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RoofPak® Singlezone Roof Mounted Heating and Cooling Units with Scroll Compressors

RPS/RDT/RFS/RCS 015-075C



ISO 9002 CERTIFIED



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Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. *Caution:* Sharp edges and coil surfaces are a potential injury hazard. Avoid contact with them.

Introduction

This manual provides general information about the "C" vintage McQuay RoofPak applied rooftop unit, models RPS, RDT, RFS and RCS. In addition to an overall description of the unit, it includes mechanical and electrical installation procedures, commissioning procedures, sequence of operation information, and maintenance instructions. For further information on the optional forced draft gas-fired furnace, refer to Bulletin No. IM 684 or IM 685.

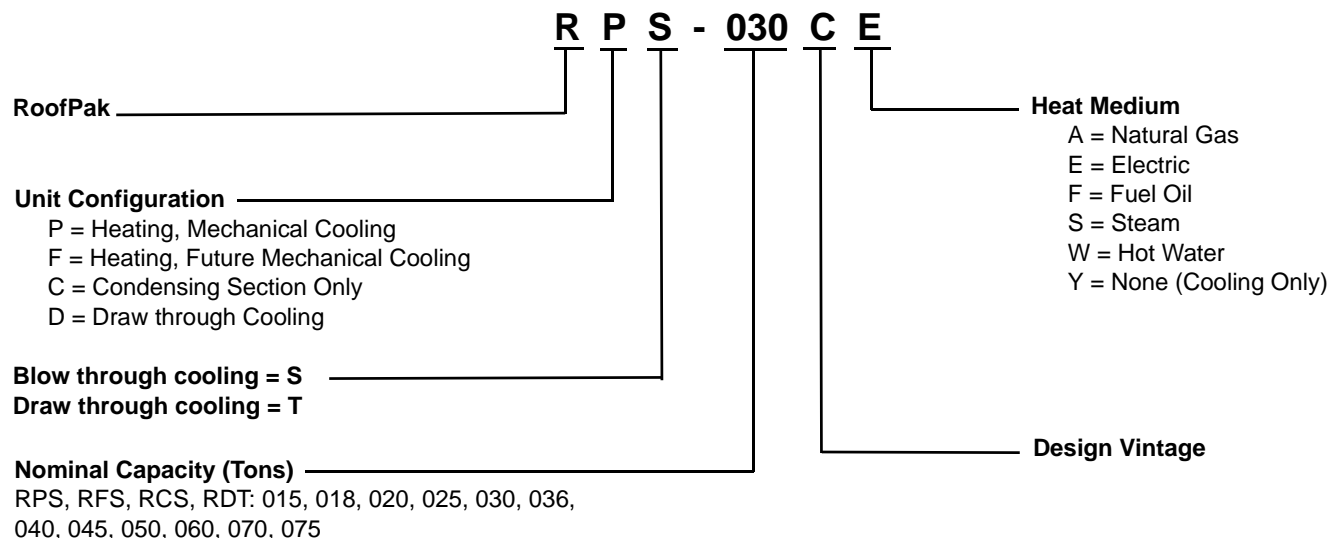
The MicroTech II applied rooftop unit controller is available on "C" vintage applied rooftop units. For a detailed description of the MicroTech II components, input/output configurations, field wiring options and requirements, and service procedures, refer to IM696 for a description of operation and information on using and programming the MicroTech II unit controller, refer to the appropriate operation manual (See Table 1).

For a description of operation and information on using the keypad to view data and set parameters, refer to the appropriate program-specific operation manual. (See Table 1).

Table 1: Program Specific Rooftop Unit Operation Literature

Rooftop Unit Control Configuration	Operation Manual Bulletin Number
VFD's	Vendor IM Manuals
Discharge Air Control (VAV or CAV)	OM 137
Space Comfort Control (CAV-Zone Temperature Control)	OM 138

Nomenclature



Unit Nameplate

The unit nameplate is located on the outside lower right corner on the main control box door. It includes the unit model number, serial number, unit part number, electrical characteristics, and refrigerant charge.

Compressor Nameplate

On units with a single compressor on each circuit, the compressor will include one compressor nameplate.

On units that utilize the tandem compressor design, each compressor will include an individual nameplate along with a nameplate identifying the tandem compressors. Compressors without rotalock fittings can be identified with the compressor nomenclature ZRT*****_*** and compressors with rotalocks can be identified with the compressor nomenclature ZZ*****_***.

Gas Burner Nameplate

On units which include gas heat, the nameplate is located on the lower right corner on the main control box door. It includes the burner model number, minimum/maximum input, maximum temperature rise and minimum CFM.

Hazard Identification Information

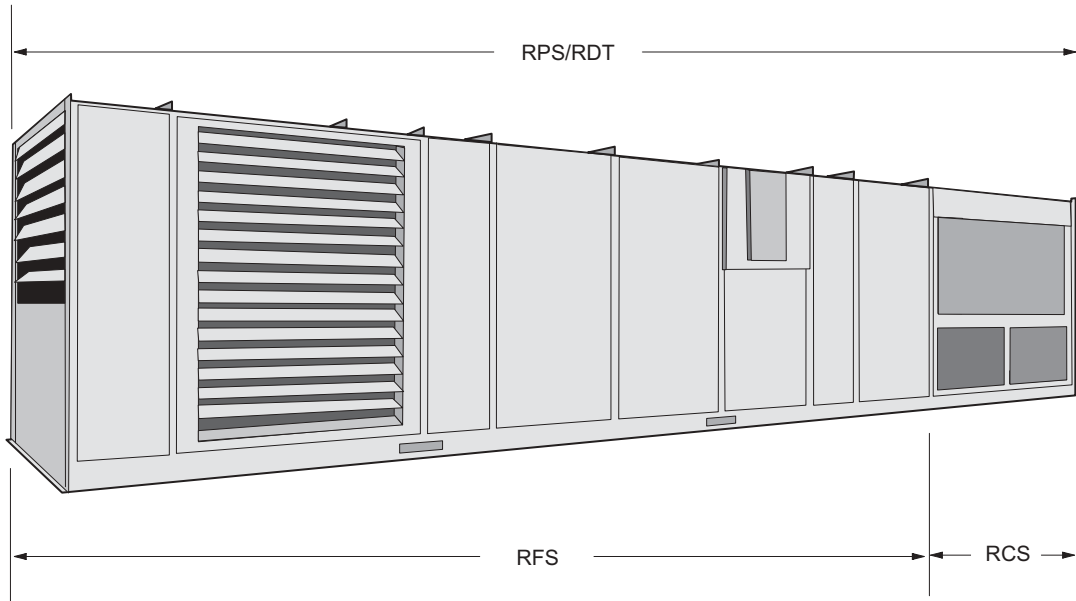
⚠ WARNING

Warnings are provided throughout this manual to indicate to installing contractors, operators, and service personnel of potentially hazardous situations which, if not avoided, can result in severe personal injury or property damage.

⚠ CAUTION

Cautions are provided throughout this manual to indicate to installing contractors, operators, and service personnel of potentially hazardous situations which, if not avoided, can result in personal injury or equipment damage.

Unit Description



Typical Component Locations

Figure 1 shows a typical RPS unit with the locations of the major components. Figure 2 on page 5 shows a typical RDT unit with the locations of the major components. These figures

are for reference only. See the certified submittals for actual specific dimensions.

Figure 1. Typical Component Locations - RPS Units

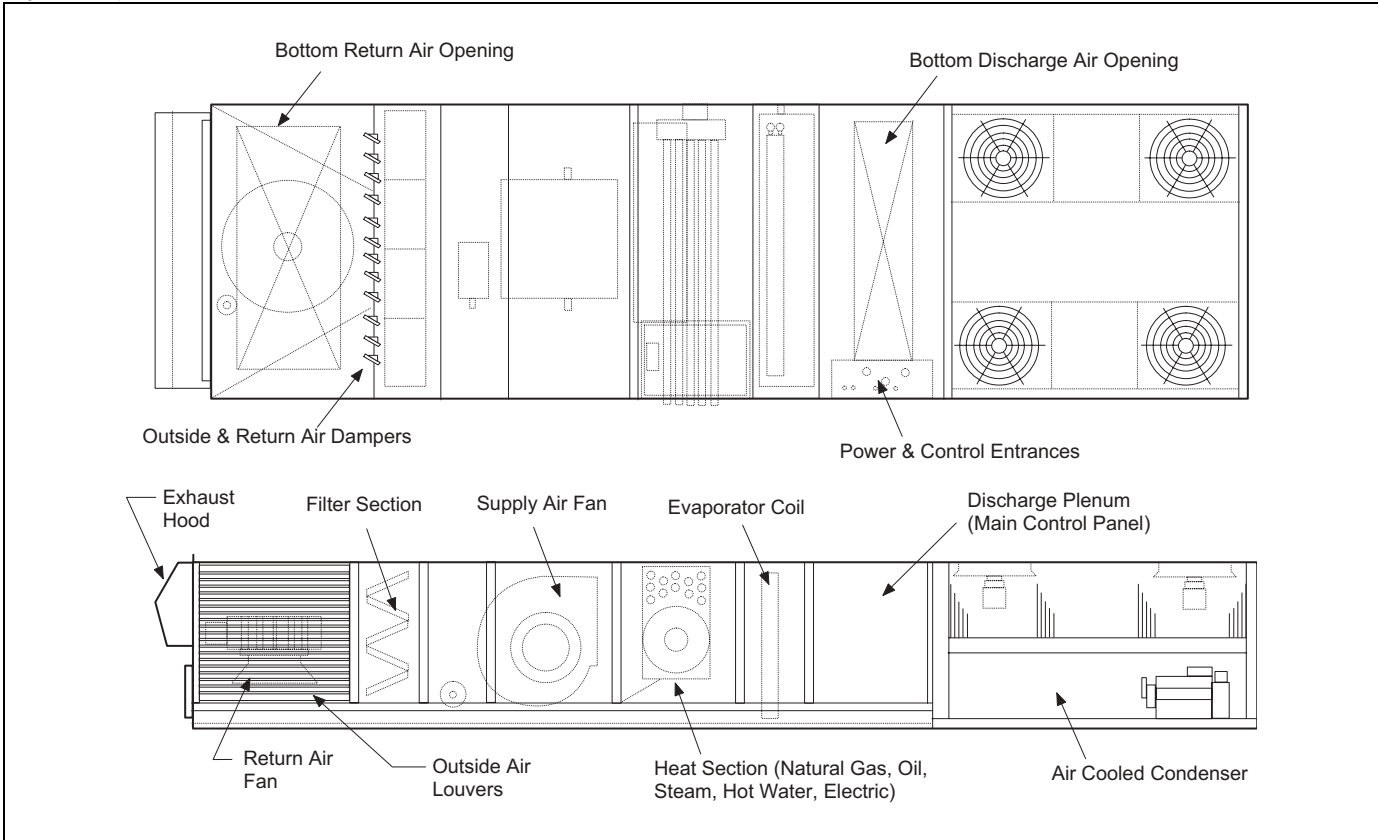
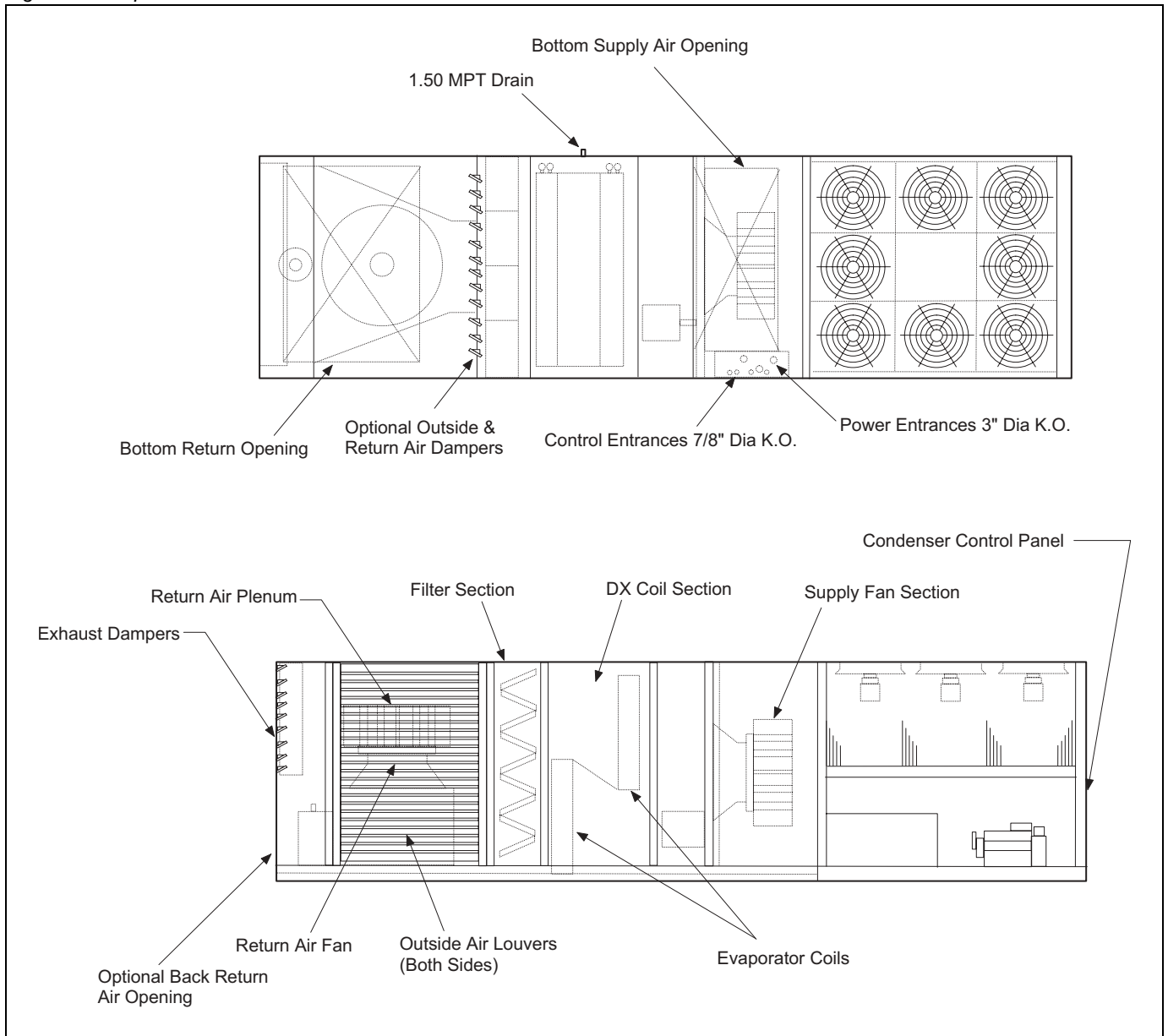


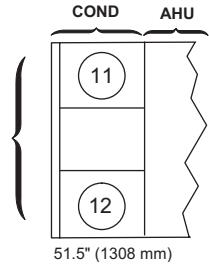
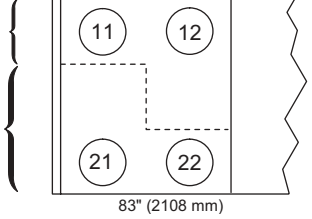
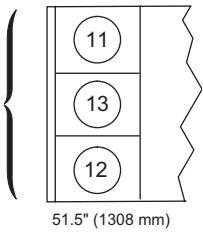
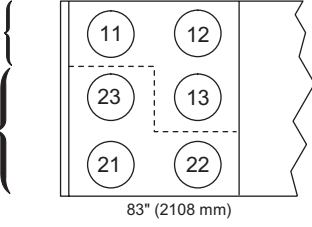
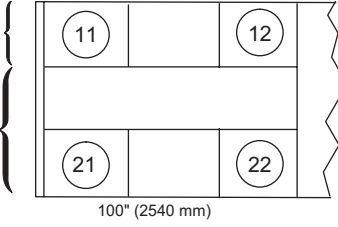
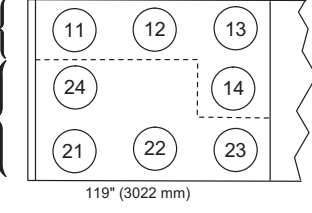
Figure 2. Component Locations - RDT Units



Condenser Fan Arrangement

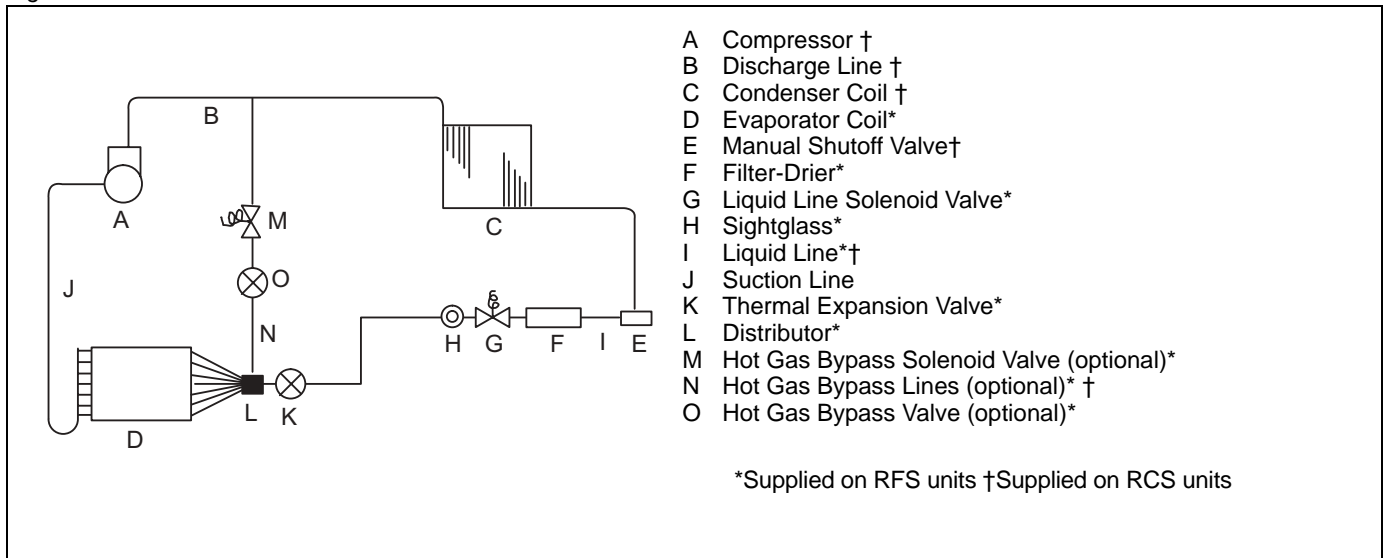
Table 2 shows the condenser fan numbering conventions and locations for each unit size.

Table 2: Condenser Fan Arrangement

UNIT SIZE	REFRIGERANT CIRCUIT	ARRANGEMENT	UNIT SIZE	REFRIGERANT CIRCUIT	ARRANGEMENT
015C 018C 020C	1 or 2		045C 050C	1 2	
025C 030C	1 or 2		060C 070C	1 2	
036C 040C	1 2		075C	1 2	

Refrigerant Circuit Schematic

Figure 3. Circuit Schematic



Refrigeration Piping

This section presents the unit refrigeration piping diagrams for the various available configurations. Component numbering

conventions are also shown. Refer to Figure 4, Figure 5 on page 8 and Figure 6 on page 9.

Figure 4. Condenser Piping 4 Compressors/2 Circuits (045C - 060C) — 3 Compressors/2 Circuits (070 - 075C)

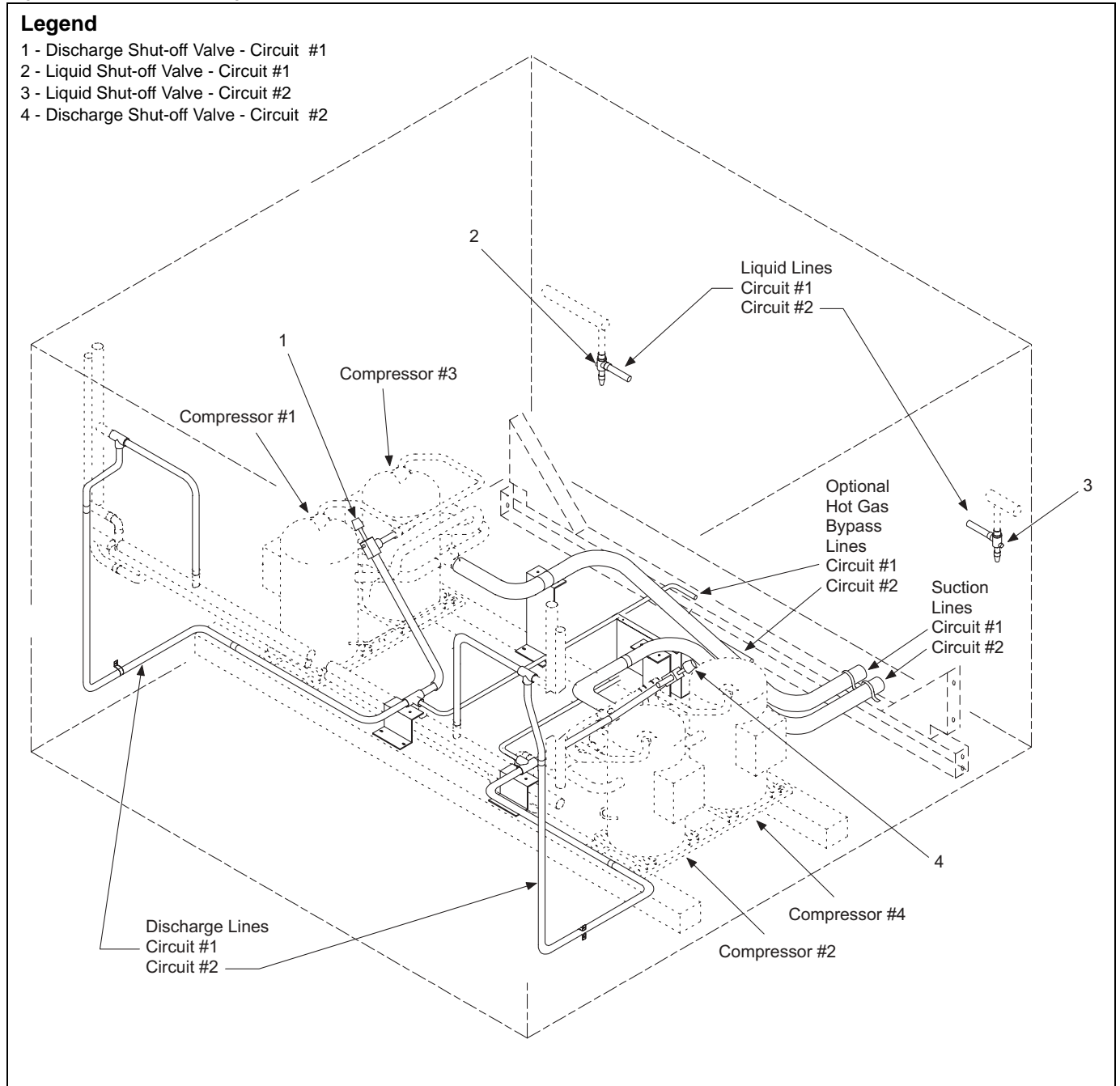


Figure 5. Air Handler Piping (Flat DX)

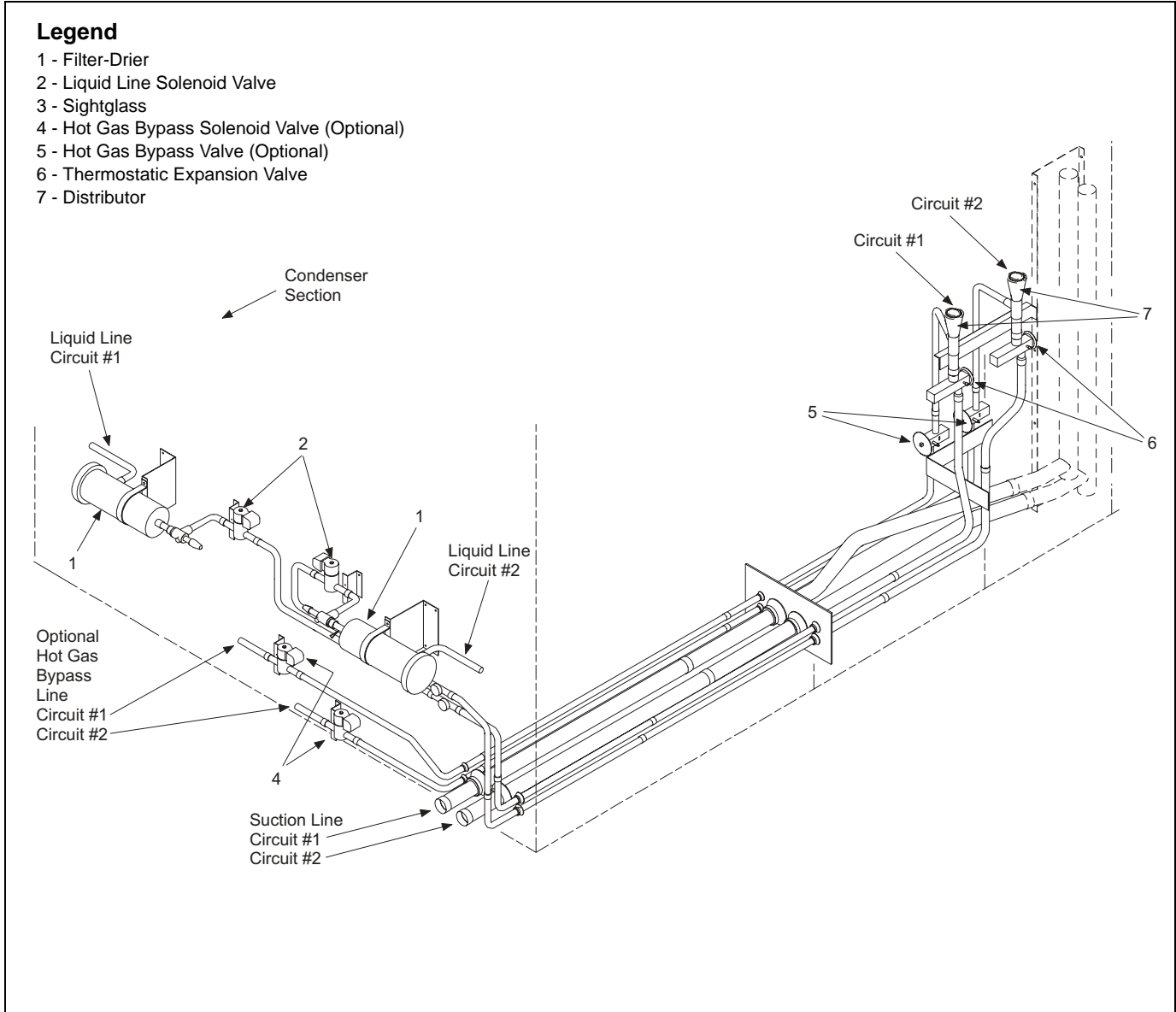
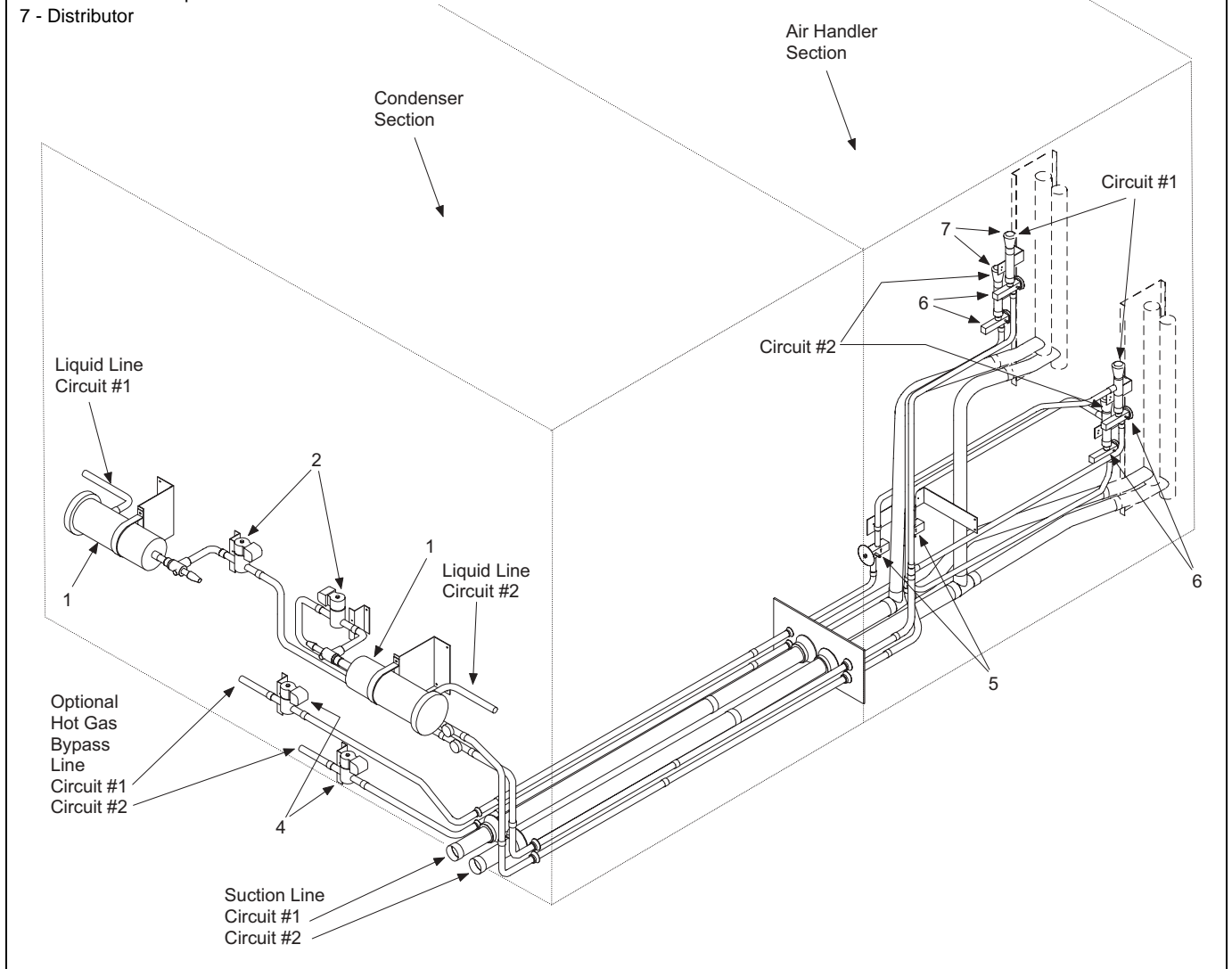


Figure 6. Air Handler Piping (Staggered DX)

Legend

- 1 - Filter-Drier
- 2 - Liquid Line Solenoid Valve
- 3 - Sightglass
- 4 - Hot Gas Bypass Solenoid Valve (Optional)
- 5 - Hot Gas Bypass Valve (Optional)
- 6 - Thermostatic Expansion Valve
- 7 - Distributor



Control Locations

Figure 7 (RPS Units) and Figure 8 on page 11 (RDT Units) show the locations of the various control components mounted throughout the units. See "Control Panel Locations" on page 12 for the locations of control components mounted in control

panels. Additional information is included in Table 3 on page 18 and the wiring diagram legend which is included in "Wiring Diagrams" on page 54.

Figure 7. Control Locations - RPS Units

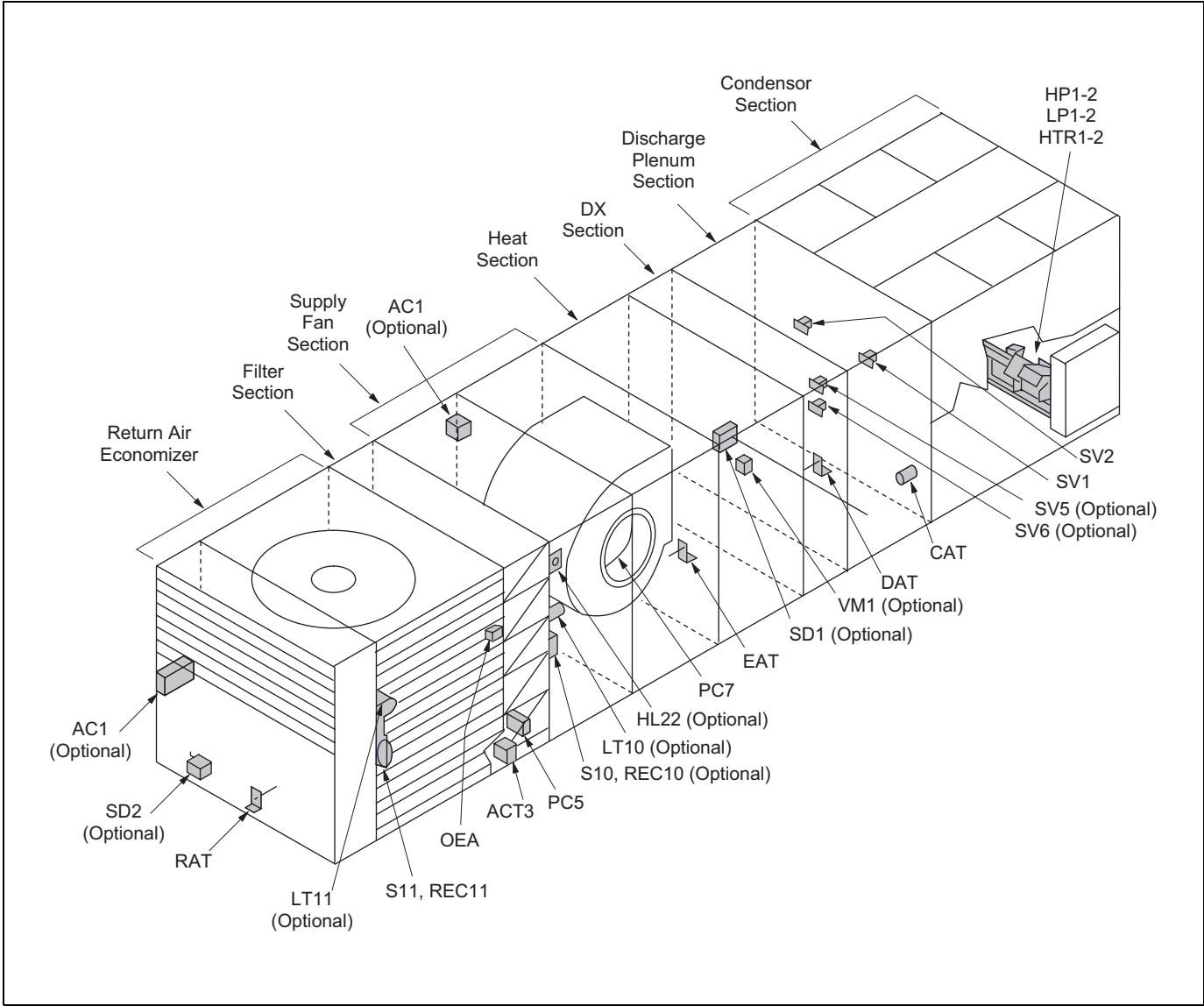
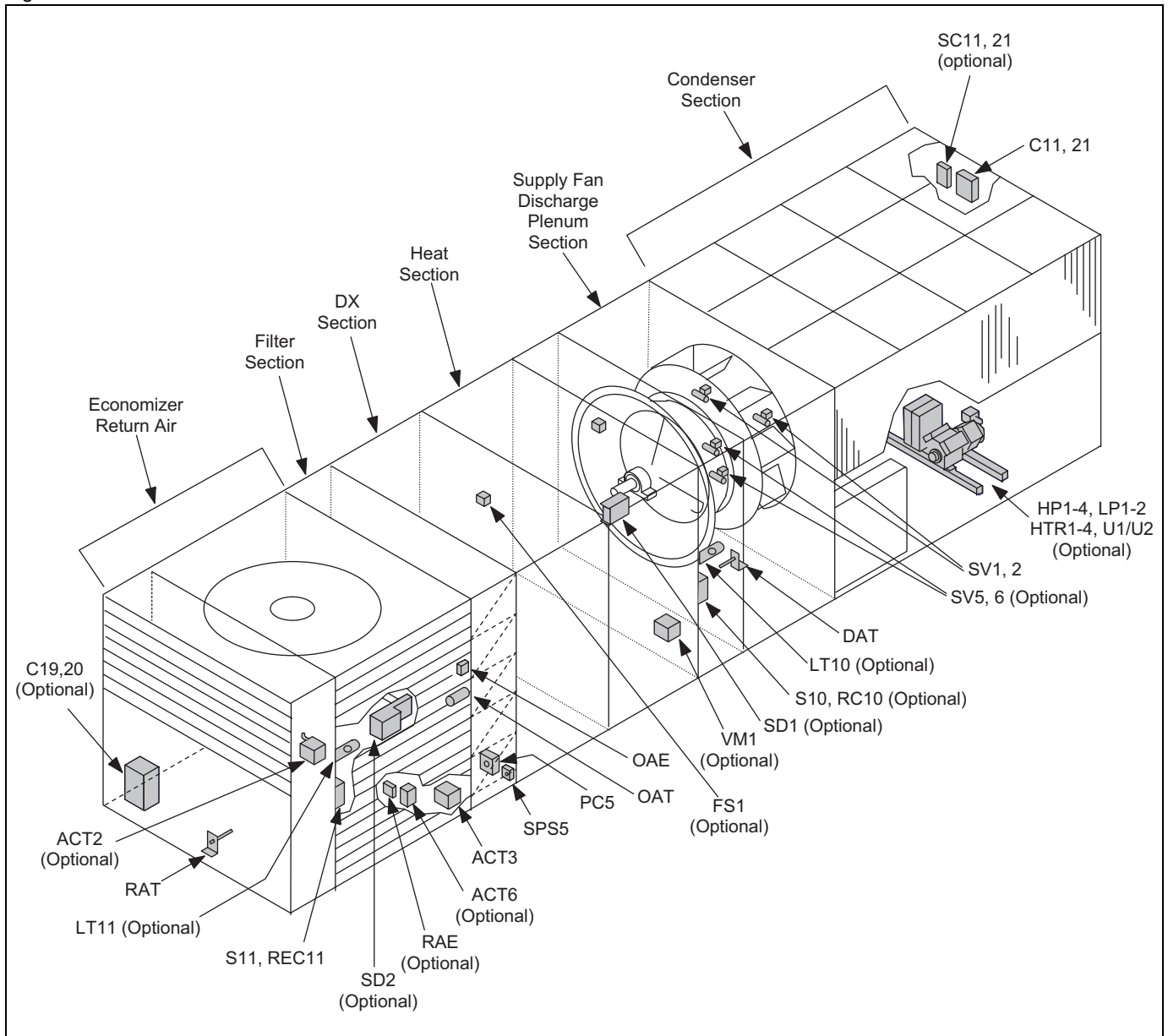


Figure 8. Control Locations - RDT Units



Control Panel Locations

The unit control panels and their locations are shown in the following figures. These figures show a typical unit configuration. Specific unit configurations may differ slightly from

these figures depending on the particular unit options. See “Wiring Diagrams” on page 54 for the Legend and component description.

Figure 9. Control Panel Locations

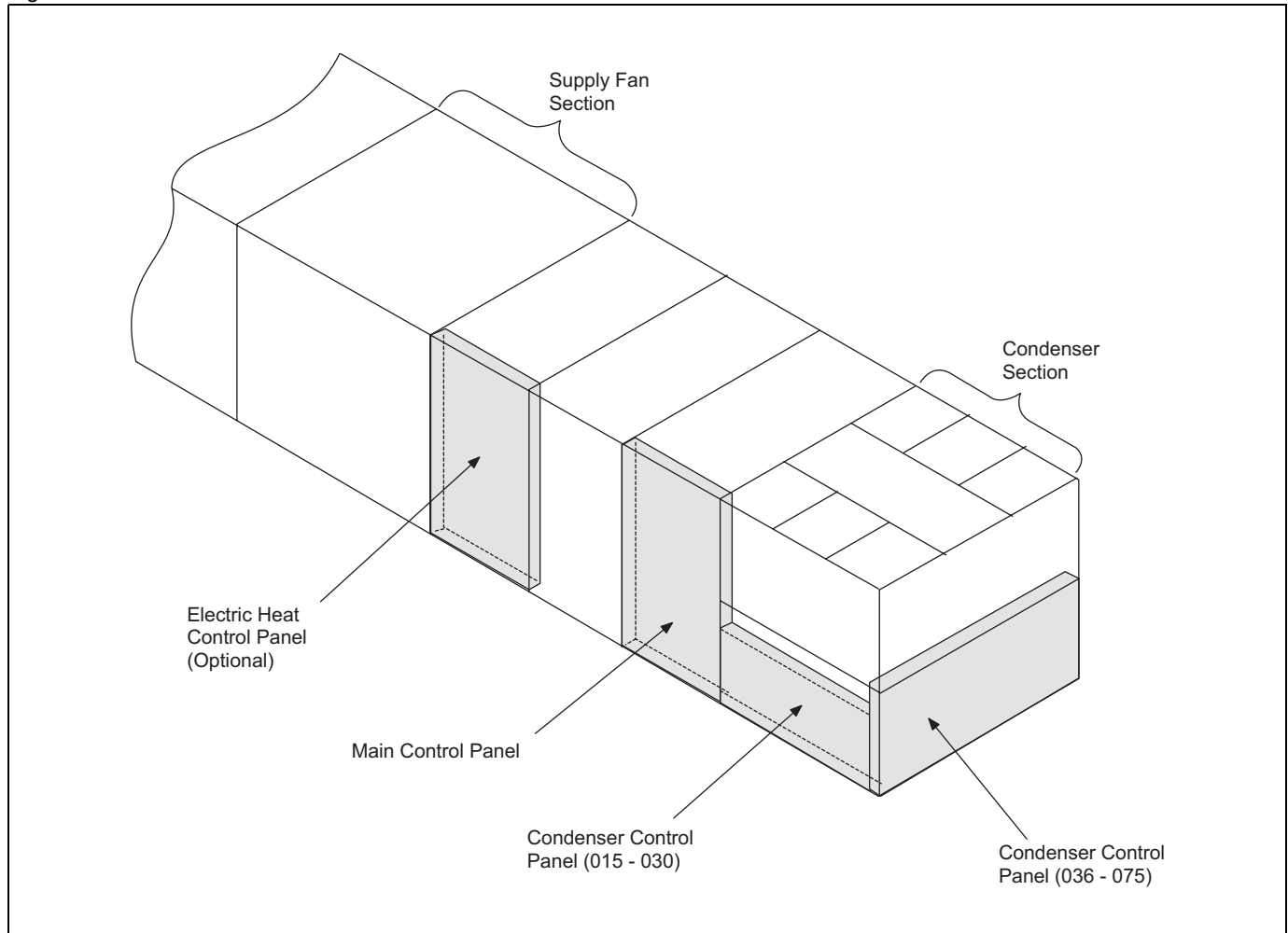


Figure 10. Main Control Panel - 015 - 040"

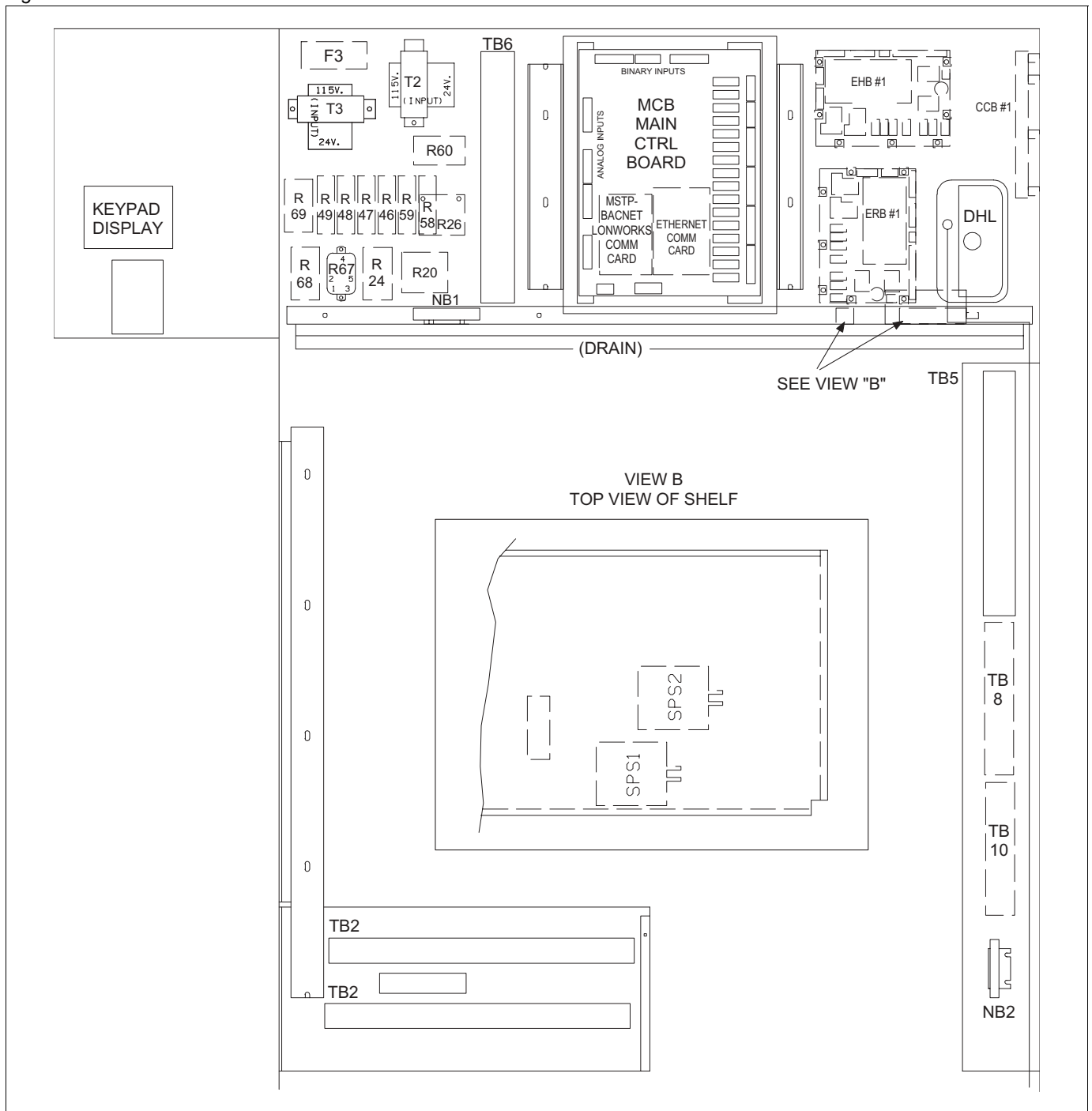


Figure 11. Main Control Panel - 045 - 075

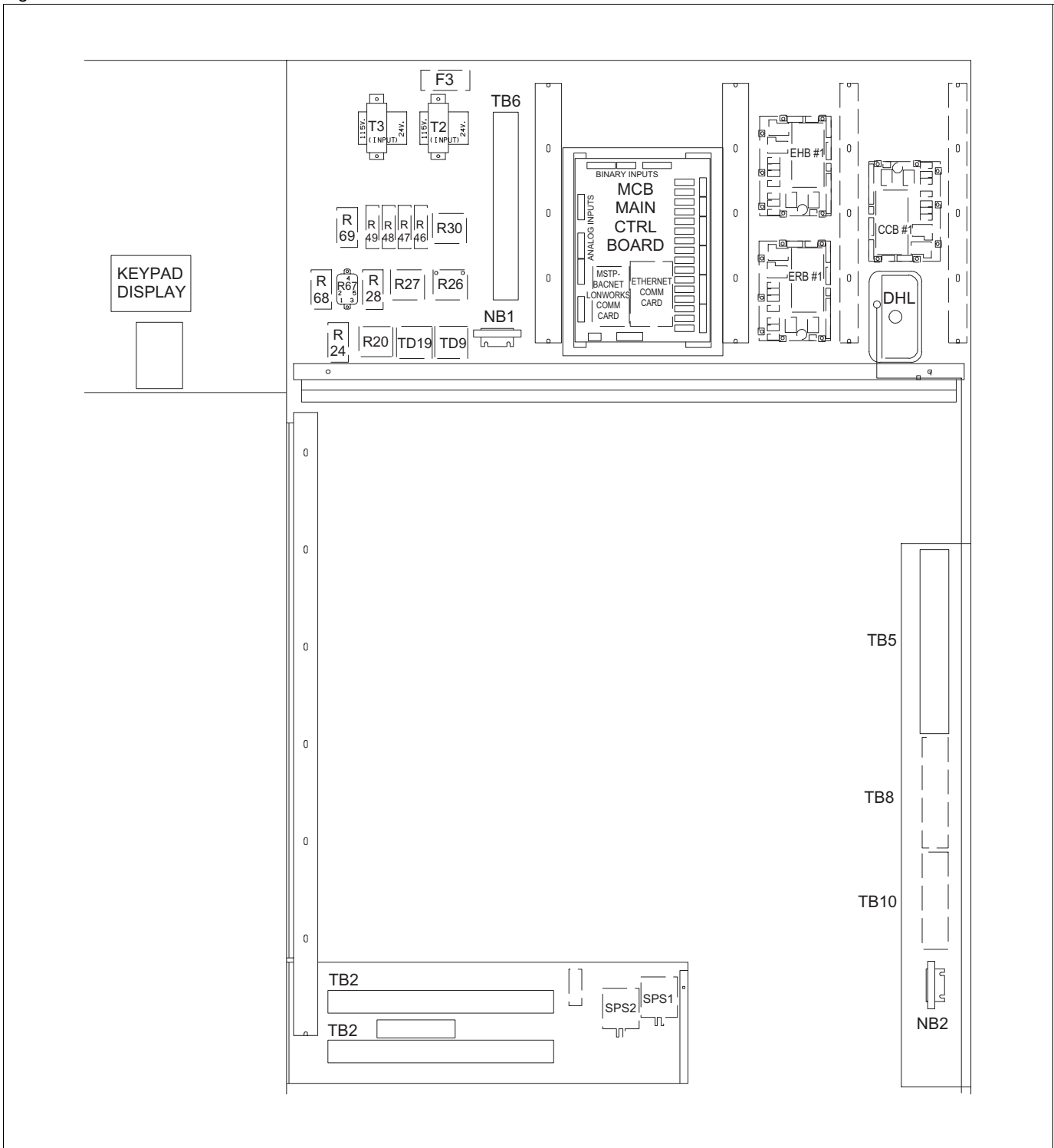


Figure 12. Condenser Control Panel with MicroTech II (015C thru 030C)

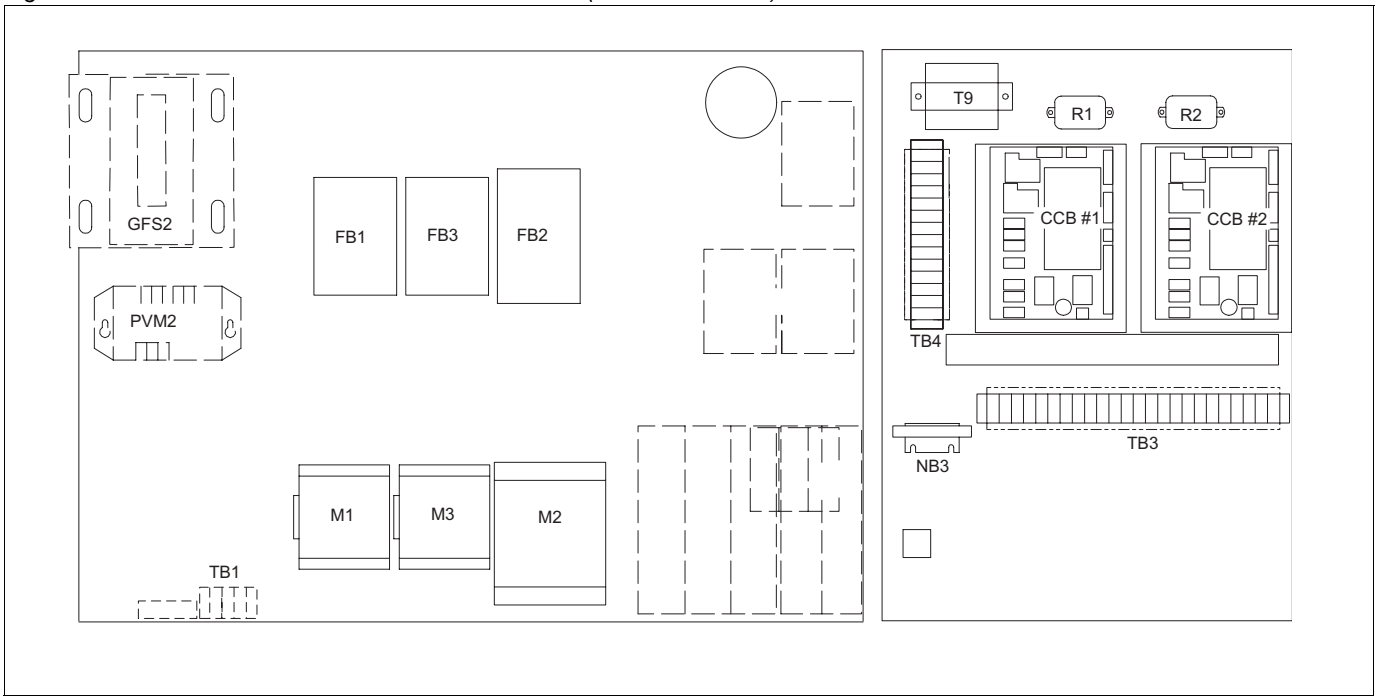


Figure 13. Condenser Control Panel with MicroTech II (036C thru 060C)

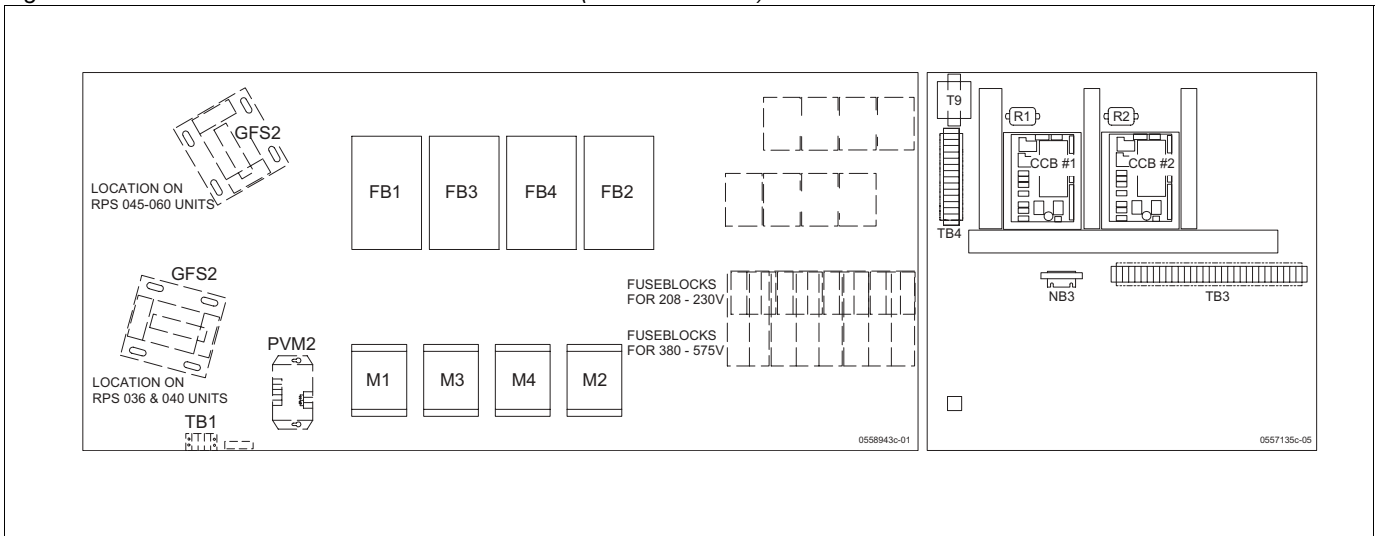


Figure 14. Condenser Control Panel with MicroTech II (045 thru 075)

