

RHS Series

3 to 8.5 Ton

Package Electric Heat Pump Units With R-410A Refrigerant



3 to 6 Ton



7-1/2 to 8-1/2 Ton

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Service and Maintenance Instructions

SAFETY CONSIDERATIONS

Installation and servicing of air-conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, repair, or service air-conditioning equipment. Untrained personnel can perform the basic maintenance functions of replacing filters. Trained service personnel should perform all other operations.

When working on air-conditioning equipment, observe precautions in the literature, tags and labels attached to the unit, and other safety precautions that may apply. Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for unbrazing operations. Have fire extinguishers available for all brazing operations.

Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions attached to the unit. Consult local building codes and National Electrical Code (NEC) for special requirements.

Recognize safety information. This is the safety-alert symbol . When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies a hazard which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **may** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

WARNING

ELECTRICAL OPERATION HAZARD

Failure to follow this warning could result in personal injury or death.

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock and rotating equipment could cause injury.

WARNING

ELECTRICAL OPERATION HAZARD

Failure to follow this warning could result in personal injury or death.

Units with convenience outlet circuits may use multiple disconnects. Check convenience outlet for power status before opening unit for service. Locate its disconnect switch, if appropriate, and open it. Tag-out this switch, if necessary.

WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could cause personal injury, death and/or equipment damage.

R-410A refrigerant systems operate at higher pressures than standard R-22 systems. Do not use R-22 service equipment or components on R-410A refrigerant equipment.

WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

Failure to follow this warning could cause personal injury or death. Relieve pressure and recover all refrigerant before system repair or final unit disposal. Wear safety glasses and gloves when handling refrigerants. Keep torches and other ignition sources away from refrigerants and oils.

CAUTION

CUT HAZARD

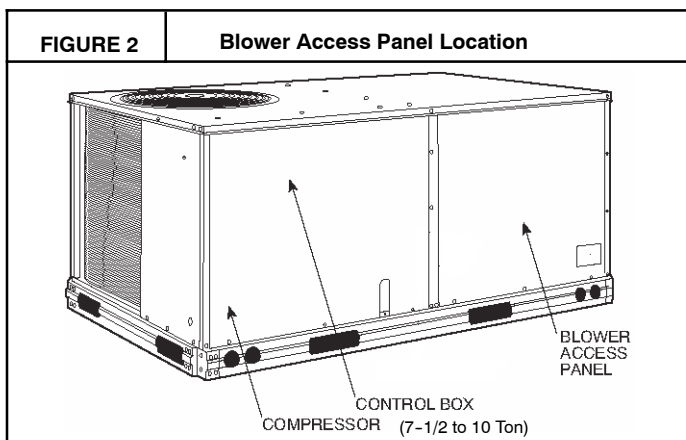
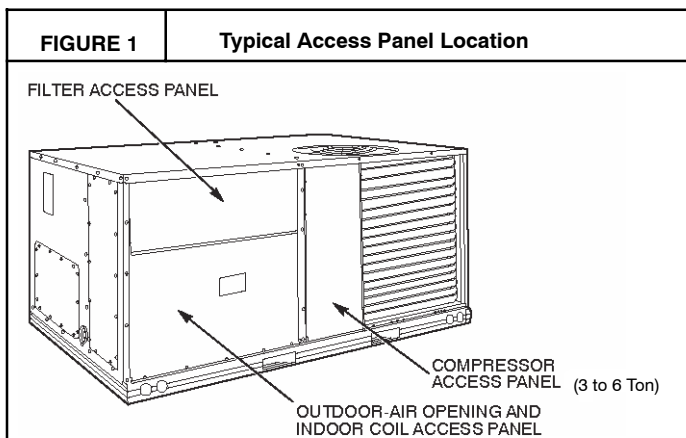
Failure to follow this caution may result in personal injury.

Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing, safety glasses and gloves when handling parts and servicing air conditioning units.

UNIT ARRANGEMENT AND ACCESS

General

Fig. 1 and Fig. 2 show general unit arrangement and access locations.



Routine Maintenance

These items should be part of a routine maintenance program, to be checked every month or two, until a specific schedule for each can be identified for this installation:

Quarterly Inspection (and 30 days after initial start)

- Return air filter replacement
- Outdoor hood inlet filters cleaned
- Belt tension checked
- Belt condition checked
- Pulley alignment checked
- Fan shaft bearing locking collar tightness checked
- Outdoor coil cleanliness checked
- Condensate drain checked

Seasonal Maintenance

These items should be checked at the beginning of each season (or more often if local conditions and usage patterns dictate):

Air Conditioning/Heat Pump

- Outdoor fan motor mounting bolts tightness
- Compressor mounting bolts
- Outdoor fan blade positioning

- Control box cleanliness and wiring condition
- Wire terminal tightness
- Refrigerant charge level
- Indoor coil cleaning
- Supply blower motor amperage

Electric Heating

- Power wire connections
- Fuses ready
- Manual-reset limit switch is closed

Economizer or Outside Air Damper

- Inlet filters condition
- Check damper travel (economizer)
- Check gear and dampers for debris and dirt

Air Filters and Screens

Each unit is equipped with return air filters. If the unit has an economizer, it will also have an outside air screen. If a manual outside air damper is added, an inlet air screen will also be present.

Each of these filters and screens will need to be periodically replaced or cleaned.

Return Air Filters

Return air filters are disposable fiberglass media type. Access to the filters is through the small lift-out panel located on the rear side of the unit, above the evaporator/return air access panel. (See Fig. 1.)

To remove the filters:

1. Grasp the bottom flange of the upper panel.
2. Lift up and swing the bottom out until the panel disengages and pulls out.
3. Reach inside and extract the filters from the filter rack.
4. Replace these filters as required with similar replacement filters of same size.

To re-install the access panel:

1. Slide the top of the panel up under the unit top panel.
2. Slide the bottom into the side channels.
3. Push the bottom flange down until it contacts the top of the lower panel (or economizer top).

IMPORTANT: DO NOT OPERATE THE UNIT WITHOUT THESE FILTERS!

Outside Air Hood

Outside air hood inlet screens are permanent aluminum-mesh type filters. Check these for cleanliness. Remove the screens when cleaning is required. Clean by washing with hot low-pressure water and soft detergent and replace all screens before restarting the unit. Observe the flow direction arrows on the side of each filter frame.

Economizer Inlet Air Screen

This air screen is retained by spring clips under the top edge of the hood. (See Fig. 3.)

SUPPLY FAN (BLOWER) SECTION

⚠ WARNING

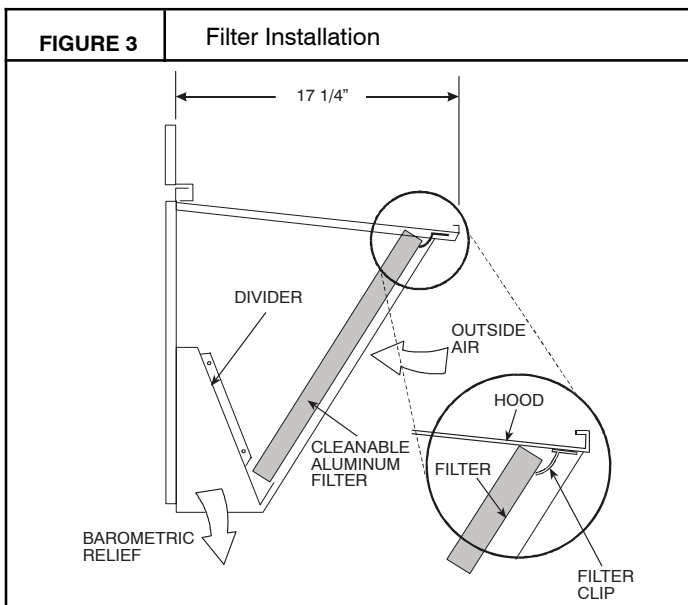
ELECTRICAL SHOCK HAZARD

Failure to follow this warning could cause personal injury or death.

Before performing service or maintenance operations on the fan system, shut off all unit power and tag-out the unit disconnect switch. Do not reach into the fan section with power still applied to unit.

Supply Fan (Direct-Drive)

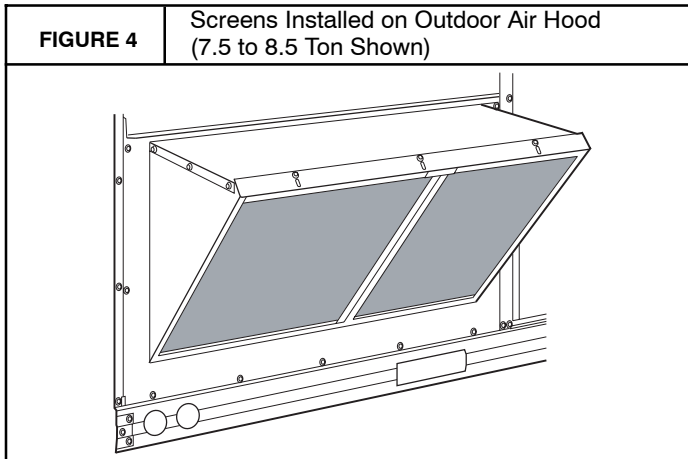
For unit sizes 036 - 060 (3-5 Ton), the Standard Static supply fan system consists of a direct-drive forward-curved centrifugal blower wheel attached to the motor shaft. The motor has taps to provide the servicer with the selection of one of five motor torque/speed ranges to best match wheel performance with attached duct system. See Fig. 5 Direct-Drive Fan Assembly) and Fig. 6 (EMC Motor Connectors).



To remove the filter, open the spring clips. Re-install the filter by placing the frame in its track, then closing the spring clips.

Manual Outside Air Hood Screen

This inlet screen is secured by a retainer angle across the top edge of the hood. (See Fig. 4.)



To remove the screen, loosen the screws in the top retainer and slip the retainer up until the filter can be removed. Re-install by placing the frame in its track, rotating the retainer back down and tighten all screws.

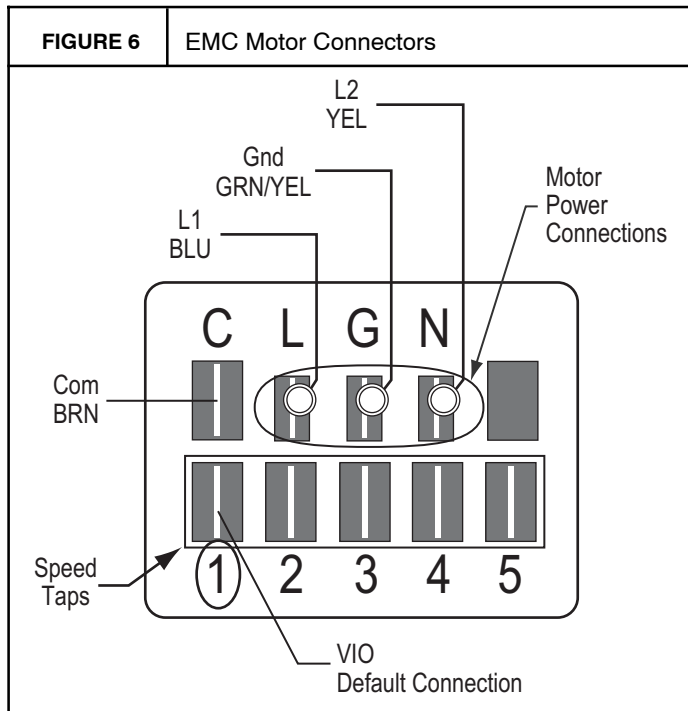
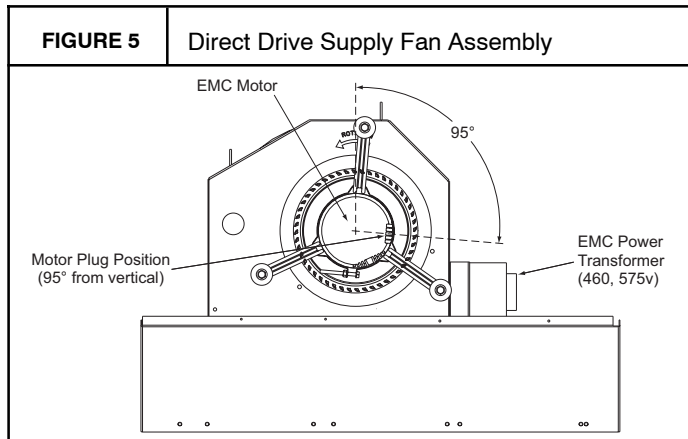
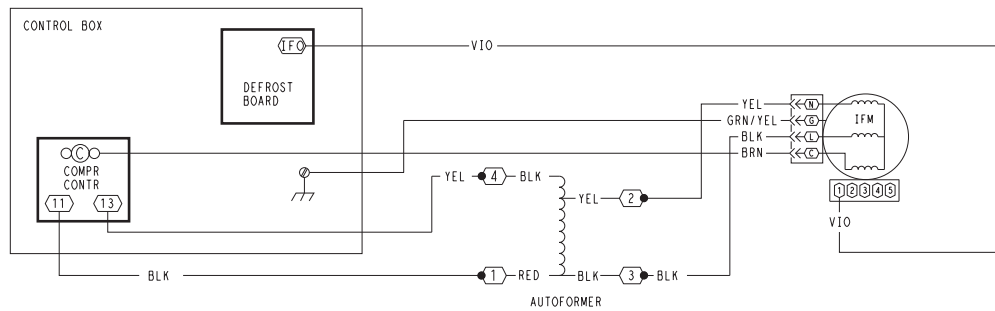
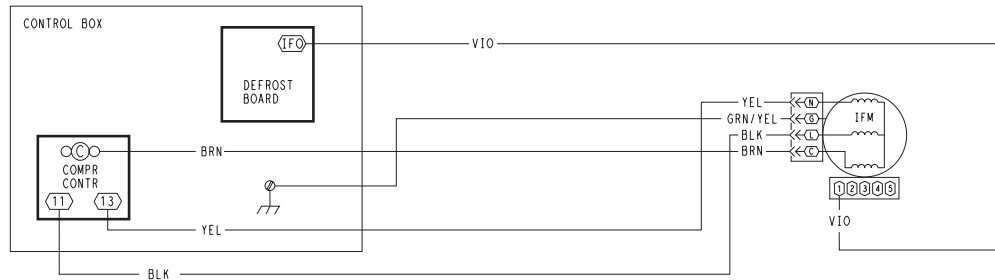


FIGURE 7

EMC Unit Wiring



460, 575-v Units



208/230-v Units

ECM Motor – The direct-drive motor is an X13 Electronically Commutated motor (ECM). An ECM contains electronic circuitry to convert single-phase line AC voltage into a 3-phase DC voltage to power the motor circuit. The motor circuit is a DC brushless design with a permanent magnet rotor. On the X13 design, the electronic circuitry is integral to the motor assembly and cannot be serviced or replaced separately.

208/230-v units use a 230-v motor. 460-v units use a 230-v motor with a stepdown transformer (mounted on the end of the fan housing, see Fig. 5). 575-v units use a 460-v motor with an autotransformer. Motor power voltage is connected to motor terminals L and N (see Fig.6 and Fig. 7); ground is connected at terminal G. The motor power voltage is ALWAYS present; it is not switched off by a motor contactor.

Motor operation is initiated by the presence of a 24-v control signal to one of the five motor communications terminals. When the 24-v signal is removed, the motor will stop. The motor control signal is switched by the defrost board's IFO output.

Evaluating motor speed – The X13 ECM is a constant torque motor design. The motor speed is adjusted by the motor control circuitry to maintain the programmed shaft torque. Consequently there is no specific speed value assigned to each control tap setting. At the Position 5 tap, the motor speed is approximately 1050 RPM (17.5 r/s) but it will vary depending on fan wheel loading.

Selecting speed tap – The five communications terminals are each programmed to provide a different motor torque output. See Table 1. Factory default tap selection is Position 1 for lowest torque/speed operation.

Table 1 – RHS Standard Static Motor Tap Programming (percent of full-load torque)

Unit Size	Tap 1	Tap 2	Tap 3	Tap 4	Tap 5
036	32	38	45	50	100
048	46	58	61	69	100
060	73	82	85	90	100

Factory Default: Tap 1 (VIO)

To select another speed:

1. Disconnect main power to the unit.
2. Remove the motor signal lead (VIO) at the motor communications terminal.
3. Reconnect the motor signal lead to the desired speed terminal.
4. Connect main power to the unit.

Motor “rocking” on start-up – When the motor first starts, the rotor (and attached wheel) will “rock” back and forth as the motor tests for rotational direction. Once the correct rotation direction is determined by the motor circuitry, the motor will ramp up to specified speed. The “rocking” is a normal operating characteristic of ECM motors.

Troubleshooting the ECM motor – Troubleshooting the X13 ECM requires a voltmeter.

1. Disconnect main power to the unit.
2. Remove the motor power plug (including the control BRN lead) and VIO control signal lead at the motor terminals.
3. Restore main unit power.
4. Check for proper line voltage at motor power leads BLK (from L terminal) and YEL (from N terminal).

Table 2 – Motor Test Volts

Unit Voltage	Motor Voltage	Min–Max Volts
208/230	230	190–250
460	230	210–250
575	460	420–500

- Apply a jumper at unit control terminals R to G to initiate a demand for motor operation. Check for 24-v output at defrost board terminal IFO.
- Check for proper control signal voltage at motor signal leads VIO and BRN. Signal should be 22 to 28-v.
- Disconnect unit main power.
- Reconnect motor power and control signal leads at the motor terminals.
- Restore unit main power.

Motor should start and run. If it does not, remove the motor assembly. Replace with same motor part number; do not substitute with an alternate design as torque/speed programming will not be same as on original factory motor.

Replacing the ECM Motor – Before removing the ECM belly-band mounting ring, measure the distance between the base of the motor shaft and the edge of the mounting ring. Remove the motor mounting band and transfer to the replacement motor. Position the mounting band at distance measured in first step. Snug the mounting bolt but do not tighten yet.

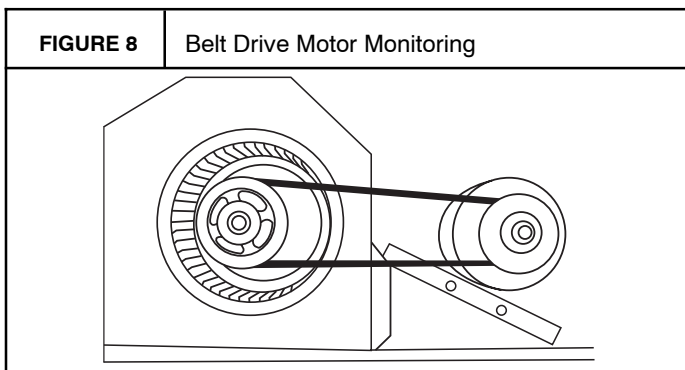
Insert the motor shaft into the fan wheel hub. Then secure the three motor mount arms to the support cushions. Torque the arm mounting screws to 60 in-lbs (6.8 N-m).

Center the fan wheel in the fan housing. Torque the fan wheel hub setscrew to 120 in-lbs (13.6 N-m).

Ensure the motor terminals are located at a position below the 3 o'clock position (see Fig. 5). Tighten the motor belly-band bolt to 80 in-lbs (9.0 N-m).

Supply Fan (Belt-Drive)

The belt-drive supply fan system consists of a forward-curved centrifugal blower wheel on a solid shaft with two concentric type bearings, one on each side of the blower housing. A fixed-pitch driven pulley is attached to the fan shaft and an adjustable-pitch driver pulley is on the motor. The pulleys are connected using a “V” type belt. (See Fig. 8.)



Belt

Check the belt condition and tension quarterly. Inspect the belt for signs of cracking, fraying or glazing along the inside surfaces. Check belt tension by using a spring-force tool (such as Browning’s Part Number “Belt Tension Checker” or equivalent tool); tension should be 6-lbs at a 5/8-in. deflection when measured at the centerline of the belt span. This point is at the center of the belt when measuring the distance between the motor shaft and the blower shaft.

NOTE: Without the spring-tension tool, place a straight edge across the belt surface at the pulleys, then deflect the belt at mid-span using one finger to a 1/2-in. deflection.

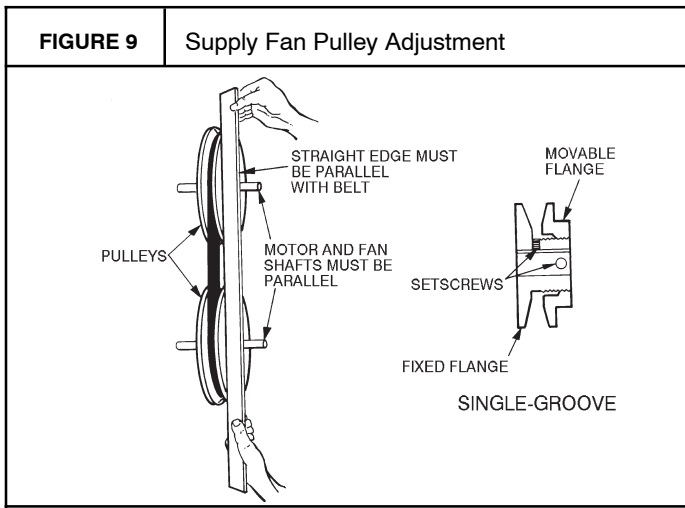
Adjust belt tension by loosening the motor mounting plate front bolts and rear bolt and sliding the plate toward the fan (to reduce tension) or away from fan (to increase tension). Ensure the blower shaft and the motor shaft are parallel to each other (pulleys aligned). Tighten all bolts when finished.

To replace the belt:

- Use a belt with same section type or similar size. Do not substitute a “FHP” type belt. When installing the new belt, do not use a tool (screwdriver or pry-bar) to force the belt over the pulley flanges, this will stress the belt and cause a reduction in belt life.
- Loosen the motor mounting plate front bolts and rear bolts.
- Push the motor and its mounting plate towards the blower housing as close as possible to reduce the center distance between fan shaft and motor shaft.
- Remove the belt by gently lifting the old belt over one of the pulleys.
- Install the new belt by gently sliding the belt over both pulleys and then sliding the motor and plate away from the fan housing until proper tension is achieved.
- Check the alignment of the pulleys, adjust if necessary.
- Tighten all bolts.
- Check the tension after a few hours of runtime and re-adjust as required.

Adjustable-Pitch Pulley on Motor

The motor pulley is an adjustable-pitch type that allows a servicer to implement changes in the fan wheel speed to match as-installed ductwork systems. The pulley consists of a fixed flange side that faces the motor (secured to the motor shaft) and a movable flange side that can be rotated around the fixed flange side that increases or reduces the pitch diameter of this driver pulley. (See Fig. 9.)



As the pitch diameter is changed by adjusting the position of the movable flange, the centerline on this pulley shifts laterally (along the motor shaft). This creates a requirement for a realignment of the pulleys after any adjustment of the movable flange. Also reset the belt tension after each realignment.

Check the condition of the motor pulley for signs of wear. Glazing of the belt contact surfaces and erosion on these surfaces are signs of improper belt tension and/or belt slippage. Pulley replacement may be necessary.

To change fan speed:

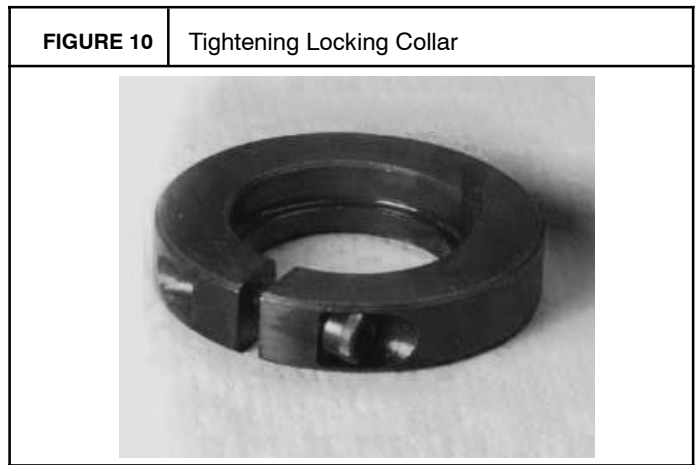
1. Shut off unit power supply.
2. Loosen belt by loosening fan motor mounting nuts. (See Fig. 8.)
3. Loosen movable pulley flange setscrew. (See Fig. 9.)
4. Screw movable flange toward fixed flange to increase speed and away from fixed flange to decrease speed. Increasing fan speed increases load on motor. Do not exceed maximum speed specified.
5. Set movable flange at nearest keyway of pulley hub and tighten setscrew to torque specifications.

To align fan and motor pulleys:

1. Loosen fan pulley setscrews.
2. Slide fan pulley along fan shaft. Make angular alignment by loosening motor from mounting.
3. Tighten fan pulley setscrews and motor mounting bolts to torque specifications.
4. Recheck belt tension.

Bearings

This fan system uses bearings featuring concentric split locking collars. The collars are tightened through a cap screw bridging the split portion of the collar. The cap screw has a Torx T25 socket head. To tighten the locking collar: Hold the locking collar tightly against the inner race of the bearing and torque the cap screw to 65-70 in-lb (7.4-7.9 Nm). See Fig. 10.



Motor

When replacing the motor, also replace the external-tooth lock washer (star washer) under the motor mounting base; this is part of the motor grounding system. Ensure the teeth on the lock washer are in contact with the motor's painted base. Tighten motor mounting bolts to 120 +/- 12 in-lbs.

Changing fan wheel speed by changing pulleys: The horsepower rating of the belt is primarily dictated by the pitch diameter of the smaller pulley in the drive system (typically the motor pulley in these units). Do not install a replacement motor pulley with a smaller pitch diameter than provided on the original factory pulley. Change fan wheel speed by changing the fan pulley (larger pitch diameter to reduce wheel speed, smaller pitch diameter to increase wheel speed) or select a new system (both pulleys and matching belt(s)).

Before changing pulleys to increase fan wheel speed, check the fan performance at the target speed and airflow rate to determine new motor loading (bhp). Use the fan performance tables or use the Packaged Rooftop Builder software program. Confirm that the motor in this unit is capable of operating at the new operating condition. Fan shaft loading increases dramatically as wheel speed is increased.

To reduce vibration, replace the motor's adjustable pitch pulley with a fixed pitch pulley (after the final airflow balance adjustment). This will reduce the amount of vibration generated by the motor/belt-drive system.

HEAT PUMP REFRIGERATION SYSTEM

WARNING

UNIT OPERATION AND SAFETY HAZARD

Failure to follow this warning could cause personal injury, death and/or equipment damage.

This system uses R-410A[®] refrigerant which has higher pressures than R-22 and other refrigerants. No other refrigerant may be used in this system. Gauge set, hoses, and recovery system must be designed to handle R-410A refrigerant. If unsure about equipment, consult the equipment manufacturer.

Outdoor Coil

The RHS outdoor coil is fabricated with round tube copper hairpins and plate fins of various materials and/or coatings (see "Appendix I - Model Number Significance" to identify the materials provided in this unit). All unit sizes use composite-type two-row coils. Composite two-row coils are two single-row coils fabricated with a single return bend end tubesheet.

Indoor Coil

The indoor coil is traditional round-tube, plate-fin technology. Tube and fin construction is of various optional materials and coatings (see Model Number Format). Coils are multiple-row.

Outdoor Coil Maintenance and Cleaning Recommendation

Routine cleaning of coil surfaces is essential to maintain proper operation of the unit. Elimination of contamination and removal of harmful residues will greatly increase the life of the coil and extend the life of the unit. The following maintenance and cleaning procedures are recommended as part of the routine maintenance activities to extend the life of the coil.

Remove Surface Loaded Fibers

Surface loaded fibers or dirt should be removed with a vacuum cleaner. If a vacuum cleaner is not available, a soft non-metallic bristle brush may be used. In either case, the tool should be applied in the direction of the fins. Coil surfaces can be easily damaged (fin edges can be easily bent over and damage the coating of a protected coil) if the tool is applied across the fins.

NOTE: Use of a water stream, such as a garden hose, against a surface loaded coil will drive the fibers and dirt into the coil. This will make cleaning efforts more difficult.

Surface loaded fibers must be completely removed prior to using low velocity clean water rinse.

Periodic Clean Water Rinse

A periodic clean water rinse is very beneficial for coils that are applied in coastal or industrial environments. However, it is very important that the water rinse is made with very low velocity water stream to avoid damaging the fin edges. Monthly cleaning as described below is recommended.

CAUTION

PERSONAL INJURY AND UNIT DAMAGE HAZARD

Failure to follow this caution may result in personal injury or equipment damage.

Only approved cleaning is recommended.

Routine Cleaning of Indoor Coil Surfaces

Periodic cleaning with environmentally sound coil cleaner is essential to extend the life of coils. This cleaner is available from our FAST parts as part number 1178704 for a one gallon container, and part number 1178705 for a 5 gallon container. It is recommended that all coils, including standard aluminum, pre-coated, copper/copper or E-coated coils be cleaned with a environmentally sound coil cleaner as described below. Coil cleaning should be part of the unit's regularly scheduled maintenance procedures to ensure long life of the coil. Failure to clean the coils may result in reduced durability in the environment.

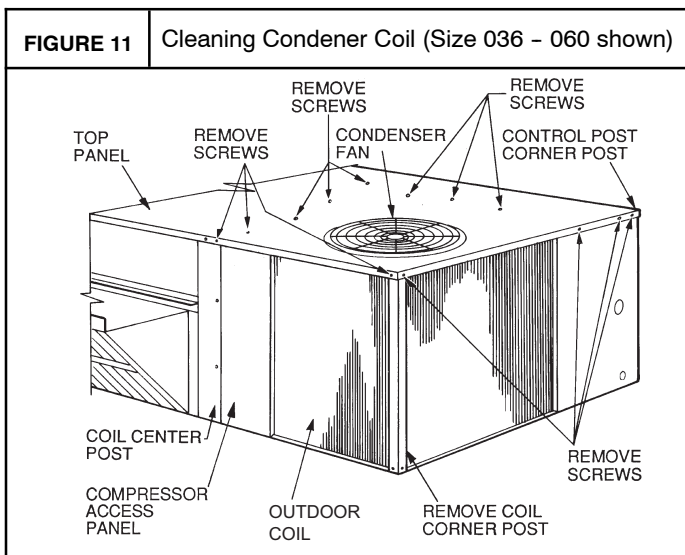
Avoid the use of

- coil brighteners
- acid cleaning prior to painting
- high pressure washers
- poor quality water for cleaning

Environmentally sound coil cleaner is nonflammable, hypoallergenic, non bacterial, and a USDA accepted biodegradable agent that will not harm the coil or surrounding components such as electrical wiring, painted metal surfaces, or insulation. Use of non-recommended coil cleaners is strongly discouraged since coil and unit durability could be affected.

Clean coil as follows:

1. Turn off unit power, tag disconnect.
2. Remove top panel screws on outdoor coil end of unit.
3. Remove coil corner post. See Fig. 11. To hold top panel open, place coil corner post between top panel and center post. See Fig. 12.



8. Reposition the outer coil section and remove the coil corner post from between the top panel and center post. Reinstall the coil corner post and replace all screws.

Environmentally Sound Coil Cleaner Application Equipment

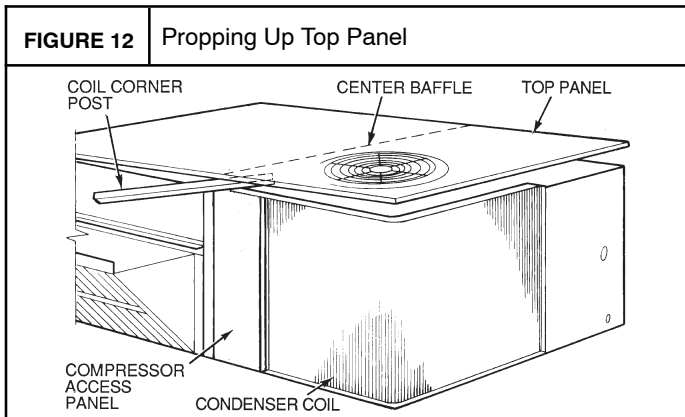
- 2-1/2 gallon garden sprayer
- Water rinse with low velocity spray nozzle

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in corrosion and damage to the unit.

Harsh chemicals, household bleach or acid or basic cleaners should not be used to clean outdoor or indoor coils of any kind. These cleaners can be very difficult to rinse out of the coil and can accelerate corrosion at the fin/tube interface where dissimilar materials are in contact. If there is dirt below the surface of the coil, use an environmentally sound coil cleaner



⚠ CAUTION

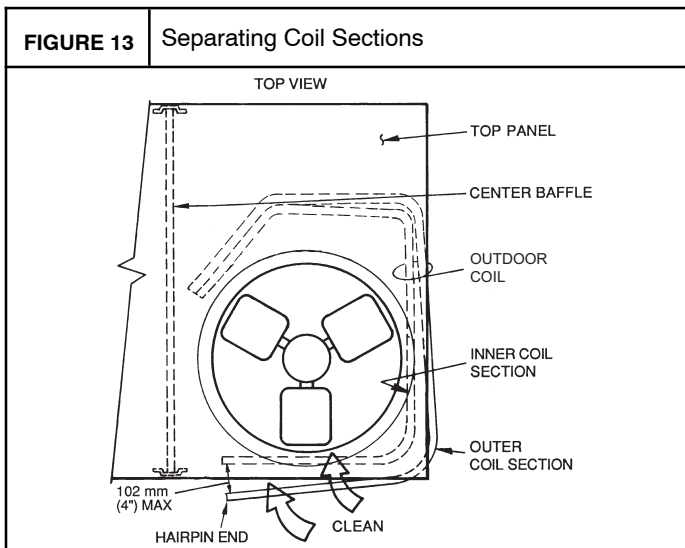
UNIT DAMAGE HAZARD

Failure to follow this caution may result in reduced unit performance.

High velocity water from a pressure washer, garden hose, or compressed air should never be used to clean a coil. The force of the water or air jet will bend the fin edges and increase airside pressure drop.

4. For Sizes 036-072: Remove screws securing coil to compressor plate and compressor access panel.
5. For Sizes 090-102: Remove fastener holding coil sections together at return end of condenser coil. Carefully separate the outdoor coil section 3 to 4 in. from the inner coil section. See Fig. 13.

Environmentally Sound Coil Cleaner Application Instructions



1. Proper eye protection such as safety glasses is recommended during mixing and application.
2. Remove all surface loaded fibers and dirt with a vacuum cleaner as described above.
3. Thoroughly wet finned surfaces with clean water and a low velocity garden hose, being carefull not to bend fins.
4. Mix environmentally sound coil cleaner in a 2 1/2 gallon garden spryer according to the instructions included with the cleaner. The optimum solution temperature is 100°F (38°C).

NOTE: Do NOT USE water in excess of 130°F (54°C), as the enzymatic activity will be destroyed.

6. Use a water hose or other suitable equipment to flush down between the 2 coil sections to remove dirt and debris. Clean the outer surfaces with a stiff brush in the normal manner.
7. Secure inner and outer coil rows together with a field-supplied fastener.

5. Thoroughly apply environmentally sound coil cleaner solution to all coil surfaces including finned area, tube sheets and coil headers.
6. Hold garden sprayer nozzle close to finned areas and apply cleaner with a vertical, up-and-down motion. Avoid spraying in horizontal pattern to minimize potential for fin damage.
7. Ensure cleaner thoroughly penetrates deep into finned areas.
8. Interior and exterior finned areas must be thoroughly cleaned.

9. Finned surfaces should remain wet with cleaning solution for 10 minutes.
10. Ensure surfaces are not allowed to dry before rinsing. Reapply cleaner as needed to ensure 10-minute saturation is achieved.
11. Thoroughly rinse all surfaces with low velocity clean water using downward rinsing motion of water spray nozzle. Protect fins from damage from the spray nozzle.

