



INDUSTRIAL  
COMMERCIAL  
EQUIPMENT  
MANUFACTURING LTD.

**BMA SERIES  
DIRECT GAS-FIRED MAKE-UP AIR  
INSTALLATION, OPERATION AND MAINTENANCE MANUAL**

**READ MANUAL CAREFULLY BEFORE INSTALLING  
OR OPERATING THE FURNACE**

**FOR YOUR SAFETY**

If you smell gas follow these instructions,

- 1) Open windows.
- 2) Do not touch electrical switches.
- 3) Extinguish any open flame.
- 4) Call the gas supplier immediately.

**FOR YOUR SAFETY**

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

**MODEL:** \_\_\_\_\_

**SERIAL NUMBER:** \_\_\_\_\_

**JOB:** \_\_\_\_\_

**DATE OF INSTALLATION:** \_\_\_\_\_

**WARNING**  
**IMPROPER INSTALLATION, ADJUSTMENT, SERVICE OR MAINTENANCE CAN  
CAUSE PROPERTY DAMAGE, INJURY OR DEATH. PLEASE READ THE  
INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTION  
THOROUGHLY.**

**\*THIS UNIT IS TO BE SERVICED BY QUALIFIED PERSONNEL\*  
\*\*DO NOT TAMPER WITH THE UNIT OR CONTROLS\*\***

**INSTALLER'S RESPONSIBILITY**

Installer please note: This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, during shipment and installation, problems such as loose wires, leaks or loose fasteners may occur. It is the installer's responsibility to inspect and correct any problems that may be found.

THIS EQUIPMENT SHALL BE INSTALLED AND WIRED IN ACCORDANCE WITH THE REGULATIONS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS, CANADIAN ELECTRIC CODE AND LOCAL GOVERNING BODIES. THE INSTALLATION CODE FOR "GAS BURNING, APPLIANCES AND EQUIPMENT, CAN 1-B149", AND APPLICABLE PROVINCIAL REGULATIONS FOR THE CLASS, WHICH SHOULD BE FOLLOWED CAREFULLY IN ALL CASES.

**INSTALLER/SERVICE CONTRACTOR**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_

CONTACT: \_\_\_\_\_

## **GENERAL INFORMATION**

### **GENERAL NOTES**

This Direct Fired BMA Series is used to provide make-up air to satisfy an exhaust system within a building. Normal discharge temperature is in the 65°F – 75°F range except for the paint booth unit which can discharge at up to 140°F in the cure mode (booth unoccupied and booth lights off). The sequence of operation and wiring diagram are located in the weatherhousing on outdoor units and control compartment on indoor units.

### **WARNING**

**Fire or Explosion hazard can cause property damage, severe injury or death. Ensure that all air taken into the unit is free from the presence of:**

- a) Flammable solids, liquids and gases.**
- b) Explosive materials. Example: grain dust, coal dust, gun powder etc.**
- c) Substance which may become toxic when exposed to heat or passing through a gas flame.**

### **INSTALLATION AND SERVICE INSTRUCTIONS**

The information provided is a guide to the proper installation, operation and troubleshooting of the unit. Retain the manual as a reference for operation and maintenance personnel. Should contact with the factory be necessary, provide the unit model number and serial number. Install and wire the equipment in accordance to the applicable national and local governing bodies codes. Authorities having jurisdiction should be consulted before making the installation. Local codes may require additional safety controls and/or interlocks.

### **UNIT LOCATION**

Prior to locating the unit check with the authorities having jurisdiction. The unit should be located with clearance to open access doors and remove filters. Ensure that the unit is installed level. Provide adequate clearance on either side of the unit to service blower, bearings, motors, drives and filters. Ensure that the position of the heater relative to support beams is correct so as to provide adequate support for the equipment. For roof mounted units, check the spacing of the roof structure beams to avoid interference with air ducts.

### **LOCATION OF ACCESSORIES**

The remote panel will be shipped as a separate package. Mount the panel and have an electrical contractor install wiring.

### **FACTORY TESTING & START UP CHECKLIST**

All BMA series units are factory fired and tested prior to shipping. Each unit is shipped with the tester's report and a start-up checklist. Complete the start-up checklist and return one copy to the factory.

## **INSPECTION OF EQUIPMENT**

All shipments are made F.O.B. the factory. The unit is securely strapped or blocked to prevent shipping damage and each shipment inspected prior to leaving the plant. All parts, where feasible, are strapped to or included in the unit. Upon receipt of goods, check the shipment against the bill of lading to ensure all items have been received. Carefully check the unit for physical damage in the presence of the carrier's representative. Should parts be missing or damage noted, file a claim immediately with the carrier. ICE does not assume responsibility for the handling of the goods in transit and is **not responsible for the initiation of freight claims.**

## **INSTALLATION AND SERVICE INSTRUCTIONS**

### **Direct Gas Fired Make-Up Air Heaters**

## **LOCATION OF UNIT AND DISTRIBUTION**

### **Inlet**

All air handled by this unit must be brought directly from outdoors. The intake shall be designed and located to prevent snow, rain, flammable gas, toxic gases and other deleterious materials from entering the unit. (Less than 500 F.P.M. is an accepted velocity.)

## **INSTALLATION**

Smaller models are shipped as one total unit. All other models are shipped in sections which are easily erected on the job site. The main sections consist of a burner damper section which contains the motor and a blower section. The secondary sections are the filter, louver, mixing box etc., which are added in sections as required.

1. All sections are pre-drilled and are bolted together in the field (as per figure 1).
2. Belts must be installed on the motor and limit and discharge controls may have to be mounted and/or wired.
3. When clearance is not a factor, ensure that the unit is adequately protected from obstruction.

**NOTE:** On roof top units the joint will have to be caulked to prevent rain from entering the unit.

### **Indoor Suspension**

On indoor models holes at the base of the units are provided for 5/8" suspension rods (see drawing No. BMA-HD). Unit must be lifted and handled from the lifting holes provided at each end of the channel iron, when suspending from the ceiling. If units are to be lifted from the bottom for mounting on a platform (as with a fork lift), unit must be supported.

**NOTE:** **DO NOT LIFT CABINET WITHOUT THIS SUPPORT.**

### **Rooftop Installation**

Support rails (minimum of 4" high) must be provided underneath the unit. In some cases, more height may be required when installing the supply duct through the roof (see figure 1) or if a unit is a bottom discharge (see figure 2).

## **CLEARANCE**

Minimum clearance from the unit, to combustible construction, is clearly marked on the rating plate attached to the unit.

No source of flammable vapors, gases or dust shall be within 20' horizontally of any unit unless that source is separated from the unit by an enclosure of fire and vapor resistive materials.

On indoor suspended units, when necessary to provide working clearance beneath the unit, the installation shall be made at a suitable height above the floor.

## **CONNECT DUCTWORK**

1. On indoor units, install fresh air duct to inlet of unit. Install intake hood or louvers with screen.
  - a) Make required opening in wall and line with angle frame inside. Should be completed before outside is started to avoid crumbling.
  - b) Insert insulated fresh air "collar" through opening with flanges turned out to provide rigidity.
  - c) Anchor intake hood with birdscreen to wall.
  - d) Caulk perimeter of opening to make rain tight.
2. Connect discharge air duct or discharge grille to unit outlet. If unit is installed on a roof, be sure that the duct going through the roof is adequately flashed and sealed to prevent leakage. (see figure 1).
3. Where a ductwork system or other enclosure is directly connected to the inlet or outlet of the heater in such a way as to cause a possible gas trap and accumulation of a flammable mixture, a pre-purge cycle shall be incorporated to provide not less than 4 complete air changes of the duct work or enclosure by volume prior to an ignition.
4. Where additional automatically operated inlet or discharge air louvers are used, they shall be electric interlocked to ensure the maximum designed opening before either starting or running circuits may be energized.

