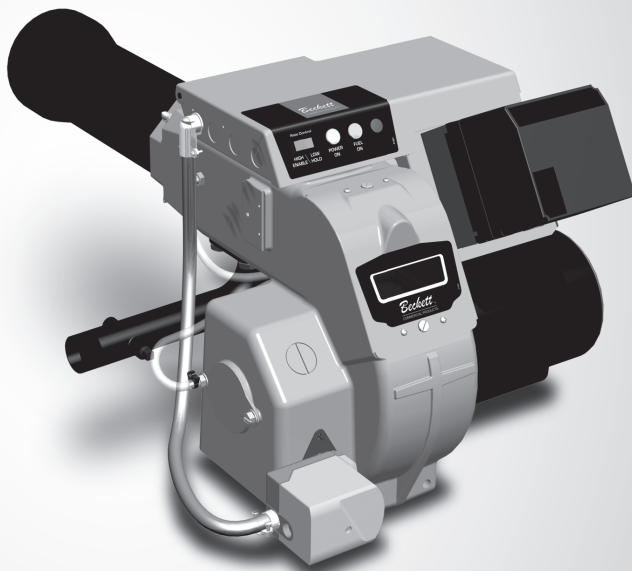


CG15 CG25 CG50

Gas Burner Manual

Operation: High/Low or Modulation



Beckett™

COMMERCIAL PRODUCTS

GAS-FIRED
C  US
LISTED

WARNING

Fire, Explosion and Asphyxiation Hazards



Failure to follow these instructions exactly could lead to fire or explosion and result in death, severe personal injury or property damage.

1. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
2. What to do if you smell gas:
 - Do not try to light any appliance.
 - Do not touch any electrical switch.
 - Do not use any phone in your building.
 - Immediately call your gas supplier from a telephone outside the building.
 - Follow the gas supplier's instructions.
 - Call the fire department if you cannot contact your supplier.
3. Installation and service must be performed by a qualified installer, service agency, or the gas supplier.

Contents

General Information	4
Hazard Definitions	4
Professional Installer's Responsibility	5
Pre-installation Checklist	5
Indoor Installation	5
Combustion Air Supply	5
Clearances	5
Fuel Gas Supply	5
Flue Vent System	5
Electrical Supply	7
Verify Burner Components	7
Verify Firing Input Range	7
Verify Burner Air Tube Assembly	7
Mount the Burner	10
Connect Gas Piping	10
Gas Trains	11
Wire the Burner	14
Sequence of Operation	14
Prepare the Burner for Start-up	17
Start-up Checklist	17
Start the Burner	18
Burner Start Procedure	18
Initial Air Settings	18
Optional Modulation Linkage Adjustment Instructions	20
Adjustment Procedure	20
Modulation Control	22
Verify Input Firing Rate	23
Estimating Rate	24
Clocking a Gas Meter	24
Uncorrected Flow Rate	24
Pressure Correction	24
Temperature Correction	24
BTU's and MBH	24
Check Operation and Safety Controls	26
Use Test Instruments to Set Combustion	27
Recommended Combustion Test Sequence	27
Maintenance and Service	28
Annual Maintenance	28
Appliance	28
Gas Supply Piping	29
Installation Area	29
Adjust the Burner for Proper Combustion	29
Flame Safeguard	29
Manual Shutdown for Long Periods	29
Ignition Reliability	29
Propane Restrictor Description	31
Installation	31
For the Operator	33
Replacement Parts	34
Limited Warranty Information	36

General Information

Hazard Definitions

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation, which, if not avoided, could result in death, or serious injury.

CAUTION Used with the safety alert symbol, indicates a hazardous situation, which, if not avoided, may result in minor or moderate injury.

Within the boundaries of the hazard warning, there will be information presented describing consequences if the warning is not heeded and instructions on how to avoid the hazard.

NOTICE Used to address practices not related to personal injury.

To the Owner:

Thank you for purchasing a Beckett burner for use with your heating appliance. Please pay attention to the Safety Warnings contained within this instruction manual. Keep this manual for your records and provide it to your qualified service agency for use in professionally setting up and maintaining your burner.

Your CG series gas burner will provide years of efficient operation if it is professionally installed and maintained by a qualified service technician. If at any time the burner does not appear to be operating properly, **immediately contact your qualified service agency** for consultation.

We recommend annual inspection/service of your gas heating system by a qualified service agency.

WARNING Owner's Responsibility



Failure to follow these instructions, misuse, or incorrect adjustment of the burner could lead to equipment malfunction and result in asphyxiation, explosion or fire.

Contact a professional, qualified service agency for the installation, adjustment, and service of your gas burning system. Thereafter, have your equipment adjusted and inspected at least annually to ensure reliable operation. This work requires technical training, trade experience, licensing or certification in some states and the proper use of special combustion test instruments.

Please carefully read and comply with the following instructions:

- See the front cover for 'What to do if you smell gas'.
- Never store or use gasoline or other flammable liquids or vapors near this burner or appliance.
- Never attempt to burn garbage or refuse in this appliance.
- Never attempt to light the burner/appliance by throwing burning material into the appliance.
- Never attempt to burn any fuel not specified and approved for use in this burner.
- Never restrict the air inlet openings to the burner or the combustion air ventilation openings in the room.

CAUTION Frozen Plumbing and Water Damage Hazard

If the facility is unattended in severely cold weather, burner primary control safety lockout, heating system component failures, power outages or other electrical system failures could result in frozen plumbing and water damage in a matter of hours. For protection, take preventive actions such as having a security system installed that operates during power outages, senses low temperature and initiates an effective action. Consult with your heating contractor or security agency.

Professional Installer's Responsibility



WARNING

Follow these instructions exactly



Failure to follow these instructions could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- Please read all instructions before proceeding. Follow all instructions completely.
- This equipment must be installed, adjusted, and started by a qualified service agency that is licensed and experienced with all applicable codes and ordinances and responsible for the installation and commissioning of the equipment.
- The installation must comply with all local codes and ordinances having jurisdiction and the latest edition of the National Fuel Gas Code ANSI Z223.1 (NFPA 54) and CAN1-B149.1 in Canada.

NOTICE

Concealed damage – If you discover damage to the burner or controls during unpacking, notify the carrier at once and file the appropriate claim forms.

High altitude installations – Accepted industry practice requires no derate of burner capacity up to 2000 feet above sea level. For altitudes higher than 2000 feet, derate the burner capacity 2% for each 1000 feet above the 2000 feet.

50 Hz motors – The burner ratings, air settings and other adjustments are based on 60 Hz motors at 3450 rpm. Derate firing capacity 20% when using 50 Hz motors. Consult factory for specific application data.

Pre-installation Checklist

Indoor Installation



WARNING

Protect against Dust and Moisture

Wet or dusty environments could lead to blocked air passages, corrosion damage to components, impaired combustion performance and result in asphyxiation, explosion or fire.

- This burner is designed for clean, dry installations.
- Electrical controls are not protected against rain or sprayed liquids.
- Keep the installation clear of dust, dirt, corrosive vapors, and moisture.
- Protective covers and more frequent maintenance may be required.

Combustion Air Supply

The burner requires combustion air and ventilation air for reliable operation. Assure that the building and/or combustion air openings comply with the latest edition of the National Fuel Gas Code ANSI Z223.1 (NFPA 54). For appliance/burner units in confined spaces, the room must have an air opening near the top of the room, plus one near the floor, each with a free area at least one square inch per 1000 Btu/hr input for all fuel-burning equipment in the room. For Canadian installations, refer to latest edition of CAN1- B149.1 standard.

If there is risk of the space being under negative pressure, or of exhaust fans or other devices depleting available air for combustion and ventilation, the appliance/burner should be installed in an isolated room provided with outside combustion air.

Clearances

With the burner installed in the appliance, there must be adequate space in front of and on the sides of the burner to allow access and operation. Verify that the clearance dimensions comply with local codes and with the appliance manufacturer's recommendations.

Fuel Gas Supply

Verify that the gas supply piping complies with all applicable local codes and the latest edition of the National Fuel Gas Code ANSI Z223.1 (NFPA 54).

Insure that the supply gas pipe size is capable of providing at least the minimum pressure required to the burner gas train inlet at the burner's full capacity rating. Refer to **Table 1**.

Flue Vent System

The flue gas vent system must be in good condition and must comply with National Fuel Gas Code ANSI Z223.1 (NFPA 54) and all other applicable codes having jurisdiction for vent construction, capacity, and sizing.

Table 1 – Burner Specifications

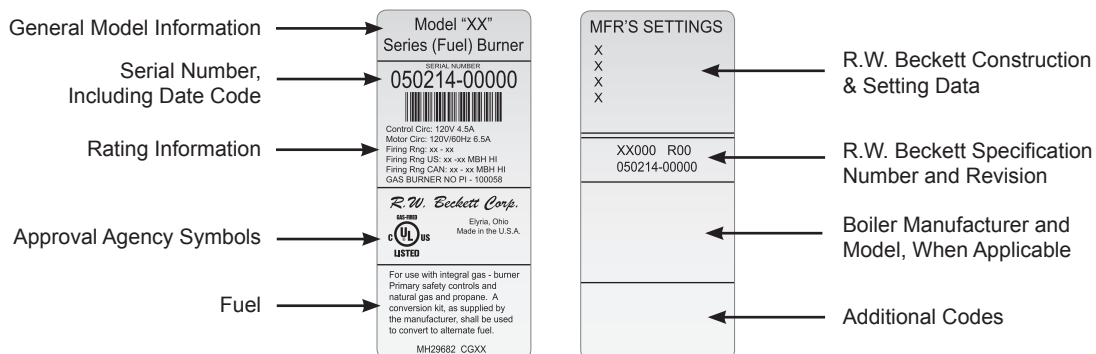
	CG15		CG25		CG50	
	USA	Canada	USA	Canada	USA	Canada
Input Firing Range†:						
High Fire (Max.)	1,500 MBH	1,370 MBH	2,700 MBH	? MBH	5,000 MBH	4,000 MBH
High Fire (Min.)	800 MBH	800 MBH	1,300 MBH	1,300 MBH	2,000 MBH	2,000 MBH
Low Fire (Max.)	560 MBH	560 MBH	990 MBH	990 MBH	1,400 MBH	1,400 MBH
Low Fire (Min.)	350 MBH	350 MBH	550 MBH	550 MBH	730 MBH	730 MBH
Fuel:						
Natural Gas	0.6 Specific Gravity Typical		0.6 Specific Gravity Typ.		0.6 Specific Gravity Typ.	
Propane (LP)	1.53 Specific Gravity Typical		1.53 Specific Gravity Typ.		1.53 Specific Gravity Typ.	
Gas Train:						
Standard	UL Listed / CSD-1 configuration		UL Listed / CSD-1 configuration		UL Listed / CSD-1 configuration	
Options	IRI, FM		IRI, FM		IRI, FM	
Gas Train Inlet Pressure:						
Minimum	3.7" WC*		3.5" WC*		3.5" WC*	
Maximum	10 PSI		10 PSI		10 PSI	
Manifold to Furnace Pressure Drop:**						
Highest High Fire	3.7" WC		3.5" WC		3.5" WC	
Lowest High Fire	2.7" WC		2.5" WC		2.5" WC	
Firing Modes Available:	Low Fire Start High/Low Modulation		- High/Low Modulation		- High/Low Modulation	
Standard Flame Safeguard:						
Low Fire Start	RM7897A		-		-	
High / Low Modulation	RM7897C RM7897C		RM7897C RM7840L		RM7897C RM7840L	
Flame Detector:						
Standard	Flame Rod		UV		UV	
Optional	UV		-		-	
Airflow Proving Switch:	Standard		Standard		Standard	
Gas Pressure Switches:	Standard High and Low		Standard High and Low		Standard High and Low	
Ignition:	Direct Ignition of Main Flame		Direct Ignition of Main Flame		Direct Ignition of Main Flame	
Motor:						
HP	1/2HP		3/4 HP		2 HP	
RPM	3450 RPM		3450 RPM		3450 RPM	
Standard Voltage	120 volt, 1 ph, 60 Hz		120 volt, 1 ph, 60 Hz		208/230v, 1 ph, 60 Hz	
Motor FLA	6.4 Amps @120 volt AC		10.4 Amps @120 volt AC		13.4 Amps @230 volt AC	
Optional Voltages	208/230v, 1 ph, 60 Hz 208/230v, 3 ph, 60 Hz 460v, 3 ph, 60 Hz 575v, 3 ph, 60 Hz		208/230v, 1 ph, 60 Hz 208/230v, 3 ph, 60 Hz 460v, 3 ph, 60 Hz 575v, 3 ph, 60 Hz		208/230v, 3 ph, 60 Hz 460v, 3 ph, 60 Hz 575v, 3 ph, 60 Hz	
Weight:	125 lbs.		145 lbs.		165 lbs.	
Dimensions:	Refer to Figures 4 & 5.					

*See manufacturer's nameplate settings for specific minimum gas pressure requirements.

** See Figures 14A, 14B, & 14C.

† Canada High Fire rate is reduced to accommodate 25% reserve air.

Figure 1 - Burner Label Location

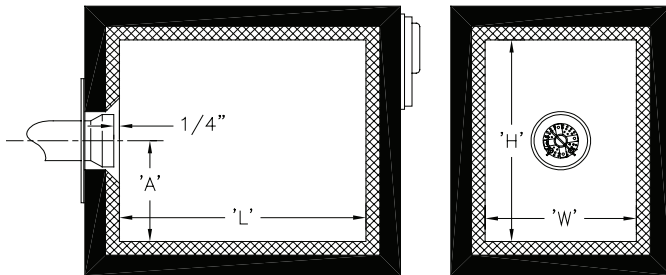


WARNING Test For Gas Pipe Leaks

Leaking gas could result in asphyxiation, explosion, or fire hazard.

- The gas supply piping must be absolutely leak-free.
- Pressure test the gas piping with air that is at least three times greater than the gas pressure being used.
- Verify that there are no leaks before proceeding.

Figure 2 - Minimum Combustion Chamber Dimensions



Minimum Inside Dimensions (inches)				
Burner Model	Width 'W'	Height 'H'	Length 'L' at Min H & W*	Burner Head Centerline to floor 'A'
CG15.1S	15	16	42	7
CG15.2S	16	17	45	8
CG15.3S	17	18	47	8
CG15.4S	18	19	50	9
CG25.1S	19	20	45	9
CG25.2S	20	21	48	10
CG25.3S	21	22	50	10
CG25.4S	22	23	52	11
CG25.5S	23	25	55	11
CG50.1S	21	23	55	10
CG50.2S	22	24	58	11
CG50.3S	24	26	62	12
CG50.4S	25	27	65	12
CG50.5S	27	29	70	13

NOTICE Dimensions shown are for cast iron sectional boilers with uptakes between sections. For minimum dimensions of other furnace types consult R. W. Beckett Corporation.

Electrical Supply

Check the nameplate on the burner to verify that the power connections available are correct for the burner. Refer to **Figure 1**. All power must be supplied through fused disconnect switches and comply with the latest edition of National Electric Code NFPA 70 (Canada CSA C22.1) and all other local or applicable codes.

Verify Burner Components

Burner model can be checked from burner carton or rating label on burner. Flange mounting arrangement (Includes high-temperature gasket and/or fiber rope for pressure firing).

Verify Firing Input Range

Refer to appliance manufacturer's instructions (if available) for the firing input range. Otherwise the maximum recommended firing range for the burner depends on the length and width of the firing chamber and the distance from the burner center to the chamber floor. Verify that the chamber dimensions are at least as large as the minimum values given in **Figure 2**. If the appliance dimensions are smaller, reduce the firing rate accordingly.

NOTICE

Flames are shaped by their furnaces and by its flue locations. Increased height and width can decrease the length requirement. When shaping is too severe flames impinge on the walls. Impingement causes CO and carbon deposits and may damage the wall. Maintaining these minimum dimensions should prevent impingement, but smaller furnaces may be acceptable depending upon the results of applications testing. We recommend factory testing of all new burner/furnace combinations by the furnace manufacturer and/or R. W. Beckett Corp.

NOTICE

The volume of the furnace also influences the combustion process. R. W. Beckett Corp. recommends at least 1 cubic foot of furnace volume for each 150,000 BTU/Hr of firing rate.

Verify Burner Air Tube Assembly

- The information in this section may be disregarded if the burner supplied by the appliance manufacturer is a matched component.
- Maximum firing capacity depends on the furnace pressure. Use the charts shown in **Figure 3A**, **Figure 3B**, and **Figure 3C**, to verify the correct burner configuration for the input rate.
- Refer to **Figures 4 & 5** to verify the air tube assembly length and mounting insertion dimensions.