Indoor Coil

Cleaning the Indoor Coil

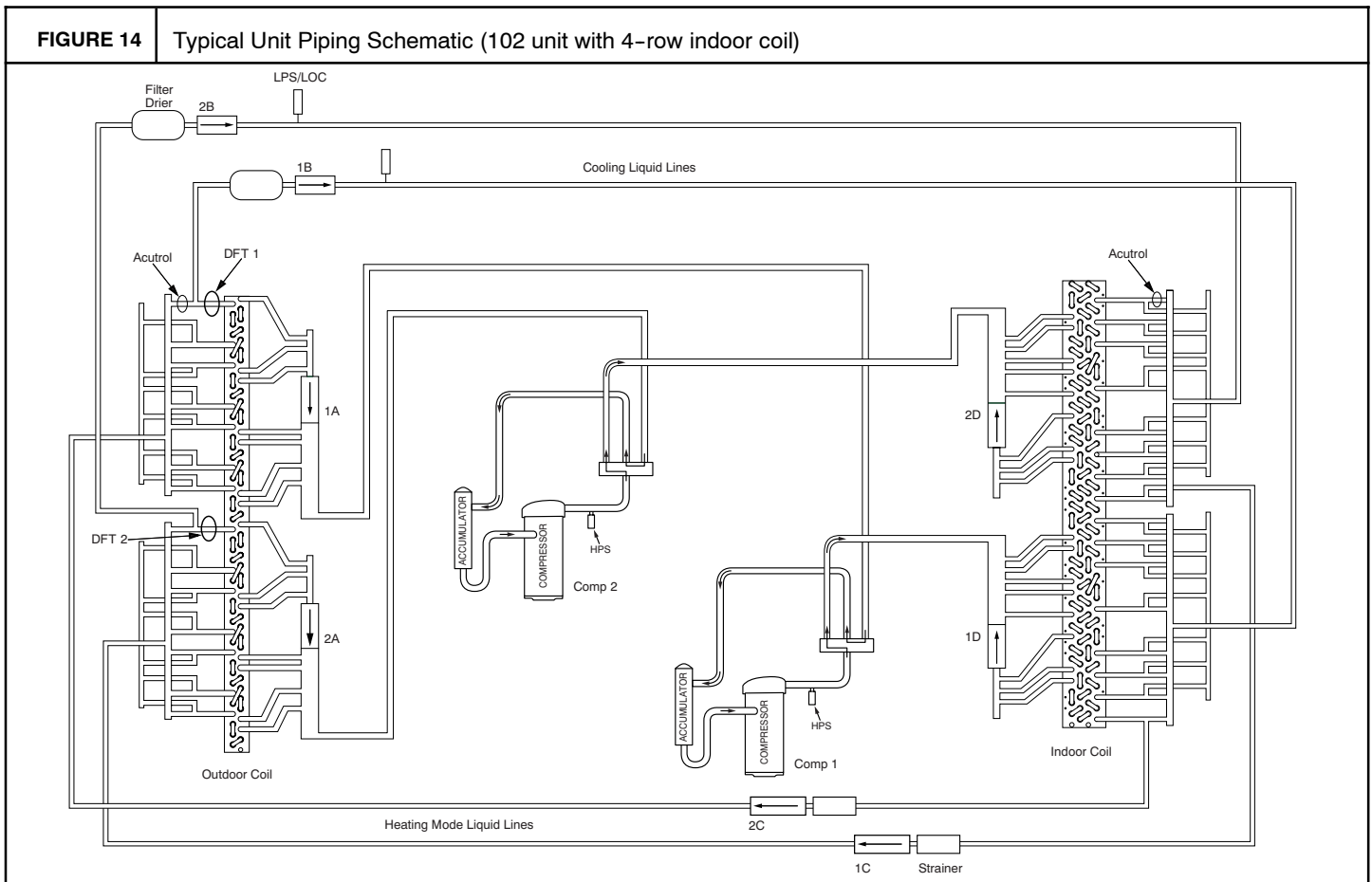
1. Turn unit power off. Install lockout tag. Remove indoor coil access panel.
2. If economizer or two-position damper is installed, remove economizer by disconnecting Molex plug and removing mounting screws.
3. Slide filters out of unit.
4. Clean coil using a commercial coil cleaner or dishwasher detergent in a pressurized spray canister. Wash both sides of coil and flush with clean water. For best results, back-flush toward return-air section to remove foreign material. Flush condensate pan after completion.
5. Reinstall economizer and filters.
6. Reconnect wiring.
7. Replace access panels.

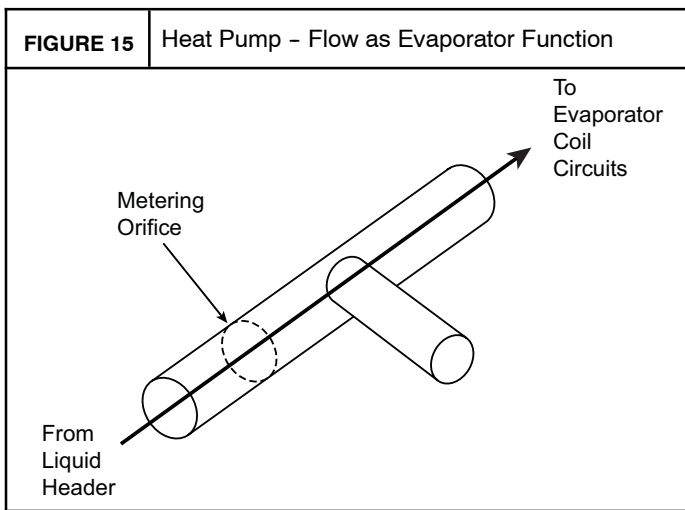
Refrigeration System Components

Each heat pump refrigeration system includes a compressor, accumulator, reversing valve, dual-function outdoor coil with vapor header check valve, cooling liquid line with filter drier and check valve, dual-function indoor coil with vapor header check valve, and heating liquid line with check valve and strainer. Unit sizes 036–072 have a single compressor-circuit; unit sizes 090 and 102 have two compressor-circuits. See Fig. 14 for typical unit piping schematic (unit size 102 (4-row indoor coil) with two compressor-circuits is depicted).

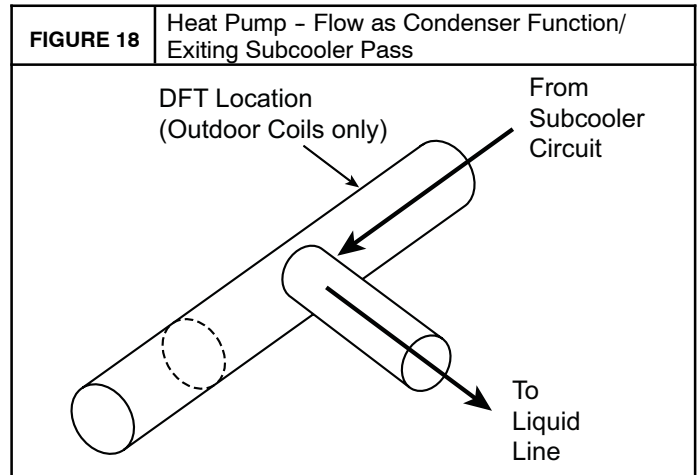
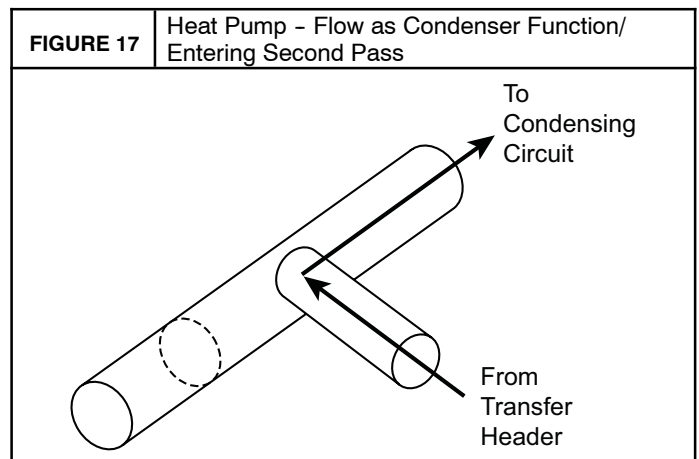
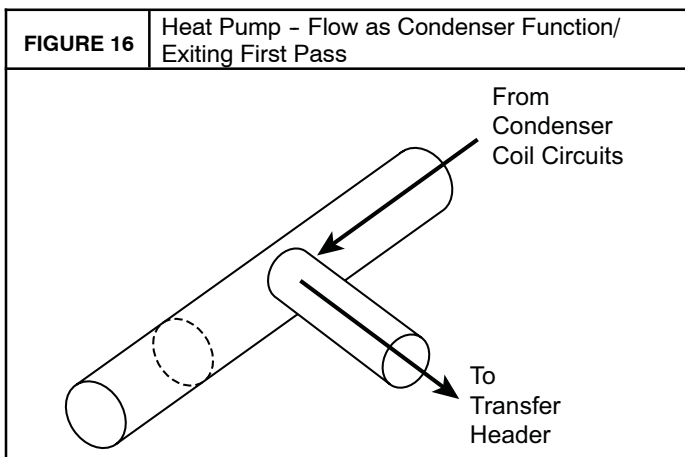
Dual-function outdoor and indoor coils are designed to provide parallel coil circuits during evaporator-function operation and converging coil circuits during condenser-function operation.

Refrigerant flow metering in the evaporator-function sequence is provided by multiple fixed-bore metering devices that are located in the tee nipples between the liquid header and the entrance to each coil circuit. The Thel metering device is swaged into the nipple tube between the liquid header end and the side-port tube. See Fig. 15. During evaporator-function operation, flow is straight through the nipple and into each evaporator circuit. Flow continues through the parallel evaporator circuits and into the vapor header.





Converging circuit flow in the condenser-function operation is accomplished with the check valve in the vapor header and the liquid transfer header connected to the side ports on all but one of the tee nipples in each circuit. During condenser-function operation, hot gas from the compressor discharge enters the header until it reaches the check valve which blocks further flow. The hot gas exits the header through the tubes above the check valve and enters these coil circuits. At the outlet of these desuperheating and condensing circuits, the refrigerant enters the tees from the coil end. The refrigerant exits the tee at the side port and enters the liquid transfer header (see Fig. 16). The refrigerant moves through the liquid transfer header and exits through the remaining tubes, through the side ports on the tees (see Fig. 17) and back into the coil circuits where additional condensing occurs. These circuits exit into the vapor header behind the check valve and exit through the remaining tube on the vapor header. In this last pass through the coil, the refrigerant is subcooled. Subcooled liquid exits at the last tee (see Fig. 18) where the side port is connected to the specific mode liquid line.



Each liquid line has a check valve to prevent backflow through the liquid line in its opposite mode. This ensures correct flow direction through filter driers and strainers and prevents emptying of off-mode liquid lines into evaporator-function coil circuits.

Reversing Valve and Check Valve Position

See Fig. 14 on page 10.

Table 3 – Cooling Mode (each circuit)

Component	Status/Position
Reversing Valve	Energized
Check Valve A	Closed
Check Valve B	Open
Check Valve C	Closed
Check Valve D	Open

Table 4 – Heating Mode (each circuit)

Component	Status/Position
Reversing Valve	De-energized
Check Valve A	Open
Check Valve B	Closed
Check Valve C	Open
Check Valve D	Closed

Table 5 – Defrost Mode

RHS036–102 / Circuit 2	
Component	Status/Position
Defrost Thermostat	Closed
Outdoor Fan(s)	Off
Reversing Valve	Energized
Check Valve A	Closed
Check Valve B	Open
Check Valve C	Closed
Check Valve D	Open

Troubleshooting Refrigerant Pressure Problems and Check Valves

Refer to Fig. 14, on page 10, and the Cooling Mode and Heating Mode tables (Tables 3 and 4) on page 11.

Coil Metering Devices

The metering devices are multiple fixed-bore devices swaged into the horizontal outlet tubes from the liquid header, located at the entrance to each evaporator coil circuit path. These are non-adjustable. Service requires replacing the entire liquid header assembly.

Check for possible blockage of one or more of these metering devices by creating a low load condition on the evaporator-function coil and then observing the frosting pattern on the finned portion of the coil.

To check the indoor coil, disconnect the supply fan signal (036–072 direct-drive fans) or contactor (IFC) coil, then

start the circuit in a Cooling Mode (jumper R to Y1 or Y2) and observe the frosting pattern on the face of the indoor coil. A frost pattern should develop uniformly across the face of the indoor coil starting at each tube at the nipple locations.

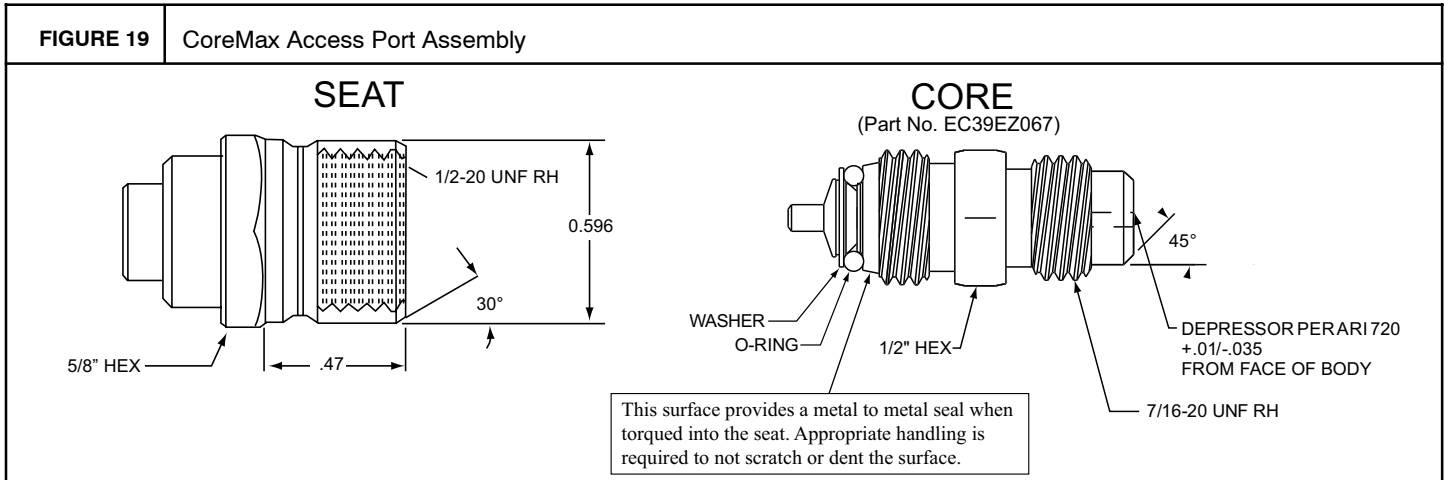
To check the outdoor coil, disconnect the outdoor fan motor. Start the circuit in a Heating Mode (jumper R to W1 or W2) and observe the frost pattern on the face of the outdoor coil.

Failure to develop frost at an outlet tube can indicate a plugged or a missing orifice.

Refrigerant System Pressure Access Ports

There are two access ports in each circuit – on the suction tube near the compressor and on the discharge tube near the compressor. These are brass fittings with black plastic caps. The hose connection fittings are standard 1/4 SAE Male Flare couplings.

The brass fittings are two-piece High Flow valves, with a receptacle base brazed to the tubing and an integral spring-closed check valve core screwed into the base. (See Fig. 19.) This check valve is permanently assembled into this core body and cannot be serviced separately; replace the entire core body if necessary. Service tools are available that allow the replacement of the check valve core without having to recover the entire system refrigerant charge. Apply compressor refrigerant oil to the check valve core’s bottom o-ring. Install the fitting body with 96 +/-10 in-lbs of torque; do not overtighten.



R-410A REFRIGERANT

This unit is designed for use with R-410A refrigerant. Do not use any other refrigerant in this system.

R-410A refrigerant is provided in pink (rose) colored cylinders. These cylinders are available with and without dip tubes; cylinders with dip tubes will have a label indicating this feature. For a cylinder with a dip tube, place the cylinder in the upright position (access valve at the top) when removing liquid refrigerant for charging. For a cylinder without a dip tube, invert the cylinder (access valve on the bottom) when removing liquid refrigerant.

Because R-410A refrigerant is a blend, it is strongly recommended that refrigerant always be removed from the cylinder as a liquid. Admit liquid refrigerant into the system in the discharge line. If adding refrigerant into the suction line, use a commercial metering/expansion device at the gauge manifold; remove liquid from the cylinder, pass it through the metering device at the gauge set and then pass it into the suction line as a vapor. Do not remove R-410A refrigerant from the cylinder as a vapor.

Refrigerant Charge

Amount of refrigerant charge is listed on the unit's nameplate. Refer to the GTAC2-5 Charging, Recovery, Recycling and Reclamation training manual and the following procedures.

Unit panels must be in place when unit is operating during the charging procedure. If unit is equipped with a head pressure control device, bypass it to ensure full fan operation during charging.

Charge checking and adjustments must be made while the system is operating in Cooling only.

No Charge

Use standard evacuation techniques for R-410A refrigerant. After evacuating system, weigh in the specified amount of refrigerant.

Low-Charge Cooling

Using Cooling Charging Charts, Fig. 20 vary refrigerant until the conditions of the appropriate chart are met. Note the charging charts are different from type normally used. Charts are based on charging the units to the correct superheat for the various operating conditions. Accurate pressure gauge and temperature sensing device are required. Connect the pressure gauge to the service port on the suction line. Mount the temperature sensing device on the suction line and insulate it so that outdoor ambient temperature does not affect the reading. Indoor-air cfm must be within the normal operating range of the unit.

To Use Cooling Charging Charts

Take the outdoor ambient temperature and read the suction pressure gauge. Refer to chart to determine what suction temperature should be. If suction temperature is high, add refrigerant. If suction temperature is low, carefully recover some of the charge. Recheck the suction pressure as charge is adjusted.

SIZE DESIGNATION	NOMINAL TONS REFERENCE
036	3
048	4
060	5
072	6
090	7.5
102	8.5

EXAMPLE:

Model RHS036

Outdoor Temperature 85°F (29°C)

Suction Pressure 140 psig (965 kPa)

Suction Temperature should be .. 55°F (13°C)

Compressors

Lubrication

Compressors are charged with the correct amount of oil at the factory.

⚠ CAUTION

UNIT DAMAGE HAZARD

Failure to follow this caution may result in damage to components.

The compressor is in a R-410A refrigerant system and uses a polyolester (POE) oil. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oils can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Avoid exposure of the oil to the atmosphere.

Replacing Compressor

The compressor used with R-410A refrigerant contains a POE oil. This oil has a high affinity for moisture. Do not remove the compressor's tube plugs until ready to insert the unit suction and discharge tube ends.

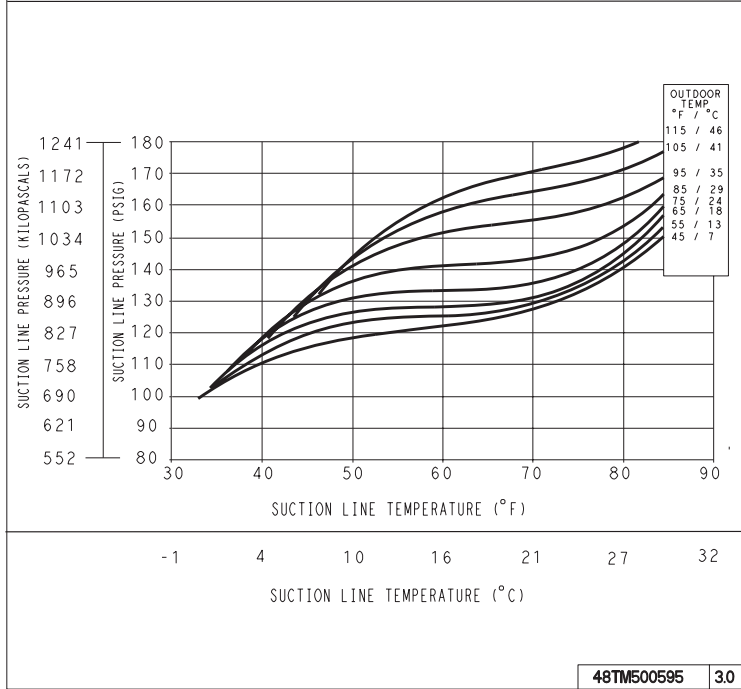
Compressor mounting bolt torque is 65-75 in-lbs (7.3-8.5 Nm).

COOLING CHARGING CHARTS

FIGURE 20 Cooling Charging Charts

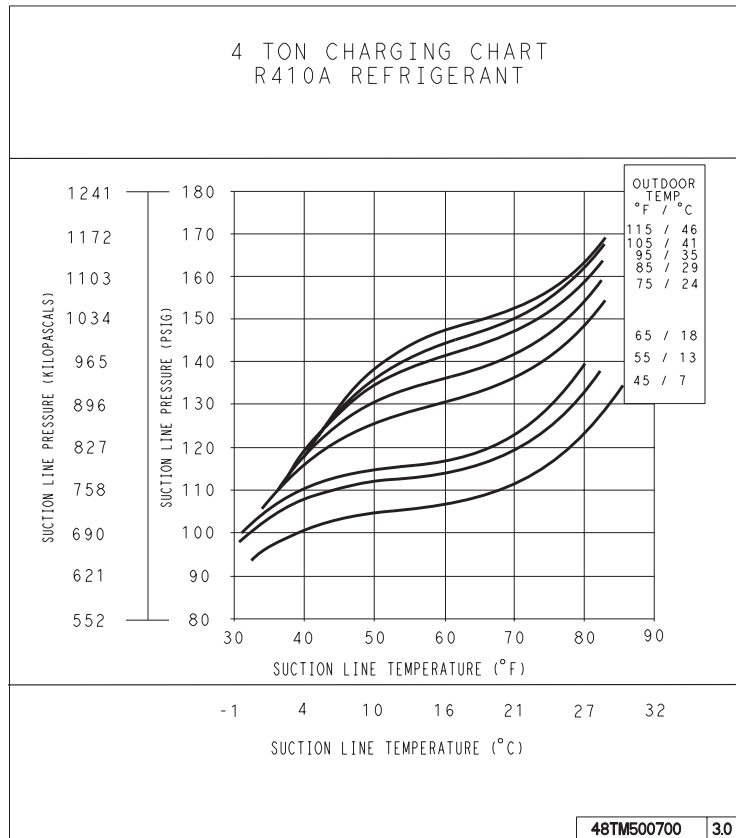
RHS036

3 TON CHARGING CHART
R410A REFRIGERANT

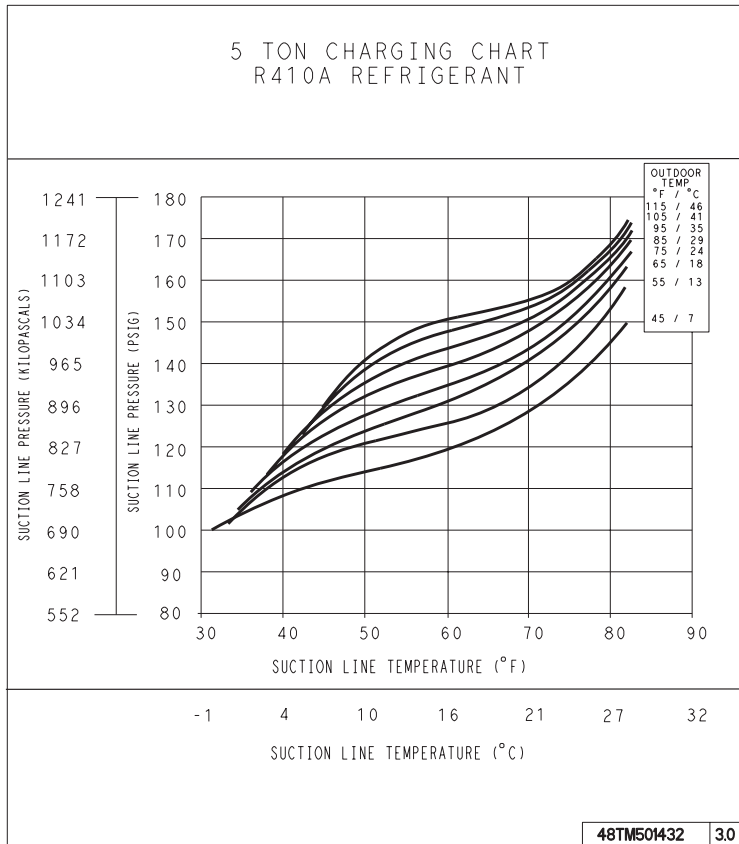


RHS048

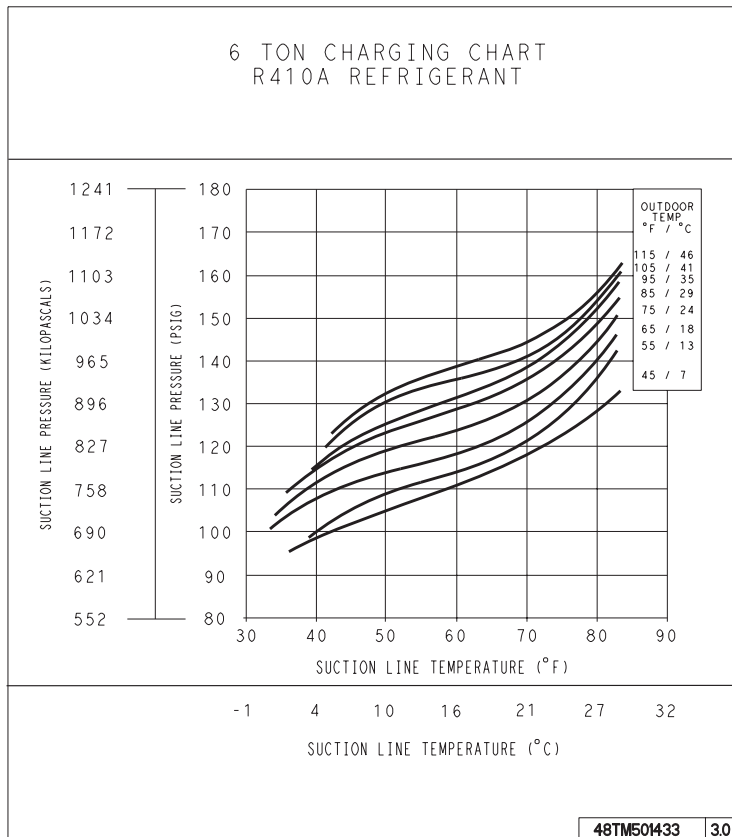
4 TON CHARGING CHART
R410A REFRIGERANT



RHS060

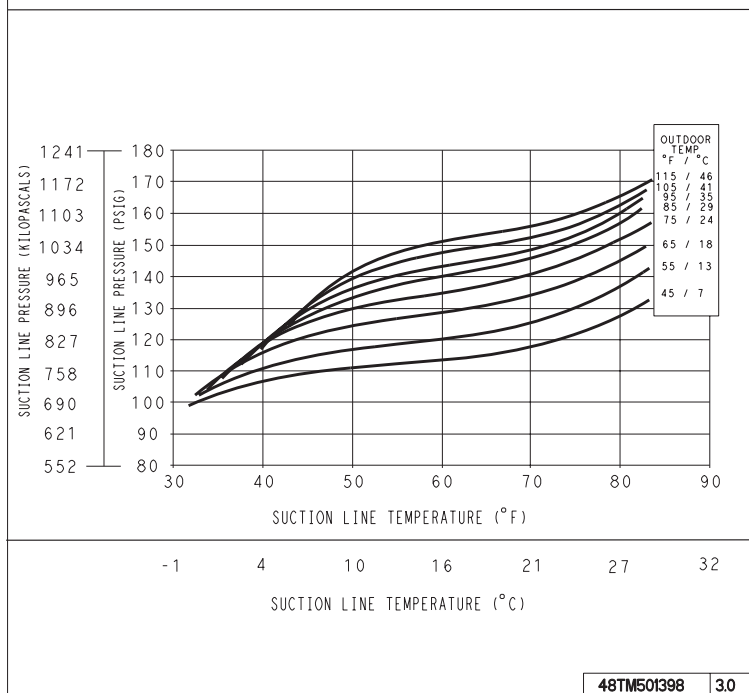


RHS072



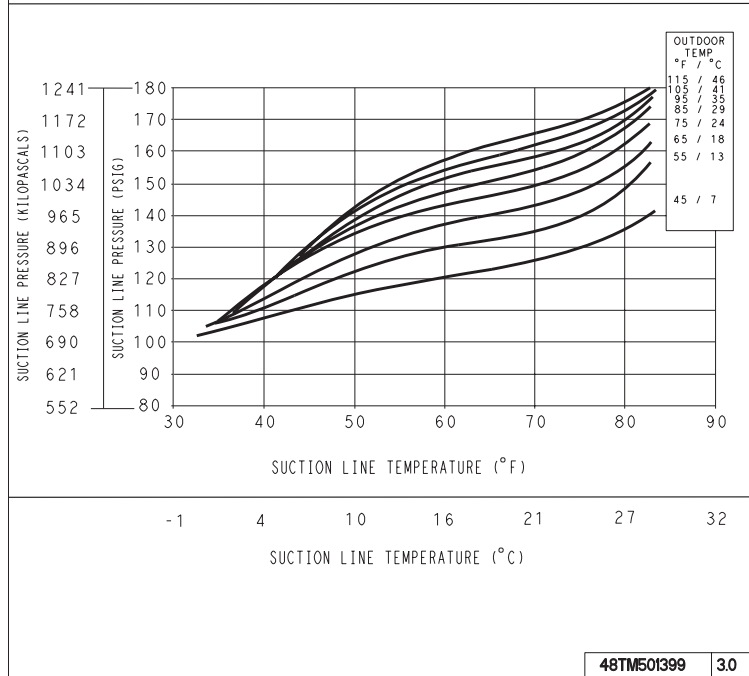
RHS090

7.5 TON CHARGING CHART
R410A REFRIGERANT



RHS102

8.5 TON CHARGING CHART
R410A REFRIGERANT



Compressor Rotation



CAUTION

PERSONAL INJURY HAZARD

Failure to follow this caution may result in personal injury.

On 3-phase units with scroll compressors, it is important to be certain compressor is rotating in the proper direction. To determine whether or not compressor is rotating in the proper direction:

1. Connect service gauges to suction and discharge pressure fittings.
2. Energize the compressor.
3. The suction pressure should drop and the discharge pressure should rise, as is normal on any start-up.

NOTE: If the suction pressure does not drop and the discharge pressure does not rise to normal levels:

4. Note that the evaporator fan is probably also rotating in the wrong direction.
5. Turn off power to the unit.
6. Reverse any two of the unit power leads.
7. Reapply power to the compressor.

The suction and discharge pressure levels should now move to their normal start-up levels.

NOTE: When the compressor is rotating in the wrong direction, the unit makes an elevated level of noise and does not provide cooling.

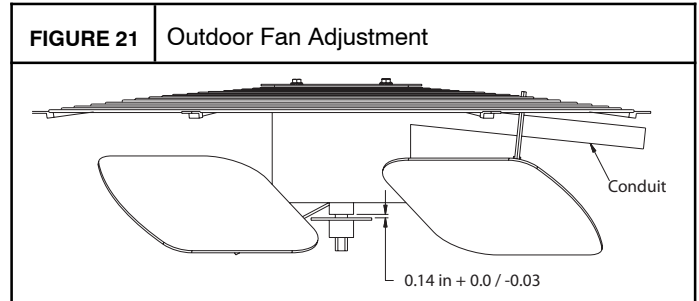
Filter Drier

Replace whenever refrigerant system is exposed to atmosphere. Only use factory specified liquid-line filter driers with working pressures no less than 650 psig. Do not install a suction-line filter drier in liquid line. A liquid-line filter drier designed for use with R-410A refrigerant is required on every unit.

Outdoor Fan Location

See Fig. 21.

1. Shut off unit power supply. Install lockout tag.
2. Remove condenser-fan assembly (grille, motor, and fan).
3. Loosen fan hub setscrews.
4. Adjust fan height as shown in Fig. 21.
5. Tighten setscrews to 84 in-lbs (9.5 Nm).
6. Replace condenser-fan assembly.



Troubleshooting Cooling System

Refer to Table 6 for additional troubleshooting topics.

Table 6 – Heating and Cooling Troubleshooting

PROBLEM	CAUSE	REMEDY
Compressor and Outdoor Fan Will Not Start.	Power failure.	Call power company.
	Fuse blown or circuit breaker tripped.	Replace fuse or reset circuit breaker. Determine root cause.
	Defective thermostat, contactor, transformer, control relay, or capacitor.	Replace component.
	Insufficient line voltage.	Determine cause and correct.
	Incorrect or faulty wiring.	Check wiring diagram and rewire correctly.
	Thermostat setting too high.	Lower thermostat setting below room temperature.
	High pressure switch tripped.	See problem "Excessive head pressure."
	Low pressure switch tripped.	Check system for leaks. Repair as necessary.
Compressor Will Not Start But Outdoor Fan Runs.	Freeze-up protection thermostat tripped.	See problem "Suction pressure too low."
	Faulty wiring or loose connections in compressor circuit.	Check wiring and repair or replace.
	Compressor motor burned out, seized, or internal overload open.	Determine cause. Replace compressor or allow enough time for internal overload to cool and reset.
	Defective run/start capacitor, overload, start relay.	Determine cause and replace compressor.
Compressor Cycles (Other Than Normally Satisfying Thermostat).	One leg of 3-phase power dead.	Replace fuse or reset circuit breaker. Determine cause.
	Refrigerant overcharge or undercharge.	Recover refrigerant, evacuate system, and recharge to name-plate.
	Defective compressor.	Replace and determine cause.
	Insufficient line voltage.	Determine cause and correct.
	Blocked outdoor coil or dirty air filter.	Determine cause and correct.
	Defective run/start capacitor, overload, or start relay.	Determine cause and replace.
	Defective thermostat.	Replace thermostat.
Compressor Operates Continuously.	Faulty outdoor-fan (cooling) or indoor-fan (heating) motor or capacitor.	Replace.
	Restriction in refrigerant system.	Locate restriction and remove.
	Dirty air filter.	Replace filter.
	Unit undersized for load.	Decrease load or increase unit size.
	Thermostat set too low (cooling).	Reset thermostat.
	Low refrigerant charge.	Locate leak; repair and recharge.
Compressor Makes Excessive Noise.	Air in system.	Recover refrigerant, evacuate system, and recharge.
	Outdoor coil dirty or restricted.	Clean coil or remove restriction.
Excessive Head Pressure.	Compressor rotating in the wrong direction.	Reverse the 3-phase power leads as described in Start-Up.
	Dirty outside air or return air filter (heating).	Replace filter.
	Dirty outdoor coil (cooling).	Clean coil.
	Refrigerant overcharged.	Recover excess refrigerant.
	Condensing air restricted or air short-cycling.	Determine cause and correct.
Head Pressure Too Low.	Air in system.	Recover refrigerant, evacuate system, and recharge.
	Low refrigerant charge.	Check for leaks; repair and recharge.
	Compressor scroll plates defective.	Replace compressor.
Excessive Suction Pressure.	Restriction in liquid tube.	Remove restriction.
	High heat load.	Check for source and eliminate.
	Compressor scroll plates defective.	Replace compressor.
Suction Pressure Too Low.	Refrigerant overcharged.	Recover excess refrigerant.
	Dirty air filter (cooling).	Replace filter.
	Dirty or heavily iced outdoor coil (heating).	Clean outdoor coil. Check defrost cycle operation.
	Low refrigerant charge.	Check for leaks; repair and recharge.
	Metering device or low side restricted.	Remove source of restriction.
	Insufficient indoor airflow (cooling mode).	Increase air quantity. Check filter and replace if necessary.
	Temperature too low in conditioned area.	Reset thermostat.
	Field-installed filter drier restricted.	Replace.
Outdoor ambient below 25°F (cooling).	Install low-ambient kit.	
Outdoor fan motor(s) not operating (heating).	Check fan motor operation.	

