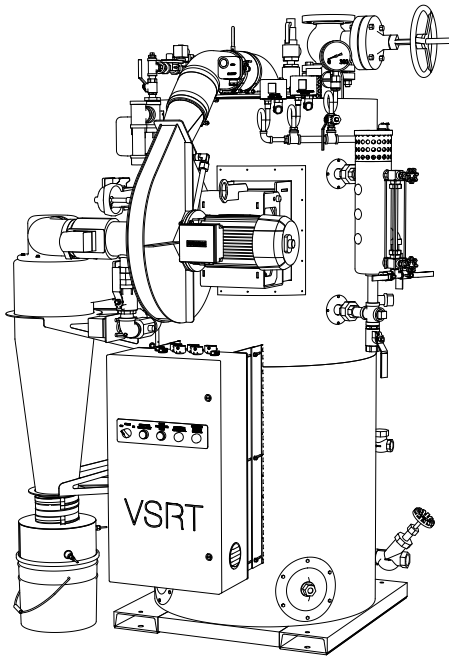
INSTALLATION AND OPERATION MANUAL

VSRT Series

Vertical Spiral-Rib Tubeless Boiler



Serial/ National Board Number _____

Model _____

Fulton Order _____

Owner _____

Site Name _____

Date _____

VSRT_IOM_2018-1213

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Section

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

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

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

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

Receiving Inspection

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

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 disconnecting when servicing controls. Wiring errors can cause improper and dangerous operation.

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

Contact your Fulton 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 gas lines have been purged.

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

WHAT TO DO IF YOU SMELL GAS:

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

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

⚠ WARNING

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

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

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

Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing fluid shutoff valves and

carefully decrease all trapped pressures to zero before performing any maintenance.

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

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

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

⚠ WARNING

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

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

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

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

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

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

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

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

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

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

⚠ 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. Airborne materials from construction and maintenance activities constitute a high-risk situation.

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

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

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

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

⚠ CAUTION

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

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

After adjustingcomponents 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, or as required per local jurisdictional codes. Failure to use an approved blow off vessel with adequate cooling could cause personnel/equipment damage.

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

⚠ CAUTION

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

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

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

Section

2 - INSTALLATION

Product Overview

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

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

Massachusetts Installations

Boilers installed in Massachusetts must have a gas pressure regulator installed upstream of the gas train provided by the manufacturer.

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 (**Figures 1-12)** is essential. Attention paid to the following points will save a great deal of difficulty in the future.

Adhere to the following for placement and rigging:

1. Verify boiler electrical classification and rating is suitable for installation environment.
2. Check building specifications for permissible floor loading.
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. See **Equipment Ventilation & Combustion Air Requirements** section of this manual.
5. *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 **Equipment Ventilation & Combustion Air Requirements** section of this manual.
6. Ensure there is adequate clearance around the unit to provide access for operators and maintenance personnel to access all parts of the equipment per local jurisdictional requirements. Ensure also that clearance provides for component removal for maintenance. The service engineer or the operator should not have to pass exposed, hot pipe work to make adjustments to the boiler. See **Clearances & Serviceability** section of this manual.
7. 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 units can be moved with forklifts. Refer to Table 3 for standard weights.
8. Never allow weight to bear on the jacket, control panel, trim, burner, fuel train or fan housing of any Fulton boiler. Use only lifting eyes or fork holes for movement.

Clearances & Serviceability

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

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

Table 1 - Minimum Clearance Around Boiler

Unit Size (BHP)	Front Panel inch (mm)	Rear/Sides inch (mm)	Vertical - from floor to ceiling - inch (m)
10-15	36 (915)	24 (610)	98.5 (2.5)
20-30	36 (915)	24 (610)	110 (2.8)
40-60	36 (915)	24 (610)	130 (3.3)

➨ ***NOTE: The vertical clearance from the floor to the ceiling is for removal of the burner for servicing.***

VSRT connections and specifications are listed in Tables 2 and 3 and shown in **Figures 1-12**.

⚠ 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.

Table 2 - VSRT Customer Connections (See Figs. 1 - 12)

	10/15 BPH		20 BPH		30 BPH		40 BPH		50/60 BPH	
Description	**Size**	**Type**	**Size**	**Type**	**Size**	**Type**			**Size**	**Type**
A. Feed Water Inlet; in. (mm)*	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.
B. Blowdown Outlet; in. (mm)*	1 (25)	N.P.T.	1.25 (32)	N.P.T.	1.25 (32)	N.P.T.	1.5 (38)	N.P.T.	1.5 (38)	N.P.T.
C. Steam Outlet; in. (mm)										
High pressure steam outlet*	1.25 (32)	N.P.T.	2 (51)	N.P.T.	2 (51)	N.P.T.	3 (76)	CL150	3 (76)	CL150
Low pressure steam outlet	2 (51)	N.P.T.	3 (76)	CL150	3 (76)	CL150	4 (102)	CL150	4 (102)	CL150
D. Exhaust Stack; in. (mm)										
Stack size standard	6 (152)	------	8 (203)	------	8 (203)	------	10 (254)	------	10 (254)	------
Stack B-vent size**	8 (203)	------	10 (254)	------	10 (254)	------	12 (305)	------	12 (305)	------
E. Safety Relief Valve; in. (mm)*	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1.25 (32)	N.P.T.
F. Fuel Inlet; in. (mm)	1 (25)	N.P.T.	1 (25)	N.P.T.	1.25 (32)	N.P.T.	1.5 (37)	N.P.T.	1.5 (37)	N.P.T.
G. Water Column Drain; in. (mm)	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.
H. Sight Glass Drain; in. (mm)*	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.
J. Water Sample Port; in. (mm)*	.25 (6)	N.P.T.	.25 (6)	.N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	.N.P.T.
K. Steam Sample Port; in. (mm)	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.	.25 (6)	N.P.T.
L. Surface Blowdown; in. (mm)	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.
M. High Water Protection; in. (mm)	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.	.75 (19)	N.P.T.
N. Single Source Power	------	------	------	------	------	------	------	------	------	------
P. Combustion Air Inlet; in.(mm)	6 (152)	------	6 (152)	------	6 (152)	------	6 (152)	------	6 (152)	------
R. Auxiliary Water Col. Connect; in. (mm)	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.	1 (25)	N.P.T.

Note: *Shipped loose; size depends on trim pressure. **Use of B-vent with Fulton VSRT boiler requires purchase of the adapter kit.

Table 3 - VSRT Specifications (See **NOTES** *at top of next page)*

Unit Size (BHP)	**10**	**15**	**20**	**30**	**40**	**50**	**60**
Maximum allowable working pressure	150 PSI	150 PSI	150 PSI	150 PSI	150 PSI	150 PSI	150 PSI
Boiler input (BTU/HR)	400,000	600,000	800,000	1,200,000	1,600,000	2,000,000	2,392,000
Boiler input (Natural gas); CU FT/HR	400	600	800	1,200	1,600	2,000	2,400
Boiler input (Propane); CU FT/HR	160	240	320	480	640	800	957
RATINGS* (Sea level to 3000 ft (914.4 m)							
Boiler Output (BTU/HR)	335,000	503,000	670,000	1,005,000	1,339,000	1,674,000	2,008,500
Steam Output - Minimum Service Capacity; LB/HR (KG/HR)	345 (156)	518 (235)	690 (313)	1,035 (470)	1,380 (626)	1,725 (782)	2,070 (939)
Net Effective Heating Service (SQ. FT)	54.5	54.5	65	65	116	116	116
Water Capacity (Operating); GAL.	94	94	112	112	333	333	333
Burner Turndown	4:1	6:1	4:1	6:1	6.7:1	8.3:1	10:1
Draft Requirements	-0.25"W.C. to +1.50"W.C.						
Minimum Incoming Gas Pressure	3"W.C.	3"W.C.	3"W.C.	3"W.C.	3"W.C.	3"W.C.	3"W.C.
Weights (Approximate)							
Dry Weight; LBS	1,932	1,932	2,711	2,830	5,850	5,850	5,850
Operating Weight; LBS	2,716	2,716	3,645	3,764	8,728	8,728	8,728
Shipping Weight; LBS	2,500	2,500	3,281	3,400	6,750	6,750	6,750
Flooded Weight; LBS	3,008	3,008	3,939	4,058	9,320	9,320	9,320
Electric Power Requirements							
Voltage	120/60/1	120/60/1	120/60/1	220/60/1	480/60/3	480/60/3	480/60/3
Operating FLA (refers to boilers rated draw at high fire)	10 AMPS	10 AMPS	10 AMPS	15 AMPS	15 AMPS	15 AMPS	15 AMPS

NOTES for *Table 3- VSRT Specifications (from previous page)*

1. Steam output LB/HR: From 0 PSIG at 212°F (0 kg/cm^2 at 100°C).
2. All clearances are factory recommendations. Consult local jurisdiction for exact code compliance.
3. Fulton recommends minimum clearance of 36" in front of electrical panels.
4. Fulton recommends 36" clearance between inspection openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
5. All dimensions inside ( ) denote reference dimensions.
6. All dimensions inside rectangles denote overall dimensions.
7. We reserve the right to change specifications and/or dimensions. All information is subject to change based on addition of any optional equipment and/or accessories. please consult the factory for project specific estimates if additional options or accessories are required.
8. Refer to fuel train drawing for fuel train venting requirements. Recommended stack run is minimum 24" straight off the rear of the boiler, prior to making a directional change.
9. Local codes can supercede Fulton recommended clearance.

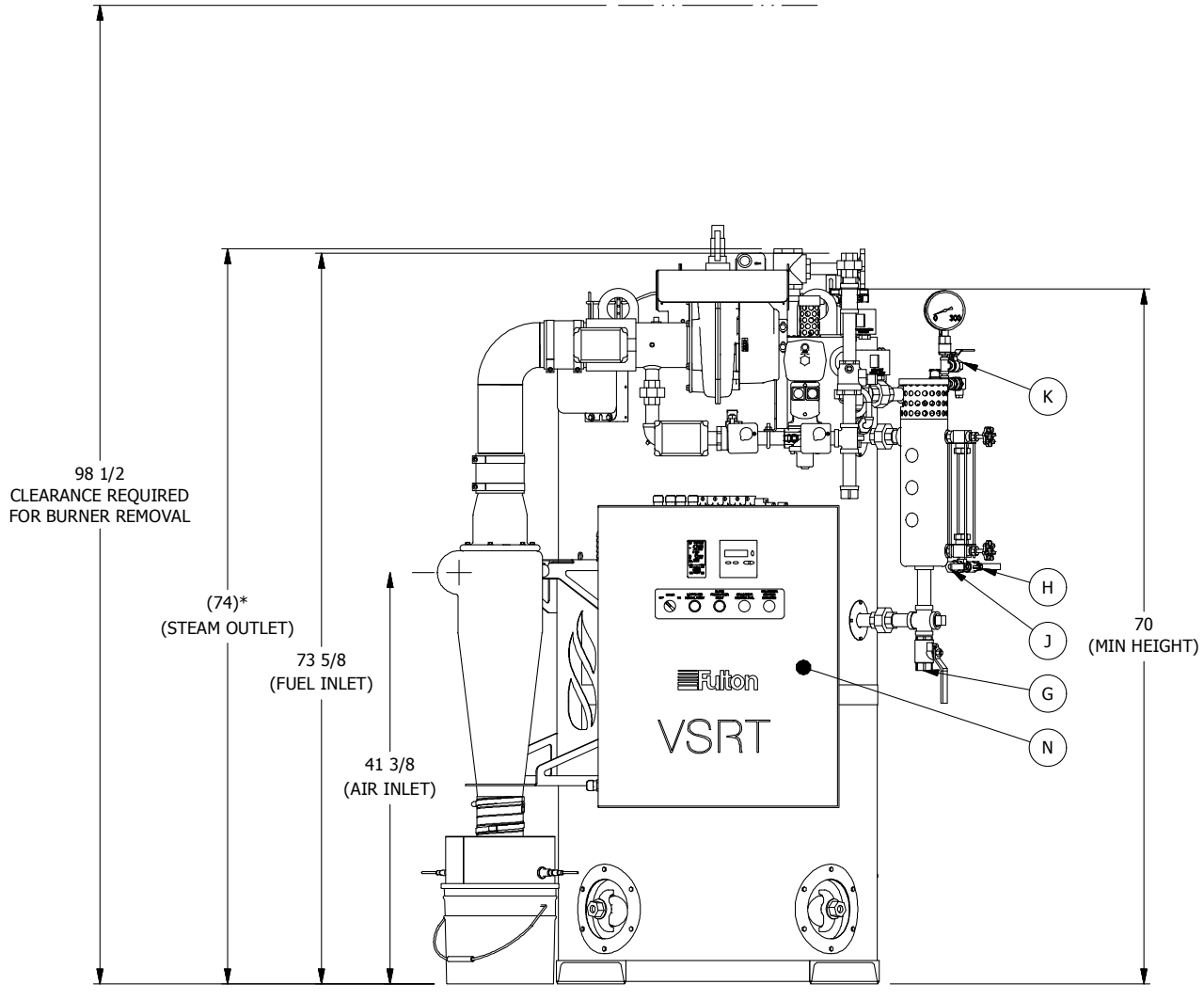


Figure 1 - 10/15-HP Model VSRT Dimensions - Front Side View (All dimensions in inches)

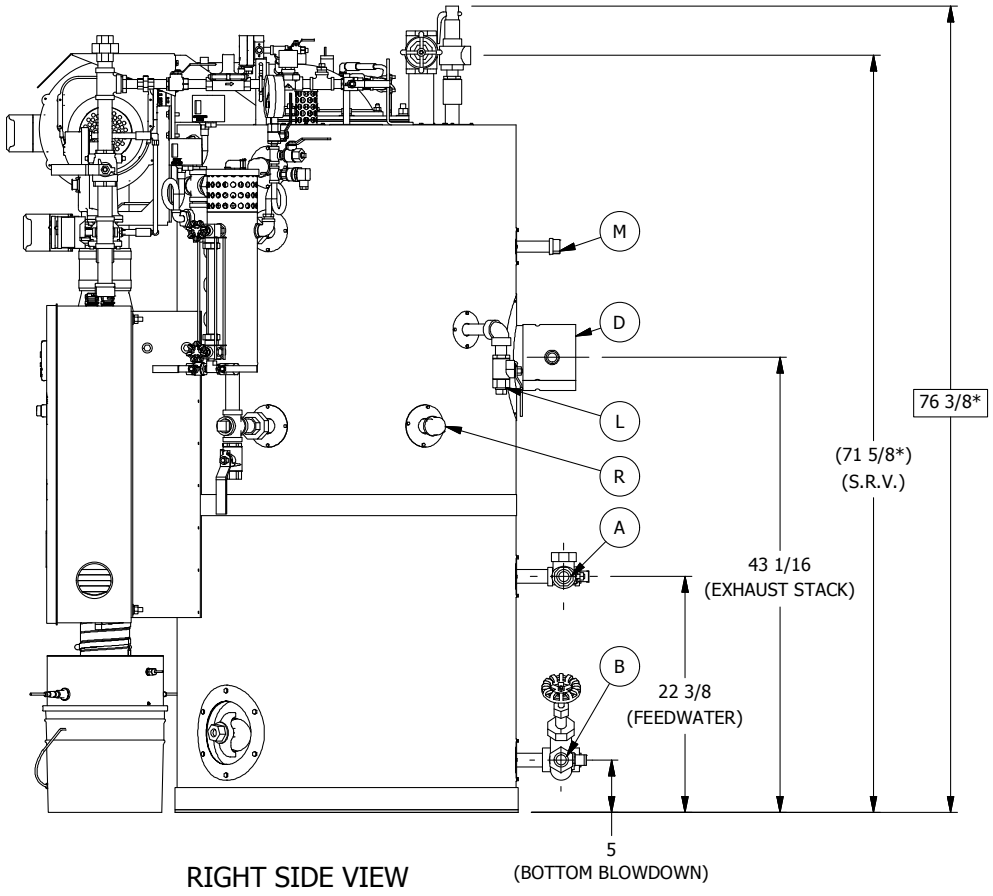
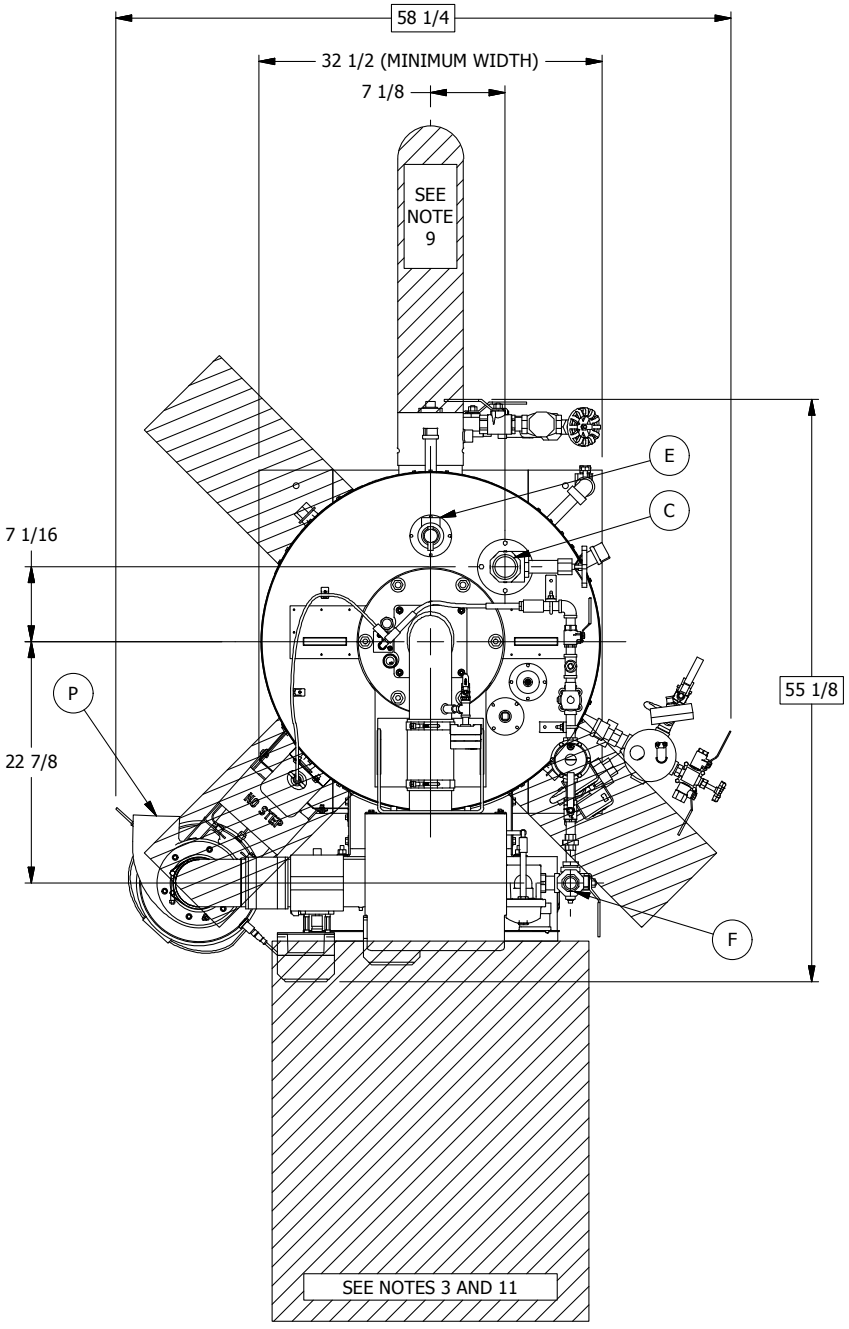


Figure 2 - 10/15-HP Model VSRT Dimensions - Right Side View (All dimensions in inches)



Note 3: Fulton recommends a minimum clearance of 36" in front of the electrical panels.
Note 9: Fulton recommends 36" clearance between openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
Note 11: Local codes supercede Fulton recommended clearances.

Figure 3 - 10/15-HP Model VSRT Dimensions - Top Side View (All dimensions in inches)

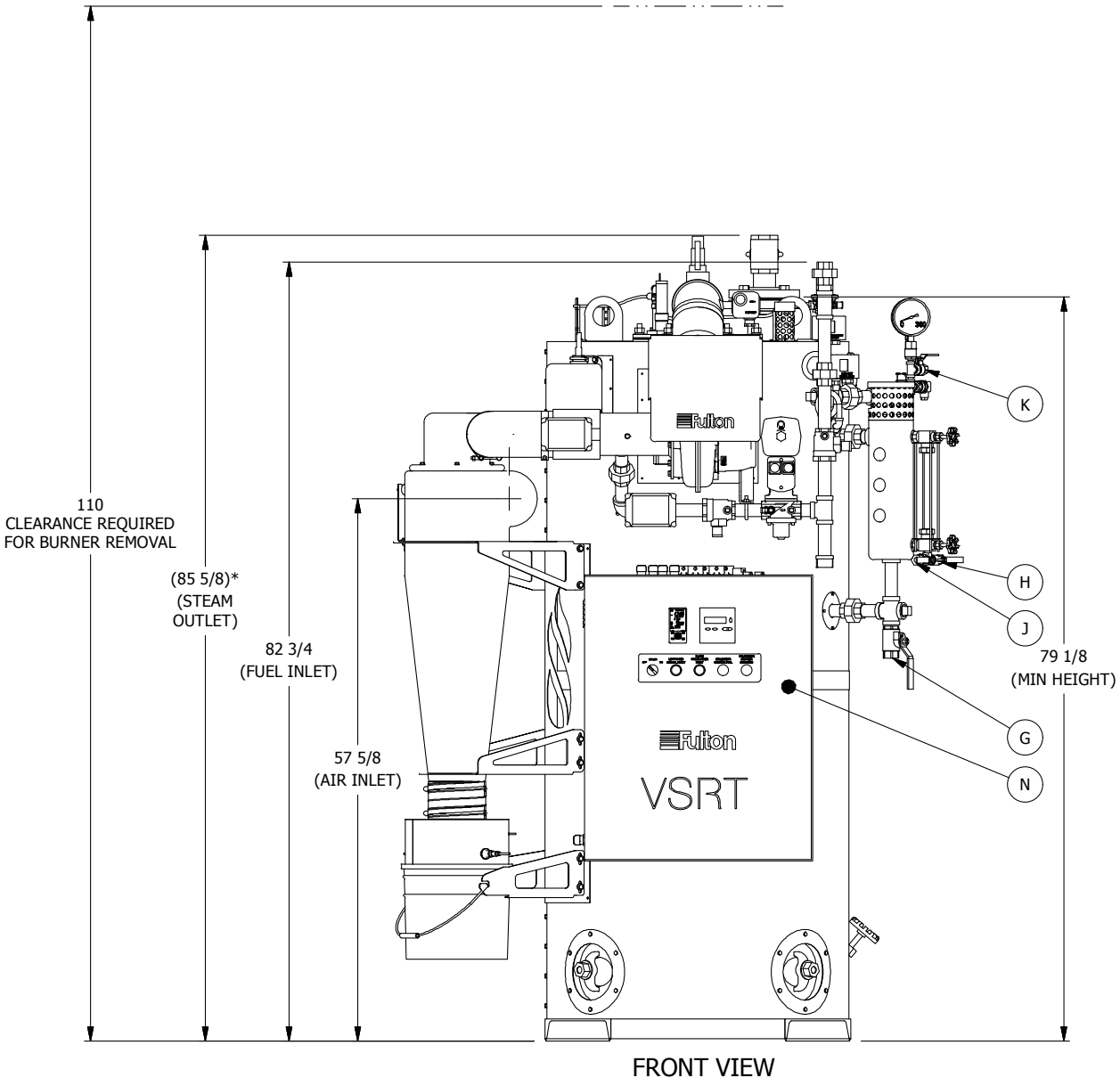


Figure 4 - 20-HP Model VSRT Dimensions - Front Side View (All dimensions in inches)

