CONDENSING UNIT

SINGLE / THREE PHASE HEAT PUMPS
INSTALLATION & SERVICE REFERENCE

© 2010-2012 Goodman Manufacturing Company, L.P.
5151 San Felipe, Suite 500, Houston, TX 77056
www.goodmanmfg.com -or- www.amana-hac.com
P/N: IO-403D Date: May 2012

NOTICE

THIS UNIT IS SHIPPED WITH A NITROGEN/HELIUM HOLDING CHARGE ONLY. UNIT MUST BE EVACUATED AND CHARGED PER INSTALLATION INSTRUCTIONS WITH REFRIGERANT LISTED ON SERIAL RATING PLATE.

NOTICE

UNITS SHIPPED WITH A HOLDING CHARGE ARE INTENDED FOR COMPONENT REPLACEMENT ONLY ON EXISTING SYSTEMS, AND NOT INTENDED FOR USE IN NEW SYSTEMS OR NEWLY CONSTRUCTED HOMES. EPA REGULATIONS PROHIBIT THE SALE OR DISTRIBUTION OF APPLIANCES PRE-CHARGED WITH THE REFRIGERANT R-22 IF THOSE APPLIANCES ARE MANUFACTURED AFTER JANUARY 1, 2010. COMPONENTS OF EXISTING R-22 SYSTEMS MAY BE REPAIRED AND/OR REPLACED.

NOTICE

UNITS MUST ONLY BE USED AS REPLACEMENT COMPONENTS FOR PRE-2010 INSTALLED SYSTEMS.

See unit rating plate for initial charge.

Important Safety Instructions

The following symbols and labels are used throughout this manual to indicate immediate or potential safety hazards. It is the owner's and installer's responsibility to read and comply with all safety information and instructions accompanying these symbols. Failure to heed safety information increases the risk of personal injury, property damage, and/or product damage.

WARNING

HIGH VOLTAGE!

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

WARNING

<u>ONLY</u> individuals meeting (at a minimum) the requirements of an "Entry Level Technician" as specified by the Air-Conditioning, Heating and Refrigeration Institute (AHRI) may use this information. Attempting to install or repair this unit without such background may result in product damage, personal injury, or death.

CAUTION

Scroll equipped units should never be used to evacuate the air conditioning system. Vacuums this low can cause internal electrical arcing resulting in a damaged or failed compressor.

Important Note to the Owner Regarding Product Warranty

Your warranty certificate is supplied as a separate document with the unit installed by your contractor. Read the limited warranty certificate carefully to determine what is and is not covered and keep the warranty certificate in a safe place. If you are unable to locate the warranty certificate please contact your installing contractor or contact customer service (877-254-4729) to obtain a copy.

Shipping Inspection

Always keep the unit upright; laying the unit on its side or top may cause equipment damage. Shipping damage, and subsequent investigation is the responsibility of the carrier. Verify the model number, specifications, electrical characteristics, and accessories are correct prior to installation. The distributor or manufacturer will not accept claims from dealers for transportation damage or installation of incorrectly shipped units.

Codes & Regulations

This product is designed and manufactured to comply with national codes. Installation in accordance with such codes and/or prevailing local codes/regulations is the responsibility of the installer. The manufacturer assumes no responsibility for equipment installed in violation of any codes or regulations. Rated performance is achieved after 72 hours of operation.

The United States Environmental Protection Agency (EPA) has issued various regulations regarding the introduction and disposal of refrigerants. Failure to follow these regulations may harm the environment and can lead to the imposition of substantial fines. Should you have any questions please contact the local office of the EPA.

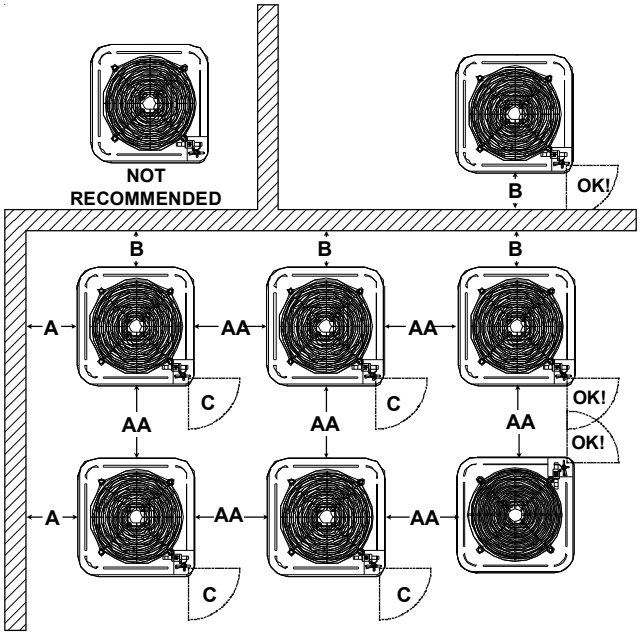
If replacing a condensing unit or air handler, the system must be manufacturer approved and Air Conditioning, Heating and Refrigeration Institute (AHRI) matched. **NOTE:** Installation of unmatched systems is strongly discouraged.

Operating the unit in a structure that is not complete (either as part of new construction or renovation) will void the warranty.

Installation Clearances

Special consideration must be given to location of the condensing unit(s) in regard to structures, obstructions, other units, and any/all other factors that may interfere with air circulation. Where possible, the top of the unit should be completely unobstructed; however, if vertical conditions require placement beneath an obstruction **there should be a minimum of 60 inches between the top of the unit and the obstruction(s).** The specified dimensions meet requirements for air circulation only. Consult all appropriate regulatory codes prior to determining final clearances.

Another important consideration in selecting a location for the unit(s) is the angle to obstructions. Either side adjacent the valves can be placed toward the structure provided the side away from the structure maintains minimum service clearance. Corner installations are strongly discouraged.



Minimum Airflow Clearance				
Model Type	**A**	**B**	**C**	**AA**
Residential	10"	10"	18"	20"
Light Commercial	12"	12"	18"	24"

This unit can be located at ground floor level or on flat roofs. At ground floor level, the unit must be on a solid, level foundation that will not shift or settle. To reduce the possibility of sound transmission, the foundation slab should not be in contact with or be an integral part of the building foundation. Ensure the foundation is sufficient to support the unit. A concrete slab raised above ground level provides a suitable base.

Rooftop Installations

If it is necessary to install this unit on a roof structure, ensure the roof structure can support the weight and that proper consideration is given to the weather-tight integrity of the roof. Since the unit can vibrate during operation, sound vibration transmission should be considered when installing the unit. Vibration absorbing pads or springs can be installed between the condensing unit legs or frame and the roof mounting assembly to reduce noise vibration.

NOTE: These units require special location consideration in areas of heavy snow accumulation and/or areas with prolonged continuous subfreezing temperatures. Heat pump unit bases have cutouts under the outdoor coil that permit drainage of frost accumulation. Situate the unit to permit free unobstructed drainage of the defrost water and ice. A minimum 3" clearance under the outdoor coil is required in the milder climates.

In more severe weather locations, it is recommended that the unit be elevated to allow unobstructed drainage and air flow. The following elevation minimums are recommended:

Design Temperature	Suggested Minimum Elevation
+15° and above	2 1/2"
-5° to +14°	8"
below -5°	12"

Safe Refrigerant Handling

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

WARNING

To avoid possible injury, explosion or death, practice safe handling of refrigerants.

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, throughly ventilate the area before beginning work.**
- **Liquid refrigerant can be very cold. To avoid possible frostbite or blindness, avoid contact 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

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. 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.

Refrigerant Lines

⚠ CAUTION

The compressor mineral oil for R-22 units is susceptible to moisture absorption and could cause compressor failure. Do not leave system open to atmosphere any longer than necessary for installation.

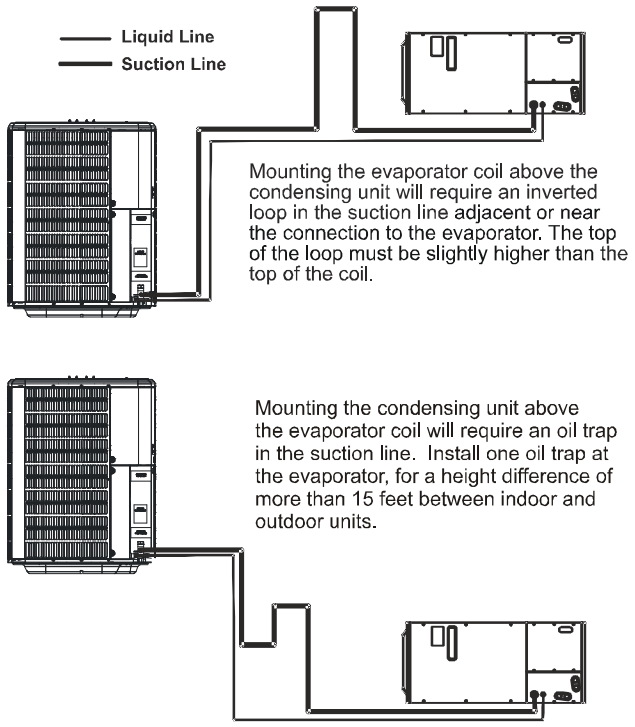
Use only refrigerant grade (dehydrated and sealed) copper tubing to connect the condensing unit with the indoor evaporator. After cutting the tubing, install plugs to keep refrigerant tubing clean and dry prior to and during installation. Tubing should always be cut square keeping ends round and free from burrs. Clean the tubing to prevent contamination.

