Installation and Maintenance Manual	IM-685-1
	Group: **Applied Systems**
	Part Number: **IM685**
	Date: **January 2004**

SuperMod™ Forced Draft Gas Fired Furnace on McQuay Applied Rooftop Systems

HT***A* with RM7895A Flame Safeguard

When writing to McQuay for service or replacement parts, refer to the model number of the unit as stamped on the serial plate, attached to the unit. If there is an in-warranty failure, state the date of installation of the unit and the date of failure along with an explanation of the malfunctions and the description of the replacement parts required. Parts are warranted for ninety (90) days unless covered by original unit warranty.

SERVICED BY:	
TELEPHONE NO:	**INSTALLATION DATE:**

Installer: Leave this manual with owner. It is to be posted and maintained in legible condition.

General

This forced draft gas burner is specifically designed for use with the furnace on McQuay applied rooftop heating and air conditioning units which are for outdoor installation only. Each model size has unique burner head components to tailor the shape of the flame to each particular stainless steel combustion chamber, to match the capacity requirement, and to offer a desirable turndown potential when arranged for modulation. This is a forced draft burner with a high pressure combustion air fan and will operate against pressure. This eliminates the need for draft inducers, chimneys, draft hoods, barometric dampers, and Breidert caps.

Warranty Exclusion

Do not operate the furnace if chlorinated vapors are present, the airflow through the furnace is not in accordance with rating plate, or if wiring or controls were modified or tampered with. Damage caused or contributed to by such conditions is not covered by the warranty.

⚠ WARNING

Do not operate gas heating units in an atmosphere contaminated with corrosive chemicals such as halogenated hydrocarbons, chlorine, cleaning solvents, refrigerants, swimming pool exhaust, etc. Exposure to these compounds can cause severe damage to the gas furnace and personal injury or death.

Ventilation & Flue Pipe Requirements

The McQuay applied rooftop unit is equipped with an outdoor air louver to supply adequate combustion air. The unit also has a flue outlet assembly and requires no additional chimney, flue pipe, Breidert cap, draft inducer, etc.

Factory Mounting

This burner and gas train has been installed and wired at the factory. See "Gas Piping." Also note that models 150 through 200 have the burner removed for shipment; see “Vestibule (Models 150 thru 200)” on page 7.

Factory Checkout

This complete heating plant was fired and tested at the factory. It was adjusted to the required capacity and efficiency. Modulating air and gas linkages, pressure regulators, and stops were adjusted for proper operation at all firing levels. The unit was fired through several complete sequences of start-up through shutoff to check operation. A check was made of the air switch, gas pressure switch, high limit operation, and combustion characteristics including CO_2 and CO (at several firing rates on modulating burners).

If the burner was specified for operation at higher altitudes, combustion air adjustments were compensated to result in proper settings at the higher altitude. This checkout normally eliminates on-the-job start-up problems; however, the equipment is subject to variable job conditions and shipping shocks can change adjustments, cause damage, and loosen connections and fasteners. Therefore, it is necessary to go through the complete start-up procedure even though the unit may appear to be operating properly.

Installation

General

The installation of this equipment must be in accordance with the regulations of authorities having jurisdiction and all applicable codes. It is the responsibility of the installer to determine and follow the applicable codes. Sheet metal parts, self-tapping screws, clips, and such items inherently have sharp edges, and it is necessary that the installer exercise caution. This equipment must be installed by an experienced professional installation company that employs fully trained technicians.

Flue Box

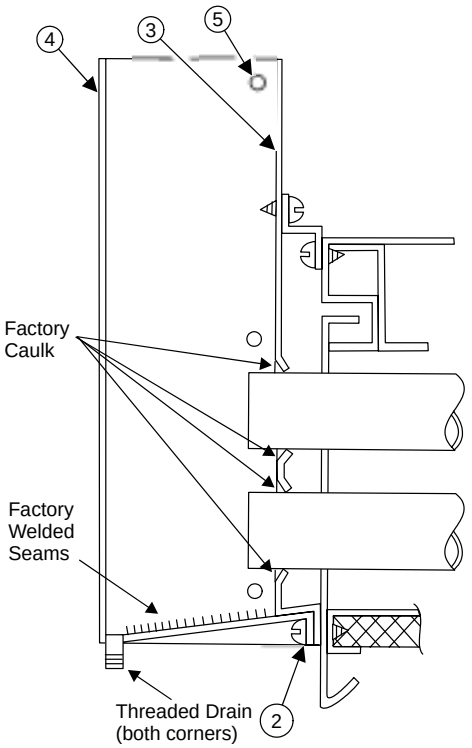
The flue box is not installed at the factory because it would increase the width of the unit beyond the allowable shipping width. All holes are prepunched, the fasteners are furnished and everything is shipped inside a box in the burner section of the unit. On Models 150 through 200, it is shipped in the same crate as the vestibule. Remove and discard the shipping cover installed over the furnace tube outlets before installing the flue box. See “Figure 1. Flue Box” on page 4.

1. Remove the screws (2) in the casing of the unit that line up with the bottom lip holes of the flue box tube sheet (3). These screws will later be replaced, at which time they will also attach the bottom of the flue box to the unit.
2. .Install flue box wrapper sheet (4) by sliding it up from below. Attach with side screws (5). At this time reinstall bottom screws (2).

McQuay Model Designation

Furnace Model	20	25	32	40	50	64	65	79	80	100	110	140	150	200
Output Capacity (MBH)	200	250	320	400	500	640	650	790	800	1000	1100	1400	1500	2000

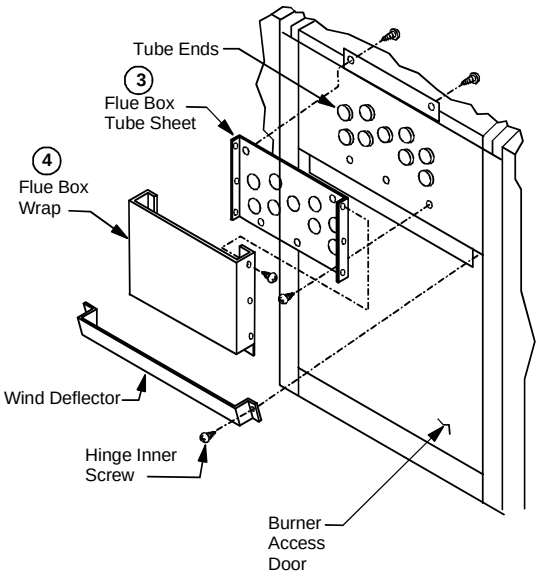
Figure 1. Flue Box



Wind Deflector

The wind deflector is not installed at the factory because it would increase the width of the unit beyond the allowable shipping width. The deflector is shipped in the burner vestibule of the unit. Install the wind deflector over the combustion air intake opening of the burner compartment before operating the burner. Use inner hinge screws on top hinged door (see Figure 2). Side hinged doors have holes for mounting (see Figure 5). Models 020 and 025 have a different style wind deflector. It mounts on the door and has a top opening flush with the roof of the unit (see Figure 14).

Figure 2. Wind Deflector (Models 032 thru 140)



Electrical

The McQuay burner receives its electrical power from the main unit control panel. No additional power wiring must be routed to the burner. The sequencing of the burner is also controlled through this panel and therefore is factory wired. No additional wiring will be required. Note that models 150 through 200 furnaces require reassembly of some electrical connections as the burner is removed for shipment.

⚠ WARNING

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

If you smell gas:

1. Open Windows and ventilate area thoroughly.
2. Don't touch electrical switches.
3. Eliminate open flames, pilot lights, arcing or sparking equipment, or other sources of ignition.
4. Evacuate the area.
5. Immediately call your gas supplier from a different area.

Do not use and store gasoline or other flammable vapors or liquids in open containers near this appliance or in areas sharing ventilation with it.

Gas Pressure Requirements

The pressure furnished to the combination gas control(s) must not exceed 13.9 in. W.C. When the supply pressure is above 13.9 in. W.C., a high pressure regulator must precede the combination gas control(s). The inlet gas pressure must not exceed the maximum pressure rating of the high pressure regulator, and the outlet pressure must furnish gas to the appliance pressure regulator within the pressure range mentioned above, preferably at 7.0 in. W.C. when firing at maximum rate.

Gas Piping

The connection size at the burner is shown in Table 5 under columns 13 thru 15. Gas piping must be sized to provide the minimum required pressure at the burner when the burner is operating at maximum input. Consult the appropriate local utility on any questions on gas pressure available, allowable piping pressure drops, and local piping requirements.

Install all piping in accordance with the National Fuel Gas Code (ANSI Z223.1), (NFPA 54-1999) and any applicable local codes.

The proper size piping must be run from the meter to the gas burner without reductions. Undersized piping will result in inadequate pressure at the burner. The pressure will be at its lowest when it is needed the most, at times of maximum demand. Therefore, it can cause intermittent hard-to-find problems because the problem may have left before the service technician has arrived. Avoid the use of bushings wherever possible.

Remove all burrs and obstructions from pipe. Do not bend pipe; use elbows or other pipe fittings to properly locate pipe. A drip leg must be installed in the vertical line before each burner such that it will not freeze. Install unions so gas train components can be removed for service. All pipe threads must have a pipe dope which is resistant to the action of LP gas. After installation, pressurize the piping as required and test all joints for tightness with a rich soap solution. Any bubbling is considered a leak and must be eliminated. Do not use a match or flame to locate leaks.

Valve & Regulator Venting

Valve diaphragm vents, pressure regulator vents, and pressure switch vents are located in the outdoor burner vestibule and therefore vent tubing is not run to the outside of this vestibule. If local regulations require that this be done, it is a part of the field gas piping hookup. Remove any plastic protector plugs from regulator and valve vents.

Normally Open Vent Valve

Vent valves such as required by IRI for over 1000 MBH input units must always be routed to the outdoors. This is field piping.

Table 1. Capacity of pipe natural gas (CFH)

WITH PRESSURE DROP OF .3" W.C. & SPECIFIC GRAVITY OF 0.60									
PIPE LENGTH (FT.)	PIPE SIZE-INCHES (IPS)								
	½	¾	1	1¼	1½	2	2½	3	4
10	132	278	520	1050	1600	2050	4800	8500	17500
20	92	190	350	730	1100	2100	3300	5900	12000
30	73	152	285	590	890	1650	2700	4700	9700
40	63	130	245	500	760	1450	2300	4100	8300
50	56	115	215	440	670	1270	2000	3600	7400
60	50	105	195	400	610	1150	1850	3250	6800
70	46	96	180	370	560	1050	1700	3000	6200
80	53	90	170	350	530	990	1600	2800	5800
90	40	84	160	320	490	930	1500	2600	5400
100	38	79	150	305	460	870	1400	2500	5100
125	34	72	130	275	410	780	1250	2200	4500
150	31	64	120	250	380	710	1130	2000	4100
175	28	59	110	225	350	650	1050	1850	3800
200	26	55	100	210	320	610	980	1700	3500

Note: Use multiplier below for other gravities and pressure drops.

Table 2. Specific gravity other than 0.60

SPECIFIC GRAVITY	MULTIPLIER
0.50	1.100
0.60	1.000
0.70	0.936
0.80	0.867
0.90	0.816
1.00	0.775

Table 3. Pressure drop other than 0.3"

PRESSURE DROP	MULTIPLIER	PRESSURE	MULTIPLIER
0.1	0.577	1.0	1.83
0.2	0.815	2.0	2.58
0.3	1.000	3.0	3.16
0.4	1.16	4.0	3.65
0.6	1.42	6.0	4.47
0.8	1.64	8.0	5.15

Gas Piping Routing Into Unit

On-The-Roof Piping (Models 020-140)

1. Remove knockout (1) at corner of burner vestibule door and saw out corner of door. See Figure 3b. Make saw cuts (2) tangent to round hole and square with door edges.
2. .Install pipe corner plate (3) on vestibule, locating on pre-punched holes. See Figure 3c. This part is shipped inside the vestibule.
3. .Route gas supply pipe through hole. Carefully plan pipe route and fitting locations to avoid interference with swinging of doors, etc.

Through-The-Curb Piping (Models 020-140)

1. Remove bottom access panel (5). See Figure 3c.
2. .Remove knockout (4) and make an opening (6) through bottom deck directly below knockout hole.
3. .Route gas pipeline through these openings and seal them off with suitable grommets (7).
   See Figure 3a Section A-A.
4. .Replace bottom access panel (5).

Figure 3a.

