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# INSTALLATION INSTRUCTIONS

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## I-TEC<sup>®</sup> SERIES PACKAGED AIR CONDITIONER

Models:

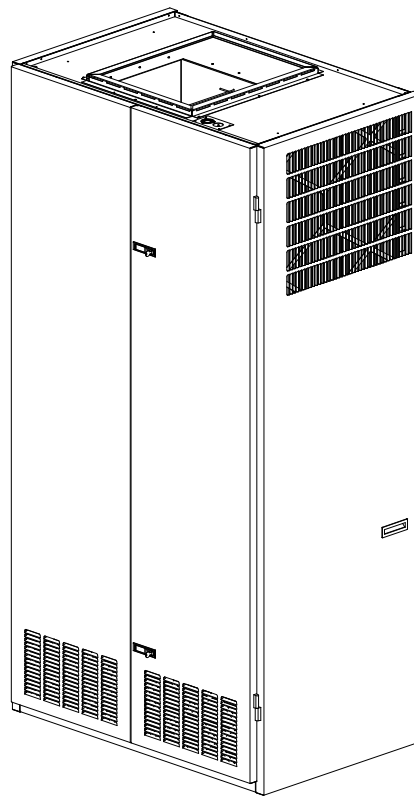
I30A1DA  
I30A1DB  
I30A1DC

I36A1DA  
I36A1DB  
I36A1DC

I42A1DA  
I42A1DB  
I42A1DC

I48A1DA  
I48A1DB  
I48A1DC

I60A1DA  
I60A1DB  
I60A1DC



MIS-2957 A



*Climate Control Solutions*

Bard Manufacturing Company, Inc.  
Bryan, Ohio 43506  
[www.bardhvac.com](http://www.bardhvac.com)

Manual: 2100-597F  
Supersedes: 2100-597E  
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## **GETTING OTHER INFORMATION AND PUBLICATIONS**

These publications can help when installing the furnace. They can usually be found at the local library or purchased directly from the publisher. Be sure to consult the current edition of each standard.

National Electrical Code ..... ANSI/NFPA 70

Standard for the Installation ..... ANSI/NFPA 90A  
of Air Conditioning and Ventilating Systems

Standard for Warm Air ..... ANSI/NFPA 90B  
Heating and Air Conditioning Systems

Load Calculation for ..... ACCA Manual J or  
Winter and Summer Manual N  
Air Conditioning

Low Pressure, Low Velocity ..... ACCA Manual D or  
Duct System Design Manual Q  
Winter and Summer Air Conditioning

### **For more information, contact these publishers:**

**ACCA**      **Air Conditioning Contractors of America**  
1712 New Hampshire Avenue  
Washington, DC 20009  
Telephone: (202) 483-9370  
Fax: (202) 234-4721

**ANSI**      **American National Standards Institute**  
11 West Street, 13th Floor  
New York, NY 10036  
Telephone: (212) 642-4900  
Fax: (212) 302-1286

**ASHRAE**   **American Society of Heating, Refrigeration,  
and Air Conditioning Engineers, Inc.**  
1791 Tullie Circle, N.E.  
Atlanta, GA 30329-2305  
Telephone: (404) 636-8400  
Fax: (404) 321-5478

**NFPA**      **National Fire Protection Association**  
Batterymarch Park  
P.O. Box 9101  
Quincy, MA 02269-9901  
Telephone: (800) 344-3555  
Fax: (617) 984-7057

## GENERAL

The equipment covered in this manual is to be installed by trained, experienced service and installation technicians.

***The I-TEC must be installed with the Bard manufactured IWS wall sleeve and ILG louver grille accessories. These are sold as separate accessories. Any substitutions will void the manufacturer's warranty.***

The unit is designed for use with or without ductwork. For use without ductwork, Plenum Box IPBDF8-color (8" height) or IPBDF12-color (12" height) is recommended.

These instructions explain the recommended method to install the air cooled self-contained unit and the electrical connections to it.

These instructions and any instructions packaged with any separate equipment required to make up the entire heating and air conditioning system should be carefully read before beginning the installation. Note particularly "Start Procedure" and any tags and/or labels attached to the equipment.

While these instructions are intended as a general recommended guide, they do not supersede any national and/or local codes in any way. Authorities having jurisdiction should be consulted before the installation is made. See Page 3 for information on codes and standards.

Size of unit for a proposed installation should be based on heat loss or heat gain calculation made according to methods of Air Conditioning Contractors of America (ACCA). The air duct should be installed in accordance with the Standards of the National Fire Protection Systems of Other Than Residence Type, NFPA No. 90A, and Residence Type Warm Air Heating and Air Conditioning Systems, NFPA No. 90B. Where local regulations are at a variance with instructions, installer should adhere to local codes.

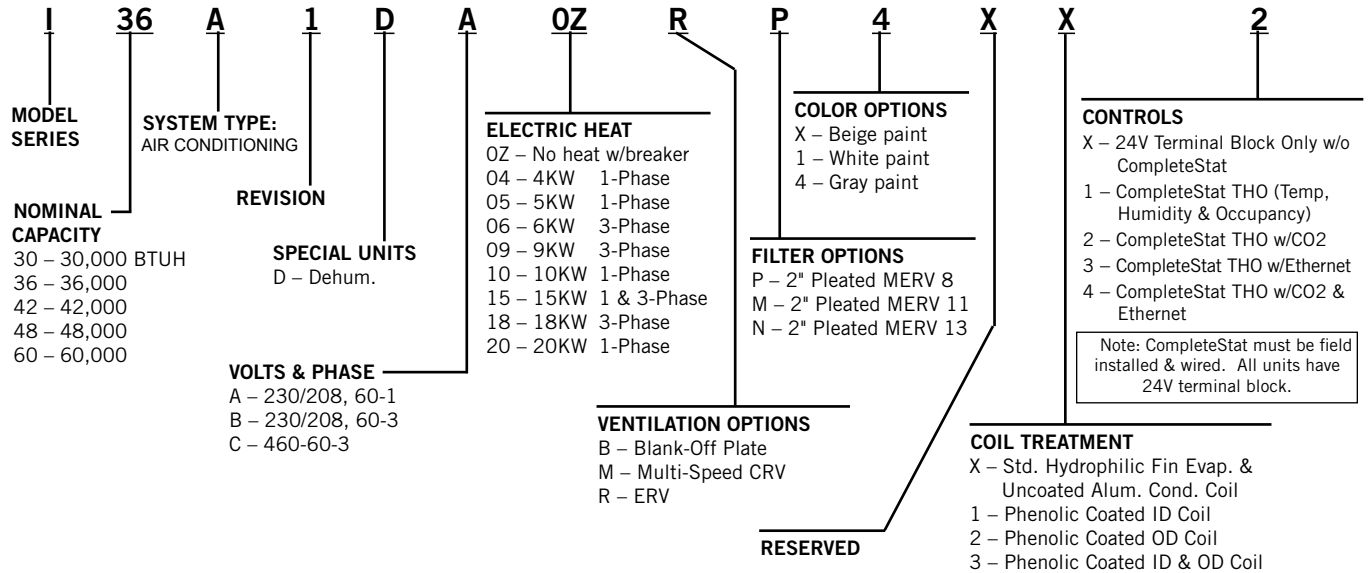
### ANSI Z535.5 Definitions:

- **DANGER:** Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury. The signal word "DANGER" is to be limited to the most extreme situations. DANGER [signs] should not be used for property damage hazards unless personal injury risk appropriate to these levels is also involved.
- **WARNING:** Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury. WARNING [signs] should not be used for property damage hazards unless personal injury risk appropriate to this level is also involved.
- **CAUTION:** Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION [signs] without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only.
- **NOTICE:** [this header is] preferred to address practices not related to personal injury. The safety alert symbol shall not be used with this signal word. As an alternative to "NOTICE" the word "CAUTION" without the safety alert symbol may be used to indicate a message not related to personal injury.



# I-TEC Series General Information

## I-TEC MODEL NOMENCLATURE



**TABLE 1A  
FACTORY BUILT-IN ELECTRIC HEAT TABLE**

| Models | I30A1DA |        | I30A1DB |        | I30A1DC | I36A1DA<br>I42A1DA |        | I36A1DB<br>I42A1DB |        | I36A1DC<br>I42A1DC | I48A1DA |        | I48A1DB<br>I60A1DB |        | I48A1DC<br>I60A1DC | I60A1DA |        |        |
|--------|---------|--------|---------|--------|---------|--------------------|--------|--------------------|--------|--------------------|---------|--------|--------------------|--------|--------------------|---------|--------|--------|
|        | 240V-1  | 208V-1 | 240V-3  | 208V-3 | 460V-3  | 240V-1             | 208V-1 | 240V-3             | 208V-3 | 460V-3             | 240V-1  | 208V-1 | 240V-3             | 208V-3 | 460V-3             | 240V-1  | 208V-1 |        |
|        | BTUH    | BTUH   | BTUH    | BTUH   | BTUH    | BTUH               | BTUH   | BTUH               | BTUH   | BTUH               | BTUH    | BTUH   | BTUH               | BTUH   | BTUH               | BTUH    | BTUH   | BTUH   |
| 4.0    |         |        |         |        |         |                    |        |                    |        |                    | 13,652  | 10,239 |                    |        |                    |         |        |        |
| 5.0    | 17,065  | 12,799 |         |        |         | 17,065             | 12,799 |                    |        |                    | 17,065  | 12,799 |                    |        |                    |         | 17,065 | 12,799 |
| 6.0    |         |        | 20,478  | 15,359 | 20,478  |                    |        | 20,478             | 15,359 | 20,478             |         |        | 20,478             | 15,359 | 20,478             |         |        |        |
| 9.0    |         |        | 30,717  | 23,038 | 30,717  |                    |        | 30,717             | 23,038 | 30,717             |         |        | 30,717             | 23,038 | 30,717             |         |        |        |
| 10.0   | 34,130  | 25,598 |         |        |         | 34,130             | 25,598 |                    |        |                    | 34,130  | 25,598 |                    |        |                    |         | 34,130 | 25,598 |
| 15.0   |         |        |         |        |         | 51,195             | 38,396 | 51,195             | 38,396 | 51,195             | 51,195  | 38,396 | 51,195             | 38,396 | 51,195             | 51,195  | 38,396 |        |
| 18.0   |         |        |         |        |         |                    |        |                    |        |                    |         |        | 61,434             | 46,076 | 61,434             |         |        |        |
| 20.0   |         |        |         |        |         |                    |        |                    |        |                    | 68,260  | 51,195 |                    |        |                    |         | 68,260 | 51,195 |

**TABLE 1B  
INDOOR BLOWER PERFORMANCE ①**

| MODEL  | Rated ESP | MAX ESP | ② Continuous Airflow | Rated 2nd Stage CFM | Rated 1st Stage CFM | ③ 5 - 9KW CFM | ④ 13.5 - 18KW CFM |
|--------|-----------|---------|----------------------|---------------------|---------------------|---------------|-------------------|
| I30A1D | .15       | 0.50    | 500                  | 900                 | 650                 | 700           | 1400              |
| I36A1D | .15       | 0.50    | 600                  | 1150                | 850                 | 700           | 1400              |
| I42A1D | .20       | 0.50    | 650                  | 1300                | 950                 | 700           | 1400              |
| I48A1D | .20       | 0.50    | 725                  | 1500                | 1050                | 700           | 1400              |
| I60A1D | .20       | 0.50    | 850                  | 1700                | 1200                | 700           | 1400              |

① Motor will deliver consistent CFM through voltage supply range with no deterioration.

② Continuous fan CFM is the total air being circulated during continuous fan mode.

③ Will occur automatically with a call for "W3" or "Emergency Heat" signal from the thermostat.

**TABLE 2  
ELECTRICAL SPECIFICATIONS**

| MODEL  | Rated<br>Volts, Hertz<br>& Phase | Single Circuit                       |                                   |  |                             |                                | Dual Circuit                   |          |   |          |                          |        |                     |          |
|--|----------------------------------|--------------------------------------|-----------------------------------|--|-----------------------------|--------------------------------|--------------------------------|----------|---|----------|--------------------------|--------|---------------------|----------|
|  |                                  | No. Field<br>Power<br>Circuits       | Minimum<br>Circuit<br>Ampacity    | Maximum<br>External<br>Fuse or Ckt.<br>Brkr. | Field<br>Power Wire<br>Size | Ground<br>Wire                 | Minimum<br>Circuit<br>Ampacity |          | Maximum<br>External Fuse or<br>Ckt. Breaker |          | Field Power<br>Wire Size |        | Ground Wire<br>Size |          |
|  |                                  |                                      |                                   |  |                             |                                | Ckt. A                         | Ckt. B   | Ckt. A                                      | Ckt. B   | Ckt. A                   | Ckt. B | Ckt. A              | Ckt. B   |
| I30A1DA0Z<br>A05<br>A10                      | 230/208-1                        | 1<br>1<br>1                          | 22<br>32<br>58                    | 35<br>35<br>60                               | 8<br>8<br>6                 | 10<br>10<br>10                 |                                |          |   |          |                          |        |                     |          |
| I30A1DB0Z<br>B06<br>B09                      | 230/208-3                        | 1<br>1<br>1                          | 17<br>23<br>32                    | 25<br>25<br>35                               | 10<br>10<br>10              | 10<br>10<br>10                 |                                |          |   |          |                          |        |                     |          |
| I30A1DC0Z<br>C06<br>C09                      | 460-3                            | 1<br>1<br>1                          | 9<br>13<br>18                     | 10<br>15<br>20                               | 14<br>14<br>12              | 14<br>14<br>12                 |                                |          |   |          |                          |        |                     |          |
| I36A1DA0Z<br>A05<br>A10<br>A15               | 230/208-1                        | 1<br>1<br>1<br>1 or 2                | 26<br>32<br>58<br>84              | 40<br>40<br>60<br>90                         | 8<br>8<br>6<br>4            | 10<br>10<br>10<br>8            | 26                             | 52       | 40  | 60       | 8                        | 6      | 10                  | 10       |
| I36A1DB0Z<br>B06<br>B09<br>B15               | 230/208-3                        | 1<br>1<br>1<br>1                     | 22<br>23<br>32<br>51              | 30<br>30<br>35<br>60                         | 10<br>10<br>8<br>6          | 10<br>10<br>10<br>10           |                                |          |   |          |                          |        |                     |          |
| I36A1DC0Z<br>C06<br>C09<br>C15               | 460-3                            | 1<br>1<br>1<br>1                     | 11<br>13<br>18<br>28              | 15<br>15<br>20<br>30                         | 14<br>14<br>12<br>10        | 14<br>14<br>12<br>10           |                                |          |   |          |                          |        |                     |          |
| I42A1DA0Z<br>A05<br>A10<br>A15               | 230/208-1                        | 1<br>1<br>1<br>1 or 2                | 30<br>32<br>58<br>82              | 45<br>40<br>60<br>90                         | 8<br>8<br>6<br>4            | 10<br>10<br>10<br>8            | 56                             | 52       | 60  | 60       | 6                        | 6      | 10                  | 10       |
| I42A1DB0Z<br>B06<br>B09<br>B15               | 230/208-3                        | 1<br>1<br>1<br>1                     | 25<br>25<br>32<br>52              | 35<br>35<br>35<br>60                         | 8<br>8<br>8<br>6            | 10<br>10<br>10<br>10           |                                |          |   |          |                          |        |                     |          |
| I42A1DC0Z<br>C06<br>C09<br>C15               | 460-3                            | 1<br>1<br>1<br>1                     | 12<br>14<br>19<br>28              | 15<br>15<br>20<br>30                         | 14<br>14<br>12<br>10        | 14<br>14<br>12<br>10           |                                |          |   |          |                          |        |                     |          |
| I48A1DA0Z<br>A04<br>A05<br>A10<br>A15<br>A20 | 230/208-1                        | 1<br>1<br>1<br>1<br>1 or 2<br>1 or 2 | 34<br>34<br>34<br>59<br>85<br>110 | 50<br>50<br>50<br>60<br>90<br>110            | 8<br>8<br>8<br>6<br>3<br>2  | 10<br>10<br>10<br>10<br>8<br>6 | 35<br>59                       | 52<br>52 | 45<br>60                                    | 60<br>60 | 8<br>6                   | 6<br>6 | 10<br>10            | 10<br>10 |
| I48A1DB0Z<br>B06<br>B09<br>B15<br>B18        | 230/208-3                        | 1<br>1<br>1<br>1<br>1                | 26<br>26<br>34<br>53<br>53        | 35<br>35<br>35<br>60<br>60                   | 8<br>8<br>8<br>6<br>6       | 10<br>10<br>10<br>10<br>10     |                                |          |   |          |                          |        |                     |          |
| I48A1DC0Z<br>C06<br>C09<br>C15<br>C18        | 460-3                            | 1<br>1<br>1<br>1<br>1                | 12<br>14<br>19<br>29<br>33        | 15<br>15<br>20<br>30<br>35                   | 12<br>12<br>12<br>10<br>8   | 12<br>12<br>12<br>10<br>10     |                                |          |   |          |                          |        |                     |          |
| I60A1DA0Z<br>A05<br>A10<br>A15<br>A20        | 230/208-1                        | 1<br>1<br>1<br>1 or 2<br>1 or 2      | 44<br>44<br>59<br>96<br>112       | 60<br>60<br>60<br>100<br>120                 | 8<br>6<br>6<br>3<br>2       | 10<br>10<br>10<br>8<br>6       | 44<br>60                       | 52<br>52 | 60<br>60                                    | 60<br>60 | 8<br>6                   | 6<br>6 | 10<br>10            | 10<br>10 |
| I60A1DB0Z<br>B06<br>B09<br>B15<br>B18        | 230/208-3                        | 1<br>1<br>1<br>1<br>1 or 2           | 31<br>31<br>35<br>58<br>63        | 45<br>45<br>45<br>60<br>70                   | 8<br>8<br>8<br>6<br>6       | 10<br>10<br>10<br>10<br>8      | 31                             | 54       | 45  | 60       | 8                        | 6      | 10                  | 10       |
| I60A1DC0Z<br>C06<br>C09<br>C15<br>C18        | 460-3                            | 1<br>1<br>1<br>1<br>1                | 15<br>15<br>19<br>29<br>29        | 20<br>20<br>20<br>30<br>30                   | 12<br>12<br>12<br>10<br>10  | 12<br>12<br>12<br>10<br>10     |                                |          |   |          |                          |        |                     |          |

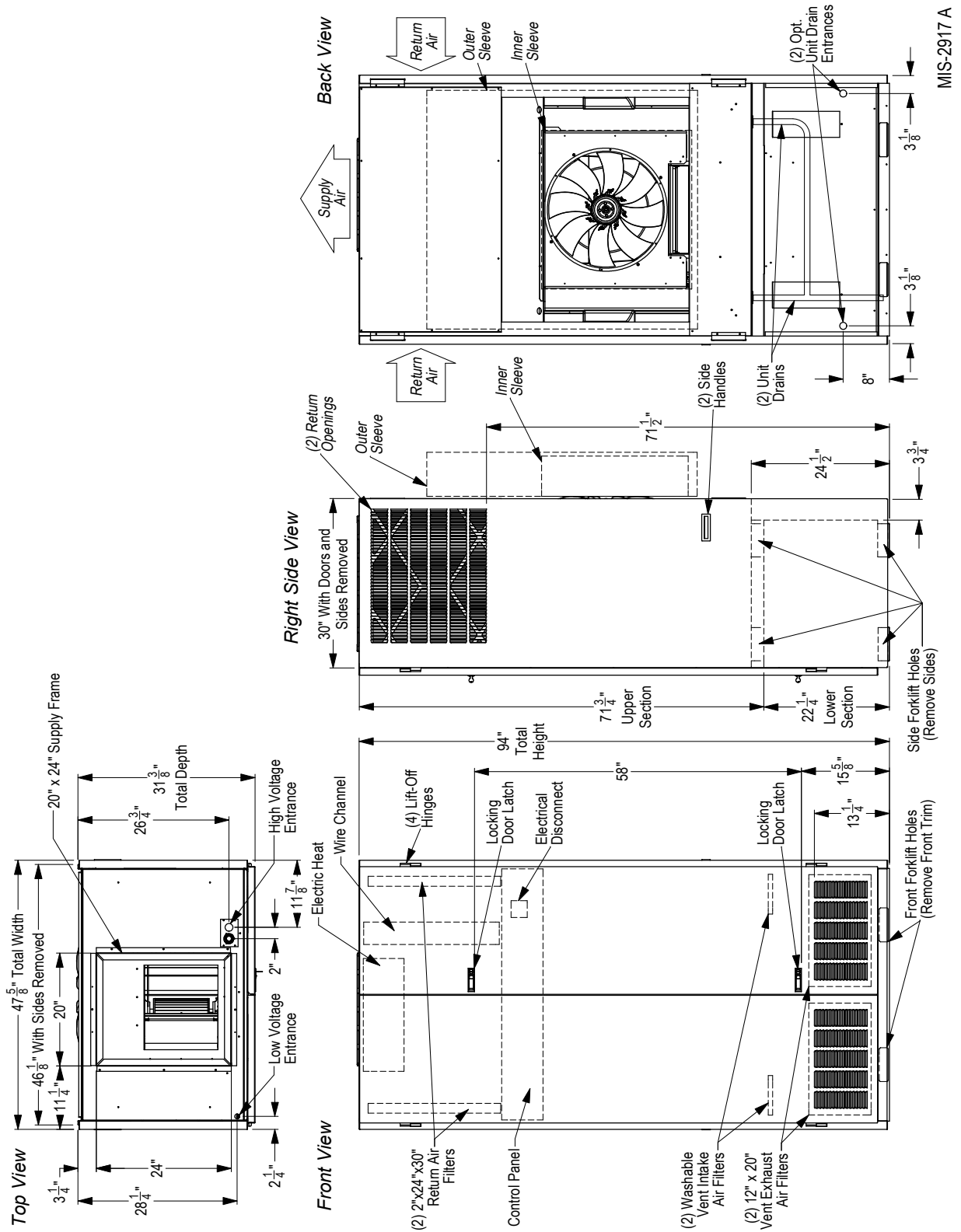
① These "Minimum Circuit Ampacity" values are to be used for sizing the field power conductors. Refer to the National Electric Code (latest revision), article 310 for power conductor sizing.

**Caution:** When more than one field power conductor circuit is run through one conduit, the conductors must be derated. Pay special attention to note 8 of table 310 regarding Ampacity Adjustment Factors when more than three conductors are in a raceway.

② Maximum size of the time delay fuse or circuit breaker for protection of field wiring conductors.

③ Based on 75°C copper wire. All wiring must conform to the National Electrical Code and all local codes.

**FIGURE 1  
UNIT DIMENSIONS**



MIS-2917 A

## SHIPPING DAMAGE

Upon receipt of equipment, the unit should be checked for external signs of shipping damage. The skid must remain attached until the unit is ready for installation. If damage is found, the receiving party must contact the last carrier immediately, preferably in writing, requesting inspection by the carrier's agent.

## UNIT REMOVAL FROM SKID

### **WARNING**

***This unit is heavy and requires more than one person to handle during installation and removal from the skid. Extreme caution must be taken to prevent injury to personnel and damage to the unit. Use appropriate safety equipment, including gloves when handling. Failure to do so may result in serious injury.***

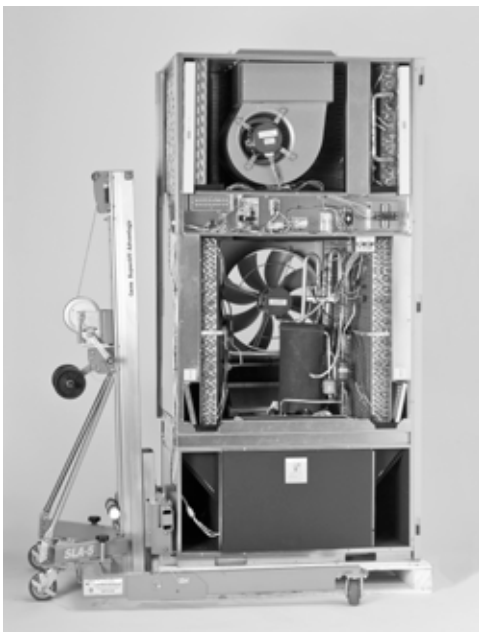
A forklift or a lift rated for the load (Figure 2A) is required to lift the unit off from the skid. This unit is top heavy and should never be tipped while moving it.

The I-TEC is designed to be lifted off the skid from the front or rear of the unit without having to remove any doors or side panels. See Figure 1 on page 7 for fork openings. The shipping brackets on front and rear of the unit must be removed and discarded. The unit can now be lifted straight up and the skid can be slid out from underneath.

### **CAUTION**

***Tip unit from left side only. Failure to do so may result in injury due to unit top-heaviness or compressor damage!***

FIGURE 2A – UNIT ON LIFT

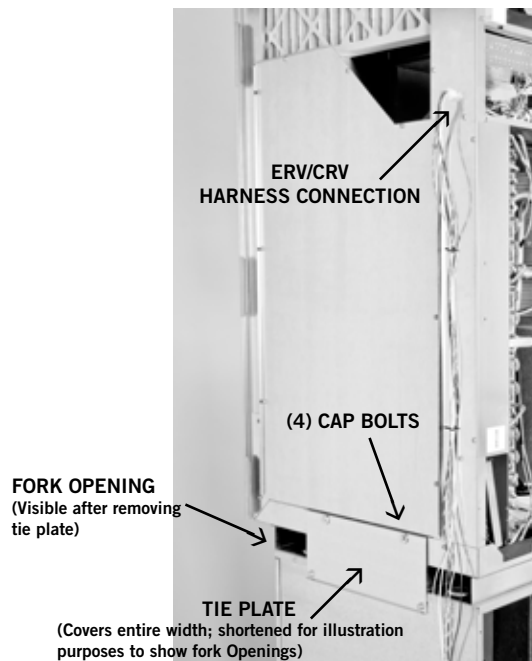


## HANDLING UNIT AFTER REMOVAL FROM SKID

If a wide and tall enough opening exists, the I-TEC can be moved as a complete assembled unit. If not, it is designed to break down into two sections to allow it to pass through a 36" wide door.

1. Depress and release both top and bottom door latches and open doors.
2. Remove the doors by lifting straight up and off from the hinge pins.
3. Remove cabinet sides by first removing the four (4) sheet metal screws from the front (leading edge) of the side panel. The panel will not fall off. Swing the panel away from the chassis 20-30° and then pull forward from the two (2) tabs supporting the rear edge.
4. On each side of the unit is a tie plate that secures the top and bottom sections with four (4) cap bolts. Using a ½" wrench or socket, remove these screws from both plates and set aside.
5. If the unit is equipped with a CRV or ERV, unplug the wire harness on the left-hand side of the control box.
6. ***A forklift or a lift rated for the load is required to lift the top section off from the bottom base. Do not attempt to do this manually. Failure to do so could result in the unit tipping over and causing bodily injury and/or damage to the unit.***
7. The top section can be forked from either the right-hand or left-hand side. See Figure 1 on page 7 for fork openings.
8. Carefully lift the top section straight up avoiding tipping.