Do NOT let refrigerant lines come in direct contact with plumbing, ductwork, floor joists, wall studs, floors, and walls. When running refrigerant lines through a foundation or wall, openings should allow for sound and vibration absorbing material to be placed or installed between tubing and foundation. Any gap between foundation or wall and refrigerant lines should be filled with a pliable silicon-based caulk, RTV or a vibration damping material. Avoid suspending refrigerant tubing from joists and studs with rigid wire or straps that would come in contact with the tubing. Use an insulated or suspension type hanger. Keep both lines separate and always insulate the suction line.

These sizes are recommended for line lengths of 79 feet or less. For other line sizing options or runs of more than fifty feet, refer to Remote Cooling Service Manual, or TP-106 Long Line Set Application R-22, or contact your distributor for assistance.

RECOMMENDED INTERCONNECTING TUBING (Ft)						
Cond Unit Tons	0-24		25-49		50-79*	
	Line Diameter (In. OD)					
	Suct	Liq	Suct	Liq	Suct	Liq
1 1/2	5/8	1/4	3/4	3/8	3/4	3/8
2	5/8	1/4	3/4	3/8	3/4	3/8
2 1/2	5/8	1/4	3/4	3/8	7/8	3/8
3	3/4	3/8	7/8	3/8	1 1/8	3/8
3 1/2	7/8	3/8	1 1/8	3/8	1 1/8	3/8
4	7/8	3/8	1 1/8	3/8	1 1/8	3/8
5	7/8	3/8	1 1/8	3/8	1 1/8	3/8

* Lines greater than 79 feet in length or vertical elevation changes more than 50 feet **refer to the Remote Cooling Service Manual or contact your distributor for assistance.**



Insulation is necessary to prevent condensation from forming and dropping from the suction line. Armflex (or satisfactory equivalent) with 3/8" min. wall thickness is recommended. In severe conditions (hot, high humidity areas) 1/2" insulation may be required. Insulation must be installed in a manner which protects tubing from damage and contamination.

Where possible, drain as much residual compressor oil from existing systems, lines, and traps; pay close attention to low areas where oil may collect. **NOTE:** If changing refrigerant types, ensure the indoor coil and metering device is compatible with the type of refrigerant being used; otherwise, the indoor coil must be replaced.

Burying Refrigerant Lines

If burying refrigerant lines can not be avoided, use the following checklist.

1. Insulate liquid and suction lines separately.
2. Enclose all underground portions of the refrigerant lines in waterproof material (conduit or pipe) sealing the ends where tubing enters/exits the enclosure.
3. If the lines must pass under or through a concrete slab, ensure lines are adequately protected and sealed.

Refrigerant Line Connections

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NOTICE

UNITS MUST ONLY BE USED AS REPLACEMENT COMPONENTS FOR PRE-2010 INSTALLED SYSTEMS.

NOTE: Holding charge must be removed before brazing. Open service valves slowly to remove holding charge. Close valves before brazing to prevent contaminants from entering system.

IMPORTANT

To avoid overheating the service valve, TXV valve, or filter drier while brazing, wrap the component with a wet rag, or use a thermal heat trap compound. Be sure to follow the manufacturer's instruction when using the heat trap compound. Note: Remove Schrader valves from service valves before brazing tubes to the valves. Use a brazing alloy of 2% minimum silver content. Do not use flux.

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.

1. The ends of the refrigerant lines must be cut square, deburred, cleaned, and be round and free from nicks or dents. Any other condition increases the chance of a refrigerant leak.
2. "Sweep" the refrigerant line with nitrogen or inert gas during brazing to prevent the formation of copper-oxide inside the refrigerant lines. This may cause a blockage or failure of the metering device.
3. After brazing, quench the joints with water or a wet cloth to prevent overheating of the service valve.
4. Ensure the filter drier paint finish is intact after brazing. If the paint of the steel filter drier has been burned or chipped, repaint or treat with a rust preventative. This is especially important on suction line filter driers which are continually wet when the unit is operating.

NOTE: Be careful not to kink or dent refrigerant lines. Kinked or dented lines will cause poor performance or compressor damage.

Do NOT make final refrigerant line connection until plugs are removed from refrigerant tubing.

NOTE: Before brazing, verify indoor piston size by checking the piston kit chart packaged with indoor unit.

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.

System Evacuation

Condensing unit liquid and suction valves are closed to contain the charge within the unit. The unit is shipped with the valve stems closed and caps installed.

WARNING

REFRIGERANT UNDER PRESSURE!
Failure to follow proper procedures may cause property damage, personal injury or death.

NOTE: Scroll compressors should never be used to evacuate or pump down a heat pump or air conditioning system.

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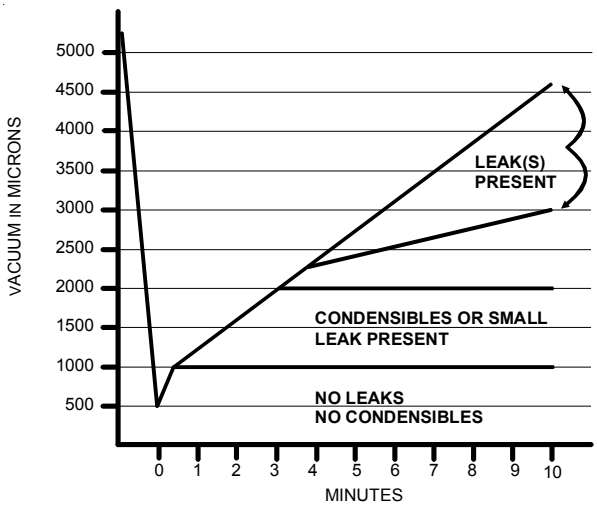
NOTE: Holding charge must be removed before brazing.

CAUTION

Prolonged operation at suction pressures less than 20 psig for more than 5 seconds will result in overheating of the scrolls and permanent damage to the scroll tips, drive bearings and internal seal.

1. Open service valves before attaching vacuum pump.
2. Connect the vacuum pump with 250 micron capability to the service valves.
3. Evacuate the system to 250 microns or less using suction **and** liquid service valves. Using both valves is necessary as some compressors create a mechanical seal separating the sides of the system.
4. Close pump valve and hold vacuum for 10 minutes. Typically pressure will rise during this period.



- If the pressure rises to 1000 microns or less and remains steady the system is considered leak-free; proceed to startup.
- If pressure rises above 1000 microns but holds steady below 2000 microns, moisture and/or noncondensibles may be present or the system may have a small leak. Return to step 2: If the same result is encountered check for leaks as previously indicated and repair as necessary then repeat evacuation.
- If pressure rises above 2000 microns, a leak is present. Check for leaks as previously indicated and repair as necessary then repeat evacuation.

Electrical Connections

WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death due to electric shock. Wiring must conform with NEC or CEC and all local codes. Undersized wires could cause poor equipment performance, equipment damage or fire.

WARNING

To avoid the risk of fire or equipment damage, use copper conductors.

NOTICE

UNITS WITH RECIPROCATING COMPRESSORS AND NON-BLEED TXV'S REQUIRE A HARD START KIT.

The condensing unit rating plate lists pertinent electrical data necessary for proper electrical service and overcurrent protection. Wires should be sized to limit voltage drop to 2% (max.) from the main breaker or fuse panel to the condensing unit. Consult the NEC, CEC, and all local codes to determine the correct wire gauge and length.

Local codes often require a disconnect switch located near the unit; do not install the switch on the unit. Refer to the installation instructions supplied with the indoor furnace/air handler for specific wiring connections and indoor unit configuration. Likewise, consult the instructions packaged with the thermostat for mounting and location information.

Overcurrent Protection

The following overcurrent protection devices are approved for use.

