Adjustment, Start and Stop

4

In this chapter, you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

DANGER

- **The RatioMatic burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled, or maintained.**
- **Do not bypass any safety features. This can cause fires and explosions.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

Adjustment Procedure

If you are adjusting the burner system for the first time, then you must follow these steps:

Step 1: Reset the System

1. Set the low gas pressure switch to 20% below the "Main Gas Inlet Pressure" range as specified in the appropriate datasheet.
2. Set the high gas pressure switch to 20% above the "Main Gas Inlet Pressure" range as specified in the appropriate datasheet.
3. Close all the burner gas valves, manual and automatic.
4. Try to ignite the burner; be sure the flame monitoring system indicates a flame failure.
5. Activate the pressure switches and other limit interlocks. Be sure the switches fail as intended in the event of a power failure.

DANGER

- **If simulated limits or simulated flame failure do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.**

6. If the burner is firing into a duct or chamber with a circulating fan, start the fan to produce a full process air flow past the burner.
7. Adjust main gas inlet pressure to the ratio regulator within the range specified in the appropriate datasheet.

WARNING

- **Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.**
- **Pressure below the specified range can impair the ability of the ratio regulator to control the gas flow.**
- **Operating the system outside the specified range can cause excess fuel consumption and the possible accumulation of unburned fuel in the chamber. In extreme cases, this accumulation of unburned fuel may cause fires or explosions.**

8. Verify that the actuator opens the air BV towards the back of the burner as shown in Figure 4.1. If it doesn't, refer to the actuator's literature for instructions on how to reverse the direction.

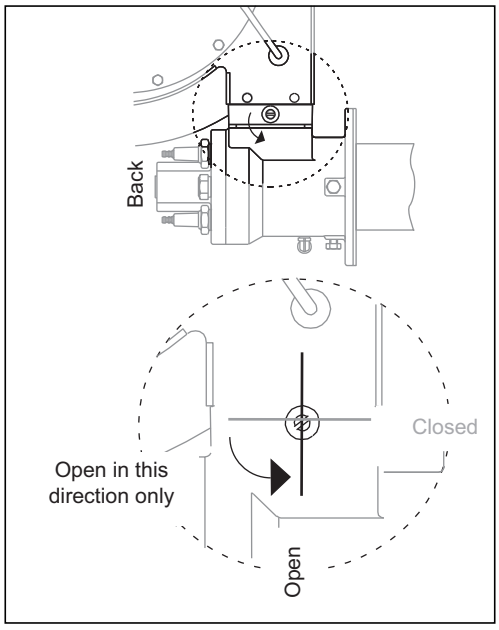

Figure 4.1. Air Butterfly Valve

Step 2: Set Low Fire Air

1. Start combustion air blower.
2. Drive control motor to low fire position.
3. Measure air differential pressure between tap “C” and combustion chamber. See the appropriate series 110, datasheet.

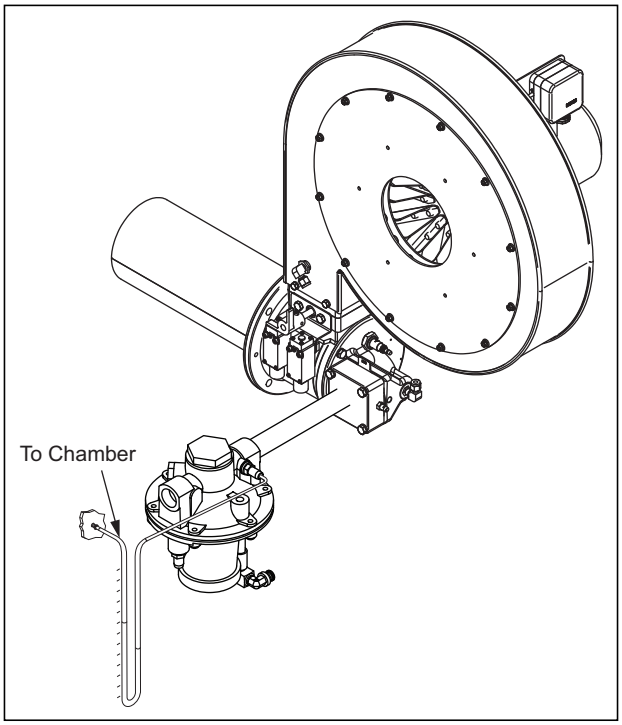

Figure 4.2.

NOTE (RM0050-RM0700): The pressure tap is in the open position when the screw inside the tap is unscrewed approximately 1/2 turn. Do not remove screw. Be sure to tighten pressure tap screw clockwise to the closed position after pressure measurements have been taken.

4. Set low fire air.
   a. For air control actuators that have a coupling with set screws, as shown in Figure 4.3, loosen the set screw ❶ on the burner side of the coupling ❷.

      For air controlled actuators that have a keyed or pinned coupling, as shown in Figure 4.4, please refer to the cam adjustment section of the actuator’s installation literature for instructions on releasing the cam’s low or off start position.

   b. There is a slot in the end of the butterfly valve shaft that is parallel to the air damper. This slot is used for visual indication of the butterfly valve position. The butterfly valve is closed when the shaft slot is perpendicular to the direction of air flow through the butterfly valve. See Figure 4.5

   c. Rotate the air butterfly valve shaft to a fully closed position. (Holes in the butterfly valve will supply low fire air.)

