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

Operation/Maintenance/Service
Form RZ-NA 440-OMS (Version A)
Obsoletes Form RGM 440-OMS

Applies to: **Reznor Model Series RDF**

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

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References: **Installation Manual, Form RZ-NA 440**
Replacement Parts, Form RZ-NA 740

FOR YOUR SAFETY

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

If you smell gas:
1. Open windows.
2. Don't touch electrical switches.
3. Extinguish any open flame.
4. Immediately call your gas supplier.

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

KEEP THIS BOOKLET FOR MAINTENANCE AND SERVICE REFERENCE.

Operating/Maintenance/Service Instructions

The information in this manual applies to Model Series RDF, direct-fired heating/makeup air systems. As with any gas burning equipment, regular maintenance procedures are required to ensure continued safety, reliability and efficiency of the installation.

If service is required, this system should be serviced only by a qualified service person. Service information in this booklet is intended as a guideline for a qualified gas-fired equipment service person.

Maintenance Section

This direct-fired makeup air system is designed to require only a minimum amount of maintenance. Some maintenance procedures outlined in this Section require inspection only and some require action. Frequency requirements of each maintenance procedure are listed in the Maintenance Schedule. Depending on the environment and the number of operating hours, more frequent inspection and/or cleaning may be required to certain components.

Although maintenance requirements are minimal, the routine maintenance procedures in this Section are necessary to ensure safe, reliable, and/or efficient operation. The paragraphs which follow discuss the components and systems that require routine inspection/maintenance. At the beginning of each paragraph, there is a code indicating why that maintenance procedure is necessary. The legend for that code is shown below.

Maintenance Codes	Reason for Maintenance
S	= **Safety** (to avoid personal injury and/or property damage)
R	= **Continued Reliability**
E	= **Efficient Operation**

WARNING: Disconnect all power to the system before doing any maintenance. Failure to do so may cause electrical shock, personal injury, or death.

Maintenance Schedule

See Chart	☐ Lubricate bearings, Paragraph 1
Quarterly	☐ Check the filters, Paragraph 2
	☐ Check air pressure sensing tubes, Paragraph 4
Semi-Annually	☐ Check blower belts, Paragraph 1
	☐ Verify gas pressures, Paragraph 3
	☐ Clean air pressure sensing tubes, Paragraph 4
	☐ Check indicator lights, Paragraph 5
Annually	☐ Check main burner and pilot assembly, Paragraph 6

R 1. Drive Components

Blower Bearings

Systems with 1/2-5HP motor with Class I blower(s) have permanently lubricated cartridge ball bearings. Systems with Class II blowers have pillow block bearings that require cleaning and lubricating. Clean the fitting and add type NLG-2 or -2 standard grade grease. Add grease with a handgun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating.

Recommended Bearing Lubrication Schedule (months)				
RPM	Bearing Bore Diameter (Inches)			
	1/2 to 1	>1 to 1-1/2	>1-1/2 to 1-15/16	>1-15/16 to 2-1/2
to 500	6	6	6	6
501 - 1000	6	6	6	5
1001 - 1500	5	5	5	4
1501 - 2000	5	4	5	3

NOTE: If unusual environmental conditions exist (temperatures below 32°F / 0°C or above 200°F / 93°C ; moisture; or contaminants) more frequent lubrication is required.

CAUTION: If the blower is unused for more than three months, the bearings should be purged with new grease prior to startup.

Belts

Check belts for proper tension and wear. Adjust belt tension as needed. Replace worn belts.

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

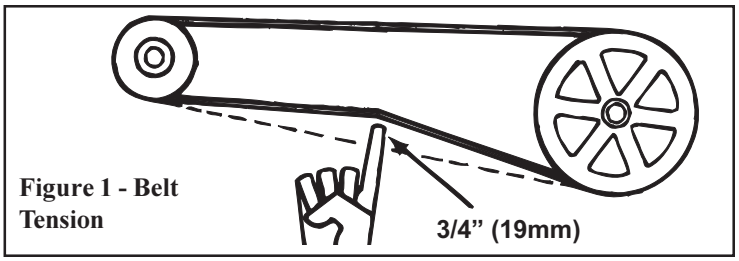


Figure 1 - Belt Tension

R E 2. Filters

If the system includes filters, check the filters quarterly. Clean or replace as needed.

Model Size	Quantity of 1" or 2" Filters	Filter Size	Filter Access Doors
1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118	3	12 x 35	One (side opposite controls only)
2-80, 2-120, 119, 120	4	12 x 35	Two (one on each side of the cabinet)
	4	12 x 24	
3-180, 3-260, 122, 130	12	12 x 35	

S 3. Manifold Gas Pressure

Semiannually, check the gas pressure to the burner and to the pilot. Measure both manifold pressure and pilot supply pressure with the blower in operation. Verify against pressures listed on the rating plate.

S 4. Air Pressure

Sensing tubes should be checked quarterly and cleaned no less than semiannually. If the sensing tubes become even partially blocked, false pressure readings may be relayed. Locate the tubing "ends" - one on each side of the burner profile plate. To clean, remove the screened end caps. Clean the screens and the tubes, if necessary. Replace the cleaned end caps. Check the pressure differential across the profile plate using a slope gauge. Air pressure differential should be between -.5" and -.65" w.c.

To attach the slope gauge, open the control compartment door panel. Connect the slope gauge between the high and low pressure connections. (Located in

the gas control compartment, the high pressure connection is on the right, low pressure is on the left.) Use a tee in the line to allow pressure switches to function normally. For instructions on measuring air pressure, see Service Section, Paragraph 10.

S 5. Main Burner and Pilot Assembly

For the most part, the burner and pilot are self cleaning. However, if the application is extremely dirty or dusty, cleaning of the burner and pilot may be necessary. Inspect the burner annually. Follow these instructions. If it is necessary to replace any parts, use only factory-authorized replacements.

1) Turn off the gas and power supply to the system.

2) Loosen the union in the gas train and move the gas train assembly out of the way for burner removal.

3) **Hot Surface Ignition** (See Figure 2A) - Disconnect the two ignition wires (male and female quick connections) and disconnect the flame sensor lead at the burner. Remove the set screw located in the ignitor tube (set screw holds the brass bushing in place). Carefully remove the brass bushing and the ignitor.

Check the hot surface ignitor for cracks or unusual deterioration. Check the flame rod for integrity. Replace the flame rod (P/N 131188) and/or the hot surface ignitor (P/N 121865) if not in good condition.

Spark Ignition (See Figure 2B) - Remove the ultraviolet sensor and the spark plug. Clean. Replace parts that are not in good condition.

Figure 2A - Burner End Plate showing Hot Surface Ignitor (units manufactured beginning 3/96 have a hot surface ignition system)

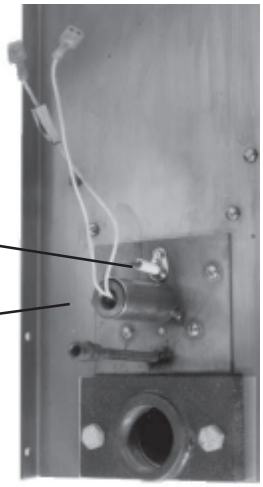
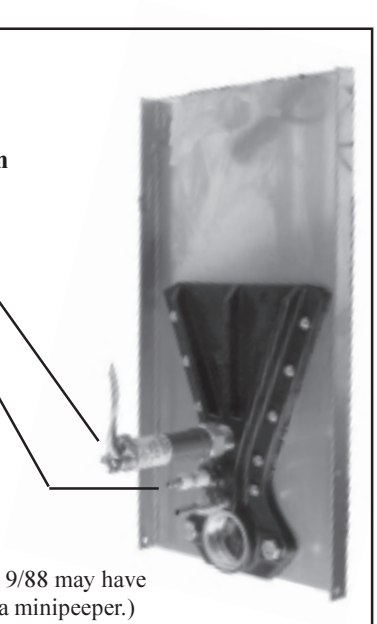


Figure 2B - Burner End Plate of a Unit Manufactured before 3/96 with a Spark Ignition System

At the Burner
- Ultraviolet Minipeeper
- Spark Plug

In the Electrical Compartment
- Spark Generator
- Flame Relay

NOTE: Burner end plate is also different.



(Units manufactured prior to 9/88 may have had a flame probe instead of a minipeeper.)

Figure 3 - Illustration of the first Burner Section

The burner length is an assembly of from one to 12 of these 6" sections

4) Clean the burner and pilot by back-flushing, using high pressure air (40-80 lbs). Continue until dust particles are completely expelled from both the upstream and downstream sides of the burner.

If air pressure does not unplug burner orifices or pilot tube, drill burner orifices with a Size #47 drill and/or pilot tube with a Size #55 drill. Do not enlarge.

