# WATER SOURCE HEAT PUMPS

## 100 Percent Outside Air Units
## Sizes 071 thru 381

# Installation, Operation and Maintenance Instructions

**Important:** These instructions are for the use of specially trained personnel, experienced in the installation of this equipment and related system components. Some states require licensing of installation and service personnel. Unqualified individuals should not attempt to interpret these instructions or install this equipment. Read instructions carefully before unpacking, installing and operating this heat pump unit.

**Inspection:** This heat pump has been factory inspected prior to shipment. However, we recommend you check the carton before unloading and note any transit damage on all copies of the bill of lading. Also inspect the unit for concealed shipping damage after removing packaging. Transit damage claims must be filed promptly with the freight company by the purchaser.

**Handling:** Always handle with care and in the horizontal position as shipped on the pallet. Moving the heat pump on its side or dropping it may damage internal parts.

**Location:** Unit must be installed indoors in any area allowing adequate room for mounting of unit and with access for maintenance and service.

## Nomenclature

**G - 141 - MHC**

**Voltage:**
F = 208-230/60/3
G = 460/60/3
K = 575/60/3
J = 380/50/3

**Unit Size (Nominal Cooling):**
071 = 72,250 Btu/hr. cooling
111 = 111,000 Btu/hr. cooling
141 = 148,000 Btu/hr. cooling
181 = 183,000 Btu/hr cooling
221 = 226,000 Btu/hr cooling
271 = 270,000 Btu/hr cooling
321 = 330,000 Btu/hr cooling
381 = 381,000 Btu/hr cooling

**Unit Type:**
MHC = 100% Outside Air, Standard Temperature Range Design Series “C”

MLC = 100% Outside Air, Low Temperature Geothermal, Design Series “C”

Mammoth is committed to a policy of continuous product improvements, and thus reserves the right to change specifications and design without notice.


(P/N 71144921)

Mammoth Inc.
www.mammoth-inc.com

# Installation

### Definition

Twin circuit 100% Outside Air unit with one fan outlet and two independent refrigerant circuits.

### Unit placement – ceiling hung

Mammoth's 100% outside air heat pump can be hung from the ceiling using the mounting rails attached to the unit and with vibration isolation grommets shipped inside the unit's electric compartment.

1. Fit the grommets into the ¾-inch diameter holes on the mounting rails. Use 5⁄16-inch or ⅜-inch threaded rods (supplied by others) to hang the unit from the ceiling. Cover the entire bottom of the 1¼-inch diameter grommet with a washer (supplied by others).

**Note:** *Never attempt to raise, lower or adjust the pitch of the unit by turning the units on the hanger rods without first taking the weight of the unit completely off the vibration isolation grommets.*

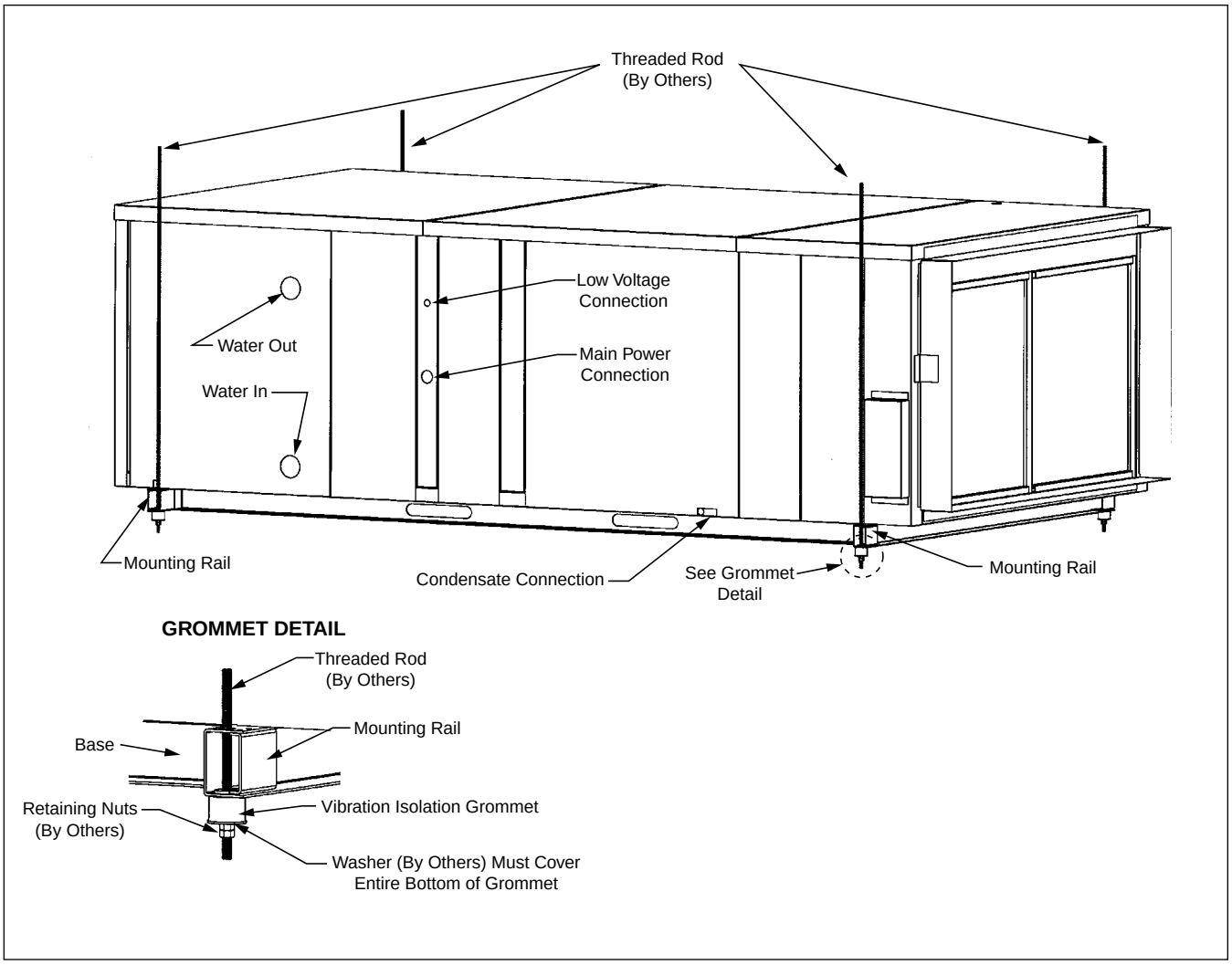
2. Mount the unit with a 5-degree (maximum) pitch toward the condensate drain connection. Outside air units are available with an optional bottom drain connection. In the ceiling-mounted arrangement this option will allow for more effective condensate removal.
3. See unit data sheet for dimensional information.

### Unit placement – slab-mounted

Mammoth's 100% outside air heat pump can also be installed on a flat level surface. It is recommended that vibration mounts be placed under the unit to prevent transmission of vibrating to the building structure. The standard side drain connection is required in this arrangement.

See unit data sheet for further dimensional details.

**Figure 1. Ceiling-hung placement**



# Application limits

| | COOLING | |
|---|---|---|
| | STD. TEMP. | LOW TEMP. |
| MINIMUM ENTERING WATER/BRINE | 55 F | 30 F |
| MAXIMUM ENTERING WATER | 110 F | 110 F |
| MINIMUM ENTERING AIR | 60 F | 60 F |
| MAXIMUM ENTERING AIR | 100 F | 100 F |

| | HEATING | |
|---|---|---|
| | STD. TEMP. | LOW TEMP. |
| MINIMUM ENTERING WATER/BRINE | 50 F | 25 F |
| MAXIMUM ENTERING WATER | 90 F | 90 F |
| MINIMUM ENTERING AIR | 40 F* | 40 F* |
| MAXIMUM ENTERING AIR | 80 F | 80 F |

Only one maximum condition can exist at the same time.

***Note:** *The minimum entering air temperature must not fall below 40 F.*

*If the outside air is cooler than 40 F it must be preconditioned or the unit must be shut off. Mammoth offers both optional electric and hot water preheat coils for this situation. See page 5 for additional information on the heaters.*

# Ductwork

Fasten the supply ductwork to the collar provided. Use a flexible duct connection between the unit and the supply duct. Make sure the blower wheel turns freely and is centered before making the connection.

If a return air is used, it may be fastened to the flanges on the filter guides. Make sure there is easy access for filter replacement.

The discharge or supply air duct should be insulated and have at least on 90-degree bend prior to the first discharge grille. Heat pump life expectancy and efficiency depends on adequate airflow. For nominal cfm information see unit data sheet.

# Water supply

The heat pump must not be operated without water flowing through its water-to-refrigerant heat exchanger coils. Severe damage to the unit may result.

For proper water flow rates, refer to the unit specification sheet.

**Condensate drain**
See Figures 2 and 3

The condensate drain is set up for ⅞-inch O.D. copper connection. The condensate pipe or hose installed must have a minimum 3-inch trap in the condensate line. All condensate piping must pitch away from the unit for proper drainage by gravity and as required by local codes. Condensate drains are available as either standard side connection or optional bottom connection.

