NOTE: It is recommended that there is a run of pipe with a length of at least 10 pipe diameters between any flow altering device and the metering orifice on the burner.

Automatic Butterfly Valve

An automatic butterfly valve is driven by an actuator (actuator and mounting bracket not illustrated).

- Install the control valve in accordance with Bulletin/ Info Guide 720.

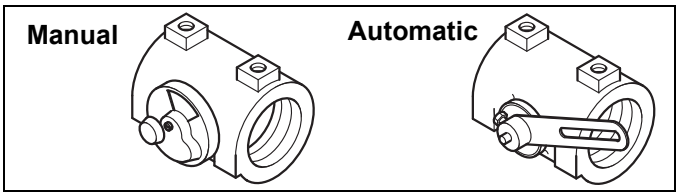


Figure 3.24 Butterfly Valves

Ratio Regulator

Connect an impulse line to the ratio regulator and to the air supply line.

NOTE: The inlet gas pressure to the ratio regulator must be higher than the impulse line pressure at high fire condition.

Checklist After Installation

To verify proper system installation, do the following:

1. Ensure there are no leaks in the gas lines and the air lines.
2. Ensure all the components of the flame monitoring control system are properly installed. This includes verifying that all switches are installed in correct locations and all wiring, pressure and impulse lines are properly connected.
3. Ensure components of spark ignition system are installed and functioning properly.
4. Ensure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.
5. Ensure all valves are installed in proper location and correctly oriented relative to the gas or air flow direction.

Prepare for Adjustment

After installation of the burner system components is complete, the following steps should be followed in order to prepare for adjustment:

1. Set the air pressure switches.
2. Close all the burner gas cocks.
3. Try to light a burner before the purge and other timers have finished their cycles. Make sure that the flame monitoring system indicates a flame failure.
4. Trip out pressure switches and other limit interlocks. Make sure that the main gas valve train closes.

⚠ DANGER

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

Inner Tube Sections for Effective Lengths

Table 3.2 Metallic and Ceramic Outer Tubes						
Effective Lengths (mm)	SER 450		SER 600		SER 800	
	Short (185mm)	Long (235mm)	Short (185mm)	Long (235mm)	Short (185mm)	Long (235mm)
800	3	1	-	-	-	-
850	2	2	-	-	-	-
900	1	3	1	3	2	2
950	0	4	0	4	1	3
1000	3	2	3	2	0	4
1050	2	3	2	3	3	2
1100	1	4	1	4	2	3
1150	0	5	0	5	1	4
1200	3	3	3	3	0	5
1250	2	4	2	4	3	3
1300	1	5	1	5	2	4
1350	0	6	0	6	1	5
1400	3	4	3	4	0	6
1450	2	5	2	5	3	4
1500	1	6	1	6	2	5
1550	0	7	0	7	1	6
1600	3	5	3	5	0	7
1650	2	6	2	6	3	5
1700	1	7	1	7	2	6
1750	0	8	0	8	1	7
1800	3	6	3	6	0	8
1850	2	7	2	7	3	6
1900	1	8	1	8	2	7
1950	-	-	0	9	1	8
2000	-	-	3	7	0	9
2050	-	-	2	8	3	7
2100	-	-	1	9	2	8
2150	-	-	0	10	1	9
2200	-	-	3	8	0	10
2250	-	-	2	9	3	8
2300	-	-	1	10	2	9
2350	-	-	0	11	1	10
2400	-	-	3	9	0	11
2450	-	-	2	10	3	9

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. Read all of this chapter before starting the system.

⚠ DANGER

- **The SER 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 feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

Adjustment Procedure

Step 1: Reset the System

1. Close the automatic gas valves and gas cocks.
2. Fully open the manual air butterfly valve at each burner.
3. Set the zone air control valve to maximum air flow.
4. Start the blower.

NOTICE

- **Make sure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.**

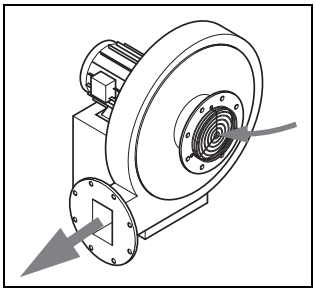


Figure 4.1. Correct Blower Rotation

Step 2: Set High Fire Air

1. With gas cocks remaining closed and the system at maximum airflow, use the air curves from the appropriate SER datasheet to find the differential air pressure needed at high fire. This is now the target value for high-fire.
2. Set high-fire air.