CONVENIENCE OUTLETS

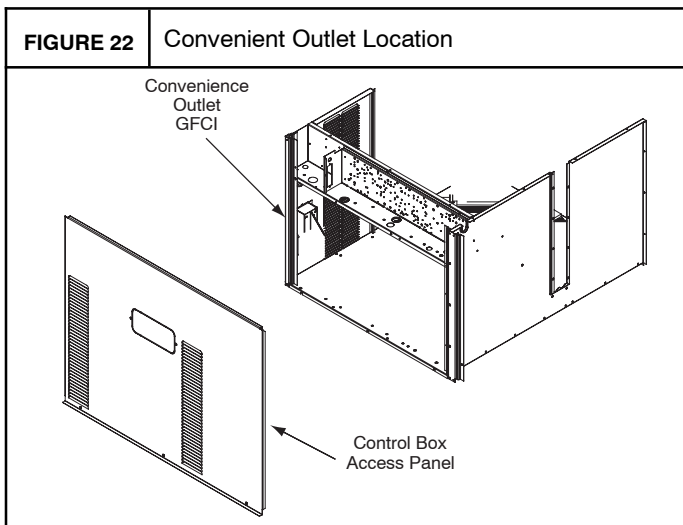
⚠ WARNING

ELECTRICAL OPERATION HAZARD

Failure to follow this warning could result in personal injury or death.

Units with convenience outlet circuits may use multiple disconnects. Check convenience outlet for power status before opening unit for service. Locate its disconnect switch, if appropriate, and open it. Tag-out this switch, if necessary.

Non-powered convenience outlets are offered on RHS models: They provide a 125-volt GFCI (ground-fault circuit-interrupter) duplex receptacle rated at 15-A behind a hinged waterproof access cover, located on the end panel of the unit. See Fig. 22.



Installing Weatherproof Cover –

A weatherproof while-in-use cover for the factory-installed convenience outlets is now required by UL standards. This cover cannot be factory-mounted due its depth; it must be installed at unit installation. For shipment, the convenience outlet is covered with a blank cover plate.

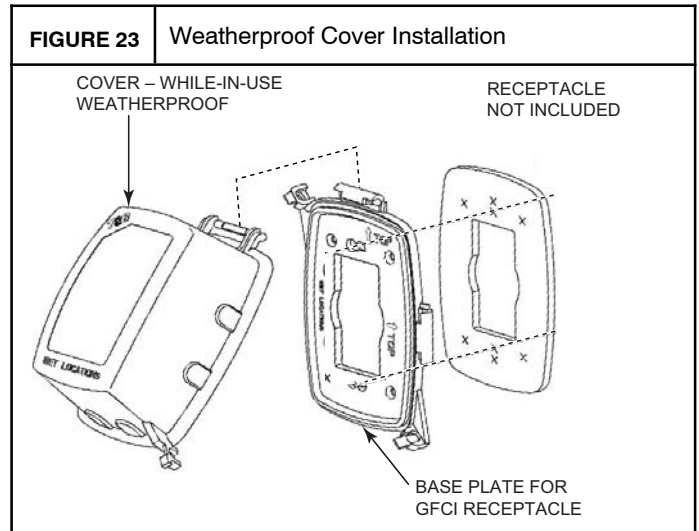
The weatherproof cover kit is shipped in the unit's control box. The kit includes the hinged cover, a backing plate and gasket.

DISCONNECT ALL POWER TO UNIT AND CONVENIENCE OUTLET.

Remove the blank cover plate at the convenience outlet; discard the blank cover.

Loosen the two screws at the GFCI duplex outlet, until approximately 1/2-in (13 mm) under screw heads are exposed. Press the gasket over the screw heads. Slip the backing plate over the screw heads at the keyhole slots and align with the gasket; tighten the two screws until snug (do not over-tighten).

Mount the weatherproof cover to the backing plate as shown in Fig. 23. Remove two slot fillers in the bottom of the cover to permit service tool cords to exit the cover. Check for full closing and latching.



Non-powered Convenient Outlet: This type requires the field installation of a general-purpose 125-volt 15-A circuit powered from a source elsewhere in the building. Observe national and local codes when selecting wire size, fuse or breaker requirements and disconnect switch size and location. Route 125-v power supply conductors into the bottom of the utility box containing the duplex receptacle.

Maintenance: Periodically test the GFCI receptacle by pressing the TEST button on the face of the receptacle. This should cause the internal circuit of the receptacle to trip and open the receptacle. Check for proper grounding wires and power line phasing if the GFCI receptacle does not trip as required. Press the RESET button to clear the tripped condition.

Using unit-mounted convenience outlets: Units with unit-mounted convenience outlet circuits will often require that two disconnects be opened to de-energize all power to the unit. Treat all units as electrically energized until the convenience outlet power is also checked and de-energization is confirmed. Observe National Electrical Code Article 210, Branch Circuits, for use of convenience outlets.

HEAT PUMP CONTROLS

Controls Terminal Board

The Controls Terminal Board (CTB) is a large printed circuit board that is located in the center of the unit control box. This printed circuit board contains multiple termination strips and connectors to simplify factory control box wiring and field control connections. Terminals are clearly marked on the board surface. See Fig 24.

The CTB contains no software and no logic. But it does include seven configuration jumpers that are cut to

configure the board to read external optional and accessory controls, including that the unit is a heat pump.

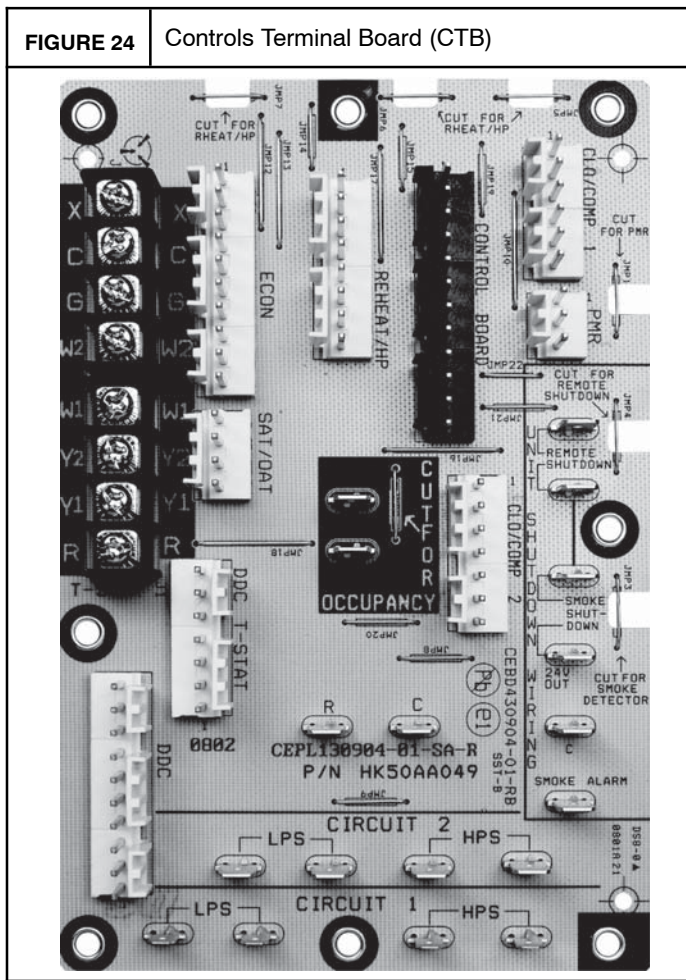


Table 7 – Jumper Configuration

Jumper	Control Function	Note
JMP1	Phase Monitor	
JMP2	Occupancy Control	
JMP3	Smoke Detector Shutdown	
JMP4	Remote Shutdown	
JMP5	Heat Pump / Reheat	RHS default: Cut
JMP6	Heat Pump / Reheat	RHS default: Cut
JMP7	Heat Pump / Reheat	RHS default: Cut

Jumpers JMP5, JMP6 and JMP7 are located in notches across the top of the CTB (see Fig. 24). These jumpers are factory cut on all heat pump units. Visually check these jumpers to confirm that they have been cut.

PROTECTIVE CONTROLS

Compressor Protection

Overcurrent

The compressor has internal linebreak motor protection.

Overtemperature

The compressor has an internal protector to protect it against excessively high discharge gas temperatures.

High Pressure Switch

The system is provided with a high pressure switch mounted on the discharge line. The switch is stem-mounted and brazed into the discharge tube. Trip setting is 630 psig +/- 10 psig (4344 +/- 69 kPa) when hot. Reset is automatic at 505 psig (3482 kPa).

Loss of Charge Switch

The system is protected against a loss of charge and low evaporator coil loading condition by a loss of charge switch located on the liquid line and a freeze protection thermostat on the indoor coil. The switch is stem-mounted. Loss of Charge Switch trip setting is 27 psig +/- 3 psig (186 +/- 21 kPa). Reset is automatic at 44 +/- 3 psig (303 +/- 21 kPa).

Freeze Protection Thermostat trip setting is 30°F +/- 5°F (-1°C +/- 3°C). Reset is automatic at 45°F +/- 5°F (7°C +/- 3°C).

Supply (Indoor) Fan Motor Protection

Disconnect and lockout power when servicing fan motor.

2.9 and 3.7 bhp motors are equipped with an overtemperature or protection device. The type of device depends on the motor size. See Table 8.

Table 8 – Overload Device per Motor Size

Motor Size (bhp)	Overload Device	Reset
1.7	Internal Linebreak	Automatic
2.4	Internal Linebreak	Automatic
2.9	Thermix	Automatic
3.7	Thermix	Automatic
4.7	External (Circuit Breaker)	Manual

The High Static option supply fan motor is equipped with a pilot-circuit Thermix combination overtemperature/overcurrent protection device. This device resets automatically. Do not bypass this switch to correct trouble. Determine the cause and correct it.

The Thermix device is a snap-action overtemperature protection device that is imbedded in the motor windings. It is a pilot-circuit device that is wired into the unit's 24-v control circuit. When this switch reaches its trip setpoint, it opens the 24-v control circuit and causes all unit operation to cease. This device resets automatically when the motor windings cool. Do not bypass this switch to correct trouble. Determine the cause and correct it.

The External motor overload device is a specially-calibrated circuit breaker that is UL recognized as a motor overload controller. It is an overcurrent device. When the motor current exceeds the circuit breaker setpoint, the device opens all motor power leads and the motor shuts down. Reset requires a manual reset at the overload switch. This device (designated IFCB) is located on the side of the supply fan housing, behind the fan access panel.

Troubleshooting supply fan motor overload trips: The supply fan used in RHS units is a forward-curved centrifugal wheel. At a constant wheel speed, this wheel had a characteristic that causes the fan shaft load to DECREASE when the static pressure in the unit-duct system increases and to INCREASE when the static pressure in the unit-duct system decreases (and fan airflow rate increases). Motor overload conditions typically develop when the unit is operated with an access panel removed, with unfinished duct work, in an economizer-open mode, or a leak develops in the duct system that allows a bypass back to unit return opening.

Outdoor Fan Motor Protection

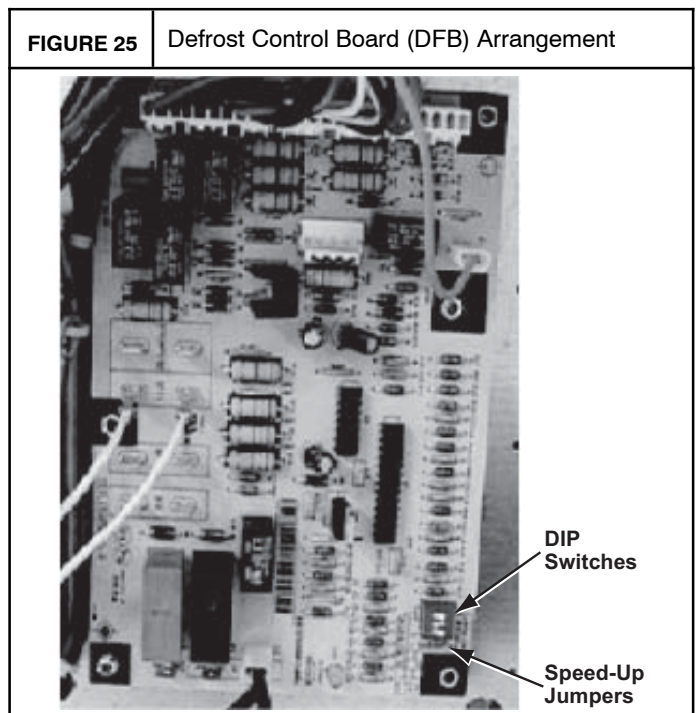
The outdoor fan motor is internally protected against overtemperature.

Control Circuit, 24-V

The control circuit is protected against overcurrent conditions by a circuit breaker mounted on control transformer TRAN. Reset is manual.

COMMERCIAL DEFROST CONTROL

The Commercial Defrost Control Board (DFB) coordinates thermostat demands for supply fan control, 1 or 2 stage cooling, 2 stage heating, emergency heating and defrost control with unit operating sequences. The DFB also provides an indoor fan off delay feature (user selectable). See Fig. 25 for board arrangement.



The DFB is located in the RHS's main control box (see Fig. 26). All connections are factory-made through harnesses to the unit's CTB, to IFC (belt-drive motor) or to ECM (direct-drive motor), reversing valve solenoids and to defrost thermostats. Refer to Table 9 for details of DFB Inputs and Outputs. Detailed unit operating sequences are provided in the Operating Sequences section starting on page 62.

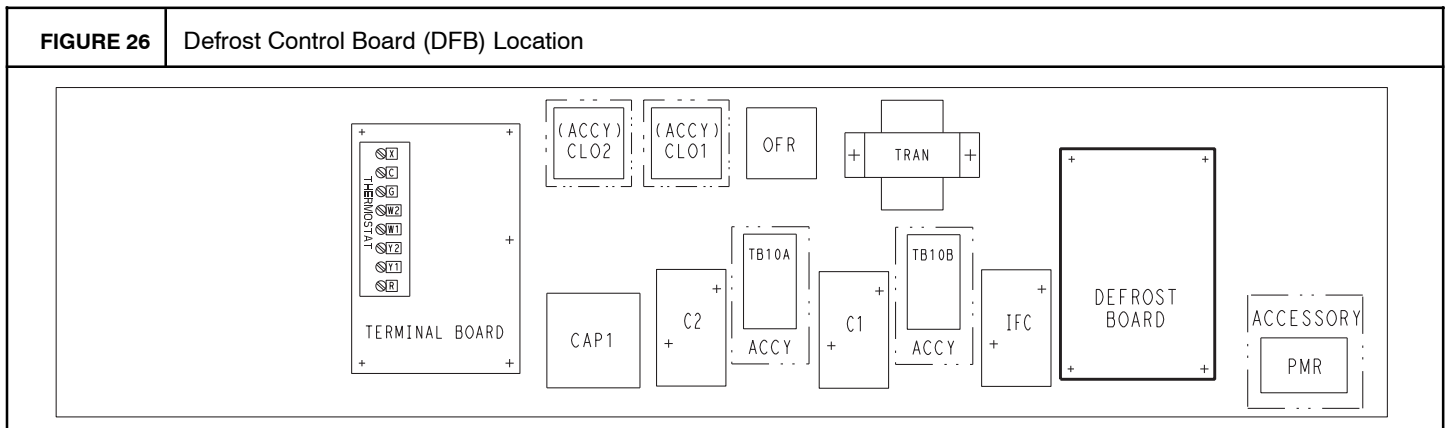


Table 9 – RHS Defrost Board I/O and Jumper Configurations

Inputs

Point Name	Type of I/O	Connection Pin Number	Unit Connection	Note
G Fan	DI, 24–vac	P2–3	LCTB–G	
Y1 Cool 1	DI, 24–vac	P2–5	LCTB–Y1	
Y2 Cool 2	DI, 24–vac	P2–4	LCTB–Y2	
W1 Heat 1	DI, 24–vac	P2–7	LCTB–W1	
W2 Heat 2	DI, 24–vac	P2–6	LCTB–W2	
R Power	24–vac	P3–1	CONTL BRD–8	
C Common	24–vac	P3–2	CONTL BRD–4	
DFT1	DI, 24–vac	DFT–1 to DFT–1		
DFT 2	DI, 24–vac	DFT–2 to DFT–2		

Outputs

Point Name	Type of I/O	Connection Pin Number	Unit Connection	Note
IFO Fan On	DO, 24–vac	P3–9	REHEAT–2	
OF OD Fan On	DO, 24–vac	OF	OFR	
RVS1	DO, 24–vac	P3–7 to P3–5		Energize in COOL
RVS2	DO, 24–vac	P3–6 to P3–4		Energize in COOL
COMP 1	DO, 24–vac	P3–10	FPT – REHEAT–6	
COMP 2	DO, 24–vac	P3–8	REHEAT–8	
HEAT 2	DO, 24–vac	E–HEAT	HC–1 (TB4–1)	
COM	24–vac	P3–3	HC–1 (TB4–3)	

Configuration

Point Name	Type of I/O	Connection Pin Number	Unit Connection	Note
Select Jumper	24–vac	P1–1		
2 Compressor	24–vac	P1–3		Use for RHS***D

Speed-Up Configuration

Point Name	Type of I/O	Connection Pin Number	Unit Connection	Note
Speed–Up Jumper		JMP17		
Speed–Up Jumper		JMP18		

Jumper for 1–3 secs: Factory Test, defrost runs for 9 secs
 Jumper for 5–20 secs: Forced Defrost, defrost runs for 30 secs if DFT2 is open

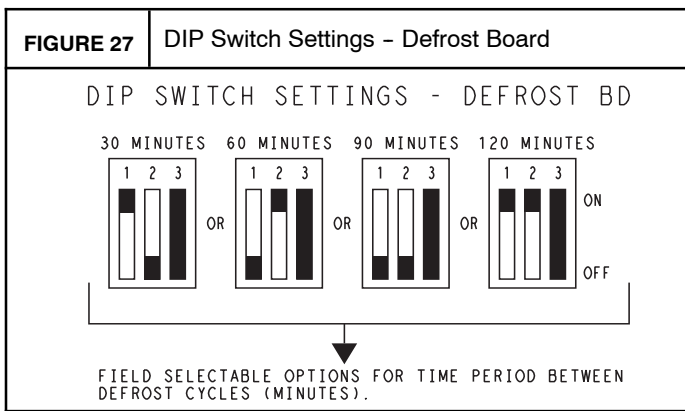
Reversing valve control — The DFB has two outputs for unit reversing valve control. Operation of the reversing valves is based on internal logic; this application does not use an “O” or “B” signal to determine reversing valve position. Reversing valves are energized during the Cooling stages and de-energized during Heating cycles. Once energized at the start of a Cooling stage, the reversing valve will remain energized until the next Heating cycle demand is received. Once de-energized at the start of a Heating cycle, the reversing valves will remain de-energized until the next Cooling stage is initiated.

Compressor control — The DFB receives inputs indicating Stage 1 Cooling, Stage 2 Cooling (sizes 090 and 102 only) and Stage 1 Heating from the space thermostat; it generates commands to start compressors with or without reversing valve operation to produce Stage 1 Cooling (one compressor), Stage 2 Cooling (both compressors run) or Stage 1 Heating (both compressors run).

Auxiliary (Electric) Heat control — The RHS unit can be equipped with one or two auxiliary electric heaters, to provide a second stage of Heating. The DFB will energize this Heating system for a Stage 2 Heating command (heaters operate concurrently with both compressors in the Stage 2 Heating cycle), for an Emergency Heating sequence (compressors are off and only the electric heaters are energized) and also during the Defrost cycle (to eliminate a “cold blow” condition in the space).

Defrost — The defrost control mode is a time/temperature sequence. There are two time components: The continuous run period and the test/defrost cycle period. The temperature component is provided by the defrost thermostat(s) (DFT1 and DFT2 (090-102 only) mounted on the outdoor coil.

The continuous run period is a fixed time period between the end of the last defrost cycle (or start of the current Heating cycle) during which no defrost will be permitted. This period can be set at 30, 60, 90 or 120 minutes by changing the positions of DIP switches SW1 and SW2 (see Fig. 27 and Table 10). The default run periods are 30 minutes for unit sizes 036-072 and 90 minutes for unit sizes 090-102.



At the end of the continuous run period, the defrost control will test for a need to defrost. On unit sizes 036-072 (single compressor designs), DFT1 controls the start and termination of the defrost cycle. If DFT1 is still open, the defrost test/run window is closed and the control repeats the continuous run period. If DFT1 is closed, the defrost cycle is initiated. The defrost period will end when DFT1 opens (indicating the outdoor coil has been cleared of frost and ice) or a 10 minute elapsed period expires, whichever comes first.

On unit sizes 090-102 (two circuit designs), DFT2 (located on the bottom circuit of the outdoor coil) controls the start and termination of the defrost cycle. If DFT2 is still open, the defrost test/run window is closed and the control repeats the continuous run period. If DFT2 is closed, the defrost cycle is initiated in Circuit 2. The defrost period will end when DFT2 opens (indicating the outdoor coil has been cleared of frost and ice) or a 10 minute elapsed period expires, whichever comes first.

On sizes 090-102, Circuit 1's defrost thermostat DFT1 (located on the upper circuit of the outdoor coil) cannot initiate a unit defrost cycle; only DFT2 may do this. But once Circuit 2 is in defrost, the DFB will monitor the status of DFT1. If DFT1 closes during a Circuit 2 defrost cycle, Circuit 1 will also enter a defrost cycle. Circuit 1's defrost cycle will end when DFT1 opens (indicating the upper portion of the outdoor coil is cleared of frost and ice) or the Circuit 2 defrost cycle is terminated.

At the end of the unit defrost cycle, the unit will be returned to Heating cycle for a full continuous run period.

If the space heating load is satisfied and compressor operation is terminated, the defrost control will remember where the run period was interrupted. On restart in Heating, the defrost control will resume unit operation at the point in the run period where it was last operating.

Defrost Thermostats — These are temperature switches that monitor the surface temperature of the outdoor coil circuits. These switches are mounted on the liquid tube exiting the outdoor coil heating circuits. These switches close on temperature drop at 30°F (-1°C) and reset open on temperature rise at 80°F (27°C).

Indoor Fan Off Delay — The DFB can provide a 30 sec delay on Indoor Fan Off if the thermostat's fan selector switch is set on AUTO control. DIP Switch SW3 on the DFB selects use of the fan off time delay feature. Setting SW3 in the OPEN position turns the Fan Off Delay feature on; setting SW3 in the CLOSED position disables this feature. The delay period begins when Y1 demand or W1 demand by the space thermostat is removed.

Defrost Speedup Functions — The DFB permits the servicer to speed-up the defrost cycle. There are two speed-up sequences: relative speed-up and an immediate forced defrost. Speed-up sequences are initiated by shorting jumper wires JMP17 and JMP18 together (see Fig. 25); use a straight-edge screwdriver.

Shorting the jumpers for a period of 1 to 3 secs reduces the defrost timer periods by a factor of 0.1 sec/minute. (For example, the 90 min run period is reduced to 9 secs.) The DFB will step the unit through a Heating cycle and a Defrost cycle using these reduced time periods. This mode ends after the Defrost cycle.

Shorting the jumpers for a period of 5 to 20 secs bypasses the remaining continuous run period and places the unit in a Forced Defrost mode. If the controlling DFT is closed when this mode is initiated, the unit will complete a normal defrost period that will terminate when the controlling DFT opens or the 10 minute defrost cycle limit is reached. If the controlling DFT is open when this mode is initiated, the Defrost cycle will run for 30 secs. Both modes end at the end of the Defrost cycle.

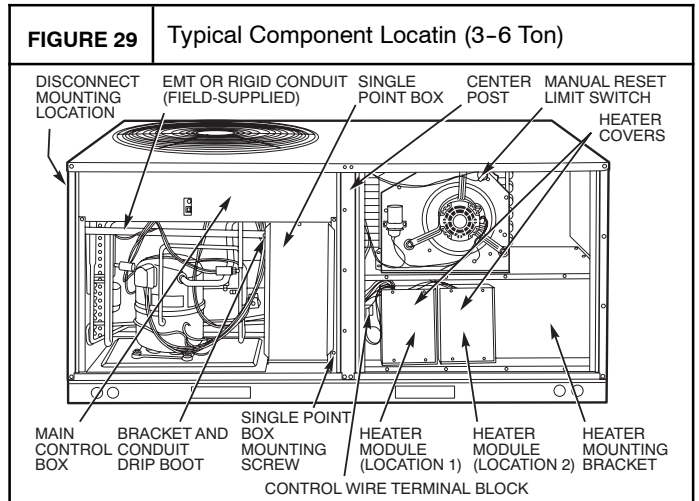
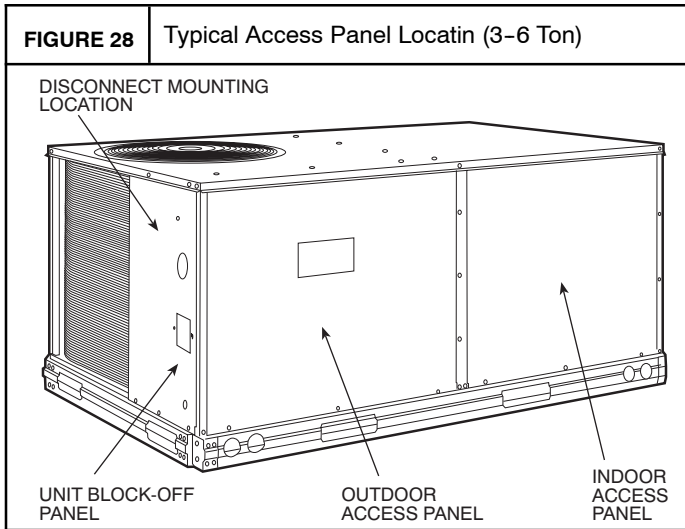
Table 10 – Dip Switch Position

Switch No.	1		2		1		2		1		2		3	
1			1	■	1	■			1	■	■	1		On
0	■	■	0	■	0		■		0			0	■	Off
	90 minutes		60 minutes		30 minutes		120 minutes		Fan Delay					

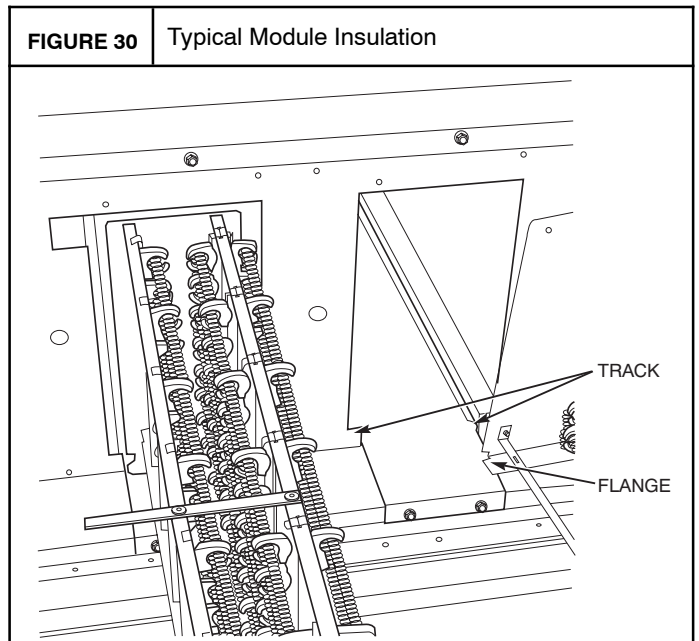
ELECTRIC HEATERS

RHS units may be equipped with field-installed accessory electric heaters. The heaters are modular in design, with heater frames holding open coil resistance wires strung through ceramic insulators, line-break limit switches and a control contactor. One or two heater modules may be used in a unit.

NOTE: The value in position 9 of the part number differs between the sales package part number (value is 1) and a bare heater model number (value is 0).



Heater modules are installed in the compartment below the indoor (supply) fan outlet. Access is through the indoor access panel. Heater modules slide into the compartment on tracks along the bottom of the heater opening. See Fig. 28, Fig. 29 and Fig. 30.



Not all available heater modules may be used in every unit. Use only those heater modules that are UL listed for use in a specific size unit. Refer to the label on the unit cabinet re approved heaters.

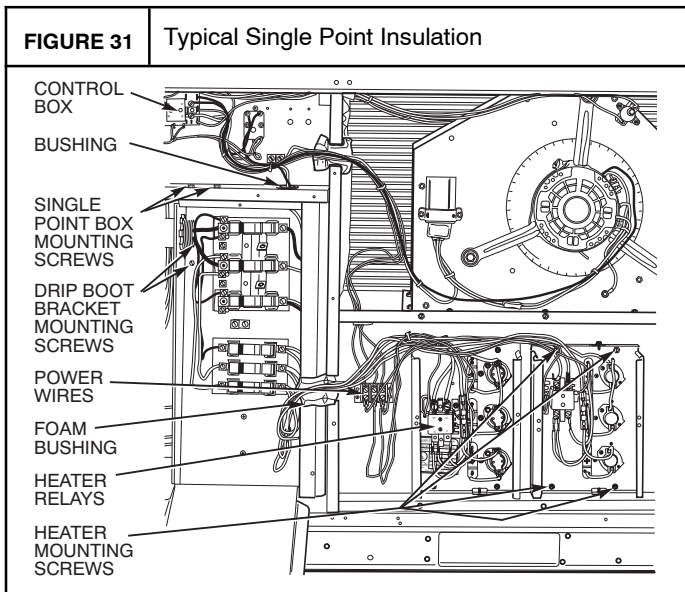
Unit heaters are marked with Heater Model Numbers. But heaters are ordered as and shipped in cartons marked with a corresponding heater Sales Package part number. See Table 11 for correlation between heater Model Number and Sales Package part number.

Table 11 – Heater Model Number

Bare Heater Model Number	C	R	H	E	A	T	E	R	0	0	1	A	0	0
Heater Sales Package PNO Includes: Bare Heater Carton and packing materials Installation sheet	C	R	H	E	A	T	E	R	1	0	1	A	0	0

Single Point Boxes and Supplementary Fuses — When the unit MOC device value exceeds 60-A, unit-mounted supplementary fuses are required for each heater circuit. These fuses are included in accessory Single Point Boxes, with power distribution and fuse

blocks. The single point box will be installed directly under the unit control box, just to the left of the partition separating the indoor section (with electric heaters) from the outdoor section. The Single Point Box has a hinged access cover. See Fig. 31.



On RHS units, all fuses are 60-A. Single point boxes containing fuses for 208/230-V applications use UL Class RK5 250-V fuses (Bussman FRNR 60 or Shawmut TR 60R). Single point boxes for 460-V and 575-V applications use UL Class T 600-V fuses (Bussman JJS 60 or Shawmut A6T 60). (Note that all heaters are qualified for use with a 60-A fuse, regardless of actual heater ampacity, so only 60-A fuses are necessary.)

Unit heater applications not requiring supplemental fuses require a special Single Point Box without any fuses. Connect power supply conductors to heater conductors and field-supplied base unit power tap leads (see text below re: “Completing Heater Installation”) inside the empty Single Point Box using UL-approved connectors.

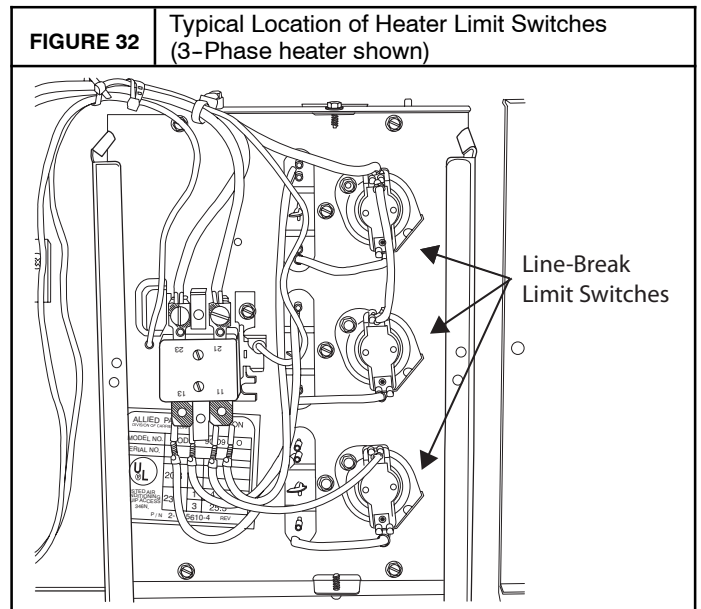
Safety Devices — Electric heater applications use a combination of line-break/auto-reset limit switches and a pilot-circuit/manual reset limit switch to protect the unit against over-temperature situations.

Line-break/auto-reset limit switches are mounted on the base plate of each heater module. See Fig. 32. These are accessed through the indoor access panel. Remove the switch by removing two screws into the base plate and extracting the existing switch.

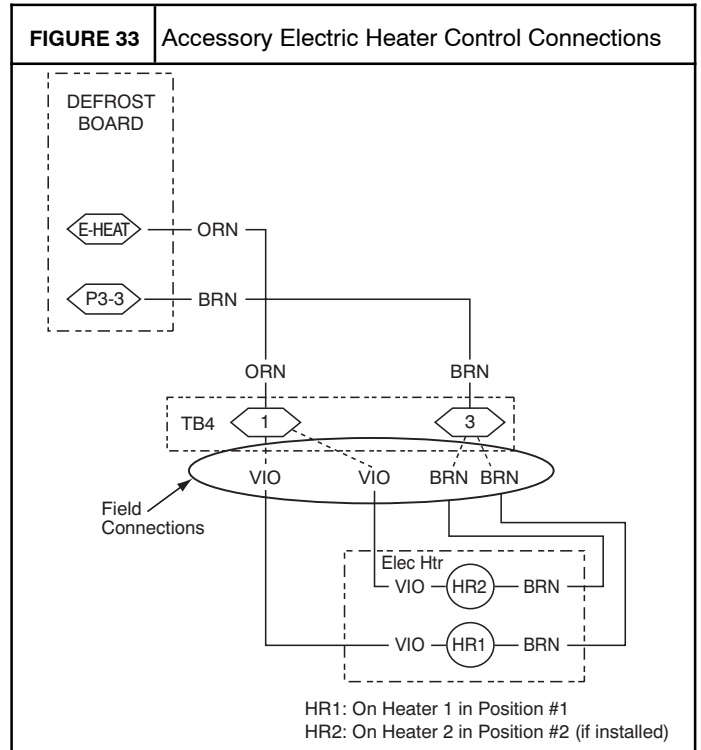
Pilot-circuit/manual reset limit switch is located in the side plate of the indoor (supply) fan housing. See Fig. 29.

Completing Heater Installation

Field Power Connections — Tap conductors must be installed between the base unit’s field power connection lugs and the Single Point Box (with or without fuses). Refer to unit wiring schematic. Use copper wire only. For connection using the Single Point Box less fuses, connect the field power supply conductors to the heater power leads and the field-supplied tap conductors inside the Single Point Box. Use UL-approved pressure connectors (field-supplied) for these splice joints.



Low-Voltage Control Connections — Pull the low-voltage control leads from the heater module(s) – VIO and BRN (two of each if two modules are installed; identify for Module #1) – to the 4-pole terminal board TB4 located on the heater bulkhead to the left of Heater #1. Connect the VIO lead from Heater #1 to terminal TB4-1. Connect the VIO lead from Heater #2 to terminal TB4-2. Connect both BRN leads to terminal TB4-3. See Fig. 33.



SMOKE DETECTORS

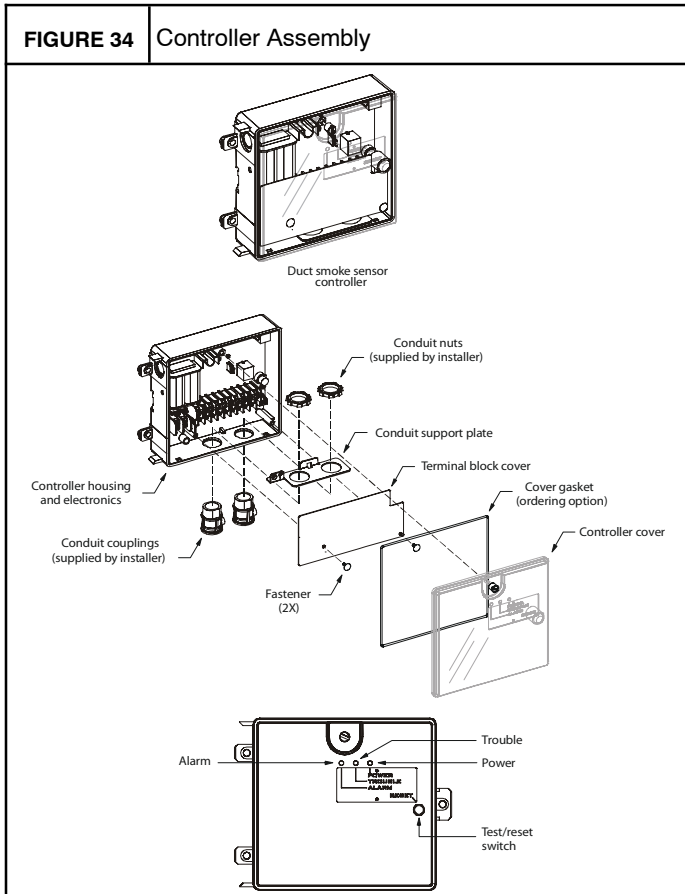
Smoke detectors are available as factory-installed options on RHS models. Smoke detectors may be specified for Supply Air only without or with economizer. All components necessary for operation are factory-provided and mounted. The unit is factory-configured for immediate smoke detector shutdown operation; additional wiring or modifications to unit terminal board may be necessary to complete the unit and smoke detector configuration to meet project requirements.

