INSTALLATION AND MAINTENANCE

king

Mini Makeup Air Unit (MMAU)

DANGER

ELECTRIC SHOCK OR FIRE HAZARD

READ ALL WIRE SIZING, VOLTAGE REQUIREMENTS AND SAFETY DATA TO AVOID PROPERTY DAMAGE AND PERSONAL INJURY

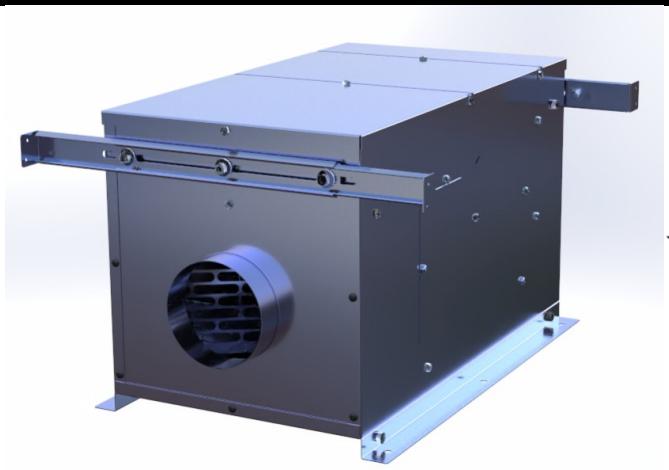


Figure 1

UNIVERSAL INSTRUCTIONS

MADE IN USA

UL LISTED

WARNING

WARNING: RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH.
DISCONNECT ALL REMOTE ELECTRIC POWER SUPPLIES BEFORE SERVICING.

It is *extremely important* you verify the electrical power supply is the same voltage of the MMAU being installed. 120V, 208V, 240V units are *not* interchangeable. Powering a 240V unit with 120V supply wires will reduce the heater output by approximately 75% and is never recommended. Powering a 120V unit with 208V or 240V supply wires will destroy the electrical components and voids all warranties.

CHECK: Be sure filters are in proper position and not torn, damaged, or clogged. The white filter is placed toward the inlet duct, and the carbon filter is placed toward the MMAU. The white filter is washable and replaceable, the carbon filter is replaceable only.

NOTE: The attached Underwriters Laboratories label pertains to Make Up Air Units only. It does not cover any HVAC systems such as: air heaters, coolers, condensing units or air cleaners which may be used in parallel or series with the MMAU. Approval of the complete HVAC system, including the MMAU, requires compliance with local codes

GENERAL REQUIREMENTS AND SPECIFICATIONS

1. LOCATION – The MMAU does not have to be centrally located to the heating area, it can operate as a stand-alone device or be multiplied parallel, or in series with other HVAC ducted systems. The unit is supplied with a 24V temperature sensor which needs to be located at least three feet downstream from the unit.

2. POSITIONS – The MMAU is designed for compact, space saving installations in any flow position except for down flow.

3. INSTALLATION CLEARANCES – Though shipped from the factory approved for “zero inch” clearance for compact, space saving installations, the MMAU is recommended to be installed with a minimum of one inch clearance and three feet from the outdoor fresh air inlet duct.

4. TEMPERATURE RISE – The MMAU is shipped to operate in the 0.20” (5 mm) W.C. (50 Pa) external static pressure range. The unit is certified for operation up to 0.50” (13 mm) W.C. (125 Pa). Check the table on the following page for temperature rise. If necessary, adjust the air flow to match the specification chart.

5. SERVICE CLEARANCE – The MMAU is serviced from the access panels. Leave at least 24” (610 mm) clearance in front of the panels to allow for field wiring, programming, troubleshooting, or repairs.

INSTALLATION AND MAINTENANCE

Product Description

The MMAU is a self-contained packaged air handling unit supplied with a washable air filter, and a disposable carbon filter. This unit has been designed specifically for use with a 100% outside air ducted supply inlet. An integral duct noise silencer is a standard feature on all units.

All models include one of two digital readout proportional inbuilt controller options. Choose from either a temperature, or a temperature and timer controller. With either option, a separate digital readout, dual speed blower controller is standard. See “Basic Setup & Configuration” for further details.

These units are designed with Pic-A-Watt® electric heating elements which temper 100% outside air to match that of the occupied space. This design includes an integrated 24V electronic outlet temperature sensor and associated control circuitry signaling modulization of the programmable electric heating elements. When programmed, the electric heating elements are only used to heat the incoming Fresh Air, or “Make Up Air” to the temperature set point. There is no overheating or inefficient use of the electric elements as they will only be powered on when the set air temperature needs to be met.

Diagrams used throughout the installation manual represent general installation requirements. Due to various model sizes available, actual unit mechanical and wiring requirements will vary depending upon specific models.

Receiving

The person and/or company signing off on the delivery Bill of Lading is the receiver who is responsibility to inspect for shipping damage. All shipping damage claims must be made by the receiver.

Storage & Handling

Packed or unpacked, the Make-Up Air unit shall not be exposed to rain, snow, or other adverse environment. This product is designed for in-building storage and installation only.

MODEL CODES:

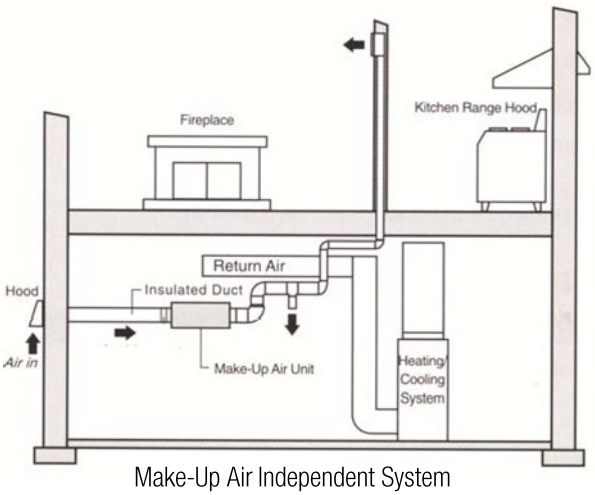
MMAU	20	06	-1	-ECM	-SSR	-190	-6
Mini Make Up Air Unit	12 = 120V 20 = 208V 24 = 240V	KW 01 to 08	Single Phase	Electro Commutated Motor	Solid State Relay Controller	CFM	Duct Size