NOTE: The pressure tap is in the open position when the screw inside the tap is unscrewed approximately 1/2 turn. Do not remove screw.

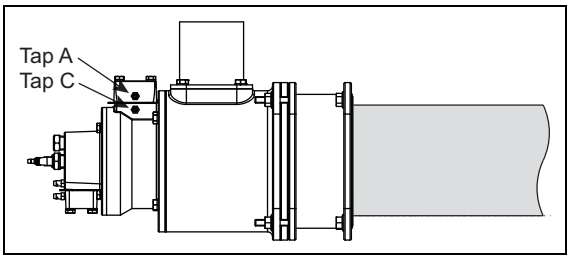


Figure 4.2. Air Taps

Burner System:

a. Adjust the zone air control valve to achieve the target differential air pressure between taps A and C for the first burner. (See Figure 4.2.)

b. Measure and note the differential air pressure across the remaining burners in the zone.

c. If all the measured differential pressures are within 0.3" w.c. (0.75 mbar) of each other, proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it will be necessary to adjust the manual control valve at each burner to improve balance.

NOTE: Be sure to tighten pressure tap screw clockwise to the closed position after pressure measurements have been taken.

3. Repeat step 2 for other zones (if applicable).

Step 3: Set Low-Fire Air

(For High/Low Pulse Only)

1. Set the system to low-fire by closing the burner main air valve and adjusting the low fire air bypass control valve. Set the low fire air ΔP to 0.3" - 0.4" w.c. (0.75 - 1.0 mbar). This is the initial setting only. Further adjustment may be necessary.
2. Repeat step 2 for all burners (if applicable).

Step 4: Verify the Air Settings

Cycle the system between low and high-fire several times, verifying that all settings remain the same.

Step 5: Ignite the Burners

Manual Ignition Steps:

NOTE: Manual ignition is the recommended start procedure for cold start-up.

1. Set the zone air control valve to maximum air flow.
2. Verify burner air valves are open. (Closed with only bypass open for high/low pulse.)
3. Make sure the combustion air blower is running.
4. Set the manual gas valve at each burner to 50% open. See Figure 4.3. If using an adjustable limiting orifice valve, set it at 5 full 360° rotations up from the bottom.

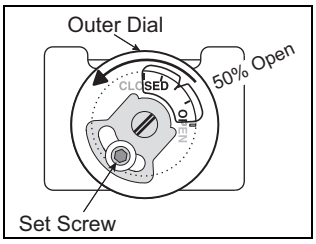


Figure 4.3. Manual Gas Butterfly 50% Open

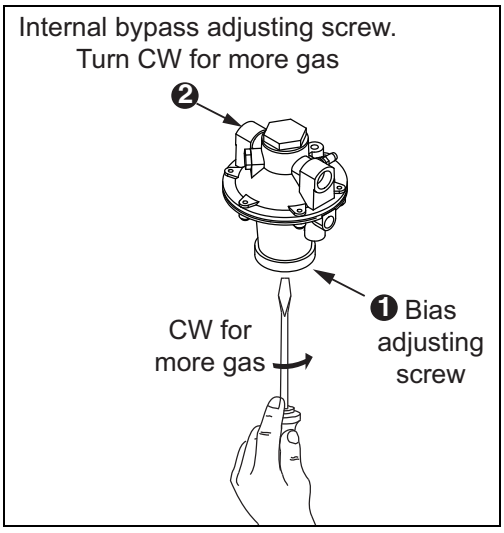


Figure 4.4. Adjusting Set Screw

5. Open the zone manual gas cock.
6. Start ignition transformer.

⚠ DANGER

- **To avoid the risk of electrical shock, do not touch the ignition plug or the ignition wire when the igniter is energized.**

7. Open burner manual gas cock. Burner should ignite.
8. If burner does not ignite in 3 seconds, close gas cock.
9. Wait at least 30 seconds for purge and repeat Step 6.
10. If the burner fails to light after the second attempt, adjust ratio regulator clockwise 1-2 turns and repeat Step 6.
11. Terminate ignition transformer.
12. Open main air valve for high/low pulse only.
13. Repeat steps 5 through 10 for all burners in the zone.

