



INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Serial # _____

National Board # _____

Model _____

Fulton Order _____

Sold To _____

Job Name _____

Date _____

Vertical Tubeless Design Gas Fired Steam Boilers

Models ICT/FB-T
9.5-30 HP



Table of Contents

Section 1:	Safety & Warnings	1-1
	Introduction	1-2
	General Warnings and Cautions	1-2
	Steam Boiler Systems Warnings and Cautions	1-5
	Disclaimers and Local Codes.....	1-6
<hr/>		
Section 2:	Installation	2-1
	Product Overview	2-2
	Placement & Rigging.....	2-3
	Clearances & Serviceability	2-4
	Equipment Ventilation & Combustion Air Requirements.....	2-6
	Utilities.....	2-7
	Electrical Supply	2-8
	Water Chemistry.....	2-9
	Water Supply.....	2-9
	Piping Specifications.....	2-12
	Insulation	2-13
	System Interfaces.....	2-13
	Assembly of Fulton Multi-Skid Engineered Systems.....	2-16
	Stack & Flue Connections	2-16
	System Piping Testing.....	2-17
	Before Leaving the Installation.....	2-18
<hr/>		
Section 3:	Operation	3-1
	Start-Up Preparation & Installation Review.....	3-2
	Start-Up Service.....	3-2
	Prepare for Initial Start-Up.....	3-2
	Perform Boil-Out	3-2
	Sequence of Operation: Gas Fired Burners	3-3
	Flame Programmers.....	3-4
	Linkageless Modulation.....	3-4
	Operating Controls	3-7
	Test of the Ignition System Safety Shut Off.....	3-9
	Cycle Testing.....	3-9
	Daily Start-Up.....	3-9
	Daily Shutdown.....	3-10
<hr/>		
Section 4:	Maintenance & Troubleshooting	4-1
	Procedure for Cleaning Water Probes.....	4-2
	Flame Scanner Adjustment for Fulton Gas Fired Steam Boilers	4-2
	Recommended Daily Maintenance Schedule.....	4-2
	Recommended Weekly Maintenance Schedule	4-4
	Recommended Monthly Maintenance Schedule	4-4
	Recommended Semi-Annual Maintenance Schedule.....	4-6
	Recommended Annual Maintenance Schedule.....	4-7
	Troubleshooting Guide.....	4-10

Section 5:	Warranty	5-1
	Standard Warranty for Fulton Boilers	5-3
	Extended Warranty for Fulton Skid Mounted Boilers.....	5-3

Section 6:	Parts	6-1
-------------------	--------------------	------------

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

1 - SAFETY & WARNINGS

Introduction

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

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.

General Warnings, Cautions & Notes

The following are general WARNINGS and CAUTIONS, which may also appear in various chapters of this manual. It is critical that all personnel read and adhere to all information contained in WARNINGS and CAUTIONS throughout this manual. In addition, there are bolded **Notes** throughout the manual, which are included as additional information for essential and effective operation and conditions.

- **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.

WARNING

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 disconnection 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 dealer 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.

WARNING

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 the 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 neighbor's phone.*
- *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.***

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.

1 - SAFETY & WARNINGS

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) Z223.1-1991 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.

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.

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

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

WARNING

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.

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.***

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. High-risk situations for particulate matter to be in the air include construction and maintenance activities.

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.

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.

Steam Boiler Systems Warnings and Cautions

The following WARNINGS and CAUTIONS are specific to Steam Boiler Systems and may also appear in various chapters of this manual. It is critical that all personnel read and adhere to all information contained in WARNINGS and CAUTIONS throughout this manual. In addition, there are bolded **Notes** throughout the manual, which are included as additional information for essential and effective operation and conditions.

WARNING

Boiler blowdown water must be cooled to <140 F (60 C) prior to discharge to a drain. 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.

1 - SAFETY & WARNINGS

CAUTION

Where an atmospheric condensate return tank is to be fitted, 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 return system 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.

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 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 life of the boiler in any way.

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 or ASME Code Section IV for steam at 15 psig or hot water at a maximum allowable working pressure of temperature of 160 psig and 250 F (121 C) respectively.

Section

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

2 - INSTALLATION

Product Overview

Prior to the performance of installation, operation, or maintenance procedures, personnel should become familiar with the equipment and its components (Figure 1 and Figure 2).

Please read this entire manual before beginning any installation, operation or maintenance procedures.

If any questions arise, contact the Fulton Companies 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.



Figure 1 Legend:

- A. Gas Pressure Switch
- B. Pressure Gauge
- C. Water Column with Water Probes
- D. Sight Glass Assembly
- E. Pressure Switches
- F. Pressure Vessel Hand Hole
- G. Furnace Cleanout
- H. Control Panel
- I. SC-570 Boiler Display
- J. Air Intake Filter
- K. Air Blower Motor Housing
- L. Ignition Transformer
- M. Gas Valve

Figure 1 - The ICT/FB-T Gas-Fired Steam Boiler

Placement & Rigging

⚠ WARNING

Competent personnel in accordance with all applicable local codes should carry out the placement and rigging of the Fulton equipment. 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.

Proper placement of your Fulton Product (Figure 1, Figure 2, and Figure 3) is essential. Attention paid to the following points will save a great deal of difficulty in the future. Correct placement is the first step to trouble-free installation, operation and maintenance.

Adhere to the following for placement and rigging:

1. Install indoors only. This boiler is certified for **indoor** installation only, unless it is configured as a NEMA 4 boiler.
2. Check building specifications for permissible floor loading.

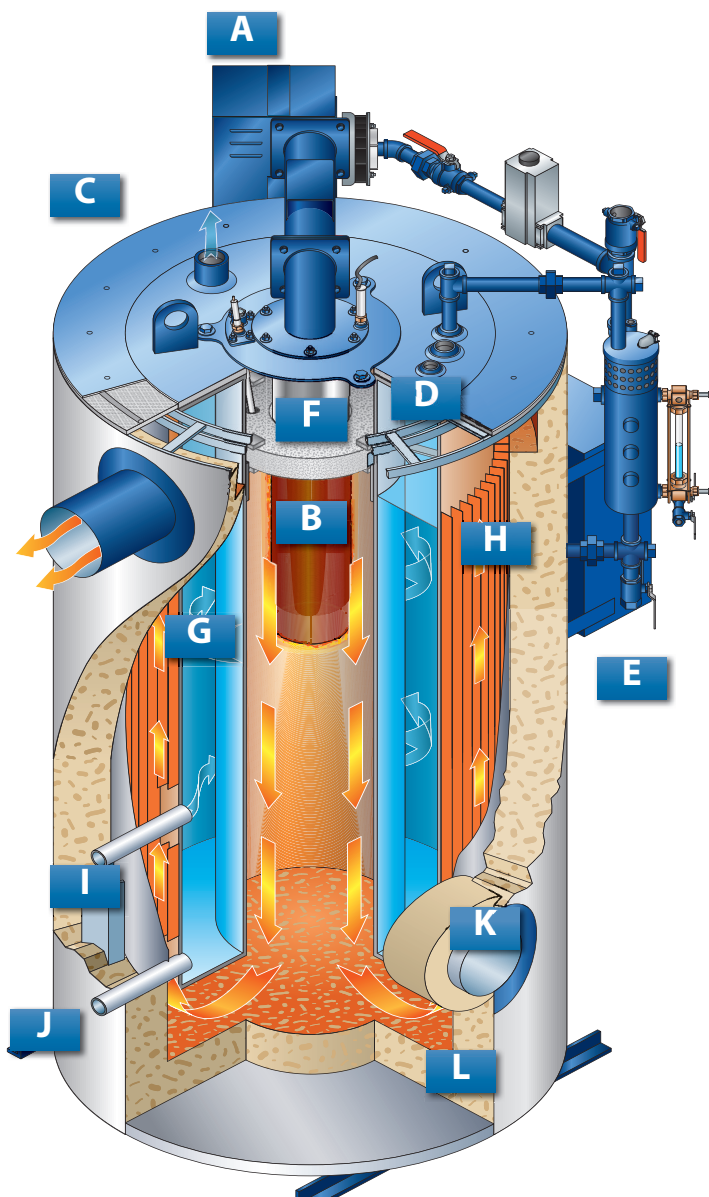


Figure 2 Legend:

- A. Variable Speed Blower Motor
- B. Fiber Mesh Burner
- C. Top Mounted Steam Outlet
- D. Large Steam Space
- E. Single Control Panel Box
- F. Top Castable Flame Retainer
- G. Water Vessel
- H. Heat Convection Fins
- I. Baffled Feed Water Inlet
- J. Bottom Blow Down Outlet
- K. Large Hand Holes
- L. High Temperature Insulation

Figure 2 - A look inside the ICT/FB-T Gas-Fired Steam Boiler

2 - INSTALLATION

3. Place equipment on a non-combustible level base with adequate clearances from combustible materials. See **Clearances & Serviceability section** of this manual.
4. Place equipment in a well ventilated room through which personnel do not normally pass. This is not essential, but the layout should eliminate traffic in potentially hazardous areas. For instance, the service engineer or the operator should not have to pass exposed, hot pipe work to make adjustments to the boiler.
5. Locate boiler as close as possible to the place where the heat will be used in order to keep pipe work costs to a minimum.
6. *When installed with the intent to use sealed combustion:* locate boiler so that the air supply and exhaust piping between the boiler and outside wall/roof are within the maximum lengths for horizontal or vertical venting. See **Clearances & Serviceability section** of this manual.
7. Ensure there is adequate clearance around the unit to provide access for operators and maintenance personnel to access all parts of the equipment. Ensure also that clearance provides for component removal for maintenance. See **Clearances & Serviceability section** of this manual.
8. Locate all equipment in such a way that the electrical components are protected from exposure to water or excessive humidity.
9. Vertical Tubeless Boilers may be shipped vertically or horizontally and are crated for forklift transport. Once uncrated (and raised to vertical for horizontally shipped boilers), transport unit by forklift or 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. All skidded units can be moved with forklifts.
10. Never allow weight to bear on the jacket, control panel, burner, fuel train or fan housing of any Fulton boiler (heater).

Clearances & Serviceability

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

Appropriate front, back, side and top clearances must be maintained (Table 1). This will allow access around the equipment to facilitate maintenance and a safe work environment.

Table 1 - Minimum Clearance Around Boiler

Unit Size (BHP)	Front of Panel inch (mm)	Rear/Sides of Boiler inch (mm)
9.5	36 (915)	24 (60)
10	36 (915)	24 (60)
15	36 (915)	24 (60)
20	36 (915)	24 (60)
30	36 (915)	24 (60)

WARNING

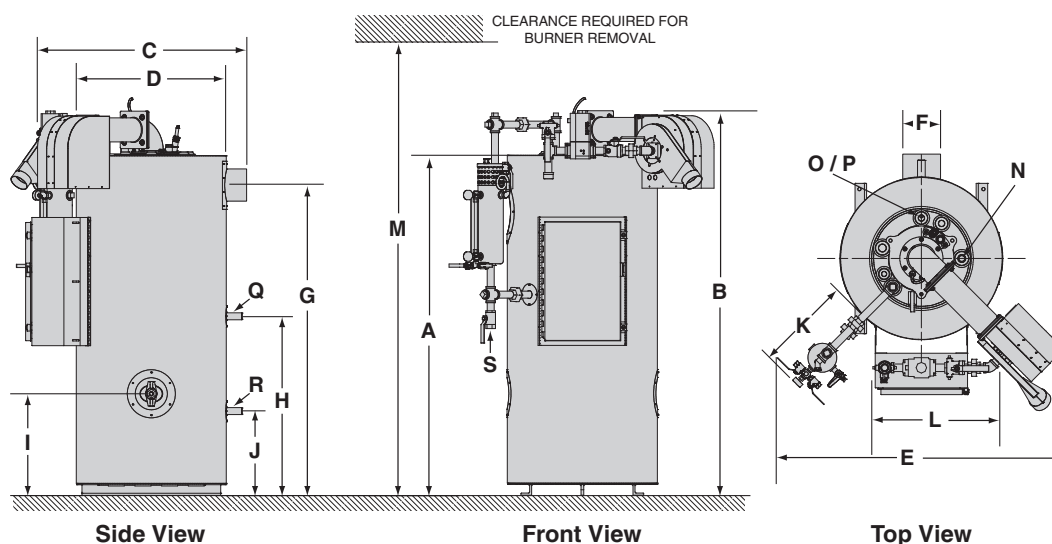
Failure to provide required and safe access to the equipment could impede commissioning and maintenance. Service technicians are instructed not to commence commissioning if hazardous conditions exist.

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.

It is necessary to have the following vertical clearance from the floor to the ceiling for removal of the burner for servicing (Table 2).

