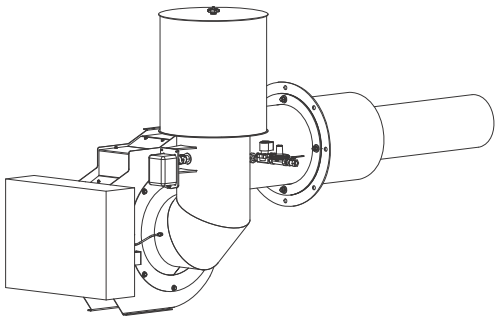
CleaverBrooks®

Profire MTH

Burner
Gas Only

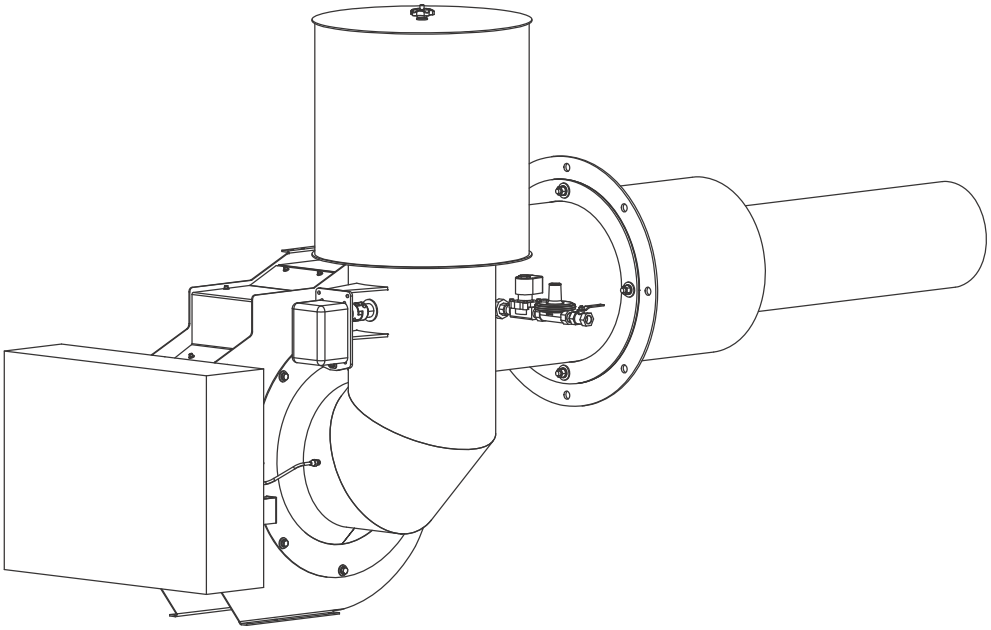
Installation
Operation
Maintenance



Manual Part No. 750-340 11/2012

PROFIRE MTH SERIES

Installation, Operation, and Service Manual



Manual Number: 750-340

Release Date: July 2011

Information to be filled out by owner:

Unit Serial Number:

Date of Installation:

Representative Information

Name:

Address:

Phone Number:

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PREFACE

It is the responsibility of the owner of this equipment to post and maintain a legible copy of this Installation, Operation and Maintenance manual while this equipment is in service.

Warning and caution references have been made in this manual and should be adhered to for smooth operation of the burner.

⚠ Warning

This symbol precedes information which, if disregarded, may result in injury to the user of the burner or to others.

⚠ Caution

This symbol precedes information which, if disregarded, may result in damage to the burner.

NOTE: This symbol precedes information which is vital to the operation or maintenance of the burner.

Model designations are based on the type of fuel(s) to be fired and the amount of furnace pressure to be overcome. Burner size is based on firing rate (rated input in Btu/hr).

Model Standards	Fuel-Air Atomization
MTH	Gas

The equipment must be installed in accordance with applicable local, state, or Provincial Installation Requirements including the National Electrical Code (NEC) and Associated Insurance Underwriters. Where applicable, the equipment shall be installed in accordance with the Provincial Installation Requirements, or in their absence, the Canadian Gas Association (CGA) B149.1 and B149.2 and Canadian Standard Association (CSA) B140 and B139 (for oil burners) Installation Codes shall prevail. Authorities having jurisdiction should be consulted before installations are made. Oil and gas burning equipment shall be connected to flues having sufficient draft at all times to assure safe and proper operation of the burner.

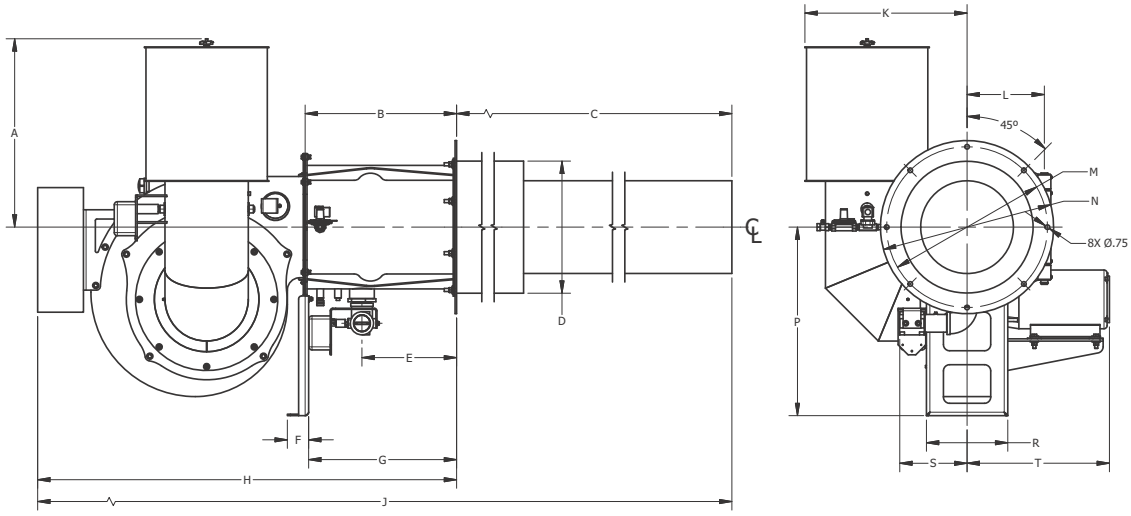
The Profire MTH Series burners are designed to burn gas only as defined by ASTM D396-2010 specifications.

Standard MTH Series Specifications								
Burner Model	**Frame Size**	**Gas Input MBtu/hr**	**BHP @80% Eff.**	**Blower Motor HP**	**Furnace Pressure ("w.c.")**	**Gas Train Size (in.)**	**Min. Gas Pressure Required (PSI)**	**Blower Motor Volt/ Ph 60 Hz**
MTH-25	2	2,500	60	2	2	2.0	1.0	115/230/1
MTH-35	2	3,500	83	5	2	2.0	1.5	115/230/1
MTH-42	3	4,200	100	5	4	2.0	1.5	208/230/460/3
MTH-52	3	5,250	125	7 1/2	4	2.0	2.0	208/230/460/3
MTH-63	3	6,300	150	10	4	1.5	1.5	208/230/460/3
MTH-84	4	8,400	200	10	6	1.5	1.5	460/3
MTH-105	4	10,500	250	15	6	1.5	2.0	460/3
MTH-126	4	12,600	300	15	6	1.5	3.0	460/3
MTH-147	4	14,700	350	20	6	1.5	3.0	460/3
MTH-160	4	16,000	380	20	6	1.5	3.5	460/3

NOTES:

1. Gas input based on natural gas at 1,000 Btu/cu. ft. and 0.60 gravity.
2. Gas pressure based on 0" w.c. furnace pressure. For total pressure at manifold, add furnace pressure.
3. Boiler overall efficiency of 80% estimated.
4. Blower wheel and motor HP is based on altitude up to 2,000 ft. above sea level. For higher altitude or 50 Hz. applications, consult factory.
5. Firing at higher furnace pressures de-rates the burner by approximately 5% per 1/2" of additional pressure. Consult factory.

MTH Series Standard Dimensions



Accompanying dimensions are for layout purposes only.

		Burner Frame Size & Model Number		
	DIM	Size 2	Size 3	Size 4
Length in inches				
Overall burner length	J	88 3/4	106 3/4	137 3/4
Length of element	C	38 3/8	49 1/4	70
Mounting flange to panel	H	50	57 1/2	67 3/4
Width in inches				
Center line to right side	T	17 1/8	17 3/4	23
Center line to left side	K	23 7/8	24 1/2	26 1/4
Height in inches				
Center line to top	A	31 1/4	29 3/4	44
Center line to bottom	P	23 1/2	27 1/4	30 1/2
Hinge pivot point in inches				
Mounting flange to hinge	B	18 1/2	21 1/2	24 1/2
Center line to hinge	L	8 5/8	9 1/4	12 1/2
Burner support in inches				
Length of support	F	9	14 3/4	3 3/8
Width of support	R	23 1/2	27 1/4	30 1/2
Mounting flange to support	G	29 1/4	34 3/4	23 7/8
Mounting flange dimensions in inches				
Outer diameter	N	20 1/2	23	28
Bolt circle diameter	M	18 1/2	21	26
Gas inlet dimensions in inches				
Center line to main gas inlet	L	8 5/8	9 1/4	12 1/2
Mounting flange to main gas inlet	E	9 1/4	12 1/4	15 1/4
Dry oven dimensions in inches				
Diameter of dry oven	D	12 5/8	16 1/8	21 3/8