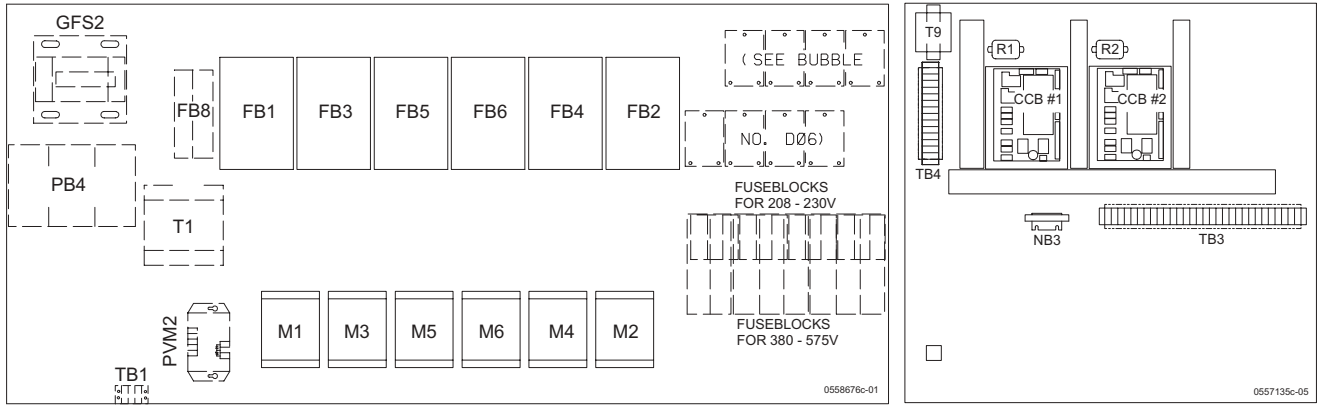


Figure 15. Condenser Control Panel with No Controls - RPS (036 thru 075)

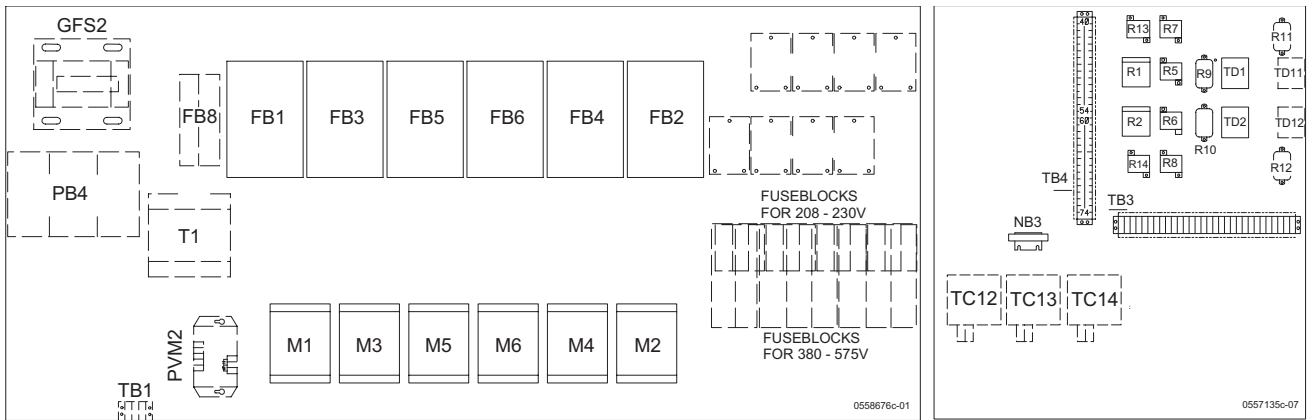


Figure 16. Condenser Control Panel with No Controls - RPS (015 thru 030)

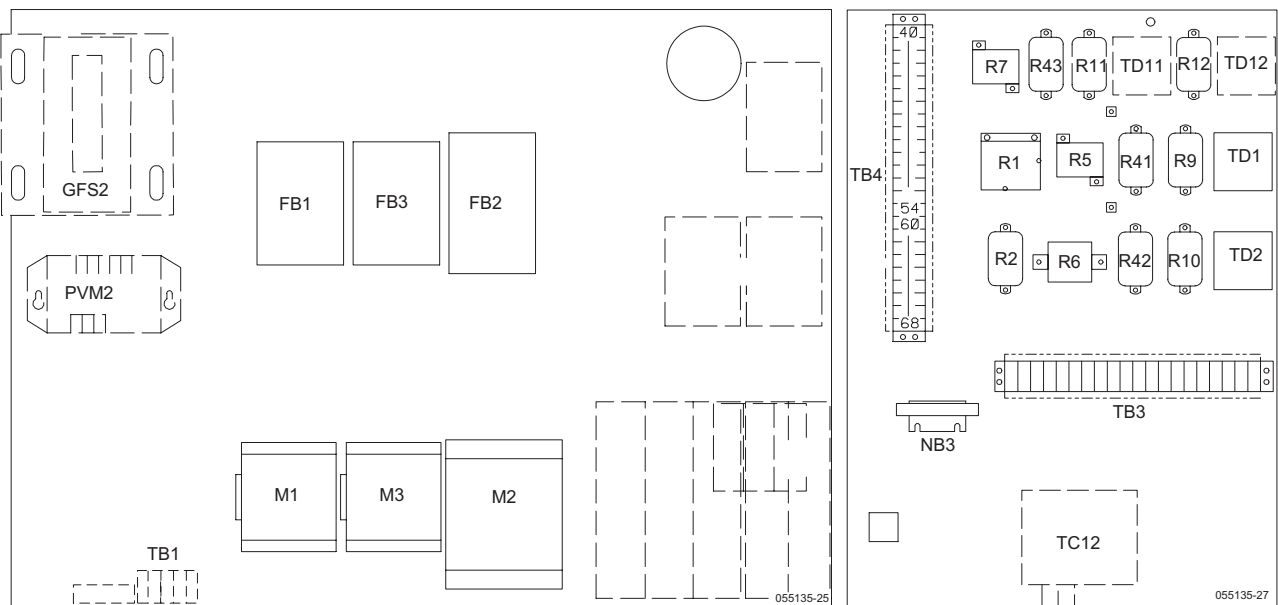


Figure 17. Electric Heat Control Panel - sizes 15 - 40C

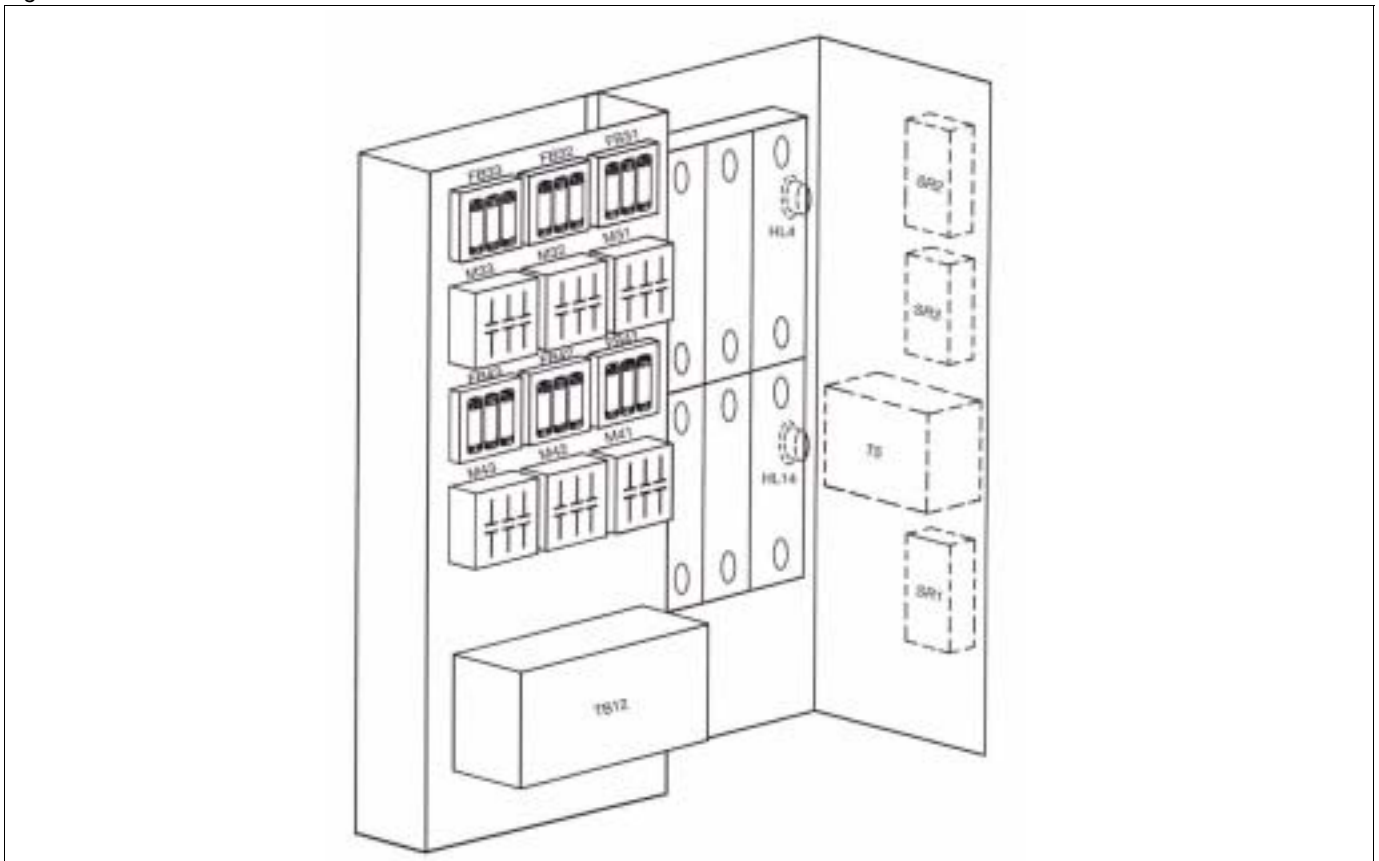
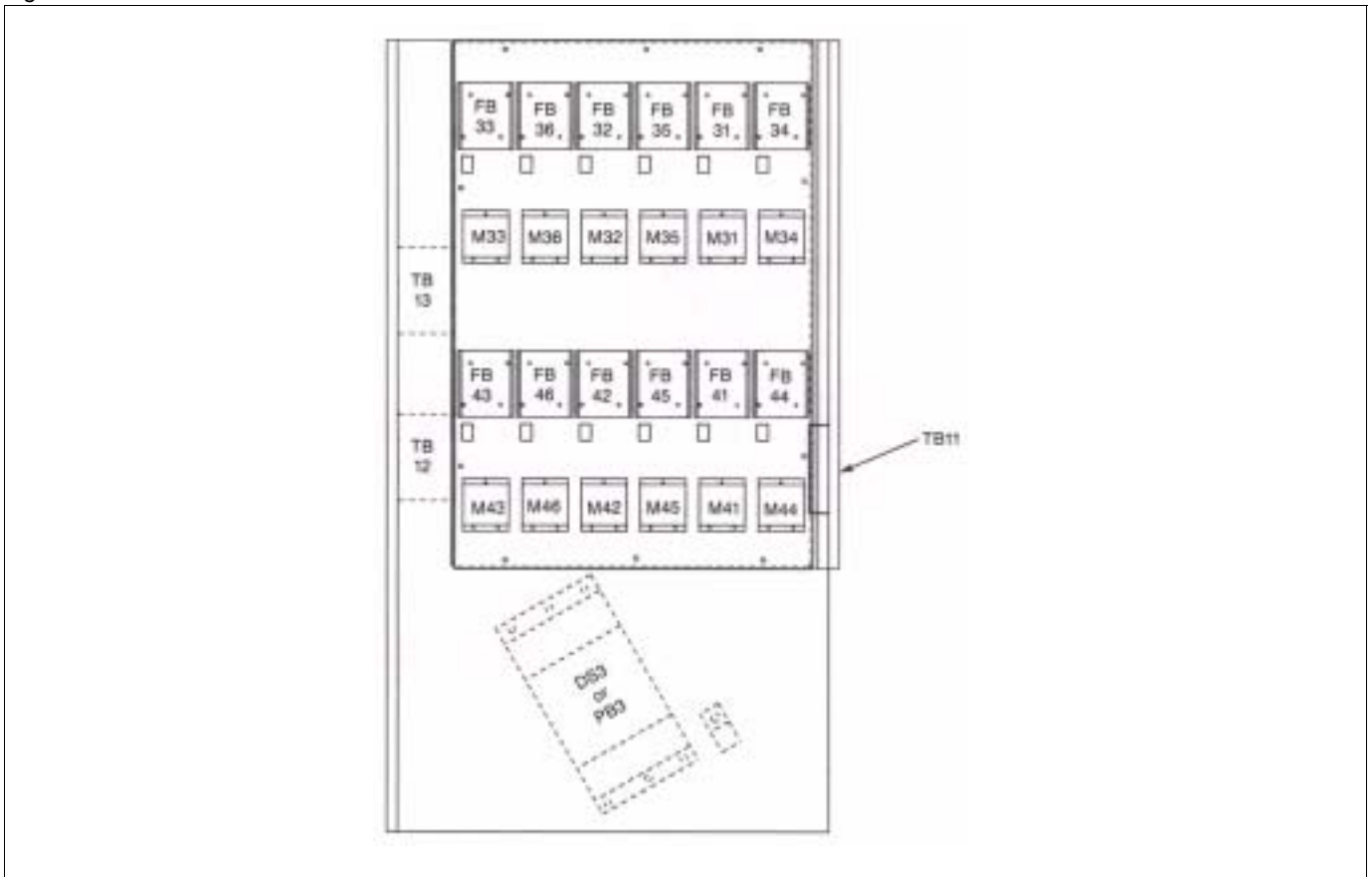


Figure 18. Electric Heat Control Panel - Sizes 45 - 75C



Controls, Settings, and Functions

Table 3 and Table 4 on page 19 present a listing of all the unit control devices. Included in the table are the device symbol, a description of the device, its function, and any reset informa-

tion, its location, any device setting, any setting ranges, differentials, and the device part number.

Table 3: Controls, settings and functions

SYMBOL	DESCRIPTION	FUNCTION	RESET	LOCATION	SETTING	RANGE	DIFFERENTIAL	PART NO.
CS1 & 2	Switch (toggle), refrigerant circuit	Shuts off compressor control circuits manually.	N/A	Condenser control box	N/A	N/A	N/A	01355000
DAT	Discharge air temperature sensor	Senses discharge air temperature.	N/A	Discharge air section	N/A	3K ohms at 77°F (25°C)	N/A	060004705
DHL	Duct high limit switch	Prevents excessive VAV duct pressures; shuts off fan.	Auto	Main control panel	3.5" w.c (871.8 Pa)	0.05-5.0" w.c. (12.5-1245.4 Pa)	.05" w.c. (12.5 Pa), fixed	065493801
EFT	Entering fan air temperature sensor	Senses entering fan air temperature	N/A	Inlet of supply fan	N/A	3K ohms at 77°F (25°C)	N/A	060004705
FP1, 2	Evaporator frost protection		N/A					
FS1	Freezestat	Shuts off fans, opens heating valve and closes outdoor damper if low air temperature at coil is detected.	Auto	Heating section	38°F (3°C) or as required	35°F - 45°F (2°C - 7°C)	12°F (7°C), fixed	065830001
HP1, 2, 3 & 4	High Pressure Control	Stops compressor when refrigerant discharge pressure is too high.	Manual (relay latched)	Compressor	Cutout = 400 psig (2758 kPa) Cutin = 300 psig (2068 kPa)	N/A	100psi (689 kPa)	047356110
LP1, 2	Low Pressure Control	Stops compressor when suction pressure is too low (used for pumpdown).	Auto	Compressor	Cutout=35 psig (241 kPa) Cutin=60 psig (414 kPa)	N/A	25 psi (172 kPa)	047356111
MCB	Main Control Board	Processes input information.	N/A	Main control box	N/A	N/A	N/A	060006101
MP1, 2, 3 & 4	Compressor motor protector	Senses motor winding temperature, shuts off compressor on high temperature. Notes: 1. Unit size 018C compressors include internal motor protector. 2. Unit sizes 020C - 036C, circuit #1 compressors include internal motor protector (refer to unit wiring diagram).	Auto at 3400 ohms	Compressor junction box	9K-18K ohms	700 ohms cold	N/A	044691509
OAE	Enthalpy control (electromechanical)	Returns outside air dampers to minimum position when enthalpy is too high.	Auto	Economizer section	"B" or as required	A — D	Temperature: 3.5°F (2°C) Humidity: 5% fixed	030706702
	Enthalpy control (electronic)	Returns outside air dampers to minimum position when outside air enthalpy is higher than return air enthalpy (use RAE)	Auto	Economizer section	Fully CW past "D" (when used with RAE)	A — D	N/A	049262201
OAT	Outside air temperature sensor	Senses outside air temperature.	N/A		N/A	3K ohms at 77°F (25°C)	N/A	060004705
PC5	Dirty Filter switch	Senses filter pressure drop.	Auto	First Filter section	As required	.05-5" w.c. (12.5-1245.4 Pa)	.05" w.c. (12.5 Pa)	065493801
PC6	Dirty Filter switch	Senses filter pressure drop.	Auto	Final Filter section	As required	.05-5" w.c. (12.5-1245.4 Pa)	.05" w.c. (12.5 Pa)	065493801
PC7	Air flow proving switch	Senses supply fan pressure to prove airflow.	Auto	Supply fan section	.10" w.c. (25 Pa)	.05-5" w.c. (12.5-1245.4 Pa)	.05" w.c. (12.5 Pa), fixed	060015801
PS1, 2	Pumpdown switch	Used to manually pump down compressor.	N/A	Condenser control box	N/A	N/A	N/A	01355000
PS3	Master pumpdown switch	Used to manually pump down all compressors.	N/A	Main control box	N/A	N/A	N/A	01355000

Table 4: Controls, settings and functions (continued)

SYMBOL	DESCRIPTION	FUNCTION	RESET	LOCATION	SETTING	RANGE	DIFFERENTIAL	PART NO.
RAE	Return air enthalpy sensor	Used to compare return air enthalpy to outside air enthalpy (used with OAE).	N/A	Economizer section	N/A	N/A	N/A	049262202
RAT	Return air temperature sensor	Senses return air temperature.	N/A	Return air section	N/A	3K ohms at 77°F (25°C)	N/A	060004705
SD1	Smoke detector, supply air	Initiates unit shutdown if smoke is detected.	Manual	Discharge air section	N/A	N/A	N/A	04925001
SD2	Smoke detector, return air	Initiates unit shutdown if smoke is detected.	Manual	Return air section	N/A	N/A	N/A	04925001
SPS1	Static Pressure Sensor Duct # 1	Converts static pressure signals to voltage signals.	N/A	Main control box	N/A	0—5" w.c. (0—1245.4 Pa) 1—6 VDC out	N/A	049545005
SPS2	Static Pressure Sensor Duct # 2	Converts static pressure signals to voltage signals and sends them to MicroTech II controller.	N/A	Main control box	N/A	0—5" w.c. (0—1245.4 Pa) 1—6 VDC out	N/A	049545005
	Static Pressure Sensor: Building (Space) Pressure	Converts static pressure signals to voltage signals.	N/A	Main control box	N/A	-0.25—0.25" w.c. (-62.3—62.3 Pa) 1—5 VDC out	N/A	049545006
SV1, 2	Solenoid valve (liquid line)	Closes liquid line for pumpdown.	N/A	Condenser section	N/A	N/A	N/A	See parts catalog
SV5, 6	Solenoid valve (hot gas bypass)	Closes hot gas bypass line for pumpdown.	N/A	Condenser section	N/A	N/A	N/A	047931304
S1	System Switch	Shuts off entire control circuit (except crankcase heaters)	N/A	Main control box	N/A	N/A	N/A	001355000
S7	ON-OFF-AUTO switch	Used to manually switch unit.	N/A	Main control box	N/A	N/A	N/A	

Mechanical Installation

The installation of this equipment shall be in accordance with the regulations of authorities having jurisdiction and all applicable codes. It is the responsibility of the installer to determine and follow the applicable codes.

Note: Low head pressure may lead to poor, erratic refrigerant feed control at the thermostatic expansion valve. The units have automatic control of the condenser fans which should provide adequate head pressure control down to 50°F (10°C) provided the unit is not exposed to windy conditions. The system designer is responsible for assuring the condensing section is not exposed to excessive wind or air recirculation.

Receiving Inspection

When the equipment is received, all items should be carefully checked against the bill of lading to be sure all crates and cartons have been received. **If the unit has become dirty during shipment (winter road chemicals are of particular concern), it should be cleaned off when received.**

All units should be carefully inspected for damage when received. Report all shipping damage to the carrier and file a claim. In most cases, equipment is shipped F.O.B. factory and claims for freight damage should be filed by the consignee.

The unit nameplate should be checked before unloading the unit to make sure the voltage complies with the power supply available.

CAUTION

Sharp edges are inherent to sheet metal parts, screws, clips, and similar items and can cause personal injury.

This equipment is to be installed and operated only by an experienced installation company and fully trained personnel.

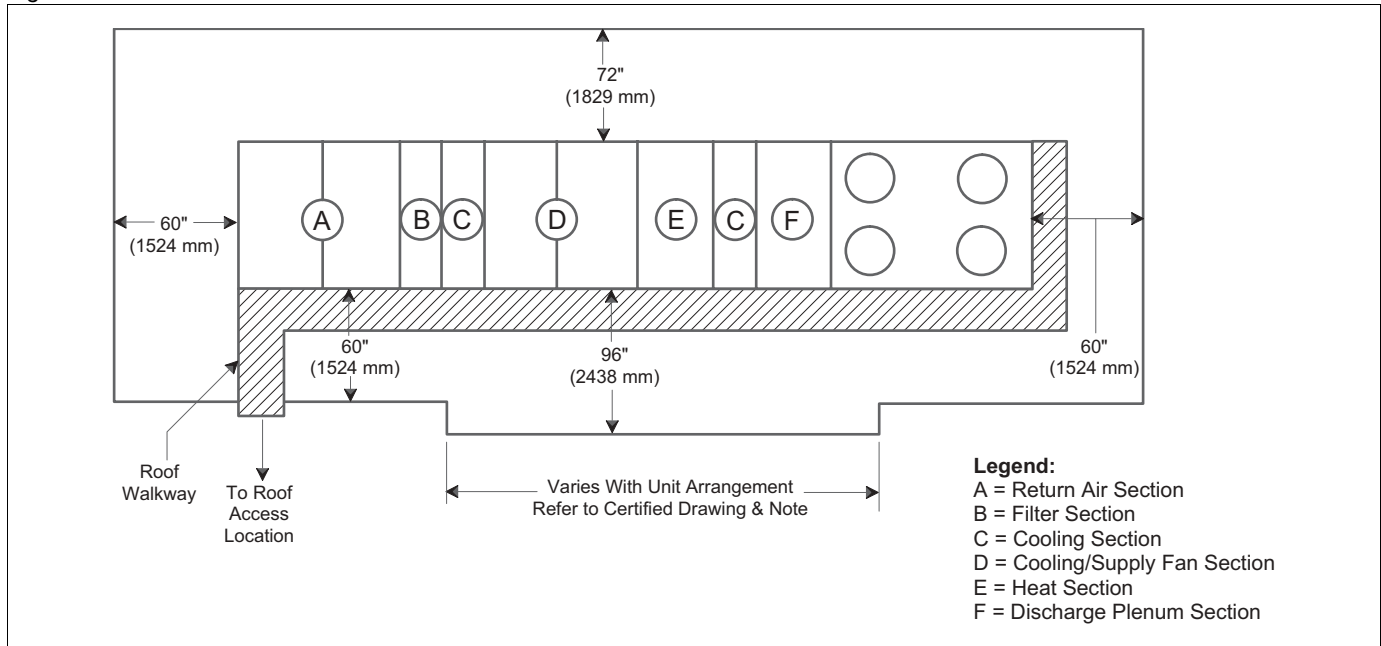
Exercise caution when servicing equipment.

Unit Clearances

Service Clearance

Allow service clearance approximately as indicated in *Figure 19*. Also, it is recommended that a roof walkway be provided to the rooftop unit and along at least the two sides of the unit that provide access to most controls and serviceable components.

Figure 19. Service Clearances



Ventilation Clearance

Following are minimum ventilation clearance recommendations. The system designer must consider each application and provide adequate ventilation. If this is not done, the unit will not perform properly.

Unit(s) surrounded by a screen or a fence:

1. The bottom of the screen or fence should be at least 1 ft. (305 mm) above the roof surface.
2. The distance between the unit and a screen or fence should be as described in "Service Clearance" on page 20. See also Figure 19 on page 20.
3. The distance between any two units within a screen or fence should be at least 120" (3048 mm).

Unit(s) surrounded by solid walls:

1. If there are walls on one or two adjacent sides of the unit, the walls may be any height. If there are walls on more than two adjacent sides of the unit, the walls should not be higher than the unit.
2. The distance between the unit and the wall should be at least 96" (2438 mm) on all sides of the unit.
3. The distance between any two units within the walls should be at least 120" (3048 mm).

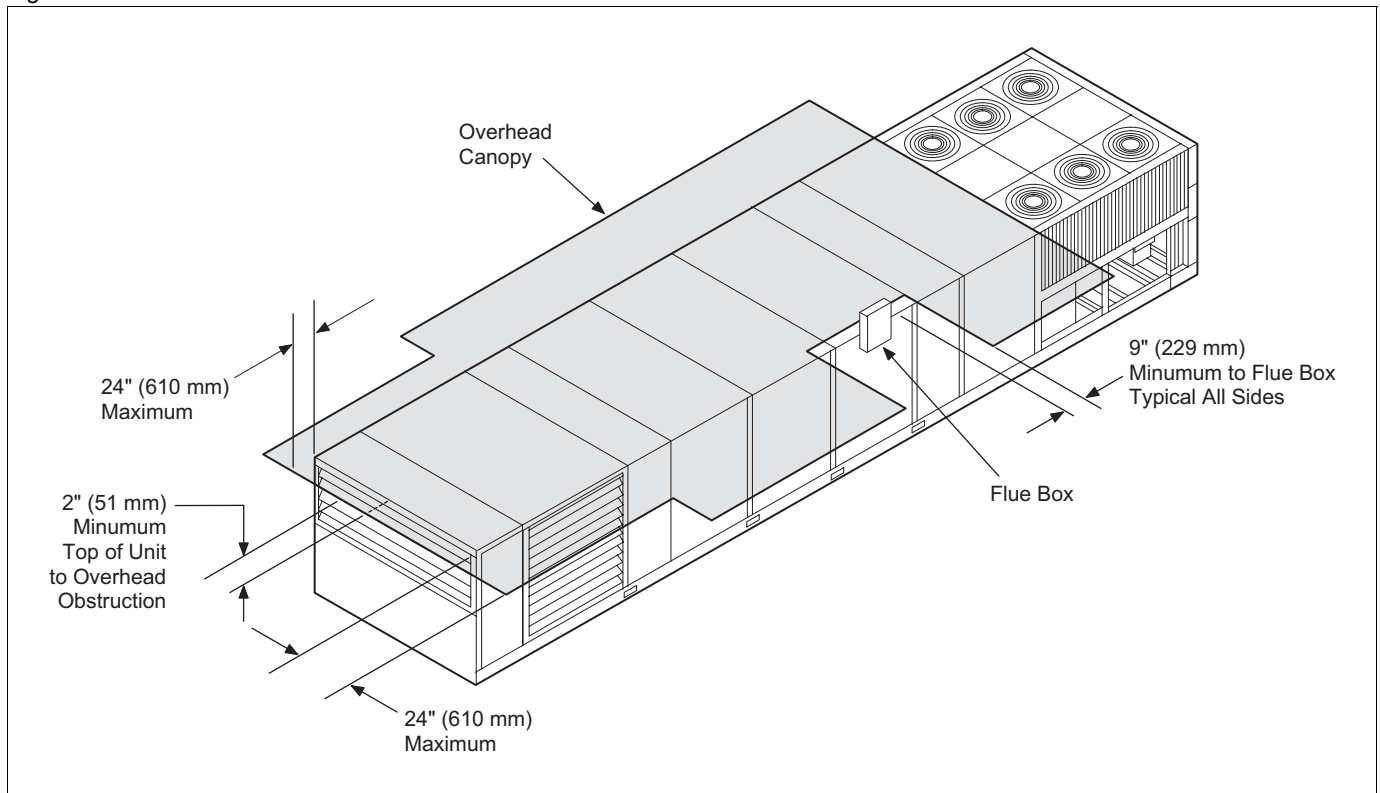
Do not locate outside air intakes near exhaust vents or other sources of contaminated air.

If the unit is installed where windy conditions are common, wind screens should be installed around the unit, maintaining the clearances specified (see Figure 20). This is particularly important to prevent blowing snow from entering outside air intakes, and to maintain adequate head pressure control when mechanical cooling is required at low outdoor air temperatures.

Overhead clearance

1. Unit(s) surrounded by screens or solid walls must have no overhead obstructions over any part of the unit.
2. The area above the condenser must be unobstructed in all installations to allow vertical air discharge.
3. The following restrictions must be observed for overhead obstructions above the air handler section (see Figure 20):
 - a. There shall be no overhead obstructions above the furnace flue, or within 9" (229 mm) of the flue box.
 - b. Overhead obstructions shall be no less than 2" (51 mm) above the top of the unit.
 - c. There shall be no overhead obstructions in the areas above the outside air and exhaust dampers that are farther than 24" (610 mm) from the side of the unit.

Figure 20. Overhead Clearance



Roof Curb Assembly and Installation

The roof curb and unit must be located on a portion of the roof that can support the weight of the unit. The unit must be supported to prevent bending or twisting of the machine.

If building construction could allow the transmission of sound and vibration into the occupied space, **it is recommended that the unit be located over a non critical area. It is the responsibility of the system designer to make adequate provisions for noise and vibration in the occupied space.**

The curb and unit must be installed level to allow the condensate drain to flow properly.

Integral supply and return air duct flanges are provided with the RPS/RFS roof curb, allowing connection of ductwork to the curb before the unit is set. The gasketed top surface of the duct flanges seals against the unit when it is set on the curb. These flanges must not support the total weight of the ductwork. Refer to "Piping Recommendations" on page 35 for details on duct connections. It is critical that the condensate drain side of the unit be no higher than the opposite side.

Assembly of a typical RPS/RDT roof curb is shown in Figure 22 on page 23. Parts A through K are common to all units having bottom return openings. Depending on the unit length, Parts L and M may be included with the roof curb kit to create the correct overall curb length. Figure 21 shows the assembly of the RCS roof curb.

RPS/RDT Assembly instructions (Figure 22 on page 23)

1. Set curbing parts A through K per dimensions shown over roof opening or on a level surface. Note location of return and supply air openings.

2. If applicable, set other curbing parts (D, L, M, etc.) in place making sure that the orientation complies with the assembly instructions. Check alignment of all mating bolt holes. See Detail "A".
3. Bolt curbing parts together using fasteners provided. Tighten all bolts finger tight.
4. Square entire curbing assembly and securely tighten all bolts.
5. Position curb assembly over roof openings. Curb must be level from side to side and over its length. Check that top surface of the curb is flat with no bowing or sagging.
6. Weld curbing in place. Caulk all seams watertight. Remove backing from 0.25" (6 mm) thick x 1.50" (38 mm) wide gasketing and apply to surfaces shown by cross-hatching.
7. Flash curbing into roof as shown in Detail "B".
8. Parts E and F are not required on units with no return shaft within the curb perimeter.
9. Parts G and H are not required on units with no supply shaft within the curb perimeter.

RCS Assembly instructions (Figure 21)

1. Set curbing parts A in place making sure that the orientation complies with the assembly instructions. Check alignment of all mating bolt holes.
2. Bolt curbing parts together using fasteners provided.
3. Curb must be level from side to side and over its length.
4. Weld curbing in place. Caulk all seams watertight and insulate between channels.
5. Flash curbing into roof as shown in Detail C.

Figure 21. RCS Roof Curb Assembly

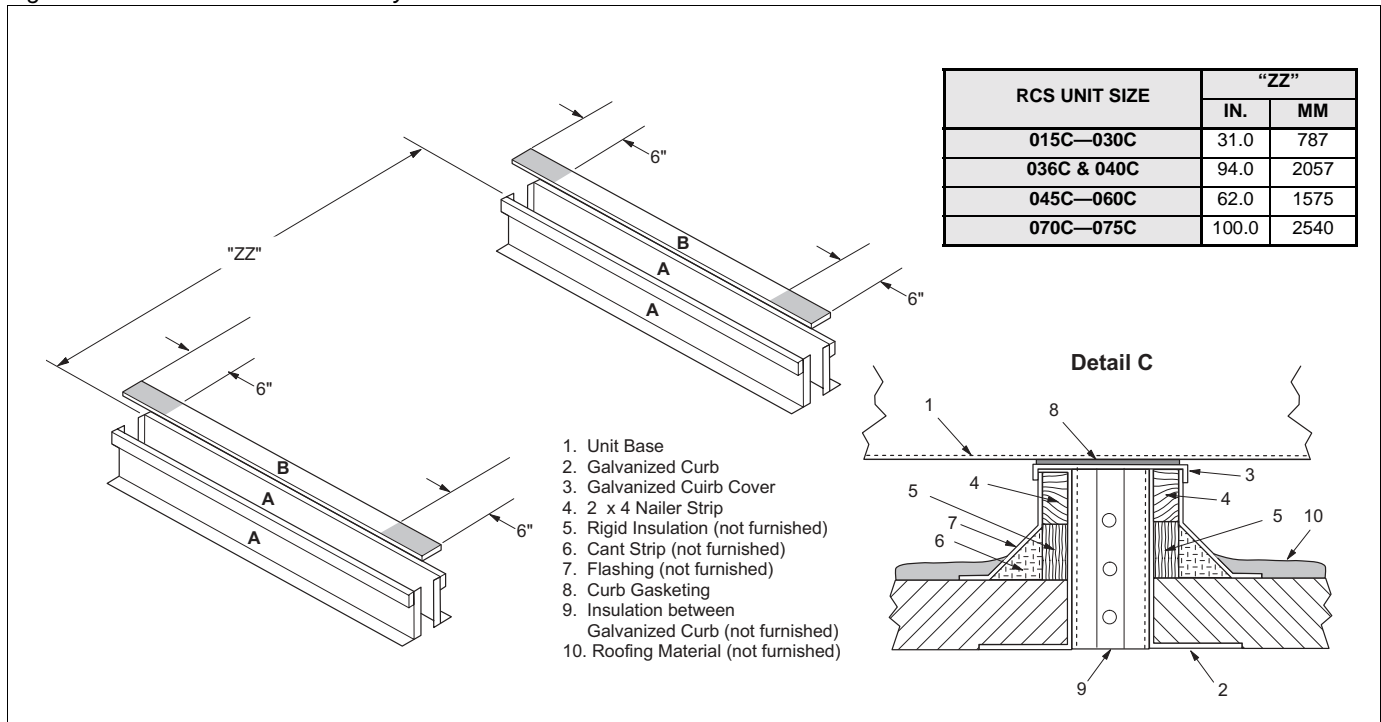
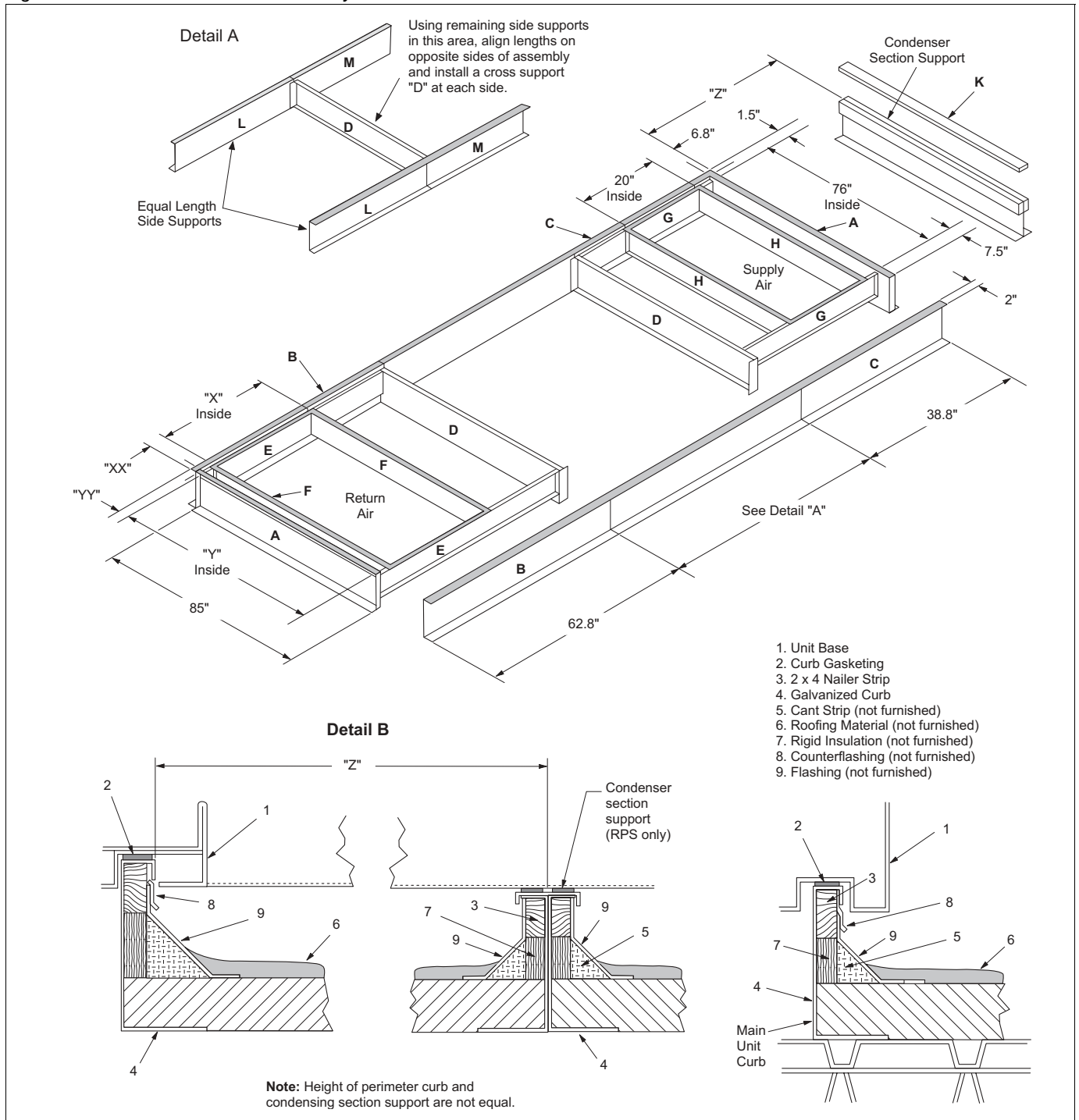


Figure 22. RPS/RFS Roof Curb Assembly



UNIT SIZE	FAN	"X"		"Y"		"XX"		"YY"	
		IN.	MM	IN.	MM	IN.	MM	IN.	MM
RPS 015-040C	NONE	24.0	610	82.0	2083	6.8	173	1.5	38
	(2) 15" FC	24.0	610	82.0	2083	6.8	173	1.5	38
	30" AF	30.0	762	76.0	1930	6.8	173	4.5	114
	40" AF	36.0	914	78.0	1981	14.8	376	3.5	89
RPS/RFS 045C-075C	All Units	38.0	965	87.0	2255	6.8	173	1.5	38

RPS UNIT SIZE	"Z"		"W"	
	IN.	MM	IN.	MM
015C—030C	45.9	1165	20.0	508
036C & 040C	94.0	2388	20.0	508
045C—075C	77.0	1956	28	712

Note: These dimensions do not apply to units with energy recovery wheels.

Post and Rail Mounting

When mounting by post and rail, the structural support should be run the full length of the unit. The structural member should be located at the base of the unit as shown in *Figure 23* assuring the shaded area is well supported by the structural member.

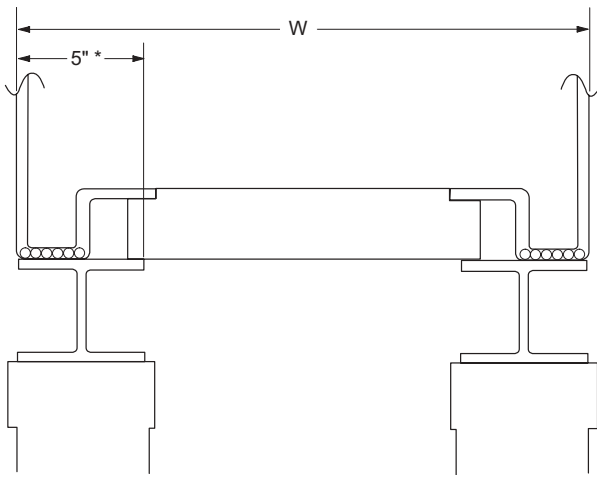
CAUTION

The unit must be level side to side and over the entire length.

Equipment damage can result if the unit is not level.

If resilient material is placed between the unit and the rail, insert a heavy steel plate between the unit and the resilient material to distribute the load. Cabinet penetrations (electrical, piping, etc.) should be properly sealed to protect against moisture and weather.

Figure 23. Post and Rail Mounting



Maximum recommended width for structural member is 5" (127 mm) to allow for adequate space for duct connections and electrical entry.

Unit	W	
	In.	mm
015C-040C	94	2388
045C-075C	99	2538

Rigging and Handling

Lifting brackets with 2" (51 mm) diameter holes are provided on the sides of the unit.

Use spreader bars, 96" to 100" (2438 to 2540 mm) wide to prevent damage to the unit cabinet. Avoid twisting or uneven lifting of the unit. The cable length from the bracket to the hook should always be longer than the distance between the outer lifting points.

If the unit must be stored at the construction site for an intermediate period, these additional precautions should be taken:

1. Make sure to support the unit well along the length of the base rail.
2. Make sure to level the unit (no twists or uneven ground surface).
3. Provide proper drainage around the unit to prevent flooding of the equipment.
4. Provide adequate protection from vandalism, mechanical contact, etc.
5. Securely close the doors.
6. If there are isolation dampers, make sure they are properly installed and fully closed to prevent the entry of animals and debris through the supply and return air openings.
7. Cover the supply and return air openings on units without isolation dampers.

Figure 24 shows an example of the rigging instruction label shipped with each unit.

WARNING

Use all lifting points. Severe personal injury and property damage can result from improper lifting adjustment.

Figure 24. Rigging and Handling Instruction Label

Rigging and Handling Instructions

Unit has either four or six lifting points (four-point shown below).

Caution: All lifting points must be used.

Note: Rigging cables must be at least as long as distance "A".

Lift Only As Indicated

Lifting Points

To determine the required lifting cable lengths and whether four- or six-point lifting is required, use *Table 5 & Table 6* and *Figure 25 & Figure 26*.

Referring to *Figure 25 & Figure 26*, note that dimension A is the distance between the outer lifting points. The four outer rigging cables must be equal to or longer than dimension A. Dimension B shows the minimum distance between the outer and the inner lifting points for six-point lifting. This can be used to roughly determine the required length of the middle cables for six-point lifting. Dimension A can be determined by subtracting dimensions X and Y from dimension Z. (i.e., $A = Z - X - Y$).

Where:

Z = Total unit length in inches
(refer to certified drawings for this dimension).

X = Outdoor/return air section length
(refer to *Table 5* for this dimension).

Y = Refer to *Table 6* for this dimension
(see *Figure 25 & Figure 26*).

If $A \leq 288"$ (7315 mm), 4-point lifting is sufficient.

If $A > 288"$ (7315 mm), 6-point lifting is required.

*Table 5: "X" Dimension (see *Figure 25 & Figure 26*)*

OUTDOOR/RETURN AIR SECTION	015C-030C	036C & 040C	045C & 075C
100 O.A.	0	0	0
PLENUM	40" (1016 mm)	52" (1321 mm)	48" (1259 mm)
0-30% O.A.	40" (1016 mm)	52" (1321 mm)	48" (1259 mm)
0-100% ECONOMIZER	40" (1016 mm)	52" (1321 mm)	72" (1829 mm)
0-100% ECONOMIZER WITH 15" RETURN FAN	62" (1575 mm)	—	—
0-100% ECONOMIZER WITH 30" RETURN FAN	52" (1321 mm)	52" (1321 mm)	—
0-100% ECONOMIZER WITH 40" RETURN FAN	—	80" (2032 mm)	—
0-100% ECONOMIZER WITH 44" RETURN FAN	—	—	72" (1829 mm)

*Table 6: "Y" Dimension (see *Figure 25 & Figure 26*)*

RPS UNIT SIZE	DIMENSION "Y"
015C — 030C	49.5" (1257 mm)
036C & 040C	38.2" (970 mm)
045C — 075C	39.5" (1003 mm)

Figure 25. Unit Type RPS/RDT Lifting Points

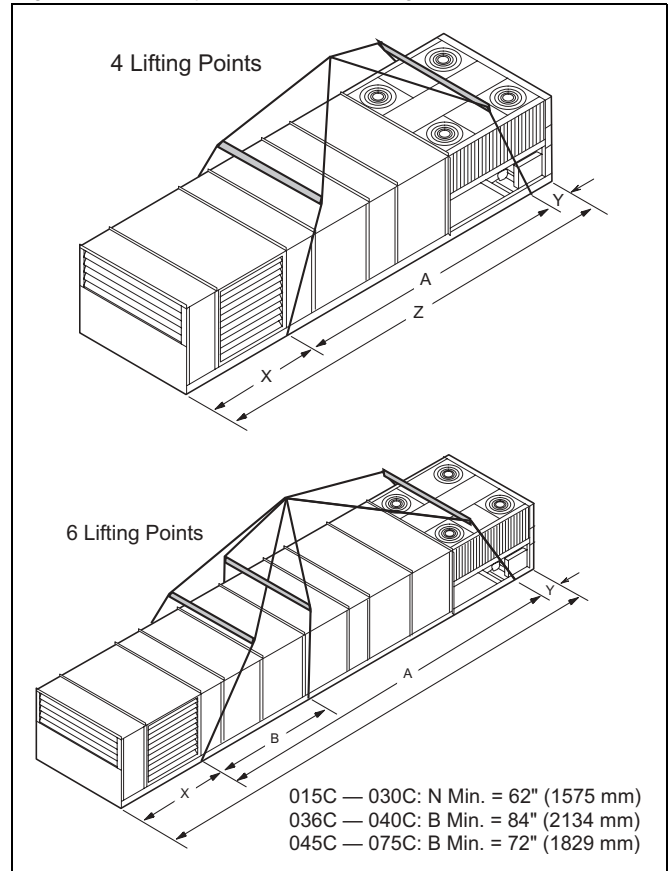


Figure 26. Unit type RFS Lifting Points

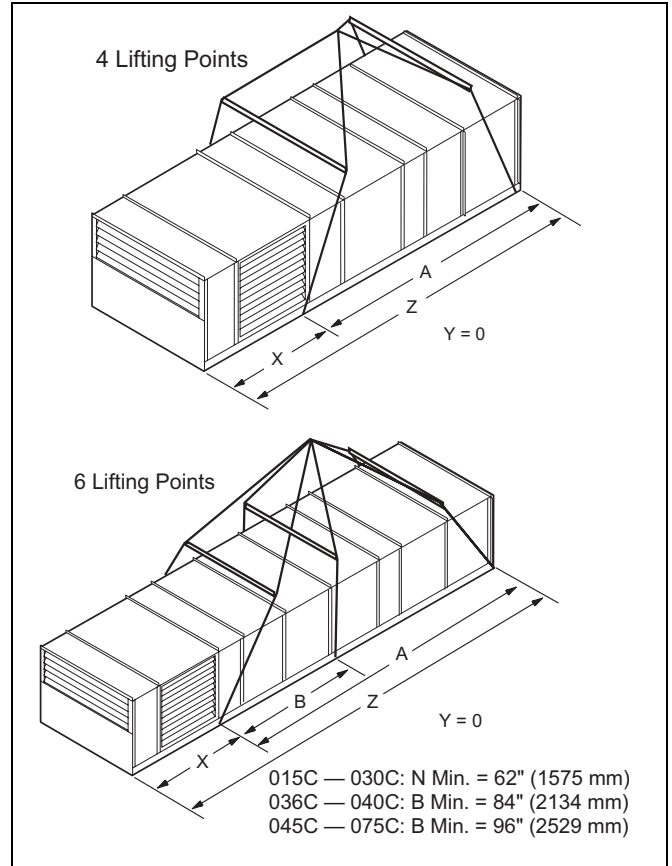


Figure 27. Figure 10c. Unit Type RCS

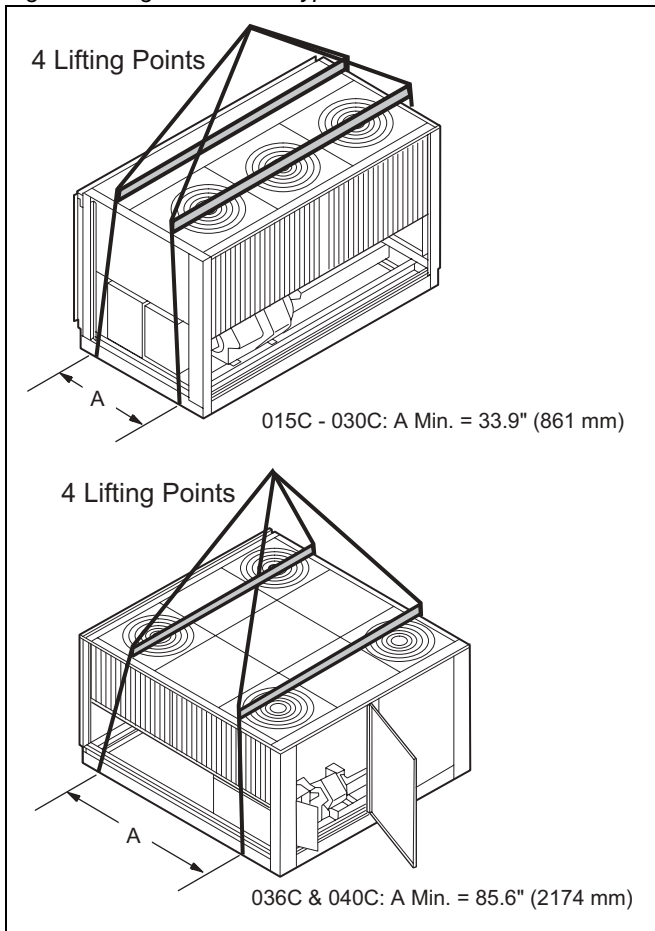
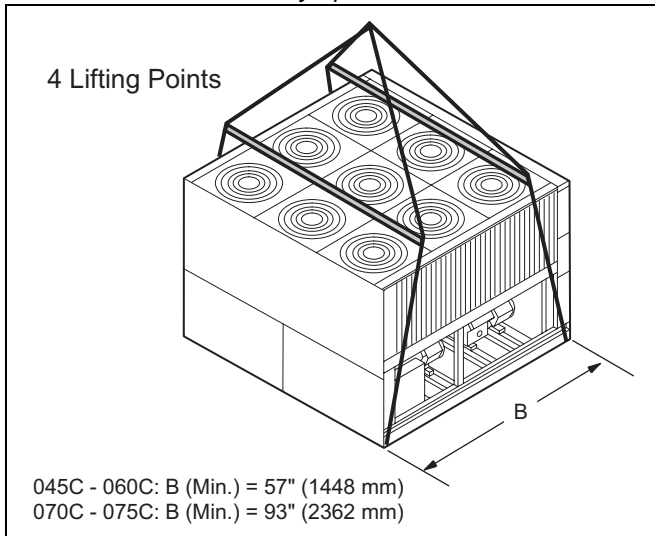


Figure 28. Unit Type RCS or Condenser Section from RPS/RDT Factory Split at Condenser



Reassembly of Split Units

Although RoofPak units typically ship from the factory as complete units, they may be split at the factory in one of three possible configurations.

1. The RFS air handler section and RCS condenser section ship as two separate units, each with its own power supply and unit nameplate. This configuration is ordered when the condenser is intended to remain remote from the air handler because of space or structural constraints.

On all units except the RFS with end discharge, refrigerant piping is stubbed out the exterior of the cabinet for convenient field piping between the RCS and RFS units, and all necessary refrigeration components are provided.

2. The RPS/RDT unit factory split at the condenser ships as an air handler section and a condenser section that will be recoupled together on the roof. This configuration would be ordered if a packaged RPS unit is desired, but cannot go to the job site because of shipping length or weight limitations. A single nameplate is attached to the air handler section and power is fed to both sections through the main control box, as it would be in a non-split RPS/RDT unit.

All interconnecting piping and refrigeration components are provided so that when the sections are coupled together only field-provided couplings are required to connect the piping.

3. The RPS/RDT unit factory split at the fan ships as two pieces, split at the supply fan bulkhead, to be recoupled together on the roof. Like the RPS/RDT unit factory split at the condenser, this configuration would be ordered if shipping length or weight limitation prevented a packaged RPS/RDT from being ordered. Splitting at the fan has the advantage of leaving all factory refrigerant piping intact so field evacuation and charging is not required.

A single nameplate is attached to the air handler section and power is fed to both sections through the main control box, as it would be in a non-split RPS/RDT unit.

RPS Factory Split at Condenser

Field reassembly of an RPS/RDT unit that has shipped split at the condenser takes place in three phases:

- Phase 1. Setting the sections and mechanically recoupling the cabinet.
- Phase 2. Reconnecting refrigerant piping.
- Phase 3. Reconnecting power and control wiring.

Phase 1. Setting the Sections and Cabinet Reassembly

The steps required to set the unit and reassemble the cabinet are shown in *Figure 29*, *Figure 33* on page 30, *Figure 34* on page 30, *Figure 35* on page 31, *Figure 37* on page 32 and *Figure 38* on page 32. The following items should be noted:

1. Top cap on air handler section and wire cover on condensing section must be removed before sections are set together. Refer to *Step 1* and *Figure 29*.
2. Piping brackets and clamps on both sections should be loosened so refrigerant lines can be moved out of the way to prevent interference and damage as the sections are set together. Refer to *Step 1* and *Figure 29*.
3. If unit is to be post-and-rail mounted on a structural beam that runs the full length of the unit, Refer to *Step 2* and *Figure 33* on page 30 (installation of condenser supports)

may be omitted. In this case, the bolts and lifting brackets shown in *Step 1* should be left in place.

Phase 2. Reconnecting Refrigerant Piping

All refrigerant piping required to reconnect the two sections is provided so that, when the piping closures are cut off, piping from the air handler and condenser sections will line up. Piping can then be connected using field supplied couplings.