**Figure 2. Condensate trap detail – bottom drain**

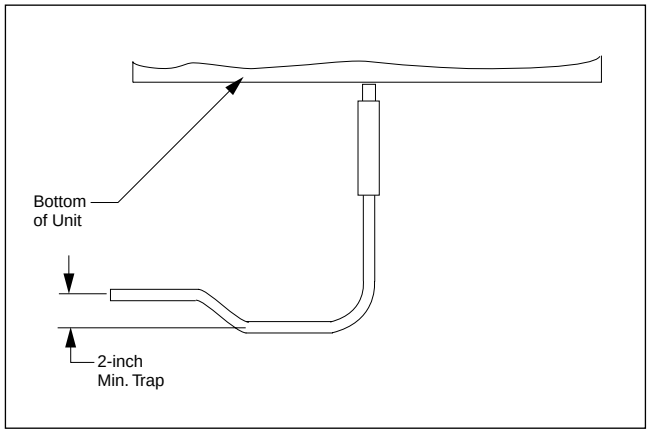
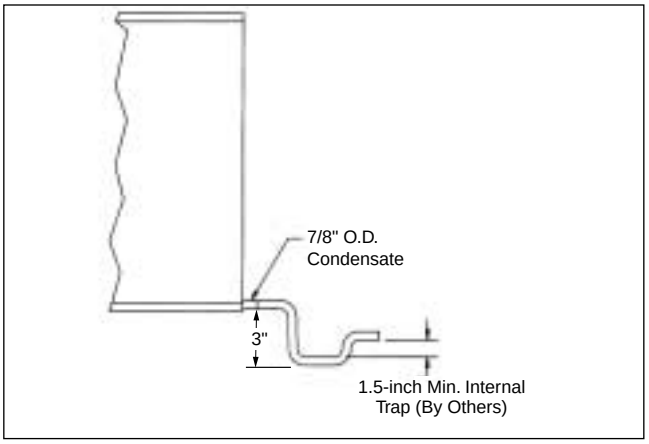



**Figure 3. Condensate trap detail – side drain**




**Closed loop systems**

1. Unit should be left unconnected or isolated using gate valves as the building water loop is initially flushed.
2. Water system should be filled with 1 lb. trisodium phosphate for every 50 gallons of water.
3. The piping should then be purged of trapped air, supplemental heater set to maintain 110 F and the solution circulated for approximately 8 hours.
4. The system should then be drained completely and the entire flushing process repeated, if necessary.
5. After completely cleaned and drained, fill loop with water at an alkaline level of approximatelly pH 7.5.
6. Connect heat pump the the piping loop.
7. Make sure all entrained air is purged from loop. Determine that specified flow rate through each unit is established.

### Optional hose kits

The flexible water hoses are 2-foot stainless steel hoses for water connections to the heat pump and adapters. Use two properly sized wrenches, one on the unit FPT fitting and one on the hexagonal fitting on the hose, when connecting hoses. Do not use wrench on hose or sleeve that crimps the fitting onto the hose. Hoses must not be subjected to stress of being pulled taut, twisted or kinked. Connections should not be over tightened.

Before pressurizing the water system, closely inspect hoses and fittings to be sure there are no cuts, abrasions, twists, kinks, stretch and hoses will not be in contact with any sharp surface or edge while in use. Also available for heat pumps is a condensate hose and two hose clamps.

For Mammoth hose kit information as to installation and specifications, see data sheets C-91 and C-93.

## Electric supply

### Electrical service and fuses

**Warning:** *Turn off electrical power before servicing controls. Severe electrical shock may result unless power is turned off.*

*Unit must be installed in compliance with NEC and local codes.*

Route wires through a properly sized disconnect switch. Consult the wiring diagrams that are found in this manual and inside the cover of the electrical box to complete the connection. see nameplate for proper fuse sizing, minimum circuit ampacity and voltage requirements. An auxiliary electrical heater must be installed with a power supply separate from the heat pump.

All factory installed electric preheat coils require a separate power supply. See the unit specification sheet for more information.

### Control wiring

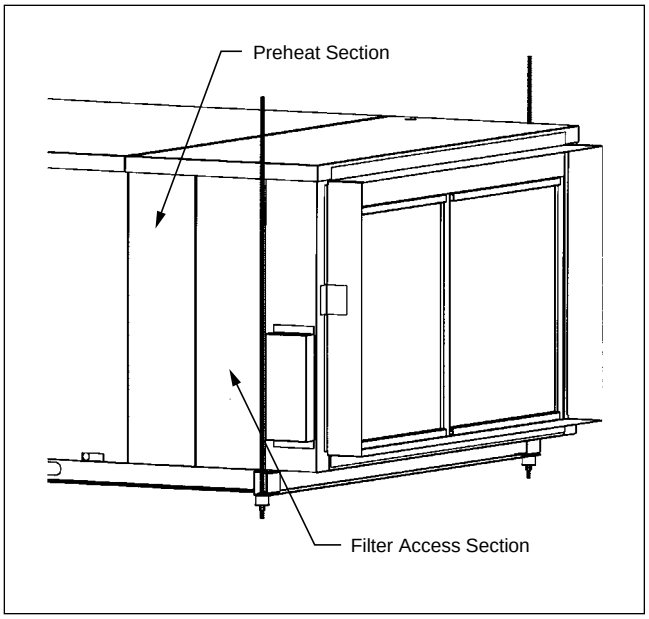
All of the heat pump functions are controlled by remote thermostat and must be wired as shown, using approved 18-gauge copper wire.

## Changing filters

The filters can be accessed from either side of the unit. The filter access panels (see Figure 4) are held in place by several sheet metal screws. After one of the access panels have been removed the filters will slide out.

The same access panel that allows access to the standard 2-inch filters also allows access to the optional 4-inch thick panel filters.

**Figure 4. Access panels**



# Optional preheat section

The preheat section is located after the outside air damper section and the filter section. It can be access via access panels on either side of the heat pump (see Figure 4).

### Electric Preheat — Optional

The Mammoth 100% Outdoor Air unit provides optional electric heat to preheat the outdoor air to a point where efficient compressor heating can take place.

The electric heater is a pre-assembled package designed to be installed internal to the unit. The elements are constructed of nichrome wire and include thermal limits, duct high limit, air proving switch, and nonfused disconnect switch. The heater operation is determined by outside air temperature, to maintain a minimum 40 F entering air temperature to the airside coil.The minimum entering air temperature to the air coil is 40 F to allow operation of the mechanical refrigeration for heating.

The heater includes its own control box separate from the unit's electrical panel. It is mounted on the outside of the unit casing, which houses all the heater control components and safety devices. The heater is U.L. listed. A separate power source from the unit is required.

### Hot Water Preheat — Optional

The Mammoth 100% Outdoor Air unit provides optional hot water coils to preheat cold outdoor air to a point where efficient compressor heating can take place.

The hot water coil is constructed of aluminum fins bonded to seamless copper tubes.

Units with the optional temperature control system include a two-way, two-position, spring return valve actuator. The valve actuator is controlled to maintain a minimum 40 F entering air temperature to the air coil to allow operation of the mechanical refrigeration for heating. A freezestat closes the outdoor air dampers and stops the fan and compressor if mixed air is below 33 F.