INSTALLATION AND MAINTENANCE

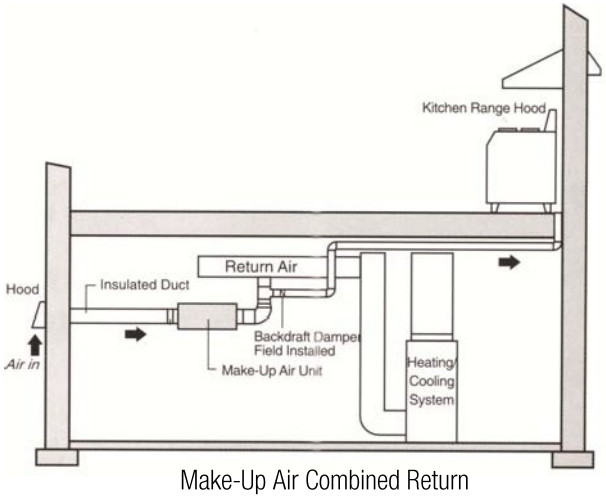
Installation Overview

This MMAU can be operated as a stand alone unit or be connected to any number of external devices which may be required for your HVAC system operate as desired. Simply wire external devices to the 24V terminal block provided. These external devices must be provided by the installing contractor and may include but are not limited to:

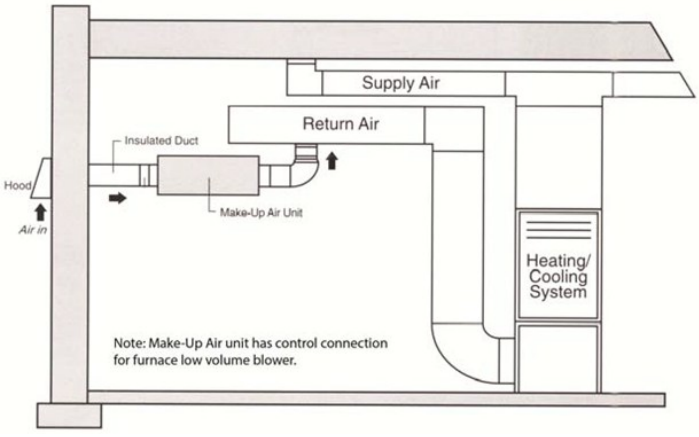
- Building Management System
- Exhaust hoods
- Duct damper
- Additional current transformer
- Ducting systems
- Air quality monitoring devices



Make-Up Air Independent System



Make-Up Air Combined Return
Tie-In & Independent System



Make-Up Air Return Tie-In System

INSTALLATION AND MAINTENANCE

Mechanical Installation

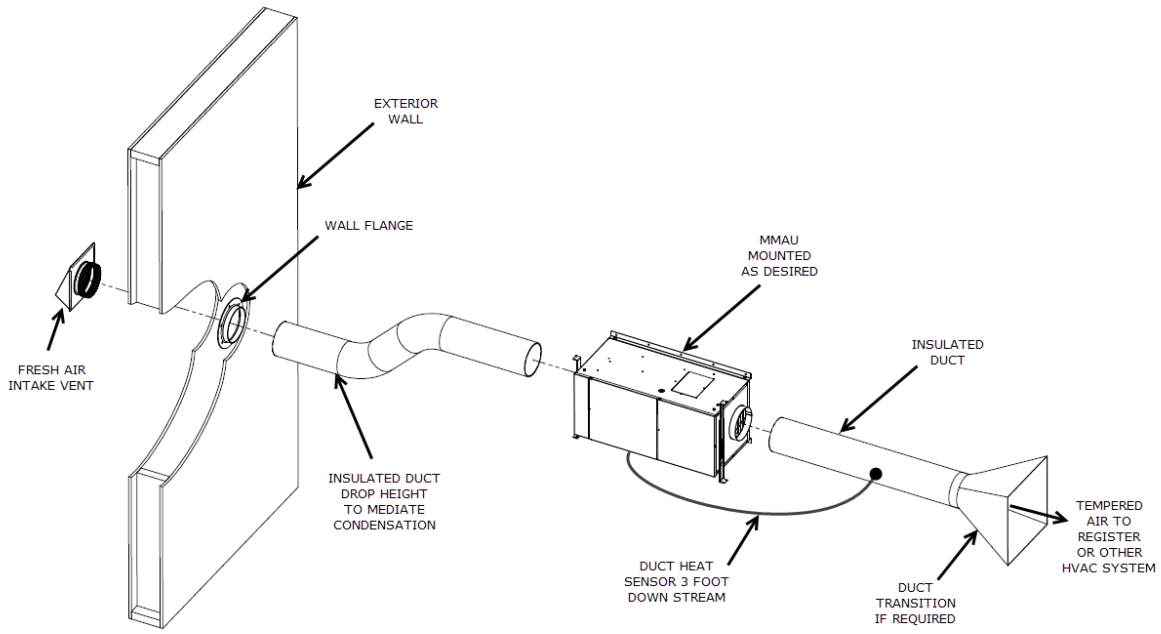
This product is certified for zero clearance, but use the following mounting and spacing criteria:

1. Unit can be installed any orientation except for downflow position where the outlet is facing towards the floor. This can cause permanent damage to the fan.
2. It is acceptable for the unit to be in direct contact with wood framing materials as the elements are double wall steel insulated.
3. No materials shall be in contact with the cabinet housing which have a flame ignition point less than wood, 300°F (150°C).
4. If a doughnut type current transformer is being used, use Class II low voltage wiring methods to connect current transformer to the MMAU's accessories terminal block locations.

General:

1. Select a location which will provide minimal blower noise and vibration to the building occupants.
2. The MMAU does not include any of the ducting items shown, it is intended for illustration only. It is the installer's responsibility to provide all necessary duct connections. Be sure a weather and bug protection air intake vent inlet is used to extend the life of the air filter.
3. In cold climates, insulated ducting must be used between the outside inlet air hood and the inlet of this unit.
4. Install unit with a air inlet incline. *The MMAU inlet must be at least ¼" higher than inlet end to mitigate any condensation.
5. Install the unit in any convenient location between an outside wall and the tempered air discharge connection. Various mounting methods are integral to the MMAU. Ceiling joist hangers are provided for mounting between ceiling joists. The unit also has an integral mounting flange for surface mounting. There are also four 1/4-20 threaded captive nuts on each side of the unit for suspending using 1/4-20 threaded rod which is typical for Unistrut® mounting in drop ceiling applications.
6. The "discharge connection" is the distribution of tempered, conditioned fresh air within the occupied space. This connection can also be tied to the cold air return of a furnace, special ducting, hallway register, etc.
7. The inlet and outlet ducting will always be sized alike and specified according to the Model Code and dimensional drawings section of this manual.

