Installation Manual	IM 685-4
	Group: **Applied Air**
	Part Number: **IM 685**
	Date: **December 2012**

SuperMod™ Forced Draft Gas Fired Furnace on Daikin Rooftop Systems

FC ****A* with RM7897A Flame Safeguard

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When writing to Daikin 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.

General

This forced draft gas burner is specifically designed for use with the furnace on Daikin 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

Warranty is void if the furnace is operated in the presence of chlorinated vapors, if the airflow through the furnace is not in accordance with rating plate, or if the wiring or controls have been modified or tampered with.

⚠ WARNING

Units equipped with gas heating must not be operated in an atmosphere contaminated with chemicals which will corrode the unit such as halogenated hydrocarbons, chlorine, cleaning solvents, refrigerants, swimming pool exhaust, etc. Exposure to these compounds may cause severe damage to the gas furnace and result in improper or dangerous operation. Operation of the gas furnace in such a contaminated atmosphere constitutes product abuse and will void all warranty coverage by the manufacturer. Questions regarding specific contaminants should be referred to your local gas utility.

Ventilation & Flue Pipe Requirements

The Daikin 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 have been installed and wired at the factory. See Gas Piping, page 5. Also note that models 150 through 200 have the burner removed for shipment. See Vestibule (Models 150 thru 200), page 8.

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 start-up through shutoff sequences 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.

General

The installation of this equipment shall 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 is to be installed by an experienced professional installation company that employs fully trained and experienced technicians.

Table 1: Furnace Height by Unit Model

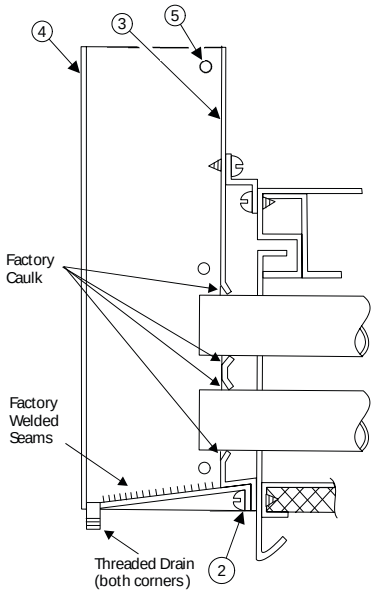
Burner Model Number	Furnace Size (Output MBH)	Unit Sizes		
		015D–042D	045D–075D	080D–105D
020	200	6.00 Inches	7.50 Inches	—
025	250			—
032	320		8.50 Inches	—
040	400			—
050	500			6.0 Inches
064	640			
065	650			
079	790			
080	800			
100	1000			
110	1100	—	—	
140	1400	—	—	
150	1500	—	—	
200	2000	—	—	

Flue Box

The flue box (see Figure 1) 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 in a box in the burner section. 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.

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 the flue box tube sheet (3), attaching top to roof dam strip with screws (1). Do not attach bottom at this time.
3. Apply a 1/8 to 3/16 inch bead of high temperature silicone around each tube to seal it to the flue box tube sheet (3) and prevent condensate from running back toward the unit along the outside of the tube. Also apply a bead of high temperature silicone to seal both sides to the bottom of the flue box wrapper (4), being careful not to obstruct the square drain holes in each front corner.
4. Install flue box wrapper sheet (4) by sliding it up from below so as not to disturb the silicone seal described in 3 above. Attach with side screws (5). At this time reinstall bottom screws (2).

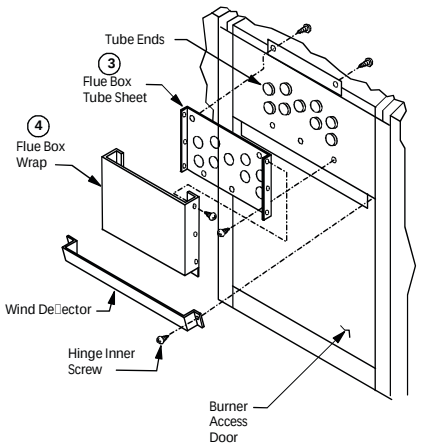
Figure 1: Flue Box



Wind Deflector

The wind deflector (see Figure 2) 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 a box in the burner section. 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. Side hinged doors have holes for mounting (see Figure 6). 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 19).

Figure 2: Wind Deflector (Models 032 thru 140)



Electrical

The Daikin 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 cannot exceed the maximum pressure rating of the high pressure regulator and the outlet pressure must be such that it will 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 9 under Column 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.

It is very important that the proper size piping 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.

Table 2: 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.

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 3: 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 4: 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 3. Make saw cuts (2) tangent to round hole and square with door edges.
2. Install pipe corner plate (3) on vestibule, locating on prepunched holes. See Figure 4. This part is shipped inside the vestibule with flue box.
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 4.
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 3 Section A-A.
4. Replace bottom access panel (5).

Figure 3: Pipe Routing and Knockout

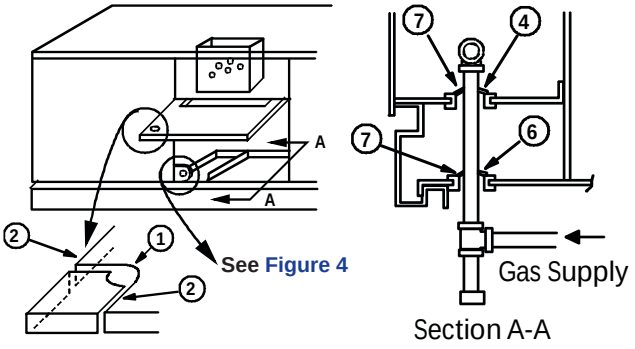
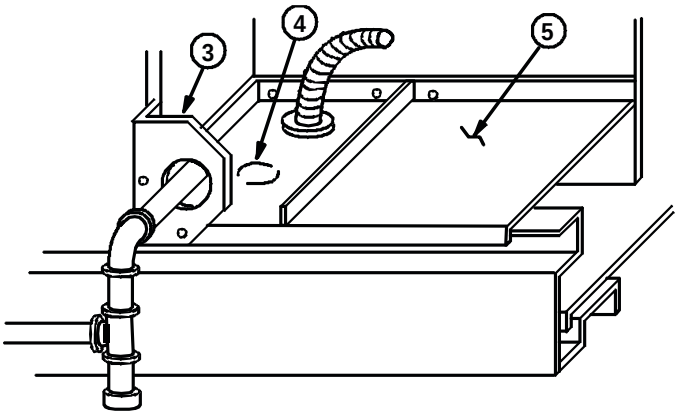
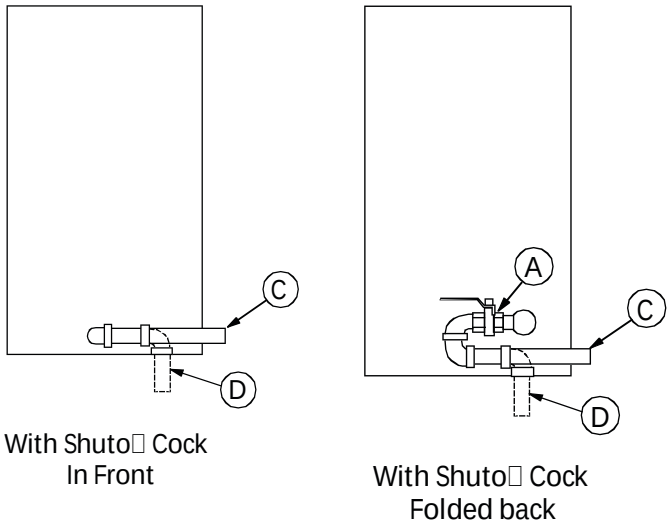


Figure 4: Pipe Corner Plate



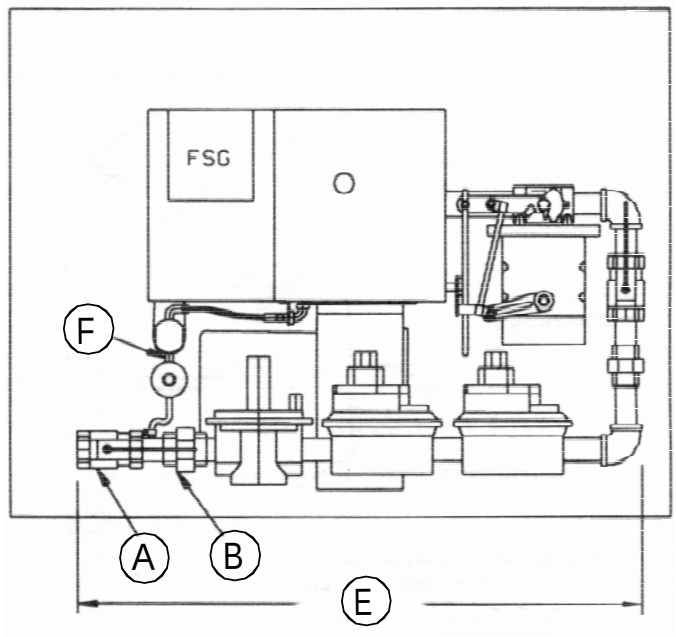
Typical Piping Connections

Figure 5: Connections



With Shuto□ Cock In Front

With Shuto□ Cock Folded back



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
F = Pilot Gas Tubing

Gas Piping (Models 150 through 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 5 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 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.

Condensate Drain

All units are equipped with a 3/4" I.P. stainless steel condensate drain pipe projecting from the back side of the furnace section (see Figure 19 and Figure 20) and the flue box corners (see Figure 1). Drainage of condensate directly onto the roof may be acceptable in certain areas, refer to local codes. If applicable codes or regulations require, this can be routed to a drain. A trap is not recommended and heat tape or some other method of freeze protection is required.