- Time delay fuses
- HACR type circuit breakers

These devices have sufficient time delay to permit the motor-compressor to start and accelerate its load.

Three Phase Compressor Rotation

CAUTION

Use care when handling scroll compressors. Dome temperatures could be hot.

Three phase compressors are power phase dependent and can rotate in either direction.

Verify proper rotation for three phase compressors by ensuring the suction pressure drops and discharge pressure rises when the compressor is energized. **NOTE:** When operated in reverse, a three phase scroll compressors is noisier and its current draw substantially reduced compared to marked values.

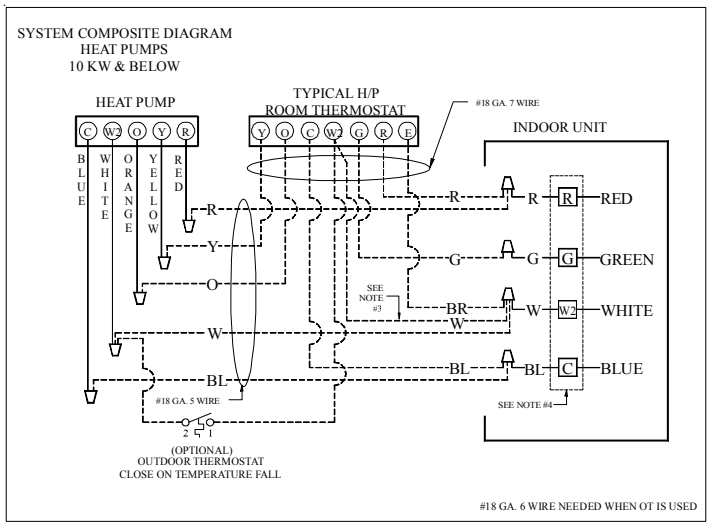
To correct, disconnect power and switch any two leads at the unit contactor and re-observe.

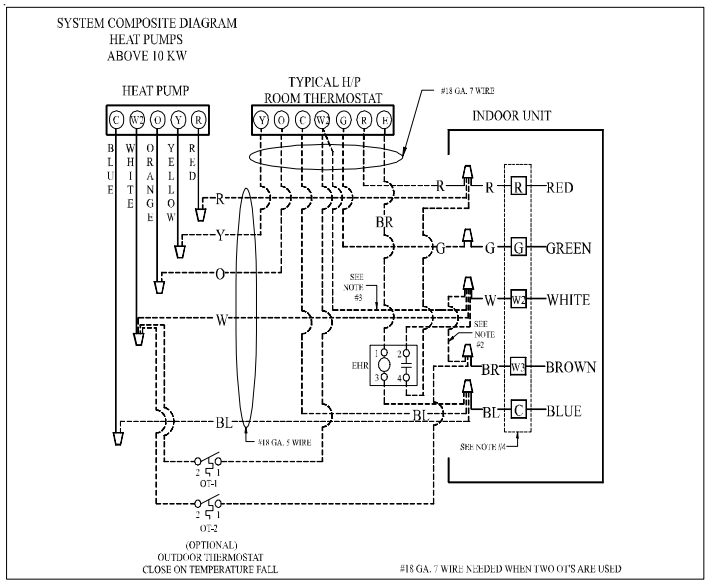
High Voltage Connections

Route power supply and ground wires through the high voltage port and terminate in accordance with the wiring diagram provided inside the control panel cover.

Low Voltage Connections

Condensing unit control wiring requires 24 Volt minimum, 25VA service from the indoor transformer. Route control wires through the low voltage port and terminate in accordance with the wiring diagram provided inside the control panel cover.





NOTES:
1) OUTDOOR THERMOSTAT (OT-1) SHOULD BE THE FIRST TO CLOSE AND THE LAST TO OPEN.
2) CONNECT WHITE AND BROWN WIRES FROM AIR-HANDLER TOGETHER IF OT-2 IS NOT USED.
3) REMOVE WIRE WHEN USING OUTDOOR THERMOSTAT
4) TERMINAL BLOCK MARKINGS ARE FOR AMANA AIRHANDLERS.

NOMENCLATURE
OT -–OUTDOOR THERMOSTAT (OPTIONAL)
EHR -EMERGENCY HEAT RELAY (OPTIONAL)

COLOR CODES
R --RED O --ORANGE
Y –YELLOW W -WHITE
BL-BLUE G --GREEN
BR-BROWN

Thermostat
with Low Voltage Wires to Heat Pump Unit

System Start Up

CAUTION

POSSIBLE REFRIGERANT LEAK
To avoid a possible refrigerant leak, open the service valves until the top of the stem is 1/8” from the retainer.

When opening valves with retainers, open each valve only until the top of the stem is 1/8” from the retainer. To avoid loss of refrigerant, DO NOT apply pressure to the retainer. When opening valves without a retainer remove service valve cap and insert a hex wrench into the valve stem and back out the stem by turning the hex wrench counterclockwise. Open the valve until it contacts the rolled lip of the valve body.

NOTE: These are not back-seating valves. It is not necessary to force the stem tightly against the rolled lip.

The service valve cap is the secondary seal for the valves and must be properly tightened to prevent leaks. Make sure cap is clean and apply refrigerant oil to threads and sealing surface on inside of cap. Tighten cap finger-tight and then tighten additional 1/6 of a turn (1 wrench flat), or to the following specification, to properly seat the sealing surfaces.

1. 3/8” valve to 5 - 10 in-lbs
2. 5/8” valve to 5 - 20 in-lbs
3. 3/4” valve to 5 - 20 in-lbs
4. 7/8” valve to 5 - 20 in-lbs

Do not introduce liquid refrigerant from the cylinder into the crankcase of the compressor as this may damage the compressor.

CAUTION

POSSIBLE REFRIGERANT LEAK
To avoid a possible refrigerant leak, open the service valves until the top of the stem is 1/8" from the retainer.

NOTICE

REFRIGERANT MUST BE ADDED TO THE SYSTEM AFTER EVACUATION IS COMPLETE.

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.

1. Add refrigerant amount for the unit being installed. *See unit rating plate for initial charge.*
2. Set thermostat to call for cooling. Check indoor and outdoor fan operation and allow system to stabilize for 10 minutes for fixed orifices and 20 minutes for expansion valves.

Charge Verification

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.

CAUTION

Use refrigerant certified to AHRI standards. Use of used refrigerant may cause compressor damage that is not covered under warranty. Most portable machines cannot clean used refrigerant to meet AHRI standards.

NOTICE

VIOLATION OF EPA REGULATIONS MAY RESULT IN FINES OR OTHER PENALTIES

CAUTION

Operating the compressor with the suction valve closed may cause serious compressor damage.

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, check subcooling and superheat as detailed in the following section.

SYSTEM SUPERHEAT

Ambient Condenser Inlet Temperature (°F Drybulb)	Return Air Temperature (50%RH)									
	Drybulb	Wetbulb	Drybulb	Wetbulb	Drybulb	Wetbulb	Drybulb	Wetbulb	Drybulb	Wetbulb
	65º	54º	70º	58º	75º	63º	80º	67º	85º	71º
115	---		---		---		---		5	
100	---		---		---		5		6	
95	---		---		5		5 *		9	
90	---		---		5		10		11	
85	---		5		5		12		17	
80	5		5		5		18		20	
75	5		5		10		20		22	
70	5		6		15		24		25	
65	5		10		20		25		29	
60	8		15		21		28		31	

NOTE: * Charge 5° super heat, all other could be ± 2°F

SATURATED SUCTION PRESSURE TEMPERATURE CHART	
SUCTION PRESSURE	SATURATED SUCTION TEMPERATURE ºF
PSIG	R-22
50	26
52	28
54	29
56	31
58	32
60	34
62	35
64	37
66	38
68	40
70	41
72	42
74	44
76	45
78	46
80	48
85	50
90	53
95	56
100	59
110	64
120	69
130	73
140	78
150	83
160	86
170	90

SATURATED LIQUID PRESSURE TEMPERATURE CHART	
LIQUID PRESSURE	SATURATED LIQUID TEMPERATURE ºF
PSIG	R-22
200	101
210	105
220	108
225	110
235	113
245	116
255	119
265	121
275	124
285	127
295	130
305	133
325	137
355	144
375	148
405	155
415	157
425	n/a
435	n/a
445	n/a
475	n/a
500	n/a
525	n/a
550	n/a
575	n/a
600	n/a
625	n/a

Fixed Orifice

CAUTION

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

1. Purge gauge lines. Connect service gauge manifold to base-valve service ports. Run system at least 10 minutes to allow pressure to stabilize.
2. For best results, temporarily install a thermometer on the suction line near the compressor. The thermometer should be located within 4" to 6" of the compressor. Ensure the thermometer makes adequate contact and is insulated.