System

The smoke detector system consists of a four-wire controller and one or two sensors. Its primary function is to shut down the rooftop unit in order to prevent smoke from circulating throughout the building. It is not to be used as a life saving device.

Controller

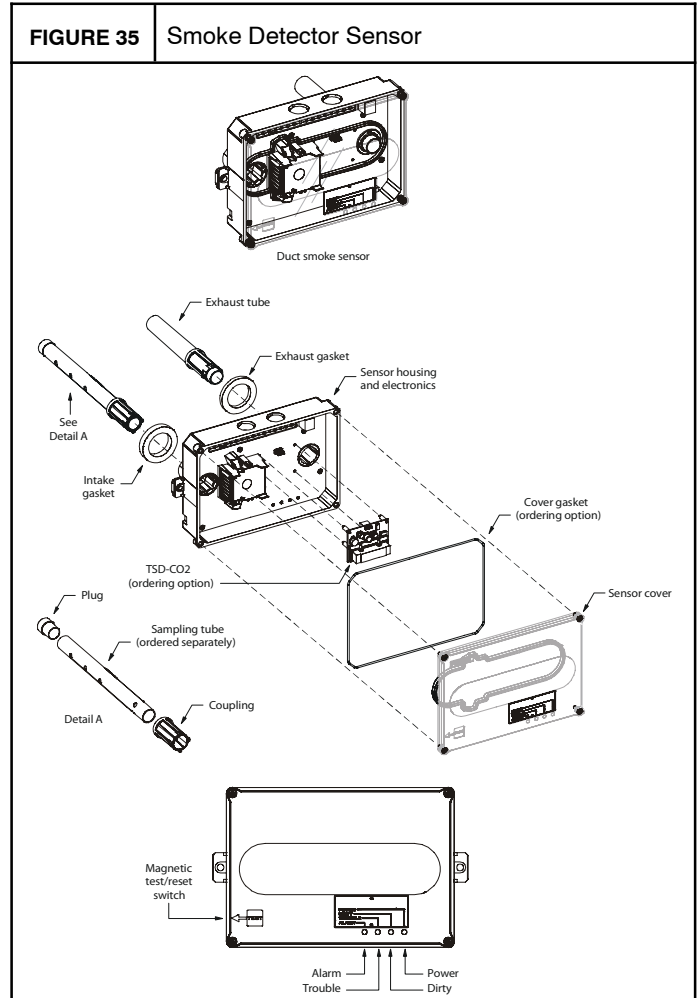
The controller (see Fig. 34) includes a controller housing, a printed circuit board, and a clear plastic cover. The controller can be connected to one or two compatible duct smoke sensors. The clear plastic cover is secured to the housing with a single captive screw for easy access to the wiring terminals. The controller has three LEDs (for Power, Trouble and Alarm) and a manual test/reset button (on the cover face).



Sensor

The sensor (see Fig. 35) includes a plastic housing, a printed circuit board, a clear plastic cover, a sampling tube

inlet and an exhaust tube. The sampling tube (when used) and exhaust tube are attached during installation. The sampling tube varies in length depending on the size of the rooftop unit. The clear plastic cover permits visual inspections without having to disassemble the sensor. The cover attaches to the sensor housing using four captive screws and forms an airtight chamber around the sensing electronics. Each sensor includes a harness with an RJ45 terminal for connecting to the controller. Each sensor has four LEDs (for Power, Trouble, Alarm and Dirty) and a manual test/reset button (on the left-side of the housing).



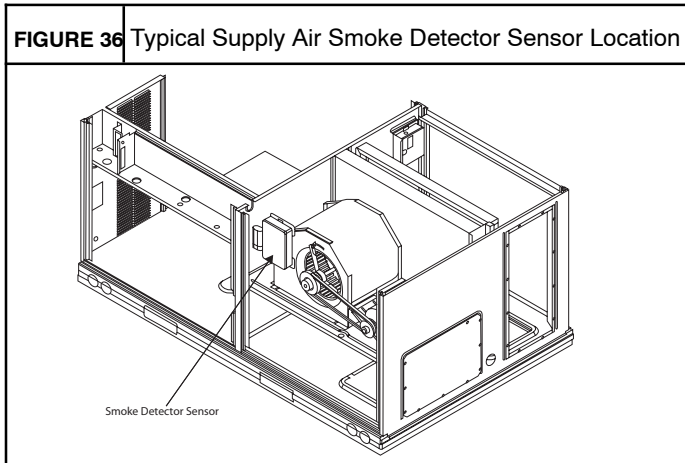
Air is introduced to the duct smoke detector sensor's sensing chamber through a sampling tube that extends into the HVAC duct and is directed back into the ventilation system through a (shorter) exhaust tube. The difference in air pressure between the two tubes pulls the sampled air through the sensing chamber. When a sufficient amount of smoke is detected in the sensing chamber, the sensor signals an alarm state and the controller automatically takes the appropriate action to shut down fans and blowers, change over air handling systems, notify the fire alarm control panel, etc.

The sensor uses a process called differential sensing to prevent gradual environmental changes from triggering false alarms. A rapid change in environmental conditions, such as smoke from a fire, causes the sensor to signal an alarm state but dust and debris accumulated over time does not.

For installations using two sensors, the duct smoke detector does not differentiate which sensor signals an alarm or trouble condition.

Smoke Detector Locations

Supply Air — The Supply Air smoke detector sensor is located to the left of the unit's indoor (supply) fan. See Fig. 36. Access is through the fan access panel. There is no sampling tube used at this location. The sampling tube inlet extends through the side plate of the fan housing (into a high pressure area). The controller is located on a bracket to the right of the return filter, accessed through the lift-off filter panel.



FIOP Smoke Detector Wiring and Response

All units: FIOP smoke detector is configured to automatically shut down all unit operations when smoke condition is detected. See Fig. 37, Typical Smoke Detector System Wiring.

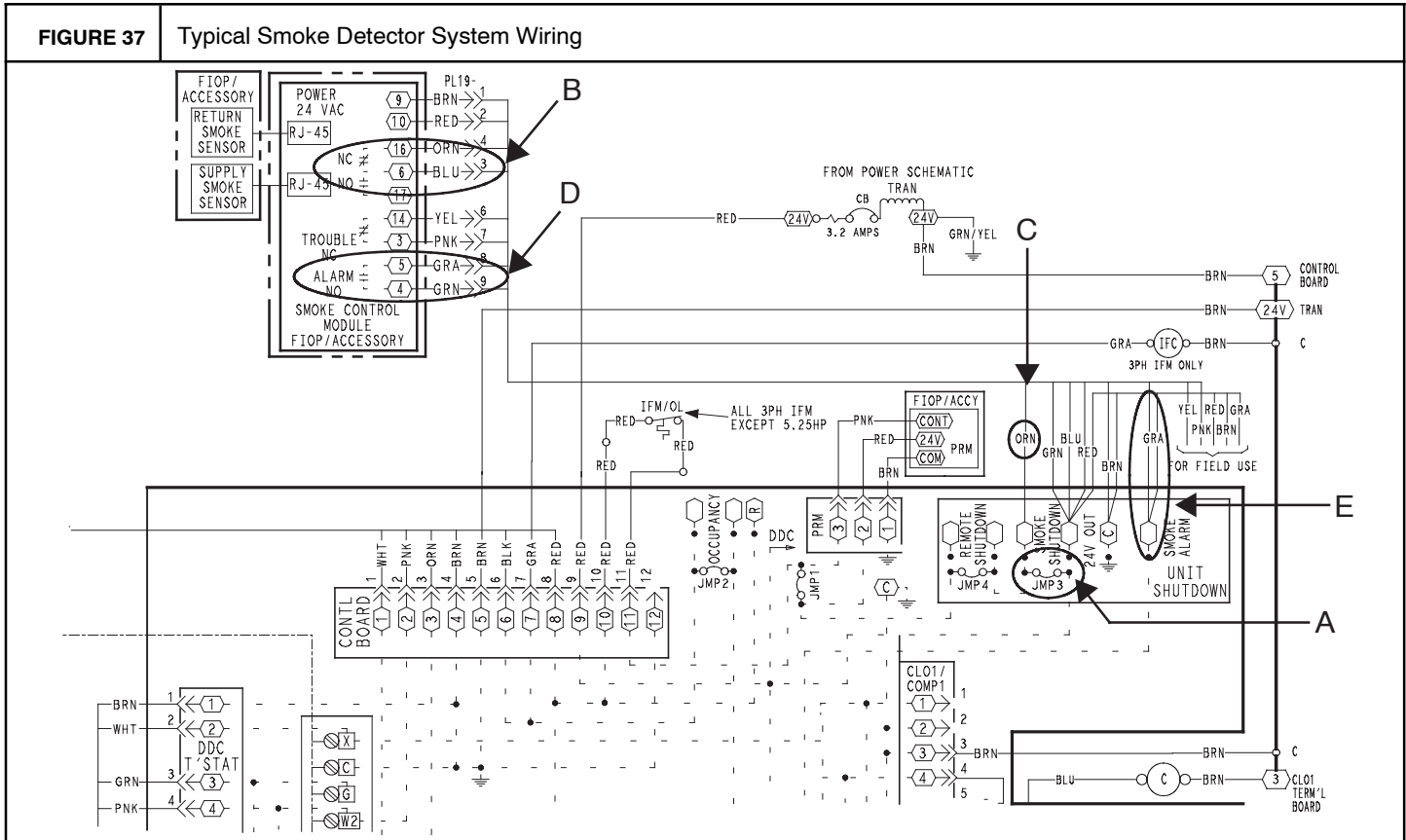
Highlight A: JMP 3 is factory-cut, transferring unit control to smoke detector.

Highlight B: Smoke detector NC contact set will open on smoke alarm condition, de-energizing the ORN conductor.

Highlight C: 24-v power signal via ORN lead is removed at Smoke Detector input on CTB (Control Terminal Board); all unit operations cease immediately.

Highlight D: On smoke alarm condition, the smoke detector NO Alarm contact will close, supplying 24-v power to GRA conductor.

Highlight E: GRA lead at Smoke Alarm input on CTB provides 24-v signal to FIOP DDC control.



Sensor and Controller Tests

Sensor Alarm Test

The sensor alarm test checks a sensor's ability to signal an alarm state. This test requires that you use a SD-MAG test magnet, approximately 1" long x 1/4" thick x 1/4" wide, located in a plastic bag in the unit control box.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

This test places the duct detector into the alarm state. Unless part of the test, disconnect all auxiliary equipment from the controller before performing the test. If the duct detector is connected to a fire alarm system, notify the proper authorities before performing the test.

Sensor Alarm Test Procedure

1. Hold the test magnet where indicated on the side of the sensor housing for seven seconds.
2. Verify that the sensor's Alarm LED turns on.
3. Reset the sensor by holding the test magnet against the sensor housing for two seconds.
4. Verify that the sensor's Alarm LED turns off.

Controller Alarm Test

The controller alarm test checks the controller's ability to initiate and indicate an alarm state.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

This test places the duct detector into the alarm state. Disconnect all auxiliary equipment from the controller before performing the test. If the duct detector is connected to a fire alarm system, notify the proper authorities before performing the test.

Controller Alarm Test Procedure

1. Press the controller's test/reset switch for seven seconds.
2. Verify that the controller's Alarm LED turns on.
3. Reset the sensor by pressing the test/reset switch for two seconds.
4. Verify that the controller's Alarm LED turns off.

Dirty Controller Test

The dirty controller test checks the controller's ability to initiate a dirty sensor test and indicate its results.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

Pressing the controller's test/reset switch for longer than seven seconds will put the duct detector into the alarm state and activate all automatic alarm responses.

Dirty Controller Test Procedure

1. Press the controller's test/reset switch for two seconds.
2. Verify that the controller's Trouble LED flashes.

Dirty Sensor Test

The dirty sensor test provides an indication of the sensor's ability to compensate for gradual environmental changes. A sensor that can no longer compensate for environmental changes is considered 100% dirty and requires cleaning or replacing. You must use a factory provided SD-MAG test magnet to initiate a sensor dirty test. The sensor's Dirty LED indicates the results of the dirty test as shown in Table 12.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

Holding the test magnet against the sensor housing for more than seven seconds will put the duct detector into the alarm state and activate all automatic alarm responses.

Table 12 – Dirty LED Test

FLASHES	DESCRIPTION
1	0–25% dirty. (Typical of a newly installed detector)
2	25–50% dirty
3	51–75% dirty
4	76–99% dirty

Dirty Sensor Test Procedure

1. Hold the test magnet where indicated on the side of the sensor housing for two seconds.
2. Verify that the sensor's Dirty LED flashes.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

Changing the dirty sensor test operation will put the detector into the alarm state and activate all automatic alarm responses. Before changing dirty sensor test operation, disconnect all auxiliary equipment from the controller and notify the proper authorities if connected to a fire alarm system.

Changing the Dirty Sensor Test

By default, sensor dirty test results are indicated by:

- The sensor's Dirty LED flashing.
- The controller's Trouble LED flashing.
- The controller's supervision relay contacts toggle.

The operation of a sensor's dirty test can be changed so that the controller's supervision relay is not used to indicate test results. When two detectors are connected to a controller, sensor dirty test operation on both sensors must be configured to operate in the same manner.

To Configure the Dirty Sensor Test Operation

1. Hold the test magnet where indicated on the side of the sensor housing until the sensor's Alarm LED turns on and its Dirty LED flashes twice (approximately 60 seconds).
2. Reset the sensor by removing the test magnet then holding it against the sensor housing again until the sensor's Alarm LED turns off (approximately 2 seconds).

Remote Station Test

The remote station alarm test checks a test/reset station's ability to initiate and indicate an alarm state.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

This test places the duct detector into the alarm state. Unless part of the test, disconnect all auxiliary equipment from the controller before performing the test. If the duct detector is connected to a fire alarm system, notify the proper authorities before performing the test.

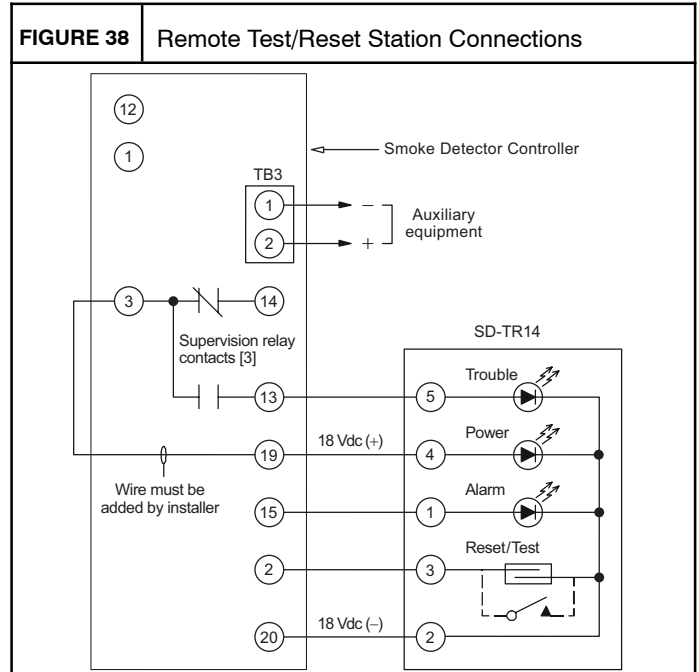
SD-TRM4 (CRSDTEST001A00) Remote Alarm Test Procedure

1. Turn the key switch to the RESET/TEST position for seven seconds.
2. Verify that the test/reset station's Alarm LED turns on.
3. Reset the sensor by turning the key switch to the RESET/TEST position for two seconds.

4. Verify that the test/reset station's Alarm LED turns off.

Remote Test/Reset Station Dirty Sensor Test

The test/reset station dirty sensor test checks the test/reset station's ability to initiate a sensor dirty test and indicate the results. It must be wired to the controller as shown in Fig. 38 and configured to operate the controller's supervision relay. For more information, see "Changing the Dirty Sensor Test."



⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

If the test/reset station's key switch is left in the RESET/TEST position for longer than seven seconds, the detector will automatically go into the alarm state and activate all automatic alarm responses.

⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

Holding the test magnet to the target area for longer than seven seconds will put the detector into the alarm state and activate all automatic alarm responses.

Dirty Sensor Test Using an SD-TRM4

1. Turn the key switch to the RESET/TEST position for two seconds.
2. Verify that the test/reset station's Trouble LED flashes.

Table 13 – Detector Indicators

CONTROL OR INDICATOR	DESCRIPTION
Magnetic test/reset switch	Resets the sensor when it is in the alarm or trouble state. Activates or tests the sensor when it is in the normal state.
Alarm LED	Indicates the sensor is in the alarm state.
Trouble LED	Indicates the sensor is in the trouble state.
Dirty LED	Indicates the amount of environmental compensation used by the sensor (flashing continuously = 100%)
Power LED	Indicates the sensor is energized.

Detector Cleaning

Cleaning the Smoke Detector

Clean the duct smoke sensor when the Dirty LED is flashing continuously or sooner if conditions warrant.

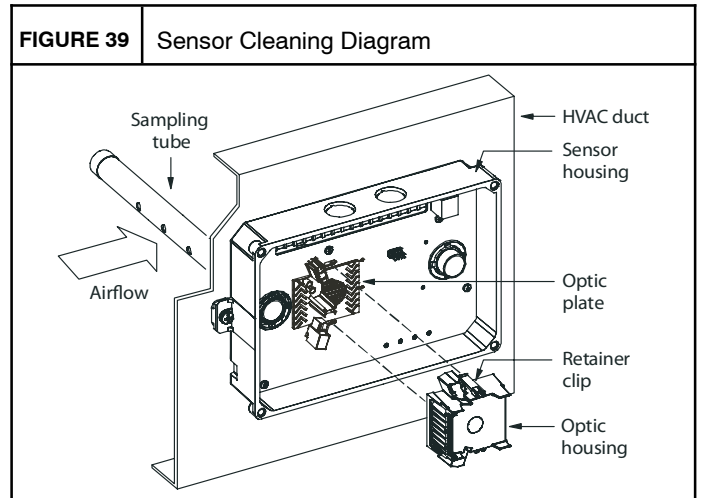
⚠ CAUTION

OPERATIONAL TEST HAZARD

Failure to follow this caution may result in personnel and authority concern.

If the smoke detector is connected to a fire alarm system, first notify the proper authorities that the detector is undergoing maintenance then disable the relevant circuit to avoid generating a false alarm.

1. Disconnect power from the duct detector then remove the sensor’s cover. (See Fig. 39.)
2. Using a vacuum cleaner, clean compressed air, or a soft bristle brush, remove loose dirt and debris from inside the sensor housing and cover. Use isopropyl alcohol and a lint-free cloth to remove dirt and other contaminants from the gasket on the sensor’s cover.
3. Squeeze the retainer clips on both sides of the optic housing then lift the housing away from the printed circuit board.
4. Gently remove dirt and debris from around the optic plate and inside the optic housing.
5. Replace the optic housing and sensor cover.
6. Connect power to the duct detector then perform a sensor alarm test.



Indicators

Normal State

The smoke detector operates in the normal state in the absence of any trouble conditions and when its sensing chamber is free of smoke. In the normal state, the Power LED on both the sensor and the controller are on and all other LEDs are off.

Alarm State

The smoke detector enters the alarm state when the amount of smoke particulate in the sensor’s sensing chamber exceeds the alarm threshold value. (See Table 13.) Upon entering the alarm state:

- The sensor’s Alarm LED and the controller’s Alarm LED turn on.
- The contacts on the controller’s two auxiliary relays switch positions.
- The contacts on the controller’s alarm initiation relay close.
- The controller’s remote alarm LED output is activated (turned on).
- The controller’s high impedance multiple fan shutdown control line is pulled to ground Trouble state.

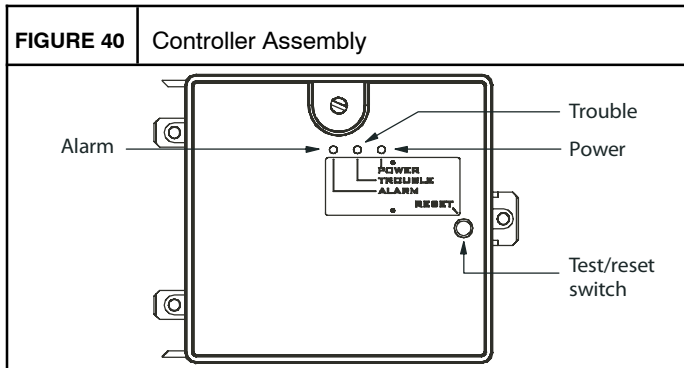
The SuperDuct duct smoke detector enters the trouble state under the following conditions:

- A sensor’s cover is removed and 20 minutes pass before it is properly secured.
- A sensor’s environmental compensation limit is reached (100% dirty).

- A wiring fault between a sensor and the controller is detected.

An internal sensor fault is detected upon entering the trouble state:

- The contacts on the controller’s supervisory relay switch positions. (See Fig. 40.)
- If a sensor trouble, the sensor’s Trouble LED and the controller’s Trouble LED turn on.
- If 100% dirty, the sensor’s Dirty LED turns on and the controller’s Trouble LED flashes continuously.
- If a wiring fault between a sensor and the controller, the controller’s Trouble LED turns on but not the sensor’s.



NOTE: All troubles are latched by the duct smoke detector. The trouble condition must be cleared and then the duct smoke detector must be reset in order to restore it to the normal state.

Resetting Alarm and Trouble Condition Trips:

Manual reset is required to restore smoke detector systems to Normal operation. For installations using two sensors, the duct smoke detector does not differentiate which sensor signals an alarm or trouble condition. Check each sensor for Alarm or Trouble status (indicated by LED). Clear the condition that has generated the trip at this sensor. Then reset the sensor by pressing and holding the reset button (on the side) for 2 seconds. Verify that the sensor’s Alarm and Trouble LEDs are now off. At the controller, clear its Alarm or Trouble state by pressing and holding the manual reset button (on the front cover) for 2 seconds. Verify that the controller’s Alarm and Trouble LEDs are now off. Replace all panels.

Troubleshooting

Controller’s Trouble LED is On

1. Check the Trouble LED on each sensor connected to the controller. If a sensor’s Trouble LED is on, determine the cause and make the necessary repairs.
2. Check the wiring between the sensor and the controller. If wiring is loose or missing, repair or replace as required.

Controller’s Trouble LED is Flashing

1. One or both of the sensors is 100% dirty.
2. Determine which Dirty LED is flashing then clean that sensor assembly as described in the detector cleaning section.

Sensor’s Trouble LED is On

1. Check the sensor’s Dirty LED. If it is flashing, the sensor is dirty and must be cleaned.
2. Check the sensor’s cover. If it is loose or missing, secure the cover to the sensor housing.
3. Replace sensor assembly.

Sensor’s Power LED is Off

1. Check the controller’s Power LED. If it is off, determine why the controller does not have power and make the necessary repairs.
2. Check the wiring between the sensor and the controller. If wiring is loose or missing, repair or replace as required.

Controller’s Power LED is Off

1. Make sure the circuit supplying power to the controller is operational. If not, make sure JP2 and JP3 are set correctly on the controller before applying power.
2. Verify that power is applied to the controller’s supply input terminals. If power is not present, replace or repair wiring as required.

Remote Test/Reset Station’s Trouble LED Does Not flash When Performing a Dirty Test, But the Controller’s Trouble LED Does

1. Verify that the remote test/station is wired as shown in Fig. 38. Repair or replace loose or missing wiring.
2. Configure the sensor dirty test to activate the controller’s supervision relay. See “To Configure the Dirty Sensor Test Operation” for details.

Sensor’s Trouble LED is On, But the Controller’s Trouble LED is OFF

Remove JP1 on the controller.

ECONOMIZER SYSTEMS

The RHS units may be equipped with a factory-installed or accessory (field-installed) economizer system. Available with a logic control system See Fig. 41 for component locations. See Fig. 42 for economizer section wiring diagrams.

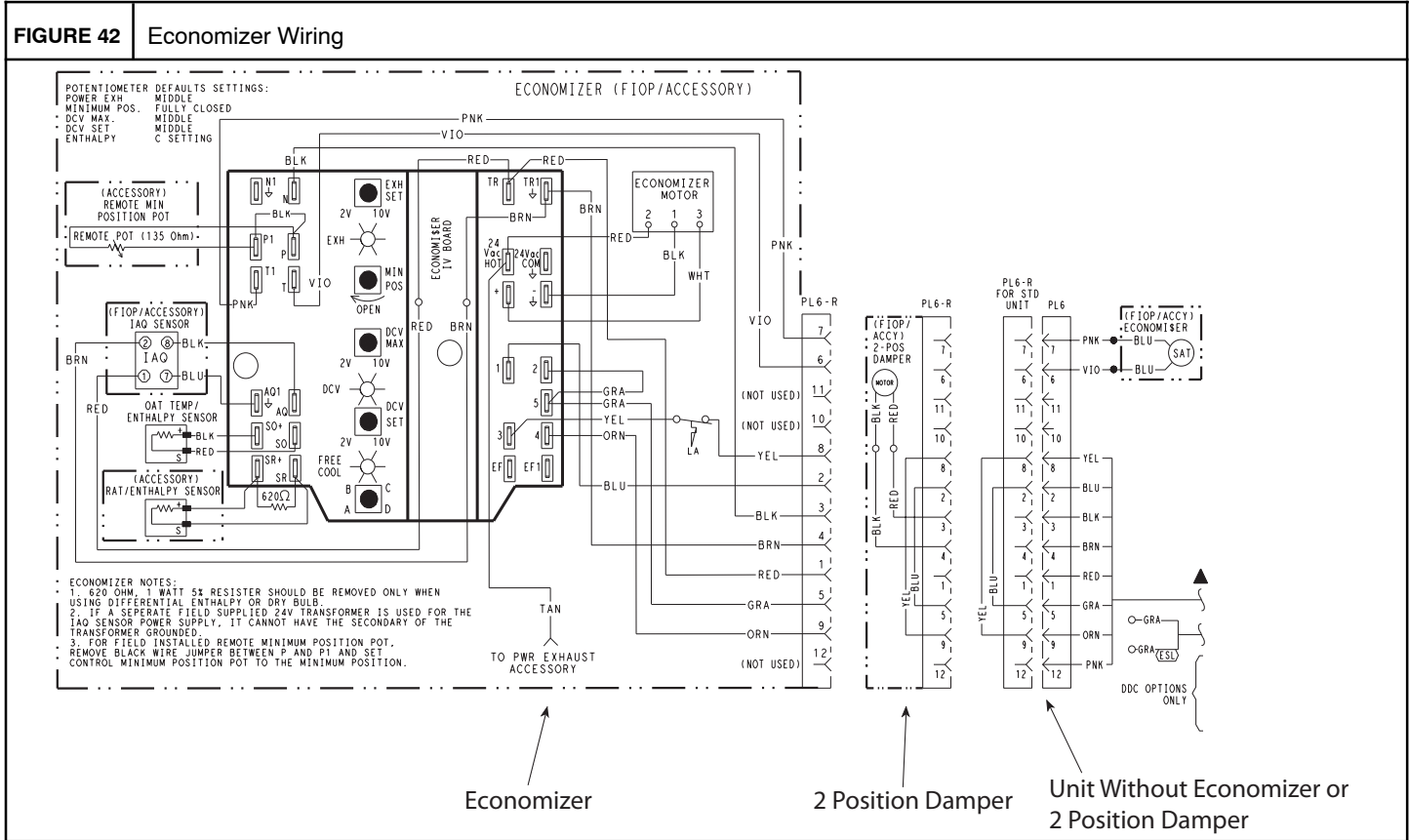
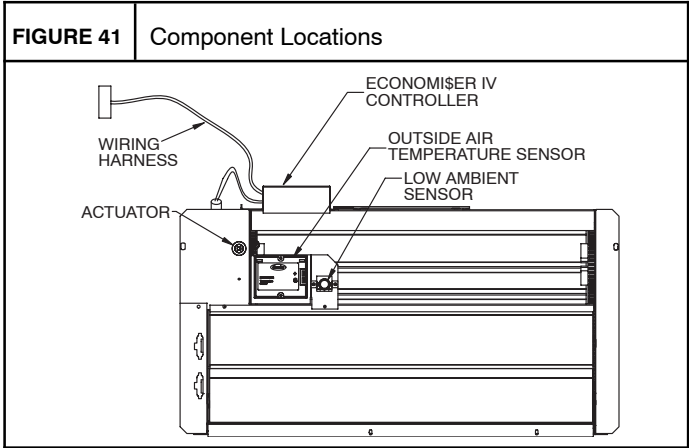
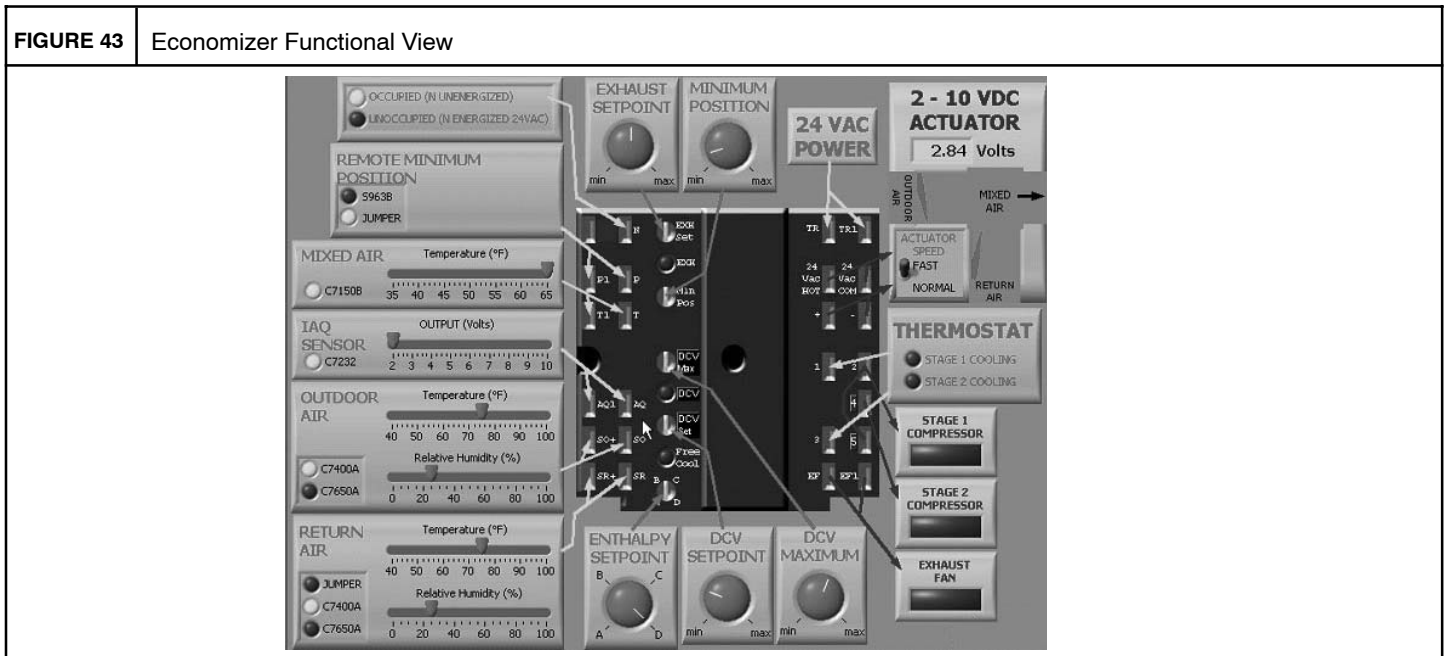


Table 14 – Economizer Input/Output Logic

Demand Control Ventilation (DCV)	INPUTS				OUTPUTS			
	Enthalpy*		Y1	Y2	Compressor		N Terminal†	
	Outdoor	Return			Stage 1	Stage 2	Occupied	Unoccupied
Below set (DCV LED Off)	High (Free Cooling LED Off)	Low	On	On	On	On	Minimum position	Closed
			On	Off	On	Off		
			Off	Off	Off	Off		
	Low (Free Cooling LED On)	High	On	On	On	Off	Modulating** (between min. position and full-open)	Modulating** (between closed and full-open)
			On	Off	Off	Off		
			Off	Off	Off	Off		
Above set (DCV LED On)	High (Free Cooling LED Off)	Low	On	On	On	On	Modulating†† (between min. position and DCV maximum)	Modulating†† (between closed and DCV maximum)
			On	Off	On	Off		
			Off	Off	Off	Off		
	Low (Free Cooling LED On)	High	On	On	On	Off	Modulating***	Modulating†††
			On	Off	Off	Off		
			Off	Off	Off	Off		

- * For single enthalpy control, the module compares outdoor enthalpy to the ABCD setpoint.
- † Power at N terminal determines Occupied/Unoccupied setting: 24 vac (Occupied), no power (Unoccupied).
- ** Modulation is based on the supply-air sensor signal.
- †† Modulation is based on the DCV signal.
- *** Modulation is based on the greater of DCV and supply-air sensor signals, between minimum position and either maximum position (DCV) or fully open (supply-air signal).
- ††† Modulation is based on the greater of DCV and supply-air sensor signals, between closed and either maximum position (DCV) or fully open (supply-air signal).



Economizer

Table 14 provides a summary of Economizer. Troubleshooting instructions are enclosed.

A functional view of the economizer is shown in Fig. 43. Typical settings, sensor ranges, and jumper positions are also shown.

Economizer Standard Sensors

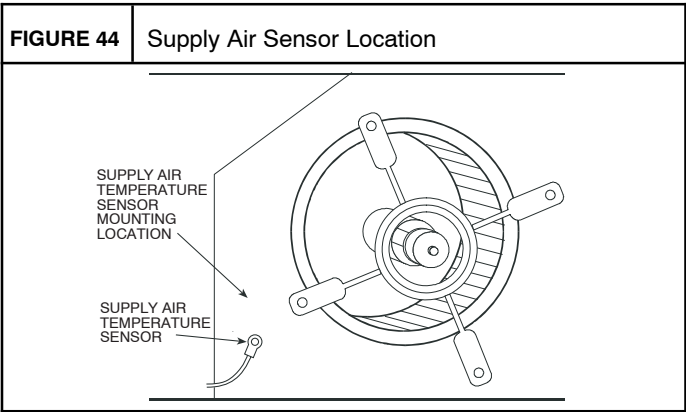
Outdoor Air Temperature (OAT) Sensor

The outdoor air temperature sensor (HH57AC074) is a 10 to 20 mA device used to measure the outdoor-air

temperature. The outdoor-air temperature is used to determine when the Economizer can be used for free cooling. The sensor is factory-installed on the Economizer in the outdoor airstream. (See Fig. 41.) The operating range of temperature measurement is 40° to 100°F (4° to 38°C). See Fig. 46.

Supply Air Temperature (SAT) Sensor

The supply air temperature sensor is a 3 K thermistor located at the inlet of the indoor fan. (See Fig. 44.) This sensor is factory installed. The operating range of temperature measurement is 0° to 158°F (-18° to 70°C).



The temperature sensor looks like an eyelet terminal with wires running to it. The sensor is located in the “crimp end” and is sealed from moisture.

Outdoor Air Lockout Sensor

The Economizer is equipped with an ambient temperature lockout switch located in the outdoor airstream which is used to lock out the compressors below a 42°F (6°C) ambient temperature. (See Fig. 41.)

