



**INDOOR OR OUTDOOR,
GAS, DIRECT-FIRED,
MAKEUP AIR/
HEATING SYSTEMS**

(Specifications subject to change without notice.)

REZNOR *Thomas & Betts*

Installation Form RGM 443

Applies to:

Model DFA

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Reference: Operating/Maintenance/Service Manual, Form RGM 443-OMS

FOR YOUR SAFETY

WARNING: The use and storage of gasoline or other flammable vapors and liquids in the vicinity of this appliance is hazardous.

If you smell gas:

- 1. Open windows.**
- 2. Don't touch electrical switches.**
- 3. Extinguish any open flame.**
- 4. Immediately call your gas supplier.**

WARNING: Improper installation, adjustment, alteration, service, or maintenance can cause property damage, injury or death. Read the installation, operation, and maintenance instructions thoroughly before installing or servicing this equipment.

WARNING: Gas-fired appliances are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, or atmospheres containing chlorinated or halogenated hydrocarbons. See Hazard Levels, page 3.

WARNING: On makeup air heaters which also recirculate room air, outside ventilation air must be provided.

Recirculation of room air may be hazardous in the presence of:

- (a) Flammable solids, liquids, and gases;**
- (b) Explosive materials; or**
- (c) Substances which may become toxic when exposed to heat.**

General Description

The information in this manual applies to base Model DFA direct-fired makeup air heating systems. Model designations including an "H" are constructed in a horizontal burner/blower configuration and are available in either horizontal or vertical discharge. Model designations including a "V" are constructed in a vertical burner/blower configuration and are available with top level horizontal discharge only.

These systems consist of a direct-fired, natural gas-fueled burner and a draw-through blower housed in a weatherized cabinet. The systems may be installed either indoors or outdoors.

This direct-fired makeup air system provides tempered makeup air. **Makeup air is defined as air that enters a building or area due to negative pressure created by an air exhaust load in excess of the volume of entering air.** This system warms the outside air and monitors the volume and temperature of the makeup air added to the building. The system may be used to provide ventilation in whole building or in spot applications. In whole building applications, adding con-

General Description (cont'd)

trolled makeup air will cause less infiltration of dust and dirt; will eliminate continuous backdraft in chimneys and vents; and will reduce space heating fuel costs.

This system is available with various air control options to meet a wide range of application requirements. Depending on the air control option ordered, the supply air volume may be varied or the outside air may be supplemented with building air (recirculation) for increased energy savings.

These systems are design-certified to ANSI Standards by the American Gas Association and are approved by the Canadian Gas Association. In order to retain certification, the installer must adhere to the installation and operation requirements in the instruction manual. These direct-fired makeup air systems are not approved for residential use.

1. Installation Codes/Requirements

Installation should be done by a qualified agency in accordance with the instructions in this manual and in compliance with all codes and requirements of authorities having jurisdiction. The qualified agency installing this system is responsible for the installation.

In the United States, this direct-fired makeup air system must be installed in accordance with the standards of the National Fire Protection Association, the National Fuel Gas Code, and all local authorities having jurisdiction. The National Fuel Gas Code ANSI Z223.1A (latest edition) is available from the American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209.

In Canada, installation must be in accordance with CAN1-B149 and B149.2, Canadian Installation Code for Gas Burning Appliances and Equipment. Canadian Codes are available from the Standards Department, Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ontario M3B 2R3.

Before installation, always consult authorities having local jurisdiction to verify that local codes and procedures are being followed.

The building should always provide adequate relief for the heater to operate at its rated capacity. It should be noted that this can be accomplished by taking into account, through standard engineering methods, the structure's designed infiltration rate; by providing properly sized relief openings; by interlocking a powered exhaust system; or by a combination of these methods. **Excessive recirculation or insufficient ventilation air which results in inadequate dilution of the combustion products generated by the heater may create hazardous concentrations of carbon dioxide, carbon monoxide, nitrogen dioxide, and other combustion products into the heated space.**

If the failure or malfunction of this heater creates a hazard to other fuel burning equipment in the building, interlock the system to open inlet dampers or other such devices.

Recirculation Requirements - Do not install a system with optional recirculation (building air) in the presence of flammable solids, liquids, and gases; explosive materials (i.e., grain dust, coal dust, gun powder, etc.); or substances which may become toxic when exposed to heat (i.e. refrigerants, aerosols, etc.). If a system with recirculation is being installed in an area where propane fork trucks or other fossil fuel powered equipment are used, the ventilation requirements for that equipment **must** be met. Recirculation is not recommended in uninsulated buildings where outside temperatures fall below 32°F.

If in doubt regarding an application, consult the heater manufacturer's representative before installation.

Codes for Special Installations: (1) Aircraft Hangar -- Installation in an aircraft hangar must be in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409 (latest edition); (2) Public Garage -- Installation in a public garage must be in accordance with the Standard for Parking Structures, ANSI/NFPA 88A (latest edition) or the Standard for Repair Garages, ANSI/NFPA 88B (latest edition).

2. Warranty

Refer to the limited warranty information on the warranty card included in the "Owner's Envelope".



DANGER: The gas burner in this direct gas-fired system is designed and equipped to provide safe and economically controlled complete combustion. However, if the installation does not permit the burner to receive the proper supply of combustion air, complete combustion may not occur. The result is incomplete combustion which produces carbon monoxide, a poisonous gas that can cause death.

Always comply with the combustion air requirements in the installation codes and operating instructions. The amount of air over the burner must be within the specified range. The burner profile plates are set at the factory to match CFM requirements. Do not adjust the burner profile plates without contacting the factory. FAILURE TO PROVIDE PROPER COMBUSTION AIR CAN RESULT IN A HEALTH HAZARD WHICH CAN CAUSE PROPERTY DAMAGE, SERIOUS INJURY, AND/OR DEATH. Direct-fired installations should provide for air changes as required by the applicable installation codes.

HAZARD INTENSITY LEVELS

1. **DANGER:** Failure to comply will result in severe personal injury or death and/or property damage.
2. **WARNING:** Failure to comply could result in severe personal injury or death and/or property damage.
3. **CAUTION:** Failure to comply could result in minor personal injury and/or property damage.

3. Technical Data

Technical Data Table							
Models		218	220	225	227	230	233
MBH Input	Minimum	250	250	500	500	750	750
	Maximum	2500	3500	5250	6250	7250	9500
CFM	Minimum	10,000	16,000	20,000	24,000	32,000	38,000
	Maximum	19,000	28,000	45,000	52,000	62,000	75,000
HP	Minimum	5	7.5	7.5	7.5	10	15
	Maximum	25	30	40	50	60	75
Blower Size (twin) - Class 2		18 x 13	20 x 15	25 x 20	27 x 20	30 x 25	33 x 27
Maximum Temperature Rise (°F)		115	115	115	115	115	115
Maximum Discharge Temperature (°F)		160	160	160	160	160	160
Maximum Supply Gas Pressure		5 psi					

4. Uncrating/Preparation

Immediately upon uncrating the unit, check the gas specifications and electrical voltage (system rating plate is in the control compartment) to be sure that they agree with the supply at the installation site. Check for any damage that may have been incurred during shipment. If damage is found, file a claim with the transporting agency. The system was inspected at the factory immediately prior to crating.

Horizontal configuration systems (Refer to Figure 1, page 4) are shipped in two sections and include the necessary components to join the sections. Shipped inside the cabinet, find:

- ⇒ hardware (bolts, nuts and screws) for joining sections
- ⇒ two "L" shaped cabinet top edge pieces
- ⇒ two caps to cover the side seams joining the two sections
- ⇒ cement and caulking for sealing the rubber top (**CAUTION:** Cement and caulking must be stored at room temperature. Comply with all label warnings.)

Vertical configuration systems (Refer to Figure 2, page 5) are shipped in two cabinet sections plus a 4-ft high, structural steel base with expanded metal sides for inlet air. Shipped with the unit find:

- ⇒ four trim pieces with four screws each to cover section joints
- ⇒ specially designed filter hook for reaching filters to service

Both Horizontal and Vertical Configurations - The following control parts are shipped loose inside the unit:

- ⇒ a discharge air temperature sensor (except units with Option AG37)
- ⇒ a disconnect switch (C.G.A. only; optional selection on A.G.A.)
- ⇒ a 3-position control switch (except units with Option AG37) **NOTE:** If an optional remote console is ordered, this switch is mounted on the console; the console is shipped separately.

Depending on the gas and/or air controls selected, the following additional parts are shipped loose inside the unit.

Gas Controls	<u>Shipped-Loose Parts</u>
Option AG30	*Remote Temperature Selector
Option AG31	Space Override Thermostat
Option AG32	*Remote Temperature Selector
Option AG33	Remote Temperature Selector
Option AG35	*Remote Temperature Selector
Option AG36	Remote Console
Option AG37	None
Air Controls	<u>Shipped-Loose Parts</u>
Option AR21	None
Option AR19	*Potentiometer
Option AR20	Remote Pressure Sensor
Option AR22	*Potentiometer
Option AR23	Remote Pressure Sensor

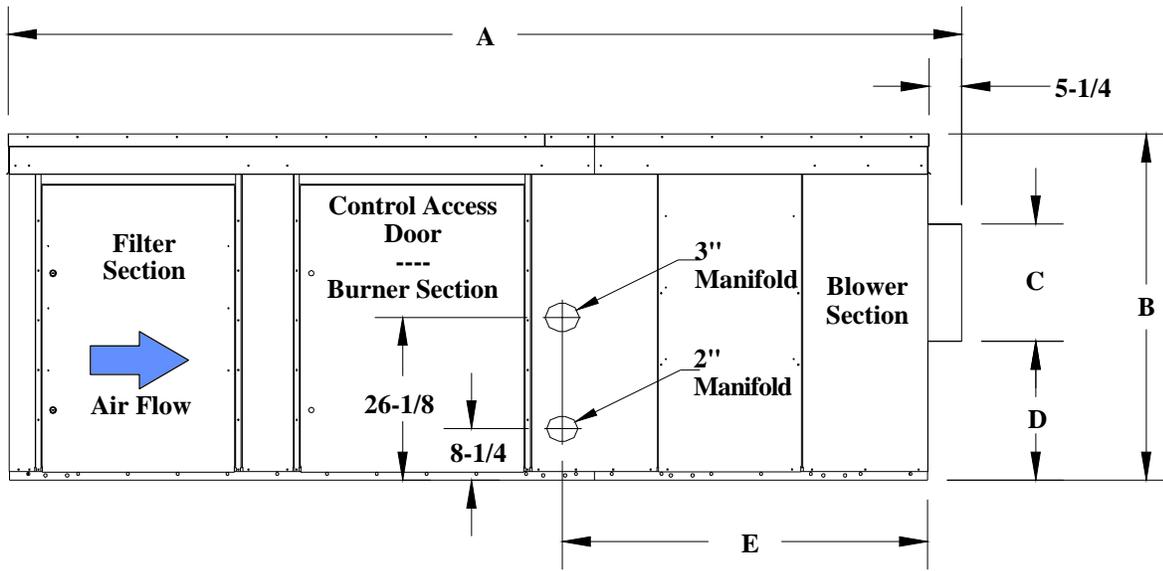
*If an optional remote console is ordered, these controls are mounted on the console. The console is shipped separately.

Be sure that all shipped-separate accessories for the installation are available. Shipped-separate accessories could include a roof curb, an outside air inlet storm hood, a service platform, discharge cowling, a disconnect switch, or a door switch.