⚠ WARNING

For installations where the ambient temperatures fall below freezing, if the condensate is not piped to the drain properly, or does not include some heat protection, the condensate will freeze. Frozen drain lines may cause a build up of condensate inside the heat exchanger resulting in leakage and damage to the rooftop unit and probably to the facility.

Vestibule (Models 150 thru 200)

These two furnace sizes exceed the allowable shipping width and 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 6. These items are packed in a crate and shipped as a separate item.

Figure 6: Vestibule — Model 020–140

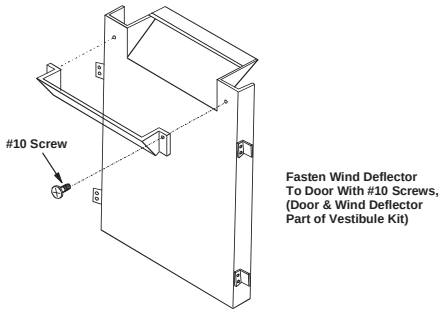
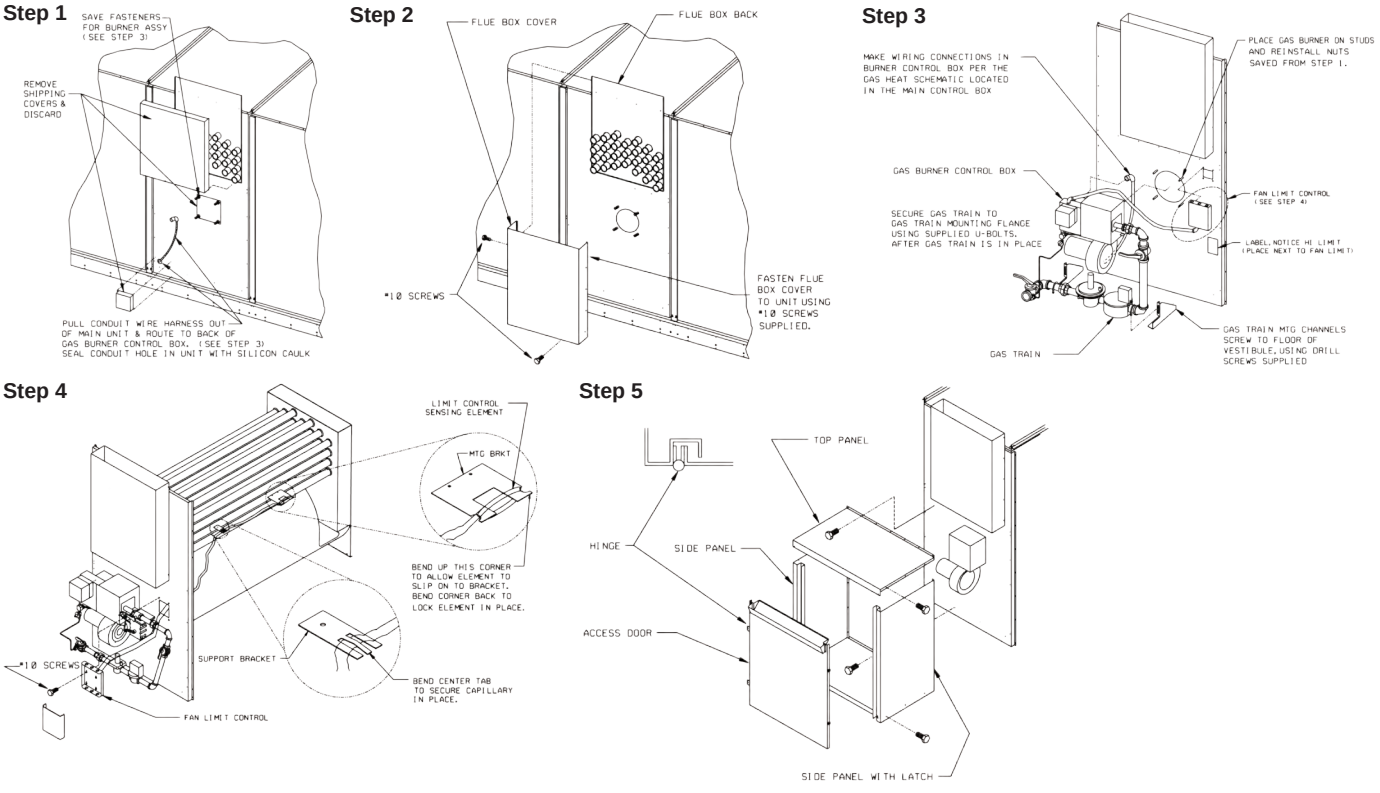


Figure 7: Vestibule — Model 150–200



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, page 21.
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, page 5.

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 Daikin 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 startup 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 any inspectors or representatives that 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 upstream of the unit.
3. Verify that power is connected to the unit and available.
4. Verify that the gas piping, meter, and service regulator has been installed, tested, and is ready to go.
5. Verify 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 he used to control the amount of heating. Set the control system to call for heat so MCB-B011 energizes Relay R20. With MCBB011 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.

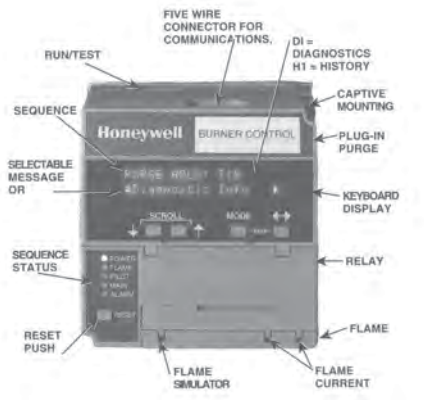
Start-Up Preliminary

1. 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 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 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 (Figure 8).
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 safeguard should come on and after a 10 second "Initiate" period the burner motor should start. Check for (CW) 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 Troubleshooting Chart, page 28. 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. Turn off electrical power. Remove the 1/8 inch pipe plug from the inlet pressure tap of the first electric gas valve in the line, open the gas line cocks upstream from there and bleed the gas line of all air. Replace the 1/8 inch pipe plug.
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. 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. 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 (4) in Figure 23 on page 35. The tube must surround the hole and seal tightly against the burner housing to measure the static pressure through the hole.
5. 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 (4) in Figure 23. The actuator will remain at this position for the first 20 seconds of the prepurge period. Typical static pressure readings are listed in Capacities and dimensions, page 35, Column 10. Any appreciable deviation from these values would indicate a burner air problem that should be found before attempting to fire the burner. These problems could include linkages disturbed during shipment, etc.

Figure 8: RM7897A Flame Safeguard



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 the Capacities and dimensions, 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 the Capacities and dimensions, Column 9 and 10. If the manifold pressure shoots above these values and then slowly returns to normal as the burner is modulating down to a lower firing rate, isolate which combination gas control is causing this. Check that valves pressure regulator adjustment per the Gas Valve Pressure Regulator Adjustment section. If this condition cannot be adjusted out, replace the valve. If combustion appears normal, proceed with the combustion test.

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
b. Check CO_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 the temperature controls calling for first minimum rates and finally maximum rates. Be alert for any hints of trouble or unexplained 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 10 on page 36). If problems develop in the future, variations in these readings will indicate what has changed and where to start looking for problems.

Figure 9: Typical Electrical Schematic for MicroTech® III Control System with RM7897A

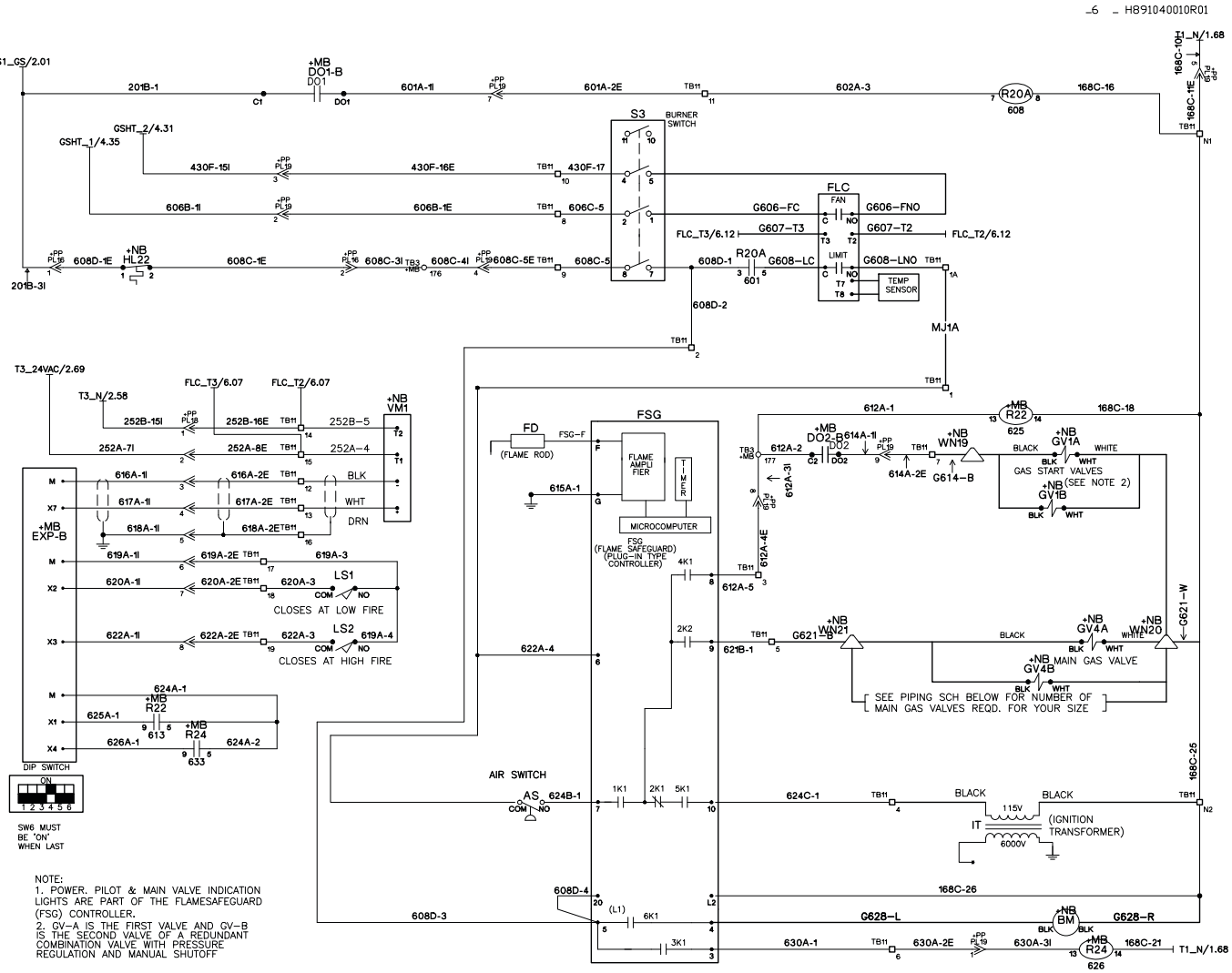
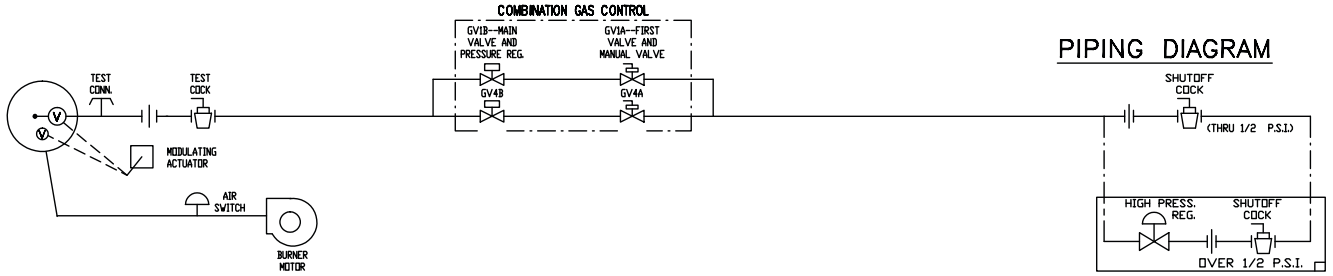