CAUTION: Wear eye protection while pressure cleaning and drilling.

WARNING: Do not enlarge burner ports or performance may be drastically affected.

Inspect the upstream and downstream sides of the mixing plates. Remove any accumulation of scale or foreign material with a wire brush. If any mixing plate fasteners are loose or missing, tighten or replace. Always use zinc plated or stainless fasteners.

If any cracks are present, replace that mixing plate. Because of the effect of flame temperature on the metal, fasteners may be difficult to remove. Be careful not to damage the gaskets that go between the mixing plates and the burner body. The gaskets are designed to overlap approximately 1/16" for tight air seal.

5) Follow Steps in reverse order to re-install the pilot assembly. Close all panels and check for proper operation.

R 6. Optional Lighted Status Panel (check bulbs)

If the system has a lighted status panel, it is located in the electrical control compartment. The lights are labeled as shown below.

Check operation of all indicator lights by switching light bulbs that are not lit with one that is currently lit. Replace all burned out indicator bulbs (P/N 101889).

Figure 4 - Optional Panel (Option BS2) with Status Lights

Control Circuit Power

Control Switch Energized
Firestat Normal
Freezestat Normal
Starter Energized
Blower ON - High Air Pressure Normal
Blower ON - Low Air Pressure Normal

Manual and Auto Limits Normal
Outside Air Cutoff Normal
Low Gas Pressure Normal
High Gas Pressure Normal
Pilot Valve Energized
Gas Safety Valve Energized

Operation/Service Section

Controls -- Location, Operation, and Service

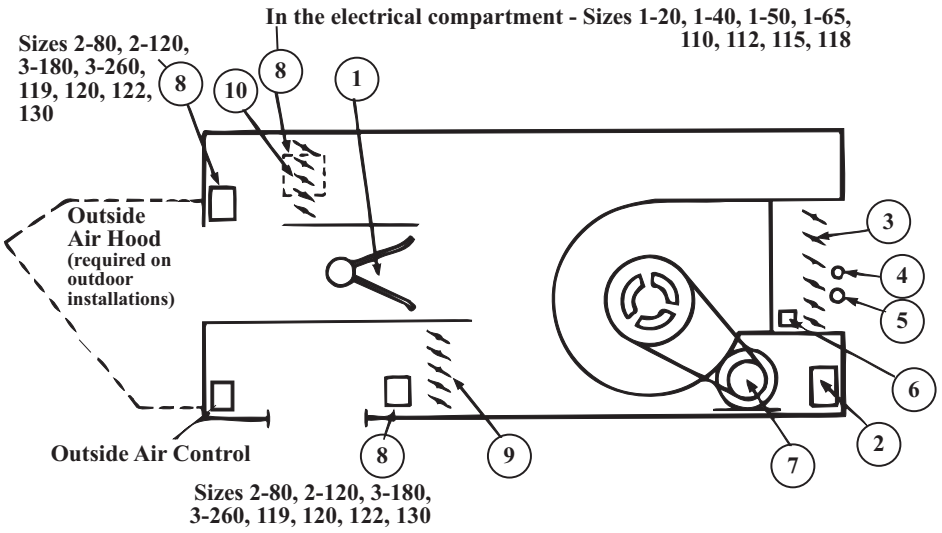
To service this system, it is necessary to understand the normal operation of the controls. Refer to the electrical box drawings in Figure 6 and to the individual illustrations to identify and locate each of the controls.

WARNING: Service work on this system should only be done by a qualified gas service person. The service information and the troubleshooting guides are intended as an aid to a qualified service person.

KEY:

1 - Burner
2 - Discharge Damper Motor (Air Control Options AR19 and AR20)
3 - Discharge Damper (Air Control Options AR19 and AR20)
4 - Manual Reset Limit
5 - Automatic Limit
6 - Discharge Air Sensor
7 - Blower Motor
8 - Damper Motor (Air Control Options AR19, AR20, AR22, and AR23)
9 - Return Air Damper (Air Control Options AR22 and AR23)
10 - Bypass Damper (Air Control Options AR19, AR20, AR22, and AR23)

Figure 5 - Control Locations

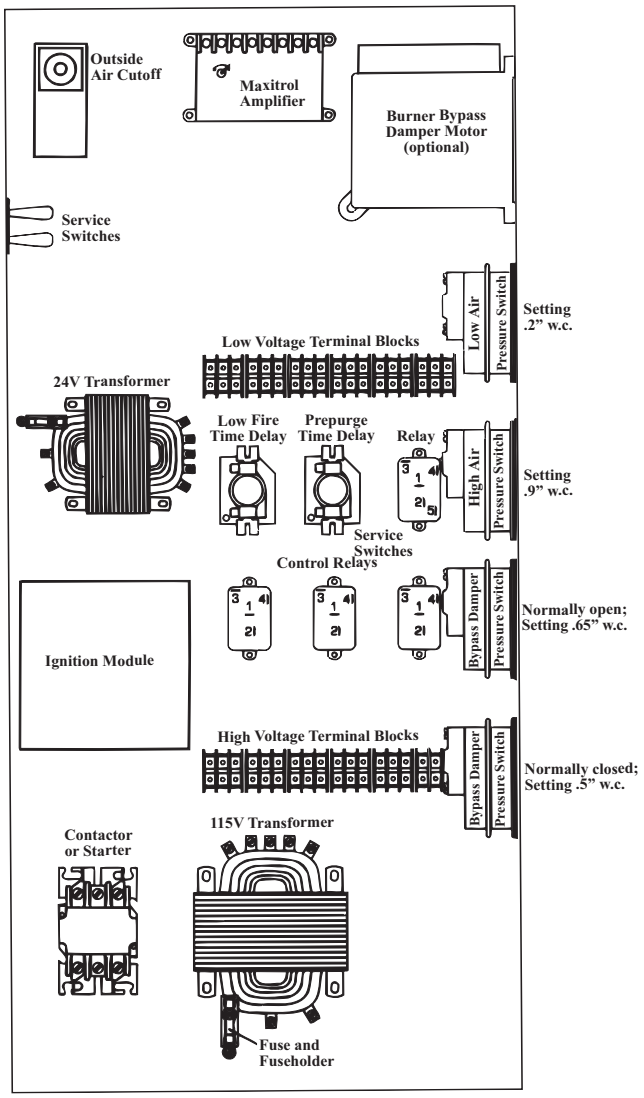


Device	Function	Location
Amplifier	Logic circuit for firing rate	Electrical Compartment
Auto Limit	Limits outlet air temperature	Blower Discharge
Blower Light	Assures that blower is operating when lit	Remote Console
Blower Service Switch	Service switch for blower operation	Electrical Compartment
Burner light	Assures that pilot is operating when lit	Remote Console
Burner Relay*	Interfaces 24V controls to 110V burner circuit	Electrical Compartment
Burner Service Switch	Service Switch for burner operation	Electrical Compartment
Ignition Module	Monitors flame and sequences ignition	Electrical Compartment
Flame Supervising Relay*	Monitors flame and sequences ignition	Electrical Compartment
Gas Valves	Main line gas valves - normally closed	Burner Compartment
High Air Pressure Switch	Prevents burner operation with high air velocity	Burner Compartment
Low Air Pressure Switch	Prevents burner operation with low air velocity	Burner Compartment
Low Fire Time Delay	Guarantees low fire ignition	Electrical Compartment
Manual Limit	Redundant safety to automatic limit	Blower Discharge
Motor Starter/Contactor	Controls blower motor on/off	Motor
Modulating/Regulating Valve	Controls firing rate	Burner Compartment
Outside Air Cutoff	Prevents burner operation during warm weather	Electrical or Burner Compartment
Pilot valve	Solenoid valve to control pilot on/off	Burner Compartment
Prepurge Time Delay	Purges the air chamber prior to ignition	Electrical Compartment
Safety Lockout Relay*	Shuts unit down if burner fails to ignite	Electrical Compartment
Safety Lockout Light	Burner failure has occurred when lit	Remote Console
Spark Generator*	Creates spark for ignition of pilot	Electric Compartment
Temperature Sensor	Measures out air temperature for amplifier	Blower Discharge
Temperature Selector	Controls outlet air temperature	Remote