Economizer Control Modes

Determine the Economizer control mode before set up of the control. Some modes of operation may require different sensors. (See Table 15.) The Economizer is supplied from the factory with a supply-air temperature sensor and an outdoor- air temperature sensor. This allows for operation of the Economizer with outdoor air dry bulb changeover control. Additional accessories can be added to allow for different types of changeover control and operation of the Economizer and unit.

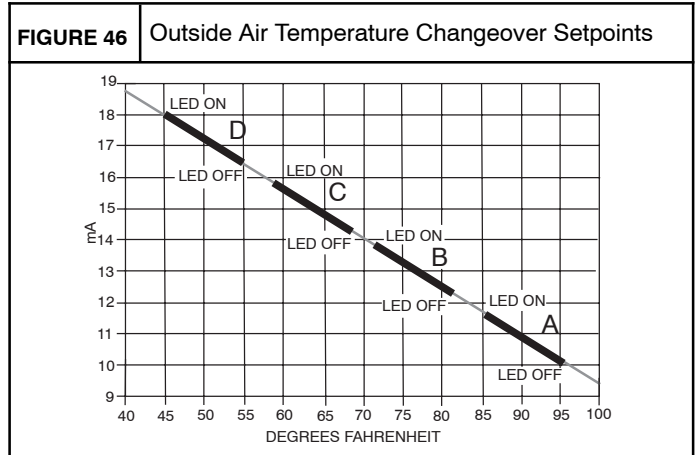
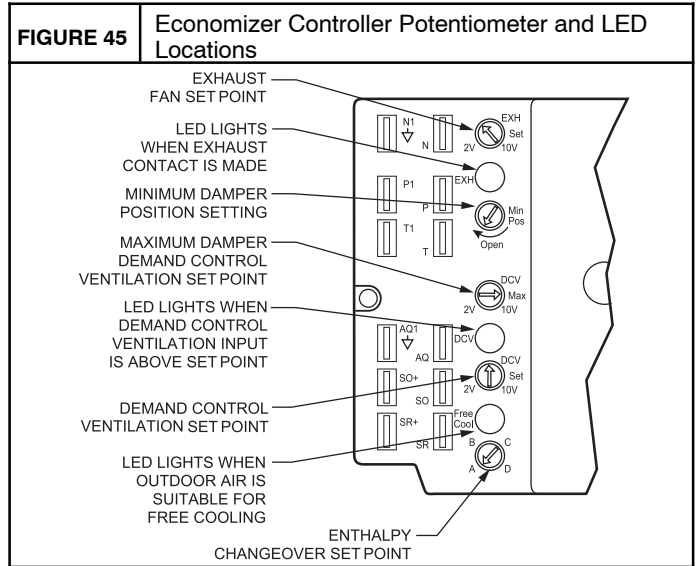
Table 15 – Economizer Sensor Usage

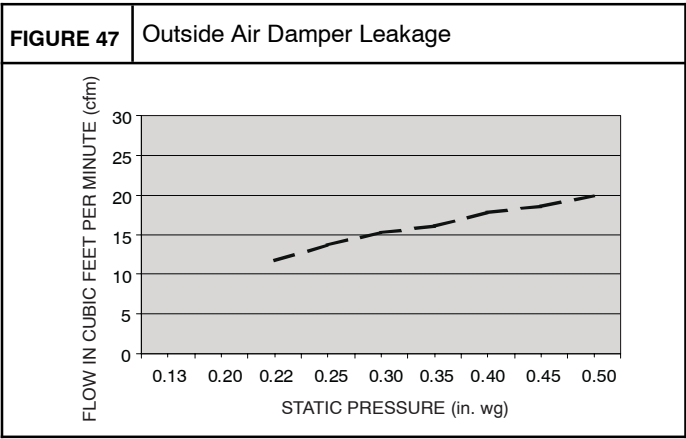
APPLICATION	Economizer WITH OUTDOOR AIR DRY BULB SENSOR
	Accessories Required
Outdoor Air Dry Bulb	None. The outdoor air dry bulb sensor is factory installed.
Differential Dry Bulb	DNTEMPSN002A00*
Single Enthalpy	AXB078ENT
Differential Enthalpy	AXB078ENT and DNENTDIF004A00*
CO ₂ for DCV Control using a Duct-Mounted CO ₂ Sensor	DNCBDIOX005A00††

* DNENTDIF004A00 and DNTEMPSN002A00 accessories are used on many different base units. As such, these kits may contain parts that will not be needed for installation.
 † 33ZCSENCO2 is an accessory CO₂ sensor.
 ** 33ZCASPCO2 is an accessory aspirator box required for duct-mounted applications.
 †† DNCBDIOX005A00 is an accessory that contains both 33ZCSENCO2 and 33ZCASPCO2 accessories.

Outdoor Dry Bulb Changeover

The standard controller is shipped from the factory configured for outdoor dry bulb changeover control. The outdoor air and supply air temperature sensors are included as standard. For this control mode, the outdoor temperature is compared to an adjustable setpoint selected on the control. If the outdoor-air temperature is above the setpoint, the economizer will adjust the outside air dampers to minimum position. If the outdoor-air temperature is below the setpoint, the position of the outside air dampers will be controlled to provided free cooling using outdoor air. When in this mode, the LED next to the free cooling setpoint potentiometer will be on. The changeover temperature setpoint is controlled by the free cooling setpoint potentiometer located on the control. (See Fig. 45.) The scale on the potentiometer is A, B, C, and D. See Fig. 46 for the corresponding temperature changeover values.





Differential Dry Bulb Control

For differential dry bulb control the standard outdoor dry bulb sensor is used in conjunction with an additional accessory dry bulb sensor (part number DNTEMPN002A00). The accessory sensor must be mounted in the return airstream. (See Fig. 49.) Wiring is provided in the economizer wiring harness.

Outdoor Enthalpy Changeover

For enthalpy control, accessory enthalpy sensor (part number AXB078ENT) is required. Replace the standard outdoor dry bulb temperature sensor with the accessory enthalpy sensor in the same mounting location. (See Fig. 41.) When the outdoor air enthalpy rises above the outdoor enthalpy changeover setpoint, the outdoor-air damper moves to its minimum position. The outdoor enthalpy changeover setpoint is set with the outdoor enthalpy setpoint potentiometer on the Economizer

controller. The setpoints are A, B, C, and D. (See Fig. 49.) The factory-installed 620-ohm jumper must be in place across terminals S_R and SR+ on the Economizer controller (see Fig. 42).

In this mode of operation, the outdoor-air temperature is compared to the return-air temperature and the lower temperature airstream is used for cooling. When using this mode of changeover control, turn the enthalpy setpoint potentiometer fully clockwise to the D setting. (See Fig. 45.)

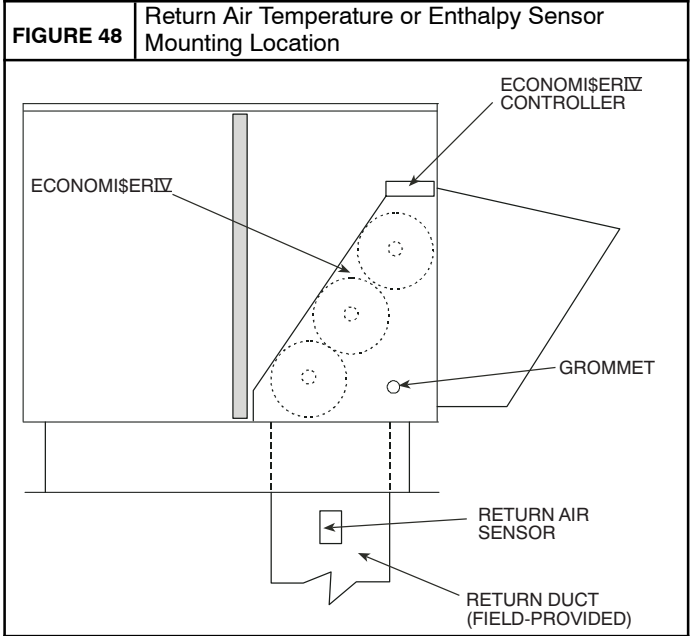


FIGURE 49 Enthalpy Changeover Setpoints

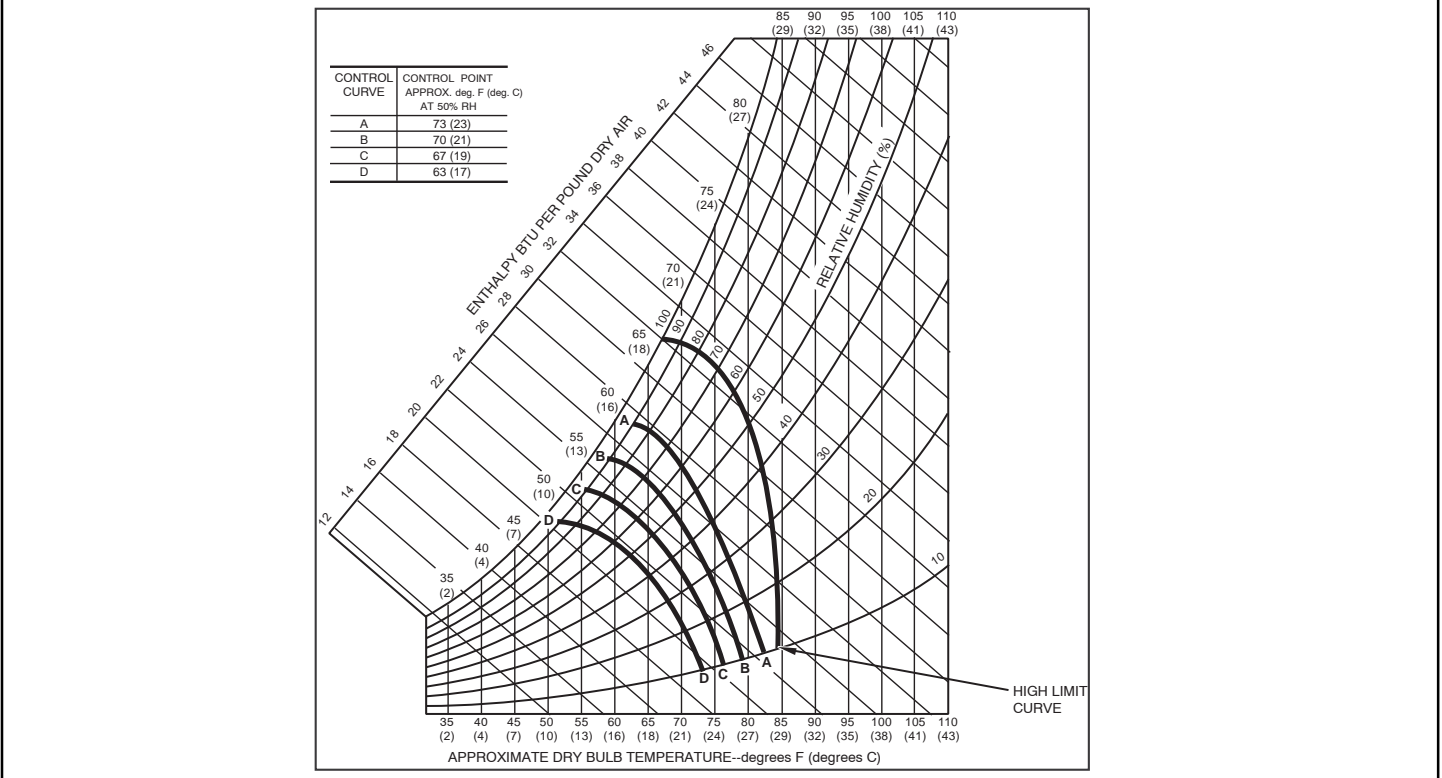
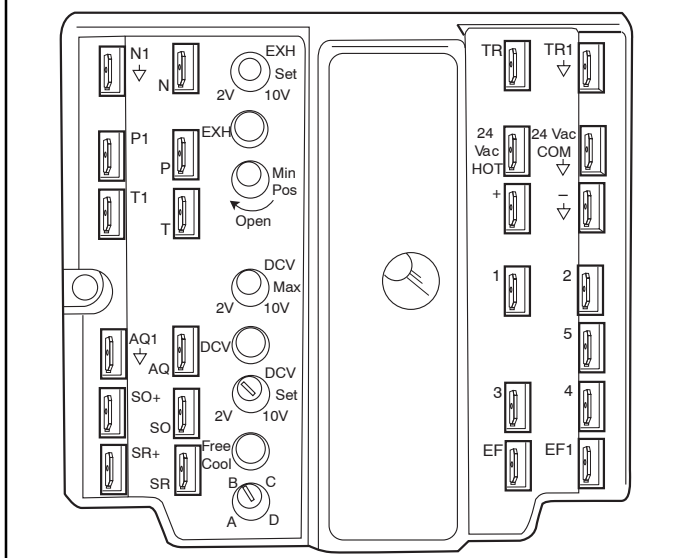


FIGURE 50 Economizer Control



Differential Enthalpy Control

For differential enthalpy control, the Economizer controller uses two enthalpy sensors (AXB078ENT and DNENTDIF004A00), one in the outside air and one in the return air duct. The economizer controller compares the outdoor air enthalpy to the return air enthalpy to determine economizer use. The controller selects the lower enthalpy air (return or outdoor) for cooling. For example, when the outdoor air has a lower enthalpy than the return air, the economizer opens to bring in outdoor air for free cooling.

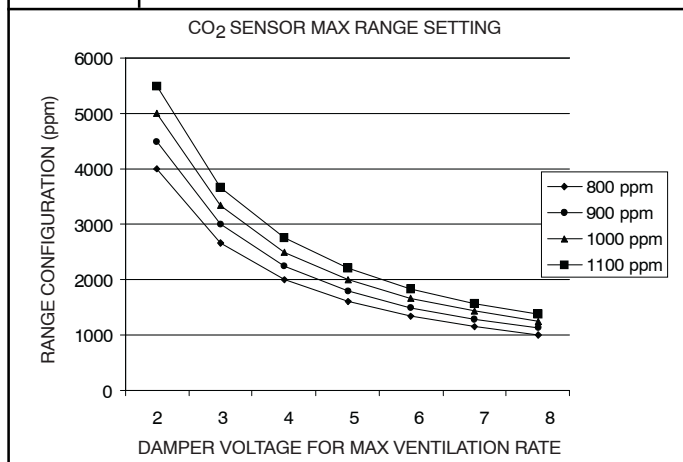
Replace the standard outside air dry bulb temperature sensor with the accessory enthalpy sensor in the same mounting location. (See Fig. 41.) Mount the return air enthalpy sensor in the return air duct. (See Fig. 48.) Wiring is provided in the economizer wiring harness. (See Fig. 41.) The outdoor enthalpy changeover setpoint is set with the outdoor enthalpy setpoint potentiometer on the Economizer controller. When using this mode of changeover control, turn the enthalpy setpoint potentiometer fully clockwise to the D setting.

Indoor Air Quality (IAQ) Sensor Input

The IAQ input can be used for demand control ventilation control based on the level of CO₂ measured in the space or return air duct.

Mount the accessory IAQ sensor according to manufacturer specifications. The IAQ sensor should be wired to the AQ and AQ1 terminals of the controller. Adjust the DCV potentiometers to correspond to the DCV voltage output of the indoor air quality sensor at the user-determined setpoint. (See Fig. 51.)

FIGURE 51 CO₂ Sensor Maximum Range Settings



If a separate field-supplied transformer is used to power the IAQ sensor, the sensor must not be grounded or the Economizer control board will be damaged.

When using demand ventilation, the minimum damper position represents the minimum ventilation position for VOC (volatile organic compounds) ventilation requirements. The maximum demand ventilation position is used for fully occupied ventilation.

When demand ventilation control is not being used, the minimum position potentiometer should be used to set the occupied ventilation position. The maximum demand ventilation position should be turned fully clockwise.

Exhaust Setpoint Adjustment

The exhaust setpoint will determine when the exhaust fan runs based on damper position (if accessory power exhaust is installed). The setpoint is modified with the Exhaust Fan Setpoint (EXH SET) potentiometer. (See Fig. 45.) The setpoint represents the damper position above which the exhaust fans will be turned on. When there is a call for exhaust, the Economizer controller provides a 45 ±15 second delay before exhaust fan activation to allow the dampers to open. This delay allows the damper to reach the appropriate position to avoid unnecessary fan overload.

Minimum Position Control

There is a minimum damper position potentiometer on the economizer controller. (See Fig. 45.) The minimum damper position maintains the minimum airflow into the building during the occupied period.

When using demand ventilation, the minimum damper position represents the minimum ventilation position for VOC (volatile organic compound) ventilation requirements. The maximum demand ventilation position is used for fully occupied ventilation.

When demand ventilation control is not being used, the minimum position potentiometer should be used to set the occupied ventilation position. The maximum demand ventilation position should be turned fully clockwise.

Adjust the minimum position potentiometer to allow the minimum amount of outdoor air, as required by local

codes, to enter the building. Make minimum position adjustments with at least 10°F temperature difference between the outdoor and return-air temperatures.

To determine the minimum position setting, perform the following procedure:

1. Calculate the appropriate mixed air temperature using the following formula:

$$(T_O \times \frac{OA}{100}) + (T_R \times \frac{RA}{100}) = T_M$$

T_O = Outdoor-Air Temperature

OA = Percent of Outdoor Air

T_R = Return-Air Temperature

RA = Percent of Return Air

T_M = Mixed-Air Temperature

As an example, if local codes require 10% outdoor air during occupied conditions, outdoor-air temperature is 60°F, and return-air temperature is 75°F.

$$(60 \times .10) + (75 \times .90) = 73.5^\circ\text{F}$$

2. Disconnect the supply air sensor from terminals T and T1.
3. Ensure that the factory-installed jumper is in place across terminals P and P1. If remote damper positioning is being used, make sure that the terminals are wired according to Fig. 42 and that the minimum position potentiometer is turned fully clockwise.
4. Connect 24 vac across terminals TR and TR1.
5. Carefully adjust the minimum position potentiometer until the measured mixed air temperature matches the calculated value.
6. Reconnect the supply air sensor to terminals T and T1.

Remote control of the economizer damper is desirable when requiring additional temporary ventilation. If a field-supplied remote potentiometer (Honeywell part number S963B1128) is wired to the economizer controller, the minimum position of the damper can be controlled from a remote location.

To control the minimum damper position remotely, remove the factory-installed jumper on the P and P1 terminals on the economizer controller. Wire the field-supplied potentiometer to the P and P1 terminals on the economizer controller. (See Fig. 50.)

Damper Movement

Damper movement from full open to full closed (or vice versa) takes 2¹/₂ minutes.

Thermostats

The economizer control works with conventional thermostats that have a Y1 (cool stage 1), Y2 (cool stage 2), W1 (heat stage 1), W2 (heat stage 2), and G (fan). The economizer control does not support space

temperature sensors. Connections are made at the thermostat terminal connection board located in the main control box.

Occupancy Control

The factory default configuration for the economizer control is occupied mode. Occupied status is provided by the black jumper from terminal TR to terminal N. When unoccupied mode is desired, install a field-supplied timeclock function in place of the jumper between TR and N. When the timeclock contacts are closed, the Economizer control will be in occupied mode. When the timeclock contacts are open (removing the 24-v signal from terminal N), the Economizer will be in unoccupied mode.

Demand Control Ventilation (DCV)

When using the economizer for demand controlled ventilation, there are some equipment selection criteria which should be considered. When selecting the heat capacity and cool capacity of the equipment, the maximum ventilation rate must be evaluated for design conditions. The maximum damper position must be calculated to provide the desired fresh air.

Typically the maximum ventilation rate will be about 5 to 10% more than the typical cfm required per person, using normal outside air design criteria.

A proportional anticipatory strategy should be taken with the following conditions: a zone with a large area, varied occupancy, and equipment that cannot exceed the required ventilation rate at design conditions. Exceeding the required ventilation rate means the equipment can condition air at a maximum ventilation rate that is greater than the required ventilation rate for maximum occupancy. A proportional-anticipatory strategy will cause the fresh air supplied to increase as the room CO₂ level increases even though the CO₂ setpoint has not been reached. By the time the CO₂ level reaches the setpoint, the damper will be at maximum ventilation and should maintain the setpoint.

In order to have the CO₂ sensor control the economizer damper in this manner, first determine the damper voltage output for minimum or base ventilation. Base ventilation is the ventilation required to remove contaminants during unoccupied periods. The following equation may be used to determine the percent of outside air entering the building for a given damper position. For best results there should be at least a 10 degree difference in outside and return-air temperatures.

$$(T_O \times \frac{OA}{100}) + (T_R \times \frac{RA}{100}) = T_M$$

T_O = Outdoor-Air Temperature

OA = Percent of Outdoor Air

T_R = Return-Air Temperature

RA = Percent of Return Air

T_M = Mixed-Air Temperature

Once base ventilation has been determined, set the minimum damper position potentiometer to the correct position.

The same equation can be used to determine the occupied or maximum ventilation rate to the building. For example, an output of 3.6 volts to the actuator provides a base ventilation rate of 5% and an output of 6.7 volts provides the maximum ventilation rate of 20% (or base plus 15 cfm per person). Use Fig. 51 to determine the maximum setting of the CO₂ sensor. For example, an 1100 ppm setpoint relates to a 15 cfm per person design. Use the 1100 ppm curve on Fig. 51 to find the point when the CO₂ sensor output will be 6.7 volts. Line up the point on the graph with the left side of the chart to determine that the range configuration for the CO₂ sensor should be 1800 ppm. The Economizer controller will output the 6.7 volts from the CO₂ sensor to the actuator when the CO₂ concentration in the space is at 1100 ppm. The DCV setpoint may be left at 2 volts since the CO₂ sensor voltage will be ignored by the Economizer controller until it rises above the 3.6 volt setting of the minimum position potentiometer.

Once the fully occupied damper position has been determined, set the maximum damper demand control ventilation potentiometer to this position. Do not set to the maximum position as this can result in over-ventilation to the space and potential high humidity levels.

CO₂ Sensor Configuration

The CO₂ sensor has preset standard voltage settings that can be selected anytime after the sensor is powered up. (See Table 16.)

Use setting 1 or 2. (See Table 16.)

1. Press Clear and Mode buttons. Hold at least 5 seconds until the sensor enters the Edit mode.
2. Press Mode twice. The STDSET Menu will appear.
3. Use the Up/Down button to select the preset number. (See Table 16.)
4. Press Enter to lock in the selection.
5. Press Mode to exit and resume normal operation.

The custom settings of the CO₂ sensor can be changed anytime after the sensor is energized. Follow the steps below to change the non-standard settings:

1. Press Clear and Mode buttons. Hold at least 5 seconds until the sensor enters the Edit mode.
2. Press Mode twice. The STDSET Menu will appear.
3. Use the Up/Down button to toggle to the NONSTD menu and press Enter.
4. Use the Up/Down button to toggle through each of the nine variables, starting with Altitude, until the desired setting is reached.
5. Press Mode to move through the variables.
6. Press Enter to lock in the selection, then press Mode to continue to the next variable.

Dehumidification of Fresh Air with DCV (Demand Controlled Ventilation) Control

If normal rooftop heating and cooling operation is not adequate for the outdoor humidity level, an energy recovery unit and/or a dehumidification option should be considered.

Table 16 – CO₂ Sensor Standard Settings

SETTING	EQUIPMENT	OUTPUT	VENTILATION RATE (cfm/Person)	ANALOG OUTPUT	CO ₂ CONTROL RANGE (ppm)	OPTIONAL RELAY SETPOINT (ppm)	RELAY HYSTERESIS (ppm)
1	Interface w/Standard Building Control System	Proportional	Any	0-10V 4-20 mA	0-2000	1000	50
2		Proportional	Any	2-10V 7-20 mA	0-2000	1000	50
3		Exponential	Any	0-10V 4-20 mA	0-2000	1100	50
4	Economizer	Proportional	15	0-10V 4-20 mA	0-1100	1100	50
5		Proportional	20	0-10V 4-20 mA	0- 900	900	50
6		Exponential	15	0-10V 4-20 mA	0-1100	1100	50
7		Exponential	20	0-10V 4-20 mA	0- 900	900	50
8	Health & Safety	Proportional	—	0-10V 4-20 mA	0-9999	5000	500
9	Parking/Air Intakes/ Loading Docks	Proportional	—	0-10V 4-20 mA	0-2000	700	50

LEGEND: ppm — Parts Per Million

Economizer Preparation

This procedure is used to prepare the Economizer for troubleshooting. No troubleshooting or testing is done by performing the following procedure.

NOTE: This procedure requires a 9-v battery, 1.2 kilo-ohm resistor, and a 5.6 kilo-ohm resistor which are not supplied with the Economizer.

IMPORTANT: Be sure to record the positions of all potentiometers before starting troubleshooting.

1. Disconnect power at TR and TR1. All LEDs should be off. Exhaust fan contacts should be open.
2. Disconnect device at P and P1.
3. Jumper P to P1.
4. Disconnect wires at T and T1. Place 5.6 kilo-ohm resistor across T and T1.
5. Jumper TR to 1.
6. Jumper TR to N.
7. If connected, remove sensor from terminals SO and +. Connect 1.2 kilo-ohm 4074EJM checkout resistor across terminals SO and +.
8. Put 620-ohm resistor across terminals SR and +.
9. Set minimum position, DCV setpoint, and exhaust potentiometers fully CCW (counterclockwise).
10. Set DCV maximum position potentiometer fully CW (clockwise).
11. Set enthalpy potentiometer to D.
12. Apply power (24 vac) to terminals TR and TR1.

Differential Enthalpy

To check differential enthalpy:

1. Make sure Economizer preparation procedure has been performed.
2. Place 620-ohm resistor across SO and +.
3. Place 1.2 kilo-ohm resistor across SR and +. The Free Cool LED should be lit.
4. Remove 620-ohm resistor across SO and +. The Free Cool LED should turn off.
5. Return Economizer settings and wiring to normal after completing troubleshooting.

Single Enthalpy

To check single enthalpy:

1. Make sure Economizer preparation procedure has been performed.
2. Set the enthalpy potentiometer to A (fully CCW). The Free Cool LED should be lit.
3. Set the enthalpy potentiometer to D (fully CW). The Free Cool LED should turn off.
4. Return Economizer settings and wiring to normal after completing troubleshooting.

DCV (Demand Controlled Ventilation) and Power

Exhaust

To check DCV and Power Exhaust:

1. Make sure Economizer preparation procedure has been performed.
2. Ensure terminals AQ and AQ1 are open. The LED for both DCV and Exhaust should be off. The actuator should be fully closed.
3. Connect a 9-v battery to AQ (positive node) and AQ1 (negative node). The LED for both DCV and Exhaust should turn on. The actuator should drive to between 90 and 95% open.
4. Turn the Exhaust potentiometer CW until the Exhaust LED turns off. The LED should turn off when the potentiometer is approximately 90%. The actuator should remain in position.
5. Turn the DCV setpoint potentiometer CW until the DCV LED turns off. The DCV LED should turn off when the potentiometer is approximately 9-v. The actuator should drive fully closed.
6. Turn the DCV and Exhaust potentiometers CCW until the Exhaust LED turns on. The exhaust contacts will close 30 to 120 seconds after the Exhaust LED turns on.
7. Return Economizer settings and wiring to normal after completing troubleshooting.

DCV Minimum and Maximum Position

To check the DCV minimum and maximum position:

1. Make sure Economizer preparation procedure has been performed.
2. Connect a 9-v battery to AQ (positive node) and AQ1 (negative node). The DCV LED should turn on. The actuator should drive to between 90 and 95% open.
3. Turn the DCV Maximum Position potentiometer to midpoint. The actuator should drive to between 20 and 80% open.
4. Turn the DCV Maximum Position potentiometer to fully CCW. The actuator should drive fully closed.
5. Turn the Minimum Position potentiometer to midpoint. The actuator should drive to between 20 and 80% open.
6. Turn the Minimum Position Potentiometer fully CW. The actuator should drive fully open.
7. Remove the jumper from TR and N. The actuator should drive fully closed.
8. Return Economizer settings and wiring to normal after completing troubleshooting.

Supply-Air Sensor Input

To check supply-air sensor input:

1. Make sure Economizer preparation procedure has been performed.
2. Set the Enthalpy potentiometer to A. The Free Cool LED turns on. The actuator should drive to between 20 and 80% open.
3. Remove the 5.6 kilo-ohm resistor and jumper T to T1. The actuator should drive fully open.
4. Remove the jumper across T and T1. The actuator should drive fully closed.

5. Return Economizer settings and wiring to normal after completing troubleshooting.

Economizer Troubleshooting Completion

This procedure is used to return the Economizer to operation. No troubleshooting or testing is done by performing the following procedure.

1. Disconnect power at TR and TR1.
2. Set enthalpy potentiometer to previous setting.
3. Set DCV maximum position potentiometer to previous setting.
4. Set minimum position, DCV setpoint, and exhaust potentiometers to previous settings.
5. Remove 620-ohm resistor from terminals SR and +.

6. Remove 1.2 kilo-ohm checkout resistor from terminals SO and +. If used, reconnect sensor from terminals SO and +.

7. Remove jumper from TR to N.
8. Remove jumper from TR to 1.
9. Remove 5.6 kilo-ohm resistor from T and T1. Reconnect wires at T and T1.
10. Remove jumper from P to P1. Reconnect device at P and P1.
11. Apply power (24 vac) to terminals TR and TR1.

WIRING DIAGRAMS

See Figure 52 and 53 for Typical Wiring Diagrams

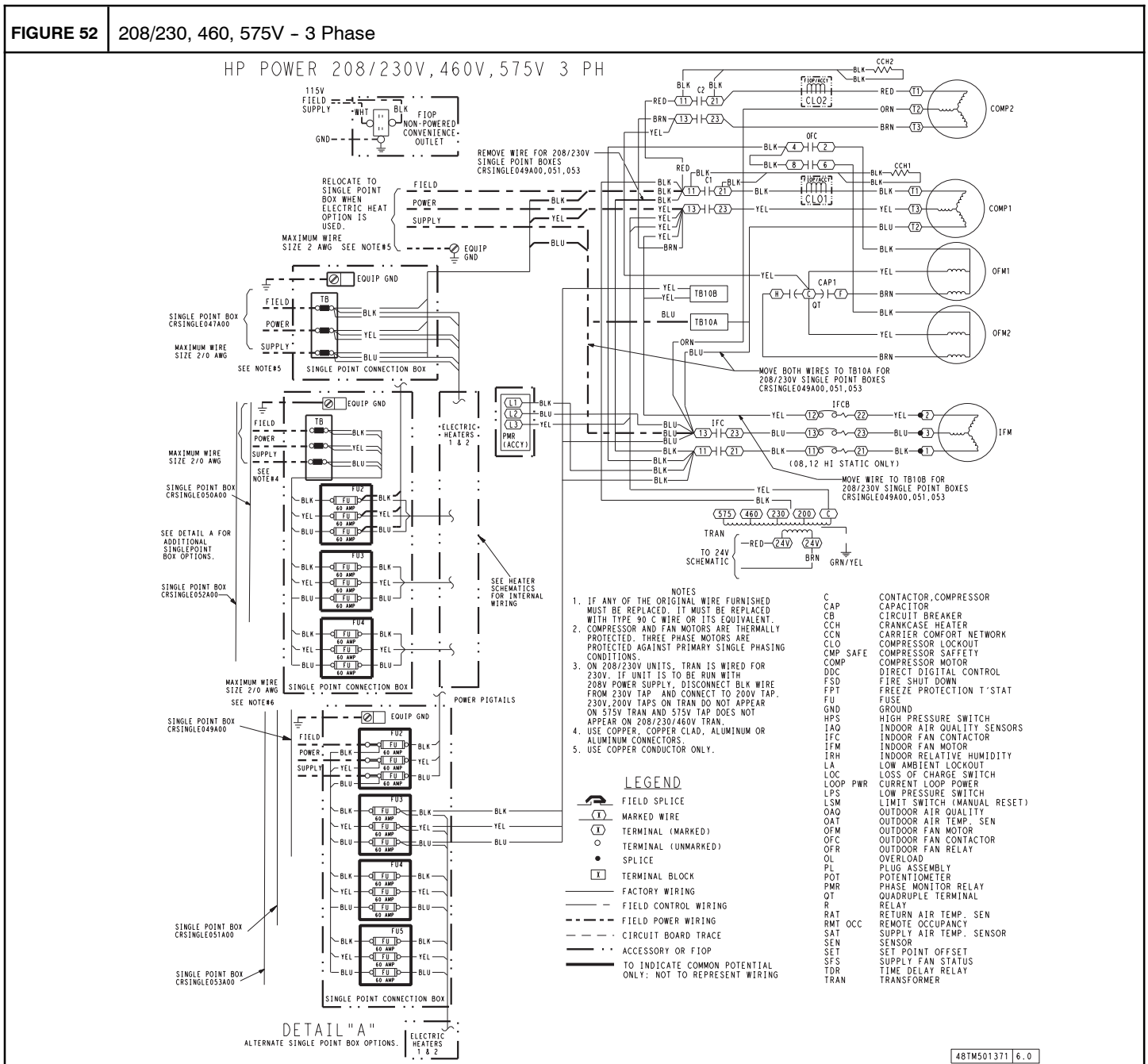
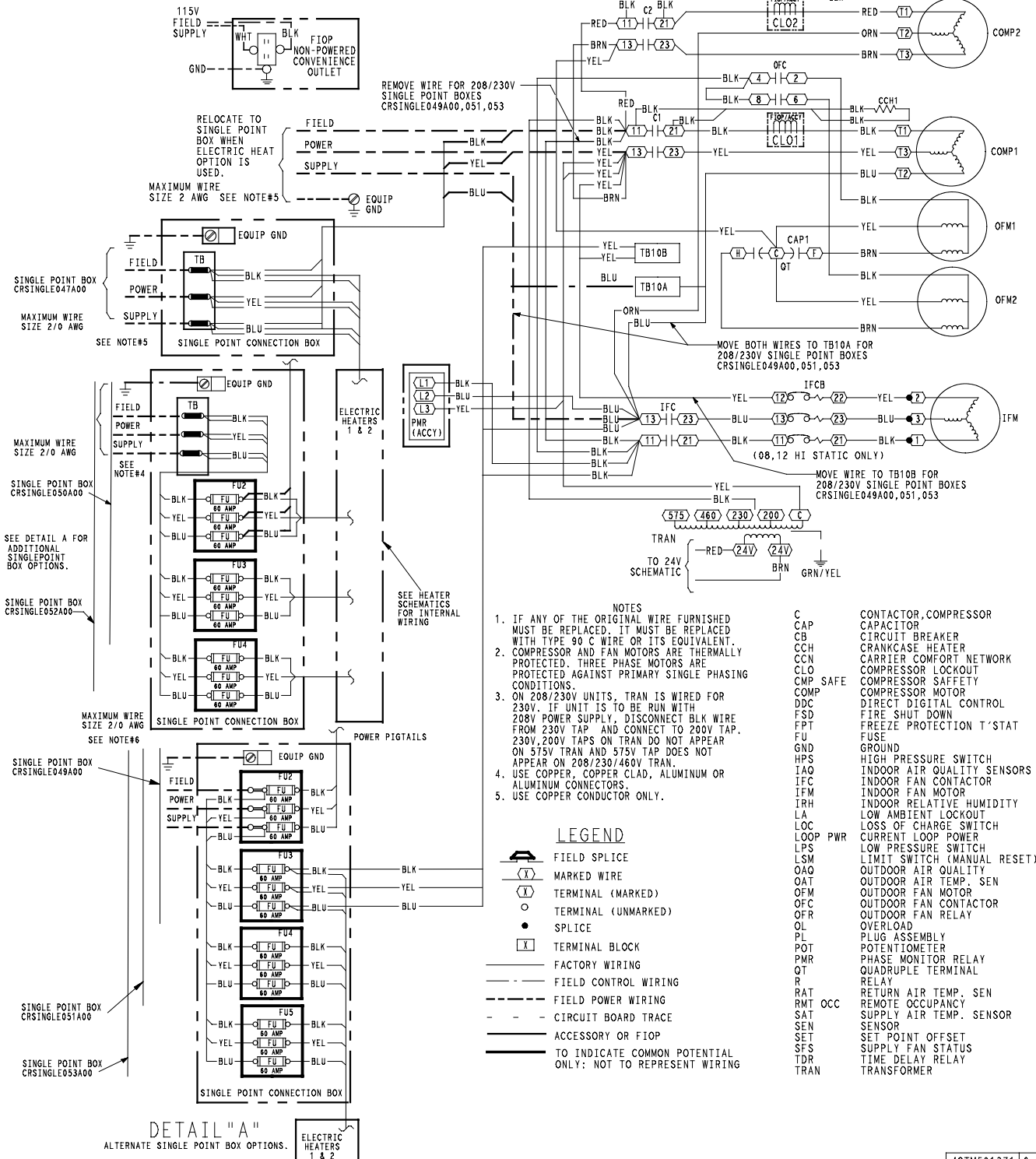


FIGURE 53 RHS Typical Unit Wiring Diagram - Power (Unit 090 208/230-3-60)

HP POWER 208/230V, 460V, 575V 3 PH



48TM501371 | 6.0

PRE-START-UP

WARNING

PERSONAL INJURY HAZARD

Failure to follow this warning could result in personal injury or death.