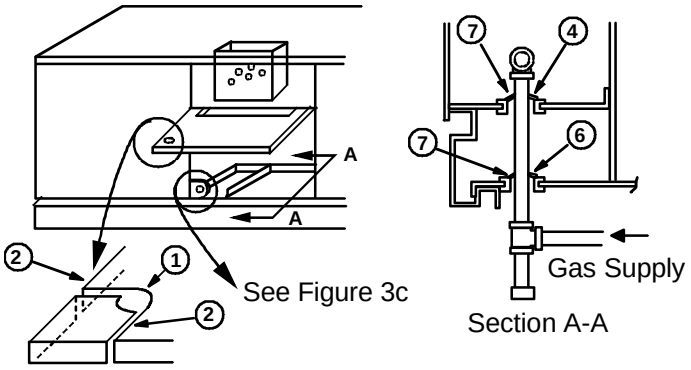
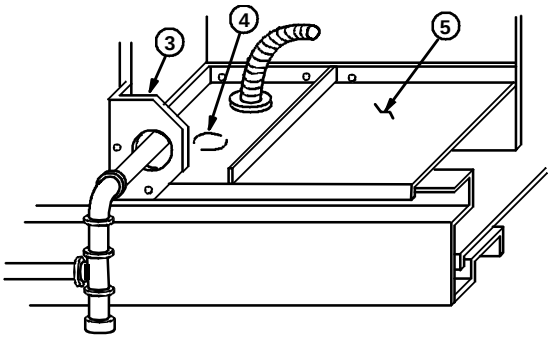


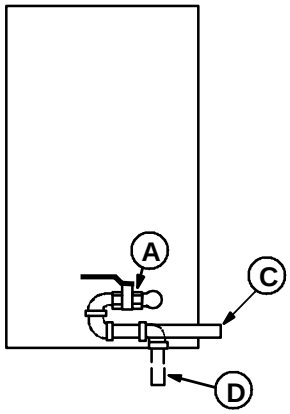
Figure 3b.

Figure 3c.



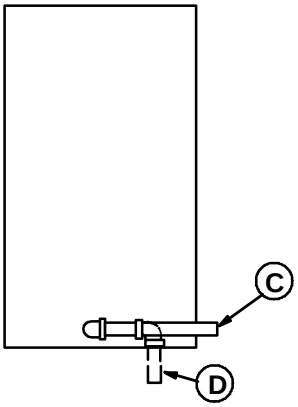
Typical Piping Connections

Figure 4.



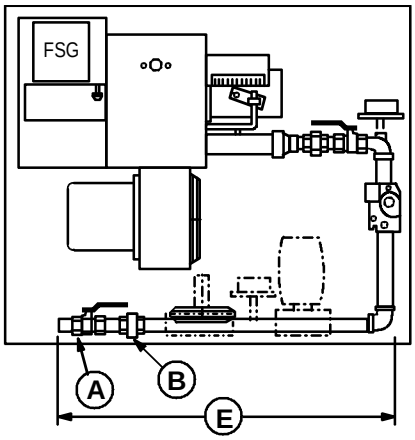
With Shutoff Cock
Folded Back

Figure 4b.



With Shutoff Cock
In Front

Figure 4a.



A = Shutoff Cock (ball valve)
B = Union - Furnished.
C = Gas Pipe - Routed in through front
D = Gas Pipe - Routed in through curb
E = Factory Piped Gas Trains

Gas Piping (Models 150 - 200)

The gas piping cannot be routed up to the burner from within the curb on Models 150 through 200. Gas piping must be routed across the roof to under the burner vestibule, or a pitch pocket can be provided there. The installer must cut a hole in the bottom panel of the overhanging burner vestibule through which to route the gas line up to the burner gas train. The bottom panel of the vestibule is at approximately the same elevation as the top of the curb.

Gas Piping within the Vestibule

The gas piping layout within the vestibule will vary according to the complexity and size of the gas train relative to the available room within the vestibule. As an example, a gas train with a high pressure regulator and an extra safety shutoff valve (when required for IRI, etc.) will require careful use of the available space. The examples shown in Figure 4 indicate typical piping layouts.

Field Gas Piping Required

The gas train components have all been factory installed and require only a connection to the supply gas line. The manual shutoff valve is located within the burner vestibule. If local codes require a manual shutoff valve that is is accessible from outside the unit, that valve must be relocated or an additional valve added. In locating such a valve, it is to be readily accessible and located such that no obstructions interfere with operation of the handle. See Figure 16a, "Valve and Regulator Venting", and "Normally Open Vent Valves".

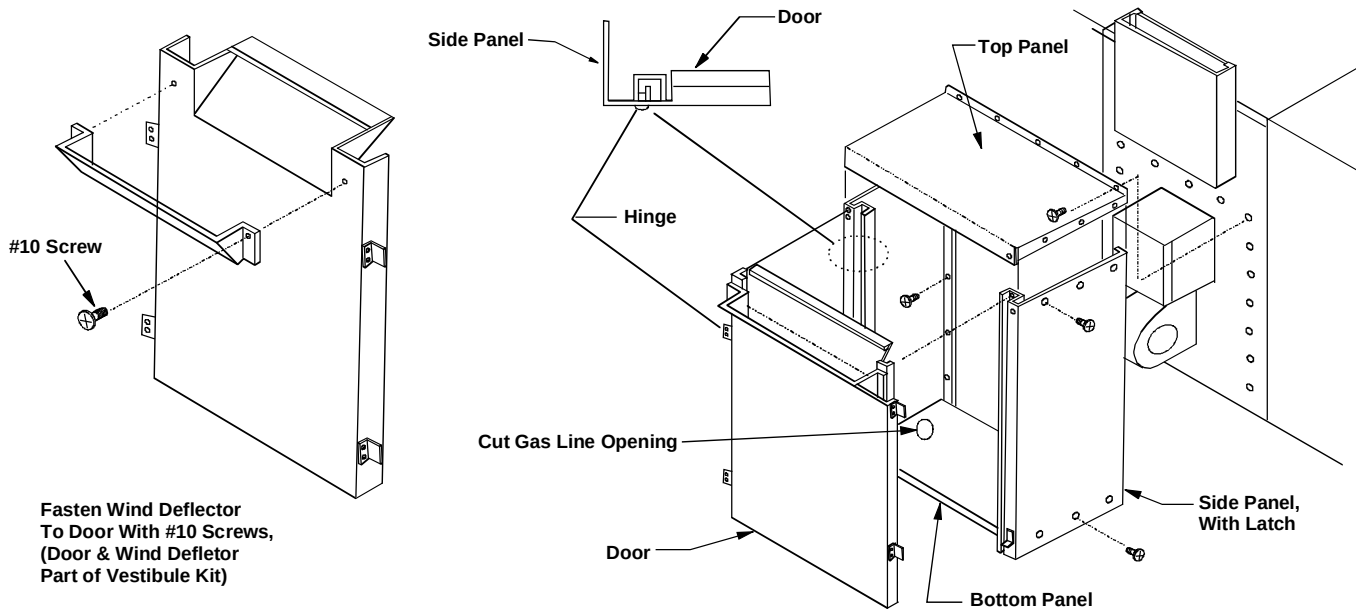
Condensate Drain

All units are equipped with a 3/4" I.P. condensate drain pipe projecting from the back side of the furnace section (See See “Figure 13. Models 032 thru 200 Heat Exchanger” on page 17. and See “Figure 14. Models 020 thru 025 Heat Exchanger” on page 18.) If applicable codes or regulations require, this can be trapped and/or routed to a drain. A trap is not recommended and heat tape or some other method of freeze prortection is required.

Vestibule (Models 150 thru 200)

These two furnace sizes exceed the allowable shipping width. For this reason the burner is disconnected and removed for shipment. A sheet metal vestibule weather enclosure is also disassembled for shipment. At installation, the burner must be re-mounted, the tagged electrical connections re-attached, and the vestibule re-assembled and mounted as shown in Figure 5. These items are packed in a crate and shipped as a separate item.

Figure 5.



Start-up & Operating Procedures

Start-up Responsibility

The start-up organization is responsible for determining that the furnace, as installed and as applied, will operate within the limits specified on the furnace rating plate.

1. .The furnace must not exceed the specified "Maximum MBH Input." See "Verify Input Rate" on Page 17.
2. .The furnace must not operate at an airflow below the specified "Minimum Airflow CFM." On variable air volume systems it must be determined that the furnace will not be operated if or when system cfm is reduced below the specified minimum airflow cfm.
3. .It must be established that the gas supply is within the proper pressure range. See "Gas Pressure Requirements" on Page 4.

Start-up Procedure

Only qualified personnel should perform the start-up and service of this equipment. It is highly recommended that the initial start-up and future service be performed by McQuay certified technicians who are familiar with the hazards of working on live equipment. A representative of the owner or the operator of the equipment should be present during start-up to receive instructions in the operation, care and adjustment of the unit.

⚠ WARNING

Overheating or failure of the gas supply to shut off can cause equipment damage, severe personal injury or death. Turn off the manual gas valve to the appliance before shutting off the electrical supply.

Before Start-up

1. Notify inspectors or representatives who may be required to be present during start-up of gas fuel equipment. These could include the gas utility company, city gas inspectors, heating inspectors, etc.
2. Review the equipment and service literature and become familiar with the location and purpose of the burner controls. Determine where the gas and power can be turned off at the unit, and before the unit.
3. Determine that power is connected to the unit and available.
4. Determine that the gas piping, meter, and service regulator have been installed, tested, and meet the equipment requirements.
5. Determine that proper instruments will be available for the start-up. A proper start-up requires the following: voltmeter, manometer or gauges with ranges for both manifold pressure and inlet gas pressure, keyboard display module or a 20K ohm/volt meter for flame safeguard, signal strength measurement, CO_2 indicator, carbon monoxide indicator, and a stopwatch for timing the gas meter.

About This Burner

Prepurge is Low-High-Low

The burner air control valve will be at the minimum position during "off" cycles. Upon a call for heat or any other time that a prepurge cycle occurs, the air control valve will be repositioned to the maximum position for the prepurge and then returned to the minimum position for low fire start.

Low Fire Start

The burner is controlled for proven low fire start. The actuator will position the modulating gas valve and the modulating air valve to the low fire position each time the burner is to light off. Switch LS1 proves the air and gas valves are at the low fire position. If LSl is not "made" at light off, the gas valves cannot open and the flame safeguard will lock out, requiring manual reset.

"Pilot" is Main Flame Modulated Down to Pilot Rate

The "pilot" is not a separate flame or burner. The "pilot" is the main flame operating at its minimum rate. That minimum rate is so low that it qualifies as a pilot burner.

Set Control System to Enable Heating

To allow start-up and check-out of the burner, the control system must be set to call for heating and must be used to control the amount of heating. Set the control system to call for heat so MCB-B011 energizes Relay R20. With MCB-B011 closed, vary the temperature control set point to increase, maintain, or reduce the firing rate of the burner as required for these tests. If MCB-B09 is closed, the firing rate will decrease. If MCB-B010 is closed the firing rate will increase. If neither are "made", the firing rate will remain unchanged.

Start-up Preliminary

1. See “Figure16a.” on page 25. Before energizing the burner verify that the modulating air and gas valve mechanism moves freely and is not binding, and check the linkage fasteners for tightness. This can be accomplished without affecting any adjustments. Remove shoulder screw (12) that connects the teflon bushing to the actuator crank arm. The control rod can now be manually moved back and forth; it should feel smooth with no binding or scraping. Always remove shoulder screw (12) and test for binding after reinstalling the gun assembly on Models HT050-200.
2. .Close the gas line cocks. Install a Keyboard Display Module, Honeywell Part No. S7800A1001, or connect a 20K ohm/volt meter to the test jack on the flame safeguard. See “Figure 7. RM7895A Flame Safegaurd” on page 12.
3. .Check the burner fan wheel for binding, rubbing, or loose set screws.
4. .Check power. Position switch S3 on burner control panel to AUTO. The LED marked POWER on the flame safe-

guard should come on and after a 10 second "Initiate" period the burner motor should start. Check for counter-clockwise rotation as viewed through the burner fan housing inlet. If the motor does not start, press the reset button on the flame safeguard. If the motor still does not start, consult the appropriate section of the "Trouble-shooting Chart" on page 22. Continue on to Item 5 when burner motor will run 10 seconds after the switch is positioned to AUTO.

5. .Check voltage. With burner switch S3 at AUTO, measure voltage across burner control box terminals 2 and NB. If it is not between 114 and 126 volts, check the voltage and tapping connections to the supplying transformer at the unit main control panel.