## **FIRE DAMPER**

Fire dampers installed in inlet or outlet duct systems shall be interlocked to shut down the unit in case of fire in the duct work and should be arranged so that the unit will only be electrically energized when in the wide open position.

## **HAZARDOUS CONDITIONS**

In the event that the make-up air heater failure creates a hazard to other fuel burning equipment in the building the unit shall be interlocked to open balancing inlet air dampers. These dampers can be of the motorized type, (see wiring diagram).

## **EXHAUST INTERLOCK**

- a) This unit shall be electrically interlocked so that it will operate only when the associated exhaust system(s) is functioning. An exhaust air flow proving switch shall be used (Refer to sheet exhaust interlock) for typical application, and (wiring diagram) for electric hookup.
- b) The total air discharge capacity of the unit cannot exceed by more than 10% the total discharge capacity of the exhaust systems in conjunction with which it is used. Where the tempered air is discharged directly into a booth, the total air discharge capacity of the booth.
- c) The exhaust air proving switches should be set as to open when the volume of exhaust drops by more than 10% (dirty exhaust filters, etc.).

## **CONNECT GAS SUPPLY**

- a) Run correctly sized gas line to the unit. Install manual shut off valve plug-cock type approved for the application.

**NOTE:** Gas line pressure must be a least 7" W.C" when unit is operating at full input (Burner manifold pressure at full input is from 4" to 4 ½" W.C.) Check rating plate on unit for maximum gas input.

- b) Bleed and vent lines shall be installed in accordance with the applicable requirements.

## **COMPLETE WIRING**

1. Install remote supervisor panel or if summer-off-winter switch (is used) in the desired location.
2. Complete wiring to supervisor panel or summer-off-winter switch is shown on wiring diagram.
3. Install fused disconnect switch (to be furnished by installer) and connect 3 phase power supply to disconnect switch mounted on unit. Voltage must correspond to voltage marked on rating plate.
4. Complete all wiring to accessories (interlocks) as per wiring diagram provided on the unit.

**NOTE:** It is recommended that filters be removed during winter operation, if up stream from burner.

## **WARNING**

**FIRE OR EXPLOSION HAZARD CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH.  
Check for gas leaks with rich soap and water solution any time work is done on a gas control.**

## **START-UP PROCEDURE**

1. Remove shipping blocks from:
  - a) Blower if rubber or spring isolated.
  - b) Check to be sure that damper opens, if tied down, remove wire.
  - c) Check modulating discharge controller, on units, to ensure that it is in the blower air stream. On some units this control may be mounted external from the unit. If so, check to see that the sensor is installed in the discharge air stream of the make-up air heater and that the controller is wired to the modulating motor, regulating gas supply to burner.
2. Make sure that the main firing valve is closed, but that gas is available in the service line.
3. Check to ensure exhaust fans are wired into the control panel and that there is power to the exhaust starter relays. Check to ensure exhaust fans interlock switches are installed and wired to the control panel.
4. Familiarize yourself with the sequence of operation and wiring diagrams. This will give you information as to how the unit operates.
5. Check voltage to ensure it matches the voltage stamped on the unit rating plate, and all wires are connected between unit and remote panel.

6. The timers TD-1 - TD-5 are factory set but you should check them to ensure they have not moved during transit to job site.
- 6A. Normal setting of high limits are -165°F.
7. Operate unit through paint mode by pushing in the system “on” push button. The unit should operate as per sequence of operation.

7A. Pilot

The Protectorelay monitors the pilot flame through the flame rod. A minute current is sent from the relay through the flame rod, and through the pilot flame to “ground”. The relay detects the current flow and acts to open the safety valve as required. When no flame exists, current cannot flow and the relay acts to close the valve. Current flow depends only on flame contact on the rod: temperature of the rod is of no importance.

Since the flame rod is a current-carrying conductor, it must be free of any contact with conductive parts of the pilot burner. Insulator must be clean, dry and free from cracks. While the flame rod is made of a heat resistant alloy it may, after long service, deteriorate to the point of flame contact. Check for serious corrosion or loss of metal. It must be tight enough in the insulator to maintain its position. Do not use too much force or the insulator may crack.

Proper operation of the flame rod can be checked by measuring the flame rod current; refer to flame safeguard instruction sheet with unit. Lacking a micrometer, a check can be made with an operating burner through all its normal phases. Relay response should be prompt with no chattering or drop out.

The spark rod (Midco Burner see figure 5 for gap setting, Maxon Burner spark ignitor No. 18075) produces a high tension arc at the correct location for lighting the pilot. Ignition transformer must be rated for 6000 Volts, 20 Miliampers secondary, minimum.

The spark rod or spark ignitor, must be free of contact with conductive parts of the pilot burner. Insulator must be clean, dry and free of cracks. Check the spark rod for serious corrosion or loss of metal. It must be held tightly enough in the insulator to maintain its position.

Gap must be 1/16” to 3/32” ( see figure 5). Setting can also be checked by cycling the pilot. Ignition must be prompt and positive. Do not allow careless positioning to cause arc of flame rod; serious relay damage would result.

If the spark ignitor on Maxon burners shows deterioration of ignitor points the complete spark ignitor should be replaced (part No. 18075).

8. If pilot tries for ignition, but locks out, the air proving switches (high and low) that are mounted across the profile plate, should be checked to make sure that the proper amount of air is flowing through the unit. Check to make sure blowers are running in the proper direction. This can be checked by placing a differential gauge across the profile plate of the burner section. If the pressure drop is between .30” W.C., and .95” W.C., these switches should be made, then check pilot to ensure proper flame. Check instruction sheet for flame safeguard system.

Pilot adjustment screw is in the Thermax shut-off valve. When setting, adjust for the best reading, then open pilot set screw slightly.

- 8A. Main flame supervision: With units that have more than three feet of burner from point of supervision, a second flame rod will be on the main burner. This switching is done with a time delay relay (see wiring diagram). This can be disconnected for testing for pilot, or you have to ensure main flame by opening up the firing valve within 15 seconds after pilot solenoid is powered. As supervision will switch from pilot to main flame in that time. Check to ensure that unit will lock-out in the event of main flame failure on low-fire by closing main firing valve.

9. Gradually open firing valve to start main flame. Check for flame over entire burner length. Adjust the pressure regulator to 4" or 4 1/2" W.C. pressure or the amount of gas marked on the rating plate.
10. On all units that have Maxitrol modulation. Read over the Maxitrol literature for the high fire and low fire setting. By removing the wire from #2 on the amplifier the unit will stay on low fire and allow you to set the by pass or low fire setting to ensure that the flame is completely across burner and is between 1" and 1 1/2" long.
11. To set up high fire you will require to remove wire from #4 on amplifiers. A resistor should be placed across #3 and #4 of the amplifier remove when test complete) to check out discharge sensor. The resistors are attached to the Maxitrol literature.

11A. Check gas pressure switch setting.

High pressure gas switch ..... 6" W.C.  
 Low pressure gas switch ..... 2" W.C.