1. Follow recognized safety practices and wear protective goggles when checking or servicing refrigerant system.
2. Do not operate compressor or provide any electric power to unit unless compressor terminal cover is in place and secured.
3. Do not remove compressor terminal cover until all electrical sources are disconnected.
4. Relieve all pressure from system before touching or disturbing anything inside terminal box if refrigerant leak is suspected around compressor terminals.
5. Never attempt to repair soldered connection while refrigerant system is under pressure.
6. Do not use torch to remove any component. System contains oil and refrigerant under pressure. To remove a component, wear protective goggles and proceed as follows:
 - a. Shut off electrical power to unit.
 - b. Recover refrigerant to relieve all pressure from system using both high-pressure and low pressure ports.
 - c. Cut component connection tubing with tubing cutter and remove component from unit.
 - d. Carefully unsweat remaining tubing stubs when necessary. Oil can ignite when exposed to torch flame.

WARNING

ELECTRICAL OPERATION HAZARD

Failure to follow this warning could result in personal injury or death.

The unit must be electrically grounded in accordance with local codes and NEC ANSI/NFPA 70 (American National Standards Institute/National Fire Protection Association.)

Proceed as follows to inspect and prepare the unit for initial start-up:

1. Remove all access panels.
2. Read and follow instructions on all WARNING, CAUTION, and INFORMATION labels attached to, or shipped with, unit.

WARNING

PERSONAL INJURY AND ENVIRONMENTAL HAZARD

Failure to follow this warning could result in personal injury or death.

Relieve pressure and recover all refrigerant before system repair or final unit disposal.

Wear safety glasses and gloves when handling refrigerants.

Keep torches and other ignition sources away from refrigerants and oils.

3. Make the following inspections:
 - a. Inspect for shipping and handling damages such as broken lines, loose parts, or disconnected wires, etc.
 - b. Inspect for oil at all refrigerant tubing connections and on unit base. Detecting oil generally indicates a refrigerant leak. Leak-test all refrigerant tubing connections using electronic leak detector, halide torch, or liquid-soap solution.
 - c. Inspect all field-wiring and factory-wiring connections. Be sure that connections are completed and tight. Be sure that wires are not in contact with refrigerant tubing or sharp edges.
 - d. Inspect coil fins. If damaged during shipping and handling, carefully straighten fins with a fin comb.
4. Verify the following conditions:
 - a. Make sure that condenser-fan blade are correctly positioned in fan orifice. See Condenser-Fan Adjustment section for more details.
 - b. Make sure that air filter(s) is in place.
 - c. Make sure that condensate drain trap is filled with water to ensure proper drainage.
 - d. Make sure that all tools and miscellaneous loose parts have been removed.

START-UP, GENERAL

Unit Preparation

Make sure that unit has been installed in accordance with installation instructions and applicable codes.

Return-Air Filters

Make sure correct filters are installed in unit (see Appendix II - Physical Data). Do not operate unit without return-air filters.

Outdoor-Air Inlet Screens

Outdoor-air inlet screen must be in place before operating unit.

Compressor Mounting

Compressors are internally spring mounted. Do not loosen or remove compressor hold down bolts.

Internal Wiring

Check all electrical connections in unit control boxes. Tighten as required.

Refrigerant Service Ports

Each unit system has two 1/4" SAE flare (with check valves) service ports: one on the suction line, and one on the compressor discharge line. Be sure that caps on the ports are tight.

Compressor Rotation

On 3-phase units with scroll compressors, it is important to be certain compressor is rotating in the proper direction. To determine whether or not compressor is rotating in the proper direction:

1. Connect service gauges to suction and discharge pressure fittings.
2. Energize the compressor.
3. The suction pressure should drop and the discharge pressure should rise, as is normal on any start-up.

If the suction pressure does not drop and the discharge pressure does not rise to normal levels:

1. Note that the evaporator fan is probably also rotating in the wrong direction.
2. Turn off power to the unit and install lockout tag.
3. Reverse any two of the unit power leads.
4. Re-energize to the compressor. Check pressures.

The suction and discharge pressure levels should now move to their normal start-up levels.

NOTE: When the compressor is rotating in the wrong direction, the unit will make an elevated level of noise and will not provide cooling.

Cooling

Set space thermostat to OFF position. To start unit, turn on main power supply. Set system selector switch at COOL position and fan switch at AUTO. position. Adjust thermostat to a setting below room temperature. Compressor starts on closure of contactor. (090-102: Second stage of thermostat will energize Circuit 2 contactor, start Compressor 2.)

Check unit charge. Refer to Refrigerant Charge section.

Reset thermostat at a position above room temperature. Compressor will shut off. Evaporator fan will shut off after a 30-second delay.

To shut off unit - set system selector switch at OFF position. Resetting thermostat at a position above room temperature shuts unit off temporarily until space temperature exceeds thermostat setting.

Heating

To start unit, turn on main power supply.

Set system selector switch at HEAT position and set thermostat at a setting above room temperature. Set fan at AUTO position.

First stage of thermostat energizes compressor heating (090-102: both compressors will start). Second stage of thermostat energizes electric heaters (if installed). Check heating effects at air supply grille(s).

If electric heaters do not energize, reset limit switch (located on supply-fan scroll) by pressing button located between terminals on the switch.

To shut off unit - set system selector switch at OFF position. Resetting thermostat at a position below room temperature temporarily shuts unit off until space temperature falls below thermostat setting.

Ventilation (Continuous Fan)

Set fan and system selector switches at ON and OFF positions, respectively. Supply fan operates continuously to provide constant air circulation.

OPERATING SEQUENCE

Indoor (Supply) Fan

Continuous fan operation is selected at the thermostat. Terminal G is energized. Defrost Board (DFB) receives this signal at P2-3 and it issues an output at P3-9.

036-060, Standard Static Drive option: 24-v signal at P3-9 is applied to direct-drive motor communication signal terminal. Direct-drive motor starts and runs.

All Belt-Drive Fan options: Contactor coil IFC is energized; indoor fan motor starts.

Fan runs continuously until fan selection at thermostat is changed to AUTO. When the selector switch is switched to AUTO, the input at P2-3 is removed and the output at P3-9 is removed; IFC is de-energized and IFM stops. If the fan selection is AUTO, indoor fan operation will be initiated by the DFB through P3-9 when Cooling or Heating sequence is initiated. Termination of fan operation will be delayed by 30 secs (if Fan Delay is configured to ON) after Cooling or Heating sequence is ended

Base Unit Controls

Cooling, Units Without Economizer

Continuous fan operation is selected at the thermostat. Terminal G is energized. Defrost Board (DFB) receives this signal at P2-3 and it issues an output at P3-9.

036-060, Standard Static Drive option: 24-v signal at P3-9 is applied to direct-drive motor communication signal terminal. Direct-drive motor starts and runs.

All Belt-Drive Fan options: Contactor coil IFC is energized; indoor fan motor starts.

Fan runs continuously until fan selection at thermostat is changed to AUTO. When the selector switch is switched to AUTO, the input at P2-3 is removed and the output at P3-9 is removed; IFC is de-energized and IFM stops. If the fan selection is AUTO, indoor fan operation will be initiated by the DFB through P3-9 when Cooling or Heating sequence is initiated. Termination of fan operation will be delayed by 30 secs (if Fan Delay is configured to ON) after Cooling or Heating sequence is ended.

The outdoor fan motors run continuously while unit is in Stage 1 or Stage 2 cooling.

090-102: If Stage 1 cooling does not satisfy the space load, the space temperature will rise until thermostat calls

for Stage 2 cooling (Y2 closes). DFB receives this input at P2-4. It issues outputs at P3-6 (RVS2) and P3-8 (COMP2). Reversing valve 2 switches to Cooling position. Compressor 2 contactor (C2) is energized; Compressor 2 starts and Circuit 2 operates in Cooling mode.

When Cooling Stage 2 is satisfied, thermostat Y2 opens. Compressor 2 contactor (C2) is de-energized; Compressor 2 stops. RVS2 remains energized.

When Cooling Stage 1 is satisfied, thermostat Y1 opens. Compressor 1 contactor (C1) is de-energized; Compressor 1 stops. Outdoor fan relay OFR is de-energized; outdoor fans stop. After the Fan Delay period, the Indoor fan contactor IFC is de-energized; indoor fan stops (unless Continuous Fan operation has been selected). RVS1 remains energized.

Reversing valve solenoids are energized in Cooling modes. Each solenoid will remain energized until the next Heating mode is initiated for this circuit.

Heating, Units Without Economizer

036-072 (single compressor model): When the thermostat calls for heating, terminal W1 is energized. DFB receives this input at P2-7. The DFB removes the output at P3-7 (RVS1) reversing valve solenoid is de-energized and reversing valve moves to Heating position. DFB issues outputs at P3-9 (IFO), OF, and P3-10 (COMP1). The indoor fan motor or contactor (IFC) is energized; indoor fan motor starts. Outdoor fan relay OFR is energized; outdoor fan motor runs. Compressor contactor C1 is energized; refrigeration circuit operates in Heating mode.

090-102 (two compressor model): When the thermostat calls for heating, terminal W1 is energized. DFB receives this input at P2-7. The DFB removes the outputs at P3-7 (RVS1) and P3-6 (RVS2)); both reversing valve solenoids are de-energized and reversing valves move to Heating position. DFB issues outputs at P3-9 (IFO), OF, P3-10 (COMP1) and P3-8 (COMP2)). The indoor fan contactor (IFC) is energized; indoor fan motor starts. Outdoor fan relay OFR is energized; both outdoor fan motors run. Compressor contactors C1 and C2 are energized; both refrigeration circuits operate in Heating mode.

If Stage 1 heating does not satisfy the space load, the space temperature will fall until thermostat calls for Stage 2 heating (W2 closes). Terminal W2 is energized. DFB receives input at P2-6. DFB issues an output at EHEAT. Heater contactor 1 (HC1) and heater contactor 2 (HC2) (if installed) are energized; all electric heaters are energized.

When space heating load is partially satisfied, thermostat terminal W2 is de-energized; this signal is removed at DFB P2-6. DFB output at EHEAT is removed; heater contactors HC1 and HC2 are de-energized and all electric heat is terminated. Stage 1 heating continues.

When the space heating load is fully satisfied, thermostat terminal W1 is also de-energized. DFB removes outputs at P3-10 (COMP1), P3-8 (COMP2) and OF. All compressor and outdoor fan operations cease. After the Fan Delay period, output P3-9 is removed and IFM

operations cease (unless Continuous Fan operation has been selected).

Reversing valve solenoids remain de-energized until the next call for Cooling mode is initiated.

Cooling, Unit With Economizer

For Occupied mode operation of Economizer, there must be a 24-v signal at terminal N (provided through harness plug PL6-3 from the unit's IFC coil). Removing the signal at N places the Economizer control in Unoccupied mode. During Occupied mode operation, indoor fan operation will be accompanied by economizer dampers moving to Minimum Position setpoint for ventilation. If indoor fan is off, dampers will close. During Unoccupied mode operation, dampers will remain closed unless a Cooling (by free cooling) or DCV demand is received.

When free cooling using outside air is not available, the unit cooling sequence will be controlled directly by the space thermostat as described above in *Cooling, Unit Without Economizer*. Outside air damper position will be closed or Minimum Position as determined by occupancy mode and fan signal.

When free cooling is available as determined by the appropriate changeover command (dry bulb, outdoor enthalpy, differential dry bulb or differential enthalpy), a call for cooling (Y1 closes at the thermostat, signal through PL6-2 to Econo-1) will cause the economizer control to modulate the dampers open and closed to maintain the unit supply air temperature at 50°F to 55°F (10°C to 12.8°C). Compressor will not run.

During free cooling operation, a supply air temperature (SAT) above 50°F (10°C) will cause the dampers to modulate between Minimum Position setpoint and 100% open. With SAT from 50°F to 45°F (10°C to 7.2°C), the dampers will maintain at the Minimum Position setting. With SAT below 45°F (7.2°C), the outside air dampers will be closed. When SAT rises to 48°F (8.9°C), the dampers will re-open to Minimum Position setting.

Should 100% outside air not be capable of satisfying the space temperature, space temperature will rise until Y2 is closed. The economizer control will call for compressor operation. Y2 signal is transferred to the DFB's Y1 input (P2-5). Stage 1 Cooling is initiated as described above in *Cooling, Unit Without Economizer*. Dampers will modulate to maintain SAT at 50°F to 55°F (10°C to 12.8°C) concurrent with Compressor 1 operation. When thermostat Stage 2 cooling is satisfied, DFB outputs for COMP1 and OF will be removed and mechanical cooling sequence will terminate.

The Low Ambient Lockout Thermostat will block compressor operation with economizer operation below 42°F (5.6°C) outside air temperature.

When space temperature demand is satisfied (thermostat Y1 opens), the dampers will return to Minimum Damper position if indoor fan is running or fully closed if fan is off. If accessory power exhaust is installed, the power exhaust fan motors will be energized by the economizer control as the dampers open above the PE-On setpoint

and will be de-energized as the dampers close below the PE-On setpoint.

Damper movement from full closed to full open (or vice versa) will take between 1¹/₂ and 2¹/₂ minutes.

Heating With Economizer

During Occupied mode operation, indoor fan operation will be accompanied by economizer dampers moving to Minimum Position setpoint for ventilation. If indoor fan is off, dampers will close. During Unoccupied mode operation, dampers will remain closed unless a DCV demand is received.

When the room temperature calls for heat (W1 closes), the heating controls are energized as described in *Heating, Unit Without Economizer* above.

Defrost Cycle

During the Heating Mode, frost and ice can develop on the outdoor coil. Defrost sequence will clear the frost and ice from the coil by briefly reversing the Heating sequence periodically.

A window to test for a need to run the Defrost cycle opens 30 minutes after the end of the last Defrost cycle or the previous test window closed. If DFT2 is closed, the Defrost cycle will start. Output at OF is removed; outdoor fans stop during the Defrost cycle. Output P3-6 (RVS2) is energized; reversing valve solenoid RVS2 is energized and reversing valve 2 changes position, placing Circuit 2 in a Cooling mode flow, directing hot gas into the outdoor coil where its heat melts the frost and looses the ice on the coil face.

During the Defrost cycle, output EHEAT is also energized (if not already energized by a thermostat W2 demand); electric heaters will be energized.

During the Defrost Cycle, LED1 on the DFB will be illuminated.

The Defrost cycle ends when DFT2 opens (as liquid temperature exiting the coil rises above DFT2 setpoint) or the defrost cycle runs for 10 minutes. Output at EHEAT is removed; electric heaters will be de-energized (unless thermostat has a W2 demand). Output at OF is restored; outdoor fans start again. Output at P3-6 (RVS2) is removed; reversing valve 2 returns to Heating position.

During the Circuit 2 defrost cycle, Circuit 1 may also enter defrost cycle if DFT1 closes. When DFT1 closes, DFB output P3-7 (RVS1) is energized; reversing valve solenoid 1 is energized, causing reversing valve 1 to switch position and place Circuit 1 in a Cooling mode flow. Defrost in Circuit 1 ends when DFT1 opens or defrost cycle in Circuit 2 is terminated.

Defrost cycle is fixed at a maximum 10 minute duration limit. The period to test and initiate a Defrost cycle can be selected at 30, 60, 90 or 120 minutes.

Emergency Heat

Emergency Heat is a non-staged heating cycle that uses the unit's electric heaters only (no compression heating is energized). Emergency Heat is initiated when the defrost board receives an input signal at W2 (P2-6) but there is no input signal at W1 (P2-7). This signal combination can be provided by thermostat configuration, manual external switch selection or by servicer disconnecting the W1 field connection.

Upon initiation of the Emergency Heat sequence, the DFB will issue output signals at IFO (P3-9) and EHEAT; IFM will run and electric heaters will be energized.

When space heating load is satisfied, the input signal at W2 (P2-6) will be removed. Output at EHEAT is removed; electric heaters are de-energized. After the Fan Delay period, the signal at IFO (P3-9) is removed; IFM stops.

Demand Controlled Ventilation

If a field-installed sensor is connected to the Economizer control, a Demand Controlled Ventilation strategy will operate automatically. As the level in the space increases above the setpoint (on the Economizer controller), the minimum position of the dampers will be increased proportionally, until the Maximum Ventilation setting is reached. As the space level decreases because of the increase in fresh air, the outdoor-damper will follow the higher demand condition from the DCV mode or from the free-cooling mode.

DCV operation is available in Occupied and Unoccupied periods with Economizer. However, a control modification will be required on the RHS unit to implement the Unoccupied period function.

Supplemental Controls

Compressor Lockout Relay (CLO) – The CLO is available as a field-installed accessory. Each compressor has a CLO. The CLO compares the demand for compressor operation (via a 24-v input from Y at CLO terminal 2) to operation of the compressor (determined via compressor current signal input at the CLO's current transformer loop); if the compressor current signal is lost while the demand input still exists, the CLO will trip open and prevent the compressor from restarting until the CLO has been manually reset. In the lockout condition, 24-v will be available at terminal X. Reset is accomplished by removing the input signal at terminal 2; open the thermostat briefly or cycle the main power to the unit.

Phase Monitor Relay (PMR) – The PMR protects the unit in the event of a loss of a phase or a reversal of power line phase in the three-phase unit power supply. In normal operation, the relay K1 is energized (contact set closed) and red LED indicator is on steady. If the PMR detects a loss of a phase or a phase sequence reversal, the relay K1 is energized, its contact set is opened and unit operation is stopped; red LED indicator will blink during lockout condition. Reset of the PMR is automatic when all phases are restored and phase sequence is correct. If no 24-v control power is available to the PMR, the red LED will be off.

FASTENER TORQUE VALUES

See Table 17 for torque values.

Table 17 – Torque Values

Supply fan motor mounting	120 ± 12 in-lbs	13.6 ± 1.4 Nm
Supply fan motor adjustment plate	120 ± 12 in-lbs	13.6 ± 1.4 Nm
Motor pulley setscrew	72 ± 5 in-lbs	8.1 ± 0.6 Nm
Fan pulley setscrew	72 ± 5 in-lbs	8.1 ± 0.6 Nm
Blower wheel hub setscrew	72 ± 5 in-lbs	8.1 ± 0.6 Nm
Bearing locking collar setscrew	65 to 70 in-lbs	7.3 to 7.9 Nm
Compressor mounting bolts	65 to 75 in-lbs	7.3 to 7.9 Nm
Condenser fan motor mounting bolts	65 to 75 in-lbs	7.3 to 7.9 Nm
Condenser fan motor mounting bolts	20 ± 2 in-lbs	2.3 ± 0.2 Nm
Condenser fan hub setscrew	84 ± 12 in-lbs	9.5 ± 1.4 Nm
036–060 Direct–Drive:		
Motor mount arm	60 ± 5 in-lbs	6.8 ± 0.5 Nm
Fan wheel hub setscrew	120 ± 12 in-lbs	13.6 ± 1.4 Nm
Motor belly band bolt	80 ± 5 in-lbs	9.0 ± 0.6 Nm

APPENDIX I. MODEL NUMBER SIGNIFICANCE

MODEL NUMBER NOMENCLATURE

MODEL SERIES	R	H	S	0	9	0	H	0	A	B	0	A	A	A
Position Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
R = Rooftop														
A = Air Conditioning (Cooling Only) H = Heat Pump G = Gas/Electric														
Type														
S = Standard ASHRAE 90.1-2010 Efficiency														
Efficiency														
036 = 36,000 = 3 Tons 048 = 48,000 = 4 Tons 060 = 60,000 = 5 Tons 072 = 72,000 = 6 Tons 090 = 90,000 = 7.5 Tons (Dual Compressor) 102 = 102,000 = 8.5 Tons (Dual Compressor)														
Nominal Cooling Capacity														
K = 208/230-1-60 H = 208/230-3-60 L = 460-3-60 S = 575-3-60														
Voltage														
0 = No Heat														
Heating Capacity														
X = Direct drive X13 Motor (3-5 Ton) A = Standard Static Option - Belt Drive (6-8.5 Ton) B = High Static Option (Belt Drive)														
Motor Option														
A = None B = Economizer w/Bara-relief, OA Temp sensor E = Economizer w/Bara-relief + CO2 Sensor, OA Temp sensor H = Economizer w/Bara-relief, enthalpy sensor L = Economizer w/Bara-relief + CO2 Sensor, enthalpy sensor P = 2-Position damper w/Baro-relief														
Outdoor Air Options / Control														
0A = No Options 4B = Non-Fused Disconnect AT = Non-powered 115v C.O. BR = Supply Air Smoke Detector 7C = Non-Fused Disconnect + Non-Powered 115v C.O. 7K = Non-Fused Disconnect + Non-Powered 115v C.O.+ SA Smoke detector 8A = Non-Fused Disconnect + SA Smoke detector														
Factory Installed Options														
A = Aluminum / Copper Cond & Evap Coil B = Precoat Alum/CU Cond & Alum / CU Evap C = E-Coated Alum/Cu Cond & Alum / CU Evap D = E-Coated Alum / Cu Cond & Evap F = Copper/Copper Cond & Evap														
Condenser / Evaporator Coil Configuration														
A = Standard														
Unit Packaging														

Serial Number Format

POSITION NUMBER	1	2	3	4	5	6	7	8	9	10
TYPICAL	G	0	9	3	5	1	2	3	4	5

POSITION

1
2-3
4-5
6-10

DESIGNATES

Manufacturing location (G = ETP, Texas, USA)
Year of manufacture ("08" = 2008)
Week of manufacture (fiscal calendar)
Sequential number

APPENDIX II. PHYSICAL DATA

Physical Data (Cooling) 3 - 6 TONS

		RHS036	RHS048	RHS060	RHS072
Refrigeration System					
# Circuits / # Comp. / Type		1 / 1 / Scroll	1 / 1 / Scroll	1 / 1 / Scroll	1 / 1 / Scroll
R-410A charge per circuit A/B (lbs-oz)		9 - 8 / -	10 -3 / -	12 - 13 / -	16 - 13 / -
Oil A/B (oz)		42 / -	42 / -	42 / -	56 / -
Metering Device		Fixed Orifice			
High-pressure Trip / Reset (psig)		630 / 505	630 / 505	630 / 505	630 / 505
Loss of Charge Pressure Trip / Reset (psig)		27 / 44	27 / 44	27 / 44	27 / 44
Evap. Coil					
Material		Cu / Al	Cu / Al	Cu / Al	Cu / Al
Coil type		3/8" RTPF	3/8" RTPF	3/8" RTPF	3/8" RTPF
Rows / FPI		3 / 15	3 / 15	4 / 15	4 / 15
Total Face Area (ft ²)		5.5	5.5	7.3	7.3
Condensate Drain Conn. Size		3/4"	3/4"	3/4"	3/4"
Evap. Fan and Motor					
Standard Static 1 phase	Motor Qty / Drive Type	1 / Direct	1 / Direct	1 / Direct	
	Max BHP	1	1	1	
	RPM Range	600-1200	600-1200	600-1200	N/A
	Motor Frame Size	48	48	48	
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	
	Fan Diameter x Length (in)	10 x 10	10 x 10	11 x 10	
Standard Static 3 phase	Motor Qty / Drive Type	1 / Direct	1 / Direct	1 / Direct	1 / Belt
	Max BHP	1	1	1	1.5
	RPM Range	600-1200	600-1200	600-1200	878-1192
	Motor Frame Size	48	48	48	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
	Fan Diameter x Length (in)	10 x 10	10 x 10	11 x 10	10 x 10
High Static 3 phase	Motor Qty / Drive Type	1 / Belt	1 / Belt	1 / Belt	1 / Belt
	Max BHP	2	2	2.9	2.9
	RPM Range	1035-1466	1035-1466	1208-1639	1208-1639
	Motor Frame Size	56	56	56	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal	1 / Centrifugal
	Fan Diameter x Length (in)	10 x 10	10 x 10	10 x 10	10 x 10
Cond. Coil					
Material		Cu / Al	Cu / Al	Cu / Al	Cu / Al
Coil type		3/8" RTPF*	3/8" RTPF*	3/8" RTPF*	3/8" RTPF*
Rows / FPI		2 / 17	2 / 17	2 / 17	2 / 17
Total Face Area (ft ²)		10.7	12.7118055	15	21.25
Cond. fan / motor					
Qty / Motor Drive Type		1 / direct	1 / direct	1 / direct	1 / direct
Motor HP / RPM		1/8 / 825	1/4 / 1100	1/4 / 1100	1/4 / 1100
Fan diameter (in)		22	22	22	22
Filters					
RA Filter # / Size (in)		2 / 16 x 25 x 2	2 / 16 x 25 x 2	4 / 16 x 16 x 2	4 / 16 x 16 x 2
OA inlet screen # / Size (in)		1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 24 x 1	1 / 20 x 24 x 1

* RTPF = Round tube plate fin coil design.

APPENDIX II. PHYSICAL DATA (cont.)

Physical Data (Cooling) 7.5 - 8.5 TONS

Refrigeration System		RHS090	RHS102
	# Circuits / # Comp. / Type	2 / 2 / Scroll	2 / 2 / Scroll
	R-410A refrig. charge per circuit A/B (lbs-oz)	10 - 3 / 10 - 3	11 - 2 / 11 - 2
	Oil A/B (oz)	42 / 42	42 / 42
	Metering Device	Fixed Orifice	
	High-pressure Trip / Reset (psig)	630 / 505	630 / 505
	Loss of Charge Pressure Trip / Reset (psig)	27 / 44	27 / 44
Evap. Coil			
	Material	Cu / Al	Cu / Al
	Coil type	3/8" RTPF	3/8" RTPF
	Rows / FPI	3 / 15	4 / 15
	Total Face Area (ft ²)	11.1	11.1
	Condensate Drain Conn. Size	3/4"	3/4"
Evap. Fan and Motor			
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Standard Static 3 phase </div>	Motor Qty / Drive Type	1 / Belt	1 / Belt
	Max BHP	1.2	1.2
	RPM Range	460-652	460-652
	Motor Frame Size	56	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal
	Fan Diameter x Length (in)	15 x 15	15 x 15
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> High Static 3 phase </div>	Motor Qty / Drive Type	1 / Belt	1 / Belt
	Max BHP	2.9	2.9
	RPM Range	838-1084	838-1084
	Motor Frame Size	56	56
	Fan Qty / Type	1 / Centrifugal	1 / Centrifugal
	Fan Diameter x Length (in)	15 x 15	15 x 15
Cond. Coil			
	Material	Cu / Al	Cu / Al
	Coil type	3/8" RTPF*	3/8" RTPF*
	Rows / FPI	2 / 17	2 / 17
	Total Face Area (ft ²)	25.1	25.1
Cond. fan / motor			
	Qty / Motor Drive Type	2 / direct	2 / direct
	Motor HP / RPM	1/4 / 1100	1/4 / 1100
	Fan diameter (in)	22.0	22.0
Filters			
	RA Filter # / Size (in)	4 / 16 x 20 x 2	4 / 20 x 20 x 2
	OA inlet screen # / Size (in)	1 / 20 x 24 x 1	1 / 20 x 24 x 1

* RTPF = Round tube plate fin coil design.

APPENDIX III. FAN PERFORMANCE

General Fan Performance Notes:

1. Interpolation is permissible. Do not extrapolate.
2. External static pressure is the static pressure difference between the return duct and the supply duct plus the static pressure caused by any FIOPs or accessories.
3. Tabular data accounts for pressure loss due to clean filters, unit casing, and wet coils. Factory options and accessories may add static pressure losses.
4. The Fan Performance tables offer motor/drive recommendations. In cases when two motor/drive combinations would work, we recommended the lower horsepower option.
5. For information on the electrical properties of motors, please see the Electrical information section of this book.

APPENDIX III. FAN PERFORMANCE

**Table 18 – RHS036, ELECTRIC DRIVE,
X13 MOTOR, 3 TON HORIZONTAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	900	0.70	0.31
	975	0.60	0.30
	1050	0.50	0.29
	1125	0.39	0.27
	1200	0.29	0.26
	1275	0.21	0.24
	1350	0.12	0.23
	1425	0.03	0.21
	1500	–	–
2	900	0.85	0.37
	975	0.76	0.36
	1050	0.66	0.36
	1125	0.55	0.34
	1200	0.46	0.34
	1275	0.36	0.32
	1350	0.27	0.31
	1425	0.17	0.29
	1500	0.07	0.27
3	900	1.02	0.44
	975	0.94	0.45
	1050	0.86	0.45
	1125	0.79	0.45
	1200	0.71	0.45
	1275	0.61	0.44
	1350	0.51	0.43
	1425	0.40	0.41
	1500	0.29	0.39
4	900	1.12	0.49
	975	1.06	0.50
	1050	1.00	0.52
	1125	0.95	0.53
	1200	0.89	0.54
	1275	0.80	0.53
	1350	0.70	0.52
	1425	0.57	0.50
	1500	0.46	0.49
5	900	1.18	0.52
	975	1.14	0.54
	1050	1.10	0.56
	1125	1.06	0.58
	1200	1.02	0.60
	1275	0.98	0.63
	1350	0.94	0.65
	1425	0.90	0.68
	1500	0.87	0.71

**Table 19 – RHS036, ELECTRIC DRIVE,
X13 MOTOR, 3 TON VERTICAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	900	0.44	0.22
	975	0.35	0.21
	1050	0.24	0.20
	1125	0.15	0.19
	1200	0.08	0.19
	1275	0.02	0.18
	1350	–	–
	1425	–	–
	1500	–	–
2	900	0.64	0.30
	975	0.53	0.29
	1050	0.42	0.28
	1125	0.32	0.27
	1200	0.24	0.26
	1275	0.15	0.25
	1350	0.07	0.24
	1425	–	–
	1500	–	–
3	900	0.93	0.42
	975	0.80	0.41
	1050	0.68	0.39
	1125	0.57	0.38
	1200	0.47	0.37
	1275	0.35	0.36
	1350	0.26	0.34
	1425	0.13	0.33
	1500	0.08	0.32
4	900	1.04	0.47
	975	0.92	0.46
	1050	0.80	0.45
	1125	0.71	0.45
	1200	0.62	0.45
	1275	0.52	0.44
	1350	0.43	0.44
	1425	0.27	0.42
	1500	0.22	0.41
5	900	1.10	0.50
	975	1.00	0.49
	1050	0.90	0.49
	1125	0.82	0.50
	1200	0.75	0.51
	1275	0.70	0.54
	1350	0.67	0.57
	1425	0.60	0.60
	1500	0.62	0.64

FAN PERFORMANCE

**Table 20 – RHS048, ELECTRIC DRIVE,
X13 MOTOR, 4 TON HORIZONTAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	1200	0.75	0.48
	1300	0.63	0.46
	1400	0.48	0.44
	1500	0.33	0.41
	1600	0.19	0.39
	1700	0.05	0.36
	1800	–	–
	1900	–	–
	2000	–	–
2	1200	0.97	0.58
	1300	0.88	0.59
	1400	0.77	0.59
	1500	0.64	0.59
	1600	0.50	0.57
	1700	0.36	0.54
	1800	0.21	0.52
	1900	0.06	0.49
	2000	–	–
3	1200	0.98	0.59
	1300	0.91	0.60
	1400	0.82	0.62
	1500	0.71	0.62
	1600	0.58	0.61
	1700	0.45	0.60
	1800	0.31	0.58
	1900	0.16	0.56
	2000	0.03	0.52
4	1200	0.98	0.59
	1300	0.92	0.62
	1400	0.86	0.64
	1500	0.79	0.66
	1600	0.70	0.68
	1700	0.62	0.70
	1800	0.52	0.71
	1900	0.37	0.69
	2000	0.21	0.67
5	1200	1.02	0.60
	1300	0.97	0.64
	1400	0.92	0.67
	1500	0.87	0.71
	1600	0.82	0.75
	1700	0.77	0.79
	1800	0.71	0.84
	1900	0.65	0.88
	2000	0.58	0.92

**Table 21 – RHS048, ELECTRIC DRIVE,
X13 MOTOR, 4 TON VERTICAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	1200	0.50	0.39
	1300	0.36	0.37
	1400	0.19	0.35
	1500	0.10	0.33
	1600	0.02	0.32
	1700	–	–
	1800	–	–
	1900	–	–
	2000	–	–
2	1200	0.80	0.55
	1300	0.69	0.55
	1400	0.50	0.54
	1500	0.38	0.52
	1600	0.24	0.50
	1700	0.13	0.48
	1800	0.01	0.46
	1900	–	–
	2000	–	–
3	1200	0.89	0.59
	1300	0.78	0.61
	1400	0.59	0.60
	1500	0.46	0.58
	1600	0.31	0.56
	1700	0.20	0.54
	1800	0.07	0.52
	1900	–	–
	2000	–	–
4	1200	0.89	0.60
	1300	0.80	0.63
	1400	0.67	0.64
	1500	0.57	0.65
	1600	0.43	0.65
	1700	0.31	0.66
	1800	0.23	0.65
	1900	0.12	0.63
	2000	0.01	0.62
5	1200	0.94	0.62
	1300	0.85	0.65
	1400	0.73	0.68
	1500	0.65	0.70
	1600	0.55	0.72
	1700	0.47	0.75
	1800	0.42	0.78
	1900	0.39	0.82
	2000	0.38	0.88

FAN PERFORMANCE

**Table 22 – RHS060, ELECTRIC DRIVE,
X13 MOTOR, 5 TON HORIZONTAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	1500	1.19	0.74
	1625	1.01	0.73
	1750	0.82	0.70
	1875	0.60	0.66
	2000	0.38	0.62
	2125	0.16	0.57
	2250	–	–
	2375	–	–
2	1500	1.40	0.86
	1625	1.25	0.88
	1750	1.08	0.86
	1875	0.90	0.84
	2000	0.67	0.80
	2125	0.44	0.75
	2250	0.20	0.71
	2375	–	–
3	1500	1.41	0.87
	1625	1.28	0.89
	1750	1.13	0.89
	1875	0.96	0.88
	2000	0.74	0.85
	2125	0.51	0.80
	2250	0.27	0.75
	2375	0.02	0.70
4	1500	1.44	0.89
	1625	1.35	0.93
	1750	1.24	0.96
	1875	1.11	0.98
	2000	0.90	0.96
	2125	0.69	0.92
	2250	0.43	0.86
	2375	0.17	0.81
5	1500	1.49	0.90
	1625	1.38	0.95
	1750	1.28	1.00
	1875	1.18	1.05
	2000	1.11	1.09
	2125	0.97	1.11
	2250	0.72	1.07
	2375	0.47	1.02
2500	0.20	0.96	

**Table 23 – RHS060, ELECTRIC DRIVE,
X13 MOTOR, 5 TON VERTICAL SUPPLY**

SPEED (TORQUE) TAP	CFM	ESP	BHP
1	1500	1.00	0.70
	1625	0.72	0.65
	1750	0.46	0.60
	1875	0.28	0.55
	2000	0.14	0.51
	2125	0.00	0.52
	2250	–	–
	2375	–	–
2	1500	1.18	0.88
	1625	1.00	0.90
	1750	0.75	0.87
	1875	0.51	0.83
	2000	0.30	0.79
	2125	0.13	0.75
	2250	–	–
	2375	–	–
3	1500	1.19	0.88
	1625	1.03	0.91
	1750	0.80	0.90
	1875	0.56	0.87
	2000	0.35	0.83
	2125	0.19	0.80
	2250	0.01	0.77
	2375	–	–
4	1500	1.25	0.89
	1625	1.09	0.93
	1750	0.89	0.96
	1875	0.65	0.94
	2000	0.45	0.93
	2125	0.26	0.89
	2250	0.12	0.86
	2375	–	–
5	1500	1.26	0.90
	1625	1.16	0.96
	1750	0.99	1.01
	1875	0.80	1.05
	2000	0.67	1.07
	2125	0.48	1.07
	2250	0.26	1.03
	2375	0.11	1.00
2500	–	–	

APPENDIX III. FAN PERFORMANCE (cont.)