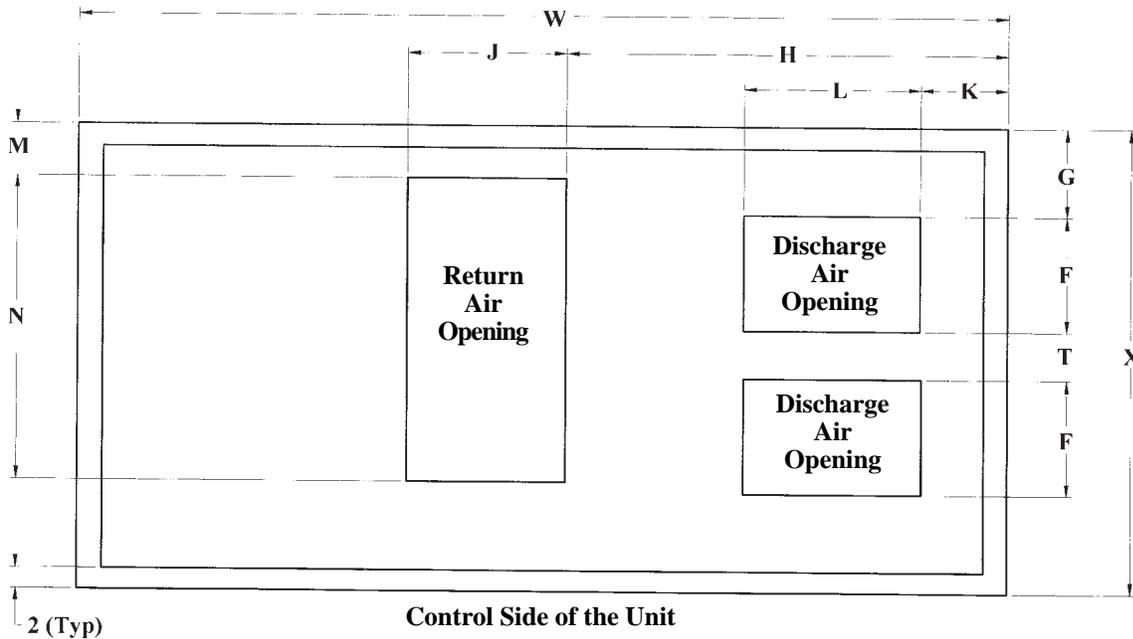
Be sure that all necessary equipment, tools, and manpower are available at the installation site.

5. Dimensions

Figure 1 - Horizontal Configuration Systems with Horizontal Inlet and either Vertical or Horizontal Discharge

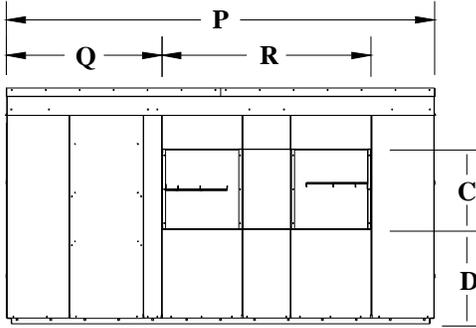


Side View

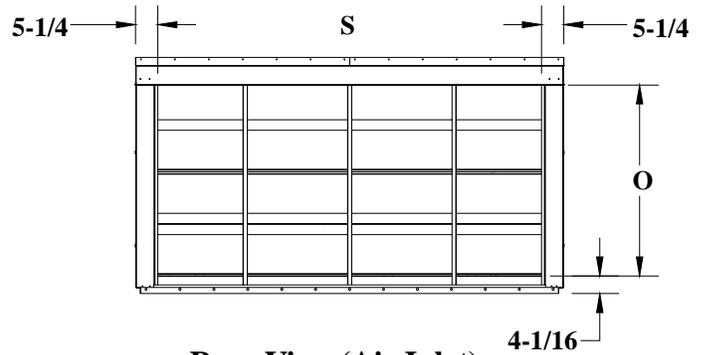


W and X are outside dimensions of the unit curb cap.

View Looking Down Into the Roof Opening



Front View (Discharge)



Rear View (Air Inlet)

Dimension Table (inches $\pm 1/16''$) - Horizontal Configuration System

Size	A	B	C	D	E	F	G	H	J	K	L
218	153-1/4	55-11/16	18-7/8	22-1/4	58-11/16	17-3/8	14-1/2	71-5/8	12-7/8	27-3/16	18-7/8
220	153-1/4	55-11/16	24-3/4	22-7/8	58-11/16	19-3/4	31-3/4	71-5/8	12-7/8	21-5/16	24-3/4
225	158-3/4	87-1/4	31-1/4	29-1/8	64-1/4	26-1/4	11-3/4	62	28	15-1/2	31-1/4
227	158-3/4	87-1/4	34-5/16	30-3/4	64-1/4	26-3/4	10-3/4	62	28	12-1/2	34-1/4
230	158-3/4	87-1/4	36-3/4	32-1/2	64-1/4	31-3/4	21-1/4	62	28	16-11/16	36-3/4
233	158-3/4	87-1/4	43	30-1/2	64-1/4	34-1/4	13-3/4	62	28	10-1/2	42-15/16

Size	M	N	O	P	Q	R	S	T	W	X
218	6-3/4	68	45-1/16	101	36-5/8	49-1/4	90-1/2	13	145-1/2	98-1/2
220	6-3/4	92	45-1/16	125	36-3/16	56-1/8	114-1/2	15	145-1/2	122-1/2
225	10-3/4	76	76-5/8	126-1/2	40-1/4	74	116	20	151	124
227	10-3/4	76	76-5/8	126-1/2	40-1/4	75	116	20	151	124
230	10-3/4	112	76-5/8	162-1/2	50-3/4	90	152	25	151	160
233	10-3/4	112	76-5/8	162-1/2	50-5/8	97-1/8	152	27-1/2	151	160

Dimensions of Duct Openings

Horizontal Discharge C x R

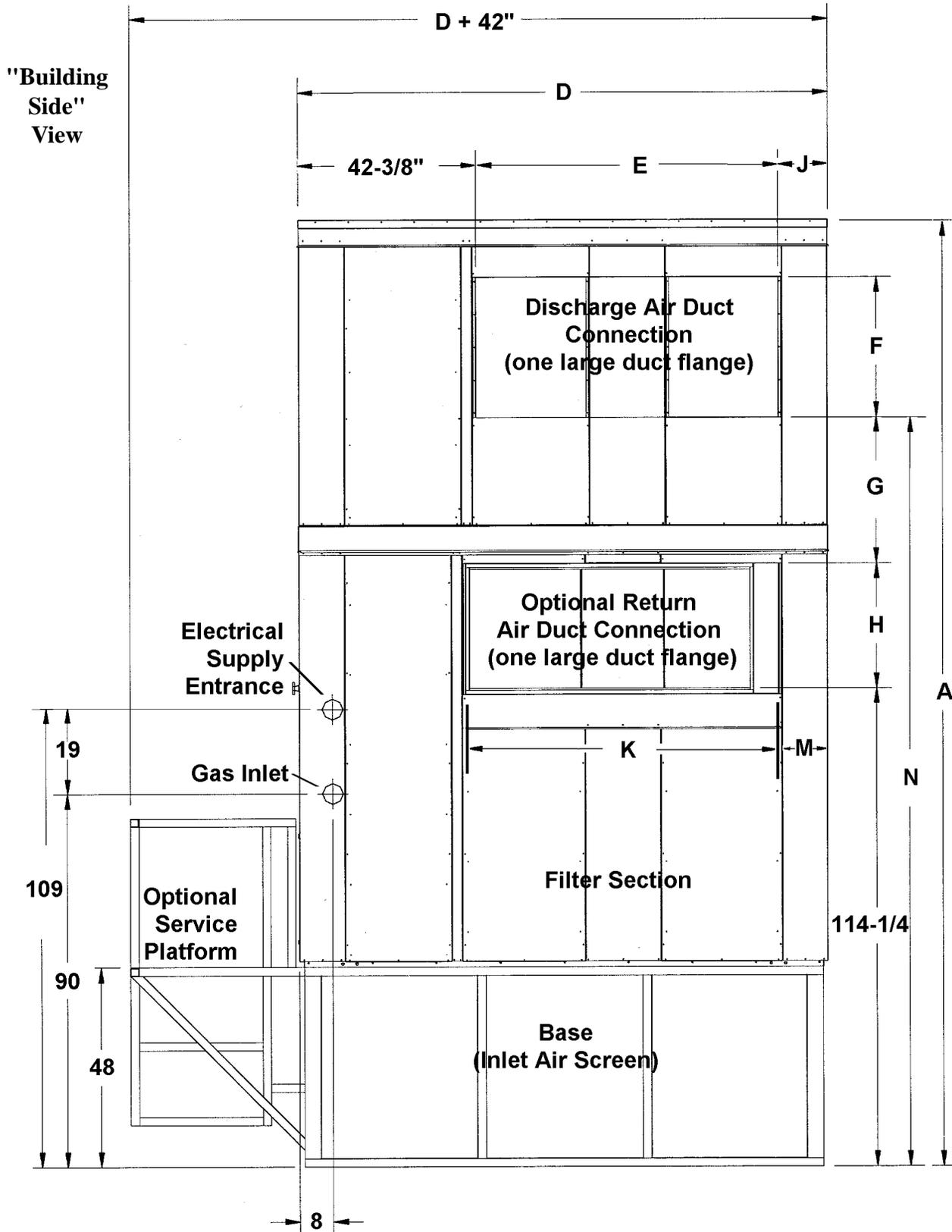
Optional Vertical Discharge (2) F x L

Horizontal Outside Air Inlet O x S

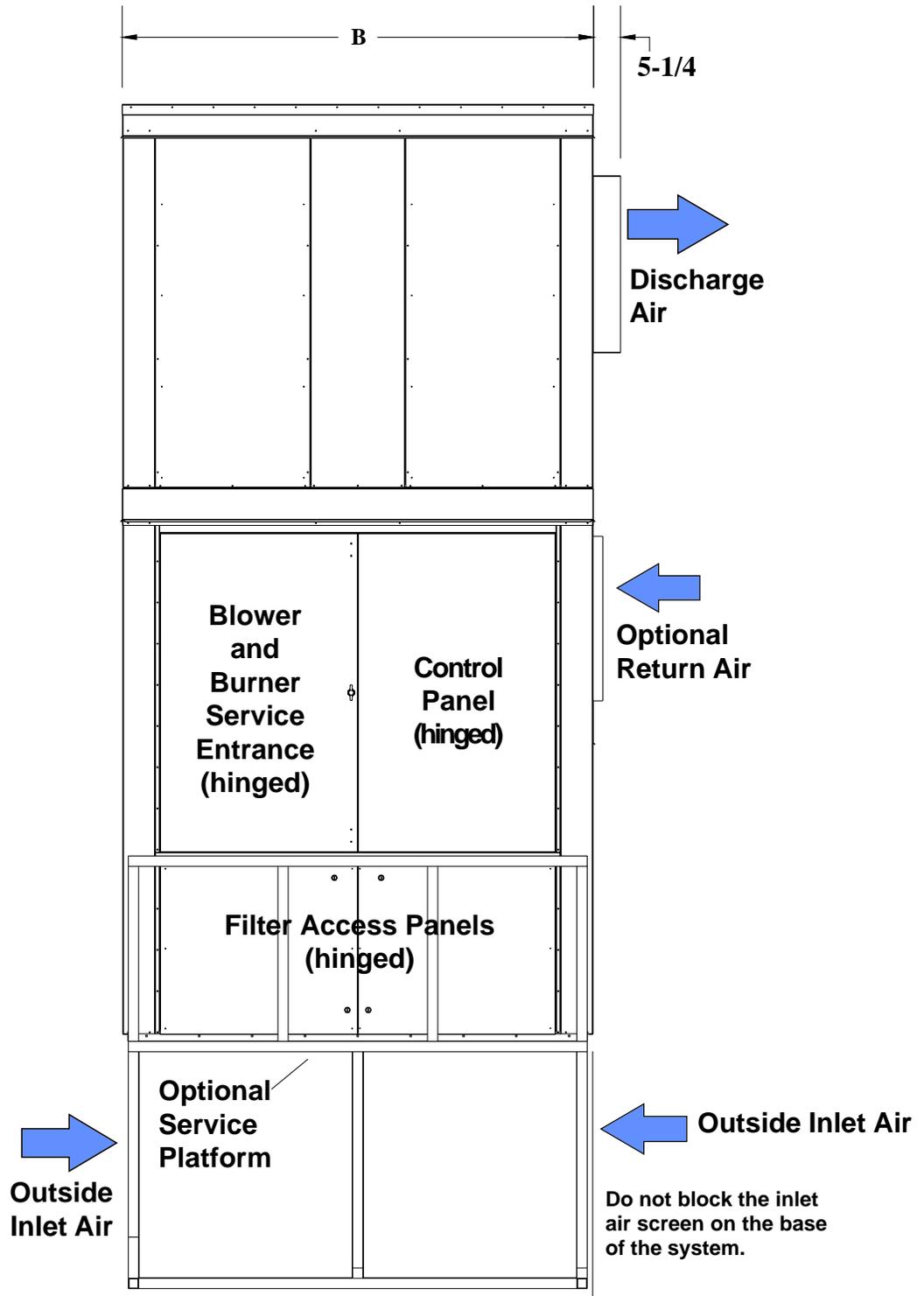
Optional Return Air Inlet J x N

5. Dimensions (cont'd)

Figure 2 -Vertical Configuration Systems with Structural Steel Base for Air Inlet and Horizontal, Top Level Discharge