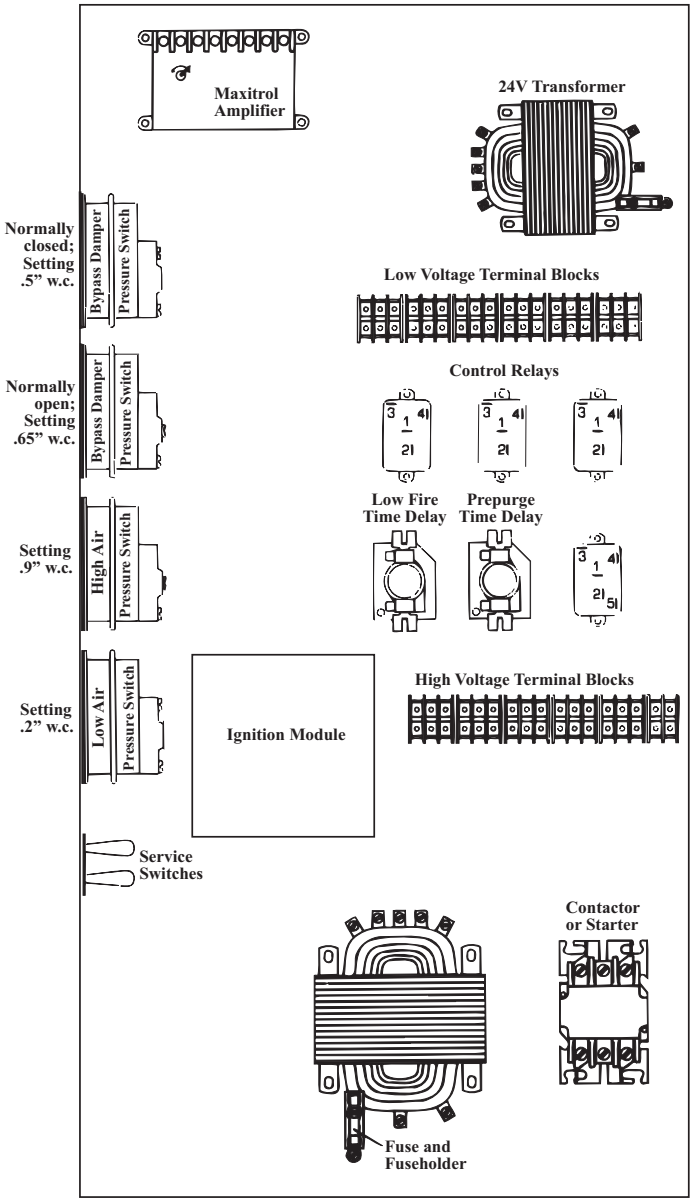
*On systems with spark ignition (units manufactured prior to 3/96)

Figure 6 - Electrical Compartment

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



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



7. Temperature Limit Safety Controls

Location: Blower Discharge

• Automatic Limit

Function: The automatic limit is a temperature activated safety control. If the temperature of the discharge air reaches the setpoint, the limit will open the circuit to the burner system and close all burner and pilot valves. The limit control will be activated if total air flow is reduced or if gas pressure surges at the burner causing excessive discharge air temperature. The system will restart when the discharge air temperature decreases below the setpoint.

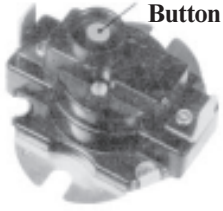
Figure 7 - Automatic Limit Control

Setting 135°F

• Manual Reset Limit Control

Function: The manual reset limit has a higher setting than the automatic limit and requires manual resetting to restart the system. If for any reason the automatic limit should fail to protect against overheating, the manual limit will shutdown the system. Should the manual reset limit activate, check the entire system to determine the cause. Make any necessary changes or adjustments before restarting the system. Restart of the unit can be done only after the limit has been cooled and the reset button depressed.

Figure 8 - Manual Reset Limit



CAUTION: If the manual reset limit activates, find and correct the cause before re-starting the system.

Service: Failure of either limit requires replacement of the control.

8. Ignition System

Location: Ignition Control Module in the Electrical Compartment (See Figure 9A); Ignitor and Flame Sensor on the Burner (See Figure 9B)

Hot Surface Ignition System with Prepurge Time Delay and Flame Sensor with 100% Lockout

Function: The ignition system including the controller, the hot surface ignitor, and the flame sensor function to ignite and prove the pilot flame. When there is a call for heat, the modular ignition controller is energized. When the controller reads 1.4 amps going to the hot surface ignitor, it opens the pilot valve for a 15-second trial for ignition. After the pilot flame rod senses pilot flame, the main gas valve is energized. If the pilot flame rod does not sense a pilot flame, the controller shuts down the pilot valve for a 10-second interpurge and then opens it again for a second ignition trial. If pilot flame is not proven on the second trial, the ignition controller locks out and must be manually reset by an interruption of the main circuit (disconnect switch).

Figure 9A - Ignition Control Module, P/N 157953, in the Electrical Compartment

Figure 9B - Ignitor and Flame Sensor on the Burner

Service: The modular ignition controller does an internal self-check each time that it is energized and will lockout if not found to be functioning properly. If the ignition controller locks out and there is no other cause, the controller module must be replaced.

9. Gas Train Including Direct-Fired Burner, Gas Control Systems, and Manifold Arrangements

Direct-Fired Burner

Function: The design of the direct-fired burner and the controlled velocity of air at the burner ensure complete combustion through the full range of burner sizes and gas inputs as determined by the gas control system. The velocity of air is controlled by the burner profile plates and monitored by a standard low and high air pressure switch.

Service: Refer to Paragraph 6 in the Maintenance Section for instructions on burner maintenance.

Makeup Air Gas Control Systems

Electronic Modulation Gas Control Options AG30 (Std) , AG31, AG32, and AG33

Function: Systems AG 30, 31, 32 and 33 provide heated makeup air at a temperature controlled by a discharge air sensor. Each system is equipped with electronic modulation controls that modulate burner flame from 1/25th of full fire input to full fire.

The electronic modulating-type gas controls act in response to discharge and/or room air temperature sensors to change the gas flow rate to the burner, thus lengthening or shortening the flame. The BTU output is varied (modulated) to maintain the required discharge air temperature.

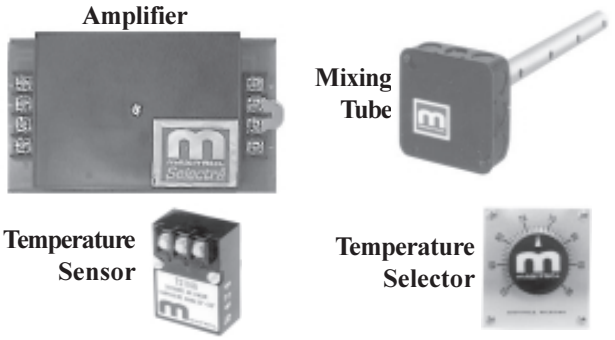
These modulating gas control options are electronic because in all cases the gas valve acts to adjust the flow of the gas to the main burner in response to DC volts emanating from an amplifier. When the DC voltage is between 0 and 5 volts, the main valve seat is closed. Low fire flow is accomplished through a mechanical bypass. The low fire flow rate is set at the factory and should not need adjustment. However, if adjustment is necessary, refer to the Maxitrol literature that is included in the heater owner's envelope.

All of the electronic modulating gas control burner systems include low fire start. On an initial call for heat, the main burner ignites at its lowest input. During mild weather, the burner may then cycle off. Such full shutdown can be dictated by the optional outdoor ambient control. As the outside air temperature climbs above the setpoint of the outdoor ambient control, the burner control circuit is de-energized. When moderately cold outside air temperatures exist, the burner will modulate between low flame and high flame. Low fire start and the outdoor ambient control prevent the makeup air system from heating already warm air and providing "too much" heat to the building.

For troubleshooting guides and further explanation of Maxitrol Series 14 and 44 electronic modulation gas control systems, refer to the Maxitrol literature in the owner's envelope.

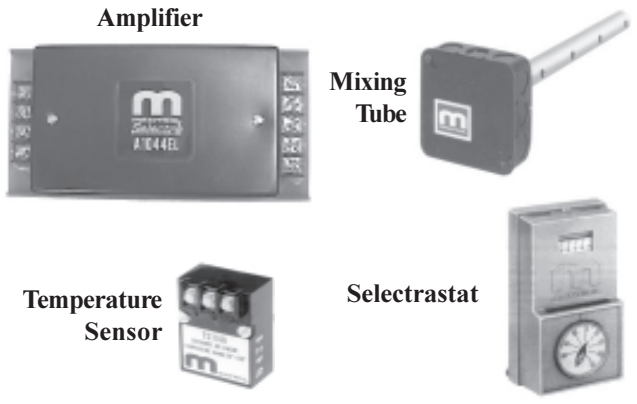
The Option AG30 (Std), AG31, and AG32 electronic modulation systems are comprised of Maxitrol Series 14 controls. The standard system (AG30) and the AG31 system electronically maintain a constant discharge air temperature in the range of 55-90°F. Option AG31 includes an overriding thermostat. Option AG32 system will maintain a constant discharge air temperature in the range of 80-130°F.