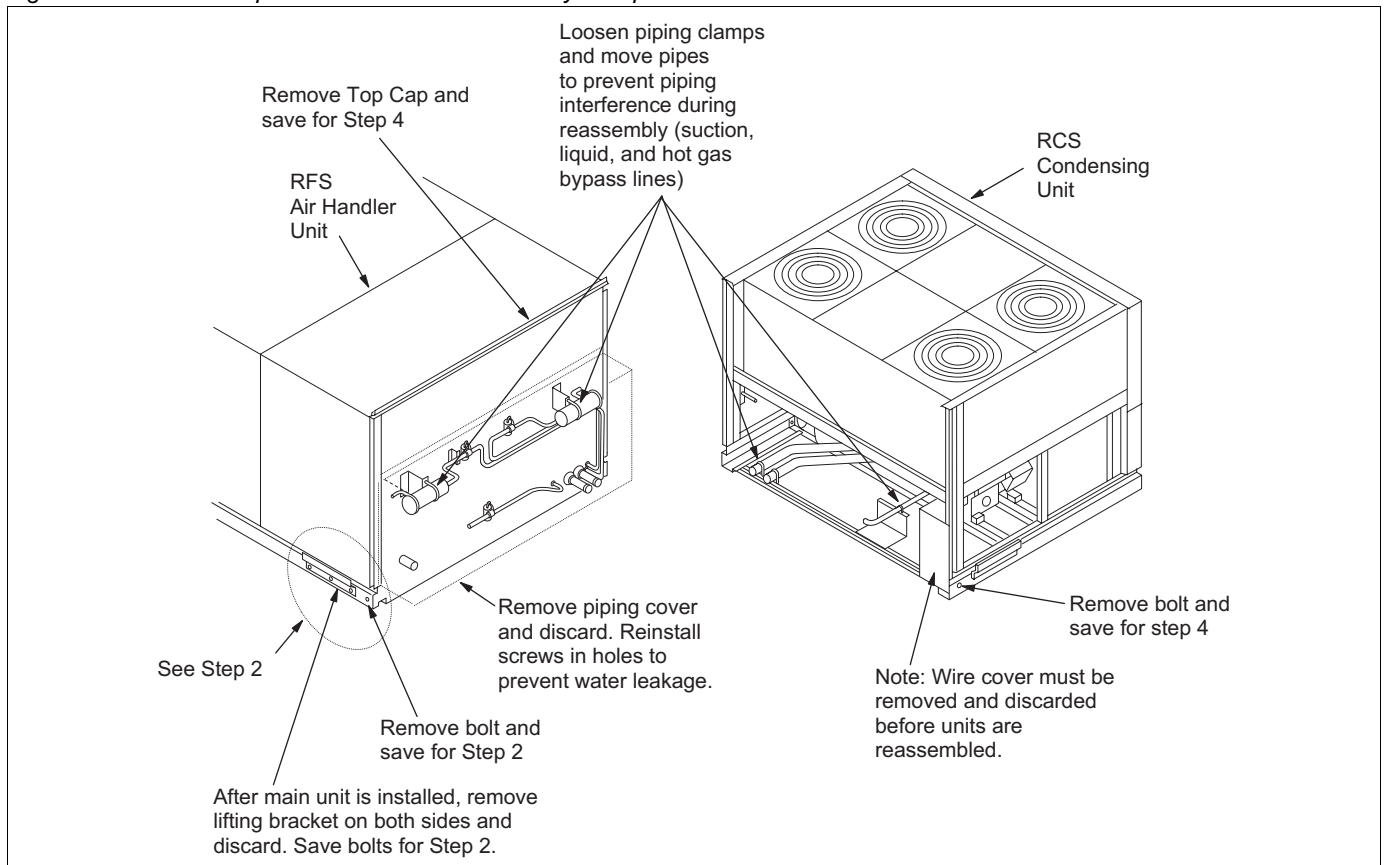
Like the RFS/RCS units, both sections of the RPS/RDT split-at-condenser unit ship from the factory with a holding charge. Before removing the piping closures, the unit should be inspected for line breakage or loosening of fittings, and it should be pressure tested as described in the previous “Holding Charge” section which is under “RFS Air Handler and RCS Condenser” above.

Leak testing, evacuation, charging the system, and refrigerant charge requirements for the split-at-condenser unit should be done per the procedures described in the “RFS Air Handler and RCS Condenser” section above.

Note: Refrigerant charge requirements for the RPS/RDT split-at-condenser can be determined from Table 5. Because no field installed refrigerant piping is required, the total charge per circuit is the sum of the base R-22 charge and the DX coil charge.

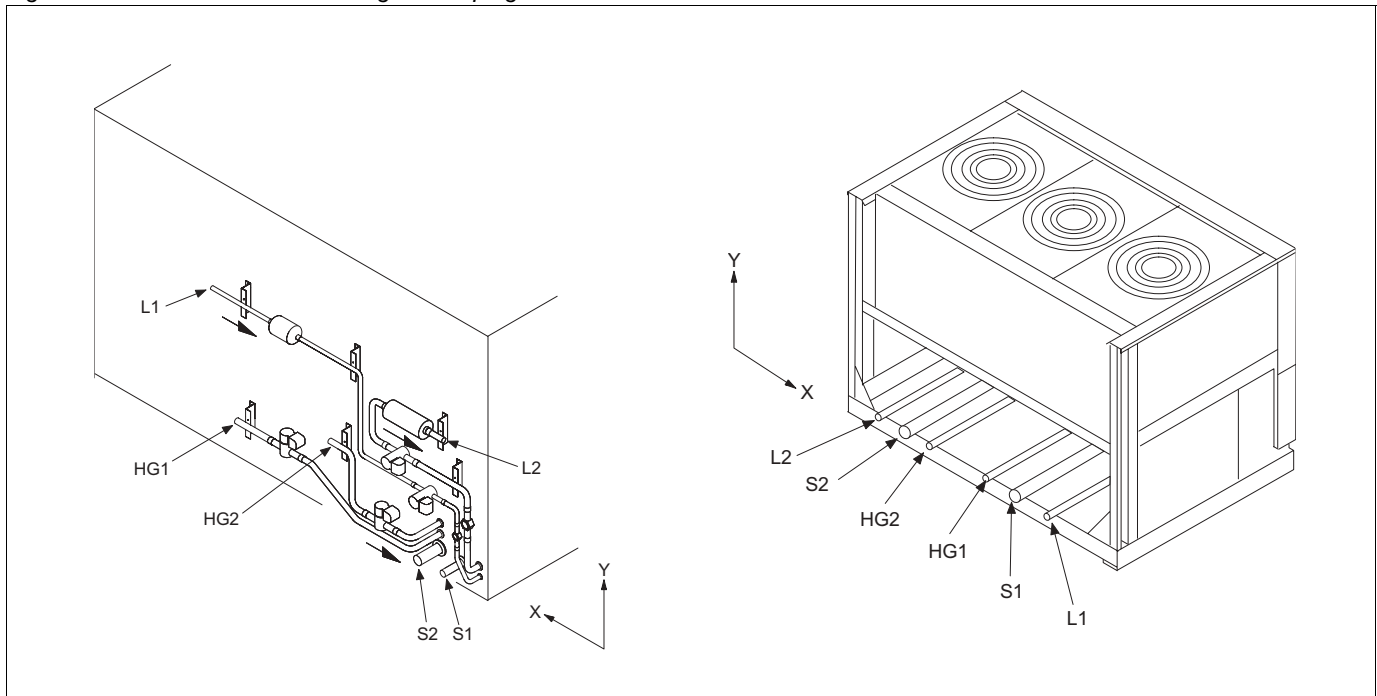
Step 1. Set the main unit in place and prepare the unit for reassembly as shown in *Figure 29*.

Figure 29. RPS/RDT Split at Condenser Reassembly - Step 1



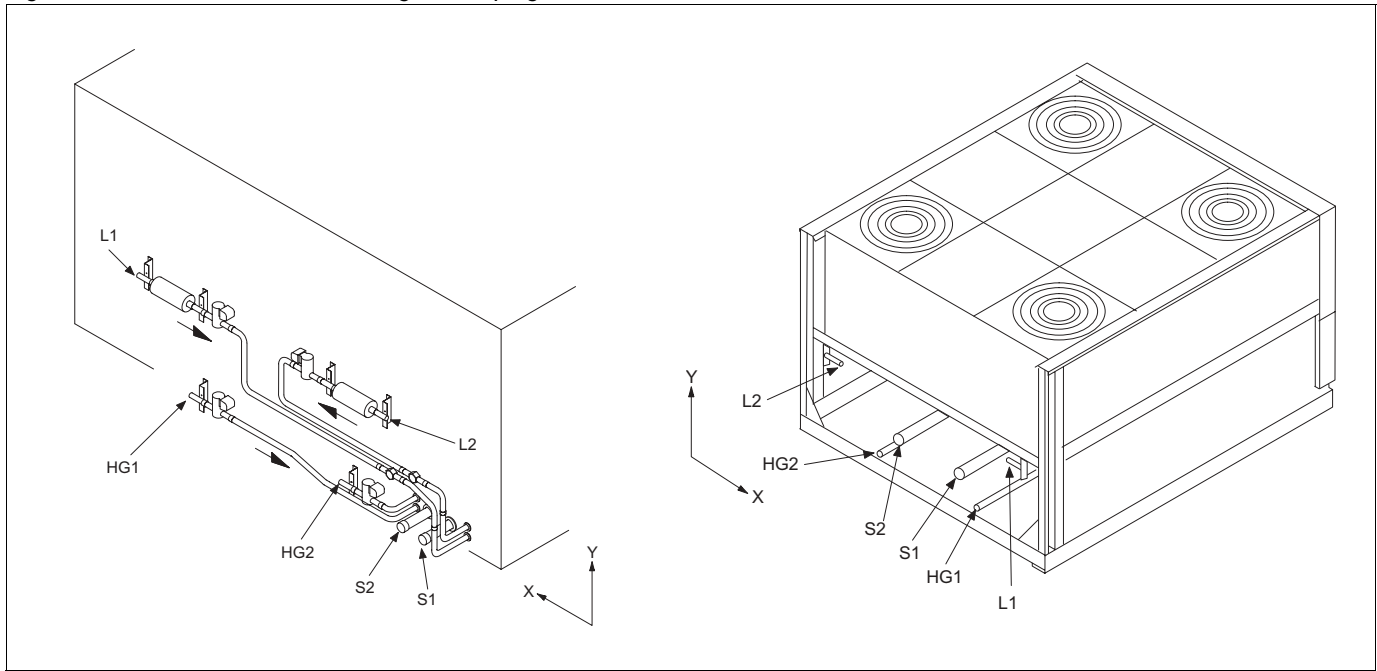
Note: RFS units with front discharge do NOT include refrigerant piping to the DX coil. Field piping is required.

Figure 30. RFS/RCS 015-030 Refrigerant Piping Connections



Note: RFS units with front discharge do NOT include refrigerant piping to the DX coil. Field piping is required.

Figure 31. RFS/RCS 036 & 040 Refrigerant Piping Connections

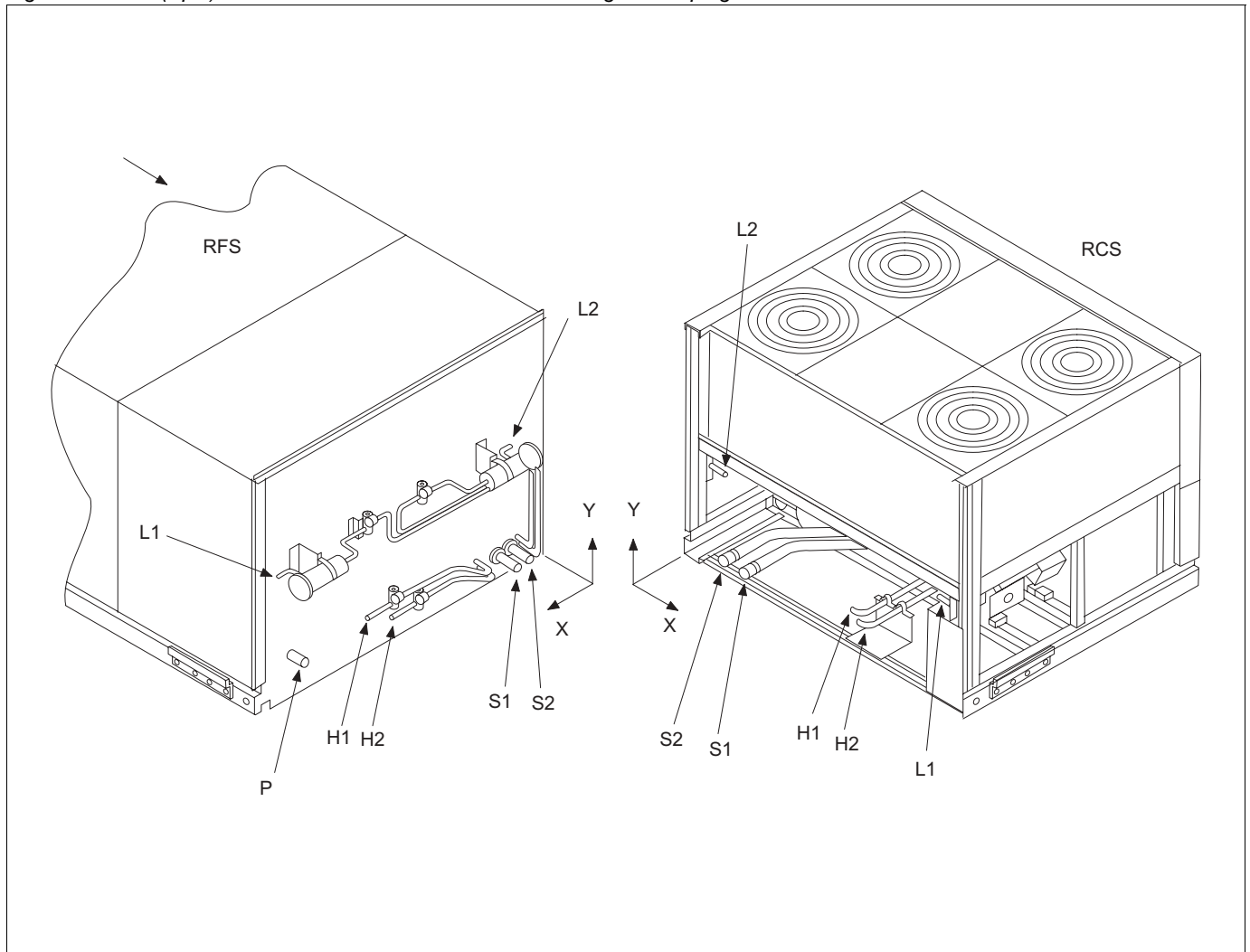


Note: RFS units with front discharge do NOT include refrigerant piping to the DX coil. Field piping is required.

Table 7:

Component Circuit			Connection Sizes				Connection Locations							
			015C	020C	025C	030C- 040C	RFS/RFR 015-030		RCS 015-030		RFS/RFR 036 & 040		RCS 036 & 040	
							X (in.)	Y (in.)	X (in.)	Y (in.)	X (in.)	Y (in.)	X (in.)	Y (in.)
S1	Suction Line	Ckt.1	1-1/8	1-1/8	1-5/8	1-5/8	9.00	5.70	67.60	6.25	8.25	5.70	59.50	19.30
S2	Suction Line	Ckt.2	1-3/8	1-5/8	1-3/8	1-5/8	14.00	5.70	28.00	6.25	13.25	5.70	34.60	19.30
L1	Liquid Line	Ckt.1	5/8	5/8	7/8	7/8	56.00	32.00	75.00	6.25	79.00	25.00	70.50	25.00
L2	Liquid Line	Ckt.2	7/8	7/8	7/8	7/8	7.60	28.00	21.00	6.25	15.00	25.00	23.50	25.00
HG1	HGBP Line	Ckt.1	7/8	7/8	7/8	7/8	52.00	10.00	60.80	6.25	67.00	6.70	64.60	6.60
HG2	HGBP Line	Ckt.2	7/8	7/8	7/8	7/8	36.00	16.00	35.50	6.25	32.00	6.70	29.50	6.00

Figure 32. RPS (Split) / RFS/RFR 045-135 RCS 045-075 Refrigerant Piping Connections



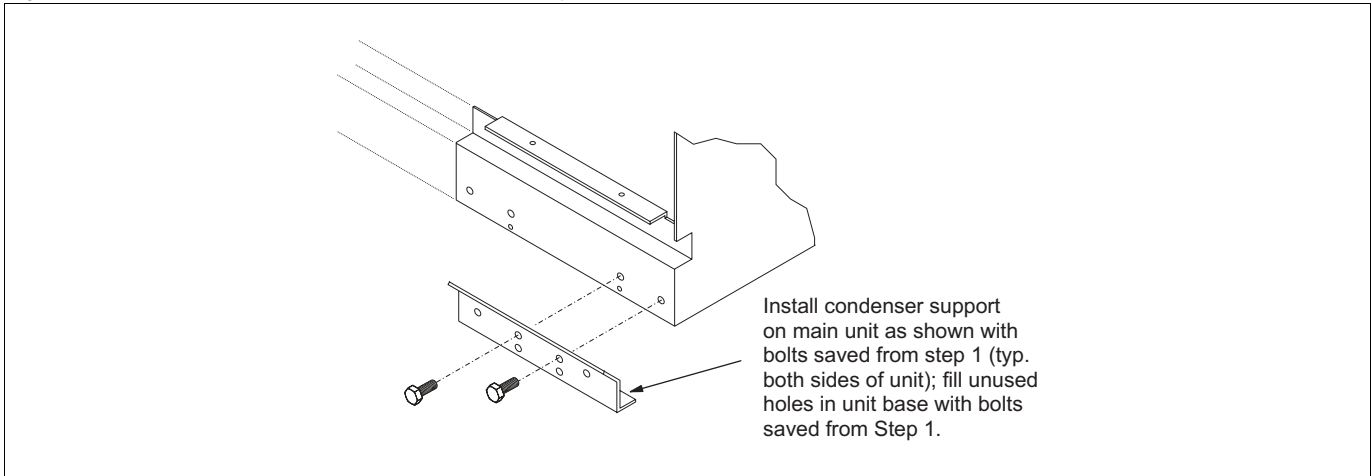
Note: RFS units with front discharge do NOT include refrigerant piping to the DX coil. Field piping is required.

Table 8:

Component Circuit			Connection Sizes		Connection Locations			
			045C	050C - 075C	RPS (Split) RFS/RFR 045 - 075C		RCS 045 - 075C	
					X (in.)	Y (in.)	X (in.)	Y (in.)
S1	Suction Line	Ckt.1	1-5/8	2-1/8	11.7	5.2	21.	7.0
S2	Suction Line	Ckt.2	1-5/8	2-1/8	7.5	5.2	16.5	7.0
L1	Liquid Line	Ckt.1	7/8	7/8	81.5	29.1	81.5	29.1
L2	Liquid Line	Ckt.2	7/8	7/8	10.3	29.1	10.3	29.1
HG1	HGBP Line	Ckt.1	7/8	7/8	52.1	10.4	52.1	10.4
HG2	HGBP Line	Ckt.2	7/8	7/8	40.9	4.7	40.9	4.7

Step 2. Install condenser supports as shown in Figure 33.

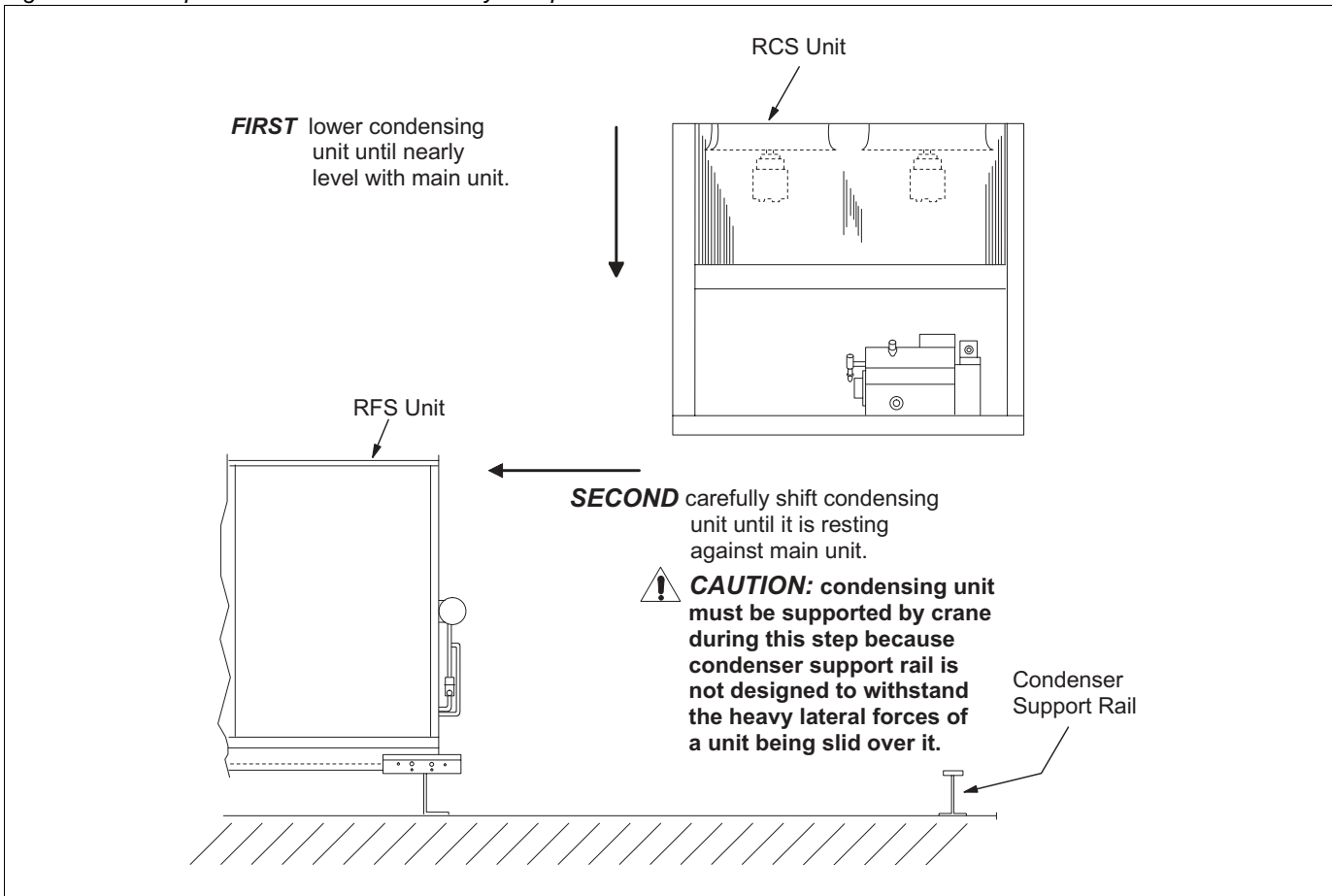
Figure 33. RPS/RDT Split at Condenser Reassembly - Step 2



Step 3. Set the condensing unit in place as shown in Figure 34.

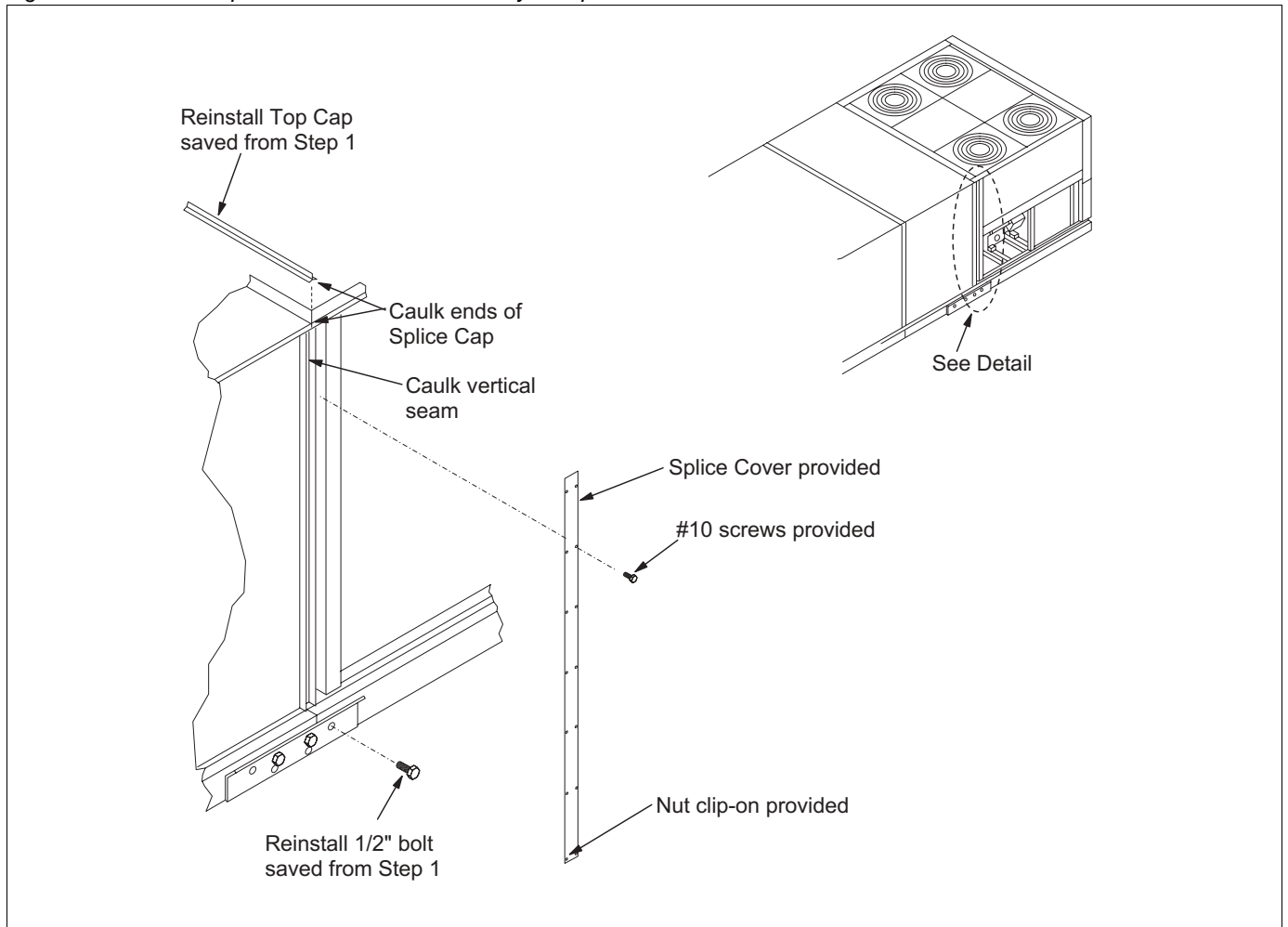
CAUTION
Do not damage piping components while setting condensing unit in place.

Figure 34. RPS Split at Condenser Reassembly - Step 3



Step 4. After condensing unit is set in place, install parts as shown in *Figure 35*.

Figure 35. RPS/RDT Split at Condenser Reassembly - Step 4



Step 5. Make refrigerant piping and electrical connections.

See Figure 30 and Figure 31 on page 28 and Figure 32 on page 29.

Reconnecting Power and Control Wiring

Units that ship split at the condenser section have complete wire harnesses for power and control wiring just as if they were a package. However, if the installed harness terminates in both the condensing section and air handler section and crosses the split, then only the condensing end is factory connected. The harness is then coiled and strapped down for shipment. The field must un-coil the wire and make the air handler termination per the wiring schematic.

1. Size 15-30- The wire is coiled in the condensing section control box. The condensing section control box has a hole in the side that lines up with a 3" nipple in the side of the air handling control box (see *Figure 36*). Uncoil the wires, run them out of the hole in the condensing section box, into the nipple in the air handling box, and make the proper connections.
2. Size 36-40 - The wire is coiled in the rail of the condensing section and you access it by removing the rail cover, per *Figure 38*.
 - a. Run the power wire into the FB7 fuse box and connect to the load size of the fuses.
 - b. Run control wire into the 3" nipple on air handling control box (see *Figure 36*) and make connections.
3. Size 45 to 60 - The wire is coiled in the rail of the condensing section. Remove the rail cover per *Figure 38* and run the wire into the 3" nipple on the air handling control box.
 - a. Connect power wire to the terminal blocks on the side of the air handling control box per.
 - b. Connect control wire per the wiring schematic.
4. Size 70 to 75 - The wire is coiled in FB 1-4 fuse box on the condensing section. Remove the end cover of the fuse box and run the wire into the 3" nipple on the air handling control box.
 - a. Connect power wire to the terminal blocks on the side of the air handling control box per *Figure 37*.
 - b. Connect control wire per the wiring schematic.

Figure 36. Connecting Power and Control Wiring (015-040)

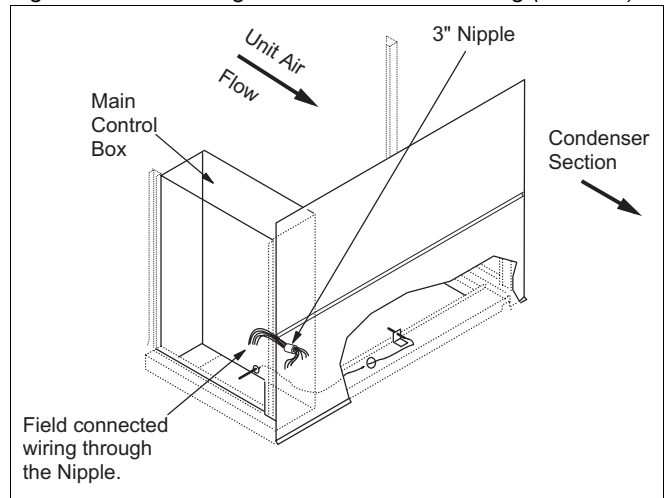


Figure 37. Connecting Power and Control Wiring (045-075)

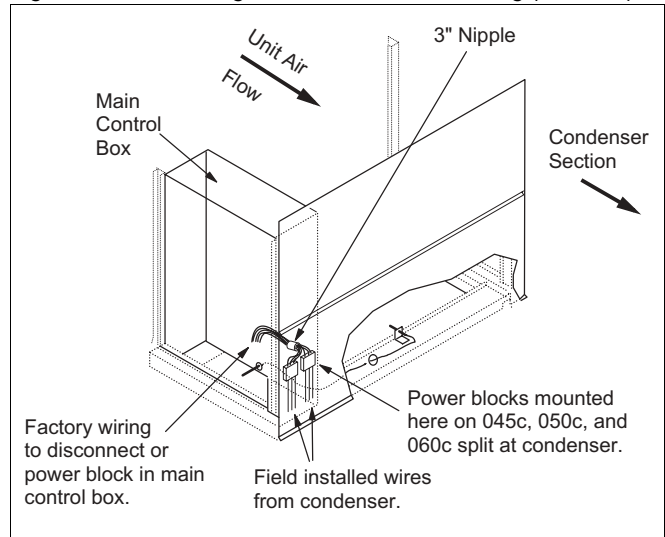
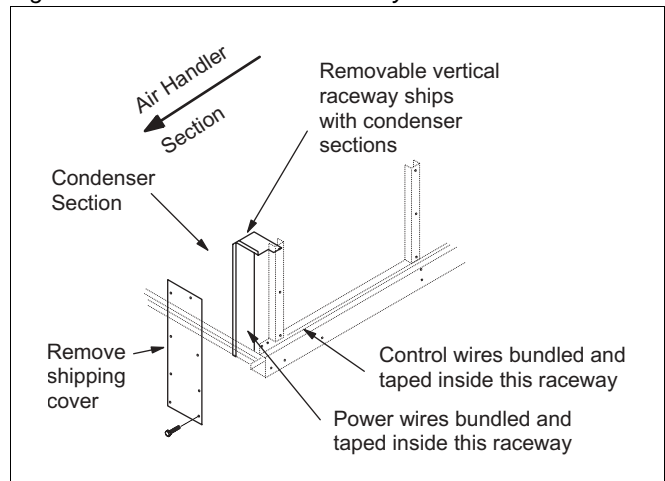


Figure 38. Remove Vertical Raceway



RPS/RDT Factory Split at Fan

Field reassembly of an RPS/RDT unit that has shipped split at the fan takes place in two phases:

Phase 1. Setting the sections and mechanically recoupling the cabinet.

Phase 2. Reconnecting power and control wiring.

Phase 1. Setting the Sections and Cabinet Reassembly

The steps required to set the unit and reassemble the cabinet are shown in Figures . The following items should be noted:

1. Top cap and plywood covers must be removed before the sections are set together, but the steel retainer clips must be left in place to secure the bulkhead. *Refer to Step 1 and Figure 39.*
2. Both sections must be carefully lowered into place to make sure that the roof curb engages the recesses in the unit base.
3. All seams at the split must be caulked watertight after recoupling the sections, as shown in *Step 3 and Figure 40 on page 34.*

Phase 2. Reconnecting Power and Control Wiring

The DX coil/condenser section contains power and control harnesses which have their excess length in the blank or heat section that is normally immediately downstream of the fan. Once the sections are physically reconnected, the ends of the power harness are fed back through the unit base into the junction box, per the unit's electrical schematics.

CAUTION

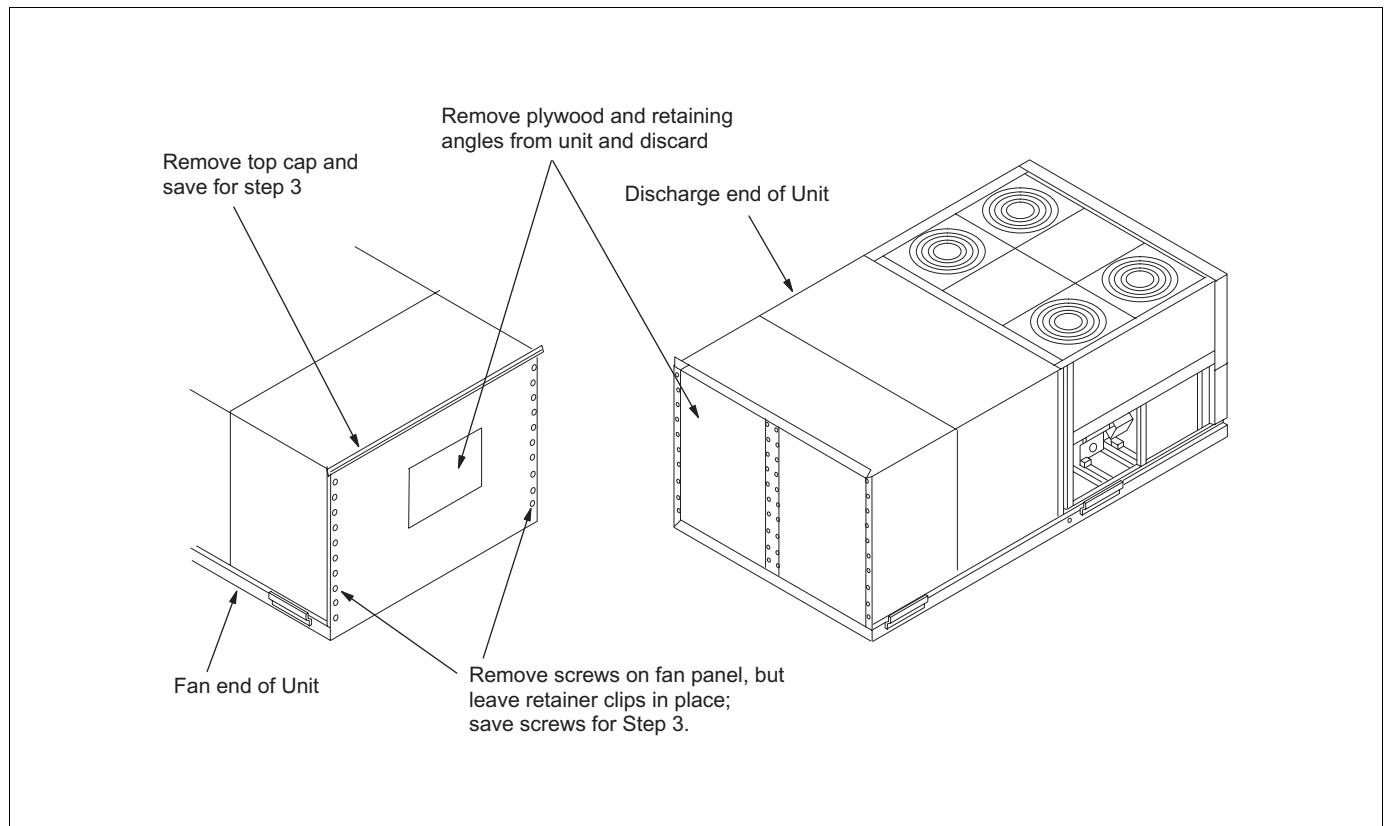
Connect the power block correctly and maintain proper phasing. Improper installation can cause severe equipment damage.

When reconnection of the power wires is complete, the inner raceway cover in the blank or heat section must be reinstalled. *Figure 41 on page 34* shows a typical installation of the raceway cover.

Control harnesses can be run by removing the external raceway covers on either side of the unit split. The excess harness length can be removed from the external raceway on the DX side of the split, routed along the raceway through the bushed hole in the fan section and into the junction box where control wiring terminal blocks are provided for reconnection. All electrical connections should be made per the unit's electrical schematics. Reinstall the external raceway covers after routing of the control wires is complete.

Step 1. Prepare the units for reassembly as shown in *Figure 39.*

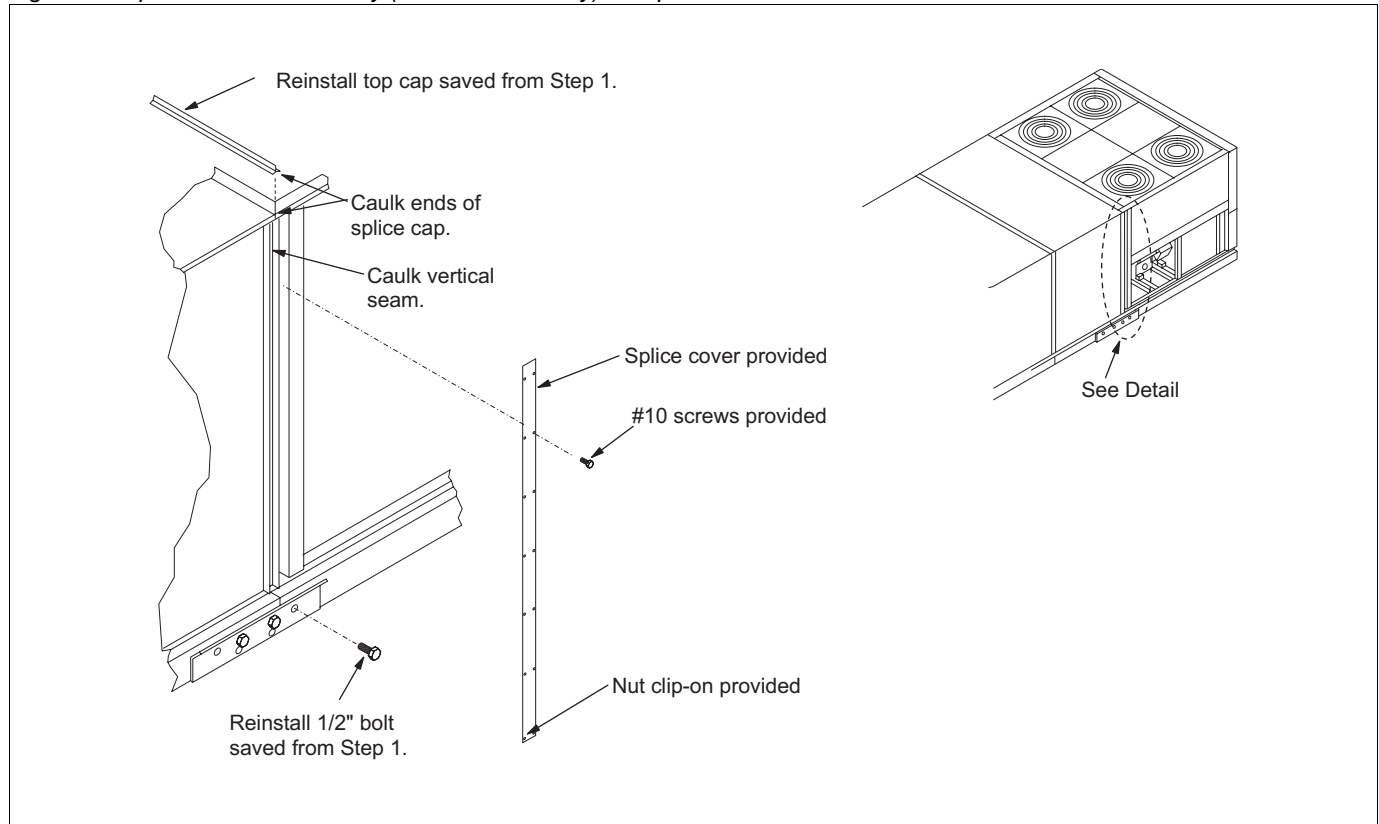
Figure 39. RPS/RDT Split at Fan Reassembly - Step 1



Step 2. Set fan end of unit and discharge end of unit in place.

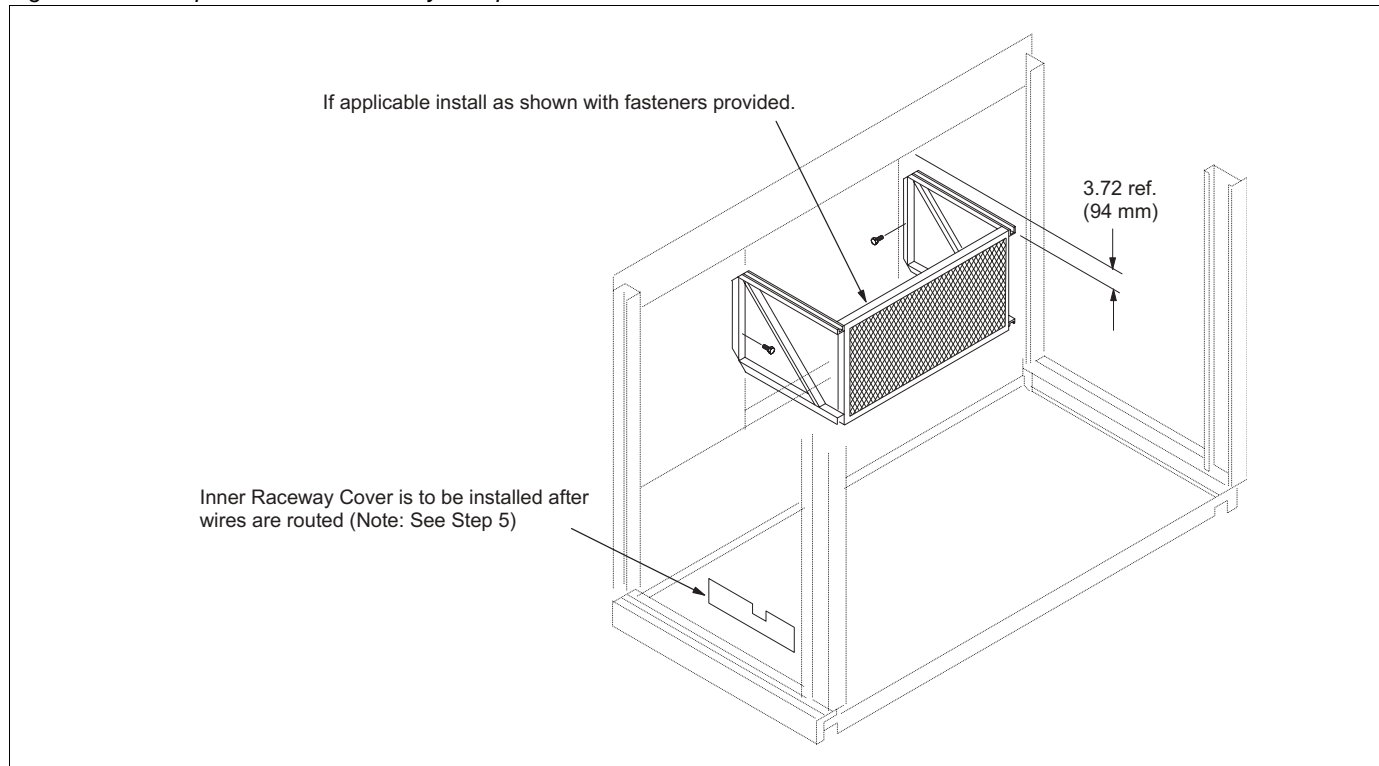
Step 3. Caulk and install parts as shown in *Figure 40*.

Figure 40. Split at Fan Reassembly (RPS 045-075 only) - Step 3



Step 4. Make electrical connections and reinstall Inner Raceway Cover as shown in *Figure 41*.

Figure 41. RPS Split at Fan Reassembly - Step 4



Piping Recommendations

1. Use type K or L clean copper tubing. All joints should be thoroughly cleaned or brazed with high temperature solder.
2. Piping sizes should be based on temperature/pressure limitations as recommended in the following paragraphs. Under no circumstances should pipe size be based strictly upon coil or condensing unit piping connection size.
3. Suction line piping pressure drop should not exceed the pressure equivalent of 2°F (1°C), 3 psi (20.7 kPa) per 100 feet (30.5 m) of equivalent pipe length. After the suction line size has been determined, the vertical suction risers should be checked to verify that oil will be carried up the riser and back to the compressor. The suction line(s) should be pitched in the direction of refrigerant flow and adequately supported. Lines should be free draining and fully insulated between the evaporator and the compressor.
4. Vertical suction risers should be checked using *Table 9 on page 35* to determine the minimum tonnage required to carry oil up suction risers of various sizes.
5. The liquid line should be sized for a pressure drop not to exceed the pressure equivalent of 2°F (1°C), 6 psi (41.4 kPa) saturated temperature. The RFS unit includes a factory installed filter-drier, solenoid valve, and sightglass in each liquid line, upstream of the thermostatic expansion valve.

Table 9: Minimum tonnage (R-22) to carry oil up suction riser at 40°F saturated suction

LINE SIZE O.D.	1-1/8"	1-3/8"	1-5/8"	2-1/8"	2-5/8"	3-1/8"	3-5/8"	4-1/8"
MIN. TONES	1.5	2.5	3.8	7.6	13.10	20.4	29.7	41.3

Holding Charge

The RFS unit and RCS unit ship with a nitrogen holding charge. At the time the unit was received, a visual inspection of the unit piping should have been made to be sure no breakage had occurred or that the fittings had not loosened. A pressure test on the RCS units should indicate a positive pressure in the unit. If no pressure is evident, the unit will have to be leak tested and the leak repaired. This should be noted and reported to the McQuay sales representative and freight carrier if the loss is due to shipping damage.

WARNING

Always vent piping to atmosphere before applying heat to removed brazed piping caps and plugs. Failure to do so could result in hazardous pressures within the refrigerant circuit, possibly resulting in a dangerous explosion.

RCS - Vent to atmosphere by opening gauge ports at the compressors and liquid line shutoff valves. Make sure manual valves are not back seated to shut off the gauge ports.

RFS - Vent to atmosphere by cutting off the process tubes on the suction line caps.

The RFS unit does not have gauge ports for pressure measurement. If no positive pressure is detected when cutting off the process tubes and removing the tubing caps, the unit should be leak tested as described above, after the interconnecting piping has been brazed in place. This test will also confirm the integrity of the field braze joints.

Leak Testing

In the case of loss of the nitrogen holding charge, the unit should be checked for leaks prior to charging the complete system. If the full charge was lost, leak testing can be done by charging the refrigerant into the unit to build the pressure to approximately 10 psig and adding sufficient dry nitrogen to bring the pressure to a maximum of 125 psig. The unit should then be leak tested with halide or electronic leak detector. After making any necessary repair, the system should be evacuated as described in the following paragraphs.

WARNING

Do not use oxygen to build up pressure.

A serious explosion could result from using oxygen to build up pressure, resulting in severe personal injury or death.

Evacuation

After it has been determined that the unit is tight and there are no refrigerant leaks, the system should be evacuated. The use of a vacuum pump with a pumping capacity of approximately 3 cu.ft./min. and the ability to reduce the vacuum in the unit to at least 1 millimeter (1000 microns) is recommended.

1. A mercury manometer or an electronic or other type of micron gauge should be connected to the unit at a point remote from the vacuum pump. For readings below 1 millimeter, an electronic or other micron gauge should be used.
2. The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 1 millimeter of vacuum. The system is first evacuated to approximately 29" (740 mm) of mercury. Enough refrigerant vapor is then added to the system to bring the pressure up to 0 pounds (0 microns).
3. Then the system is once again evacuated to 29" (740 mm) of vacuum. This procedure is repeated three times. This method can be most effective by holding system pressure at 0 pounds (0 microns) for a minimum of 1 hour between evacuations. The first pulldown will remove about 90% of the noncondensables, the second about 90% of that remaining from the first pulldown, after the third, only 1/10 of 1% of noncondensables will remain.

Table 13 on page 37 shows the relationship between pressure, microns, atmospheres, and the boiling point of water.

CAUTION

On systems with optional hot gas bypass, it is important that the bypass solenoid valve be located on the RCS and not on the RFS unit to prevent liquid return and damage to the compressor.

CAUTION

To service liquid line components, the manual shutoff valve is closed and refrigerant is pumped into the condenser. The pounds of refrigerant in the system may exceed the capacity of the condenser, depending on the amount of refrigerant in the liquid lines between the RFS and RCS units. Suitable means of containing the refrigerant is required.

CAUTION

Before replacing refrigerant sensors or safeties, see "Refrigerant Charge" on page 96 for an important warning to prevent an abrupt loss of the entire charge.

Table 10: Approximate Refrigerant Charge per Circuit

Unit Size	Base R-22 Charge Lb. Per Circuit (Less DX Coil)		EVAP. COIL (LBS/CKT/ COIL ROW)	Additional Charge for Heat Section Additional Length		COND. PUMPDOWN CAPACITY * (LBS. R-22)
	Circuit 1	Circuit 2		Circuit 1	Circuit 2	
015C	11	18	3.3	.5	1	52.0
020C	11	18	3.3	1	1	52.0
025C	23	22	4.9	1	1	73.6
030C	23	21	4.9	1	1	73.6
036C	32	32	4.9	1	1	81.7
040C	33	32	2.5	1	1	50.9

*Condenser pumpdown capacity is based on volume between condenser entrance and liquid line solenoid at 90°F, 90% full

Table 11: Approximate Refrigerant Charge per Circuit

Unit Size	Base R-22 Charge Lb. Per Circuit (Less DX Coil)				DX Coil R-22 Charge — Lb. per Circuit		Condenser Pumpdown Capacity** (Lb. R-22)
	RPS		RDT		DX=S*	DX=L*	
	Circuit #1	Circuit #2	Circuit #1	Circuit #2			
045C	34	33	34	28	3 x No. of DX rows	—	47
050C	34	33	35	34	3 x No. of DX rows	3-1/2 x No. of DX rows	49
060C	35	34	35	34	3 x No. of DX rows	3-1/2 x No. of DX rows	49
070C	39	39	40	40	3 x No. of DX rows	3-1/2 x No. of DX rows	67
075C	39	39	40	40	3 x No. of DX rows	3-1/2 x No. of DX rows	67

*DX coil configuration (S = Standard, L = Large) is identified by the 8th digit of the RPS/RDT or RFS model number, found on the unit nameplate. For example, DX = L for unit model number RFS06OCLY.

**Condenser pumpdown capacity is based on volume between condenser entrance and liquid line solenoid at 90° F, 90% full.

Table 12: Weight of refrigerant R-22 in copper lines (pounds per 100 feet of Type L tubing)

O.D. LINE SIZE	VOL. PER 100 FT. IN CUBIC FEET	WEIGHT OF REFRIGERANT, LBS./100 FEET			
		LIQUID @100°F	HOT GAS @120°F COND.	SUCTION GAS (SUPERHEAT TO 85°F)	
				30°F	40°F
3/8"	0.054	3.84	0.202	0.052	0.077
1/2"	0.100	7.12	0.374	0.098	0.143
5/8"	0.162	7.12	0.605	0.158	0.232
7/8"	0.336	24.00	1.260	0.323	0.480
1-1/8"	0.573	40.80	2.140	0.550	0.820
1-3/8"	0.872	62.10	3.260	0.839	1.250
1-5/8"	1.237	88.00	4.620	1.190	1.770
2-1/8"	2.147	153.00	8.040	2.060	3.060
2-5/8"	3.312	236.00	12.400	3.180	4.720
3-1/8"	4.728	336.00	17.700	4.550	6.750
3-5/8"	6.398	456.00	24.000	6.150	9.140
4-1/8"	8.313	592.00	31.100	8.000	11.190

Refrigeration Service Valves

The unit is shipped with all refrigeration service valves closed. RDT, RPS and RCS units have the following:

Discharge Valve - One per refrigerant circuit, located between the compressors and condenser.

Liquid Valve - One per refrigeration circuit, located at end of condensing section opposite the condenser control box.

RFS units do not ship with service valves installed. Before attempting to start the compressors, all refrigeration service valves should be fully opened and backseated.

Table 13: Pressure-vacuum equivalents

ABSOLUTE PRESSURE ABOVE ZERO		VACUUM BELOW 1 ATMOSPHERE		APPROXIMATE FRACTION OF 1 ATMOSPHERE	BOILING POINT OF H2O AT EACH PRESSURE (°F)
MICRONS	PSIA	MERCURY (MM)	MERCURY (IN.)		
0	0	760.00	29.921	—	—
50	0.001	759.95	29.920	1/15,200	—50
100	0.002	759.90	29.920	1/7,600	-40
150	0.003	759.85	29.920	1/5,100	—33
200	0.004	759.80	29.910	1/3,800	—28
300	0.006	759.70	29.910	1/2,500	—21
500	0.009	759.50	29.900	1/1,520	—12
1,000	0.019	759.00	29.880	1/760	1
2000	0.039	758.00	29.840	1/380	15
4,000	0.078	756.00	29.760	1/189	29
6000	0.117	754.00	29.690	1/127	39
8,000	0.156	752.00	29.600	1/95	46
10,000	0.193	750.00	29.530	1/76	52
15,000	0.290	745.00	29.330	1/50	63
20,000	0.387	740.00	29.130	1/38	72
30,000	0.580	730.00	28.740	1/25	84
50,000	0.967	710.00	27.950	1/15	101
100,000	1.930	660.00	25.980	2/15	125
200,000	3.870	560.00	22.050	1/4	152
500,000	9.670	260.00	10.240	2/3	192
760,000	14.697	0	0	1 Atmosphere	212

Charging the System

RCS units are leak tested at the factory and shipped with a nitrogen holding charge. If the holding charge has been lost due to shipping damage, the system should be charged with enough refrigerant to raise the unit pressure to 30 psig after first repairing the leaks and evacuating the system.

1. After all refrigerant piping is complete and the system has been evacuated, it can be charged as described in the paragraphs following. Connect the refrigerant drum to the gauge port on the liquid shutoff valve, and purge the charging line between the refrigerant cylinder and the valve. Then open the valve to the midposition.
2. If the system is under a vacuum, stand the refrigerant drum with the connection up, open the drum and break the vacuum with refrigerant gas.
3. With a system gas pressure higher than the equivalent of a freezing temperature, invert the charging cylinder and elevate the drum above the condenser. With the drum in this position and the valves open, liquid refrigerant will flow into the condenser. Approximately 75% of the total requirement estimated for the unit can be charged in this manner.
4. After 75% of the required charge has entered the condenser, reconnect the refrigerant drum and charging line to the suction side of the system. Again purge the connect-

ing line, stand the drum with the connection side up, and place the service valve in the open position.

Important: At this point, the charging procedure should be interrupted and prestart checks made before attempting to complete the refrigerant charge.

Note: It is recommended that the total operating charge per circuit be stamped on the unit nameplate for future reference.

Refrigerant Charge

Each unit is designed for use with R-22. The total charge per circuit is the sum of four values. The exact charge for a one piece RPS/RDT is on the unit nameplate.

1. Condenser section charge - refer to Table 10 on page 36.
2. Evaporator coil charge - refer to Table 10 on page 36.
3. Charge for length of unit piping to the evaporator coil - refer to Table 10 on page 36.
4. Charge for length of interconnecting piping between the RCS and RFS units, installed by field - refer to Table 12 on page 36.

Note: The values shown in Table 10 and Table 12 are for each circuit.

Note: The total operating charge per circuit should not exceed the pumpdown capacity per circuit, shown in Table 10.

Subcooling

When field charging the unit, the following must be followed to properly charge the unit:

- All compressors on each circuit operating at full capacity.
- Allowable subcooling ranges are between 13°F to 20°F.
- Ambient temperature must be between 60°F and 105°F.
- Hot Gas Bypass NOT operating (only if unit is supplied with option)
- SpeedTrol motors operating at 100% (only if unit is supplied with option)

If any one of the above items is not followed, subcooling readings will not be accurate and the potential exists for over or undercharging of the refrigerant circuit.

Condensate Drain Connection

The unit is provided with a 1.5" male NPT condensate drain connection. Refer to certified drawings for the exact location. The unit and drain pan must be level side to side and a P-trap must be installed for proper drainage.

RPS units may have positive or negative pressure sections. It is recommended that traps be used in both cases with care given to negative pressure sections. In Figure 42, dimension "A" should be a minimum of 8" (203 mm). As a conservative measure to prevent the cabinet static pressure from blowing or drawing the water out of the trap and causing air leakage, dimension A should be two times the maximum static pressure encountered in the coil section in inches w.c.

Drainage of condensate directly onto the roof may be acceptable; refer to local codes. It is recommended that a small drip pad of either stone, mortar, wood or metal be provided to protect the roof against possible damage.

