



REZNOR *Thomas & Betts*

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

(Specifications subject to change without notice.)

**Installation Form RZ-NA 440 (Version B)
Obsoletes Form RZ-NA 440 (Version A)**

Applies to: Reznor® Model Series RDF

NOTE: Obsolete Form RGM 440-9 included installation, operation, and maintenance information. Form 440 (Version B) includes only installation information. For operation and maintenance information, refer to Form 440-OMS (Version A).

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**Reference: Operating/Maintenance/Service Manual, Form RZ-NA 440-OMS
Replacement Parts Manual, Form RZ-NA 740**

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 2.

WARNING: On makeup air heaters which also recirculate room air, outside ventilation air must be provided in accordance with the information shown on the heater nameplate.

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 Reznor® Model RDF direct-fired makeup air heating systems. 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 ap-

General Description (cont'd)

plications, adding controlled 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 up to 75% building air (recirculation) for increased energy savings.

These systems are designed-certified to ANSI Standards by the Canadian Standards 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.

These units must be installed in accordance with local building codes. In the absence of local codes, the unit must be installed in accordance with the National Fuel Gas Code ANSI Z223.1a (latest edition). This code is available from CSA Information Services, 1-800-463-6727.

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, or 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 (0°C).

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).

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.**
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2. Warranty

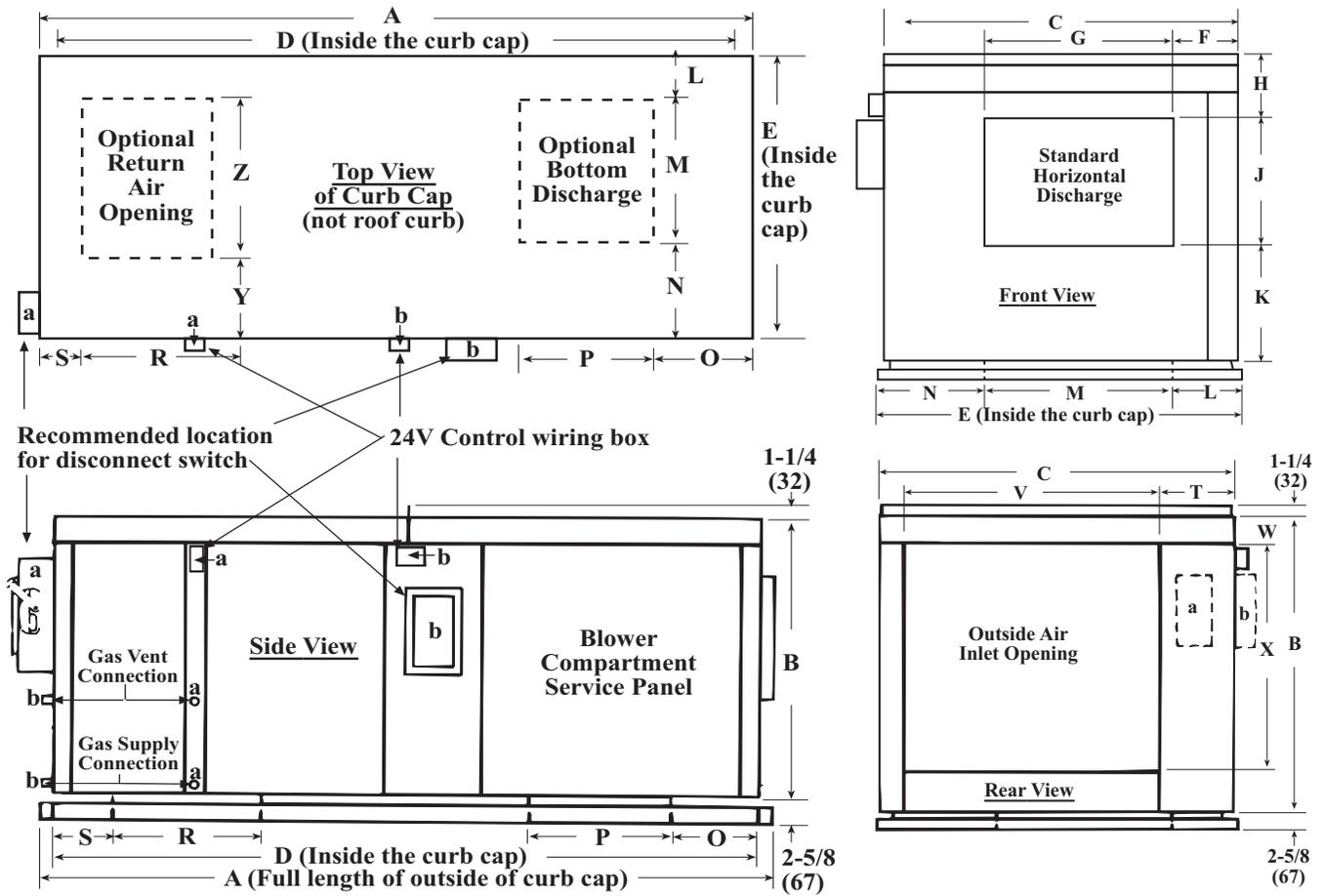
Refer to the limited warranty information on the warranty card included in the "Owner's Envelope".

3. Technical Data

Model Sizes	1-20	1-40	1-50	1-65	2-80	2-120	3-180	3-260
	110-A	112-A	115-A	118-A	119-A	120-A	122-A	130-A
Maximum Capacity (MBH)	400	600	750	750	1500	1500	2500	3000
CFM Range	1,000 - 3,000	2,000 - 4,500	3,000 - 6,000	4,000 - 6,500	6,000 - 12,000	9,000 - 16,000	11,000 - 20,000	16,000 - 28,000
Maximum Temperature Rise (°F)	120	120	120	120	120	120	120	120
Control Amps (110V)	6	6	6	6	6	6	6	6
Net Weight (Lbs)	915	925	935	950	1455	1505	2410	2480

4. System Dimensions

Figure 1 - Dimensions (inches and mm)



Location Key:

a = Recommended locations for disconnect switch and 24 volt control wiring box on Sizes 1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118

b = Recommended locations for disconnect switch and 24 volt control wiring box on Sizes 2-80, 2-120, 3-180, 3-260, 119, 120, 122, 130

Dimensions (inches)

Model Sizes	A	B	C	D	E	F	G	H	J	K	L*	M
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	88-3/8	37-1/8	44-1/4	85-1/4	45-1/2	7-5/8	22	5-3/8	18-7/8	12-7/8	8-1/4	22
2-80, 2-120, 119, 120	88-1/8	48-3/4	68-1/4	85-1/4	69-7/16	16-1/8	27-1/4	6-5/8	27-1/4	14-7/8	16-3/4	27-1/2
3-180, 3-260, 122, 130	136-1/8	61-3/4	82-1/2	132-5/8	83-1/16	14-1/4	37	4	37	20-3/4	14-25/32	37

Model Sizes	N*	O*	P	R	S*	T	V	W	X	Y*	Z
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	15-1/4	12-5/8	19-1/8	17	2-3/8	10-1/16	31-1/8	3	33-5/8	15-1/8	22-1/8
2-80, 2-120, 119, 120	25-3/16	9-5/8	27-1/2	22	6-1/2	10	55-3/16	3	45-9/16	18-1/16	41-7/8
3-180, 3-260, 122, 130	31-5/16	9-3/16	37	30-1/4	11-11/16	12-1/2	67-1/8	3	54-5/8	13-15/16	57-1/8

Dimensions (mm)

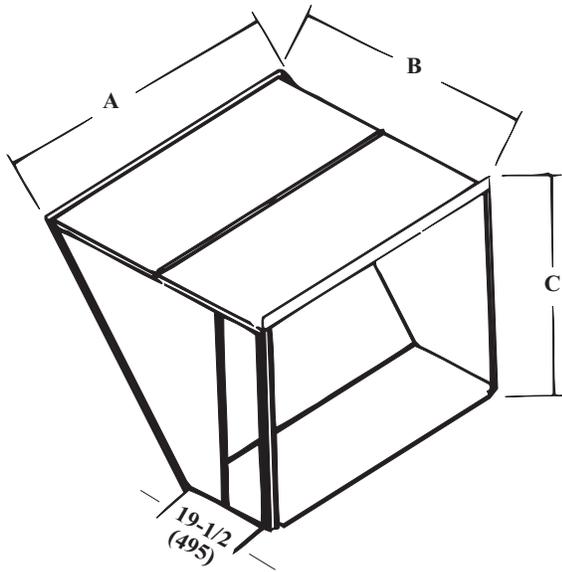
Model Sizes	A	B	C	D	E	F	G	H	J	K	L*	M
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2245	943	1124	2165	1156	194	559	137	479	327	210	559
2-80, 2-120, 119, 120	2238	1238	1734	2165	1764	410	692	168	692	378	425	699
3-180, 3-260, 122, 130	3458	1568	2096	3369	2110	362	940	102	940	527	375	940

Model Sizes	N*	O*	P	R	S*	T	V	W	X	Y*	Z
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	387	321	486	432	60	256	791	76	854	384	562
2-80, 2-120, 119, 120	640	244	699	559	165	254	1402	76	1157	459	1064
3-180, 3-260, 122, 130	794	233	940	768	297	318	1704	76	1387	354	1451

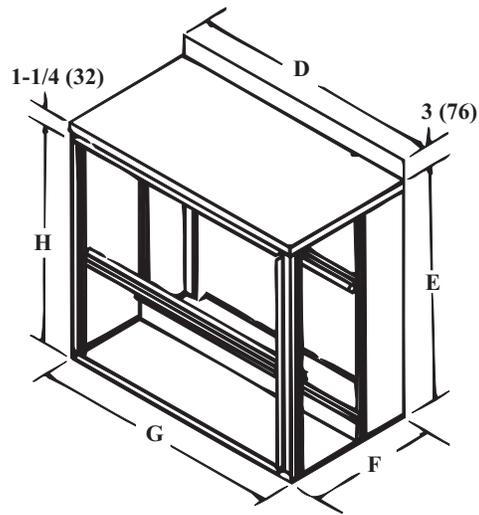
*Measurements for locating bottom air openings are from the edge of the inside of the curb cap. For dimensions to optional roof curb, see Figure 3.

5. Accessories - Technical Data and Dimensions

Figure 2 - Optional Outside Air Hoods and Filter Cabinets with and without Filters
 Technical Data and Dimensions - inches (mm)



AS2 Outside Air Hood
 AS6 Outside Air Hood with 1" Filters
 AS7 Outside Air Hood with 2" Filters



AW3 Indoor Filter Cabinet with 1" Filters
 AW6 Indoor Filter Cabinet with 2" Filters

Dimensions - inches (mm)

Size	1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2-80, 2-120, 119, 120	3-180, 3-260, 122, 130
A	38 (965)	62 (1575)	74-1/4 (1886)
B	55 (1397)	54 (1372)	64 (1626)
C	36 (914)	47-1/2 (1207)	61-3/8 (1559)
D	35-9/16 (903)	59-9/16 (1513)	71-9/16 (1818)
E	33-1/8 (841)	44-5/8 (1133)	58-1/2 (1486)
F	19-1/2 (495)	19-1/2 (495)	19-1/2 (495)
G*	32-15/16 (837)	56-15/16 (1446)	69-3/8 (1762)
H*	30-3/8 (772)	41-7/8 (1064)	57-7/16 (1459)

*Duct connection

Technical Data

Sizes	No. of Filters	Filter Size		Approximate Weight					
		AS6, AW3	AS7, AW6	AS2	AS6	AS7	AW3	AW6	
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	3	12x35x1	12x35x2	lbs	225	250	270	100	120
				kg	102	113	122	45	54
2-80, 2-120, 119, 120	4	12x35x1	12x35x2	lbs	310	350	380	150	180
	4	12x24x1	12x24x2	kg	141	159	172	68	82
3-180, 3-260, 122, 130	12	12x35x1	12x35x2	lbs	400	450	490	200	240
				kg	181	204	222	91	109

Description/Installation

All of the inlet options (outside air hood and filter cabinets) require field attachment directly to the system cabinet. To prevent damage, it is recommended that the system be set in its permanent location before installing the air hood or filter cabinet option.

