Marvair®
An ACS Brand

Air Conditioner Product Manual
Vertical Wall-Mount Air Conditioners with DC Evaporator Fan Motor

Installation & Operation Manual
10-11 EER Vertical Wall-Mount Air Conditioners with 48VDC Evaporator Fan Motor

MODELS:

MAH1036D-MAH1042D

MAH1048D-MAH1060D

MGH1072D

AHRI CERTIFIED® www.ahridirectory.org Single Package Vertical AC AHRI Standard 390

Intertek

Designed, Engineered & Assembled In the USA

IMPORTANT

This manual may include information for options and features which may not be included on the unit being installed. Refer to the unit data label or Model Identification to determine which features and options this unit is equipped with.

INSTALLER: Affix the instructions on the inside of the building adjacent to the thermostat.

END USER: Retain this manual for future reference.

Manufactured By:

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The most current version of this manual can be found at www.Marvair.com.

How To Use This Manual

This manual is intended to be a guide to Marvair's MAH1036D–1060D & MGH1072D line of vertical air conditioners. It contains installation, troubleshooting, maintenance, warranty, and application information. The information contained in this manual is to be used by the installer as a guide only. This manual does not supersede or circumvent any applicable national or local codes.

If you are installing the MAH/MGH unit, first read Chapter 1 and scan the entire manual before beginning the installation as described in Chapter 2. Chapter 1 contains general, descriptive information and provides an overview which can speed up the installation process and simplify troubleshooting.

If a malfunction occurs, follow this troubleshooting sequence:

1. Make sure you understand how the unit works (Chapters 1 & 3).
2. Identify and correct installation errors (Chapter 2).
3. Refer to the troubleshooting information in Chapter 4 and the Frequently Asked Questions in Chapter 5.

If you are still unable to correct the problem, contact the Factory at 1-800-841-7854 for additional assistance.

Please read the following "Important Safety Precautions" before beginning any work.

Important Safety Precautions

1. This unit uses an A2L, or mildly flammable, refrigerant. Extra precautions should be taken when handling or servicing the unit so as not to puncture the refrigerant tubing.

WARNING - Risk Of Fire. Flammable Refrigerant Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture Refrigerant Tubing.

WARNING - Risk Of Fire. Dispose Of Properly In Accordance With Federal Or Local Regulations. Flammable Refrigerant Used.

2. LEAK DETECTION SYSTEM Installed. Unit must be powered on except for service.
3. FULLY EVACUATE the system and verify that there is no refrigerant in the working area before brazing.
4. USE CARE when LIFTING or TRANSPORTING equipment.
5. TRANSPORT the UNIT UPRIGHT. Laying it down on its side may cause oil to leave the compressor and breakage or damage to other components.
6. TURN ELECTRICAL POWER OFF AT THE breaker or fuse box BEFORE installing or working on the equipment. LINE VOLTAGES ARE HAZARDOUS or LETHAL.
7. OBSERVE and COMPLY with ALL applicable PLUMBING, ELECTRICAL, and BUILDING CODES and ordinances.
8. DO NOT USE MEANS TO ACCELERATE THE DEFROSTING PROCESS OR TO CLEAN, other than those recommended by the manufacturer.
9. The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater).
10. DO NOT PIERCE OR BURN.
11. BE AWARE THAT REFRIGERANTS MAY NOT CONTAIN AN ODOR.
12. SERVICE may be performed ONLY by QUALIFIED and EXPERIENCED PERSONS.
    - *** Wear safety goggles when servicing the refrigeration circuit**
    - *** Beware of hot surfaces on refrigerant circuit components**
    - *** Beware of sharp edges on sheet metal components**
    - *** Use care when recovering or adding refrigerant**
13. **Use COMMON SENSE - BE SAFETY-CONSCIOUS**

This is the safety alert symbol ⚠. When you see this symbol on the Marvair unit and in the instruction manuals be alert to the potential for personal injury. Understand the signal word DANGER, WARNING, CAUTION and IMPORTANT. These words are used to identify levels of the seriousness of the hazard.

DANGER	Failure to comply will result in death or severe personal injury and/or property damage.
WARNING	Failure to comply could result in death or severe personal injury and/or property damage.
CAUTION	Failure to comply could result in minor personal injury and/or property damage.
IMPORTANT	Used to point out helpful suggestions that will result in improved installation, reliability or operation.

WARNING

- **If the information in these instructions are not followed exactly, a fire may result causing property damage, personal injury or loss of life.**
- **Read all instructions carefully prior to beginning the installation. Do not begin installation if you do not understand any of the instructions.**
- **Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life.**
- **Installation and service must be performed by a qualified installer or service agency in accordance with these instructions and in compliance with all codes and requirements of authorities having jurisdiction.**

INSTALLER: Affix the instructions on the inside of the building adjacent to the thermostat.
END USER: Retain these instructions for future reference.

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Chapter 1 Description & Specifications

1.1 General Description

Marvair® MAH1036D–1060D & MGH1072D air conditioners are designed to cool telecommunications shelters where the high internal heat load requires year round cooling-even when ambient temperatures are below 60°F (15°C). All models are certified for efficiency and cooling capacity (BTUH) according to AHRI standard 390. To provide cooling during a wide range of ambient conditions, the air conditioners have the necessary controls and components for year round cooling. All models use the non-ozone depleting R-454B refrigerant.

DC power provides emergency cooling/ventilation

Should there be loss of power to the site, the Marvair DC Free Air ventilation mode will continue to cool/ventilate the site by utilizing DC power to introduce outside air into the shelter for free cooling. The DC Free Air vent will continue to ventilate the site and extend the run time of the equipment until battery power is exhausted or, at the minimum, owner specified pull down of battery drain.

All MAH and MGH models operate on both AC and DC power. The compressor, condenser fan motor and electric heat operate on AC power, but the evaporator motors, the 100% free cooling economizer damper and the internal control board operate on DC power – an inverter is **not** required. Since these key components are all powered by 48 VDC – the same 48 VDC power used by the shelter's radios-they are always operational.

The 48 VDC power supply connects to an internal DC breaker in the air conditioner to provide DC power to the indoor air mover and control board. A 48 VDC to 24 VDC converter powers the 100% DC free cooling damper.

All models in this manual are equipped with a leak detection system. Once the unit is installed it must be powered, at all times, except for service. During normal operation the leak detection system has no impact on the operation of the unit, however upon detection of R-454B refrigerant all operations are stopped except for the indoor blower. The unit will then re-circulate air in the room for a minimum of 5 minutes. Once the 5 minutes have expired and the concentration of the refrigerant is below 8 percent of the Lower Flammability Limit (LFL) the unit will be allowed to operate as normal. If the concentration of the refrigerant remains above 8 percent of the LFL the unit will remain in re-circulation mode. To verify actuation of mitigation simply remove the sensor from the mitigation control board and the system should stop all operation except for the indoor blower. There is no need to calibrate or service the sensor. The sensor will provide an alarm upon failure or end of life. The sensor must be replaced with an identical sensor, or a manufacturer approved alternative.

Free Cooling with the Marvair 100% Full flow Economizer

When the outside air is cool and dry, the economizer damper opens and draws in filtered, outside air to cool the shelter. The Marvair 100% full flow economizer means the same CFM of outside air is brought into the shelter as the rated air flow of the unit. The innovative design of the full flow economizer assembly also allows outside air to exit the building – pressure relief- when the full flow economizer is operating. This design eliminates the need for additional, costly penetrations in the shelter.

Free cooling provides temperature control, energy savings, and increased reliability by decreasing the operating hours of the compressor and the condenser fan. To insure proper operation and optimum performance, all economizers are non-removable, factory installed and tested.

CoolLinks™ PLC controller

The CoolLinks PLC controller sequences the operation of the air conditioners to provide the most efficient cooling of the shelter. The CoolLinks controller communicates with the Marvair air conditioners over Ethernet. An Ethernet connection is also provided for an SNMP interface through which the Network Operations Center can receive traps (alarms), monitor/change heating and cooling set points and monitor HVAC and system operational parameters.

A complete description of the operation and installation of the CoolLinks controller is in the CoolLinks Installation and Operation manual. This manual is shipped with each controller.

1.2 Model Identification

The model identification number is found on the data sticker. Rating plate located on side panel.

Example	M	A	H	1	0	3	6	D	A	0	5	0	C	R	+	+	+	1	D	A	+	A	1	1	+	+	+	+	+	+
Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

1	Unit Designation/Family	**M** = Marvair Wall Mount
2	Energy Efficiency Ratio (EER)	**A** = 11 **G** = 10
3	Refrigerant Type	**H** = R-454B
4	Compressor Type/Quantity	**1** = Single **2** = 2-Stage/Single
5 6 7	Unit Capacity/Nominal Cooling (BTUH)	**036** = 36,000 **060** = 60,000 **042** = 42,000 **072** = 72,000 **048** = 48,000
8	System Type	**D** = 48VDC Dual Power Supply
9	Power Supply (Volts-Hz-Phase)	**A** = 208/230-60-1 **D** = 460-3-60 **C** = 208/230-60-3
10 11 12	Heat Designation @ Rated Voltage **KW** = Kilowatt	**000** = No Heat **060** = 6KW **050** = 5KW **100** = 10KW
13	Ventilation Configuration	**A** = Solid Front Door **C** = Economizer **$** = Special
14	Dehumidification	**R** = Electric Reheat **T** = Electric Reheat w/Humidity Control **+** = None **$** = Special
15	Controls	**A** = Power Fail Alarm w/Additional Lockouts **C** = 24V EMS Relay Kit **+** = None **$** = Special
16	Operating Condition	**A** = Evaporator Freeze Sensor (EFS) **C** = EFS w/Hot Gas Bypass **N** = Hard Start **P** = Hard Start w/Low Ambient & CCH **Q** = Hard Start w/Low Ambient & Fan Cycle Control (FCC) **R** = Crank Case Heater (CCH) **T** = Hard Start w/EFS **U** = Hard Start w/Hot Gas Bypass **V** = Hard Start w/Low Ambient & CCH & EFS **W** = Low Ambient w/CCH **X** = Hot Gas Bypass **Y** = Low Ambient w/CCH & FCC **Z** = Low Ambient w/CCH & EFS **1** = Low Ambient w/FCC **2** = Low Ambient w/FCC & EFS **3** = CCH w/Hot Gas Bypass **+** = None **$** = Special

17	Indoor Air Quality Features	**D** = Dry Bulb Sensor **E** = Dry Bulb Sensor w/Dirty Filter **G** = Dirty Filter Sensor **+** = None **$** = Special
18	Air Flow	**1** = Top Supply/Center Return **$** = Special
19	Compressor Location	**D** = Left Hand **E** = Right Hand
20	Filter Option	**A** = 2" Pleated (MERV 8, AC/HP-C) **C** = 2" Charcoal **D** = MERV 11 High Filtration Package **E** = MERV 13 High Filtration Package **F** = Filter Access Through Return Air Grille **W** = Aluminum Washable **+** = None **$** = Special
21	Corrosion Protection	**A** = Condenser Coil Only **C** = Evaporator Coil Only **D** = Both Coils Condenser & Evaporator **E** = All Coils Cond/Evap/Reheat **F** = Coat All **K** = Coastal Package **+** = None **$** = Special
22 23	Engineering Revision Level	A1
24	Cabinet Color	**1** = Marvair Beige (STD) **2** = Gray (STD) **3** = Carlsbad Canyon (STD) **4** = White (STD) **5** = Stainless Steel Exterior **9** = Pebble Gray **A** = Stainless Steel - Unit **$** = Custom Color (Powder Coat)
25	Sound Attenuation	**2** = Compressor Blanket **+** = None
26	Security Option	**A** = Lockable Access Plate/Tamper Proof **+** = None **$** = Special
27	Fastener/Drain Pan Option	**A** = Stainless Steel Fasteners **C** = Stainless Steel Drain Pan **D** = Stainless Steel Fasteners & Drain Pan **+** = None **$** = Special
28	Unused	**+** = None **$** = Special
29	Unused	**+** = None **$** = Special
30	Special Variation	**+** = None **$** = Special Configuration Not Covered by Model Nomenclature

Note: Not all options are available with all configurations. Contact your Marvair sales representative for configuration details and feature compatibility.