Figure 3A - Maximum Capacity (at 3% O₂) vs Furnace Pressure - CG15, 60Hz.

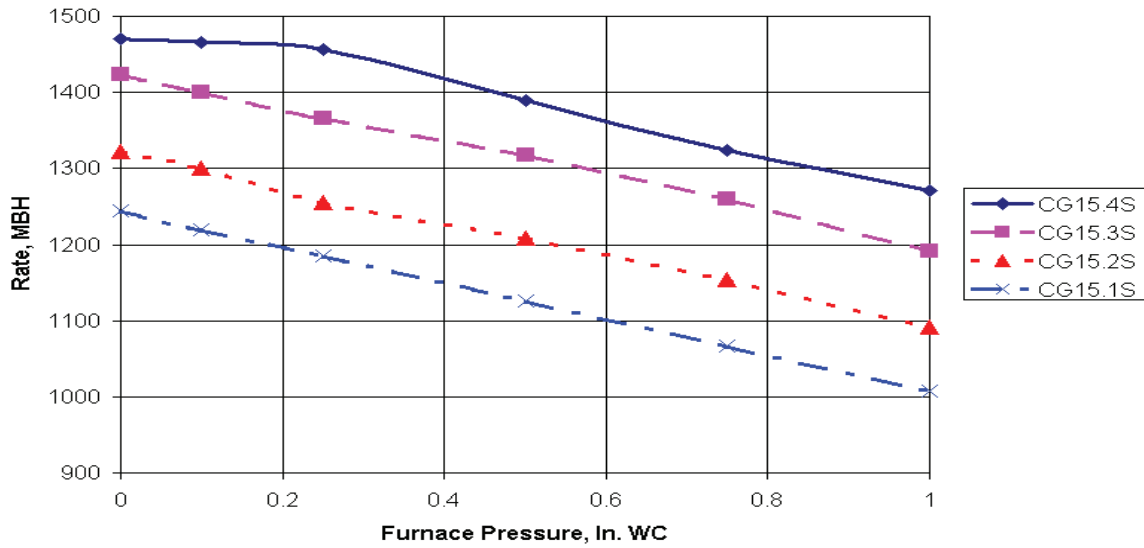


Figure 3B - Maximum Capacity (at 3% O₂) vs Furnace Pressure - CG25, 60Hz.

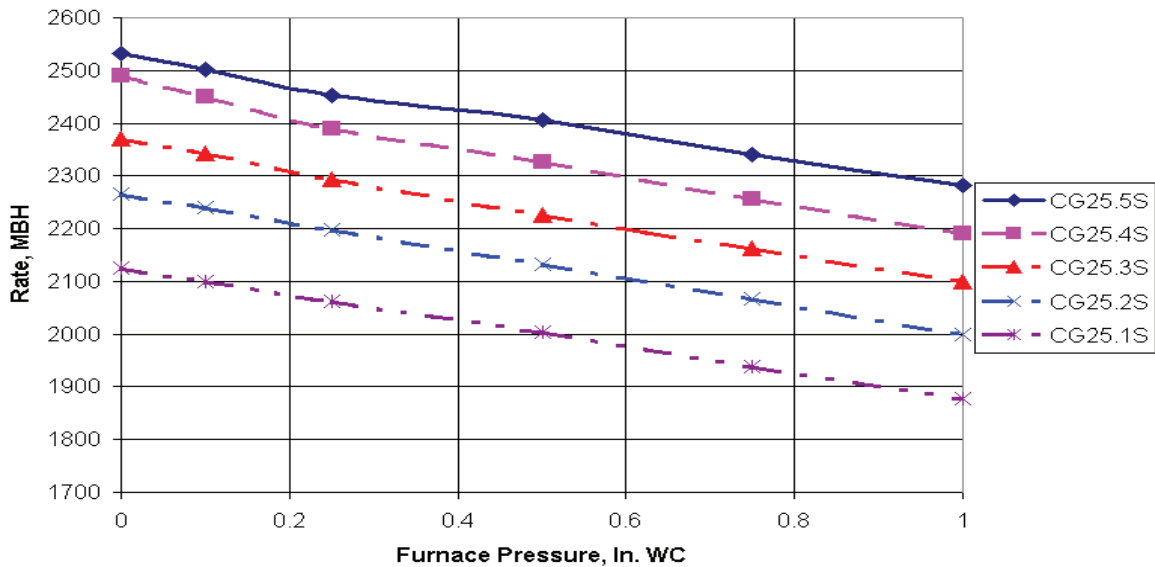


Figure 3C - Maximum Capacity (at 3% O₂) vs Furnace Pressure - CG50, 60Hz.

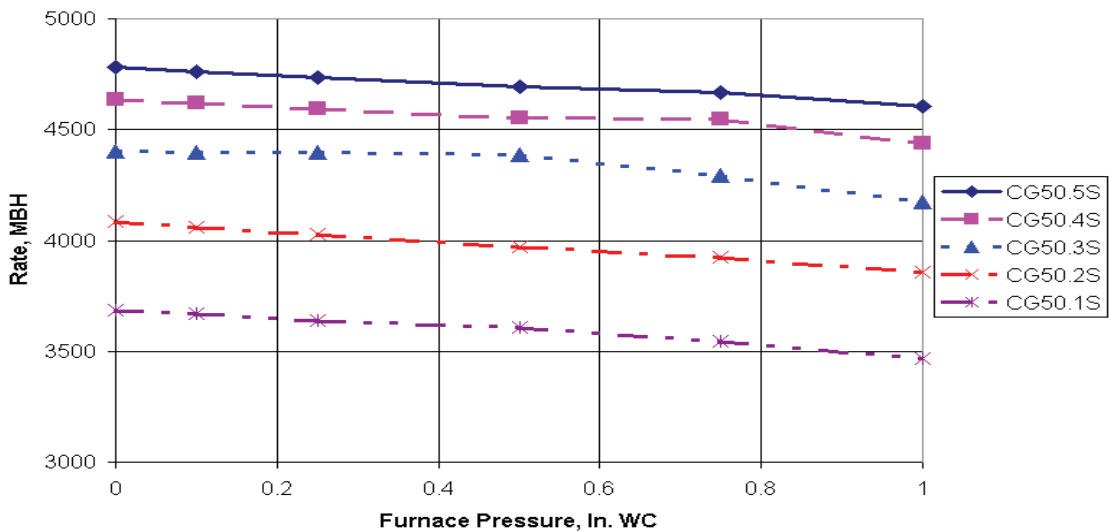
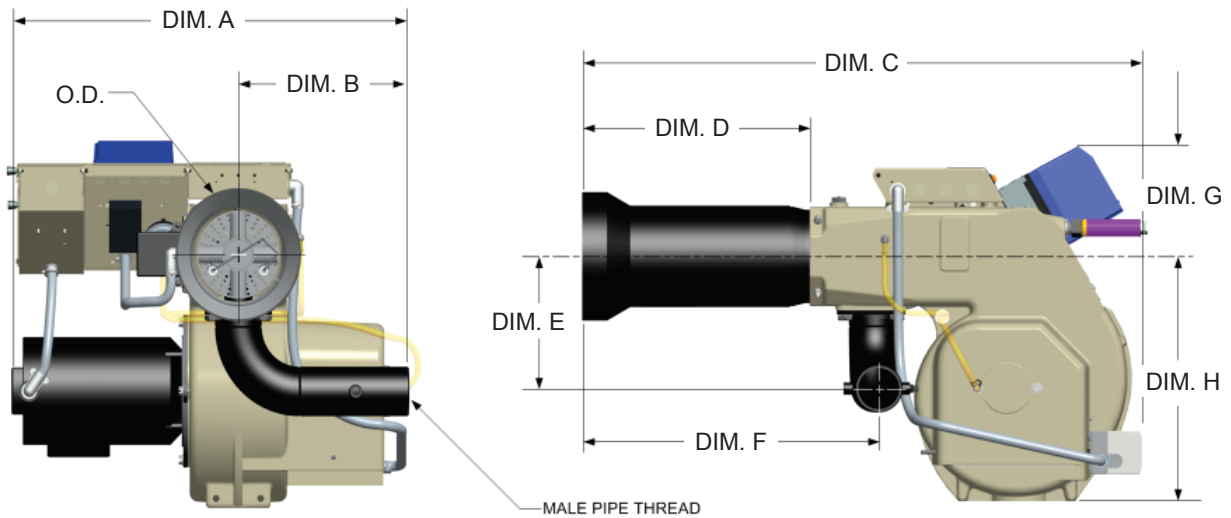


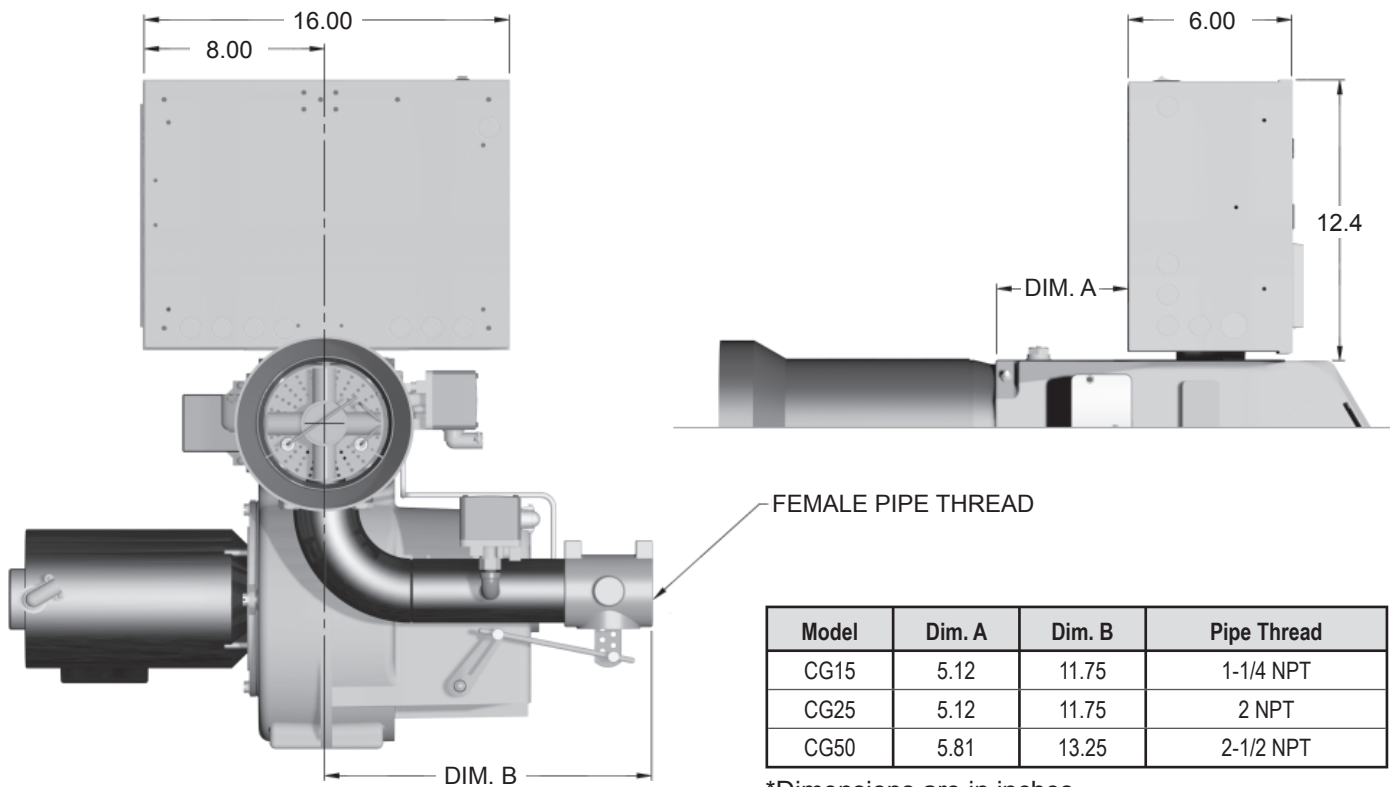
Figure 4 - Burner Dimensions



Model	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Dim. F	Dim. G	Dim. H	O.D.	Pipe Thread
CG15	20.8	9.4	32.7	13.7	5.2	18.4	6.2	10.8	5.6	1-1/4 NPT
CG25	20.9	9.3	33.2	13.4	6.8	17.8	6.7	12.6	6.9	2 NPT
CG50	24.4	10.5	33.6	13.5	7.5	17.4	6.7	14.6	7.7	2-1/2 NPT

NOTE: All dimensions are in inches.

Figure 5 - Panel and Modulating Valve Dimensions



Model	Dim. A	Dim. B	Pipe Thread
CG15	5.12	11.75	1-1/4 NPT
CG25	5.12	11.75	2 NPT
CG50	5.81	13.25	2-1/2 NPT

*Dimensions are in inches

Mount the Burner

Mount the burner to the appliance. The burner specified for packaged equipment will have a flange welded for the required insertion. Follow the appliance manufacturer's instructions for mounting.

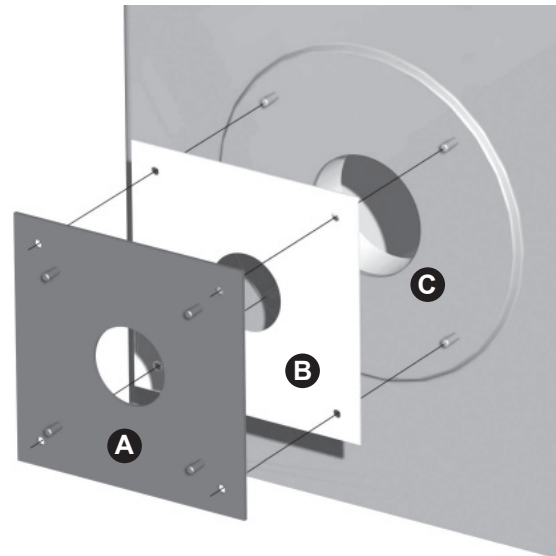
In the absence of instructions, or for retrofits, make sure that the air tube insertion dimension, measured along the side of the air tube from the welded flange to the end of burner air tube, is correct.

CAUTION Protect the Air Tube from Overheating

Overheating could cause damage to the air tube and other combustion components leading to equipment malfunction and impaired combustion performance.

- The end of the air tube must not extend into the combustion chamber unprotected unless it has been factory-tested and specified by the appliance manufacturer.
 - The end of the air tube should be set back $\frac{1}{4}$ " from flush with the refractory inside wall to prevent damage from overheating.
 - Refer to the instructions outlined in this section for methods of additional protection.
-
- If this dimension cannot be achieved, protect the end of the air tube by installing a suitable ceramic refractory material such as a refractory mill board capable of withstanding at least 2300 degrees F. The entry hole diameter in the appliance should be 1" larger than the air tube to facilitate ease of installation and provide adequate protection.
 - Referring to **Figure 6**, if the front plate opening (C) in the boiler is larger than the burner flange bolt circle, then a custom mounting plate (A) of at least $\frac{1}{4}$ " thickness must be used with a suitable high-temperature refractory material anchored on the fire-side. A suitable high-temperature gasket (B) must be used for an effective seal.
 - Attach the plate and gasket to the boiler and tighten the mounting nuts or bolts securely.
 - Verify that the air tube is $\frac{1}{4}$ " back from flush (see **Figure 2**), and there is nothing blocking the flame zone that could cause flame impingement.

Figure 6 - Custom Mounting Plate



Key:

- A = Burner mounting flange
- B = Gasket
- C = Appliance mounting plate

Connect Gas Piping

WARNING Do Not Use Teflon Tape on Gas Piping

Damage to gas valve cutoff seals and valve bodies could cause gas leaks and result in asphyxiation, explosion or fire.

- Pieces of tape can be cut loose during installation and lodge in gas valves causing cutoff seal problems.
- Teflon tape 'lubricates' pipe threads, allowing iron pipes to penetrate too deeply into aluminum valve bodies causing distortion and leakage.
- Use only pipe sealant compounds that are resistant to the gas being used.

NOTICE All gas piping installation must comply with the latest edition of the National Fuel Gas Code ANSI Z223.1 (NFPA 54) and other applicable local codes.

