



Air-Cooled Condenser Installation & Operation

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Air-Cooled Condensers

Installation and Operation Guide

Applicable for Bohn, Larkin, Climate Control, and Chandler brands



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A2L Condensing Units

A2L condensing units function in much the same way as standard A1 condensing units with some exceptions. This manual describes recommendations and requirements unique to A2L condensing units.

Symbols

Listed below are the warning symbols and their meanings used on the A2L condensing units.



WARNING: Risk of fire/flammable materials

WARNING

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall only be installed outdoors.

Do not pierce or burn.

Be aware that refrigerants may not contain an odour.

In Canada, the French translation is:

MISE EN GARDE

N'utilisez pas de moyens pour accélérer le processus dégivrage ou pour nettoyer, autres que ceux recommandés par le fabricant.

L'appareil ne doit être installé qu'à l'extérieur.

Ne pas percer ni brûler.

Sachez que les fluides frigorigènes peuvent ne pas contenir d'odeur.

Installation Instructions

- This product shall not be installed within 6.1 m (20 feet) of any building opening.
- If this product is enclosed within a penthouse, lean-to, or other open structure, natural or mechanical ventilation shall be provided.
- Any pressure-relief devices and fusible plugs shall discharge to the atmosphere at a location not less than 4,57 m (15 ft) above the adjoining ground level and not less than 6,1 m (20 ft) from any window, ventilation opening, or exit in any building.
- Refrigerant circuit access ports located outdoors shall be secured to prevent unauthorized access.

Instructions for partial units with A2L Refrigerant

- Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.
- Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.
- Where safety shut off valves are required in the field-installed interconnecting refrigerant piping, the installation location of the valve in the REFRIGERATING SYSTEM, relative to the occupied spaces shall be provided.
- The maximum operating pressure is considered when connecting to any condensers.
- PARTIAL UNITS shall only be connected to an appliance suitable for the same refrigerant.

General Information

- information for spaces where refrigerant pipes are allowed
 - piping material, pipe routing, and installation shall include protection from physical damage in operation and service and be in compliance with national and local codes and standards, such as ANSI/ASHRAE 15, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed;
 - the installation of pipe-work shall be kept to a minimum;
 - pipe-work in the case of flammable refrigerants shall be protected and not be installed in an area where it can be damaged.
 - mechanical connections where connections are brazed or joined in the field shall be accessible for maintenance purposes;
 - provision shall be made for expansion and contraction of long runs of piping;
 - protection devices, piping, and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris;
 - piping in refrigeration systems shall be so designed and installed to minimize the likelihood of hydraulic shock damaging the system;
 - steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation;
 - flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces, and that they should be checked for mechanical damage annually;
 - precautions shall be taken to avoid excessive vibration or pulsation;
 - after completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements:

- The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.

- The test pressure after removal of pressure source shall be maintained for at least 1 h with no decrease of pressure indicated by the test gauge, with test gauge resolution not exceeding 5% of the test pressure.

- During the evacuation test, after achieving a vacuum level specified in the manual or less, the refrigeration system shall be isolated from the vacuum pump and the pressure shall not rise above 1500 microns within 10 min. The vacuum pressure level shall be specified in the manual and shall be the lesser of 500 microns or the value required for compliance with national and local codes and standards, which may vary between residential, commercial, and industrial buildings.

- See the refrigerant charging instruction section in the condenser IO manual H-IM-90 to determine the REFRIGERANT CHARGE needed and how to complete the REFRIGERANT CHARGE on the label to note the resulting total refrigerant charge for each refrigerating system per clause. Refer the below label on refrigerant charge located on the condensers.

LABEL REFRIGERANT CHARGE A2L

REFRIGERANT AMOUNT	
R454A	_____ lbs
R454C	_____ lbs
R455A	_____ lbs
P/N:22014901 REV-	

General Information (cont.)

- c) See correct working procedures section for information on handling, installation, cleaning, servicing and disposal of refrigerant;
- d) For A2L condensing units using FLAMMABLE REFRIGERANTS, instructions shall include the REFRIGERANT CHARGE mc in both SI and IP units
- e) Notice that servicing shall be performed only as recommended by Heatcraft;
- f) **WARNING - THIS UNIT SHALL ONLY BE CONNECTED TO AN APPLIANCE SUITABLE FOR THE SAME REFRIGERANT**

Qualification of workers

Working personnel for maintenance, service, and repair operations should be trained and qualified to work on A2L refrigeration systems. Personnel should have the appropriate technical training and experience necessary to be aware of hazards to which he or she is exposed in performing a task and of measures necessary to minimize the danger to themselves or other persons. Every working procedure that affects safety means shall only be carried out by competent persons after undergoing training of the procedures by national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

Examples for such working procedures are

- a) breaking into the refrigerating circuit;
- b) opening of sealed components;
- c) opening of ventilated enclosures.

General Information for Service Personnel

The below sections contain specific information for service personnel

Checks to the area

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the REFRIGERATING SYSTEM, sections listed below for service personnel shall be completed prior to conducting work on the system.

Work procedure

Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapour being present while the work is being performed.

General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e., non sparking, adequately sealed, or intrinsically safe.

Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available on hand. A dry chemical or CO₂ fire extinguisher should be adjacent to the charging area.

No ignition sources

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment shall be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times, the maintenance and service guidelines shall be followed. If in doubt, consult Heatcraft's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- a) the ventilation machinery and outlets are operating adequately and are not obstructed;
- b) if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- c) marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- d) refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- a) that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- b) that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- c) that there is continuity of earth bonding.

Repairs to sealed components

During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with Heatcraft's specifications.

Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.

Replace components only with parts specified by Heatcraft. Other parts can result in the ignition of refrigerant in the atmosphere from a leak.

NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

Cablling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity might not be adequate, or might need re- calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine can react with the refrigerant and corrode the copper pipework.

NOTE Examples of leak detection fluids are

- bubble method,
- fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to clause Removal and evacuation.

Removal and evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

- a) safely remove refrigerant following local and national regulations;
- b) purge the circuit with inert gas;
- c) evacuate (optional for A2L);
- d) purge with inert gas (optional for A2L);
- e) open the circuit by cutting or brazing.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is available.

Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

- a) Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.

- b) Cylinders shall be kept in an appropriate position according to the instructions.
- c) Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- d) Label the system when charging is complete (if not already).
- e) Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

- a) Become familiar with the equipment and its operation.
- b) Isolate the system electrically.
- c) Before attempting the procedure, ensure that:
 - i) mechanical handling equipment is available, if required, for handling refrigerant cylinders;
 - ii) all personal protective equipment is available and being used correctly;
 - iii) the recovery process is supervised at all times by a competent person;
 - iv) recovery equipment and cylinders conform to the appropriate standards.
- d) Pump down refrigerant system, if possible.
- e) if a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
- f) Make sure that cylinder is situated on the scales before recovery takes place.
- g) Start the recovery machine and operate in accordance with instructions.
- h) Do not overfill cylinders (no more than 80 % volume liquid charge).
- i) Do not exceed the maximum working pressure of the cylinder, even temporarily.
- j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
- k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

Labeling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e., special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable,

FLAMMABLE REFRIGERANTS. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult Heatcraft if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that FLAMMABLE REFRIGERANT does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

- l) Pump down refrigerant system, if possible.
- m) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
- n) Make sure that cylinder is situated on the scales before recovery takes place.
- o) Start the recovery machine and operate in accordance with instructions.
- p) Do not overfill cylinders (no more than 80 % volume liquid charge).
- q) Do not exceed the maximum working pressure of the cylinder, even temporarily.
- r) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
- s) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

Correct working procedures:

Commissioning

- i) Ensure that the floor area is sufficient for the REFRIGERANT CHARGE or that the ventilation duct is assembled in a correct manner.
- ii) Connect the pipes and carry out a leak test before charging with refrigerant.
- iii) Check safety equipment before putting into service.

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 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 units shipping base until it has been moved to the final location.

Note: Installation and maintenance to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment.

System Warranty

This equipment is designed to operate properly and produce rated capacity when installed in accordance with accepted industry standards. Failure to meet the following conditions may result in voiding of the system warranty:

1. System piping must be installed following industry standards for good piping practices.
2. Inert gas must be charged into piping during welding.
3. System must be thoroughly leak checked and evacuated before initial charging. High vacuum gauge capable of reading microns is mandatory. Dial indicating pressure gauges are not acceptable.
4. Power supply to system must meet the following conditions:
 - a. Voltage for 208/230 motors not less than 195 volts or more than 253 volts.
 - b. All other voltages must not exceed +/- 10% of nameplate ratings.
 - c. Phase imbalance not to exceed 2%.
5. All controls and safety switch circuits properly connected per wiring diagram.
6. Factory installed wiring must not be changed without written factory approval.

Installation

Note: Installation and maintenance to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment.

Caution: Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

Unit Location

Units are designed for outdoor application and may be mounted on a roof or concrete slab (ground level installation). Roof mounted units should be installed level on steel channels or an I-beam frame to support the unit above the roof. Use of vibration pads or isolators is recommended. The roof must be strong enough to support the weight of the unit. Concrete slabs used for unit mounting should be installed level and be properly supported to prevent settling. A one-piece concrete slab with footings extending below the frost line is recommended.

The condenser should be located far enough away from any wall or other obstruction to provide sufficient clearance for air entrance. Do not attach ductwork to the coil inlet or fan outlet. Care should be taken to avoid air recirculation conditions that can be caused by sight screening, walls, etc. Also keep unit fan discharge away from any building air intakes. See page 4 for space and location requirements.

Sound Vibration

Units should be installed away from occupied spaces and above or outside of utility areas, corridors and auxiliary spaces to reduce the transmission of sound and vibration to occupied spaces. The refrigerant piping should be flexible enough to prevent the transmission of noise and vibration from the unit into the building. If the refrigerant lines are to be suspended from the structure of the building, isolation hangers should be used to prevent the transmission of vibration. Where piping passes through a wall, it is advisable to pack fiberglass and sealing compound around the lines to minimize vibration and retain flexibility in the lines.

The unit needs to be secured in its final location. Holes are provided in the base runner for this purpose.

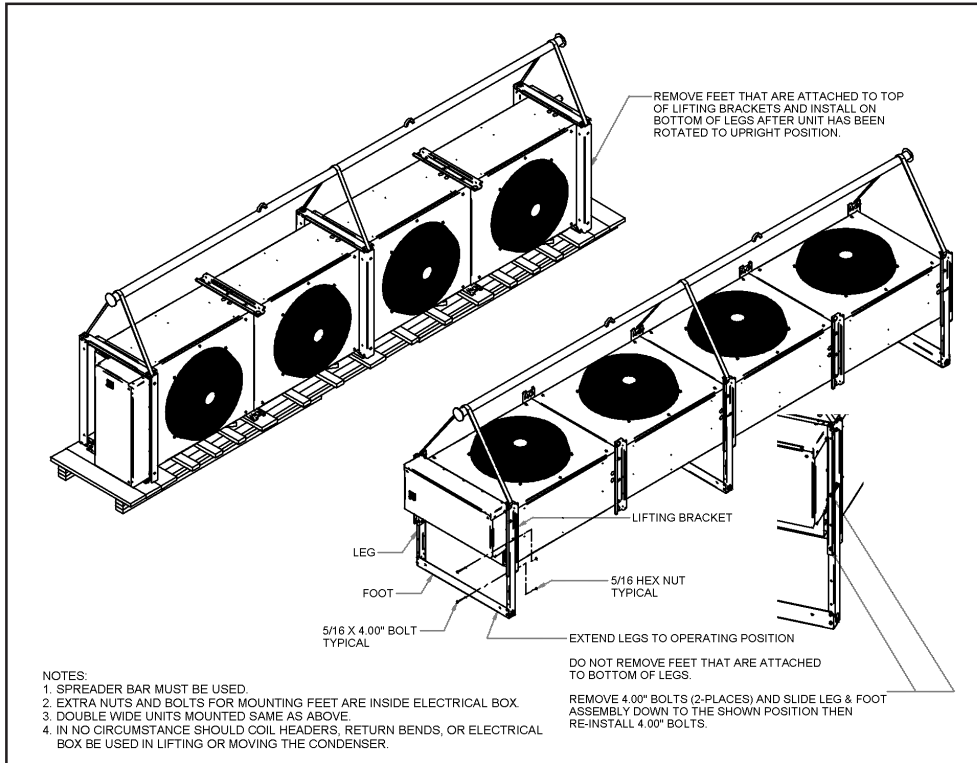
Warning: This equipment may contain a substance which harms the public health and environment by destroying ozone in the upper atmosphere. Venting of certain refrigerants to the atmosphere is illegal. Refrigerant recovery devices must be used when installing or servicing this product. Consult your local codes for requirements in your location.

