TecumsehARGUS™

Remote Condensing Unit
Installation Instructions

Tecumseh®

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GENERAL SAFETY INFORMATION

1. Installation and maintenance to be performed only by qualified personnel who are familiar with this type of equipment.
2. Units are pressurized with dry air or inert gas. All units must be evacuated before charging with refrigerant.
3. Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
4. Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
5. Make sure all power sources are disconnected before any service work is done on units.

⚠ WARNING

Main power supply should always be disconnected and locked off to avoid accidental start up or electric shock. Failure to do so could result in injury or death.

Some parts like condenser fins or some corners on the sheet metal parts are sharp and may potentially cause injury. Use extra caution when working around these parts.

This product can expose you to chemicals including lead which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

INSPECTION

Responsibility should be assigned to a dependable individual at the job site to receive material. Each shipment should be carefully checked against the bill of lading. The shipping receipt should not be signed until all items listed on the bill of lading have been inspected and accounted for. Check carefully for concealed damage. Any shortage or damages should be reported to the delivering carrier. Damaged material becomes the delivering carrier's responsibility, and should not be returned to the manufacturer unless prior approval is given to do so. When uncrating, care should be taken to prevent damage. Heavy equipment should be left on its shipping base until it has been moved to the final location. Check the serial tag information with invoice. Report any discrepancies to your Tecumseh Representative.

If damages to the packing are obvious but no visible damage on the unit or the parts are noted then a report should be compiled and a claim for "probable hidden damages" should be filed with the transportation carrier. The manufacturer is not responsible for damages or loss caused by the transportation carrier.

GENERAL INSTALLATION INSTRUCTIONS

* To properly locate these outdoor air-cooled condensing units, carefully consider these important factors:

- Weight of the unit. If units are installed on the roof, their weight and weight distribution should be checked against the building specifications and the local building codes.
- Distance of the unit to the refrigerated cabinet.
- Distance to the power supply.
- Space around the condensing unit and in between adjacent units. This should consider prevention of the re-circulation of the air and insure enough airflow through the unit for proper cooling. These distances should also provide enough room around the units so that enclosure panels may be removed and that adequate accessibility is provided to the compressor, electrical boxes and other controls.
  (See Figure 1 on the next page)
- Orientation of the units should consider the prevailing wind direction. It is recommended not to position the units in such a way that the airflow direction through the unit faces the prevailing wind direction for the area.

The units should be mounted and secured on adequate rigid and leveled bases to avoid improper lubrication conditions for the compressor. Never use the shipment pallet as a permanent mounting base. If vibration is a concern, proper vibration isolators should be installed.

Space and Location Requirements

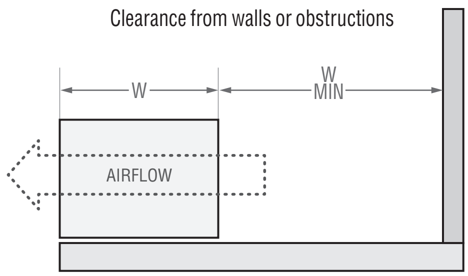
Figure 1

WALLS OR OBSTRUCTIONS

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access all sides of the unit should be a minimum of "W" away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. Overhead obstructions are not permitted. When the unit is in the area where it is enclosed by three walls the unit must be installed as indicated for units in a pit.

Walls or Obstructions for Horizontal Air Flow

Clearance from walls or obstructions

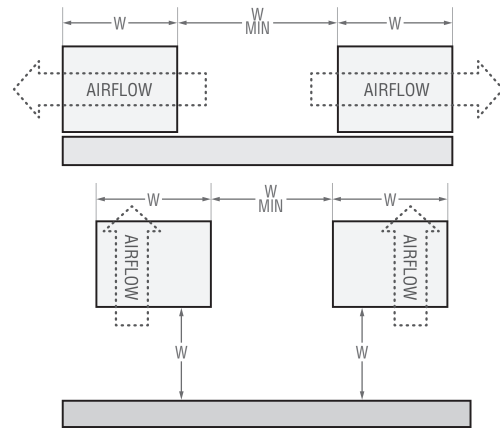


MULTIPLE UNITS

For units placed side by side, the minimum distance between units is the width of the largest unit. If units are placed end to end, the minimum distance between units is four feet.

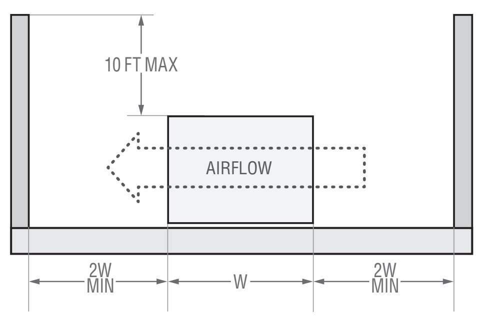
Multiple Units with Horizontal Air Flow

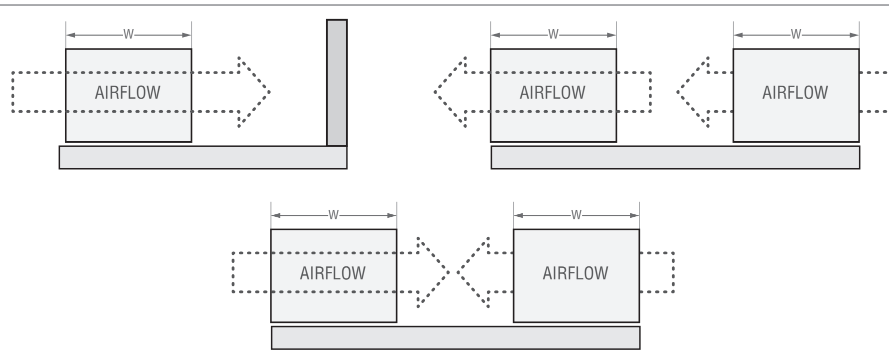
Clearance from walls or obstructions



UNITS IN PITS

Side distance increased to "2W"





NOT RECOMMENDED

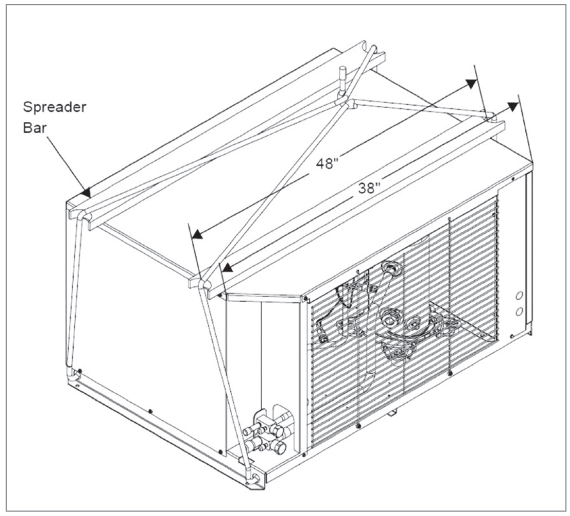
*"W" = Total width of the condensing unit.

Lifting/Handling Instructions

When a crane is used to lift the unit proper measures should be taken to protect the enclosure panels. The application of spreader bars are strongly recommended to prevent damages to the sides. **(See Figure 2)** Some care should be taken to locate the center of gravity before lifting. The compressor, which is the heaviest part of the unit may not be located in the center of the unit base.

Never lift or displace the outdoor units with enclosure panels removed. All the panels should be in place and properly tightened. Don't remove the shipment pallet until the unit arrives at the final destination. If unit has to be re-located use a proper pallet to carry the unit.

Figure 2



Ground Mounting

Concrete slab raised six inches above ground level provides a suitable base. Raising the base above ground level provides some protection from ground water and windblown matter. Before tightening mounting bolts, recheck level of unit. The unit should be located with a clear space in all directions that is at a minimum, equal to the height of the unit above the mounting surface. A condensing unit mounted in a corner formed by two walls, may result in discharge air recirculation with resulting loss of capacity.

Roof Mounting

Due to the weight of the units, a structural analysis by a qualified engineer may be required before mounting. Roof mounted units should be installed level on steel channels or an I-beam frame capable of supporting the weight of the unit. Vibration absorbing pads or springs should be installed between the condensing unit legs or frame and the roof mounting assembly.

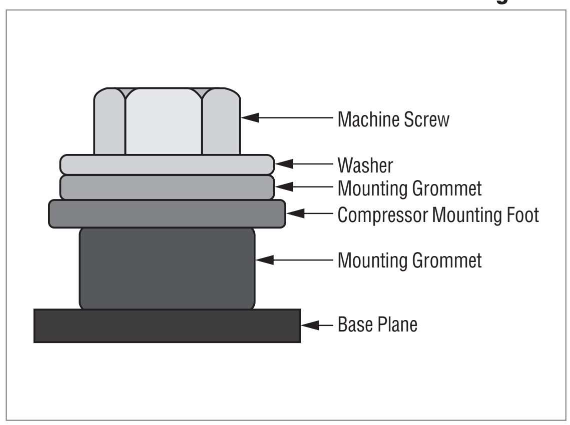
Snow

If snow is a possibility, mount unit to ensure access for maintenance and proper air flow.

Rigid Mount Compressors

Check the compressor mounting bolts to ensure they have not vibrated loose during shipment. (**See figure 3)**

Figure 3



ELECTRICAL CONNECTIONS

In order that these units have the starting, operating and dependability characteristics required of them, the compressor and its protective devices are designed for operation within a very specific minimum and maximum voltage range. This voltage range is defined in the following table:

Voltage shown on Unit Nameplate	Voltage Code	Voltage Range
115/60/1	AA	103 - 126.5
208 - 230/60/1	NA	254 - 187
200 - 230/60/3	XT, FA	254 - 180

Verify before any electrical installation if the voltage and phases of the supply satisfy those required of the unit.

ELECTRICAL CONNECTIONS (Continued)

Refer to "Minimum Circuit Ampacity" and "Maximum Fuse Size" data on the unit nameplate and applicable electrical codes to size the electrical wires, fuses and over current protection devices.

Refer to wiring diagram (attached inside of the electrical cabinet) to complete unit control circuit.

A pump down cycle should be employed to control all these units. Solenoid valve for the liquid line is an option that may be supplied loose and should be field installed by others. Room thermostat is supplied and installed by others.

Generally the wiring diagrams will show all electrical components, even those that are offered as options or should be supplied and installed by others.

Should any component be added to the unit as a field supplied option then the wiring should follow the given diagram (diagrams in Appendix).

CAUTION: Any non-compliance with voltage ranges and phase balances or any altering of electrical components without Tecumseh written approval will void the warranty.

PIPING (See Suction and Liquid Line Sizes in Appendix)

Employ only Refrigeration grade copper tubing. Always keep the tubes free of moisture and dirt and remove any burrs present on the tubes. The thermostatic expansion valve must be the externally equalized type. It can be mounted inside the unit cooler end compartment. Mount the expansion valve bulb on a horizontal run of suction line as close as possible to the suction header. Use the clamps provided with the valve to fasten the bulb securely so there is a tight line-to-line contact between the bulb and the suction line. Suction and liquid connections are made on the outside of the unit.