   NOTE: An optional, less accurate, method is to locate the thermometer at the suction line service valve. Ensure the thermometer makes adequate contact and is insulated.
3. Refer to the superheat table provided for proper system superheat. Add charge to lower superheat or recover charge to raise superheat.
4. Disconnect manifold set, installation is complete.

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

Expansion Valve System

1. Purge gauge lines. Connect service gauge manifold to base-valve service ports. Run system at least 10 minutes to allow pressure to stabilize.
2. Temporarily install thermometer on liquid (small) line near liquid line service valve with adequate contact and insulate for best possible reading.
3. Check subcooling and superheat. Systems with TXV application should have a subcooling of 7 ± 2 ºF and superheat of 8 ± 1 ºF.
   a. If subcooling and superheat are low, **adjust** TXV to 7 to 9 ºF superheat, then check subcooling.

      NOTE: To adjust superheat, turn the valve stem clockwise to increase and counter clockwise to decrease.
   b. If subcooling is low and superheat is high, **add** charge to raise subcooling to 7 ± 2ºF then check superheat.
   c. If subcooling and superheat are high, **adjust** TXV valve to 8 ± 1 ºF superheat, then check subcooling.
   d. If subcooling is high and superheat is low, **adjust** TXV valve to 8 ± 1 ºF superheat and **remove** charge to lower the subcooling to 7 ± 2ºF.

   NOTE: Do **NOT** adjust the charge based on suction pressure unless there is a gross undercharge.
4. Disconnect manifold set, installation is complete.

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

NOTE: Check the Schrader ports for leaks and tighten valve cores if necessary. Install caps finger-tight.

Heat Pump - Heating Cycle

The proper method of charging a heat pump in the heat mode is by weight with the additional charge adjustments for line size, line length, and other system components.

Troubleshooting Information

Complaint	No Cooling							Unsatisfactory Cooling/Heating								System Operating Pressures				Test Method Remedy
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
Blown Fuse	●		●	●																Inspect Fuse Size & Type
Unbalanced Power, 3PH		●				●	●													Test Voltage
Loose Connection	●			●		●														Inspect Connection - Tighten
Shorted or Broken Wires	●	●	●	●	●	●														Test Circuits With Ohmmeter
Open Fan Overload				●	●															Test Continuity of Overload
Faulty Thermostat	●		●	●					●											Test Continuity of Thermostat & Wiring
Faulty Transformer	●		●																	Check Control Circuit with Voltmeter
Shorted or Open Capacitor		●		●	●	●	●													Test Capacitor
Internal Compressor Overload Open		●											♦							Test Continuity of Overload
Shorted or Grounded Compressor		●				●														Test Motor Windings
Compressor Stuck		●				●	●						♦							Use Test Cord
Faulty Compressor Contactor			●		●	●														Test Continuity of Coil & Contacts
Faulty Fan Relay				●																Test Continuity of Coil And Contacts
Open Control Circuit				●																Test Control Circuit with Voltmeter
Low Voltage		●				●	●													Test Voltage
Faulty Evap. Fan Motor				●												●			♦	Repair or Replace
Shorted or Grounded Fan Motor					●														●	Test Motor Windings
Improper Cooling Anticipator							●		●											Check Resistance of Anticipator
Shortage of Refrigerant							●	●					♦			●	●			Test For Leaks, Add Refrigerant
Restricted Liquid Line							●	●								●	●		●	Remove Restriction, Replace Restricted Part
Open Element or Limit on Elec. Heater								♦					♦							Test Heater Element and Controls
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
Too much air across Indoor Coil																	♦	●		Reduce Blower Speed
Overcharge of Refrigerant						●	●					●	♦					●	●	Recover Part of Charge
Dirty Outdoor Coil						●	●			●						♦			●	Inspect Coil - Clean
Noncondensibles							●			●			♦						●	Recover Charge, Evacuate, Recharge
Recirculation of Condensing Air							●			●									●	Remove Obstruction to Air Flow
Infiltration of Outdoor Air								●		●	●									Check Windows, Doors, Vent Fans, Etc.
Improperly Located Thermostat						●			●											Relocate Thermostat
Air Flow Unbalanced									●		●									Readjust Air Volume Dampers
System Undersized								●		●										Refigure Cooling Load
Broken Internal Parts												●	♦							Replace Compressor
Broken Valves								●				●					●	●		Test Compressor Efficiency
Inefficient Compressor								●					♦				●	●		Test Compressor Efficiency
Wrong Type Expansion Valve						●	●	●		●						●	●		♦	Replace Valve
Expansion Device Restricted						●	●	●		●						●	●		●	Remove Restriction or Replace Expansion Device
Oversized Expansion Valve								●											●	Replace Valve
Undersized Expansion Valve						●	●	●		●						●				Replace Valve
Expansion Valve Bulb Loose												●						●		Tighten Bulb Bracket
Inoperative Expansion Valve						●		●								●				Check Valve Operation
Loose Hold-down Bolts												●								Tighten Bolts
Faulty Reversing Valve						●							♦	♦	♦		♦	♦	♦	Replace Valve or Solenoid
Faulty Defrost Control					●								♦	♦	♦	♦	♦		♦	Test Control
Faulty Defrost Thermostat													♦	♦	♦	♦	♦	♦	♦	Test Defrost Thermostat
Flowrator Not Seating Properly								●									●	●		Check Flowrator & Seat or Replace Flowrator

● Cooling or Heating Cycle (Heat Pump) ♦ Heating Cycle Only (Heat Pump)

For detailed service information refer to the Remote Condensing Unit Service manual.

NOTICE

UNITS WITH ROTARY OR RECIPROCATING COMPRESSORS AND NON-BLEED TXV'S REQUIRE A HARD START KIT.

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SPLIT SYSTEMS

AIR CONDITIONING AND HEAT PUMP HOMEOWNER'S ROUTINE MAINTENANCE RECOMMENDATIONS

We strongly recommend a bi-annual maintenance checkup be performed before the heating and cooling seasons begin by a ***qualified servicer****.*

Replace or Clean Filter

IMPORTANT NOTE: Never operate unit without a filter installed as dust and lint will build up on internal parts resulting in loss of efficiency, equipment damage and possible fire.

An indoor air filter must be used with your comfort system. A properly maintained filter will keep the indoor coil of your comfort system clean. A dirty coil could cause poor operation and/or severe equipment damage.

Your air filter or filters could be located in your furnace, in a blower unit, or in "filter grilles" in your ceiling or walls. The installer of your air conditioner or heat pump can tell you where your filter(s) are, and how to clean or replace them.

Check your filter(s) at least once a month. When they are dirty, replace or clean as required. Disposable type filters should be replaced. Reusable type filters may be cleaned.

You may want to ask your dealer about high efficiency filters. High efficiency filters are available in both electronic and non-electronic types. These filters can do a better job of catching small airborne particles.

Compressor

The compressor motor is hermetically sealed and does not require additional oiling.

Motors

Indoor and outdoor fan motors are permanently lubricated and do not require additional oiling.

Clean Outside Coil (Qualified Servicer Only)

WARNING

HIGH VOLTAGE!

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

Air must be able to flow through the outdoor unit of your comfort system. Do not construct a fence near the unit or build a deck or patio over the unit without first discussing your plans with your dealer or other qualified servicer. Restricted airflow could lead to poor operation and/or severe equipment damage.

Likewise, it is important to keep the outdoor coil clean. Dirt, leaves, or debris could also restrict the airflow. If cleaning of the outdoor coil becomes necessary, hire a qualified servicer. Inexperienced people could easily puncture the tubing in the coil. Even a small hole in the tubing could eventually cause a large loss of refrigerant. Loss of refrigerant can cause poor operation and/or severe equipment damage.

Do not use a condensing unit cover to "protect" the outdoor unit during the winter, unless you first discuss it with your dealer. Any cover used must include "breathable" fabric to avoid moisture buildup.

BEFORE CALLING YOUR SERVICER

- Check the thermostat to confirm that it is properly set.
- Wait 15 minutes. Some devices in the outdoor unit or in programmable thermostats will prevent compressor operation for awhile, and then reset automatically. Also, some power companies will install devices which shut off air conditioners for several minutes on hot days. If you wait several minutes, the unit may begin operation on its own.