**NOTE:** The high and low gas pressure switches may be the manual reset type on some units.

**FLAME SUPERVISION CHECK**

- a) The flame supervision should be checked periodically to insure that the controls are operational. With the unit on full operation and firing, close the main manual firing valve and pilot manual firing valve. This should lock out the unit.
- b) The units with more than 3 feet of burner from the point of supervision have dual flame rod and a delay timer for main flame supervision. Closing the main firing valve should lock out the safety relay and the unit should shut-down.
- c) The main safety valve should be checked for gas tightness by placing a manometer in the manifold between the safety valve and the manual firing valve (a 1/8" plug is provided for this). If there is a build up of pressure with the unit locked out and the manual valve closed, the safety valve should be replaced.
- d) The complete gas line and manifold should be checked for gas tightness.

**C.F.M.**

- a) This unit depends upon an adequate supply of air for good combustion and operation. Care should be taken to ensure that properly sized inlet hood and ductwork are installed and that the unit is discharging the right amount of C.F.M.

**TROUBLE SHOOTING GUIDE**

On start up, the unit will not operate properly. It may be an electrical mix up in the wire from the unit to the control panel (see wiring drawing).

The wire connector shown (12) are in the remote panel.

The wire connector shown Ø12 are on the unit.

It is recommended you have a volt meter AC/DC, and a differential pressure gauge 0" - 2" (magnehelic) and a gas pressure gauge 0" - 12".

1. If inlet damper fails to open when system switch is pushed in.
  - a) Check to see if power is on #4. If no power supply starter overloads (1 OLS-1), may be open R1-1 normally closed contacts may be open. Main flame safe guard relay needs to be reset.

2. Fresh air damper open, but no power on #9.
  - a) Damper end switch open (DMES-1) reset
3. High exhaust fan operating, no power on #13.
  - a) Check high exhaust fan inter lock switch.
4. If supply fan is not operating, check delay start timer (TD1) normally set at 3 seconds to allow for exhaust fan to come up to speed to keep the booth from over pressure and blow the doors open.
  - a) Balance exhaust and supply fan.
5. No power on #12.
  - a) Check summer/winter switch.
  - b) Spray high limit (HL-S).
  - c) Check air flow across burner with a magnehelic gauge to ensure proper air flow. Should be a difference between .45" and .65" W.C.
6. Power on #12, but burner will not come on.
  - a) Change flame safe guard relay.
7. Power on #12 burner tries to fire up but locks out.
  - a) Check pilot solenoid valve.
  - b) Check ignition transformer.
  - c) Check flame rod, if dirty clean, if cracked isolator replace.
8. Burner on low fire only.
  - a) Check TD2 timer low fire timer should be set at 20 seconds.
  - b) Check DC volts on #14 and #15, if above 5 V.D.C. modulation valve may be defective, replace.
9. See Maxitrol literature to trouble shoot the system.



## **OPERATING PRINCIPLES OF THE RAW GAS BURNER**

The raw gas burner is designed to operate in a duct of flowing fresh air. Fuel gas is fed directly to the burners; kinetic energy of the air stream furnishes combustion air. The burner must be installed to fire with, and parallel to, the air flow. By virtue of velocity impact and suction generated by the diverging shape of the combustion baffles, air is induced into the air ports in the combustion zone. The air supply is constant though only that which mixes with the gas flowing from the burner ports, takes part in combustion.

When a very small quantity of gas is admitted to the burner, sufficient mixing takes place in the low fire slot within the burner, casting and combustion takes place in this zone. Since the low fire zone is contained within the burner casting it is effectively shielded from fire disrupting uncontrolled air entry.

As the gas is increased the flame progresses into the intermediate fire zone where an additional supply of air is available. High or full capacity, mixing occurs at the larger air ports of the high fire zone augmented by air spilling over the end of the baffles.

On a reduction of gas supply the reverse sequence takes place. The flame receding to a location of lesser air supply until the low fire zone is reached. The system above is suitable for a turn down range of approximately 30 to 1.

With the suction by the blower there is a pressure in the gas manifold of less than zero at low fire. Therefore, when checking the manifold pressure you will find that the pressure will range from approximately 4" W.C. to less than zero, when the unit is modulating from high to low fire.

### **EXAMPLE FOR CALCULATING C.F.M.**

#### **Example for Calculating The Amount of Air and Gas in a Direct Fired Make-Up Air Unit Pull Through Type**

**YOU WILL NEED:** A pressure differential gauge (Manometer) (Magnehelic) Thermometer -30°F - 200 °F.

All units are factory set with a profile opening around to burner sized for 2950 F.P.M. velocity. Due to more or less external static pressure the velocity may not be within this range on start up of unit. The pressure drop should be checked to insure the unit is operating around this velocity.

A pulley adjustment or change should be done to bring the velocity within operating range. If an air balance has been done and the C.F.M. verified to be correct as stamped on the rating plate and the velocity across the burner is not correct the profile area should be adjusted.

If velocity is higher than 2950 FPM then the profile area should be increased. This can be achieved by readjusting the top and bottom profile plates.

The profile area is stamped on the rating plate, but to get to the free area you will have to deduct the space taken up by the burner.

If Midco burner is used deduct .65 sq. feet for each 1-foot section, or .33 sq. feet for each 6" section.

If Maxon burner is used deduct .45 sq. feet for each 1-foot section, or .23 sq. feet for each 6" section.

Using a magnehelic differential gauge across the burner profile will give you the pressure drop and using the burner capacity chart will tell you what velocity you have through the profile. If the unit is operating between .45 W.C. and .65 W.C. it is considered to be within operating range, as the low air switch is factory set to make at .25 W.C. and the high profile switch is set to open at .95 W.C.

This should allow for a wide leeway before the unit will lock out due to low air / high air velocity across the profile plate. Under normal servicing the tubes from the air switch should be checked to insure they are free of any moisture or dirt as this could cause the burner to lockout on the flame safeguard relay as both switches are in the flame rod circuit.

If moisture is entering the tubes they may have to be repositioned to a lower area on the cabinet. Care must be taken to insure that they will operate to shut down the unit if the velocity is out of the operating set points.



**TABLE II  
PERMISSIBLE CLEARNCES WITH  
SPECIFIED FORMS OF PROTECTION**

(Clearance in Inches)

TYPE OF PROTECTION SEE NOTE	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:							
	36 INCHES		18 INCHES		12 INCHES		6 INCHES	
	ABOVE	SIDES REAR	ABOVE	SIDES REAR	ABOVE	SIDES REAR	ABOVE	SIDES REAR
¼" asbestos millboard spaced out 1"*	30	18	15	9	9	6	3	2
28 gauge sheet metal on ¼" asbestos millboard	24	18	12	9	9	6	3	2
28 gauge sheet metal space out 1"*	18	12	9	6	6	4	2	2
28 gauge sheet metal on 1/8" asbestos millboard spaced out 1"*	18	12	9	6	6	4	2	2
1-½" asbestos cement covering on heating appliance	18	12	9	6	6	4	2	1
¼" asbestos millboard on 1" rockwool batts reinforced with wire mesh or equivalent	18	12	6	6	4	4	2	2
22 gauge sheet metal on 1" rockwool batts reinforced with wire mesh or equivalent	18	12	4	3	2	2	2	2
¼" asbestos cement board or ¼" asbestos millboard	36	36	36	18	12	12	4	4
¼" cellular asbestos	36	36	36	18	12	12	3	3