*Note: In cold climates, frost and or condensation may collect on metal parts of this product. Providing duct insulation may be required in certain situations. An inlet damper with an inlet sensor can help prevent cold air migration. Installing the unit slightly inclined from the inlet duct will also mediate moisture from collecting inside the unit and it will be directed away to the outside of the building through the intake vent.



INSTALLATION AND MAINTENANCE

Fresh air with HVAC System components:

The MMAU improves indoor air quality by delivering tempered fan forced air from outdoors into occupied spaces of a building. Heating of the incoming outside air to a preset temperature is accomplished using a Solid State Relay Controller which modulates the electric heat to a preset discharge temperature. This tempered air can be delivered directly into a return air plenum, a separate fresh air ductwork system, or register. The Solid State Relay Controller circuit accommodates the provision of field installed auxiliary items such as:

Fresh Air Cycle timer – This is a 24 hour cycle timer that activates the unit for 100% outside air turns. These timers are based on minutes per hour of fresh air required and are typically broken into ½ hour segments. The MMAU can be programed to work with the primary HVAC unit by supplying fresh air on demand when the HVAC system is operating. If the HVAC unit does not call for heat during the 1 hour cycle, the MMAU will turn on automatically to fulfill the timer setting for Fresh Air turns. The MMAU may cycle on and off several times during the 1 hour cycle in conjunction with the HVAC unit in order to meet time and temperature requirements. The entire fresh air cycle will always be met each hour by prioritizing the call for heat and then run independently to add the balance of time required. This design feature improves the overall HVAC system efficiency.

Exhaust Fans – The MMAU Solid State Relay Controller will activate when a field installed exhaust fan (or any auxiliary equipment) is wired in series at the 24V terminal board location noted on the wiring diagram provided with the unit.

Poor Air Quality Sensing Devices - Operates on the same principle as the exhaust fan. When demand calls for it, the MMAU will turn on to improve air quality until the sensing device is satisfied. These devices may sample many different indoor air pollutants such as dust, mold, chemicals, condensation, radon.

Carbon Monoxide or Dioxide Detectors – These devices are used to monitor indoor air quality by sampling CO or CO2. If set off, these devices sound an alarm. The MMAU can help to exchange 100% outside air after the problem has been mitigated.

Oxygen Sensors - Will signal a Fresh Air demand when oxygen levels drop below desired value. This usually occurs during high occupancy and is not an alarmed function.

Simple on/off wall switches – There may be occasion to implement this simple system when room occupancy changes. Such a switch can be used to manually activate the MMAU to bring in 100% outside air to balance out occupancy increases. This could be used for meeting rooms, bars, schools or anywhere a room occupancy is expected to rise at odd intervals.

Air Monitoring:

Measuring and controlling indoor air quality is extremely important to improving health and well-being. People spend nearly 80-90% of their time in enclosed indoor spaces. Stagnant indoor air can contain a myriad of unhealthy conditions producing what is known as Sick Building Syndrome or SBS or airborne viruses. Symptoms such a headache, eye irritations, fatigue, nausea or sensitivity to smells tend to subside after one is moved to fresh air. Accumulations of dust, mold, germs, chemicals, and smoke, some due to every day activities like cleaning, cooking, use of candles, or smoking can contribute to indoor air pollutants.

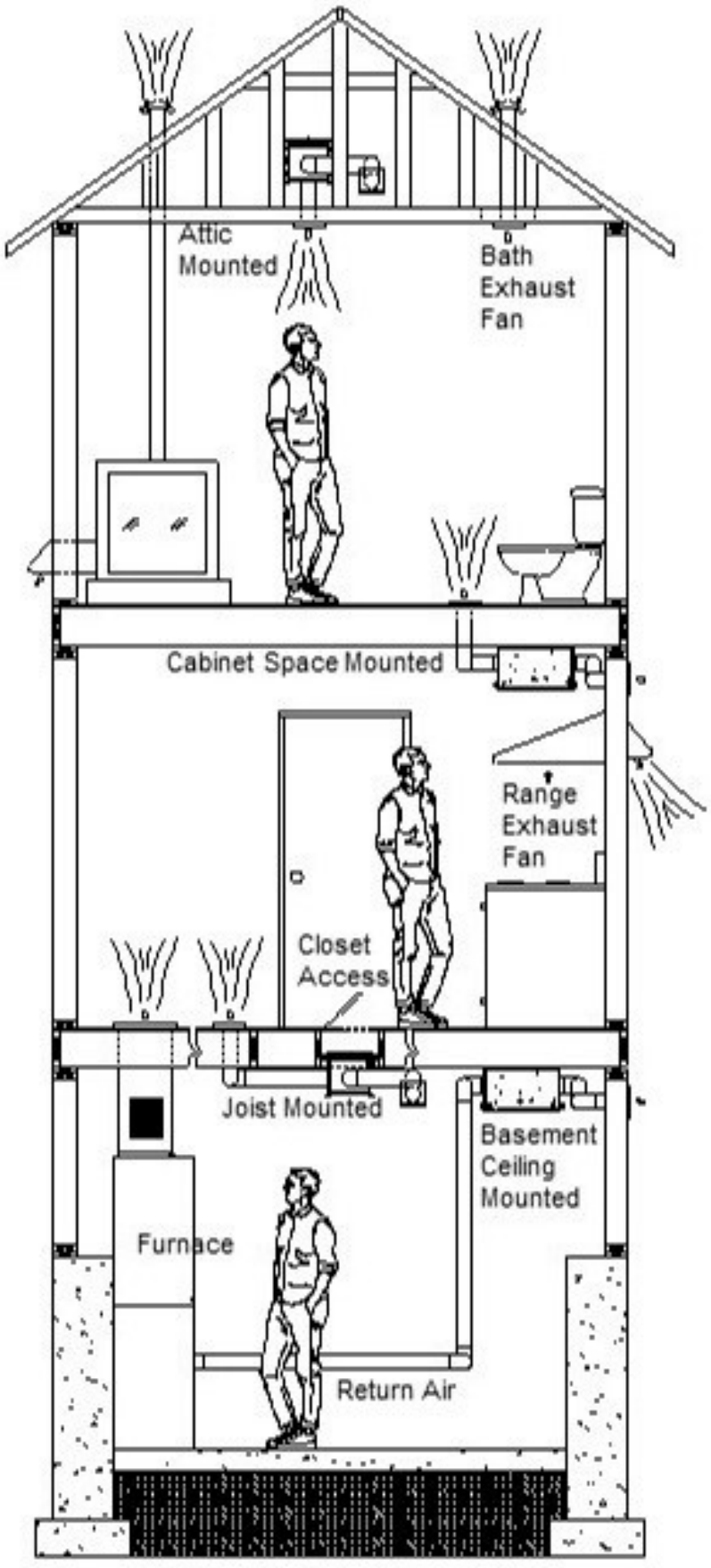
The Mini Make Up Air Unit is included as a recommended device to accomplish all four of the incentives described in the Clean Air in Buildings Challenge.