1.3 Serial Number Date Code

A = January	E = May	J = September	D = 2014	H = 2018	M = 2022
B = February	F = June	K = October	E = 2015	J = 2019	N = 2023
C = March	G = July	L = November	F = 2016	K = 2020	P = 2024
D = April	H = August	M = December	G = 2017	L = 2021	R = 2025

1.4 Air Flow, Weights and Filter Sizes

Complete electrical and performance specifications and dimensional drawings are in the Product Data Sheet.

Note: Follow local codes and standards when designing duct runs to deliver the required airflow. Minimize noise and excessive pressure drops caused by duct aspect ratio changes, bends, dampers and outlet grilles in duct runs.

MODEL	0.10	0.15	0.20	0.25	0.30	0.40	0.50
MAH1036D	1290	1230	1170	1115	1060	1000	***920***
MAH1042D	1500	1430	1360	1295	1230	1160	***1070***
MAH1048D	1900	1850	1800	1700	1600	1500	***1350***
MAH1060D	1900	1850	1800	1700	1600	1500	***1350***
MGH1072D			2100	1950	1800	1730	***1660***

Values in bold are the minimum air flow. Air flow ratings of 208-230 volt units are at 230v. Air flow ratings of 460 volt units are at 460 volts. Operation of units at a voltage different from the rating point will affect air flow. Air flow ratings for 575 volt units are at 575 volts. Marvair does not recommend operating at airflows lower than what is stated in this table

Table 1. CFM @ External Static Pressure (Wet Coil) (IWG)

MODEL	INCHES	MILLIMETERS	PART NUMBER	FILTERS PER UNIT	MERV RATING
MAH1036D/1042D/1048D	36½ x 22 x 2	927 x 559 x 52	80162	1	8 (STD)
MAH1060D/MGH1072D	18 x 24 x 2	457 x 610 x 52	92491	2	8 (STD)

Table 2. Return Air Filter Sizes

MODEL	LBS	KG
MAH1036D/1042D	590	268
MAH1048D/1060D/MGH1072D	640	291

Table 3. Shipping Weights

	MAH1036D	MAH1042D	MAH1048D	MAA1060D	MGA1072D
Refrigerant Charge (oz.)	90	112	112	105	135
Minimum Room Size (ft^2)	88.3	109.8	109.8	103.3	132.4
Minimum Supply Height (ft)	6.9	6.9	6.9	6.9	6.9

Table 4. Refrigerant Charge and Room Size Limitations

Altitude (Meters)	Altitude (Feet)	Correction Factor
0	0	1.0
200	660	1.0
400	1310	1.0
600	1970	1.0
800	2620	1.0
1000	3280	1.1
1200	3940	1.1
1400	4590	1.1
1600	5250	1.1
1800	5910	1.2
2000	6560	1.2
2200	7220	1.2
2400	7870	1.3
2600	8530	1.3
2800	9190	1.3
3000	9840	1.4
3200	10500	1.4
3400	11150	1.5
3600	11810	1.5
3800	12470	1.6
4000	13120	1.6
4200	13780	1.7
4400	14440	1.7
4600	15090	1.8
4800	15750	1.9
5000	16400	1.9
In accordance with UL 60335-2-40, for units above 600m, multiply the minimum room area stated in the table above by the correction factor that corresponds with the altitude the unit is located at. This will give you a new minimum room area that is adjusted for your altitude. The units listed in this manual are not intended for use above 5000 meters.		

Table 5. Altitude Correction Factor

1.5 General Operation

Refrigerant Cycle (Cooling Mode)

All Marvair® MAH/MGH models use R-454B refrigerant in a conventional vapor-compression refrigeration cycle to transfer heat from air in an enclosed space to the outside. Two backward curved motorized impellers blow indoor air across the evaporator. Cold liquid refrigerant passing through the evaporator is boiled into gas by heat removed from the air. The warmed refrigerant gas enters the compressor where its temperature and pressure are increased. The hot refrigerant gas condenses to liquid as heat is transferred to outdoor air drawn across the condenser by the condenser fan. Liquid refrigerant is metered into the evaporator to repeat the cycle.

Heating Mode

The CoolLinks controller controls the heating cycle of models which incorporate resistance heating elements. On a call for heat, the thermostat closes the heat relay to energize the indoor fan and the resistance elements. Please see Appendix A for instructions on field installing electric heaters.

Economizer Operation

The economizer is a regulated damper system with controls. The damper regulates the circulation of outside air into the enclosure (when the outdoor air conditions are suitable) to reduce the need for mechanical cooling, save energy, and extend compressor life.

Depending upon the options selected, the damper responds to the dew point of the outdoor air. On a call for cooling from a space thermostat, it operates as follows:

When the dew point of the outdoor air is below the set point, the outdoor air damper is proportionally open (and return air damper is proportionally closed) to maintain approximately 55°F (13°C) at the mixed/discharge air sensor. Integral pressure relief allows the indoor air to exit the shelter through the air conditioner.

When the dew point of the outdoor air is above the set point, the outdoor air damper closes to its minimum position. A call for cooling from the CoolLinks controller brings on mechanical cooling.

1.6 Control Board Mode of Operation

Normal

24 VAC power must be continuously applied to "R" and "C". Upon a call for cooling "Y" and with the high pressure switch (HPS) closed, the compressor will be energized. (Note: See the delay on make feature.) The compressor will remain energized during the 3 minute timed low pressure by-pass cycle. If the low pressure switch (LPS) is open after the 3 minute by-pass cycle, the compressor will de-energize.

Lock-out

If either of the fault conditions (LPS or HPS) occurs twice during the same call for cooling, the control board will enter into and indicate the lockout mode. In the lockout mode, the compressor is turned off. If there is a call for indoor air flow "G", the blower remains energized, the alarm output is energized and the status LED will blink to indicate which fault has occurred. When the lockout condition is cleared, the unit will reset if the demand for the thermostat is removed or when the power is reset. With the control board, the user can now have either normally closed or normally open remote alarm dry contacts. The air conditioners are factory wired to be normally open.

Delay on Break

If the compressor is de-energized due to a loss of a cooling "Y" call or the first fault, the unit re-start will be delayed 3 minutes from the time the contactor is de-energized. (Note: There is no delay on break if the lockout condition is reset.)

Delay on Make

On initial power up only, the unit will wait 0.03 to 10 minutes from the cooling "Y" call before allowing the contactor to energize. The delay can be adjusted by the DOM wheel on the board. Factory recommended wait is 3 minutes.

Low Pressure By-Pass Time

When starting, the low pressure switch (LPS) fault condition will be by-passed for 3 minutes before the contactor is de-energized.

Post Purge

Upon a call for indoor airflow "G" the blower will energize immediately. When in the cooling mode, the indoor air mover will remain energized for 10 to 90 seconds (adjustable) after the compressor has been de-energized. The time period can be changed by fan purge wheel on the board. Factory setting is 90 seconds.

LED Indicator Lights

COLOR	TYPE	STATUS	DESCRIPTION
Green	Power	Constant On	24 VAC power has been applied
Red	Status	Constant On	Normal operation
Red	Status	1 Blink	High pressure switch has opened twice
Red	Status	2 Blinks	Low pressure switch has opened twice

Low Ambient Control

The low ambient control permits cooling when outdoor ambient temperatures are low. The control uses

a reverse-acting high pressure switch to cycle the condenser fan motor according to liquid refrigerant pressure conditions. Switch closure and fan operation occurs when the pressure reaches 400 PSIG. The switch opens again when the refrigerant pressure falls to 290 PSIG. Therefore, the outdoor fan always starts after the compressor, and **it will cycle frequently during normal operation at low outdoor conditions.**

High Pressure Switch

The high pressure switch is mounted on the liquid line. It is electrically connected to a lockout circuit on the board which shuts down the system if the refrigerant pressure rises to 650 PSIG. This protects the unit if airflow through the condenser is blocked or if the outdoor fan motor fails.

Although the contacts of the high pressure switch close when the refrigerant pressure falls to approximately 450 PSIG, the system must be manually reset once the lockout circuit is activated. A manual reset is necessary to prevent harmful short-cycling. To reset switch, turn primary power off, then back on or turn thermostat system switch off, then back on.

Low Pressure Switch

The low pressure switch is mounted on the compressor suction line. It is designed to open if the refrigerant pressure drops to 40 PSIG; it resets when the pressure rises to 60 PSIG. The switch protects the unit if airflow through the indoor blower is impeded, if the blower motor fails, or if there is a loss of refrigerant.

1.7 Optional Controls & Packages

Hard Start Kit

Used on single phase equipment to give the compressor higher starting torque under low voltage conditions.

Extreme Duty Package

The Extreme Duty Package allows the air conditioners to operate in extremely cold and hot ambient conditions. The Extreme Duty Kit is always factory installed. Economizer equipped air conditioners will operate from -20° F to 130° F (-29° to 54°C).

The Extreme Duty Package includes a suction line accumulator, thermal expansion valve (TXV), crankcase heater, hard start kit, an auto reset, high pressure switch and an outdoor thermostat and fan cycle switch. The fan cycle control is standard on all MAH/MGH air conditioners and operates based upon the liquid line pressure. The outside thermostat closes whenever the outside temperature is below 50°F (10°C) and opens when the outside temperature is 50° F (10°C) or higher. Whenever the temperature is below 50°F (10°C), the fan cycle switch is in the circuit; when temperatures are 50° F (10°C) or higher, the fan cycle switch is not in the circuit. The fan cycle control is used with a TXV to prevent excessive cycling or "hunting" of the TXV.

Protective Coating Packages

Typically only non-economizer units are used in corrosive environments, but economizer equipped air conditioner are also available with corrosion protection. Two corrosion protection packages are offered- one for the condenser section (the Coastal Environmental package) and the other for the entire unit (the Coat-All Package).

The condenser protection package includes:

- Corrosion resistant fasteners
- Sealed or partially sealed condenser fan motor
- Two layer epoxy/urethane applied to all exposed internal copper and metal in the in the condenser section
- An impregnated polyurethane on the condenser coil.

The Coat-all package includes all of the above but also includes an impregnated polyurethane on the evaporator coil and the two layer epoxy/urethane on all exterior and interior components and sheet metal. (Note: the internal sheet metal which is insulated and the internal control box are not coated).

See the Sept. 2013 Sales and Marketing Notice, Coastal Environmental Package, the Coat-All Package and coated condenser & evaporator coils for more details.

Three Phase Voltage Monitor

Continuously measures the voltage of each of the three phases. The monitor separately senses low and high voltage, voltage unbalance including phase loss and phase reversal. A RED LED glows to indicate a fault. A GREEN indicator glows when all voltages are acceptable. Automatically resets when voltages and phases are within operating tolerances. Not required on 1ø units.

Dirty Filter Indicator

A diaphragm type of indicator measures the air pressure on either side of the filter and when the pressure drops below the set point, a red LED is illuminated. The set point is adjustable.

Protective Coil Coatings

Either the condenser or evaporator coil can be coated, however, coating of the evaporator coil is not common. For harsh conditions, e.g., power plants, paper mills or sites were the unit will be exposed to salt water, the condenser coil should be coated. Note: Cooling capacity may be reduced by up to 5% on units with coated coils.

Lockable Disconnect Access Cover Plate

The access plate to the service disconnect switch can be equipped with a lockable cover.

Cabinet Color

Marvair air conditioners are available in six different cabinet colors. The standard colors are Marvair® beige, white, gray and Carlsbad Canyon (brown). The standard cabinet's sides, top and front panels are constructed of 20 gauge painted steel. Contact your Marvair representative for color chips. Custom colors are also available; contact Marvair for details.

