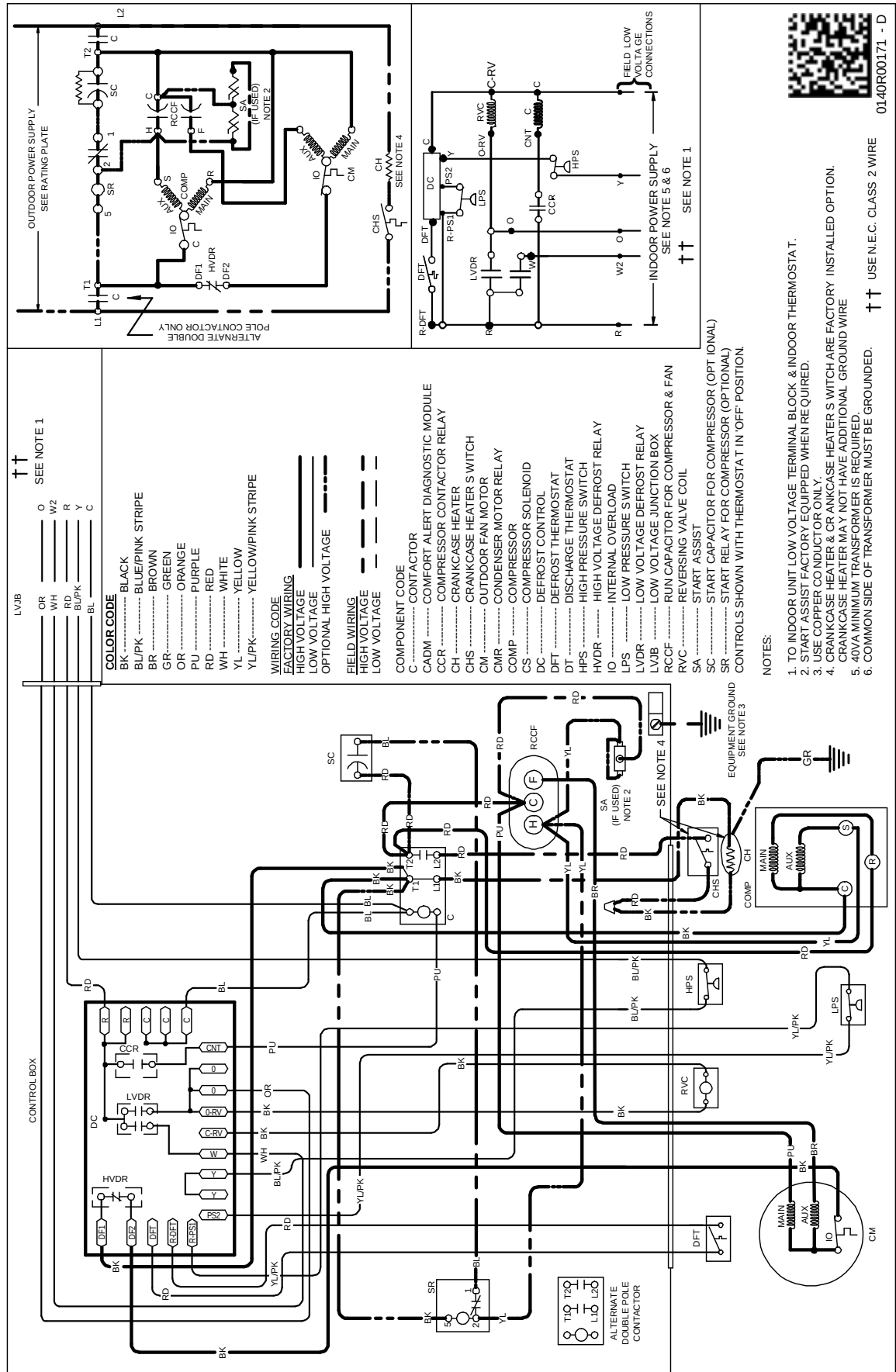
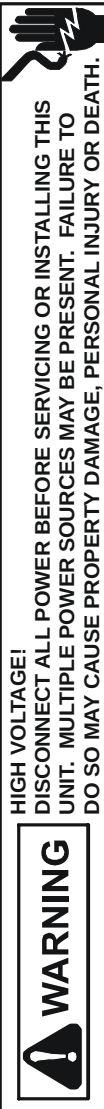
HIGH VOLTAGE!
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Typical Wiring Schematic ASPF with Electric Heat.
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