Warning: There may be more than one source of electrical current in this unit. Do not service before disconnecting all power supplies.

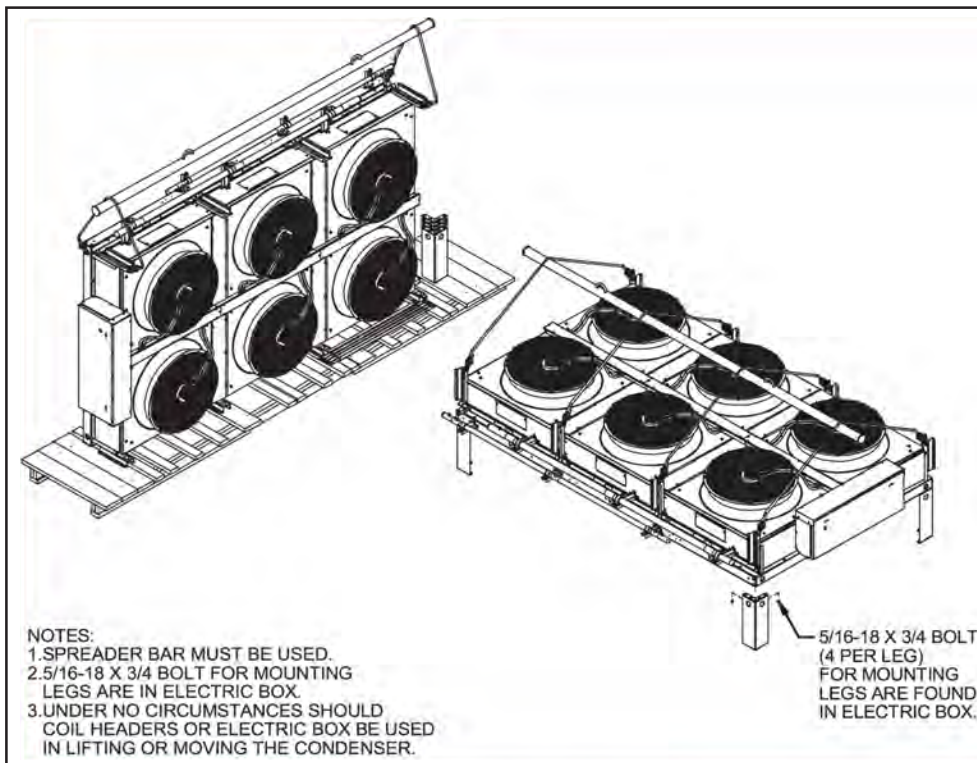
Rigging Instructions

- 1). Spreader bar must be used for all rigging.
- 2). Under no circumstance should coil connections, coil headers, return bends, or electrical box be used in lifting or moving the condenser.
- 3). Under no circumstance should any person be under the condenser.
- 4). If there are more than four lifting points on the condenser, more than four lifting points should be used.
- 5). Under no circumstance should the condenser lifting points be used to lift a condenser that has been attached to other equipment, like a steel frame. If condenser has been attached to other equipment, use lifting points provided on other equipment to lift complete assembly.

Drawing 1. Rigging Instructions for Standard Air-Cooled Condenser



Drawing 2. Rigging Instructions for Air-Cooled Condenser



Space and Location Requirements

The most important consideration which must be taken into account when deciding upon the location of air-cooled equipment is the provision for a supply of ambient air to the condenser, and removal of heated air from the condenser area. Where this essential requirement is not adhered to, it will result in higher head pressures, which cause poor operation and possible eventual failure of equipment. Units must not be located in the vicinity of steam, hot air or fume exhausts.

Another consideration which must be taken is that the unit should be mounted away from noise sensitive spaces and must have adequate support to avoid vibration and noise transmission into the building. Units should be mounted over corridors, utility areas, rest rooms and other auxiliary areas where high levels of sound are not an important factor. Sound and structural consultants should be retained for recommendations.

Consideration should also be made to make sure there is sufficient space for removal/replacement of microchannel coils (when supplied). A minimum of one unit width should be allowed on the header end of the unit to provide sufficient clearance.

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 an area where it is enclosed by three walls the unit must be installed as indicated for units in a pit.

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 4 feet.

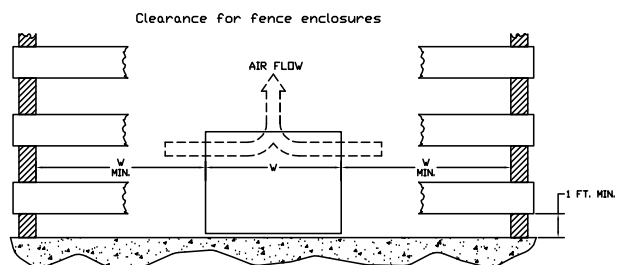
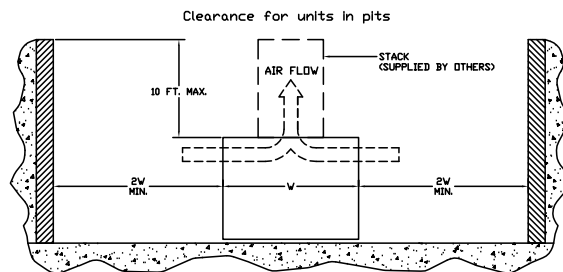
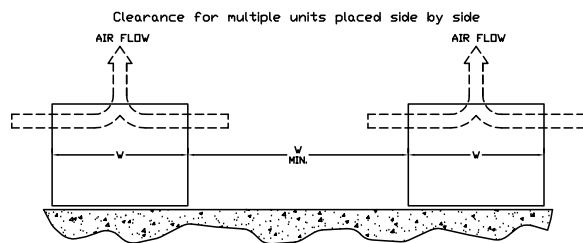
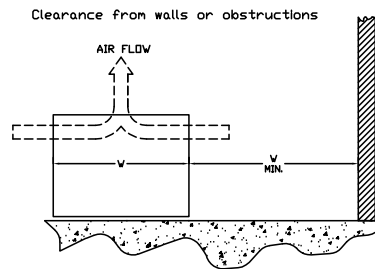
Units in Pits

The top of the unit should be level with the top of the pit, and side distance increased to "2W".

If the top of the unit is not level with the top of pit, discharge cones or stacks must be used to raise discharge air to the top of the pit. This is a minimum requirement.

Decorative Fences

Fences must have 50% free area, with 1 foot undercut, a "W" minimum clearance, and must not exceed the top of unit. If these requirements are not met, unit must be installed as indicated for "Units in pits".



* "W" = Total width of the condenser.

Typical Arrangements

Figure 1 illustrates a typical piping arrangement involving a remote condenser located at a higher elevation, as commonly encountered when the condenser is on a roof and the compressor and receiver are on grade level or in a basement equipment room.

In this case, the design of the discharge line is very critical. If properly sized for full load condition, the gas velocity might be too low at reduced loads to carry oil up through the discharge line and condenser coil. Reducing the discharge line size would increase the gas velocity sufficiently at reduced load conditions; however, when operating at full load, the line would be greatly undersized, and thereby create an excessive refrigerant pressure drop. This condition can be overcome in one of two following ways:

1. The discharge line may be properly sized for the desired pressure drop at full load conditions and an oil separator installed at the bottom of the trap in the discharge line from the compressor.
2. A double riser discharge line may be used as shown in Figure 2. Line "A" should be sized to carry the oil at minimum load conditions and the line "B" should be sized so that at the full load conditions both lines would have sufficient flow velocity to carry the oil to the condenser.

For more complete information, refer to the ASHRAE Handbook on Systems.

Figure 1

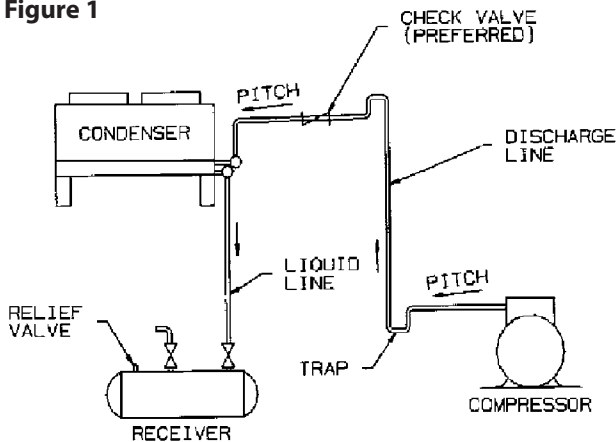
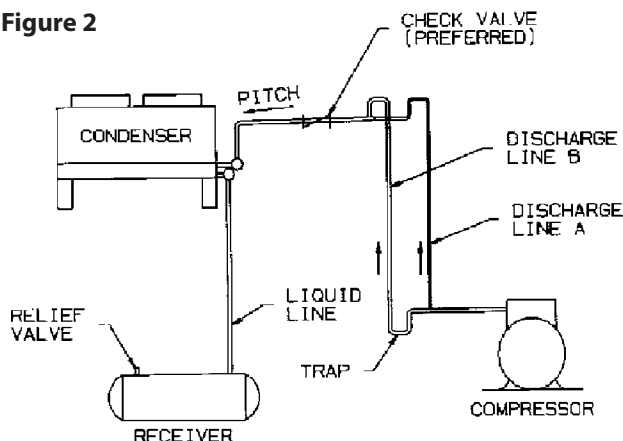


Figure 2



Notes:

1. All oil traps are to be as short in radius as possible. Common practice is to fabricate the trap using three 90 degrees ells.
2. Pressure relief valves are recommended at the condenser for protection of the coil.
3. A drain line check valve is recommended for applications where the condenser may be at a lower temperature than the receiver.

Installation, Refrigerant Piping

Install piping according to standard accepted refrigeration practice. The following recommendations should be adhered to:

1. See Tables 1, 2 and 3 for discharge and liquid drain line sizes for remote condenser connections.
2. Use only refrigeration grade copper tubing.
3. Soft solder joints are not acceptable.
4. Put dry nitrogen through lines while brazing.
5. Do not leave dehydrated piping or components open to the atmosphere any longer than is absolutely necessary.
6. Inverted traps should be located near coil inlets as shown in Figures 1 & 2.

Discharge Lines

The proper design of discharge lines involves two objectives:

1. To minimize refrigerant pressure drop, since high pressure losses cause increased compressor horsepower per ton of refrigerant.
2. To maintain sufficiently high gas velocity to carry oil through to the condenser coil and receiver at all loading conditions.