**Figure 5. Optional preheat wiring diagram**

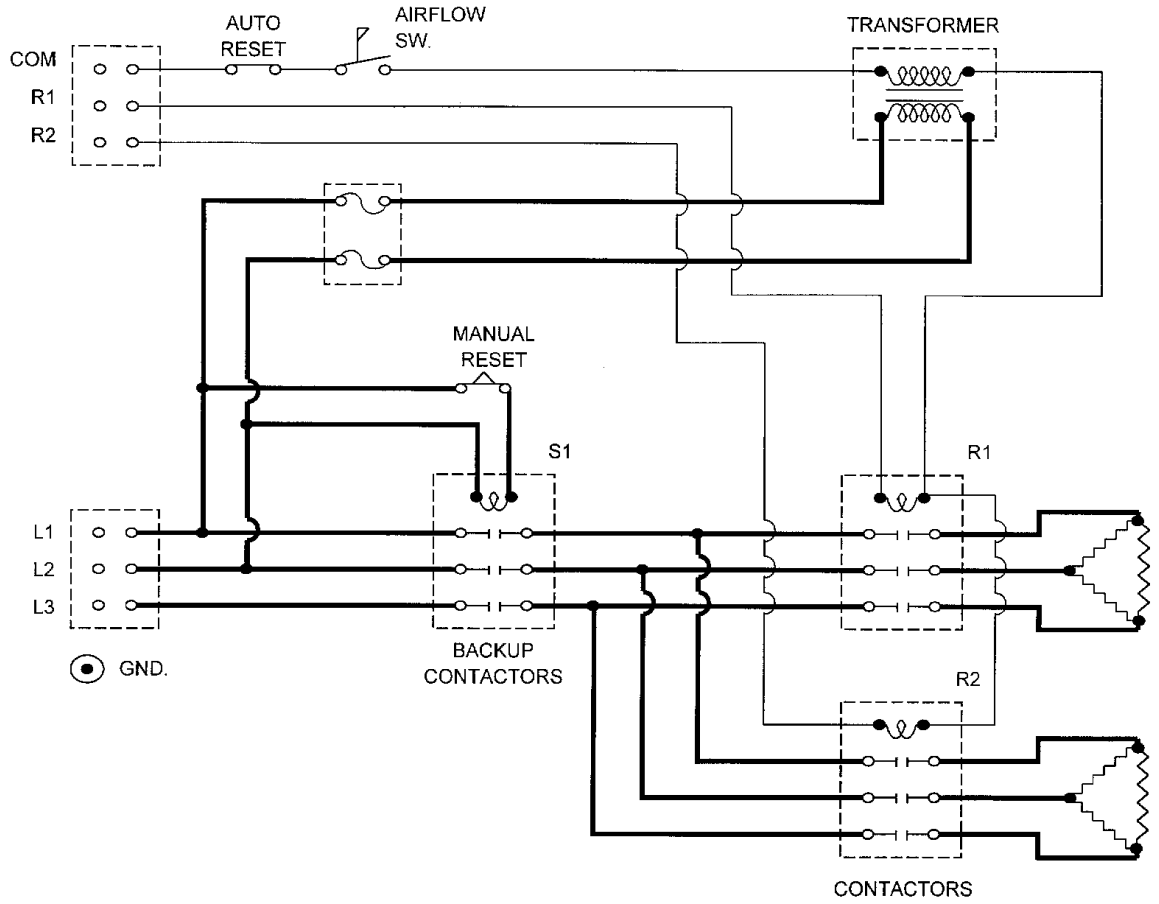
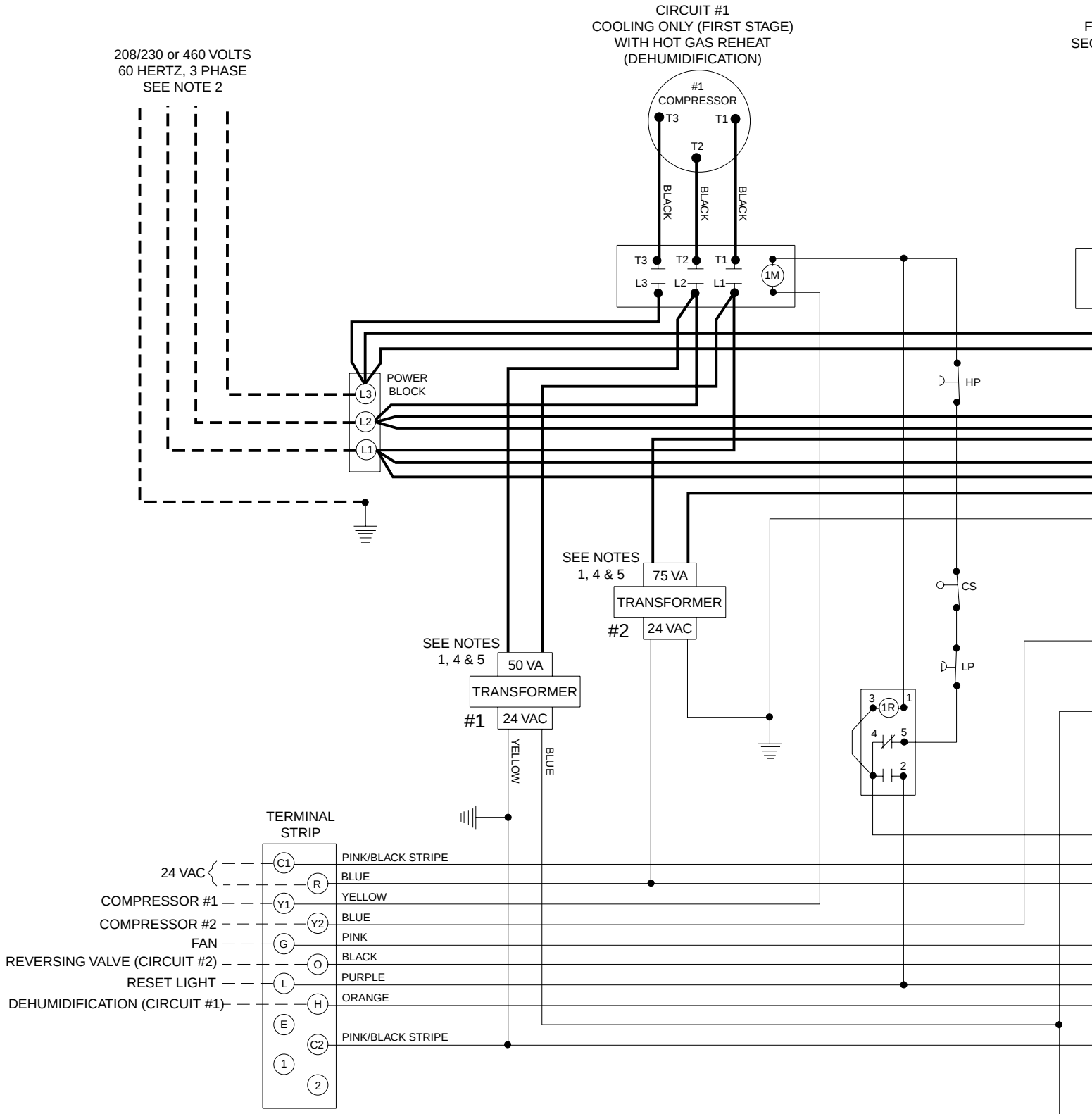
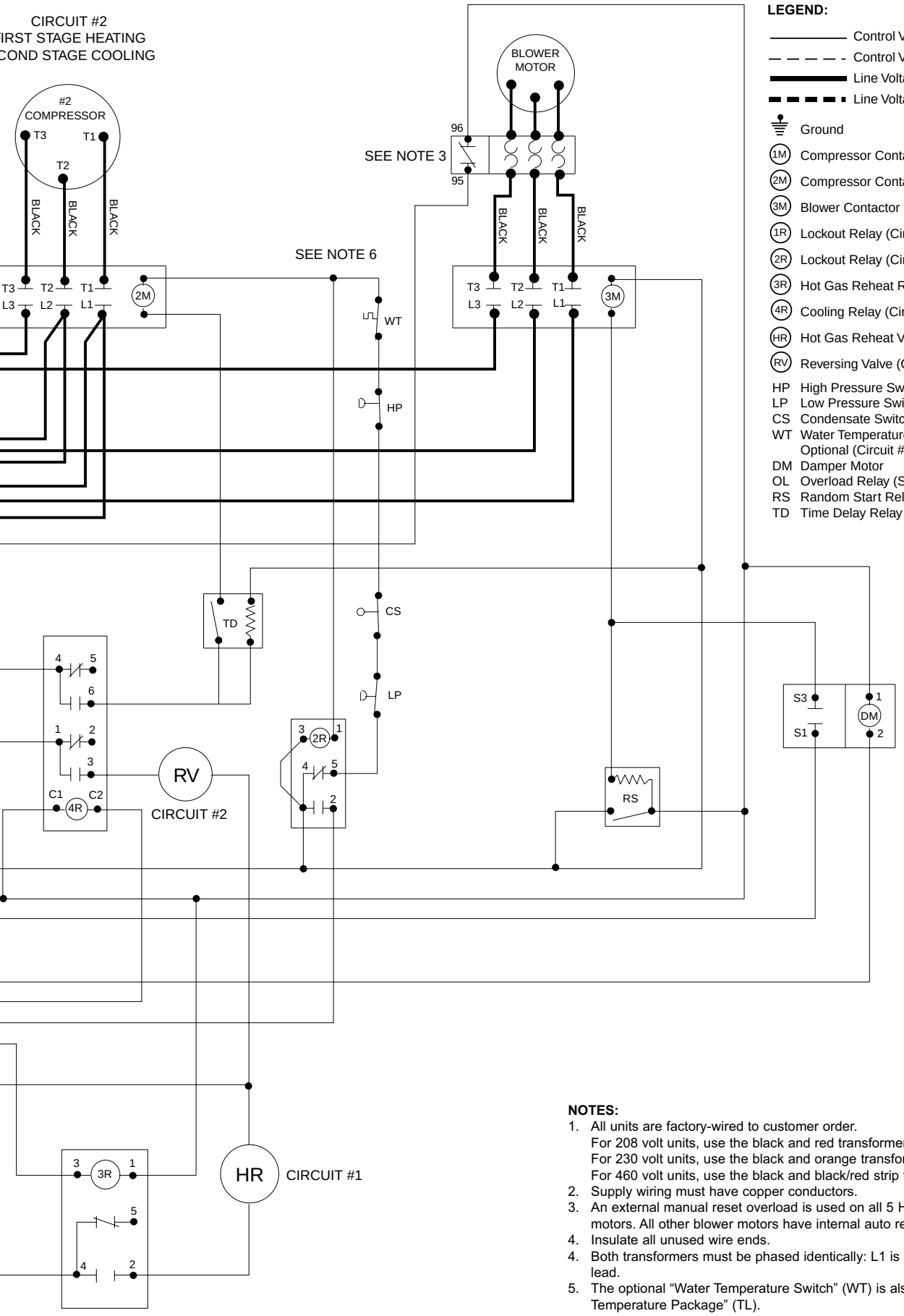