**Control
Side View**



Dimension Table (inches ±1/2") - Vertical Configuration System

Size	A	B	D	E	F	G	H	J	K	M	N	Dimensions of Duct Openings	
218	210	61-1/2	122-1/2	49-1/4	18-7/8	45-9/16	16-3/4	31-5/8	68	13-7/8	176-9/16	Horizontal Discharge	E x F
220	210	61-1/2	146-1/2	56-1/8	24-3/4	46-3/16	16-3/4	49	92	13-7/8	177-3/16	Optional Return Air Inlet	K x H
225	230	91-1/2	128-1/2	74	31-1/4	33-1/4	31-7/8	13	76	11-7/8	179-3/8		
227	230	91-1/2	128-1/2	75	34-1/4	35-11/16	31-7/8	12	76	11-7/8	181-13/16		
230	230	91-1/2	164-1/2	90	36-3/4	34-5/8	31-7/8	33	112	11-7/8	180-3/4		
233	230	91-1/2	164-1/2	97-1/8	43	32-5/8	31-7/8	25-1/2	112	11-7/8	178-3/4		

6. Clearances - All Models and Sizes

Clearances (inches)				
Configuration	Top	Control Side	Side Opposite Controls	Bottom
Horizontal	0	As needed for service.	0	0
Vertical	0		0	0

In order to service the system, the minimum clearance on the control side of the unit must be equal to the width of the unit.

7. Rigging

All cabinets are shipped in two sections. Each cabinet section is furnished with four lifting lugs for attaching rigging. To prevent damage to the cabinet, use spreader bars with the rigging chains. Vertical configuration units include a 4-ft high structural steel base section; horizontal configuration units are constructed on a curb cap structural steel base.

IMPORTANT INSTALLATION NOTE for Horizontal Configuration Systems: It is recommended that the sections of a horizontal configuration system be attached *after* being placed on the curb or mounting rails. If it is necessary to connect the sections before lifting, use all eight lifting lugs to raise the unit. **Do not attempt to lift the assembled unit using only four lifting lugs.**

8. Mounting

Mounting is the responsibility of the installer. Verify that the supporting structure has sufficient load-carrying capacity to support the weight.

Net Weight (lbs) of Basic System including Cabinet, Blowers, and Angle Iron Base (Vertical System)						
Size	218	220	225	227	230	233
Horizontal	2220	2560	3700	3870	4850	5050
Vertical	2620	2960	4300	4470	5650	5850

NOTE: Net weights are approximate for the standard cabinet, blowers, and base. **Burners, motors, and optional equipment can add substantial weight and must be added to the figure in the table.**

Depending on the building and its use, determine whether or not additional field measures should be taken to reduce the effect of blower vibration and/or noise.

When selecting a location for an outdoor installation, position the unit so that the air inlet will **NOT** be facing into the prevailing wind.

Prior to installation, be sure that the method of support is in agreement with all local building codes. For both indoor and outdoor installations, check for service platform requirements.

8A. Mounting a Vertical Configuration System (See Figure 2, page 6)

Before rigging and lifting the sections, determine the correct "stacking" direction.

- **First**, position the structural steel base.
- **Second**, lift the burner section and place it over the "pins" on the corners of the base.
- **Last**, lift the blower section and place it over the "pins" extending up from the corners of the burner section.

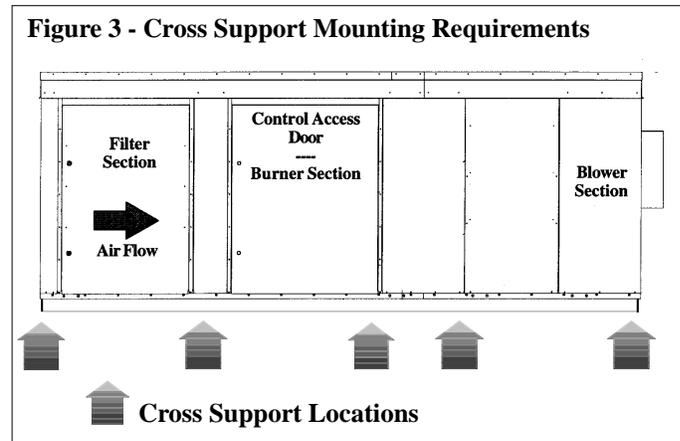
8B. Mounting a Horizontal Configuration System

The horizontal system is equipped with a load-bearing structural steel base which forms an integral part of the unit. The structural steel base provides a flat surface suitable for slab mounting. If the specification requires curb mounting, an angle is factory-welded to the base so that the system will fit over the curb.

IMPORTANT INSTALLATION NOTE for Horizontal Configuration Systems: It is recommended that the sections of a horizontal configuration system be attached *after* being placed on the roof or slab. If it is necessary to connect the sections before lifting, use all eight lifting lugs to raise the unit. **Do not attempt to lift the assembled unit using only four lifting lugs.**

Mounting on a Slab or Cross Supports

If the system is being slab or surface mounted, no additional supports are required. Lift and position the two cabinet sections onto the flat surface. If cross supports are required, position them as illustrated in Figure 3.



Mounting on a Roof Curb

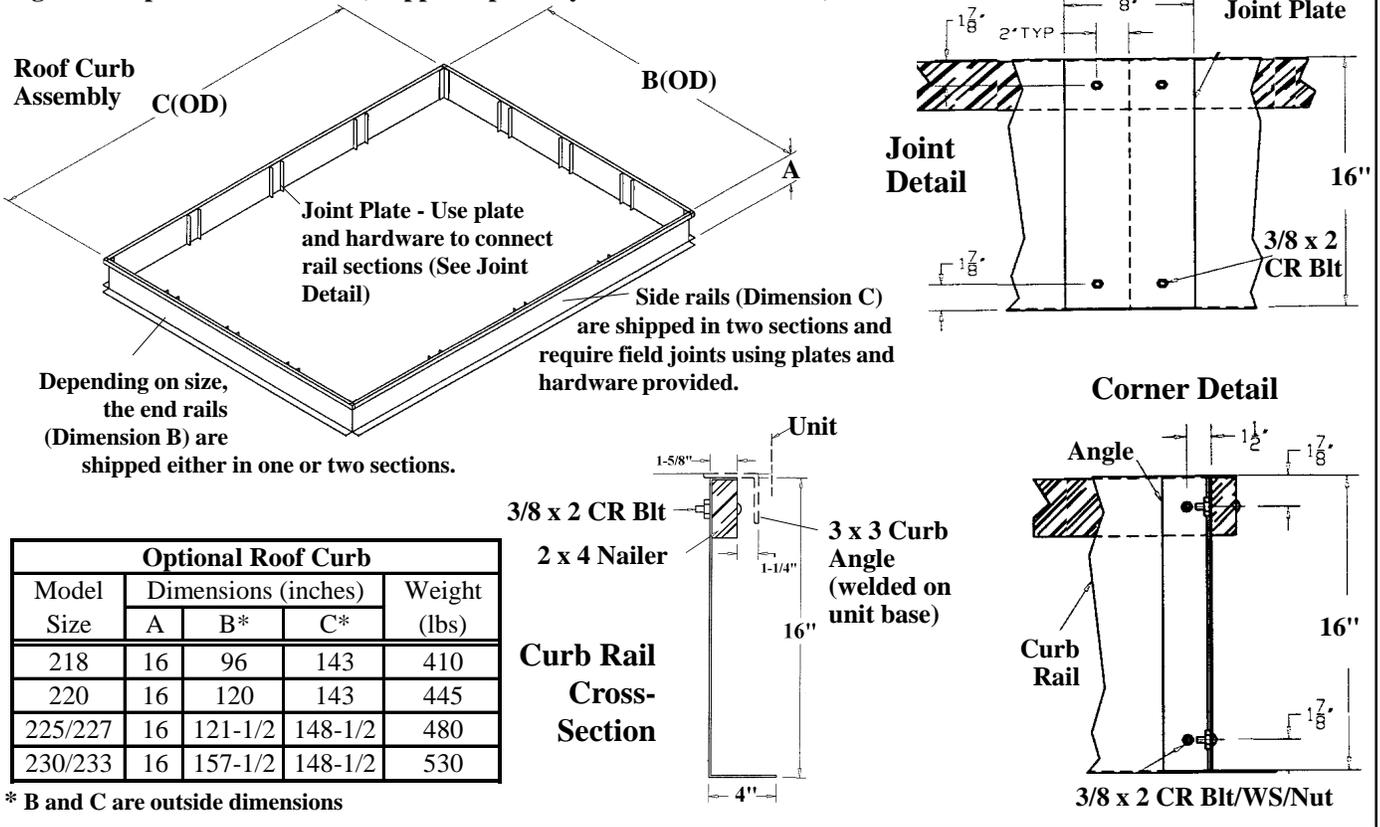
Before assembly, re-check to be sure that the correct curb has been ordered. Be sure that the curb selected matches the unit ordered. Verify the dimensions of the curb received with the curb dimension table, Figure 4.

Installation Instructions for 16" Optional Roof Curb (Option CJ3) - Refer to Figure 4

NOTE: Curb rail sections, joint plates, and hardware for assembling curb are provided. Insulation and flashing are field supplied.

1. Depending on the size of the system, the curb side rails are shipped in six or eight sections (the side rails are always in two pieces; the end rails are either in one or two pieces). Check the dimensions and select the sections to be joined. Join the sections using the joint plates and hardware provided (see Curb Joint detail in Figure 4).
2. With the rail sections joined, position the curb cross rails and the curb side rails as shown in the assembly drawing in Figure 4.
3. Refer to the Corner Detail illustration in Figure 4 and fasten corners.
4. Level the roof curb. To ensure a good weatherproof seal between the curb cap and the roof curb, the roof curb must be leveled in both directions with no twist end to end. Shim as required and secure curb to roof deck before installing flashing.
5. Install field-supplied flashing.

Figure 4 - Optional Roof Curb (Shipped separately to be field assembled)



9. Mechanically Connect the Cabinet Sections

9A. Connect the Sections of a Horizontal System

Supplies provided:

- Bolts, nuts and washers to attach cabinet sections
- Cabinet top angles
- Cabinet side covers
- Splice cleaner
- Quart of cement for the rubber top
- Caulking for rubber top

WARNING: Store EPDM® cement and caulking at room temperature. Adhere to all label warnings including, "Contains ingredients which can be toxic and are extremely flammable. Use only in ventilated areas. Inhalation can cause dizziness, drowsiness and upper respiratory irritation."

Tools/Supplies required:

- Two 9/16" wrenches (or equivalent tools)
- Clean, non-linting, natural fiber rag or scrubbing pad (do not use rag made of synthetic fibers such as polyester or rayon)
- Warm water with low sudsing soap (when surface is extremely dirty)
- Stirrer for the cement
- 3" medium nap paint roller or 3" or 4" wide 1/2" thick brush
- 2" wide steel hand roller

Instructions:

- 1) Using the hardware provided, attach the cabinet sections across the bottom and up each side. Fasten securely.
- 2) Lap, Clean, and Cement the Rubber Top
 - a) The rubber roof sections overlap by approximately eight inches.

Position the extended lap over the edge of the adjoining section. Turn the flap back exposing the two surfaces to be cemented.

- b) Clean the exposed surfaces. If the surfaces have heavy accumulations of dirt or other contaminants, wash them first with warm water and a low sudsing soap.