If condensate is to be piped into the building drainage system, the drain line should be pitched away from the unit at a minimum of 1/8" per foot. The drain line must penetrate the roof external to the unit. Refer to local codes for additional requirements. Sealed drain lines require venting to provide proper condensate flow.

Where the cooling coils have intermediate condensate pans on the face of the evaporator coil, copper tubes near both ends of the coil provide drainage to the main drain pan. Check that the copper tubes are in place and open before the unit is put into operation.

Because drain pans in any air conditioning unit will have some moisture in them, algae, etc. will grow. Periodic cleaning is necessary to prevent this buildup from plugging the drain and causing the drain pan to overflow. Also, the drain pans should be kept clean to prevent the spread of disease. Cleaning should be performed by qualified personnel.

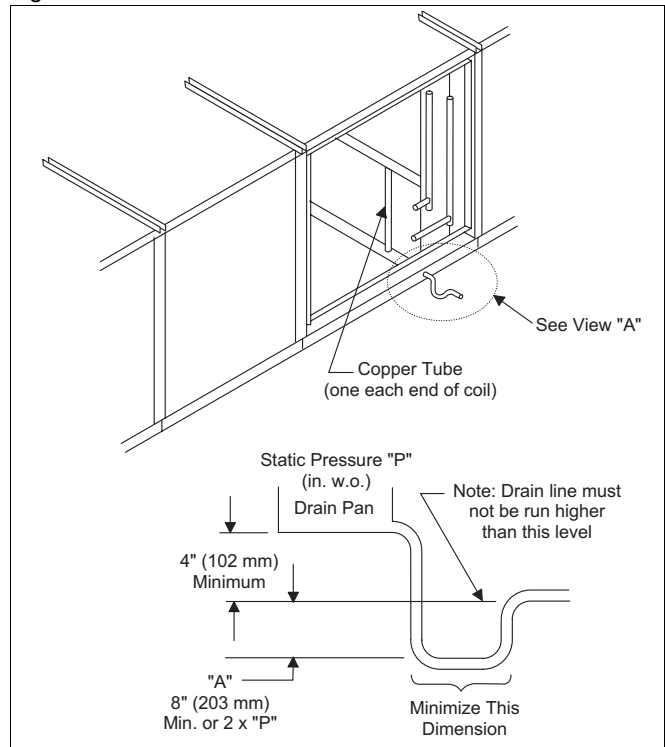


WARNING

Material that can grow in drain pans should be cleaned on periodically. Material in uncleaned drain pans may cause disease.

Cleaning should be performed by qualified personnel.

Figure 42. Condensate drain connection



Unit Piping

Gas Piping

See the "Installation" section of the gas-fired furnace installation manual, Bulletin No. IM 684 or 685.

Fuel Oil Piping

See the "Installation" section of the forced draft oil-fired furnace installation manual, Bulletin No. IM 198.

Hot Water Coil Piping

Hot water coils are provided without valves for field piping or piped with three-way valves and actuator motors. Note: If the unit is equipped with an iron valve, connecting to a copper piping system will likely cause galvanic corrosion to occur and the valve will not last. All coils have vents and drains factory installed.

Hot water coils are not normally recommended for use with entering air temperatures below 40°F (4°C). No control system can guarantee a 100% safeguard against coil freeze-up. Glycol solutions or brines are the only freeze-safe media for operation of water coils at low entering air temperature conditions.

When no factory piping or valve is included, the coil connections are 1 5/8" ODM copper. With the factory piping and valve package, field piping connections are the same NPT size as the valve with female threading (see Figure 43 on page 39).

Refer to the certified drawings for the recommended piping entrance locations. All piping penetrations must be sealed to prevent air and water leakage.

Note: The valve actuator spring returns to a stem down position upon power failure. This allows full flow through the coil.

WARNING

Coil freeze possible. May damage equipment.

Carefully read instruction for mixing antifreeze solution used. Some products will have higher freezing points in their natural state than when mixed with water. The freezing of coils is not the responsibility of McQuay International. Refer to "Winterizing Water Coils" on page 96.

Steam Coil Piping

Steam coils are provided without valves for field piping, or piped with two-way valves and actuator motors.

The steam coil is pitched at 1/8" (3 mm) per foot (305 mm) to provide positive condensate removal. When no factory piping or valve is included, the coil connections are 2.5" male NPT iron pipe.

With the factory piping and valve package, the field supply connection is the same NPT size as the valve with female threading (see Figure 45 on page 40).

Refer to the certified drawings for the recommended piping entrance locations. All piping penetrations must be sealed to prevent air and water leakage.

Note: The valve actuator spring returns to a stem up position upon power failure. This allows full flow through the coil.

Steam Piping Recommendations

1. Be certain that adequate piping flexibility is provided. Stresses resulting from expansion of closely coupled piping and coil arrangement can cause serious damage.
2. Do not reduce pipe size at the coil return connection. Carry return connection size through the dirt pocket, making the reduction at the branch leading to the trap.
3. It is recommended that vacuum breakers be installed on all applications to prevent retaining condensate in the coil. Generally, the vacuum breaker is to be connected between the coil inlet and the return main. However, if the system has a flooded return main, the vacuum breaker should be open to the atmosphere and the trap design should allow venting of the large quantities of air.
4. Do not drain steam mains or takeoffs through coils. Drain mains ahead of coils through a steam trap to the return line.
5. Do not attempt to lift condensate.
6. Pitch all supply and return steam piping down a minimum of 1" (25 mm) per 10 feet (3 m) of direction of flow.

Steam Trap Recommendations

1. Size traps in accordance with manufacturers' recommendations. Be certain that the required pressure differential will always be available. Do not undersize.
2. Float and thermostatic or bucket traps are recommended for low pressure steam. Use bucket traps on systems with on-off control only.
3. Locate traps at least 12" (305 mm) below the coil return connection.
4. Always install strainers as close as possible to the inlet side of the trap.
5. A single trap may generally be used for coils piped in parallel, but an individual trap for each coil is preferred.

Steam Coil Freeze Conditions

If the air entering the steam coil is below 35°F (2°C), note the following recommendations:

1. 5 psi (34.5 kPa) steam must be supplied to coils at all times.
2. Modulating valves are not recommended. Control should be by means of face and bypass dampers.
3. As additional protection against freeze-up, the tap should be installed sufficiently far below the coil to provide an adequate hydrostatic head to ensure removal of condensate during an interruption on the steam pressure. Estimate 3 ft. (914 mm) for each 1 psi (7 kPa) of trap differential required.
4. If the unit is to be operated in environments with possible freezing temperatures, an optional freezestat is recommended. See "Freeze Protection" on page 65 for additional information.

Figure 43. Hot water valve package

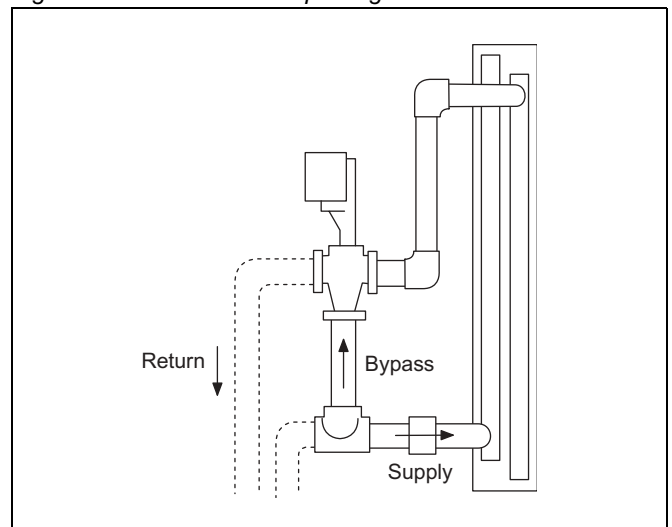


Figure 44. Valve Assembly

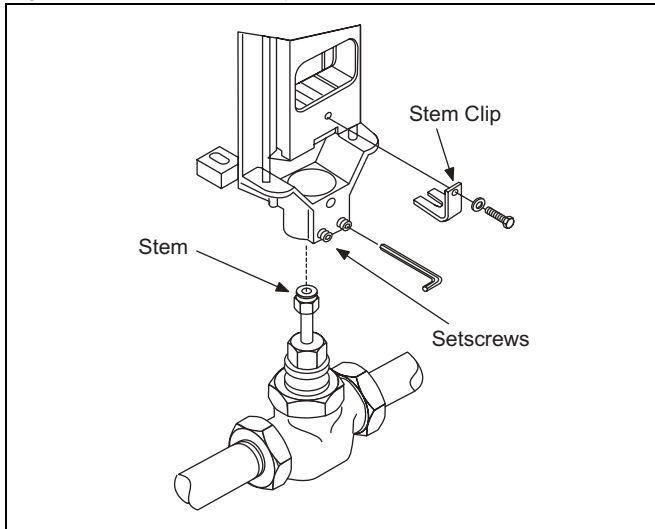
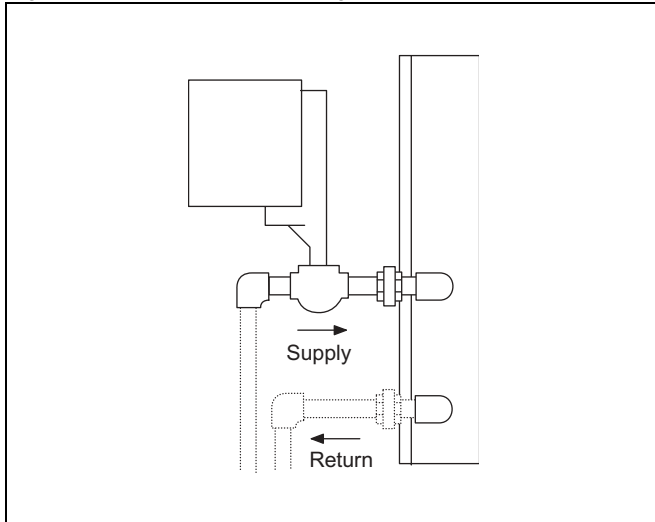


Figure 45. Steam Valve Package



Damper Assemblies

The optional damper assemblies described in this section are provided with manually adjustable linkages, or may be shipped with factory installed actuators and linkages.

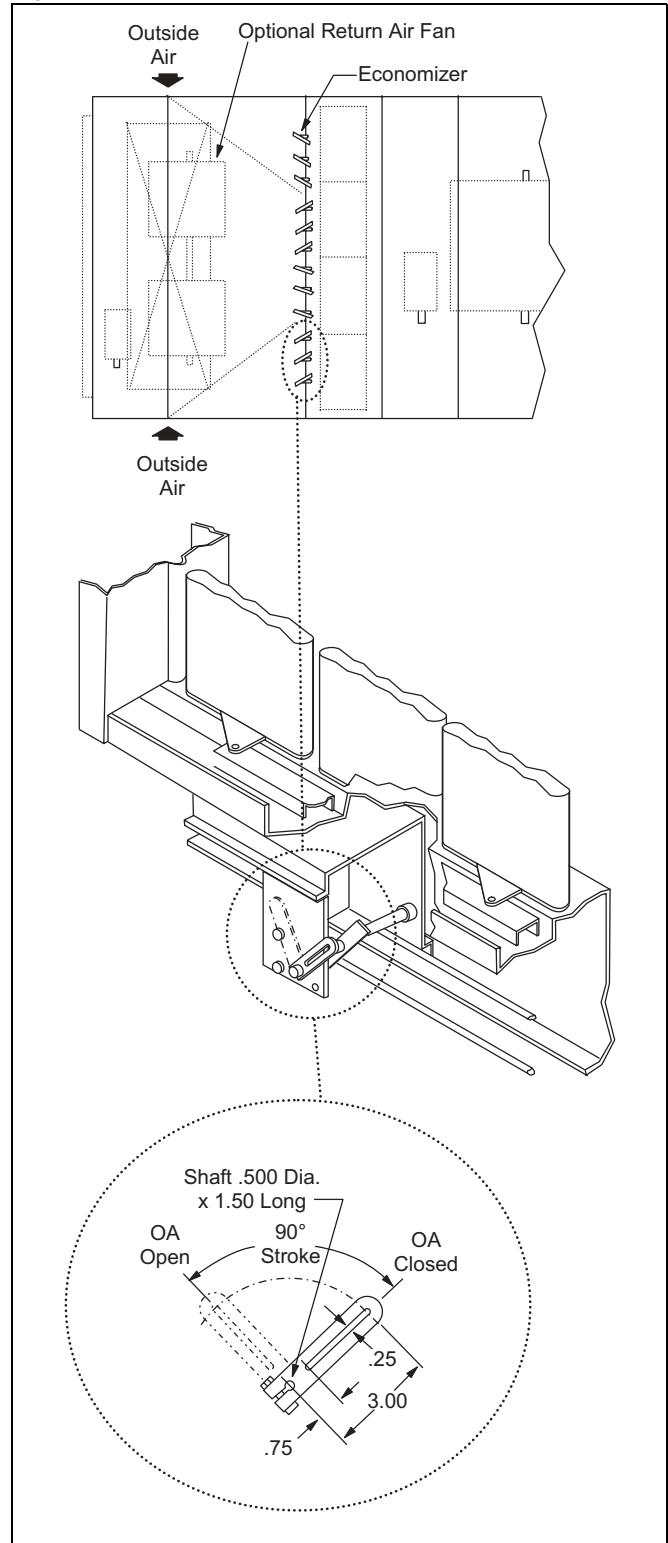
Economizer Dampers

Outside air intake is provided on both sides of the unit, and the return air path is at the center of the damper set. As the single actuator modulates the outside air dampers open, the return air dampers close. Exhaust air exits the unit through the gravity relief dampers provided at the end of the economizer section.

The outside air return air damper assembly (economizer) comes with manually adjustable linkage. This adjustable linkage can also be used for connection of a damper operator.

The damper is set so that the crankarm moves through a 90-degree angle to bring the economizer dampers from full open to full close. Mechanical stops have been placed in the crankarm mounting bracket. Do not remove stops. If the crankarm is driven past the stops, damage to the linkage or damper will result. The unit will ship with a shipping bolt securing the linkage crankarm. Remove shipping bolt before use.

Figure 46. Damper Adjustment



Note: For good airflow control, adjust linkages so damper blades do not open beyond 70 degrees. Opening a damper blade beyond 70 degrees has little effect on its airflow.

Do not "overclose" low leak damper blades. The edge seal should just lightly contact the adjoining blade. The blades will lock up if they are closed so far the seal goes over center.

Intake Hood Damper (0 to 100% outside air)

Units requiring 100% outside air are provided with a rain hood and dampers which may be controlled by a single actuator. The actuator provides two-position control for opening the dampers fully during unit operation and closing the dampers during the off cycle. No unit mounted exhaust dampers are provided.

Intake Hood Damper (0 to 30% outside air)

These dampers are intended to remain at a fixed position during unit operation, providing fresh air quantities from 0 to 30% of the total system airflow, depending on the damper setting. This setting is made at the linkage rod on units with manually adjustable linkages.

On units provided with MicroTech II controls, the damper position may be set at the controller keypad. During unit operation, the two-position actuator drives the damper to the position set on the keypad. During the off cycle, the damper is automatically closed.

No unit mounted exhaust dampers are provided with this option.

Figure 47. Intake Hood Damper Adjustment.

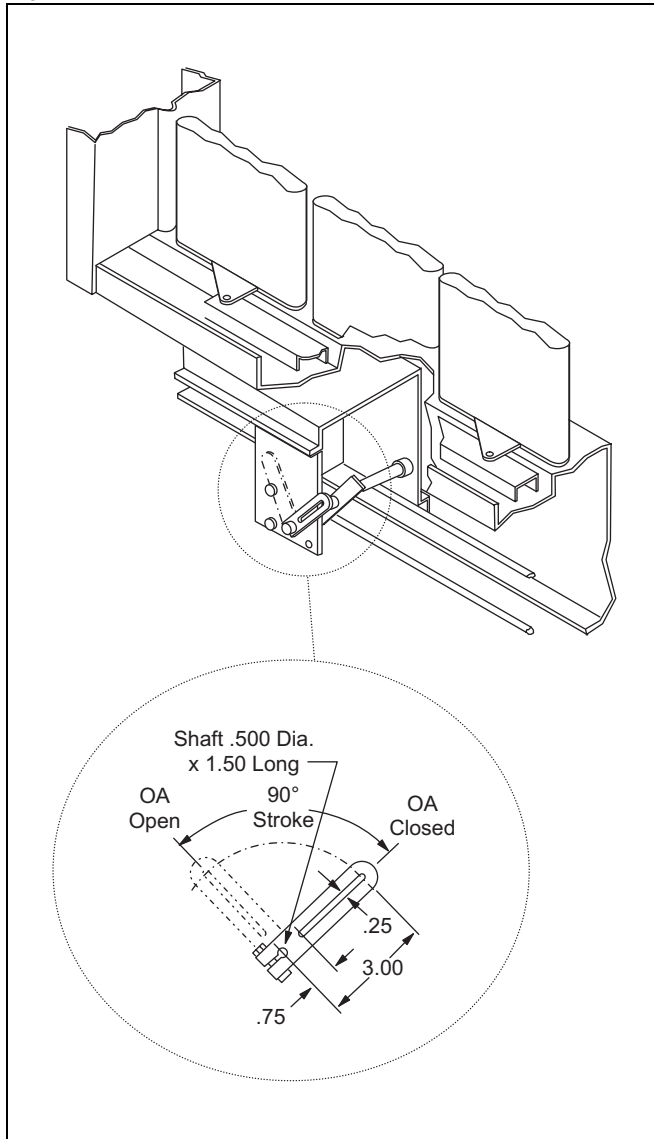
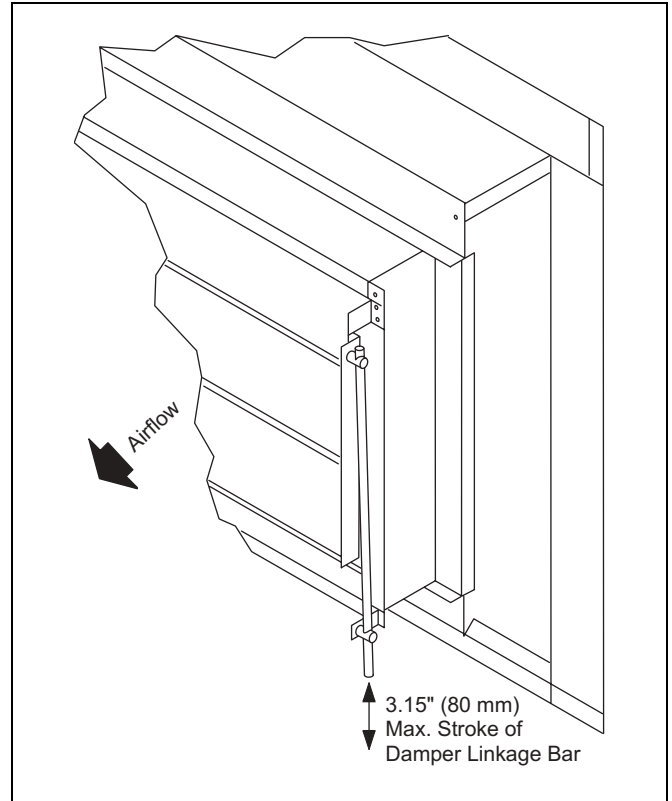


Figure 48. Damper Linkage Bar Typical for all sizes. Size 15C-40C shown.



Cabinet Weatherproofing

This unit ships from the factory with fully gasketed access doors and cabinet caulking to provide weatherproof operation. After the unit has been set in place, all door gaskets should be inspected for shipping damage and replaced if necessary.

It is recommended the unit be protected from overhead runoff from overhangs or other such structures.

Field assembled options such as external piping or vestibules are to be recaulked per the installation instructions provided with the option.

Installing Ductwork

On bottom-supply/bottom-return units, the installing contractor should make an airtight connection by attaching field fabricated duct collars to the bottom surface of either the roof curb's duct flange or the unit's duct opening if a McQuay roof curb is not used. Do not support the total weight of the ductwork from the unit or these duct flanges. Refer to Figure 49.

Units with optional back return, side discharge, or end discharge (on RFS units) all have duct collars provided. The discharge duct collars on a side discharge unit are exposed by removing the plenum section access door and the door gasketing.

Flexible connections should be used between the unit and ductwork to avoid transmission of vibration from the unit to the structure.

Ductwork should be designed per ASHRAE and SMACNA recommendations to minimize losses and sound transmission.

Where return air ducts are not required, it is recommended that a sound absorbing T or L section be connected to the unit return to reduce noise transmission to the occupied space.

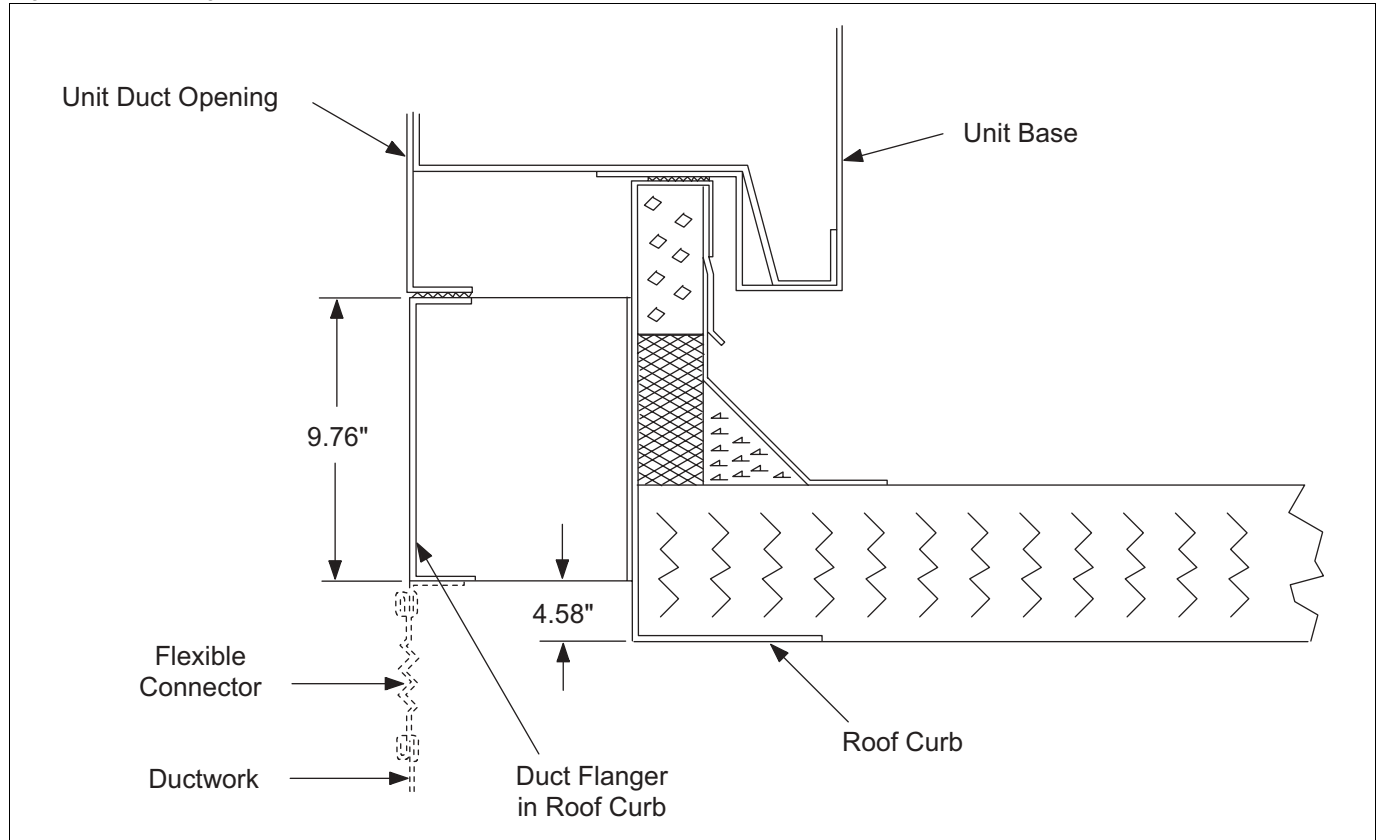
Ductwork exposed to outdoor conditions must be built in accordance with ASHRAE and SMACNA recommendations and local building codes.

NOTICE

Installer must provide access in the ductwork for plenum mounted controls.

On units with side discharge, access to plenum mounted components becomes difficult once ductwork is installed.

Figure 49. Installing Ductwork



Installing Duct Static Pressure Sensor Taps

For all VAV units, duct static pressure taps must be field installed and connected to the pressure sensors in the unit. Sensor SPS1 is standard; additional sensor SPS2 is optional. These sensors are located at the bottom of the main control panel next to terminal block TB2 (see "Control Panel Locations" on page 12).

The duct static pressure sensing tap must be carefully located and installed. Improper location or installation of the sensing tap will cause unsatisfactory operation of the entire variable air volume system. Following are pressure tap location and installation recommendations. The installation must comply with local code requirements.

NOTICE

Installer must provide access in the ductwork for plenum mounted controls.

On units with side discharge, access to plenum mounted components becomes difficult once ductwork is installed.

1. Install a tee fitting with a leak-tight removable cap in each tube near the sensor. This will facilitate connecting a manometer or pressure gauge if testing is required.
2. Use different colored tubing for the duct pressure (HI) and reference pressure (LO) taps, or tag the tubes.
3. Locate the duct pressure (HI) tap near the end of a long duct to ensure that all terminal box take-offs along the run will have adequate static pressure.
4. Locate the duct tap in a nonturbulent flow area of the duct. Keep it several duct diameters away from take-off points, bends, neckdowns, attenuators, vanes, or other irregularities.

5. Use a static pressure tip (Dwyer A302 or equivalent) or the bare end of the plastic tubing for the duct tap. (If the duct is lined inside, use a static pressure tip device.)
6. Install the duct tap so that it senses only static pressure (not velocity pressure). If an L-shaped pressure tip device is used, the point must face the airstream. If a bare tube end is used, it must be smooth, square (not cut at an angle), and perpendicular to the airstream. (see Figure 51).
7. Locate the reference pressure (LO) tap somewhere near the duct pressure tap within the building (see Figure 50). If the reference tap is not connected to the sensor, unsatisfactory operation will result.
8. Route the tubes between the curb and the supply duct, and feed them into the unit through the knockout in the bottom of the control panel (see Figure 50). Connect the tubes to the appropriate 1/8 inch fittings on the sensors. Make sure that the sensors do not support the weight of the tubing; use tube clamps or some other means.

Figure 50. Static Pressure Tubing Entrance Location

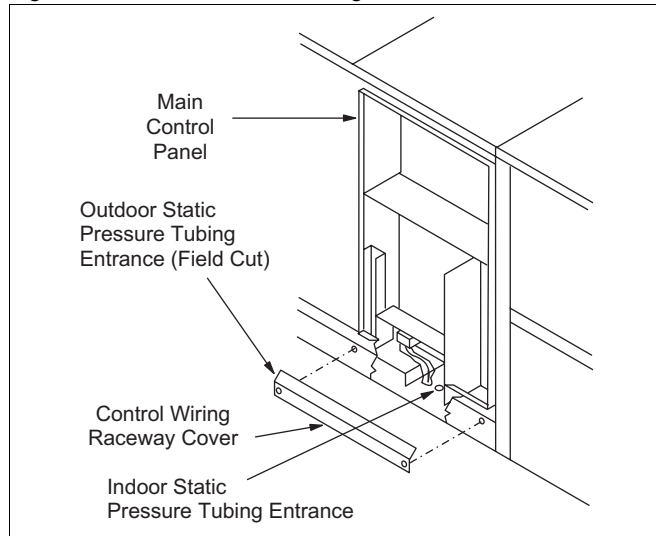
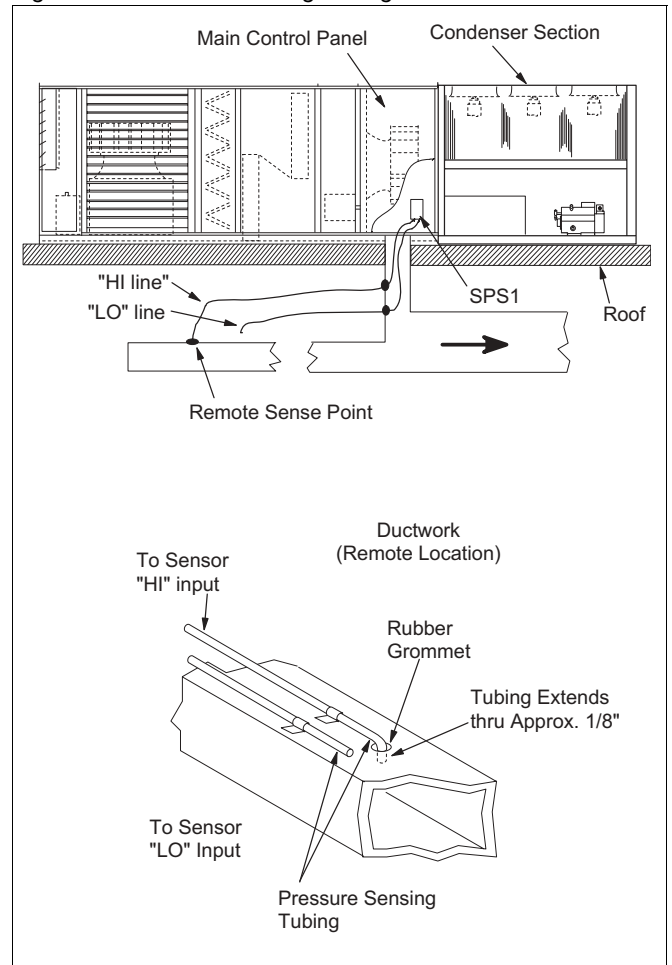


Figure 51. Pressure Sensing Tubing Installation



Electrical Installation

Field Power Wiring

Wiring must comply with all applicable codes and ordinances. The warranty is voided if wiring is not in accordance with these specifications. An open fuse indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor or fan motor, the trouble must be found and corrected.

According to the National Electrical Code, a disconnecting means shall be located within sight of and readily accessible from the air conditioning equipment. The unit may be ordered with an optional factory mounted disconnect switch. This switch is not fused. Power leads must be over-current protected at the point of distribution. The maximum allowable overcurrent protection is shown on the unit nameplate.

All Units

All units are provided with internal power wiring for single or dual point power connection. The power block or an optional disconnect switch is located within the main control panel. Field power leads are brought into the unit through 3" knockouts in the bottom of the main control panel. Refer to the unit nameplate to determine the number of power connections.

Refer to Figure 52.

WARNING

**Hazardous voltage.
May cause severe injury or death.**

Disconnect electric power before servicing equipment. More than one disconnect may be required to de-energize the unit.

If the unit has a factory mounted disconnect switch, the switch must generally be turned off to open the main control panel door. However, the door can be opened without disconnecting power by turning the screw at the bottom of disconnect switch clockwise while pulling the door open. If this is done, however, caution must be used since power is not removed from the unit or the controller.

Note: Refer to certified drawings for dimensions to wire entry points.

Figure 52. RPS/RDT and RFS Power Wiring Connections

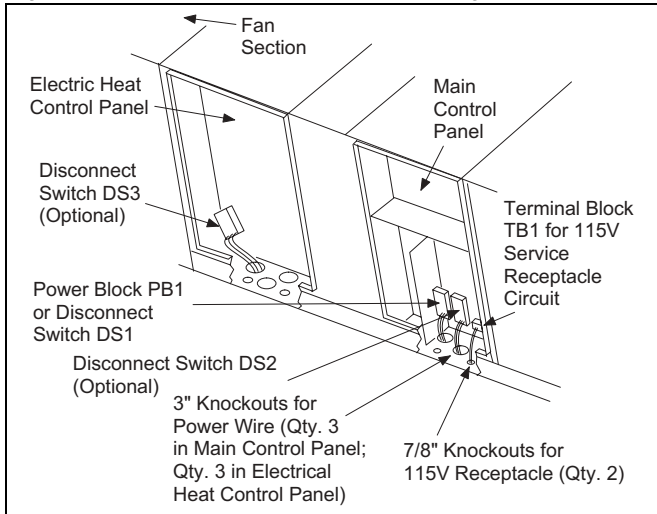
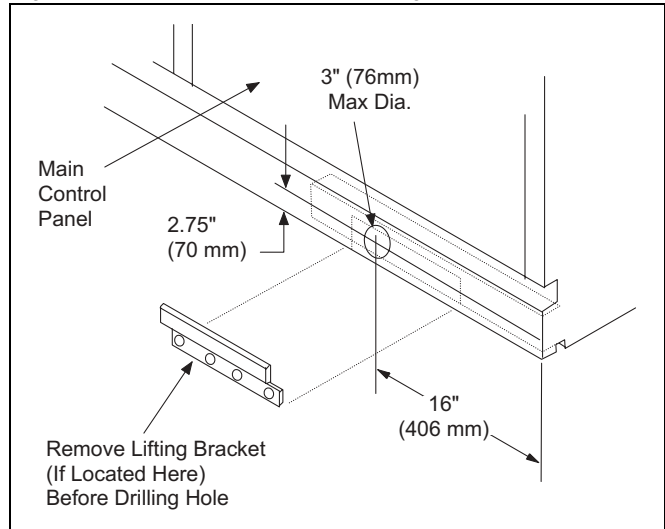


Figure 53. Optional Side Power Wiring Entrance



The preferred entrance for power cables is through the bottom knockouts provided on the unit. If side entrance is the only option, a drilling location is provided. The drilling dimensions must be followed exactly to prevent damage to the control panel. The dimensions provided are the only possible point of side entrance for the power cables.

RCS Units

Field power wiring is connected from the main control panel in the RFS unit to fuse blocks located in the condenser control panel of the RCS unit. Power leads enter the left front corner of the condenser control panel through the conduit hubs shipped with the unit. Refer to Figure 54 and Figure 55 on page 46.

All Units

The minimum circuit ampacity (wire sizing amps) is shown on the unit nameplate. Refer to Table 17 on page 46 for the recommended number of power wires.

Copper wire is required for all conductors. Size wires in accordance with the ampacity tables in Article 310 of the National Electrical Code. If long wires are required, it may be necessary to increase the wire size to prevent excessive voltage drop. Wires should be sized for a maximum of 3% voltage drop. Supply voltage must not vary by more than 10% of nameplate. Phase voltage imbalance must not exceed 2%. (Calculate the average voltage of the three legs. The leg with voltage deviating the farthest from the average value must not be more than 2% away.) Contact the local power company for correction of improper voltage or phase imbalance.

WARNING

Provide proper line voltage and phase balance.

Improper line voltage or excessive phase imbalance constitutes product abuse. May cause severe damage to the unit's electrical components.

A ground lug is provided in the control panel for each power conduit. Size grounding conductor in accordance with Table 250-95 of the National Electrical Code.

In compliance with the National Electrical Code, an electrically isolated 115V circuit is provided in the unit to supply the factory mounted service receptacle outlet and optional unit lights. This circuit is powered by a field connected 15A, 115V power supply. Leads are brought into the RFS and RPS units through a 7/8" knockout in the bottom of the main control panel, near the power wire entry point.

Note: The National Electrical Code requires that this 115V circuit be protected by a ground fault circuit interrupter (GFI) device (field supplied).

 WARNING
Electrical shock hazard. May cause severe injury or death.
All protective deadfront panels must be reinstalled and secured when power wiring is complete.

Fan Trol

FanTrol is provided on all units and is a method of head pressure control which automatically cycles the condenser fans in response to ambient air temperature. This feature maintains head pressure and allows the unit to run at low ambient air temperatures.

RPS/RDT & RCS units have two independent refrigerant circuits with one to four condenser fans being controlled independently by the ambient air temperature of each circuit. See the following sections for sequence of operation for condenser fans with FanTrol.

Table 14: FanTrol Setpoints in °F with MicroTech II Controls

RPS RDT	RCS RPR	B05		B06		B07		B08	
		Setpoint	Differential	Setpoint	Differential	Setpoint	Differential	Setpoint	Differential
015		0	5	60	5	—	—	—	—
018		0	5	60	5	—	—	—	—
020		0	5	60	5	—	—	—	—
025		0	5	65	5	—	—	—	—
030		0	5	65	5	—	—	—	—
036		0	5	70	5	—	—	—	—
040		0	5	65	5	—	—	—	—
045		0	5	65	5	—	—	—	—
050		0	5	60	5	—	—	—	—
060		0	5	25	5	70	5	—	—
070		0	5	25	5	70	5	—	—
070 scroll		0	5	40	5	70	5	—	—
075		0	5	65	5	75	5	0	5

Table 15: FanTrol Setpoints - units with no Controls - Or pre-MicroTech II Controls

Unit Size	Compressor	Control ID.	Cut Out - °F	Cut In - °F	Differential - °F	Description
018C	Scroll	TC12	60	66	6	Adjustable Setpoints
020C	Scroll	TC12	60	66	6	Adjustable Setpoints
025C	Scroll	TC12	60	66	6	Adjustable Setpoints
030C	Scroll	TC12	60	66	6	Adjustable Setpoints
036C	Scroll	TC12	60	66	6	Adjustable Setpoints
040C	Scroll	TC12	60	66	6	Adjustable Setpoints
045C	Scroll	TC12	60	66	6	Adjustable Setpoints
050C	Scroll	TC12	60	66	6	Adjustable Setpoints
060C	Scroll	TC12	60	66	6	Adjustable Setpoints
070C	Scroll	TC12	65	74	9	Adjustable Setpoints
			35	40	5	Adjustable Setpoints
075C	Scroll	TC13	52	57	5	Adjustable Setpoints
		TC14	70	80	10	Adjustable Setpoints

Figure 54. RCS 015C-030C Power Wiring Connections

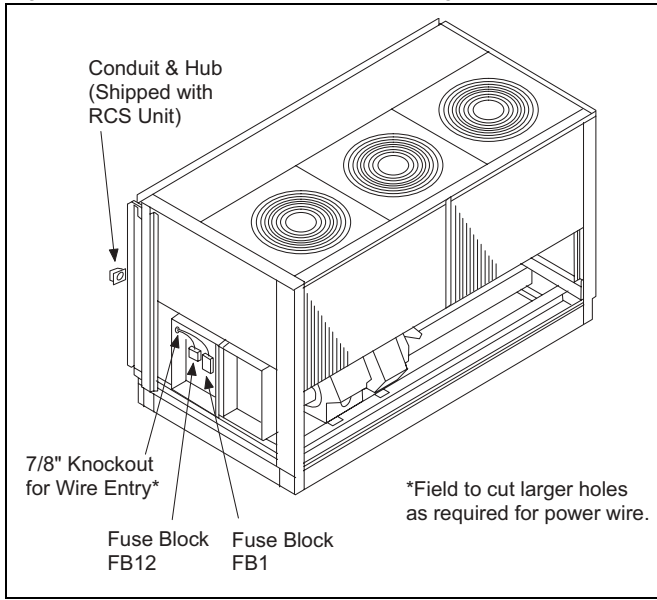


Figure 55. RCS 036C & 040C Power Wiring Connections

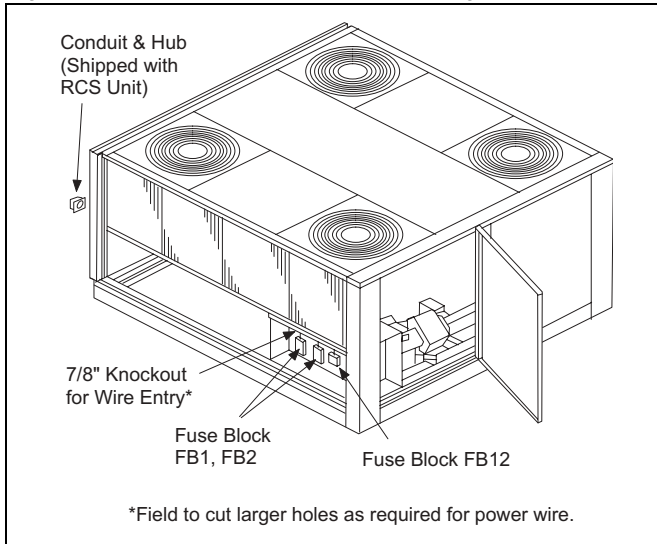


Figure 56. RCS 045 - 075 Power Wiring Connections

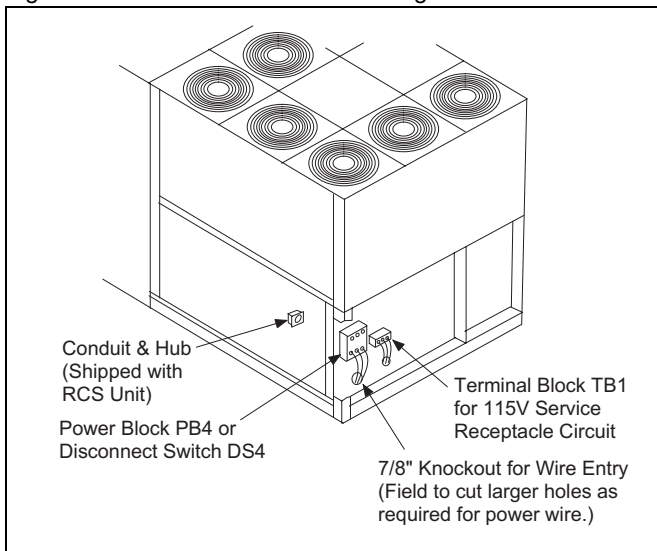


Table 16: Multiple Point Power Connection Options

Number of Electrical Circuits	Disconnect Designation	Load	Location (See Figure 21)
2	DS2	Supply & return fan motors	Main control panel
	DS1	Balance of unit	Main control panel
2	DS3	Electric heat	Electric heat control panel
	DS1	Balance of unit	Main control panel
3	DS3	Electric heat	Electric heat control panel
	DS2	Supply & return fan motors, controls	Main control panel
	DS1	Balance of unit	Main control panel

Table 17: Recommended 3-phase power wiring*

WIRE GAUGE	QTY./ POLE	INSULATION RATING (°C)	NO. OF CONDUITS	CONDUIT (TRADE SIZE, IN.)	FOR MCA UP TO (AMPS)
10	1	60	1	1/2	30
8	1	60	1	3/4	40
6	1	60	1	1	55
4	1	60	1	1-1/4	70
3	1	60	1	1-1/4	85
2	1	60	1	1-1/4	95
1	1	75	1	1-1/4	130
1/0	1	75	1	1-1/2	150
2/0	1	75	1	2	175
3/0	1	75	1	2	200
4/0	1	75	1	2	230
250	1	75	1	2-1/2	255
300	1	75	1	2-1/2	285
350	1	75	1	3	310
400	1	75	1	3	335
500	1	75	1	3	380
3/0	2	75	2	2	400
4/0	2	75	2	2	460
250	2	75	2	2-1/2	510
300	2	75	2	2-1/2	570
350	2	75	2	3	620
400	2	75	2	3	670
500	2	75	2	3	760
250	3	75	3	2-1/2	765
300	3	75	3	2-1/2	855
350	3	75	3	3	930

Notes:

1. All wire sizes assume separate conduit for each set of parallel conductors.
 2. All wire sizes based on NEC Table 310-16 for THW wire (copper). Canadian electrical code wire ampacities may vary.
 3. All wire sizes assume no voltage drop for short power leads.
- *To provide that disconnects and power blocks mate with power wiring.

Field Control Wiring

Roof Pak applied rooftop units are available with several control arrangements which may require low voltage field wiring. Detailed descriptions of various field control wiring options and requirements are included in the "Field Wiring" section of Bulletin No. IM 696, "MicroTech II Applied Rooftop Unit Controller." Refer to the unit wiring diagrams for additional installation information.

Wiring must comply with applicable codes and ordinances. The warranty is voided if wiring is not in accordance with these specifications.



WARNING

**Electrical shock hazard.
Can cause severe injury or death.**

Connect only low voltage NEC Class II circuits to terminal blocks TB2 and TB7.

Reinstall and secure all protective deadfront panels when the wiring installation is complete.

RPS,RDT and RFS Units

Most field control wiring connections are made at terminal block TB2, which is located in the main control panel. Some control options require field wiring connections to terminal block TB7, which is also located in the main control panel. Refer to Figure 57 and see "Control Panel Locations" on page 12. Two 7/8" knockouts are provided for wire entry.

RFS/RCS Units

The RCS unit receives 115V and 24V control circuit power and a number of control signals from the RFS unit. Two 7/8" knockouts are provided in the right side of the RCS control box. The 115V wiring is connected to terminal block TB3 through the upper knockout. The 24V wiring is connected to terminal block TB2 through the lower knockout.

Interconnecting wiring enters the RFS unit through 7/8" knockouts in the bottom of the main control panel. The 115V wiring is connected to TB5 and 24V wiring is connected to terminal block TB7. Refer to Figure 58.

A 7/8" knockout is also available in the end of the unit base as shown in Figure 58.

Note: If a single conduit containing 24V and 115V wiring is run above the roofline between the RFS and RCS units, the 24V wiring must be reinstalled as an NEC Class I wiring system.

Figure 57. RDT, RFS, RPS Field Control Wiring Connections

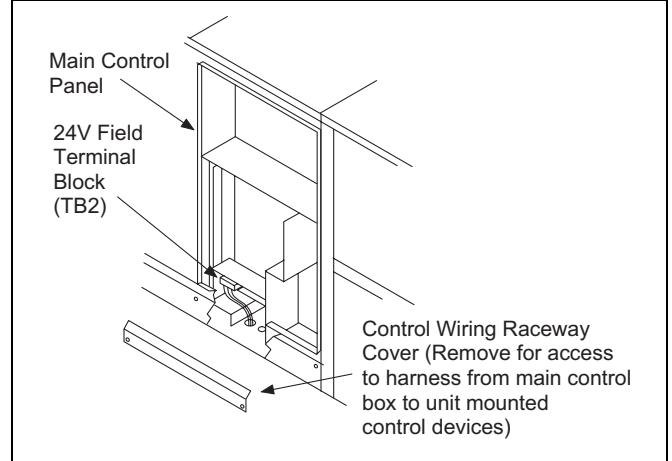
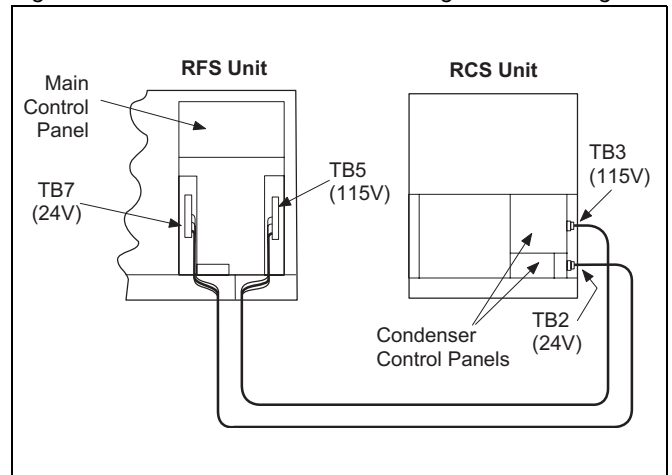


Figure 58. RFS and RPS Interconnecting Control Wiring



Preparing Unit for Operation

WARNING

**Moving machinery hazard.
May cause severe injury or death.**

Disconnect power and lock off before servicing equipment. More than one disconnect may be required to de-energize unit.

Relief Damper Tie-Down

Economizer sections with a 30" or 40" return fan have a relief damper that is tied down for shipping. Two brackets and two screws must be removed before operation to allow free movement of dampers. Access is from inside the economizer section.

Spring Isolated Fans

Release of Spring Mounts

The optional spring-mounted supply and return fans are locked down for shipment. Hold-down fasteners are located at each spring mount. These fasteners must be removed before operating the fans. *Figure 59* shows a typical spring mount. Note that the 3/8" hold-down bolt securing the fan base to the unit cross channel must be removed, as well as all 1/4" screws directly above the spring mount.

In some unit arrangements, one of the 3/8" hold-down bolts lies below the motor base. The bolt can be reached with a 9/16" socket and **must be removed**.

After removing the hold-down fasteners, the fan assembly should be rocked by hand to check for freedom of movement.

Figure 59. Spring Mounted Hold-Down Fasteners - All Units

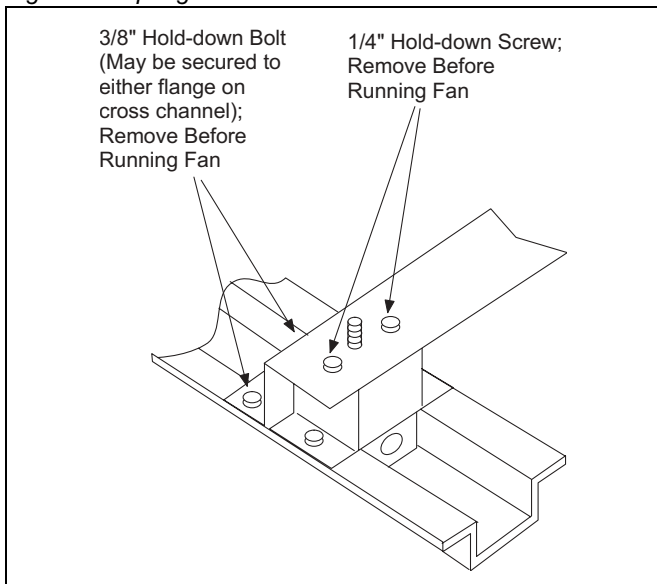
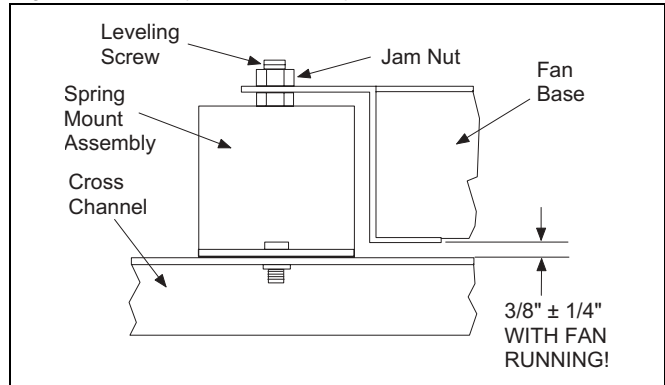


Figure 60. Supply Fan Assembly - All Units



Adjustment of Spring Mounts

During operation, all fans should ride level, with the bottom of the fan base approximately 3/8" (10mm) above the top of the unit's cross channel. Unhoused single-width "plug" fans will also ride at this level when at rest.

WARNING

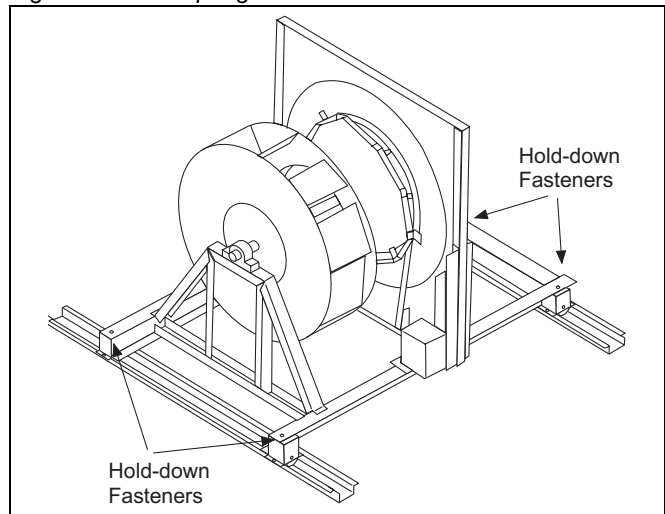
**Moving machinery hazard.
May cause severe injury or death.**

The fans must be started for the first time in accordance with the "Check, Test, and Start Procedures" on page 77. If this is not done, severe fan damage can occur.

When not operating, housed double-width fans will ride lower at the discharge end of the fan base than at the motor end. When the fan is operating against a static pressure, it should run level. If not, level the assembly as follows (refer to *Figure 61*):

1. Loosen the 15/16" jam nut above the fan base.
2. Using a large, straight blade screwdriver, turn the 5/8" leveling screw clockwise to lower the fan base, counter-clockwise to raise the fan base.
3. When properly adjusted, retighten the jam nut.

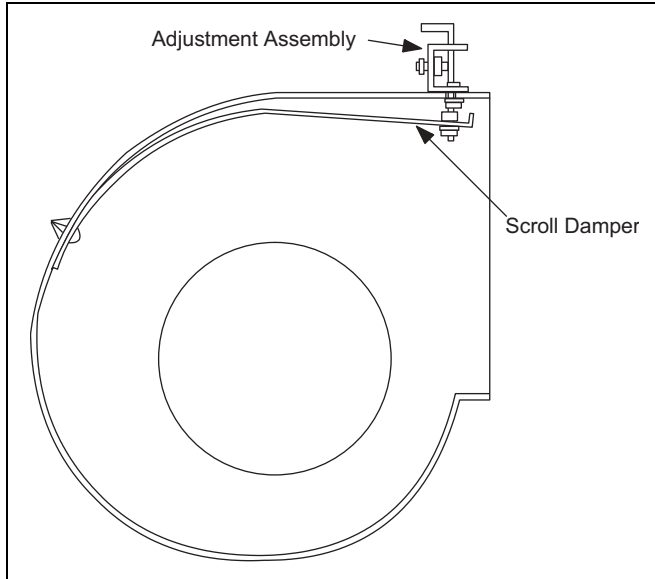
Figure 61. RDT Spring Mount Hold Down Fasteners



Adjustment of Scroll Dampers

Two sets of scroll dampers are provided in the housing of the twin 15" x 6" supply fan to allow control of air volume to each fan wheel. At the factory, these dampers are fully closed unrestricting airflow. If fan paralleling occurs, correction can be made by loosening the adjustment screw on top of the fan housing (see Figure 62) and slightly lowering the rod until air distribution between the fans is even.

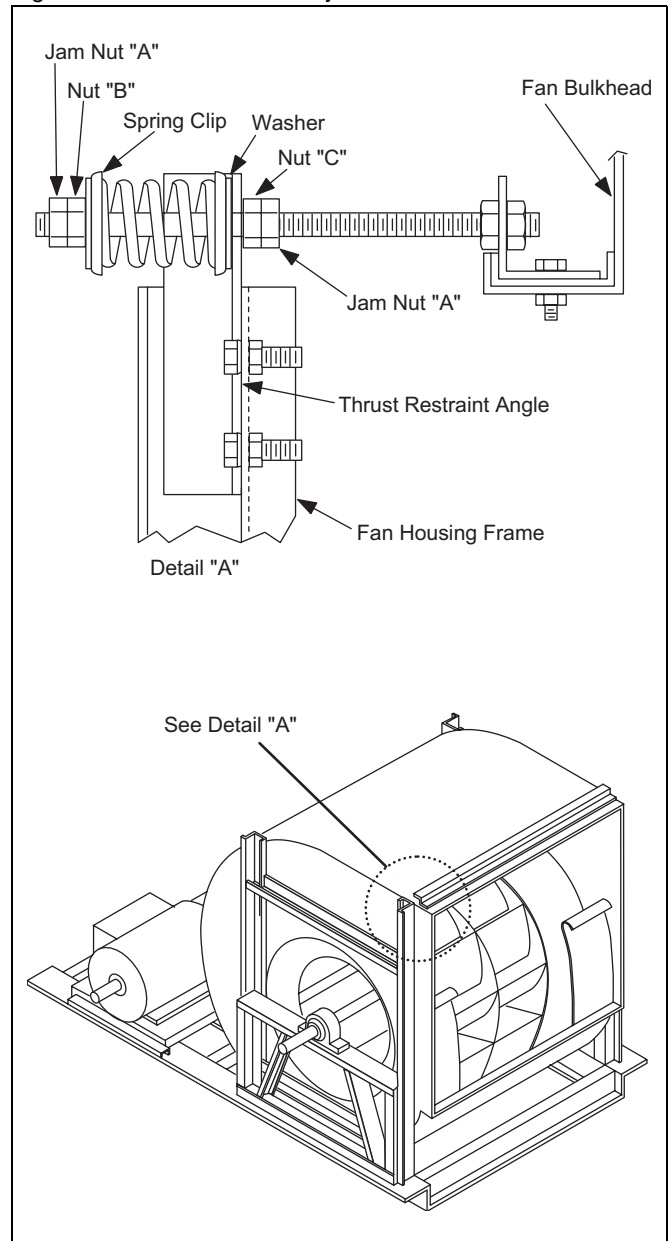
Figure 62. Scroll Damper Adjustment



Adjustment of Supply Fan Thrust Restraints

Thrust restraints are provided when housed double-width fans are mounted on springs. After the spring mounts have been adjusted for level operation when the fan is running, the thrust restraints should be checked. With the fan off, the adjustment nuts should be set so the spring is slightly compressed against the angle bolted to the fan housing frame. Refer to Figure 63. When the fan is turned on, the fan will move back to a level position and the thrust restraint springs will compress.