Table 1. Tons of Refrigeration

Line Size Type L Copper OD	Discharge Line						Drain Line Velocity 100 FPM Refrigerant	
	R-22 Sat. Suction Temp (°F)			R-404A/R-507 Sat. Suction Temp (°F)			R-22	R-404A/R-507
	-40	0	40	-40	0	40		
1/2	0.75	0.8	0.85	0.56	0.63	0.7	2.3	1.5
5/8	1.4	1.5	1.6	1.0	1.2	1.3	3.7	2.3
7/8	3.7	4.0	4.2	2.7	3.1	3.4	7.8	4.9
1-1/8	7.5	8.0	8.5	5.5	6.3	7.0	13.2	8.3
1-3/8	13.1	14.0	14.8	9.6	10.9	12.1	20.2	12.6
1-5/8	20.7	22.0	23.4	15.2	17.2	19.1	28.5	17.9
2-1/8	42.8	45.7	48.5	31.4	35.6	39.5	49.6	31.1
2-5/8	75.4	80.4	85.4	55.3	62.8	69.5	76.5	48.0
3-1/8	120.2	128.2	136.2	87.9	99.8	110.5	109.2	68.4
3-5/8	178.4	190.3	202.1	130.5	148.1	164.0	147.8	92.6
4-1/8	251.1	267.8	284.4	183.7	208.4	230.9	192.1	120.3

Source: ASHRAE Refrigeration Handbook:

1. Line sizes based on pressure drop equivalent to 1°F per 100 equivalent feet.
2. Values in Table are based on 105°F condensing temperature. Multiply Table capacities by the factors in Table 2 for other condensing temperatures.
3. If subcooling is substantial or the line is short, a smaller line size may be used. Applications with very little subcooling or very long lines may require larger sizes

Table 2. Tons of Refrigeration

Line Size Type L Copper OD	Discharge Line												Drain Line Velocity 100 FPM Refrigerant			
	R-454A Sat. Suction Temp (°F)			R-454B Sat. Suction Temp (°F)			R-454C Sat. Suction Temp (°F)			R-455A Sat. Suction Temp (°F)			R-454A	R-454B	R-454C	R-455A
	-40	0	40	-40	0	40	-40	0	40	-40	0	40				
1/2	1.16	1.33	1.48	1.92	2.17	2.41	0.87	1.01	1.13	0.99	1.14	1.29	1.81	2.36	1.63	1.65
5/8	2.10	2.40	2.68	3.48	3.92	4.35	1.57	1.82	2.05	1.78	2.07	2.33	2.91	3.79	2.62	2.65
7/8	5.22	5.98	6.67	8.66	9.76	10.83	3.91	4.54	5.11	4.44	5.15	5.80	6.03	7.86	5.43	5.49
1-1/8	10.17	11.65	12.99	16.87	19.02	21.10	7.62	8.84	9.95	8.64	10.03	11.30	10.29	13.41	9.25	9.36
1-3/8	17.21	19.71	21.99	28.54	32.18	35.70	12.90	14.95	16.83	14.62	16.96	19.13	15.67	20.42	14.10	14.26
1-5/8	26.57	30.42	33.94	44.07	49.69	55.12	19.92	23.08	25.99	22.57	26.19	29.53	22.18	28.90	19.95	20.18
2-1/8	53.08	60.78	67.81	88.04	99.27	110.12	39.80	46.12	51.93	45.10	52.33	58.99	38.58	50.28	34.71	35.11
2-5/8	91.22	104.46	116.54	151.29	170.59	189.24	68.39	79.25	89.23	77.50	89.92	101.37	59.50	77.54	53.52	54.15
3-1/8	142.33	162.97	181.82	236.04	266.15	295.24	106.69	123.64	139.22	120.92	140.29	158.16	84.92	110.68	76.40	77.29
3-5/8	207.60	237.71	265.20	344.28	388.21	430.65	155.62	180.35	203.06	176.37	204.63	230.69	114.86	149.69	103.33	104.54
4-1/8	288.15	329.94	368.10	477.88	538.85	597.75	216.01	250.33	281.86	244.81	284.04	320.21	149.31	194.59	134.32	135.89

Source: ASHRAE Refrigeration Handbook:

1. Line sizes based on pressure drop equivalent to 1°F per 100 equivalent feet.
2. Values in Table are based on 105°F condensing temperature. Multiply Table capacities by the factors in Table 2 for other condensing temperatures.
3. If subcooling is substantial or the line is short, a smaller line size may be used. Applications with very little subcooling or very long lines may require larger sizes

Discharge Lines (cont.)

Table 3. Condensing Temperature Correction Factor

Condensing Temperature	Discharge Line									
	R-22	R-404A	R-507	R-407C	R-410A	R-134a	R-454A	R-454B	R-454C	R-455A
90	0.88	0.922	0.924	0.872	0.889	0.882	0.96	0.95	0.97	0.97
100	0.95	0.974	0.975	0.957	0.963	0.961	1.01	1.02	1.02	1.02
110	1.04	1.009	1.005	1.036	1.032	1.026	1.06	1.07	1.06	1.06
120	1.10	1.026	1.014	1.009	1.096	1.078	1.1	1.12	1.1	1.09
130	1.18	1.043	1.024	1.182	1.160	1.156	1.13	1.16	1.12	1.11

Electrical Wiring

The electrical installation should be in accordance with National Electrical Code, local codes and regulations. Proper overcurrent protection should be provided for the fan motors.

All standard motors have internal inherent overload protectors. Therefore, contactors can be used instead of starters requiring thermal protectors, eliminating the problem of furnishing the proper heating elements.

All air-cooled condensers are furnished with either single-phase or three-phase fan motors which are identified by the unit dataplate.

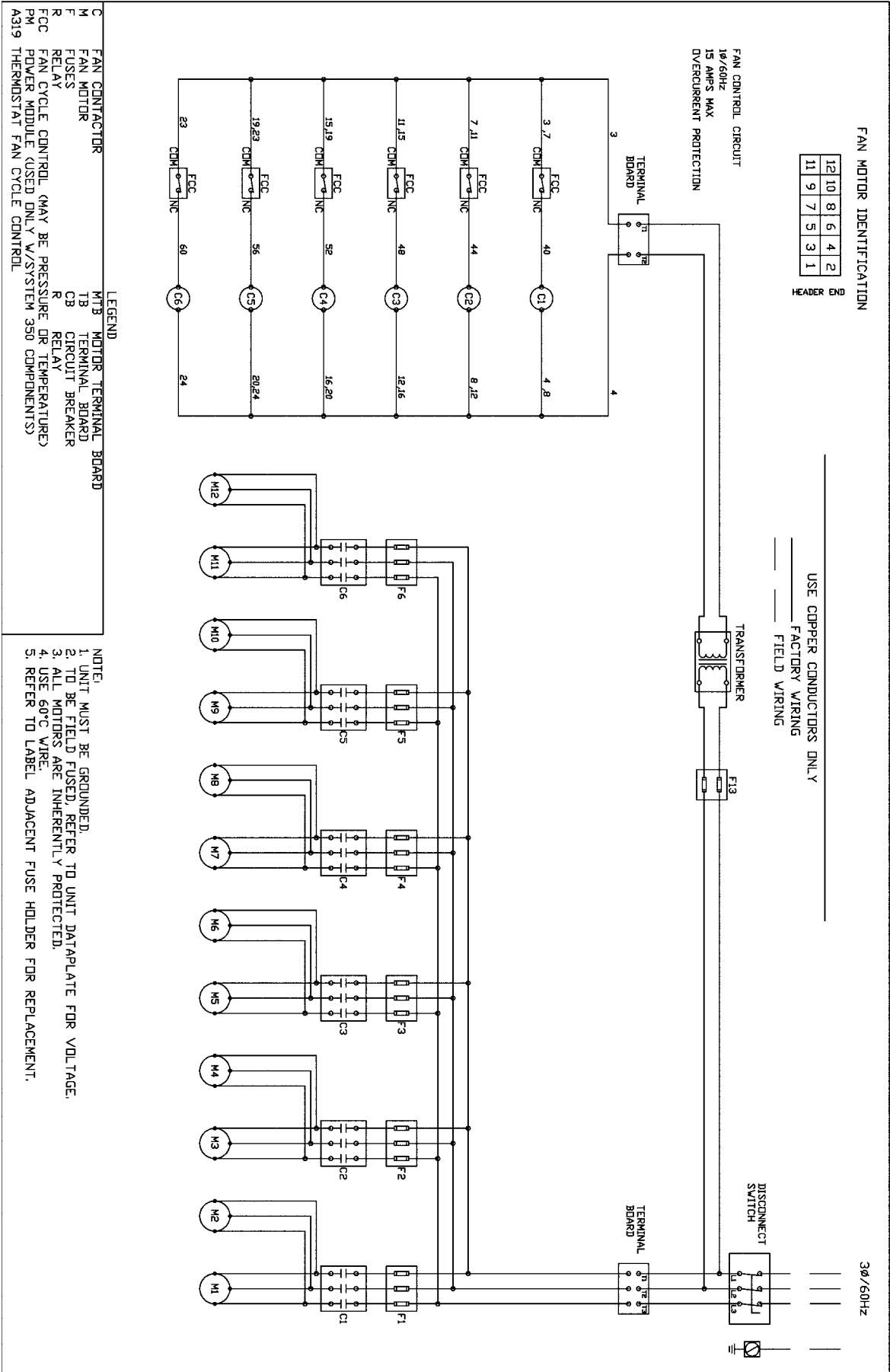
Electrical leads from each motor terminate at the unit junction box. Field connections must be made from these leads in accordance with local, state and national codes.

Three-phase motors must be connected to three-phase power of voltage to agree with motor and unit dataplate.

The motors are wired into a common junction box. Where fan cycling is furnished and factory installed, the motors are completely wired through the control and to the contactors. The motors must be checked for proper rotation. Be sure to check that motor voltage and control connection agree with electric services furnished.

WARNING: There may be more than one source of electrical current in this unit. Do not service before disconnecting all power supplies.

Diagram 1. Typical Condenser Wiring Diagram with Fan Cycle Controls



Start-Up

Check for proper fan rotation. Air is drawn through the coil on all units. Be sure the fans turn freely.

Rotation of the motors and blades should be in a "CW" direction looking at the unit from the blade side. On three phase units, it may be necessary to reverse two of the three power leads to the unit.

NOTE: The manifold assembly is not designed to support field piping. Any damages to the condenser due to excessive weight, pressure or vibration will not be covered by our standard warranty.

Discharge Gas Pulsation

Gas pulsations in a refrigeration system are most commonly associated with the compressor and connecting discharge piping. Variations in the system piping configuration, line sizing, operating pressures and compressor and component mounting all contribute to the presence and magnitude of these pulsations.

The vibration and movement of components caused by the pulsations may result in line breakage or damage to the condenser. In order to eliminate discharge pulsations and the potential for related condenser damage, it is recommended that a discharge muffler be installed in the refrigeration piping. In all cases, the recommendations of the compressor or muffler manufacturer must be followed when selecting these components.

Operation Winter Operation Head Pressure Control

The capacity of an air-cooled condenser varies with the difference between the entering air dry bulb temperature and the condensing temperature of the refrigerant. Since air temperature in some regions varies as much as 100° from summer to winter, some means must be employed to keep the condensing temperature sufficiently high to insure proper operation of the refrigerant expansion valve during low ambient operation, and also allow sufficient capacity so that excessively high condensing temperatures do not result during high ambient conditions.