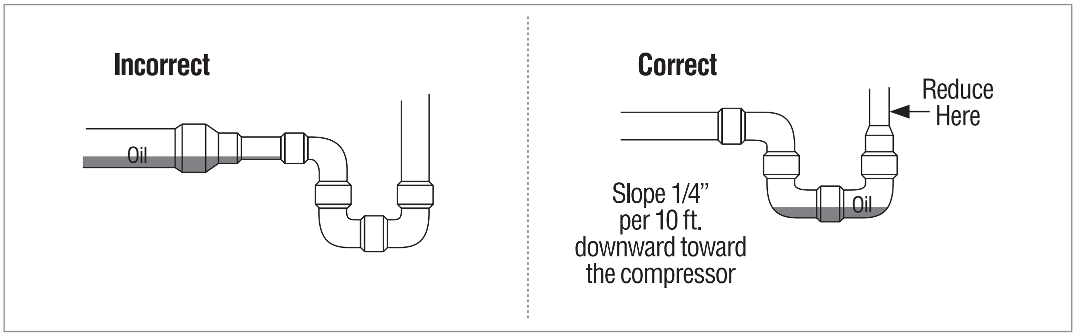
Standard piping practices and local/national codes should be employed to size and install refrigerant gas and liquid lines.

A) The selection of the suction gas line sizes should be guided by the following criteria:

- Assurance of adequate velocity, thus ensuring oil return capability (the tube size must be limited to maintain velocities no less than 750 fpm for horizontal and down flow and no less then 1500 fpm for up flow)
- Assurance of acceptable pressure drop (The tube size should be limited to maintain pressure drop no greater than the equivalent of a 2°F temperature drop.)
- Assurance of satisfactory sound level (the tube size should be limited to maintain velocities no greater than 3000 fpm.)

Horizontal suction lines should be sloped downward in the direction of the compressor at least ½" per 10' of line. The appendix tables recommend suction line sizes for installations where the line is horizontal or down flow. In the event the suction line is up flow, use "one standard size" smaller. A suction trap should be installed at the base of suction risers. Prefabricated wrought copper traps are available, or a trap can be made by using two street ells and one regular ell. The suction trap must be the same size as the suction line. For long vertical risers, additional traps may be necessary. Generally, one trap is recommended for each 10 ft. to 15 ft. for suction risers exceeding 20 feet to insure proper oil movement. See Figure 4 for methods of constructing proper suction line P-traps. Suction line lengths in excess 100 feet may require additional oil be added to the compressor.

Suction P-Traps **Figure 4**



B) Liquid line sizes are based on pressure drops that will not permit gas formation for horizontal lengths up to 100’. For lines longer than 100’ horizontal and for lines that travel up vertically additional sub-cooling must be provided to overcome the vertical liquid head pressures and extra length. Liquid refrigerant in vertical column will exert a downward pressure of 0.5 – 0.6 pounds per linear foot of tube, and depending upon the direction of the refrigerant flow, will either add or subtract from the liquid line pressure drop.

Liquid lines should be sized for a minimum pressure drop to prevent ‘’flashing”. Flashing in the liquid lines would create additional pressure drop and poor expansion valve operation. If a system requires long liquid lines from the receiver to the evaporator or if the liquid must rise vertically upward any distance, the losses should be calculated to determine if a heat exchanger is required or not. The use of a suction to liquid heat exchanger may be used to subcool the liquid to prevent flashing. This method of subcooling will normally provide no more than 20°F subcooling on high pressure systems. The amount of subcooling will depend on the design and size of the heat exchanger and on the operating suction and discharge pressures. An additional benefit from the use of the suction to liquid type heat exchanger is that it can help raise the superheat in the suction line to prevent liquid return to the compressor via the suction lines.

C) Elbows, valves and reduced joint sizes increase pressure drop and deserve additional consideration.

D) Long radius elbows should be employed to minimize pressure losses.

E) To prevent oxidation and scale forming inside the tubes it is recommended to flow dry nitrogen through the tubing during the soldering operations. A light flow of about ¼ CFM is sufficient.

F) Follow the manufacturer’s instructions when brazing service valves or other parts that may be damaged by excessive heat.

G) After all leak check procedures are complete, refrigerant lines that may be exposed to high and low ambient temperatures should be insulated. As a rule of thumb, suction lines should be insulated with an industry accepted material of no less than ¾” wall thickness. Liquid lines should also be insulated with at least ½” wall thickness. The insulating material should be of a kind intended for outdoor use.

PRESSURE TESTING FOR LEAKS

Use of electronic leak detection equipment is highly recommended due to its potential accuracy when used correctly in accordance with the manufacturers instructions. If trace amounts of refrigerant are used, use only the refrigerant indicated on the serial label of the condensing unit.

If de minimis amounts of refrigerant are used during the leak check procedure, this must be properly recovered and disposed of in an appropriate manner to protect the environment. As an added precaution, the leak check charge should be left in the system for no less than 12 hours without loss of pressure.

Every joint in the system including, but not limited to, factory welds, flare nuts and pressure controls must be leak checked.

A leak free system is required for the installation to function correctly.

SYSTEM FLUSHING, PURGING, AND PRESSURE TESTING FOR LEAKS

Failure to properly flush, purge, or pressure test a system for leaks can result in serious injury or death from explosion, fire, or contact with acid-saturated refrigerant or oil mists. A pressure leak test is mandatory and is to be performed for the complete refrigeration system, including the condensing unit, prior to system charging.

To thoroughly leak check the system, the system should be pressurized to a maximum of 150 psig with dry nitrogen to the high and low side of the system. With the pressure equalized at 150 psig, a leak check should be performed on EVERY joint in the system, including the condensing unit, to ensure that no major leaks are present. The initial charge may then be released.

Follow these precautions when flushing, purging or pressure testing a system for leaks:

- Use flushing products according to the manufacturer's instructions
- To purge a system, use only dry nitrogen.
- When pressure testing for leaks, use only regulated dry nitrogen or dry nitrogen plus de minimis amounts of serial label refrigerant.
- When purging or pressure testing any refrigeration or air conditioning system for leaks, never use air, oxygen or acetylene.
    1. Oxygen can explode on contact with oil.
    2. Acetylene can decompose and explode when exposed to pressures greater than approximately 15 psig.
    3. Combining an oxidizing gas, such as oxygen or air, with an HCFC or HFC refrigerant under pressure can result in a fire or explosion.

Use a pressure regulating valve and pressure gauges.

- Commercial Cylinders of nitrogen contain pressures in excess of 2000 psig at 70°F. At pressures much lower than 2000 psig, compressors can explode and cause serious injury or death. To avoid over pressurizing the system, always use a pressure-regulating valve on the nitrogen cylinder discharge. The pressure regulator must be able to reduce the pressure down to 1 to 2 psig and maintain this pressure.

- The regulating valve must be equipped with two pressure gauges:
  - One gauge to measure cylinder pressure
  - One gauge to measure discharge or down stream pressure
- Use a pressure relief valve.
  - In addition to pressure regulating valve and gauges, always install a pressure relief valve. This can also be a burst disc type pressure relief device. This device should have a discharge port at least ½" NPT size. The valve or frangible disc device must be set to 175 psig.
- Do not pressurize the system beyond 150 psig field leak test pressure.
- Disconnect nitrogen cylinder and release the pressure in the system before evacuating and connecting a refrigerant container.
- Always protect low (or dual) pressure control from excessive high pressure. It is recommended to disconnect the low-pressure (or the low side of the dual pressure) control prior to pressurization.

SYSTEM EVACUATION

Following the pressure testing for leaks, the system must be evacuated.

Confirm system pressure of 0 psi before connecting vacuum pump to system.

Use a vacuum pump (not a compressor) to draw a vacuum of 500 microns or less from both sides of the system. Do not attempt to draw a vacuum on the system with the pump connected only on the low side. The high side of the system should be interconnected with the low side by using a minimum 3/8" OD copper tube. Use a good electronic gauge to measure the vacuum because a refrigeration gauge cannot provide an accurate reading at this resolution.

Break the vacuum with dry nitrogen.

Note: Never use a compressor to evacuate a system. Instead, use a high pressure vacuum pump specifically designed for that purpose. Never start the compressor while it is under a deep vacuum. Always break the vacuum with a refrigerant charge before energizing the compressor. Failure to follow these instructions can damage the hermetic terminal. As always, to avoid serious injury or death from terminal venting with ignition, never energize the compressor unless the terminal cover is securely fastened.

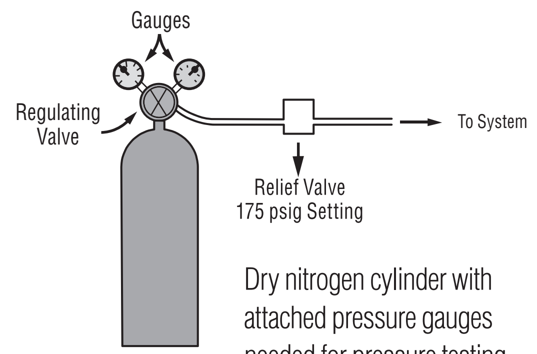
SYSTEM CHARGING

Failure to properly charge the system can result in serious injury or death from explosion or fire.

Follow these precautions when charging a system:

- Do not operate the compressor without charge in the system.
- Operating the compressor without a charge in the system can damage the hermetic terminal. As always, to avoid serious injury or death from terminal venting with ignition, never energize the compressor unless the protective terminal cover is securely fastened.
- Use proper refrigerant.

  – Use only the serial label refrigerant when charging the system. Using a different refrigerant can lead to excess system pressure and an explosion. Use of a refrigerant other than the serial label refrigerant will void the compressor warranty.
- Do not overcharge a refrigeration or air conditioning system.
  - Overcharging a refrigeration or air conditioning system can result in explosion. To avoid serious injury or death, never overcharge the system. Always use proper charging techniques. Limit charge amounts to those specified on the system equipment serial label or in the original equipment manufacturer's service information.
  - Overcharging the system immerses the compressor motor, piston, connecting rods, and cylinders in liquid refrigerant. This creates a hydraulic block preventing the compressor from starting.
  - Continued supply of electricity to the system causes heat to build in the compressor. This heat will eventually vaporize the refrigerant and rapidly increase system pressure. If, for any reason, the thermal protector fails to open the electrical circuit, system pressure can rise to high enough levels to cause a compressor housing explosion.



Dry nitrogen cylinder with attached pressure gauges needed for pressure testing for leaks and purging.

HEAD PRESSURE SYSTEMS

If you are charging the system by using a clear sight glass as an indication of proper charge (210 psi for R404A units) the following must be considered.

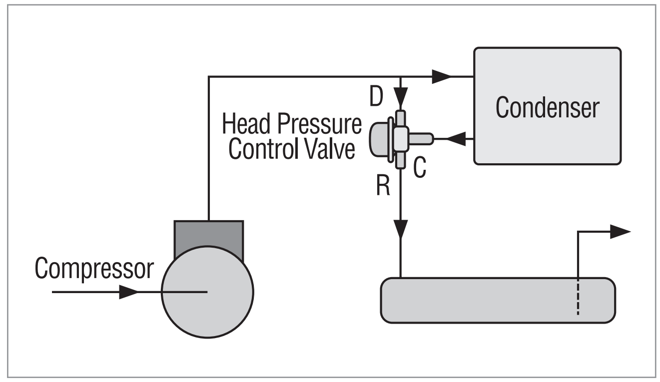
Check the condensing temperature. It must be above 92°F. If not, it will be necessary to reduce the amount of air going through the condenser from fans still running. Simply reduce the effective condenser face area to raise the discharge pressure above the equivalent 92°F condensing temperature and then proceed to charge to clear the sight glass. Adjust evaporator superheat. Return to full condenser face area and allow the system to balance.

HEAD PRESSURE CONTROLS

The standard Head Pressure Control Valve used on low ambient refrigeration systems controls the head pressure. There is no adjustment for this valve.