MTH Series Spare Parts List

Part Description	Burner Size	Part Number
HEAD, BURNER MESH (2.5 MMBTU)	2	132-02861-000
HEAD, BURNER MESH (3.5 MMBTU)	2	132-02825-000
FILTER, AIR, 14” ID X 19.625” OD	2	332-00050-000
ELECTRODE, ASSY 0.438 DRAWER ASSEMBLY	2	435-00560-000
ELECTRODE, WLDMT DRAWER ASSEMBLY	2	435-00531-000
TUBE, SCANNER SIGHT	2	090-04461-000
THERMOCOUPLE	2	496-00131-000
HEAD, BURNER MESH (4.2 MMBTU)	3	132-02862-000
HEAD, BURNER MESH (5.3 MMBTU)	3	132-02863-000
HEAD, BURNER MESH (6.3 MMBTU)	3	132-02796-000
FILTER, AIR, 14” ID X 19.625” OD	3	332-00050-000
ELECTRODE, ASSY 0.438 DRAWER ASSEMBLY	3	435-00561-000
ELECTRODE, WLDMT DRAWER ASSEMBLY	3	435-00529-000
TUBE, SCANNER SIGHT	3	090-04392-000
THERMOCOUPLE	3	496-00131-000
HEAD, BURNER MESH (8.4 MMBTU)	4	132-02864-000
HEAD, BURNER MESH (10.5 MMBTU)	4	132-02865-000
HEAD, BURNER MESH (12.6 MMBTU)	4	132-02866-000
HEAD, BURNER MESH (14.7 MMBTU)	4	132-02799-000
HEAD, BURNER MESH (16.0 MMBTU)	4	132-02867-000
FILTER, AIR, 19” ID X 23” OD X 14” HGT	4	332-00060-000
ELECTRODE, ASSY 0.438 DRAWER ASSEMBLY	4	435-00547-000
ELECTRODE, WLDMT DRAWER ASSEMBLY	4	435-00527-000
TUBE, SCANNER SIGHT	4	090-04407-000
THERMOCOUPLE	4	496-00131-000

Profire MTH Series

Table of Contents

CHAPTER 1

Introduction

1.1 — Overview

Profire MTH series burners are completely assembled, wired, and tested at the factory.

⚠ Caution

Only factory authorized burner service personnel should start up, adjust, or service this equipment.

⚠ Warning

Burner air, fuel metering valves and positioning motors have not been pre-set by the factory for proper combustion and must be set by a qualified and authorized technician. Failure to follow this procedure could result in property damage and personal injury.

The operator must be familiar with the individual functioning of all controls to understand the operations and procedures described in this manual.

1.2 — Description

The Profire MTH series are gas only, pre-mix type burners. All burners feature ignition by spark-ignited gas pilot flame. The burner operates with full modulation. A switch permits changeover from automatic fully modulated firing to manually set firing at any desired rate between minimum and maximum. Additional safeguards assure that the burner always returns to the minimum firing position for ignition.

Profire MTH series burners are designed for automatic, unattended operation except for periodic inspection and maintenance. After selecting the proper overload settings for the starter, the rest of the control panel components require little attention except for occasional cleaning.

1.3 — Operating Controls

1.3.1 — Control Panel

The control panel contains a flame safeguard programming control, motor starters, relays, time delays, and terminal strips mounted internally on a panel sub-base. Lights, switches, potentiometers, a control circuit breaker, and flame safeguard displays are mounted externally on the panel.

Component	Details
Control Circuit Breaker	Supplementary low overcurrent protection only. No larger than 15 amps.
Auto-Manual Modulation Selector Switch	a) Auto Position: Selects boiler modulation control. b) Manual Position: Selects manual potentiometer for modulating control.
Manual Modulating Control	Increases or decreases the burner firing rate manually.
Signal Lamps	a) LOAD DEMAND (white): Illuminates when the control circuit is energized (powered). b) LOW WATER (red): Illuminates when the water level in the boiler gets too low. c) FUEL VALVE (green): Illuminates when the main fuel valve or valves (gas or oil) are energized (open). d) FLAME FAILURE (red): Illuminates when the flame safeguard system fails to detect pilot or main flame.

1.3.2 — Flame Safeguard Controls

The flame safeguard programmer incorporates a flame sensing cell (scanner) to shut down the burner in the event of pilot flame or main flame failure. Other safety controls shut down the burner based on sequence of operation as shown in the manufacturer's flame safeguard manual.

⚠ Warning

Read the flame safeguard manual and fully understand its contents before attempting to operate this equipment. Failure to do so may result in serious personal injury or death.

1.3.3 — Firing Rate Controls

Regardless of the fuel used, burner input is fully modulated between low fire and high fire on boiler demand. The firing rate is controlled by the parallel positioning control system. The combustion air control damper, and/or gas butterfly valve are controlled by actuators. The actuator rotates 90° from low to high position.

1.4 — Combustion Air Handling System

The combustion air handling system consists of three major components:

Component	Details
Damper Assembly	A rotary damper regulates the combustion air volume and is positioned by a modulating motor. The damper is normally almost closed in the low fire position and opens as the burner drives toward a high fire position.
Motor Driven Impeller	The diameter of the impeller determines available air pressure and the width determines air capacity in cubic feet per minute. Alternate motor-impeller combinations are available for 50 cycle or 60 cycle power and for firing against either moderate or high furnace pressure. All standard impellers are sized for up to 2,000 ft. altitudes and up to 6" W.C. furnace pressures. Alternate impeller wheels are available. For higher altitudes and higher furnace pressures, motor and impeller combinations are determined at the factory.
Air Filter	99%+ Removal efficiency to two microns

1.5 — Firing Head

Access to the firing head is provided by swinging open the impeller housing. An internal gas pilot is standard on all burners. Pilot gas pressure is adjusted at the pilot pressure regulator.

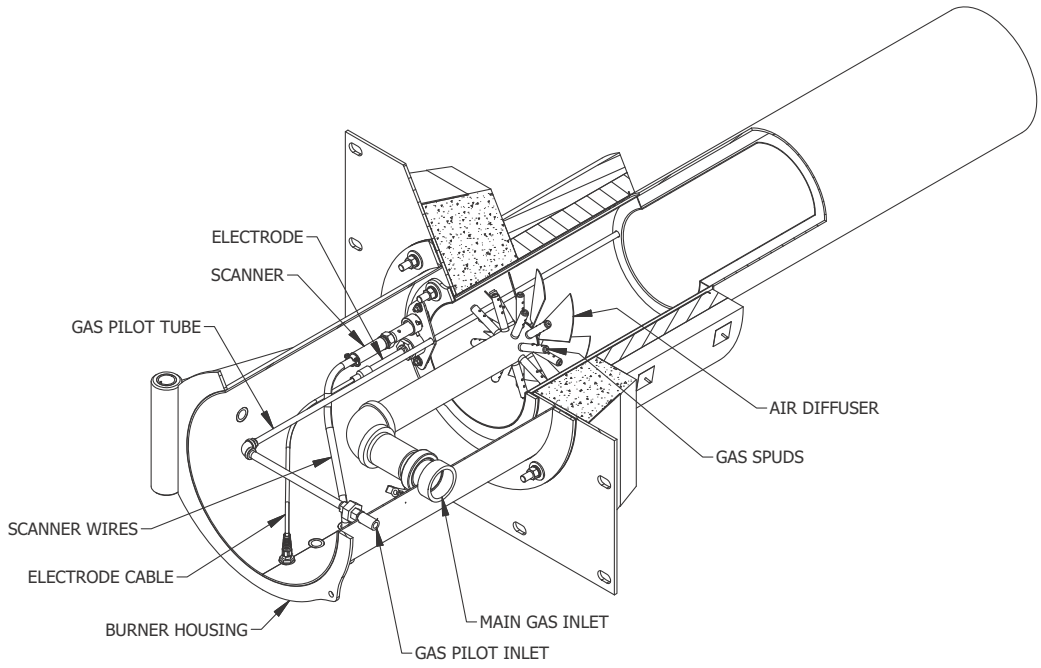


FIGURE 1-1. Burner Housing

1.6 — Gas System

Gas is introduced into the combustion zone from a circular manifold through multiple ports in the manifold. The firing rate is regulated by a rotary, butterfly-type throttling valve at the manifold inlet. The valve is actuated by the actuator. Depending upon specific requirements, one or two safety shutoff motorized main gas valves are provided for installation in the gas train upstream of the butterfly valve. Safety shutoff gas valves are wired into the programming control to automatically open and close at the proper time in the operating sequence.

1.6.1 — Main Gas Train Components

Depending upon the requirements of the regulating authority, the gas control system and gas train may consist of some, or all, of the following items:

Component	Description
Gas Volume Valve	The butterfly-type valve is positioned by linkage from the modulating motor and controls the rate of flow of the gas.
Main Gas Valves	Electrically operated safety shutoff valve(s) that open to admit gas to the burner. Standard U.L. burners include: • Models MTH25-42: One motorized gas valve w/POC. • Models MTH52-105: One motorized gas valve w/POC and one solenoid valve. • Models MTH126-147: One dual motorized gas valve w/POC
Main Gas Regulator	Regulates gas train pressure to specified pressure required at inlet to the gas train. Input is set my the main gas pressure regulator adjustment.
Main Gas Cocks	For manual shutoff of the gas supply upstream of the pressure regulator. A second shutoff cock downstream of the main gas valve(s) provides a means of testing for leakage through the gas valve(s).
High Gas Pressure Switch	A pressure actuated switch that remains closed when gas pressure is below a pre-selected setting. Should the pressure rise above the setting, the switch contacts will open causing main gas valve(s) to close. This switch requires manual reset after being tripped.
Low Gas Pressure Switch	A pressure actuated switch that remains closed when gas pressure is above a pre-selected setting. Should the pressure drop below this setting, the switch contacts will open, causing main gas valve(s) to close. This switch requires manual reset after being tripped.