The low limit of the head pressure is dependent upon the required pressure drop across the thermostatic expansion valve. For normal air conditioning applications, head pressure should be maintained above a condensing temperature corresponding to 90° F. This, in effect, corresponds to a normal lower limit of about 60° F ambient air. Since air conditioning is not normally required at these lower ambient temperatures, condenser head pressure control may not always be necessary. However for those applications which are of such a nature that operation is required below 60° F ambient air temperature, additional head pressure control will be required.

Fan Cycling

A decrease in ambient air temperature results in a capacity increase in the air-cooled condenser. This capacity increase is directly proportional to the temperature difference between the condensing temperature and the temperature of the ambient air entering the condenser. Since air-cooled condensers are often required to operate over a wide range of ambient air temperatures and variable loading conditions, provisions must be made to maintain the overall system balance. Any air-cooled condenser tends to run at a low head pressure when operating in a low ambient air temperature. Low head pressures could result in poor expansion valve operation and poor system operation.

The cycling of condenser fans provides an automatic means of maintaining head pressure control, within reasonable limits, at lower ambient air temperatures. A fan cycling control system allows fans to cycle in sequence by sensing either ambient temperature or condensing pressures. However, care must be used by the engineer or installing contractor in making adjustments to prevent short cycling of the fan motors. Short cycling is normally caused by too close a differential in the control settings or set points. If flooding valves are used with fan cycling, they must be set to follow the fan cycling.

Recommended differential settings for ambient sensing thermostats are 5° F and a minimum of 35 PSIG differential for pressure switches. However, system or climate conditions vary and the controls may require further field adjustment to provide optimum system performance and prevent short cycling.

Any fan cycle that is less than three minutes is considered short cycling, and could be detrimental to the system. Adjust controls accordingly. It is also recommended that the fan closest to the header end of the condenser be wired to run continuously, whenever the compressor(s) is (are) operational. Cycling all of the fans off usually results in rapid, short cycling of the fans and erratic head pressure control.

If additional head pressure control is necessary beyond letting the lead fan run, we recommend adding variable speed or flooding controls. If cycling the header fan is necessary for adequate head pressure control, we recommend cycling on pressure. Ambient sensing thermostats should never be used to cycle the lead fan.

Fans must not cycle in multiples except on double wide single circuit condensers where they may cycle in pairs (one motor on each side). Do not cycle more than two fans at a time on double wide condensers and only one fan at a time on single wide condensers.

Fan Cycling Head Pressure Controls

Condenser fans are cycled to maintain adequate head pressure. Ambient and pressure fan cycling are available as optional equipment.

Ambient fan cycling cycles fans in response to the ambient air temperature. This control is ideal for multi-circuited condensers or for systems operating in mild ambient conditions. See table 3 for minimum ambient temperatures for fan cycling. Set points for thermostats will vary depending on the number of fans and condenser design T.D. See table 4 for recommended set points.

Pressure fan cycling cycles fans in response to condenser pressure. This style of control is more appropriate where the load on the condenser will vary due to multiple compressor operation or stages of unloading or systems incorporating heat reclaim or hot gas defrost.

Variable Speed

Condenser head pressure control is provided by varying the air flow through the condenser by changing the RPM of the condenser fan. This control package is offered in combination with ambient fan cycling. The fan motor next to the header end of the condenser is the variable speed fan.

The remainder of the fans are constant speed and are cycled separately using ambient sensing thermostats. On condensers with two rows of fans, two variable speed fans are provided (one per row) and the remainder of the fans are constant speed and are cycled in pairs.

Splitting Controls

Additional head pressure can be provided by valving off a portion of the condenser circuit and removing that portion from the refrigeration circuit. This is often referred to as splitting a condenser. In addition to providing a means of head pressure control, this control will reduce the amount of refrigerant required to operate the condenser with a flooded head pressure control.

Condenser splitting is recommended as a seasonal adjustment controlled by ambient temperature. An initial setting of 50° to 55° F with a 20° F differential is recommended. A pressure switch is also provided as a backup control to prevent high head pressures from occurring during heavy load conditions.

On condensers with a single row of fans the control package consists of an ambient sensing thermostat, a pressure switch sensing condensing pressure and a splitting relay. The splitting relay provides a set of dry contacts to control the valves required to split the condenser (valves supplied by others).

On condensers with double rows of fans, additional controls and contactors are provided to cycle all of the fans on the side of the condenser which has been split off.

Except as noted above, the splitting packages do not control fan cycling. It is recommended that fan cycling be controlled by combining the splitting package with pressure fan cycling.

Flooding Head Pressure Controls

Another means of head pressure control is to change the condenser capacity by filling the inside of the condenser with liquid refrigerant. Flooding controls are ideal for condensers operating in low ambient conditions (beyond the limits of fan cycling controls) or under partial load conditions. These controls require additional refrigerant charge to flood the condenser. This additional refrigerant charge can often be reduced by incorporating the flooded control with one of the fan cycle controls previously described.

Several styles of flooding valves or combinations of valves are available. Contact the valve manufacturer for specific recommendations.

Refrigerant Charge

The refrigerant charge for summer operation can be found in tables 14 to 18. This table also contains the additional charge required by flooding style controls.

Tables 9 to 13 contains the recommended flooding charge required when combining fan cycling with flooding valves.

Table 4. Minimum Ambient for Fan Cycling for Standard Air-Cooled Condensers

Number of Fans		Design T.D.*				
Single Row	Double Row	30	25	20	15	10
2	4	35	45	55	60	70
3	6	15	30	40	55	65
4	8	0	15	30	45	60
5	10	0	10	20	35	55
6 / 7	12 / 14	0	0	10	30	50

* Based on maintaining 90°F minimum condensing temperature.

Table 5. Mechanical Fan Cycling Thermostat Settings for Standard Air-Cooled Condensers

Number of Fans

Single Row	Double Rows	Design T.D.	Thermostat Setting				
			1	2	3	4	5
2	4	30	60				
		25	65				
		20	70				
		15	75				
		10	80				
3	6	30	60	40			
		25	65	55			
		20	70	60			
		15	75	65			
		10	80	65			
4	8	30	60	50	30		
		25	65	55	40		
		20	70	65	50		
		15	75	70	60		
		10	80	75	70		
5	10	30	60	55	45	30	
		25	65	60	50	35	
		20	70	65	60	40	
		15	75	70	65	55	
		10	80	75	70	65	
6 / 7	12 / 14	30	55	50	40	30	25
		25	65	60	55	45	35
		20	70	65	60	50	40
		15	75	70	65	60	50
		10	80	75	70	65	60

Table 6. Electronic Fan Cycling Thermostat Settings * for Standard Air-Cooled Condensers

Number of Fans		A350 Design T.D.	Set Point	S350 Temperature Stage Modules			
Single Row	Double Rows			Offset Settings			
				2	3	4	5
2	4	30	60				
		25	65				
		20	70				
		15	75				
		10	80				
3	6	30	60	20			
		25	65	10			
		20	70	10			
		15	75	10			
		10	80	15			
4	8	30	60	10	30		
		25	65	10	25		
		20	70	5	20		
		15	75	5	15		
		10	80	5	10		
5	10	30	60	5	15	30	
		25	65	5	15	30	
		20	70	5	10	30	
		15	75	5	10	20	
		10	80	5	10	15	
6 / 7	12 / 14	30	55	5	15	25	30
		25	65	5	10	20	30
		20	70	5	10	20	30
		15	75	5	10	15	25
		10	80	5	10	15	20

* Johnson Controls Style S350 operation.
5° differential set on all modules. All modules set in the “heating” mode.

Table 7. Pressure Chart for Standard Air-Cooled Condensers

Number of Fans		Design T.D.	Refrigerant	Control Settings				
Single Row	Double Rows			Pressure Switch Cut-In Settings				
				PC1	PC2	PC3	PC4	PC5
2	4	20	R134a	147				
			R22	215				
			R404A	220				
3	6	20	R134a	147	155			
			R22	215	245			
			R404A	220	247			
4	8	20	R134a	147	155	160		
			R22	215	231	247		
			R404A	220	238	255		
5	10	20	R134a	147	153	156	160	
			R22	215	225	236	247	
			R404A	220	238	250	260	
6 / 7	12 / 14	20	R134a	147	150	153	157	160
			R22	215	223	230	239	247
			R404A	220	238	245	255	265

Based on 20° T.D.;
For (R404A/R507) set cutout 35 PSIG below cut-in; for (R134A) set cutout 25 PSIG below cut-in.
Fan on header end to remain on whenever compressor is operating.

Table 8. Pressure chart for Standard Air Cooled Condensers Electronic Fan Cycling Thermostat Settings

Single Row	Double Rows	Design T.D.	Refrigerant	PC1	PC2	PC3	PC4	PC5
2	4	20	R454A	269				
			R454B	315				
			R454C	237				
			R455A	272				
3	6	20	R454A	269	306			
			R454B	315	361			
			R454C	237	270			
			R455A	272	307			
4	8	20	R454A	269	287	306		
			R454B	315	337	361		
			R454C	237	253	270		
			R455A	272	289	307		
5	10	20	R454A	269	276	291	306	
			R454B	315	324	342	361	
			R454C	237	244	257	270	
			R455A	272	279	293	307	
6/7	12/14	20	R454A	269	276	283	291	306
			R454B	315	324	333	342	361
			R454C	237	244	250	257	270
			R455A	272	279	286	293	307

Table 9. Refrigerant Charge for Fan Cycling plus Flooded Condenser (lbs. R-404A) on Standard Air-Cooled Condensers

Model	Sum-mer Charge	25°TD					20°TD					15°TD					10°TD				
		+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F
S01-A007	7	6	7	8	8	9	7	8	9	9	9	9	9	10	10	10	10	10	10	10	10
S01-A009	9	8	11	12	12	13	10	12	13	13	14	12	13	14	14	14	13	14	15	14	15
S02-A011	9	1	5	7	8	9	4	7	9	10	10	6	9	11	12	11	9	12	12	13	13
S02-A015	14	2	8	11	12	13	6	11	14	15	15	11	14	16	17	18	15	17	19	19	20
S02-A017	18	3	10	15	16	17	8	15	18	19	20	14	19	22	22	23	20	23	25	25	25
S03-A022	20	0	3	9	12	14	0	9	15	16	18	0	16	20	21	22	0	22	25	26	27
S03-A026	27	0	3	12	15	18	0	11	18	21	24	0	19	25	27	29	0	27	31	33	35
S04-A029	46	0	0	7	15	20	0	5	21	27	32	0	20	34	40	44	0	34	48	53	55
S04-A034	64	0	0	10	19	27	0	7	28	35	42	0	26	46	52	57	0	45	64	69	73
S05-A037	58	0	0	0	5	13	0	0	15	23	30	0	0	35	40	47	0	0	55	58	63
S05-A044	78	0	0	0	7	18	0	0	20	31	40	0	0	45	55	62	0	0	71	79	85
S06-A053	93	0	0	0	0	5	0	0	7	22	34	0	0	34	52	62	0	0	60	82	91
S07-A061	107	0	0	0	0	0	0	0	0	11	26	0	0	0	45	62	0	0	0	79	99
D04-A021	17	3	11	16	17	18	8	15	19	20	21	14	20	23	23	24	20	25	26	26	27
D04-A029	26	4	15	22	25	27	12	22	27	29	31	20	28	32	34	35	28	35	37	38	39
D04-A034	36	5	20	29	32	35	15	28	35	38	40	26	36	42	44	45	37	45	49	50	51
D06-A044	40	0	5	18	24	28	0	16	28	33	36	0	28	38	42	45	0	40	48	51	53
D06-A051	53	0	6	25	31	38	0	23	38	44	49	0	39	52	56	61	0	55	65	68	72
D08-A058	95	0	0	15	29	40	0	11	43	54	63	0	39	70	79	86	0	67	98	104	109
D08-A068	127	0	0	20	38	52	0	15	56	71	83	0	52	93	104	113	0	90	129	137	144
D10-A074	114	0	0	0	11	27	0	0	31	47	61	0	0	70	84	95	0	0	109	121	129
D10-A088	157	0	0	0	14	35	0	0	40	62	80	0	0	91	110	125	0	0	142	158	169
D12-A106	183	0	0	0	0	10	0	0	15	45	67	0	0	68	106	125	0	0	120	168	182
D14-A122	215	0	0	0	0	0	0	0	0	22	52	0	0	0	90	123	0	0	0	158	194

See Model Cross Reference Table # 19.