⚠ WARNING

- **These procedures are written with the assumption that each burner is connected to a flame monitoring control system that is installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

Automatic Ignition Steps:

1. Set the zone air control valve to maximum air flow.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% open. See Figure 4.3. If using an adjustable limiting orifice valve, set it at 5 full 360° rotation up from the bottom.
4. Open the zone manual gas cock.
5. Open the manual gas cock at each burner.
6. Initiate the ignition sequence through the flame monitoring system (check for flame, initiate spark, open gas solenoid, trial time, check for flame).
7. Check that all the burners in the zone have ignited.
8. If the burner fails to light after repeated attempts, adjust ratio regulator clockwise 1-2 turns and repeat Step 6.
9. If a gas solenoid valve is fitted at each burner, repeat Step 6 for each burner in the zone.

Step 6: Set High Fire Gas

1. With the burners lit, open main air valve.
2. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not

exceed the maximum pressure rating of the ratio regulator.

WARNING

- **Insufficient gas inlet pressure may cause the ratio regulator to remain fully open as the burner system turns down from high fire, causing excess fuel operation and the possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.**

3. Use the gas curve from the appropriate SER datasheet for the gas and orifice plate being used to find the differential gas pressure needed at high fire. This is the target value for high fire.
4. Adjust the high fire gas flow by adjusting the manual gas balancing valve until the pressure differential across the gas orifice between tap B and tap D is at the target value. (See Figure 4.5.)

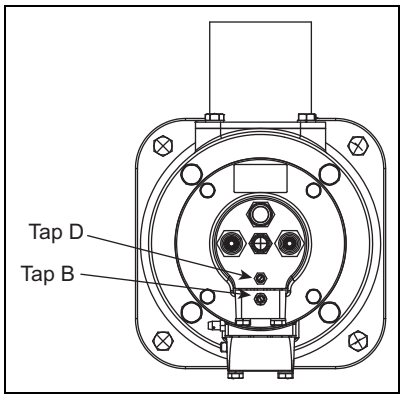


Figure 4.5. Set High Fire Gas

NOTE: Be sure to tighten pressure tap screw clockwise to the closed position after pressure measurements have been taken.

5. Repeat step 3 for the other burners in the zone.
6. Bring furnace temperature to operational level.
7. Verify high-fire air pressure differential (Step 2a page 16). Adjust zone manual air valves if necessary to obtain correct levels or manual valves to restore balance between burners.
8. Fine adjust the gas balancing valves to obtain 3% to 5% O_2 in the exhaust gas.

NOTE: Lower than recommended O_2 levels may result in premature wear of burner components. Higher than recommended O_2 levels will result in reduced efficiency.

9. Repeat Steps 7 & 8 for other burners in the zone.

Step 7: Set Low Fire Gas
(High/Low Pulse Only)

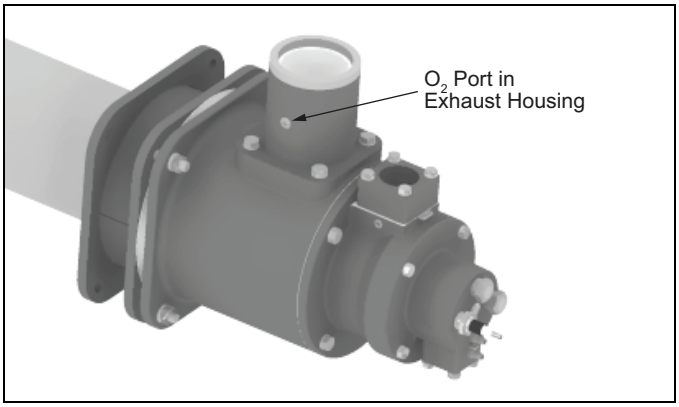


Figure 4.6. Set Low Fire Gas

1. Leave the air bypass valve open and close the main air valves.
2. Adjust the ratio-regulator to achieve 12% to 15% O_2 in the exhaust gases. Turning the adjusting screw counter-clockwise lowers gas flow and increases O_2 reading.
3. As the initial air ΔP setting may provide a wide range of air flows depending on burner model and orifice size, it may be necessary to lower the air flow from the initial setting if additional turn-down is required (while maintaining 12% - 15% O_2 in the exhaust gas).

