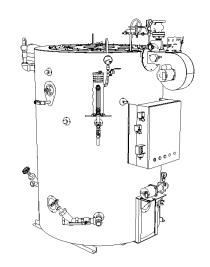


INSTALLATION AND OPERATION MANUAL

Vertical Multi-Port (VMP)
Gas/Oil-Fired Steam Boilers
Model VMP
40-150 HP



Serial/ National Board Number	
Model	
Fulton Order	
Sold To	
Job Name	
Date	



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Do not operate, or allow others to operate, service or repair this equipment unless you (they) fully understand all applicable sections of this manual and are qualified to operate/maintain the equipment.

This boiler is equipped with an ignition device, which automatically lights the burner. Do not try to light the burner by hand.

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

Assure all electrical connections are powered down prior to attempting replacement or service of electrical components or connections of the equipment.

Label all wires prior to disconnecting when servicing controls. Wiring errors can cause improper and dangerous operation.

Operating the equipment beyond its design limits can damage the equipment and can also be dangerous. Do not operate the equipment outside its limits. Do not try to upgrade the equipment performance by unapproved modifications. Unapproved modifications can cause injury and damage.

Contact your Fulton Representative before modifying the equipment.

Defective equipment can injure you or others. Do not operate equipment which is defective or has missing parts. Make sure all repairs or maintenance procedures are completed before using the equipment. Do not attempt repairs or any other maintenance work you do not understand.

Never attempt to operate equipment that has failed to pass all the safety checks.

Please read these instructions and save for reference.

Overview

Prior to shipment, the following inspections and tests are made to ensure the highest standards of manufacturing for our customers:

- Material inspections
- Manufacturing process inspections
- American Society of Mechanical Engineers (ASME) welding inspection
- ASME hydrostatic test inspection
- Electrical components inspection
- Operating test
- Final engineering inspection
- Crating inspection

This manual is provided as a guide to the correct operation and maintenance of your Fulton equipment, and should be read in its entirety and be made permanently available to the staff responsible for the operation of the boiler. It should not, however, be considered as a complete code of practice, nor should it replace existing codes or standards which may be applicable. Fulton reserves the right to change any part of this installation, operation and maintenance manual.

Installation, start-up, and maintenance of this equipment can be hazardous and requires trained, qualified installers and service personnel. Trained personnel are responsible for the installation, operation, and maintenance of this product, and for the safety assurance of installation, operation, and maintenance processes. Do not install, operate, service or repair any component of this equipment unless you are qualified and fully understand all requirements and procedures. Trained personnel refers to those who have completed Fulton Service School training specific to this product.

When working on this equipment, observe all warnings, cautions, and notes in literature, on stickers and labels, and any additional safety precautions that apply. Follow all safety codes and wear appropriate safety protection. Follow all jurisdictional codes and consult any jurisdictional authorities prior to installation.

Receiving Inspection

The customer should examine the equipment for any damage. It is the responsibility of the installer to ensure all parts supplied with the equipment are fitted in a correct and safe manner.

Warnings & Cautions

WARNINGS and CAUTIONS appear in various chapters of this manual. It is critical that all personnel read and adhere to all information contained in WARNINGS and CAUTIONS.

- WARNINGS must be observed to prevent serious injury or death to personnel.
- CAUTIONS must be observed to prevent damage or destruction of equipment or loss of operating effectiveness.

All Warnings and Cautions are for reference and guidance purposes, and do not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes or regulations.

In addition, there are bolded **Notes** throughout the manual, which are included as additional information for essential and effective operation and conditions.

MARNING

After checking controls by manual adjustment, always ensure they are reset to their proper settings.

Follow proper lockout/tagout procedures for the electrical, gas and water connections.

If any "Manual Reset" limit device trips, DO NOT reset without determining and correcting the cause. (Manual Reset Limits may include: flame safeguard, high or low gas pressure, high temperature limit, high pressure limit.)

Never tamper with low water (liquid level) cutoff sensors or circuitry.

Before commissioning the equipment, verify with authorized personnel that gas lines have been purged.

Check daily that the equipment area is free and clear of any combustible materials, including flammable vapors & liquids.

WHAT TO DO IF YOU SMELL GAS:

- Do not use matches, candles, flame or other sources of ignition to check for gas leaks.
- Do not try to light the appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a safe location.
- Follow the gas supplier's instructions. If you cannot reach your gas supplier, call the fire department.

A qualified installer, service agency or the gas supplier must perform installation and service on the fuel delivery system.

WARNING

Do not store or use gasoline or other flammable vapors and liquids or corrosive materials in the vicinity of this or any other appliances. Cements for plastic pipe should be kept away from all sources of ignition. Proper ventilation should be maintained to reduce the hazard and to minimize breathing of cement vapors.

No shutoff of any kind shall be placed between the safety relief valve and the equipment or in the discharge pipe between such valve and the atmosphere. Doing so can cause an accidental explosion from overpressure.

The discharge from the safety relief valve shall be so arranged that there will be no danger of scalding personnel or damage to equipment. Provisions should be made to properly drain safety relief valve discharge piping.

Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing fluid shutoff valves and carefully decrease all trapped pressures to zero before performing any maintenance.

Do not attempt to start the equipment for any testing prior to filling and purging the vessel. A dry fire will seriously damage the equipment and may result in property damage or personnel injury and is not covered by warranty. In case of a dry firing event, shut off the fuel supply and allow the vessel to cool to room temperature before fluid is reintroduced to the pressure vessel. The boiler should be inspected by a qualified individual prior to commissioning the unit.

When opening any drains on the equipment or piping system, steps should be taken to avoid scalding/burning of personnel due to hot fluids. Whenever possible, the system should be cooled prior to opening any drains.

Post these instructions in an appropriate place near the equipment and maintain in good legible condition.

🔨 WARNING

Boiler blowdown water must be cooled to $<140^{\circ}F$ (60°C) prior to discharge to a drain, or as required per local jurisdictional codes. Failure to use an approved blow off vessel with adequate cooling could cause personnel/equipment damage.

Improper installation or maintenance of gauge glass and connections can cause immediate or delayed breakage resulting in bodily injury and/or property damage. Only properly trained personnel should install and maintain gauge glass connections. Wear safety glasses during installation. Be sure all parts are free of chips and debris.

riangle caution

Where an atmospheric feedwater tank is to be installed, this should: 1) Be vented to a safe location; 2) Have capacity sufficient to satisfy boiler consumption, as well as maintain proper return tank temperature; 3) Vent pipe should not be downsized, as it may caused pressure build up in the tank; 4) Return pipes must not be insulated as this can cause overheating in the feedwater tank and potential vapor lock in the pump. Return pipes should be shielded to prevent burn hazard.

Gauge glass valves need to be fully open during boiler operation to prevent boiler damage in case of gauge glass failure.

After installation is complete and prior to operation, the pressure vessel should be cleaned or boiled out per instructions in this manual.

WARNING

The vent line connection on the gas pressure regulator must be piped to outdoor air by the installer in accordance with the National Fuel Gas Code, American National Standards Institute (ANSI) Z2231991 or latest addenda. In Canada, gas installations must be in accordance with the current CAN/Compressed Gas Association (CGA) B149.1 and 2 and/or local codes.

Hot surfaces (over 120 F [49 C]) should be insulated or shielded for safety. See Installation section.

Use only your hand to turn valve handles. Never use tools. If the handle will not turn by hand, don't try to repair. Forced or attempted repair may result in fire or explosion.

Should overheating occur or the gas supply fails to shut off, manually shut off the gas supply external to the equipment.

For reasons of safety, the hot exhaust gas duct and chimney must be insulated or shielded within the locality of the heater in compliance with local codes and regulations.

Check daily that the boiler area is free and clear of any combustible materials, including flammable vapors and liquids.

Do not use matches, candles, flame or other sources of ignition to check for gas leaks.

These instructions must not be considered as a complete code of practice nor should they replace existing codes or standards which may be applicable.

<u>∕!\</u> WARNING

Commissioning/Start up by a non-Fulton authorized person will void the product warranty.

To ensure that your Fulton equipment is operating safely and efficiently, follow the maintenance procedures set forth in this manual.

SAFETY COMPONENTS: The end user of the boiler must maintain all labels on the boiler in clean, legible condition. All connections and safety devices, both mechanical and electrical, must be kept clean, with ease of access for inspection, use and maintenance.

CAUTION

Maintenance procedures for this equipment should be completed by trained personnel. Appropriate training and instruction are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Representative.

When calculating ventilation requirements, heat losses from the Fulton equipment (and other equipment) should be considered.

The stack arrangement and draft conditions should be in accordance with the information in this manual for proper performance of the equipment.

A competent rigger experienced in handling heavy equipment should handle rigging your equipment into position.

CAUTION

Competent personnel in accordance with all applicable local codes should carry out the installation of the Fulton equipment. "Factory-Trained Personnel" refers to someone who has attended a Fulton Service School specifically for the equipment covered in this manual.

All state and jurisdictional codes beyond the scope of the applicable ASME Boiler and Pressure Vessel Codes, for its corresponding classification, should be followed in all cases. Jurisdictional authorities must be consulted prior to installation.

The equipment must be installed on a non-combustible surface.

CAUTION

Some soap used for leak testing is corrosive to certain types of metals. Clean all piping thoroughly after completing the leak check.

A temperature exceeding 120°F (49°C)* in the boiler room may cause premature failure of electrical components. Provisions should be made to maintain an ambient temperature of 120°F (49°C)* or less (the panel box interior should not exceed 125°F [52°C]*).

*Pumps, Programmable Logic Controllers (PLC) or ModSync panels may require lower ambient temperatures or additional cooling.

riangle caution

Particulate matter or chemicals (example: perchlorethylene, chlorine, or halogenated compounds) in the combustion air supply to the boiler will cause damage or failure to the burner and is not covered under warranty. Airborne materials from construction and maintenance activities constitute a high-risk situation.

An exhaust fan may draw products of combustion into the work environment creating a possible hazard to personnel.

Never leave an opened manual air vent unattended. In the event an opened vent is left unattended, water or fluid damage could occur. The exception to this warning is a feed water deaerator manual vent cracked open may be left unattended.

Do not use this equipment if any part has been under water (or subjected to heavy rains/water if the equipment does not have National Electrical Manufacturers Association (NEMA) 4 wiring, controls and instrumentation). Immediately call a qualified service technician to inspect the equipment and to replace any part of the control system and/or gas control(s) which have been under water.

For all systems containing boilers or unfired steam generators, the water chemistry in the boiler must be kept within the limits outlined in this manual. Failure to do so may cause premature pressure vessel failure and poor steam quality and will void the warranty.

CAUTION

Do not use the equipment as support for ducted air piping. Ducted piping must be supported independently of the equipment.

Do not run the pump dry. Irreparable damage to the seal can result. Prime the pump in accordance with the manufacturer's instructions. Never operate the pump with a closed discharge valve.

After adjusting components in the fuel or air delivery system combustion/emissions must be verified throughout the firing range. If emissions are improper, adjust combustion following the appropriate procedure in this manual.

Should you suspect that the boilers flue passage ways have become blocked, contact your authorized Fulton representative.

Disclaimers and Local Codes

Installation of the equipment shall conform to all the requirements or all national, state and local codes established by the authorities having jurisdiction or, in the absence of such requirements, in the US to the National Fuel Gas Code ANSI Z2231/National Fire Protection Association (NFPA) 54 latest edition, and the specific instructions in this manual. Authorities having jurisdiction should be consulted prior to installation.

When required by local codes, the installation must conform to the ASME Safety Code for Controls and Safety Devices for Automatically Fired Boilers (ASME CSD-1).

The standard boiler is manufactured and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section I for a maximum working pressure of 150 psig per ASME Boiler and Pressure Vessel Code, Section IV for a maximum working pressure of 15 psig.

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MARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Unless otherwise noted, this boiler is certified for indoor installation only.

A competent rigger experienced in handling heavy equipment should handle rigging your equipment into position.

The equipment must be installed on a non-combustible surface.

Do not store or use gasoline or other flammable vapors and liquids or corrosive materials in the vicinity of this or any other appliances.

Installation must be carried out by qualified personnel only. All aspects of the installation must comply with applicable codes.

CAUTION

Do not allow weight to bear on equipment components to prevent damage.

Under no circumstances may shipping legs be used to mount or anchor boiler. Shipping legs are for shipping purposes only.

Product Overview

Prior to the installation, operation, or maintenance procedures, personnel should become familiar with the equipment and its components. Please read this entire manual before beginning any installation, operation or maintenance procedures.

If any questions arise, contact Fulton before proceeding. The information contained in this installation, operation and maintenance manual is subject to change due to continuous product improvement. Additionally, these instructions should be regarded as a general guide and must not be considered as a complete code of practice. This manual does not replace existing codes or standards which may be applicable.

Massachusetts Installations

Boilers installed in Massachusetts must have the following:

A gas pressure regulator installed upstream of the gas train provided by the manufacturer or installing contractor.

Two safety shutoff valves, in series, one of which is of the type incorporating a valve seal overtravel interlock when the maximum firing rate per combustion chamber exceeds 5,000,000 BTU/hour.

Placement & Rigging

Adhere to the following for placement and rigging:

- 1. Check building specifications for permissible floor loading. Use Table 3 for unit reference.
- 2. Conform to all the requirements of all national, state and local codes established by the authorities having jurisdiction and/or the U.S. to the National Fuel Gas Code, latest edition. Authorities having jurisdiction should be consulted before installations are made. Where required by local codes, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers (ASME CSD-1).
- 3. Since an external electrical source is utilized, the boiler, when installed, must be electrically ground in accordance with the National Electric Code, American National Standards Institute (ANSI) National Fire Protection Association (NFPA) 70, latest edition.
- 4. The boiler is designed for room temperatures above 32°F (0°C) and not exceeding 120°F (48.9°C).
- 5. Install so that all system components are protected from water (dripping, spraying, rain, etc.) and debris (dry wall dust, insulation particles, etc.) during boiler operation and service.

- 6. Install on a level, non-combustible surface. Concrete or steel is recommended. The surface must be elevated a minimum of 4" (102 mm) above the floor. The use of shims may be required to ensure the boiler is level. Do not install the boiler on springs.
- 7. Transport unit by lifting lugs at the top of the boiler. If means of lifting are not available, rollers should be placed beneath the frame of the equipment and it should be guided to the installation location. Refer to Table 3 for standard weights.
- 8. Never allow weight to bear on the jacket, control panel, trim, burner, fuel train or fan housing of any Fulton boiler. Use only lifting eyes or fork holes for movement.
- Locate the boiler so that the combustion air supply and exhaust piping between the boiler and outside wall/roof are within the draft pressure requirements

- for horizontal or vertical venting. See **Clearances and Serviceability** section of this manual.
- Place equipment in a well ventilated room. See
 Equipment Ventilation & Combustion Air
 Requirements section of this manual.
- 11. Ensure there is adequate clearance around the unit to provide access for operators and maintenance personnel to access all parts of the equipment per local jurisdictional requirements. Ensure also that clearance provides for component removal for maintenance. The service engineer or the operator should not have to pass exposed, hot pipe work to make adjustments to the boiler. See **Clearances & Serviceability** section of this manual.
- 12. Ensure the boiler is located a safe distance from the fuel oil tank (if applicable).

TABLE 1 - VMP CUSTOMER CONNECTIONS (SEE FIGS. 1 - 72)

		40 BHP		49.5 BHP		50 BHP		60 BHP	
	Description	Size	Туре	Size	Туре	Size	Туре	Size	Туре
Α	Feedwater Inlet; in. (mm)	1 (25)	NPT						
В	Blowdown Outlet (2x); in. (mm)	1.5 (38)	NPT						
C	Steam Outlet ; in. (mm)								
	High Pressure steam outlet	3 (76)	150#	3 (76)	NPT	3 (76)	NPT	3 (76)	NPT
	Low Pressure steam outlet	4 (102)	150#	4 (102)	NPT	4 (102)	NPT	4 (102)	NPT
D	Exhaust Stack; in. (mm)	12 (305)		12 (305)		12 (305)		12 (305)	
Е	Safety Relief Valve Inlet; in. (mm)								
	150psi trim	.75 (19) QTY: 2	NPT	1.25 (32) QTY: 2	NPT	1.25 (32) QTY: 2	NPT	1.5 (38) QTY: 2	NPT
	15psi trim	1.25 (32) QTY: 2	NPT	1.25 (32) QTY: 2	NPT	1.25 (32) QTY: 2	NPT	1.5 (38) QTY: 2	NPT
F	Safety Relief Valve Outlet; in. (mm)								
	150psi trim	1 (25)	NPT	1.25 (32)	NPT	1.25 (32)	NPT	1.25 (32)	NPT
	15psi trim	1.5 (38) QTY: 2	NPT	2 (51) QTY: 2	NPT	2 (51) QTY: 2	NPT	2 (51) QTY: 2	NPT
G	Water Column Drain; in. (mm)	1 (25)	NPT						
Н	Sight Glass Drain; in. (mm)	.25 (6)	NPT						
J	Water Sample Port; in. (mm)	.25 (6)	NPT						
K	Steam Sample Port; in. (mm)	.25 (6)	NPT						
L	Surface Blowdown; in. (mm)	.75 (19)	NPT						
М	High Water Protection; in. (mm)	.75 (19)	NPT						
N	Combustion Air Inlet; in. (mm)	8.5 (92)		8.5 (92)		8.5 (92)		8.5 (92)	
Р	Single Source Power								
Q	Hand Holes (4x); in. (mm)	3 x 4 (76 x 102)							
R	Oil Supply; in.(mm)	.25 (6)	NPT	.25 (6)	NPT	.25 (6)	NPT		NPT
S	Oil Return; in. (mm)	.25 (6)	NPT						
Т	Gas Inlet; in. (mm)	1.5 (38)	NPT	1.5 (38)	NPT	1.5 (38)	NPT	2 (51)	NPT

TABLE 1 (CONTINUED) - VMP CUSTOMER CONNECTIONS (SEE FIGS. 1 - 72)

		80 BHP		100 BHP		130 BHP		150 BHP	
	Description	Size	Туре	Size	Type	Size	Туре	Size	Туре
Α	Feedwater Inlet; in. (mm)	1 (25)	NPT	1.25 (32)	NPT	1.25 (32)	NPT	1.25 (32)	NPT
В	Blowdown Outlet (2x); in. (mm)	1.5 (38)	NPT	2 (51)	NPT	2 (51)	NPT	2 (51)	NPT
C	Steam Outlet ; in. (mm)								
	High Pressure steam outlet	4 (102)	NPT						
	Low Pressure steam outlet	6 (152)	NPT	6 (153)	NPT	6 (153)	NPT	6 (153)	NPT
D	Exhaust Stack; in. (mm)	14 (254)		14 (356)		14 (356)		16 (407)	
Е	Safety Relief Valve Inlet; in. (mm)								
	150psi trim	2 (51) QTY: 2	NPT	2 (51) QTY: 2	NPT	2 (51) QTY: 3	NPT	2 (51) QTY: 3	NPT
	15psi trim	2 (51) QTY: 2	NPT	2 (51) QTY: 2	NPT	2 (51) QTY: 3	NPT	2 (51) QTY: 3	NPT
F	Safety Relief Valve Outlet; in. (mm)								
	150psi trim	1.5 (38)	NPT	1.5 (38)	NPT	2 (51)	NPT	2 (51	NPT
	15psi trim	2.5 (64) QTY: 2	NPT	2.5 (64) QTY: 2	NPT	2.5 (64) QTY: 3	NPT	2.5 (64) QTY: 3	NPT
G	Water Column Drain; in. (mm)	1 (25)	NPT						
Н	Sight Glass Drain; in. (mm)	.25 (6)	NPT						
J	Water Sample Port; in. (mm)	.25 (6)	NPT						
K	Steam Sample Port; in. (mm)	.25 (6)	NPT						
L	Surface Blowdown; in. (mm)	.75 (19)	NPT						
М	High Water Protection; in. (mm)	.75 (19)	NPT						
N	Combustion Air Inlet; in. (mm)	8.5 (92)		8.5 (92)		8.5 (92)		8.5 (92)	
Р	Single Source Power								
Q	Hand Holes (4x); in. (mm)	3 x 4 (76 x 102)							
R	Oil Supply; in.(mm)	.25 (6)	NPT						
S	Oil Return; in. (mm)	.25 (6)	NPT						
Т	Gas Inlet; in. (mm)	2 (51)	NPT						

Notes for Table 3

- 1. Steam output LB/HR: From 0 PSIG at 212°F (0 kg/cm² at 100°C).
- 2. All clearances are factory recommendations. Consult local jurisdiction for exact code compliance.
- 3. Fulton recommends minimum clearance of 36" in front of electrical panels.
- 4. Fulton recommends 36" clearance between inspection openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
- 5. All dimensions inside () denote reference dimensions.

- 6. All dimensions inside rectangles denote overall dimensions.
- 7. We reserve the right to change specifications and/or dimensions. All information is subject to change based on addition of any optional equipment and/or accessories. Please consult the factory for project specific estimates if additional options or accessories are required.
- 8. Refer to fuel train drawing for fuel train venting requirements. Recommended stack run is minimum 24" straight off the rear of the boiler, prior to making a directional change.
- 9. Local codes can supercede Fulton recommended clearance.

SECTION 2

TABLE 2 - VMP SPECIFICATIONS

Unit Size (BHP)	40 BHP	49.5 BHP	50 BHP	60 BHP	80 BHP	100 BHP	130 BHP	150 BHP
Maximum allowable working pressure	150 PSI	150 PSI	150 PSI	150 PSI				
Boiler input (BTU/HR)	1,594,000	1,974,000	1,993,000	2,392,000	3,188,000	3,986,000	5,181,000	5,979,000
Boiler input (Natural gas); CU FT/HR (+)	1594	1974	1993	2,392	3,188	3,986	5,181	5,979
Boiler input (Propane); CU FT/HR (+)	638	790	797	957	1275	1594	2082	2392
Boiler Input (Oil); GPH (+)	11.4	14.1	14.3	17.1	22.8	28.5	37.1	42.8
RATINGS* (Sea level to 3000 ft (914.4 m)								
Boiler Output (BTU/HR)	1,339,000	1,658,000	1,673,000	2,009,000	2,678,000	3,348,000	4,352,000	5,022,000
Steam Output - Minimum Service Capacity; LB/HR (KG/HR)	1,380 (626)	1,708 (775)	1,725 (783)	2,070 (939)	2,760 (1,252)	3,450 (1,565)	4,485 (2,035)	5,175 (2,347)
Net Effective Heating Service (SQ. FT)	95	95	121	134	179	215	303	303
Water Capacity (Operating); GAL.	153	231	219	245	348	477	749	749
Burner Turndown (Gas, Standard)	3;1	3;1	3;1	3;1	3;1	5;1	5;1	5;1
Gas Burner Turndown (Gas, High Turndown)	5;1	5;1	5;1	5;1	5;1	8;1	8;1	8;1
Burner Turndown (#2 Oil)	2;1	2;1	2;1	2;1	2;1	2;1	2;1	2;1
Draft Requirements				*-0.02"W.C.	to -0.04"W.C.			
Incoming Gas Pressure (Standard Emissions)								
Minimum "W.C.	9	9	9	9	9	11	40	40
Maximum "W.C.	138	138	138	138	138	138	138	138
Incoming Gas Pressure (<9ppm and below)								
Minimum "W.C.	40	40	40	40	40	40	40	40
Maximum "W.C.	138	138	138	138	138	138	138	138
Weights (Approximate)								
Operating Weight; LBS	7,175	8,424	8,631	9,545	12,208	14,577	21,749	22,649
Shipping Weight; LBS	5,900	6,500	6,800	7,500	9,300	10,600	15,500	16,400
Flooded Weight; LBS	7,546	8,933	9,117	10,031	12,837	15,430	22,668	23,381
Electric Power Requirements (GAS ONLY)**								
208V, 50/60 CY, 3 PHASE	11.5	11.5	11.5	11.5	16	16	35.5	35.5
230V, 50/60 CY, 3 PHASE	9.5	9.5	9.5	9.5	13	13	31.5	31.5
460V, 50/60 CY, 3 PHASE	5	5	5	5	7	7	16	16
575V, 60 CY, 3 PHASE	4	4	4	4	5.5	5.5	14	14
Electric Power Requirements (Combo GAS/O								
208V, 50/60 CY, 3 PHASE	14	14	14	14	18	18	38	38
230V, 50/60 CY, 3 PHASE	12.0	12	12	12	15	15	33.5	33.5
460V, 50/60 CY, 3 PHASE	6	6	6	6	7.5	7.5	17	17
575V, 60 CY, 3 PHASE	5	5	5	5	6	6	12.5	12.5

Note: Specifications and dimensions are approximate. Fulton reserves the right to change specifications and/or dimensions.

^{*} Steam output ratings at 212°F (100°C) feedwater temperature 0 PSIG.

^{**} Power requirements shown are for standard unit packages and may vary slightly when additional control options are added.

⁺ Consumption based on natural gas 1000 BTU/ft³, propane 2500 BTU/ft³, light oil 140,000 BTU/g.

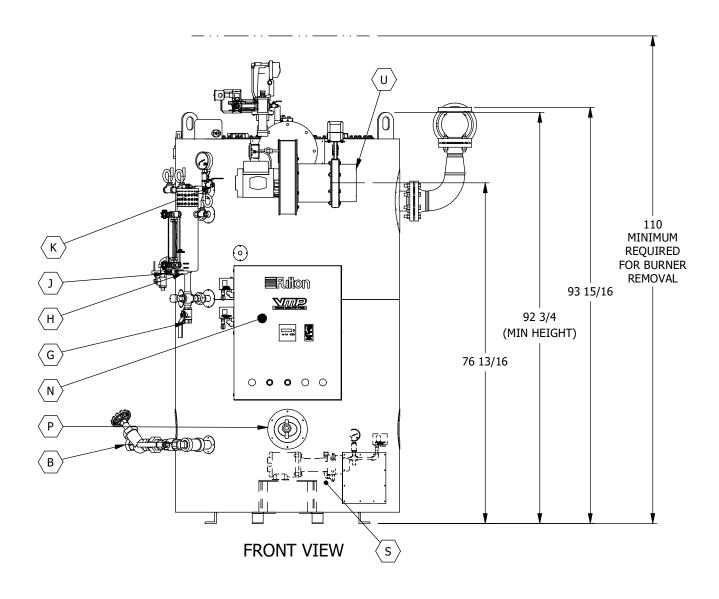


FIGURE 1 - 40 HP **(GAS ONLY)** - MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

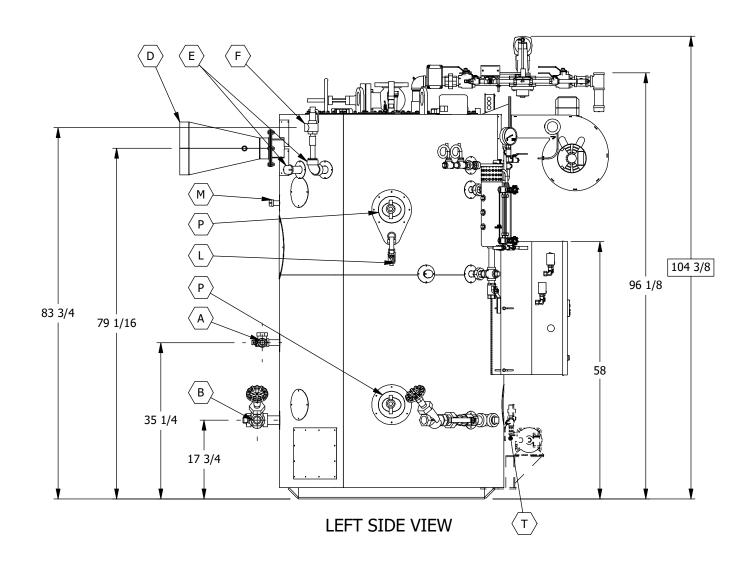


FIGURE 2 - 40 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

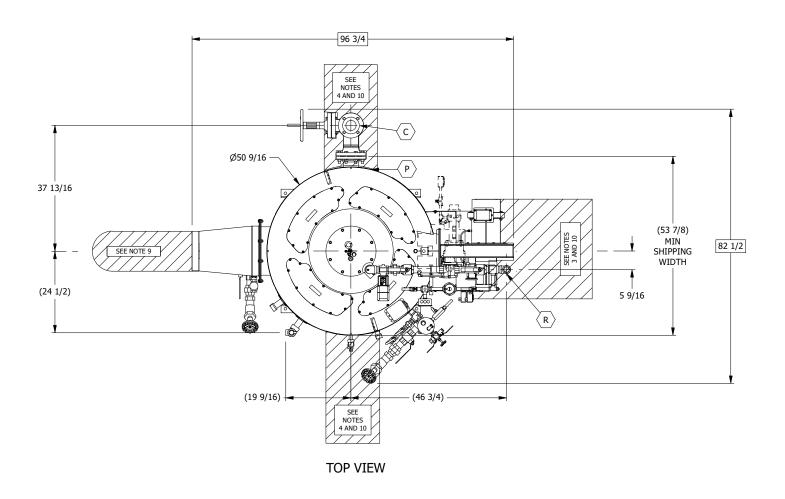


FIGURE 3 - 40 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

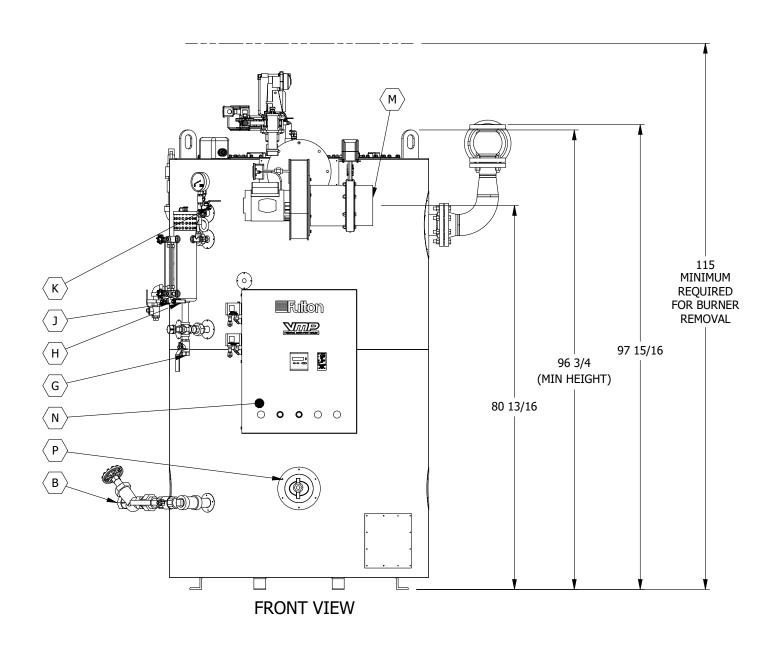


FIGURE 4 - 49.5 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

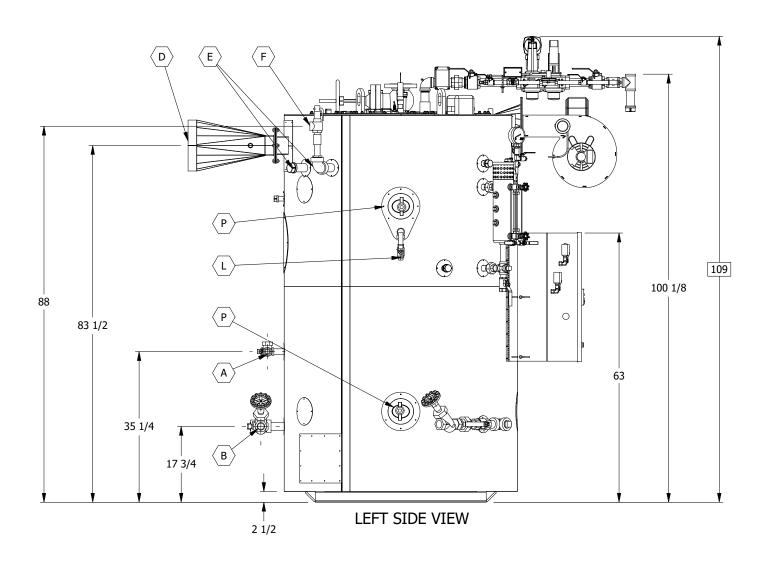


FIGURE 5 - 49.5 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

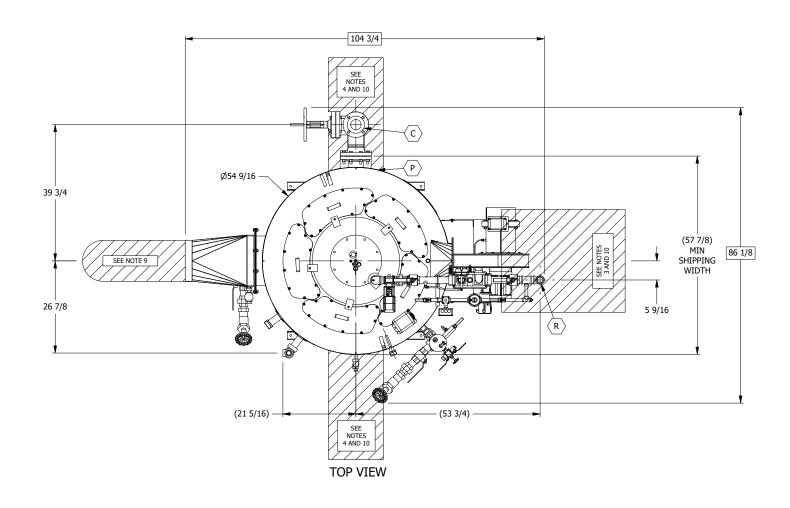


FIGURE 6 - 49.5 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

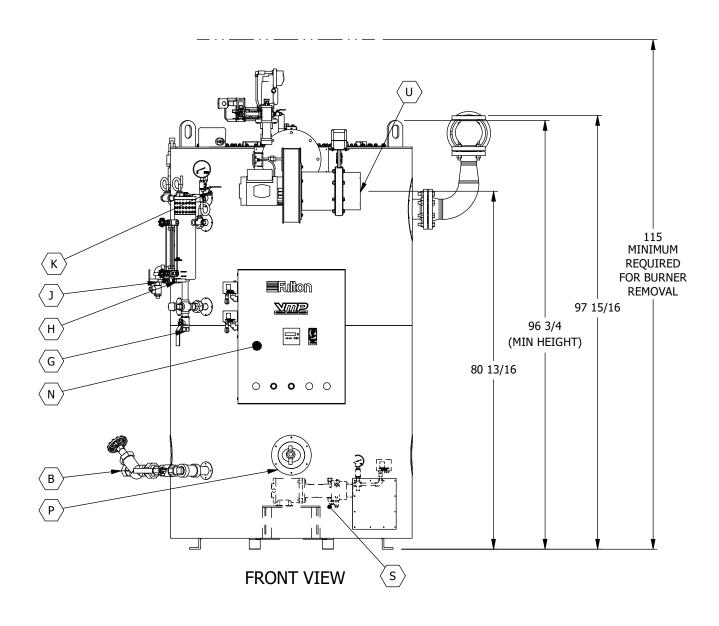


FIGURE 7 - 50 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

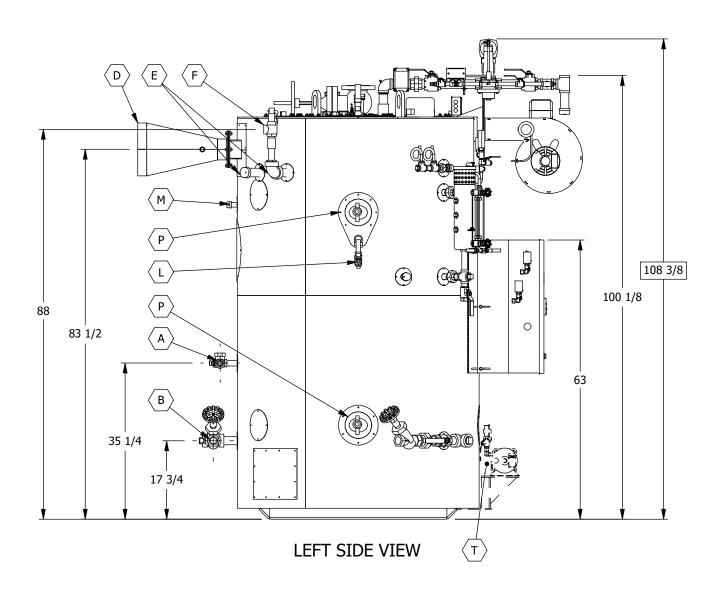


FIGURE 8 - 50 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

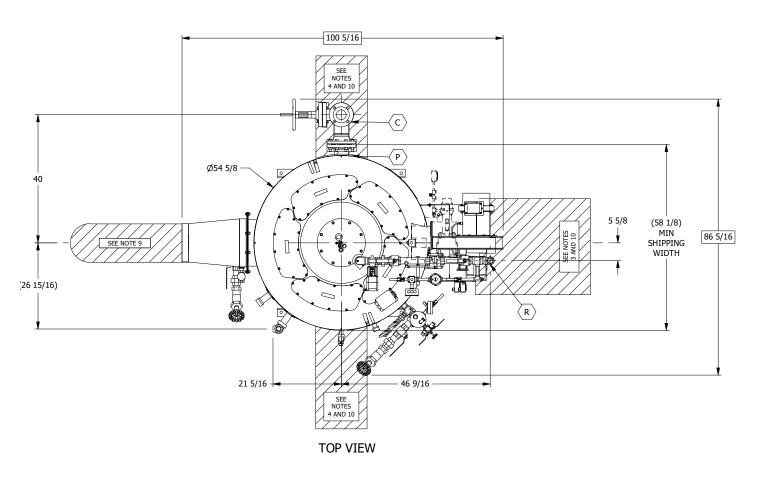


FIGURE 9 - 50 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

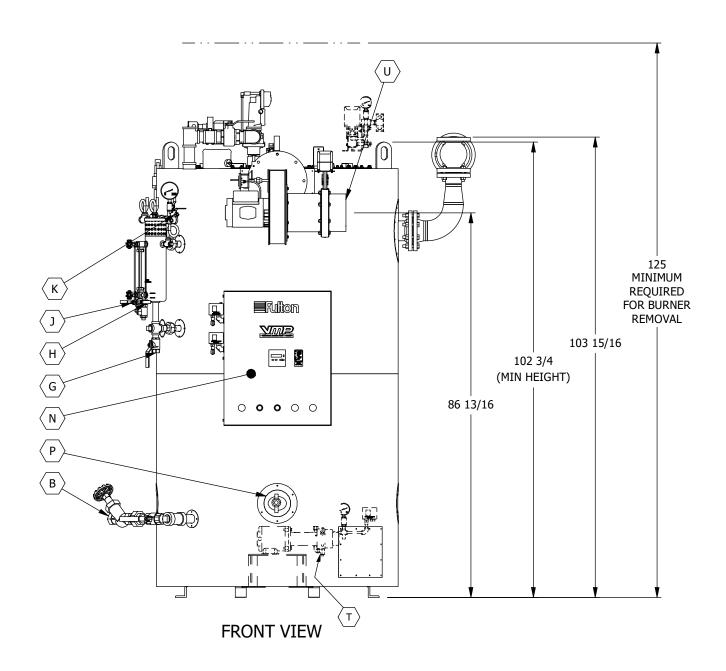


FIGURE 10 - 60 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

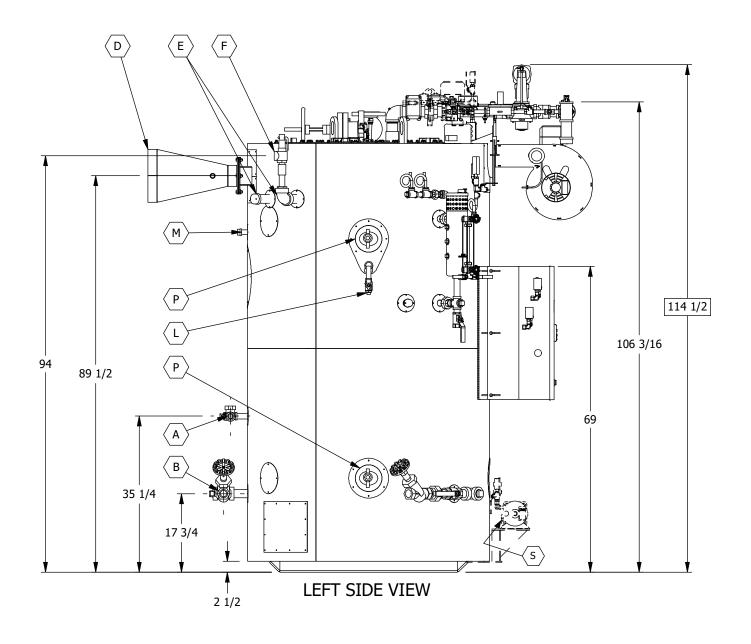


FIGURE 11 - 60 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

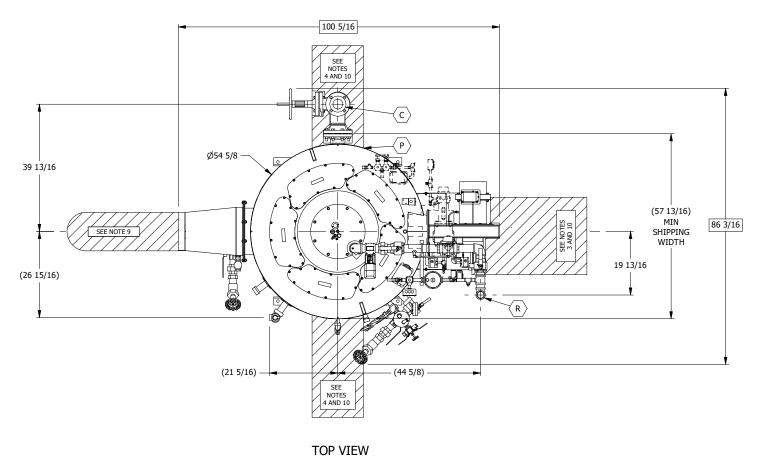


FIGURE 12 - 60 HP (GAS ONLY) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