The gas supply system must be sized to deliver at least the minimum required pressure to the gas train inlet. Contact your local gas utility for verification of gas pressures, allowable pressure drops, and any local piping code requirements. Refer to **Figure 7** for an illustration of a gas piping layout and refer to **Table 2** for pipe sizing.

WARNING Install a Drip Leg in Gas Supply Piping



Foreign matter could lodge in gas valve cutoff seals, resulting in gas leak-through, explosion or fire.

Install a full-size drip leg or dirt pocket in the piping directly ahead of the main shutoff valve to capture foreign matter.

Gas Trains

WARNING Gas Leaks and Explosion Hazards

Provide Over-pressure Protection

CSD-1 requires that if gas pressure entering the building exceeds the rating of any gas train component an overpressure protection device must be installed.

Standard – An Underwriters Laboratories (UL) listed gas train is standard for the CG10 gas burner. This configuration also meets CSD-1 requirements. See **Figures 8A** and **8B** for typical component layout.

Propane (LP) – When the correct propane restrictor is added to a burner's gas pipe assembly it changes the burner's gas pressure drop so that the propane pressure drop is equal to the natural gas pressure drop of the same BTU firing rate. That is why the Manifold

to Furnace Pressure Drop curves of **Figures 14A, 14B,** and **14C** are correct for both propane and natural gas. That is also why a gas train adjusted for the burner's natural gas requirements will be correctly adjusted for its propane requirements. R. W. Beckett provides the same pressure regulating safety shutoff valve in the gas train (usually a Honeywell V4944B) for both natural gas and propane. The valve is marked for natural gas due to its primary usage in a pressure range normally used by natural gas appliances. It is safe and effective for propane usage in this design application.

Optional – Gas trains for IRI and FM are available and must be specified when ordering a burner.

Verify – Verify that the train components are not damaged and all piping and fittings are clean inside and out. The gas train is normally shipped as components and must be assembled and installed at the site.

Vent Lines – Install vent lines to any gas valve component that requires atmospheric air pressure to balance a diaphragm. Vent lines must be run to the outdoors, with the termination point away from fresh air intakes and windows. The terminal opening must be fitted with a wire mesh screen to block insects and other contaminants from entering the vent and must be mounted in such a position that water, ice, dirt, or any other foreign matter cannot infiltrate and block the vent piping. Make sure the final assembly is anchored securely.

Figure 7 - Typical Gas Piping Layout

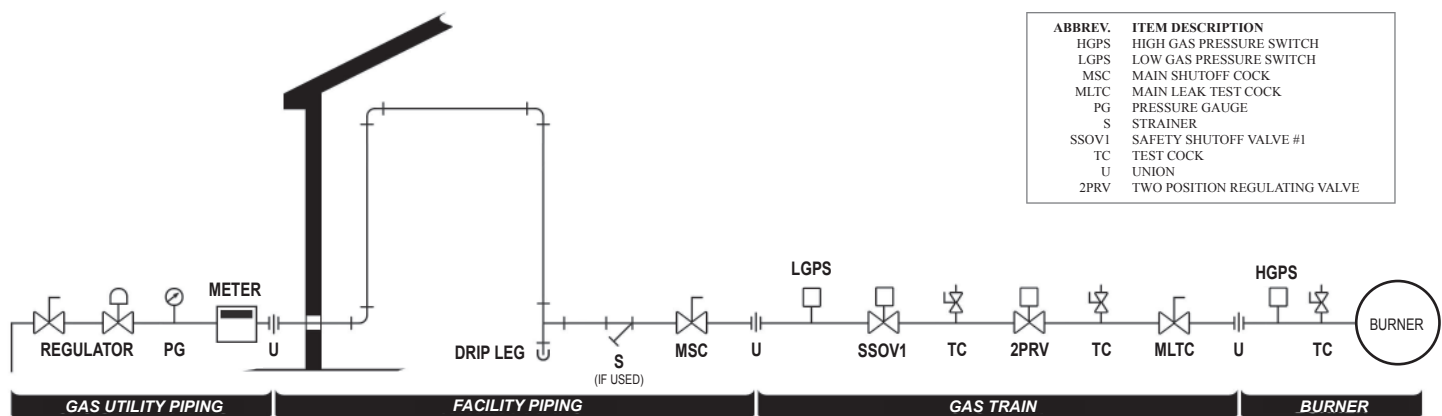


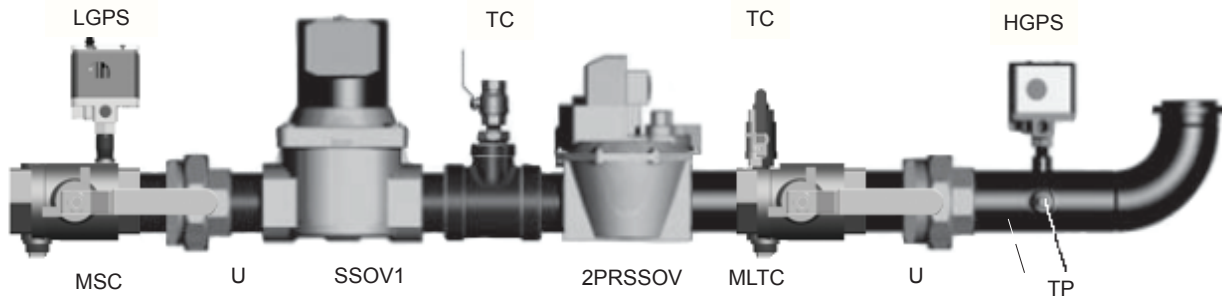
Table 2A - Natural Gas Supply Piping Capacity

Schedule 40 metallic pipe with 0.50 psi or less inlet pressure and 0.30" W.C. pressure drop								
Maximum capacity in cubic feet of gas per hour (CFH). Natural gas with 0.60 specific gravity. Pipe size (inches) IPS								
Pipe length (feet)	0.75"	1.0"	1.25"	1.5"	2.0"	2.5"	3.0"	4.0"
10	278	520	1050	1600	3050	4800	8500	17500
20	190	350	730	1100	2100	3300	5900	12000
30	152	285	590	800	1650	2700	4700	9700
40	130	245	500	760	1450	2300	4100	8300
50	115	215	440	670	1270	2000	3600	7400
60	105	195	400	610	1150	1850	3250	6800
70	96	180	370	560	1050	1700	3000	6200
80	90	170	350	530	990	1600	2800	5800
90	84	160	320	490	930	1500	2600	5400
100	79	150	305	460	870	1400	2500	5100
125	72	130	275	410	780	1250	2200	4500
150	64	120	250	380	710	1130	2000	4100
175	59	110	225	350	650	1050	1850	3800
200	55	100	210	320	610	980	1700	3500

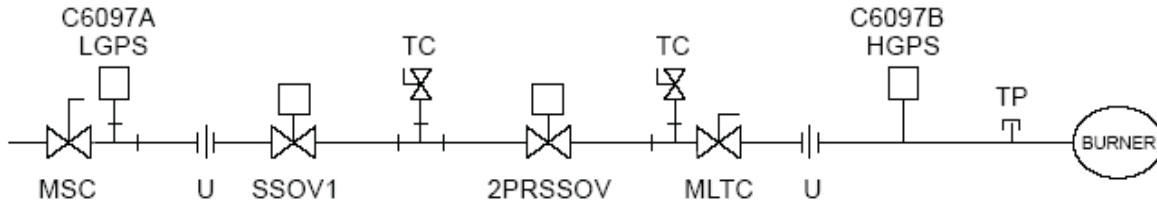
Table 2B - Propane (LP) Gas Supply Piping Capacity

Schedule 40 metallic pipe with 11"W.C. inlet pressure and 0.50" W.C. pressure drop								
Maximum capacity in thousands of BTU/HR (MBH). LP Gas with 1.53 Specific Gravity. Pipe Size (inches) IPS								
Pipe length (feet)	0.5"	.75"	1.0"	1.25"	1.5"	2.0"	2.5"	3.0"
10	275	567	1,071	2,205	3,307	6,221	10,140	17,990
20	189	393	732	1,496	2,299	4,331	7,046	12,510
30	152	315	590	1,212	1,858	3,465	5,695	10,110
40	129	267	504	1,039	1,559	2,992	4,778	8,481
50	114	237	448	913	1,417	2,646	4,343	7,708
60	103	217	409	834	1,275	2,394	3,908	6,936
80	89	185	346	724	1,086	2,047	3,329	5,908
100	78	162	307	630	976	1,811	2,991	5,309
125	69	146	275	567	866	1,606	2,654	4,711
150	63	132	252	511	787	1,496	2,412	4,281
200	54	112	209	439	665	1,282	2,038	3,618

Figure 8A - UL Gas Train - High/Low and Low Fire Start

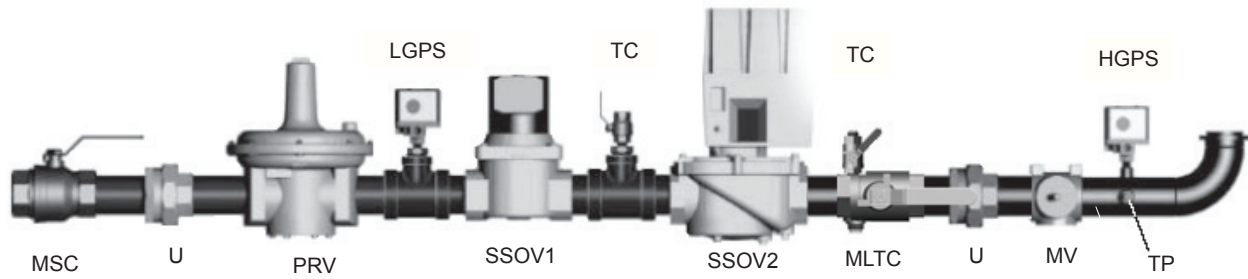


SK9982

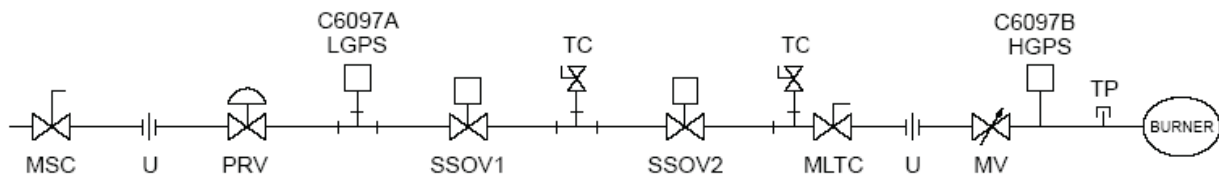


SK9983

Figure 8B - UL Gas Train - Modulating



SK9984



SK9985

ABBREVIATION	ITEM DESCRIPTION
HGPS	HIGH GAS PRESSURE SWITCH
LGPS	LOW GAS PRESSURE SWITCH
MSC	MAIN SHUTOFF COCK
MLTC	MAIN LEAK TEST COCK
MV	MODULATION VALVE
SSOV1	SAFETY SHUTOFF VALVE #1
SSOV2	SAFETY SHUTOFF VALVE #2
TC	TEST COCK
TP	TEST PORT
U	UNION
2PRSSOV	HIGH/LOW PRESSURE REGULATING SAFETY SHUTOFF VALVE

NOTICE

When pressure reducing safety shutoff valves are used, the distance from the final shutoff valve (2PRSSOV in Figure 8A) to the burner manifold must be kept to a minimum for good light-off reliability. R. W. Beckett recommends the following maximum lengths:

Pipe Size	Maximum Length
1"	12"
1-1/4"	15"
1-1/2"	18"
2"	24"

If Normally Open Vent Valve (not shown) is used, the distance between the SSOVs must be kept to a minimum using the shortest practical nipples.

Wire the Burner

Install the burner and all wiring in accordance with the National Electric Code ANSI/NFPA 70 (Canada CSA C22.1) and all applicable codes and requirements. Wire the burner in compliance with all instructions and diagrams provided by the appliance manufacturer. Verify operation of all controls in accordance with the appliance manufacturer's guidelines.


WARNING Do Not Bypass Safety Controls

Tampering with, or bypassing safety controls could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- Safety controls are designed and installed to provide protection.
- Do NOT tamper with or bypass any safety control.
- If a safety control is not functioning properly, shut off all main electrical power and gas supply to the burner and call a qualified service agency immediately.

NOTICE See *Figures 9A & 9B* for typical wiring diagrams, with the flame safeguard control, for reference purposes only. Check the literature that was packaged with the burner for the primary control manufacturer's instructions and the exact wiring diagram for your specific burner.

WARNING Electrical Shock Hazard

 *Electrical shock can cause severe personal injury or death.*

- Disconnect electrical power before installing or servicing the burner.
- Provide ground wiring to the burner, metal control enclosures and accessories. (This may also be required to aid proper control system operation.)
- Perform all wiring in compliance with the National Electrical Code ANSI/NFPA 70 (Canada CSA C22.1)

CAUTION Keep Service Access Covers Securely Installed

These covers must be securely in place to prevent electrical shock, damage from external elements, and protect against injury from moving parts.

- All covers or service access plates must be in place at all times except during maintenance and service.
- This applies to all controls, panels, enclosures, switches, and guards or any component with a cover as part of its design.

CAUTION Incorrect Wiring Will Result in Improper Control Operation

WARNING Fire or Explosion Hazard

Can cause severe injury, death, or property damage.

- The control can malfunction if it gets wet, leading to accumulation of explosive vapors.
- Never install where water can flood, drip or condense on the control.
- Never use a control that has been wet - replace it.

Sequence of Operation

RM7897C & RM7840L Flame Safeguard Controls

1. **Initiate** – The primary control enters the INITIATE sequence when the control is first powered on or power returns after an interruption. The initiate sequence is a ten second delay during which the control verifies line voltage stability.
2. **Standby** – The control enters STANDBY until the limits, operating limit control, burner switch, and all microcomputer-monitored circuits are in the correct state.
3. **Load Demand** – Operating limit control contacts close on drop in temperature (or pressure) and initiates the start sequence.
4. **Prepurge** – The control will signal the PREPURGE sequence when the airflow interlock and all switches are in the correct state. The Prepurge sequence is the amount of time the blower motor runs prior to the ignition start sequence. Timing for the Prepurge sequence is determined by a card mounted inside the control module (typically 30 seconds). For the RM7897A control, Prepurge is conducted with the air damper in the low fire position. For the RM7840 control the air damper opens to the high fire position for the timed prepurge period and returns to the low fire position before releasing the control for ignition.
5. **Trial for Ignition (TFI)** – After the Prepurge sequence has timed out, the ignition and main gas valves will be energized. Because the burner has direct spark ignition for the main flame, the flame must be established and detected by the control within 4 seconds or lockout will occur.
6. **Flame Stabilization** – The burner will operate in low fire for 10 seconds before initiating high fire.
7. **Run** – With a flame established and the control

continuing to detect a flame, the burner will operate in the RUN mode until the load demand is satisfied or a limit opens.

- For High/Low control wiring (**Figure 9A**), if terminals RC1 and RC2 are jumpered, the burner operates in the Low-High-Off mode. The burner starts at Low and goes to High after the flame stabilization period. Flame is extinguished when the load is satisfied or a limit opens, and the burner is sent to post purge.
- For High/Low control wiring (**Figure 9A**), if a high / low control has been wired between terminals RC1 and RC2 the burner starts at Low and is released to go to High after the flame stabilization period. It can repeatedly cycle between low and high as necessary to meet load demand until the load is satisfied or a limit opens, and the burner is sent to post purge.

- For modulating control wiring (**Figure 9B**), the burner starts at Low and is released to modulate after the flame stabilization period. It can modulate between low and high as necessary to meet load demand until the load is satisfied or a limit opens, and the burner is sent to post purge.

8. Load Satisfied – The fuel valves are closed. After a 15 second post purge, the burner switches to idle until the next call for operation.

NOTICE This operation sequence is typical and for reference only. The primary control could vary, depending on the customer specification and code requirements. For the specific operating sequence that applies to your installation, consult the appliance manufacturer's directions, wiring instructions, and control manufacturer's literature supplied with your burner.

