



# VERTICAL AHU INSTALLATION MANUAL

BULLETIN 30-015

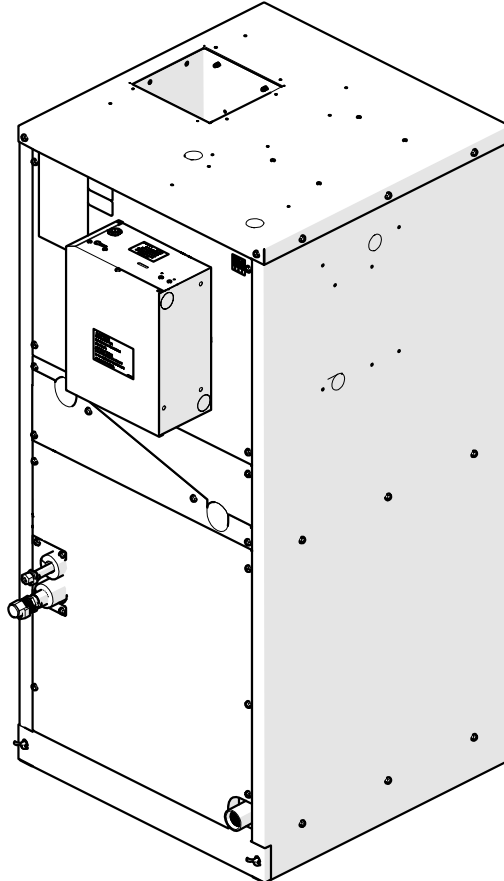


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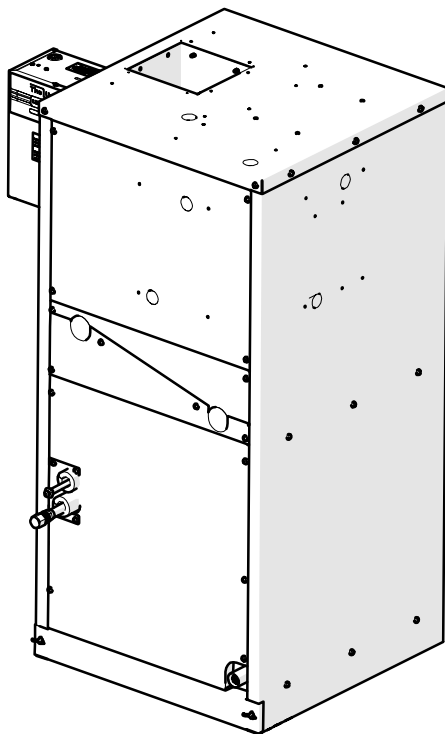
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Certified to UL Standard 1995  
Conforms to CAN/CSA Standard C22.2 NO. 236

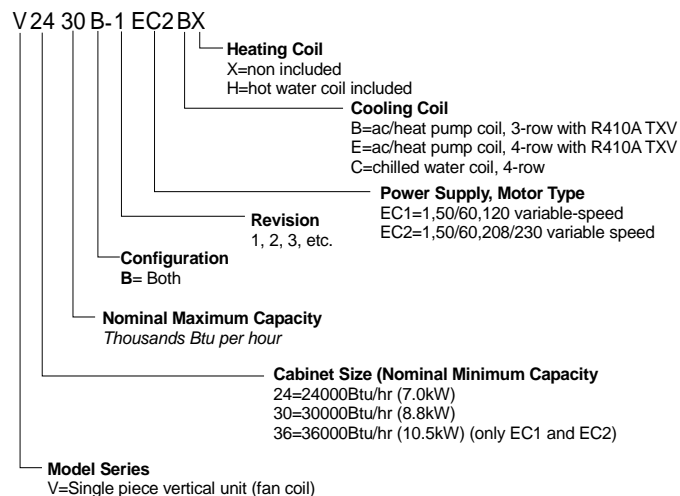


Unico products comply with the European regulations that guarantee product safety.

# Installation Specifications



## Model Number Key



## INTRODUCTION

**General.** The information on the following pages is to help the installer save time, provide the best possible installation and insure continuous trouble-free operation.

**Scope.** These instructions apply to the Unico V2430/3036/3642 Vertical Air Handler Unit. The Unico vertical air handler unit (V-AHU) is a single packaged unit. The cooling and heating coils are contained within the same cabinet. The unit is mounted in a vertical up-flow configuration. The coils can be combined as a heating-only, cooling-only, or heating and cooling fan coil unit (see Figure 1). The vertical unit is available in three sizes: 2430, 3036, and 3642. The heating only system includes the blower/motor and a hot water coil. The cooling only system includes the blower/motor and a cooling coil. For the heating and cooling system both coils are provided. The cooling coil is a heat pump coil (B-Style or E-Style) or chilled water coil.

All *Unico System* Vertical air handlers feature closed-cell insulation for improved sound attenuation.

The Unico System is a complete indoor comfort system that includes an indoor fan coil unit and small duct system. The fan coil unit and duct system are designed to operate together to provide the proper

airflow in every installation. The conditioned air is supplied through a series of two-inch diameter ducts as a stream of air that entrains and mixes with the room air. This process of aspiration produces a more even temperature distribution in the room than a conventional air system.

Installation instructions for the air distribution system are covered in other bulletins. Before beginning any installation, a detailed system layout must be done in accordance with *Bulletin 40-40 System Sizing and Layout bulletin*.

## SUFFICIENT BUILDING INSULATION IS ESSENTIAL FOR THE MOST ECONOMICAL OPERATION

**General Precautions and Safety Tips** Do not attempt to install or startup unit without first reading and understanding the appropriate sections in this manual. Before operating, be sure the unit is properly grounded.

- Installation should be in accordance with all local codes and regulations and with the National Fire Protection Association and Underwriters Laboratories applicable standards and regulations. In case of conflict, local codes take precedence.

- All electrical wiring should be in accordance with the latest edition of the National Electrical Code and all local codes and regulations.
- Condensate piping should be installed in accordance with governing code.
- Always install a secondary drain pan when an overflow of condensate could cause damage.

### Options.

An electric duct heater is another option that is available to add additional features or to simplify installation. Please refer to the latest Unico Catalog for information on this and other options.

### Temperature Limitations

The fan coil unit will operate properly under normal air conditioning and heating temperature conditions. However, there is a possibility that ice could form inside the unit under unusual conditions.

For refrigerant systems, the anti-frost switch provides some protection against frosting. It is not complete protection however. To prevent coil frosting, avoid low return air temperature below 65°F, low airflow below 200 CFM/nominal ton, low outdoor temperatures below 65°F, and especially all of these together.

Special care must be made when using water coils. The hot water coil is affected by the refrigerant coil so it is very important to verify that the air temperature leaving the refrigerant coil is always greater than 32°F. If not, or if unsure, install an averaging air temperature thermostat (Honeywell Part Number T675A1425) on the front of the hot water coil to automatically shut down the system should the air entering the hot water coil fall below 35°F. The same must be done if bringing in fresh outside air that could be below freezing.