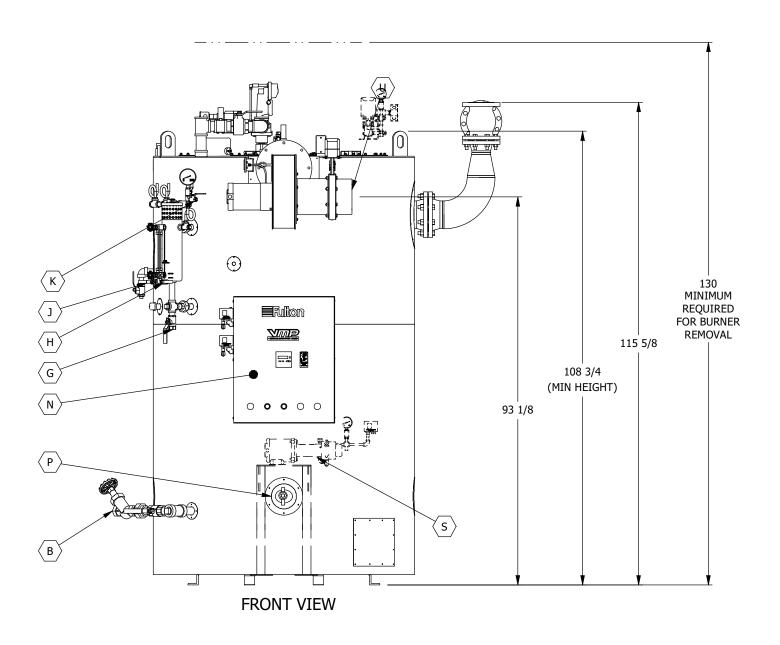


FIGURE 13 - 80 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

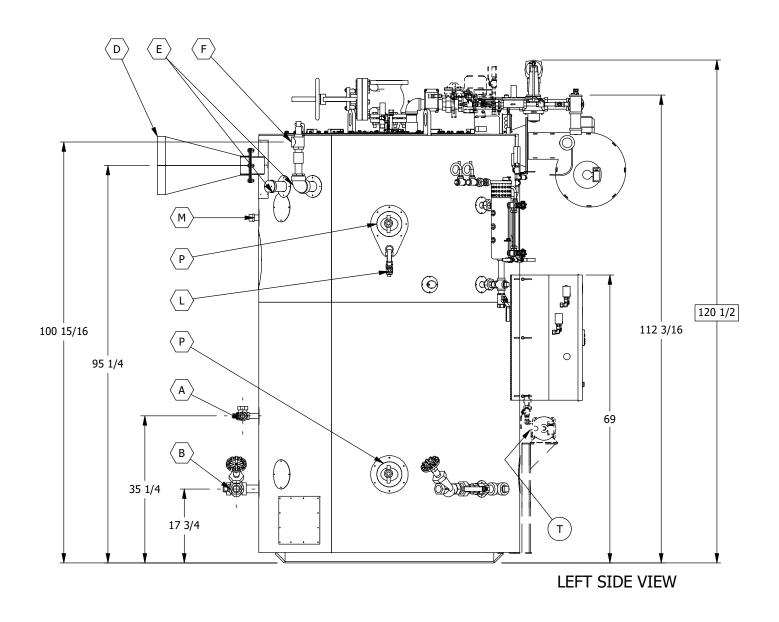


FIGURE 14 - 80 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

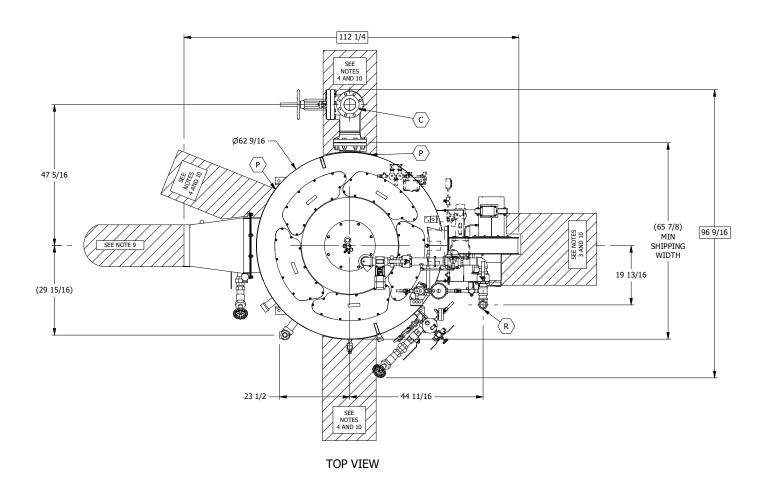


FIGURE 15 - 80 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

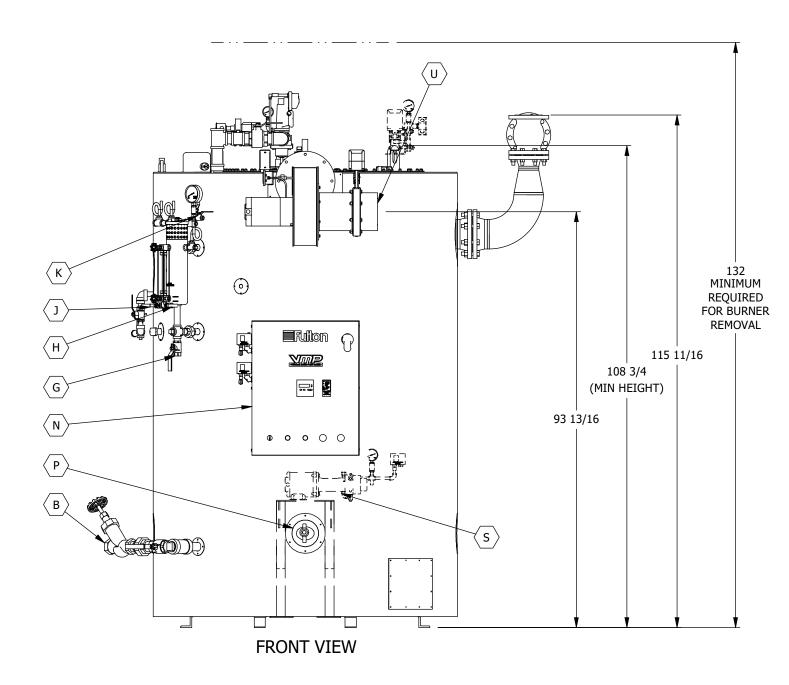


FIGURE 16 - 100 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

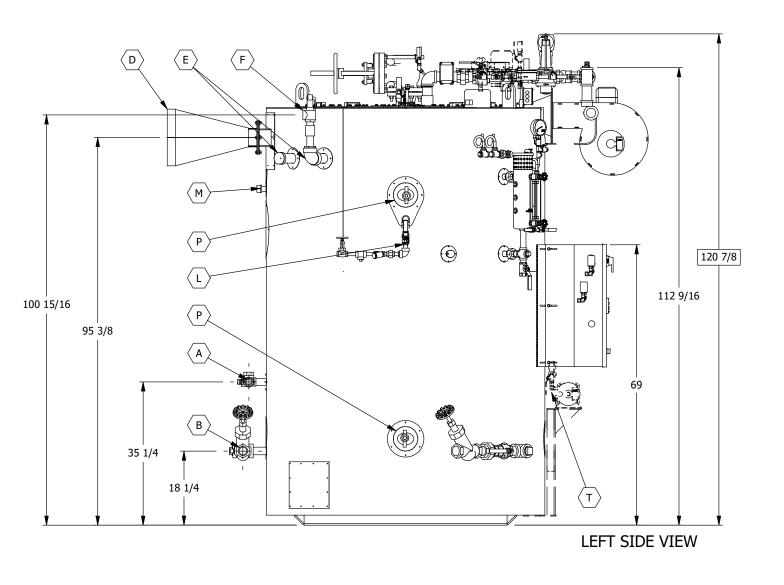


FIGURE 17 - 100 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

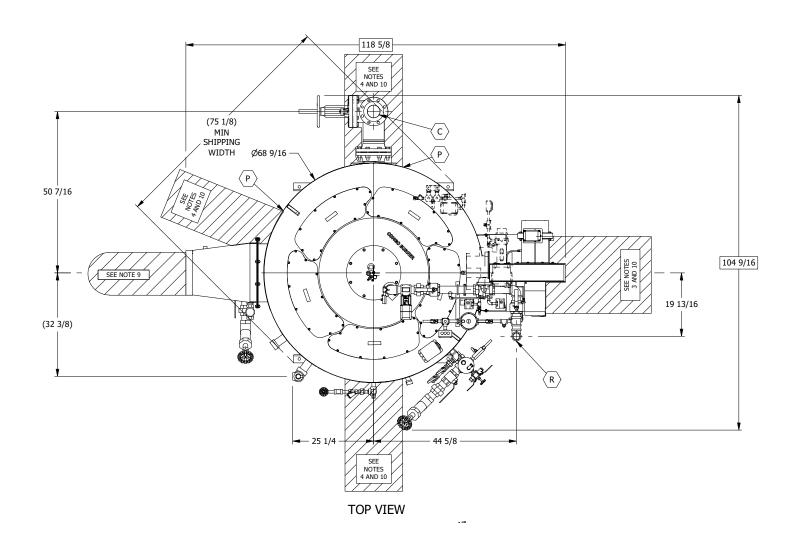


FIGURE 18 - 100 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

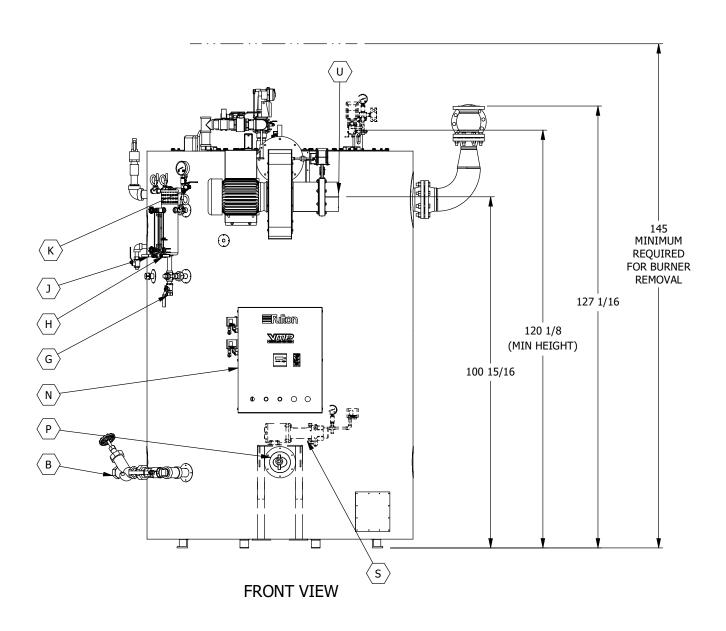
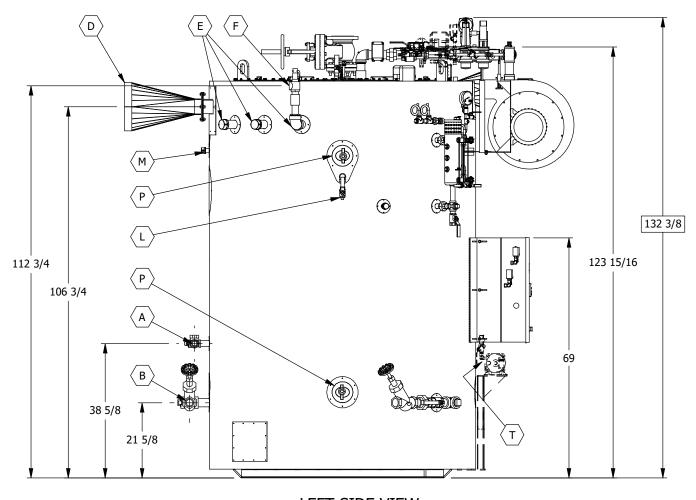


FIGURE 19 - 130 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 20 - 130 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

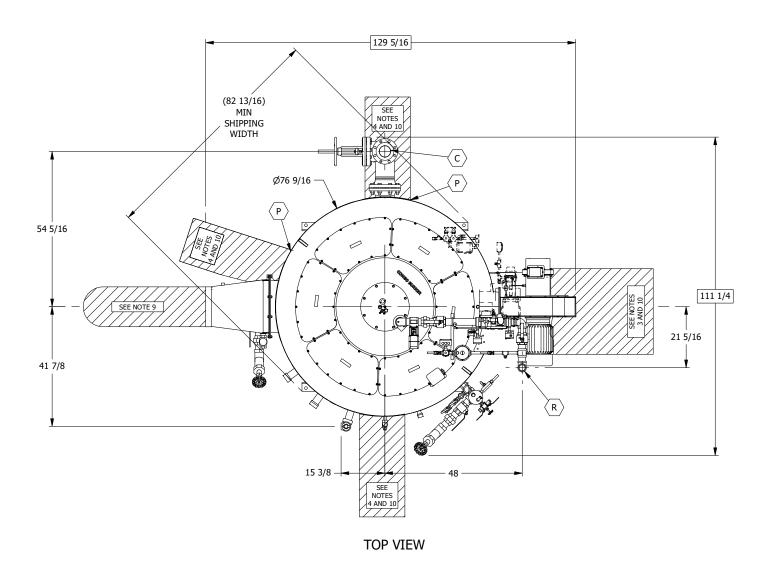


FIGURE 21 - 130 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

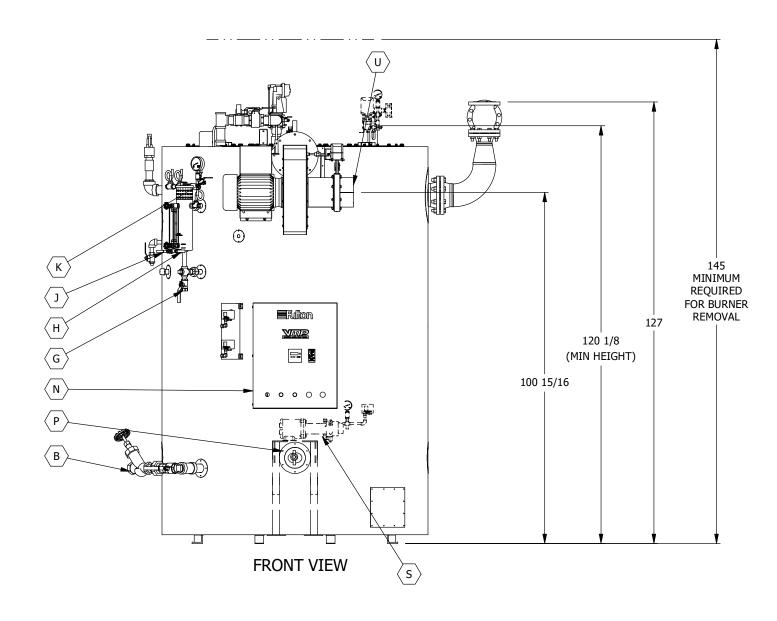


FIGURE 22 - 150 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

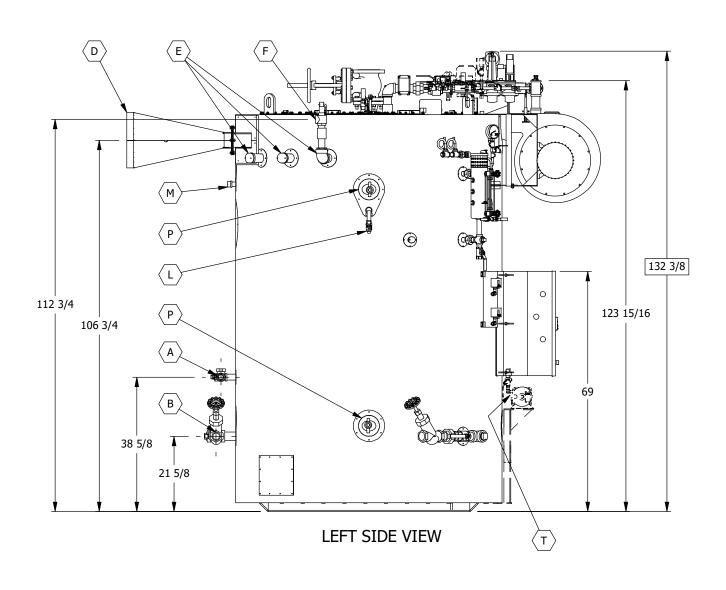


FIGURE 23 - 150 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

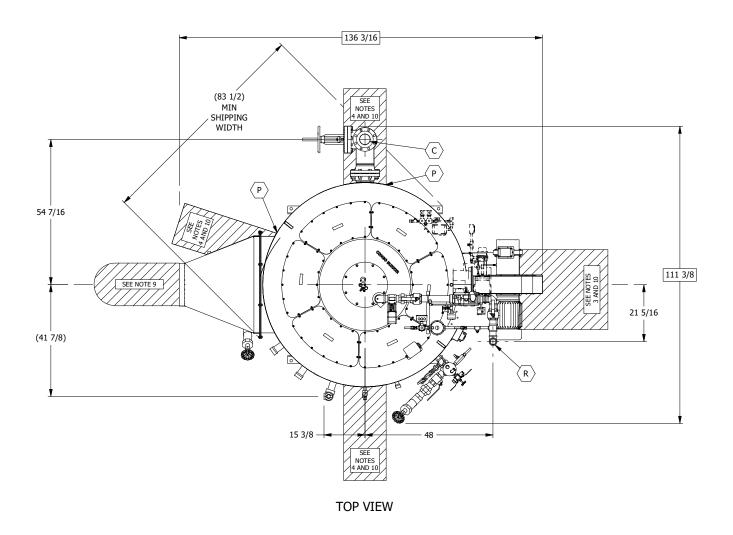
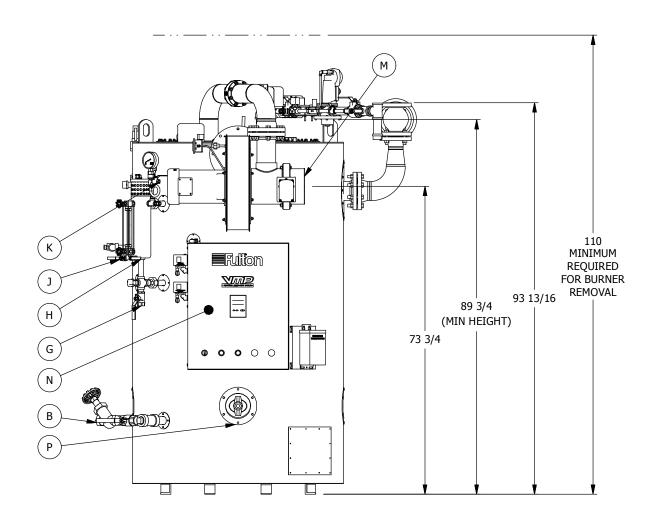
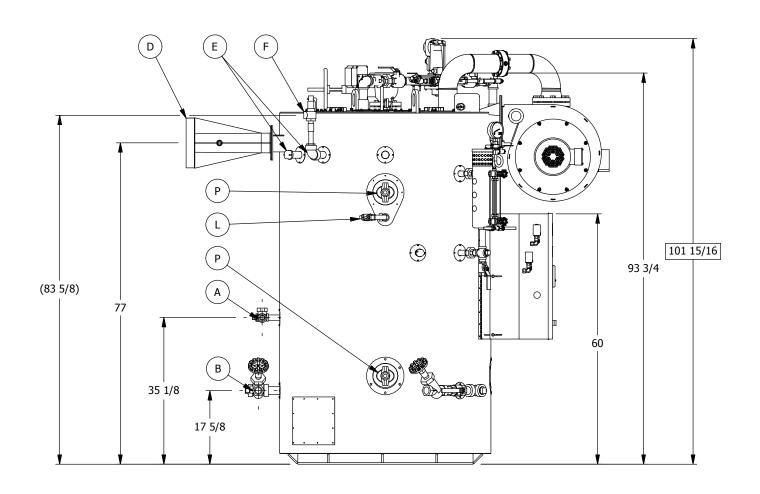


FIGURE 24 - 150 HP **(GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 25 - 40 HP (**LE GAS ONLY**) - MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 26 - 40 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

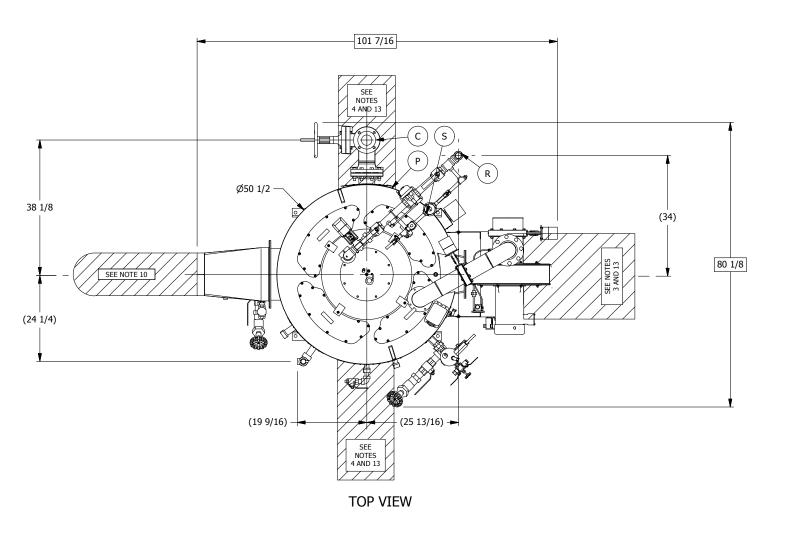
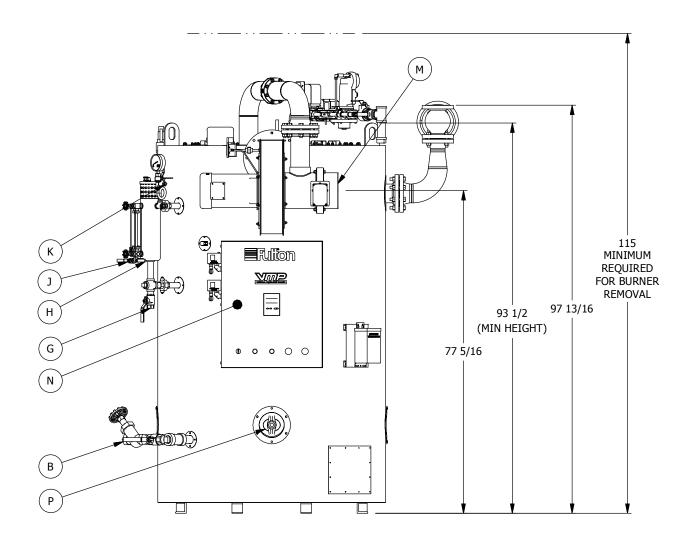
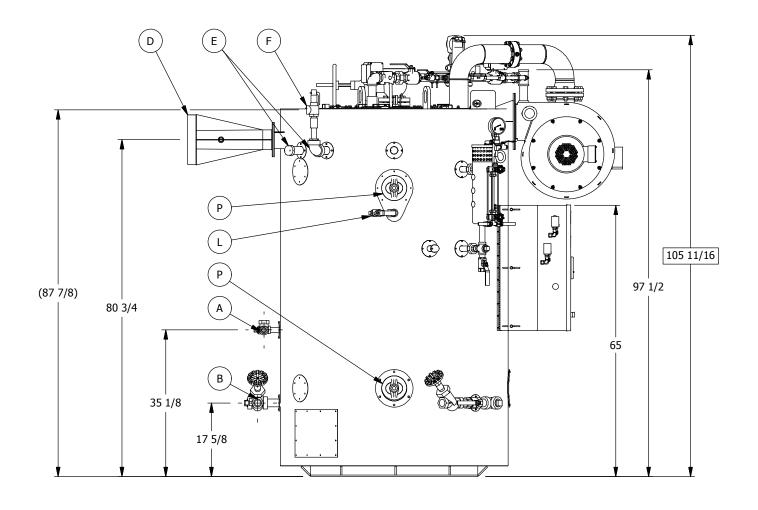


FIGURE 27 - 40 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



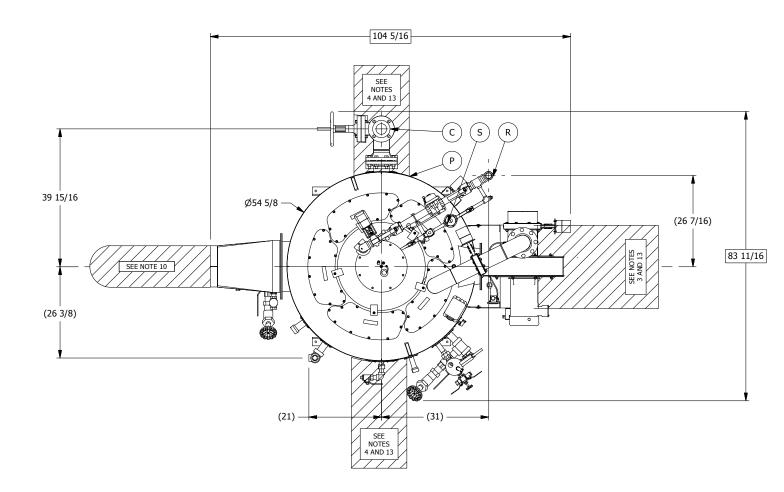
FRONT VIEW

FIGURE 28 - 49.5 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



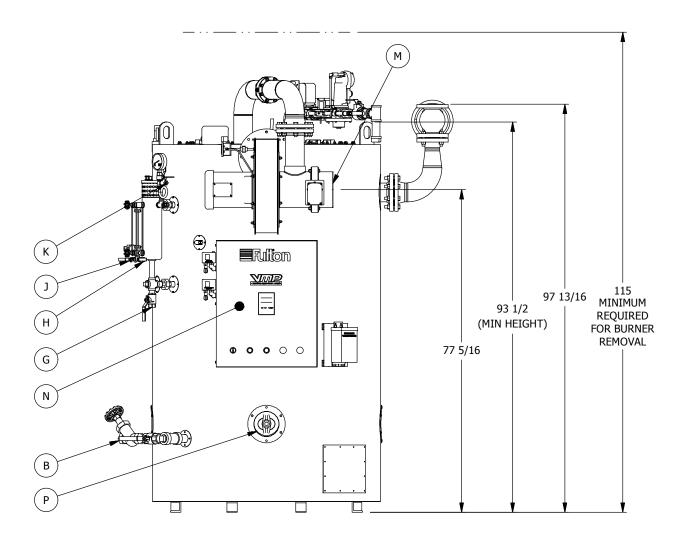
LEFT SIDE VIEW

FIGURE 29 - 49.5 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)



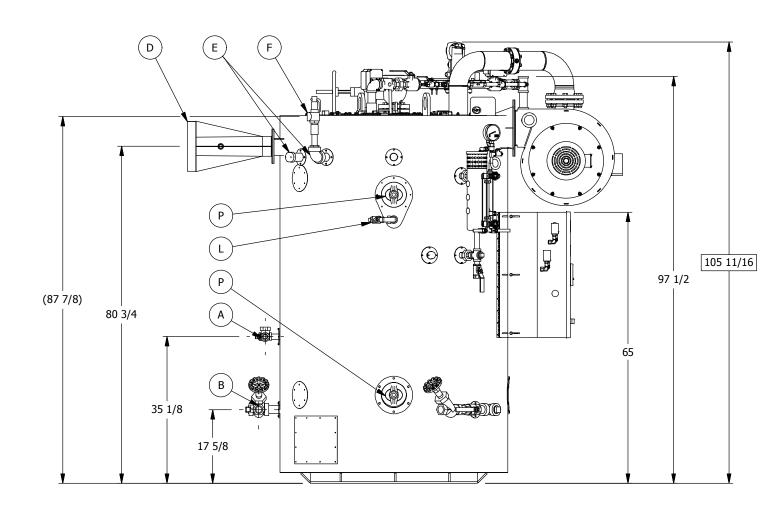
TOP VIEW

FIGURE 30 - 49.5 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



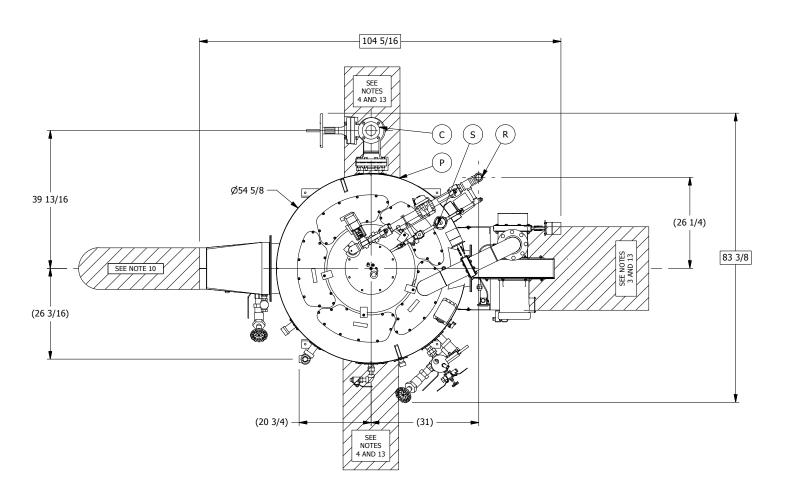
FRONT VIEW

FIGURE 31 - 50 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 32 - 50 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)



TOP VIEW

FIGURE 33 - 50 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

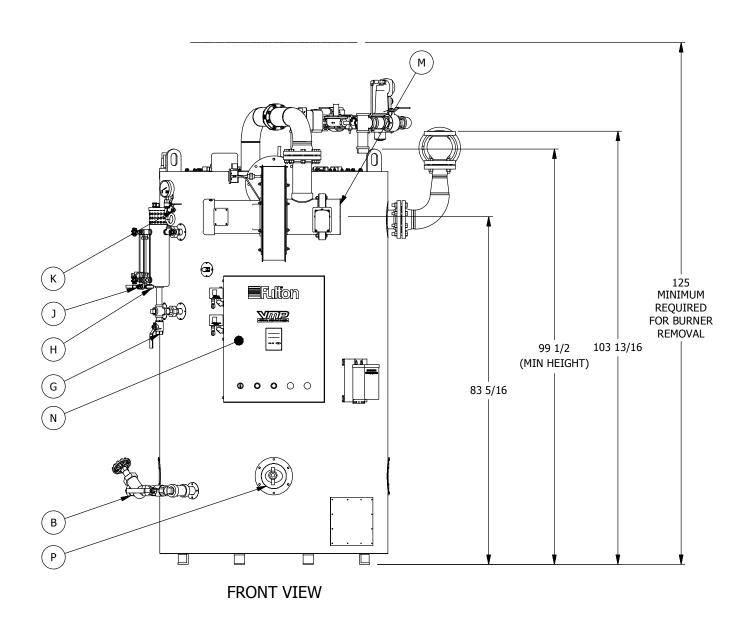
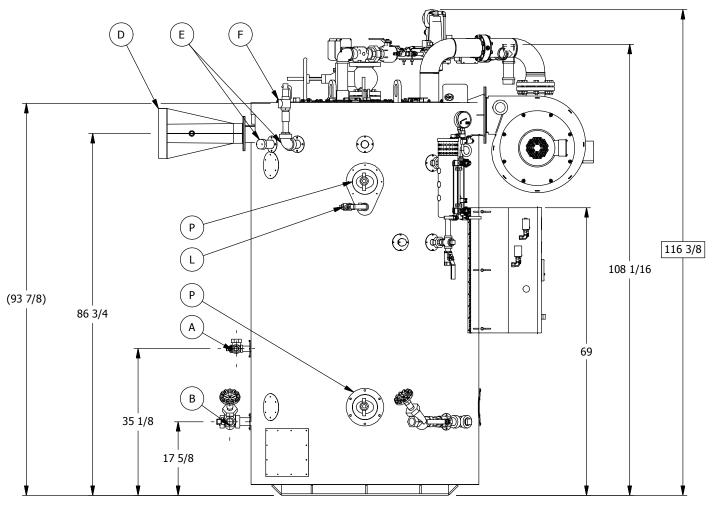
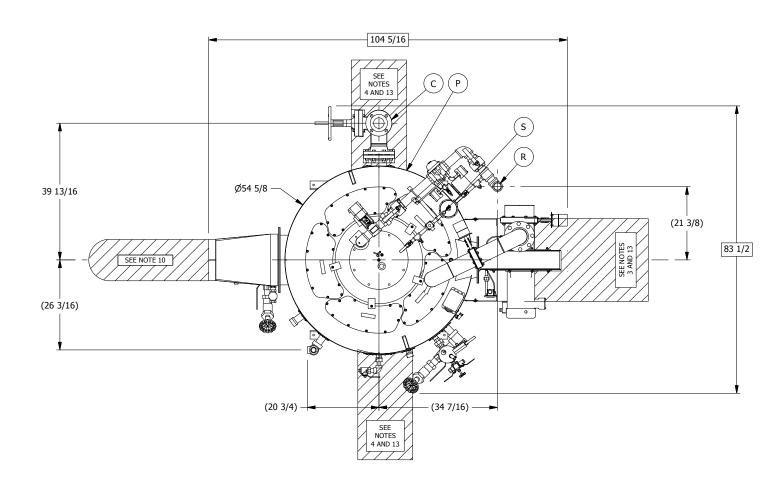