Figure 10 - Components of the Gas Control System (Maxitrol Series 14) used in Gas Control Options AG30 (Std), AG31, and AG32



Option AG33 electronic modulation system is comprised of Maxitrol Series 44 controls. The low limit (20-60°F) and the high limit (60-140°F) for control of discharge air temperature are set at the amplifier located in the control compartment. The space temperature is set at the remote selectrastat (55-90°F range) located in the space. When the temperature is below the space temperature setpoint, the control system operates the burner to automatically adjust the discharge air temperature within the maximum and minimum limits set on the amplifier.

Figure 11 - Components of the Gas Control System (Maxitrol Series 44) used in Gas Control Option AG33



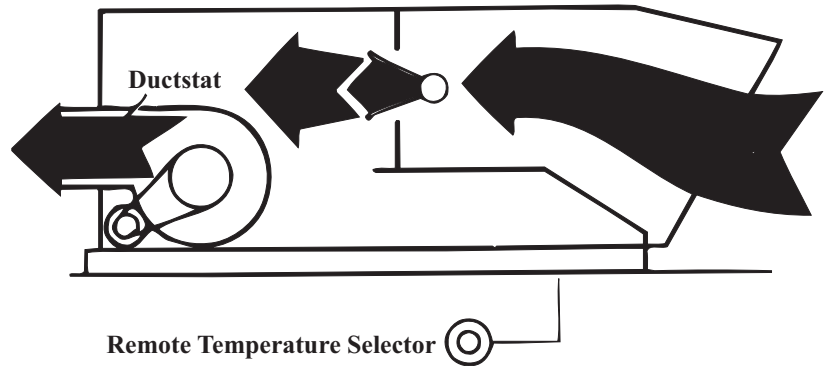
Electronic Modulation Gas Control Option AG37

Function: Control Option AG37 does not have a duct sensor or amplifier. Instead, a Maxitrol A200 signal conditioner is activated by a customer-supplied input signal (either 4-20 milliamps or 0-10 volt) to control the modulation of the gas valve.

Figure 12 - Maxitrol A200 Signal Conditioner

Service: Check all electrical connections. A qualified service person should refer to the Maxitrol Troubleshooting Guides for assistance in identifying problems and determining the correct solution. None of the Maxitrol controls have field replaceable parts. All components must be replaced with identical replacement parts.

Figure 13 - Gas Control Application - Options AG30, 31, 32 and 33

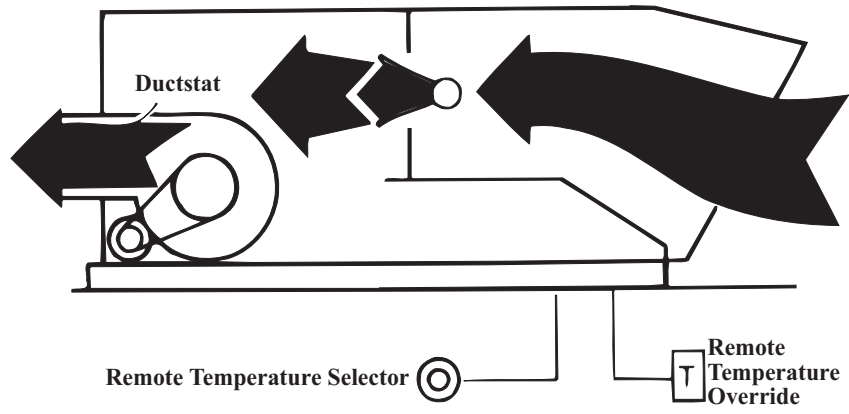


Standard Gas Control (AG30)

- Provides constant discharge temperature 55°-90°F as manually set on a remote temperature selector

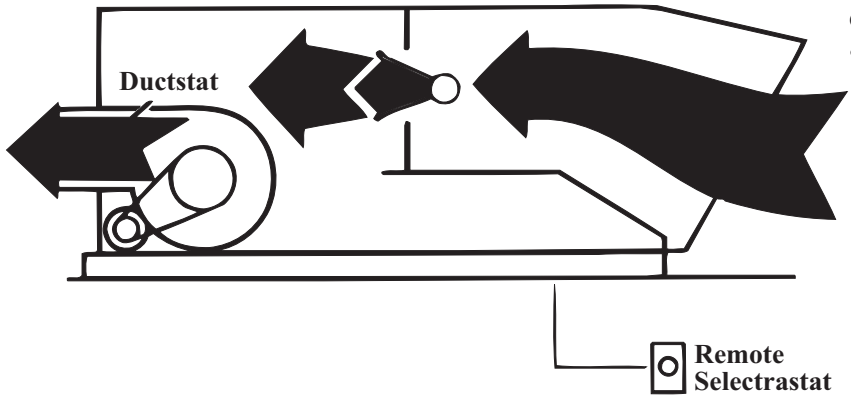
Gas Control Option AG32

- Provides constant discharge temperature 80°-130°F as manually set on a remote temperature selector



Gas Control Option AG31

- Provides constant discharge temperature 55°-90°F as manually set on a remote temperature selector but with the addition of an automatic override sensor that temporarily resets the discharge air temperature if the space temperature falls below the override setpoint



Gas Control Option AG33

- Provides constant space temperature 55°-90°F as controlled automatically by a remote selectrastat that adjusts the discharge air temperature (maximum range 60°-120°F; minimum range 20°-60°F) to maintain a space temperature variation of ±1°F

9. Gas Train Including Direct-Fired Burner, Gas Control Systems, and Manifold Arrangements (cont'd)

Manifold Arrangements

Description: The manifold is the gas train from the gas supply connection to the burner. The manifold selection ordered determines the manifold arrangement including all of the gas train components (except the main control valve). Manifold arrangements are available for BTUH ranges and gas controls and include versions that meet FM or IRI requirements.

All of the manifold arrangements include main gas and pilot shutoff cocks, manual shutoff leak test valve, pilot regulator, a pilot solenoid valve, and main gas regulator.

The table on the right lists the gas pressure drop through each available gas train. For maximum capacity, 5.0" w.c. natural gas pressure or 2.0" w.c. propane gas pressure is required at the burner. Add the required pressure (5.0" or 2.0" w.c.) to the manifold pressure drop for the manifold to calculate the required minimum inlet pressure for your installation.

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

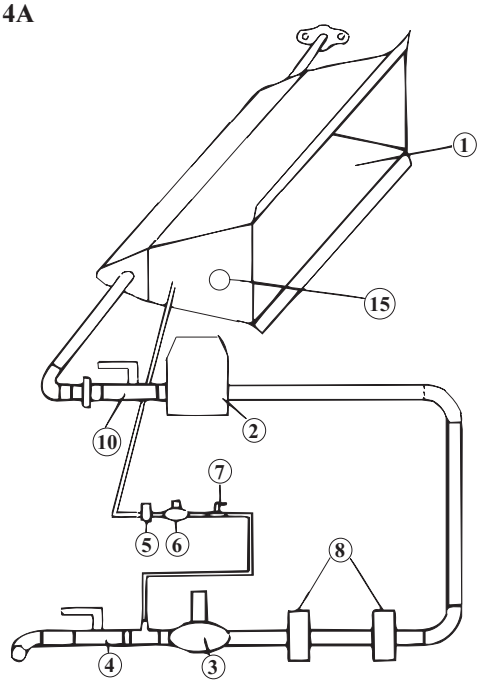
MBH	Burner	Standard Manifold	Option BM5 or BM7	Option BM9, BM10, or BM11
250	Std	0.9	0.7	N/A
500	BL2	2.3	1.9	N/A
750	BL3	6.8	3.9	N/A
1000	BL4	N/A	N/A	3.0
1250	BL5	N/A	N/A	4.0
1500	BL6	N/A	N/A	5.1
1750	BL7	N/A	N/A	6.6
2000	BL8	N/A	N/A	8.0
2250	BL9	N/A	N/A	2.5
2500	BL10	N/A	N/A	2.9
2750	BL11	N/A	N/A	3.3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

Figure 14 - Manifold Arrangements (Standard, Option BM5, Option BM7, Option BM9, Option BM10, and Option BM11)

KEY to Illustrations in Figures 14A-14F:

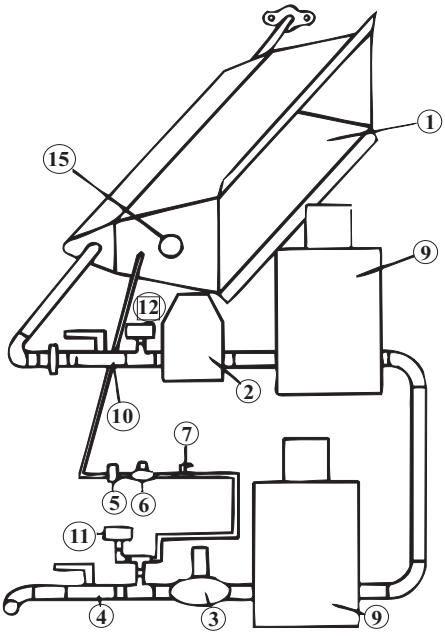
1 Burner
2 Modulating Gas Control Valve
3 Pressure Regulator
4 Main Gas Manual Shutoff
5 Pilot Solenoid Valve
6 Pilot Regulator
7 Pilot Manual Shutoff
8 Main Gas Solenoid Valve
9 Main Gas Motorized Fluid Power Valve
10 Manual Shutoff Leak-Test Valve
11 Low Gas Pressure Safety Switch
12 High Gas Pressure Safety Switch
13 Vent Solenoid Valve
14 Combination Regulator/Modulating Valve
15 Hot Surface Ignitor

Figure 14A



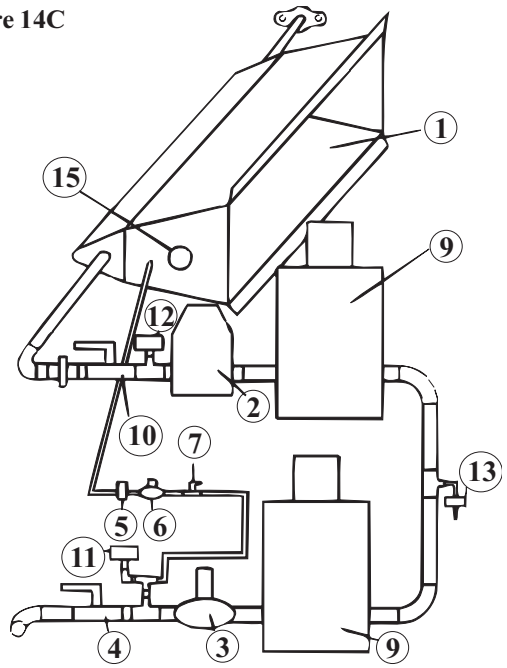
STD: Standard manifold arrangement includes two solenoid main gas valves. Meets ANSI requirements to 750 MBH. (6" w.c. to 5 psi gas inlet pressure)

Figure 14B



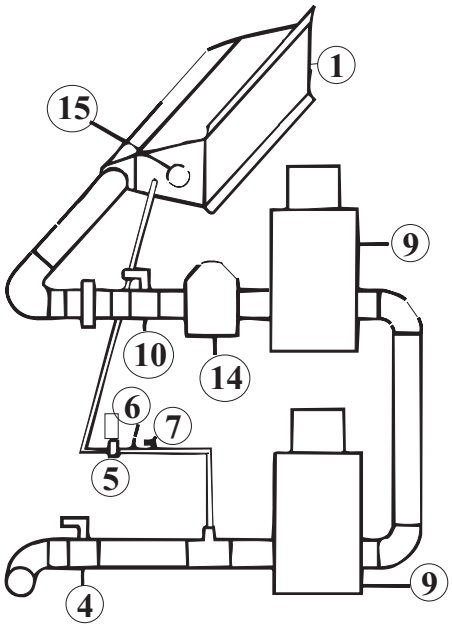
Option BM5: Optional manifold arrangement to meet FM requirements on outdoor units without filters and IRI requirements on all units. For inputs less than or equal to 750 MBH. Includes two fluid power valves (in place of the two standard solenoid valves), high and low gas pressure switches, and a manual shutoff leak-test valve. (6"w.c. to 5 psi gas inlet pressure)

Figure 14C



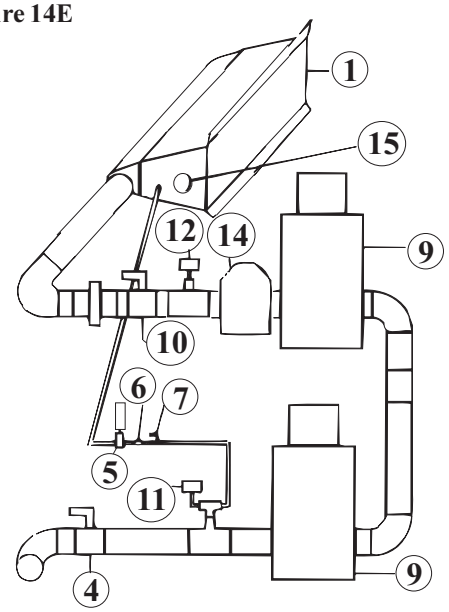
Option BM7: Optional manifold arrangement to meet FM requirements on outdoor units with filters and all indoor units. For inputs less than or equal to 750 MBH. Includes two fluid power valves instead of solenoid valves, high and low gas pressure switches, vent valve and a manual shutoff leak test valve (6" w.c. to 5 psi gas inlet pressure).

Figure 14D



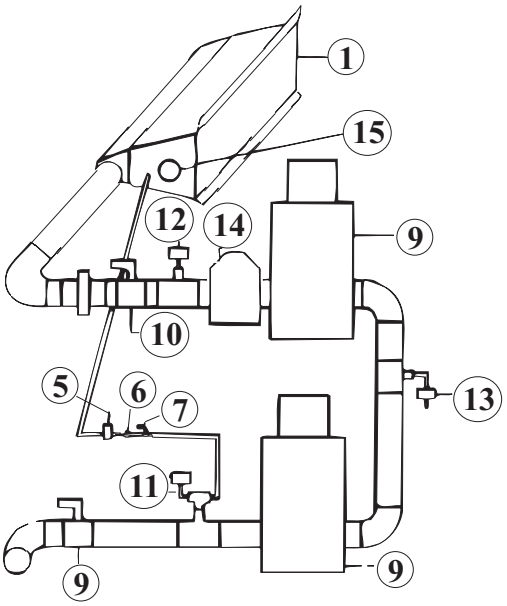
Option BM9: Optional manifold arrangement to meet ANSI requirements greater than 750 MBH. The pressure regulator and modulating valve are replaced with a combination pressure regulating, modulating valve The two solenoids are replaced by two fluid power valves, and a manual shutoff leak test valve is added.

Figure 14E



Option BM10: Optional manifold to meet IRI requirements on units with inputs greater than 750 MBH but less than 1,000 MBH and FM requirements on outdoor units without filers with inputs greater than 750 MBH. The standard pressure regulator and modulating valve are replaced by a combination pressure regulating, modulating valve, the two standard solenoid valves are replaced by two fluid power valves. A manual shutoff leak-test valve and two gas pressure switches are added.

Figure 14F



Option BM11: Optional manifold to meet IRI requirements on units with inputs greater than or equal to 1,000 MBH and FM requirements on all indoor units and outdoor units with filters with inputs greater than 750 MBH. The standard pressure regulator and modulating valve are replaced by a combination pressure regulating, modulating valve, the two standard solenoid valves are replaced by two fluid power valves, and a normally open vent solenoid valve. A manual shutoff leak-test valve and two gas pressure switches are added.

10. Air Pressure Switches

Location: Electrical Compartment (See Figure 6)

Depending on the air control options selected, there are two or four switches.

Figure 15 - Air Pressure Switch

• Low Air Pressure Switch

Function: The low air flow switch is a velocity pressure switch that monitors air flow across the burner. Until the air flow attains adequate volume for combustion, the switch remains open. When the switch recognizes adequate air volume, it closes, permitting both the pilot and burner to operate. Low pressure switch is normally open; it closes on pressure rise at .2" w.c. Do not alter or adjust setting.

• High Air Pressure Switch

Function: The high air flow switch is a velocity pressure switch that monitors air flow across the burner. If the high air flow switch senses air velocity above the prescribed limit, it will shutdown gas flow to the burner. High pressure switch is normally closed; it opens when pressure rises above .9" w.c. Do not alter or adjust setting.

Sensing Pressure Check: (requires a slope gauge, several feet of 1/4" O.D. tubing and two 1/4" O.D. barbed tees.)

Attach a slope gauge (0 to 1.0" scale) to the tubing connections in the control compartment. Disconnect plastic tubing from the high and low air pressure connections (mark tubing) in electrical control compartment. Connect slope gauge between the high and low pressure connections (Located in the gas control compartment, the high pressure connection is on the right, low pressure is on the left.)

A) If the system includes an optional discharge damper, before measuring burner differential air pressure, check to be sure that the damper is fully open. Turn the disconnect switch OFF. Check damper. If not fully open, adjust damper to the fully open position. Turn ON the disconnect switch.

B) With the blower operating, the pressure differential on the slope gauge should read between -.5" and -.65" w.c. If the slope gauge reading is within those limits, no adjustments are necessary.

If the slope gauge reading is not within the setpoint limits of the air flow switch(es) (.2" to .9" w.c.), and the system is operating, replace the air pressure switch(es).