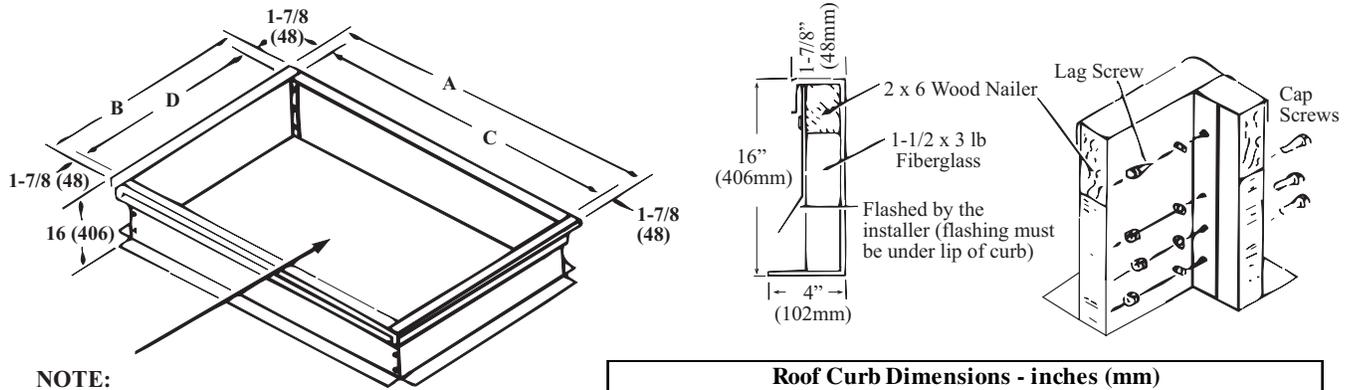
The unit should be positioned so that an outside air hood is not facing into the prevailing wind. A minimum clearance of 14" (356mm) is required from the bottom of the hood to the mounting surface (roof).

Refer to the chart below for specifications and field requirements of each option.

Refer to Paragraph 15 for assembly and installation instructions.

Options	AS2			AS6 and AS7			AW3 and AW6		
Model Sizes	1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2-80, 2-120, 119, 120	3-180, 3-260, 122, 130	1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2-80, 2-120, 119, 120	3-180, 3-260, 122, 130	1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2-80, 2-120, 119, 120	3-180, 3-260, 122, 130
Shipped Separately	X	X	X	X	X	X	X	X	X
Factory Assembled	X	X		X	X		X	X	
Requires Field Assembly	See instructions					X			X
Requires Field Installation	beginning on page 18.			X	X	X	X	X	X
Includes Filters				X	X	X	X	X	X
One Filter Door - Side Opposite Controls only							X		
Two Filter Doors - Both Sides				X	X	X		X	X

Figure 3 - Optional Roof Curb (Option CJ3) - Shipped Separately



NOTE:

IMPORTANT: Area enclosed by roof curb must comply with clearance to combustible materials. If the roof is constructed of combustible materials, area within the roof curb must be ventilated, left open, or covered with non-combustible material which has an "R" value of at least 5. If area within curb is left open, higher radiated sound levels may result.

Roof Curb Dimensions - inches (mm)			
Sizes	1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	2-80, 2-120, 119, 120	3-180, 3-260, 122, 130
A	84-5/8 (2149)	84-5/8 (2149)	131-3/4 (3346)
B	43-5/8 (1108)	67-9/16 (1716)	82-1/16 (2084)
C	80-7/8 (2054)	80-7/8 (2054)	128 (3251)
D	39-7/8 (1013)	63-13/16 (1621)	78-5/16 (1989)
Weight	133 lbs (60 kg)	167 lbs (76 kg)	236 lbs (107 kg)

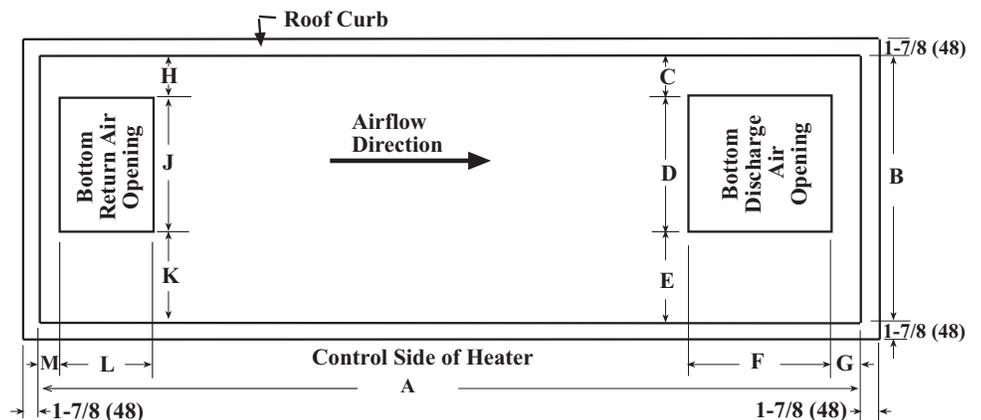
Roof Curb Installation Instructions - Option CJ3

CAUTION: Before assembly, recheck 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 dimension table above.

1. Position the curb cross rails and curb side rails as shown in the assembly drawing. Fasten curbing pieces with bolts and lag screws as illustrated in the corner detail.
2. Check the assembly for squareness. The curb must be adjusted so that the diagonal measurements are equal within a tolerance of $\pm 1/8"$.
3. Level the roof curb. To ensure a good weatherproof seal between the unit 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 the roof deck before installing flashing.
4. Install field-supplied flashing.
5. Before placing the unit into position, apply furnished 1/4" x 1-1/4" foam sealant tape to the top surface of the curb, making good butt joints at corners. The unit must be sealed to the curb to prevent water leakage into the curb area due to blown rain and capillary action.

Roof Curb and Bottom Duct Connections - If the system being installed has a bottom return air and/or a bottom discharge air opening, the openings have duct flanges for connection to field installed ductwork. This illustration shows duct opening sizes and spacing in relation to currently manufactured optional roof curbs.

Note: Duct openings should be cut larger than the duct size for installation clearance.



Dimensions

Sizes		A	B	C	D	E	F	G	H	J	K	L	M
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	inches	80-7/8	39-7/8	5-7/16	22	12-7/16	19-1/8	10-7/16	5-7/16	22-1/8	12-5/16	17	3/16
	mm	2054	1013	138	559	316	486	265	138	562	313	432	5
2-80, 2-120, 119, 120	inches	80-7/8	63-13/16	13-15/16	27-1/2	22-3/8	27-1/2	7-7/16	6-11/16	41-7/8	15-1/4	22	4-5/16
	mm	2054	1621	354	699	568	699	189	170	1064	387	559	110
3-180, 3-260, 122, 130	inches	128	78-5/16	12-13/32	37	28-29/32	37	6-7/8	9-5/8	57-1/8	11-9/16	30-1/4	9-3/8
	mm	3251	1989	315	940	734	940	175	244	1451	294	768	238

6. Uncrating

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, document the damage with the carrier and contact your distributor.

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

Gas Controls

Standard Gas Control (AG30)
Option AG31
Option AG32
Option AG33

Air Controls

Standard Air Control (AR21)
Option AR19
Option AR20
Option AR22
Option AR23

Shipped-Loose Parts

*Remote Temperature Selector
Space Override Thermostat
*Remote Temperature Selector
Remote Temperature Selector
Shipped-Loose Parts
None
*Potentiometer
Remote Pressure Sensor
*Potentiometer
Remote Pressure Sensor

*These controls are mounted on the console. The console is shipped separately.

On Size 3-180, 3-260, 122, and 130 systems, the 24-volt wiring enclosure is packed inside the cabinet for field-installation. The package includes the enclosure base with waterproof plugs, the enclosure cover, and hardware. (See Paragraph 11 for installation instructions.)

On all sizes with an optional dirty filter switch, the tubing and clamps are shipped inside the cabinet.

Be sure that all shipped-separate accessories for the installation are available. All installations include a remote console. Other shipped-separate accessories could include a roof curb, an outside air hood, a disconnect switch, and/or an indoor filter cabinet.

7. Clearances - All Sizes

Clearance to combustibles is defined as the minimum distance from the heater to a surface or object that is necessary to ensure that a surface temperature of 90°F above the surrounding ambient temperature is not exceeded. 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.

Clearances - inches (mm)				
Top	Control Side	Side Opposite Controls	Bottom	
			To Combustibles	To Non-Combustibles
3 (76)	Width of unit	3 (76)	3 (76)	0 - Curb

8. Rigging

All cabinets are furnished with a curb cap and four lifting lugs for attaching rigging. To prevent damage to the cabinet, use spreader bars with the rigging chains.

9. Mounting

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

NOTE: Net weights are approximate for the standard system. Optional equipment is not included.

Net Weight of Basic System								
Sizes	1-20	1-40	1-50	1-65	2-80	2-120	3-180	3-260
	110-A	112-A	115-A	118-A	119-A	120-A	122-A	130-A
lbs	915	925	935	950	1455	1505	2410	2480
kg	415	420	424	431	670	683	1093	1125

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

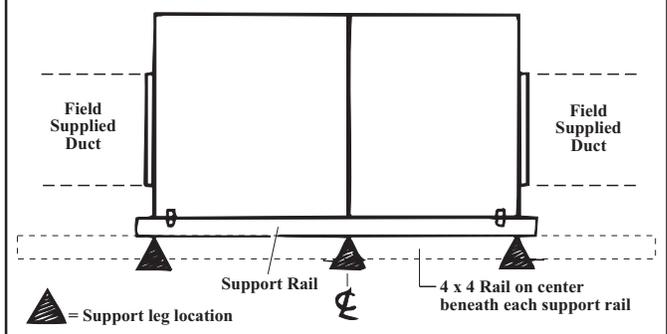
When selecting a location for an outdoor installation, position the unit so that the air inlet will **NOT** be facing into the prevailing wind. A minimum of 14" (356mm) clearance is required from the bottom of the air inlet hood to the mounting surface.

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.

Mounting on Field-Supplied Supports

Units may be placed directly on a slab or on a roof where support is adequate. The curb cap provides required clearance from combustibles.

Figure 4 - Slab Mounting

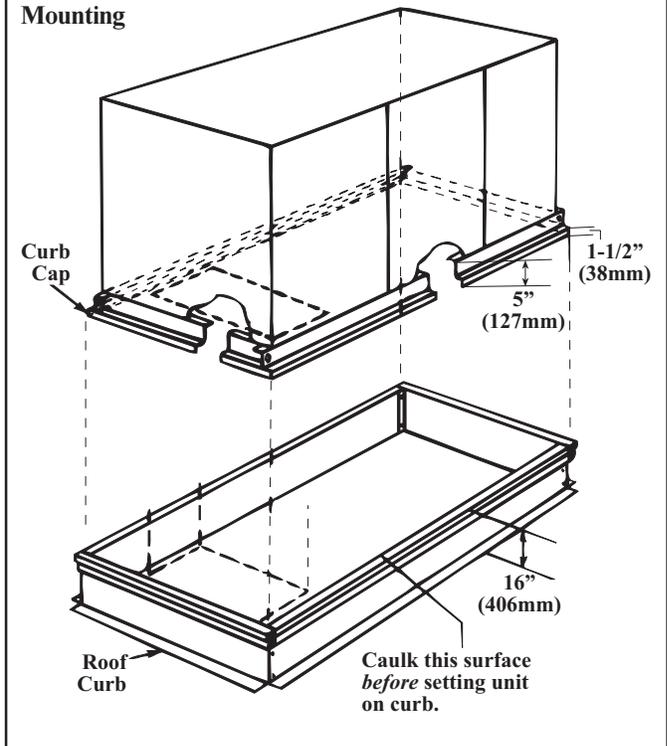


Mounting on a Roof Curb

CAUTION: Before installation, 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 in Figure 3.