6. .Purge the gas lines. Close the main gas valves and turn the electrical switches off. Make sure there are no arcing or sparking switches, motors, or other equipment, pilot lights, open flames, or other sources of ignition in the areas sharing ventilation. Disconnect the pilot gas tube at the pilot pressure regulator and bleed the gas line of all air. Close the pilot cock and reconnect the pilot tubing.

7. .Leak check. Using a rich soap-water mixture and a brush, check the gas lines for leaks. Correct all leaks before starting burner. After the burner is operating and all the downstream valves are open, leak check that portion of the gas train.

8. .Connect a manometer to measure gas manifold pressure at (1), Figure 16a. There is a 1/8 inch pipe size plugged tapping in the gas line just before it enters the burner housing.

Preliminary "Dry" Run

1. Close the gas line cock, Remove the burner front cover and open the control panel door. Switches LS1 and LS2 in the lower right hand corner of the control box should be in view and the modulating actuator VM1 should be at the minimum rate position. Verify that the right hand switch LS1 is being held in the 'made' position by the collar on the control rod and that the switch lever is not bottomed out against the plastic switch housing.

2. .Position the burner switch S3 to AUTO. The flame safeguard will go through a 10 second "Initiate" period, after which the burner motor will start. The modulating gas valve actuator VM1 will drive the air valve and gas valve to the maximum rate position. Observe the linkage for any binding, loose fasteners, or other problems that could have resulted from shipping.

3. .When the actuator reaches the maximum rate position, verify that the left hand switch LS2 is held in the 'made' position by the collar on the control rod and that the switch lever is not bottomed out against the plastic switch housing.

4. .See "Figure 16b." on page 25. Position the burner switch S3 to OFF. Close the control panel door and reinstall the burner front cover. Prepare to measure the burner air box pressure by holding a rubber manometer tube tightly over port ✍✔✉ . The tube must surround the hole and seal tightly against the burner housing to measure the static pressure through the hole.

5. .See "Figure 16b." on page 25. Position the burner switch S3 to AUTO and with the burner actuator VM1 at the maximum rate position measure the burner air box pressure at port ✍✔✉ . The actuator will remain at this position for the first 20 seconds of the prepurge period. Typical static pressure readings are listed in Table 5, Column 6 on page 25. Any appreciable deviation from these values indicate a burner air problem. Find and fix the problem before attempting to fire the burner. These problems could include linkages disturbed during shipment, etc.

Flame Start-up

1. Open the gas line cocks and position switch S3 to AUTO. The flame safeguard will go through the 10 second "Initiate" period, after which the burner motor will start. The modulating air and gas valve actuator VM1 will drive the air valve to the full open position. At full open, the 60 second prepurge period will begin. After 20 seconds at maximum open, the actuator will begin a 30 second stroke to reposition the air valve back to the minimum position. Upon completion of the 60 second prepurge cycle, gas valve GV1 will open (as indicated when the LED marked PILOT comes on), the ignition transformer is powered and the flame should come on at minimum rate.

2. .Observe the gas manifold pressure manometer during this sequence. The manifold pressure should be close to zero (it will indicate a slight heat exchanger pressure caused by the burner combustion air fan). When gas valve GV1 opens, it should indicate a manifold pressure approximate to the values listed in Table 5, Column 10. Approximately 3 seconds after GV1 is powered, the flame will come on and the flame signal will read 1.5 to 5.0 volts DC. The LED marked FLAME will come on when flame is detected and the LED marked MAIN will come on if flame is being detected at the end of the 10 second trail for ignition period. When the LED marked MAIN comes on, gas valves GV4-GV8 (when included) will also open and the firing rate will be determined by the control system. On the initial start-up, if the flame does not light and the flame safeguard locks out, reset it and make several attempts to light before assuming there are problems other than more air in the gas lines. If initial flame operation is erratic wait until after a period of main flame operation has further purged the gas lines before trying to "adjust out" something that may actually be caused by air in the lines.

Modulate Firing Rates

Set the temperature control system so the burner actuator VM1 will modulate to increase the firing rate. Observe the flame signal and the manifold pressure manometer as this is occurring. The flame signal should remain between 1.5 to 5.0 volts DC through the entire range of the burner, and the manifold pressure should be between the values indicated by

Combustion Tests

These tests should be run when the furnace is at normal operating temperature (after the furnace has been running 10 to 15 minutes), and should be run at several firing rates including maximum and minimum.

a. Check input: See “Verify Input Rate” on page 17.

b. Check $C0_2$: See Check CO_2, CO & Stack Temperature

c. Check CO: See Check CO_2, CO & Stack Temperature

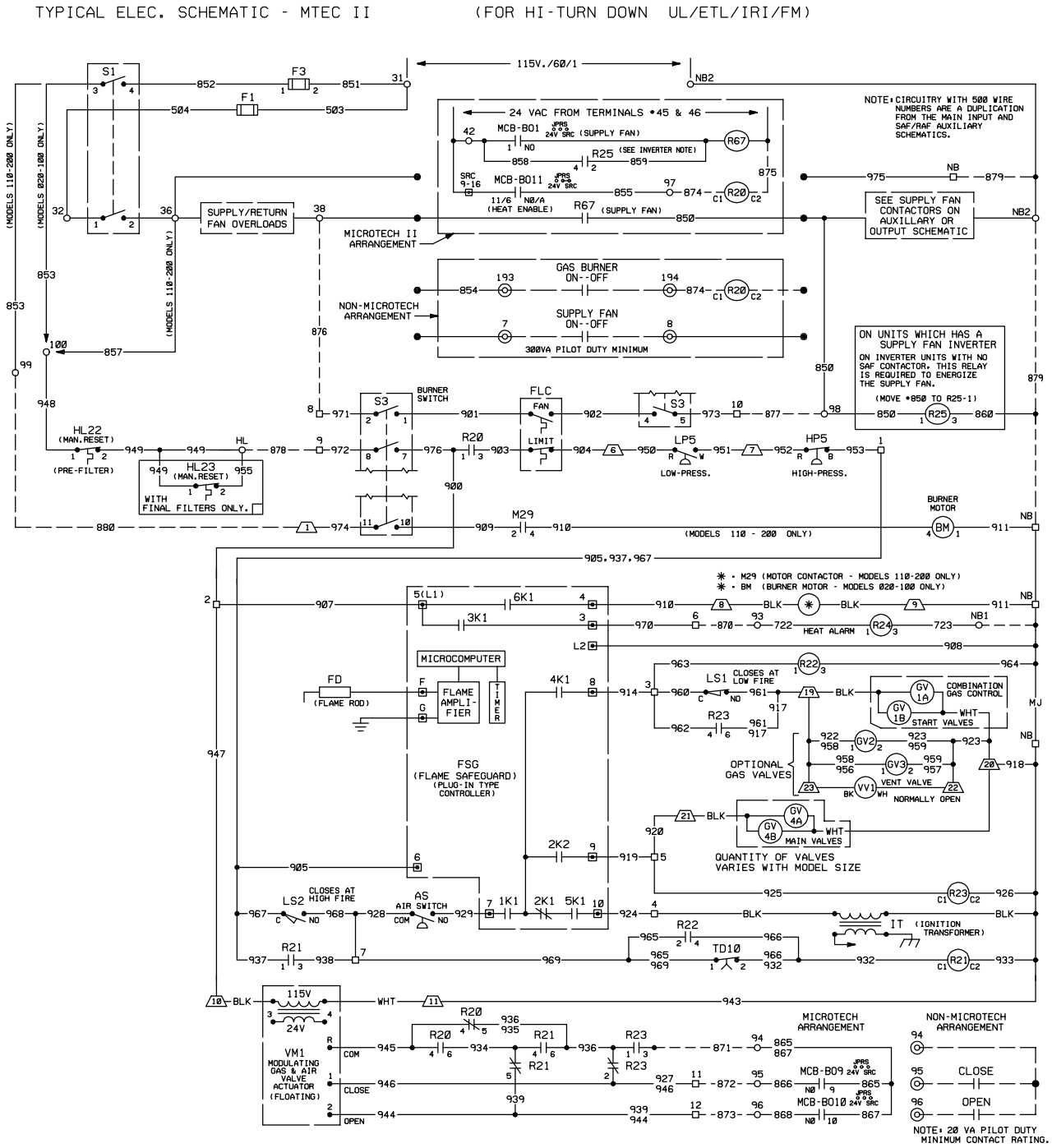
Cycle the Unit

Cycle the unit through several start-ups with controls calling for first low fire and finally high fire. Watch for any indications that the unit is not operating as expected, and for inconsistencies that could indicate future problems.

Record Data

After the gas burner has been successfully started up, checked out and is operating correctly, readings should be taken and recorded for future reference (see Table 6). If problems develop in the future, variations in these readings will indicate what has changed and where to start looking for problems.

Figure 6a. Typical Electrical Schematic with RM7895A



Typical Sequence of Operation

When the rooftop unit is energized, 120 volt power is supplied to the system on/off switch (S1), to burner on/off switch (S3) and 24 volts to the (BO#11) contacts on the main control board (MCB).

Note: On field supplied controls, 120V power is supplied through the system on/off switch (S1) to burner on/off switch (S3) and to the field supplied gas heat on/off contacts.

Burner on/off switch (S3) will power the modulating gas valve actuator (VM1) and terminal #5 (L1) on the flame safeguard (FSG). Upon a call for heat, the control system will close (BO#11) on the main control board (MCB), thus energizing relay (R20). When 120V power is furnished through the system on/off switch (S1), through the burner on/off switch (S3), through relay (R20) contacts, through the high limit control (FLC) and through the optional automatic reset low gas pressure switch (LP5) and the optional manual reset high gas pressure switch (HP5), terminal #6 on the flame safeguard (FSG) is powered. The flame safeguard then energizes its terminal #4, which powers the burner combustion air blower motor (BM). Whenever power is restored to the flame safeguard, the flame safeguard will go through a 10 second initiation period before the prepurge period will begin.

The burner air control valve will be at minimum position during off cycles. Upon a call for heat or any other time that a prepurge cycle occurs the air control valve will be re-positioned to the maximum position for the prepurge and then returned to the minimum position for low fire start.

(VM1), through the N/C contacts of (R20) and (R23), positions the burner air and gas control valves to minimum after run cycle. When (R20) is energized for a new call for heat, (VM1) through the N/O contacts of (R20) and the N/C contacts of (R21), will re-position the burner air valve to its maximum open position for pre-purge. When the air control valve reaches the full open position, switch (LS2) is 'made', powering (FSG) terminal #7 through the burner air switch (AS). This initiates the 60 second prepurge cycle. Concurrently, (LS2) powers timer (TD10) which will energize relay (R21) after 20 seconds. When (R21) is energized (VM1) will start the air control valve on its way toward the minimum air valve position through the N/O contact of (R21) and the N/C contact of (R23). At the completion of the 60 second prepurge cycle the valve will be at the minimum open position and the minimum position switch (LS1) will be 'made'. If (LS1) is not 'made' the combination gas control start valves (GV1) will not open and the burner will lockout.

After completion of the 60 second prepurge period there will be a 10 second trial for ignition during which terminal #8 (combination gas valve - GV1) and terminal #10 (ignition transformer - IT) will be energized. If flame is being detected through the flame rod (FD) at the completion of the 10 second trial for ignition period, terminal #10 (ignition transformer - IT) will be de-energized and terminal #9 (relay R23 coil and main gas valves - GV4 and GV5) will be energized and the control system will be allowed to control the firing rate. The flame safeguard contains 'LEDS' (lower left corner) that will glow to indicated operation.

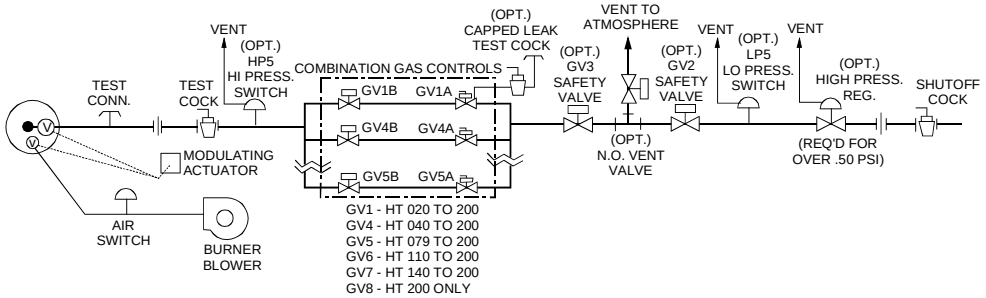
After the flame has lit and been proven, relay (R23) is energized, allowing (VM1), as controlled by (BO#9) and (BO#10) on the main control board, (MCB), to position the burner air and gas valves for the required firing rate. When the main control system closes (BO#10), the gas valve actuator will re-position toward a higher firing rate until (BO#10) opens or the actuator reaches its maximum position. When the main control system closes (BO#9), the actuator will re-position toward a lower firing rate. If neither (BO#9) or (BO#10) on the main control board (MCB) are closed, the actuator will remain at its present position. The heating capacity is monitored by the main control board (MCB) through (AI #10) via a position feedback potentiometer on the actuator.