Figure 9A - Typical Wiring Using Model RM7897C for High/Low Control (For Reference Only)

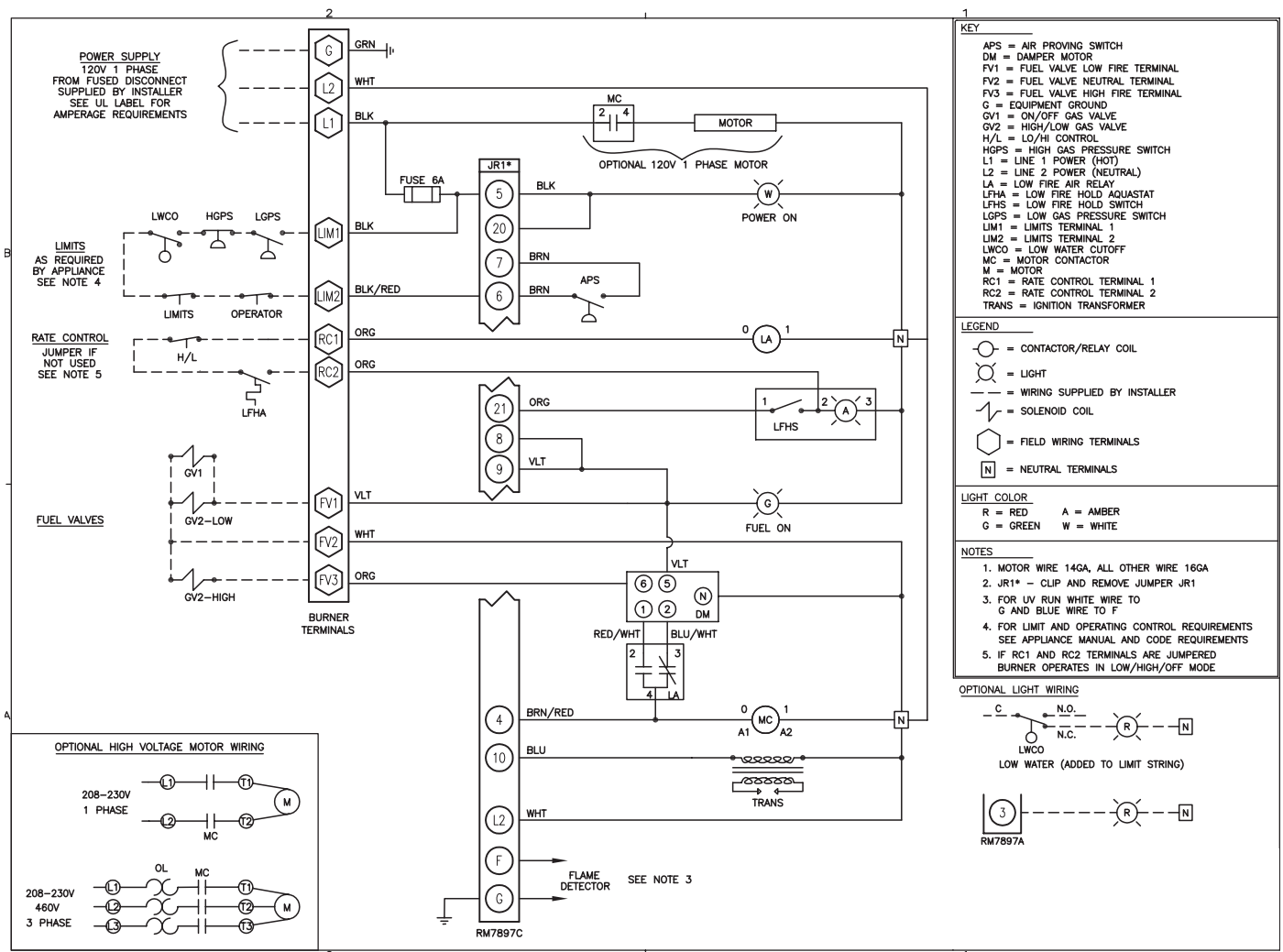
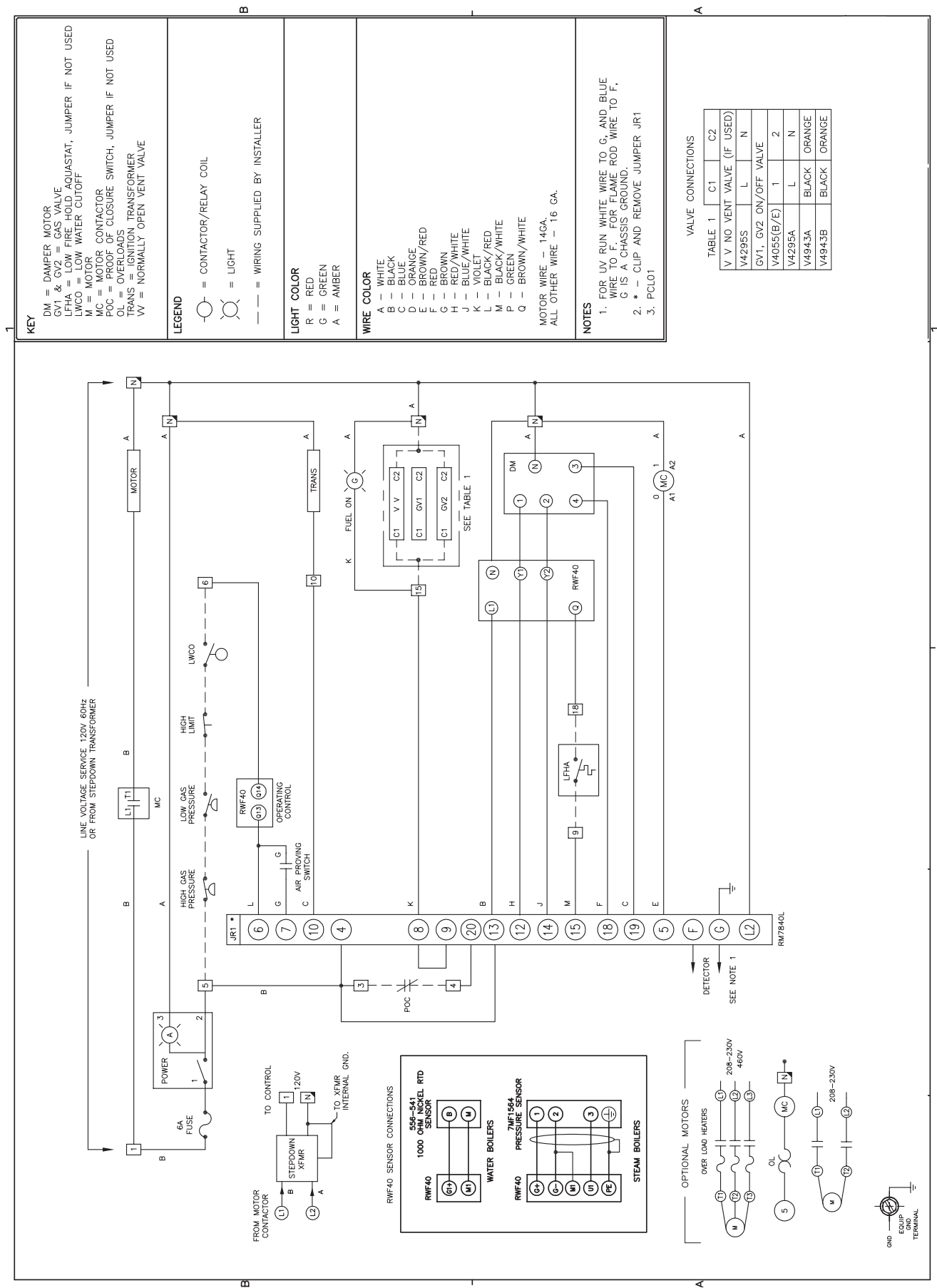


Figure 9B - Typical Wiring Using Model RM7840L for Modulating Control (For Reference Only)



Prepare the Burner for Start-up



WARNING

Professional Installation and Service Required



Incorrect installation and mishandling of start-up could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- This burner must be installed and prepared for start-up by a qualified service technician who is trained and experienced in commercial gas burner system installation and operation.
- Carefully follow the wiring diagrams, control instruction sheets, flame safeguard sequence of operation, test procedures and all appliance manufacturer's directions that pertain to this installation.
- If any of these items are not clear or are unavailable, call Beckett at 1-800-645-2876 for assistance.



WARNING

Delayed Ignition, Explosion and Fire Hazards



This is a direct spark ignition burner and by code requirements must have a primary control with a 4-second flame establishment period. Exceeding 4 seconds could result in delayed ignition, explosions and fire.

Always verify the primary control has a 4-second flame establishment period by carefully following the control manufacturers' configuration instructions.

Example: Honeywell RM Series requires clipping and removing the JR1 resistor.

Start-up Checklist

Verify the following before attempting to start the burner.

1. General

- Carefully read and become familiar with the manual, flame safeguard control instructions, sequence of operation, pertinent wiring diagrams, gas system layout, insurance requirements, other controls and valve literature pertinent to the installation.
- Follow the appliance manufacturer's start-up procedures (when available).
- Inspect the combustion air supply and exhaust venting and verify that they are free of obstructions and installed and sized in accordance with all applicable codes.
- Notify appropriate personnel to schedule start-up (gas utility, owner, operators, subcontractors, etc.).

2. Gas Supply Piping

- Insure that the gas piping is properly sized and has been inspected by the gas utility, leak tested at all joints, and purged.
- To protect the gas train and controls, insure that a drip leg or dirt pocket has been properly installed.
- Insure that the fuel gas being supplied is compatible with the burner specification and is available at the correct regulated pressure. (See burner name plate and specification sheets).
- Insure that the vent lines for the diaphragm valves have been run to the outside and properly terminated.
- Use RWB recommended maximum pipe lengths for good light-off (**Figure 8A/B**).

3. Electrical

- Insure that all wiring has been completed and complies with the National Electric Code NFPA 70 and local requirements.
- Refer to **Figure 1** and verify that the electrical supply to the burner matches the voltage specification on the label.

4. Boiler or Appliance

- Insure that the flue passages and combustion area have been thoroughly cleaned and are in good condition.
- Set the breech damper to the required position for system operation.
- Fill the appliance with water (boilers).
- Check all safety and operating controls for correct application, installation, wiring, and operation.
- Insure that the maximum capacity of the appliance is compatible with the specified burner input firing rate.

5. Burner - See Replacement Parts Illustration for Familiarization

- Insure that the gas burner model and capacity meet the requirements for the installation.
- Insure that the gas train meets operating specifications, all safety codes and insurance requirements.
- Refer to **Table 3** and **Figures 10A** and **10B** to insure that the burner air damper is positioned for initial start-up preliminary settings.
- Insure that the burner is securely mounted in the appliance with the pressure firing plate and all gaskets in place for pressurized chamber applications.
- For propane-firing burners, insure that the propane restrictor has been correctly selected for your burner model (see **Table 4**) and properly installed (see **Propane Restrictor Installation** instructions).
- Before operating insure that all protective cover

plates, enclosures and guards are in place and securely fastened.

- When available, refer to the appliance manufacturer's instructions and install the burner accordingly.

6. Test Instruments

- The following calibrated test equipment is required to properly install the appliance. Whether these are included in one kit or are individual test components, they should be calibrated and in good working order.
- A combustion analyzer capable of measuring oxygen (or carbon dioxide), carbon monoxide, stack temperature, ambient temperature, and appliance efficiency.
- Electrical multi-meter capable of measuring voltage, ohms, amps, and DC micro-ammeter for measuring the flame signal. These could be included in one meter or separate meters, but should be calibrated and accurate.
- Calibrated manometers and gauges capable of measuring all pressure ranges in the gas supply and appliance draft. This could typically range from a few psi to 0.01" W. C.
- Having several manometers or U tubes with the correct range can simplify the testing and set up procedures.

Start the Burner



WARNING

Professional Installation and Service Required



Incorrect installation and mishandling of start-up could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- This burner must be installed and prepared for start-up by a qualified service technician who is trained and experienced in commercial gas burner system installation and operation.
- Do not attempt to start the burner unless you are fully qualified.
- Do not continue with this procedure until all items in the 'Prepare the Burner for Start-up' section have been verified.
- Carefully follow the wiring diagrams, control instruction sheets, flame safeguard sequence of operation, test procedures and all appliance manufacturer's directions that pertain to this installation.
- If any of these items are not clear or are unavailable, call Beckett at 1-800-645-2876 for assistance.

Burner Start Procedure

(Before proceeding, turn off and lock out electrical power and close the main leak test cock to shut off gas to the burner.)

1. With the power and main gas supply to the burner turned off, make sure gas has not accumulated in the boiler or flues.
2. Check the initial air settings for the input firing rate. Check the manufacturer's settings either on the nameplate shown in **Figure 1** or listed in **Table 3**. If adjustment is necessary refer to **Figures 10A & 10B** and set the damper motor cam so that the indicator points to the values shown on the nameplate or listed in **Table 3**.
3. With the main gas supply valve closed. Set the limit or controller to call for heat then apply power to start the burner. Reset the high and low gas pressure switches if necessary.
4. In order to check the function of each component (i.e: flame safeguard sequence, airflow proving switch, ignition transformer, gas valves, safety lockout timing, etc.), with the gas supply closed off, monitor a complete burner run sequence. Note that the flame safeguard control will lock out since the fuel supply has been closed off.
5. If component operation sequence and function is correct, reset the flame safeguard and initiate a new cycle. Monitor the start-up cycle and manually open the main leak test cock as soon as the flame safeguard powers the safety shutoff valves. If the boiler room is quiet you may be able to hear the valve open, if not you can generally place your hand on the valve and feel it open. After you have observed main flame for a brief time, trip any of the switches in the limit string to shut the burner down. Monitor the flame and safety shutoff valves to assure that shutdown is controlled by the valves and that they operate properly. With this test passed you may safely initiate automatic start-ups on subsequent cycles.

Initial Air Settings

If your burner was built for a specific OEM (Original Equipment Manufacturer) application, the "Mfr's Settings" label (see **Figure 1**) will indicate the application and the initial air settings made at Beckett. Please verify those settings using the following procedure.

If your burner was not built for a specified application, the following steps outline the procedure for initially setting the damper (these settings may be different from settings specific to a particular OEM).

Refer to **Figure 10A** and **10B** for this procedure.

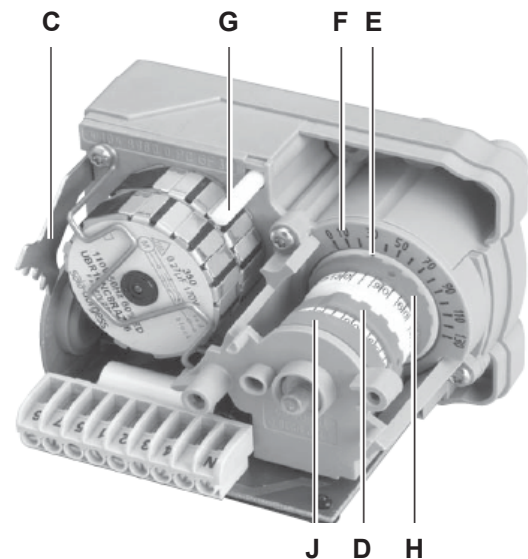
1. Remove the cover screw (**A**) then the cover (**B**) and set aside.

- Push in on pin (G) to disengage the motor from the damper shaft and cam stack. Rotate the damper shaft by hand to place the adjustment cams in a position where their adjustment scale can be easily seen. Release pin (G) to secure the damper shaft and cam stack to the motor.
- Using the wrench (C) supplied with the damper motor, adjust the blue low fire cam (D) to the initial setting listed in **Table 3**.
- Using the same wrench, adjust the red high fire cam (H) to the initial settings listed in **Table 3**.
- To adjust the high fire transition, use a small straight edge screwdriver. For high/low firing burners, turn the white adjustment screw located in the orange transition cam (J) until the cam indicator is half way between the high and low settings on the scale. For modulating burners the orange transition cam is not used.
- After setting all the cams, make sure the damper shaft and cam stack is set between its low fire setting and its high fire setting. (If you don't it may not move when it is powered.) Push in pin (G), move the damper by hand so that notch (E) is between the low fire setting and high fire setting on scale (F), then release pin (G) to re-engage the motor. When the motor is powered it will go to its low fire setting.
- This initial setting should be adequate for starting the burner at low fire. Once the burner is in operation, the air setting will be adjusted for best performance as discussed later in this manual. Don't forget to re-install the cover after all adjustments have been made.

NOTICE

The damper plate is attached by screws to its shaft, and bears against a flat on the shaft for alignment. The shaft is secured to the damper motor by a sleeve coupling with two setscrews bearing against the damper shaft and two more against the motor shaft. The motor shaft has a flat matching the one on the damper shaft. The flats on the damper shaft and the motor shaft should be aligned so that the position indicator in the damper motor reads accurately. The best way to align the flats is to tighten the setscrews that bear against the flats on the shafts first, and then tighten the ones that bear against the round surface of the shafts afterward.