      When firing into a positive chamber pressure, rotate the air butterfly valve from the closed position in the direction of actuator travel to obtain a minimum
      0.3" w.c. (0,8 mbar) air differential pressure.

   d. For air control actuators that have a coupling with set screws, as shown in Figure 4.3, hold the butterfly valve firmly in place and tighten the set screw ❷.

      For air control actuators that have a keyed or pinned coupling, as shown in Figure 4.4, hold the butterfly valve firmly in place and re-engage the cam’s low or off starting position.

   e. High fire air adjustment is not required if the burner is firing into a neutral pressure chamber and a 90° travel control motor is used. It may be necessary to limit control motor stroke to less than 90° if firing into a large negative chamber. Contact Eclipse for further information.

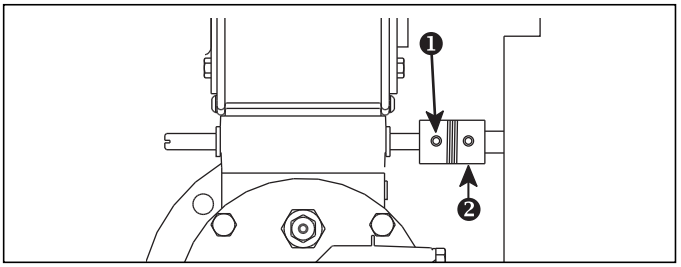

Figure 4.3. Actuator with Flexible Coupling

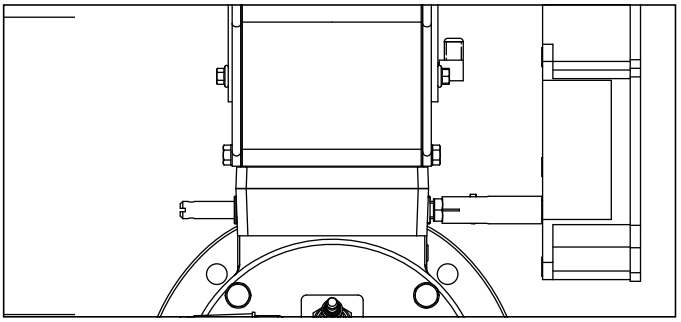

Figure 4.4. Actuator with Keyed Coupling

5. Verify high fire air:
   a. Drive control motor to high fire, full open.
   b. Compare the high fire air differential pressure between **Tap C** and the combustion chamber to the approximate datasheet chart “Air ∆p vs. Input”. If high fire air is insufficient, refer to section 5, “Troubleshooting & Maintenance”, in this document.

6. Return the control motor to the low fire position.
7. Close the pressure taps.

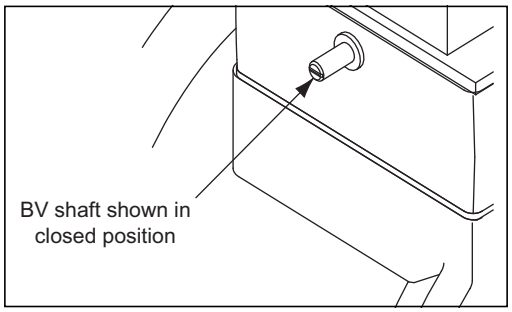

Figure 4.5. Air Butterfly Valve Shaft

NOTE: Steps 3-5 RM0050-RM0700 Only (see page 21 for RM1000-RM3000)

Step 3: Ignite the Burner (RM0050-RM0700 only)

WARNING

- **This procedure is written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

Determine system layout and use the applicable ignition procedure.