Table 2 - Minimum Clearance for Burner Removal

Unit Size (BHP)	inch (mm)
9.5	86 (2184)
10	86 (2184)
15	92 (2337)
20	96 (2438)
30	106 (2692)



Unit Size (BHP)	9.5	10	15	20	30
A. Boiler Height; inches (mm)	67.5 (1715)	63.5 (1613)	69.5 (1765)	72.5 (1842)	82.5 (2069)
B. Boiler Height With Trim & Fuel Train Assembly; inches (mm)	85 (2159)	80.5 (2045)	86.5 (2197)	92.5 (2350)	102 (2591)
C. Overall Depth Stack to Burner Fan Housing; inches (mm)	44 (1118)	46 (1168)	47 (1194)	58 (1474)	67 (1702)
D. Boiler Diameter; inches (mm)	26 (660)	28 (710)	30 (760)	39 (990)	46 (1170)
E. Overall Width with Water Column; inches (mm)	33 (838)	33.5 (851)	35.5 (902)	43 (1091)	49 (1244)
F. Flue Outlet Diameter	6 (152)	6 (152)	8 (203)	10 (254)	12 (305)
G. To Center of Flue Outlet; inches (mm)	62 (1575)	58 (1473)	63 (1600)	66 (1675)	73.5 (1867)
H. Feedwater Inlet; inches (mm)	33.5 (851)	33 (840)	33.5 (851)	34 (865)	34 (865)
I. Handholes; inches (mm)	19 (485)	19 (485)	19 (485)	19 (485)	19 (485)
J. Blowdown Outlet; inches (mm)	15.5 (394)	15.5 (394)	15.5 (394)	16.5 (420)	16.5 (420)
K. Water Column Extension; inches (mm)	14 (355)	14 (355)	14 (355)	14 (355)	14 (355)
L. Gas Train Extension (CSD-1); inches (mm)	25 (635)	21.5 (546)	20.5 (521)	25 (635)	27 (686)
M. Clearance Required for Burner Removal; inches (mm)	86 (2184)	86 (2184)	92 (2337)	96 (2438)	106 (2692)
Approx. Shipping Weight lbs (kg)	1900 (862)	2000 (910)	2280 (1036)	3400 (1545)	4780 (2173)

Note: Unit specifications continue in Table 4.

Figure 3 - Model ICT/FB-T Dimensions

2 - INSTALLATION

Equipment Ventilation & Combustion Air Requirements

Ventilation must be sufficient to maintain a building temperature of 100F (38 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. Install two fresh air openings, one at a low level, 24 in (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.

⚠ CAUTION

A temperature exceeding 100F (38 C) in the boiler room may cause premature failure of electrical components. Provisions should be made to maintain an ambient temperature of 100F (38 C) or less (the panel box interior should not exceed 125 F [52 C]).

To burn fuel properly, the burner must have an adequate supply of air. Based on National Board Inspection Code (NBIC) recommendations, unobstructed air openings shall be sized on the basis of 0.5 square inch of free area per 1,000 BTU/hr input 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.

See Table 3 for minimum make-up air required and the recommended area of each opening for each model.

Table 3-Minimum Make Up Air Requirements and Recommended Area of Each Opening for Vents

Unit Size (BHP)	Minimum Make Up Air Requirements (SCFM)*	Opening Area in ² (cm ²)**
9.5	80	199 (1284)
10	84	210 (1354)
15	126	315 (2032)
20	168	420 (2709)
30	252	630 (4064)

*Minimum make up air requirements are based on a maximum of 25% excess air at high fire.

**Opening areas are calculated based input of a single boiler/heater and do not account for the ventilation needs of the equipment room. These measurements are subject to state and location regulations.

If positive forced ventilation is adopted, you must ensure that there will be no appreciable pressure variation in the equipment room.

⚠ WARNING

An exhaust fan may draw products of combustion into the work environment creating a possible hazard to personnel. A spill switch installed in the stack is highly recommended.

⚠ CAUTION

It is essential that only fresh air be allowed to enter the combustion air system. Foreign substances, such as combustible volatiles and lint in the combustion system 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.

Particulate matter like lint, dust or smog or chemicals (example: perchlorethylene, halogenated compounds) in the combustion air supply to the equipment will cause damage or failure of the burner and is not covered under warranty. High risk situations for particulate matter to be in the air include construction and maintenance activities.

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

Utilities

THE GAS SUPPLY

WARNING

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

Gas piping must be installed in compliance with all applicable codes.

Adhere to the following for installation:

1. The pipe and fittings used must be new and free of dirt or other deposits.
2. 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.
3. 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 heads.
4. Piping must be installed such that no piping stresses are transmitted to the equipment. The equipment shall not be used as a pipe anchor.
5. Diaphragms, gas valves, pressure regulators, and pressure switches on all gas-fired units have vent connections which must be vented per local code.
6. On gas-fired units with NFPA 85 valve trains, there is a vent valve which must be piped to atmosphere per local code.
7. The boiler/heater must be disconnected at the boiler/heater manual shutoff valve (located at the end of the supplied gas train) from the gas supply piping system during any pressure testing of the system at pressures in excess of 1/2 psig (14 inch wc).
8. The supply pressure must be regulated by a non-stacking, tight, shut-off regulator.
9. After gas piping is completed and before wiring installation is started, carefully check all piping

connections (factory and field) for gas leaks. Use a soap and water solution.

10. All gas piping must be arranged so that it does not interfere with any cover or burner, inhibit service or maintenance, or prevent access between unit and walls or another unit.

WARNING

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

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. Clean all piping thoroughly after completing the leak check.

11. The burner assembly and gas controls terminate at a manual stop valve to which the gas supply should be connected. Piping should be sized for a gas flow consistent with the required BTU/Hr input. Large pressure drops must be avoided. Fulton recommends that the supply piping between the pressure regulator and the inlet to the boiler be kept to a minimum.
12. The specific gas pressure requirements for each boiler are indicated on the boiler nameplate, located on the back of the boiler. Parameters depend on what fuel(s) the boiler is designed to burn.
13. For **natural gas** a pressure of 4" to 11" wc is required at the gas train at full input. Do not exceed 13" wc. For **propane**, a pressure of 11" to 13" wc is required at the gas train at full input. Do not exceed 14" wc. For installations equipped with gas pressures exceeding 14"wc, consult the factory for gas pressure requirements.

2 - INSTALLATION

Electrical Supply

WARNING

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

Adhere to the following:

1. Install wiring and grounding equipment in
2. Make sure the information on the electrical drawing corresponds to your voltage and frequency. Check the supply voltage and make sure that there is no over-or under-voltage exceeding 10% of the nominal value.
3. Locate schematic. Each boiler is shipped with its own unique electrical schematic diagram, a copy

accordance with jurisdictional authority. In the absence of such requirements, install in accordance with National Electrical Code, ANSI/NFPA 70.

Table 4 - Specifications (Refer to Figure 3)

Unit Size (BHP)	9.5	10	15	20	30
BOILER CONNECTIONS					
N. Steam Outlet 15 PSI; inches (mm)	NA	1.5 (38)	2 (51)	3 (76)	3 (76)
N. Steam Outlet 150 PSI (9.5 HP - 100 PSI); inches (mm)	1 (25)	1 (25)	1.25 (32)	1.5 (38)	2 (51)
O. Safety Valve Outlet 15 PSI; inches (mm)	NA	0.75 (19)	1.25 (32)	1.5 (38)	1.5 (38)
O. Safety Valve Outlet 150 PSI+ (9.5 HP - 100 PSI); inches (mm)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)
P. Safety Valve Inlet 15 PSI; inches (mm)	NA	0.75 (19)	1 (25)	1.25 (32)	1.25 (32)
P. Safety Valve Inlet 150 PSI (9.5 HP - 100 PSI); inches (mm)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)	0.75 (19)
Q. Feedwater Inlet; inches (mm)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)
R. Blowdown Outlet; inches (mm)	1 (25)	1 (25)	1 (25)	1.25 (32)	1.25 (32)
S. Water Column Blowdown ; inches (mm)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)
RATINGS* (Sea level to 3000 ft (914.4 m))					
Output; 1000 BTU/HR (KCAL/HR)	318 (80.1)	335 (84.4)	503 (127)	670 (169)	1005 (253)
Steam Output; LB/HR (KG/HR)	328 (149)	345 (157)	518 (235)	690 (313)	1035 (470)
Approx. Fuel Consumption at Rated Capacity+++					
NG/LPG Gas Boiler Connection Size (std CSD-1); inches (mm)	1 (25)	1 (25)	1 (25)	1.25 (32)	1.5 (38)
Fuel Usage ft ³ /hr; NG (LPG)	384 (153)	403 (161)	606 (242)	807 (323)	1210 (484)
Burner Motor HP	1/3	1/3	1/3	3/4	3/4
Electric Power Requirements - Burner Only (in Amps)					
120V, 60 CY, 1 Phase	5.2	5.2	5.2	9.2	9.2
240V, 50/60 CY, 1 Phase	2.6	2.6	2.6	4.6	4.6
208V, 50/60 CY, 3 Phase	1.9	1.9	1.9	3.1	3.1
240V, 50/60 CY, 3 Phase	1.6	1.6	1.6	2.8	2.8
480V, 50/60 CY, 3 Phase	0.8	0.8	0.8	1.4	1.4
Water Content; Gallons (Liters)	16 (61)	24 (91)	39 (148)	77 (292)	170 (644)

LEGEND

Specifications and dimensions are approximate. We reserve the right to change specifications and/or dimensions.

+High pressure boilers purchased with low pressure openings may have larger than specified opening sizes; consult factory for correct opening sizes.

+++ Consumption based on Natural Gas 1000 BTU/ft³; Propane 2500 BTU/ft³

* All ratings from 0 psig and at 212 F (100 C) Control circuit electrical requirement will vary with the system voltage; please consult factory.

of which is located in an envelope on the inside door of the panel box.

4. 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.
5. Fuses must be sized according to motor name plates and local electrical codes.
6. Connect power to the terminal strip as supplied on the inside of the panel box. **Note:** Single skid systems are generally shipped completely prewired.
7. Multiple skid systems may require wiring between the skids. Please note that Fulton will run conduit and wire the devices on each skid. For the devices that have to come down 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.
8. If the unit is not skid-mounted at the factory, the client/contractor is required to wire the circulating / feed water pump starter. **Note:** If the circulating pump motor is not supplied by Fulton, the motor starter will not be supplied.

Water Chemistry

RECOMMENDED WATER CONDITIONS FOR BOILERS/UNFIRED STEAM GENERATORS

Table 5 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 be 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.

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.

2 - INSTALLATION

The Fulton Warranty does not cover damage or failure that can be attributed to excessive corrosion, scale or fouling.

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.

Piping Specifications

For piping the basic considerations are: the design temperature, the pressure retained by the pipe, the fluid

Table 5 - Water Chemistry Requirements for Fulton Boilers (Heaters)

Parameter	Carbon Steel			Stainless Steel		
	Feedwater	Vertical Boiler/ SteamPac Water	Horizontal Boiler/ SteamPac Water	Feedwater	Vertical Boiler/ SteamPac Water	Horizontal Boiler/ SteamPac Water
pH	7.5-9.5	8.5-10.5	8.5-10.5	6.0-9.5	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
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	Colorless liquid++	Colorless liquid++	Colorless liquid++	Colorless liquid++	Colorless liquid++	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

* Feedwater temperatures below 200 F (93 C) will require an oxygen scavenger.

**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. Hold the sample against a white background. The water should have no visible yellow, red or orange tinge.

ND: None Detected

ppm: parts per million

2 - INSTALLATION

in the pipe, the load resulting from thermal expansion or contraction, impact or shock loads imparted (such as water hammer, external loads, wind loads and vibration from equipment).

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 SA 53B, or SA 106S Schedule 80. For higher pressures, SA 106B Schedule 80 is recommended.
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.
8. All threaded joints may be used for connections 2.5 in (63.5 mm) and smaller. For larger diameters, all pipe joints should be welded or flanged construction. Stainless steel piping should be welded or flanged for connections greater than 1 in (25.4 mm).
9. 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. Flexible graphite gaskets are suited for most applications. Recommended gasket thickness is 1/10 - 1/8 inch. Ensure that all bolts are tightened evenly and to the torque recommended values provided by the gasket manufacturer.
10. High point bleeds are to be installed at all high points in the system piping. 1/2 in x 12 in (2.5 mm x 304.8 mm) nipples welded in the top of the piping with ball valves and plugs attached are to be used.
11. All pipes should be installed with a pitch to facilitate draining and venting.

Insulation

WARNING

After the appropriate system tests have been satisfactorily completed, all hot pipework and vessels must be adequately insulated with material suited to the temperature and application to prevent both heat loss and personnel injury.

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

Adhere to the following:

1. Return 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.
2. Blowoff vessels should **not** be insulated.

System Interfaces

Refer to System Diagram (Figure 4).

CONDENSATE RETURN FEED SET TANK

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

1. Vent to a safe location.
2. Have a capacity sufficient to satisfy boiler consumption as well as maintain proper return tank temperature. Capacity should provide 2 ½ times the evaporation rate of the boiler at a minimum discharge pressure of 3% higher than the safety valve set pressure. 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.
3. 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 **Return System Instructions Manual** for detailed instructions.