CAUTION

TO AVOID THE RISK OF EQUIPMENT DAMAGE OR FIRE, INSTALL THE SAME AMPERAGE BREAKER OR FUSE AS YOU ARE REPLACING. IF THE CIRCUIT BREAKER OR FUSE SHOULD OPEN AGAIN WITHIN THIRTY DAYS, CONTACT A QUALIFIED SERVICER TO CORRECT THE PROBLEM.
IF YOU REPEATEDLY RESET THE BREAKER OR REPLACE THE FUSE WITHOUT HAVING THE PROBLEM CORRECTED, YOU RUN THE RISK OF SEVERE EQUIPMENT DAMAGE.

- Check the electrical panel for tripped circuit breakers or failed fuses. Reset the circuit breakers or replace fuses as necessary.
- Check the disconnect switch near the indoor furnace or blower to confirm that it is closed.
- Check for obstructions on the outdoor unit . Confirm that it has not been covered on the sides or the top. Remove any obstruction that can be safely removed. If the unit is covered with dirt or debris, call a qualified servicer to clean it.
- Check for blockage of the indoor air inlets and outlets. Confirm that they are open and have not been blocked by objects (rugs, curtains or furniture).
- Check the filter. If it is dirty, clean or replace it.
- Listen for any unusual noise(s), other than normal operating noise, that might be coming from the outdoor unit. If you hear unusual noise(s) coming from the unit, call a qualified servicer.

CONDENSING UNIT

3-PHASE 7.5 & 10 TON HEAT PUMP
INSTALLATION & SERVICE REFERENCE

© 2010-2012 Goodman Manufacturing Company, L.P.
5151 San Felipe, Suite 500, Houston, TX 77056
www.goodmanmfg.com -or- www.amana-hac.com
P/N: IO-405C Date: May 2012

NOTICE

THIS UNIT IS SHIPPED WITH A NITROGEN/HELIUM HOLDING CHARGE ONLY. UNIT MUST BE EVACUATED AND CHARGED PER INSTALLATION INSTRUCTIONS WITH REFRIGERANT LISTED ON SERIAL RATING PLATE.

NOTICE

UNITS SHIPPED WITH A HOLDING CHARGE ARE INTENDED FOR COMPONENT REPLACEMENT ONLY ON EXISTING SYSTEMS, AND NOT INTENDED FOR USE IN NEW SYSTEMS OR NEWLY CONSTRUCTED HOMES.

NOTICE

UNITS MUST ONLY BE USED AS REPLACEMENT COMPONENTS FOR PRE-2010 INSTALLED SYSTEMS.

Important Safety Instructions

The following symbols and labels are used throughout this manual to indicate immediate or potential safety hazards. It is the owner's and installer's responsibility to read and comply with all safety information and instructions accompanying these symbols. Failure to heed safety information increases the risk of personal injury, property damage, and/or product damage.

WARNING

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

WARNING

<u>ONLY</u> individuals meeting the requirements of an "Entry Level Technician", at a minimum, as specified by the Air Conditioning, Heating and Refrigeration Institute (AHRI) may use this information. Attempting to install or repair this unit without such background may result in product damage, personal injury, or death.

CAUTION

Scroll equipped units should never be used to evacuate the air conditioning system. Vacuums this low can cause internal electrical arcing resulting in a damaged or failed compressor.

Shipping Inspection

Always keep the unit upright; laying the unit on its side or top may cause equipment damage. Shipping damage, and subsequent investigation is the responsibility of the carrier. Verify the model number, specifications, electrical characteristics, and accessories are correct prior to installation. The distributor or manufacturer will not accept claims from dealers for transportation damage or installation of incorrectly shipped units.

Codes & Regulations

This product is designed and manufactured to comply with national codes. Installation in accordance with such codes and/or prevailing local codes/regulations is the responsibility of the installer. The manufacturer assumes no responsibility for equipment installed in violation of any codes or regulations. Rated performance is achieved after 72 hours of operation.

The United States Environmental Protection Agency (EPA) has issued various regulations regarding the introduction and disposal of refrigerants. Failure to follow these regulations may harm the environment and can lead to the imposition of substantial fines. Should you have any questions please contact the local office of the EPA.

If replacing a condensing unit or air handler, the system must be manufacturer approved and Air Conditioning, Heating and Refrigeration Institute (AHRI) matched. **NOTE:** Installation of unmatched systems is strongly discouraged.

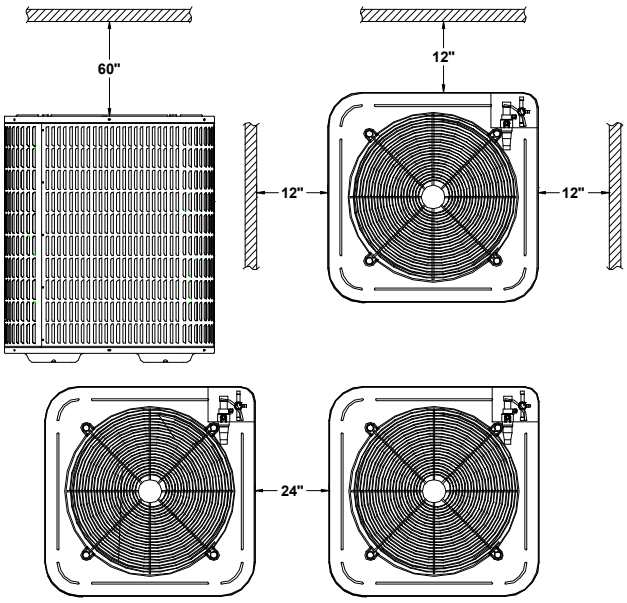
Operating the unit in a structure that is not complete (either as part of new construction or renovation) will void the warranty.

Refer to the unit Specification Sheet for the recommended indoor model selection. **NOTE:** This unit must be used with a purchased single stage room thermostat with 24 VAC control circuitry.

Installation Clearances

This unit is designed for outdoor installations only. Special consideration must be given to location of the condensing unit(s) in regard to structures, obstructions, other units, and any/all other factors that may interfere with air circulation. Where possible, the top of the unit should be completely unobstructed; however, if vertical conditions require placement beneath an obstruction **there should be a minimum of 60 inches between the top of the unit and the obstruction(s).** The specified dimensions meet requirements for air circulation only. Consult all appropriate regulatory codes prior to determining final clearances.

Another important consideration in selecting a location for the unit(s) is the angle to obstructions. Either side adjacent the valves can be placed toward the structure provided the side away from the structure maintains minimum service clearance. Corner installations are strongly discouraged.



This unit can be located at ground floor level or on flat roofs. At ground floor level, the unit must be on a solid, level foundation that will not shift or settle. To reduce the possibility of sound transmission, the foundation slab should not be in contact with or be an integral part of the building foundation. The foundation slab should be a minimum of 6” wider than the unit in all directions. Ensure the foundation is sufficient to support the unit. A concrete slab raised above ground level provides a suitable base.

The selected site should be no greater than 50’ below or 70’ above the evaporator section. For optimum performance, the minimum length interconnecting tubing is preferred. When possible minimize the amount of bends and turns.

Rooftop Installations

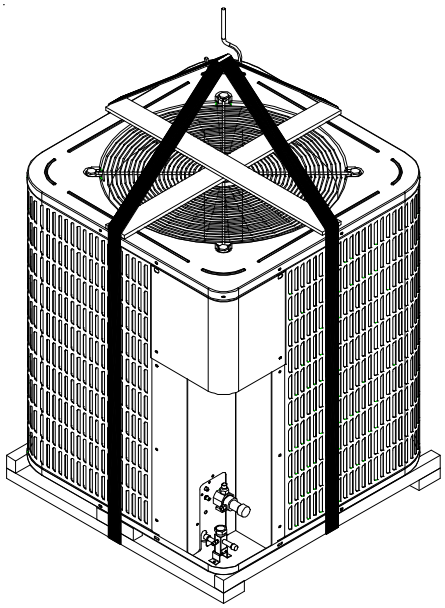
If it is necessary to install this unit on a roof structure, ensure the roof structure can support the weight and that proper consideration is given to the weather-tight integrity of the roof. Since the unit can vibrate during operation, sound vibration transmission should be considered when installing the unit. Vibration absorbing pads or springs can be installed between the condensing unit legs or frame and the roof mounting assembly to reduce noise vibration.

NOTE: These units require special location consideration in areas of heavy snow accumulation and/or areas with prolonged continuous subfreezing temperatures. Heat pump unit bases have cutouts under the outdoor coil that permit drainage of frost accumulation. Situate the unit to permit free unobstructed drainage of the defrost water and ice. A minimum 3" clearance under the outdoor coil is required in the milder climates.
In more severe weather locations, it is recommended that the unit be elevated to allow unobstructed drainage and air flow. The following elevation minimums are recommended:

Rigging

⚠ WARNING

To avoid possible injury or death, all panels must be in position and secured before lifting this equipment



Use field-supplied spreader bars when lifting the unit to minimize the possibility of lifting cable/straps damage. To protect the cabinet louvers, use protective material such as plywood behind the cable/straps. Arrange the straps to form a central suspension point. **NOTE:** When raising and setting the unit, observe all safety rules. Remove shipping skid and all protection and lifting material after the unit is in place.