FIGURE 34 - 60 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 35 - 60 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)



TOP VIEW

FIGURE 36 - 60 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

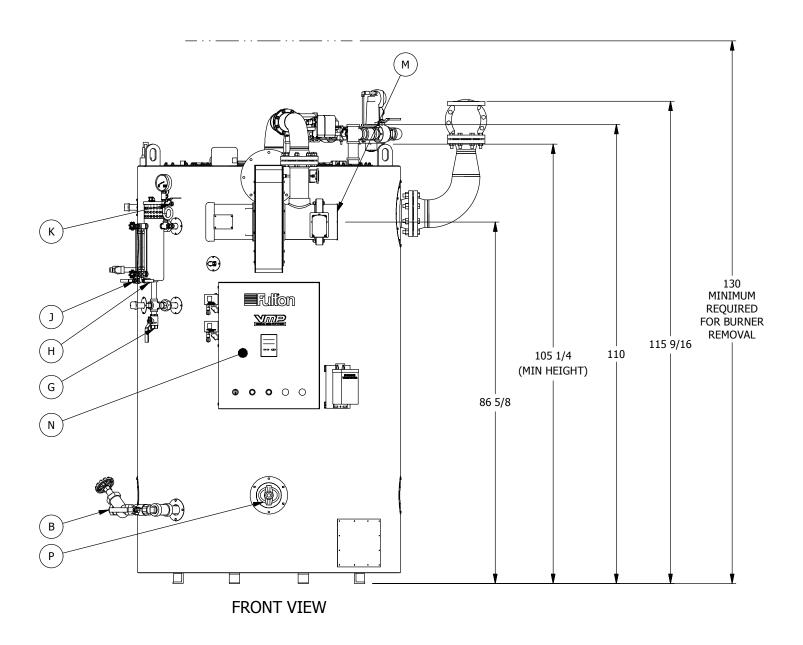


FIGURE 37 - 80 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

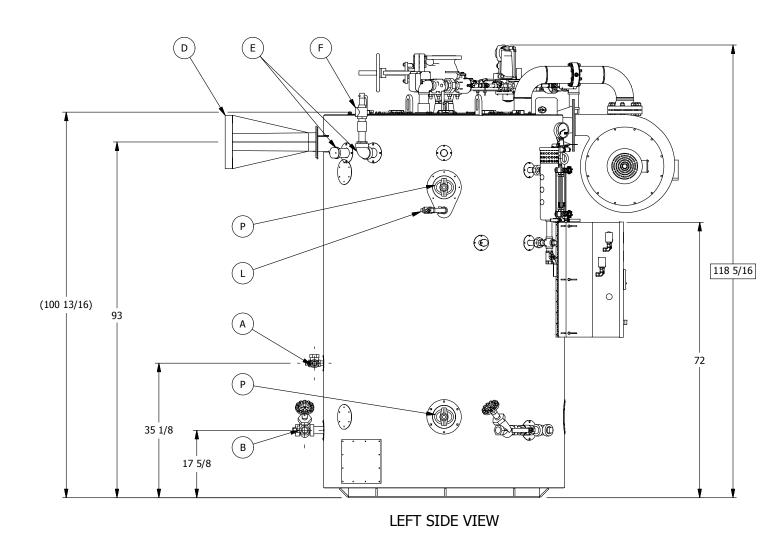


FIGURE 38 - 80 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

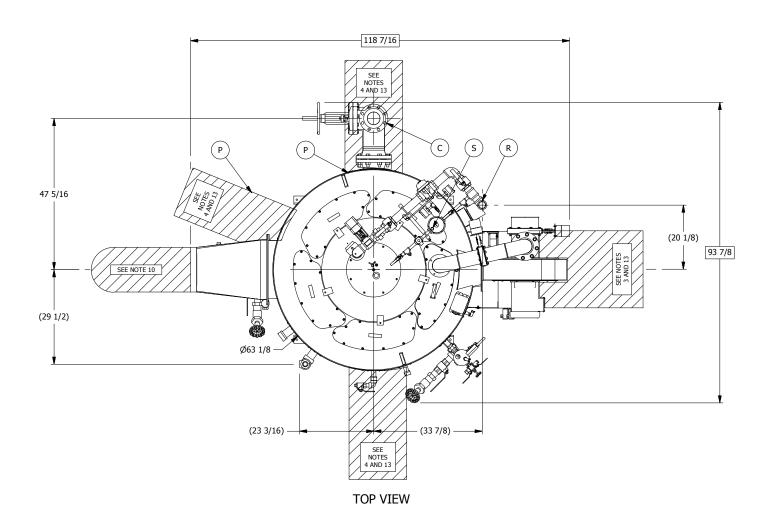


FIGURE 39 - 80 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

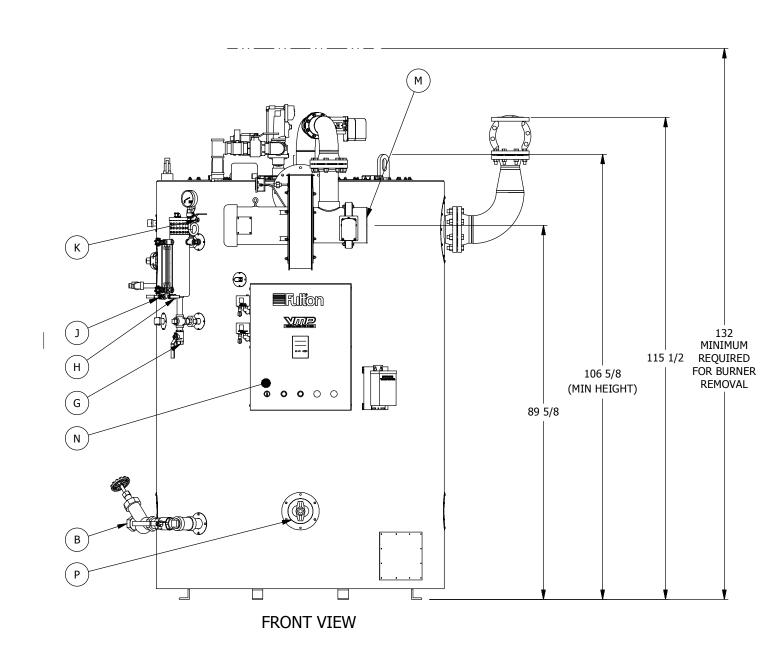
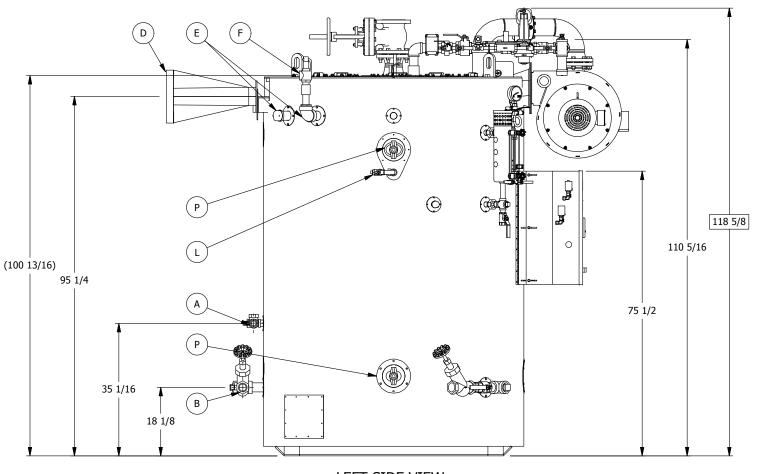


FIGURE 40 - 100 HP **(LE GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 41 - 100 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

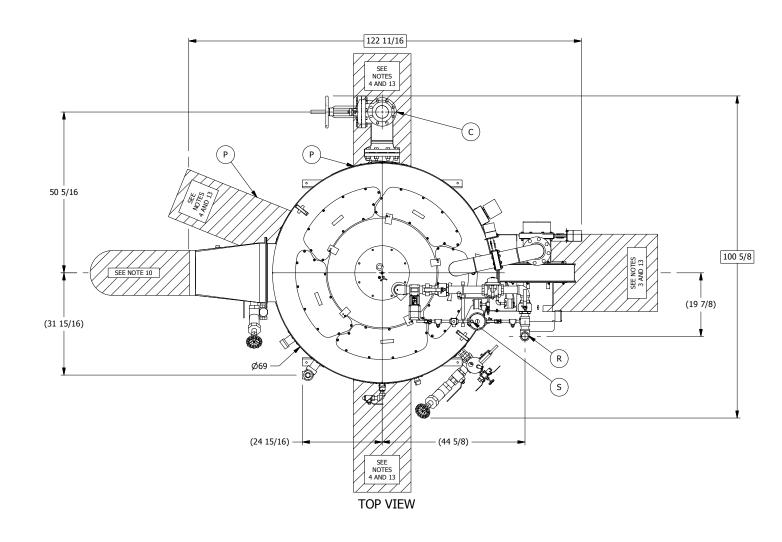
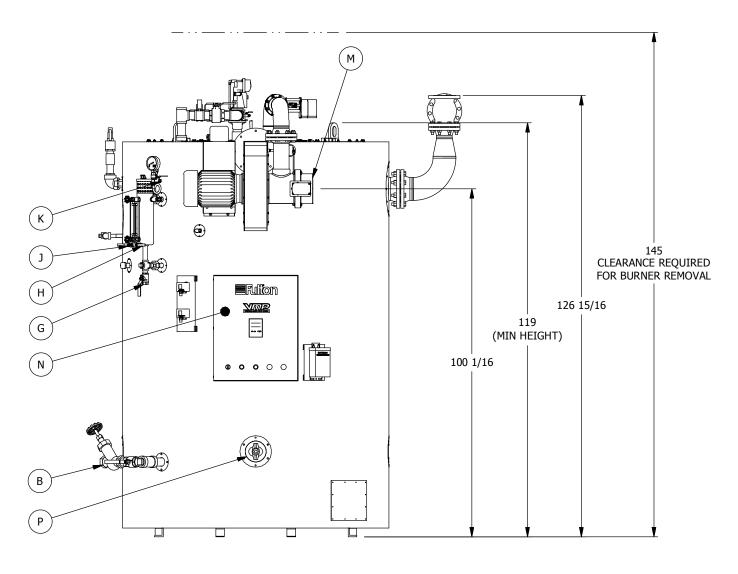
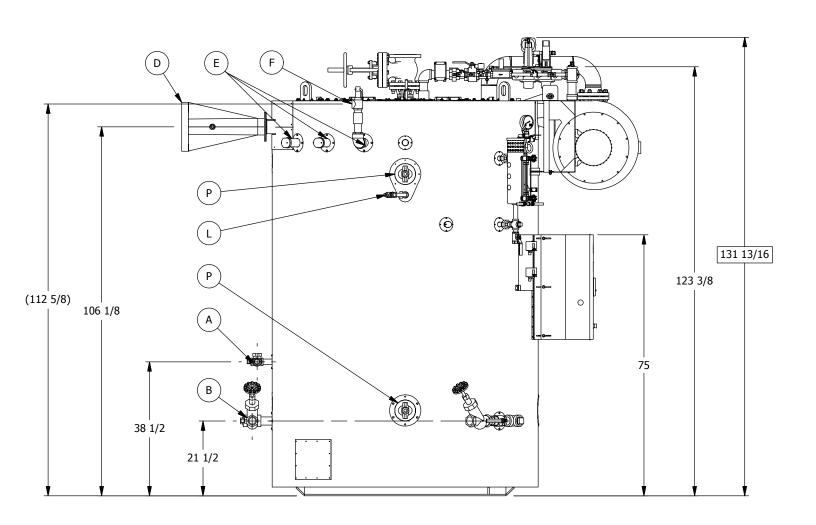


FIGURE 42 - 100 HP **(LE GAS ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 43 - 130 HP **(LE GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 44 - 130 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

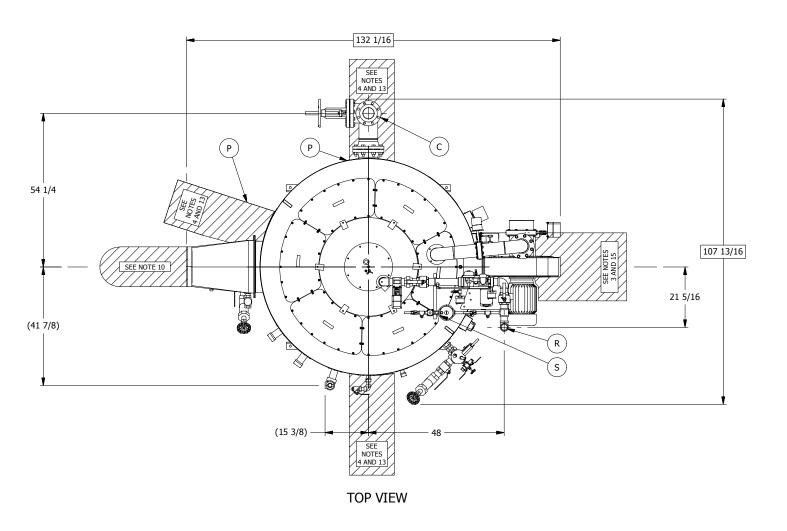
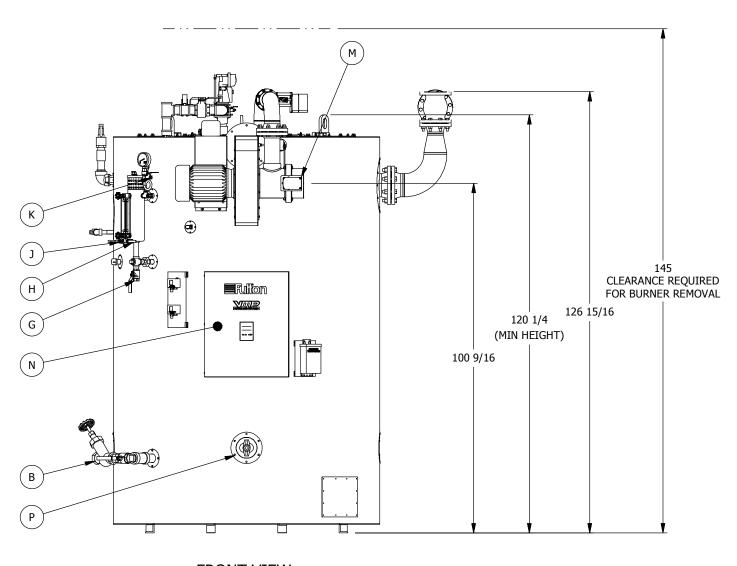
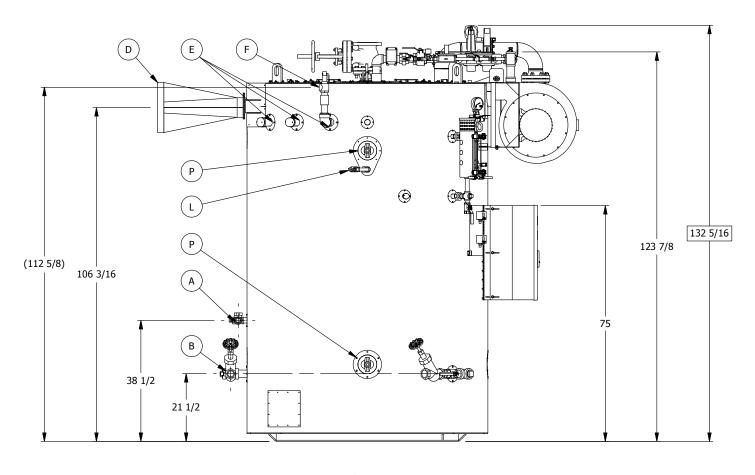


FIGURE 45 - 130 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 46 - 150 HP **(LE GAS ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 47 - 150 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

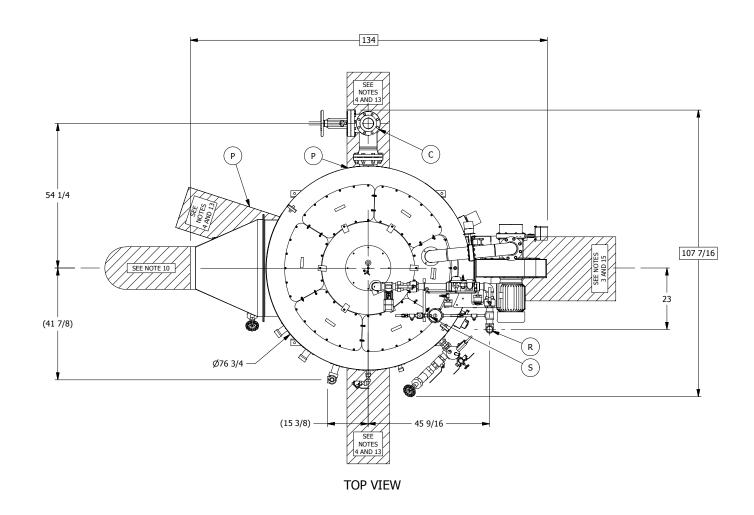
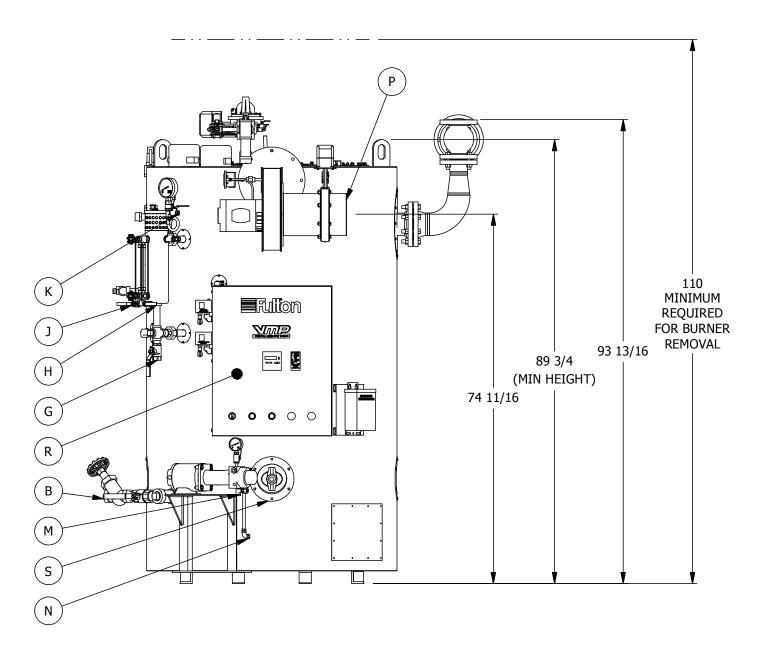
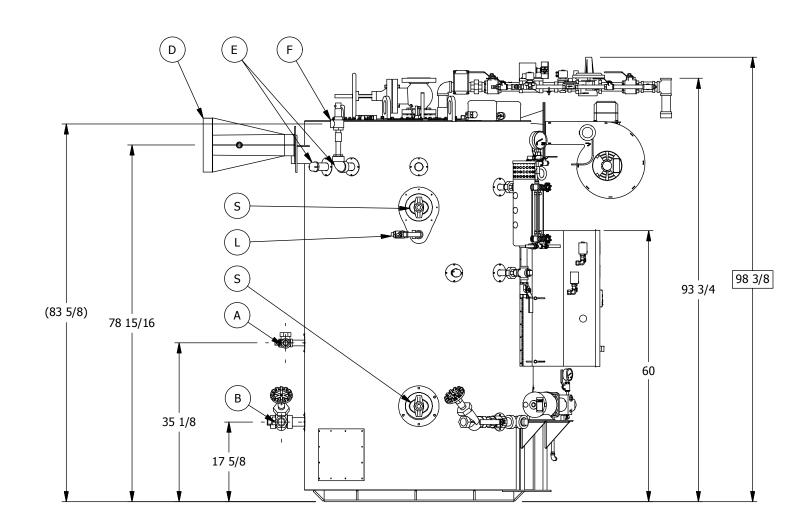


FIGURE 48 - 150 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 49 - 40 HP **(GAS/OIL ONLY)** - MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 50 - 40 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

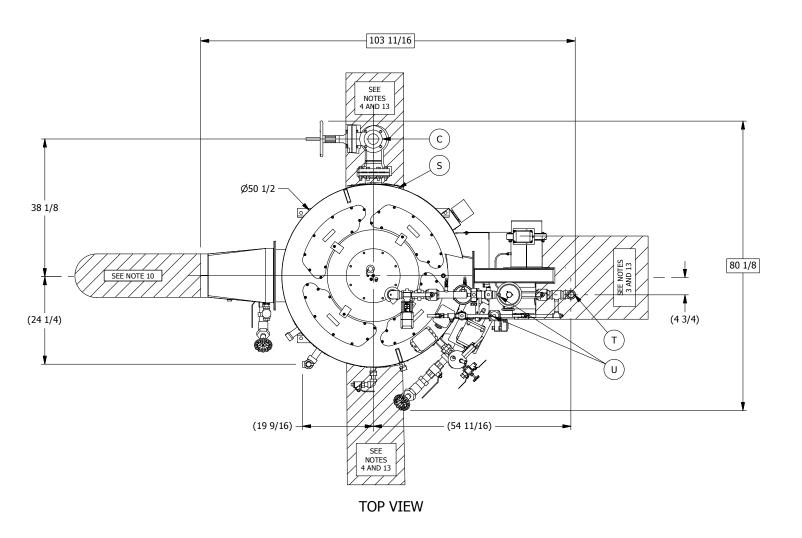
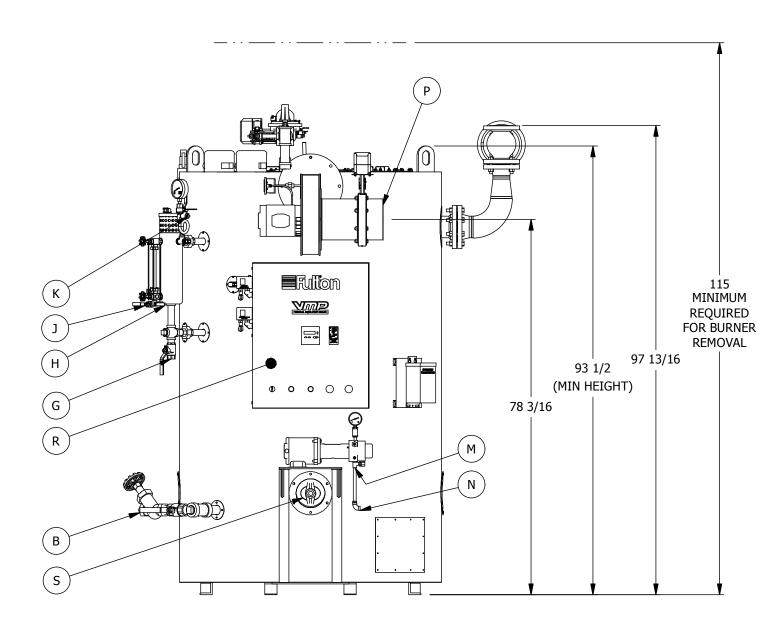
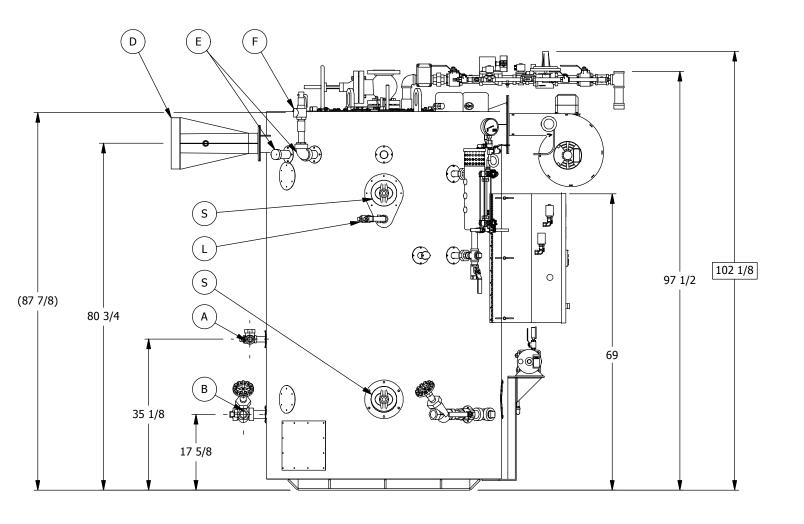


FIGURE 51 - 40 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



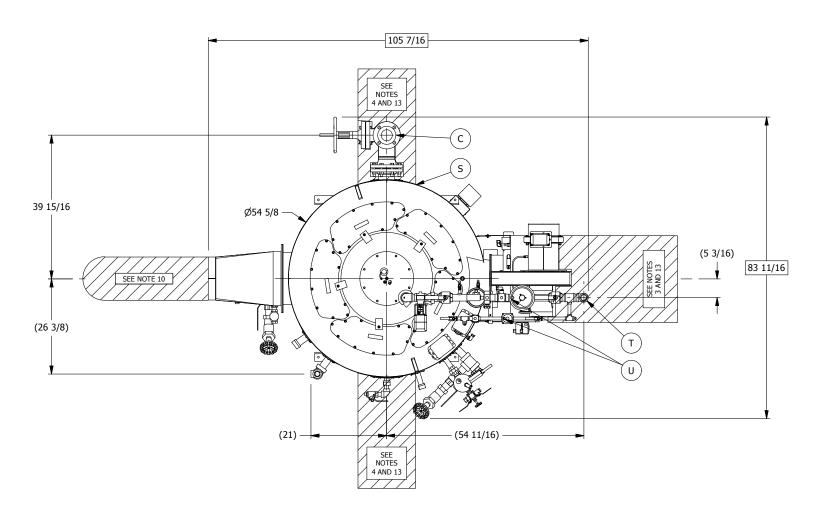
FRONT VIEW

FIGURE 52 - 49.5 HP (**LE GAS ONLY**) MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



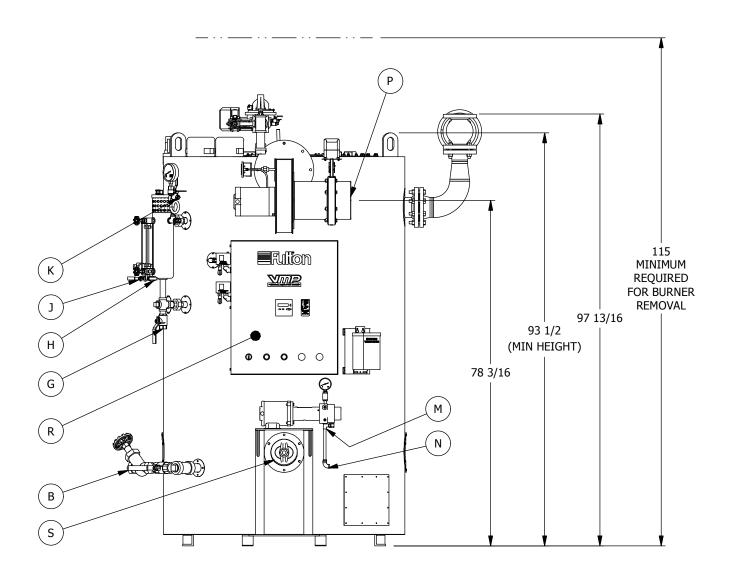
LEFT SIDE VIEW

FIGURE 53 - 49.5 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)



TOP VIEW

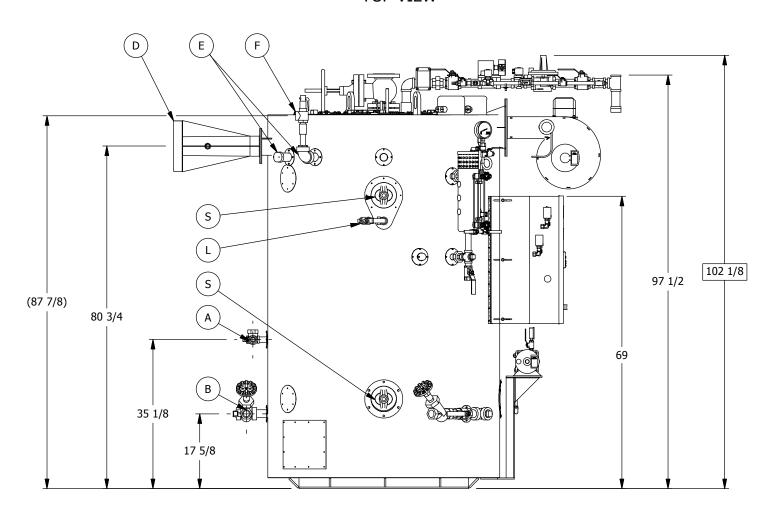
FIGURE 54 - 49.5 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

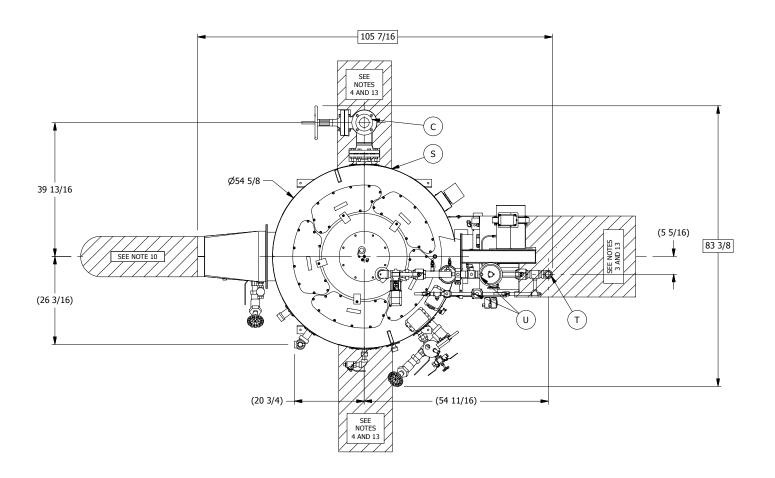
FIGURE 55 - 50 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

TOP VIEW



LEFT SIDE VIEW

FIGURE 56 - 50 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)



TOP VIEW

FIGURE 57 - 50 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

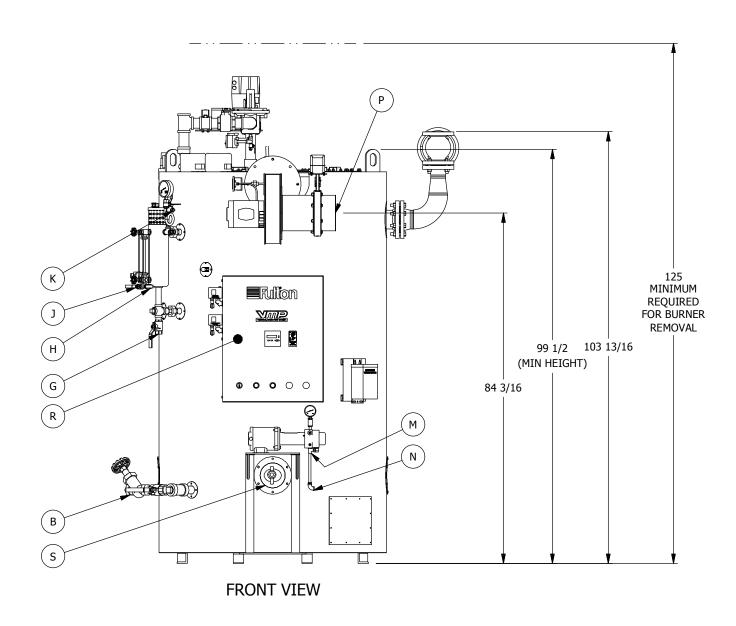
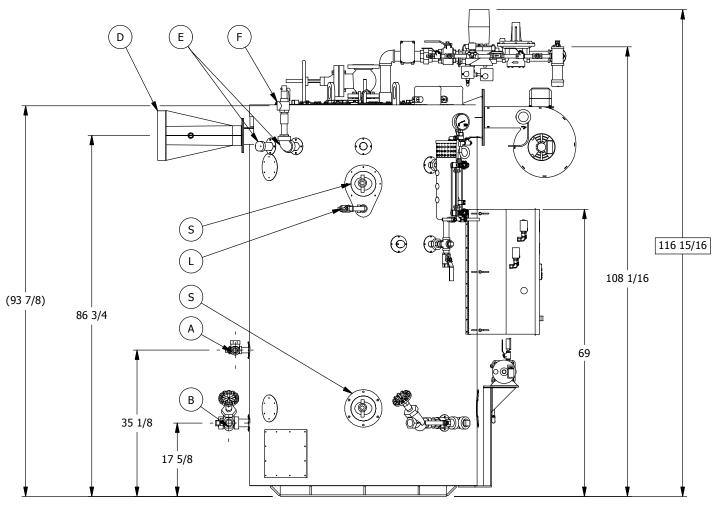


FIGURE 58 - 60 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 59 - 60 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