**Figure 6. 100% outside air unit wiring diagram**






**LEGEND:**

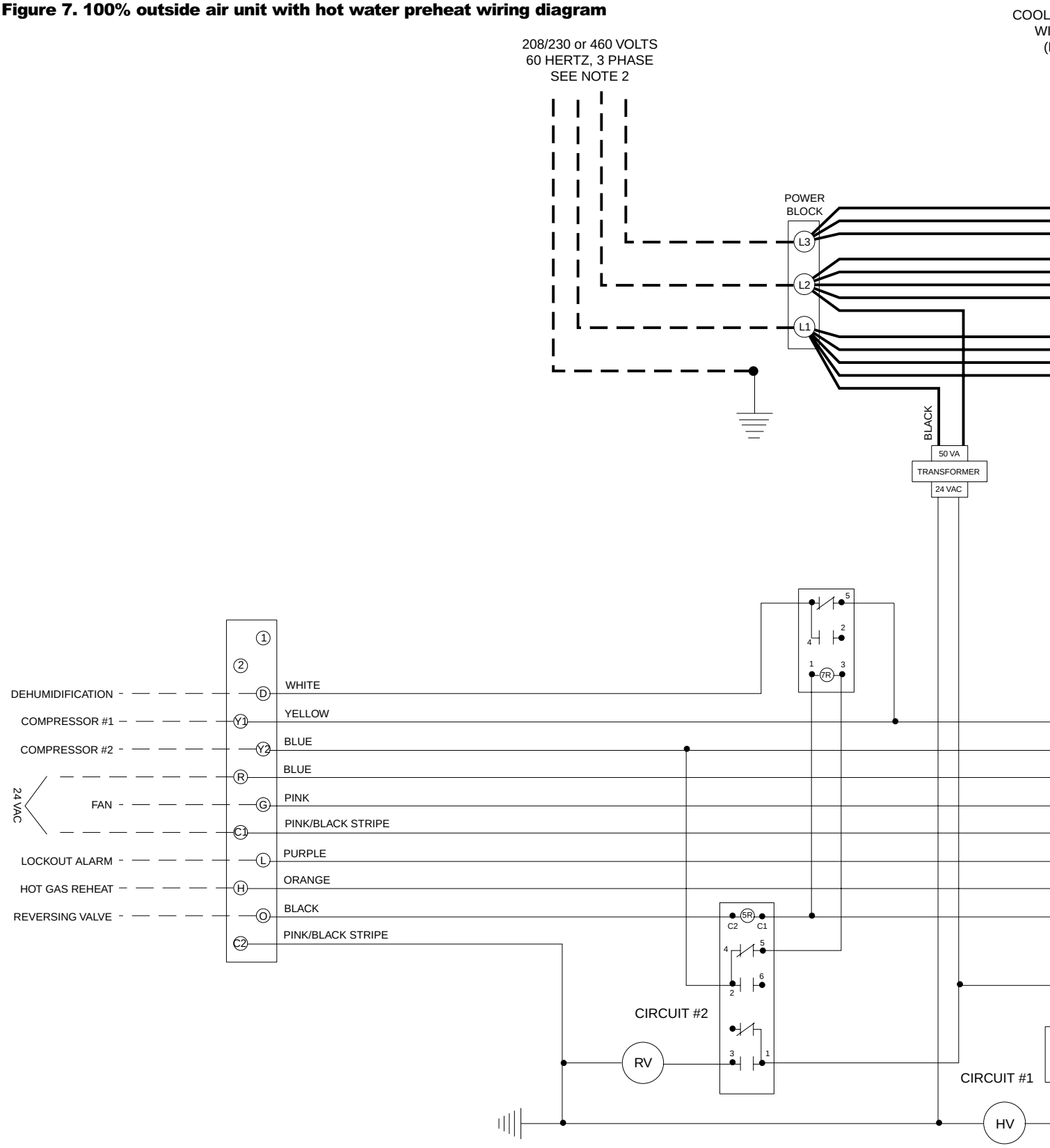
- Control Voltage Factory Wiring (24 VAC)
- Control Voltage Field Wiring (24 VAC)
- Line Voltage Factory Wiring
- Line Voltage Field Wiring
- Ground
- (1M) Compressor Contactor (Circuit #1)
- (2M) Compressor Contactor (Circuit #2)
- (3M) Blower Contactor
- (1R) Lockout Relay (Circuit #1)
- (2R) Lockout Relay (Circuit #2)
- (3R) Hot Gas Reheat Relay (Circuit #1)
- (4R) Cooling Relay (Circuit #2)
- (HR) Hot Gas Reheat Valve (Circuit #2)
- (RV) Reversing Valve (Circuit #2)

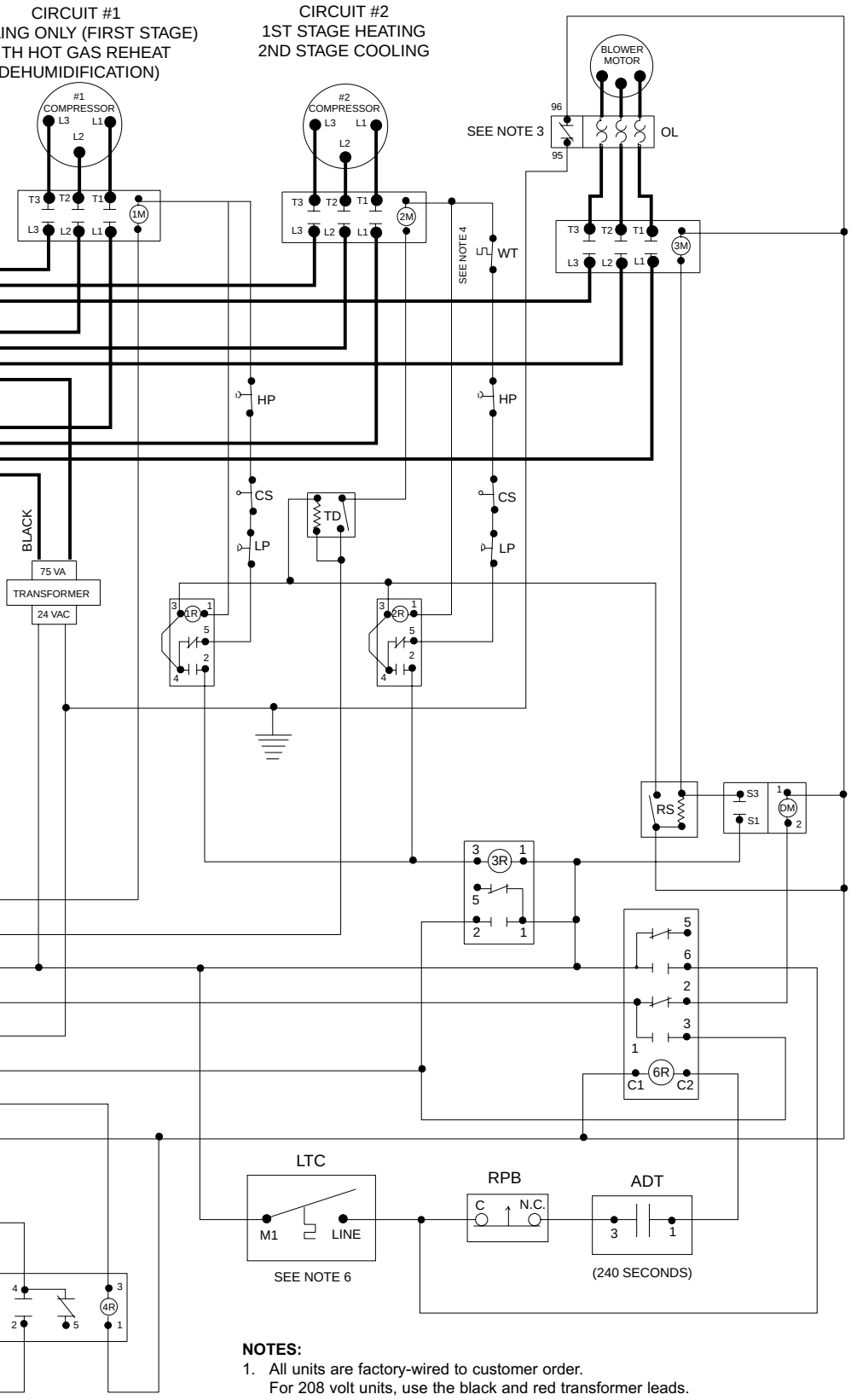
HP High Pressure Switch (400 psi)
LP Low Pressure Switch (7 psi)
CS Condensate Switch (Optional)
WT Water Temperature Switch (32 F) Optional (Circuit #2)
DM Damper Motor
OL Overload Relay (See Note 2)
RS Random Start Relay (25-60 Seconds)
TD Time Delay Relay (25-60 Seconds)

**NOTES:**

1. All units are factory-wired to customer order.
   For 208 volt units, use the black and red transformer leads.
   For 230 volt units, use the black and orange transformer leads.
   For 460 volt units, use the black and black/red strip transformer leads.
2. Supply wiring must have copper conductors.
3. An external manual reset overload is used on all 5 HP through 20 HP blower motors. All other blower motors have internal auto reset overloads.
4. Insulate all unused wire ends.
4. Both transformers must be phased identically: L1 is always the transformer's black lead.
5. The optional "Water Temperature Switch" (WT) is also included in the optional "Low Temperature Package" (TL).