WIRING DIAGRAMS

GSZ130[19-37]1A* / GSZ130251B* / GSZ140[191, 251, 311, 371]AA

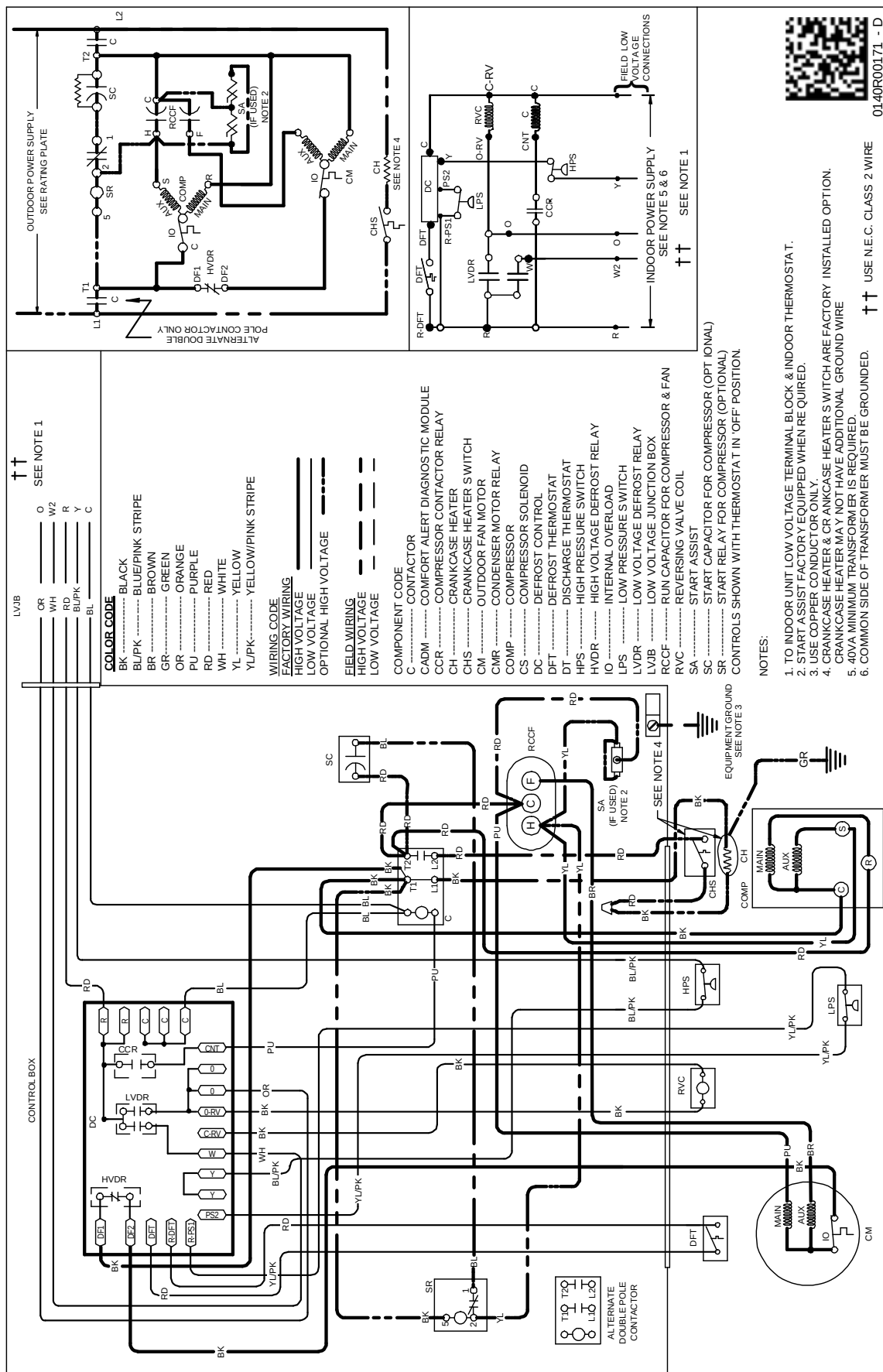


Wiring is subject to change, always refer to the wiring diagram on the unit for the most up-to-date wiring.

WARNING

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