Table 10. Refrigerant Charge for Fan Cycling plus Flooded Condenser (lbs. R454B) on Standard Air Cooled Condensers

Model	Summer Charge	25°TD					20°TD					15°TD					10°TD				
		+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F
1	7	6	7	8	8	8	7	8	9	9	9	8	9	9	9	9	9	9	10	10	10
2	9	8	10	11	11	12	9	11	12	12	13	11	12	13	13	14	13	13	14	14	14
3	9	1	5	7	8	8	3	7	9	9	9	6	9	10	11	11	8	11	12	12	12
4	13	2	7	10	12	13	6	10	13	14	15	10	13	15	16	17	14	16	18	18	18
5	17	2	10	14	15	16	8	14	17	18	19	13	18	20	21	21	18	22	23	24	24
6	19	0	2	9	11	13	0	9	14	15	17	0	15	19	20	21	0	21	23	24	25
7	26	0	3	11	14	17	0	10	17	20	22	0	18	23	25	27	0	25	29	31	33
8	44	0	0	7	14	19	0	5	20	26	30	0	18	32	38	41	0	32	45	50	52
9	60	0	0	9	18	25	0	7	27	33	39	0	25	44	49	54	0	42	61	65	68
10	55	0	0	0	5	13	0	0	15	21	28	0	0	33	38	44	0	0	51	54	60
11	74	0	0	0	7	17	0	0	19	29	38	0	0	43	52	59	0	0	67	74	80
12	87	0	0	0	0	5	0	0	7	21	32	0	0	32	49	59	0	0	57	77	86
13	101	0	0	0	0	0	0	0	0	10	25	0	0	0	42	59	0	0	0	74	93
14	16	2	10	15	16	17	8	15	18	19	20	13	19	21	22	22	18	23	25	25	25
15	25	3	15	21	23	25	11	21	26	27	29	19	27	30	32	33	27	33	35	36	37
16	34	4	19	27	30	33	15	27	33	36	38	25	34	40	42	43	35	42	46	47	48
17	38	0	4	17	22	26	0	15	27	31	34	0	26	36	39	42	0	37	45	48	50
18	50	0	6	23	30	35	0	21	36	41	46	0	37	49	53	57	0	52	61	64	68
19	89	0	0	14	27	37	0	10	40	50	59	0	37	66	74	81	0	63	92	98	102
20	120	0	0	19	36	49	0	14	53	67	78	0	49	87	98	106	0	84	121	129	135
21	107	0	0	0	10	25	0	0	29	44	57	0	0	66	79	89	0	0	103	113	121
22	147	0	0	0	13	33	0	0	38	58	75	0	0	85	103	117	0	0	133	148	159
23	172	0	0	0	0	9	0	0	14	42	63	0	0	63	100	117	0	0	113	158	171
24	202	0	0	0	0	0	0	0	0	21	49	0	0	0	85	115	0	0	0	149	182

See Model Cross Reference Table # 19.

Table 11. Refrigerant Charge for Fan Cycling plus Flooded Condenser (lbs. R455A) on Standard Air Cooled Condensers

Model	Sum-mer Charge	25°TD					20°TD					15°TD					10°TD				
		+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F
1	7	6	7	8	8	8	7	8	9	9	9	8	9	10	10	10	10	10	10	10	10
2	9	8	10	12	12	13	10	12	13	13	14	12	13	14	13	14	13	14	15	14	15
3	9	1	5	7	8	9	4	7	9	10	10	6	9	11	11	11	9	11	12	13	13
4	14	2	8	11	12	13	6	11	14	14	15	11	14	16	17	17	15	17	19	19	19
5	18	2	10	15	16	17	8	14	18	19	20	14	19	21	22	23	19	23	25	25	25
6	20	0	3	9	12	14	0	9	14	16	18	0	15	19	21	22	0	22	25	25	26
7	27	0	3	12	15	18	0	11	18	21	23	0	19	24	27	29	0	26	31	32	34
8	46	0	0	7	14	20	0	5	21	27	32	0	19	34	40	43	0	33	47	52	55
9	63	0	0	10	19	26	0	7	28	35	41	0	26	46	52	57	0	44	64	68	72
10	58	0	0	0	5	13	0	0	15	23	30	0	0	35	40	46	0	0	54	57	63
11	77	0	0	0	7	18	0	0	20	31	40	0	0	45	54	62	0	0	70	78	84
12	92	0	0	0	0	5	0	0	7	22	33	0	0	33	51	62	0	0	60	81	90
13	106	0	0	0	0	0	0	0	0	11	26	0	0	0	45	62	0	0	0	78	98
14	17	2	11	15	17	18	8	15	19	20	21	14	20	22	23	24	19	24	26	26	26
15	26	4	15	22	24	26	12	22	27	29	31	20	28	32	33	35	28	34	37	38	39
16	36	5	20	29	32	34	15	28	35	38	40	26	36	42	44	45	37	44	48	50	50
17	40	0	5	18	23	28	0	16	28	32	36	0	28	38	42	44	0	39	48	51	53
18	52	0	6	25	31	37	0	23	38	43	49	0	39	51	55	60	0	55	64	68	71
19	94	0	0	15	28	39	0	11	42	53	62	0	39	70	78	85	0	67	97	103	108
20	126	0	0	20	37	52	0	14	56	70	82	0	52	92	103	112	0	89	128	136	142
21	113	0	0	0	11	27	0	0	31	47	60	0	0	70	83	94	0	0	108	119	128
22	155	0	0	0	14	35	0	0	40	61	79	0	0	90	109	123	0	0	140	156	168
23	181	0	0	0	0	10	0	0	14	44	67	0	0	67	105	123	0	0	119	166	180
24	213	0	0	0	0	0	0	0	0	22	51	0	0	0	89	122	0	0	0	157	192

See Model Cross Reference Table # 19.

Table 12. Refrigerant Charge for Fan Cycling plus Flooded Condenser (lbs. R454C) on Standard Air Cooled Condensers

Model	Summer Charge	25°TD					20°TD					15°TD					10°TD				
		+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F
1	7	6	7	8	8	9	7	8	9	9	9	9	9	10	10	10	10	10	10	10	10
2	9	8	11	12	12	13	10	12	13	13	14	12	13	14	14	14	13	14	15	14	15
3	9	1	5	7	8	9	4	7	9	10	10	6	9	11	12	11	9	12	12	13	13
4	14	2	8	11	12	13	6	11	14	15	15	11	14	16	17	18	15	17	19	19	20
5	18	3	10	15	16	17	8	15	18	19	20	14	19	22	22	23	20	23	25	25	25
6	20	0	3	9	12	14	0	9	15	16	18	0	16	20	21	22	0	22	25	26	27
7	27	0	3	12	15	18	0	11	18	21	24	0	19	25	27	29	0	27	31	33	35
8	46	0	0	7	15	20	0	5	21	27	32	0	20	34	40	44	0	34	48	53	55
9	64	0	0	10	19	27	0	7	28	35	42	0	26	46	52	57	0	45	64	69	73
10	58	0	0	0	5	13	0	0	15	23	30	0	0	35	40	47	0	0	55	58	63
11	78	0	0	0	7	18	0	0	20	31	40	0	0	45	55	62	0	0	71	79	85
12	93	0	0	0	0	5	0	0	7	22	34	0	0	34	52	62	0	0	60	82	91
13	107	0	0	0	0	0	0	0	0	11	26	0	0	0	45	62	0	0	0	79	99
14	17	3	11	16	17	18	8	15	19	20	21	14	20	23	23	24	20	25	26	26	27
15	26	4	15	22	25	27	12	22	27	29	31	20	28	32	34	35	28	35	37	38	39
16	36	5	20	29	32	35	15	28	35	38	40	26	36	42	44	45	37	45	49	50	51
17	40	0	5	18	24	28	0	16	28	33	36	0	28	38	42	45	0	40	48	51	53
18	53	0	6	25	31	38	0	23	38	44	49	0	39	52	56	61	0	55	65	68	72
19	95	0	0	15	29	40	0	11	43	54	63	0	39	70	79	86	0	67	98	104	109
20	127	0	0	20	38	52	0	15	56	71	83	0	52	93	104	113	0	90	129	137	144
21	114	0	0	0	11	27	0	0	31	47	61	0	0	70	84	95	0	0	109	121	129
22	157	0	0	0	14	35	0	0	40	62	80	0	0	91	110	125	0	0	142	158	169
23	183	0	0	0	0	10	0	0	15	45	67	0	0	68	106	125	0	0	120	168	182
24	215	0	0	0	0	0	0	0	0	22	52	0	0	0	90	123	0	0	0	158	194

See Model Cross Reference Table # 19.

Table 13. Refrigerant Charge for Fan Cycling plus Flooded Condenser (lbs. R454A) on Standard Air Cooled Condensers

Model	Sum-mer Charge	25°TD					20°TD					15°TD					10°TD				
		+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F	+40°F	+20°F	+0°F	-10°F	-20°F
1	7	6	7	8	8	8	7	8	9	9	9	8	9	10	10	9	10	10	10	10	10
2	9	8	10	12	12	13	10	12	12	12	13	11	13	13	13	14	13	14	14	14	15
3	9	1	5	7	8	8	4	7	9	10	10	6	9	11	11	11	9	11	12	13	12
4	13	2	8	11	12	13	6	11	13	14	15	11	14	16	17	17	15	17	18	19	19
5	18	2	10	15	16	17	8	14	18	19	20	14	18	21	22	22	19	23	24	25	25
6	20	0	3	9	12	14	0	9	14	16	18	0	15	19	21	22	0	22	24	25	26
7	27	0	3	12	15	18	0	11	18	21	23	0	18	24	26	29	0	26	30	32	34
8	45	0	0	7	14	20	0	5	21	27	31	0	19	34	39	43	0	33	47	52	54
9	62	0	0	10	19	26	0	7	28	35	41	0	26	45	51	56	0	44	63	67	71
10	57	0	0	0	5	13	0	0	15	22	29	0	0	34	40	46	0	0	54	57	62
11	77	0	0	0	7	17	0	0	20	30	39	0	0	45	54	61	0	0	69	77	83
12	91	0	0	0	0	5	0	0	7	21	33	0	0	33	51	61	0	0	59	80	89
13	105	0	0	0	0	0	0	0	0	11	26	0	0	0	44	61	0	0	0	78	97
14	17	2	11	15	17	18	8	15	19	20	21	14	20	22	23	23	19	24	26	26	26
15	26	4	15	22	24	26	12	21	27	29	30	20	28	32	33	34	28	34	37	37	39
16	36	5	20	28	32	34	15	28	35	37	39	26	36	41	43	45	36	44	48	49	50
17	39	0	5	18	23	27	0	16	28	32	36	0	28	37	41	44	0	39	47	50	52
18	52	0	6	24	31	37	0	22	37	43	48	0	38	51	55	59	0	54	64	67	71
19	93	0	0	15	28	39	0	11	42	53	62	0	38	69	77	84	0	66	96	102	107
20	125	0	0	20	37	51	0	14	55	70	81	0	51	91	102	111	0	88	126	134	141
21	111	0	0	0	10	26	0	0	30	46	60	0	0	69	82	93	0	0	107	118	126
22	153	0	0	0	14	35	0	0	39	61	78	0	0	89	108	122	0	0	139	155	166
23	179	0	0	0	0	10	0	0	14	44	66	0	0	66	104	122	0	0	118	164	178
24	210	0	0	0	0	0	0	0	0	21	51	0	0	0	88	120	0	0	0	155	190

See Model Cross Reference Table # 19.