**Figure 7. 100% outside air unit with hot water preheat wiring diagram**






**LEGEND:**

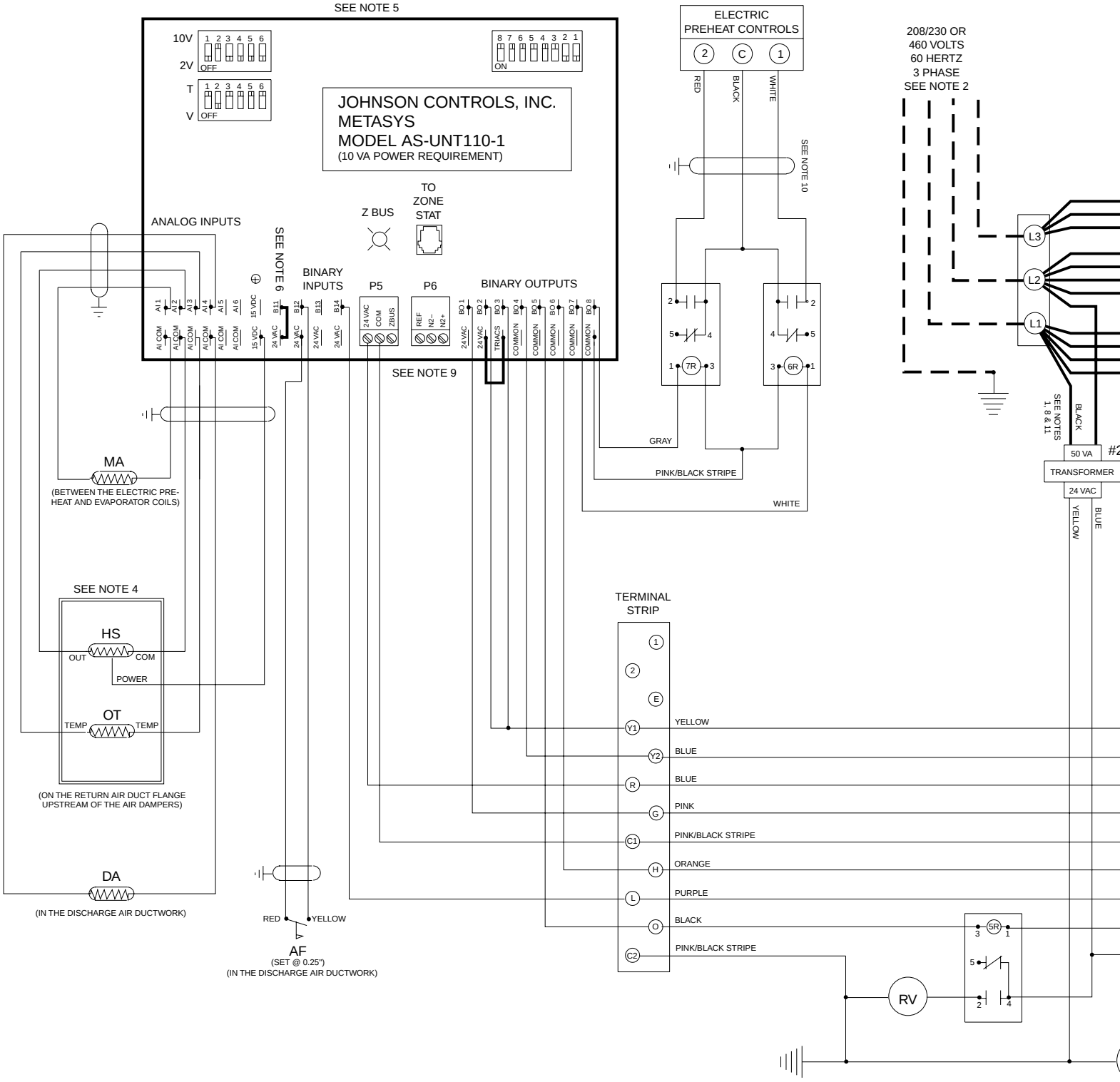
- Control Voltage Factory Wiring (24 VAC)
- Control Voltage Field Wiring (24 VAC)
- Line Voltage Factory Wiring
- Line Voltage Field Wiring
- Ground
- (1M) Compressor Contactor (Circuit #1)
- (2M) Compressor Contactor (Circuit #2)
- (3M) Blower Contactor
- (1R) Lockout Relay (Circuit #1)
- (2R) Lockout Relay (Circuit #2)
- (3R) Lockout Signal Relay
- (4R) Hot Gas Reheat Relay (Circuit #1)
- (5R) Cooling Relay (Circuit #2)
- (6R) Low Temperature Lockout Relay
- (7R) Dehumidification Lockout in Heating Mode Relay
- (HR) Hot Gas Reheat Valve (Circuit #1)
- (RV) 4-Way Reversing Valve (Circuit #2)

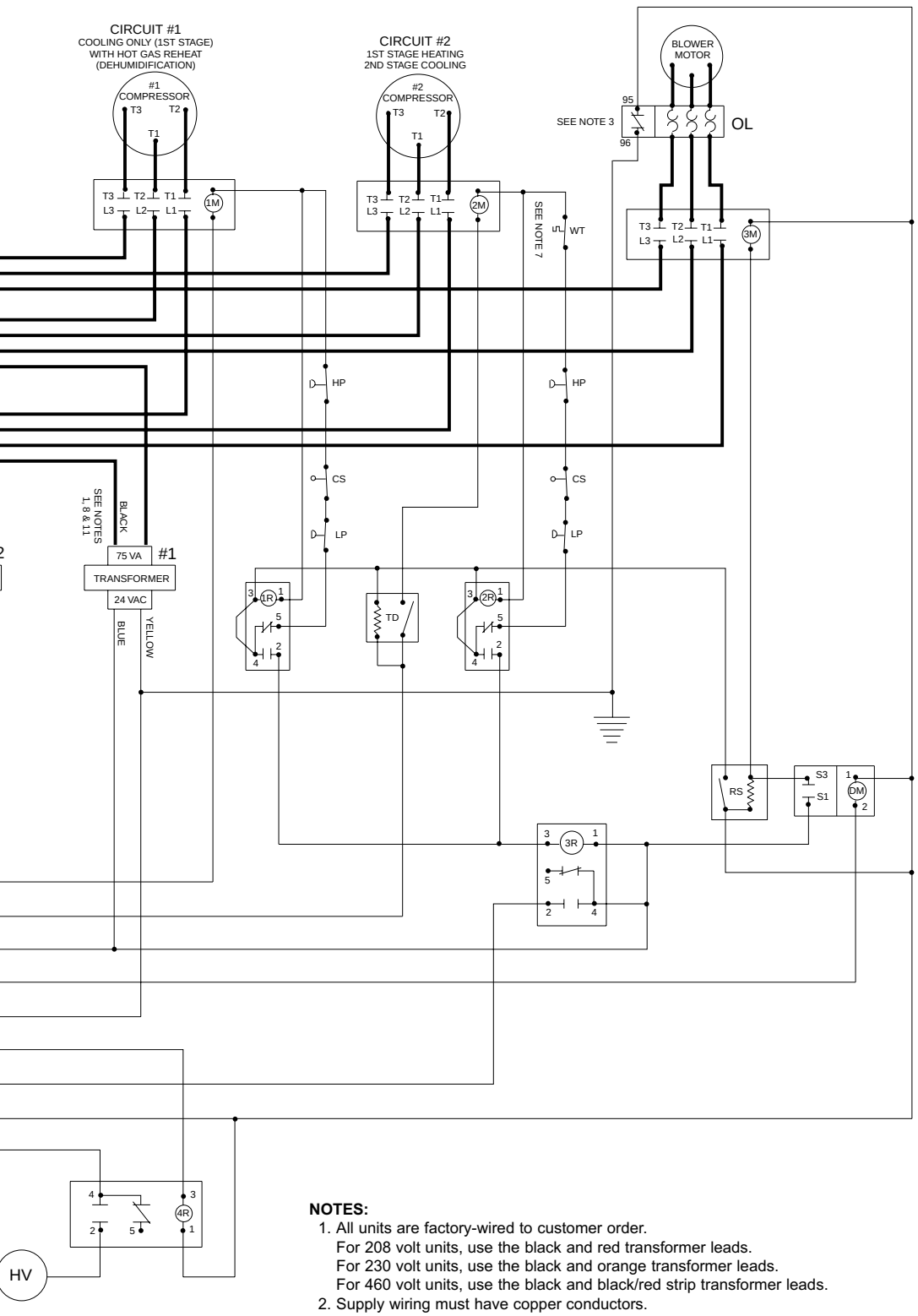
HP High Pressure Switch (400 psi)
LP Low Pressure Switch (7 psi)
CS Condensate Switch (Optional)
WT Water Temperature Switch (Optional)
RS Random Start Relay (25-60 Seconds)
TD Time Delay Relay (25-60 Seconds)
LTC Low Temperature Cutout
RPB Reset Push Button
ADT Adjustable Delay-on-Make Timer
DM Damper Motor
OL Overload (See Note 3)

**NOTES:**

1. All units are factory-wired to customer order.
   For 208 volt units, use the black and red transformer leads.
   For 230 volt units, use the black and orange transformer leads.
   For 460 volt units, use the black and black/red strip transformer leads.
2. Supply wiring must have copper conductors.
3. An external manual reset overload is used on all 5 HP through 20 HP blower motors. All other blower motors have internal auto reset overloads.
4. The optional “Water Temperature Switch” (WT) is also included in the optional “Low Temperature Package” (TL).
5. Both transformers must be phased identically: L1 is always the transformer’s black lead.
6. If “Low Temperature Cutout Switch” (P/N 71042410) is factory set at 33 F. Its bulb is positioned across the discharge side of the preheat coil.
7. Insulate all unused wire ends.