Safe Refrigerant Handling

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

⚠ WARNING

To avoid possible injury, explosion or death, practice safe handling of refrigerants.

⚠ 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 frostbite or blindness, avoid contact 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

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. 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.

Refrigerant Lines

⚠ CAUTION

The compressor mineral oil for R-22 units is susceptible to moisture absorption and could cause compressor failure. Do not leave system open to atmosphere any longer than necessary for installation.

NOTE: For improved refrigerant management, equip the evaporator coil with a field-supplied thermal expansion valve (TXV) and the liquid line with a field-supplied liquid line solenoid. Ensure the solenoid is installed as close as possible to the evaporator coil to prevent refrigeration migration in the compressor "OFF" cycle.

Use only refrigerant grade (dehydrated and sealed) copper tubing to connect the condensing unit with the indoor evaporator. After cutting the tubing, install plugs to keep refrigerant tubing clean and dry prior to and during installation. Tubing should always be cut square keeping ends round and free from burrs. Clean the tubing to prevent contamination.

Do NOT let refrigerant lines come in direct contact with plumbing, ductwork, floor joists, wall studs, floors, and walls. When running refrigerant lines through a foundation or wall, openings should allow for sound and vibration absorbing material to be placed or installed between tubing and foundation. Any gap between foundation or wall and refrigerant lines should be filled with a pliable silicon-based caulk, RTV or a vibration damping material. Avoid suspending refrigerant tubing from joists and studs with rigid wire or straps that would come in contact with the tubing. Use an insulated or suspension type hanger. Keep both lines separate and always insulate the suction line.

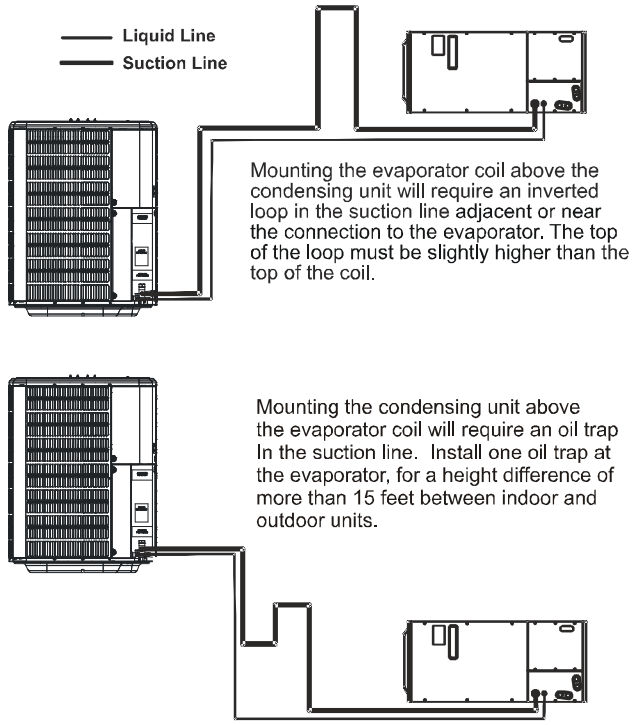
These sizes are suitable for line lengths of 74 feet or less. If a run of more than fifty feet is required, refer to Remote Cooling Service Manual, or TP-106 Long Line Set Application R-22, or contact your distributor for assistance.

Cond Unit (Tons)	REFRIGERANT LINE LENGTH (ft)					
	0-24		25-49*		50-74**	
	Line Diameter (In. OD)					
	Suct	Liq	Suct	Liq	Suct	Liq
7 1/2	1 1/8	5/8	1 3/8	5/8	1 3/8	5/8
10	1 3/8	5/8	1 5/8	5/8	1 5/8	5/8

* Full rating line size

** Lines greater than 74 feet in length or vertical elevation changes more than 50 feet **refer to the Remote Cooling Service Manual or contact your distributor for assistance.**

Refrigerant Lines



Insulation is necessary to prevent condensation from forming and dropping from the suction line. Armflex® (or satisfactory equivalent) with 3/8" min. wall thickness is recommended. In severe conditions (hot, high humidity areas) 1/2" insulation may be required. Insulation must be installed in a manner which protects tubing from damage and contamination.

Where possible, drain as much residual compressor oil from existing systems, lines, and traps; pay close attention to low areas where oil may collect.

NOTE: If changing refrigerant types, ensure the indoor coil and metering device is compatible with the type of refrigerant being used; otherwise, the indoor coil must be replaced. To facilitate oil return to the compressor, a horizontal suction line should be pitched (1/2" per 10' toward the condensing unit.

Filter Drier and Sight Glass

A liquid line filter drier is factory installed. Field-install the supplied sight glass/moisture indicator on the liquid line as close as practical to the service valve.

Burying Refrigerant Lines

If burying refrigerant lines can not be avoided, use the following checklist.

1. Insulate liquid and suction lines separately.

2. Enclose all underground portions of the refrigerant lines in waterproof material (conduit or pipe) sealing the ends where tubing enters/exits the enclosure.

3. If the lines must pass under or through a concrete slab, ensure lines are adequately protected and sealed.

Refrigerant Line Connections

NOTICE

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NOTICE

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NOTICE

UNITS MUST ONLY BE USED AS REPLACEMENT COMPONENTS FOR PRE-2010 INSTALLED SYSTEMS.

NOTE: Holding charge must be removed before brazing. Open service valves slowly to remove holding charge. Close valves before brazing to prevent contaminants from entering system.

IMPORTANT: To avoid overheating the service valve, TXV valve, or filter drier while brazing, wrap the component with a wet rag, or use a thermal heat trap compound as recommended by the compound manufacturer. Use a brazing alloy of 2% minimum silver content. Do not use flux.

1. The ends of the refrigerant lines must be cut square, deburred, cleaned, and be round and free from nicks or dents. Any other condition increases the chance of a refrigerant leak.

2. "Sweep" the refrigerant line with nitrogen or inert gas during brazing to prevent the formation of copper-oxide inside the refrigerant lines.

3. After brazing, quench the joints with water or a wet cloth to prevent overheating of the service valve.

4. Ensure the filter drier paint finish is intact after brazing. If the paint of the steel filter drier has been burned or chipped, repaint or treat with a rust preventative. This is especially important on suction line filter driers which are continually wet when the unit is operating.

NOTE: Be careful not to kink or dent refrigerant lines. Kinked or dented lines will cause poor performance or compressor damage.

Do NOT make final refrigerant line connection until plugs are removed from refrigerant tubing.

NOTE: Before brazing, verify indoor piston size by checking the piston kit chart packaged with indoor unit.

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.*

System Evacuation

Condensing unit liquid and suction valves are closed to contain the charge within the unit. The unit is shipped with the valve stems closed and caps installed.

WARNING

REFRIGERANT UNDER PRESSURE!

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

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NOTICE

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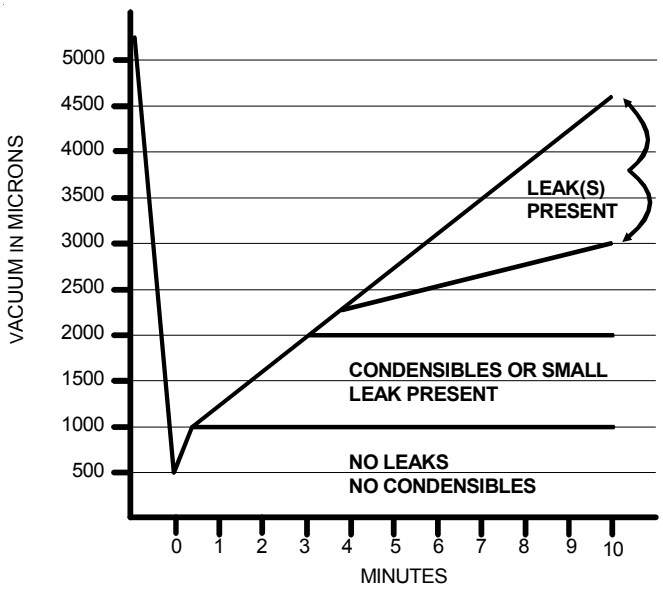
NOTE: Holding charge must be removed before brazing.