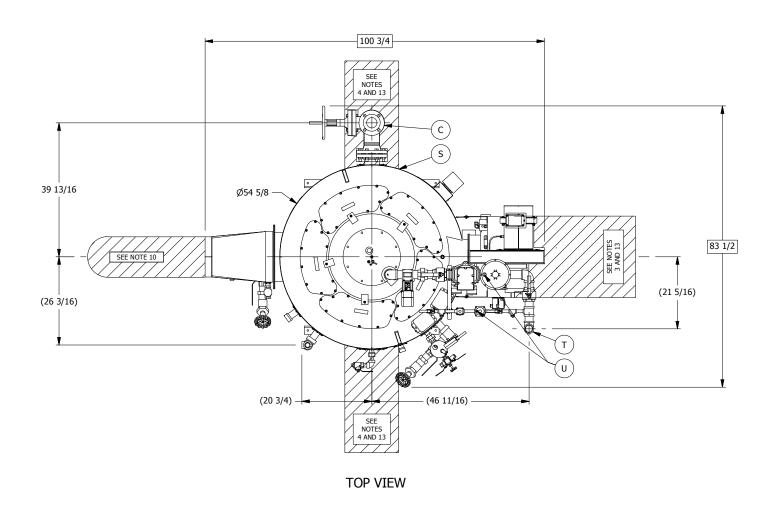


FIGURE 60 - 60 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

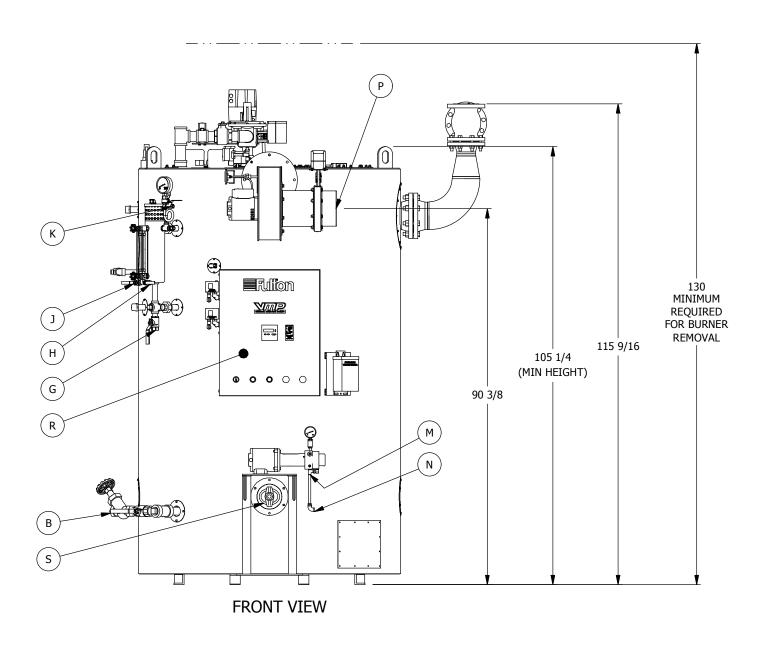


FIGURE 61 - 80 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

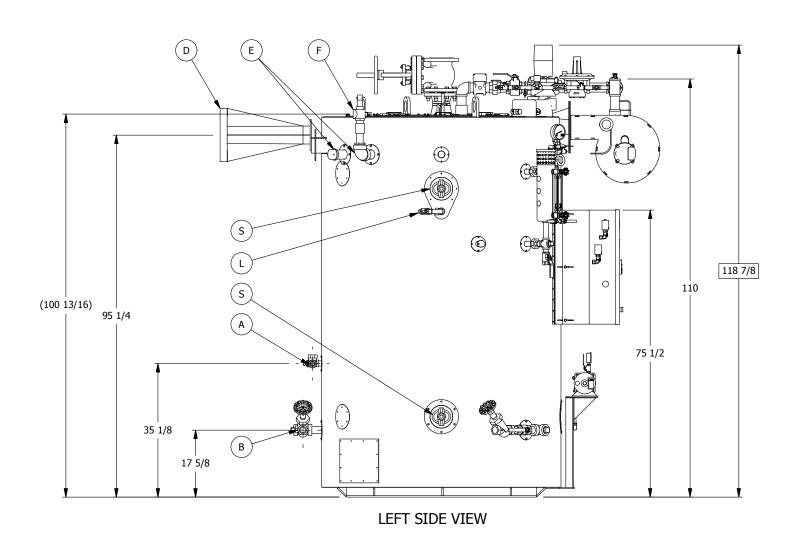


FIGURE 62 - 80 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

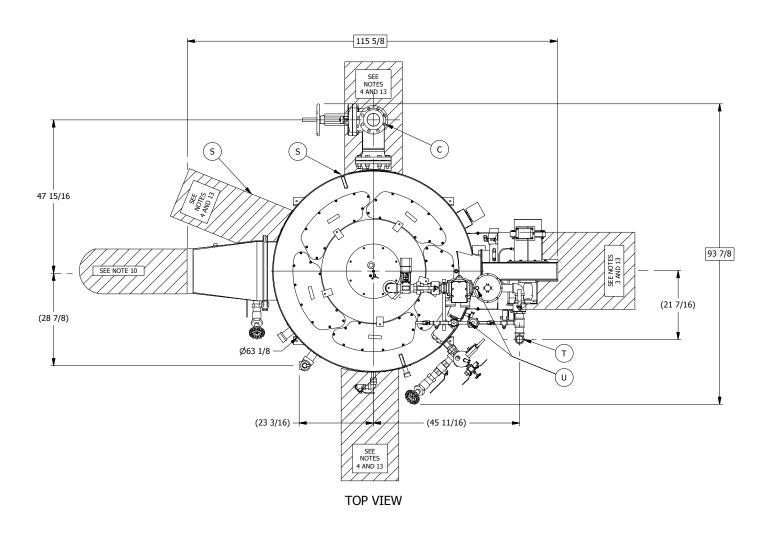


FIGURE 63 - 80 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

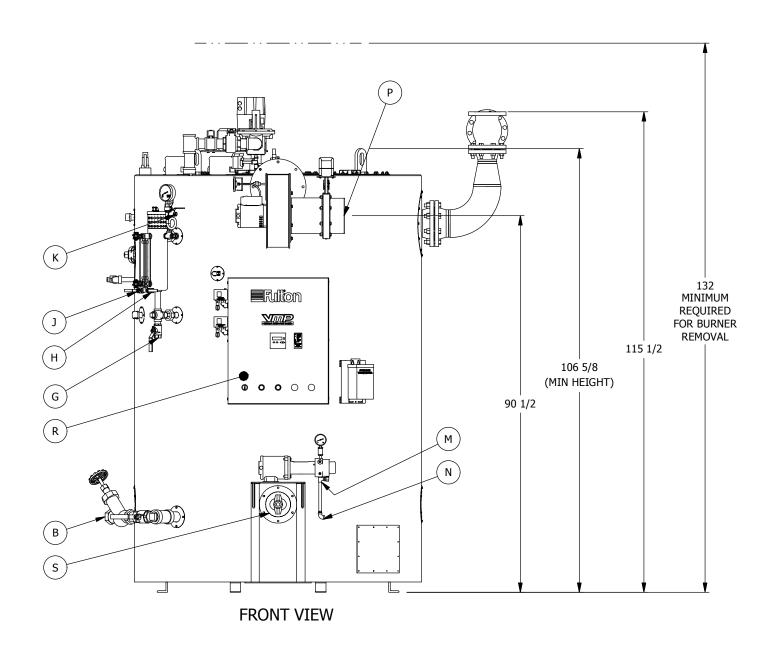


FIGURE 64 - 100 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)

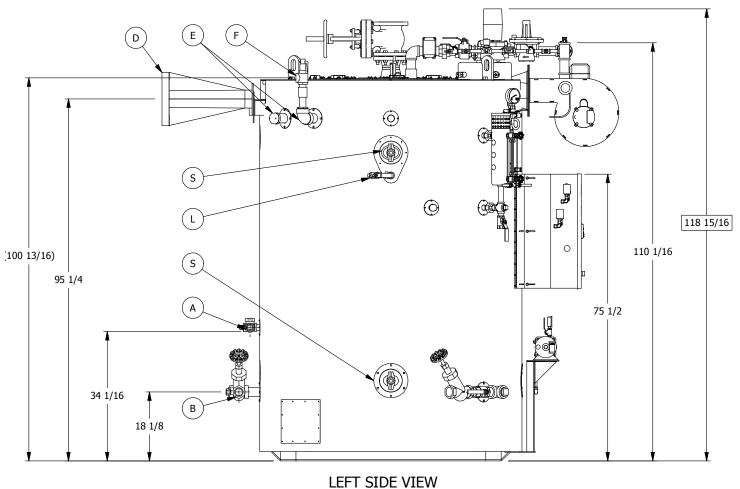


FIGURE 65 - 100 HP (GAS/OIL ONLY) MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

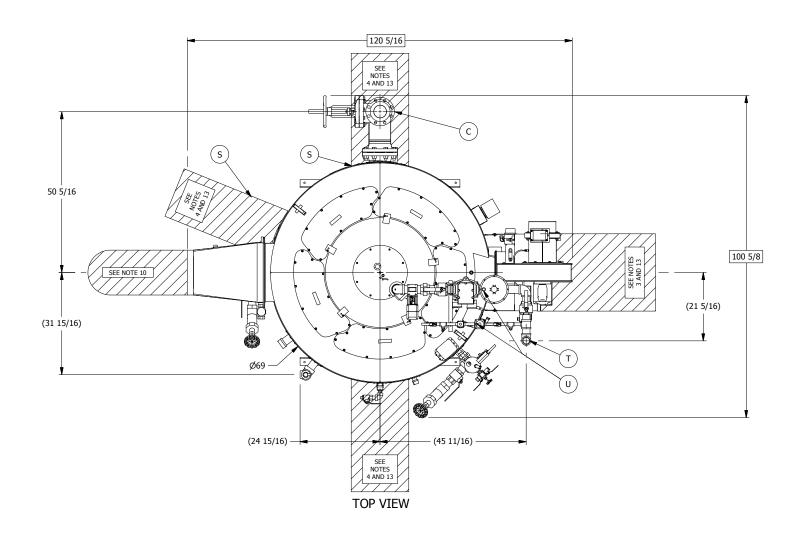
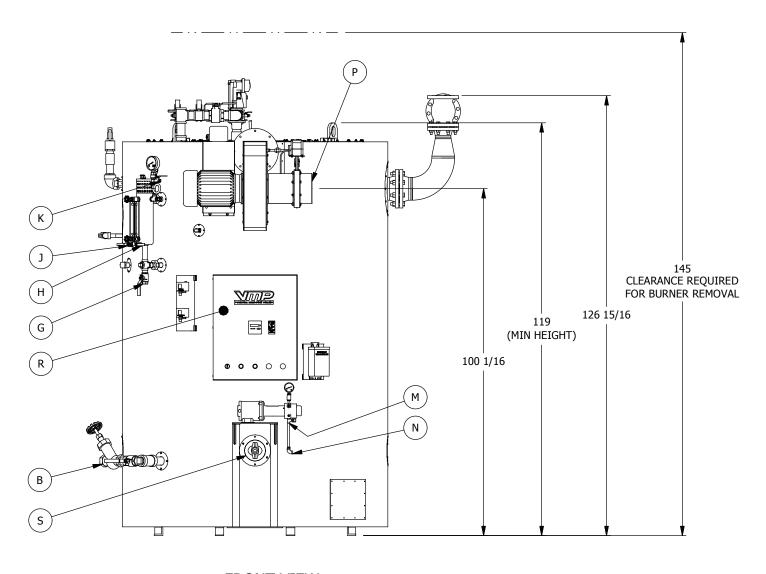
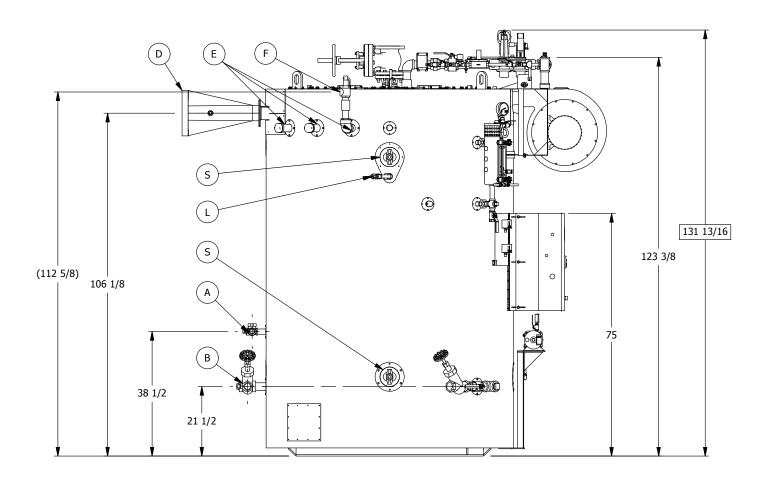


FIGURE 66 - 100 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 67 - 130 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 68 - 130 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

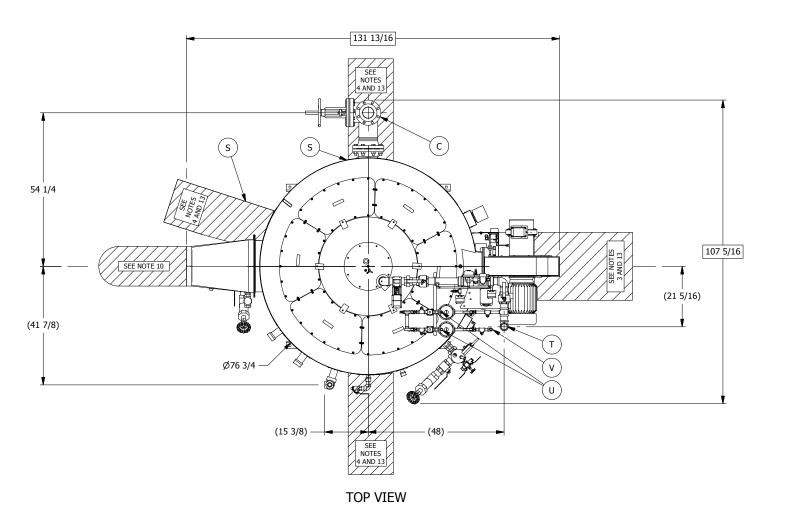
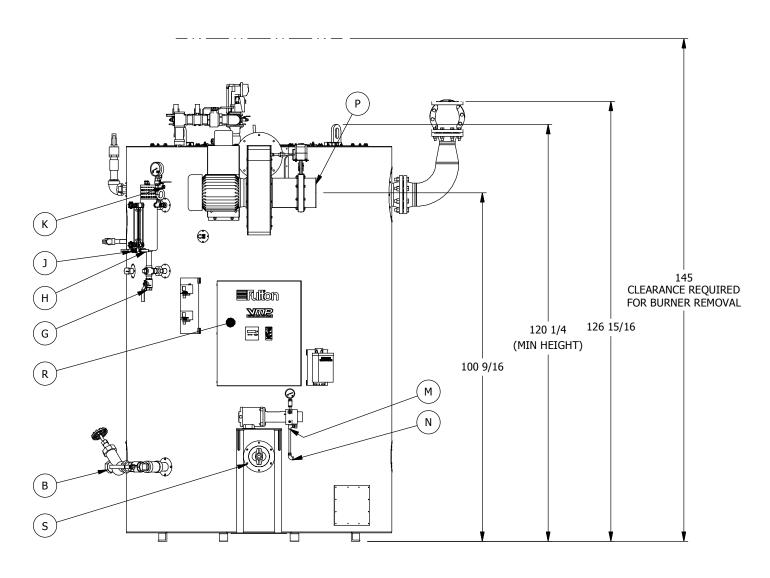
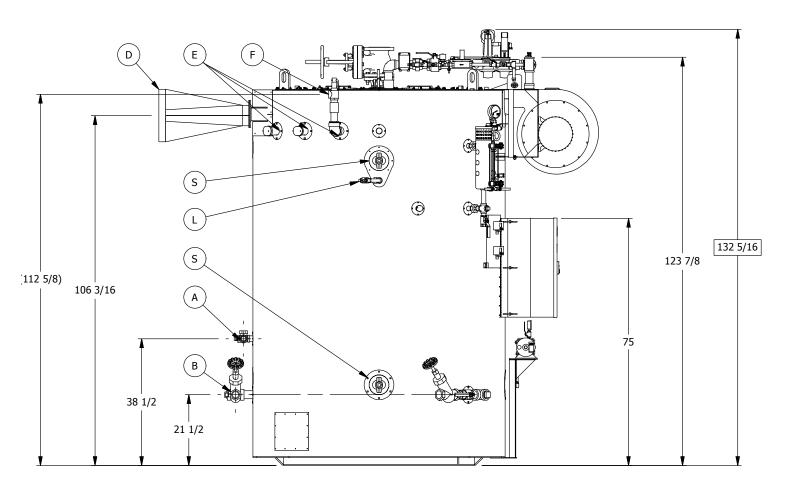


FIGURE 69 - 130 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)



FRONT VIEW

FIGURE 70 - 150 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - FRONT VIEW (ALL DIMENSIONS IN INCHES)



LEFT SIDE VIEW

FIGURE 71 - 150 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - SIDE VIEW (ALL DIMENSIONS IN INCHES)

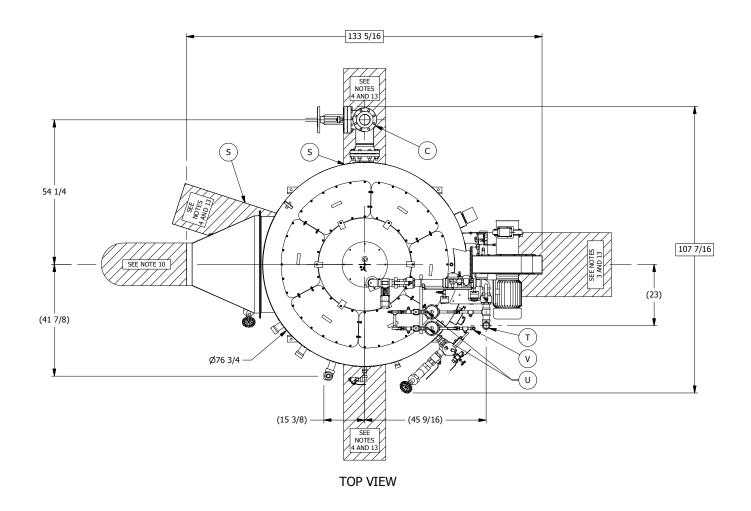


FIGURE 72 - 150 HP **(GAS/OIL ONLY)** MODEL VMP DIMENSIONS - TOP VIEW (ALL DIMENSIONS IN INCHES)

MARNING

INSTALLATION

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

TABLE 3 - WEIGHTS OF VMP BOILERS*

	Shipping Weight	Operating Weight	Flooded Weight
40	5475	6750	7125
49.5	6160	8085	8595
50	6880	8635	9120
60	7075	9120	9610
80	9425	12335	12965
100	10510	14490	15345
130	12890	19140	20060
150	12890	19140	20060

^{*}Standard weights, weights of boilers with features and options are subject to change. Contact Fulton for exact weights.

Clearances & Serviceability

All local and national codes (NFPA, ANSI, UL, CSA, ASME) must be followed for proper clearances and serviceability of your boiler. Authorities having jurisdiction should be consulted before installations are made.

Adhere to the following for equipment clearances and serviceability:

- 1. Ensure appropriate front, back, sides and top clearances are met. This will allow access around the equipment to facilitate maintenance and a safe work environment, and ensure technicians will commission the unit. Technicians will not commence commissioning if hazardous conditions
- 2. Place boiler with clearances to from floor to ceiling to protect and for burner removal:

TABLE 4 - VMP CLEARANCES

Unit Size BHP	Front Panel in (mm)	Rear/Sides in (mm)	Vertical/ From Floor to Ceiling in (m)
40	36 (915)	24 (610)	110 (2.8)
49.5-50	36 (915)	24 (610)	115 (2.9)
60	36 (915)	24 (610)	125 (3.2)
80	36 (915)	24 (610)	130 (3.3)
100	36 (915)	24 (610)	132 (3.4)
130-150	36 (915)	24 (610)	145 (3.7)

- 4. Pipes must not be run within 10" (254 mm) of any control cabinets or combustible material.
- 5. Verify that all clearances are acceptable with the local ordinances.
- 6. It is recommended to have a minimum of 36 inches of vertical rise out of the steam header outlet. This is considered a good piping practice and will allow for proper operation.
- 7. Steam outlet sizes should not be reduced until after a minimum of 36 inches of vertical rise.

INSTALLATION

Equipment Ventilation & Combustion Air Requirements

Ventilation must be sufficient to maintain a building temperature of 120 F (49 C) or less and the panel box temperature must not exceed 125 F (52 C). Consistent, proper ventilation of the equipment room is essential for good combustion. Ventilation in the room must be sufficient to provide adequate air flow throughout the room. Good venting practices must be followed to ensure adequate air movement throughout the entire room.

For proper combustion, the burner must have an adequate supply of fresh air. Based on National Board Inspection Code (NBIC) recommendations, unobstructed air openings shall be sized on the basis of 1.0 square inch of free area per 2,000 BTU/ hr of the maximum fuel input of the combined burners in the equipment room, or as specified by applicable national or local codes. The equipment room air supply openings shall be kept clear at all times. Please note that the required opening is the required "free space" opening.

If positive forced ventilation (make-up air flow) is adopted, you must ensure that there will be no appreciable pressure variation in the equipment room.

Adhere to the following to meet ventilation and combustion air requirements:

- 1. Install two fresh air openings, one at a low level, 24" (610 mm) from the floor, and one at a higher level on the equipment room wall. This will provide a flow of air to exhaust the hot air from the equipment room.
- 2. Avoid ventilation which creates a negative pressure for boiler combustion air, as it will seriously affect combustion and proper operation of the stack. The equipment requires a steady neutral or slightly positive combustion air supply. Unless sealed combustion is used, the installation of an exhaust fan in a boiler room is not recommended. An exhaust fan, or similar equipment, can create down draft in the stack, or restrict the burner's air supply, which will result in poor combustion or nuisance failures.
- 3. It is essential that only fresh air be allowed to enter the combustion air system. Foreign substances in the combustion system can create hazardous conditions. Particulate matter like lint, combustible volatiles, dust, smog or chemicals (example, perchlorethlylene, halogenated compounds) in the combustion air supply to the equipment will cause damage or failure of the burner and is not covered under warranty.
- 4. The boiler is capable of ducted combustion air. Note that with ducted combustion air, proper room ventilation is still required.

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✓ WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

Hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

Failure to provide required and safe access to the equipment could impede commissioning and maintenance.
Service technicians are instructed not to commence commissioning if hazardous conditions exist.

Failure to provide proper minimum clearances between equipment and combustible materials may result in fire.

The installation of an exhaust fan in the boiler room is not recommended. An exhaust fan or similar equipment can create a downdraft in the stack or restrict the burner's air supply and result in poor combustion. It is essential only fresh air be allowed to enter the combustion air system. Foreign substances such as combustible volatiles and lint may create hazardous conditions.

Ensure all labels on the boiler are legible. All connections and safety devices, both mechanical and electrical, must be kept clean, with ease of access for inspection, use and maintenance.

It is essential that only fresh air be allowed to enter the combustion air system.

Foreign substances can create hazardous conditions. If foreign substances can enter the air stream, the combustion air inlet must be piped to an outside location.

Failure to do so will void the warranty.

Utilities

Gas Supply

- Gas Piping should be installed in accordance with National Fuel Gas Code, ANSI-Z223-1-1984 or latest addenda and any other local codes which may apply. In Canada gas installations must be in accordance with the current CAN/CGA B149.1 and .2 and/or local codes.
- 2. Install a dirt trap ahead of all of the gas valves.
- 3. The pipe and the fittings used must be new and free of dirt or other deposits.
- 4. The piping must be of the proper size to ensure adequate gas supply to the gas head assembly. Consult your gas company for specific recommendations.
- 5. For natural gas and propane, at 40-80 BHP a pressure of 9"w.c. to 138"w.c. is required at the gas train at full input. At 100 BHP, 11" w.c. to 1378" w.c. is required, and at 130-150 BHP, 40"w.c. to 135" w.c. is required. Do no exceed 138"w.c. For installations equipped with pressures exceeding 138"w.c., consult the factory for gas pressure requirements.
- 6. When making gas piping joints, use a sealing compound resistant to the action of liquefied petroleum gases. Do not use teflon tape on gas line threads.
- 7. The main and the pilot gas pressure regulators must be vented to the atmosphere.
- 8. After gas piping is completed carefully check all piping connections, (factory and field), for gas leaks. Use a soap and water solution.
- NOTE: Some soaps used for leak testing are corrosive to certain types of metals.
 Rinse all piping thoroughly with clean water after leak check has been completed.
- 9. The boiler must be disconnected at the boiler shut off valve from the gas supply piping system during any pressure testing of the system at pressure in excess of 1/2 PSIG-14"W.C.
- 10. The boiler must be isolated from the gas supply piping system by closing the shut-off cock during any pressure testing of the gas supply piping system at pressures equal to or less than 1/2 PSIG--14"W.C.

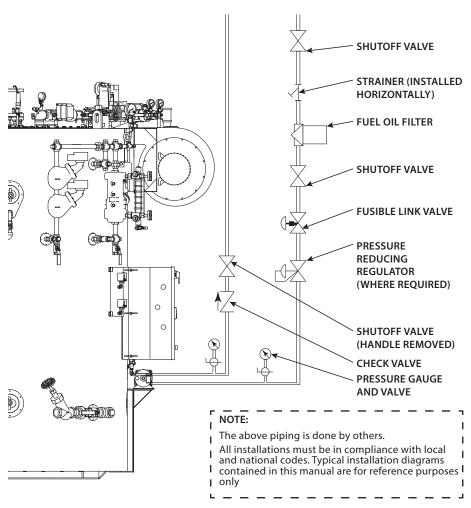


FIGURE 73 - COMMON OIL PIPING

■ The Fuel Oil Supply

Adhere to the following for installation, see Figure 73:

- Fuel pipes must be of approved materials and of a diameter suitable for the quantity of oil being delivered to the burner. Vacuum must not exceed 13 in. (330 mm) of mercury at the pump inlet. Maximum inlet pressure to oil pump is 3 PSIG.
- 2. Oil burners are of a two-pipe design system, requiring a return line and a supply line. The oil pump is factory set per Test Fire Sheet. Do not alter the setting without consulting the factory.
- 3. A stop valve, a check valve, and an oil filter must be installed on the oil supply line.
- 4. When one line is feeding two burners, a check valve must be installed in each unit.
- 5. Ensure there are no loose fittings. Loose fittings in the fuel oil line will permit air to enter the fuel line and cause improper firing.

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

A qualified installer must perform installation and service on the fuel delivery system.

Ensure all electrical connections are powered down prior to attempting work on electrical components or connections.

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CAUTION

Loose fittings in the fuel oil line will permit air to enter the fuel line and cause improper firing.

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

\triangle CAUTION

A large amount of improperly treated makeup water can cause premature failure of the heat exchanger resulting from scale build up. Scale build up will reduce the efficiency and useful life of the boiler and is not covered under warranty.



NOTE

The Gas Supply for LE Models

A minimum of 40" w.c. gas pressure is required at the inlet of the gas train while operating for the 40-100HP; 60" w.c. for the 130-150HP boiler.

For units equipped with Flue Gas Recirculation, FGR, the ducting must be insulated.

Do not exceed the rated pressure of the fuel train.

■ Electrical Connections and Devices

■ NOTE: This boiler is factory configured for site voltage and is not intended for field conversion. See data plate on rear of boiler cabinet for rating.

The boiler is designed to operate within the following limits at the connection terminals:

- AC power supplied is within +/- 10% of the motor rated voltage with the rated frequency applied; or AC power supplied is within +/- 5% of the rated frequency and with the rated voltage; or a combined variation in voltage and frequency of +/-10% (sum of absolute values) of rated values provided the frequency variation does not exceed +/-5% of rated frequency.
- When installed in a 208/3/60 service, the minimum supply voltage applied to the boiler terminals is 207 volts and must always be met. This boiler is not designed for use on High-Leg Delta electrical service. A transformer (not provided) will be required to convert High-Leg Delta to standard Delta or Wye service.
- When installed in a 575/3/60 service, the maximum supply voltage applied to the boiler terminals is 600 volts and must always be met.

Full Load Amps (FLA) is the measured amperage for the boiler at its maximum operating condition at rated voltage. The type of breaker/fusing selected, in combination with the FLA, will affect proper circuit sizing/protection. Please refer to your state's adoption of NEC or the authority having jurisdiction for proper sizing/selection. Refer to Table 2 for FLA requirements.

Adhere to the following when making electrical connections:

- 1. Install wiring in accordance with NEC Sec. 110.3(B) or CSA C22.1 for Canada for a maximum recommended branch circuit voltage drop of 3% and a maximum total voltage drop for a combination of both branch circuit and feeder not to exceed 5%.
- 2. Install wiring and ground in boiler in accordance with authority having jurisdiction or in absence of such requirements National Electrical Code, ANSI/NFPA 70.
- 3. Connect power to the boiler using connectors rated for the minimum in Table 2, and are compliant with local electrical codes.
- 4. Provide separate power supplies for external devices. Do not power external devices through the boiler.
- Locate schematic. Each boiler is shipped with the electrical schematic diagram, a copy of which is located in an envelope on the inside of the panel box door.
- 6. A wall-mounted, fused disconnect sized for the unit must be provided and fitted by the client/contractor if disconnect is not supplied on the panel.
- 7. Fuses must be sized according to motor name plates and local electrical codes.
- 8. Connect power to the terminal strip as supplied on the inside of the panel box.
- NOTE: Single skid systems are generally shipped completely pre-wired.

- 9. Multiple skid systems may require wiring between the skids. Please note that Fulton will run conduit and wire the devices on each skid. For devices that are disconnected for shipping, the wire will be left at the end of the conduit where possible and wired in the field (by others). When the system has multiple skids that are adjoining, the conduit will be installed to break at the skid joints. The wire for the conduit running between the skids will be shipped loose to prevent damage when the skids are put back together. These wires will need to be run by the installing contractor in the field and wired to proper locations. If there is wiring between skids that are not adjoining, then this will need to be done by others.
- If the unit is not skid-mounted at the factory, the client/ contractor is required to wire the feed water pump starter.
- NOTE: If the pump motor is not supplied by Fulton, the motor starter may not be supplied.

Water Chemistry

RECOMMENDED WATER CONDITIONS FOR BOILERS/ UNFIRED STEAM GENERATORS

Table 5 below lists recommendations for feed water and boiler water. Contact your local water treatment professional for testing and treatment recommendations. It is very important that a strict water treatment program is followed.

It is critical that the boiler water chemistry follow Table 5 whenever water is in the boiler. Solids that enter with the feed water will concentrate in the boiler. A regular schedule of boiler blowdown (see **Maintenance** section of this manual) must be maintained to prevent high solid concentrations from corroding the vessel or forming deposits.

TABLE 5 - WATE	R CHEMISTRY REG	DUIREMENTS	FOR FULTO	N BOILERS

	Carbon Steel			Stainless Steel		
Parameter	Feedwater	Vertical Boiler/ SteamPac Water	Horizontal Boiler/ SteamPac Water	Feedwater	Vertical Boiler/ SteamPac Water	Horizontal Boiler/ SteamPac Water
рН	7.5-9.2	8.5-10.5	8.5-10.5	6.0-9.2	8.5-10.5	8.5-10.5
Feedwater Temperature	140 F (60 C)*			140 F (60 C)*		
Hardness as CaCO ₃	< 2ppm	< 10 ppm	< 15 ppm	< 2ppm	< 10 ppm	< 15 ppm
Chlorides		***	***		50 ppm	50 ppm
Total Alkalinity		< 300 ppm	< 500 ppm		< 300 ppm	< 500 ppm
OH Alkalinity		200-300 ppm	200-300 ppm		200-300 ppm	200-300 ppm
Total Dissolved Solids		< 2000 ppm	< 3000 ppm		< 2000 ppm	< 3000 ppm
Suspended Solids	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**	No visual turbidity**
Total Organic Carbon	No sheen No foam +	No sheen No foam +	No sheen No foam +	No sheen No foam +	No sheen No foam +	No sheen No foam +
Iron	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++
Dissolved Oxygen	<1 ppm*	ND	ND	< 5 ppm	ND	ND
Visual Oil	ND	ND	ND	ND	ND	ND
Conductivity (mS/cm)		< 2985	< 4477		< 2985	< 4477

^{*} This is a minimum temp. Feedwater temperatures below 200 F (93 C) will require an oxygen scavenger.

ND: None Detected ppm: parts per million

^{**}Suspended solids: Take a water sample. After the sample sits for 10 minutes, no solids should be visible.

⁺Total Organic Carbon: Take a water sample. Shake vigorously for 30 seconds. No sheen or foam should be visible.

⁺⁺ Iron: Take a water sample. The upper limit is 0.1 ppm. Hold the sample against a white background. The water should have no visible yellow, red or orange tinge.

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WARNING

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Hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

Water Supply

The quality of the water used in the boiler will affect the life of the pressure vessel (PV). It is strongly recommended that a competent water treatment company be consulted prior to the installation of the boiler. Elements/PV damaged due to adverse water conditions will not be replaced under warranty.

Natural feedwater supplies contain solids and dissolved gases. These may promote scale, foaming, corrosion, and/or poor steam quality. To prevent this, feedwater must be studied individually and treated accordingly. The treatment should provide quality feedwater to the boiler such that corrosion and deposition in the boiler will be minimized.

Thermal cycling, dissolved oxygen, high or low pH can all be major causes of corrosion. Untreated hardness is the major cause of scale deposits. Poor quality feedwater requires increased blowdown and increased chemical treatment costs to prevent boiler corrosion and scaling.

One way to lower the amount of dissolved gases in the boiler feed water is to preheat the feedwater. This option injects live steam into the feedwater to increase the water temperature to 180 F (82 C) or higher which removes oxygen and carbon dioxide from the water.

Reverse Osmosis / Deionized (RO/DI) water is water from which all dissolved solids have been removed. Reverse osmosis is a process that uses a semi-permeable membrane, under pressure, to reject dissolved salts and allow only water to pass through. RO/DI water has no buffering capacity and a pH of <7.0. It is corrosive to carbon steel; however, it is not corrosive to stainless steel. Very high purity steam quality can be obtained with RO/DI water.

If RO/DI water is used as a water source in a carbon steel boiler, it must be neutralized to pH >7.5 prior to entering the boiler. Failure to neutralize the RO/DI will void the PV warranty and cause high general corrosion rates.

GLOSSARY OF WATER SUPPLY TERMS

Dissolved Oxygen: Oxygen that is dissolved in the feedwater will cause the steel in the boiler and the feedwater system to be attacked by the water in a manner described as "pitting". The pits that are produced can vary from tiny depressions to holes large enough to penetrate the boiler metal and are usually covered with tubercles of iron oxide. Once pitting starts, it may be extremely hard to arrest. Pitting can proceed at a surprisingly rapid rate and can occur not only in the boiler proper, but also in pre-boiler equipment such as economizers, feedwater tanks, and feedwater lines.

Suspended Solids: Suspended solids are the undissolved matter in water, including dirt, silt, vegetation, iron oxides, and any other insoluble matter. Normally suspended solids are expressed in terms of turbidity. Suspended solids may also deposit in low velocity areas and create fouling. In line filters, or various types of pretreatment can be used to lower the suspended solids level. Periodic blowdowns will eliminate suspended solids.

Alkalinity: Alkalinity is the capacity of a water to neutralize acids. Common water alkalinities consist of bicarbonate, carbonates, hydroxide, phosphate, and silicate. These alkalinities, especially bicarbonates and carbonates, break down to form carbon dioxide in steam, which is a major factor in the corrosion on condensate lines. High alkalinity also causes foaming and carry over in boilers. Both foaming and carry over cause erratic boiler operation. The reason for the high alkalinity should be determined. It may result from lack of sufficient blow off. The source of alkalinity may be due to an overdose of alkaline internal water treatment chemical.

pH: pH is a measure of the degree of acid or base of solution. A pH range of 8.5-10.5 will have little influence on the corrosion rate of carbon steel. A low pH can result in corrosion of metals, while a high pH can result in scale formation or caustic embrittlement. In order to control boilers and equipment used for the external treatment of make-up water, it is essential that reliable pH measurements be made. RO/DI water will have a pH of 6.0 - 6.5 and will require neutralization if used in a carbon steel vessel. It is critical that the boiler pH be alkaline (8.5-10.5) whenever water is in the boiler.

Chlorides: If chloride levels are high enough to cause severe corrosion, they can be controlled by limiting the cycles of concentration and increasing boiler blowdowns. Corrosion from chlorides can also be controlled by increasing the amount of corrosion inhibitor, or changing to a more effective inhibitor. Reverse osmosis is another method of pretreatment to reduce chlorides. Chloride stress corrosion is a major concern in a stainless steel vessel.

Oil: Oil is not a natural constituent of boiler water; still it can frequently enter a system through leaks in a condenser or other heat exchanger. Oil can also enter a system through the lubrication of steam driven reciprocating equipment. Whatever the source, the presence of oil in boiler water is undesirable. Oil can act as a binder to form scale. In high heat-transfer areas oil can carbonize and further contribute to the formation of scale and low pH. Foaming is one indication of oil in boiler water. Its presence can also be confirmed by first shaking a bottle containing boiler water. If oil is present foam will result. Often oil in boiler water will originate in the condensate. This contaminated condensate should be directed to the sewer until the source of the oil is determined and corrective steps taken.

Iron (oxides): Iron in any of its oxide or complex forms is undesirable in boiler water. Iron in its various forms can originate in the raw water makeup, condensate return water, or form directly in the boiler as a result of corrosion. It can concentrate in the boiler and it tends to collect in stagnant areas.

Water Hardness: Water hardness is the measure of calcium and magnesium content as calcium carbonate equivalents. Water hardness is a primary source of scale in boiler equipment. Hardness is removed by softening.

Periodically, the ion exchange resin bed requires regeneration by flushing through with a brine solution followed by rising with fresh water. The interval between regeneration is dependent upon the raw water hardness and flow rate.

In all cases the water hardness should be tested periodically and prior to starting the generator to ensure efficient operation of the softener. Unsoftened water should not be allowed to enter the steam generator unless sufficient scale inhibitor chemical is used.

Feedwater: Feedwater is the combination of fresh makeup and returning condensate that is pumped to the boiler.

Condensate: Condensate is condensed steam that is normally low in dissolved solids. Hence, it does not contribute to the dissolved solid content of the feedwater. In addition, condensate is very expensive to waste. It's been chemically treated, heated, pumped, converted to steam, and condensed.

Dissolved Solids: Dissolved solids are salts in the water that stay in solution. They are invisible to the naked eye. As the boiler generates steam, dissolved solids will concentrate. If the concentration becomes too high, they will precipitate, form a suspended solid, and concentrate in the vessel. Daily boiler blowdown is recommended to help prevent the formation of deposits. Consult Blowdown procedure in the **Daily Maintenance Schedule** section of this manual.

Chemical Dosing: In addition to softening the feedwater, it is also important to consider other factors such as dissolved oxygen and acidity. Depending on the results of an analysis, it may be necessary to inject appropriate amounts of corrective chemical into the feedwater system. This is usually achieved by means of a chemical compound solution and variable output metering pump mounted at the storage vessel. It is important that the chemicals and quantities are correct and it is advisable to contact a water treatment company to arrange a feedwater analysis.

MARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

The vent line connection on the gas pressure regulator must be piped to outdoor air by the installer in accordance with National Fuel Gas Code, ANSI Z223-1-1991 or latest addenda. In Canada, gas installations must be in accordance with the current CAN/CGA B149.1 and 2 and/or local codes.