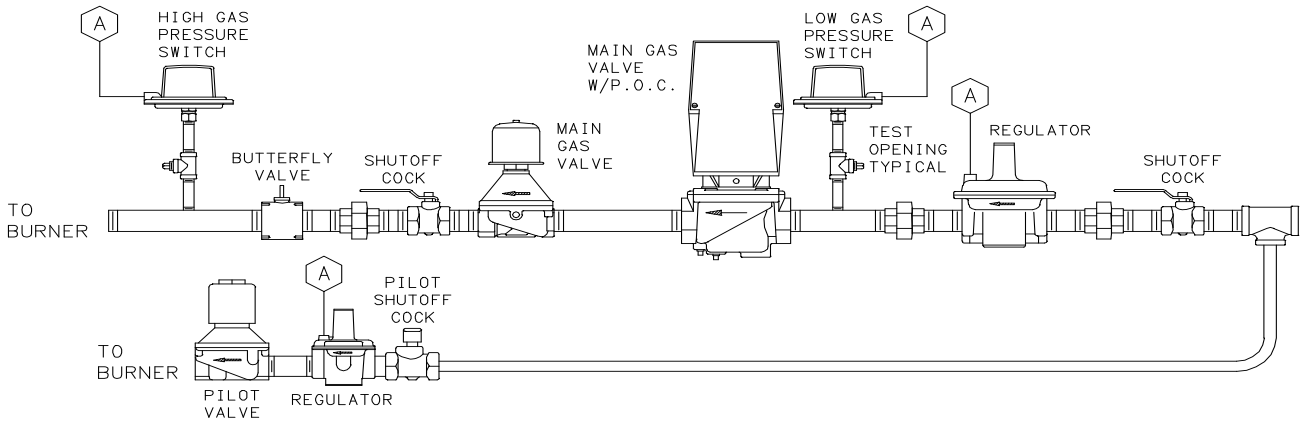


FIGURE 1-2. Main Gas Train (MTH-25 to MTH-105)

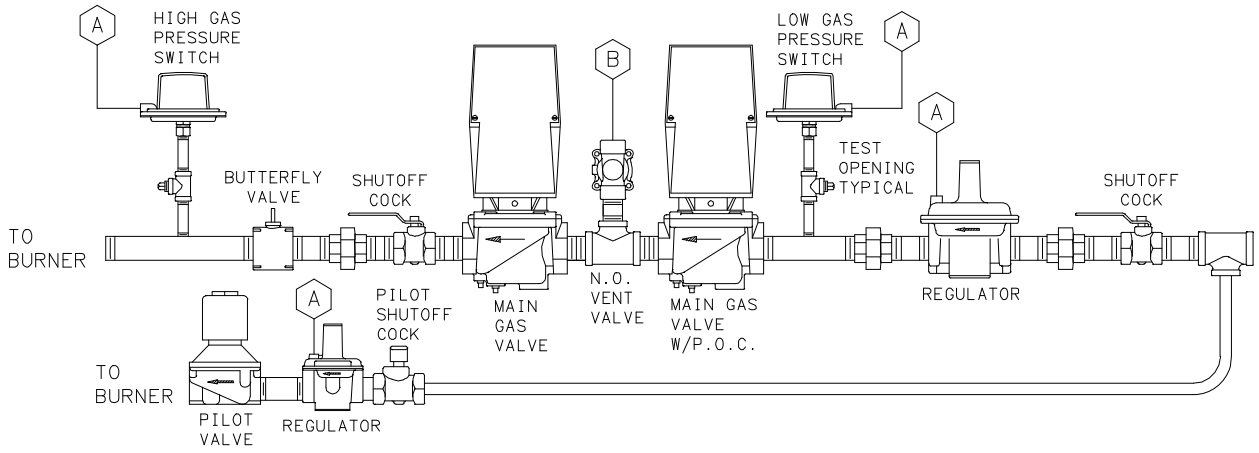


FIGURE 1-3. Main Gas Train (MTH-126 to MTH-160)

NOTE: These piping layouts are for reference only and are subject to change without notice. Optional equipment may change a layout.

1.6.2 — Pilot Gas Train Components

Component	Description
Gas Pilot Valve	A solenoid valve that opens during the ignition period to admit fuel to the pilot. It closes after main flame is established.
Gas Pressure Regulator	Reduces gas pressure to that required by the pilot.
Gas Pilot Shutoff Cock	For manually closing the pilot gas supply.

1.6.3 — Operation

Metered gas flows through the main gas shutoff cock, through the pressure regulator to the automatic gas valves and butterfly valve to the gas manifold.

The butterfly gas valve modulates flow to burner input demand. The butterfly valve is positioned through the actuator. The air control damper is positioned simultaneously by the actuator and controlled by the parallel positioning control system.

The automatic gas valve(s) cannot be energized unless the combustion air proving switch is closed. The low and high gas pressure switches must be closed to prove proper gas pressure.

A normally open vent valve, if required, is located between the two automatic gas valves. This valve is shut when the automatic gas valves are open. When the automatic valves are closed, the vent valve is open for venting gas to the outside, should any be present.

CHAPTER 2

Installation

2.1 — Application

Electrical power available is usually 208 volt, 3-phase, 60 cycle, 230/460 volt, 3-phase, 60 cycle or 380 volt, 3-phase, 50 cycle. Control circuit is 115 volt, single phase, 60 cycle or 115 volt, single phase, 50 cycle. Refer to the electrical schematic diagram shipped with the burner. Power connections are made at the control panel. Wiring from the panel to burner mounted components is installed at the factory. Wiring from the burner panel to boiler controls, low water controls, remote compressor motor, and remotely located fuel valves is furnished by the installer.

2.2 — Draft Conditions

Automatic over-fire draft control or barometric draft regulators are not usually required except where the system has a tall chimney. The exact height of a chimney requiring draft control is indeterminate, but draft regulation is seldom needed for chimneys less than fifty feet high, especially with Scotch Marine or sealed firebox boilers. Gas piping instructions are described in this Chapter.

2.3 — Combustion Air Supply

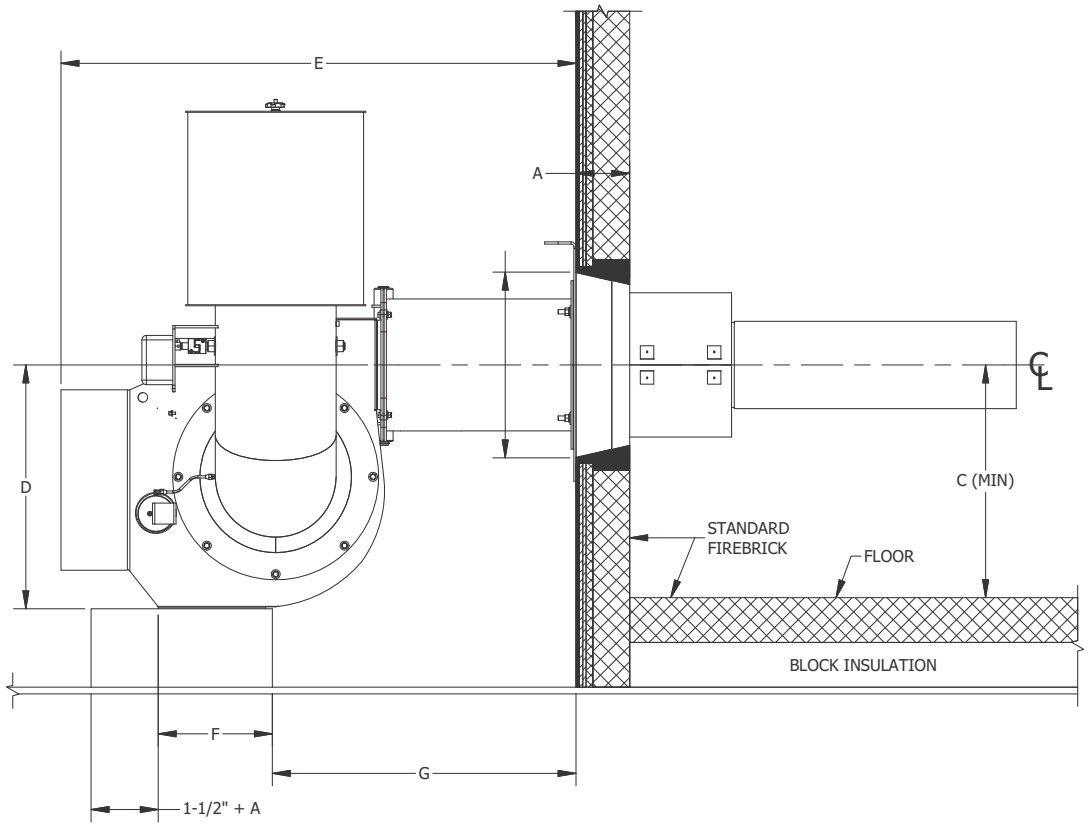
The space in which a burner operates must be supplied with adequate fresh air for combustion and ventilation purposes. Fresh air supply must meet or exceed all code requirements. Consult with insurance carrier and/or local authorities for specific regulations.