Figure 63. Thrust restraint adjustment



Thrust Restraint Adjustment (With Fan Off)

1. Loosen jam nuts "A".
2. Turn nut "C" until spring cup and washer contact thrust restraint angle.
3. Turn nut "B" until spring is compressed by two turns of nut "B".
4. Tighten jam nuts "A".

Adjustment of Seismic Restraints

Spring mounted supply air and return air fans may be ordered with factory installed seismic restraints. The system consists of four snubbers, one located next to each spring isolator. These snubbers will allow free movement of the fan assemblies during normal operation because normal operation will not cause fan movements that exceed .25" (6 mm). However, they will restrain the fan assembly and limit movement to .25" (6 mm) in any direction if an abnormal condition were to occur.

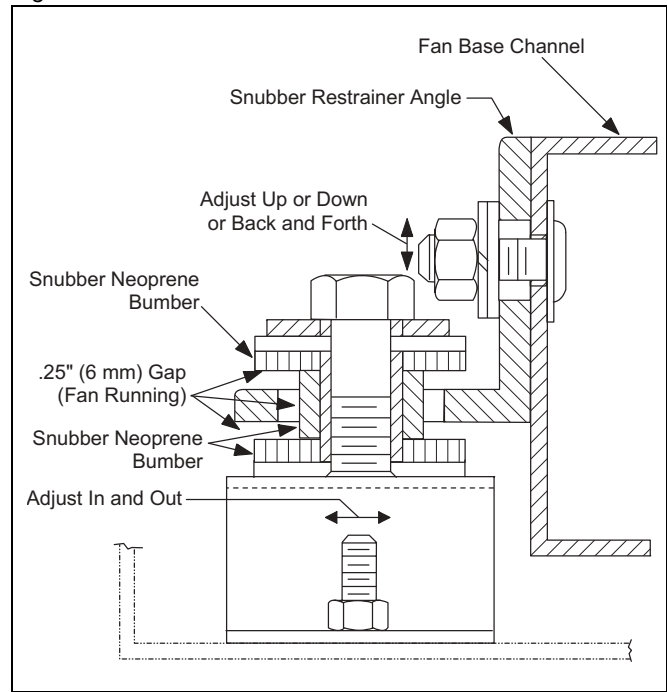
The position the fan will assume during normal operation will be determined by actual job site airflow and static pressure. Therefore, for proper operation the seismic restraints must be field adjusted as part of the normal "Check, Test and Start" procedure. When the fan is operating in a normal manner there should be no contact between the snubber restrainer angle and the snubber neoprene bumper. However, in a "seismic event," the snubber will limit movement of the spring mounted fan assembly to .25" (6 mm) in any direction, thereby preventing the fan from being tossed about and damaged, or causing damage.

When a seismic restraint is properly adjusted and the fan is operating normally, the neoprene center bumper will be centered within the 2" (51 mm) diameter hole in the restrainer angle, and the restrainer angle will be centered vertically between the flanges of the neoprene center bumper. This results in .25" (6 mm) clearance in all directions. When the fan is turned off the restrainer angle may come to rest on the neoprene center bumper.

The seismic restraint is adjustable in all directions. Vertical slots in the restrainer angle and horizontal slots in the blower base allow the restrainer angle to be adjusted up and down and back and forth. The neoprene center bumper is mounted on a slotted hole allowing its adjustment in and out.

Removing the neoprene center bumper bolt allows removal, disassembly, and replacement of the neoprene components.

Figure 64. Cross Section of Seismic Restraint



Sequences of Operation

The following sequences of operation are for a typical "C" vintage applied rooftop unit that is equipped with MicroTech II, an economizer, 4 compressor/4stage cooling, 3 to 1 turn down burner, variable frequency drives (VFD), a return air fan and an external time clock. These sequences describe the ladder wiring diagram logic in detail; refer to "Wiring Diagrams" on page 54 as you read them. Note that your unit's sequences of operation may vary from those described here. Refer to the wiring diagrams supplied with the unit for exact information.

For detailed description of operation information relating to the MicroTech II controller's software, refer to the appropriate operation manual (see *Table 1 on page 3*). These manuals describe the various setpoints, parameters, operating states, and control algorithms that affect rooftop unit operation.

Power-up

When primary power is connected to the unit, 115VAC power is fed through control circuit transformer TI and control circuit fuse FI (line 200) to compressor crankcase heaters HTR-1, HTR-2, HTR-3 and HTR-4 (lines 825, 875, 823 and 873).

When system switch S1 (line 205) is closed, low voltage transformers T2 (line 205), T3 (line 300) and T9 (line 805) are energized, and 115VAC power is supplied to the following:

- Smoke detectors (line 284)
- Economizer actuator ACT3 (line 336)
- Supply fan vane actuator ACT1 (line 340) or M30A to energize the supply fan VFD (line 311)
- Return fan vane actuator ACT2 (line 346) or M40A to energize the return fan VFD (line 316)
- Heating control panel
- Compressor circuit switches CSI and CS2 (lines 831 and 881)

Transformer T2 supplies 24VAC power to terminals 24V & 24C on the main control board MCB (lines 207 and 208). By way of terminal TB6-48 (lines 206), transformer T2 supplies 24VAC power to the following:

- Switch S7 On-Auto-Off (line 223)
- Enthalpy sensor OAE (line 265)
- External time clock contacts (line 222)
- External exhaust fan status contacts (line 273, VAV only)
- Airflow interlock switch PC7 (line 248)
- Dirty filter switches PC5 and PC6 (lines 256 and 260)
- Duct high limit switch DHL (line 276, DTC only)
- Gas furnace alarm relay R24 (line 244)
- Freezestat switch FS1 (line 251, hot water or steam heat only)
- Smoke detectors SDI and SD2 (line 254)

When the field supplied Cool Enable switch is in the "off" position, field wiring terminal 105 is de-energized (line 233). Binary input MCB-BI3 will be de-energized and the cooling will be disabled. When the field supplied Heat Enable switch is in the "off" position, field wiring terminal 106 is de-energized (line 242). Binary input MCB-BI4 will be de-energized and the heating will be disabled. Note: Unit ships with factory installed jumpers between 101 and 105 and between 101 and 106.

Fan Operation

When the supply and return fans are commanded to start by the Microprocessor Control Board (MCB), the unit enters the Startup Initial operating state. As a result, a 3-minute timer is set, output MCB-BO3 (line 394) energizes and relay R26 energizes (line 393). On VAV units with inlet vanes, outputs MCB-BO14 and MCB-BO16 energize (lines 344, 342), causing the supply and return fan inlet vanes to open. When the vanes open to their minimum positions, MCB-BO14 and MCB-BO16 are de-energized, causing the inlet vanes to hold.

After the 3-minute timer expires, the unit enters the Recirculate operating state. As a result, output MCB-BO1 energizes relay R67 (line 304). This gives a start signal to supply fan drive AFD10 (line 343). Four seconds after MCB-BO1 is energized, output MCB-BO2 energizes relay R68 (line 305). This gives a start signal to return fan drive AFD20 (line 343). Overload relays OL9, OL10, OL19, and OL20 (line 311) protect the fans from excessive current draw. If either the supply or return fan is drawing excessive current, one of the relays will open its contacts and cause both fans to stop.

Within 120 seconds after the fans start, the controller expects airflow switch PC7 (line 248) to close and thus energize binary input MCB-BI6. (If MCB-BI6 does not energize, the controller will assume the fans did not start. It will then shut down the unit and generate an alarm.)

During the Recirculate operating state, the outside air damper is held closed. The controller does this by energizing output MCB-BO5 (line 338). On VAV units, output MCB-BO12, the VAV box output, is also de-energized (line 395) during the Recirculate state.

On VAV units, the supply fan adjustable frequency drive (AFD10) or inlet vanes (ACT1) are modulated to maintain the duct static pressure setpoint. When energized, output MCB-BO14 drives AFD10/ACT1 towards increased capacity, and MCB-BO13 drives them towards decreased capacity (line 344). On VAV units or CAV units equipped with return fan capacity control, the adjustable frequency drive (AFD20) or the return fan vanes (ACT2) are modulated to maintain an acceptable building static pressure (using either VaneTrol logic or direct measurement of building pressure: see the appropriate OM for more information). When energized, output MCB-BO16 drives AFD20/ACT2 towards increased capacity, and MCB-BO15 drives them towards decreased capacity (line 342).

Economizer Operation

When the outdoor air is suitable for free cooling, the switch in enthalpy sensor OAE is in position "3" (line 267) energizing binary input MCB-BI11. When MCB-BI11 is energized, the economizer is enabled. (Note: If selected from the keypad, the enthalpy decision can be made based on outdoor temperature. In that condition, if the outdoor air temperature is less than or equal to the changeover setpoint, the economizer is enabled.) If cooling is required, the economizer dampers (ACT3) are modulated to maintain the discharge air temperature setpoint. When energized, output MCB-BO6

drives the outdoor air dampers towards the open position, and MCB-BO5 towards the closed (line 338). If the outdoor air dampers are wide open and more cooling is required, the dampers will hold their positions and mechanical cooling will be activated (see below).

When the outdoor air is not suitable for free cooling, the switch in enthalpy sensor OAE is in position "1", de-energizing binary input MCB-BI11 (Alternatively, the outdoor air temperature is above the changeover setpoint plus the economizer changeover differential). When the economizer is disabled, the dampers are held at their minimum position.

Mechanical Cooling Operation

4-Compressor/4 Stage Unit

Refer to "Typical Condensing Unit Control for RPS with MicroTech II Control (4 Compressor Unit Shown. RCS has minor variations)" on page 58 as you read this sequence of operation. In this configuration there are 4 equally sized compressors and two cooling circuits. In the following description, compressor #1 is lead. However, if Auto Lead/Lag Staging is selected on the keypad, the lead compressor will be the one in the lead circuit with the least number of run hours.

When the unit disconnect is closed, 115VAC power is supplied directly from control transformer T1 to the compressor crankcase heaters, HTR-1, 2, 3 & 4 (lines 825, 875, 823, 873) and motor protectors MP1, 2, 3 & 4 (lines 826, 876, 824, 874). This same 115 VAC source also goes through:

1. System switch, S1 (line 205)
2. The optional phase voltage monitors, PVM1 & 2 (lines 205, 805)
3. The optional ground fault relays, GFR1 & 2 (lines 205, 805)
4. Compressor control switches, CSI & 2 (lines 828, 881)
5. Transformer T9 is also powered

Compressor control switches, CS1 & 2 also provide 24 VAC from transformer T9 to compressor control boards CCB1 and CCB2 (lines 811, 861) as well as the following cooling circuit binary inputs:

1. Frost protect FP1 to CCB1-BI8 (line 814) - Optional when no hot gas bypass is ordered on the unit
2. Frost protect FP2 to CCB2-BI8 (line 864) - Optional when no hot gas bypass is ordered on the unit
3. HP relay R1 to CCB1-BI7 (lines 815)
4. HP relay R2 to CCB2-BI7 (lines 865)
5. Compressor contactor status M1-AUX2 to CCB1-BI9 (line 816)
6. Compressor contactor status M2-AUX2 to CCB2-BI9 (line 866)
7. Compressor contactor status M3-AUX2 to CCB1-BI10 (line 817)
8. Compressor contactor status M4-AUX2 to CCB2-BI10 (line 867)
9. Unit pump down switch PS3 (lines 818)
10. Circuit pump down switch PS1 to CCB1-BI11(line 818)

11. Circuit pump down switch PS2 to CCB2-BI11(line 868)
12. Cool enable from MCB-B07 to CCB1-BI12 and CCB2-BI12 (lines 820, 870)

When manual pumpdown switches PS1, PS2, and PS3 are closed, all four compressors are fully enabled and ready to start if commanded to by the MicroTech II control system.

Cross Circuit Loading

If cooling is enabled (MCB-BI3 is energized) and mechanical cooling is required, the MCB will energize cool enable output MCB-BO7 (lines 820) to binary inputs CCB1-BI12 (lines 820) and CCB2-BI12 (line 870). The MCB will also send a digital communications signal to CCB1 & 2 to enable cooling. CCB1-BO4 output will energize and open liquid line solenoid valve SV1 (line 841), allowing refrigerant to flow into the evaporator coil. As the refrigerant evaporates, the suction pressure increases until low pressure switch LP1 closes (line 820) as a binary input to CCB1-BI6. When CCB1 senses that LP1 has closed, CCB1-BO1 & BO5 will energize contactors M1 and M11 (lines 827 and 842) to start compressor #1 and condenser fan #11. (The above description applies to units without the low ambient start option, For a description of low ambient start, see the "Unit Options" section of this manual.) Additional condenser fan stages will be added as the outdoor air temperature rises above setpoints input through the keypad. CCB1-BO6 controls contactor M12 (line 843), which cycles condenser fan 12. CCB1-BO7 controls contactor M13 (line 844), which cycles condenser fan 13. This is stage 1.

If more cooling is required, CCB2-BO4 will energize and open liquid line solenoid valve SV2 (line 891), allowing refrigerant to flow into the evaporator coil. As the refrigerant evaporates, the suction pressure increases until low pressure switch LP2 closes (line 870) as a binary input to CCB2-BI6. When CCB2 senses that LP2 has closed, CCB2-BO1 & BO5 will energize contactors M2 and M21 (lines 877 and 892) to start compressor #2 and condenser fan #21. Additional condenser fan stages will be added as the outdoor air temperature rises above setpoints input through the keypad. CCB2-BO6 controls contactor M22 (line 893), which cycles condenser fan 22. CCB2-BO7 controls contactor M23 (line 894), which cycles condenser fan 23. This is stage 2.

If more cooling is required, CCB1-BO2 will energize contactor M3 (line 832) to start compressor #3. This is stage 3.

If more cooling is required, CCB2-BO2 will energize contactor M4 (line 882) to start compressor #4. This is stage 4.

When the cooling demand is satisfied, MCB works through CCB1 & 2 to stage down the compressors. If Auto Lead/Lag Staging is selected, the compressor with the most hours will stage off first and so on. When both circuits are running with only one compressor each (stage 2) and less cooling is required, if circuit #2 is lag, CCB2-BO4 de-energizes to close liquid line solenoid valve SV2 (line 891). As a result, compressor #2 pumps down refrigeration circuit #2 until the suction pressure drops low enough to open low pressure control LP2 (line 870). When LP2 opens, CCB2-BO1, BO5, (BO6 and BO7) will de-energize to shut down compressor #2 and its associated condenser fan(s).

When mechanical cooling is no longer necessary, CCB1-

BO4 de-energizes to close liquid line solenoid valve SV1 (line 841). As a result, compressor #1 pumps down refrigeration circuit #1 until the suction pressure drops low enough to open low pressure control LP1 (line 820). When LP1 opens, CCB1-BO1, BO5, (BO6 and BO7) will de-energize to shut down compressor #1 and its associated condenser fan(s).

Lead Circuit Loading

The loading and unloading process is similar except that both compressors in the lead cooling circuit will energize before energizing any compressors in lag circuit.

Compressor Safeties

If a compressor motor protector trips, it will immediately disable its associated compressor contactor M1, 2, 3 or 4 (lines 827, 877, 832 and 882).

If high pressure switch HP3 trips (line 837), compressors #1 and #3 will be disabled and relay R1 will signal CCB1 of the event. (line 815). CCB1 will then de-energize CCB1-BO1 and BO2 (lines 827 & 832) to keep compressors #1 and #3 locked out. If high pressure switch HP4 trips (line 887), compressors #2 and #4 will be disabled and relay R2 will signal CCB2 of the event. (line 815). CCB2 will then de-energize CCB2-BO1 and BO2 (lines 877 & 882) to keep compressors #2 and #4 locked out.

If frost protect switch FP1 trips (line 814), CCB1-BO4 will de-energize (lines 841) to close SV1 and pump down circuit #1. If frost protect switch FP2 trips (line 864), CCB2-BO4 will de-energize (lines 891) to close SV2 and pump down circuit #2. For both of these alarms, the circuit will remain off for at least one cooling stage timer interval. If cooling is still needed, the cooling will try to restart. The cooling will reset up to three times in a 24 hour period (between 2:00 AM and 2:00 AM). After the third trip, the alarm will remain until manually cleared at the keypad or over the network.

Heating

Gas Furnace, Modulating Burner (3 to 1 turn down)

Refer to “*Typical Gas Furnace Control Circuit (Modulating Burner, Mixed Air Intake)*” on page 61” as you read this sequence of operation. Note that the gas furnace wiring diagrams supplied with the units include a detailed sequence of operation. Refer to the wiring diagram supplied with the unit for exact wiring and sequence of operation information.

When system switch S1 is closed, 115 VAC power is supplied to the furnace control circuit. If burner switch S3 and safeties HL22, HL23 are closed, terminal 5 (line 615) on the flame safeguard control (FSG) will be energized as will the modulating gas valve VM1. If heating is enabled (MCB-BI4 is energized) and heating is required, the MCB-BO11 will energize (line 605), thus energizing relay R20. The normally open R20 contacts (line 610) close, and if manual burner switch S3 and safeties HL22, HL23, FLC (high limit switch), LP5, and HP5 are closed, terminal 6 (line 631) on the flame safeguard control (FSG) will be energized. FSG will energize terminal 4 to start the blower motor (BM) through contactor M29 (line 615). If the blower is operational, air switch AS (line 633) will close and make FSG terminal 6 to 7. After a 90-second prepurge period, FSG terminals 8 (line 621) and 10 (line 630) are energized. As a result, ignition transformer IT and pilot gas valve GVI are energized. The pilot flame

will ignite and be detected by FSG through flame rod FD (line 622). Upon detection of pilot flame after the 10 second trial for ignition period, the FSG will de-energize terminal 10 and energize terminal 9 to energize main gas valves GV2 and GV3 (lines 625, 626) and low fire start relay R23 (line 628). The R23 contacts (lines 642 and 643) allow the MCB to modulate gas valve actuator VM1 as required to satisfy the heating demand.

Whenever the burner is operating, its firing rate will be determined by the position of gas valve actuator VM1. This actuator modulates the butterfly gas valve and combustion air damper (lines 690 and 692), thus varying the furnace firing rate between 33% and 100% of full capacity. When the MCB-BO10 energizes (line 645), VM1 modulates toward open and the firing rate increases. When MCB-BO9 energizes (line 644), VM1 modulates toward closed and the firing rate decreases. When both MCB-BO10 and MCB-BO9 are open, VM1 holds its position and the firing rate remains constant.

When heating is no longer necessary, MCB-BO11 opens, de-energizing relay R20 and opening its contacts in line 610. As a result, the flame safeguard control is de-energized, all gas valves close, the combustion air blower motor stops, and gas valve actuator VM1 closes. If the furnace is warm enough to close it, the FLC fan controls switch (line 609) will override supply fan start/stop output MCB-BO1 through R67 (line 607) and keep the supply fan running until the furnace cools down (this might happen during night setback operation).

If the furnace overheats, the FLC high limit control (line 610) will cycle the burner, preventing the furnace temperature from exceeding the limit control's set point. When the furnace is cycled off, low fire start relay R23 de-energizes. The normally closed R23 contacts (line 643) cause VM1 to drive to its minimum position, overriding MicroTech II control of VM1 via MCB-BO10 and MCB-BO9. Because relay R23 is de-energized whenever GV2 is de-energized, the burner will always start at low fire.

Safety Lockout

If the pilot flame does not ignite or the flame safeguard fails to detect its flame within 10 seconds, the flame safeguard control will enter the "safety lockout" state. FSG terminals 4, 8,9 and 10 will be de-energized and the burner will be shut down. FSG terminal 3 will energize relay R24 (line 633). The R24 contacts (line 244) signal the controller that the problem exists by energizing the input to MCB-BI5. If a safety lockout occurs, the flame safeguard control must be manually reset.

Wiring Diagrams

Legend

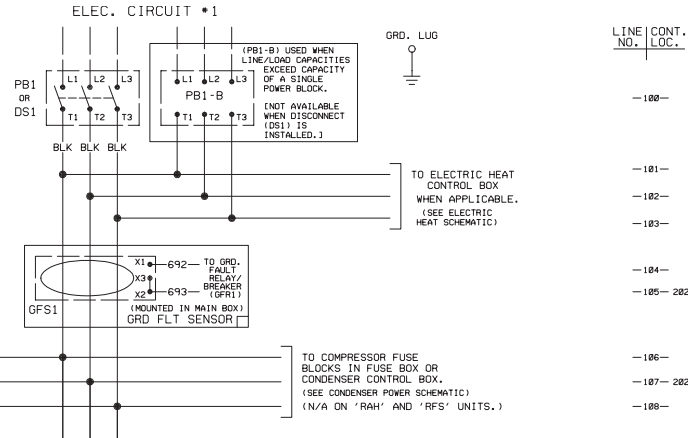
Designation	Description	Std. Location	Designation	Description	Std. Location
ACT1	Actuator Motor, Supply Fan Vanes	Supply Air Sect.	PB1	Powerblock, Total Unit or Cond/Heat	Main Control Box
ACT2	Actuator Motor, Return Fan Vanes	Return Air Sect.	PB2	Powerblock, SAF/RAF/Controls	Main Control Box
ACT3, 4	Actuator Motors, Economizer Dampers	Economizer Sect.	PB3	Powerblock, Electric Heat	Electric Heat Sect.
ACT5	Actuator Motor, Discharge Isolation Damper	Discharge Sect.	PB4	Powerblock, Condenser	Cond. Control Box
ACT6	Actuator Motor, Return Air Isolation Damper	Return Air Sect.	PB9, 10	Powerblocks, Supply Fan	Unit Split Jct. Box
ACT 10, 11	Actuator Motors, Exhaust Dampers	Return Air Sect.	PB19, 20	Powerblocks, Return Fan	Unit Split Jct. Box
ADI	ADI Board	Main Control Box	PC5	Pressure Control, Clogged Filter	Filter Sect.
AS	Blower Air Switch	Furnace Sect.	PC6	Pressure Control, Clogged Final Filter	Final Filter Sect.
BM	Burner Blower Motor	Furnace Sect.	PC7	Pressure Control, Proof of Airflow	Supply Air Filter
CI, 5	Power Factor Capacitors, Compressor #1	Condenser Sect.	PC8	Pressure Control, Minimum Airflow	Evaporator Coil Sect
C2, 6	Power Factor Capacitors, Compressor #2	Condenser Sect.	PC12, 22	Pressure Control, FanTrol	Cond. Bulkhead
C9, 10	Power Factor Capacitors, Supply Fan	Supply Air Sect.	PM1	Phone Modem	Main Control Box
C11	Capacitor, Speed Trol (Circuit #1)	Cond. Bulkhead	PS1, 2	Pumpdown Switches, Refrigerant Circuits	Cond. Control Box
C19, 20	Power Factor Capacitors, Return Fan	Return Air Fan	PS3	Pumpdown Switch, Unit	Main Control Box
C21	Capacitor, SpeedTrol (Circuit #2)	Cond. Bulkhead	PVM1	Phase Voltage Monitor, RPS Unit	Main Control Box
COMP#1, 2	Compressors 1 & 2	Condenser Sect.	PVM2	Phase Voltage Monitor, RCS Unit	Cond./Fuse Ctrl Box
CS1, 2	Control Switches, Refrigerant Circuits	Cond. Control Box	R1, 2	Relays, High Pressure Reset	Cond. Control Box
DHL	Duct High Limit	Main Control Box	R5, 6	Relays, Compressor #1, #2 Safety/Cool Fall	Cond. Control Box
DS1	Disconnect, Total Unit or Condenser/Heat	Main Control Box	R9, 10	Relays, Compressor Lockout	Cond. Control Box
DS2	Disconnect, SAF/RAF/Controls	Main Control Box	R11, 12	Relays, Low Ambient	Cond. Control Box
DS3	Disconnect, Electric Heat	Electric Heat Sect.	R20	Relay, Gas, Steam, Hot Water Heat	Main Control Box
DS4	Disconnect, Condenser	Cond. Control Box	R21, 22	Relays, Gas Heat, 100% OA	Furnace Sect.
F1	Fuse, Control Circuit	Main Control Box	R23	Relay, Gas Heat, Modulating Valve	Furnace Sect.
F2	Fuse, Control Circuit	Cond. Control Box	R24	Relay, Gas Heat Alarm	Main Control Box
F3	Fuse, Burner Motor	Main Control Box	R26	Relay, Occupied/Unoccupied	Main Control Box
FB1, 2	Fuseblocks, Compressor #1 & #2	Cond./Fuse Ctrl Box	R27	Relay, Exhaust Dampers	Main Control Box
FB8	Fuseblock, Main Transformer	Main Control Box	R28	Relay, Isolation Dampers	Main Control Box
FB9, 10	Fuseblocks, Supply Fan	Main Control Box	R60-69	Relays, Special	Main Control Box
FB11-18	Fuseblocks, Condenser Fans	Cond. Control Box	RAE	Return Air Enthalpy Sensor	Return Air Sect.
FB19, 20	Fuseblocks, Return Fan	Main Control Box	RAT	Return Air Temperature Sensor	Return Air Sect.
FB31-40	Fuseblocks, Electric Heat (Top Bank)	Electric Heat Sect.	REC1	Receptacle, Main Box	Main Control Box
FB41-50	Fuseblocks, Electric Heat (Bottom Bank)	Electric Heat Sect.	REC2	Receptacle, Condenser Box	Cond. Control Box
FD	Flame Detector	Furnace Sect.	REC3	Receptacle, Field Power, 115V	Discharge Bulkhead
FLC	Fan Limit Control	Furnace Sect.	REC10-22	Receptacles, Cabinet Section	Cabinet Sections
FS1	Freezestat Control	Heat Sect.	S1	Switch, System On/Off, RPS Unit	Main Control Box
FSG	Flame Safeguard	Furnace Sect.	S2	Switch, System On/Off, RCS Unit	Cond. Control Box
GFS1/GFR1	Ground Fault Sensor/Relay, RPS Unit	Main Control Box	S3	Switch, Furnace On/Off	Furnace Sect.
GFS3/GFR2	Ground Fault Sensor/Relay, RCS Unit	Cond. Control Box	S6	Switch, Return Fan Vanes Adjustment	Main Control Box
GRD	Ground	All Control Boxes	S10-22	Switches, Cabinet Section Lights	Cabinet Sections
GV1	Gas Valve, Pilot	Furnace Sect.	SAT	Supply Air Temperature Sensor	Discharge Sect.
GV2, 3	Gas Valves, Main	Furnace Sect.	SB1	Staging Board #1, Cooling	Main Control Box
HL1-10	High Limits, Elec. Heaters, Power (Top Bank)	Electric Heat Sect.	SB2	Staging Board #2, Heating	Main Control Box
HL11-20	High Limits, Elec. Heaters, Power (Bottom Bank)	Electric Heat Sect.	SC11	Speed Control, Circuit #1	Cond. Bulkhead
HL22	High Limit, Gas Heat (Prefilters)	Supply Air Sect.	SC21	Speed Control, Circuit #2	Cond. Bulkhead
HL23	High Limit, Gas Heat (Final Filter)	Final Filter Sect.	SD1	Smoke Detector, Supply Air	Discharge Sect.
HL31-40	High Limits, Elec. Heaters, Control (Top Bank)	Electric Heat Sect.	SD2	Smoke Detector, Return Air	Return Air Sect.
HL41-50	High Limits, Elec. Heaters, Control (Bottom Bank)	Electric Heat Sect.	SPS1, 2	Static Pressure Sensors, Duct or Building	Main Control Box
HP1, 2	High Pressure Controls, Refrigerant	On Compr. #1, #2	SPS5	Static Pressure Sensor, Clogged Filter	Filter Sect.
HP5	High Pressure Control, Gas	Furnace Sect.	SPS6	Static Pressure Sensor, Clogged Final Filter	Final Filter Sect.
HS1	Heat Switch, Electric, Shutdown	Main Control Box	SR1-3	Sequence Relays, Electric Heat	Electric Heat Sect.
HTR1, 2	Crankcase Heaters	On Compr. #1, #2	SV1, 2	Solenoid Valves, Liquid	Discharge Bulkhead
IT	Ignition Transformer	Furnace Sect.	SV5-6	Solenoid Valves, Hot Gas	Discharge Bulkhead
LP1, 2	Low Pressure Controls, Refrigerant	On Compr.	T1	Transformer, Main Control	Main Control Box
LP5	Low Pressure Control, Gas	Furnace Sect.	T2	Transformer, Unit 24V	Main Control Box
LT2	Light, Furnace On	Furnace Sect.	T3	Transformer, Controller, 18V	Main Control Box
LT3	Light, Pilot Gas Valve On	Furnace Sect.	T4	Transformer, Exhaust Dampers	Main Control Box
LT4	Light, Main Gas Valve On	Furnace Sect.	T5	Transformer, Electric Heat	Electric Heat Sect.
LT10	Light, Supply Fan	Supply Air Sect.	17	Transformer, Gas Pilot Valve	Furnace Sect.
LT11	Light, Return Fan	Return Air Sect.	T8	Transformer, Gas Main Valve	Furnace Sect.
LT12	Light, Heat Section	Heat Sect.	T10	Transformer, SpeedTrol, 24V	Cond. Control Box
LT13	Light, Filter Section	Filter Sect.	T11	Transformer, SpeedTrol, 230V	Cond. Control Sect.
LT14	Light, Final Filter Section	Final Filter Sect.	TB1	Terminal Block, 115V, Field	Main/Cond. Ctrl Box
LT15	Light, Discharge Section	Discharge Sect.	TB2	Terminal Block, 24V, Field	Main/Cond. Ctrl Box
LT16	Light, Blow-through Coil Section	Blow-thru Coil Sect.	TB3, 4	Terminal Blocks, Condenser	Cond. Control Box
LT17	Light, Evaporator Coil Section	Evaporator Coil Sect	TB5	Terminal Block, 115V, Factory	Main Control Box
LT18	Light, Preheat Section	Preheat Sect.	TB6	Terminal Block, 115V/24V, Factory	Main Control Box
LT19	Light, Blank Section	Blank Sect.	TB7, 8	Terminal Block, 24V, Factory	Main Control Box
LT20	Light, Blank Compartment	Blank Compartment	TB10	Terminal Block, Heating	Main Control Box
LT22	Light, Condenser Section	Condenser Sect.	TB11	Terminal Block, Heating	Electric Heat Sect.
M1, 5	Contactors, Compressor #1	Cond. Control Box	TB12, 13	Terminal Blocks, Electric Heat, Power	Electric Heat Sect.
M2, 6	Contactors, Compressor #2	Cond. Control Box	TB25	Terminal Block, 11 5V, Factory	Unit Split Jct. Box
Mg, 10	Contactors, Supply Fan	Main Control Box	TB27, 28	Terminal Blocks, 24V, Factory	Unit Split Jct. Box
M11-18	Contactors, Condenser Fans, Circuit #1	Cond. Control Box	TC1, 2	Temperature Controls, FanTrol	Cond. Control Box
M19, 20	Contactors, Return Fan	Main Control Box	TD1, 2	Time Delays, Compr. #1, #2, Lockout	Cond. Control Box
M21-28	Contactors, Condenser Fans, Circuit #2	Cond. Control Box	TD5, 6	Time Delays, Compr. #1, #2, Part Winding	Cond. Control Box
M29	Contactors, Burner Motor	Furnace Sect.	TD9	Time Delay, Supply Fan Part Winding	Main Control Box
M31-39	Contactors, Elec. Heaters (Top Bank)	Electric Heat Sect.	TD11, 12	Time Delays, Low Ambient	Cond. Control Box
M41-50	Contactors, Elec. Heaters (Bottom Bank)	Electric Heat Sect.	TD19	Time Delays, Return Fan Part Winding	Main Control Box
MAT	Mixed Air Temperature Sensor	Supply Air Sect.	UM1, 2	Unloaders, Compressors	On Compressors
MCB1	Microprocessor Control Board #1	Main Control Box	V1	Valve Motor #1, Heating	Heating Sect.
MJ	Mechanical Jumpers	Terminal Blocks	ZNT1	Zone Temperature Sensor, Control	Field Installed
MP1, 2	Motor Protectors, Compressor #1, #2	On Compr. #1, #2	ZNT2-5	Zone Temperature Sensors, Special	Field Installed
NB1, 2	Neutral Blocks	Main Control Box			
NB3	Neutral Block	Cond. Control Box			
OAE	Outside Air Enthalpy Control	Economizer Sect.			
OAT	Outside Air Temperature Sensor	Discharge Bulkhead			
OBA	Output Board A, Standard	Main Control Box			
OB	Output Board B, Cooling	Main Control Box			
OBC	Output Board C, Heating	Main Control Box			
OL9, 10	Overload Relays, Supply Fan	Main Control Box			
OL19, 20	Overload Relays, Return Fan	Main Control Box			
OP1, 2	Oil Pressure Controls, Compr. #1, #2	Cond. Control Box			

Typical Power Circuit Wiring (6 Compressor Arrangement with VFD Shown)

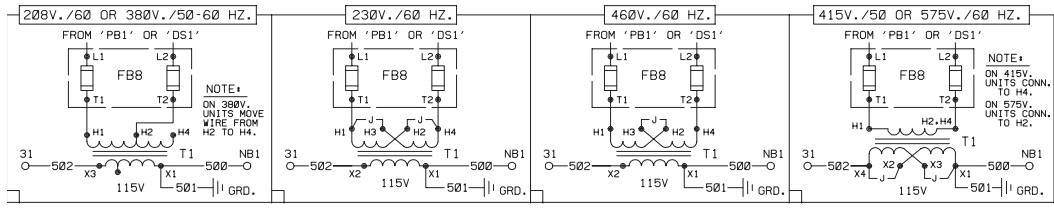
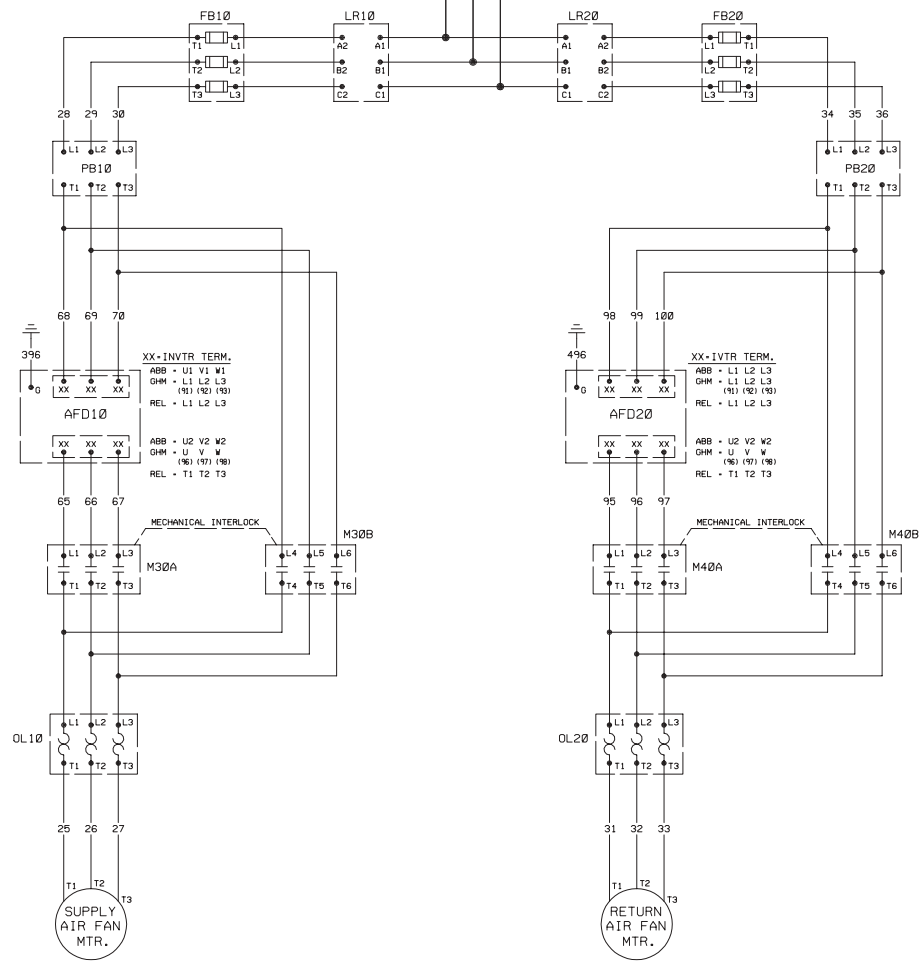
SCHEM. 599414D-11 REV. 0

MODELS:
RPS, RFS, RDT, RAH, RRS, RSS, REC, RWC

VOLTAGES & HORSE POWER:
 SUPPLY FAN--(AL) RETURN FAN--(AL)
 208V--1HP THRU 75HP. 208V--1HP THRU 75HP.
 230V--1HP THRU 75HP. 230V--1HP THRU 75HP.
 380V-575V--1HP THRU 75HP. 380V-575V--1HP THRU 75HP.



LINE NO.	CONT. LOC.
100	
101	
102	
103	
104	
105	202
106	
107	202
108	
122	
123	
124	
128	
134	
136	
141	
150	312
160	



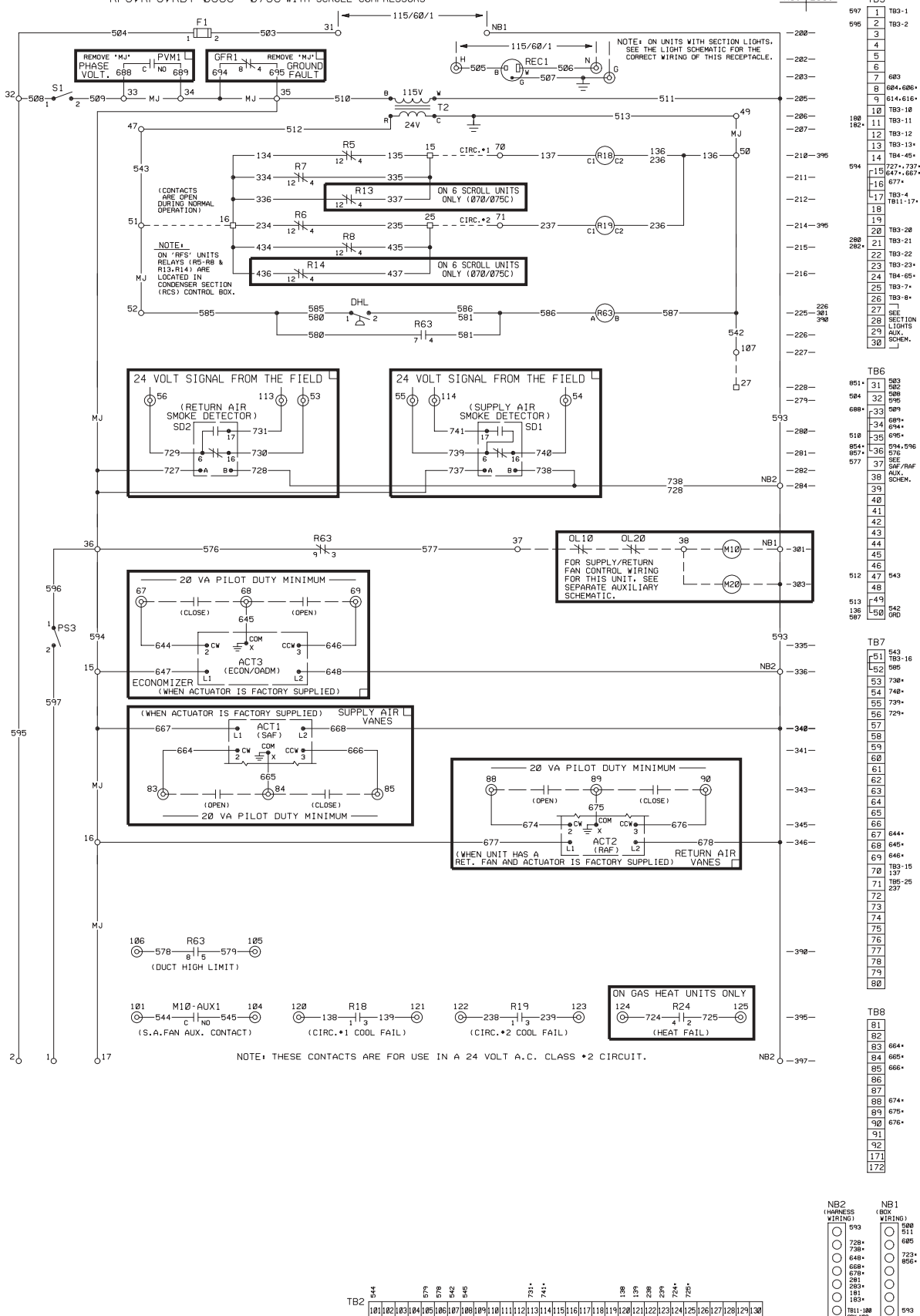
Typical Main Circuit Wiring (with Inlet Vane and Controls by Others)

SCHEM. 558660D-01 REV. E

MODELS: RFS, RFS, RDT 105C--135C WITH SEMI-HERMETIC COMPRESSORS
 RFS, RFS, RDT 036C--075C WITH SCROLL COMPRESSORS

NO CONTROL--4 & 6 COMPR. WITH VANES

LINE NO. CONT. LOC.



Typical Main Circuit Wiring (with VFD and Controls by Others)

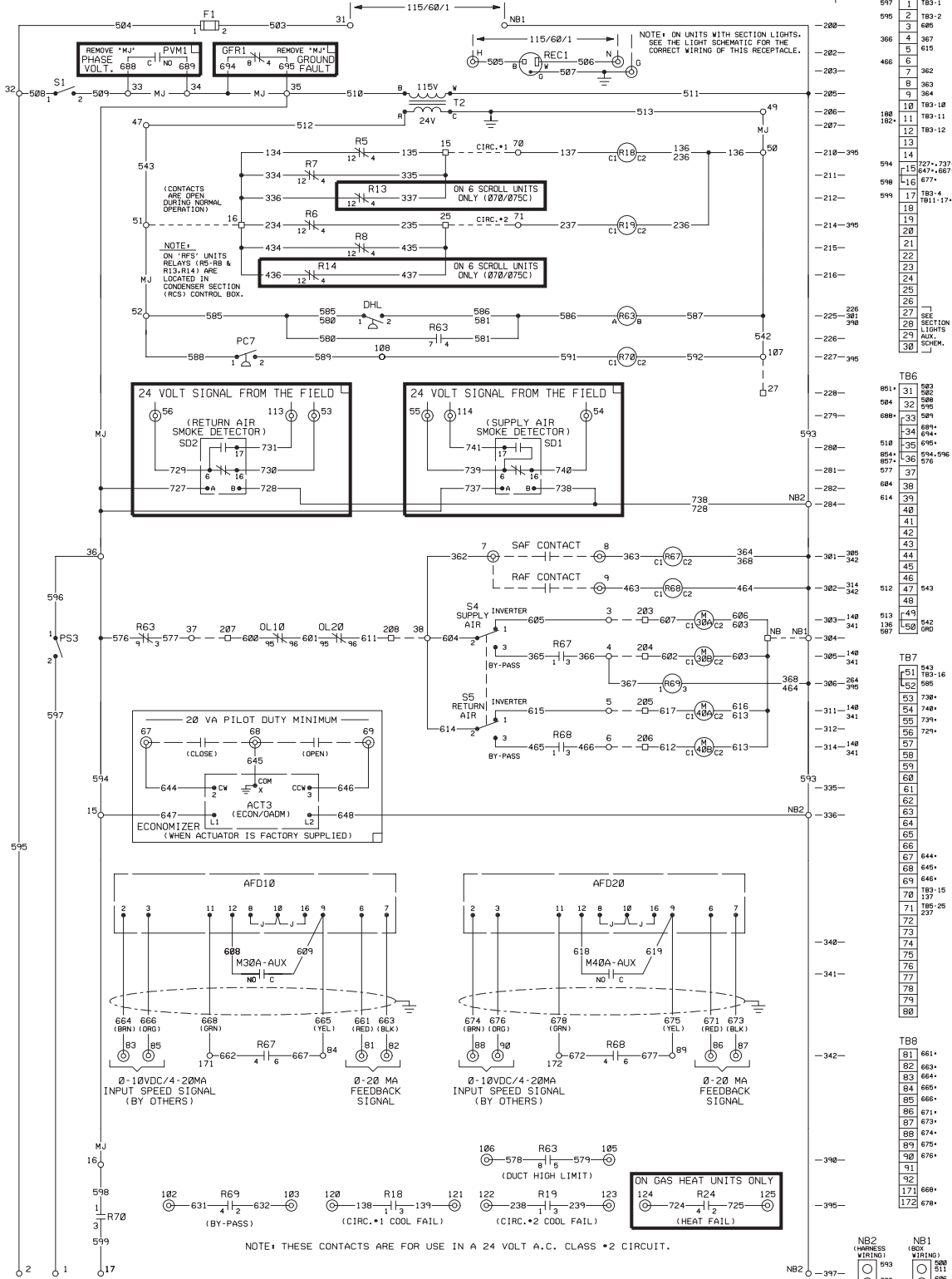
Microtech II Schematics are in OM-696

SCHEM. 0917541D-01 REV. A

MODELS: RPS,RFS, RDT 105C-135C WITH SEMI-HERMETIC COMPRESSORS
RPS,RFS, RDT 036C-075C WITH SCROLL COMPRESSORS

NO CONTROL --- 4 & 6 COMPRESSOR WITH INVERTERS*

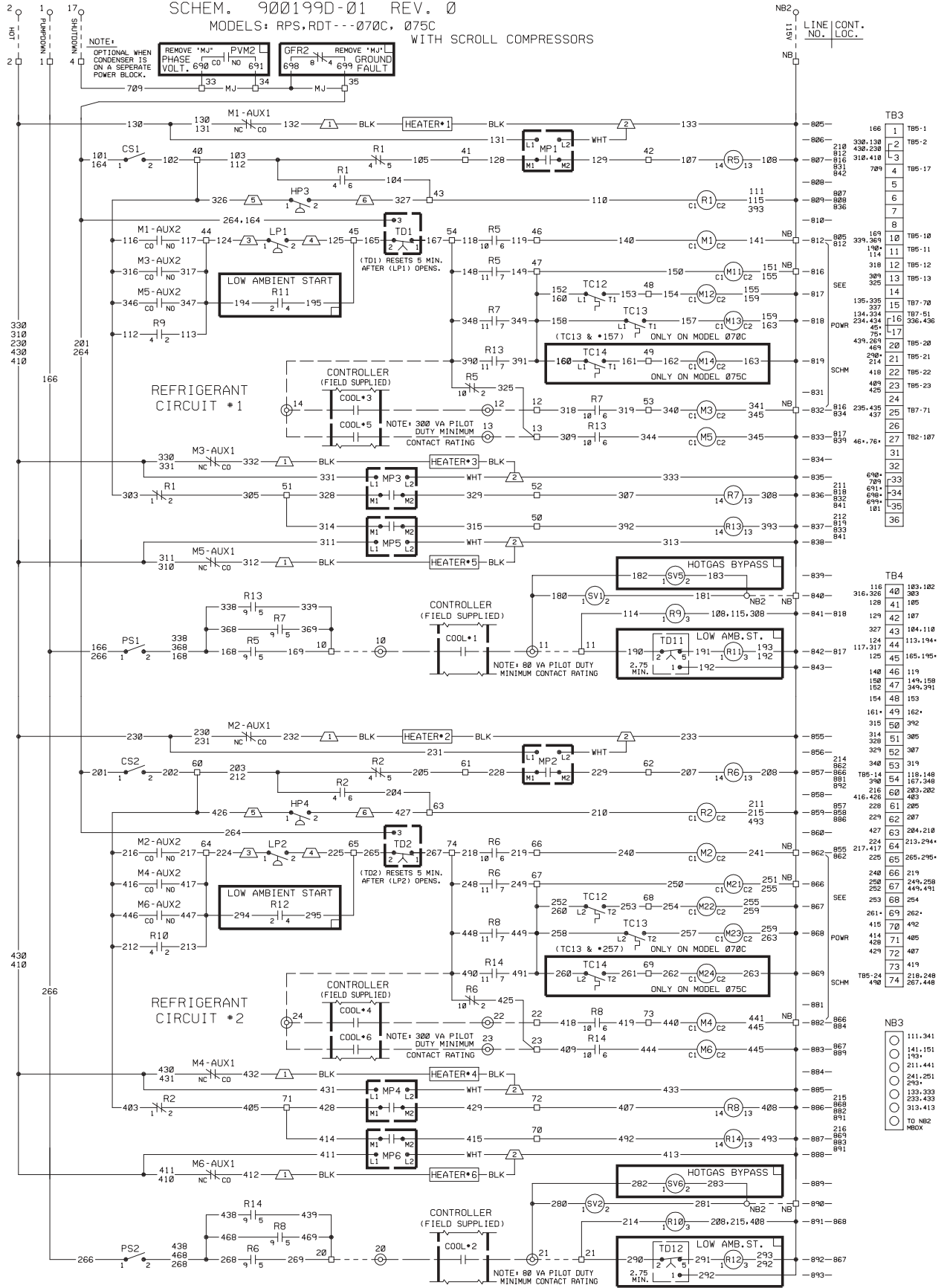
LINE CONT. NO. LOC.



NOTE: THESE CONTACTS ARE FOR USE IN A 24 VOLT A.C. CLASS *2 CIRCUIT.

101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Typical Condensing Unit Control with Control Schematic for RPS (Controls by Others, 6 Compressor Unit Shown, RCS Has Minor Variations)



Typical Supply / Return Fan Control Circuit Wiring (No Controls)

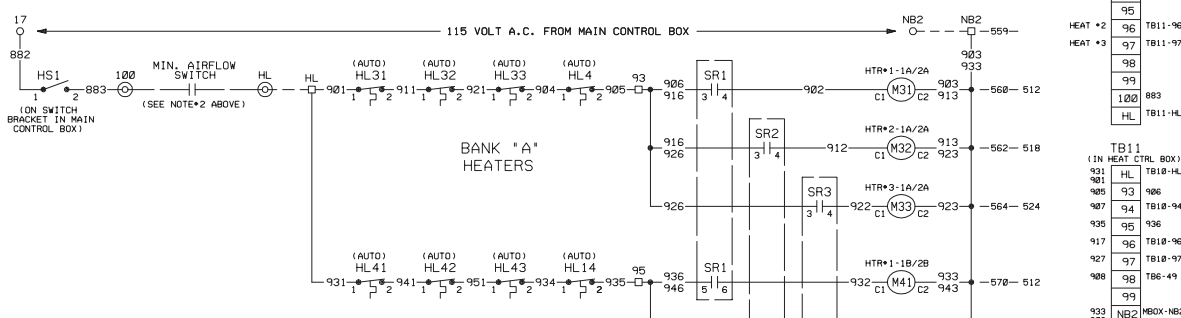
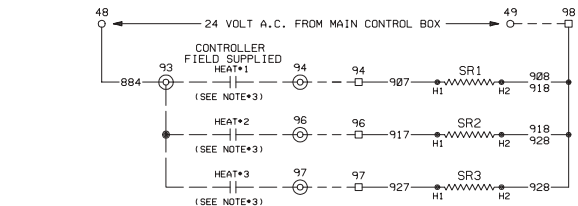
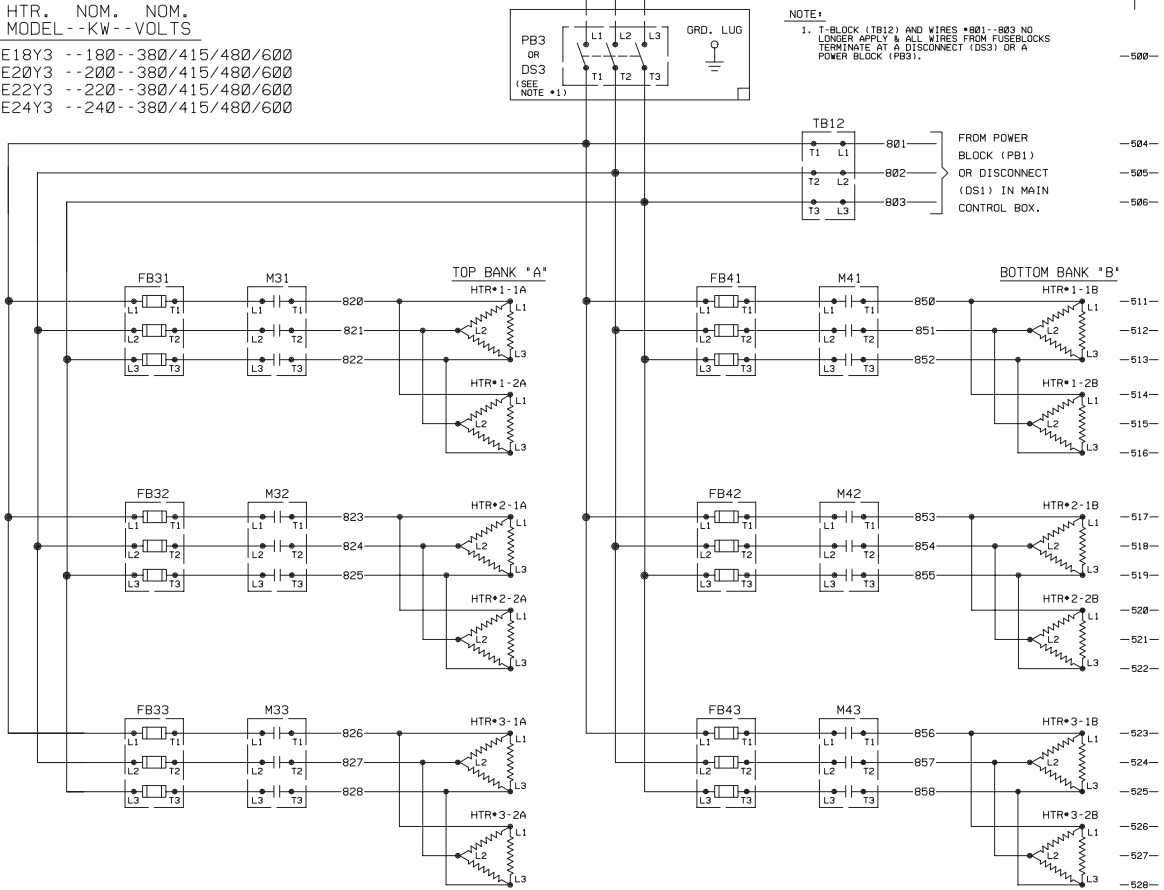
SCHEM. 5/25/4D-01 REV. 0

HTR. NOM. NOM.
MODEL -KW- VOLTS

E18Y3 -- 180-380/415/480/600
E20Y3 -- 200-380/415/480/600
E22Y3 -- 220-380/415/480/600
E24Y3 -- 240-380/415/480/600

ELEC. CIRCUIT #3

LINE | CONT.
NO. | LOC.