Figure 10: Piping Schematic



Typical Sequence of Operation (20-1 gas burner) for MicroTech III Control System

When 120V power is furnished through the system on/off switch (S1), through the burner on/off switch (S3), and through the high limit control (FLC), terminal #6 on the flame safeguard (FSG) is powered on a call for heat.

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 repositioned to the maximum position for prepurge and then returned to the minimum position for low fire start.

Upon a call for heat, the controller will close digital output (EXPB-DO1) and energize the R20A relay. Once the normally open contacts of the R20A relay close 120V power is supplied to terminal # 6 on the FSG. The FSG then energizes its terminal #4, which powers the burner combustion air blower motor (BM) and starts the 90 second prepurge cycle. Blower operation is sensed by the Air Switch (AS), which makes terminal FSG-6 to FSG-7 during the prepurge cycle. The controller will reposition the burner air valve to its maximum open position via analog output EXPB-AO_X7 for prepurge. When the burner air valve reaches the full open position switch (LS2) will 'make' and provide a digital input to the controller (EXPB-DI_X3). This digital input will initiate a 20 second (adjustable) timing period in the controller. At the completion of the timing period, the controller will begin to drive the burner air valve to its minimum (low fire) position. When the valve reaches the minimum position switch LS1 will 'make' and provide a digital input to the controller (EXPB-DI_X2) indicating the controller's prepurge sequence is complete. As soon as th FSG prepurge time expires FSG terminal #8 will energize relay R22 which will turn on a digital input to the controller (EXPB-DI-X1). As soon as this digital input is 'made' the controller will close digital output (EXPB-DO2) allowing the combination gas valve(s) (GV1) to be energized.

After completion of the FSG 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 (main gas valves - GV4 and GV5 depending on burner size) will be energized and the control system will be allowed to control the firing rate once the heating stage timer (default 5 minutes) has passed. After the flame has lit and been proven and the heating stage time has passed, the controller will modulate (VM1) to the required firing rate via analog output EXPB-AO_X7. 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. The FSG will then lockout and would require manual resetting. If the FSG lockout occurs, FSG terminal #3 will energize the R24 alarm input status relay which will 'make' a digital input to the controller (EXPB-DI_X4). When this digital input is 'made' the controller will drive VM1 to the closed position, de-energize digital output EXPB-DO2 and the prepurge sequence will be disabled and reset. If the FSG terminal # 8 de-energizes R22 (EXPB-DI_X1) after having it turned on and the FSG is not off on safety lockout, the prepurge sequence will start over.

If an attempt is made to restart the burner by resetting the FSG 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. The flame safeguard contains 'LEDS' (lower left corner) that will glow to indicate operation.

Figure 11: Typical Electrical Schematic with no MicroTech III Control System

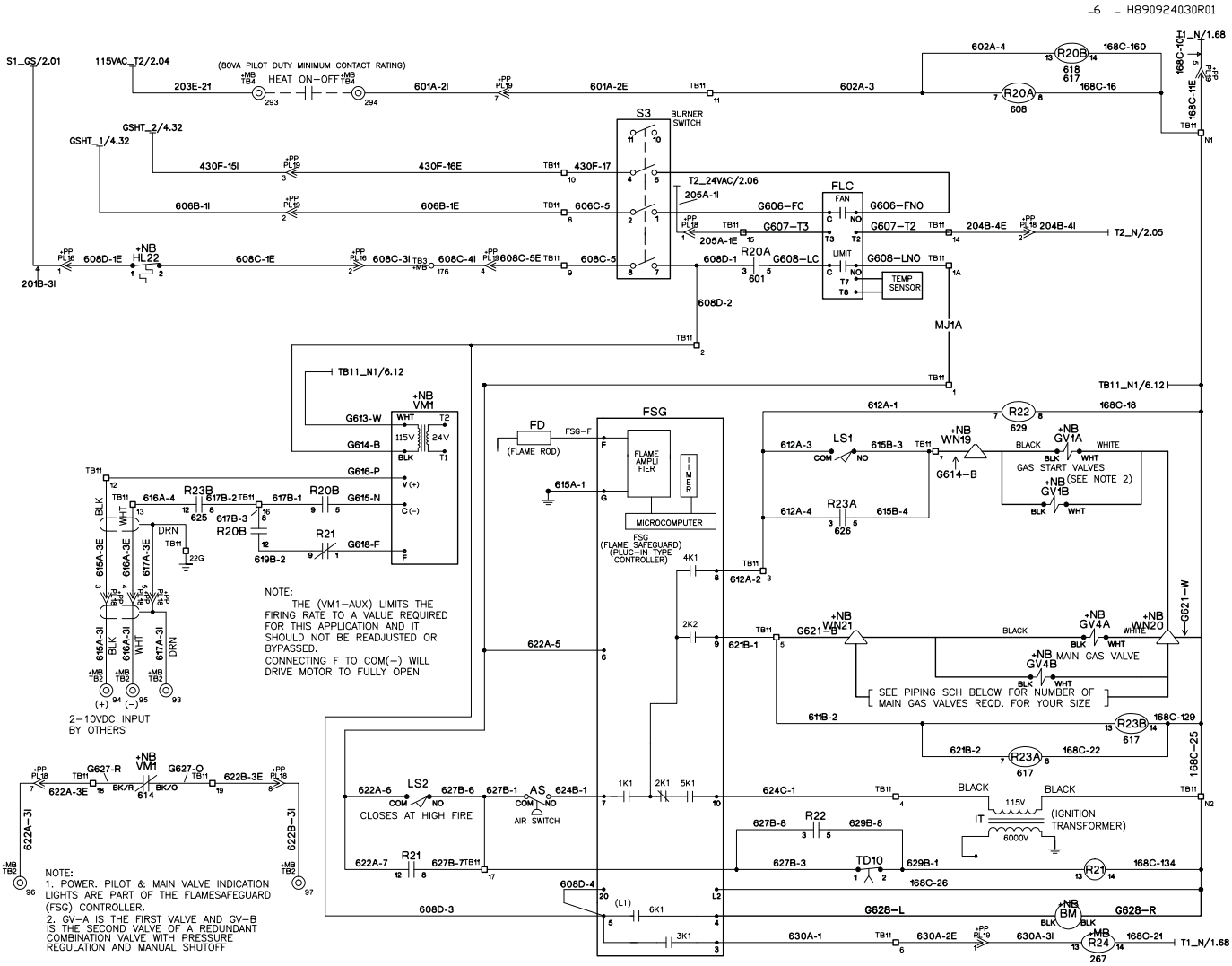
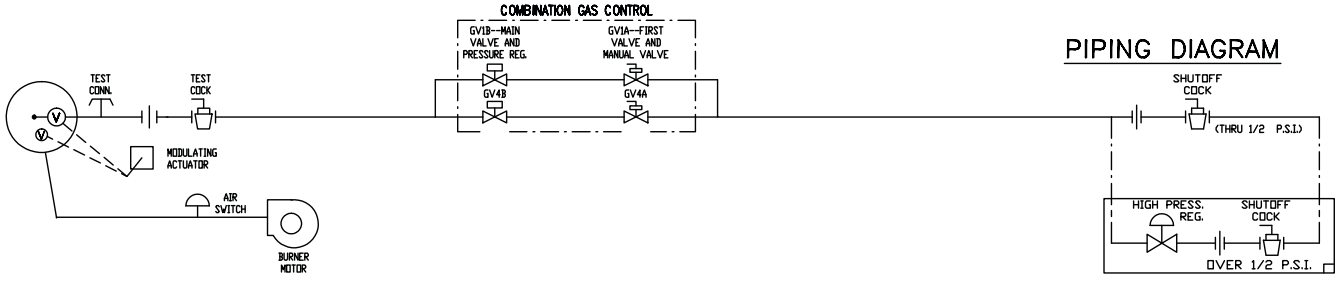


Figure 12: Piping Schematic



Typical Sequence of Operation (20-1 gas burner) without MicroTech III Control System

When the rooftop unit is energized, 120V power is supplied through the System On-Off Switch (S1) to the Heat On-Off Contacts. Upon a call-for-heat, the Heat On-Off will close energizing Relay (R20) which supplies power to the Burner On-Off Switch (S3). The Burner On-Off Switch (S3) will power the Modulating Gas Valve Actuator (VM1) and Terminal #5 (L1) on the Flame Safeguard (FSG). When 120V power is furnished through the System On-Off Switch (S1), the Burner On-Off Switch (S3), Relay (R20) Contacts, the High Limit Control (FLC) and Terminal #6 on the Flame Safeguard is powered. The Flame Safeguard energizes Terminal #4 which powers the Burner Combustion Air Blower Motor (BM). Blower operation is sensed by the Air Switch (AS) "makes" Terminals FSG6 and FSG7 during the prepurge cycle.