⚠ Warning

The boiler room pressure must be at least equal to the outdoor atmospheric pressure. Where fan ventilation is used, air must be forced into the boiler room. Never exhaust air from the boiler room. Adjoining areas having exhaust fans must be positively isolated from the boiler room.

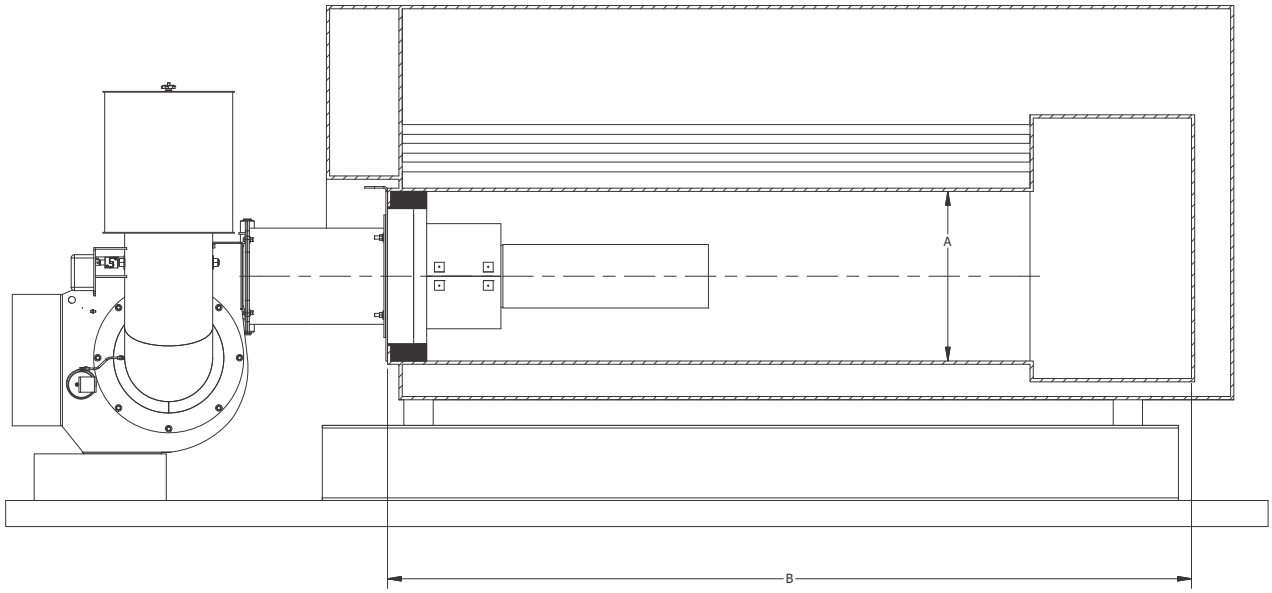
2.4 — Combustion Chamber Recommendations

The combustion chamber dimensions should be adequately sized to prevent flame impingements.



Burner Size	A	B	C	D	E	F	G	Combustion Chamber Min. Width (in.)	Combustion Chamber Min. Length (in.)
25	6	14.8	7.5	23.5	50.0	9.0	29.2	18	45
35	6	14.8	7.5	23.5	50.0	9.0	29.2	20	55
42	6	20.8	10.5	27.3	57.5	14.75	34.75	22	60
52	6	20.8	10.5	27.3	57.5	14.75	34.75	22	60
63	6	20.8	10.5	27.3	57.5	14.75	34.75	22	80
84	6	22.6	11.5	30.5	67.8	3.375	23.9	30	80
105	6	22.6	11.5	30.5	67.8	3.375	23.9	30	80
126	6	22.6	11.5	30.5	67.8	3.375	23.9	30	90
147	6	22.6	11.5	30.5	67.8	3.375	23.9	32	90
160	6	22.6	11.5	30.5	67.8	3.375	23.9	32	90

FIGURE 2-1. **Combustion Chamber Dimensions**



Burner Model	Boiler HP	A	B
25	60	18	45
35	83	20	55
42	100	22	60
52	125	20	60
63	150	22	80
84	200	30	80
105	250	30	80
126	300	30	90
147	350	32	90
160	380	32	90

FIGURE 2-2. **Burner Model/Boiler HP**

2.5 — Installation

The burner is designed for operation with the blast tube level. Do not tilt the burner up or excessively downward. Securely support the burner pedestal on the floor or foundation. Allow enough clearance at the rear of the burner to allow the housing to swing open for service and maintenance. Many boilers, including some Scotch Marine types, do not have sufficiently rigid front plates and require additional support under the burner base. Bases under the support leg must be long enough to support the burner when being inserted or withdrawn from the boiler. Boilers operating with the combustion pressure above atmospheric pressure must be sealed to prevent escape of combustion products into the boiler room. The burner mounting flange is designed to provide for a seal. The face of the boiler and burner flange must be sealed

with a rope gasket (not supplied with the burner). Make sure the dry oven and burner blast tube are concentric. For maximum safety, it is recommended that boilers not operating under pressure should also be sealed.

2.6 — Packing Plastic Refractory Around Oven (If Dry Oven is Supplied)

⚠Caution

It is important that you provide support for the housing when in the open position to prevent damage to the hinges and subsequent components.

The area between the outside circumference of the dry oven and existing refractory should be packed with Kaiser Refractory Mono T-9 Airset or equal within two hours after coating the dry oven with Trowleze. From inside the furnace, ram the plastic refractory from the front to the rear, parallel to the outside surface of the dry oven.

2.7 — Gas Piping

Refer to Figures, 1-2 and 1-3 for typical gas piping schematics.

Gas service and house piping must supply the quantity of gas demanded by the unit at the pressure required at the burner gas train inlet. All piping must be in strict accordance with applicable codes, ordinances, and regulations of the supplying utility. In the absence of other codes, piping should be in accordance with the following standards: “National Fuel Gas Code” NFPA No. 54, ANSI No. Z 223.1 (for Canada, the Canadian Gas Association (CGA) B149 and Canadian Standards Association (CSA) B140 codes shall prevail).

Gas train components upstream of the butterfly valve are shipped loose. These components should be mounted by the installer as close to the butterfly valve as practical. Normally, the control train is ordered to suit a particular code or insurance regulation, such as Underwriters Laboratories Inc., CGA, or Factory Mutual.

Arrange gas piping at the burner so that the burner is accessible for servicing without disassembly.

The gas pilot supply line must be connected upstream of the main gas regulator. If a reducing bushing is required between the house piping and the burner piping, it should be close to the burner shut-off valve.

The gas piping must be internally clean and free of foreign material. Before using in service, a leak test must be performed.

2.8 — Installation Checklist

All burners are carefully assembled and tested at the factory, but before being placed in service, all connectors should again be checked for looseness caused during shipment.

Check:

- Electrical terminals in the control panel and on all electrical components.
- Pipe fittings and unions.
- Tubing connections.
- Nuts, bolts, screws.

Before connecting electrical current to any component, be sure the supply voltage is the same as that specified on component nameplates.

Before burner operation, be sure all motors are rotating in the correct direction.

Before firing, make sure that the burner mounting flange is properly sealed to the boiler front plate.

It is the installers responsibility to identify the main electrical power disconnect and the manual shut-off valve on the gas supply drop-line to the burner.

Make certain that the operator in charge is properly instructed in the operation and maintenance procedures.

⚠ Caution

Before opening the gas shutoff valves, read the regulator instructions carefully. Open the shutoff valve slowly to allow inlet pressure to build up slowly in the regulator until it is fully pressurized. Opening the shutoff valve quickly will damage the regulator.

Do not exceed the regulator pressure ratings.

CHAPTER 3

Operation

3.1 — Preparations for Starting

When the installation is complete and all electrical, fuel, water, and vent stack connections are made, make certain said connections are tight. The operator should become familiar with the burner, boiler controls, and components. To identify controls and components, refer to contents of Chapter 1. Adjustment procedures given in Chapter 4 should be reviewed prior to firing. The wiring diagram should also be studied along with the operating sequence of burner programmer. Read and understand starting instructions before attempting to operate the burner. Before attempting to start the burner, the following checks must be made:

Item	Check
Boiler	Check the boiler water level. Be sure all boiler valves are installed correctly and positioned properly. Set the high limit control slightly above the desired temperature. Set modulating controls at the desired temperature or pressure.
Burner	Check the electrical power supply to the burner in accordance with the nameplate voltage on all motors and the control circuit. Check the direction or rotation of the motors. Open the housing to check the electrode setting. Check the gas pilot pressure at the pilot gas regulator. The normal setting is 6” W.C. For protection in shipment, the flame safeguard control chassis is shipped unmounted. Check all screw connections before attaching the flame safeguard chassis to the base. The screw must be secure to assure low resistance connections. The relay chassis is mounted on the sub-base with a screw which, when tightened, completes the connection between the sub-base and chassis contacts. Press the manual reset button to be sure safety switch contacts are closed. Check the control actuator for proper movement of the air volume damper and fuel metering components. Check the air shutter and adjust low fire setting.

3.1.1 — Firing Preparations for Gas Burners

A representative of the gas utility should turn on the gas. Determine by a test gauge upstream of the burner regulator that sufficient pressure exists at the entrance to the gas train. The gas pressure regulator must be adjusted to the pressure required and the pressure setting recorded.

On combination fuel models, set the selector switch to the desired fuel. On initial startup, it is recommended that the main gas shutoff cock remain closed until the programmer has cycled through pre-purge and pilot sequences to determine that the main gas valve opens. Turn the burner switch “OFF” and let the programmer finish its cycle. Check to see that the gas valve closes tightly. Set the high and low gas pressure switches.