### WARNING!

**LIMIT EWT OF HW COIL TO  
150°F-155°F (65°C-68°C)**

For chilled water coils, if the unit will be installed in an area that has temperatures below freezing, then the water must be protected from freezing. The most common anti-freeze is propylene glycol or ethylene glycol mixed with water. Propylene glycol is non-toxic and must be used for food-service installation. Ethylene glycol is toxic. We recommend using corrosion inhibited glycol such as DowFrost® or DowTherm® (trademark of Dow Chemical) to increase coil life. When using propylene glycol, the coil can safely operate and survive at temperatures above the values shown in Table 1. If you use corrosion inhibited glycol, the freezing point will be a 2°F (1°C) warmer.

**Table 1. Temperature Values for Propylene Glycol**

Minimum amount (% vol) of glycol required for freeze protection.			
Lowest Expected Outdoor Temperature		Propylene Glycol†	Ethylene Glycol‡
°F	(°C)		
26	-3	11	10
20	-7	18	17
10	-12	29	27
0	-18	36	35
-10	-23	42	41
-20	-29	46	47
-30	-34	50	51
-40	-40	54	55
-50	-46	57	59
-60	-51	60	63

† Dow Chemical DOWFROST inhibited propylene glycol bulletin 180-01314-1101

‡ Dow Chemical DOWTHERM SR-1 inhibited ethylene glycol bulletin 180-01312-602

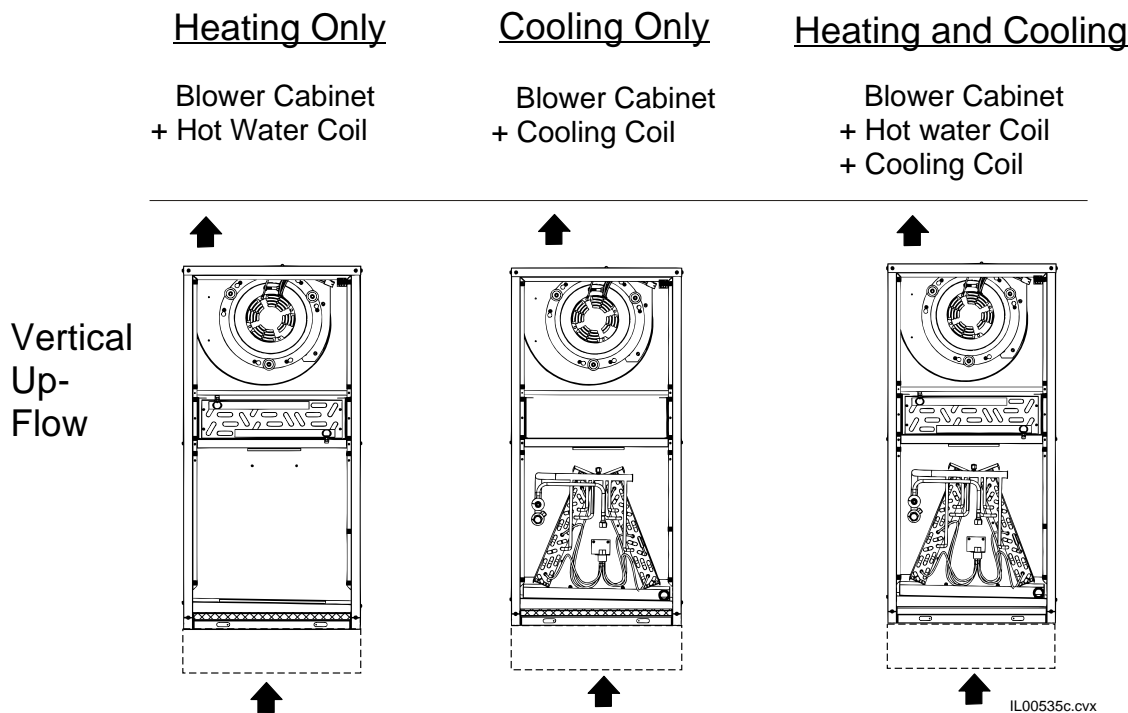
### Unpacking

All units are inspected prior to shipping and are carefully packaged in individual cartons. Inspect all cartons prior to unpacking. Notify carrier of any damage.

Lift up carton over the unit to reveal the unit. Inspect unit for visible signs of concealed damage and notify carrier of any such damage. All materials are sold FOB Factory and it is the responsibility of the consignee to file any claims with the delivering carrier for materials received in a damaged condition. Remove the control box from its carton sent inside the Vertical AHU carton. The expansion valve is shipped loose and is located in a separate Spare Parts box shipped inside the packaging.

## MOUNTING

There is no assembly or mounting required. The unit comes factory ready for vertical airflow applications (see Figure 1). The unit should be placed on a field fabricated plenum or directly on the floor if the floor has a return opening



**Figure 1. Unit Arrangement**

## LOCATION

Locate the air handler to minimize the number of plenum elbows and fittings while keeping the supply duct runs as short as possible. (See *Bulletin 40-30, Component Layout*). The fully insulated cabinet allows installation with zero clearance to the top, bottom, or sides of the unit. However, clearance must be provided for servicing. All components are accessible from the front. Provide a minimum of 26 inches (660 mm) in the front. Servicing of the blower/motor assembly and coils can be performed by removing the access panels located in the front.

Each unit is designed to fit into a closet, basement or utility room (see Figure 2). The unit dimensions are shown in Table 3.

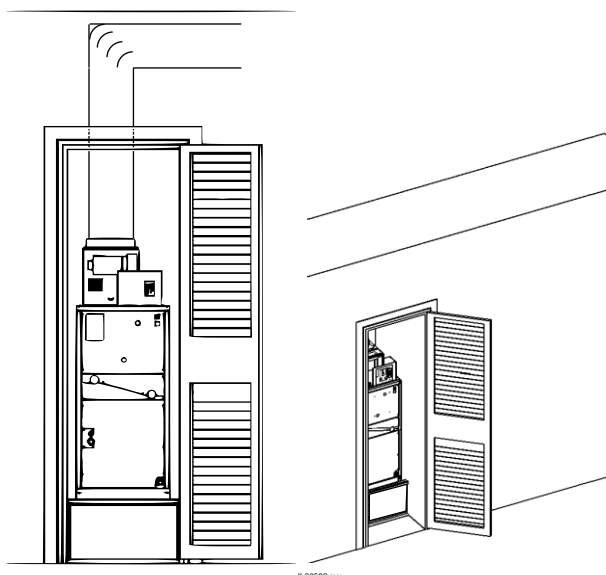
The airflow enters the bottom of the unit so either set the unit on the floor with a cutout to allow air from underneath, or set the unit on a plenum base (not provided by Unico).