Table 14. Refrigerant Charge, Lbs. R-404A for Flooded Condenser

Model*	Refrigerant R404A Charge for Summer Operation, Lbs	Additional Refrigerant R404A Charge Required for Flooded Condenser Operation Lbs. For 20°F TD Minimum Ambient at Condenser				
		+60	+40	+20	+0	-20
1	7	7	9	10	10	10
2	9	9	12	13	14	14
3	9	9	12	13	13	14
4	14	13	17	19	19	20
5	18	17	23	26	27	28
6	21	19	25	28	29	30
7	28	25	33	37	38	40
8	47	44	59	65	68	70
9	65	57	76	84	88	91
10	59	55	73	81	84	87
11	80	72	96	106	111	115
12	95	87	115	128	133	139
13	109	102	136	151	157	163
14	18	17	23	25	27	28
15	27	26	34	38	40	41
16	37	34	45	50	52	54
17	40	39	52	57	60	62
18	53	52	69	77	80	83
19	97	86	114	127	132	138
20	130	114	152	169	176	183
21	116	110	147	163	170	176
22	160	144	192	212	221	230
23	186	176	234	260	271	281
24	219	204	271	301	313	326

See Model Cross Reference Table # 19.

Table 15. Refrigerant Charge, Lbs. R-454B for Flooded Condenser

Model*	Refrigerant R454B Charge for Summer Operation, Lbs	Additional Refrigerant R454B Charge Required for Flooded Condenser Operation Lbs. For 20°F TD Minimum Ambient at Condenser				
		+60	+40	+20	+0	-20
1	7	7	8	9	9	9
2	8	8	11	12	13	13
3	8	8	11	12	12	13
4	13	12	16	18	18	19
5	17	16	22	24	25	26
6	20	18	24	26	27	28
7	26	24	31	35	36	38
8	44	41	55	61	64	66
9	61	54	71	79	83	86
10	55	52	69	76	79	82
11	75	68	90	100	104	108
12	89	82	108	120	125	131
13	102	96	128	142	148	153
14	17	16	22	24	25	26
15	25	24	32	36	38	39
16	35	32	42	47	49	51
17	38	37	49	54	56	58
18	50	49	65	72	75	78
19	91	81	107	119	124	130
20	122	107	143	159	165	172
21	109	103	138	153	160	165
22	150	135	180	199	208	216
23	175	165	220	244	255	264
24	206	192	255	283	294	306

See Model Cross Reference Table # 19.

Table 16. Refrigerant Charge, Lbs. R-454A for Flooded Condenser

Model*	Refrigerant R454A Charge for Summer Operation, Lbs	Additional Refrigerant R454A Charge Required for Flooded Condenser Operation Lbs. For 20°F TD Minimum Ambient at Condenser				
		+60	+40	+20	+0	-20
1	7	7	9	10	10	10
2	9	9	12	13	14	14
3	9	9	12	13	13	14
4	14	13	17	19	19	20
5	18	17	23	25	26	27
6	21	19	25	27	28	29
7	27	25	32	36	37	39
8	46	43	58	64	67	69
9	64	56	74	82	86	89
10	58	54	72	79	82	85
11	78	71	94	104	109	113
12	93	85	113	125	130	136
13	107	100	133	148	154	160
14	18	17	23	25	26	27
15	26	25	33	37	39	40
16	36	33	44	49	51	53
17	39	38	51	56	59	61
18	52	51	68	75	78	81
19	95	84	112	124	129	135
20	127	112	149	166	172	179
21	114	108	144	160	167	172
22	157	141	188	208	217	225
23	182	172	229	255	266	275
24	215	200	266	295	307	319

See Model Cross Reference Table # 19.

Table 17. Refrigerant Charge, Lbs. R-454C for Flooded Condenser

Model*	Refrigerant R454C Charge for Summer Operation, Lbs	Additional Refrigerant R454C Charge Required for Flooded Condenser Operation Lbs. For 20°F TD Minimum Ambient at Condenser				
		+60	+40	+20	+0	-20
1	7	7	9	10	10	10
2	9	9	12	13	14	14
3	9	9	12	13	13	14
4	14	13	17	19	19	20
5	18	17	23	26	27	28
6	21	19	25	28	29	30
7	28	25	33	37	38	40
8	47	44	59	65	68	70
9	65	57	76	84	88	91
10	59	55	73	81	84	87
11	80	72	96	106	111	115
12	95	87	115	128	133	139
13	109	102	136	151	157	163
14	18	17	23	25	27	28
15	27	26	34	38	40	41
16	37	34	45	50	52	54
17	40	39	52	57	60	62
18	53	52	69	77	80	83
19	97	86	114	127	132	138
20	130	114	152	169	176	183
21	116	110	147	163	170	176
22	160	144	192	212	221	230
23	186	176	234	260	271	281
24	219	204	271	301	313	326

See Model Cross Reference Table # 19.

Table 18. Refrigerant Charge, Lbs. R-455A for Flooded Condenser

Model*	Refrigerant R455A Charge for Summer Operation, Lbs	Additional Refrigerant R455A Charge Required for Flooded Condenser Operation Lbs. For 20°F TD Minimum Ambient at Condenser				
		+60	+40	+20	+0	-20
1	7	7	9	10	10	10
2	9	9	12	13	14	14
3	9	9	12	13	13	14
4	14	13	17	19	19	20
5	18	17	23	26	27	28
6	21	19	25	28	29	30
7	28	25	33	37	38	40
8	47	44	58	64	67	69
9	64	56	75	83	87	90
10	58	54	72	80	83	86
11	79	71	95	105	110	114
12	94	86	114	127	132	138
13	108	101	135	149	155	161
14	18	17	23	25	27	28
15	27	26	34	38	40	41
16	37	34	45	50	51	53
17	40	39	51	56	59	61
18	52	51	68	76	79	82
19	96	85	113	126	131	137
20	129	113	150	167	174	181
21	115	109	146	161	168	174
22	158	143	190	210	219	228
23	184	174	232	257	268	278
24	217	202	268	298	310	323

See Model Cross Reference Table # 19.

Table 19. Flooded Charge Temperature Difference Factor for Standard Air-Cooled Condensers

Ambient, °F	30	25	20	15	10
+60	–	0.38	1.0	1.74	2.46
+40	0.59	0.80	1.0	1.19	1.40
+20	0.76	0.88	1.0	1.13	1.25
0	0.84	0.91	1.0	1.07	1.16
-20	0.88	0.93	1.0	1.05	1.13

Table 20. Model Cross Reference for Standard Air-Cooled Condensers

Model Reference	*NH	*NL	*NX	*NQ	*NE
1	*NH-S01-A007	*NL-S01-A007	*NX-S01-A006	*NQ-S01-A005	*NE-S01-A008
2	*NH-S01-A009	*NL-S01-A008	*NX-S01-A008	*NQ-S01-A006	*NE-S01-A009
3	*NH-S02-A011	*NL-S02-A010	*NX-S02-A010	*NQ-S02-A008	*NE-S02-A011
4	*NH-S02-A015	*NL-S02-A014	*NX-S02-A013	*NQ-S02-A010	*NE-S02-A015
5	*NH-S02-A017	*NL-S02-A016	*NX-S02-A015	*NQ-S02-A012	*NE-S02-A018
6	*NH-S03-A022	*NL-S03-A021	*NX-S03-A020	*NQ-S03-A016	*NE-S03-A023
7	*NH-S03-A026	*NL-S03-A024	*NX-S03-A023	*NQ-S03-A017	*NE-S03-A027
8	*NH-S04-A029	*NL-S04-A028	*NX-S04-A026	*NQ-S04-A021	*NE-S04-A031
9	*NH-S04-A034	*NL-S04-A032	*NX-S04-A030	*NQ-S04-A023	*NE-S04-A036
10	*NH-S05-A037	*NL-S05-A036	*NX-S05-A033	*NQ-S05-A026	*NE-S05-A039
11	*NH-S05-A044	*NL-S05-A042	*NX-S05-A038	*NQ-S05-A029	*NE-S05-A047
12	*NH-S06-A053	*NL-S06-A050	*NX-S06-A045	*NQ-S06-A034	*NE-S06-A056
13	*NH-S07-A061	*NL-S07-A055	*NX-S07-A052	*NQ-S07-A042	*NE-S07-A065
14	*NH-D04-A021	*NL-D04-A020	*NX-D04-A020	*NQ-D04-A016	*NE-D04-A023
15	*NH-D04-A029	*NL-D04-A028	*NX-D04-A026	*NQ-D04-A021	*NE-D04-A031
16	*NH-D04-A034	*NL-D04-A032	*NX-D04-A030	*NQ-D04-A023	*NE-D04-A036
17	*NH-D06-A044	*NL-D06-A042	*NX-D06-A040	*NQ-D06-A031	*NE-D06-A046
18	*NH-D06-A051	*NL-D06-A048	*NX-D06-A045	*NQ-D06-A034	*NE-D06-A054
19	*NH-D08-A058	*NL-D08-A056	*NX-D08-A053	*NQ-D08-A041	*NE-D08-A062
20	*NH-D08-A068	*NL-D08-A065	*NX-D08-A061	*NQ-D08-A046	*NE-D08-A073
21	*NH-D10-A074	*NL-D10-A071	*NX-D10-A066	*NQ-D10-A052	*NE-D10-A079
22	*NH-D10-A088	*NL-D10-A083	*NX-D10-A076	*NQ-D10-A057	*NE-D10-A093
23	*NH-D12-A106	*NL-D12-A100	*NX-D12-A091	*NQ-D12-A069	*NE-D12-A112
24	*NH-D14-A123	*NL-D14-A110	*NX-D14-A104	*NQ-D14-A083	*NE-D14-A129

* First letter of model corresponds to a particular brand. B is Bohn. L is Larkin. C is Climate Control. H is Chandler.

Maintenance

Air-cooled condensing units require a minimum of maintenance. The unit coil will require a periodic cleaning and this can be accomplished by a brush, vacuum cleaner, pressurized air stream or a commercially available coil cleaning foam. All of the condenser fan motors have sealed ball bearings. The only acceptable service to these bearings is replacement.

General Cleaning Instructions

Heatcraft recommends that the finned surface of this unit be cleaned approximately every six months; more frequent cleaning may be required if extreme conditions cause clogging or fouling of air passages through the finned surface.

Calgon Corporation's CalClean 41352 (or equal) should be acceptable for cleaning this unit. CalClean should be applied liberally to entering air and leaving air surfaces of the finned area in accordance with the label directions.

CAUTION: Under no circumstances should this unit be cleaned with an acid-based cleaner.

In-Warranty Return Material Procedure

Material may not be returned except by permission of authorized factory service personnel of Heatcraft Refrigeration Products in Stone Mountain, Georgia. A "Return Goods" tag will be sent to be included with the returned material. Enter the required information on the tag in order to expedite handling at our factories and prompt issuance of credits. All parts shall be returned to the factory designated on the "Return Goods" tag, transportation charges prepaid.