Two stainless steel cabinet constructions are available:

Stainless Steel Exterior (Option "5"): This option replaces all standard exterior painted surfaces with stainless steel. This option also replaces the standard unpainted compressor base of the unit and exterior cabinet screws with stainless steel. No other standard construction surfaces are stainless steel in this option, unless listed in this description. Back panel is not stainless steel with this option. This option is designed to give a more economical alternative to full stainless steel, and still offer an enhanced level of protection. For further corrosion protection, please see our "A" offering at full stainless on all metal components.

Stainless Steel Unit (Option "A"): This option replaces all interior and exterior steel sheet metal parts with stainless steel. All galvanized and painted steel surfaces found in the standard unit are stainless steel with this option. All cabinet screws are stainless steel. No other standard construction surfaces are stainless steel, unless listed in this description. This option is designed to give our most robust protection against steel corrosion.

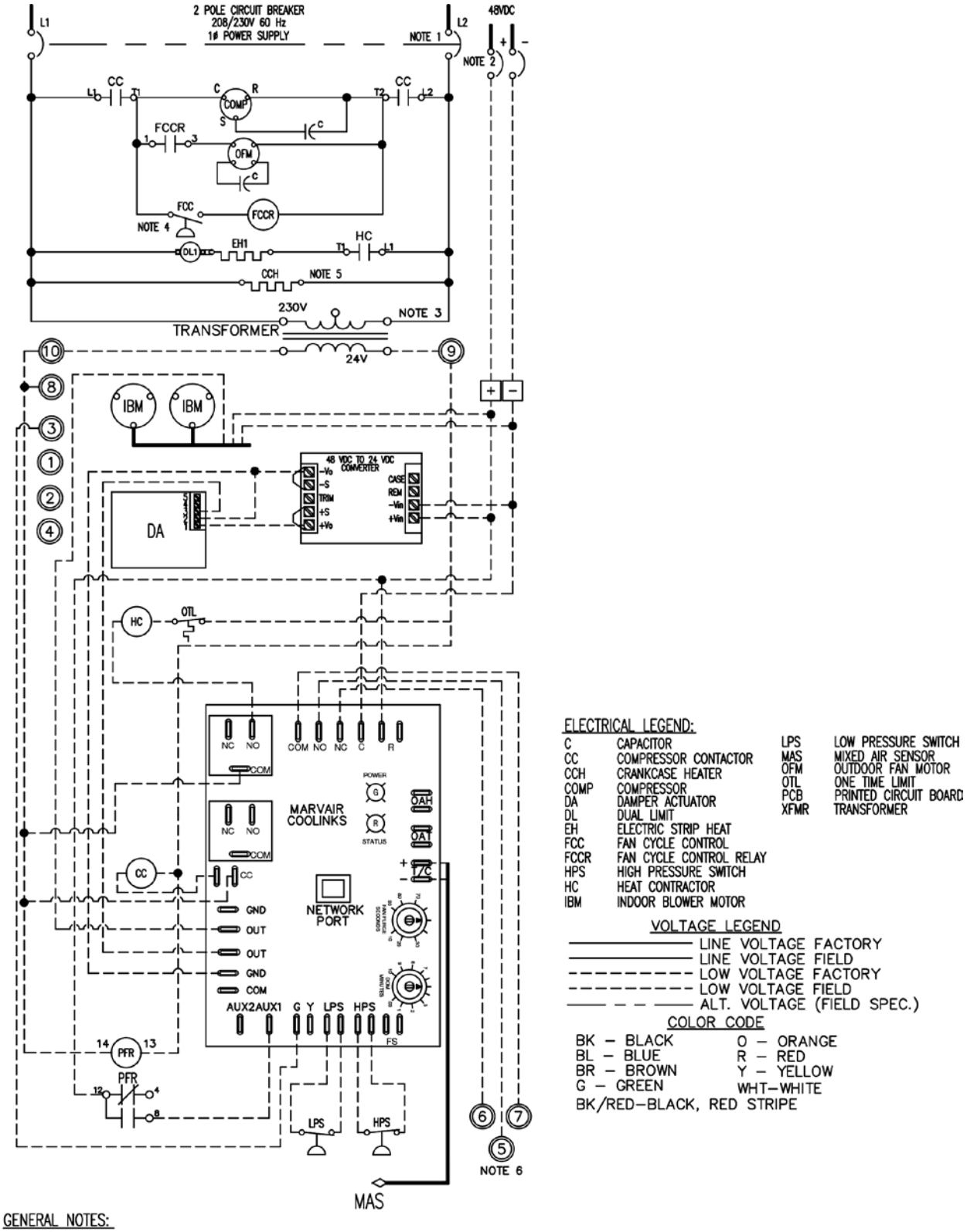
1.8 Electrical Operation

The compressor and condenser fan are energized with a contactor controlled by a 24 VAC pilot signal.

Some compressors incorporate an internal PTC crankcase heater that functions as long as primary power is available. The heater drives liquid refrigerant from the crankcase and prevents loss of lubrication caused by oil dilution. Power must be applied to the unit for 24 hours before starting the compressor.

The condenser (outside fan) motor is energized by the same contactor. However, the motor is cycled on and off by the low ambient control (see low ambient control 1.6).

The indoor evaporator fan motor and the free cooling damper require 48 VDC power. A 48 VDC to 24 VDC converter powers the 100% free air damper.



ELECTRICAL LEGEND:

C	CAPACITOR	LPS	LOW PRESSURE SWITCH
CC	COMPRESSOR CONTACTOR	MAS	MIXED AIR SENSOR
CCH	CRANKCASE HEATER	OFM	OUTDOOR FAN MOTOR
COMP	COMPRESSOR	OTL	ONE TIME LIMIT
DA	DAMPER ACTUATOR	PCB	PRINTED CIRCUIT BOARD
DL	DUAL LIMIT	XFMR	TRANSFORMER
EH	ELECTRIC STRIP HEAT		
FCC	FAN CYCLE CONTROL		
FCCR	FAN CYCLE CONTROL RELAY		
HPS	HIGH PRESSURE SWITCH		
HC	HEAT CONTRACTOR		
IBM	INDOOR BLOWER MOTOR		

VOLTAGE LEGEND

- LINE VOLTAGE FACTORY
- LINE VOLTAGE FIELD
- LOW VOLTAGE FACTORY
- LOW VOLTAGE FIELD
- ALT. VOLTAGE (FIELD SPEC.)

COLOR CODE

BK – BLACK	O – ORANGE
BL – BLUE	R – RED
BR – BROWN	Y – YELLOW
G – GREEN	WHT–WHITE

BK/RED–BLACK, RED STRIPE

GENERAL NOTES:

1. 208/230 VOLT 60 Hz 1ø POWER SUPPLY. SEE DATA PLATE FOR AMPACITY & FUSE SIZE. OPTIONAL CKT BKR SHOWN.
2. 48VDC POWER SUPPLY. POLARITY MUST BE CORRECT TO AVOID SYSTEM DAMAGE.
3. TRANSFORMER IS FACTORY WIRED FOR 230 VOLT OPERATION. FOR LOWER VOLTAGES, INTERCHANGE ORANGE AND RED LEADS. INSULATE UNUSED LEADS.
4. ALTERNATE DEVICE IS NOT ADJUSTABLE AND HAS ORANGE LEADS.
5. CRANKCASE HEATER MAY NOT BE REQUIRED ON ALL COMPRESSORS.
6. THE LOCKOUT CIRCUIT CONTACTS ARE N.O. BETWEEN TERMINALS 5 AND 7 OF THE LOW VOLTAGE TERMINAL BOARD AND N.C. BETWEEN TERMINALS 7 AND 6 OF THE LOW VOLTAGE TERMINAL BOARD.

Figure 1. Typical Electrical Schematic - MAH/MGH Air Conditioners

1.9 Economizer Components

Damper Actuator:
The damper actuator is a 48VDC motor that modulates the position of the damper blade. It is capable of driving a full 90 degrees within 90 seconds. The assembly has a spring return to close the damper during power outage.

Controls:
The economizer is controlled by a dew point sensor.

Economizer Changeover Control:
When the calculated dew point is below 60°F (15.5°C), the outside temperature is below 70°F (21°C) and the outside relative humidity is below 80%, mechanical cooling is disabled and outside air is introduced to cool shelter. All three conditions must be satisfied before the DC Free-Air cooling is enabled. In DC free air cooling, the damper is opened and its position regulated to mix outside air with internal shelter air. Every 24 hours, the damper is opened to 50% to verify operation of the motor, the damper fault switch and the damper actuator linkage,.

Once the dew point sensor has selected outside air, the mixed air sensor will limit the air temperature delivered to the space by modulating the damper blade to "mix in" a quantity of inside air and cooler outside air. Every 24 hours, the damper is opened 50% to verify operation of the damper motor, damper fault switch and the damper acutator linkage.

On a call for cooling from the CoolLinks controller, if outdoor conditions are suitable, the sensor will open the damper and admit outside air (i.e., economizer cooling). If the outdoor ambient is too hot or humid, the sensor will place the actuator in the closed or minimum open position and activate mechanical cooling. The compressor is locked out during the economizer cooling mode.

Mixed Air Sensor:
When the air conditioner is in the free cooling mode, a thermocouple senses the return air and modulates the damper to mix outside air and return air so that approximately 55°F (13ºC) air is delivered to the shelter. Mixing return and outside air by modulating the damper prevents "shocking”the equipment if the outside is extremely cold.

Chapter 2 Installation

⚠ WARNING

Failure to observe and follow Warnings and Cautions and these Instructions could result in death, bodily injury or property damage. Read this manual and follow its instructions and adhere to all Cautions and Warnings in the manual and on the Marvair unit.

2.1 Equipment Inspection

Concealed Damage

Inspect all cartons and packages upon receipt for damage in transit Remove cartons and check for concealed damage. **Important: keep the unit upright at all times.** Remove access panels and examine component parts. (Note: the "L"-shaped bottom bracket is screwed to the shipping pallet, against the air conditioner. Remove it before replacing the side screen). Inspect refrigerant circuit for fractures or breaks. The presence of refrigerant oil usually indicates a rupture. If damage is apparent, immediately file a claim with the freight carrier.

Units that have been turned on their sides or tops may have concealed damage to compressor motor mounts or to the oil system. If the unit is not upright, immediately file a claim for concealed damages and follow these steps:

1. Set unit upright and allow to stand for 24 hours with primary power turned on.
2. Attempt to start the compressor after 24 hours.
3. If the compressor will not start, makes excessive noise, or will not pump, return the unit to the freight carrier.

2.2 Pre Checks

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

1. The actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed.
2. The ventilation machinery and outlets are operating adequately and are not obstructed.
3. If an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant.
4. Marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.
5. Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.
6. Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

2.3 Installation Requirements

General

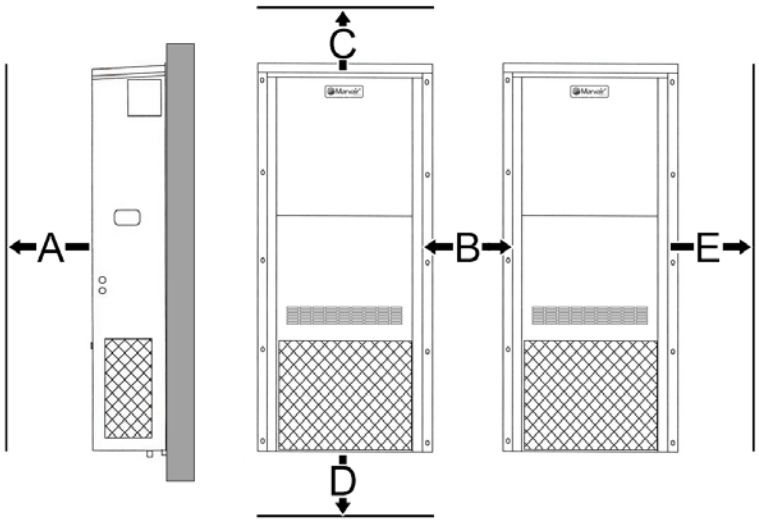
1. Inspect unit for completeness. Check for missing parts (e.g. hardware). Refer to the installation kit information in section 2.4.