CAUTION

Some soap used for leak testing is corrosive to certain types of metals. Use an appropriate leak test solution. Clean all piping thoroughly after completing the leak check.

Piping Specifications

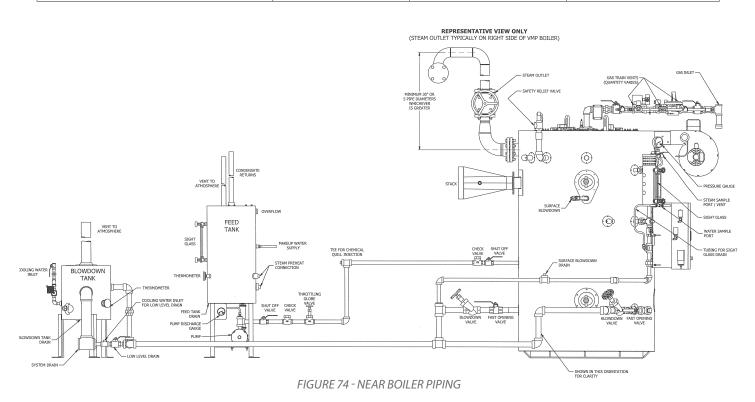
For piping, the basic considerations are the design temperature, the pressure retained by the pipe, the fluid in the pipe, the load resulting from thermal expansion or contraction and, impact or shock loads imparted (such as water hammer, external loads, wind loads, and vibration from equipment).

While referencing Table 1 and Figure 5 adhere to the following:

- 1. The arrangement of the piping and its appurtenances must take into consideration the location of other structures and equipment adjacent to the piping. The potential for freezing interference and/or damage as a result of expansion, contraction, vibration, or other movements must be factored.
- 2. Valves are used in piping systems to stop and start the flow of fluids, to regulate flow, to prevent back flow, and to relieve excessive pressure build-up in the piping. Consideration should be given to the appropriate location and orientation of valves necessary for safe operation and isolation of the piping.
- 3. All piping and piping components used should be suitable for the design temperatures, pressure and fluid used in the system.
- 4. For boilers to 200 psig, it is recommended that boiler external pipe nipples be per tables at end of this section of the manual.
- 5. During the installation, ensure that no dirt, water, or residue from welding is left in the system.
- 6. Expansion joints or properly designed and sited loops should be provided to accommodate thermal expansion. Thermal expansion should be calculated using the maximum possible utilization fluid temperature, regardless of whether the pipe considered is in the feed or return circuit. Steel pipe will expand approximately 1 "per 100' over a 100 F temperature rise (1 mm per meter over 100 C rise).
- 7. Supports and anchors must be provided for all pipes, as necessary, to prevent undue stresses from being placed on equipment, including pumps, valves, and the heater. Supports and anchors which will not interfere with thermal expansion should be chosen. The equipment should never be used or considered as an anchor. No additional loads should be applied to any factory connection.
- 8. Gaskets must be used to make all flanged connections. Gasketing material must be suitable for use with the pressure, temperatures and fluids in the system. Ensure that all bolts are tightened evenly and to the torque recommended values provided by the gasket manufacturer.
- 9. High point bleeds/air vents are to be installed at all high points in the system piping.
- 10. All pipes should be installed with a pitch to facilitate draining and venting.

TABLE 6 - SKID PACKAGED STEAM SYSTEM PIPING SPECIFICATION (BOILERS WITH A MAXIMUM OPERATING PRESSURE OF 125 PSIG, 150 PSIG MAX. TRIM PRESSURE)

Service	Pipe	Fittings	Joints	
Blowoff	Sch 80 SA 53A or B or SA	≤ 2.5" Forged Steel CL3000	≤ 2.5"Threaded	
	106B	≥3" SA 234/SA 105	≥3" welded/flanged 300#	
Surface Blowdown Piping	Sch 80 SA 53A or B or SA 106B	Forged Steel CL 3000	Threaded	
Condensate (i.e. any piping that may come in contact with the condensate that is not deaerated – water piping).	Sch 80 SA 53A or B or SA	≤ 2.5" Forged Steel CL3000	≤ 2.5"Threaded	
	106B	≥3" SA 234/SA 105	≥3" welded/flanged 150#	
Feedwater – between the pump	Sch 80 SA 53A or B or SA	≤ 2.5" malleable iron CL150	≤ 2.5"Threaded	
and the boiler	106B	≥3" SA 234/SA 105	≥3" welded/flanged 150#	
Pump Recirculation Orifice	e Piping	A length of straight pipe a minimum of 20 pipe diameters directly downstream of the orifice shall be sch. 80 Stainless Steel pipe and the first elbow shall be an extra heavy Stainless Steel elbow. Remaining piping to follow the requirements for condensate piping above.		
Steam Headers/Deaerator steam piping to	Sch 80 SA 53A or B or SA	≤ 2.5" malleable iron CL 150	≤ 2.5"Threaded	
125 psig incoming steam pressure+	106B	≥3" SA 234/SA 105	≥3" welded/flanged 150#	
Overflow/Drain piping (water) including	Sch 80 SA 53A or B or SA	≤ 2.5" malleable iron CL 150	≤ 2.5"Threaded	
DA liquid drainer piping	106B	≥3" SA 234/SA 105	≥3" welded/flanged 150#	
Blow off tank drain and outlet piping	Sch 40 SA 53A or B or SA 106B	malleable iron CL 150	Threaded	
100% fresh cold water make up (includ- ing: DA tanks, water softener, etc)	Type L copper			



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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

Assure all electrical connections are powered down prior to attempting replacement or service of electrical components or connections of the equipment.

Cements for plastic pipe should be kept away from all sources of ignition. Proper ventilation should be maintained to reduce the hazard and to minimize breathing of cement vapors.

Insulation

■ NOTE: It is recommended that for inspection and maintenance, pumps, flanges, valves and fittings are left uninsulated but suitably shielded for safety.

Adhere to the following:

- The boiler is insulated at the factory. No additional insulation on the boiler pressure vessel is required. Adding insulation may damage the boiler and its components.
- 2. Feedwater tanks, surge tanks and deaerators should be insulated. Insulation should be chosen with care such that the fluid in the tanks does not exceed the maximum operating temperature of the pump.
- 3. Blowoff vessels should **not** be insulated.
- 4. Equipment should be insulated with material suitable for the application and temperatures expected.

System Interfaces

Proper selection and installation of the components in the system will ensure proper and safe operation of the boiler.

■ Feedwater Tank

Where an atmospheric condensate return tank is to be fitted, adhere to the following:

- 1. Vent to a safe location.
- 2. Have a pump capacity sufficient to satisfy boiler consumption as well as maintain proper return tank temperature. Capacity should provide 2.5x the evaporation rate of the boiler for on/off pumps and 1.5x for continuously running pumps at a minimum discharge pressure of 3% higher than the safety valve set pressure, plus the pressure drop of the components between the pump discharge and the boiler feedwater inlet. Maximum temperature of the condensate return tank is dependent on the Net Positive Suction Head Required (NPSHR) of the feed water pump selected. Consult factory for details.
- Do not downsize vent pipe (this may cause pressure build up in the condensate tank).
- 4. Shield return pipes to prevent burn hazard.
- 5. See **Feedwater System Manual** for detailed instructions.

INSTALLATION

■ The Feed Water Piping

Where the feed water piping is to be fitted, adhere to the following:

- 1. Size makeup water piping adequately to provide proper water supply. Do not reduce feedwater piping smaller than supplied line size. Depending on installation, feedwater piping may need to be larger to minimize pressure drop of feedwater piping.
- 2. Do not use the feed water pump as a support for the feed water piping. This could add undue strain to the pump head. Use proper piping supports as necessary to support feed water piping.
- 3. Do not use stainless steel within the Boiler External Piping (BEP) boundary.
- 4. Ensure all piping is done in compliance with all applicable codes.
- 5. See Feedwater Instruction Manuals for detailed instructions.

■ Blowdown Tank

Where a blow off separator is to be fitted, adhere to the following:

- 1. Vent to a safe location.
- 2. Have a capacity sufficient to satisfy boiler blow- off, as well as maintain proper drain temperature.
- 3. Ensure compliance with all applicable codes when determining connection piping between the boiler and the blowdown tank
- 4. Do not downsize vent pipe (this may cause pressure build up in the blowdown tank).
- 5. Include a thermostatically controlled cooling kit in cases where drain temperature exceeds 120 F (49 C) or maximum allowable temperatures allowed by local jurisdiction.
- 6. Do not insulate blowdown tank.

■ The Blow Off Valves

Where the boiler blow off valves are to be fitted, adhere to the following:

- 1. Ensure pipes and connections are clean and free of any foreign material.
- 2. Pipe blow off pipes to a blowdown tank of approved design.
- 3. Ensure that for each blow off line there is a slow-opening and a fastopening valve.
- 4. Between the boiler and the second blow down valve, ensure all piping is Schedule 80 and fittings are CL 3000 forged steel.
- 5. Ensure compliance with all applicable codes.

🗥 WARNING

Improper installation or maintenance of the gauge glass assembly can cause immediate or delayed breakage resulting in bodily injury and/or property damage.

No shutoff of any kind may be placed between the safety relief valve and the equipment, or in the discharge pipe between such valve and the atmosphere. Doing so may cause accidental explosion from overpressure.

Discharge from safety relief valve must be configured so that there is no danger of scalding personnel or causing equipment damage. Provisions must be made to properly drain safety relief valve discharge piping.

■ Steam Safety Valve

Adhere to the following:

- 1. Use only the safety valve provided with the boiler as noted on the ASME data report.
- 2. Ensure pipes and connections are clean and free of any foreign material.
- 3. Do not install using a pipe wrench. Use the appropriately sized wrench on the bonnet nut.
- 4. Install the valve vertically with no unnecessary intervening piping between the boiler and the valve.
- 5. Do not cap or plug the weep hole on the side of the safety valve.
- 6. Ensure that the valve is vented to a safe location.
- 7. A discharge pipe shall be of a pipe size equal to, or greater than, the outlet of the safety valve.
- 8. Consult local codes for combined safety valve pipe sizing.
- 9. Minimize discharge piping fittings and overall piping run to avoid over pressurization of the piping, limiting safety valve discharge volume.

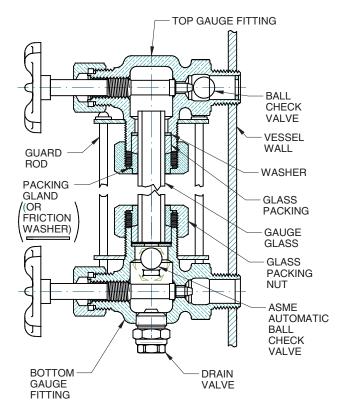


FIGURE 75 - STEAM SIGHT GAUGE GLASS

- Do not support discharge piping with the safety valve.
 Discharge piping must be supported adequately by appropriate means.
- 11. Fulton recommends the use of a drip pan elbow, as this provides the needed drainage and isolation from expansion as required.
- Terminate the discharge pipe directly to atmosphere.
 Discharge pipe must not contain a shut off valve of any sort.

Steam Pressure Gauge Assembly

Where a steam pressure gauge is to be fitted, adhere to the following:

- 1. Ensure pipes and connections are clean and free of any foreign material.
- 2. Do not install using a pipe wrench. Use the appropriately sized wrench on the connection fitting.
- 3. Install using a siphon loop flooded with water to act as a water seal to buffer the gauge element.
- 4. Face the gauge in a direction easily viewable by the operator.
- 5. Range the gauge to approximately double the pressure at which the safety relief valve is set but in no case less than 1.5 times the safety relief valve set pressure.

■ The Water Column and Water Gauge Glass

When installing the water column and gauge connections, adhere to the following:

- 1. Inspect the water gauge glass to ensure that the glass is free of cracks or chips. Do not subject the gauge glass to bending or torsional stresses.
- 2. Install the piping from the water column and gauge glass to a safe blow off vessel of approved design.
- 3. Install the top fitting (the fitting without the drain port) into the upper fitting on the water bottle using Teflon tape or pipe sealant. Wrench tighten the fitting until it is snug and the glass outlet is pointing at about 5 o'clock (about 1/8 turn from its final downward vertical position).
- 4. Install the bottom fitting (the fitting with the drain port) into the lower fitting on the water bottle using Teflon tape or pipe sealant. Wrench tighten the fitting until it is snug and the glass outlet is pointing directly upward.

INSTALLATION

- 5. Verify that the top and bottom fittings are threaded into the water bottle tappings the same amount.
- 6. Remove the glass packing nut, friction washer and glass packing from the fittings and place them in the same order on either end of the water gauge glass. Push both packings about 1in (25.4 mm) from the end of the water gauge glass.
- 7. Gently insert one end of the water gauge glass into the top gauge fitting. Keeping the glass inside the fitting, gently rotate the top fitting clockwise until it is vertically aligned with the bottom fitting.
- 8. Insert the gauge glass into the bottom fitting until it bottoms out, and then gently raise glass about 1/16 in (1.6 mm). Do not allow glass to remain in contact with any metal surface.
- 9. Carefully slide the bottom glass packing down until the glass packing is touching the lower gauge fitting. Carefully slide the top glass packing up until the glass packing is touching the upper gauge fitting.
- 10. Hand tighten both glass packing nuts, then tighten ½ turn more by wrench. Do not over- tighten. If any leakage occurs, tighten the packing nut slightly, no more than a ¼ turn at a time, until the leak stops.
- 11. Install the protective guard over the gauge glass assembly.
- 12. The gauge glass valves are fitted with ball checks. Make sure that the valves are fully open to ensure that the ball check will function properly in the event that the gauge glass breaks.
- 13. Install drain piping from water bottle and lower water gauge class fitting to the boiler blow off piping.

Assembly of Multi-Skid Systems

Adhere to the following for multi-skid engineered systems:

- 1. Refer to the Fulton mechanical/electrical drawings during assembly.
- 2. Ensure that equipment orientation allows for operation interface and maintenance.
- 3. Align the skids as shown on the drawings ensuring that skid fasteners (skid joint angles) are matched. The skid joint angles are a matched set and the edges of the fasteners should be exactly aligned.
- NOTE: Do not bolt the skids to the housekeeping pad/floor until all of the piping has been reassembled and tightened.
- 4. Ensure the skids are level and flat before fastening the skids together with the supplied bolts. The skids should be leveled front to back, side to side and corner to corner. Failure to properly level the skids will result in piping misalignment. A level or laser level should be used to verify skid alignment (when a standard level is used, the length should be appropriate for the

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

Assure all electrical connections are powered down prior to attempting replacement or service of electrical components or connections of the equipment.

Cements for plastic pipe should be kept away from all sources of ignition. Proper ventilation should be maintained to reduce the hazard and to minimize breathing of cement vapors. skid). If assembling multi-component support stands, attach sections using the supplied bolts through the tank frame mounting plates. These should be hand tight until all of the piping is assembled. Note: skids are leveled at the factory using a laser level.

- 5. Connect the piping between the skids by matching the union connections and/or flange stamps and tightening. Refer to the mechanical drawing as necessary to confirm location of spool pieces etc. as the flange stamps are shown on the drawing in hexagonal callouts. The flange stamps should matched and aligned (the flange stamps should be directly across from one another. Rotating a flange will result in piping misalignment). Bolts should be hand tight until all of the piping is assembled. Refer to the appropriate instructions to tighten the flanges to the required torque specifications. Support pipe runs as required.
- 6. Ensure that a low point drain is installed in the piping.
- 7. Connect the conduit runs between the skids and tighten conduit connectors.
- 8. Locate the supplied wiring for the equipment and pull wiring through the appropriate conduit runs. Electrical wires are labeled for easy landing. Connect all wiring per the Fulton supplied electrical drawings.
- 9. If a header is supplied, mount the header as shown in the mechanical drawing.
- NOTE: For piping supplied in sections, make up and connect hand tight until all sections are in place to ensure sections align properly. Sections are match marked for reassembly.
- 10. Tighten all connections.
- 11. Pneumatically test the piping (at 15 psig maximum) prior to filling the systems.
- 12. Check bolts and connections for tightness after the first heat up cycle. Retorquing may be required.

Stack & Flue Connections

Adhere to the following for stack and flue connections:

- An appropriately-sized stack should be connected to the flue gas outlet at the boiler. The proper flue size and draft control is most important for proper burner operation. The flue must be as large or larger than the outlet on the vessel. Avoid long flue piping and too many elbows by placing the equipment as close as possible to the chimney.
- 2. The stack should rise continuously to the connection at the chimney and should contain no more than two bends at 45 degree angles or less. If required, as a result of space limitations, one 90 degree elbow (or tee) can be fitted at the back of the vessel.
- 3. There should be two feet (0.6 m) of straight, horizontal flue before any change in direction, fitting or draft regulator. This is to prevent potential pilot or main flame failures due to back pressure build up during ignition. Any alternative stack arrangement must supply -0.02" w.c. to -0.04" w.c. (508 1016 mm) pressure with the burner off and a draft of -0.04" w.c. to -0.08" w.c. (1016 2032 mm) with the burner running.
- 4. Any alternative stack arrangement must supply the following draft:
 - Positive pressure draft requires a CAT 3 stack.
- 5. The run in the total distance of stack ducting, as measured in a straight line from the outlet of the boiler to the outlet of the stack, should not exceed 25% of the rise. With the exception of the duct run previously described, horizontal sections of ducting must be avoided and should not exceed four feet total. The stack and chimney material shall comply with all applicable codes.
- Adequate provision must be made for the support of the weight of the chimney and stack to avoid having a load imparted to the outlet connection of the equipment.
- The installation of a draft regulator by the client/ contractor is recommended at all installations. This will help to maintain the required draft.

INSTALLATION

Venting Terminations

Adhere to the following for installation:

- All vent pipes and fittings must be installed with appropriate air space clearances to combustibles. These air space clearances apply to indoor or outdoor vents whether they are open, enclosed, horizontal or vertical or pass through floors, walls, roofs, or framed spaces. The air space clearances should be observed to joists, studs, sub floors, plywood, drywall or plaster enclosures, insulating sheathing, rafters, roofing, and any other material classed as combustible.
- To prevent the possible re-circulation of flue gases, the vent designer must take into consideration such things as prevailing winds, eddy zones, building configurations, etc. Fulton cannot be held responsible for the effects such adverse conditions may have on the operation of the boilers.
- 3. The required minimum air space clearances also apply to electrical wires and any kind of building insulation.
- 4. Listed termination parts must be used.
- 5. Select the air intake point of penetration where a minimum of 1/4" per foot (6.35 mm per .3 m) upward pitch can be maintained.
- 6. It is recommended to install a mesh bird screen, with minimum 1/2" by 1/2" openings, at the combustion air intake termination. Climates subject to extreme cold may require alternate configurations to provide an increased surface area, such a cylindrical screens. Consult your venting supplier for recommendations.
- 7. It is important to locate the exhaust termination in such a way that it does not become blocked due to snow, ice, and other natural or man-made obstructions. If terminating into a prevailing wind, direct elbow upward. Avoid areas (example: courtyards) where swirling high winds may be present.

Roof Vent Termination

Adhere to the following for installation:

1. The minimum vent height should extend at least 6 feet (1.8 m) above the roof, or at least 6 feet (1.8 m) above the highest part of any structure within 10 feet of the vent.

2. When installing inlet and exhaust terminations above the roof, the exhaust outlet must be installed 4 feet (1.22 m) minimum above and 4 feet (1.22 m) minimum downwind from air supply inlet to prevent exhaust recirculation.

■ Side Wall Vent Termination

Adhere to the following for installation:

- NOTE: The vent termination is joined to the vent pipe outside the wall. Use the same joining procedures for vent pipe and fittings.
- When penetrating a non-combustible wall, the hole through the wall must be large enough to maintain the pitch of the vent and provide sealing. Use adhesive material to seal around the vent on both sides of the wall. When penetrating a combustible wall, a wall thimble must be used. See **Figures 29, 31** for installation instructions. Minimum wall thickness through which vent system may be installed is 3.25 inches (8.26 cm). Maximum wall thickness through which vent system may be installed is 20 inches (50.8 cm).
- 2. The termination of the vent system must be at least 12 inches (30.48 cm)above the finished grade, or at least 12 inches (30.48 cm) above normal snow accumulation level (for applicable geographical areas).
- 3. The termination of the vent system shall not be located in traffic areas such as walk ways, adjacent buildings, operable windows and building openings unless the venting system is at least 7 ft (2.1 m) above finished grade, (National Fuel Gas Code, ANSI Z223.1).
- 4. The vent terminations must be at least 4 ft (1.22 m) horizontally from electric meters, gas meters, regulators, and relief equipment.
- When installing inlet and exhaust terminations on the same wall, the exhaust outlet must be installed 4 feet (1.22 m) minimum above and 10 feet (3.05 m) minimum downwind from air supply inlet to prevent exhaust recirculation.

Under certain wind conditions, some building materials may be affected by flue products expelled in close proximity to unprotected surfaces. Sealing or shielding of the exposed surfaces with a corrosion resistant material (such as an aluminum sheet) may be required to prevent staining or deterioration. Flue should be directed away from surfaces, if possible.

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WARNING

For reasons of safety, the hot exhaust gas duct and chimney must be insulated or shielded within the locality of the heater in compliance with local codes and regulations.

\triangle CAUTION

The stack arrangement and draft conditions should be in accordance with the information in this manual for proper performance of the equipment.

System Piping Testing

Upon completion of the installation, adhere to the following for system piping testing:

- 1. Perform a pressure test.
- 2. Perform soap tests at all welds and joints to ensure that the system is free from leaks.

Testing

Upon completion of the installation, perform the following testing:

- 1. A pneumatic test not exceeding 15 psig.
- 2. Leak tests at all welds and joints to ensure that the system is free from leaks.

Before Leaving the Installation

Before leaving the installation, adhere to the following:

- 1. Check all controls to ensure they are operating properly.
- 2. Cycle the boiler several times.
- 3. Make sure the installation complies with all applicable codes.

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

Do not operate, or allow others to operate, service or repair this equipment unless you (they) fully understand all applicable sections of this manual and are qualified to operate/maintain the equipment.

Defective or improperly installed equipment is hazardous. Do not operate equipment which is defective or improperly installed.

Defective equipment can injure you or others. Do not operate equipment which is defective or has missing parts. Make sure all repairs or maintenance procedures are completed before using the equipment. Do not attempt repairs or any other maintenance work you do not understand.

\triangle CAUTION

Installation in accordance with the guidelines within the manual should be fully completed before performing the initial start-up; and start-up must be complete prior to putting the unit into service. Starting a unit without the proper piping, venting or electrical systems can be dangerous and may void the product warranty.

"Factory Trained Personnel" refers to someone who has attended a Fulton Service School specifically for the equipment covered in this manual.

Start-Up Preparation & Installation Review

Check with local authorities where approval for start-up is required. In some localities, final inspection of services may be required.

Review the installation section of this manual carefully. Confirm accordance with installation guidelines, including:

- 1. You have read and followed all safety information.
- 2. The equipment area is in conformance with established boiler room requirements. Review national and local codes.
- 3. There are no obstructions left in the piping from pressure leak testing such as blanking plates in flanged joints or unions.
- 4. Pipework is free to expand naturally when hot.
- 5. Equipment is located with the proper clearances.
- 6. Relief valves have been properly piped as described in the **Installation** section of this manual.
- 7. Flue gas from the equipment is properly vented.
- 8. Combustion air openings are not obstructed in any way and have adequate capacity.
- 9. There are no flammable liquids, materials or hazardous fumes present in the environment.
- Nothing was damaged or knocked loose during installation. Inspect the main gas train and trim assembly to be sure they were not damaged during installation.
- 11. Installation Checklist (provided with equipment) is complete.

Start-Up Service

If start-up service has been included in the order, the factory should be contacted after the installation has been successfully completed and approved by the client's representative or engineers. Where possible, contact the factory at least three weeks before a Fulton service engineer is required on site.

Careful preparation can expedite the commissioning of your boiler. Most delays can be avoided by following the instructions in this manual. Failure to complete required procedures properly can result in the need for further service time, at extra cost to the customer.

Service people will not commence start-up if there are obvious system deficiencies. However, start-up service in no way constitutes a system design check or approval of the installation.

In addition to commissioning the boiler, the service person will also familiarize boiler room personnel with the operation of all Fulton equipment. Personnel must be qualified to understand the basic operation and function of controls.

OPERATION

Burner Considerations

Initial Settings

The burner settings will be factory set for normal initial settings. These should be adjusted at start-up to match the application. Only trained personnel should perform any combustion adjustments, limit controls, and burner startup.

Before proceeding with startup and adjustment, perform the following checks:

- All wiring is properly installed and connected
- All fuel lines are connected and tight
- Burner is properly mounted and secured
- The linkage is correct and tight
- The stack is properly connected and draft controls are operational
- Gas vent lines are properly connected
- All cleanout doors are in place and properly secured
- Operating controls are ready
- A combustion analyzer is available to tune combustion. Other testing equipment (manometers, gauges, volt meter) are available

Prepare For Initial Start-Up

These instructions are for use when the unit is being started for the first time, or after prolonged shutdown. They are to be used in conjunction with the information in **Daily-Start-Up** section of this manual.

Perform Boil Out

Fulton recommends boil out be accomplished prior to boiler system operation. This procedure ensures that all oils, sealants and other organic compounds that may cause erratic water level control are removed from the boiler and piping. Consequently, if boil out is not accomplished prior to system operation, erratic water level control and surging may occur. Fulton strongly recommends that a boiler chemical specialist be consulted for the purchase of chemicals for boiler cleaning.

Boil Out Procedure

Fulton recommends pressure vessel cleaning prior to system operation or after major maintenance. This boil-out procedure removes oils, greases and other organic compounds that may cause erratic water level control and surging. There are many chemicals on the market that may be used and our recommendations are as follows:

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WARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/professional codes and regulations.

riangle caution

Do not use this equipment if any part has been under water (or subjected to heavy rains/water if the equipment does not have NEMA 4 wiring, controls and instrumentation). Immediately call a qualified service technician to inspect the equipment and to replace any part of the control system and/or gas control(s) which have been under water.

Please read these instructions and post in an appropriate place near the equipment. Maintain in good legible condition.

MARNING

All information in this manual is for reference and guidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Crystalline silica may be present in components of this equipment. Exposure to crystalline silica may pose significant health hazards, including but not limited to eye and respiratory system damage. Per the Centers for Disease Control and Prevention (CDC) and Occupational Safety and Health Administration (OSHA), appropriate Personal Protective Equipment must be worn to minimize exposure to hazardous substances. Refer to most current guidelines offered by the CDC and OSHA for more information, including Personal Protective Equipment recommendations.

When opening any drains on the equipment or piping system, steps should be taken to avoid scalding/burning of personnel due to hot fluids. Whenever possible, the system should be cooled prior to opening any drains.

Use only your hand to turn valve handles. Never use tools. If the handle will not turn by hand, don't try to repair. Forced or attempted repair may result in fire or explosion.

WHAT TO DO IF YOU SMELL GAS:

Do not use matches, candles, flame or other sources of ignition to check for gas leaks. Do not try to light the appliance. Do not touch any electrical switch; do not use any phone in your building. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions. If you cannot reach your gas supplier, call the fire department.

- For many years Fulton has recommended the use of washing soda (sodium carbonate) to wash out boilers. Sodium carbonate (also known as washing soda or soda ash), Na2CO3 is a sodium salt of carbonic acid. Called washing soda, soda crystals, or sal soda in the detergent section of stores, it effectively removes oil and grease.
- Trisodium phosphate (TSP, E339) is an excellent degreaser and alternative to washing soda. It is a white, granular or crystalline solid, highly soluble in water producing an alkaline solution. The item of commerce is often partially hydrated and may range from anhydrous trisodium phosphate, Na3PO4, to the dodecahydrate, Na3PO4·12H2O. Most often found in white powder form, it can also be called trisodium orthophosphate or just plain sodium phosphate.

Adhere to the following when performing boil-out:

- 1. The boil-out shall include "over-the-top" wasting of water. A temporary 2" pipe shall be run from the relief valve tapping to a suitable point of discharge as required by local jurisdiction(s) to assure that grease and oils are floated to the top and out of the unit. Minimum time for the procedure shall be four (4) hours of constant water discharge alternating between bottom and top blowdown. At least two (2) complete bottom blowdown and complete refills shall be done. A suitable manner of chemical waste handling shall be employed to meet local jurisdictional requirements.
- 2. Do not introduce steam to the system until the boiler has been properly boiled out.
- 3. On new systems, send condensate returns to the drain to ensure the new system piping has been flushed free of debris and is fully clean. If debrisfilled condensate is not wasted, additional boil-out(s) may be required.

Boiler Blowdown Process

During installation the temperature sensor for the cooling valve will need to be installed in the correct location on the blowdown tank.

Prior to starting to blowdown a boiler, verify the following valve positions and tank level.

- The drain valve on the blowdown tank should be fully closed.
- Cold water valve to the cooling kit should be fully opened.
- Set the above cooling valve so that adequate cooling water flows to keep the drain water temperature below 140 deg. F or below the required temperature of the local jurisdiction if different.
- Verify blowdown tank is flooded via sight glass if provided.
- Auxiliary cooling line valve closed.
- Low level drain valve closed
- Boiler fast and slow opening bottom blowdown valves are closed

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OPERATION

- Boiler water column blowdown valve is closed
- Boiler sight glass blowdown valve is closed

Once the blowdown tank is flooded, it should remain flooded. In the event the blowdown tank is drained, it will need to be re-filled prior to preforming a boiler blowdown.

Flame Programmers

■ Flame Safeguard Control

This is the main control in the panel box. The programmer in conjunction with a sensing device (UV scanner) supervises the flame ignition sequence, proves that the flame is satisfactory and monitors the established flame. Should any fault occur, either during the ignition sequence or during normal operation, the programmer will immediately go to "lock-out" and the burner will shut down.

Sequence of Operation: Gas Fired Burners

The burner is of forced draft design. The Sequence of Operation for the burner is as follows:

- Check main gas valve, which provides proper pressure to burner. Refer to **Table 2** for maximum gas pressure. A step-down regulator may be necessary.
- 2. Combustion air is delivered by a centrifugal blower fan. An air switch monitors the pressure and is part of the flame programmer safety interlock circuit.
- The flame programmer monitors the safe operation of the burner.
 Functions include pre-purge of the combustion chamber, provision of ignition via the ignition transformer and electrode, opening main gas valves and providing post-purge of the combustion chamber.
- 4. The flame is monitored by a flame sensor. In the event of insufficient, unstable, or non existent pilot or main flame, the flame sensor will cause a safety lockout of the flame programmer. Safety lockout can also be caused if the flame sensor is improperly positioned or grounded. After fault has been corrected, reset by pressing the appropriate reset button on the boiler panel or the burner controller.

Sequence of Operation: Modulated Burner

The burner is equipped with modulating controls, which will provide up to a 10:1 turndown of the burner (dependent on Boiler HP). This system is linkageless, and operates a fuel control valve, an air control valve and a variable speed drive to achieve turndown.

Beginning from an off state, and assuming there is a load on the system (call

♠ WARNING

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Do not attempt to start the equipment for any testing prior to filling and purging the vessel. A dry fire will seriously damage the equipment and may result in property damage or personnel injury and is not covered by warranty. In case of a dry firing event, shut off the fuel supply and allow the vessel to cool to room temperature before fluid is reintroduced to the pressure vessel.

\triangle CAUTION

A qualified installer, service agency or the gas supplier must perform installation and service on the fuel delivery system.

Before commissioning the equipment, verify with authorized personnel that the gas lines have been purged.

Never attempt to operate equipment that has failed to pass all the safety checks.

After checking controls by manual adjustment, make sure they are always reset to their proper settings. Contact your Fulton dealer before modifying the equipment.

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WARNING

This boiler is equipped with an ignition device which automatically lights the burner. Do not try to light burner by hand.

Operating this equipment beyond its design limits can damage the equipment and can be dangerous. Do not operate the equipment outside of its limits. Do not try to upgrade the equipment performance through unapproved modifications. Unapproved modifications may cause injury, equipment damage, and will void the warranty.

Check daily that the equipment area is free and clear of any combustible materials, including flammable vapors and liquids.

Do not tamper with safety features provided by the operating controls.

Should overheating occur or the gas supply fails to shut off, manually shut off the gas supply external to the equipment.

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CAUTION

Operation of the circulating pump for any amount of time without first bleeding will result in equipment damage.

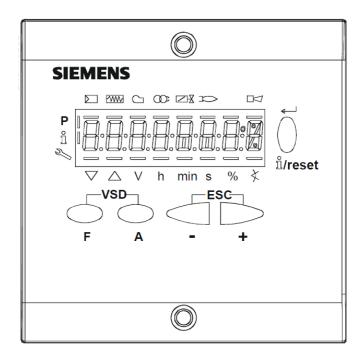
For all systems containing boilers or unfired steam generators, the water chemistry in the boiler (generator) must be kept within required limits. Failure to do so may cause premature pressure vessel failure and poor steam quality and will void the warranty.

If any "Manual Reset" limit device trips DO NOT reset without determining and correcting the cause. (Manual Reset Limits may include: flame safeguard, high or low gas pressure, high temperature limit, low water).

Never tamper with low water (liquid level) cutoff sensors or circuitry.

for heat), when turning the switch to on, the following will be the sequence of operations.

1. The flame programmer will engage the blower motor and begin to open the air butterfly to the purge position. The air switch will prove flow, and once all devices are in purge position/speed, and the air switch is made, the flame programmer will begin to count down the specified purge time (30 seconds).



- 2. Once purge is completed, the control will drive the blower speed, the air butterfly and the gas butterfly to the ignition position.
- 3. Once all devices are stable, the control will energize the ignition transformer, followed by opening the pilot gas valve, igniting the pilot flame.
- 4. Once pilot flame is established, the ignition spark will de-energize, and the pilot flame must remain proven by the scanner for a short safety time.
- 5. The main gas valve will now be energized, supplying fuel to the burner, and lighting the main flame.
- 6. The pilot valve turns off, and the main flame must remain proven by the scanner for a second short safety time.
- 7. The control now releases to modulation. The firing rate will now be dictated by the load on the system, as measured by the pressure controller.
- 8. The burner output will vary from high fire down to low fire continuously in order to match load.
- 9. Once the system load has been satisfied (steam pressure in the system exceed setpoint) the burner will initiate it's shutdown sequence.
- 10. If possible in time allotted (and if the system is set-up and sized properly),

the burner will modulate to low fire before shutting down. Regardless of firing rate, the shutdown begins with the main gas valve de-energizing, stopping fuel flow to the burner.

- The control will then drive air damper and the blower to their specified post-purge position, after which it will purge combustion gasses from the unit for 15 seconds.
- 12. The control will then de-energize the blower motor and drive all gas and air dampers to their closed position
- 13. The burner will remain in the off state until the system steam pressure falls below setpoint for the burner to turn back on.

Siemens Linkageless Modulation

The Siemens LMV3 system is a fully packaged burner management system, linkageless control and first out annunciator.

The left and right arrow keys are used for scrolling through the menu and changing controller parameters. "Enter" accepts the menu and parameter changes. It is possible to return to the main menu at any time by repeatedly pressing "Escape" (pressing the "+" and "-" keys at the same time).

Siemens LMV3 Controller Navigation

Perform the following steps once you have completed first-time programming of the Siemens LMV3:

Note: Fulton recommends use of the flame programmer manual/Quick Start

Guide when performing any changes on the unit flame programmer.

- 1. Press and hold the F and A buttons simultaneously. You will be prompted for your password (####).
- ► NOTE: #### is the last four digits of the national board number.
- 2. Enter your password and press the "Enter" button.
- 3. Using the "-" button, scroll to parameter level 100.
- 4. To enter into a parameter level and start programming, press the enter button.
- 5. Use the "+" and "-" buttons to scroll through the parameters.

- 6. Press the enter button to enter the parameter. The current value will start flashing.
- 7. Use the "-" button to decrease the value or "+" button to increase the value.
- 8. Once the desired value has been set, press the "Enter" button. The number will stop flashing.
- 9. Press the "-" and "+" buttons together to back out of the parameter level when finished.
- 10. Press the "-" or "+" buttons to scroll to the next section of the program.
- 11. Repeat this process until all parameters have been reviewed and set.
- 12. Once the parameters have been programmed, back out to the front screen by pressing the and + buttons together.

Commissioning the Unit

Perform the following steps for commissioning the unit with the Siemens LMV3:

- NOTE: A combustion analyzer will be needed when performing changes to the profile. Combustion settings should only be adjusted by a qualified factory trained and certified technician.
- 1. Press and hold the "F" and "A" buttons simultaneously. You will be prompted for your password (####).
- NOTE: Note: #### is the last four digits of the national board number.
- 2. Enter your password and press the "Enter" button.
- 3. Using the "+" or "-" button, scroll to parameter level 400. Press the "Enter" button. RUN will appear. Press the enter button again.
- 4. Turn the boiler on and make sure that there is a call for heat. PH12 means the unit is in standby and is looking for a call for heat to start. The unit should start to Prepurge (PH22) and drive to 100% purge (PH24), then begin purge countdown in PH30.
- 5. Once the control has reached the Ignition Position (PH36), press the "+" button. This will allow the boiler to ignite the pilot flame. Once the pilot is established, the boiler will transfer to main flame.