Apply weather stripping or caulking to the roof curb. Lift the unit to the roof and set it on the curb.

Figure 5 - Curb Mounting



10. 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 (See Figure 1 for duct connection dimensions.):

- 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.).
- 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, the 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.

11. 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). Check any local ordinances or utility company requirements that apply.

Wire Gauge Sizes -- 100 ft maximum								
Full Load Amps	5	10	15	20	25	30	35	40
Wire Gauge	14	14	12	10	8	8	6	6

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 60°C. For motor load amps, see Paragraph 13 or check the motor nameplate. System FLA is on the rating plate.

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. Refer to Figure 6 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.

When providing or replacing fuses in a fusible disconnect switch, use dual element time delay fuses and size according to 1.25 times the maximum total input amps.

Convenience Outlet Option

When a convenience outlet option is included, an individual power supply must be provided to the receptacle. This circuit **MUST BE** on a ground fault breaker to meet requirements. All wiring to the convenience outlet must meet National Electrical Code ANSI/NFPA No. 70 (latest edition) and any local or utility codes that may apply.

Control Wiring

A separate weatherproof field wiring enclosure is provided as the entrance of 24-volt control wiring to the electrical compartment. For locations, see Figure 6, page 8. Low voltage wiring must be in individual conduit, separated from primary high voltage wiring.

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.

A 3-position control switch is the standard switch supplied with each system, either packed loose inside the unit or mounted on a remote console.

Control Wiring Enclosure

On Sizes 1-20, 1-40, 1-50, 1-65, 2-80, 2-120, 110, 112, 115, 118, and 119, the 24-volt field-wiring enclosure is factory-mounted on the heater. Remove the cover to facilitate feeding the 24-volt wiring through the enclosure. When replacing the cover, be careful to slide it under the edge of the heater to maintain waterproof integrity.

On Sizes 3-180, 3-260, 122 and 130, the 24-volt field-wiring enclosure is packed inside the heater for field installation. The package contains all items in the table.

Qty	Description
10	1/2 x 10 Sheetmetal Screws
1	SB-1, 500-21 Heyco Bushing
1	Enclosure Base with three plugs
1	Enclosure Cover

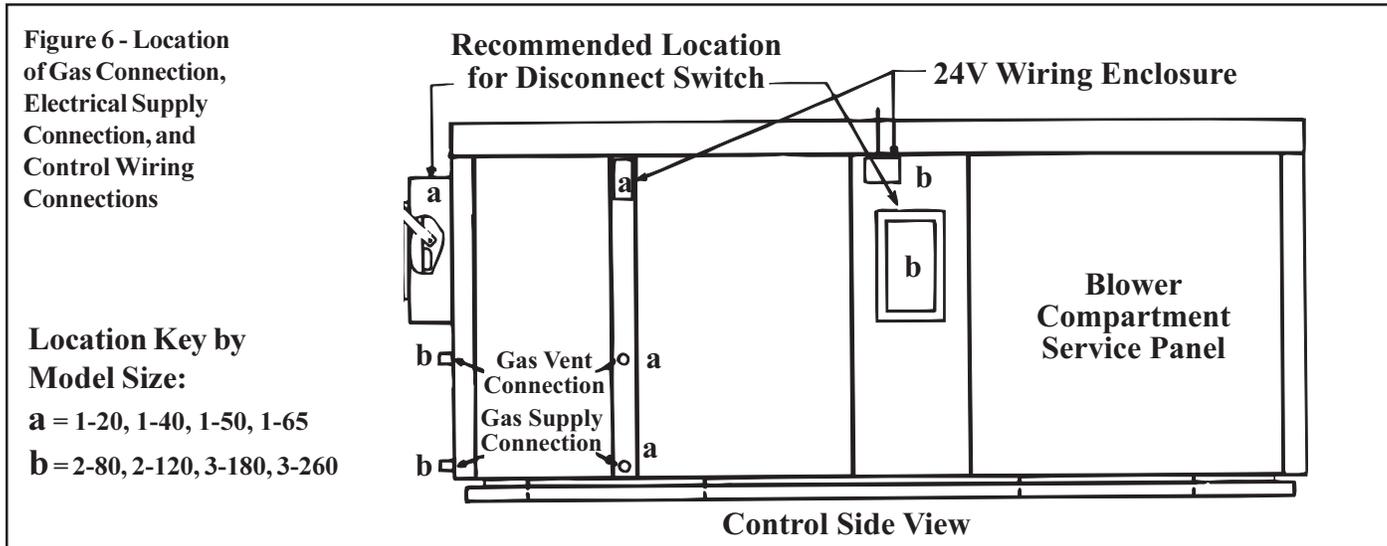
Instructions for Installing 24-volt Wiring Enclosure

1. Refer to Figure 6, page 8, for mounting location. Loosen the screws that are in the top side of the cabinet in the selected location. Slide the field-wiring enclosure base under the edge of the top of the cabinet.
2. Align the four mounting holes in the enclosure base with the holes in the cabinet side panel. Attach the enclosure base with four sheetmetal screws.
3. Insert the Heyco bushing through the side panel of the unit.
4. Feed the 24-volt control wiring through the control-wiring enclosure.
5. To install the enclosure cover, slide the upper edge of the enclosure cover under the top panel of the cabinet. Place the cover on the base and secure it using the six remaining sheetmetal screws.
6. Tighten the two screws loosened in Step No. 1.

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

Control Wiring Enclosure (cont'd)

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.



Control Wiring - Maximum Lengths			
Volts	Wire Gauge	Total Wire Length	Distance from Unit to Control
24	18	150 ft (45.7M)	75 ft (22.9M)
24	16	250 ft (76.2M)	125 ft (38.1M)
24	14	350 ft (106.7M)	175 ft (53.3M)

CAUTION: If any of the original wire must be replaced, the replacement wire must have a temperature rating of at least 105°C except for sensor lead wire which must be 150°C. See Hazard Levels, page 2.

Figure 7 - Technical Data of the Remote Console (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 (mm)			Locations of Knockout Holes (dimensions to centerlines of holes)
				L****	H****	D	
Yes	3	Yes	No	10-3/4 (273)	7-3/16 (183)	2-5/8 (67)	
Yes	3	No	No	10-3/4 (273)	7-3/16 (183)	2-5/8 (67)	
Yes	3	Yes	Yes	15-3/4 (400)	7-3/16 (183)	2-5/8 (67)	
Yes	3	No	Yes	10-3/4 (273)	7-3/16 (183)	2-5/8 (67)	
Yes	4	Yes	No	15-3/4 (400)	7-3/16 (183)	2-5/8 (67)	
Yes	4	No	Yes	15-3/4 (400)	7-3/16 (183)	2-5/8 (67)	
Yes	4	Yes	Yes	15-3/4 (400)	7-3/16 (183)	2-5/8 (67)	
Yes	4	No	No	15-3/4 (400)	7-3/16 (183)	2-5/8 (67)	

* 3 - Blower On, Burner On, and Safety Lockout;
 4th light is Dirty Filter Indicator
 ** On the console with Standard Gas Controls, Options AG31, 32, or 33
 *** On the console with Air Control Options AR19 or AR22
 **** Subtract 5/8" (16mm) when recessing

Remote Indicator/Control Console - The remote console is shipped separately. Remote consoles include terminal blocks for wiring. All consoles include a 3-position summer/winter/vent switch and three indicator lights. The lights are labeled "Burner on", Blower on", and "Safety Lockout". Depending on what gas control or inlet air options were ordered, the console could include a temperature selector and/or a potentiometer. If a dirty filter switch is ordered the indicator light is on the console. See Figure 7 for console size.

Dirty Filter Light - When a console with a dirty filter indicator is selected, the remote console includes a fourth light (dirty filter indicator

light). The light is activated by an adjustable, single-pole/normally open differential pressure switch that senses air pressure across the filter bank. There are field-installation procedures that must be done for the proper operation of the dirty filter indicator light.

Instructions

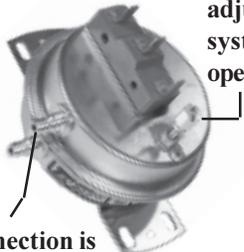
- Before the system is operating, connect the sensing tubes from the switch to their sensing locations in the field-installed filter cabinet. (Cabinet installation instructions are in Paragraph 15.)
 - Run the tubes through the holes in the cabinet wall. Pull gently to extend the tubing to its entire length without stress.

- 2) Position the tubing approximately at the center of the height of the filter rack.
- 3) Identify the tube connected to the positive connection on the switch (Figure 8) as the positive pressure tube. Determine the length of tubing required to attach the **positive pressure tube so that it will sense pressure at the inlet side** of the filter rack. Identify the tube connected to the negative connection on the switch (Figure 8) as the negative pressure tube. Determine the length of tubing required to attach the **negative pressure tube so that it will sense the pressure at the blower side** of the filter rack.

(NOTE: Tubing shipped is the same length for all sizes of systems; cut to the appropriate length for the smaller systems.)

Figure 8 - Dirty Filter Pressure Switch

Negative pressure connection is toward the "back or bottom" of the switch (senses blower side of filters)



Set screw (on front of switch) must be manually adjusted after system is in operation.

Positive pressure connection is toward the "front or top" of the switch (senses air inlet side of filters)

- 4) If required, cut the tubing to the proper lengths. Using the clamps provided, attach the ends of the tubing to the filter rack at about center height being careful not to kink or compress the tubing.
- **After the system is operating, the filter switch must be manually set.** With clean filters in place, blower doors closed, and blower in operation, increase the pressure setting by adjusting 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 that setpoint, the filter light will be activated at approximately 50% filter blockage.

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-.20" 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 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. Conversely, as less pressure is required, the switch drives the damper in the opposite direction.

Installation Instructions for Pressure Null Switch (Refer to Figure 9):

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.