2. Remove access panels and check for loose wires. Tighten screw connections.
3. Complete and mail the warranty registration card.

You must consider all of the following when choosing the installation site:

1. **Noise.** Install the unit so that the least amount of noise will be transmitted to inhabited spaces.
2. **Condensate Drainage**. Condensate produced during operation must be discharged to a suitable drain.
3. **Placement.**
   A) Place the unit in a shaded area, if possible.
   B) Install it above ground for protection against flooding.
   C) The unit exhausts air. Be sure that the airflow is not impeded by shrubbery or other obstructions.
   D) When installing multiple units, please note the recommended clearances noted in Table 4.
4. **Airflow Requirements:**
   Note the maximum static pressure (Table 6). Keep duct lengths as short as possible. Do not obstruct airflow through the unit.

   Duct work should be designed and installed in accordance with *all* applicable safety codes and standards. Marvair® strongly recommends referring to the current edition of the National Fire Protection Association Standards 90A and 90B *before* designing and installing duct work. The duct system must be engineered to insure sufficient air flow through the unit to prevent over-heating of the heater element. This includes proper supply duct sizing, sufficient quantity of supply registers, and adequate return and filter areas. Duct work must be of correct material and must be properly insulated. Duct work must be constructed of galvanized steel with a minimum thickness of .019 inches. Duct work must be firmly attached, secured, and sealed to prevent air leakage. See section 2.4 for additional duct work requirements.
5. **Clearances:**
   Note the minimum clearances required for proper operation and service.



MODEL	MIN. CLEARANCE TO FRONT OF UNIT	MIN. CLEARANCE BETWEEN UNITS (TWO UNITS)	MIN. SPACE ABOVE UNIT	MIN. SPACE BELOW UNIT	MIN. CLEARANCE AROUND SIDES (SINGLE UNIT)
	A	B	C	D	E
1036D	10 feet (3 meters)	18 inches (46 cm)	24 inches (61 cm)	6 inches (15 cm)	30 inches (76 cm)
1042D/1048D/1060D/1072D	10 feet (3 meters)	30 inches (76 cm)	24 inches (61 cm)	6 inches (15 cm)	30 inches (76 cm)

Figure 2. Minimum Clearances

6. **Codes:**
   Make sure your installation conforms to all applicable electrical, plumbing, building, and municipal codes. Some codes may limit installation to single story structures.

7. **Electrical Supply:**
   The power supply must have the appropriate voltage, phase, and ampacity for the model selected. Voltage must be maintained above minimum specified values listed below. Refer to the data sticker on the unit for ampacity requirements.

Electrical Rating Designations*	A	C
Nominal Voltage	208/230	208/230
Phase	1	3
Minimum Voltage	197	197
Maximum Voltage	253	253

* Letters refer to model number code designations. Refer to page 5.

Table 6 Voltage Limitations

2.4 Installation Materials

Installation Kits

The units are shipped with one 12 Ga. "L" shaped bottom bracket. If you have not yet unpacked the unit, follow the instructions in section 2.1. All units have built-in full length mounting flanges. Therefore, use of mounting brackets is not required.

Kit Components:

1. One 12 Ga. "L"-shaped bottom bracket.

Accessories:

The package may include other factory-supplied items (optional) as follows on the next page:

For MAH1036D

Supply Grille:
28” x 8” (711mm x 203mm) ..... P/N 80675

Return Grille:
20” x 12” (508mm x 356mm) ..... P/N 80678

For MAH1042D-1048D-1060D & MGH1072D

Supply Grille:
30” x 10” (762mm x 254mm) ..... P/N 80676

Return Grille:
30” x 16” (762mm x 406mm) ..... P/N 80679

Additional Items Needed:

Additional hardware and miscellaneous supplies (not furnished by Marvair®) are needed for installation. For example, the list below contains approximate quantities of items typically needed for mounting a unit on a wood frame wall structure. Concrete or fiberglass structures have different requirements.

(10) **3/8" carriage head mounting bolts** for unit mounting flanges. The length needed is typically the wall thickness plus one inch.

(20) **3/8" washers**

(10) **3/8" hex nuts**

(6) **3/8" x 2-1/2" lag screws** for bottom bracket

- **Silicone Sealer** to seal around cracks and openings
- **Minimum 5 conductor low voltage multicolored wire cable** (i.e. thermostat wire)
- **Appropriate electrical supplies** such as **conduit, electrical boxes, fittings, wire connectors,** etc.
- **High voltage wire**, sized to handle the MCA (minimum circuit ampacity) listed on the data plate.
- **Over-Current Protection Device** sized in accordance with the MFS (maximum fuse size) listed on the unit data plate.

⚠ WARNING FIRE HAZARD

Improper adjustment, alteration, service, maintenance or installation could cause serious injury, death and/or property damage.

Installation or repairs made by unqualified persons could result in hazards to you and others. Installation MUST conform with local codes or, in the absence of local codes, with codes of all governmental authorities have jurisdiction.

The information contained in this manual is intended for use by a qualified service agency that is experienced in such work, is familiar with all precautions and safety procedures required in such work, and is equipped with the proper tools and test instruments.

2.5 Porting and Duct Work

General Information

Note: The following instructions are for general guidance only. Due to the wide variety of installation possibilities, specific instructions will not be given. When in doubt, follow standard and accepted installation practices, or contact Marvair® for additional assistance.

Wall Openings

Measure the dimensions of the supply and return ports on the unit.

Cut the openings in the exterior wall for the supply and return. **IMPORTANT: All units with electric heat must have 1" (25.4mm) clearance on all four sides of the supply outlet duct flange on the unit. The 1" (25.4mm) clearance must extend on all sides of the supply duct for the first 3 feet (1 meter) from the unit.**

IMPORTANT: Marvair® requires a minimum of 1" (25.4mm) from the surface of any supply ducts to combustible material for the first 3 feet (1 meter) of the duct.

Ducting

Extensions should be cut flush with the inside wall for applications without duct work.

Applications using duct work should be designed and installed in accordance with *all* applicable safety codes and standards. Marvair® strongly recommends referring to the current edition of the National Fire Protection Association Standards 90A and 90B *before* designing and installing duct work. The duct system must be engineered to insure sufficient air flow through the unit to prevent over-heating of the heater element. This includes proper supply duct sizing, sufficient quantity of supply registers, adequate return and filter area. Ductwork must be of correct material and must be properly insulated. Duct work must be constructed of galvanized steel with a minimum thickness of .019 inches for the first 3 feet (1 meter). Ductwork must be firmly attached, secured and sealed to prevent air leakage. Do not use duct liner on inside of supply duct within 4 feet (122cm) of the unit.

Galvanized metal duct extensions should be used to simplify connections to duct work and grilles. Use fabric boots to prevent the transmission of vibration through the duct system. The fabric must be U.L. rated to a minimum of 197°F (92°C).

Auxiliary devices which may be a POTENTIAL IGNITION SOURCE shall not be installed in the duct work. Examples of such POTENTIAL IGNITION SOURCES are hot surfaces with a temperature exceeding 1,292ºF (700°C) and electric switching devices.

Minimum Airflow Requirements

The duct system must be engineered to assure sufficient air flow through the unit even under adverse conditions such as dirty filters, etc. Use **Table 6** below and **Table 1**, **CFM at External Static Pressure (Wet Coil)** in section 1.4.

BASIC MODEL	MAXIMUM TOTAL STATIC
MAH1036D/1042D	.50
MAH1048D/1060D/MGH1072D	.50

Table 7. Maximum Static Pressure (For units with 2" Pleated Filters)

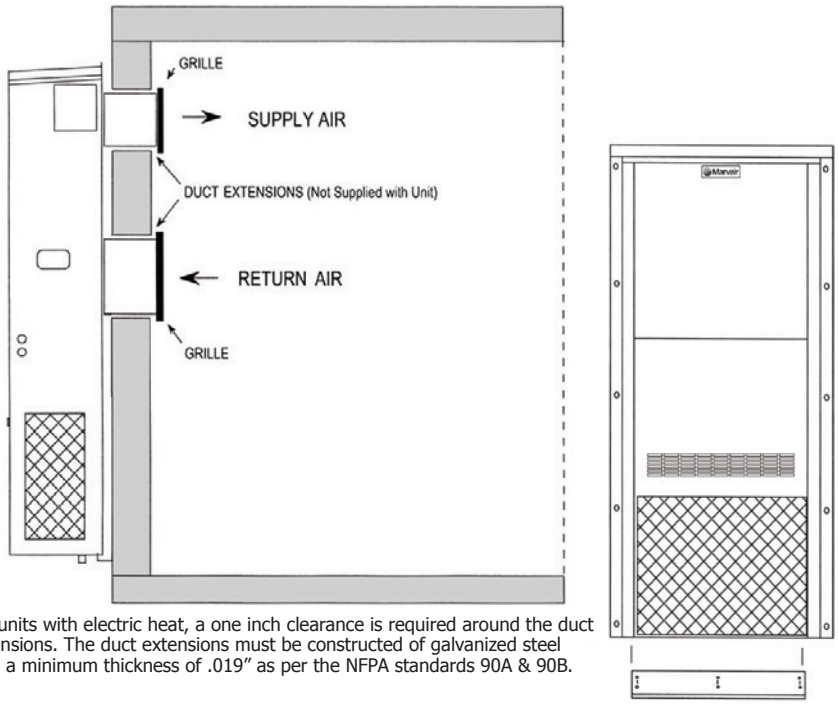
2.6 Bracket Installation

1. All models have built-in mounting flanges.
2. Apply a bead of silicone sealer on the wall side of the bottom support brackets on the unit. Circle the mounting holes with the silicone bead.
3. Refer to Figure 2. Attach the bottom support bracket to the wall using appropriate 3/8" diameter hardware.

For example, on wooden structures, use 3/8" x 2-1/2" all-thread lag screws. The screws must penetrate the center of the wall stud. Drill a pilot hole in the stud to prevent it from splitting.

2.7 Mounting The Unit

1. For wiring into the back of unit, locate the lower of the two knockouts on the wall side of the unit. Drill a one inch hole in the shelter wall to match this opening. Allow sufficient clearance to run 3/4" conduit through the hole and to the unit.
2. Using an appropriate and safe lifting device, set the unit on the bottom support bracket mounted on the wall. You must stabilize the unit on the bracket with the lifting device or by some other means - the bracket alone is not sufficient.
3. Make sure that the duct flanges are properly aligned with the wall opening. Adjust as necessary.
4. Note the holes in each side flange. Using the holes for guides, drill holes through the wall with a 3/8" drill bit. Insert the 3/8" x 5" bolts through the flanges. Install nuts and washers on the inside of the shelter. Tighten the bolts to secure the unit.
5. Apply a bead of silicone where the mounting flange contacts the unit and the shelter wall.
6. On the inside of the shelter, install the wall sleeves in the supply and return air openings. The sleeves may be trimmed to fit flush with the inside wall.
7. Check the fit of each sleeve to its mating flange for possible air leaks. Apply silicone sealer to close any gaps. Install the air return and supply grilles.



For units with electric heat, a one inch clearance is required around the duct extensions. The duct extensions must be constructed of galvanized steel with a minimum thickness of .019" as per the NFPA standards 90A & 90B.