Using a clean, non-linting, natural fiber rag or scrubbing pad, clean the surfaces with the SPM® Splice Cleaner. Particular attention should be given to cleaning the factory splices in the membrane, since release agent (the powdery substance put on the rubber during manufacturing to allow it to be released from the mold and to be rolled without sticking) tends to accumulate in this area during the manufacturing process. Scrub the cleaner into the factory splice in the direction of the splice to remove all traces of the release agent. Turn the cleaning rags frequently and replace them often to assure any release agent and dirt are removed. Allow the surface to dry before applying cement.

- c) Open the cement and thoroughly stir, scraping the sides and bottom of the container until the adhesive has a solid black appearance and has an even consistency. A minimum of five minutes of stirring is recommended. Do not thin the adhesive.

- d) Using a roller or brush, apply the lap cement to both surfaces. Apply an even, heavy coat of adhesive to each bonding surface, avoiding blobs and puddles. Do not apply cement to any more of the mating surfaces than can be joined together when the cement is properly set-up.



- e) Allow the adhesive to dry until it is slightly tacky and does not string or stick when touched with a dry finger. Test by pushing your finger across the surface of the cement to check for "skinning" of the cement. If the surface skin can be moved over the wet splicing cement underneath, allow the cement to dry longer. Once there is no surface movement during this "push test", the seam is ready to be spliced. **Do not mate surfaces while adhesive is wet.**

9A. Connect the Horizontal System (cont'd)

Typical time between application of adhesive and mating of surfaces will be about 30 minutes or less. Actual time will be depend on the ambient conditions.

When cement is ready, carefully "roll" the top overlapping piece along the entire length of the lap allowing it to fall freely into place. Apply hand pressure immediately to bring mating surfaces into complete contact over the entire area of the lap. Avoid stretching; it is important to avoid inducing any stress into the splice. In order to remove trapped air, roll diagonally with a 2" wide steel hand roller. Roll diagonally; do not roll parallel to the lap.



f) Allow the seam to age for a minimum of two hours. Clean an area approximately one inch on either side of the exposed edge of the splice. Apply a generous bead of SPM® Lap Caulk along the exposed edge of the splice, making sure to contact the top surface of both sheets, entirely covering the exposed edge. If necessary use a forming tool to smooth the bead but do not flatten it or wipe it off.

- 3) Position the metal side panel joint covers and attach with sheetmetal screws. Along the edges of the top of the cabinet, attach the two "L" pieces to fill the "gaps" in the cabinet top edge. Use the screws provided.

9B. Connect the Sections of a Vertical System

Each section of a vertical system is designed to fit over the "pins" extending from the section below it. Four trim pieces are shipped separately with each vertical unit to cover the horizontal joints between the blower section and the burner/control section. Position each trim piece and attach with the screws provided. Each piece requires four self-drilling screws.

10. Electrical Supply and Connections

All electrical wiring and connections including electrical grounding must be in accordance with the National Electric Code ANSI/NFPA No. 70 (latest edition) or the Canadian Electrical Code Part 1-C.S.A. Standard C22.1. Check any local ordinances or utility company requirements that apply.

Supply Wire Size - with temperature rating of 75°C (167°F); based on ambient air temperature of 30°C (86°F)												
Full Load Amps	20	25	35	50	65	85	100	115	130	150	175	200
Wire Gauge	14	12	10	8	6	4	3	2	1	1/0	2/0	3/0

Run a separate line voltage supply directly from the building electrical panel to the disconnect switch for the system. All external wiring must be within approved conduit and have a minimum temperature rise rating of 63°F. For motor load amps, see Paragraph 13 or check the motor nameplate.

Specific wiring diagrams and complete instructions are packed with each unit and should be kept readily accessible in legible condition.

Disconnect Switch

A safety disconnect is required. Install either an optional disconnect or a field-supplied disconnect. (NOTE: Systems with an C.G.A. label include a disconnect switch.) Refer to Figure 8 for recommended location and install the disconnect switch in accordance with Article 430 of the National Electrical Code ANSI/NFPA 70. When attaching the disconnect switch to the heater, use hardware with "teeth" to provide electrical grounding. The "teeth" should face the disconnect switch, scratching off the painted surface. Attach the disconnect tightly against the heater cabinet.

Control Wiring

Refer to Figure 8 for location of control wiring connections. Low voltage wiring must be in individual conduit, separated from primary high voltage wiring.

Control Wiring	Volts	Wire Gauge	Total Wire Length	Distance from Unit to Control
Maximum	24	18	150 ft	75 ft
Lengths	24	16	250 ft	125 ft
	24	14	350 ft	175 ft

CAUTION: Supply voltage and 24-volt control wiring cannot be installed in the same conduit. Maxitrol systems will be adversely affected if control wiring is in conduit with supply voltage wiring.

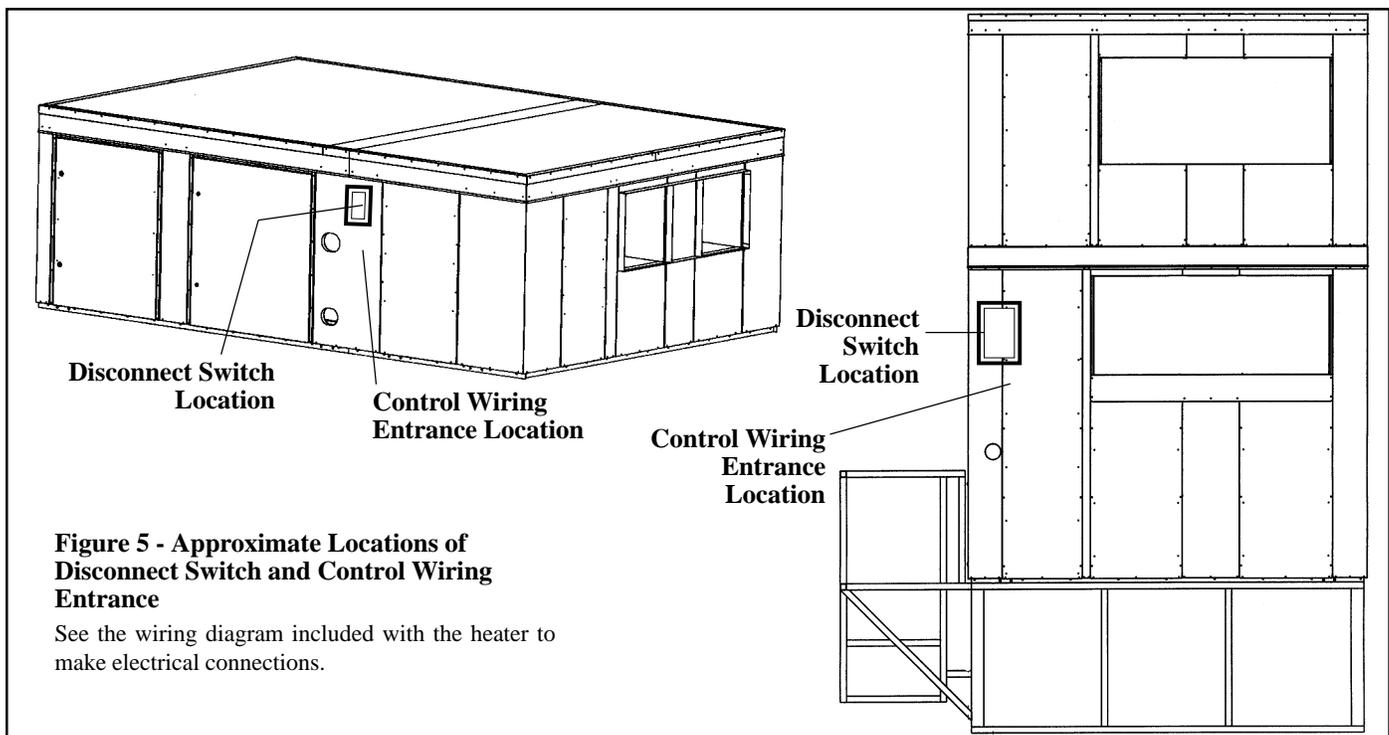


Figure 5 - Approximate Locations of Disconnect Switch and Control Wiring Entrance

See the wiring diagram included with the heater to make electrical connections.

Figure 6 - Technical Data of the Optional Remote Console - Applies to both Options RC13 and RC14 (Variations depend on options selected; consult custom wiring diagram for controls and to determine wiring required.)

Control Switch	Qty of Lights*	Temperature Selector**	Potentiometer ***	Dimensions (inches)			Locations of Knockout Holes (dimensions to centerlines of holes)
				L****	H****	D	
Yes	3	Yes	No	10-3/4	5-1/4	2-5/8	
Yes	3	No	No	10-3/4	5-1/4	2-5/8	
Yes	3	Yes	Yes	15-3/4	5-1/4	2-5/8	
Yes	3	No	Yes	10-3/4	5-1/4	2-5/8	
Yes	4	Yes	No	15-3/4	5-1/4	2-5/8	
Yes	4	No	Yes	15-3/4	5-1/4	2-5/8	
Yes	4	Yes	Yes	15-3/4	5-1/4	2-5/8	
Yes	4	No	No	15-3/4	5-1/4	2-5/8	

*3 - Blower On, Burner On, and Safety Lockout on both Option RC13 and RC14; 4th light is Dirty Filter Indicator on Option RC14 only
 ** On the console with Gas Controls identified as Option AG30, 31, 32, 33, or 35
 *** On the console with Air Control Options AR19 or AR22
 **** Subtract 5/8" when recessing.

A 3-position control switch is supplied with each system (exception - not included with systems with Option AG37), either packed loose inside the unit, or if an optional control console (Option RC13 or RC14) is ordered, the switch is mounted on the console. Control wiring requirements depend on the options selected. Follow the custom wiring diagram supplied with the system to connect any remote controls. For additional reference, the control manufacturer's instructions are included in the owner's envelope.

Internal Wiring Connections - Follow the wiring diagram provided for connecting the wires from the electrical components in the blower section (limit control and blower motor) to the electrical control compartment. Field wiring connection is required for the discharge sensor and/or for an optional discharge damper motor.

Discharge Sensor - A discharge sensor is shipped separately for field installation (exception - not required for units with Option AG37). Attach the discharge sensor in the ductwork about six feet from the discharge opening of the system. The sensor housing is not waterproof. If the installation is outdoors, field-fabricate a waterproof protective enclosure for the discharge sensor, being careful not to affect its air temperature sensing capability. Refer to the wiring diagram and connect the sensor to the electrical compartment. (The wires are in the electrical box.)

Optional Freezestat - If the system has an optional freezestat, the control is in the electrical box. The sensing bulb must be field-mounted in the blower discharge duct connector. Uncoil the control and extend the bulb to the blower discharge, being careful not interfere with any mechanical parts. Use the bulb holder provided and mount the sensor according to the manufacturer's instructions.

Optional Door Switch - If the system is to be used as an overhead door heater, an optional door switch (Option BX1) must be installed. The function of the switch is to energize and interlock the system when an outside overhead door reaches approximately 80% of full open travel. The switch will de-energize the system when the overhead door closes approximately 20%. Follow the installation instructions in the door switch option package.

Optional Dirty Filter Light - When the optional remote console includes a fourth light, it is a dirty filter indicator light. The light is activated by an adjustable, single-pole/normally open differential switch that senses air flow across the filter bank. The switch which is located in the electrical junction box requires a manual setpoint. Set the switch after the system is in operation. Instructions are included in Check/Test/Startup Paragraph 15.

Optional Pressure Null Switch (applies to systems with Air Control Option AR20 or AR23) - If the system includes Air Control Option AR20 or 23, a pressure null switch is shipped in the control

cabinet. Refer to the following paragraphs and to the manufacturer's installation instructions to install and connect this switch.

The pressure null switch is Dwyer #1460-0 with a range of .01-.02" w.c. The pressure null switch is a diaphragm operated differential pressure switch used in makeup air applications to control building pressure. It maintains a selected positive or negative pressure setpoint by changing the amount of outside air being introduced to the building through the modulating outside air dampers. As more pressure is required in the building, the pressure null switch activates the damper motor driving the outside air damper towards the full open position and the recirculated air damper towards the closed position. Conversely, as less pressure is required, the switch drives the dampers in the opposite direction.