THE FEED WATER PIPING

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

1. Size piping adequately to provide proper water supply. Minimum piping sizes:

Unit Size (BHP)	inch (mm)
9.5	1/2 (12.5)
10	1/2 (12.5)
15	3/4 (19)
20	3/4 (19)
30	1 (25)

2. *When feeding the boiler using a Fulton return system with float valve assembly:* ensure the water pressure does not exceed 40 psi. A pressure reducing valve should be installed ahead of the return tank when pressures exceed 40 psi. Other configurations may allow for higher pressures.
3. 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.

4. Do not use stainless steel within the Boiler External Piping (BEP) boundary.
5. Ensure all piping is done in compliance with all applicable codes.

BLOW OFF SEPARATOR

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 blow off separator.
4. Do not downsize vent pipe (this may cause pressure build up in the blow off separator 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 blow down separator.

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 blow off separator of approved design.
3. Ensure that for each blow off line there is a slow-opening and a fast-opening 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.

STEAM SAFETY VALVE (FIGURE 4)

Where a steam safety valve is to be fitted, adhere to the

2 - INSTALLATION

following:

1. Have a capacity sufficient to satisfy maximum boiler output in lbs/hr or Btu/hr.
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.

WARNING

Under no circumstances should there be any shut off valve or restriction smaller than the safety valve inlet between the boiler and the safety 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. When a discharge pipe is used, ensure it is of a pipe size equal to, or greater than, the outlet of the safety valve.
8. Use Schedule 40 piping only for the discharge. Do not use Schedule 80, extra strong or double extra strong piping as the internal diameter is of reduced size and will increase discharge restriction.
9. Minimize discharge piping fittings and overall piping run to avoid over pressurization of the piping, limiting safety valve discharge volume.
10. Do not support discharge piping with the safety valve. Discharge piping must be supported adequately by appropriate means.
11. Terminate the discharge pipe directly to atmosphere. Discharge pipe must not contain a shut off valve of any sort.

STEAM PRESSURE GAUGE ASSEMBLY (FIGURE 4)

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

WARNING

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

When installing the water column and gauge connections (refer to Figure 4), 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.
5. Verify that the top and bottom fittings are

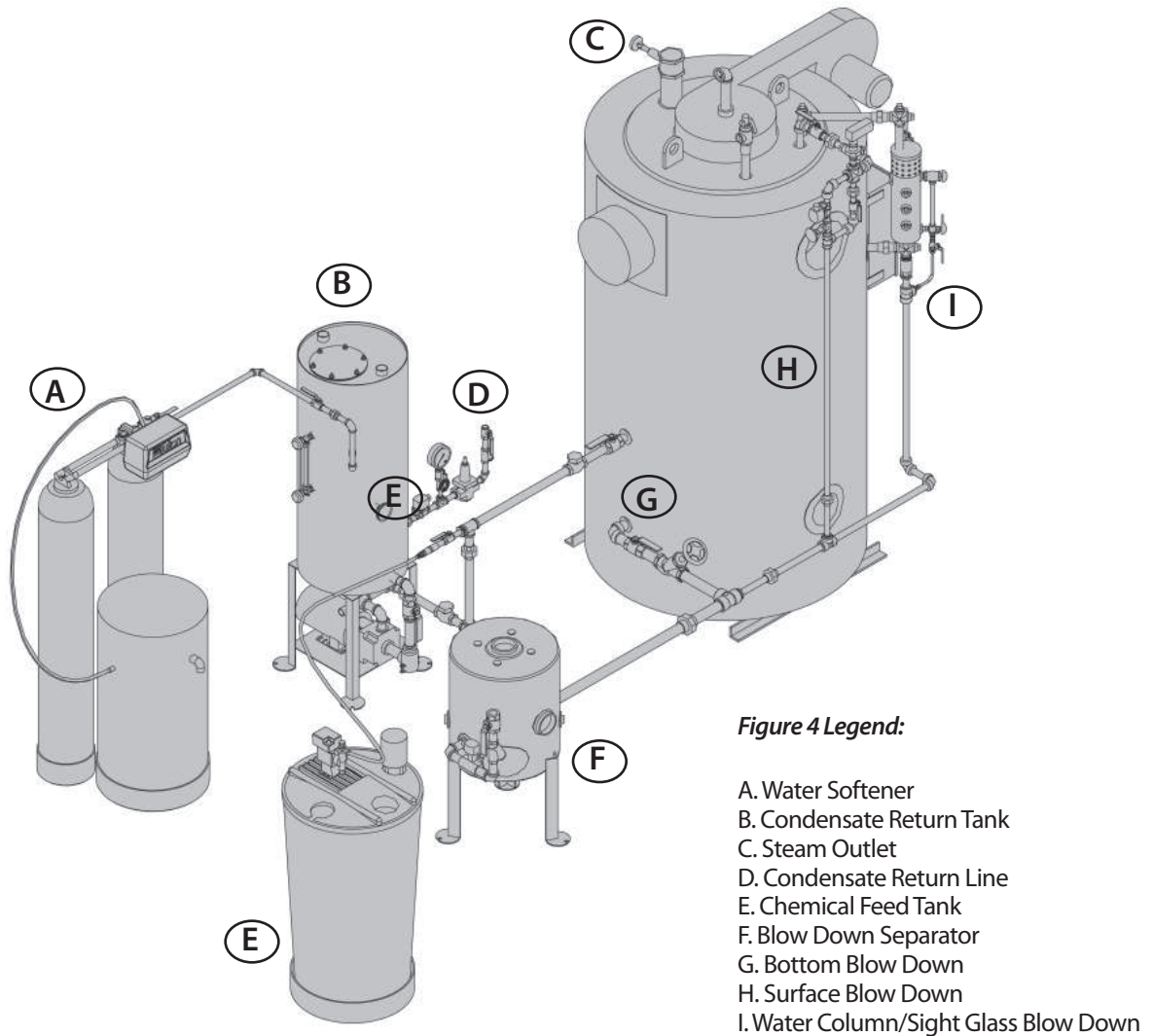


Figure 4 - System Diagram

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 1 in (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

2 - INSTALLATION

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 glass fitting to the boiler blow off piping.

tightening. Refer to the appropriate instructions to tighten the flanges and 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 skids and tighten the conduit connectors.
8. Locate the supplied wiring for the equipment and pull wiring through the appropriate conduit runs. Electrical wires are labeled.
9. Connect all wiring per the Fulton supplied electrical drawing.
10. If a steam header is supplied, mount the header as shown in the mechanical drawing.

Note: If header is supplied in sections it should be connected hand tight until all sections are in place to ensure sections align properly. Sections are match marked for reassembly.

Assembly of Fulton Multi-Skid Engineered Systems

Adhere to the following:

1. Refer to the Fulton mechanical/electrical drawings during assembly.
2. Ensure that the equipment orientation allows for operation interface and maintenance.
3. Align the skids as shown in the drawings, ensuring that the skid fasteners are matched.
4. Ensure the skids are leveled. 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 skid). If assembling multi-component support stands, attach sections using the supplied bolts through the tank frame mounting plates. Fasten the skids together using the supplied bolts. These should be hand tight until all piping has been assembled and tightened.
5. Connect the piping between skids by matching the union connections and/or flange stamps and

11. Tighten all connections.
12. Pneumatically test the piping (at 15 psig maximum) prior to filling the system.
13. 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:

1. 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 flue piping and 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 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.
4. Any alternative stack arrangement must supply negative 0.02 to 0.04" wc draft at the boiler.
5. The run in the total distance of stack ducting, as measured in a straight line from the outlet of the heater to the outlet of the stack, should not exceed 70% 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. See Figure 5.
6. The stack, chimney, and any components associated with the stack, such as heat reclaimers or assist fans must be constructed from material that is rated for a 1000 F (538 C) operating temperature.
7. The stack and chimney material shall comply with all applicable codes.
8. 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.
9. The draft when firing should be negative and constant. A reading of -0.02 to -0.04" wc when the unit and stack are cold usually indicates sufficient draft. When the unit is running and the stack is hot, the draft should read 0.04 to 0.08 " wc negative.
10. The installation of a draft regulator by the client/contractor is recommended at all installations. This will help to maintain the required draft. The placement of the draft regulator should be as shown in Figure 5.

WARNING

To maintain a reasonable temperature in the equipment area and ensure safety to personnel, the section of the chimney duct within the building should be insulated.

CAUTION

Concentration levels of only a few ppm of chlorine containing compounds in combustion air can produce serious corrosion of the flue over long periods of time. High chlorine containing compounds such as carbon tetrachloride or perchloroethylene would be prime suspects.

EXHAUST SIDE WALL VENTING

Boilers for which sidewall venting (Figure 6) may be utilized are propane, natural gas, or combination propane and natural gas sizes 9.5 to 30 HP. Adhere to the following for installations requiring sidewall venting:

1. Flue vent piping must be pitched upward at ¼ in (6.35 mm) per one foot (3.048 m) of length.
2. An UL-approved draft fan must be installed to provide sufficient draft (-0.02 to -0.04" wc) to safely vent products of combustion.
3. The draft fan should be located as close to the flue outlet as possible.
4. Draft regulation sufficient to lower the draft to between -0.02 to -0.04 " wc may be required. The draft regulator must be between the boiler and the fan.
5. The draft fan shall have an air flow proving switch wired in series with the boiler air safety switch.
6. The sidewall vent total length from boiler exhaust to termination shall not exceed 35 feet (10.6 m) with 4 elbows maximum.

System Piping Testing

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

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

2 - INSTALLATION

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 by raising and lowering operating temperature on the thermostat.
3. Make sure the installation complies with all applicable codes.