At condensing pressures above the valve setting, flow enters Port C and leaves Port R. When the condensing pressure falls below the valve setting, the valve modulates to permit discharge gas to enter Port D. Metering discharge gas into the refrigerant flow leaving the condenser produces a higher pressure at the condenser outlet, reduces the flow, and causes the level of liquid refrigerant to rise in the condenser. This “flooding” of the condenser with liquid refrigerant reduces the available condensing surface, holding the condensing pressure at the valve setting. **(See Figure 5)**

Single Valve Flooding Piping Arrangement **Figure 5**



REFRIGERANT FLOODING CHARGE

The Refrigerant Flooding Charge Tables (appendix) summarize the additional coil charges for ARGUS Outdoor Condensing Units.

Winter charge assumes 90% flooded coil; Summer charge assumes 10% flooded coil.

These charges are approximate and should not be used as absolute rules for charging the system.

To determine total system charge, the liquid line and unit cooler/evaporator must be considered.

REFRIGERATION OILS

Approved Hermetic Compressor Oils

Hermetic compressors are charged with optimum oil that will be adequate for systems designed in accordance with good engineering practice. **For questions call Technical Support.**

Refrigerant	Approved Compressor Oils
R-404A, R-407A, R-448A, R-452A, and R-449A	**Polyol Ester (with approved additives)**
AE, AK, AK, AJ, AW, AV, AG, VS	Emgard 32ML, Solest-32-TC, Emgard 32SL, CP-2932AE, Everest HC 32 A W

Some system designs containing unusual evaporators or extensive interconnecting pipes, may require additional oil. Since excess oil can also damage compressors, care should be taken not to exceed the oil charge amounts specified.

POLYOL ESTER LUBRICANTS

POE's must be used if HFC refrigerants are used in the system. They are also acceptable for use with any of the traditional refrigerants or interim blends and are compatible with mineral oils.

HYGROSCOPICITY

Ester lubricants (POE) have the characteristic of quickly absorbing moisture from the ambient surroundings. Since moisture levels greater than 100 ppm will result in system corrosion and ultimate failure, it is imperative that compressors, components, containers and the entire system be kept sealed as much as possible. Lubricants will be packaged in specially designed, sealed containers. After opening, all the lubricant in a container should be used at once since it will readily absorb moisture if left exposed to the ambient. Any unused lubricant should be properly disposed of. Similarly, work on systems and compressors must be carried out with the open time as short as possible. Leaving the system or compressor open during breaks or overnight MUST BE AVOIDED!

Color

As received, the POE lubricant will be clear or straw colored. After use, it may acquire a darker color. This does not indicate a problem as the darker color merely reflects the activity of the lubricant's protective additive.

SYSTEM START-UP PROCEDURE

- Check the electrical connections to verify that they are properly attached and secured.
- Check the electrical supply versus nameplate specifications.
- Check if the voltage deviation is within the specified range.
- Check all mechanical and electrical connections to verify if they are properly tightened and secured. Compressor mounting parts, fan motor mounting screws, fan blade tightening screw, shroud and electrical boxes, etc.
- Check that the safety and pressure controls are connected and set correctly.
- Check that the applicable suction and liquid valves are open.
- Check by isolating the compressor motor if the control circuit including thermostat and solenoid valve (if used) is wired and operates correctly.
- Confirm that the system has been properly leak tested, evacuated and charged. If not, then follow the leak testing, evacuating and charging procedures described respectively in this manual "Pressure testing for leaks," "System evacuation" and "Refrigerant charging." **If the system has been previously charged, make sure that the crank case heater is turned on at least 24 hours prior to start up.** Otherwise warm up the compressor bottom shell to assure that the refrigerant will not cause damage to the compressor due to the slugging condition. **Do not attempt to warm up the compressor by applying a flame to the crankcase.**
- Insure all electrical covers are in place.
- Turn on the electrical power to the condensing unit and unit cooler(s). The compressor will start when the low-pressure control closes and the pressure rises.
- Always re-assemble the enclosure panels when start-up job is completed. Make sure all panels are secure and panel screws are properly tightened.

SYSTEM BALANCING – COMPRESSOR SUPERHEAT

IMPORTANT: In order to obtain the maximum capacity from a system, and to ensure trouble-free operation, it is necessary to balance each and every system.

This is extremely important with any refrigeration system. The critical value which must be checked is suction superheat. Suction superheat should be checked at the compressor as follows:

1. Measure the suction pressure at the suction service valve of the compressor and determine the saturation temperature corresponding to this pressure from a “Temperature-Pressure” chart.
2. Measure the suction temperature of the suction line about one foot back from the compressor using an accurate thermometer.
3. Subtract the saturated temperature from the actual suction line temperature. The difference is superheat.

Too low a suction superheat can result in liquid being returned to the compressor.
This will cause dilution of the oil and eventual failure of the bearings and rings or in the extreme case, valve failure.

Too high a suction superheat will result in excessive discharge temperatures which cause a breakdown of the oil and results in piston ring wear, piston and cylinder wall damage.

It should also be remembered that the system capacity decreases as the suction superheat increases. For maximum system capacity, suction superheat should be kept as low as is practical. We recommend that the superheat at the compressor be between 10°F and 20°F maximum, to meet compressor manufacture guidelines.

If adjustments to the suction superheat need to be made, the expansion valve at the evaporator should he adjusted.

NOTE: All adjustable controls and valves must be field adjusted to meet desired operation. There are no factory preset controls or valve adjustments. This includes low pressure, high pressure, adjustable head pressure systems and expansion valves.

GENERAL SEQUENCE OF OPERATION

Refrigeration Cycle

1. Power is supplied to the timer at terminals “1” and “N.”
2. The fan delay and the defrost termination thermostat is closed in the fan delay position and open in the defrost termination position. The unit cooler fans run continuously on medium temperature applications.
3. The defrost heaters are off.
4. The room thermostat closes when the temperature rises above the desired setting.
5. The liquid line solenoid is energized and opens, which allows liquid refrigerant to flow through the unit cooler.
6. The low-pressure control closes when the suction pressure rises above the cut in setting of the control.
7. The compressor contactor closes. The compressor and condenser fan start simultaneously.
8. The room temperature gradually decreases to the desired temperature.
9. Once the desired temperature is reached, the thermostat opens and the liquid line solenoid closes, stopping refrigerant flow through the evaporator.
10. Suction pressure decreases, and the compressor contactor opens when the pressure drops below the cutout setting on the low-pressure control. The compressor and condenser fan stop running.
11. This cycle is repeated as many times as necessary to satisfy the room thermostat.
12. Frost starts to form on the evaporator coil and continues to form until the defrost cycle is initiated.

Defrost Cycle

1. The defrost cycle starts automatically by the timer at predetermined times. Typical settings are two to four defrost cycles per day for freezers. For heavier frost loads additional settings may be required.
2. Switch ‘2” to ‘4’ opens in the timer which breaks the circuit to the room thermostat, liquid line solenoid, and evaporator fan motors, allowing the compressor to pump down and shut off. Simultaneously switch “1” to “3” closes in the timer allowing current to flow to one side of the defrost heater contactor. When the compressor shuts off, an auxiliary contact will send power to the contactor holding coil; thus, energizing the defrost heaters.
3. The heaters raise the temperature of the coil to 32°F causing the frost to melt off the coil.
4. When the coil warms to 45°F to 55°F, the defrost termination thermostat closes, which allows current to the switching solenoid in the timer allowing the refrigeration cycle to begin again.
5. The evaporator heaters are off. If the termination thermostat fails to close, the fail-safe set on the timer will terminate defrost.
6. The low-pressure control closes, and the compressor will start.
7. When the coil temperature reaches 23°F to 30°F, the fan delay closes. This allows the current to flow to the fan motors. The fan motors start running.
8. The system will now operate in the refrigeration cycle until another defrost period is initiated by the timer.

Electric Defrost Troubleshooting

The electric defrost units are relatively simple and trouble-free in operation:

Timer

If the system does not go through its proper sequence check timer operation through a defrost cycle. Check for loose wires or terminals. Before replacing timer, check other components.

Operation of Paragon Timer

To set time of day grasp knob which is in the center of the inner (fail-safe) dial and rotate it in a counter-clockwise direction. This will cause the outer (24 hour) dial to revolve. Line up the correct time of day on the outer dial with the time pointer. Do not try to set the time control by grasping the other (24 hour) dial.
Place pins in the outer dial at the time of day that defrost is required,

Operation of Grasslin Timer

To set the time, turn the minute hand clockwise until the time of day (and AM or PM) on the outer dial is aligned with the triangle marker on the inner dial. Do not rotate minute hand counter-clockwise. Move the white tab (tripper) on the outer dial outward at each desired initiation time. Each white tab (tripper) is a 15-minute interval and provides 15 minutes of defrost, for longer defrost duration, move additional tabs (following in time) from the initiation tab. For example, if a 45 minute defrost is to start at 7:00 AM, move the tabs outward that lie between 7:00 - 7:15, 7:15 - 7:30 and 7:30 - 7:45 on the AM side of the dial. The defrost will initiate at 7:00 AM and time terminate at 7:45 AM (if temperature termination does not occur first). For models with plastic cover on timer assembly; re-install cover after adjustment.

Operation of Adaptive Defrost Control

The commercial Refrigeration DDSX Adaptive Defrost Control combines scheduled defrost cycles with sensor data for maximum efficiency. The control only initiates a scheduled defrost cycle if frost buildup is detected, and it terminates the cycles when the evaporator coil is frost free. The timer functions as a fail-safe measure to terminate defrost cycles if the sensor fails to do so.

The sensor, connected to the evaporator coil, has contacts that close when the temperature or pressure rises to above freezing level, indicating that frost and ice have melted from the coil.

After a defrost cycle is terminated, a temperature switch (typically a wide differential SPDT switch) wired to the fans delays turning on the fans until the coil temperature falls below freezing again. In most applications, the contacts at terminals 2-4 are Normally Closed when the time is energized, and control the fans and refrigeration equipment or compressor.

You can connect up to four thermistor probes to a single DDSX control in order to monitor multiple evaporator coils.

NOTE: After correcting faulty condition, it is essential that the coil and unit be free of ice before placing unit back on automatic operation.

NOTES:

1. Lockout relays or normally closed switch of auxiliary contact on the compressor contactor may be wired to defrost contactor. Its purpose is to prevent energizing of the defrost heaters until the compressor has pumped down and stopped, thus keeping power demand to a minimum.
2. If the control voltage is to remain energized for any period with the compressor disabled, remove the defrost clock pins to prevent the defrost heaters from energizing.
3. A Preventative Maintenance schedule should be set up as soon as possible after start-up to maintain equipment integrity.

Operational Checkout Procedure

- Check if the voltage deviation is within the specified range.
- Check that the ampere draw doesn't exceed the amperage specified on the nameplate.
- Check the phase unbalance if there is a three-phase connection. Unbalanced voltage should not exceed 2%.
- Check proper phase connections on three phase models only.
- Check that the discharge and suction pressures are within the allowable design limits.
- Check the liquid flow in the liquid sight glass.
- Measure compressor and evaporator superheats. Make proper adjustments if necessary.
- Check the high-pressure control setting by simulating a condenser block, shutting off the fans and observing with extreme caution the pressure rise.
- Check the low-pressure setting by simulating a pump-down cycle. Observe the cut-off pressure, and adjust accordingly.
- Check (if equipped) the defrost and timer controls for proper initiation and termination settings.
- If any malfunction is observed at any time during either start-up or operational checkout procedures, stop the unit, disconnect power and correct the malfunction accordingly.
- **Re-check after 48 hours** of operation for loose electrical connections, abnormal vibrations that may have developed, refrigerant charge and correct any probable malfunction observed.
- Always re-assemble the enclosure panels when operational check out procedure is completed. Never leave loose or not properly tightened panels.