Table 24 – RHS036, 3 TON HORIZONTAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	574	0.13	707	0.23	817	0.34	913	0.47	999	0.61
975	597	0.15	727	0.25	835	0.37	929	0.50	1015	0.64
1050	621	0.18	747	0.28	853	0.40	946	0.53	1030	0.68
1125	646	0.20	768	0.31	872	0.43	964	0.57	1047	0.72
1200	671	0.23	790	0.34	892	0.47	982	0.61	1064	0.76
1275	696	0.26	812	0.38	912	0.51	1001	0.65	1082	0.81
1350	723	0.30	835	0.42	933	0.55	1020	0.70	1100	0.86
1425	749	0.34	859	0.46	955	0.60	1040	0.75	1119	0.91
1500	776	0.38	883	0.51	977	0.65	1061	0.80	1138	0.97

Med static – 819 to 1251 rpm, 1.5 max bhp

High static – 1035 to 1466 rpm, 2.0 max bhp

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1078	0.77	1151	0.93	1220	1.11	1284	1.30	1346	1.49
975	1093	0.80	1165	0.97	1233	1.15	1297	1.33	1358	1.53
1050	1108	0.84	1180	1.01	1247	1.19	1311	1.38	1371	1.58
1125	1123	0.88	1195	1.05	1261	1.23	1325	1.42	1385	1.62
1200	1140	0.92	1210	1.10	1276	1.28	1339	1.47	1399	1.68
1275	1157	0.97	1226	1.15	1292	1.33	1354	1.53	1414	1.73
1350	1174	1.02	1243	1.20	1308	1.39	1370	1.59	1429	1.80
1425	1192	1.08	1260	1.26	1325	1.45	1386	1.65	1444	1.86
1500	1210	1.14	1278	1.33	1342	1.52	1403	1.72	1461	1.93

Med static – 819 to 1251 rpm, 1.5 max bhp

High static – 1035 to 1466 rpm, 2.0 max bhp

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Table 25 – RHS036, 3 TON VERTICAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	594	0.15	740	0.25	867	0.37	981	0.52	1084	0.68
975	618	0.17	758	0.28	881	0.40	991	0.55	1092	0.71
1050	642	0.19	777	0.30	896	0.43	1003	0.58	1102	0.75
1125	668	0.22	797	0.34	912	0.47	1017	0.62	1113	0.79
1200	695	0.25	818	0.37	930	0.51	1032	0.66	1126	0.83
1275	722	0.29	841	0.41	949	0.55	1048	0.71	1140	0.88
1350	750	0.33	864	0.46	968	0.60	1065	0.76	1155	0.93
1425	778	0.37	888	0.50	989	0.65	1083	0.81	1171	0.99
1500	807	0.42	913	0.56	1011	0.71	1103	0.87	1188	1.05

Med static – 819 to 1251 rpm, 1.5 max bhp

High static – 1035 to 1466 rpm, 2.0 max bhp

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
900	1180	0.86	1269	1.05	1354	1.25	1434	1.47	1511	1.70
975	1186	0.89	1275	1.08	1358	1.29	1437	1.51	1513	1.74
1050	1194	0.92	1281	1.12	1363	1.32	1441	1.54	1516	1.78
1125	1204	0.97	1289	1.16	1370	1.37	1447	1.59	1520	1.82
1200	1215	1.01	1298	1.21	1378	1.42	1454	1.64	1526	1.87
1275	1227	1.06	1309	1.26	1387	1.47	1462	1.69	1533	1.92
1350	1240	1.12	1321	1.32	1397	1.53	1471	1.75	1541	1.99
1425	1254	1.18	1333	1.38	1409	1.59	1481	1.82	–	–
1500	1270	1.24	1347	1.45	1421	1.66	1492	1.89	–	–

Med static – 819 to 1251 rpm, 1.5 max bhp

High static – 1035 to 1466 rpm, 2.0 max bhp

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Bold Face indicates field-supplied drive

1.Recommend using field-supplied fan pulley (part no. 1178447), motor pulley (part no. 1070551) and belt (part no.1178129).

FAN PERFORMANCE (cont.)

Table 26 – RHS048, 4 TON HORIZONTAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	671	0.23	790	0.34	892	0.47	982	0.61	1064	0.76
1300	705	0.28	820	0.39	919	0.52	1007	0.67	1088	0.82
1400	740	0.33	851	0.45	947	0.58	1034	0.73	1113	0.89
1500	776	0.38	883	0.51	977	0.65	1061	0.80	1138	0.97
1600	813	0.45	916	0.58	1007	0.73	1089	0.89	1165	1.05
1700	851	0.52	949	0.66	1038	0.81	1118	0.97	1192	1.15
1800	888	0.60	984	0.75	1069	0.90	1148	1.07	1221	1.25
1900	927	0.69	1019	0.84	1102	1.00	1179	1.18	1250	1.36
2000	965	0.78	1054	0.94	1135	1.11	1210	1.29	1280	1.48
Med static – 920 to 1303 rpm, 1.5 max bhp										
High static – 1035 to 1466 rpm, 2.0 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1140	0.92	1210	1.10	1276	1.28	1339	1.47	1399	1.68
1300	1162	0.99	1232	1.16	1297	1.35	1360	1.55	1419	1.75
1400	1186	1.06	1254	1.24	1319	1.43	1381	1.63	1439	1.84
1500	1210	1.14	1278	1.33	1342	1.52	1403	1.72	1461	1.93
1600	1236	1.23	1302	1.42	1365	1.62	1425	1.82	1483	2.04
1700	1262	1.33	1328	1.52	1390	1.72	1449	1.93	1505	2.15
1800	1289	1.44	1354	1.63	1415	1.84	1473	2.05	1529	2.27
1900	1317	1.55	1380	1.75	1441	1.96	1498	2.18	–	–
2000	1345	1.68	1408	1.88	1467	2.10	1524	2.32	–	–
Med static – 920 to 1303 rpm, 1.5 max bhp										
High static – 1035 to 1466 rpm, 2.0 max bhp										

Bold Face indicates field–supplied drive

1.Recommend using field–supplied fan pulley (part no. 1178447), motor pulley (part no. 1070551) and belt (part no.1178129).

NOTE: For Medium static applications order high static model and use field–supplied pulley and drives.

Table 27 – RHS048, 4 TON VERTICAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	695	0.25	818	0.37	930	0.51	1032	0.66	1126	0.83
1300	731	0.30	849	0.43	955	0.57	1053	0.72	1145	0.89
1400	769	0.36	880	0.49	982	0.63	1077	0.79	1166	0.97
1500	807	0.42	913	0.56	1011	0.71	1103	0.87	1188	1.05
1600	847	0.49	948	0.63	1042	0.79	1130	0.96	1213	1.14
1700	887	0.57	983	0.72	1073	0.88	1158	1.06	1239	1.24
1800	928	0.66	1020	0.82	1106	0.98	1188	1.16	1266	1.35
1900	969	0.76	1057	0.92	1140	1.09	1219	1.28	1295	1.48
2000	1010	0.87	1095	1.04	1175	1.21	1251	1.41	1325	1.61
Med static – 920 to 1303 rpm, 1.5 max bhp										
High static – 1035 to 1466 rpm, 2.0 max bhp										

High static – 1035 to 1466 rpm, 2.0 max bhp

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	1215	1.01	1298	1.21	1378	1.42	1454	1.64	1526	1.87
1300	1231	1.08	1313	1.28	1390	1.49	1465	1.71	1536	1.94
1400	1249	1.16	1329	1.36	1405	1.57	1478	1.79	–	–
1500	1270	1.24	1347	1.45	1421	1.66	1492	1.89	–	–
1600	1292	1.34	1367	1.54	1440	1.76	1509	1.99	–	–
1700	1315	1.44	1389	1.65	1459	1.88	1527	2.11	–	–
1800	1341	1.56	1412	1.77	1481	2.00	–	–	–	–
1900	1367	1.68	1437	1.90	1504	2.13	–	–	–	–
2000	1395	1.82	1463	2.04	1528	2.28	–	–	–	–
Med static – 920 to 1303 rpm, 1.5 max bhp										
High static – 1035 to 1466 rpm, 2.0 max bhp										

Bold Face indicates field–supplied drive

NOTE: For Medium static applications order high static model and use field–supplied pulley and drives.

1.Recommend using field–supplied fan pulley (part no. 1178447), motor pulley (part no. 1070551) and belt (part no.1178129).

FAN PERFORMANCE (cont.)

Table 28 – RHS060, 5 TON HORIZONTAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	725	0.33	840	0.46	937	0.60	1023	0.75	1101	0.90
1625	765	0.40	876	0.54	970	0.68	1054	0.84	1131	1.00
1750	806	0.48	912	0.63	1004	0.78	1087	0.94	1162	1.11
1875	847	0.57	950	0.72	1039	0.88	1120	1.05	1194	1.23
2000	889	0.66	988	0.83	1075	1.00	1154	1.18	1226	1.36
2125	931	0.78	1027	0.95	1112	1.13	1189	1.31	1260	1.50
2250	974	0.90	1067	1.08	1149	1.27	1224	1.46	1294	1.66
2375	1018	1.03	1107	1.23	1187	1.43	1261	1.63	1329	1.84
2500	1061	1.19	1148	1.39	1226	1.59	1297	1.81	1364	2.02
Med static – 1066 to 1380 rpm, 2.0 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1172	1.06	1239	1.23	1302	1.40	1361	1.58	1418	1.77
1625	1201	1.16	1267	1.34	1329	1.52	1388	1.71	1444	1.90
1750	1231	1.28	1296	1.46	1358	1.65	1416	1.84	1472	2.04
1875	1262	1.41	1326	1.60	1387	1.79	1445	1.99	1499	2.20
2000	1294	1.55	1357	1.74	1417	1.95	1474	2.15	1528	2.36
2125	1326	1.70	1388	1.90	1447	2.11	1504	2.33	1557	2.55
2250	1359	1.87	1420	2.08	1479	2.29	1534	2.51	1587	2.74
2375	1393	2.05	1453	2.27	1511	2.49	1566	2.72	1618	2.95
2500	1427	2.24	1487	2.47	1543	2.70	1597	2.94	1649	3.18
Med static – 1066 to 1380 rpm, 2.0 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Table 29 – RHS060, 5 TON VERTICAL SUPPLY, 3 PHASE BELT DRIVE

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	794	0.41	902	0.55	993	0.69	1074	0.85	1147	1.00
1625	840	0.49	945	0.64	1034	0.80	1113	0.96	1185	1.13
1750	888	0.59	988	0.75	1075	0.92	1153	1.09	1223	1.26
1875	936	0.70	1033	0.87	1117	1.05	1193	1.23	1263	1.41
2000	984	0.82	1078	1.00	1160	1.19	1235	1.39	1303	1.58
2125	1033	0.96	1124	1.15	1204	1.35	1277	1.56	1343	1.76
2250	1083	1.11	1170	1.32	1248	1.53	1319	1.74	1385	1.96
2375	1133	1.28	1217	1.50	1293	1.72	1363	1.95	1427	2.17
2500	1183	1.47	1265	1.70	1339	1.93	1406	2.17	1470	2.41
Med static – 1066 to 1380 rpm, 2.0 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1500	1214	1.16	1277	1.33	1336	1.50	1392	1.67	1445	1.85
1625	1251	1.30	1313	1.47	1371	1.65	1427	1.83	1479	2.02
1750	1289	1.44	1350	1.63	1407	1.81	1462	2.01	1514	2.20
1875	1327	1.60	1387	1.80	1444	1.99	1498	2.19	1550	2.40
2000	1366	1.78	1426	1.98	1482	2.19	1535	2.40	1586	2.61
2125	1406	1.97	1464	2.18	1520	2.40	1573	2.62	1623	2.84
2250	1446	2.18	1504	2.40	1559	2.62	1611	2.85	1661	3.09
2375	1487	2.40	1544	2.63	1598	2.87	1650	3.11	–	–
2500	1529	2.64	1585	2.89	1638	3.13	–	–	–	–
Med static – 1066 to 1380 rpm, 2.0 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

FAN PERFORMANCE (cont.)
Table 30 – RHS072, 6 TON HORIZONTAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	822	0.51	927	0.66	1018	0.82	1100	0.98	1174	1.15
1950	872	0.62	973	0.79	1061	0.95	1140	1.13	1213	1.31
2100	923	0.75	1019	0.92	1104	1.10	1182	1.29	1253	1.48
2250	974	0.90	1067	1.08	1149	1.27	1224	1.46	1294	1.66
2400	1026	1.06	1115	1.26	1195	1.46	1268	1.66	1336	1.87
2550	1079	1.25	1164	1.46	1241	1.67	1312	1.88	1379	2.10
2700	1132	1.46	1214	1.67	1289	1.90	1358	2.12	1422	2.35
2850	1186	1.69	1264	1.92	1336	2.15	1404	2.39	1467	2.63
3000	1240	1.94	1315	2.18	1385	2.43	1451	2.68	1512	2.93
Std static – 878 to 1192 rpm, 1.5 max bhp										
Med static – 1066 to 1380 rpm, 2.9 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	1244	1.33	1308	1.51	1369	1.70	1427	1.90	1483	2.10
1950	1281	1.49	1345	1.68	1405	1.88	1462	2.09	1517	2.30
2100	1320	1.67	1382	1.87	1441	2.08	1498	2.29	1552	2.51
2250	1359	1.87	1420	2.08	1479	2.29	1534	2.51	1587	2.74
2400	1400	2.09	1460	2.31	1517	2.53	1572	2.76	1624	2.99
2550	1441	2.33	1500	2.55	1557	2.79	1610	3.03	1662	3.27
2700	1483	2.59	1541	2.83	1597	3.07	1650	3.32	–	–
2850	1527	2.87	1583	3.12	1638	3.37	–	–	–	–
3000	1571	3.18	1626	3.44	1680	3.70	–	–	–	–
Std static – 878 to 1192 rpm, 1.5 max bhp										
Med static – 1066 to 1380 rpm, 2.9 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Table 31 – RHS072, 6 TON VERTICAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	907	0.63	1006	0.80	1092	0.97	1169	1.14	1239	1.32
1950	965	0.77	1060	0.95	1143	1.13	1218	1.32	1287	1.51
2100	1024	0.93	1115	1.12	1195	1.32	1268	1.52	1335	1.72
2250	1083	1.11	1170	1.32	1248	1.53	1319	1.74	1385	1.96
2400	1143	1.32	1227	1.54	1302	1.76	1371	1.99	1435	2.22
2550	1203	1.55	1284	1.78	1357	2.02	1424	2.26	1487	2.50
2700	1264	1.81	1342	2.06	1412	2.31	1478	2.56	1539	2.82
2850	1326	2.09	1400	2.36	1469	2.62	1532	2.89	1592	3.16
3000	1387	2.41	1459	2.69	1525	2.97	1587	3.25	1646	3.53
Std static – 878 to 1192 rpm, 1.5 max bhp										
Med static – 1066 to 1380 rpm, 2.9 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1800	1304	1.51	1365	1.69	1422	1.88	1477	2.08	1528	2.28
1950	1350	1.71	1410	1.91	1467	2.11	1520	2.31	1572	2.52
2100	1398	1.93	1457	2.14	1512	2.35	1565	2.57	1616	2.79
2250	1446	2.18	1504	2.40	1559	2.62	1611	2.85	1661	3.09
2400	1496	2.45	1552	2.68	1606	2.92	1658	3.16	–	–
2550	1546	2.75	1601	2.99	1654	3.24	–	–	–	–
2700	1597	3.07	1651	3.33	–	–	–	–	–	–
2850	1648	3.43	–	–	–	–	–	–	–	–
3000	–	–	–	–	–	–	–	–	–	–
Std static – 878 to 1192 rpm, 1.5 max bhp										
Med static – 1066 to 1380 rpm, 2.9 max bhp										
High static – 1208 to 1639 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

FAN PERFORMANCE (cont.)

Table 32 – RHS090, 7.5 TON HORIZONTAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	423	0.28	509	0.40	587	0.52	659	0.66	725	0.80
2438	444	0.34	525	0.46	600	0.59	669	0.73	733	0.88
2625	465	0.40	543	0.53	614	0.67	680	0.82	743	0.97
2813	487	0.47	561	0.61	629	0.76	693	0.91	753	1.08
3000	510	0.55	580	0.70	646	0.86	707	1.02	765	1.19
3188	534	0.65	600	0.80	663	0.96	722	1.13	779	1.31
3375	557	0.75	621	0.91	681	1.08	738	1.26	793	1.44
3563	582	0.86	642	1.03	700	1.21	755	1.39	808	1.58
3750	606	0.99	664	1.17	720	1.35	773	1.54	824	1.74
Std static – 460 to 652 rpm, 1.2 max bhp										
Med static – 591 to 838 rpm, 2.9 max bhp										
High static – 838 to 1085 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	788	0.94	847	1.09	903	1.25	957	1.41	1009	1.58
2438	794	1.03	852	1.19	907	1.36	959	1.52	1010	1.70
2625	802	1.13	858	1.30	911	1.47	963	1.64	1012	1.82
2813	811	1.24	865	1.41	917	1.59	967	1.77	1016	1.96
3000	821	1.36	874	1.54	925	1.72	974	1.91	1021	2.11
3188	832	1.49	884	1.68	933	1.87	981	2.06	1028	2.26
3375	845	1.63	895	1.82	943	2.02	990	2.22	1035	2.43
3563	858	1.78	907	1.98	954	2.19	1000	2.40	1044	2.61
3750	873	1.94	920	2.15	966	2.36	1011	2.58	1054	2.80
Std static – 460 to 652 rpm, 1.2 max bhp										
Med static – 591 to 838 rpm, 2.9 max bhp										
High static – 838 to 1085 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Table 33 – RHS090, 3 PHASE, 7.5 TON VERTICAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	447	0.31	528	0.43	597	0.54	658	0.66	713	0.78
2438	470	0.37	548	0.50	615	0.62	675	0.75	729	0.88
2625	494	0.45	569	0.58	634	0.71	692	0.85	745	0.99
2813	518	0.53	590	0.67	653	0.82	710	0.96	763	1.11
3000	543	0.62	612	0.77	673	0.93	729	1.08	780	1.24
3188	568	0.72	635	0.89	694	1.05	749	1.21	799	1.38
3375	593	0.84	658	1.01	716	1.19	769	1.36	818	1.53
3563	619	0.97	681	1.15	737	1.33	789	1.52	837	1.70
3750	645	1.11	705	1.30	760	1.49	810	1.68	857	1.88
Std static – 460 to 652 rpm, 1.2 max bhp										
Med static – 591 to 838 rpm, 2.9 max bhp										
High static – 838 to 1085 rpm, 2.9 max bhp										

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2250	764	0.89	812	1.02	856	1.14	899	1.26	939	1.39
2438	779	1.00	826	1.13	870	1.26	912	1.40	952	1.53
2625	795	1.12	841	1.26	885	1.40	926	1.54	966	1.68
2813	811	1.25	857	1.40	900	1.55	941	1.69	980	1.84
3000	828	1.39	873	1.55	916	1.70	956	1.86	995	2.02
3188	846	1.54	890	1.71	932	1.87	972	2.04	1010	2.21
3375	864	1.70	907	1.88	949	2.05	988	2.23	1026	2.40
3563	882	1.88	925	2.06	966	2.25	1005	2.43	1042	2.62
3750	902	2.07	944	2.26	984	2.45	1022	2.65	1059	2.84
Std static – 460 to 652 rpm, 1.2 max bhp										
Med static – 591 to 838 rpm, 2.9 max bhp										
High static – 838 to 1085 rpm, 2.9 max bhp										

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

FAN PERFORMANCE (cont.)

Table 34 – RHS102, 8.5 TON HORIZONTAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2550	468	0.39	546	0.52	618	0.66	684	0.80	747	0.96
2763	493	0.47	567	0.61	635	0.76	699	0.91	760	1.07
2975	520	0.57	589	0.72	654	0.87	716	1.03	774	1.20
3188	547	0.68	613	0.83	675	1.00	733	1.17	789	1.34
3400	575	0.80	637	0.96	696	1.14	752	1.31	806	1.50
3613	603	0.94	662	1.11	719	1.29	773	1.48	824	1.67
3825	631	1.09	688	1.27	742	1.46	794	1.66	843	1.86
4038	660	1.26	714	1.45	766	1.65	816	1.85	864	2.06
4250	689	1.45	741	1.65	790	1.86	838	2.07	885	2.29

Std static – 460 to 652 rpm, 1.2 max bhp

Med static – 591 to 838 rpm, 2.9 max bhp

High static – 838 to 1085 rpm, 2.9 max bhp

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2550	806	1.11	863	1.28	916	1.45	968	1.62	1018	1.80
2763	817	1.24	871	1.41	924	1.59	974	1.77	1022	1.95
2975	829	1.37	882	1.55	932	1.74	981	1.93	1028	2.12
3188	843	1.53	894	1.71	943	1.90	990	2.10	1036	2.30
3400	858	1.69	907	1.88	955	2.09	1001	2.29	1046	2.50
3613	874	1.87	922	2.07	968	2.28	1013	2.49	1057	2.71
3825	891	2.07	938	2.28	983	2.49	1027	2.71	1069	2.94
4038	910	2.28	955	2.50	999	2.72	1041	2.95	1083	3.19
4250	930	2.51	973	2.74	1015	2.97	1057	3.21	1097	3.45

Std static – 460 to 652 rpm, 1.2 max bhp

Med static – 591 to 838 rpm, 2.9 max bhp

High static – 838 to 1085 rpm, 2.9 max bhp

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

Table 35 – RHS102, 8.5 TON VERTICAL SUPPLY

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	0.2		0.4		0.6		0.8		1.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2550	495	0.43	570	0.56	634	0.70	693	0.83	746	0.96
2763	524	0.53	595	0.67	657	0.81	714	0.95	766	1.09
2975	552	0.63	620	0.79	681	0.94	736	1.09	787	1.24
3188	582	0.76	647	0.92	705	1.08	759	1.25	808	1.41
3400	611	0.89	674	1.07	730	1.24	782	1.42	831	1.59
3613	641	1.05	701	1.23	756	1.42	806	1.60	854	1.79
3825	672	1.22	729	1.42	782	1.61	831	1.81	877	2.00
4038	702	1.41	758	1.62	809	1.83	857	2.03	901	2.24
4250	733	1.62	787	1.84	836	2.06	883	2.28	926	2.49

Std static – 460 to 652 rpm, 1.2 max bhp

Med static – 591 to 838 rpm, 2.9 max bhp

High static – 838 to 1085 rpm, 2.9 max bhp

CFM	AVAILABLE EXTERNAL STATIC PRESSURE (IN. WG)									
	1.2		1.4		1.6		1.8		2.0	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2550	795	1.09	841	1.23	885	1.36	926	1.50	965	1.64
2763	814	1.24	859	1.38	902	1.53	943	1.68	982	1.82
2975	834	1.40	878	1.55	921	1.71	961	1.86	999	2.02
3188	855	1.57	898	1.74	940	1.90	979	2.07	1017	2.24
3400	876	1.76	919	1.94	960	2.12	998	2.29	1036	2.47
3613	898	1.97	940	2.16	980	2.34	1018	2.53	1055	2.72
3825	921	2.20	962	2.40	1001	2.59	1039	2.79	1075	2.99
4038	944	2.45	984	2.65	1023	2.86	1060	3.07	1096	3.27
4250	968	2.71	1007	2.93	1045	3.15	1081	3.36	1117	3.58

Std static – 460 to 652 rpm, 1.2 max bhp

Med static – 591 to 838 rpm, 2.9 max bhp

High static – 838 to 1085 rpm, 2.9 max bhp

NOTE: For Medium static applications order high static model and use field-supplied pulley and drives.

APPENDIX III. FAN PERFORMANCE (cont.)

Table 36 – PULLEY ADJUSTMENT

UNIT RHS	PHASE	MOTOR/DRIVE COMBO	MOTOR PULLEY TURNS OPEN										
			0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
036	3	Medium Static*	1251	1208	1165	1121	1078	1035	992	949	905	862	819
		High Static	1466	1423	1380	1337	1294	1251	1207	1164	1121	1078	1035
048	3	Medium Static*	1303	1265	1226	1188	1150	1112	1073	1035	997	958	920
		High Static	1466	1423	1380	1337	1294	1251	1207	1164	1121	1078	1035
060	3	Medium Static*	1380	1349	1317	1286	1254	1223	1192	1160	1129	1097	1066
		High Static	1639	1596	1553	1510	1467	1424	1380	1337	1294	1251	1208
072	3	Standard Static	1192	1161	1129	1098	1066	1035	1004	972	941	909	878
		Medium Static*	1380	1349	1317	1286	1254	1223	1192	1160	1129	1097	1066
		High Static	1639	1596	1553	1510	1467	1424	1380	1337	1294	1251	1208
090	3	Standard Static	652	633	614	594	575	556	537	518	498	479	460
		Medium Static*	838	813	789	764	739	715	690	665	640	616	591
		High Static	1084	1059	1035	1010	986	961	936	912	887	863	838
102	3	Standard Static	652	633	614	594	575	556	537	518	498	479	460
		Medium Static*	838	813	789	764	739	715	690	665	640	616	591
		High Static	1084	1059	1035	1010	986	961	936	912	887	863	838

NOTE: Do not adjust pulley further than 5 turns open.

■ – Factory settings

* Available with the high static fan motor option and field supplied drives available from FAST

APPENDIX IV. ELECTRICAL INFORMATION

Table 37 – RHS036, 3 TONS.....1-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-1-60	187	253	17.9	112	190	0.9	DD-STD	980	7.8	84%	7.4
230-1-60	187	253	17.9	112	190	0.9	DD-STD	980	7.8	84%	7.4
208-3-60	187	253	13.2	88	190	0.9	DD-STD	980	7.8	84%	7.4
							HIGH	2000	5.5	80%	5.2
230-3-60	187	253	13.2	88	190	0.9	DD-STD	980	7.8	84%	7.4
							HIGH	2000	5.5	80%	5.2
460-3-60	414	506	6.0	44	190	0.5	DD-STD	980	8.0	84%	7.6
							HIGH	2000	2.7	80%	2.6
575-3-60	518	633	NA	NA	190	0.4	DD-STD	980	4.2	84%	4.0
							HIGH	2000	2.1	80%	2.0

Table 38 – RHS048, 4 TONS.....1-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-1-60	187	253	21.8	117	325	1.5	DD-STD	980	7.8	84%	7.4
230-1-60	187	253	21.8	117	325	1.5	DD-STD	980	7.8	84%	7.4
208-3-60	187	253	13.7	83	325	1.5	DD-STD	980	7.8	84%	7.4
							HIGH	2000	5.5	80%	5.2
230-3-60	187	253	13.7	83	325	1.5	DD-STD	980	7.8	84%	7.4
							HIGH	2000	5.5	80%	5.2
460-3-60	414	506	6.2	41	325	0.8	DD-STD	980	8.0	84%	7.6
							HIGH	2000	2.7	80%	2.6
575-3-60	518	633	4.8	37	325	0.6	DD-STD	980	4.2	84%	4.0
							HIGH	2000	2.1	80%	2.0

Table 39 – RHS060, 5 TONS.....1-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-1-60	187	253	26.2	134	325	1.5	DD-STD	980	7.8	84%	7.4
230-1-60	187	253	26.2	134	325	1.5	DD-STD	980	7.8	84%	7.4
208-3-60	187	253	15.6	110	325	1.5	DD-STD	980	7.8	84%	7.4
							HIGH	2770	7.9	81%	7.5
230-3-60	187	253	15.6	110	325	1.5	DD-STD	980	7.8	84%	7.4
							HIGH	2770	7.9	81%	7.5
460-3-60	414	506	7.7	52	325	0.8	DD-STD	980	8.0	84%	7.6
							HIGH	2770	3.6	81%	3.4
575-3-60	518	633	5.8	39	325	0.6	DD-STD	980	4.2	84%	4.0
							HIGH	2770	2.9	81%	2.8

APPENDIX IV. ELECTRICAL INFORMATION

ELECTRICAL INFORMATION (cont.)

Table 40 – RHS072, 6 TONS.....1-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (ea)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-3-60	187	253	19.0	123	325	1.5	STD	1600	5.5	80%	5.2
							HIGH	2770	7.9	81%	7.5
230-3-60	187	253	19.0	123	325	1.5	STD	1600	5.5	80%	5.2
							HIGH	2770	7.9	81%	7.5
460-3-60	414	506	9.7	62	325	0.8	STD	1600	2.7	80%	2.6
							HIGH	2770	3.6	81%	3.4
575-3-60	518	633	7.4	50	325	0.6	STD	1600	2.5	80%	2.4
							HIGH	2770	2.9	81%	2.8

Table 41 – RHS090, 7.5 TONS.....2-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-3-60	187	253	13.1	83	13.1	83	325	1.5	STD	1310	5.5	80%	5.2
									HIGH	2770	7.9	81%	7.5
230-3-60	187	253	13.1	83	13.1	83	325	1.5	STD	1310	5.5	80%	5.2
									HIGH	2770	7.9	81%	7.5
460-3-60	414	506	6.1	41	6.1	41	325	0.8	STD	1310	2.7	80%	2.6
									HIGH	2770	3.6	81%	3.4
575-3-60	518	633	4.4	33	4.4	33	325	0.6	STD	1310	2.5	80%	2.4
									HIGH	2770	2.9	81%	2.8

Table 42 – RHS102, 8.5 TONS.....2-Stage Cooling

V-Ph-Hz	VOLTAGE RANGE		COMP (Cir 1)		COMP (Cir 2)		OFM (ea)		IFM				
	MIN	MAX	RLA	LRA	RLA	LRA	WATTS	FLA	TYPE	Max WATTS	Max AMP Draw	EFF at Full Load	FLA
208-3-60	187	253	16.0	91	13.7	83	325	1.5	STD	1310	5.5	80%	5.2
									HIGH	2770	7.9	80%	7.5
230-3-60	187	253	16.0	91	13.7	83	325	1.5	STD	1310	5.5	80%	5.2
									HIGH	2770	7.9	80%	7.5
460-3-60	414	506	7.0	46	6.2	41	325	0.8	STD	1310	2.7	80%	2.6
									HIGH	2770	3.6	80%	3.4
575-3-60	518	633	5.6	37	4.8	37	325	0.6	STD	1310	2.5	80%	2.4
									HIGH	2770	2.9	81%	2.8

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 43 – MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

Unit RHS	V-Ph-Hz*	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.							
			Nom (kW)	FLA	WITHOUT PE.				WITH PE.			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
036	208/230-1-60	DD-STD	-	-	30.7	45	30	121	32.6	50	32	123
			3.3/4.4	15.9/18.3	50.6/53.6	60/60	48/51	137/139	52.5/55.5	60/60	51/53	139/141
			4.9/6.5	23.5/27.1	60.1/64.6	70/70	57/61	145/148	62.0/66.5	70/70	59/63	147/150
			6.5/8.7	31.4/36.3	69.9/76.1	70/80	66/72	152/157	71.8/78.0	80/80	68/74	154/159
			7.9/10.5	37.9/43.8	78.1/85.4	80/90	74/81	159/165	80.0/87.3	80/90	76/83	161/167
			9.8/13.0	46.9/54.2	89.3/98.4	90/100	84/92	215/229	91.2/100.3	100/110	86/95	217/231
	208/230-3-60	DD-STD	-	-	24.8	30	25	97	26.7	30	27	99
			3.3/4.4	9.2/10.6	36.3/38.1	45/45	35/37	106/108	38.2/40.0	45/50	37/39	108/110
			4.9/6.5	13.6/15.6	41.8/44.3	50/50	40/43	111/113	43.7/46.2	50/50	43/45	113/115
			6.5/8.7	18.1/20.9	47.4/50.9	50/60	46/49	115/118	49.3/52.8	50/60	48/51	117/120
			7.9/10.5	21.9/25.3	52.2/56.4	60/60	50/54	119/122	54.1/58.3	60/60	52/56	121/124
			12.0/16.0	33.4/38.5	66.6/72.9	70/80	63/69	130/136	68.5/74.8	70/80	65/71	132/138
		MED**	-	-	22.6	30	22	109	24.5	30	24	111
			3.3/4.4	9.2/10.6	34.1/35.9	45/45	33/34	118/120	36.0/37.8	45/45	35/37	120/122
			4.9/6.5	13.6/15.6	39.6/42.1	45/50	38/40	123/125	41.5/44.0	50/50	40/42	125/127
			6.5/8.7	18.1/20.9	45.2/48.7	50/50	43/46	127/130	47.1/50.6	50/60	45/48	129/132
			7.9/10.5	21.9/25.3	50.0/54.2	50/60	47/51	131/134	51.9/56.1	60/60	50/53	133/136
			12.0/16.0	33.4/38.5	64.4/70.7	70/80	61/66	142/148	66.3/72.6	70/80	63/69	144/150
	HIGH	-	-	22.6	30	22	120	24.5	30	24	122	
		3.3/4.4	9.2/10.6	34.1/35.9	45/45	33/34	129/131	36.0/37.8	45/45	35/37	131/133	
		4.9/6.5	13.6/15.6	39.6/42.1	45/50	38/40	134/136	41.5/44.0	50/50	40/42	136/138	
		6.5/8.7	18.1/20.9	45.2/48.7	50/50	43/46	138/141	47.1/50.6	50/60	45/48	140/143	
		7.9/10.5	21.9/25.3	50.0/54.2	50/60	47/51	142/145	51.9/56.1	60/60	50/53	144/147	
		12.0/16.0	33.4/38.5	64.4/70.7	70/80	61/66	153/159	66.3/72.6	70/80	63/69	155/161	
460-3-60	DD-STD	-	-	16.0	20	16	53	17.0	20	17	54	
		6.0	7.2	25.0	30	24	60	26.0	30	26	61	
		8.8	10.6	29.3	30	28	64	30.3	35	30	65	
		11.5	13.8	33.3	35	32	67	34.3	35	33	68	
	MED**	-	-	10.6	15	10	54	11.6	15	12	55	
		6.0	7.2	19.6	20	19	61	20.6	25	20	62	
		8.8	10.6	23.9	25	23	65	24.9	25	24	66	
		11.5	13.8	27.9	30	26	68	28.9	30	27	69	
	HIGH	-	-	10.6	15	10	60	11.6	15	12	61	
		6.0	7.2	19.6	20	19	67	20.6	25	20	68	
		8.8	10.6	23.9	25	23	71	24.9	25	24	72	
		11.5	13.8	27.9	30	26	74	28.9	30	27	75	
575-3-60	DD-STD	-	-	5.4	15	5	5	7.4	15	7	7	
		-	-	3.4	15	3	8	5.4	15	5	10	
		-	-	2.9	15	3	12	4.9	15	5	14	
		-	-	-	-	-	-	-	-	-	-	-
	MED**	-	-	5.4	15	5	5	7.4	15	7	7	
		-	-	3.4	15	3	8	5.4	15	5	10	
		-	-	2.9	15	3	12	4.9	15	5	14	
		-	-	-	-	-	-	-	-	-	-	-
	HIGH	-	-	5.4	15	5	5	7.4	15	7	7	
		-	-	3.4	15	3	8	5.4	15	5	10	
		-	-	2.9	15	3	12	4.9	15	5	14	
		-	-	-	-	-	-	-	-	-	-	-

*Nominal values, listed as 208/240V, 480V or 600V as appropriate.