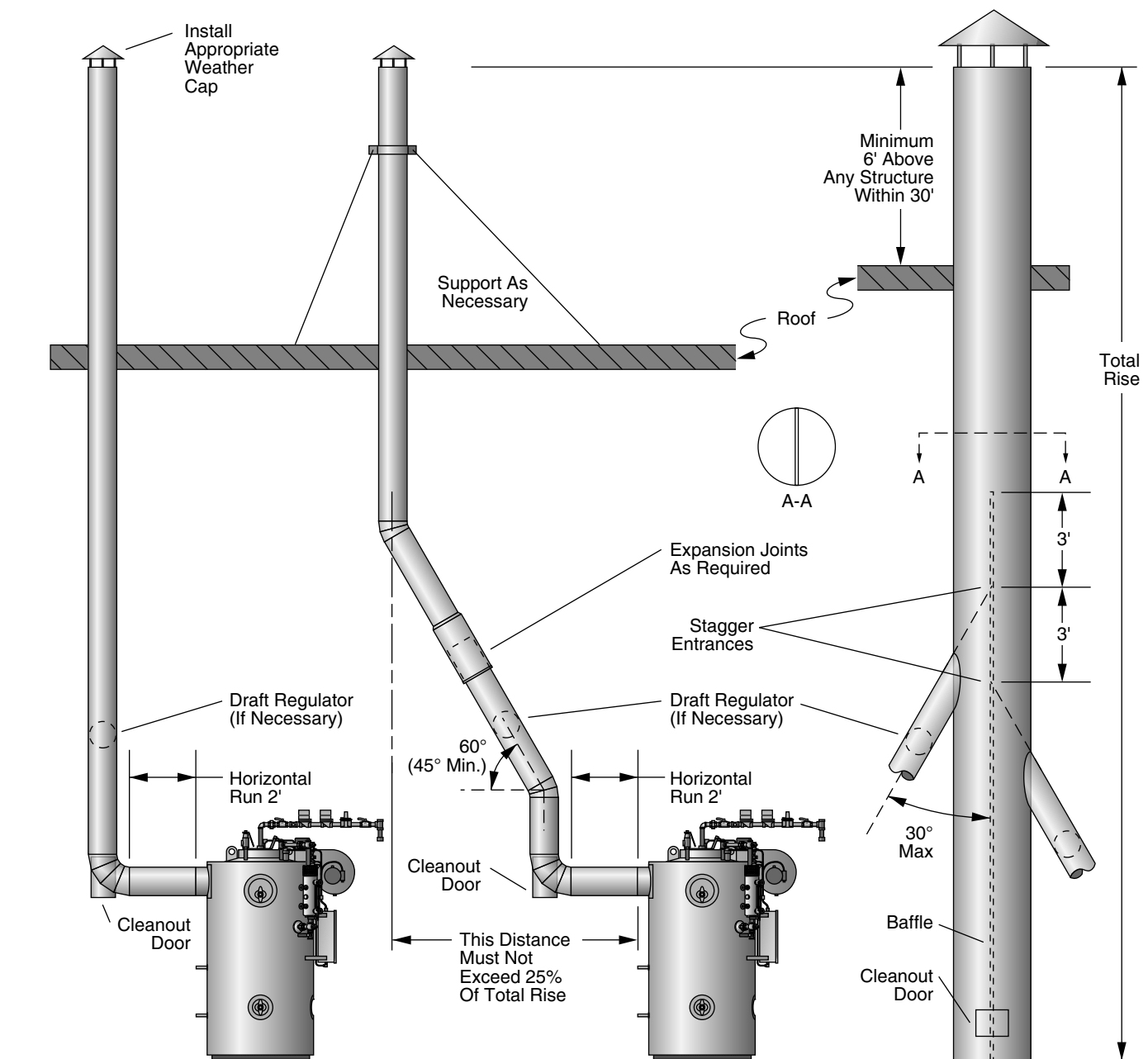


Figure 5 - Typical Stack

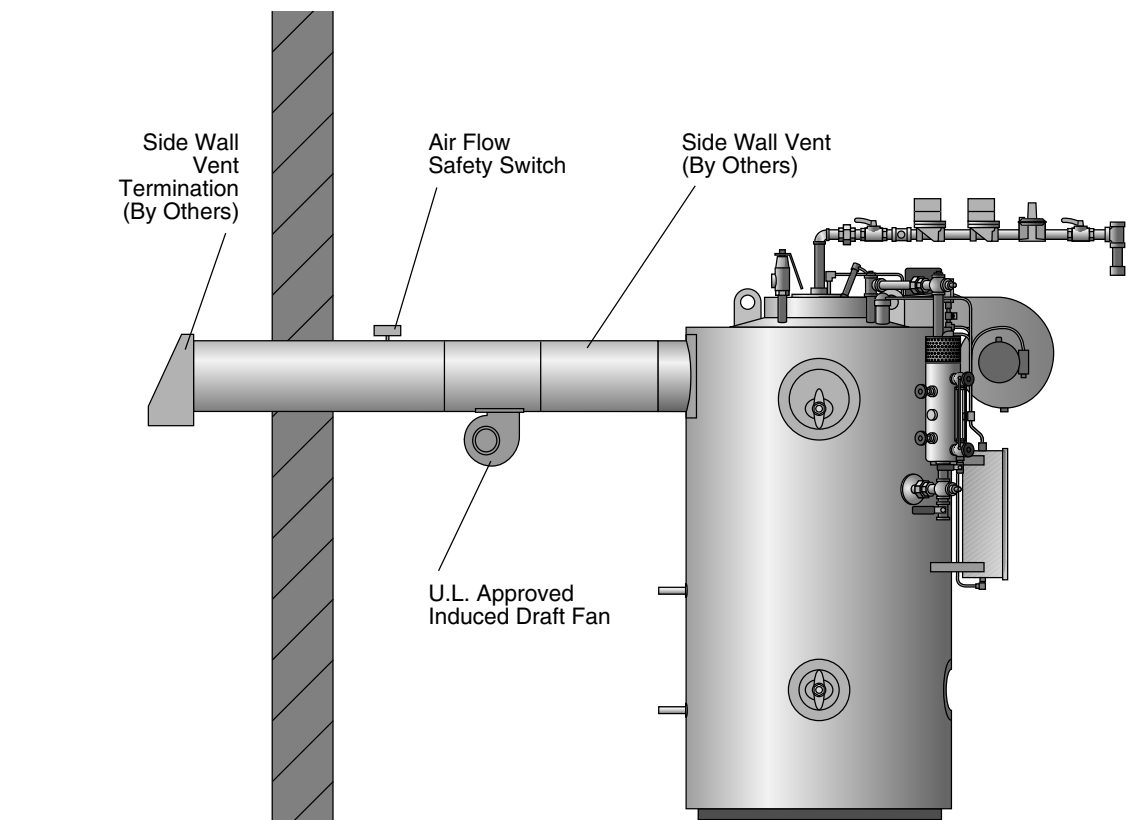


Figure 6 - Typical Sidewall Venting

2 - INSTALLATION

Section

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

3 - OPERATION

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 fluid circuit from pressure leak testing such as blanking plates in flanged joints.
4. Pipework is free to expand naturally when hot. Open all valves to user circuits, including air bleed valves at high points and drains at low points in the piping system.
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.
10. 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. Local authorities have been consulted where approval for start-up is required. In some localities, final inspection of services may be required.
12. **Installation Checklist** (provided with equipment) is complete.

WARNING

Do not attempt to start the boiler for any testing prior to filling and purging the boiler. A dry fire will seriously damage the equipment and may result in property damage or personnel injury and is not covered by warranty.

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. If possible, contact the factory at least one week 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 heater room personnel with the operation of all Fulton equipment. Personnel must be qualified to understand the basic operation and function of controls.

Prepare for Initial Start-Up

These instructions are for use when the unit is being started up 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

We recommend boil out be accomplished prior to boiler system operation. This procedure ensures that all oils, sealants and other organic compounds are solubilized and 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.

Note: Our experience has indicated that if boil out is not performed as recommended, there is little benefit from boil out once the boilers have been in operation for over 50 hours.

BOIL OUT PROCEDURE

1. Fill boiler/feed system with water and energize boiler/burner until boiler starts to build steam pressure.
2. Turn off boiler power and lock out control panel in "off position."
3. Open blowdown valve and drain boiler completely. Ensure feedwater pump is shut off.
4. Mix boil out chemical (soda ash or Oxyclean) at a rate of 0.5 oz per BHP in a container with water.
5. Remove safety valve, surface blowdown, or steam stop opening and pour or pump into boiler. Re-install boiler system integrity.
6. Re-energize boiler control panel and feedwater pump to allow boiler to fill to normal water level.
7. Turn on boiler and allow to come up to operating pressure.
8. Turn off boiler and allow steam pressure to dissipate to < 5 PSIG. Allow boiler to sit idle for at least ten minutes.
9. Open blowdown valve and drain boiler. Turn feedwater pump to "off position."
10. Refill boiler and repeat steps 6 – 9. **Note:** This will provide a clean, boiled-out boiler.
11. If an entire steam system boil out is desired, then complete the following procedure:
12. Ensure steps 1 – 10 have been completed.
13. Add 8 – 16 oz of boil out chemical to the DA or return system tank. Ensure chemical is fully dissolved prior to adding to the tank.
14. Turn on boiler and operate under normal operating conditions.
15. Valve in steam loads one at a time to ensure each load has good steam flow. Bypassing steam traps can accelerate system boil out. However, be careful not to blow raw steam back into the

return tank.

16. Once all loads have been valved in and operated for a few minutes, shut the boiler off and allow steam pressure to lower to zero.
17. De-energize control panels and drain entire system. Refill, repeat steps 13 -16 once more.
18. Perform a final drain on the system, refill and place system in operation.

Sequence of Operation: Gas Fired Burners

The burner is of forced draft design. The Sequence of Operation for the burner (See Figure 7) is as follows:

1. Check main valve, which provides proper pressure to burner. The maximum is 0.5 psig; step down regulator if 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.
3. 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 red push button on the casing of the burner control box.

MODULATING BURNER

The function of the flame programmer must be greatly extended in a modulated system. Along with limit controls, operating controls and interlock devices, the programmer automatically controls the operation of the

3 - OPERATION

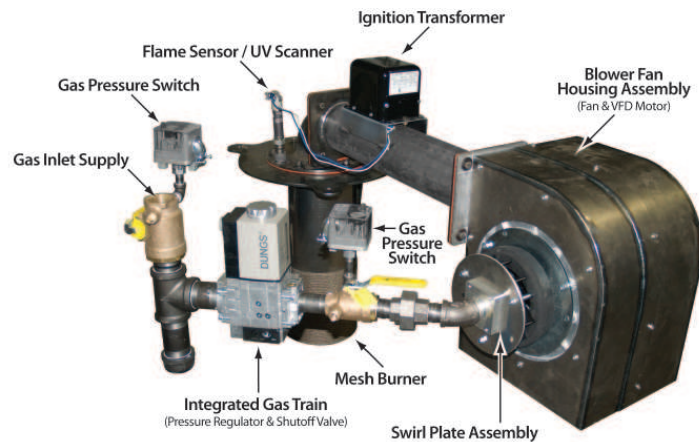


Figure 7 - Gas Train Assembly

burner, blower motor, ignition and main fuel valves.

The sequence of operation begins with power on, limit switch and fuel valves closed, and modulating limit controller closed and calling for heat. The flame programmer begins its cycle and the blower motor starts pre-purge. The modulating circuit closes, driving the blower to maximum for pre-purge.

The air flow proving switch must be closed now. After timed prepurge, the blower drives to its low fire position. All start interlocks must be proven or the flame programmer will lockout.

With spark ignition, the spark is energized and a timed trial for ignition begins. With the flame proven, the control advances through its main light off sequence, and the ignition shuts off. At this time, with the flame proven, the blower is released to automatic.

When the blower is released to automatic, it receives its signal from the modulating temperature controller. The flame programmer then drives the variable speed fan in proportion to heat demand.

As the temperature set point is approached, the blower motor will continue to reduce the input until low-fire position is reached. Input automatically increases and decreases according to load demand.

When the steam pressure reaches the set point of the temperature controller or of the optional operating limit controller, all fuel valves will close and the flame programmer will advance to the purge cycle. When the

postpurge cycle begins, the blower motor will drive to high fire. At the end of postpurge, the burner motor stops and the entire system is ready for restart on demand.

Flame Programmers

FLAME SAFEGUARD CONTROL

This is the main control in the panel box. The programmer in conjunction with a sensing device (flame rod or UV scanner) supervises the flame ignition sequence, proves 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.

Siemens Linkageless Modulation

⚠ WARNING

This information is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

The Siemens LMV37 system is a fully packaged burner management system, linkageless control and first out annunciator. When operating the Siemens LMV systems,

all changes are made through the Siemens AZL display. 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. When running the boiler, the status of the burner is to be monitored with the Siemens AZL display.

NEW CONTROL PROGRAMMING (FIRST TIME ONLY)

WARNING

This information is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

Perform the following steps for first-time programming of the Siemens LMV37:

1. Power up the control. When the control is being powered up for the first time the access password is ENTRY.
2. Enter into the program by holding the F and A buttons simultaneously.
3. Use the – button to scroll to parameter level “00” and press enter.
4. Use the – button to scroll to parameter 41. Change the value to the first four digits of the National Board number of the heater.
5. Use the – button to scroll to parameter 42. Change the value from ENTRY to AAAAA.
6. To back out from a level of the program, press and hold the – and + buttons simultaneously.
7. Proceed to Initial Programming.

INITIAL PROGRAMMING

WARNING

This information is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability,

and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

Perform the following steps once you have completed first-time programming of the Siemens LMV37:

1. Press and hold the F and A buttons simultaneously. You be prompted for your password (AAAAA).
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 - button 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

WARNING

This information is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

3 - OPERATION

Perform the following steps for commissioning the unit with the Siemens LMV37:

Note: A combustion analyzer will be needed when performing changes to the profile.

1. Press and hold the F and A buttons simultaneously. You be prompted for your password (AAAAA).
2. Enter your password and press the enter button.
3. Using the – button scroll to parameter level 400. Press the enter button. RUN will appear. Press the enter button again.
4. Turn the heater 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 Pre-purge (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 heater to light.
6. You will be at P0. P0 is the start of the profile and the Ignition position.
7. Make changes to the fuel profile. Two changes will need to be made: fan output and fuel settings. Increasing or decreasing the fan output will primarily increase or decrease the input to the unit. Making fuel valve changes will primarily affect the fuel-air ratio, and will have some small effect on the input to the unit.

To make changes:

- » Drive the unit to the high-fire position, P9. Check the O2 level in the stack. To increase the O2 level, turn the valve offset adjustment (Figure 8) screw counter-clockwise. To decrease the O2 level in the stack, turn adjustment screw clockwise. Adjustments should be made in 1/8th turn increments or less. Once the desired O2 level is reached, increase or decrease the fan output to achieve desired input at that point by holding the F and A buttons simultaneously and making changes with the + or - buttons.
- » Drive the unit to the low-fire position, P1. Check the O2 level in the stack. To increase the O2 level, turn the valve offset adjustment (Figure 8) screw counter-clockwise. To

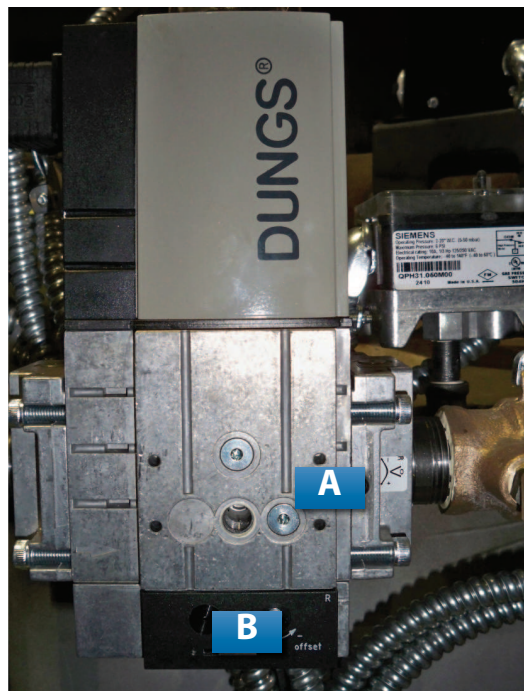


Figure 8 - Main Valve and Offset Valve Location

Figure 8 Legend:

- A. Main Valve Adjustment
- B. Valve Offset Adjustment

decrease the O2 level in the stack, turn adjustment screw clockwise. Adjustments should be made in 10 degree increments or less. Once the desired O2 level is reached, increase or decrease the fan output to achieve desired input at that point by holding the F and A buttons simultaneously and making changes with the + or - buttons.