Check for leaks and determine there is adequate gas pressure available at the burner for operating at full capacity. Check with the local utility if necessary. Check gas pressure at the pilot and the main burner. Close the manual gas valve.

3.1.2 — Burner Settings

To ensure reliable and safe burner performance, the air damper blade must be adjusted, relative to the established flow rates, to provide the correct amount of air for complete efficient combustion.

The damper blade is not preset at the factory, and must be checked prior to placing the burner into initial service, or after conducting any service work that may have altered its position.

3.1.3 — Combustion Settings

Fuel and air flow rates are individually adjusted at low fire and at high fire to achieve rated heat input, firing rate turndown, optimum efficiency, safe operation, and the ability to cope with environmental changes (including air temperature, humidity, barometric pressure), and fuel property changes. Refer to the nameplate inside the control panel for minimum and maximum fuel input ratings.

3.1.4 — Test Equipment

The following tests should be conducted on site:

1. Combustion analyzer with O_2 indication
2. U-Tube manometer, or pressure gauge, to measure gas pressures (Main and Pilot)
3. Inclined manometer to measure draft pressures
4. CO analyzer
5. Voltmeter/Ammeter
6. Stack thermometer and thermocouple

⚠ Warning

Should a starting failure occur for any reason, combustible fumes may fill the combustion chamber. Never attempt to re-light the burner under these conditions without first purging the chamber.

Warning

Read the flame safeguard manual and fully understand its content before attempting to operate this equipment. If this instruction is ignored, serious injury or death may result.

3.2 — Electrical Interference Test

Prior to putting the burner into service, conduct the following test to ascertain that the ignition spark will not cause the flame relay to pull in.

3.2.1 — Gas Fired

1. Close the pilot and the main line manual gas valves.
2. Start the burner and at the time of the pilot trial, with just the electrical ignition system energized, the flame relay should not pull in (be energized).
3. Upon completion of successful test, proceed with startup procedures.

3.3 — Gas Pilot Flame Adjustment

The gas pilot flame is regulated by adjusting the pressure setting of the pilot regulator. Normal setting is 6" W.C. when the pilot is burning. The flame must be sufficient to be proven by the flame detector and ignite the main flame.

Although it is possible to visibly adjust the size of the pilot flame, obtain a proper DC volt or microamp reading of the flame signal. Refer to Flame Safeguard manufacturers instructions for optimal flame signal readings.

The flame safeguard amplifier has a meter jack for this purpose. At initial startup and during planned maintenance, test the pilot flame signal, pilot turndown, and safety switch lockout.

3.4 — Startup Sequence

The programming control sequences the operation of all controls and components through the starting, ignition, firing, and shutdown cycle. The burner and control system are in starting condition when:

- The operating and high limit control (temperature or pressure) are below their cutoff setting.
- All power supply switches are closed.
- Power is present at the control panel.

Refer to the manufacturer's literature on programming controls and burner wiring diagrams for detailed information.

1. Begin starting sequence, with burner switch off, and with all manual valves closed. Switch main power on.
2. Open the main manual gas valve.

3. Manually reset the high and low gas pressure switches.
4. When the burner motor starts, open the gas cock.
5. When the main fuel lamp lights indicating pilot flame proven, slowly open the second shutoff cock downstream of the main gas valve(s).

Refer to the manufacturer's literature on primary control sequence of operations.

3.5 — Automatic Shutdown

Limit or operating controls open:

1. Fuel valves close. Main fuel lamp goes off. Flame safeguard timer starts.
2. Flame safeguard timer and burner motor stop. Burner is ready for startup on the next call for heat.

3.6 — Manual Shutdown

1. When the burner motor stops, close all manual valves.

3.7 — Safety Shutdown

1. If at any time during the operating cycle a flame failure occurs, the burner shuts down as in Automatic Shutdown, with an additional post-purge, and the flame failure lamp is energized.

⚠ Warning

Read the Flame Safeguard manual and fully understand its contents before attempting to operate this equipment. If the manual is not read and understood, serious personal injury or death may result.

⚠ Warning

Should a starting failure occur for any reason, combustible fumes may fill the combustion chamber. Never attempt to re-light the burner under these conditions. The combustion chamber must first be purged before re-lighting.

⚠ Warning

Keep fingers away from the combustion air intake below the damper. The damper is actuated with sufficient force to cause severe injury. Always make high and intermediate rate adjustments when the burner has reached low fire position. Do not disturb the low fire setting.

A. The lockout switch on the flame safeguard control must be manually reset before the burner will fire again.

2. If a low water condition occurs, the burner shuts down as in Automatic Shutdown.
3. If a high or low gas pressure condition occurs while firing on gas, the burner shuts down as in Automatic Shutdown.
   A. Condition must be corrected and the respective gas pressure switch manually reset before the burner will fire again on gas.

3.8 — Startup and Operating

3.8.1 — Gas Burners

A gas valve leak test (Bubble Test) must be performed on the automatic safety shutoff valves located in the main gas train prior to any initial commissioning or subsequent maintenance of the burner and gas train systems, where automatic valve proving systems interlocked with the main burner safety control are not provided. This test should be performed periodically to ensure no leakage of valves in their closed or de-energized position (refer to valve manufacturers procedures).

The unit should be taken out of service if the unit fails any part of the gas valve leak test. Any defective part must be replaced prior to putting the equipment back into service.

⚠ Warning

Failure to follow this startup procedure may result in explosion, fire, property damage, and personal injury. This procedure must be performed only by authorized and qualified personnel.

1. Close the main and pilot gas cocks.
2. Make sure the ON-OFF switch is in the “OFF” position and the fuel selector switch is turned to “GAS.”
3. Actuate the manual reset button of the flame safeguard control to close the safety switch contacts.
4. Set the MANUAL-AUTO switch in the “MANUAL” position.
5. Set the manual potentiometer in the low fire position.
6. Open the gas pilot cock.
7. Set the ON-OFF switch to “ON.” The burner will start and pre-purge. After pre-purge, the ignition transformer and the gas pilot solenoid are energized. Before proceeding, conduct electrical interference and pilot turndown tests if not previously done (see Section 3.2).
8. On initial startup it is recommended that the main gas shutoff cock remains closed until the programmer has cycled through pre-purge and pilot sequence. Then determine that the main gas valve opens. When this is confirmed, turn the burner switch “OFF” and let the programmer finish its cycle.
9. Check to see that the gas valve has closed tightly. If ignition does not occur, turn the burner switch “OFF” and allow the programmer to recycle for a new ignition trial.Turn the burner “ON” and after pilot ignition when the flame relay pulls in, the slow opening, motorized, main gas valve is energized. The main flame should ignite at this time. The gas valve and air damper continue advancing until high fire is reached.

10. Do not repeat unsuccessful light off attempts without rechecking burner and pilot adjustment. Vent fuel vapors from the combustion chamber after each unsuccessful light off attempt.
11. Set the gas low fire rate by adjusting the gas butterfly valve and air valve.
12. When low fire is adjusted, shut down the burner.
13. Restart several times to be sure the low fire setting is suitable. Readjust if necessary. Never start the burner with fuel vapor in the furnace. In case of an emergency, open the main power switches and close all fuel valves.
14. After combustion adjustments are satisfactorily set, allow the heating vessel to slowly reach normal operating pressure or temperature.
15. Turn the potentiometer switch to the high fire position. Check high fire at this point using combustion instruments.
16. Do not disturb established low fire adjustment. Allow the burner to return to low fire position before adjusting high or intermediate settings.

High fire combustion analysis typically is 7% to 8% O_2. When conditions covered above are assured, refer to Sections 3.9 and 3.10.

3.9 — Normal Operation

Normal operation must be with the MANUAL-AUTO switch set on “AUTO.”

In automatic operation, the operating cycle always proceeds sequentially through pre-purge, pilot ignition, main flame ignition, run, and post-purge. The length of the purge and ignition trial vary according to the type of programmer used.

During the run cycle, burner input is regulated to the load demand by the modulating pressure or temperature control on the boiler. The burner will continue to modulate until the operating pressure or temperature is reached.

Programmer control operation should be tested when the burner is initially placed into service, when a control is replaced, and at scheduled intervals in the maintenance program.

Refer to adjustment procedures and maintenance instruction given in Chapters 4 and 5.

3.10 — Shutdown

When the operating limit control setting is reached or the burner switch is in the “OFF” position, the following sequence occurs:

1. The fuel valve(s) de-energize and the flame extinguishes. The blower motor continues running during post-purge.
2. At the end of post-purge, the blower motor is de-energized.
3. The programmer returns to its starting position and stops. The unit is ready to restart.

Abnormal shutdown might result from motor overload, flame outage, low water, current or fuel supply interruption, combustion air pressure below minimum level, tripped circuit breakers, blown fuses, or other interlock devices. Check for the cause and make the necessary corrections before restarting the burner.

Safety shutdown caused by ignition or flame failure will actuate a red indicator light and energize an audible alarm (if so equipped). If the programmer has a non-recycling interlock circuit, any interruption in this circuit during the pre-purge or firing cycle will cause a safety shutdown. This type of shutdown requires manual reset of the programming control and must be corrected before operation can be resumed.

⚠ Warning

An ultraviolet flame sensor electrical spark interference test must be performed after final adjustment. See Section 3.2 in this chapter for additional information.