- 6. You will be at P0. P0 is the start of the profile and the Ignition position.
- 7. Make changes to the fuel profile. Three changes will need to be made: fan output, fuel and air settings. To make changes:
 - » Safely drive the unit to the high-fire position, P9, by pressing the "+" button to proceed from P0 through P9.
 - » Check the O2 level in the stack outlet.
 - » Once the desired O2 level and input (last elbow pressure) is reached, proceed to the next combustion point until all points have been set.

8. Back out to the front screen by pressing the "-" and "+" buttons together.

■ Adjusting the Profile

See the table below, for a Siemens LMV3 fault history listing. Refer to Table 7 at the end of this section of this manual for Siemens LMV3 parameter information.

Fault History					
	Key: Red indicates "Flashing"				
OFF UPr	F A - + 1/reset	Hold until Ser is displayed, and release			
5 E r		(Momentarily displayed)			
954: 0		1st parameter shown is flame signal (parameter 954)			
701:01: 62	F A - + il/reset	+ until parameter 701 is displayed (701 is the most recent fault, 725 is the oldest)			
<u> 101:01: 62</u>		Each fault has "indexes" for more information In this example, "62" is the <i>Error code</i>			
701:01: 62	F A - + 1/reset	Hold Return, until index "01" flashes, and release			
7 0 1: <mark>02</mark> : 0	F A - +	+ to display parameter 701, index "02" In this example "0" is the <i>Diagnostic code</i>			
701:03:0	F A - +	+ to display parameter 701, index "03" In this example "0" is the <i>Class</i> (UK use ONLY)			
7 0 1: 04: 10	F A - + il/reset	+ to display parameter 701, index "04" In this example "10" is the <i>Phase</i>			
7 0 1: <mark>05</mark> : 22	F A - +	+ to display parameter 701, index "05" In this example "22" is the <i>Startup number</i>			
7 0 1: 05 ·	F A - + il/reset	+ to display parameter 701, index "06" In this example ""indicates no Load (firing rate)			
701:07:0	F A - +	+ to display parameter 701, index "07" In this example "0" is the <i>Fuel</i> (Fuel 0, or Fuel 1)			
- End-	F A - + il/reset	+ at this point displays - End - , to indicate that there are no more "indexes"			
701:01: 62	F A - + 1/reset	Esc to go back to parameter 701:01			
<u> </u>	F A - +	+ to display parameter 702			
702:01:87	F A - + 1/reset	Hold Return, until index "01" flashes, and release			
7 0 2: <mark>0 2</mark> : 1		+ to display parameter 702, index "02" In this example "1" is the <i>Diagnostic code</i>			

OPERATION

Operating Controls

The following specifications, data, equipment and operating descriptions apply to typical Vertical Boiler units. These sections are provided for general information purposes only, and do not necessarily reflect the specific details of individual systems.

At commissioning, the operation of all safeties and interlocks should be verified. Setpoints of all pressure and temperature switches as well as the programs for all programmable controls (pressure controls, pressure limits, operating controls, servo motors etc.) should be recorded for future reference. Contact the Fulton Service Department with any questions regarding the proper operation, set points and verification procedures for these controls.

▶ AIR SAFETY SWITCH

To test, perfrom the following:

- 1. Disconnect power to boiler.
- 2. Remove air supply from the air switch, and turn on the boiler.
- 3. Once the boiler is in the purge process, the safety interlock should appear and shut down the burner.
- 4. Turn the burner off and reattach the air switch air supply.
- 5. Reset the flame programmer.
- 6. Set the Air Switch:
- While the boiler is running on the lowest modulation rate (usually 0% low fire), adjust air switch clockwise to raise the setpoint pressure and counter-clockwise to lower the setpoint pressure.
- Adjust until switch trips and locks boiler out on air pressure.
- The air switch should be turned the opposite way from the desired set point 1-2 full turns.
- Cycle the boiler multiple times to be sure that no nuisance fault occurs.

▶ BLOWER MOTOR STARTER

For units equipped with manual trip test button or motor starter:

- 1. While firing, actuate the manual trip button on blower motor starter. Unit should lock out. Attempt re-start by resetting the flame programmer. Purge cycle will not begin.
- 2. Reset motor starter; blower should start and purge cycle will begin.

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WARNING

Make sure you have read and followed all previous safety information. Check with local authorities where approval for start-up is required. In some localities, final inspection of services may be required. In general, ensure that the boiler area is in conformance with established boiler room requirements. Review national and local codes.

When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.

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When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.

▶ PUMP MOTOR STARTER

If a pump starter is supplied, the pump motor starter will be located in the boiler/ heater panel or pump skid. When the pump start button is pushed, the pump motor starter will engage the pump.

- 1. While firing, actuate the manual trip button on the pump motor starter. Pump and burner will shut down. The blower should continue to run for approximately 30 seconds.
- 2. Attempt to restart pump by depressing the pump start push button. The pump should not start.
- 3. Reset starter and start pump.

► LOW WATER CUT-OFF

Each cutoff device shall be installed to prevent startup, and to cut off the boiler fuel or energy supply automatically, prior to the fall of the water level below the lowest visible level of the gauge glass. Standard low water cutoff devices are Fulton level probes. Alternate cutoff devices are MM-63, MM-150, MM-157, MM-193-7b. Test as follows:

PRIMARY LOW WATER CUT-OFF

This is the first low water safety cut-off, typically an automatic reset safety. Some local jurisdictions require this safety control to be a manual reset.

To test this safety:

- 1. Slowly drain the boiler, open the blowdown valves while boiler is operating, and make sure the that when the safety switch trips, the boiler is shut down. Close the blowdown valves.
- 2. Once water level is above the cut-off point, the burner will automatically turn back on.

SECONDARY LOW WATER CUT-OFF

This is always a manual reset safety.

To test this safety:

- 1. Slowly drain to the secondary cut-off level. This must be above the bottom of the lowest visible point in the sight glass. Once the secondary level cutoff is tripped, a light on the panel will become illuminated.
- 2. Do not push the manual reset button for the low water safety cut-off at this time. Refill the boiler first.
- 3. Once boiler is refilled, turn the boiler ON switch. With the low water cut-off light still illuminated, the burner should not turn on.
- 4. Push the low water reset button. Once this button is reset, the burner should begin the ignition process as long as all other safety interlock devices are satisified.

OPERATION

▶ HIGH LIMIT PRESSURE SWITCH

Perform the following to test:

- 1. With burner on and the boiler under pressure, lower the set pressure on the switch until it trips and shuts down the burner. Be sure that the pressure is the same as the boiler operating pressure.
- 2. To test the manual reset button, wait until the boiler has fully completed the post purge phase. Once the boiler is in standby position, reset the switch to the original set point.
- 3. Press the manual reset switch on the pressure control. This will ensure that the manual reset switch is functioning correctly. The burner should not start until the reset button is pressed.

OPERATING PRESSURE LIMIT SWITCH

Perform the following to test:

- 1. With the boiler under pressure, lower the set pressure on the switch until it trips and shuts down the burner. Be sure that the pressure is the same as the boiler operating pressure.
- 2. This switch is an auto reset. Reset the switch to the original set point. The burner should turn back on automatically.

▶ FLAME SCANNER

Perform the following to test:

- 1. Verify that the flame scanner is observing flame with the burner running.
- 2. Shut down burner.
- 3. Verify that the combustion setting sare correct.
- 4. Remove the flame scanner and cover it up.
- 5. Turn the burner on. This will cause flame failure and verify that the scanner is operating correctly.
- 6. Reinstall scanner.
- 7. Once boiler is completely off and has completed the post puge cycle, normal boiler operation can be resumed.

MODULATING CONTROLS

All boilers are standard-equipped with modulating controls.

The modulating pressure controller continuously regulates the burner between the minimum firing rate and high fire. When the unit is on low fire and the pressure continues to climb past the setpoint, the boiler will shut down. It will typically re-start when the process pressure drops below the setpoint.

See Table 2 for modulation specific to boiler.

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CAUTION

Installation in accordance with the guidelines within the manual should be fully completed before performing the initial start-up; and start-up must be complete prior to putting the unit into service. Starting a unit without the proper piping, venting or electrical systems can be dangerous and may void the product warranty.

"Factory Trained Personnel" refers to someone who has attended a Fulton Service School specifically for the equipment covered in this manual.

🗥 WARNING

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Hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

▶ PRESSURE RELIEF VALVE

Located on the boiler, this valve limits the maximum operating pressure of the equipment.

SIGHT GLASS ISOLATION VALVES

The brass sight glass isolation valves are equipped with an internal ball check. In the event that a sight glass should break, the ball will set, preventing discharge of steam and water. The brass valve stem must be opened fully to enable this feature If the valve is in any other position, the ball will not seat.

▶ PROOF OF CLOSURE

- 1. Disconnect power to the boiler.
- 2. While the boiler is off, remove the common wire to the proof of closure (POC) switch on the oil/gas valve.
- 3. Restore power to the boiler. The boiler should immediately lock out on alarm due to the POC being disconnected.
- 4. Disconnect power and reconnect the POC wire.
- 5. Restore power to the boiler and reset any flame programmer faults.
- 6. Cycle the burner and observe for proper operation.

Burner Settings

Burner combustion settings:

- Boiler is fully test fired at the factory, please refer to the test fire sheet for combustion information.
 - » P0 set point is typically between P1 and P2 on combustion curve.
- NOTE: Pilot pressure range is to be 2.5" w.c. to 3.5" w.c.
 - » Lower O2 settings can reduce burner mesh life.
 - » Higher O₂ settings will reduce the overall efficiency of the burner.

Burner combustion adjustment guidelines:

	Up	Down
Fan Speed Adjustment	More O₂, More Input	Less O ₂ , Less Input
Gas Servo Adjustment	More Input, Less O₂	Less Input, More O ₂
Air Servo Adjustment	More O ₂ , Less Input	Less O ₂ , More Input
SKP-25 Adjustment	More Input, Less O₂	Less Input, More O ₂

OPERATION

Gas Burner Set Up

- 1. Open the manual gas valves on the pilot and main lines of the gas head.
- 2. Switch on the main power to the burner. The water level relay is equipped with a manual reset. Depress the button on the box.
- 3. The flame programmer is the main control in the panel box. The programmer in conjunction with a sensing device, either a flame rod or a UV scanner, "supervises" the ignition sequence proves the flame is satisfactory, and finally "monitors" the established flame. Should any fault occur either during the ignition sequence or during normal running, the programmer will immediately go to "lock-out" and the burner will shut down.
- NOTE: To reset the boiler burner after a "Lock out" signal, push the reset button on the control.
- 4. When the pilot flame is established, the flame rod (or ultra-violet scanner) senses the voltage which is created in the flame between the flame rod and the gas nozzle (ground). This signal is transmitted back to the flame programmer which opens the main gas valve giving a main flame.
- 5. All Fulton propane or butane boilers and Fulton natural gas boilers 50 HP and above are standardly furnished with UV Scanners.
 - a. If the installation is new or the burner has been disassembled, the burner may not fire at the first attempt due to air which must be purged from the gas lines. This will result in the burner flame programmer going to lockout. Repeat the procedure for starting the burner.
 - The main gas valve will remain open as long as there is a demand for heat and the flame is carrying a sufficient signal to the flame programmer.
 - c. If the flame is not established at the start, the safety switch in the flame programmer control will open the contacts and shut off the burner.
 - d. Push the reset button on the control to reset. If trouble persists, it may be necessary to check the flame rod setting or the UV scanner. See Maintenance Section 4 for procedure to check flame rod setting or UV Scanner.

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Hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

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WARNING

For units equipped with Flue Gas Recirculation (FGR), the ducting must be insulated.

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

■ Gas Burner Set Up For LE Models

For units equipped with Flue Gas Recirculation (FGR), the ducting must be insulated.

- 1. Open the manual gas valves on the pilot and main lines of the gas head.
- 2. Switch on the main power to the burner. The water level relay is equipped with a manual reset. Depress the button on the box.
- 3. The flame programmer is the main control in the panel box. The programmer in conjunction with a UV scanner or IR infrared scanner "supervises" the ignition sequence proves the flame is satisfactory, and finally "monitors" the established flame. Should any fault occur, either during the ignition sequence or during normal running, the programmer will immediately go to "lock-out" and the burner will shut down.
- 4. When the pilot flame is established, ultra-violet scanner or IR infrared scanner senses the flame. This signal is transmitted back to the flame programmer which opens the main gas valve giving a main flame.
- 5. If the installation is new or the burner has been disassembled, the burner may not fire at the first attempt due to air which must be purged from the gas lines. This will result in the burner flame programmer going to lockout. Repeat the procedure for starting the burner.
- 6. The main gas valve will remain open as long as there is a demand for heat and the flame is carrying a sufficient signal to the flame programmer.
- 7. If the flame is not established at the start, the safety switch in the flame programmer control will open the contacts and shut off the burner.
- 8. Push the reset button on the control to reset. If trouble persists, it may be necessary to check the UV scanner. See Maintenance Section for procedure to check UV Scanner.

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

■ LMV Control for LE Models

■ NOTE: The following procedure must be repeated for each fuel the boiler is equipped to operate on.

▶ PRE-IGNITION STEPS

- 1. Verify the main burner switch is in the
- 2. OFF position. If the boiler has dual fuels, verify the fuel selector switch is turned to the correct fuel. Supply power to the boiler. The AZL will display "system test" and then move to the main menu.

OPERATION

- 3. Select PWLogin, press Enter. Select AccessServ. Press Enter. (This type of step will be shown as PWLogin > AccessServ for the remainder of this section. Enter the service passwords using the arrow key. The password is case sensitive. The case of a letter can be changed by pressing the other arrow key. (For example, if you used the right arrow key to get to the letter A, press the left arrow key to get a). After you have pressed Enter on the last character of the password, press Enter once more to accept the password. If you do not have the password, contact your Fulton Authorized Representative to perform the changes.
- 4. Select Params&Display. Press Enter. Select RatioControl. Press Enter. Select ProgramStop. Press Enter. Change the Program Stop to 44 Interv1 by using the arrow keys. Confirm the change by pressing Enter. This will set the burner management system to a 'pilot hold' setting.

Verify that the current value "curr" changes to 44 Interv 1.

When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.

The full list of program stops are:

24	Air damper in the prepurge position	
32	Traveling to the FGR position (if the unit is equipped with FGR)	
36	Ignition position (before pilot ignition)	
44	Ignition position (after pilot ignition)	
52	Ignition position (after main burner ignition)	
72	72 Air damper in the postpurge position	
76	Traveling to the FGR position (if the unit is equipped with FGR)	

- 5. Press **Escape** 4 times to get back to the main menu.
- 6. Under **ManualOperation** > **Setload**, change the load to 0% by using the arrow keys. Press enter and verify the 0% has been acknowledged in the "curr" field.
- 7. Press **Escap**e once to get back to the **Manual Operation** menu.
- 8. Under **Auto/Manual/Off**, change the operation to **Burner On** by using the arrow keys. Press **Enter** and verify that "**Burner On**" is acknowledged in the current field.
- 9. Press **Escape** twice to get back to the main menu.
- 10. Increase the setpoint on the temperature controller to create a heat demand.
- 11. Turn the main burner switch to the **Local** or **On** position.

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WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.

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WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

- NOTE: If the burner loses flame while driving to a point then:
 - Turn the main ON/OFF switch to OFF. Reset the loss of flame fault. Press Escape on the AZL once. Press Enter on the AZL to reset the control. The red light on the panel box door should go out.
 - Adjust the air and gas servos for that point while the burner is off. Follow steps
 - Turn the main ON/OFF switch to ON.
- 12. Under Params&Display > RatioControl ProgramStop, change the program stop to deactivated by using the arrow keys. Confirm that 'deactivated' is acknowledged in the current field.
- 13. This change will allow the burner to modulate. The burner will now drive t low fire. Remember, it is only important at this stage to set low fire to be stable and with clean combustion. Exact setting is to be performed once high fire is confirmed.
- 14. Press **Escape** 5 times to get back to the main menu.
- 15. You can observe the status of the burner by going to **OperationalStat** > NormalOperation.
- 16. Verify the flame signal on the display, measure input if fuel meter is available. If not, match last elbow pressures and combustion from test fire sheet. Adjust the burner as needed. To adjust the servo position, follow steps 17-18.

SETTING LOW FIRE

- NOTE: As soon as a servo position is altered, the servo will move to that position. Only change servo settings by a maximum of 0.5° at a time before verifying combustion.
- 1. Go to Params&Display > RatioControl > GasSettings (or Oil Settings, depending on the current fuel) > CurveParams.
- 2. Wait for the spinning line on the left to disappear. Press **Enter.** The number 1 should appear to the right of the cursor, this is the Point Number.

Press **Enter** once. Select **ChangePoint** by pressing the arrow keys to highlight and then press Enter to select. This will cause the servo motors to move to this low fire point.

Check combustion and adjust the servo motors as required. To adjust a servo motor, arrow to it and press **Enter**. Then adjust the setting as required and press **Enter**. You can now adjust another servo motor if needed.

When combustion is properly set for that point, press **Escape** once more. If it asks you to store the point, press **Enter**. Note the AZL will only ask to save if either servo value has been altered.

Low fire is now set and stored.

OPFRATION

▶ SETTING THE COMPLETE RANGE

- 1. Remember it is only necessary to approximate the setting through the modulation range until high fire conditions are established.
- 2. Press **Enter** once more to have access to the point number field. Increase the point number by one and press **Enter**. Select **ChangePoint** and press **Enter**. The servos will now move to that point.
- 3. Verify combustion is satisfactory.
- 4. Measure input or monitor last elbow pressure. Verify that these points are in general correspondence with the test fire sheet. Repeat step 20 until the point position has a load value of 100%. You are now at high fire. Verify combustion is per test fire sheet.
- 5. If operating on gas, adjust the incoming gas pressure at the main gas regulator to match the test fire report. Adjust the gas servo motor to change the last elbow pressure to match the test fire report. Adjust the air servo motor to adjust the emissions as needed. If operating on oil, adjust the oil pump and air pressure regulator to match the pressures on the test fire sheet. Adjust the oil servo until the oil flow rate matches the test fire sheet. Adjust the air servo to match the test fire sheet.
- 6. Repeat step 17 but start at the high fire point number. Continually decrease the point number after combustion has been verified at each point.
- 7. Once all the points have been verified, press Escape until you are back to the main menu.
- 8. You can observe the status of the burner by going to **OperationalStat** > NormalOperation.
- 9. Turn the main **ON/OFF** switch to **OFF**. The control will now postpurge.
- 10. Follow steps 3-20 again to verify ignition with the new gas pressures.
- 11. Turn the main burner switch to **OFF**. The control will now post purge.
- 12. Change the operation to Automatic under **ManualOperation** > **Auto/** Manual/Off and press Enter and confirm Automatic is entered in the current field.
- 13. Press **Escape** twice to get back to the main menu.
- 14. Under **Updating** > **ParamBackup**, select **LMV51 AZL**. This will store all of the adjustments that have been made in the LMV base module to the display. If the base module were to fail, the display can be used to download all of the parameters into a new base module.
- 15. Press **Escape** 4 times. Select **PW Logout**, the password is now logged out.
- 16. Press **Escape** twice. Select **OperationalStat** > **NormalOperation**. The control is now on the normal operational display screen.
- 17. The boiler is now ready to run. Adjust your setpoint on the temperature control to the desired temperature and turn the main ON/OFF switch to **ON** for the burner to operate.

✓ WARNING

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WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.

^

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CAUTION

Do not tamper with the safety features of the low water safety cut out.



WARNING

When stopping the boiler for any extensive repairs, shut off main disconnect switches on both the boiler side as well as the feed water side.

▶ BEFORE LEAVING THE INSTALLATION

Check all controls to insure they are operating properly. Cycle the boiler several times. Make sure the installation complies with all applicable codes.

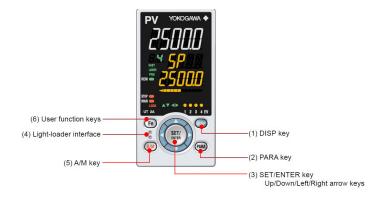
- ► NOTE: Decreasing the primary will typically decrease the NOx levels. If the primary is decreased too much, stability may be compromised.
 - a. Start the boiler and check for table combustion at low fire. Refer to the test fire sheet for acceptable parameters.
 - b. Adjust secondary servo air/gas if needed to bring combustion into an acceptable range. Adjust carefully as this is the main fuel adjustment.
 - c. After a stable flame is achieved and the combustion is within the test fire sheet parameters, manually and slowly drive the servo's motor to high fire insuring that the combustion readings stay within the given parameters. Adjust secondary servo as needed.
 - d. If the last elbow pressure is above or below the stated requirement on the test fire sheet, adjust the combustion air damper to bring the last elbow pressure inline. The gas pressure is directly proportional to the air pressure and therefore, increasing the air pressure to the burner will increase the gas input proportionally.
 - e. Manually drive the unit back to low fire and check combustion.
 - f. If the combustion is outside of the test fire parameters for the servo, adjust the secondary.
 - g. After the unit is brought back into range, manually drive the unit back to high fire.
 - h. Adjust secondary air/gas ratio slightly if needed.
 - i. Repeat this procedure 2 or 3 times until you obtain consistency in high and low fire combustion.
 - j. In most cases, the primary gas should only be adjusted if the unit is unstabe at low fire and/or NOx are not acceptable at low fire.

Pressure Modulation Controller

ADJUSTMENT OF THE YOKOGAWA UT-32A OPERATING CONTROLLER:

Front panel keys are shown below and explained in the text that follows.

VMP-IOM-GAS-OIL-STEAM-2023-0124



- (1) DISP key used to switch the Operation Displays. Press the key in the Menu Display or Parameter Setting Display to return to the Operation Display.
- (2) PARA key hold down the key for 3 seconds to move to the Operation Parameter Setting display. Hold down the key and the left arrow key simultaneously for 3 seconds to move to the Setup Parameter Setting Display. Press the DISP key in the Parameter Setting Display to return to the Menu Display. Press the SET/ENTER key once to cancel the parameter setting (set point is blinking)
- (3) SET/Enter key press the key in the Menu Display to the Parameter Setting Display of the Menu. Press the key in the Parameter Setting Mode to change the set point.
- (4) Light-loader interface is the communication interface to the adapter cable when setting and storing parameters via PC.
- (5) A/M key used to switch between AUTO and MAN modes.
- (6) Fn user function key defined by user. PID will display when Fn key is pressed.

Parameter set-point adjustments are shown in the figure on the next page and explained in the text that follows.

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WARNING

When stopping the boiler for any extensive repairs, shut off main disconnect switches on both the boiler side as well as the feed water side.

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CAUTION

Do not tamper with the safety features of the low water safety cut out.



WARNING

Commissioning/Start Up by a non-Fulton authorized person will void the product warranty. Before commissioning the boiler, verify with authorized personnel that the gas lines have been purged.

When commissioning this boiler, firing rate must remain at low fire during first 4 hours of operation. The output may then be increased 7% to 10% per hour, until a firing rate of 75% is reached. The 75% firing rate should be maintained for 3 to 4 hours.



- 1. Display the Parameter Setting Display.
 - 2. Press the SET/ENTER key to move to the setting mode (the setpoint blinks).
 - **3.** Press the Left arrow key to move one digit to the left. (Press the Right arrow key to move one digit to the right.)
 - 4. Press the Up or Down arrow key to change the setpoint.
 Press the Up arrow key when 9 is displayed to move one digit to the left.
 Press the Down arrow key when 0 is displayed to move one digit to the right.
- 5. Press the SET/ENTER key to register the setpoint.

To adjust the "Boiler On" set point (A1): Press the "Display" key until A1 is shown on the controller. Press the "Set/Enter" key to adjust (the value will be flashing). Use the directional up and down arrows to change the value. With a negative setting for A1, the boiler will turn back on under the selected set point. For example, if the set point is 100 PSIG and the boiler burner is to turn back on at 80 PSIG, A1 would be set to (negative) - 20.

To adjust your "Boiler On" set point, you choose the negative number for how far under the set point you would like the boiler burner to turn back on. Press the "Set/Enter" key once the desired number is reached to lock in the set point. The value will now stop flashing to signify that it is set. Press the "Display" key to return to the Set Point (SP) home screen.

To adjust the "Boiler Off" set point (Hy1): Press the "Display" key until HY1 is shown on the controller. Press the "Set/Enter" key to adjust (the value will be flashing). Use the directional up and down arrows to change the value. With a positive setting for Hy1, the boiler will turn off over the selected set point. To adjust your "Boiler Off" set point, you have to calculate the difference between your "Boiler On" set point value and the "Boiler Off" set point value. Example: Boiler On at 100 PSIG and Boiler Off at 120 PSIG, the Hy1 setting is to be 20. Use the directional up and down arrows to change the value. Press the "Set/Enter" key once the desired number is reached to lock in the set point. The value will now stop flashing to signify that it is set. Press the "Display" key to return to the Set Point (SP) home screen.

To adjust the PID settings, follow the steps below:

- 1. Pressing the "Fn" button will directly bring you to the PID parameters
- 2. "P" will be displayed
- 3. Pressing the ↓will display "I."
- 4. Pressing the ↓ again will display "d."
- 5. Pressing DISP will return to SP

OPFRATIO

6. "P" - Proportional Band

- 7. Percentage of set point at which the burner begins to modulate down from 100% firing rate.
- 8. The smaller the number, the longer the unit will remain at 100% firing rate.
- 9. With Proportional only setting, the boiler typically will never reach set point.

10. "I" - Integral Band

- 11. How often the unit checks to adjust the firing rate.
- 12. The smaller the number, the faster the controller reacts. If it reacts too fast, it will oscillate.
- 13. Integral setting allows the boiler to reach the set point
- 14. Fulton standard Integral time setting is "minutes/seconds per repeat"

15. "D" - Derivative Band

- 16. Proportional does the heavy lifting getting the temperature close to the set point and Integral gradually removes error. Most systems you will not need it.
- 17. D is used to compensate for dead (or lag) time.
- 18. The D term adds to, or subtracts from, the output an amount defined by the mathematical derivative or rate of change of the operating value.
- 19. PID Settings for a typical boiler system with the boiler correctly sized is P=20 / I=45 / D=0

To change the controllers from Automatic Mode to Manual Mode

- 1. Press the "A/M" button until the red light illuminates next to MAN and OUt is displayed.
- 2. Use the \uparrow/\downarrow to change the output from 0.0 to 100.0

To return to Automatic Mode, press the "A/M" key again and the red light will turn

Boiler Controls

■ Flame Programmer

Refer to cut sheets for provided flame programmer.

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MARNING

When stopping the boiler for any extensive repairs, shut off main disconnect switches on both the boiler side as well as the feed water side.

CAUTION

During startup insure that adequate gas pressure is supplied to the main valves. The indicator on the actuator should never reach the bottom of the indicator window. *In the event that this happens, adjustability* will be lost. See minimum incoming gas pressure requirement on the test fire sheet. The SKP10 actuator functions only as on/off. When activated, the indicator will reach the bottom of the indication window. The main gas pressure regulator is only used to comply with standard regulations and therefore uses a high outlet pressure spring that is set at the max. The SKP70 fuel valves have a built in regulator function.

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WARNING

Prior to the commencement of any work requiring the removal of cover plates and the opening of the control panel box, the electrical supply to the boiler must be disconnected.

Cycle Testing

The boiler should be cycle-tested and automatically allowed to go through its normal starting sequence several times to verify that all components are functioning accurately.

This will also verify that combustion is set properly so that boiler light-off has a smooth transition from ignition to main flame.

It is recommended that a minimum of 10 cycles should be met without any flame failures, with combustion readings comparable to the factory test fire sheet and no interlocks causing the boiler to shutdown.

Daily Start-Up

To initiate daily start-up:

- 1. Turn Switch to **On** or **Local** (depending on model). The blower/fan will start up and ramp to high fire speed/rpm. The blower/fan will purge for 30 seconds, then ramp down to light off position (near low fire). When stable, ignition sequence begins.
- 2. As spark is generated inside the combustion chamber, the pilot gas valve opens. There should be an audible click of the pilot solenoid valve.
- 3. Once pilot flame is established, the main gas valve will open. There should be an audible click from the main gas valve solenoid valve. There may be a slight whooshing sound as the main burner flame lights.

Daily Shutdown

To initiate daily shutdown:

- 1. Turn switch to Off. If burner is currently on, the unit will start ramping down to low fire before turning off.
- 2. Gas valve will shut. The blower/fan may increase speed briefly as the flow of gas is cut off. The blower/fan will ramp to high-fire speed/rpm, and continue to run there for a 15-second post purge.

Glossary of Terms

PRIMARY GAS

The smaller gas line injects fuel at the burner head.

SECONDARY GAS

The main gas line inject fuel prior to the burner head.

REVERSING ACTUATOR

Used for positioning control inlet damper, combustion air.

AIR/GAS RATIO CONTROLLING ACTUATOR

Regulates gas flow according to air pressure.

TABLE 7 - STEAM PROGRAM FOR SIEMENS LMV3*

Parameter	Min Value	Max Value	Fulton Setting	Customer
Internal Parameters			·	
Password	0	65535		NB/SN
General			<u> </u>	-
Identification Date	0	255		
Identification Number	0	65535		
Pre-selected parameter set : Code	0	255	9	
Pre-selected parameter set: Vers.	0	0xFFFF	V.01.01	
Software version	0	0xFFFF	V 01.80	
Software variant	0	255	1	
Burner identification	0	99999999		
Manual output	0%	100%	Undefined	
Undefined = automatic mode				
Main frequency	0	1	1	
0 = 50 hz				
1 = 60 hz				
Display brightness	0%	100%	100%	
Timeout for menu operation	10 min	120 min	30 min	
Fuel meter: pulse valency [pulses per volumetric	0	400	0	
flow unit]				
Delete display of error history: to delete the	-5	2	0	
display, set to 1 then to 2				
Operating mode BACS	0	2	1	
0 = off				
1 = Modbus				
2 = reserved				
Setback time in the event of communication	0 s	7200 s	1 s	
breakdown				
Reserved	1	8	1	
Reserved	10 s	60 s	30 s	
Device address for Modbus	1	247	2	
Baud rate for Modbus	0	1	1	
0 = 9600				
1 = 19200				
Parity for Modbus	0	2	0	
0 = none				
	0 %	100%	Undefined	
	Internal Parameters Password General Identification Date Identification Number Pre-selected parameter set: Code Pre-selected parameter set: Vers. Software version Software variant Burner identification Manual output Undefined = automatic mode Main frequency 0 = 50 hz 1 = 60 hz Display brightness Timeout for menu operation Fuel meter: pulse valency [pulses per volumetric flow unit] Delete display of error history: to delete the display, set to 1 then to 2 Operating mode BACS 0 = off 1 = Modbus 2 = reserved Setback time in the event of communication breakdown Reserved Reserved Device address for Modbus Baud rate for Modbus 0 = 9600 1 = 19200 Parity for Modbus	Internal Parameters Password Qeneral Identification Date Identification Number OPre-selected parameter set: Code OPre-selected parameter set: Vers. OSoftware version OSoftware variant OBurner identification OManual output Undefined = automatic mode Main frequency O=50 hz 1=60 hz Display brightness Timeout for menu operation Fuel meter: pulse valency [pulses per volumetric flow unit] Delete display of error history: to delete the display, set to 1 then to 2 Operating mode BACS O= off 1= Modbus 2= reserved Setback time in the event of communication breakdown Reserved 10 s Device address for Modbus Baud rate for Modbus O=9600 1=19200 Parity for Modbus O=none 1= odd 2= even Performance standard at interruption of communication with building automation. For modulation operation O19.9 = burner off 20100 = 20100% burner rating For multi-stage operation O=burner off	Internal Parameters	Internal Parameters

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+Out of Test Fire

TABLE 6 - STEAM PROGRAM FOR SIEMENS LMV3*

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
161	Number of faults	0	65535		
162	Operating hours resettable	0 h	99999999 h		
163	Operating hours when unit is live	0 h	99999999 h		
164	Number of start ups resettable	0	99999999		
166	Total number of start ups	0	9999999		
167	Fuel volume resettable	0	99999999		
200	Burner Control				
201	Burner operating mode (fuel train, modulating /	1	22	3	
	multistage, actuators, etc.)	'			
	= undefined (delete curves)				
	1 = G mod				
	2 = Gp1 mod				
	3 = Gp2 mod				
	4 = Lo mod				
	5 = Lo 2-stage				
	6 = Lo 3-stage				
	7 = G mod pneu				
	8 = Gp1 mod pneu				
	9 = Gp2 mod pneu				
	10 = LoGp mod				
	11 = LoGp 2-stage				
	12 = Lo mod 2 fuel valves				
	13 = LoGp mod 2 fuel valves				
	14 = G mod pneu without actuator				
	15 = Gp1 mod pneu without actuator				
	16 = Gp2 mod pneu without actuator				
	17 = Lo 2-stufig without actuator				
	18 = Lo 3-stufig without actuator				
	19 = G mod only gas actuator				
	20 = Gp1 mod only gas actuator				
	21 = Gp2 mod only gas actuator				
	22 = Lo mod only oil actuator				
208	Program stop	0	4	0	
	0 = deactivated				
	1 = PrePurgP (Ph24)				
	2 = IgnitPos (Ph36)				
	3 = interval 1 (Ph44)				
	4 = interval 2 (ph52)				
210	Alarm in the event of start prevention	0	1	0	
	0 = deactivated				
	1 = activated				
211	Fan ramp up time	2 s	60 s	5 s	
212	Max time down to low fire	0.2 s	10 min	30 s	10 s

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SECTION 3 VMP-IOM-GAS-OIL-STEAM-2023-0124 OPERATION

TABLE 6 - STEAM PROGRAM FOR SIEMENS LMV3*

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
213	Min time home run	2 s	60 s	2 s	
214	Max time start release	0.2 s	10 min	20 s	
215	Repetition limit safety loop	1	16	1	
217	Max time to detector signal	5 s	10 min	30 s	
221	Gas: Active detector flame evaluation $0 = QRB / QRC$ $1 = ION / QRA$	0	1	1	
222	Gas: Pre-purging 0 = deactivated 1 = activated	0	1	1	

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
223	Repetition limit pressure switch mini-gas	1	16	1	
225	Gas: Pre-purge time	20 s	60 s	30 s	
226	Gas: Pre-ignition time	0.2 s	60 min	2 s	
227	Gas: Safety time 1 (TSA1)	0.2 s	10 s	5 s	
229	Gas: time to respond to pressure faults in TSA1	0.2 s	9.8 s	1.8 s	
230	Gas: Interval 1	0.2 s	60 s	5 s	
231	Gas: Safety time 2 (TSA2)	0.2 s	10 s	5 s	
232	Gas: Interval 2	0.2 s	60 s	2.0 s	
233	Gas: Afterburn time	0.2 s	60 s	8 s	
234	Gas: Post purge time	0.2 s	108 mi,	15 s	
237	Gas pressure switch-max / POC input 0 = deactivated 1 = pressure switch-max 2 = POC	1	2	2	
239	Gas: Forced intermittent operation 0 = deactivated 1 = activated	0	1	1	
240	Gas: Repetition limit loss of flame	1	2	1	
241	Gas: Execution leakage test 0 = no leakage test 1 = leakage test on start up 2 = leakage test on shut down 3 = leakage test on both	0	3	0	
242	Gas: Leakage test evacuation time	0.2 s	10s	3 s	
243	Gas: Leakage test time atm pressure	0.2 s	60 s	10 s	
244	Gas: Leakage test filling time	0.2 s	10s	3 s	
245	Gas: Leakage test time gas pressure	0.2 s	60 s	10 s	
246	Gas: Waiting time gas shortage	0.2 s	60 s	10 s	

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TABLE 6 - STEAM PROGRAM FOR SIEMENS LMV3*

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
400	Ratio Curves				
401	Ratio control curve fuel actuator	0	90		
402	Ratio control curve air actuator	0	90		
403	Ratio control curve VSD	20 %	100 %		
500	Ratio Control				
501	No-flame positions fuel actuator Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0	90	0 0 0	
502	No-flame positions air actuator Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0	90	0 65 45	
503	No-flame speeds VSD Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0 %	100 %	0 65 % 65 %	
522	Ramp up	5 s	20 s	20 s	
523	Ramp down	5 s	20 s	20 s	
542	Activation of VSD / PWM fan	0	1	1	
544	Modulation Ramp	32 s	80 s	32 s	
545	Lower load limit	20 %	100 %	20%	
546	Upper load limit	20 %	100 %	100%	
600	Actuators				

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⁺Out of Test Fire

OPERATION

VMP-IOM-GAS-OIL-STEAM-2023-0124

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
Par. No. 602	Actuator's direction of rotation	0	1	0	
	Index 0 = fuel, Index 1 = air			0	
	0 = counterclockwise				
	1 = clockwise				
606	Tolerance limit of position monitoring	0.5	2.5	1.7	
641	Control of speed standardization of VSD	-25	1	0	
642	Standardized speed	650	6500	Undefined	
	Index 0 = uC1				
	Index 1 = uC2				
645	Configuration of analog output	0	2	0	
	0 = DC 010 V				
	1 = DC 210 V				
700	2 = DC 0/210 V				
700	Error History				1
701	Error history: 701-725.01. Code	0	255		
•	Error history: 701-725.02. Diagnostic Code	0	255		
	Error history: 701-725.03. Error class	0	6		
•	Error history: 701-725.04. Phase	0	255		
•	Error history: 701-725.05. Startup counter	0	9999999		
725	Error history: 701-725.06. Load	0 %	100 %		
900	Process Data			'	
903	Current output	0 %	100 %	0	
	Index 0 = fuel				
	Index 1 = air				
922	Incremental position of actuators	-50	150	0	
	Index 0 = fuel				
	Index 1 = air				
935	Absolute speed	0	65535	0	
936	Standardized speed	-200 %	200 %		
942	Active load source	0	255		
947	Result of contact sensing (bit-coded)	0	255		
950	Required relay state (bit-coded)	0	255		
954	Intensity of flame	0 %	100 %		
960	Actual flow rate	0	65525		
961	Status for external modules and display	0	255		
981	Error storage: Code	0	255		
982	Error storage: Diagnostic code	0	255		
992	Error flags	0	0xFFFFFFF		

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 $\textbf{Note:} \ \textbf{Customer settings should be recorded in the Customer column for reference}.$

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INTRODUCTION

INSTALLATION

2

OPERATION

3

MAINTENANCE & TROUBLESHOOTING

4

WARRANTY

5

MARNING

All information in this manual is for reference and quidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Follow all proper lockout/tagout procedures for service.