- » Step the unit through all eight points while checking O2 to ensure that the desired changes have been made. Adjust the fan output at each point as needed to achieve a smooth fuel air curve. Valve adjustments should only be made at high and low fire, as described. The mid-fire points will react to the adjustments made at high and low fire.

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

ADJUSTING THE PROFILE

WARNING

This information is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

Perform the following steps for adjusting the profile with the Siemens LMV37:

Note: A combustion analyzer will be needed when performing changes to the profile.

1. Press the F and A buttons simultaneously. You be prompted for your password (AAAAA).
2. Enter your password and press the enter button.
3. Press the F and A buttons simultaneously again. This will bring you to parameter level 400.
4. Press enter, which will bring you to position P1.
5. Make changes to the fuel profile. Two changes will need to be made: fan output and fuel settings. Increasing or decreasing the fan output will primarily increase or decrease the input to

the unit. Making fuel valve changes will primarily affect the fuel-air ratio, and will have some small effect on the input to the unit.

To make changes:

- » Drive the unit to the high-fire position, P9. Check the O2 level in the stack. To increase the O2 level, turn the main valve adjustment screw counter-clockwise. To decrease the O2 level in the stack, turn adjustment screw clockwise. Adjustments should be made in 1/8th turn increments or less. Once the desired O2 level is reached, increase or decrease the fan output to achieve desired input at that point by holding the F and A buttons simultaneously and making changes with the + or - buttons.
 - » Drive the unit to the low-fire position, P1. Check the O2 level in the stack. To increase the O2 level, turn the valve offset adjustment screw counter-clockwise. To decrease the O2 level in the stack, turn adjustment screw clockwise. Adjustments should be made in 10 degree increments or less. Once the desired O2 level is reached, increase or decrease the fan output to achieve desired input at that point by holding the F and A buttons simultaneously and making changes with the + or - buttons.
 - » Step the unit through all eight points while checking O2 to ensure that the desired changes have been made. Adjust the fan output at each point as needed to achieve a smooth fuel air curve. Valve adjustments should only be made at high and low fire, as described. The mid-fire points will react to the adjustments made at high and low fire.
6. Back out to the front screen by pressing the – and + buttons together.

Refer to Table 6 at the end of the **Operations** section of this manual for Siemens LMV37 parameter information.

Operating Controls

The following specifications, data, equipment and operating descriptions apply to typical Vertical Boiler units. These sections are provided for general

3 - OPERATION

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

Located on the burner scroll, this switch is operated by the pressure of air entering the burner. This switch requires that the blower fan deliver combustion air before energizing any fuel valves.

1. While firing, disconnect the copper line from the fitting in the top cover of the air switch. The burner should shut down.
2. Attempt to restart the unit by resetting the flame programmer. Blower motor will start, but firing sequence should not begin.

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.

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.

GAS PRESSURE SWITCH

The high and low gas pressure switches are located on the gas train (see Figure 7). The switches are used to ensure that the incoming gas pressure and gas pressure to the burner are within the appropriate range.

1. While firing, shut main gas cock. Unit will lock out.
2. Attempt restart by resetting flame programmer. Unit will start purge and lock out.
3. Open main gas valve and reset flame programmer.
4. Reset high side of switch. Unit will start purge and fire.

LOW WATER CUT-OFF – PROBE TYPE

The low water cut-off will shut down the boiler when the water level is too low (after a 3 second time delay [time delay for 9.5 BHP unit is 30 seconds] to avoid nuisance shutdowns). Fulton boilers are equipped with ASME CSD-1 Code controls which include a manual reset feature on the burner low water cut off relay and ASME CSD-1 Code controls also feature an independent second low water cut off relay. Press the low water reset button and the boiler will start.

HIGH LIMIT PRESSURE CONTROL

Located in the control panel box and connected to the steam pressure gauge assembly by means of copper tubing, this control will shut down the boiler if the pressure exceeds the setpoint. The setpoint is typically 10 to 15 psig above the operating pressure but below the maximum pressure of the boiler. The high limit control must be manually reset if tripped.

OPERATING STEAM PRESSURE CONTROL

This pressure controller is located in the control panel box and connected to the steam pressure gauge assembly by means of copper tubing. The pressure

control regulates the operation of the burner. The burner will shut off when the maximum pressure is reached and will switch on when the steam pressure falls below a predetermined level.

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 temperature drops below the setpoint.

Minimum load depends on the degree of modulation provided. Typically 3:1 or 5:1 modulation is provided. In this case minimum load is one third of full firing rate.

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.

Test of the Ignition System Safety Shutoff

Test the ignition system safety shutoff as follows:

1. Close the last gas valve between the inlet to the burner and the butterfly valve.
2. With the main gas cock (inlet manual gas valve) open, the burner should be cycled on. After all the safety limits such as gas pressure, water flow and temperature are satisfied, the blower will run and pre-purge the boiler.
3. Once the purge is complete (30 seconds), the ignition transformer will be energized. There will be a 4 second trial for ignition period. During this

period, indicator lights on the flame safeguard (pilot and main).

Note: The main gas valve will not open because there is no power to the valve due to the disconnected wires. Hence, no flame will be established and the flame safeguard will not receive a flame signal from the UV scanner.

4. After 4 seconds, the flame safeguard programmer will assume a "Flame Failure" condition and go to a "lockout" mode. Lockout will require manual reset of the flame safeguard.
5. After completing this test, open the gas valve.

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.

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 Local. Fan will start up and ramp to high fire rpm. 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 at burner location, the main gas valve opens. There should be an audible click of the gas solenoid. There may also be a slight whooshing or chirping sound as the burner lights.
3. Once flame is stable, the unit will release to modulation. Firing rate will then be determined by load.

3 - OPERATION

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 fan may increase speed briefly as the flow of gas is cut off. Fan will ramp to high-fire rpm, and continue to run there for a 30 second purge.

Table 6 - Steam Program for Siemens LMV37*

Par. No.	Parameter	Min Value	Max Value	Fulton Default+	Customer
000	Internal Parameters				
41	Password	0	65535		NB/SN
42	OEM Password	0	65535		AAAAA
100	General				
102	Identification Date	0	255		
103	Identification Number	0	65535		
104	Pre-selected parameter set : Code	0	255	9	
105	Pre-selected parameter set : Vers.	0	0xFFFF	V.01.01	
107	Software version	0	0xFFFF	V 01.80	
108	Software variant	0	255	1	
113	Burner identification	0	99999999		
121	Manual output Undefined = automatic mode	0%	100%	Undefined	
125	Main frequency 0 = 50 hz 1 = 60 hz	0	1	1	
126	Display brightness	0%	100%	100%	
127	Timeout for menu operation	10 min	120 min	30 min	
128	Fuel meter: pulse valency [pulses per volumetric flow unit]	0	400	0	
130	Delete display of error history: to delete the display, set to 1 then to 2	-5	2	0	
141	Operating mode BACS 0 = off 1 = Modbus 2 = reserved	0	2	1	
142	Setback time in the event of communication breakdown	0 s	7200 s	1 s	
143	Reserved	1	8	1	
144	Reserved	10 s	60 s	30 s	
145	Device address for Modbus	1	247	2	
146	Baud rate for Modbus 0 = 9600 1 = 19200	0	1	1	
147	Parity for Modbus 0 = none 1 = odd 2 = even	0	2	0	
148	Performance standard at interruption of communication with building automation. For modulation operation ... 0...19.9 = burner off 20...100 = 20...100% burner rating For multi-stage operation ... 0 = burner off invalid = no performance	0 %	100%	Undefined	
161	Number of faults	0	65535		

*Data is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

+Out of Test Fire

Note: Customer settings should be recorded in the Customer column for reference.

3 - OPERATION

Table 6 - Steam Program for Siemens LMV37*

Par. No.	Parameter	Min Value	Max Value	Fulton Default+	Customer
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	99999999		
167	Fuel volume resettable	0	99999999		
200	Burner Control				
201	Burner operating mode (fuel train, modulating / 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	1	9	14	
208	Program stop 0 = deactivated 1 = PrePurgP (Ph24) 2 = IgnitPos (Ph36) 3 = interval 1 (Ph44) 4 = interval 2 (ph52)	0	4	0	
210	Alarm in the event of start prevention 0 = deactivated 1 = activated	0	1	0	
211	Fan ramp up time	2 s	60 s	2 s	
212	Max time down to low fire	0.2 s	10 min		10 s
213	Min time home run	2 s	60 s	2 s	
214	Max time start release	0.2 s	10 min	25 s	
215	Repetition limit safety loop	1	16	1	
217	Max time to detector signal	5 s	10 min	5 s	
221	Gas: Active detector flame evaluation 0 = QRB / QRC 1 = ION / QRA	0	1	1	

*Data is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

+Out of Test Fire

Note: Customer settings should be recorded in the Customer column for reference.

Table 6 - Steam Program for Siemens LMV37*

Par. No.	Parameter	Min Value	Max Value	Fulton Default+	Customer
222	Gas: Pre-purging 0 = deactivated 1 = activated	0	1	1	
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	5 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	5 s	
233	Gas: Afterburn time	0.2 s	60 s	30 s	
234	Gas: Post purge time	0.2 s	108 mi,	30 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	0	
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	
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	

*Data is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

+Out of Test Fire

Note: Customer settings should be recorded in the Customer column for reference.

3 - OPERATION

Table 6 - Steam Program for Siemens LMV37*

Par. No.	Parameter	Min Value	Max Value	Fulton Default+	Customer
502	No-flame positions air actuator Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0	90	0	
503	No-flame speeds VSD Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0 %	100 %	0 100 % 50 %	
522	Ramp up	5 s	20 s	10 s	
523	Ramp down	5 s	20 s	10 s	
542	Activation of VSD / PWM fan	0	1	1	
545	Lower load limit	20 %	100 %	20%	
546	Upper load limit	20 %	100 %	100%	
600	Actuators				
601	Selection of reference point Index 0 = fuel Index 1 = air 0 = closed (<0) 1 = open (>90)	0	1		
602	Actuator's direction of rotation Index 0 = fuel, Index 1 = air 0 = counterclockwise 1 = clockwise	0	1	0	
606	Tolerance limit of position monitoring	0.5	2.5	2.0	
641	Control of speed standardization of VSD	-25	1	0	
642	Standardized speed Index 0 = uC1 Index 1 = uC2	650	6500	Undefined	
645	Configuration of analog output 0 = DC 0...10 V 1 = DC 2...10 V 2 = DC 0/2...10 V	0	2	0	
700	Error History				
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	99999999		
725	Error history: 701-725.06. Load	0 %	100 %		
900	Process Data				
903	Current output Index 0 = fuel Index 1 = air	0 %	100 %	0	

*Data is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

+Out of Test Fire

Note: Customer settings should be recorded in the Customer column for reference.

Table 6 - Steam Program for Siemens LMV37*

Par. No.	Parameter	Min Value	Max Value	Fulton Default+	Customer
922	Incremental position of actuators Index 0 = fuel Index 1 = air	-50	150	0	
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	0xFFFFFFFF		

*Data is for reference purposes only. Fulton Companies is not responsible for this product, including (but not limited to) its accuracy, reliability, and safety. No Fulton document should substitute for full review of documentation available from the product manufacturer.

+Out of Test Fire

Note: Customer settings should be recorded in the Customer column for reference.

3 - OPERATION

Section

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

4 - MAINTENANCE & TROUBLESHOOTING

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.

Proper lockout / tagout procedures must be employed when servicing this unit.

Hazard analysis should be performed by end user to insure safety of their employees and/or service technicians.

Qualified and knowledgeable personnel should perform all weekly, monthly and annual maintenance checks.

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

CAUTION

Verify proper operation after servicing.

To ensure the continued safety and efficiency of the boiler, you must adhere to the schedule of maintenance outlined in this section.

Installation and service must be performed by a qualified and knowledgeable individual, such as a Fulton Heating Solutions representative, qualified installer, service agency or gas supplier. Any potential warranty issues that arise after an unqualified individual has manipulated boiler parameters will not be considered.

Procedure for Cleaning Water Probes

To clean probe on top of boiler shell and probes in water column:

1. Make sure there is no pressure on the boiler during the removal of the probes.
2. 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 9. 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.

Flame Scanner Adjustments for Fulton Gas Fired Steam Boilers

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

If the scanner is found to be defective, replace.

Adjustments to establish a good signal may include the following items:

- Primary and secondary air adjustments
- Increasing the gas through the gas regulator

Recommended Daily Maintenance Schedule

WARNING

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

CAUTION

Observe operating temperature and general conditions. Make sure that the flow of combustion and ventilating air to the boiler is not obstructed.

The following steps should be carried out daily. They are designed to prevent the build-up 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 blow-off receptacle must be provided for the appropriate pressure.