The return of a part does not constitute an order for replacement. Therefore, a purchase order must be entered through your nearest Heatcraft Refrigeration Products representative. The order should include part number, model number and serial number of the unit involved.

Following our careful inspection of the returned part and if it is determined that the failure is due to faulty material or workmanship, credit will be issued on customer's purchase order.

Parts by InterLink™

When writing to the factory for service or replacement parts, refer to the model number and serial number of the unit as stamped on the serial plate attached to the unit. If replacement parts are required, mention the date of installation of the unit and date of failure, along with an explanation of the malfunctions and a description of the replacement parts required.



Table 21. InterLink™ Condenser Parts List

Fan RPM	Motor Size	Fan Motor Part No.	Fan Blade Part No.	Fan Guard Part No.
1140 (H Models)	1.5 HP	25316401	22900401	23105701
1140 (Var. Speed)	0.75 HP	25317101	2292625	23105701
830 (L Models)	1.5 HP	25316601	22929501	23105701
830 (X Models)	1 HP	25316301	22929501	23105701
540 (Q Models)	0.5 HP	25316201	22929301	23105701
1030 (E Models, 230V)	2.2 kW	25316905 (7 blade)		--
1030 (E Models, 460V)	2.2 kW	25317005 (7 blade)		--
850 (G Models, 230V)	815 W	25321201		--
850 (G Models, 460V)	815 W	25321301		--
1130 (E Models, 230V)	2.0 kW	25318801 (5 blade)		--
1130 (E Models, 460V)	2.0 kW	25318901 (5 blade)		--

Contact the InterLink™ Customer Service Department for parts to specific condenser models at 800-686-7278, interlinkparts@heatcraftprd.com, or www.interlinkparts.com.

E & G Series Motors with Integrated Variable Speed

E & G Series units use an EC motor/fan blade combination to provide variable speed condenser control.

All components required to run the motor at variable speeds are built into the motor.



Warning! When connecting the unit to the supply power dangerous voltages occur. Do not open the motor within the first 5 minutes after disconnection of all phases.
Be sure that the unit is isolated.



Warning! Dangerous external voltages can be present at terminal KL2 even with the unit turned off.



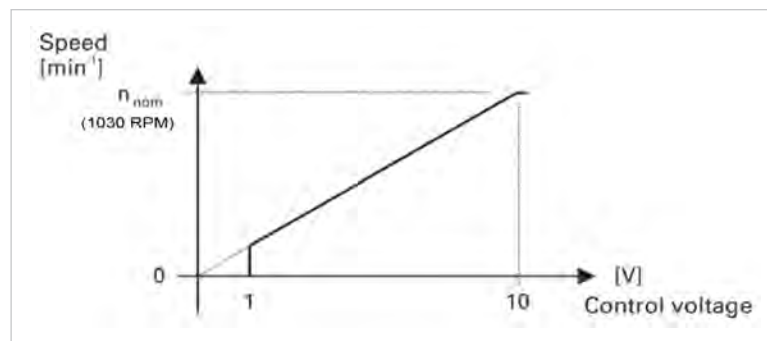
Warning! With a control voltage fed in or a set speed value being saved, the motor will restart automatically after a power failure.

Speed Adjustment Characteristics

The EC motor varies its speed linearly based on a 0-10V input signal. At 10 VDC, the motor runs at full speed. At 0 VDC, the motor turns off. A chart of the speed control curve is shown below.

The input control signal can be supplied from any control-

ler that outputs a 0-10 VDC signal. For units with a control signal supplied from a rack control or other external controller, the unit is provided with a terminal board for control signal wiring. Units with factory installed proportional pressure controls require no installation wiring.



External Control Signal

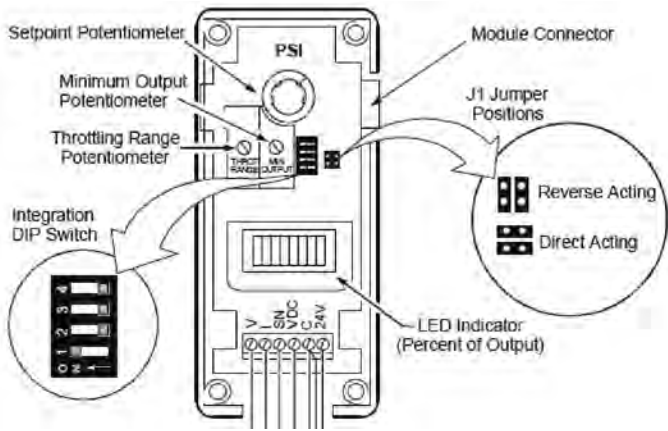
Contact control manufacturer for setup of external controller to provide 0-10 VDC control signal. Wire the control signal to terminal board in unit control box.

See Diagrams #2 and #3 for typical external signal control wiring.

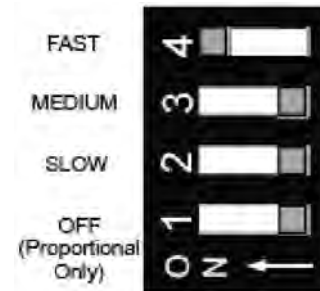
Proportional Pressure Control

Units with factory installed proportional pressure controls use a PI controller to vary the motor speed in order to maintain a constant desired head pressure. The PI controller has five user adjustable features:

- Head Pressure Setpoint
- Integration constant
- Minimum Output
- Reverse acting or direct acting mode of operation
- Throttling range



The integration constant switch provides ability to change controller from a proportional only control to a proportional plus integral control. To provide the most responsive system to maintain a stable head pressure, it is recommended this setting be left on "fast."



Head Pressure Setpoint

The head pressure setpoint potentiometer is adjustable from 90-250 psig. Typical setpoints are from 170-200 psig.

Note: Very low setpoints may cause the fan motors to run full speed continually if the condenser is not properly sized. The fans will turn off if the system pressure falls below the desired setpoint.

Minimum Output

The minimum output potentiometer controls the minimum signal sent to the motor. It is adjustable from 0-60%. If this is adjusted to 60%, the motors will not start running until 6V is applied to the motor. The motor will start running at 60% of full speed. To maximize sound reduction and energy savings and to provide the most stable control, it is recommended this setting be left at 0%.

Throttling Range

The throttling range potentiometer controls how far the system pressure must deviate from the control setpoint to generate a 100% output signal from the control. It is adjustable from 10-100 psig. The throttling range determines how quickly the motor will reach full speed when detecting a change in head pressure. For example, if the setpoint is 200 psig and the throttling range is 50 psig, when the system pressure is below 200 psig, the fans will be off. When the system pressure reaches 250 psig, the fans will be at full speed (see Chart 1 below). To make the fans ramp more slowly the throttling range should be increased (see Chart 2 below). To maximize sound reduction and energy savings and to provide the most stable control, it is recommended this setting be left at 100 psig.

Reverse Acting or Direct Acting Mode of Operation

The reverse acting/direct acting jumper is used to ensure the controller responds correctly to maintain desired head pressure. In Direct Acting (DA) mode, the motor speed increases as the pressure rises above desired setpoint. For proper condenser operation, this jumper MUST be in Direct Acting (DA) mode. Failure to ensure J1 jumper is in direct acting mode will cause the system to trip on high head pressure.

See Diagram #4 for typical proportional pressure control wiring.

Integration Constant

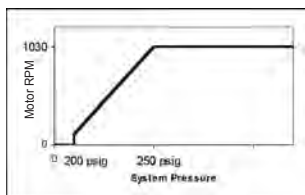


Chart 1. Ramp characteristics with 200 psig setpoint and 50 psig throttling range

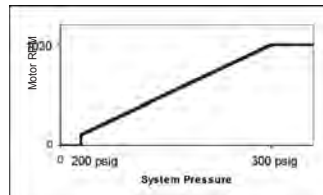


Chart 2. Ramp characteristics with 200 psig setpoint and 100 psig throttling range

Standard Wiring Configuration

Standard VSEC units are wired in a Direct Acting Series Wired configuration. This configuration allows for the maximum sound and energy reduction as well as the most stable head pressure control. The control signal is delivered to the lead motor (located at the header end of the unit). The lead motor relays the control signal to the adjacent lag motor. This relay is done until the last motor is reached. As each lag relays the control signal, it adjusts the signal so the next lag will run slightly slower than the upstream motor. The end result of this is that when a motor receives a small enough signal, it will turn off. This provides built-in fan cycling.

Protective Features

The EC motors have many built-in protective features.

The EC motors have functions within the motor to protect against:

- over-temperature of electronics
- over-temperature of motor
- incorrect rotor position detection

With any of these failures, the motor stops electronically and the alarm relay is switched. With one of these failures, the motor WILL NOT automatically restart. To reset, the power supply has to be switched off for a minimum 20 seconds once the motor is at standstill.

Locked-Rotor Protection

As soon as the rotor is blocked, the motor gets switched off electronically and the alarm relay is switched. After de-blocking, the motor WILL restart automatically.

Under-Voltage Protection

If power supply voltage falls below ~150VAC/3Ø (for 230V motors) or ~290VAC/3Ø (for 460V motors) for 5 seconds minimum, the motor will be switched off electronically and the alarm relay is switched. If power supply voltage returns to correct values, the motor WILL restart automatically.

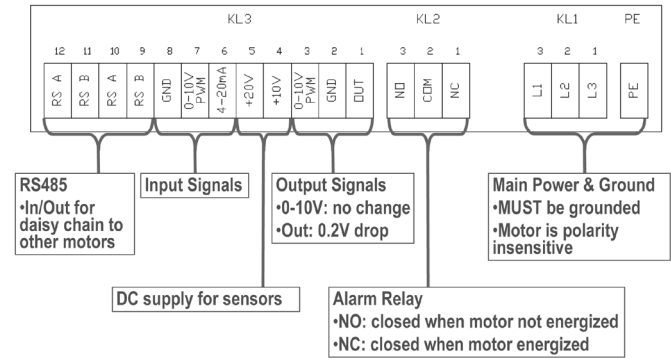
Phase Failure

If 1 phase fails for 5 seconds minimum, the motor will be switched off electronically and the alarm relay is switched. If all 3 phases return to correct values, the motor WILL restart automatically within 10-40 seconds.

EC Motor Wiring

All EC motor wiring is done at the factory. If any motor wiring needs to be done in the field, the diagrams below indicate the terminal pin configurations inside the motor junction box.