** Field supplied belts and pulleys required to achieve medium static.

See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RHS	V-Ph-Hz	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.								
			Nom (kW)	FLA	WITHOUT P.E.				WITH P.E.				
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE		
							FLA	LRA			FLA	LRA	
048	208/230-1-60	DD-STD	-	-	36.2	50	35	128	38.1	50	37	130	
			3.3/4.4	15.9/18.3	56.0/59.0	60/60	54/56	144/146	57.9/60.9	60/70	56/59	146/148	
			6.5/8.7	31.4/36.3	75.4/81.5	80/90	71/77	159/164	77.3/83.4	80/90	74/79	161/166	
			9.8/13.0	46.9/54.2	94.8/103.9	100/110	89/98	222/236	96.7/105.8	100/110	91/100	224/238	
			13.1/17.4	62.8/72.5	114.7/126.8	125/150	108/119	254/273	116.6/128.7	125/150	110/121	256/275	
			15.8/21.0	75.8/87.5	130.9/145.5	150/150	122/136	280/303	132.8/147.4	150/150	125/138	282/305	
	208/230-3-60	DD-STD	-	-	26.0	30	26	94	27.9	40	28	96	
			4.9/6.5	13.6/15.6	43.0/45.5	50/50	42/44	108/110	44.9/47.4	50/50	44/46	110/112	
			6.5/8.7	18.1/20.9	48.7/52.2	50/60	47/50	112/115	50.6/54.1	60/60	49/52	114/117	
			12.0/16.0	33.4/38.5	67.8/74.2	70/80	64/70	127/133	69.7/76.1	70/80	67/72	129/135	
		MED**	-	-	23.8	30	23	106	25.7	30	26	108	
			4.9/6.5	13.6/15.6	40.8/43.3	50/50	39/41	120/122	42.7/45.2	50/50	41/44	122/124	
			6.5/8.7	18.1/20.9	46.5/50.0	50/50	44/47	124/127	48.4/51.9	50/60	46/50	126/129	
			12.0/16.0	33.4/38.5	65.6/72.0	70/80	62/68	139/145	67.5/73.9	70/80	64/70	141/147	
		HIGH	-	-	23.8	30	23	117	25.7	30	26	119	
			4.9/6.5	13.6/15.6	40.8/43.3	50/50	39/41	131/133	42.7/45.2	50/50	41/44	133/135	
			6.5/8.7	18.1/20.9	46.5/50.0	50/50	44/47	135/138	48.4/51.9	50/60	46/50	137/140	
			12.0/16.0	33.4/38.5	65.6/72.0	70/80	62/68	150/156	67.5/73.9	70/80	64/70	152/158	
	460-3-60	DD-STD	-	-	16.5	20	17	51	17.5	25	18	52	
			6.0	7.2	25.5	30	25	58	26.5	30	26	59	
			11.5	13.8	33.8	35	33	65	34.8	35	34	66	
			14.0	16.8	37.5	40	36	68	38.5	40	37	69	
			23.0	27.7	51.1	60	49	106	52.1	60	50	107	
			-	-	11.2	15	11	52	12.2	15	12	53	
MED**		6.0	7.2	20.2	25	19	59	21.2	25	20	60		
		11.5	13.8	28.4	30	27	66	29.4	30	28	67		
		14.0	16.8	32.2	35	30	69	33.2	35	32	70		
		23.0	27.7	45.8	50	43	107	46.8	50	44	108		
		-	-	11.2	15	11	58	12.2	15	12	59		
		6.0	7.2	20.2	25	19	65	21.2	25	20	66		
HIGH		11.5	13.8	28.4	30	27	72	29.4	30	28	73		
		14.0	16.8	32.2	35	30	75	33.2	35	32	76		
		23.0	27.7	45.8	50	43	113	46.8	50	44	114		
		-	-	10.6	15	11	43	12.5	15	13	45		
		575-3-60	DD-STD	-	-	10.6	15	11	43	12.5	15	13	45
			MED**	-	-	9.0	15	9	46	10.9	15	11	48
HIGH	-		-	8.6	15	9	50	10.5	15	11	52		

*Nominal values, listed as 208/240V, 480V or 600V as appropriate.

** Field supplied belts and pulleys required to achieve medium static.

See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RHS	V-Ph-Hz*	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.							
			Nom (kW)	FLA	WITHOUT P.E.				WITH P.E.			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
060	208/230-1-60	DD-STD	-	-	41.7	60	40	145	43.6	60	43	147
			4.9/6.5	23.5/27.1	71.0/75.5	80/80	67/72	169/172	72.9/77.4	80/80	70/74	171/174
			6.5/8.7	31.4/36.3	80.9/87.0	90/100	76/82	176/181	82.8/88.9	100/100	79/84	178/183
			9.8/13.0	46.9/54.2	100.3/109.4	110/110	94/103	239/253	102.2/111.3	110/125	96/105	241/255
			13.1/17.4	62.8/72.5	120.2/132.3	125/150	113/124	271/290	122.1/134.2	125/150	115/126	273/292
			15.8/21.0	75.8/87.5	136.4/151.0	150/175	128/141	297/320	138.3/152.9	150/175	130/143	299/322
	208/230-3-60	DD-STD	-	-	28.4	40	28	121	30.3	45	30	123
			4.9/6.5	13.6/15.6	45.4/47.9	50/50	44/46	135/137	47.3/49.8	50/60	46/48	137/139
			7.9/10.5	21.9/25.3	55.8/60.0	60/70	53/57	143/146	57.7/61.9	60/70	56/59	145/148
			12.0/16.0	33.4/38.5	70.2/76.5	80/80	67/72	154/160	72.1/78.4	80/80	69/75	156/162
			15.8/21.0	43.8/50.5	83.2/91.5	90/100	79/86	209/222	85.1/93.4	90/100	81/88	211/224
			19.9/26.5	55.2/63.8	97.4/108.2	100/110	92/102	231/249	99.3/110.1	100/125	94/104	233/251
		MED**	-	-	26.2	40	26	144	28.1	40	28	146
			4.9/6.5	13.6/15.6	43.2/45.7	50/50	41/44	158/160	45.1/47.6	50/50	43/46	160/162
			7.9/10.5	21.9/25.3	53.6/57.8	60/60	51/55	166/169	55.5/59.7	60/60	53/57	168/171
			12.0/16.0	33.4/38.5	68.0/74.3	70/80	64/70	177/183	69.9/76.2	70/80	66/72	179/185
			15.8/21.0	43.8/50.5	81.0/89.3	90/90	76/84	232/245	82.9/91.2	90/100	78/86	234/247
			19.9/26.5	55.2/63.8	95.2/106.0	100/110	89/99	254/272	97.1/107.9	100/110	91/101	256/274
	HIGH	-	-	28.5	40	28	170	30.4	45	30	172	
		4.9/6.5	13.6/15.6	45.5/48.0	50/50	44/46	184/186	47.4/49.9	50/60	46/48	186/188	
		7.9/10.5	21.9/25.3	55.9/60.1	60/70	53/57	192/195	57.8/62.0	60/70	56/60	194/197	
		12.0/16.0	33.4/38.5	70.3/76.6	80/80	67/73	203/209	72.2/78.5	80/80	69/75	205/211	
		15.8/21.0	43.8/50.5	83.3/91.6	90/100	79/86	258/271	85.2/93.5	90/100	81/89	260/273	
		19.9/26.5	55.2/63.8	97.5/108.3	100/110	92/102	280/298	99.4/110.2	100/125	94/104	282/300	
460-3-60	DD-STD	-	-	18.0	25	19	62	19.0	25	20	63	
		6.0	7.2	27.0	30	27	69	28.0	30	28	70	
		11.5	13.8	35.3	40	34	76	36.3	40	36	77	
		14.0	16.8	39.0	40	38	79	40.0	45	39	80	
		23.0	27.7	52.7	60	50	117	53.7	60	52	118	
		25.5	30.7	56.4	60	54	123	57.4	60	55	124	
	MED**	-	-	13.0	20	13	69	14.0	20	14	70	
		6.0	7.2	22.0	25	21	76	23.0	25	22	77	
		11.5	13.8	30.3	35	29	83	31.3	35	30	84	
		14.0	16.8	34.0	35	32	86	35.0	40	33	87	
		23.0	27.7	47.7	50	45	124	48.7	50	46	125	
		25.5	30.7	51.4	60	48	130	52.4	60	49	131	
	HIGH	-	-	13.8	20	14	82	14.8	20	15	83	
		6.0	7.2	22.8	25	22	89	23.8	25	23	90	
		11.5	13.8	31.1	35	30	96	32.1	35	31	97	
		14.0	16.8	34.8	35	33	99	35.8	40	34	100	
		23.0	27.7	48.5	50	46	137	49.5	50	47	138	
		25.5	30.7	52.2	60	49	143	53.2	60	50	144	
575-3-60	DD-STD	-	-	11.9	15	12	45	13.8	20	14	47	
	MED**	-	-	9.9	15	10	52	11.8	15	12	54	
	HIGH	-	-	10.7	15	11	63	12.6	15	13	65	

*Nominal values, listed as 208/240V, 480V or 600V as appropriate.

** Field supplied belts and pulleys required to achieve medium static.

See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RHS	V-Ph-Hz*	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.							
			Nom (kW)	FLA	WITHOUT P.E.				WITH P.E.			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
072	208/230-3-60	STD	-	-	30.5	45	30	146	32.4	50	32	148
			4.9/6.5	13.6/15.6	47.5/50.0	60/60	45/47	160/162	49.4/51.9	60/60	47/50	162/164
			7.9/10.5	21.9/25.3	57.8/62.1	60/70	55/59	168/171	59.7/64.0	60/70	57/61	170/173
			12.0/16.0	33.4/38.5	72.2/78.6	80/80	68/74	179/185	74.1/80.5	80/90	70/76	181/187
			15.8/21.0	43.8/50.5	85.2/93.6	90/100	80/88	234/247	87.1/95.5	90/100	82/90	236/249
			19.9/26.5	55.2/63.8	99.5/110.2	100/125	93/103	256/274	101.4/112.1	110/125	95/105	258/276
		MED**	-	-	32.8	50	32	183	34.7	50	34	185
			4.9/6.5	13.6/15.6	49.8/52.3	60/60	48/50	197/199	51.7/54.2	60/60	50/52	199/201
			7.9/10.5	21.9/25.3	60.1/64.4	70/70	57/61	205/208	62.0/66.3	70/70	60/63	207/210
			12.0/16.0	33.4/38.5	74.5/80.9	80/90	71/76	216/222	76.4/82.8	80/90	73/79	218/224
			15.8/21.0	43.8/50.5	87.5/95.9	90/100	83/90	271/284	89.4/97.8	90/100	85/92	273/286
			19.9/26.5	55.2/63.8	101.8/112.5	110/125	96/106	293/311	103.7/114.4	110/125	98/108	295/313
	HIGH	-	-	32.8	50	32	183	34.7	50	34	185	
		4.9/6.5	13.6/15.6	49.8/52.3	60/60	48/50	197/199	51.7/54.2	60/60	50/52	199/201	
		7.9/10.5	21.9/25.3	60.1/64.4	70/70	57/61	205/208	62.0/66.3	70/70	60/63	207/210	
		12.0/16.0	33.4/38.5	74.5/80.9	80/90	71/76	216/222	76.4/82.8	80/90	73/79	218/224	
		15.8/21.0	43.8/50.5	87.5/95.9	90/100	83/90	271/284	89.4/97.8	90/100	85/92	273/286	
		19.9/26.5	55.2/63.8	101.8/112.5	110/125	96/106	293/311	103.7/114.4	110/125	98/108	295/313	
	460-3-60	STD	-	-	15.5	25	15	73	16.5	25	16	74
			6.0	7.2	24.5	30	23	80	25.5	30	24	81
			11.5	13.8	32.8	35	31	87	33.8	40	32	88
			14.0	16.8	36.5	40	34	90	37.5	40	36	91
			23.0	27.7	50.2	60	47	128	51.2	60	48	129
			25.5	30.7	53.9	60	50	134	54.9	60	52	135
MED**		-	-	16.3	25	16	92	17.3	25	17	93	
		6.0	7.2	25.3	30	24	99	26.3	30	25	100	
		11.5	13.8	33.6	35	32	106	34.6	40	33	107	
		14.0	16.8	37.3	40	35	109	38.3	40	36	110	
		23.0	27.7	51.0	60	48	147	52.0	60	49	148	
		25.5	30.7	54.7	60	51	153	55.7	60	52	154	
HIGH		-	-	16.3	25	16	92	17.3	25	17	93	
		6.0	7.2	25.3	30	24	99	26.3	30	25	100	
		11.5	13.8	33.6	35	32	106	34.6	40	33	107	
		14.0	16.8	37.3	40	35	109	38.3	40	36	110	
		23.0	27.7	51.0	60	48	147	52.0	60	49	148	
		25.5	30.7	54.7	60	51	153	55.7	60	52	154	
575-3-60	STD	-	-	12.3	15	12	59	14.2	20	14	61	
	MED**	-	-	12.7	20	12	74	14.6	20	15	76	
	HIGH	-	-	12.7	20	12	74	14.6	20	15	76	

*Nominal values, listed as 208/240V, 480V or 600V as appropriate.

** Field supplied belts and pulleys required to achieve medium static.

See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RHS	V-Ph-Hz	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.							
			Nom (kW)	FLA	WITHOUT PE.				WITH PE.			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
090	208/23-3-60	STD	-	-	37.7	50	40	193	41.5	50	44	197
			7.8/10.4	21.7/25.0	64.8/68.9	70/70	65/68	215/218	68.6/72.7	70/80	69/73	219/222
			12.0/16.0	33.4/38.5	79.4/85.8	80/90	78/84	226/232	83.2/89.6	90/90	82/88	230/236
			18.6/24.8	51.7/59.7	102.3/112.3	110/125	99/108	245/253	106.1/116.1	110/125	103/113	249/257
			24.0/32.0	66.7/77.0	121.1/133.9	125/150	116/128	260/270	124.9/137.7	125/150	121/132	264/274
			31.8/42.4	88.4/102.0	148.2/165.2	150/175	141/157	370/397	152.0/169.0	175/175	146/161	374/401
		MED**	-	-	40.0	50	42	230	43.8	50	47	234
			7.8/10.4	21.7/25.0	67.1/71.2	70/80	67/71	252/255	70.9/75.0	80/80	72/75	256/259
			12.0/16.0	33.4/38.5	81.7/88.1	90/90	81/86	263/269	85.5/91.9	90/100	85/91	267/273
			18.6/24.8	51.7/59.7	104.6/114.6	110/125	102/111	282/290	108.4/118.4	110/125	106/115	286/294
			24.0/32.0	66.7/77.0	123.4/136.2	125/150	119/131	297/307	127.2/140.0	150/150	123/135	301/311
			31.8/42.4	88.4/102.0	150.5/167.5	175/175	144/160	407/434	154.3/171.3	175/175	148/164	411/438
	HIGH	-	-	40.0	50	42	230	43.8	50	47	234	
		7.8/10.4	21.7/25.0	67.1/71.2	70/80	67/71	252/255	70.9/75.0	80/80	72/75	256/259	
		12.0/16.0	33.4/38.5	81.7/88.1	90/90	81/86	263/269	85.5/91.9	90/100	85/91	267/273	
		18.6/24.8	51.7/59.7	104.6/114.6	110/125	102/111	282/290	108.4/118.4	110/125	106/115	286/294	
		24.0/32.0	66.7/77.0	123.4/136.2	125/150	119/131	297/307	127.2/140.0	150/150	123/135	301/311	
		31.8/42.4	88.4/102.0	150.5/167.5	175/175	144/160	407/434	154.3/171.3	175/175	148/164	411/438	
	460-3-60	STD	-	-	17.9	20	19	95	19.7	25	21	97
			13.9	16.7	38.8	40	38	112	40.6	45	40	114
			16.5	19.8	42.7	45	42	115	44.5	45	44	117
			27.8	33.4	59.7	60	57	128	61.5	70	59	130
			33.0	39.7	67.6	70	65	135	69.4	70	67	137
			41.7	50.2	80.7	90	77	195	82.5	90	79	197
MED**		-	-	18.7	25	20	114	20.5	25	22	116	
		13.9	16.7	39.6	40	39	131	41.4	45	41	133	
		16.5	19.8	43.5	45	43	134	45.3	50	45	136	
		27.8	33.4	60.5	70	58	147	62.3	70	60	149	
		33.0	39.7	68.4	70	65	154	70.2	80	68	156	
		41.7	50.2	81.5	90	78	214	83.3	90	80	216	
HIGH		-	-	18.7	25	20	114	20.5	25	22	116	
		13.9	16.7	39.6	40	39	131	41.4	45	41	133	
		16.5	19.8	43.5	45	43	134	45.3	50	45	136	
		27.8	33.4	60.5	70	58	147	62.3	70	60	149	
		33.0	39.7	68.4	70	65	154	70.2	80	68	156	
		41.7	50.2	81.5	90	78	214	83.3	90	80	216	
575-3-60	STD	-	-	13.5	15	14	77	17.3	20	19	81	
		17.0	20.4	39.0	40	38	97	42.8	45	42	101	
		34.0	40.9	64.6	70	61	118	68.4	70	66	122	
	MED**	-	-	13.9	20	15	92	17.7	20	19	96	
		17.0	20.4	39.4	40	38	112	43.2	45	43	116	
		34.0	40.9	65.0	70	62	133	68.8	70	66	137	
	HIGH	-	-	13.9	20	15	92	17.7	20	19	96	
		17.0	20.4	39.4	40	38	112	43.2	45	43	116	
		34.0	40.9	65.0	70	62	133	68.8	70	66	137	

*Nominal valves, listed as 208/240V, 480V or 600V as appropriate.
 ** Field supplied belts and pulleys required to achieve medium static.
 See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

UNIT RHS	V-Ph-Hz	IFM TYPE	ELEC. HTR		WITHOUT C.O. or UNPWR C.O.							
			Nom (kW)	FLA	WITHOUT P.E.				WITH P.E.			
					MCA	MOCP	DISC. SIZE		MCA	MOCP	DISC. SIZE	
							FLA	LRA			FLA	LRA
102	208/230-3-60	STD	-	-	41.9	50	44	201	45.7	60	48	205
			7.8/10.4	21.7/25.0	69.0/73.2	70/80	69/72	223/226	72.8/77.0	80/80	73/77	227/230
			12.0/16.0	33.4/38.5	83.7/90.0	90/100	82/88	234/240	87.5/93.8	90/100	86/92	238/244
			18.6/24.8	51.7/59.7	106.5/116.5	110/125	103/112	253/261	110.3/120.3	125/125	107/117	257/265
			24.0/32.0	66.7/77.0	125.3/138.2	150/150	120/132	268/278	129.1/142.0	150/150	125/137	272/282
			31.8/42.4	88.4/102.0	152.4/169.4	175/175	145/161	378/405	156.2/173.2	175/175	150/165	382/409
		MED**	-	-	44.2	60	46	238	48.0	60	51	242
			7.8/10.4	21.7/25.0	71.3/75.5	80/80	71/75	260/263	75.1/79.3	80/80	76/79	264/267
			12.0/16.0	33.4/38.5	86.0/92.3	90/100	85/91	271/277	89.8/96.1	90/100	89/95	275/281
			18.6/24.8	51.7/59.7	108.8/118.8	110/125	106/115	290/298	112.6/122.6	125/125	110/119	294/302
			24.0/32.0	66.7/77.0	127.6/140.5	150/150	123/135	305/315	131.4/144.3	150/150	127/139	309/319
			31.8/42.4	88.4/102.0	154.7/171.7	175/175	148/164	415/442	158.5/175.5	175/200	152/168	419/446
	HIGH	-	-	44.2	60	46	238	48.0	60	51	242	
		7.8/10.4	21.7/25.0	71.3/75.5	80/80	71/75	260/263	75.1/79.3	80/80	76/79	264/267	
		12.0/16.0	33.4/38.5	86.0/92.3	90/100	85/91	271/277	89.8/96.1	90/100	89/95	275/281	
		18.6/24.8	51.7/59.7	108.8/118.8	110/125	106/115	290/298	112.6/122.6	125/125	110/119	294/302	
		24.0/32.0	66.7/77.0	127.6/140.5	150/150	123/135	305/315	131.4/144.3	150/150	127/139	309/319	
		31.8/42.4	88.4/102.0	154.7/171.7	175/175	148/164	415/442	158.5/175.5	175/200	152/168	419/446	
	460-3-60	STD	-	-	19.2	25	20	100	21.0	25	22	102
			13.9	16.7	40.0	45	39	117	41.8	45	41	119
			16.5	19.8	43.9	45	43	120	45.7	50	45	122
			27.8	33.4	60.9	70	58	133	62.7	70	60	135
			33.0	39.7	68.8	70	66	140	70.6	80	68	142
			41.7	50.2	81.9	90	78	200	83.7	90	80	202
MED**		-	-	20.0	25	21	119	21.8	25	23	121	
		13.9	16.7	40.8	45	40	136	42.6	45	42	138	
		16.5	19.8	44.7	45	44	139	46.5	50	46	141	
		27.8	33.4	61.7	70	59	152	63.5	70	61	154	
		33.0	39.7	69.6	70	67	159	71.4	80	69	161	
		41.7	50.2	82.7	90	79	219	84.5	90	81	221	
HIGH		-	-	20.0	25	21	119	21.8	25	23	121	
		13.9	16.7	40.8	45	40	136	42.6	45	42	138	
		16.5	19.8	44.7	45	44	139	46.5	50	46	141	
		27.8	33.4	61.7	70	59	152	63.5	70	61	154	
		33.0	39.7	69.6	70	67	159	71.4	80	69	161	
		41.7	50.2	82.7	90	79	219	84.5	90	81	221	
575-3-60	STD	-	-	15.4	20	16	85	19.2	25	20	89	
		17.0	20.4	40.9	45	40	105	44.7	45	44	109	
		34.0	40.9	66.5	70	63	126	70.3	80	68	130	
	MED**	-	-	15.8	20	17	100	19.6	25	21	104	
		17.0	20.4	41.3	45	40	120	45.1	50	44	124	
		34.0	40.9	66.9	70	64	141	70.7	80	68	145	
	HIGH	-	-	15.8	20	17	100	19.6	25	21	104	
		17.0	20.4	41.3	45	40	120	45.1	50	44	124	
		34.0	40.9	66.9	70	64	141	70.7	80	68	145	

*Nominal valves, listed as 208/240V, 480V or 600V as appropriate.
 ** Field supplied belts and pulleys required to achieve medium static.
 See Legend and calculations on page 75.

APPENDIX IV. ELECTRICAL INFORMATION (cont.)

Table 45 (cont.) MCA/MOCP DETERMINATION NO C.O. OR UNPWRD C.O.

* Nominal valves, listed as 208/240V, 480V or 600V as appropriate.

** Available from Fast Parts.

See Legend and calculations on page 75.

¹Fuse or breaker

LEGEND:

- CO - Convenient outlet
- DISC - Disconnect
- FLA - Full load amps
- IFM - Indoor fan motor
- LRA - Locked rotor amps
- MCA - Minimum circuit amps
- MOCP - Maximum over current protection
- PE - Power exhaust
- UNPWRD CO - Unpowered convenient outlet



Example: Supply voltage is 230-3-60



AB = 224 v
BC = 231 v
AC = 226 v

$$\text{Average Voltage} = \frac{(224 + 231 + 226)}{3} = \frac{681}{3} = 227$$

Determine maximum deviation from average voltage.

(AB) 227 - 224 = 3 v

(BC) 231 - 227 = 4 v

(AC) 227 - 226 = 1 v

Maximum deviation is 4 v.

Determine percent of voltage imbalance.

$$\begin{aligned} \text{\% Voltage Imbalance} &= 100 \times \frac{4}{227} \\ &= 1.76\% \end{aligned}$$

NOTES:

1. In compliance with NEC requirements for multimotor and combination load equipment (refer to NEC Articles 430 and 440), the overcurrent protective device for the unit shall be fuse or HACR breaker. Canadian units may be fuse or circuit breaker.

1. Unbalanced 3-Phase Supply Voltage

Never operate a motor where a phase imbalance in supply voltage is greater than 2%. Use the following formula to determine the percentage of voltage imbalance.

$$\text{\% Voltage Imbalance} = 100 \times \frac{\text{max voltage deviation from average voltage}}{\text{average voltage}}$$

This amount of phase imbalance is satisfactory as it is below the maximum allowable 2%.

IMPORTANT: If the supply voltage phase imbalance is more than 2%, contact your local electric utility company immediately.

APPENDIX V. WIRING DIAGRAM LIST

Wiring Diagrams

SIZE	VOLTAGE	RHS	
		CONTROL	POWER
036	208/230-1-60	48TM501434.02	48TM501435.02
	208/230-3-60	48TM501434.02	48TM501436.02
	460-3-60	48TM501434.02	48TM501436.02
	575-3-60	48TM501434.02	48TM501436.02
048	208/230-1-60	48TM501434.02	48TM501435.02
	208/230-3-60	48TM501434.02	48TM501436.02
	460-3-60	48TM501434.02	48TM501436.02
	575-3-60	48TM501434.02	48TM501436.02
060	208/230-1-60	48TM501434.02	48TM501435.02
	208/230-3-60	48TM501434.02	48TM501436.02
	460-3-60	48TM501434.02	48TM501436.02
	575-3-60	48TM501434.02	48TM501436.02
072	208/230-3-60	48TM501434.02	48TM501436.0
	460-3-60	48TM501434.02	48TM501436.0
	575-3-60	48TM501434.02	48TM501436.0
090	208/230-3-60	48TM501370.03	48TM501371.04
	460-3-60	48TM501370.03	48TM501371.04
	575-3-60	48TM501370.03	48TM501371.04
102	208/230-3-60	48TM501370.03	48TM501371.04
	460-3-60	48TM501370.03	48TM501371.04
	575-3-60	48TM501370.03	48TM501371.04

NOTE: Component arrangement on Control; Legend on Power Schematic

APPENDIX VI. MOTORMASTER SENSOR LOCATIONS

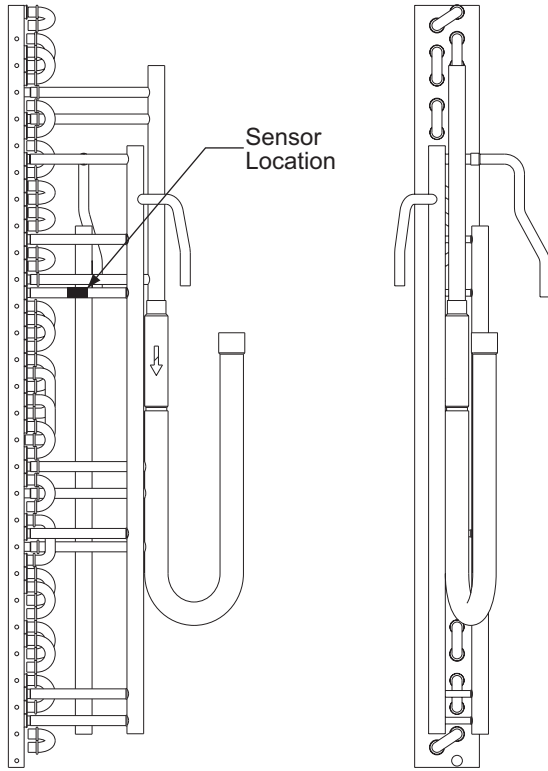


FIGURE 54 RHS036 Outdoor Circuiter

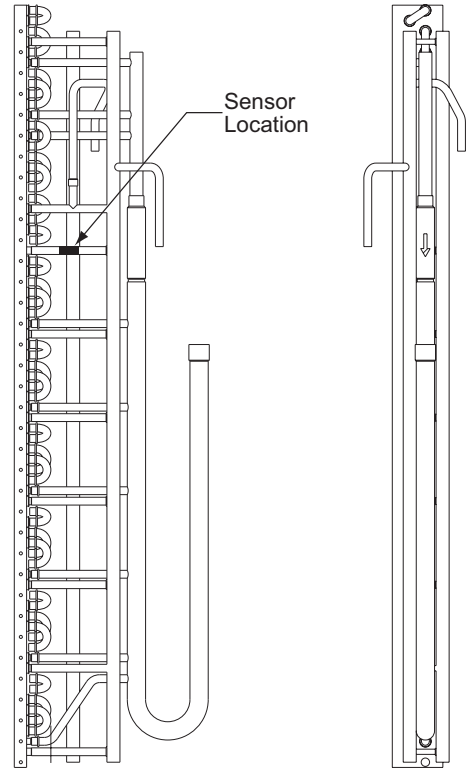


FIGURE 56 RHS060 Outdoor Circuiter

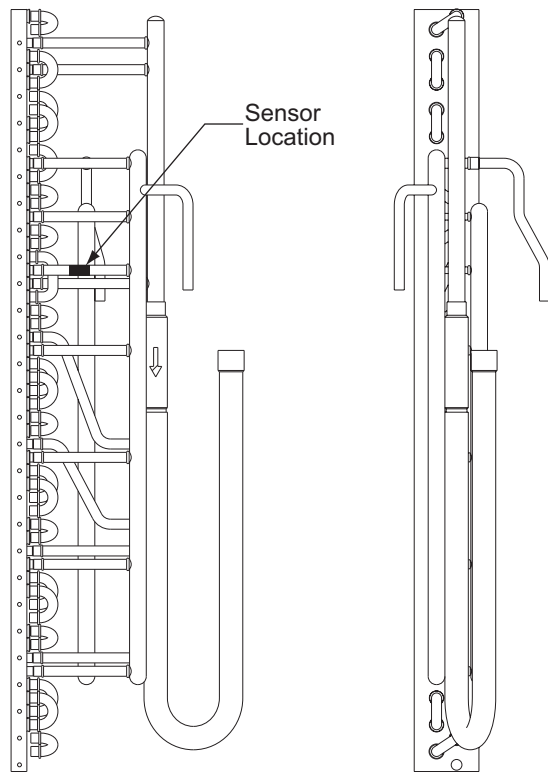


FIGURE 55 RHS048 Outdoor Circuiter

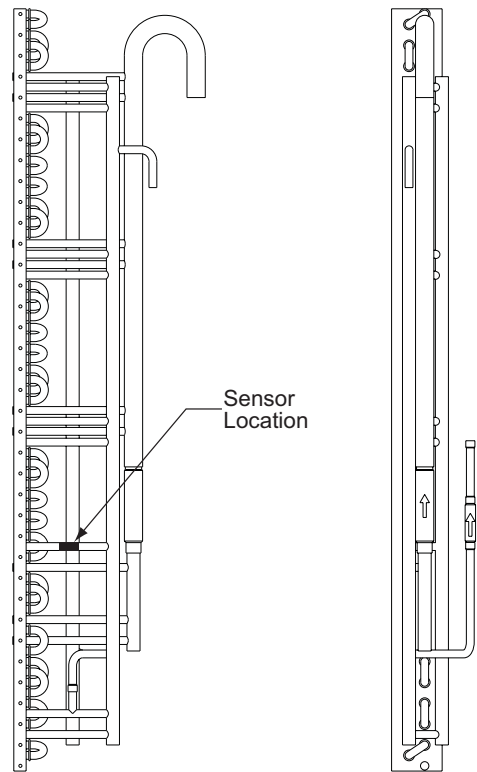


FIGURE 57 RHS072 Outdoor Circuiter

APPENDIX VI. MOTORMASTER SENSOR LOCATIONS

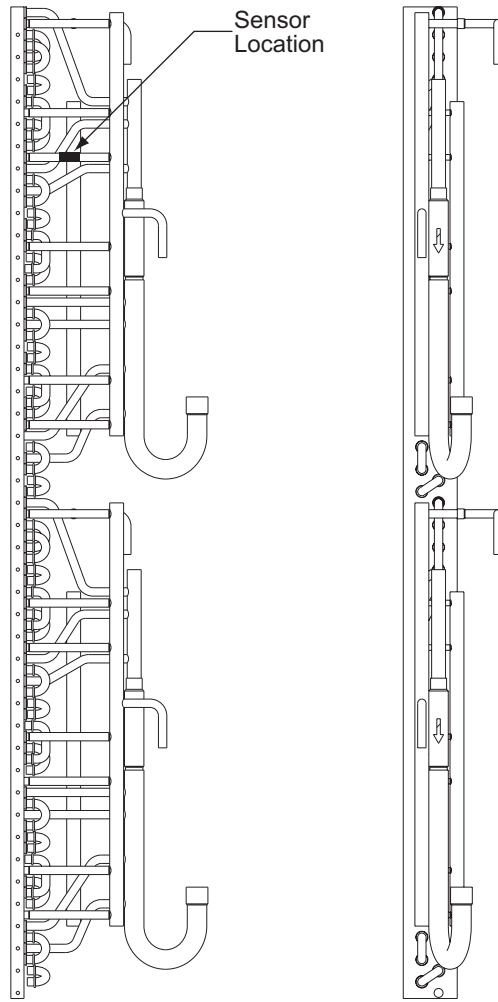


FIGURE 58 RHS090/102 Outdoor Circuiting

START-UP CHECKLIST
(Remove and Store in Job File)

I. PRELIMINARY INFORMATION

MODEL NO.: _____ SERIAL NO.: _____
DATE: _____ TECHNICIAN: _____

II. PRE-START-UP (insert checkmark in box as each item is completed)

- VERIFY THAT JOBSITE VOLTAGE AGREES WITH VOLTAGE LISTED ON RATING PLATE
- VERIFY THAT ALL PACKAGING MATERIALS HAVE BEEN REMOVED FROM UNIT
- REMOVE ALL SHIPPING HOLD DOWN BOLTS AND BRACKETS PER INSTALLATION INSTRUCTIONS
- VERIFY THAT CONDENSATE CONNECTION IS INSTALLED PER INSTALLATION INSTRUCTIONS
- CHECK REFRIGERANT PIPING FOR INDICATIONS OF LEAKS; INVESTIGATE AND REPAIR IF NECESSARY
- CHECK ALL ELECTRICAL CONNECTIONS AND TERMINALS FOR TIGHTNESS
- CHECK THAT RETURN (INDOOR) AIR FILTERS ARE CLEAN AND IN PLACE
- VERIFY THAT UNIT INSTALLATION IS LEVEL
- CHECK FAN WHEELS AND PROPELLER FOR LOCATION IN HOUSING/ORIFICE AND SETSCREW TIGHTNESS
- CHECK TO ENSURE THAT ELECTRICAL WIRING IS NOT IN CONTACT WITH REFRIGERANT LINES OR SHARP METAL EDGES
- CHECK PULLEY ALIGNMENT AND BELT TENSION PER INSTALLATION INSTRUCTIONS

III. START-UP

ELECTRICAL

SUPPLY VOLTAGE	L1-L2 _____	L2-L3 _____	L3-L1 _____
CIRCUIT 1 COMPRESSOR AMPS	L1 _____	L2 _____	L3 _____
CIRCUIT 2 COMPRESSOR AMPS	L1 _____	L2 _____	L3 _____
INDOOR-FAN AMPS	_____	_____	_____
OUTDOOR-FAN AMPS	NO. 1 _____	NO. 2 _____	_____

TEMPERATURES

OUTDOOR-AIR TEMPERATURE	_____ DB	_____ WB
RETURN-AIR TEMPERATURE	_____ DB	_____ WB
COOLING SUPPLY AIR	_____ DB	_____ WB

PRESSURES (Cooling Mode)

REFRIGERANT SUCTION, CIRCUIT 1	_____ PSIG	_____ F
REFRIGERANT SUCTION, CIRCUIT 2	_____ PSIG	_____ F
REFRIGERANT DISCHARGE, CIRCUIT 1	_____ PSIG	_____ F
REFRIGERANT DISCHARGE, CIRCUIT 2	_____ PSIG	_____ F

- VERIFY THAT 3-PHASE FAN MOTOR AND BLOWER ARE ROTATING IN CORRECT DIRECTION.
- VERIFY THAT 3-PHASE SCROLL COMPRESSOR IS ROTATING IN THE CORRECT DIRECTION
- VERIFY REFRIGERANT CHARGE USING CHARGING CHARTS

GENERAL

- SET ECONOMIZER MINIMUM VENT AND CHANGEOVER SETTINGS TO MATCH JOB REQUIREMENTS (IF EQUIPPED)