In the event the flame fails to ignite or the flame safeguard fails to detect its flame within 10 seconds, terminals #4, 8, 9, and 10 will be de-energized, thus de-energizing the burner and terminal #3 will become energized. The flame safeguard would then lockout and would require manual resetting. Terminal #3 will energize the heat alarm relay (R24), which would then energize the remote 'HEAT FAIL' indicator light and send a fail signal to binary input #5 in Micro-Tech II main control board (MCB).

If an attempt is made to restart the burner by resetting the flame safeguard, or if an automatic restart is initiated after flame failure the earlier described prepurge cycle with the wide open air valve will be repeated.

If the unit overheats, the high limit control (FLC) will cycle the burner, limiting furnace temperature to the limit control set point.

Figure 6b. Typical Piping Schematic



Flame Safeguard

See manufacturer's bulletin for more detailed information on flame safeguard RM7895A.

The Honeywell RM7895A is a microprocessor based integrated burner control that will perform self-diagnostics, troubleshooting, and status indication, as well as the burner sequencing and flame supervision.

Keyboard Display Module

The Honeywell S7800A1001 module is an optional device available for use with the RM7895A. It can be a permanent accessory added to the RM7895A or it can be carried by the service technician as a tool that is very easy to mount when servicing the RM7895A. It mounts directly onto the RM7895A and has a 2 row by 20 column display. The module will indicate flame signal DC volts, sequence status, sequence time, hold status, lockout/alarm status, total hours of operation, total cycles of operation, and can provide 127 different diagnostic messages for troubleshooting the system.

The module will give a fault history. It can be mounted to the RM7895A and will retrieve information on the six most recent faults.

Consult the Honeywell bulletin 65-0090-1 "7800 Series, Keyboard Display Module" and 65-0118-1 "7800 Series, System Annunciation, Diagnostics and Troubleshooting".

Operation

Initiate Period: When the relay module is powered it goes through a 10 second "Initiate" period. It will also enter into the "Initiate" period if electrical power problems such as low voltage or momentary interruption occur while the unit is operating. Operation of the burner fan motor is delayed throughout the "Initiate" period.

Standby: After the initiate period is completed the module will enter the standby mode and await a call for heat by the temperature control system.

Normal Start-up:

Prepurge: Upon a call for heat the prepurge period will begin. If the air switch does not detect fan operation in the first 10 seconds into the prepurge period a recycle to the beginning of the prepurge will occur.

Ignition Trial: The "start" combination gas control and the ignition transformer are powered for 10 seconds following the prepurge. Flame must be proven at the end of that 10 second period or shutdown will occur.

Run: If flame is proven at the end of the 10 second ignition trial the "start" combination gas control will remain powered and on multiple valve units, the other parallel piped main valves will become powered. If a flameout occurs the module will recycle within 3 seconds, and initiate a new prepurge period. If flame continues to be detected, the module will be in Run until the power is interrupted to terminal 6 indicating that the temperature control system no longer requires heat, or that the high limit or another safety control has opened.

LED Display

There are five labeled LED's located on the front of the RM7895A which are energized to indicate operation as follows:

POWER The RM7895A is powered.

PILOT The prepurge period is complete and the terminal for the "start" combination gas control is powered.

FLAME Flame is detected.

MAIN The ignition trial period is complete, flame is detected, and the terminal for the main gas valve is powered and a normal recycle is underway.

ALARM The RM7895A is on safety lockout.

Figure 6c. Typical Burner Control Box

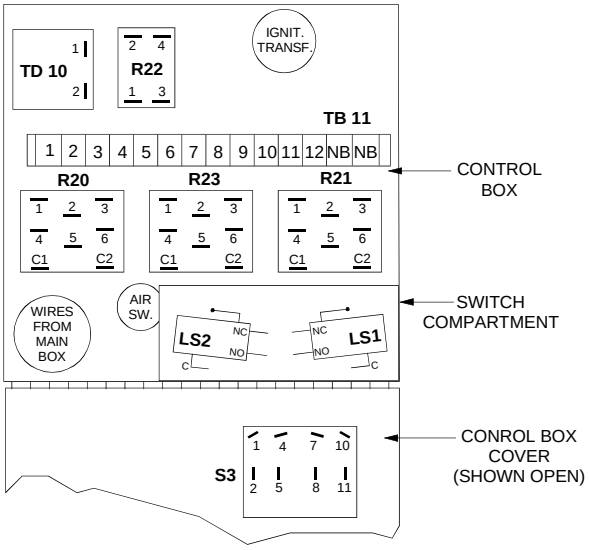
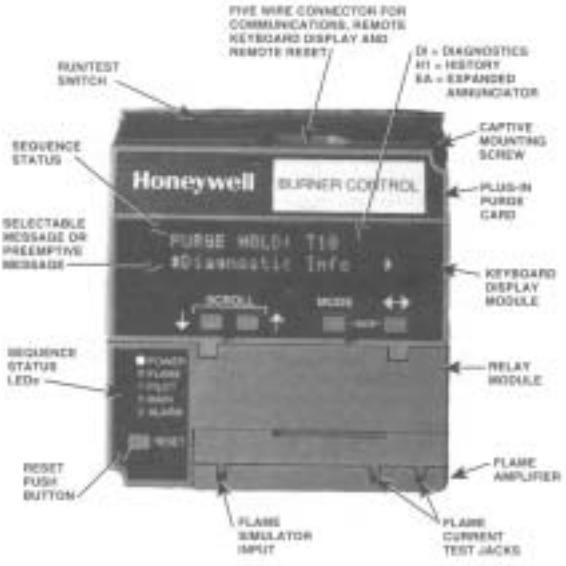


Figure 7. RM7895A Flame Safegaurd



Service

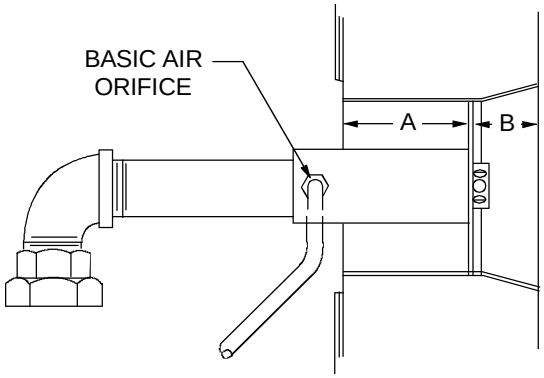
General

Before starting service on this burner, take the time to read the sections "About This Burner" and the 'Sequence of Operation" to get an overview.

Gun Assembly

The McQuay gas burner gun assembly is easily removable and includes the ignition electrode assembly, the flame rod assembly, and a "Base Air" fitting with orifice. The positioning of this assembly is not considered field adjustable. When positioned correctly the gun disc will be perpendicular to the blast tube and back in the cylindrical portion of the blast tube as shown in Figure 8. The gun pipe will be concentric with the blast tube.

Figure 8. Gun Assembly



Model HT***	A	B	Base Air Orifice I.D.
020	1.98	1.94	.060
025	2.04	1.88	.060
032	2.04	1.88	.067
040	2.17	1.75	.070
050	2.17	1.75	.089
064	217	1.75	.089
065	2.17	1.75	.089
079	2.07	1.85	.102
080	2.07	1.85	.102
100	2.30	1.62	.102
110	2.24	1.68	.098
140	2.30	1 62	.110
150	4.13	1.62	.110
200	4.13	1.62	.110

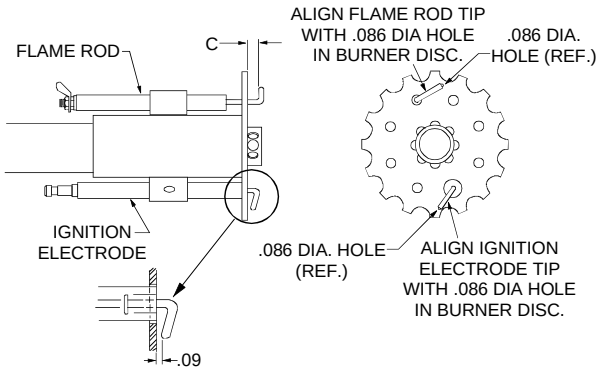
Gun Assembly Removal and Installation

Unplug the ignition lead from the ignition electrode and unplug the flame rod lead from the flame rod. Disconnect the 3/8 inch copper tube at the brass fitting on the left side of the gun pipe, open the pipe union and remove the gun assembly. Models 050-200 include an air tube that must be lifted up and out of the grommeted hole it is nested into as the gun assembly is removed. The gun assembly may have to be manipulated and wiggled as the disc is withdrawn back through the blast tube. Reassemble in reverse order, being particularly careful to correctly reinsert the air tube into the grommeted hole. The tube should slip into the grommet so there is little leakage, but it should not bear down on it or it can cause binding on the sliding air valve. Always remove shoulder screw (12), Figure 16a, and manually slide the control rod back and forth to test for binding after reinstalling the gun assembly on Models HT050-200. Do not operate the burner without a tight seal at the grommet.

Flame Rod Adjustment

The gun assembly is removed for flame rod inspection or service. When correctly adjusted, the flame rod insulator will be concentric with the hole it passes through, not be shorted out against the disc, the 0.75 inch long end tip will point toward the 0.086 inch diameter alignment hole, and the end tip will clear the disc according to dimension 'C' Figure 9.

Figure 9. Flame Rod and Ignition Electrode



Model HT***	C
020	.09
025	.09
032	.09
040	.09
050	.40
064	.40
065	.40
079	.40
080	.40
100	.44
110	.35
140	.35
150	.48
200	.75

Flame Rod Installation

The flame rod must be disassembled from its porcelain insulator for removal or installation. Remove the two nuts on the threaded end of the flame rod, pull the rod out of the insulator, and then remove the insulator by loosening its clamp screw.

Ignition Electrode Adjustment

The gun assembly is removed for ignition electrode inspection or service. When correctly adjusted, the ignition electrode insulator will he concentric with the hole it passes through, the end of the insulator will be flush with the outside surface of the gun disc, the electrode tip will point toward the 0.086 inch diameter alignment hole, and there will be a 0.09 inch spark gap to the gun disc (see Figure 9). The ignition electrode can he removed by loosening the clamp screw and sliding the entire assembly through the disc hole.

Air and Gas Adjustments

The burner has been adjusted and tested at the factory with accurate instruments. Readjusting the burner after the unit has been installed should not be necessary.

Verify that the gas supply pressure is correct, the electrical power is correct, and test the burner thoroughly. Do no make adjustments unless there is a clear indication that there is a problem, and proper instruments are available so the adjustments can be made correctly.

Gas Supply Pressure

The maximum pressure rating of the combination gas control(s) used on this burner is 0.50 psi (13.9 in. w.c.), as measured at (2), Figure 16a. If the gas supply pressure is higher than this an additional regulator must be installed so the pressure will not exceed 0.50 psi.

Gas burner problems are often due to gas supply pressure problems. High or low gas pressures can cause nuisance lockouts of the flame safeguard and combustion problems. Low gas pressure will reduce the heat output of the furnace and, if extreme, can cause combustion problems and flame safeguard lockouts. Every gas supply system has a high pressure regulator somewhere upstream. If it is at the meter and adjusting the outlet pressure is not an option, the following paragraph "High Pressure Regulator" would still apply.

High Pressure Regulator

If a high pressure regulator is included as part of the burner gas train or is included elsewhere in the gas supply line, it should be adjusted so the pressure at the inlet tap to the combination gas valves is 7.0 in. w.c. The inlet tap is (2) on Figure 16a. Check that the pressure is relatively consistent as the firing rate changes. If any other equipment is served by that same gas line or pressure regulator, check that the gas pressure also remains relatively consistent when that equipment is turned on and off. Verify that the regulator closes off tightly at zero flow by observing that the pressure does not creep up when the unit is off. If it does, excessive pressure will have built up over the off period, possibly exceeding the pressure rating of the combination gas controls, and causing other problems at light off.