FIGURE 2B – UNIT SIDE





9. Move the top section through the doorway and place on flat surface free of debris.
10. The bottom base can now be moved through the doorway the same way.
11. Reassemble the unit by reversing this procedure.

## REQUIRED STEPS AFTER FINAL PLACEMENT

The compressor is secured to the base with two (2) bolts for shipping. Although the unit will perform as designed with the shipping bolts in place, there may be a noticeable additional noise and vibration noted. To obtain the lowest noise and vibration levels, remove the shipping bolts after the unit is in its final operating location. To gain access to the compressor, the compressor access panel must be removed (see Figure 5 on page 13). Once this panel is removed, the CRV/ERV air duct must be removed (see Figure 5).

The air duct is removed by pulling it straight out; there are no screws securing it in place. Both the top and bottom will slide out at the same time (*pull hard*). Once removed, the compressor is visible as well as the tags on the shipping bolts (see Figure 6 on page 13).

After the compressor shipping bolts have been removed, the CRV/ERV air duct can be slid back in place and the compressor access panel re-attached.

## MINIMUM INSTALLATION HEIGHT

The minimum installation height to the bottom of the roof or fixed ceiling for ducted applications is 9' 7". This provides enough clearance to install the duct work. See Figure 7A on page 14.

The IWS Series wall sleeve has a built-in vertical adjustment to fit window sill heights from 31-34". If additional height is required, two riser platform accessories are available. The IRP3 increases the unit height by 3" (Figure 7B on page 15) and the IRP6 by 6" (Figure 7C on page 16).

## SECURING UNIT TO STRUCTURE

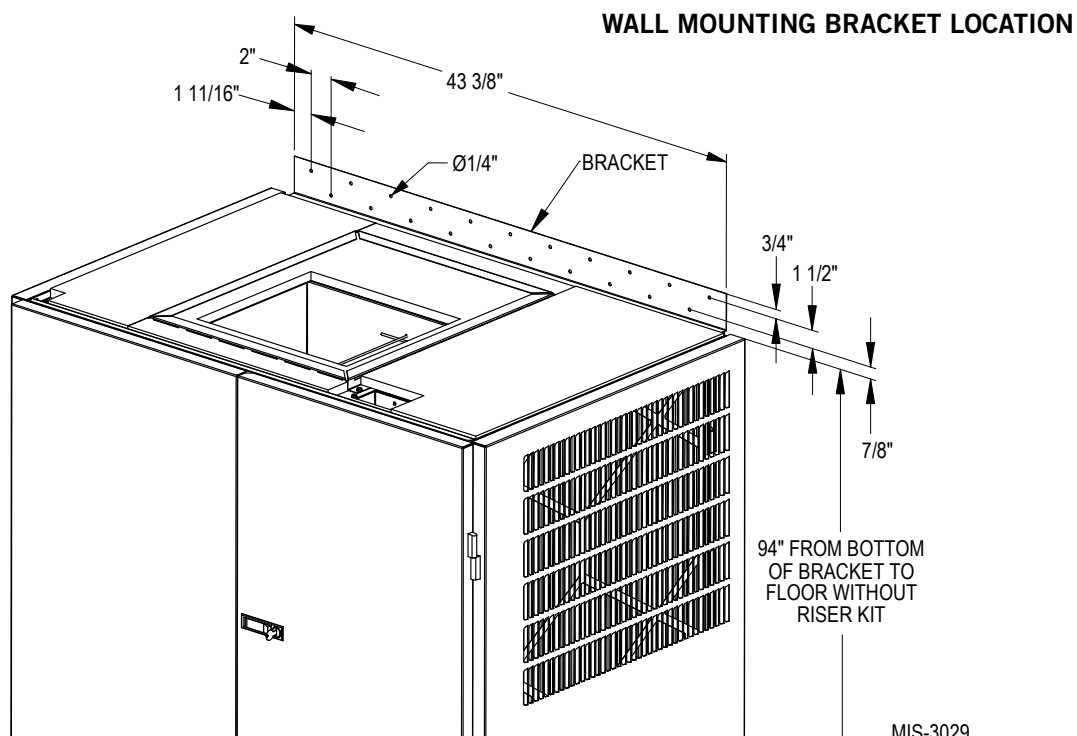
Shipped with the I-TEC unit is a wall mounting bracket (screwed to shipping skid on backside of unit). This bracket can be utilized to secure the top portion of the unit to the wall using the appropriate field-supplied hardware based upon the material you are fastening to. (*There are several offset holes, sized to accept up to a 1/4" diameter fastener that will easily allow you to hit studs on a framed wall.*) See **BRACKET WALL SECTION VIEW** (page 10) for locating this top wall bracket which will need to be applied after the unit is located in the final position.

Additional/optional mounting holes for up to a 3/8" diameter fastener are also available in the backside of the unit. These can be accessed by:

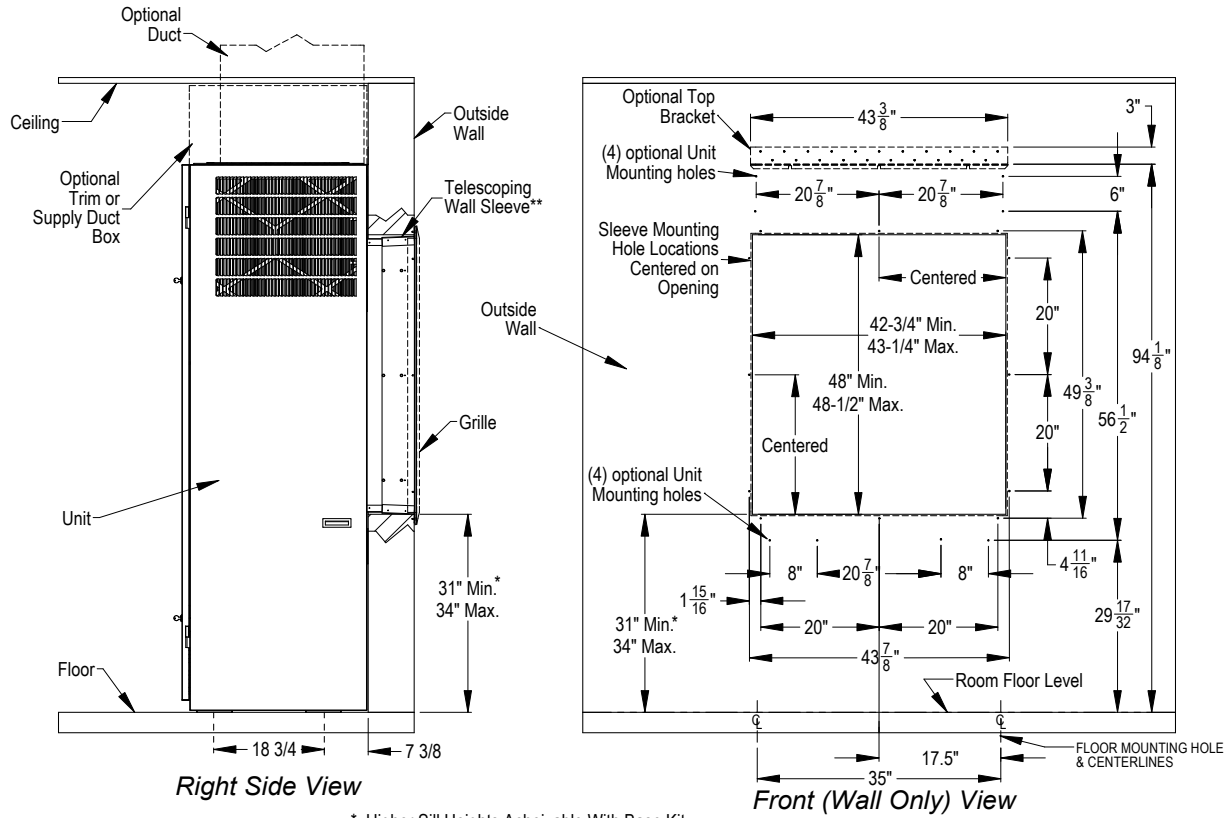
- removing the air filters for the uppermost set
- removing the compressor section service door for the lower set

Refer to **WOOD FRAMED INSTALLATION** (page 10) for additional framing required to secure unit to wall.

*The additional/optional mounting holes will require a long extension to drive the fasteners.*



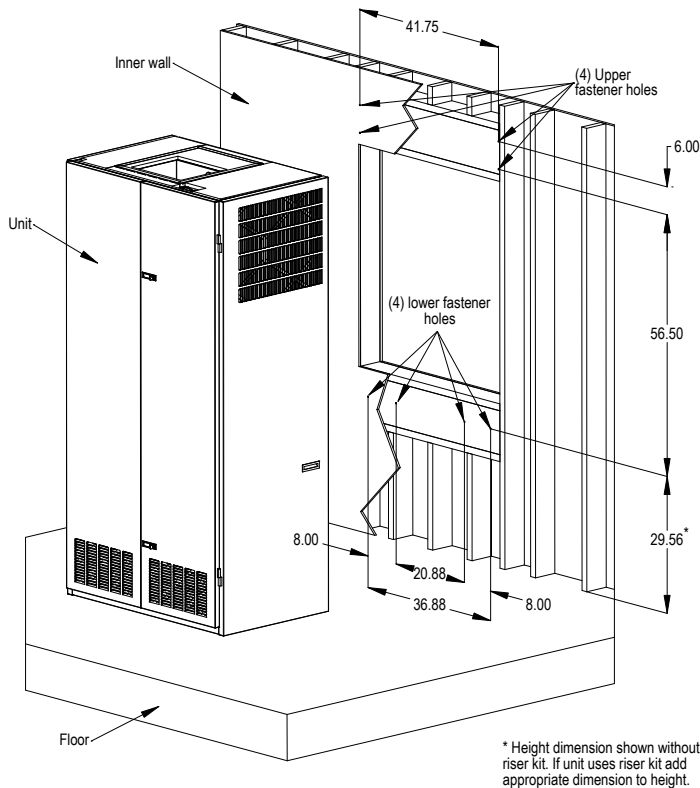
## BRACKET WALL SECTION VIEW



\* Higher Sill Heights Achievable With Base Kit.  
 \*\* Separate telescoping sleeves available for different wall thicknesses.

MIS-2918 C

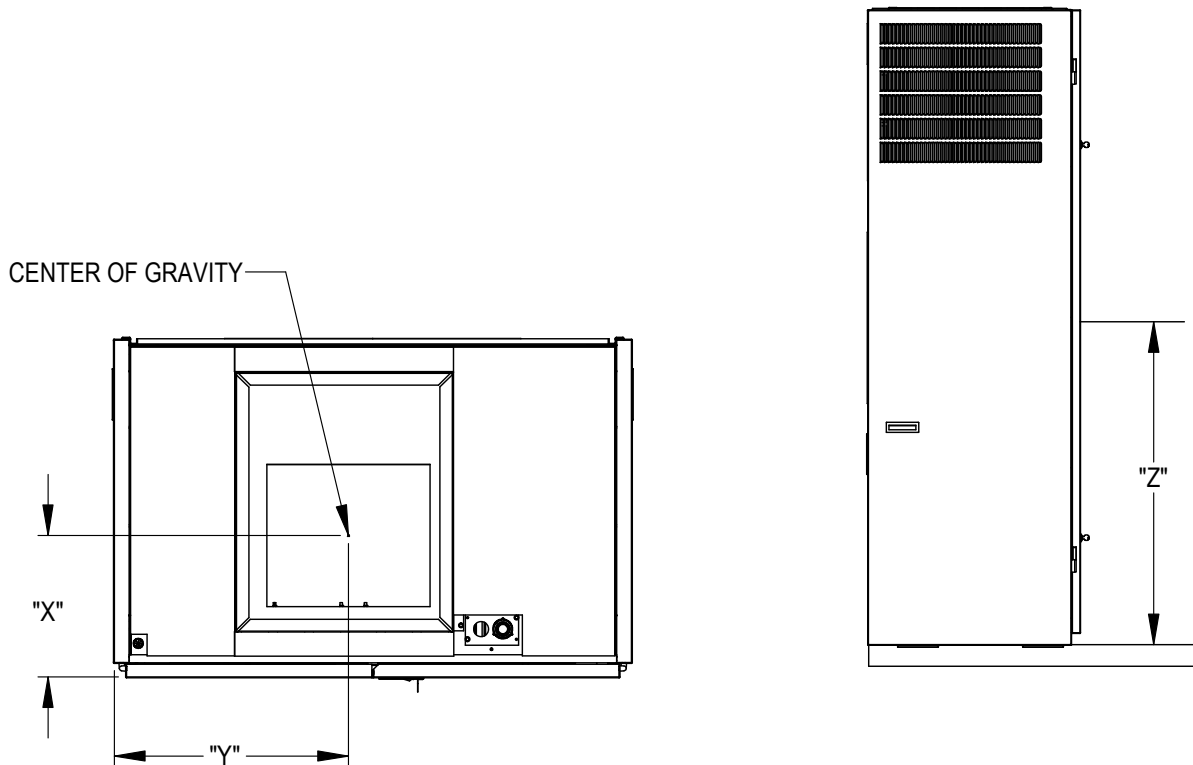
## WOOD FRAMED INSTALLATION (for Wall Attachment)



\* Height dimension shown without riser kit. If unit uses riser kit add appropriate dimension to height.

MIS-3072

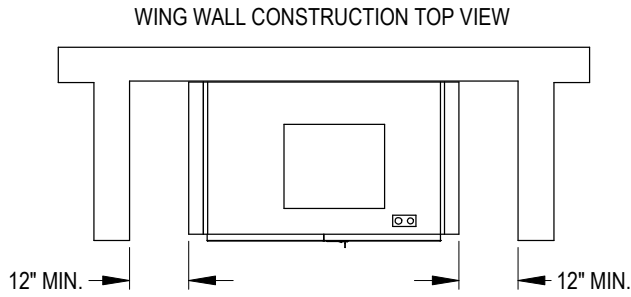
**FIGURE 3  
CENTER OF GRAVITY**



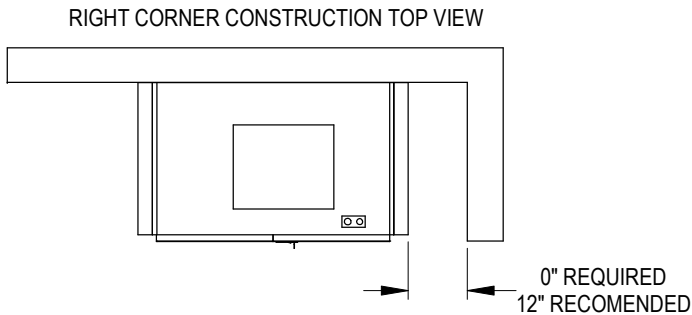
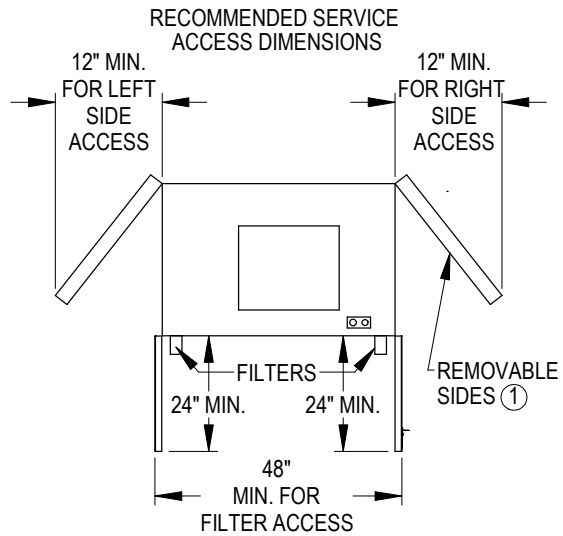
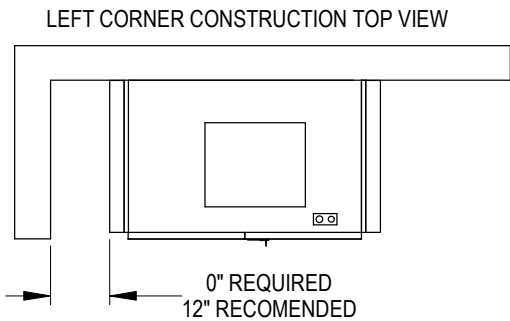
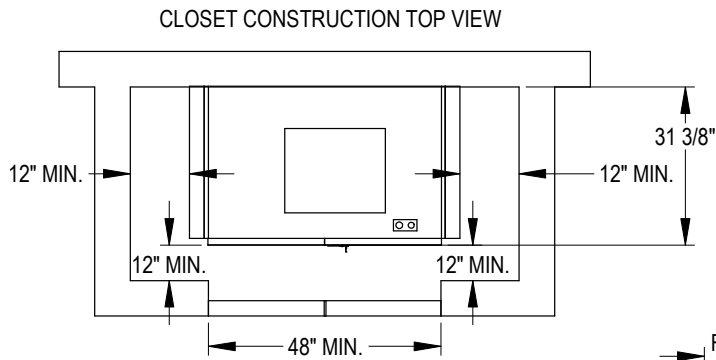
MIS-3269

| UNIT TESTED | FRONT OF UNIT<br>DOOR TO CENTER | LEFT SIDE<br>TO CENTER | FLOOR TO CENTER<br>CRV & ERV | FLOOR TO CENTER<br>NO VENT |
|-------------|---------------------------------|------------------------|------------------------------|----------------------------|
|             | "X" Dimension                   | "Y" Dimension          | "Z" Dimension                | "Z" Dimension              |
| I30A1DA, DB | 13-3/4"                         | 24"                    | 43½"                         | 47"                        |
| I30A1DC     | 13-3/4"                         | 24¼"                   | 43½"                         | 47"                        |
| I36A1DA, DB | 13-3/4"                         | 24"                    | 43½"                         | 47"                        |
| I36A1DC     | 13-3/4"                         | 24¼"                   | 43½"                         | 47"                        |
| I42A1DA, DB | 13-3/4"                         | 24"                    | 43½"                         | 47"                        |
| I42A1DC     | 13-3/4"                         | 24¼"                   | 43½"                         | 47"                        |
| I48A1DA, DB | 13-3/4"                         | 24"                    | 43½"                         | 47"                        |
| I48A1DC     | 13-3/4"                         | 24¼"                   | 43½"                         | 47"                        |
| I60A1D, DB  | 13-3/4"                         | 24"                    | 43½"                         | 47"                        |
| I60A1DC     | 13-3/4"                         | 24¼"                   | 43½"                         | 47"                        |

**FIGURE 4  
REQUIRED CLEARANCES AND RECOMMENDED ACCESS**



**IMPORTANT**  
Unit can be located in corner with 0" clearance as long as other side is unobstructed



① ALL FILTER AND COMPONENT ACCESS IS FROM THE FRONT. COILS CAN BE CLEANED FROM THE FRONT, BUT SIDES ARE EASILY REMOVED FOR ENHANCED ACCESS.