\*Spacer shall be of non combustible material

### LIMIT OF TOXIC VAPORS AND GASES

**DURING NORMAL OPERATION OF THE HEATER, THE CONTENT OF TOXIC VAPORS AND GASES IN THE TEMPERED AIR AT THE POINT OF DISCHARGE INTO THE BUILDING MUST BE SUCH THAT NO IRRITATING EFFECTS ARE EVIDENT. THE INSTALLATION SHALL NOT BE CONSIDERED ACCEPTABLE IF THE DISCHARGE OF TOXIC PRODUCTS IS KNOWN TO EXCEED THE LIMITS SET OUT IN THE FOLLOWING TABLE.**

SUBSTANCE	PERCENT	PPM	SUBSTANCE	PERCENT	PPM
Acetaldehyde	.001	10	Formaldehyde	.000025	0.25
Carbon Dioxide	.250	2500	Nitrogen Dioxide	.0001	1
Carbon Monoxide	.001	10	Sulfur Dioxide	.00005	0.5

**NOTE:** At 100°F the CO<sub>2</sub> concentration will be in the order of 2500 P.P.M.

**TYPICAL SEQUENCE OF OPERATION MAKE-UP AIR**  
**(WARNING: FOR ACTUAL UNIT SEQUENCE OF OPERATION, PLEASE CONSULT SHOP DRAWINGS)**  
**With Supervisor panel**

**SUMMER OPERATION:**

1. When exhaust interlock contacts close, the damper opens.
2. Exhaust light indicates exhaust on.
3. Damper interlock closes, powering blower motor starter.
4. Blower motor auxiliary contacts close.
5. High limit switch is closed.
6. "Fan" lights indicate that blowers are running.

**WINTER OPERATION:**

1. Exhaust system interlock contacts must be closed.
2. Exhaust light indicates exhaust on.
3. Interlock circuit on safety relay is closed.
4. When damper is open, end-switch contacts close and energize the blower motor starter.
5. Blower motor starter auxiliary contact closes.
6. Air flow proving switch closes (low).
7. "Fan lights indicate that blowers are running.
8. Summer-winter switch, "on".
9. Combustion control is energized.
10. Pre-purge timer (optional) is energized and contacts close after predetermined purge period.
11. High gas pressure switch, low gas pressure switch, optional contacts are normally closed.
12. High temperature limit switch is normally closed. Switch must be manually reset if air temperature has exceeded set point.
13. Outdoor thermostat contacts close when outside air temperature falls below set point (optional).
14. Limit circuit to primary safety control is complete.
15. Ignition transformer is energized and sparks provided.
16. Pilot gas valve opens and pilot is proved.
17. Main gas valve(s) is energized.
18. "Burner" lights indicate that gas valve(s) is energized.
19. Presence of flame is proved by flame rod. Ignition is de-energized and main gas valve remains open.
20. (Optional) Low limit light stays on indicating that air temperature exceeds setting of low limit switch. Manual start push button may be disengaged.
21. Modulating temperature control maintains discharge air temperature at a set-point with 30-1 turn-down ratio.
22. Alarm light indicates flame failure of burner or failure of air proving switch.

**NOTE:** Sequence of operations is the same on units with summer-off winter switch except that the indicating lights show blower on and burner switch in the winter position.

## **MAINTENANCE**

Regular maintenance is necessary to ensure the efficient operation and long life of this unit. This maintenance should be performed by, or supervised by, qualified service personnel. A maintenance schedule should be prepared for the unit based on its application and location.

### **RECOMMENDED MONTHLY MAINTENANCE**

1. Check for loose connections in the wiring.
2. Check the voltage at the unit while it is in operation.
3. Check motor amperage draws against rating plate values.
4. Inspect all contactors to ensure that they are clean and making good contact.
5. Check all fittings, valves and lines for leaks.
6. Check the burner; clean and adjust if necessary.
7. Check the flame sensor; clean if necessary.
8. Check the fuel supply pressure to the unit.
9. On gas fired units, check the manifold pressure.
10. Clean or replace air filters if necessary. Replace filters only with type equivalent to those supplied with the unit by the factory.
11. Check all damper, linkages and damper actuators; adjust and tighten as required.
12. Check all belts; adjust or replace as necessary.
13. Check operation of all safety controls.

### **RECOMMENDED YEARLY MAINTENANCE**

1. Perform the monthly maintenance recommended.
2. Inspect blower wheels and housing; clean if necessary.
3. Inspect all set screws on blower wheels and pulleys to ensure that they are secured to their respective shafts.
4. Check ignition spark and adjust gap if necessary.
5. Inspect and clean ignition electrodes.
6. Check flame supervisor relay.
7. Inspect all operating and safety controls; clean and replace if necessary.
8. Clean the burner.

**NOTE:** Refer to manufacturer literature provided for maintenance requirements of optional equipment.

## **BEARING INSTALLATION AND MAINTENANCE**

**NOTE:** To prevent premature failure – please ensure greasing instructions below are applied. As well, tighten bearing set screws, collars, and wheel lugs every four to six months.

### **ENGINEERING – BALL & ROLLER BEARINGS LUBRICATION**

For bearings that are equipped with a hydraulic grease fitting threaded into the housing for ease of lubrication, the proper amount of lubricant in the bearing is important. Both excessive and inadequate lubrication may cause failure. The bearings should be re-lubricated while they are rotating (if it is safe to do so); the grease should be pumped in slowly until a slight bead forms around the seals. The bead in addition to acting as an indicator of adequate re-lubrication provides additional protection against the entry of foreign matter and helps flush out contaminants in the bearing.

By the time the slight bead is formed, it will be noticed that the bearing temperature will rise. It is not uncommon for the temperature to rise as much as 30 degrees Fahrenheit after re-lubrication. If necessary to re-lubricate while the bearing is idle, refer to the recommended re-lubrication grease chart tables on the following page for various sizes of the bearings.

#### **Lubricant-Standard Bearings:**

All bearing units are pre-lubricated at the factory with a lithium soap grease which is compatible with multi-purpose grease readily available from local suppliers. The lubricant selected for factory lubrication uses a highly refined mineral oil with a high viscosity index, thickened with lithium soap to conform to NLGI grade 2 consistency. A suitable additive package is added to protect the highly polished rolling contact surfaces from corrosion and oxidation of the lubricant. The lubricant is satisfactory for an operating temperature range of -30 F to +250 F.

Select standard industrial grade greases that conform to the following specification for optimum bearing performance:

#### General Duty Ball & Roller;

58-75 SUS @ 210 F  
450-750 SUS @ 100 F

#### Premium Duty Ball & Roller;

68-75 SUS @ 210 F  
600-750 SUS @ 100 F

#### Heavy Duty Roller Bearing;

82 SUS @ 210 F  
886 SUS @ 100 F

**NOTE:** For heavy loaded roller bearing applications, grease with EP additives are often recommended for optimum performance.

**Table III. Recommended Lubrication**

<b>Ball Bearings</b>		<b>Roller Bearings</b>	
Shaft Size (inches)	Grease Charge (ounces)	Shaft Size (inches)	Grease Charge (ounces)
1/4 to 3/16	0.03	1-3/16 to 1-1/4	0.1
1/2 to 3/4	0.1	1-3/8 to 1-7/16	0.22
1-1/4 to 1-1/2	0.15	1-1/2 to 1-11/16	0.32
1-11/16 to 1-15/16	0.2	1-3/4 to 2	0.5
2 to 2-7/16	0.3	2 to 2-3/16	0.55
2-1/2 to 2-15/16	0.5	2-1/4 to 2-1/2	0.65
3 to 3-7/16	0.85	2-11/16 to 3	0.85
3-1/2 to 4	1.5	3-3/16 to 3-1/2	1.25
-	-	3-15/16 to 4	2.5
-	-	4-7/16 to 4-1/2	3.1

Frequency of re-lubrication depends upon operating conditions. The bearing operating temperature is the best index for determining a re-lubrication schedule. The following chart gives the frequency of re-lubrication based upon continuous operation for various operating temperatures and can be used as a satisfactory guide for determining when bearings should be re-lubricated.