If the slope gauge reading is not between -.5" and -.65" w.c., but within the setpoint limits, clean the sensing tubes (Follow the instructions in Maintenance Section, Paragraph 4).

C) When air pressure is within the proper range, turn the disconnect switch OFF. Disconnect the manometer and the slope gauge. Replace the caps removed to connect the slope gauge.

Service: If the pressure check determines that an air flow switch is not functioning properly, the switch cannot be serviced and must be replaced with an identical replacement. Low air pressure switch is P/N 86986; high air pressure switch is P/N 86987; bypass damper switches, P/N 87249 (normally closed, set to open at .5" w.c.) or P/N 87250 (normally open, set to close at .65" w.c.).

• Bypass Damper Air Pressure Switches

(systems with Air Control Options AR19, AR20, AR22, or AR23)

Function: With a bypass damper, the volume of outside air supplied to the building is adjusted by a manually set potentiometer (Option AR19 and AR22) or automatically by a pressure sensor switch (Option AR20 or AR23). With Options AR19 and AR20, the supply air is varied by adjusting the position of a damper at the blower discharge. With Options AR22 and AR23, a return air damper is adjusted to vary the volume of return air. The unit is arranged so that a fixed amount (25%) of the rated volume flows over the burner at a constant velocity. The remainder (75%) of the rated air volume flows either through a balancing bypass damper or a combination of bypass and return air damper. As the supply air volume is varied by the return air or discharge damper, the balancing damper is adjusted to maintain the required air velocity over the burner. Adjustment of the bypass damper is controlled by the bypass damper pressure switches. One pressure switch is normally closed with a setting of .5" w.c.; the other is normally open with a setting of .65" w.c.

11. Inlet Air Controls

Description: The system is equipped with one of five types of inlet air control arrangements (See Figure 19). All systems provide a constant flow of outside air across the burner at the required air volume (CFM).

Air Flow Dampers

Function: Dampers operate in response to controls to provide the rated flow of makeup air to the building.

Service: Clean dampers of dust or dirt.

Damper Motors

Function: Damper motors automatically actuate the return air, bypass, and/or discharge dampers in response to an electrical control device. Damper linkage connects the damper motor to the damper.

Service: There is no service required on these motors other than external cleaning. If the motors or linkage need replaced, replace with parts identical to the original factory parts.

Figure 16 - Example of a Damper Motor

Potentiometer

Function: The potentiometer is a manually set switch that operates either the discharge damper (Option AR19) or the return air damper (Option AR22) providing a mixture of return and outside air. It is remotely located switch that requires manual adjustment.

Service: If the potentiometer does not function properly, replace it with an identical switch.

Figure 17 - Potentiometer

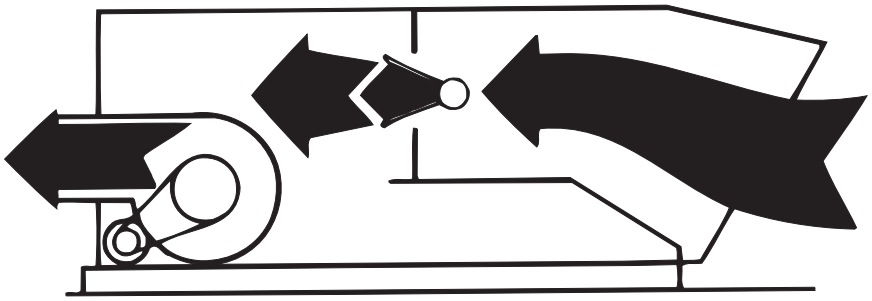
Pressure Null Switch (automatic building pressure sensor)

Description/Function: The pressure null switch is a diaphragm operated differential pressure switch used in makeup air applications to automatically control building pressure. It maintains a selected positive or negative pressure setpoint by changing the amount of outside air being introduced to the building through modulating outside air damper. As more pressure is required in the

Figure 18 - Pressure Null Switch (building pressure sensor)

(continued on page 12)

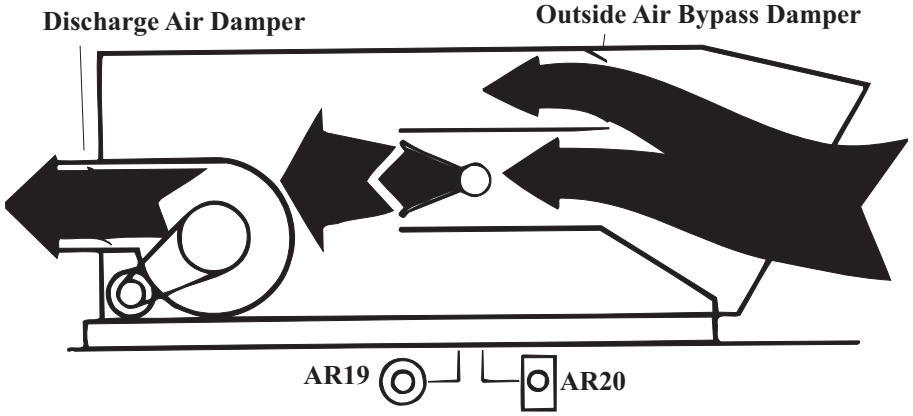
Figure 19 - Air Control Arrangements/Operation



Standard constant volume of 100% outside makeup air

Constant Volume of 100% Outside Makeup Air

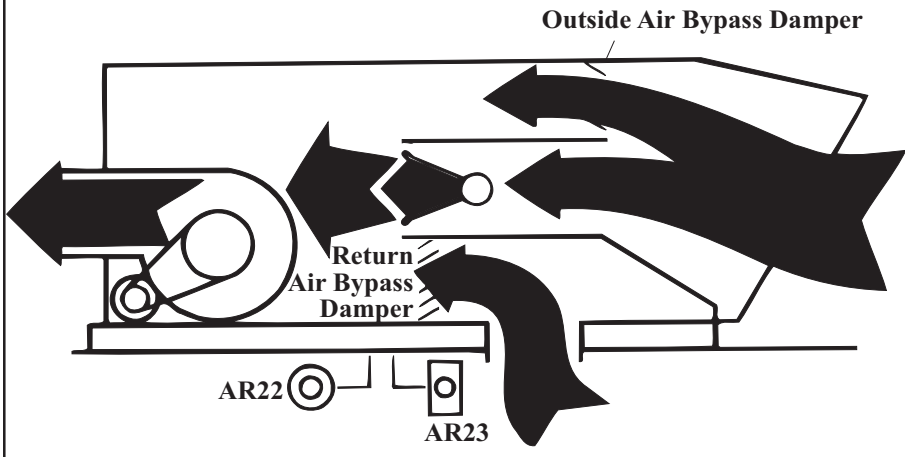
The **standard** air control arrangement provides 100% makeup outside air across the burner. Profile plates are factory set to provide constant air velocity across the burner at the required air volume (CFM). The airflow volume is monitored by the high and low pressure switches.



100% outside air makeup air with optional variable air volume from 25% to 100% controlled by a manually set potentiometer (Option AR19) or by an automatic building pressure switch (Option AR20)

Variable Volume (25% to 100% of Rated Airflow) of 100% Outside Makeup Air

This system allows for the amount of outside makeup air to be varied from 100% to 25% of rated air flow (CFM). The supply air is varied by adjusting the position of a discharge damper at the blower discharge. The system is arranged so that a fixed amount (25%) of the rated air volume (CFM) always flows over the burner at a constant velocity. The remainder (75%) of the rated air volume flows through a balancing bypass damper. As the supply air volume is varied by the discharge damper, the balancing damper is adjusted to maintain the required air velocity over the burner. Bypass damper airflow volume is monitored by the bypass damper air pressure switches.



A constant air volume made up of no less than 25% of outside air and varying portions of return and outside air as controlled by a manually set potentiometer (Option AR22) or by an automatic building pressure switch (Option AR23)

Constant Volume of Mixed Outside Air and Return Air

This system provides for a combination of outside air and recirculation air from the building. The system supplies a constant air volume with 25% of the rated air volume from outside air flowing over the burner. Both the return dampers and outside air dampers are in bypass positions (do not flow over the burner) and handle 75% of the rated air flow. Either a manually set potentiometer or an automatic building pressure sensor operates the return air damper to maintain the desired building pressure. The outside air damper operates as a balancing damper to reduce outside air as the volume of return air is increased. The outside air damper is monitored by the bypass pressure switches and is mechanically independent of the return air damper.

WARNING: Profile plates are factory set to match CFM requirements.
Do not adjust burner profile plates.
If a change in air volume is desired, contact a factory representative.

11. Inlet Air Controls (cont'd)

Pressure Null Switch (cont'd)

building, the pressure null switch activates the damper motor driving the outside air damper towards the full open position and the bypass return air damper towards the closed position. Conversely, as less pressure is required, the switch drives the dampers in the opposite direction.