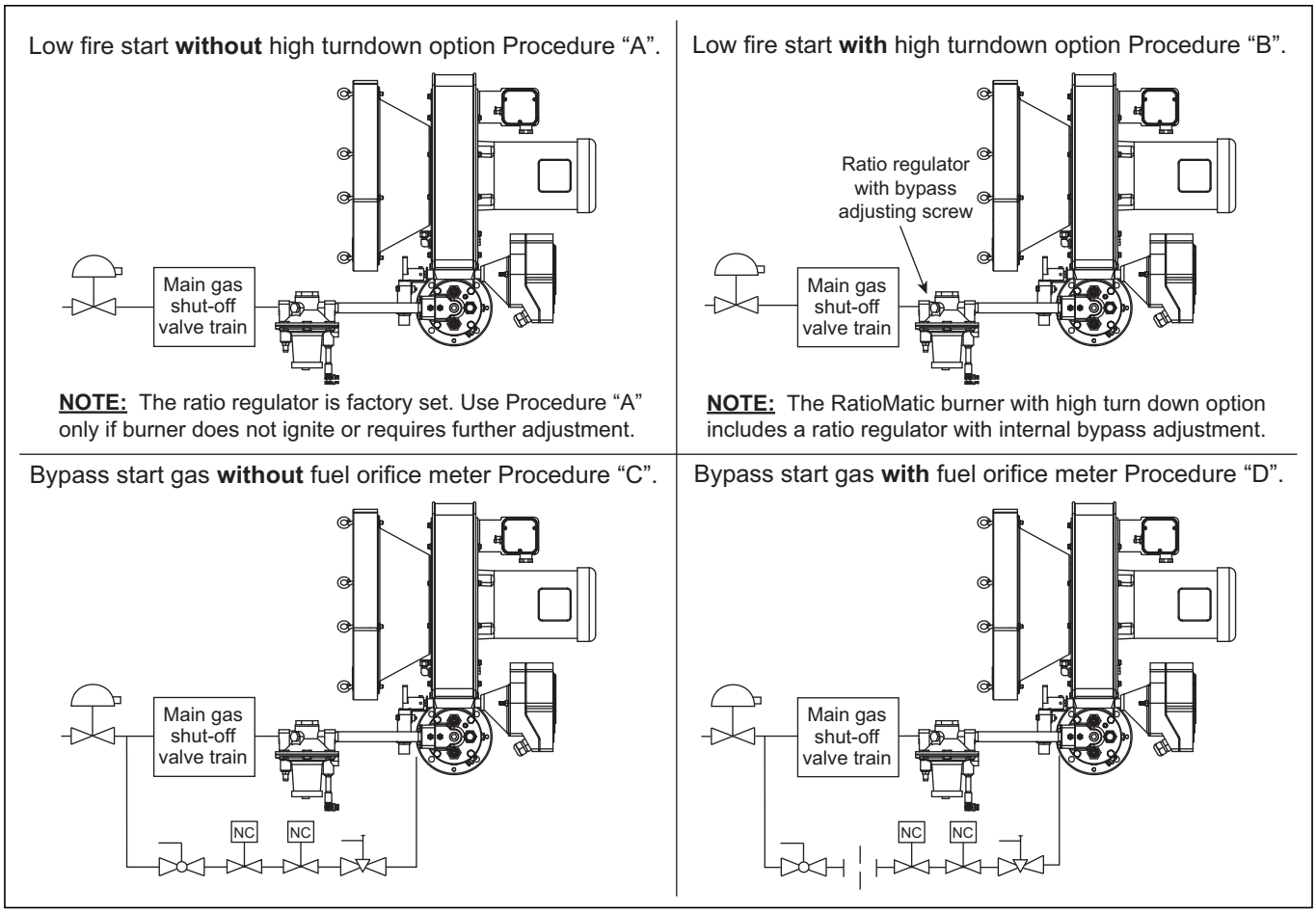

Figure 4.6.

Procedure A: Low fire start *without* high turndown option

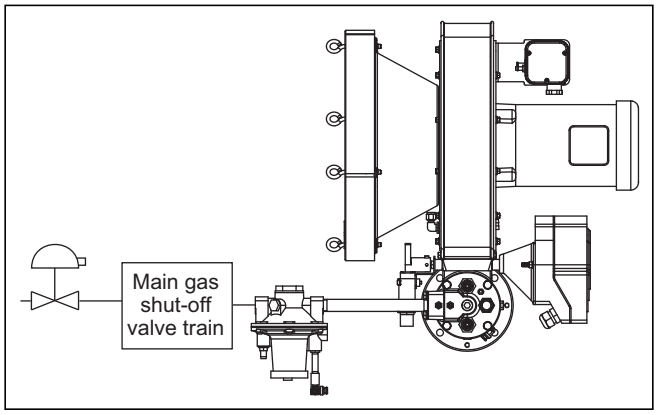

Figure 4.7. Procedure A

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.

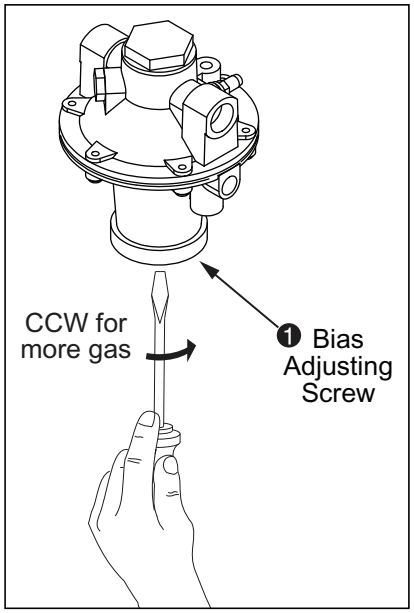

Figure 4.8. Ratio Regulator

3. Open main gas manual shut off valves.
4. Set system control to stay at low fire during and after ignition sequence.
5. Attempt to ignite burner.
6. If burner does not ignite:
   a. Attempt to ignite burner again to purge air from the gas piping.
   b. If burner still does not ignite, turn bias adjusting screw ❶ a half turn counterclockwise to increase gas flow.
   c. Attempt to ignite burner.
   d. Repeat steps **b** and **c** until burner ignites. If necessary, refer to Chapter 5 for troubleshooting tips.
7. Flame signal strength: Adjust gas flow with bias adjusting screw ❶ for lowest gas flow that maintains a stable flame signal:
   • counterclockwise, for more fuel
   • clockwise, for less fuel
8. Verify low fire flame:
   a. Shut off gas. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
   b. Restart combustion air blower and ignite burner.
   c. Verify repeatability of ignition and low fire flame signal.

Procedure B: Low fire start *with* high turndown option

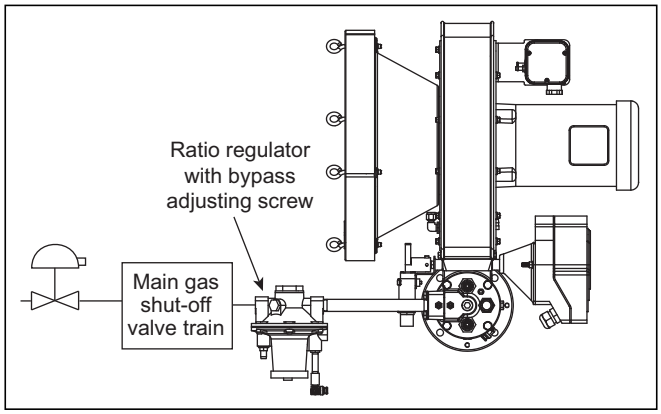

Figure 4.9. Procedure B

NOTE: The RatioMatic burner with high turndown option includes a ratio regulator with internal bypass adjustment.