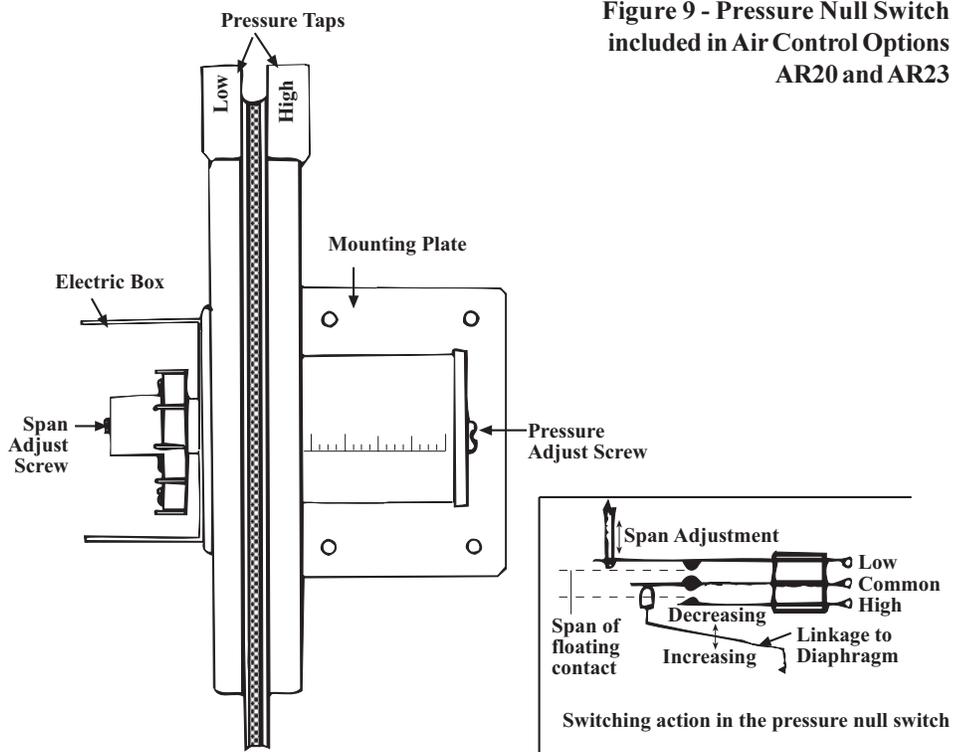


Figure 9 - Pressure Null Switch included in Air Control Options AR20 and AR23

12. 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. 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 10. Local codes may require a 6" condensate trap. Gas connection is either 1", 1-1/4", or 2" depending on the size of the system.

WARNING: All components of the gas supply system must be leak tested prior to placing equipment in service. NEVER TEST FOR LEAKS WITH AN OPEN FLAME.

High pressure testing of supply lines is acceptable, provided the supply line has been disconnected from the unit and the pipe end is capped. See Hazard Levels, page 2.

Supply Pressure - These direct-fired makeup air systems are designed to operate on a natural gas supply pressure range from 6" w.c. minimum 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 stepdown gas regulator in the supply line. Measure the gas pressure between the stepdown regulator and the unit. Refer to the table below for the minimum supply pressure.

Gas Supply Pressure Requirements

Natural Gas	Minimum	6" w.c. plus the manifold pressure drop
	Maximum	5 psi
Propane Gas	Minimum	2" w.c. plus the manifold pressure drop
	Maximum	5 psi

Follow the steps and instructions in Paragraph 14, Check-Test-Start, to determine minimum gas inlet pressure for your specific installation.

Manifold Pressure Drops and Minimum Supply Pressure (" w.c.)

MBH	Burner	Standard Manifold	Option BM5 or BM7	Option BM9, BM10, or BM11
250	Std	0.9	0.7	N/A
500	BL2	2.3	1.9	N/A
750	BL3	6.8	3.9	N/A
1000	BL4	N/A	N/A	3.0
1250	BL5	N/A	N/A	4.0
1500	BL6	N/A	N/A	5.1
1750	BL7	N/A	N/A	6.6
2000	BL8	N/A	N/A </td <td>8.0</td>	8.0
2250	BL9	N/A	N/A	2.5
2500	BL10	N/A	N/A	2.9
2750	BL11	N/A	N/A	3.3
3000	BL13	N/A	N/A	3.8

Pilot Supply Pressure - These systems are designed to operate on a natural gas pilot supply pressure of 3.5" w.c. or propane gas of 6.0" w.c.

Measure both operating pressure and pilot supply pressure with the blower in operation.

Figure 10 - Gas Supply Connection

Gas Pipe Connections at the Unit

Burner Size MBH	Burner Option	Pipe Size
250 - 750	BL2, BL3	1" IP
>750 - 2,000	BL4, BL5, BL6, BL7, BL8	1-1/4" IP
>2,000 - 3,000	BL9, BL10, BL11, BL13	2" IP

CAUTION: Gas piping connections are determined by burner BTU. Use this table as reference for pipe connection at the unit only.

Manifold Pressure - Manifold pressure is defined as the gas pressure as measured at the burner pressure tap. Measure manifold gas pressure with the blowers operating. Minimum gas supply pressure is determined by adding 6" w.c. (minimum required) plus the pressure drop through the manifold.

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: On units manufacturing beginning April 1993, gas pressure switches incorporate a vent limiting device and do not require venting to the outdoors when used in an application installed indoors. Indoor units manufactured prior to April 1993 with optional gas pressure require a 3/4" vent line to the outdoors.)

Gas Vent Piping for Optional Vent Valve (applies only to an indoor installation with Manifold Option BM7 or BM11) - When a system installed indoors is equipped with an optional vent valve (part of manifold Option BM7 and 11), piping must be field-installed to terminate the vent outdoors. Locate the 3/4" male pipe threads protruding from the intermediate post next to the control compartment. Extend the 3/4" piping to the outside of the building and terminate with a screen.

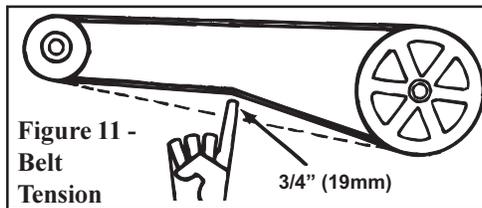
Gas Supply Piping		Capacity of Piping													
		Cubic Feet per Hour based on 0.3" w.c. Pressure Drop													
		Specific Gravity for Natural Gas -- 0.6 (Natural Gas -- 1000 BTU/Cubic Ft)													
		Specific Gravity for Propane Gas -- 1.6 (Propane Gas -- 2550 BTU/Cubic Ft)													
Length of Pipe	Diameter of Pipe														
	1"		1-1/4"		1-1/2"		2"		2-1/2"		3"		4"		
	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	Natural	Propane	
20'	350	214	730	445	1100	671	2100	1281	3300	2013	5900	3599	12000	7320	
30'	285	174	590	360	890	543	1650	1007	2700	1647	4700	2867	9700	5917	
40'	245	149	500	305	760	464	1450	885	2300	1403	4100	2501	8300	5063	
50'	215	131	440	268	670	409	1270	775	2000	1220	3600	2196	7400	4514	
60'	195	119	400	244	610	372	1105	674	1850	1129	3250	1983	6800	4148	
70'	180	110	370	226	560	342	1050	641	1700	1037	3000	1830	6200	3782	
80'	170	104	350	214	530	323	990	604	1600	976	2800	1708	5800	3538	
90'	160	98	320	195	490	299	930	567	1500	915	2600	1586	5400	3294	
100'	150	92	305	186	460	281	870	531	1400	854	2500	1525	5100	3111	
125'	130	79	275	168	410	250	780	476	1250	763	2200	1342	4500	2745	
150'	120	73	250	153	380	232	710	433	1130	689	2000	1220	4100	2501	
175'	110	67	225	137	350	214	650	397	1050	641	1850	1129	3800	2318	
200'	100	61	210	128	320	195	610	372	980	598	1700	1037	3500	2135	

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

13. Blowers, Drives, and Motors

Belt Tension

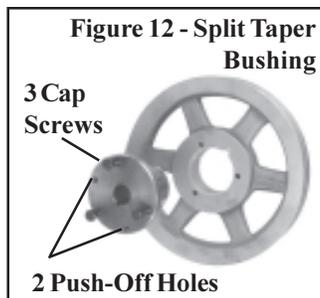
Check belt tension. Proper belt tension is important to the long life of the belt and motor. A loose belt will cause wear and slippage. Too much



tension will cause excessive motor and blower bearing wear. If adjustment is required, adjust belt tension by means of the adjusting screw on the motor base until the belt can be depressed 1/2" to 3/4" (Figure 11). Tighten the lock nut on the adjusting screw. Be sure the belt is aligned in the pulleys.

Motor and Belt Shipping Position for Sizes 2-80, 2-120, 3-180, 3-260, 119, 120, 122, 130 - To relieve tension on the motor mounting bracket, the belt(s) are taken off the motor and blower sheaves before shipping. The belt(s) are taped to the blower shaft to prevent loss or damage during shipment. Install the belt(s) and adjust for proper belt tension.

Blower Pulley - Size 2-80, 2-120, 119 and 120 systems equipped with 3 and 5 HP motors with a 15.4" diameter and larger blower pulley or a 7-1/2 HP and larger motor and all Size 3-180, 3-260, 122, and 130 systems are equipped with a split taper bushing in the blower pulley. The split taper bushings must be loosened in order to remove the pulley. Follow these instructions to loosen the bushing.



- 1) Notice that there are three cap screws in the bushing and two holes without screws, called push-off holes (See Figure 12).
- 2) Remove the three cap screws.
- 3) Put two of the cap screws into the two push-off holes. Tighten these two screws evenly until the pulley is loosened.
- 4) Pulley may now be removed from the shaft.

Blower Speed Adjustment - Units are set at the factory for the RPM required to meet the CFM and external static pressure specified on the order. If the estimated external static is incorrect, or changes are made to the duct

system, the blower RPM may have to be changed. Motors are equipped with adjustable pitch pulleys which permit adjustment of blower speed. Instructions are included in Paragraph 14, Check-Test-Start for adjusting blower speed.

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 - Use an ammeter to check motor amps. Amps may be adjusted downward by reducing blower RPM or by increasing duct system static pressure. For accurate amps, read the motor manufacturer's rating plate; amps will vary depending upon motor manufacturer. The chart below can be used for sizing line wiring.

Blower Motor Full Load Amps (open motors)						
Motor HP	1 phase		3 phase			
	115V	230V	208V	230V	460V	575V
1/2	9.8	4.9	2.2	2.0	1.0	N/A
3/4	13.8	6.9	3.1	2.8	1.4	N/A
1	16.0	8.0	4.1	3.6	1.8	1.4
1.5	N/A	10.0	5.75	5.2	2.6	2.0
2	N/A	N/A	7.5	6.8	3.4	2.4
3	N/A	N/A	10.6	9.6	4.8	3.6
5	N/A	N/A	16.8	15.2	7.6	5.4
7.5	N/A	N/A	21.0	19.0	9.5	8.4
10	N/A	N/A	29.0	25.2	12.6	10.4
15	N/A	N/A	42.0	40.0	20.0	16.0
20	N/A	N/A	53.0	50.0	25.0	20.0
25	N/A	N/A	66.0	63.0	31.5	26.0
30	N/A	N/A	78.0	74.0	37.0	28.5
110V Std Control Amps	6.0	3.0	3.4	3.0	1.5	1.2

CAUTION: The above chart lists full load amp requirement of standard motor and standard controls. Optional controls will increase amp requirement. Add motor amps and control amps for approximate unit full load amps. System FLA are shown on the rating plate.