Better Air. Peace of mind.

ORDER INFORMATION CHART

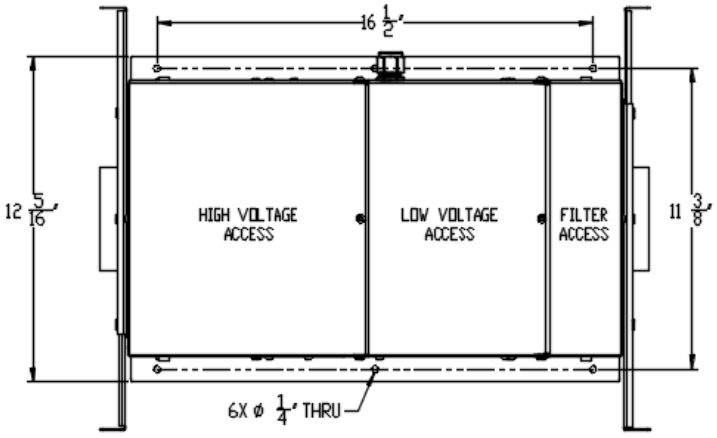
MODEL	KW	BTUH	PHASE	VOLTS	AMPS	CFM @0.0" WC	CFM @2.0" WC	DUCT
MMAU1201-1-175-4-PT	1.5	5,120.00	1	120	12.5	171	132	4
MMAU1201-1-175-4-PTT	1.5	5,120.00	1	120	12.5	171	132	4
MMAU2002-1-175-4-PT	2.25	7,679.00	1	208	10.8	171	132	4
MMAU2002-1-175-4-PTT	2.25	7,679.00	1	208	10.8	171	132	4
MMAU2402-1-175-4-PT	2.25	7,679.00	1	240	9.4	171	132	4
MMAU2402-1-175-4-PTT	2.25	7,679.00	1	240	9.4	171	132	4
MMAU2005-1-190-6-PT	4.5	15,359.00	1	208	21.6	358	332	6
MMAU2005-1-190-6-PTT	4.5	15,359.00	1	208	21.6	358	332	6
MMAU2405-1-190-6-PT	4.5	15,359.00	1	240	18.8	358	332	6
MMAU2405-1-190-6-PTT	4.5	15,359.00	1	240	18.8	358	332	6
MMAU2006-1-190-6-PT	5.7	19,454.00	1	208	27.4	358	332	6
MMAU2006-1-190-6-PTT	5.7	19,454.00	1	208	27.4	358	332	6
MMAU2006-3-190-6-PT	5.7	19,454.00	3	208	15.8	358	332	6
MMAU2006-3-190-6-PTT	5.7	19,454.00	3	208	15.8	358	332	6
MMAU2406-1-190-6-PT	5.7	19,454.00	1	240	23.8	358	332	6
MMAU2406-1-190-6-PTT	5.7	19,454.00	1	240	23.8	358	332	6
MMAU2406-3-190-6-PT	5.7	19,454.00	3	240	13.7	358	332	6
MMAU2406-3-190-6-PTT	5.7	19,454.00	3	240	13.7	358	332	6
MMAU2008-1-220-6-PT	7.5	25,598.00	1	208	36.1	530	490	6
MMAU2008-1-220-6-PTT	7.5	25,598.00	1	208	36.1	530	490	6
MMAU2008-3-220-6-PT	7.5	25,598.00	3	208	20.8	530	490	6
MMAU2008-3-220-6-PTT	7.5	25,598.00	3	208	20.8	530	490	6
MMAU2408-1-220-6-PT	7.5	25,598.00	1	240	31.3	530	490	6
MMAU2408-1-220-6-PTT	7.5	25,598.00	1	240	31.3	530	490	6
MMAU2408-3-220-6-PT	7.5	25,598.00	3	240	18.1	530	490	6
MMAU2408-3-220-6-PTT	7.5	25,598.00	3	240	18.1	530	490	6