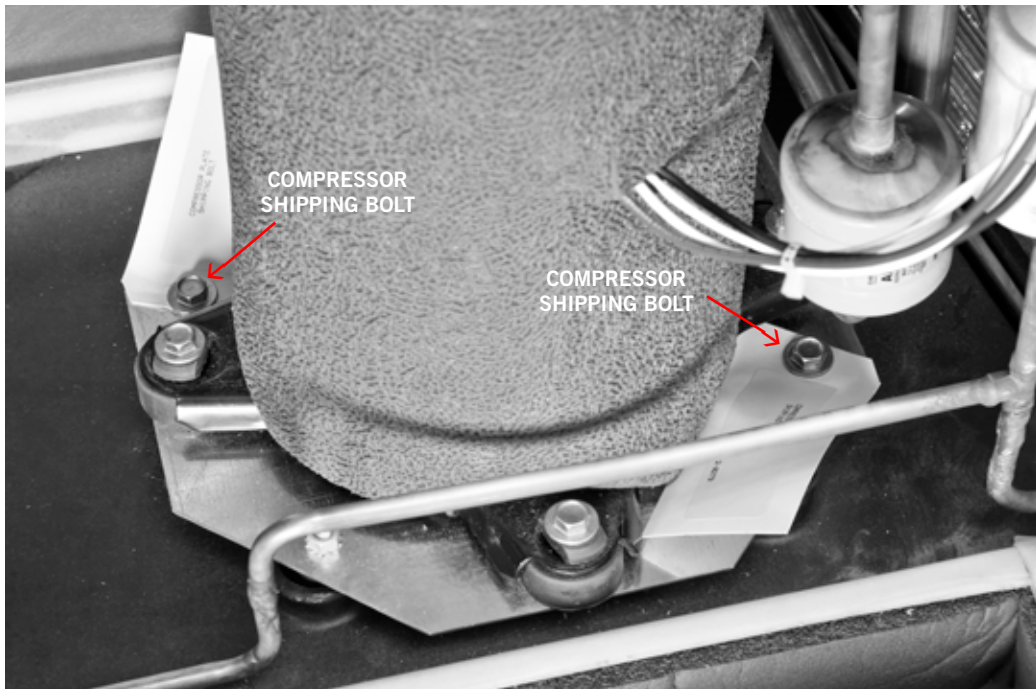
MIS-3273

**FIGURE 5  
REMOVAL OF AIR DUCT**

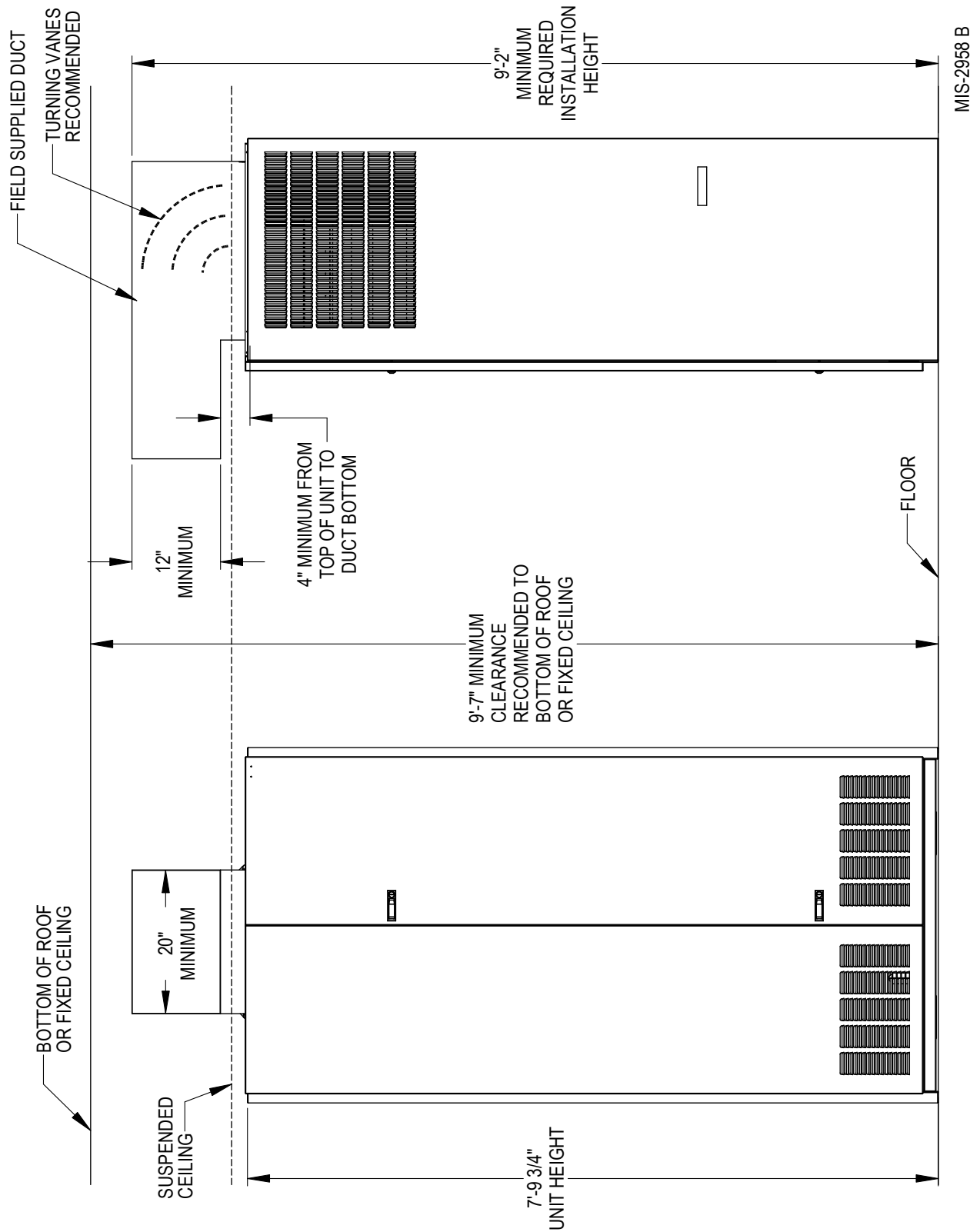
**CRV/ERV  
AIR DUCT**



**FIGURE 6  
COMPRESSOR SHIPPING BOLTS**

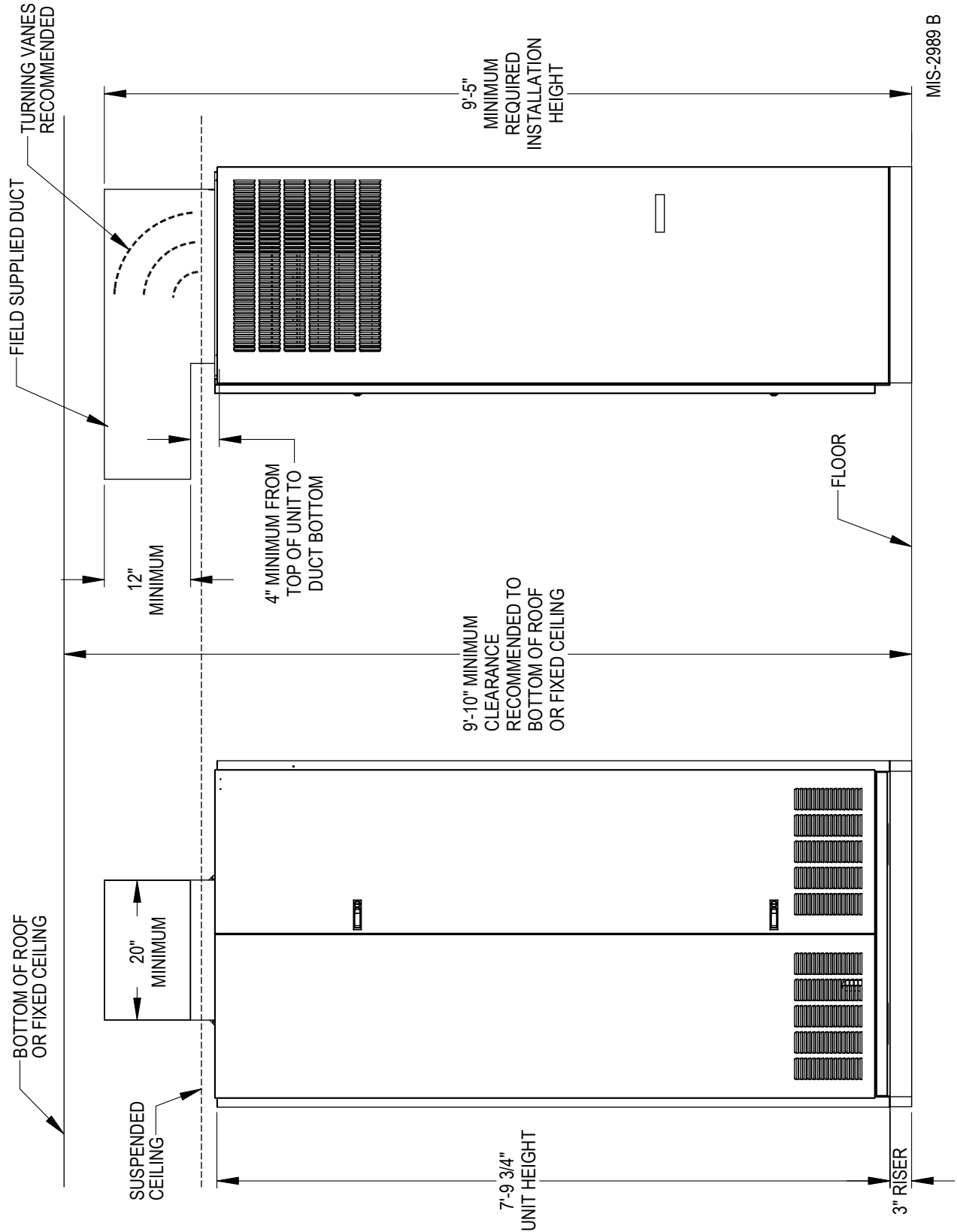


**FIGURE 7A**  
**DUCTED APPLICATION – BASIC UNIT**



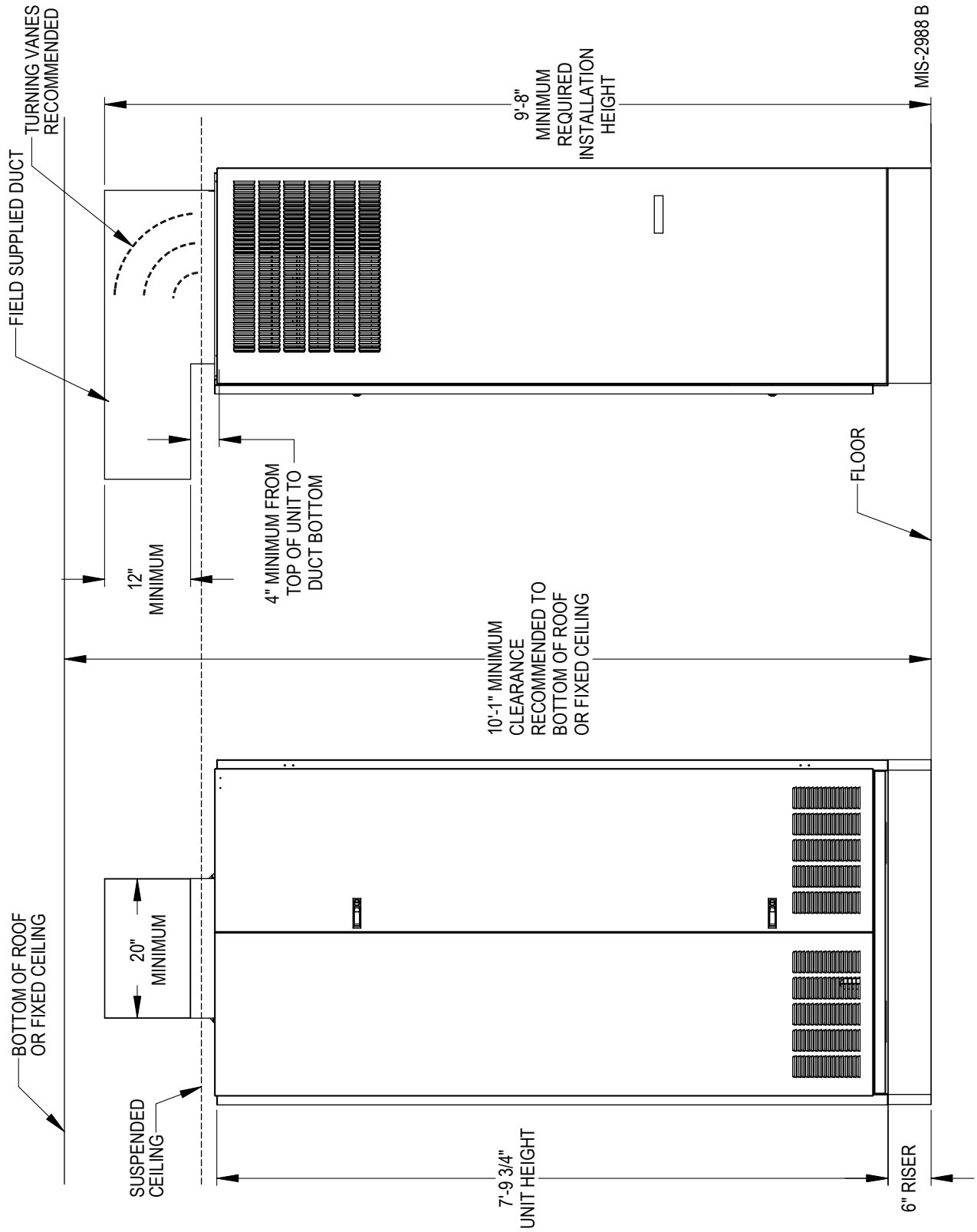
MIS-2958 B

**FIGURE 7B**  
**3" RISER APPLICATION**



MIS-2989 B

**FIGURE 7C**  
**6" RISER APPLICATION**



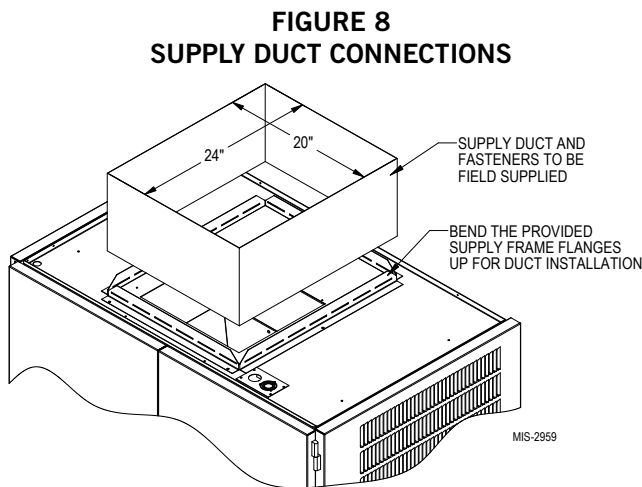


## DUCT WORK

All duct work must be properly sized for the design airflow requirement of the equipment. Air Conditioning Contractors of America (ACCA) is an excellent guide to proper sizing. All duct work or portions thereof not in the conditioned space should be properly insulated in order to both conserve energy and prevent condensation or moisture damage. When duct runs through unheated spaces, it should be insulated with a minimum of 1" of insulation. Use insulation with a vapor barrier on the outside of the insulation. Flexible joints should be used to connect the duct work to the equipment in order to keep the noise transmission to a minimum.

The I-TEC Series models have provision to attach a supply air duct to the top of the unit. Duct connection size is 20" x 24". The flanges are shipped flat and must be bent upward using sheet metal flanging pliers. The duct work is field supplied. See Figure 8 for suggested attachment method.

**Make sure to seal the slots in the bend-up flange at the time of securing your ductwork to the flange. This can be accomplished with either foil tape or caulk. Failing to do so may cause air leakage/whistling of air.**



**NOTE:** Unit cabinet, supply air duct and duct free plenum are approved for "0" clearance to combustible material.

The I-TEC Series models are designed for use with free return (non-ducted) and either duct free with the use of IPBDF Series Plenum Box (8" or 12") or a duct supply air system.

The IPBDF Plenum Box mounts on top of the unit and has both vertically and horizontally adjustable louvers on the front discharge grille.

When used with a ducted supply, an ICX28 Cabinet Extension may be used to conceal the ductwork above the unit to the ceiling. The ICX28 extends 28" above the unit for a total height of 10'-2" for a floor mounted

install (10'-5" with IRP3 riser and 10'-8" with IRP6 riser). It can be trimmed in the field for installations that require less than 10'-2".

The unit is equipped with a variable speed indoor blower motor which increases in speed with an increase in duct static pressure. The unit will therefore deliver proper rated airflow up to the maximum ESP shown in Table 1B on page 5. However, for quiet operation of the air system, the duct static should be kept as low as practical, within the guidelines of good duct design.

## FILTERS

Two 2" throw away filters (24 x 30) and two 1" throw away filters (12 x 20) are supplied with each unit. The 2" filters slide into brackets on both sides for the return air openings. The 1" filters are in the cabinet doors for the vent (room air) exhaust. If a CRV or ERV vent option is used, there are two additional ½" (8 x 17) washable filters included with that option. See Figure 9 for specific locations. The filters are serviced from the inside of the building by opening the cabinet doors and do not require any tools to access.

**FIGURE 9  
FILTER LOCATION**



## CONDENSATE DRAIN

There are two condensate drain connections from the condenser drain pan (compressor area). These are visible from the rear of the unit. Factory-installed tubing connects the two drains at a tee connection and then a single drain hose with a barbed hose connector carries the condensate to the draining option chosen. Enough tubing is provided to reach all drain options and can be cut down in length.

The unit is shipped from the factory with the drain line on the left-hand side (looking at the rear of the unit). The tubing can be removed from the drain connections and flipped for a right-hand drain. See Figure 10.

The drain can be routed directly through the floor or through the wall. There are also two optional drain locations in the lower rear back panel. See Figure 10.

The I-TEC design does not require a trap in the condensate disposal tubing. Check local codes to see if a "P" trap is required.

For a stand pipe floor drain or through the wall, there is adequate hose length to reach anything located behind the unit. The lower rear portion of the cabinet is recessed approximately 4" allowing room for a "P" trap to be installed with the cabinet flush with the wall. The drain line must be able to be removed from the unit if necessary to remove the unit from the wall.

Access plates are located on the rear of the unit for servicing the drain trap (see Figure 10). **If the drain line is to be routed through an unconditioned space, it must be protected from freezing.**

The condensate drain line can also be routed back into the unit through either the right-hand or left-hand optional drain locations on the rear of the unit. The hole is covered by insulation on the inside of the unit and will have to be cut away. Drain holes are located inside the unit in the bottom of the base about 12" in from the front on both the left and right side. These holes are covered with insulation and are not visible. They are located very close to the side panels and can be found by pressing down on the insulation. Cut insulation away to expose the hole. A drain trap can now be installed inside of the cabinet, and the drain hose routed directly through the floor.

Once the I-TEC is installed, the rear drains exiting the condenser section can be easily serviced with removal of the pre-painted metal sides (lift-off doors, remove four (4) screws to remove side).

If side access is not available, the drain lines and trap can be serviced by removing either one of the drain access panels on the rear of the unit (in the ventilation package area.) See Figure 10.

## WITH NO VENT OPTION

To access the drain access panels in the rear of this section, remove the front door/cover from the box, and the plates are located in the rear of the box.

## WITH COMMERCIAL ROOM VENTILATOR

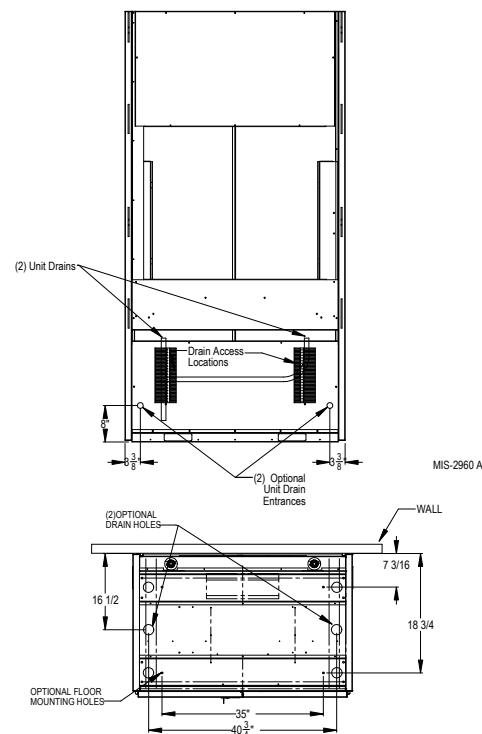
1. Open hinged front doors.
2. Disconnect unit power to eliminate shock hazard.
3. Remove front cover/door of CRV vent package. (Can leave filter access panels in place.)
4. Unplug wires coming in on left side from upper unit section.
5. Unplug two wire harness from front (intake) blower.
6. Remove two (2) screws securing front (intake) blower and slide blower out of unit.
7. Remove four (4) screws that retain the partition behind/beneath intake blower removed in Step 6.
8. Rear drain access panels are now visible on both right-hand and left-hand sides in rear of box.

## WITH ENERGY RECOVERY VENTILATOR

To access the rear drain access panels of this section:

1. Open hinged front doors.
2. Disconnect unit power to eliminate shock hazard.
3. Remove front cover/door of ERV vent package. (Can leave filter access panels in place.)
4. Unplug wires coming in on left side from upper unit section.
5. Unplug heat recovery cassette on the side you wish to access, and slide cassette out the front of the unit.
6. Remove two (2) screws securing partition on outboard side of cassette and remove.
7. Rear drain access panels are now visible on both right-hand and left-hand sides in rear of box.

FIGURE 10 – DRAIN LOCATIONS



**FIGURE 11A  
UNIT MOUNTING**

Use (12) Field Supplied Concrete or Wood Screws to Secure Outer Sleeve to Structure.

**IMPORTANT!**  
Apply liberal amount of caulk to back of flange before installing.

REF. A

Use (6) 3/4" Long Self Tapping Screws to Attach Inner Sleeve to Outer Sleeve

**IMPORTANT!**  
Apply Caulk bead to entire perimeter seam between inner and outer sleeve.

REF. B

Use (12) 3/4" Long Self Tapping Screws to Attach Inner Sleeve to Unit Back

**IMPORTANT!**

Use care when inserting screws to not damage gasketing material. Doing so may compromise water seal between unit and sleeve.

Pull Inner Frame Out Until Flush With Louver Mounting Angle

Use (4) 1-1/2" Long Screws to Attach Louver to Outer Sleeve.

REF. E

NO CAULK BEHIND Louver

REF. C

Use (6) 3/4" Long Screws to Attach Exhaust Sleeve to Unit Fan Shroud

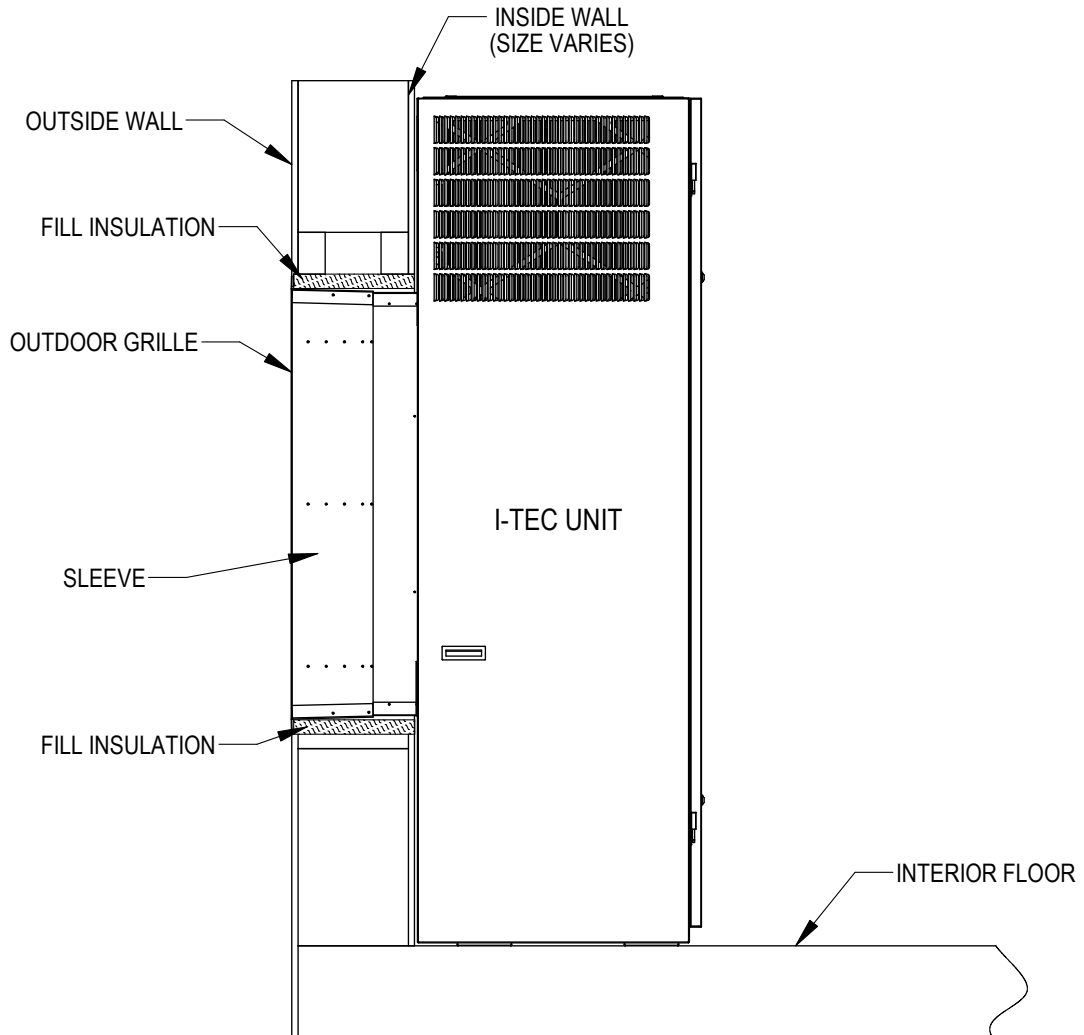
REF. D

Use (4) 1/2" Long Screws to Attach frame to Exhaust Sleeve

|                                |              |  |
|--------------------------------|--------------|--|
| (18) 5/16" - 3/4" SELF TAPPING | REF. A AND B |  |
| (6) 5/16" - 3/4" NON-TAPPING   | REF. C       |  |
| (4) 5/16" - 1/2" NON-TAPPING   | REF. D       |  |
| (4) 1-1/2" LONG SCREWS         | REF. E       |  |

MIS-3014 B

**FIGURE 11B  
UNIT MOUNTING**



MIS-2928 A

## MOUNTING THE UNIT

*The wall sleeve is attached to the I-TEC unit from the outside of the building. See Figures 9A and 9B. Refer to wall sleeve Manual 2100-562 supplied with sleeve.*

Following are the steps for attaching the I-TEC to the wall sleeve.

1. Lift the unit into place making sure that it is aligned side to side.
2. Push the unit back until the rear panel touches the sleeve gasket.
3. This unit must be level from side to side and from front to back. If adjustments are necessary, shim up under the base rails with sheets of metal or any substance not affected by moisture.
4. Attach the sleeve to the unit using the ten (10)  $\frac{3}{4}$ " long self-tapping screws supplied with the sleeve.
5. The exhaust sleeve has three (3)  $\frac{3}{4}$ " long screw slots in each side flange. Line these up with the screw engagement holes in the fan panel. Attach using six (6)  $\frac{3}{4}$ " long pointed sheet metal screws supplied with the sleeve. Extend the sleeve out until it is flush with the louver grill attachment angles.
6. Lock the sleeve in place using two (2)  $\frac{1}{2}$ " long pointed sheet metal screws on each side by shooting through the slot into a pre-punched hole.
7. A bottom trim piece is shipped loose for installation beneath the doors. Attach the trim piece to the unit with screws provided.
8. The compressor is secured to the base with two (2) bolts for shipping. Both bolts are identified with a tag. Remove shipping bolts (see Figure 5 on page 13).

## WIRING – MAIN POWER

Refer to the unit rating plate and/or Table 2 on page 6 for wire sizing information and maximum fuse or circuit breaker size. Each unit is marked with a "Minimum Circuit Ampacity". This means that the field wiring used must be sized to carry that amount of current. Depending on the installed KW of electric heat, there may be two field power circuits required. If this is the case, the unit serial plate will so indicate. All models are suitable only for connection with copper wire. Each unit and/or wiring diagram will be marked "Use Copper Conductors Only suitable for at least 75°C". **THESE INSTRUCTIONS MUST BE ADHERED TO.** Refer to the National Electrical Code (NEC) for complete current carrying capacity data on the various insulation grades of wiring material. All wiring must conform to NEC and all local codes.

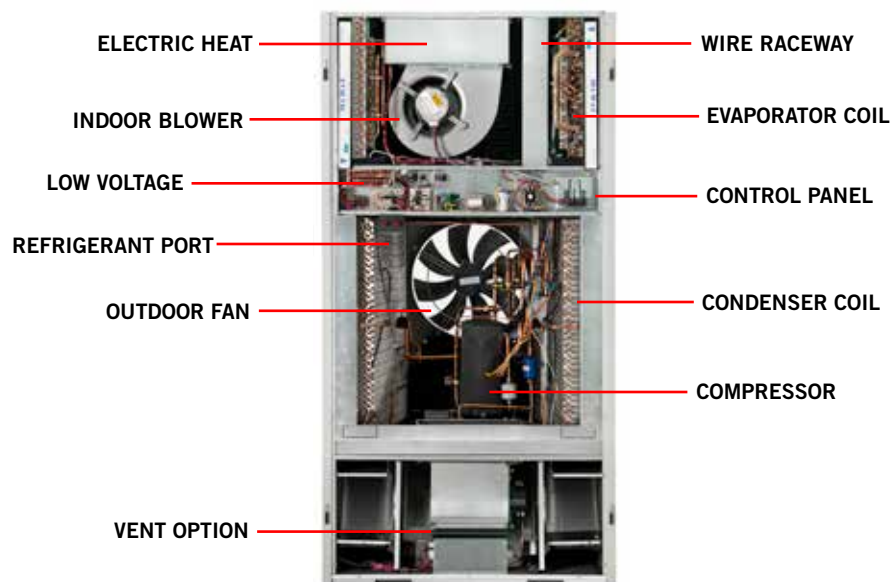
The electrical data lists fuse and wire sizes (75°C copper) for all models, including the most commonly used heater sizes. Also shown are the number of field power circuits required for the various models with heaters.

The unit rating plate lists a "Maximum Time Delay Relay Fuse" or circuit breaker that is to be used with the equipment. The correct size must be used for proper circuit protection, and also to assure that there will be no nuisance tripping due to the momentary high starting current of the compressor motor.

See "START UP" section for information on three phase scroll compressor start-ups.

The field wiring conduit connections are located on the top right-hand corner of the unit with a wire raceway to feed the wires down to the circuit breaker(s). See Figure 12.

**FIGURE 12  
COMPONENT LOCATION**



## WIRING – LOW VOLTAGE WIRING

### 230/208V, 1 PHASE AND 3 PHASE EQUIPMENT DUAL PRIMARY VOLTAGE TRANSFORMERS

All equipment leaves the factory wired on 240V tap. For 208V operation, reconnect from 240V to 208V tap. The acceptable operating voltage range for the 240 and 208V taps are as noted in Table 3.

**TABLE 3 – OPERATING VOLTAGE RANGE**

| TAP  | RANGE     |
|------|-----------|
| 240V | 253 – 216 |
| 208V | 220 – 187 |

**NOTE:** The voltage should be measured at the field power connection point in the unit and while the unit is operating at full load (maximum amperage operating condition).

The standard unit includes a remote thermostat connection terminal strip. See Figures 13-18 on pages 23 through 28 for connection diagrams. Compatible thermostats are listed in Table 4.

**TABLE 4 – WALL THERMOSTATS**

| Thermostat                         | Predominant Features   |
|------------------------------------|--|
| 8403-060<br>(1120-445)             | 3 Stage Cool; 3 Stage Heat<br>Programmable/Non-Programmable Electronic<br>HP or Conventional<br>Auto or Manual changeover  |
| 8403-067<br>(CDT-2W40-LCD-<br>RLY) | Carbon Dioxide Sensor with LCD for<br>Sensor Readings  |
| CS9B-THO                           | 3 Stage Heat, 3 Stage Cool, Prog/NonProg, HP or<br>Conv,<br>Auto or Manual Changeover, Humidity Sensor w/<br>dehumidification, Motion Sensor w/ Intelligent<br>Learning Control, BACnet-compatible                                     |
| CS9B-THOC                          | 3 Stage Heat, 3 Stage Cool, Prog/NonProg, HP or<br>Conv,<br>Auto or Manual Changeover, Humidity Sensor w/<br>dehumidification, CO2 Sensor, Motion Sensor w/<br>Intelligent Learning Control, BACnet-compatible                         |
| CS9BE-THO                          | 3 Stage Heat, 3 Stage Cool, Prog/NonProg, HP or<br>Conv,<br>Auto or Manual Changeover, Humidity Sensor<br>w/ dehumidification, Motion Sensor, Intelligent<br>Learning Control, BACnet-compatible, Ethernet-<br>compatible              |
| CS9BE-THOC                         | 3 Stage Heat, 3 Stage Cool, Prog/NonProg, HP or<br>Conv,<br>Auto or Manual Changeover, Humidity Sensor w/<br>dehumidification, CO2 Sensor, Motion Sensor w/<br>Intelligent Learning Control, BACnet-compatible,<br>Ethernet-compatible |

## LOW VOLTAGE CONNECTIONS

These units use a grounded 24 volt AC low voltage circuit.

“G” terminal is the *fan input*.

“Y1” terminal is the *compressor part load input*.

“Y2” terminal is the *compressor full load input*.

“R” terminal is *24 VAC hot*.

“C” terminal is *24 VAC grounded*.

“L” terminal is *compressor lockout output*. This terminal is activated on a high or low pressure trip and condensate overflow trip. This is a 24 VAC output.

“W2” terminal is *first stage electric heat* (if equipped). First stage electric heat can be operated simultaneously with the heat pump operating.

“A” terminal is the *ventilation input*. This terminal energizes any factory installed ventilation option.

“W3” terminal is *second stage electric heat*. When “W3” terminal is energized, it locks out compressor operation to limit discharge air temperature and required branch circuit ampacity.

“D” terminal is the *dehumidification mode* (on models so equipped).