Read and understand starting instructions before attempting to operate the burner. Before attempting to start the burner, the following checks must be made:

Item	Check
Boiler	Check the boiler water level. Be sure all boiler valves are installed correctly and positioned properly. Set the high limit control slightly above the desired temperature. Set modulating controls at the desired temperature or pressure.
Burner	Check the electrical power supply to the burner in accordance with the nameplate voltage on all motors and the control circuit. Check the direction or rotation of the motors. Open the housing to check the electrode setting. Check the gas pilot pressure at the pilot gas regulator. The normal setting is 6” W.C. For protection in shipment, the flame safeguard control chassis is shipped unmounted. Check all screw connections before attaching the flame safeguard chassis to the base. The screw must be secure to assure low resistance connections. The relay chassis is mounted on the sub-base with a screw which, when tightened, completes the connection between the sub-base and chassis contacts. Press the manual reset button to be sure safety switch contacts are closed. Check the control actuator for proper movement of the air volume damper and fuel metering components. Check the air shutter and adjust low fire setting.

CHAPTER 4

Adjustments

4.1 — Overview

While each burner is tested at the factory for correct operation before shipment, variable conditions such as burning characteristics of the fuel used and operating load conditions may require further adjustment after installation to assure maximum operating efficiency.

Prior to placing the boiler into initial service, a complete inspection should be made of all controls, connecting piping, wiring and all fastenings such as nuts, bolts and setscrews to be sure that no damage or misadjustments occurred during shipping and installation.

A combustion efficiency analysis made during the initial start-up will help to determine what additional adjustments are required in a particular installation.

4.2 — Combustion Adjustment on Gas

Efficient combustion cannot be properly judged by flame appearance, although it may help in making preliminary settings.

The proper settings of air-fuel ratios must be determined by flue gas analysis. Combustion gas analysis indicates the air to fuel ratio and the degree of complete combustion. Instruments are available to measure carbon dioxide (CO_2), oxygen (O_2), and carbon monoxide (CO).

4.2.1 — Stack Temperature

Net stack temperature is obtained by subtracting the ambient temperature from the flue gas temperature. A high net stack temperature indicates wasted heat. Stack temperature should be as low as possible without causing flue gas condensation.

Stack heat loss can be reduced by decreasing either the temperature or the volume of the flue gas, or both. Flue gas temperature is reduced by improving heat transfer or by reducing excess combustion air. A certain amount of excess air is necessary to complete combustion. More efficient burners require minimum excess air.

4.2.2 — Gas Adjustments

Low fire combustion analysis typically is 7% to 9% O_2 and less than .04% CO (400 ppm). A high fire reading typically is 7% to 8% O_2 and less than .04% CO.

4.3 — Electrical Interference Test

Prior to putting the burner into service, conduct the following test to ascertain that ignition spark will not cause the flame relay to pull in.

Gas Fired Test:

1. Close the pilot and main line manual gas valves.
2. Start the burner and at time of pilot trial with just the electrical ignition system energized, the flame relay should not pull in (be energized).
3. Upon completion of successful test, proceed with startup procedures.
4. Reconnect the power supply and proceed with startup procedures.

4.4 — Gas System

4.4.1 — Gas Pressure

Gas must be supplied at a pressure high enough to overcome the pressure loss in the burner gas train and furnace pressure while running at full input. Refer to nameplate inside control panel for gas pressure requirements at train inlet and manifold. The pressures listed are based on nominal 1000 Btu/cu ft. natural gas at elevations up to 2000 feet above sea level.

4.4.2 — Gas Flow

The volume of gas is measured in cubic feet as determined by a meter reading. The gas flow rate required depends on the heating value (Btu/cu ft.). The supplying utility can provide this information as well as pressure correction factors. To determine the required number of cubic feet per hour of gas, divide burner input (Btu/hr) by the heating value (Btu/cu ft.).

NOTE: When checking the input rate, Make sure no other equipment is operating on the same meter.

4.4.3 — Gas Pilot Flame Adjustment

The gas pilot flame is regulated by adjusting the pressure setting of the pilot regulator. Normal setting is 6” W.C. when the pilot is burning. The flame must be sufficient to be proven by the flame detector and ignite the main flame.

Although it is possible to visibly adjust the size of the pilot flame, obtain a proper DC volt or microamp reading of the flame signal.

The flame safeguard amplifier has a meter jack for this purpose. At initial startup and during planned maintenance, test the pilot flame signal, pilot turndown, and safety switch lockout.

⚠ Warning

An ultra-violet flame sensor electrical spark interference test must be performed after final adjustment. See Section 4.3 of this chapter for additional information.

4.4.4 — Main Gas Pressure Regulator

The gas pressure required at the burner manifold is the pressure that is required to fire the burner at its rated capacity. The gas pressure regulator must be adjusted to achieve this pressure to assure full input. Refer to manufacturer's literature for regulator adjustment.

4.4.5 — Low Gas Pressure Switch

Turn adjusting screw until indicator moves to a pressure setting slightly below the operating gas pressure. The control will break a circuit if pressure is below this set point. The control should be finally adjusted to prevent operation with low gas pressure, but not at a pressure so close to normal operating pressure that unnecessary shutdowns occur. The switch must be manually reset after tripping. To reset, allow gas pressure to rise and press the manual reset button.

4.4.6 — High Gas Pressure Switch

Turn the adjusting screw until the indicator moves to a pressure setting slightly above the maximum operating gas pressure. The control will break a circuit if pressure exceeds this value. The control should be adjusted to prevent operation with excessive gas pressure, but not at a pressure so close to normal operating pressure that unnecessary shutdowns occur.This switch must be manually reset after tripping. To reset, allow gas pressure to drop and press the manual reset button.

4.4.7 — Gas Combustion Adjustment

After operating for a sufficient period of time to assure a warm boiler, make adjustments for most efficient combustion.The butterfly gas valve directly controls the rate of flow. The low fire light-off setting should be regarded as preliminary until proper gas pressure for high fire operation is established.

Determine the actual gas flow from a meter reading at high fire. With the butterfly valve open and with regulated gas pressure set, the actual flow rate should be quite close to the required input. If corrections are necessary, increase or decrease the gas pressure by adjusting the gas pressure regulator, following manufacturer's directions for regulator adjustment.

When proper gas flow is obtained, take a flue gas analysis reading.

With the high fire air-fuel ratio established, the gas pressure regulator needs no further adjusting.

Recheck low fire and adjust if necessary.

Proper setting of the air-fuel ratios at all rates must be determined by combustion analysis. See Section 4.2 of this chapter for additional information.

NOTE: Check for CO through the entire firing range.

4.5 — Parallel Positioning Adjustment

For parallel positioning systems refer to the control manufacturer's documentation and to the accompanying wiring diagram for information on adjusting the system. In a properly tuned parallel positioning system the independent actuators for fuel, and air will be coordinated to provide optimum combustion throughout the firing range.

Normally, the air control damper will be approximately 1" open in low fire position. Excessive opening in low fire can cause pilot ignition problems. Air to the pilot is supplied under pressure to compensate for variations in furnace pressure, but the damper must be in low fire position for reliable ignition.

⚠ Warning

Keep fingers away from the air intake below the damper. The damper is actuated with sufficient force to cause severe injury.

CHAPTER 5 Maintenance

5.1 — Overview

⚠ Warning

Any cover plates, enclosures, or guards anchored to the burner, or any burner related equipment, must remain in position at all times. Only during maintenance and service shutdown can these cover plates, enclosures, or guards be removed. They must be replaced, and securely anchored before testing, adjusting, or running the burner or burner related equipment.

⚠ Caution

It is important that you provide support for the housing when in the open position to prevent damage to the hinges and other components.

A maintenance program avoids unnecessary down time, costly repairs, and promotes safety. It is recommended that a record be maintained of daily, weekly, monthly, and yearly maintenance activities.

Electrical and mechanical devices require systematic and periodic inspection and maintenance. Any “automatic” features do not relieve the operator from responsibility, but rather free him from certain repetitive chores, providing time for upkeep and maintenance.

Unusual noise, improper gauge reading, leak, sign of overheating, etc., can indicate a developing malfunction, requiring corrective action.

5.2 — Control System

Most operating controls require very little maintenance beyond regular inspection. Examine electrical connections. Keep the controls clean. Remove any dust from the interior of the control. Covers should be left on controls at all times. Keep the control cabinet doors closed. Dust and dirt can damage motor starters and relay contacts. Starter contacts are plated with silver and are not harmed by discoloration. Never use files or abrasive materials such as sandpaper on contact points.

5.2.1 — Programming Control

This control requires no adjustment, nor should any attempt be made to alter contact settings or timing logic. Those programmers with contacts may require occasional cleaning. If so, follow instructions given in the manufacturer's bulletin. Never use abrasive materials. The manufacturer's bulletin also contains troubleshooting information. The flame detector lens should be cleaned as often as conditions demand. A periodic safety check procedure should be established to test the complete safeguard system. Tests should verify safety shutdown with a safety lock out upon failure to ignite the pilot or the main flame, and upon loss of flame. Each of these conditions should be checked on a scheduled basis. The safety check procedures are contained in the manufacturer's bulletin.

5.3 — Impeller and Inlet Cone

Proper clearance between the impeller and the inlet housing set at 3/8” nominal. Adjust the inlet cone so it is centered in the inlet of the impeller and tighten the bolts. There should be no contact between the inlet cone and the impeller. Inserting a bar through the impeller blade and using it as a lever will only damage the blade and also void the impeller warranty.

5.4 — Firing Head Inspection

Release the impeller housing latches and swing the housing open for access to the firing head. Inspect the flame scanner lens to be sure it is clean Inspect the lead wire to the ignition electrode. It must be firmly attached and the insulation should be clean and free of cracks.