Installation Instructions for Pressure Null Switch (Refer to Figure 7, page 12):

Select an indoor location free from excessive vibration where oil or water will not drip on the switch and where ambient temperature will be within a range of -30°F (dry air) to 110°F.

Mount the switch with the diaphragm in a vertical plane. The switch is position sensitive and is calibrated to operate properly when the diaphragm is vertical. Mount switch securely.

Connect the pressure taps on the top of switch to sources of air pressure differential. Metal tubing with 1/4" O.D. is recommended but any tubing which will not unduly restrict the airflow can be used. To maintain a positive building pressure, vent the low pressure tap to the outdoors and allow the high pressure tap to monitor building pressure. To maintain a negative building pressure, reverse the functions of the high and low pressure taps. In either case, be sure that the outdoor vent is protected from the wind and screened from insects.

Adjustment of the Switch - The "high" actuation point of the null switch is indicated on a calibrated scale secured to the transparent range screw enclosure. Building pressure is set by turning the adjustment screw. The "low" actuation point is set by adjusting the span on the null by turning the span adjustment screw. The span range is .01 to .03" w.c.

IMPORTANT: To eliminate shipping damage to the switch contacts, the manufacturer reduced the span adjustment to zero before shipping. The span should be adjusted prior to using the switch. (If the switch has been installed, disconnect the vent tube so that the null switch is in a neutral position.)

Remove the switch electrical box cover and while observing the contacts, turn the span adjustment screw slowly in a clockwise direction. Continue turning the adjustment screw until you are able to see gaps between the common and both the low and high contacts. A minimum gap provides the greatest sensitivity. The wider the gap, the lower the sensitivity.

10. Electrical Supply, Connections, and Controls (cont'd)

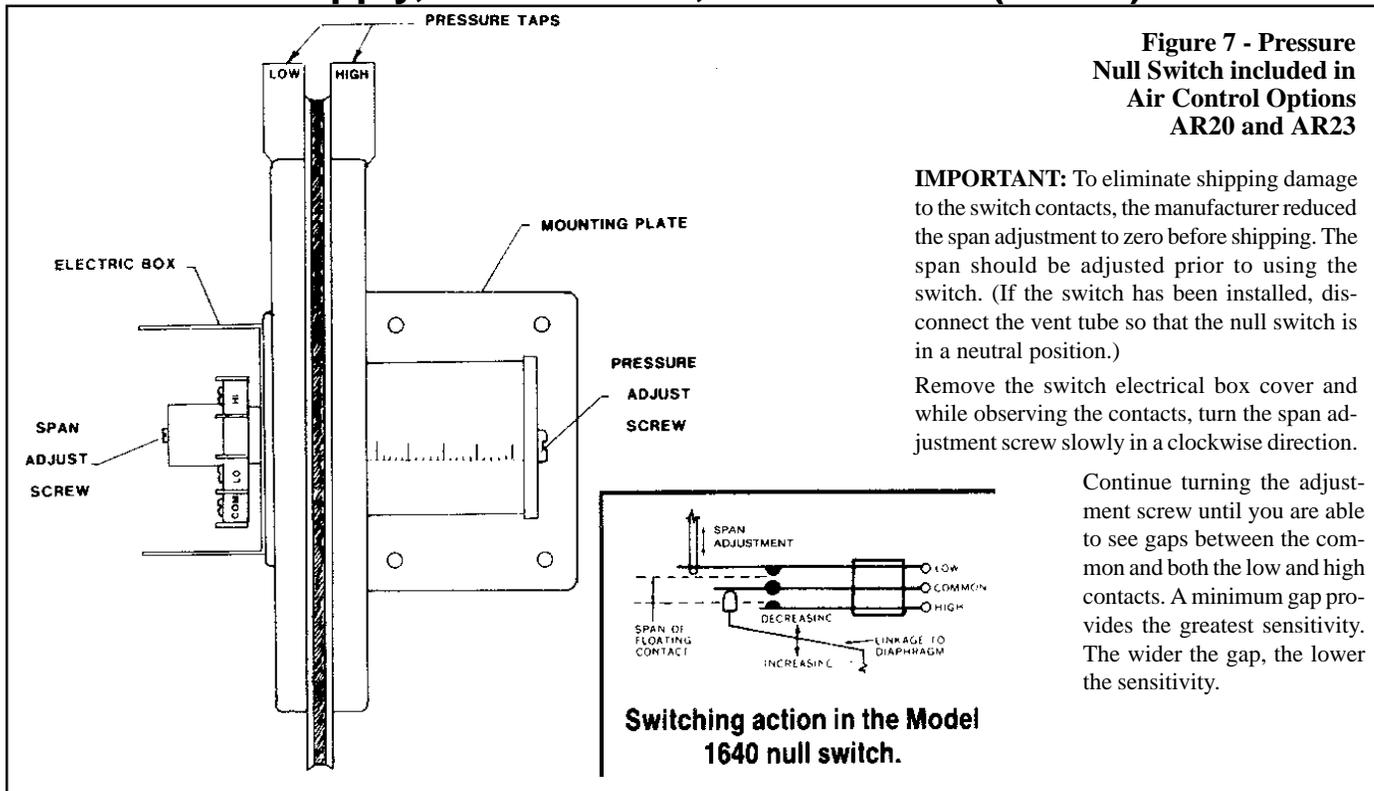


Figure 7 - Pressure Null Switch included in Air Control Options AR20 and AR23

IMPORTANT: To eliminate shipping damage to the switch contacts, the manufacturer reduced the span adjustment to zero before shipping. The span should be adjusted prior to using the switch. (If the switch has been installed, disconnect the vent tube so that the null switch is in a neutral position.)

Remove the switch electrical box cover and while observing the contacts, turn the span adjustment screw slowly in a clockwise direction.

Continue turning the adjustment screw until you are able to see gaps between the common and both the low and high contacts. A minimum gap provides the greatest sensitivity. The wider the gap, the lower the sensitivity.

11. Gas Piping and Pressures

All piping must be in accordance with the requirements of the National Fuel Gas Code ANSI/Z223.1 (latest edition) published by the American Gas Association or CAN1 B149.1 and B149.2 as published by the Canadian Gas Association. Gas supply piping installation must conform with good practice and with all local codes.

Read this section of the installation manual to determine the minimum gas supply pressure required to provide a maximum gas capacity. Minimum gas supply pressure is also stated on the heater rating plate. The heater manifold terminates at the gas supply connection with a black iron pipe union. See Figure 11. Local codes may require a 6" condensate trap. Gas connection is either 2" or 3" depending on the size of the system.

Supply Pressure - These direct-fired makeup air systems are designed to operate on a natural gas supply pressure range of a minimum of 5" w.c. plus the manifold pressure drop to a maximum of 5 psi. If the natural gas supply pressure is above the maximum allowed, it is necessary to install a field-supplied step-down gas regulator in the supply line. Measure the gas pressure between the step-down regulator and the unit. Refer to the table on the right for the minimum supply pressure.

Natural Gas Supply Pressure Requirements

- Minimum** 5" w.c. + the manifold pressure drop
- Maximum** 5 psi

Follow the steps and instructions in Paragraph 15, Check-Test-Start, to determine minimum gas inlet pressure for your specific installation.

Pilot Supply Pressure - These systems are designed to operate on a natural gas pilot supply pressure of 3.5" w.c.

See Figure 12 for locations of pressure taps for measuring operating pressure and pilot supply pressure. Measure both operating pressure and pilot supply pressure with the blowers in operation.

Manifold Pressure - Manifold pressure is defined as the gas pressure as measured at the burner pressure tap (See Figure 9). Measure manifold gas pressure with the blowers operating. Minimum gas supply pressure is determined by adding 5" w.c. (minimum required) plus the pressure drop through the manifold.

Manifold Pressure Drops and Minimum Supply Pressure (" w.c.)				
MBH	2" Manifold		3" Manifold	
	Pressure Drop	Minimum Gas Supply Pressure (P.D. + 5" w.c.)	Pressure Drop	Minimum Gas Supply Pressure (P.D. + 5" w.c.)
250	0.07	5.07	0.01	5.01
750	0.60	5.60	0.13	5.13
1000	1.06	6.06	0.24	5.24
1500	2.39	7.39	0.54	5.54
2000	4.25	9.25	0.95	5.95
2500	6.63	11.63	1.49	6.49
3000	9.55	14.55	2.15	7.15
3500	13.00	18.00	2.92	7.92
4000	16.98	21.98	3.82	8.82
4500	21.49	26.49	4.83	9.83
5000	26.53	31.53	5.96	10.96
5500	32.10	37.10	7.21	12.21
6000	38.21	43.21	8.59	13.59
6500	—	—	10.08	15.08
7000	—	—	11.69	16.69
7500	—	—	13.42	18.42
8000	—	—	15.26	20.26
8500	—	—	17.23	22.23
9000	—	—	19.32	24.32
9500	—	—	21.52	26.52

A manual shut off valve and an adapter with a 1/8" N.P.T. plugged hole for test gage connection must be installed immediately upstream of the gas supply connection to the appliance.

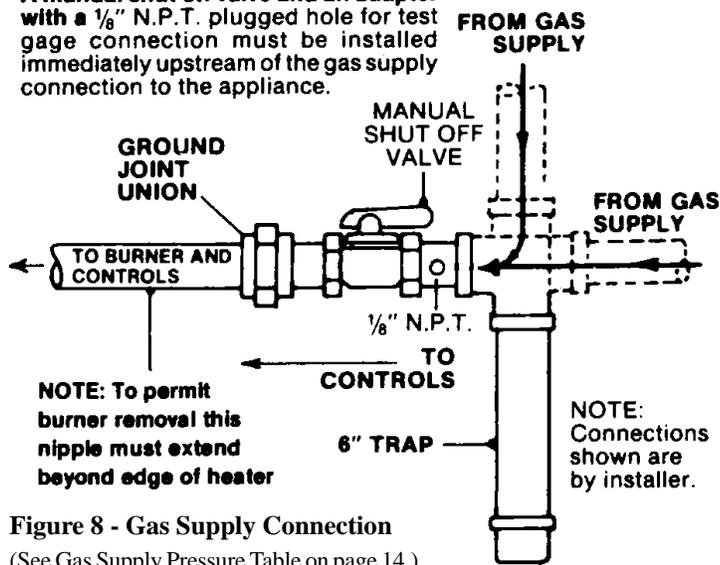


Figure 8 - Gas Supply Connection

(See Gas Supply Pressure Table on page 14.)

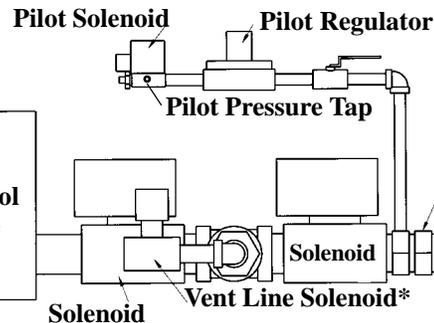
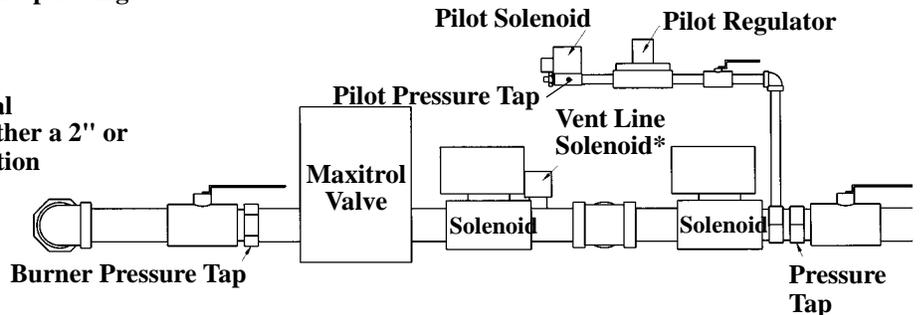
Optional Gas Pressure Switches - Gas pressure switches included in the system's gas train monitor gas pressure downstream from the safety valves. If the gas pressure at this point on a system equipped with a high gas pressure switch (Option BP2) exceeds the setpoint, the switch will open the electrical circuit to the burner, stopping all gas flow. The high gas pressure switch is a manual reset device.