**NOTE:** For total and proper control using DDC, a minimum of nine controlled outputs are needed when above 10KW electric heat is employed with ventilation, a total of eight controlled outputs with below 10KW electric heat with ventilation, seven controlled outputs below 10KW electric heat with no ventilation, seven controlled outputs with no electric heat but with ventilation, and six controlled outputs with no electric heat and no ventilation. If dehumidification model and vent, ten controlled outputs are needed when above 10KW electric heat is employed with ventilation.

### LOW VOLTAGE CONNECTIONS FOR DDC CONTROL

|   |                    |
|---|--------------------|
| Fan Only                                | Energize G         |
| Cooling Part Load                       | Energize G, Y1     |
| Cooling Full Load                       | Energize G, Y1, Y2 |
| Heating with Bank #1 Electric Heat Only | Energize G, W2     |
| Emergency Heat                          | Energize G, W2, W3 |
| Ventilation                             | Energize A         |
| Dehumidification                        | Energize G, D      |

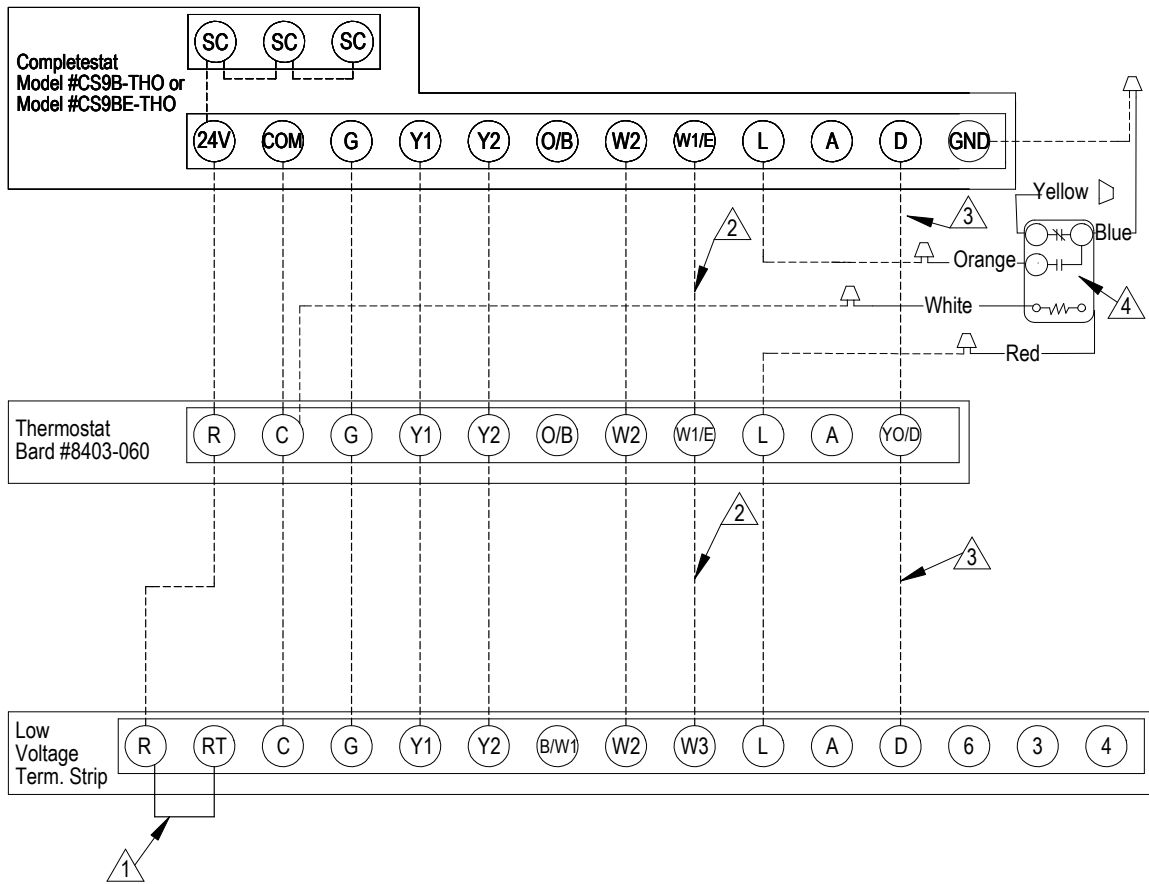
## GENERAL

This unit is equipped with a variable speed ECM motor. The motor is designed to maintain rated airflow up to the maximum static allowed. **It is important that the blower motor plugs are not plugged in or unplugged while the power is on. Failure to remove power prior to unplugging or plugging in the motor could result in motor failure.**

## CAUTION

Do not plug in or unplug blower motor connectors while the power is on. Failure to do so may result in motor failure.

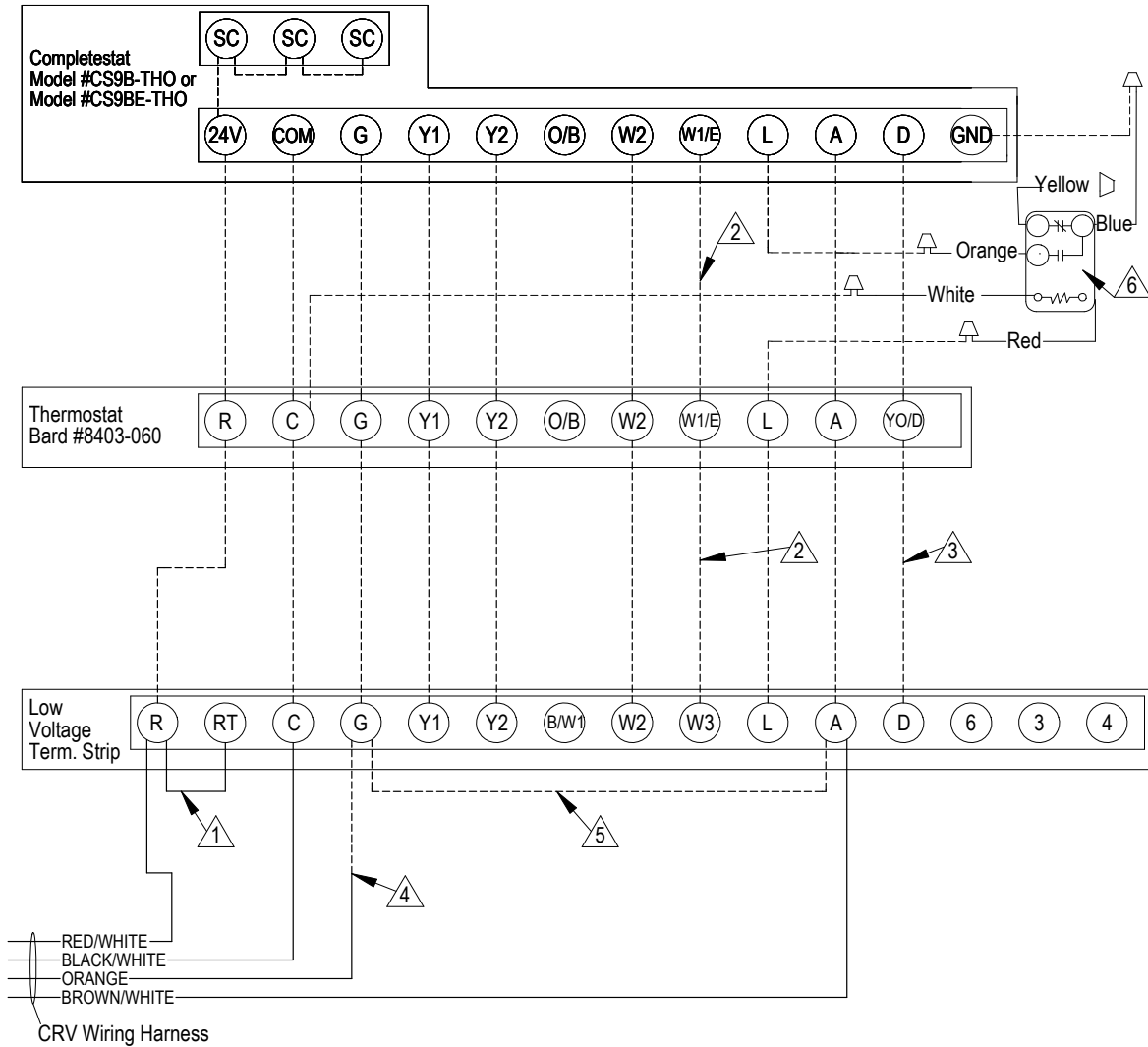
**FIGURE 13  
BASIC AIR CONDITIONER WITH NO VENTILATION PACKAGE**



- △ 1 Factory installed jumper. Remove jumper and connect to N.C fire alarm
- △ 2 Not needed below 15KW
- △ 3 Additional wire required for dehumidification models
- △ 4 Relay Provided with Completestat

MIS-3257 A

**FIGURE 14**  
**AIR CONDITIONER WITH CRV, WITHOUT CO<sub>2</sub> CONTROL**

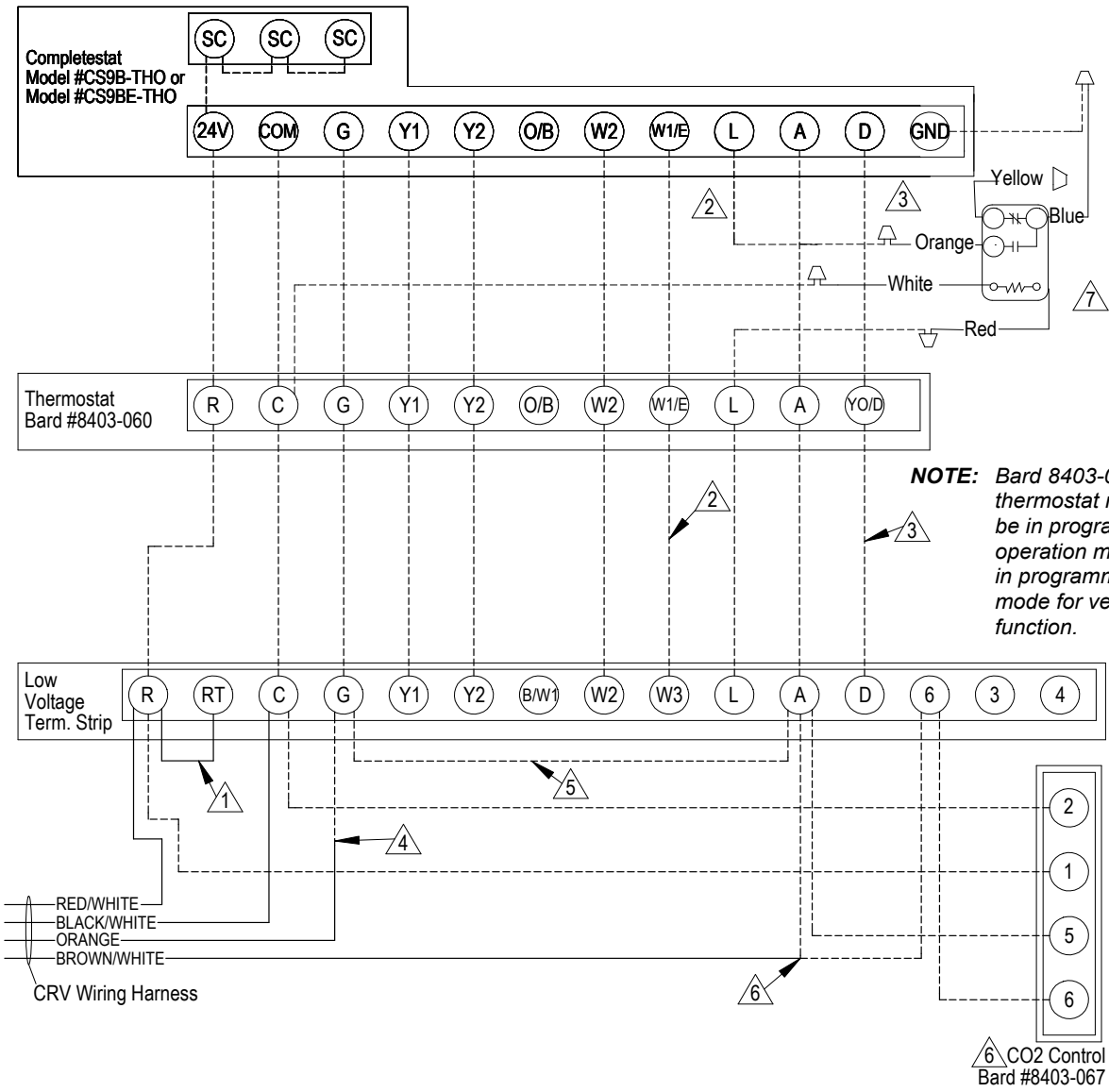


- ① Factory installed jumper. Remove jumper and connect to N.C fire alarm circuit if emergency shutdown required.
- ② Not needed below 15KW.
- ③ Additional wire required for dehumidification models.
- ④ Connect to "G" terminal when thermostat has "Occupancy Signal".
- ⑤ Install a jumper between "G" and "A" only when thermostat without "Occupancy Signal" is used.
- ⑥ Relay Provided with Completestat

MIS-3258 A



**FIGURE 15**  
**AIR CONDITIONER WITH CRV AND CO<sub>2</sub> CONTROL**

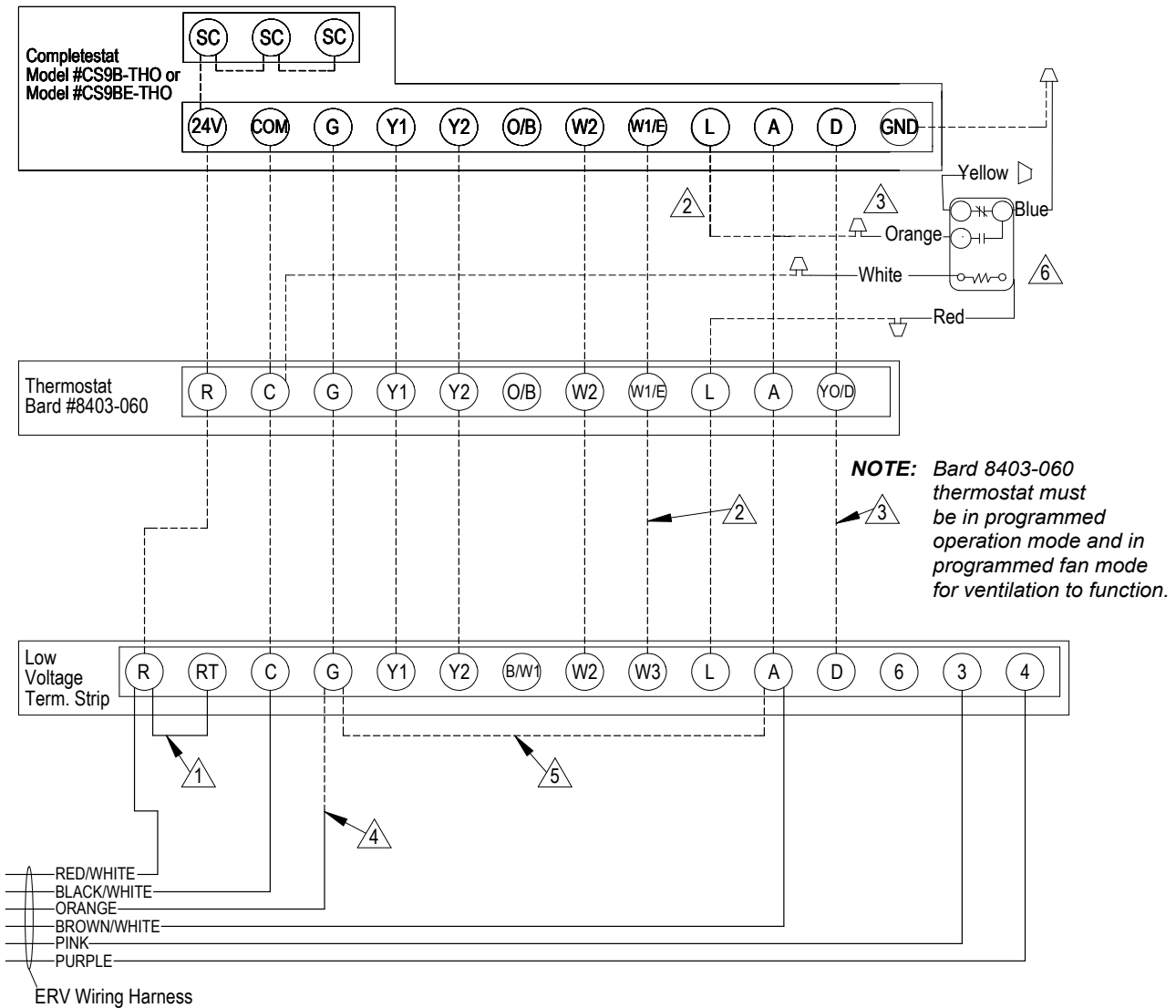


**NOTE:** Bard 8403-060 thermostat must be in programmed operation mode and in programmed fan mode for ventilation to function.

- △1 Factory installed jumper. Remove jumper and connect to N.C fire alarm circuit if emergency shutdown required.
- △2 Not needed below 15KW.
- △3 Additional wire required for dehumidification models.
- △4 Connect to "G" terminal when thermostat has "Occupancy Signal".
- △5 Install a jumper between "G" and "A" only when thermostat without "Occupancy Signal" is used.
- △6 If CS9B-THOC or CS9BE-THOC is used, connect "Brown/White" directly to "A" and do not use separate CO2 controller.
- △7 Relay Provided with Completestat

MIS-3259 A

**FIGURE 16**  
**AIR CONDITIONER WITH ERV, WITHOUT CO<sub>2</sub> CONTROL**



1 Factory installed jumper. Remove jumper and connect to N.C fire alarm circuit if emergency shutdown required.

2 Not needed below 15KW.

3 Additional wire required for dehumidification models.

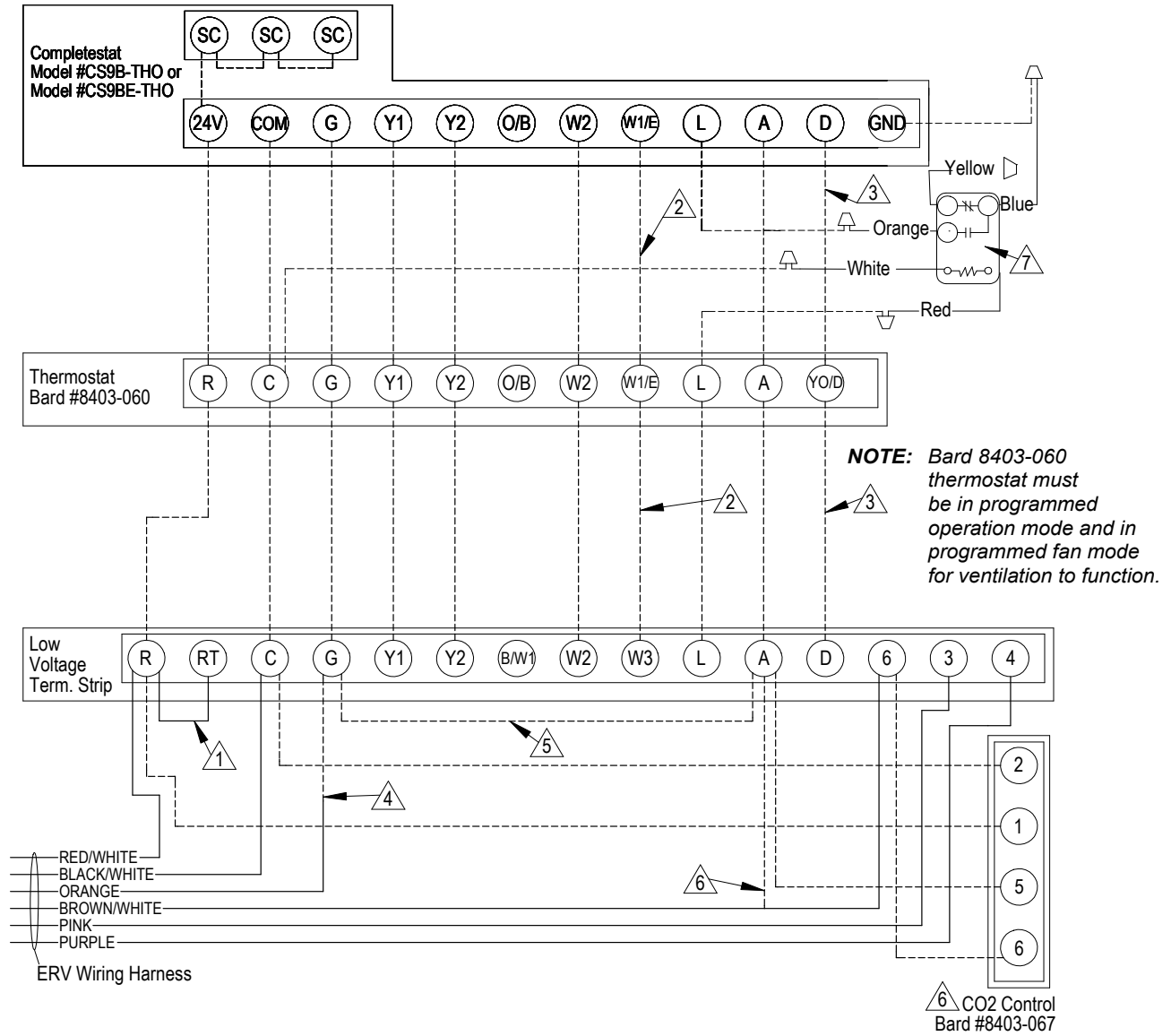
4 Connect to "G" terminal when thermostat has "Occupancy Signal".

5 Install a jumper between "G" and "A" only when thermostat without "Occupancy Signal" is used.

6 Relay Provided with Completestat

MIS-3260 A

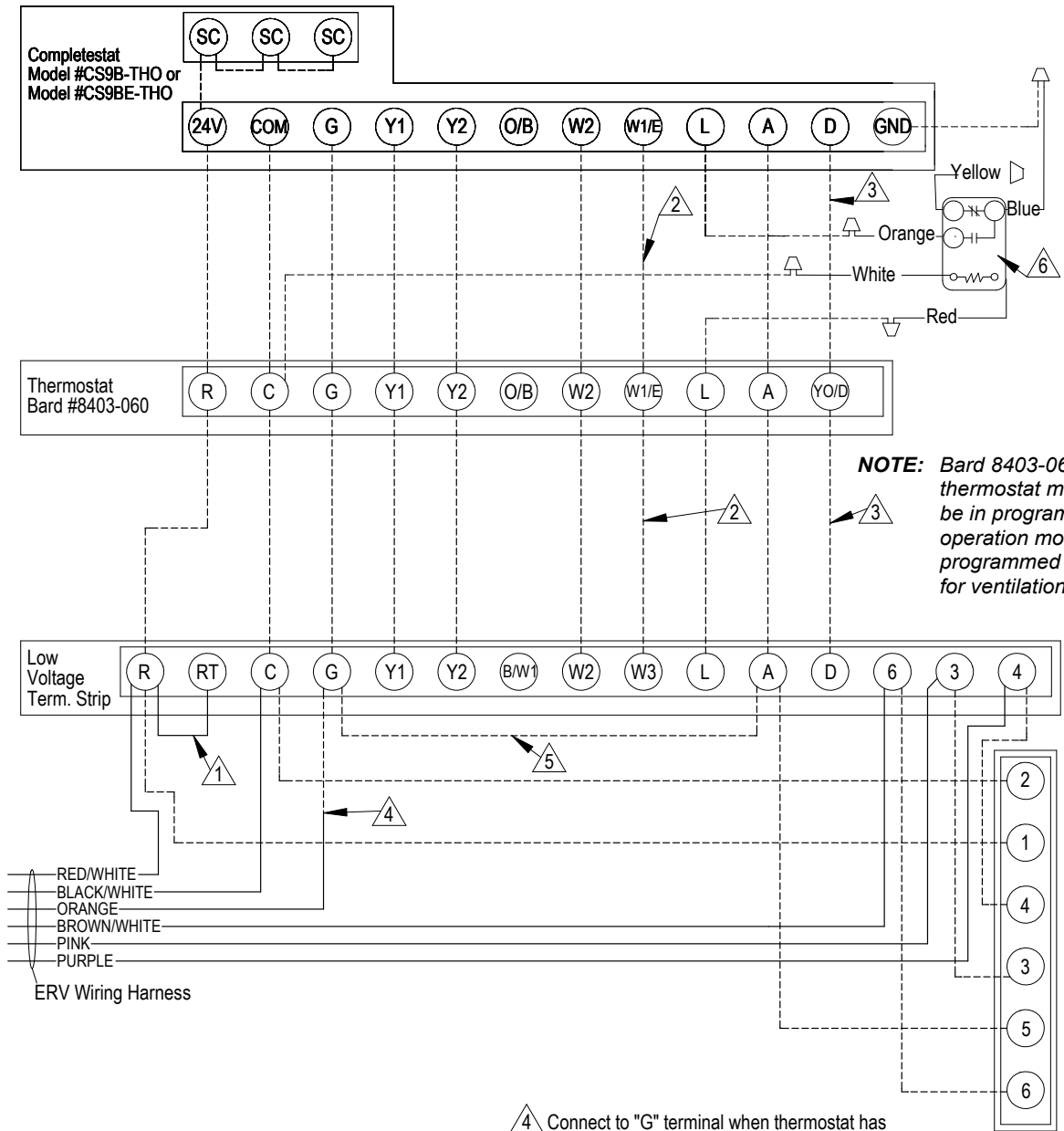
**FIGURE 17**  
**AIR CONDITIONER WITH ERV AND CO<sub>2</sub> CONTROL (ON/OFF CYCLING)**



- |  |   |
|--|---|
| <p>1 Factory installed jumper. Remove jumper and connect to N.C fire alarm circuit if emergency shutdown required.</p> <p>2 Not needed below 15KW.</p> <p>3 Additional wire required for dehumidification models.</p> <p>4 Connect to "G" terminal when thermostat has "Occupancy Signal".</p> | <p>5 Install a jumper between "G" and "A" only when thermostat without "Occupancy Signal" is used.</p> <p>6 If CS9B-THOC or CS9BE-THOC is used, connect "Brown/White" directly to "A" and do not use separate CO2 controller.</p> <p>7 Relay Provided with Completestat</p> |
|--|---|

MIS-3261 A

**FIGURE 18**  
**AIR CONDITIONER WITH ERV AND CO<sub>2</sub> CONTROL (FULLY MODULATING)**



**NOTE:** Bard 8403-060 thermostat must be in programmed operation mode and in programmed fan mode for ventilation to function.

- 1 Factory installed jumper. Remove jumper and connect to N.C fire alarm circuit if emergency shutdown required.
- 2 Not needed below 15KW.
- 3 Additional wire required for dehumidification models.