FIELD WIRING

WARNING: All wiring must be done in accordance with applicable codes and local ordinances.

The field wiring should enter the areas provided on the unit. The wiring diagram for each unit is located on the inside of the electrical panel door. All field wiring should be done in a professional manner and in accordance with all governing codes. Before operating unit, double check all wiring connections, including the factory terminals. Factory connections can vibrate loose during shipment.

1. Consult the wiring diagram in the unit cooler and in the condensing unit for proper connections.
2. Wire type should be of copper conductor only and of the proper size to handle the connected load.
3. The unit must be grounded.
4. For multiple evaporator systems, the defrost termination controls should be wired in series. Follow the wiring diagrams for multiple evaporator systems carefully. This will assure complete defrost of all evaporators in the system.
5. Multiple evaporator systems should operate from one thermostat.
6. If a remote defrost timer is to be used, the timer should be located outside the refrigerated space.

PHASE LOSS MONITOR

The combination phase sequence and loss monitor relay protects the system against phase loss (single phasing), phase reversal (improper sequence) and low voltage (brownout). When phase sequence is correct and full line voltage is present on all three phases, the relay is energized as the normal condition indicator light glows.

NOTE: If compressor fails to operate and the normal condition indicator light on the phase monitor does not glow, then the supplied electrical current is not in phase with the monitor.

This problem is easily corrected by the following steps:

1. Turn power off at disconnect switch.
2. Swap any two of the three power input wires.
3. Turn power on. Indicator light should glow and compressor should start.
4. Observe motors for correct rotation.

MAINTENANCE

The refrigeration systems should be scheduled for check-up, inspection and maintenance service, at least twice a year, in order to assure a trouble free operation for many years. When servicing these systems the main power supply must be disconnected and locked off. Extreme care must be used when servicing a unit that requires the power to be "ON".

- Inspect for abnormal indications, vibration, noise.
- Inspect and feel the bottom crankcase housing and determine that it is warm. Make sure that the upper housing is not sweating.
- Inspect all electrical parts for loose connections. Tighten them if necessary
- Inspect insulation status of all wires.
- Inspect contactors and make sure that they are functioning correctly.
- Inspect the fan motors, make sure that the fan blades are tight and all mounting joints are tight. Refer to the figure on the right for proper positioning of the fan on the motor shaft.
- Check the crankcase and receiver heaters for proper operation. Use an ampere meter to check for current draw.
- Inspect refrigerant level in the system.
- Check and make sure that the condenser surface is clean and free of dirt and debris.
- Inspect the operation of the control system. Make sure that all of the safety controls are operational and functioning properly.
- Check all refrigeration piping. Make sure that all mechanical joints and flare nuts are tight.
- Always re-assemble the enclosure panels when maintenance job is completed. Never leave loose or not properly tightened panels.

⚠ ATTENTION!
Make sure all screws are re-tightened before start-up
Make sure all wires are hooked up per wiring diagram

TROUBLESHOOTING

Basic troubleshooting tips are provided in the appendix. For more in-depth help, please refer to the Tecumseh Hermetic Compressor Service Handbook or Electrical Service Parts Guidebook available on our website at www.tecumseh.com.

QUESTIONS AND SUPPORT

Tecumseh Tech Support: 800.211.3427 or Email: technical.service@tecumseh.com

Tecumseh reserves the right to change any information in this publication at any time.

This document is not intended to replace the training required for professional service personnel, or replace other information available from refrigeration and air conditioning equipment manufacturers.

APPENDIX

Argus Outdoor Condensing Unit Refrigerant Charge (LBS) Adjustment For Low Ambient Conditions

R404A

COND UNIT HORSEPOWER	DESCRIPTION	CONDENSER COIL	MINIMUM AMBIENT TEMPERATURE DEG F			
			40	20	0	-20
1/2, 3/4	Small Frame w- RTPF-2R	CDK-01	1.3	1.9	2.4	3.0
1, 1-1/4	Small Frame w- RTPF-3R	CDK-02	1.6	2.4	3.3	4.1
1/2, 3/4, 1, 1-1/4	Small Frame w- MC	CDK-06	1.3	1.8	2.3	2.8
2, 2-3/4	Medium Frame w- RTPF-3R	CDK-03	3.6	5.2	6.8	8.4
2, 2-3/4	Medium Frame w- MC	CDK-07	2.7	3.5	4.2	5.0
3, 4	Large Frame w- RTPF-2R	CDK-04	3.9	6.0	8.0	10.0
5, 6	Large Frame w- RTPF-3R	CDK-05	4.9	7.9	11.0	14.0
3, 4, 5, 6	Large Frame w- MC	CDK-08	3.5	5.1	6.7	8.3

R448A/R449A

COND UNIT HORSEPOWER	DESCRIPTION	CONDENSER COIL	MINIMUM AMBIENT TEMPERATURE DEG F			
			40	20	0	-20
1/2, 3/4	Small Frame w- RTPF-2R	CDK-01	1.3	1.9	2.5	3.0
1, 1-1/4	Small Frame w- RTPF-3R	CDK-02	1.6	2.5	3.3	4.2
1/2, 3/4, 1, 1-1/4	Small Frame w- MC	CDK-06	1.3	1.8	2.3	2.9
2, 2-3/4	Medium Frame w- RTPF-3R	CDK-03	3.6	5.3	7.0	8.7
2, 2-3/4	Medium Frame w- MC	CDK-07	2.7	3.5	4.3	5.1
3, 4	Large Frame w- RTPF-2R	CDK-04	3.9	6.0	8.2	10.3
5, 6	Large Frame w- RTPF-3R	CDK-05	4.9	8.1	11.3	14.5
3, 4, 5, 6	Large Frame w- MC	CDK-08	3.5	5.2	6.9	8.6

R452A

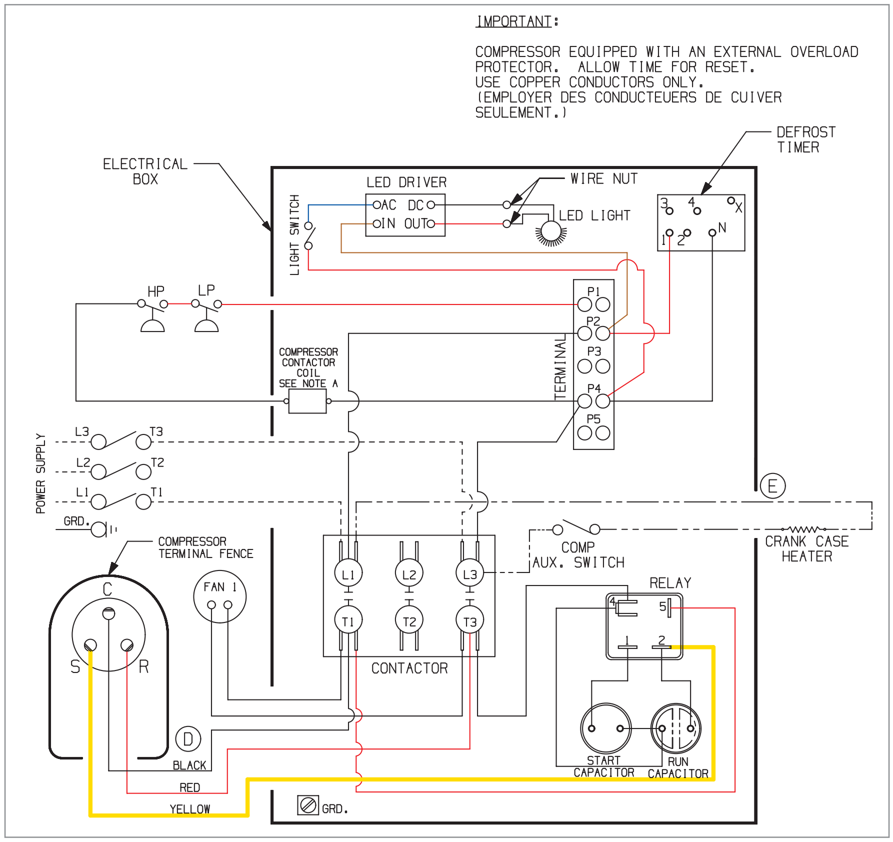
COND UNIT HORSEPOWER	DESCRIPTION	CONDENSER COIL	MINIMUM AMBIENT TEMPERATURE DEG F			
			40	20	0	-20
1/2, 3/4	Small Frame w- RTPF-2R	CDK-01	1.4	2.0	2.6	3.2
1, 1-1/4	Small Frame w- RTPF-3R	CDK-02	1.7	2.6	3.5	4.4
1/2, 3/4, 1, 1-1/4	Small Frame w- MC	CDK-06	1.4	1.9	2.5	3.0
2, 2-3/4	Medium Frame w- RTPF-3R	CDK-03	3.8	5.5	7.3	9.0
2, 2-3/4	Medium Frame w- MC	CDK-07	2.9	3.7	4.5	5.3
3, 4	Large Frame w- RTPF-2R	CDK-04	4.2	6.4	8.6	10.8
5, 6	Large Frame w- RTPF-3R	CDK-05	5.2	8.5	11.8	15.1
3, 4, 5, 6	Large Frame w- MC	CDK-08	3.7	5.5	7.2	8.9