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.
3. Open main gas manual shut off valves.

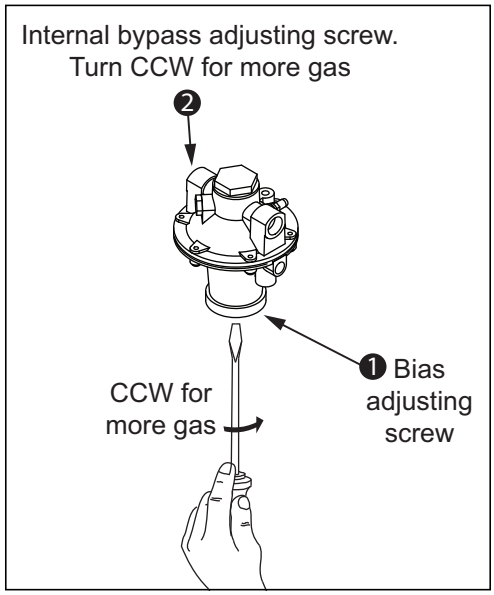

Figure 4.10. Ratio Regulator with Internal Bypass Adjusting Screw

4. Close internal bypass adjusting screw ❷ by turning it clockwise to closed position.
5. Set system control to stay at low fire during and after ignition sequence.
6. Attempt to ignite burner.
7. If burner does not ignite:
   a. Attempt to ignite burner again to purge air from the gas piping.
   b. If burner still does not ignite, turn bias adjusting screw ❶ a half turn counterclockwise to increase gas flow.
   c. Attempt to ignite burner.
   d. Repeat steps **b** and **c** until burner ignites. If necessary, refer to Chapter 5 for troubleshooting tips.
8. After burner ignites, slowly decrease gas flow with bias adjusting screw ❶. Decrease gas flow until the flame signal becomes erratic. (Refer to flame monitoring relay literature for a description of an erratic flame signal.)
9. If burner has gone out: Repeat ignition sequence. Turn internal bypass adjusting screw ❷ a half turn counterclockwise to increase gas flow at each attempt until burner lights.
10. Flame signal strength: Adjust gas flow with internal bypass adjusting screw ❷ for lowest gas flow that maintains a stable flame signal:
    • counterclockwise, for more fuel
    • clockwise, for less fuel
11. Verify low fire flame:
    a. Shut off gas. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
    b. Restart combustion air blower and ignite burner.
    c. Verify repeatability of ignition and low fire flame signal.

Procedure C: Bypass start gas *without* fuel orifice meter

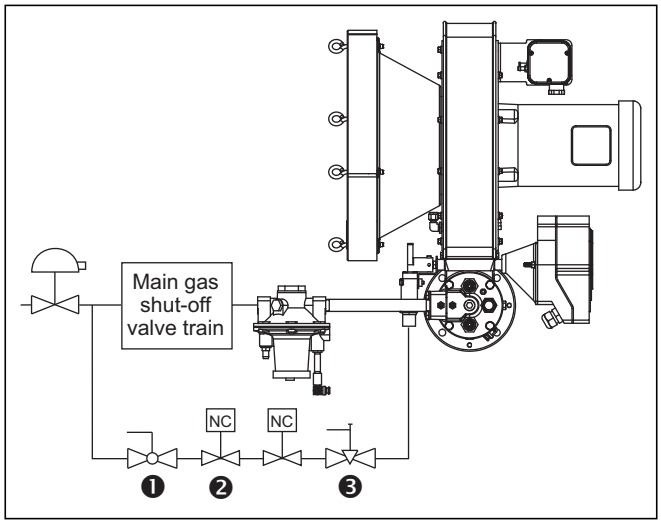

Figure 4.11. Procedure C

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.
3. Be sure main gas manual shut off valves are closed.
4. Open main gas manual shut off valve ❶ in the bypass.

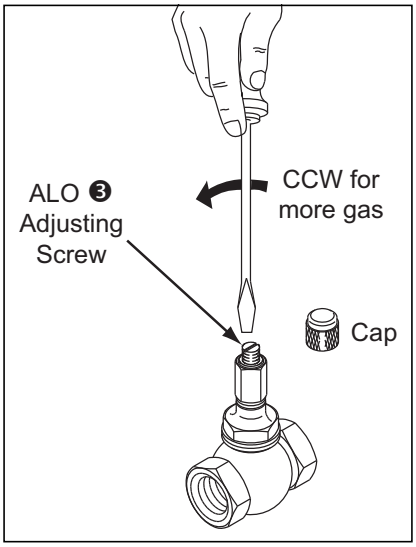

Figure 4.12. Adjusting Limiting Orifice (ALO)

5. Set the system to operate on bypass gas only.
6. Attempt to ignite burner by energizing spark and bypass gas solenoid valves ❷.
7. If burner does not ignite:
   a. Attempt to ignite burner again to purge air from the gas piping.
   b. If burner still does not ignite, turn ALO adjusting screw ❸ a half turn counterclockwise to increase gas flow.
   c. Attempt to ignite burner.
   d. Repeat steps **b** and **c** until burner ignites. If necessary, refer to Chapter 5 for troubleshooting tips.
8. Flame signal strength: Adjust gas flow ALO adjusting screw ❸ for lowest gas flow that maintains a stable flame signal:
   • counterclockwise, for more fuel
   • clockwise, for less fuel
9. Verify low fire flame:
   a. Shut off gas. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
   b. Restart combustion air blower and ignite burner.
   c. Verify repeatability of ignition and low fire flame signal.