The test for proper alignment is to disengage the damper motor from its shaft using the disengaging pin (Item G in Figure 10B) and rotate the damper plate to its full closed position. The position indicator should point to 0° within +/- 5° tolerance.

Figure 10A - Damper Motor with Cover**Figure 10B - Damper Motor with Cover Removed****Legend (Figures 10A & 10B)**

- | | |
|-------------------------|-----------------------------|
| A - Cover screw | F - Damper motor scale |
| B - Cover | G - Disengaging pin |
| C - Wrench | H - High fire cam (red) |
| D - Low fire cam (blue) | J - Transition cam (orange) |
| E - Cam notch | |

Optional Modulation Linkage Adjustment Instructions

The optional modulation linkage assembly has been designed as an economic means to adjust the damper and the butterfly valve to maintain air to gas ratios. When the optional Modulation linkage assembly is supplied with the burner, initial adjustments will be made at the factory. To ensure optimum operation, minor additional adjustments must be made after the burner is fired on a boiler.

The following adjustment will be pre-set at the factory, but may require minor adjustment at start-up:

- The damper motor high fire and low fire cams will be preset.
- The linkage between the damper and the butterfly valve will be preset as illustrated in the manual.
- The butterfly valve shaft will be set to a nominal position.

Figure 11 - Modulation Assembly for Right Handed Gas Entry (Optional Construction)

*CG50 SHOWN - CG25 AND CG15 ARE SIMILAR

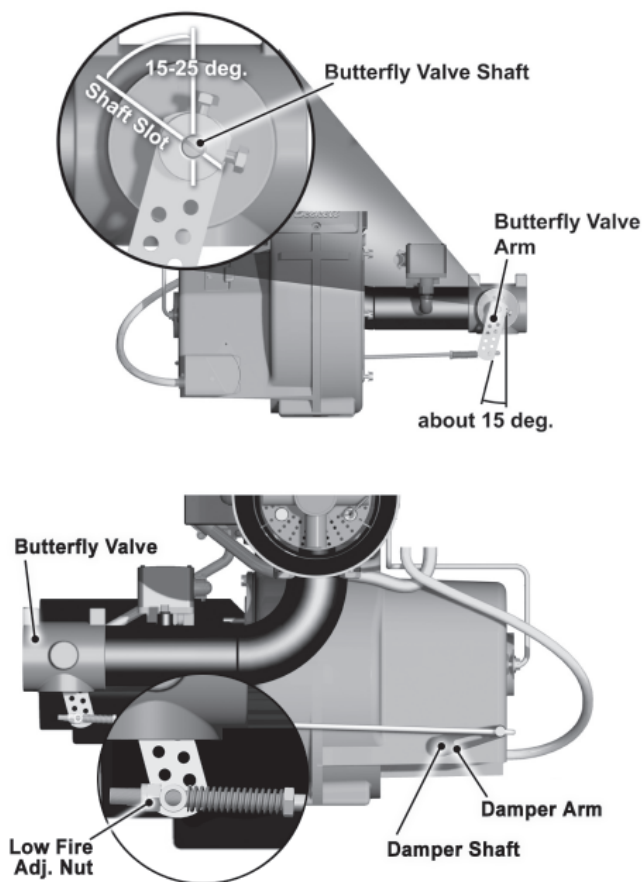
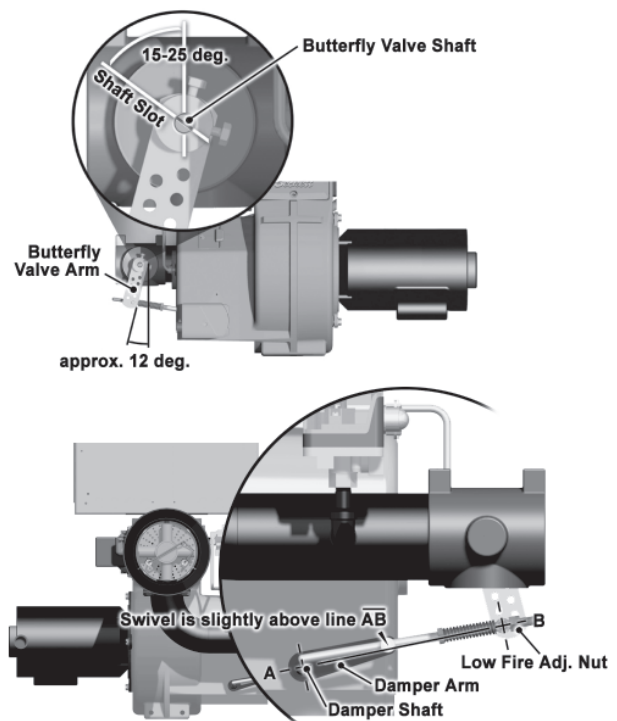


Figure 12 - Modulation Assembly for Left Handed Gas Entry (Standard Construction)

*CG50 SHOWN - CG25 AND CG15 ARE SIMILAR



Adjustment Procedure

NOTICE

Referring to the appliance manufacturer's literature, insure that all preliminary adjustments and calibrations required for the burner and appliance have been performed.

A) Prior to starting the burner

1. Verify that the damper motor high fire and low fire cam settings match the nameplate (**Figure 1**) or **Table 3**.
2. Examine the linkage for signs of damage.
3. Referring to the illustrations in **Figures 11 or 12**, verify that the linkage is installed as shown.
4. Prior to adjusting the burner, have available all the necessary test equipment.
 - A manometer to check pressures downstream of the gas pressure regulator; at the manifold pressure test connection and in the furnace
 - A draft gauge to check breaching pressure
 - A flue gas analyzer that can measure O₂ (or CO₂) and CO.
5. Adjust the gas pressure regulator to about ½" WC higher than the anticipated high fire gas pressure (see **Table 3**).
6. To prevent the burner from modulating to high fire, set the modulation controller to the manual control mode. If necessary, refer to the manual supplied with the modulation controller.

Table 3 - Initial Burner Settings for Both Propane & Natural Gas

			Furnace Pressure at High Fire															
			0" W.C.				0.25" W.C.				0.50" W.C.				1.00" W.C.			
High Fire Rate MBH	Low Fire Rate MBH	Burner Model	Low Fire Gas Pressure, inch WC	Low Fire Damper Setting	High Fire Gas Pressure, inch WC	High Fire Damper Setting	Low Fire Gas Pressure, inch WC	Low Fire Damper Setting	High Fire Gas Pressure, inch WC	High Fire Damper Setting	Low Fire Gas Pressure, inch WC	Low Fire Damper Setting	High Fire Gas Pressure, inch WC	High Fire Damper Setting	Low Fire Gas Pressure, inch WC	Low Fire Damper Setting	High Fire Gas Pressure, inch WC	High Fire Damper Setting
CG15																		
800	468	CG15.1S	0.9	9	2.7	25	1.0	9	2.9	26	1.1	9	3.2	27	1.3	10	3.7	31
900	468	CG15.1S	0.9	9	3.4	32	1.0	9	3.7	34	1.1	9	3.9	37	1.2	10	4.4	43
950	548	CG15.2S	0.9	12	2.6	30	0.9	13	2.9	33	1.0	13	3.1	36	1.2	14	3.6	42
1050	548	CG15.2S	0.9	12	3.2	38	0.9	13	3.4	48	1.0	13	3.7	58	1.1	14	4.2	84
1150	641	CG15.3S	0.9	16	2.8	42	0.9	17	3.1	49	1.0	17	3.3	56	1.2	19	3.8	74
1250	641	CG15.3S	0.9	16	3.3	52	0.9	17	3.6	68	1.0	17	3.8	85	-	-	-	-
1300	750	CG15.4S	0.9	20	2.7	51	1.0	21	2.9	66	1.0	22	3.2	80	-	-	-	-
1400	750	CG15.4S	0.9	20	3.1	66	1.0	21	3.3	100	-	-	-	-	-	-	-	-
CG25																		
1350	669	CG25.1S	0.7	17	2.7	38	0.7	17	3.0	38	0.8	17	3.2	39	0.9	18	3.7	41
1450	669	CG25.1S	0.7	17	3.1	41	0.7	17	3.4	41	0.8	17	3.6	42	0.9	18	4.1	41
1550	774	CG25.2S	0.7	20	2.7	41	0.7	20	2.9	42	0.8	21	3.2	43	0.9	23	3.7	46
1700	774	CG25.2S	0.7	20	3.2	48	0.7	20	3.4	49	0.8	21	3.7	51	0.9	23	4.2	56
1800	896	CG25.3S	0.7	23	2.7	54	0.7	23	2.9	55	0.8	24	3.2	56	0.9	26	3.7	60
2000	896	CG25.3S	0.7	23	3.3	66	0.7	23	3.6	68	0.8	24	3.8	70	0.9	26	4.3	78
2100	1037	CG25.4S	0.7	27	2.8	66	0.7	27	3.1	71	0.8	28	3.3	76	0.9	30	3.8	90
2300	1037	CG25.4S	0.7	27	3.4	84	0.7	27	3.6	93	0.8	28	3.9	102	-	-	-	-
2400	1200	CG25.5S	0.6	30	2.5	85	0.7	30	2.8	100	0.8	31	3.0	115	-	-	-	-
2500	1200	CG25.5S	0.6	30	3.0	100	0.7	30	3.2	115	-	-	-	-	-	-	-	-
CG50																		
2000	888	CG50.1S	0.5	7	2.4	20	0.5	7	2.6	20	0.6	7	2.9	21	0.7	8	3.4	23
2200	888	CG50.1S	0.5	7	3.1	22	0.5	7	3.3	23	0.6	7	3.6	24	0.7	8	4.1	26
2400	1044	CG50.2S	0.5	8	2.5	23	0.5	8	2.8	24	0.6	9	3.0	25	0.7	10	3.5	28
2700	1044	CG50.2S	0.5	8	3.2	28	0.5	8	3.5	29	0.6	9	3.7	30	0.6	10	4.2	34
2900	1228	CG50.3S	0.5	9	2.6	27	0.5	9	2.9	28	0.6	10	3.1	29	0.6	11	3.6	33
3200	1228	CG50.3S	0.5	9	3.2	31	0.5	9	3.5	33	0.6	10	3.7	35	0.6	11	4.2	41
3400	1443	CG50.4S	0.5	11	2.7	33	0.5	11	2.9	35	0.6	12	3.2	37	0.7	13	3.7	42
3800	1443	CG50.4S	0.5	11	3.3	44	0.5	11	3.6	46	0.6	12	3.8	48	0.6	13	4.3	54
4000	1700	CG50.5S	0.5	13	2.7	50	0.5	13	3.0	52	0.6	14	3.2	54	0.7	17	3.7	60
4500	1700	CG50.5S	0.5	13	3.5	70	0.5	13	3.7	76	0.6	14	4.0	82	0.6	17	4.5	96
4800	1700	CG50.5S	0.5	13	4.0	98	0.5	13	4.2	115	-	-	-	-	-	-	-	-

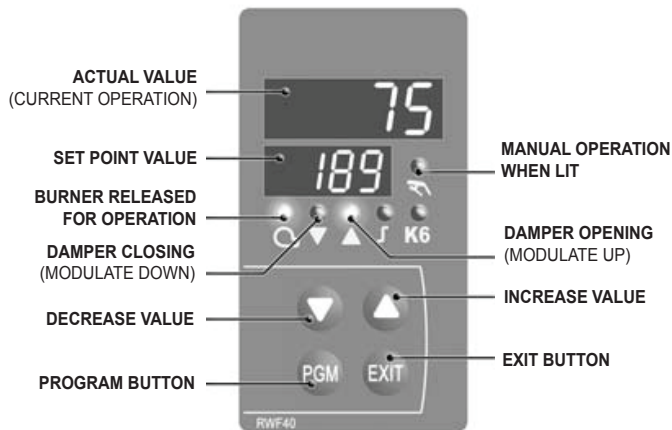
Gas pressures are as measured at the manifold test connection.

Notice: The settings in this chart are for reference only. The actual conditions at the installation may require further adjustment by the fully qualified and experienced start-up technician.

Notice: The light-off rate must not be set below the low fire recommendation. Lower rates will lengthen the time it takes for gas to get to the burner head and may cause ignition failures.

Modulation Control

Figure 13A - Display Meaning



Modulation of the burner's firing rate is accomplished by driving the damper motor in small increments to either increase or decrease rate in response to boiler demand. A pressure transducer (for steam boilers) or temperature sensor (for water boilers) senses boiler demand and communicates it to the controller. Display and programming functions for the Siemens RWF40 controller are shown in **Figure 13A** with the controller in the basic display mode.

Figure 13B - Manual Mode



Putting in manual mode:

- Press and hold exit button for 10 seconds.
- Manual operation light will illuminate.

The damper motor can be manually operated for set-up and service of the burner by placing the controller in the manual mode, as shown in **Figure 13B**. Press and hold the EXIT button for 10 seconds to enter the manual mode. The manual operation light will illuminate.

Figure 13C - Manual Operation



Operation in manual mode:

- Once in Manual Mode, the damper motor can be driven from high to low using the up/down arrows.
- To return to the automatic mode, press and hold exit button for ten seconds.

The damper motor can be driven from low to high or high to low by pressing the up and down arrows as shown in **Figure 13C**. Pressing EXIT for 10 seconds returns the controller to the automatic mode.

Figure 13D - Operation Set Point



Setting operation set point:

- From the original display, press program button once. (User level)
- Set point 1 is displayed.
- Use up/down arrows to change setting.
- When finished, press exit.

The operating set point can be changed as shown in **Figure 13D**. Pressing the PGM button accesses the User Level of the software, where this change is made. The up and down arrow buttons raise and lower the operating set point. Pressing EXIT returns the control to the Basic Display level and saves your changes.

Programming functions within the software are used to match its settings to the connected hardware, and to adjust the control's response to unusual job site requirements if necessary. A manual for the controller is provided with the burner to allow programming at that level.

B) At burner start-up - Note, as soon as the burner lights, be prepared to adjust the butterfly valve to set the low fire rate adjustment.

1. Monitor the flame through the observation port. If it appears to be too rich (yellow-orange flame), move the butterfly valve shaft slot setting toward a more vertical position. (This adjustment is made by turning the nut holding the spring-loaded swivel on the butterfly valve arm. If insufficient adjustment is available by this method the butterfly valve shaft can be repositioned in the arm. Care must be taken to make only small changes.)
2. Use a flue gas analyzer to check the flue gas ratings for O₂ and CO. Your target should be 4% O₂ and CO should be well below 50 PPM. (Note that the CO is usually near 0 at 4% O₂.)
3. If the O₂ and CO levels are not on target, turn the low fire adjustment nut as required to meet the target listed in Step 2.
4. Check the low fire rate. Either clock the meter or compare the manifold pressure drop to factory standards. Adjust the low fire cam setting in the damper motor (if necessary refer to the **Initial Air Setting** procedure described previously) and the butterfly valve shaft slot position as described in Step 1. Refer to Step 2 in this procedure and double check the O₂ and CO readings.
5. When low fire is set, use the modulation controller to manually step the burner up to its high fire rate.
6. Check flue gas O₂ and CO. Your target should be 3% O₂. CO should be well below 50 PPM, and is usually near 0 for that O₂. Adjust the regulated gas pressure as required to meet the target.
7. Check the high fire rate and adjust the high fire cam setting and regulated gas pressure as required to meet the target. (If necessary, refer to the **Initial Air Setting** procedure described previously.)
8. Using the modulation controller, manually step the burner back down to low fire and verify the O₂ and CO ratings. If the high fire adjustments were significant they may have affected the low fire settings as well. Refer to Step 4 in this procedure to make adjustments as necessary.
9. Using the modulation controller, manually step the burner through its range, stopping at several points to check O₂ and CO measurements.
10. After you are satisfied with the modulation linkage adjustments secure all linkage fasteners and continue the start-up procedure.

NOTICE

It is acceptable for a burner with linkage control of the fuel to show 2% variation in O₂ through the range as long as O₂ stays above the target points. If the O₂ drops below the target points it may lead to a CO problem. Moving the damper arm position on the damper shaft changes mid-range O₂. Loosening the clamping screws and moving the swivel end of the arm downward increases midrange O₂, upward decreases it. This change will affect the low fire O₂ setting, and you'll need to re-set it.