RTPF - Round Tube Plate Fin
MC - MicroChannel

CU Wiring Diagrams

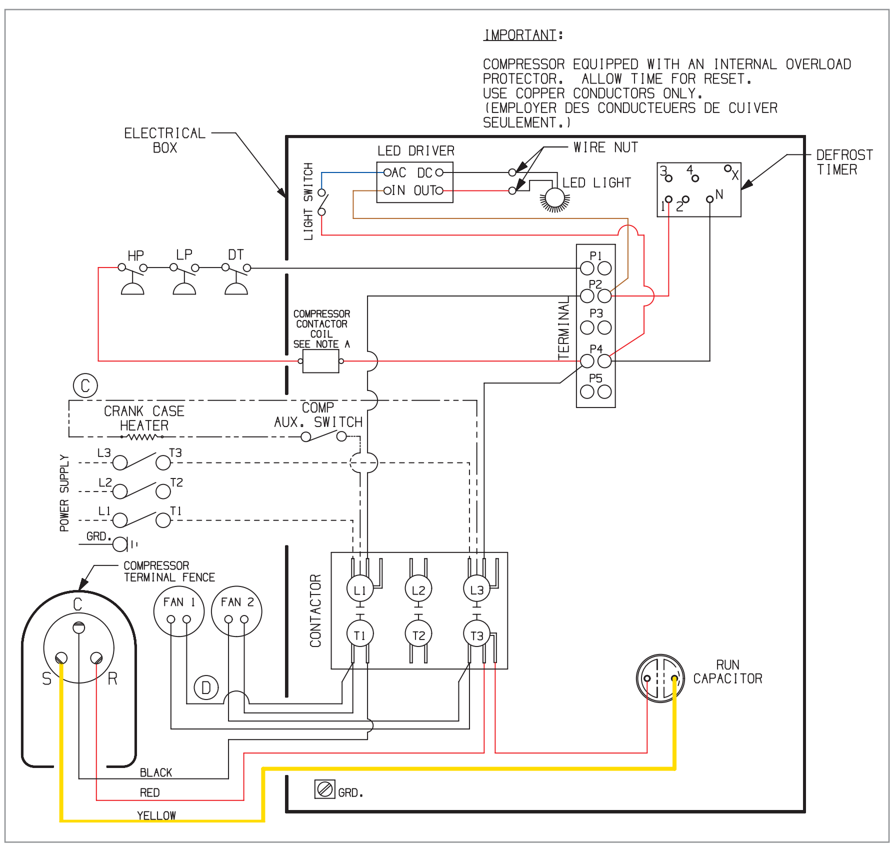
91292

115 & 230 Volt
1 Phase
1 Fan Motor



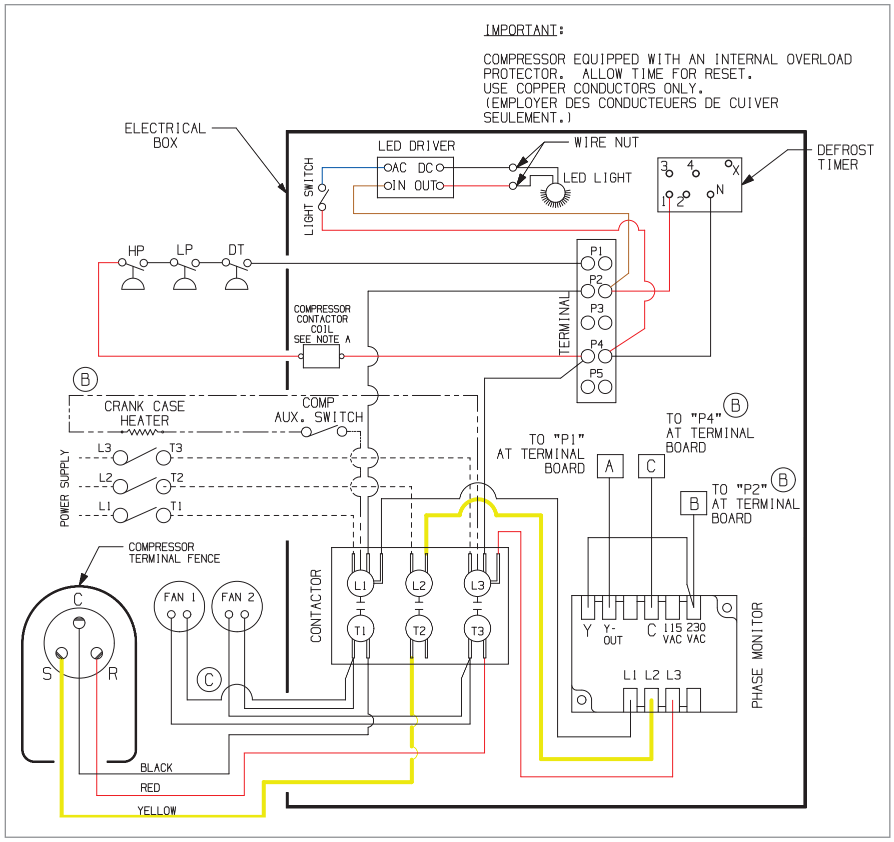
91293

208-230 Volt
1 Phase
2 Fan Motors
1 Fan Control



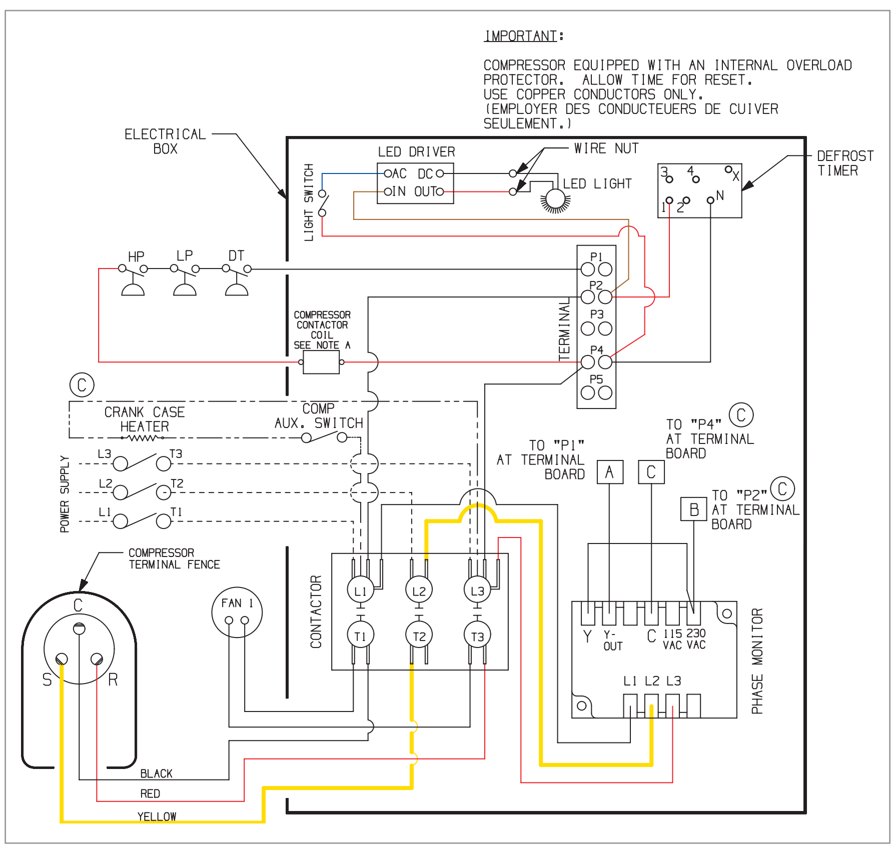
91293-1

220-230 Volt
3 Phase
2 Fan Motors



91294

200-230 Volt
3 Phase
1 Fan Motor

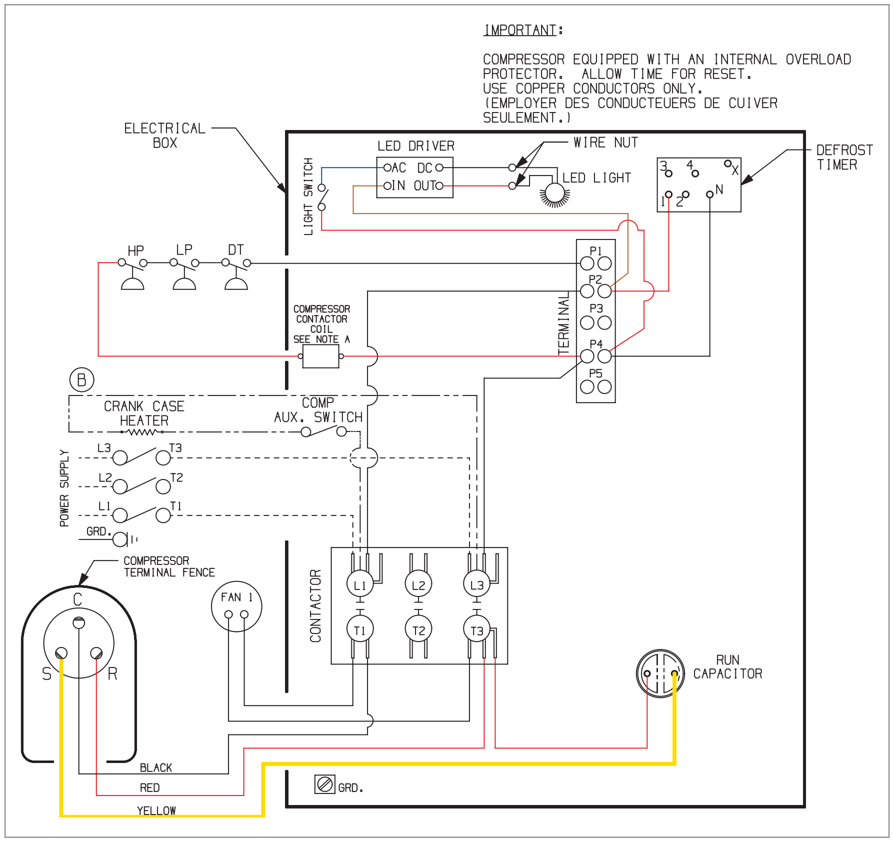


CU Wiring Diagrams

(Continued)