Before beginning any maintenance, ensure area is free of any combustible materials and other dangers.

What to do if you smell gas: Do not try to light the appliance. Do not touch any electrical switch. Do not use any phone in the building. Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

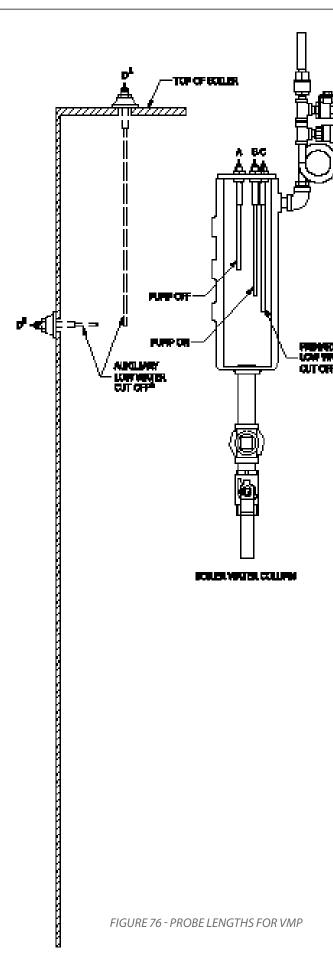
Procedure for Cleaning Water Probes

- 1. To clean probe in the boiler shell and probes in water column:
- Make sure there is no pressure in the boiler during the removal of the probes.
- 3. Remove one probe (using a 7/8" socket), clean with very fine emory cloth and replace it before removing another to assure no probe mix-ups that would change the control functions. For replacement purposes, installed probe lengths are indicated in Figure 76. For a universally adaptable plug and probe which can be cut to length in the field to fit all boilers, order Part No. 2-20-017.

TABLE 8 - PROBE INFORMATION

	VMP
ALWCO	2-10-000010
Pump Off Probe	2-10-000010
Pump On Probe	2-10-000011
Low Water Probe	2-10-000106
High Water	2-20-000009
Probe Assembly	3-50-000702

Part Number	Legnth
2-20-000009	4"
2-10-000010	7.25"
2-10-000011	9.25"
2-10-000106	10.5"



Note: *Depending on model and date manufactured, AUX LOW WATER CUT OFF off may enter boiler from the side, or top of boiler.

If your water column does not appear as pictured, there will be no internal water column probes to be cleaned or replaced other than the ALWCO.



\triangle caution

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In order to meet warranty conditions, ensure all appropriate maintenance activities are performed.

If flame and/or gas is permitted to exist in the blast tube area, backfiring and destruction of electrodes may result. Ensure primary air adjustment is adequate to avoid this condition.

Checking the Stainless Steel Combustion Ring on Fulton Gas Fired Steam Boilers

- 1. The stainless steel combustion ring in Fulton gas fired boilers are designed to bring guick and effective flame transfer to the fire wall. The ring should fit securely and tight against the furnace wall for best results.
- 2. The ring should be inspected for distortion in the event of poor combustion which could result in flame failures.

Flame Scanner Adjustments for Fulton Gas Fired **Steam Boilers**

Flame detector adjustments are made with the detectors installed and the burner running. It is essential to obtain optimum flame signal detection for safe and continual operation of the control relay

If a detector is inoperable, it may prove the detector is working and only an adjustment to the flame is needed to improve the signal.

If the detector is found to be defective, replace.

Adjustments to establish a good signal may include the following:

- Air damper adjustments in the combustion settings.
- · Adjusting gas pressure through the gas regulator.

Furnace Refractory Replacement Procedure

- 1. Remove the burner plate and top plate assembly, up and out of the air-toair heat exchanger.
- 2. Remove the stainless steel combustion ring from the furnace.
- 3. Remove the clean-out plugs from the bottom sides of the boiler. The boiler has two clean out plugs, one is located at the bottom of the boiler to the right hand side of the panel box. The second is 180 degrees on the opposite side of the boiler.
- 4. Break off the top holding clips that were used to keep the refractory in position during shipping. The boiler has welded flat bars beneath the top refractory. These bars will have to be cut to change the lower refractory. Rewelding of the bars will be required prior to installation of the top refractory. For the lower refractory, you will also need to break off the top holding clips that were used to keep the refractory in position during shipping.
- 5. Break up the top and/or bottom refractories and remove the pieces from the boiler through the clean out plugs.

- 6. Round and bevel the outer edges of the new refractories. The bottom refractory has the larger hole, while the top refractory has the smaller.
- 7. Lower the bottom refractory down into the furnace with wire fastened in three locations. When the refractory is close to position, it can be tipped by maneuvering the wire to drop it flat onto the holding clips. If the refractory will not tip, it may have to be removed and again rounded and beveled.
- 8. Install the top refractory in the same manner as the bottom refractory. When installed, the outer edges must be sealed with insulcrete - a castable refractory mix available from the Fulton factory. It is not necessary to reinstall the shipping clips.
- 9. Install the stainless steel combustion ring, burner assembly, and clean out plug.
- 10. Normal operation can be resumed immediately.

Recommended Daily Maintenance Schedule

The following procedures should be carried out daily as recommended maintenance. They are designed to prevent the buildup of scale, silt, or sludge in the bottom of the boiler and in the pipes leading to the water gauge. In addition to these procedures, the advice of a water treatment supplier should be sought and followed. An ASME Section VIII blowdown tank must be provided.

1. Blow down the boiler each morning by starting the boiler and generating not more than 10 PSI (.7 kg/cm2) of steam. Turn on cooling water to blowdown tank, if equipped, then open the boiler blow off valve for approximately 10 seconds, then close valve. See **Figure 77**. Be sure that the slow opening valve (Y-Valve) is adjusted properly. The slow opening valve is to be adjusted so that only 1-2" of water empty from the boiler sight glass during the 4-10 second bottom blowdown. During each blowdown, there should be 1-2" of level drop in the sight glass. If a manual method of cooling water is used, be sure to shut off the cooling water supply. If there are two bottom blowdown connections on the boiler, both should be blown down daily.

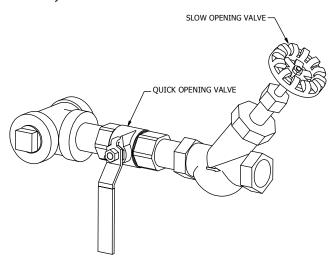


FIGURE 77 - BOTTOM BLOWDOWN VALVES



✓ WARNING

All information in this manual is for reference and quidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Never use open flame or other sources of ignition to check for gas leaks.



CAUTION

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In order to meet warranty conditions, ensure all appropriate maintenance activities are performed.

Use caution when using any cleaning solutions. Refer to local regulations for proper cleaning solution disposal.

If the gasket leaks while pressure is being built up, tighten only enough to stop leakage. Never tighten more than necessary to prevent leakage. Excessive tightening may shorten the life of the gasket.

∕!\ WARNING

All information in this manual is for reference and quidance purposes, and does not substitute for required professional training, conduct, and strict adherence to applicable jurisdictional/ professional codes and regulations.

Follow proper lockout / tag out procedures for the electrical, gas and water connections. Use caution when lifting heavy parts.

CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative..

After a new Fulton Boiler has been in operation for several months, pieces of burned metal will be found in the space at the bottom of the boiler. These pieces of metal are the remains of a light gauge metal form which was used during manufacture for forming the boiler insulation. This is a normal condition and does not affect the efficiency or the life of the boiler in any way.

- 2. Blow down water column each morning when boiler is at 10 PSI (.7 kg/ cm2) by opening the water column and the water gauge blowoff valves for approximately five seconds, then close the valves. On boilers with float type level devices, refer to the water column cut sheet for proper blowdown technique. Any water column on the system should be blown down daily following the above procedure.
- 3. If the feed water is being treated by chemical compounds, make sure that this treatment is carried out carefully and according to the chemical supplier's instructions.
- NOTE: Fulton recommends that the feedwater chemical treatment should be added between the pump and the boiler.
 - 4. Check water level in sight glass.
 - 5. Check to be sure feed water pump is working.
 - 6. For float type water level control, blow down the float chamber.
 - 7. Check water chemistry.

Recommended Weekly Maintenance Schedule

Weekly maintenance and inspection must include checking that the low water cut-off relay is operating correctly in the following manner:

- 1. Make sure that the boiler is cool with little or no pressure showing on the steam pressure gauge.
- 2. With burner operating, open the boiler blow-down valves. When the water drops below the required level (note the level in the water gauge glass), the burner should shut off; this is when the water level falls below the primary low water cutoff device in the water column assembly and/or the boiler shell. Manual reset of the secondary low water cutoff device is required.

Recommended Monthly Maintenance Schedule

The following steps should be carried out monthly:

- 1. Clean the water gauge glass using a commercial non-abrasive glass cleaner. Use diluted acids such as hydrochloric (muriatic) acid when regular cleaners do not seem to work. Do not use wire brushes or any abrasive materials that could scratch the glass. If leakage is evident, replace the gaskets.
- 2. Always reinstall the gauge glass protectors.
- 3. Clean feedwater pump strainers.
- 4. Check scanner or flame rod and ignition electrodes.
- 5. Check starter contacts. Burned or pitted contacts must be replaced. Do not use sand paper to file or clean.

- 6. Clean all system strainers for steam, water, and fuel.
- 7. Check operation of all steam traps on all boiler and system piping.

Burner Components

Check the linkage and cams for wear and loose parts. Replace and worn parts immediately.

Recommended Semi-Annual Maintenance Schedule

The following steps should be carried out semi-annually:

- 1. Check combustion settings for all fuels.
- 2. Check and adjust combustion to the correct settings.
- 3. Check for proper operation of steam traps in your system.
- 4. Check feedwater pumps for correct operation.
- 5. Check and clean burner.
- 6. Check settings of flame rod (if applicable) and ignition electrode.
- 7. Inspect ignition electrode for cracks.
- Clean water safety and level probes.
- 9. Check burner and boiler refractory for cracks.
- 10. Inspect stainless steel ring in furnace (if present)
- 11. Check operation of steam safety valve at no more than 15 PSIG.
- 12. Drain and clean feedwater tank.
- 13. Check electrical controls and motors for correct operation.
- 14. Shut off the boiler completely and drain.
- 15. Remove brass pipe plug at the cross connection below the water column and inspect and clean the nipple into the boiler. The boiler must be cold and the water level must below the pipe connection.
- 16. Remove the hand holes and inspect the interior of the vessel for scale or sludge deposits. See **Figure 78**. The amount of deposits will indicate the efficiency of the water treatment being used. The frequency of the inspection will depend on the condition of the water side of the boiler.

\triangle CAUTION

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In order to meet warranty conditions, ensure all appropriate maintenance activities are performed.

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What to do if you smell gas: Do not try to light the appliance. Do not touch any electrical switch. Do not use any phone in the building. Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

FIGURE 78 - INSPECT HAND HOLES FOR SCALE OR SLUDGE BUILDUP



- 17. Replace hand hole gaskets as follows:
 - » Remove the hand hole assembly using a 1-1/4" tee handle wrench or 1-1/4" 1/2" drive socket wrench. See Figure 79.

FIGURE 79 - REMOVING HAND ASSEMBLY WITH TEE HANDLE WRENCH



- » Remove the old gasket and thoroughly clean the surface on the boiler and the plate.
- NOTE: Do not reuse old gasket(s).
- 18. Fit the hand hole assembly as follows:
 - » Place the gasket on the hand hole plate and ensure that it is seating correctly. Do not use any grease, lubricant, or adhesive

MAINTENANCE & TROUBLESHOOTING





FIGURE 81 - OVERCOMPRESSED GASKET



- » Position the plate in the boiler. Set the yoke and tighten the securing nut sufficiently enough to provide a snug fit. Verify the position of the plate in the boiler, then make it hand tight and then snug with wrench about 1/4 turn. Do not compress excessively. See Figures 80-81.
- » Refill the boiler with fresh water.

Inspection and Maintenance of the Pilot Assembly

Your boiler is equipped with an interrupted pilot. This pilot uses gas from the pilot gas train, and combustion air The pilot is ignited via a spark from the ignition electrode.

- 1. Remove the pilot assembly This can be done with the burner in place
 - » Shut the manual valve in the pilot line, and ensure that power to the boiler is disconnected
 - » Disconnect the pilot gas whip from the pilot assembly
 - » Remove the ignition cable from the ignition electrode
 - » Remove the bolts holding the pilot assembly

riangle caution

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In order to meet warranty conditions, ensure all appropriate maintenance activities are performed.

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CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

WARNING

Burner adjustments must be performed by qualified personnel only. Attempting to perform any burner maintenance or start-up by anyone other than qualified personnel may result in death, personal injury, or equipment damage.

Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when combustion chamber is hot.

- » Remove the pilot assembly by lifting straight up or horizontally (depends on model) - taking care not to lose the O-ring seal
- 2. Inspect the pilot assembly
 - » Ensure that the pilot orifice is not clogged.
 - » Inspect and ensure that there are no signs of overheating, these would be visible as burnt or scaling metal, or distortion of the pilot parts
 - » Inspect the gap from the ignition electrode to the sparking notch in the pilot sleeve.
 - » Electrode should be centered vertically in the notch, and the minimum gap from electrode to sparking surface should be 3/16"
 - » Ensure that the ceramic on the ignition electrode is not cracked or damaged

If any parts of the pilot assembly or the deadzone of the burner are overheated, this could indicate a failure in the seal at the burner plate, or the premix transition, which allows combustion to flow upward. Inspect all seals if this is the case.

NOTE: Removing the burner plate will require replacement gaskets.

Examine The Venting System

- 1. Check all joints and pipe connections for tightness. Check vent for corrosion or deterioration. If any venting needs replacing, do so immediately.
- 2. Perform any recommended maintenance as required by the vent material manufacturer.
- 3. Inspect heating system for other problems.
- 4. Perform combustion analysis and adjust if necessary.
- 5. Inspect premix flexible couplings for damage or excessive wear.
- 6. Check for leaks in gas train, blower, and blower-to-burner piping.

Recommended Annual Maintenance

The following steps should be carried out annually:

- 1. Have combustion (CO2, O2, CO) and input checked by qualified personnel.
- 2. Clean dirty flues to prevent air flow restrictions resulting in poor combustion and loss of efficiency, as follows:
- Remove outer flue cover.
- Remove inner plate and turbulators.

- Remove clean-out plugs at lowest part of unit, and clean the bottom of the combustion chamber.
- Remove all soot from the top, and from the clean-out plugs at the bottom, with a vacuum cleaner.
- Replace clean-out plugs carefully so as not to damage insulation, and replace burner and flue cover plates.
- Flush boiler if necessary. See **Boil Out Procedure** section of this manual.
 More extensive cleaning may be required; consult a local water chemistry expert for recommendations.
- 4. Provide annual inspection by a qualified ASME boiler inspector, as required by local codes.

After All Repairs or Maintenance

- 1. Follow "Pre-Start Check List" and all Safety Checks.
- 2. Operate the boiler and perform combustion safety checks.
- 3. Analyze combustion throughout the range and verify proper operation of safety devices.

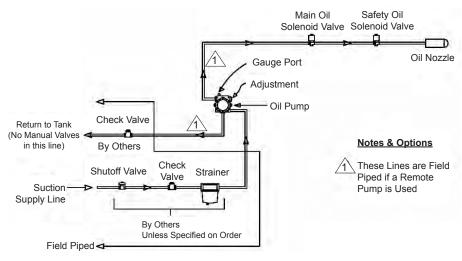


FIGURE 82 - PRESSURE ATOMIZED OIL SYSTEMS
"A" - ON - OFF

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WARNING

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\wedge

CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

Ensure that the blower/gas train assembly is fully supported during removal/cleaning or burner, as the transition elbow will be removed.

\triangle

WARNING

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Follow all proper lockout/tagout procedures for service.

Before beginning any maintenance, ensure area is free of any combustible materials and other dangers.

What to do if you smell gas:
Do not try to light the appliance.
Do not touch any electrical switch.
Do not use any phone in the building.
Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

\wedge

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Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when combustion chamber is hot.

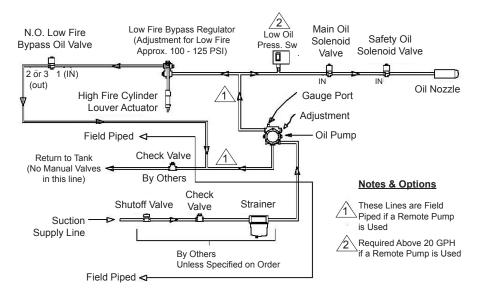


FIGURE 83 - PRESSURE ATOMIZED OIL SYSTEMS "L" - LOW FIRE START OR "H" LOW-HI-LOW

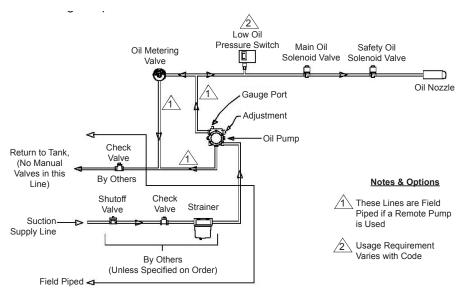


FIGURE 84 - PRESSURE ATOMIZED OIL SYSTEMS "MP" MODULATING SIMPLEX NOZZLES

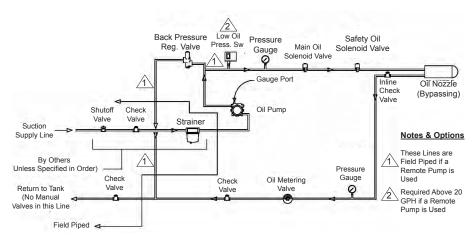


FIGURE 85 - PRESSURE ATOMIZED OIL SYSTEMS "MP"
MODULATING RETURN FLOW NOZZLES

Care of Burner

The burner can be equipped with a wide range of fuel and operating systems to control fuel, air, modulation, and pilots. This section describes how these systems operate. Burner start-up must be performed by qualified, trained personnel. The following illustrations identify the devices that have adjustment features. All adjustments must be performed by qualified personnel.

Initial Burner Settings

The burner will be factory-set for normal initial settings. These are adjusted at start-up.

▶ OIL NOZZLE POSITION

The oil nozzle position is indicated in Figure 86 and should be set per Table 9 below.

FIGURE 86 - OIL NOZZLE POSITION

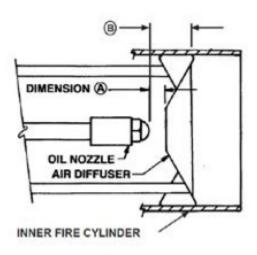


TABLE 9 - VMP NOZZLE CHART

HP	Model	Diffuser I.D.	Qty of Nozzles	Spray Angle	Dimensions (in)
40	JB1	1 1/2"	1	30	7/8
50	JB1	1 1/2"	1	45	3/4
60	JB1	1 1/2"	2	30	3/8
80	JB2	1 3/4"	2	60	1/2
100	JB2	1 3/4"	2	60	1/2
130	JB2	1 3/4"	2	60	1/2
150	JB2	1 3/4"	2	60	1/2

GAS PILOT ASSEMBLY

It is critical that the pilot be properly adjusted and kept clean. The following figures show typical configurations. Pilot gas pressure should be measured at the 1/8" port, located on he downstream side of the last pilot solenoid valve. Additional figures show initial settings for direct spark oil. for pressure atomizing, the low fire position should be adjusted to get the correct low fire pressure, as indicated on the rating label. Typically this would be 100 psi for simplex systems and 65 psi for return flow nozzles. the high fire position should be about 45 degrees to 60 degrees travel from low fire.

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riangle caution

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

Ensure that the blower/gas train assembly is fully supported during removal/cleaning or burner, as the transition elbow will be removed.

$\hat{\mathbf{M}}$

WARNING

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Follow all proper lockout/tagout procedures for service.

Before beginning any maintenance, ensure area is free of any combustible materials and other dangers.

What to do if you smell gas:
Do not try to light the appliance.
Do not touch any electrical switch.
Do not use any phone in the building.
Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

\triangle CAUTION

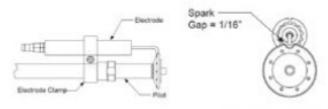
All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

⚠ WARNING

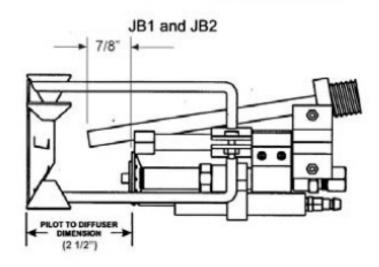
Burner adjustments must be performed by qualified personnel only. Attempting to perform any burner maintenance or start-up by anyone other than qualified personnel may result in death, personal injury, or equipment damage.

Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when combustion chamber is hot.

FIGURE 87 - PRESSURE ATOMIZED OIL SYSTEMS "MP" MODUL ATING RETURN FLOW NOZZI FS



Note: Required 2 1/2" - 3" wc pressure for natural gas ans 1/2" - 2" for LP, as measured at the last solenoid in the pilot train.



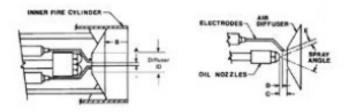


TABLE 10- DIMENSIONS FOR DIRECT SPARK OIL IGNITION (PRESSURE ATOMIZING)

Burner Data		Nozzle	e Data		Adjustm	ent Settings	s (inches)	
Model	Diffuser I.D.	Qty	Spray Angle	Α	В	С	D	E
	1″	1	30		1/2	1/2		
		1	45		3/8	3/8		
JB1	1 1/2"	1	30			7/8		
JOI		1	45			3/4		
		2	30	1/8		1/4	5/16	1/4
		2	45		1 1/2	1/4		
			30			3/4		
JB2	1 3/4"	2	45			5/8		
			60		,	1/2		

▶ BURNER DRAWER ADJUSTMENTS

The burner drawer has adjustment capabilities, allowing the combustion to be tuned. Be sure to retain the position of other components, and follow the sequence provided. Before making adjustments, mark the position of each component with a felt tip pen or tape, as follows:

- Mark the distance of the oil nozzle tube from the backplate.
- Mark the distance of the gas pilot line from the backplate.

Once marked, proceed as follows to adjust the diffuser to inner fire cylinder dimension:

- 1. Measure the dimension from the backplate to the end of the oil nozzle tube. This dimension, along with the initial position, will determine the limit of the adjustment.
- 2. Loosen the two set screws locking the pilot gas line and oil nozzle tube to the backplate.
- 3. Adjust the diffuser by moving the oil nozzle tube in and out per step 1's measurement. When the best position is located, lock into place with the two set screws.

To adjust the oil nozzle to diffuser position:

- 1. Remove the drawer assembly, per instructions below.
- 2. Adjust the oil nozzle, watching for spray back on the diffuser when the oil nozzle is pulled too far back. The flame may appear to be good, but carbon will quickly develop on the diffuser.

To remove the burner drawer assembly:

- 1. Disconnect the pilot gas line. Move the pilot line so the drawer can be pulled out without interference.
- 2. Disconnect oil line(s) and move out of way to avoid interference.
- Remove screws on the burner drawer.
- 4. Disconnect ignition cable from drawer assembly.
- 5. Pull drawer out, holding it centered to prevent it from hanging up when removing.
- 6. Disconnect the scanner by unscrewing it from the scanner tube.
- Set drawer down horizontally to prevent damage to the diffuser and/or changing settings.
- 8. To reinstall, reverse steps.

MARNING

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\triangle CAUTION

The boiler emissions may not be correct after changing the servo motor. Verify the emissions throughout the range of modulation. If emissions are off, the servo motor can be adjusted by following the procedure in the Commissioning the Boiler section of this manual.

\triangle CAUTION

All maintenance procedures should be completed by trained personnel. Appropriate training and instructions are available from the Fulton Service Department at (315) 298-5121 or your local Fulton Thermal Representative.

Ensure that the blower/gas train assembly is fully supported during removal/cleaning or burner, as the transition elbow will be removed.

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What to do if you smell gas: Do not try to light the appliance. Do not touch any electrical switch. Do not use any phone in the building. Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

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WARNING

Burner adjustments must be performed by qualified personnel only. Attempting to perform any burner maintenance or start-up by anyone other than qualified personnel may result in death, personal injury, or equipment damage.

Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when combustion chamber is hot.

▶ PRESSURE ATOMIZED OIL SETUP

The pressure atomized oil system has a limited range of adjustments for low/high fire, as dictated by the operation of the oil nozzle.

For burners equipped with FGR with linkage, the type of FGR control must be determined prior to starting. For oil only combustion, the NOx level will be provided on the burner detail sheet, and should be used in setting the control valve.

- 1. Place the burner swtich in OFF position.
- 2. Place AUTO-MANUAL switch in manual position, or low fire hold switch in the hold position for LO-HI-LO operation.
- 3. Place manual flame control potentiometer in the min (low fire) position on modulation units.
- 4. Turn on electrical power to the burner/boiler/related components.
- 5. Verify the oil metering valve is nearly opened (it will be closed at high fire).
- 6. Turn burner switch ON. This will start the blower motor and initiate the purge cycle.
- 7. When the pre-purge sequence is complete and the low fire switch (if applicable) is made, the pilot valve will open and the pilot flame should be visible through the burner sight port. As pilot flame is established, the flame safeguard will energize the main oil valves and the burner should ignite at low fire. This operation of the main fuel valves must be visually checked by observing the valve stem moving up with a motorized valve, or hearing the clicking noise from the solenoid valve. The main flame may not light on the first attempt, because it must fill the oil lines before providing oil to the nozzle. Press the restart button on the flame safeguard to restart the burner.
- 8. After a few seconds, the combustion analyzer should provide an accurate reading of the O2 in the stack. The O2 level should be between 5% and 7% and the nozzle oil should be 100 PSIG for the JB1/JB2 burner, low fire oil pressure.
- 9. If the unit is equipped with FGR, the FGR control valve should be set for the approximate NOx level required.
- 10. Operate the burner until the boiler is warmed up, and operating pressure/ temperature has been acheived.
- 11. Increase the firing rate, using the manual potentiometer, or put the low fire hold switch in AUTO position, while monitoring and adjusting the O2 level. Adjust the cam as needed to reach the high fire input. If burner is equipped with FGR, adjsut the FGR control as needed to maintain the NOx level.
- 12. At high fire, adjust the high fire input (open or close the fuel valve) to match the maximum input and/or pressure listed on the rating label. The fuel metering valve should be closed or nearly closed, at this point, and the

nozzle pressure should be about 150 PSIG return line for the JB3 burner, 250-300 PSIG for the JB1/JB2 burner.

- 13. If equipped with FGR, adjust the NOx level to be about 10% below any guaranteed NOx performance.
- 14. Modulate the burner to low fire, adjusting the O2 level as the burner modulates.
- 15. Adjust the low fire input, using teh fuel cam or low fire regulator on LO-HI-LO systems and air damper adjsutments.
- 16. Readjust the midfire opoints for the correct O2 levels. The linkage may require adjustment to retain correct relationship between fuel valve and air damper.
- 17. The burner should be opeating at low fire to adjust the air proving switch. Turn the adjusting screw clockwise until the burner trips. Then turn the adjustment screw counterclockwise 1.5 turns from the point of shutdowm. Check operation at higher rates.
- 18. Adjust the oil pressure switch to trip and shutdown the burner at a prssure that is 10% lower than the supply oil pressure.

OPERATING CONTROL ADJUSTMENTS

The operating controls must be adjusted to properly cycle the burner ON and OFF, and provide modulation. The controls shoud not force the burner into rapid ON-OFF cycles, as this may cause unit damage.

The operating control must be adjusted to provide the ON pressure or temperature desired. The OFF pressure or temperature must be sufficiently above the ON point to allow reasonable run time.

The modulating control must be adjusted to start modulation at some reasonable point below the ON temperature or pressure, or provide modulation to high fire at the lowest temperature or pressure.

Burner Shutdown

Normal operation of the burner will allow the operating controls to shut the burner down when demand is satisfied. If burner must be shut down for any reason, use the ON-OFF switch. This will cause fuel valves to close and start a post-purge cycle to remove any unburned fuel from the unit.

It is recommended that the burner be manually driven to low fire before turning the burner off, as this reduces dynamic and thermal stress. If the burner will remain off for some time, the manual fuel valves, fuel pumps, and power supply should be turned off.

▶ EMERGENCY BURNER SHUTDOWN

All fuel and electrical power should be de-energized or turned off to secure the burner. This includes the main power disconnect, manual gas shutoff valve at the drop-down line, and the manual oil valve (if equipped).

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CAUTION

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Ensure that the blower/gas train assembly is fully supported during removal/cleaning or burner, as the transition elbow will be removed.

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Before beginning any maintenance, ensure area is free of any combustible materials and other dangers.

What to do if you smell gas: Do not try to light the appliance. Do not touch any electrical switch. Do not use any phone in the building. Leave building and contact gas supplier from neighbor's phone. If you cannot reach gas supplier, phone the fire department.

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WARNING

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CARE OF BURNER DURING EXTENDED SHUTDOWN

The following should be conducted when the burner will be placed out of service for an extended shutdown.

- 1. Turn main fuel valve off.
- Turn main electrical disconnect to the burner off.
- 3. Follow proper tagout/lockout procedures.
- 4. If burner will be in an area subject to sweating/condensation, cover the control cabinet and electrical devices with plastic and secure tightly.
- 5. If burner is to be out of service for more than 30 days, a complete operation safety check must be made at the time of restart.

▶ RESTARTING THE BURNER AFTER EXTENDED SHUTDOWN

Follow same procedure as normal shutdown, however the air atomized oil nozzle should also be removed and cleaned. If pressure atomized, it should be replaced. In addition, oil filter and strainer must be removed and cleaned prior to starting. Conduct a complete operational safety check.

■ Pilot Adjustment for Fulton LoNOx Burner

- Close downstream shut off valve.
- 1. Start boiler and check flame signal on pilot, lock programmer into pilot
- 2. Adjust air and gas regulator as needed to obtain a strong pilot signal.
- 3. Slowly open downstream shut off valves and take the flame programmer off of hold.

Main Flame Adjustment For LE Models

- 1. Place a combustion analyzer in the exhaust of the boiler.
- 2. Do not adjust main gas regulator. To increase fuel to the burner, the servos that control modulating gas valves require adjustment.

Burner Tile Replacement For LE Models

- 1. Remove scroll assembly.
- 2. Break off top holding clips.
- 3. Remove ceramic fiber burner tile.
- 4. Replace burner tile bottom holding clips if needed.
- 5. Replace with new burner tile.
- 6. Carefully replace scroll assembly so that the ceramic fiber burner tile is not damaged.

Servo Motor Replacement

If it is determined that a servo motor needs to be replaced, the first step in this process is to verify the model number of the new servo motor is the same as the old servo motor. The model number starts with the letters SQM and is displayed on a label on the side of the motor. Once the new motor has been verified to be correct, turn power to the boiler off.

- 1. Turn off all electricity to the boiler.
- 2. Remove the cover on the servo motor to be changed.
- 3. Remove the green wiring plugs and the conduit termination point from the motor by pulling them towards you. A black grounding wire runs from the motor to the conduit termination point. Pull it off from the conduit termination point.
- Also note the location of the jumper on the left side of the motor.
- Loosen the allen screws on the motor end of the motor to valve coupling.
- Unbolt the motor from the mounting bracket and remove the motor.
- 7. Turn the valve so it is in the closed position and can rotate clockwise to open.
- 8. Mark the coupling or valve shaft if needed so the position of the valve can be determined when the servo motor is installed.
- Bolt the new servo motor on to the mounting bracket with the motor shaft inserted into the coupling.
- 10. Rotate the valve shaft/coupling assembly closed as stated above.
- 11. While holding the valve closed, tighten the allen screws on the coupling.
- 12. Install the wired green wiring plugs and the conduit termination point on the new motor. Connect the black grounding wire from the motor to the conduit termination point.
- 13. Verify the jumper on the motor is located on the same pins as the motor that was replaced.
- 14. Turn power to the boiler on.
- 15. The screen will display 'system test'. The fault "Fault Feedback Air Actuator" will be displayed. DO NOT RESET THIS FAULT YET. Press Escape twice to clear the fault from the screen.
- 16. Press Escape to get to the main menu. Under Params&Display > Actuators > Addressing, select either the gas actuator or air actuator depending upon which was replaced. The control will run an actuator check then display 'Start Address Assignment with ENTER'. Press Enter. The display will then have you press the addressing button on the actuator. This is the red button on the actuator. The screen will then display 'Actuator Address Assignment Successful'.

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17. Press Escape until the main menu is reached. Under OperationalStat > Status/Reset, reset the fault.

The boiler emissions may not be correct after changing the servo motor. Verify the emissions throughout the range of modulation. If emissions are off, the servo motor can be adjusted by following the procedure in the Commissioning the Boiler section of this manual.

18. Attach cover to servo motor.

Boiler Blowdown

■ NOTE: Fulton recommends the boiler(s) be blown down at low pressure (10psig or less) whenever possible. If this is not practical, the boiler may be blowdown at operating pressure, however additional flash steam will be generated. It will also be more critical to control the volume and duration of the blowdown to prevent discharging additional water and/or prevent damage to any equipment.

■ Bottom Boiler Blowdown:

The valves that will be used are the quick opening and slow opening valves on the boiler bottom blowdown connection(s). Some boiler models have (2) two bottom blowdown openings.

To complete a bottom blowdown, every connection on the bottom of the boiler should be blown down individually each blowdown instance. Typical bottom blowdown frequency is once every 8 hours, but may be modified based on water chemistry requirements.

The typical bottom blowdown valves are pictured below with the fast opening ball valve and slow opening Y-valve.

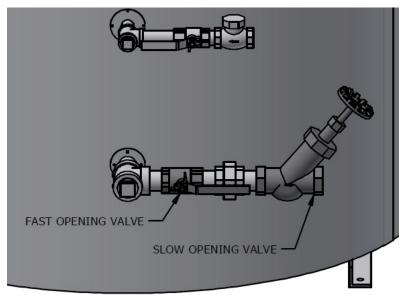


FIGURE 89 - TYPICAL BOTTOM BLOWDOWN

Fulton recommends that bottom blowdown be completed at least once per day. The blowdown should last ten seconds and have a drop in the boiler sight glass level of 1-2" in height.

When completing a bottom blowdown, the valves should be opened slowly and carefully. If possible, the boiler should be blown down at lower firing rates. Blowdown valves are to be tightly closed after each blowdown is completed.

To complete a bottom blowdown, please follow the instructions below. Some Fulton boilers have two bottom blowdown openings; this process is to be completed for each opening to satisfy the blowdown requirements. Also check to be sure that proper cooling water is available and turned on.

- 1. Check to see that all bottom blowdown valves are fully closed
- 2. Open the quick opening blowdown valve (nearest to the boiler)
- 3. Open the slow opening valve
 - The boiler water level should drop 1-2" over the (10) ten second bottom blowdown.
- 4. Allow the boiler to blowdown to occur for the above specified amount of time or as specified by your water treatment consultant. Some instances will require multiple bottom blowdowns depending on operation duration and water chemistry.
- 5. Close the slow opening valve
- 6. Close the quick opening valve
- 7. Open the slow opening valve again to drain the line in between the slow and quick opening valves
- 8. Close the slow opening valve and double check that all valves are shut off tightly.
- NOTE: Never pump the quick opening valve to blowdown the boiler. Such action could cause water hammer and damage piping and valves. It could also cause personal injury. Never leave an open blowdown valve unattended.