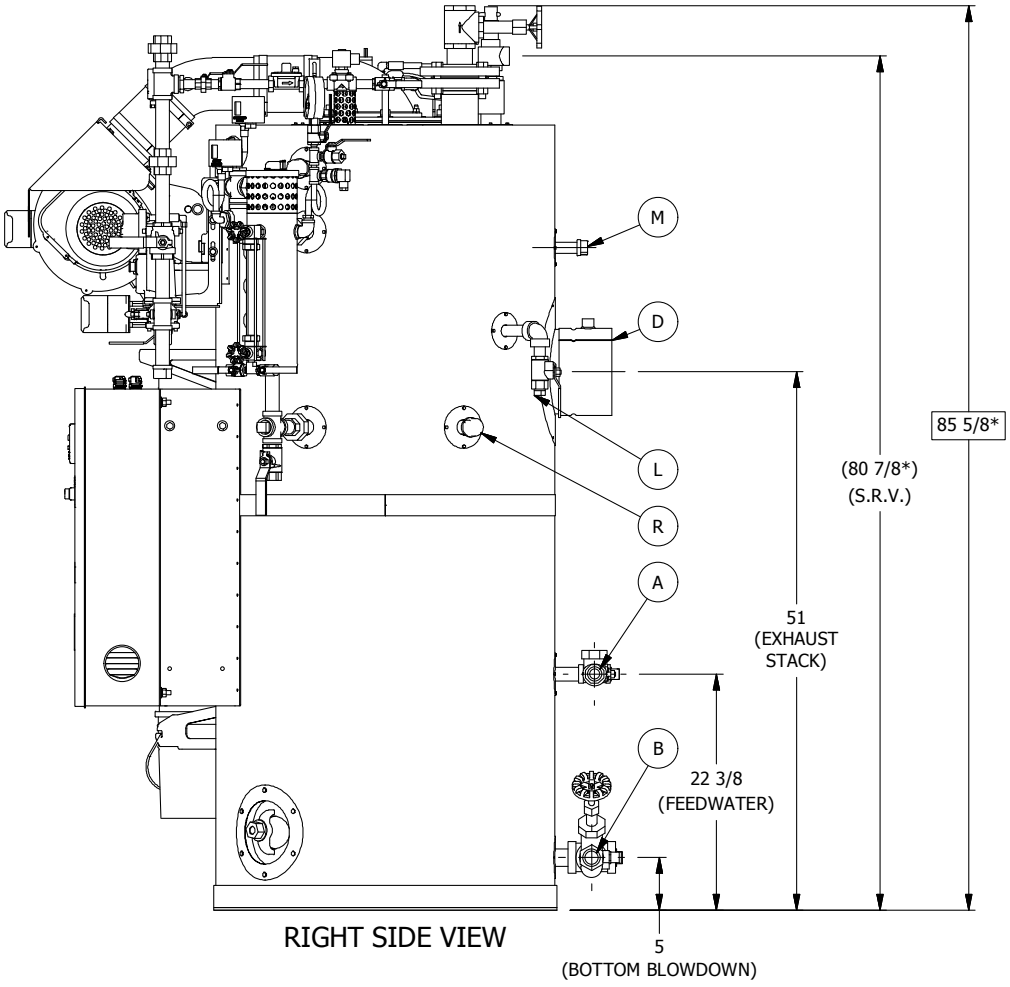
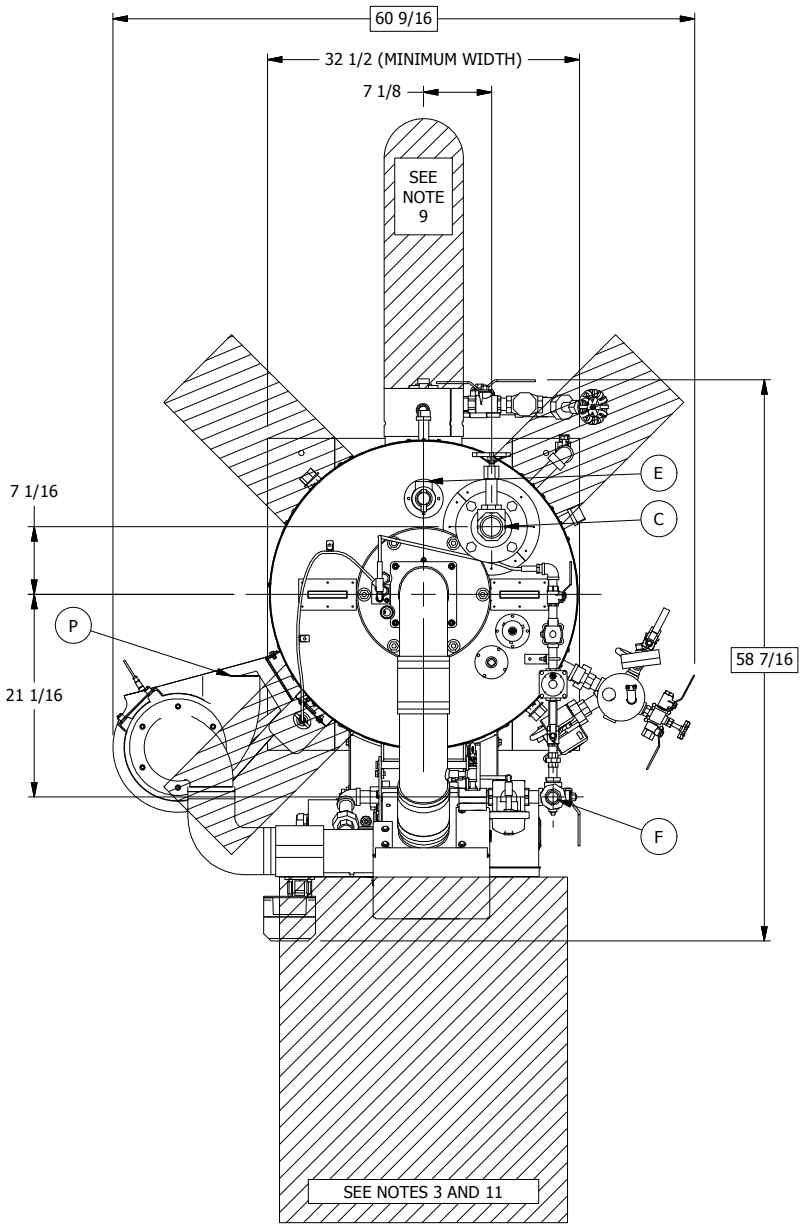


Figure 5 - 20-HP Model VSRT Dimensions - Right Side View (All dimensions in inches)



Note 3: Fulton recommends a minimum clearance of 36" in front of the electrical panels.
Note 9: Fulton recommends 36" clearance between openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
Note 11: Local codes supercede Fulton recommended clearances.

Figure 6 - 20-HP Model VSRT Dimensions - Top Side View (All dimensions in inches)

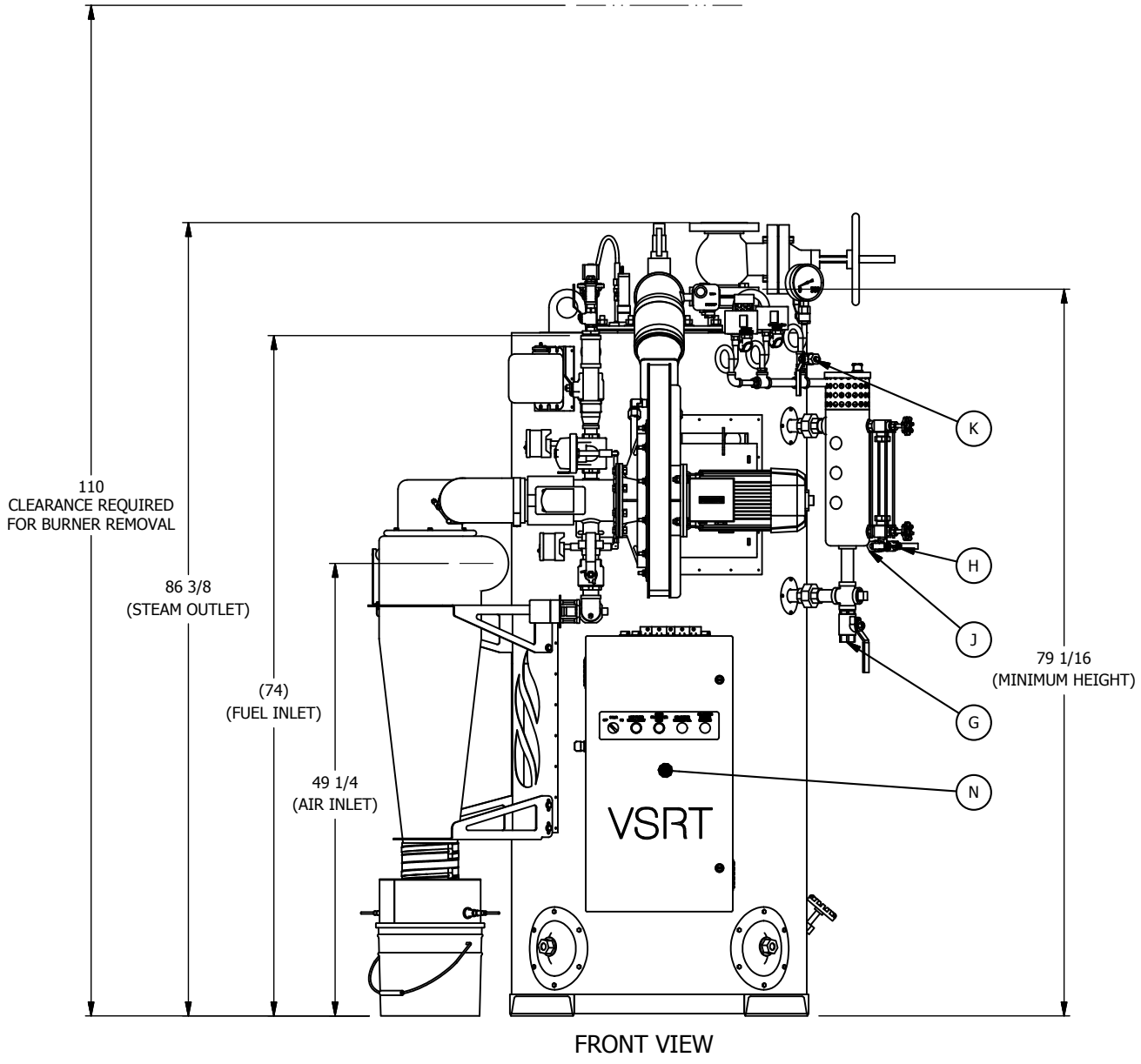


Figure 7 - 30-HP Model VSRT Dimensions - Front View
(All dimensions in inches)

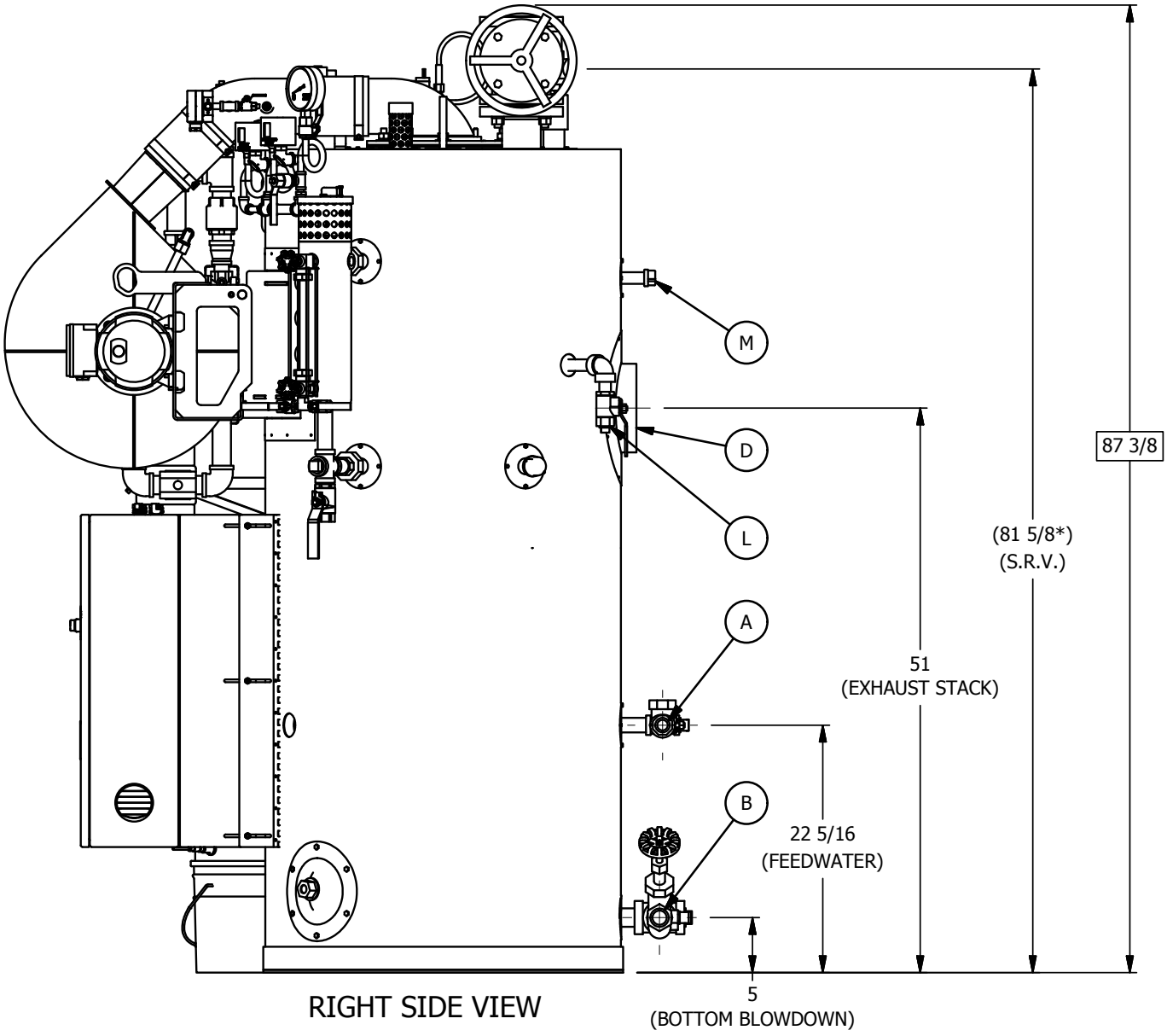
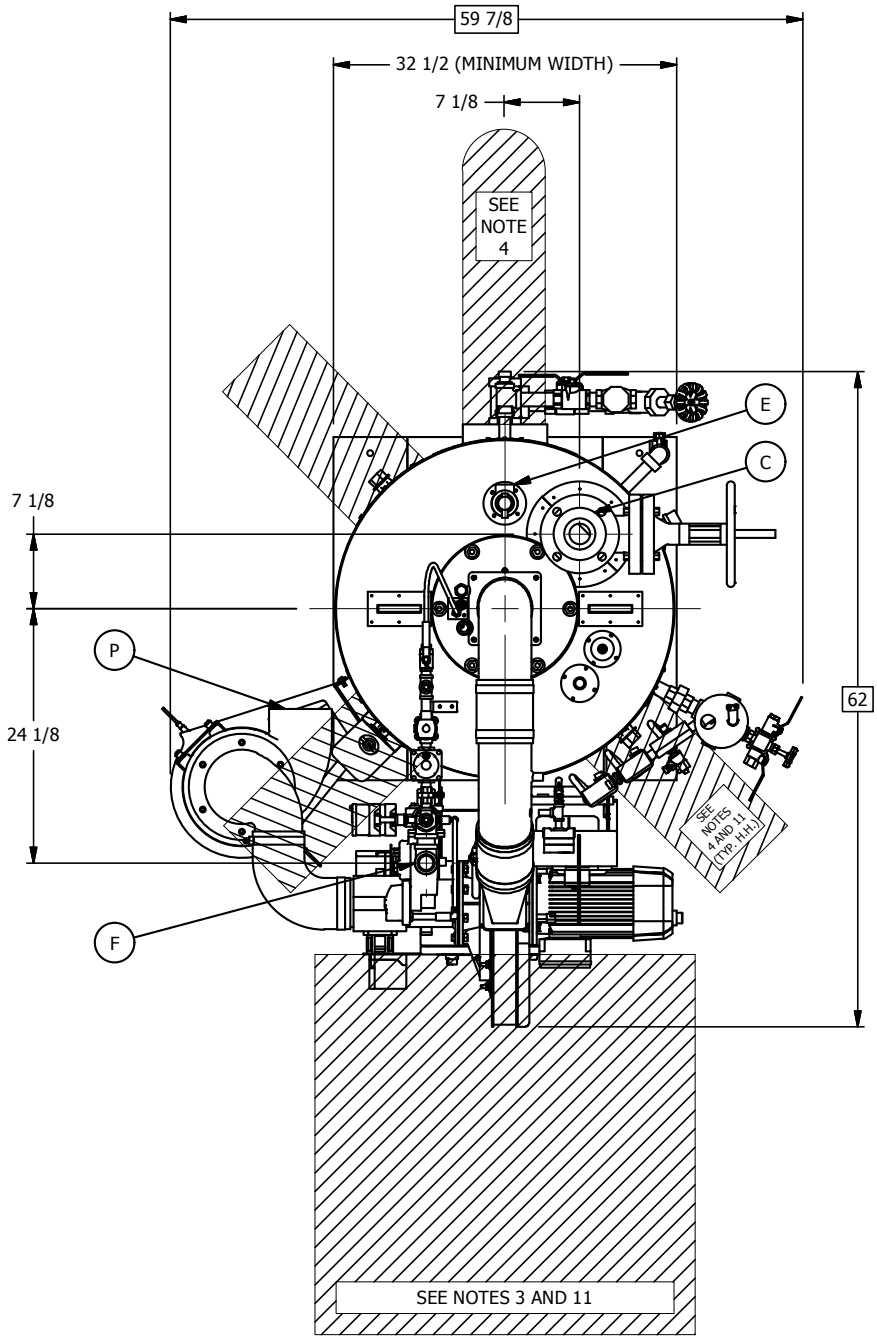


Figure 8 - 30-HP Model VSRT Dimensions - Right Side View (All dimensions in inches)



Note 3: Fulton recommends a minimum clearance of 36" in front of the electrical panels.
Note 4: Fulton recommends 36" clearance between openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
Note 11: Local codes supercede Fulton recommended clearances.

Figure 9 - 30-HP Model VSRT Dimensions - Top View (All dimensions in inches)

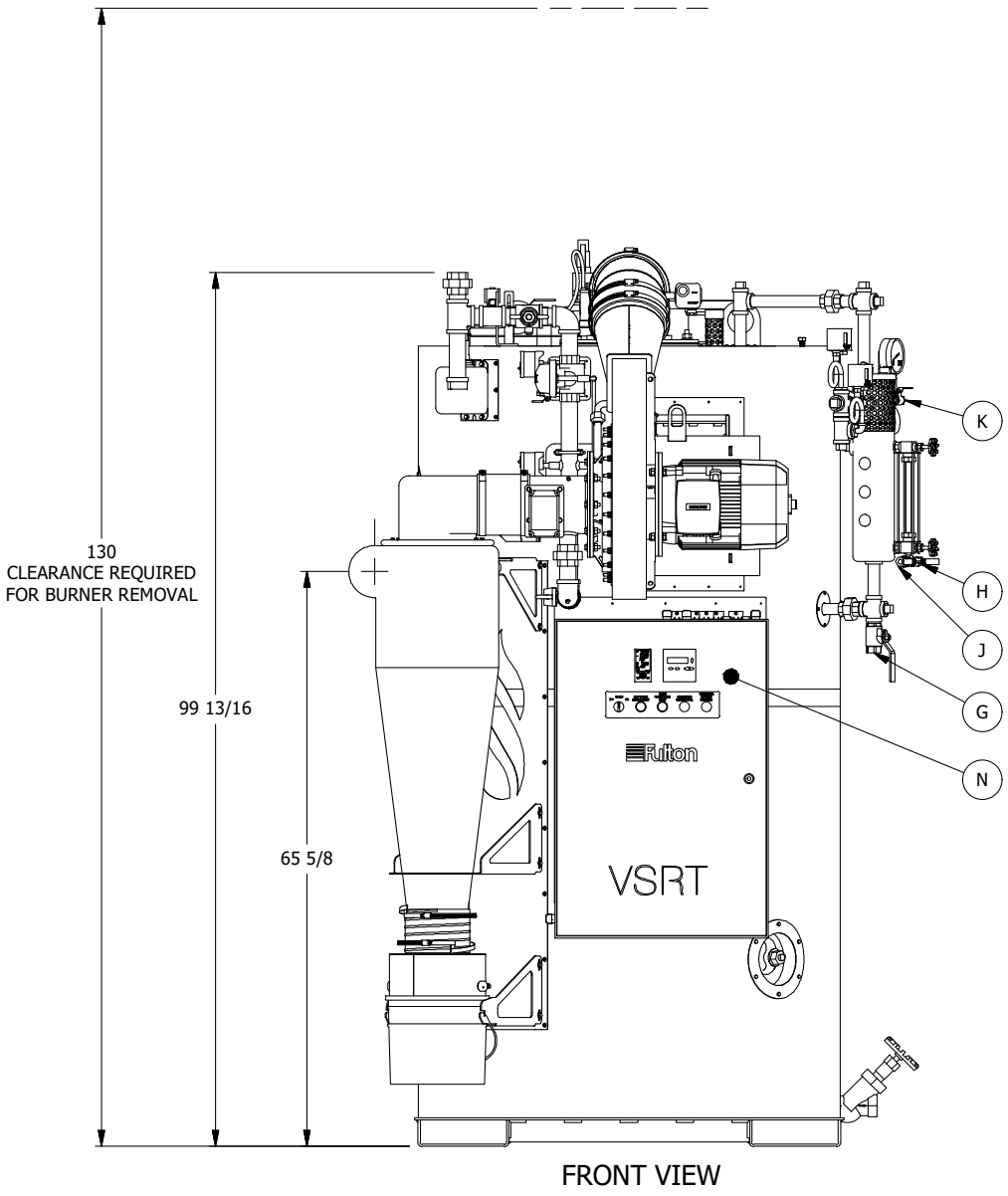


Figure 10 - 40/50/60-HP Model VSRT Dimensions - Front View (All dimensions in inches)