**Figure 8. 100% outside air unit with Johnson Metasys controls and electric preheat wiring diagram**






**LEGEND:**

- Control Voltage Factory Wiring (24 VAC)
- Control Voltage Field Wiring (24 VAC)
- Line Voltage Factory Wiring
- Line Voltage Field Wiring
- Ground
- (1M) Compressor Contactor (Circuit #1)
- (2M) Compressor Contactor (Circuit #2)
- (3M) Blower Contactor
- (1R) Lockout Relay (Circuit #1)
- (2R) Lockout Relay (Circuit #2)
- (3R) Lockout Signal Relay
- (4R) Hot Gas Reheat Relay (Circuit #1)
- (5R) Cooling Relay (Circuit #2)
- (6R) Stage #1 Electric Preheat Relay (PE)
- (7R) Stage #2 Electric Preheat Relay (PE)
- (HV) Hot-Gas Reheat Valve (Circuit #1)
- (RV) 4-Way Reversing Valve (Circuit #2)

| | |
|---|---|
| HP | High Pressure Switch (400 psi) |
| LP | Low Pressure Switch (7 psi) |
| CS | Condensate Switch (Optional) |
| WT | Water Temperature Switch (Optional) |
| RS | Random Start Relay (25-60 Seconds) |
| TD | Time Delay Relay (25-60 Seconds) |
| DM | Damper Motor |
| OL | Overload (See Note 3) |
| AF | Airflow Sensor |
| DA | Discharge Air Sensor |
| HS | Humidistat (See Note 4) |
| MA | Mixed Airflow |
| OT | Outdoor Thermostat (See Note 4) |

**NOTES:**

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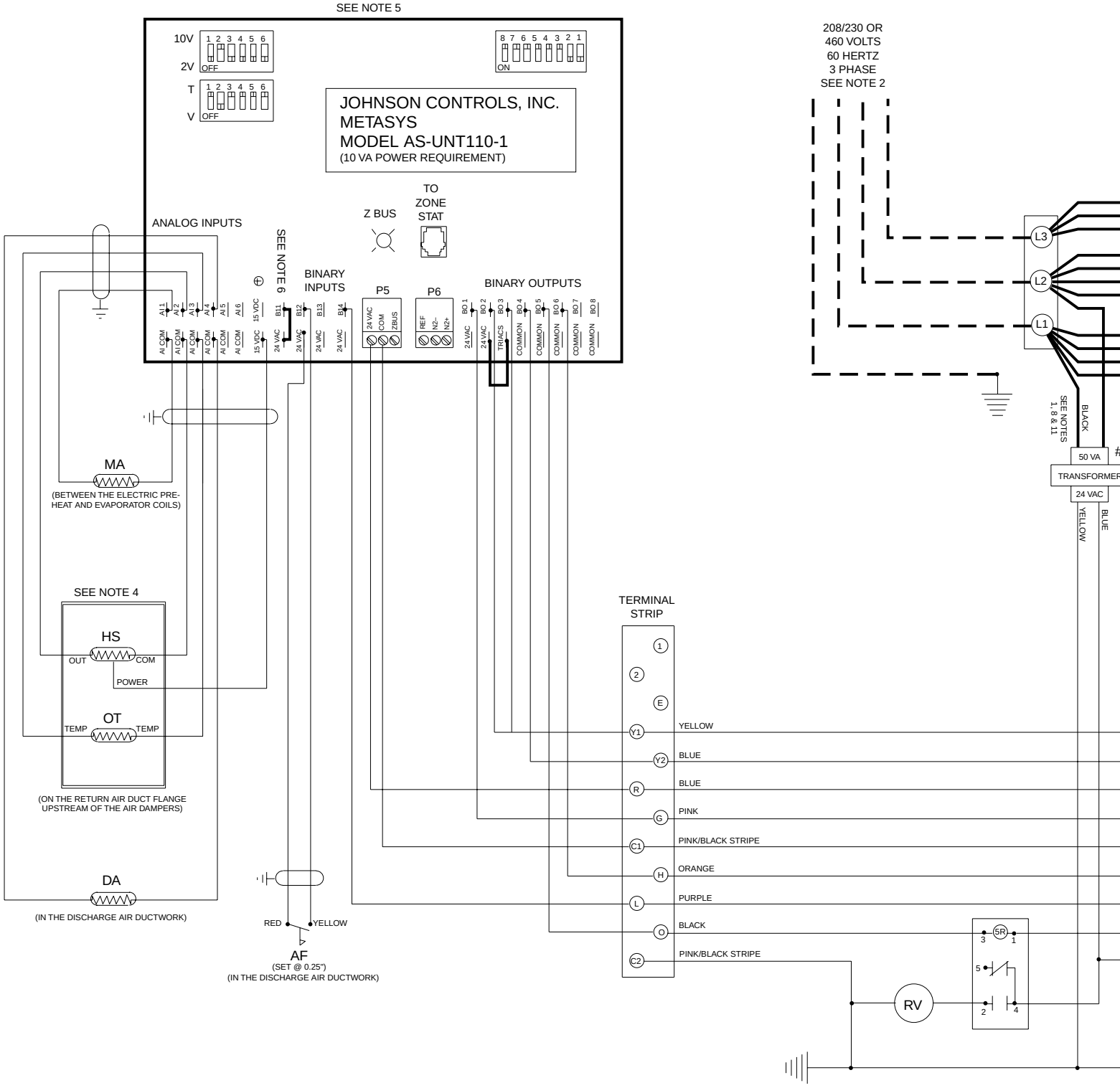
   For 208 volt units, use the black and red transformer leads.
   For 230 volt units, use the black and orange transformer leads.
   For 460 volt units, use the black and black/red strip transformer leads.
2. Supply wiring must have copper conductors.
3. An external manual reset overload is used on all 5 HP blower motors. All other blower motors have auto reset overloads.
4. Both the HS and OT sensors are contained within one device.
5. JCI Metasys UNT110-1 uses a factory installed program.
6. This factory wired jumper between terminals BI1 and 24 VAC indicates occupied status.
7. The optional “Water Temperature Switch” (WT) is also included in the optional “Low Temperature Package” (TL).
8. Both transformers must be phased identically: L1 is always the transformer’s black lead.
9. Johnson Controls, Inc. supplied jumper wire. Remove this jumper wire only if using a separate load transformer (by others).
10. The use of three-conductor shielded cable is required between relays 6R and 7R and the electric preheat control panel’s terminal block.
11. Insulate all unused wire ends.

**Figure 9. 100% outside air unit with Johnson Metasys controls and hot water preheat wiring diagram**

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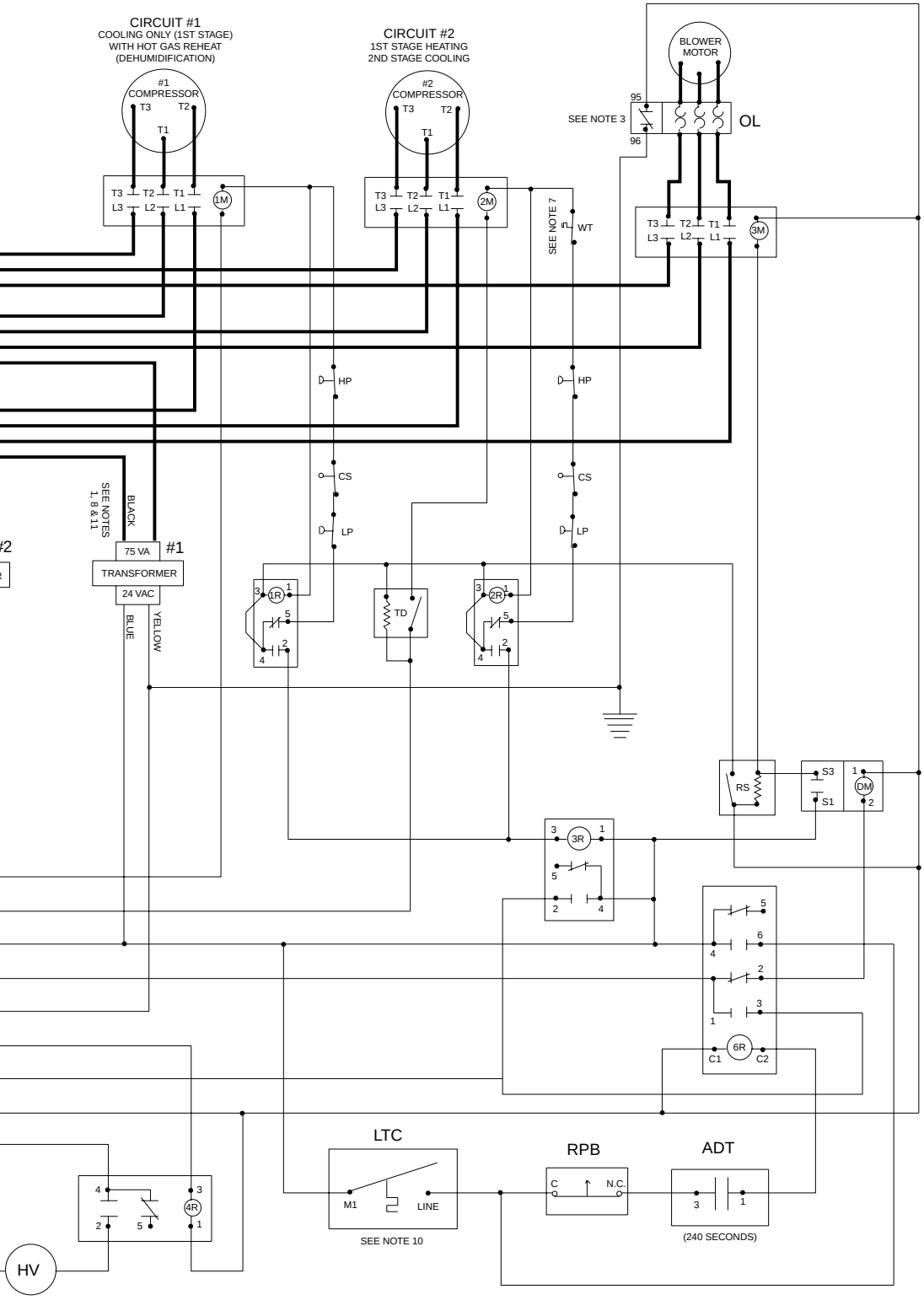
4. Both the HS and OT sensors are contained within one device.
5. JCI Metasys UNT110-1 uses a factory installed program.
6. This factory wired jumper between terminals BI1 and 24 VAC indicates occupied status.
7. The optional “Water Temperature Switch” (WT) is also included in the optional “Low Temperature Package” (TL).
8. Both transformers must be phased identically: L1 is always the transformer’s black lead.
9. Johnson Controls, Inc. supplied jumper wire. Remove this jumper wire only if using a separate load transformer (by others).
10. The “Low Temperature Cutout” switch (P/N 71042410) is factory set at 33 F. Its bulb is positioned across the discharge side of the preheat coil.
11. Insulate all unused wire ends.