1. Blow down the boiler each morning by starting the boiler and generating not more than 10 psi (.703 kg/cm²) of steam.
2. Turn on tap water to blow-off separator, then open the boiler blow off valve for approximately 10 seconds. See Figure 10.
3. Close the valve.
4. Shut off tap water to blow-off separator.

Note: If the boiler is being operated automatically on a time clock, the blow off operation may be done once during the working day and once at the end of the day when at 10 PSIG or less.

5. Blow down water column each morning when boiler is at 10 psi (.703 kg/cm²) by opening the water column and the water gauge blow-off valves for approximately 5 seconds, then close the valves. See Figure 11.



A = 7-1/4" -- 184 mm
B = 9-1/4" -- 235 mm
C = 11-1/4" -- 286 mm
D = 17-1/8" -- 435 mm



Figure 9 - Probe Lengths

4 - MAINTENANCE & TROUBLESHOOTING

⚠ CAUTION

If the feed water is being treated by compounds, make sure that this treatment is carried out carefully and according to the manufacturer's instructions.

Fulton recommends that the feedwater treatment should be added between the pump and the boiler.

6. Make sure ignition and burner are working properly.
7. Check water level in sight glass.
8. Check to be sure feed water pump is working.
9. For float type water level control, blow-down float chamber.



Figure 10 - Blow down water column each morning by opening the water column and the water gauge blow-off valves.

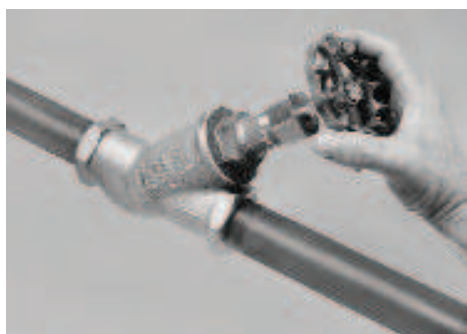


Figure 11 - Blow Down Boiler Daily. Shown is the blow down "Y" valve.

Recommended Weekly Maintenance Schedule

The following steps should be carried out weekly:

1. Check that the low water cut-off relay is operating correctly as follows:
 - » Make sure that the boiler is cool with little or no pressure showing on the steam pressure gauge.
 - » With the burner operating, open the boiler blow-off valve. 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 low water electrode in the water column assembly and/or the boiler shell. Manual reset of the low water relay is required.
2. Observe the conditions of the main flame. A normal high fire flame shows an orange screen with a blue halo. In Low fire, the burner should display a reddish-orange glow.

⚠ CAUTION

Correct air adjustment is essential for the efficient operation of this boiler. If an adjustment to the combustion is necessary, the flue gas composition should be checked with a carbon dioxide (CO₂) or oxygen (O₂) analyzer to set conditions.

Recommended Monthly Maintenance Schedule

The following steps should be carried out monthly:

⚠ WARNING

Make sure main power switch is off before starting work.

⚠ CAUTION

Do not clean the gauge or gauge glass while pressurized or in operation.

1. Clean the water gauge glass with 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 other abrasive materials which could scratch the glass. If any leakage is evident, replace the gaskets. See Figure 12.

Note: Always replace the high impact plastic gauge glass protector which is standard on all Fulton Boilers.



Figure 12 - Clean Glass; Replace Gaskets if Leaking

2. Clean water pump strainers.
3. Check scanner and ignition electrodes.
4. Check starter contacts. Burned or pitted contacts should be replaced. Do not use sand paper or file to clean.
5. Clean water traps and strainers in fuel lines.
6. Check operation of all steam traps on condensate return system.
7. Remove brass pipe plug at the cross connection below water column and clean nipple into boiler. See Figure 13. Boiler must be cold and water level below pipe.
8. View flame detection strength via the boiler control.
9. Test high-limit Pressuretrol by reducing setting below the operating temperature. Burner should shut off. Return high limit to previous setting.
10. Test operating Pressuretrol by reducing temperature setting as necessary to check burner operation.
11. Check flue gas temperature at outlet. If there is a temperature increase over previous readings, the probable cause is soot or water-scale build-up on heat exchanger surfaces. Consult Fulton Heating Solutions immediately if there is a concern.
12. Test low gas pressure switch by turning the setting on the switch down during boiler operation until the boiler locks out. If the boiler does not lock out, replace the switch.
13. Test high gas pressure by closing the downstream main gas cock, and starting the boiler. Once the trial for ignition period is reached, the main gas valve will open,



Figure 13 - Remove plug at cross-section; clean nipple to boiler

pressurizing the line. This will trip the high gas pressure switch. The high gas pressure switch must be manually reset after it trips. If the boiler does not lock out, replace the switch.

14. Inspect and clean the inlet filter of any accumulated dust or lint as follows:
 - » Remove the filter by loosening the hose clamp that holds it in place.
 - » Remove all debris and dirt from the filter using compressed air. If filter does not come clean, use low pressure water from the inside of the filter to flush away dirt. Allow to fully dry.
 - » Return the filter to its original position and tighten the hose clamp.
15. Test the relief valve per manufacturer's instructions, or every two months, by lifting the lever for 5 seconds and allowing the valve to snap shut. See the manufacturer's recommendations on the relief valve tag.

4 - MAINTENANCE & TROUBLESHOOTING

Recommended Semi-Annual Maintenance Schedule

The following steps should be carried out semi-annually:

1. Clean the gas burner assembly:
 - » Disconnect the gas head from the burner by disconnecting the union. Withdraw the burner assembly and clean the flame rod and ignition electrode.
 - » Check that the settings of the gap, if applicable, and ignition electrode correspond to those Figure 7.
 - » Reassemble the burner assembly and check the scanner setting.
 - » Check the combustion efficiency of the burner and adjust if necessary.
 - » Clean probe on top of boiler shell and probes in water column. There must be no pressure on the boiler during the removal of the probes.
 - » With the boiler under no more than 15 psig pressure, check that the steam safety valve is operating by lifting the lever.
2. Drain condensate tank and clean tank by flushing with hose. Check float valve operation.
3. Check electrical controls and motors for correct operation.
4. Check water pump for correct operation.
5. Shut off the boiler completely and drain.
6. Remove the hand holes and inspect the interior of the vessel for scale or sludge deposits. See Figure 14. 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.
7. 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 15.
 - » Remove the old gasket and thoroughly clean the surface on the boiler and the plate.



Figure 14 - Inspect hand holes for scale or sludge buildup

8. 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.



Figure 15 - Removing Hand Assembly with Tee Handle Wrench

- » 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 16 and 17.

» Refill the boiler with fresh water.

CAUTION

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.

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.

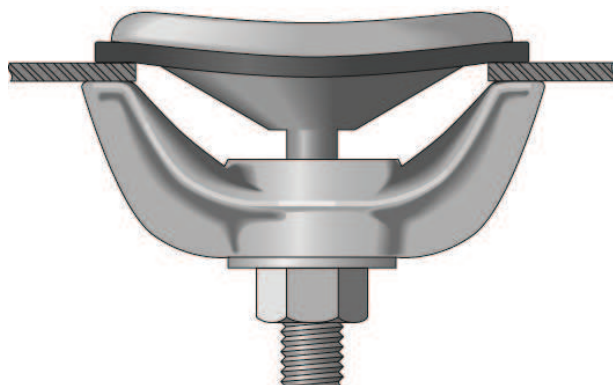


Figure 16 - Correct pressure on gasket

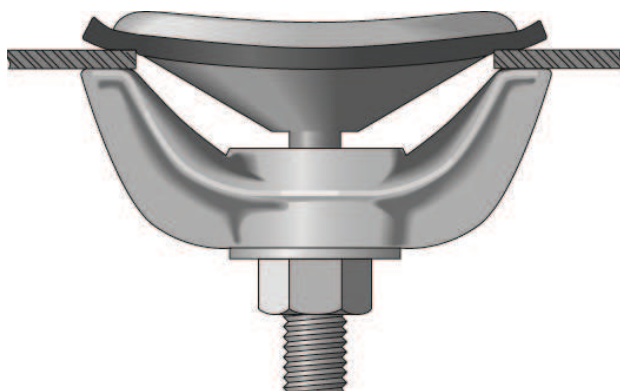


Figure 17 - Overcompressed Gasket

Recommended Annual Maintenance Schedule

The following steps should be carried out annually:

1. Have combustion (CO₂, O₂, CO) and input checked by appropriate personnel.
2. Clean flues as follows:
 - » Remove the burner and flue cover plate. See Figure 18.
 - » Wire brush flue passages. See Figure 19.
 - » Remove clean-out plugs at lowest part of unit (See Figure 20) and clean the bottom of 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.

NOTE: Dirty flues can cause air flow restrictions resulting in poor combustion and loss of efficiency.



Figure 18 - Removing burner and flue cover plate

4 - MAINTENANCE & TROUBLESHOOTING

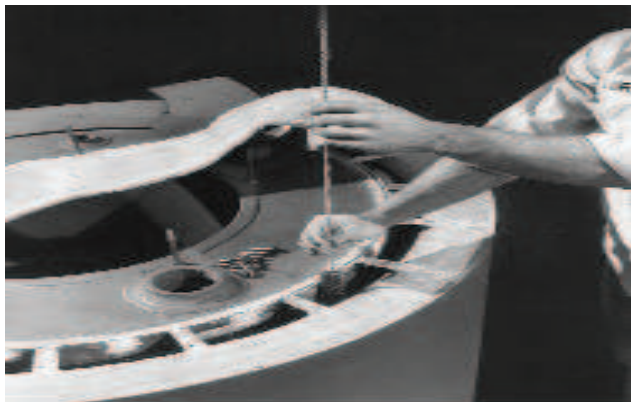


Figure 19 - Wire Brushing the Flue Passages

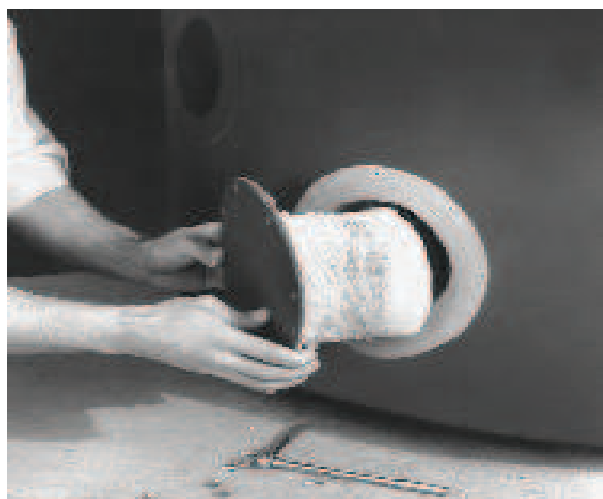


Figure 20 - Removing Clean-Out Plugs

Inspect the burner and wipe off and/or use low pressure air (do not scrub or use wire brush) to remove any soot or foreign material that may have accumulated. If there is evidence of deterioration or corrosion, replace immediately. Refer to **Procedure for Removing/Cleaning the Burner section** in this manual for cleaning and burner removal procedures. The burner must be removed to perform a thorough inspection and cleaning.

INSPECT IGNITION ASSEMBLY

3. Check gap between grounding rod and ignition electrode. Adjust if necessary.
4. Check the Spark Gap:
 - » Remove the ignition assembly from unit. This assembly will be held in place by two ¼"-20 nuts. Check gap between grounding rod and ignitor. Gap should be 1/8" + 1/16" – 0"

Electrode end should be centered and not in contact with any other metal. To adjust depth, loosen fastening nut at top of assembly. Slide electrode to desired position. Being careful to hold the electrode in place, retighten the fastening nut.

INSPECT AND TEST UV SCANNER

1. Remove UV scanner via fastening nut located on the bottom of the scanner.
2. Clean any debris from the lens with a soft, clean cloth.
3. Using masking tape, cover the lens and reinstall the UV scanner.
4. Attempt to light off unit. Boiler should lock out due to "failed ignition".
5. Remove UV Scanner, remove tape, and ensure that the lens is still clean.
6. Reinstall UV Scanner.

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.

PROCEDURE FOR REMOVING/CLEANING THE BURNER

⚠ WARNING:

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

Ensure that the blower/gas train assembly is fully supported, as the transition elbow will be removed.

1. Remove all bolts that connect the transition elbow to the burner plate, and to the scroll tube.

2. Pull burner out of unit by flange.
3. Inspect burner and wipe off (do not scrub or use wire brush) any soot or foreign material that may have accumulated. If available, use compressed air to clear the burner. Wipe out the inside of the burner with a clean cloth.
4. Reverse removal steps for reinstallation of the burner assembly.
5. Test fire the boiler and use a combustion analyzer to ensure that the fuel/air ratio is set correctly throughout the range. Refer to the Fulton Heating Solutions factory test fire sheet for combustion settings.