**Table 2. Lubrication Frequency**

<b>Speed</b>	<b>Temperature</b>	<b>Cleanliness</b>	<b>Greasing Interval</b>
100 RPM	Up to 120 F	Clean	5 months
500 RPM	Up to 130 F	Clean	2 months
1000 RPM	Up to 210 F	Clean	2 weeks
1500 RPM	Over 150 F	Clean	Weekly
Any speed	Up to 150 F	Dirty	1 week to 1 month
Any speed	Over 150 F	Dirty	Daily to 1 week
Any speed	Any temperature	Very dirty	Daily to 1 week
Any speed	Any temperature	Extreme conditions	Daily to 1 week

## TENSIONING V-BELT DRIVES

1. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
2. Check tension frequently during the first 24-48 hours of operation.
3. Over-tensioning shortens the belt and bearing life.
4. Keep belts free from foreign material that may cause slip.
5. Make V-drive inspection on a periodic basis. Tension when slipping. Never apply belt dressing as this will damage the belt and cause early failure.

Check and tighten belt tension. The following procedure is recommended for tightening belts:

- a) Measure span "X" shown in Figure A.
- b) At the center of span length "X", apply a force perpendicular to the span and large enough to deflect belt 1/64" for each inch of span length. Example- the required deflection for a 40" span would be 40/64" or 5/8".
- c) Compare the force applied with the values given in Table III. If force is between the minimum and maximum range shown, the drive tension should be satisfactory. A force below the minimum value indicates an under tightened belt and force that exceeds the maximum value indicates an over tightened belt.

FIGURE A

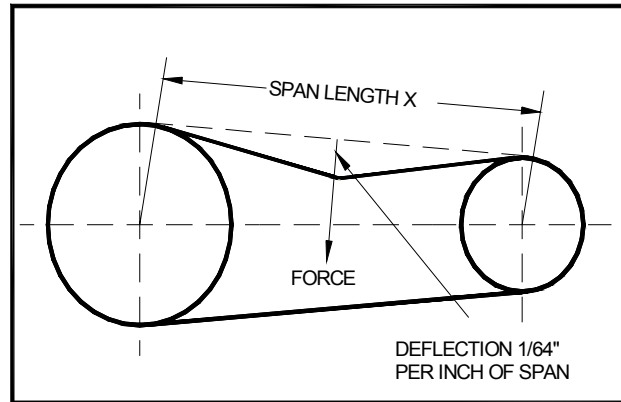


TABLE III

BELT CROSS SECTION (Marked on Belt)	MOTOR PULLEY PITCH DIAMETER	DEFLECTION FORCE	
		MINIMUM	MAXIMUM
A	3.0" - 3.6"	2.62lbs.	3.25lbs.
	3.8" - 4.8"	3.0lbs.	4.0lbs.
	5.0" - 7.0'	3.25lbs.	5.0lbs.
B	3.4" - 4.2"	3.0lbs.	5.0lbs.
	4.4" - 5.6'	4.0lbs.	5.87lbs.
	5.8" - 8.6"	5.25lbs.	7.87lbs.



## DIRECT FIRED WARRANTY

The warranty on the ICE Manufacturing Direct Gas Fired Make-up Air Units are one (1) year from installation date or 15 months from date of shipment from our factory.

Our warranty applies for original shipment on all parts and components fabricated by or installed by us with the exception of air filters, flame rods, igniters, and blower belts.

Within the one year warranty, replacement parts will be shipped collect and charged to customer account with credit being issued after receipt of, and examination of the returned parts: freight prepaid to the factory.

This warranty does not include freight, labor, or sales taxes, that may be incurred by the purchasers and is subject to the following conditions:

- 1) The unit shall be installed by a qualified heating contractor in accordance with the provisions of the service manual.
- 2) The unit shall have been installed in accordance with all provincial and local codes.
- 3) The unit shall have been subject to only normal use in service and shall not have been misused, neglected, altered or otherwise damaged.
- 4) The unit shall have been operated within its published capacity and with the prescribed fuel.
- 5) All automatic controls shall have been operative at all times.
- 6) The unit has not been allowed to exceed its proper temperature limits due to control malfunction or inadequate air circulation.
- 7) There is no evidence of tampering or deliberate destruction.

No representative of ICE or any of its distributors or dealers is authorized to assume for ICE any other obligations or liability in connection with this product, nor alter the terms of this warranty in anyway. This warranty is limited to the express provisions contained herein and does not extend to liability for labor costs incurred in replacing defective parts.

Authorization to return any alleged defective parts must be obtained from the factory before the part is transported and the owner shall prepay the transportation charges for any alleged defective parts. ICE will not accept charges for parts purchased unless the conditions of this warranty have been satisfied.

The express warranties herein contained are in lieu of any other warranties, expressed or implied, including the warranty of merchantability and of fitness for any particular purpose. ICE shall not be liable for damages, including special, incidental, or consequential damages arising out of or in connection with the performance of the Direct Gas Fired Make-up Air Units, or its use by the owner. ICE liability is limited exclusively to repair and or replacement of the defective part. Parts can be obtained from ICE Manufacturing, 51 Aikins Street, Winnipeg, Manitoba, R2W 4E3, on the basis that credit will be issued if defective parts returned qualify for replacement pursuant to the terms and conditions of this warranty.