Procedure D: Bypass start gas *with* fuel orifice meter

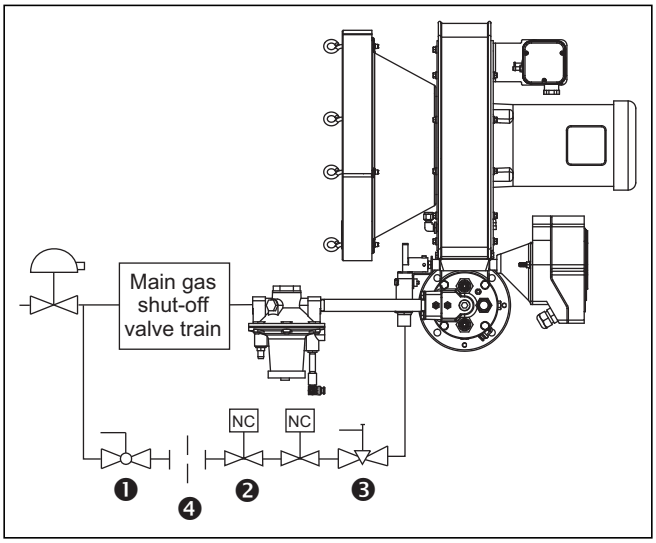

Figure 4.13. Procedure D

1. Drive control motor to low fire.
2. Be sure combustion air blower is running.
3. Be sure main gas manual shut off valves are closed.
4. Prepare to measure bypass gas flow at the fuel orifice meter ❹.
5. Open manual shut off valve ❶ in the bypass.
6. Set the system to operate on bypass gas only.
7. Attempt to ignite burner by energizing spark and bypass gas solenoid valves ❷.

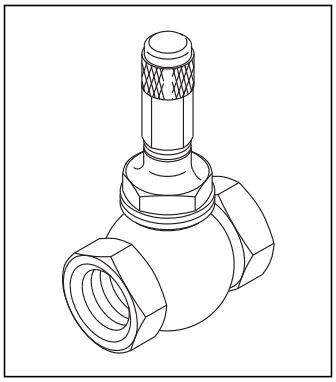

Figure 4.14. Adjusting Limiting Orifice (ALO)

8. If burner does not ignite:
   a. Attempt to ignite burner again to purge air from the gas piping.
   b. If burner still does not ignite, turn ALO adjusting screw ❸ a half turn counterclockwise to increase gas flow.
   c. Attempt to ignite burner.
   d. Repeat steps **b** and **c** until burner ignites. If necessary, refer to Chapter 5 for troubleshooting tips.
9. Adjust bypass gas flow with ALO adjusting screw ❸ to achieve the low fire gas flow indicated on datasheet. Refer to the fuel orifice meter literature for instructions on flow measurement.

NOTE: When firing into negative or fluctuating chamber pressures, a higher bypass gas flow may be necessary.

10. Verify the bypass gas flame:
    a. Shut off gas. When chamber temperature is below 250°F (121°C), shut off combustion air blower.
    b. Restart combustion air blower and ignite burner.
    c. Verify repeatability of ignition and low fire flame signal.

Step 4: Set Low Fire Gas (RM0050-RM0700 only)

(Only required if Bypass Start is Used)

⚠ WARNING

- **This procedure is written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system control and purge timing should not be bypassed.**

This step is only necessary when bypass start gas is used. Determine the piping method (low fire or bypass) and ratio regulator installed (standard or high turndown), and proceed with the applicable procedure:

Bypass Start Gas with Standard Turndown Ratio Regulator

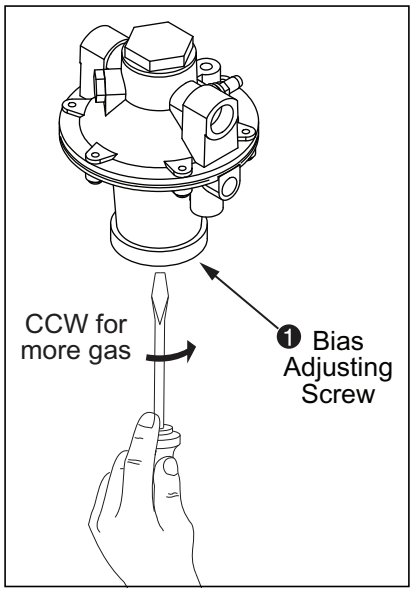

Figure 4.15. Ratio Regulator

1. Open all manual gas shut off valves.
2. Set system control to stay at low fire during and after ignition sequence.
3. Ignite the burner.
4. If burner goes out due to main gas flame failure, turn bias adjusting screw ❶ a half turn counterclockwise to increase gas flow. Repeat ignition sequence until burner lights.
5. Flame signal strength: adjust gas flow with bias adjusting screw ❶ for lowest gas flow that maintains a stable flame signal:
   • counterclockwise, for more fuel
   • clockwise, for less fuel
6. Verify low fire flame:
   a. Drive control motor from low fire and back. Verify low fire and stable flame signal are repeated.
   b. Turn the burner off and repeat the ignition sequence. Verify low flow and stable flame signal are repeated.