The Flame Safeguard will go through a 10 second initiation period before the prepurge cycle whenever power is restored to it. 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 Burner Air Control Valve will change to the maximum position for the prepurge cycle then return to the minimum position for the low fire start.

The Modulating Gas Valve Actuator (VM1), N/C Contacts of R20 and R23 positions the Burner Air and Gas Control Valves to the minimum position after a run cycle. Upon a new call-for heat, R20 is energized. VM1, N/O Contacts of R20 and the N/C Contacts of R21 will set the Burner Air Control Valve to maximum open for the prepurge cycle. When the Burner Air Control Valve reaches the full open position, Switch (LS2) is "made", powering FSG Terminal #7 and the Burner Air Switch (AS). This initiates a 60 second prepurge cycle. Concurrently, LS2 powers Timer (TD10) which will energize the R21 relay after 20 seconds. When R21 is energized VM1 will begin to reset the Burner Air Control Valve to the minimum air valve position through the N/O Contact of R21 and N/C Contact of R23. The valve will be minimum open position at the end of the 60 second prepurge cycle and the Minimum Position Switch (LS1) will be "made". If LS1 is not "made", the Combination Gas Control Start Valve will not open and the burner will go out on a safety lockout.

There will be a 10 second trial-for-ignition after completion of a 60 second prepurge cycle which Terminal #8 (the 3% Start Valve - GV1) and Terminal #10 (Ignition Transformer - IT) will be energized. If a flame is detected through the Flame Rod (FD) at the end of the 10 second trial-for-ignition, Terminal #10 (IT) will be de-energized and Terminal #9 (Safety Shutoff Valve - GV2, Relay R23 Coil and the Gas Valves GV4 —GV9) will be energized. The Control System will be allowed to manage the firing rate. The Flame Safeguard LED (lower left corner) indicators will glow to indicate operation.

Relay R23 is energized after a flame has been lit and proven. This allows the firing rate to be determined by the "floating" Modulating Gas Valve Actuator (VM1). This actuator positions the Burner Air and Gas Control Valves and can set the firing rate between 5% and 100% of the normal rate. VM1 will reposition to a higher rate (up to 10V) when the field-supplied 2–10V analog signal increases to 10V or the actuator reaches the maximum position. The actuator will reposition to a lower firing rate (down to 2V) when the field-supplied voltage is decreased to 2V. The Actuator timing is 30 seconds for a full stroke.

Terminals #4, #8, #9 and #10 will de-energize in the event of flame ignition failure or the flame safeguard fails to detect a flame after 10 seconds resulting in the shut down of the burner and the energizing of Terminal #3. Terminal #3 will energize the Heat Alarm Relay (R24) and send a fail signal to the Heat Fail Contacts located on the Main Control Schematic. The Flame Safeguard will be on a safety lockout and will require manual resetting.

An open Air Valve position will be repeated if restarting the burner by resetting the Flame Safeguard or initiating an automatic restart after flame failure is attempted.

In the event of the unit overheating, the High Limit Control (FLC) will cycle the burner limiting the furnace temperature to the Limit Control Setpoint.

⚠ WARNING

The Gas Valve Motor must stop increasing the Gas Valve percent open when the VM1 Auxiliary Switch Contacts are open. This is the indication that the maximum allowable firing rate has been reached. This is a "control-by-others" requirement and must be coordinated with the 2–10VDC control signal. Failure to coordinate these control signals may result in overheating or severe damage to the equipment.

Flame Safeguard

See manufacturer's bulletin for more detailed information on flame safeguard RM7897A.

The Honeywell RM7897A 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 RM7897A. It can be a permanent accessory added to the RM7897A or it can be carried by the service technician as a tool that is very easy to mount when servicing the RM7897A. It mounts directly on to the RM7897A 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 RM7897A 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.

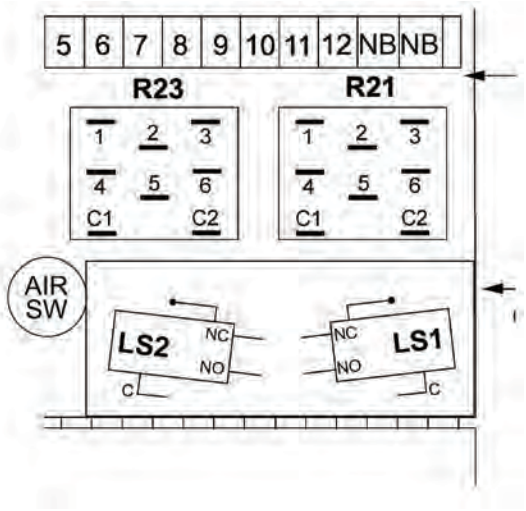
Normal Start-Up

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 safety 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.

Figure 13: Typical Burner Control Box



General

Before starting service on this burner take the time to read the sections About This Burner, page 9 and Typical Sequence of Operation (20-1 gas burner) for MicroTech III Control System, page 13 to get an overview.

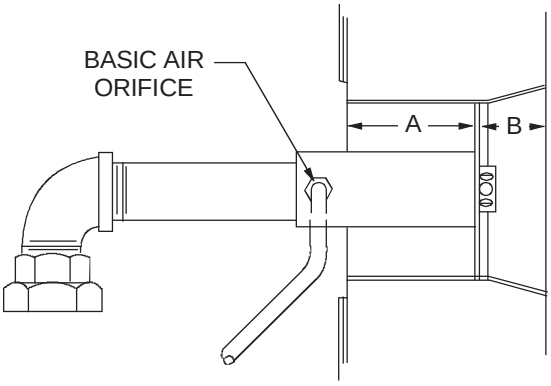
Gun Assembly

The Daikin 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 14. The gun pipe will be concentric with the orifice.

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" in Figure 15.

Figure 14: Gun Assembly

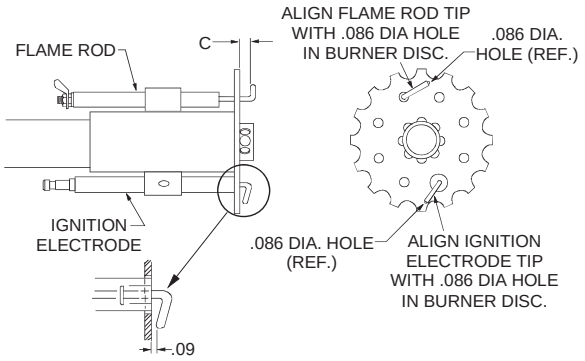


Model HT***	A	B	Base Air Orifice I.D.
020	1.98	1.94	0.060
025	2.04	1.88	0.060
032	2.04	1.88	0.067
040	2.17	1.75	0.070
050	2.17	1.75	0.089
064	2.17	1.75	0.089
065	2.17	1.75	0.089
079	2.07	1.85	0.102
080	2.07	1.85	0.102
100	2.30	1.62	0.102
110	2.24	1.68	0.098
140	2.30	1.62	0.110
150	4.13	1.62	0.110
200	4.13	1.62	0.110

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 23, 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.

Figure 15: Flame Rod and Ignition Electrode



Model HT***	C
020	0.09
025	0.09
032	0.09
040	0.09
050	0.40
064	0.40
065	0.40
079	0.40
080	0.40
100	0.44
110	0.35
140	0.35
150	0.48
200	0.75

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 15). 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. There should not be a need to readjust the burner after the unit has been installed.

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 23. If the gas supply pressure is higher than this an additional regulator must be installed so the pressure will not exceed 0.50 psi.

Many gas burner problems are 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. Perhaps it is at the meter and adjusting the outlet pressure is not an option, the following discussion on the “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 23. 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, page 20, 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 16. 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) in Figure 23, and compare those readings with Columns 6 and 8 in Table 9. A significant difference should be checked out.

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 that 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” in Figure 16. With that sliding plate in this minimum rate position, check dimension “E” in Figure 16. 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 16, 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.

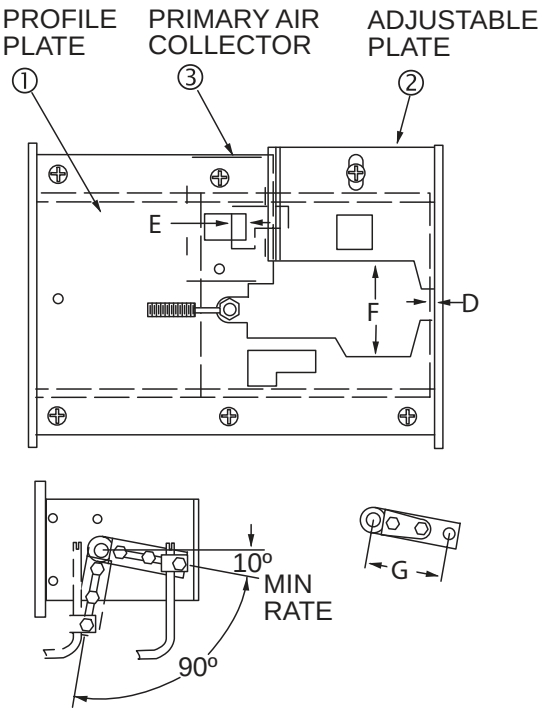
At the maximum rate position the sliding blade should be full open, but it should not be forced against the left side piece of the air box.