Verify Input Firing Rate

1. Clock the meter, correct for pressure and temperature to get SCFH and calculate the input firing rate. Compare the calculated rate to the specified input for the boiler found on the specification sheets and on the rating plates for the burner and boiler. Do not exceed the specified maximum input for the boiler.
2. Attach a manometer to the manifold test port, clock the meter, and adjust the regulated pressure until the specified input level is achieved. Refer to **Table 3**.
3. Be sure to set the breech or furnace pressure to the correct value, since this will have an effect on the manifold pressure.

NOTICE Estimating Rate

Manifold to Furnace Pressure information can be used to estimate the burner's firing rate when it is not possible to clock a meter for the rate.

To estimate the burner's firing rate:

- Measure the furnace pressure over fire
- Measure the manifold pressure (at the manifold pressure test connection).
- Subtract the furnace pressure from the manifold pressure
- Compare the result to the data in Figures 14A, 14B, or 14C as appropriate for your burner.

NOTICE Clocking a Gas Meter

Before you clock the meter you must make sure that the burner is operating at a steady rate, and that it is the only thing that is using gas that would flow through the meter.

NOTICE Uncorrected Flow Rate

- Locate the dial that moves the fastest and determine how many cubic feet are represented by one revolution of its dial.
- Use your watch for timing and observe how many cubic feet are used in one minute.
- Multiply by 60

Example: The dial is a one cubic foot dial, and goes around $7 \frac{1}{2}$ times in one minute. That gives 7.5 cubic feet per minute. Multiply by 60 to get 450 cubic feet per hour (CFH) as your uncorrected flow rate.

NOTICE Pressure Correction

Gas is compressible, the higher the pressure on it, the smaller the number of cubic feet it occupies. To correct for that you will need to know the gas pressure at the meter.

- If there's a gauge at the meter, read it while the gas is flowing. (If not, measure the gas pressure in the line downstream of the meter before any valves or regulators, with no gas flowing.)
- Convert the gas pressure to PSI if you measure it in any other units. (1 PSI = 27.7 inches water column)
- Add 14.7 to the meter pressure, divide their sum by 14.7, and multiply that result times the uncorrected flow rate to obtain the pressure corrected flow rate.

Example: The meter in the example above is operating at 14" WC.

$14 / 27.7 = 0.5$ PSI at the gauge; $14.7 + 0.5 = 15.2$; $15.2 / 14.7 = 1.034$ correction factor;

$1.034 \times 450 = 465$ CFH corrected for pressure

NOTICE Temperature Correction

Gas volume also changes with the temperature of the gas. Most gas meters are temperature compensated. They say so on the face of the index and don't require temperature correction. The temperature we correct to is 60° F. That's close to the temperature of the ground, so usually it's not necessary to correct for temperature from underground lines.

- Measure the gas temperature at the meter.
- Add 460 to the gas temperature and divide 520 by the result to obtain the correction factor.
- Multiply the pressure corrected flow rate times the temperature correction factor.

Example: The meter in the example is connected to an above ground line on a hot day and shows 100° F gas temperature. $460 + 100 = 560$; $520 / 560 = 0.929$; $465 \times 0.929 = 432$ CFH corrected for pressure and temperature. This figure is often called SCFH (for standard cubic feet per hour).

NOTICE BTU's and MBH

Natural Gas

The BTU content of natural gas varies from one location to another, and even from day to day at a fixed location. For firing estimates it is usually assumed to be 1000 BTU's per standard cubic foot.

To calculate BTU/Hr firing rates multiply SCFH times 1000.

Example: $432 \text{ SCFH} \times 1000 = 432,000 \text{ BTU/Hr}$. MBH stands for thousands of BTU's per hour. Since 1 cubic foot of natural gas contains 1000 BTU, 1 MBH equals 1 SCFH of gas flow.

Example: $432 \text{ SCFH} = 1,080 \text{ MBH}$

LP (Liquified Petroleum) Gas

The BTU content of LP gas varies with the relative quantities of propane and butane in each delivery of gas and changes as liquid level in the tank falls. For firing estimates it is usually assumed to be 2,500 BTUs per standard cubic foot.

To calculate BTU/Hr firing rates multiply SCFH times 2,500.

Example: $432 \text{ SCFH} \times 2500 = 1,080,000 \text{ BTU/Hr}$. MBH stands for thousands of BTU's per hour. Since 1 cubic foot of propane gas contains 2,500 BTU, 1 MBH equals 0.4 SCFH of gas flow.

Example: $432 \text{ SCFH} = 1,080 \text{ MBH}$

Figure 14A - Manifold to Furnace Pressure Drop vs Rate CG15 *

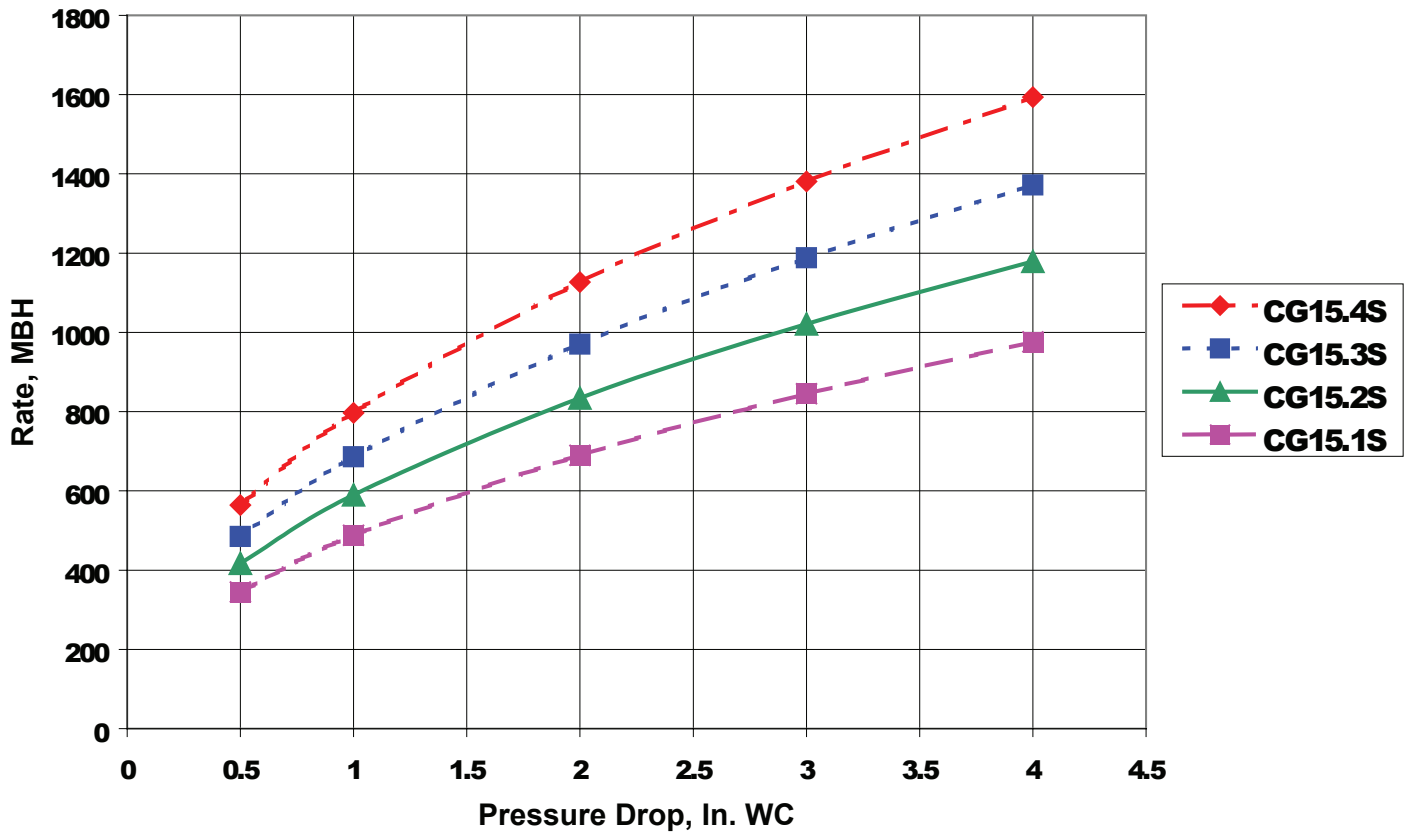
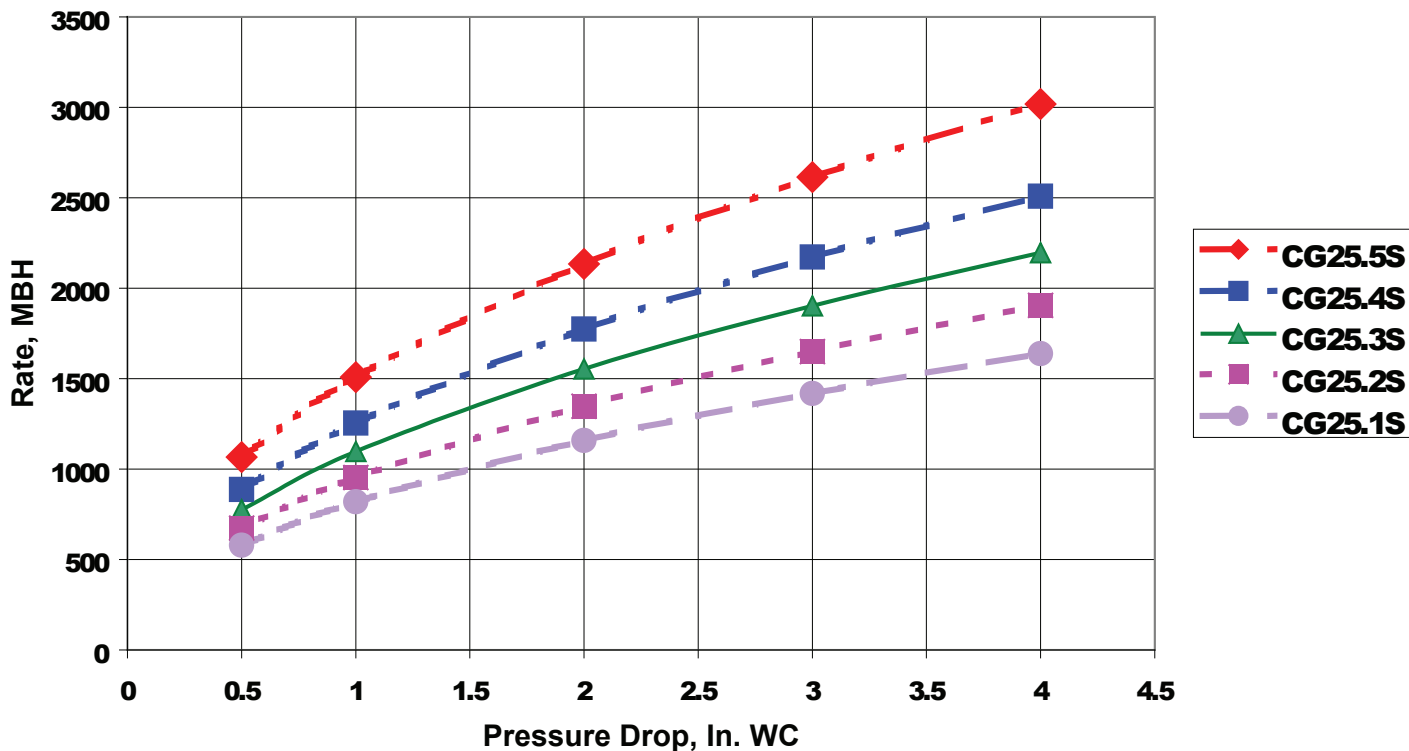
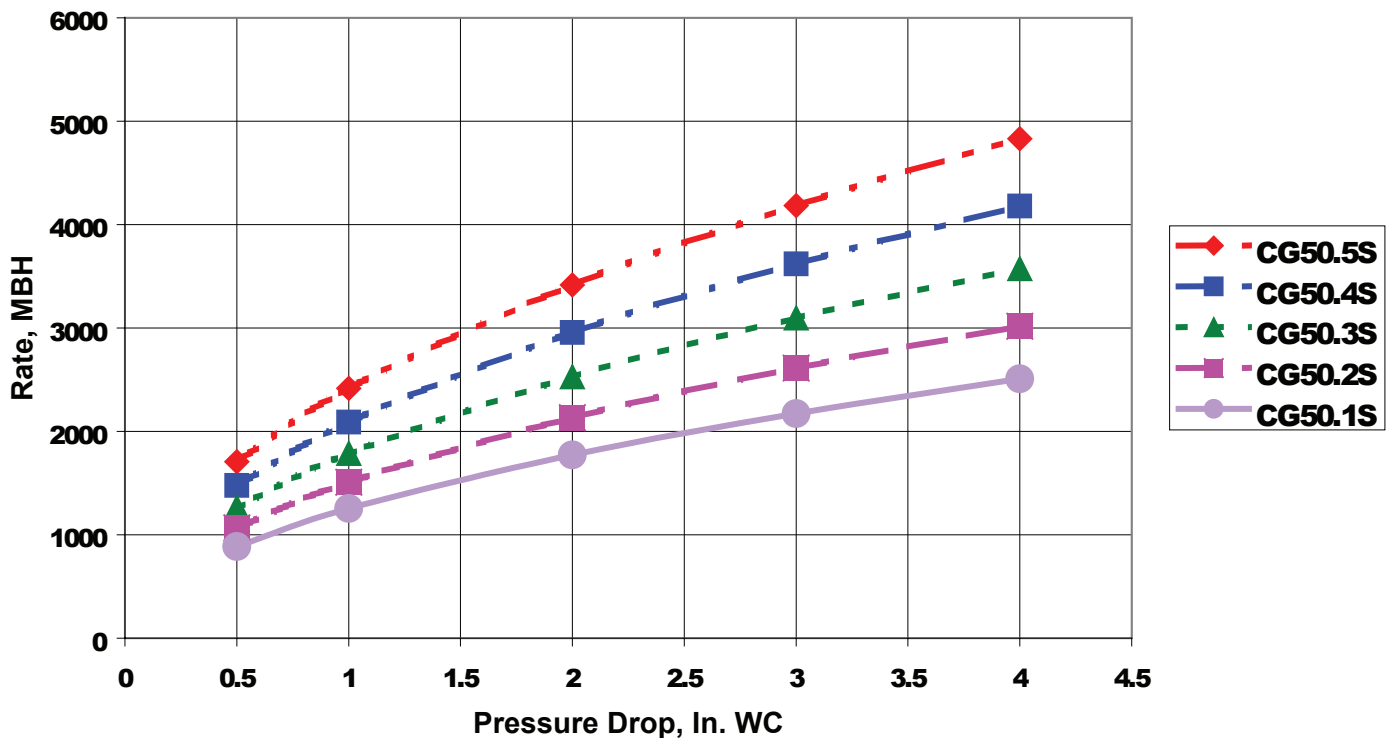


Figure 14B - Manifold to Furnace Pressure Drop vs Rate CG25*



* Charts represent both natural and propane gas.

Figure 14C - Manifold to Furnace Pressure Drop vs Rate CG50*



* Charts represent both natural and propane gas.

Check Operation and Safety Controls

WARNING Testing by Qualified Technician Required.

Failure to properly test and verify the correct function of operation and safety controls could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- The testing of operation and safety controls requires technical training and experience with commercial gas burning systems.
- Carefully follow the manufacturer's instructions supplied with the controls.
- Verify the correct function of all operation and safety controls used in the installation.
- If instructions are not available, use the following recommended procedures and record all results in a start-up log.
- Refer to Figure 7 for typical test points and component locations.

1. **High limit** – To check the High Limit, raise the temperature or pressure of the operating control to a higher level and lower the limit to a setting less than the operating control. Run the burner until the high limit opens and shuts the burner off. Adjust the controls back to the desired settings.

2. **Operating control** – Run the burner until the operating control shuts it off. If necessary, make adjustments to ensure the control cycles the burner in the desired temperature or pressure range.

NOTICE Operating controls should be set to minimize the number of firing cycles that the burner runs. High cycling rates increase the possibility of light-off lock outs.