**Table 2. Secondary Drain Pan (field supplied)**

Unit Size	Part No.	Dimensions inches (mm)
V2430	N/A	22 x 22 (560 x 560)
V3036	N/A	22 x 26 (560 x 660)
V3642	N/A	26 x 27 (660 x 690)

**Table 3. Unit Dimensions**

Unit Size	H	W	D
V2430	42 (1067)	20 (508)	20 (508)
V3036	42 (1067)	20 (508)	24 (610)
V3642	44 (1118)	23.75 (603)	25 (635)



**Figure 2. Typical closed installation with 'Wild' return**

### Secondary Drain Pan

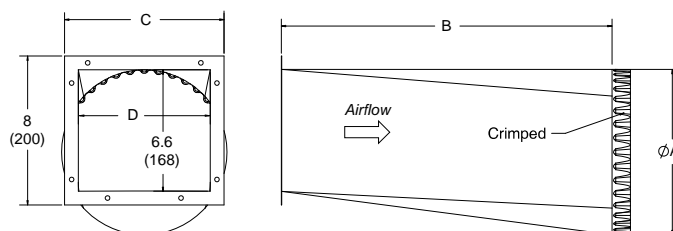
Where an overflow of condensate could cause water damage, a secondary drain pan **MUST BE INSTALLED**. Place the drain pan under the entire unit, including any plenum base that may be installed. Be sure to allow enough room for the drain line and connection (refer to Table 1). The unit should be placed over the secondary drain pan. Use rubber pads for isolation to raise the unit high enough in the secondary drain pan for the drain line to clear the side.

## DUCT CONNECTION

### Supply Plenum

The unit must have a plenum attached to the blower discharge. The plenum can be most any type of duct, provided it is the correct size and is insulated. The EC motor is variable speed so no restrictor plate is required. The supply duct attaches to the air handler with a supply adapter (sold separately). There are two adapters: one for square plenum and one for round. These are listed in the table below. The electric furnace, if used, includes its own supply adapter. Refer to the electric furnace installation manual for more information.

The adapter for round supply duct is a crimped metal duct transition as shown in Figure 3.



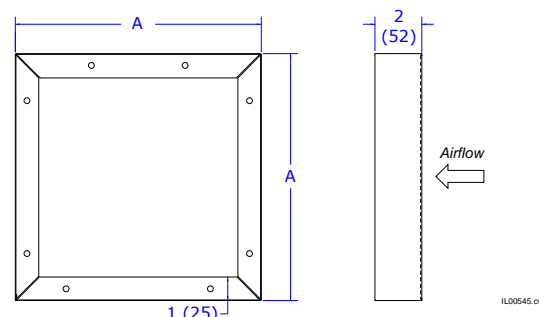
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Model	Part No.	A	B	C	D
V2430	UPC-61-2430	7 (178)	12 (300)	7.5 (190)	6.0 (152)
V3036	UPC-61-3036	9 (228)	18 (450)	8.5 (215)	7.2 (183)
V3642	UPC-61-3642	9 (228)	18 (450)	8.5 (215)	7.2 (183)

Note: UPC-61-3036 and UPC-61-3642 are identical.

**Figure 3. Supply plenum adapter, round metal duct**

The square adapter is typically used with fiberglass ductboard but can be used with any square duct. The standard square adapter is designed for 1-inch (25 mm) thick ductboard. Use the R6 adapter if using 1.5 inch (38 mm) thick ductboard. The ductboard plenum should be made to fit snugly inside the adapter. See Figure 4 for standard sizes for the square adapter.



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Model	Part No.	A	Part No. (R-6)	A
V2430	UPC-62-2430	8.5 (216)	UPC-62R6-2430	9.5 (241)
V3036	UPC-62-3036	10.5 (267)	UPC-62R6-3036	11.5 (292)
V3642	UPC-62-3642	10.5 (267)	UPC-62R6-3642	11.5 (292)

Note: UPC-62-3036 and UPC-62-3642 are identical.

**Figure 4. Supply plenum adapter, square duct**

To attach the plenum adapter to the unit, align the holes on the adapter with the holes located around the supply outlet on the unit. Mount the adapter with eight (8) sheet metal screws.

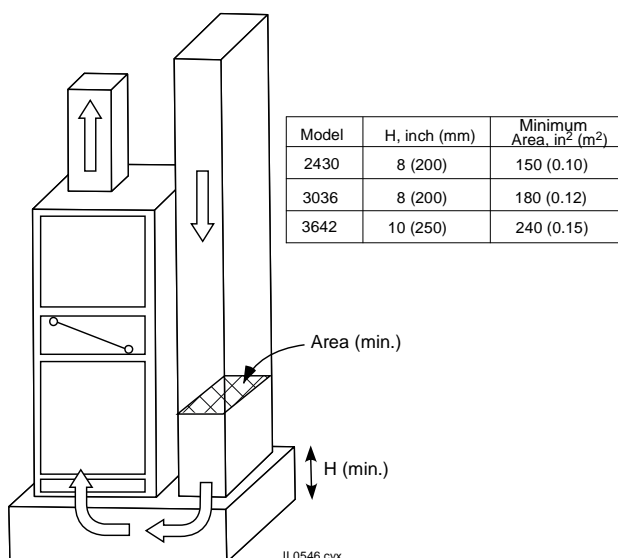
For metal duct, attach the plenum to the adapter by inserting it over the collar. Use three (3) or four (4) equally spaced sheet metal screws to secure the duct to the collar and then tape around the seam with UL 181A aluminum tape. Then wrap the 1-in fiberglass blanket duct insulation around the adapter and seal with UL 181A aluminum tape.

Other size plenum may be used provided it is similar in cross-sectional area. Refer to the design manual for alternate sizes.

## Return Duct

The Unico return air system typically has a single return that includes the return air box with filter, the acoustical flex return duct, and the return air adapter. Multiple returns or extra-long returns are possible so long as the maximum pressure loss is not exceeded. The return system is designed for a maximum static pressure drop of 0.15 inches of water (37 Pa) including the filter. The return duct should have at least one 90 degree bend between the unit and filter box to reduce sound transmission directly from the unit.

The return air must always enter the unit from the bottom. Set the unit on a field fabricated duct (Figure 5) or use a field supplied plenum base. If using a duct, be sure that the inside of the duct is insulated with acoustical insulation (typically duct liner). The minimum height of the plenum duct is shown in figure 5.



**Figure 5. Minimum duct return**

Although Unico only supplies a single return system, the return system can be redesigned for multiple returns. The return duct system is not high velocity. Therefore, the return system static pressure should not exceed 0.15 inches of water column. Generally, this means sizing the duct for a pressure loss of 0.05 inches of water column at the required airflow and sizing the filter for a pressure drop of 0.10 inches of water column at the required airflow.