The control rod bracket that connects the air and gas valves must be correctly positioned on the control rod such that 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” in Figure 16, 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) in Figure 16 is positioned to provide an opening per dimension “F.”

Figure 16: Air and Gas Control Linkage



Model HT***	D	E	F	G
020	0.005	0.116	0.50	3.30
025	0.005	0.125	0.83	3.30
032	0.005	0.101	0.82	3.30
040	0.005	0.101	1.25	3.30
050	0.020	0.099	1.25	3.30
064	0.020	0.136	1.60	3.30
065	0.020	0.136	1.60	3.30
079	0.020	0.106	1.88	3.30
080	0.020	0.106	1.88	3.30
100	0.020	0.110	2.44	3.30
110	0.020	0.136	1.05	4.28
140	0.020	0.136	3.30	4.28
150	0.020	0.140	3.30	4.28
200	0.020	0.140	4.40	4.28

Actuator Crankarm

The actuator crankarm should not require adjustment. The radius indicated by "G" dimension in Figure 16, 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 crankarm.

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. The switches should be adjusted 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 above 2000 feet, the gas burner must be derated 4% for every 1000 feet of altitude.

Example: An 800 MBh output furnace at an altitude of 3000 feet is derated (0.04 × 3 = 0.12). At 1000 MBh input (1000 × 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 for the pilot and main burner. First, refer to Table 9. Multiply the Gas Manifold Orifice Pressure (at max. rate) shown under Column 9, by the following altitude factors:

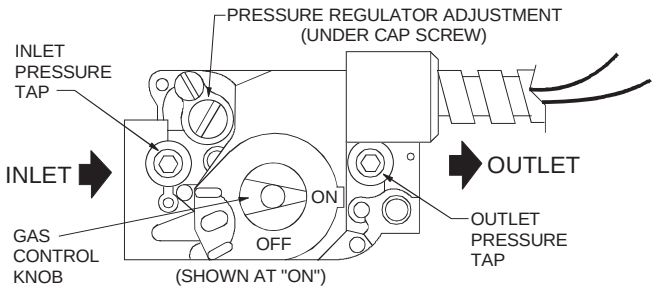
2000 feet = 1.0	5000 feet = 0.774
3000 feet = 0.922	6000 feet = 0.706
4000 feet = 0.846	7000 feet = 0.64

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 17).

Figure 17: 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 9, 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.

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:

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 loosing 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.

a. 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.

b. 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.

c. 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, this would indicate that 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 9, 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 1, 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:

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

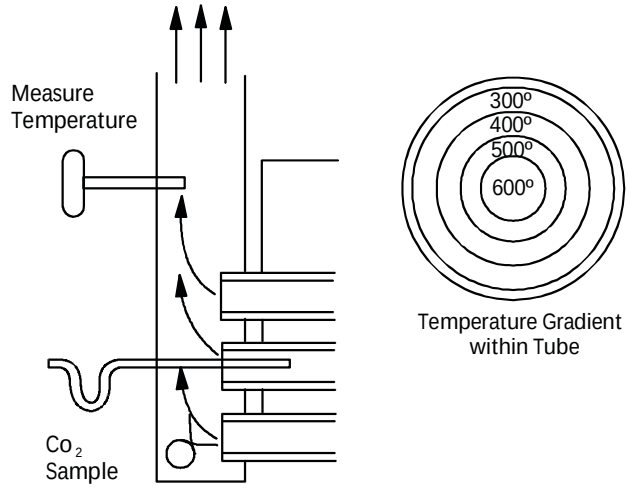
Where: A = BTU/cu. ft. of gas
Typical: Natural gas= 1000, LP gas=2500
B = Cu. ft. per revolution of meter dial
C = Seconds required for 1 revolution of meter dial

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 would cause high readings near the center of the tube and low readings near the edge. Temperatures should be measured 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, page 28.

Figure 18: Checking Temperature



Typical Readings:

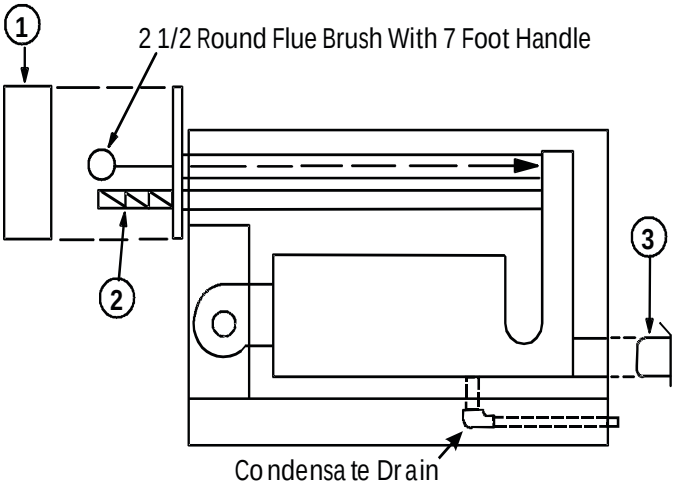
CO_2	9½ to 10½ percent at maximum rate
	4 to 7 percent at minimum rate
CO	0.005 percent (50 PPM) or less

Cleaning Heat Exchangers

Models 032 thru 200 (see Figure 19)

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.
5. Reinstall the inspection door (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).

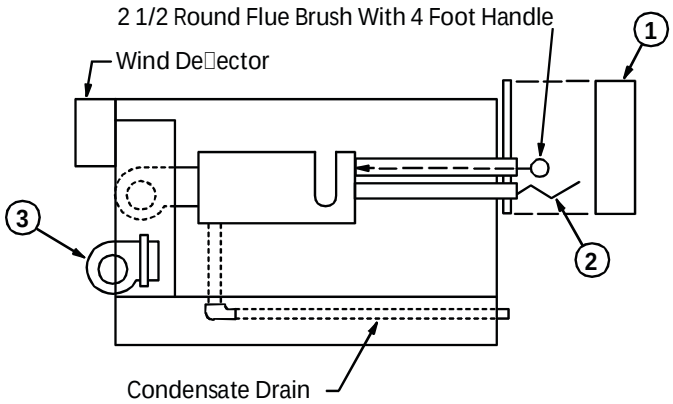
Figure 19: Models 032 thru 200 Heat Exchanger



Models 020 thru 025 (see Figure 20)

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 20, 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 20: Models 020 thru 025 Heat Exchanger



Leakage Symptoms

1. **Odor -** Odors in the building are usually being brought in through the outdoor air intakes and do not indicate leakage from the furnace. Check for down draft conditions and check the 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 or danger 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 and then when the supply fan came on it would blow those products of combustion into the supply duct.
2. **Low CO2 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

1. Open up the rear casing panel **while the unit is shut off** and visually inspect the heat exchanger.
2. **Visually inspect the heat exchanger** while the burner is operating, looking for light coming through holes. The burner should only be operated for a few minutes with the supply fan off, and take necessary safety precautions around the hot heat exchanger.
3. **Perform consecutive CO2 tests** with supply fan off and on. See Item 2 under "Leakage Symptoms."
4. **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, page 21.
2. **Control Failure -** The limit control does not function properly to shut off the burner when the heat exchanger temperature becomes excessive. In most situations, a properly controlled unit will never even require the limit control to shut off the unit. The limit control should be a backup control and a problem attributed to a limit failure would generally indicate a control problem in addition to the limit failure.
3. **Excessive Condensation -** Applications which will produce condensation require an all stainless steel heat exchanger that is resistant to the effects of this condensation and that will give long 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 have loosened up and moved can distort the airflow and cause failures. Construction rubbish, shipping cartons, and insulation that has come loose will occasionally end up inside a unit and block airflow to part of the furnace, resulting in a failure. These items can also 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,

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. Models 020 and 025 have a piped combustion chamber condensate drain, and Models 032 through 200 have a rear cleanout port with an integral condensate drain.

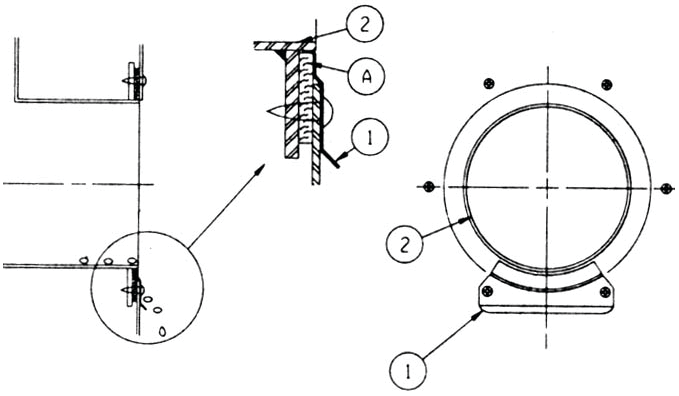
Condensate will also drip from the drains in the two outer corners of the flue box, and from the drip shield below the rear cleanout port. Condensate should not be running down the unit, except at times the wind may blow the dripping condensate mentioned above. The drip shield below the rear cleanout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

Rear Inspection Cover

The rear inspection cover (see Figure 21) 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. 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 out of the rear inspection cover, check the condensate drain for blockage and clean if necessary. Check the Rear Condensate Drain annually for blockage.