- 4 Connect to "G" terminal when thermostat has "Occupancy Signal".
- 5 Install a jumper between "G" and "A" only when thermostat without "Occupancy Signal" is used.
- 6 Relay Provided with Completestat

CO2 Control  
 Bard #8403-067

MIS-3262 A

## THESE UNITS REQUIRE R-410A REFRIGERANT AND POLYOL ESTER OIL.

### GENERAL:

1. Use separate service equipment to avoid cross contamination of oil and refrigerants.
2. Use recovery equipment rated for R-410A refrigerant.
3. Use manifold gauges rated for R-410A (800 psi/250 psi low).
4. R-410A is a binary blend of HFC-32 and HFC-125.
5. R-410A is nearly azeotropic—similar to R-22 and R-12. Although nearly azeotropic, charge with liquid refrigerant.
6. R-410A operates at 40-70% higher pressure than R-22, and systems designed for R-22 cannot withstand this higher pressure.
7. R-410A has an ozone depletion potential of zero, but must be reclaimed due to its global warming potential.
8. R-410A compressors use Polyol Ester oil.
9. Polyol Ester oil is hygroscopic; it will rapidly absorb moisture and strongly hold this moisture in the oil.
10. A liquid line dryer must be used; even a deep vacuum will not separate moisture from the oil.
11. Limit atmospheric exposure to 15 minutes.
12. If compressor removal is necessary, always plug compressor immediately after removal. Purge with small amount of nitrogen when inserting plugs.

### TOPPING OFF SYSTEM CHARGE

If a leak has occurred in the system, Bard Manufacturing recommends reclaiming, evacuating (see criteria above), and charging to the nameplate charge. However, if done correctly, topping off the system charge can be done without problems.

With R-410A, there are no significant changes in the refrigerant composition during multiple leaks and recharges. R-410A refrigerant is close to being an azeotropic blend (it behaves like a pure compound or single component refrigerant). The remaining refrigerant charge, in the system, may be used after leaks have occurred and then “top-off” the charge by utilizing the charging charts on the inner control panel cover as a guideline.

REMEMBER: When adding R-410A refrigerant, it must come out of the charging cylinder/tank as a liquid to avoid any fractionation, and to insure optimal system performance. Refer to instructions for the cylinder that is being utilized for proper method of liquid extraction.



## WARNING

**Failure to conform to these practices could lead to injury or death.**

### SAFETY PRACTICES:

1. Never mix R-410A with other refrigerants.
2. Use gloves and safety glasses. Polyol Ester oils can be irritating to the skin, and liquid refrigerant will freeze the skin.
3. Never use air and R-410A to leak check; the mixture may become flammable.
4. Do not inhale R-410A—the vapor attacks the nervous system, creating dizziness, loss of coordination and slurred speech. Cardiac irregularities, unconsciousness and ultimate death can result from breathing this concentration.
5. Do not burn R-410A. This decomposition produces hazardous vapors. Evacuate the area if exposed.
6. Use only cylinders rated DOT4BA/4BW 400.
7. Never fill cylinders over 80% of total capacity.
8. Store cylinders in a cool area, out of direct sunlight.
9. Never heat cylinders above 125°F.
10. Never trap liquid R-410A in manifold sets, gauge lines or cylinders. R-410A expands significantly at warmer temperatures. Once a cylinder or line is full of liquid, any further rise in temperature will cause it to burst.

## DESCRIPTION OF STANDARD EQUIPMENT

### **High/Low Pressure Switch**

Provides refrigerant circuit high pressure and loss of charge protection. Includes lockout circuit built into compressor control module that is resettable from room thermostat.

### **5-Minute Compressor Time Delay**

Provides short cycle protection for the compressor which extends compressor life. Built into the electronic compressor control module as standard.

### **Condensate Overflow**

Senses and provides system shut down if draining issue causes water level to rise in the lower drain pan.

### **Low Ambient Control**

The low ambient control permits cooling operation down to 0°F outdoor ambient.

## IMPORTANT INSTALLER NOTE

For improved start-up performance, wash the indoor coil with a dishwasher detergent.

## PHASE MONITOR

All units with three phase scroll compressors are equipped with a 3 phase line monitor to prevent compressor damage due to phase reversal.

The phase monitor in this unit is equipped with two LEDs. If the Y signal is present at the phase monitor and phases are correct the green LED will light and the compressor contactor is allowed to energize.

If phases are reversed, the red fault LED will be lit and compressor operation is inhibited.

If a fault condition occurs, reverse two of the supply leads to the unit. Do not reverse any of the unit factory wires as damage may occur.

## THREE PHASE SCROLL COMPRESSOR START UP INFORMATION

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. 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 the power. Since there is a 50-50 chance of connecting power in such a way as to cause rotation in the reverse direction, **verification of proper rotation must be made.** Verification of proper rotation direction is made by observing that suction pressure drops and discharge pressure rises when the compressor is energized. Reverse rotation also results in an elevated sound level over that with correct rotation, as well as, substantially reduced current draw compared to tabulated values.

**Verification of proper rotation must be made at the time the equipment is put into service. If improper rotation is corrected at this time there will be no negative impact on the durability of the compressor. However, reverse operation for even one hour may have a negative impact on the bearing due to oil pump out.**

All three phase scroll compressors used in the I-TEC series are wired identically internally. As a result, once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same Fusite terminal should maintain proper rotation direction. The direction of rotation of the motor may be changed by reversing any two line connections to the unit.

## SERVICE HINTS

1. Caution user to maintain clean air filters at all times and to not needlessly close off supply air registers. This may reduce airflow through the system, which shortens equipment service life as well as increasing operating costs and noise levels.
2. Check all power fuses or circuit breakers to be sure they are the correct rating.
3. Periodic cleaning of the outdoor coils to permit full and unrestricted airflow circulation is essential.
4. Annual maintenance is required to make sure that all of the systems are functioning properly.
  - a. Check to make sure that the drains are not obstructed in any way.
  - b. Remove any debris in the condenser section of the unit.
  - c. Inspect and wash outdoor coils as necessary.
5. All motors are sealed and require no oiling.

## SEQUENCE OF OPERATION

**COOLING PART LOAD** – Circuit R-Y1 makes at thermostat pulling in compressor contactor, starting the compressor and outdoor motor. The G (indoor motor) circuit is automatically completed on any call for cooling operation or can be energized by manual fan switch on subbase for constant air circulation.

**COOLING FULL LOAD** – Circuit R-Y1 & Y2 makes at the thermostat energizing the 2nd stage solenoid in the compressor. The default position of the compressor staging solenoid is non-energized. The compressor will run at low capacity until this solenoid is energized.

**HEATING STAGE 1** – Circuit R-G & W1 makes at the thermostat energizing the corresponding heater contactors. The indoor blower is also energized.

**HEATING STAGE 2** – Circuit R & W2 makes at the thermostat energizing the corresponding heater contactors. The indoor blower remains energized.

## COMPRESSOR CONTROL MODULE

The compressor control module is standard on all models covered by this manual. The compressor control module is an anti-short cycle/lockout timer with high and low pressure switch monitoring and alarm relay output.

### Adjustable Delay-on-Make and Delay-on-Break Timer

On initial power up or anytime power is interrupted to the unit, the *delay-on-make* period begins, which will be 2 minutes plus 10% of the *delay-on-break* setting. When the delay-on-make is complete and the high pressure switch and low pressure switch are closed, the compressor contactor is energized. Upon shutdown, the delay-on-break timer starts and prevents restart until the delay-on-break and delay-on-make periods have expired.

During routine operation of the unit with no power interruptions, the compressor will operate on demand with no delay.

### High Pressure Switch and Lockout Sequence

If the high pressure switch opens, the compressor contactor will de-energize immediately. The lockout timer will go into a *soft lockout* and stay in soft lockout until the high pressure switch closes and the delay-on-break time has expired. If the high pressure switch opens again in this same operating cycle, the unit will go into *manual lockout* condition and the alarm relay circuit will energize. Recycling the wall thermostat resets the manual lockout.

### Low Pressure Switch, Bypass and Lockout Sequence

If the low pressure switch opens for more than 120 seconds, the compressor contactor will de-energize and go into a soft lockout. Regardless the state of the low pressure switch, the contactor will reenergize after the delay-on-make time delay has expired. If the low pressure switch remains open, or opens again for longer than 120 seconds, the unit will go into manual lockout condition and the alarm relay circuit will energize. Recycling the wall thermostat resets the manual lockout.

### Alarm Relay Output

Alarm terminal is output connection for applications where alarm relay is employed. This terminal is powered whenever the compressor is locked out due to HPC or LPC sequences as described.

*NOTE: Both high and low pressure switch controls are inherently automatic reset devices. The high pressure switch and low pressure switch cut out and cut in settings are fixed by specific air conditioner unit model. The lockout features, both soft and manual, are a function of the compressor control module.*

## Adjustments

### Adjustable Delay-on-Make and Delay-on-Break Timer

The potentiometer is used to select delay-on-break time from 30 seconds to 5 minutes. Delay-on-make (DOM) timing on power up and after power interruptions is equal to 2 minutes plus 10% of delay-on-break (DOB) setting:

0.5 minute (30 seconds) DOB = 123 second DOM  
1.0 minute (60 seconds) DOB = 126 second DOM  
2.0 minute (120 seconds) DOB = 132 second DOM  
3.0 minute (180 seconds) DOB = 138 second DOM  
4.0 minute (240 seconds) DOB = 144 second DOM  
5.0 minute (300 seconds) DOB = 150 second DOM

During routine operation of the unit with no power interruptions, the compressor will operate on demand with no delay.

### Typical Settings for Dual Unit Installation:

Unit 1: DOB set at 2 minutes and DOM is 132 seconds

Unit 2: DOB set at 4 minutes and DOM is 144 seconds

## PRESSURE SERVICE PORTS

High and low pressure service ports are installed on all units so that the system operating pressures can be observed. Pressure tables covering all models can be found on pages 52 and 53. It is imperative to match the correct pressure table to the unit by model number.

This unit employs high-flow Coremax valves instead of the typical Shrader type valves.

***WARNING! Do NOT use a Schrader valve core removal tool with these valves. Use of such a tool could result in eye injuries or refrigerant burns!***

To change a Coremax valve without first removing the refrigerant, a special tool is required which can be obtained at [www.fastestinc.com/en/SCCA07H](http://www.fastestinc.com/en/SCCA07H). See the replacement parts manual for replacement core part numbers.

## **LOWERING OUTDOOR FAN SPEED FOR SOUND**

Supplied in the literature assembly is a fan control resistor assembly that can be installed to lower the fan speed for reduced sound performance. This resistor assembly is to be installed in series with the outdoor fan control thermistor to change the temperature curve that the fan logic control sees.

*It is anticipated that a 2-3% drop in system capacity and efficiency will be seen when this resistor is installed.*

To install the resistor assembly:

1. Locate fan control resistor assembly in literature packet hanging on right inside door of unit.
2. Throw main power disconnect to the "OFF" position to eliminate risk of injury or death due to electrical shock.
3. Remove four (4) screws that retain the control panel cover to the unit.
4. Locate fan logic control board.
5. Locate one of the red leads of the fan control thermistor where it attaches to the fan logic control and remove it.
6. Install resistor in-line with the thermistor lead removed in Step #5, and then connect back onto the fan logic control board.



# I-TEC COMMERCIAL ROOM VENTILATOR SYSTEM

## GENERAL DESCRIPTION

The I-TEC Commercial Room Ventilator (CRV) is designed to be used with all Bard I-TEC models. The only intent of this device is to provide the required ventilation by delivering fresh air to meet IAQ (indoor air quality) requirements. In the installed application, this system also includes exhaust provisions which are balanced with the intake air to maintain building pressurization requirements of ASHRAE 62.1 Standard.

Ventilation is accomplished with two blower/motor assemblies for maximum ventilation at low sound levels. The intake and exhaust blowers are programmed independently and are balanced to maintain a slight positive pressurization in accordance to ASHRAE 62.1 Standard.

The I-TEC CRV is also provided with filters to reduce the required service needed and to further improve the IAQ. The exhaust air blowers are protected by disposable filters and the intake air blowers are protected by washable filters. Both are accessible without the need for tools.

## CONTROL WIRING

The I-TEC CRV comes wired from the factory set to 375 CFM of ventilation. Care must be taken when deciding how to control the operation of the ventilator. When designing the control circuit for the ventilator, the following requirements must be met.

1. The indoor blower must be run whenever the I-TEC CRV is run.
2. Select and configure the correct CFM ventilation level that the I-TEC CRV needs to operate and configure the system to this level following later instructions within this section. Over ventilating serves no useful purpose and significantly affects the overall efficiency of the heat pump system. System operating costs would also increase.
3. Run the I-TEC CRV only during periods when the conditioned space is occupied. Running the ventilation during unoccupied periods wastes energy, decreases the expected life of the CRV, and can result in large moisture buildup in the structure. Running the CRV when the structure is unoccupied allows moisture to build up in the structure because there is little or no cooling load. Thus, the air conditioner is not running enough to remove the excess moisture being brought in. Use a control system that in some way can control the system based upon occupancy.

## NOTICE

Operating the I-TEC CRV during unoccupied periods can result in a build up of excess moisture in the structure.

## RECOMMENDED CONTROL SEQUENCES

Several possible scenarios are listed below:


1. Use a programmable electronic thermostat with auxiliary terminal to control the CRV based on daily programmed occupancy periods. Bard markets and recommends Bard Part #8403-060 programmable electronic thermostat.
2. Use Bard CompleteStat™ that incorporates temperature, humidity and occupancy control with learning capability into a single device. No programming required.
3. Use a DDC control system to control the CRV-based upon a room occupancy schedule to control the CRV.
4. Tie the operation of the CRV into the light switch. The lights in a room are usually on only when occupied.
5. Use a manual timer that the occupants turn to energize the CRV for a specific number of hours.
6. Use a programmable mechanical timer to energize the CRV and indoor blower during occupied periods of the day.

**NOTE:** The ventilation package comes with a blower interlock function, but is disabled when it is shipped from the factory in case a thermostat with an occupancy output or occupancy sensor is not utilized. In this situation, "A" terminal must be tied to "G" terminal to drive the ventilation package. If a thermostat or control that drives occupancy output is utilized, the tape from the orange wire located in the low voltage terminal box will need to be removed and the orange wire connected to the "G" terminal to activate this function. (See Figures 13-18 on pages 23 to 28.)

## SETTING THE VENTILATION CFM LEVELS

The I-TEC CRV has four pre-set levels of ventilation CFM available. These are 300, 375, 450 and 525 CFM of ventilation air. The I-TEC CRV is shipped from the factory set on the 375 CFM ventilation level. To change between these four different levels of provided ventilation CFM, first refer to Figure 19 to look up the corresponding CFM needed for the intake and exhaust

blowers to meet the design criteria and determine which “speed/wire color” is needed. Then, perform the following steps.



# WARNING

- **Hazard of electrical shock.**
- **Electrical shock can result in serious injury or death.**
- **Disconnect the remote electric power supply or supplies before servicing.**

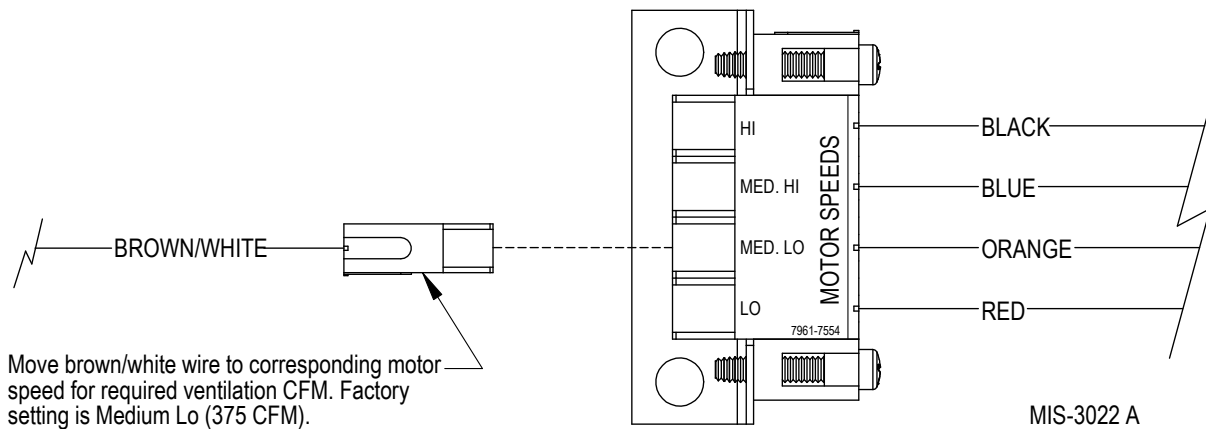
1. Open front swinging doors of main unit (by popping front door latches).
2. Throw main power disconnect to the “OFF” position to eliminate risk of injury or death due to electrical shock.
3. Remove five (5) screws holding front CRV door in place (see Figure 20 on page 34).
4. Locate “Brown Wire with White Trace” that has a black terminal on the end where it connects to the terminal strip (see Figure 19).
5. Move “Brown Wire with White Trace” to the corresponding CFM level needed in accordance with Figure 19.

**FIGURE 19**  
**CRV MOTOR SPEED/CFM CONFIGURATION**

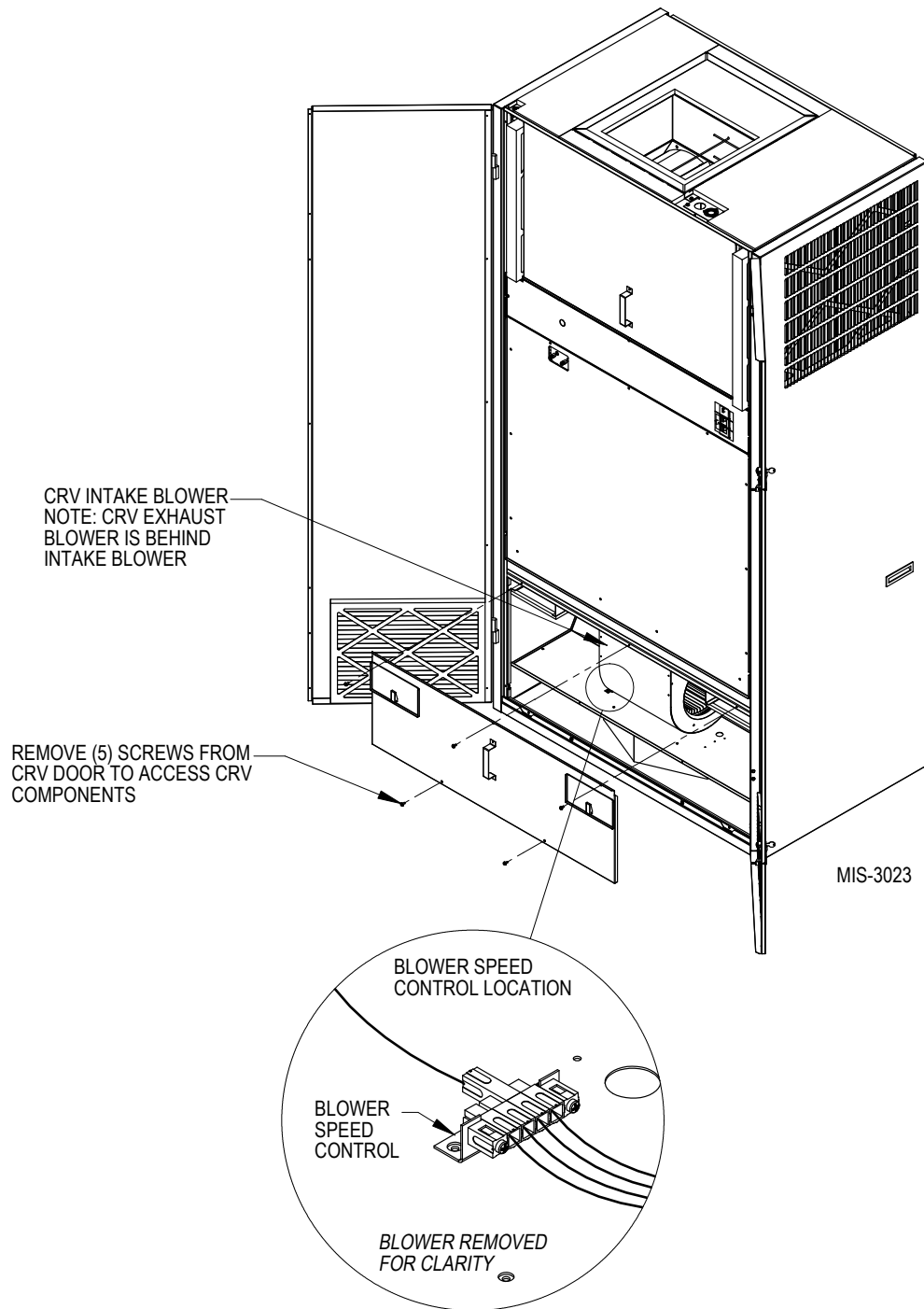
| VENT OPTION INTAKE/EXHAUST SPEEDS |        |          |
|-----------------------------------|--------|----------|
| WIRE COLOR                        | SPEED  | NOM. CFM |
| BLACK                             | HI     | 525      |
| BLUE                              | MED-HI | 450      |
| ORANGE                            | MED-LO | 375      |
| RED                               | LO     | 300      |

TO CHANGE SPEEDS, MOVE BROWN WIRE WITH WHITE TRACE.

7961-755-2



**FIGURE 20**  
**CRV SPEED CHANGE TERMINAL ACCESS**



# I-TEC ENERGY RECOVERY VENTILATOR SYSTEM

## GENERAL DESCRIPTION

The I-TEC Energy Recovery Ventilator (ERV) was designed to provide energy efficient, cost effective ventilation to meet IAQ (indoor air quality) requirements while still maintaining good indoor comfort and humidity control for a variety of applications such as schools, classrooms, lounges, conference rooms and others. It provides a constant supply of fresh air for control of airborne pollutants including CO<sub>2</sub>, smoke, radon, formaldehyde, excess moisture, virus and bacteria.

The ERV incorporates patented rotary heat exchanger technology to remove both heat and moisture. The package consists of unique rotary Energy Recovery Cassettes that can be easily removed for cleaning or maintenance. It has two 15" diameter heat transfer wheels for efficient heat transfer. The heat transfer wheels use a permanently bonded dry desiccant coating for total heat recovery.

The I-TEC ERV is also provided with filters to reduce the required service needed and to extend the life of the heat recovery wheels. The exhaust air blower is protected by disposable filters and the intake air blower is protected by washable filters. Both are accessible without the need for tools.

Ventilation is accomplished with two blower/motor assemblies for maximum ventilation at low sound levels. The intake and exhaust blowers can be independently adjusted to maintain desired building pressurization conditions. The rotating wheels provide the heat transfer effectively during both summer and winter conditions. Provides required ventilation to meet the requirements of ASHRAE 62.1 Standard.

**NOTE: During operation below 5°F outdoor temperature, freezing of moisture in the heat transfer wheel can occur. Consult the factory if this possibility exists.**

The I-TEC ERV can be controlled in different ways. It can be turned ON/OFF with an occupancy control, thermostat or CO<sub>2</sub> control. It can also be configured for fully modulating variable speed with a CO<sub>2</sub> control to only bring in the minimal amount of ventilation required (helping to minimize sound levels and ventilation load on the structure).

## CONTROL WIRING

The I-TEC ERV comes wired from the factory ready to operate in manual mode (ON/OFF cycling) and set to 375 CFM of ventilation. Care must be taken when deciding how to control the operation of the ventilator. When designing the control circuit for the ventilator, the following requirements must be met:

1. The indoor blower must be run whenever the I-TEC ERV is run.
2. Select and configure the correct CFM ventilation level that the I-TEC ERV needs to operate and configure the system to this level following later instructions within this section. Over ventilating serves no useful purpose and significantly affects the overall efficiency of the system. System operating costs would also increase.
3. Run the I-TEC ERV only during periods when the conditioned space is occupied. Running the ERV during unoccupied periods wastes energy, decreases the expected life of the ERV, and can result in large moisture buildup in the structure. The ERV removes 60-70% of the moisture in the incoming air, not 100% of it. Running the ERV when the structure is unoccupied allows moisture to build up in the structure because there is little or no cooling load. Thus, the air conditioner is not running enough to remove the excess moisture being brought in. Use a control system that in some way can control the system based upon occupancy.

## NOTICE

Operating the I-TEC ERV during unoccupied periods can result in a build up of excess moisture in the structure.

## RECOMMENDED CONTROL SEQUENCES


Several possible scenarios are listed below:

1. Use a programmable electronic thermostat with auxiliary terminal to control the ERV based on daily programmed occupancy periods. Bard markets and recommends Bard Part #8403-060 programmable electronic thermostat.
2. Install a Bard CompleteStat™ with occupancy sensor which learns room usage and automatically engages ventilation.
3. Use a DDC control system to control the ERV based upon a room occupancy schedule to control the ERV.
4. Tie the operation of the ERV into the light switch. The lights in a room are usually on only when occupied.

5. Use a manual timer that the occupants turn to energize the ERV for a specific number of hours.
6. Use a programmable mechanical timer to energize the ERV and indoor blower during occupied periods of the day.

**NOTE:** The ventilation package comes with a blower interlock function, but is disabled when it is shipped from the factory in case a thermostat with an occupancy output or occupancy sensor is not utilized. In this situation, “A” terminal must be tied to “G” terminal to drive the ventilation package. If a thermostat or control that drives occupancy output is utilized, the tape from the orange wire located in the low voltage terminal box will need to be removed and the orange wire connected to the “G” terminal to activate this function. (See Figures 13-18 on pages 23 to 28.)

## CHANGING VENTILATION CFM RATES IN MANUAL MODE



# WARNING

- **Hazard of electrical shock.**
- **Electrical shock can result in serious injury or death.**
- **Disconnect the remote electric power supply or supplies before servicing.**

To adjust the airflow ventilation rate, first refer to Figure 21A on page 38 to look up the “FLOW INDEX” needed for the intake and exhaust blowers for the CFM required. Then, perform the following steps:

1. Open front swinging doors of main unit (by popping front door latches).
2. Throw main power disconnect to the “OFF” position to eliminate risk of injury or death due to electrical shock.
3. Remove five (5) screws holding front ERV door in place (see Figure 23 on page 40).
4. Remove ERV control panel cover by removing four (4) screws (see Figure 23).
5. Locate two 0-10Vdc motor control boards in control panel (see Figure 24 on page 41).
6. On intake motor control board, observing “GREEN STATUS LIGHT”, turn manual adjust potentiometer “CCW” to increase “FLOW INDEX” or CW to reduce “FLOW INDEX” to match desired setting.

**NOTE:** After long pause, the green status light will blink long-blinks for the “TEN COUNT” of the “FLOW RATE INDEX”, then immediately followed by fast blinks which indicate the second digit. For example, a Flow Index of 23 would be two long blinks, followed by three fast blinks of the “GREEN STATUS LIGHT”.