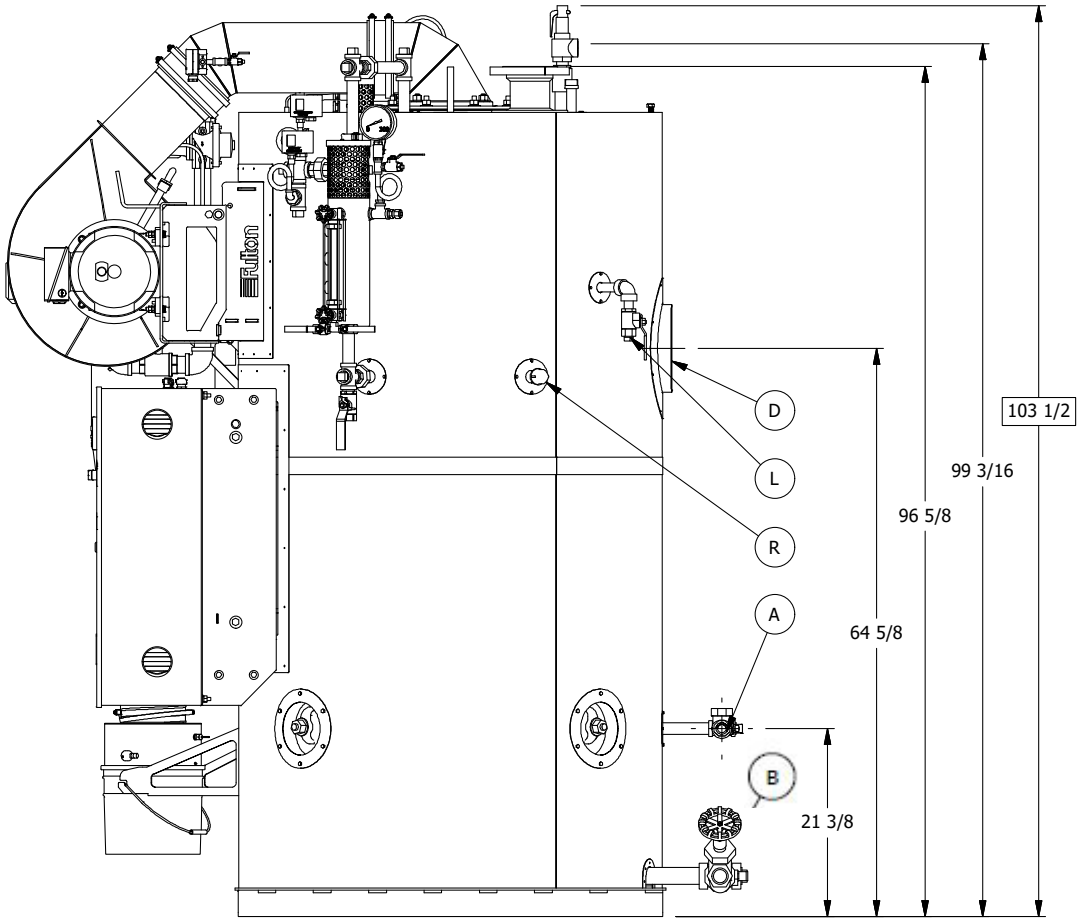
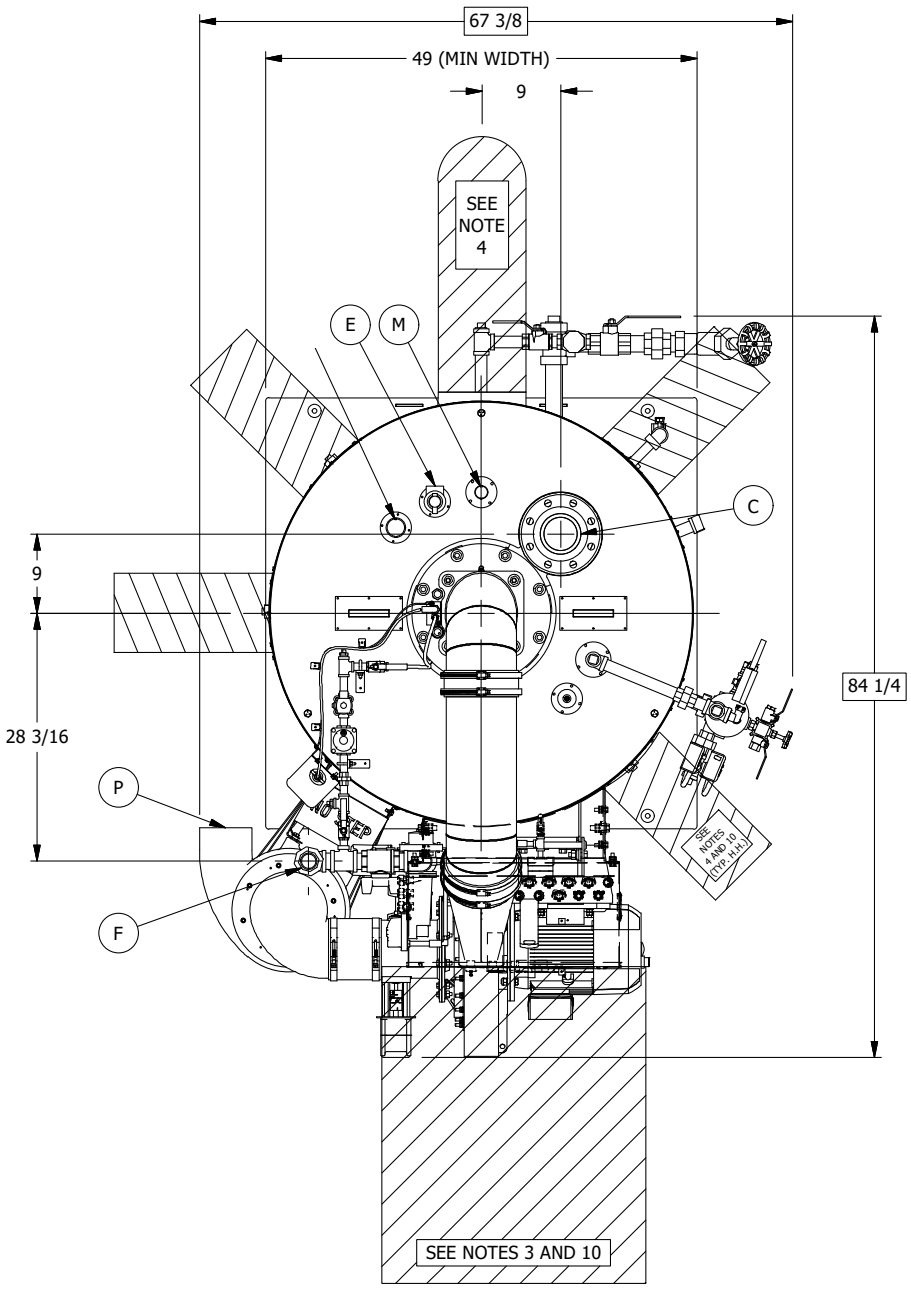


Figure 11 - 40/50/60-HP Model VSRT Dimensions - Side View (All dimensions in inches)



TOP VIEW

Note 3: Fulton recommends a minimum clearance of 36" in front of the electrical panels.
Note 4: Fulton recommends 36" clearance between openings of all boilers, 18" clearance of handholes, and 18" from exhaust stack.
Note 10: Local codes supercede Fulton recommended clearances.

Figure 12 - 40/50/60HP Model VSRT Dimensions - Top View (All dimensions in inches)

Equipment Ventilation & Combustion Air Requirements

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

⚠ CAUTION

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]).

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

See Table 4 for minimum make-up air required and the recommended area of each opening for each model.

Table 4 - Minimum Make Up Air Requirements and Recommended Area of Each Opening for Vents

Unit Size (BHP)	Minimum Make Up Air Requirements (SCFM)*	Free Opening Area in²**
10	88	200
15	134	300
20	177	400
30	242	600
40	353	800
50	442	1,000
60	530	1,196

*Minimum make-up air requirements are based on a maximum of 25% excess air at high fire at 60° ambient temperature.

**Opening areas are calculated based input of a single boiler and do not account for the ventilation needs of the equipment room. These measurements are subject to state and location regulations. (one square inch of free area per 2,000 BTU/hr input per NBIC). Free opening area must take into account the space taken up by louvers, expanded metal, etc.

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

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

1. Install two fresh air openings, one at a low level, 24" (610 mm) from the floor, and one at a higher level on the equipment room wall. This will provide a flow of air to exhaust the hot air from the equipment room.
2. Avoid ventilation which creates a negative pressure for boiler combustion air, as it will seriously affect combustion and proper operation of the stack. The equipment requires a steady neutral or slightly positive combustion air supply. Unless sealed combustion is used, the installation of an exhaust fan in a boiler room is not recommended. An exhaust fan, or similar equipment, can create down draft in the stack, or restrict the burner's air supply, which will result in poor combustion or nuisance failures.
3. It is essential that only fresh air be allowed to enter the combustion air system. Foreign substances in the combustion system can create hazardous conditions. Particulate matter like lint, combustible volatiles, dust, smog or chemicals (example, perchlorethlylene, halogenated compounds) in the combustion air supply to the equipment will cause damage or failure of the burner and is not covered under warranty. Use of a cyclone separator (VSRT) will separate solid particles. It will not separate any chemical fumes. Eliminate potential for high risk situations for particulate matter to be in the air supply (e.g., as the result of construction or maintenance activities). 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.
4. VSRT Boiler is capable of ducted combustion air. Reference Figure 16 and 17 at the end of the section. Note that with ducted combustion air, proper room ventilation is still required.

⚠ 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 and is required in some jurisdictions.

⚠ 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: perchlorethlylene, halogenated compounds) in the combustion air supply to the equipment will cause damage or failure of the burner and is not covered under warranty. 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. No changes shall be made to the factory fuel train.
2. The pipe and fittings used must be new and free of dirt or other deposits.
3. The piping must be of the proper size to ensure adequate gas supply to the gas head assembly without a pressure loss. Consult your gas company for specific recommendations.
4. When making gas piping joints, use a sealing compound resistant to the action of liquefied petroleum gases. Do not use Teflon tape on gas piping.
5. Piping must be installed such that no piping stresses are transmitted to the equipment. The equipment shall not be used as a pipe anchor.
6. Components may have vent connections which must be vented per local codes.
7. The boiler gas train must be isolated from the gas supply piping system during any pressure testing of the system at pressures in excess of 1/2 psig (13.8 inch w.c.).
8. If the supply pressure will exceed 13.8" w.c., incoming gas supply pressure must be regulated by a non-stacking, tight, shut-off regulator. Overpressure protection must be provided per local jurisdictional requirements.
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 specific gas pressure requirement for each boiler is indicated on the boiler nameplate, located on the boiler. Parameters depend on what fuel(s) the boiler is designed to burn. (See Table 4 gas inputs and pressures.)

12. For **natural gas** a pressure of 3" to 13.8" w.c. is required at the gas train at full input. Do not exceed 13.8" w.c. For **propane**, a pressure of 7" to 13.8" w.c. is required at the gas train at full input. Do not exceed 13.8" w.c. For installations equipped with gas pressures exceeding 13.8"w.c., consult the factory for gas pressure requirements.

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

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. For three-phase motors, the line to line full load voltage must be balanced within 1% of the rated motor voltage. Operation outside of these limits will degrade motor performance. 575V rated motors cannot be operated at voltages above 600V. Depending on the motor manufacturer, a 208V rated motor may not be able to run below the design voltage.

4. Locate schematic. Each boiler is shipped with its own unique electrical schematic diagram, a copy of which is located in an envelope on the inside of the panel box door.

5. 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.

6. Fuses must be sized according to motor name plates and local electrical codes.

7. Connect power to the terminal strip as supplied on the inside of the panel box. **Note:** Single skid systems are generally shipped completely prewired.

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

9. If the unit is not skid-mounted at the factory, the client/contractor is required to wire the feed water pump starter. **Note:** If the pump motor is not supplied by Fulton, the motor starter may not be supplied.

Water Chemistry

RECOMMENDED WATER CONDITIONS FOR BOILERS/UNFIRED STEAM GENERATORS

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

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

Steam Outlet

It is recommended to have 30 inch or five pipe diameter (whichever is greater) of vertical rise out of the steam outlet. This is considered a good piping practice and will allow for proper operation.

Steam outlet sizes should not be reduced until after the steam outlet and at the end of the near boiler piping, as shown in Figure 13. Steam piping should be sized for appropriate velocities for the application and pressure. Steam piping shown in Figure 13 is to be sized for 4,500 ft./min. This piping includes the steam outlet piping through the outlet of the main steam header. After the main steam header, distribution piping may be sized for velocities of 4,000 – 6,000 ft./min. for low pressure steam (0-30 PSIG), 6,000 – 8,000 ft./min. for medium pressure steam (30 -75 PSIG), and 8,000 – 12,000 ft./min. for high pressure steam (75 PSIG and above).

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 is consulted prior to the operation of the boiler. Elements/PV damaged due to adverse water conditions will not be replaced or repaired under warranty.

Natural feedwater supplies contain hardness, solids and dissolved gases. These may promote scale, foaming, corrosion, and/or poor steam quality. To prevent this, feedwater must be analyzed 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.

Table 5 - Water Chemistry Requirements for Fulton Boilers

	Carbon Steel	
Parameter	Feedwater	Vertical Boiler
pH	7.5-9.2	8.5-10.5
Feedwater Temperature	140 F (60 C)*	---
Hardness as $CaCO_3$	< 2ppm	< 10 ppm
Chlorides	---	---
Total Alkalinity	---	< 300 ppm
Total Dissolved Solids	---	< 2000 ppm
Suspended Solids	No visual turbidity**	No visual turbidity**
Total Organic Carbon	No sheen No foam +	No sheen No foam +
Iron	0.1 ppm and colorless liquid++	0.1 ppm and colorless liquid++
Dissolved Oxygen	<1 ppm*	ND
Visual Oil	ND	ND
Conductivity (mS/cm)	---	< 2985

* 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. The upper limit is 0.1 ppm. Hold the sample against a white background. The water should have no visible yellow, red or orange tinge.
ND: None Detected
ppm: parts per million

Be sure that the supplied feedwater pump will operate at elevated feedwater tank temperatures. The standard turbine pump has a maximum operating feedwater temperature of 180˚ F.

Reverse Osmosis / Deionized (RO/DI) water is water from which all dissolved solids have been removed. (Consult factory for recommended controls and equipment for operating on 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.

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 low pH 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.

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 boiler or generator to ensure efficient operation of the softener. Unsoftened water should not be allowed to enter the steam boiler or 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 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).

While referencing Table 6 and **Figure 13**, 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. During the installation, ensure that no dirt, water, or residue from welding is left in the system.
5. 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).
6. Supports and anchors must be provided for all pipes, as necessary, to prevent undue stresses from being placed on equipment, including pumps, valves, and the heater. Supports and anchors which will not interfere with thermal expansion should be chosen. The equipment should never be used or considered as an anchor. No additional loads should be applied to any factory connection.
7. Gaskets must be used to make all flanged connections. Gasketing material must be suitable for use with the pressure, temperatures and fluids in the system. Ensure that all bolts are tightened evenly and to the torque recommended values provided by the gasket manufacturer.

8. High point bleeds/air vents are to be installed at all high points in the system piping.
9. All pipes should be installed with a pitch to facilitate draining and venting.

Table 6 - Sample Piping Specification

Skid Packaged Steam System Piping Specification

(Boilers with a maximum operating pressure of 125 psig, 150 psig max. trim pressure)

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

Note: Piping within the boiler's ASME code piping boundary supersedes the information in this table.

++ If there is no preheat in the feedwater tank, feed water piping between the feedwater tank and the boiler should be sch 80, SA 106B.

+++ Welded/flanged pipe (3" and greater) may be sch. 40.

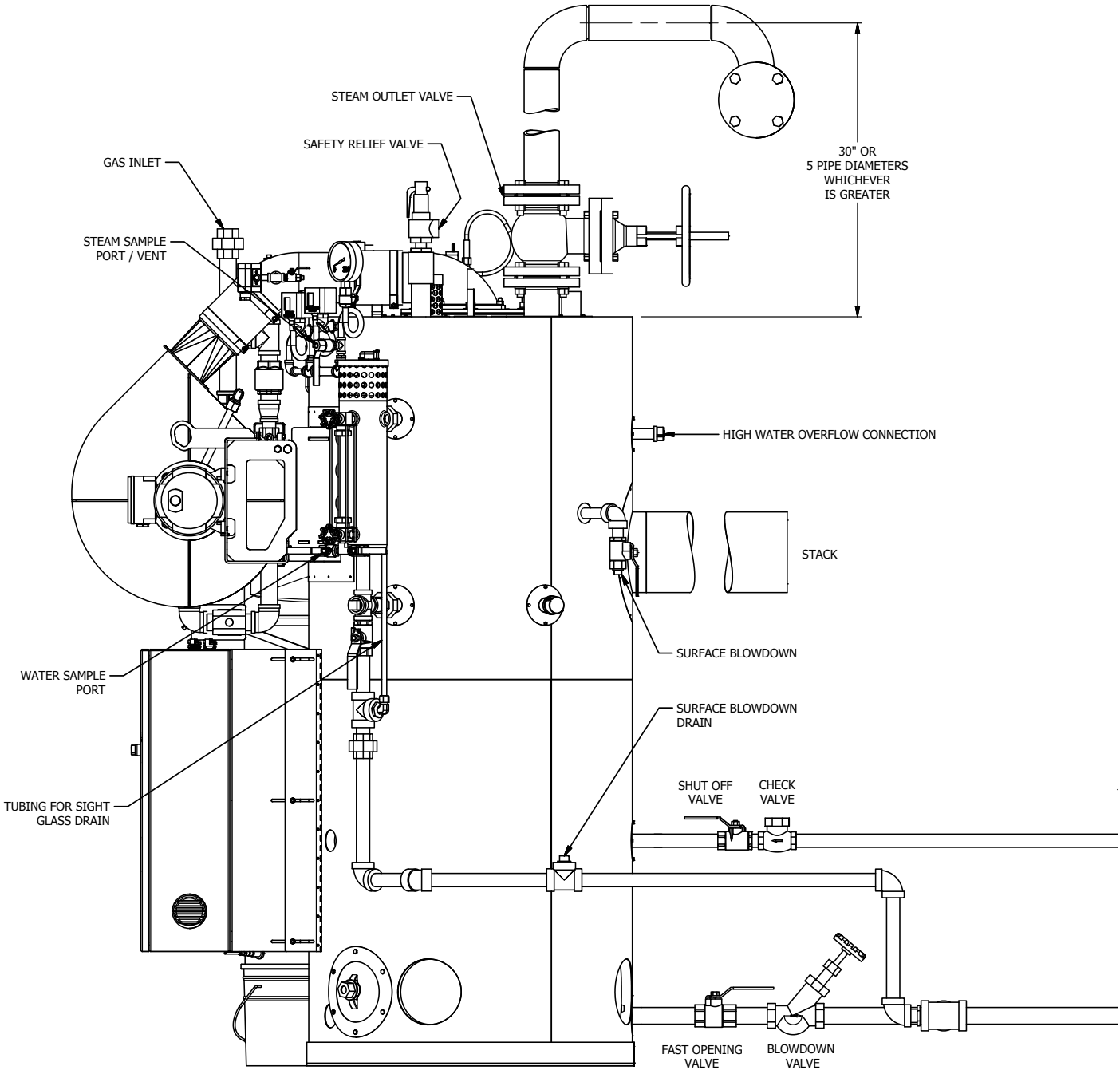


Figure 13 - Near Boiler Piping (continued on next page)

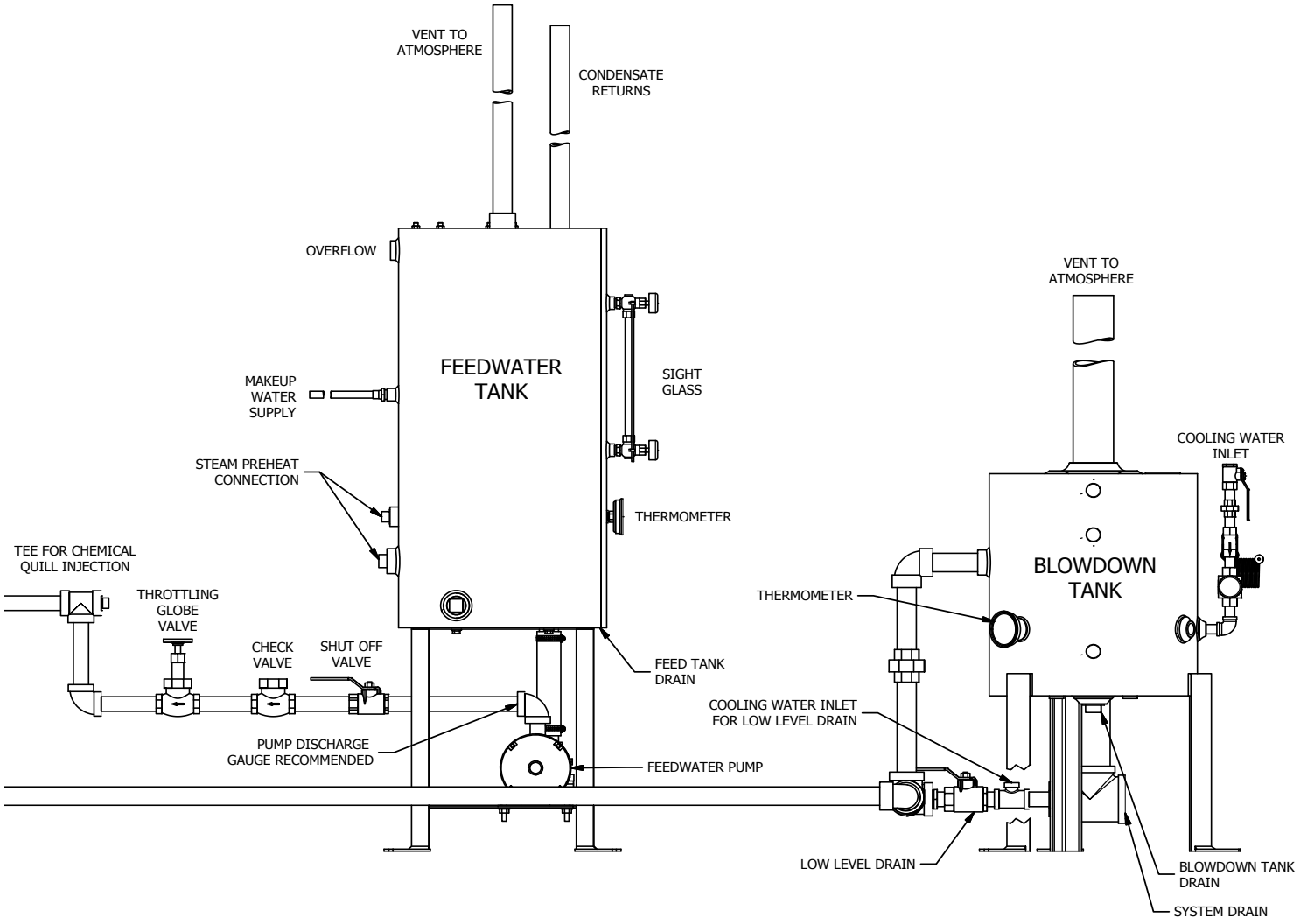


Figure 13 - Near Boiler Piping (continued from previous page)

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 are left uninsulated but suitably shielded for safety.

Adhere to the following:

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

System Interfaces

Refer to System Diagram (Figure 13).

CONDENSATE RETURN FEEDWATER TANK

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

1. Vent to a safe location.
2. Boiler feed tank shall have a capacity sufficient to satisfy boiler consumption as well as maintain proper feedwater tank temperature. Capacity should provide a minimum of 10 minutes of storage. Boiler pump is to provide a capacity of 2.5 times the evaporation rate for on/off pumps and 1.5 times the evaporation rate for continuous running pumps. The discharge pressure of the pump must be 3% over the boiler safety valve setting and include the necessary additional pressure to overcome piping losses.
3. See **Feedwater Instruction Manuals** for detailed instructions.

THE FEED WATER PIPING

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

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

BLOWDOWN TANK

Where a blowdown tank is to be fitted, adhere to the following:

1. Vent to a safe location.
2. Have a capacity sufficient to satisfy boiler blow-off, as well as maintain proper drain temperature.
3. Ensure compliance with all applicable codes when determining connection piping between the boiler and the blowdown tank.
4. Do not downsize vent pipe (this may cause pressure build up in the blowdown tank).
5. Ensure means to control discharge to drain temperature below140 F or maximum allowable temperatures allowed by local jurisdiction.
6. Do not insulate the blowdown tank.

THE BLOW OFF VALVES

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

1. Ensure pipes and connections are clean and free of any foreign material.
2. Pipe blow off pipes to a blowdown tank of approved design.
3. Ensure that for each blow off line there is a slow-opening and a fast-opening valve.
4. Ensure compliance with all applicable codes.

STEAM SAFETY VALVE

Adhere to the following:

1. Use only the safety valve provided with the boiler as noted on the ASME data report.
2. Ensure pipes and connections are clean and free of any foreign material.
3. Do not install using a pipe wrench. Use the appropriately sized wrench on the bonnet nut.
4. Install the valve vertically with no unnecessary intervening piping between the boiler and the valve.

⚠ 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. A discharge pipe shall be of a pipe size equal to, or greater than, the outlet of the safety valve.
8. Consult local codes for combined safety valve pipe sizing.
9. Minimize discharge piping fittings and overall piping run to avoid over pressurization of the piping, limiting safety valve discharge volume.
10. Do not support discharge piping with the safety valve. Discharge piping must be supported adequately by appropriate means.
11. Fulton recommends the use of a drip pan elbow, as this provides the needed drainage and isolation from expansion as required.
12. Terminate the discharge pipe directly to atmosphere. Discharge pipe must not contain a shut off valve of any sort.

STEAM PRESSURE GAUGE ASSEMBLY

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 no more than 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 glass connections (refer to **Figure 14**), 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 service rated 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).

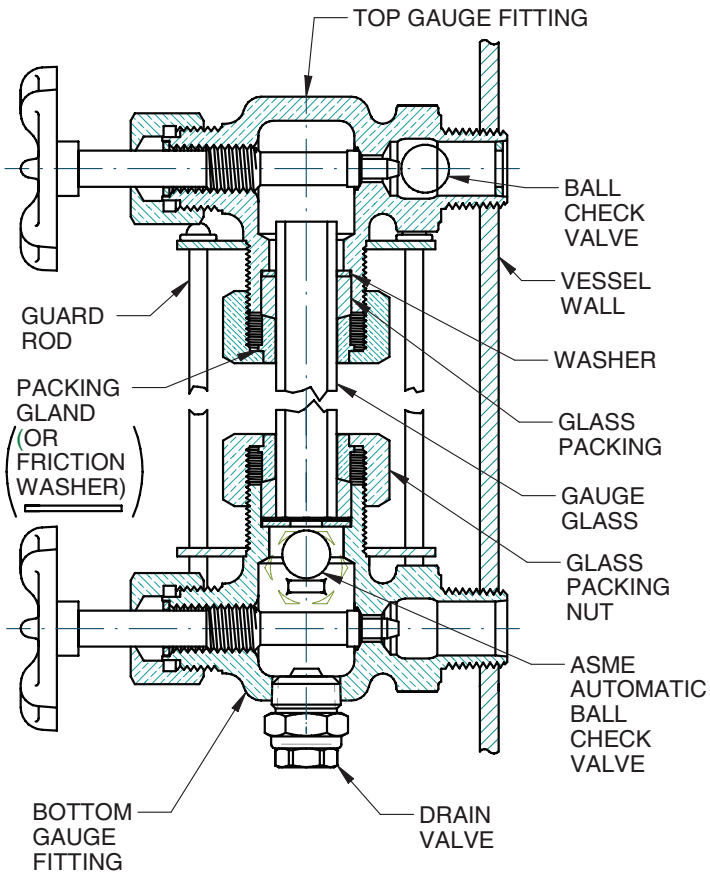


Figure 14 - Sight Gauge Glass

4. Install the bottom fitting (the fitting with the drain port) into the lower fitting on the water bottle. 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 threaded into the water bottle tappings the same amount (horizontally).
6. Remove the glass packing nut, friction washer and glass packing from the fittings and place them in the same order on either end of the water gauge glass. Push both packings about 1in (25.4 mm) from the end of the water gauge glass.
7. Gently insert one end of the water gauge glass into the top gauge fitting. Keeping the glass inside the fitting, gently rotate the top fitting clockwise until it is vertically aligned with the bottom fitting. **It is crucial that the gauge glass valves are aligned both vertically and horizontally**. **If not aligned, they may leak.**
8. Insert the gauge glass into the bottom fitting until it bottoms out, and then gently raise glass about 1/16 in (1.6 mm). Do not allow glass to remain in contact with any metal surface.
9. Carefully slide the bottom glass packing down until the glass packing is touching the lower gauge fitting. Carefully slide the top glass packing up until the glass packing is touching the upper gauge fitting.
10. Hand tighten both glass packing nuts, then tighten ½ turn more by wrench. Do not over-tighten. If any leakage occurs, tighten the packing nut slightly, no more than a ¼ turn at a time, until the leak stops.
11. When provided, 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.