HTR #	HTR #	HTR #	TOP BANK 'A'		
2A	M33	1A	2A	M32	1A
	M31	1A			
(30KW)-(30KW)-(30KW)=90KW (30KW)-(20KW)-(40KW)=100KW (30KW)-(40KW)-(40KW)=110KW (40KW)-(40KW)-(40KW)=120KW					
BOTTOM BANK 'B'					
2B	M43	1B	2B	M42	1B
	M41	1B			
(30KW)-(30KW)-(30KW)=90KW (30KW)-(30KW)-(40KW)=100KW (30KW)-(40KW)-(40KW)=110KW (40KW)-(40KW)-(40KW)=120KW					

TB10 (IN MAIN CTRL BOX)

24V TO CONTROLLER	93	884
HEAT *1	94	TB11-94
HEAT *2	95	TB11-96
HEAT *3	96	TB11-97
	97	
	98	
	99	
	100	883
HL		TB11-HL

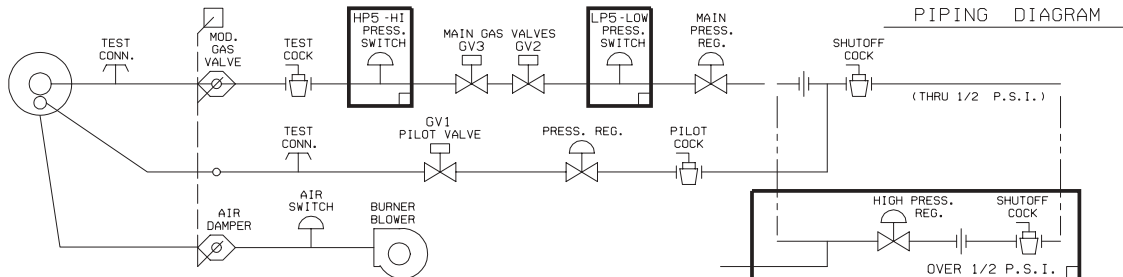
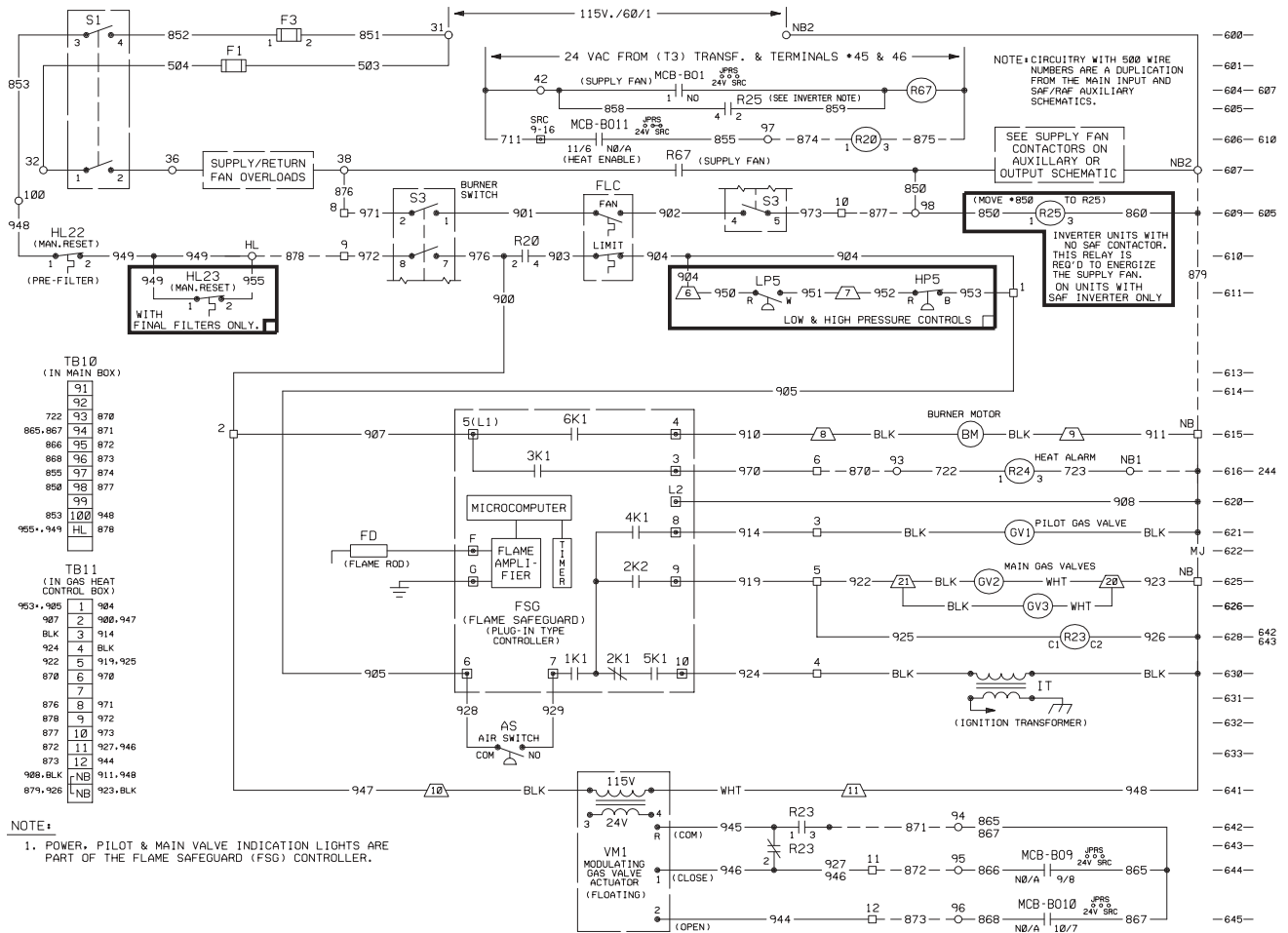
TB11 (IN HEAT CTRL BOX)

931	HL	TB10-HL
921		
905	93	906
907	94	TB10-94
935	95	936
917	96	TB10-96
927	97	TB10-97
908	98	T86-49
	99	
933		NB2X-NB2
903		

Typical Gas Furnace Control Circuit (Modulating Burner, Mixed Air Intake)

BURNER SIZE: 400MBH--1000MBH SCHEM. 557746D-11
 MODELS: ROOFTOP 'C' VINTAGE (MICROTECH II)

LINE NO. CONT. LOC.



Unit Options

Enthalpy Control

Outside Air Enthalpy Control (OAE)

Units with MicroTech II control and an economizer come standard with an electromechanical enthalpy control device (OAE) which senses both the humidity and temperature of the outside air entering the unit. This device has an enthalpy scale marked A through D. *Table 18* shows the control points at 50% RH for settings A through D. *Figure 65* shows this scale on a psychrometric chart. When the outside air conditions exceed the setting of the device, the outside air dampers are positioned to the minimum outside air intake position by the MicroTech II controller.

Table 18: Enthalpy control settings

CONTROL CURVE	CONTROL POINT TEMP. AT 50% RH
A	73°F (23°C)
B	70°F (21°C)
C	67°F (19°C)
D	63°F (17°C)

Differential Enthalpy Control (OAE/RAE)

An optional electric differential enthalpy control arrangement (OAE/RAE) is available on units with MicroTech II control. In this configuration a solid-state humidity and temperature sensing device is located in both the return (RAE) and outside intake (OAE) airstreams. This OAE device has the same A through D scale as the device described above. However, with the OAE/RAE arrangement the switch on OAE must be set all the way past the "D" setting. With this done, the MicroTech II controller will adjust the return and outside air dampers to use the airstream with the lowest enthalpy.

Low Ambient Start

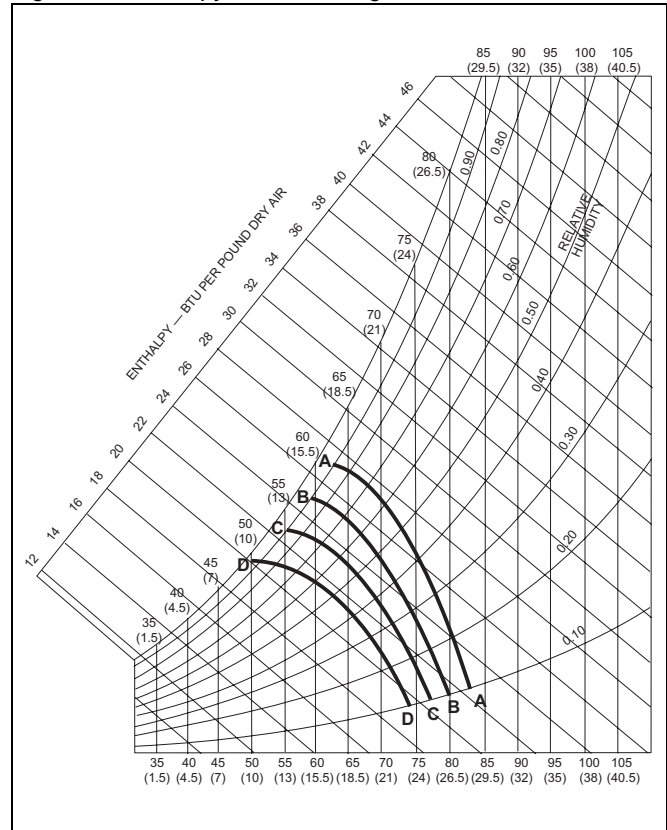
At low outdoor air temperature conditions, the low ambient start option provides that the compressors will start and operate long enough to develop sufficient suction pressure to close the low pressure switches (LPI and LP2). The low ambient start sequence of operation is described below. Refer to "Typical Condensing Unit Control with Control Schematic for RPS (Controls by Others, 6 Compressor Unit Shown, RCS Has Minor Variations)" on page 59.

Assume that switches CS I and PS I are closed (lines 807 and 842). When time delay relay TD1 times out, relays R5 and R9 (lines 807 and 811) are energized. If cooling is required, the MicroTech II controller will energize output relay OBA1 (line 842), thus energizing liquid line solenoid valve SV1 (line 841). At the same time, relay R11 is energized through time delay relay TD11 (line 842). The R11 contacts in line 815 then close, bypassing LP 1. The TD 11 contacts remain closed for 2.75 minutes, and thus R11 remains energized and its contacts remain closed. When the TD 11 timer expires, it opens the circuit, de-energizing relay R11. The R11 contacts then open, and LPI controls the compressor as usual

Ground Fault Protection

The ground fault protection is designed to protect motors from destructive arcing ground faults. The system consists of a ground fault relay and a ground fault current sensor. The ground fault relay employs solid state circuits that will instantaneously trip and open a set of relay contacts in the 115 volt control circuit to shut the unit down whenever a ground fault condition exists. The ground fault relay is self powered. The ground fault sensor is a current transformer type of device located on the load side of the power block through which the power wires of all phases are run.

Figure 65. Enthalpy control settings



Phase Voltage Monitor

The phase voltage monitor protects against phase loss (single phasing) when any one of three line voltages drops to 74% or less of setting. This device also protects against phase reversal when improper phase sequence is applied to equipment, and low voltage (brownout) when all three line voltages drop to 90% or less of setting. An indicator run light is "on" when all phase voltages are within specified limits. The phase voltage monitor is located on the load side of the power block with a set of contacts wired to the 115 volt control circuit to shut the unit down whenever the phase voltages are outside the specified limits.

Hot Gas Bypass

Hot gas bypass is a system for maintaining evaporator pressure at or above a minimum value. The purpose for regulating the hot gas into the distributor is to keep the velocity of the refrigerant as it passes through the evaporator high enough for proper oil return to the compressor when cooling load conditions are light.

The system consists of a solenoid valve piped in series with a pressure regulating valve as shown in *Figure 67*. The solenoid valves are factory wired to open whenever the controller calls for the first stage of cooling. The pressure regulating valve operates as shown in *Figure 66*. Since the bulb is factory mounted in the discharge airstream where the ambient temperature is about 55°F (13°C), the chart indicates that the valve is factory set to begin opening at about 57 psig (393 kPa).

This setting can be changed by changing the pressure of the air charge in the adjustable bulb (*refer to Figure 67*). To raise the pressure setting, remove the cap on the bulb and turn the adjustment screw clockwise. To lower the setting, turn the screw counterclockwise. One turn is equivalent to a change of about 1 psi (7 kPa). Do not force the adjustment beyond the range it is designed for, as this will damage the assembly.

The regulating valve opening point can be determined by slowly reducing the system load or reducing the required dis-

charge air temperature setting while observing the suction pressure. When the bypass valve starts to open, the refrigerant line on the evaporator side of the valve will begin to feel warm to the touch.

CAUTION

The hot gas line may become hot enough to cause injury in a very short time, so care should be taken during valve checkout.

Figure 66. Hot Gas Bypass Adjustment Range Chart

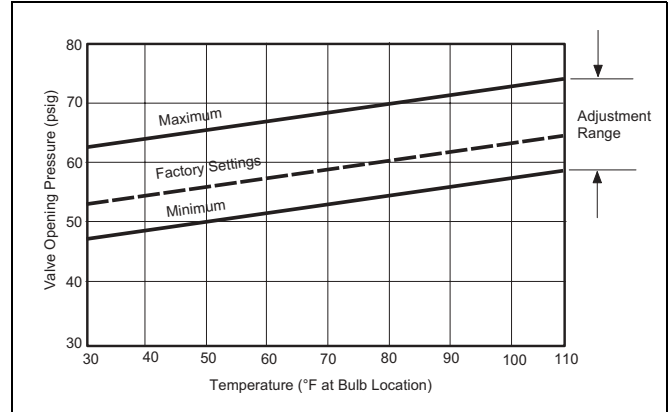
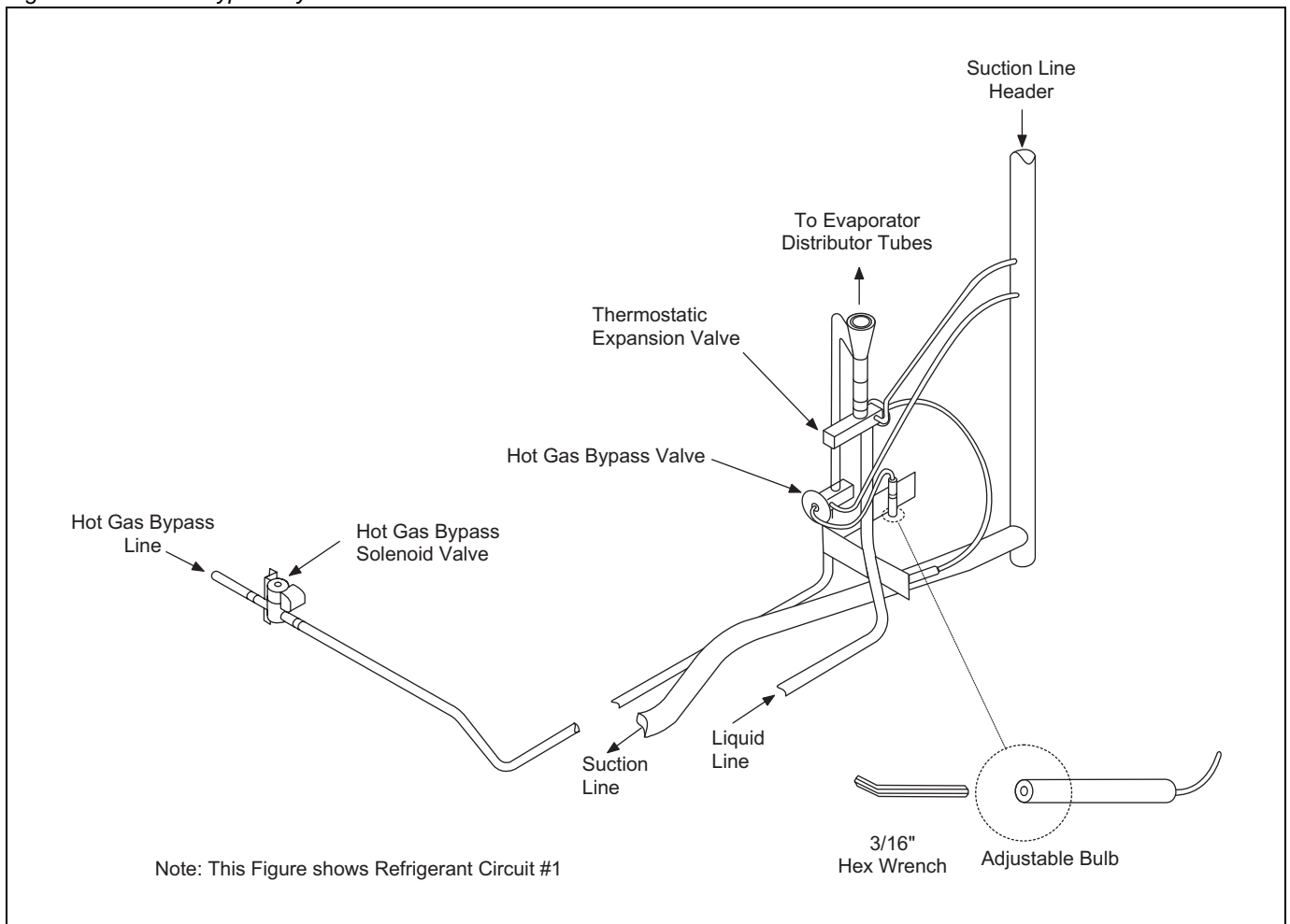


Figure 67. Hot Gas Bypass System



External Time Clock

An external time clock can be used as an alternative to (or in addition to) the MicroTech II controller's internal scheduling function. The external timing mechanism is set up to open and close the circuit between field terminals 101 and 102. When the circuit is open, power is not supplied to digital input DI (terminal DH1-1) on the ADI board. This is the normal condition in which the programmable internal schedule is followed. When the circuit is closed, power is fed to DH1-1. The MicroTech II controller responds by placing the unit in the occupied mode, overriding any set internal schedule.

For more information, please see the "Digital Inputs" section of Bulletin No. IM 696, "MicroTech II Applied Rooftop Unit Controller."

Smoke Detectors

Optional smoke detectors can be located at the supply and return openings. The wiring for these smoke detectors is shown on any of the "Typical Main Control Circuit" wiring schematics within the section "Wiring Diagrams" on page 54.

The sequence of operation for these detectors is as follows: When the smoke is detected by either sensor, the normally closed sensor contacts open. This removes power from digital input MCB BI 18 on the Main Control Board.

The MicroTech II controller responds by shutting the unit down. The controller is placed in the Alarm Off state, and cannot be restarted until the alarm is manually cleared. *Refer to the operation manual supplied with the unit for information on clearing alarms (page 55, OM138 or page 58, Om137).*

The smoke detectors themselves must be manually reset once they have tripped. Power must be cycled to the smoke detector to reset.

Freeze Protection

An optional freezestat is available on units with MicroTech II control that have hot water or steam heating coils. The sensing element is located on the downstream side of the heating coil in the heating section of the unit. If the freezestat detects a freezing condition and closes, the MicroTech II controller will take different action, depending on whether the fans are on or off. The freezestat is an auto reset type of control; however, the controller alarm it causes is manual reset if the fan is on and auto reset if the fan is off.

Fan On Operation

If the freezestat detects a freezing condition while the fan is on, the MicroTech II controller will shut down the fans, close the outdoor air dampers, open the heating valve, and set a 10-minute timer. The MicroTech II controller's active alarm will be "Freeze Stat Fault."

When the 10-minute timer expires, the controller begins checking the freezestat again. If the freezestat is open, the heating valve will close. If the freezestat closes again, the heating valve will open, and the 10-minute timer will reset.

The unit will remain shut down until the "Freeze Stat Fail" alarm is manually cleared. *Refer to the operation manual supplied with the unit for information clearing alarms (page 55, OM138 or page 58, Om137).*

Fan Off Operation

If the freezestat detects a freezing condition while the fan is off, the MicroTech II controller will open the heating valve and set a 10-minute timer. The MicroTech II controller's active alarm will be "Freeze Problem."

When the 10-minute timer expires, the controller begins checking the freezestat again. If the freezestat is open, the heating valve will close. If the freezestat closes again, the heating valve will open, and the 10-minute timer will reset.

When the freezestat opens again, the "Freeze Stat Prob" alarm automatically clears. This feature protects the coil and allows the system to start normally after a cold night.

Mixed Air Temperature Alarm

A mixed air temperature (MAT) sensor and an associated "Low Airflow Alarm" are provided on VAV units with MicroTech II control and gas or electric heat. The MAT sensor is located in the supply fan section of the unit at the supply air funnel.

Heat will be disabled whenever the airflow is detected to be too low for safe heating operation. This condition is indicated when the supply air temperature exceeds the mixed air temperature by more than 60°F (16°C). In this case, a "Low Airflow Alarm" is generated and heat will not be re-enabled until the alarm is manually cleared. *Refer to the operation manual supplied with the unit for information on clearing alarms (page 55, OM138 or page 58, Om137).*

Duct High Pressure Limit

The duct high pressure limit control (DHL) is provided on all VAV units, including the CAV-DTC unit that can be field converted to VAV. The DHL protects the ductwork, the terminal boxes, and the unit from over pressurization which could be caused by, for example, tripped fire dampers or control failure.

The DHL control is factory set to open when the discharge plenum pressure rises to 3.5" w.c. (872 Pa). This setting should be correct for most applications; however, it is adjustable. Removing the front cover of the device reveals a scale showing the current setting. Turning the adjustment screw located on the bottom of the device adjusts the setting up or down.

If the DHL switch opens, digital input MCB BI 14 on the Main Control Board will be de-energized. The MicroTech II controller then shuts down the unit and enters the Off-Alarm state. The alarm must be manually cleared before the unit can start again. *Refer to the operation manual supplied with your unit for more information on clearing alarms (page 55, OM138 or page 58, Om137).*

Variable Inlet Vanes

Variable inlet vanes are installed on the supply and return fans of VAV units. They are also installed on the return fans of constant volume units that have direct building static pressure control capability.

The inlet vane assemblies consist of airfoil type inlet funnels with integral sets of lever-actuated radial vanes. Supply fans have one assembly on each side of the fan. Return fans have one assembly on the inlet side of the fan only. When they open, the inlet vanes direct air in the direction of wheel rotation.

The vanes are able to rotate 90 degrees from full closed to full open. A stop limits the amount of travel open and must not be changed. Driving the vanes past this stop will cause the vane hub cam linkage to disengage. The vanes will turn independently of each other, and the hub assembly will have to be overhauled. The moving parts of the vanes are permanently lubricated. All threaded fasteners must be periodically checked for tightness.

All fans with inlet vanes are provided without motor actuators for field control installation, or may be shipped from the factory with complete linkage and actuator assemblies. Field installed linkages and actuators would be connected as shown in *Figure 69 on page 67 thru Figure 75 on page 70*.

Minimum Vane Position

Operation with the inlet vanes closed completely may result in fan pulsation and excessive vibration. In units equipped with MicroTech II controls, the vanes are automatically opened approximately 5 degrees by the control system prior to fan start-up. Field installed linkages and actuators should be pre-set to close to no less than 5 degrees open.

Supply Fan Vane Adjustment

Figure 69 & Figure 70 on page 67, Figure 71 on page 68 and Figure 74 on page 69 thru Figure 75 on page 70 show the supply fan vane linkage assembly. Both sets of vanes on the supply fan must operate in unison. Adjustments to the motor rod end and locknut as well as to the floating link ends (Point A) can be made to provide uniformity between the linkage assemblies.

The vane actuators must have 180-degree rotation. Do not make linkage adjustments to compensate for improper actuator rotation, but correct the actuator rotation adjustment. Refer to “*Actuator Rotation Adjustment*” on this page.

On units with vane controls on both the supply and return fan, it is important that both actuators have exactly 180-degree rotation to provide proper “tracking” of the two actuators.

Inlet vanes must not be adjusted to close tight during fan operation. A minimum of 5° open is recommended to avoid fan pulsation. Units with factory installed MicroTech II controls will automatically open vanes 5 degrees prior to start-up.

As the actuator moves from 0° to 180°, the vanes should move from 0° (closed) to 90° (full open). This can be adjusted by changing the linkage rod length by loosening the nut and sliding the rod at Point A or Point B and retightening the nut.

NOTICE

Inlet vanes must not be adjusted to close tight during fan operation.

A minimum operating position of 5 degrees open is recommended to avoid pulsation.

Units with factory installed MicroTech II controls will automatically open vanes 5 degrees prior to start-up.

Return Fan Vane Adjustment

Refer to *Figure 71 on page 68* for 30" wheels and *Figure 70 on page 67 thru Figure 73 on page 69* for 40" wheels. The vane actuator must have 180-degree rotation. Do not make linkage adjustments to compensate for improper rotation, but correct the actuator rotation adjustment. (Refer to the “*Actuator Rotation Adjustment*” section following.)

As the actuator crankarm rotates from 0 degrees to 180 degrees, the vanes should move from 0 degree (closed) to 90 degrees (full open). This can be adjusted by changing the linkage rod length by loosening the nut and sliding the rod at Point A or Point B and retightening the nut.

Inlet vanes must not be adjusted to close tight during fan operation. A minimum of 5° open is recommended to avoid fan pulsation. Units with factory installed MicroTech II controls will automatically open vanes 5° prior to startup.

Actuator Rotation Adjustment

The counterclockwise (as viewed from shaft end of actuator) limit switch is adjustable on the Siebe actuator. The clockwise limit is not adjustable. The counterclockwise limit setting can be changed in the field by inserting a screwdriver through the opening in the top plate directly ahead of the terminal block on the shaft side and engaging the screwdriver blade with the edge of the notched cam nearest the front of the actuator. Turning the cam clockwise (as viewed from the shaft) increases the amount of actuator rotation. Each click of the cam represents about 3 degrees of change in actuator rotation. The actuator should be set for 180-degree rotation.

Table 19: Applicable Actuator Linkage Configurations

Supply Fan Wheel Size (In Inches)	Z (Refer to Figure 71 on page 68)	Motor HP	Figure 71 on page 68 Reference View
27	38.1 (968mm)	5—40	2
30	42.3 (1074mm)	5—40	2
33	46.4 (1179mm)	5—40	2

Figure 69. Supply Fan or Return Vane Assembly (RPS 15-40)

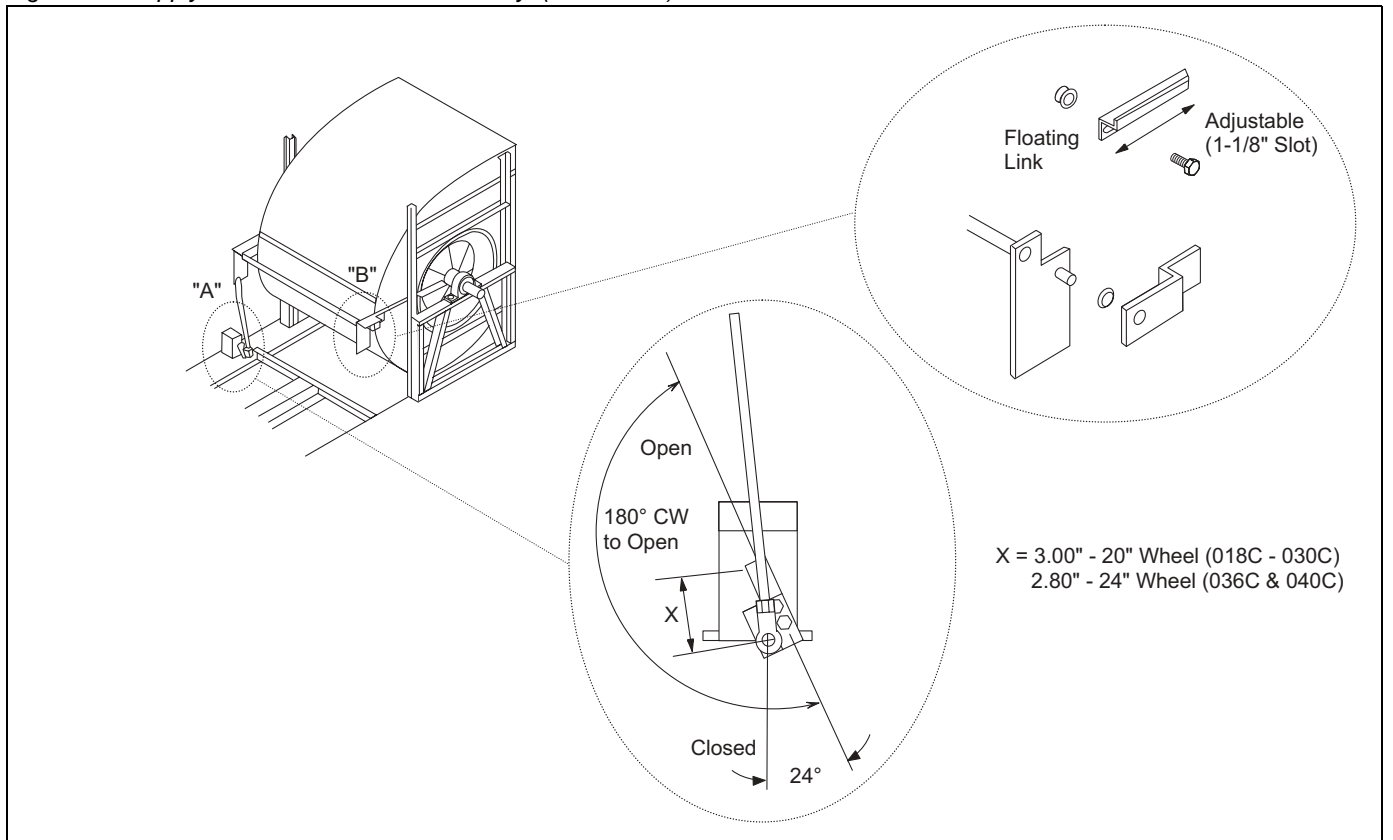


Figure 70. Return Fan Vane Assembly

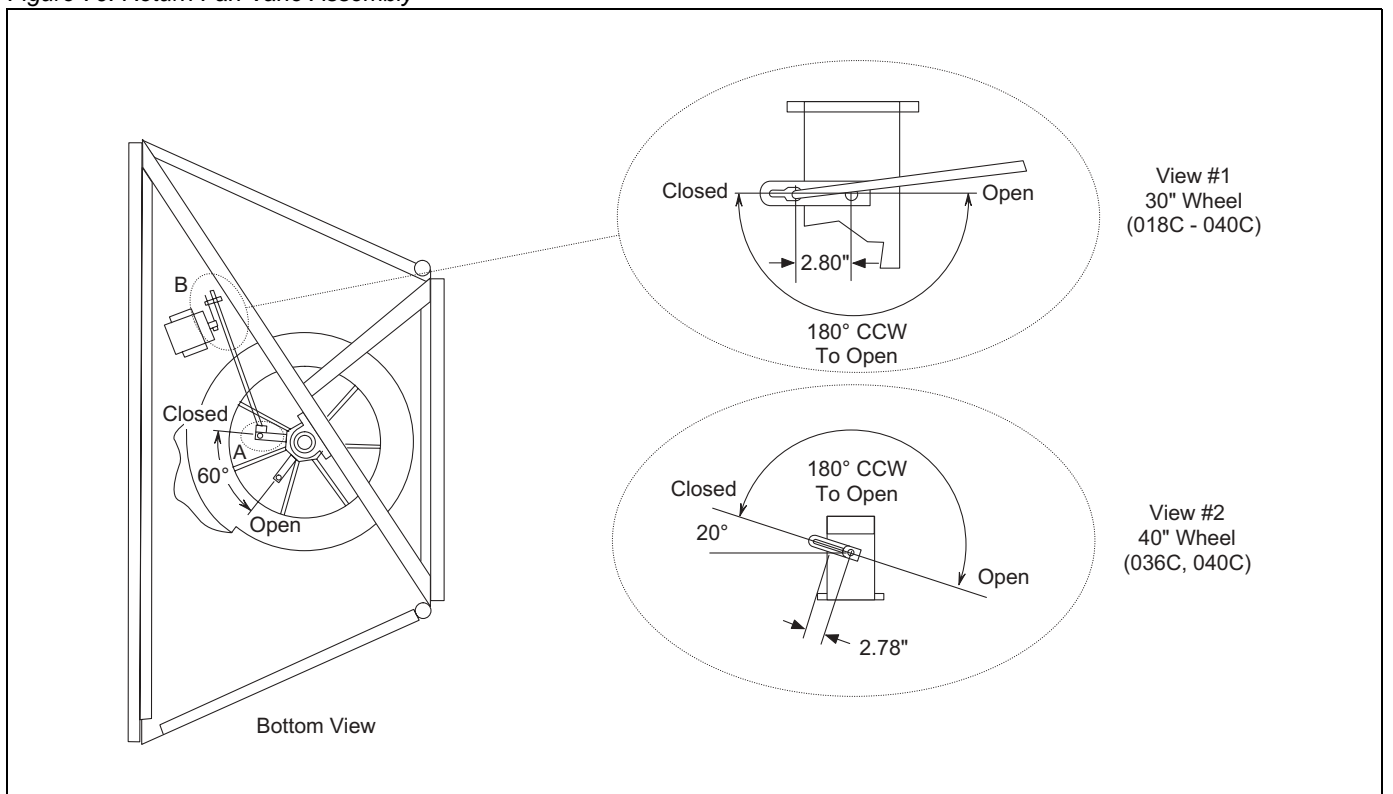
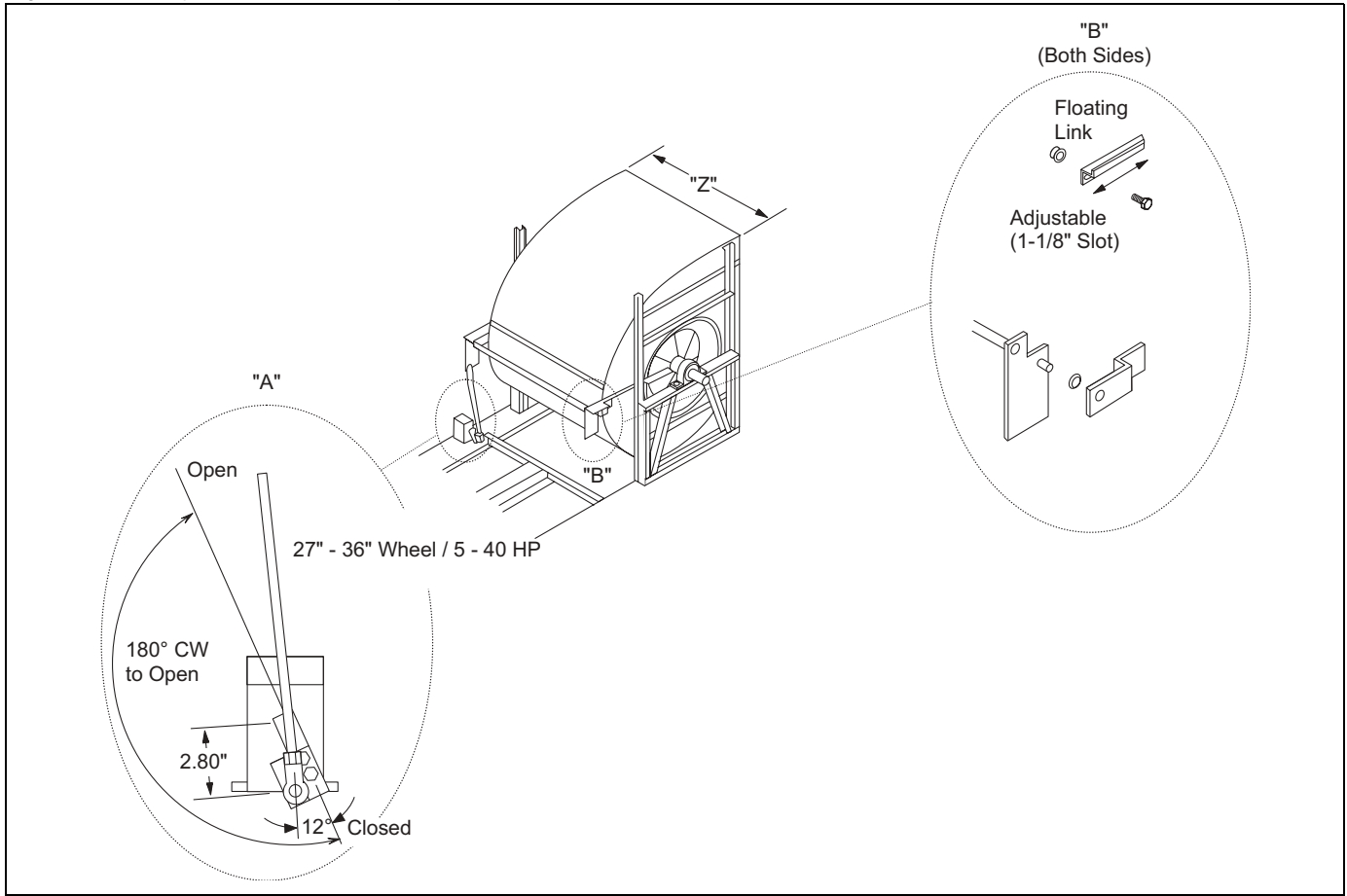


Figure 71. Supply Fan Vane Assembly (RPS 45-075)



Note: Dimension "Z" is referenced in Table 19 on page 66

Figure 72. Return Fan Vane Assembly (40" Wheels)

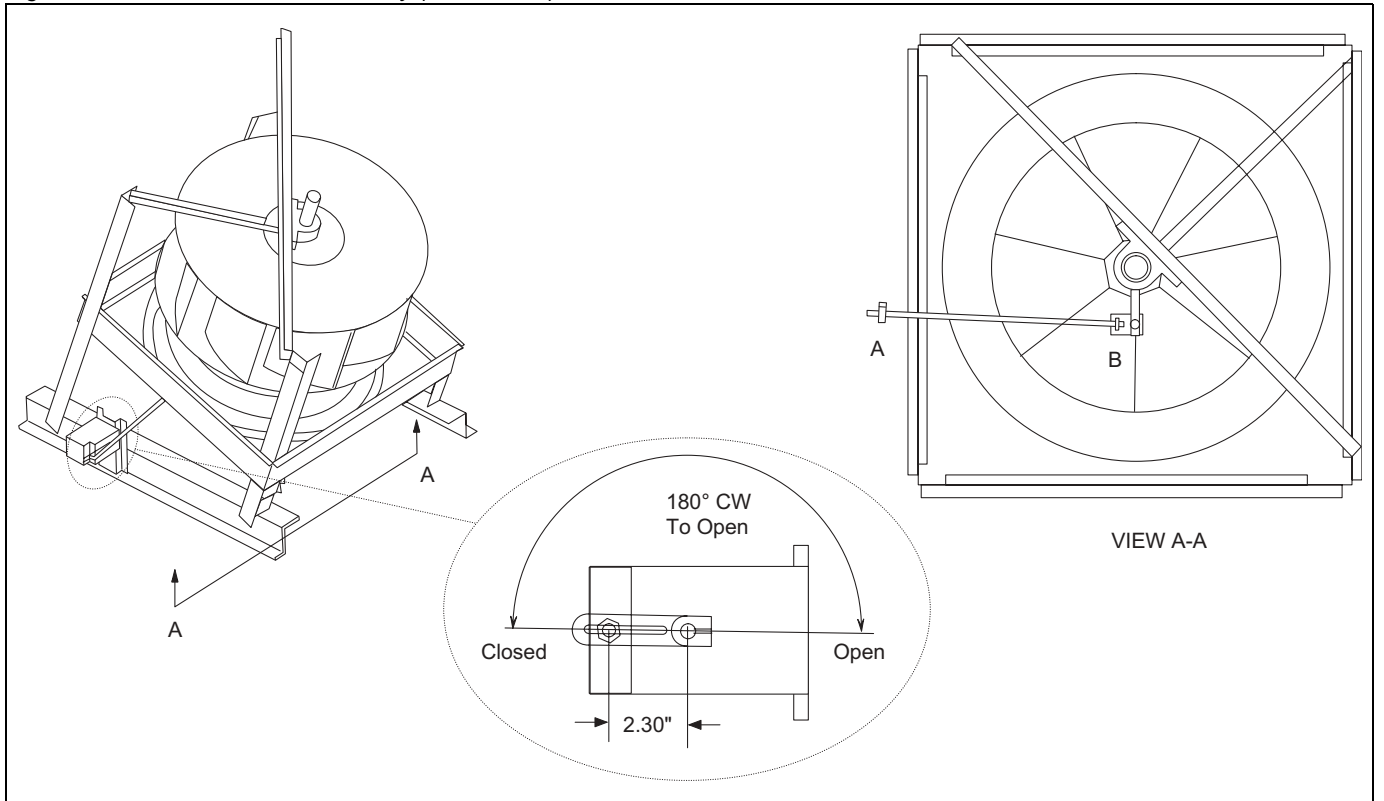


Figure 73. Return Fan Vane Assembly (RPS - 44" Wheels)

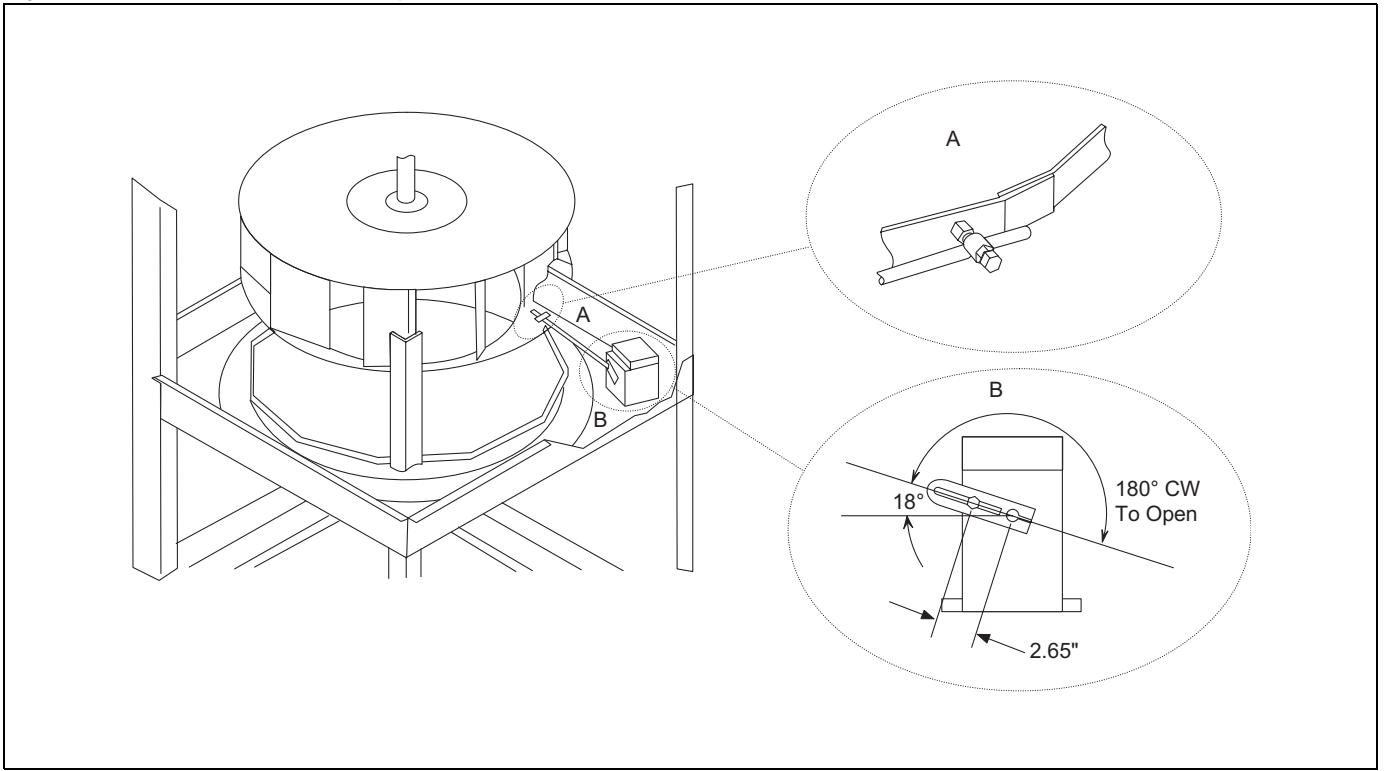


Figure 74. Supply Fan Assembly (40" Wheels - RDT 45 - 075)

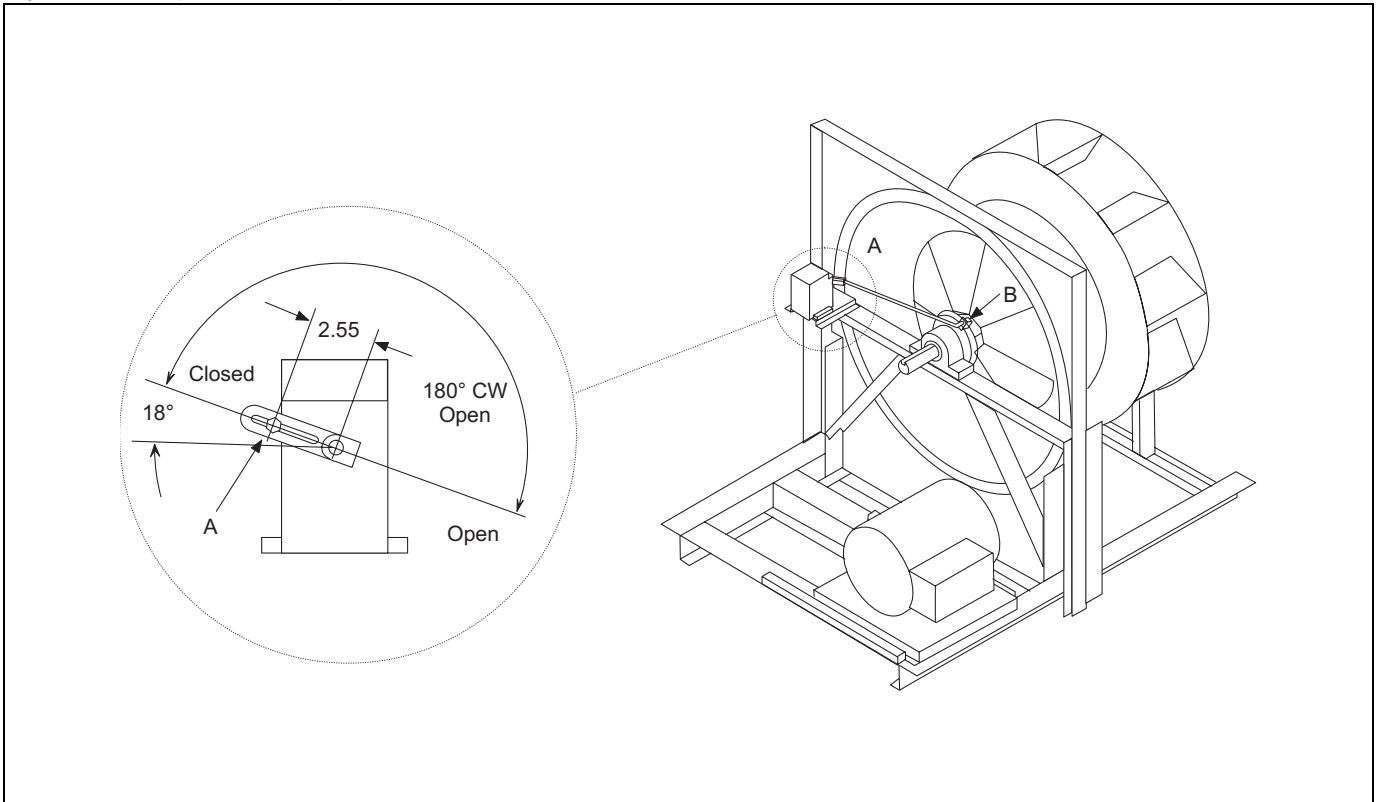
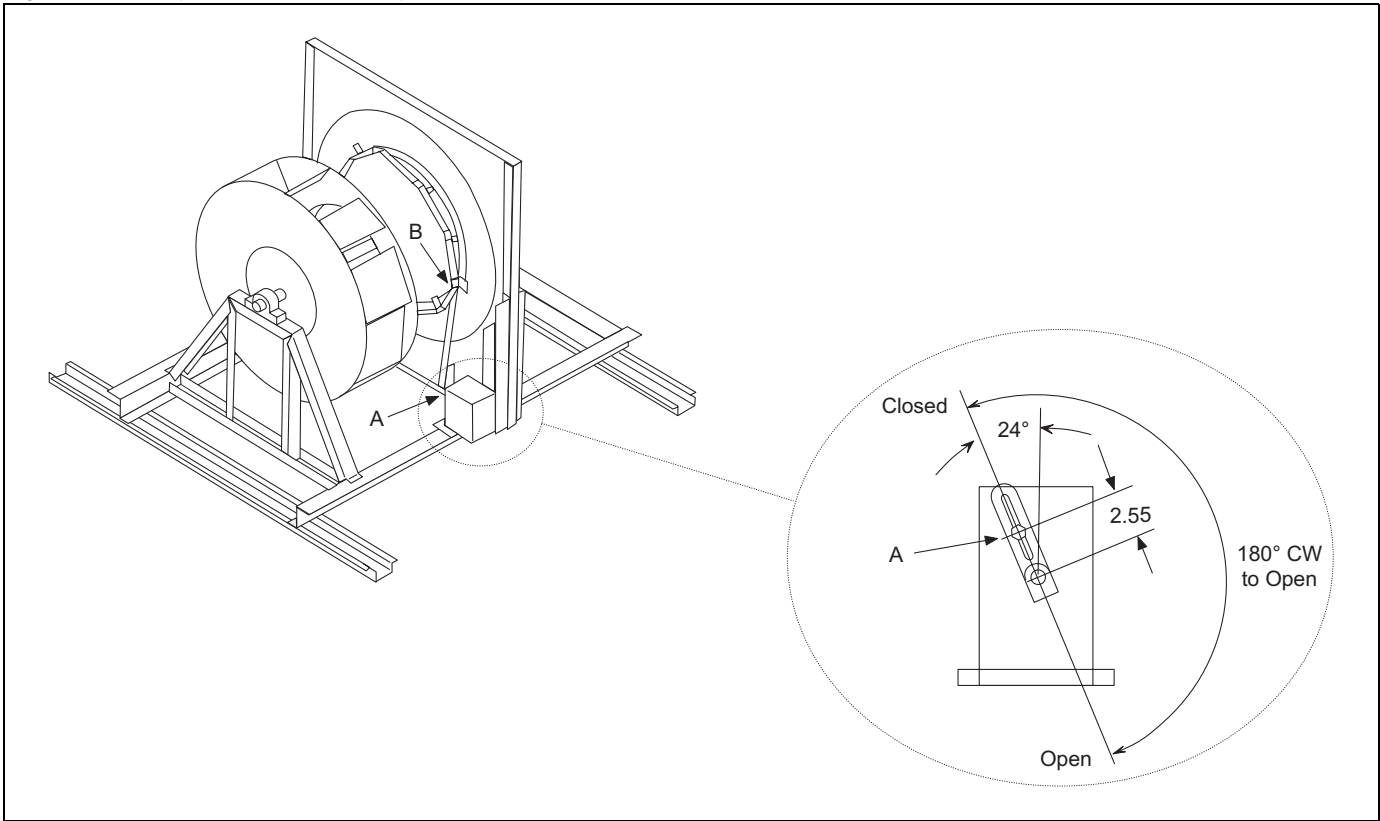


Figure 75. Supply Fan Vane Assembly (44" Wheels - RDT 45 - 135)



Variable Frequency Drive Operation

Refer to the vendor instructions supplied with the unit.

Convenience Receptacle/Section Lights

A convenience receptacle is provided in the main control box on all units. To utilize this receptacle, a separate field supplied 115V power wiring circuit must be connected to the 115V field terminal block TB1, located in the main control box. Note that the National Electrical Code requires that this circuit be protected by a ground fault circuit interrupter (GFI) device.

Optional lights are available for certain sections in the unit. Each light includes a switch and convenience receptacle, and is powered by the external 115V power supply connected to TB1.

DesignFlow™ Outdoor Air Damper Option

DesignFlow™ airflow measurement stations are located inside the louvered outdoor air intake doors between the intake louver and outside air dampers. Essentially, they consist of a vane that is repositioned by airflow, the amount of rotation indicating the amount of airflow. They have been precision calibrated at the factory and no further calibration is required. However, a leveling adjustment is required. The DesignFlow unit must be accurately leveled so that when operating it will be orientated the same as when it was calibrated.

The rotational position of the DesignFlow unit vane is translated into CFM by the microprocessor in the MicroTech II control system. The position of the vane is determined by two things - the force of the airflow impacting the vane and the gravitational effect on the vane. Gravity is the only factor at the lower CFM end of the range. On a correctly leveled unit, this gravitational effect will be the same as when the unit was calibrated in the factory.

Both the right-hand and left-hand DesignFlow stations must be accurately leveled. To accurately level a station, a precise mechanical force is applied against the vane. That force should cause the vane to move to a specific position if the DesignFlow unit is correctly leveled. If the vane does not move to the correct position with the force applied, the DesignFlow unit is not properly leveled and gravity is causing the difference.

The DesignFlow unit is mounted such that it pivots at the top. A lock nut, a slotted hole, and a threaded adjuster allow positioning the bottom of the assembly so it can be correctly leveled. When the lock nut is loosened, the threaded adjuster allows precise, controlled movements. Make sure that power has been supplied to the unit. The leveling component can be found in the main control box.

DesignFlow Airflow Measurement

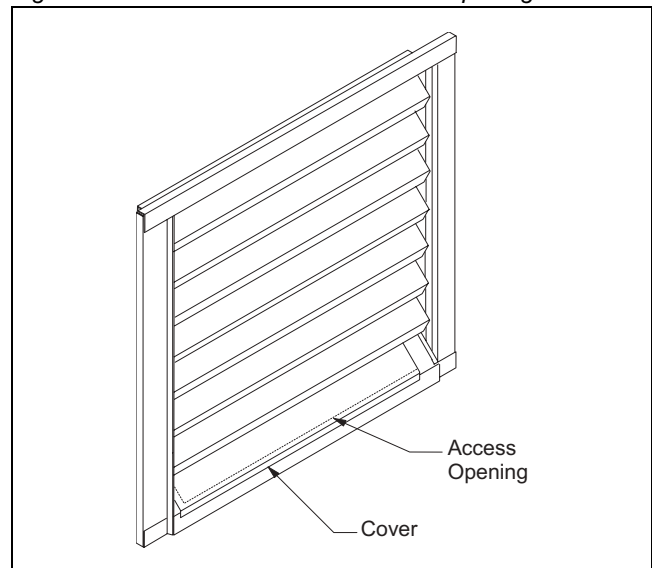
Station Startup:

Note: Before starting the station startup procedure, locate the leveling components kit that can be found in the main unit control box.

Note: Before starting the station startup procedures, verify that power has been supplied to the unit's MicroTech II control system. The DesignFlow startup procedure cannot be completed without use of the MicroTech II controls.

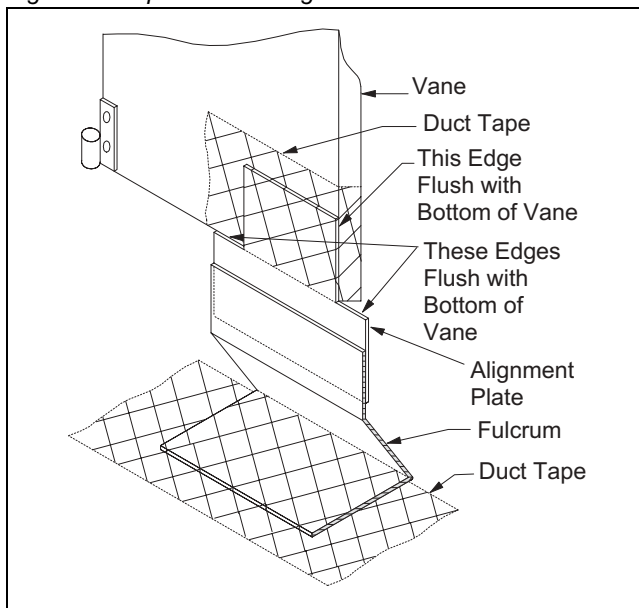
1. The swinging vanes on the measurement stations have been locked in place for shipment. The stations are accessible when the louvered outdoor air intake doors are opened. Remove the two shipping screws from each vane. One screw is located one inch from the top of the vane. The other is one inch from the bottom of the vane. Both are about eight inches in from the outer edge of the vane.
2. Examine the station for shipping damage. Manually rotate the vane and verify that it does not rub against anything. Close and latch the louvered intake door.
3. Remove the covers from the access opening in the bottom blade of the outdoor air intake louvers (See Figure 76). The leveling procedure must be accomplished with the louvered door in the closed position. These openings provide access for leveling.