7. On exhaust motor control board, observing “GREEN STATUS LIGHT”, turn manual adjust potentiometer “CCW” to increase “FLOW INDEX” or CW to reduce “FLOW INDEX” to match desired setting.

**NOTE:** Same “GREEN STATUS LIGHT” blink as Step #6.

## CHANGING TO FULLY MODULATING MODE

To operate the ERV in fully variable mode (only run at required speed to maintain set-point CO<sub>2</sub> levels), the ERV needs to be configured to the following:

1. Open front swinging doors of main unit (by popping front door latches).
2. Throw main power disconnect to the “OFF” position to eliminate risk of injury or death due to electrical shock.
3. Remove ERV control panel cover by removing four (4) screws (see Figure 23 on page 40).
4. Locate two 0-10Vdc motor control boards in control panel (see Figure 24 on page 41).
5. Pull jumper pins from “M” terminals and move to “P” terminals (see Figure 24).
6. Connect “+” 0-10Vdc output from CO<sub>2</sub> control to Terminal #3 (along with pink wire) and connect “-” to Terminal #4 (along with purple wire) of unit low voltage terminal strip.
7. Follow the directions supplied with the CO<sub>2</sub> control to configure the control appropriately.

# PERFORMANCE AND APPLICATION DATA

## SUMMER COOLING PERFORMANCE (INDOOR DESIGN CONDITIONS 75°DB/62°WB)

| Ambient O.D. | DB/WB | VENTILATION RATE 450 CFM<br>65% EFFICIENCY |       |       |       |      |       | VENTILATION RATE 375 CFM<br>66% EFFICIENCY |       |       |       |      |       | VENTILATION RATE 300 CFM<br>67% EFFICIENCY |      |       |       |      |       |
|--------------|-------|--|-------|-------|-------|------|-------|--|-------|-------|-------|------|-------|--|------|-------|-------|------|-------|
|              |       | F  | VLT   | VLS   | VLL   | HRT  | HRS   | HRL  | VLT   | VLS   | VLL   | HRT  | HRS   | HRL  | VLT  | VLS   | VLL   | HRT  | HRS   |
| 105          | 75    | 21465                                      | 14580 | 6884  | 13952 | 9477 | 4475  | 17887                                      | 12150 | 5737  | 11805 | 8018 | 3786  | 14310                                      | 9720 | 4590  | 9587  | 6512 | 3075  |
|              | 70    | 14580                                      | 14580 | 0     | 9477  | 9477 | 0     | 12150                                      | 12150 | 0     | 8018  | 8018 | 0     | 9720                                       | 9720 | 0     | 6512  | 6512 | 0     |
|              | 65    | 14580                                      | 14580 | 0     | 9477  | 9477 | 0     | 12150                                      | 12150 | 0     | 8018  | 8018 | 0     | 9720                                       | 9720 | 0     | 6512  | 6512 | 0     |
| 100          | 80    | 31590                                      | 12150 | 19440 | 20533 | 7897 | 12635 | 26325                                      | 10125 | 16200 | 17374 | 6682 | 10692 | 21060                                      | 8100 | 12960 | 14110 | 5427 | 8683  |
|              | 75    | 21465                                      | 12150 | 9314  | 13952 | 7897 | 6054  | 17887                                      | 10125 | 7762  | 11805 | 6682 | 5123  | 14310                                      | 8100 | 6210  | 9587  | 5427 | 4160  |
|              | 70    | 12352                                      | 12150 | 202   | 8029  | 7897 | 131   | 10293                                      | 10125 | 168   | 6793  | 6682 | 111   | 8235                                       | 8100 | 135   | 5517  | 5427 | 90    |
|              | 65    | 12150                                      | 12150 | 0     | 7897  | 7897 | 0     | 10125                                      | 10125 | 0     | 6682  | 6682 | 0     | 8100                                       | 8100 | 0     | 5427  | 5427 | 0     |
|              | 60    | 12150                                      | 12150 | 0     | 7897  | 7897 | 0     | 10125                                      | 10125 | 0     | 6682  | 6682 | 0     | 8100                                       | 8100 | 0     | 5427  | 5427 | 0     |
| 95           | 80    | 31590                                      | 9720  | 21870 | 20533 | 6318 | 14215 | 26325                                      | 8100  | 18225 | 17374 | 5345 | 12028 | 21060                                      | 6480 | 14580 | 14110 | 4341 | 9768  |
|              | 75    | 21465                                      | 9720  | 11744 | 13952 | 6318 | 7634  | 17887                                      | 8100  | 9787  | 11805 | 5345 | 6459  | 14310                                      | 6480 | 7830  | 9587  | 4341 | 5246  |
|              | 70    | 12352                                      | 9720  | 2632  | 8029  | 6318 | 1711  | 10293                                      | 8100  | 2193  | 6793  | 5345 | 1447  | 8235                                       | 6480 | 1755  | 5517  | 4341 | 1175  |
|              | 65    | 9720                                       | 9720  | 0     | 6318  | 6318 | 0     | 8100                                       | 8100  | 0     | 5345  | 5345 | 0     | 6480                                       | 6480 | 0     | 4341  | 4341 | 0     |
|              | 60    | 9720                                       | 9720  | 0     | 6318  | 6318 | 0     | 8100                                       | 8100  | 0     | 5345  | 5345 | 0     | 6480                                       | 6480 | 0     | 4341  | 4341 | 0     |
| 90           | 80    | 31590                                      | 7290  | 24300 | 20533 | 4738 | 15794 | 26325                                      | 6075  | 20250 | 17374 | 4009 | 13365 | 21060                                      | 4860 | 16200 | 14110 | 3256 | 10854 |
|              | 75    | 21465                                      | 7290  | 14175 | 13952 | 4738 | 9213  | 17887                                      | 6075  | 11812 | 11805 | 4009 | 7796  | 14310                                      | 4860 | 9450  | 9587  | 3256 | 6331  |
|              | 70    | 12352                                      | 7290  | 5062  | 8029  | 4738 | 3290  | 10293                                      | 6075  | 4218  | 6793  | 4009 | 2784  | 8235                                       | 4860 | 3375  | 5517  | 3256 | 2261  |
|              | 65    | 7290                                       | 7290  | 0     | 4738  | 4738 | 0     | 6075                                       | 6075  | 0     | 4009  | 4009 | 0     | 4860                                       | 4860 | 0     | 3256  | 3256 | 0     |
|              | 60    | 7290                                       | 7290  | 0     | 4738  | 4738 | 0     | 6075                                       | 6075  | 0     | 4009  | 4009 | 0     | 4860                                       | 4860 | 0     | 3256  | 3256 | 0     |
| 85           | 80    | 31590                                      | 4860  | 26730 | 20533 | 3159 | 17374 | 26325                                      | 4050  | 22275 | 17374 | 2672 | 14701 | 21060                                      | 3240 | 17820 | 14110 | 2170 | 11939 |
|              | 75    | 21465                                      | 4860  | 16605 | 13952 | 3159 | 10793 | 17887                                      | 4050  | 13837 | 11805 | 2672 | 9132  | 14310                                      | 3240 | 11070 | 9587  | 2170 | 7416  |
|              | 70    | 12352                                      | 4860  | 7492  | 8029  | 3159 | 4870  | 10293                                      | 4050  | 6243  | 6793  | 2672 | 4120  | 8235                                       | 3240 | 4995  | 5517  | 2170 | 3346  |
|              | 65    | 4860                                       | 4860  | 0     | 3159  | 3159 | 0     | 4050                                       | 4050  | 0     | 2672  | 2672 | 0     | 3240                                       | 3240 | 0     | 2170  | 2170 | 0     |
|              | 60    | 4860                                       | 4860  | 0     | 3159  | 3159 | 0     | 4050                                       | 4050  | 0     | 2672  | 2672 | 0     | 3240                                       | 3240 | 0     | 2170  | 2170 | 0     |
| 80           | 75    | 21465                                      | 2430  | 19035 | 13952 | 1579 | 12372 | 17887                                      | 2025  | 15862 | 11805 | 1336 | 10469 | 14310                                      | 1620 | 12690 | 9587  | 1085 | 8502  |
|              | 70    | 12352                                      | 2430  | 9922  | 8029  | 1579 | 6449  | 10293                                      | 2025  | 8268  | 6793  | 1336 | 5457  | 8235                                       | 1620 | 6615  | 5517  | 1085 | 4432  |
|              | 65    | 4252                                       | 2430  | 1822  | 2764  | 1579 | 1184  | 3543                                       | 2025  | 1518  | 2338  | 1336 | 1002  | 2835                                       | 1620 | 1215  | 1899  | 1085 | 814   |
|              | 60    | 2430                                       | 2430  | 0     | 1579  | 1579 | 0     | 2025                                       | 2025  | 0     | 1336  | 1336 | 0     | 1620                                       | 1620 | 0     | 1085  | 1085 | 0     |
| 75           | 70    | 12352                                      | 0     | 12352 | 8029  | 0    | 8029  | 10293                                      | 0     | 10293 | 6793  | 0    | 6793  | 8235                                       | 0    | 8235  | 5517  | 0    | 5517  |
|              | 65    | 4252                                       | 0     | 4252  | 2764  | 0    | 2764  | 3543                                       | 0     | 3543  | 2338  | 0    | 2338  | 2835                                       | 0    | 2835  | 1899  | 0    | 1899  |
|              | 60    | 0  | 0     | 0     | 0     | 0    | 0     | 0  | 0     | 0     | 0     | 0    | 0     | 0  | 0    | 0     | 0     | 0    | 0     |

## WINTER HEATING PERFORMANCE (INDOOR DESIGN CONDITIONS 70°F DB)

| Ambient O.D. | VENTILATION RATE          |       |                           |       |                           |       |
|--------------|---------------------------|-------|---------------------------|-------|---------------------------|-------|
|              | 450 CFM<br>80% EFFICIENCY |       | 375 CFM<br>81% EFFICIENCY |       | 300 CFM<br>82% EFFICIENCY |       |
|              | WVL                       | WHR   | WVL                       | WHR   | WVL                       | WHR   |
| 65           | 2430                      | 1944  | 2025                      | 1640  | 1620                      | 1328  |
| 60           | 4860                      | 3888  | 4050                      | 3280  | 3240                      | 2656  |
| 55           | 7290                      | 5832  | 6075                      | 4920  | 4860                      | 3985  |
| 50           | 9720                      | 7776  | 8100                      | 6561  | 6480                      | 5313  |
| 45           | 12150                     | 9720  | 10125                     | 8201  | 8100                      | 6642  |
| 40           | 14580                     | 11664 | 12150                     | 9841  | 9720                      | 7970  |
| 35           | 17010                     | 13608 | 14175                     | 11481 | 11340                     | 9298  |
| 30           | 19440                     | 15552 | 16200                     | 13122 | 12960                     | 10627 |
| 25           | 21870                     | 17496 | 18225                     | 14762 | 14580                     | 11955 |
| 20           | 24300                     | 19440 | 20250                     | 16402 | 16200                     | 13284 |
| 15           | 26730                     | 21384 | 22275                     | 18042 | 17820                     | 14612 |

### LEGEND:

- VLT = Ventilation Load – Total
- VLS = Ventilation Load – Sensible
- VLL = Ventilation Load – Latent
- HRT = Heat Recovery – Total
- HRS = Heat Recovery – Sensible
- HRL = Heat Recovery – Latent
- WVL = Winter Ventilation Load
- WHR = Winter Heat Recovery

*Note: All performance data is based on operating intake and exhaust blower on the same speed.*

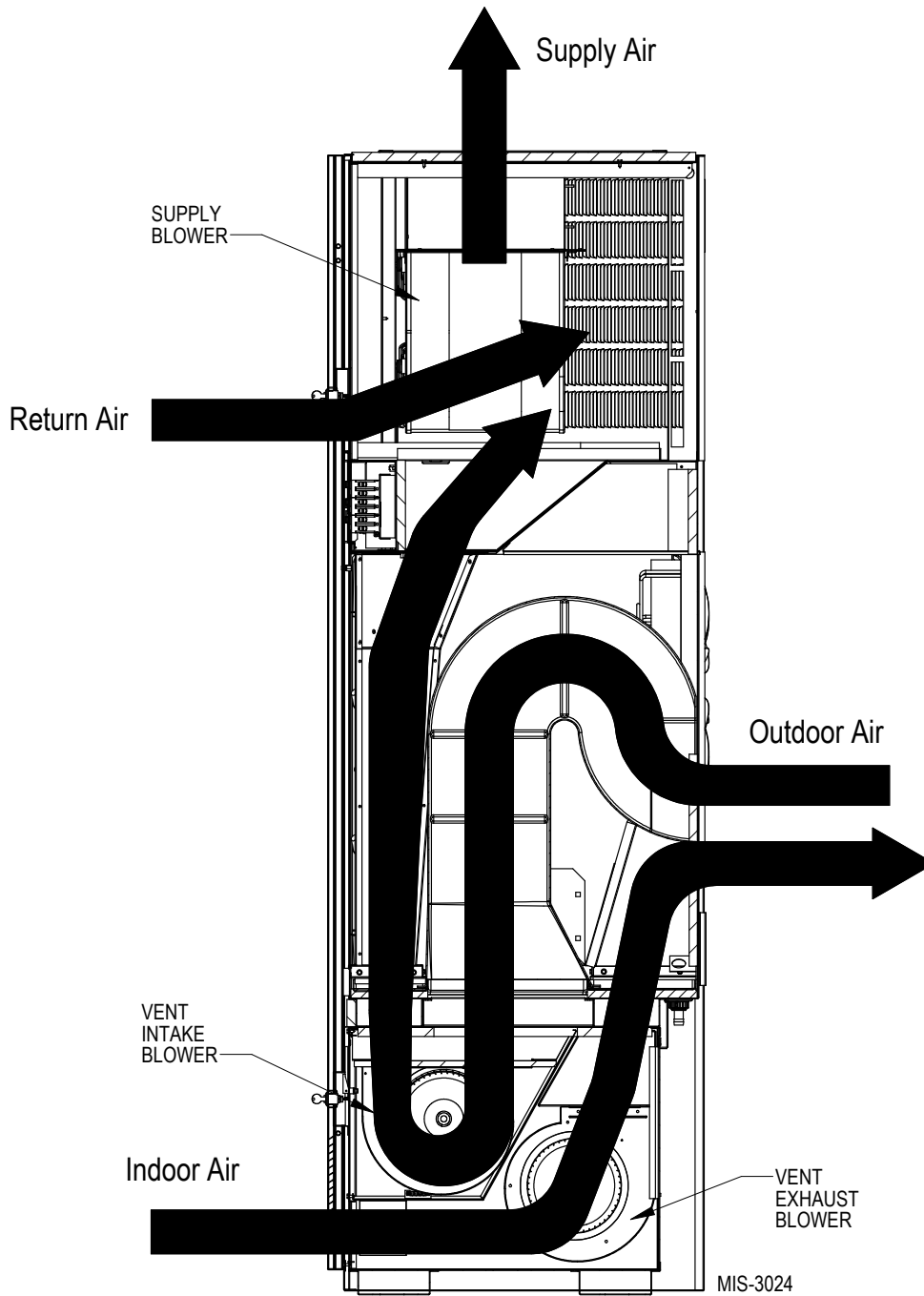
**FIGURE 21A**  
**ERV "MANUAL MODE" JUMPER PIN ON "M" TERMINAL**

| ERV CFM | FLOW INDEX (Light Blink Code) | To adjust the airflow ventilation rate ( <i>NO CO<sub>2</sub> CONTROL/NON-MODULATING</i> ), determine the "FLOW INDEX" needed for the intake and exhaust blowers for the CFM required.   |
|---------|-------------------------------|--|
| 450     | 100                           |  |
| 425     | 89                            | 1.> Locate two 0-10Vdc Motor Control Boards in control panel   |
| 400     | 83                            |  |
| 375     | 76                            | 2.> On intake Motor Control Board, observing "GREEN STATUS LIGHT", turn manual adjust potentiometer (with a small phillips-head screwdriver) "CCW" to increase "FLOW INDEX" or CW to reduce "FLOW INDEX" to match desired setting. <b><i>(NOTE: After long pause, the green status light will blink long-blinks for the "TEN COUNT" of the "FLOW RATE INDEX", which then is immediately followed by fast blinks which indicate the second digit. For example, a Flow Index of 23 would be two long blinks, followed by three fast blinks of the "GREEN STATUS LIGHT".)</i></b> |
| 350     | 59                            |  |
| 325     | 50                            |  |
| 300     | 40                            |  |
| 275     | 32                            |  |
| 250     | 25                            |  |
| 225     | 12                            |  |
| 200     | 9                             | 3.> On exhaust Motor Control Board, observing "GREEN STATUS LIGHT", turn manual adjust potentiometer (with a small phillips-head screwdriver) "CCW" to increase "FLOW INDEX" or CW to reduce "FLOW INDEX" to match desired setting. <b><i>(Same GREEN STATUS LIGHT blink (refer to Step #2))</i></b>   |
| 175     | 4                             |  |
| 150     | 1                             |  |

**FIGURE 21B**  
**ERV "MODULATING MODE" JUMPER PIN ON "P" TERMINAL**

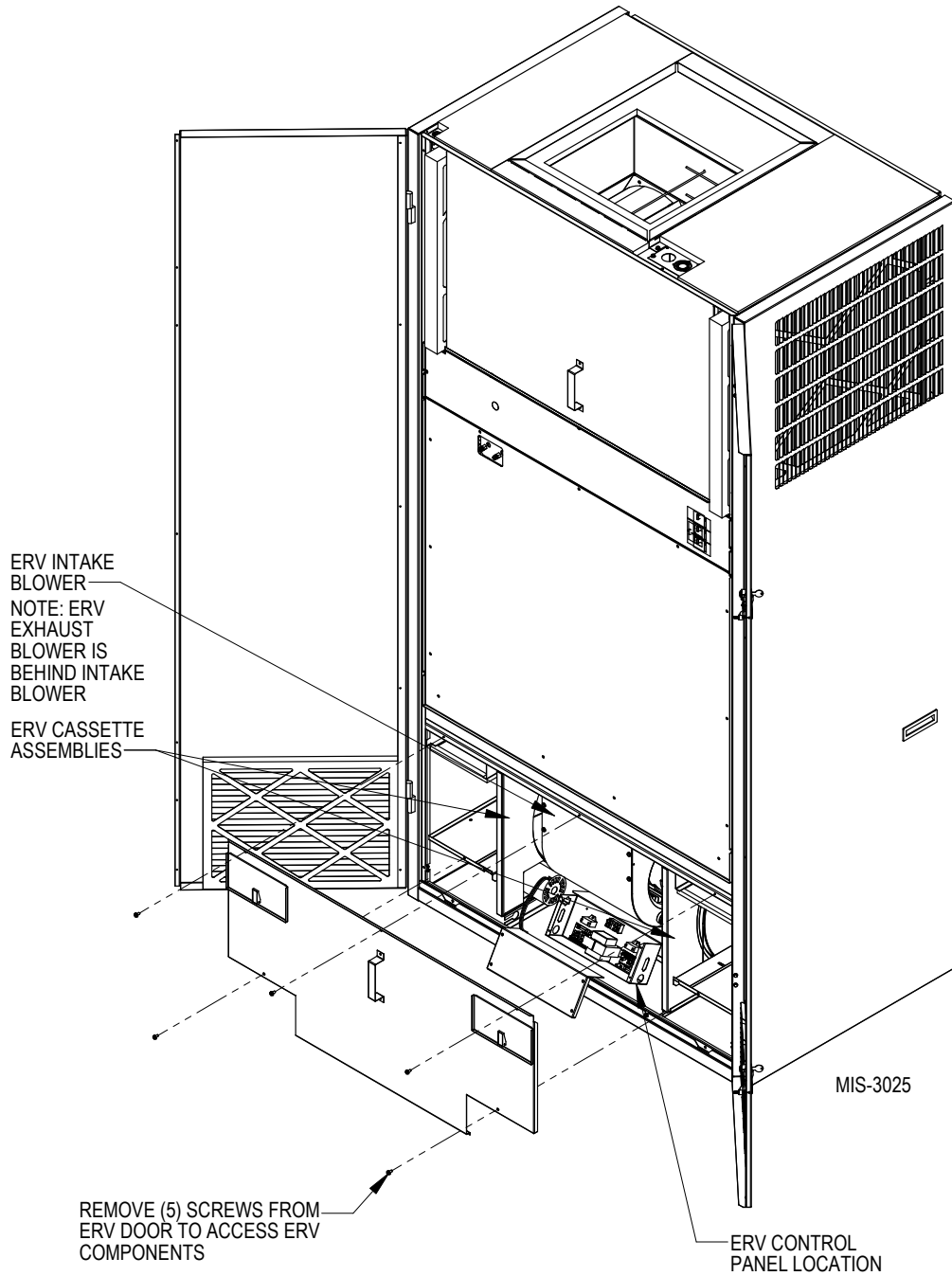
| CFM | Vdc Signal from CO <sub>2</sub> Control | After determining the air volume rates needed for the intended application (Maximum & Minimum), the table immediately to the left will allow the programming of CO <sub>2</sub> control output voltages in correlation to the CO <sub>2</sub> levels to be controlled when Bard Part # 8403-067 CO <sub>2</sub> Control is applied. |
|-----|---|---|
| 450 | 10                                      |   |
| 425 | 8.87                                    |   |
| 400 | 8.31                                    |   |
| 375 | 7.61                                    |   |
| 350 | 6.73                                    |   |
| 325 | 5.91                                    |   |
| 300 | 5.15                                    |   |
| 275 | 4.58                                    |   |
| 250 | 4.06                                    |   |
| 225 | 2.91                                    |   |
| 200 | 2.57                                    |   |
| 175 | 2.24                                    |   |
| 150 | 1.74                                    |   |
| 125 | 0.96                                    |   |
| 100 | 0.77                                    |   |

**FIGURE 22**  
**VENTILATION AIRFLOW DIAGRAM**

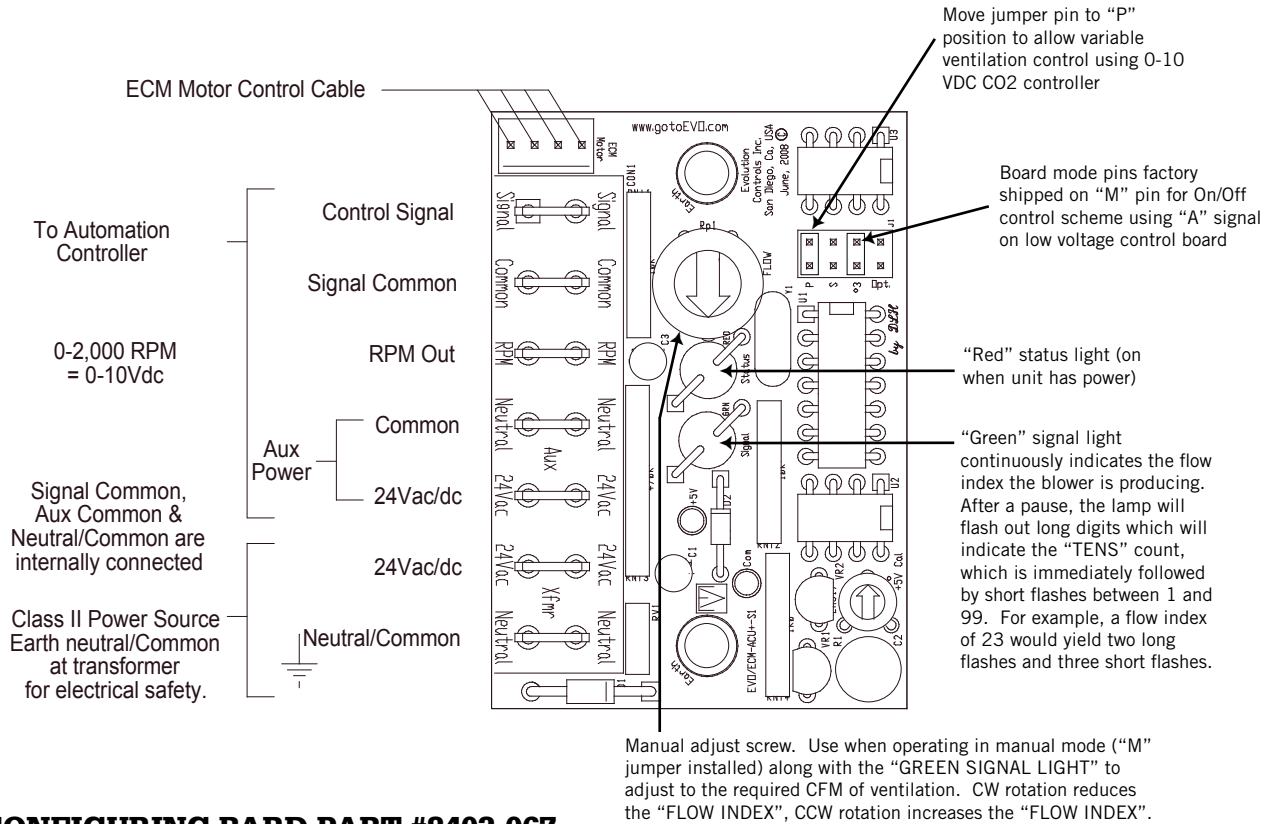




**FIGURE 23**  
**ERV ACCESS**



**FIGURE 24  
CONTROL BOARD CONFIGURATION/SETTING**



**CONFIGURING BARD PART #8403-067  
CO<sub>2</sub> CONTROL for ERV MODULATING  
CONTROL**

**BARD PART #8403-067**

Carbon Dioxide and Temperature Transmitters accurately monitor the CO<sub>2</sub> concentration and temperature in schools, office buildings and other indoor environments to help achieve LEED® certification.

**SPECIFICATIONS**

- Range:** CO<sub>2</sub>: 0 to 2000 or 0 to 5000 ppm (depending on model)
- Temperature: 32 to 122°F (0 to 50°C).
- Accuracy:** ±40 ppm + 3% of reading.
- Temperature Dependence:** ±8 ppm / °C at 1100 ppm.
- Non-Linearity:** 16 ppm.
- Pressure Dependence:** 0.13% of reading per mm of Hg.
- Response Time:** 2 minutes for 99% step change.
- Ambient Operating Temperature:** 32 to 122°F (0 to 50°C).
- Ambient Operating Humidity:** 10 to 95% RH (non-condensing).
- Power Requirements:** 16 to 35 VDC / 19 to 28 VAC.
- Power Consumption:** Average: 2 watts; Peak: 3.75 watts.
- Sensor:** Single beam, dual-wave length NDIR.
- Output:**
  - Current: 4 to 20 mA (max 500 Ω);
  - Voltage: 0 to 5 VDC or 0 to 10 VDC (min 500 Ω);
  - Relay: SPST NO 2A @ 30 VDC;
  - RTD or thermistor per r-t curves (depending on model)

**Weight:** 5.6 oz (158.8 g)

**WARNING** Disconnect power supply before installation to prevent electrical shock and equipment damage.

Make sure all connections are in accordance with the job wiring diagram and in accordance with national and local electrical codes. Use copper conductors only.