Gas Adjustments

See the sections on "Gas Valve Pressure Regulator Adjustment", "Gas Supply Pressure", and "High Pressure Regulator". The gas flow rate is determined by the gas pressure and a characterized element within the modulating gas valve. The stem of the valve connects to the bracket that positions it with lock nuts that are adjusted at the factory and determine the minimum firing rate of the burner. Other than gas pressure adjustments, this is the only adjustable control of the gas. Adjusting the minimum rate is not intended to be a routine field adjustment. Properly adjusting the minimum rate requires clocking a gas meter at very low flow rates, or connecting a test flow meter into the gas train.

Air Adjustments

Airflow and the resultant combustion characteristics have been preset and tested at the factory and no further adjustments should be required. Airflow to the burner is determined by the characterized plate on the air valve outlet (1) and an adjustable plate (2) on Figure l0a. The adjustable plate can increase or decrease airflow across the entire stroke of the valve. If burner airflow is in question, measure the static pressure at Ports (4) and (5), Figure 16, and compare those readings with Columns 6 and 8 in Table 5. A significant difference can be a symptom of a problem and the cause should be investigated.

Air and Gas Control Linkage

An L-shaped control rod is connected to the actuator and passes through the burner housing and into the control box. This control rod positions the valves that control the burner air and gas, and actuates switches in the control box to prove when it is at the maximum and minimum position. When the actuator positions the control rod to the minimum rate position, the bracket on the rod that connects to the air valve and gas valve should be firmly bottomed against the end of the gas valve which acts as its stop. The linkages to the air and gas valve should be straight and in alignment. Although the bracket is to bottom out, the plate connected to it which slides from right to left to control airflow should slide freely and not be forced against either the right or left side member of the air box.

At the minimum rate position, maintain a gap according to dimension "D", Figure 10a. With that sliding plate in this minimum rate position, check dimension "E", Figure 10a. To gauge opening "E", use a drill blank held perpendicular to the plate. For Models 050-200, opening "E" can be accessed through the grommeted opening in the primary air collector. See (3), Figure 10a. for Models 020-040, the primary air collector must be removed. Generally, it is easier to remove the collector with the inch diameter tube still attached by disconnecting the tube at the other end.

At the maximum rate position, the sliding blade should be full open, but it should not be forced against the left side piece of the air box.

The control rod bracket that connects the air and gas valves must be correctly positioned on the control rod so the bracket will be firmly held under tension against its stop when the actuator is in the minimum rate position, and so the sliding blade will open fully without making contact at the end of the stroke. When modulating towards the minimum rate position the actuator will continue to travel after the bracket contacts the stop, flexing the vertical end of the control rod so the bracket is held under tension. To correctly locate the bracket on the rod, first adjust the air damper linkage so there will be a gap per dimension "D", Figure 10a, when the bracket is bottomed out against the end of the valve. Second, loosen both set screws on the bracket assembly so the bracket is free to slide on the rod. Third, position the actuator to the maximum rate position. Position the sliding blade to the wide open position.

Grasp the rod and while applying some thrust to the rod in the direction of the actuator to take up any free play, and with the bracket in alignment with the linkages that connect to it, tighten the two set screws. Return the actuator to the minimum rate position.

The adjustable plate (2), Figure 10a is positioned to provide an opening per dimension "F".

Figure 10. Air and Gas Control Linkage

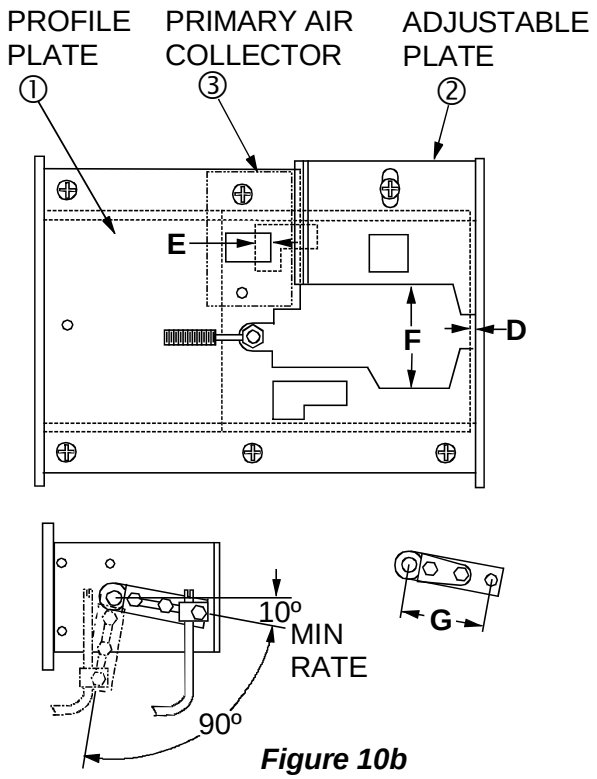


Figure 10b

Model HT***	D	E	F	G
020	.005	.116	.50	3.30
025	.005	.125	.83	3.30
032	.005	.101	.82	3.30
040	.005	.101	1.25	3.30
050	.020	.099	1.25	3.30
064	.020	.136	1.60	3.30
065	.020	.136	1.60	3.30
079	.020	.106	1.88	3.30
080	.020	.106	1.88	3.30
100	.020	.110	2.44	3.30
110	.020	.136	1.05	4.28
140	.020	.136	3.30	4.28
150	.020	.140	3.30	4.28
200	.020	.140	4.40	4.28

Actuator Crankarm

The actuator crankarm should not require adjustment. The radius indicated by "G" dimension, Figure 10b will result in a complete stroke from minimum to maximum, and provide the correct amount of over travel to bottom out the linkage bracket at the minimum rate position. Do not attempt to modify firing rates, etc. by changing the radius of the crackarm.

Switch Adjustment

Switches LS1 and LS2 prove maximum and minimum position of the control rod. These switches are located in the control box switch compartment and have a limited range of adjustment. When the two nuts that secure the switches are loosened, the switch will pivot on the inner stud and the outer stud can be moved up and down. Adjust he switches such that when the collar mounted on the actuator rod is moved into position and pushes in the lever on the switch, the switch will click to the "made" position, but the lever will not bottom out against the switch body. When properly adjusted the lever can move an additional 0.02 inches, as proven by slipping a feeler gauge between the switch lever and the collar when in the "made" position. The collar on the control rod should be adjusted so the switch lever it is actuating will rest squarely on the outer surface of the collar but only 0.03 inches from the edge. If the collar is located for an engagement that is longer than 0.03 inches, the collar may not reach the actuator on the other switch when at the other end of its stroke.

Altitude Considerations

For altitudes of 2000 feet and higher, the gas burner must be derated 4% for every 1000 feet of altitude.

Example: Model HT080 at an altitude of 3000 feet is derated (0.04 x 3 = 0.12). At 1000 mbh input (1000 x 0.12 = 120 mbh), the actual input is (1000 - 120 = 880 mbh) at 3000 feet.

The method of derating the burner is to reduce the manifold pressure. Multiply the Maximum Rate Manifold Pressure shown under Column 8 in Table 5 by the following altitude factors:

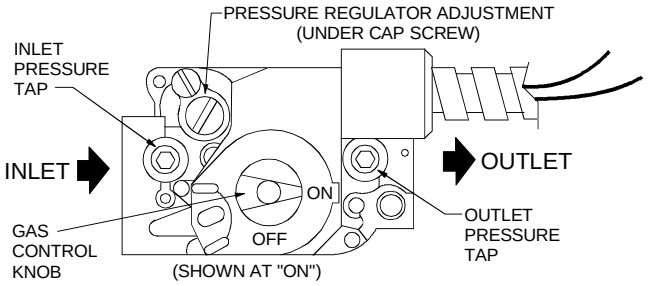
2000 feet = 0.845	5000 feet = 0.640
3000 feet = 0.774	6000 feet = 0.578
4000 feet = 0.706	7000 feet = 0.518

Gas Valve Pressure Regulator Adjustment

The high turndown burner uses combination gas controls to provide redundant on-off gas control and pressure regulation. A burner will have from one to six of these controls piped in parallel, depending on the BTU rating of the burner. When two or more valves are in parallel, their pressure regulators must be adjusted so the valves maintain the specified manifold pressure and are balanced so each valve handles its share of the load. To determine that the valves are balanced, the manifold pressure must be measured and adjustments made at both maximum and minimum capacity. As the burner modulates from maximum capacity down to minimum capacity, it is normal for the manifold pressure to rise. This is because the pressure loss through the valve and fittings is being reduced as the flow rate is reduced. If one (or more) valve is not in balance with the others, the pressure at the minimum rate will rise higher than normal.

Clockwise rotation of the pressure adjusting screw on the combination gas controls will increase the pressure set point, and counter-clockwise rotation will reduce the pressure set point (see Figure 11).

Figure 11. Combination Gas Controls



Adjustment Procedure for Parallel Valves

When a manifold pressure adjustment is required, the first step is to adjust the pressure regulator of each combination gas control to the minimum rate manifold pressure (Table 5, Column 10) while only that valve is operational and it is handling approximately its normal maximum rate CFH of gas. The manual shutoff valve knobs are used to control gas flow so just one valve is operating at a time.

To determine a firing rate suitable for this adjustment, first modulate the burner down to the minimum rate. At this flow rate, only the valve with the highest pressure regulator set point will be operational; the other valves will be shut down by their integral pressure regulators because the manifold pressure is slightly higher than their set point. While the burner is operating at that minimum firing rate, slowly close all but one of the manual shutoff valve knobs on the combination gas controls. With care, this can be done without the burner losing flame and shutting down. Watch the manifold pressure manometer as each valve is being closed. If the manifold pressure starts to drop rapidly in response to the knob movement, it indicates this combination gas control has the higher pressure adjustment and is supplying the gas to the manifold. Leave this valve open, and continue closing the remaining valves until only that one valve is open, and then adjust that combination gas control first.

While the burner is operating and only one combination gas control is open, increase the firing rate of the burner. As the firing rate is increased, the manifold pressure will be relatively constant until the gas flow rate exceeds the capacity of that single valve and the manifold pressure starts to drop off. The pressure adjustments should be made at the maximum gas flow rate just before the manifold pressure starts to drop off, and the following should be considered:

1. .The manifold pressure does not always immediately respond to regulator adjustments. Wait a few seconds after making an adjuster movement for the regulator to respond and equalize.
2. .When making an adjustment, rotate the adjuster CCW until the manifold pressure is below the desired set point, and then slowly rotate the adjuster CW and nudge the pressure up to the desired set point.
3. .If the regulator cannot be adjusted up to the required set point, or if that set point seems to be the highest pressure the regulator can be adjusted to, the flow rate used for this procedure is too high and must be reduced by repositioning the actuator to a lower firing rate, or the gas supply line pressure is too low.

After adjusting valve 1, open valve 2. If opening the additional valve does not cause the manifold pressure to go up, increase the pressure regulator setting of valve 2 until an increase is observed. That indicates the valve has started functioning. Then slowly close the first valve. Proceed to adjust valve 2. Repeat this procedure until all valves have been adjusted.

Open the manual shut off knobs on all the combination gas controls and modulate the burner up to the maximum firing rate. The resulting manifold pressure should be close to the Maximum Rate Manifold Pressure indicated in Table 5, Column 6. If further adjustment is required, it should not be necessary to go through the entire procedure again. If the manifold pressure is to be increased, make small but equal (about 1/4 revolution) CW rotations of the pressure adjusting screw on every combination gas control and check the resulting manifold pressure, both at maximum and minimum rate.

Check Manifold Pressure at Minimum Rate

When several combination gas controls are in parallel and are handling a low flow rate, the combination gas control with the highest set point is essentially handling all the gas. Observe the gas manifold pressure at the minimum rate. If it is higher than the pressure specified under Column 10 in Table 5, locate and adjust the dominant combination gas control. Test each combination gas control by slowly manipulating the manual shutoff knob toward the closed position while observing the manifold pressure. The pressure will only respond to movement of the knob on the dominant valve. The manifold pressure will drop as the gas flow is throttled back, using the knob on the combination gas control to partially close that manual valve.

Generally, a valve will he found that has an effect, and very little adjustment will cause a reduction in the minimum rate manifold pressure. Reduce the pressure adjustment of that dominant valve by slowly rotating the adjuster CCW until the manifold pressure no longer drops in response to that adjuster movement. If the manifold pressure is still high after that first adjustment, another valve may have become the dominant valve and that may also have to be isolated and adjusted to get down to the specified minimum rate manifold pressure. After making this type of adjustment, it is necessary to recheck the maximum firing rate manifold pressure and perhaps readjust it, making very small but equal adjuster movements on each valve.