Bypass Start Gas with High Turndown Option

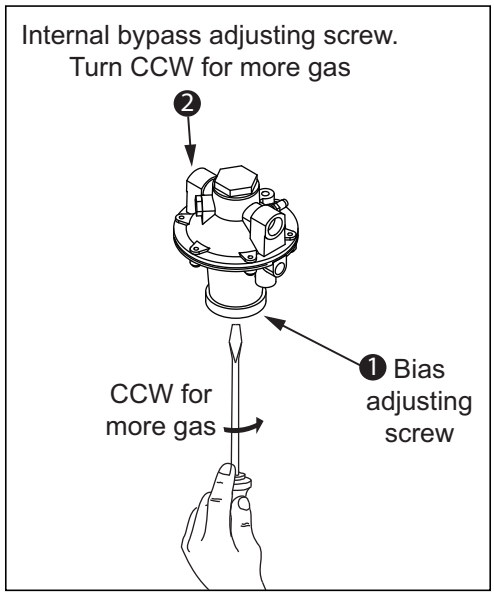

Figure 4.16. Ratio Regulator with Internal Bypass Adjusting Screw

1. Open all manual shut off valves.
2. Close internal bypass adjusting screw ❷ by turning it clockwise to closed position.
3. Set system control to stay at low fire during and after ignition sequence.
4. Ignite the burner.
5. If burner goes out due to main gas flame failure, turn bias adjusting screw ❶ a half turn counterclockwise to increase gas flow. Repeat ignition sequence until burner lights.
6. Slowly decrease gas flow with bias adjusting screw ❶. Decrease gas flow until the flame signal becomes erratic. (Refer to flame monitoring relay literature for a description of an erratic flame signal.)
7. If burner has gone out, repeat ignition sequence. Turn internal bypass adjusting screw ❷ a half turn counterclockwise to increase gas flow at each attempt until burner lights.
8. Flame signal strength, adjust gas flow with internal bypass adjusting screw ❷ for lowest gas flow that maintains a stable flame signal:
   - counterclockwise, for more fuel
   - clockwise, for less fuel
9. Verify low fire flame:
   a. Drive the control motor from low fire and back. Verify low fire and stable flame signal are repeated.
   b. Turn the burner off and repeat the ignition sequence. Verify low fire and stable flame signal are repeated.

Step 5: Verify Air Settings (RM0050-RM0700 only)

NOTE: There are no high fire gas adjustments or air adjustments when firing into a neutral chamber. However, air and gas pressures can be used to verify the burner system is properly adjusted.

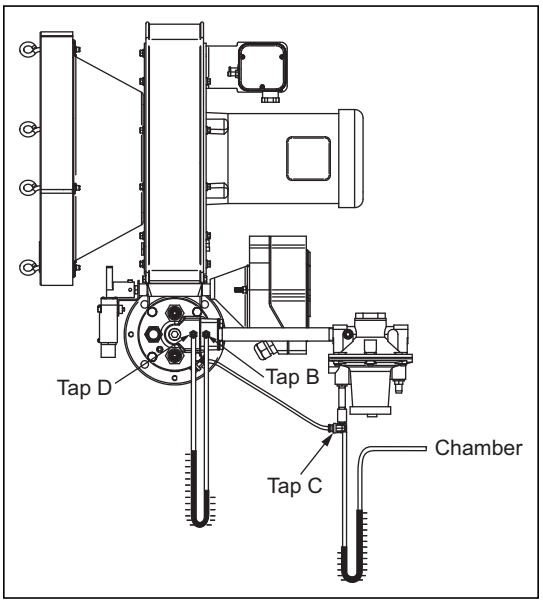

Figure 4.17. Setting Verification

1. With burner lit, drive control motor to high fire.
2. Wait for the chamber to reach normal operating conditions (e.g. chamber temperature, process flows, etc.).
3. Measure high fire fuel differential pressure between tap “B” and tap “D”. this to the “Fuel Orifice ΔP vs. Input” graph on the datasheet.
4. Measure high fire air differential pressure between tap “C” and the chamber. Compare this pressure to the “Air ΔP vs. Air Flow” graph on the datasheet.
5. Drive the control motor to low fire and verify low fire flame signal and flame appearance (if viewing).

NOTE: Gas pressure at low fire will be too low to measure and verify the fuel settings.

6. Cycle burner from high to low several times to check repeatability of settings.

7. Readjust burner if the settings do not repeat as expected. If necessary refer to Chapter 5, Maintenance & Troubleshooting.
8. Record all setup data as an aid for future troubleshooting and setup operations.
9. Stop the burner.

NOTE: Steps 3-5 RM1000-RM3000 Only (see page 15 for RM0050-RM0700)

Step 3: Adjust Pilot (RM1000-RM3000 only)

1. Drive the control motor to low fire and set the system to operate on pilot only
2. Turn the handle of the pilot adjusting cock open to light the pilot.
3. Turn the internal screw (Figure 4.18) counterclockwise to increase flow, clockwise to decrease flow, until the pilot gives reliable ignition and a steady flame signal with minimum pilot gas flow.

Step 4: Set High Fire Gas (RM1000-RM3000 only)

1. With the pilot lit and the control motor in the low fire position, open the main gas shut-off valve. The main flame should light.
2. Drive the control motor to its high fire position.
3. Measure the gas differential pressure as shown in Figure 4.19.
4. If necessary, adjust the gas flow with the butterfly valve. The flame should be clear blue. If the flame is yellow, see Troubleshooting, page 21.