Figure 76. Remove Covers from Access Opening



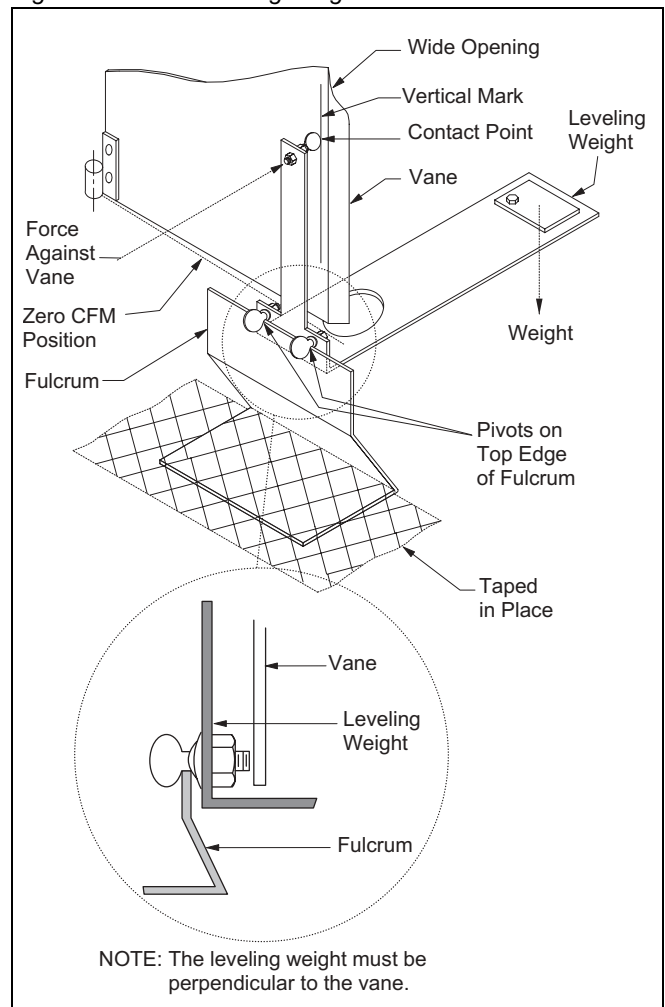
4. The leveling procedure is performed with the fans off and the outdoor air dampers closed. If there is a wind, the outdoor air louvers should be covered with poly film, cardboard, etc. to prevent adverse readings due to wind.

Figure 77. Tape Fulcrum Alignment Plate to Vane



5. Tape the fulcrum Alignment Plate to the vane (See Figure 77). Locate the Alignment Plate so the bottom edge of its notches are flush with the bottom edge of the vane, one side of one notch is even with the bend near the outer edge of the vane, and the plate is flat against the outer surface of the vane.
6. Install the fulcrum that is used in the leveling procedure (See Figure 77). The fulcrum will be held in place with duct tape. Wipe the bottom of the louver door where the fulcrum will be located so the tape will stick. Pre-apply the duct tape to the top surface of the bottom flat of the fulcrum, having it extend about one inch beyond the edges on three sides. Once the fulcrum is positioned, these extensions can be pressed down to tape the fulcrum in place. Use the Alignment Plate to locate the fulcrum. With the Alignment Plate taped to the vane and the vane in the zero airflow position, the fulcrum is located parallel to and against the Alignment Plate. The zero airflow position is when the vane is swung away from the back wall and resting against its stop. Remove the Alignment Plate after locating the fulcrum.
7. Place the leveling weight on the fulcrum (See Figure 78). The vane has a small marker hole one inch up from the bottom and .50 inch in from the bend near the outer edge. There is a vertical mark intersecting the hole. The leveling weight should contact the vane along this vertical mark.

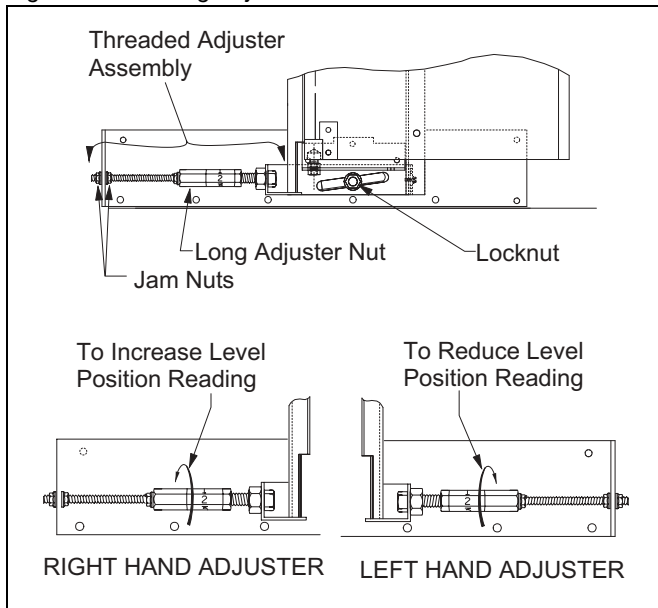
Figure 78. Place Leveling Weight on Fulcrum



NOTE: The leveling weight must be perpendicular to the vane.

8. Set up the leveling test. While holding the weight so it stays on the fulcrum, manually rotate the vane to the wide-open position, manually return it to the zero CFM position, and gently release the vane. Locate the Leveling Weight so its contact point is against the vertical mark on the vane. While the weight teeters on the fulcrum, gently rap the base frame to slightly vibrate the assembly and encourage the vane to seek its equilibrium point.
9. Read the current vane leveling position through the unit keypad/display. This is done by viewing the *LH Lvl Pos=* or *RH Lvl Pos=* parameter in the DesignFlow Setup menu. The *LH Lvl Pos=* parameter indicates the current position of the vane for the left-hand DesignFlow station. The *RH Lvl Pos=* parameter indicates the current position of the vane for the right-hand DesignFlow station. These parameters will vary from 20% to 80% depending on the position of the DesignFlow vane. For detailed information regarding operation and navigation through the unit keypad menu structure, refer to operation manual *OM137 (discharge air control units)* or *OM138 (zone control units)*.

Figure 79. Leveling Adjustment



10. If the value indicated by the *LH Lvl Pos=(or RH Lvl Pos=)* parameter is not within the range of 23.64 to 24.08%, a leveling adjustment is required (See Figure 79). Leveling adjustments are accomplished by shifting the bottom of the measuring station to the right or left. If the *LH Lvl Pos=(or RH Lvl Pos=)* parameter indication is higher than specified, the bottom of the DesignFlow frame must be moved closer to the outdoor air damper. If the *LH Lvl Pos=(or RH Lvl Pos=)* parameter indication is lower than specified, the bottom of the DesignFlow frame must be moved farther from the outdoor air damper.

To make an adjustment, loosen the .25-20 NC lock nut at the slotted hole at the bottom of the frame. The threaded adjuster facilitates small accurate movements. Reposition the two .25-20 NC jam nuts on the threaded rod to make large adjustments, then use the long adjuster nut to make fine adjustments. Rotate the long adjuster nut to move the bottom of the station. Unscrewing the long adjuster nut from the large bolt makes the assembly longer and reduces the *LH Lvl Pos=(or RH Lvl Pos=)* parameter indication. Screwing in the long adjuster nut from the large bolt makes the assembly shorter and increases the *LH Lvl Pos=(or RH Lvl Pos=)* parameter indication.

After an adjustment is made, retighten the lock nut, gently rap the base frame to slightly vibrate the assembly and encourage the vane to seek its equilibrium point. Confirm that the contact point on the fulcrum is on the vertical mark on the damper. If the contact point is not on the vertical mark, reposition the fulcrum contact point to line up with vertical mark (Figure 78 on page 72) and take another reading.

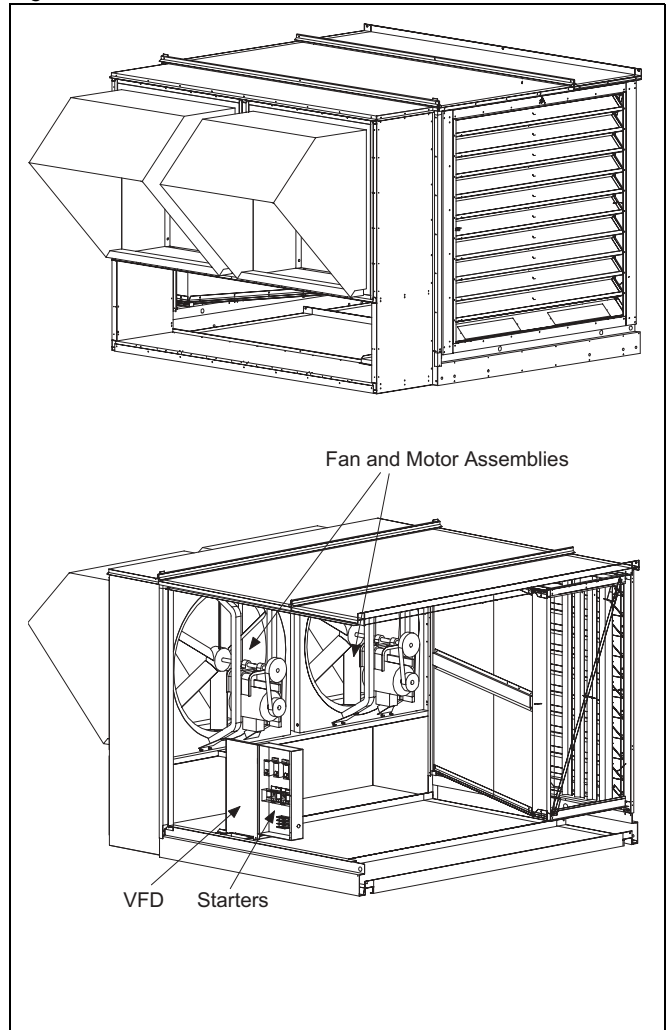
Important: After an adjustment is made, wait until the *LH Lvl Pos=(or RH Lvl Pos=)* value on the keypad/display stabilizes before making further adjustments. This can take several seconds.

11. After leveling, remove fulcrum and replace the access opening covers.

Propeller Exhaust Fan Option

Economizer units may include propeller exhaust or centrifugal return fan options. This section covers maintenance and operating instructions for the propeller exhaust option. Centrifugal return fan construction, maintenance and operation is similar to that for supply fans and covered in other sections of this manual.

Figure 80. 2 Fans with Back Return Shown



Prestarting Checks

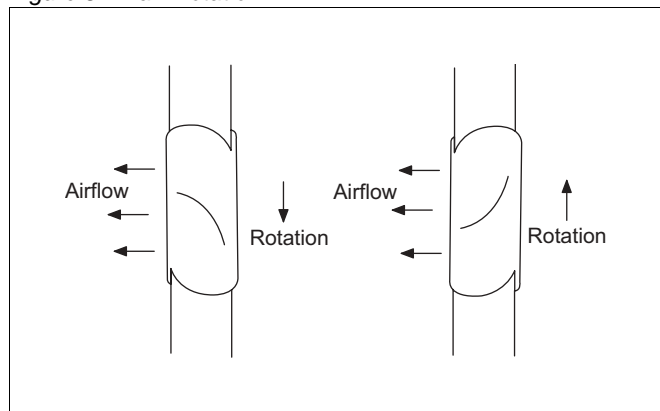
Check all fasteners and set screws for tightness. This is especially important for bearing set screws.

The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit or as shown in Figure 81 on page 74. For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

The adjustable motor pulley is preset at the factory for the specified fan RPM. Fan speed can be increased by closing or decreased by opening the adjustable pulley. Two or three

groove variable pitch pulleys must be adjusted an equal number of turns open. Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to name plate rating when changing fan speed.

Figure 81. Fan Rotation



Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are:

- Belts
- Bearings
- Fasteners
- Setscrews
- Lubrication
- Removal of Dust/Dirt

Belts

Premature belt failures are frequently caused by improper belt tension (either too tight or too loose) or misaligned pulleys. The proper tension for operating a V-belt is the lowest tension at which the belts will not slip peak load conditions. For initial tensioning, the proper belt deflection half way between pulley centers is 1/64" for each inch of belt span. For example, if the belt span is 64 inches, the belt deflection should be one inch using moderate thumb pressure at midpoint of the drive,

See Figure 82. Check belt tension two times during the first 24 hours of operation and periodically thereafter. To adjust belt tension, simply loosen four fasteners (two on each side of the motor plate) and slide the motor plate away from the fan shaft until proper belt tension is attained. On some fans, fasteners attaching the motor to the motor plate must be loosened in order to adjust the belt.

It is very important that the drive pulleys remain in proper alignment after adjustments are made. Misalignment of pulleys will result in premature belt wear noise, vibration and power loss, See Figure 83.

Figure 82. Belt Adjustment

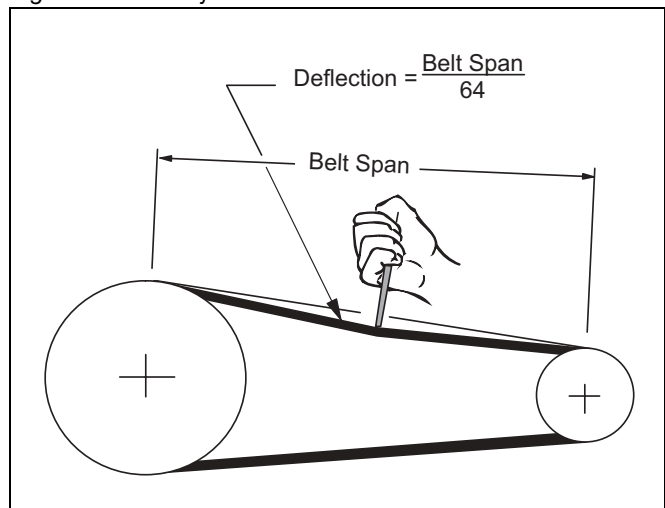
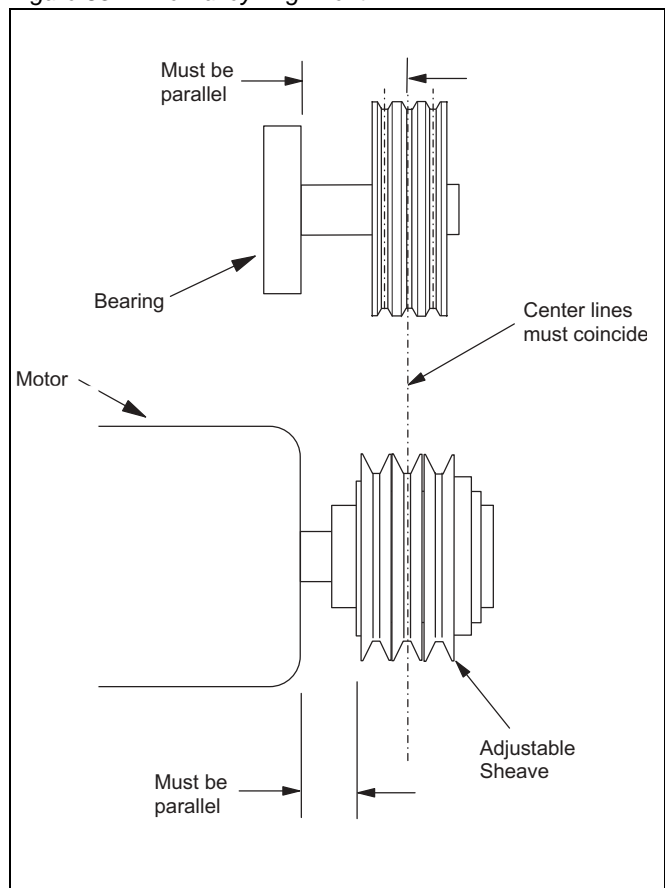


Figure 83. Drive Pulley Alignment



Bearings

Bearings are the most critical moving part of the fan and should be inspected at periodic intervals. Locking collars and set screws, in addition to fasteners attaching the bearings to the bearing plate, must be checked for tightness. In a clean environment and temperatures above 32°F./below 200° F., fan shaft bearings with grease fittings should be lubricated semi-annually using a high quality lithium based grease. If unusual environmental conditions exist temperatures below 32°F. / above 200°F., moisture or contaminants, more frequent lubrication is required.

With the unit running, add grease very slowly with a manual grease gun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating or using excessive pressure. Bearings without grease fittings are lubricated for life.

Fasteners and Setscrews

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners and set screws for tightness. Particular attention should be paid to setscrews attaching the propeller to the shaft and the shaft to the bearings. Loose bearing set screws will lead to premature failure of the fan shaft.

Lubrication

Refer to "Bearings" on page 74 for bearing lubrication. Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further attention.

Motors equipped with oil holes should be oiled in accordance with the manufacturer's instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate.

Motors supplied with grease fittings should be greased according to directions printed on the motor.

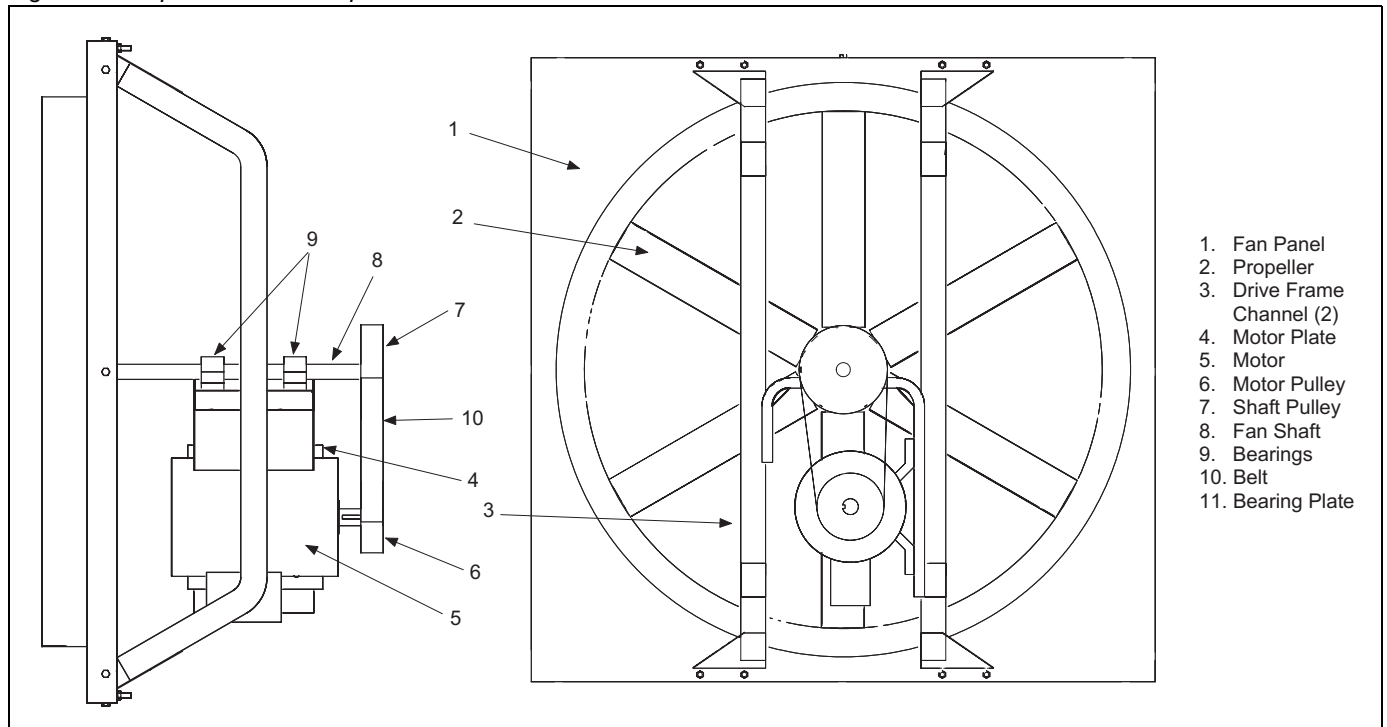
Removal of Dust/Dirt

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water or solvents to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam or water.

Table 20: Propeller Exhaust Fan Troubleshooting

Problem	Cause	Corrective Action
Reduced Airflow	System resistance is too high.	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply for air exhaust fans or exhaust air for supply fans.
	Unit running backwards.	See "Prestarting Checks" on page 73
	Fan speed too low.	Increase fan speed
	Excessive dirt on propeller.	Clean propeller
Excessive Noise	Bearings	Tighten bearing collars and setscrews. Lubricate bearings. Replace defective bearings.
	V-Belt drive	Tighten pulleys on motor shaft and fan shaft. Adjust belt tension. Align pulleys. Replace worn belts or pulleys.
	Excessive vibration	Clean dirt build-up from propeller. Check all setscrews and fasteners for tightness. Check for worn bearing. Correct propeller imbalance. Check for loose dampers, guards or ductwork.
	Defective motor	Replace motor.

Figure 84. Propeller Exhaust Replacement Parts List



Propeller Exhaust Fan Control

Exhaust Fan On/Off Control

The Exhaust fans are turned on and off based on building static pressure, outdoor air damper position, and discharge fan capacity. Exhaust fans do not have to always run while the supply fan is on, as the does a return fan. They are turned on and off through DO # 2 on the Mod DCU as described below.

The Exhaust Fans are turned on when:

- All of the following are true for longer than the Min Start Time (Default Time = 120 Seconds). :
 - OA Damper Capacity exceeds Min OA Dmpr Pos
 - Either the Discharge Fan Capacity exceeds the Min DF Cap or the Discharge Fan Control Type is Constant Volume. This two part condition may be able to be reduced to one condition if there is one attribute that is set to 100% when constant volume units are on and to the current fan speed or actuator position for variable air volume units.
 - The type of control (RF/EF Ctrl) is set to Building Pressure
 - The building static pressure is above the building static pressure setpoint by more than the deadband/2.

OR

- All of the following are true for longer than the Min Start Time (Default Time = 120 Seconds).
 - OA Damper Capacity exceeds Min OA Dmpr Pos
 - The Discharge Fan Capacity exceeds the Min DF Cap or the Discharge Fan Control Type is Constant Volume. This two part condition may be able to be reduced to one condition if there is one attribute that is set to 100% when constant volume units are on and to the current fan speed or actuator position for variable air volume units.
 - The type of control (RF/EF Ctrl) is set to Position
 - The Exhaust Fan VFD capacity (Rem RF/EF Cap) is set to a value above the Min Exh Fan Cap (Default = 25%) .

The Exhaust Fans are turned off when:

- All of the following are true:
 - The type of control (RF/EF Ctrl) is set to Building Pressure
 - The building static pressure is below the building static pressure setpoint by more than the deadband/2
 - The Exhaust Fan capacity is at the Min Exh Fan Cap (Default = 25%) or lower for longer than the Min Stop Time (Default Time = 120 Seconds).

OR

- Both of the following are true:
 - The type of control (RF/EF Ctrl) is set to Position
 - The Remote Exhaust Fan capacity setpoint (Rem RF/EF Cap) is set below the Min Exh Fan Cap (Default = 25%) for longer than the Min Stop Time (Default Time = 120 Seconds).

OR

- The unit is off

Exhaust Fan Speed Control

The exhaust fan variable frequency drive can be controlled by two different methods that maintain building static pressure. Fan tracking is not provided with exhaust fans. The Exhaust Fan VFD speed is increased through BO # 16 and decreased through BO # 15 on the Mod-DCU just like the Return Fan.

The minimum speed of the Exhaust Fan will be set to it's Min Exh Fan Cap (Default = 25%) through the keypad on the VFD. This same minimum speed value is to be entered through the MicroTech II keypad to provide the capability to turn on and off the Exhaust Fans as described above.

When Building Static pressure is selected, the exhaust variable frequency drive is controlled to maintain building static pressure directly. A minimum speed is maintained by the VFD, not by MicroTech II.

The outputs, BO # 15 and BO # 16, will be controlled by a Proportional/Integral (PI) algorithm that increases the speed of the VFD in order to lower the building static pressure and decreases the speed of the VFD in order to raise the building static pressure. The building static pressure will be provided as it is now through AI # 14 with a range of - .25 IWC to + .25 IWC. This control algorithm is identical to that currently used to control building static pressure using a return fan VFD except that the minimum speed (Default = 25%) is not maintained by MicroTech II.

When position control is selected, the speed of the exhaust fan variable frequency drive is controlled to the Remote RF/EF setting. BO # 15 and BO # 16 are controlled to maintain a fixed speed provided through a connected network or the keypad. This control algorithm similar to that currently used to control a return fan VFD to maintain a fixed speed except that the minimum speed (Default = 25%) is not maintained by MicroTech II. This minimum speed is maintained by the VFD.

When the unit is in an off state, the variable frequency drive is turned off by turning off BO #2. At the same time, BO #15 is turned on, and BO #16 is turned off.

Keypad Entries

Add a new table menu, Exhaust Fan Setup, after Bldg Static P Setup and before Zone Temp Setup with the following entries.

Exhaust Fan Setup

Min Exh Fan Cap = 25%(1 - 99%)

Min OA Dmpr Pos= 5%(1 - 99%)

Min DF Cap = 10%(1 - 99%)

Min Start Time=120 s(10 - 240 sec)

Min Stop Time=120 s(10 - 240 sec)

Check, Test, and Start Procedures

WARNING

Electric shock and moving machinery hazard. Can cause severe equipment damage, personal injury, or death.

Disconnect electrical power before servicing this equipment.

All start-up and service work must be performed by qualified technicians who are familiar with the hazards of working on this type of equipment.

Do not attempt to operate or service this equipment without first reading and understanding this manual, the "MicroTech II Applied Rooftop Unit Controller" manual (Bulletin No. IM 483), and the applicable operation manual (Bulletin No. OM 108, OM 109, or OM 110).

Provide that the frame of the equipment is bonded to the building electrical ground by use of the grounding terminal or by other acceptable means.

All units are completely run tested at the factory to promote proper operation in the field. Nevertheless, the following check, test, and start procedures must be performed to properly start the unit. To obtain full warranty coverage, the check, test, and start form supplied with the unit must be completed, signed, and returned to McQuay International.

A representative of the owner or the operator of the equipment should be present during start-up to receive instructions in the operation, care, and maintenance of the unit.

Before Start-up

1. Verify that the unit is completely and properly installed with ductwork connected. Verify that all construction debris is removed, and that the filters are clean.
2. Verify that all electrical work is complete and properly terminated. Verify that all electrical connections in the unit control panel and compressor terminal box are tight, and that the proper voltage is connected. Verify all nameplate electrical data is compatible with the power supply. Verify the phase voltage imbalance is no greater than 10 %.
3. Verify that gas piping is complete and leak tight. Verify that the shutoff cock is installed ahead of the furnace, and that all air has been bled from the gas lines.
4. Manually rotate all fans and verify that they rotate freely. Verify that the belts are tight and the sheaves are aligned.
5. Verify that all setscrews and fasteners on the fan assemblies are still tight. Do this by reading and following the instructions in "Setscrews" which is in the "Maintenance" section of this manual.
6. Verify that the evaporator condensate drain is trapped, and that the drain pan is level.
7. If unit is curb mounted, verify that the curb is properly flashed to prevent water leakage.
8. Before attempting to operate the unit, review the control layout description to become familiar with the control locations.

Review the equipment and service literature, the sequences of operation, and the wiring diagrams to become familiar with the functions and purposes of the controls and devices.

Determine which optional controls are included with the unit.

9. Before closing the power disconnect switch, open the following unit control circuit switches:
 - a. Main Control Panel
 - Turn system switch S1 to "off."
 - Electric heat units: turn switch HS1 to "off."
 - b. Compressor Compartment
 - Turn compressor control circuit switches CS1, CS2 to "off."
 - Turn liquid line solenoid valve switches PS1, PS2, PS3 to "off."
 - c. Furnace Control Compartment
 - Turn furnace switch S3 to "off."
 - d. Main Control Panel Switch S7.
10. If the VAV or CAV-DTC unit does not have an optional zone temperature sensor (ZNT1) connected to it, change the entry under keypad menu item 28C ("Space Sensor=") from "Yes" to "No."
11. If desired, all MicroTech II internal control timers can be reduced to 20 seconds by changing the entry under keypad menu item 28B ("Timers=") from "Normal" to "Fast." This will reduce the delays associated with normal control action for 15 minutes or until the entry is changed back to "Normal."

Power-up

1. Close the unit disconnect switch. With the control system switch S1 in the "off" position, power should only be available to the compressor crankcase heaters.
2. Turn the S1 switch to "on." Power should now be supplied to the MicroTech II controller, and the LEDs on MCB1 (red, green, and amber) should follow the normal startup sequence (*refer to the "Component Data" section of IM 483*).
3. Turn Switch S7 to ON or AUTO.

Fan Start-up

1. Verify all duct isolation dampers are open. Unit mounted isolation dampers may be mounted in the supply or return sections.
2. Place the unit into the "Occ-Fan Only" mode through keypad menu 11 ("Control Mode"). The controller should enter the "Startup Initial" operating state. After the Startup Initial timer has expired (3 to 4 minutes), the fans should start. Observe the fan rotation and, if it is backwards, disconnect power and reverse two legs of the power supply. If a fan does not run, do the following:
 - a. Check the control circuit fuse F1.
 - b. Verify that the overloads have not tripped.
 - c. Check the fan motor power fuses.
 - d. Verify that the Remote Monitor Panel wiring (if any) is correct.
 - e. Trace the circuits.

3. If the fans are equipped with optional spring isolators, check the fan spring mount adjustment. When the fans are running they should be level. Refer to “*Spring Isolated Fans*” on page 48.
4. Verify the rotation is correct.
5. Verify the DHL safety is opening at a pressure compatible with duct working pressure limits.

Note: The supply and return fan drives are usually selected for operation in the drive's midspeed range. The return fan drives are usually shipped with fixed pitch sheaves that will provide the selected fan speed; however, the supply fan drives are usually shipped with variable pitch sheaves that are adjusted to provide the minimum fan speed. Both drives should be adjusted for proper airflow during air balancing. For more information, refer to “*Air Balancing*” on page 80.

Economizer Start-up

CAUTION

Adjust dampers properly. Improper adjustment may damage the dampers.

When an economizer is ordered without an actuator, the linkage requires a 3.14" linear stroke to fully open it. Do not allow dampers to be driven beyond their normal full closed or full open position.

1. Check whether the outdoor air is suitable for free cooling by displaying keypad menu 9. "Low" indicates low outdoor air enthalpy; "High" indicates high outdoor air enthalpy.
Refer to “Enthalpy Control” on page 62 to verify that the enthalpy changeover control is working properly. You may want to take temperature and humidity measurements.
2. Verify that switches PS1 and PS2 are at "off." This will prevent compressor operation during the procedure.
3. At the keypad, set the cooling setpoints low enough so that the controller will call for cooling. On CAV-ZTC units, adjust the "Cooling Spt =" entry on menu item 12C. On VAV or CAV-DTC units, adjust the "Cooling Spt =" entry on menu item 12B and the "Setpoint=" entry on menu item 13A.
4. Place the unit into the "Occ-Cool Only" mode through keypad menu 11 ("Control Mode").
5. Observe the outdoor air dampers:
If the outdoor air enthalpy is low, the Step-and-Wait algorithm should modulate the dampers open.
If the outdoor air enthalpy is high, the dampers should maintain their minimum position. Set the "Mm Airflow=" entry on menu item 21A to some other value. Verify that the dampers move toward the new minimum position setpoint.
6. If the unit is equipped with the electromechanical enthalpy changeover control (Honeywell H205) and the outdoor air is borderline, attempt to change its input to the MicroTech

II controller by turning the switch to "A" or "D". Check menu 9. If the changeover occurred, go to step 5.

Note: It may not be possible to check the economizer operation in both low and high enthalpy states on the same day. If this is the case, repeat this procedure on another day when the opposite outdoor air enthalpy conditions exist.

Compressor Start-up

WARNING

Low ambient temperature hazard. Can cause compressor damage.

Do not attempt to start up and check out the refrigeration system when the outdoor air temperature is below 50°F unless the unit is specially equipped for low ambient operation.

With the supply and return fans operational, prepare for compressor operation.

The unit is shipped with refrigeration service valves closed. Backseat (open) the discharge, and liquid line valves. Connect service gauges and crack the valves off the backseat position (one turn forward). Verify that the unit has not lost its refrigerant charge.

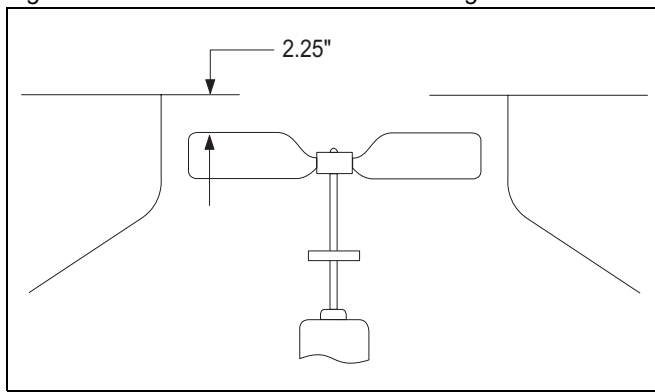
Scroll compressors only compress in one rotational direction. Three phase compressors will rotate in either direction depending upon phasing of the power to L1, L2 and L3. Since there is a 50/50 chance of connecting power to cause rotation in the reverse direction, it is important to verify the compressor rotates in the proper direction after the system is installed. If the compressor is rotating properly, suction pressure will drop and discharge pressure will rise when the compressor is energized. If the compressor is rotating in reverse, the sound level is louder and current draw is substantially reduced. After several minutes of operation, the compressor's internal protector will trip.

All three-phase compressors are internally wired the same. Therefore, once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same terminals should maintain proper rotation direction.

Verify that the crankcase heaters are operating. These should operate for at least 24 hours before starting the compressors.

Verify that the condenser fan blades are positioned properly and that the screws are tight (*See Figure 85*). The fan blade must be correctly positioned within its orifice for proper airflow across the condenser coils.

Figure 85. Condenser Fan Blade Positioning



Perform the following procedure:

1. At the keypad, set the cooling setpoints low enough so that the controller will call for multiple stages of mechanical cooling. On CAV-ZTC units, adjust the "Cooling Spt=" entry on menu item 12C. On VAV or CAV-DTC units, adjust the "Cooling Spt=" entry on menu item 12B and the "Setpoint=" entry on menu item 13A.
2. Place the unit into the "Occ-Cool Only" mode through keypad menu 11 ("Control Mode").
3. Verify that the low ambient compressor lockout temperature, "Min OAT=" (menu item 13B), is set below the outdoor air temperature.
Note: Do not attempt to operate the compressors if the outdoor air is too cool. See the warning statement under "Compressor Start-up" on page 78.
4. Turn pumpdown switch PS3 to "on."
5. Turn compressor control circuit switch CS1 and pump-down switch PS1 to "on."
Now refrigeration circuit #1 is enabled and circuit #2 is disabled. After CS1 is closed, time delay relay TD1 starts its 5-minute timing cycle. Note that if the unit has an economizer and the outdoor air enthalpy is low, the economizer must fully open before the controller will energize mechanical cooling. When the outdoor air damper has fully opened and the TD1 timer has expired, liquid line solenoid valve SV1 should open. If the solenoid valve does not open, do the following:
 - a. Verify that there is a call for cooling by checking the display on menu 1, "Unit Status."
 - b. Verify that the oil safety control is not tripped. If it is, it must be manually reset.
 - c. Trace the circuits.

NOTICE

Venting refrigerant to atmosphere is not allowed per most local laws and/or codes.

6. Verify that compressor #1 starts. On units without optional low ambient start, the compressor should start shortly after the solenoid valve opens. On units with low ambient start, the compressor should start when the solenoid valve opens. If the compressor motor hums but does not run, verify that

it is getting three-phase power.

The compressor should operate continuously while there is a call for cooling. If the compressor stops because the oil pressure switch trips, see "Oil Pressure" below. If the compressor cycles on its low pressure switch, do the following:

- a. Verify that the circuit is not short of refrigerant.
 - b. Check for low airflow.
 - c. Check for clogged filters.
 - d. Check for restricted ductwork.
 - e. Check for very low temperature return air entering the unit.
 - f. Verify that the liquid line components, expansion valve, and distributor tubes are feeding the evaporator coil.
 - g. Verify that all air handling section panels are closed.
 - h. Verify that the suction service valve and the liquid line service valves are completely open.
7. Verify that the compressor stages properly. When compressor #1 starts, the unloaders (if any) should be energized. As the controller stages and further loads the compressor, it de-energizes the unloaders. For more information on staging sequences, see the "Controller Outputs" section of Bulletin No. IM 483, "MicroTech II Applied Rooftop Unit Controller."
 8. Verify that the condenser fans are cycling and rotating properly (blowing air upward). When the compressor starts, at least one condenser fan should also start. The FanTrol pressure and temperature switches should cycle the remaining fans as required to maintain the refrigerant head pressure. Refer to the unit wiring diagrams and to "Condenser Fan Arrangement" on page 6.
 9. Check the oil level in the compressor sightglass. See "Oil Pressure" below. If a low oil level and heavy foaming is observed in the compressor sightglass, it is possible that excess liquid refrigerant is returning to the compressor. Check the suction superheat, see "Checking Superheat" on page 80; it should be between 10°F (-12°C) and 13°F (-11°C). See "Expansion Valve Superheat Adjustment" .
 10. Close solenoid valve SV1 by turning switch PS1 to "Off." The circuit should pump down and then the compressor(s) should stop. Place the unit into the "Occ-Fan Only" mode through keypad menu 11.
 11. Check refrigerant circuit #2 by repeating steps 2 through 10, substituting circuit #2 component nomenclature for circuit #1 nomenclature (CS2, PS2, TD2, SV2, compressor #2).
Note: The unit is wired for continuous, recycling pump-down. If switches CS1 and CS2 are closed, the compressor will start and pump down again whenever the low pressure switch closes. Small leakages through the compressor valves and liquid line solenoid valves can cause the circuit to pump down periodically during the off cycles. This is usually normal. If a compressor pumps down more than once every 15 minutes during an off cycle, the unit should be serviced.
 12. Verify the condenser refrigerant subcooling at full capacity is between 12-16°F.

Expansion Valve Superheat Adjustment

It is very important that the expansion valve superheat setting be adjusted to be between 10° F (-12° C) and 13° F (-11° C). Insufficient superheat will cause liquid floodback to the compressor which may result in slugging. Excessive superheat will reduce system capacity and shorten compressor life.

Turn the adjustment stem clockwise to increase superheat. Not exceeding one turn, adjust the stem and then observe the superheat. Allow up to 30 minutes for the system to rebalance at the final superheat setting.

On refrigeration circuits with multiple expansion valves, the superheat adjustment should be approximately the same for all valves in the circuit.

Checking Superheat

Following are recommendations for checking superheat:

1. Close the unit section doors. Running the unit with its doors open will affect expansion valve and system operation considerably.
2. For units with one expansion valve per circuit, check the pressure and temperature at the compressor suction valve.
3. For units with multiple expansion valves per circuit, check the pressure at the compressor, and check the temperature at the suction header that is fed by the valve.

Heating System Start-up

General

1. At the keypad, set the heating set points high enough so that the controller will call for heating. On CAV-ZTC units, adjust the "Heating Spt=" entry on menu item 12D. On VAV or CAV-DTC units, adjust the "Heating Spt=" entry on menu item 12C, and if equipped with modulating heat, the "Set Point=" entry on menu item 14A.
2. Place the unit into the "Occ-Heat Only" mode through keypad menu 11 ("Control Mode").
3. Verify that the high ambient heating lockout temperature, "Max OAT=" (menu item 14B), is set above the outdoor air temperature.

Gas Furnace

Refer to the "Start-up and Operating Procedures" section of the *Forced Draft Gas Fired Furnace Installation Manual, Bulletin No. IM 684 or 685*. Perform the start-up procedures given in it.

Electric Heat

Turn the electric heater switch HS1 to "on." The electric heaters should energize. If the unit has multistage electric heat, the MicroTech II controller should energize the heaters in successive stages. The rate of staging is controlled by the programmable parameter with the menu name "Heating Setup" and item name "Stage time = ___ min." (see page 79 in *OM138* or page 58 in *OM137*).

Steam Heat

The steam valve actuator should open the valve. The steam valve is open when the valve stem is up. If the unit loses power, the spring in the actuator should drive the valve wide open. Check this by opening system switch S1.

Hot Water Heat

The hot water valve actuator should open the valve to the coil. The three-way hot water valve is open to the coil when the valve stem is down. If the unit loses power, the spring in the actuator should drive the valve wide open to the coil. Check this by opening system switch S1.

Air Balancing

Air balancing should be performed by a qualified air balancing technician. Note that the supply fan motors are usually shipped with variable pitch sheaves which are typically set at the low end of the drive's fan rpm range. See "Mounting and Adjusting Motor Sheaves" on page 82. The return fan motors are usually shipped with fixed pitch sheaves.

WARNING

Moving machinery hazard. Can cause severe personal injury or death.

Use a strobe tachometer to measure the speed of return fans. Safety considerations prohibit the use of a mechanically driven tachometer on this fan arrangement.

The following should be performed as part of the air balancing procedure:

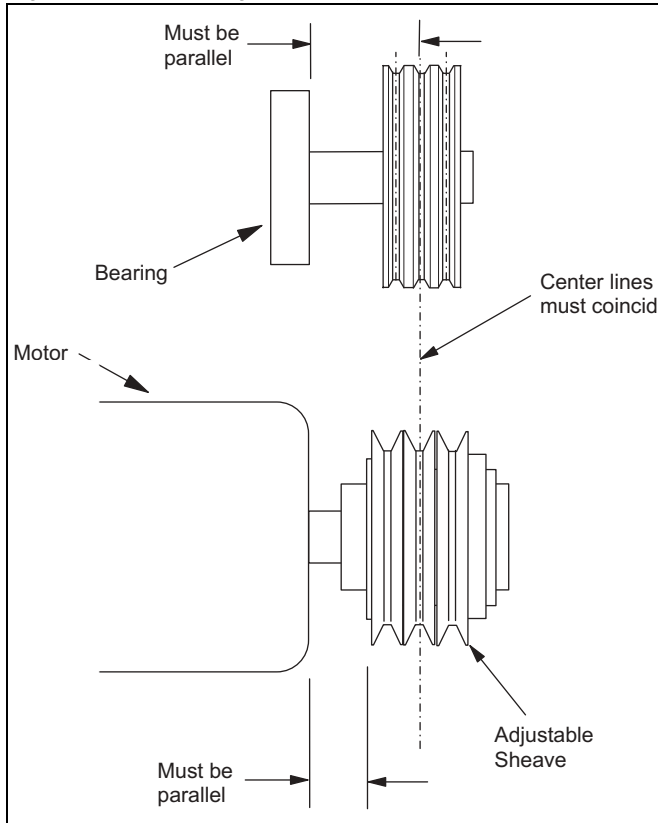
1. Check the operating balance with the economizer dampers positioned for both full outdoor air and minimum outdoor air.
2. Verify that the total airflow will never be less than that required for operation of the electric heaters or gas furnace.
3. For VAV units that have fan tracking control, adjust the supply/return fan balance by using the MicroTech II controller's built-in, automatic capability. For complete information on using this feature, see the "Return Fan Airflow Control: Fan Tracking" section in *Bulletin No. OM 108, "MicroTech II Applied Rooftop Unit Controller: VAV Control."*
4. When the final drive adjustments or changes are complete, check the current draw of the supply and return fan motors. The amperage must not exceed the service factor stamped on the motor nameplate.
5. Upon completion of the air balance, replace variable pitch motor sheaves (if any) with comparably sized fixed pitch sheaves. A fixed pitch sheave will reduce vibration and provide longer belt and bearing life.

Sheave Alignment

Mounting:

1. Verify both driving and driven sheaves are in alignment and the shafts are parallel. The center line of the driving sheave must be in line with the center line of the driven sheave. See Figure 86.
2. Verify that all setscrews are torqued to the values shown in Table 25 on page 95 before starting drive. Check set-screw torque and belt tension after 24 hours of service.

Figure 86. Sheave Alignment (adjustable shown)



Drive Belt Adjustment

General Rules of Tensioning

1. The ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over tensioning shortens belt and bearing life.
4. Keep belts free from foreign material which may cause slippage.
5. Make V-drive inspection on a periodic basis. Adjust tension if the belt is slipping. Do not apply belt dressing. This may damage the belt and cause early failure.

Tension Measurement Procedure

1. Measure the belt span. See Figure 87.
2. Place belt tension checker squarely on one belt at the center of the belt span. Apply force to the checker, perpendicular to the belt span, until the belt deflection equals belt span distance divided by 64. Determine force applied while in this position.
3. Compare this force to the values in Table 21 on page 82.

Figure 87. Drive Belt Adjustment

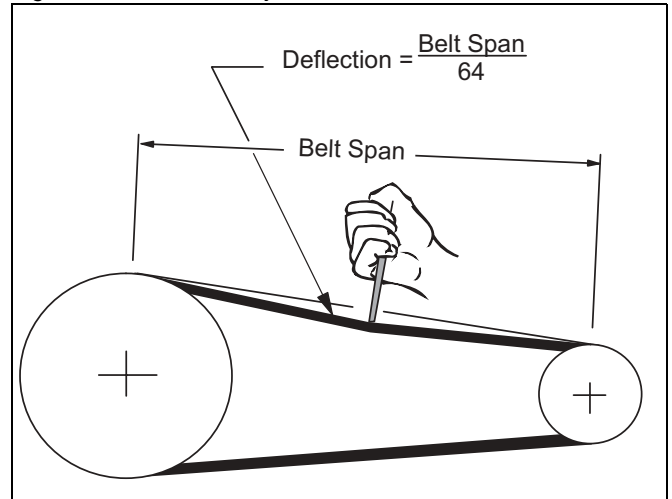
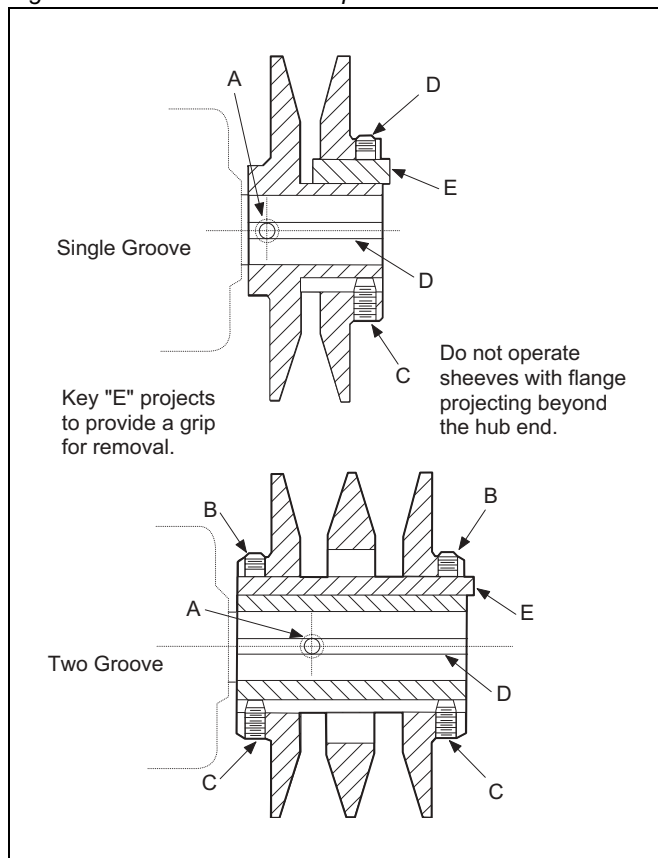


Table 21: Belt Deflection Force (not applicable for Exhaust Fans - see "Belts" on page 74)

CROSS SECTION	SHEAVE DIAMETER (INCHES)		DEFLECTION FORCE (LBS.)			
	SMALLEST SHEAVE DIAMETER RANGE	RPM RANGE	BELT DEFLECTION FORCE			
			CROSS SECTION A, B, 5V		CROSS SECTION AX, BX, 5VX	
			USED BELT	NEW BELT	USED BELT	NEW BELT
A, AX	3.0-3.6	1000-2500	3.7	5.5	4.1	6.1
		2501-4000	2.8	4.2	3.4	5.0
	3.8-4.8	1000-2500	4.5	6.8	5.0	7.4
		2501-4000	3.8	5.7	4.3	6.4
	5.0-7.0	1000-2500	5.4	8.0	5.7	9.4
		2501-4000	4.7	7.0	5.1	7.6
B, BX	3.4-4.2	850-2500			4.9	7.2
		2501-4000			4.2	6.2
	4.4-5.6	860-2500	5.3	7.9	7.1	10.5
		2501-4000	4.5	6.7	7.1	9.1
	5.8-8.6	860-2500	6.3	9.4	8.5	12.6
		2501-4000	6.0	8.9	7.3	10.9
5V, 5VX	4.4-6.7	500-1749			10.2	15.2
		1750-3000			8.8	13.2
		3001-4000			5.6	8.5
	7.1-10.9	500-1740	12.7	18.9	14.8	22.1
		1741-3000	11.2	16.7	13.7	20.1
	11.8-16.0	500-1740	15.5	23.4	17.1	25.5
		1741-3000			16.8	25.0
				14.6	21.8	

Mounting and Adjusting Motor Sheaves

Figure 88. VM and VP variable pitch sheaves



VM and VP Variable Pitch Sheaves

Mounting:

1. All sheaves should be mounted on the motor shaft with setscrew "A" toward the motor (see Figure 88 on page 82).
2. Be sure both the driving and driven sheaves are in alignment and that the shafts are parallel.
3. Fit internal key "D" between sheave and shaft, and lock setscrew "A" securely in place.

Adjusting:

1. Slack off all belt tension by moving the motor toward the driven shaft until the belts are free from the grooves. For easiest adjustment, remove the belts.
2. Loosen setscrews "B" and "C" in the moving parts of the sheave and pull out external key "E" (see Figure 88). This key projects a small amount to provide a grip for removing.
3. Adjust the sheave pitch diameter for the desired fan speed by opening the moving parts by half or full turns from closed position. **Do not open more than five full turns for "A" belts or six full turns for "B" belts.** Adjust both halves of two-groove sheaves by the same number of turns from closed to ensure that both grooves have the same pitch diameter.
4. Replace external key "E" and securely tighten setscrews "B" over the key. Tighten setscrews "C" into the keyway in the fixed half of the sheave.
5. Put on belts and adjust the belt tension. **Do not force belts over grooves.** Loosen the belts by adjusting the motor base closer to the fan shaft.

6. Be sure that all keys are in place and that all setscrews are tight before starting the drive. Check the setscrews and belt tension after 24 hours of service.

LVP Variable Pitch Sheaves

Mounting:

1. For single-groove sheaves, slide the sheave onto the motor shaft so that the side of the sheave with setscrew "A" is next to the motor (*see Figure 89 on page 84*).
For two-groove sheaves, slide the sheave onto the motor shaft so that the side of the sheave with setscrew "A" is away from the motor (*see Figure 89 on page 84*).
2. To remove the flange and locking rings:
 - a. Loosen setscrews "D".
 - b. Loosen **but do not remove** capscrews "E".
 - c. Remove key "F". This key projects a small amount to provide a grip for removing.
 - d. Rotate the flange counterclockwise until it disengages the threads on the shaft barrel.
3. Be sure that the driving and driven sheaves are in alignment and the shafts are parallel. When aligning two-groove sheaves, allow room between the sheave and motor to get to capscrews "E".
4. Insert key "C" between the sheave and the shaft and tighten setscrew "A" securely.

Adjusting:

1. Slack off all belt tension by moving the motor toward the driven shaft until the belts are free from the grooves. For easiest adjustment, remove the belts.
2. Loosen setscrews "D".
3. Loosen **but do not remove** capscrews "E".
4. Remove key "F". This key projects a small amount to provide a grip for removing.
5. Adjust the pitch diameter by opening or closing the movable flange by half or full turns. Note that two-groove sheaves are supplied with both grooves set at the same pitch diameter. **Both movable flanges must be moved the same number of turns to ensure the same pitch diameter for satisfactory operation. Do not open sheaves more than five turns for "A" belts or six turns for "B" belts.**

6. Replace key "F".
7. Tighten setscrews "D" and capscrews "E".
8. Put on the belts and adjust the belt tension. Do not force belts over grooves. Loosen the belts by adjusting the motor base closer to the fan shaft.
9. Be sure that all keys are in place and that all setscrews and all capscrews are tight before starting the drive. Check and retighten all screws and retension the belts after approximately 24 hours of operation.

MVP Variable Pitch Sheaves

Adjusting:

1. Slack off belt tension by moving the motor toward the driven shaft until the belts are free from the grooves. For easiest adjustment, remove the belts.
2. Loosen both locking screws "A" in outer locking ring, **but do not remove** them from the sheave. There is a gap of approximately 1/2" (1 mm) between the inner and outer locking rings. This gap must be maintained for satisfactory locking of the sheave.
If locking screws "A" are removed by accident and the gap is lost, screw the outer locking ring down until it touches the inner locking ring. Then back off the outer ring 1/2 to 3/4 turn until the inner and outer ring screw holes are lined up. Reinsert locking screws "A", but do not tighten them until after adjustment is made.
3. Adjust the sheave to the desired pitch diameter by turning the outer locking ring with a spanner wrench. Any pitch diameter can be obtained within the sheave range. One complete turn of the outer locking ring will result in a 0.233" (6 mm) change in pitch diameter. **Do not open "A-B" sheaves more than 43/4 turns for "A" belts or 6 turns for "B" belts. Do not open "C" sheaves more than 9-1/2 turns.**
4. Tighten both locking screws "A" in the outer locking ring.
5. Put on the belts and adjust the belt tension. **Do not force belts over grooves.** Loosen the belts by adjusting the motor base closer to the fan shaft.