A low gas pressure switch (Option BP3) will shutoff the gas flow if the gas pressure drops below the setpoint of the low pressure switch. The low gas pressure switch will automatically reset when the gas pressure rises above the setpoint. (NOTE: Both high and low gas pressure switches incorporate a vent limiting device and do not require venting to the outdoors when used in an application installed indoors.)

Gas Piping for Optional Vent Valve (applies only to an indoor installation with Manifold Option BM58) - When a system installed indoors is equipped with an optional vent valve (part of manifold Option BM58), piping must be field-installed to terminate the vent outdoors. Locate the 3/4" male pipe threads protruding (from the bottom pan underneath the control compartment). Extend the 3/4" piping to the outside of the building and terminate with a screen.

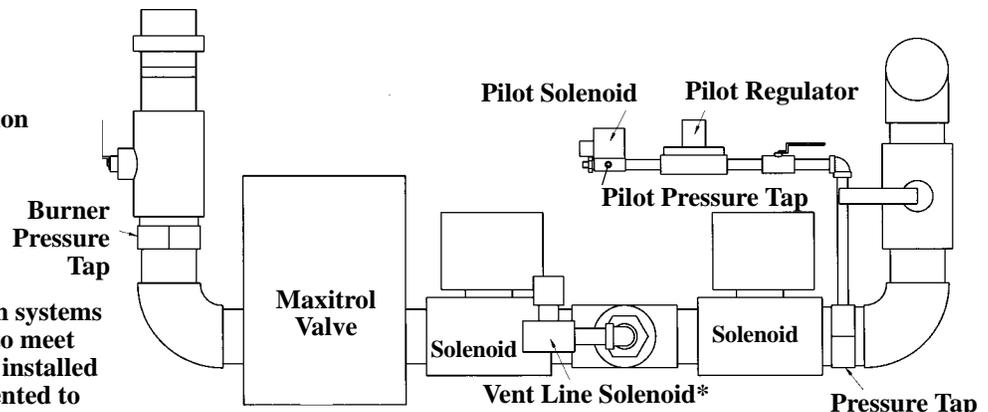
Figure 9 - Location of pressure taps for measuring burner and pilot supply pressure. Measure with blower operating.

Typical Gas Train of a Vertical Configuration System with either a 2" or 3" Manifold and Gas Connection



Typical Gas Train of a Horizontal Configuration System with a 2" Manifold and Gas Connection

Typical Gas Train of a Horizontal Configuration System with a 3" Manifold and Gas Connection



*Vent valve is included only on systems with Manifold Option BM58 to meet IRI requirements. If system is installed indoors, vent valve must be vented to the outdoors.

11. Gas Piping and Pressures (cont'd)

Gas Supply Pressure

Capacity of Piping					
Cubic Feet per Hour based on 0.3" w.c. Pressure Drop Specific Gravity for Natural Gas -- 0.6 (Natural Gas -- 1000 BTU/Cubic Ft)					
Length of Pipe	Diameter of Pipe				
	1-1/2"	2"	2-1/2"	3"	4"
20'	1100	2100	3300	5900	12000
30'	890	1650	2700	4700	9700
40'	760	1450	2300	4100	8300
50'	670	1270	2000	3600	7400
60'	610	1105	1850	3250	6800
70'	560	1050	1700	3000	6200
80'	530	990	1600	2800	5800
90'	490	930	1500	2600	5400
100'	460	870	1400	2500	5100
125'	410	780	1250	2200	4500
150'	380	710	1130	2000	4100
175'	350	650	1050	1850	3800
200'	320	610	980	1700	3500

Note: When sizing supply lines, consider possibilities of future expansion and increased requirements. Refer to National Fuel Gas Code for information on line sizing.

12. Distribution of Makeup Air

Makeup air can be introduced to the building either through distribution ducts or through controlled pressurization with little or no ductwork. Makeup air should be introduced and maintained using the lowest possible air velocity. With ductwork distribution, this is accomplished using a multiplicity of discharge openings over the greatest centerline distance. When a makeup air system is automatically controlled to maintain a set building pressure, the entering air will travel naturally toward the relief areas at the perimeter walls using the building structure as the distribution ductwork.

Makeup air should enter at the highest point practical. By doing this, the fresh air will entrain dust laden air at the ceiling and move it toward the point of exhaust. Also, fresh air directed downward from the roof or ceiling will mix with hot ceiling air resulting in improved distribution of heat in the building.

Always introduce fresh makeup air so that it moves across the greatest distance within the room or building before reaching an exhauster.

Sizing and Installation of Distribution Ductwork - Proper sizing of warm air ductwork is necessary to ensure a satisfactory heating installation. The recognized authority for such information is the Air Conditioning Contractors Association, 1228 17th Street, N.W., Washington, DC 20036. A manual covering duct sizing in detail may be purchased directly from them.

Installing Ducts:

- The type of duct installation depends in part on the type of construction of the roof (wood joist, steelbar joist, steel truss, pre-cast concrete, etc.) and the ceiling (hung, flush, etc.).
See Paragraph 5 for dimensions of discharge duct connections.
- Rectangular ducts should be constructed of not lighter than No. 26 U.S. gauge galvanized iron or No. 24 B&S gauge aluminum.
- All duct sections 24" or wider, and over 48" in length, should be cross-broken on top and bottom and have seams or angle-iron braces. Joints should be S and drive strip or locked.
- Warm air ducts should not contact masonry walls. Insulate around all air ducts through masonry walls with not less than 1/2" of insulation.

- Insulate all exposed warm air ducts passing through an unheated space with at least 1/2" thickness of insulation.
- Duct Supports** - Suspend all ducts securely from adjacent building members. Do not support ducts from unit duct connections.
- Duct Connections** - At the heater, use a flexible canvas connection on indoor units to eliminate vibration transmission. On outdoor installations, ducts can be slid over the flange of the heater and then sealed for an airtight and watertight fit. On duct-to-heater connections, use sheetmetal screws to fasten ducts to the heater flange. Use stiffening flanges around the perimeter of the duct connections.
- Return Air Duct** - The return air duct **must be sized for a pressure drop of .5" w.c. at 2850 fpm in order to balance the system.** If not sized properly, there may be difficulty in obtaining the desired air flow over the burner when the return air damper is full open.

13. Blowers, Drives, and Motors

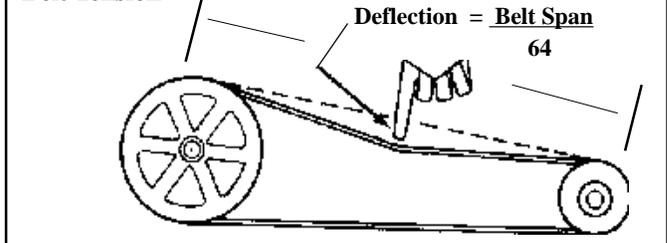
Access to the blowers, drive and motors depends on the configuration of the system:

Horizontal Configuration Systems - Remove the large service panel on the discharge end of the control side of the system.

Vertical Configuration Systems - Open the service entrance door (large door to the left of the electrical control compartment panel). Enter the cabinet and climb the ladder to the blower section level.

Check belt tension. Proper belt tension is important to the long life of the belt and motor. A loose belt will cause wear and slippage. Too much tension will cause excessive motor and blower bearing wear. If adjustment is required, adjust the motor base until the belt can be depressed 1/64" for each inch of belt span. (Figure 10). Be sure the belt is aligned in the pulleys.

Figure 10 - Belt Tension



Motor Pulleys and Blower Speed - These systems have fixed pulleys that are selected and set at the factory for the RPM required to provide the CFM at the external static pressure specified on the order.

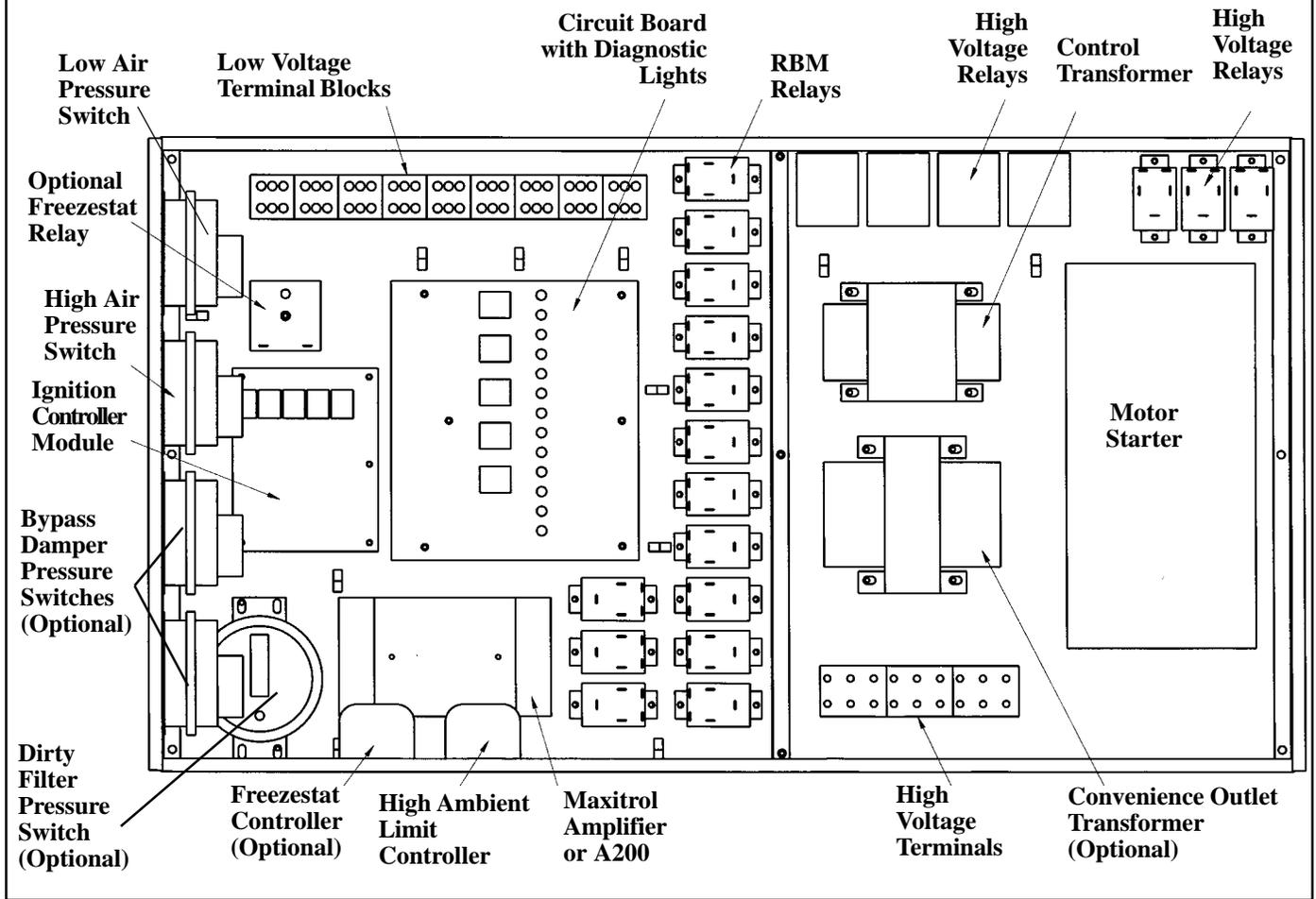
Blower Rotation - Each blower housing is marked for proper rotation. Instructions for checking blower rotation are included in the Check-Test-Start Procedure in Paragraph 14.

Motor Loads - The open motor amp chart below can be used for sizing line wiring. For accurate amps, read the motor manufacturer's rating plate; amps will vary depending upon type of motor and motor manufacturer.

Blower Motor Full Load Amps (open motors)				
HP	208V/3	230V/3	460V/3	575V/3
5	16.0	14.6	7.3	5.9
7.5	22.0	21.0	10.5	8.4
10	42.7	38.0	19.0	9.7
15	43.1	39.0	19.5	16.0
20	53.0	50.0	25.0	20.0
25	66.0	63.0	31.5	26.0
30	86.0	74.6	37.3	29.7
40	105.0	104.0	52.0	37.6
50	140.0	126.0	63.0	48.0
60		140.0	70.0	57.0
75		170.0	85.0	71.5

14. Check-Test-Start

Figure 11 - Control Locations - Electrical Compartment



Check/Test/Startup Procedures

Before Startup - Turn power and gas off.