**LEGEND:**

- Control Voltage Factory Wiring (24 VAC)
- Control Voltage Field Wiring (24 VAC)
- Line Voltage Factory Wiring
- Line Voltage Field Wiring
- Ground
- 1M Compressor Contactor (Circuit #1)
- 2M Compressor Contactor (Circuit #2)
- 3M Blower Contactor
- 1R Lockout Relay (Circuit #1)
- 2R Lockout Relay (Circuit #2)
- 3R Lockout Signal Relay
- 4R Hot Gas Reheat Relay (Circuit #1)
- 5R Cooling Relay (Circuit #2)
- 6R Low Temperature Lockout Relay
- 7R Stage #2 Electric Preheat Relay (PE)
- HV Hot-Gas Reheat Valve (Circuit #1)
- RV 4-Way Reversing Valve (Circuit #2)

HP High Pressure Switch (400 psi)
LP Low Pressure Switch (7 psi)
CS Condensate Switch (Optional)
WT Water Temperature Switch (Optional)
RS Random Start Relay (25-60 Seconds)
TD Time Delay Relay (25-60 Seconds)
DM Damper Motor
OL Overload (See Note 3)
AF Airflow Sensor
DA Discharge Air Sensor
HS Humidistat (See Note 4)
MA Mixed Air Sensor
OT Outdoor Thermostat (See Note 4)
LTC Low Temperature Cutout
ADT Adjustable Delay-on-Make Timer

# Optional temperature control

Mammoth's 100% Outdoor Air heat pump units offer three choices of temperature control:

1. An optional Mammoth DDC control system for complete unit control. Wiring diagrams and startup information for the MDDC controller is not provided in this document. Each MDCC controller has an individual Installation and Operation Manual created for it. Contact Mammoth for more details.
2. A Johnson Metasys DDC controller that can be used as a stand-alone controller or with a Johnson Metasys BMS.

   Several typical wiring diagrams have been provided for this option (Figure 8 and Figure 9). Startup information for the Johnson Metasys controller is provided on page 15.
3. Temperature control by others which includes a 24-volt terminal strip for connection of a controller to operate the compressors, fan motor, reversing valve and reheat valve.

   Several typical wiring diagrams have been provided for this option (Figure 6 and Figure 7). Consult the factory for a specific diagram. Startup for controls by others is not provided in this document. It is not common but it is possible to operate a 100% OA unit using a thermostat with humidity control (by others). Startup instructions are provided on page 15.

# Sequence of operation Johnson Metasys

The Metasys control system is can be tied in to a Metasys Building Automation System or it can be an independent, stand-alone control system. The system includes:

- Outdoor air temperature sensor
- Mixed air temperature sensor
- Outdoor air humidity sensor
- Discharge air temperature sensor
- Cooling control from outdoor air and humidity sensors
- Heating control from discharge air sensor
- Reheat control for discharge air
- Neutral discharge air temperature
- Fan operation from damper end switch
- Adjustable temperature/humidity set points
- Adjustable differential for heating, cooling
- Spring return outdoor damper actuator with end switch
- Air proving switch
- Optional Zone Terminal for field modification of set points on stand-alone controls.

On a call for unit operation, the outdoor air damper will open. The controller will first examine the mixed air temperature. If the outdoor air is below the set point of the mixed air sensor, the preheat will be energized to increase the air temperature. When the damper is fully open, the fan will run continuously.

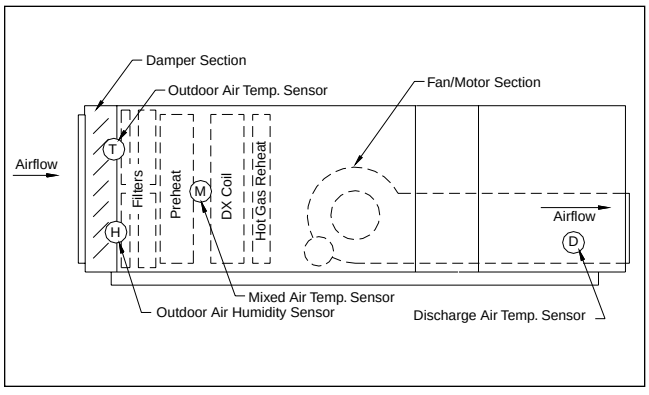
After the need for preheat is examined, the controller then looks at the need for compressor cooling. If the outdoor air is above the first stage cooling set point, then the first stage compressor will operate in the cooling mode. If the outdoor air humidity is above the set point, the controller will energize stage one cooling operation. On a further increase in outdoor temperature, the second stage-cooling compressor will be energized.

If the discharge air temperature is below the set point (55 F and adjustable), the hot gas reheat valve will be activated to provide hot refrigerant gas to the reheat coil to increase the discharge air temperature. If the discharge air temperature rises above the set point of the discharge air temperature, the hot gas reheat valve will be de-activated. If the outdoor air temperature falls below the second stage cooling control set point, the second stage cooling will be de-activated.

If the outdoor air humidity falls below the outdoor air humidity set point, first stage cooling will remain on until the outdoor air temperature is below the first stage cooling set point. The first stage cooling will remain on until the outdoor air humidity and temperature are below their set points.

If the outdoor air temperature falls below the first stage heating set point, the compressor will operate in the heating mode. If the mixed air temperature falls below the preheat set point (40 F and adjustable), the optional preheat coil will be activated to provide heating. If the mixed air temperature rises above the set point, the preheat will be de-activated. If the discharge temperature rises above the set point, the compressor heating will be de-activated.

**Figure 10. Metasys control points and unit schematic**



# Operation

**Startup using Mammoth DDC controls**

Consult the factory for specific instructions for your unit.

**Startup with factory-mounted Johnson Metasys controls**

1. Turn power on.
2. The green light on the Johnson Metasys UNT DDC controller should blink.
3. The outside air damper will open.
4. When the damper has opened 60-75%, the fan will start.
5. Unit will operate according to the mixed air temperature. If the mixed air temperature is above the set point of the controller, the unit will cool. If the outdoor air temperature is below the set point of the controller, the unit will heat. Only the fan will run if the mixed air is in the dead band of the set points.
6. Plug the ZT (Zone Terminal) into the UNT controller using the supplied phone cord. The inputs listed on the left side of the ZT can be monitored. The binary outputs are listed on the right side of the ZT. A hash mark indicates a call for that particular output to operate. Zone Terminal controller is available as Mammoth part number 73399930.
7. The adjustable set points are: *Occupied Cooling, Occupied Heating, Unoccupied Cooling* and *Unoccupied Heating*. To adjust the set point, open the access cover on the bottom of the ZT and push the button to the left of the four LEDs (Monitor, Adjust, Time Schedule and Password) until the adjust LED is lit. Adjust the set point up or down within the program limitations using the up and down arrows. Your set point will appear next to the Actual Clg Set and Actual Htg Set.
8. While the unit is operating in the cooling mode with both compressors, adjust the water flow to obtain a 12 F temperature rise in the leaving water temperature as compared to the entering water temperature.

   **Note:** *Set point adjustment in #7 above may be required to get both compressors on.*
9. Check for clean filters. Replace if necessary.
10. The unit is ready for continuous operation.

**Note:** *Minimum dry bulb temperature drop between supply and return airstreams should be about 16 F. a water temperature rise of 12-25 F could be anticipated at relatively low water flow rates.*

**Startup using thermostat**

A special thermostat (supplied by others) will be required for humidity control.

After installing the unit, connecting ductwork water, condensate lines and the wiring as described in the preceding instructions, the unit is ready for startup. Check all wire connections in the unit and to the external control devices

Make certain that the thermostat system switch is in the “OFF” position and the fan switch is in the “AUTO” position. Also, the electric box cover and access panels should be mounted in place. Then turn on the power to the unit.

Turn the thermostat fan switch to the “ON” position. The unit blower should operate.

**Note:** *Unit may not start for 2-5 minutes due to usage of random start relays and/or anti-short cycle relays.*

1. Check the airflow and make sure no supply grilles or duct dampers are closed to restrict airflow.
2. Set the thermostat temperature setting low and turn the system switch to the heating mode.
3. Increase the temperature setting low and turn the system switch to the heating mode.
4. After operating the unit for approximately ten minutes, check the air temperature rise between supply and return airstreams. The minimum temperature rise should be about 18 F.
5. Using a surface pyrometer or other device, check the temperature of the entering and leaving water temperatures at the unit. The recommended water temperature drop between entering and leaving water may range from 5 to 9 F at 45 F entering water temperature (ENT) and from 8 to 15 F at 70 F EWT.

If any of the above conditions do not exist, one or more of the following problems exist: low airflow, low water flow or unit not performing properly (contact service department for assistance.

Next set the thermostat system switch to cooling mode and reduce temperature setting gradually until unit starts. After operating the unit for a few minutes, check if unit is functioning properly and providing satisfactory cooling.

**Note:** *Minimum dry bulb drop between supply and return airstreams should be about 16 F. A water temperature rise of 12 to 25 F could be anticipated at relatively low water flow rates.*

# Maintenance

Mammoth 100% Outside Air units may require more frequent maintenance than standard water source heat pumps.

**Air filters**
Do not operate the heat pump unit without an air filter. Clean the filters as often as necessary or at least once every three months and more frequently in dusty or other unclean environments.

**Note**: *Dirty filters will cause inefficient heat pump performance.*

**Air coil and blower wheel**
Check the air coil and blower wheel at least once each year. More frequent cleaning of blower and heat transfer surfaces may be required in locations with dirty air to maintain airflow and peak operating performance. Clean as often as necessary.