Caution: Do not loosen any screws other than the two locking screws "A" in the outer locking ring. **These screws must be tightened securely before the drive is operated.**

Figure 89. LVP variable pitch sleeves

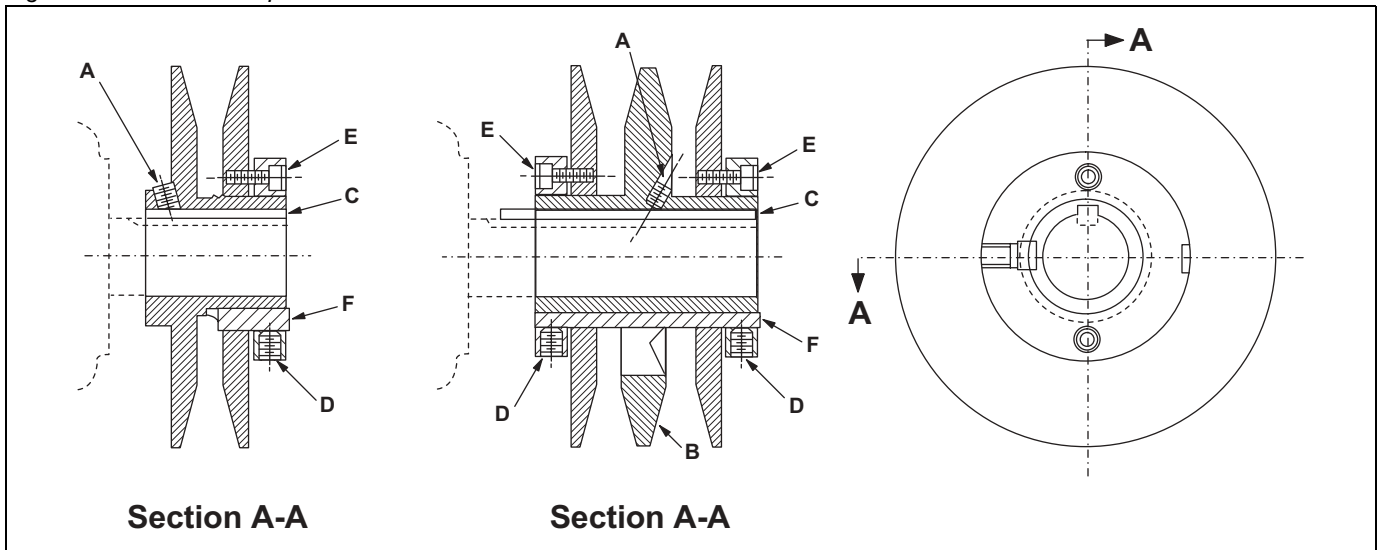


Figure 90. MVP variable pitch sheaves (type A-B)

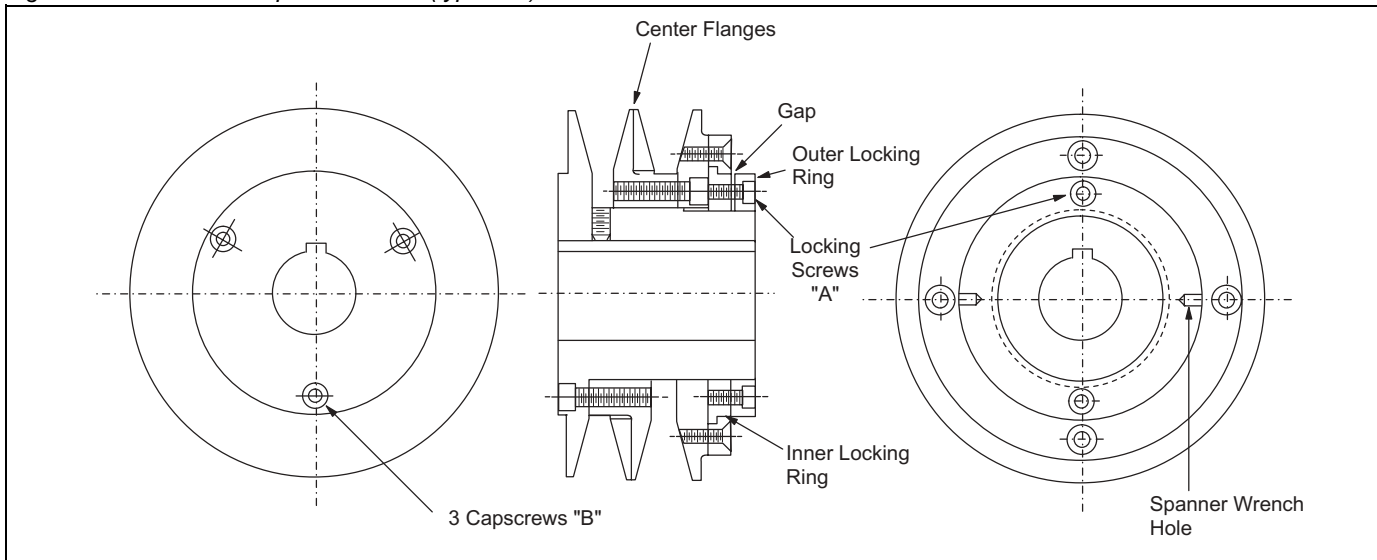
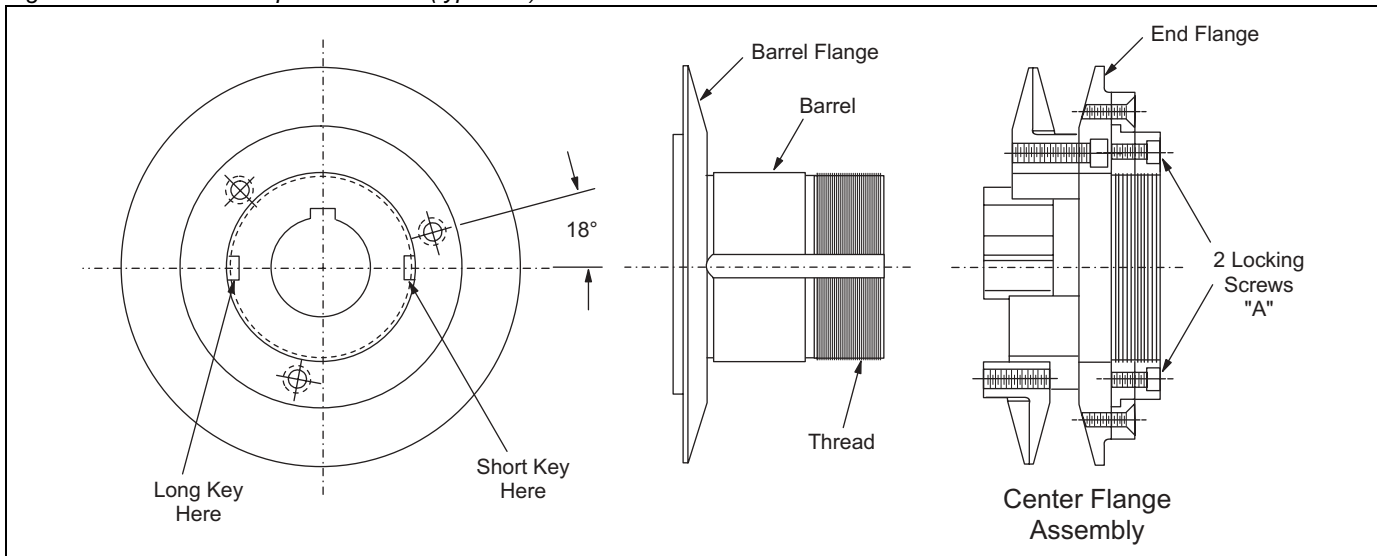


Figure 91. MVP variable pitch sheaves (type A-B)





Rooftop Equipment Warranty Registration Form:

This form must be filled out and returned to McQuay, Warranty Department, within 10 days in order to comply with the terms of McQuay Warranty.

Check, Test and Start Procedure for RoofPak roof mounted air conditioners with or without heat recovery; roof mounted air handlers and SuperPak roof mounted supermarket units.

Job Name: _____ McQuay G.O. No.: _____

Installation Address: _____

City: _____ State: _____

Purchasing Contractor: _____

City: _____ State: _____

Name of Person doing Start-up (print) _____

Company Name _____

Address _____

City/State/Zip _____

Unit Model No.: _____ Unit Serial No.: _____

Compressor No. 1 Model No.: _____ Serial No.: _____

Compressor No. 2 Model No.: _____ Serial No.: _____

Compressor No. 3 Model No.: _____ Serial No.: _____

Compressor No. 4 Model No.: _____ Serial No.: _____

Compressor No. 5 Model No.: _____ Serial No.: _____

Compressor No. 6 Model No.: _____ Serial No.: _____

Circle "Yes" or "No". Mark N/A on all items not applying to the type of the unit. See IM Bulletin for more information.

Any additional comments may be made on a separate sheet of paper and attached to this form.

I. INITIAL CHECK

- A. Is any shipping damage visible? Yes No
- B. Are fan drives properly aligned and belts properly adjusted? Yes No
- C. Tightened all setscrews on pulleys, bearings and fans? Yes No
- D. Have the hold-down bolts been backed off on spring mounted fan isolators? Yes No
- E. Do fans turn freely? Yes No
- F. Has the discharge static pressure reference line been properly located within the building? Yes No
- G. Electrical service corresponds to unit nameplate? Yes No
Volts _____ Hertz _____ Phase _____
- H. Is the main disconnect adequately fused and are fuses installed? Yes No
- I. Are crankcase heaters operating, and have they been operating 24 hours prior to start-up? Yes No
- J. Are **all** electrical power connections tight? (Check compressor electrical box) Yes No
- K. Is the condensate drain trapped? Yes No

II. FAN DATA

- A. Check rotation of **Supply** fan? Yes No
- B. Voltage at Supply fan motor: 1-2 _____ V 2-3 _____ V 1-3 _____ V
- C. Supply fan motor amp draw per phase: _____ L1 _____ L2 _____ L3
- D. Fuse sizes
- E. What is the Supply fan rpm?
- F. Check rotation of **Return** fan? Yes No
- G. Voltage at Return fan motor: 1-2 _____ V 2-3 _____ V 1-3 _____ V
- H. Return fan motor amp draw per phase: _____ L1 _____ L2 _____ L3
- I. Fuse sizes
- J. What is the Return fan rpm?
- K. Record supply static pressure at unit Inches of H₂O
- L. Record return static pressure at unit (with outside air dampers closed) Inches of H₂O

III. START-UP COMPRESSOR OPERATION

- A. Do compressors have holding charges?
Circuit #1 Yes No
Circuit #2 Yes No
- B. Backseat discharge, suction and liquid line valves? Yes No
- C. Are compressors rotating in the right direction? Yes No
- D. Do condenser fans rotate in the right direction? Yes No
- E. Ambient Temperature °F

Warranty Registration Form (continued)

- F. Compressor lockout timers function (5 minutes)..... Yes No
- G. Does unit start-up and perform per sequence of operation?..... Yes No

IV. PERFORMANCE DATA

- A. Compressor voltage across each phase: _____ 1-2 V _____ 2-3 V _____ 1-3 V
- B. Compressor amperage of fully loaded compressor:

	Phase		
Compressor #1.....	1 _____	2 _____	3 _____
Compressor #2.....	1 _____	2 _____	3 _____
Compressor #3.....	1 _____	2 _____	3 _____
Compressor #4.....	1 _____	2 _____	3 _____
Compressor #5.....	1 _____	2 _____	3 _____
Compressor #6.....	1 _____	2 _____	3 _____

- | | Circuit 1 | Circuit 2 | | |
|---|------------|------------|------------|----|
| C. Low pressure cut-out:..... | _____ psig | _____ psig | | |
| Low pressure cut-in:..... | _____ psig | _____ psig | | |
| D. High pressure cut-out:..... | _____ psig | _____ psig | | |
| E. Discharge pressure 1 Compressor:..... | _____ psig | _____ psig | | |
| Discharge pressure fully loaded, 2-3 Compressors:..... | _____ psig | _____ psig | | |
| F. Suction pressure 1 Compressor:..... | _____ psig | _____ psig | | |
| Suction pressure fully loaded, 2-3 Compressors:..... | _____ psig | _____ psig | | |
| Liquid press, fully loaded, 2-3 Comp: (at liquid line shutoff valve): . | _____ psig | _____ psig | | |
| Liquid temperature, fully loaded, 2-3 Compressors:..... | _____ psig | _____ psig | | |
| G. Suction line temperature:..... | _____ °F | _____ °F | | |
| H. Superheat:..... | _____ °F | _____ °F | | |
| I. Is the liquid in the line sightglass clear and dry?..... | | | Yes | No |
| J. Does the hot gas bypass valve function properly?..... | | | Yes | No |
| K. At what suction pressure does the hot gas bypass valve open?..... | _____ psig | _____ psig | _____ psig | |
| L. Record discharge air temperature at discharge of unit:..... | _____ °F | | | |
| M. Are all control lines secure to prevent excessive vibration and wear?..... | | | Yes | No |
| N. Are all gauges shut off and valve caps and packings tight after start-up?..... | | | Yes | No |

V. ELECTRIC HEAT CHECK, TEST & START

- A. Electric heat electrical service corresponds to unit nameplate?..... Yes No
 _____ V _____ Hz _____ Ph
- B. Are there any signs of physical damage to the electric heat coils?..... Yes No
- C. Have all electrical terminals been tightened?..... Yes No
- D. Does sequence controller stage contactors properly?..... Yes No
- E. Electric heater voltage across each phase: _____ 1-2 V _____ 2-3 V _____ 1-3
- F. Amp draw across each phase at each heating stage:

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Phase L1:.....	_____	_____	_____	_____	_____	_____
Phase L2:.....	_____	_____	_____	_____	_____	_____
Phase L3:.....	_____	_____	_____	_____	_____	_____
- G. FLA:..... L1 _____ L2 _____ L3 _____
- H. Operate electric heat with fans off. Electric heat must cycle on high limit control.

Warranty Registration Form (continued)

VI. GAS & OIL BURNER CHECK, TEST & START

(Gas) = Information which applies to gas burners.

(Oil) = Information which applies to oil burners.

(Both) = Information which applies to both gas and oil burners.

Specifications:

For Gas = See Forced Draft Gas Burner Installation and Maintenance Bulletin.

For Oil = See Oil Fired Furnace Installation and Maintenance Bulletin.

- A. (Both) – Furnace Model No. _____
- B. (Both) – Burner Model No. _____ Serial No. _____
- C. (Gas) – Type Firing:..... Single Stage Two Stage Modulation
- D. (Oil) – Type Firing Start: Full Fire Start Low Fire Start
- E. (Gas) – Rated Firing Rate: _____ MBH Input
- F. (Oil) – Rated Firing Rate: _____ GPH, #2 Fuel Oil
- G. (Both) – Altitude: _____ Ft. Above Sea Level
- H. Is there a circulating tank? Yes No

VII. GAS BURNER CHECK, TEST & START

- A. Input: _____ CFH
- B. Gas Pressure at Burner: Inches W.C. _____
- C. CO₂ : _____ %
- D. CO : _____ %
- E. Pilot Flame Only: _____ Microamps (steady at low fire)
- F. Pilot Tap-Gas Pressure: Inches W.C. _____
- G. Motor Only/Burner: FLA _____ Running Amps _____
- H. High Limit Control OK? Yes No
- I. Flame Safeguard: Microamps _____
- J. Flame Failure Shutoff: _____ Seconds
- K. Airswitch OK? Yes No
- L. High Gas Pressure Switch OK? Yes No
- M. Low Gas Pressure Switch OK? Yes No
- N. Main Gas Valve Close-off OK? Yes No

VIII. OIL BURNER CHECK, TEST & START

- A. Nozzle(s): Type/Manufacturer _____ GPH _____ Angle _____ Pattern Manufacturer _____
- B. Nozzle Pressure _____ psi
- C. CO₂ : _____ %
- D. Smoke Spot: Number _____
- E. Running Amps _____ FLA _____
- F. _____ Flame Safeguard: Microamps
- G. High Limit Control OK? Yes No
- H. Flame Failure Shutoff OK? Yes No
- I. Ignition Failure Check OK? Yes No

- IX. Have all electronic or electrical controls been checked, adjusted, and tested for proper operation per the installation and maintenance bulletins? Yes No

X. MAINTAINING MICROTECH CONTROL PARAMETER RECORDS —

After the unit has been checked, tested and started and the final control parameters (Menus 11 through 28) have been set, the control parameter record in the back of IM 485, 486 or 487 should be photocopied and the final settings recorded. These records should be kept on file and updated whenever changes to the control parameters are made. This will facilitate any required analysis and troubleshooting of the system operation.

Signature: _____ Date of Start-up: _____

RETURN COMPLETED FORM TO:

McQuay International Warranty Department, 13600 Industrial Park Boulevard, Minneapolis, MN 55441

Comments: Please list any additional comments which could affect the operation of this unit; i.e., shipping damage, failed components, adverse installation applications, etc., on a separate sheet and attach to this form.

Warranty Registration Form (continued)

QUALITY ASSURANCE SURVEY REPORT

To Whom it may concern:

Please review the below items upon receiving and installing our product. Mark N/A on any item that does not apply to the product.

Job Name: _____ McQuay G.O. No.: _____

Installation Address: _____

City: _____ State: _____

Purchasing Contractor: _____

City: _____ State: _____

Name of Person doing Start-up (print) _____

1. Is there any shipping damage visible? Yes No
 Location on unit _____
2. How would you rate the overall appearance of the product; i.e., paint, fin damage, etc.?

	Excellent	Good	Fair	Poor
--	-----------	------	------	------
3. Did all sections of the unit fit together properly? Yes No
4. Did the cabinet have any air leakage? Yes No
 Location of product _____
5. Were there any refrigerant leaks? Yes No

Shipping	Workmanship	Design
----------	-------------	--------
6. Does the refrigerant piping have excessive vibration? Yes No
 Location of product _____
7. Did all of the electrical controls function at start-up? Yes No
 Comments _____
8. Did the labeling and schematics provide adequate information? Yes No
9. How would you rate the serviceability of the product?

	Excellent	Good	Fair	Poor
--	-----------	------	------	------
10. How would you rate the overall quality of the product?

	Excellent	Good	Fair	Poor
--	-----------	------	------	------
11. How does the quality of McQuay products rank in relation to competitive products?

	Excellent	Good	Fair	Poor
--	-----------	------	------	------

Comments:

Please list any additional comments which could affect the operation of this unit; i.e., shipping damage, failed components, adverse installation applications, etc., on a separate sheet and attach to this form.



Final Control Settings

When all start-up procedures have been completed, set the controls and program the MicroTech II controller for normal operation. Use the following list as a guide; some items may not apply to your unit. *For more detail, refer to OM696.*

1. Turn system switch S1 & S7 to "on."
2. Turn gas furnace switch S3 to "auto" or turn electric heat switch HS1 to "on."
3. Turn compressor control switches CS1 and CS2 to "on."
4. Turn liquid line solenoid switches PS1, PS2, and PS3 to "on."
5. Set the electromechanical (Honeywell H205) enthalpy control (OAE) as required (A, B, C, or D). Set the solid-state (Honeywell H705/C7400) enthalpy control (OAE/ RAE) past "D".
6. Set the heating and cooling control parameters as required (keypad menus 12 through 14).
7. Set the low ambient compressor lockout set point "Min OAT=" (keypad menu item 1-3/8), as required. Do not set it below 50 °F (10°C) unless the unit is equipped for low ambient operation.
8. Set the high ambient heating lockout set point, "Max OAT=" (keypad menu item 14B), as required.
9. Set the alarm limits as required (keypad menu 15).
10. Set the compressor lead-lag function as desired (keypad menu 16 or Staging Board 1 jumper).
Note: If the unit has hot gas bypass on circuit #1 only, compressor #1 must always be lead. Verify that the entry under menu 16 is "#1" or that the SB1 jumper is positioned at "A Lead" (as applicable).
11. Set the unoccupied heating and cooling set points as required (keypad menu 17).
12. Set the duct static pressure control parameters as required (keypad menu 18).
13. Set the fan tracking or building static pressure control parameters as required (keypad menu 19).

14. Set the economizer control parameters as required (keypad menu 21).
15. Set the dirty filter set points as required (keypad menu 22). The maximum recommended settings are 0.5' w.c. (125 kPa) for throwaway-type filters, 1.0" w.c. (249 kPa) for 30% pleat-type filters, and 1.5" w.c. (374 kPa) for cartridge-type filters.
16. Set the control timers as required (keypad menu 23).
17. Set the date and time (keypad menu 24).
18. Set the operating schedule as required (keypad menus 25 and 26).
19. Place the unit into the Calibrate mode by selecting it from keypad menu 11, "Control Mode." Calibrate will automatically zero all pressure sensors and calibrate any actuator feedback pots connected to the MicroTech II controller. When Calibrate is finished, set the control mode as required.

Maintaining Control Parameter Records

It is recommended that the MicroTech II controller's set points and parameters be recorded and saved for future reference. If the Microprocessor Control Board ever requires replacement, this record will facilitate entering the unit's proper data. The following tables display all the set points, monitoring points, and program variables offered by MicroTech II plus the keypad road map used to find each parameter. All user adjusted set points and program variables are highlighted along with their default values.

Light gray boxes in *Figure 92 on page 90, Figure 93 on page 91 & Figure 94 on page 92* indicate parameters specifically associated with discharge air temperature control.

Medium gray boxes in *Figure 92 on page 90, Figure 93 on page 91 & Figure 94 on page 92* indicate parameters specifically associated with space temperature control.

Dark gray boxes in *Figure 92 on page 90, Figure 93 on page 91 & Figure 94 on page 92* indicate parameters common to both control methods.

Keep a record of any changes made to the shaded boxes.

Figure 92. Keypad Accessible Menu Structure

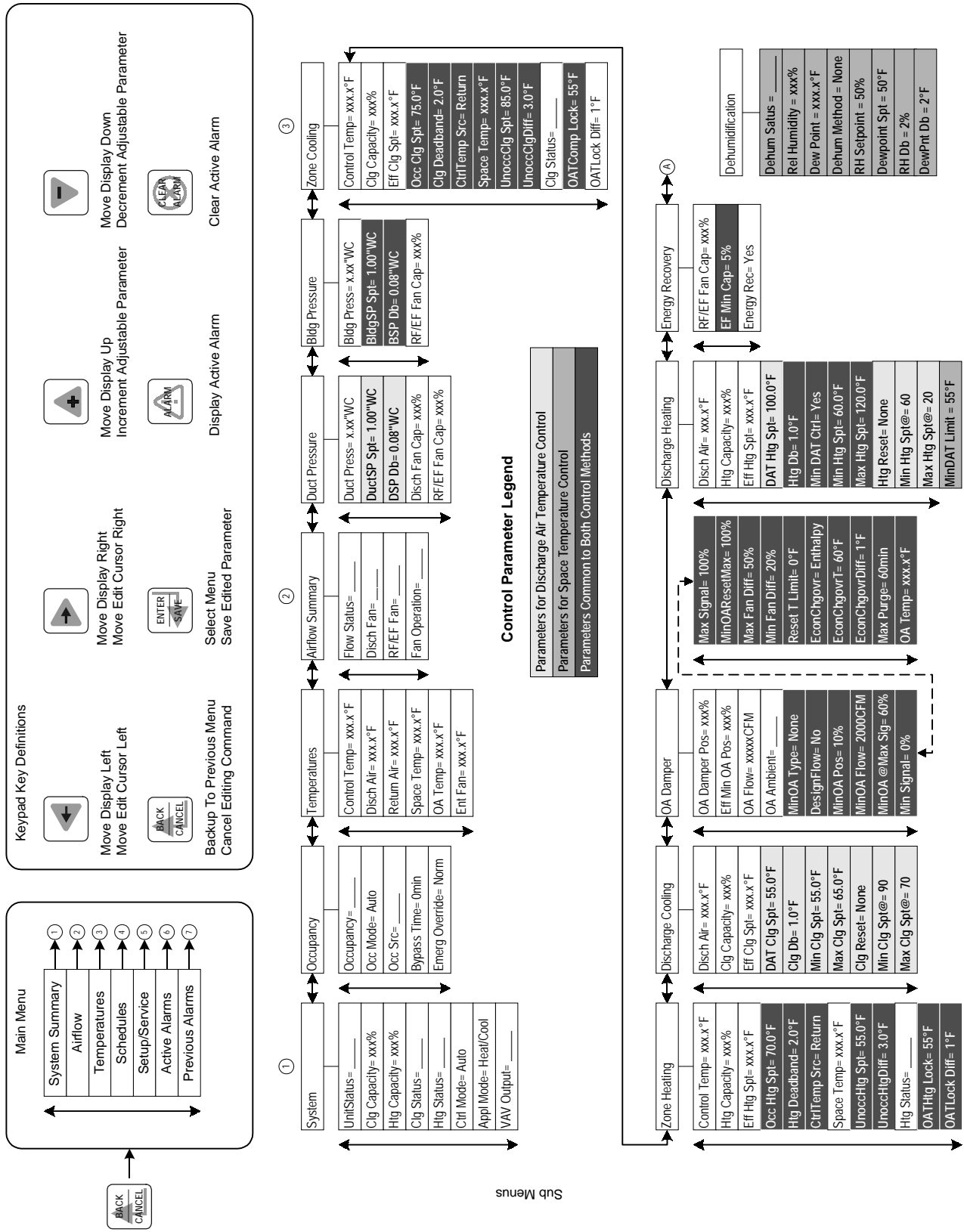
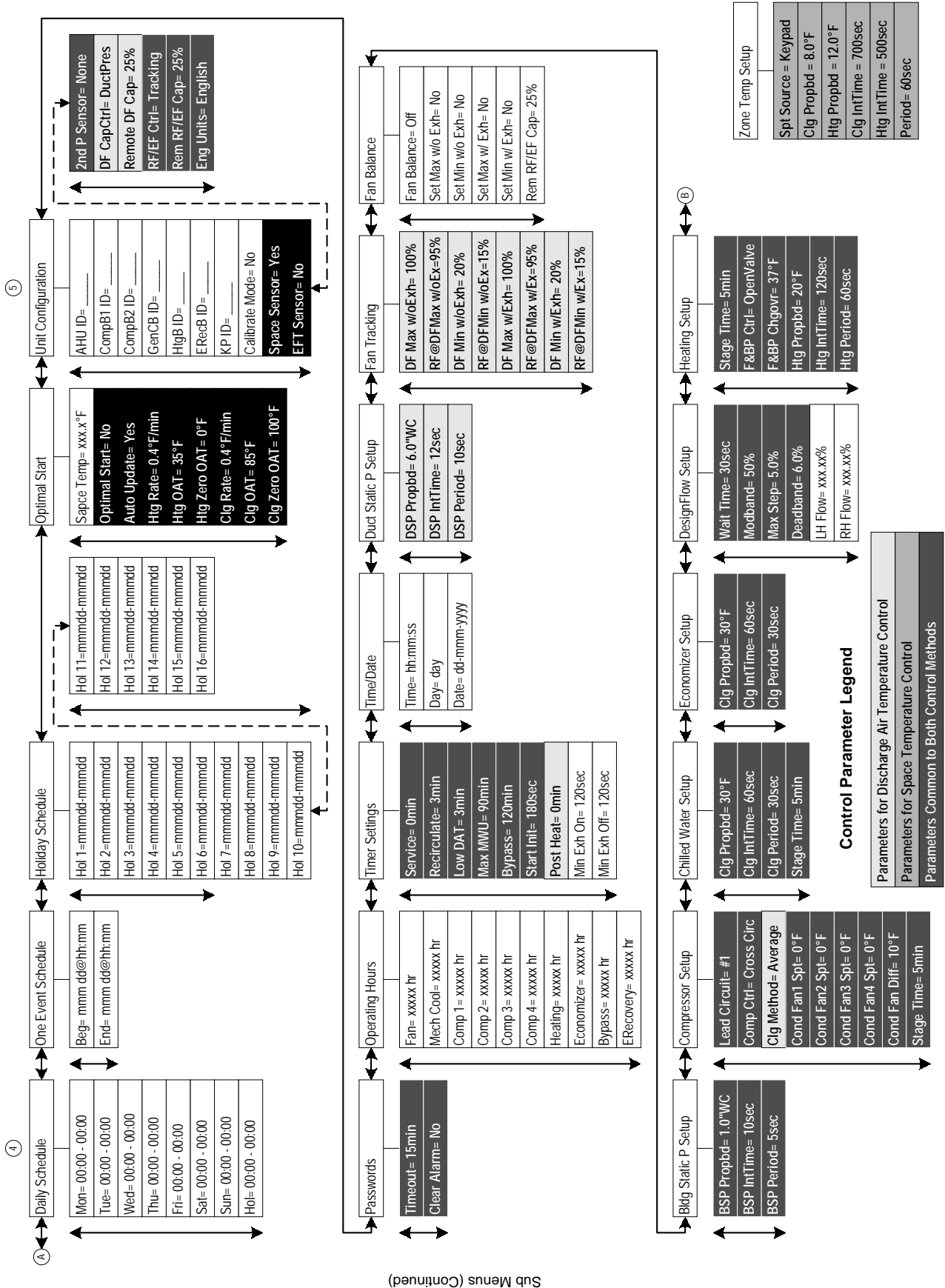
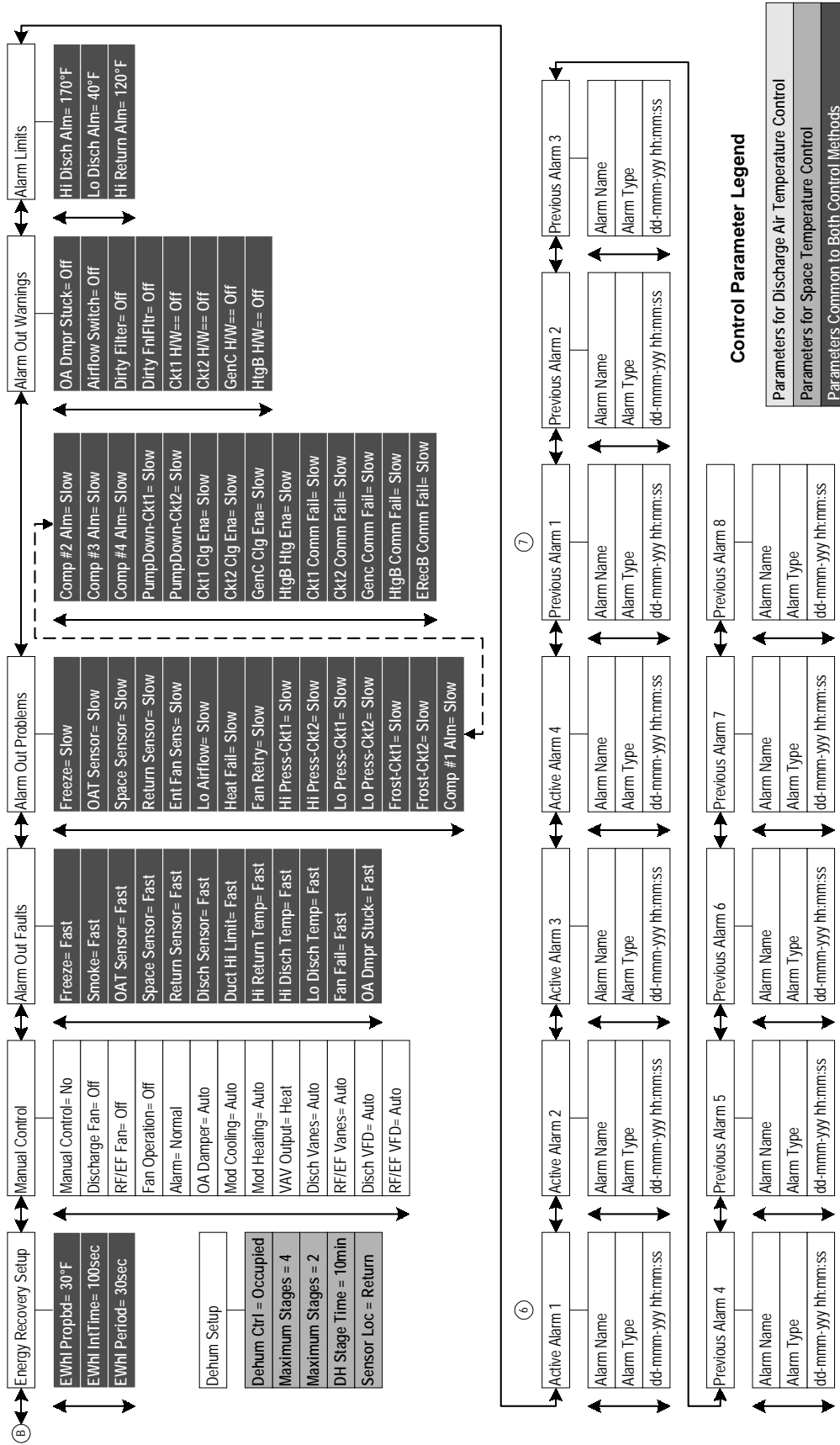


Figure 93. Keypad Accessible Menu Structure (continued)



Sub Menus (Continued)

Figure 94. Keypad Accessible Menu Structure (continued)



Sub Menus (Continued)

Maintenance

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



WARNING

Moving machinery and electrical power hazards. May cause severe personal injury or death.

Disconnect and lock off power before servicing equipment.



CAUTION

Sharp edges are inherent to sheet metal parts, screws, clips, and similar items. May cause personal injury.

Exercise caution when servicing equipment.

Preventive Maintenance

Preventive maintenance is the best way to avoid unnecessary expense and inconvenience. Have this system inspected at regular intervals by a qualified service technician. The required frequency of inspections depends upon the total operating time and the indoor and outdoor environmental conditions. Routine maintenance should cover the following items:

1. Tighten all belts, wire connections, and setscrews.
2. Clean the evaporator and condenser coils mechanically or with cold water, if necessary. Usually any fouling is only matted on the entering air face of the coil and can be removed by brushing.
3. Lubricate the motor and fan shaft bearings.
4. Align or replace the belts as needed.
5. Clean or replace the filters as needed.
6. Check each circuit's refrigerant sightglass when the circuit is operating under steady-state, full load conditions. The sightglass should then be full and clear. If it is not, check for refrigerant leaks.
Note: A partially full sight glass is not uncommon at part load conditions.
7. Check for proper superheat.
See "Checking Superheat" on page 80.
8. Check for blockage of the condensate drain. Clean the condensate pan as needed.
9. Check the power and control voltages.
10. Check the running amperage of all motors.
11. Check all operating temperatures and pressures.
12. Check and adjust all temperature and pressure controls as needed.
13. Check and adjust all damper linkages as needed.

14. Check the operation of all safety controls.
15. Examine the gas furnace (*see Bulletin No. IM 684 or 685*).
16. Check the condenser fans and tighten their setscrews.
17. Lubricate the door latch mechanisms.

Unit Storage

Location

The McQuay Rooftop Packaged System Unit is an outdoor unit. However, the schedule may dictate storage either on the ground or in its final position at the site. If the unit is stored on the ground, additional precautions should be taken as follows:

1. Make sure that the unit is well supported along the length of the base rail.
2. Make sure that the unit is level (no twists or uneven ground surface).
3. Provide proper drainage around the unit to prevent flooding of the equipment
4. Provide adequate protection from vandalism, mechanical contact, etc. The condenser fins are particularly vulnerable to damage by even light contact with ground based objects.
5. Provide unit doors are securely closed.
6. If isolation dampers are provided, verify that they are properly installed and fully closed to prevent the entry of animals and debris through the supply and return air openings.
7. Units without isolation dampers should be fitted with covers over the supply and return air openings.

Preparation

Supply (and Return) fans

1. Move the motor base to check and lubricate slides and leadscrews.
2. Remove the drive belts, tag them with the fan name and unit serial number and store them in a conditioned space out of direct sunlight.
3. Once every two weeks, rotate the fan and motor shafts. Mark the shaft positions first to make sure they stop in a different position.
4. Depending on local climatic conditions, condensate ~ collect on components inside the units. To prevent surface rust and discoloration, spray all bare metal parts with a rust preventive compound. Pay close attention to fan shafts, sheaves, bearings and bearing supports,

Cabinet Sections

1. Once a month, open a door on each section and verify that no moisture or debris is accumulating in the unit.

Cooling circuits

1. Provide that each circuit is properly pumped down.
2. Pull the fuses to each compressor (store them in the control cabinet)
3. Close all the refrigerant service valves on each circuit

4. Tag the valves as a warning for the technician who will be restarting the units
5. Note: steps I. to 4. are not necessary if the unit had not yet been started.

Gas Furnace

If the unit is equipped with a gas furnace, close the gas shutoff valve and open furnace control switch S3.

Control Compartment

1. McQuay International recommends that the electronic control equipment in the unit be stored in a 5% to 95% RH (non-condensing) environment.
2. It may be necessary to put a heat source (light bulb) in the main control panel to prevent the accumulation of atmospheric condensate within the panel.
3. The location and wattage of the heat source will be dependent on local environmental conditions.
4. Check the control compartment every two weeks to provide that the heat source is functional and is adequate for current conditions.

Restart

After extended storage, a very complete start up must be performed. Inevitable accumulations of dirt, insect nests, etc. can contribute to problems if not cleaned out thoroughly prior to start up. In addition, thermal cycling will have tended to loosen mechanical and electrical connections. Following the start up procedure will help discover these and other issues that may have developed during the storage interval.

Gas Furnace

For information on maintenance of the gas furnace, refer to Bulletin No. IM 684 or 685.

Bearing Lubrication

CAUTION

Bearing overheating potential. Can cause damage to the equipment.

Do not overlubricate bearings.

Use only a high grade mineral grease with a 200°F safe operating temperature. Refer to Table 22 on page 94 for specific recommended lubricants.

Motor Bearings

Supply and return fans - Supply and return fan motors should have grease added after every 2,000 hours of operation. Use one of the greases shown in Table 22 on page 94. Using the following procedure, relubricate the bearings while the motor is warm, but not running.

1. Remove and clean upper and lower grease plugs.
2. Insert a grease fitting into the upper hole and add a small amount of clean grease with a low pressure gun.
3. Run the motor for five minutes before replacing the plugs.

Note: Specific greasing instructions may be found on a tag attached to the motor. If special lubrication instructions are on the motor, they will supersede all other instructions.

Condenser fan - Condenser fan motors are permanently lubricated and require no periodic lubrication.

Fan Shaft Bearings

Fan shaft bearings should be relubricated periodically. Relubricate according to the schedule shown in Table 23. If the bearings are exposed to wet conditions, wide temperature variations, or other severe atmospheric conditions, relubricate more frequently. Use one of the greases shown in Table 22.

While the bearing is at normal operating temperatures, rotate the fan by hand and add only enough grease to purge the seals. The seals will bleed slightly when this has occurred. Do not overlubricate.

Table 22: Recommended greases

MANUFACTURER	PRODUCT NAME	TEMP. RANGE (°F)
Texaco Lubricants Co.	Premium RB	-30 to 300
Keystone Ind. Lubricants	84EP-2	-40 to 200
Mobil Oil Corporation	Mobilith AW2	-40 to 325
Chevron U.S.A. Inc.	SRI-2	-20 to 325
Exxon Company. U.S.A.	Ronex MP	-40 to 300
Shell Oil Company	Alvania No. 2	-20 to 240

Table 23: Recommended Fan Shaft Bearing Lubrication Intervals

OPERATING DUTY	BEARING AMBIENT TEMPERATURE		
	TO 130°F	TO 150°F	OVER 150°F
Continuous	6 months	4 months	2 months
12 Hrs./Day	12 months	12 months	6 months

Vibration Levels

Each unit as shipped has been trim-balanced to operate smoothly. To provide satisfactory operation after shipping and installation, use the accepted industry guidelines for field balancing fans. See Table 24.

Table 24: Vibration Levels

FAN SPEED (RPM)	VIBRATION
800 or less	5 mils maximum displacement
801 or greater	0.20 in/sec. maximum velocity

Note: Excessive vibration from any cause contributes to premature fan and motor bearing failure. Overall vibration levels should be monitored every six months of operation. An increase in levels is an indication of potential trouble.

Vibration Causes

1. Wheel imbalance.
 - a. Dirt or debris on wheel blades.
 - b. Loose setscrews in wheel hub or bearing-to-shaft.
 - c. Wheel distorted from overspeed.
2. Bent shaft.
3. Drive faulty.
 - a. Variable pitch sheaves - Axial and radial runout of flanges; uneven groove spacing; out of balance. Also similar faults in driven sheave.

- b. Bad V-belts; lumpy, or mismatched; belt tension too tight or too loose.
- 4. Bad bearings, loose bearing hold-down bolts.
- 5. Motor imbalance.
- 6. Fan section not supported evenly on foundation.

Periodic Service and Maintenance

- 1. Check all moving parts for wear every six months.
- 2. Check bearing collar, sheave, and wheel hub setscrews, sheave capscrews, and bearing hold-down bolts for tightness every six months.

Setscrews

Setscrews lock bearings, sheaves, locking collars, and fan wheels to their shafts. It is very important that all setscrews be checked periodically to provide that they have not loosened. If this is not done, severe equipment damage could occur.

Using *Table 25*, check the tightness of all setscrews with a torque wrench. Note that if the return fan bearings setscrews must be retightened, a special procedure is required to equally load both bearings (*see "Return Fan Bearing Setscrews"*).

Table 25: Setscrew Minimum Torque Specifications

SETScrew DIAMETER (IN.)	MINIMUM TORQUE (FT.LB)
1/4	5.5
5/16	10.5
3/8	19.0
7/16	29.0
1/2	42.0
5/8	92.0

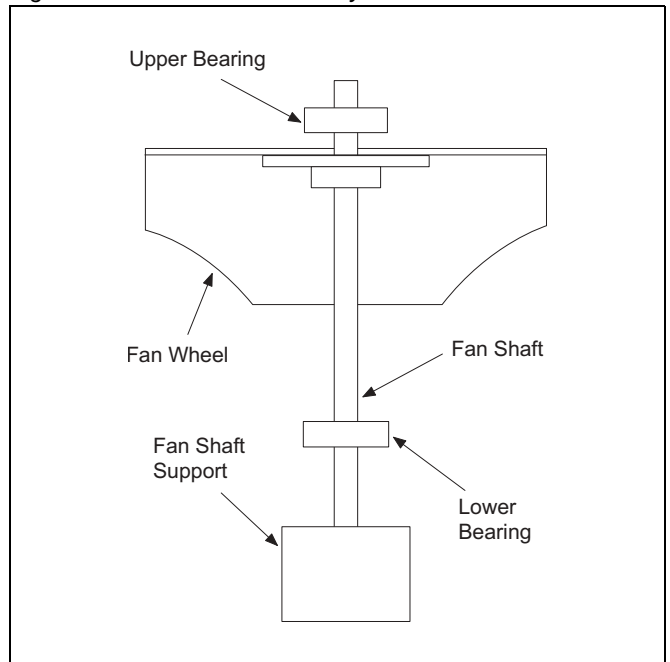
Return Fan Bearing Setscrews

Because the return fan is mounted on a vertical shaft, the following procedure must be used to retighten any return fan bearing setscrews that have loosened. This procedure will provide that both bearings are equally loaded. If one bearing is carrying the entire weight of the fan, it could fail prematurely.

- 1. Loosen the fan belts.
- 2. Support the weight of the fan and the fan shaft with timbers or some other suitable means (*see Figure 95*).

Important:In order to maintain proper drive alignment and fan-to-tunnel clearance, the fan and shaft must not drop at all when the setscrews are loosened in Step 4.
- 3. Verify that the upper shaft collar is securely fastened to the shaft. Check the setscrew torque.
- 4. Loosen the upper and lower bearing setscrews. The entire weight of the fan and shaft is now supported by the fan shaft support.
- 5. Retighten all bearings to the torque specification given in *Table 25*.
- 6. Remove the fan shaft support and retension the belts.

Figure 95. Return Fan Assembly



Supply Fan Wheel-to-Funnel Alignment

If the unit is equipped with an airfoil or backward curved supply fan, the fan wheel-to-funnel alignment must be as shown in *Figure 96*, *Figure 97*, *Figure 99* & *Figure 100* to obtain proper air delivery and operating clearance. If necessary, adjustments are made as follows:

- 1. Verify that the fan shaft has not moved in its bearings.
- 2. Loosen the fan hub setscrews and move the wheel(s) along the shaft as necessary to obtain the correct dimension shown in *Table 26*, *Table 27* & *Table 28* on page 96.
- 3. Retighten the setscrews to the torque specification given in *Table 25* on page 95. Tighten the setscrews over the keyway first; tighten those at 90 degrees to the keyway last.
- 4. Verify that the radial clearance around the fan is uniform. Radial clearance can be adjusted by slightly loosening the funnel hold-down fasteners, shifting the funnel as required, and retightening the fasteners.

Figure 96. 20" Airfoil Wheel-to-Funnel (015C-030C)

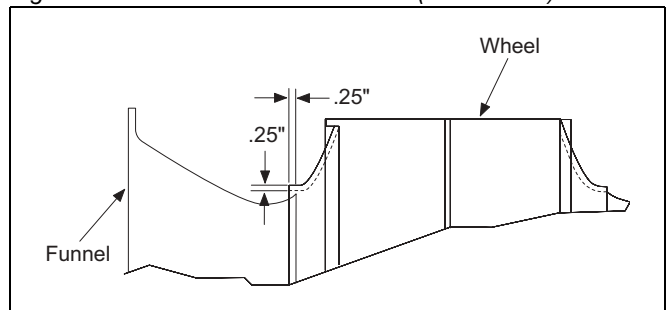


Figure 97. 24" Backward Curved Wheel-to-Funnel
(036C, 040C)

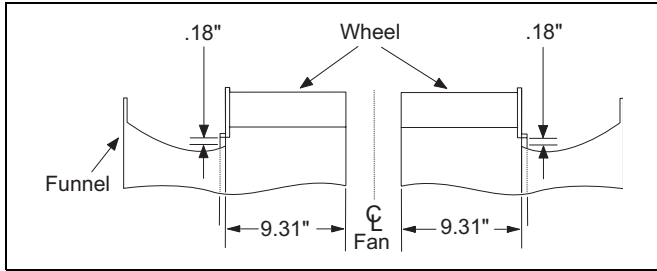


Figure 98. Airfoil Wheel-to-Funnel Alignment

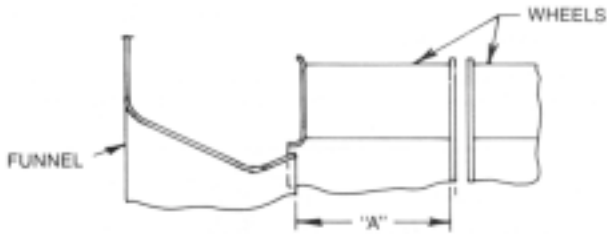


Table 26: Airfoil Wheel-to-Funnel Tolerances

Wheel-to-Funnel Relationship (In Inches)	
Wheel Diameter (Inches)	"A" +0.3/ -0.0
27	9.90 (246mm)
30	10.60 (269mm)
33	11.70 (297mm)

Figure 99. 40" Airfoil Wheel-to-Funnel Alignment
(RDT 045 -075)

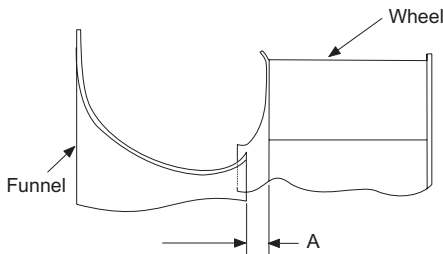


Table 27: 40" Airfoil Wheel-to-Funnel Tolerances
(RDT 045 -075)

WHEEL-TO-FUNNEL RELATIONSHIP	
WHEEL DIA. (IN.)	"A" (IN INCHES)
40	62

Figure 100. 44" Airfoil Wheel-to-Funnel Alignment

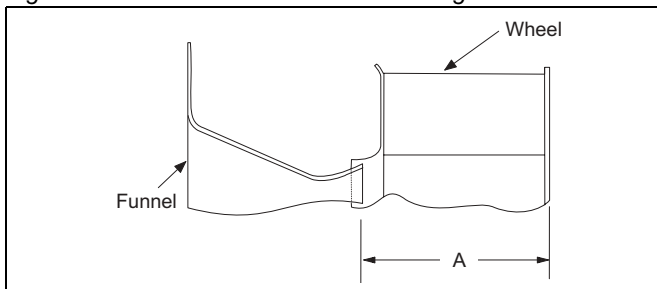


Table 28: 44" Airfoil Wheel-to-Funnel Tolerances
(RDT 045 -075)

WHEEL-TO-FUNNEL RELATIONSHIP	
WHEEL DIA. (IN.)	"A" (IN INCHES)
44	16.21

Refrigerant Charge

The unit nameplate references proper charge for each refrigerant circuit in case a full charge must be added to the unit.

WARNING

Potential severe loss of charge may occur if the high refrigerant pressure switch is replaced before reclaiming the refrigerant.
Replace switch after reclaiming refrigerant.

Replacing Failed Refrigerant Sensors or Switches

The McQuay Rooftop Unit includes the following refrigerant sensors or switches.

1. Low refrigerant sensing, operating switch
2. SpeedTrol refrigerant sensing, operating sensor [see "SpeedTrol (NA Unit Sizes 015C - 030C)" on page 64]
3. High refrigerant pressure, safety switch

The low pressure and Speedtrol sensors/ switches sense refrigerant pressure through schrader fittings that contain cores. The cores are stop valves that will not allow refrigerant to flow through the schrader unless the device is in place. Therefore the low pressure and Speedtrol sensors/switches can be replaced without reclaiming the refrigerant.

The schrader that serves the high pressure switch does not contain a core, in order to maximize the functionality of the safety. Therefore it cannot be replaced unless the refrigerant has already been reclaimed.

Winterizing Water Coils

Coil freeze-up can be caused by such things as air stratification and failure of outdoor dampers and/or preheat coils. Routine draining of water cooling coils for winter shutdown cannot be depended upon as insurance against freeze-up. Severe coil damage may result. It is recommended that all coils be drained as thoroughly as possible and then treated in the following manner.

Fill each coil independently with an antifreeze solution using a small circulating pump and again thoroughly drain.

Check freezing point of antifreeze before proceeding to next coil. Due to a small amount of water always remaining in each coil, there will be a diluting effect. The small amount of antifreeze solution remaining in the coil must always be concentrated enough to prevent freeze-up.

Note: Carefully read instructions for mixing antifreeze solution used. Some products will have a higher freezing point in their natural state than when mixed with water.

Replacement Parts List

Table 29: Microtech II Components Parts List

Component Designation	Description	McQuay Part Number
MCB	Main Control Board	060006101
CCB1	Auxiliary Cooling Control Board (DX Circuit #1 or Generic Condenser)	106102701
CCB2	Auxiliary Cooling Control Board (DX Circuit #2)	106102701
EHB1	Auxiliary Electric Heat Control Board	106102801
ERB1	Auxiliary Energy Recovery Control Board	106102701
-	Keypad/Display	060006301
-	Keypad-Main Control Board Cable	111044601
ZNT1	Zone Temperature Sensor with Tenant Override	111048101
	Zone Temperature Sensor with Tenant Override & Remote Setpoint Adjustment (SCC units only)	111048102
DAT	Discharge Air Temperature Sensor (50 ft cable length-field cut to length)	060004705
ENT	Entering Fan Air Temperature Sensor (50 ft cable length-field cut to length)	060004705
OAT	Outside Air Temperature Sensor (50 ft cable length-field cut to length)	060004705
RAT	Return Air Temperature Sensor (50 ft cable length-field cut to length)	060004705
SPS1	Static Pressure Sensor: Duct, No. 1	049545007
SPS2	Static Pressure Sensor: Duct, No. 2	049545007
	Static Pressure Sensor: Building (Space) Pressure	049545006
T2	Transformer: 115/24 VAC	060004601
T3	Transformer: 115/24 VAC	060004601
T9	Transformer: 115/24 VAC	060630801
HUM1	Humidity Sensor: Wall Mount	067294901
	Humidity Sensor: Duct Mount	067295001
PC5	Dirty Filter Switch: First Filter Section	065493801
PC6	Dirty Filter Switch: Final Filter Section	065493801
PC7	Airflow Proving Switch	060015801
DHL	Duct High Limit Switch	065493801
OAE	Enthalpy Control: Electromechanical	030706702
	Enthalpy Control: Electronic (Used with RAE)	049262201
RAE	Return Air Enthalpy Sensor (Used with Electronic OAE)	049262202
SD1	Smoke Detector: Supply Air	049025001
SD2	Smoke Detector: Return Air	049025001
-	BACnet MS/TP Communication Module (RS485)	060006202
-	BACnet/IP Communication Module (Ethernet Cable 10BASET)	060006201
-	LonMark Space Comfort Controller (SCC) Communication Module	060006203
-	LonMark Discharge Air Controller (DAC) Communication Module	060006204
-	N2 Communication Module (For Auxiliary Control Boards)	106457101
-	5 VDC Power Supply	111049601
-	Serial Port Ribbon	111047201

Service and Warranty Procedure

Replacement Parts

When writing to McQuay for service or replacement parts, provide the model number, serial number, and unit part number of the unit as stamped on the serial plate attached to the unit. For questions regarding wiring diagrams, it will be necessary to provide the number on the specific diagram. If replacement parts are required, include the date of unit installation, the date of failure, an explanation of the malfunction, and a description of the replacement parts required.

Compressor

McQuay Rooftops use the following Copeland Scroll Compressors.

1. Single compressors, one per refrigerant circuit
2. Tandem compressors, basically two compressors specifically manufactured by Copeland into a single assembly.
3. Trio compressors, basically three single compressors factory piped in parallel with equalization lines.

Scroll service replacement compressors for McQuay Rooftop Units can be obtained from two sources.

McQuay Service Parts maintains a stock of replacement compressors.

Copeland Refrigeration has stocking wholesalers throughout the U.S. who maintain a limited stock of replacement scroll compressors. The stock of single compressors is much better than the stock of tandems "tandem/trio ready", single compressors. Trios are almost never in wholesaler stock and are not recommended for use on McQuay Rooftops due to piping interference. Copeland does offer quick ship options through their wholesalers.

Both sources can be used, at the customer's discretion, within the following limitations.

1. RPS18-20 (with single compressors. No limitations).
2. RPS25-30 (with single and tandem compressors).
 - a.If any part of the tandem fails then the entire tandem must be replaced. Both sources are acceptable.
 - b.Single compressor. No limitations.
3. RPS36 (with tandem compressors).
 - a.Circuit #1 tandem - If any part of the tandem fails then the entire tandem must be replaced. Both sources are acceptable.
 - b. Circuit #2 tandem - Each of the tandem's compressors have a rotalock and only the failed portion of the tandem may need replacement. See below.
4. RPS40-60 - Each of the tandem's compressors have a rotalock and only the failed portion of the tandem may need replacement. See below.
5. RPS70-75 - Each of the tandem's compressors have a rotalock and only the failed portion of the tandem may need replacement. See below.

The decision to replace the failed portion of the tandem or trio, as opposed to replacing the entire tandem or trio, must be decided based on the following.

1. The entire tandem must be replaced if the individual portions do not include rotalocks and rotalocks are not available on the RPS25-30 (tandems and the RPS circuit #1 tandem).
2. In warranty - Warranty will only cover replacement of the failed portion of the tandem or trio. Either source may be used.
3. Out of warranty - The customer decides whether to replace the entire tandem / trio or just a portion and either source may be used.
4. Only a "tandem or trio ready" compressor, with oil equalizer lines, can be used to replace a portion of the tandem or trio.

When replacing an "in warranty" compressor through a Copeland Wholesaler, take the failed compressor to the wholesaler for an over-the-counter or an advanced replacement exchange. Credit is issued by Copeland on the returned motor compressor upon receipt and factory inspection of the inoperative motor compressor. In this transaction, be certain that the motor compressor is definitely defective. If a motor compressor is received from the field that tests satisfactorily, a service charge plus a transportation charge will be charged against its original credit value.

In-Warranty Return Material Procedure

Material other than compressors may not be returned except by permission of authorized factory service personnel of McQuay International at Minneapolis, Minnesota.

A "return goods" tag will be sent to be included with the returned material. Enter the information as called for on the tag in order to expedite handling at our factories and issuance of credits. All parts shall be returned to the factory designated on the return goods tag, transportation charges prepaid.

The return of the part does not constitute an order for replacement. A purchase order for the replacement part must be entered through your nearest McQuay representative. The order should include the component's part number and description and the model and serial numbers of the unit involved.

If it is determined that the failure of the returned part is due to faulty material or workmanship within the standard warranty period, credit will be issued on the customer's purchase order.

Limited Product Warranty (North America)

McQuay International ("Company") warrants to contractor, purchaser and any owner of the product (collectively "Owner") that Company, at its option, will repair or replace defective parts in the event any product manufactured by Company, including products sold under the brand names McQuay Air Conditioning, AAF Air Conditioning, AAF HermanNelson and McQuay Service, and used in the United States or Canada, proves defective in material or workmanship within twelve (12) months from initial startup or eighteen (18) months from the date shipped by Company, whichever occurs first. Authorized replaced parts are warranted for the duration of the original warranty. All shipments of such parts will be made FOB factory, freight prepaid and allowed. Company reserves the right to select carrier and method of shipment.

In addition, labor to repair or replace warranty parts is provided during Company normal working hours on products with rotary screw compressors, centrifugal compressors and on absorption chillers. Warranty labor is not provided for any other products.

Company's liability to Owner under this warranty shall not exceed the lesser of the cost of correcting defects in the products sold or the original purchase price of the products.

PRODUCT STARTUP ON ABSORPTION, CENTRIFUGAL AND SCREW COMPRESSOR PRODUCTS IS MANDATORY and must be performed by McQuayService or a Company authorized service representative.

It is Owner's responsibility to complete and return the Registration and Startup Forms accompanying the product to Company within ten (10) days of original startup. If this is not done, the ship date and the startup date will be deemed the same for warranty period determination, and this warranty shall expire twelve (12) months from that date.

Exceptions

1. If free warranty labor is available as set forth above, such free labor does not include diagnostic visits, inspections, travel time and related expenses, or unusual access time or costs required by product location.

2. Refrigerants, fluids, oils and expendable items such as filters are not covered by this warranty.
3. This warranty shall not apply to products or parts which (a) have been opened, disassembled, repaired, or altered by anyone other than Company or its authorized service representative; or (b) have been subjected to misuse, negligence, accidents, damage, or abnormal use or service; or (c) have been operated, installed, or startup has been provided in a manner contrary to Company's printed instructions, or (d) were manufactured or furnished by others and which are not an integral part of a product manufactured by Company; or (e) have not been fully paid for by Owner.

Assistance

To obtain assistance or information regarding this warranty, please contact your local sales representative or McQuayService office.

Sole Remedy

THIS WARRANTY CONSTITUTES THE OWNER'S SOLE REMEDY. IT IS GIVEN IN LIEU OF ALL OTHER WARRANTIES. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT AND UNDER NO CIRCUMSTANCE SHALL COMPANY BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL, CONTINGENT OR CONSEQUENTIAL DAMAGES, WHETHER THE THEORY BE BREACH OF THIS OR ANY OTHER WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

No person (including any agent, sales representative, dealer or distributor) has the authority to expand the Company's obligation beyond the terms of this express warranty or to state that the performance of the product is other than that published by Company.

For additional consideration, Company will provide an extended warranty(ies) on certain products or components thereof. The terms of the extended warranty(ies) are shown on a separate extended warranty statement.

This document contains the most current product information as of this printing. For the most up-to-date product information, please go to **www.mcquay.com**.