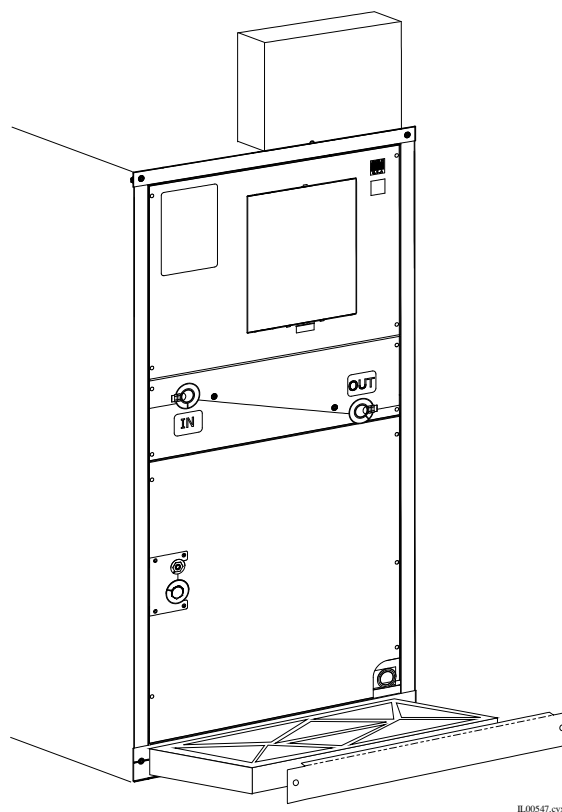
It should also have some form of sound attenuation. Sound attenuation can be accomplished with fabricated duct board, lined sheet metal, or acoustical flex. For best attenuation, always have at least one 90 degree bend to eliminate direct line-of-site from the unit to the return opening.

## AIR FILTRATION

The unit includes a 1 inch (25 mm) thick pleated filter (Table 3). You can remove this filter (Figure 6) and replace it with a 2" filter or install another filter elsewhere in the system.

**Table 3. Unit Filter Size, 1 inch (25 mm)**

Model	Filter Part No.	Dimensions, inch (mm)
2430	A00558-005	18 x 18 (457 x 457)
3036	A00558-008	18 x 22 (457 x 559)
3642	A00558-009	21 x 22 (533 x 584)

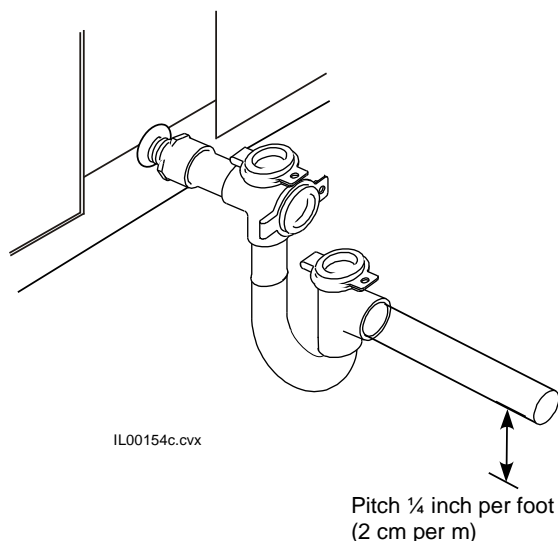


**Figure 6 Air Filter Removal**

## PIPING

All piping must be in accordance with all local codes and ordinances.

### Condensate Lines



**Figure 7. Typical Condensate Trap**

The primary drain pan condensate connection is a 3/4 inch (19 mm) female pipe thread fitting. Elevate the unit so the condensate lines are pitched at least 1/4 inch per lineal foot (20 mm per meter). Trap the condensate line near the unit as shown in Figure 7.

The Vertical AHU includes a condensate U-Trap which features a clear trap that is easy to visually inspect for clogs. The U-Trap is designed for the *Unico System* with a 2.5 inch (64mm) deep trap to handle the higher static pressures. The U-Traps have easy to remove clean-out caps and incorporate tees to accommodate any piping arrangement (Part No. A00924-G05).

## Refrigerant Connections

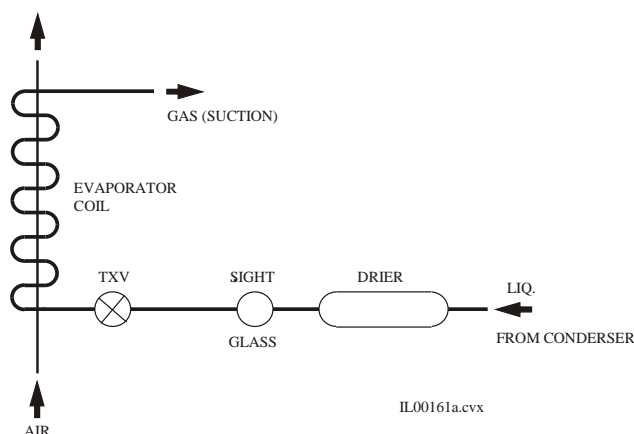
**CAUTION: WHEN BRAZING, PURGE WITH NITROGEN GAS TO PREVENT THE FORMATION OF OXIDES.**

The refrigerant lines are copper flare connections. The sizes are shown in Table 4. Refer to the condensing unit manufacturer's instruction for proper line sizing information based on distance from condenser.

**Table 4. Liquid and Suction line size**

Model Size	Liquid line	Vapor line
2430	1/4 Flare to 3/8" Solder	1/2 Flare to 5/8" Solder
3036	3/8 Flare to 3/8" Solder	5/8 Flare to 3/4" Solder
3642	3/8 Flare to 3/8" Solder	3/4 Flare to 3/4" Solder

Install a liquid line filter drier as close to the coil as possible to protect the evaporator from foreign object debris. For troubleshooting purposes, especially for attic installations or when using long line sets, an optional moisture indicating sight glass should also be installed between the filter-drier and expansion valve near the indoor unit (see Fig. 8).



**Figure 8. Refrigeration Schematic**

## Expansion Valve

The expansion valve is shipped loose inside the spare parts box which is inside the vertical unit shipping box (for refrigerant coils only). Use the following steps when installing the TXV:

1. Remove plastic caps to external equalizer line and distributor inlet.
2. Install the white Teflon o-ring in both connections of the TXV. Attach and tighten lower connecting nut to the distributor as shown in Figure 9.
3. Connect the outlet to the 3/8" (9.5 mm) OD copper refrigerant fitting. Make sure the threaded fitting is tight (Figure 10).
4. After all lines have been connected, pressure check the connections by charging the system with 150 psig of dry nitrogen and check for leaks at all connections.

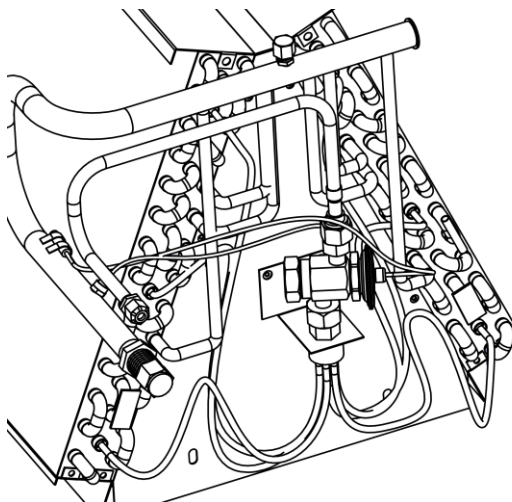
Locate the bulb at the 2, 4, 8, and 10 o'clock position on a horizontal straight section of the suction line. Attach the bulb to the tubing with the two pieces of cork tape that are provided. Placement is shown in Figure 11. For satisfactory expansion valve control, good thermal contact between the bulb and the suction line is essential.