**CAUTION** Use electrostatic discharge precautions (e.g., use of wrist straps) during installation and wiring to prevent equipment damage.

**CAUTION** Avoid locations where severe shock or vibration, excessive moisture or corrosive fumes are present.

**CAUTION** Do not exceed ratings of this device, permanent damage not covered by warranty may result.

**NOTICE** Upon powering the transmitter, the firmware version will flash on the display. A warm up period of 30 minutes is required for the transmitter to adjust to the current CO<sub>2</sub> concentration.

**NOTICE** Self calibration feature of the transmitter requires exposure to normal outdoor equivalent carbon dioxide level once every thirty days.

## MOUNTING

1. Push tab on bottom of cover and lift cover from back plate.
2. Select the mounting location, away from diffusers, lights or any external influences.
3. Mount transmitter on a vertical surface to a standard electrical box using the two #6 M2C type screws provided.
4. Pull wires through sub base hole and make necessary connections.
5. Reattach cover to base plate.

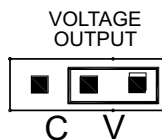
## WIRING

Use maximum 18 AWG wire for wiring to terminals. Refer to Figures 13-18 on pages 23 to 28 for wiring information.

## SELECTION OF VOLTAGE OUTPUTS

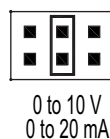
Prior to wiring, verify the voltage selector jumpers on jumpers PJ1 and PJ2 are set to voltage.

### CURRENT/VOLTAGE OUTPUT SELECTION JUMPER (PJ1 & PJ2)



Next, move jumper PJ5 to the 0-10V range.

### OUTPUT RANGE SELECTION JUMPER PJ5



## EDITING MENU PARAMETERS

Before any adjustment can be made to the transmitter, the Menu Lockout Jumper (PJ4) must be set to the "ON" position.

### MENU LOCKOUT JUMPER



Finish installing/wiring the control. Then, refer to Figure 21B on page 38 and the building ventilation

specifications to decide what the maximum ventilation rate desired is and what the minimum/maximum voltage signal is required for those levels.

Next, enter the control programming stage listed below once the system is powered up to configure the control.

## ACCESSING MENU PARAMETERS

- Step 1:** To enter the menu structure, press and simultaneously for 5 seconds (display will show RON parameter).
- Step 2:** Press or to cycle between menu items.
- Step 3:** Press to edit the value for the displayed menu item (SET will appear on display).
- Step 4:** Press or to adjust the value of the menu item.
- Step 5:** Press to save the changes (SET will disappear).
- Step 6:** Repeat Steps 2 through 5 for each of the parameters.
- Step 7:** To exit the menu at any time, press and hold and simultaneously for 5 seconds or wait 10 seconds without pushing any buttons.

## MENU DESCRIPTIONS

- RON** Relay on setpoint  
Sets the CO<sub>2</sub> concentration which the optional relay is energized.  
Low limit: 0 PPM  
Factory setting: 1000 PPM  
High limit: 2000/5000 PPM (depending on model)
- ROF** Relay off setpoint  
Sets the CO<sub>2</sub> concentration which the optional relay is de-energized. Setting value lower than RON provides direct action for detecting high concentrations of CO<sub>2</sub>. Setting value higher than RON provides indirect action for detecting low concentrations of CO<sub>2</sub>. or on the LCD display will be lit to indicate when the relay is energized.  
Low limit: 0 PPM  
Factory setting: 950 PPM  
High limit: 2000/5000 PPM (depending on model)
- DSP** Display configuration  
Determines the LCD display configuration during normal operation. The LCD display can indicate the CO<sub>2</sub> concentration and the temperature, the CO<sub>2</sub> concentration only or the temperature only. The factory default is to display both the temperature and the CO<sub>2</sub> concentration.
- CT CO<sub>2</sub> concentration and temperature  
C CO<sub>2</sub> concentration only  
T Temperature only

- UNI** Units selection  
Temperature and barometric pressure measurements can be displayed in US engineering units or SI engineering units. The factory default is to display US engineering units.
- US units F for temperature and in Hg for barometric pressure
- SI units C for temperature and hPa for barometric pressure
- COL** CO<sub>2</sub> low output range  
Sets the CO<sub>2</sub> concentration for the lowest output (4 mA or 0 VDC).  
Low limit: 0 PPM  
Factory setting: 0 PPM  
High limit: 2000/5000 PPM (depending on model)
- COH** CO<sub>2</sub> high output range  
Sets the CO<sub>2</sub> concentration for the highest output (20 mA, 5 VDC or 10 VDC). When COH is set above COL, the transmitter is direct acting and the output will increase with an increase in CO<sub>2</sub> level. When COH is below COL, the transmitter is reverse acting and the output will increase with a decrease in CO<sub>2</sub> level.  
Low limit: 0 PPM  
Factory setting: 2000/5000 PPM (depending on model)  
High limit: 2000/5000 PPM (depending on model)
- TOL** Temperature low output range  
Sets the temperature for the lowest output (4 mA or 0 VDC).  
Low limit: 32.0°F/0.0°C  
Factory setting: 32.0°F/0.0°C  
High limit: 122.0°F/50.0°C
- TOH** Temperature high output range  
Sets the temperature for the highest output (20 mA, 5 VDC or 10 VDC). When TOH is set above TOL, the transmitter is direct acting and the output will increase with an increase in temperature. When TOH is below TOL, the transmitter is reverse acting and the output will increase with a decrease in temperature.  
Low limit: 32.0°F/0.0°C  
Factory setting: 122.0°F/50.0°C  
High limit: 122.0°F/50.0°C

- BAR** Barometric pressure  
Sets the typical barometric pressure for the location where the transmitter is mounted. The factory setting is for standard pressure at sea level. Adjusting the barometric pressure gives a more accurate measurement, especially at higher elevations.  
Low limit: 20.0 in Hg/600 hPa  
Factory setting: 29.9 in Hg/1013 hPa  
High limit: 32.0 in Hg/1100 hPa

## **ENERGY RECOVERY VENTILATOR MAINTENANCE**

### **General Information**

The ability to clean exposed surfaces within air moving systems is an important design consideration for the maintenance of system performance and air quality. The need for periodic cleaning will be a function of operating schedule, climate and contaminants in the indoor air being exhausted and in the outdoor air being supplied to the building. All components exposed to the airstream, including energy recovery wheels, may require cleaning in most applications.

Rotary counterflow heat exchanges (heat wheels) with laminar airflow are “self-cleaning” with respect to dry particles. Smaller particles pass through; larger particles land on the surface and are blown clear as the flow direction is reversed. For this reason, the primary need for cleaning is to remove films of oil-based aerosols that have condensed on energy transfer surfaces. Buildup of material over time may eventually reduce airflow. Most importantly, in the case of desiccant coated (enthalpy) wheels, such films can close off micron sized pores at the surface of the desiccant material, reducing the efficiency with which the desiccant can absorb and desorb moisture.

### **Frequency**

In a reasonably clean indoor environment such as a school, office building or home, experience shows that reductions of airflow or loss of sensible (temperature) effectiveness may not occur for 10 or more years. However, experience also shows that measurable changes in latent energy (water vapor) transfer can occur in shorter periods of time in commercial, institutional and residential applications experiencing moderate occupant smoking or with cooking facilities. In applications experiencing unusually high levels of occupant smoking, such as smoking lounges, nightclubs, bars and restaurants, washing of energy transfer surfaces as frequently as every 6 months may be necessary to maintain latent transfer efficiency. Similar washing cycles may also be appropriate for industrial applications involving the ventilation of high

levels of smoke or oil-based aerosols such as those found in welding or machining operations, for example. In these applications, latent efficiency losses of as much as 40% or more may develop over a period of 1 to 3 years.

### Cleanability and Performance

In order to maintain energy recovery ventilation systems, energy transfer surfaces must be accessible for washing to remove oils, grease, tars and dirt that can impede performance or generate odors. Washing of the desiccant surfaces is required to remove contaminate buildups that can reduce adsorption of water molecules. The continued ability of an enthalpy wheel to transfer latent energy depends upon the permanence of the bond between the desiccant and the energy transfer surfaces.

Bard wheels feature silica gel desiccant permanently bonded to the heat exchange surface without adhesives; the desiccant will not be lost in the washing process. Proper cleaning of the Bard energy recovery wheel will restore latent effectiveness to near original performance.

### Maintenance Procedures

**NOTE:** *Local conditions can vary and affect the required time between routine maintenance procedures, therefore all sites (or specific units at a site) may not have the same schedule to maintain acceptable performance. The following timetables are recommended and can be altered based on local experience.*

#### Quarterly Maintenance

1. Inspect mist eliminator/prefilter and clean if necessary. This filter is located in the fresh air intake hood on the front of the unit. This is an aluminum mesh filter and can be cleaned with water and any detergent not harmful to aluminum.
2. Inspect wall mount unit filter and clean or replace as necessary. This filter is located either in the unit, in a return air filter grille assembly or both. If in the unit it can be accessed by removing the lower service door on the front of the unit. If in a return air filter grille, gain access by hinging the grille open.
3. Inspect energy recovery ventilator for proper wheel rotation and dirt buildup. This can be done in conjunction with Step 2. Energize the energy recovery ventilator after inspecting the filter and observe for proper rotation and/or dirt buildup.
4. Follow Steps 5 through 8 for recommended energy recovery wheel cleaning procedures.

5. Disconnect all power to unit. Remove the lower service door of the wall mount unit to gain access to the energy recovery ventilator.
6. Remove the front access panel on the ventilator. Unplug amp connectors to cassette motors. Slide energy recovery cassette out of ventilator.
7. Use a shop vacuum with brush attachment to clean both sides of the energy recovery wheels.
8. Reverse shop vacuum to use as a blower and blow out any residual dry debris from the wheel.

**NOTE:** *Discoloration and staining of the wheel does not affect its performance. Only excessive buildup of foreign material needs to be removed.*

9. If any belt chirping or squealing noise is present, apply a small amount of LPS-1 or equivalent dry film lubricant to the belt.

### ANNUAL MAINTENANCE

1. Inspect and conduct the same procedures as outlined under **Quarterly Maintenance**.
2. To maintain peak latent (moisture) removal capacity, it is recommended that the energy recovery wheels be sprayed with a diluted nonacid based evaporator coil cleaner or alkaline detergent solution such as 409.

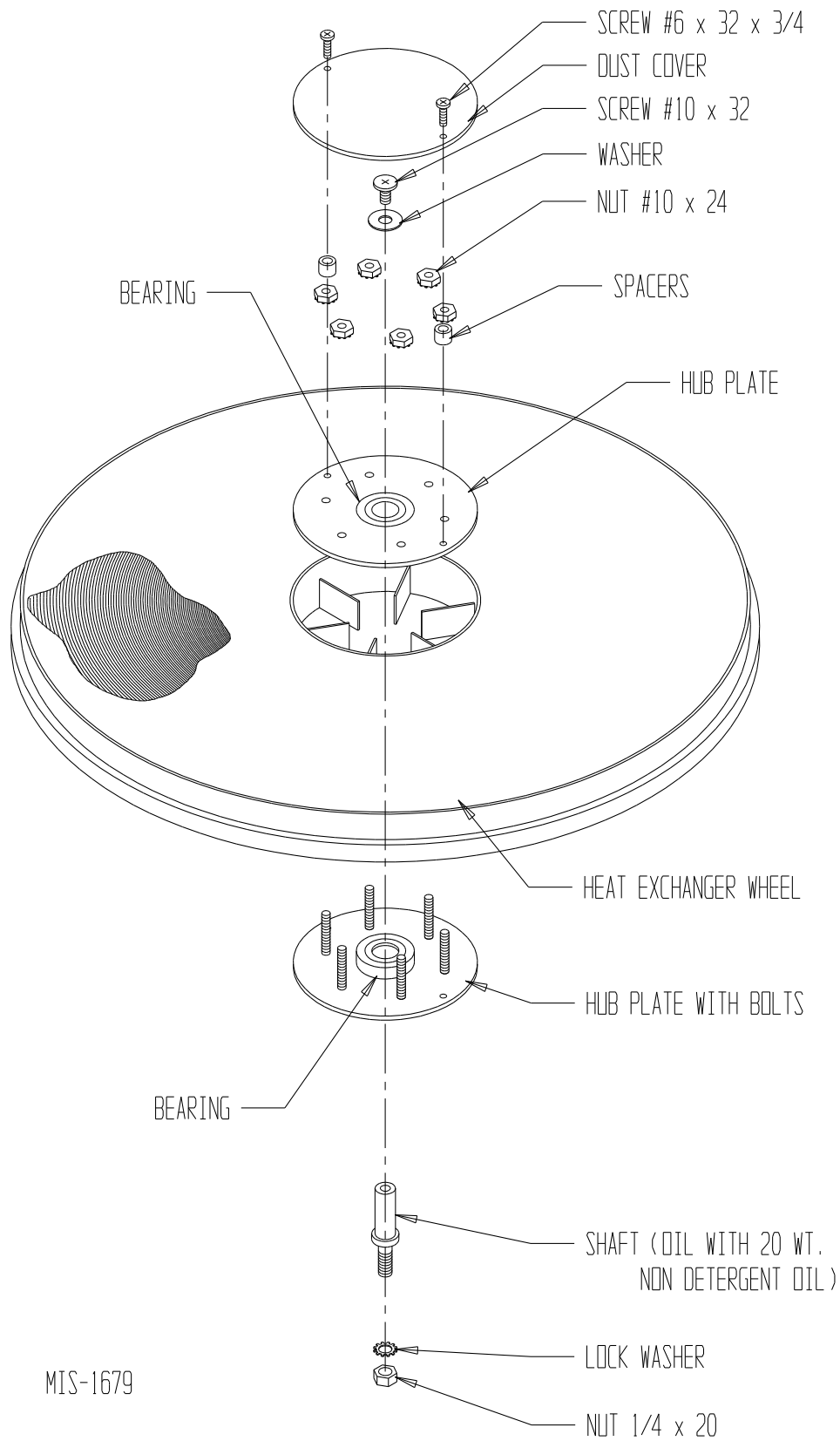
**NOTE:** *Do not use acid-based cleaners, aromatic solvents, temperatures in excess of 170°F or steam. Damage to the wheel may result.*

*Do not disassemble and immerse the entire heat wheel in a soaking solution, as bearing and other damage may result.*

3. Rinse wheel thoroughly after application of the cleaning solution and allow to drain before re-installing.
4. No re-lubrication is required to heat wheel bearings of the drive motor or to the intake and exhaust blower motors.
5. If any belt chirping or squealing noise is present, apply a small amount of LPS-1 or equivalent dry film lubricant to the belt.

See Figure 25 on page 46.

**FIGURE 25**  
**HUB ASSEMBLY WITH BALL BEARINGS**



MIS-1679

# TROUBLESHOOTING

## CHECKING TEMPERATURE SENSOR

1. Disconnect temperature sensor from board and from right-hand outdoor coil.
2. Use an ohmmeter and measure the resistance of the sensor. Also use ohmmeter to check for short or open.
3. Check resistance reading to chart of resistance use sensor ambient temperature. (Tolerance of part is  $\pm 10\%$ .)
4. If sensor resistance reads very low, sensor is shorted and will not allow proper operation of the heat pump control.
5. If sensor is out of tolerance, shorted, open or reads very low ohms, it should be replaced.

**TABLE 5**  
**Temperature (F) vs. Resistance (R) of Temperature Sensor**

| F   | R      | F  | R     | F  | R     | F   | R    |
|-----|--------|----|-------|----|-------|-----|------|
| -25 | 196871 | 13 | 56985 | 51 | 19374 | 89  | 7507 |
| -24 | 190099 | 14 | 55284 | 52 | 18867 | 90  | 7334 |
| -23 | 183585 | 15 | 53640 | 53 | 18375 | 91  | 7165 |
| -22 | 177318 | 16 | 52051 | 54 | 17989 | 92  | 7000 |
| -21 | 171289 | 17 | 50514 | 55 | 17434 | 93  | 6840 |
| -20 | 165487 | 18 | 49028 | 56 | 16984 | 94  | 6683 |
| -19 | 159904 | 19 | 47590 | 57 | 16547 | 95  | 6531 |
| -18 | 154529 | 20 | 46200 | 58 | 16122 | 96  | 6383 |
| -17 | 149355 | 21 | 44855 | 59 | 15710 | 97  | 6239 |
| -16 | 144374 | 22 | 43554 | 60 | 15310 | 98  | 6098 |
| -15 | 139576 | 23 | 42295 | 61 | 14921 | 99  | 5961 |
| -14 | 134956 | 24 | 41077 | 62 | 14544 | 100 | 5827 |
| -13 | 130506 | 25 | 39898 | 63 | 14177 | 101 | 5697 |
| -12 | 126219 | 26 | 38757 | 64 | 13820 | 102 | 5570 |
| -11 | 122089 | 27 | 37652 | 65 | 13474 | 103 | 5446 |
| -10 | 118108 | 28 | 36583 | 66 | 13137 | 104 | 5326 |
| -9  | 114272 | 29 | 35548 | 67 | 12810 | 105 | 5208 |
| -8  | 110575 | 30 | 34545 | 68 | 12492 | 106 | 5094 |
| -7  | 107010 | 31 | 33574 | 69 | 12183 | 107 | 4982 |
| -6  | 103574 | 32 | 32634 | 70 | 11883 | 108 | 4873 |
| -5  | 100260 | 33 | 31723 | 71 | 11591 | 109 | 4767 |
| -4  | 97064  | 34 | 30840 | 72 | 11307 | 110 | 4663 |
| -3  | 93981  | 35 | 29986 | 73 | 11031 | 111 | 4562 |
| -2  | 91008  | 36 | 29157 | 74 | 10762 | 112 | 4464 |
| -1  | 88139  | 37 | 28355 | 75 | 10501 | 113 | 4367 |
| 0   | 85371  | 38 | 27577 | 76 | 10247 | 114 | 4274 |
| 1   | 82699  | 39 | 26823 | 77 | 10000 | 115 | 4182 |
| 2   | 80121  | 40 | 26092 | 78 | 9760  | 116 | 4093 |
| 3   | 77632  | 41 | 25383 | 79 | 9526  | 117 | 4006 |
| 4   | 75230  | 42 | 24696 | 80 | 9299  | 118 | 3921 |
| 5   | 72910  | 43 | 24030 | 81 | 9077  | 119 | 3838 |
| 6   | 70670  | 44 | 23384 | 82 | 8862  | 120 | 3757 |
| 7   | 68507  | 45 | 22758 | 83 | 8653  | 121 | 3678 |
| 8   | 66418  | 46 | 22150 | 84 | 8449  | 122 | 3601 |
| 9   | 64399  | 47 | 21561 | 85 | 8250  | 123 | 3526 |
| 10  | 62449  | 48 | 20989 | 86 | 8057  | 124 | 3452 |
| 11  | 60565  | 49 | 20435 | 87 | 7869  |     |      |
| 12  | 58745  | 50 | 19896 | 88 | 7686  |     |      |

## Troubleshooting Condensate Overflow Systems

The Bard I-TEC Series is equipped with dual condensate overflow switches. One switch (float type) is located in the indoor drain pan. It is secured to the drain pan with a screw-down clamp (see Figure 26). The second switch (electronic/conductance) is located in the control panel with the sensor mounted adjacent to the left outdoor coil in the outdoor drain pan (see Figure 27).

The float type switch in the indoor drain pan is equipped with an LED light that indicates when an overflow condition is present.

Electrically, the two condensate switches are wired in series with the unit's high pressure switch. All three switches have normally closed contacts, but if any of them are activated, it will then activate initially a soft lockout of the compressor circuit. If recurrence

happens on the same cooling call cycle, a hard lockout of the compressor circuit will occur. (See **Sequence of Operation** on page 31.)

The electronic switch for the outdoor drain pan has three LED lights giving a status update (see Figure 28).

To test the electronic overflow switch function, bridge across the probes with a wet finger. The unit should stop, and the RED LED should come on. Remove the finger from the probe. After approximately 5 seconds, the RED LED should go off and the GREEN and AMBER LEDs should come on.

To Reset (Clear AMBER LED):

Bridge across the sensor probes with wet finger until the RED LED comes on, then remove the bridge quickly. While the RED LED is still on, bridge the probes again quickly (within 2 seconds). Hold until the AMBER LED goes off, then immediately remove the bridge.

**FIGURE 26**  
**INDOOR CONDENSATE OVERFLOW SWITCH**



**FIGURE 27**  
**OUTDOOR CONDENSATE SENSOR**



**FIGURE 28**  
**OUTDOOR CONDENSATE CONTROL**



**RED LED Illuminated:**  
Overflow currently being detected, switch activated

**GREEN LED Illuminated:**  
No overflow currently being detected

**AMBER LED Illuminated:**  
Previous condition detected



## Troubleshooting ECM™ 142R Outdoor Fan Motor



### WARNING

- **Exposed moving parts.**
- **Disconnect all electrical power before servicing.**
- **Failure to do so can result in severe injury or amputation.**



### WARNING

- **Hazard of electrical shock.**
- **Electrical shock can result in serious injury or death.**
- **Disconnect the remote electric power supply or supplies before servicing.**

1. In normal operation, this motor may rock back and forth on start up. Do not replace if this is the only symptom identified.
2. If the system is operating properly, but the motor appears to run slower than it should, the motor is good. High efficiency systems with optimized fan blades are engineered to run slow to decrease noise. The Bard I-TEC Series models also adjust fan speed based upon varied outdoor ambient conditions to optimize sound and unit efficiency.
3. If the system is noisy, freezing up, running a high head pressure, tripping the high pressure switch or compressor overload, check the following:
  - a. Ensure cleanliness of condenser coil(s) and fan blade/shroud.
  - b. Confirm the fan blade is not bent or deformed, isn't rubbing on the shroud, and that it is tight on the motor shaft. Also ensure the motor is secure in its mounting system, and the mounting system is secure to the unit.
  - c. The Bard I-TEC is equipped with a low ambient control pressure switch. This pressure switch completes the 24VAC Common feed to the outdoor fan motor control in cooling mode. If this switch is defective, the outdoor air temperature is too cold to raise the head pressure to the 350# switch closing setpoint or the system charge is too low, this could be the cause of the issue.
  - d. If motor is not running, go to next section.



### CAUTION

**Do not operate motor without fan blade attached. Such operations will cause the motor to oscillate up and down.**



### CAUTION

**The correct motor that is a direct replacement for the failed motor must be obtained from the manufacturer.**

**USING THE WRONG MOTOR VOIDS ALL WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.**

4. If the motor does not appear to be running at the proper speed or does not shut off, refer to the next section for voltage checks to determine if the motor is getting the proper input signals.

If the motor IS NOT receiving any communication, troubleshoot the communication issue using the diagnostic table for the fan logic control.

- a. This motor uses a 7-wire harness to control the motor.
  - Line power is connected as follows:
    - “Red Wire” connects to “L1”
    - “Black Wire” connects to “L2”
    - “Green/Yellow Wire” connects to “Ground”
  - Control power is connected as follows:
    - “Blue Wire” connects to "BR" terminal on the fan logic control board, and subsequently connects to 24VAC Common through the fan logic control board.\*
    - “Yellow Wire” connects to “Y” on the fan logic control board. “White Wire” connects to “W” on the fan logic control board.
    - “Orange Wire” connects to “O” on the fan logic control board.

**NOTE:** A combination of the “Yellow”, “White” and “Orange” wires being energized (with 24V “R” signal) determines five different speeds the fan motor will operate at. The fan logic control board uses an outdoor thermistor sensor to determine the speed the fan should operate.

- \* The common wire to the "BR" terminal is interrupted by the low ambient control. This will stop the condenser fan operation until liquid pressure reaches 350#.

**TABLE 6**  
**Troubleshooting ECM™ 142R Outdoor Fan Motor**

|  |   |
|--|---|
| Check line power to motor  | Check between red and black wires for line power  |
|  | Verify ground by checking green wire to L1 and L2 line power  |
| Check for 24VAC common signal to motor (against Transformer "R" Signal)  | Check "BR" terminal of fan logic control board  |
|  | Check "Blue" fan lead on "Fan Relay Terminal" of "Fan Logic Control"  |
|  | ** Is not energized in cooling mode until low ambient fan cycling control is closed by 325 PSIG refrigerant pressure. |
| Check 24VAC "hot" outputs (to "Blue" on fan logic control) to motor. See the following tables based upon outdoor temperature and model of operation. |   |

**TROUBLESHOOTING FAN LOGIC CONTROL**

Please reference the Thermistor Temperature/Resistance Chart in this manual (Table 5 on page 46).

- GREEN STATUS LED – Blinks indicating there is a call for fan operation (simultaneous to call for compressor operation) and is normal.
- RED STATUS LIGHT (LA) – Is illuminated when low ambient control switch is in the closed position. (NOTE: This is not required in heat pump operation as the low ambient switch is bypassed in this mode of operation.)
- YELLOW STATUS LIGHT (B) – Is illuminated when there is a reversing valve call (for heat pump operation). (NOTE: As mentioned above, this mode

of operation negates the low ambient fan cycling control.)

If the board is reading a fan temperature thermistor value of 3375Ω or less (equivalent to 125°F or an "open" sensor), the fan will operate at the highest speed setting (energizes "W" and "Y" outputs on the board).

If the board is reading a fan temperature value of 118,110Ω or greater (equivalent to -10°F or a "shorted" sensor), the fan will operate at the highest speed setting (energizes "W" and "Y" outputs on the board).

If the low ambient switch is open, the red light will not be illuminated and the "BR" terminal will show open. The "BR" terminal is the "24 volt common" switching output to the outdoor fan motor.

**TABLE 7**  
**COOLING MODE**

| O.D. Temp Sensor    | 24VAC Signals Between    |
|---------------------|--------------------------|
| Below 55°F          | Orange to Blue           |
| Between 56° - 69°F  | White to Blue            |
| Between 70° - 85°F  | Yellow to Blue           |
| Between 86° - 112°F | Orange and White to Blue |
| Above 112°F         | White and Yellow to Blue |

*If the output signals are not matching the specified temperature range, go to Table 6 and verify the thermistor output curve. If the motor is receiving proper communications and proper high voltage power, and is still not running, proceed with motor replacement. (When checking the resistance/temperature curve, don't forget about the optional 2.2k ohm fan control resistor assembly.)*

**REPLACING THE MOTOR**

This motor is replaced in one piece. The control cannot be replaced separately from the motor. Even if the control is remotely located, the replacement part will be a new control with harness and new motor.

Be sure to have the correct replacement motor from the manufacturer that is a direct replacement for the failed motor.

**USING THE WRONG MOTOR VOIDS ALL PRODUCT WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.**

Always mount the replacement motor and control according to the manufacturers specifications using all required hardware to reduce vibration. Make sure all wires are free of the fan blade and not pinched in mountings or cabinet through points.