NOTE: The main objective of setting low fire is to provide a clean stable flame with a reliable flame signal. For tubes < 60 inches (1500 mm) in length, slightly higher O_2 levels are recommended. Lower than recommended O_2 levels may result in over-heating of internal burner components.

Maintenance and Troubleshooting

5

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

Maintenance

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance system is a list of periodic tasks.

NOTE: These are guidelines only. The customer should make the final determination on maintenance intervals and tasks to be performed while considering the working environment.

Monthly Checklist

1. Inspect flame sensing devices for good conditions, and cleanliness.

2. Check for proper inlet air/gas ratios (refer to the SER datasheets, series 325).

3. Test all the alarm systems 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. Leak test the safety shut-off valves for tightness of closure.

2. Test the pressure switch settings by checking the switch movements against pressure settings and comparing these with the actual impulse pressure.

3. Visually check igniter cable and connectors.

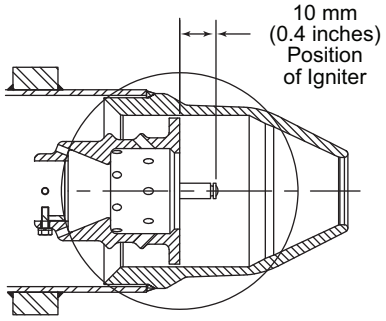
4. Inspect impulse line for leaks.

5. Be sure the following components are not damaged or excessively dirty:
   - the burner nozzle
   - the igniter
   - the flame sensors
   - the inner and outer tubes

6. Rotate metallic outer tubes 180°.

NOTE: Burner nozzle can be inspected by removing the rear cover assembly shown on page 11. Inspection of the inner tube sections and outer tube can be done by removing the burner assembly from the mounting extension or furnace. This can be done by reversing the steps on page 8.

Troubleshooting Procedures

Problem	Possible Cause	Solution
Start-up sequence runs but does not light, no ignition 	There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	Open circuit between the ignition transformer and the ignition rod.	Repair or replace the wiring to the ignition rod.
	The igniter needs cleaning.	Clean the igniter.
	The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. Do not use grease on the threads on the igniter.
	Igniter insulator is broke. Igniter is grounding out.	Inspect the igniter. Replace if broken.
	Ignitor in wrong position.	Check that the igniter extends the proper distance beyond the nozzle face. See illustration on the left.
Start-up sequence runs but does not light, not enough gas	The gas pressure going into the ratio regulator is too low.	Check the gas pressure out of the main gas regulator and adjust if necessary.
	The impulse line to the ratio regulator is leaking.	Repair any leaks.
	Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace if necessary.
	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.
	Air in the gas line.	Repeat the start attempt several times to purge air from the gas line.
Start-up sequence runs but does not light, too much gas	Gas pressure out of ratio regulator is too high.	Check the gas pressure out of the main gas regulator and adjust if necessary.
	Improper component piping sequence.	Make sure solenoid valve is down stream of ratio regulator.
	Gas BV too far open (high fire).	Check for proper setting.
	Ratio regulator adjustment (low fire).	Check for proper setting.
Start-up sequence runs but does not light, no flame signal	Dirty UV scanner lens.	Inspect and clean sensor. Replace if necessary.
The low fire flame is weak or unstable	Not enough gas flowing to the burner.	Adjust the ratio regulator.
	Not enough air.	Adjust the air control valve to increase low fire air flow.

Problem	Possible Cause	Solution
The burner goes out when it cycles to high fire	Insufficient air.	Check start-up settings. Check air filter, clean or replace if required.
	Insufficient pressure into ratio regulator.	Adjust pressure settings on main gas regulator or change spring.
	Main gas adjustable valve not open enough.	Adjust the main gas adjustable valve.
	Marginal air pressure switch setting.	Adjust air pressure switch setting.
	Gas pressure switch set incorrectly.	Adjust switch setting.
The burner is erratic and does not respond to adjustment	Lost impulse line pressure	Check that the impulse air pressure line is clean and clear of moisture of dirt, and is tight on connections.
	Internal damage to the burner. Some parts inside the burner are loose, dirty, or burned out.	Contact your Eclipse representative for further information.
	Flame signal is weak.	Check the condition of the flame monitoring device.
	Damage to ratio regulator	Replace ratio regulator.
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 initial start-up settings and adjust them where necessary.
	Bleed fitting (if used) is dirty.	Clean fitting.
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.
	Loading line pressure too low.	Open the zone air control valve to increase the air volume and pressure. Recheck all burner settings.
	Adjusting valve has closed.	Open the valve to previous setting and check the input and flue gas settings to verify proper operations.
	Blower is wired incorrectly.	A blower wired to turn backwards will produce approximately 60% of its rated capacity. Check the rotation of the blower impeller. If spinning backwards, contact a qualified electrician.
	Poor piping practices.	Contact the factory.