Figure 21: Inspection Cover (Models 032 thru 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.

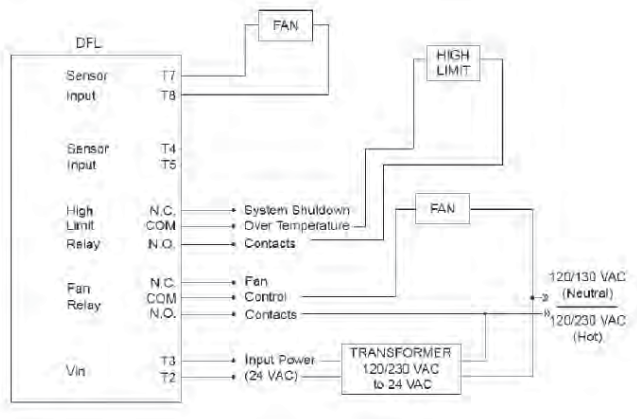
Table 5: LIMIT control set points

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

Replacing “White Rogers” Fan Limit Controller with “Antunes”

Wire 24 VAC input power to terminals T2 and T3. Wire temperature sensor from the secondary tubes at the heat exchanger to terminals T7 and T8. Connect N.C and COM wires for internal fan and high limit relays

Figure 22: Antunes® Fan Limit Controller



Maintenance

Preventative maintenance is the best way to avoid unnecessary expense and inconvenience. The system should be inspected at regular intervals by a qualified service technician. The service intervals below are typical for average situations but will have to be adjusted to suit the particular circumstances.

Fuel pressure settings, control settings, and linkage adjustments should only be made by persons thoroughly experienced with the burner and control system and should 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. Maintenance of flame safeguard, controls, gas valves, and other such components should be performed 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

1. 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.
2. 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.
3. Flame Safeguard Perform a flame failure check and "pilot" turndown test. See control manufacturer's bulletin for further information.
4. 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.
5. If the burner is to be out of service for the summer, turn off the burner control switch and close the manual gas cocks.

Flame Safeguard

See manufacturer's bulletin for more detailed information or for information on flame safeguard other than the RM7897A.

The Honeywell RM17897A is a microprocessor based integrated burner control that will do self-diagnostics, troubleshooting, and status indication, as well as the b u rner sequencing and flame supervision.

Keyboard Display Module

The Honeywell S7800A1001 module is an optional device available for use with the RM7897A. It can be a permanent accessory added to the RM7897A or it can be carried by the service technician as a tool that is very easy to mount when servicing the RM7897A. It mounts directly on to the RM7897A 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 RM7897A 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 within 10 seconds into the prepurge, a recycle to the beginning of the prepurge will occur.

Ignition Trial: The pilot gas valve and the ignition transformer are powered for 10 seconds following the prepurge. Pilot flame must be proven at the end of that 10 second period or a shutdown will occur.

Run: If Pilot flame is proven at the end of the 10 second ignition trial. the main gas valve will be powered. If a flameout occurs, the module will recycle within 3 seconds, and initiate a new prepurge period. If pilot 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 control has opened.

LED Display

There are five labeled LED's located on the front of the RM7897A which are energized to indicate operation as follows:

POWER: The RM7897A is powered.

PILOT: The prepurge period is complete and the terminal for the pilot gas valve is powered.

FLAME: Pilot flame is detected.

MAIN: The ignition trial period is complete, flame is detected, and the terminal for the main gas valve is powered.

ALARM: The RM7897A is on equipment protection lockout.

Troubleshooting

The RM7897A flame safeguard is equipped with an LED to aid in the diagnosis of burner operation and problems. Fault identification is a series of fast and slow-blinking LED lights. The fast blinks identify the tens portion of the fault code (two fast blinks is 20), while the slow blinks identify the units portion of the fault code (two slow blinks is 2). Two fast blinks followed by two slow blinks would be fault code 2-2. This identifies a flame signal absent at the end of the pilot flame establishing period. (See Table 7: Fault codes on page 31 for Blinking Fault Code List.) The LED code repeats as long as the fault exists. To clear the fault, press the RESET button.

In addition, a Keyboard Display Module is available and is a valuable aid for indicating flame signal DC volts, fault messages, sequence status, etc. Refer to Typical Sequence of Operation (20-1 gas burner) without MicroTech III Control System on page 15 for additional information on the Keyboard Display Module.

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.

Voltage checks can be accomplished without removing the Flame Safeguard by removing the Electrical Access Slot Covers on the side of the sub-base and then using those electrical access slots.

Table 6: Troubleshooting Chart

Burner Motor Does Not Run (After 10 Second "Initiate" Period And With Switch At Auto):		
1.1	Power LED is off.	Power is not getting to burner.
1.2	Entire unit seems to be off.	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.	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. Check Table 7. The LED code may diagnose the problem. b. 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.) c. Remove the left side electrical access cover on the flame safeguard sub-base and test for line voltage at terminal 4 and L2. If powered, the problem is with the burner motor or its associated controls. On Models 1100-2000, terminal 4 only controls a contactor and burner motor power comes from its own circuit breaker. If terminal 4 is dead, check for power to terminals 6 and L2. d. 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), the low fire end switch on the modulating operator (if included), or relay contact in the main control system. Consult the schematic and determine the interruption. e. If voltage is satisfactory at terminals 6 and L2 and terminal 4 does not become energized after 10 seconds, and pressing the safety reset button has no effect, replace the RM7897A.
Burner Motor Runs, But...		
2.1	Burner motor runs continuously, but burner does not start (pilot LED) does not come on after 30 (60 or 90) seconds.	a. Check Table 7. The LED code may diagnose the problem. b. The air switch sensing tube is not in the blower housing and sensing pressure. c. The air switch or its wiring is defective. 120 volts should appear between terminals 7 and L2 if airflow switch contacts are made.
2.2	Burner motor starts when the reset button on RM7897A is pressed. The motor runs for 40 (70, 100) seconds and then the burner shuts down and requires manual resetting.	a. Check Table 7. The LED code may diagnose the problem. b. If the PILOT LED did not come on for the 10 seconds before shutdown check for voltage between terminal 10 and L2 during the final 10 seconds before control locks out. If zero voltage, replace the RM7897A. c. If the PILOT LED did come on for 10 seconds before shutdown the pilot flame is not igniting or is not being detected by the flame safeguard. Check that the manual gas valves are open. d. Check the flame safeguard with a flame simulator. 1. Close the main gas test cock. 2. Plug the flame simulator into the flame safeguard. 3. When the pilot indicator light comes on, touch the simulator G post to ground. If the FLAME LED now comes on the flame safeguard is working, but it is not receiving an adequate flame signal. If the FLAME LED did not come on replace the R7847A amplifier or/and the RM7897A.

Burner Motor Runs, But... (continued)	
2.3 During the 10 second period before shutdown there is:	a. Check Table 7. The LED code may diagnose the problem. b. Close the main gas cock (pilot gas cock open) and observe the pilot through the inspection window as it goes through a sequence.
2.3.1 No spark or flame.	a. Close the main gas cock (pilot gas cock open) and observe the pilot through the inspection window as it goes through a sequence. b. Remove the burner gun assembly and check for shorted ignition electrode, open ignition lead, defective ignition transformer, or loose terminal screw on flame safeguard subbase. Check for voltage between terminal 10 and L2 during the final 10 seconds before the control locks out. If zero voltage, replace the RM7897A.
2.3.2 Spark but no flame.	a. Close the main gas cock (pilot gas cock open) and observe the pilot through the inspection window as it goes through a sequence. b. Improper pilot and gas adjustments. Connect a manometer to the pilot test tee and adjust per Pilot Air & Gas Adjustments on page 15. If the specified settings cannot be attained, a problem is indicated.
2.4 Improper pilot air readings.	a. The pilot air pickup tube is not inserted into the blower housing, is broken, cracked, kinked, or improperly positioned. b. Plugged air tube. c. Tubing to the pilot burner is not connected, is loose or cracked. d. Plugged pilot gas orifice.
2.5 Proper pilot air and gas readings, spark but no pilot flame.	a. Porcelain sleeve around ignition electrode is not adequately reducing airflow through this opening. See Ignition Electrode Adjustments on page 15. b. Air in gas lines as a result of inadequate bleeding or recent service work or construction. c. Readjustment of pilot air and gas is required. Refer to “Pilot Air and Gas Adjustment” section.
2.6 Pilot flame comes on, but flame safeguard still locks out.	a. The flame safeguard is not detecting pilot flame. Check flame safeguard using Table 7. If this confirms flame safeguard is working, and the pilot is coming on during the 10 second ignition trial period, then the pilot is not producing an adequate flame signal. Check pilot and its adjustments as listed above in 2.6-b, c and d. b. Disconnected, shorted or open flame rod lead.

Motor Runs, Pilot Ignites...	
3.1 Burner motor starts. After 30 (60 or 90) seconds the PILOT LED comes on, the FLAME LED comes on momentarily and then goes out.	a. Check Table 7. The LED code may diagnose the problem. b. The power is only momentarily proving itself to the flame safeguard. It must be proven at the end of the of the 10 second ignition trial. c. On a new start-up, this could indicate the gas lines have not been sufficiently purged of air. d. Improper flame rod position. e. Improper pilot air or gas adjustments. f. Air leakage into the pilot burner at the porcelain bushing or through cracks in pilot burner. g. Defective or improperly installed pressure regulator upstream of pilot gas cock that passes enough gas for pilot, but when main valve opens, gas pressure drops drastically.
3.2 Pilot operates, the flame safeguard does not lock out. but the main flame does not come on.	a. Check Table 7. The LED code may diagnose the problem. b. Check that the main manual gas cocks are open. c. If the Main LED does not come on, check the voltage at terminals 9 to L2. If no voltage across 9 to L2, replace the RM7897A. d. Check for defective or improperly installed pressure regulators and determine that their vents are not plugged. e. Check for defective or improperly installed main gas valves, or open wires to the valve. f. On diaphragm type gas valves, check for plugged or misadjusted bleed orifice or bleed line.