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 and that skids are fully supported on a non-combustable base.
4. Ensure the skids are leveled and fully supported on a non-combustable base. 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. 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.

11. Tighten all connections.
12. Pneumatically test the piping prior to commissioning 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 long flue piping and too many elbows by placing the equipment as close as possible to the chimney.
2. The stack should rise continuously to the connection at the chimney and should contain no more than two bends at 45 degree angles or less. If required, as a result of space limitations, one 90 degree elbow (or tee) can be fitted at the back of the vessel.
3. There should be two feet 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 the following draft:
    - » Model ICS (FB-A), ICX (FB-F), ICT (FB-T), and VMP boilers must supply a draft condition of -0.02" w.c. to -0.04"' w.c. standing hot and -0.04" w.c. to -0.08" w.c. running hot.
    - » Model VSRT must supply a draft condition of -0.25" w.c. to + 1.50" w.c draft at the boiler.
    - » Positive pressure draft requires a CAT 3 stack.

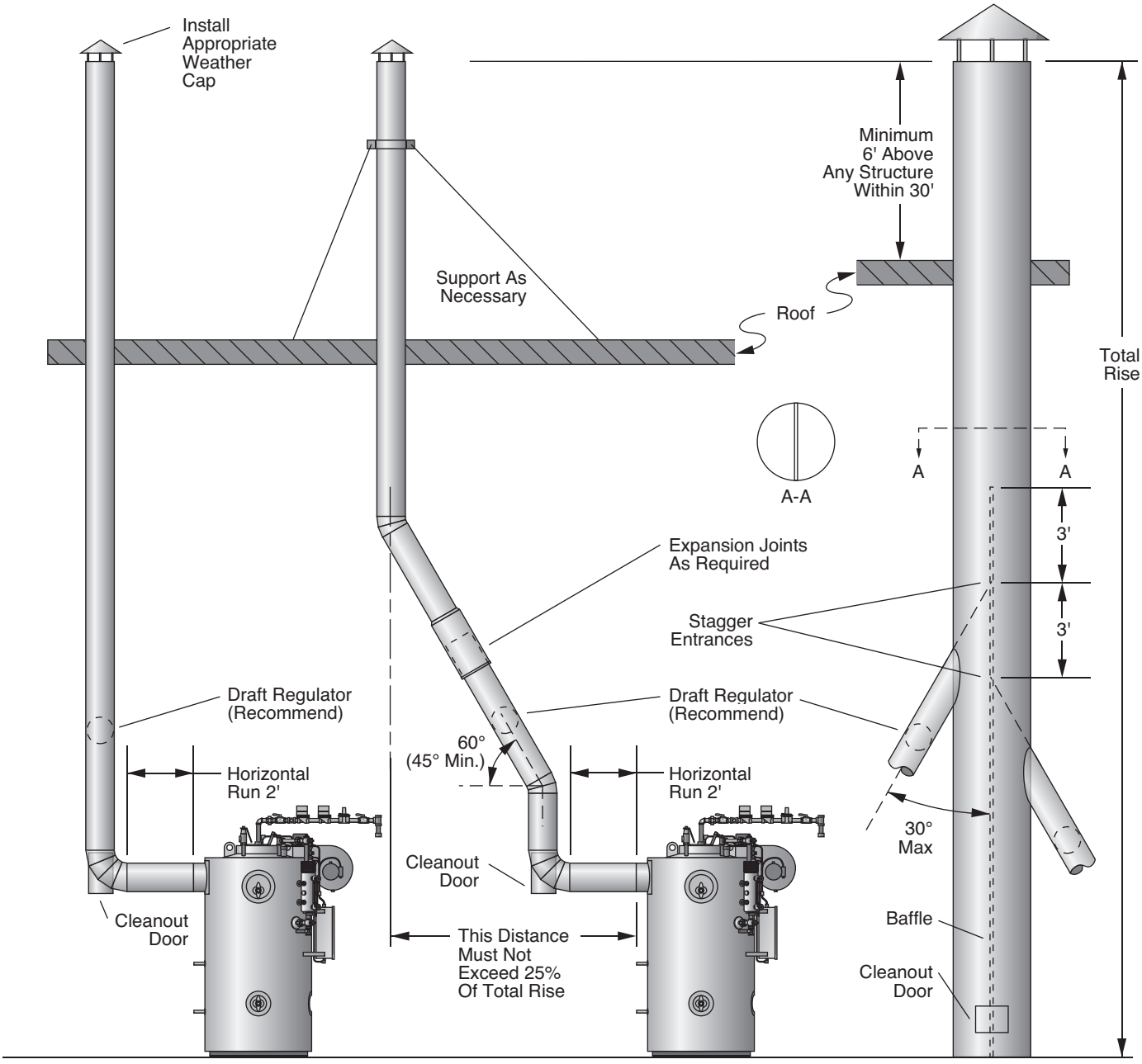


Figure 15 - Typical Stack

5. The run in the total distance of stack ducting, as measured in a straight line from the outlet of the boiler to the outlet of the stack, should not exceed 25% of the rise. With the exception of the duct run previously described, horizontal sections of ducting must be avoided and should not exceed four feet total. See **Figure 15.**
6. The stack and chimney material shall comply with all applicable codes.
7. 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.
8. 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 15.

⚠ 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.

Venting Terminations

Adhere to the following for installation:

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

ROOF VENT TERMINATION

Adhere to the following for installation (see **Figure 15**):

1. The minimum vent height should extend at least 6 feet (1.8 m) above the roof, or at least 6 feet (1.8 m) above the highest part of any structure within 10 feet of the vent.
2. When installing inlet and exhaust terminations above the roof, the exhaust outlet must be installed 4 feet (1.22 m) minimum above and 4 feet (1.22 m) minimum downwind from air supply inlet to prevent exhaust recirculation (see **Figure 16**).

SIDE WALL VENT TERMINATION

Adhere to the following for installation (see **Figure 17**):

➨ ***NOTE: The vent termination is joined to the vent pipe outside the wall. Use the same joining procedures for vent pipe and fittings.***

1. When penetrating a non-combustible wall, the hole through the wall must be large enough to maintain the pitch of the vent and provide sealing. Use adhesive material to seal around the vent on both sides of the wall. When penetrating a combustible wall, a wall thimble must be used. See **Figure 17** for installation instructions. Minimum wall thickness through which vent system may be installed is 3.25 inches (8.26 cm). Maximum wall thickness through which vent system may be installed is 20 inches (50.8 cm).
2. The termination of the vent system must be at least 12 inches (30.48 cm)above the finished grade, or at least 12 inches (30.48 cm) above normal snow accumulation level (for applicable geographical areas).
3. The termination of the vent system shall not be located in traffic areas such as walk ways, adjacent buildings, operable windows and building openings unless the venting system is at least 7 ft (2.1 m) above finished grade, (National Fuel Gas Code, ANSI Z223.1).
4. The vent terminations must be at least 4 ft (1.22 m) horizontally from electric meters, gas meters, regulators, and relief equipment.
5. When installing inlet and exhaust terminations on the same wall, the exhaust outlet must be installed 4 feet (1.22 m) minimum above and 10 feet (3.05 m) minimum downwind from air supply inlet to prevent exhaust recirculation.
6. Under certain wind conditions, some building materials may be affected by flue products expelled in close proximity to unprotected surfaces. Sealing or shielding of the exposed surfaces with a corrosion resistant material (such as an aluminum sheet) may be required to prevent staining or deterioration. Flue should be directed away from surfaces, if possible.

System Piping Testing

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

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

Before Leaving the Installation

Before leaving the installation, adhere to the following:

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

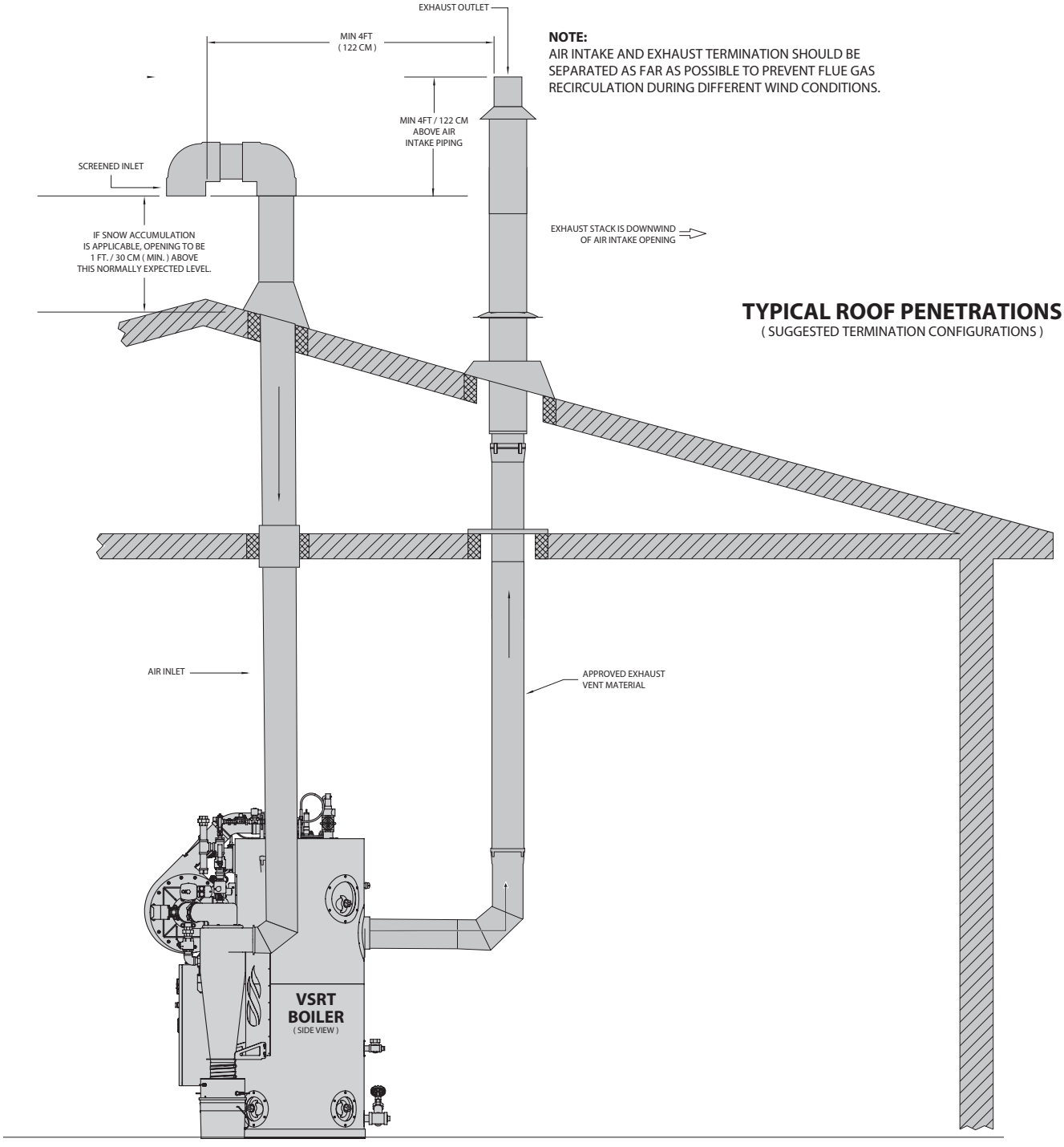
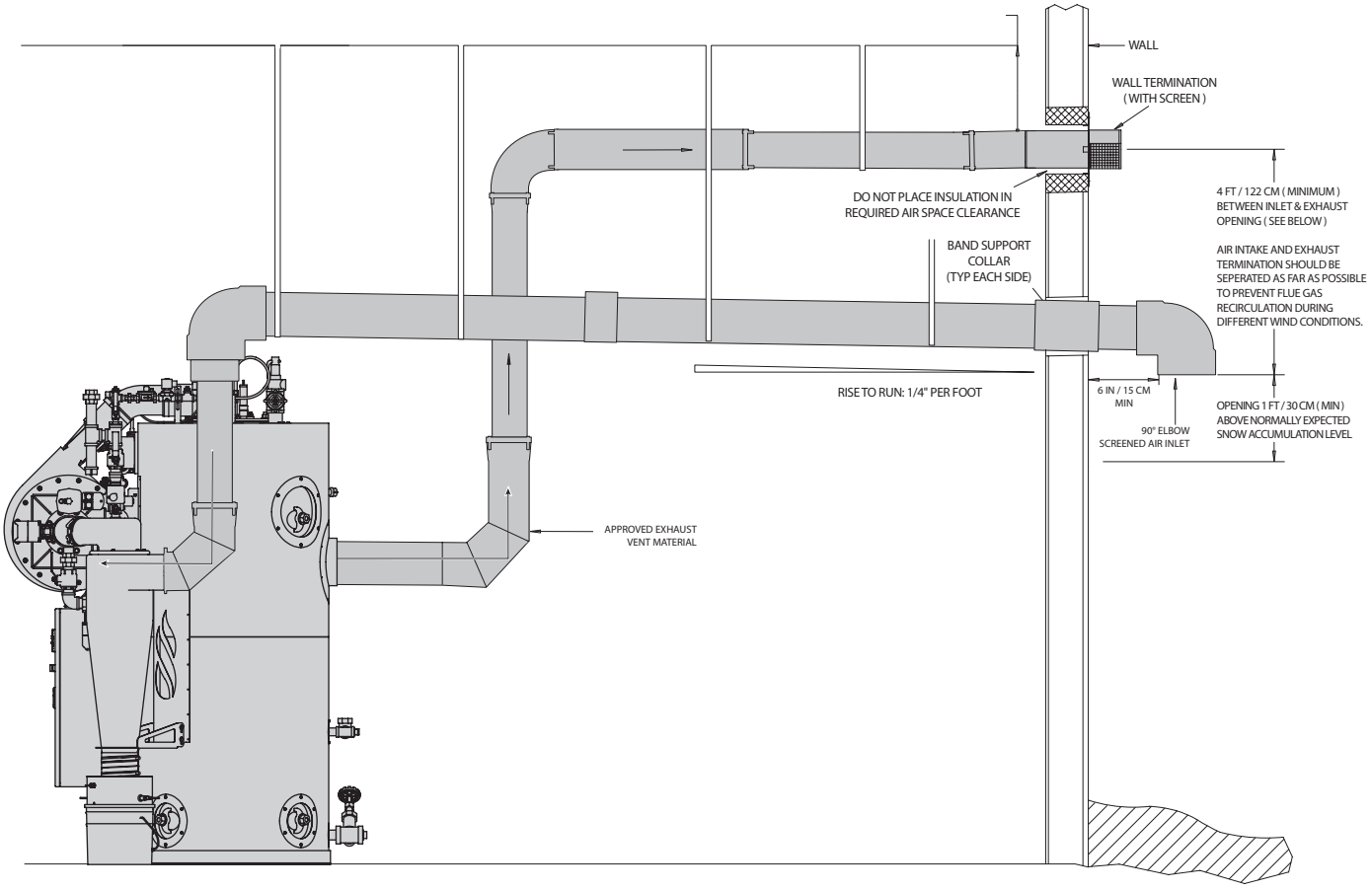
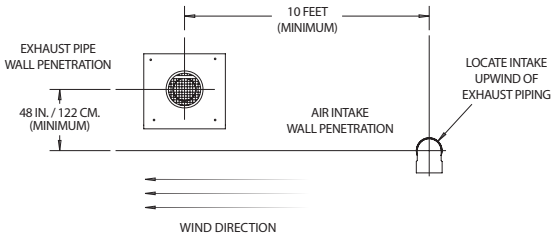


Figure 16 - Roof Penetration Details

NOTE:
1.) When using horizontal runs follow a 1/4" per foot rise to run ratio
2.) Maintain minimum 9" / 22.86 cm air space clearances to combustables, wires and insulation
3.) Install support straps at 5 FT / 152 CM horizontal intervals and at elbows



AIR INTAKE & EXHAUST PIPES WALL PENETRATION CLEARANCES



CAUTION:
AIR INTAKE AND EXHAUST TERMINATION SHOULD BE SEPARATED AS FAR AS POSSIBLE TO PREVENT FLUE GAS RECIRCULATION DURING DIFFERENT WIND CONDITIONS

NOTE:
MAINTAIN MINIMUM 9"/22.86 CM AIR SPACE CLEARANCES TO COMBUSTABLES, WIRES AND INSULATION

NOTE:
1.) When using horizontal runs follow a 1/4" per foot rise to run ratio
2.) Maintain minimum 9" / 22.86 cm air space clearances to combustables, wires and insulation
3.) Install support straps at 5 FT / 152 CM horizontal intervals and at elbows

Figure 17 - Side Wall Penetration Details

Section

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 piping from pressure leak testing such as blanking plates in flanged joints or unions.
4. Pipework is free to expand naturally when hot.
5. Equipment is located with the proper clearances.
6. Relief valves have been properly piped as described in the **Installation** section of this manual.
7. Flue gas from the equipment is properly vented.
8. Combustion air openings are not obstructed in any way and have adequate capacity.
9. There are no flammable liquids, materials or hazardous fumes present in the environment.
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. **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 two weeks before a Fulton service engineer is required on site.

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

Service technicians 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 technician will also familiarize boiler room personnel with the operation of all Fulton equipment. Personnel must be qualified to understand the basic operation and function of controls.

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

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

BOIL OUT PROCEDURE

Fulton recommends pressure vessel cleaning prior to system operation or after major maintenance. This boil-

out procedure removes oils, greases and other organic compounds that may cause erratic water level control and surging. There are many chemicals on the market that may be used and our recommendations are as follows:

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

Adhere to the following when performing boil-out:

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

Sequence of Operation: Gas Fired Burners

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

1. Check main gas valve, which provides proper pressure to burner. The maximum is 13.8" w.c. A step-down regulator may be necessary.
2. Combustion air is delivered by a centrifugal blower fan. An air switch monitors the pressure and is part of the flame programmer safety interlock circuit.
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 appropriate reset button on the boiler panel or the burner controller.

SEQUENCE OF OPERATION: MODULATED BURNER

The burner is equipped with modulating controls, which will provide up to a 6:1 turndown of the burner. This system is linkageless, and operates a fuel control valve, an air control valve and a variable speed drive to achieve turndown.

Beginning from an off state, and assuming there is a load on the system, when turning the switch to on, the following will be the sequence of operations.

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

2. Once purge is completed, the control will drive the blower speed, the air butterfly and the gas butterfly to the ignition position.
3. Once all devices are stable, the control will energize the ignition transformer, followed by opening the pilot gas valve, igniting the pilot flame.
4. Once pilot flame is established, the ignition spark will de-energize, and the pilot flame must remain proven by the scanner for a short safety time.
5. The main gas valve will now be energized, supplying fuel to the burner, and lighting the main flame.
6. The pilot valve turns off, and the main flame must remain proven by the scanner for a second short safety time.
7. The control now releases to modulation. The firing rate will now be dictated by the load on the system, as measured by the pressure controller.
8. The burner output will vary from high fire down to low fire continuously in order to match load.
9. Once the system load has been satisfied (steam pressure in the system exceed setpoint) the burner will initiate it's shutdown sequence.
10. If possible in time allotted (and if the system is set-up and sized properly), the burner will modulate to low fire before shutting down. Regardless of firing rate, the shutdown begins with the main gas valve de-energizing, stopping fuel flow to the burner.
11. The control will then drive air damper and the blower to their specified post-purge position, after which it will purge combustion gasses from the unit for 15 seconds.
12. The control will then de-energize the blower motor and drive all gas and air dampers to their closed position
13. The burner will remain in the off state until the system steam pressure falls below setpoint for the burner to turn back on.

Flame Programmers

FLAME SAFEGUARD CONTROL

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

Siemens Linkageless Modulation

⚠ WARNING

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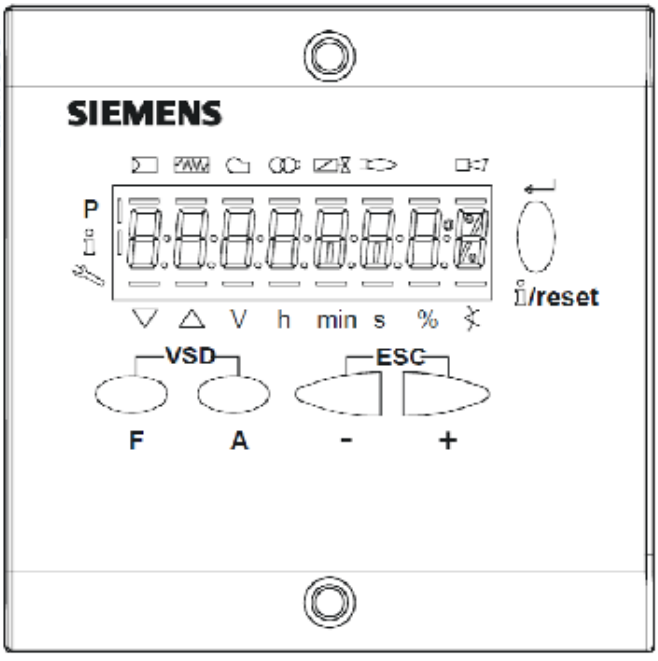
The Siemens LMV3 system is a fully packaged burner management system, linkageless control and first out annunciator. When operating the Siemens LMV3 systems, all changes are made through the Siemens AZL display. The left and right arrow keys are used for scrolling through the menu and changing controller parameters. "Enter" accepts the menu and parameter changes. It is possible to return to the main menu at any time by repeatedly pressing "Escape" (pressing the "+" and "-" keys at the same time). When running the boiler, the status of the burner is to be monitored with the Siemens AZL display (see below).



SIEMENS LMV3 CONTROLLER NAVIGATION

⚠ WARNING

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

Note: Fulton recommends use of the flame programmer manual/Quick Start Guide when performing any changes on the unit flame programmer.

1. Press and hold the F and A buttons simultaneously. You will be prompted for your password (####).

Note: #### is the last four digits of the national board number.

2. Enter your password and press the "Enter" button.
3. Using the "–" button, scroll to parameter level 100.
4. To enter into a parameter level and start programming, press the enter button.
5. Use the "+" and "-" buttons to scroll through the parameters.
6. Press the enter button to enter the parameter. The current value will start flashing.
7. Use the "–" button to decrease the value or "+" button to increase the value.
8. Once the desired value has been set, press the "Enter" button. The number will stop flashing.
9. Press the "–" and "+" buttons together to back out of the parameter level when finished.
10. Press the "–" or "+" buttons to scroll to the next section of the program.
11. Repeat this process until all parameters have been reviewed and set.
12. Once the parameters have been programmed, back out to the front screen by pressing the – and + buttons together.

Commissioning the Unit

⚠ WARNING

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

Note: A combustion analyzer will be needed when performing changes to the profile. Combustion settings should only be adjusted by a qualified factory trained and certified technician.