- 1. Check to be sure that all field-installed accessories are installed.
- 2. Check all field-installed wiring (including limit controls, discharge damper motor, discharge air sensor, blower motor).
- 3. Check all ductwork for obstructions; open all diffusers. Check location and connection of discharge air sensor; sensor should be field-installed in the ductwork about six feet from the system discharge.
- 4. Turn the three-position switch or optional summer/off/winter remote console switch to OFF position. To prevent someone from turning the system ON, tape the switch leaving a note that it should be left in the OFF position.
- 5. If the system includes an air control with a remote potentiometer, set the position as follows:
 - Option AR19 (Variable Air Volume) - Turn full "open"
 - Option AR22 (Return Air) - Turn full "closed"

6. Check disconnect switch --

- Turn disconnect switch OFF.
 - Check disconnect switch to be sure that it is tightly secured against the cabinet.
 - If disconnect is fusible, check that fuses are installed. If fuses are not installed, insert correct fuses.
- Verify continuity of fuses.

14. Check-Test Start (cont'd)

Check Before Startup (cont'd)

7. Open the hinged control compartment door panel --

- Close all manual gas valves.
 - Open hinged electrical panel cover.
 - Check all wiring and wiring connections on gas controls and electrical components.
 - If equipped with any manually reset devices such as a firestat limit switch or high gas pressure switch, reset devices.
-

8. In the blower compartment --

- Remove any blocking and shipping supports.
 - Check all fasteners for tightness and all parts to be sure they are secure.
 - Rotate the blower wheel to be sure that no parts are rubbing. Check for and remove any obstructions and/or foreign material that may damage the blower wheel.
 - Check for bearing alignment and lubrication.
 - Check that the blower belts have correct tension (See Paragraph 13) and that pulleys are in alignment and locked to the shaft.
 - Reset manual limit switch.
 - Check wiring connections to limit switch, discharge air sensor, and motor.
 - Close blower compartment door panel; secure latches.
-

9. Turn ON gas supply valve and inlet manual shutoff valve on the manifold --

- Leak test gas connections upstream of the electric gas valve. Be sure all connections are tight and leak tested. **WARNING: DO NOT TEST WITH OPEN FLAME.**
 - Turn OFF manual gas valves.
-

Startup

1. Prepare system for startup testing --

- Attach a slope gauge (0 to 1.0" scale) to the tubing connections in the control compartment. The two connections are located just above the electrical box. Remove the caps on the 1/8" NPT test connections and attach the slope gauge. (The recommended method for attaching the slope gauge is to use field-supplied 1/8" NPT x 1/4" OD barbed hose connections.)
 - Set BOTH the blower and burner service switches (located on the electronic circuit board) to the OFF position.
-

2. Observe status lights on the electronic circuit board (assuming an optional control relay is installed) --

- Turn ON power to the system at the disconnect switch.
 - Check the electronic circuit board. A single light should be lit - "**Control Power**".
 - Turn OFF the disconnect switch.
 - If the system has an optional relay (check wiring diagram - Option BG), remove the wire from Terminal 3 and Terminal 4 that connects the circuit to the optional "control relay" contacts. Place a jumper wire from that Terminal 3 to Terminal 4.
 - Turn ON the disconnect switch. One or two lights should be lit - "**Control Power**" - plus if equipped with a firestat - "**Firestat Normal**".
-

3. Check blower switch and blower rotation.

- Place the blower switch (on the electronic circuit board) in TEST position. This will bring on one or two additional lights - "**Starter Energized**" - and if equipped with a freezestat - "**Freezestat Normal**".

NOTE: If unit is equipped with a discharge damper, the damper will begin to open. When the damper reaches 80% open, the blower motor will be energized and **then** the "**Starter Energized**" light will be actuated.

After the blower obtains normal speed (minimum .2" positive air pressure), the low air proving switch will close and the following lights will be energized: "**Low Air Pressure Normal**"; "**Limit Controls Normal**"; and if these options are included, "**High Air Pressure Normal**"; "**Outside Air Cutoff Normal**"; "**Low Gas Pressure Normal**"; "**High Gas Pressure Normal**".

- Check blower rotation. If blower is turning backwards (see rotation arrows), do the following.
- (A) Turn disconnect switch OFF and:

Three-phase units - interchange any two motor leads at the motor contactor or starter.

- (B) Turn disconnect switch ON and verify correct blower rotation.
 - Check blower operation to be sure there is no excessive vibration. If excessive vibration is present, re-check belt tension, pulley alignment, bearing alignment, blower wheel balance, and that components are attached securely. Determine and eliminate the cause of excessive vibration before the system is put into operation.
-

4. Measure burner differential air pressure on the slope gauge (connected to the unit in Startup Step 1)

- (A) If the system includes an optional discharge damper, before measuring burner differential air pressure, check to be sure that the damper is fully open. If not fully open, turn the disconnect switch OFF and adjust damper to the fully open position. Close all door panels and turn ON the disconnect switch.
 - (B) With the blower operating, the pressure differential on the slope gauge should read between $-.5"$ and $-.7"$ w.c. If the slope gauge reading is within those limits, continue to (C). If the slope gauge reading is not within those limits, turn off the disconnect switch. Record CFM, RPM, external static pressure, pressure drop through the unit, and the motor amp draw. Contact your distributor, Sale Representative, or the manufacturer's Customer Service Department to determine the correct drive components to achieve the required CFM.
 - (C) When the differential air pressure is within the limits, check the motor amp draw with an ammeter to be sure that the motor is not overloaded. Amps are shown on the motor nameplate.
 - (D) If an inlet or outlet duct system is attached to the heater, run the blower to purge the volume of air from the duct system with at least four air changes.
 - (E) If the system includes an optional dirty filter light, while the blower continues to operate, set the switch so that the indicator light will activate at approximately 50% filter blockage. (NOTE: Make sure filters are installed and that they are not dirty. If ductwork is installed, ensure that the test and balance procedures have been completed.) Calibrate the switch to this measurement by turning the set screw on the switch clockwise until the filter light is energized or the screw is bottomed out. At that point, adjust the set screw three full turns counterclockwise or until the screw is top ended. At this setting the contacts will close at $.17$ to $5.0"$ w.c. causing the light to signal that the filters require cleaning at approximately 50% blockage.
 - (F) Turn the disconnect switch OFF. Disconnect the slope gauge and replace the caps.
-

5. Check pilot and burner ignition --

- Connect a "U"-tube manometer to the main burner pressure tap (See Figure 9).
 - Turn the disconnect switch ON. (Lights as explained in Startup Steps 2 and 3 should be energized). Put the burner switch (on the electronic circuit board) in TEST position. After 15-20 seconds, the "Pilot Valve" light will light to signal the pilot ignition, followed by the "Main Valve" light signaling main burner operation. All lights should be lit **except "System Switch" (12 lights total)**.
 - With both the burner and blower operating, measure the gas pressure at the burner. Gas pressure should match the required manifold pressure listed on the rating plate. (If pressure does not match the required pressure, further testing is required in Step 7.) Remove the manometer.
 - Leak test all connections in the pilot and main burner supply lines. **WARNING: DO NOT TEST WITH OPEN FLAME.**
 - Turn OFF the manual gas valve. Wait 30 seconds for unit to cool. Return both burner and blower switch to OFF position. Turn OFF disconnect switch.
-

6. Check pilot pressure and operation --

- To check pilot gas pressure, connect a "U"-tube manometer to the pressure tap on the downstream side of the pilot solenoid valve (See Figure 12).
 - Put BOTH blower and burner switches in TEST position (Switches are on the electronic circuit board). Turn ON disconnect switch. After blower reaches speed, **all** lights should be lit **except "Pilot Valve" and "Main Valve"**. Turn on the gas supply. **After 14-20 seconds**, the "Pilot Valve" light will be energized, followed by the "Main Valve" light.
 - Measure pilot gas pressure. Pilot pressure for natural gas should be $3.5"$ w.c. Pilot pressure should be correct, but if the pressure is not correct, discontinue startup until the pilot gas pressure is regulated correctly. (To adjust pilot pressure, remove the cap from the regulator. Turn adjustment clockwise to increase gas pressure or counterclockwise to decrease gas pressure.) When pressure is correct, shut off the gas, remove the manometer, and replace the pressure tap cap on the pilot solenoid valve.
 - To check lockout feature of the pilot ignition system, turn pilot manual shutoff valve OFF. Pilot should lockout after two trials for ignition. To reset unit, open the valve and cycle the main disconnect switch.
-

14. Check-Test Start (cont'd)

7. If, with the blower and burner operating, the main gas pressure **measured in Step 5 does not** correspond with what is stated on the rating plate, check the main burner **gas differential pressure**.

- Turn disconnect switch OFF.
- Re-connect the "U"-tube manometer to the main burner pressure tap.
- Turn the disconnect switch ON. Place the blower switch in TEST position. Record the negative pressure reading (blower operating) on the manometer in the gas line.
- Turn the disconnect switch OFF. Place the burner switch in TEST position. Turn the pilot manual shutoff valve back ON. Turn the disconnect switch ON. Ignition sequence will occur.
- Observe the main burner; light off should occur along the entire length of the burner. After approximately one minute, record the gas pressure reading on the manometer.

Calculate the burner differential gas pressure to determine absolute minimum supply pressure--

Factor 1 - Actual gas pressure reading with burner and blower operating

Factor 2 - Negative pressure reading in the gas line with the blower operating

Ignoring the minus, deduct the negative pressure from the actual gas pressure.

EXAMPLE:	Gas Pressure Reading	8.3" w.c.
	Negative Pressure	-.6" w.c.
	Differential Pressure	7.7" w.c.

Minimum supply pressure is the differential burner pressure plus the pressure drop as listed in the table in Paragraph 12.

Determine pressure required for less-than-maximum firing: For maximum firing rate, a minimum of 5" w.c. of actual measured natural gas pressure is required at the burner. (If maximum firing rate is not required, divide the actual input rate by the maximum rate, square the answer, and multiply by 5" w.c. to determine the required gas pressure at less than maximum capacity.)

- Turn disconnect switch OFF. If the gas pressure is determined to be adequate, continue with the startup of the system. If the gas pressure is not adequate for the system, discontinue startup until the gas pressure problem is resolved.
- Remove the manometer and replace the plug.

Startup for Continuous Operation

- If connected in Startup Step 2, remove the jumper wire running from Terminal 3 to Terminal 4. Re-connect the optional "control relay" contacts to Terminal 3 and Terminal 4..
- Put BOTH the burner and blower switches in RUN position.
- Close the electrical box and close the control door panel. Secure latches.
- Turn ON the disconnect switch. The system is now operational from the control switch, the remote console, or other type of optional automatic control.

After Startup

- Return this manual to the owner's envelope. Keep for future reference.
- To check for toxic vapors coming from the surrounding outside atmosphere or being produced by the installation (See DANGER below), it is recommended that the tempered makeup air entering the building be tested at its point of discharge from the heating unit. The table below shows limits for various substances including carbon monoxide.

Certified, portable detector tubes may be used; follow the manufacturer's instructions.