Figure 3. A/C Wall Mount Detail

2.8 Installation of the Indoor Sensor

Shipped in the CoolLinks enclosure are:

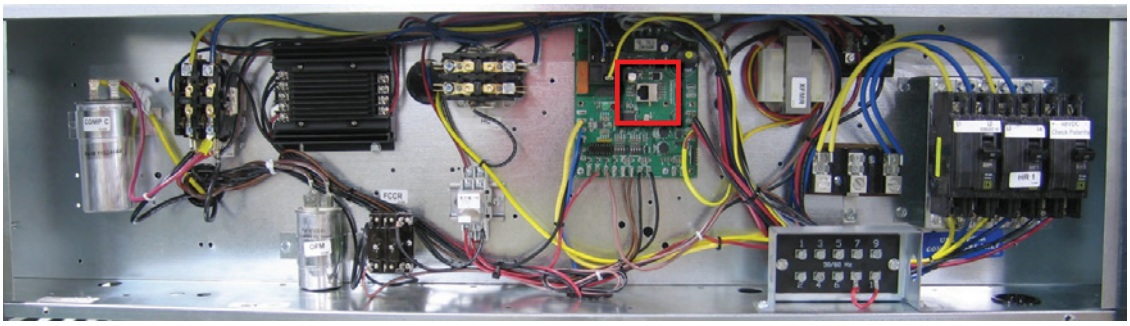
1. The indoor temperature sensor, Airtest part number EE10,
2. 40 ft. of 18 AWG, 4-conductor indoor sensor cable, and
3. Two fifty foot long Cat5e Ethernet cables

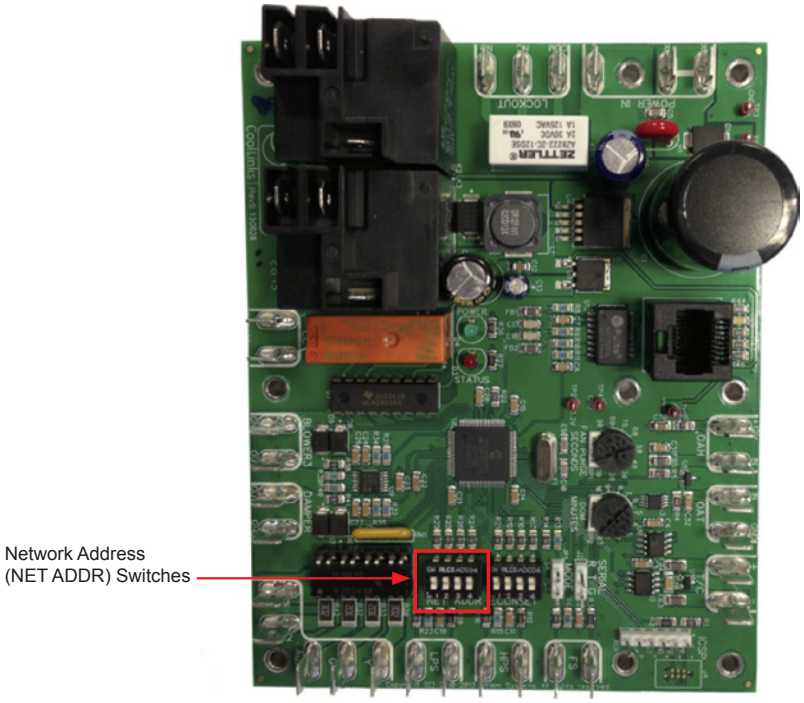
The indoor temperature sensor, Airtest part number EE10, should be mounted on the interior wall between the return air grilles. Install the sensor and route the sensor cable from the indoor sensor to the PLC enclosure as required by the customer. Connect the cable to the terminals in the CoolLinks PLC as shown in the CoolLinks electrical connection diagram. The connection diagram is in the installation instructions for the CoolLinks controller.

The outdoor temperature and humidity sensor is installed in the air conditioner at the factory. Connect the cable to the terminals in the CoolLinks PLC as shown in the CoolLinks electrical connection diagram. The connection diagram is in the installation instructions for the CoolLinks controller.

2.9 Connection Of PLC Controller Board In Shelter To Coollinks™ Board In The Air Conditioner

Route a Cat 5e shielded Ethernet cable from the PC board in each air conditioner to the PLC controller in the shelter. If the cable is routed through the air stream, it must be plenum rated.





2.10 Configuration of AC Unit Address on CoolLinks™ Board in the Air Conditioner

Each AC unit must be designated as either AC unit 1 or AC unit 2. The AC unit address is configured with the NET ADDR switches on the CoolLinks™ board. Standing inside the shelter facing the AC return air vents, AC unit 1 is the left-hand unit and AC unit 2 is the right-hand unit. For AC unit 1, set all NET ADDR switches down (default). For AC unit 2, set NET ADDR switch 1 up (ON) and all other switches down. (See photo following).

2.11 Electrical Connections

⚠ WARNING ELECTRICAL SHOCK HAZARD

Failure to follow safety warnings exactly could result in serious injury, death, and/or property damage.

Turn off electrical power at fuse box or service panel BEFORE making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

⚠ CAUTION

NOTICE TO INSTALLER/CONTRACTORS: This unit's internal control circuit/transformer is designed to power factory installed unit components only. Connecting external component loads may be done at your own risk of voiding the manufacturer's product warranty.

Important

All electrical work must meet the requirements of local codes and ordinances. Work should be done **only** by qualified persons.

Marvair MAH/MGH units may incorporate an internal crankcase heater for compressor protection. **The crankcase heater must be energized for at least 24 hours prior to starting the compressor.**

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. The direction of rotation is not an issue with single-phase compressors since they will always start and run in the proper direction. However, three phase compressors will rotate in either direction depending upon phasing of power. Since there is a 50-50 chance of connecting power in such a way as to cause rotation in the reverse direction, it is imperative to confirm that the compressor is rotating in the proper direction at the initial field start-up of the system. Verification of proper rotation is made by observing that the suction pressure drops and the discharge pressure rises when the compressor is energized. An alternate method of verification for self contained system with small critical refrigerant charges, where the installation of gauges may be objectionable, can be made by monitoring the temperature of the refrigerant lines at the compressor. The temperature should rise on the discharge line while the suction line temperature decreases. Reverse rotation also results in a substantially reduced current draw when compared to tabulated values.

There is no negative impact on durability caused by operating three phase compressors in the reversed direction for a short duration of time, usually defined as less than one hour. However, after several minutes of operation the compressor's internal protector will trip. The compressor will then cycle on the protector until the phasing is corrected. Reverse operation for longer than one hour may have a negative impact on the bearings.

To change the rotation, turn off power to the unit and reverse L1 & L2 at the disconnect in the air conditioner.

High Voltage Wiring - (Single Units)

The power supply should have the proper voltage, phase, and ampacity for the selected model.

1. Refer to the electrical data on the data sticker on the unit for field wiring requirements of the unit. Size the incoming power supply lines and the fuse(s) or HACR breaker(s) according to requirements described in the National Electric Code. Run the power conductors through the knockouts on the side or back of the unit. Use appropriate conduit and strain reliefs.

⚠ CAUTION

Note: Power supply service must be within allowable range (+10% - 5%) of rated voltage stamped on the unit rating plate. To operate nominal 230/208V unit at 208V, change the transformer line tap from 240V to 208V following the instruction on wiring label in unit.

2. Connect the wires to the input side of the internal breaker or terminal block (L1 & L2 for single-phase units; L1, L2, & L3 for three-phase models).
3. Install the ground wire on the ground lug.
4. For units designed for operation on 208/230V, 60Hz power supply, the transformer is factory wired for a 230V power supply. For a 208V power supply, remove the orange lead from the transformer and connect the red lead. Insulate the orange lead.
5. 460V units have a step down transformer for 230V motors.

⚠ CAUTION

The external breaker(s) that provide power to the air conditioner must be sized per the maximum Fuse Size (MFS) shown on the Unit's data label.

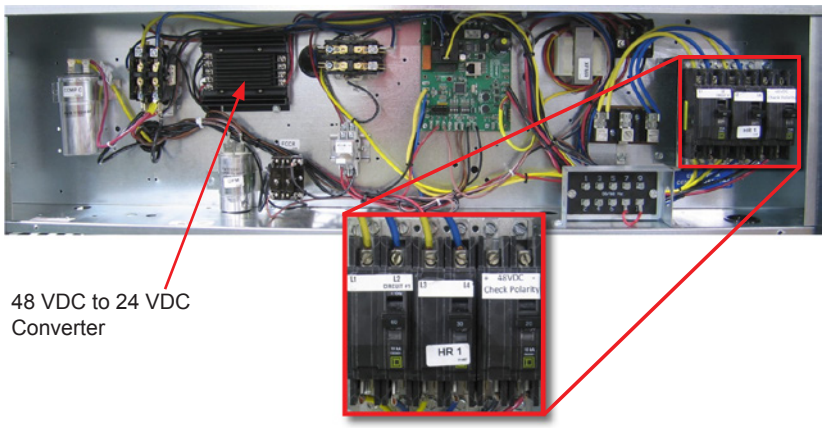
Dual Unit Phasing

1. Wire each unit as described in steps 1 through 4 above.
2. Test for proper phasing as follows:
   A. Power up the units.
   B. Using an AC volt meter set to the 300 volt scale, measure voltage between terminal L1 on the compressor contactor of unit #1 and terminal L1 on the compressor contactor of unit #2 If voltage is present, units are wired out of phase and must be rewired.
   C. If units are not in phase, turn off power and reverse the field power leads connected to the internal circuit breaker on one of the units only.
   D. Restore power and retest the phase (step B). When the voltage reads "0", the units are in phase.
   E. Turn off power and proceed.

48 VDC Wiring

The air conditioners require a 48 Volt DC power to operate the evaporator air movers and the free cooling damper motor. A 48 VDC to 24 VDC converter powers the 100% DC free cooling damper.

1. If the air conditioners are powered, remove AC and DC power to the air conditioners by switching the breakers in the shelter to the OFF position. Size a 2 conductor wire 12 AWG cable per NEC standard. Connect the cable between a DC breaker in the DC power plant and the DC breaker in the air conditioner. The DC breaker in the air conditioner is located on the right side of the bank of breakers.
2. Size the DC conductor wires per NEC standard. Distances of up to approximately 30 feet (9 meters) require a 12AWG feed. For distances greater than 30 feet (9meters), size the DC wire accordingly. Wire sizes 14AWG thru 10AWG shall be TelcoFlex®III or KS24194®L3 type wiring. Wire sizes 8AWG or larger shall be TelcoFlex®IV or KS24194®L4 telecommunications type wiring. All wire connections to the DC power plant must utilize 2-hole compression lugs sized per the wire being installed. 1-hole lugs are prohibited unless the DC plant cannot accommodate 2-hole lugs. Connect the cable between a DC breaker in the DC power plant and the DC breaker in the air conditioner. The DC breaker in the air conditioner is located on the right side of the bank of breakers.



3. Install a 20A DC breaker in the power plant. Breaker will be supplied by the end user or local market for the applicable DC power plant.
4. **Prior to turning on the breaker in the DC power plant, ensure the 48 VDC polarity is correct.**

Verifying Polarity at the air conditioners

1. Turn the DC breaker/disconnect in the air conditioner to the OFF position.
2. Turn DC breaker in the shelter's DC power plant to the ON position.
3. Place the RED test probe on the + (positive) terminal and the BLACK probe on the – (negative) terminal at the top of the breaker/disconnect as shown below.

DC Field Voltage Connections at Top of the Breaker

DC Field Voltage Connections at Bottom of the Breaker

4. If the test meter reads a NEGATIVE voltage turn OFF the DC power to the breaker/disconnect and reverse the power leads on the input of the DC breaker in the air conditioner.

Indication of Negative DC Voltage

5. Turn DC breaker in the shelter's DC power plant to the ON position.

Indication of Positive DC Voltage

6. Repeat step 3 to make certain that the DC power is POSITIVE voltage.
7. When the test meter reads POSITIVE, the DC breaker/disconnect in the air conditioner can be switched to the ON position.