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Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when combustion chamber is hot.

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Do not try to light the appliance.
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■ Water Column Blowdown

NOTE: Be sure that the water column is properly piped per the IOM to an adequate drain prior to completing the blowdown procedure.

Blowdown of the Fulton Probe
Type water column: The water
column is be blown down once
every 8 hours of operation and
a minimum of once per day. To
blowdown the Fulton water column,
the "Water Column Valve" is opened
for a minimum period of 5 seconds
or until the low water cutoff causes
the burner to cycle.

For other types of water columns, please refer to the installation and operation manual for the column for the blowdown procedure. The frequency of blowdown is still to be once every 8 hours with a minimum of once per day.

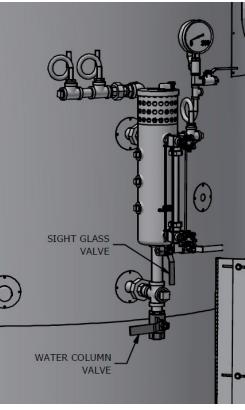


FIGURE 90 - WATER COLUMN BLOWDOWN

■ Water Column Sight Glass Blowdown

NOTE: Be sure that the sight glass is properly piped per the IOM to an adequate drain prior to completing the blowdown procedure.

Blowdown of the water column sight glass is to be once every 8 hours and a minimum of once per day. To blowdown the sigh glass, the "Sight Glass Valve" is opened for 5 seconds. If the water in the sight glass is dirty, repeat blowdown of "Sight Glass Valve" and "Water Column Valve" until water is clean.

Boiler Lay-Up Procedure

The following information includes suggested protocol and guidelines for boiler and ancillary equipment lay-up. When working on this equipment, it is critical to follow all product warning and caution information available in the product installation and operation manual. All content herein is subject to change without prior notice. A water treatment professional must be consulted for procedures/requirements, and actual site conditions must be factored. Guidelines below are for the vessel only. For additional information regarding the steam boilers, control panels and accessories, please contact Fulton.

Waterside Protection

The best corrosion-control program of operating boilers and ancillary equipment can be completely offset by neglect during outages, as metal surfaces are often attacked and damaged by oxygen during shut-downs. Protection can be achieved by:

- 9. Excluding all air from the boiler and ancillary equipment (wet lay-up).
- 10. Keeping the surfaces completely dry (dry lay-up).

The choice between wet and dry lay-up depends on the length of time a boiler and ancillary equipment will be out of service. Wet lay-up is recommended for short outages (30 days or less); dry lay-up is recommended for longer periods. The wet method has the advantage of permitting the boiler to be returned to service on short notice. Dry lay-up is practical only if the unit can be drained while hot.

Boilers and ancillary equipment should be drained and inspected prior to any layup. When time does not allow for inspection, the boiler and ancillary equipment may be stored wet without draining if the chemical treatment is injected into the boiler before it comes offline.

■ Dry Lay-Up

- 1. Secure fire equipment and close all steam stop and water feed valves.
- 2. Drain the boiler and ancillary equipment completely and dry all waterside surfaces by opening all handholes and manholes while the unit is still warm enough to vaporize all moisture (180 degrees F 200 degrees F).
- 3. Inspect for scale and sediment deposits on waterside surfaces. Consider that a 0.1" scale deposit may increase fuel consumption as much as 16%. Cleaning should be done before final lay-up preparation.
- 4. Thoroughly dry internal surfaces with hot air. Fans and other air driven blowers can be used by directing them into the bottom handholes or manhole opening.
- 5. All areas that are not completely dry should be blown with dry compressed air. No steam or feedwater can be allowed to enter the boiler and ancillary equipment. Moisture on the waterside will cause oxygen corrosion to begin in a very short period of time and will ultimately cause serious corrosion problems.
- 6. Leave boiler and ancillary equipment open to atmosphere if boiler room is dry and well ventilated.
- 7. In damp boiler rooms or for periods exceeding the normal summer shutdown, one of three following commercial grade desiccants should be spread on water-tight wood or corrosion resistant trays.
 - Quick lime -- used at a rate of six pounds per 100 cu. ft. of boiler volume.
 - Silica gel -- used at a rate of eight pounds per 100 cu. ft. of boiler volume.

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- Activated alumina -- used at a rate of eight pounds per 100 cu. ft. of boiler volume.
- 8. Trays are to be placed on the top tubes of the boiler. All manholes, handholes, vents, and connections are to be blanked and tightly closed to seal the boiler and ancillary equipment.
- 9. Inspect every two months for evidence of active corrosion. Check the desiccant and regenerate or replace when necessary. Reseal and restore the boiler and ancillary equipment to proper conditions.

■ Wet Lay Up

- 1. Drain boiler and ancillary equipment and thoroughly inspect for sediment and scale, and clean as in points 2 through 6 above.
- 2. Fill boiler and ancillary equipment completely using feedwater preheated to a minimum of 208 degrees F taking care to vent all air from boiler.
- 3. While filling, feed in treatment chemicals recommended by a reputable water treatment firm. Levels of approximately 300-500 parts per million (ppm) phenolphthalein (P) alkalinity and 100-150 ppm sulfite residual should be reached and maintained.
- 4. Fire boiler and ancillary equipment to ensure good mixing and vent boiler to purge the unit of air. All feed and blow down valves should be leak free to prevent loss of treated water or addition of untreated water. It is important to seal off and keep the unit air-tight since any air entering the boiler will promote corrosion.
- 5. Test the boiler water bi-monthly during the outage to ensure proper control levels are being maintained.
- 6. If a piece of equipment is not able to be isolated and airtight, a dry layup of that equipment may be necessary.

■ Fireside

Fireside lay-up procedures are designed to keep metal surfaces dry. Moisture, oxygen, and combustion residuals produce corrosion by forming acids that attack steel. Precautions taken during lay-up inhibit metal degradation and prolong boiler life.

Corrosion is a threat to a cold boiler regardless of fuel type. The common factor in all fuels is the level of impurities. While the boiler is still firing, the impurities may be thermally decomposed as they pass through the flame zone. The elements of the impurities combine into an assortment of different compounds. As the compounds stabilize, they may form either solid deposits on the tube surfaces or acidic liquids that corrode the metal.

Lay-up is a critical period for boiler maintenance and repair. It is important to clean fireside surfaces to maximize the amount of heat transfer. Consider that a 3/32" scale deposit on the fireside may increase fuel consumption by as much as 10.7%.

The deposits themselves may initiate 3) types of problems. First, as deposits form they may produce corrosion at the interface of the metal and deposit surface. Second, the deposit may trap fly-ash which adds to the bulk of the deposit surface. Third, fly-ash constituents such as iron, vanadium, and sodium may act with sulfur compounds to form highly corrosive, low ph deposits.

Fireside Protection

- 1. When boiler is cool, thoroughly clean tubes and other fireside heating surfaces and scrape down to the bare metal. A metal surface below 300 degrees F with 10 ppm S03 present will be cool enough to cause condensation of sulfuric acid, opening the door to corrosion. Iron or vanadium will catalyze this reaction and intensify the corrosion.
- 2. Clean smoke box and other areas where soot may accumulate.
- 3. Swab or spray fireside with a neutral mineral oil for protection of surfaces.
- 4. If boiler room is damp, place trays of calcium chloride or unslaked lime in combustion chamber and replace when it becomes damp.

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Troubleshooting for Oil

Refer to the table on following pages for troubleshooting.

TABLE 11 - TROUBLESHOOTING FOR OIL

Issue	Cause	Correction
Burner doesn't start	Main disconnect switch is open	Close switch
	Loose electrical connection	Check electrical connections
	Operating controls are tripped	Check and reset operating limits
	High or low fuel pressure	Check fuel supply, reset switches
High CO at low fire	Improper excess air level	Readjust excess air
(firing gas)	Input too low for burner components	Check input and compare to rating label
	High stack draft (especially at low fire)	Stabilize draft
	Poor air flow distribution (off center flame)	Adjust air straightener blade
	Diffuser not in optimum position	Adjust diffuser position (in or out)
	Fluctuating gas pressure (regulator not holding pressure)	Check regulator pressure, sensing line and supply pressure for proper sizing
Gas combustion noise	Input too low for burner components	Check input and compare to rating label
(rumbling)	Improper excess air	Readjust excess air
	Fluctuating gas pressure (regulator not holding pressure)	Check regulator pressure and supply
	High stack draft (especially at low pressure)	Stabilize draft
	Diffuser not in optimum position	Adjust diffuser position (in or out)
	Poor air flow distribution (off center flame)	Adjust air straightener blade
Oil combustion smoking	Oil nozzle dirty or plugged	Clean oil nozzle
	Improper excess air	Readjust excess air
	Input too low for burner components	Check input, compare to rating label
	High stack draft (especially at low fire)	Stabilize draft
	Incorrect nozzle position	Adjust the nozzle to diffuser position
	Fluctuating oil pressures(regulator not holding)	Check regulator pressure and oil supply
	Poor air flow distribution (off center flame)	Adjust air straightener blade
	Too much FGR (if equipped)	Reduce FGR rate
Fuel-Air Ratios are not	Linkage flexing	Realign linkage, straighten rods
consistent	Linkage slip	Check linkage and tighten all joints
	Fuel cam screws have moved	Replace fuel cam
	Fuel line plugged	Check and clean lines, strainers and filters
	Fuel supply pressure changing	Check and/or replace pressure regulator
	Combustion air temperature changed	Retune burner
	Draft condition changed	Check draft and outlet damper
	Plugged or leaky FGR line	Clean/repair
	Gas control valve - low fire stop not set (if used)	Adjust low fire stop

TABLE 11 (CONTINUED)- TROUBLESHOOTING FOR OIL

Issue	Cause	Correction
No ignition (no spark)	Electrode is grounded	Replace
	Cracked porcelain	Replace
	Electrode is improperly positioned	Recheck dimensions and adjust
	Loose ignition wire connection	Reconnect or tighten
	Defective ignition transformer	Check and replace as needed
No ignition (with spark,	Lack of fuel, no gas pressure, closed fuel valve	Check fuel supply and valves
but no flame)	No voltage to pilot solenoid	Check electrical connections
	Defective pilot solenoid valve	Replace
	Incorrect location of pilot	Check location of pilot
	Improper raw gas tube position	Check location of raw gas tube
	Improperly positioned electrodes	Recheck dimensions
	Too much combustion air flow	Check air damper position
Pilot not detected, but	Scanner tube not properly positioned	Check location/position of scanner tube
flame is present	Scanner tube dirty or wet (oil film)	Clean scanner tube/scanner
	Faulty scanner or amplifier	Replace
	Pilot improperly positioned	Check pilot position
	Incorrect gas pressure to pilot	Readjust pressure
	Combustion air flow rate too high	Readjust damper
No main gas flame (pilot	Weak scanner signal	Clean scanner lens and tube
OK)	Damper or fuel control valve setting incorrect	Readjust
	Fuel valve(s) not opening	Check wiring to valves
No main oil flame (pilot	Weak scanner signal	Clean scanner lens and tube
OK)	Damper or fuel control valve setting incorrect	Readjust
	Fuel valve(s) not opening	Check wiring to valves
	Oil nozzle or line obstructed	Check and clean
	No atomizing air pressure	Check compressor wiring
	Compressor pressure too high or too low	Adjust
	Burner not level, oil is draining into vessel	Check level, adjust as required
Burner stays at low fire	Manual pot in low fire position (low fire hold)	Readjust to high fire position
	Manual-auto switch or low fire hold switch in wrong position	Change switch position
	Modulating control or lo-hi-lo control wiring is faulty	Check wiring or replace
	Loose linkage	Readjust and tighten
		Deadingt or realize
	Binding linkage or valve	Readjust or replace
Burner shuts down	Binding linkage or valve Loose electrical connection	Check and tighten connections
Burner shuts down during operation		

TABLE 11 (CONTINUED)- TROUBLESHOOTING FOR OIL

Issue	Cause	Correction
Fuel-Air ratios have	Linkage wear	Check linkage and tighten all joints
changed over time	Fuel cam screws have moved	Replace fuel cam
	Air damper seal worn	Replae air damper seals
	Fuel lines plugged	Check and clean lines, strainers and filters
	Fuel control valve worn	Replace fuel control valve
	Gas orifices or gas manifold plugged	Clean and/or replace
	Combustion air temperature changed	Retune burner
	Draft condition changed	Check draft and outlet damper
	Vessel plugged	Clean vessel
	Plugged or leaky FGR valve	Clean/repair
Cannot obtain capacity	Wrong spring range in regulator	Install higher spring range
on gas	Too many elbows before control valve	Rework piping to reduce elbows
	Gas line too small, high pressure drop	Use larger pipe size
	Supply pressure lower than stated	Increase supply pressure
	Supply pressure drops too low at high fire	Use larger gas line sizes/ orifice in service regulator
	Regulator to small for flow and pressure	Change regulator
Cannot obtain rated	Oil nozzles plugged	Clean/replace nozzles
input on oil firing	By-pass seal on nozzle leaking	Replace nozzles
(pressure atomized)	Oil pressure is too low	Increase oil pressure
	Flow valve set too low (should be closed at high fire)	Adjust oil control valve
Cannot obtain rated	Oil nozzles plugged	Clean/replace nozzles
input on oil firing (air	Air pressure too low	Replace nozzle
atomized)	Oil pressure is too low	Increase oil pressure
	Flow valve set too low	Adjust oil control valve
Cannot obtain NOx	FGR valve not full open	Adjust FGR valve to full open
levels on gas	FGR valve full of condensate	Clean duct and add drains
	FGR duct not direct to flue stream	Add angle cut in center of the stack
	FGR line too small	Check sizing; use fittings with less drop
	Operating on propane, not natural gas	Resize FGR for propane operation
	Shutoff valve is not full open	Check FGR shutoff valve position

Troubleshooting for Gas

Refer to table on following pages for troubleshooting.

TABLE 12 - TROUBLESHOOTING FOR GAS

PROBLEM	CAUSE	REMEDY
Ignition Failure	1. Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	2. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment. Readjust if necessary. Check for cracks in porcelain. If found,replace."
	3. Transformer	"Check voltage between transformer leads at terminal block to be sure transformer is being powered."
	4. Flame Safeguard Control	Check voltage between ignition terminal and neutral. Check must be made before control locks out on safety. If no power, replace control.
	5. Faulty Air Switch	Check for bad air switch by jumpering the two air switch leads at the terminal block. If the boiler starts and runs with these terminals jumpered, the air switch should be replaced.
	6. Gas Valve Sticking (Pilot)	"Check for dirt in valve or orifice and clean if necessary. Check for faulty actuator or valve and replace if necessary."
	7. Gas Supply	"Check for gas pressure and for intermittent supply problems. Gas pressure for natural gas should be 3-1/2"" W.C. plus fan pressure at the elbow to the burner and 7"" to 11"" W.C. at the head of the train."
	8. Loose wire connection	Check connections to all components.
Flame Failure	1. Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	2. Gas Supply	"Check for gas pressure and for intermittent supply problems. Gas pressure for natural gas should be 3-1/2"" W.C. plus fan pressure at the elbow to the burner and 7"" to 11"" W.C. at the head of the train."
	3. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment. Readjust if necessary. Check for cracks in porcelain; if found, replace."
	4. Primary Air Adjustment	Check air adjustment.
	5. UV Scanner Adjustment	"Check for dirt on flame scanner and clean. Check for proper location of detector."
	6. Flame Safeguard Control	"Check voltage at terminal leading to main gas valve. If no power, replace thecontrol."
	7. Loose wire at fuel valve circuit	Tighten wiring connections.
	8. Contact open on air safety switch	Adjust to proper setting.
	9. Scanner wiring reversed at panel box.	Change to correct terminals.

TABLE 12 (CONTINUED)- TROUBLESHOOTING FOR GAS

PROBLEM	CAUSE	REMEDY
Burner Cut-Off	1. Power Supply	Check fuse or circuit; reset or replace, as necessary.
	2. Gas Supply	Check to be sure main gas cock is not closed. Check coil in gas valve with OHM meter. Replace if faulty. Check gas regulator setting and readjust as necessary. Check inlet gas pressure and increase or decrease as necessary.
	3. Ignition Electrodes	Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment Readjust if necessary. Check for cracks in porcelain; if found replace.
	4. Air Switch	Check for bad air switch by jumpering the two air switch leads at the terminal block. If the boiler starts and runs with these terminals jumpered, the air switch should be replaced.
	5. Gas Valve Sticking (Pilot)	Check for dirt in valve or orifice and clean if necessary. Check for faulty actuator or valve and replace if necessary.
	6. Weak Amplifier	Replace.
	7. Weak Pilot	Adjust to larger pilot by adjusting pilot gas pressure regulator.
	8. Faulty Liquid Level Control	Check to see if there is power to terminal number 10 when the sight glass shows the proper water level. If there is no power at this terminal, the control is bad and must be replaced.
	9. Dirty or defective UV Scanner	Clean or replace.
Poor Combustion	1. Refractories	Check refractories to see if they are plugged with soot or broken inpieces. Clean or replace as necessary.
	2. S.S. Ring	Check to be sure ring is present and fits tight against the furnace wall.
	3. Primary Air Adjustment	Check air adjustment. Air/fuel mixture may be off. Open primary air so fire is to outside wall of furnace.
	4. Secondary Air Adjustment	Check main air adjustment to see if it is loosened up. Adjust as necessary and tighten plate in position.
Burner back fires	1. Refractories	Check refractories to see if they are plugged with soot or broken in pieces. Replace as necessary.
	2. Ignition Electrodes	Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment Readjust if necessary. Check for cracks in porcelain; if found replace.
	3. Draft	Check draft with a gauge. Draft should be a02 " to04" W.C. with burner off or04" to06" when operating. May need to install a barometric damper.
	4. Negative Room Pressure	Make sure no exhaust fans are running in the boiler room.
Boiler will not maintain pressure	1. Gas Supply	Check gas pressure coming into gas train. If low, contact gas company. Check coil in gas valve with AMP meter. Replace if bad. Check gas regulator setting and readjust as necessary.
	2. Dirty Flue	Check flue for carbon buildup or blockage. Clean flue passages with brush.
	3. Pressuretrol	Disconnect all power to the controller. Disconnect the wires from the
	4. Scale Built up in boiler	Refer to Section 2 "Pressure Vessel Cleaning".

TABLE 12 (CONTINUED)- TROUBLESHOOTING FOR GAS

PROBLEM	CAUSE	REMEDY
	5. Refractories	Check refractories to see if they are cracked or broken in pieces. Replace as necessary.
	6. Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	7. Boiler size.	Boiler may be undersized.
Boiler is Surging	1. Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	2. High organic in boiler (i.e. Perc or oil)	Drain and clean boiler with washing soda per instruction manual.
	3. High boiler TDS	Drain boiler and flush system. Refill and increase blow-down rate/frequency.
	4. Too much water akalinity (high PH)	Have water tested by water treatment company, lower boiler alkalinity to recommended level.
	5. High sudden steam load	Check total equipment horsepower required against horsepower of boiler being used. Decrease amount of equipment being used at one time, or reduce the steam flow by partially closing the steam stop valve.
	6. High level of water treatment chemicals recommended levels.	Consult water treatment expert and adjust levels to boiler
Boiler Rumbles and Pulsates	1. Draft problem	Check draft with a gauge. Draft should be a02" to04" W.C. with burner off or04" to06" when operating. May need to install a barometric damper.
Boiler pushing water with the steam (carryover)	1. Steam Traps Check traps.	Clean or replace as necessary.
(curryover)	2. High boiler TDS rate/frequency.	Drain boiler and flush system. Refill and increase blow-down
	High level of water treatment chemicals	Consult water treatment expert and adjust to boiler recommended levels.
Pump will not cut	1. Dirty Probes	Clean or replace as necessary.
off	2. Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	3. Ground Connection	Check for tightness and clean.
	"4. Probes not sensitive enough (RO/DI Water)"	Replace probes and relays with extra sensitive ones.
Pump runs but does not put water into boiler	1. Vapor locking of pump	"Allow system to cool down, check steam traps and check to be sure return lines are not insulated. Check return tank temp. If it is above 180°F (82°C) vapor locking of pump may occur. Inspect check valves. Clean and replace as needed. Replace pump with multistage centrifugal good for 250°F (121°C)."
	2. Impeller Adjustment	"Check for impeller wear and adjust per component information ininstruction manual (Burks only)."
	3. Pump suction plugged	Remove/clean inlet strainer.
	4. Plugged feed water nipple	Check and clean or replace as necessary.
	5. Pump undersized/worn	Replace with appropriate pump.
	6. Back pressure on pump	Need to install repair kit on pump.

TABLE 12 (CONTINUED)- TROUBLESHOOTING FOR GAS

PROBLEM	CAUSE	REMEDY
Water pump will not	1. Scale on probes.	Check and clean or replace as necessary.
come on at times	2. Bad Pump Contactor	"Check to see if contactor is being powered. Check to see if contactor coil is pulling in. Replace if necessary."
	3. Bad Pump Motor	"Check the incoming power to the pump to be sure it is receiving power. If power is present but motor does not run, replace it."
Low Fuel pressure	1. Gas pressure regulator	Check and replace.

Troubleshooting Gas-Fired Boilers - LE Models

Refer to table on following pages for troubleshooting.

TABLE 13 - TROUBLESHOOTING FOR GAS (LE MODELS)

PROBLEM	CAUSE	REMEDY
Ignition Failure	1. Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	2. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustments. Readjust if necessary. Check for cracks in porcelain. If found, replace."
	3. Transformer	"Check voltage between transformer leads at terminal block to be sure transformer is being powered."
	4. Flame Safeguard Control	"Check voltage between ignition terminal and neutral. Check must be made before control locks out on safety. If no power, replace control."
	5. Faulty Air Switch	"Check for bad air switch by jum pering the two air switch leads at the terminal block. If the boiler starts and runs with these terminals jumpered, the air switch should be replaced."
	6. Gas Valve Sticking (Pilot)	Check for dirt in valve or orifice and clean if necessary. Check for faulty actuator or valve and replace if necessary.
	7. Gas Supply	Check for gas pressure and for intermittent supply problems. See test fire sheet for last elbow.
	8. Loose wire connection	Check connections to all components.
Main Flame Fails	1. Gas Servo Motor not set properly	"Verify the last elbow gas pressure matches the start up report. Adjust gas servo setting."
	2. Air Servo Motor not set properly	"Verify the over burner pressure matches the start up report. Adjust the air servo motor."
"Boiler Fails while Modulating"	1. Gas Servo Motor not set properly	"Verify the last elbow gas pressure matches the start up report. adjust gas servo setting."
	2. Air Servo Motor not set properly	Verify the over burner pressure matches the start up report. Adjust air servo setting.

PROBLEM	CAUSE	REMEDY
Flame Failure	1. Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	2. Gas Supply	Check for gas pressure and for intermittent supply problems.
	3. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment. Readjust if necessary. Check for cracks in porcelain; if found, replace."
	4. Primary Air Adjustment	Check air adjustment. Air may be blowing flame away from burner head.
	5. Scanner	"Check for dirt on flame scanner and clean. Check for proper location of detector."
	6. Flame Safeguard Control	"Check voltage at terminal leading to main gas valve. If no power, replace the control."
	7. Loose wire at fuel valve circuit	Tighten wiring connections.
	8. Contact open on air safety switch	Adjust to proper setting.
	"9. Scanner wiring reversed at panel box"	Change to correct terminals.
Burner Cut-Off	1. Power Supply	Check fuse or circuit; reset or replace, as necessary.
	2. Gas Supply	"Check to be sure main gas cock is not closed. Check coil in gas valve with OHM meter. Replace if faulty. Check gas regulator setting and readjust as necessary. Check inlet gas pressure and increase or decrease as necessary."
	3. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment. Readjust if necessary. Check for cracks in porcelain; if found, replace."
	4. Scanner	"Check for dirt on flame scanner and clean. Check for proper location of detector."
	5. Air Switch	"Check for bad air switch by jumpering the two air switch leads as the terminal block. If the boiler starts and runs with these terminals jumpered, the air switch should be replaced."
	6. Gas Valve Sticking (Pilot)	"Check for dirt in valve or orifice and clean if necessary. Check for faulty actuator or valve and replace if necessary."
	7. Weak Amplifier	Replace.
	8. Weak Pilot	Adjust to larger pilot by adjusting pilot gas pressure regulator.
	9. Faulty Liquid Level Control	"Check to see if there is power to terminal number 10 when the sight glass shows the proper water level. If there is no power at this terminal, the control is bad and must be replaced."
	10. Dirty or defective UV Scanner	Clean or replace.

PROBLEM	CAUSE	REMEDY
Boiler Flooding	1. Pump does not shut off	Dirty Probes. Clean or replace as necessary.
	2. Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	3. Ground Connection	Check for tightness and clean.
	4. Vacuum created with boiler off	"As the boiler cools off, it pulls water from the system piping. To prevent this, add a 1/4"" check valve on the steam gauge assembly piping, which closes under pressure and opens under vacuum."

PROBLEM	CAUSE	REMEDY
Poor Combustion	1. Refractories	"Check refractories to see if they are plugged with soot or broken in pieces. Clean or replace as necessary."
	2. Air Adjustment	Check CO2 and O2 levels. Adjust Gas/Air Ratio.
	3. Draft	"Check draft with a gauge. Draft should be a02" to04" W.C. with burner off or04" to06" when operating. May need to install a barometric damper."
	4. Dirty Flue	Check flue for carbon buildup or blockage. Clean flue passages with brush.
	5. Negative Room Pressure	Make sure no exhaust fans are running in the boiler room.
	6. Gas Servo Malset	Adjust gas servo setting.
	7. Air Servo Malset	Adjust air servo setting.
Burner back fires	1. Refractories	"Check refractories to see if they are plugged with soot or broken in pieces. Replace as necessary."
	2. Ignition Electrodes	"Check electrodes for carbon buildup and clean if necessary. Check for proper adjustment. Readjust if necessary. Check for cracks i nporcelain; if found, replace."
	3. UV Scanner	"Check for dirt on flame scanner and clean. Check for proper location of detector."
	4. Draft	"Check draft with a gauge. Draft should be a02" to04" W.C. with burner off or04" to06" when operating. May need to install a barometric damper."
	5. Negative Room Pressure	Make sure no exhaust fans are running in the boiler room.

PROBLEM	CAUSE	REMEDY
Boiler will not maintain pressure	1. Gas Supply	Check gas pressure coming into gas train. If low, contact gas company.
	2. Dirty Flue	Check flue for carbon buildup or blockage. Clean flue passages with brush.
	3. Pressuretrol	"Disconnect all power to the controller. Disconnect the wires from the controller. Put an OHM meter between the switch terminals. Lower the set point and recheck with OHM meter. Switch should break. If the controller operates improperly, replace it."
	4. Scale Built up in boiler	Refer to Section 2 "Pressure Vessel Cleaning".
	5. Refractories	"Check refractories to see if they are cracked or broken in pieces. Replace as necessary."
	6. Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	7. Boiler size	Boiler may be undersized.
Boiler is Surging	1. Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	"2. High organic in boiler (i.e. Perc or oil)"	Drain and clean boiler with washing soda per instruction manual.
	3. High boiler TDS	"Drain boiler and flush system. Refill and increase blow-down rate/frequency."
	"4. Too much water akalinity (high PH)"	"Have water tested by water treatment company, lower boiler alkalinity to recommended level."
	5. High sudden steam load	"Check total equipment horsepower required against horsepower of boiler being used. Decrease amount of equipment being used at one time, or reduce the steam flow by partially closing the steam stop valve."
	"6. High level of water treatment chemicals"	"Consult water treatment expert and adjust levels to boiler recommended levels."
"Boiler Rumbles and Pulsates"	1. Draft problem	"Check draft with a gauge. Draft should be a02" to04" W.C. with burner off or04" to06" when operating. May need to install a barometric damper."
Boiler pushing water	1. Steam Traps	Check traps. Clean or replace as necessary.
with the steam (carryover)"	2. High boiler TDS	"Drain boiler and flush system. Refill and increase blow-down rate/frequency."
	3. High level of water treatment chemicals	Consult water treatment expert and adjust to boiler recommended levels.
Pump will not cut off	1. Dirty Probes	Clean or replace as necessary.
	2. Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	3. Ground Connection	Check for tightness and clean.
	"4. Probes not sensitive enough (RO/DI Water)"	Replace probes and relays with extra sensitive ones.

PROBLEM	CAUSE	REMEDY
Pump runs but does not put water into boiler	1. Vapor locking of pump	"Allow system to cool down, check steam traps and check temp. If it is to be sure return lines are not insulated. Check return tank above 180°F (82°C) vapor locking of pump may occur. Inspect check valves. Clean and replace as needed. Replace pump with multistage centrifugal good for 250°F (121°C)."
	2. Impeller Adjustment	"Check for impeller wear and adjust per component information in instruction manual (Burks only)."
	3. Pump suction plugged	Remove/clean inlet strainer.
	4. Plugged feed water nipple	Check and clean or replace as necessary.
	5. Pump undersized/worn	Replace with appropriate pump.
Water pump will not	1. Scale on probes	Check and clean or replace as necessary.
come on at times	2. Bad Pump Contactor	"Check to see if contactor is being powered. Check to see if contactor coil is pulling in. Replace if necessary."
	3. Bad Pump Motor	"Check the incoming power to the pump to be sure it is receiving power. If power is present but motor does not run, replace it."
Low Fuel pressure	1. Gas pressure regulator	Check and replace.
Boiler Flooding	1. Pump does not shut off	Dirty probes. Clean or replace as necessary.
	2. Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	3. Ground Connection	Check for tightness and clean.
	4. Vacuum created with boiler off	"As the boiler cools off, it pulls water from the system piping. To prevent this, add a 1/4" check valve on the steam gauge assembly piping, which closes under pressure and opens under vacuum."

INTRODUCTION

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WARRANTY

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Limited Warranty for all VMP Boilers

Effective Date: 2022-12-30

Provided the boiler is installed, commissioned, controlled, operated, and maintained in accordance with Fulton's Installation, Operation and Maintenance Manual, and the Fulton Authorized Representative or Fulton Factory Technician has successfully completed and returned the equipment Installation and Operation Checklists to the Fulton Quality department, Fulton provides the following limited warranty:

PRESSURE VESSEL WARRANTY

The pressure vessel is warrantied for five (5) years from the date of shipment from the factory against failures determined by Fulton to be the result of defective materials or workmanship. If so determined, Fulton will repair, replace, exchange or credit, at Fulton's sole discretion, the pressure vessel, F.C.A. factory. Waterside corrosion or scaling is not covered. Failures outside of the ASME pressure vessel boundary are not covered under this section.

PARTS WARRANTY

Fulton will repair or replace F.C.A. factory any part of the equipment of our manufacture that is found to be defective in workmanship or material within eighteen (18) months of shipment from the factory or one (1) year from startup provided this equipment has been installed, operated, and maintained by the buyer in accordance with requirements in the manuals of Fulton and the component's manufacturer.

CONDITIONS OF WARRANTY

The warranty is valid for the original installation and original owner only. Any modifications, adjustments, repairs, or replacement parts to the equipment not authorized by Fulton will void this warranty.

Fulton shall be notified in writing as soon as any defect or failure becomes apparent. These can be emailed to warranty@fulton. com. Failure to do so may limit Fulton's obligations under this warranty or render the warranty invalid in whole or in part. No agent or representative of Fulton has authority to modify or alter the conditions of warranty. A formal Purchase Order is required prior to shipment of any replacement warranty item. This warranty does not include freight, handling, or labor charges.

To the extent not prohibited by law in the state, province, jurisdiction or country of purchase, this warranty and the remedies set forth are exclusive and in lieu of all other warranties, remedies, and conditions, whether oral, written, statutory, express, or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. In no event or under any circumstances shall Fulton be liable for any consequential, incidental, special, punitive, or other indirect damages arising in any way including, but not limited to, loss of profits or business, even if Fulton has been advised of the possibility of such damages. Under no circumstances shall Fulton's liability exceed the amount paid to Fulton for the original equipment.

THIS LIMITED WARRANTY IS GOVERNED BY AND CONSTRUED UNDER THE LAWS OF THE STATE, COUNTRY, JURISDICTION, OR PROVINCE IN WHICH THE PRODUCT WAS ORIGINALLY SOLD BY FULTON. THE LIMITED WARRANTY TERMS CONTAINED IN THIS STATEMENT, EXCEPT TO THE EXTENT LAWFULLY PERMITTED, DO NOT EXCLUDE, RESTRICT, OR MODIFY BUT ARE IN ADDITION TO THE MANDATORY STATUTORY RIGHTS APPLICABLE TO THE SALE OF THIS PRODUCT. OUTSIDE THE UNITED STATES AND CANADA AND TO THE EXTENT SUCH WARRANTIES, TERMS AND CONDITIONS CANNOT BE DISCLAIMED AND ARE PERMITTED BY APPLICABLE LAW, FULTON LIMITS THE DURATION AND REMEDIES OF SUCH WARRANTIES AND CONDITIONS TO EIGHTEEN (18) MONTHS OF SHIPMENT FROM THE FACTORY OR ONE (1) YEAR FROM STARTUP, WHICHEVER COMES FIRST. THIS LIMITED WARRANTY GIVES THE PURCHASER SPECIFIC LEGAL RIGHTS, AND THE PURCHASER MAY HAVE OTHER LEGAL RIGHTS, WHICH MAY VARY BY STATE, COUNTRY, JURISDICTION, OR PROVINCE.

SECTION 5

WARRANTY

Extended Warranty for Fulton Skid Mounted Steam Boilers

Effective Date: 2010-08-20

WARRANTY VALID FOR MODELS ICS, ICX, VMP, FB-A, FB-F, FB-L TEN (10) YEAR MATERIAL AND WORKMANSHIP WARRANTY

The pressure vessel is covered against defective material or workmanship for a period of ten (10) years from the date of shipment from the factory. Fulton will repair or replace at our option, F.O.B. factory any part of the equipment, as defined above, provided this equipment has been installed, operated and maintained in accordance with the Installation, Operation and Maintenance Manual.

The commissioning agency must also successfully complete and return the equipment Installation and Operation Checklist to Fulton's Service Department. This warranty covers any failure caused by defective material or workmanship, however, waterside corrosion or scaling is not covered. Therefore, it is imperative that the boiler water management and chemistry be maintained as outlined in the Installation, Operation and Maintenance Manual.

The extended warranty is valid only for steam boilers that are purchased as part of a skid mounted boiler system. Generally, this system MUST include ALL of the following equipment in order for the warranty to apply.

- 1. Fulton boiler with model number as listed above.
- 2. Fulton DA or condensate return system with preheat kit.
- 3. Fulton blowdown tank/separator
- 4. Water softener
- 5. Chemical feed system
- 6. Automatic surface or bottom blowdown, which must operate to maintain TDS levels as specified in the Installation, Operation and Maintenance Manual.

Any deviation or additional equipment specified by Fulton Engineering must be used and maintained per the Installation, Operation and Maintenance Manual

There is a \$1,000 labor allowance for any failed pressure vessel that is covered under the above warranty.

PARTS WARRANTY

Fulton will repair or replace FOB factory any part of the equipment of our manufacture that is found to be defective in workmanship or material within twelve (12) months of shipment from the factory provided this equipment has

been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by both Fulton and the component manufacturers.

GENERAL

Fulton shall be notified in writing as soon as any defect becomes apparent. This warranty does not include freight, handling or labor charges of any kind.

No Sales Manager or other representative of Fulton other than the Quality Manager or an officer of the company has warranty authority. Fulton will not pay any charges unless they were pre-approved, in writing, by the Fulton Quality Manager.

This warranty is exclusive and in lieu of all other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Fulton shall in no event by liable for any consequential or incidental damages arising in any way, including but not limited to any loss of profits or business, even if Fulton has been advised of the possibility of such damages. Fulton's liability shall never exceed the amount paid for the original equipment found to be defective.

CONDITIONS OF WARRANTY

Warranties are only valid if the boiler is installed, operated and maintained as outlined in the Installation, Operation and Maintenance Manual. Fulton shall accept no responsibility if the equipment has been improperly installed, operated or maintained or if the buyer has permitted any unauthorized modification, adjustment, and/or repairs to the equipment. The use of replacement parts not manufactured or authorized by Fulton will void any warranty express or implied.

Warranty coverage for all components and equipment in said warranty are not valid unless the boiler is started up by a factory certified technician. The commissioning agency must successfully complete and return the equipment Installation and Operation Checklist to Fulton's Service department.

The boiler must be maintained in accordance with the product manual and annual combustion and maintenance reports must be produced for warranty consideration.

The warranty is valid for the original installation only in the U.S.A and Canada.

No part of this Installation, Operation, and Maintenance manual may be reproduced in any form or by any means without permission in writing from the Fulton Companies.

Fulton Boiler Works, Inc., Fulton Heating Solutions, Inc. & Fulton Thermal Corporation are part of the Fulton Group of Companies, a global manufacturer of steam, hot water and thermal fluid heat transfer systems.

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