Burner Operates; However...		
4.1	Main flame light off is rough.	a. The furnace is being fired above its rated capacity. See Verify Input Rate on page 17. b. Heat exchanger needs cleaning. Increased pressure drop through heat exchanger reduces airflow through burner and affects combustion. c. At light off, the gas valve is opening too fast. On diaphragm type valves check the bleed orifice adjustment. Some models use a bleed orifice on the pressure regulator to smooth its opening. When replacing regulators, the bleed orifice must be reinstalled on the new regulator. d. The burner is improperly adjusted. Check gas pressure and orifice size or time a gas meter to verify firing rate; check the CO_2 to verify the combustion air adjustment. e. Check the adjustment of the burner gun assembly. Particularly check the pilot position within the gun on Models 200 and 250. f. Inspect the gun assembly and blast table for warpage or deterioration.
4.2	Flame is not symmetrical as observed through rear	a. Unproportionally high airflow. Check CO_2. b. The gun discs are not perpendicular to the blast tube, or the discs are warped or otherwise out of alignment.
4.3	Nuisance tripping of the flame safeguard.	a. Check Table 7. The LED code may diagnose the problem. b. Check gas pressure situation. Marginal pressure during normal times can become low pressure during time of 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. (1/2 psi) into the standard gas train. Pressures higher than this require an additional stepdown regulator to maintain the pressure below 13.9" W.C. even at “no flow” conditions. 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. c. Undersized piping can also cause problems by delivering reducing pressure during times of maximum demand. d. On modulating burners check the pilot ignition and flame signal when operating at both high fire and low fire. e. Check that the pilot ignition electrode porcelain bushing is blocking air passage into hole in pilot assembly. Check the pilot burner for cracks that could allow air leakage into the pilot burner. On modulating burners, this leakage changes as the burner air damper changes air pressure, and perhaps the pilot will produce a strong microamp signal at low fire but not at high, etc. f. Observe the flame signal DC volts when turning on the burner switch Any movement of meter needle before the ignition cycle could indicate a short to ground. This could be an intermittent situation from moisture conditions. With pilot gas cock closed, any movement during the ignition attempt indicates ignition interference. g. Check for loose or cracked pilot gas tubes, air tubes, and fittings that could vary leakage from time to time as vibration might move them around. h. Check supply voltage and if suspicion warrants arrange to have a recording voltmeter connected to the burner for a period of time. i. Marginal flame signal. Adjust pilot air and gas and flame rod position. j. If the pilot air pickup tube is kinked or flattened from bending, pilot air is reduced. When this happens, the pilot is unstable and nuisance tripping results. Replace the pilot air pickup tube.
4.4	Modulating burners: Pilot lights, 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 damper opens further to provide more air for an increased firing rate, the static pressure inside the fan scroll 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 flat rate can occur.
4.5	At the instant spark comes on, the flame safeguard drops out and restarts the pre-purge cycle.	a. Check Table 7. The LED code may diagnose the problem. b. Ignition interference. Flame rod or its wire is sensing voltage from ignition. Also determine that ignition electrode spark gap is within specifications.
4.6	When the flame safeguard is powered it locks out and the ALARM LED comes on.	a. Check Table 7. The LED code may diagnose the problem. b. 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 RM7897A as indicated.

Table 7: Fault codes

Blinking Fault Codes...		
Fault Code	**System Failure**	
Code 1-1 *Low AC Line Voltage*	Low AC Line detected.	a. Check the relay module and display module connections. b. Reset and sequence the Relay Module. c. Check the 7800 power supply and make sure that frequency and voltage meet specifications. d. Check the backup power supply, as appropriate.
Code 1-2 *AC QualityProblem*	Excessive noise or device running on slow, fast, or AC line dropout detected.	
Code 2-1 *UnexpectedFlame Signal*	Flame sensed when no flame is expected during STANDBY or PURGE.	a. Check that flame is not present in the combustion chamber; correct any errors. b. Make sure that the flame amplifier and flame detector are compatible. c. Check the wiring and correct any errors. d. Remove the flame amplifier and inspect its connections. Reseat the amplifier. e. Reset and sequence the relay module. f. If the code reappears, replace the flame amplifier and/or the flame detector. g. If the fault persists, replace the relay module.
Blinking Fault Codes... (continued)		
Fault Code	**System Failure**	
Code 2-2 *Flame Signal Absent*	No-flame time present at the end of the Pilot Flame Establishing Period; lost during the Main Flame Establishing Period or during RUN.	a. Measure the flame signal. If one exists, verify that it meets specifications. b. Make sure that the flame amplifier and flame detector are compatible. c. Inspect the main fuel valve(s) and valve connection(s). d. Verify that the fuel pressure is sufficient to supply fuel to the combustion chamber. Inspect the connections to the fuel pressure switches. Make sure they are functioning properly. e. Inspect the Airflow Switch and make sure that it is functioning properly. f. Check the flame detector sighting position; reset and recycle. Measure the flame signal strength. Verify that it meets specifications. If not, refer to the flame detector and/or flame amplifier checkout procedures in the installation instructions. g. Replace the flame amplifier and/or the flame detector, if necessary. h. If the fault persists, replace the relay module
Code 2-3 *Flame Signal Overrange*	Flame signal value is too high to be valid.	a. Make sure the flame detector and flame amplifier are compatible. b. Remove the flame amplifier and inspect its connections. Reset the flame amplifier. c. Reset and sequence the relay module. d. Check the flame detector sighting position; reset and recycle. Measure flame strength. Verify that it meets specifications. If not, refer to the flame detector and/or flame amplifier checkout procedures in the installation instructions. e. If the code reappears, replace the flame amplifier and/or the flame detector. f. If the fault persists, replace the relay module.
Code 3-1 *Running/Interlock Switch Problem*	Running or Lockout Interlock fault during Prepurge.	a. Check wiring; correct any errors. b. Inspect the fan; make sure there is no air intake blockage and that it is supplying air. c. Make sure the Lockout Interlock switches are functioning properly and the contacts are free from contaminants. d. Reset and sequence the relay module to Prepurge (place the TEST/RUN Switch in the TEST position, if available). Measure the voltage between terminal 7 and G (ground); 120 Vac should be present. Switch TEST/RUN back to RUN. e. If steps 1 through 4 are correct and the fault persists, replace the relay module.

Blinking Fault Codes... (continued)		
Fault Code	**System Failure**	
Code 3-2 *Running/Interlock On During Standby*	Lockout Interlock powered at improper point in sequence or On in Standby.	a. Check wiring to make sure that the Lockout Interlocks are connected properly between terminals 6 and 7. Correct any errors. b. Reset and sequence the relay module. c. If the fault persists, measure the voltage between terminal 6 and G (ground), then between terminal 7 and G. If there is 120 Vac at terminal 6 when the controller is off, the controller switch may be bad or is jumpered. d. If steps 1 through 3 are correct and there is 120 Vac at terminal 7 when the controller is closed and the fault persists, check for a welded or jumpered Running Interlock or Airflow Switch. Correct any errors. e. If steps 1 through 4 are correct and the fault persists, replace the relay module.
Code 3-3 *VPS in Improper State*	VPS (Valve Proving Switch) in wrong state during VPS Test.	a. Check wiring, making sure upstream valve is connected to terminal 9 and downstream valve is connected to terminal 17. b. Conduct Valve Seat leakage test using a manometer. c. Reset and sequence the relay module; if fault repeats, test VPS (connected to terminal 16) is functioning properly; replace if necessary. d. Reset and sequence the relay module. e. If fault persists, replace the relay module.
Code 4-1 *Purge CardProblem*	No purge card or the purge card timing has changed from the original configuration.	a. Make sure the purge card is seated properly. b. Inspect the purge card and the connector on the relay module for any damage or contaminants. c. Reset and sequence the relay module. d. If the fault code reappears, replace the purge card. e. Reset and sequence the relay module. f. If the fault code persists, replace the relay module.
Code 4-2 *Wiring Problem/Internal Fault*	Pilot (ignition) valve terminal, main valve, ignition or Main Valve 2 was on when it should be off.	⚠ **WARNING:** Electrical Shock Hazard; Fire or Explosion Hazard. Can cause severe injury, death or property damage. Remove system power and turn off power supply. a. Remove system power and turn off fuel supply. b. Check wiring; correct any errors. c. Inspect Pilot Fuel Valve(s), both places, and connections. d. Reset and sequence the relay module. e. If the fault persists, replace the relay module.
Code 4-3 *Flame Amplifier Problem*	Flame not sensed, sensed when it should be on or off.	a. Check wiring; correct any errors. b. Make sure the flame amplifier and flame detector are compatible. c. Remove the flame amplifier and inspect the connections. Reseat the amplifier. d. Reset and sequence the relay module. e. If the code reappears, replace the flame amplifier and/or the flame detector. f. If the fault persists, replace the relay module.
Code 4-4 *Configuration Jumper Problem*	The configuration jumpers differ from the sample taken at startup.	a. Inspect the jumper connections. Make sure the clipped jumpers were completely removed. b. Reset and sequence the relay module. c. If the fault persists, replace the relay module.
Code 5-1 *Preignition Interlock*	Preignition Interlock fault.	a. Check wiring and correct any errors. b. Check Preignition Interlock switches to assure proper functioning. c. Check fuel valve operation. d. Reset and sequence the relay module; monitor the Preignition Interlock status. e. If the fault persists, replace the relay module.