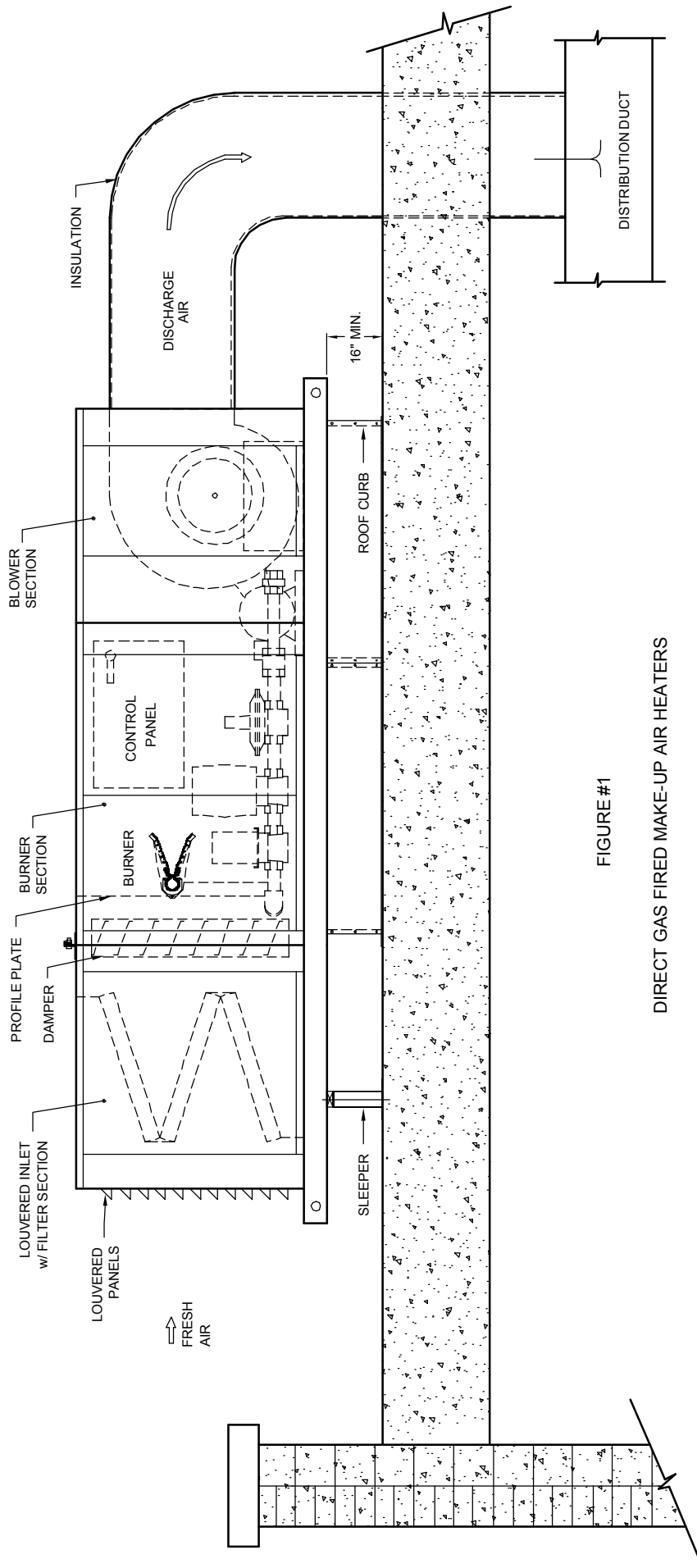


FIGURE #1

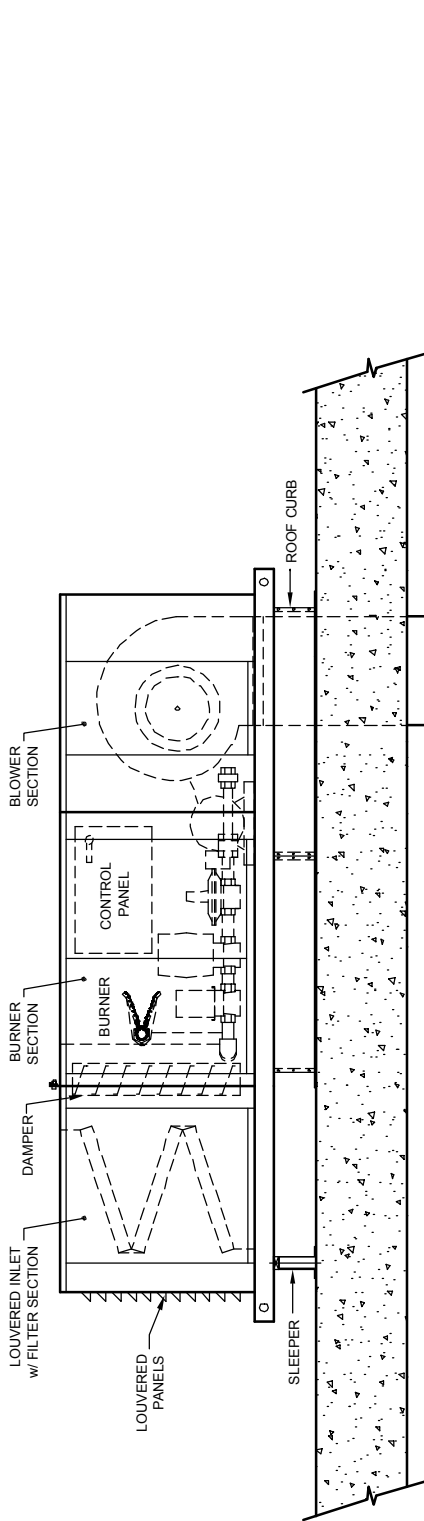
DIRECT GAS FIRED MAKE-UP AIR HEATERS

TITLE

DIRECT GAS FIRED MAKE-UP AIR HEATERS  
INSTALLATIONS AND SERVICE INSTRUCTIONS

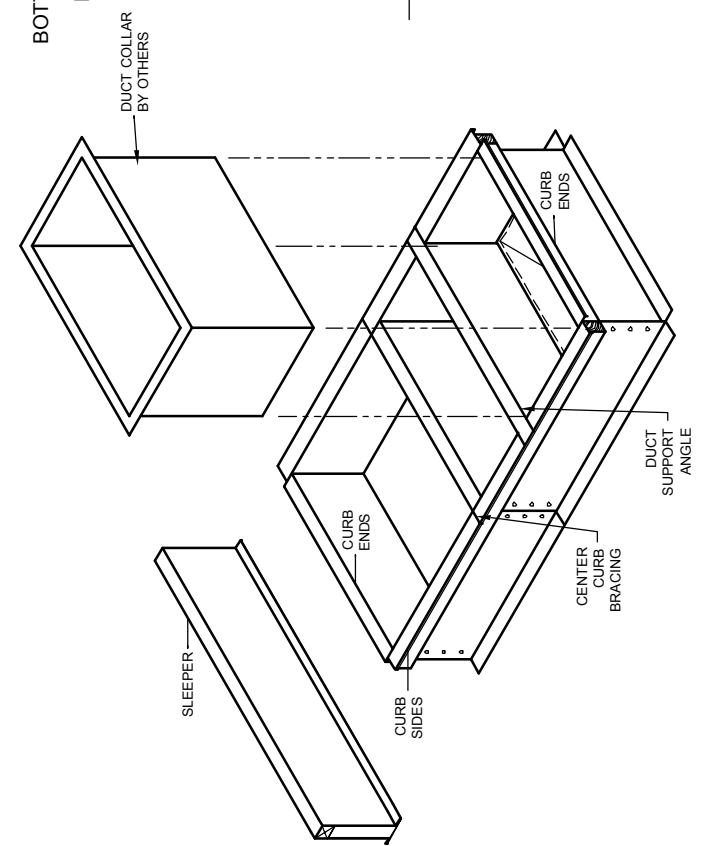
DRAWN BY JV	ISSUED BY JV	SCALE NTS	DRW. NO. FIG. 1
CHK. BY JS	DATE JUNE 10/98	JOB NO.	REV -



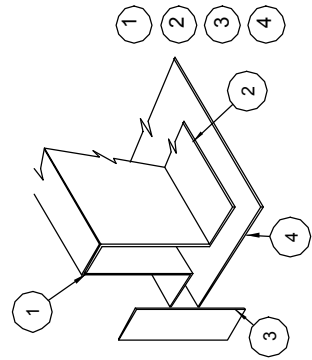


BOTTOM DISCHARGE  
FIGURE #2

ONE EXAMPLE OF CURBING



ROOF CURB DETAIL



- ① LARGE SLEEPER SIDE
- ② SMALL SLEEPER SIDE
- ③ END PLATE
- ④ BASE PLATE

SLEEPER ASSEMBLY

SLEEPER DETAIL  
MATERIAL = 16 GA. CB.



TITLE  
DIRECT GAS FIRED MAKE-UP AIR HEATERS  
INSTALLATIONS AND SERVICE INSTRUCTIONS

DRAWN BY JV	ISSUED BY JV	SCALE INTS	DRW. NO. FIG. 2
CHK. BY JS	DATE JUNE 12/98	JOB NO.	REV _

48" MINIMUM

MAKE-UP AIR UNIT

ON ALL TWIN BLOWERS UNIT WITH DUCT A STUB DISCHARGE DUCT MUST BE INSTALLED WITH A MINIMUM LENGTH OF 48".