Limits Based on Eight -Hour Exposure and a Five-Day Week (Guide Only)

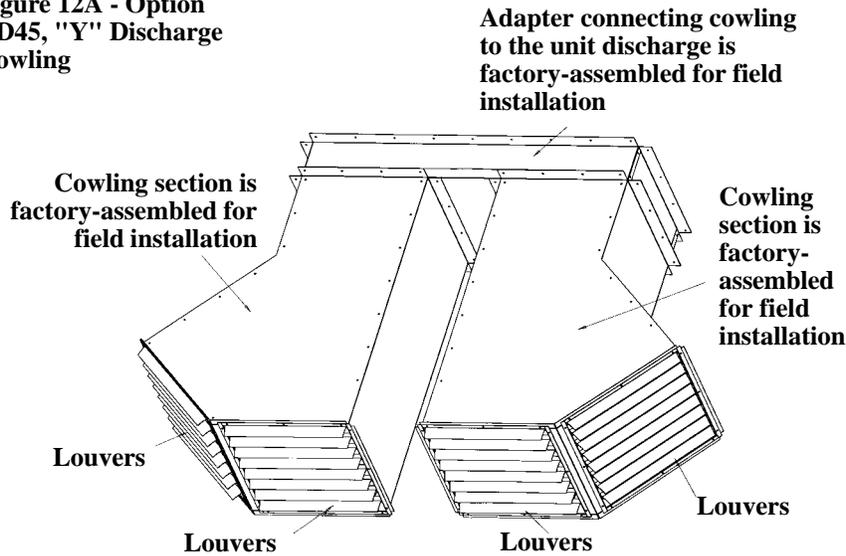
Substance	Percent	PPM
Acetaldehyde	.001	10
Carbon Dioxide	.250	2500
Carbon Monoxide	.001	10
Formaldehyde	.000025	0.25
Nitrogen Dioxide	.0001	1
Sulphur Dioxide	.00005	0.5

Note: At 100°F rise the CO₂ concentration will be in the order of 2500 ppm.

Field Installed Accessories

15. Discharge Cowling - Applies to Vertical and Horizontal Configuration Systems with Horizontal Discharge

Figure 12A - Option CD45, "Y" Discharge Cowling



Description

The optional "Y" discharge cowling is designed to direct the tempered air to provide a larger pattern of distribution. The adapter and each cowling section are shipped factory-assembled for field installation. The cowling is designed to be used on a vertical configuration system but may also be used on a horizontal configuration system with horizontal discharge.

Components Shipped: Assembled sleeve adapter; (2) assembled cowl sections; 2x2 structural angle with holes (for suspension dimension, measure distance between "end" hanger holes); and sheet metal screws

Components Field-Supplied: (2) Threaded hanger rods and hardware

Installation Instructions (See Figures 12B and 12C)

1. Attach the adapter to the discharge opening.

- a) If equipped with a motorized discharge damper, remove the pin from the side of the sleeve-type connection on the heater discharge.
- b) Slide the adapter over the sleeve-type opening and attach with the sheet metal screws.
- c) If equipped with a damper, replace pin and install the damper motor and damper motor junction box so that the pin allows the motor to activate the dampers. Refer to the wiring diagram and make required connections.

2. Attach and suspend the cowling sections.

- a) Position the 2 x 2 structural support angle across the **bottom** of **one** of the cowl sections in the location shown in Figure 12B. Position at a right angle with the inside edge of the cowl section and attach across the bottom with sheet metal screws, being sure to allow for suspension.

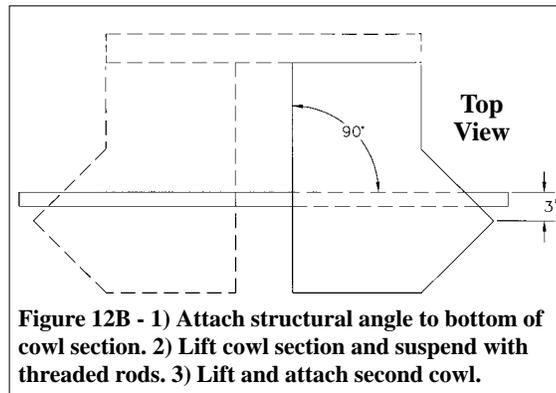


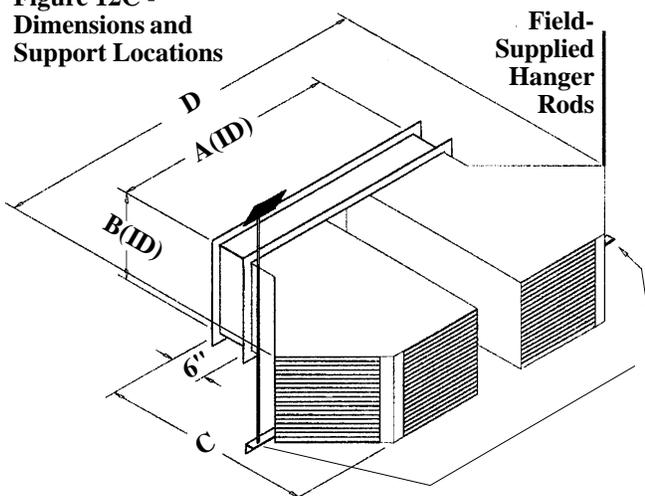
Figure 12B - 1) Attach structural angle to bottom of cowl section. 2) Lift cowl section and suspend with threaded rods. 3) Lift and attach second cowl.

- b) Lift the cowling section (with the angle attached to the bottom) and attach the cowl to the sleeve adapter with sheet metal screws. **NOTE:** Continue to support the cowl until the suspension is added.

- c) Suspend the angle from the building structure using field-supplied hanger rods and hardware.

- d) Position the second cowling section. Attach cowling to adapter. Attach support angle to cowling section bottom panel.

Figure 12C - Dimensions and Support Locations



Cowling for Horizontal and Vertical Configuration Systems with Horizontal Discharge					
Model Size	Dimensions (inches)				Weight (lbs)
	A	B	C	D	
218	49-1/2	19-1/4	51	85	203
220	56-1/2	25	54-1/2	95-1/2	283
225	74-1/4	31-1/2	57	122-1/4	406
227	75-1/4	34-3/4	57	124	451
230	90-1/4	37	57	146	513
233	97-1/2	43-1/4	57	157	601

To support the cowling from the building structure, the installer must provide threaded hanger rods and hardware to suspend the angle attached across the bottom of the cowls. Be sure that the building structure used has a load bearing capacity that will support the total weight (see table above) of the cowling. Attach securely.

Field Installed Accessories (cont'd)

16. Optional Screened Outside Air Storm Hood - Applies to Horizontal Configuration Systems

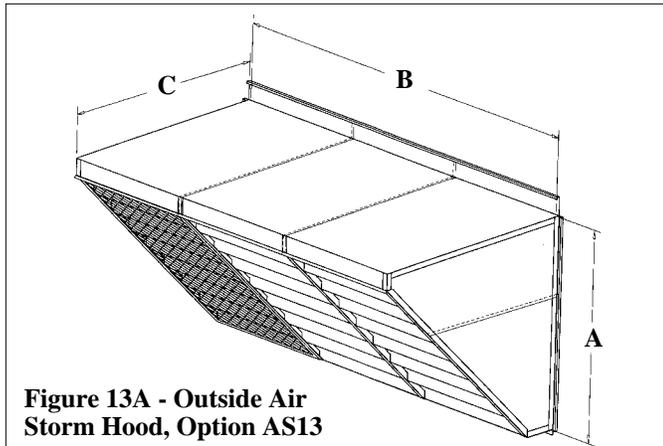


Figure 13A - Outside Air Storm Hood, Option AS13

Technical Data and Dimensions - Weatherhood for Horizontal System					
CFM Maximum	Model Size	Dimensions (inches)			Weight (lbs)
		A	B	C	
19,000	218	44	86-1/2	40	327
28,000	220	44	110-1/2	45	410
45,000	225	76	112	70	790
52,000	227	76	112	70	790
62,000	230	76	148	80	986
75,000	233	76	148	80	986

Description

The optional screened outside air hood is shipped factory-assembled for field installation. To prevent damage, it is recommended that the system be in its permanent location before installing the air hood.

The system should be positioned so that an outside air hood is not facing into the prevailing wind.

Installation Instructions (NOTE: Assembled weatherhood is very heavy; see weights in table above.)

Components Shipped: Assembled weatherhood; (2) "C"-shaped side joint covers; and hardware (bolts, lockwashers and sheet metal screws)

- Slide the vertical edge of the weatherhood top behind the cabinet roof flashing. See Figure 13B. Center the weatherhood in the inlet opening and set in place on the bottom support leg (See Figure 13D).

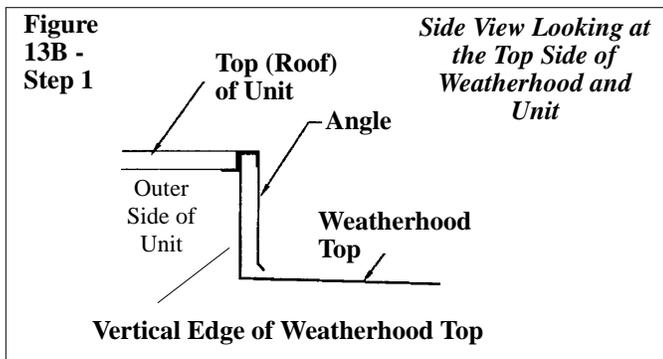


Figure 13B - Step 1

Side View Looking at the Top Side of Weatherhood and Unit

- From inside the filter cabinet, verify that the plates extending from the frame of the weatherhood are next to the side of the vertical tubular posts without the welded nut. Bolt the plate to the cabinet post securing it into the nut. Repeat, attaching all plates extending from the weatherhood to the cabinet framing. See Figure 13C.
- On the outside, position a C-shaped joint cover over the vertical joint between the weatherhood and the cabinet and attach with sheet metal screws. See Figure 13C. Repeat on the opposite side.

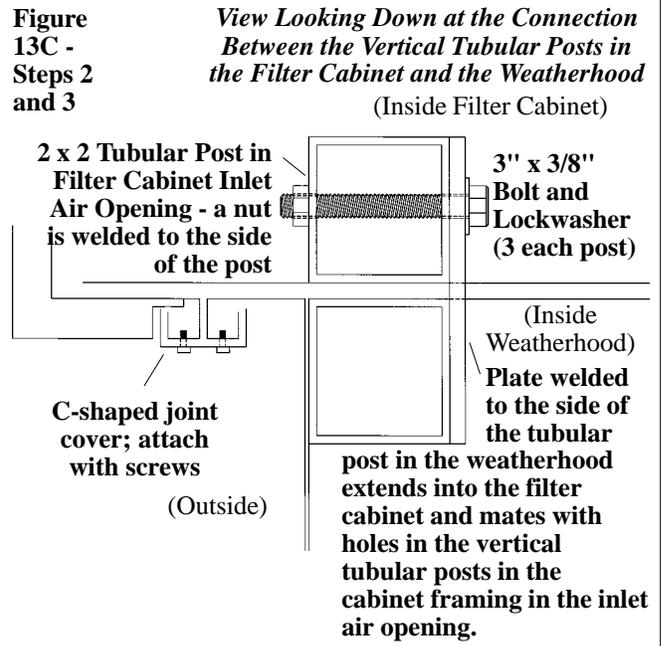


Figure 13C - Steps 2 and 3

View Looking Down at the Connection Between the Vertical Tubular Posts in the Filter Cabinet and the Weatherhood

(Inside Filter Cabinet)

- Using sheet metal screws, attach the weatherhood frame to the cabinet across the vertical edge of the bottom of the weatherhood. See Figure 13D.

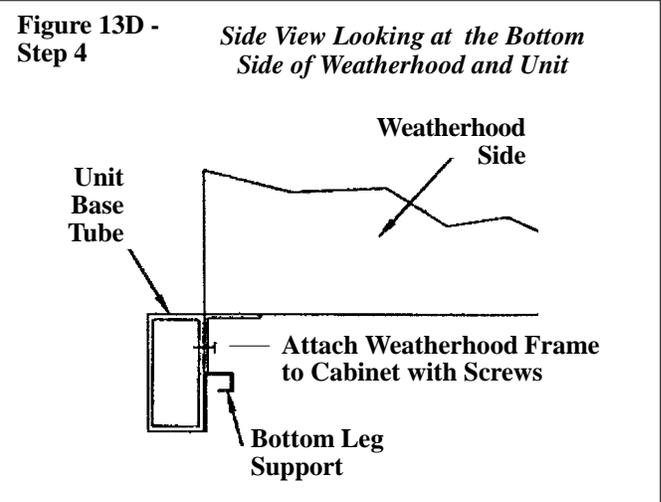


Figure 13D - Step 4

Side View Looking at the Bottom Side of Weatherhood and Unit

REFERENCE: For Operating, Maintenance, and Service Information, refer to Form RGM 443-OMS.