**Caution:** *Disconnect electric power supply to heat pump before removing cabinet access panels.*

**Compressor**
The 100% Outdoor Air heat pumps have been designed with switches that protect the unit's refrigerant system if refrigerant pressure exceeds either high or low limits. If unsuitable pressure occurs, the compressors will automatically shut down. (Some thermostats will indicate a compressor shutdown with a "reset" light.)

If the compressor shuts down, turn the controller system switch to the "OFF" position. After approximately 10 minutes turn the controller system switch to "ON" and restart the unit. If the compressor shuts down again after only brief operation, a problem exists and qualified service personnel must be called to provide service.

**General service**
Any repair or service on the unit may be performed only by qualified service personnel.

**Warranty**
Mammoth's Standard Limited Warranty on all Water Source Heat Pumps will be in effect for the first 12 months after startup or 18 months from actual shipment if no startup date is provided. Extended warranties are also available for an additional charge.

**Parts**
Parts can be ordered from:

Mammoth Inc.
101 West 82nd Street
Chaska, MN 55318
Phone: (952) 361-2711
Fax: (952) 361-2629

# Guidelines for refrigerant circuit diagnosis

**Normal Conditions**

| | |
|---|---|
| Subcooling: | 10 to 12 F |
| Superheat: | 8 to 12 F |
| Discharge: | 140 to 150 F |
| Head Pressure: | 210# |
| Suction Pressure: | 70# |
| Evap. Temperature: | 38 to 55 F, or 10-20 F below leaving air temperature |

**Over-Charged Unit**

| | |
|---|---|
| Subcooling: | 20 to 25 F |
| Superheat: | 8 to 12 F |
| Discharge: | 120 to 130 F |
| Head Pressure: | 220# or higher than normal |
| Suction Pressure: | 80# or higher than normal |

**Under-Charged Unit**

| | |
|---|---|
| Subcooling: | 6 to 8 F or lower than normal |
| Superheat: | 25 to 30 F or higher than normal |
| Discharge: | Over 200 F |
| Head Pressure: | 180# or lower than normal |
| Suction Pressure: | 25# if lost a lot of refrigerant |
| Other: | Lower than normal evaporative temperature |

**Plugged Thermal Expansion Valve**

| | |
|---|---|
| Subcooling: | 15 to 20 F or higher than normal |
| Superheat: | 25 to 30 F or higher than normal |
| Discharge: | +200 F or warmer than normal |
| Head Pressure: | 250# or higher than normal |
| Suction Pressure: | 45# or lower than normal |
| Other: | May have frost on air coil<br>May have high leaving air temperature<br>The air coil may not be wet |

**Low Evaporator Temperature**

- Undercharged.
- Poor refrigerant distribution.
- Low airflow (clogged filter or air coil).
- Excess oil in refrigerant air bypassing the coil.
- Damaged fins on the coil or poor fin-to-tube bond.

**Subcooling in Cooling Mode**

- Subcooled refrigerant is found after the coax and before the TXV.
- The liquid line is almost always subcooled.
- The liquid line should be several degrees colder than the leaving water temperature.
- Superheated refrigerant is found after the air coil and before the compressor.
- Superheated refrigerant is found after the compressor and before the coax.

**High Suction Superheat**

- Under-charged refrigerant circuit.
- Poorly adjusted TXV — open it.
- Plugged TXV.
- High entering air temp in the cooling mode.
  Poorly insulated suction line.

**Low Suction Superheat**

- Over-charged refrigerant circuit.
- Poorly adjusted TXV — close it.
- Low entering air temp in the cooling mode.
- Low airflow in the cooling mode.

**Discharge Superheat**

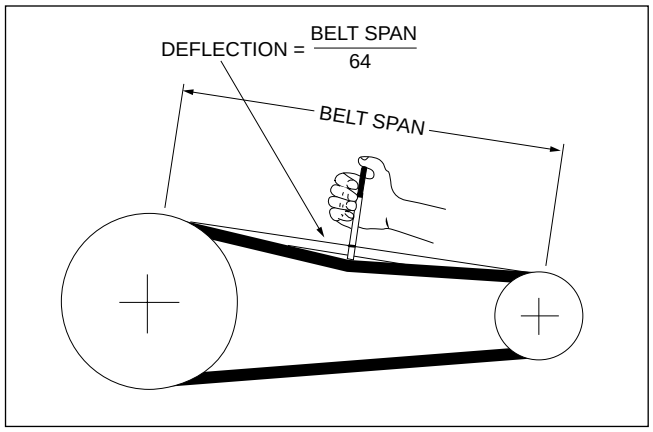
- High discharge superheat:
  High suction superheat
  Compressor lubrication problems
  Compressor electrical problems
- Low discharge superheat:
  Low suction superheat
  Flooding-back

# Procedure for belt tensioning

### Instructions

Set tension of new drives at the maximum deflection force recommended. Check tension at least twice during the first day of operation, since there will normally be a rapid decrease in belt tension until belts have run in. Check tension periodically after the first day of operation and keep tension in recommended range. The correct operating tension for a V-belt drive is the lowest tension at which the belts will not slip under peak load conditions. Shafts must be adequate for the tensions required.

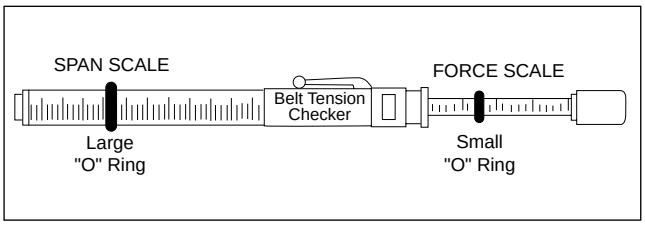
**Figure 11. Belt deflection**




To determine lbs. force required to tension a drive with belt tensioner, do the following:

1. Measure belt span as shown (Figure 11).
2. Divide belt span by 64 to get belt deflection.
3. Set large “O” ring on “span scale” at required belt deflection. This scale is in 1/16 inch (1.6 mm) increments.
4. Set small “O” ring at zero on “force scale” (plunger).
5. Place larger end of tension tool squarely on one belt at center of belt span. Apply force on plunger until the bottom of the large “O” ring is even with the top of the next belt or with the bottom of a straightedge laid across the sheaves.

**Figure 12.**




6. Read force scale under the small “O” ring to determine the force required to give the needed deflection
7. Compare the force scale reading with the correct value for the belt style and cross section used as given in Table 1. The force should be between the minimum and maximum values shown.
8. If there is too little deflection force, tighten belts. If there is too much deflection force, loosen belts.

### Example

1. Belt span is 64 inches (152 cm). Small sleeve has a 6-inch (152 mm) pitch diameter with “B” Super Gripbelts.
2. Sixty-four inch ÷ 64 = 1 inch (25 mm) deflection needed.
3. Set large “O” ring at 1 inch (25 mm) on span scale.
4. Set small “O” ring at zero plunger.
5. Press down on plunger until bottom of large “O” ring is even with top of next belt in set, or with bottom of a straightedge.
6. Check lbs. force required for a 1-inch (25 mm) deflection of belt.
7. Super Gripbelt table (below) shows a “B” belt used with 6-inch (152 mm) pitch diameter. Small sheave should have a deflection force between 6 lbs. 6 oz. (2.89 kg) and 8 lbs. 8 oz. (3.97 kg).
8. Increase or decrease tension on belts until deflection force lies in the required range.

**Table 1. Super Gripbelts**

| BELT CROSS SECTION | SMALLEST SHEAVE | RPM | DEFLECTION FORCE (LBS.) | | | |
|---|---|---|---|---|---|---|
| | | | SUPER GRIPBELTS UNNOTCHED BRANDS | | GRIPNOTCH BELTS NOTCHED BRANDS | |
| B, BX | 4.4 – 5.6 | 860 – 2500 | 5.3 | 7.9 | 7.1 | 10.5 |
| | | 2501 – 4000 | 4.5 | 6.7 | 7.1 | 9.1 |
| | 5.5 – 8.6 | 860 – 2501 | 6.3 | 9.4 | 8.5 | 12.6 |
| | | 2501 – 4001 | 6.0 | 8.9 | 7.3 | 11.9 |

# Heat pump check-out sheet _____

Job Name _____ Date _____

Address _____

_____

Phone _____ Unit No. _____

## Nameplate Data

Make _____

Model _____ Serial No. _____

R-22 Factory Charge_____oz.

Compressor RLA _____ LRA _____ Blower FLA _____

Maximum Current Rating of Supply Circuit _____amps

Minimum Circuit Activity_____amps

Branch Circuit Selection Current_____amps

## Running Conditions

| | HEAT | COOL | | HEAT | COOL | |
|---|---|---|---|---|---|---|
| Entering Air | _____F | _____F | Leaving Air | _____F | _____F | _____cfm |
| Entering Water | _____F | _____F | Leaving Water | _____F | _____F | _____GPM |
| Discharge | _____PSI | _____PSI | Suction | _____PSI | _____PSI | |
| Discharge | _____F | _____F | Suction | _____ F | _____F | |
| Blower | _____amps | _____amps | Superheat | _____ F | _____F | |
| Compressor | _____ F | _____F | | | | |

## Auxiliary Heat

Make _____ Model _____

Serial No. _____ Maximum Fuse _____amps

Entering Air_____F Leaving Air_____F

Comments _____

_____

_____

_____

**Form HP/COS-02** SAVE THIS FORM FOR MAINTENANCE REFERENCE

**Mammoth Inc.**

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