14. Check-Test Start

Figure 13A

KEY:

- 1 - Burner
- 2 - Discharge Damper Motor (Options AR19 & 20)
- 3 - Discharge Damper (Options AR19 & 20)
- 4 - Manual Reset Limit
- 5 - Automatic Limit
- 6 - Discharge Air Sensor
- 7 - Blower Motor
- 8 - Damper Motor (Optional)
- 9 - Return Air Damper (Options AR22 & 23)
- 10 - Bypass Damper (Options AR19, 20, 22 & 23)

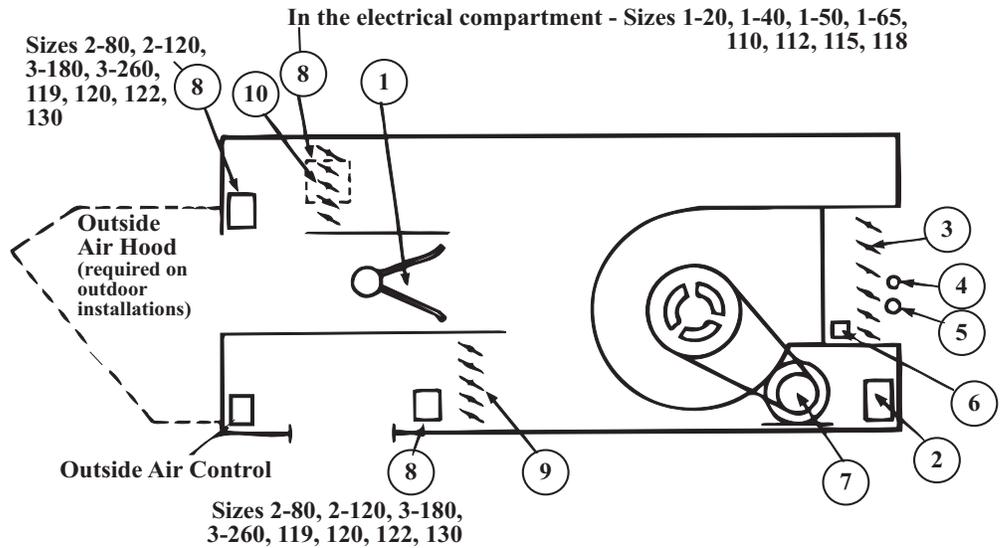
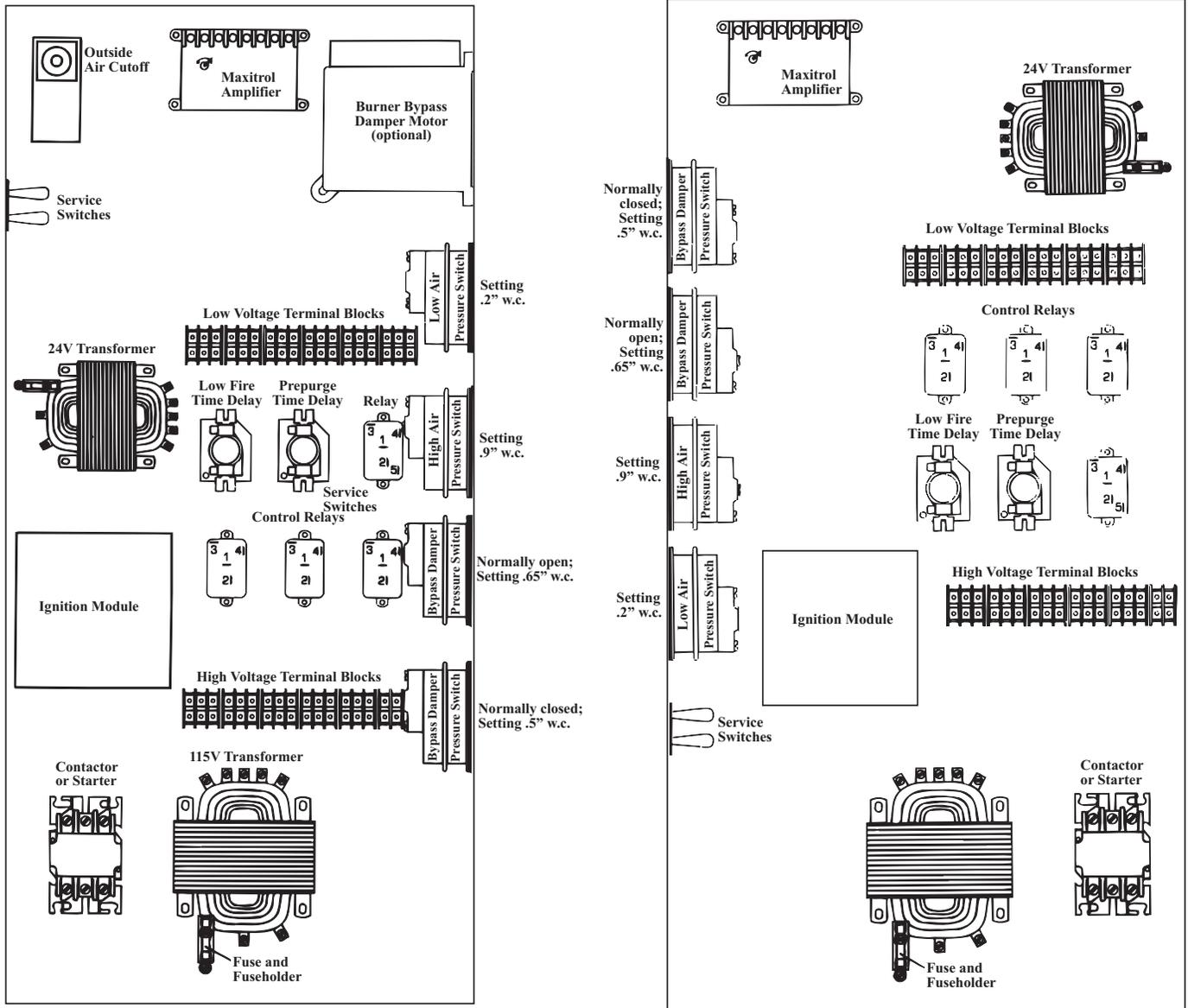


Figure 13B - Electrical Compartment (Optional diagnostic status light board is not shown.)

Sizes 1-20, 1-40, 1-50, 1-65, 110, 112, 115, and 118

Sizes 2-80, 2-120, 3-180, 3-260, 119, 120, 122, and 130



Check/Test/Startup Procedures (Follow Steps in Sequence)

KEY: Procedure applies to all units.

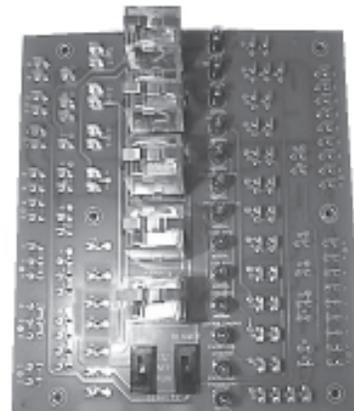
Procedure only applies to units with the optional component referred to in that procedure

Before Startup

- 1. Check to be sure that all field-installed accessories are installed.
- 2. Check all field-installed wiring.
- 3. Check all ductwork for obstructions; open all diffusers.
- 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 dual element time delay fuses sized 1.25 times the maximum total input amps. Verify continuity of fuses.
- 7. Open the gas and electric control compartment door panels --
 - Close all manual gas valves.
 - Check all wiring and wiring connections on gas controls and electrical components.
 - If equipped with any manually reset devices such as an optional firestat limit switch, a high limit switch, and/or optional high gas pressure switch, reset devices. Check setpoint on the outside air control (60°F).
- 8. In the blower compartment --
 - Remove any blocking and shipping supports.
 - Check that the blower belts are installed and have correct tension and that pulleys are in alignment and locked to the shaft (See Paragraph 13).
 - Inside the compartment, remove the cover from the limit switch junction box.
 - Reset manual limit switch.
 - Check wiring connections to limit switches, discharge air sensor, and motor.
 - Replace the junction box cover.
- 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.
- 10. Turn blower service switch (Electrical Compartment, See Figure 13) to OFF position. If present, verify that damper test switch is in TEST position.

Startup

- 1. Prepare system for startup testing --
 - Attach a slope gauge (0 to 1.0" scale) to the tubing connections in the control compartment. Disconnect plastic tubing from high and low air pressure connections (mark tubing) in electrical control compartment. Connect slope gauge between the high and low pressure connections. (Located in the gas control compartment, the high pressure connection is on the right, low pressure is on the left.)
 - Connect a "U"-tube manometer to the main burner pressure tap.
 - Check optional status lights (If the system is equipped with an optional lighted status board (Option BS2), check the lights at each step in the Startup procedure.)
 - Turn ON disconnect switch.
 - If equipped with optional status lights, check the lighted status panel - "Circuit Control Power" light is lit.
 - Turn OFF disconnect switch.
 - Turn the disconnect switch ON and the blower service switch to TEST position.
 - If equipped with optional status lights, check for lights - "Control Switch Energized", "Starter Energized", and if equipped with a freezestat, "Freezestat". After blower obtains normal speed, check for these lights - "Outside Air Cutoff Normal";



14. Check-Test Start (cont'd)

Startup (cont'd)

"Low Air Pressure Normal", "Limit Controls Normal"; "High Air Pressure Normal"; and if equipped with options; "Low Gas Pressure Normal"; and/or "High Gas Pressure Normal")

- Check for blower rotation. If the blower is turning backwards (see rotation arrows), do the following:

Turn the disconnect switch OFF

Single-phase units -- rewire motor per instructions on motor wiring plate

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

Turn disconnect switch ON and verify rotation.

2. Measure (1) burner differential **air** pressure on the slope gauge and (2) the negative pressure created in the gas line by operation of the blower. With the blower operating, differential air should read between $-.5"$ and $-.65"$ w.c. If the slope gauge reading is not within the limits of these numbers, do one of the following:

If the slope gauge reading is greater than $-.5"$ (such as $-.3"$ w.c.), adjust the drive to increase the blower speed.

- (1) Turn disconnect switch OFF.

- (2) If equipped with a discharge damper, remove opposite side blower door panel.

Turn disconnect switch ON.

Check that discharge damper is full open by loosening or tightening the linkage.

Turn disconnect switch OFF.

Replace door panel.

Turn disconnect switch ON and recheck slope gauge.

Turn disconnect switch OFF.

- (3) If reading is still greater than $-.5"$ w.c., adjust drive to increase fan RPM.

For systems with smaller than 7-1/2 HP motor

- (a) Loosen belt tension and remove belt.

- (b) Loosen the set screw on the side of the pulley away from the motor.

- (c) Turn adjustable half of the pulley inward to increase blower speed. One turn of the pulley will change speed 8 to 10%.

- (d) Tighten the set screw on the flat portion of the pulley shaft.

For systems with 7-1/2 HP and larger motor

- (a) Slack off all belt tension by moving the motor toward driven shaft until the belts are free of grooves. For easiest adjustment, remove the belts from the grooves.

- (b) On the outer locking ring, locate the two locking screws that are directly across from each other. Loosen, but do not remove, those two screws. Do not loosen any other screws.

- (c) Adjust sheave to desired pitch diameter by turning the outer locking ring. One complete turn of the outer locking ring will result in $.233"$ change in pitch diameter. To increase blower speed, decrease diameter. **CAUTION:** Do not adjust sheaves in either direction to the point where moveable and stationary flanges are in contact.

- (d) Re-tighten the locking screws.

All Motor Sizes - Replace the belts and check belt tension. Be sure that belts are aligned in the pulley grooves and are not angled from pulley to pulley.

If the slope gauge reading is less than $-.65"$ (such as $-.9"$ w.c.), adjust the drive to decrease the blower speed.

- (1) Turn disconnect switch OFF.

- (2) If equipped with a discharge damper, remove opposite side blower door panel.

Turn disconnect switch ON.

Check that discharge damper is full open by loosening or tightening the linkage.

Turn disconnect switch OFF.

Replace door panel.

Turn disconnect switch ON and recheck slope gauge.

Turn disconnect switch OFF.

- (3) If reading is still less than $-.65"$ w.c., adjust drive to decrease fan RPM.

For systems with smaller than 7-1/2 HP motor

- (a) Loosen belt tension and remove the belt.

- (b) Loosen the set screw on the side of the pulley away from the motor.

- (c) Turn the adjustable half of the pulley outward to decrease blower speed. One turn of the pulley will change speed 8% to 10%.

- (d) Tighten the set screw on the flat portion of the pulley shaft.