Blinking Fault Codes... (continued)		
Fault Code	**System Failure**	
Code 5-2 *High Fire Sw. or Low Fire Sw.*	Either High Fire Switch or Low Fire Switch failure.	a. Check wiring and correct any errors. b. Reset and sequence the relay module. c. Use manual motor potentiometer to drive the motor open and closed. Verify at motor switch that the end switches are operating properly. Use RUN/TEST switch if manual potentiometer is not available. d. Reset and sequence the relay module. e. If the fault persists, replace the relay module.
Code 5-3 *Man-Open Sw.; Start Sw. or Control On*	Man-Open Switch, Start Switch or Control On in the wrong operational state.	a. Check wiring and correct any errors. b. Make sure that the Manual Open Valve Switch, Start Switch and Control are operating properly. c. Stat Switch held On too long. d. Reset and sequence the relay module. e. Reset and sequence the relay module. If the fault persists, replace the relay module (RM7838A1014; RM7838B1013 or RM7838C1004 only).
Code 6-1 *Internal Faults*	Relay Module self-test failure.	a. Reset and sequence the relay module. b. If fault reappears, remove power from the device, reapply power, then reset and sequence the relay module. c. If the fault persists, replace the relay module.
Code 6-2 *Internal Faults*	Relay Module Self-Test failure.	a. Reset and sequence the relay module. b. If fault reappears, remove power from the device, reapply power, then reset and sequence the relay module. c. If fault does not repeat on the next cycle, check for electrical noise being copied into the relay module through the external loads or possibly an electrical grounding issue. d. If the fault persists, replace the relay module.

Typical Parts List

Table 8: Typical Parts List 60 Hz

Qty.	Description	Sym.	Part Number
	Wheel – 0.5" bore, CCW		
1	200 thru 800 MBH Furnace		034861102
1	1100- 1500 MBH Furnace		034249005
1	2000 MBH Furnace		034249004
	Motor – 0.25 HP, 115/60/1		
1	200 thru 800 MBH Furnace		034249200
1	1000- 1500 MBH Furnace		032248600
1	2000 MBH Furnace		032248400
1	Burner Gun Assembly:		
1	200 MBH Furnace		096414801
1	250 MBH Furnace		096414802
1	320 MBH Furnace		096414803
1	400 MBH Furnace		096414804
1	500 MBH Furnace		096414805
1	640 MBH Furnace		096414806
1	650 MBH Furnace		096414806
1	790 MBH Furnace		096414808
1	800 MBH Furnace		096414808
1	1000 MBH Furnace		096414810
1	1100 MBH Furnace		096414811
1	1400 MBH Furnace		096414812
1	1500 MBH Furnace		096414813
1	2000 MBH Furnace		096414814
	Burner Blast Tube:		
1	200 - 400 MBH Furnace		037378802
1	500 MBH Furnace		034101703
1	640 MBH Furnace		034101703
1	650 - 1000 MBH Furnace		034101707
1	1100, 4000 MBH Furnace		034101706
1	1500, 2000 MBH Furnace		035164701
	Burner Orifice Assembly		
1	200 MBH Furnace		096414701
1	250 MBH Furnace		096414702
1	320 MBH Furnace		096414703
1	400 MBH Furnace/UL Units		096414704
1	400 MBH Furnace/CSA Units		096414724
1	500 MBH Furnace/UL Units		096414705
1	500 MBH Furnace/CSA Units		096414725
1	640 MBH Furnace/UL Units		096414706
1	640 MBH Furnace/CSA Units		096414726
1	650 MBH Furnace/UL Units		096414707
1	650 MBH Furnace/CSA Units		096414727
1	790 & 800 MBH Furnace/UL Units		096414708
1	790 & 800 MBH Furnace/CSA Units		096414728
1	1000 MBH Furnace/UL Units		096414710
1	1000 MBH Furnace/CSA Units		096414730
1	1100 MBH Furnace		096414711
1	1400 MBH Furnace		096414712
1	1500 MBH Furnace		096414712
1	2000 MBH Furnace		096414714
	Burner Ignition Wire Assy		
1	200-1000 MBH Furnace		034742902
1	1100- 2000 MBH Furnace		036518500
	Burner Actuator Motor		
1	Motor (until 3/01)		047936110
1	Motor (3/01 & later)		111047701

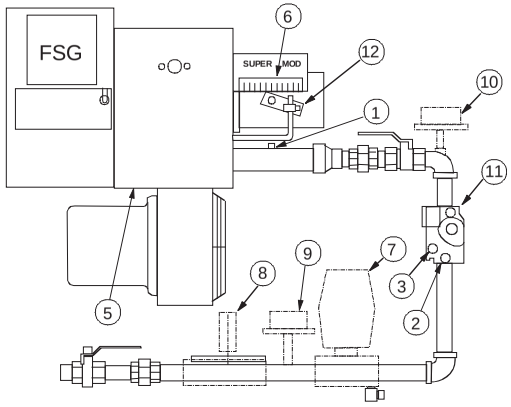
Qty.	Description	Sym.	Part Number
	Burner Actuator Control Arm		
1	200 - 1000 MBH Furnace		059862114
1	1100 - 2000 MBH Furnace		059862144
	Burner Actuator Control Rod		
1	200 - 1000 MBH Furnace		059861101
1	1100 - 2000 MBH Furnace		059650501
	Burner Actuator Crank Arm		
1	200 - 1000 MBH Furnace		059645101
1	1100 - 2000 MBH Furnace		023463200
1	Control- Flame Safeguard	FSG	073300803
1	Amplifier		073300901
1	Time Delay- Flame Safeguard		
	No Controls Units		073301003
	MicroTech II Controls Units		073301003
1	MicroTech III Controls Units		073301002
1	Switch- Toggle	S3	033536700
1	Transformer- Ignition	IT	034482600
1	Switch- Air	AS	033003800
1	Control- Fan Limit	FLC	193423703
1	Switch- Limit	LS1/LS2	059975301
	Relays- No Controls Units (C12= YC, YM)		
1	Relay- Code 12= YC (before 3/10)	R20	073340001
1	Relay- Code 12= YM (before 3/10)	R20	019643000
1	Relay (after 3/10)	R20A	349934764
1	Relay (after 3/10)	R20B	193454703
1	Relay (before 3/10)	R21	019643000
1	Relay (after 3/10)	R21	193454703
1	Relay (before 3/10)	R22	027400700
1	Relay (before 3/10)	R23	019643000
1	Relay (after 3/10)	R20A	349934764
1	Relay (after 3/10)	R23A	349934764
1	Relay (after 3/10)	R23B	193454703
1	Time Delay Relay- 20 sec.	TD10	028210106
	Relays- MicroTech II Units		
1	Relay (before 3/10)	R20	016508002
1	Relay (after 3/10)	R20A	349934764
1	Relay (after 3/10)	R20B	193454703
1	Relay (before 3/10)	R21	019643000
1	Relay (after 3/10)	R21	193454703
1	Relay (before 3/10)	R22	027400700
1	Relay (before 3/10)	R23	019643000
1	Relay (after 3/10)	R20A	349934764
1	Relay (after 3/10)	R23A	349934764
1	Relay (after 3/10)	R23B	193454703
	Relays- MicroTech III Units		
1	Relay- High Amp/DPDT/120V	R20A	349934764
1	Relay- Low Amp/DPDT/120V	R20B	193424341
1	Relay- Low Amp/DPDT/120V	R21	193424341
1	Relay- High Amp/DPDT/120V— 1100-2000 MBH	R23A	349934764
1	Relay- Low Amp/DPDT/120V— 1100-2000 MBH	R23B	193424341
1	Relay- High Amp/DPDT/120V— 1100-2000 MBH	M29	349934764

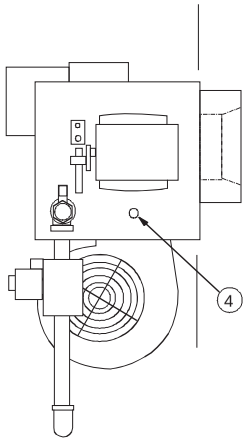
For complete Gas Heat Parts List with Diagrams see the following:
RPL 571177— RPS/RDT 015- 040 C Vintage
RPL 7000069— RPS/RDT 045- 075 C Vintage
RPL 7000070— RPS/RDT 080- 135 C Vintage
RPL 7000150— RPS/RDT 015- 042 D Vintage
RPL 7000137— RPS/RDT 045-079 D Vintage
RPL 7000108— RPS/RDT 080-140 D Vintage

Table 9: Capacities and dimensions

(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 Amps	Gas Connection Size (IP)		
					In Box Measured: At Port 4		In Valve At Port 5	Manifold Measure at Tap (1)		Supply Line Measure @ Tap (2) Note 1, 2		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			To 0.5	2 — 3 Note 2	5 — 10 Note 2
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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
HT 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

Figure 23: Linkage adjustments





Valves, Dampers & Operators shown in Low Fire Position

Notes:

1. Pressure is for modulating burners with standard UL gas train. For On-Off burners, deduct 1.00".
2. GFH of natural gas @ 1000 BTU/cu. ft.
3. Gas inlet pressures over 0.50 PSI (13.9 in. W.C., 8 oz / sq. in.) require an additional high pressure regulator.
4. Minimum fire on modulating burner.
5. GSA burner = 6.00 inches

Key:

1. Pilot gas pressure adjustment
2. Pilot pressure gauge tap (1/4" flare male)
3. Main gas pressure adjustment
4. Burner air adjustment
5. Burner air pressure port
6. Main gas orifice (inside union)
7. Pilot gas orifice (inside test tee)
8. Pilot gas test tee
9. Main manifold pressure tap

Table 10: Service history

	Firing Rate	Description of Reading	Date of Readings												
1	Max. Rate Scale = 100	Gas Manifold Pressure (In. W.C.)*													
2		Gas Life Pressure (In. W.C.)*													
3		Flame Signal (DC Volts)													
4		Ambient Temperature (Deg. F)													
5		Flue Gas Temperature (Deg. F)													
6		Flue Gas C02 (percent)													
7		Flue Gas CO (PPM)													
8		Air Pressure in 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 C02 (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 C02 (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.

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