Combustion Testing

Proper start-up and maintenance requires periodic combustion tests and the systematic recording of those test results for future reference. Before making combustion air adjustments, check for proper input rate.

Verify Input Rate

To determine the input rate, it is necessary to know the BTU per cubic foot of gas being used. If this is not known, contact the gas supplier. Check input rate by timing the gas meter dial with all other appliances and their pilot lights off.

To verify the input rate using the gas meter, use a stopwatch and time one revolution of the dial. Calculate the input with the following formula:

$$\text{MBH Input} = \frac{A \times B \times 3.6}{C}$$

Where: A = BTU/cu. ft. of gas
Typical: Natural gas= 1000, LP gas=2500

B = Cu. ft. per revolution of meter dial

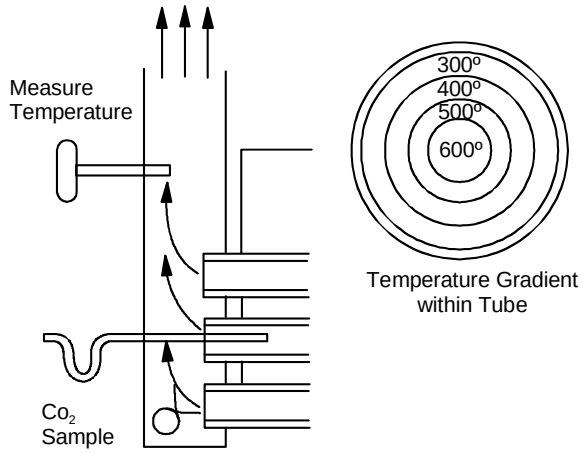
C = Seconds required for 1 revolution of meter dial

Check CO_2, CO & Stack Temperature

Flue gas samples are to be taken from inside one of the secondary tubes. If the sample is taken from the flue box rather than the tube, the sample will be diluted with outside air and lower readings will result. If flue gas temperature is to be measured, this must be done in the flue box, not in the tube. The temperature gradient within the tubes will cause high readings near the center of the tube and low readings near the edge. Measure temperatures within the flue box where a good mix will be present. The flue box includes two 5/16" holes for test purposes. One hole lines up with the end of a secondary tube for taking flue gas samples. The other hole, through the side of the flue box, is for thermometer insertion.

If the CO_2 and/or CO readings are not within the range indicated, see “Troubleshooting Chart” on page 22 and refer to Sections 4.1 and 4.2.

Figure 12a *Figure 12b*



Typical Readings:

CO_2 9½ to 10½ percent at maximum rate
4 to 7 percent at minimum rate

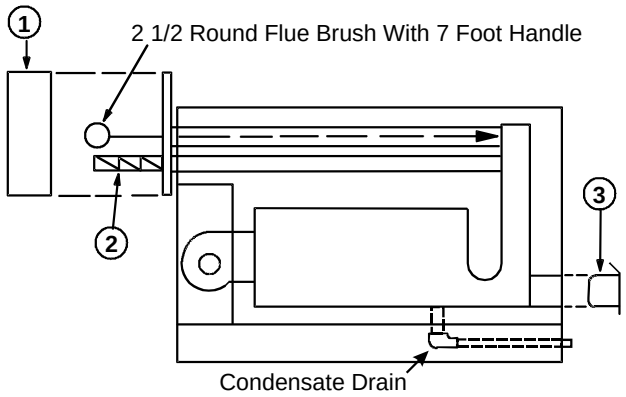
CO .005 percent (50 PPM) or less

Cleaning Heat Exchangers

Models 032 thru 200 (see Figure 13)

1. Remove the flue box front wrap (1) and the rear inspection cover (3).
2. .Remove and clean the turbulator (2), from each tube and clean the flue box.
3. .Clean each tube with a 2½" round flue brush.
4. .Remove the brushings and if required clean the combustion chamber and header through the rear inspection door port.

Figure 13. Models 032 thru 200 Heat Exchanger

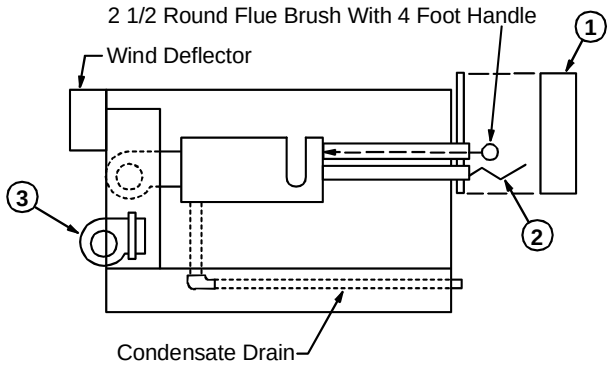


5. .Reinstall the inspection cover (3). Snug the screws but do not overtighten and crush the insulation.
6. .Reinstall a turbulator (2) in each tube approximately flush with the tube ends. The end of the turbulators are formed such that the end will bind within the tube end and lock the turbulator in place.
7. .Reinstall flue box front wrap (1) .

Models 020 thru 025 (see Figure 14)

1. To gain access to the inside of the combustion chamber, detach the burner from the furnace and set it on the floor of the vestibule (see Figure 14, Item (3)). The burner is attached to the furnace studs with four nuts. Conduit lengths allows this movement of the burner without disconnecting wiring. The union on the gas line must be opened.
2. .Remove the flue box front wrap (1) .
3. .Remove and clean the turbulator (2) from each tube and clean the flue box.
4. .Clean each tube with a 2½" round flue brush.
5. .Remove the brushings and if required clean the combustion chamber and header through the burner mounting tube.
6. .Reinstall the burner.
7. .Reinstall a turbulator in each tube approximately flush with the tube end, locking them in place with the wedge clips on each turbulator.
8. .Reinstall flue box front wrap (1).

Figure 14. Models 020 thru 025 Heat Exchanger



Leakage Symptoms

1. **Odor -** Odors in the building are usually brought in through the outdoor air intakes and do not indicate leakage from the furnace. Check for down draft conditions and check for location of the flue exhausts of other equipment that may be pulled into the outdoor air intake. A major and obvious furnace rupture can be a source of odor. In general, small leaks in a furnace will not be a source of odor because the pressure created by the supply fan is greater than the pressure inside the furnace. Therefore, when the supply fan is operating, leakage will be **into** the furnace, not **out of** the furnace and into the air stream. If the control system is such that the furnace comes on and warms up the heat exchanger before the supply air fan comes on, and there is odor when the supply fan first comes on, this could be caused by leakage. During the time the furnace is on and the supply fan is off, the leakage would be out off the furnace. Then, when the supply fan came on, it would blow those products of combustion into the supply duct.
2. .**Low CO_2 Readings** - Low CO_2 readings that cannot be corrected can be caused by air leaking into the heat exchanger and diluting the flue gas. If this is suspected, take two consecutive CO_2 readings, one with the supply fan running and one with the supply fan off. If the CO_2 increases with the supply fan off, it could indicate leakage. Note that CO_2 samples must be taken from inside a tube, not just from inside the flue box.

Checking for Leaks

3. .Open up the rear casing panel while the unit is shut off and visually inspect the heat exchanger.
4. .Visually inspect the heat exchanger while the burner is operating, looking for light coming through holes. The burner must be operated for only a few minutes with the supply fan off. The heat exchanger can become hot enough to cause severe burns. take care not to touch it.
5. .Perform consecutive CO_2 tests with supply fan off and on. See Item 2 under "Leakage Symptoms."
6. .**Smoke Bomb Test -** Cover the flue box openings, open the rear casing panel so the heat exchanger is accessible, toss a smoke bomb into the heat exchanger through the rear inspection port, replace the port cover, and with a bright light look for smoke leaking through the heat exchanger. Remove the remains of the smoke bomb and uncover the flue box openings before attempting to operate the furnace.

Note: In most cases small leaks in the heat exchanger are not a source of danger. Because the pressure created by the supply fan is greater than that inside the heat exchanger, the leakage will be **into** the heat exchanger, not **out of** the heat exchanger and into the airstream.

Causes of Failures

1. **Improper Application -** The furnace rating plate specifies a "Minimum Airflow CFM." The furnace must not be operated when airflow is below this minimum cfm. If the furnace is being used on a variable air volume system, the control system must be such that the furnace will not operate when the supply fan cfm has fallen below this minimum specified cfm. The furnace rating plate also specifies a "Maximum MBH Input" which must not be exceeded. See “Verify Input Rate” on page 17.
2. **Control Failure -** The limit control does not function properly and shuts off the burner when the heat exchanger temperature becomes excessive. In most situations, a properly controlled unit will never require the limit control to shut off the unit. The limit control should be a backup control; a problem attributed to a limit failure generally indicates a control problem in addition to the limit failure.

3. **Excessive Condensation -** Applications which will produce condensation require an all stainless steel heat exchanger to be resistant to the effects of this condensation and to give longer heat exchanger life. The likelihood of condensation increases with:

    a. Colder supply air temperature across the secondary tubes, as on units taking in a lot of outdoor air in colder weather.

    b. Lower heat flow through the secondary tubes, as on modulating burners when operating at reduced input.

    c. High airflow across the secondary tubes such as any application with a low temperature rise furnace.

4. **Chemical Deterioration** - Refrigerant leaks, some aerosol can propellants, fumes from dry cleaning establishments, beauty shops, swimming pools, and others, often have detrimental effects on heat exchangers when they get into the combustion air supply and thereby into the combustion. Even fumes from nearby roof exhaust fans can cause problems.

5. **Inadequate or Distorted Airflow -** Internal baffles that have been repositioned or that have loosened up and moved can distort the airflow and cause failures. Construction rubbish, shipping cartons, and insulation that has come loose can end up inside a unit and block airflow to part of the furnace, resulting in a failure. Or these items can alter the air or heat flow to the fan limit or some other control and contribute to a failure.

Replacing Heat Exchanger

1. Remove the complete flue box, the casing panel through which the flue tubes pass, and the rear inspection cover. Open the hinged rear door.

2. The burner is mounted on and supported by the heat exchanger studs with four nuts. When removing the heat exchanger, the burner must either be removed or blocked in place. Remove the four burner mounting nuts and the two exchanger bolts located 2" above the upper burner mounting nuts.

3. When it is necessary to remove any air baffles surrounding the heat exchanger, carefully note the locations and clearances of these baffles before removing them so they can be replaced in the exact same position.

4. Remove the two bottom bolts at the back of the heat exchanger.

5. Withdraw the heat exchanger through the back of the casing.

Furnace Condensation

A furnace will produce condensation when the flue gas temperature falls below its dew point temperature. A more efficient furnace will transfer more of its heat into the building, and leave less heat in the flue gas. This results in a lower flue gas temperature and more condensate.

A modulating burner will produce more condensate than an on-off burner. As the firing rate of the burner is reduced, the flue gas temperature will he reduced, and if it is reduced below its dew point condensate will be produced.

A furnace that is heating a high percentage of outside air will also produce more condensate. The colder the air contacting the heat exchanger, the lower the resulting flue gas temperature, and consequently the more condensate.

Do not think a furnace has a problem because it produces condensate anymore than you would think a cooling coil has a problem because it produces condensate. However, suitable steps should be taken to manage the flow of the condensate produced.

Most condensate will be produced in the secondary tubes where flue gas will sweep it into the flue box. Condensate will also come from the combustion chamber. All models have a piped combustion chamber condensate drain, and Models 032-200 have a rear inspection cover that provides access to the drain line.

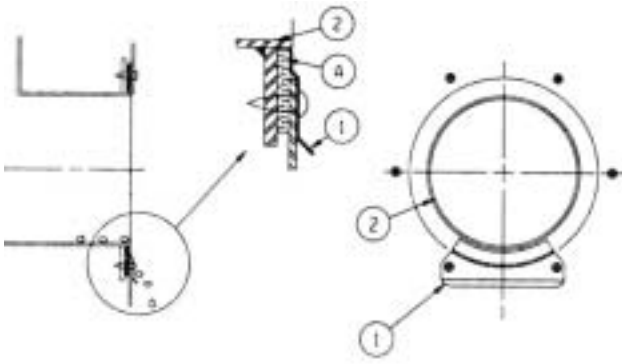
Condensate will also drip from the drains in the two outer corners of the flue box, and from the drip shield below the rear cleanout port. Condensate should not be running down the unit, except at times the wind may blow the dripping condensate mentioned above. The drip shield below the rear cleanout port must be correctly installed as shown in the following section.