The CoolLinks PLC controller requires a 5A DC breaker in the DC power plant rather than the 20A breaker necessary for each air conditioner. Other than breaker size, the steps for installation and verification of the 48 VDC supply to the CoolLinks PLC controller are similar to the above steps.

2.12 Installation of the CoolLinks Controller

Installation instructions for the CoolLinks controller are in the CoolLinks enclosure.

Chapter 3 Start-Up

3.1 Check-Out of Cooling Cycle

⚠ IMPORTANT

Be sure that the crankcase heater (if used) has been energized for at least 24 hours before starting the unit(s). Double-check all electrical connections before applying power. Marvair air conditioners with scroll compressors running on 3Ø power must be checked for proper rotation during the initial start-up. Please refer to Section 2.8 for determining if the 3Ø compressors are rotating correctly. Incorrect rotation can damage the compressor and is not covered by the warranty

CoolLinks Function Test Procedure

- Ensure all cables and connections are properly installed from each HVAC unit to the CoolLinks control panel.
- Switch the AC and DC breakers to the ON position in each connected HVAC.
- Switch the DC breaker powering the CoolLinks control panel to the ON position. This breaker is located inside the shelter and provides power to the CoolLinks PLC.
- Wait for the CoolLinks control panel to display the home screen. (Approx. 30 sec.)
- Observe the home screen for any active alarms (allow 1 minute) and address any issues at this time.
- Observe the Indoor air temperature, Outdoor air temperature, Dew point and Relative Humidity at this time. Make sure all values are within reason to actual conditions.

Mechanical Cooling Test

NOTE: The Indoor Blower will always operate continuously on the Lead unit.

- Set the Cooling first stage set point 3°F below the Indoor air temperature displayed on the screen.
- The Lead unit will start in the Mechanical cooling mode if the outdoor conditions are not favorable for DC free cooling.
- Allow the Lead unit to operate in mechanical cooling.
- Press the Lead Swap button on the screen to swap the Lead unit to the Lag unit.
- The former Lag unit will now become the Lead unit and the mechanical cooling will start.
- Allow the now Lead unit to operate in mechanical cooling.
- To allow both HVAC units to operate in the mechanical cooling mode simultaneously, set the Cooling first stage set point 10°F below the Indoor temperature displayed on the screen. The Lag unit will start in the mechanical cooling mode. The anti-short cycle timer of the compressor circuit may be active.

NOTE: The HVAC units have a minimum runtime of 5 minutes in mechanical cooling mode regardless of the temperature set point being met.

Electric Heater Test

- Set the Cooling first stage set point to 90°F (32.2ºC).
- Set the Heating first stage set point 2°F (1.1ºC) above the indoor air temperature displayed on the screen.
- The Lead unit will start in the heating mode.
- Allow the heater to operate for a minute to verify heating.
- Press the Lead Swap button on the screen to swap the Lead unit to the Lag unit.

- The former Lag unit will now become the Lead unit and the heating mode will start.
- Allow the now Lead unit to operate in the heating mode.
- Change the heating and cooling set points back to the default values.

Emergency Ventilation and Exercising the Damper

- Switch "ALL" AC voltage breakers to the OFF position and keep the DC voltage breakers in the ON position in ALL connected HVAC units.
- The CoolLinks control panel will activate the Land Line power fail sequence after approximately 30 seconds.
- The indoor air temperature must be equal to or greater than the outdoor air temperature to activate the Emergency ventilation mode. The DC free air damper will open at this time.
- If the indoor air temperature is less than the outdoor air temperature, gradually warm the indoor air temperature sensor until it is greater than the outdoor air temperature.

⚠ CAUTION

Do not use an open flame or lighter to heat the sensor. This will damage the sensor. A hairdryer may be used to warm the sensor to prevent damage to the sensor

Smoke Alarm Test

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Smoke Alarm input.
- When the Smoke Alarm input of the PLC is powered, all functions of each connected HVAC will shut down to prevent air movement in the shelter.
- Remove the temporary jumper to deactivate the Smoke alarm and allow HVAC operation to resume.

Hydrogen Alarm Test

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Hydrogen Alarm input.
- When the Hydrogen Alarm input of the PLC is powered, the damper(s) on units that are not currently mechanically cooling will open fully and the Indoor Blower will operate. This will expel the noxious gases and induce outside air into the shelter.
- Remove the temporary jumper to deactivate the Hydrogen alarm and allow HVAC operation to resume.
- The damper(s) will close at this time and resume normal operation.

Generator Running Testing

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Generator Running input.
- When the Generator Running input of the PLC is powered, only one HVAC is allowed to operate in the mechanical cooling mode based on the cooling set points.
- The Lag unit will not operate at any time during the Generator Running mode.
- The DC free air damper is also inoperable during the Generator Running mode. This is to prevent the wet stacking effect on the generator due to insufficient load.
- Remove the temporary jumper to deactivate the Generator Running mode and allow HVAC operation to resume.

Chapter 4 Troubleshooting

4.1 Overview

A comprehensive understanding of the operation of the Marvair A/C unit is a prerequisite to trouble-shooting. Please read the Chapter 1 for basic information about the unit.

Marvair's air conditioners are thoroughly tested before they are shipped from the factory. Of course, it is possible that a defect may escape undetected, or damage may have occurred during transportation. However, the great majority of problems result from installation errors.

If you experience difficulties with the Marvair A/C, please review the installation steps in Chapter 2.

Much time can be saved by taking a thoughtful and orderly approach to troubleshooting. Start with a visual check - are there loose wires, crimped tubing, missing parts, etc? Begin deeper analysis only after making this initial inspection.

The troubleshooting information in this manual is basic. The troubleshooting section contains problem/solution charts for general problems, followed by a compressor section.

Not every problem can be anticipated. If you discover a problem that is not covered in this manual, we would be very grateful if you would bring it to the attention of our service department for incorporation in future revisions.

As always, please exercise caution and good judgement when servicing the unit. Use only safe and proven service techniques. Use refrigeration goggles when servicing the refrigeration circuit.

⚠ WARNING

The refrigerant circuit has hot surfaces, and the electrical voltages inside of the unit may be hazardous or lethal. SERVICE MAY BE PERFORMED ONLY BY QUALIFIED AND EXPERIENCED PERSONS.

4.2 Failure Symptoms Guide

PROBLEM/SYMPTOM	LIKELY CAUSE(S)	CORRECTION
A. Unit does not run. **NOTE**: An internal anti-short-cycle timer will prevent the unit from starting for .2 to 8 minutes following start-up.	1. Power supply problem.	1. Check power supply for adequate phase and voltage. Check wiring to unit and external breakers or fuses.
	2. Tripped internal disconnect.	2. Check internal circuit protection devices for continuity.
	3. Shut off by external thermostat or thermostat is defective.	3. Check operation of wall-mounted thermostat.
	4. Unit off on high or low pressure limit.	4. Reset pressure switch.
	5. Internal component or connection failure.	5. Check for loose wiring. Check components for failure.
B. Unit runs for long periods or continuously; cooling is insufficient.	1. Dirty filter or reduced airflow	1. Check air filter(s). Check blower operation. Remove airflow restriction.
	2. Low refrigerant.	2. Check for proper charge and possible refrigerant leak.
	3. Component failure.	3. Check internal components, especially compressor for proper operation.
	4. Unit undersized for job.	4. Add additional units for greater capacity.
C. Unit cycles on high/low pressure limit.	1. Loss or restriction of airflow.	1. Check blower assembly for proper operation. Look for airflow restrictions, e.g.. the air filter. Check blower motor and condenser fan.
	2. Restriction in refrigerant circuit.	2. Check for blockage or restriction, especially filter drier and capillary tube assembly.
	3. Refrigerant overcharge (following field service)	3. Evacuate and recharge to factory specifications.
	4. Defective pressure control.	4. Check limit cutout pressures. Control is set to actuate at approximately 60 PSIG (low pressure) and 650 PSIG (high pressure)
D. Unit blows fuses or trips circuit breaker.	1. Inadequate circuit ampacity.	1. Note electrical requirements in Chapter 2 and correct as necessary.
	2. Short, loose, or improper connection in field wiring.	2. Check field wiring for errors.
	3. Internal short circuit. Loose or improper connection(s) in unit.	3. Check wiring in unit. See wiring and schematic diagrams. Test components (especially the compressor) for shorts.
	4. Excessively high or low supply voltage or phase loss (3ø only)	4. Note voltage range limitations specific to the compressor troubleshooting section.
E. Water on floor near unit.	1. Obstruction in condensate line.	1. Check for clog or restriction.
	2. Obstruction or leak in condensate pan.	2. Check pan for leak or blockage.
	3. Unit is not level.	3. Level unit.
F. No space heating or reduced heating (units equipped with resistance elements)	1. Defective heating element(s).	1. Check resistance element(s) for continuity.
	2. Thermal limit open.	2. Check continuity across thermal limit switch.
	3. Defective heater contactor.	3. Check relay for proper operation. Replace if defective.

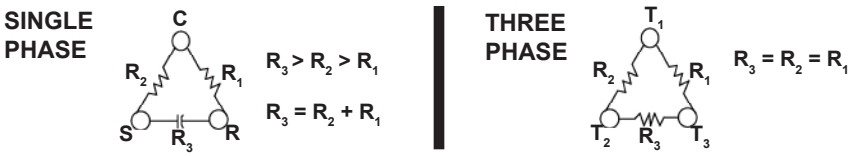
4.3 Compressor Troubleshooting

NOTE: It is important to rule out other component failures before condemning the compressor.

The following electrical tests will aid diagnosis:

1. **Start-Up Voltage**: Measure the voltage at the compressor contactor during start-up. The voltage must exceed the minimum shown in Table 5, section 2.2, or compressor failure is likely. A low voltage condition must be corrected.
2. **Running Amperage**: Connect a clip-on type ammeter to the (common) lead to the compressor. Turn on the supply voltage and energize the unit. The compressor will initially draw high amperage; it should soon drop to the RLA value or less. If the amperage stays high, check the motor winding resistances.

   NOTE: Feel the top of the compressor to see if it has overheated. If it is hot, the internal overload may be open. You may have to wait several hours for it to reset.
3. **Motor Winding Resistances:** Using a digital volt-ohm meter (VOM), measure the resistance across the compressor windings as shown below.



   Resistance can be measured as shown above. Any deviation from above values could indicate a defective compressor.
4. **High Voltage/Insulation Test:** Test internal leakage with a megohmeter. Attach one lead to the compressor case on a bare metal tube and to each compressor terminal to test the motor windings. A short circuit at high voltages indicates a motor defect. Do not do this test under vacuum.
5. On single phase models, check the capacitor by substitution.

Chapter 5 Frequently Asked Questions

5.1 Frequently Asked Questions

Temperature and Humidity Sensors:

Q. Why is the indoor temperature reading is not correct?

Answers:

1. If the indoor sensor is reading 32ºF-38ºF (0ºC-3.3ºC) degrees on the display, the red wire or +V connection is disconnected. The electric heat on both HVAC's will operate when this condition is present.
2. If the indoor sensor is reading 139ºF (59.4ºC) degrees on the display, the green wire or GND connection is disconnected. The mechanical cooling on both HVAC's will operate when this condition is present.
3. If the indoor sensor is reading 47ºF (8.3ºC) degrees on the display, the white wire or T connection is disconnected or the red and green wires are reversed. The electric heat on both HVAC's will operate when this condition is present.