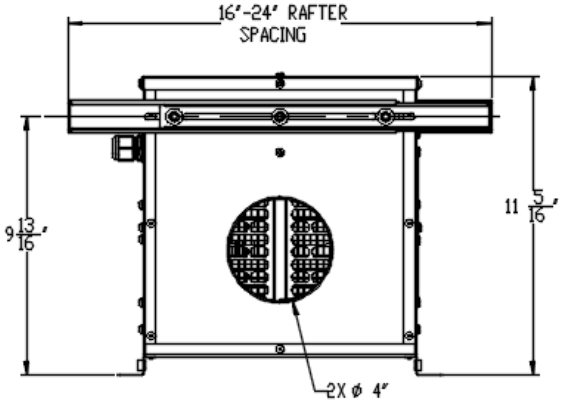
INSTALLATION DIAGRAMS

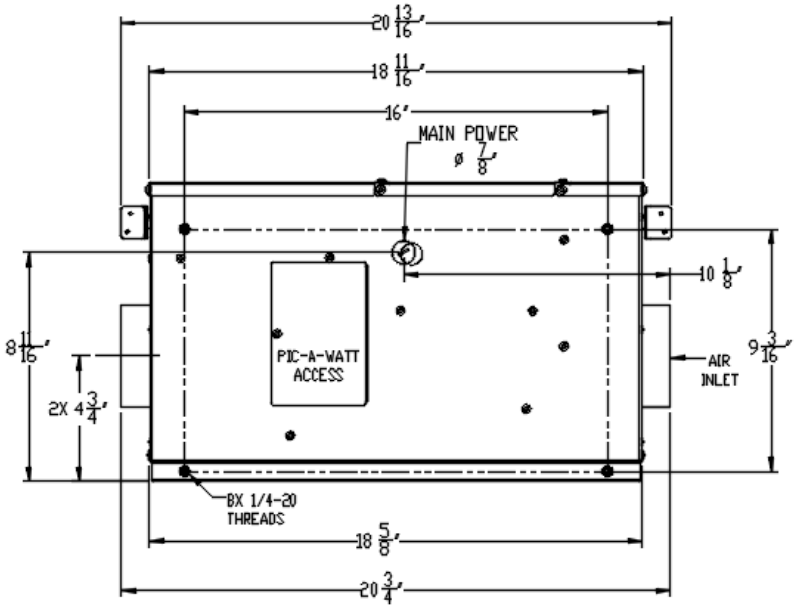


DIMENSIONAL DATA

INTERFACE DIMENSIONS MODEL 175:

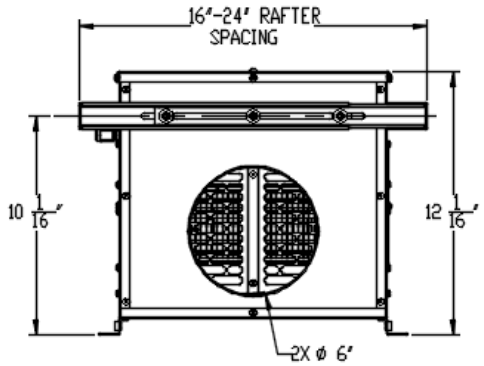


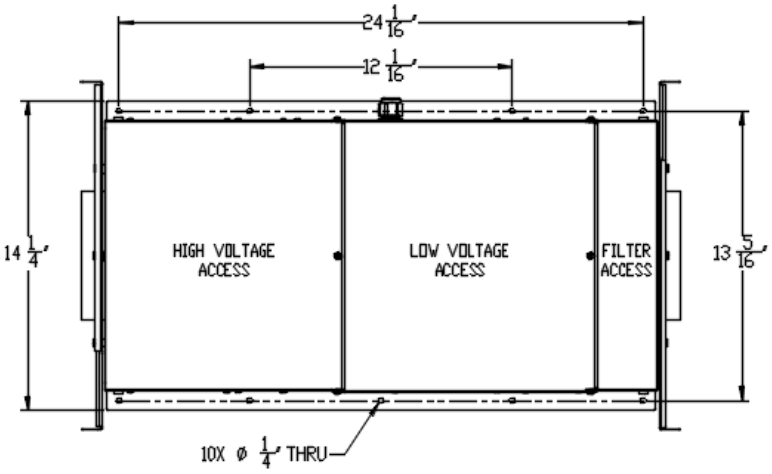


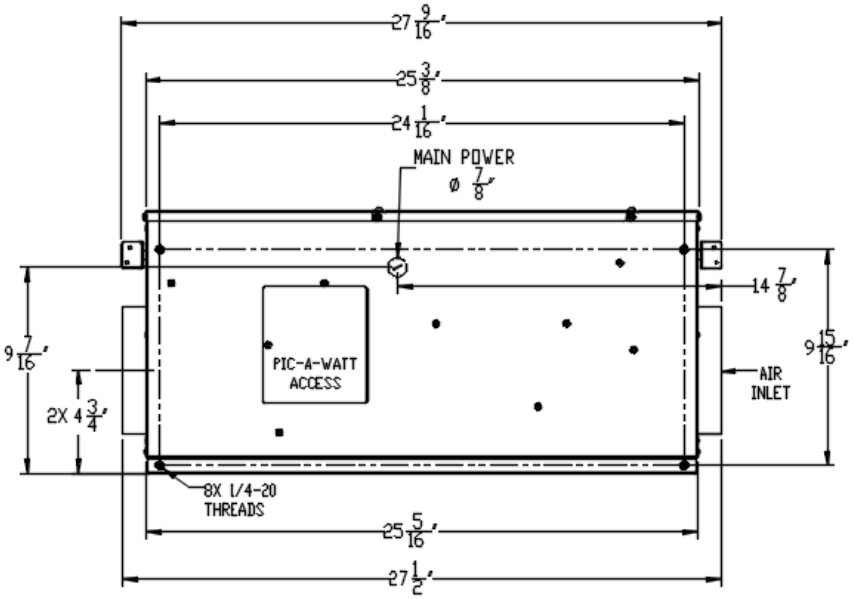


DIMENSIONAL DATA

INTERFACE DIMENSIONS MODEL 190:

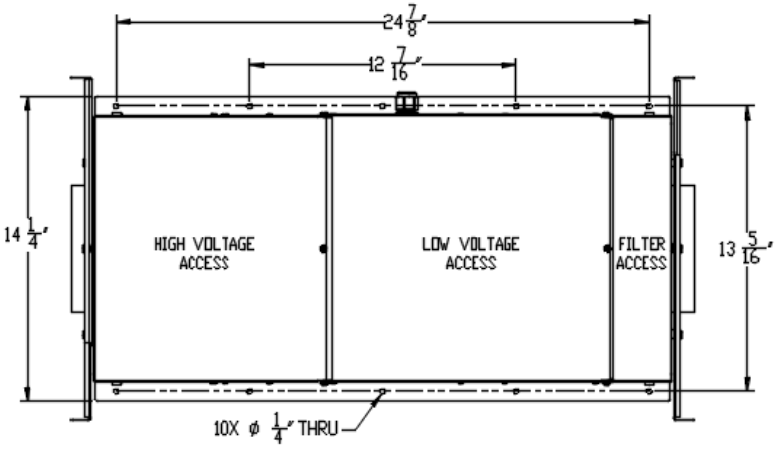


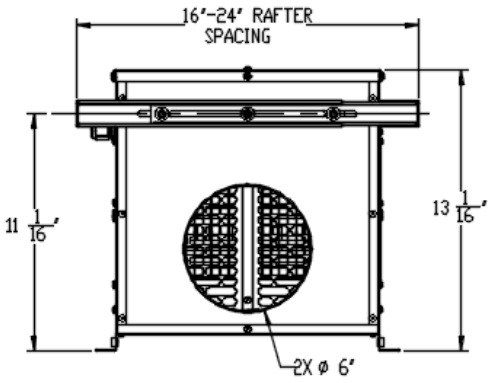


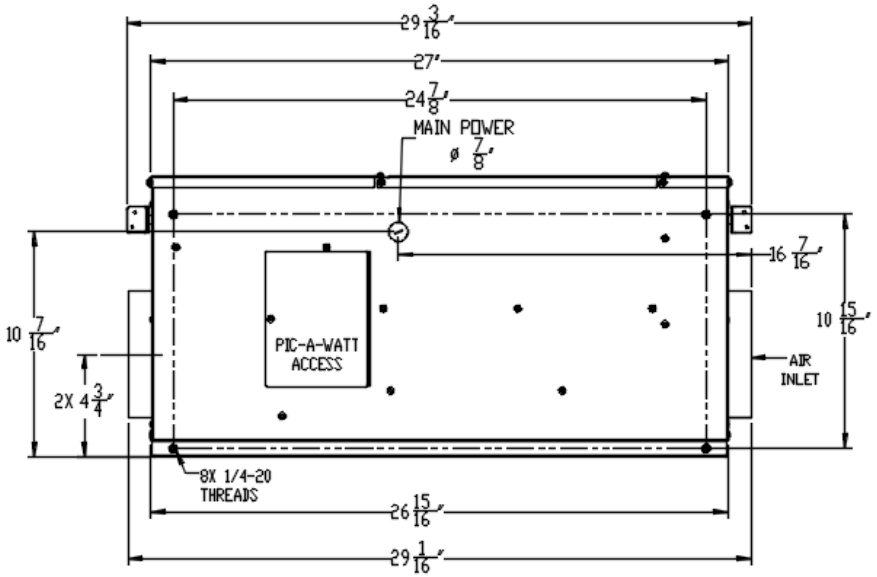


DIMENSIONAL DATA

INTERFACE DIMENSIONS MODEL 220:

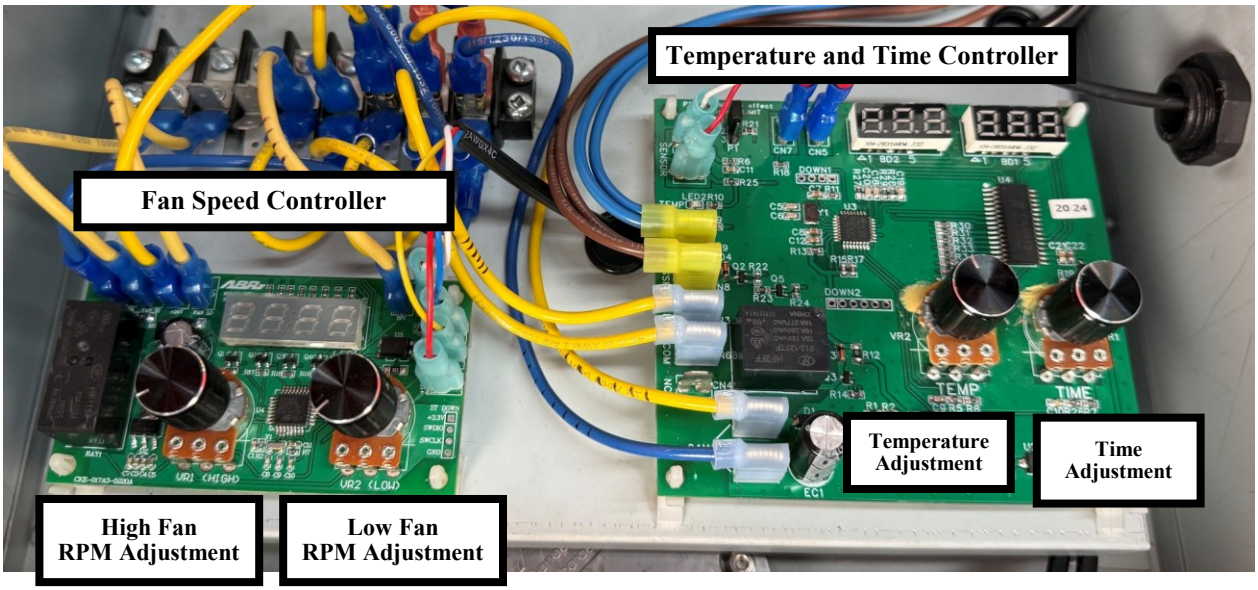






Operating The Control Boards

The MMAU comes with 2 separate customer interfacing control boards. These will allow the customer full control over the speed of the fan and the temperature of the air fed into the room or ducting. The temperature control board will also allow for a built-in timer function to allow the unit to cycle ON and OFF in predetermined hourly intervals. The full schedule can be found on the next page. If the MMAU is going to be operated based on external timers or switches, the TIME can be set to 60, which will make sure the fan and heater is always active when the High or Low fan switch is ON.



Fan Speed Controller

The Fan Speed Controller comes with 2 adjustment knobs labelled HIGH and LOW on the board. These will allow you to set two different RPM settings on the fan. RPM can be set from 750 up to 3200 on each of the dials. The fan speed that is selected is based on which switch is turned on at that time. Reference the wiring diagram to see these 2 switch locations. When the Low switch is turned on, the RPM set via the LOW dial will be displayed on the LED screen. Adjust this to your preferred low speed based on airflow needed and noise level preferred. A higher RPM will deliver more air at the cost of more noise. When the HIGH switch is turned ON and the LOW switch is turned OFF, the RPM set via the HIGH dial will be displayed on the screen. Adjust the dial to your preferred fan speed. Once you have these 2 dials set at your preferred speeds, you can switch between the HIGH and LOW speeds at any time via the switches.

Temperature and Time Controller

The temperature and time controller will allow you to adjust the temperature that you want the outlet duct sensor to achieve. The TEMP dial will allow you to select a temperature from 45F to 90F. This will be the duct temperature that the duct sensor is reading and that your MMAU is maintaining Typically, you would select a comfortable ambient temperature that you room is maintaining, around 70F. If you would like to anticipate loss of heat from your ducting, a temperature higher than your current room ambient can be selected. While the unit is on and either the fan low or fan high switch is turned on, the MMAU will maintain that set temperature and stay ON until the unit is told to shut off. The TIMER control can act as an alternative to setting up local switches for the high and low fan. The TIME dial will allow you to set a number between 0-60 minutes, where the number selected will tell you how many minutes per hour the MMAU will be on. 60 will mean the unit is always on (Use 60 if you plan to turn the MMAU ON/OFF with the Low and High Fan switches.), where 0 will mean the unit is always OFF.