# TROUBLESHOOTING INDOOR ECM™ BLOWER MOTORS

## CAUTION:

Disconnect power from unit before removing or replacing connectors, or servicing motor. To avoid electric shock from the motor's capacitors, disconnect power and wait at least 5 minutes before opening motor.

### Symptom

**Motor rocks slightly when starting**

**Motor won't start**  
• No movement

• Motor rocks, but won't start

**Motor oscillates up & down while being tested off of blower**

**Motor starts, but runs erratically**  
• Varies up and down or intermittent

• "Hunts" or "puffs" at high CFM (speed)

• Stays at low CFM despite system call for cool or heat CFM

• Stays at high CFM

• Blower won't shut off

**Excessive noise**

• Air noise

### Cause/Procedure

• This is normal start-up for ECM

- Check blower turns by hand
- Check power at motor
- Check low voltage (24 Vac R to C) at motor
- Check low voltage connections (G, Y, W, R, C) at motor
- Check for unseated pins in connectors on motor harness
- Test with a temporary jumper between R - G
- Check motor for tight shaft
- Perform motor/control replacement check
- **Perform Moisture Check**

- Check for loose or compliant motor mount
- Make sure blower wheel is tight on shaft
- Perform motor/control replacement check

• It is normal for motor to oscillate with no load on shaft

- Check line voltage for variation or "sag"
- Check low voltage connections (G, Y, W, R, C) at motor, unseated pins in motor harness connectors
- Check "Bk" for erratic CFM command (in variable-speed applications)
- Check out system controls, Thermostat
- **Perform Moisture Check**

• Does removing panel or filter reduce "puffing"?  
- Reduce restriction  
- Reduce max airflow

- Check low voltage (Thermostat) wires and connections
- Verify fan is not in delay mode; wait until delay complete
- "R" missing/not connected at motor
- Perform motor/control replacement check

• "R" missing/not connected at motor  
• Is fan in delay mode? - wait until delay time complete  
• Perform motor/control replacement check

• Current leakage from controls into G, Y or W? Check for Triac switched thermostat or solid-state relay

• Determine if it's air noise, cabinet, duct or motor noise; interview customer, if necessary

- High static creating high blower speed?  
- Is airflow set properly?
- Does removing filter cause blower to slow down? Check filter
- Use low-pressure drop filter
- Check/correct duct restrictions

### Symptom

• Noisy blower or cabinet

• "Hunts" or "puffs" at high CFM (speed)

### Evidence of Moisture

- Motor failure or malfunction has occurred and moisture is present
- Evidence of moisture present inside air mover

### Do

- Check out motor, controls, wiring and connections thoroughly before replacing motor
- Orient connectors down so water can't get in  
- Install "drip loops"
- Use authorized motor and model #'s for replacement
- Keep static pressure to a minimum:  
- Recommend high efficiency, low static filters  
- Recommend keeping filters clean.  
- Design ductwork for min. static, max. comfort  
- Look for and recommend ductwork improvement, where necessary

• Size the equipment wisely  
• Check orientation before inserting motor connectors

### Moisture Check

- Connectors are oriented "down" (or as recommended by equipment manufacturer)
- Arrange harness with "drip loop" under motor
- Is condensate drain plugged?
- Check for low airflow (too much latent capacity)
- Check for undercharged condition
- Check and plug leaks in return ducts, cabinet

### Comfort Check

- Check proper airflow settings
- Low static pressure for lowest noise
- Set low continuous-fan CFM
- Use humidistat and 2-speed cooling units
- Use zoning controls designed for ECM that regulate CFM
- Thermostat in bad location?

### Cause/Procedure

- Check for loose blower housing, panels, etc.
- High static creating high blower speed?  
- Check for air whistling through seams in ducts, cabinets or panels  
- Check for cabinet/duct deformation

• Does removing panel or filter reduce "puffing"?  
- Reduce restriction  
- Reduce max. airflow

• Replace motor and **Perform Moisture Check**

• **Perform Moisture Check**

### Don't

- Automatically assume the motor is bad.
- Locate connectors above 7 and 4 o'clock positions
- Replace one motor or control model # with another (unless an authorized replacement)
- Use high pressure drop filters some have ½" H2O drop!
- Use restricted returns

• Oversize system, then compensate with low airflow  
• Plug in power connector backwards  
• Force plugs

## Replacing ECM Control Module

To replace the control module for the GE variable-speed indoor blower motor you need to take the following steps:

1. You **MUST** have the correct replacement module. The controls are factory programmed for specific operating modes. Even though they look alike, different modules may have completely different functionality.

**USING THE WRONG CONTROL MODULE VOIDS ALL PRODUCT WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.**

2. Begin by removing AC power from the unit being serviced. **DO NOT WORK ON THE MOTOR WITH AC POWER APPLIED.** To avoid electric shock from the motor's capacitors, disconnect power and wait at least 5 minutes before opening motor.

3. It is not necessary to remove the motor from the blower assembly, nor the blower assembly from the unit. Unplug the two cable connectors to the motor control assembly. There are latches on each connector. **DO NOT PULL ON THE WIRES.** The plugs remove easily when properly released.

4. Locate the screws that retain to the motor control bracket to the sheet metal of the unit and remove them. Remove two (2) nuts that retain the control to the bracket and then remove two (2) nuts that retain sheet metal motor control end plate. Refer to Figure 29.

5. Disconnect the three (3) wires interior of the motor control by using your thumb and forefinger squeezing the latch tab and the opposite side of the connector plug, gently pulling the connector. **DO NOT PULL ON THE WIRES, GRIP THE PLUG ONLY.** Refer to Figure 29.

6. The control module is now completely detached from the motor. Verify with a standard ohmmeter that the resistance from each motor lead (in the motor plug just removed) to the motor shell is >100K ohms. Refer to Figure 30. (Measure to unpainted motor end plate.) If any motor lead fails this test, do not proceed to install the control module. **THE MOTOR IS DEFECTIVE AND MUST BE REPLACED.** Installing the new control module will cause it to fail also.

7. Verify that the replacement control is correct for your application. Refer to the manufacturer's authorized replacement list. **USING THE WRONG CONTROL WILL RESULT IN IMPROPER OR NO BLOWER OPERATION.** Orient the control module so that the 3-wire motor plug can be inserted into the socket in the control. Carefully insert the plug and press it into the socket until it latches. **A SLIGHT CLICK WILL BE HEARD WHEN PROPERLY INSERTED.**

8. Reverse the steps #5, 4, 3 to reconnect the motor control to the motor wires, securing the motor control cover plate, mounting the control to the bracket, and mounting the motor control bracket back into the unit. **MAKE SURE THE ORIENTATION YOU SELECT FOR REPLACING THE CONTROL ASSURES THE CONTROL'S CABLE CONNECTORS WILL BE LOCATED DOWNWARD IN THE APPLICATION SO THAT WATER CANNOT RUN DOWN THE CABLES AND INTO THE CONTROL. DO NOT OVERTIGHTEN THE BOLTS.**

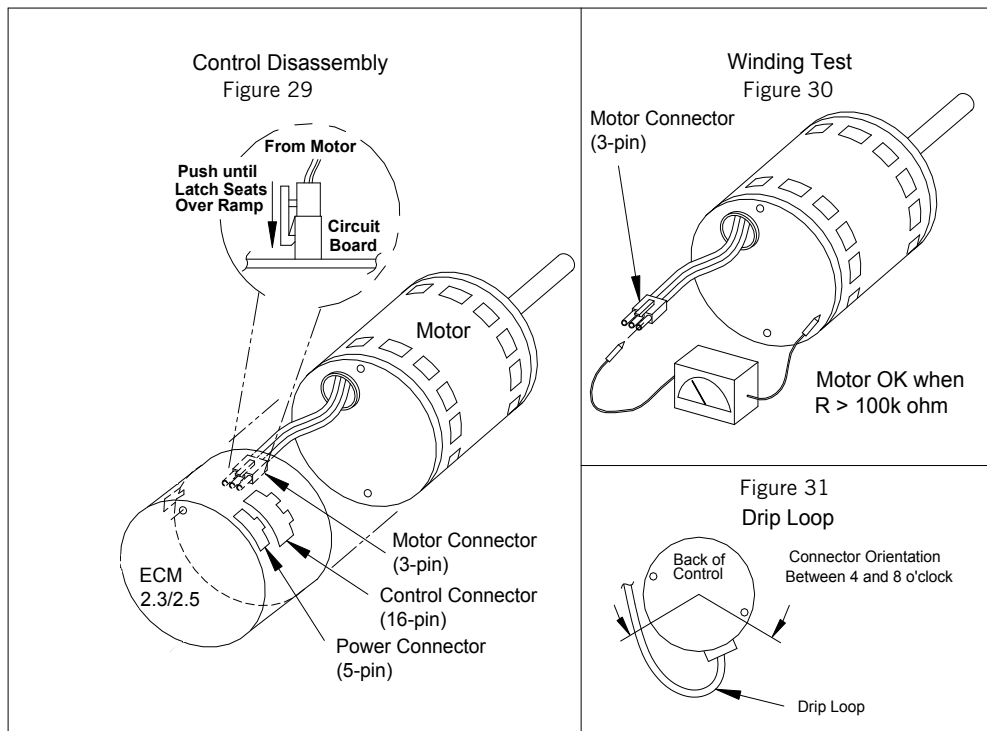
9. Plug the 16-pin control plug into the motor. The plug is keyed. Make sure the connector is properly seated and latched.

10. Plug the 5-pin power connector into the motor. Even though the plug is keyed, **OBSERVE THE PROPER ORIENTATION. DO NOT FORCE THE CONNECTOR.** It plugs in very easily when properly oriented. **REVERSING THIS PLUG WILL CAUSE IMMEDIATE FAILURE OF THE CONTROL MODULE.**

11. Final installation check. Make sure the motor is installed as follows:

- Motor connectors should be oriented between the 4 o'clock and 8 o'clock positions when the control is positioned in its final location and orientation.
- Add a drip loop to the cables so that water cannot enter the motor by draining down the cables. Refer to Figure 31.

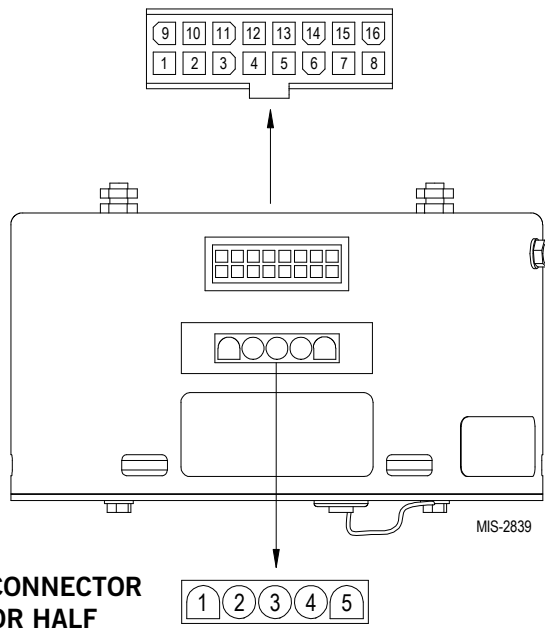
The installation is now complete. Reapply the AC power to the HVAC equipment and verify that the new motor control module is working properly. Follow the manufacturer's procedures for disposition of the old control module.



## TROUBLESHOOTING ECM™ BLOWER MOTORS

| MODE of OPERATION               | OFF  | Continuous Blower (Ventilation Mode) | Part Load Cooling | Full Load Cooling | Dehum. Mode (when equipped) | Part Load Heat Pump | Full Load Heat Pump  | Heat Pump Full Load w/ 1st Bank of Elec. Heat | Heat Pump Full Load w/ 1st & 2nd Bank of Elec. Heat | Emergency Heat Mode |
|---------------------------------|--|--------------------------------------|-------------------|-------------------|-----------------------------|---------------------|----------------------|---|---|---------------------|
| Thermostat 24 VAC Input Signals | —  | "G"                                  | "G", "Y1", "Y2"   | "G", "Y1", "Y2"   | "D"                         | "G", "B", "Y1"      | "G", "B", "Y1", "Y2" | "G", "Y1", "Y2", "B", "W1"                    | "G", "Y1", "Y2", "B", "W2", "W3"                    | "G", "W2", "W3"     |
| <b>Pin #1</b>                   | 24 VAC "C" (Common) Signal, Always Energized |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #2</b>                   |  |                                      |                   |                   |                             |                     |                      | X   |   |                     |
| <b>Pin #3</b>                   | 24 VAC "C" (Common) Signal, Always Energized |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #4</b>                   | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #5</b>                   | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #6</b>                   |  |                                      | X                 | X                 | X                           | X                   | X                    | X   | X   |                     |
| <b>Pin #7</b>                   | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #8</b>                   | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #9</b>                   |  |                                      |                   |                   |                             | X                   | X                    | X   |   |                     |
| <b>Pin #10</b>                  | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #11</b>                  | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #12</b>                  | 24 VAC Hot "R" Signal, Always Energized      |                                      |                   |                   |                             |                     |                      |   |   |                     |
| <b>Pin #13</b>                  |  |                                      |                   |                   |                             |                     |                      |   | X   | X                   |
| <b>Pin #14</b>                  |  |                                      |                   | X                 | X                           | X                   |                      | X   | X   |                     |
| <b>Pin #15</b>                  |  | X                                    | X                 | X                 | X                           | X                   | X                    | X   | X   | X                   |
| <b>Pin #16</b>                  | Not Used                                     |                                      |                   |                   |                             |                     |                      |   |   |                     |

**FIGURE 29**  
**CONTROL CONNECTOR MOTOR HALF**



| POWER CONNECTOR |   |
|-----------------|---|
| PWB HEADER      | AMP 1-350945-0                                      |
| PIN             | Description   |
| 1               | Jumper Pin 1 to Pin 2 for 120VAC Line Input Only ** |
| 2               |   |
| 3               | Chassis Ground                                      |
| 4               | AC Line   |
| 5               | AC Line   |

\* Suggested mating connector  
Housing — AMP 350809-1  
Contact — AMP 350537-1

\*\* **WARNING** — Applying 240VAC line input with PIN 1 to PIN 2 jumper in place will permanently damage unit!

### FAN BLADE SETTING DIMENSIONS

The position of the fan blade should be flush with the leaving face of the orifice plate. Check to make sure the blades do not extend beyond the rear casing of the unit. Spin the blade by hand to make sure it does not hit the ring.

### REFRIGERANT CHARGE

This unit was charged at the factory with the quantity of refrigerant listed on the serial plate. AHRI capacity and efficiency ratings were determined by testing with this refrigerant charge quantity. The pressure tables found on the following pages show nominal pressures and temperatures for the units. Since many installation specific situations can affect the pressure readings, this information should only be used by certified technicians as a guide for evaluating proper system performance. They shall not be used to adjust charge. If charge is in doubt, reclaim, evacuate and recharge the unit to the serial plate charge.

**TABLE 8  
FULL LOAD COOLING PRESSURE/TEMPERATURE**

| Model  | Return Air Temp. | Pressure              | AIR TEMPERATURE ENTERING OUTDOOR COIL °F |            |            |            |            |            |            |            |            |            |            |            |            |            |            |
|--------|------------------|-----------------------|--|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|        |                  |                       | 55°                                      | 60°        | 65°        | 70°        | 75°        | 80°        | 85°        | 90°        | 95°        | 100°       | 105°       | 110°       | 115°       | 120°       | 125°       |
| I30A1D | 75° DB<br>62° WB | Low Side<br>High Side | 117<br>202                               | 118<br>224 | 120<br>246 | 121<br>267 | 123<br>289 | 124<br>310 | 126<br>332 | 128<br>354 | 129<br>375 | 130<br>399 | 132<br>423 | 133<br>448 | 135<br>472 | 136<br>496 | 137<br>520 |
|        | 80° DB<br>67° WB | Low Side<br>High Side | 130<br>201                               | 131<br>225 | 133<br>248 | 134<br>271 | 136<br>294 | 139<br>315 | 140<br>345 | 141<br>362 | 142<br>386 | 144<br>411 | 145<br>436 | 147<br>461 | 148<br>486 | 150<br>510 | 151<br>535 |
|        | 85° DB<br>72° WB | Low Side<br>High Side | 145<br>210                               | 146<br>233 | 148<br>256 | 149<br>278 | 151<br>301 | 152<br>323 | 154<br>346 | 156<br>369 | 157<br>391 | 159<br>416 | 160<br>442 | 162<br>467 | 164<br>492 | 165<br>517 | 167<br>542 |
| I36A1D | 75° DB<br>62° WB | Low Side<br>High Side | 126<br>209                               | 127<br>231 | 129<br>252 | 130<br>274 | 131<br>295 | 132<br>317 | 134<br>338 | 135<br>360 | 136<br>381 | 137<br>405 | 138<br>429 | 139<br>452 | 141<br>476 | 142<br>500 | 143<br>524 |
|        | 80° DB<br>67° WB | Low Side<br>High Side | 139<br>208                               | 140<br>231 | 142<br>254 | 143<br>277 | 144<br>300 | 146<br>327 | 147<br>358 | 148<br>370 | 149<br>392 | 150<br>417 | 152<br>441 | 153<br>466 | 154<br>490 | 155<br>515 | 157<br>539 |
|        | 85° DB<br>72° WB | Low Side<br>High Side | 154<br>217                               | 155<br>240 | 157<br>262 | 158<br>285 | 159<br>307 | 160<br>330 | 162<br>352 | 163<br>375 | 164<br>397 | 165<br>422 | 167<br>447 | 168<br>471 | 170<br>496 | 171<br>521 | 172<br>540 |
| I42A1D | 75° DB<br>62° WB | Low Side<br>High Side | 122<br>218                               | 123<br>238 | 125<br>258 | 127<br>279 | 128<br>299 | 130<br>319 | 131<br>339 | 133<br>360 | 134<br>380 | 135<br>404 | 136<br>428 | 137<br>452 | 138<br>476 | 139<br>500 | 140<br>524 |
|        | 80° DB<br>67° WB | Low Side<br>High Side | 134<br>217                               | 136<br>239 | 138<br>260 | 139<br>282 | 141<br>304 | 142<br>326 | 144<br>355 | 146<br>369 | 147<br>391 | 148<br>416 | 149<br>440 | 150<br>465 | 151<br>490 | 152<br>514 | 153<br>539 |
|        | 85° DB<br>72° WB | Low Side<br>High Side | 139<br>226                               | 140<br>247 | 142<br>269 | 143<br>290 | 144<br>311 | 145<br>332 | 147<br>353 | 148<br>375 | 149<br>396 | 150<br>421 | 151<br>446 | 152<br>471 | 153<br>496 | 154<br>521 | 155<br>546 |
| I48A1D | 75° DB<br>62° WB | Low Side<br>High Side | 125<br>203                               | 126<br>225 | 127<br>248 | 128<br>271 | 129<br>293 | 129<br>316 | 130<br>339 | 131<br>361 | 132<br>384 | 134<br>411 | 135<br>437 | 136<br>464 | 138<br>491 | 139<br>517 | 140<br>544 |
|        | 80° DB<br>67° WB | Low Side<br>High Side | 136<br>208                               | 138<br>231 | 139<br>254 | 140<br>276 | 141<br>299 | 143<br>321 | 144<br>351 | 145<br>367 | 147<br>390 | 148<br>417 | 150<br>444 | 151<br>471 | 153<br>498 | 154<br>526 | 156<br>553 |
|        | 85° DB<br>72° WB | Low Side<br>High Side | 148<br>215                               | 149<br>238 | 151<br>261 | 153<br>284 | 154<br>307 | 156<br>331 | 158<br>354 | 159<br>377 | 161<br>400 | 162<br>428 | 164<br>456 | 166<br>484 | 167<br>512 | 169<br>539 | 171<br>567 |
| I60A1D | 75° DB<br>62° WB | Low Side<br>High Side | 123<br>218                               | 124<br>241 | 124<br>265 | 125<br>289 | 126<br>312 | 127<br>336 | 128<br>360 | 129<br>383 | 129<br>407 | 131<br>434 | 132<br>462 | 133<br>489 | 134<br>516 | 135<br>544 | 136<br>571 |
|        | 80° DB<br>67° WB | Low Side<br>High Side | 134<br>224                               | 135<br>248 | 137<br>271 | 138<br>295 | 139<br>319 | 140<br>341 | 141<br>373 | 142<br>389 | 143<br>413 | 145<br>441 | 146<br>469 | 147<br>497 | 148<br>524 | 150<br>552 | 151<br>580 |
|        | 85° DB<br>72° WB | Low Side<br>High Side | 146<br>231                               | 147<br>255 | 148<br>279 | 150<br>303 | 151<br>327 | 153<br>352 | 154<br>376 | 156<br>400 | 157<br>424 | 159<br>453 | 160<br>481 | 161<br>510 | 163<br>538 | 164<br>567 | 166<br>595 |

**TABLE 9  
PART LOAD COOLING PRESSURE/TEMPERATURE**

| Model  | Return Air Temp. | Pressure  | AIR TEMPERATURE ENTERING OUTDOOR COIL °F |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|--------|------------------|-----------|--|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
|        |                  |           | 55°                                      | 60° | 65° | 70° | 75° | 80° | 85° | 90° | 95° | 100° | 105° | 110° | 115° | 120° | 125° |
| I30A1D | 75° DB<br>62° WB | Low Side  | 127                                      | 128 | 129 | 129 | 130 | 131 | 132 | 133 | 134 | 135  | 137  | 138  | 140  | 141  | 143  |
|        |                  | High Side | 184                                      | 206 | 227 | 249 | 270 | 292 | 313 | 334 | 356 | 380  | 403  | 427  | 451  | 475  | 498  |
|        | 80° DB<br>67° WB | Low Side  | 141                                      | 141 | 142 | 143 | 143 | 144 | 144 | 145 | 146 | 147  | 149  | 151  | 152  | 154  | 156  |
|        |                  | High Side | 187                                      | 209 | 231 | 252 | 274 | 293 | 322 | 338 | 361 | 385  | 409  | 433  | 457  | 481  | 505  |
|        | 85° DB<br>72° WB | Low Side  | 154                                      | 154 | 155 | 156 | 156 | 157 | 157 | 158 | 159 | 161  | 162  | 164  | 166  | 168  | 170  |
|        |                  | High Side | 194                                      | 216 | 237 | 259 | 280 | 302 | 323 | 344 | 366 | 390  | 415  | 439  | 464  | 488  | 512  |
| I36A1D | 75° DB<br>62° WB | Low Side  | 131                                      | 133 | 134 | 136 | 137 | 139 | 140 | 142 | 143 | 144  | 145  | 146  | 148  | 149  | 150  |
|        |                  | High Side | 188                                      | 209 | 230 | 250 | 271 | 292 | 313 | 333 | 354 | 378  | 403  | 427  | 452  | 476  | 500  |
|        | 80° DB<br>67° WB | Low Side  | 145                                      | 146 | 148 | 149 | 150 | 152 | 153 | 154 | 155 | 156  | 158  | 159  | 160  | 161  | 163  |
|        |                  | High Side | 191                                      | 212 | 233 | 254 | 275 | 295 | 323 | 338 | 359 | 384  | 409  | 433  | 458  | 483  | 508  |
|        | 85° DB<br>72° WB | Low Side  | 158                                      | 159 | 161 | 162 | 163 | 164 | 166 | 167 | 168 | 169  | 171  | 172  | 173  | 175  | 176  |
|        |                  | High Side | 198                                      | 219 | 240 | 260 | 281 | 302 | 323 | 343 | 364 | 389  | 414  | 439  | 464  | 489  | 515  |
| I42A1D | 75° DB<br>62° WB | Low Side  | 126                                      | 128 | 130 | 132 | 134 | 136 | 138 | 139 | 141 | 142  | 143  | 144  | 145  | 146  | 147  |
|        |                  | High Side | 192                                      | 212 | 233 | 253 | 274 | 294 | 315 | 335 | 356 | 379  | 402  | 426  | 449  | 472  | 496  |
|        | 80° DB<br>67° WB | Low Side  | 140                                      | 141 | 143 | 145 | 146 | 148 | 150 | 151 | 153 | 154  | 155  | 156  | 157  | 158  | 159  |
|        |                  | High Side | 195                                      | 216 | 236 | 257 | 278 | 299 | 326 | 340 | 361 | 384  | 408  | 432  | 455  | 479  | 503  |
|        | 85° DB<br>72° WB | Low Side  | 144                                      | 145 | 147 | 148 | 150 | 151 | 152 | 154 | 155 | 156  | 157  | 158  | 159  | 160  | 161  |
|        |                  | High Side | 202                                      | 223 | 243 | 264 | 284 | 304 | 325 | 345 | 366 | 390  | 414  | 438  | 462  | 486  | 510  |
| I48A1D | 75° DB<br>62° WB | Low Side  | 129                                      | 130 | 131 | 132 | 133 | 133 | 134 | 135 | 136 | 137  | 139  | 140  | 142  | 143  | 144  |
|        |                  | High Side | 183                                      | 205 | 226 | 248 | 269 | 291 | 313 | 334 | 356 | 381  | 407  | 432  | 458  | 484  | 509  |
|        | 80° DB<br>67° WB | Low Side  | 140                                      | 141 | 142 | 144 | 145 | 146 | 148 | 149 | 151 | 152  | 154  | 155  | 157  | 158  | 160  |
|        |                  | High Side | 187                                      | 209 | 230 | 252 | 274 | 295 | 324 | 339 | 361 | 387  | 413  | 439  | 465  | 491  | 517  |
|        | 85° DB<br>72° WB | Low Side  | 154                                      | 155 | 157 | 158 | 160 | 161 | 162 | 164 | 165 | 167  | 168  | 170  | 172  | 173  | 175  |
|        |                  | High Side | 189                                      | 212 | 234 | 257 | 280 | 303 | 325 | 348 | 371 | 397  | 424  | 451  | 477  | 504  | 530  |
| I60A1D | 75° DB<br>62° WB | Low Side  | 127                                      | 127 | 128 | 128 | 129 | 130 | 130 | 131 | 131 | 133  | 134  | 135  | 136  | 137  | 139  |
|        |                  | High Side | 196                                      | 218 | 240 | 261 | 283 | 305 | 326 | 348 | 370 | 396  | 422  | 448  | 474  | 500  | 526  |
|        | 80° DB<br>67° WB | Low Side  | 137                                      | 138 | 139 | 140 | 142 | 142 | 143 | 144 | 146 | 147  | 148  | 150  | 151  | 152  | 154  |
|        |                  | High Side | 200                                      | 222 | 244 | 266 | 288 | 310 | 339 | 353 | 375 | 402  | 428  | 454  | 481  | 507  | 534  |
|        | 85° DB<br>72° WB | Low Side  | 152                                      | 153 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 161  | 162  | 164  | 165  | 167  | 168  |
|        |                  | High Side | 203                                      | 226 | 249 | 271 | 294 | 317 | 340 | 363 | 385 | 412  | 440  | 467  | 494  | 521  | 548  |