1. Openservice valves before attaching vacuum pump.
2. Connect the vacuum pump with 250 micron capability to the service valves.
3. Evacuate the system to 250 microns or less using suction **and** liquid service valves. Using both valves is necessary as some compressors create a mechanical seal separating the sides of the system.
4. Close pump valve and hold vacuum for 10 minutes. Typically pressure will rise during this period.



- If the pressure rises to 1000 microns or less and remains steady the system is considered leak-free; proceed to startup.
- If pressure rises above 1000 microns but holds steady below 2000 microns, moisture and/or noncondensibles may be present or the system may have a small leak. Return to step 2: If the same result is encountered check for leaks as previously indicated and repair as necessary then repeat evacuation.
- If pressure rises above 2000 microns, a leak is present. Check for leaks as previously indicated and repair as necessary then repeat evacuation.

Refer to the Remote Condensing Unit Service Manual for more detailed instructions on system evacuation, preliminary charge adjustment, and final charge adjustment.

Electrical Connections

WARNING

HIGH VOLTAGE!

Disconnect ALL power before servicing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death due to electric shock. Wiring must conform with NEC or CEC and all local codes. Undersized wires could cause poor equipment performance, equipment damage or fire.

WARNING

To avoid the risk of fire or equipment damage, use copper conductors.

NOTICE

Units with reciprocating compressors and non-bleed TXV's require a Hard Start Kit.

This unit is designed for three phase operation. DO NOT OPERATE ON A SINGLE PHASE POWER SUPPLY. Measure the power supply to the unit. The supply voltage **must** be in agreement with the unit rating plate power requirements and within the range listed below:

MODEL	MINIMUM SUPPLY VOLTAGE	MAXIMUM SUPPLY VOLTAGE
GSH100903	197	253
GSH100904	414	506
GSH101203	197	253
GSH101204	414	506

The condensing unit rating plate lists pertinent electrical data necessary for proper electrical service and overcurrent protection. Wires should be sized to limit voltage drop to 2% (max.) from the main breaker or fuse panel to the condensing unit. Consult the NEC, CEC, and all local codes to determine the correct wire gauge and length. The wire size must be sufficient to carry the Minimum Circuit Ampacity (MCA) listed on the serial plate and the following table:

MODEL	MCA
GSH100903	37.6
GSH100904	18.7
GSH101203	43.2
GSH101204	22.1

The supply voltage can be unbalanced (phase to phase) within 2%. The following formula can be used to determine the percentage of voltage unbalance for your unit.

$$\text{Percentage Voltage Unbalance} = 100 \times \frac{\text{Max. Voltage Deviation Form Average Voltage}}{\text{Average Voltage}}$$

Example:

L1-L2 = 220V
L2-L3 = 216V

Average Voltage = (220 + 216 + 213)/3
= 649/3

Maximum Deviation from Average = 220 - 216 = 4

% Voltage Unbalance = 100 x (4/216)
= 400/216

MAXIMUM ALLOWABLE LENGTH IN FEET TO LIMIT VOLTAGE DROP TO 2%

Wire Size (AWG)	Minimum Circuit Ampacity (MCA)							
	10	15	20	25	30	35	40	45
14	75	50	37	NR	NR	NR	NR	NR
12	118	79	59	47	NR	NR	NR	NR
10	188	125	95	75	63	54	NR	NR
8	301	201	150	120	100	86	75	68
6	471	314	235	188	157	134	118	110

*Based on NEC 1996

Example:
A GSH100903 is to be installed. The distance from the building to the unit is 75'. Calculate the minimum wire size assuming no more than 2% voltage drop.

MCA for GSH100903 = 43.3 (from S& R plate and table).

Applying previous table wire sizes less than #8 AWG cannot be used for circuits which have a rating of 45A. The #8 wire is not suitable since the maximum length for a 45A circuit is 68'.
Solution: Use a #6 AWG wire suitable up to 110'.

NOTE: It is the contractors's responsibility to follow the NEC(USA) or CEC (Canada) when sizing the service wire for this unit.

Local codes often require a disconnect switch located near the unit; do not install the switch on the unit. Refer to the installation instructions supplied with the indoor furnace/air handler for specific wiring connections and indoor unit configuration. Likewise, consult the instructions packaged with the thermostat for mounting and location information.

Overcurrent Protection

The following overcurrent protection devices are approved for use.

- Time delay fuses
- HACR type circuit breakers

These devices have sufficient time delay to permit the motor-compressor to start and accelerate its load.

Refer to the unit serial plate and this table for the maximum overcurrent protection permitted.

MODEL	*MAXIMUM FUSE
GSH100903	60
GSH100904	30
GSH101203	70
GSH101204	33

*Fuse or HACR of same value

Run all line voltage wiring a conduit from the service disconnect box to the unit. Refer to the NEC (USA) or CEC (Canada) codes for the correct size conduit based on the wire size. The conduit enters the control box through the hole provided in the bottom. **NOTE:** The control box hole is sized for 3/4" conduit. If permitted by code, a flexible conduit is preferred to minimize vibration transmission from the unit to the building.

Connect the line voltage wires to the L1, L2, and L3 terminals of the definite purpose contactor (located in the unit control box). Refer to the wiring diagram attached to the unit when making these connections.

Three Phase Compressor Rotation

CAUTION

Use care when handling scroll compressors. Dome temperatures could be hot.

Three phase scrolls are power phase dependent and can compress in more than one direction.

Verify proper rotation for three phase compressors by ensuring the suction pressure drops and discharge pressure rises when the compressor is energized. **NOTE:** When operated in reverse, a three phase scroll compressors is noisier and its current draw substantially reduced compared to marked values.

To correct, disconnect power and switch any two leads at the unit contactor and re-observe.

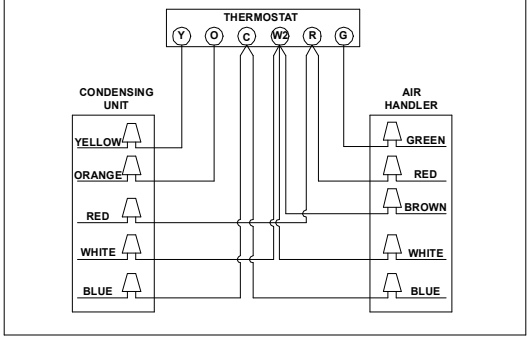
High Voltage Connections

Route power supply and ground wires through the high voltage port and terminate in accordance with the wiring diagram provided inside the control panel cover.

Low Voltage Connections

Condensing unit control wiring requires a five-conductor low voltage circuit from the room thermostat (without options). The wires should be no smaller than 18 AWG and the field connection for this circuit must be made in the unit control box using solderless connectors (i.e. wire nuts). See the following diagram for a typical low voltage hook-up.

SINGLE STAGE LOW VOLTAGE HOOK-UP



System Start Up

Never operate the compressor with the suction valve closed to test the compressor's pumping efficiency. In some cases, this can result in serious compressor damage and loss of warranty coverage.

NOTICE

THIS UNIT IS SHIPPED WITH A NITROGEN/HELIUM HOLDING CHARGE ONLY. UNIT MUST BE EVACUATED AND CHARGED PER INSTALLATION INSTRUCTIONS WITH REFRIGERANT LISTED ON SERIAL RATING PLATE.

NOTICE

UNITS SHIPPED WITH A HOLDING CHARGE ARE INTENDED FOR COMPONENT REPLACEMENT ONLY ON EXISTING SYSTEMS, AND NOT INTENDED FOR USE IN NEW SYSTEMS OR NEWLY CONSTRUCTED HOMES.

NOTICE

UNITS MUST ONLY BE USED AS REPLACEMENT COMPONENTS FOR PRE-2010 INSTALLED SYSTEMS.

For the 7-1/2 ton unit starting charge should be 15 lb of R-22 and 18 lbs for the 10 ton unit. The length of line set, indoor unit airflow, condensing unit location and number of tubing fittings will have an impact on final unit charge amount. Turn the electrical power on, and let the system run. Wait for the refrigerant pressures to stabilize.

Charge Verification

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.

CAUTION

Use refrigerant certified to AHRI standards. Use of used refrigerant may cause compressor damage that is not covered under warranty. Most portable machines cannot clean used refrigerant to meet AHRI standards.

NOTICE

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

CAUTION

Operating the compressor with the suction valve closed may cause serious compressor damage.

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, check subcooling and superheat as detailed in the following section.

Expansion Valve System

1. Purge gauge lines. Connect service gauge manifold tobase-valve service ports. Run system at least 10 minutes to allow pressure to stabilize.

2. Temporarily install thermometer on liquid (small) line near liquid line service valve with adequate contact and insulate for best possible reading.