Step 5: Adjust Low Fire Flame (RM1000-RM3000 only)

1. Return the control motor to the low fire position.
2. Check the combustion air differential pressure as discussed in Step 2.
3. Gas pressure drop across the burner will be too low to read reliably, but the flame should be clear blue, entirely within the firing tube, and tight on the burner head.
4. If necessary, adjust the ratio regulator bias screw as shown in Figure 4.20 to obtain the proper low fire flame. If the flame cannot be viewed, adjust the bias screw to produce the minimum gas flow that will generate a steady flame detector signal of sufficient strength.
5. After adjusting the low fire flame, return to high fire and check gas differential pressure as described in Step 4.

⚠ CAUTION

- **Do not turn the blower off until the chamber temperature is below 250°F (121°C). This will prevent hot gases from flowing back through the burner and blower and damaging them.**

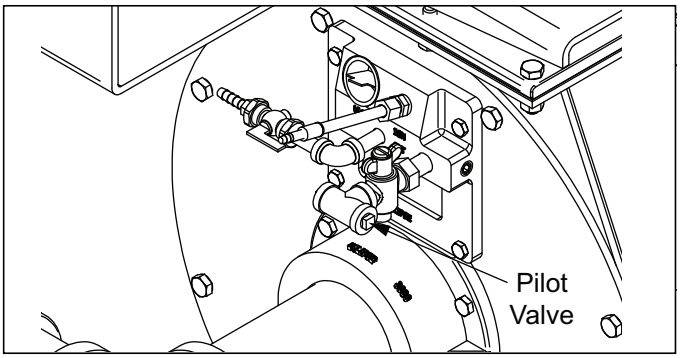

Figure 4.18. Pilot Valve Adjustment

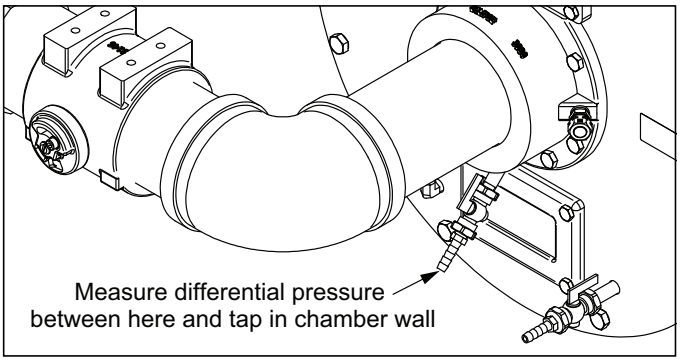

Figure 4.19. High Fire Differential Gas Pressure

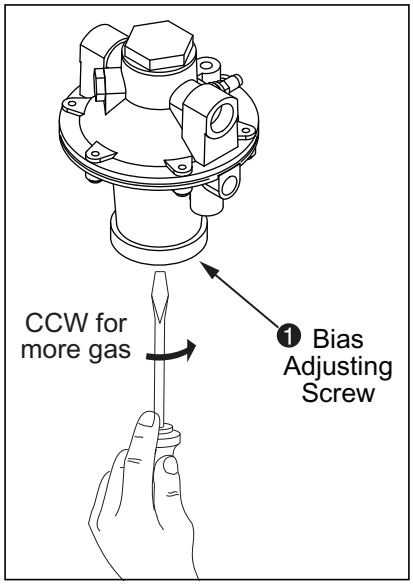

Figure 4.20. Ratio Regulator

Maintenance and Troubleshooting

5

This section is divided into two parts. The first part describes the maintenance procedures, and the second part helps you to identify problems that may occur and gives advice on how to solve these problems.

Preventative maintenance is the key to a reliable, safe and efficient system. The following are suggested guidelines for periodic maintenance. Burners in severe environments or operational conditions should be checked more frequently.

NOTE: The monthly and yearly lists are an average interval. If your environment is dirty, then the intervals may be shorter. Check with local authorities having jurisdiction on their recommended maintenance schedules.

Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness.
2. Check for proper air/gas pressures (refer to the RatioMatic Datasheets, Series 110).
3. Test all the system alarms for proper response signals.
4. Check and clean igniter electrodes.
5. Check the air control valve for smooth, trouble free operation and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test the interlock sequence on all safety equipment. Manually force each interlock to intentionally fail while at the same time noting if related equipment closes or stops as specified by the manufacturer. Test the flame safeguard by manually shutting off the gas to the burner.
8. Test the manual gas shut off cocks for proper operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure settings and comparing these with the actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Clean and inspect all burners.
6. Remove and clean the orifice plate ❹, see Figure 5.1.
7. Be sure the following components are not damaged or distorted:
   - the burner nozzle
   - the igniter
   - the flame sensors
   - the combustion tube or block

The nozzle and combustion tube/block can be inspected without removing the burner from the chamber wall or entering the chamber. See Figure 5.1. Perform the following:

a. Shut the burner off and manually close the main gas shut off cocks.

b. Allow the chamber temperature to cool down to 250°F (121°C).

c. Disconnect the gas piping at a union or the gas inlet flange ❶ provided on the burner.

d. Remove the rear cover bolts ❷.

e. Remove the rear cover ❸ from the burner housing ❺.

f. To re-assemble, follow this sequence in the reverse order.