FIGURE #3

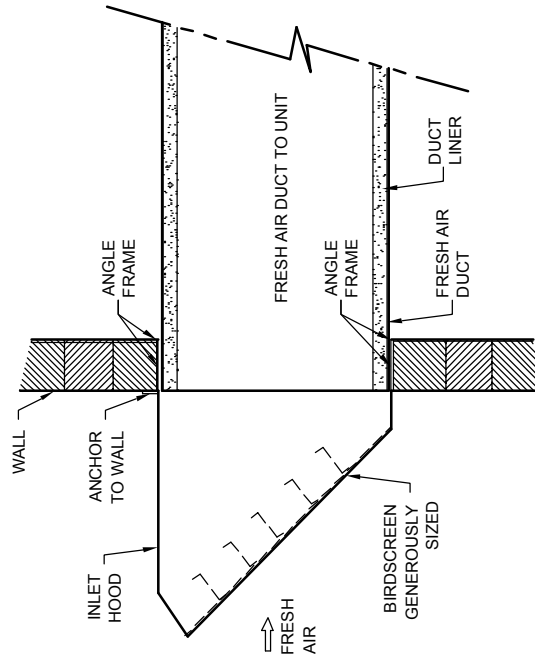
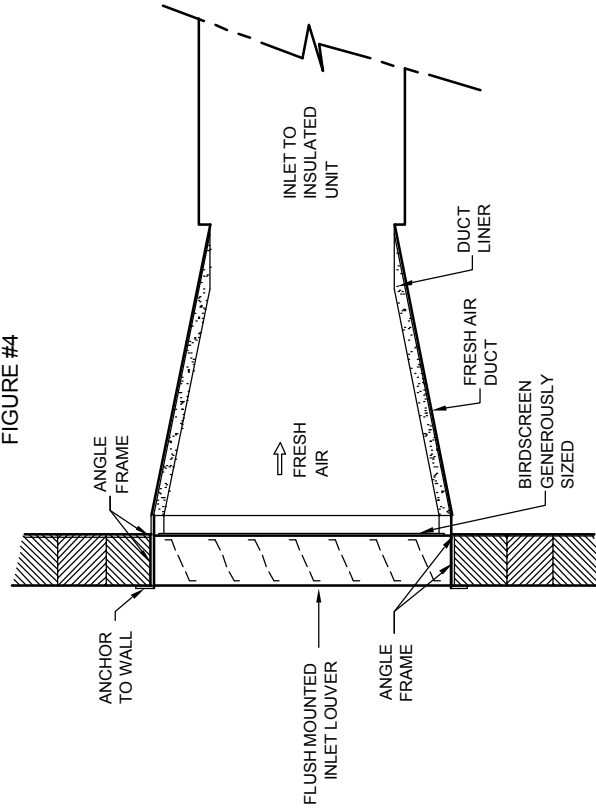


FIGURE #4



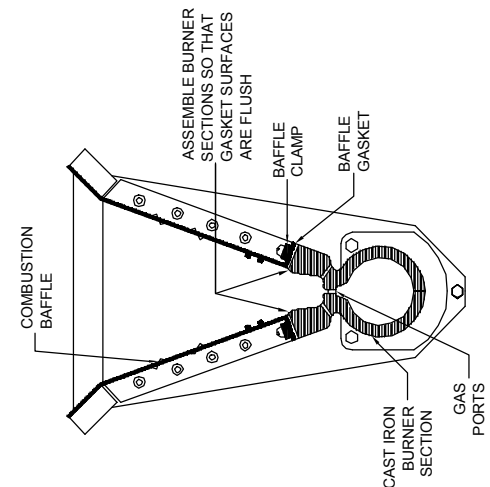
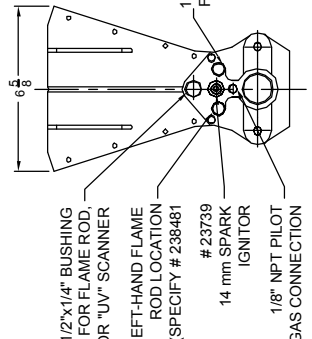
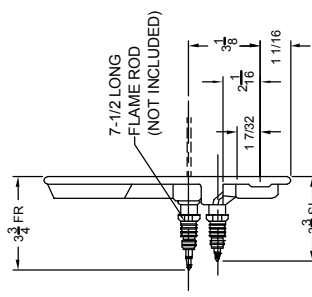
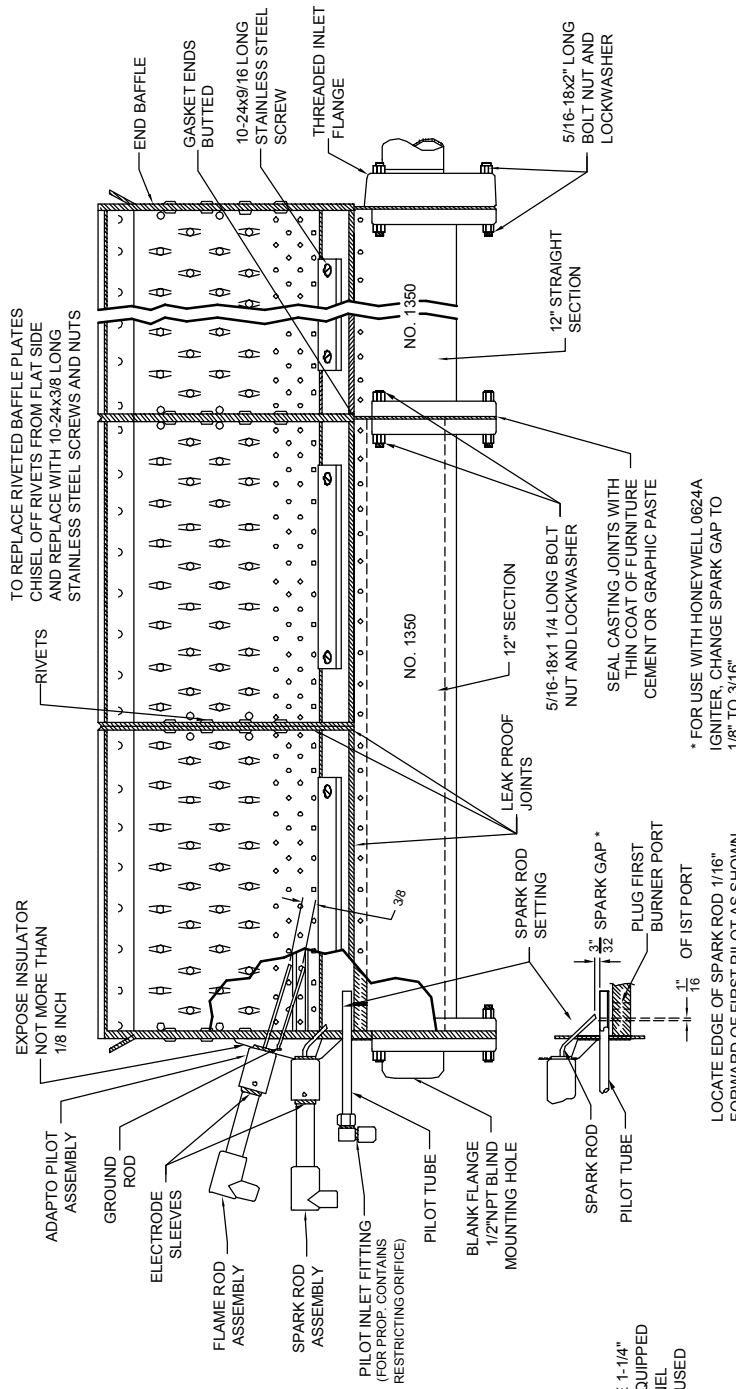
TITLE