3. Check subcooling and superheat. Systems with TXV application should have a subcooling of 11 ± 2 ºF and superheat of 9 ± 1 ºF.

   a. If subcooling and superheat are low, **adjust** TXV to 9 ± 1 ºF superheat, then check subcooling.

   NOTE: To adjust superheat, turn the valve stem clockwise to increase and counter clockwise to decrease.

   b. If subcooling is low and superheat is high, **add** charge to raise subcooling to 11 ± 2ºF then check superheat.

   c. If subcooling and superheat are high, **adjust** TXV valve to 9 ± 1 ºF superheat, then check subcooling.

   d. If subcooling is high and superheat is low, **adjust** TXV valve to 9 ± 1 ºF superheat and **remove** charge to lower the subcooling to 11 ± 2ºF.

   NOTE: Do **NOT** adjust the charge based on suction pressure unless there is a gross undercharge.

4. Disconnect manifold set, installation is complete.

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

NOTE: Check the Schrader ports for leaks and tighten valve cores if necessary. Install caps finger-tight.

System Charging Heating Mode. Measure the hot gas discharge at the compressor to check the system charge in heat mode.

1. Allow the system to operate for at least 20 minutes.
2. Attach and insulate an electronic thermometer to the hot gas discharge line mid way between the compressor and the reversing valve. **Note:** The thermometer is to be well insulated to prevent ambient influences.
3. Adjust the charge to maintain a clear sight glass.
4. Allow the compressor to operate for about 10 additional minutes and measure the hot gas discharge temperature.
5. Using an additional electronic thermometer, measure the ambient.
6. Adjust the charge until the hot gas temperature equals 105˚F + ambient (+ or – 5˚F). Remove charge to increase the temperature.

NOTE: When adjusting the charge, allow the compressor to operate for about 10 minutes before taking readings.

NOTE: Subsequent opening and replace of the cap will require only 1/2 to 1 hex flat. See the table below for the torque required for an effective seal on the valve bonnet (1/6 turn past finger tight.

TUBING SIZE	TORQUE (ft-lbs)
5/8	14
1 3/8	16

After closing the valve bonnet, perform a final refrigerant leak test on the valves and sweat connections. Return the room thermostat to the desired settings.

Defrost Control Adjustments

The GSH uses a Time/Temperature method for defrost. A thermal sensor electrically set to “Normally Open” is wired to the electronic defrost control located in the control box. The thermal sensor attached to the condenser coil determines the outdoor coil temperature.

Both coil temperature and compressor “run time” determine defrosting of the outdoor coil. Adjustments to the defrost timing selection can be changed from the 60 minute factory setting to either 30 or 90 minutes by moving the jumper on the defrost control. For the system to initiate a defrost, the following statements must be true:

- The Defrost Sensor is closed, and
- The compressor “run time” is equal to the timing selection on the defrost board.

During defrost the following actions occur:

1. The reversing valve is energized and the heat pump operates in the cooling mode.

NOTE: 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".

2. The airhandler auxiliary heat (if equipped) is activated.

3. The condenser fan motor is shut-off.

If the defrost cycle has not terminated after ten (12) minutes the control will override the defrost sensor and revert to a heating mode.

The defrost control has test pins which can be useful when troubleshooting in the heating mode. These test pins accelerate the compressor run time counter. The suggested method for accessing this feature is:

1. Run unit in heat mode.
2. Check unit for proper charge.

   NOTE: Bands of frost indicate low refrigerant charge.
3. Shut off power to unit.
4. Disconnect outdoor fan by removing the purple lead from the Condenser Fan Defrost Relay.
5. Restart unit and allow frost to accumulate.
6. After a few minutes the defrost thermostat should close. To verify the position of the thermostat check for 24V between "DFT" and "C" on the defrost board. Should the defrost thermostat fail to close after a heavy build-up of frost and the thermostat is less than 28°, the thermostat is to be replaced.
7. After the thermostat has closed, short across the test pins with the a screwdriver blade until the reversing valve shifts. This could take up to 22 seconds depending upon the position of the timing setting on the defrost board. Immediately upon the action of the reversing valve, remove the short. **Note:** If this short is not removed immediately, the defrost activity will last only 3 seconds.
8. After defrost has terminated (up to 12 minutes) check the defrost thermostat for 24V between "DFT" and "C". This reading should be 0V (open sensor).
9. Shut off power to the unit.
10. Replace outdoor fan motor wire removed in Step d.

NOTE: The compressor "run time' is accumulative during multiple heating cycles. The timer will reset to zero only when the defrost sensor returns to an open condition. If the room thermostat is operating in the "EM HT" mode, no accumulation of compressor time is recorded.

Troubleshooting (Qualified Installer/Servicer Only)

When troubleshooting, the first step should always be to check for clean coils, clean filter(s), and proper airflow. Indoor airflow should be 375 to 425 CFM per ton of cooling based on the size of the outdoor unit. The most common way of establishing indoor airflow is heating temperature rise. Indoor airflow will then be (Heating output of equipment) / (1.1 x temp. rise). In other cases, measurement of external static pressure is helpful. For details, see the Installation Instructions for your indoor unit.

Common Causes for Unsatisfactory Operation of Heat Pumps in Heating Mode

Dirty Filters

Dirty filters or inadequate airflow through the indoor coil. Failure to keep clean filters and adequate airflow (375-425 CFM/ ton) will cause excessive discharge pressures that may cause the high-pressure switch to function.

Low Return Air Temperatures

Return ductwork temperatures that are less than 60°F will cause low discharge pressure, low suction pressure and excessive defrost cycling.

Undercharging

An undercharged system will cause low discharge pressure, low suction pressure and an accumulation of frost on the lower section of the outdoor coil.

Poor Termination of Defrost

The defrost sensor must make good contact with the outside coil return bend or a non-termination of defrost may occur.

Reversing Valve

A reversing valve may not function correctly for the following reasons:

Solenoid does not energize when voltage is present.	*Replace the reversing valve.*
No voltage to the solenoid.	*Check the wiring.*
The valve will not shift.	
a. Undercharged	*Check for leaks*
b. Valve body damage	*Replace the reversing valve*
c. Valve sticking	*Replace the reversing valve*

TROUBLE SHOOTING ANALYSIS TABLE

1. High Head Pressure	1. Excessive charge of refrigerant in system.	1. Purge or pump-down excessive charge.
	2. Inadequate supply of air across the condenser coil.	2. Make certain that coil is not fouled in any way, or that air is not re-circulating.
	3. Non-condensate gases in the system.	3. Purge these gases from the system. Recharge system, if necessary.
2. Low Head Pressure	1. System low on refrigerant.	1. Charge system until sight glass is clear of bubbles.
	2. Compressor valves broken.	2. Replace compressor.
3. Low Suction Pressure	1. Liquid line valve closed.	1. Open the liquid line valve.
	2. Restricted liquid line.	2. Replace filter-dryer.
	3. The bulb of the thermal expansion valve has lost its charge.	3. Detach the bulb from the suction line and hold in one hand. If no liquid refrigerant goes through the valve, replace the valve.
	4. System low on refrigerant.	4. Test the unit for leaks. Add refrigerant until sight glass is free from bubbles, after repairing leak.
	5. Dirty filters.	5. Clean or replace filter.
	6. Coil frosted up.	6. Defrost and clean coil. Clean or replace filters.
	7. Flash gas in the liquid line.	7. Excessive liquid line drop. Check liquid line size.
	8. Quantity of air through evaporator not adequate.	8. Increase the blower speed.
4. High Suction Pressure	1. Expansion valve stuck open.	1. Correct valve action or replace the valve.
	2. Expansion valve bulb not in contact with suction line.	2. Fasten bulb securely to suction line.
	3. Suction and/or discharge valve leaking or broken.	3. Replace compressor.
5. Compressor will not start.	1. Disconnect switch open.	1. Close the disconnect switch.
	2. Blow fuse or fuse at disconnect switch.	2. Check the cause of failure and replace the fuse.
	3. Thermostat set too high.	3. Adjust to lower temperature.
	4. Selector switch in "Off" position.	4. Turn selector switch knob to "Cool" position.
	5. Contactor and/or relay coils burned out.	5. Replace contactor and/or relay.
	6. Loose or open electrical connection in either the control or power circuit.	6. Inspect and secure all electrical connections.

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NOTE: SPECIFICATIONS AND PERFORMANCE DATA LISTED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE

Quality Makes the Difference!

All of our systems are designed and manufactured with the same high quality standards regardless of size or efficiency. We have designed these units to significantly reduce the most frequent causes of product failure. They are simple to service and forgiving to operate. We use quality materials and components. Finally, every unit is run tested before it leaves the factory. That's why we know. . .**There's No Better Quality.**

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