For systems with 7-1/2 HP and larger motor

- (a) Slack off all belt tension by moving the motor toward driven shaft until the belts are free of grooves. For easiest adjustment, remove the belts from the grooves.

- (b) On the outer locking ring, locate the two locking screws that are directly across from each other. Loosen, but do not remove, those two screws. Do not loosen any other screws.

- (c) Adjust sheave to desired pitch diameter by turning the outer locking ring. One complete turn of the outer locking ring will result in $.233"$ change in pitch diameter. To decrease blower speed, increase diameter. **CAUTION:** Do not adjust sheaves in either direction to the point where moveable and stationary flanges are in contact.

- (d) Re-tighten the locking screws.

All Motor Sizes - Replace the belts and check belt tension. Be sure that belts are aligned in the pulley grooves and are not angled from pulley to pulley.

- Turn on the disconnect switch and re-check the slope gauge. If air pressure differential is within the limits of $-.5"$ to $-.65"$ w.c., no further adjustment is required. If the air pressure differential is not within those limits, re-adjust the blower speed.

- 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.

- Record the negative pressure reading (blower operating) on the manometer in the gas line. (This measurement will be needed if Startup Step 5 is required.)

- 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.

- Turn the blower switch to OFF and damper test switch to RUN. Turn the disconnect switch OFF. Disconnect the manometer and the slope gauge. Reconnect the tubing to the correct pressure connections.

DETERMINE the type of gas control system from the unit rating plate:

<u>Serial No. Suffix</u>	<u>Option</u>	<u>Gas Control System</u>
MV7	AG30 or AG31	Maxitrol Series #14 (Amplifier A1014)
MV8	AG32	Maxitrol Series #14A (Amplifier A1014)
MV9	AG33	Maxitrol Series #44 (Amplifier A1044)
MVC	AG37	Maxitrol Series #DDC (Signal Conditioner A200)

For units with Maxitrol Series 14 or 14A, remove and individually tape wires from Terminals #4 and #8 on the amplifier

For units with Maxitrol Series 44, remove and individually tape wires from Terminals #2, #4 and #8 on the amplifier

For units with Maxitrol Series DDC, the customer provided input signal must be 4-20 milliamps (conditioner dip switch "on") or 0-10 volt DC (conditioner dip switch "off").

IMPORTANT NOTE: The instructions in 3A are designed for systems manufactured after 3/96 equipped with hot surface ignition. If the system being started is equipped with a spark pilot and a flame rectification or ultraviolet flame sensor, follow instructions in 3B.

3A. Check pilot and burner ignition and pilot operation (hot surface ignition)

- Turn the disconnect switch ON. Turn blower service switch and burner service switch to TEST position.
- Observe for ignition through the viewport.
- If equipped with optional status lights, check for lights - Lights listed in prior Steps should be energized). 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.
- 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 5.) Remove the manometer.
- Leak test all connections in the pilot and main burner supply lines. **WARNING: DO NOT TEST WITH OPEN FLAME.**
- Check output of pilot flame signal. Use microampmeter; reading should be .5.
- 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.
- 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.

3B. Check pilot and burner ignition and pilot operation

- Remove cover from flame safeguard relay (in the electrical compartment).
- Disconnect and tape orange wire from Terminal C on 115 volt terminal strip leading to flame safeguard relay. Wire must be taped. This disrupts power to safety valve(s) after establishing pilot.
- Jumper Terminals K and L on 115 volt terminal block. This bypasses outside air cutoff.
- Open main, pilot and leak test shutoff valves.
- Turn the disconnect switch ON. Turn blower service switch and burner service switch to TEST position.
- Observe pilot for spark and ignition through the viewport.
- Turn pilot manual shutoff valve OFF. After pilot goes out, flame safeguard relay should lockout.
- Turn disconnect switch OFF and burner service switch to OFF. Reset flame safeguard relay and replace cover. Turn pilot manual shutoff valve ON. Reconnect wire to Terminal C on 115 volt terminal block from the flame safeguard relay. Turn disconnect switch ON. Turn burner service switch to TEST position. Observe spark and pilot operation. Observe "low-fire" start. Burner should lightoff across the whole length.
- If equipped with optional status lights, check for lights - Lights listed in prior Steps should be energized). 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.
- Using microampmeter, check the output of pilot flame at flame safeguard relay. (May require a flame current test jack.)

Type of Flame Sensor	Microamps
RA890F (Flame Rectification)	2.0-5.0
RA890G (Ultraviolet)	1.5-3.0
R7795A (Ultraviolet)	3.5-7.5
R7795B (Flame Rectification)	2.0-5.0

14. Check-Test Start (cont'd)

Startup (cont'd)

- 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 5.) Remove the manometer.
- Leak test all connections in the pilot and main burner supply lines. **WARNING: DO NOT TEST WITH OPEN FLAME.**
- Turn disconnect switch OFF. Reconnect wire to Terminal #8 on the amplifier. Turn disconnect switch ON. Observe burner. Unit should stage through spark, pilot, low-fire, and then go to high-fire.
- 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.

4. Check pilot pressure (hot surface ignition units only) --

- To check pilot gas pressure, connect a "U"-tube manometer to the pressure tap on the downstream side of the pilot solenoid valve.
- Put BOTH the blower and burner switch in TEST position. Turn ON disconnect switch. Blower should be energized.
- Measure pilot gas pressure. Pilot pressure for natural gas should be 3.5" w.c.; pilot pressure for propane gas should be 6" 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 counter-clockwise 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.

5. If, with the blower and burner operating, the main gas pressure measured in Step 3 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 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. NOTE: High outside air temperature on high fire may cause the automatic high limit to trip. Manometer reading may only be available for a very short time.

Calculate the required burner differential gas pressure --
Factor 1 - Actual Gas Pressure Reading with blower and burner operating (just recorded)

Factor 2 - Negative pressure Reading in the gas line with blower operating as recorded in Startup Step 2

Ignoring the minus, deduct the negative pressure from the actual gas pressure. **EXAMPLE:**

Gas Pressure Reading	5.7" w.c.
Negative Pressure	-.6" w.c.
Differential Pressure	5.1" w.c.

Differential gas pressure is the figure used when determining minimum gas supply pressure. Add differential gas pressure plus the drop in gas pressure as it flows through the gas train (See Paragraph 13) to determine the minimum required supply pressure of inlet gas.

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.
- Remove the manometer and replace the plug.

Startup for Continuous Operation

- System with flame rectification or ultraviolet sensor (manufactured prior to 3/96), reconnect wires to Terminals #2 and #4 on the amplifier.
- Remove all jumper wires and reconnect wires.
- Verify that the blower, burner, and damper switches are in RUN position. **CAUTION:** If blower or burner service switches are left in TEST position, they will override control from the remote console, switch, or automatic control.
- Check that all manual valves are ON.
- 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. **CAUTION:** Burner will not operate if ambient air temperature is above setpoint of outside air control (factory setting is 60°F).

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.

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 a factory representative. 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.

Field Installed Accessories

15. Optional Screened Air Hood for outdoor Units (Options AS2, AS6, AS7) and Filter Sections for Indoor Units (Options AW3, AW6)

All of these air inlet accessories are designed to be attached directly to the system cabinet. All are shipped separately and require field installation. See Paragraph 5 for a brief description and the dimensions of these optional accessories.

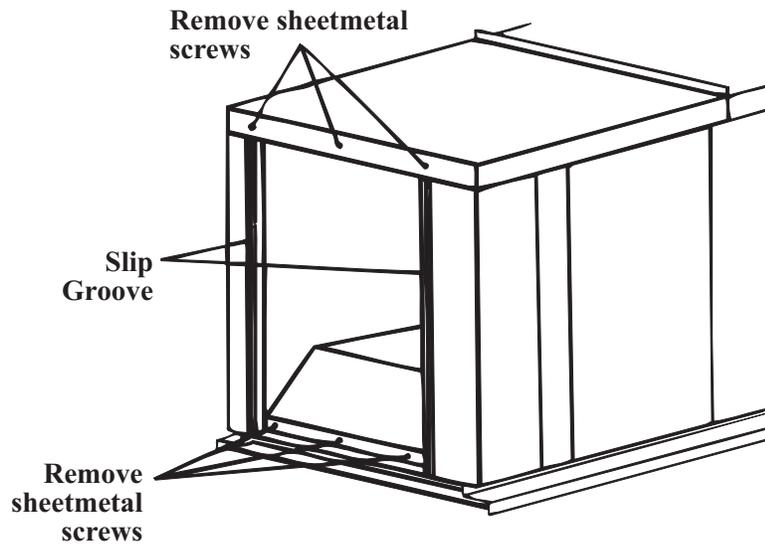
CAUTION: It is recommended that the inlet to the outside air hood NOT be facing into prevailing wind.

Provide a minimum of 14" clearance from the bottom of the air hood to the mounting surface.

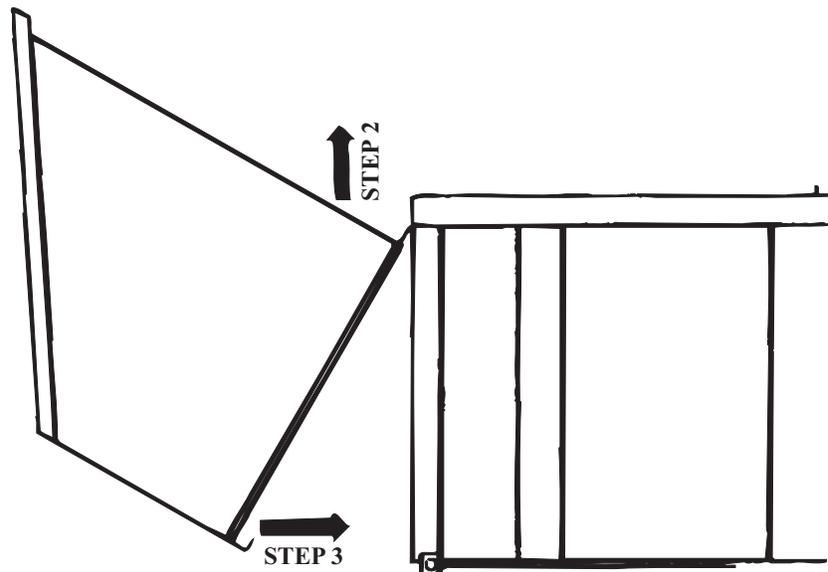
Item	Options	Description	For Sizes	Installation Requirements
1	AS2, AS6, AS7	Outdoor Screened Air Hood with and without filters	1-20, 1-40, 1-50, 1-65, 2-80, 2-120, 110, 112, 115, 118, 119, 120	Factory Assembled; Field Installed - Follow instructions below.
2	AS2, AS6, AS7	Outdoor Screened Air Hood with and without filters	3-180, 3-260, 122, 130	Field Assembled and Installed - Follow instructions pages 19 to 22.
3	AW3, AW6	Indoor Filter Cabinet with Filters	All	Factory Assembled; Field Installed - Follow instructions below.

Installation Instructions for Items 1 and 3 above

- 1) Remove the sheetmetal screws from the bottom rear inset and across the top rear of the cabinet.



- 2) Align edges of assembly to the slip grooves. Slide top edge of assembly under the lip formed by the top rear of the cabinet.
- 3) Rotate the inlet assembly so that it fits into the recess across the bottom of the cabinet. Replace all screws removed in Step 1.
- 4) If the system has filters with an optional dirty filter light, follow the instructions on page 9 to attach the sensing tubes.