Service: Clean the tubing and the screened ends of the pressure tap vents. Be sure that the switch is installed with the diaphragm in a vertical plane and that the pressure taps are sheltered from the wind. For further service, follow the manufacturer's instructions included with the switch.

12. Outside Air Cutoff Control

Location: Sizes 1-20, 1-40, 1-50, 1-65, 110, 112, 115, 118 - control in the electrical compartment, sensor at the air inlet; Sizes 2-80, 2-120, 3-180, 3-260, 122, 130 - control in the burner compartment, sensor at the air inlet

Function: After sensing pilot flame, the burner ignites at its lowest input rate. The "amount of heat" required to reach the desired discharge temperature also depends on the temperature of the incoming outside air. The outside air control is factory set at 60°F (adjustable 25-250°F). The burner reacts differently depending on the entering air temperature and the setting on the outside air control. The burner --

Figure 20 - Outside Air Cutoff Control

- may not ignite (pilot valve will not open),

  If the actual temperature of the outside air is above the setpoint on the outside air control, the burner will not ignite.

- may modulate to satisfy discharge setting,
- may shutdown, or

  Burner shutdown or modulating operation will depend on the temperature rise between the outside air and the discharge air setting.

- may remain on continuous low fire.

  If the outside air control is set too high, the burner will continuously burn on low fire as long as the control switch is set to "winter".

When the outside air control is set properly for the climate, the system blower will continue to provide the required makeup air (ventilation at the ambient outdoor temperature (burner not operating) even when the control switch is set to "winter".

Service: If the control does not function properly, replace it with an identical switch.

13. Dirty Filter Switch

Function: The dirty filter switch is a pressure switch that activates an indicator light on the remote console when the filters need cleaned or replaced (See Service Section, Paragraph 2). This switch is only on systems with an optional console that includes a dirty filter light. The pressure switch is set during installation so that the light will be activated at approximately 50% filter blockage. Contacts should close within a range of .17" to 5.0" w.c. ± .05" w.c.

Service: Clean the sensor tubes. If the dirty filter indicator system still does not function properly, check the setting of the switch. With clean filters in place, blower doors closed, and blower in operation, decrease the pressure setting by adjusting the set screw on the switch clockwise until the filter light is energized or screw is bottomed out. At that point, adjust the set screw three full turns counterclockwise or until the screw is top ended.

If it is determined that the switch needs replacing, use an identical switch. When a new switch is installed, connect the positive pressure tube (top or front of switch) to sense inlet side of filters. Connect the negative pressure tube (bottom or back of switch) to sense the airflow on the blower side of the filters. Follow the instructions above to set the switch.

14. Troubleshooting

Chart 1 - General Troubleshooting Guide (If system has Option BS2, lighted status board, see Chart 2)

Symptom or Problem	Cause and Remedy
Disconnect switch is closed; system is not starting	1. Fuses are missing or blown in disconnect switch - replace fuses. 2. Transformer not wired according to diagram - check wiring. 3. Secondary 8A fuse (on transformer) is missing or blown - replace fuse. 4. Optional control relay or door switch contacts are open - to test, jump terminals 3 to 4 or 1 to 2. 5. Optional firestat manual reset tripped - reset firestat control.
Disconnect closed, blower switch in test position, blower motor is not operating (Verify that causes in first block are not at fault.)	1. Optional freezestat relay contacts are open - checking setting on control. 2. End switch on damper motor not closed. - check end switch wiring. 3. Faulty damper relay - replace relay. 4. Damper motor miswired - rewire damper motor per wiring diagram. 5. Blower motor not wired correctly - check wiring diagram on motor. 6. Faulty motor starter - replace (check coil first). 7. Faulty blower motor relay - replace relay.
Disconnect closed; blower and burner switches in run position, blower motor is operating, but no pilot (ignitor is not becoming energized or beginning to glow) (Or, on a system with spark ignition, no spark)	1. Low air switch open - verify pressure drop at burner. 2. Faulty low air switch - replace pressure switch (P/N 86986). 3. High air switch open - verify pressure drop at burner. 4. Faulty high air switch - replace pressure switch (P/N 86987). 5. Tripped manual reset limit control(s) - reset manual control. 6. Faulty manual limit control(s) - replace limit control. 7. Outside air control contacts open - check setting on control. 8. Faulty burner enable relay - replace relay. 9. Low stage relay contacts are not closed - check air controller or thermostat setting. 10. Faulty low stage relay - replace relay.

Symptom or Problem (cont'd)	Cause and Remedy (cont'd)
Disconnect closed; blower and burner switches in run position, blower motor is operating, but no pilot (cont'd)	11. Optional low gas pressure switch contacts open - check setting on control; check gas pressure. 12. Faulty optional low gas pressure switch - replace gas pressure switch.
	13. Optional high gas pressure switch contacts open - check setting on control; check gas pressure. 14. Optional high gas pressure switch manual reset tripped - reset pressure switch manual reset. 15. Faulty optional high gas pressure switch - replace gas pressure switch.
	System with hot surface ignition 1. Faulty hot surface ignitor - check continuity at the ignition module. and circuit board. If reading is greater than 5-6 ohms, replace ignitor. 2. Faulty ignition module - replace entire module.
	System with spark ignition 1.Check voltage to spark ignitor and pilot valve. If no voltage present, check flame safeguard relay. If not voltage through the relay, replace relay. If voltage is not present to relay, test safety limits before relay. If voltage is present, check spark plug gap (3/32") or replace spark transformer. 2. Check cast iron burner end plate for flaking. Clean the end plate and the spark plug.
Disconnect closed; blower and burner switches in run position, blower motor is operating, but pilot is not proving	1. Air in the pilot gas line - bleed pilot line. 2. Inadequate pilot gas pressure. 3. Faulty pilot valve - replace pilot solenoid valve.
	System with hot surface ignition 1. Ignitor not reading 1.4A threshold - check voltage and current to ignitor. 2. Faulty hot surface ignitor - check continuity; replace ignitor. 3. Faulty ignition module - replace ignition module.
	System with spark ignition 1. Check microamps from flame sensor -- Model RA890F, 2-5; Model RA890G, 1.5-3; Model R7795A, 3.5-7.5; Model R7795B, 2-5 -- If microamps are within tolerance, replace the relay. If outside, adjust pilot. 2. Check flame safety limit. If open, replace limit.
Disconnect closed; blower and burner switches in run position, blower motor is operating, pilot flame is present and stable, but either the main gas valve will not open or the valve is rapid cycling	1. Microamp signal on flame rod is inadequate - check position and condition of flame rod and signal. 2. Grounding for unit or flame rod inadequate - check ground path. 3. Faulty main gas valve - replace main gas valve. 4. Faulty ignition module - replace ignition module. 5. Inadequate main gas pressure - verify main burner pressure.
Disconnect closed; blower and burner switches in run position, blower motor is operating, pilot flame is present and stable, low fire on the main burner is present and stable, but the unit will not progress to high fire	1. Faulty main gas valve - replace main gas valve. 2. Inadequate timing on high fire time delay relay - adjust setting. 3. Faulty high fire time delay - replace time delay relay. 4. High stage relay contacts are not closed - check control setting. 5. Inadequate main gas pressure - verify main burner gas pressure. 6. Pilot gas pressure too high - check and adjust. 7. Faulty high stage relay - replace relay.
Erratic Temperature Control	Maxitrol gas control system faulty. Refer to Maxitrol field service check list included with the heater.
Motor Failure	Improper supply voltage -- Check voltage and correct.
	Motor tripping on internal overload - check amperage; if outside of limits on the motor rating plate, replace motor.
	Motor overheating externally - check gas pressure; check air pressure; make required adjustments.
Low Air Pressure Switch Failure	Air sensing tubes blocked - clean tubes.

Chart 2 - General Troubleshooting Guide for System with an Optional Lighted Status Board

Symptom or Problem	Cause and Remedy
1. Disconnect switch is closed, but **"control circuit power"** light is ***not*** lit.	1. Fuses are missing or blown in disconnect switch - replace fuses. 2. Transformer not wired according to diagram - check wiring. 3. Secondary 8A fuse (on transformer) is missing or blown - replace fuse. 4. Indicator light is burned out - replace bulb (P/N 101889).
2. Disconnect switch is closed, but **"firestat normal"** light is ***not*** lit.	1. See causes and remedies for Problem 1 above. 2. Optional control relay or door switch contacts are open - to test, jump terminals 3 to 4 or 1 to 2. 3. Firestat option not ordered - verify order/wiring diagram. 4. Firestat manual reset tripped - reset firestat control.