Rear Inspection Cover

The rear inspection cover is equipped with a stainless steel drip shield to keep condensate away from the side of the unit if condensate drips out of the inspection cover. (see Figure 15). The shield (1) must fit snugly against the bottom of the cleanout port tube (2) at (3) so condensate (4) cannot run back along the underside of the tube and into the unit or down the side of the rear panel.

Note: If an excessive amount of condensate is dripping from the rear inspection cover, check the condensate drain for blockage and clean if necessary. Inspect the rear condensate drain annually for blockage.

Figure 15a. Rear Inspection Cover (models 032 - 200)



Combination Fan and Limit Control

The fan limit control is a hydraulic action type with a remote sensing element and connecting capillary tube. The sensing element is locked into a bracket located on one of the heat exchanger tubes about halfway toward the back of the furnace, on the side away from the blower. One corner of the bracket is bent aside to remove the element.

Normal setting of the FAN control: FAN On=125°F., Fan Off=100°F.

The LIMIT control must never be set higher than the temperature listed below. If the burner is shutting off on high limit at these settings, it indicates that there is a problem with the furnace not getting enough air or it is being overfired.

Table 4. LIMIT control set points

BURNER MODEL	LIMIT CONTROL SET POINT	BURNER MODEL	LIMIT CONTROL SET POINT
020	215	079	181
025	160	080	229
032	196	100	170
040	154	110	222
050	229	140	168
064	185	150	194
065	232	200	151

Maintenance

Planned maintenance is the best way to avoid unnecessary expense and inconvenience. Have this system inspected at regular intervals by a trained and experienced service technician. The following service intervals are typical for average situations but will have to be adjusted to suit your particular circumstances.

Fuel pressure settings, control settings, and linkage adjustments should be made only by persons thoroughly experienced with the burner and control system, and must not be tampered with by persons without such experience.

Always replace covers on burner controls and boxes as the electrical contacts are sensitive to dust and dirt. Perform maintenance of flame safeguard, controls, gas valves, and other such components in accordance with instructions contained in the manufacturer's bulletins.

Monthly

1. Check air filters and main supply fan drives, replacing if required.
2. .Check flame signal with a keyboard display module or a DC voltmeter.

Twice Yearly

1. **Burner Air** - Check burner fan wheel for dirt build-up and lint. Check combustion air intake louver and flue box for dirt buildup and accumulation of wind borne debris.
2. .**Cleaning** - Inspect flue tubes and combustion chamber, cleaning as required. Keep burner vestibule clean. Dirt and debris can result in burner air blockages.

Yearly

3. .**Gas Train** - Check all valves, piping, and connections for leakage. Remove burner gun assembly. Inspect, and if required, clean the flame rod, ignition electrode, main burner disc, and blast tube. Check tightness of linkage fasteners and bolts that could work loose from vibration and movement.
4. .**Combustion** - Check quality of combustion. Test CO_2 and CO and look for irregularities in fire shape. If combustion characteristics have changed since the last test, determine the cause. Changes in input, changes in the BTU content of gas being supplied, reduced combustion air due to dirty blower wheel, or flue passages in need of cleaning can all cause changes in CO_2 reading. When a readjustment seems necessary, do not make the adjustment without first trying to determine if the required change is not an indication that something else is in need of correction.
5. .**Flame Safeguard** - Perform a flame failure check and "pilot" turndown test. See control manufacturer's bulletin for further information.
6. .**Motor** - Motor life will be increased by proper oiling. There are provisions in both end shields for relubrication. Re-oil each bearing with 150 drops (approximately 1 teaspoon) SAE-20 oil.
7. .If the burner is to be out of service for the summer, turn off the burner control switch and close the manual gas cocks.
8. .Inspect Rear Condensate Drain for leakage.

Troubleshooting Chart

The RM7895A flame safeguard is equipped with five LEDs to aid in the diagnosis of burner operation and problems. In addition, a Keyboard Display Module is available and is a valuable aid for indicating flame signal DC volts, fault messages, sequence status, etc. See "Flame Safeguard (RM7895A)" for additional information on the Keyboard Display Module and for a description of the function of the LEDs.

Some of the steps listed in this troubleshooting chart will be unnecessary if a Keyboard Display Module is used, as that module will pinpoint many problems.

BURNER MOTOR DOES NOT RUN (AFTER 10 SECOND "INITIATE" PERIOD AND WITH SWITCH AT AUTO):	
1.1 Power LED is off.	a. Power is not getting to burner
1.2 Entire unit seems to be off.	a. Burner power comes from the main control panel which has a main disconnect switch, a stepdown transformer with primary winding fuses, a 120V secondary winding fuse, and an on-off service switch. If any of these were open, the burner as well as the supply fan would be inoperative. The control system also has firestat type temperature sensors which will shut down the entire unit if supply or return air temperatures exceed set points. On some control systems the firestats only lock out the supply and return fans. Check main control schematic as these would not be burner problems.
1.3 Supply fan will operate.	a. Check the manual reset limit control located between the filters and the supply fan and reset if required. b. Check that the control system has energized relay R20 located in the main control panel.
1.4 Power LED is on.	a. Push the reset button on the flame safeguard.
1.5 Resetting flame safeguard does not start motor after the 10 second "Initiate" period is completed.	a. Push the reset button on the burner motor. (**Note:** If motor is hot and probably tripped, it has to cool sufficiently before it can be reset.) b. Test for line voltage across burner terminal 8 and NB. If powered, the problem is with the burner motor or its associated controls. On Models 1100-2000, terminal 8 only controls a contactor and burner motor power comes from its own circuit breaker. If terminal 8 is dead, check for power across terminals 1 and NB. c. IF VOLTAGE IS ZERO: The power is being interrupted by the limit control, the manual reset high or auto reset low gas pressure switches (if included), or relay contacts (R20). Consult the schematic and determine the interruption. d. If voltage is satisfactory across terminals 1 and NB and terminal 8 does not become energized after 10 seconds, and pressing the safety reset button has no effect, replace the RM7895A.
BURNER MOTOR RUNS, BUT...	
2.1 Burner motor runs valve actuator travels to the maximum rate position and stays there, the Keyboard Display Module indicates "Purge Hold".	a. Switch LS2 is not being actuated by the collar on the control rod when at the maximum rate position. b. The air proving switch AS is not sensing burner fan pressure. Check the connecting tube, setpoint, and wiring. If LS2 and AS are functioning, 120 volts can be measured across terminals 7 and L2 on the flame safeguard when the burner fan is running.
2.2 Burner motor runs, valve actuator travels to the maximum rate position and stays there, the Keyboard Display Module goes through the prepurge countdown. At approximately 20 seconds, Relay (R21) does not energize.	a. Timer TD10 is not 'making' after 20 seconds. Check that there is 120 volts on TD10 tab 1 when the actuator is at the maximum rate position. TD10 tab 2 should become energized 20 seconds after tab 1 is powered. b. Relay R21 is not being energized by TD10, check for power across C1 and C2 after TD10 has become energized and replace R21 if indicated.
2.3 Burner motor runs, prepurge appears normal, LED marked PILOT comes on for 10 seconds, then the flame safeguard locks out on flame failure.	a. Flame is not igniting or is not being detected by the flame safeguard. Check that the manual gas valves are open. Check for manifold pressure at Tap (1), Figure 16, during the 10 seconds the LED marked Pilot is on: 1. If zero, verify that there is pressure at Tap (2), Figure 16, during the same 10 second period. If so, check that LS1 is being actuated by the collar on the control rod when at the low fire position. Check that the manual knob on GV1 is not closed and power is supplied to valve. 2. If manifold pressure is normal, check for disconnected or shorted flame rod or ignition lead wire. Watch the ignition attempt through inspection window on burner and check that spark is in the appropriate location. If not, this indicates a short. If flame is observed but not detected by the flame safeguard, remove the burner gun assembly and check the flame rod, lead wire, and connections. 3. Check the flame safeguard with a flame simulator: a. Close main gas test cock. b. Plug the flame simulator into the flame safeguard. c. When the LED marked PILOT comes on, touch the simulator G post to ground. If the LED marked FLAME now comes on, the flame safeguard is working, but it is not receiving an adequate flame signal. If the LED marked FLAME did not come on, replace the R7847A amplifier and/or the RM7895A flame safeguard. 4. If there is spark but no flame, check for faults that would cause way too much air or too little gas.

BURNER MOTOR RUNS, FLAME IGNITES...	
3.1 Burner motor starts, a normal prepurge cycle occurs, the LED marked FLAME comes on momentarily and then goes out.	a. The flame is momentarily proving itself to the flame safeguard. It must be proven at the end of the 10 second trial for ignition period. b. On a new start-up, this could indicate the gas lines have not been sufficiently purged of air. c. Improper flame rod position. d. Defective or improperly installed pressure regulator that passes enough gas during the off cycle to build up pressure for light off but when the valve opens quickly drops pressure.
3.2 Burner ignites, the flame safeguard does not lock out but the burner remains at the minimum rate.	a. The temperature control system has contacts that turn the burner on and separate contacts that control firing rate. Verify that the contacts that control firing rate are calling for an increase rate. b. Verify that Relay R23 is functioning properly.
BURNER OPERATES; HOWEVER ...	
4.1 Combustion tests indicate CO_2 and/or CO are not within the expected range.	a. Measure gas manifold pressure at Port (1), Figure 16, both at the maximum and minimum firing rate and correct if required. See Table 5, Column (9) and (10). b. Measure the burner air pressures at Port (4) and (5), Figure 16. If readings are significantly different, from Table 5, Columns (6), (7), and (8) determine why. Possible reasons include a clogged blower wheel, air leaks, or loosened components that could cause variations. c. Combustion test should be performed when the furnace is at operating temperature (typically after 10 to 15 min.) d. Models 040 and larger have multiple valves in parallel. Determine that they are all functioning. While operating at maximum rate use the manual operator to momentarily close the valves one at a time while observing the manifold pressure. If a reduction in manifold pressure does not occur the valve was not open before the test.
4.2 At maximum firing rate, the burner runs rough.	a. Gas manifold pressure is too high and furnace is being fired above its rated capacity. See "Verify Input Rate". Also check CO_2 and CO levels. b. The heat exchanger needs cleaning. Increased pressure drop through heat exchanger reduces airflow and affects combustion. c. Inspect gun assembly and blast tube for warpage or deterioration.
4.3 Flame is not symmetrical as observed through rear inspection window.	a. Too high airflow relative to gas flow. Check gas manifold pressure. Check CO_2 level. b. Gun disc is not perpendicular to the blast tube, or gun disc is warped or otherwise out of alignment.
4.4 Nuisance tripping of the flame safeguard.	a. Check gas pressure situation. Marginal pressure during normal times can become low pressure during time of peak demand and lead to trip-outs, etc. Pressures higher than that for which the gas train is designed can also cause problems. Line pressure should not exceed 13.9' W.C. (½ psi) into the combination gas controls. Pressures higher than this require an additional stepdown regulator to maintain the pressure below 13.9" W.C. even at "no flow" conditions. The preferred pressure to the combination gas controls is 7.0 in. W.C. A regulator that does not shut off tight at "no flow" will allow a small amount of gas to leak past and eventually the high pressure will build up on the downstream side, thus exceeding the rating of the gas train components. b. Undersized piping can also cause problems by delivering reduced pressure during times of maximum demand. c. Check the flame signal while modulating from minimum to maximum firing rate. d. Check the ignition electrode gap and orientation. Check the porcelain for cracks or other defects. e. Observe the flame signal DC volts when turning on the burner switch. Any indications before the ignition cycle could indicate a short to ground. This could be an intermittent situation from moisture conditions. With line gas cock closed any movement during the ignition attempt would indicate ignition interference. f. Check supply voltage and if suspicion warrants arrange to have a recording voltmeter connected to the burner for a period of time. g. Marginal flame signal. Adjust flame rod position. h. Check the ground path from FSG terminal G to the burner gun assembly. A wire runs from G to the ground screw on the left side of the burner air box. The path continues through the variable orifice valve through the union to the burner gun assembly.
4.5 Main flame comes on at low fire, but as actuator attempts to reposition for an increased firing rate the flame goes out. Then the sequence is repeated.	a. Check the burner fan air proving switch and tube. As the burner air control valve opens further to provide more air for an increased firing rate, the static pressure inside the air valve box is reduced. This is the pressure being sensed by the air proving switch, and if it falls below its set point the burner will drop out. The adjustment screw is located next to the wiring box cover. Turn screw CCW to reduce set point. b. Use a manometer to determine if the gas pressure at the orifice is dropping prior to the flame going out. If gas pressure is dropping, check for a plugged vent on a gas pressure regulator or something that restricts the gas flow in the line so only a low firing rate can occur. Also see 4.1d.
4.6 At the instant spark comes on, the flame safeguard drops out and restarts the pre-purge cycle.	a. Ignition interference. Flame rod or its wire is sensing voltage from ignition. Also verify that ignition electrode spark gap is within specifications.
4.7 When the flame safeguard is powered it locks out and the ALARM LED comes on.	a. Purge card missing or bad, terminals are energized that should not be at that stage, or there is an internal system fault. Replace purge card or RM7895A as indicated.