3. **Low water cutoff (LWCO)** – With the burner firing, open the blow down valve on the low water cutoff, if applicable. As the water level drops, the LWCO switch contacts open and shut the burner off. When the water level rises, the LWCO contacts close and restart the burner. Monitor the LWCO switch operation in relation to the water level in the sight-glass for synchronization.
4. **Airflow proving switch** – With the burner firing at its lowest rate, loosen the tubing connection to the airflow proving switch. A loss in air pressure at the tubing should immediately cause the diaphragm in the switch to open and recycle or lockout the safeguard control.
5. **Low gas pressure switch** – With the burner firing and a manometer attached to a test port near the low pressure switch, gradually close the main leak test cock to shut off the gas supply. Note the pressure at which the low gas pressure switch opens and shuts the burner off. Manually reset the switch. The low gas pressure switch should be set at half of the normal supply pressure in the line.

6. **High gas pressure switch** – With the burner firing and a manometer attached to the test port nearest the high pressure switch, gradually increase the gas pressure until the high pressure switch opens and shuts the burner off. Note the pressure and manually reset the switch. The high gas pressure switch should be set at one and one half times the high fire manifold pressure (see nameplate data in **Figure 1** or set switch as determined by testing).
7. **Leak-test valve** – With the burner firing and manometer attached to the leak-test valve port, turn the burner electrical switch off and observe that the gas pressure does not increase after several minutes. This proves total closure of the main gas valve.
8. **Flame safeguard safety lockout** – Simulate a flame failure by turning the main gas supply off. The control should shut the burner off on safety within the safety lockout time.
9. **Flame sensor circuit (flame rod)** – With the burner power switch turned off, refer to the wiring diagram supplied with the control and locate the sensor connection terminals. Place DC voltmeter probes in the flame amplifier test jacks. With the burner firing, the flame signal should be steady and at least 1.25 VDC.
10. **Flame sensor circuit (UV scanner)** – With the burner power switch turned off, refer to the wiring diagram supplied with the control and locate the sensor connection terminals. Place DC voltmeter probes in the flame amplifier test jacks. With the burner firing, the flame signal should be steady and at least 1.25 VDC.

Use Test Instruments to Set Combustion

Verify that all boiler sections, canopy, and access plates or doors are fully equipped with gaskets and sealed against any leakage, which could affect the combustion test results. Before making these tests, operate the burner for several minutes to allow the heating system temperature to stabilize or nearly reach steady-state levels. Record all results in the start-up log for future reference.

Draft – Set the breech or furnace pressure to the level specified by the appliance manufacturer. Typical example: +0.10" W. C.

NOTICE

Always use calibrated test instruments to set combustion levels. Verify that test instruments are calibrated and in good working condition. If not already provided, drill test access holes in the flue pipe near the breech (or upstream of the boiler breech damper, if applicable) and in the front mounting plate area for firebox pressure. Be careful not to damage any water-backed surface.

Oxygen – For both low fire and high fire it is recommended that you measure the oxygen (O₂) early in the test sequence because high levels of carbon monoxide can be created at very low or even very high O₂ levels. The typical operating range is between 2.5% – 4.5 %. The equivalent carbon dioxide (CO₂) operating range is 9% – 10.5%.

NOTICE

High excess air levels reduce the flame's UV output and the scanner signal that proves the burner is firing.

Carbon monoxide (CO) – An operating range of 0 -50 PPM is recommended for the burner. The maximum carbon monoxide (CO) level permitted in the flue gas by the UL 795 Standard is 400 PPM (0.04%).

Stack Temperature – The stack temperature should be within the range specified by the appliance manufacturer. It is influenced by input firing rate, flame shape, excess air ratio, and cleanliness of boiler flue passages. This temperature, combined with the ambient temperature, and O₂% (or CO₂) is used in calculating the appliance efficiency.

Recommended Combustion Test Sequence

1. Adjust the draft or breech pressure to the appliance manufacturer's recommended level.
2. Measure the carbon monoxide level and adjust air settings, if necessary, to regulate it to about 50 PPM for a starting point.
3. Measure the O₂ or CO₂ at the 50 PPM CO level. For this discussion, assume the O₂ is 1.5% (11% CO₂).
4. Open the air adjustment until the O₂ level is increased by at least 1% or to 3% O₂ (whichever is higher). This should reduce the CO level and provide a margin of reserve air to accommodate variable conditions.
5. Sample the CO level again. It should be in the 0 to 20 PPM range.
6. Check the draft to ensure it still meets specifications. If a major change in draft is required, repeat the above steps.
7. Perform any final adjustments and lock the air settings securely. Run the burner through several cycles to verify prompt ignition and stable burner operation.

Maintenance and Service

WARNING Annual Professional Service Required



Tampering with or making incorrect adjustments could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- Do not tamper with the burner or controls or make any adjustments unless you are a trained and qualified service technician.
- To ensure continued reliable operation, a qualified service technician must service this burner annually.
- More frequent service intervals may be required in dusty or adverse environments.
- Operation and adjustment of the burner requires technical training and skillful use of combustion test instruments and other test equipment.

WARNING Turn Off Electric and Gas Supply Before Servicing

Failure to turn off electric and gas supply could result in electrical shock, gas leakage, explosion, or fire hazards.

- Turn main gas valves and electric power off before performing any maintenance.
- If a maintenance procedure requires electrical power, use extreme caution.

Annual Maintenance

(The following should be performed by a qualified service technician only.)

Burner:

1. Run the burner and perform a complete combustion test using the proper instruments before proceeding. If necessary refer to the section labeled **Start the Burner**. Record the results for reference.
2. Inspect and clean all dirt accumulation from the gas train, burner exterior, burner air damper, and surrounding area.
3. Remove the blower motor and clean any accumulated matter from the blower wheel and motor end bell.
4. Clean all flue passages and flue pipe. Replace corroded or damaged pipes.
5. Check wheel for damage and the hub setscrew for tightness. If the blower wheel must be removed from the motor shaft, insure that clearance

specifications are maintained (blower wheel hub to motor clearance should be .020”).

6. Clean the inside surfaces of the burner housing scroll and especially the air intake area and airflow proving switch suction tube.
7. If the blower motor does not have permanently lubricated bearings, oil the motor. Clear any debris from the air vents on the motor body.
8. Clean the ignition transformer, baseplate, and terminal bushings. Inspect the ignition leads for signs of deterioration and loose terminals.
9. If the burner flame detection is a UV scanner, inspect the mounting and clean the lens according to the component manufacturer's recommendations.
10. Remove the gas gun assembly and clean the entire unit, paying special attention to the air diffuser and spuds.
11. Inspect the flame rod (if used) for oxidation or distortion. Clean all surfaces, set the probe position, and insure that the flame rod is securely fastened. Refer to **Figures 15A**, and **15B**.
12. Inspect the ignition electrode for any damage. Clean all surfaces, set the proper electrode gap, and make sure it is securely fastened.
13. Clean the inside of the air tube and inspect the combustion end for any deterioration. Referring to **Figure 2**, check the recess dimension from refractory.
14. Inspect gas tube O-ring condition and replace if damaged. Install gas gun assembly back into the burner and use the jacking screw to tighten the gas gun securely in place. (Automotive chassis or bearing grease is suitable for o-ring lubrication.)
15. Inspect the condition of the appliance mounting plate and burner mounting flange gaskets and replace any damaged materials. See **Figure 6**.
16. Inspect all burner control wiring and the burner control panel for damaged insulation and loose terminals/connections.
17. Verify that the source voltage to the burner and control panel is within 10% of the burner rating as listed on the nameplate. (**Figure 1**)

Appliance

(Follow appliance manufacturer's service procedures. The following steps are emphasized because they relate to burner operation)

1. Check the condition of the combustion chamber refractory, the front-plate insulation, and all gaskets and seals. Repair or replace as necessary
2. Insure that the flue passages, flue vent pipes, and chimney flues are clean and unobstructed.

3. Check barometric damper or draft hood for proper operation.
4. Inspect boiler sections and system load piping for possible leaks. Make all necessary repairs.
5. Check all operating and safety controls on the boiler for proper installation and operation.
6. Perform all maintenance and tests according to the burner control manufacturer's instructions (limits, controllers, low water cutoff, relief valves, feed valves, etc.)

Gas Supply Piping

Inspect all piping for leakage and proper installation. Perform necessary repairs to comply with all codes.

Installation Area

1. Insure that there are no combustible materials, flammable liquids or vapors in the vicinity of the heating appliance.
2. Verify that the combustion air supply is functioning properly, adequately sized, clean, and properly lubricated.

Adjust the Burner for Proper Combustion

Follow the guidelines under **Start the Burner** to set the combustion levels using test instruments.

Flame Safeguard

Follow the control manufacturer's instructions and verify that the control is functioning to specifications. See **Page 14** or **16** for appropriate sequence of operation and Items 8 through 10 on **Page 28** for control system checks.

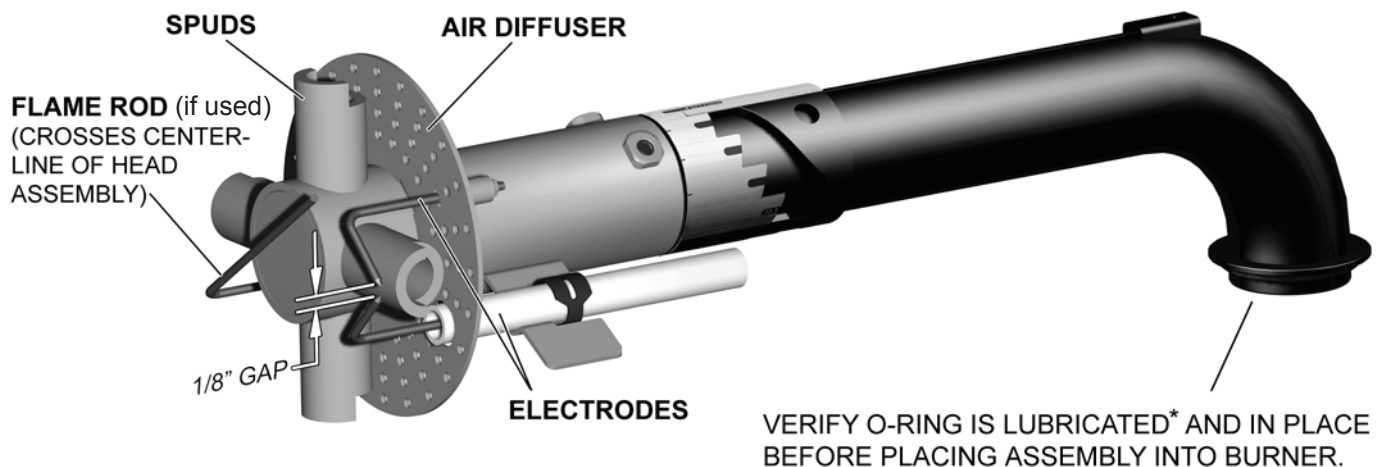
Manual Shutdown for Long Periods

1. Close all gas valves in the gas supply piping system.
2. Turn off all electrical power to the burner.
3. Protect the burner and controls from moisture and dirt.

Ignition Reliability

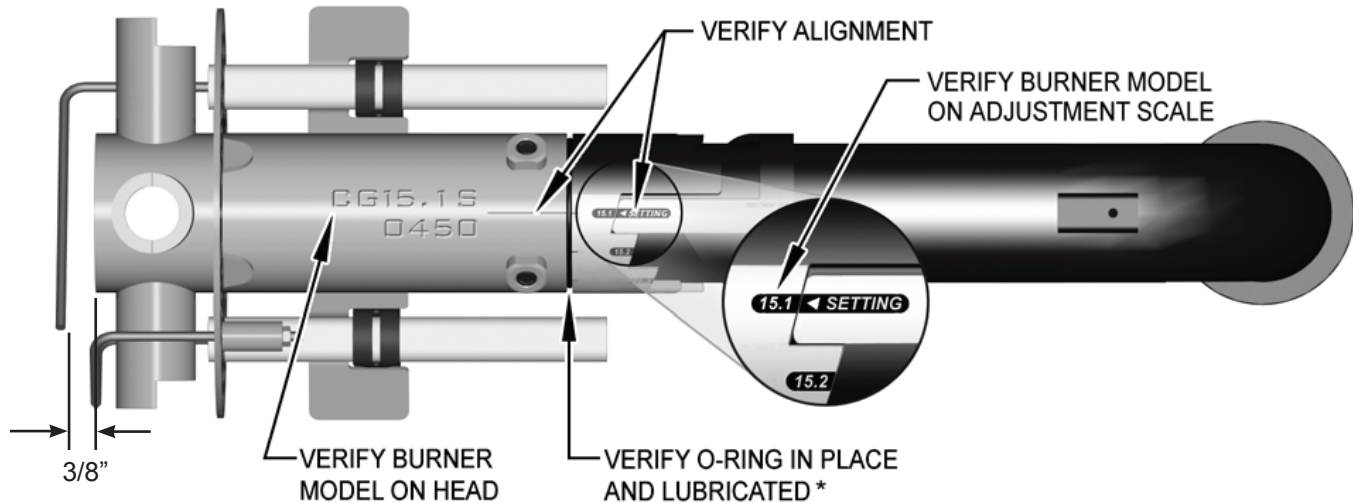
1. Examine ignition electrode insulators for cracks.
2. Examine ignition wires for worn insulation.
3. Examine ignition electrodes for wear.
4. Check ignition transformer functionality.
5. Verify that the head is centered in the airtube and that the head is not damaged.
6. Check inlet pressure to the gas train SSOVs.
7. Verify maximum recommended pipe lengths used in gas trains (**Figure 8A/B**)
8. Verify low fire light-off rate (**Table 3**)

Figure 15A – Gas Gun Assembly



* Automotive chassis or bearing grease is satisfactory o-ring lubricant.

Figure 15B – Gas Gun Assembly



* Automotive chassis or bearing grease is a satisfactory o-ring lubricant.
- Disassembly of gas gun is not required for cleaning.

Burner Head Adjustment - There is an optimum gas orifice size and burner head setting for each firing rate of the burner. The gas orifice size sets the gas flow velocity; the head setting establishes the airflow velocity. When those velocities are properly matched the burner provides its best performance and stability.

The gas orifice size is built into the burner head. You can verify the correct selection by looking for the burner model number stamped on the top centerline of the stainless steel tube that forms the base of the burner head. It should match the model number on the Beckett burner data label on the blower housing. The head setting is established by a notched sleeve on the gas tube that can be rotated to positions on a scale marked by the burner's model number. The scale should normally be set to the model number on the Beckett burner data label. (If specific application requirements dictate an alternate head setting it will be noted by a label on the gun assembly.)

For normal service requirements it is not necessary to disassemble the head from the gas tube. If you disassemble the gas gun, make sure that when you re-assemble it:

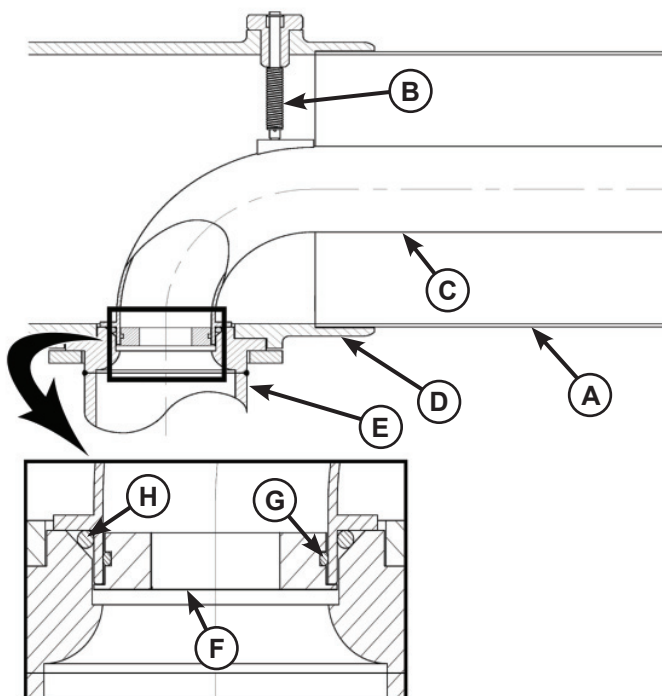
1. The adjustment scale is set to the correct position as indicated by the burner model number or Gun Label.
2. The alignment marks on the head, scale and stop are in alignment.
3. The O-ring between the head and the adjustment scale is in place, is lubricated with grease, and is compressed between the head and scale as the setscrews that retain the head are tightened.

Propane Restrictor Description

The Beckett Propane Restrictor Conversion Kit allows for the conversion of CG15, CG25, and CG50 burners for use with propane gas. With the proper installation of the restrictor and attached O-ring, adjustments and settings for propane use will be the same as the adjustments and settings for natural gas use as detailed in the burner manual.