Q. Why is the outdoor temperature and humidity reading not correct?

Answers:

1. If the outdoor temperature and dew point are reading a negative value on the display, the black wire or connection to the PLC analog input (1) from the sensor is disconnected.
2. If the dew point and humidity are reading a ### or 0% value on the display, the white wire or connection to the PLC analog input (0) from the sensor is disconnected.
3. If the outdoor temperature, dew point and humidity are reading a very high value on the display, the blue wire or connection to the -24vdc terminal block from the sensor is disconnected. If the blue and brown wires are reversed at the -24vdc and +24vdc terminal block these values will also read very high. The red ERROR light on the PLC will also flash indicating improper connection.
4. If the outdoor temperature is reading -40ºF (-40ºC) degrees, the dew point is reading ### and the humidity is reading 0%. The brown wire or connection to the +24vdc terminal block is disconnected. These values will also appear if the sensor is disconnected from the sensor cable on the outside of the shelter or if the sensor is not connected to the CoolLinks™ controller.

Q. Why does the CoolLinks™ display show (###) in the areas where a number should be displayed?

Answer:

1. The Ethernet cable from the HMI to the 8 port hub is disconnected or the Ethernet cable from the PLC to the 8 port hub is disconnected. When connected, an LED at each connection point should flash to indicate a connection.

CoolLinks™ Controller HMI Display and Power:

Q. Why doesn't the CoolLinks™ Controller HMI power up?

Answers:

1. The power connector at the bottom of the display is disconnected.
2. The polarity of the DC power supply is reversed (Phoenix Contact). Source power should be +48vdc.
3. The DC breaker in the DC power bay is OFF.

Q. Why does the DC breaker for the CoolLinks™ Controller trip in the DC power bay?

Answer:

1. If the polarity of the CoolLinks™ DC power supply to the DC converter is reversed (-48vdc) the DC converter will be damaged (black CUI converter). The converter will need to be replaced in order to operate. *(Reference: Marvair Polarity Check Bulletin 104)*

CoolLinks™ Controller Alarms:

Q. What do these alarms mean?

Communications Alarm- The CoolLinks™ controller is not communicating with the HVAC control board.

Troubleshooting:

1. The Ethernet cable from the CoolLinks™ Controller to the HVAC is disconnected or damaged.
2. The NET ADDRESS dip switches 1-4 on the control board need to be properly set. Unit #1 should be set with all 4 dip switches in the OFF or down position. Unit #2 should be set with the number 1 dip switch in the ON or up position and dip switches 2,3 and 4 in the OFF or down position.

Damper Alarm- The actuator damper in the HVAC has failed to open when economizer mode is available. *(Reference: Marvair CoolLinks™ Damper Alarm Bulletin 103)*

HVAC Troubleshooting:

Q. Why does the DC breaker for the HVAC trip in the DC power bay?

Answers:

1. The DC breaker may be undersized. The correct breaker sizing is 20amps for each HVAC.
2. The polarity of the DC power supply is reversed (-48vdc) and the DC converter is damaged as a result. The polarity must be corrected to (+48vdc) and the DC converter inside the HVAC must be replaced.

Note: The DC converter can be disconnected from the (+48vdc) source to allow the HVAC to operate until the DC converter is replaced. With the DC converter disconnected, the actuator damper will not operate.

(Reference: Marvair Polarity Check Bulletin 104)

Q. Why does the blower run continuously?

Answer:

1. The blower of the Lead unit will operate continuously by default. This is to keep air moving in the shelter at all times and aid in preventing hot spots.

Q. Can I disable the continuous blower?

Answer:

1. This function cannot be disabled and is programmed into the PLC firmware.

Q. Why does the HVAC continue to operate in mechanical cooling when the cooling set-point has been reached?

Answer:

1. The CoolLinks™ Controller is programmed by default to operate in the mechanical cooling mode for a minimum of 5 minutes. This is to prevent short-cycling of the unit and to allow the compressor sufficient time to remove moisture from the air as well cool the shelter.

Q. When do the HVAC's swap Lead unit operation?

Answer:

1. The CoolLinks™ Controller will swap the lead unit on each call for cooling and the blower will run continuously on the lead unit.

Q. How do I get both HVAC's to operate simultaneously?

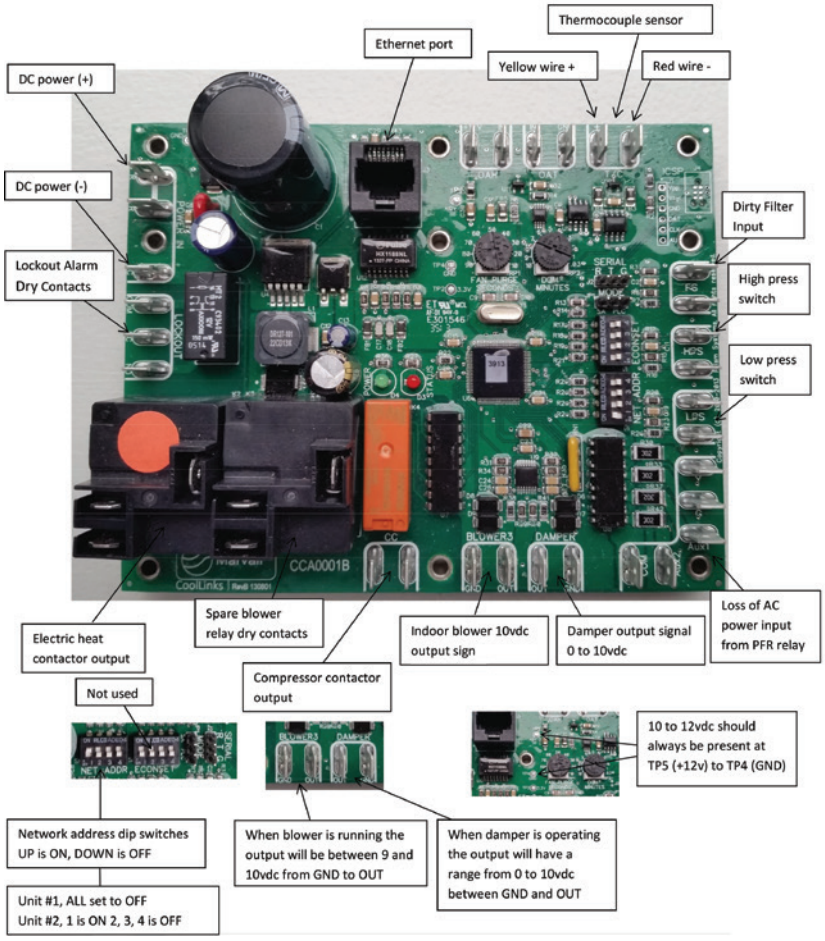
Answer:

1. Press the button in the center of the CoolLinks™ controller touchscreen where the indoor temperature is displayed and enter a new cooling set-point and press the enter arrow at the lower right of the screen. This set-point should be at least 10 degrees lower than the indoor temperature displayed. Once operation is confirmed, return the cooling set-point back to the previous value. The default cooling setpoint is 78°F (25.6°C).

Q. How can I test the damper in the HVAC's?

Answer:

1. Switch the AC breakers OFF in both HVAC's and keep the DC breakers ON. Wait for the inside shelter temperature to rise greater than the outdoor temperature. When the inside temperature is greater than the outside temperature the dampers will begin to open in both HVAC's. This is referred to as emergency ventilation.



Chapter 6 Maintenance

6.1 Scheduled Maintenance

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised. Initial safety checks shall include:

- That capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking
- That no live electrical components and wiring are exposed while charging, recovering or purging the system
- That there is continuity of earth bonding
- Sealed electrical components shall be replaced
- Intrinsically safe components must be replaced

Marvair® strongly recommends that the air conditioner be serviced a minimum of twice a year – once prior to the heating season and once prior to the cooling season. At this time the filters, evaporator coil, condenser coil, the cabinet, and condensate drains should be serviced as described below. Also at this time, the air conditioner should be operated in the cooling and heating cycles as described in Chapter 3, Start-Up. In addition to this seasonal check-out, the A/C should be maintained as follows:

Air Filter

Replace the air filter whenever it is visibly dirty. Never operate the unit without the filter in place.

Evaporator

If the evaporator becomes clogged or dirty, it may be cleaned by careful vacuuming or with a commercial evaporator cleaning spray. DO NOT use a solvent containing bleach, acetone, or flammable substances. Turn off power before cleaning. Be careful not to wet any of the electrical components. Be sure the unit has dried before restarting.

Condenser

Periodically inspect the outdoor condenser coil and the cabinet air reliefs for dirt or obstructions. Remove foreign objects such as leaves, paper, etc.

If the condenser coil is dirty, it may be washed off with a commercial solvent intended for this purpose. TURN OFF POWER BEFORE CLEANING! Be sure that all electrical components are thoroughly dry before restoring power. Use a fin comb of the correct spacing to straighten mashed or bent fins.

Cabinet

The cabinet may be cleaned with a sponge and warm, soapy water or a mild detergent. Do not use bleach, abrasive chemicals or harmful solvents.

Drains

Regularly check the condensate drain. If a commercial drain solvent is used, flush out the drain pan and system with plenty of fresh water to prevent corrosion.

Lubrication

Oiling of the condenser fan motor or the evaporator motor is not recommended.

Chapter 7 Service & Charging/Recovery

7.1 Safety Precautions

Service

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the REFRIGERATING SYSTEM, the following shall be completed prior to conducting work on the system.

1. Work shall be undertaken under a controlled procedure to minimize the risk of flammable gas or vapor being present while the work is being performed.
2. All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.
3. The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection.
4. If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.
5. No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. “No Smoking” signs shall be displayed.
6. Ensure that the area is open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.
7. The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system, cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.

7.2 Leak Detection

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used. The following leak detection methods are deemed acceptable for all refrigerant systems. Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed. Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipework. ***Note:*** Examples of leak detection fluids are

1. Bubble method

2. Fluorescent method agents

If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

7.3 Charging Procedures

In addition to conventional charging procedures, the following requirements shall be followed.

1. Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
2. Cylinders shall be kept in an appropriate position according to the instructions.
3. Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
4. Label the system when charging is complete (if not already).
5. Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.
6. Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

	MAH1036D	MAH1042D	MAH1048D	MAA1060D	MGA1072D
Refrigerant Charge (oz.)	90	112	112	105	135

Refrigerant Charge (R454B, Ounces)

7.4 Refrigerant Recovery

When removing refrigerants from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely. When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

1. Safely remove refrigerant following local and national regulations.
2. Evacuate.
3. Continuously flush or purge with inert gas when using flame to open circuit
4. Open the circuit
5. The REFRIGERANT CHARGE shall be recovered into the correct recovery cylinders. For appliances containing FLAMMABLE REFRIGERANTS other than A2L REFRIGERANTS, the system shall be purged with oxygen-free nitrogen to render the appliance safe for FLAMMABLE REFRIGERANTS. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.
6. For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place
7. The outlet for the vacuum pump shall not be close to any potential ignition sources, and
8. Ventilation shall be available.

9. When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.
10. The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant. If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.
11. The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.
12. If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Chapter 8 Decommissioning

8.1 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task commences.

1. Become familiar with the equipment and its operation.
2. Isolate the system electrically.
3. Before attempting the procedure, ensure that:
   - Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
   - All personal protective equipment is available and being used correctly.
   - The recovery process is supervised at all times by a competent person.
   - Recovery equipment and cylinders conform to the appropriate standards.
4. Pump down the refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80 % volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

Chapter 9 Warranty

9.1 Marvair, Inc. Limited Product Warranty

Marvair Inc., warrants its products to be free from defects in materials and workmanship under normal use to the original purchaser for the period of time in the table below. If any part of your product fails within 12 months from start-up, or 18 months from shipment from the factory, whichever comes first, Marvair, Inc. will furnish without charge, EXW Cordele, Georgia, the required replacement part. The owner must provide proof of the date of the original start-up. The contractor's invoice, the certificate of occupancy, or similar documents are examples of acceptable proof of the date of the original start-up.