Typical Parts List -60 Hz

QTY.	MCQUAY PART NO.	VENDOR	VENDOR PART NO.	USED ON MODELS HT ***	DESCRIPTION
1	0342492-00	Emerson	4526	020 — 080	Burner Fan: Motor 1/4 hp, 3450 rpm
1	0322486-00	Emerson	457	100 — 150	Motor 1/2 hp, 3450 rpm
1	0322484-00	Emerson	458	200	Motor 3/4 hp, 3450 rpm
1	0348611-02	Beckett	22031-07	020 — 080	Burner Fan Wheel: 6.25 x 3.438 (.500")
1	0348611-01			100 — 150	7.09 x 3.160(.625")
1	0342480-04			200	7.50 x 3.160 (.625")
1	0330038-00	Antones	SMP 4130	020 — 200	Air Switch
1	0344826-00	Allison	1092	020 — 200	Ignition Transformer
1	0733371-01	W/R	5A75-1 0	032 — 200	Fan Limit Control
1	0733371-02	W/R	5A75-12	020 — 025	Fan Limit Control
1	0733008-01	HW	RM7895A1014	020 — 200	Flame Safeguard (less amplifier & timer)
1	0733009-01	HW	R7847A1033	020 — 200	Amplifier Only (3 seconds)
1	073301O-03	HW	ST7800A1054	020 — 200	Timer Only (60 seconds)
1	0733007-02	HW	Q7800A1005	020 — 200	Subbase for Flame Safeguard
1	0598677-01			020 — 200	Flame Rod Assembly
1	0347430-02			020 — 100	Flame Rod Lead Wire Assembly
1	0347430-03			110 — 200	Flame Rod Lead Wire Assembly
1	0598678-01			020 — 200	Ignition Electrode Assembly
1	0347429-02			020 — 100	Ignition Electrode Cable
1	0365185-02			110 — 200	Ignition Electrode Cable
1	0964148-01			020	Burner Gun Assembly
1	0964148-02			025	Burner Gun Assembly
1	0964148-03			032	Burner Gun Assembly
1	0964148-04			040	Burner Gun Assembly
1	0964148-05			050	Burner Gun Assembly
1	0964148-06			064 — 065	Burner Gun Assembly
1	0964148-08			079 — 080	Burner Gun Assembly
1	0964148-10			100	Burner Gun Assembly
1	0964148-1 1			110	Burner Gun Assembly
1	0964148-12			140	Burner Gun Assembly
1	0964148-13			150	Burner Gun Assembly
1	0964148-14			200	Burner Gun Assembly
1	0373788-02			020 — 040	Blast Tube Assembly, 4.00 x 20°
1	0341017-03			050	Blast Tube Assembly, 5.00 x 20°
1	0341017-07			064 — 100	Blast Tube Assembly, 5.00 x 27½°
1	0341017-06			110 — 140	Blast Tube Assembly, 7.00 x 27½° (Sm)
1	0351647-01			150 — 200	Blast Tube Assembly, 7.00 x 27½° (Lg)
1	0341020-00			020 — 100	Blast Tube Gasket, 4-5"
1	0341019-00			110 — 200	Blast Tube Gasket, 7"
3	0196430-00	RBM	91 -131006-13000	020 — 200	Relay R20, R21, R23, DPDT 120 volt
1	0274007-00	RBM	184-20202-101J	020 — 200	Relay R22, SPST/NO 120 volt
1	0274007-00	RBM	184-20202-101J	110 — 200	Contactor M29
1	0282101-06	SSAC	TAC1420	020 — 200	Timer TD10
2	0599753-01	OMRON	V-10G5-1C24-K	020 — 200	Switch LS1 & LS2
1	0335367-00	McGill	0140-4000	020 — 200	Switch S3, Toggle 4PST
1	0004981-00			020 — 200	Grommet 0.380 ID, Base Air Tube
1	0599887-00			050 — 100	Grommet 0.750 ID, Pri Air Tube
1	0599888-00			110 — 200	Grommet 1.125 ID, Pri Air Tube
1	0479361-01	HW	M6161A1004	020 — 200	Actuator, Floating
1 — 6	0733365-04	HW	VR4305M4540	020 — 200	Combination Gas Control
1	0598613-01			020 — 200	Control Rod, Sliding Bushing
1	0594700-01			020 — 200	Shoulder Screw
1	0598621-10			020 — 200	Crank Arm Extension
1	0964149-01			020 — 200	Air Damper Flex Link

Table 5.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Burner Model No.	Input MBH or CFH Note 3		Furnace		Air Pressure (In. W.C.)			Gas Pressure (in. W.C.)			Burner Running Current	Gas Connection Size (IP)		
					In Box Measured: At Port 4		In Valve At Port 5	Manifold Measure at Tap (1)		Supply Line		Inlet Pressure (PSI)		
	@ Max. Rate	@ Min. Rate Note 4	Min. CFM	Max. TR Deg F	During Prepurge @ Max. Rate	Burner Operating @ Max. Rate	During Prepurge @ Max. Rate	@ Max. Rate	@ Min. Rate Note 5	Measure @ Tap (2) Note 1, 2	Amps	To 0.5	2 — 3 Note 2	5 — 10 Note 2
020	250	12.5	2,300	80	1.59	1.48	3.80	3.01	3.12	4.5	3.4	0.75	0.75	0.75
025	312	15.6	3,800	61	1.95	1.95	3.71	3.46	3.55	5.5	3.5	0.75	0.75	0.75
032	400	20.0	2,950	100	2.30	2.34	3.50	2.94	3.21	6.0	3.5	0.75	0.75	0.75
040	500	25.0	6,000	61	2.69	2.74	3.29	4.14	4.39	5.0	3.6	1.00	1.00	1.00
050	625	31.3	4,600	100	2.43	2.49	3.42	2.98	3.25	5.5	3.6	1.00	1.00	1.00
064	800	40.0	9,600	61	2.04	2.15	3.50	2.86	3.22	7.0	3.8	1.25	1.25	1.25
065	812	40.6	5,970	100	1.62	1.55	3.44	2.89	3.33	7.0	3.8	1.25	1.25	1.25
079	1000	50.0	12,000	61	1.62	1.64	3.66	3.45	3.84	6.5	4.0	1.25	1.25	1.25
080	1000	50.0	7,340	100	1.45	1.40	3.48	3.14	3.45	6.5	4.0	1.25	1.25	1.25
100	1250	62.5	15,000	61	1.63	2.09	4.60	3.20	3.72	6.5	7.5	1.25	1.25	1.25
110	1375	68.8	10,100	100	2.50	2.60	4.45	2.90	3.50	5.0	7.8	1.50	1.25	1.25
140	1750	87.5	21,000	61	2.25	2.45	4.45	2.80	3.30	5.0	7.8	1.50	1.25	1.25
150	1875	93.8	13,700	100	2.32	2.50	4.50	3.10	3.60	5.0	8.4	1.50	1.25	1.25
200	2500	125.0	30,000	61	2.60	3.65	4.90	3.70	4.10	6.0	11.2	2.00	1.50	1.25

Notes:
1. Pressure to obtain 100% input with standard UL gas train. For IRI, FM, Etc. add 1.00 in. W.C.
2. Gas inlet pressures over 0.50 PSI (13.9 in. W.C.,8 oz./sq. in.) require an additional high pressure regulator.
3. CFH of natural gas @ 1000 BTU/cu. ft.
4. At minimum firing rate the MBH should be 90 to 100% of this value.
5. This is approximate. A higher reading indicates multiple valves are not in balance. See section on "Gas Valve Pressure Regulator Adjustment".

Key:
(1) Gas Manifold Pressure Tap (1/8 inch I.P.)
(2) Gas Line Pressure Tap (1/8 inch I.P.)
(3) Gas Pressure Regulator Adjustment
(4) Burner Box Air Pressure Port
(5) Air Valve Pressure Port (On Box Bottom)
(6) Firing Rate Indicator Scale
(7) Optional Additional Gas Valve(s)
(8) Optional High Pressure Regulator
(9) Optional Low Gas Pressure Switch
(10) Optional High Gas Pressure Switch
(11) Combination Gas Control
(12) Shoulder Screw Attaching Bushing To Crankarm

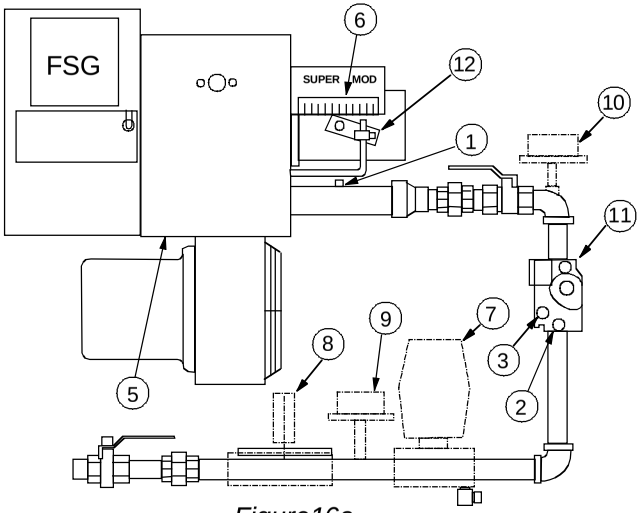
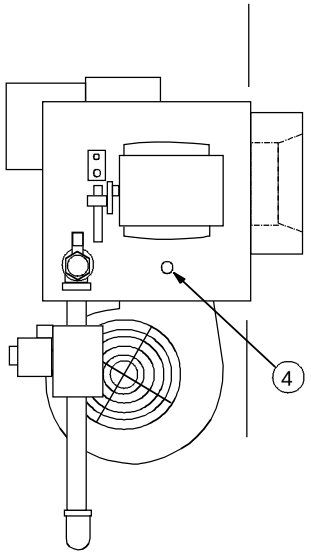


Figure16a.



Figure

Performance & Service History

Table 6.

	Firing Rate	Description of Reading	Date of Readings												
1	**Max. Rate** Scale = 100	Gas Manifold Pressure (In. W.C.)*													
2		Gas Line Pressure (In. W.C.)*													
3		Flame Signal (DC Volts)													
4		Ambient Temperature (Deg. F)													
5		Flue Gas Temperature (Deg. F)													
6		Flue Gas CO_2 (percent)													
7		Flue Gas CO (PPM)													
8		Air Pressure i Box (In. W.C.)													
9		Burner Motor Volts													
10		Burner Motor Amps													
11	**Mid. Rate** Scale = 50	Gas Manifold Pressure (In. W.C.)*													
12		Gas Line Pressure (In. W.C.)*													
13		Flame Signal (DC Volts)													
14		Ambient Temperature (Deg. F)													
15		Flue Gas Temperature (Deg. F)													
16		Flue Gas CO_2 (percent)													
17		Flue Gas CO (PPM)													
18		Air Pressure in Box (In. W.C.)													
19	**Min. Rate** Scale = 5	Gas Manifold Pressure (In. W.C.)*													
20		Gas Line Pressure (In. W.C.)*													
21		Flame Signal (DC Volts)													
22		Ambient Temperature (Deg. F)													
23		Flue Gas Temperature (Deg. F)													
24		Flue Gas CO_2 (percent)													
25		Flue Gas CO (PPM)													
26		Air Pressure in Box (In. W.C.)													
27	**Comments** (Summarize any service work performed)	Reference Number:	(1)												
28		(1) Initial Startup of Furnace													

*** Tap Locations are shown as (2) and (9) on Figure 16.**

Notes:

McQuay International

13600 Industrial Park Boulevard, P.O. Box 1551, Minneapolis, MN 55440 USA (612) 553-5330