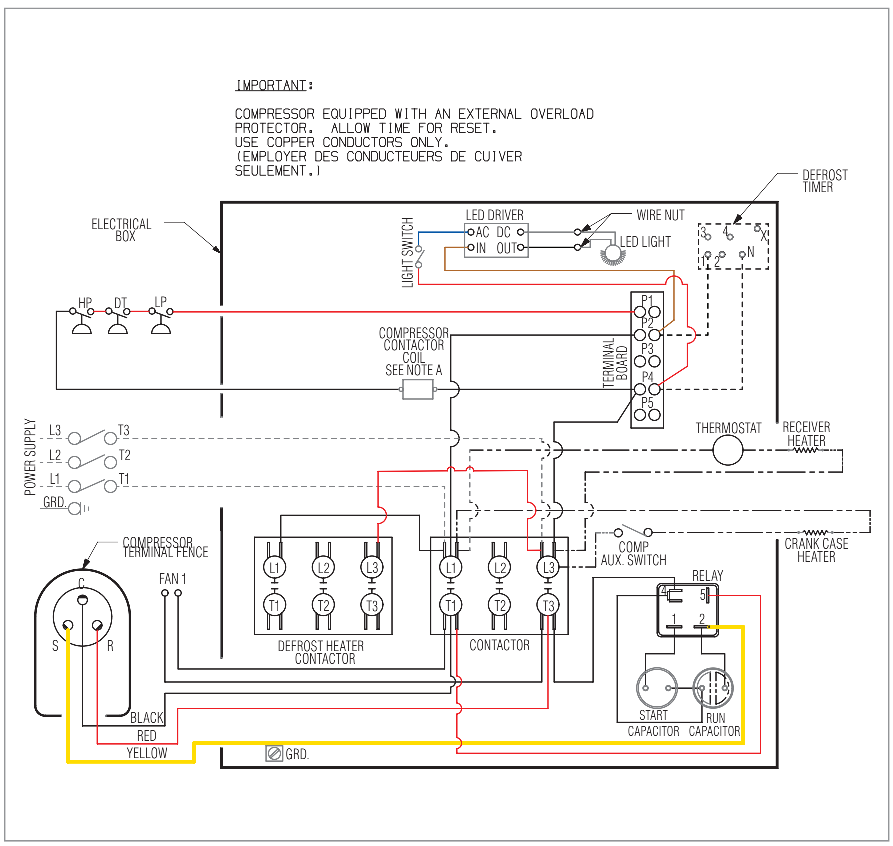
91294-1

200-230 Volt
3 Phase
1 Fan Motor



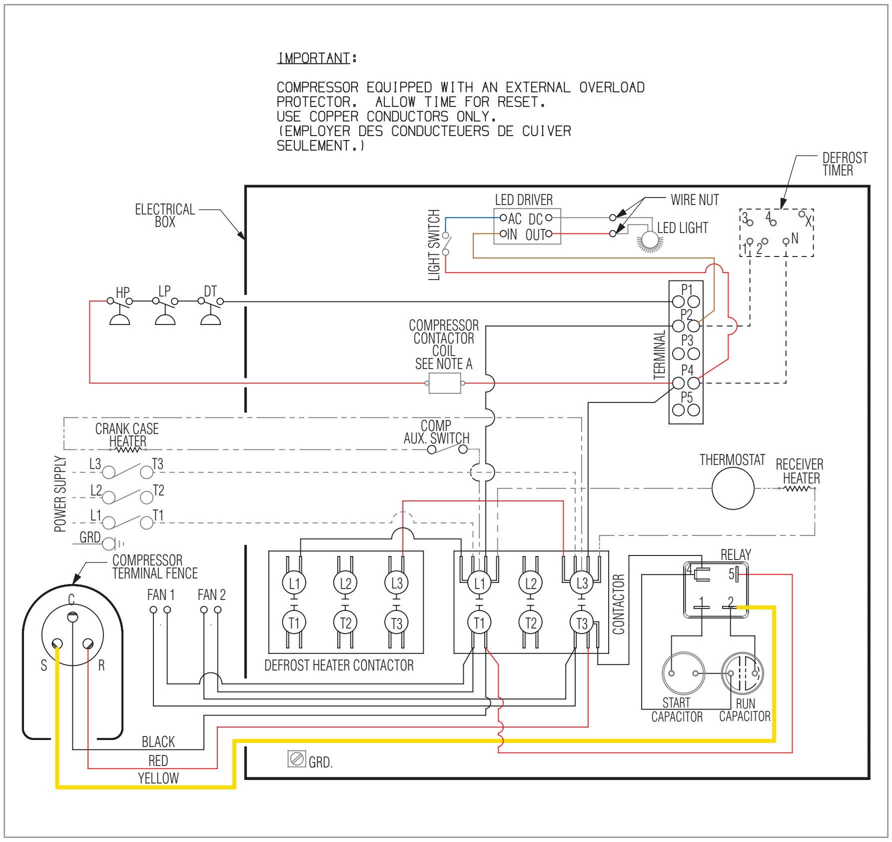
91300

208-230 Volt
1 Phase
1 Fan Motor



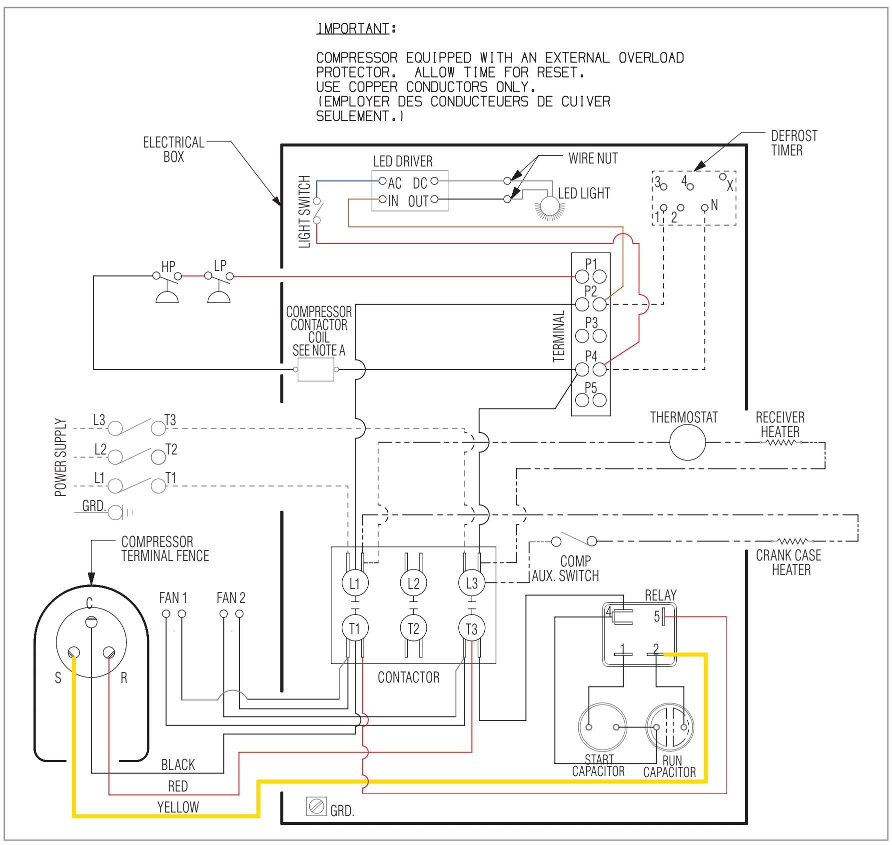
91301

208-230 Volt
1 Phase
2 Fan Motors



91307

208-230 Volt
1 Phase
2 Fan Motors



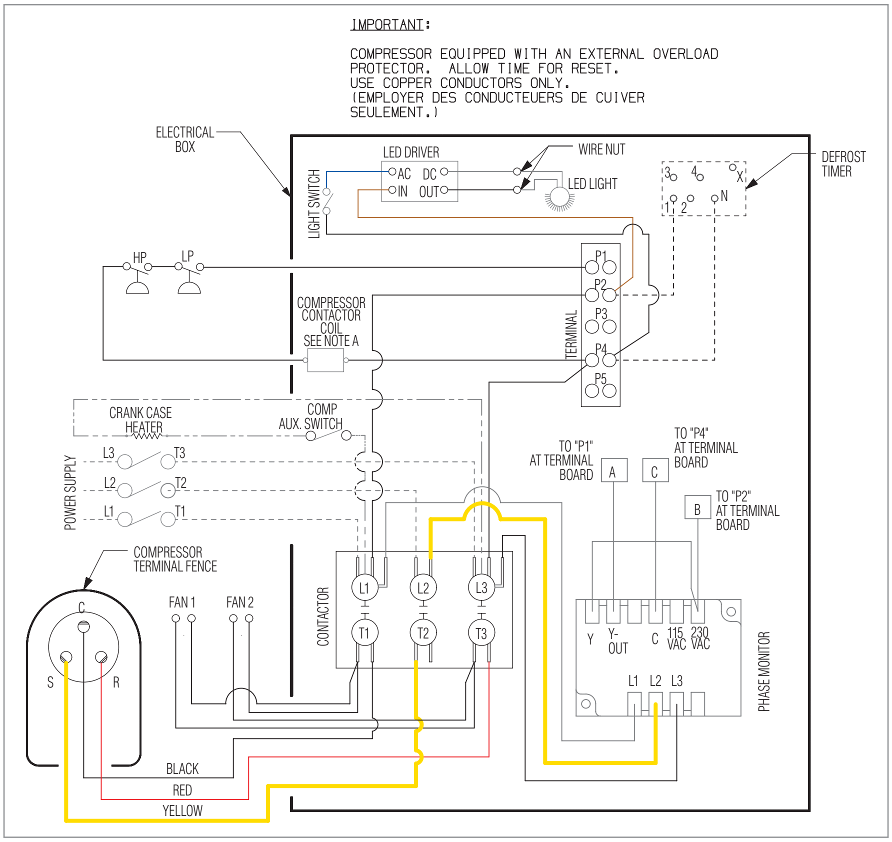
Tecumseh

CU Wiring Diagrams

(Continued)