5.5 — Air Filter Inspection

The air filter needs to be inspected daily and replaced on an as needed basis.

5.6 — Pilot and Ignition Electrode

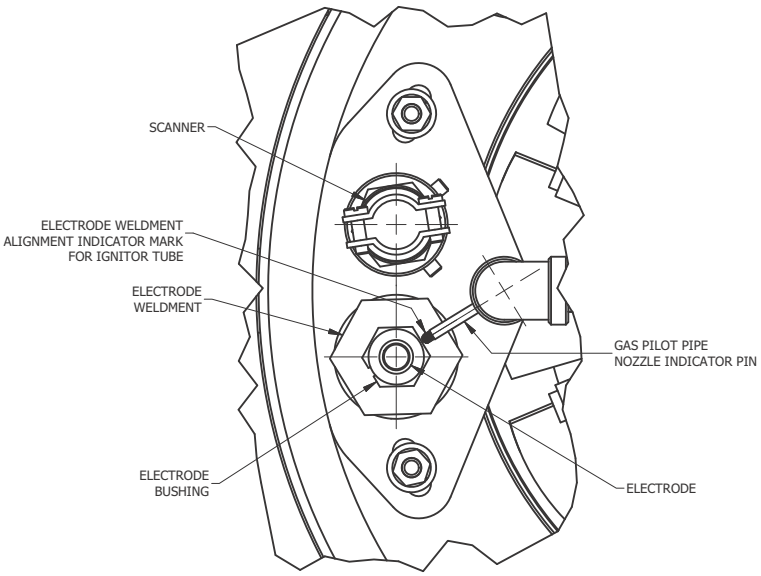


FIGURE 5-1. Pilot Electrode Orientation

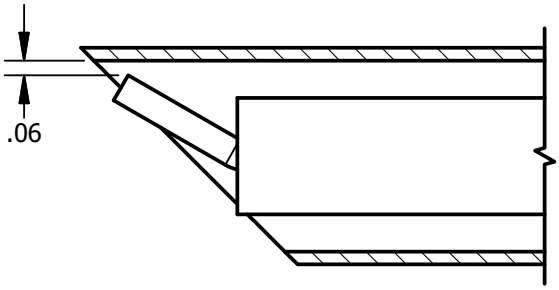


FIGURE 5-2. Pilot Electrode Gap

The ignition transformer requires little attention other than making sure the ignition wire is firmly attached to the transformer and the electrode. Be sure the wire insulation is in good condition and not grounded. Failure to keep the ignition electrode clean and properly set can cause faulty operation. The pilot assembly is supported by a socket in the diffuser and gas inlet tube. No adjustment is required except proper positioning of the electrode wire.

5.7 — Flame Scanner

The scanner must be clean. Even a small amount of contamination will reduce the flame signal. Wipe the scanner lens with a clean soft cloth.

5.8 — Firing Rate Controls

Make sure all connections are tight. Adjust if necessary. Perform a combustion test as explained in Chapter 4, and readjust the burner if necessary.

5.9 — Burner Mounting Inspection

The seal between the burner flange and furnace front plate must not permit combustion gases to escape. Periodic inspection is important. Replace the gasket if necessary. Inspect the burner head for signs of discoloration. A change the head color paint might indicate gas leakage between the burner flange and the boiler refractory. If leakage occurs, refer to Chapter 2, Section 2.4, for proper sealing procedure.

5.10 — Gas System

⚠ Caution

Disconnect all power before servicing the valves.

5.10.1 — Motorized Main Gas Valves

Should the valve fail to operate, check for voltage at the valve. Make certain that the main shutoff cock is closed prior to testing. The actuator is not field repairable nor should it be disassembled. Replace the actuator if the valve fails to operate. After replacement, cycle the valve with the fuel shutoff to determine that it opens and closes. If the valve has a visual indicator, observe its position for correct operation.

5.10.2 — Solenoid Valves

A slight hum from the solenoid is normal when the coil is energized. Should the valve fail to operate, check that there is voltage at the valve coil. If there is no voltage at coil, check for loose wiring connections. If there is proper voltage at the valve coil and the valve still fails to open, replace the coil. Refer to manufacturer's bulletin for correct procedure in coil replacement.

Should it become necessary to replace the complete valve, be sure that the flow is in the direction of the arrow on the body.

Test for gas leaks and check valve action several times to ensure proper operation before attempting to relight the burner.

5.11 — Electrical System

Because of the many types of flame safeguard systems applicable to this equipment, complete descriptions of all burner electrical systems are beyond the scope of this manual. An individual electrical schematic drawing is shipped with each burner and complete operation and troubleshooting instructions are available from the various flame safeguard system manufacturers.

5.11.1 — Electric Motors

Motor supply voltage must not vary more than 10 percent from nameplate ratings. At initial startup and at least once a year thereafter, check the motor current with a meter while the burner is in high fire position. If the reading exceeds the nameplate rating plus service factor, determine the cause and correct it immediately. In dusty locations, clean the motor regularly to assure adequate cooling. Lubricate in accordance with the manufacturer's instructions.

5.12 — Extended Shutdown

When shutting down the burner for an extended period of time, the operator should use the following general guidelines to protect the burner from its surrounding elements. This will add to the operating life of the burner.

1. Turn the main electrical disconnect switch to the burner to “OFF.”
2. Close all main fuel valves.
3. If the burner operates in a damp environment, cover it with plastic to protect all electrical components from moisture. Remove the flame safeguard control and store in a dry atmosphere.

5.13 — Recommended Maintenance Schedule

Item	Service By	Remarks
DAILY		
Gauges, Monitors, Indicators	Operator	Make visual inspection and record readings in log.
Instrument & Equipment Settings	Operator	Make visual check against recommended specifications.
Low Water, Fuel Cutoff & Alarms	Operator	Refer to instructions.
Air Filter	Operator	Refer to instructions.
WEEKLY		
Firing Rate Control	Operator	Verify factory settings.
Igniter	Operator	Make visual inspection. Check flame signal strength.
Pilot & Main Fuel Valves	Operator	Open limit switch. Make audible and visual check. Check valve position indicators, and check fuel meters.
Flame Failure Controls	Operator	Close manual fuel supply for (1) pilot and (2) main fuel cock and/or valve(s). Check safety shutdown timing. Record in log.
Flame Signal Strength Controls	Operator	Read and log the flame signal for both pilot and main flame. Notify Service if readings are very high, very low, or fluctuating.
MONTHLY		
Low Fan Pressure Interlock	Operator	Manually adjust until switch opens.
High & Low Gas Pressure Interlocks	Operator	Refer to instructions. Manually adjust until switch opens.
Scanner	Operator	Check, inspect, and clean for soot buildup.
Pilot Assembly	Operator	Check for loosening of components, erosion, or carbon buildup.
ANNUALLY		
Impeller	Operator	Inspect and clean the combustion impeller.
Combustion Test	Service Tech	Perform a complete combustion test. Adjust burner if necessary. Read and log data.
Pilot Turndown Test	Service Tech	Required after any adjustment to flame, scanner, or pilot adjustment.
Operating Controls	Service Tech	Refer to instructions.

CHAPTER 6

Troubleshooting

Warning

Troubleshooting should be performed only by personnel who are familiar with the equipment and who have read and understood the contents of this manual. Failure to follow these instructions could result in serious personal injury or death.

Warning

Disconnect and lockout the main power supply in order to avoid the hazard of electrical shock. Failure to follow these instructions could result in serious personal injury or death.

6.1 — Awareness

Chapter 6 assumes that:

- The unit in question has been properly installed and that it has been running for some time.
- The operator has become thoroughly familiar with both the burner and the manual by this time.

The points set forth under each heading are brief, possible causes, suggestions or clues to simplify locating the source of the trouble. Methods of correcting the trouble, once it has been identified, may be found elsewhere in this manual.

If the burner will not start or operate properly, the Troubleshooting section should be referred to for assistance in pinpointing problems that may not be readily apparent.

The program relay has the capability to self-diagnose and to display a code or message that indicates the failure condition. Refer to the control bulletin for specifics and suggested remedies.

Familiarity with the programmer and other controls in the system may be obtained by studying the contents of this manual. Knowledge of the system and its controls will make trouble shooting that much easier. Costly downtime or delays can be prevented by systematic checks of actual operation against the normal

sequence to determine the stage at which performance deviates from normal. Following a set routine may help to detect obvious conditions, often ones that are relatively simple to correct.

If an obvious condition is not apparent, check the continuity of each circuit with a voltmeter or test lamp. Each circuit can be checked and the fault isolated and corrected. In most cases, circuit-checking can be accomplished between appropriate terminal on the terminal boards in the control cabinet or entrance box. Refer to the wiring schematic supplied for terminal identification.

Never attempt to circumvent any of the safety features.

⚠ Warning

The cause for loss of flame or any other unusual condition should be investigated and corrected before attempting to restart. Failure to do so may result in serious personal injury or death.

⚠ Warning

Do not repeat unsuccessful lighting attempts without rechecking the burner and pilot adjustments. Damage to the boiler or serious personal injury or death may result.

⚠ Warning

Do not relight the pilot or attempt to start the main burner if the combustion chamber is hot and/or if gas is present in the furnace or flue passages. Promptly correct any conditions causing leakage. Failure to follow these instructions could result in serious personal injury or death.