Motors with 7 fan blades



Motors with 5 fan blades

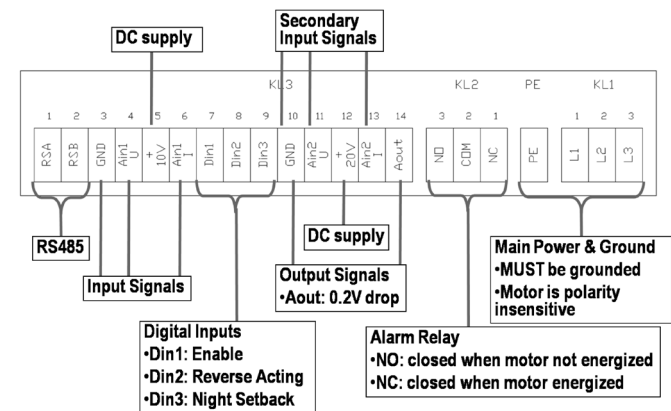


Diagram 2. Typical "G" Condenser Wiring Diagram with External Signal

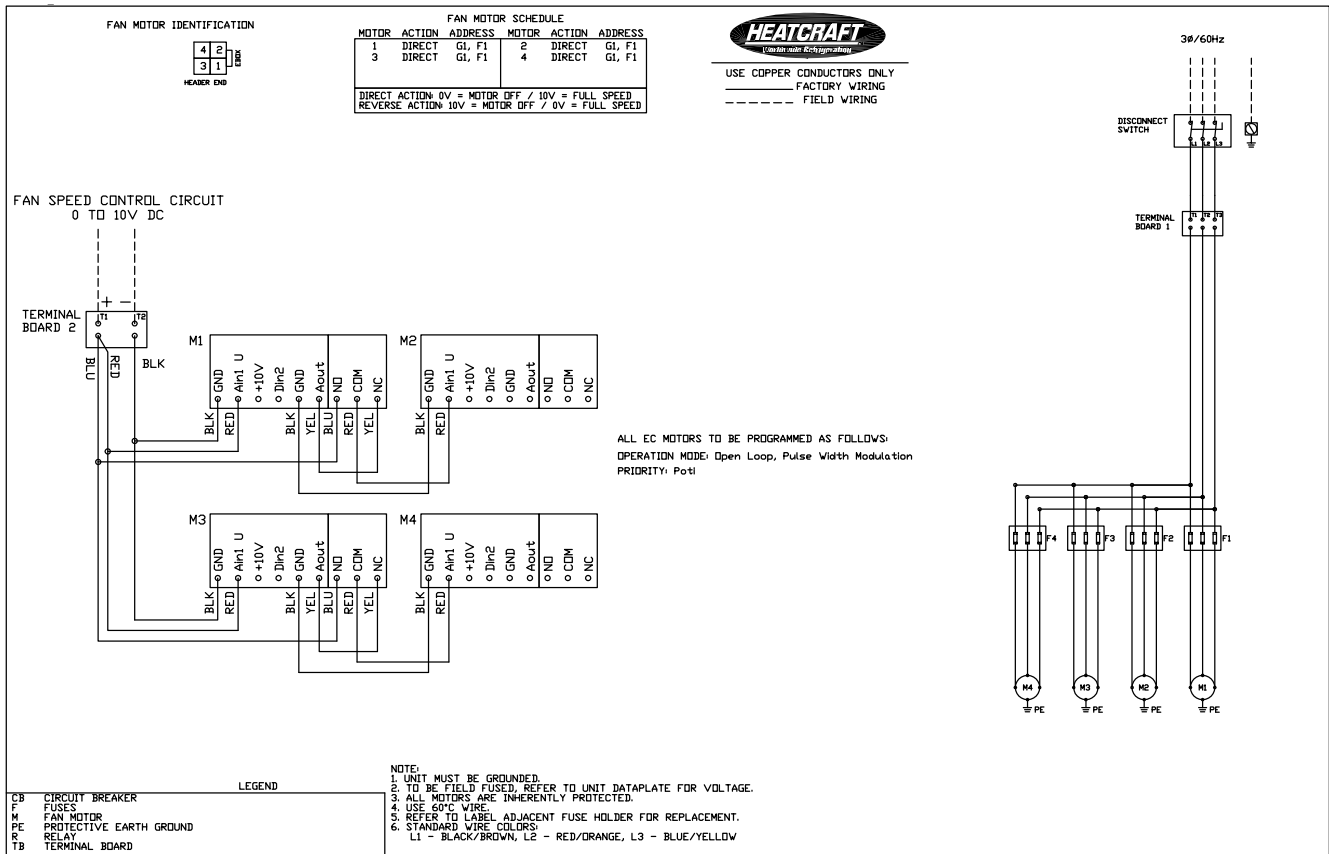


Diagram 3. Typical E Condenser Wiring Diagram with External Signal

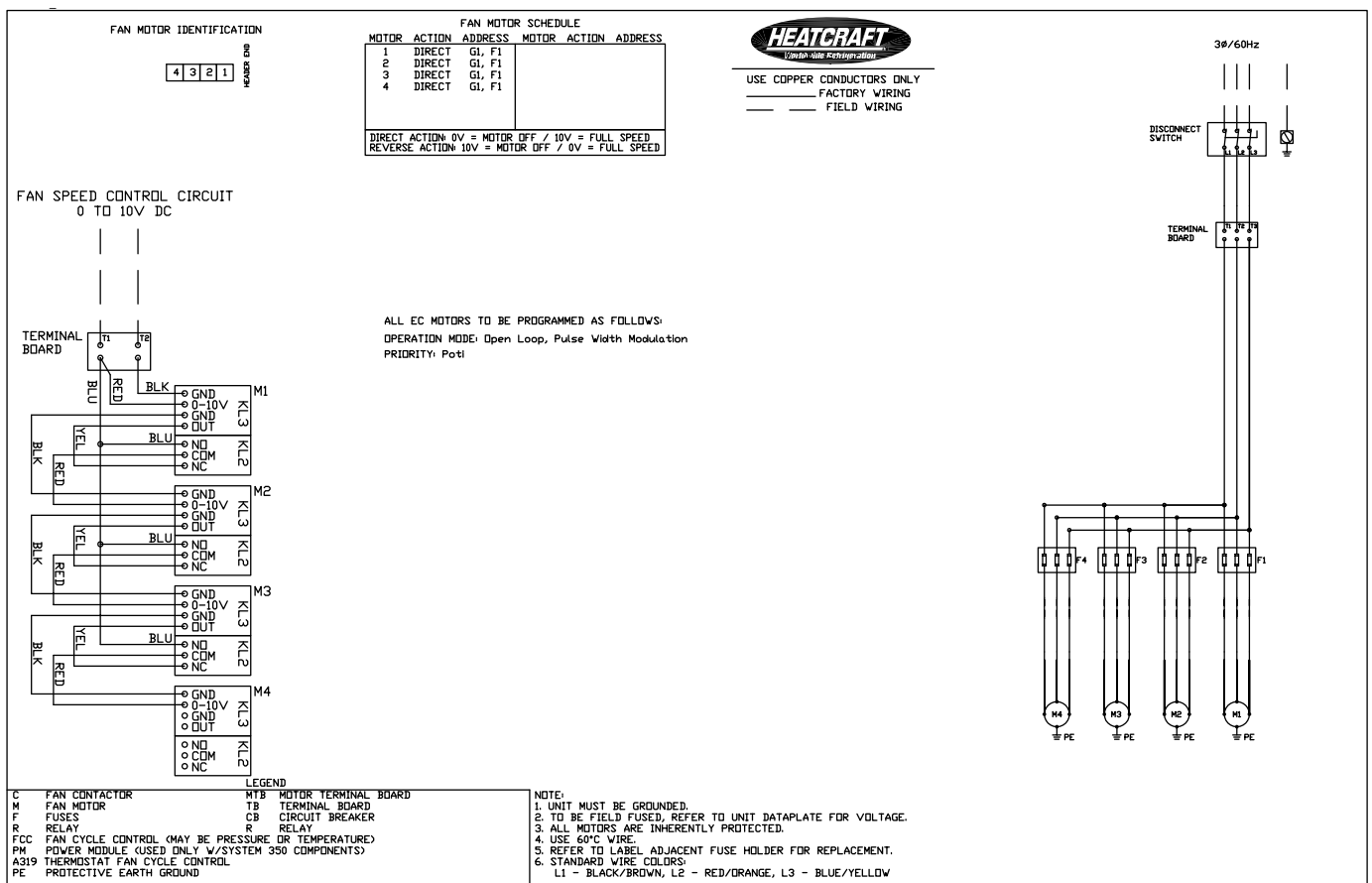
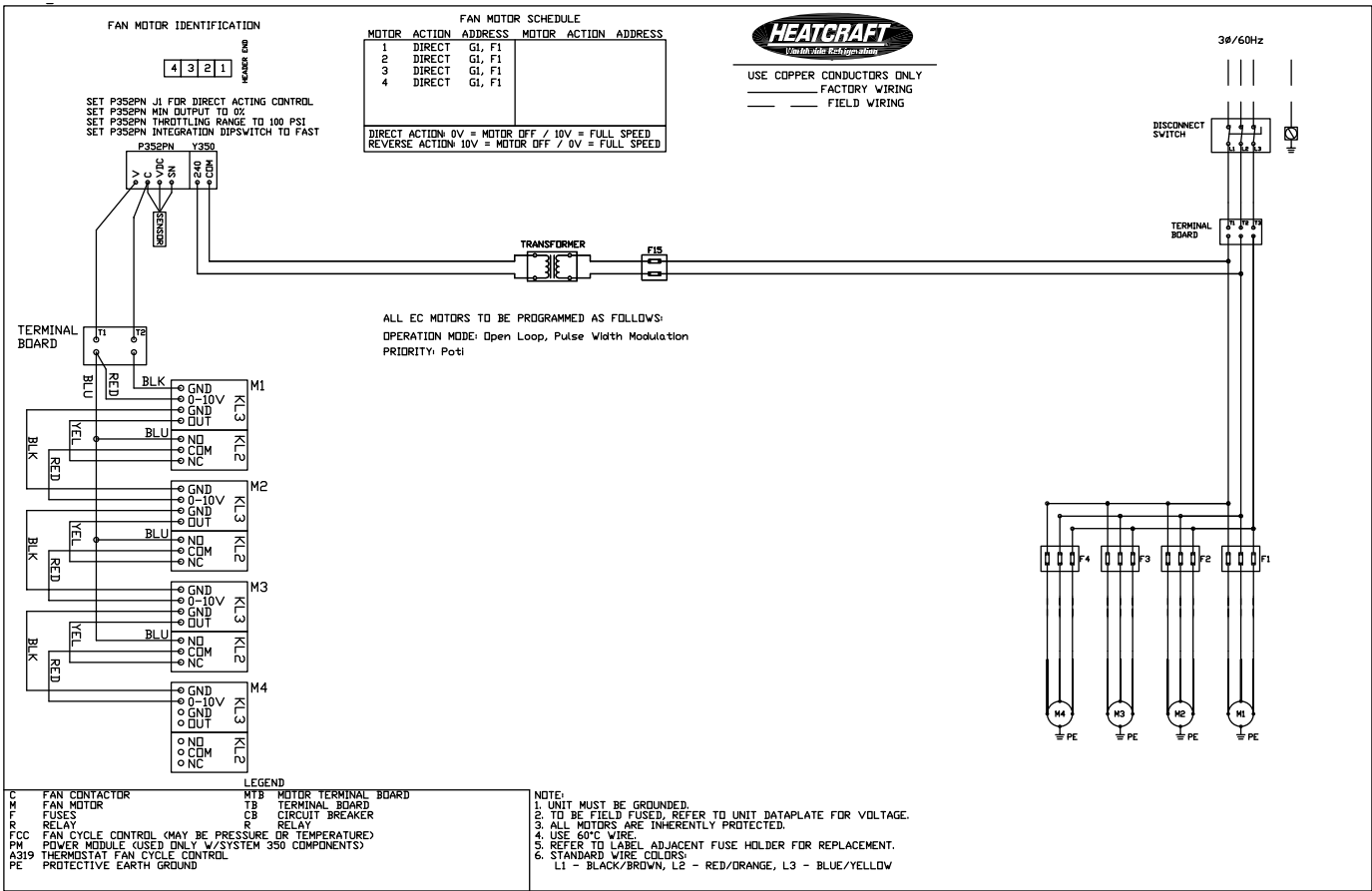


Diagram 4. Typical E Condenser Wiring Diagram with Proportional Pressure Control



Installation Check List

Condenser

Start Up Date _____

Model # _____

Serial # _____

Electrical

Voltage _____

Amperage _____

Installer: **Name & Address**

Telephone:

Please retain this information with the condenser.

Since product improvement is a continuing effort, we reserve the right to make changes in specifications without notice.

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