1. Press and hold the "F" and "A" buttons simultaneously. You will be prompted for your password (####).

➨ ***NOTE: Note: #### is the last four digits of the national board number.***

2. Enter your password and press the "Enter" button.
3. Using the "+" or "–" button, scroll to parameter level 400. Press the "Enter" button. RUN will appear. Press the enter button again.
4. Turn the boiler on and make sure that there is a call for heat. PH12 means the unit is in standby and is looking for a call for heat to start. The unit should start to 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 boiler to ignite the pilot flame. Once the pilot is established, the boiler will transfer to main flame.
6. You will be at P0. P0 is the start of the profile and the Ignition position.

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

ADJUSTING THE PROFILE

⚠ WARNING

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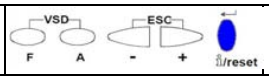
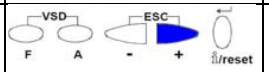
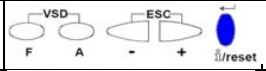
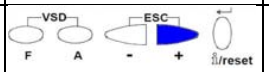
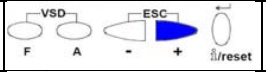
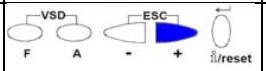
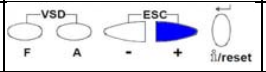
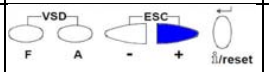
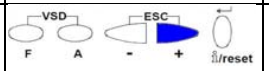
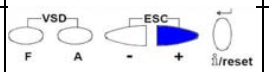
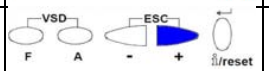
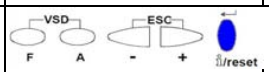
See the table, below, for a Siemens LMV3 fault history listing. Refer to Table 7 at the end of this section of this manual for Siemens LMV3 parameter information.

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

Operating Controls

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

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

Burner Settings

Burner combustion settings:

- Typical O2 for proper combustion is 4.5-6%.
- Typical O2 for the ignition position (P0) is 3.5-5% for reliable light off and flame sensing..
  - » P0 set point is typically between P1 and P2 on combustion curve.

➨ ***NOTE: Pilot pressure range is to be 2.5" w.c. to 3.5" w.c.***

  - » Lower O_2 settings can reduce burner mesh life.
  - » Higher O_2 settings will reduce the overall efficiency of the burner.
- Boiler pressure controller is Yokogawa UT-32A.

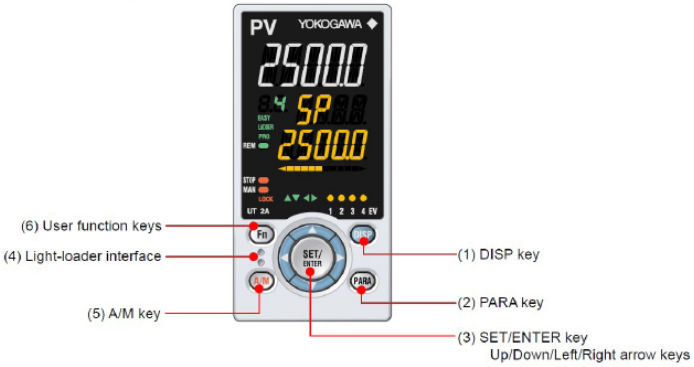
Burner combustion adjustment guidelines:

	Up	Down
Fan Speed Adjustment	More O_2, More Input	Less O_2, Less Input
Gas Servo Adjustment	More Input, Less O_2	Less Input, More O_2
Air Servo Adjustment	More O_2, Less Input	Less O_2, More Input
SKP-25 Adjustment	More Input, Less O_2	Less Input, More O_2

Pressure Modulation Controller

ADJUSTMENT OF THE YOKOGAWA UT-32A OPERATING CONTROLLER:

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

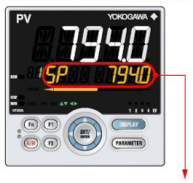


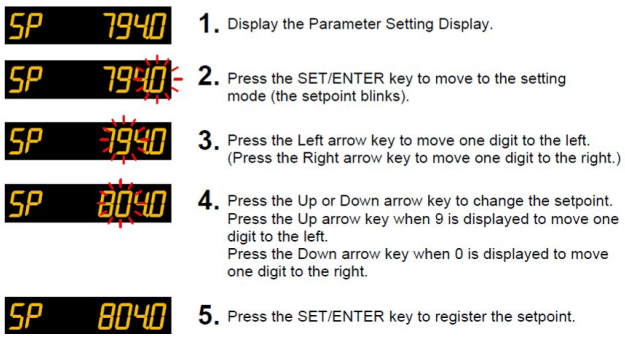
- (1) – DISP key used to switch the Operation Displays. Press the key in the Menu Display or Parameter Setting Display to return to the Operation Display.
- (2) – PARA key hold down the key for 3 seconds to move to the Operation Parameter Setting display. Hold down the key and the left arrow key simultaneously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

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

3 - OPERATION

Numeric Value Setting





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

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

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

To adjust the PID settings, follow the steps below:

1. Pressing the "Fn" button will directly bring you to the PID parameters
2. "P" will be displayed
3. Pressing the ↓will display "I."
4. Pressing the ↓ again will display "d."
5. Pressing DISP will return to SP
6. **"P" – Proportional Band**
7. Percentage of set point at which the burner begins to modulate down from 100% firing rate.
8. The smaller the number, the longer the unit will remain at 100% firing rate.
9. With Proportional only setting, the boiler typically will never reach set point.
10. **"I" – Integral Band**
11. How often the unit checks to adjust the firing rate.
12. The smaller the number, the faster the controller reacts. If it reacts too fast, it will oscillate.
13. Integral setting allows the boiler to reach the set point
14. Fulton standard Integral time setting is "minutes/seconds per repeat"
15. **"D" – Derivative Band**
16. Proportional does the heavy lifting getting the temperature close to the set point and Integral gradually removes error. Most systems you will not need it.
17. D is used to compensate for dead (or lag) time.
18. The D term adds to, or subtracts from, the output an amount defined by the mathematical derivative or rate of change of the operating value.
19. PID Settings for a typical boiler system with the boiler correctly sized is P=20 / I=45 / D=0

To change the controllers from Automatic Mode to Manual Mode

1. Press the "A/M" button until the red light illuminates next to MAN and OUt is displayed.

2. Use the ↑/↓ to change the output from 0.0 to 100.0
3. To return to Automatic Mode, press the "A/M" key again and the red light will turn off.

FLAME PROGRAMMER

Refer to cut sheets for provided flame programmer.

AIR SAFETY SWITCH

To test, perform the following:

1. Disconnect power to boiler.
2. Remove air supply from the air switch, and turn on the boiler.
3. Once the boiler is in the purge process, the safety interlock should appear and shut down the burner.
4. Turn the burner off and reattach the air switch air supply.
5. Reset the flame programmer.
6. Set the Air Switch:

- While the boiler is running on the lowest modulation rate (usually 0% low fire), adjust air switch clockwise to raise the setpoint pressure and counter-clockwise to lower the setpoint pressure.
- Adjust clockwise until switch trips and locks boiler out on air pressure.
- The air switch should be turned counter clockwise from the desired set point 1-2 full turns.
- Cycle the boiler multiple times to be sure that no nuisance fault occurs.

BLOWER MOTOR STARTER

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

1. With the boiler running, 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.

LOW WATER CUT-OFF

Each cutoff device shall be installed to prevent startup, and to cut off the boiler fuel or energy supply automatically, prior to the fall of the water level below the lowest visible level of the gauge glass. Standard low water cutoff devices are Fulton level probes. Alternate cutoff devices are MM-150, MM-157, MM-193-7b. Fulton probe type low water cutoff devices have a built in 3 second time delay feature. Float type low water cutoff controllers have a 30-second delay. Test as follows:

PRIMARY LOW WATER CUT-OFF

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

To test this safety:

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

SECONDARY LOW WATER CUT-OFF

This is always a manual reset safety.

To test this safety:

1. Slowly drain to the secondary cut-off level. This must be above the bottom of the lowest visible

point in the sight glass. Once the secondary level cut-off is tripped, a light on the panel will become illuminated.

2. Do not push the manual reset button for the low water safety cut-off at this time. Refill the boiler first.
3. Once boiler is refilled, turn the boiler ON switch. With the low water cut-off light still illuminated, the burner should not turn on.
4. Push the low water reset button. Once this button is reset, the burner should begin the pre-ignition process as long as all other safety interlock devices are satisfied.

HIGH LIMIT PRESSURE SWITCH

Perform the following to test:

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

OPERATING PRESSURE LIMIT SWITCH

Perform the following to test:

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

FLAME SCANNER

Perform the following to test:

1. Verify that the flame scanner is observing flame with the burner running by confirming that a flame signal is present with a flame in the boiler.
2. Shut down the burner.

⚠ WARNING

Do not shut off gas supply with the burner running. This is extremely dangerous. Damage to the boiler/ burner may occur.

3. Close both the main gas supply isolation valve and gas pilot line isolation valve.
4. Turn the burner on. This will cause a flame failure and verify that the pilot flame failure function is operating correctly.
5. Turn the boiler off and open the gas pilot line isolation valve. This will allow for the burner to cycle though the pilot light off and test main flame failure. Turn the boiler off after this test is complete.

Note: On smaller boilers, the pilot flame will be sufficient to allow the boiler to cycle through the main flame test. If this occurs, shut the pilot line isolation valve. This will cause the boiler to fail on main flame.

6. Once boiler is completely off and has completed the post purge cycle, open the main gas supply valve and normal boiler operation can be resumed.

MODULATING CONTROLS

All boilers are standard-equipped with modulating controls.

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

PRESSURE RELIEF VALVE

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

SIGHT GLASS ISOLATION VALVES

The brass sight glass isolation valves are equipped with an internal ball check. In the event that a sight glass should break, the ball will set, preventing discharge of

steam and water. The brass valve stem must be opened fully to enable this feature If the valve is in any other position, the ball will not seat.

PROOF OF CLOSURE - IF APPLICABLE TO YOUR MODEL

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

Cycle Testing

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

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

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

Daily Start-Up

To initiate daily start-up:

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

Daily Shutdown

To initiate daily shutdown:

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

*Table 7 - Steam Program for Siemens LMV3**

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
000	Internal Parameters				
41	Password	0	65535		NB/SN
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		
162	Operating hours resettable	0 h	99999999 h		

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+Out of Test Fire
Note: Customer settings should be recorded in the Customer column for reference.

*Table 7 - Steam Program for Siemens LMV3**

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
163	Operating hours when unit is live	0 h	99999999 h		
164	Number of start ups resettable	0	99999999		
166	Total number of start ups	0	9999999		
167	Fuel volume resettable	0	99999999		
200	Burner Control				
201	Burner operating mode (fuel train, modulating / 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	22	3	
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	5 s	
212	Max time down to low fire	0.2 s	10 min	30 s	10 s
213	Min time home run	2 s	60 s	2 s	
214	Max time start release	0.2 s	10 min	20 s	
215	Repetition limit safety loop	1	16	1	
217	Max time to detector signal	5 s	10 min	30 s	
221	Gas: Active detector flame evaluation 0 = QRB / QRC 1 = ION / QRA	0	1	1	
222	Gas: Pre-purging 0 = deactivated 1 = activated	0	1	1	

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*Table 7 - Steam Program for Siemens LMV3**

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
223	Repetition limit pressure switch mini-gas	1	16	1	
225	Gas: Pre-purge time	20 s	60 s	30 s	
226	Gas: Pre-ignition time	0.2 s	60 min	2 s	
227	Gas: Safety time 1 (TSA1)	0.2 s	10 s	5 s	
229	Gas: time to respond to pressure faults in TSA1	0.2 s	9.8 s	1.8 s	
230	Gas: Interval 1	0.2 s	60 s	5 s	
231	Gas: Safety time 2 (TSA2)	0.2 s	10 s	5 s	
232	Gas: Interval 2	0.2 s	60 s	2.0 s	
233	Gas: Afterburn time	0.2 s	60 s	8 s	
234	Gas: Post purge time	0.2 s	108 mi,	15 s	
237	Gas pressure switch-max / POC input 0 = deactivated 1 = pressure switch-max 2 = POC	1	2	2	
239	Gas: Forced intermittent operation 0 = deactivated 1 = activated	0	1	1	
240	Gas: Repetition limit loss of flame	1	2	1	
241	Gas: Execution leakage test 0 = no leakage test 1 = leakage test on start up 2 = leakage test on shut down 3 = leakage test on both	0	3	0	
242	Gas: Leakage test evacuation time	0.2 s	10s	3 s	
243	Gas: Leakage test time atm pressure	0.2 s	60 s	10 s	
244	Gas: Leakage test filling time	0.2 s	10s	3 s	
245	Gas: Leakage test time gas pressure	0.2 s	60 s	10 s	
246	Gas: Waiting time gas shortage	0.2 s	60 s	10 s	
400	Ratio Curves				
401	Ratio control curve fuel actuator	0	90		
402	Ratio control curve air actuator	0	90		
403	Ratio control curve VSD	20 %	100 %		
500	Ratio Control				
501	No-flame positions fuel actuator Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0	90	0 0 0	
502	No-flame positions air actuator Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0	90	0 65 45	

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+Out of Test Fire
Note: Customer settings should be recorded in the Customer column for reference.

*Table 7 - Steam Program for Siemens LMV3**

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
503	No-flame speeds VSD Index 0 = no-load position Index 1 = pre-purge position Index 2 = post-purge position	0 %	100 %	0 65 % 65 %	
522	Ramp up	5 s	20 s	20 s	
523	Ramp down	5 s	20 s	20 s	
542	Activation of VSD / PWM fan	0	1	1	
544	Modulation Ramp	32 s	80 s	32 s	
545	Lower load limit	20 %	100 %	20%	
546	Upper load limit	20 %	100 %	100%	
600	Actuators				
601	Selection of reference point Index 0 = fuel Index 1 = air 0 = closed (<0) 1 = open (>90)	0	1	1 0	
602	Actuator's direction of rotation Index 0 = fuel, Index 1 = air 0 = counterclockwise 1 = clockwise	0	1	0 0	
606	Tolerance limit of position monitoring	0.5	2.5	1.7	
641	Control of speed standardization of VSD	-25	1	0	
642	Standardized speed 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	
922	Incremental position of actuators Index 0 = fuel Index 1 = air	-50	150	0	
935	Absolute speed	0	65535	0	

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+Out of Test Fire
Note: Customer settings should be recorded in the Customer column for reference.

*Table 7 - Steam Program for Siemens LMV3**

Par. No.	Parameter	Min Value	Max Value	Fulton Setting	Customer
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.

Section

⚠ 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 disconnecting 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 Steam 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 in 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 18**. 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 detector adjustments are made with the detectors installed and the burner running. It is essential to obtain optimum flame signal detection for safe and continual operation of the control relay

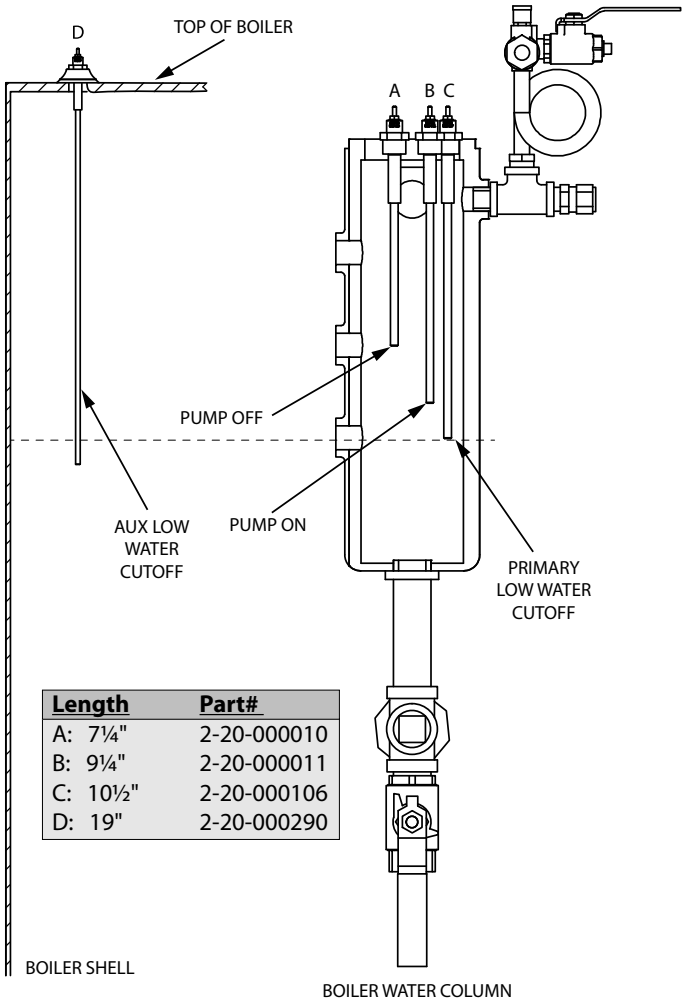
If a detector is inoperable, it may prove the detector is working and only an adjustment to the flame is needed to improve the signal.

If the detector is found to be defective, replace.

Adjustments to establish a good signal may include the following:

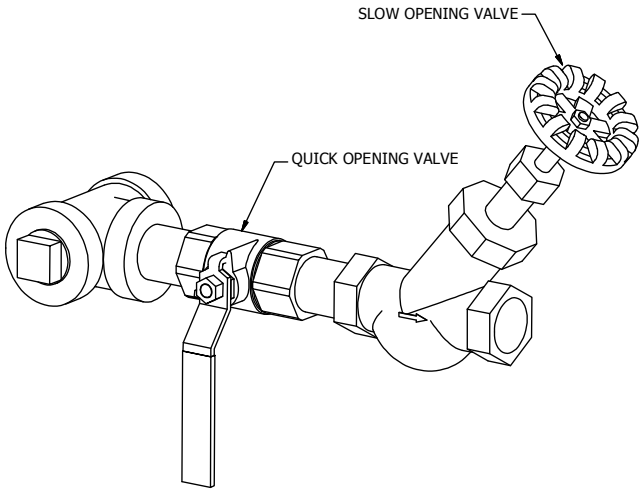
- Air damper adjustments in the combustion settings.
- Adjusting gas pressure through the gas regulator.

Figure 18 - Probe Lengths



Length	Part#
A: 7¼"	2-20-000010
B: 9¼"	2-20-000011
C: 10½"	2-20-000106
D: 19"	2-20-000290

Figure 19 - Bottom Blowdown Valves



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.

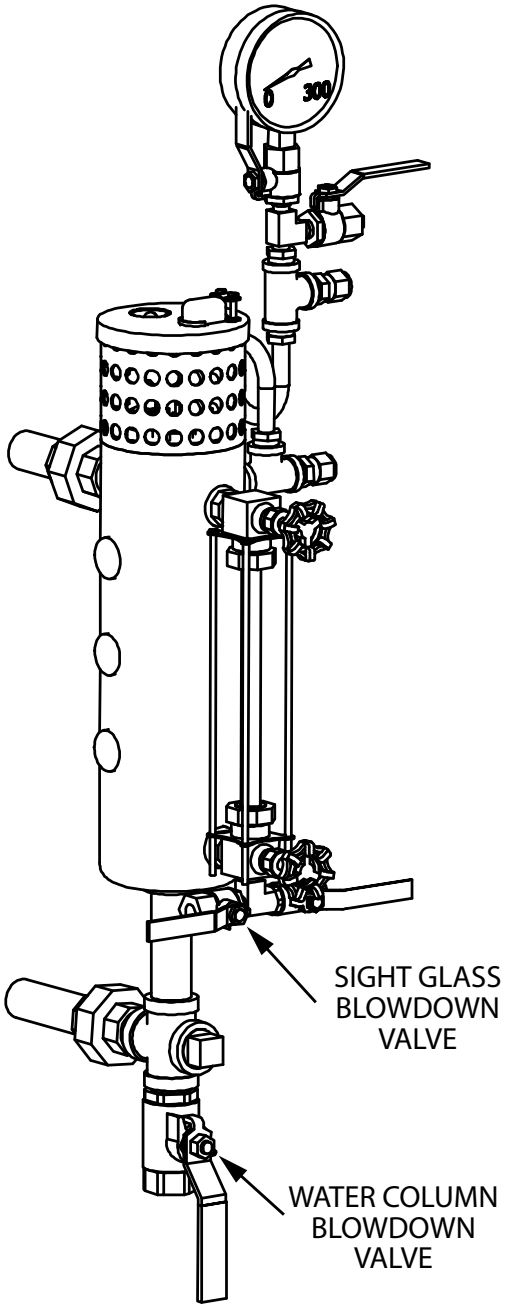
The following procedures should be carried out daily as recommended maintenance. They are designed to prevent the buildup of scale, silt, or sludge in the bottom of the boiler and in the pipes leading to the water gauge. In addition to these procedures, the advice of a water treatment supplier should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

1. Blow down the boiler each morning by starting the boiler and generating not more than 10 PSI (.7 kg/cm2) of steam. Turn on cooling water to blowdown tank, if equipped, then open the boiler blow off valve for approximately 10 seconds, then close valve. See **Figure 19**. Be sure that the slow opening valve (Y-Valve) is adjusted properly. The slow opening valve is to be adjusted so that only 1-2" of water empty from the boiler sight glass during the 4-10 second bottom blowdown. During each blowdown, there should be 1-2" of level drop in the sight glass. If a manual method of cooling water is used, be sure to shut off the cooling water supply. If there are two bottom blowdown connections on the boiler, both should be blown down daily.
2. Blow down water column each morning when boiler is at 10 PSI (.7 kg/cm2) by opening the water column and the water gauge blowoff valves (see **Figure 20**) for approximately five seconds, then close the valves. On boilers with float type level devices, refer to the water column cut sheet for proper blowdown technique. Any water column on the system should be blown down daily following the above procedure.
3. If the feed water is being treated by chemical

compounds, make sure that this treatment is carried out carefully and according to the chemical supplier's instructions.

➨ ***NOTE: Fulton recommends that the feedwater chemical treatment should be added between the pump and the boiler.***

Figure 20 - Water Column



4. Check water level in sight glass.
5. Check to be sure feed water pump is working.
6. For float type water level control, blow down the float chamber.
7. Check water chemistry.

⚠ CAUTION

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

Recommended Weekly Maintenance Schedule

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

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

⚠ CAUTION

Correct combustion 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 combustion analyzer to set conditions.

Recommended Monthly Maintenance Schedule

⚠ WARNING

Make sure main power switch is off before starting work.

⚠ CAUTION

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

The following steps should be carried out monthly:

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

BURNER COMPONENTS

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

Recommended Semi-Annual Maintenance Schedule

The following steps should be carried out semi-annually:

1. Check combustion settings for all fuels.
2. Check and adjust combustion to the correct settings.
3. Check for proper operation of steam traps in your system.
4. Check feedwater pumps for correct operation.
5. Check and clean burner. See next page for directions.
6. Check settings of flame rod (if applicable) and ignition electrode.
7. Inspect ignition electrode for cracks.
8. Clean water safety and level probes.
9. Check burner and boiler refractory for cracks.
10. Inspect stainless steel ring in furnace (if present)
11. Check operation of steam safety valve at no more than 15 PSIG.
12. Drain and clean feedwater tank.
13. Check electrical controls and motors for correct operation.
14. Shut off the boiler completely and drain.
15. Remove brass pipe plug at the cross connection below the water column and inspect and clean the nipple into the boiler. The boiler must be cold and the water level must below the pipe connection.
16. Remove the hand holes and inspect the interior of the vessel for scale or sludge deposits. See **Figure 21**. 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.
17. Replace hand hole gaskets as follows:
    - » Remove the hand hole assembly using a 1-1/4" tee handle wrench or 1-1/4" 1/2" drive socket wrench. See **Figure 22**.
    - » Remove the old gasket and thoroughly clean the surface on the boiler and the plate.

Note: Do not reuse old gasket(s).

18. Clean and empty cyclone bucket collector.

Figure 21 - Inspect hand holes for scale or sludge buildup

19. 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.

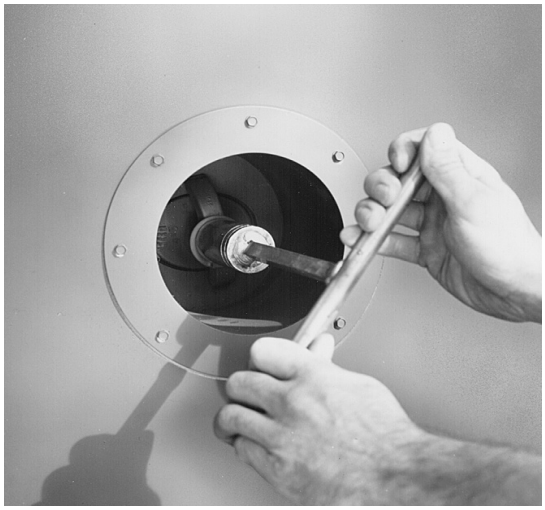


Figure 22 - Removing Hand Assembly with Tee Handle Wrench

    » 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 23** and **24**.