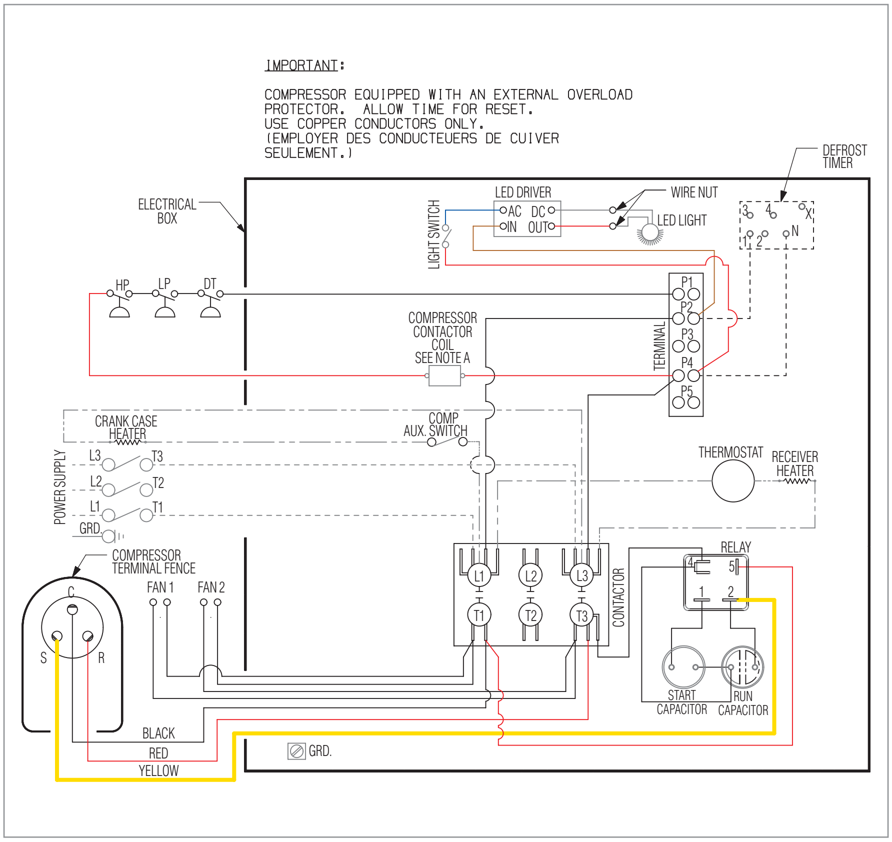
91308

208-230 Volt
3 Phase
2 Fan Motors



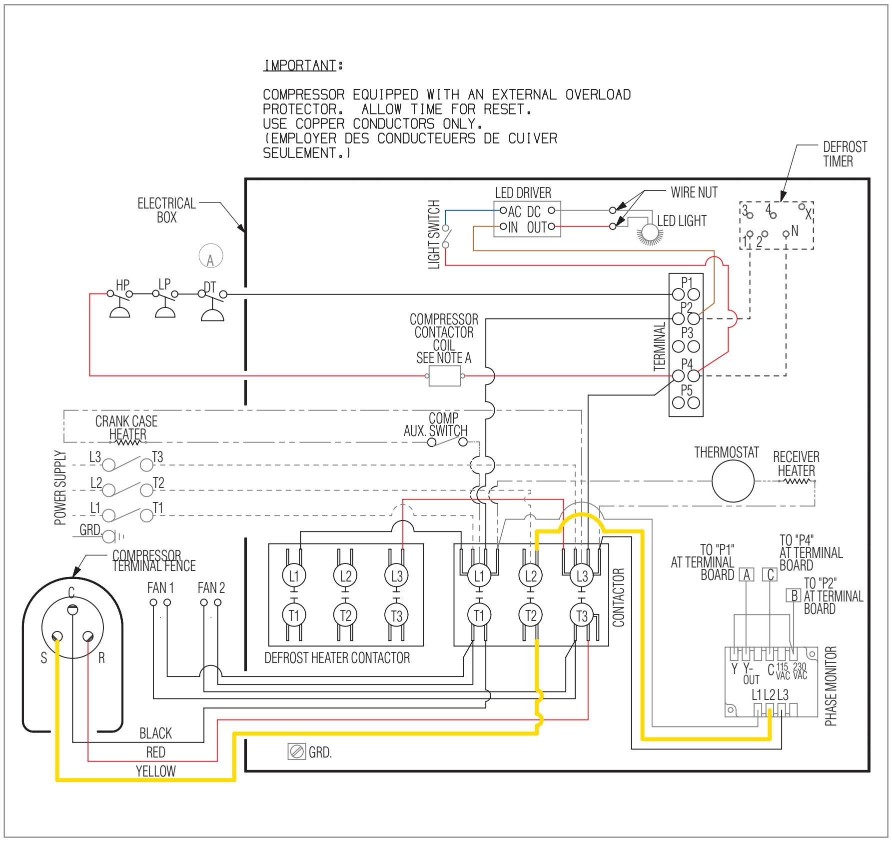
91309

208-230 Volt
1 Phase
1 Fan Motor



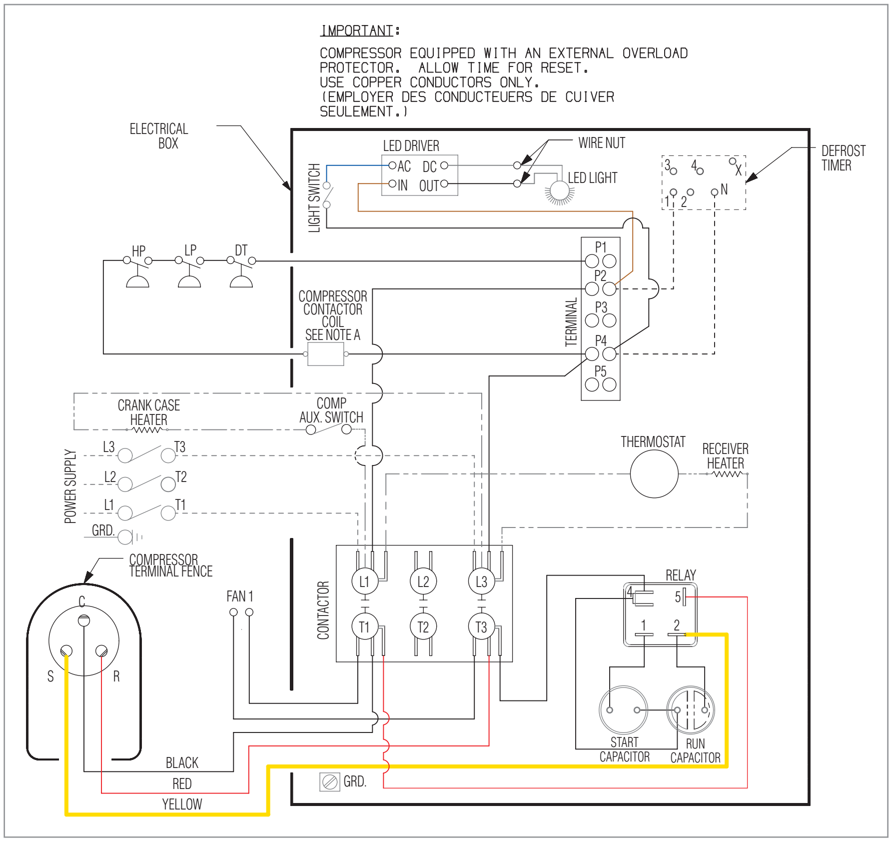
91310

208-230 Volt
2 Phase
2 Fan Motors



91311

208-230 Volt
1 Phase
1 Fan Motor



Line Sizing

The following Tables 5 and 6 indicate liquid lines and suction lines for all condensing units for R-404A, R-507, R-407A/C/F, R-448A and R-449A. When determining the refrigerant line length, be sure to add an allowance for fittings. See Table 3. Total equivalent length of refrigerant lines is the sum of the actual linear footage and the allowance for fittings.

TABLE 1 – Weight of Refrigerants in Copper Lines During Operation

(Pounds per 100 lineal feet of type “L” tubing)

Line Size O.D. (Inches)	Refrigerant	Liquid Line	Hot Gas Line	Suction Line at Suction Temperature				
				-40°F	-20°F	0°F	+20°F	+40°F
3/8	R-448A/R-449A	3.6	0.24	0,02	0.03	0.04	0.06	0.09
	R-507, R-404A	3.4	0.31	0.03	0.04	0.06	0.09	0.13
1/2	R-448A/R-449A	6.7	0.44	0.03	0.05	0.07	0.11	0.16
	R-507, R-404A	6.4	0.58	0.04	0.07	0.13	0.16	0.24
5/8	R-448A/R-449A	10.8	0.71	0.05	0.08	0.12	0.18	0.26
	R-507, R-404A	10.3	0.93	0.07	0.11	0.17	0.25	0.35
7/8	R-448A/R-449A	22,5	1.48	0.10	0.16	0.25	0.37	0.54
	R-507, R-404A	21.2	1.92	0.15	0.23	0.37	0.51	0.72
1-1/8	R-448A/R-449A	38.4	2.53	0.17	0.27	0.42	0.63	0.92
	R-507, R-404A	36.1	3.27	0.26	0.39	0.63	0.86	1.24
1-3/8	R-448A/R-449A	58.4	3.85	0.25	0.41	0.64	0.96	1.40
	R-507, R-404A	55.0	4.98	0.40	0.58	0.95	1.32	1.87
1-5/8	R-448A/R-449A	82.7	5.45	0.36	0,58	0.90	1.36	1.98
	R-507, R-404A	78.0	7.07	0.56	0.82	1.35	1.86	2.64
2-1/8	R-448A/R-449A	143.8	9.48	0.62	1.01	1.57	2.36	3.44
	R-507, R-404A	134	12.25	0.98	1.43	2.35	3.23	4.58
2-5/8	R-448A/R-449A	222	14.62	0.96	1.56	2.42	3.65	5,30
	R-507, R-404A	209	18.92	1.51	2.21	3.62	5.00	7.07
3-1/8	R-448A/R-449A	317	20.86	1.37	2.22	3.45	5.20	7.57
	R-507, R-404A	298	27.05	2.16	3.15	5.17	7.14	9.95
3-5/8	R-448A/R-449A	428	28.22	1.86	3.01	4.67	7.04	10.24
	R-507, R-407A	403	36.50	2.92	4.25	6.97	19.65	13.67
4-1/8	R-448A/R-449A	554	36.53	2.40	3.89	6.05	9.00	13.25
	R-507, R-404A	526	47.57	3.80	5.55	9.09	12.58	17.80

Line Sizing

(Continued)

TABLE 2 – Pressure Loss of Liquid Refrigerants in Liquid Line Risers

(Expressed in Pressure Drop, PSIG and Subcooling loss, °F)

Refrigerant	Liquid Line Rise in Feet																	
	10’		15’		20’		25’		30’		40’		50’		75’		100’	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R-448A, R-449A	4.3	1.1	6.5	1.7	8.7	2.3	10.9	2.8	13.0	3.4	17.4	4.5	21.7	5.6	32.6	8.3	43.5	10.9
R-507, R-404A	4.1	1.1	6.1	1.6	8.2	2.1	10.2	2.7	12.2	3.3	16.3	4.1	20.4	5.6	30.6	8.3	40.8	11.8

Based on 110 F° Liquid Temperature

TABLE 3 – Equivalent Feet of Pipe Due to Valve and Fitting Friction

Copper Tube, O.D., Type"L"	1/2	5/8	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8	5-1/8	6-1/8
Globe Valve (Open)	14	16	22	28	36	42	57	69	83	99	118	138	168
Angle Valve (Open)	7	9	12	15	18	21	28	34	42	49	57	70	83
90° Turn Through Tee	3	4	5	6	8	9	12	14	17	20	22	28	34
Tee (Straight Through) or Sweep Below	3/4	1	1-1/2	2	2-1/2	3	3-1/2	4	5	6	7	9	11
90° Elbow or Reducing Tee (Straight Through)	1	2	2	3	4	4	5	7	8	10	12	14	16

Line Sizing

(Continued)

TABLE 4 – Recommended Remote Condenser Line Sizes

Net Evaporator Capacity	Total Equiv. Length	R-448A & R-449/A		R-507 & R-404A	
		Discharge Line O.D.	Liquid Line Cond. To Receiver O.D.	Discharge Line O.D.	Liquid Line Cond. To Receiver O.D.
3,000	50	3/8	3/8	3/8	3/8
	100	3/8	3/8	3/8	3/8
6,000	50	3/8	3/8	1/2	3/8
	100	1/2	3/8	1/2	3/8
9,000	50	1/2	3/8	1/2	3/8
	100	1/2	3/8	1/2	3/8
12,000	50	1/2	3/8	1/2	3/8
	100	5/8	3/8	5/8	1/2
18,000	50	5/8	3/8	5/8	1/2
	100	5/8	3/8	7/8	1/2
24,000	50	5/8	0	5/8	1/2
	100	7/8	1/2	7/8	5/8
36,000	50	7/8	1/2	7/8	5/8
	100	7/8	5/8	7/8	7/8
48,000	50	7/8	5/8	7/8	5/8
	100	7/8	7/8	1-1/8	7/8
60,000	50	7/8	5/8	7/8	7/8
	100	1-1/8	7/8	1-1/8	7/8
72,000	50	7/8	7/8	1-1/8	7/8
	100	1-1/8	7/8	1-1/8	1-1/8
90,000	50	1-1/8	7/8	1-1/8	7/8
	100	1-1/8	7/8	1-1/8	1-1/8
120,000	50	1-1/8	7/8	1-1/8	1-1/8
	100	1-3/8	1-1/8	1-3/8	1-3/8

Line Sizing

(Continued)

TABLE 5 – Recommended Line Sizes for R-404A, R-507*

Capacity BTUH	Suction Line Size												Maximum Suction Line Riser Size						
	Suction Temperature												R404A/507 Suction Temperature °F						
	+40 F° Equivalent Lengths				+20 F° Equivalent Lengths				+10 F° Equivalent Lengths										
	25’	50’	100’	150’	25’	50’	100’	150’	25’	50’	100’	150’	40	20	10	-10	-20	-30	-40
1,000	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2
3,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	1/2	1/2	1/2	1/2	1/2
4,000	3/8	1/2	1/2	1/2	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8
6,000	1/2	1/2	1/2	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	1/2	1/2	5/8	5/8	7/8
9,000	1/2	5/8	5/8	5/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	5/8	7/8	7/8	7/8	7/8
12,000	1/2	5/8	7/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	1/2	7/8	7/8	7/8	7/8	1-1/8	1-1/8
15,000	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	5/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8
18,000	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	5/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8
24,000	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	5/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
30,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
36,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
42,000	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
48,000	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
54,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
60,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
66,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
72,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
78,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
84,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8
90,000	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8
120,000	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8	2-1/8

*NOTES:

1. Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size.
2. All sizes shown are for O.D. Type "L" copper tubing.
3. Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.

Line Sizing

(Continued)

TABLE 5A – Recommended Line Sizes for R-404A, R-507*(Continued)

Capacity BTUH	Suction Line Size																Liquid Line Size			
	Suction Temperature																Receiver to Expansion Value Equivalent Lengths			
	-10 F° Equivalent Lengths				-20 F° Equivalent Lengths				-30 F° Equivalent Lengths				-40 F° Equivalent Lengths							
	25’	50’	100’	150’	25’	50’	100’	150’	25’	50’	100’	150’	25’	50’	100’	150’	25’	50’	100’	150’
1,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	3/8	3/8
3,000	1/2	1/2	5/8	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	3/8	3/8	3/8	3/8
4,000	1/2	5/8	5/8	7/8	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	7/8	7/8	3/8	3/8	3/8	3/8
6,000	1/2	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7,4	7/8	3/8	3/8	3/8	3/8
9,000	5/8	7/8	7/8	7/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	5/8	7/8	7/8	1-1/8	3/8	3/8	3/8	3/8
12,000	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
15,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	1/2
18,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	3/8	3/8	1/2	1/2
24,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
30,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	1/2	1/2	1/2
36,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	1/2
42,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	5/8
48,000	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	5/8	5/8
54,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
60,000	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
66,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
72,000	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	5/8	5/8	5/8
78,000	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	1-5/8	2-1/8	5/8	5/8	5/8	5/8
84,000	1-3/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	5/8	5/8	5/8	7/8
90,000	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	5/8	5/8	7/8	7/8
120,000	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	1-5/8	2-1/8	2-1/8	2-5/8	5/8	5/8	7/8	7/8

*NOTES:

1. Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size.
2. All sizes shown are for O.D. Type ”L“ copper tubing.
3. Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.