**Figure 9. Attaching TXV to Distributor**



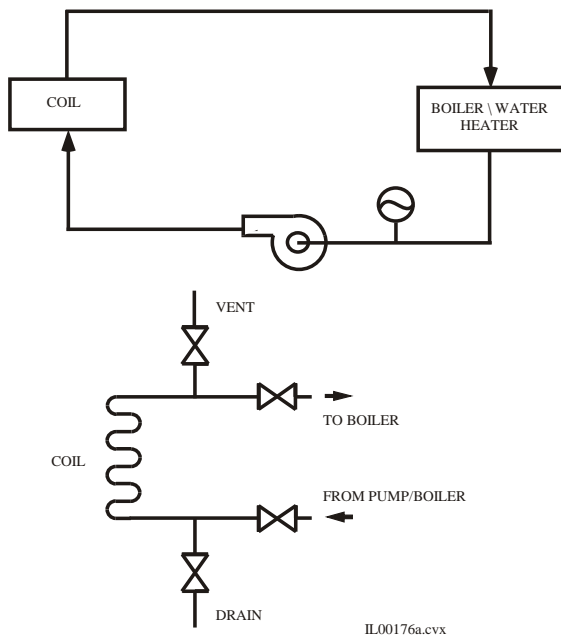
**Figure 10. Attaching TXV to Liquid Line**



**Figure 11. TXV bulb placement**

## Water Connections

If you are installing the hot water coil, remove the side coil access panel. Slide the coil into the cabinet if not already installed at the factory and reinstall the door panel. After removing plugs in the inlet and outlet holes, caulk around connections to prevent leakage.



**Figure 12. Water Piping Schematic**

Pump and pipe sizing should be based on proper flow rate. Refer to Bulletin 20-019 for chilled water coil capacities based on flow rate.

Sweat the water connections, then fill the system. Install a vent valve at the highest point and a drain valve at the lowest point of the water system (refer to Fig. 12). Fill and bleed the air from the system. If unit is in an unconditioned space care must be taken to prevent the water from freezing. Use a glycol-water antifreeze solution with a freezing point below the coldest temperature expected.

As an alternate to an anti-freeze solution, the water can be continuously circulated to prevent freezing. If the coil will not be used for an extended period of time during cold temperatures, drain the system then flush with a glycol solution.

## Wiring

### WARNING!

**DISCONNECT ELECTRICAL SUPPLY BEFORE WIRING UNIT TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK.**

All electrical wiring must comply with all local codes and ordinances. Make electrical connection in accordance with the wiring diagram shown in Figure 12 for 230V and Figure 13 for 120V. Refer to separate control box manual for additional wiring instructions.

The vertical unit uses the EC motor and SCB control as standard. The vertical unit is sold as 230V or 120V power. Use a separate 1ph, 60/50 Hz power supply with a 15 amp fuse or breaker and appropriate wire gauge per local code.

1. Connect the power supply to terminals L1 and L2/N of the terminal block.

The low voltage transformer is factory wired for a primary voltage of 230V. If power supply is 208V, move the switch on the control board to the 208 setting.

2. Connect the ground to the ground terminal.
3. Plug the motor cable to the motor.
4. Connect the anti-frost wires if using a refrigerant coil.
5. Connect the thermostat wires.
6. Connect the condensing unit wire