After All Repairs or Maintenance

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

4 - MAINTENANCE & TROUBLESHOOTING

Troubleshooting Gas Fired Boilers		
Problem	Cause	Remedy
Ignition Failure	Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	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.
	Transformer	Check voltage between transformer leads at terminal block to be sure transformer is being powered.
	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.
	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.
	Gas Supply*	Check for gas pressure and for intermittent supply problems. Gas pressure for natural gas should be 4 in to 11 in wc at the head of the train.
	Loose Wire Connection	Check connections to all components.
Flame Failure	Power Supply	Check fuse or circuit breaker. Reset or replace, as necessary.
	Gas Supply*	Check for gas pressure and for intermittent supply problems. Gas pressure for natural gas should be 4 in to 11 in wc at the head of the train.
	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.
	UV Scanner	Check for debris on flame scanner and clean as needed.
		Check for proper location of detector.
	Flame Safeguard Control	Check voltage at terminal leading to main gas valve. If no power, replace the control.
	Loose wire at fuel valve circuit	Tighten wiring connections.
	Contact open on air safety switch	Adjust to proper setting.
	Scanner wiring reversed at panel box	Change to correct terminals.
* For natural gas fired boilers. Refer to the test fire sheet for all other fuels.		

MAINTENANCE & TROUBLESHOOTING - 4

Troubleshooting Gas Fired Boilers		
Problem	Cause	Remedy
Burner Cut-Off	Power Supply	Check fuse or circuit; reset or replace, as necessary.
	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.
	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.
	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.
	Faulty Liquid Level Control	Check to see if there is power to common side of On/Off Switch 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.
	Dirty or defective UV Scanner	Clean or replace.
Water pump will not come on at times	Scale on probes	Check and clean or replace as necessary.
	Bad pump contactor	Check to see if contactor is being powered. Check to see if contactor coil is pulling in. Replace if necessary.
	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	Gas Pressure Regulator	Check and replace.
Boiler Flooding	Pump does not shut off	Dirty probes. Clean or replace as necessary.
	Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	Ground Connection	Check for tightness and clean.
	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.

4 - MAINTENANCE & TROUBLESHOOTING

Troubleshooting Gas Fired Boilers		
Problem	Cause	Remedy
Poor Combustion	Refractories	Check refractories to see if they are plugged with soot or broken in pieces. Clean or replace as necessary.
	Not Enough Air/Build-Up on Fan Wheel (<i>Rich; Burner Hums</i>)	Check CO ₂ /O ₂ levels. If rich, disassemble filter housing and gas train. Look inside inlet to the fan. If there is build-up on the fan blades, clean fan. Recheck the CO ₂ /O ₂ and adjust gas valve as necessary for all combustion points.
	Fuel Valve Adjusted Too High (<i>Rich; Burner Hums</i>)	Check CO ₂ /O ₂ levels. Check gas pressure at outlet of valve. If the pressure is too high, make an adjustment at the valve. Be sure to check all combustion points.
	Fan Speed Too High (<i>Lean; Unstable Flame</i>)	Check fan discharge pressure. If too high, adjust fan speed. Check CO ₂ /O ₂ levels and adjust gas valve as necessary. Be sure to check all combustion points.
	Gas Valve Adjusted Too Low (<i>Lean; Unstable Flame</i>)	Check CO ₂ and O ₂ levels. Check pressure at outlet of the valve. If too negative, adjust gas valve as necessary.
	Draft	Check draft with a gauge. Draft should be a -.02 in to -.04 in wc with burner off or -.04 in to -.06 in when operating. May need to install a barometric damper.
	Dirty Flue	Check flue for carbon buildup or blockage. Clean flue passages with brush.
	Negative Room Pressure	Make sure no exhaust fans are running in the boiler room.
Burner back fires	Refractories	Check refractories to see if they are plugged with soot or broken in pieces. Clean or replace as necessary.
	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.
	UV Scanner	Check for debris on flame scanner and clean as needed. Check for proper location of detector.
	Draft	Check draft with a gauge. Draft should be a -.02 in to -.04 in wc with burner off or -.04 in to -.06 in when operating. May need to install a barometric damper.
	Negative Room Pressure	Make sure no exhaust fans are running in the boiler room.

Troubleshooting Gas Fired Boilers		
Problem	Cause	Remedy
Boiler will not maintain pressure	Gas Supply	Check gas pressure coming into gas train. If low, maintain pressure contact gas company. Should be 7 in to 11 in wc. Check coil in gas valve with AMP meter. Replace if bad. Check gas regulator setting and readjust as necessary.
	Dirty Flue	Check flue for carbon buildup or blockage. Clean flue passages with brush.
	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 of the controller.
		Switch should make. Raise the set point and recheck with OHM meter. Switch should break. If the controller operates improperly, replace it.
	Scale Built up in boiler	Refer to Recommended Daily Maintenance section of this manual.
	Refractories	Check refractories to see if they are cracked or broken in pieces. Replace as necessary.
	Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	Boiler Size	Boiler may be undersized.
Boiler is Surging	Steam traps blowing through	Check traps to see if they are clean or replace as necessary.
	Perc (cleaning solvent in boiler)	Clean boiler with washing soda.
	Scale build-up or lime deposits	Call water treatment professional and consult factory.
	Too much compound in system (water treatment)	Dump return tank and flush system. Have water tested by water treatment company.
	Too much water softener (high pH)	Have water tested by water treatment company.
	Too much of a load	Check total equipment horsepower required against horsepower of boiler being used. Decrease amount of equipment being used at one time.
	Boiler new (not cleaned)	Clean per Boil Out procedure in this manual.
Boiler pushing water with the steam	Steam Traps	Check traps. Clean or replace as necessary.
	Too much boiler compound	Dump return tank and flush system. Have water tested by water treatment company.

4 - MAINTENANCE & TROUBLESHOOTING

Troubleshooting Gas Fired Boilers		
Problem	Cause	Remedy
Pump will not cut off	Dirty Probes	Clean or replace as necessary.
	Relay failed	Make sure relay is plugged in tightly. If so, replace water level relay.
	Ground Connection	Check for tightness and clean.
Pump runs but does not put water into boiler	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 temperature. If it is above 180 F (82 C) vapor locking will occur. Inspect check valves. Clean and replace as needed. Replace pump with multistage centrifugal good for 250 F (121 C).
	Impeller Adjustment	Check for impeller wear and adjust per component information in instruction manual (Burks only).
	Back pressure on pump	Install repair kit on pump.
	Plugged feed water nipple	Check and clean or replace as necessary.

Section

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

5 - WARRANTY

Standard Warranty for Fulton Boilers

WARRANTY VALID FOR MODELS ICS, ICX, ICT, ICW, ICXW, VMP, VMPW, FB-A, FB-F, FB-L, FB-S, FB-T, FB-W

Five (5) Year (60 Months) Material and Workmanship Warranty

The pressure vessel is covered against defective material or workmanship for a period of five (5) years from the date of shipment from the factory. Fulton will repair or replace F.O.B. factory any part of the equipment, as defined above, provided this equipment has been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by Fulton. The commissioning agency must also successfully complete and return the equipment Installation and Operation Checklists to Fulton's Quality Assurance department. This warranty covers any failure caused 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 and Operation Manual.

Parts Warranty

Fulton will repair or replace F.O.B. factory any part of the equipment of our manufacture that is found to be defective in workmanship or material within one (1) year 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 and the commissioning agency has successfully completed and returned the equipment Installation and Operation Checklists to Fulton's Quality Assurance department.

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.

These warranties are contingent upon the proper sizing, installation, operation and maintenance of the boiler and peripheral components and equipment. Warranties valid only if installed, operated, and maintained as

outlined in the Fulton Installation and Operation Manual.

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 be liable for any consequential or incidental damages arising in any way, including but not limited to any loss of profits or business, even if the Fulton Companies 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.

To activate the warranty for this product, the appropriate commissioning sheets must be completed and returned to the Fulton Quality Assurance department for review and approval.

Extended Warranty for Fulton Skid Mounted Boilers

WARRANTY VALID FOR MODELS ICS, ICX, ICT, ICW, VMP, FB-A, FB-F, FB-L, FB-S, FB-T, FB-W

Ten (10) Year (120 Months) 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 F.O.B. factory any part of the equipment, as defined above, provided this equipment has been installed, operated and maintained by the buyer in accordance with approved practices and recommendations made by Fulton. The commissioning agency must also successfully complete and return the equipment Installation and Operation Checklists to Fulton's Quality Assurance department. This warranty covers any failure caused 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 and Operation Manual.

5 - WARRANTY

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 F.O.B. factory any part of the equipment of our manufacture that is found to be defective in workmanship or material within one (1) year 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 and the commissioning agency has successfully completed and returned the equipment Installation and Operation Checklists to Fulton's Quality Assurance department.

General

The extended warranty is valid only for 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. Any deviation or additional equipment specified by Fulton Engineering must be used and maintained per the Installation and Operation Manual as well.

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 a TDS level as specified in the Installation and Operation Manual.

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 except as noted above.

These warranties are contingent upon the proper sizing, installation, operation and maintenance of the boiler and peripheral components and equipment. Warranties valid only if installed, operated, and maintained as outlined in the Fulton Installation and Operation Manual.

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 be liable for any consequential or incidental damages arising in any way, including but not limited to any loss of profits or business, even if the Fulton Companies 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.

This warranty applies only in the U.S.A. and Canada.

To activate the warranty for this product, the appropriate commissioning sheets must be completed and returned to the Fulton Quality Assurance department for review and approval.



5 - WARRANTY

Section

Safety & Warnings

1

Installation

2

Operation

3

Maintenance & Troubleshooting

4

Warranty

5

Parts

6

6 - PARTS

Spare and replacement parts may be ordered from your local representative or through the Fulton Companies. Refer to the parts lists. Factory-direct replacement parts must be used to ensure proper equipment operation.

When ordering replacement parts, please have the model number and serial number of your boiler ready.

⚠ CAUTION

Use of non-factory authorized replacement parts is not recommended for this equipment. Use of non-factory authorized parts may jeopardize safety and performance of the system, and voids the product warranty.

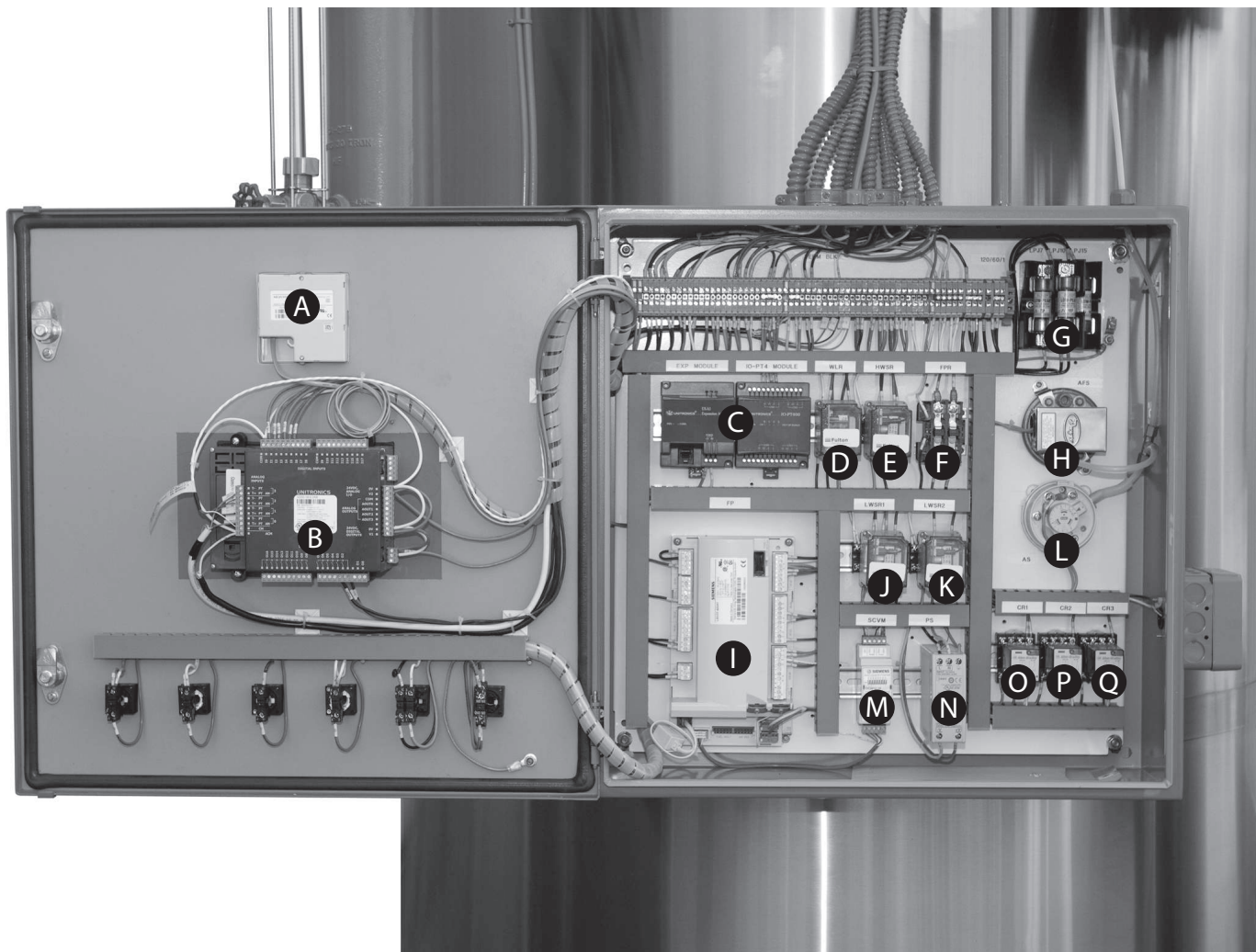


Figure 21 - Panel Box Parts (See Table 7)