Line Sizing

(Continued)

TABLE 6 – Recommended Line Sizes for R-448A and R-449A*

Capacity BTUH	Suction Line Size												Maximum Suction Line Riser Size						
	Suction Temperature												R-448A/R-449A Suction Temperature						
	+40 F° Equivalent Lengths				+20 F° Equivalent Lengths				+10 F° Equivalent Lengths										
	25’	50’	100’	150’	25’	50’	100’	150’	25’	50’	100’	150’	40	20	10	-10	-20	-30	-40
1,000	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2
3,000	3/8	3/8	1/2	1/2	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	3/8	3/8	1/2	1/2	1/2	1/2	5/8
4,000	3/8	1/2	1/2	1/2	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8
6,000	1/2	1/2	1/2	5/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	1/2	1/2	5/8	5/8	7/8
9,000	1/2	5/8	5/8	5/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	1/2	5/8	5/8	7/8	7/8	7/8	7/8
12,000	1/2	5/8	5/8	7/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	1/2	7/8	7/8	7/8	7/8	1-1/8	1-1/8
15,000	5/8	5/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	5/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8
18,000	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	5/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8
24,000	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	5/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
30,000	5/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
36,000	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8
42,000	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
48,000	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	7/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
54,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-3/8	1-3/8	1-5/8	1-5/8
60,000	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
66,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
72,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
78,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8
84,000	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8
90,000	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	1-5/8	2-1/8	2-1/8	2-1/8
120,000	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8

*NOTES:

1. Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size.
2. All sizes shown are for O.D. Type ”L“ copper tubing.
3. Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.

Line Sizing

(Continued)

TABLE 6A – Recommended Line Sizes for R-448A and R-449A*(Continued)

Capacity BTUH	Suction Line Size																Liquid Line Size			
	Suction Temperature																Receiver to Expansion Valve Equivalent Lengths			
	-10 °F Equivalent Lengths				-20 °F Equivalent Lengths				-30 °F Equivalent Lengths				-40 °F Equivalent Lengths							
	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'	25'	50'	100'	150'
1,000	3/8	3/8	1/2	1/2	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	1/2	1/2	5/8	3/8	3/8	3/8	3/8
3,000	1/2	1/2	5/8	5/8	3/8	3/8	1/2	1/2	3/8	1/2	1/2	5/8	1/2	1/2	5/8	7/8	3/8	3/8	3/8	3/8
4,000	1/2	5/8	5/8	7/8	3/8	1/2	1/2	5/8	1/2	1/2	5/8	5/8	1/2	5/8	7/8	7/8	3/8	3/8	3/8	3/8
6,000	1/2	5/8	7/8	7/8	1/2	1/2	5/8	7/8	1/2	1/2	5/8	7/8	5/8	5/8	7/8	7/8	3/8	3/8	3/8	3/8
9,000	5/8	7/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	5/8	7/8	7/8	5/8	7/8	7/8	1-1/8	3/8	3/8	3/8	3/8
12,000	7/8	7/8	7/8	1-1/8	5/8	7/8	7/8	7/8	5/8	7/8	7/8	7/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
15,000	7/8	7/8	1-1/8	1-1/8	5/8	7/8	7/8	7/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	3/8	3/8	3/8	3/8
18,000	7/8	7/8	1-1/8	1-1/8	7/8	7/8	7/8	1-1/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	3/8	3/8	3/8	1/2
24,000	7/8	1-1/8	1 -1/8	1-3/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8	1 -1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
30,000	1-1/8	1-1/8	1-3/8	1-3/8	7/8	7/8	1-1/8	1-1/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	3/8	3/8	1/2	1/2
36,000	1 -1 /8	1-1/8	1-3/8	1-3/8	7/8	1-1/8	1-1/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	3/8	1/2	1/2	1/2
42,000	1 -1 /8	1-3/8	1-3/8	1-5/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	3/8	1/2	1/2	1/2
48,000	1 -1 /8	1-3/8	1-3/8	1-5/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-1/8	1-3/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1/2	1/2	1/2	1/2
54,000	1-3/8	1-3/8	1-5/8	1-5/8	1-1/8	1-1/8	1-3/8	1-3/8	1-1/8	1-3/8	1-3/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	1/2	5/8
60,000	1-3/8	1-3/8	1-5/8	1-5/8	1 -1/8	1-1/8	1-3/8	1-5/8	1 -1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
66,000	1-3/8	1-5/8	1-5/8	1-5/8	1-1/8	1-3/8	1-3/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
72,000	1-3/8	1-5/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-5/8	1-5/8	1-5/8	1/2	1/2	5/8	5/8
78,000	1-3/8	1-5/8	1-5/8	1-5/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8	2-1/8	1/2	1/2	5/8	5/8
84,000	1-3/8	1-5/8	1-5/8	2-1/8	1-1/8	1-3/8	1-5/8	1-5/8	1-3/8	1-3/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1/2	5/8	5/8	5/8
90,000	1-5/8	1-5/8	2-1/8	2-1/8	1-3/8	1-3/8	1-5/8	2-1/8	1-3/8	1-5/8	1-5/8	2-1/8	1-5/8	1-5/8	2-1/8	2-1/8	1/2	5/8	5/8	7/8
120,000	1-5/8	2-1/8	2-1/8	2-5/8	1-3/8	1-5/8	2-1/8	2-1/8	1-3/8	1-5/8	2-1/8	2-1/8	1-5/8	2-1/8	2-1/8	2-5/8	5/8	5/8	7/8	7/8

*NOTES:

1. Sizes that are highlighted indicate maximum suction line sizes that should be used for risers. Riser size should not exceed horizontal size.
2. All sizes shown are for O.D. Type "L" copper tubing.
3. Suction line sizes selected at pressure drop equivalent to 2°F. Reduce estimate of system capacity accordingly.

ARGUS Nomenclature

Model Nomenclature (Example: ASHR9440ZNAMP1)

CU Family	Product Type	Compressor	Application Range	Nominal Capacity *R404A	Refrigerant	Power Supply	Unit Configuration (Application	Factory Installed Options	Generation
AS	H (Outdoor - remote)	S (Scroll)	9 (Commercial)	450 (3 significant digits, 3 digits for capacity)	Z R-404A R-448A R-449A R-452A R-407a)	AA (115/1/60)	M (microchannel with PSC fan motor)	S Silver	1 (1st)
	N (Indoor - remote)	R (Recip)	2 (low)			NA (208-230/1/60)	F (tube and fin with PSC fan motor	P Platinum	
						FA (208-230/3/60)	N (microchannel with high efficient, EC fan motor)	G Gold	
							H (tube and fin with high efficient, EC fan motor)	C Custom	

BOM Nomenclature (Example: 2JH200-PM)

First 4 to 7 digits follow same spec today (w/ New Prefix)	Feature Package	Unit Configuration	Additions
J (indoor), JH (outdoor), JL (indoor with controls, JLH (outdoor with controls)	Platinum (P)	M, F, N, H	W (disconnect switch, Z (e-coating)
J (indoor), JH (outdoor), JL (indoor with controls, JLH (outdoor with controls)	Silver (S)	M, F, N, H	W (disconnect switch, Z (e-coating)
J (indoor), JH (outdoor), JL (indoor with controls, JLH (outdoor with controls)	Gold (G)	M, F, N, H	W (disconnect switch, Z (e-coating)
J (indoor), JH (outdoor), JL (indoor with controls, JLH (outdoor with controls)	Custom (C)	M, F, N, H	L (adjustable LP control), A (air-defrost timer), E (electric defrost timer), F (liquid line filter drier and sight glass), R (oversized receiver) , H (heated receiver), W (disconnect switch), Z (e-coating), C (accumulator)

Troubleshooting Chart

This trouble-shooting chart is not designed to replace the training required for a professional refrigeration service person, nor is it comprehensive. As a trained professional, for your safety and others always be aware of the following issues:

- Terminal venting and electrocution
- Properties of refrigerant and other chemicals involved
- Proper compressor removal methods
- Proper system flushing, purging and leak testing methods
- Proper system charging methods
- Proper system evacuation method
- Start capacitor overheating issues

Complaint	Possible Causes
A. Compressor will not start - no hum	1. System component not functioning properly: • Control/contactor stuck in open position • Control off due to cold location • Thermostat not functioning properly 2. Line disconnect switch open 3. Circuit breaker tripped or fuse open or removed 4. Thermal protector not working properly 5. Wiring improper or loose 6. Compressor motor has a ground fault (also known as a short circuit to ground)
B. Compressor will not start - hums but trips on thermal protector	1. Improperly wired 2. Low voltage to compressor 3. System component, such as thermostat or control/contactor, not functioning properly 4. Compressor electrical problems: • Compressor motor has a winding open or shorted • Start capacitor not working properly • Relay does not close 5. Liquid refrigerant in compressor 6. Internal mechanical trouble in compressor.
C. Compressor starts, but does not switch off of start winding	1. Improperly wired 2. Low voltage to compressor 3. Compressor electrical problems: • Compressor motor has a winding open or shorted • Relay failing to open • Run capacitor not working properly 4. Discharge pressure too high 5. Internal mechanical trouble in compressor
D. Compressor starts and runs, but short cycles on thermal protector	1. Too much current passing through thermal protector: a. Extra sources of current draw b. Compressor motor has winding shorted 2. Low voltage to compressor (single phase) or unbalanced voltage (three-phase) 3. Compressor electrical problems, such as thermal protector or run capacitor not working properly 4. Discharge pressure too high 5. Suction pressure too high 6. Return gas too warm
E. Unit runs OK, but run cycle is shorter than normal (due to component(s) other than thermal protector)	1. System components, such as thermostat, control or contactor, not functioning properly 2. High pressure cut-out due to: a. Insufficient air or water supply b. Overcharge of refrigerant c. Air in system d. Water leak into refrigerant side of a water-utilizing system 3. Low pressure cut-out due to: a. Liquid line solenoid leaking b. Undercharge of refrigerant c. Restriction in expansion device

Start-up Information

IMPORTANT: This start-up information should be completely filled in for each installation and remain with the unit as a permanent record for future reference.

Project Name: ______________________________

Address of Installation: ______________________________

Installing Contractor Name: ______________________________

Address: ______________________________

Phone: ______________________________

Type of System (Cooler, Freezer, etc…):			
Design Box Temperature: _________ºF _________ºC		Thermostat setting : _________ºF _________ºC	
Condensing Unit System start-up date:			
Unit model #:		Evaporator(s) Manufacturer:	
Unit serial #:		Evaporator(s) QTY:	
Compressor model #:		Expansion valve - Manufacturer:	
Compressor serial #:		Expansion Valve Model #:	
Leak Check Procedure:			
Unit leak check by:			
Company:		Date:	
Refrigerant Type:		Total Charge:	
System evacuation # of times		Final micron:	
Ambient at start-up: _________ºF _________ºC		Operating box temperature: _________ºF _________ºC	
Defrost settings: / day		Minutes fail safe:	
Condensing unit electrical rating:	Volts:	Phase :	Hz:
Voltage at compressor terminals:	L1:	L2:	L3:
L1/L3Amperage at compressor:	L1:	L2:	L3:
Compressor discharge pressure: ____________ psig		Compressor suction pressure: ____________ psig	
Discharge line temperature at compressor _________ºF _________ºC			
Suction line temperature at compressor _________ºF _________ºC			
Superheat at compressor : _________ºF _________ºC		Superheat at evaporator : _________ºF _________ºC	
Suction line temperature at evaporator TX valve bulb: _________ºF _________ºC			

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