    » 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.

Figure 23 - Correct pressure on gasket

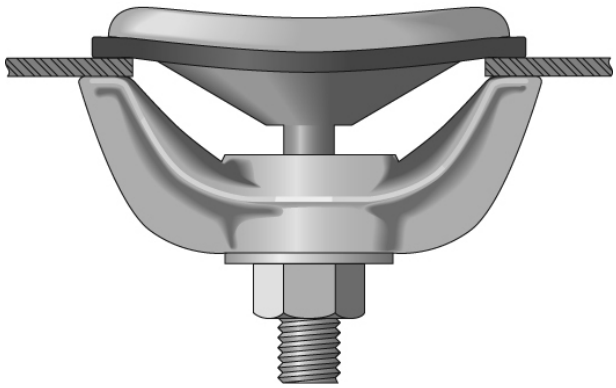
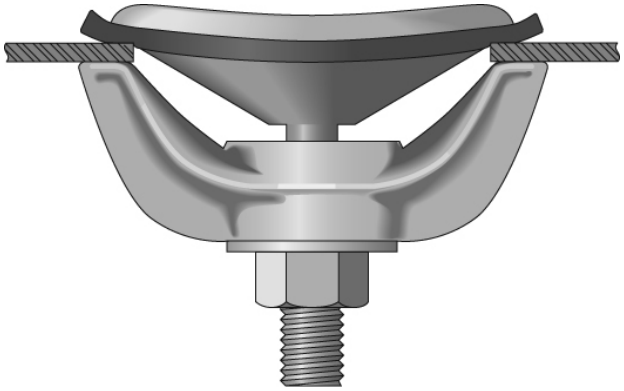


Figure 24 - Overcompressed Gasket



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 entitled **Inspection/ Cleaning of the Burner Assembly** at the end of this section for cleaning and burner removal procedures.

The burner must be removed to perform a thorough inspection and cleaning.

INSPECTION AND MAINTENANCE OF THE PILOT ASSEMBLY

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

1. Remove the pilot assembly – This can be done with the burner in place
    - » Shut the manual valve in the pilot line, and ensure that power to the boiler is disconnected
    - » Disconnect the pilot gas whip from the pilot assembly
    - » Remove the ignition cable from the ignition electrode
    - » Remove the bolts holding the pilot assembly
    - » Remove the pilot assembly by lifting straight up, taking care not to lose the O-ring seal
2. Inspect the pilot assembly
    - » Ensure that the pilot orifice is not clogged.
    - » Inspect and ensure that there are no signs of overheating, these would be visible as burnt or scaling metal, or distortion of the pilot parts
    - » Inspect the gap from the ignition electrode to the sparking notch in the pilot sleeve.
    - » Electrode should be centered vertically in the notch, and the minimum gap from electrode to sparking surface should be 3/16”
    - » Ensure that the ceramic on the ignition electrode is not cracked or damaged

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

➨ ***NOTE: Removing the burner plate will require replacement gaskets.***

➨ ***NOTE: The burner assembly drawings are located at the end of this chapter, just before Troubleshooting.***

INSPECTION/CLEANING OF THE BURNER ASSEMBLY

Most of the particulate matter in the combustion air stream should be caught by a pre-filter or cyclone. However it is necessary to pull the burner head once a year, and inspect and clean it

1. Remove Burner
    - » Loosen the flexible coupler between the blower fan and the premix transition. It should only be necessary to loosen the end of the transition, but both can be loosened.
    - » Loosen the hose clamps on the flex connector closest to the burner inlet elbow. Once these hose clamps are loose, slide the flex connector back towards the front of the boiler.
    - » Lift the premix transition straight up, then slide out of the flexible coupler.
    - » You should now be able to lift the burner straight out of the burner plate (NOTE: Do not remove burner plate, as gasket will need replacement if it is moved).
2. Inspect and Clean the Burner
    - » The burner should be clean and free of dust. This can be accomplished using compressed air. Blow compressed air through the mesh from the outside in, then empty any contaminates inside the burner can.
    - » Inspect the burner for signs of local overheating, or soot. If soot is present, either the pilot or the main burner is not running the proper fuel air ratio, and the combustion controls should be checked, while local overheating will result in discolored mesh or possible detaching or sagging.

EXAMINE THE VENTING SYSTEM

1. Check all joints and pipe connections for tightness. Check vent for corrosion or deterioration. If any venting needs replacing, do so immediately.
2. Perform any recommended maintenance as required by the vent material manufacturer.

3. Inspect heating system for other problems.
4. Perform combustion analysis and adjust if necessary.
5. Inspect premix flexible couplings for damage or excessive wear.
6. Check for leaks in gas train, blower, and blower-to-burner piping.

Recommended Annual Maintenance

The following steps should be carried out annually:

1. Have combustion (CO2, O2, CO) and input checked by qualified personnel.
2. Clean dirty flues to prevent air flow restrictions resulting in poor combustion and loss of efficiency.
3. Flush boiler if necessary. See **Boil Out Procedure** section of this manual. More extensive cleaning may be required; consult a local water chemistry expert for recommendations.
4. Provide annual inspection by a qualified ASME boiler inspector, as required by local codes.

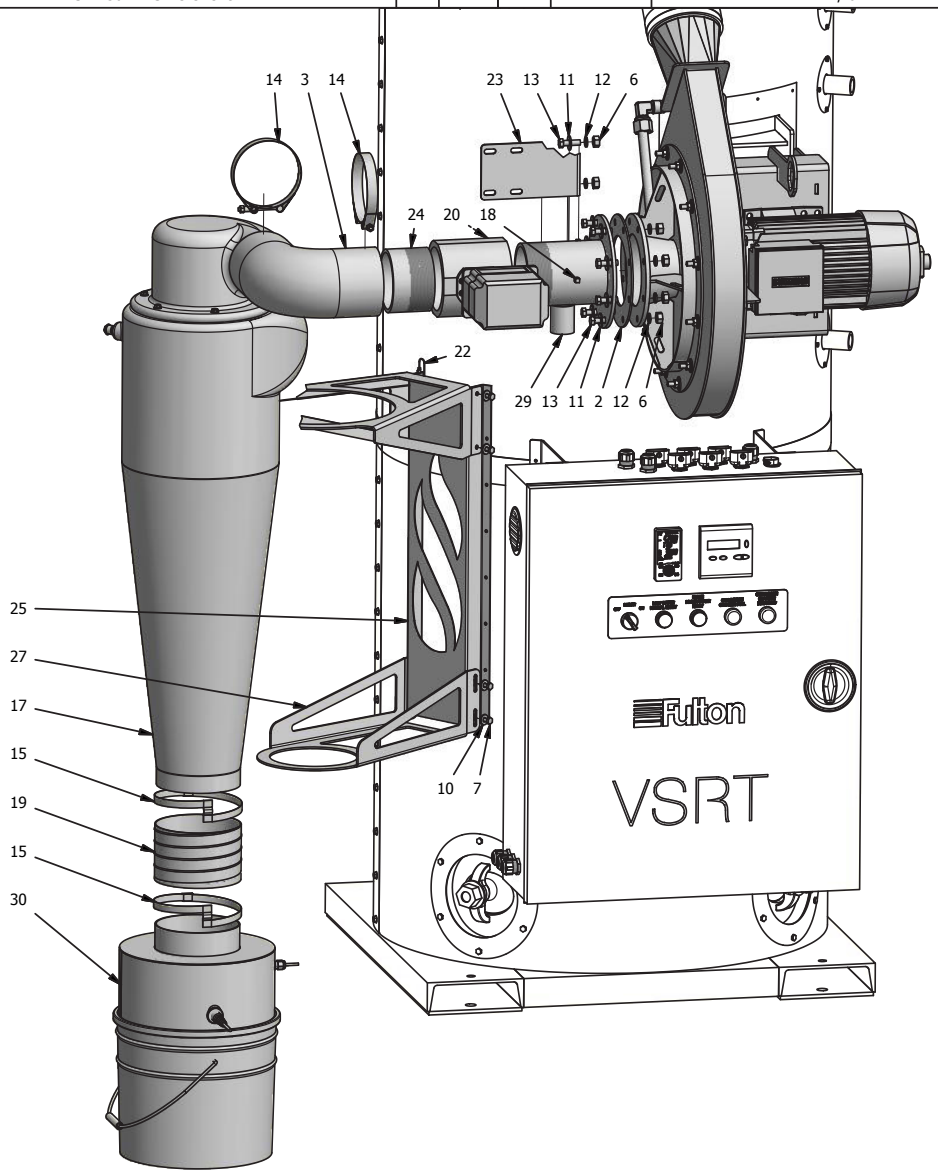
After All Repairs or Maintenance

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

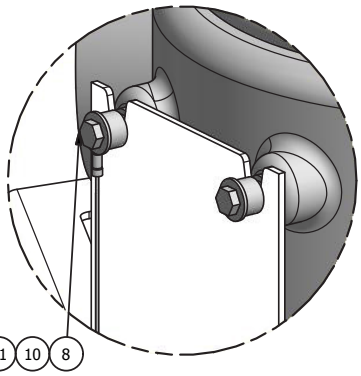
Assembly Drawings and BOMs

Refer to the figures and tables on the following pages for VSRT assembly drawings and BOMs.

BILL OF MATERIAL					BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.	ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-12-000429	PVC GROMMET 5/8" OD X 1/4" ID FOR 11 GA. PANEL (MCMASTER # 93115132)	2	EA.	18	2-35-000249	1/8" 3000# PLUG	1	EA.
					19	2-35-290030	6" CYCLONE COLLECTION CHAMBER HOSE	1	FT.
2	2-12-290010	VSRT BLOWER INLET GASKET	1	EA.	20	2-40-001096	SQM33 TO 4" FULL PORT BUTTERFLY VALVE - VA33-NF-400	1	EA.
3	2-12-290037	4.5" ID 90 DEG SILICONE ELBOW	1	EA.	21	2-45-000431	EYELET WIRE RING TERMINAL, 16-14 AWG NYLON EXPANDED INSULATION (14RB-14)	2	EA.
4	2-12-290469	1/4-20 TWIST RESISTANT HEX RIVET NUT (MCMASTER 90720A450)	8	EA.					
					22	2-45-000999	16 AWG WIRE	1	FT.
5	2-22-000001	1/4-20 HEX NUT, GR. 5	2	EA.	23	5-05-290032	VSRT-30 GAS TRAIN BRACKET	1	EA.
6	2-22-000003	3/8-16 HEX NUT, GR. 5	10	EA.	24	5-05-290035	VSRT 4" AIR INLET	1	EA.
7	2-22-000009	1/4-20 X 3/4" HHCS, SAE GR. 5 BOLT	10	EA.	25	5-05-290037	VSRT CYCLONE FILTER PRESSURE VESSEL BRACKET (90 DEG CYCLONE ORIENTATION)	1	EA.
8	2-22-000011	1/4-20 X 1 1/4" HHCS, SAE GR. 5 BOLT	2	EA.					
9	2-22-000033	10-24 X 1/2" UNC HEX HEAD SELF TAPPING SCREW	1	EA.	26	5-05-290038	VSRT CYLONE FILTER TOP BRACKET (90 DEG CYCLONE ORIENTATION)	1	EA.
10	2-22-000039	1/4" USS FLAT WASHER	12	EA.					
11	2-22-000041	3/8" USS FLAT WASHER	10	EA.	27	5-05-290039	VSRT CYCLONE FILTER LOWER BRACKET (90 DEG CYCLONE ORIENTATION)	1	EA.
12	2-22-000047	3/8" MEDIUM LOCK WASHER	14	EA.					
13	2-22-000199	3/8-16 X 1 1/4" HHCS, SAE GR. 5 BOLT	14	EA.	28	5-05-290042	VSRT CYCLONE FILTER MOUNTING BRACKET (90 DEG CYCLONE ORIENTATION)	1	EA.
14	2-22-000430	IDEAL 4.75" - 5.06" ID SS T-BOLT BAND CLAMP - 30010-0475	2	EA.					
					29	5-10-290022	VSRT-30 4" AIR INLET ASSEMBLY W/ 1-1/4" GAS CONNECTION	1	EA.
15	2-22-290030	6" SPIRAL HOSE CLAMP (CW) (MCMASTER 45955K73)	2	EA.					
16	2-30-290032	VSRT-30 CBI BLOWER	1	EA.	30	5-10-290040	VSRT CYCLONE FILTER COLLECTION CHAMBER ASSEMBLY W/ 6" INLET	1	EA.
17	2-30-292030	VSRT-30 PLASTIC CYCLONE - NYB	1	EA.					

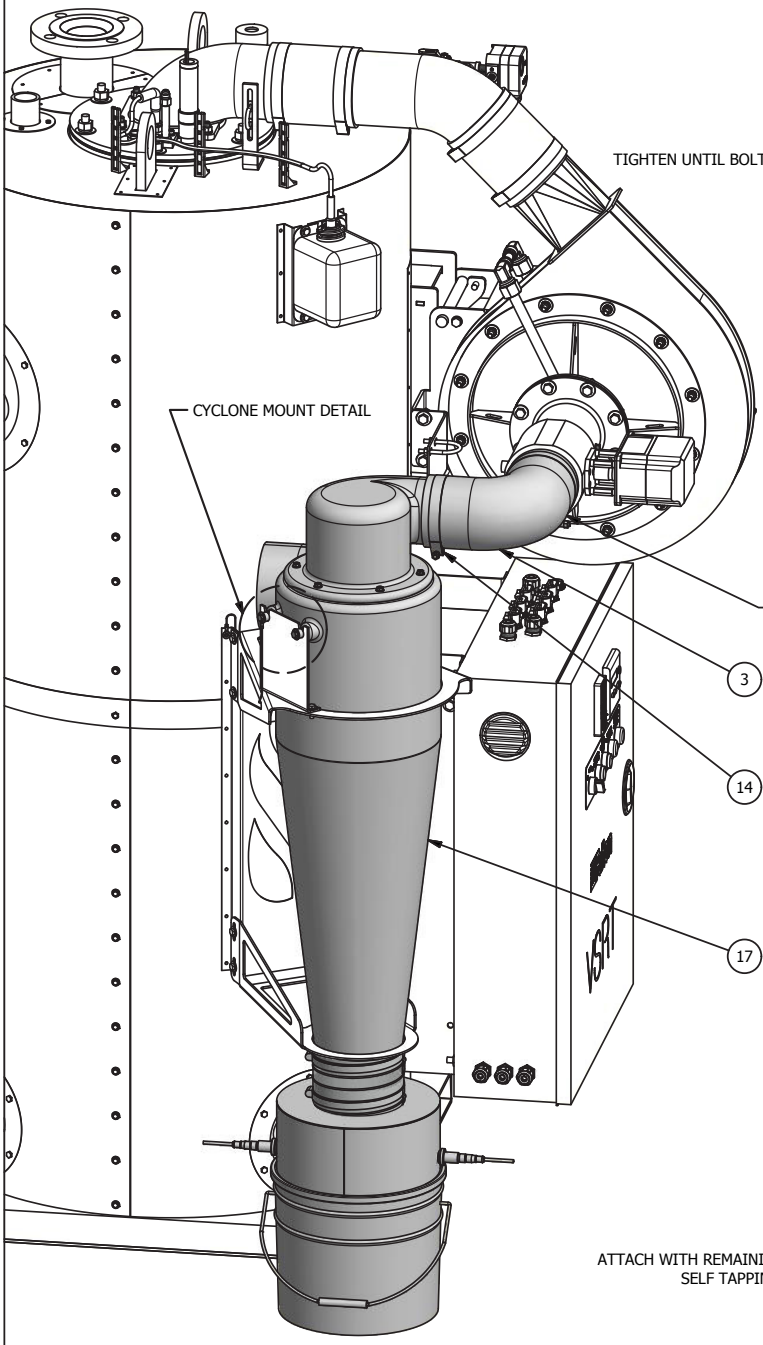


BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-12-000429	PVC GROMMET 5/8" OD X 1/4" ID FOR 11 GA. PANEL (MCMASTER # 93115132)	2	EA.
8	2-22-000011	1/4-20 X 1 1/4" HHCS, SAE GR. 5 BOLT	2	EA.
10	2-22-000039	1/4" USS FLAT WASHER	2	EA.
17	2-30-292030	VSRT-30 PLASTIC CYCLONE - NYB	1	EA.
21	2-45-000431	EYELET WIRE RING TERMINAL, 16-14 AWG NYLON EXPANDED INSULATION (14RB-14)	2	EA.
22	2-45-000999	16 AWG WIRE	1.885	FT.

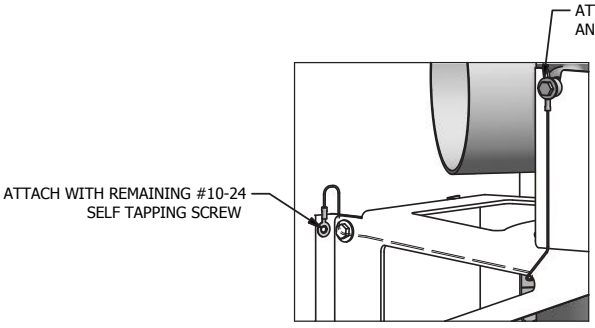


TIGHTEN UNTIL BOLT BOTTOMS OUT IN INSERT
DO NOT OVERTIGHTEN (TYP. 2 PLCS.)
1 21 10 8

CYCLONE MOUNT DETAIL
(INSTALL HARDWARE/GROMMETS FIRST, AND ADJUST TOP AND LOWER CYCLONE BRACKET IF NEEDED)

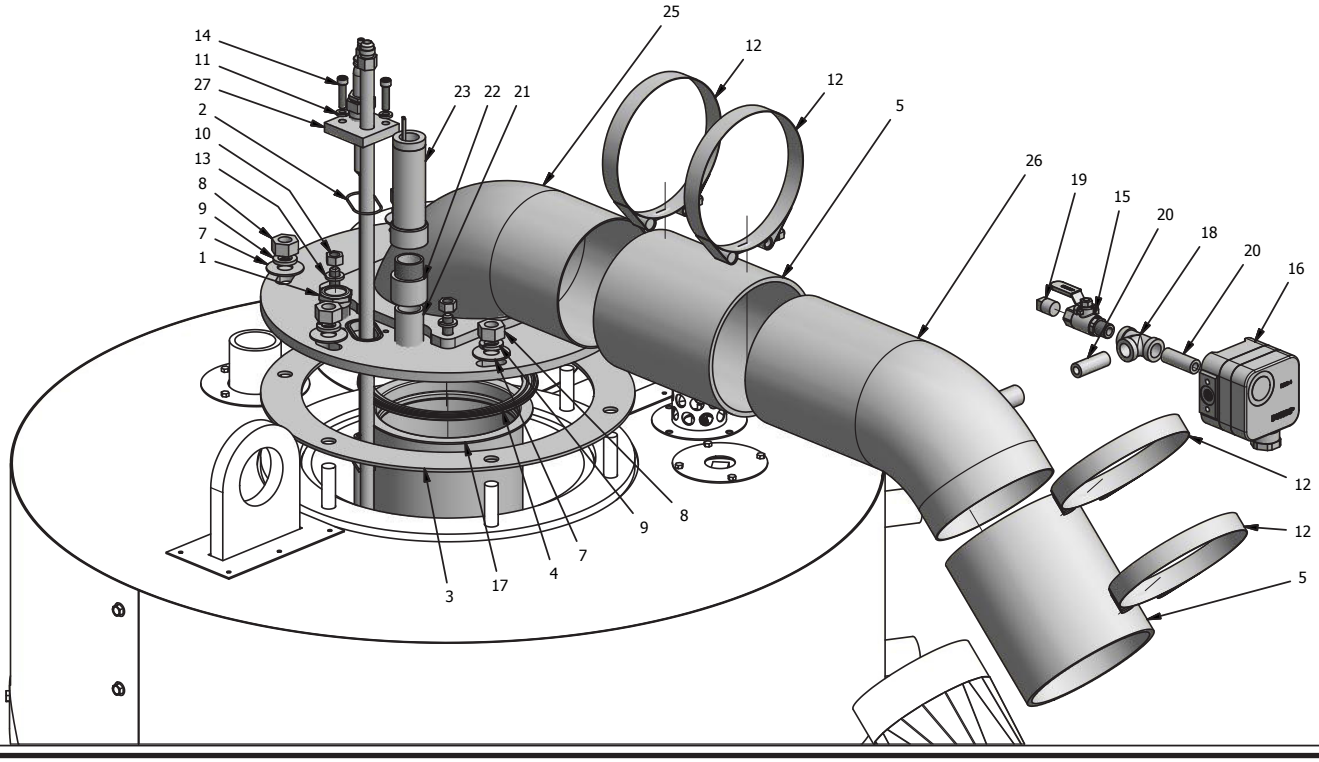


CYCLONE ASSEMBLY

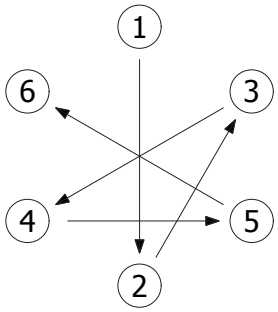


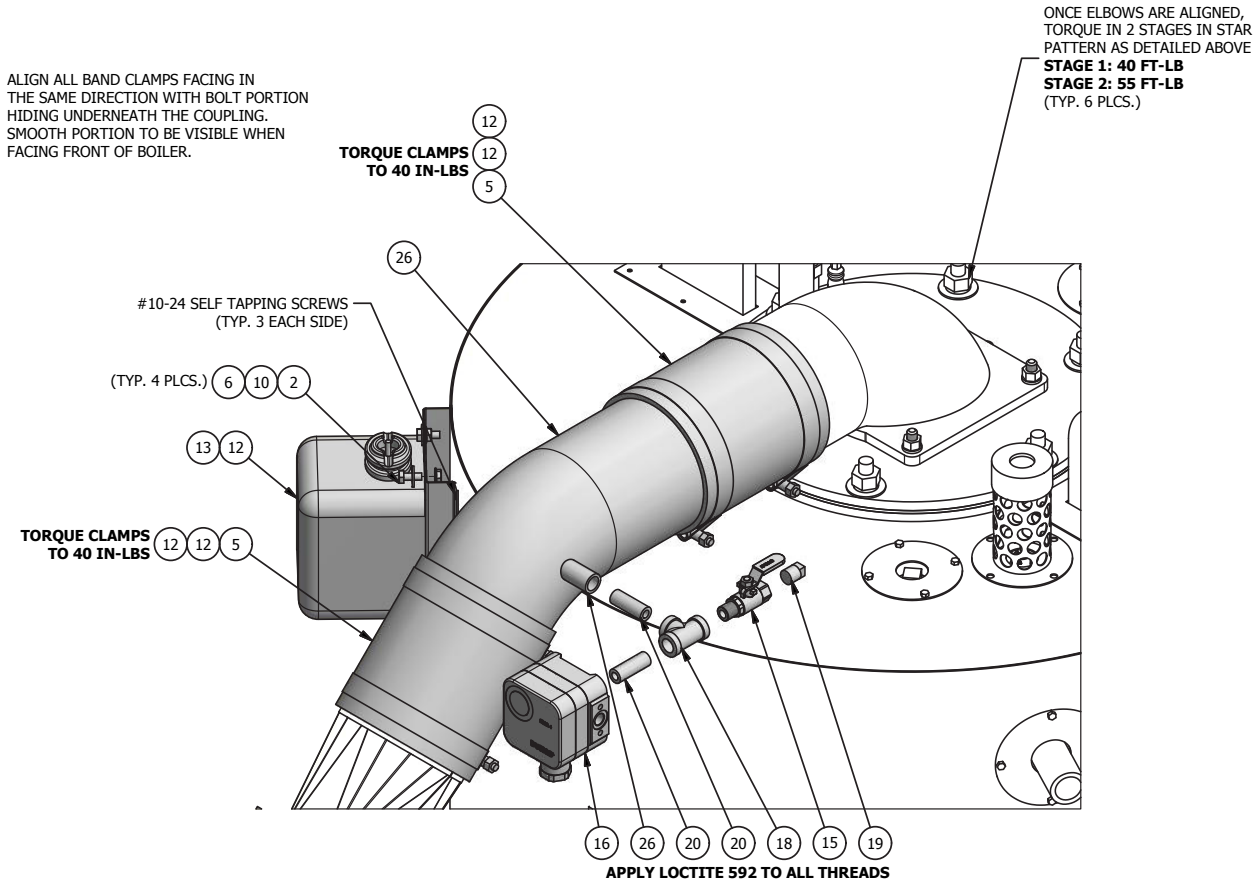
ATTACH GROUNDING WIRE

BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-12-000012	3/4" NPT SIGHT OBSERVATION PORT	1	EA.
2	2-12-000721	029 1/16" VITON O-RING 1.625 OD	1	EA.
3	2-12-290014	VSRT PV FLANGE TO TOP PLATE GASKET FOR 10" FURNACE	1	EA.
4	2-12-290015	VSRT 140MM BURNER GASKET	1	EA.
5	2-12-290036	5" ID X 6" LG. NITRILE FLEX COUPLING	2	EA.
9	2-22-000033	10-24 X 1/2" UNC HEX HEAD SELF TAPPING SCREW	1	EA.
7	2-22-000042	1/2" USS FLAT WASHER	6	EA.
8	2-22-000058	1/2-13 HEX NUT, GR. 2H	6	EA.
9	2-22-000059	1/2" MEDIUM LOCK WASHER	6	EA.
10	2-22-000156	3/8-16 NiCu400 HEX NUT (MONEL400)	4	EA.
11	2-22-000268	1/4" 316 STAINLESS STEEL LOCK WASHER	2	EA.
12	2-22-000431	IDEAL 5.25" - 5.56" ID SS T-BOLT BAND CLAMP - 30010-0525	4	EA.
13	2-22-000461	3/8" 316 STAINLESS STEEL LOCK WASHER	4	EA.
14	2-22-290000	1/4-20 x 1" A286 SOCKET HEAD CAP SCREW	2	EA.
15	2-30-000282	1/4" FNPT X 1/4" MNPT BALL VALVE CSA	1	EA.
16	2-30-005098	DUNGS PRESSURE SWITCH .16" - 1.2" WC (GAO-A4-4-2)	1	EA.
17	2-30-290300	WORGAS PREMIX BURNER 140MM OD (PX.1803)	1	EA.
18	2-35-000204	1/4" THREADED TEE	1	EA.
19	2-35-000306	1/4" 3000# PLUG	1	EA.
20	2-35-000394	1/4" X 1 1/2" - NPT SCH 80 NIPPLE	2	EA.
21	2-35-001178	3/4" X 1-1/2" - NPT STAINLESS STEEL SCH 40 (316L) NIPPLE	1	EA.
22	2-40-000464	3/4" - 14 NPSM THERMAL BARRIER FOR FLAME DETECTOR	1	EA.
23	2-40-001107	SIEMENS LMV2-3 HIGH SENSITIVITY UV SCANNER	1	EA.
24	5-10-290006	VSRT TOP PLATE ASSEMBLY	1	EA.
25	5-10-290018	VSRT PREMIX ELBOW - BURNER SIDE ELBOW ASSEMBLY	1	EA.
26	5-10-290021	VSRT-30 - PREMIX ELBOW WITH PRESSURE SWITCH COUPLING	1	EA.
27	7-20-290030	VSRT PILOT ASSEMBLY (19 3/8" LONG)	1	EA.