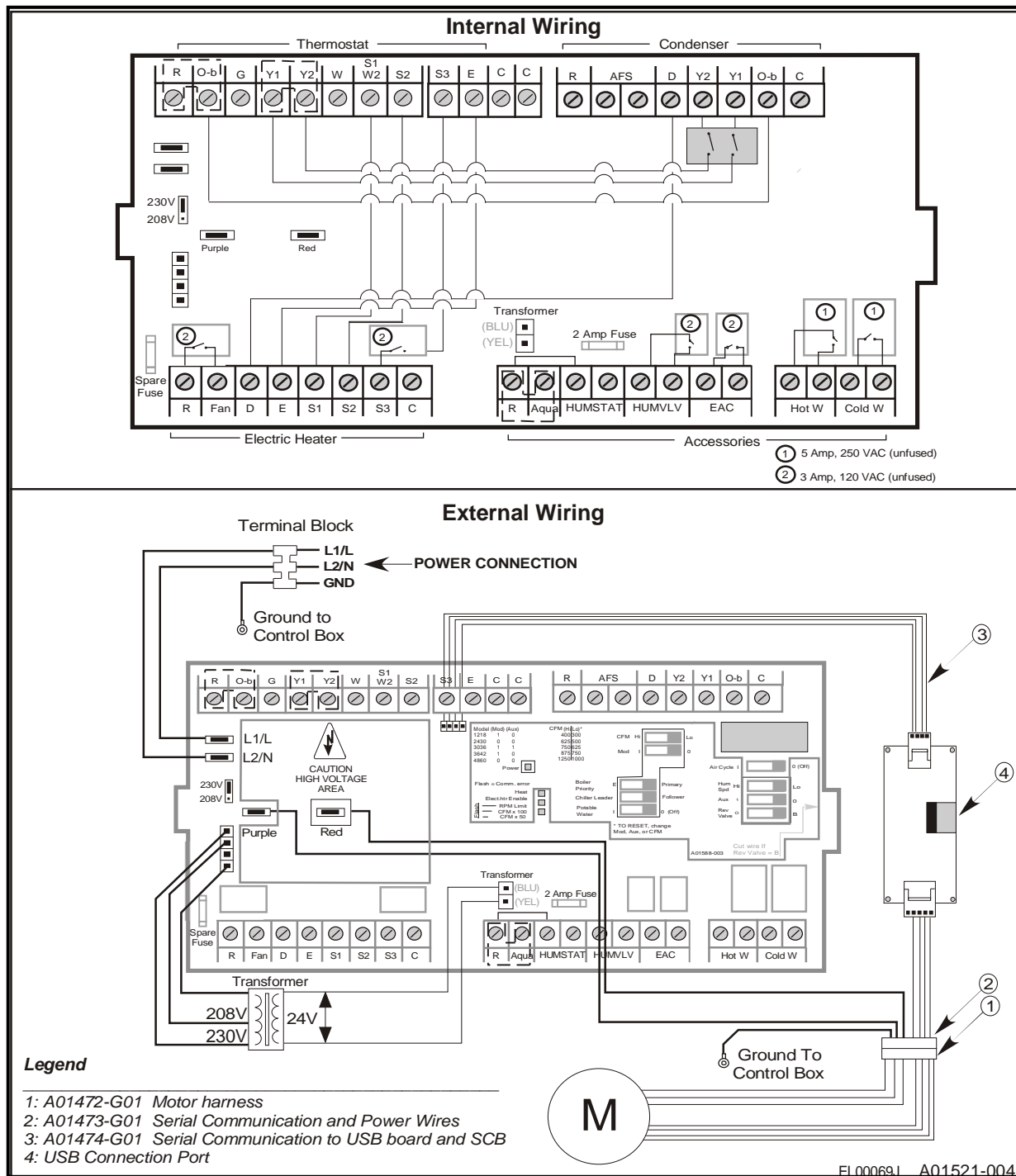


Figure 13. Wiring Schematic, 230V

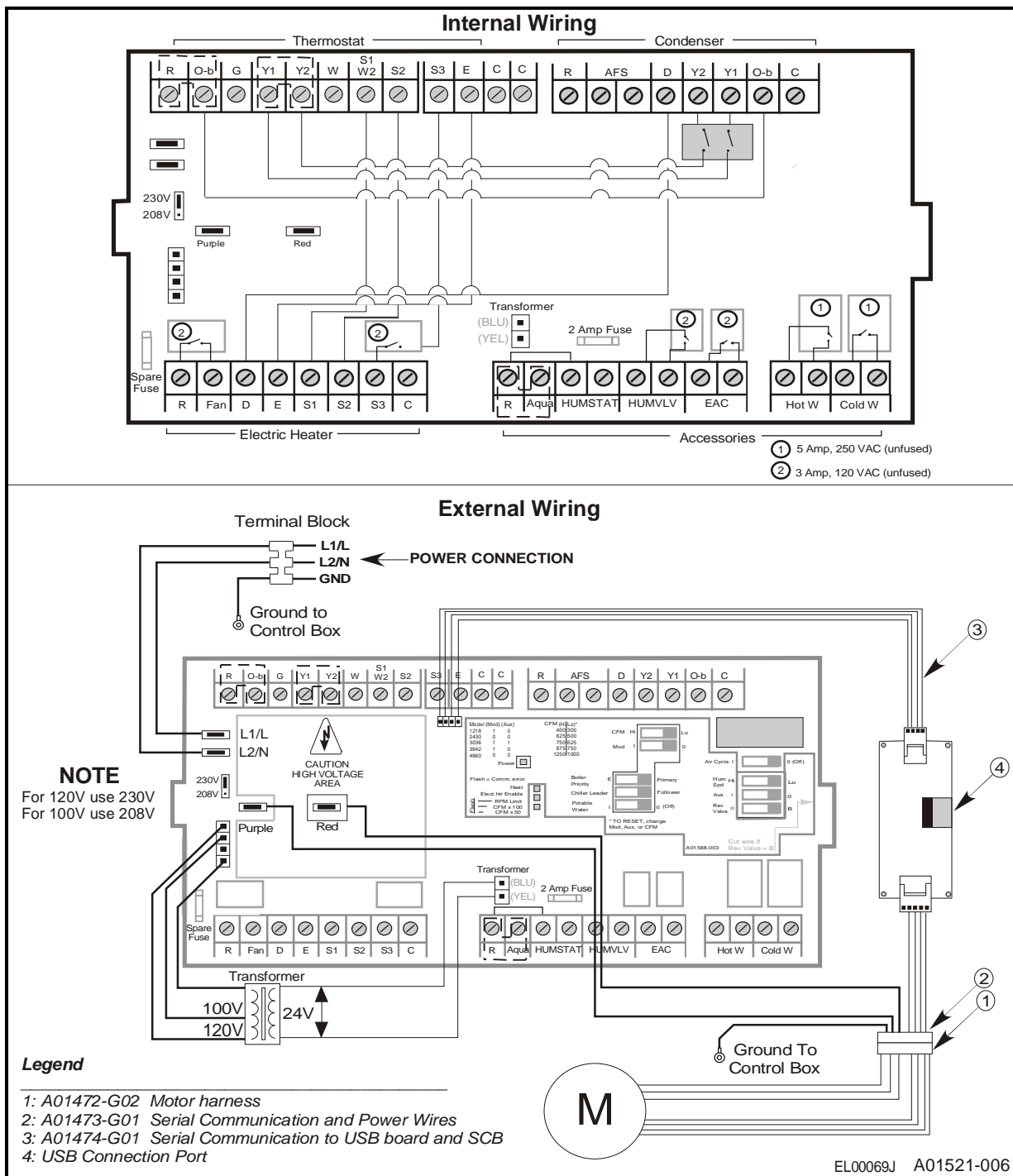


Figure 14. Wiring Schematic, 120V

## SEQUENCE OF OPERATION

The sequence of operation depends on the options installed and type of control thermostat used. Most thermostats have a fan AUTO-ON switch. When the fan switch is set to ON, the “G” circuit is closed and the blower relay is energized. The indoor blower starts after about a 45 second delay. The following paragraphs describe the sequence of operation when the fan is set to AUTO. If the fan switch is set to ON, the sequence is the same except the “G” circuit is always closed and the indoor fan is always operating.

### Cooling Cycle (A/C or Heat Pump)

When the thermostat calls for cooling, the “Y” and the “G” circuits are closed, and a 24 V signal is sent to the compressor contactor in the outdoor unit and fan relay in the indoor unit. After about 45 seconds, the indoor blower starts. At the same time, the compressor and outdoor fan also start. Depending on the control circuitry in the outdoor unit, there may be a time delay before the outdoor unit starts. If the system was just turned off, the time delay could be as much as five minutes. The cooling system is now operating.

For heat pump thermostats setting the switch to ‘cooling’ immediately closes the “O” circuit, which is used to energize the reversing valve solenoid if required by the heat pump. Otherwise, the “B” circuit, which closes when switched in heating, is used to energize the reversing valve solenoid. (Refer to the heat pump manufacturer’s instructions to see which mode the solenoid needs to be energized – whether in heating or cooling.)

When the thermostat is satisfied, the 24 V signals open and the outdoor unit stops. The indoor blower continues to operate for about 40 seconds, then stops. The system is now off.

### Heating Cycle (Heat Pump)

Setting the thermostat to HEATING will automatically switch the reversing valve solenoid. This setting closes the “B” circuit which sends a 24V signal to energize the solenoid if required by the heat pump. Otherwise the “B” circuit is not used and the solenoid is not energized during heating.

When the thermostat calls for heating, the “Y” and “G” circuits are closed, sending a 24 V signal to the compressor contactor in the outdoor unit and the fan relay in the indoor unit. This starts the indoor blower and the outdoor compressor and blower. There is a time delay of about 45 seconds for the indoor unit. The heating system is now operating in stage one.

If the first stage does not satisfy the thermostat, the second stage thermostat calls for more heat. This closes the “W2” contacts and energizes the sequencer for electric heat. When the second stage thermostat is satisfied, the “W2” circuit is broken and the sequencer is de-energized. The electric heating system is now off.

When the first stage thermostat is satisfied, the 24 V signals open and the outdoor unit stops. The indoor blower continues to operate for about 45 seconds, then stops. The system is now off.

### Cooling Cycle (Chilled Water)

When the thermostat calls for cooling, the “Y1” circuit brings on the fan at low speed and “Y2” at full speed. The chilled water relay is used to energize either a chiller, valve, or pump

When the thermostat is satisfied, the 24 V signal to the relay opens the chilled water circuit which stops the pump or closes a valve. The fan circuit opens and de-energizes the fan relay. After about 45-seconds the blower stops.