WARNING This conversion kit shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. (In Canada, in accordance with the requirements of the CAN/CGA-B149 Installation Code.) If the information in these instructions is not followed exactly, a fire, explosion, or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency is responsible for the proper installation of this kit. The installation is not proper and complete until the operation of the converted appliance is checked, as specified in the manufacturer's instructions supplied with the kit.

Figure 16 – Propane Conversion Major Components



Installation

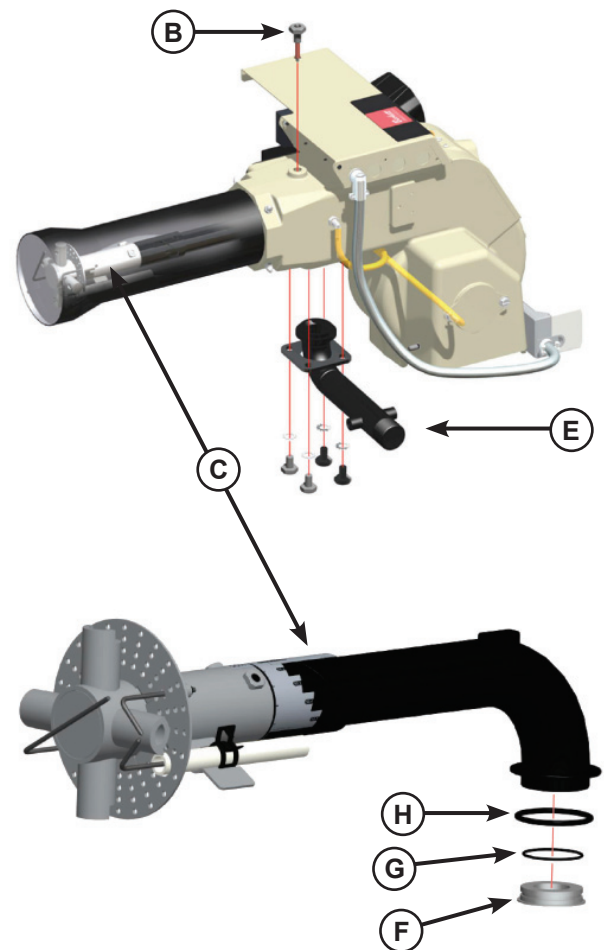
Note that Steps 1 and 2 on the reverse side refer to fully assembled burners. Skip to Step 3 when converting a burner without the air tube assembly installed. Refer to **Figures 16** and **17** when performing the following steps.

NOTICE

CG15 is shown in the illustrations. CG25 and CG50 are similar.

CG10 is similar with the exception of having the gas gun assembly mounted into the air tube instead of the housing.

Figure 17 – Component Locations



Major Component Key for Figure 16 & 17			
A	Air Tube	E	External Gas Manifold
B	Jacking Screw	F	Propane Restrictor
C	Internal Gas Tube	G	Restrictor O-ring
D	Burner Housing	H	Gas Tube O-ring

NOTICE

Use authorized replacement parts only. Restrictors are precision-machined parts and O-rings are rated for fuel contact. Do not attempt to replicate or modify any parts. Refer to **Table 4**.

NOTICE

The gun assembly is secured inside the air tube by a spring-loaded jacking screw. It is spring loaded in order to control the force it can impose on the gun assembly. When installing the jacking screw look inside the air tube to verify that the pointed tip of the jacking screw pin is seated into the small slot on the locating pad on top of the gun. There is also an external verification of correct assembly: when the screw is fully tightened, the e-clip on the top of the center pin should come flush with the top of the screw. Refer to **Figure 18**.

1. Remove the jacking screw (B) from the housing to free the internal gas tube (C).
2. Gently rock the internal gas tube (C) to loosen the tube from the burner housing (D).
3. Inspect the O-rings and insure that they are properly lubricated. (A silicon O-ring lubricant is recommended, but automotive chassis or bearing grease is an acceptable substitute.)
4. Referring to **Figure 17**, place the restrictor (F) with pre-attached, pre-lubricated O-ring (G) into the internal gas tube (C). Use your hand to press the restrictor into the tube. The O-ring will hold the restrictor in place.
5. Insure that the O-ring (H), attached to the outside diameter of internal gas tube, is properly lubricated and seated against the flange on the internal gas tube.
6. Install the internal gas tube (C) back into the housing, refer to **Figure 16**. Fit the end of the tube into the external gas manifold (E).
7. Re-install the jacking screw (B). (Refer to the above notice for installation details.)
8. Fill out and place the supplied Conversion Data Plate adjacent to the rating plate.
9. Complete and attach the supplied Adjustment Data

NOTICE

With the gas restrictor installed, as shown in **Figures 16 & 17**, all burner air adjustments and gas manifold pressure adjustments for propane will be approximately the same as the natural gas adjustments shown in the burner manual, or printed on the "Mfr's Settings" label on the burner housing. For a copy of the current burner manual go to <http://www.beckettcorp.com/protect/tech.asp>. If further Technical assistance is required, call 800-645-2876, Monday thru Friday, 8AM to 5PM EST.

Figure 18 – Gas Gun Installation

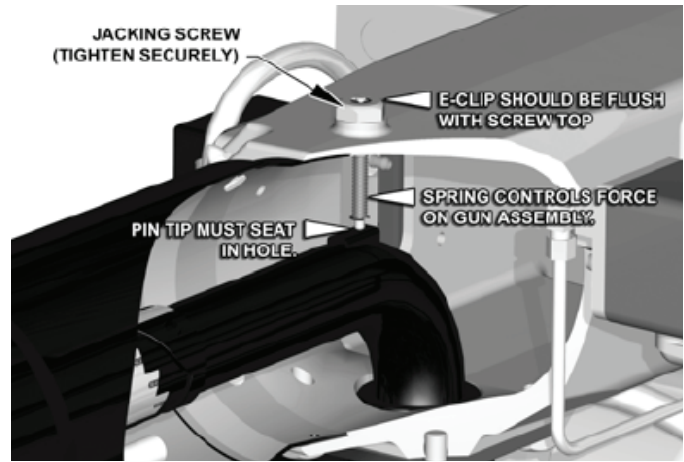


Table 4 - Propane Restrictors Replacement Part Numbers

Burner Model	Restrictor Part Number	Restrictor Inside Diameter	O-Ring Part Number
CG15.1S	3246709U	0.532	3226401U
CG15.2S	3246710U	0.576	3226401U
CG15.3S	3246711U	0.623	3226401U
CG15.4S	3246712U	0.677	3226401U
CG25.1S	3246713U	0.712	3226402U
CG25.2S	3246714U	0.742	3226402U
CG25.3S	3246715U	0.796	3226402U
CG25.4S	3246716U	0.833	3226402U
CG25.5S	3246717U	0.889	3226402U
CG50.1S	3246718U	0.925	3226403U
CG50.2S	3246719U	0.980	3226403U
CG50.3S	3246720U	1.031	3226403U
CG50.4S	3246721U	1.103	3226403U
CG50.5S	3246722U	1.150	3226403U

For the Operator


WARNING

Inspect Heating System Regularly

Lack of regular inspections and inadequate maintenance could lead to equipment malfunction and result in asphyxiation, explosion or fire.

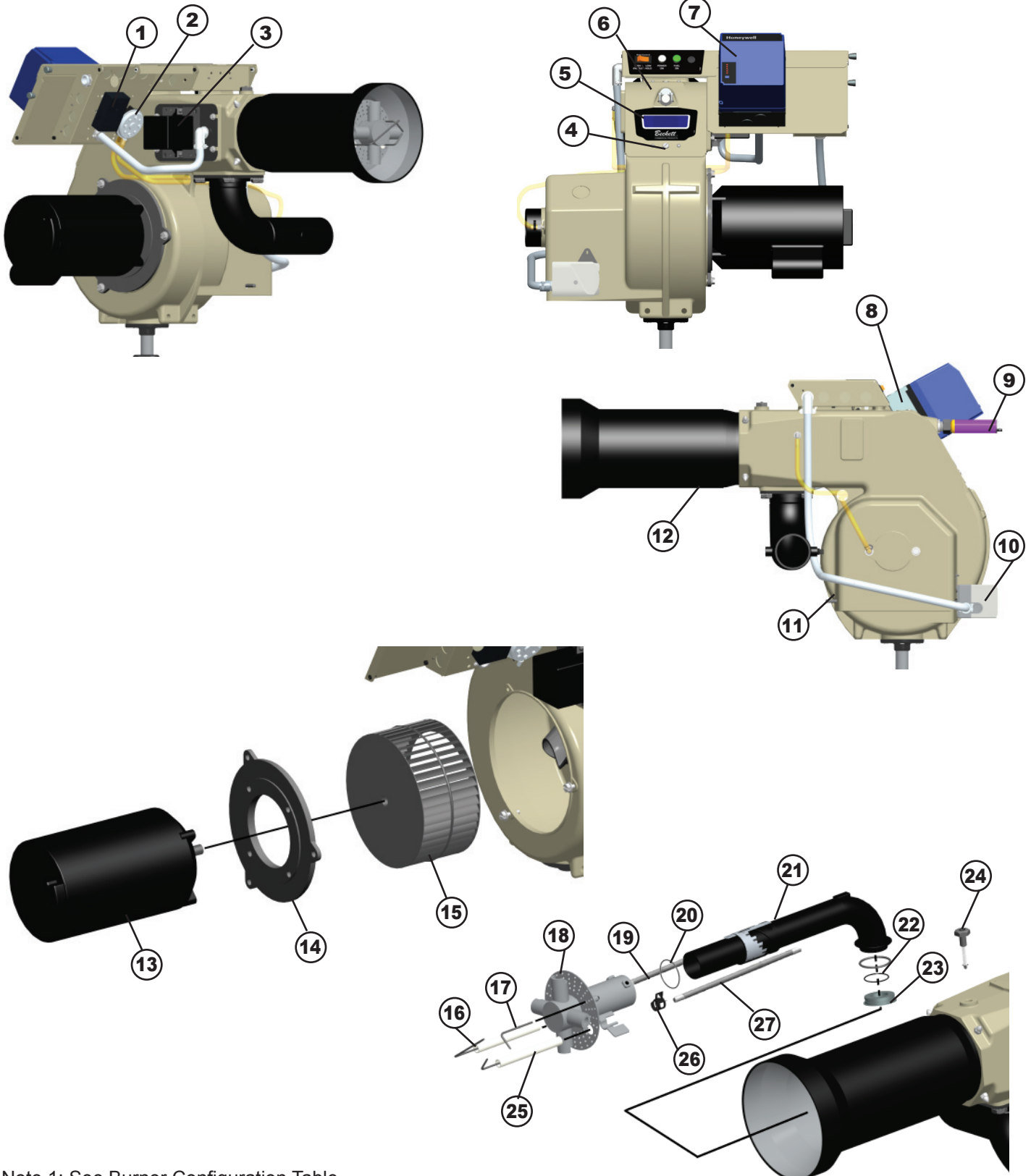
- (Always follow the appliance manufacturer's recommended service instructions, when available.)
- The following checklist is intended to be used as a minimum reference guide only and does not supersede or replace the heating appliance manufacturer's recommended service and maintenance instructions or any code requirements.
- Consult the installation and service instructions provided by the individual control or component manufacturer and carefully follow their directions.
- Maintenance and testing may be required more frequently due to dusty or severe operating conditions.
- If unusual or questionable performance is observed, shut the system down and contact your qualified service agency immediately.

Table 5 - Periodic Inspection Sheet

Test/Inspection	Frequency	Comments
Inspect area surrounding heating plant	Daily	Keep area clean and free of clutter
Inspect gas supply system for leaks	Daily	Use visual and electronic leak detection
Inspect appliance & piping for water leaks	Daily	Keep burner and controls dry at all times
Inspect gauges, indicators, monitors	Daily	Note condition. Replace defective parts
Check temperature and pressure levels	Daily	Compare to manufacturer's specifications
Make visual inspection of flame	Daily	Look for changes in shape, size, and color.
Monitor burner start-up	Daily	Verify prompt ignition and flame stability.
Monitor stack temperature	Daily	Compare to start-up and trend level.
Test low water cutoff and alarm	Daily	Follow control manufacturer's instructions & procedures in ASME Boiler & pressure vessel Code, Section VI - Recommended rules for care and operation of heating boilers.
Calculate fuel gas input firing rate	Weekly	Compare to appliance manufacturer's Specifications
Check flame safeguard sequence of operation.	Weekly	Follow control manufacturer's instructions
Flame failure response & lockout timing.	Weekly	Follow control manufacturer's instructions
Flame sensor signal level (if meter is hard-wired)	Weekly	Compare to control manufacturer's specifications
Main fuel gas valves	Weekly	Open high limit and verify cutoff operation
Inspect exhaust vent system for blockage	Weekly	Remove any restrictions
Inspect combustion air supply	Monthly	Remove any restrictions
Check high and low gas pressure interlocks	Monthly	Follow control manufacturer's instructions
Check safety valves	As needed	Follow control manufacturer's instructions & procedures in ASME Boiler & Pressure Vessel Code, Section VI - Recommended Rules for Care and Operation of Heating Boilers.

Replacement Parts

For best performance specify genuine *Beckett* replacement parts.



Note 1: See Burner Configuration Table.

Item	Description	CG15 Part No.	CG25 Part No.	CG50 Part No.
1	Timer (if used)	21295U	21295U	21295U
2	Air Proving Switch	22181U	22181U	22182U
3	Ignition Transformer	7503U	7503U	7503U
4	Spring Latch (Dzus Fastener)	32444U	32444U	32444U
5	Sight Glass**	31346U	31346U	31346U
6	Rear Access Door* For UV For Flame Rod	5201303U 5201301U	5201304U 5201302U	5201304U 5201302U
7	Control	Refer to UL Label for Model Numbers		
8	Control Subbase	Refer to UL Label for Model Numbers		
9	UV Sensor (If Not Using Flame Rod)	7247U	7247U	7247U
10	Damper Motor Lo/Hi Modulation	750601U 750603U	750601U 750603U	750601U 750603U
11	Nylon Bushing	32294U	32294U	32294U
12	Air Tube	Specify Model		
13	Motor 115-208-203V 208-230/380-460V 575V	21401U 21638U 21735U	21402U 21499U 21734U	21527U 21547U 21733U
14	Mounting Flange	N/A	31347U	31449U
15	Blower Wheel	21268U	21267U	21528U
16	Flame Rod	2191302U	N/A	N/A
17	Ground Electrode	2191106U	2191107U	2191108U
18	Head, Welded Assembly	Specify Model		
19	Cable, Flame Rod (If Used) Panel No Panel	5990480U 5990360U	5990480U 5990360U	5990480U 5990360U
20	O-ring Set (2 included)	3226402U	3226403U	3226404U
21	Gas Tube, Welded Assembly	5193202BKU	5193203BKU	5193204BKU
22	Restrictor O-ring (LP Only)	3226401U	3226402U	3226403U
23	Propane Restrictor (LP Only)	See Table 4		
24	Jacking Screw Assembly	5193402U	5193403U	5193403U
25	Ignition Electrode	2191206U	2191207U	2191208U
26	Clamp	4474U	4474U	4474U
27	Cable, Ignition Electrode	5990184U	5990184U	5990184U
NS	Low Gas Pressure Switch	2190902U	2190902U	2190902U
NS	High Gas Pressure Switch	2190903U	2190903U	2190903U

* Includes Sight Glass, Label, Gaskets, and Fasteners

**Includes Beckett Label and Window Gasket

NS = Not Shown

Limited Warranty Information

The R. W. BECKETT CORPORATION ("Beckett") warrants to persons who purchase its "Products" from Beckett for resale, or for incorporation into a product for resale ("Customers"), that its equipment is free from defects in material and workmanship. To qualify for warranty benefits, products must be installed by a qualified service agency in full compliance with all codes and authorities having jurisdiction, and used within the tolerances of Beckett's defined product specifications.

To review the complete warranty policy and duration of coverage for a specific product, or obtain a written copy of warranty form 61545, please choose one of the following options:

1. Visit our website at: www.beckettcorp.com/warranty
2. Email your request to: rwb-customer-service@beckettcorp.com
3. Write to: R. W. Beckett Corporation, P. O. Box 1289, Elyria, OH 44036

NOTE: Beckett is not responsible for any labor cost for removal and replacement of equipment.

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Part Number 6104 BCF50 R13, Printed in the U.S.A. 06/10

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