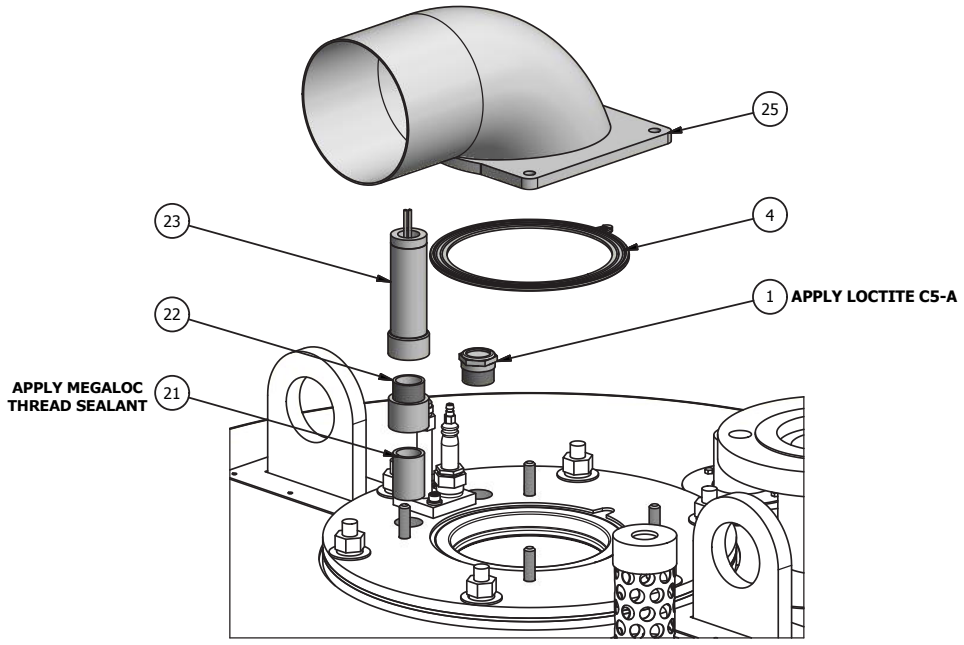
BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
5	2-12-290036	5" ID X 6" LG. NITRILE FLEX COUPLING	2	EA.
2	2-22-000008	1/4-20 X 5/8" HHCS, SAE GR. 5 BOLT	4	EA.
9	2-22-000033	10-24 X 1/2" UNC HEX HEAD SELF TAPPING SCREW	1	EA.
10	2-22-000039	1/4" USS FLAT WASHER	4	EA.
12	2-22-000431	IDEAL 5.25" - 5.56" ID SS T-BOLT BAND CLAMP - 30010-0525	4	EA.
6	2-22-001000	1/4-20 UNC HEX SERRATED FLANGE NUT	4	EA.
15	2-30-000282	1/4" FNPT X 1/4" MNPT BALL VALVE CSA	1	EA.
16	2-30-005098	DUNGS PRESSURE SWITCH .16" - 1.2" WC (GAO-A4-4-2)	1	EA.
18	2-35-000204	1/4" THREADED TEE	1	EA.
19	2-35-000306	1/4" 3000# PLUG	1	EA.
20	2-35-000394	1/4" X 1 1/2" - NPT SCH 80 NIPPLE	2	EA.
12	2-40-000082	SINGLE POLE IGNITION TRANSFORMER 6KVA 120/60	1	EA.
13	5-05-290029	VSRT TRANSFORMER BRACKET	1	EA.
26	5-10-290021	VSRT-30 - PREMIX ELBOW WITH PRESSURE SWITCH COUPLING	1	EA.



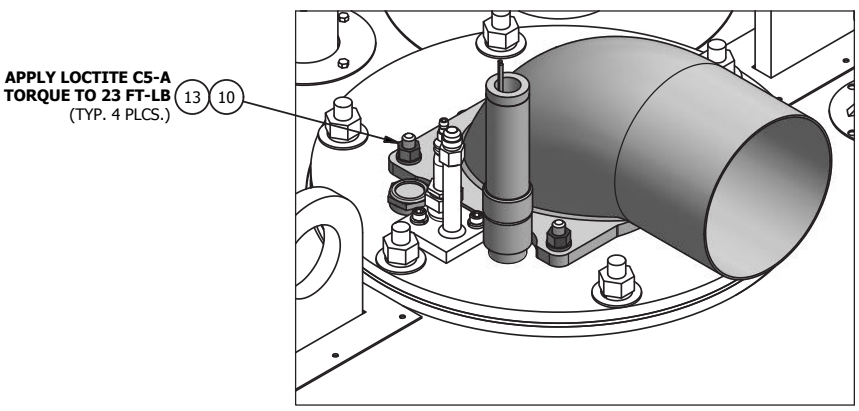


PREMIX AND PRESSURE SWITCH

BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-12-000012	3/4" NPT SIGHT OBSERVATION PORT	1	EA.
4	2-12-290015	VSRT 140MM BURNER GASKET	1	EA.
10	2-22-000156	3/8-16 NiCu400 HEX NUT (MONEL400)	4	EA.
13	2-22-000461	3/8" 316 STAINLESS STEEL LOCK WASHER	4	EA.
21	2-35-001178	3/4" X 1-1/2" - NPT STAINLESS STEEL SCH 40 (316L) NIPPLE	1	EA.
22	2-40-000464	3/4" - 14 NPSM THERMAL BARRIER FOR FLAME DETECTOR	1	EA.
23	2-40-001107	SIEMENS LMV2-3 HIGH SENSITIVITY UV SCANNER	1	EA.
25	5-10-290018	VSRT PREMIX ELBOW - BURNER SIDE ELBOW ASSEMBLY	1	EA.

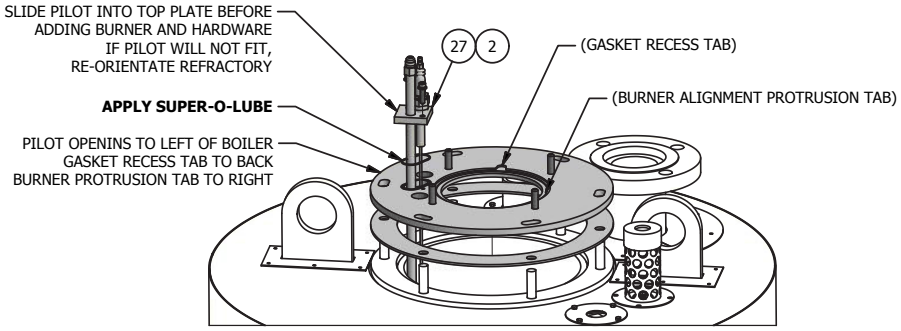


PREMIX ELBOW / UV SCANNER / SIGHT GLASS

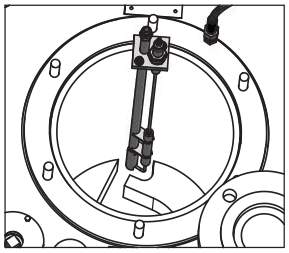


PREMIX ELBOW HARDWARE

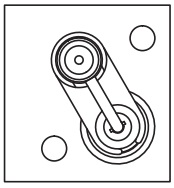
BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
2	2-12-000721	029 1/16" VITON O-RING 1.625 OD	1	EA.
3	2-12-290014	VSRT PV FLANGE TO TOP PLATE GASKET FOR 10" FURNACE	1	EA.
7	2-22-000042	1/2" USS FLAT WASHER	6	EA.
8	2-22-000058	1/2-13 HEX NUT, GR. 2H	6	EA.
9	2-22-000059	1/2" MEDIUM LOCK WASHER	6	EA.
11	2-22-000268	1/4" 316 STAINLESS STEEL LOCK WASHER	2	EA.
14	2-22-290000	1/4-20 x 1" A286 SOCKET HEAD CAP SCREW	2	EA.
17	2-30-290300	WORGAS PREMIX BURNER 140MM OD (PX.1803)	1	EA.
24	5-10-290006	VSRT TOP PLATE ASSEMBLY	1	EA.
27	7-20-290030	VSRT PILOT ASSEMBLY (19 3/8" LONG)	1	EA.



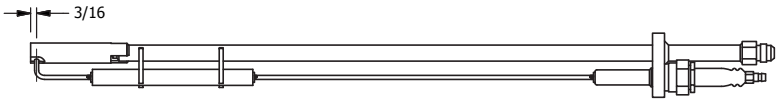
TOP PLATE AND PILOT ASSEMBLY



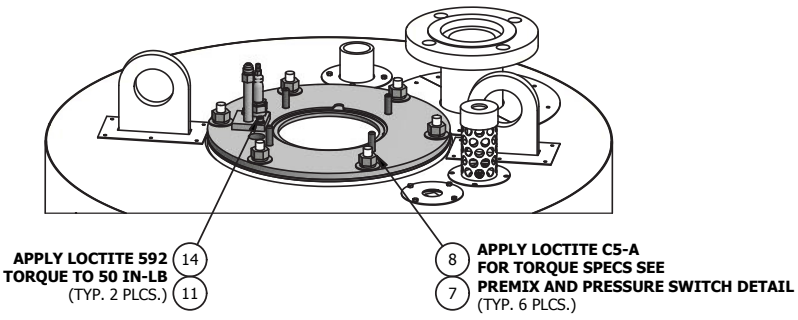
ELECTRODE VS. REFRACTORY ALIGNMENT



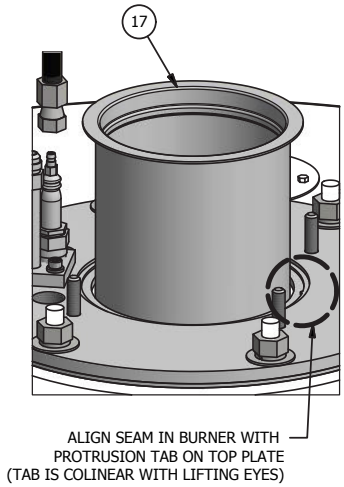
ELECTRODE BOTTOM VIEW



ELECTRODE SIDE VIEW

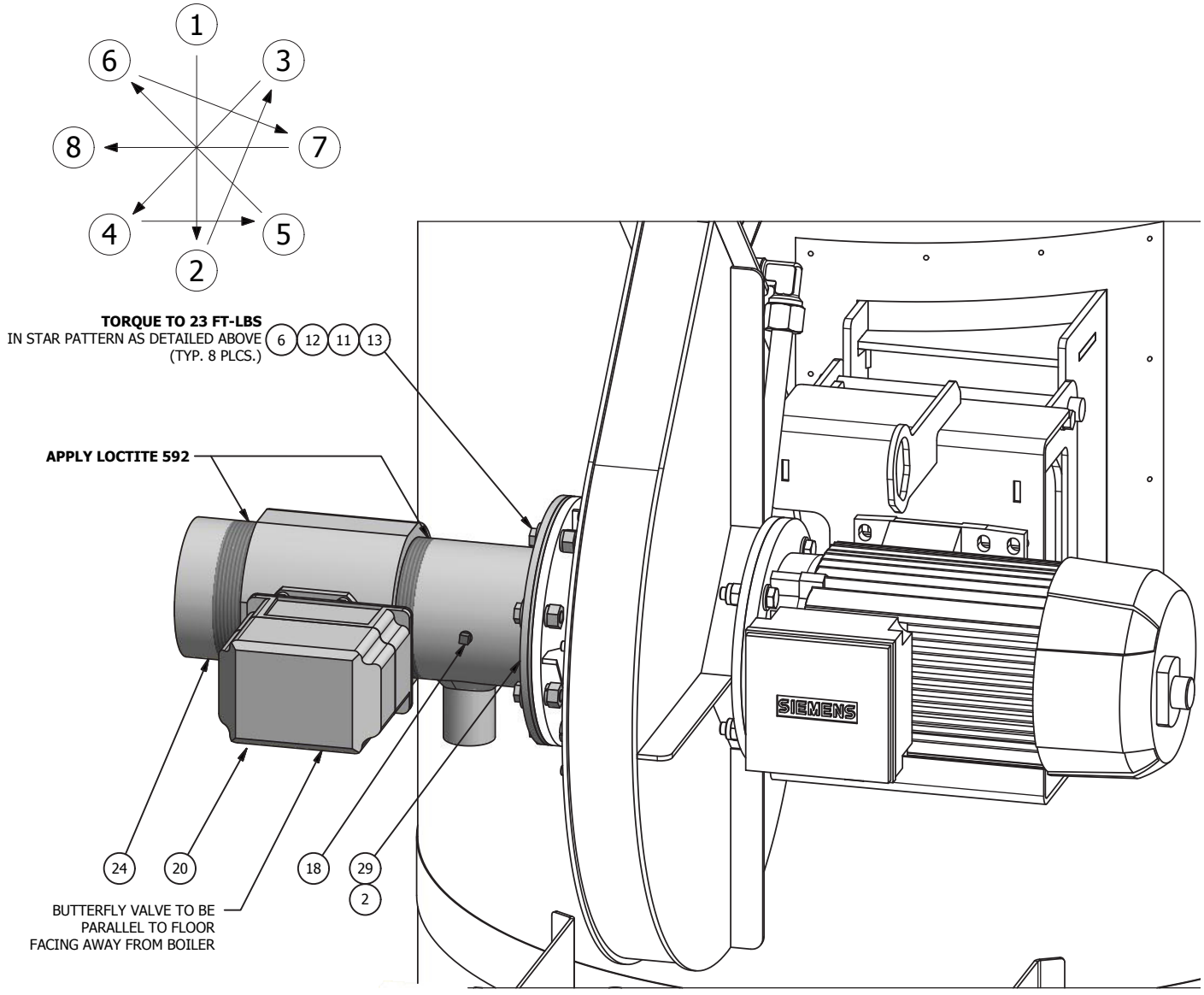


HARDWARE DETAIL

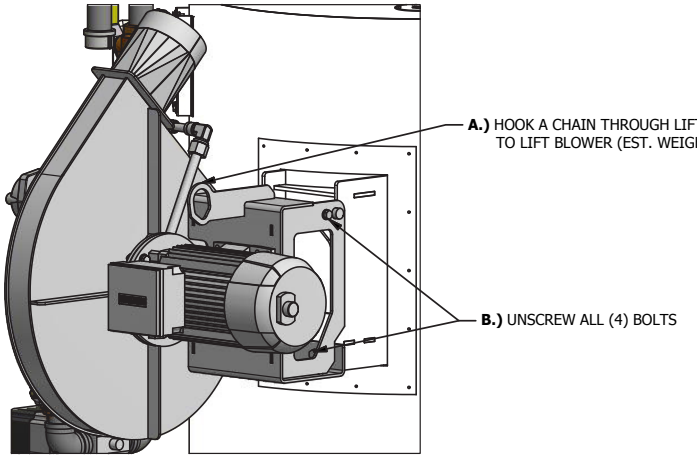


BURNER ALIGNMENT

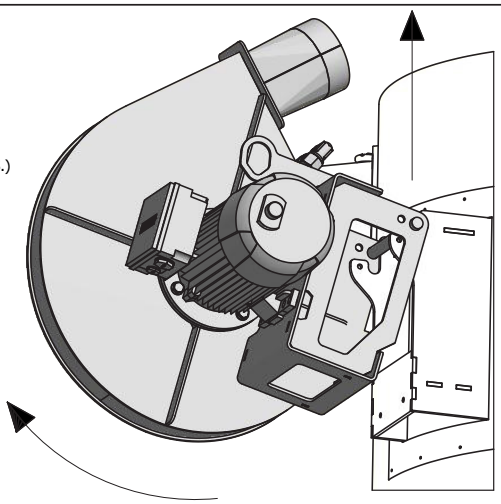
BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
2	2-12-290010	VSRT BLOWER INLET GASKET	1	EA.
6	2-22-000003	3/8-16 HEX NUT, GR. 5	8	EA.
11	2-22-000041	3/8" USS FLAT WASHER	8	EA.
12	2-22-000047	3/8" MEDIUM LOCK WASHER	8	EA.
13	2-22-000199	3/8-16 X 1 1/4" HHCS, SAE GR. 5 BOLT	8	EA.
18	2-35-000249	1/8" 3000# PLUG	1	EA.
20	2-40-001096	SQM33 TO 4" FULL PORT BUTTERFLY VALVE - VA33-NF-400	1	EA.
24	5-05-290035	VSRT 4" AIR INLET	1	EA.
29	5-10-290022	VSRT-30 4" AIR INLET ASSEMBLY W/ 1-1/4" GAS CONNECTION	1	EA.



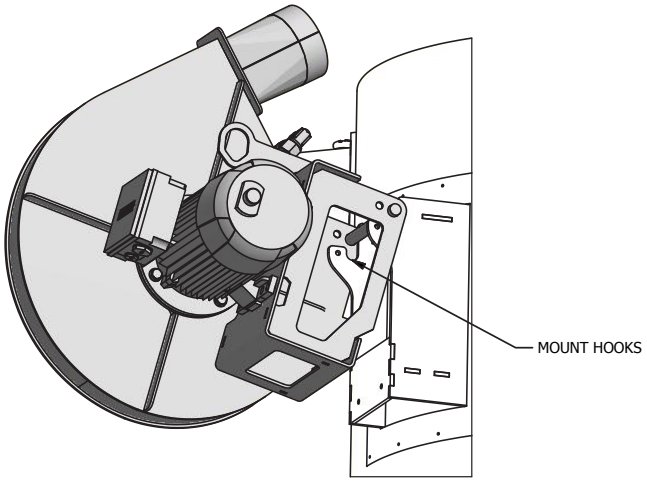
AIR INLET DETAIL



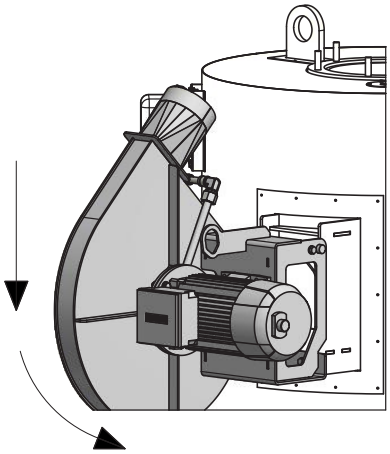
STEP 1: HARDWARE



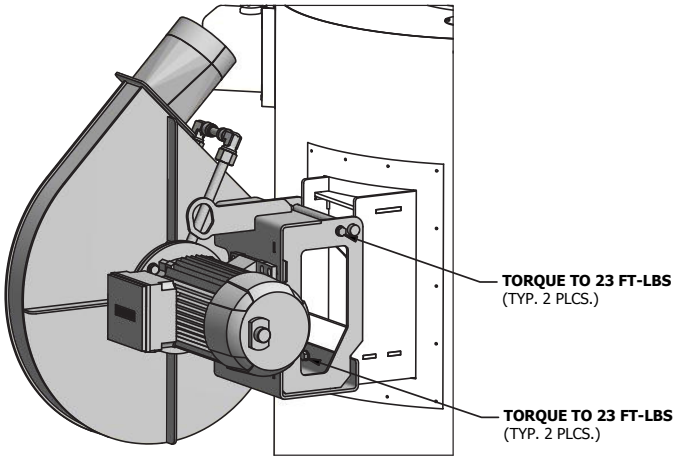
STEP 2: SWING OUT AND LIFT



STEP 3: LIFT NEW BLOWER IN SAME MANNER AS THE OLD WAS REMOVED

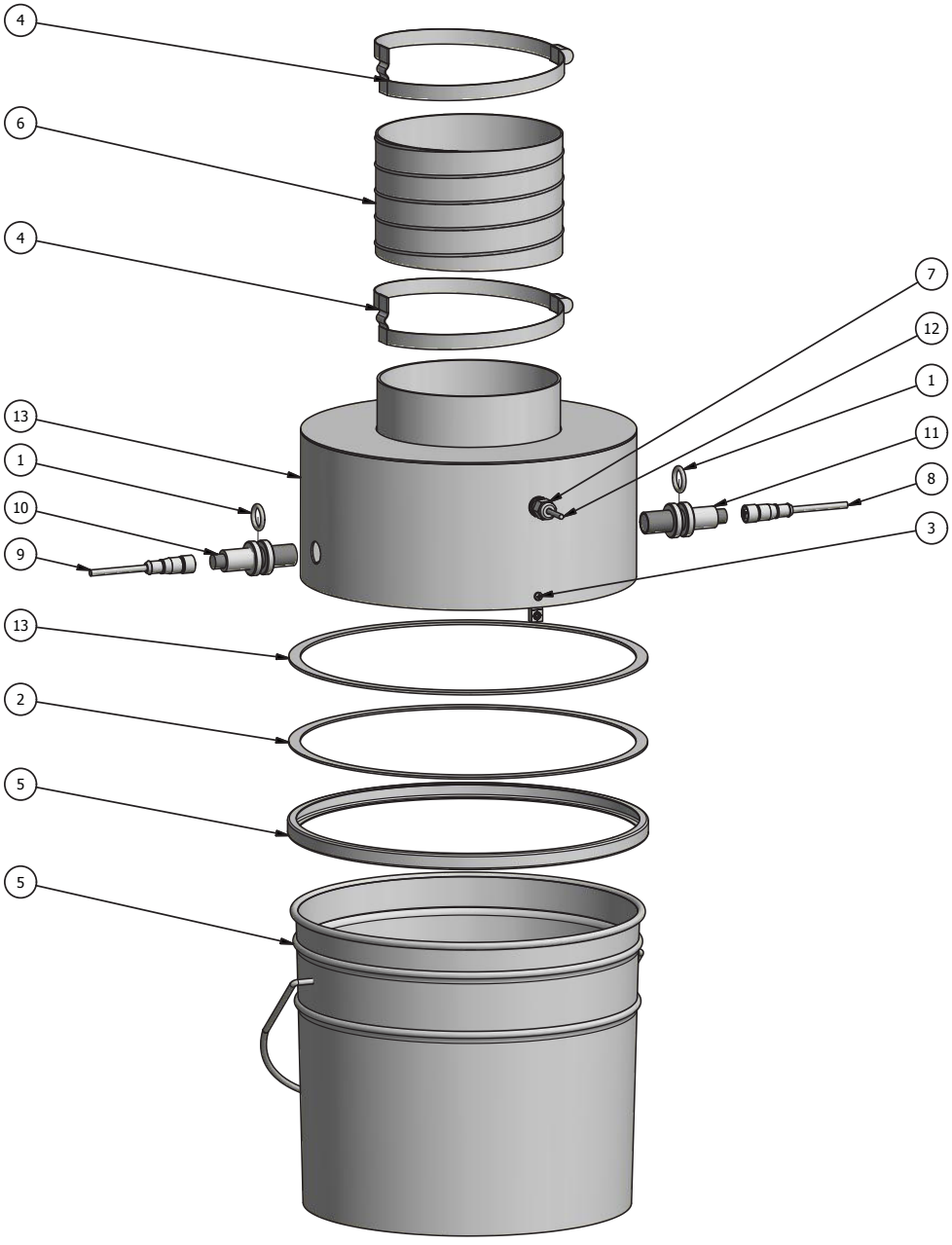


STEP 4: LOWER BLOWER INTO HOOKS



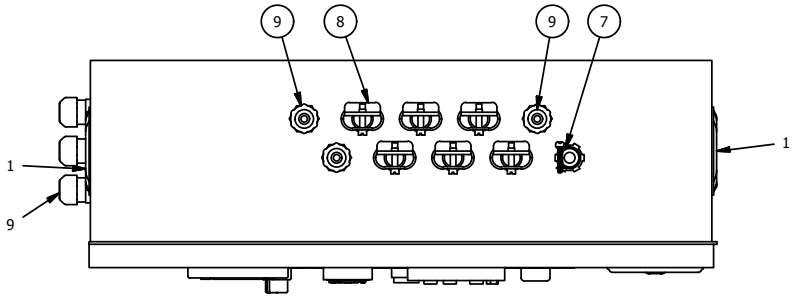
STEP 5: REINSTALL HARDWARE

BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-12-000720	1/8" BUNA-N OIL RESISTANT MULTI-PURPOSE O-RING	2	EA.
2	2-12-290040	VSRT COLLECTION CHAMBER GASKET	1	EA.
3	2-22-000026	6-32 X 1/2" PAN HEAD T/S F PHILLIPS HEAD SELF TAPPING SCREW	1	EA.
4	2-22-290030	6" SPIRAL HOSE CLAMP (CW) (MCMASTER 45955K73)	2	EA.
5	2-30-290031	3.5 GALLON STEEL PAIL WITH LID AND LEVER LOCK RING	1	EA.
6	2-35-290030	6" CYCLONE COLLECTION CHAMBER HOSE	1	FT.
7	2-45-000649	COMPACT LIQUID TIGHT CORD GRIP FOR .12-.26 CORD (MCMASTER 69915K47)	1	EA.
8	2-45-000671	BANNER MQDC 430 27142 EURO-STYLE QUICK DISCONNECT WIRE	1	EA.
9	2-45-000673	BANNER MQDC 415 26850 EURO-STYLE QUICK DISCONNECT WIRE	1	EA.
10	2-45-290010	BANNER S18-2NAEL-Q8 - S18-2 SERIES LONG RANGE EMITTER	1	EA.
11	2-45-290011	BANNER S18-2VPRL-Q8 - S18-2 SERIES RECEIVER	1	EA.
12	2-45-290014	PEPPERL + FUCHS NBN4-F29-E2 INDUCTIVE SENSOR	1	EA.
13	5-10-290039	VSRT CYCLONE FILTER COLLECTION CHAMBER FABRICATED TOP W/ 6" INLET	1	EA.