Instructions for Installing Item 2 above →

Installation Instructions for Item 2 on page 18

- Option AS2** Outdoor Screened Air Hood without Filters - Pkg P/N 71150
Option AS6 Outdoor Screened Air Hood with 1" Filters - Pkg P/N 71152
Option AS7 Outdoor Screened Air Hood with 2" Filters - Pkg P/N 72627

Components	Option AS2		Option AS6		Option AS7	
	Qty	P/N	Qty	P/N	Qty	P/N
Top of Inlet Hood Cabinet Section	1	91575	1	91575	1	91575
Top of Inlet Hood	1	91576	1	91576	1	91576
Clamp for Top Seam (Hood to Cabinet)	1	91577	1	91577	1	91577
Bottom of Hood Cabinet Section	1	91567	1	91567	1	91567
Supports (2 pieces per leg)	6	91581	6	91581	6	91581
Left Side of Hood	1	91568	1	91568	1	91568
Right Side of Hood	1	91569	1	91569	1	91569
Intermediate Posts - Cabinet Section	2	91578	2	91578	2	91578
Right Corner Post - Cabinet Section	1	91579	1	91579	1	91579
Left Corner Post - Cabinet Section	1	91579	1	91579	1	91579
Doors (Filter Access on AS6 and AS7)	2	91585	2	91585	2	91585
Center Louver Top/Bottom Supports	2	91582	2	91582	2	91582
Factory-assembled Louver Sections with Screens	2	113003	2	113003	2	113003
Top and Bottom Filter Channels		N/A	2	91580	2	94224
Pre-assembled Center Filter Channels		N/A	5	91586	5	94223
Top Filter Block Off Plate		N/A	1	91584	1	98764
Bottom Filter Block Off Plate		N/A	1	91584	1	98764
Filter Block Off Sections		N/A	6	95335	6	96335
Permanent Filters		N/A	12	1", 87251	12	2", 94383
Sheetmetal Screws #10 x 1/2" long	100	11813	100	11813	100	11813
Screws 1/4-20 x 5/8" long (bolt type)	15	10393	15	10393	15	10393
Hex Nuts 1/4-20 (Keps)	15	7328	15	7328	15	7328
Sheetmetal Screws #14-110 x 3/4" long	3	41463	3	41463	3	41463
Tinnerman Clip, Palnut #PW-1880-008-21	5	87900	5	87900	5	87900

(See Paragraph 5 for dimensions and weights.)

Assembly and Installation Instructions (Do not install while system is operating.)

- Screened Air Inlet Hoods *with* Filters** (Options AS6 and AS7 for Sizes 3-180, 3-260) - Build filter racks and cabinet section; *follow all Steps*.
Screened Air Inlet Hood *without* Filters (Option AS2 for Sizes 3-180, 3-260) - Build cabinet section; skip Steps 1A, 1B, and 1C. **Start with Step 1D** ignoring filter rack illustrations.

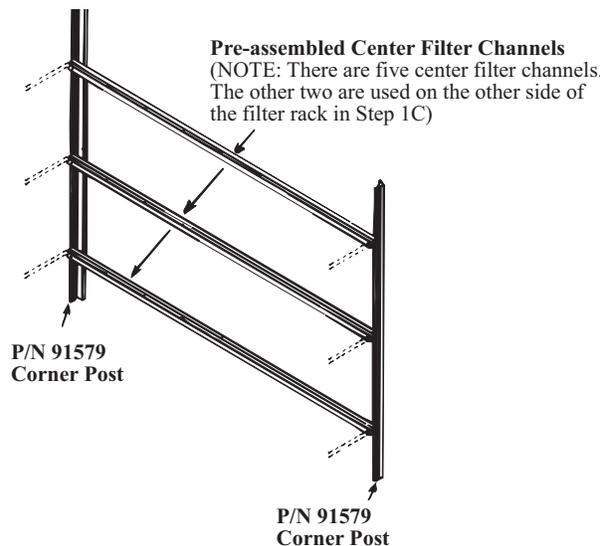
Step 1A - Assemble Inner Side of Filter Rack (Applies to Options AS6 and AS7 only; for Option AS2 without filters, proceed to Step 1D)

Parts Required -- Right corner post, left corner post, three of the five pre-assembled center filter channels, and twelve 1/2" long screws

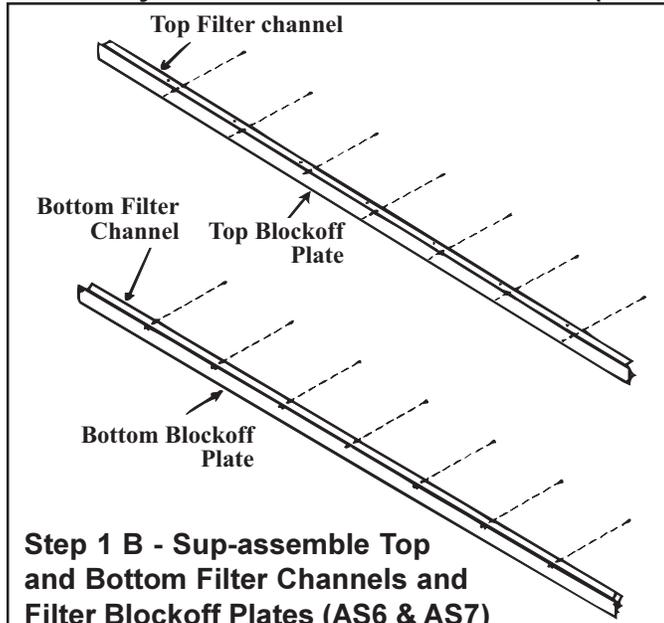
Corner posts come with two sets of holes.

For 1" filters (Option AS6), attach the three filter channel assemblies using the holes in the corner posts closest to the inside.

For 2" filters (Option AS7), attach the three filter channel assemblies using the holes in the corner posts closest to the outside edge.



Assembly and Installation Instructions (cont'd)



Step 1 B - Sup-assemble Top and Bottom Filter Channels and Filter Blockoff Plates (AS6 & AS7)

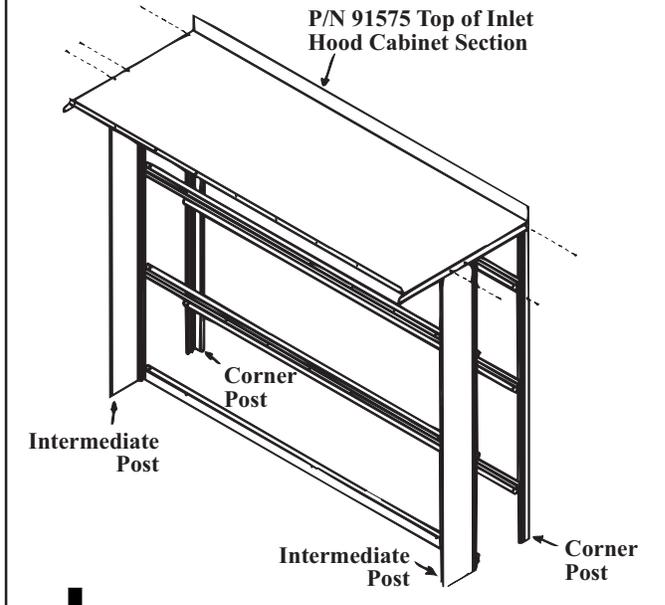
Parts Required - Top and bottom filter channel; top and bottom filter blockoff plates; and 14 screws (1/2" long)

Assemble the top blockoff plate and the top filter channel being sure the filter channel groove is on the same side as the 90° bend in the blockoff plate but directed away from it. Use seven screws to attach the top blockoff plate to the top filter channel. Repeat the process with the bottom filter channel and bottom blockoff plate.

Step 1D - Attach Cabinet Section To Corner Posts and Intermediate Posts (Options AS2, AS6, and AS7)

Parts Required - Cabinet top; the two corner cabinet posts (if inlet hood with filters, posts will be sub-assembled to filter channels - Step 1A) (if AS2 with no filters, ignore illustrated filter rack); the two intermediate cabinet posts (if inlet hood with filters, posts will be sub-assembled to filter channels - Step 1C); and six 1/2" long sheetmetal screws.

Attach cabinet section top to the four posts as illustrated.

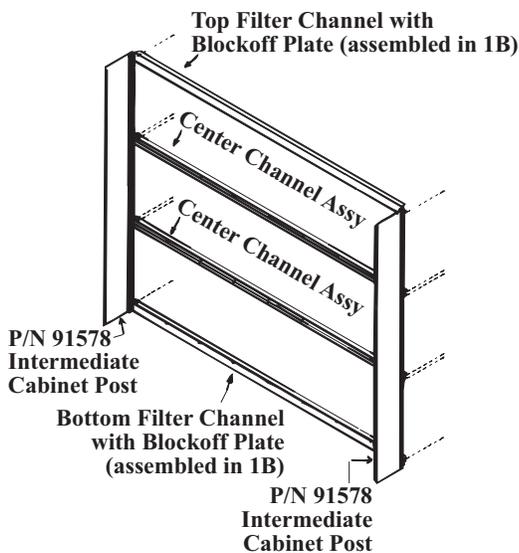


Step 1C - Assemble Outer Side of Filter Rack (Options AS6 and AS7 only)

Parts Required - Two intermediate posts; two remaining pre-assembled center filter channels; the top and bottom filter channel/blockoff plate assemblies from Step 1B; and 12 sheetmetal screws (1/2" long)

For 1" filters (Option AS6), attach the channel assemblies to the holes closest to the inside of the intermediate posts.

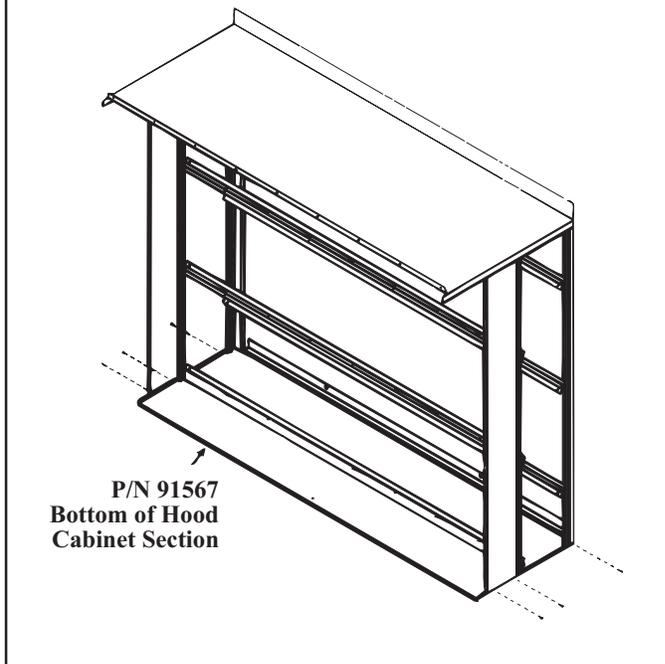
For 2" filters (Option AS7), attach the channel assemblies to the holes closest to the outside edge of the posts.



Step 1E - Attach Cabinet Section Bottom

Parts Required - Subassembly from Step 1D; cabinet section bottom; and six 1/2" sheetmetal screws.

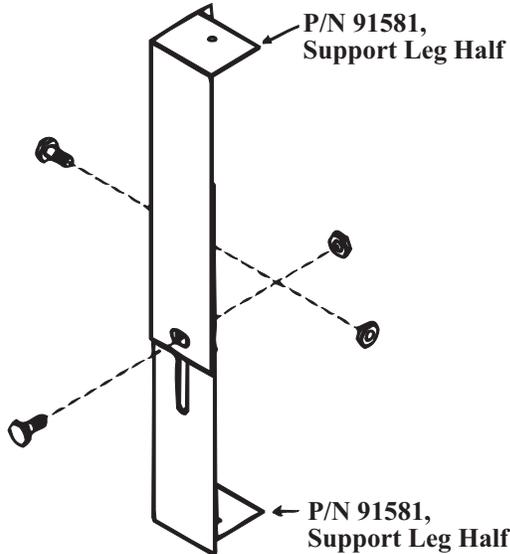
Position the cabinet section bottom to the inside of the four posts (corners). Attach as illustrated.