(***continued on page 14***)

14. Troubleshooting (cont'd)

Chart 2 - General Troubleshooting Guide for System with an Optional Lighted Status Board (cont'd)

Symptom or Problem (cont'd)	Cause and Remedy (cont'd)
3. Disconnect closed, blower switch in test position, **"firestat"** light is lit, but **"freezestat"** light is ***not*** lit.	1. Freezestat option not ordered - verify order/wiring diagram. 2. Freezestat relay contacts are open - checking setting on control. 3. Indicator bulb is burned out - replace bulb (P/N 101889).
4. Disconnect closed, blower switch in test position, **"firestat"** and **"freezestat"** lights are lit, but **"starter energized"** light is ***not*** lit and the blower motor is not operating.	1. End switch on damper motor not closed. - check end switch wiring. 2. Faulty damper relay - replace relay. 3. Damper motor miswired - rewire damper motor per wiring diagram.
5. Disconnect closed, blower switch in test position, **"firestat", "freezestat"** and **"starter energized"** lights are lit, but the blower motor is not operating.	1. Blower motor not wired correctly - check wiring diagram on motor. 2. Faulty motor starter - replace (check coil first). 3. Faulty blower motor relay - replace relay.
6. Disconnect closed; blower switch in test position; **"firestat", "freezestat"** and **"starter energized"** lights are lit and the blower motor is operating; but the **"low air light"** is ***not*** lit.	1. Low air switch open - verify pressure drop at burner. 2. Indicator light is burned out - replace bulb (P/N 101889). 3. Faulty low air switch - replace pressure switch (P/N 86986).
7. Disconnect closed; blower switch in test position; **"firestat", "freezestat", "starter energized"** and **"low air"** lights are lit and the blower motor is operating; but the **"high air light"** is ***not*** lit.	1. High air switch open - verify pressure drop at burner. 2. Indicator light is burned out - replace bulb (P/N 101889). 3. High air switch option not ordered - verify order/wiring diagram. 4. Faulty high air switch - replace pressure switch (P/N 86987).
8. Disconnect closed; blower switch in test position; **"firestat", "freezestat", "starter energized", "low air"** and **"high air"** are lit; but the **"manual & auto limit normal"** light is ***not*** lit.	1. Indicator light is burned out - replace bulb (P/N 101889). 2. Tripped manual reset limit control(s) - reset manual control. 3. Faulty manual limit control(s) - replace limit control.
9. Disconnect closed; blower switch in test position; **"firestat", "freezestat", "starter energized", "low air", "high air"** and **"limit control normal"** lights are lit; but the **"outside air cutoff normal"** light is ***not*** lit.	1. Indicator light is burned out - replace bulb (P/N 101889). 2. Outside air cutoff control contacts open - check setting on control.
10. Disconnect closed; blower switch in test position; **"firestat", "freezestat", "starter energized", "low air", "high air", "limit control normal"** and **"ambient cutoff normal"** lights are lit; but the **"low gas pressure normal"** light is ***not*** lit.	1. Indicator light is burned out - replace bulb (P/N 101889). 2. Low gas pressure switch option not ordered - verify order/wiring diagram. 3. Low gas pressure switch contacts open - check setting on control. 4. Low gas pressure switch contacts open - check gas pressure. 5. Faulty gas pressure switch - replace gas pressure switch.
11. Disconnect closed; blower switch in test position; **"firestat", "freezestat", "starter energized", "low air", "high air", "limit controls normal", "ambient cutoff normal"** and **"low gas pressure normal"** lights are lit; but the **"high gas pressure normal"** light is ***not*** lit.	1. Indicator light is burned out - replace bulb (P/N 101889). 2. High gas pressure switch option not ordered - verify order/wiring diagram. 3. High gas pressure switch contacts open - check setting on control. 4. High gas pressure switch contacts open - check gas pressure. 5. Manual reset on switch tripped - reset pressure switch manual reset. 6. Faulty gas pressure switch - replace gas pressure switch.
12. Disconnect closed; blower and burner switches in run position; control switch is in **"winter" position; "control circuit power", "high gas normal"; "low gas normal"; "firestat normal"; "control switch energized"; "starter energized"** and **"freezestat normal"** lights are lit; but ignitor is not becoming energized or beginning to glow.	1. Lack of power at L1 on ignition module - ECO blown, find cause then replace ECO. 2. Faulty burner enable relay - replace relay. 3. Low stage relay contacts are not closed - check air controller or thermostat setting. 4. Faulty low stage relay - replace relay. 5. Faulty hot surface ignitor - check continuity at the ignition module and circuit board. If reading is greater than 5-6 ohms, replace ignitor. 6. Faulty ignition module - replace entire module.
13. Disconnect closed; blower and burner switches in run position; control switch is in "winter" position; **"control power", "high gas normal"; "low gas normal"; "firestat normal"; "system switch energized"; "starter energized"** and **"freezestat normal"** lights are lit; ignitor glowing but **"pilot valve normal"** light (thus the pilot valve) is not energized.	1. Ignitor not reaching 1.4A threshold - check voltage and current to ignitor. 2. Faulty hot surface ignitor - check continuity, replace ignitor. 3. Faulty ignition module - replace entire module.

Symptom or Problem (cont'd)	Cause and Remedy (cont'd)
14. Disconnect closed; blower and burner switches in run position; control switch is in "winter" position; **"control power"; "high gas normal"; "low gas normal"; "firestat normal"; "system switch energized"; "starter energized"** and **"freezestat normal"** lights are lit; ignitor has reached 1.4A and has opened the pilot valve bringing on the **"pilot valve normal"** light; but the pilot flame is not present. (After two trials the unit will go into safety lockout requiring cycling of the main disconnect switch.)	1. Air in pilot gas line - bleed pilot line. 2. Inadequate pilot gas pressure - verify pilot gas pressure (3.5" w.c.) 3. Faulty pilot valve - replace pilot solenoid valve. 4. Faulty ignition module - replace entire module.
15. Disconnect closed; blower and burner switches in run position; control switch is in "winter" position; all status lights are lit *except* **"main valve normal"** light. The pilot flame is present and stable, but the (low stage portion or) main gas valve will not open, or rapid cycling of the main valve is occurring.	1. Microamp signal on flame rod is inadequate - check position and condition of flame rod and signal (minimum 0.5 microamps required.) 2. Grounding for unit or flame rod inadequate - check ground path. 3. Faulty main gas valve - replace main gas valve. 4. Faulty ignition module - replace ignition module. 5. Inadequate main gas pressure - verify main burner pressure.
16. Disconnect closed; blower and burner switches in run position; control switch is in "winter" position; all status lights are lit; the pilot flame and low fire on the main burner are present and stable, but the unit will not progress to a high fire condition.	1. Faulty main gas valve - replace main gas valve. 2. Inadequate timing on high fire time delay relay - adjust setting. 3. Faulty high fire time delay relay - replace time delay relay. 4. High stage relay contacts are not closed - check control setting. 5. Inadequate main gas pressure - verify main burner gas pressure. 6. Faulty high stage relay - replace relay. 7. Faulty ignition module - replace entire module.
Erratic Temperature Control	Maxitrol gas control system faulty. Refer to Maxitrol field service check list included with the heater.
Motor Failure	Improper supply voltage -- Check voltage and correct.
	Motor tripping on internal overload - check amperage; if outside of limits on the motor rating plate, replace motor.
	Motor overheating externally - check gas pressure; check air pressure; make required adjustments.
Low Air Pressure Switch Failure	Air sensing tubes blocked - clean tubes.

REFERENCE: For troubleshooting information on the Maxitrol controls, refer to the manufacturer's literature covering that system. Component literature is included in the owner's envelope shipped with the unit.

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

Always comply with the combustion air requirements in the installation codes and operating instructions. The amount of air over the burner must be within the specified range. The burner profile plates are set at the factory to match CFM requirements. Do not adjust the burner profile plates without contacting a factory representative.

FAILURE TO PROVIDE PROPER COMBUSTION AIR CAN RESULT IN A HEALTH HAZARD WHICH CAN CAUSE PROPERTY DAMAGE, SERIOUS INJURY, AND/OR DEATH. Direct-fired installations should provide for air changes as required by the applicable installation codes.

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FOR SERVICE OR REPAIR, FOLLOW THESE STEPS IN ORDER:

FIRST: **Contact the Installer**

Name _____

Address _____

_____

_____

Phone _____

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

THIRD: **Contact** REZNOR®/Thomas & Betts Corporation
150 McKinley Avenue
Mercer, PA 16137
Phone: (724) 662-4400

Model No. _____

Unit Serial No. _____

Date of Installation _____

ISO 9001 QMI REGISTERED QUALITY SYSTEM

Thomas&Betts

MANUFACTURER OF HEATING, COOLING, AND VENTILATING SYSTEMS

(800) 695-1901; www.ReznorOnLine.com
1/02 YL Form 440OMS (Version A)