DIRECT GAS FIRED MAKE-UP AIR HEATERS  
INSTALLATIONS AND SERVICE INSTRUCTIONS

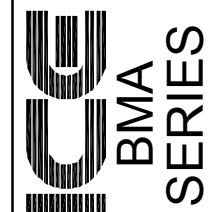
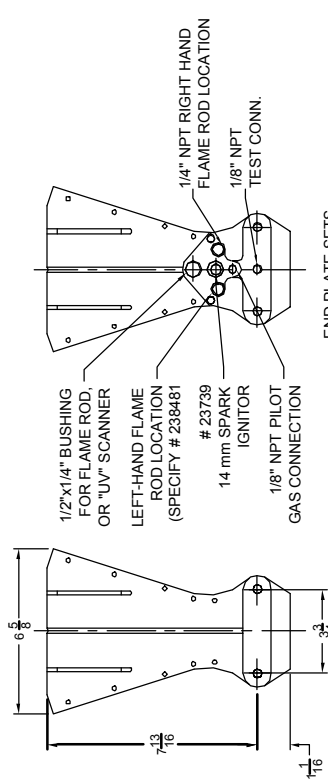
DRAWN BY JV	ISSUED BY JV	SCALE NTS	DRW. NO. FIG. 3 & 4
CHK. BY JS	DATE JUNE 10/98	JOB NO.	REV -

MIDCO DIRECT FIRED GAS BURNER PILOT ARRANGEMENT WITH FLAME ROD AND IGNITOR



BUILT-IN PILOTS

BOTH THE END PLATE ILLUSTRATED ABOVE AND THE 1-1/4" END INLET FLANGE IN THE SKETCHES BELOW ARE EQUIPPED WITH PILOT GAS CONNECTION LEADING TO A CHANNEL OF THE MAIN BURNER. EITHER MAY THEREFORE BE USED AS A PILOT.



TITLE  
MIDCO DIRECT FIRED GAS BURNER PILOT ARRANGEMENTS W/ FLAME ROD AND IGNITOR

DRAWN BY JV	ISSUED BY JV	SCALE INTS	DRW. NO. FIG. 5
CHK. BY JS	DATE JUNE 16/98	JOB NO.	REV -

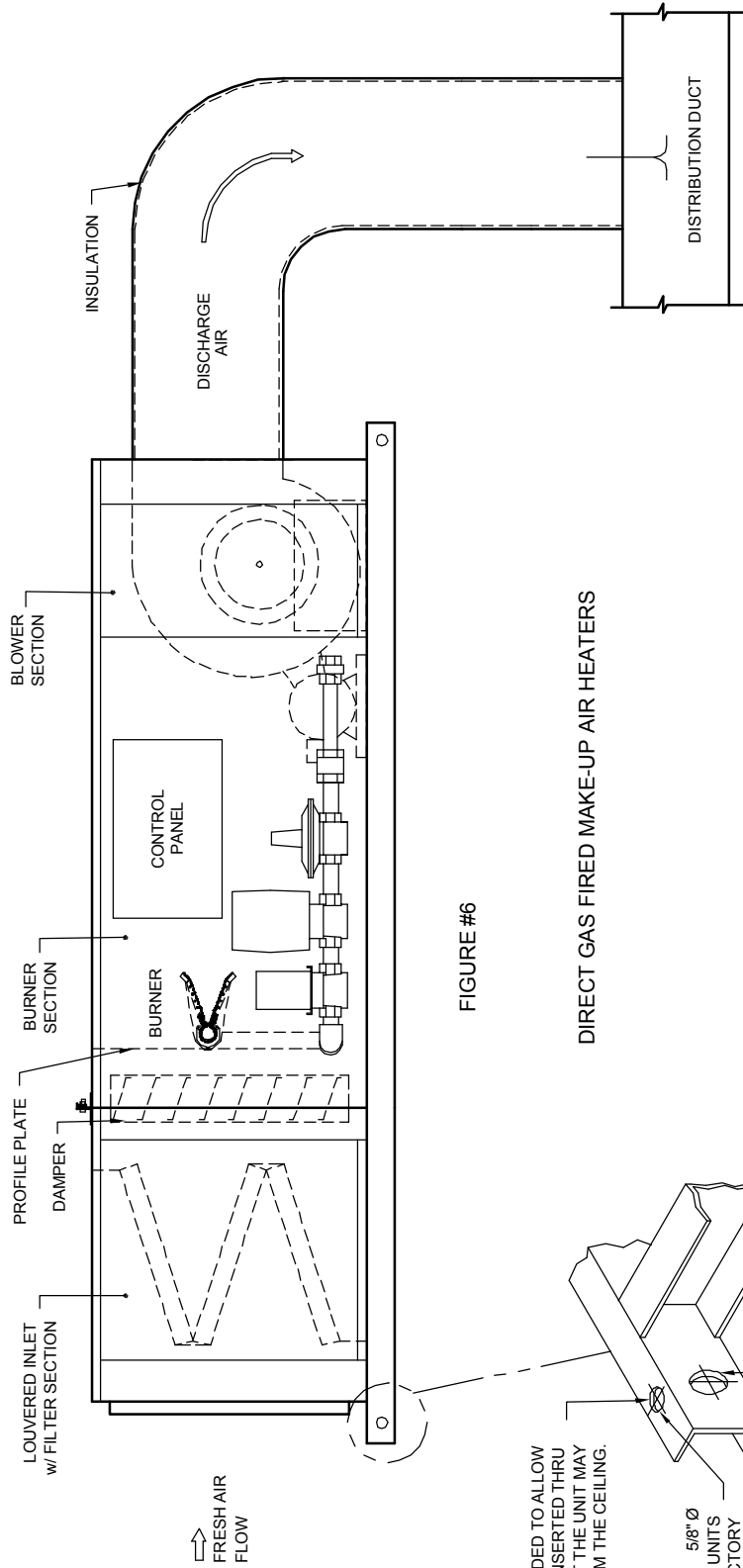


FIGURE #6

DIRECT GAS FIRED MAKE-UP AIR HEATERS

THESE HOLES ARE PROVIDED TO ALLOW SUSPENSION RODS TO BE INSERTED THRU THE BASERAIL SO THAT THE UNIT MAY BE SUSPENDED FROM THE CEILING.

5/8" Ø  
(FOR LARGE UNITS  
CONSULT FACTORY  
FOR HOLE SIZE)

UNIT MUST BE LIFTED  
AND HANDLED WITH THESE HOLES  
WHEN MOVING UNIT INTO POSITION  
TO BE SUSPENDED FROM CEILING.

LIFTING LUG DETAIL

TITLE

DIRECT GAS FIRED MAKE-UP AIR HEATERS  
SUSPENSION HOLES DETAIL FOR INDOOR UNIT



DRAWN BY JV	ISSUED BY JV	SCALE NTS	DRW. NO. FIG. 6
CHK. BY JS	DATE DEC 20/2000	JOB NO.	REV -