### Heating Cycle (Electric Heat)

When the thermostat calls for heating, the “W2” and “G” circuits are closed. The W2 circuit completes the 24V signal to the sequencer in the electric duct heater, which cycles on the electric heating elements. The heating system is now operating.

When the thermostat is satisfied, the 24 V signals open and the indoor blower stops after about 40 seconds. At the same time the sequencer cuts the power to the electric elements. The system is now off.

### Heating Cycle (Hydronic Heat)

When the thermostat calls for heating, the “W1” circuit brings on the fan at low speed and “W2” at full speed. The HotW relay is used to energize either a boiler, valve, or pump. For ‘combo’ systems, where potable water is circulated through the hot water heating coil, it is necessary to ensure that the water is never stagnant in the coil. The switch will activate a timer so that the HotW relay will energize a pump to circulate water once per day for 5 minutes regardless.

If an aquastat is utilized between R and aqua, the fan relay circuit will remain open until the aquastat is closed. R-Aqua allows the HotW relay to function without an optional aquastat. If an aquastat is used, this jumper must be removed.

When the thermostat is satisfied, the 24 V signal to the heat relay opens the HotW circuit which stops the pump or closes a valve. The fan circuit opens and de-energizes the fan relay. After about 45-seconds the blower stops.

## CHECKING AIRFLOW

**CAUTION. DO NOT OPERATE BLOWER WITH FREE DISCHARGE OR LOW STATIC PRESSURES (BELOW 1 INCH WC (250 Pa)) TO PREVENT MOTOR FROM OVERLOADING.**

After the system is installed and before charging system, check for proper airflow. Record the plenum static pressure. With this information, the amount of airflow can be determined by counting the flashes on the SCB.

As a recommended further check on airflow, use the Turbo-Meter (Davis Instruments Catalog No. DS105I07) to measure the CFM from each outlet. This hand held vane type velocity meter that fits directly over the outlet is the most convenient instrument to use. The Turbo-Meter will give a direct LED readout on the KNOTS (FPM x 100) setting, when multiplied by a simple factor gives the CFM of the outlet within an accuracy of 10%. Refer to Technote 113 for more information on the use of the Turbo-Meter.

By measuring and totaling the CFM of all outlets and comparing the total to the SCB readout, one can determine whether there is gross leakage in the duct system. If the values are more than 20% or 150 CFM apart, inspect the duct system for leaks and repair. Refer to Bulletin 30-039 for checking airflow for an EC motor.

### Static Pressure

It is not necessary to measure the return duct static pressure unless it was field fabricated or the static pressure is lower than expected. That's because checking the airflow is mainly useful for determining if there is restriction in the duct.

If you are to measure the static pressure, measure the external static pressure (see figure 15) in the supply plenum at least two feet (0.6 m) from the unit and verify that it is within the allowable range.

The maximum return static pressure (including filters) should be 0.15 inches of water column (37 Pa). If it is greater than 0.15 inches of water column, add the return system pressure drop to the supply plenum static pressure to get the total static pressure drop.

**For example:** If the supply static pressure is measured to be 1.6 inches w.c. and the return system pressure drop is 0.25 inches w.c., the total static pressure drop is:  $1.6 + 0.25 = 1.85$ . In this case the static pressure is too high.

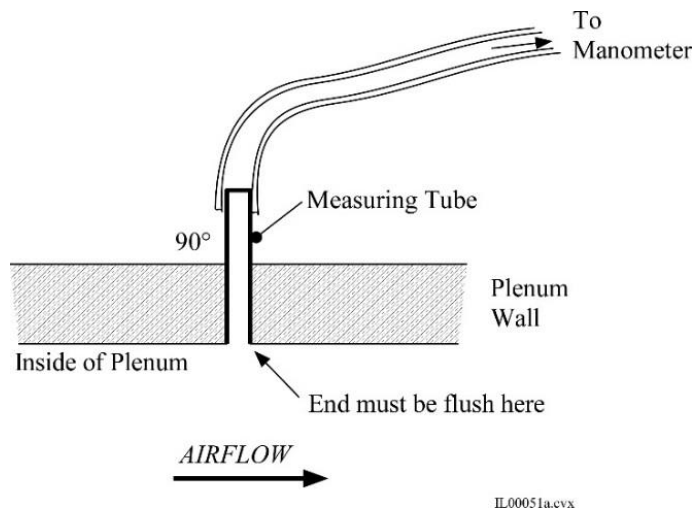


Figure 15. Measuring Plenum Static Pressure

## CHARGING A COOLING SYSTEM

**DO NOT VENT REFRIGERANT TO THE ATMOSPHERE!!** It is a violation of federal law and in some cases local ordinances. Always use a refrigerant recovery or recycling device.

If charging a heat pump, refer to *Bulletin 30-024, Instructions for "M" Series Modular Heat Pump Systems*. The following procedure is only valid for charging the system during the cooling mode.

To check for proper charge, record the refrigerant pressures and temperatures. Check the refrigerant charge by measuring the amount of sub-cooling (or 'approach' temperature for some condensing units). If the outdoor manufacturer does not have sub-cooling or "approach" temperature charts, then be sure that the sub-cooling is between 8 and 5 °F (2 to 5°C). For long refrigerant lines or when the evaporator is above the condenser, the sub-cooling should be close to 8°F; otherwise, aim for the low end of the range.

After the refrigerant lines and evaporator have been carefully leak tested and evacuated, release the R410A operating charge in the condensing unit. The system is now ready for refrigerant charge adjustment.

Start up the system and check line voltage to assure it is within acceptable limits for the system as dictated by the condensing unit manufacturer. Run the system for 20 to 30 minutes to get reasonably stabilized conditions. Do not attempt to adjust charge with outdoor temperature below 75°F (24 °C). An outdoor temperature of 75 to 85°F (24 to 29 °C) is preferred.

If the system charge must be checked when the outdoor temperature is below 80°F (26.7 °C), block the condenser coil until the head pressure is approximately equal to what its charging chart specifies for an 85°F (29 °C) day.

For heat pumps always check the charge in cooling mode. If this is not possible because of low outdoor temperatures, charge the system in the heating mode, but return later when the weather is warmer before the system is switched to cooling.

### Sub-cooling Method

Many condensing unit manufacturers publish the amount of sub-cooling that the condenser will produce. Follow their instructions to charge the unit. Typical sub-cooling values will be between 8 and 15°F (5 to 9 °C). The unit should ALWAYS have some amount of sub-cooling. To be sure there is enough sub-cooling, especially if the unit is in a hot attic, check the liquid line sight glass near the evaporator for bubbles or measure the refrigerant liquid line pressure and temperature AT THE EVAPORATOR.