Table 7 - Panel Box Parts List (See Figure 21)

Item	PART #	Description	Approx Weight	
			lbs.	kgs.
A	2-40-000471	LMV 3 LINKAGELESS CONTROLLER	1.45	0.66
B	2-40-000473	AZL DISPLAY	0.25	0.12
C	2-45-000430	SC-750 (5.7" COLOR)	1.6	0.73
C	2-45-001039	SNAP IN MODULE	0.6	0.28
D	2-45-001035	EXPANSION MODULE	0.35	0.15
E	2-45-001037	PT100 MODULE	0.35	0.15
F	2-45-001040	24 VDC POWER SUPPLY	0.55	0.25
G	2-40-000420	WATER LEVEL RELAY	0.5	0.23
H	2-40-000421	HIGH WATER SAFETY RELAY	0.5	0.23
I	2-45-000267	10 AMP LPJ FUSE	0.1	0.04
J	2-45-000363	7 SMP LPJ FUSE	0.1	0.04
K	2-40-000200	FEED PUMP CONTACTS	0.6	0.27
L	2-30-000260	AIR FILTER SWITCH	0.48	0.22
M	2-30-000232	AIR SWITCH	0.48	0.22
N	2-40-000421	LOW WATER SAFETY RELAY	0.5	0.23
O	2-40-000131	CONTROL RELAY	0.2	0.09
P	2-45-000912	SIEMENS CONVERTER MODULE	0.2	0.09
Q	2-40-003040	HIGH LIMIT PRESSURE CONTROL 150 PSI *	0.84	0.38
R	2-40-003043	OPERATING PRESSURE CONTROL 150 PSI *	0.84	0.38
S	2-40-000475	UV SCANNER *	0.45	0.2
T	2-40-003049	DANFOSS PRESSURE TRANSDUCER*	0.5	0.23
U	2-40-000390	HIGH GAS PRESSURE SWITCH *	0.5	0.23
V	2-40-000387	LOW GAS PRESSURE SWITCH *	0.5	0.23
X	2-40-000819	4" PT100 RTD *	0.25	0.1

* Denotes item not visible in Figure.

Note: Parts, part numbers, and parts availability subject to change.

6 - PARTS

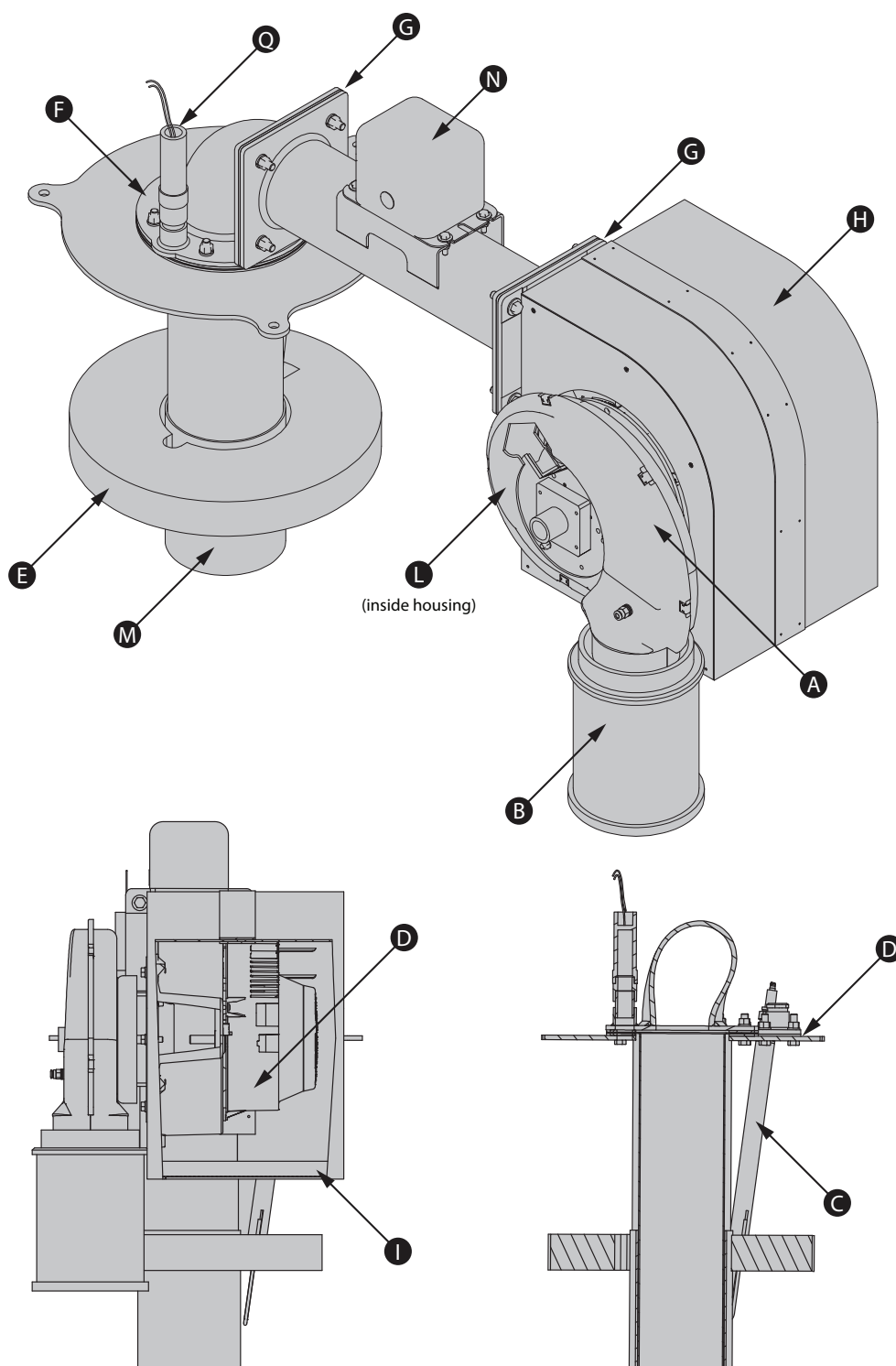


Figure 22 - Burner Parts (See Table 8)

Table 8 - Burner and Gas Train Parts (See Figures 22 and 23)

Item	Description	9.5 HP	10 HP	15 HP	20 HP	30 HP
A	Air Inlet (Filter attachment) Housing	5-21-002256			2-30-005066	
B	Air Inlet Filter	2-30-005064			2-30-005065	
C	Ignition assembly	5-21-002255	5-21-002258		5-21-002262	5-21-002266
D	Ignition Assembly Gasket	2-12-001255	2-12-001256		2-12-001257	2-12-001258
E	Refractory	2-12-000226	2-12-000227		2-12-000228	2-12-000229
F	Burner/flange gasket	2-12-001250	2-12-001251		2-12-001252	2-12-001253
G	Tube Gasket	2-12-001254				
H	Blower Shroud	5-21-002269			5-21-002270	
I	Blower Screen Box	5-21-002271			5-21-002272	
J	EBM Blower	2-30-001641			2-30-001637	
K	Dungs Gas Valve	2-30-005067				
L	Dungs Swirl Plate Kit	2-30-005068		2-30-005069	2-30-005070	
M	Mesh Burner Tube	2-40-005200			2-40-005201	2-40-005202
N	Ignition Transformer	2-40-000082				
O	Low Gas Pressure Switch	2-40-000387				
P	High Gas Pressure Switch	2-40-000390				
Q	UV Scanner	2-40-000475				

Note: Parts, part numbers, and parts availability subject to change. Figure depicts Low Emissions Fiber Mesh Burner Design. Contact your Fulton representative for assistance.

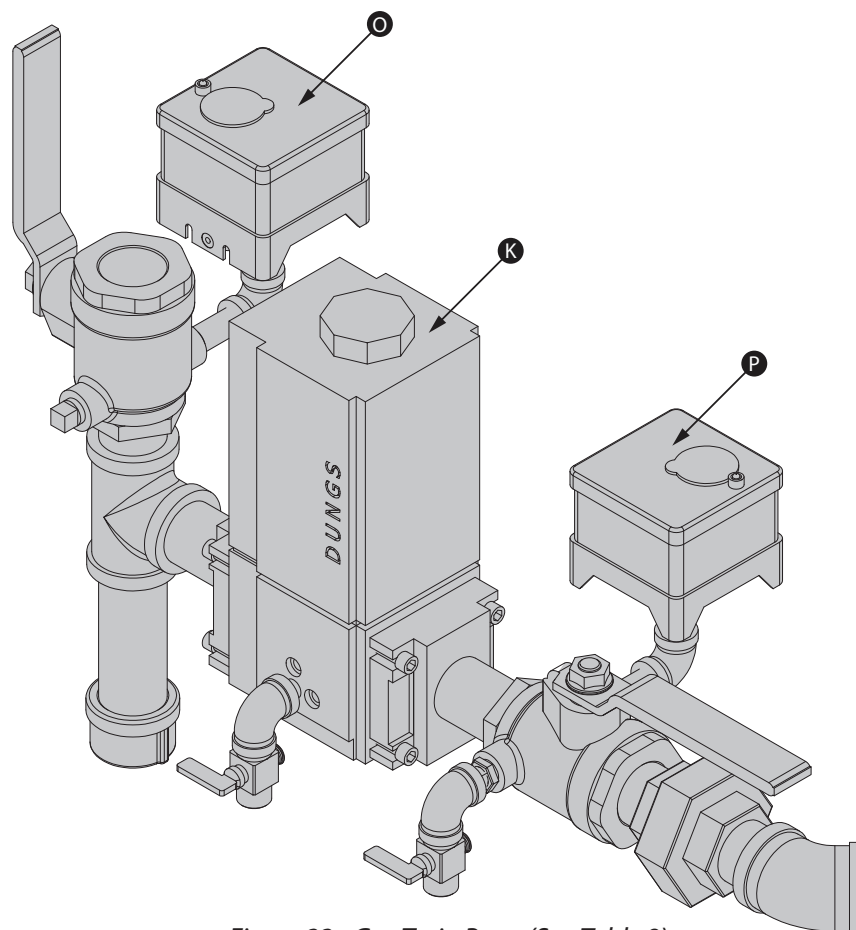


Figure 23 - Gas Train Parts (See Table 8)

6 - PARTS

Table 9 - Trim Parts List

PART #	Description	Approx Weight	
		lbs.	kgs.
2-30-000070	3/4" 150 PSI SAFETY RELIEF VALVE 10-30HP - 19KEDA150	1.4	0.64
2-30-000068	3/4" 100 PSI SAFETY RELIEF VALVE STEAM 9.5 HP - 19KEDA100	2	0.91
2-30-000215	15 PSI SAFETY RELIEF VALVE 10 HP	4.3	1.95
2-30-000216	15 PSI SAFETY RELIEF VALVE 15, 20 & 30 HP	6.75	3.1
2-11-000206	15-5/16" I 200# WATER COLUMN BOTTLE CASTING WITHOUT HIGH WATER		
5-20-000042	15" WATER BOTTLE CASTING WITH HIGH WATER PROBE OPENING		
2-20-000009	HIGH WATER PROBE - 4"	0.02	0.09
2-20-000010	PUMP OFF PROBE - 7-1/4"	0.2	0.09
2-20-000011	PUMP ON PROBE - 9-1/4"	0.2	0.09
2-20-000012	LOW WATER PROBE IN WATER COLUMN - 11-1/4"	0.3	0.14
2-20-000017	LOW WATER PROBE IN BOILER - 17-1/2"	0.5	0.23
2-30-000255	1/2" WATER GAUGE VALVE W/ BALL CHECK	1.5	0.68
2-12-000256	GRAPHITE GAUGE GLASS GASKET 5/8" ID x 15/16" OD		
2-12-000188	5/8" X 24" STD REDLINE GAUGE GLASS		
2-30-000330	11 5/8" LONG GAUGE GLASS GUARD ROD	0.04	0.02
2-12-000004	HANDHOLE GASKET	0.05	0.02
5-10-000397	HAND HOLE T-WRENCH	2.7	1.23
5-12-000001	4-30HP CLEANOUT PLUG	10	4.55
2-40-000994	PRESSURE TRANSDUCER 0-200 PSI	0.5	0.23

Note: Parts, part numbers, and parts availability subject to change.

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.

© The Fulton Companies 2011



The heat transfer innovators.

The Fulton Companies

972 Centerville Road, Pulaski, NY 13142

Call: (315) 298-5121 • Fax: (315) 298-6390



www.fulton.com

ICT-IOM-2011-07-11