2. Assemble and Install Support Legs

Step 2A - Sub-assemble Support Legs

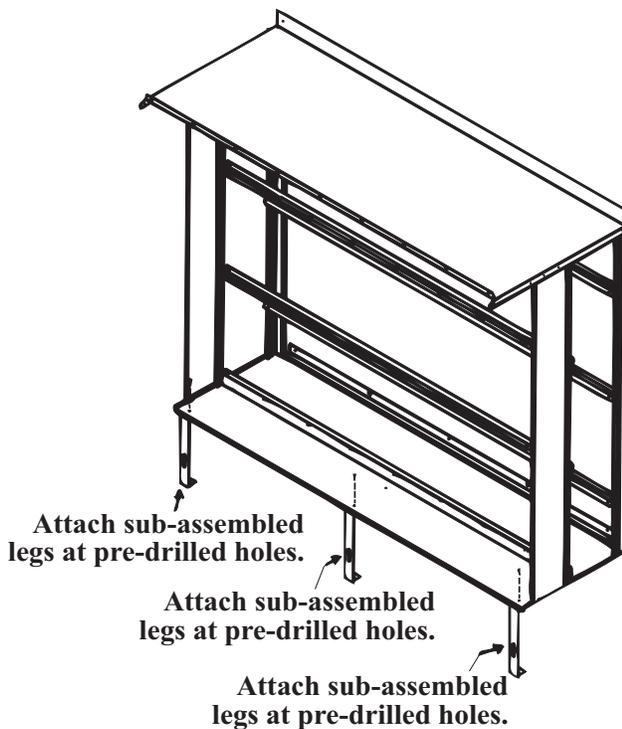
Parts Required - Six support leg halves and six 5/8" bolts and nuts
Assemble support legs as illustrated. Adjust legs to shortest length and tighten bolts finger tight. Length of supports will be re-adjusted to suit the application after cabinet is installed.



Step 2B - Install Support Legs

Parts Required - Three sub-assembled legs and three 3/4" sheetmetal screws

Attach leg assemblies to cabinet bottom.



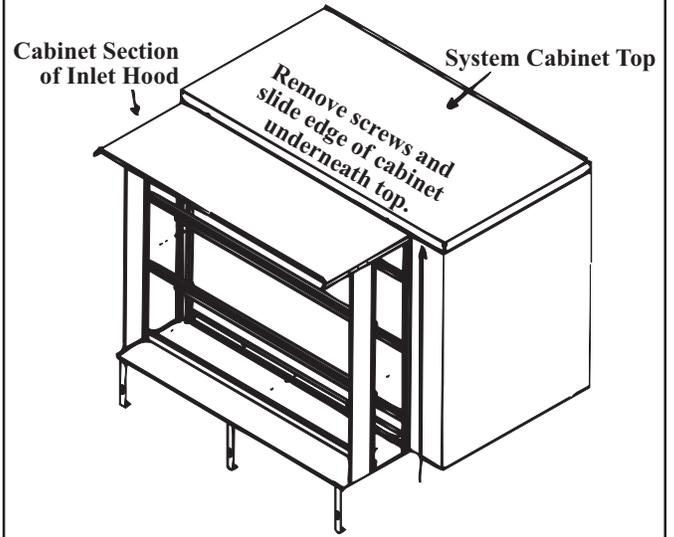
3. Attach Assembled Cabinet Section

Step 3 - Attach Filter Cabinet to System

On the air inlet opening side of the system cabinet, remove the sheetmetal screws from the bottom rear inset and the screws across the top edge.

Align the edges of the inlet hood cabinet section with the grooves in the system cabinet. Slide top edge of the inlet hood cabinet section underneath the edge of the system cabinet top.

Rotate the assembly so that it fits into the recess across the bottom of the cabinet opening. Attach by replacing the two corner screws and one center screw across the top, the three screws across the bottom, and one halfway up on each side as illustrated. Adjust the support legs to the appropriate height and tighten bolts securely.

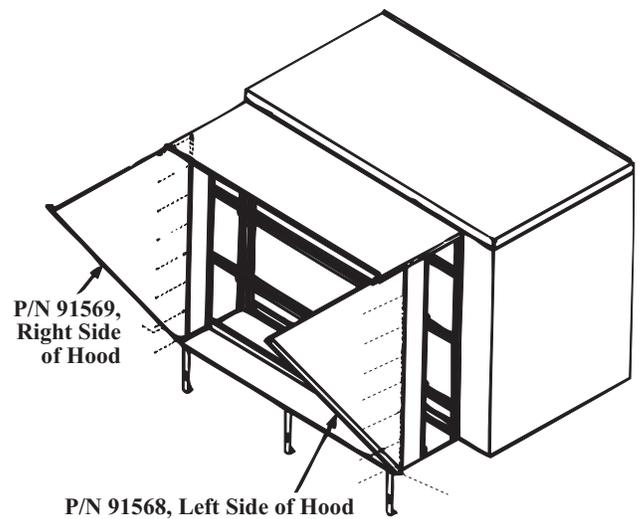


4. Assemble Air Inlet Hood Section with Louvers

Step 4A - Attach Hood Sides

Parts Required - Right and left triangular shaped sides and 18 sheetmetal screws (1/2" long)

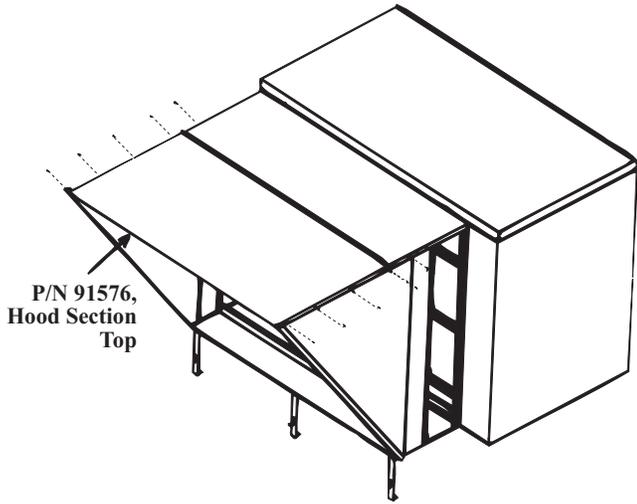
Attach the sides to the intermediate posts and bottom panel of the installed cabinet section.



Assembly and Installation Instructions (cont'd)

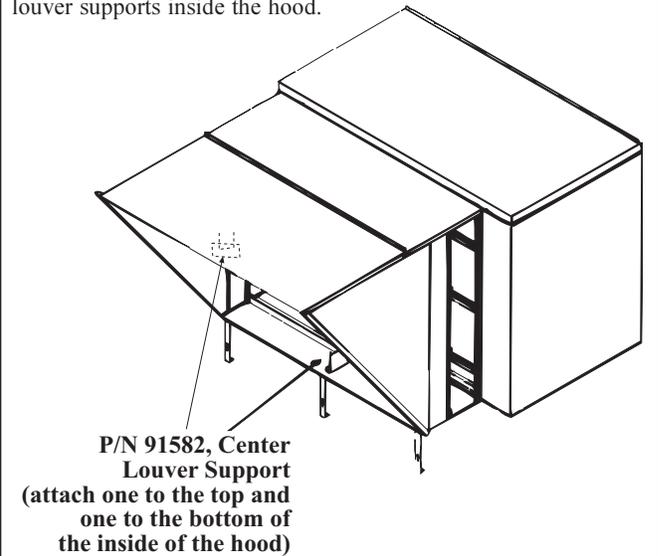
Step 4B - Attach Hood Section Top

Parts Required - Hood section top and ten 1/2" long screws
Attach hood section top as illustrated.



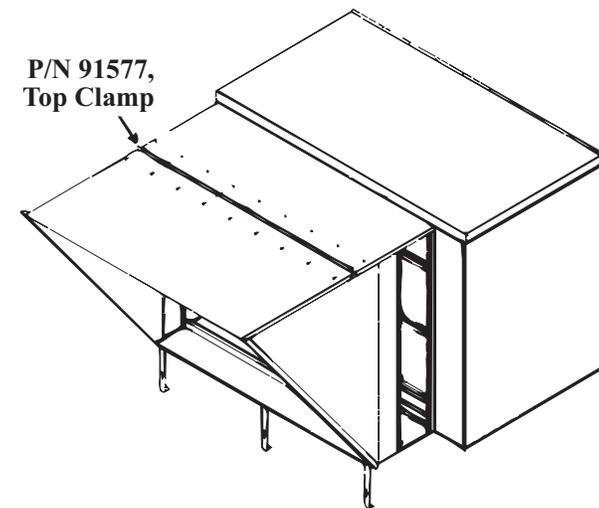
Step 4D - Install Center Louver Supports

Parts Required - Center louver supports and four 1/2" long screws
At the holes in the center of the top and bottom of the hood, use the screws to attach the center louver supports inside the hood.



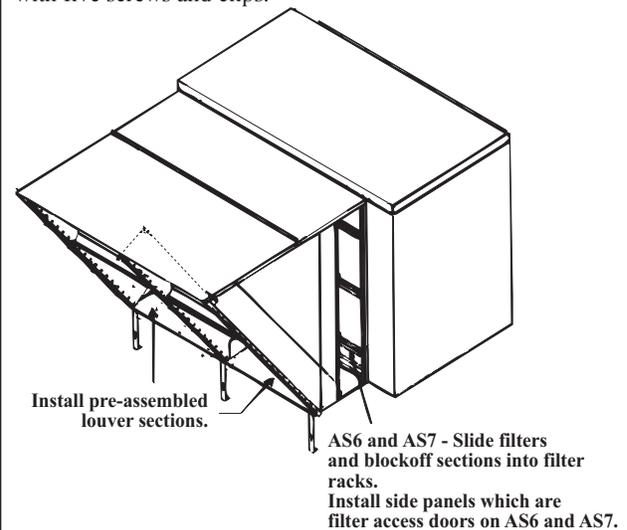
Step 4C - Install Top Clamp

Parts Required - Top clamp and nine 5/8" long screws (bolt type) and nuts
Fit clamp over seam and attach as shown with bolt-type screws and nuts.



Step 4E - Install Louvers

Parts Required - Two factory-assembled louver sections; 19 screws (1/2" long); and five Tinnerman clips
Position one louver section in the left side of the hood; attach it to the hood side and the center supports. Install the other louver section in the right side. In the center, join the two louver sections with five screws and clips.



5. Install Filters, Block Off Sections and Door Panels

On hoods with filters, position filters and blockoffs on filter racks on all hoods.

If the system has an optional dirty filter switch, follow the instructions on page 9 to connect the sensing tubes.

Slide the "door" panels into position on each side of the cabinet section. Fasten each panel with two 1/2" long screws.

FOR SERVICE OR REPAIR, FOLLOW THESE STEPS IN ORDER:

FIRST: Contact the Installer

Name _____

Address _____

Phone _____

SECOND: Contact the nearest distributor (See Yellow Pages). If no listing, contact Authorized Factory Representative, 1-800-695-1901 (Press 1).

THIRD: Contact REZNOR®/Thomas & Betts Corporation

150 McKinley Avenue

Mercer, PA 16137

Phone: (724) 662-4400

Model No. _____

Unit Serial No. _____

Date of Installation _____

Thomas & Betts