See the detailed diagram below to figure out when your make-up air unit will cycle depending on your TIME setting. Different TIME selections will have different ON/OFF cycles. Choose what will work best for you.

The Timer Function

The MMAU comes with a built-in timer function that will cycle the flow of make-up air into your building. Depending on the amount of time per hour you want fresh air delivered, you can select a setting on the TIME dial. 60 represents a 100% ON time for the make-up air unit when the LOW or HIGH fan speed is switched ON. 0 on the LED screen means a 0% ON time for the make-up air unit when a LOW or HIGH fan speed is switched ON. Referencing the table below, select the amount of minutes per hour you would like fresh air delivered to your building. The ON and OFF cycles depending on the amount of time selected are listed below.

TIMER SET POINT	Percentage On Setting	CYCLES/HR	Minutes OFF	Minutes ON	Minutes OFF	Minutes ON	Minutes OFF	Minutes ON	On Time	Off Time
0	0%	0	60	-	-	-	-	-	0	60
1 to 3	5%	1	28.5	3	28.5	-	-	-	3	57
4 to 6	10%	2	27	3	27	3	-	-	6	54
7 to 9	15%	2	12.75	4.5	25.5	4.5	12.75	-	9	51
10 to 12	20%	2	12	6	24	6	12	-	12	48
13 to 15	25%	3	15	5	15	5	15	5	15	45
16 to 18	30%	3	14	6	14	6	14	6	18	42
19 to 21	35%	3	13	7	13	7	13	7	21	39
22 to 24	40%	3	12	8	12	8	12	8	24	36
25 to 27	45%	3	11	9	11	9	11	9	27	33
28 to 30	50%	3	10	10	10	10	10	10	30	30
31 to 33	55%	3	9	11	9	11	9	11	33	27
34 to 36	60%	3	8	12	8	12	8	12	36	24
37 to 39	65%	3	7	13	7	13	7	13	39	21
40 to 42	70%	3	6	14	6	14	6	14	42	18
43 to 45	75%	3	5	15	5	15	5	15	45	15
46 to 48	80%	3	4	16	4	16	4	16	48	12
49 to 51	85%	2	4.5	25.5	4.5	25.5	-	-	51	9
52 to 54	90%	2	3	27	3	27	-	-	54	6
55 to 57	95%	1	1.5	57	1.5	-	-	-	57	3
58 to 60	100%	1	0	60	-	-	-	-	60	0

INSTALLATION AND MAINTENANCE

SEQUENCE OF OPERATION

1. If the exhaust duct air temperature reads about 69°F and the unit is set to temper 100% outside air to 70°F, the internal thermostat switch is enabled and will call for power to the heating elements. This signal for power includes a 30 second blower delay which enables the heater elements to reach sufficient temperature to ensure only warm air is delivered.

2. When the MMAU temperature setting is satisfied, the elements will turn off automatically but the blower may continue to operate, this is a normal energy saving function of the MMAU.

2. Because the factory supplied heat sensor is to be located in the exhaust duct approximately three feet from the MMAU, and because there are many variables which can effect exhaust air heat loss (cold wall, drafts, duct length, duct type, etc.), you may need to set the MMAU thermostat higher or lower to achieve the desired exhaust air temperature at the heat register furthest away from the unit.

3. The MMAU cannot deliver warm air:

    a) unless all the electric circuit breaker for this unit is turned "ON".
    b) if the intake filters are clogged with dirt and dust. Heat is exchanged through air flow volume. In order to deliver 100% outside air, the volume of the intake air must match that of the exhaust air demand. If this volume is impeded by clogged filters, there will not be sufficient heat transfer air volume. This can also cause a build up of heat within the unit which may trip the high limit safety feature. Clean filters will ensure proper functionality and safety.
    c) If the thermostat on the unit is set incorrectly as described above.
    d) If 100% outside air supply is blocked. Check for any air flow blockages at the duct intake screen.
    e) If warm air registers are blocked with furniture, throw rugs, etc.

4. If the building HVAC system is equipped to cool as well as heat, the air conditioning condensing unit must be turned "ON" when summer cooling is required. The MMAU will continue to supply 100% outdoor air on demand. Be sure to set the MMAU thermostat seasonally, this will ensure the electric heating elements do not turn on during the heat of summer.

5. The heat/cool thermostat of a building HVAC unit typically has HEAT/OFF, COOL, FAN AUTO, and FAN ON positions. The MMAU should be wired in series with each of these air demands to ensure 100% outside air is supplied in all seasons.

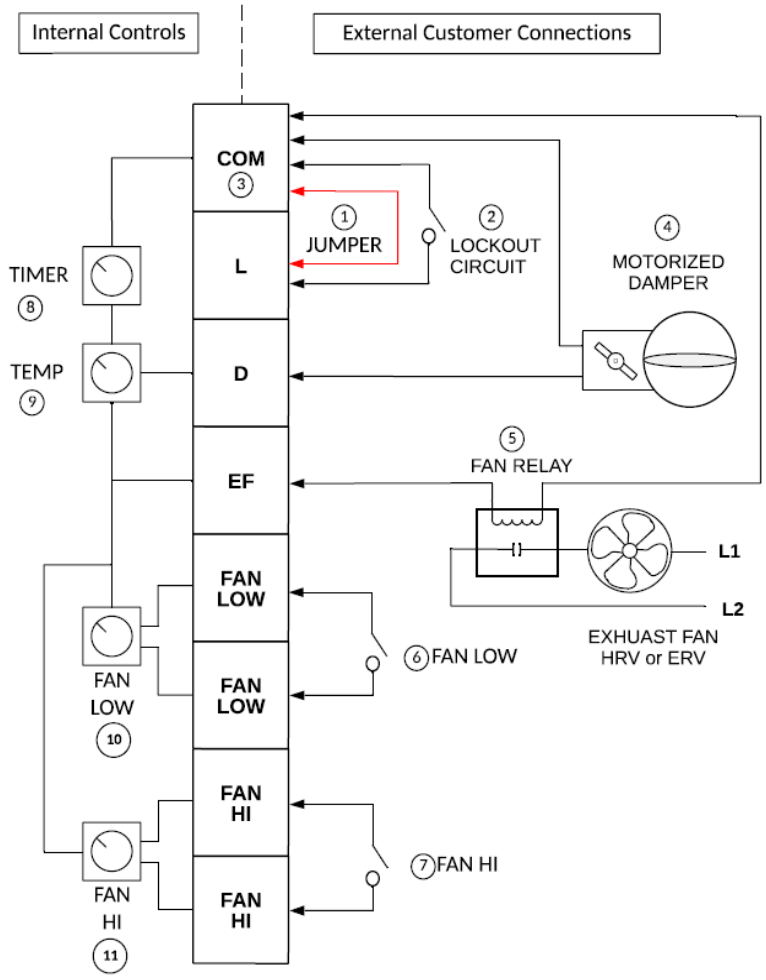
FIELD WIRING:

The KW size of the MMAU determines how many circuits are required. The units power and electrical rating table indicates how many circuits each model furnace requires, the size of the branch circuit protection at the distribution panel and the wire size required from distribution panel to the furnace. If there is any questions-consult your local and national electric codes. All wiring used must be approved for 75°C. NOTE: no wire may have more than 240 VAC potential to ground. This must be checked on installation to avoid motor damage. Unit must be grounded by connection of grounding wire from the distribution panel to the terminal provided in furnace. When the line voltage terminal block option is specified for single strike, see wiring diagram for wire size and circuit protection requirements.

INSTALLATION AND MAINTENANCE

Optional Controls Integration

The MMAU comes with the ability to work with many other HVAC controls that will exist in your ducting system. Reference the chart below to show how your system might integrate with the MMAU. Only the Internal Controls and the Jumper cable are provided. Switching devices for the Fan Low, Fan Hi, and Lockout Circuit will need to be provided by the customer.



Control Logic Notes:

1. (L – COM) are tied together with a Jumper wire as the factory default setting.

2. To enable the lockout circuit, remove the jumper wire and connect the lockout device between L and COM. Common devices are an outdoor thermostat / humidistat and/or a building management system (BMS).

3. Com = Common side of the 24VAC power supply, 40VA Max for all internal and external devices.

4. Enables a motorized damper to open by sending 24VAC to power the motor, requires a spring return to close.

5. Enables a (Fan) Relay by sending 24VAC to the energize the relay coil. Common devices are an exhaust fan, HRV or ERV. Duct the fresh air side of the HRV or ERV into the supply side of the MMAU.

6. Activates the low fan speed and modulating heat. Overrides the internal cycle timer unless it is set to 0 (zero=off) making the timer inactive.

7. Activates the high fan speed and modulating heat. Overrides low fan speed and the internal cycle timer unless it is set to 0 (zero=off) making the timer inactive.

8. CYCLE TIMER – Unit will run without external control signal in either continuous: timer set to 60, intermittent: timer set between 1 and 59. External control is required when: timer set to 0 which disables the timer function.

9. TEMPERATURE CONTROL – Adjustable temperature control of the discharge air. Modulates electric heat to maintain set temperature. Mount the sensor inside the duct a minimum of 3 feet from the unit.

10. FAN LOW – Adjustable speed control for fan low setting.

11. FAN HI – Adjustable speed control for fan high setting. This is a boost function that overrides the fan low setting.

TROUBLESHOOTING

The first step in identifying an operational problem is to determine whether the fault is in the furnace or in the thermostat and/or its connecting wiring.

To help make this determination, the furnace is equipped with a "Thermostat ON" diagnostic light. If the light is "ON", it indicates the thermostat has closed and is calling for heat; the blower should be running. If the light is "OFF", the furnace should not be operating (unless the Continuous Speed switch is set to run the motor continuously).

1. If the furnace will not start:
Turn the thermostat to its highest setting. If the light goes on, the thermostat has closed, so the fault is in the furnace. If the light does not go on, the thermostat or its connecting wiring is the problem.

2. If the furnace will not turn off:
Turn the thermostat to its lowest setting. If the light goes off and the furnace continues to run, the thermostat has opened properly and the fault is in the furnace. If the light stays on, the fault is in the thermostat or its connecting wiring.

After the fault area is isolated by use of the diagnostic light, a check of the following components can be made more efficiently.

SYMPTOM	PROBLEM	SOLUTION
Unit Is Blowing Cold Air	1. Temperature is set too low on the heat control board. 2. Thermostat temperature probe is in an incorrect location.	1. Increase the temperature by turning the knob on the temperature control board in the low voltage compartment. 2. Move the temperature probe to the outlet duct, 3 feet from the outlet of the makeup air unit.
Unit is not turning on	1. Incorrect voltage is applied. 2. Fan High and Fan Low Switches are both open	1. Check the voltage rating on the unit and make sure supplied voltage matches the unit. 2. Check that you can close the switches to allow 24V to pass between the High and Low fan settings when called for. Reference wiring diagram to locate these switch locations.
Furnace will not **start**	1. Stat wire not connected 2. Circuit breaker off 3. 24 Volt transformer burned out 4. Wire connection off or broken wires 5. Reset button tripped 6. Wrong Voltage	1. Repair 2. Reset 3. Replace 4. Repair or Replace 5. Reset 6. Check your power source
Motor will not stop	1. Defective sequencer or contactor	1. Replace
Furnace goes off on high limit	1. Dirty ducts 2. Dirty Air Filter 3. Defective Sequencer 4. Defective Limit Control 5. Power Failure	1. Clean 2. Repair or replace thermostat 3. Replace 4. Reset 5. Replace
Furnace blower making too much air noise	1. Air Filter Dirty 2. To small of a duct 3. Too small plenum chamber 4. Not enough cold air	1. Replace 2. Enlarge or replace 3. Replace 4. Enlarge
Vibration noise	1. Blower assembly loose 2. Lack of insulation	1. Secure motor and blower cage 2. Wrap furnace & ducts with insulation
Furnace has a buzzing sound when not in use	1. Low voltage transformer defective or loose	1. Replace or tighten
Furnace continues to t1eat after room is up to set temperature - does not shut off	1. Defective sequencer 2. Defective thermostat 3. Stat wire to ground 4. Motor wires to ground 5. Thermostat accidentally shorted & contacts are welded	1. Replace 2. Replace 3. Repair 4. Repair 5. Replace—Make sure connections are tight

NOTE: When converting from oil, gas, etc., to electric, replace your old low voltage thermostat that has a fixed-heat anticipator with one that has an adjustable heat anticipator.