To measure sub-cooling use the following procedure:

1. Measure and record the liquid line pressure using an accurate refrigerant gauge. Record the corresponding saturation temperature for this pressure (see Table 3).
2. Measure and record the liquid line temperature using an accurate metal or glass thermometer, or thermocouple. Tape or strap the sensor firmly against the surface of the liquid line and cover with insulation.
3. Determine the sub-cooling with the following equation:

$$\frac{\text{SATURATED TEMPERATURE} - \text{LIQUID LINE TEMPERATURE}}{\text{SUBCOOLING}}$$

If the sub-cooling temperature at the condenser is low, the system is undercharged. If it is high, the system is overcharged and some refrigerant must be removed and collected in an empty refrigerant container. ***Do not vent the refrigerant; it is a violation of federal law!***

In some cases, such as in a hot attic, the liquid line will pick up heat and lose its sub-cooling. This will be apparent if the sub-cooling at the evaporator is low. In these cases, the liquid line should be insulated or strapped to the suction line and both insulated. The same problem can occur for long refrigerant lines; in this case, increase the size of the liquid line to reduce the pressure drop.

### **CAUTION. TO MAINTAIN PROPER HEAT PUMP OPERATION, DO NOT STRAP THE LIQUID AND SUCTION LINES TOGETHER FOR HEAT PUMP SYSTEMS.**

### Superheat Method

Do not charge the system based on superheat. Superheat measurements should only be used to verify that the expansion valve is working properly. If it is more than expected please refer to *Tech note 114* on troubleshooting expansion valves.

The superheat should be between 8 to 12°F (4 to 7°C) at the indoor coil. In some cases, particularly for the larger capacity match-ups (i.e. 3 ton and 5 ton), a superheat of 15 to 18°F (8 to 10°C) is satisfactory. It is not uncommon to measure a superheat above 20 to 25°F (11 to 14°C) at the condensing unit.

Be aware that the superheat value is also dependent on the outdoor air temperature. At lower air temperatures the superheat will be higher than at higher air temperatures. If the condenser ambient temperature is between 75 and 85°F (24 to 29°C), superheat should be approximately 10 to 12°F (5 to 7°C). If the outdoor temperature is between 85 and 105°F (29 to 40°C), superheat should be approximately 8 to 10°F (4 to 5°C).

To measure the superheat use the following:

1. Measure and record the suction pressure at the evaporator outlet using an accurate refrigerant gauge. If this is not possible, measure the pressure at the service port on the suction valve fitting at the condensing unit and add the estimated pressure loss in the suction line between the condensing unit and evaporator. Record the corresponding saturation temperature for this pressure (see Table 5).
2. Measure the suction line temperature at the evaporator outlet using an accurate metal or glass thermometer, or thermocouple. Insert the thermometer under the insulation on the suction line and tape firmly against the surface of the suction tube.
3. Determine the superheat with the following equation:

$$\frac{\text{Suction Line Temperature} - \text{Saturated Temperature}}{\text{Superheat}}$$

### Charging by Gauge Pressures

It is not possible to charge the system by gauge pressures. Gauge pressure should only be used to verify the system is working properly

The Unico System will show a lower suction pressure during the cooling mode than a conventional system. Generally, it will be 10 to 15 psi (70 to 100 kPa) less. For example, a normal suction pressure for the Unico System will be about 65 psig (450 kPa) with an 85 to 95°F (29 to 35°C) outdoor temperature. Expect lower pressures when the outdoor temperatures are lower.

The head pressures should be similar to a conventional system when in the cooling mode.

### Using a Low Ambient Control Kit

Since the Unico System operates at colder coil temperatures (in cooling mode), an anti-frost switch is installed on the coil to prevent coil freeze-up. In certain instances, such as when the outdoor ambient temperature is low, the condensing unit will cycle on the anti-frost switch. This may reduce the cooling capacity at a time when the cooling load is still fairly high. To provide better control and comfort, install a *low ambient control* on the condensing unit. Typically, a low ambient control is necessary when operating the unit at outdoor temperatures below 70°F (21.1 °C).

These controls come in different configurations such as the Hoffman Controls Corp. series 800AA head pressure control. This control modulates the outdoor blower to maintain a minimum liquid line temperature. Other controls may cycle the fan on off. In either case, check with the condensing unit manufacturer to determine what controls are compatible with the condensing unit.

## CHARGING A HEAT PUMP SYSTEM

### Charging in Cooling Mode

Charging a heat pump, by its nature, is more difficult than a cooling-only refrigerant system. Quite often the ideal charge for cooling is different than the ideal charge for heating, making the system much more sensitive to the amount of charge. In some cases, the compressor will trip on high head pressure during the heating mode because it is overcharged if the system was charged during cooling. Likewise, the system may cycle on the anti-frost control because of a low refrigerant charge if the system was charged during heating.

To compensate for this charge difference some outdoor unit manufacturers have a charge compensator device that stores charge while in heating mode. Unfortunately there are no add-on devices to accomplish the same thing and only a few (usually the most expensive) model lines will have one. For this reason, it is often necessary to compromise the charge.

Although the unit can be charged in the heating mode, it is best to charge the unit during the cooling mode as described earlier. Then recheck the charge in the heating mode to be sure the system is not over charged.

## Charging in Heating Mode

If the system is started up on heating where the return air temperature is significantly lower than the normal operating range of 65 to 75 °F (18.2 to 23.8 C), the suction pressure can be very low. Operate the system to bring up the return air temperature, using auxiliary heat if necessary, before checking system charge.

In heating mode, the Unico System will have a slightly higher discharge (LIQ.) pressure than a conventional system, usually about 40 to 50 psig higher. It is this higher pressure that produces a warmer air temperature; preventing “cold blow”, where the house is being heated with an air stream that feels cold.

Some outdoor heat pump units include a manual high-pressure switch. It is important that the system be operated at pressures below the trip pressure of the high-pressure switch to avoid nuisance shut downs. If this occurs, use a high head kit as described below

### Using a High Head Kit (Mild Weather Kit)

When any heat pump is operated during mild weather (temperatures above 50°F (10 C)), the compressor may trip out on the high pressure limit. The Unico System is particularly sensitive to this since it operates at a higher pressure.

To overcome this problem, install a mild weather kit (UPC-65X) to cycle the outdoor fan based on the compressor discharge pressure. However, be sure this control is compatible with the outdoor heat pump section being used.

**Table 5. R410A Saturation Pressure - Temperature**

°F	psig		°C	kPa (gauge)
0	48.4		-18	334
2	51.1		-17	352
4	53.8		-16	371
6	56.6		-14	390
8	59.4		-13	410
10	62.4		-12	430
12	65.4		-11	451
14	68.6		-10	473
16	71.8		-9	495
18	75.1		-8	518
20	78.5		-7	541
22	82.1		-6	566
24	85.7		-4	591
26	89.4		-3	616
28	93.2		-2	643
30	97.2		-1	670
32	101		0	696
34	105		1	724
36	110		2	758
38	114		3	786
40	119		4	820
42	123		6	848
44	128		7	883
46	133		8	917
48	138		9	951
50	143		10	986
55	156		13	1076
60	170		16	1172
.	.		.	.
.	.		.	.
.	.		.	.
90	274		32	1889
95	295		35	2034
100	317		38	2186
105	341		41	2351
110	365		43	2517
115	391		46	2696
120	418		49	2882
125	447		52	3082
130	477		54	3289