Problem	Possible Cause	Solution
Cannot initiate start sequence	Air pressure switch has not made contact.	Check air pressure switch adjustment, air filter, blower rotation, and outlet pressure from blower.
	Purge cycle not complete.	Check flame monitoring control system or purge timer.
	High gas pressure switch has activated or low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operate.
	Malfunction of flame safeguard system.	Contact a qualified electrician.
	No power to control unit.	Contact a qualified electrician.
	Main power is off.	Ensure main power to the system is switched to the “On” position.
	Interlocks may not have been met.	Check other additional interlocks or safeties.

Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/h (am^3/h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm^3/h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	Btu/ft^3 (standard)	26.86

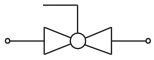
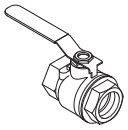
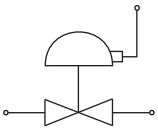
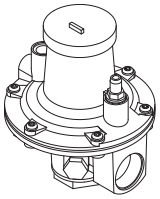
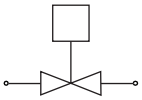
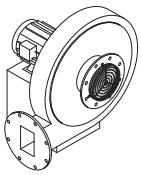
Metric to Metric

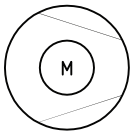
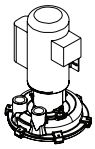
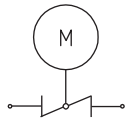
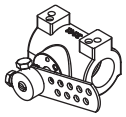
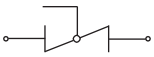
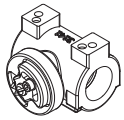
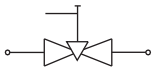
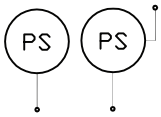
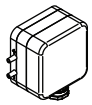
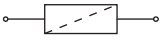
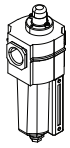
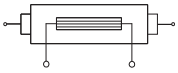
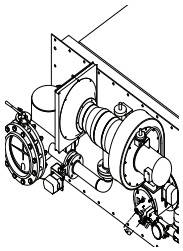
From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am^3/h)	2.832×10^{-2}
standard cubic foot /h (scfh)	normal cubic meter/h (Nm^3/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft^3 (standard)	MJ/Nm^3	37.2×10^{-3}

System Schematics

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Gas Cock	Gas cocks are used to manually shut off the gas supply.	710
		Ratio Regulator	A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas pressure in ratio with the air pressure. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the burner body.	
Main Gas Shut-Off Valve Train		Main Gas Shut-Off Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
Pilot Gas Shut-Off Valve Train		Pilot Gas Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
		Automatic Shut-Off Valve	Shut-off valves are used to automatically shut off the gas supply on a gas system or a burner.	
		Orifice Meter	Orifice meters are used to measure flow.	929
		Combustion Air Blower	The combustion air blower provides the combustion air to the burner(s).	610, 612

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Hermetic Booster	Booster is used to increase gas pressure.	620
		Automatic Butterfly Valve	Automatic butterfly valves are typically used to set the output of the system.	720
		Manual Butterfly Valve	Manual butterfly valves are used to balance the air or gas flow at each burner.	720
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	728/730
		Pressure Switch	A switch activated by rise or fall in pressure. A manual reset version requires pushing a button to transfer the contacts when the pressure set point is satisfied.	
		Pressure Gauge	A device to indicate pressure.	
		Check Valve	A check valve permits flow only in one direction and is used to prevent back flow of gas.	780
		Strainer	A strainer traps sediment to prevent blockage of sensitive components downstream.	
		Flexible Connector	Flexible connectors isolate components from vibration, mechanical, and thermal stresses.	
		Heat Exchanger	Heat exchangers transfer heat from one medium to another.	500
		Pressure Taps	Pressure taps measure static pressure.	

Notes

Automation and Control Solutions
Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

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