6.2 — Emergency Shutdown

In case of emergency, shut down the burner by turning the ON-OFF switch to the “OFF” position. Turn the fuel selector switch to the “OFF” position. Shut off the main manual fuel shut off valves on the fuel supply line. The unit can also be shut down with the main electrical power disconnect. Inspect the burner carefully and troubleshoot before re-starting the unit. Follow instructions in Chapter 3 for starting and operating.

6.3 — Problem/Possible Causes

Problem	Possible Causes
Burner Does Not Start	1. No voltage at the program relay power input terminals. a. Main disconnect switch open. b. Blown control circuit fuse. c. Loose or broken electrical connection.
	2. Program relay safety switch requires resetting.
	3. Limit circuit not completed - no voltage at end of limit circuit program relay terminal. a. Pressure or temperature is above setting of operation control b. Water below required level. Low-water light (and alarm horn) should indicate this condition. Check manual reset button, if provided, on low-water control. c. Fuel pressure must be within settings of low pressure and high pressure switches. d. Check burner air proving switch and high-fire limit switch. e. Check air filter, replace if necessary.
	4. Fuel valve interlock circuit not completed. a. Fuel valve auxiliary switch not closed.
No Ignition	1. Lack of spark. a. Electrode grounded or porcelain cracked. b. Improper electrode setting. c. Loose terminal on ignition cable, cable shorted. d. Inoperative ignition transformer. e. Insufficient or no voltage at pilot ignition circuit terminal.
	2. Spark but no flame. a. Lack of fuel - no gas pressure, closed valve, empty tank, broken line, etc.
	3. Low-fire switch open in low-fire proving circuit. a. Damper motor not closed, slipped cam, defective switch. b. Damper jammed or linkage binding.
	4. Running interlock circuit not completed. a. Combustion air proving switches defective or not properly set. b. Motor starter interlock contact not closed.

Problem	Possible Causes
Pilot Flame, but No Main Flame	1. Insufficient pilot flame.
	2. Gas fired unit: a. Manual gas cock closed. b. Main gas valve inoperative. c. Gas pressure regulator inoperative.
	3. Flame detector defective, sight tube obstructed or lens dirty.
	4. Insufficient or no voltage at main fuel valve circuit terminal.

Problem	Possible Causes
Burner Stays in Low-Fire	1. Pressure or temperature above modulating control setting.
	2. Manual-automatic switch in wrong position.
	3. Inoperative modulating motor.
	4. Defective modulating control.
Shutdown Occurs During Firing	1. Loss or stoppage of fuel supply.
	2. Defective fuel valve, loose electrical connection.
	3. Flame detector weak or defective.
	4. Scanner lens dirty or sight tube obstructed.
	5. If the programmer lockout switch has not tripped, check the limit circuit for an opened safety control.
	6. If the programmer lockout switch has tripped: a. Check fuel lines and valves. b. Check flame detector. c. Check for open circuit in running interlock circuit. d. The flame failure light is energized by ignition failure, main flame failure, inadequate flame signal, or open control in the running interlock circuit.
	7. Improper air/fuel ratio (lean fire). a. Damper stuck open. b. fluctuating fuel supply. Temporary obstruction in the fuel line. Temporary drop in gas pressure.
	8. Interlock device inoperative or defective.
Actuator Does Not Operate	1. Manual/automatic switch in wrong position.
	2. Motor does not drive to open or close during pre-purge or close on burner shutdown. a. Motor defective. b. Loose electrical connection. c. Damper motor transformer defective.
	3. Motor does not operate on demand. a. Manual/automatic switch in wrong position. b. Modulating control improperly set or inoperative. c. Motor defective. d. Loose electrical connection. e. Damper motor transformer defective.

Startup/Service Report

The following information should be filled in by the service technician at startup or after any adjustment to the burner.

A copy of the startup report MUST be forwarded to C-B in order to validate the warranty of the burner.

Burner Model _____ Serial Number_____ Startup Date_____

Electric Motors	Voltage			Amperage		
	L1	L2	L3	L1	L2	L3
Control Voltage						
Blower Motor						
Air Compressor						
Air-Oil or Metering						

Test Conducted	Gas			Oil		
	Low	50%	High	Low	50%	High
Firing Rate MMBtu/gph						
Stack Temp (gross) ° F						
Room Temp ° F						
O2%						
CO%						
CO (PPM)						
NOx (PPM)						
Smoke (Bacharach)						
Combustion Eff.%						
Stack Draft “W.C.						
Furnace Pressure “W.C.						
Blast Tube Pressure “W.C.						
Steam Pressure PSIG						
Water Temp ° F						
Supply Oil Pressure PSIG	N/A	N/A	N/A	N/A	N/A	N/A
Return Oil Pressure PSIG	N/A	N/A	N/A	N/A	N/A	N/A
Vacuum Oil Pump “HG	N/A	N/A	N/A	N/A	N/A	N/A
Oil Temp	N/A	N/A	N/A	N/A	N/A	N/A
Atom. Air Pressure						
Gas Pressure @ Burner Manifold “ W.C.	Inner Manifold			N/A	N/A	N/A
	Outer Manifold			N/A	N/A	N/A
Center Gas Pressure “W.C.				N/A	N/A	N/A
Gas Pressure @ Regulator Inlet PSIG						
Gas Pressure @ Regulator Outlet PSIG						
Pilot Gas Pressure @ Regulator Outlet “ W.C.						
Flame Signal Main	Low		50%		High	

Control Check	Test	Set Point
Low Water Cutoff		
Aux. LWCO		
High Water Cutoff		
Operating Limit		
High Limit		
Operating Control		
Stack Temp Interlock		
Flame Failure		
Combustion Air Switch		
High Purge Switch		
Low Fire Interlock		
Oil Pressure Switch	N/A	N/A
Oil Valve w/P.O.C. Interlock	N/A	N/A
High Gas Pressure Switch		
Low Gas Pressure Switch		
Gas Valve P.O.C. Interlock		
Pilot Turndown Test		
Flame Signal Pilot		
(For Low NOx Burners)		
Blast Tube Temp Interlock		
FGR Line Purge Switch		
FGR Valve P.O.C.		

Adjusted by:

Date:

Accepted by:

(Signature Required)

Warranty Policy

Limited Warranty: The Company warrants that at the time of shipment, the equipment manufactured by it shall be merchantable, free from defects in material and workmanship and shall possess the characteristics represented in writing by the Company. The Company's warranty is conditioned upon the equipment being properly installed and maintained and operated within the equipment's capacity under normal load conditions with competent supervised operators.

Equipment, accessories, and other parts and components not manufactured by the Company are warranted only to the extent of and by the original manufacturer's warranty to the Company. In no event shall such other manufacturer's warranty create any more extensive warranty obligations of the Company to the Buyer than the Company's warranty covering equipment manufactured by the Company.

Exclusions From Warranty: (I) THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, ORAL OR EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT. THERE ARE NO EXPRESS WARRANTIES OTHER THAN THOSE CONTAINED HEREIN TO THE EXTENT PERMITTED BY THE LAW. THERE ARE NO IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. THE PROVISIONS AS TO DURATION, WARRANTY ADJUSTMENT AND LIMITATION OF LIABILITY SHALL BE THE SAME FOR BOTH IMPLIED WARRANTIES (IF ANY) AND EXPRESSED WARRANTIES.

(II) The Company's warranty is solely as stated in (a) above and does not apply or extend, for example, to: expendable item; ordinary wear and tear; altered units; units repaired by persons not expressly approved by the Company; materials not of the Company's manufacture; or damage caused by accident, the elements, abuse, misuse, temporary heat, overloading, or by erosive or corrosive substances or by the alien presence of oil, grease, scale, deposits or other contaminants in the equipment.

Warranty Adjustment: Buyer must make claim of any breach of any warranty by written notice to the Company's home office within thirty (30) days of the discovery of any defect. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts of the equipment which within twelve (12) months from the date of initial operation but no more than eighteen (18) months from date of shipment shall prove the Company's satisfaction (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within the above warranty. Any warranty adjustments made by the Company shall not extend the initial warranty period set forth above. Expenses incurred by Buyer in replacing or repairing or returning the equipment or any part or parts will not be reimbursed by the Company.

Spare and Replacement Parts Warranty Adjustment: The Company sells spare and replacement parts. This subparagraph (10.4) is the warranty adjustment for such parts. Buyer must make claim of any breach of any spare or replacement parts by written notice to the Company's home office within thirty (30) days of the discovery of any alleged defect for all such parts manufactured by the company. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts or material it manufacture which, within one (1) year from the date of shipment shall prove to Company's satisfaction (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within this part warranty. The warranty and warranty period for spare and replacement parts not manufactured by the company (purchased by the Company, from third party suppliers) shall be limited to the warranty and warranty adjustment extended to the Company by the original manufacturer of such parts; In no event shall such other manufacturer's warranty create any more

extensive warranty obligations of the Company to the Buyer for such parts than the Company's warranty adjustment covering part manufactured by the Company as set forth in this subparagraph (10.4). Expenses incurred by Buyer in replacing or repairing or returning the spare or replacement parts will not be reimbursed by the Company.

Limitation of Liability: The above warranty adjustment set forth Buyer's exclusive remedy and the extent of the Company's liability for breach of implied (if any) and express warranties, representations, instructions or defects from any cause in connection with the sale or use of the equipment. THE COMPANY SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE OR EXPENSE, DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF THE EQUIPMENT OR FROM ANY OTHER CAUSE WHETHER BASED ON WARRANTY (EXPRESS OR IMPLIED) OR TORT OR CONTRACT, and regardless of any advice or recommendations that may have been rendered concerning the purchase, installation, or use of the equipment.