Marvair, ICE, Eubank Products
90 Days[1] w/Flat Rate Labor[2] *(See Marvair, ICE, Eubank Flat Rate Labor Guidelines)*
1 Year Parts[2,3]
5 Years Compressor[2]

[1]If any part of your Marvair, Inc. unit fails within 90 days of the commencement of the warranty, Marvair, Inc. will furnish without charge, EX Works, Cordele, Georgia, the required replacement part and pay for the labor to replace the part in accordance with the Marvair, Inc. Flat Rate Labor Guidelines.

[2]All OTR (over the road) applications that are moved from one location to another: Factory Warranty applies only up to the point of initial start-up and test at all OEM manufacturing locations or subsequent facility. Once it goes into OTR service, the warranty expires immediately for compressor and sealed system components. This OTR exemption does not apply to relocatable classrooms, construction or office trailers.

[3]All warranty replacement parts shall be shipped Ground only. Expedited shipping is available upon request for additional cost.

The responsibility of the equipment owner includes:

1. To operate the equipment in accordance with the manufacturer's instructions.
2. To provide easy accessibility for servicing.
3. To check and reset any circuit breaker(s) and/or disconnect(s) prior to calling for service.
4. To keep the unit clean and free of dirt and containment and replace filters as required.
5. To keep the outdoor coil clean and free of leaves, paper, or other debris.
6. To pay the charges incurred when any of the above have not been done.
7. To pay for repair or replacement of any material or part other than those within the Marvair unit or controller.

Marvair, Inc., will not be responsible for labor after 90 days, transportation costs, delays or failures to complete repairs caused by events beyond our control (labor hours incurred due to required site-specific training, time waiting to gain access, or extended drive time for remote sites). This warranty does not cover:

1. Any transportation, related service labor, diagnosis calls, filter, driers, refrigerant, or any other material charges.
2. Damages caused by shipping, accident, abuse, negligence, misuse, fire, flood, or Acts of God.
3. Damages caused by operating or staging the unit in a corrosive environment.
4. Damages caused by improper application of the product.
5. Damages caused by failing to perform proper routine maintenance.
6. Expenses incurred for erecting, disconnecting or dismantling the product or installing the replacement part(s).
7. Products not installed or operated according to the included instructions, local codes, and good trade practices.
8. Products moved from the original installation site.
9. Products lost or stolen
10. Consequential damages or incidental expenses including losses to persons, property or business.
11. Modifications to original unit after it leaves the factory, such as breaking into any part of the sealed systems unless authorized in advance in writing by Marvair, Inc..
12. Damages as a result of operating as a construction site cooler / dehumidifier.

When labor (first 90 days only) is required, it must be performed during normal working hours (8:00 AM - 5:00 PM) Monday - Friday and must be performed by Marvair, Inc., personnel or a designated Service Representative.

The owner of the product may ship the allegedly defective or malfunctioning product or part to Marvair, Inc.,, at such owner's expense, and Marvair, Inc., will diagnose the defect and, if the defect is covered under this warranty, Marvair, Inc., will honor its warranty and furnish the required replacement part. All costs for shipment and risk of loss during shipment of the product to Marvair, Inc., and back to the owner shall be the responsibility and liability of the owner. Upon written request by an owner, Marvair, Inc., may arrange for remote diagnosis of the allegedly defective or malfunctioning product or part but all costs for transportation, lodging and related expenses with regard to such diagnostic services shall be the responsibility and liability of the owner.

An owner requesting performance under this Warranty shall provide reasonable access to the allegedly defective or malfunctioning product or part to Marvair, Inc., and its authorized agents and employees.

THIS WARRANTY CONSTITUTES THE EXCLUSIVE REMEDY OF ANY PURCHASER OF A MARVAIR HEAT PUMP OR AIR CONDITIONER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE, TO THE FULLEST EXTENT PERMITTED BY LAW. IN NO EVENT SHALL ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE EXCEED THE TERMS OF THE APPLICABLE WARRANTY STATED ABOVE AND MARVAIR SHALL HAVE NO OTHER OBLIGATION OR LIABILITY. IN NO EVENT SHALL MARVAIR BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR MONETARY DAMAGES.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE-TO-STATE. Some states do not allow limitations or exclusions, so the above limitations and exclusions may not apply to you.

APPENDIX A: Installation Instructions for Field Installed Electric Heat, Models 36-72

⚠ WARNING
FIRE HAZARD

Improper adjustment, alteration, service, maintenance or installation could cause serious injury, death and/or property damage.

Installation or repairs made by unqualified persons could result in hazards to you and others. Installation MUST conform with local codes or, in the absence of local codes, with codes of all governmental authorities have jurisdiction.

The information contained in this manual is intended for use by a qualified service agency that is experienced in such work, is familiar with all precautions and safety procedures required in such work, and is equipped with the proper tools and test instruments.

Duct Work

General Information

Note: The following instructions are for general guidance only. Due to the wide variety of installation possibilities, specific instructions will not be given. When in doubt, follow standard and accepted installation practices, or contact Marvair for additional assistance.

Wall Openings

Measure the dimensions of the supply and return ports on the unit.

Cut the openings in the exterior wall for the supply and return. **IMPORTANT: All units with electric heat must have 1" (25.4 mm) clearance on all four sides of the supply outlet duct flange on the unit. The 1" (25.4 mm) clearance must extend on all sides of the supply duct for the first 3 feet (1 meter) from the unit.**

IMPORTANT: Marvair requires a minimum of 1" (25.4 mm) from the surface of any supply ducts to combustible material for the first 3 feet (1 meter) of the duct.

Ducting

Extensions should be cut flush with the inside wall for applications without duct work.

Applications using duct work should be designed and installed in accordance with all applicable safety codes and standards. Marvair strongly recommends referring to the current edition of the National Fire Protection Association Standards 90A and 90B before designing and installing duct work. The duct system must be engineered to insure sufficient air flow through the unit to prevent over-heating of the heater element. This includes proper supply duct sizing, sufficient quantity of supply registers, adequate return and filter area. Ductwork must be of correct material and must be properly insulated. Duct work must be constructed of galvanized steel with a minimum thickness of .019 inches for the first 3 feet (1 meter). Ductwork must be firmly attached, secured and sealed to prevent air leakage. Do not use duct liner on inside of supply duct within 4 feet (122 cm) of the unit. Galvanized metal duct extensions should be used to simplify connections to duct work and grilles. Use fabric boots to prevent the transmission of vibration through the duct system. The fabric must be U.L. rated to a minimum of 197°F (92°C).

⚠ WARNING

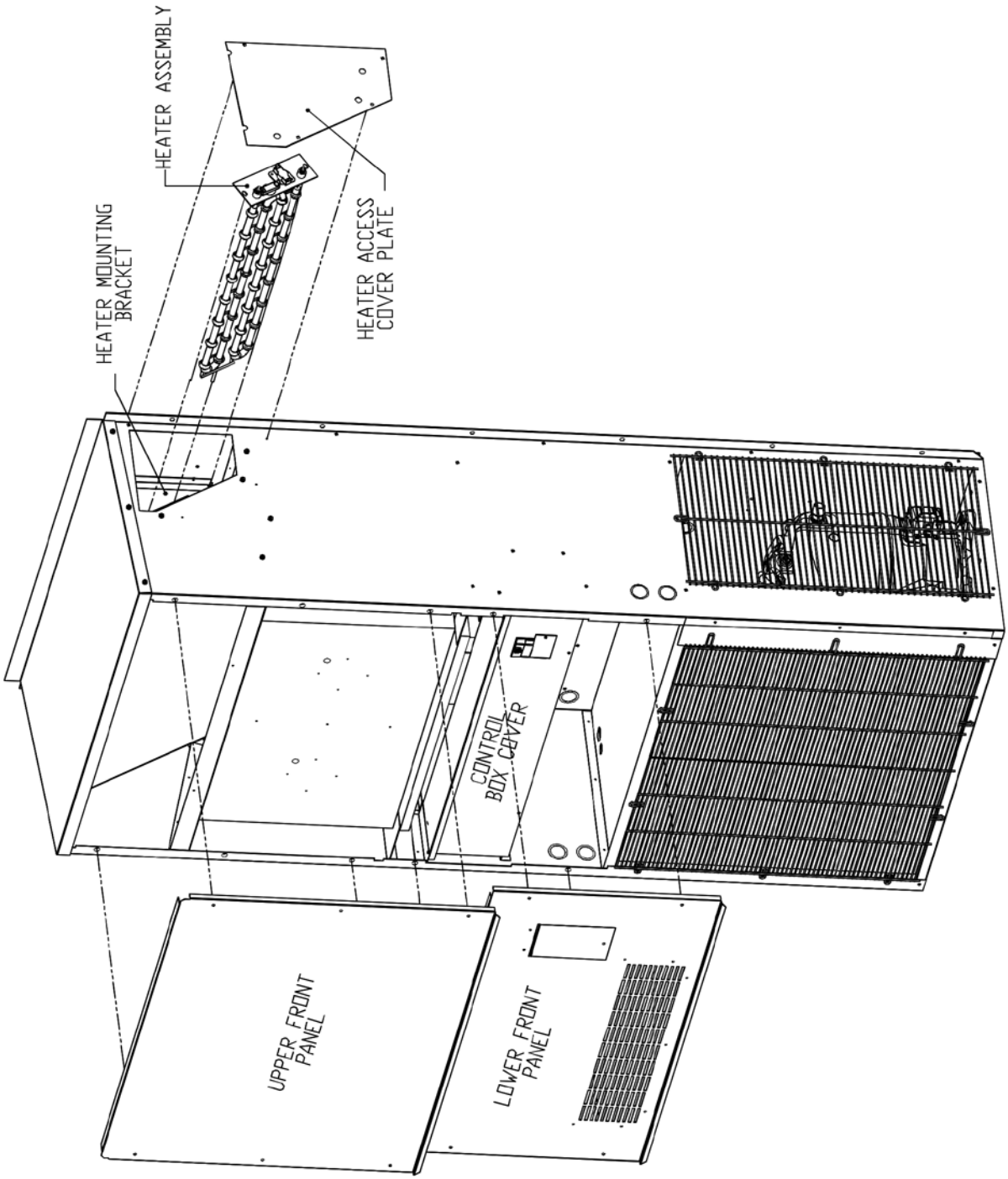
ELECTRICAL SHOCK HAZARD

Failure to follow safety warnings exactly could result in serious injury, death, and/or property damage.

Turn off electrical power at fuse box or service panel BEFORE making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

Heater installation (see drawings and wiring diagram)

1. Remove top front panel.
2. Remove bottom front panel.
3. Remove the control box cover.
4. Remove the heater access cover plate on the upper right side of the unit by removing the three screws. Cut insulation on two sides and fold down out of way.
5. Slide new heater assembly into place by lining up stem with hole on far end. Make sure stem of new heater assembly is inserted into correct hole. The hole nearest to the indoor coil is for three element heaters and the farthest away from indoor coil is for all other heaters.
6. Install the two No. 10 screws in the heater assembly plate.
7. Install wire harness in hole provided in drain pan and then through filter bracket and then into control box.
8. Wire the heater as shown in the wiring diagram provided with the heater kit (the insulated terminal ends are to be connected at the heater)
9. Install pop tie in appropriate hole in back panel to secure wire.
10. Install closed cell strip around wires where they pass through the drain pan.
11. Reinstall the heater access cover.
12. Mount the heat contactor inside the control box where the mounting holes are provided for the heat contactor.
13. Make the wiring connections inside the control box as shown in the wiring diagram provided with the heater kit. Bundle loose wires with wire ties.
14. With a permanent marker, place an (X) in the space provided next to the heater kit rating of the installed heater on the unit data label.
15. Place the wiring diagram provided with the heater kit inside the zip lock bag which is affixed to the back side of the control box cover.
16. Replace the control box cover, the bottom front cover and the top front panel.


HEATER ASSEMBLY
HEATER MOUNTING BRACKET
HEATER ACCESS COVER PLATE
CONTROL BOX COVER
UPPER FRONT PANEL
LOWER FRONT PANEL