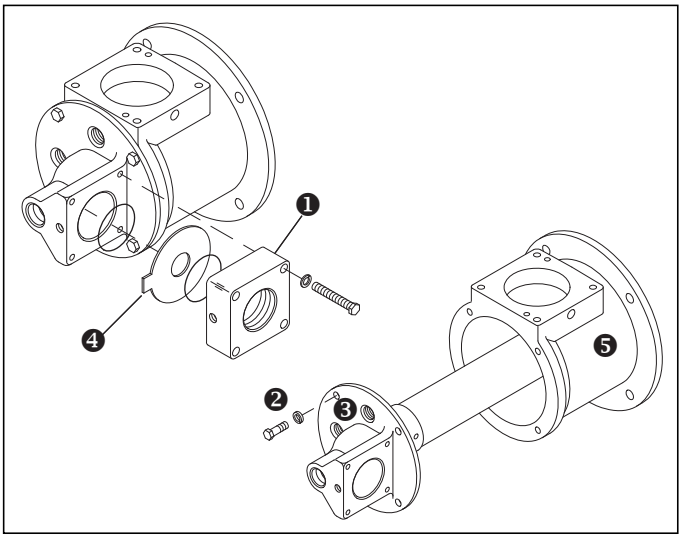

Figure 5.1.

Troubleshooting

Problem	Possible Cause	Solution
Start-up sequence runs but burner does not light.	No ignition: There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	No ignition: Open circuit between the ignition transformer and the igniter.	Repair or replace the wiring of the igniter.
	No ignition: The igniter needs cleaning.	Clean the igniter.
	No ignition: The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. **NOTE:** Do not apply grease to the threads on the igniter.
	No ignition: Igniter insulation is broken. Igniter is grounding out.	Inspect the igniter, replace if broken.
	Not enough gas: The gas pressure going into the ratio regulator (RM0050-RM0700) or pilot regulator (RM1000-RM3000) is too low.	Check the start-up settings. Measure the gas pressures and adjust where necessary.
	Not enough gas: The impulse line to the ratio regulator is leaking.	Repair any leaks.
	Not enough gas: The pilot adjusting valve or bypass valve is not open far enough.	Adjust bypass or low fire gas.
	Not enough gas: Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace it if necessary.
	Not enough gas: Gas valve does not open.	Check the wiring to the automatic gas shut-off valve. Check the output from the flame safeguard. Open manual gas cock.
	Not enough gas: Ratio regulator is incorrectly set.	Adjust the ratio regulator to the proper setting.

Problem	Possible Cause	Solution
Start-up sequence runs but burner does not light (Continued)	No flame signal: Broken flamerod or dirty UV scanner lens.	Inspect and clean sensor. Replace if necessary.
	No flame signal: Spark plug and flamerod reversed.	Exchange spark plug / flamerod or their wiring.
	Too much gas: Wrong or missing burner fuel orifice.	Check RatioMatic Datasheets, Series 110 for fuel orifice and given fuel.
The low fire flame is weak or unstable.	Not enough gas flowing to the burner.	Adjust the ratio regulator to increase the gas flow.
	Not enough air.	Check for proper blower rotation. Check air filter for blockage. Compensate for chamber by opening the low fire air butterfly valve position.
	Flamerod is directly beneath the combustion air inlet.	Swap the flamerod with the spark rod so that the flamerod is 180° from the combustion air inlet.
The burner goes out when it cycles to high fire.	Not enough gas pressure into the ratio regulator.	Check the start-up settings. Measure the gas pressures and adjust them where necessary. Check for valve train pressure loss.
	Loading line to the ratio regulator is leaking.	Repair the leak in the loading line.
	Pilot set too lean, becoming unstable as air increases.	Increase pressure into the pilot regulator.
	Main gas adjusting valve not open enough.	Increase valve opening.
	Suction or back pressure in chamber fluctuates, upsetting pilot stability.	Cross-connect pilot regulator vent to the combustion chamber, but not via the burner air pressure tap.
The burner is erratic and does not respond to adjustment.	Internal damage to the burner: Some parts inside the burner are loose, dirty, or burned out.	Contact Eclipse for further information.
The burner is unstable or produces soot, smoke, or excessive carbon monoxide.	The air/gas ratio is out of adjustment.	Measure all the gas pressures and air pressures. Compare these pressures to the documented initial start-up settings and adjust them where necessary.
The burner cannot achieve full capacity.	Air filter is blocked.	Clean or replace the air filter.
	Gas pressure going into the ratio regulator is too low.	Adjust the gas pressure.

Problem	Possible Cause	Solution
Cannot initiate a start sequence.	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	High gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Malfunction of the flame safeguard system (e.g. shorted out flame sensor or electrical noise in the sensor line).	Have a qualified electrician troubleshoot and correct the problem.
	No power to the control unit.	Have a qualified electrician troubleshoot and correct the problem.
	Main power is off.	Be sure the main power to the system is switched to the “on” position.
Main flame too long and yellow at high fire.	Gas flame is too high.	Gas butterfly valve is open too far or main gas regulator spring is screwed in too far.
Main flame too short at high fire.	Gas flow is too low.	Gas butterfly valve is closed too far, or main gas regulator spring is screwed out too far.
Low fire (pilot) flame is too long, soft or yellow.	Too much gas flow.	Main gas proportionator spring is set for too much flow, or pilot gas cock adjustment is open too far.
		Insufficient air flow due to dirty blow filter or impeller.