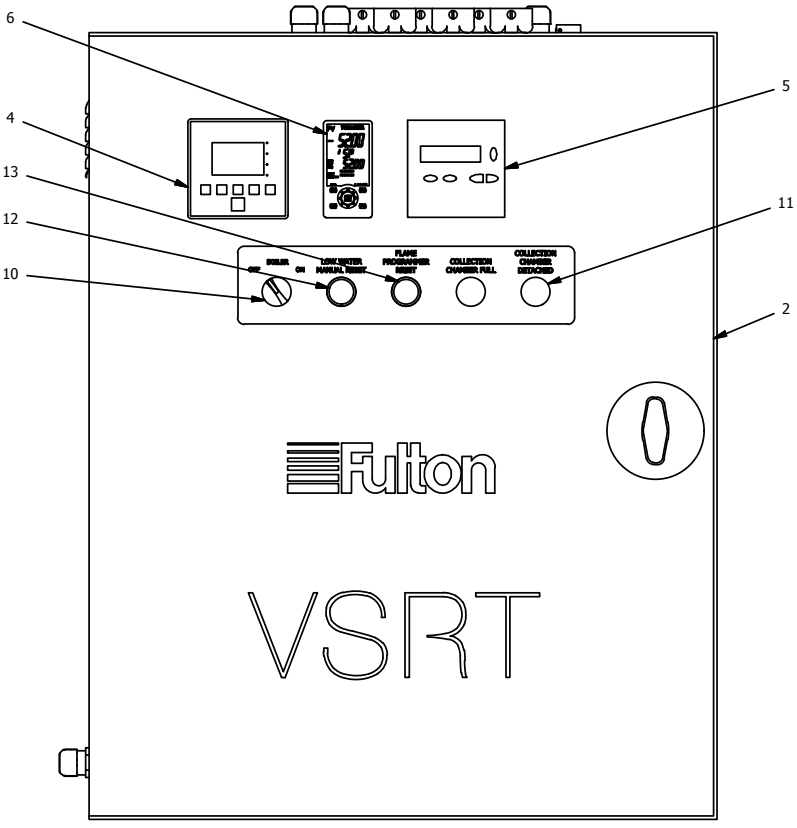


CYCLONE COLLECTION CHAMBER

BILL OF MATERIAL					
ITEM	PART NUMBER	REV	DESCRIPTION	QTY	U.O.M.
1	2-21-000032	-	LOUVER 3IN REG 6 TABS	2	EA.
2	2-21-000100		30" X 24" X 8.62" NEMA 1 PANEL BOX	1	EA.
3	2-23-290000	-	VSRT PANEL BOX - 5 HOLE OVERLAY	1	EA.
4	2-40-000371		WALCHEM CONDUCTIVITY CONTROL WITH ANOLOG OUTPUT (WCNP110-A-N)	1	EA.
5	2-40-000473		AZL DISPLAY MODULE FOR LMV 3	1	EA.
6	2-40-000863		YOKOGAWA UT32A PROCESS CONTROLLER	1	EA.
7	2-45-000033		3/8" T&B STRAIGHT CONNECTOR	1	EA.
8	2-45-000039		3/8" DUPLEX CONNECTOR	6	EA.
9	2-45-000165	-	1/2" STRAIN RELIEF CORD CONNECTOR - T&B	6	EA.
10	2-45-000307	-	ILLUM 2 POS GREEN SWITCH 1 NO / 1 NC CONTACT	1	EA.
11	2-45-000411		RED 120V PILOT LIGHT	2	EA.
12	2-45-000545		120V RED ILLUMINATED PUSH BUTTON W/ SINGLE POLE N/C CONTACT	1	EA.
13	2-45-000546		120V RED ILLUMINATED PUSH BUTTON W/ SINGLE POLE N/O CONTACT	1	EA.
14	5-21-030312	-	VSRT-30 BACK PLATE FOR 24" X 30" MODULATED PANEL BOX	1	EA.

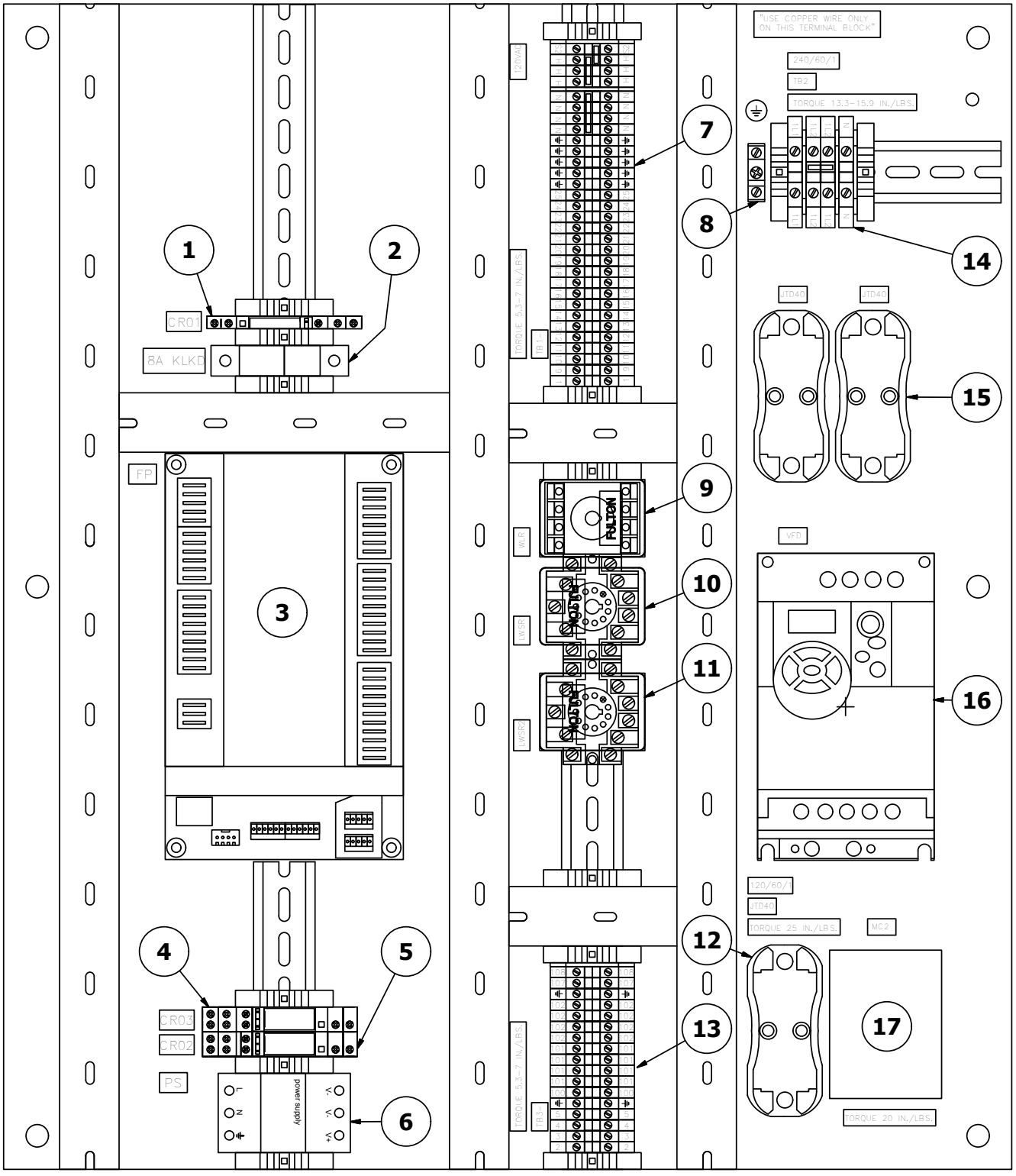


TOP VIEW

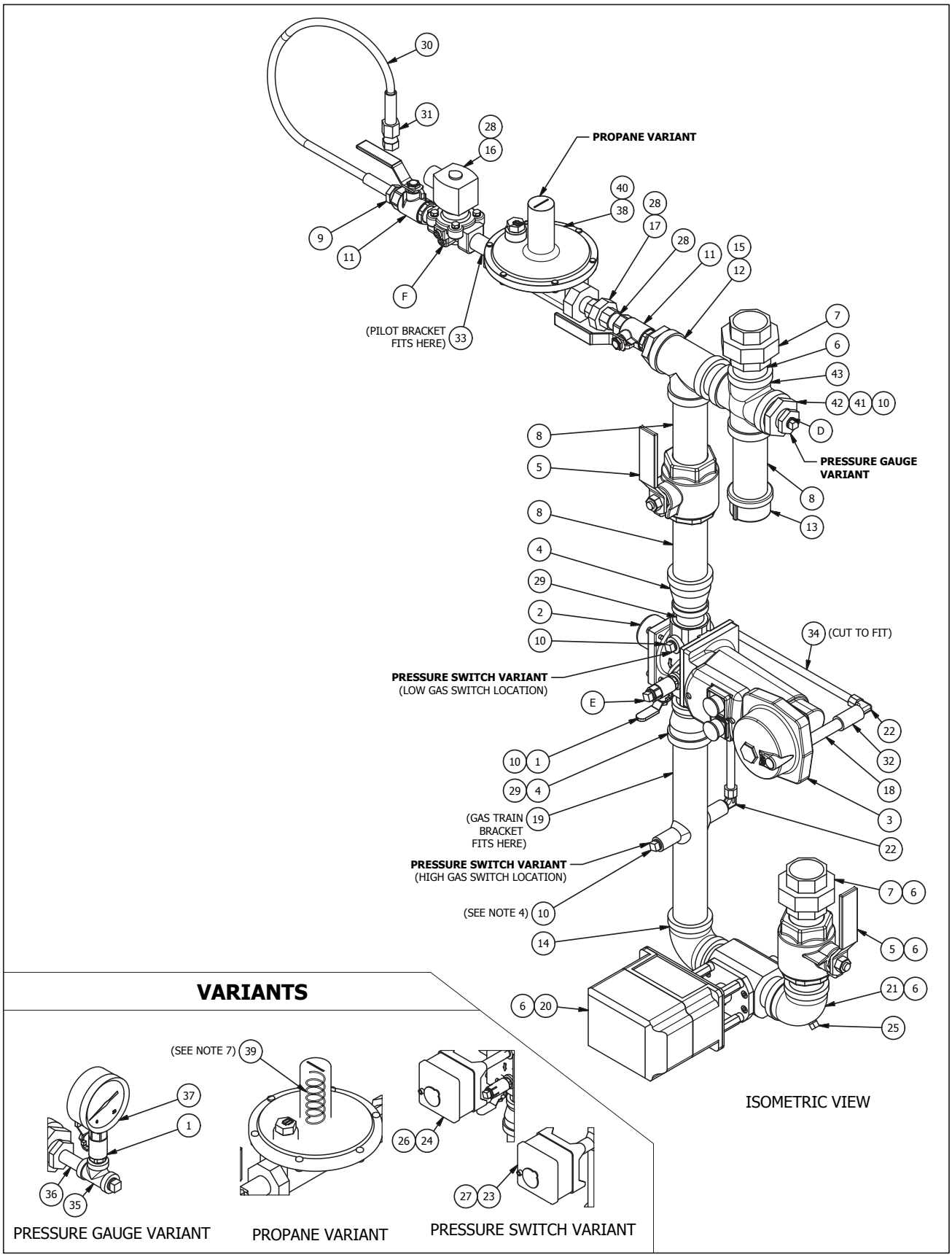


FRONT VIEW

PANEL LAYOUT



PANEL LAYOUT LEGEND	
ITEM	DESCRIPTION
1	CONTROL RELAY 1
2	CONTROL POWER FUSE
3	FLAME PROGRAMMER
4	CONTROL RELAY 3
5	CONTROL RELAY 2
6	24v POWER SUPPLY
7	120v TERMINAL BLOCK 1
8	GROUND LUG
9	WATER LEVEL RELAY
10	LOW WATER SAFETY RELAY 1
11	LOW WATER SAFETY RELAY 2
12	FEEDWATER PUMP FUSE
13	LOW VOLTAGE TERMINAL BLOCK
14	INCOMING POWER TERMINAL BLOCK 2
15	MAIN POWER FUSES
16	VARIABLE SPEED DRIVE
17	FEEDWATER PUMP MOTOR CONTACTOR


30
31
28
16
PROPANE VARIANT
40
38
28
17
9
11
F
28
11
15
12
(PILOT BRACKET FITS HERE)
33
7
6
43
42
41
10
D
PRESSURE GAUGE VARIANT
8
5
8
13
8
4
29
2
10
34 (CUT TO FIT)
PRESSURE SWITCH VARIANT
(LOW GAS SWITCH LOCATION)
E
22
10
1
32
29
4
18
(GAS TRAIN BRACKET FITS HERE)
19
3
22
PRESSURE SWITCH VARIANT
(HIGH GAS SWITCH LOCATION)
7
6
(SEE NOTE 4)
10
14
5
6
21
6
6
20
25
ISOMETRIC VIEW
VARIANTS
(SEE NOTE 7)
39
37
1
36
35
PRESSURE GAUGE VARIANT
PROPANE VARIANT
26
24
27
23
PRESSURE SWITCH VARIANT

BILL OF MATERIAL				
ITEM	PART NUMBER	DESCRIPTION	QTY	U.O.M.
1	2-30-000282	1/4" FNPT X 1/4" MNPT BALL VALVE CSA	2	EA.
2	2-30-000002	1" N.P.T. GAS VALVE VGG10.254U	1	EA.
3	2-40-000884	SKP25.011U1 SIEMENS AIR/GAS RATIO VALVE 120V	1	EA.
4	2-35-001117	1 1/4" X 1" 150# REDUCING COUPLING	2	EA.
5	2-30-001248	1 1/4" NPT CSA/UL/FM GAS BALL VALVE (SERIES 94A)	2	EA.
6	2-35-000140	1 1/4" X 2" - NPT SCH 40 NIPPLE	6	EA.
7	2-35-000295	1 1/4" SCH. 40 UNION	2	EA.
8	2-35-000739	1 1/4" X 5" - NPT SCH 40 NIPPLE	3	EA.
9	2-35-000262	1/2" X 1/4" 150# BUSHING	1	EA.
10	2-35-000306	1/4" 3000# PLUG	4	EA.
11	2-30-001246	1/2" NPT CSA/UL/FM GAS BALL VALVE (SERIES 94A)	2	EA.
12	2-35-000232	1 1/4" THREADED TEE	1	EA.
13	2-35-000287	1 1/4" 150# THREADED CAP	1	EA.
14	2-35-000272	1 1/4" THREADED ELBOW	1	EA.
15	2-35-001404	1 1/4" X 1/2" 150# BUSHING	1	EA.
16	2-30-000298	1/2" AUTOMATIC PILOT GAS VALVE (120/60) CSA/UL/FM (8214G020) 5 PSI MAX	1	EA.
17	2-35-000282	1/2" SCH. 40 UNION	1	EA.
18	2-35-000393	1/4" X 3" - NPT SCH 80 NIPPLE	1	EA.
19	5-10-001550	1 1/4" X 12" STD NIPPLE WITH (2) 1/4" COUPLINGS	1	EA.
20	2-40-001097	SQM33 TO 1-1/4" FULL PORT ALUMINUM BUTTERFLY VALVE - VA33-NF-125	1	EA.
21	2-20-000025	1 1/4" DRILLED AND TAPPED THREADED ELBOW	1	EA.
22	2-35-001352	3/8" COMP X 1/4" MNPT ALUMINUM 90 DEG TUBING COMPRESSION FITTING	2	EA.
23	2-40-000390	SIEMENS QPH31.050M00 HIGH GAS PRESSURE SWITCH W/ MANUAL RESET 2"-20" WC	1	EA.
24	2-40-000387	SIEMENS QPL31.050M00 LOW GAS PRESSURE SWITCH W/ MANUAL RESET 1"-20" WC	1	EA.
25	2-35-000249	1/8" 3000# PLUG	1	EA.
26	2-35-000536	1/4" X 4" - NPT SCH 80 NIPPLE	1	EA.
27	2-35-000394	1/4" X 1 1/2" - NPT SCH 80 NIPPLE	1	EA.
28	2-35-000086	1/2" X 1 1/2" - NPT SCH 40 NIPPLE	4	EA.
29	2-35-000129	1" X 2" - NPT SCH 40 NIPPLE	2	EA.
30	2-30-000575	1/4" ID X 24" OAL CGA FLEX HOSE S.S. W/ C.S. SCH 80 MALE NPT ENDS	1	EA.
31	2-35-001824	PARKER 6 G6X-S - STEEL 3/8" 37 DEG. SWIVEL TO 1/4" NPTF	1	EA.
32	2-35-000178	1/4" 3000# FULL COUPLING	1	EA.
33	2-35-000088	1/2" X 2 1/2" - NPT SCH 40 NIPPLE	1	EA.
34	2-10-000189	3/8' OD X .049 WALL ALUMINUM TUBING	1.2	FT.
35	2-35-000204	1/4" THREADED TEE	1	EA.
36	2-35-000371	1/4" X 2" - NPT SCH 80 NIPPLE	1	EA.
37	2-30-000542	0-15 PSI GAS PRESSURE GAUGE	1	EA.
38	2-30-004020	1/2" MAXITROL 325-5A PILOT REGULATOR (5 PSI MAX)	1	EA.
39	2-30-001216	YELLOW SPRING FOR 325-5A	1	EA.
40	2-30-001284	3/8" NPT VENT LIMITER FOR 325-5A PILOT REGULATOR (12A39)	1	EA.
41	2-35-000261	3/4" X 1/4" 150# BUSHING	1	EA.
42	2-35-000641	1 1/4" X 3/4" 150# BUSHING	1	EA.
43	2-35-001667	1 1/4" 150# THREADED CROSS	1	EA.

Troubleshooting

Refer to table below for 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	Use a volt meter in series with the air switch to check to see if the switch is making (closing). Also check the adjustment of the air switch setting. If both above do not work, check the range of the air switch and measure the burner fan pressure at the air pressure switch sensing port to make sure the air switch is within range.
	Gas Supply*	Check for gas pressure and for intermittent supply problems. Gas pressure for natural gas should be 3 in. to 13.8 in. w.c. 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 3 in. to 13.8 in. w.c. 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.*

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	Use a volt meter in series with the air switch to check to see if the switch is making (closing). Also check the adjustment of the air switch setting. If both above do not work, check the range of the air switch and measure the burner fan pressure at the air pressure switch sensing port to make sure the air switch is within range.
	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.

Troubleshooting Gas Fired Boilers

Problem	Cause	Remedy
Poor Combustion	Damaged Refractory	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 (*Rich; Burner Hums*)	Check CO2/O2 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 CO2/O2 and adjust gas valve as necessary for all combustion points.
	Fuel Valve Adjusted Too High (*Rich; Burner Hums*)	Check CO2/O2 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 *(Lean; Unstable Flame)*	Check fan discharge pressure. If too high, adjust fan speed. Check CO2/O2 levels and adjust gas valve as necessary. Be sure to check all combustion points.
	Gas Valve Adjusted Too Low *(Lean; Unstable Flame)*	Check CO2 and O2 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 within the range of -0.25" w.c. to + 1.50" w.c. 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	Damaged Refractory	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 within the range of -0.25" w.c. to + 1.50" w.c. 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 3 in. to 13.8 in. w.c. 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.
	Damaged Refractory	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 feedwater tank and flush system. Have water tested by water treatment company.
	Too much water softener	Have water tested by water treatment company.
	(high pH)	
	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 feedwater tank and flush system. Have water tested by water treatment company.
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.

Troubleshooting Gas Fired Boilers		
Problem	**Cause**	**Remedy**
Pump runs but does not put water into boiler	Vapor locking of pump	Allow system to cool down, check steam traps to make sure they are operating properly, and check to be sure return lines are not insulated. Check feedwater tank temperature. If it is above 180 F (82 C) vapor locking may occur, depending on pump selection. Inspect check valves. Clean and replace as needed. Replace pump with multistage pump good for 250 F (121 C).
	Impeller Adjustment	Check for impeller wear and adjust per component information in instruction manual (Burks/MTH only).
	Back pressure on pump	Install repair kit on pump.
	Plugged feed water nipple	Check and clean or replace as necessary.

Section

5 - WARRANTY

Standard Warranty for Fulton Boilers

WARRANTY FOR VSRT

Ten (10) Year (120 Months) Pressure Vessel 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 by defective material or workmanship; however, waterside corrosion or scaling is not covered. Therefore, it is imperative that the boiler water management and chemistry is 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 eighteen (18) months from date of shipment from the factory or twelve (12) months from start-up (whichever occurs first) 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 Warranty 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 Warranty 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.

Additional VSRT Warranty

VSRT model boilers have an additional extended burner warranty covering manufacturer defects. The burner head warranty is five (5) years from ship date. All extended burner head warranties adhere to the same requirements as the Materials and Workmanship and General guidelines listed in this section.

Fulton®

Effective: 04.26.2018

The Fulton Group of companies are global manufacturers of steam, hot water and thermal fluid heat transfer systems.

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VSRT_IOM_2018-1213